Jetter automation

User Manual

JM-215B-480 - Digital Servo Amplifier

60874944

We automate your success.

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Translation of the original manual in German language.

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This User Manual is an Integral Part of the JetMove 215B-480:

Model:	
Serial #:	
Year of Manufacture:	
Order #:	

CE

To be entered by the customer:

Inventory #:	
Place of Operation:	

Significance of this User Manual

This user manual is an integral part of the digital servo amplifier JetMove 215B-480.
- Therefore it must be kept in a way that it is always at hand until the digital servo amplifier JetMove 215B-480 will be disposed of.
- Pass this manual on if the JetMove 215B-480 is sold or loaned/leased out.

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.

From the servo amplifier JetMove 215B-480 module may result unavoidable residual risks to persons and property. For this reason, any person who has to deal with the transport, installation, operation, maintenance, and repair of the digital servo amplifier JetMove 215B-480 must have been familiarized 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 Jetter AG. Therefore, the operating company is recommended to have the instruction of the persons concerned confirmed in writing.

History

Revision	Meaning
1.00	Original issue of this manual
2.00	Modifications: see Appendix A of user manual rev. 2.00
2.01	Style and spelling have been revised
2.10	Modifications: see Appendix A of user manual rev. 2.10
2.11	Modifications: see Appendix A of user manual rev. 2.11
2.20	Modifications: see Appendix A of user manual rev. 2.20

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 indicates that you must 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.

Reference to PC keyboard and HMI 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.

Contents

Appendix

1 Safety Instructions

1.1 General Information

The digital servo amplifier JetMove 215B-480 fulfills the accepted safety regulations and standards. Special emphasis was given to the safety of the users.

The following additional regulations apply to the user:
- pertinent accident prevention regulations;
- accepted safety rules;
- EC guidelines and other country-specific regulations.

1.1.1 Intended conditions of use

Usage as agreed upon includes operation in accordance with this user manual.
The digital servo amplifier JetMove 215B-480 may only be operated in the closed control cabinet and within the range of the set values.
Do not apply a voltage to the digital servo amplifier JetMove 215B-480 that is higher than the prescribed operating voltage.

Each of the three phases of the digital servo amplifier JetMove 215B-480 has got an operating voltage ranging between AC 340 V and AC 530 V. Thus, the digital servo amplifier JetMove 215B-480 comes under the EG Low Voltage Directive.

It is the explicit purpose of the digital servo controller JetMove 215B-480 to torque-, speed- and/or position-control, and to drive brushless synchronous servo motors. The rated voltage 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 215B-480 is used to control machinery, such as conveyors, production machines, and handling machines.

1.1.2 Non-intended use

The digital servo amplifier JetMove 215B-480 must not be used in technical systems which to a high degree have to be fail-save, e. g. ropeways and aeroplanes.

Please do not use the integrated braking circuit in applications, where safety hazards can occur.

The JetMove 204-480 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 97.

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 2215B-480 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 engineering, such as industrial electronics engineers.
Commissioning / Programming:	Trained and instructed specialist personnel having got broad knowledge 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 automotive engineering, such as industrial electronics engineers.

1.1.4 Modifications and alterations

Due to safety reasons, no modifications and alterations to the digital servo amplifier JetMove 215B-480 and its functions are allowed.
Any modifications to the servo amplifier JetMove 215B-480 not expressly authorized by the manufacturer will result in a loss of any liability claims to Jetter AG.

The original parts are specifically designed for the servo amplifier JetMove 215B-480. Parts and equipment from other manufacturers are not tested on our part, and are, therefore, not released by Jetter AG.
The installation of such parts may impair the safety and the proper functioning of the digital servo amplifier JetMove 215B-480.

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

1.1.5 Servicing and repairs

Repairs at the digital servo amplifier JetMove 215B-480 must not be carried out by the operator. The digital servo amplifier JetMove 215B-480 does not contain any parts to be repaired by the operator.
For being repaired, the servo amplifier JetMove 215B -480 must be sent to Jetter AG.

The digital servo amplifier JetMove 215B-480 is maintenance-free. Therefore, absolutely no inspection or maintenance works are required for the operation of the module.

1.1.6 Disposal

In case of obvious damage or erratic behavior, the servo amplifier must not be used any more.

The environmental regulations for the respective country apply to disposing of the digital servo JetMove 215B-480 amplifier on the operating company's premises.

You can disassemble the digital servo amplifier JetMove 215B-480 into its main components by unscrewing it (aluminium heat sink and side plate, steel casing cover, electronic boards).

1.2 Ensure Your Own Safety

DANGER

- Isolate the digital servo amplifier JetMove 215B-480 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.
  Please 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 must never be shunted or by-passed.
- Dismantled protective equipment, such as the fuses and the thermal motor circuit-breakers, must be reattached prior to commissioning and checked for proper functioning.
- Before commissioning, the machine manufacturer must carry out a danger analysis of the respective machine and take adequate measures so that inadvertent motions will not lead to personal injury and to material damage.

1.2.1 Malfunctions

- **In the case of malfunctions or other faults, please immediately separate the digital servo amplifier JetMove 215B-480 from the mains.**
  Please follow the information given in chapter 1.3 "Residual Dangers", page 16.
- Malfunctions or other damages are to be reported to a responsible person at once.
- Secure the digital servo amplifier JetMove 215B-480 against misuse or accidental use.

1.2.2 Information signs and labels

Markings, information signs, and labels always have to be observed and kept readable.

Damaged or unreadable information signs and labels have to be replaced.

1.2.3 Earthing procedure

Screw the enclosure of the digital servo amplifier JetMove 215B-480 onto a high-conductance, earthed panel.

Do only use the digital servo amplifier JetMove 215B-480 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 digital servo amplifier must not be operated when connected to unearthed networks and to unsymmetrically earthed networks.

The digital servo amplifier JetMove 215B-480 has got a leakage current greater than 3.5 mA. In order to avoid electric shocks, a second protective earth conductor is required.
For this, the following measures must be taken:

- Connect the protective earth bus to the PE bolt (1) located on the top side of the rack as well as to the PE terminal X1 (2) (please refer to Fig. 1).
  The cross-sectional area of the two earthing conductors must be equal to, or greater than the cross-sectional area of the supply lines (min. 2.5 mm^2 / AWG 14).
- Provide a permanent connection with the power supply of the digital servo amplifier JetMove 215B-480.
- The PE (GND) bus must be wired according to the connection diagram (cf. chapter 10 "Connection Diagrams", page 83).

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!

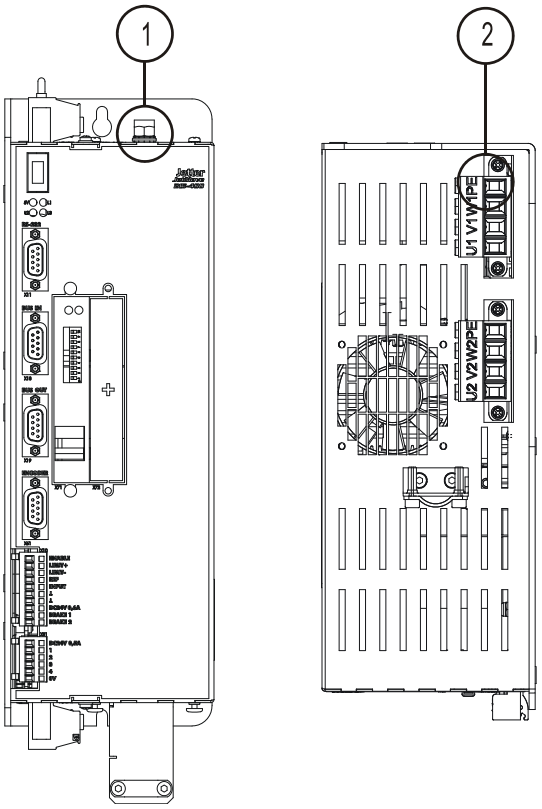


Fig. 1: Double earthing

NOTICE

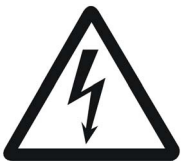
Do not install an earth-leakage current breaker in the mains power supply circuit.

If this advice is disregarded and an ELCB is installed, it will switch off the servo amplifier although there is no error.
When an ELCB needs to be installed, an isolating transformer must be used.

1.3 Residual Dangers

1.3.1 Hazards during operation

Hazard caused by high operating voltage!



WARNING

Extremely hazardous voltages of up to 850 V may occur!

These voltages lead to muscle cramps, burns, unconsciousness, respiratory standstill, and death.

- During operation, all coverings and control cabinet doors have to be kept closed.
- Do not open the device.
- Do by no means disconnect the electric connections of the digital servo amplifier JetMove 215B-480 when it is live.
- **Do not touch the terminals X1, X62, and X63 while the servo amplifier is running.**
  In the given context, the terminals have the following meaning:

  X1: AC 400/480 V voltage supply

  X62: DC motor voltage up to 850 V

  X63: DC link voltage up to 850 V

WARNING

Warning! Hot surfaces!

WARNING

During operation, the surfaces, respectively the heat sinks of the digital servo amplifier JetMove 215B-480 can heat up. The internal heat sink can reach temperatures of up to 85 °C.

- **Do by no means touch the enclosure of the digital servo amplifier JetMove 215B-480 near the internal heat sink during operation and during the cooling-off period after switching off the device.**
- Ensure that no temperature sensitive parts are attached to the digital servo amplifier JetMove 215B-480.

Danger in a potentially explosive atmosphere!

WARNING

➢ **Do not operate the digital servo amplifier JetMove 215B-480 in a potentially explosive atmosphere.**

Danger of injuries caused by mechanic force!

CAUTION

The digital servo amplifier JetMove 215B-480 drives a servo motor. This servo motor moves mechanic parts or sharp edges. Therefore, failure or malfunctioning of the digital servo amplifier JetMove 215B-480 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 moving unintentionally.

➢ Do not remove any guards.

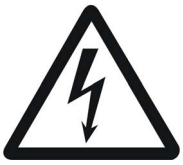
WARNING

➢ **Do not wear gloves!** They could get caught in the rotating shaft.

➢ **Never touch a rotating drive shaft.**

1.3.2 Hazards after POWER has been turned OFF

DANGER resulting from electric shock!



WARNING

Up to 7 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 7 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, X62 and X63;
  – Disconnecting the terminals and touching the contacts.

1.4 Instructions on EMI

The digital servo amplifier JetMove 215B-480 is intended for use in industrial surroundings. This module can cause radio interferences in residential areas. This module is operated at the operator's own risk.

The noise immunity of a system depends on 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:

- Earth the device adequately according to chapter 1.2.3 "Earthing procedure", page 14.
- Connect all grounding terminals of the JetMove 215B-480. A double grounding terminal is required!
  - Connect the earth to the cover. For this please refer to Fig. 1 on Page 15.
  - Connect protective earth (PE / GND) at terminal X1.
- The distance between the optional line filters and the digital servo amplifier JetMove 215B-480 has to 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 the Electric Cabinet" published by Jetter AG.

The following instructions are excerpts from Application Note 016:

- On principle, **physical separation** should be maintained between signal and power lines. We recommend spacings greater than 20 cm. Cables and lines should cross each other at an angle of 90°.
- Shielded cables **must** be used for the following lines:
  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.
- Shield cables **at both ends**.
- Unshielded wire ends of shielded cables should be as short as possible.

➢ The **entire** shield must be drawn behind the isolation, and then be clamped under a flat earthed cable strap at the greatest possible surface area.

When male connectors are used:

➢ 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).

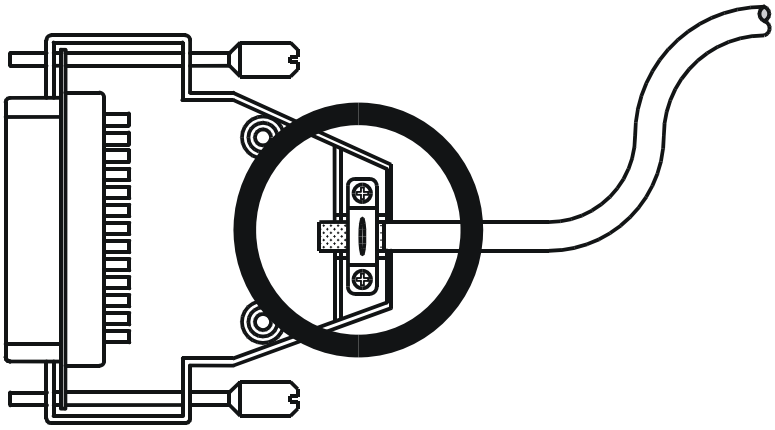


Fig. 2: Shielding of SUB-D connectors in conformity with EMC standards

If the shield cannot be attached to the connector directly, 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.

