BUCHER automation




# User Manual

## JM-203B-230 - Digital Servo Amplifier

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# This user manual is an integral part of the JetMove 203B-230:

Type: _____

Serial no.: _____

Year of manufacture: _____

Order no.: _____

CE

To be entered by the customer:

Inventory no.: _____

Place of operation: _____

# Significance of this user manual

This user manual is an integral part of the digital servo amplifier JetMove 203B-230 and

- must be kept in a way that it is always at hand until the digital servo amplifier JetMove 203B-230, will be disposed of.
- Pass this manual on, if the digital servo amplifier JetMove 203B-230 is sold, alienated or loaned.

In any case you encounter difficulties to clearly understand this user manual, please contact the manufacturer.
We would appreciate any suggestions and contributions on your part and would ask you to contact us. This will help us to produce manuals that are more user-friendly and to address your wishes and requirements.

Unavoidable residual hazards for persons and property may result from this digital servo amplifier JetMove 203B-230. For this reason, any person who has to deal with the transport, installation, operation, maintenance, and repair of the digital servo amplifier JetMove 203B-230 must have been familiarised with it and must be aware of these dangers.
Therefore, this person must carefully read, understand and observe this manual, and especially the safety instructions.

Missing or inadequate knowledge of the manual results in the loss of any claim of liability on part of Bucher Automation AG. Therefore, the operating company is recommended to have the instruction of the persons concerned confirmed in writing.

# History

| Revision | Remarks |
|---|---|
| 2.00 | Original issue of the user manual |
| 3.00 | For revisions, please refer to Appendix A: "Recent revisions" of the user manual, revision 3.00 |
| 3.01 | Corrections to style and orthography |
| 3.10 | For revisions, please refer to Appendix A: "Recent revisions" of the user manual, revision 3.10 |
| 3.11 | For revisions, please refer to Appendix A: "Recent revisions" of the user manual, revision 3.11 |
| 3.20 | For revisions, please refer to Appendix A: "Recent revisions" of the user manual, revision 3.20 |
| 4.00 | Restructuring to Bucher Automation AG |

# Description of symbols



**DANGER**

This sign is to indicate a possible impending danger of serious physical damage or death.



**CAUTION**

This sign is to indicate a possible impending danger of light physical damage. This sign is also to warn you of material damage.



This sign indicates hazard of life due to electric shock caused by a high operating voltage.



This sign is to indicate hazard of serious physical damage or death due to accidentally touching dangerous parts of the device.



This sign instructs you to wear protective goggles. Failure to comply may lead to injuries.



This sign is to warn you of material damage due to applying hard blows or shocks to the motor flange and shaft.



**NOTICE**

This sign is to indicate a possible impending situation which might bring damage to the product or to its surroundings.
It also identifies requirements necessary to ensure faultless operation.



**INFO**

You will be informed of various possible applications and will receive further useful suggestions.
It also gives you words of advice on how to efficiently use hardware and software in order to avoid unnecessary efforts.

**· / -**

Enumerations are marked by full stops, strokes or scores.



Operating instructions are marked by this arrow.



Automatically running processes or results to be achieved are marked by this arrow.




PC and user interface keys.



This symbol informs you of additional references (data sheets, literature, etc.) associated with the given subject, product, etc. It also helps you to find your way around this manual.

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# 1 Safety instructions

## 1.1 General safety instructions

The digital servo amplifier JetMove 203B-230 fulfills the accepted safety regulations and standards. Special emphasis was given to the safety of the users.

Further, the user should adhere to the following regulations:
- pertinent accident prevention regulations;
- accepted safety rules;
- EC guidelines and other country-specific regulations.

### 1.1.1 Intended Use

Usage according to the intended conditions of use includes operation in accordance with these operating instructions.

**Operate the digital servo amplifier JetMove 203B-230 only in a closed control cabinet and within the range of the specified values, see chapter 5 "Technical data", page 35.**
**Do not apply a voltage to the digital servo amplifier JetMove 203B-230 that is higher than the prescribed operating voltage.**

The single phase or three phase operating voltage is AC 195 V ... AC 265 V. Thus, it is subject to the EU Low Voltage Directive.

The JetMove 203B servo amplifier has been designed to drive 3-phase brushless synchronous servo motors in the following modes: speed control, torque control and/or position control. The winding insulation of the motors must be higher than, or at least equal to, the DC link voltage supplied by the servo amplifier.

The digital servo amplifier JetMove 203B-230 is used to drive machinery, such as conveyors, production machines, and handling machines.

### 1.1.2 Usage other than intended

**The digital servo amplifier JetMove 203B-230 must not be used in technical systems which to a high degree have to be fail-save, e.g. ropeways and aeroplanes.**

**Do not apply the integrated brake control in safety-relevant systems.**

**The JetMove 203B-230 is no safety-related part as per Machinery Directive 2006/42/EC. This servo amplifier is not qualified for safety-relevant applications and must, therefore, NOT be used to protect persons.**

**An exception to this rule is the STO function of devices with the -S1 option, see chapter 13 "Safe Torque OFF (STO) Option", page 88.**

### 1.1.3 Qualified personnel

Depending on individual phases of the product life cycle, there are different demands on the personnel being involved. These demands have to be met, in order to grant safety in handling the JetMove 203B-230 at each phase of the product life cycle.

| Phase of the product life cycle | Minimum demands on the personnel |
|---|---|
| **Transport/storage:** | Only properly trained and instructed personnel with knowledge of correctly handling electrostatically sensitive components. |
| **Mounting/installation:** | Trained personnel specified in electrical automotive engineering, such as industrial electronics engineers. |
| **Commissioning/ programming:** | Trained and instructed specialist personnel having got broad knowledge of, and experience in electrical engineering/motion systems, such as industrial electronics engineers of automation engineering. |
| **Operation:** | Only trained, instructed and authorized personnel with knowledge of correctly handling electrostatically sensitive devices. |
| **Decommissioning:** | Trained personnel specified in electrical engineering, such as industrial electronics engineers. |

### 1.1.4 Modifications and alterations to the device

**For safety reasons, no modifications and alterations to the digital servo amplifier JetMove 203B-230 and its functions are permitted.**
Any modifications to the servo amplifier JetMove 203B-230 not expressly authorised by the manufacturer will result in a loss of any liability claims to Bucher Automation AG.

**The original parts are specifically designed for the servo amplifier JetMove 203B-230. Parts and equipment from other manufacturers are not tested by Bucher Automation AG, and are, therefore, not released by Bucher Automation AG.**
The installation of such parts may impair the safety and the proper functioning of the digital servo amplifier JetMove 203B-230.

Any liability on the part of Bucher Automation AG for any damages resulting from the use of non-original parts and equipment is excluded.

### 1.1.5 Repair and maintenance

Repairs at the digital servo amplifier JetMove 203B-230 must not be carried out by the operator. The servo amplifier JetMove 203B-230 does not contain any parts to be repaired by the operator.
For being repaired, the servo amplifier JetMove 203B-230 must be sent to Bucher Automation AG.

The digital servo amplifier JetMove203B-230 is maintenance-free. Therefore, absolutely no inspection or maintenance works are required for the operation of this device.

### 1.1.6 Disposal

When disposing of the digital servo amplifier, the local environmental regulations must be complied with.

You can disassemble the servo amplifier JetMove 203B-230 into its main components by unscrewing it (aluminum heat sink and side plate, steel casing cover, electronic boards).

# 1.2 Ensure your own safety



**Warning**

- Isolate the digital servo amplifier JetMove 203B-230 from the mains, if maintenance works have to be carried out. By doing so, you will prevent accidents resulting from electric voltage and moving parts.
  Follow the information given in chapter 1.3 "Residual dangers", page 16.
- Safety and protective devices, e.g. the barrier and cover of the terminal box or the thermal motor circuit-breaker must not in any case be shunted or by-passed.
- Dismantled protective equipment, such as guards and thermal motor circuit-breakers, must be reattached and checked for proper functioning prior to commissioning.
- Prior to commissioning, the machine manufacturer shall conduct a hazard analysis for the machine and take appropriate measures to prevent personal injury and damage to property resulting from accidental movements.

## 1.2.1 Malfunctions

- **In the case of malfunctions or other faults, please immediately separate the digital servo amplifier JetMove 203B-230 from the mains.**
  Follow the information given in chapter 1.3 "Residual dangers", page 16.
- Malfunctions or other damages have to be reported to a responsible person at once.
- Secure the servo amplifier JetMove 203B-230 against misuse or accidental use.

## 1.2.2 Information signs and labels

- Follow the instructions given on markings, information signs, and labels. Keep markings, signs and labels readable.
- Replace damaged or unreadable information signs and labels.

### 1.2.3 Earthing procedure

- Screw the enclosure of the digital servo amplifier JetMove 203B-230 onto a highly conducting, earthed panel.

- Do only use the servo amplifier JetMove 203B-230 at the three-phase, earthed industrial network (TN network, TT network with earthed neutral, 5,000 A max, symmetric rated current at 400/480 V + 10 %).
  The servo amplifier must not be operated when connected to unearthed networks and to unsymmetrically earthed networks.
  A one-phase connection to these mains can be established by means of a mains phase and a neutral wire.
  The three-phase connection may only be established by means of an isolating or autotransformer (also refer to chapter "Power supply connection", page 35, and chapter 10 "Connection diagrams", page 75).

- **The leakage current of the digital servo amplifier JetMove 203B-230 is greater than 3.5 mA. Therefore, a second protective earth conductor is required in order to avoid electric shocks.**
  For this, the following measures have to be taken:
  - The protective earth conductor must be connected to the PE screw (1) located at the top side of the rack as well as to the PE terminal X1 (2); for this, please refer to fig. 1.
    The cross-sectional areas of the two earthing conductors must be equal to the cross-sectional areas of the supply lines (1.5 $mm^2$ min.).
  - A durable connection with the power supply of the digital servo amplifier JetMove 203B-230 has to be provided.
  - Correct cabling of the PE bus according to the connection diagram must be carried out, chapter 10 "Connection diagrams", page 75.

**NOTICE**

Follow the installation instruction below for the tightening torque of the PE bolt (1) so that it does not become loose or even break off:

- Do not overtighten the nut of the PE bolt (1). The maximum tightening torque is 3 Nm!

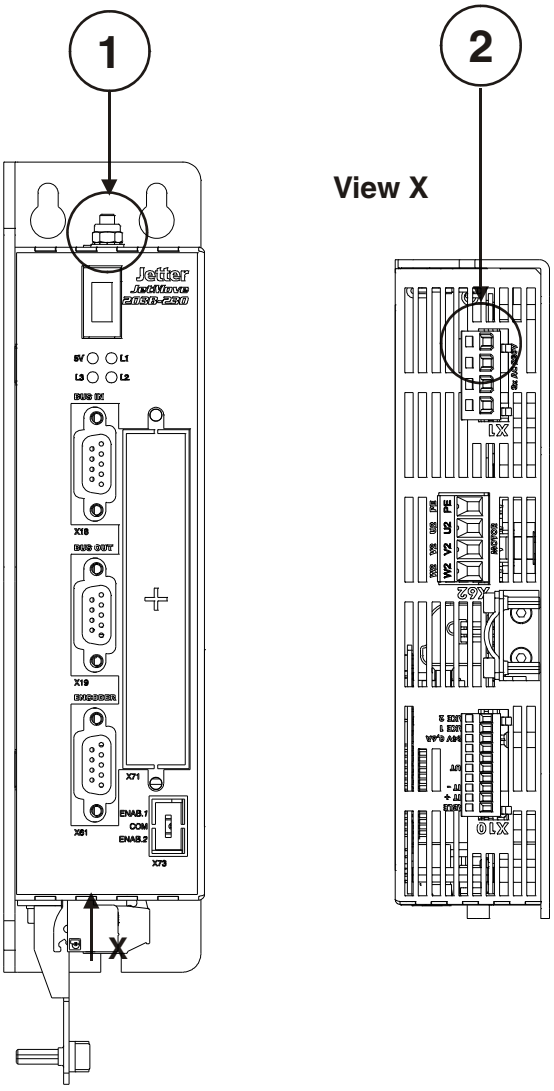



**Fig.: 1: Double earthing**

**NOTICE!**

**Do not install an earth-leakage current breaker in the mains power supply.**

Using an earth-leakage current breaker (FI) within the mains power supply is not possible.
If, in spite of this, an earth-leakage current breaker is installed, it will switch off the digital servo amplifier JetMove 203B-230, although there is no fault.
When a leakage current screen needs to be installed in the JetMove 203B-230, an isolating transformer must be used.

# 1.3 Residual dangers

## 1.3.1 Hazards during operation

### HAZARD caused by high operating voltage!



**DANGER!**

### Extremely hazardous voltages of up to DC 480 V occur!

Such voltages may result in muscle cramps, burns, unconsciousness, respiratory standstill, or death.

- During operation, all coverings and control cabinet doors have to be kept closed.
- Do not remove the cover.
- Do not disconnect the electric connections of the servo amplifier JetMove 203B-230 when it is live.
- **Do not touch the screws of the terminals X1 and X62 during operation**.
  The terminals have the following meaning:

  **X1:** AC 230 V voltage supply

  **X62:** DC motor voltage up to 480 V



**DANGER!**

### Hot surface hazard!



**CAUTION!**

During operation, the surfaces, respectively the heat sinks of the digital servo amplifier JetMove 203B-230 can heat up. The left sidewall can reach temperatures of up to 80 °C.

- Never touch the left sidewall of the servo amplifier JetMove D203 during operation and after switching off, while the device is still cooling down.
- Make sure that no temperature-sensitive parts have been connected or fastened to the servo amplifier JetMove 203B-230.

## DANGER in a potentially explosive atmosphere!



**DANGER!**

**Do not operate the digital servo amplifier JetMove 203B-230 in a potentially explosive atmosphere.**

## DANGER of injuries caused by mechanic force!



**CAUTION!**

The digital servo amplifier JetMove 203B-230 drives a servo motor. This servo motor moves mechanic parts or sharp edges. Therefore, failure or malfunctioning of the digital servo amplifier JetMove 203B-230 can be dangerous for man or damage the manufacturing plant to an amount depending on the respective kind of plant. This should be prevented by installing additional safety devices.

- One safety precaution is to install a second set of limit switches to interrupt the power supply of the motor.
- Another safety precaution would be installing a guard.

Make sure that hazards to persons are precluded even when the drive is rotating unintentionally.

Do not remove any guards.



**DANGER!**

**Do not wear gloves**, lest they should get caught in the rotating drive shaft.

**Never touch a rotating drive shaft.**

### 1.3.2 Hazards after POWER is turned OFF

**DANGER resulting from electric shock!**



**WARNING**

Up to 5 minutes after switching off the operating voltages, capacitors still carry hazardous residual voltages.

- As a precaution, measure the voltage in the DC link circuit (amplifier terminal) and wait until it has fallen below DC 40 V.
- **Always** wait at least 5 minutes after switching off the device, before separating it from the mains or loosening the connections.
- **Always** wait at least 10 minutes after switching off the device before taking the following actions:
  – Touching the screws of the terminals X1 and X62;
  – Disconnecting the terminals and touching the contacts.

# 1.4 Instructions on EMI

The digital servo amplifier JetMove 203B-230 is intended for use in industrial surroundings. It may cause radio interferences when used in residential areas. It is operated at the operator's own risk.

The noise immunity of a system is determined by the weakest component of the system. For this reason, correct wiring and shielding of cables is of paramount importance.



**NOTICE!**

Measures for increasing immunity to interference:

- Ground the enclosure according to chapter 1.2.3 "Earthing procedure", page 14.
- Connect all grounding terminals of the JetMove 203B-230. A double grounding terminal is required!
  – Connect the protective earth terminal located on the enclosure.
  – Connect the protective earth (PE) to terminal X1.
  Please refer to fig. 1 on page 15.
- The distance between the optional line filters and the servo amplifier 203B-230 must be as short as possible.
- When of a motor cable with included brake lines is used, these brake lines have to be shielded separately.
- Follow the instructions given in Application Note 016 "EMC-Compatible Installation of theElectric Cabinet" published by Bucher Automation AG.

**The following instructions are excerpts from Application Note 016:**

- Screw the enclosure of the digital servo amplifier JetMove 203B-230 onto a highly conducting, earthed panel.
- On principle, **physical separation** should be maintained between signal and voltage lines. We recommend spacings greater than 20 cm. Cables and lines should cross each other at an angle of 90°.
- For the following lines, shielded cables are to be used:
  Analog lines, data lines, motor cables coming from inverter drives (servo output stage, frequency converter), lines between components and interference suppressor filter, if the suppressor filter has not been placed at the component directly.
- **Both ends of the cable** must be shielded.

- Unshielded wire ends of shielded cables should be as short as possible.

- The **entire shield** must be drawn behind the isolation, its **greatest possible surface area** being clamped under a strain relief which is extensively earthed.

**When male connectors are used:**

- The shield **must,** in its entire perimeter, be drawn behind the shielding clamp of the metallized connector housing, respectively of the EMC gland bushing, its greatest possible surface area being clamped under a strain relief.

- Only use metallized connectors, e.g. Sub-D with metallized housing. Make sure that the strain relief is directly connected with the housing here as well (see fig. 2).

