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# User manual

JM-105 - Digital Servo Amplifier

60872838_03

Item # 60872838_03
Revision 3.00.2
October 2025 / Printed in Germany

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# This User Manual is an Integral Part of the JetMove 105:

Type: _____

Serial #: _____

Year of manufacture: _____

Order #: _____



To be entered by the customer:

Inventory #: _____

Place of operation: _____

# Significance of this User Manual

This operator's manual is an integral part of the digital servo amplifier JetMove 105 and

- must be kept in a way that it is always at hand until the the digital servo amplifier JetMove 105 will be disposed of.
- Pass this manual on if the digital servo amplifier JetMove 105 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.

This manual contains important information on how to transport, erect, install, operate, maintain and repair the digital servo amplifier JetMove 105.
Therefore, the persons carrying out these jobs must carefully read, understand and observe this manual, and especially the safety instructions.

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

# System Requirements

This user manual is giving a description of the servo amplifier JetMove 105 with operating system version 2.17.0.00.

# History

| Revision | Remarks |
|---|---|
| 2.12.2 | Original revision in English |
| 2.16.1 | Earthing, max. cable length, motor line reactor |
| 3.00.1 | Restructuring to Bucher Automation AG |
| 3.00.2 | Title photo with Bucher Automation.<br>New errors F43 - F45 |

# Description of Symbols



**Warning**

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.



**Important**

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.



**Note**

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. Further, this text provides helpful hints for your guidance through the manual.

# Contents


**1 Safety Instructions 11**

1.1 General Safety Instructions 11

1.1.1 Intended Conditions of Use 11
1.1.2 Usage Other Than Intended 11
1.1.3 Personnel Qualification 12
1.1.4 Modifications and Alterations to the Module 12
1.1.5 Repair and Maintenance 13
1.1.6 Disposal 13

1.2 Ensure Your Own Safety 14

1.2.1 Malfunctions 14
1.2.2 Information Signs and Labels 14
1.2.3 Earthing procedure 15

1.3 Residual Dangers 15

1.3.1 Hazards during Operation 15

1.4 Instructions on EMC 16

**2 Installing the JetMove 105 19**

2.1 Scope of delivery 19

2.2 Mechanical Installation 20

2.3 Electrical Installation 23

2.4 Checking the Installation 24

2.5 Notes on Safety as regards Commissioning 25

**3 Operating Conditions 26**

**4 Physical Dimensions 31**

**5 Technical Specifications 32**

5.1 Electrical Specification 32

5.2 Motor Protection 35

5.2.1 I²t Calculation 35

**6 Drive Controller Structure 37**

**7 Description of Connections 39**

7.1 Demands on the Power Supply Unit for Motor Operating Voltage39

7.1.1 Recommendations on the power supply circuit breaker +Vmot 40
7.1.2 General remarks 41
7.1.3 Recommendations on preventing overvoltage at braking or lowering a vertical load42

7.2 Power Supply 46

7.3 Servo Motor 48
7.3.1 Motor with male connector 50
7.3.2 Motor with screw clamping terminals and cables with male connectors50
7.3.3 Motor with screw clamping terminals and cables with male connectors51
7.3.4 Pre-fabricated motor cable with SC mating connector 52
7.3.5 Motor Cable Permanently Fixed to the Motor 55
7.4 Brush-Type DC Motor 57
7.5 2-Phase Stepper Motor 59
7.5.1 Stepper motor control 61
7.5.2 Acceleration and deceleration 63
7.6 LinMot® 64
7.7 Connection of the Resolver 67
7.7.1 Specification 67
7.7.2 Resolver Cable With Mating Connector 67
7.7.3 Resolver Cable Without Mating Connector 69
7.8 Sin- / Cos-Encoder Connection 70
7.8.1 Specification 70
7.9 Connection of the Incremental Encoder 73
7.9.1 Specification 73
7.10 Digital and Analog Inputs and Outputs 76
7.11 JX2 System Bus 78
7.11.1 JX2 System Bus Cable Specification 78
**8 Status Monitoring 80**
**9 Diagnostics 82**
9.1 Error Messages 82
9.2 Alarms 86
**10 Wiring Diagrams 87**
**11 Ordering Information 89**
11.1 List of Documentation 89
11.2 Device 89
11.3 Motor power cable with mating connector SC 90
11.4 Resolver Cable 91
11.5 System Bus Cable 91

# List of Appendices

Appendix A: Recent revisions 94
Appendix B: Glossary 95
Appendix C: List of Illustrations 98
Appendix D: Index 99

# 1 Safety Instructions

## 1.1 General Safety Instructions

The digital servo amplifier JetMove 105 meets the applicable safety regulations and standards. Special emphasis was given to the safety of the users.

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

### 1.1.1 Intended Conditions of Use

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

**The digital servo amplifier JetMove 105 may only be operated in the closed control cabinet and within the range of the set values, see chapter 5 "Technical Specifications", page 32.**
**Do not apply a voltage to the digital servo amplifier JetMove 105 that is higher than the specified operating voltage.**
The operating voltage for motor supply by the digital servo amplifier JetMove 105 ranges between 12 V and 48 V DC. Thus, the digital servo amplifier is not subject to the EG Low Voltage Directive.

**The servo amplifier JetMove 105 is for driving electric motors of various designs. The winding insulation of the motors must be higher than, or at least equal to, the DC link voltage supplied by the servo amplifier.**

The digital servo amplifier JetMove 105 is used to drive machinery, such as conveyors, production machines, and handling machines.

### 1.1.2 Usage Other Than Intended

**This digital servo amplifier must not be used in technical systems which to a high degree have to be fail-safe, e.g. ropeways and aeroplanes.**

**Do not use the integrated braking circuit in applications, where, in case of braking circuit failure, safety hazards can occur.**

**The servo amplifier JetMove 105 is not a safety-relevant device according to the machinery directive 2006/42/EG. Therefore, using this servo amplifier for safety-relevant applications as regards safety of persons is neither adequate nor permitted.**

If the digital servo amplifier JetMove 105 is to be run under operating conditions, which differ from the conditions mentioned in chapter 3 "Operating Conditions", page 26, the manufacturer must be contacted beforehand.

### 1.1.3 Personnel Qualification

Depending on the life cycle of the product, the persons involved must possess different qualifications. These demands have to be met, in order to grant safety in handling the JetMove 105 at each phase of the product life cycle.

| Product Life Cycle | Minimum Qualification |
|---|---|
| **Transport / Storage:** | Trained and instructed personnel with knowledge in handling electrostatic sensitive components. |
| **Mounting / Installation:** | Specialized personnel with training in electrical engineering, such as industrial electronics engineer. |
| **Commissioning / Programming:** | Trained and instructed experts with profound knowledge of, and experience with, electrical / drive engineering, such as electronics engineer for automation technology. |
| **Operation:** | Trained, instructed and assigned personnel with knowledge in operating electronic devices. |
| **Decommissioning:** | Specialized personnel with training in electrical engineering, such as industrial electronics technician. |

### 1.1.4 Modifications and Alterations to the Module

**Due to safety reasons, neither opening the digital servo amplifier JetMove 105, nor carrying out any modifications or alterations to the device and its functions is allowed.**
Any modifications to the servo amplifier JetMove 105 not expressly authorized by the manufacturer will result in a loss of any liability claims to Bucher Automation AG.

**The original parts are specifically designed for the servo amplifier JetMove 105. Parts and equipment from other manufacturers are not tested on our part, and are, therefore, not released by Bucher Automation AG.**
The installation of such parts may impair the safety and the proper functioning of the digital servo amplifier JetMove 105.

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

### 1.1.5 Repair and Maintenance

Repairs to the digital servo amplifier JetMove 105 must not be carried out by the operator. The servo amplifier JetMove 105 does not contain any parts to be repaired by the operator.
For being repaired, the servo amplifier JetMove 105 must be sent to Bucher Automation AG.

The digital servo amplifier JetMove 105 is maintenance-free. Therefore, absolutely no inspection or maintenance works are required for the operation of this device.

### 1.1.6 Disposal

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

When disposing of devices, the local environmental regulations must be complied with.

You can disassemble the digital servo amplifier JetMove 105 into its main components by unscrewing it (aluminum heat sink and side plate, steel casing cover, PCBs).