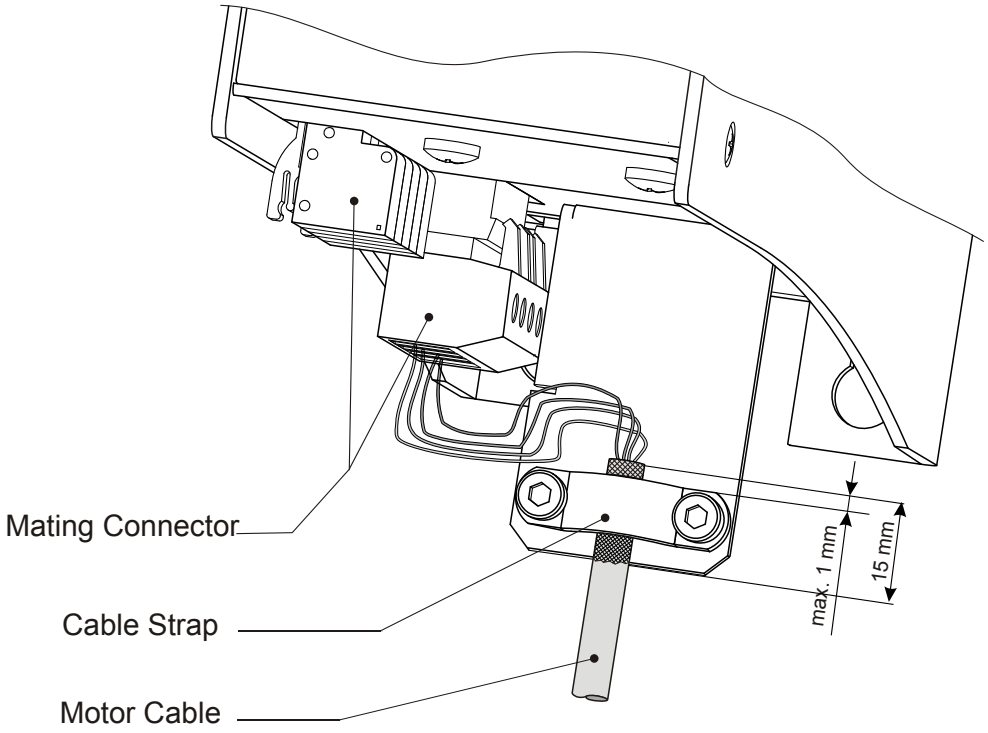


Fig. 3: EMC-compatible connection of motor cables

2 Installing the JetMove 215B-480

2.1 Scope of Delivery

- Digital servo amplifier JetMove 215B-480
- Mating connector 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 Jetter headquarters, the Jetter subsidiaries or the distributors.)

- System bus cable of cable confection no. 530 x.x m; length: 0.2 m through 5.0 m; see chapter 7.9 "JX2 System Bus", page 72
- Motor power cable, see chapter 7.2 "Motor Connection", page 46
- Resolver cable; refer to chapter 7.3 "Resolver Connection", page 55
- HIPERFACE cable, see chapter 7.4 "HIPERFACE Connection", page 57
- Synchronous servo motors, e. g. the Jetter motor types JL, JK, or JH
- Motor circuit-breaker; refer to chapter 5 "Technical Data", page 35
- Circuit-breaker, see chapter 5 "Technical Data", page 35
- Thermostatic motor circuit-breaker; refer to chapter 7 "Description of Connections", page 45
- Mounting screws, 2 pcs.; refer to fig. 5, page 33

Note:

If you are not sure which accessories you will need, please contact Jetter AG.

2.2 Mechanical Installation

- Prior to installing the digital servo amplifier check it for possible transport damages.
- Please check the shipment for completeness.
- Fix the cable strap serving as strain relief and motor cable shield next to connector X62 (see fig. 3, page 21).
- To ensure proper functioning of the JetMove 215B-480, check whether the mounting plate in the electric cabinet is unpainted.
- The only possible mounting position is vertical - see “Rear and front view of the JetMove 215B-480 enclosure with mounting holes" on page 25.
- Please make sure there is a clearance of at least 100 mm under and above the JetMove 215B-480 - unobstructed ventilation has to be ensured.
- Please mark on the panel two positions for the fastening screw threads of the JetMove 215B-480 (see fig. 4, page 25).
- 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 215B-480 by the fitting bolts; then screw them tightly.

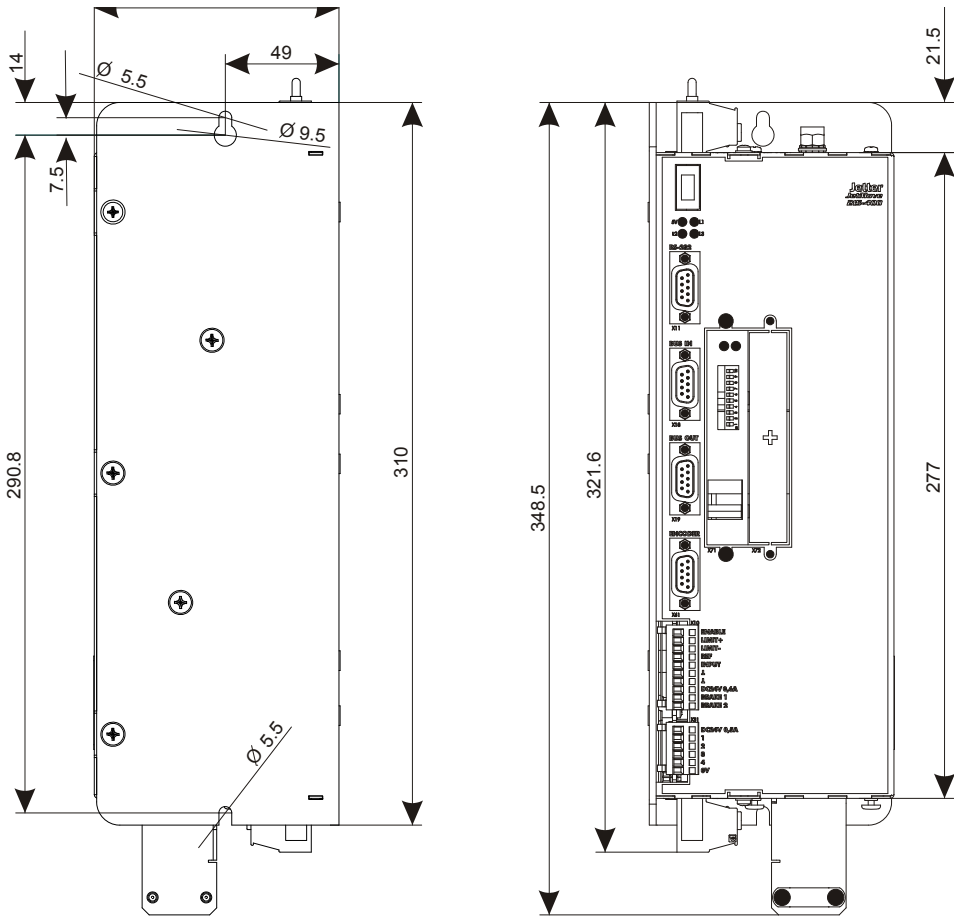


Fig. 4: Rear and front view of the JetMove 215B-480 enclosure with mounting holes

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 850 V min.; please also refer to “Compatible Synchronous Servo Motors" on page 40.

- Connect the JetMove 215B-480 according to the connection wiring diagram shown in chapter 10 "Connection Diagrams", page 83.
  Especially check the power lines for appropriate protection, see “Overload protection" on page 36.
  Protecting the motor cables is not advisable.

- Select the cables according to standards.

- Check whether all ground cables are connected (double earthing), see chapter 1.2.3 "Earthing procedure", page 14.
  Do not exceed the max. tightening torque, see appendix G.

- To connect resolvers or power units you can use prefabricated cables available from Jetter or opt for self-made cables. For details see chapter 7 "Description of Connections", page 45.

- To ensure that installation is carried out in conformance with EMC regulations, the following items have to be observed especially:
  – If possible, run control cables and power cables separately;
  – Connect the encoder (resolver or HIPERFACE encoder);
  – 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 fig. 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.
- 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 and electric shock!

DANGER

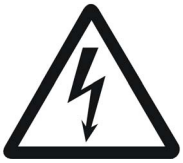
Extremely hazardous voltages of up to 850 V may occur!

Please observe the following precautions in order to avoid muscle cramps, burns, unconsciousness, respiratory standstill, etc., and death:

- Have installation and maintenance jobs carried out by qualified personnel only, see chapter 1.1.3 "Qualified personnel", page 12.
- Switch off the operating voltage.
- Please take into account the information on residual dangers given in chapter 1.3.2 "Hazards after POWER has been turned OFF", page 18.
- Before carrying out installation and maintenance jobs, separate the servo amplifier JetMove 215B-480 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 and electric shock!



DANGER

Extremely hazardous voltages of up to 850 V may occur!

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

- Have commissioning jobs carried out by qualified personnel only, see chapter 1.1.3 "Qualified personnel", page 12.

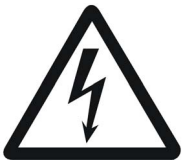
Prior to commissioning, please do the following:

- Reattach dismantled protective equipment and check it for proper functioning.
  By doing so, you will prevent accidents resulting from moving parts.
- Secure the servo amplifier JetMove 215B-480 against accidental contact with conductive parts and components.
- Only connect devices or electrical components to the signal lines of the digital servo amplifier JetMove 215B-480 (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.
- The digital servo amplifier JetMove 215B-480 has got a leakage current greater than 3.5 mA. In order to avoid electric shocks, a second protective earth conductor is required. For this, the measures listed in chapter 1.2.3 "Earthing procedure", page 14 have to be taken.
- Each commissioning, even a short functional test, always has to be carried out with a PE (GND) bus correctly connected.

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.

Dangerous 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 ensured.

Make sure that the following operating parameters are met.

Operating Parameters		
Ambient Conditions		**Reference**
Transport conditions (units within packing)	Temperature: -25 °C ... 70 °C Air humidity: 5 % ... 95 % Non-condensing	DIN EN 50178
Storage conditions (units within packing)	Temperature: -25 °C ... 55 °C Change max. 20 K/h Air humidity: 5 % ... 95 % Non-condensing Max. storage time: 1 year	DIN EN 50178

The "Storage conditions" are continued on the next page.

Operating Parameters		
	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 must 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. 1,000 to 2,000 m above sea level with derating of 1.5 % per 100 m increas 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: with 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 25) 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 Isolation	Power to earth and Power to logic 2.65 kVdc, 2 s Power to earth and Power to logic > 1 MOhm at 500 V	DIN EN 61800-5-1 DIN EN 60146-1-1 DIN EN 60204
Protective connection	12 V, 10 A, 0.1 Ohm	DIN EN 60204
Overvoltage category	III	DIN EN 61800-5-1 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 met.

The following note must be observed for the amplifier models JM-2xx-xxx-OEM-... and JM-D203-JC-2xx-...

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**
Housing	• Frequency range 30 ... 230 MHz, limit 30 dB (µV/m) at 30 m • Frequency range 230 ... 1,000 MHz, limit 37 dB (µV/m) at 30 m (class B)	DIN EN 61800-3
Line AC	• Frequency range 0.15 ... 0.5 MHz, limit 79 dB (µV) • Frequency range 0.5 ... 30 MHz, limit 73 dB (µV)	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. See “Line filter” on page 39.

EMC		
Interference Immunity: Enclosure		
Parameter	**Value**	**Reference**
RF field, amplitude-modulated	Frequency range 80 ... 1,000 MHz; Test field strength 10 V/m AM 80 % at 1 kHz Criterion A	DIN EN 61000-4-3 DIN EN 61800-3
ESD	Contact discharge: Test peak voltage 6 kV Criterion B	DIN EN 61800-3 DIN EN 61000-4-2

EMC		
Interference Immunity: Power Connections and Power Interfaces		
Parameter	**Value**	**Reference**
Conducted radio disturbances	Frequency 0.15 ... 80 MHz Test voltage 10 V AM 80 % at 1 kHz Criterion A	DIN EN 61800-3 DIN EN 61000-4-6
Burst (fast transients)	Test voltage 2 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion B	DIN EN 61800-3 DIN EN 61000-4-4
Impulse voltages	tr/th 1.2/50 µs, 8/20 µs 1 kV (phase to phase) 2 kV (phase to ground) Criterion B	DIN EN 61800-3 DIN EN 61000-4-5
Interference Immunity: Process, Measuring and Control Lines		
Parameter	**Value**	**Reference**
Conducted radio disturbances	Frequency 0.15 ... 80 MHz Test voltage 10 V AM 80 % at 1 kHz Criterion A	DIN EN 61800-3 DIN EN 61000-4-6
Burst (fast transients)	Test voltage 2 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion B	DIN EN 61800-3 DIN EN 61000-4-4
Interference Immunity: Signal Interfaces		
Parameter	**Value**	**Reference**
Conducted radio disturbances	Frequency 0.15 ... 80 MHz Test voltage 10 V AM 80 % at 1 kHz Criterion A	DIN EN 61800-3 DIN EN 61000-4-6
Burst (fast transients)	Test voltage 1 kV tr/tn 5/50 ns Repetition frequency 5 kHz Criterion B	DIN EN 61800-3 DIN EN 61000-4-4