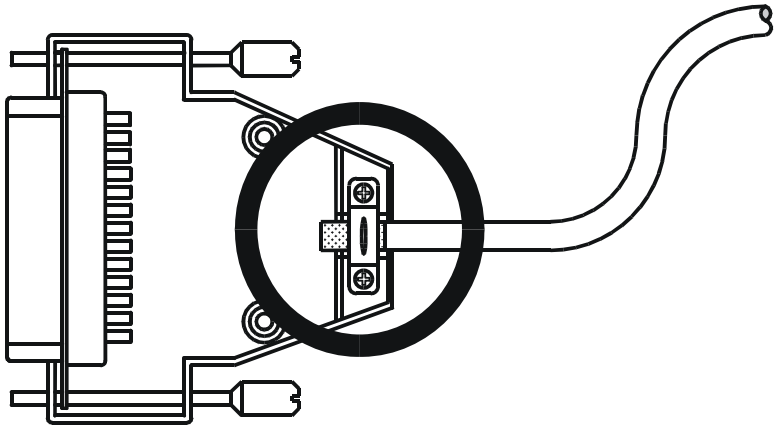


**Fig.: 2: Shielding of Sub-D connectors in conformity with EMC standards**

**If the shield cannot be attached to the connector, for example, with a screw type terminal:**

It is important that shield and strain relief are highly conductive and directly connected to a grounded surface with the greatest possible surface area. When doing so, grounding must be implemented in a way that the unshielded portion of the cable is as short as possible (refer to fig. 3).

We recommend installing the enclosed ferrite core on the motor power supply cable as shown in figure 3.
For optimum results, increase the number of turns around the ferrite.

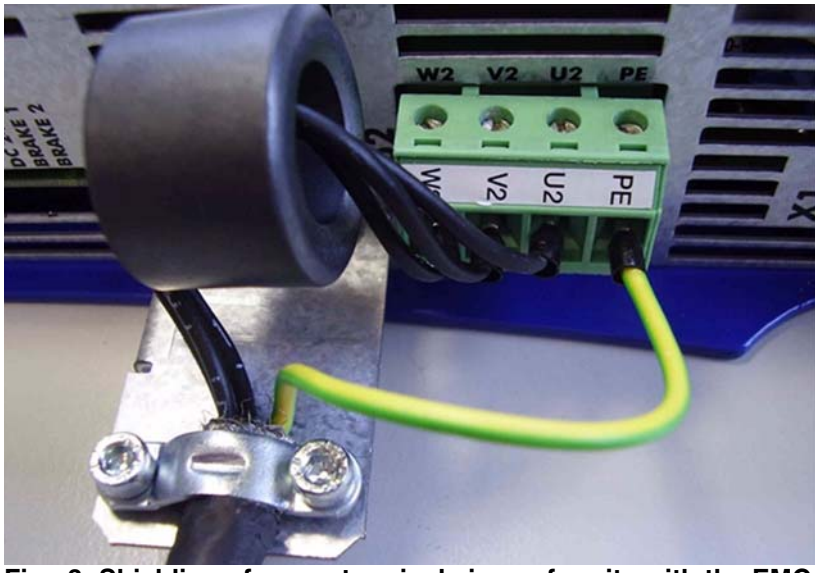



**Fig.: 3: Shielding of screw terminals in conformity with the EMC standards**

# 2 JetMove 203B-230 - Installation instructions

## 2.1 Scope of delivery

- Digital servo amplifier JetMove 203B-230
- The mating connector is plugged-on.
- Cable strap serving as strain relief and motor cable shield
- User manual

## Installation accessories (not included in the scope of delivery)

(Please obtain an individual offer from the Bucher Automation headquarters, the subsidiaries or the distributors.)

- System bus cable of cable assembly number 530 x.x m; length: 0.2 m to 5.0 m. See chapter 7.7 "JX2 System Bus", page 63.
- Motor power cable, see chapter 7.2 "Motor connection", page 47.
- Resolver cable, see chapter 7.3 "Resolver connection", page 53.
- HIPERFACE cable, see chapter 7.4 "HIPERFACE connection", page 55.
- Synchronous servo motors, e. g. the Bucher motor types JL, JK, or JH
- Motor circuit braker, see chapter 5 "Technical data", page 35.
- Circuit braker, see chapter 5 "Technical data", page 35.
- Isolating transformer or autotransformer
- Mounting screws, 3 pcs.; refer to 4, page 24.



**INFO!**

If you are not sure which mounting accessories you will need, please contact Bucher Automation AG.

# 2.2 Mechanical installation

- Prior to installing the digital servo amplifier, check it for possible transport damages.
- Check the shipment for completeness.
- Fix the cable strap serving as strain relief and motor cable shield next to connector X62 (see 3, page 21).
- To ensure proper functioning of the JetMove 203B-230, check whether the mounting plate in the electric cabinet is unpainted.
- The only possible mounting position is vertical - see 4, page 24.
- For sufficient air flow there has to be a clearance of 100 mm min. above and below the enclosure of the JetMove 203B-230.
- Mark on the panel two positions for the fastening screw threads of the JetMove 203B-230 (see 4, page 24).
- Drill the holes and cut the respective threads into the panel.
- Screw the corresponding fitting bolts into the thread by approximately half of their length.
- By means of the oblong holes in the rear plate, hang up the JetMove 203B-230 by the fitting bolts; then screw them tightly.

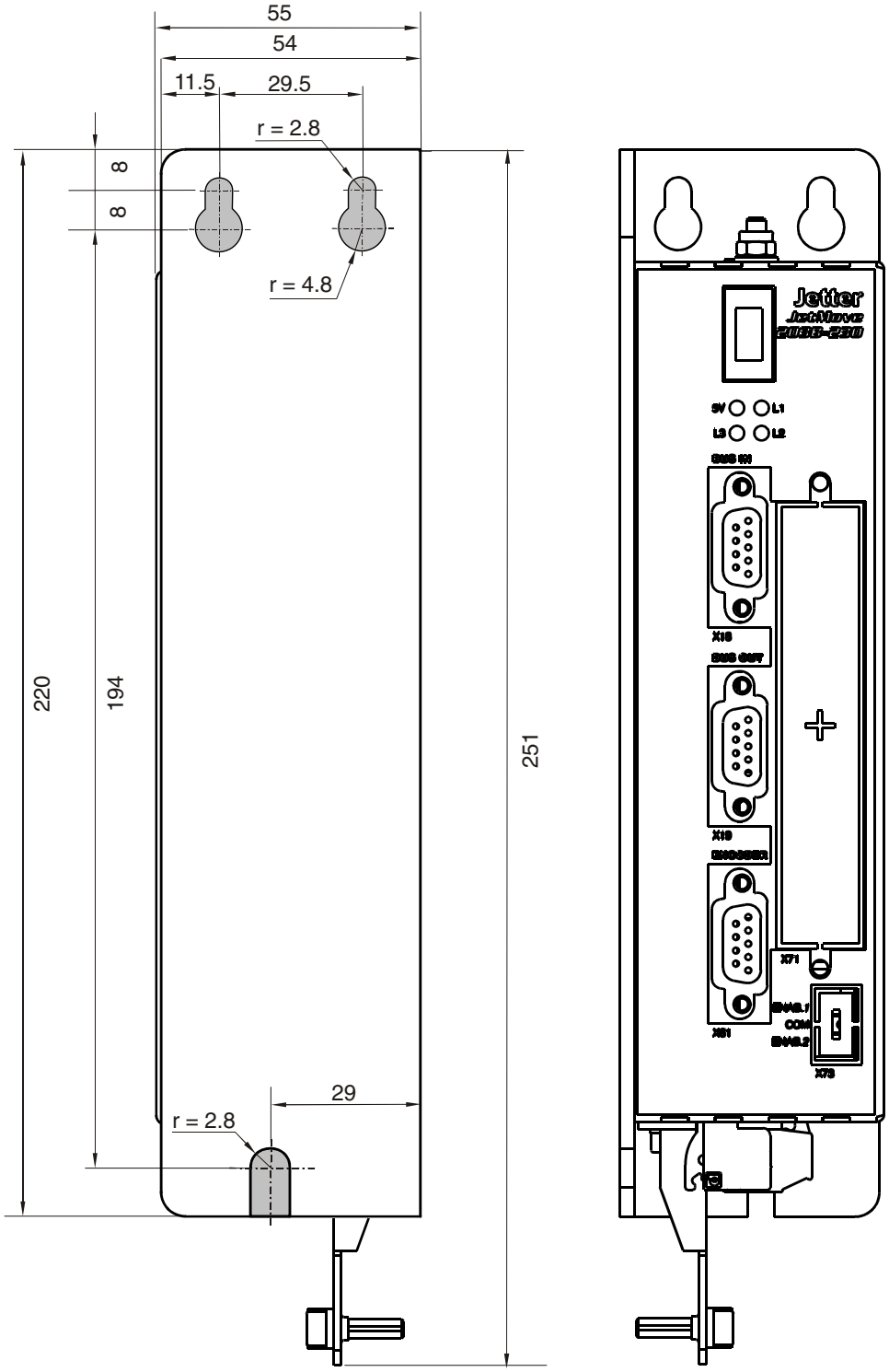



**Fig.: 4: Rear and front view of the JetMove 203B-230 enclosure with mounting holes**

# 2.3 Electrical installation

- Check for correct motor and servo amplifier assignment.
- Compare rated voltage and continuous rated current of servo amplifier and motor.
  The motor must be isolated against voltages of DC 480 V min.; also refer to , .
- Connect the JetMove 203B-230 according to the connection wiring diagram shown in chapter 10 "Connection diagrams", page 75.
  Especially check the power lines for appropriate protection. For more information see “Overload protection” on page 36.
  Protecting the motor cables is not advisable.
- Select the cables according to standards.
- Verify that all earthing cables are connected (double earthing).
  Observe the max. tightening torque, see appendex F.
- To connect resolvers or power units you can use prefabricated cables available from Bucher or opt for self-made cables. Please refer to chapter 7 "Description of connections", page 45.
- Please regard the following items regarding installation according to EMC:
  – If possible, run control cables and power cables separately;
  – Connect resolver;
  – Use shielded terminals or EMC-compatible connectors;
  – Connect holding brake, if available, and connect shields on both sides of the cables;
  – Connect the motor lines according to 3, page 21.

  Please further note the chapter 1.4 "Instructions on EMI", page 19.

## 2.4 Checking the installation

- Check motor and servo amplifier wiring and connections by means of the connection diagrams used.
- Check the holding brake, if existing, for proper functioning.
- Check to see whether all necessary protection measures against accidental contact with live or moving parts have been taken.
- Carry out any other checks specific to, or required, for your system.

## 2.5 Notes on safety as regards the installation

**HAZARD caused by high operating voltage!**



**DANGER!**

**Extremely hazardous voltages of up to DC 480 V may occur!**

Please, observe the following precautions in order to avoid injuries such as muscle cramps, burns, unconsciousness, respiratory standstill or possibly death:

- Have installation and maintenance jobs carried out by qualified personnel only chapter 1.1.3 "Qualified personnel", page 11.
- Switch off the operating voltage.
- Please take into account the information on residual dangers given in chapter 1.3.2 "Hazards after POWER is turned OFF", page 18.
- Before carrying out installation and maintenance jobs, separate the servo amplifier JetMove 203B-230 and all connected devices from the mains (pull out the mains plug).

# 2.6 Notes on safety as regards commissioning

## HAZARD caused by high operating voltage!



**Danger**

## Extremely hazardous voltages of up to DC 480 V may occur!

Please, observe the following precautions in order to avoid injuries such as muscle cramps, burns, unconsciousness, respiratory standstill or possibly death:

- Have commissioning jobs carried out by qualified personnel only, see chapter 1.1.3 "Qualified personnel", page 11.

### Before energizing the device make sure that the following requirements are complied with:

- Reattach dismantled protective equipment and check it for proper functioning.
  This way, protection from moving parts of the machine will be achieved.
- Secure the servo amplifier JetMove 203B-230 against accidental contact with conductive parts and components.
- Only connect devices or electrical components to the signal lines of the digital servo amplifier JetMove 203B-230 (Enable, Limit+/-, REF, BRAKE 1 and BRAKE 2) that have been sufficiently isolated against the connected electric circuits. These signal lines may only be connected with units that have got the ground potential of the DC 24 V power supply.
- Only connect resolver, HIPERFACE and servo motor to the servo amplifier, if they have been sufficiently isolated from the connected electric circuits.
- The leakage current of the digital servo amplifier JetMove 203B-230 is greater than 3.5 mA. Therefore, a second protective earth conductor is required in order to avoid electric shocks.
  For this, the measures listed in
  chapter 1.2.3 "Earthing procedure", page 14 have to be taken.
- Always carry out each commissioning, even a short functional test, with correctly connected PE bus.

# 2.7 Notes on decommissioning



Before returning the device, remove the cable strap serving as strain relief and motor cable shield.

# 3 Operating conditions



**DANGER**

**Danger in the event that the operating parameters for the "Safe Torque Off" option of the JM-2xx-xxx...-S1 amplifiers are not complied with.**

**Serious injuries can occur!**

For example from
- electric shock because the electrical safety has been violated by not complying with the degree of pollution;
- crushing if the functionality of the safety function STO is no longer guaranteed.

Make sure that the following operating parameters are met.

| Operating parameters | | |
|---|---|---|
| **Ambient conditions** | | **Reference** |
| Transport conditions<br>(units within packing) | Temperature:<br>-25 °C ... 70 °C<br>Air humidity:<br>5 % ... 95 %<br>Non-condensing | DIN EN 50178 |
| Storage conditions<br>(units within packing) | Temperature:<br>-25 °C ... 55 °C<br>Change<br>max. 20 K/h<br>Air humidity:<br>5 % ... 95 %<br>Non-condensing<br>Max. storage time:<br>1 year without any limitations | DIN EN 50178 |

The "Storage Conditions" are continued on the next page

| Operating parameters | | |
|---|---|---|
| Storage conditions (units within packing) | If this storage time has been exceeded, the device must be connected for at least 2 hours to the mains voltage prior to commissioning. The motor must remain de-energized and the logics circuit must be supplied with power. The servo amplifier can then be used again without restriction. | |
| Ambient temperature | 0 ... 45 °C (45 °C ... 55 °C with derating of 2.5 %/K) Please be careful of sufficient cooling | DIN EN 50178 |
| Air humidity | 5 % ... 85 % Non-condensing | DIN EN 50178 |
| Pollution degree | 2 | DIN EN 50178 |
| Corrosion immunity / chemical resistance | No special protection against corrosion Ambient air has to be free from higher concentrations of acids, alcaline solutions, salts, metal vapours, or other corrosive or electroconductive contaminants. | DIN EN 50178 |
| Operating altitude | Up to 1,000 m above sea level without derating. From 1,000 to 2,000 m above sea level: Derating of 1.5 % per 100 m increase in altitude. | DIN EN 50178 |
| | | |
| **Mechanical conditions** | | **Reference** |
| Free falls withstanding test | Within original packing, the device withstands dropping over all of its edges. | DIN EN 50178 DIN EN 60068-2-31 |
| Vibration resistance | 10 Hz ... 57 Hz at an amplitude of 0.075 mm 57 Hz ... 150 Hz: 1.0 g constant acceleration 1 octave per minute, 10 frequency sweeps (sinusoidal), all three spatial axes | DIN EN 50178 DIN EN 60068-2-6 |
| Degree of protection | IP20 | DIN EN 60529 |

| Operating parameters | | |
|---|---|---|
| Mounting position | Vertical (refer to Fig. 4 page 24)<br>For sufficient air flow there has to be a clearance of 100 mm above and below the device. | |
| **Electrical safety conditions** | | **Reference** |
| Class of protection | I | DIN EN 61800-5-1 |
| Dielectric strength<br><br><br><br>Isolation | Power to earth and power to logic<br>1.7 kVdc, 2 s<br>Power to earth and power to logic<br>> 1 MOhm at 500 V | DIN EN 61800-5-1<br>DIN EN 60146-1-1<br>DIN EN 60204 |
| Protective connection | 12 V, 25 A, 0.1 Ohm | DIN EN 61800-5-1 |
| Overvoltage category | III | DIN EN 61800-5-1<br>DIN VDE 0110-1 |

**NOTICE!**

Measures to avoid damages in transit and storage:

- The packaging material and the storage place are to be chosen in a way that the values given in the above table "Operating parameters" on page 29 are kept to.

The following note must be observed for the amplifier models JM-2xx-xxx-JC310-.....

**NOTICE**

The quality of the Ethernet cable has a significant influence on the EMC values given in the following tables.