# 1.2 Ensure Your Own Safety



**Warning**

- Isolate the digital servo amplifier JetMove 105 from the mains, if maintenance works have to be carried out. By doing so, you will prevent accidents resulting from electric voltage and moving parts.
  Follow the information given in chapter 1.3 "Residual Dangers", page 15.
- Safety and protective devices, e.g. guards, must not in any case be shunted or by-passed.
- Prior to commissioning reattach dismantled protective equipment, such as guards, and check them for proper functioning.
- Prior to commissioning, the machine manufacturer shall conduct a hazard analysis for the machine and take appropriate measures to prevent personal injury and damage to property resulting from accidental movements.

## 1.2.1 Malfunctions

- **In the case of malfunctions or other faults, immediately separate the digital servo amplifier JetMove 105 from the mains.**
  Follow the information given in chapter 1.3 "Residual Dangers", page 15.
- Immediately report any malfunctions or other damages to the responsible person.
- Secure the servo amplifier JetMove 105 against misuse or accidental use.

## 1.2.2 Information Signs and Labels

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

### 1.2.3 Earthing procedure

- Screw the enclosure of the digital servo amplifier JetMove 105 down to a highly conducting, plane and earthed panel.
- Connect the earthing terminal (X1:PE) to an earth point of low impedance. Use a short line of a great cross-section.

## 1.3 Residual Dangers

### 1.3.1 Hazards during Operation

**WARNING! Hot Surfaces!**



**Warning**

During operation, the surfaces, respectively the heat sinks of the servo amplifier JetMove 105 can heat up. The left sidewall and the rear panel can reach temperatures of up to 85 °C.

- **Do not touch the left sidewall or rear panel of the servo amplifier JetMove 105 during operation and after switching off, while the device is still cooling down.**
- Make sure that no temperature-sensitive parts have been connected or fastened to the servo amplifier JetMove 105.

**DANGER in a potentially explosive atmosphere!**



**Warning**

- **Do not operate the digital servo amplifier JetMove 105 in a potentially explosive atmosphere.**



**Caution**

### DANGER of injuries caused by mechanic force!

The digital servo amplifier JetMove 105 drives a motor. This motor moves mechanic parts or sharp edges. Therefore, failure or malfunctioning of the digital servo amplifier JetMove 105 can be dangerous for persons or damage the machinery. This should be prevented by installing additional safety devices.

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

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



**Warning**

Do not remove any guards.

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

**Never touch a rotating drive shaft.**

**Do not touch the motor during or after operation:**
Temperatures can reach as high as 140 °C.

# 1.4 Instructions on EMC

The digital servo amplifier JetMove 105 is intended for use in industrial environment. It may cause radio interferences when used in residential areas. It is operated at the operator's own risk.

The electromagnetic 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.



**Important!**

Measures for increasing EMC in electric plants:

Earth the device adequately according to chapter 1.2.3 "Earthing procedure", page 15.

- Connect the motor cable. If applicable, an optional PE bus must be near the servo amplifier. Shield cables on both ends.

- If a motor power cable is used which includes cores for brake control, the brake control cores must be separately shielded. The shielding braid must be connected on both ends of the cables.

- Follow the instructions given in Application Note 016 "EMC-Compatible Installation of the Electric Cabinet" published by Bucher Automation AG.

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

- Screw the enclosure of the digital servo amplifier JetMove 105 down to a highly conducting, plane and earthed panel.

- Keep signal and power lines **physically separated**. 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.

- **Both ends** of the cable must be shielded.

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

- The **entire** shield must be drawn behind the isolation, and then be clamped under an earthed strain relief with the **greatest possible surface area**.

**When male connectors are used:**

- The shield (impedance shielding) **must**, in its entire perimeter, be drawn behind the shielding clamp of the metallized connector housing, respectively of the EMC gland bushing, its greatest possible surface area being clamped under the strain relief of the JetMove 105.

- 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. 1).

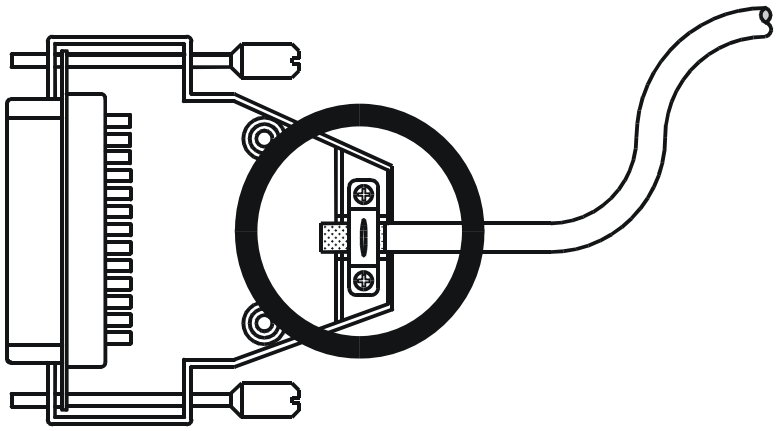


**Fig. 1: Shielding of SUB-D connectors in conformity with EMC standards**

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

It is important that shield and strain relief are highly conductive and directly connected to a grounded surface with the greatest possible surface area. When doing so, grounding must be implemented in a way that the unshielded portion of the cable is as short as possible (refer to Fig. 2).

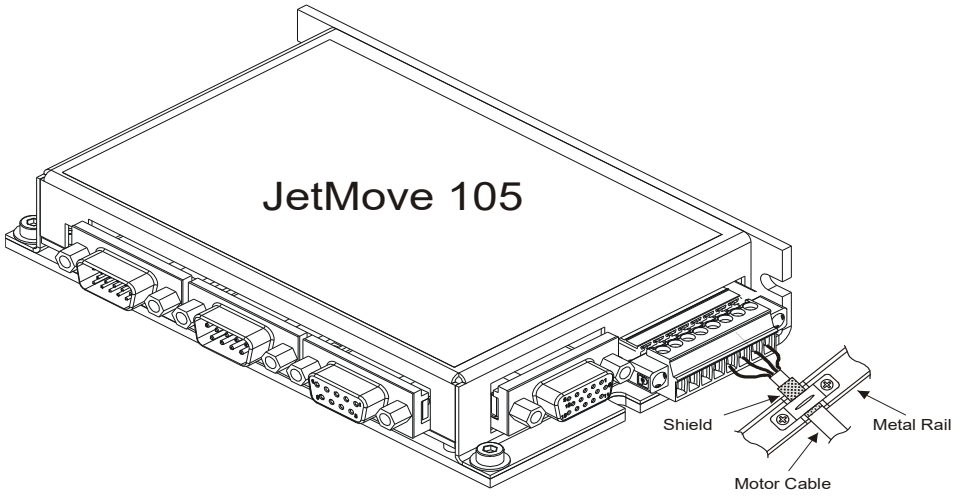



**Fig. 2: Shielding of screw terminals to EMC standards**

# 2 Installing the JetMove 105

## 2.1 Scope of delivery

- Digital servo amplifier JetMove 105
- Mating connector plugged-on
- User Manual

## Accessories

**The accessories are not part of the scope of delivery!**

- System bus cable of cable confection no. 530 x.x m; length: 0.2 m through 5.0 m See also chapter 7 "Description of Connections", page 39.
- Motor power cable, see also chapter 7.3 "Servo Motor", page 48.
- Encoder cable, see also chapter 7.7 "Connection of the Resolver", page 67.
- Motors, e.g. synchronous servo motors of the BucherBucher Automation motor series JL1 or JH2.
- DC power supply unit
- Ballast Resistor



**Note!**

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

# 2.2 Mechanical Installation

- Prior to installing the digital servo amplifier check it for possible transport damages.
- Please check the shipment for completeness.
- To ensure proper functioning of the JetMove 105, check whether the mounting plate in the electric cabinet is unpainted.
- The JetMove 105 has been designed for natural convection. Mount the JetMove in horizontal orientation (label on top) or vertical orientation (motor line below). In both cases, make sure there is a clearance of 25 mm between the JetMove and adjacent devices (see Fig. 4, page 22).
- Make sure there is a clearance of at least 25 mm under and above the JetMove 105 - unobstructed ventilation must be granted.
- Mark on the panel two positions for the fastening screw threads of the JetMove 105 (see Fig. 4, page 22).
- Drill the holes and cut the respective threads (M4) into the panel.
- Screw the lower fitting screws into the thread by approximately half of their length.
- By means of the oblong holes in the rear plate, hang up the JetMove 105 by the fitting screws; then screw them down tightly.
- Screw down the upper fitting screws.