4 Physical Dimensions

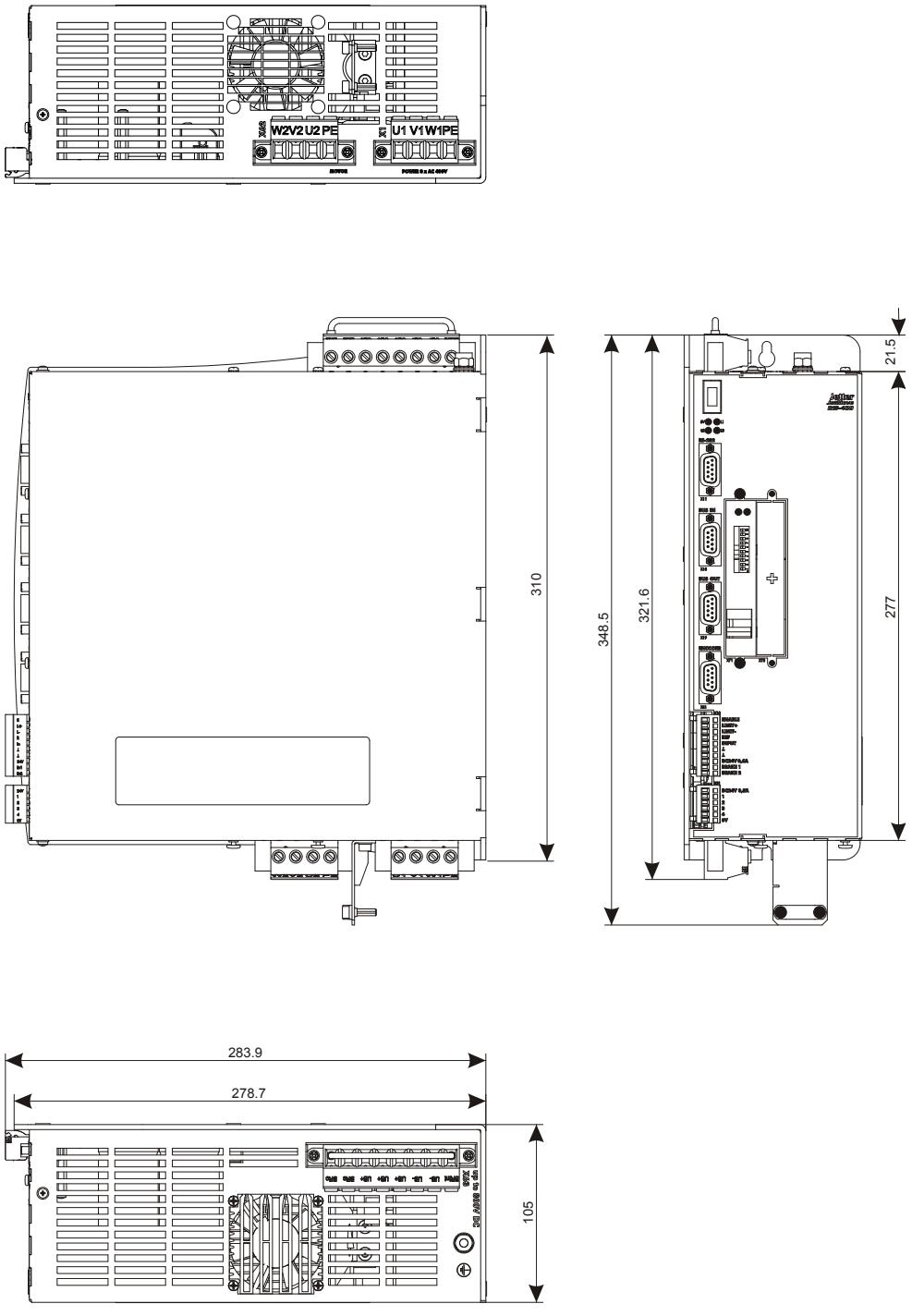
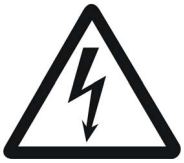


Fig. 5: Physical dimensions of the JetMove 215B-480 (in mm)

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

Dangerous injuries can occur!

For example from
- electric shock because the electrical safety has been violated by not observing the degree of pollution;
- 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	• 3-phase Direct supply V_{rms} = 3x400/480 V Common mode of the voltage 2 % max. (voltage dips at continuous output of 10 ms max.) • 48 ... 62 Hz (frequency change 2 % / s max.)
Power supply tolerance	-15 % ... +10 %
Inrush current limitation	< 10 A limited to < 500 ms during the switch-on-sequence

Electrical Specifications	
Overload protection	For each phase an external overload protection is required, for example – Circuit-breaker 32 A C – Fuse 32 A M (medium time lag) – Motor circuit-breaker 32 A For systems with NRTL approval use overload protection devices that are NRTL listed (acc. To UL 508)(NKJH)) self protected combination motor controller (specification: 480 V, 32 A). The JetMove 215B-480 is suitable for use on a circuit capable of delivering not more than 5000 (rms) symmetrical Amperes, 480 Volts maximum.
Supply cable Cable size Material Temperature class	 4 * 2.5 mm^2 min. (AWG 14) Copper > 60 °C
Max. output voltage of the motor	850 V
Motor output current at an ambient temperature of 45 °C	Nominal current: I_{rms} = 15 A Peak current for a max. period of 5 minutes: I_{rms} = 30 A (The duration depends on the temperature of the heat sink) See “INFO 1” on page 39.
Continuous output	5.5 kW (7.49 hp)
Short-circuit protection, motor side	Designed for: • Phase to phase • Phase to earth
Motor overload protection	Refer to “Motor Protection" on page 40.
Motor cable Cable size Material Capacitance Temperature class Max. length of the motor cable	 4 * 2.5 mm^2 min. (AWG 14) Copper < 150 pF/m > 60 °C max. 50 m (for greater lengths, please contact Jetter AG)

Electrical Specifications	
Line filter	Line filter ensuring EMC in a residential environment to DIN EN 61800-3. The following filters can be applied with input circuits: – FMAC-932-1610 with I_r = 16 A – FMAC-932-2510 with I_r = 25 A – FMAC-934-3610 with I_r = 36 A See “INFO 2” on page 39.
Voltage supply of processor logics (demands on power supply module)	• DC 24 V (20 ... 28.8 V) • ≤ 0.6 A • The voltage output of the power supply unit must comply with the SELV or PELV type.
Internal ballast resistor	• Resistor: 60 Ω (PTC) • Continuous output: 210 Watt (energy dissipation is dependent on the actual heat sink temperature.) • Maximum capacity: 11 kW for 0.6 s • Overload protection internal (warning and error)
External ballast resistor	In order to achieve greater brake power, an external ballast resistor can be installed. For this, see “Connection of External Ballast Resistor and DC Link Circuit of Another JM-215B-480" on page 64
Residual voltage	To avoid hazard of electrical shock wait at least 7 minutes after switching-off the digital servo amplifier before attempting to pull out the plug or remove this unit (see Page 18).
Leakage current	> 3.5 mA **See “DANGER” on page 40.**
Digital inputs – Enable (E), – Reference switch (R); – Limit switch right (L+); – Limit switch left (L-); – 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. See “Digital Inputs, Logic Power Supply” on page 69.

Electrical Specifications	
Braking relay	V_{max} = DC 30 V I_{max} = DC 2 A Contact: Type NO connected to BR1 and BR2 on X10 The lines may only be connected to devices that are related to the same potential as the power supply of the controller logic. Can be switched by the control program of PLC or by operating system of JetMove 215B-480 together with software enable.
Digital outputs Number of outputs Type of outputs Rated voltage Voltage range Load current Electrical isolation Protective circuit Protection against inductive loads Signal voltage ON	 4 Transistor pnp type 24 V 20 ... 28.8 V related to the ground potential of voltage supply of processor logics max. 0.5 A / output None Short-circuit proof, overload, overvoltage, overtemperature protection Yes Type V_{supply} - 1.5 V
Power loss P_v	Output stage: 250 W max. Logic circuit: 20 W max.

INFO 1

Active Cooling:

- The fan is activated at 60 °C and deactivated at 40 °C.
- The temperature limit for overtemperature protection is set dynamically, depending on the overload limit.

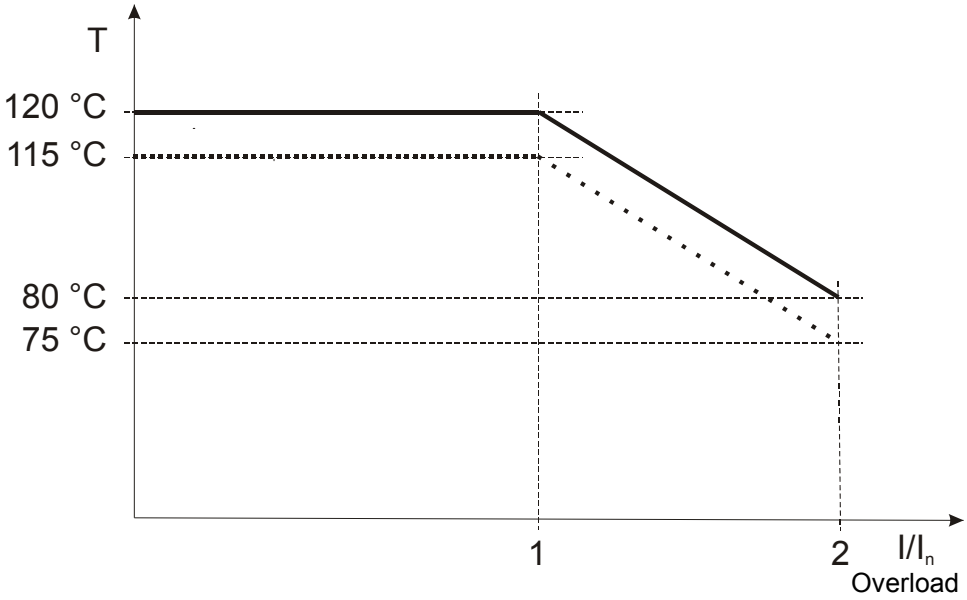


Fig. 6: Maximum heat sink temperature depending on the motor current

Shutdown threshold for heat sink temperature monitoring

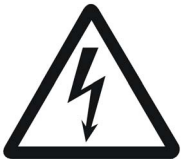
Alarm threshold for heat sink temperature monitoring

- The duration of operation by maximum motor current is evaluated by a starting temperature of 45 °C at the heat sink.

INFO 2

A line filter can supply several digital servo amplifiers, as long as I_f (line filter current) is greater than the total current required by all connected servo amplifiers.

DANGER resulting from electric shock!



DANGER

In order to prevent electric shocks, ground the digital servo amplifier JetMove 215B-480 **by all means** via two positions; for this, refer to chapter 1.2.3 "Earthing procedure", page 14.

Compatible Synchronous Servo Motors	
Motor types	Jetter motors of the JHN, JHQ, and JI series with 2-cable technology. Please also refer to the User Manual of the motors or contact the sales department of Jetter AG.

INFO

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

5.2 Motor Protection

There are three ways of motor protection:

5.2.1 Built-in thermal sensor

The JetMove 215B-480 servo amplifier is able to run by means of three different temperature sensors and to evaluate their data:

Sensor type	Type of sensor signal evaluation
KTY83-110	The temperature is measured in °C The warning level is adjustable Activation of an error message at maximum motor temperature
PTC	Go-no-go decision Activation of an error message at maximum motor temperature
Temperature switch	Go-no-go decision Activation of an error message at maximum motor temperature

5.2.2 I²t calculation

The digital servo amplifier JetMove 215B-480 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 following 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 215B-480 through JetSym or the PLC.

The digital servo amplifier JetMove 215B-480 calculates the percentage of motor power loss according to the following formula:

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

x(t) = displayed value of motor power loss 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 nominal 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:

Nominal current:	15 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 30 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 204-480 is switched on (that is, when parameterization of I^2t calculation is completed and 24 V logic power supply is applied).

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 motor overload calculation always starts with zero, the result is wrong if the motor is already hot when the digital servo amplifier JetMove 215B-480 is switched on (i. e. at the time of connecting the 24 V logic power supply).

6 Drive Controller Structure

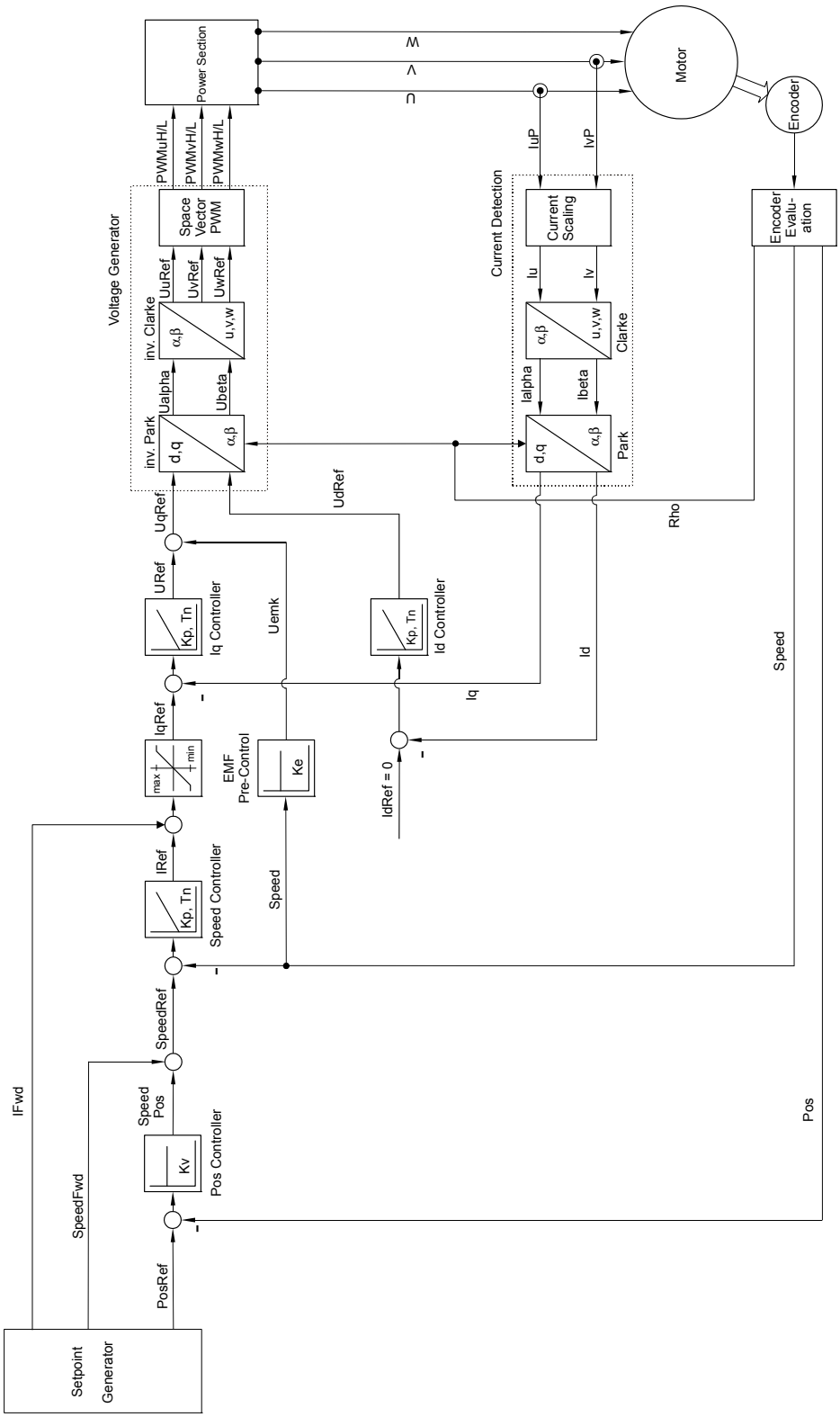


Fig. 7: Block diagram of drive controller structure

All drive controllers can be parameterized through the control program.