- Use a CAT6 cable (S/FTP design) as Ethernet cable.

| EMC | | |
|---|---|---|
| **Emitted interference** | | |
| **Parameter** | **Value** | **Reference** |
| Enclosure | • Frequency range 30 ... 230 MHz, limit 50 dB (µV/m) at 3 m<br>• Frequency range 230 ... 1,000 MHz, limit 57 dB (µV/m) at 3 m<br>(First environment, category C2 facility) | DIN EN 61800-3 |
| Line AC | • Frequency range 0.15 ... 0.5 MHz, limit 79 dB (µV)<br>• Frequency range 0.5 ... 30 MHz, limit 73 dB (µV)<br>• (First environment, category C2 facility) | DIN EN 61800-3 |



**NOTICE**

This is a product of restricted availability according to IEC/EN 61800-3 and may cause radio interferences in a residential environment.
Follow the instructions below:



If this product is used in a residential environment, take appropriate measures. One of the measures is to use additional line filters. Siehe “Line filter” auf Seite 36.

| EMC | | |
|---|---|---|
| **Interference immunity: Enclosure** | | |
| **Parameter** | **Value** | **Reference** |
| RF field, amplitude-modulated | Frequency band 80 ... 1,000 MHz; test field strength 10 V/m<br>AM 80 % at 1 kHz<br>Criterion A | DIN EN 61000-4-3<br>DIN EN 61800-3 |

| EMC | | |
|---|---|---|
| ESD | Contact discharge:<br>Test peak voltage 6 kV<br>Criterion B | DIN EN 61800-3<br>DIN EN 61000-4-2 |
| **Interference immunity: Power connections and power interfaces** | | |
| **Parameter** | **Value** | **Reference** |
| Conducted radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 10 V<br>AM 80 % at 1 kHz<br>Criterion A | DIN EN 61800-3<br>DIN EN 61000-4-6 |
| Burst (fast transients) | Test voltage 2 kV<br>tr/tn 5/50 ns<br>Repetition frequency 5 kHz<br>Criterion B | DIN EN 61800-3<br>DIN EN 61000-4-4 |
| Voltage surges | tr/th 1.2/50 µs, 8/20 µs<br>1 kV (phase to phase)<br>2 kV (phase to ground)<br>Criterion B | DIN EN 61800-3<br>DIN EN 61000-4-5 |
| **Interference immunity: Process, measuring and control lines** | | |
| **Parameter** | **Value** | **Reference** |
| Conducted radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 10 V<br>AM 80 % at 1 kHz<br>Criterion A | DIN EN 61800-3<br>DIN EN 61000-4-6 |
| Burst (fast transients) | Test voltage 2 kV<br>tr/tn 5/50 ns<br>Repetition frequency 5 kHz<br>Criterion B | DIN EN 61800-3<br>DIN EN 61000-4-4 |
| **Interference immunity: Signal interfaces** | | |
| **Parameter** | **Value** | **Reference** |
| Conducted radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 10 V<br>AM 80 % at 1 kHz<br>Criterion A | DIN EN 61800-3<br>DIN EN 61000-4-6 |
| Burst (fast transients) | Test voltage 1 kV<br>tr/tn 5/50 ns<br>Repetition frequency 5 kHz<br>Criterion B | DIN EN 61800-3<br>DIN EN 61000-4-4 |

# 4 Physical dimensions

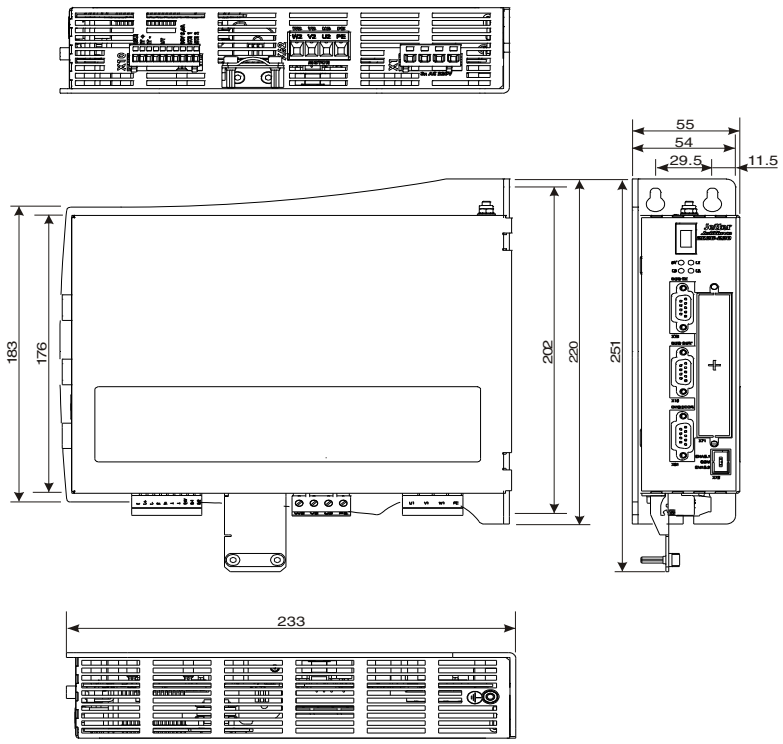



**Fig.: 5: Physical dimensions of the JetMove 203B-230 (in mm)**

For installation, please also refer to fig. 4 on page 24.

# 5 Technical data

## 5.1 Electrical specifications



**DANGER**

**Danger in the event that the Electrical Specification for the "Safe Torque Off (STO)" option of the JM-2xx-xxx...-S1 amplifiers are not complied with.**

**Serious injuries can occur!**

For example from crushing if the functionality of the safety function STO is not ensured.

Make sure that the following electrical specifications are met.

| Electrical specifications | |
|---|---|
| Rated voltage supply | • Direct supply $U_{eff}$ = 230 V<br>Common mode voltage 2 % max.<br>Power dissipation 3 ms max.<br>• 48 ... 62 Hz<br>Frequency change max. 2 %/s |
| Power supply connection | • 1-phase: direct ($U_{eff}$ = 230 V: L to N)<br>• 3-phase: via autotransformer or isolating transformer<br>e.g.<br>Primary circuit: $U_{eff}$ = 3 x 400 V.<br>Secondary circuit: $U_{eff}$ = 3 x 230 V<br><br>**See "Note 1!" on page 38.** |
| Power supply tolerance | $U_{eff}$ = 195 V ... 265 V (-15 % ... + 15 %) |
| Inrush current limitation | < 45 A limited to 10 ms during the switch-on-sequence<br><br>**Refer to "Time between deactivating and activating the mains power supply" on page 38** |

| Electrical specifications | |
|---|---|
| Overload protection | For each phase an external overload protection is required, for example<br>– circuit breaker 10 A C<br>– Fuse 10 A M (medium time lag)<br>– Motor circuit breaker 10 A<br><br>For systems with NRTL approval use overload protection devices that are NRTL listed (acc. To UL 508)(NKJH) ) self protected combination motor controller (specification: 10 A).<br>The JetMove 203B-230 is suitable for use on a circuit capable of delivering not more than 5000 (rms) symmetrical Amperes, 480 Volts maximum. |
| Output voltage of the motor | Three-phase with 325 V typical (480 V max.) |
| Motor output current at an ambient temperature of 45 °C | Nominal current: $I_{eff}$ = 3 A<br>Peak current for 30 seconds min.: $I_{eff}$ = 6 A<br>(The duration depends on the temperature of the heat sink)<br><br>**See "Note 2!" on page 38.** |
| Continuous output | 0.5 kW |
| Short-circuit protection, motor side | Designed for<br>• phase to phase<br>• phase to earth |
| Motor overload protection | See "Motor protection" on page 40. |
| Motor cable<br>Cable size<br>Material<br>Capacitance<br>Temperature class<br>Max. length of the motor cable | <br>4 * min. 0.75 $mm^2$ (min. AWG 18)<br>Copper<br>< 150 pF/m<br>> 60 °C<br>50 m max.<br>(for greater lengths please contact Bucher Automation AG) |
| Line filter | Line filter ensuring EMC in a residential environment to DIN EN 61800-3 with no limitations. The following filters can be applied with input circuits:<br><br>– FMAC-931-0810 8 A<br>– FMAC-932-1610 16 A<br>– FMAC-932-2510 25 A<br>– FMAC-934-3610 36 A<br><br>**See "Note 3!" on page 38.** |

| Electrical specifications | |
|---|---|
| Voltage supply of processor logics (demands on the power supply module) | • DC 24 V (20 ... 28.8 V)<br>• ≤ 0.6 A<br>• The voltage output of the power supply unit must comply with the SELV or PELV type. |
| Internal ballast resistor | • Resistor: 175 Ω (PTC)<br>• Continuous output: 70 W<br>• Maximum capacity internally limited to 1 kW at 0.6 s (warning and error message) |
| Residual voltage | To havoid hazard of electrical shock wait at least 5 minutes after switching off the digital servo amplifier before attempting to pull out the plug or remove this unit (refer to page 18). |
| Leakage current | > 3.5 mA<br><br>**See "DANGER resulting from electric shock!" on page 38.** |
| Digital inputs<br>– Enable (E)<br>– Reference switch (R)<br>– Limit switch right (L+)<br>– Limit switch left (L-)<br>– Input (Inp) | DC 20 V ... 28.8 V related to the ground potential of voltage supply of processor logics, with an input current of 7.5 mA max. each.<br><br>See "Digital inputs, logic power supply" on page 62. |
| Braking relay (contacts: Br1 and Br2) | $V_{max}$ = DC 30 V<br>$I_{max}$ = DC 2 A<br>Contact: N/O<br>connected to BR1 and BR2 on X10<br>The lines may only be connected to devices that are related to the same potential as the power supply of the controller logic.<br><br>Can be switched by the control program of the PLC or by the operating system of JetMove 203B-230 together with the software enable command. |
| Power dissipation $P_v$ | Output stage: 25 W max.<br>Logic circuit: 18 W max. |



**Note 1!**

**When a transformer is used:**
The neutral point on the secondary side of the circuit must be grounded.



**Note 2!**

**Cooling:**
- The overtemperature protection is activated at 80 °C.
- The overtemperature alarm is activated at 75 °C.
- The duration of the peak current is measured at a starting temperature of 45 °C at the heat sink.



**Note 3!**

A line filter can supply several digital servo amplifiers JetMove 203B-230, as soon as $I_f$ (the current of the line filter) is greater than the total current of the connected servo amplifiers.



**Important**

**Time between deactivating and activating the mains power supply**

If the drive system has been run by motor power (speed and torque at the moment) and the mains power supply is deactivated, the inrush current limitation unit must cool down for 2 to 3 minutes. If this is not considered, the inrush current limitation unit can be destroyed.

## DANGER resulting from electric shock!



**Warning**

In order to prevent electric shocks, ground the digital servo amplifier JetMove 203B-230 **by all means** via two positions; for this, refer to chapter 1.2.3 "Earthing procedure", page 14.

| Compatible synchronous servo motors | |
|---|---|
| Motor types | Bucher motors of the JHN, JHQ, and JI series with 2-cable technology.<br>Please also refer to the User Manual of the motors or contact the sales department of Bucher Automation AG. |



**INFO!**

In case you intend to use motors other than the above mentioned types, please contact Bucher Automation AG.

# 5.2 Motor protection

There are three ways of motor protection:

## 5.2.1 Thermal sensor integrated in the motor

The servo amplifier JetMove 203B-230 can read out and process three different motor temperature sensors:

| Sensor type | Type of sensor signal evaluation |
|---|---|
| KTY83-110 | Temperature is measured in °C<br>The warning threshold can be set<br>Error detection at maximum motor temperature |
| PTC | Go-no-go decision<br>Error detection at maximum motor temperature |
| Temperature switch | Go-no-go decision<br>Error detection at maximum motor temperature |

## 5.2.2 I²t calculation

The digital servo amplifier JetMove 203B-230 calculates the model of motor power loss by an I²t calculation. The calculated value is a measure of the average power dissipation of the motor. It is calculated in percent of the maximum motor power dissipation.
For this calculation it is important, that the parameters are entered correctly:
– Continuous rated current (either continuous rated motor current or continuous rated amplifier current, taking the lower value of the two)
– Overload factor
– and time constant of the motor

The I²t calculation has to be activated by JetSym or by the PLC program.
It is possible to parameterize the warning level. The error level (error 30) is set to 100 %.

The I²t value is readable in a variable of JetMove 203B-230 through JetSym or the PLC.

The digital servo amplifier JetMove 203B-230 calculates the percentage of motor power loss according to the following formula:

$$x(t) = 100\% \times \left(\frac{\text{average motor current}}{\text{rated current}}\right)^2 \times \left(1 - e^{-\frac{t}{T}}\right)$$

x(t) = displayed value of motor power dissipation in %
t = Time since start of motor running it with the average current (in seconds)
T = Motor time constant (in seconds)

The formula shows that the 100 % value will never be reached as long as the average motor current is lower than the continuous rated current of the motor.
Further, calculating always starts by 0 (at t = 0, the result of the equation is 0). After some time that is by far longer than the motor time constant, the result does virtually not change any more.
The time till error stop (x = 100 %) is a result of the following formula:

$$t = -T \times \ln\left[1 - \left(\frac{\text{rated current}}{\text{average motor current}}\right)^2\right]$$

After reset, the values of the important parameters are:

| | |
|---|---|
| Rated current: | 3 A |
| Overload factor: | 2 |
| Motor time constant: | 1,800 s (30 min) |

With these parameters the 100 % error level will be reached if, for example the motor is run by a current of 6 A for about 8 minutes and 30 seconds.



**NOTICE**

Because of the fact that after reset the $I^2t$ calculation always starts at zero, the motor overload calculation is wrong if the motor is already hot when the digital servo amplifier JetMove 203B-230 is switched on (that is, when parameterization of $I^2t$ calculation is completed and 24 V logic power supply is applied).



Therefore wait until the motor is cold before enabling the axis again.

## 5.2.3 Motor overload protection according to UL

The UL standard prescribes a motor overload detection for a servo amplifier according to the following criteria:

The "trip current" is defined to be 1.15 times the user-set continuous rated current.

- If the average motor current corresponds to the trip current, the overload protection has to switch off the motor after a limited time.
- If the average motor current is 2 times higher than the trip current the overload protection has to switch off the motor after at least 8 minutes.
- If the average motor current is 6 times higher than the trip current the overload protection must switch of the motor after at least 20 seconds.

This protection (error message 31 is activated) can be parameterized only through the rated current value.
The motor overload protection is always active and cannot be deactivated.



**NOTICE**

Because of the fact that after reset the $I^2t$ calculation always starts at zero, the motor overload calculation is wrong if the motor is already hot when the digital servo amplifier JetMove 203B-230 is switched on (that is, when parameterization of $I^2t$ calculation is completed and 24 V logic power supply is applied).



Therefore wait until the motor is cold before enabling the axis again.

# 6 Drive controller structure

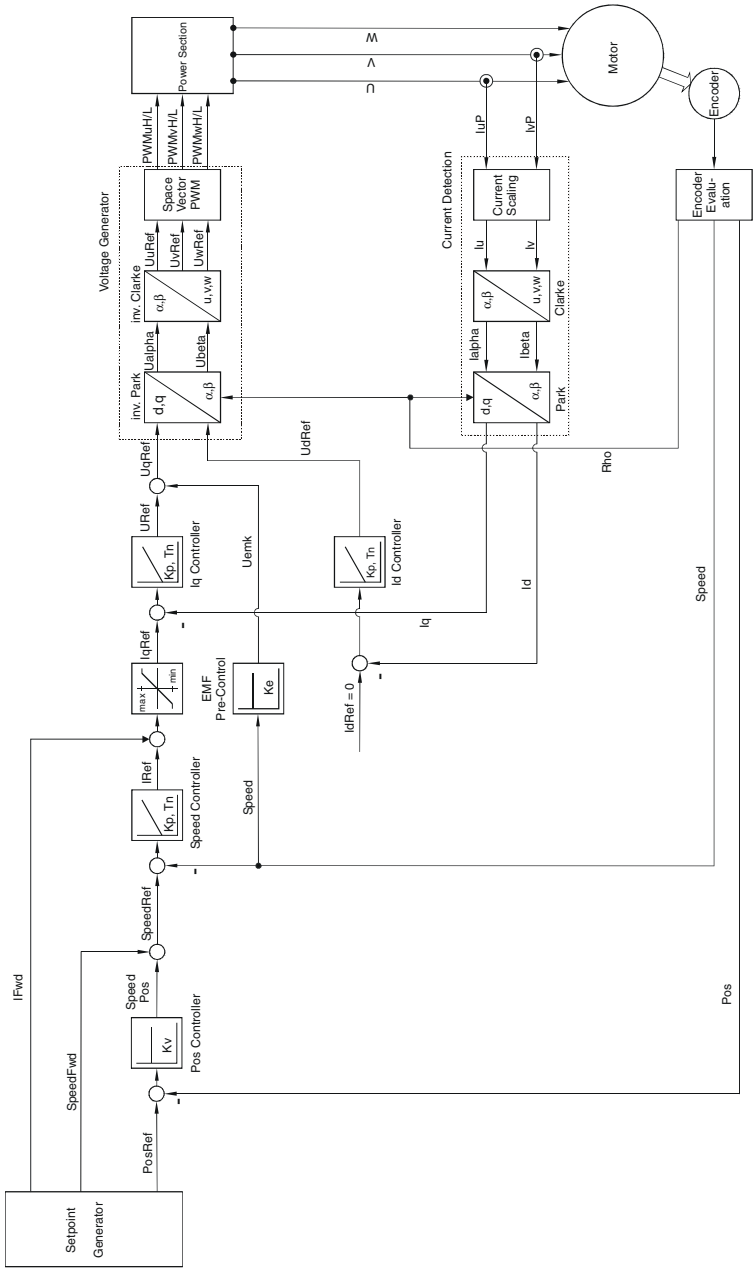



**Fig.: 6: Block diagram of drive controller structure**

All drive controller types can be parameterized through the control program.

| Controller type | Specification |
|---|---|
| **Motor control** (commutation) | Space vector modulation |
| **PWM frequency** | 16 kHz |
| **Current controller** | |
| – Cycle time | 62.5 µs |
| **Speed controller** | |
| – Cycle time<br>– Current pre-control | 125 µs<br>adjustable |
| **Position controller** | |
| – Cycle time<br>– Speed pre-control | 250 µs<br>adjustable |
| **Position setpoint generator** | |
| – Sine-square and linear acceleration and deceleration ramps<br>– Setpoint output cycle (position feedback controller interpolation) | can be parameterized individually<br>2 ms |
| **Position sensing** | |
| **Resolver:** | |
| – Resolution<br>– Scan time | 12 bits per revolution<br>62.5 µs |
| **Absolute encoder** (Multiturn and Single-Turn)**:** | |
| – Interface<br>– Resolution of absolute position<br>– Resolution of velocity pickup<br>– Scan time | HIPERFACE<br>15 bits per revolution<br>20 bits per revolution<br>62.5 µs |

# 7 Description of connections

## 7.1 Power supply connection

### Specification of terminal X1

- 4-pin spring tension terminal (type ZEC 1.5/ 4-ST-7.5 C2 R1,4; for printed circuit boards)
- Allowed conductor size: **0.25 ... 1.5** $mm^2$ (AWG 24 ... AWG 16)
- Bladed screw-driver: 0.6 x 3.5 x 100 $mm^2$

### Connecting cable specifications

- Cable size: 4 * 0.75 $mm^2$ (AWG 18(4))
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Bootlace ferrules are not required.