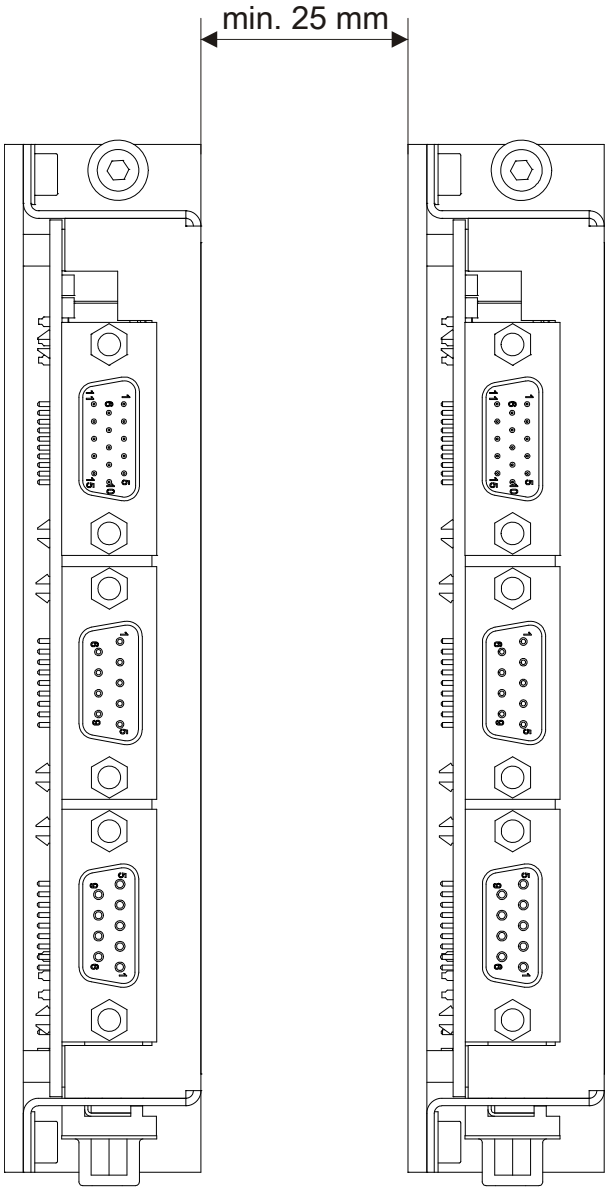



**Fig. 3: Recommended mounting**

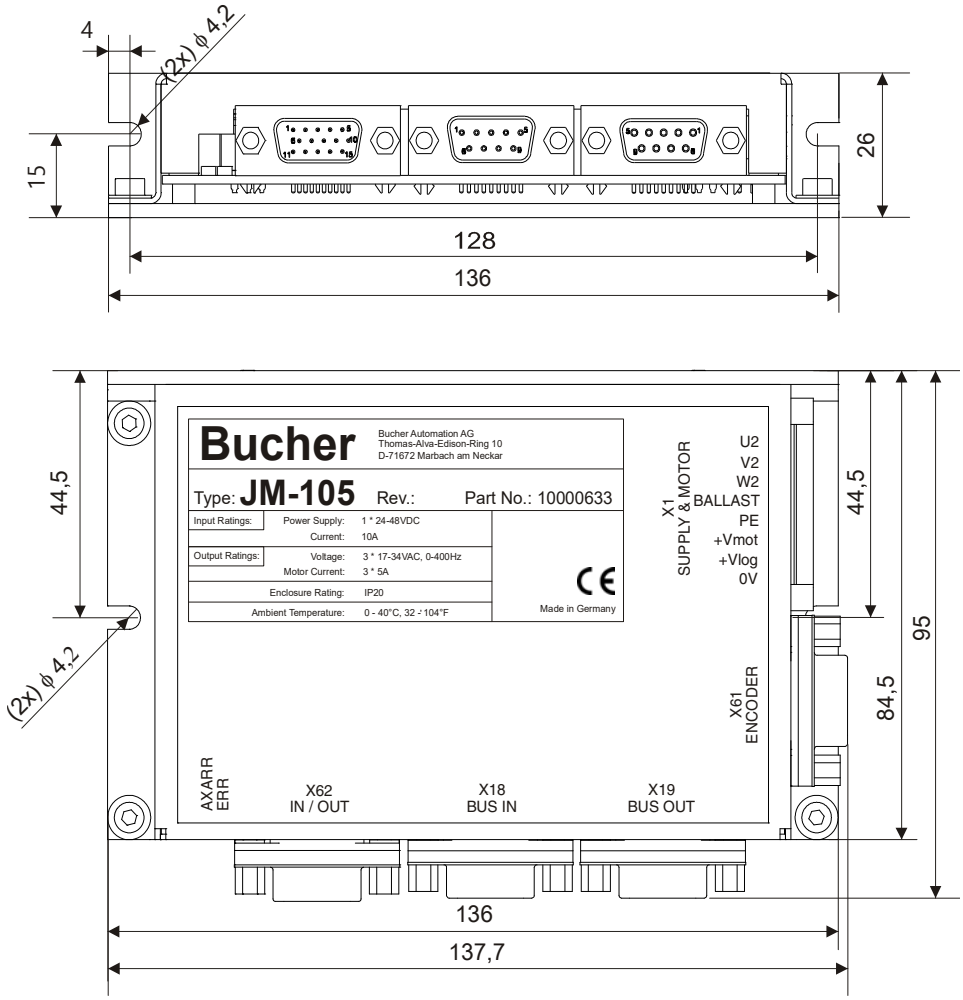



**Fig. 4: Mounting holes in the enclosure**

# 2.3 Electrical Installation

- Check the assignments of servo amplifier and motor.
- Compare rated voltage and continuous rated current of servo amplifier and motor.
  The motor must be isolated against voltages of DC 100 V min.; also refer to “Compatible Synchronous Servo Motors” on page 34.
- Connect the JetMove 105 according to the wiring diagram shown in chapter 10 "Wiring Diagrams", page 87.
  Especially check the mains lines for appropriate protection, see “Usage of short-circuit breakers when several JetMove 105 are connected.” on page 88.
  Protecting the motor cables is not advisable.
- Select the cables according to standards.
- Check whether the ground cable is connected.
- To connect resolvers or power units you can use prefabricated cables available from Bucher or opt for self-made cables. Please refer to chapter 7 "Description of Connections", page 39.
- To ensure that installation is carried out in conformance with EMC regulations, the following items have to be observed especially:
  – Please ground the 0 V line as closely to the motor power supply unit as possible.
  – If possible, do not run the controller cable together with the power supply and motor cable;
  – Connect the position transducer;
  – Use shielded terminals or EMC-compatible connectors;
  – Connect holding brake, if available, and connect shields on both sides of the cables;
  – Connect the motor leads according to fig. 2, page 18.

  Please further note the chapter 1.4 "Instructions on EMC", page 16.

# 2.4 Checking the Installation

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

# 2.5 Notes on Safety as regards Commissioning

➢ Have commissioning jobs carried out by qualified personnel only, see chapter 1.1.3 "Personnel Qualification", page 12.

**Prior to commissioning, please do the following:**

➢ Reattach dismantled protective equipment and check it for proper functioning.
This way, protection from moving parts of the machine will be achieved.

➢ Secure the servo amplifier JetMove 105 against accidental contact with conductive parts and components.

➢ Only connect devices or electrical components to the signal lines of the digital servo amplifier JetMove 105 (Enable, Limit+/-, REF, BRAKE) that have been sufficiently isolated from the mains circuit. These signal lines may only be connected with units that have got the ground potential of the $+V_{LOG}$ power supply.

➢ Accordingly, do only connect encoders with the servo amplifier, if they have been sufficiently isolated from the connected mains and motor power supply.