Controller Type	Description
Motor control (commutation)	Space vector modulation
PWM frequency	8 kHz
Current controller – Cycle time	 62.5 µs
Speed controller – Cycle time – Current pre-control	 125 µs adjustable
Position feedback controller – Cycle time – Speed pre-control	 250 µs adjustable
Position setpoint generator – Sine-square and linear acceleration/deceleration ramps – Setpoint output cycle (position feedback controller interpolation)	 can be parameterized individually 2 ms
Position sensing **Resolver:** – Resolution – Sampling interval T **Sine-cosine encoder** (multi- and single-turn): – Interface – Resolution of absolute position – Resolution of velocity pickup – Sampling interval T	 12 bits per revolution 62.5 µs HIPERFACE 15 bits per revolution 20 bits per revolution 62.5 µs

7 Description of Connections

7.1 Power Supply Connection

Specification of Terminal X1

- 4-pin male connector; screw connection (type: Phoenix PC 6/4-ST-10,16)
- Allowed conductor size: 0.5 ... 6 mm^2 (AWG 20 ... 7)
- Torque: 1.2 ... 1.5 Nm (10.6 ... 13.3 lbf-inch)
- Ambient temperature: max. 45 °C
- Field wiring

Specifications of Connecting Cable

- Cable size: min. 4 * 2.5 mm² (AWG 14)
- Material: Copper
- Temperature class: 60 °C

Shielding

- Not required.

Power Supply		
Wiring Terminal X1	**Power Lines**	**Specification**
U1	L1	• AC 400 ... 480 V between the power lines
V1	L2	
W1	L3	
PE (GND)	PE / GND conductor	

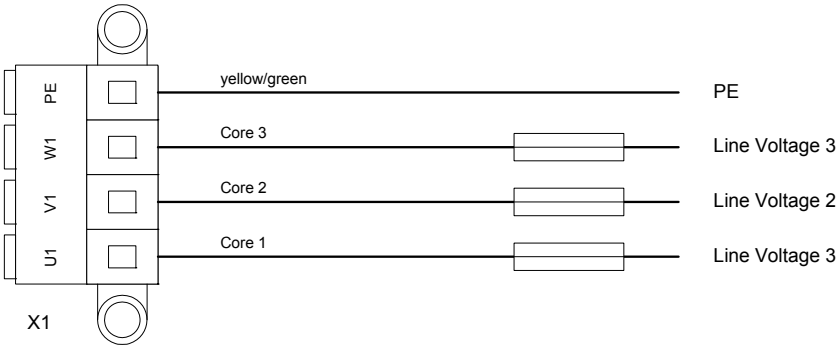


Fig. 8: Power supply connection

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 Terminal X62

- 4-pin connector (type Phoenix PC 6 / 4 - ST - 10,16)
- Allowed conductor size: 0.5 ... 6 mm^2 (AWG 20 ... 7)
- Torque: 1.2 ... 1.5 Nm (10.6 ... 13.3 lbf-inch)
- Ambient temperature: max. 45 °C
- Field wiring

Specifications of Connecting Cable

- Cable size: min. 4 * 2.5 mm² (AWG 14)
- Material: Copper
- Temperature class: 60 °C

Shielding

- Braided copper shield of 80 % coverage

Connection of the motor to the digital servo amplifier JetMove 215B-480 has to be done following the wiring diagram below. Connection of the brake is optional. In this case, the wires for the brake have to be at least 300 mm longer than the wires of the motor.

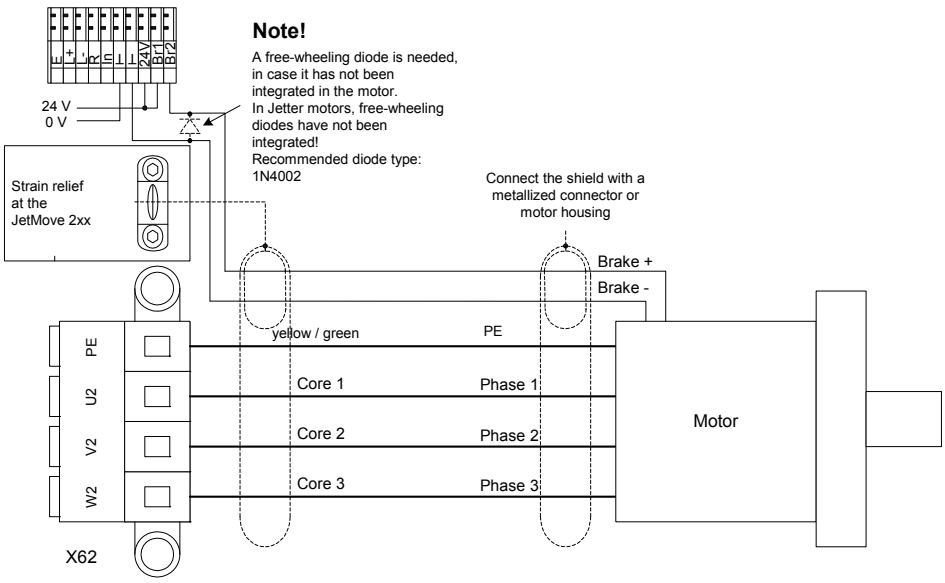


Fig. 9: Connection of motor lines

7.2.3 Motor power cable with mating connector SC

INFO

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

INFO

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

Without brake:	Cable confection no. 26.1
With brake:	Cable confection no. 24.1

Mating connector of the motor (solder side)

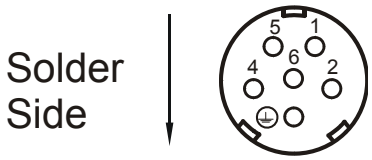
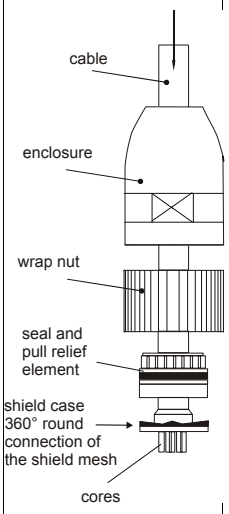
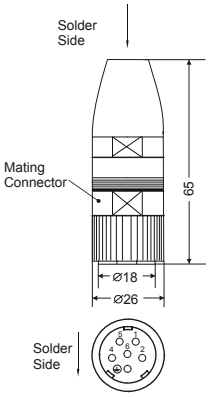
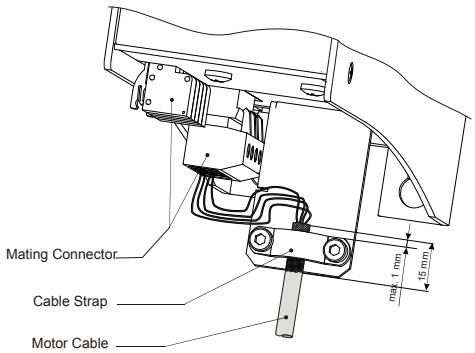


Fig. 10: View on the SC series mating connector of the motor (internal thread M23)

Cable specification of the motor power cable with mating connector SC for JetMove 215B-480

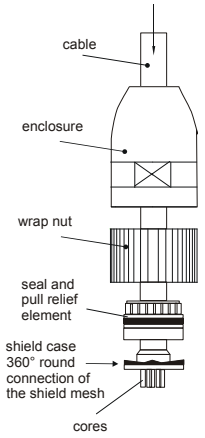
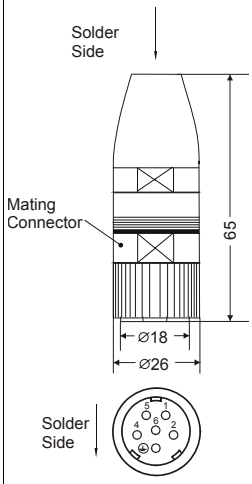
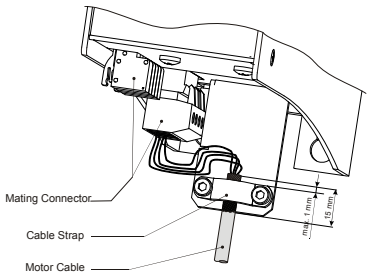
For connection without motor holding brake

Motor Power Cable - Cable Confection No. 26.1			
Field Wiring Terminals of the JetMove 215B-480	**Shielding**		**Mating Connector of the Motor (female, solder side)**
4 x 1.5 mm^2 (AWG 16(4)) The wires are equipped with wire end ferrules.	Shielded, highly flexible 4-wire cable with PE (GND).		
			
Connect both sides of the shield with the greatest possible surface area! Use metallized housing only!			
Pin	**Wire Number**	**Signal**	**Pin**
X62.U2	1	Phase 1	1
X62.V2	2	Phase 2	5
X62.W2	3	Phase 3	2
X62.PE (GND)	yellow-green	PE/GND grounding	⏚

Dimensions of the motor mating connector are specified in millimeters.

For connection with motor holding brake

<table>
<tr><th colspan="4">Motor Power Cable - Cable Confection No. 24.1</th></tr>
<tr><td>Field Wiring Terminals of the JetMove 215B-480</td><td colspan="2">Shielding</td><td>Mating Connector of the Motor (female, solder side)</td></tr>
<tr><td>(4 x 1.5 mm^2
(2 x 1.5 mm^2))
(AWG 16(6))

The wires are equipped with wire end ferrules.</td><td>Highly flexible 6-wire cable with PE (GND) (separately shielded brake lines and all-over shielding)</td><td> 
</td><td rowspan="2"> 
</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td></td><td colspan="2">Connect both sides of the shield with the greatest possible surface area!
Use metallized housing only!</td><td></td></tr>
<tr><td>Pin</td><td>Wire Number</td><td>Signal</td><td>Pin</td></tr>
<tr><td>X62.U2</td><td>U1</td><td>Phase 1</td><td>1</td></tr>
<tr><td>X62.V2</td><td>V2</td><td>Phase 2</td><td>5</td></tr>
<tr><td>X62.W2</td><td>W3</td><td>Phase 3</td><td>2</td></tr>
<tr><td>X62.PE</td><td>yellow-green</td><td>PE conductor</td><td>  </td></tr>
<tr><td>X10.BRAKE2</td><td>BR1</td><td>Brake +</td><td>6</td></tr>
<tr><td>X10.GND</td><td>BR2</td><td>Brake -</td><td>4</td></tr>
</table>

Dimensions of the motor mating connector are specified in millimeters.

7.2.4 Motor power cable with mating connector SM

INFO

The compatible mating connector SM (female connector) can be ordered from Jetter AG under part number 60860443.

INFO

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

Without brake:	Cable confection no. 201
With brake:	Cable confection no. 202

Mating connector of the motor (solder side)

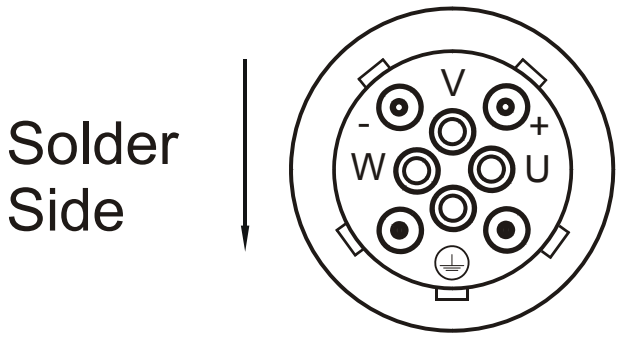
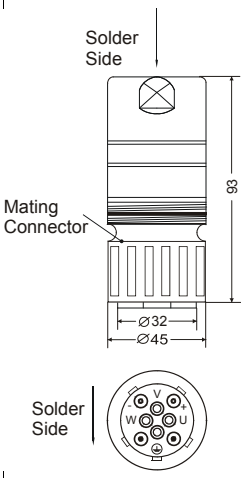
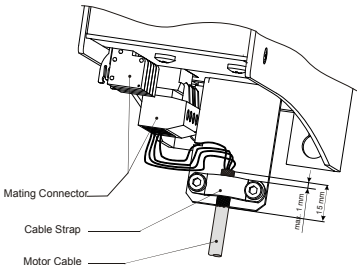


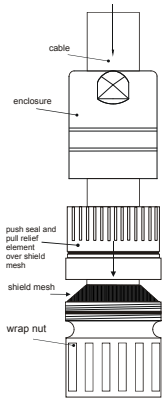
Fig. 11: View on the SM series mating connector of the motor (internal thread M40)

Specification of the motor power cable with mating connector SM for JetMove 215B-480

For connection without motor holding brake

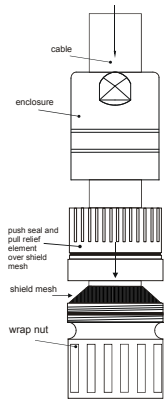
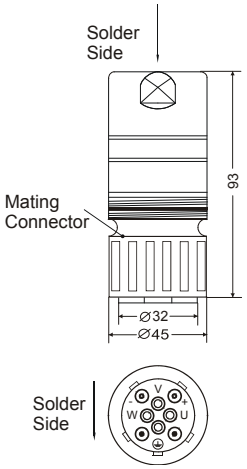
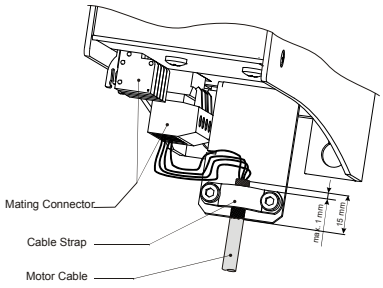
<table>
<tr><th colspan="4">Motor Power Cable - Cable Confection No. 201</th></tr>
<tr><td>Field Wiring Terminals of the JetMove 215B-480</td><td colspan="2">Shielding</td><td>Mating Connector of the Motor (female, solder side)</td></tr>
<tr><td>4 x 4 mm^2
(AWG 12(4))

The wires are equipped with wire end ferrules.</td><td colspan="2">Shielded, highly flexible 4-wire cable with PE (GND).</td><td rowspan="2"> 
</td></tr>
<tr><td colspan="2"> 


</td></tr>
<tr><td></td><td colspan="2">Connect both sides of the shield with the greatest possible surface area! Use metallized housing only!</td><td></td></tr>
<tr><td>Pin</td><td>Wire Number</td><td>Signal</td><td>Pin</td></tr>
<tr><td>X62.U2</td><td>1</td><td>Phase 1</td><td>U</td></tr>
<tr><td>X62.V2</td><td>2</td><td>Phase 2</td><td>V</td></tr>
<tr><td>X62.W2</td><td>3</td><td>Phase 3</td><td>W</td></tr>
<tr><td>X62.PE (GND)</td><td>yellow-green</td><td>PE / GND conductor</td><td>  </td></tr>
</table>

Dimensions of the motor mating connector are specified in millimeters.