### Cable shielding

- Not needed

| Power supply<br>3-phase connection | | |
|---|---|---|
| **Terminals X1** | **Signal** | **Specification** |
| U1 | L1 | • AC 230 V between the power lines |
| V1 | L2 | |
| W1 | L3 | |
| PE | PE conductor | |

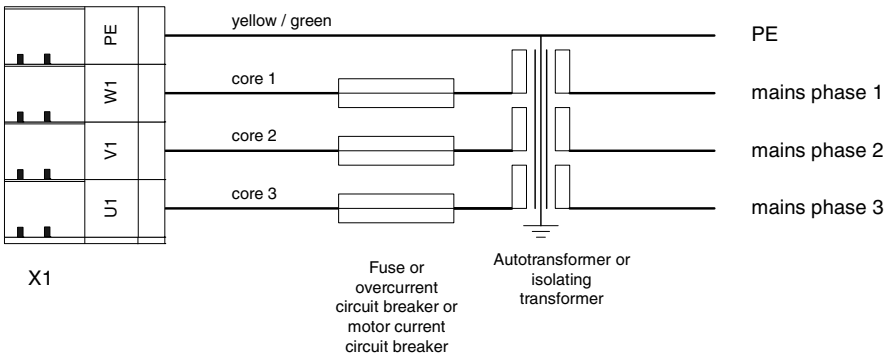



**Fig.: 7: Connection of the 3-phase supply line**

| Power supply<br>1-phase connection | | |
|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Specification** |
| U1 | L | • AC 230 V between mains phase and neutral conductor |
| V1 | N | |
| W1 | | |
| PE | PE conductor | |

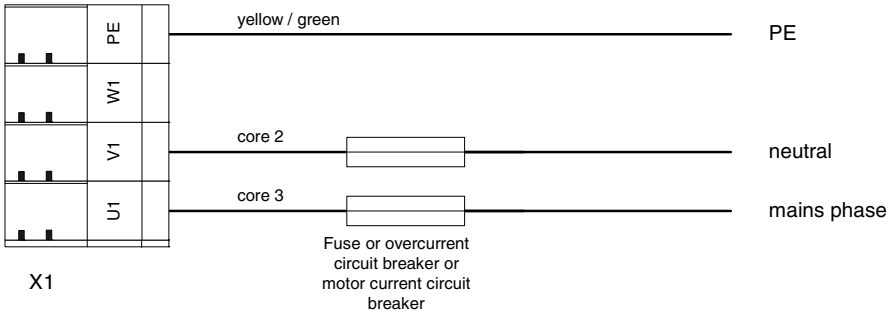



**Fig.: 8: Connection of the 1-phase supply line**

# 7.2 Motor connection

## 7.2.1 General remarks



**NOTICE!**

Measures to avoid malfunctions of the control system and the motor:

- Always connect brake lines to a separate power supply unit DC 24 V if brake and motor lines are run together in one bunch of cables, and are not separately shielded.



**NOTICE!**

Measures to avoid oscillation and blocking of the motor:

- Avoid mixing-up of phase cables, resp. be sure to connect the phase cables according to pin assignment.

## 7.2.2 Assignment and specifications

### Specification of the connector for terminal X62

- 4-pin connector (type PC 4/ 4-ST-7.62)
- Allowed conductor size: **0.25 ... 4.0** $mm^2$ (AWG 24 ... AWG 12)
- Bladed screw-driver: 0.6 x 3.5 x 100 $mm^2$
- Stud torque for the screw clamping terminal:
  0.5 Nm (4.4 ... 5.3 lbf-inch)

### Specification of the motor cable

- Cable size: 4 * 0.75 $mm^2$ (AWG 18(4))
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Bootlace ferrules are recommended.

### Cable shielding

- Braided copper shield of 80 % coverage

Connection of the motor to the digital servo amplifier JetMove 203B-230 has to be done following the wiring diagram below. Connection of the brake is optional.

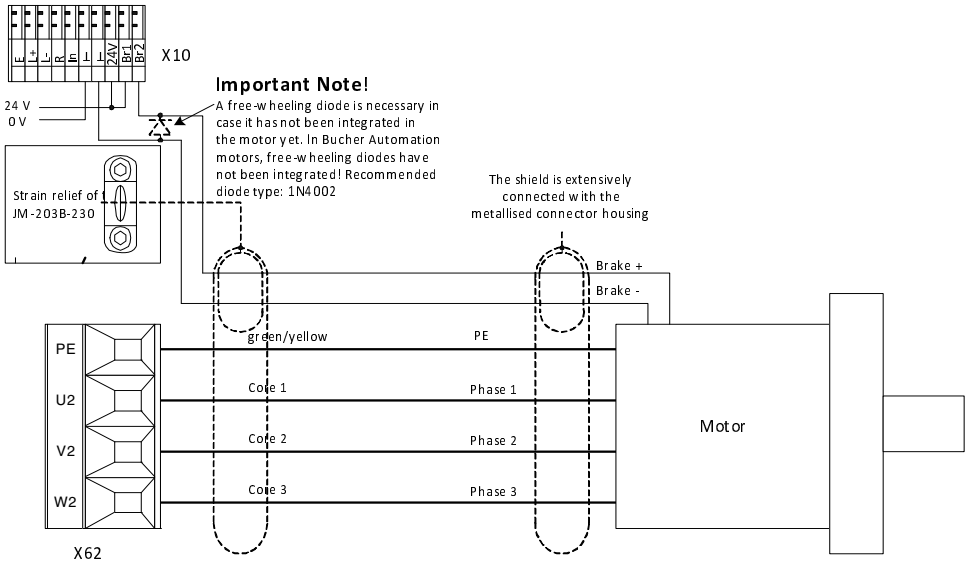



**Fig.: 9: Connection of motor lines**

## 7.2.3 Motor power cable with mating connector SC



**INFO**

The suitable mating connector SC (female connector) can be ordered from Bucher Automation AG under part number 15100070.



**INFO**

The ready-made motor power cable with SC mating connector can be ordered from Bucher Automation AG. It is equipped with the corresponding motor mating connector and can be ordered from Bucher Automation AG by specifying the following cable confection number (KABEL-KONF):

**Without brake:**

Cable confection # 26.1

**With brake:**

Cable confection # 24.1

### Mating connector of the motor (solder side)

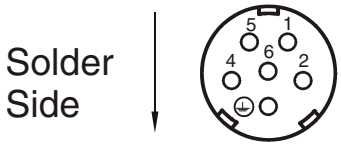
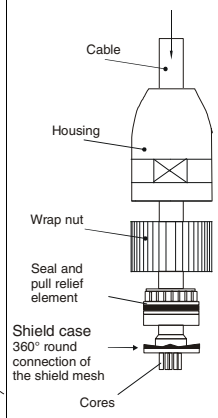
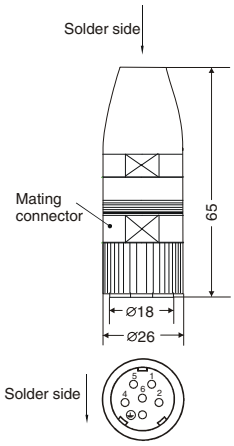
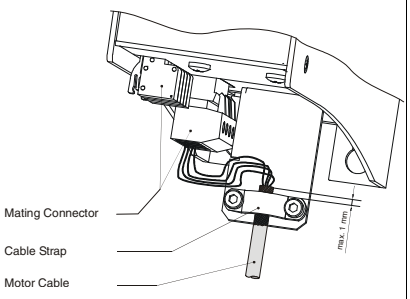



**Fig.: 10: View on the SC series mating connector of the motor (internal thread M23)**

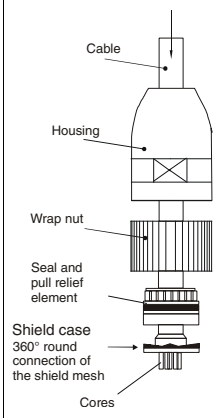
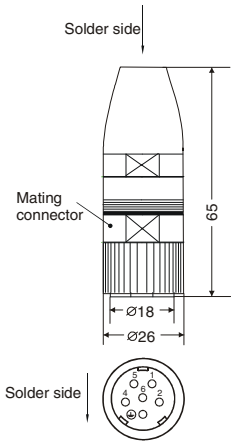
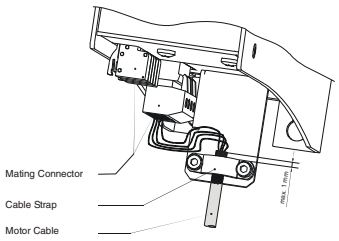
## Specification of the motor power cable with mating connector SC for JetMove 203B-230

For connection without motor holding brake

| Motor power cable, cable assy no. 26.1 | | | |
|---|---|---|---|
| **Field wiring terminals of the JM-203B-230** | **Shielding** | | **Motor mating connector (female, solder side)** |
| (4 x 1.5 $mm^2$ (2 x 1.5 $mm^2$)) (AWG 16(6))<br>The wires are equipped with wire end ferrules. | Highly flexible 6-wire cable with PE (GND) (separately shielded brake lines and all-over shielding) |  |  |
|  | | | |
| | Connect both sides of the shield with the greatest possible surface area!<br>Use metallized housing only! | | |
| **Pin** | **Wire number** | **Signal** | **Pin** |
| X62.U2 | U1 | Phase 1 | 1 |
| X62.V2 | V2 | Phase 2 | 5 |
| X62.W2 | W3 | Phase 3 | 2 |
| X62.PE | yellow-green | PE conductor | ⏚ |
| X10.BRAKE2 | BR1 | Brake + | 6 |
| X10.GND | BR2 | Brake - | 4 |

Dimensions of the motor mating connector are specified in millimeters.

For connection with motor holding brake

| Motor power cable, cable assy no. 24.1 | | | |
|---|---|---|---|
| **Field wiring terminals of the JM-203B-230** | **Shielding** | | **Mating connector of the motor (female, solder side)** |
| (4 x 1.5 $mm^2$ (2 x 1.5 $mm^2$)) (AWG 16(6))<br>The wires are equipped with wire end ferrules. | Highly flexible 6-wire cable with PE (GND) (separately shielded brake lines and all-over shielding) |  |  |
|  | | | |
| | Connect both sides of the shield with the greatest possible surface area!<br>Use metallized housing only! | | |
| **Pin** | **Wire number** | **Signal** | **Pin** |
| X62.U2 | U1 | Phase 1 | 1 |
| X62.V2 | V2 | Phase 2 | 5 |
| X62.W2 | W3 | Phase 3 | 2 |
| X62.PE | yellow-green | PE conductor |  |
| X10.BRAKE2 | BR1 | Brake + | 6 |
| X10.GND | BR2 | Brake - | 4 |

Dimensions of the motor mating connector are specified in millimeters.

### 7.2.4 Connection assignment of terminal box

| Connection assignment of terminal box*) | | |
|---|---|---|
| **Field wiring terminals of the amplifier** | **Motor terminal box - terminal assignment** | |
| X62.U2 | Pin 1 | Phase 1 |
| X62.V2 | Pin 2 | Phase 2 |
| X62.W2 | Pin 3 | Phase 3 |
| X62.PE | Pin 4 |  Protective earth |
| X10.BRAKE2 | Pin 7 | Brake + |
| X10.GND | Pin 8 | Brake - |

*) alternative to motor connectors

# 7.3 Resolver connection

## 7.3.1 Specification

### Specification of the connector for terminal X61 (ENCODER)

- 9-pin male Sub-D connector
- Metallized enclosure

### Specification of the resolver cable

- Cable size: 4 * 2 * 0.14 mm² (AWG 26(8)) min.
- Cores have to be shielded and twisted in pairs and have to be included in an overall shielding.
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

## 7.3.2 Resolver cable with mating connector



**INFO!**

The resolver respectively HIPERFACE mating connector can be ordered from Bucher Automation AG by specifying its item # 15100069.

The complete resolver cable between the servo amplifier series JetMove 2xx and Bucher motors can be obtained from Bucher Automation AG. It can be ordered by specifying the following cable assy number:

| | |
|---|---|
| Cable assy no. 23 | For the servo amplifier series JetMove 2xx |

### Mating connector of the resolver (solder side)

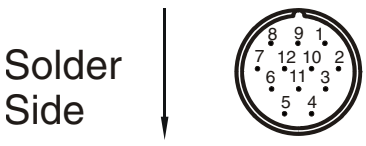
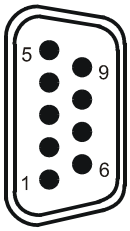
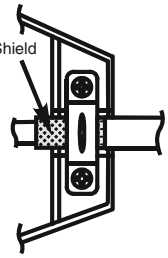
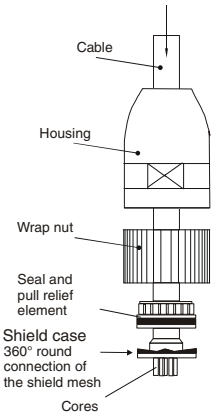
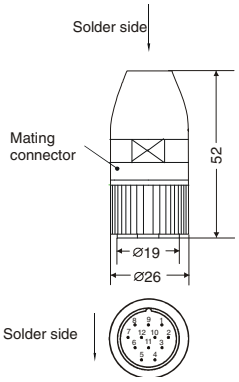



**Fig.: 11: RC series mating connector of the resolver (internal thread M23)**

## Resolver cable of cable assy no. 23

| JetMove 2xx (Sub-D male connector X61) | Shielding | | Motor (resolver) (female, solder side) |
|---|---|---|---|
|  Attaching screws must have a metric thread! |  |  |  |
| | Connect shield with the greatest possible surface area! Use metallized housing only! | | |

| Pin | Signal | Core color | Pin |
|---|---|---|---|
| 8 | Cosine + | red | 1 |
| 3 | Cosine - | blue | 2 |
| 2 | Sine - | amber | 3 |
| 7 | Sine + | green | 4 |
| 1 | R1R (exciter winding +) | pink | 5 |
| 6 | R2L (exciter winding -) | gray | 6 |
| 9 | Th1 Thermal sensor + | white | 7 |
| 4 | Th2 Thermal sensor - | brown | 8 |
| - | Unassigned | - | 9 - 12 |

Dimensions of the resolver mating connector are specified in millimeters.

# 7.4 HIPERFACE connection

## 7.4.1 Specification

### Specification of the connector for terminal X61 (ENCODER)

- 9-pin male Sub-D connector
- Metallized enclosure

### HIPERFACE cable specification

- Cable size:
  4 * 2 * 0.14 mm² + 2 * 0.5 mm² (AWG 26(8) + AWG 20(2)) min.
  2 * 0.5 mm² (AWG 20(2)) must be used for the power supply unit and for GND.
- Twisted-pair cables shielded with the all-over shield must be used; the signal lines must also be twisted in pairs:
  Sine + and reference sine
  Cosine + and reference cosine
  DATA - and DATA +
  0 V and power supply
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

## 7.4.2 HIPERFACE cable with mating connector



**INFO**

The compatible resolver or HIPERFACE mating connector can be ordered from Bucher Automation AG by specifying its item # 15100069.