➢ Always carry out each commissioning, even a short functional test, with correctly connected PE bus;

# 3 Operating Conditions

| Operating Parameters Power Rating | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Power rating | Power section at X1:+Vmot<br>24 / 48 V DC (12 ... 48 V DC)<br>SELV or PELV<br>$I_{max.}$ = 27.5 A<br><br>Logic section at X1:+Vlog<br>24 V DC (12 ... 40 V DC)<br>SELV or PELV<br>$I_{max.}$= 250 mA at 24 V | |
| Fluctuations of power supply | Voltage dips<br>3 ms max. | |

| Operating Parameters Environment | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Environmental conditions | Temperature:<br>0 °C to +40 °C (+40 °C to +50 °C: Derating 2.5 %/K)<br>Air humidity:<br>5 % to 85 %, non-condensing<br>Make sure the control cabinet is being cooled sufficiently. | DIN EN 50178 |
| Storage conditions (units within packing) | Temperature: -25 °C bis +55 °C, maximum fluctuation: 20 K/h<br>Air humidity:<br>5 % to 95 %, non-condensing<br>Maximum storage period:<br>< 1 year without restrictions | DIN EN 50178 |
| Transport conditions (units within packing) | Temperature: -25 °C to +70 °C<br>Air humidity:<br>5 % to 95 %, 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, alkaline solutions, corrosive agents, salts, metal vapors, or other corrosive or electroconductive contaminants | - |
| Max. operating altitude | Up to 1,000 m above sea level.<br>From 1,000 to 2,500 m above sea level: derating of 1.5% per 100 m increase in alitude | DIN EN 50178 |

| Operating Parameters Mechanical Parameters | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Free Falls Withstanding Test | Within original packing, the device withstands dropping over all of its edges | DIN EN 50178<br>DIN EN 60068-2-31 |
| Vibration resistance | • 10 Hz ... 57 Hz: 0.075 mm amplitude<br>• 57 Hz ... 150 Hz: 1 g acceleration:<br>• 1 octave per minute, 10 frequency sweeps (sinusoidal), all three spatial axes | DIN EN 50178<br>DIN EN 60068-2-6 |
| Degree of protection | IP20 | DIN EN 60529 |
| Mounting Orientation | Vertical or horizontal<br>Please make sure there is a clearance of at least 25 mm under and above the JetMove - sufficient ventilation must be granted. | |

**Important!**

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 Mechanical Parameters” on page 27 are kept to.

| Operating Parameters Electrical Safety | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Protection Class | III | DIN EN 61800-5-1 |
| Dielectric strength | Protective network conductor and network logics: 380 V DC, 5 s | DIN EN 61800-5-1 |
| Isolation | Protective network conductor and network logics: > 1 MΩ at 500 V | DIN EN 61800-5-1 |
| Protective Connection | < 60 V, 25 A, 0.1 Ω | DIN EN 61800-5-1 |
| Overvoltage category | I | DIN EN 61800-5-1<br>DIN EN 50178<br>DIN VDE 0110-1<br>UL 508C |

| Operating Parameters<br>EMC - Emitted Interference | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Enclosure | • Frequency range<br>30 ... 230 MHz, limit 50 dB (µV/m) at 3 m<br>• Frequency range<br>230 ... 1000 MHz, limit 57 dB (µV/m) at 3 m<br>(1st environment, cat. 2 installation) | DIN EN 61800-3 |
| Signal and control line connections, DC voltage supply inputs and outputs | • Frequency bands<br>0.15 to 0.5 MHz, limit 79 dB (µV)*<br>• Frequency bands<br>0.5 to 30 MHz, limit 73 dB (µV),<br>(1st environment, cat. 2 installation) | DIN EN 61800-3 |



**NOTICE**



This is a product of restricted availability according to IEC/EN 61800-3. This module can cause radio interferences in residential areas. In this case, the user must take adequate measures to prevent this.



If this product is used in a residential environment, take appropriate measures. One of the measures is to use additional line filters.

| Operating Parameters<br>EMC - Immunity to Interference<br>Enclosure | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| ESD | Discharge through air:<br>Test peak voltage 8 kV<br>Contact Discharge:<br>Test peak voltage 4 kV<br>Acceptance criterion B | DIN EN 61800-3<br>DIN EN 61000-4-2 |
| RF Field amplitude-modulated | Frequency band 80 ... 1000 MHz;<br>test field strength 10 V/m<br>AM 80 % with 1 kHz<br>Acceptance criterion A | DIN EN 61800-3<br>DIN EN 61000-4-3 |

| Operating Parameters<br>EMC - Immunity to Interference<br>Power Connections | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Burst (fast transients) | Test voltage 2 kV<br>Repetition rate 5 kHz<br>Acceptance criterion B<br>($2^{nd}$ environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-4 |
| Impulse voltages | tr/th 1.2/50 µs, 8/20 µs<br>1 kV (phase to phase)<br>2 kV (phase to ground)<br>Acceptance criterion B<br>($2^{nd}$ environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-5 |
| Guided radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 10 V<br>AM 80 % with 1 kHz<br>Acceptance criterion A<br>($2^{nd}$ environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-6 |

| Operating Parameters<br>EMC - Immunity to Interference<br>Power interfaces | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Burst (fast transients) | Test voltage 2 kV<br>Repetition rate 5 kHz<br>Capacitive interference<br>Acceptance criterion B<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-4 |

| Operating Parameters<br>EMC - Immunity to Interference<br>Signal interfaces | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Burst (fast transients) | Test voltage 1 kV<br>Repetition rate 5 kHz<br>Capacitive interference<br>Acceptance criterion B<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-4 |
| Guided radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 10 V<br>AM 80 % with 1 kHz<br>Acceptance criterion A<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-6 |

| Operating Parameters<br>EMC - Immunity to Interference<br>Measuring and Control Lines in Process Environments | | |
|---|---|---|
| **Parameter** | **Value(s)** | **Reference Standard** |
| Burst (fast transients) | Test voltage 2 kV<br>Repetition rate 5 kHz<br>Capacitive interference<br>Acceptance criterion B<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-4 |
| Impulse voltages | tr/th 1.2/50 µs, 8/20 µs<br>1 kV (phase to ground)<br>Acceptance criterion B<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-5 |
| Guided radio disturbances | Frequency 0.15 ... 80 MHz<br>Test voltage 3 V<br>AM 80 % with 1 kHz<br>Acceptance criterion A<br>(2nd environment, cat. 3 installation) | DIN EN 61800-3<br>DIN EN 61000-4-6 |