For connection with motor holding brake

Motor Power Cable - Cable Confection No. 202			
Field Wiring Terminals of the JetMove 215B-480	**Shielding**		**Mating Connector of the Motor (female, solder side)**
(4 x 4 mm² + (2 x 0.5 mm^2)) (AWG 12(4) + AWG 20(2)) 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! Use metallized housing only!		

Pin	Wire number	Signal	Pin
X62.U2	1	Phase 1	U
X62.V2	2	Phase 2	V
X62.W2	3	Phase 3	W
X62.PE (GND)	yellow-green	PE / GND conductor	⏚
X10.BRAKE2	5	Brake +	+
X10.GND	6	Brake -	-

Dimensions of the motor mating connector are specified in millimeters.

7.2.5 Connection assignment of terminal box

Connection Assignment of Terminal Box*) for Jetter Motor Types		
Wiring Terminals	**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 (GND)	Pin 4	 PE / GND conductor
X10.BRAKE2	Pin 7	Brake +
X10.GND	Pin 8	Brake -

*) alternative to motor connectors

7.3 Resolver Connection

7.3.1 Specifications

Specifications of the Mating Connector for X61 (ENCODER)

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

Specification of Resolver Cable

- Cable size: 4 * 2 * 0.14 mm² (AWG 26(8))
- 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
- Max. cable length: 50 m

7.3.2 Resolver cable with mating connector

INFO

The compatible resolver or HIPERFACE mating connector can be ordered from Jetter AG by specifying the part number below:

Part # 15100069	Resolver / HIPERFACE

The ready-made resolver cable between JetMove 2xx servo amplifiers and Jetter motors can be ordered from Jetter AG by specifying the following cable confection number (KABEL-KONF):

Cable confection # 23	For servo amplifiers of the JetMove 2xx series

Mating connector of the resolver (solder side)

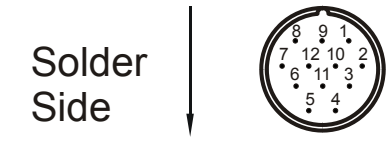
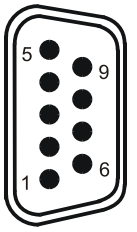
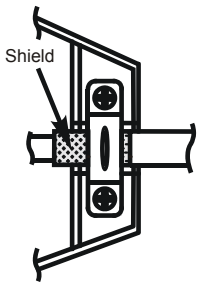
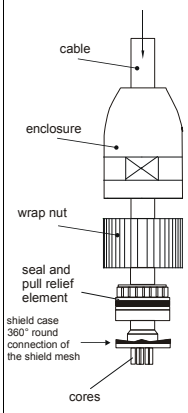
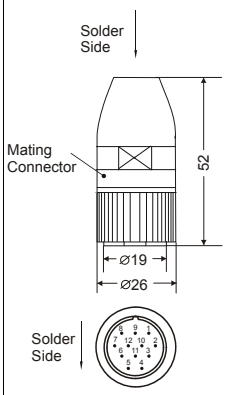


Fig. 12: View on the RC series mating connector of the resolver (internal thread M23)

Resolver Cable - Cable Confection No. 23			
JetMove 2xx (SUB-D 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 -	yellow	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 Specifications

Specifications of the Mating Connector for X61 (ENCODER)

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

Specification of HIPERFACE Cable

- Cable size: 4 * 2 * 0.14 mm² + 2 * 0.5 mm² (AWG 26(8) + AWG 20(2))
  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
  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
- Max. cable length: 50 m

7.4.2 HIPERFACE cable with mating connector

INFO

The compatible resolver or HIPERFACE mating connector can be ordered from Jetter AG under the part number below:

Part # 15100069	Resolver / HIPERFACE

The complete HIPERFACE cable between servo amplifier of the JetMove 2xx series and the Jetter motors can be ordered from Jetter AG. It can be ordered by specifying the following cable confection number and the respective cable length in cm:

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

HIPERFACE mating connector (solder side)

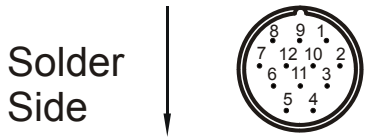
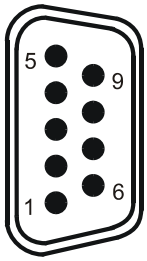
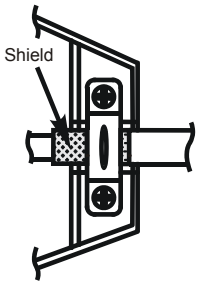
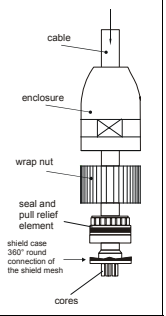
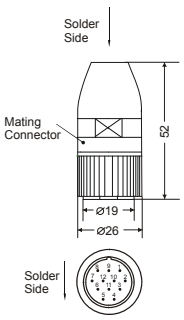


Fig. 13: RC series HIPERFACE mating connector (internal thread M23)

HIPERFACE Cable - KAY_0723-xxxx

JetMove 2xx (SUB-D 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	yellow	6
6	DATA - (RS-485)	gray	7
1	DATA + (RS-485)	pink	8
4	0 V	blue	9 *)
5	Power supply (7 through 12 V)	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 Jetter AG by the following specification:

JM-200-ENC-ADAP (Part # 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 Specifications

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 no 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 voltage 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

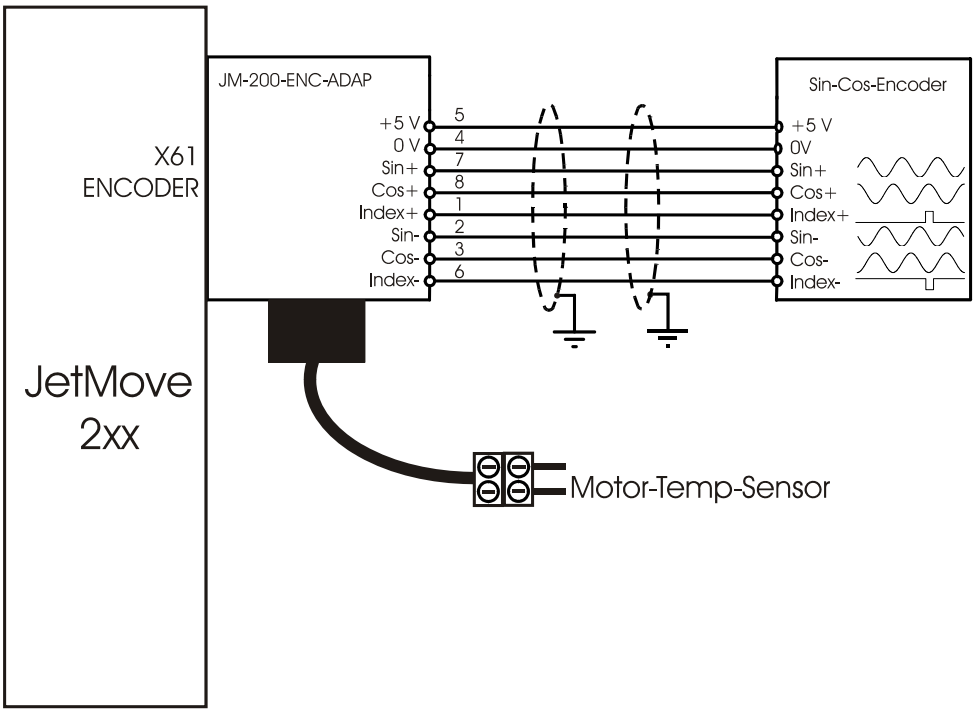
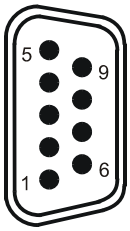
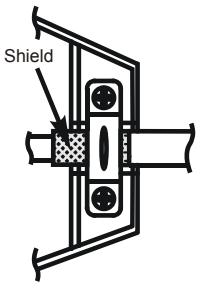


Fig. 14: Sin-cos encoder connection with adapter

Sin-Cos Encoder Cable	
JetMove 2xx (SUB-D connector X61) with Adapter JM-200-ENC-ADAP	**Shielding**
	
Screws must have a metric thread!	Connect shield with the greatest possible surface area! 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, commutation finding **always** has to be carried out after applying the logic power supply and before giving the first enable.
  If this is not considered, the motor might move uncontrollably.

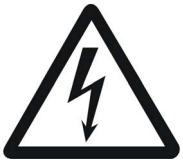
- The counting direction of the position in the JetMove 2xx is reversed in the following cases:
  Case 1: The signal sine+ is exchanged with the signal cosine+, and the signal reference sine is exchanged with the signal reference cosine
  Case 2: The signal sine is exchanged with the signal reference 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 must have a greater cross-sectional area.

- 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 External Ballast Resistor and DC Link Connection

Connection of External Ballast Resistor and DC Link Circuit of Another JM-215B-480	
Terminals X63	**Connector Pin Assignment**
U_B-	Negative pole of the DC link voltage
U_B+	Positive pole of the DC link voltage
BR_{int}	Connection with the internal ballast resistor (for this purpose, it must be connected with BR_c)
BR_c	Reference potential for the ballasting circuit



DANGER

Hazard caused by high operating voltage!

Extremely hazardous voltages of up to 850 V may occur!

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

A high DC link voltage is applied to each of the eight terminals X63!

Do **never** establish a connection to these terminals, while power is being supplied to the JetMove 215B-480 or up to 7 minutes after having separated the JetMove 215B-480 from the power supply.

Ballast System

When a mechanic system is braked by the motor, the energy will be given back to the servo amplifier. This energy is led to the ballast resistor to convert it into heat. The ballast resistor is switched into the DC link circuit by the ballast circuit.
The JetMove 215B-480 is supplied with an internal ballast resistor. If the power that is supplied back is too high for the internal resistor, an external ballast resistor can be added. It is also possible to run the JetMove 215B-480 with an external ballast resistor only.

Use of internal ballast resistor (delivered condition)

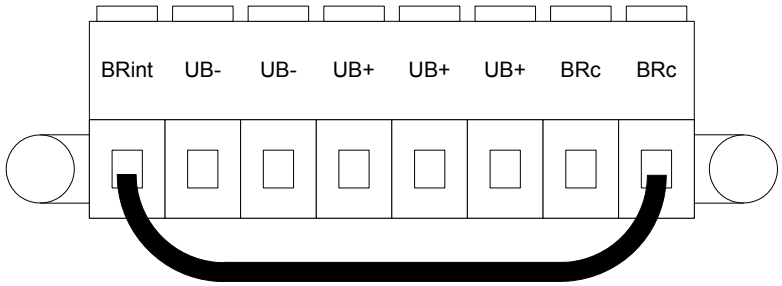


Fig. 15: Wiring of X63 for connecting the internal ballast resistor

For the use of the internal ballast resistor the terminal BRint and one BRc terminal of X63 have to be connected. This is the standard wiring of the JetMove 215B-480 in delivered condition by Jetter AG.

JetMove 215B-480 is measuring the load of the ballast resistor and sets a warning bit, if the ballast load reaches a specific value. If the resistor is overloaded, an error occurs (error F06).
In this case, an external ballast resistor has to be used.

Use of an external ballast resistor instead of the internal ballast resistor

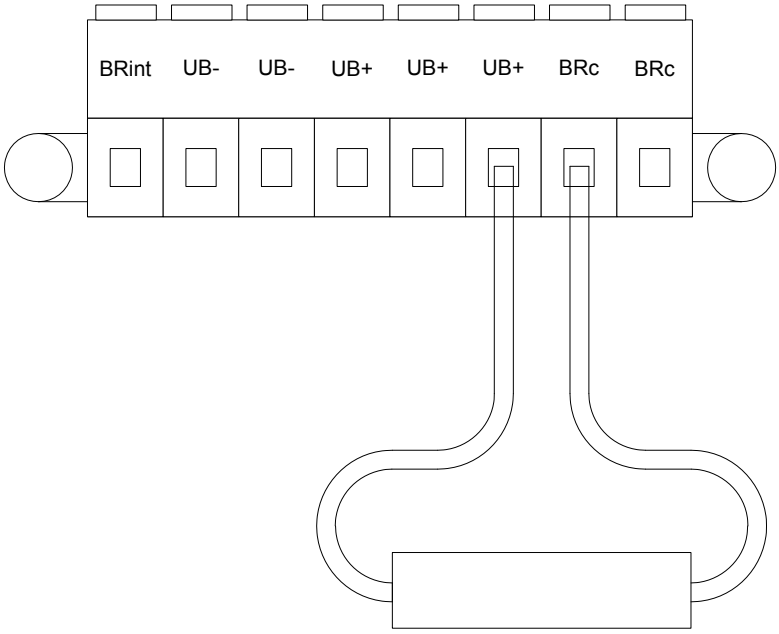


Fig. 16: Wiring of X63 for connecting the external ballast resistor

Mount the external ballast resistor between a terminal UB+ and a terminal BR_c.
Remove the bridge between BR_{int} and BR_c.