The ready-made HIPERFACE cable between servo amplifiers of the JetMove 2xx series and Bucher motors can be ordered from Bucher Automation AG by specifying the cable confection number (KABEL-KONF) and the respective cable length in cm:

| | |
|---|---|
| KAY_0723-xxxx | For servo amplifiers of the JetMove 2xx series |

HIPERFACE mating connector (solder side)

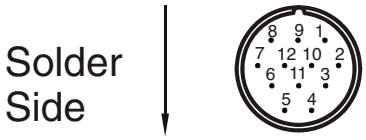
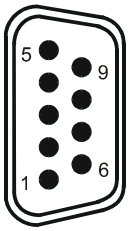
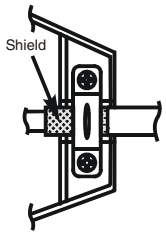
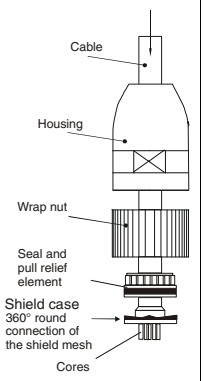
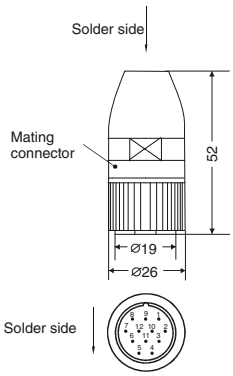



**Fig.: 12: RC series HIPERFACE mating connector (internal thread M23)**

## HIPERFACE cable of KAY_0723-xxxx

| JetMove 2xx (Sub-D male connector X61) | Shielding | | Motor (HIPERFACE) (female, solder side) |
|---|---|---|---|
|  Attaching screws must have a metric thread! |  |  |  |
| | Connect shield with the greatest possible surface area! Use metallized housing only! | | |

| Pin | Signal | Core color | Pin |
|---|---|---|---|
| - | Unassigned | - | 1 |
| - | Unassigned | - | 2 |
| 7 | Sine + | white | 3 |
| 2 | Reference sine | brown | 4 |
| 8 | Cosine + | green | 5 |
| 3 | Reference cosine | amber | 6 |
| 6 | DATA - (RS-485) | gray | 7 |
| 1 | DATA + (RS-485) | pink | 8 |
| 4 | 0 V | blue | 9 *) |
| 5 | Power supply (7 through 12 volts) | red | 10 |
| 9 | Thermal sensor + | black | 11 |
| | Thermal sensor - | - | 12 *) |

*) Pin 9 and pin 12 are short-circuited.
Dimensions of the HIPERFACE mating connector are specified in millimeters.

# 7.5 Sin-cos encoder connection

## 7.5.1 Adapter

An adapter is needed for connecting a sin-cos encoder. This adapter can be obtained from Bucher Automation AG by the following specification:

JM-200-ENC-ADAP (item no. 10000430)

Another 9-pin SUB-D connector of the encoder cable can be connected to this adapter. Further, this adapter allows for connecting an individual temperature sensor of the motor, as normally these signals are not conducted via the encoder cable, if a sin-cos encoder is used.

## 7.5.2 Specification

### Specifications of the mating connector for X61 (ENCODER)

- 9-pin male Sub-D connector
- Metallized enclosure

### Sin-cos encoder cable specifications

- Cable size: 2 * 2 * 0.14 mm² + 2 * 0.5 mm² (AWG 26(4) + AWG 20(2)), if there is no index signal.
- Cable size: 3 * 2 * 0.14 mm² + 2 * 0.5 mm² (AWG 26(6) + AWG 20(2)), if there is an index signal.
- 2 * 0.5 mm² (AWG 20(2)) must be used for the power supply unit and for GND.
- Cores have to be twisted in pairs and have to be included in an overall shielding.
- The following signal lines have to be twisted in pairs:
  Sine + and reference sine
  Cosine + and reference cosine
  Index + and reference index
  0 V and power supply
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Max. cable length: 100 m

### 7.5.3 Connection diagram

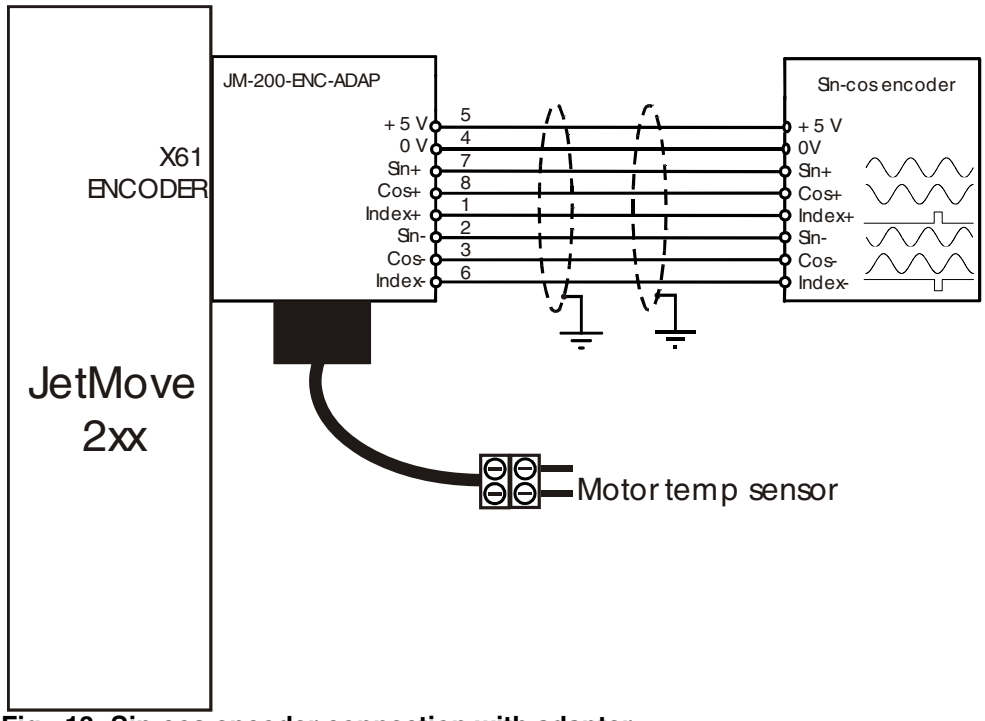
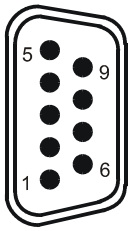
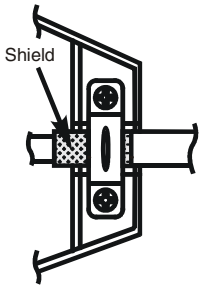



**Fig.: 13: Sin-cos encoder connection with adapter**

| Sin-cos encoder cable | |
|---|---|
| **JetMove 2xx (Sub-D connector X61) with adapter JM-200-ENC-ADAP** | **Shielding** |
|  |  |
| Attaching screws must have a metric thread! | Connect shield with the greatest possible surface area!<br>Use metallized housing only! |
| **Pin** | **Signal** |
| 7 | Sine + |
| 2 | Reference sine |
| 8 | Cosine + |
| 3 | Reference cosine |
| 1 | Index + |
| 6 | Reference index |
| 4 | 0 V |
| 5 | Power supply (5 V - 100 mA max.) |
| 9 | Unassigned |



**NOTICE!**

**To be considered before connecting sin-cos encoders:**

- If a sin-cos encoder is to be used, after applying the logic power supply to the JetMove 2xx and before the first enable, commutation finding **always** has to be carried out.
  If this is not considered, the motor might move uncontrollably.

- The counting direction of the position in the JetMove 2xx is reversed in the following cases:
  Case 1: The signal sine+ is exchanged with the signal cosine+, and the signal reference-sine is exchanged with the signal reference cosine.
  Case 2: The signal sine is exchanged with the signal reference sine
  Case 3: The signal cosine is exchanged with the signal reference cosine

- Due to conduction loss, a voltage smaller than 5 V might reach the encoder. If necessary, the encoder supply cords have to have a greater diameter.

- If a motor temperature sensor is not used, the inputs have to be short-circuited at the adapter, so the JetMove 2xx will not give an error message.

# 7.6 Digital inputs, logic power supply

## Specification of terminal X10

- 10-pin spring tension terminal (type ZEC 1.0/10-ST-3.5)
- Diameter of the cable apt for connecting: **0.2 ... 1** $mm^2$ (AWG 24 ... AWG 16) with bootlace ferrules in a plastic sleeve: 0.25 - 0.75 $mm^2$ (AWG 24 - AWG 18)
- Bladed screw-driver: 0.4 x 2.5 mm

| Digital inputs, logic power supply | | | |
|---|---|---|---|
| **Terminals X10** | **Signal** | **Description** | **Specification** |
| ENABLE | Hardware enable for the power supply of the motor (Input) | • At this input, a high signal is necessary for power supply of the motor (This signal must have been applied before carrying out the software enable).<br>• A low signal de-energizes the motor immediately. | • DC 24 V<br>• 7.5 mA max.<br>• Operating point: < 6 V low,<br>> 15 V high |
| REF | Reference switch (Input) | • Depending on the parameter setting, this input is used for reference run. | • DC 24 V<br>• 7.5 mA max.<br>• Operating point: < 6 V low,<br>> 15 V high<br><br>NC or NO contact |
| LIMIT + | Positive limit switch (input) | • Depending on the parameter setting, this input is used as a positive limit switch. | • DC 24 V<br>• 7.5 mA max.<br>• Operating point: < 6 V low,<br>> 15 V high<br><br>NC or NO contact |
| LIMIT - | Negative limit switch (input) | • Depending on the parameter setting, this input is used as a negative limit switch. | • DC 24 V<br>• 7.5 mA max.<br>• Operating point: < 6 V low,<br>> 15 V high<br><br>NC or NO contact |

| | | | |
|---|---|---|---|
| INPUT | Digital input | • Depending on the parameter setting, this input can be used for quick stop, position capture or referencing without stop. | • DC 24 V<br>•<br>• 7.5 mA max.<br>• Operating point: < 6 V low,<br>> 15 V high |
| ⊥ | Common ground | | GND*) for all inputs and supply of the logic |
| ⊥ | Common ground | | GND*) for all inputs and supply of the logic |
| DC 24 V | Voltage supply of processor logics | | DC 20 ... 28,8 V (I ≤ 0.6 A) |
| BRAKE 1 | Braking relay contact Br1 | Relay contact for motor holding brake<br><br>The relay can be operated either by the control program or by the firmware of the JetMove 203B-230 at release of the motor current.<br><br>**Important note!**<br>A free-wheeling diode is necessary in case it has not been integrated in the motor yet.<br>In Bucher motors, free-wheeling diodes have not been integrated!<br>Recommended diode type: 1N4002 | $V_{max}$ = DC 30 V<br>$I_{max}$ = DC 2 A<br><br>N/O<br><br>These connections are only for devices having got the same reference to ground as the power supply of the logic. |
| BRAKE 2 | Braking relay contact Br2 | | |

*) is connected to the ground of the control system.

For connection diagram please refer to “Connection diagrams” auf Seite 75.

# 7.7 JX2 System Bus

By means of the JX2 System Bus, the JetMove 203B-230 is interlinked with the controller, additional JetMove amplifiers, or Bucher peripheral modules. The JX2 system bus input BUS-IN is a 9-pin Sub-D male connector, and the JX2 system bus output BUS-OUT is a 9-pin Sub-D female connector.

## 7.7.1 JX2 System Bus cable - Specifications

### Specification of connectors

**On the BUS-OUT (X19) side**
- 9-pin male Sub-D connector
- Metallized enclosure

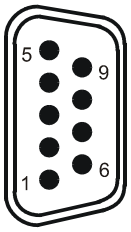
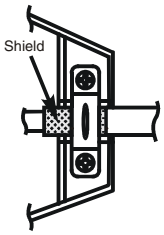
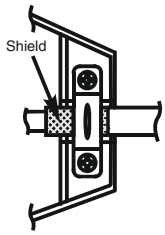
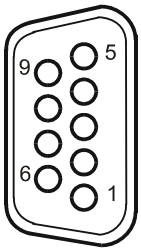
**On the BUS-IN (X18) side**
- 9-pin female Sub-D connector
- Metallized enclosure

### System bus cable specification

The following minimum requirements apply to the manufacture of the system bus cable:

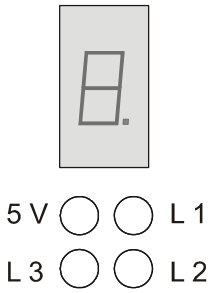
| System bus cable - technical data | | |
|---|---|---|
| **Description** | **Specification** | |
| Cable size | 1 MBaud: | 0.25 - 0.34 $mm^2$ |
| | 500 kBaud: | 0.34 - 0.50 $mm^2$ |
| | 250 kBaud: | 0.34 - 0.60 $mm^2$ |
| | 125 kBaud: | 0.50 - 0.60 $mm^2$ |
| Cable capacitance | 60 pF/m max. | |
| Resistivity | 1 MBaud: | 70 max. Ω/km |
| | 500 kBaud: | 60 max. Ω/km |
| | 250 kBaud: | 60 max. Ω/km |
| | 125 kBaud: | 60 max. Ω/km |
| Number of cores | 5 | |
| Shielding | Complete shielding, no paired shielding | |
| Twisting | Core pairs CL and CH must be twisted. | |
| Material | Copper | |
| Temperature class | 60 °C | |

| Allowed cable lengths | | | |
|---|---|---|---|
| **Baud rate** | **Max. cable length** | **Max. tap line length** | **Max. overall tap line length** |
| 1 MBaud | 30 m | 0.3 m | 3 m |
| 500 kBaud | 100 m | 1 m | 39 m |
| 250 kBaud | 200 m | 3 m | 78 m |
| 125 kBaud | 200 m | - | - |

| System bus cable of cable assy no. 530 | | |
|---|---|---|
| | **Shielding** | |
|  |   |  |
| **BUS-OUT** | Connect shield with the greatest possible surface area!<br>Use metallized housing only! | **BUS-IN** |
| **Pin** | **Signal** | **Pin** |
| 1 | CMODE0 | 1 |
| 2 | CL | 2 |
| 3 | GND | 3 |
| 4 | CMODE1 | 4 |
| 5 | TERM | 5 |
| 6 | Unassigned | 6 |
| 7 | CH | 7 |
| 8 | Unassigned | 8 |
| 9 | Do not connect | 9 |

# 8 Status monitoring

The output stage LEDs indicate the operating status of the digital servo amplifier.




| JetMove 203B-230 - LEDs | | | |
|---|---|---|---|
| **LED** | **Color** | **State** | **Description** |
| 5 V | green | is lit | Logic module voltage is OK. |
| L1 | amber | is lit | Axis is standing still (speed = 0) |
| L2 | amber | is lit | A voltage of 24 V is applied to the input of the positive limit switch (LIMIT+). |
| L3 | amber | is lit | A voltage of 24 V is applied to the input of the negative limit switch (LIMIT-). |

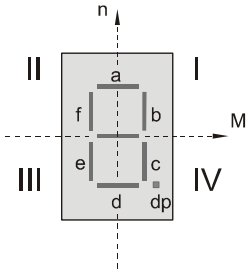


**INFO!**

The seven-segment display of the output stage indicates the operating and fault conditions of the digital servo amplifier JetMove 203B-230. The various display modes are set by the Motion Setup. Mode 0 (default) is used for normal operation and mode 1 for commissioning.

| JetMove 203B-230 - Seven-segment display<br>Mode 0: Normal operation | | |
|---|---|---|
| **Value** | **State** | **Description** |
| **0** | NOT READY TO BE SWITCHED ON | Initialization of amplifier functions |
| **1** | SWITCH-ON INHIBIT | Initialization completed. Safe state. Is achieved after initialising and after acknowledging errors.<br>The drive controller can be switched on. |
| **2** | READY TO BE SWITCHED ON | Drive controller has been disabled by software command.<br>The drive controller can be switched on. |
| **3** | SWITCHED ON | DC link monitoring is activated. |
| **4** | OPERATION_ENABLED | The drive controller has been enabled. |

| JetMove 203B-230 - Seven-segment display<br>Mode 0: Normal operation | | |
|---|---|---|
| **Value** | **State** | **Description** |
| **7** | QUICK STOP ACTIVATED | A quick stop has been activated.<br>The drive is being decelerated to n = 0 and then locked. |
| **E** | ERROR REACTION IS ACTIVATED | An error was recognized.<br>An adjustable error reaction may be active. |
| **F** | MALFUNCTION | The drive controller is locked, error can be acknowledged. |
| **F X. X.** | ERROR NUMBER | Error with number X. X. has occurred. |
| **.** | Flashing dot | Warning activated |
| **0.** | Flashing "ZERO" | Boot sector activated |
| **C.** | Flashing "C" | OS flash is cleared. |
| **E.** | Flashing "E" | OS flash is cleared. |
| **L.** | Flashing "L" | OS loader gets loaded. |
| **P.** | Flashing "P" | OS is transferred to the flash memory. |
| **U.** | Flashing "U" | The boot sector waits for OS update. |




| JetMove 203B-230 - Seven-segment display<br>Mode 1: Commissioning | | |
|---|---|---|
| **Value** | **Description** | |
| **g** | $\mathbf{n}_{\text{as-is value}}$ < 0.5 % $\mathbf{n}_{\text{max.}}$ | -- |
| **b** | **M > 0**, **n > 0** --> Quadrant I | Mode of operation - Motor |
| **c** | **M < 0**, **n > 0** --> Quadrant II | Mode of operation - Generator |
| **e** | **M < 0**, **n < 0** --> Quadrant III | Mode of operation - Motor |
| **f** | **M > 0**, **n < 0** --> Quadrant IV | Mode of operation - Generator |
| **a** | Positive current limit has been reached. | -- |
| **d** | Negative current limit has been reached. | -- |

# 9 Diagnostics

## 9.1 Error messages



**INFO!**

In case of an error message, the letter "F" and two successive numbers appear on the seven-segment display every second.