# 4 Physical Dimensions

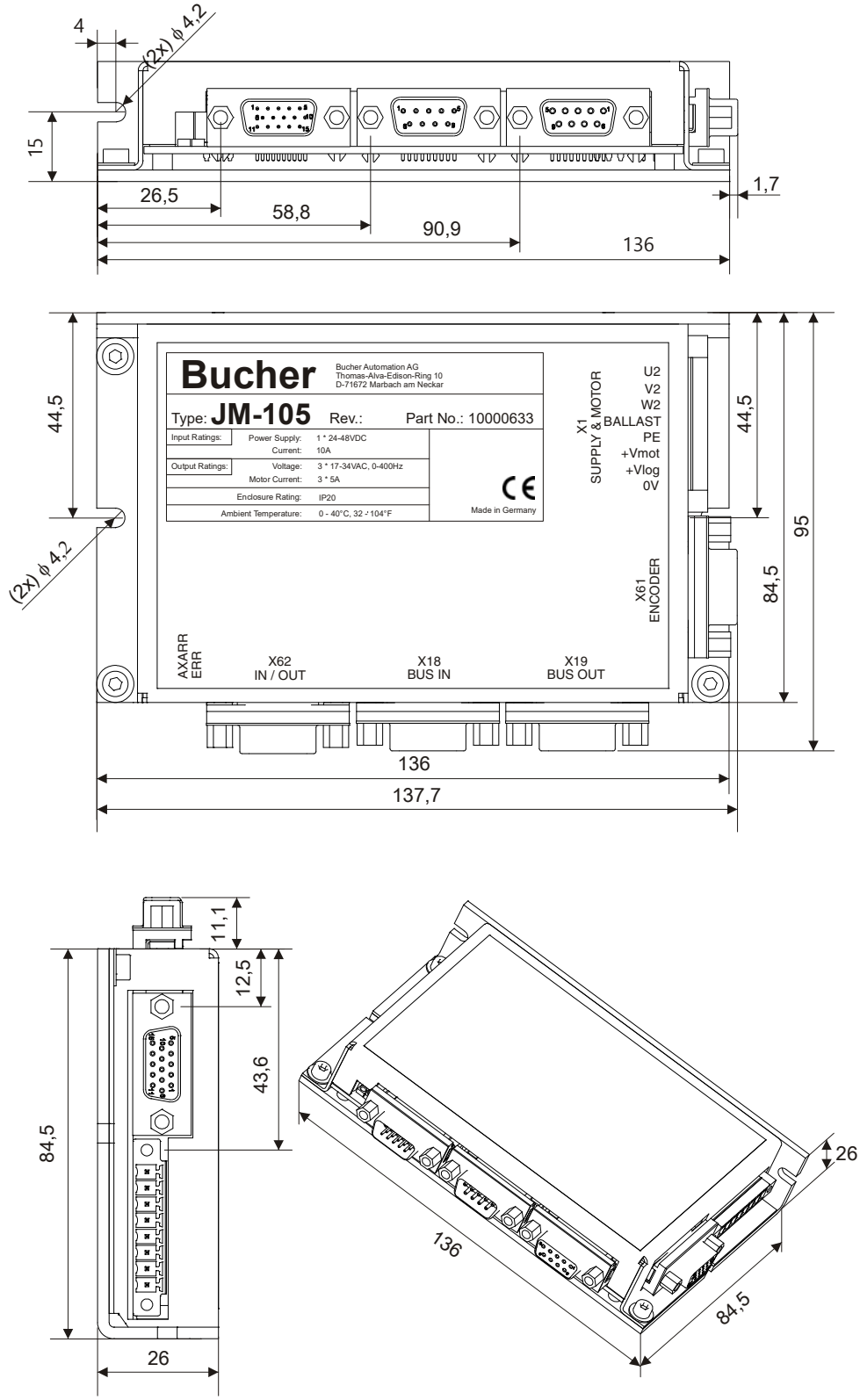



**Fig. 5: Physical Dimensions - JetMove 105**

For more information on installation, please also refer to fig. 3 on page 21

# 5 Technical Specifications

## 5.1 Electrical Specification

| Electrical Specification | |
|---|---|
| Rated voltage supply | • 24 / 48 V DC (12 ... 48 V DC)<br>$I_{max.}$ = 27.5 A<br>• The voltage output has to comply with the power supply unit of the SELV or PELV type. |
| Inrush current limitation | The JM-105 is equipped with an internal 200 µF capacitors for buffering.<br>The inrush current is not limited.<br>See "Recommendations on the power supply circuit breaker +Vmot" on page 40. |
| Supply cable<br>Cable size<br>Material<br>Temperature class | <br>1.0 $mm^2$ min.<br>Copper<br>> 60 °C |
| Max. output voltage of the motor | 60 V |
| Motor output current at an ambient temperature of 40 °C | Nominal current: $I_{eff}$ = 8 A<br>Peak current: $I_{eff}$ = 16 A (t <= 10 s at T < 40°C)<br><br>**See "Note 1!" on page 34.** |
| Continuous output | 384 W |
| Short-circuit protection, motor side | Designed for<br>• phase to phase<br>• phase to 0 V or ground |
| Motor overload protection | See "Motor Protection" on page 35. |
| Motor inductivity | 125 µH min. between any two motor lines |
| Motor cable<br>Cable size<br>Material<br>Capacity<br>Temperature class<br>Maximum length | <br>4 * 0.75 $mm^2$ min. (AWG 18)<br>Copper<br>< 150 pF/m<br>> 60 °C<br>maximum line length is 25 m<br>(for greater length please contact Bucher Automation AG) |
| Ballast resistor | An internal ballast resistor has not been installed. If the DC link voltage increases too much at decelerating the motor, install an external ballast resistor. |

| Electrical Specification | |
|---|---|
| Residual voltage | The DC link voltage is discharged within 10 seconds at switching off the device. |
| Leakage current | < 0.1 mA at a cable length of 3 m.<br>The leakage current increases at increasing cable length.<br>The 0 V connection is connected to earth by a resistor of 400 kΩ and a capacitor of 75 nF. |
| Voltage supply of processor logics (demands on power supply module) | • 24 V DC (12 ... 40 V)<br>250 mA at 24 V<br>Additonally: 500 mA for digital output<br>Additonally: 300 mA for encoder supply at X61<br>• The voltage output has to comply with the power supply unit of the SELV or PELV type. |
| Inrush current limitation of the processor logics | The JM-105 is equipped with an internal 200 µF capacitors for buffering.<br>The inrush current is not limited. |
| Enable1/2,<br>reference switch (REF),<br>positive limit switch (Limit+),<br>negative limit switch (Limit-),<br>and Input (Inp) | • DC 24 V (14 ... 32 V) related to the controller potential<br>• Input current of 8 mA max. each<br>• Refer to: chapter 7.10 "Digital and Analog Inputs and Outputs", page 76 |
| Brake circuit (X62:2) | Can be switched by the application program of the PLC or automatically at enable of the motor current.<br>24 V DC ($+V_{log}$ - 0.5 V)<br>$I_{max.}$ = 0.5 A<br>Contact: Semiconductor switch (NOC with integrated free-wheeling diode and short-circuit monitoring)<br>Connect this pin only to devices that are related to the same potential as the power supply of the controller logic. |
| Encoder supply (X61:1 and 6) | • Encoder supply voltage:<br>5 V DC +/-5 %, max. 350 mA<br>• Encoder supply voltage:<br>24 V DC ($+Vl_{og}$ - 0.5 V), max. 300 mA |
| Resolver inputs | • Resolver excitation: 8 Vpp<br>• Frequency: 8 kHz<br>• Input impedance: 30 kΩ |
| SinCos encoder inputs | • 1 Vpp differential signals<br>• max. frequency:<br>analog 450 kHz, digital 5 MHz<br>• Input impedance: 30 kΩ |

| Electrical Specification | |
|---|---|
| Incremental encoder inputs | • 5 V differential signals (RS-422) or 5 V single-ended<br>• max. frequency: 8 MHz, min. pulse duration 50 ns<br>• Input impedance: 15 kΩ |
| Analog input | • 1 differential channel<br>• 12-bit resolution<br>• Voltage range 0 ... 10 V<br>• Value range 0 ... 32767 (in steps of 8)<br>• Sampling interval 2ms<br>• Input impedance 20 kΩ |
| Power loss $P_v$ | • Amplifier at rated output: typically 24 W, 36 W max.<br>• Logic circuit: 6 W max. |
| Weight (mating connectors included) | • 500 g |



**Note 1!**

**Cooling:**
- The overtemperature protection trips at 85 °C
- The overtemperature alarm is activated at 80 °C

| Compatible Synchronous Servo Motors | |
|---|---|
| Motor types | Bucher motors of the JL1 and JH2 series. Please refer to "Bucher Motor Catalog" or contact the sales department of Bucher Automation AG. |



**Note!**

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

# 5.2 Motor Protection

## 5.2.1 I²t Calculation

The digital servo amplifierJetMove 105 calculates the model of motor power dissipation by an I²t calculation. The calculated value is a measure of the average power dissipation of the motor. It is calculated in percent of the maximum motor power dissipation.
For this calculation it is important, that the parameters are entered correctly:
– Nominal current (which is the minimum of nominal motor current and nominal servo amplifier current),
– 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 105 through JetSym or the PLC.

The digital servo amplifier JetMove 105 calculates the percentage of motor power loss according to the following formula:

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

| | |
|---|---|
| x(t) = | Displayed value of the 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 trip (x = 100 %) is a result of the following formula:

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

After reset, the values of the important parameters are:

| | |
|---|---|
| Nominal current: | 8 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 16 A for about 8 minutes and 30 seconds.



**Important**

Because of the fact that after reset the $I^2t$ calculation always starts with zero, the motor overload calculation is wrong if the motor is already hot when the digital servo amplifier JetMove 105 is switched on (i. e. at the time of parameters of $I^2t$ calculation are written after switching on 24 V logic power supply).
For this reason, please wait, until the motor has cooled down before re-enabling the axis.