Parameters of the external ballast resistor

Value of the resistor:	50 Ω
Continuous output:	500 W or greater
Maximum capacity:	15 kW min. for 0.6 s
Type:	low inductivity

This configuration causes the energy dissipation to be approximately twice as high as it would be if configured with an internal resistor only.
In this resistor, internal overload monitoring is working the same way, as if the internal ballast resistor were being used.

If a still smaller external resistor is required for dissipating peaks of braking energy, the following minimum values have to be set for the resistor:

Value of the resistor:	32 min. Ω
Continuous output:	250 W min.
Maximum capacity:	21 kW min. for 0.6 s
Type:	Low inductivity

NOTICE

Please mind that, in this case, overload calculation in the servo amplifier will not be able to function properly any more. For this reason, error detection in this fault condition (F 06) has to be deactivated. Instead, overload monitoring has to be carried out externally at the braking resistor (e.g. by means of the thermal sensor).

Coupling DC Link Circuits of Two or Three JetMove 215B-480

Another way uf utilizing the braking energy of the motor is to couple the DC links of several JetMove 215B-480. In most cases, not all axes of a machine have to decelerate at the same time. This way, other axes can use the feedback energy for acceleration.
The coupling both reduces the heat inside the amplifier emitted by the ballast resistor and leads to higher dynamic performance, provided that not all axes accelerate at the same time.

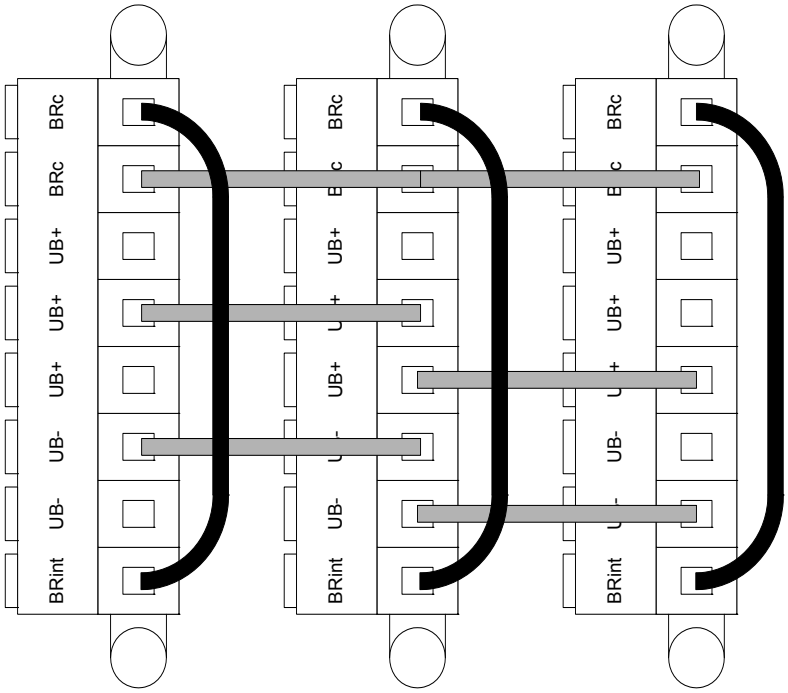


Fig. 17: Wiring of X63 for coupling DC links of up to three JetMove 215B-480

Coupling DC links guarantees equal distribution of load for all internal ballast resistors. A special ballast circuit ensures that the braking energy which is not used by another amplifier is equally distributed among all ballast resistors.

NOTICE

Requirements on the coupling of DC link circuits:

- Before connecting a coupled JetMove 215B-480, completely connect all wires of X63.
  Otherwise the device could be damaged!
- Do not couple more than three JetMove 215B-480.

- Do not couple the JetMove 215B-480 with other amplifier types.
- Do not enable the other JetMove 215B-480 devices, if one of the coupled devices is not ready for operation.
- The power supplies of coupled JetMove 215B-480 must be activated and deactivated simultaneously.
  For this reason, connect the supply lines of the coupled JetMove 215B-480 with identical contactors and fuses, as well as identical cable cross-sectional areas and cable lengths (difference < 0.5 m).
- The minimum cable size for a DC link coupling is 4 mm² (AWG 12).
- The maximum cable length between two JetMove 215B-480 devices is 0.5 m.

It is also possible to combine coupled DC links with external ballast resistors. In this case, it is important to use identical resistors and cables for all coupled JetMove 215B-480.

7.7 Digital Inputs, Logic Power Supply

Specification of terminal X10

- 10-pin spring tension terminal (type ZEC 1,0/10-ST-3,5)
- Cross-sectional area of the connecting cable: 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			
Wiring Terminal X10	**Signal**	**Description**	**Specification**
ENABLE	Hardware enable for the power supply of the motor (input)	• A high signal at this input is necessary for the motor to be supplied (the power supply has to be connected before software enable). • A low signal de-energizes the motor immediately.	• DC 24 V • 7.5 mA max. • Operating point: < 6 V low, > 15 V high
REF	Reference switch (input)	• Depending on the parameter setting, this input is used for referencing.	• DC 24 V • 7.5 mA max. • Operating point: < 6 V low, > 15 V high 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 • 7.5 mA max. • Operating point: < 6 V low, > 15 V high NC or NO contact NC contact recommended
LIMIT -	Negative limit switch (input)	• Depending on the parameter setting, this input is used as a negative limit switch.	• DC 24 V • 7.5 mA max. • Operating point: < 6 V low, > 15 V high 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 • 7.5 mA max. • Operating point: < 6 V low, > 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	Power supply for the controller logic		DC 20 ... 28.8 V (I ≤ 0.6 A)
BRAKE 1	Braking relay contact Br1	Relay contact for motor holding brake The relay can be operated either by the control program or by the firmware of the JetMove 215B-480 at release of the motor current. **Important Note!** A free-wheeling diode is necessary if not integrated in the motor already. In Jetter motors, free-wheeling diodes have not been integrated! Recommended diode type: 1N4002	$V_{max.}$ = DC 30 V $I_{max.}$ = DC 2 A Contact: Type NO 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 GND of the control system

For connection diagram please refer to “Connection Diagrams", page 83.

7.8 Connection Details for Digital Outputs

Digital Outputs		
Terminals X31	**Signal**	**Specification**
DC 24 V	Power supply for the outputs	DC 20 ... 28.8 V at I = 2 A max. (0.5 A max. per output)
1 2 3 4	Digital output signals (PNP outputs)	For more information refer to “Digital outputs", page 38.
0 V	Common ground	Ground*)

*) is connected to the GND of the control system

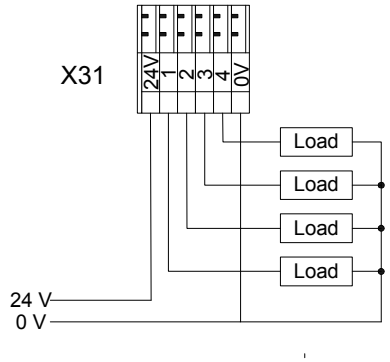


Fig. 18: Connection details for digital outputs

7.9 JX2 System Bus

The JX2 System Bus is used for connecting the JetMove 215B-480 to the PLC and to other JetMoves or Jetter PLC modules. The system bus input BUS-IN is a 9-pin SUB-D male connector, while the output BUS-OUT is a 9-pin SUB-D female connector.

7.9.1 Specifications of the JX2 System Bus cable

Specification of Connectors

BUS-OUT side (X19)
- 9-pin male SUB-D connector
- Metallized enclosure

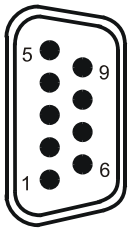
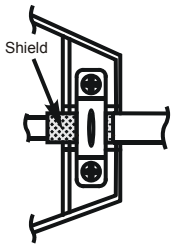
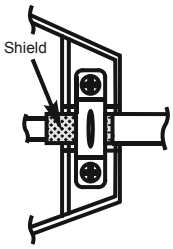
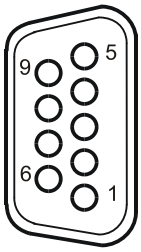
BUS-IN side (X18)
- 9-pin female SUB-D connector
- Metallized enclosure

System bus cable specification

For manufacturing a system bus cable, the following minimum requirements have to be considered:

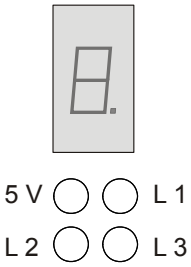
System Bus Cable - Technical Data		
Function	**Description**	
Core cross-sectional area	1 MBaud:	0.25 to 0.34 mm^2 (AWG 24 to 22)
	500 kBaud:	0.34 to 0.50 mm^2 (AWG 22 to 20)
	250 kBaud:	0.34 to 0.60 mm^2 (AWG 22 to 19)
	125 kBaud:	0.50 to 0.60 mm^2 (AWG 20 to 19)
Cable capacitance	Maximum 60 pF/m	
Resistivity	1 MBaud:	maximum 70 Ω/km
	500 kBaud:	maximum 60 Ω/km
	250 kBaud:	maximum 60 Ω/km
	125 kBaud:	maximum 60 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 - Cable Confection No. 530		
	Shielding	
	 	
BUS-OUT	Connect shield with the greatest possible surface area! 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.



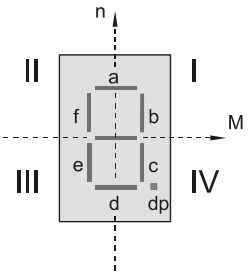
JetMove 215B-480 - LEDs		
LED	**Color**	**Description**
5 V	green	Logic module voltage is OK
L1	yellow	Axis is standing still (speed = 0)
L2	yellow	A voltage of 24 V is applied to the input of the positive limit switch (LIMIT+).
L3INFO	yellow	A voltage of 24 V is applied to the input of the negative limit switch (LIMIT-).

INFO

The 7-segment display of the output stage indicates the operating and fault conditions of the digital servo amplifier. The various display modes are set by the Motion Setup. Mode 0 (default) is used for normal operation and mode 1 for commissioning.

JetMove 215B-480 - 7-Segment Display 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 achieved after initialization and acknowledgement of errors. The drive controller can be switched on.
2	READY TO BE SWITCHED ON	Drive controller has been disabled by software command. The drive controller can be switched on.
3	SWITCHED ON	DC link monitoring is activated.
4	OPERATION_ENABLED	The drive controller is enabled.
7	QUICK STOP ACTIVATED	A quick stop has been activated. The drive was decelerated to n = 0 and then locked.

JetMove 215B-480 - 7-Segment Display Mode 0: Normal Operation		
Value	**State**	**Description**
E	ERROR REACTION ACTIVATED	A fault has been recognized. An adjustable error reaction may have been activated.
F	MALFUNCTION	The drive controller is locked, the error can be acknowledged.
F X. X.	ERROR NUMBER	Error number X. X. has occurred.
.	Flashing dot	Warning has been activated.
0.	Flashing "ZERO"	Boot sector has been activated.
C.	Flashing C	OS flash gets deleted.
E.	Flashing E	OS flash gets deleted.
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 215B-480 - 7-Segment Display Mode 1: Commissioning		
Value	**State**	**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 the case of an error message, the letter "F" and two successive numbers appear on the 7-segment display every second.

JetMove 215B-480 - Table of Motor Faults				
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 – Return the amplifier for repair
F 01	Internal power supply error	One or more power supply voltages are beyond their limits.	– Immediate motor power disable	– Separate the drive controller from the power lines – Return the amplifier for repair
F 02	Mains phase error	Failure of one of the mains phases.	– Immediate motor power disable	– Check fuses and wiring – Acknowledge failure
F 03	Motor cable breakage	The motor cable is broken. 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 – Acknowledge failure
F 04	Overvoltage in the DC link	A DC link voltage >850 V has been detected.	– Immediate motor power disable	– Check input power supply – If the motor is used as generator, reduce the regenerating power – Acknowledge failure

JetMove 215B-480 - Table of Motor Faults				
Error Number	**Type of Error**	**Description**	**Error Response**	**Troubleshooting**
F 05	Over-current	Output current was greater than 2.5 x rated current.	– Immediate motor power disable	– Check the motor for short circuit – Check motor cable for short circuit between lines or lines to earth – Check current control parameters. If necessary, correct parameters. – Acknowledge failure
F 06	Ballast resistor overload	The ballast resistor has been overloaded.	– Immediate motor power disable	– Let the amplifier cool down – When the motor has cooled down, acknowledge failure – Reduce regeneration power
F 07	Amplifier overtemperature	The amplifier has reached the maximum temperature.	– Immediate motor power disable	– Let the amplifier cool down – When the motor has cooled down, acknowledge failure – Reduce power of the motion system
F 08	Motor overtemperature	The motor has reached the maximum temperature. Also refer to “Built-in thermal sensor", page 40	– Immediate motor power disable	– Let the motor cool down – When the motor has cooled down, acknowledge failure – Reduce the average load of the motor
F 09	Encoder failure	Encoder breakage or initialization error	– Immediate motor power disable	– For extended diagnostics purposes use Motion Setup – Check the encoder line and all plug-in connections – 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 – Control the speed parameters. Change parameters if necessary – Acknowledge failure