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 00** | Hardware error | Internal hardware defect | – Immediate motor power disable | – Separate the drive controller from the power lines.<br>– Return the amplifier for repair. |
| **F 01** | Internal voltage supply error | One or more power supply voltages are beyond their limits. | – Immediate motor power disable | – Separate the drive controller from the power lines.<br>– Return the amplifier for repair. |
| **F 02** | Mains phase error (is only active in case of a 3-phase connection) | Failure of one of the mains phases. | – Immediate motor power disable | – Check fuses and wiring.<br>– Acknowledge failure. |
| **F 03** | Motor cable breakage | The motor cable is broken.<br><br>Please be careful: The motor cable is tested when the drive controller is enabled for the first time. | – Immediate motor power disable | – Check the motor cable connections.<br>– Acknowledge failure. |
| **F 04** | Overvoltage in the DC link | A DC link voltage of > 480 V has been detected. | – Immediate motor power disable | – Check input voltage supply.<br>– If the motor is used as generator, reduce the regenerating power.<br>– Acknowledge failure. |

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 05** | Over-current | The output current has been greater than 2.5 x the rated current. | – Immediate motor power disable | – Check cable and motor for a short circuit.<br>– Check current control parameters. If necessary, correct parameters.<br>– Acknowledge failure. |
| **F 06** | Ballast resistor overload | The ballast resistor has been overloaded. | – Immediate motor power disable | – Let the amplifier cool down.<br>– After cooling down, acknowledge failure.<br>– Reduce regeneration power. |
| **F 07** | Amplifier overtemperature | The amplifier has reached the maximum temperature. | – Immediate motor power disable | – Let the amplifier cool down.<br>– After cooling down, acknowledge failure.<br>– Reduce power of the motion system. |
| **F 08** | Motor overtemperature | The motor has reached the maximum temperature. | – Immediate motor power disable | – Let the motor cool down.<br>– After cooling down, acknowledge failure.<br>– Reduce the power of the drive. |
| **F 09** | Encoder failure | Encoder breakage or initialization error | – Immediate motor power disable | – For extended diagnostics purposes use Motion Setup.<br>– Check the encoder line and all plug-in connections.<br>– Acknowledge failure. |
| **F 10** | Overspeed | The actual shaft speed has exceeded a value of 1.25 x maximum speed. | – Immediate motor power disable | – Check motor and encoder connections.<br>– Check speed controller parameters. If necessary, modify parameters.<br>– Acknowledge failure. |
| **F 11** | Current overrange | A current temporarily too high has been detected. | – Immediate motor power disable | – Reduce $K_p$ of the current controller by 10 to 20 %.<br>– Acknowledge failure. |

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 12** | Ground fault | One or several phases of the motor cable or inside the motor have been short-circuited to earth. | – Immediate motor power disable | – Check the motor cable and the motor.<br>– Acknowledge failure. |
| **F 13 (combined with F00)** | Internal checksum error | An internal checksum error has occurred. | – Immediate motor power disable | – Switch the 24 V supply off and on again.<br>– If the error occurs repeatedly, return the amplifier for repair. |
| **F 14 (combined with F 00)** | Internal communication error | An internal communication error has occurred. | – Immediate motor power disable | – Switch the 24 V supply off and on again.<br>– If the error occurs repeatedly, return the amplifier for repair. |
| **F 15** | The hardware enable is missing. | The software enable is given without a hardware enable. | – Immediate motor power disable | – Disable the drive by means of the software.<br>– Acknowledge failure. |
| **F 16** | Power input overcurrent | The current at the power input is too high. | – Immediate motor power disable | – Check input voltage.<br>– Reduce mechanical power of the motor.<br>– Acknowledge failure. |
| **F 17** | Software limit switch is activated. | Actual position is outside the programmed range, and a software limit switch has tripped. | – Stop at max. current (max. torque). | – Check target position.<br>– Check reference position.<br>– Acknowledge failure.<br>– Return the axis to a position within the software travel limits (monitoring of software limit switches is re-enabled automatically at entering this range). |

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 18** | The hardware limit switch is active. | A hardware limit switch is active. | – Stop at max. current (max. torque). | – Check target position.<br>– Check reference position.<br>– Acknowledge failure.<br>– Return the axis to a position within the machine travel limits (monitoring of hardware limit switches is re-enabled automatically at entering this range). |
| **F 20** | Undervoltage in the DC link | The DC link voltage is less than the set minimum value. | – Stop with emergency deceleration ramp. | – Check the supply voltage.<br>– Check the parameter "$U_{ZK}$ min. trip".<br>– Acknowledge failure. |
| **F 21** | Overvoltage of the DC link voltage | The DC link voltage has exceeded the set maximum value. | – Stop with emergency deceleration ramp. | – Check the supply voltage.<br>– In generator operation, reduce braking power.<br>– Acknowledge failure. |
| **F 22** | The drive is blocked. | The drive could not overcome the n = 0 threshold within the time limit specified by the parameter "blocking-tripping time". | – Immediate motor power disable | – Eliminate the cause of blocking.<br>– Acknowledge failure. |
| **F 23** | Tracking error | The tracking error has exceeded the limit defined in the parameter "tracking error limit" for the time specified in "tracking window time". | – Stop with emergency deceleration ramp. | – Check the drive mechanism.<br>– Check steepness of acceleration/ deceleration ramps and amplifier parameters in relation to the parameters "tracking error limit" and "tracking error window time".<br>– Acknowledge failure. |
| **F 24 (combined with F 01)** | Error in 24 V supply voltage | The external 24 V supply was lower than 18 V. | – Immediate motor power disable | – Check external power supply.<br>– Acknowledge failure. |

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 25 - F 27 (combined with F 01)** | Internal power supply error | One or more internal supply voltages have fallen below their limits. | – Immediate motor power disable | – Note the fault number.<br>– Return the amplifier for repair. |
| **F 29** | The mains power is too high. | The average mains power of the 230 V supply was too high. | – Immediate motor power disable | – Acknowledge failure.<br>– Reduce the average load of the motor. |
| **F 30** | I²t error | The average power loss of the motor has been greater than the max. value configured by nominal motor current, overload factor and motor time constant.<br>See "I²t calculation" on page 40. | – Immediate motor power disable | – Let the motor cool down.<br>– Acknowledge failure.<br>– Check the configuration of nominal motor current, overload factor and motor time constant.<br>– Reduce the average load of the motor. |
| **F 31** | Motor overload measuring to UL | The average motor power loss was higher than has been defined according to UL.<br>See chapter 5.2.3 "Motor overload protection according to UL", page 41. | – Immediate motor power disable | – Let the motor cool down.<br>– Acknowledge failure.<br>– Reduce the average load of the motor. |
| **F 38** | Asymmetric encoder signal | The amplitudes of the analog sine-cosine signals are not identical. | – Immediate motor power disable | – Check wiring or encoder signals.<br>– Acknowledge failure. |
| **F 39** | Error at commutation finding | Measuring the commutation offset could not be completed with results being guaranteed. | – Immediate motor power disable | – Check parametering.<br>– Check wiring or encoder signal.<br>– Acknowledge failure. |
| **F 42** | Malfunctioning of encoder 2 (only for the option CNT) | Encoder breakage or initialization error | – Immediate motor power disable | – Check the encoder line and all plug-in connections.<br>– Acknowledge failure. |
| **F 43** | Communication error | Termination after a max. number of lost cyclic data transmissions | – Stop with emergency stop ramp | – Check the communication connection |

| Error message table JetMove 203B-230 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Error response** | **Troubleshooting** |
| **F 44** | Communication error | CAN controller is in Error Passive state. The error counter value exceeds 127. | – Stop with emergency stop ramp | – Check the communication connection |
| **F 45** | Communication error | CAN controller is in Bus OFF state. The error counter value has reached 255. | – Stop with emergency stop ramp | – Check the communication connection |
| **F 46** | Communication error | A smart encoder (EnDat 2.2) may have sent an error message | – Immediate motor power disable | – Check the parameters<br>– Check the encoder |

## 9.2 WARNINGS

If the dot in the seven-segment display is flashing, one or several warnings have been recognized. Check in the Motion Setup or by issuing the motion instructions in the controller program which warning is active.