# 6 Drive Controller Structure

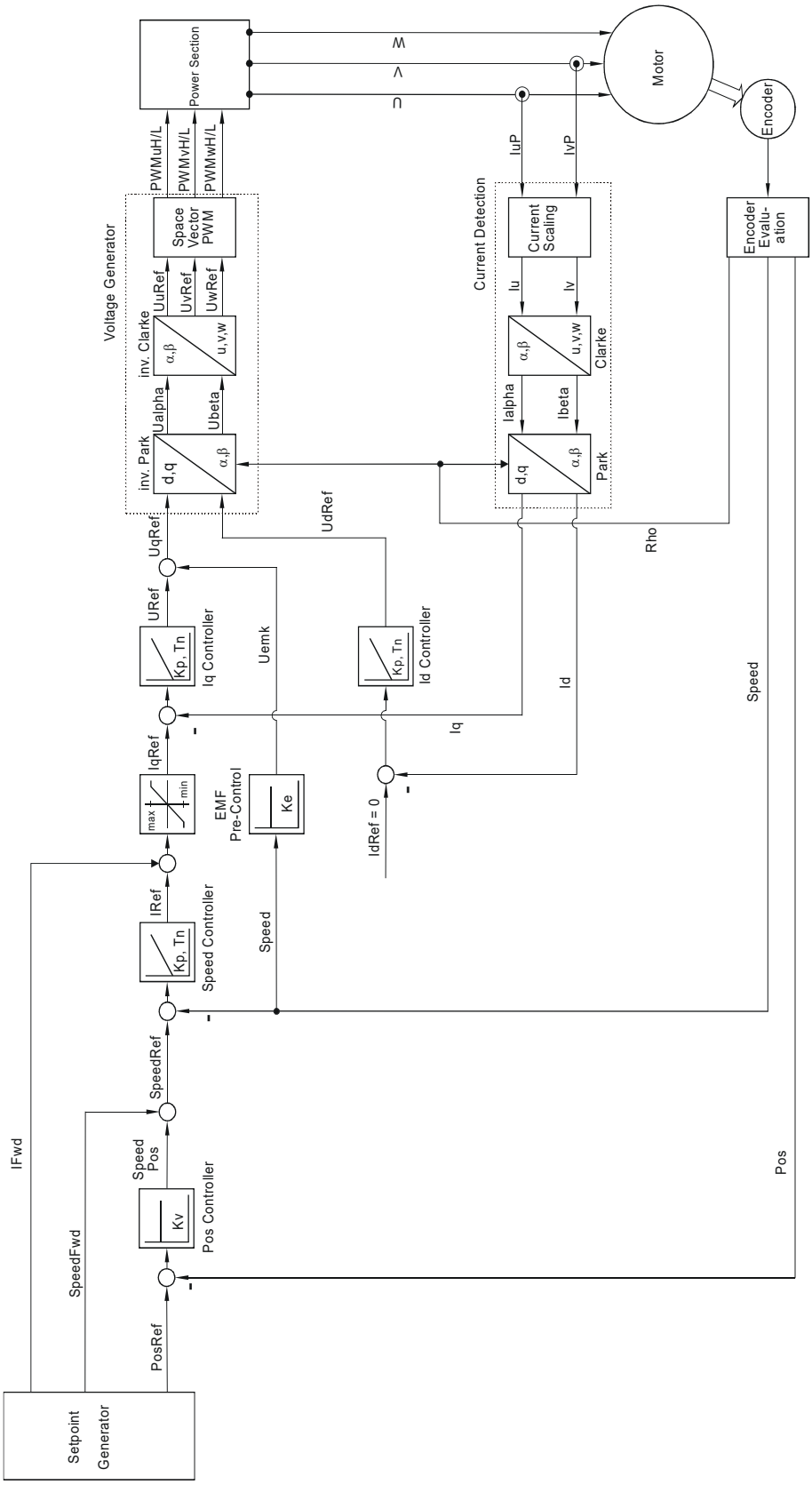



**Fig. 6: Block Diagram of Drive Controller Structure**

## Drive Controller Specification

All servo amplifiers can be parameterized through the control program.

| Description | Remarks |
|---|---|
| **Motor control** (commutation) | Space vector modulation |
| **PWM frequency** | 16 kHz |
| **Current controller** | |
| – Cycle time | 62.5 µs |
| **Speed controller** | |
| – Cycle time | 125 µs |
| – Power supply | adjustable |
| **Position feedback controller** | |
| – Cycle time | 250 µs |
| – Speed pre-control | adjustable |
| **Position setpoint generator** | |
| – Sine-square and linear acceleration/deceleration ramp | can be parameterized individually |
| – Setpoint output cycle (position feedback controller interpolation) | 2 ms |
| **Position sensing** | |
| **Resolver:** | |
| – Resolution | 12 bits per revolution |
| – Sampling interval | 62.5 µs |
| **Sine/cosine encoder:** | |
| – Resolution of absolute position | 15 Bit per encoder period |
| – Resolution of velocity pickup | 20 Bit per encoder period |
| – Sampling interval | 62.5 µs |

# 7 Description of Connections

## 7.1 Demands on the Power Supply Unit for Motor Operating Voltage

We recommend a power supply unit configuration consisting of transformer, rectifier and charging capacitor (electrolytic capacitor).

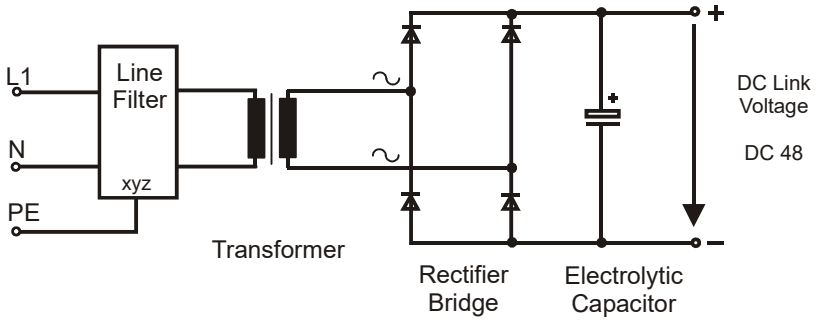



**Fig. 7: Configuration of the power supply unit for motor operating voltage**

The power supply unit can be configured with a 1- or 3-phase wiring.

The output of the power supply unit is rated at the output required by the motor:

$$P = \frac{M \cdot n}{9,55} + P_{Dissipation}$$

Output power P in Watt (W)
Torque M in Nm
Revolutions n in 1/min
Power dissipation $P_{Dissipation}$ in Watt (W)

The power supply voltage is rated at the required speed and torque:

$$U = U_n + U_M$$

Where:

$$U_N = \frac{K_E \cdot n}{1000}$$

Counter-EMF $U_n$ in Volt (V)
Back EMF constant $K_E$ in V*min/1000
Revolutions n in 1/min

Voltage $U_M$ generating the required torque at maximum RPM.

By the energy fed back into the JetMove 105, the voltage at the output of the power supply unit can be increased to 60 V. See "Recommendations on preventing overvoltage at braking or lowering a vertical load" on page 42.

Between amplifier and power supply unit, significant pulse-like currents of short rise-times are flowing.
In each supply cable, there is an ohmic and an inductive component. If the values are too high, the efficiency of the power supply unit buffer is questionable.
– Blocking capacitors will be thermally overloaded.
– Peak voltages can lead to destruction of the controller board.

From this, the following requirements to the supply cable result:
- Make sure, the cross-section is sufficient.
- decrease the inductance by twisting.

Install an external charging capacitor close to the JetMove 105, if the distance the between power supply unit and the JetMove 105 is greater than 20 m.
The charging capacitor must stand a high AC load. Electrolytic capacitors meet this requirement. For more information refer to Fig. 9.

In order to prevent EMI, the 0 V potential that is close to the power supply unit for motor operation voltage should be connected to earth.

### 7.1.1 Recommendations on the power supply circuit breaker +Vmot

If the $+V_{MOT}$ power supply is energized abruptly, the inrush current might reach a value high enough to destroy the servo amplifier. We recommend to place the circuit breaker for the motor power supply at the INPUT of the power supply unit (see Fig. 8), and NOT at its output, i.e. between power supply unit and servo amplifier. This way, the current-limiting circuitry of the power supply is used to limit the inrush current of the JetMove 105.

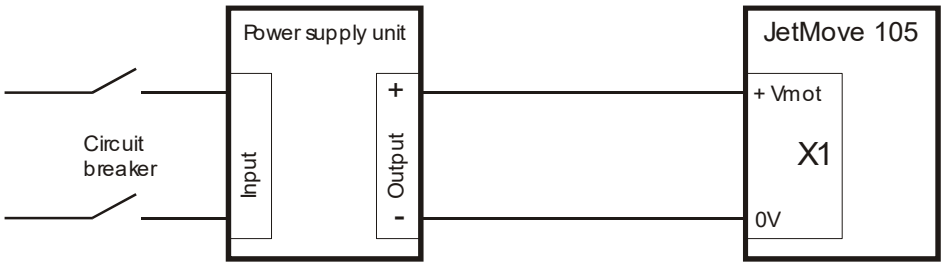



**Fig. 8: Terminal X1 - Recommended inrush current limitation**

If the solution just mentioned cannot be put into practice (in case of power supplies that cannot be interrupted, or if batteries/accus are used), connect an external capacitor of at least 470 µF / 100 V between circuit breaker and servo amplifier, in order to limit the slew rate of the motor supply voltage.