JetMove 215B-480 - Table of Motor Faults				
Error Number	**Type of Error**	**Description**	**Error Response**	**Troubleshooting**
F 11	Current overrange	A current temporarily too high has been detected.	– Immediate motor power disable	– Reduce Kp of the current controller by 10 to 20 % – Acknowledge failure
F 12	Earth 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 – Acknowledge failure
F 13 (combined with F 00)	Internal checksum error	An internal checksum error has occurred.	– Immediate motor power disable	– Switch the 24 V supply off and on again – 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 – 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 – Acknowledge failure
F 16	Power input overcurrent	The current at the power input is too high.	– Immediate motor power disable	– Check input voltage – Reduce mechanical power of the motor – Acknowledge failure
F 17	Software limit switch has been actuated	Actual position is outside the programmed range and a software limit switch has tripped	– Stop at max. current (max. torque)	– Check target position – Acknowledge failure – Return the axis to a position within the software travel limits (monitoring of software limit switches is re-enabled automatically at entering this range)

JetMove 215B-480 - Table of Motor Faults				
Error Number	**Type of Error**	**Description**	**Error Response**	**Troubleshooting**
F 18	Hardware limit switch has been actuated	One hardware limit switch has tripped	– Stop at max. current (max. torque)	– Check target position – Check reference position – Acknowledge failure – 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 – Check parameter "U_{ZK} min. trip" – Acknowledge failure
F 21	Overvoltage DC link voltage	The DC link voltage has exceeded the set maximum value.	– Stop with emergency deceleration ramp	– Check the supply voltage – In generator operation, reduce braking power – Acknowledge failure
F 22	The drive has stalled	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 stalling – 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 error window time".	– Stop with emergency deceleration ramp	– Check the drive mechanism – Check steepness of acceleration/ deceleration ramps and amplifier parameters in relation to the parameters "tracking error limit" and "tracking error window time" – Acknowledge failure
F 24 (combined with F 01)	Error in 24 V supply voltage	The external 24 V supply has actually been lower than 18 V.	– Immediate motor power disable	– Check external power supply – Acknowledge failure

JetMove 215B-480 - Table of Motor Faults				
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 – Return the amplifier for repair
F 28	Error in power charging circuit	The input current limitation circuit is defective.	– Immediate motor power disable	– Note the fault number – Return the amplifier for repair
F 29	Mains power too high	The average mains power of the 400/480 V supply has been too high.	– Immediate motor power disable	– Acknowledge failure – 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. Refer to “I²t calculation", page 41.	– Immediate motor power disable	– Let the motor cool down – When the motor has cooled down, acknowledge failure – Check the configuration of nominal motor current, overload factor and motor time constant – Reduce the average load of the motor
F 31	Motor overload protection to UL	Average motor power dissipation has been higher than defined according to UL. See chapter 5.2.3 "Motor overload protection according to UL", page 42.	– Immediate motor power disable	– Let the motor cool down – Acknowledge failure – 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 – 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 – Check wiring or encoder signal – Acknowledge failure

JetMove 215B-480 - Table of Motor Faults				
Error Number	**Type of Error**	**Description**	**Error Response**	**Troubleshooting**
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 – 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
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 – Check the encoder

9.2 Alarms

If the dot in the display is flashing, one or several alarms have been recognized. Please check in the Motion Setup or by issuing the motion instructions in the controller program which alarm is active.

10 Connection Diagrams

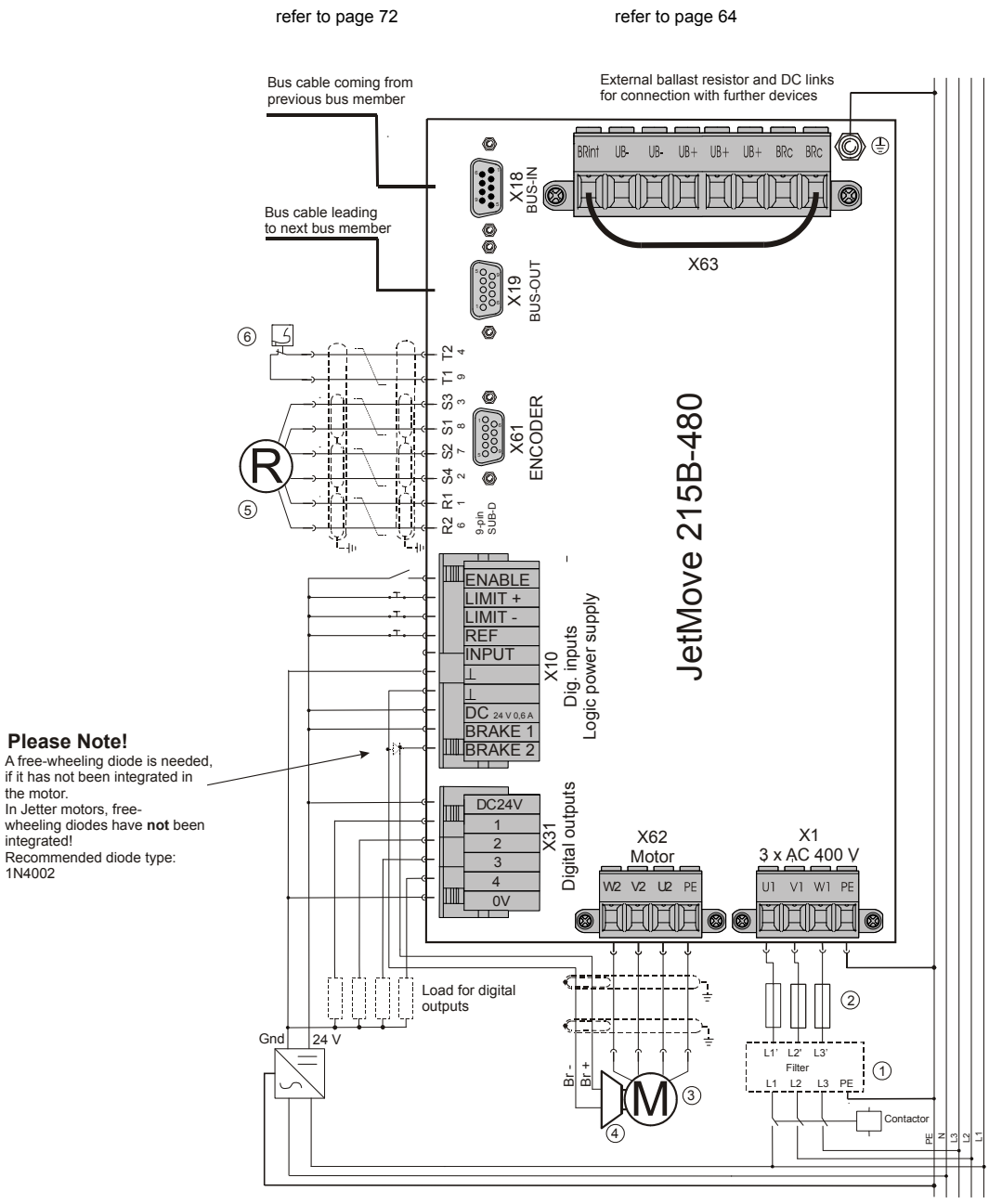


Fig. 19: Connection diagram of JetMove 215B-480 with resolver

refer to page 72 refer to page 64

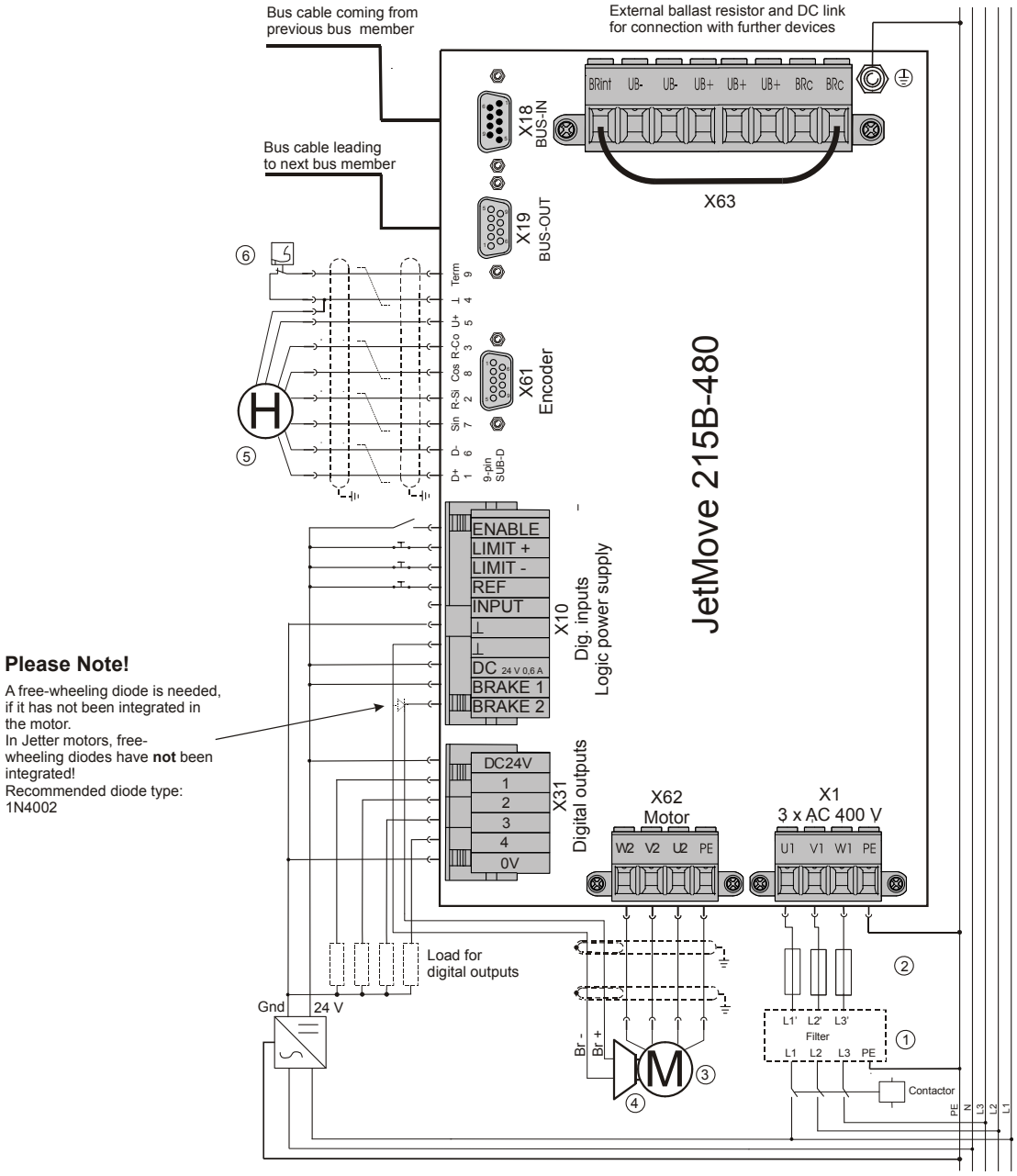


Fig. 20: Connection diagram of JetMove 215B-480 with HIPERFACE encoder

Key to the connection diagrams:

1	Line filter (optional) (refer to “Line filter" on page 37)
2	Mains protection (refer to “Overload protection" on page 36)
3	Motor
4	Motor holding brake (optional)
5	Resolver or HIPERFACE encoder
6	Motor overtemperature protection

11 Analog Input (Option)

11.1 Function

For the digital servo amplifier JetMove 215B-480, an optional integrated analog input card can be ordered (article designation of the device: JM-215B-480 ... -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. In this case, a pressure sensor in the machine connected to the analog input of the JetMove would deliver the actual pressure value to the control loop.

11.2 Technical Data

Technical Data - Analog Input	
Type of 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 Zero error Gain error	 max. ± 5 LSB (± 40 values), correspond to ± 12.2 mV max. ± 20 LSB (± 160 values), correspond to ± 48.8 mV

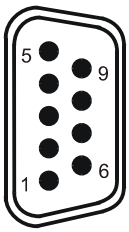
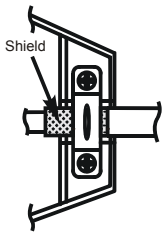
11.3 Description of Connections

Specification of Mating Connector for X72

- 9-pin female SUB-D connector
- Metallized enclosure

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 - Analog Input	
	Shielding
	
X72	Connect shield with the greatest possible surface area! 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 Function

For the JetMove 215B-480, an optional integrated Ethernet interface can be ordered (article designation of the device: JM-215B-480...-OEM). This allows for the JetMove 215B-480 to be addressed by the controller via Ethernet instead of the JX2 System Bus.

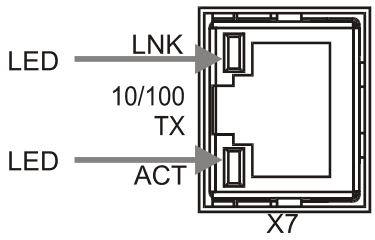
Functional Equipment	
1 Ethernet interface	10/100 MBit/s, TX
10-pin DIP switch for the lower 8 bits of the IP address and of various operating modes	RUN / STOP / LOAD
LED for status indication	RUN / ERR

12.2 Description of Connections

The digital servo amplifier JetMove 215B-480...-OEM 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 cables
- Crossover cables (transmitting and receiving lines are crossed)



The LEDs of the JetMove 215B-480...-OEM Ethernet	
Name	Function
ACT	Activity: The JetMove 215B-480...-OEM transmits or receives data via the Ethernet
LNK	Linkage: The JetMove 215B-480...-OEM is linked with the Ethernet

12.2.1 Connection between the JetMove 215B-480...-OEM and a PC or JetControl

Direct connection between a PC or JetControl and a JetMove 215B-480...-OEM is established by means of a crossover cable.

12.2.2 Connection between the JetMove 215-480...-OEM and a PC or JetControl through a switch

If connection between PC and JetControl and a JetMove 215B-480...-OEM is to be 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...-OEM
- etc.

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

- PC to switch
- JetControl to switch
- JetMove...-OEM 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, Switches

12.3.1 LEDs

Logic LEDs	
ERR (red)	Flashes shortly at initializing. 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 seen in register 10182.

.