# 10 Connection diagrams

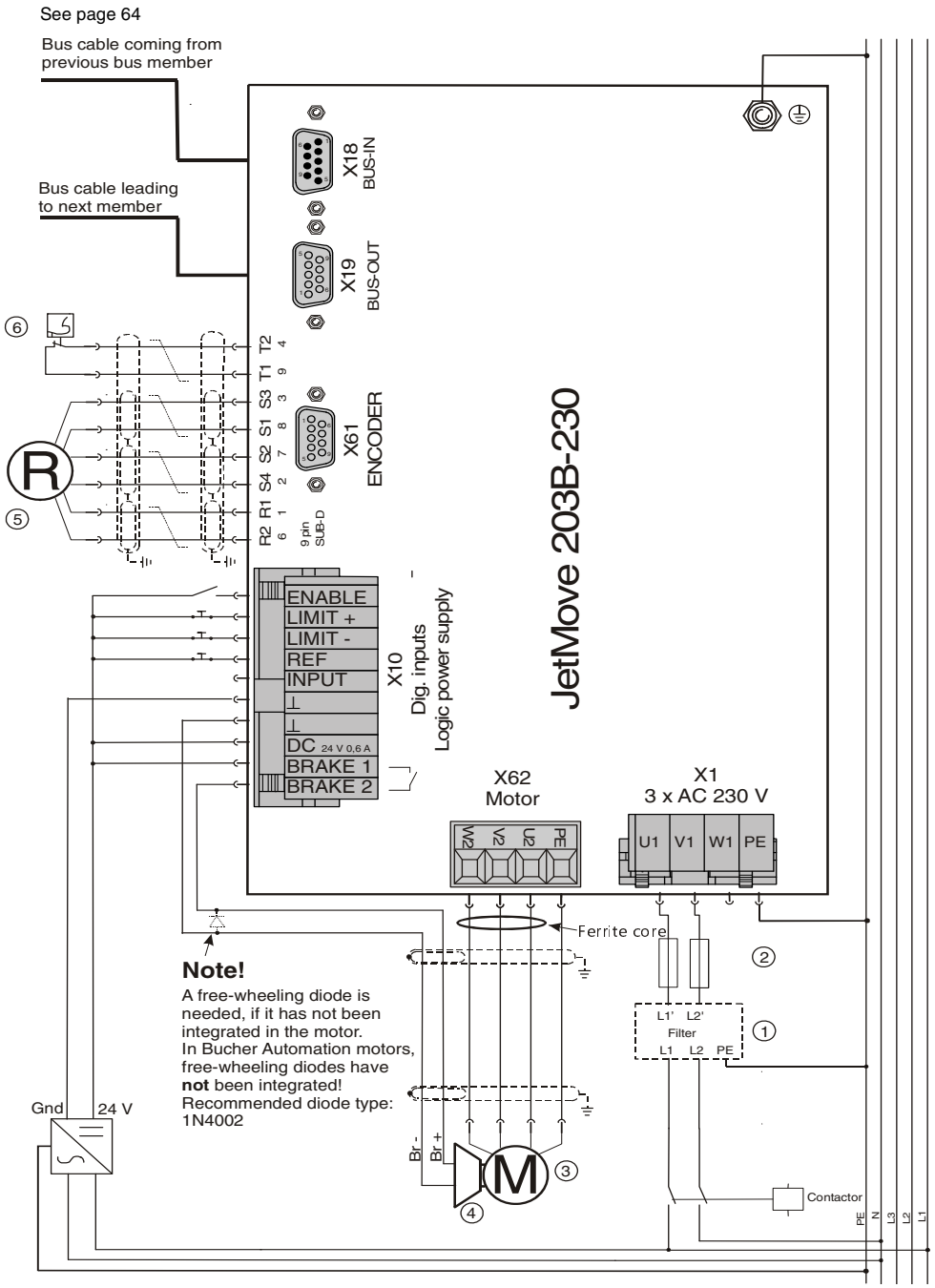



**Fig.: 14: Connection diagram JetMove 203B-230, 1-phase connection, type of position transducer: Resolver**

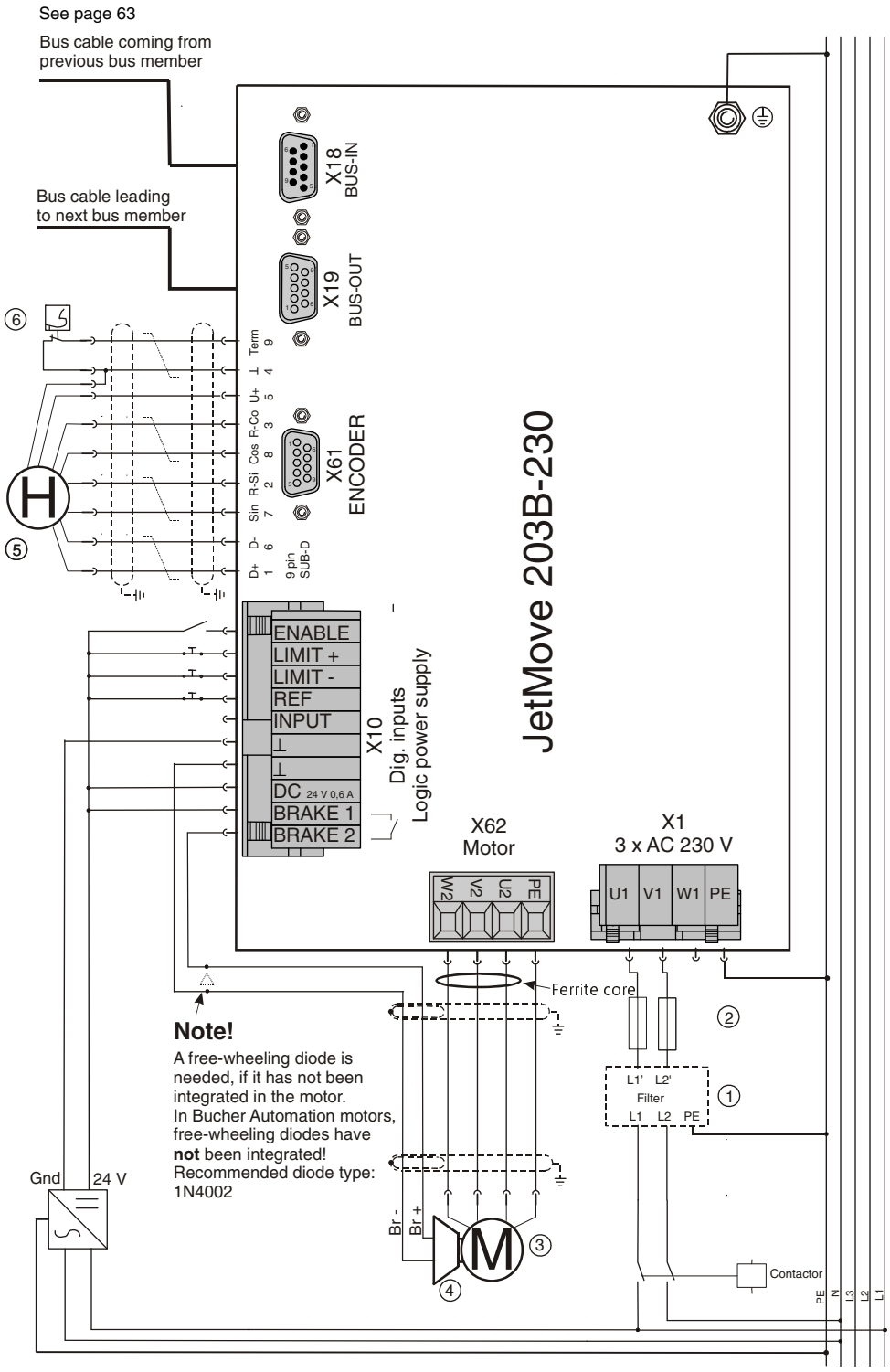



**Fig.: 15: Connection diagram JetMove 203B-230, 1-phase connection, type of position transducer: HIPERFACE**

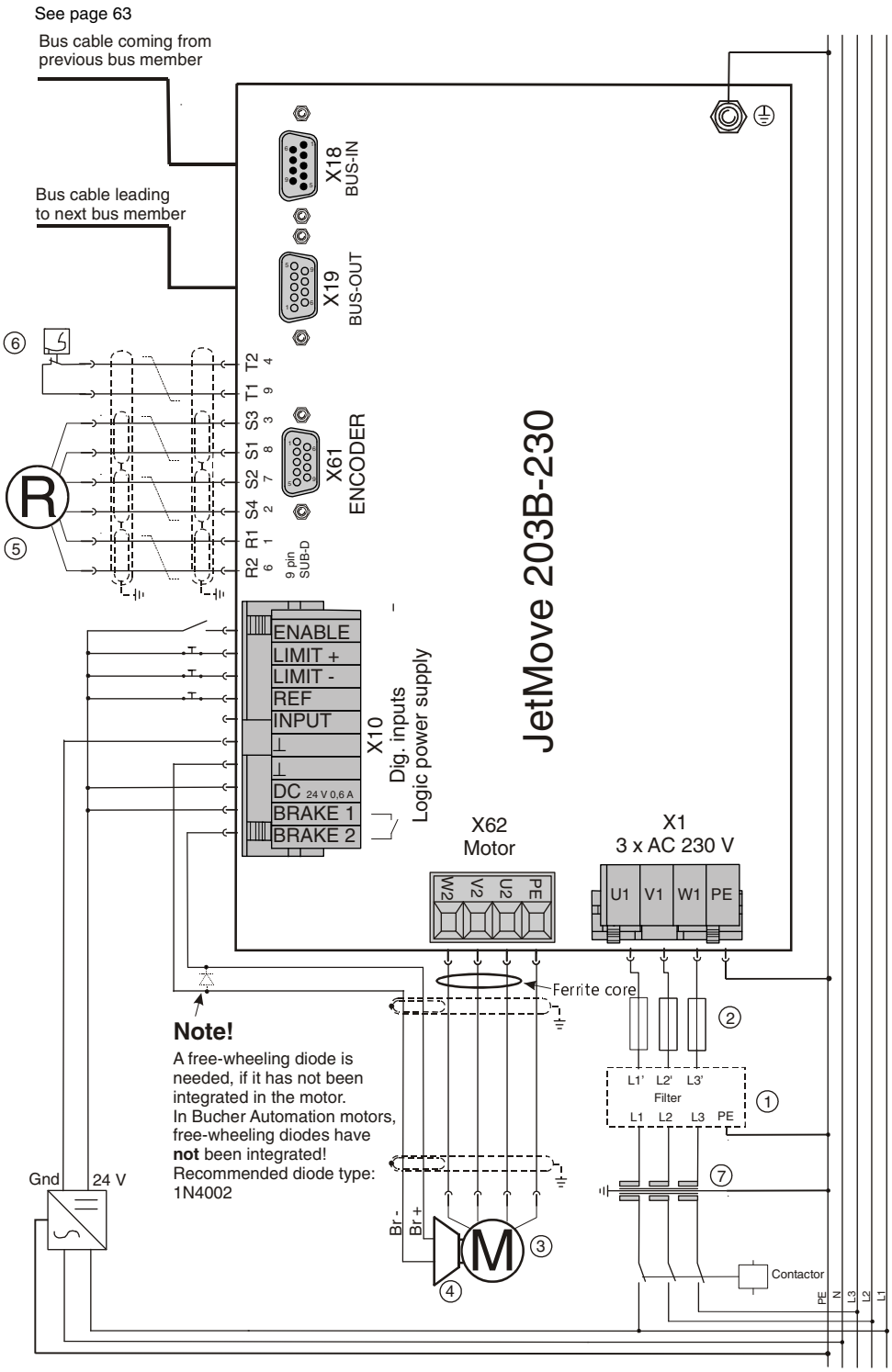



**Fig.: 16: Connection diagram JetMove 203B-230, 3-phase connection, type of position transducer: Resolver**

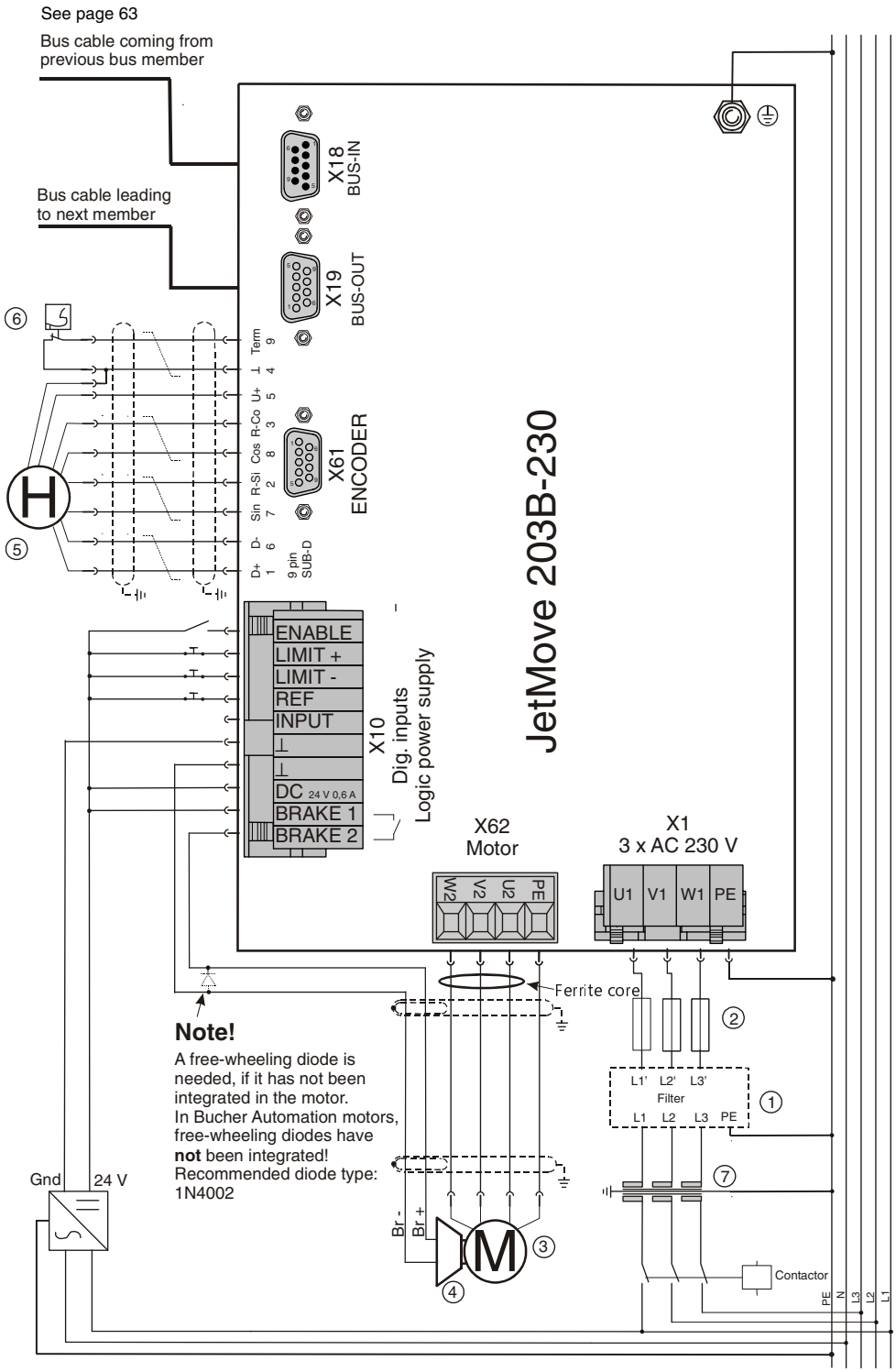



**Fig.: 17: Connection diagram JetMove 203B-230, 3-phase connection, type of position transducer: HIPERFACE**

## Key to the connection diagrams:

| | |
|---|---|
| **1** | Line filter (optional) (refer to "Line filter" on page 36) |
| **2** | Mains protection (refer to "Overload protection" on page 36) |
| **3** | Motor |
| **4** | Motor holding brake (option) |
| **5** | Position transducer (resolver or HIPERFACE encoder) |
| **6** | Motor overtemperature protection |
| **7** | Isolating transformer or autotransformer |

# 11 Analog input (option)

## 11.1 Operating principle

For the digital servo amplifier JetMove 203B-230, an optional integrated analog input card can be ordered (article designation of the device: JM-203B-230...-IA1). This card supplies an analog input of a 12-bit resolution. The converted value of the measured voltage can be read by a register of the JetMove in the PLC program or processed by the firmware of the JetMove in an additional controller. This way it is possible for example, to realize a pressure control loop in which the motor controlled by the JetMove generates the pressure. A pressure sensor in the machine is connected to the analog input of the JetMove to deliver the actual pressure value for the control loop.

## 11.2 Technical data

| Technical data of the analog input | |
|---|---|
| Connection | Sub-D connector (male) at the device |
| Voltage range | 0 ... 10 V |
| Input current | 1.4 mA max. |
| Resolution | 12 bits |
| Value range | 0 ... 32767 (resolution in steps of 8) |
| Electrical isolation | None |
| Accuracy<br>Zero error<br>Gain error | <br>max. ± 5 LSB (± 40 values) corresponds to ± 12.2 mV<br>max. ± 20 LSB (± 160 values) corresponds to ± 48.8 mV |

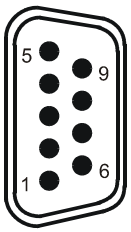
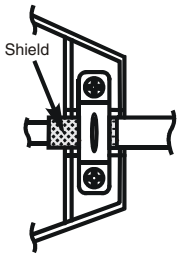
# 11.3 Description of connections

## Specification of the mating connector for X71

- 9-pin female Sub-D connector
- Metallized housing

## Specification of the cable leading to the analog input

- Cable size: 2 * 0.14 mm² min. (AWG 26(2))
- Cores have to be twisted and entirely shielded.
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C

| Pin assignment of the analog input | |
|---|---|
| | **Shielding** |
|  |  |
| **X71** | Connect shield with the greatest possible surface area!<br>Use metallized housing only! |
| **Pin** | **Signal** |
| 1 | Analog signal (0 - 10 V to pin 6) |
| 6 - 9 | Analog GND (connected to earth in the device) |
| 2 - 5 | Do not use |

# 12 Ethernet interface (option)

## 12.1 Operating principle

For the digital servo amplifier JetMove 203B-230, an optional integrated Ethernet interface can be ordered (article designation of the device: JM-203B-230...-JC310). This option lets you address the JetMove 203B-230 from the controller via Bucher Ethernet system bus instead of the JX2 System Bus.

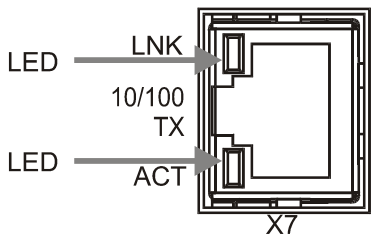
| Functional equipment | |
|---|---|
| 1 Ethernet interface | 10/100 MBit/s, TX |
| 10-pin DIP switch for the lower 8 bits of the IP address and of various operating modes | RUN / STOP / LOAD |
| LED for status indication | RUN / ERR |

## 12.2 Description of connections

The digital servo amplifier JetMove 203B-230...-JC310 is connected with the Ethernet by a RJ45 socket (X71).

There are two types of interconnecting cables used for 10/100 MBit/s twisted pair Ethernet.

- Straight-through twisted pair cable
- Crossover cables (transmitting and receiving lines are crossed)



| The LEDs of the JetMove 203B-230...-JC310 Ethernet | |
|---|---|
| Designation | Operating principle |
| ACT | Activity: The JetMove 203B-230...-JC310 transmits or receives data via the Ethernet. |
| LNK | Linkage: The JetMove 203B-230...-JC310 is linked with the Ethernet. |

### 12.2.1 Connection between the JetMove 203B-230...-JC310 and a PC or JetControl

Direct connection between a PC or JetControl and a JetMove 203B-230...-JC310 is established by means of a crossover cable.

### 12.2.2 Connection between the JetMove 203B-230...-JC310 and a PC or JetControl through a switch

If connection between PC or JetControl and a JetMove 203B-230...-JC310 is established through a switch, straight-through cables have to be used.



**INFO!**

**Terminals have to be interconnected by means of crossover cables:**

- PC to PC
- JetControl to PC
- JetControl to JetMove...-JC310
- etc.

**Terminals with infrastructure components (e.g. switch) have to be interconnected via straight-through cables:**

- PC to switch
- JetControl to switch
- JetMove...-JC310 to switch
- etc.



**INFO!**

If the proper cable is not available, the uplink port of a switch/hub can be used. The pin assignment of an uplink port allows connection of terminals or can be switched over.

Some devices are provided with an automatic crossover function which ensures automatic adjustment to the cable and distant station.

# 12.3 Logic circuit LEDs, DIP switches

## 12.3.1 LEDs

| Logic circuit LEDs | |
|---|---|
| ERR (red) | Flashes shortly at initializing.<br>It remains lit in case of an initialization error at the Ethernet interface. |
| RUN (green) | Flashes regularly at correct functioning of the Ethernet interface. |

The as-is state of the LED can be scanned in register 10182.

.

| Error Messages indicated via LEDs | |
|---|---|
| Following power-up the red LED (ERR) and the green LED (RUN) are flashing. | The selector is in LOAD position.<br>The boot loader is running.<br>The OS of the Ethernet interface is neither checked nor launched. |
| Following power-up the red LED (ERR) flashes three times, then both LEDs (red = ERR, green = RUN) are flashing. | The selector is in RUN or STOP position.<br>The boot loader is running.<br>There is no valid operating system of the Ethernet interface available. |
| The red LED (ERR) and the green LED (RUN) are flashing alternately with intermittent breaks during runtime. | Fatal operating system error of the Ethernet interface |

### 12.3.2 The DIP switches

The switches are evaluated at switching on the JetMove 203B-230...-JC310. Switches 1 through 8 influence the IP address; switches 9 through 10 influence starting the operating system.

#### Start-up process

| Switches 9 and 10 | |
|---|---|
| Position | Meaning |
| 9 = OFF, 10 = OFF (NORMAL OPERATION) | Normal function of the Ethernet interface |
| 9 = OFF, 10 = ON (LOAD) | The booting proceeds as far as to the initial program loader of the Ethernet interface. |
| 9 = ON | Reserved |

After booting, the switch has no influence on the interface functions. The current position of the mode selector can be scanned in register 10181.

## 12.4 Setting the IP address

There are four ways of assigning an IP address to a JetMove 203B-230...-JC310. The actually used IP address can be scanned in register 2931.

### 12.4.1 Default IP address

If, at activating the controller, DIP switches 1 through 8 are in "OFF" position, the JetMove 203B-230...-JC310 has got IP address 192.168.10.15.
In case of any uncertainties with regard to the IP address used, you can use this "loophole" to set the JetControl to a defined state.

### 12.4.2 IP address out of the configuration memory

If, at activating the JetMove 203B-230...-JC310, the DIP switches 1 through 8 are in "ON" position, the JetControl has got the IP address saved in the configuration memory.
The configuration memory can be accessed by means of the "/System/cfgvar.ini" file or registers 10131 through 10145.

## Configuration file

In order to gain access to the configuration file "/System/cfgvar.ini", the user having got the administrator rights must have been connected.
This file has the same structure as a Windows *.INI file:

```
[CFGVAR]
Version       = 4
IP_Address    = 192.128. 10. 97
IP_SubNetMask = 255.255.255.  0
IP_DefGateway = 192.128. 10.  1
BasePort      = 50000
IP_DNS        = 192.118.210.209
```



**NOTICE!**

In no case change the version number.

## Registers

Alternative access to the configuration memory is possible via registers 10131 through 10145.
In order to make a change via registers, first password register 10159 with password value 2002149714 (0x77566152) has to be loaded. Then, registers 10132 through 10145 are modified. Finally, the changes to the configuration memory have to be saved by entering an arbitrary value into register 10100.

| Registers | Meaning | Value used in the example |
|---|---|---|
| 10100 | Saving the configuration values | |
| 10131 | Version number | 4 |
| 10132 | IP address MSB | 192 |
| 10133 | IP address 3SB | 128 |
| 10134 | IP address 2SB | 10 |
| 10135 | IP address LSB | 97 |
| 10136 | Subnet mask MSB | 255 |
| 10137 | Subnet mask 3SB | 255 |
| 10138 | Subnet mask 2SB | 255 |
| 10139 | Subnet mask LSB | 0 |

| Registers | Meaning | Value used in the example |
|---|---|---|
| 10140 | Default gateway MSB | 192 |
| 10141 | Default gateway 3SB | 128 |
| 10142 | Default gateway 2SB | 10 |
| 10143 | Default gateway LSB | 1 |
| 10144 | Port number of the JetIP server | 50000 |
| 10145 | IP address of the DNS server | 0xC076D2D1 (192.118.210.209) |
| 10159 | Password | 2002149714 (0x77566152) |



**NOTICE!**

Do not change the version number contained in register 10131.

### 12.4.3 IP address taken from the switch position

In all other switch positions, the IP-address is taken out of the configuration memory; the lowest-order byte (fourth octet) is substituted by the position of DIP switches 1 through 8.

To make up the IP address, the position of DIP switches 1 through 8 is read in once during the start-up procedure.
The actual settings of DIP switches 1 through 8 can be scanned from register 10180.

# 13 Safe Torque OFF (STO) Option

For information on the -S1 option "Safe Torque Off (STO)" refer to the corresponding Function Description which can be downloaded from our homepage:
https://www.bucherautomation.com/en/products/motion-systems/jetmove-series/



**jm-2xx_sto-option_fb_xxx_function_description**

Functional description with safety instructions to be observed and measures concerning "STO".



**INFO**

At Bucher Automation AG, the safety function "STO" is referred to as "Safe Standstill" in the order list for example.

# 14 Counting input (option)

## 14.1 Operating principle

For the digital servo amplifier JetMove 203B-230, an optional integrated analog counting card can be ordered (article designation of the device: JM-203B-230...-CNT). It supplies a counting input equipped with the following interface:

- EnDat 2.2 by Heidenhain
- Synchronous Serial Interface (SSI)
- Incremental counter

The received or counted value of an actual position can be read via a JetMove register by the controller program or processed by the firmware of the JetMove in the controllers.

Yet, the actual position of an SSI encoder cannot be used for position control. It only indicates the position of the leading axis.

## 14.2 EnDat 2.2

### 14.2.1 Technical data

| Technical data - EnDat 2.2 input | |
|---|---|
| Encoder types | Absolute encoders (single, multiturn or linear) |
| Scanning | 62.5 µs |
| Transfer rate | 8 MHz |
| Maximum cable length | 100 m |
| Type of signal | 5 V differential signals |
| Input impedance | 22 kΩ |
| Bus termination | 120 Ω Integrated resistance |
| Electrical isolation | None |

## 14.2.2 Description of connections

### Specification of the mating connector for X71

- 9-pin male Sub-D connector
- Metallized enclosure

### EnDat cable specification

- Cable size: 2 * 2 * 0.14 mm² + 2 * 0.25 mm² (AWG 26(4) + AWG 23(2))
  2 * 0.25 mm² must be used for the power supply unit and for GND.
- The cables have to be twisted in pairs and included in an overall shielding
- The following signal lines have to be twisted in pairs:
  DATA - and DATA +
  Clock - and Clock +
  0 V and power supply
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 100 m

## 14.2.3 EnDat cable with mating connector



**INFO!**

The EnDat mating connector can be ordered from Bucher Automation AG by specifying its item number 15100069.