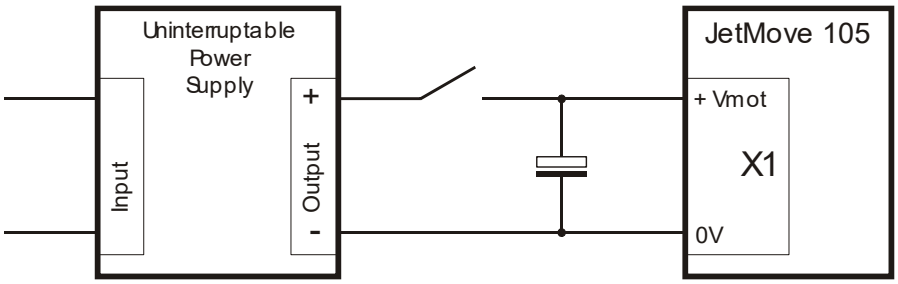



**Fig. 9: Terminal X1 - Alternative inrush current limitation**

## 7.1.2 General remarks

**Important!**

Recommended wiring of the voltage supply +Vmot

- Always make sure there is an external circuit breaker to switch off the power supply. Always switch off the power supply before installing the motion system.
- Always limit the inrush current of the motion system. Otherwise the motion system can be destroyed.
- Always use short wires of a large cross-section to connect the voltage supply and the JetMove 105. If the lines are to be longer than 2 meters, use twisted wires for the supply and earthing return line. If wires of more than 20 meters are to be used, apply a capacitor of at least 1,000 µF (set for the maximum possible voltage) close to the X1 terminal.
- If the same power supply is used for multiple motion systems, apply a star-connection the electrical center of which consists of the supply outputs. Connect each motion system to the general motor voltage supply using different wires for either positive or feedback phases.
- Connect the grounding wire / the shielding of the JetMove 105 with a fixed earthing position. The JetMove 105 generates electro-magnetic disturbances if its enclosure has not been earthed.
  Apply a short connection of a large cross-section between the PE of the servo amplifier and the connection to ground. Whenever this is possible, mount the JetMove 105 on a metallized and earthed surface.

### 7.1.3 Recommendations on preventing overvoltage at braking or lowering a vertical load

At fast braking or reversing the axis motion, the braking energy is fed back to the motor power supply. This can cause the DC link voltage to increase. If the voltage has reached a limit of 60 V, the overvoltage error is recognized and the motor control deactivated. There are two ways of preventing overvoltage:

**Possibility # 1:**

- Connecting an external capacitor:
  The external capacitor must be able to take up the back-fed energy.
  The capacitor must be designed for a voltage of at least 100 V.

- Designing an external capacitor:

$$C = \frac{2E_M}{U_{Max}^2 - U_{Nom}^2} - C_{Int}$$

Where:
$U_{Max}$ = 60 V
$C_{Int}$ = 200 µF
$U_{Nom}$ = 48 V
$E_M$: back-fed energy [J]

- Calculating the braking energy in case of a rotatory motor:

$$E_M = \underbrace{\frac{1}{2}(J_M + J_L)2\pi n_M}_{\text{Kinetic energy}} + \underbrace{m_L g(h_1 - h_2)}_{\text{Potential energy}} - \underbrace{3I_M^2 R_{Ph} t_d}_{\text{Switching losses}} - \underbrace{M_L t_d \pi n_M}_{\text{Friction}}$$

Where:
$J_M$: Inertia of the motor [kgm$^2$]
$J_L$: Inertia load of the motor [kgm$^2$]
$n_M$: Motor speed before deceleration [1/s]
$m_L$: Mass of the load at non-horizontal motion [kg]
g = 9.81 m/s$^2$
$h_1$: Height before deceleration [m]
$h_2$: Height after deceleration [m]
$I_M$: Motor current during deceleration [A]
$R_{Ph}$: Resistance of the motor [Ω]
$t_d$: Delay time [s]
$M_L$: Friction torque of the motor [Nm]

Calculating the braking energy in case of a linear motor:

$$E_M = \underbrace{\frac{1}{2}(m_M + m_L)v_M^2}_{\text{Kinetic energy}} + \underbrace{(m_M + m_L)g(h_1 - h_2)}_{\text{Potential energy}} - \underbrace{3I_M^2 R_{Ph} t_d}_{\text{Switching losses}} - \underbrace{F_L \frac{t_d \times v_M}{2}}_{\text{Friction}}$$

Where:

$m_M$: Motor mass [kg]

$m_L$: Mass of the load [kg]

$v_M$: Motor speed before deceleration [m/s]

$g = 9.81\ m/s^2$

$h_1$: Height before deceleration [m]

$h_2$: Height after deceleration [m]

$I_M$: Motor current during deceleration [A]

$R_{Ph}$: Resistance of the motor [$\Omega$]

$t_d$: Delay time [s]

$F_L$: Friction power of the motor [N]

If the calculation described above cannot be carried out because of missing values, a good starting value for the capacitor is 10,000 µF / 100 V.

**Possibility # 2:**

Connecting an external braking (ballast) resistor:
The motion system leads the back-fed energy to the braking resistor, as soon as the threshold of 55 V has been reached.
The following conditions have to be met before selecting the braking resistor:

1. Limiting the maximum current:

$$R_{Bl} > \frac{U_{Max}}{I_{Peak}}$$

Where:
$U_{Max}$ = 60 V
$I_{Peak}$ = 27.5 A

2. Limiting by means of the maximum braking power:

$$R_{Bl} < \frac{U_{Bl}^2}{2P_{Bl}}$$

Calculating the braking power:

$$P_{Bl} = \frac{E_M - \frac{1}{2}C(U_{Max}^2 - U_{Bl}^2)}{t_d}$$

Where:
$C = C_{Ext} + C_{Int}$ and $C_{Int}$ = 200 µF
$U_{Max}$ = 60 V
$U_{Bl}$ = 55 V
$E_M$: Braking energy (see above)
$t_d$: Delay time [s]

3. Limiting by means of the average current value:

$$R_{Bl} > \frac{P_{Bl} \cdot t_d}{t_{Cycle} \cdot I_{Nom}^2}$$

Where:
$t_{Cycle}$: Time interval between two delays in case of recurring motions
$I_{Nom}$ = 8 A

4. Selection by means of average power and peak value:

$$P_{Av} = \frac{P_{Bl} \cdot t_d}{t_{Cycle}}$$

$$P_{Peak} = \frac{U_{Max}^2}{R_{Bl}}$$



**Note 1!**

If $\frac{U_{Max}}{I_{Peak}} > \frac{U_{Bl}^{2}}{2P_{Bl}}$ , the braking power must be decreased.
This can either be attained by a longer delay time or by a larger $C_{Ext}$ (external capacitor at the power supply).



**Note 2!**

If $\frac{P_{Bl} \cdot t_d}{t_{Cycle} \cdot I_{Nom}^{2}} > \frac{U_{Bl}^{2}}{2P_{Bl}}$ either the braking power has to be decreased or else the cycle time of the delays has to be increased.

## WARNING! Hot Surfaces!



**Caution**

The surface of the braking resistor can heat up during operation.

- **During operation or during the cooling-off period after the power has been turned off, do touch the braking resistor.**
- Please make sure that no temperature-sensitive parts have been connected or fastened to the braking resistor.



**Note!**

Options 1 and 2 can also be combined.

# 7.2 Power Supply

## Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 $mm^2$ with bootlace ferrules and plastic sleeve: 0.25 - 1 $mm^2$
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

## Specifications of Connecting Cable

- Cable size: 2 * 1.0 mm² for the motor power supply
- Cable size: 1 * 0.5 mm² for the logic power supply
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Shielding not required

| Power Supply | | |
|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Specification** |
| PE | PE conductor | The PE conductor is connected to the enclosure. |
| $+V_{MOT}$ | DC link supply | 24 / 48 V DC (12 ... 48 V DC)<br>$I_{max.}$ = 27.5 A<br>No inrush current limitation |
| $+V_{LOG}$ | Power supply of the logic unit | 24 V DC (12 .. 30 V)<br>$I_{max.}$ = 250 mA at 24 V<br>No inrush current limitation |
| 0V | Zero potential for the power supply | Ground reference for $+V_{MOT}$ and $+V_{LOG}$ |