Error Messages indicated by LEDs	
Following power-up the red LED (ERR) and the green LED (RUN) are flashing.	The switch is in LOAD position. Boot loader is running. 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 switch is in RUN or STOP position. Boot loader is running. There is no valid operating system of the Ethernet interface available.
The red LED (ERR) and the green LED (RUN) are flashing alternately 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 215B-480...-OEM. 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 boot process proceeds as far as to the initial program loader of the Ethernet interface
9 = ON	Reserved

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

12.4 Setting the IP Address

There are 4 ways to assign an IP address to a JetMove 215B-480...-OEM. The actually used IP address can be read from register 2931.

12.4.1 Default IP address

If, at activating the controller, DIP switches 1 through 8 are in "OFF" position, the JetMove 215B-480...-OEM 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 from the configuration memory

If, at activating the JetMove 215B-480...-OEM, 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

By no means ever 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

Registers	Meaning	Value Used in the Example
10138	Subnet mask 2SB	255
10139	Subnet mask LSB	0
10140	Default gateway MSB	192
10141	Default gateway 3SB	128
10142	Default gateway 2SB	10
10143	Default gateway LSB	1
10144	Port number of JetIP server	50000
10145	IP address of 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 read out of register 10180.

13 Safe Torque Off (Option)

For information on the "Safe Torque Off (STO)" option refer to the corresponding Function Description which can be downloaded from our homepage: https://www.jetter.de/en/downloads/motion-systems/jetmove-series/jetmove-2xx.html

jm-2xx_sto-option_fb_xxx_function_description

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

INFO

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

14 Counting Input (Option)

14.1 Function

For the digital servo amplifier JetMove 215B-480, an optional integrated counter card can be ordered (article designation of the device: JM-215B-480...-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
Baud 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 Mating Connector for X72

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

EnDat Cable Specification

- Cable size: 4 * 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 voltage 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 Jetter AG by specifying the part number 15100069.

The ready-made EnDat cable between servo amplifiers of the JetMove 2xx series and Jetter motors can be ordered from Jetter AG by specifying the following cable confection number:

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

HIPERFACE mating connector (solder side)

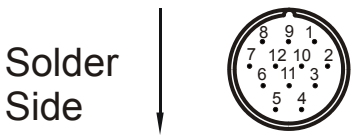
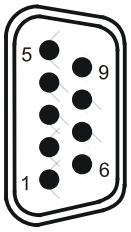
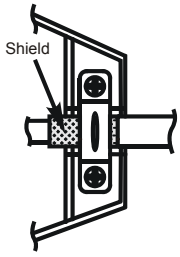
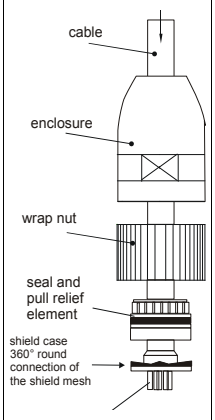
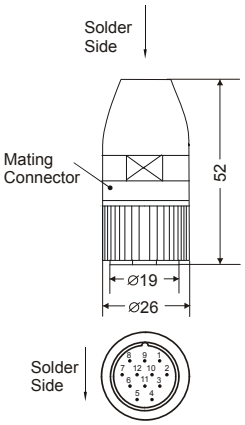


Fig. 31: View on RC series mating connector of the EnDat (internal thread M23)

EnDat Cable - KAY_0723-xxxx

JetMove 2xx (SUB-D male connector X72)	Shielding		Motor (EnDat) (female, solder side)
 Attaching screws must have a metric thread!	 5 * 2 * 0.25 mm^2		
	Connect shield with the greatest possible surface area! 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	yellow	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 Δ 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-sectional area:

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

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

By means of the instructions	ΔU :	Voltage drop in V
	I_n :	Current consumption by the measuring device in A
	A :	Cross-sectional areas section of the supply cable in mm^2
	l :	Cable length
	γ :	Electric conductivity (for copper: $56 \frac{m}{\Omega mm^2}$)

Example:
At a cable cross-sectional area of 0.34 mm^2, the maximum cable length is l = 54.74 m or - at a cable length of 80 m - the following cross-sectional area 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

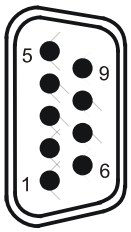
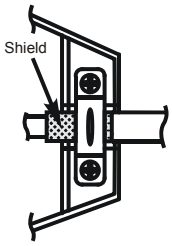
Specification of Mating Connector for X72

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

Specification of SSI Cable

- Cable size: 4 * 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 voltage 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 X72)	**Shielding**	**Specifications of the Cable**
		Encoder signal: 5 V differential signal Maximum cable length: 100 m
Attaching screws must have a metric thread!	Connect shield with the greatest possible surface area! Use metallized housing only!	
Pin	**Signal**	
1	Clock+	
2	DATA +	
3	do not use	
4	0 V	
5	Power supply 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 - 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

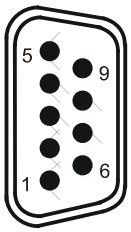
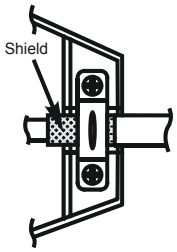
Specification of Mating Connector for X72

- 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 X72)	**Shielding**	**Specification of the Cable**
		Encoder signal: 5 V differential signal Maximum cable length: 100 m
Screws must have a metric thread!	Connect shield with the greatest possible surface area! Use metallized housing only!	
Pin	**Signal**	
1	K0 +	
2	K1 +	
3	K2 +	
4	0 V	
5	Power supply 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 our website at http://www.jetter.de for download.

Programming

jetmove_2xx_at_jetcontrol_bi_xxxx_user_information.pdf
User information on configuration and operation of the JetMove 2xx series at the JetControl 24x
Part # 60874950

jetmove_2xx_at_the_nano_bi_xxxx_user_information.pdf
User information on configuration and operation of the JetMove 2xx series at the NANO-B/C/D
Part # 60867325

15.2 Options

Designation	Ethernet Interface (Page 89)	Analog Input (Page 87)	Counting Input (Page 107)	Safe Torque Off (Page 95)
JM-215B-480				
JM-215B-480-OEM	✓			
JM-215B-480-IA1		✓		
JM-215B-480-CNT			✓	
JM-215B-480-S1				✓
JM-215B-480-OEM-IA1	✓	✓		
JM-215B-480-OEM-CNT	✓		✓	
JM-215B-480-OEM-S1	✓			✓
JM-215B-480-IA1-S1		✓		✓
JM-215B-480-CNT-S1			✓	✓
JM-215B-480-OEM-IA1-S1	✓	✓		✓
JM-215B-480-OEM-CNT-S1	✓		✓	✓

Appendix

Appendix A:Recent Revisions

Chapter	Comments	Revised	Added	Deleted
Introduction	Language of the original document		✓	
Whole document	Attention replaced by CAUTION Important replaced by NOTICE Note replaced by INFO	✓		
1.1.2	A servo amplifier as such is not a safety component. An exception is the STO feature in devices with option -S1		✓	
1.2.3	Information on damage to the device due to excessive tightening torque of the PE bolt		✓	
3	Danger notice in case of non-compliance with the operating parameters for devices with option -S1		✓	
3	Instructions for action after expiry of the maximum storage period		✓	
3	Note that this product may cause radio interference	✓		
3	Note on the quality of the Ethernet cable		✓	
3	Operating altitude	✓		
5	Tolerance of the power supply of the logics circuit	✓		
5.1	Hazard warning in case of non-compliance with the technical specification for devices with -S1 option		✓	
5.1	Overload protection for UL devices	✓		
5.1	Compatible servomotors. Reference to User Manual instead of Motor Catalog	✓		
5.1	Tolerance of power supply for control logic, digital inputs and digital outputs	✓		
6	Controller specification			✓
6	Function -> Controller type	✓		

Chapter	Comments	Revised	Added	Deleted
6	Meaning -> Specification	✓		
7.2.3	INFO 1	✓		
7.2.3	INFO 2	✓		
7.2.4	INFO 1	✓		
7.2.4	INFO 2	✓		
7.3.2	INFO 1	✓		
7.4.2	INFO 1	✓		
7.7	Function -> Description in table header	✓		
7.7	Specification in line „DC 24 V“ -> DC 20 ... 28.8 V (I < 0.6 A)	✓		
7.8	Specification in line „DC 24 V“ -> DC 20 ... 28.8 V at 2 A max.	✓		
7.9	Introduction the JX2 system bus	✓		
8	Color -> Value	✓		
9	Error F05: Check motor cable for short circuit		✓	
9	Error messages F43 ... F46		✓	
12.3.1	Table header „LED error messages“	✓		
13	Text on STO			✓
13	Link to separate document on STO for JM-2xx		✓	
14.2.3	INFO, first part	✓		
15.1	Link to Jetter AG homepage		✓	
App. C	Abbreviation JX2-SBK1			✓
Whole document	Safe Standstill -> Safe Torque Off (STO)	✓		
Whole document	Hand symbol: Important -> NOTICE	✓		
Whole document	Light bulb symbol: Note -> INFO	✓		
Whole document	Jetter System Bus -> JX2 System Bus	✓		
Whole document	Index entries	✓	✓	✓

Appendix B: Differences between JetMove 215-480 and JetMove 215B-480

The JetMove 215-480 servo amplifier has been developed further to become the servo amplifier JetMove 215B-480.
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 further grant interchangeability.

Automatic Encoder Recognition

The JetMove 215B-480 is not equipped with two varieties for different position transducers any more. (Earlier, the customer had to decide whether to order the JetMove 215-480-RE servo amplifier for the resolver input circuit or the servo amplifier JetMove 215-480-HI for the HIPERFACE input circuit.)
The JetMove 215B-480 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.

"Safe Torque Off" option

The JetMove 215B-480 can be ordered with "Safe Torque Off" (-S1) option.

Combining Internal and External Braking Resistor

The servo amplifier JetMove 215B-480 has been equipped with an intrinsically safe braking resistor. This means that combining an internal and external braking resistor does not make sense any more (see “External Ballast Resistor and DC Link Connection” on page 64).

NOTICE

The servo amplifier JM-215B-480 can only be operated with firmware versions 2.11.0.0 upwards. When older versions are used, the servo amplifier will issue an error message.

Appendix C: Glossary

Analog	A parameter, e.g. voltage, which is steplessly adjustable. Contrasted with digital.
Autotransformer	Transformer without electrical isolation between primary and secondary circuit.
Ballast resistor	Resistor converting into heat the energy fed back to the drive during rheostatic braking or braking operation.
Circuit-breaker	A circuit-breaker without monitoring function. Also known as automatic circuit-breaker.
DC link voltage	DC circuit within a servo drive on the basis of which the motor currents are generated.
Digital	Presentation of a parameter, e.g. time, in the form of characters or figures. This parameter in digital representation can be changed in given steps only. Contrasted with analog.
Electromagnetic Compatibility (EMC)	Definition according to the EMC regulations: "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."
Encoder	A feedback element that converts linear or rotary position (absolute or incremental) into a digital signal.
HIPERFACE	HIPERFACE designates a sensor-transducer system by SICK AG. The SinCos motor feedback system with the standardized HIPERFACE interface is often used in digital drive technology. Unlike the resolver, the SinCos motor feedback system with HIPERFACE interface contains electronic components.
Interference	(lat. interferre - to carry in) Superposition of waves.
JetMove 215B-480	JetMove 2xx identifies a product series of digital servo amplifiers by Jetter AG. The extension represents the following features: – 215 identifies a rated current of 15 A; – 480 identifies an operating voltage of 480 V max.
Earth-leakage current breaker (ELCB)	A protection device that is monitoring whether the sum of all currents flowing into a circuit and out of it is zero. If the limit is exceeded, the circuit will be de-energized.
Line filter	A filter installed in the mains to suppress radio-frequency interferences in the supply voltage.
Motor circuit-breaker	A circuit-breaker with monitoring functions of phases and temperature of a motor.
Primary circuit	Incoming circuit of a transformer.
Process	A program or a part of it. A related sequence of steps carried out by a program.

Register	A high-speed memory for a group of bits placed in a microprocessor or in another electronic device where data can be buffered for a specific purpose. On Jetter controllers, usually, these are 32 bit wide storage positions in a remanent RAM.
Resolver	Expansion to an electric motor to specify the position of the rotor. The resolver is a measuring system continually specifying the angle angular position of the rotor. The resolver itself does not contain any electronic components.
Secondary circuit	Output circuit of a transformer.
Sensor	Electronic detector, pick-up.

Appendix D: List of Abbreviations

AC	**A**lternating **C**urrent
cf.	cf. = see
DC V	**D**irect **C**urrent **V**oltage
e.g.	e.g. - Latin: exempli gratia
EMC	**E**lectro**M**agnetic **C**ompatibility
COI	**E**arth-**l**eakage **c**urrent **b**reaker Earth-leakage current breaker
GND (Ground)	**G**rou**nd**
HIPERFACE	**Hi**gh **Per**formance Inter**face**. Interface definition by SICK AG
Hz	Hertz
IEC	**I**nternational **E**lectrotechnical **C**ommissionInternational Electrotechnical Commission
IP	**I**nternational **P**rotectionDegree of protection
LED	**L**ight **E**mitting **D**iode
n	Speed
PE	**P**rotective **E**arth
PELV	**P**rotective **E**xtra **L**ow **V**oltage
PFC	**P**ower **F**actor **C**ontrol
P_V	Power loss
PWM	**P**ulse **W**idth **M**odulation
RS-485	**RS**: **R**ecommended **S**tandard - an accepted industry standard for serial data transmission. RS-485 is used for transmission distances over 15 m, two lines for differential mode evaluation; transmitting and sending on the same line.
SELV	**S**afe **E**xtra **L**ow **V**oltage: Voltage up to 60 V, galvanically separated from the network.
SUB-D	Type name of a plug-in connector
Temp	**Temp**erature
U	Symbol for voltage (electric potential difference)

Appendix E: Index of Illustrations

Appendix F: Index

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