The complete EnDat cable between servo amplifiers of the JetMove 2xx series and the Bucher motors can be ordered from Bucher Automation AG. It can be ordered by submitting the following cable specifications and the respective cable length in cm:

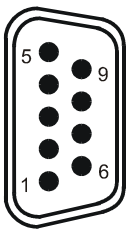
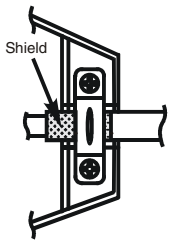
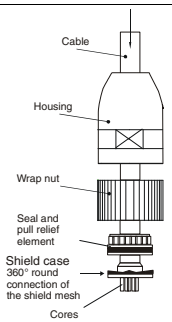
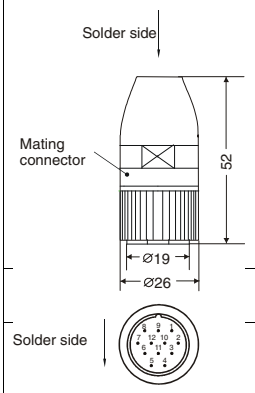
| | |
|---|---|
| KAY_0723-xxxx | For servo amplifiers of the JetMove 2xx series |

**EnDat mating connector (solder side)**




**Fig.: 18: View on EnDat mating connector of the RC series (internal thread M23)**

## EnDat Cable with KAY_0723-xxxx

| JetMove 2xx (Sub-D male connector X71) | Shielding | | Motor (EnDat) (female, solder side) |
|---|---|---|---|
|  |  5 * 2 * 0.25 mm$^2$ |  |  |
| Attaching screws must have a metric thread! | Connect shield with the greatest possible surface area!<br>Use metallized housing only! | | |

| Pin | Signal | Core color | Pin |
|---|---|---|---|
| - | Unassigned | - | 1 |
| - | Unassigned | - | 2 |
| 7 | DATA - (RS-485) | white | 3 |
| 2 | DATA + (RS-485) | brown | 4 |
| 8 | Unassigned | green | 5 |
| 3 | Unassigned | amber | 6 |
| 6 | Clock - (RS-485) | gray | 7 |
| 1 | Clock + (RS-485) | pink | 8 |
| 4 | 0 V | blue | 9 *) |
| 5 | 5 V power supply 200 mA max. | red | 10 |
| 9 | Unassigned | black | 11 |
| | Unassigned | - | 12 *) |

*) Pin 9 and pin 12 are short-circuited (thermal sensor HIPERFACE)
The measurements of the EnDat mating connector are specified in millimeters.

## 14.2.4 Power supply of the encoder

The optional counter card supplies a voltage of 5 V +/- 5 %.
The EnDat encoders by Heidenhain have been specified to 3.6 through 5.25 V of 0.2 A max. This results in a maximum voltage drop of $\Delta U = 1.15$ V on the EnDat cable. The voltage drop can generally be calculated as follows:

$$\Delta U = \frac{2 \cdot I_n \cdot l}{\gamma \cdot A}$$

This results in the maximum cable length or in a minimum cable cross section:

$$l = \frac{\Delta U \cdot \gamma \cdot A}{2 \cdot I_n} = 161 \cdot \frac{m}{mm^2} \cdot A$$

$$A = \frac{2 \cdot I_n}{\Delta U \cdot \gamma} = \frac{mm^2}{161 \cdot m} \cdot l$$

| | | |
|---|---|---|
| Given | $\Delta U$: | Voltage drop in V |
| | $I_n$: | Current consumption by the measuring device in A |
| | $A$: | Cross section of the supply cable in $mm^2$ |
| | $l$: | Cable length |
| | $\gamma$: | Electric conductivity (for copper: $56 \frac{m}{\Omega \, mm^2}$) |

**Example:**
At a cable cross section of 0.34 $mm^2$, there results a maximum cable length of $l = 54.74\,m$ or - at a cable length of 80 m - the following cross section is needed: $A = 0.5\,mm^2$.
By a double wiring arrangement, the cable length can be doubled.

# 14.3 Synchronous Serial Interface (SSI)

## 14.3.1 Technical data

| Technical data of the SSI input | |
|---|---|
| Encoder types | Multiturn absolute encoder |
| Scanning | up to 2 ms |
| Transmission rate | 100 kHz ... 1 MHz |
| Maximum cable length | 50 ... 100 m |
| Type of signal | 5 V differential signals |
| Input impedance | 22 kΩ |
| Bus termination | 120 Ω integrated resistance |
| Electrical isolation | None |

## 14.3.2 Description of connections

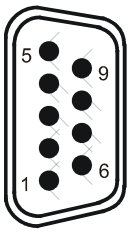
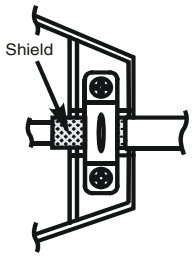
### Specification of the mating connector for X71

- 9-pin male Sub-D connector
- Metallized enclosure

### Specification of the SSI cable

- Cable size: 2 * 2 * 0.14 mm² + 2 * 0.25 mm² (AWG 26(4) + AWG 23(2))
  2 * 0.25 mm² must be used for the power supply unit and for GND.
- The cables have to be twisted in pairs and included in an overall shielding.
- The following signal lines have to be twisted in pairs:
  Clock - and Clock +
  DATA - and DATA +
  0 V and power supply
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 100 m
  Dependent on the encoder type, the transmission frequency has to be reduced due to the signal runtimes in long cables.

## 14.3.3 SSI cable

| SSI cable | | |
|---|---|---|
| **JetMove 2xx (Sub-D male connector X71)** | **Shielding** | **Specification of the cable** |
|  |  | Encoder signal:<br>5 V differential signal<br>Maximum cable length:<br>100 m |
| Attaching screws must have a metric thread! | Connect shield with the greatest possible surface area!<br>Use metallized housing only! | |
| **Pin** | **Signal** | |
| 1 | Clock + | |
| 2 | DATA + | |
| 3 | do not use | |
| 4 | 0 V | |
| 5 | Power supply<br>5 V, 200 mA max. | |
| 6 | Clock - | |
| 7 | DATA - | |
| 8 | do not use | |
| 9 | do not use | |

# 14.4 Incremental encoder

## 14.4.1 Technical data

| Technical data of the incremental encoder input | |
|---|---|
| Encoder types | Rotatory or linear encoders |
| Scanning | 62.5 µs |
| Maximum counting rate | 20 MHz |
| Maximum cable length | 100 m |
| Type of signal | 5 V differential signals |
| Input impedance | 22 kΩ |
| Bus termination | 120 Ω integrated resistance |
| Electrical isolation | None |

## 14.4.2 Description of connections

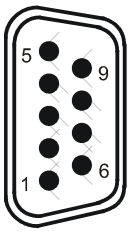
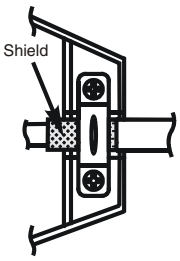
### Specification of the mating connector for X71

- 9-pin male Sub-D connector
- Metallized enclosure

### Specification of the incremental encoder cable

- Cable size: 3 * 2 * 0.14 mm² + 2 * 0.25 mm² (AWG 26(6) + AWG 23(2))
  2 * 0.25 mm² must be used for the power supply unit and for GND.
- The cables have to be twisted in pairs and included in an overall shielding.
- The following signal lines have to be twisted in pairs:
  K0 - and K0 +
  K1 - and K1 +
  K2 - and K2 +
  0 V and power supply
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 100 m

### 14.4.3 Incremental encoder cable

| Incremental encoder cable | | |
|---|---|---|
| **JetMove 2xx (Sub-D male connector X71)** | **Shielding** | **Specification of the cable** |
|  |  | Encoder signal:<br>5 V differential signal<br>Maximum cable length:<br>100 m |
| Attaching screws must have a metric thread! | Connect shield with the greatest possible surface area!<br>Use metallized housing only! | |
| **Pin** | **Signal** | |
| 1 | K0 + | |
| 2 | K1 + | |
| 3 | K2 + | |
| 4 | 0 V | |
| 5 | Power supply<br>5 V, 200 mA max. | |
| 6 | K0 - | |
| 7 | K1 - | |
| 8 | K2 - | |
| 9 | do not use | |

# 15 Ordering information

## 15.1 List of documentation

The documents listed below are available for download from the website of Bucher Automation AG at https://www.bucherautomation.com/en/products/ on the respective product page.

### Programming



**jetmove_2xx_D203_at_the_jetcontrol_bi_xxxx_user_information.pdf**
User information on configuration and operation of the JetMove2xx series at the JetControl 24x
Item no. 60874950

## 15.2 Options

| Designation | **Ethernet interface** (page 82) | **Analog input** (page 80) | **Counter input** (page 89) | **-S1 (STO)** (page 88) |
|---|---|---|---|---|
| JM-203B-230 | | | | |
| JM-203B-230-JC310 | P | | | |
| JM-203B-230-IA1 | | P | | |
| JM-203B-230-CNT | | | P | |
| JM-203B-230-S1 | | | | P |
| JM-203B-230-JC310-S1 | P | | | P |
| JM-203B-230-IA1-S1 | | P | | P |
| JM-203B-230-CNT-S1 | | | P | P |

# Appendices

# Appendix A: Recent revisions

| Chapter | Comments | Revised | Added | Deleted |
|---|---|---|---|---|
| Whole document | Change Jetter -> Bucher | ✓ | | |
| Whole document | Change OEM -> JC310 | ✓ | | |
| 1.3.2 | Discharge time 5 min | ✓ | | |
| 3 | Values for interference emission changed. Notes added. | ✓ | | |
| 7.3.2<br>7.4.2 | Note:<br>Thermosensor +/- | ✓ | | |

# Appendix B: Differences between JetMove 203-230 and 203B-230

The JetMove 203-230 servo amplifier has been developed further to become the servo amplifier JetMove 203B-230.
The objectives of this further development have been the following:
- To save components, in order to achieve greater dependability
- To decrease the amount of various models

In the development process, special attention was paid to providing a large scope of interchangeability.
For technical reasons, there will still remain certain differences which must be considered in individual cases.

## Automatic encoder recognition

The JetMove 203B-230 is not equipped with two varieties for different position transducers any more. (Up to now, the customer had to decide whether to order the JetMove 203-230-RE servo amplifier for the resolver input circuit or the servo amplifier JetMove 203-230-HI for the HIPERFACE input circuit.)
The JetMove 203B-230 servo amplifier can automatically recognize which encoder has been connected to it and configure its input circuit respectively.

Consequences for the user:
- Even with both encoder types being applied, double stock-keeping can be avoided.
- Irrespective of the encoder type used, the order number is the same.

## UL certification

On the development of the servo amplifier JetMove 203B-230 special attention was given to UL certification.

Consequences for the user:
- In future, the servo amplifier JetMove 203B-230 will also be available with UL certification.

## Power factor correction

Using a 1-phase power supply the servo amplifier JetMove 203-230 was operated with a power factor correction circuit. In the JetMove 203B-230 amplifier, this is not applied any more.
Consequences for the user:
- In case of a 1-phase connection, the DC link voltage in motor mode (no feedback by braking) is 325 V instead of 380 V. This means that the maximum possible speed by which a motor can be run is decreased by about 15 %. Moreover, the DC link voltage now is directly proportional to the input voltage and no longer independent of it.
- Operating from a 1-phase power supply, the RMS value of the input current is approximately 2.3 times higher at the same motor output level. For this reason, at an average motor power of 500 W, the crucial fusing value (and accordingly the cable size of the power line) has to be increased from 4 A to 10 A.

Operating from a 3-phase power supply, there will be no differences.

## Option -S1: Safe Torque Off (STO)

The servo amplifier JetMove 203B-230 can optionally be ordered with option "Safe Torque Off" (-S1).



**Important**

The servo amplifier JM-203B-230 can only be operated with OS version 2.11.0.0 or higher. When older versions are used, the servo amplifier will issue an error message.

# Appendix C: Glossary

| | |
|---|---|
| AC | **A**lternating **C**urrent |
| CE | **C**ommunautés **E**uropéenes<br>European Union |
| DC | **D**irect **C**urrent |
| DIN | **D**eutsches **I**nstitut für **N**ormung e.V. = German Industry Standard |
| EU | **E**uropäische **G**emeinschaft = **E**uropean **U**nion |
| EC Low Voltage Directive | To be considered when using electric devices of a rated voltage between 50 and 1,000 V AC and between 75 and 1,500 V DC. |
| Electro-Magnetic Compatibility (EMC) | Definition according to the EMC regulations:<br>"EMC is the ability of a device to function in a satisfactory way in an electro-magnetic environment without causing electromagnetic disturbances itself, which would be unbearable for other devices in this environment." |
| EN | **E**uropäische **N**orm = European Standard |
| ESD | **E**lectro**s**tatic **D**ischarge |
| Hazard analysis | Excerpt from the Machinery Directive:<br>The manufacturer is under an obligation to assess the hazards in order to identify all of those which apply to his machine; he must then design and construct it taking account of his assessment. |
| HIPERFACE | **Hi**gh **Per**formance Inter**face**<br>HIPERFACE designates a sensor-transducer system by Sick / Stegmann. The SinCos motor feedback system with the standardised HIPERFACE interface is often used in digital drive technology. Unlike the resolver, the SinCos motor feedback system with HIPERFACE interface contains electronic components. Over several motor rotations, a HIPERFACE will report the absolute position values; this cannot be performed by a resolver. A HIPERFACE is far more precise than a resolver, but also more expensive. |
| IEC | **I**nternational **E**lectrotechnical **C**ommission |
| IP | **I**nternational **P**rotection |
| JetMove | JetMove is the type designation of a digital servo amplifier series produced by Bucher Automation AG. The extension 203B-230, for example, marks the following features:<br>– 203 identifies a rated current of 3 A.<br>– 230 identifies the operating voltage of the rated power supply. |

| | |
|---|---|
| JX2 System Bus | The JX2 System Bus is a system-bus system of a cable length of 200 m max. and of fast data transmission rates of 1 MBit/s max. In addition to this, the JX2 System Bus is highly immune to interferences. Therefore, the JX2 System Bus is suited to realise field bus applications in a limited space. |
| JetWeb | Control technology comprising control systems, motion systems, user interfaces, visualization devices, remote I/Os and industrial PCs. Programming by means of multitasking and a modern sequence-oriented language. Communication by means of Ethernet TCP/IP and making use of the Web technologies. |
| Motor circuit-breaker | A circuit-breaker with monitoring functions of phases and temperature of a motor. |
| NN | **N**ormal **N**ull = Sea Level |
| PE | "**P**rotective **E**arth", respectively "Protective Earth Conductor" |
| Resolver | Feedback unit at a servo motor for determining the absolute position within one revolution. Other than a HIPERFACE, the resolver will not provide any information on how many revolutions the motor has performed so far.<br>A resolver could be envisaged as a transformer; the couplings of its secondary windings (sine and cosine) change in relation to the position of the motor shaft. Basically, a resolver consists of a rotor with one coil and a stator with two coils. The stator windings are displaced by 90° (sine and cosine). The resolver itself does not contain any electronic components. |
| SELV | **S**afe **E**xtra **L**ow **V**oltage:<br>Voltage, which, under all operating conditions will not exceed a peak or DC voltage of 42.4 V. This voltage is either measured between two conductors or between one conductor and earth.<br>The circuit, in which this voltage occurs, must be separated from the mains power supply by a safety isolating transformer or some equivalent. |
| Sub-D | Type name of a plug-in connector |
| $t_r/t_h$ | **t**ime **r**ise / **t**ime **h**old: "Rise time of a pulse / total hold time of a pulse" |
| $t_r/t_n$ | **t**ime **r**ise / **t**ime **n**ormal: "Rise time of a pulse / total duration of a pulse" |
| TN network | Supply network which is solidly earthed in the neutral point and which is equipped with a protective earth conductor. |

| | |
|---|---|
| TT network | Supply network which is solidly earthed in the neutral point, yet, which is not equipped with a protective earth conductor. Earthing is carried out by means of a local protective earth. |
| UL | **U**nderwriters **L**aboratories Inc. |
| VDE | **V**erband **d**eutscher **E**lektrotechniker e.V. = Association of German Electrical Engineers |
| DC link voltage | DC circuit within a servo drive on the basis of which the motor currents are generated. |

**Units:**

| | |
|---|---|
| A | Ampere |
| mA | Milliampere (1 mA = $10^{-3}$ A) |
| dB | Decibel |
| g | Gram |
| h | Hour |
| Hz | Hertz |
| K | Kelvin |
| m | Meter |
| cm | Centimeter (1 cm = $10^{-2}$ m) |
| mm | Millimeter (1 mm = $10^{-3}$ m) |
| s | Second |
| V | Volt |
| µV | Microvolt (1 µV = $10^{-6}$ V) |
| W | Watt |
| Ω | Ohm |
| °C | Degrees centigrade (temperature unit) |
| ° | Degrees (angular dimension) |

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