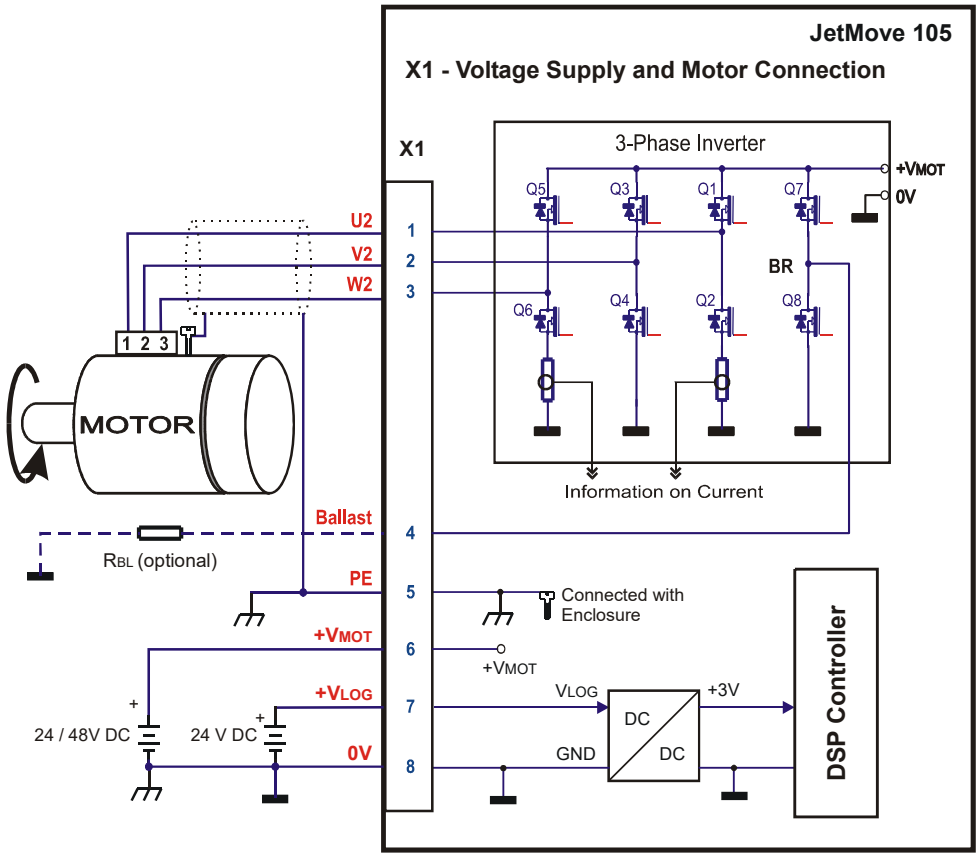



**Fig. 10: X1 - Supply Voltage**

# 7.3 Servo Motor

## Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 $mm^2$
  with bootlace ferrules and plastic sleeve: 0.25 - 1 $mm^2$
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

## Specification of the Motor Cable

- Cable size: 4 * 1.00 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 50 m
  As of a line length of 40 m, we recommend using a motor line reactor at the JM-105 (see "Motor line reactor to be mounted on the DIN rail, screwing connection", page 89)

| Motor connection | | |
|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Specification** |
| U2 | Motor phase 1 | Motor cable |
| V2 | Motor phase 2 | Motor cable |
| W2 | Motor phase 3 | Motor cable |
| BALLAST | Ballast resistor | An optional ballast resistor can be connected between this terminal and ground. |
| PE | PE conductor | The PE conductor is connected to the enclosure. |

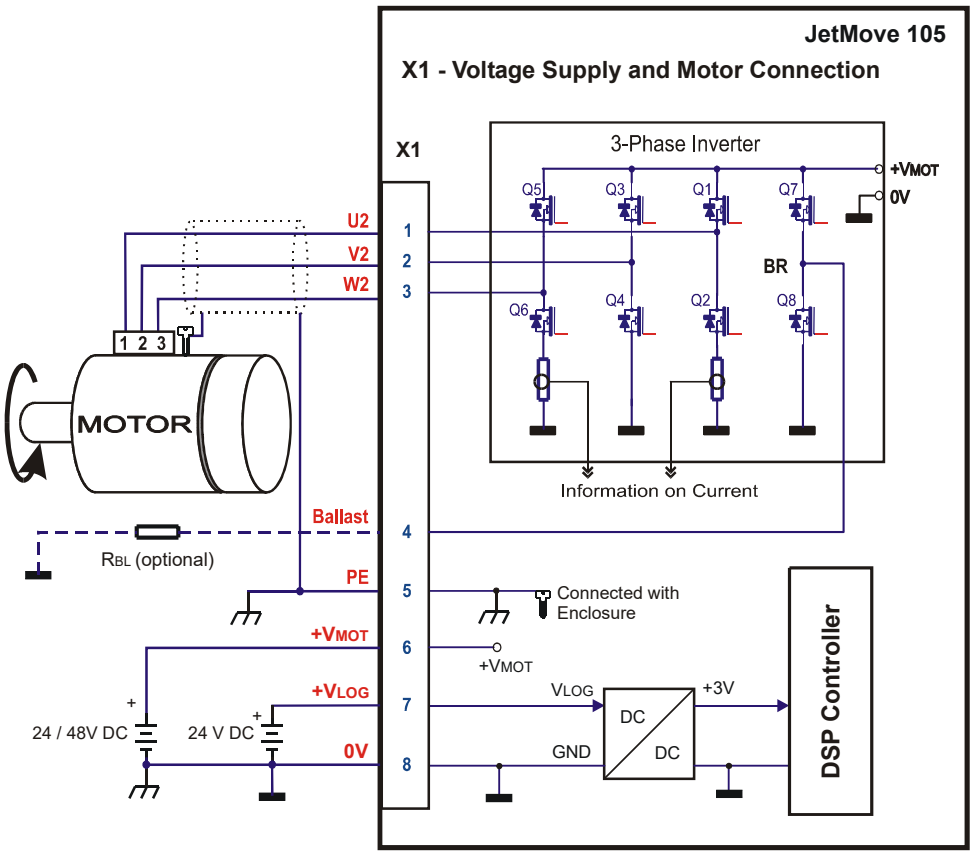



**Fig. 11: X1 - Servo motor connection**

**Important!**

Alternative measures to avoid malfunctions of the control system and the motor:

- The brake has to be operated through a separately shielded brake line.

**Important!**

Measures to avoid oscillation and blocking of the motor:

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

There are two motor cabling options:

### 7.3.1 Motor with male connector

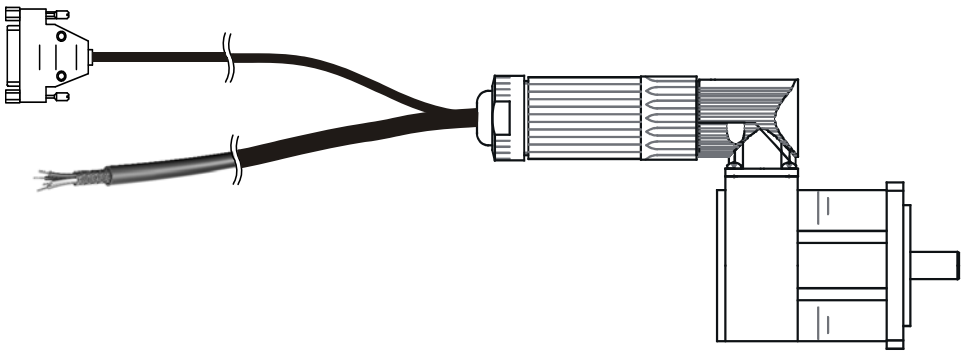


**Fig. 12: Motor with male connector**

For the power connections and for the feedback, the motor has been equipped with screw clamping terminals. With the help of prefabricated cables, the connection to the JetMove 105 is established (See "Pre-fabricated motor cable with SC mating connector" on page 52. and “Resolver Cable With Mating Connector” on page 67).
Motor specification: S, S-A, S-B or S-X for JH2 motors

### 7.3.2 Motor with screw clamping terminals and cables with male connectors



**Fig. 13: Motor with cables and male connectors**

The motor is equipped with screw clamping terminals with cables for power and feedback cables. In the type designation xxx.x,, the cable length is specified in meters. At the cable ends, male connectors have been fixed that correspond to the pre-fabricated JetMove 105 connection cables (See "Pre-fabricated motor cable with SC mating connector" on page 52. und “Resolver Cable With Mating Connector” on page 67).
Motor specification: S4-xxx.x for JH2 and JL1 motors

### 7.3.3 Motor with screw clamping terminals and cables with male connectors



**Fig. 14: Motor with cable and without a male connector**

The motor is equipped with screw clamping terminals with cables for power and feedback cables. In the type designation xxx.x, the cable length is specified in meters. The cable ends are not equipped with connectors. This way, the motor cable can be connected with the JetMove 105 directly. The feedback cable has to be connected with a SUB-D male connector.
Motor specification: S3-xxx.x for JH2 and JL1 motors

### 7.3.4 Pre-fabricated motor cable with SC mating connector

The pre-fabricated motor cable is used with the variants “Motor with male connector” on page 50 and “Motor with screw clamping terminals and cables with male connectors” on page 50.



**Note!**

The suitable mating connector SC (female connector) can be ordered from Bucher Automation AG by supplying the following particulars:

| | |
|---|---|
| Article # 15100070 | Motor connector for the Bucher motor series JH2, JH3, JH4, JH5, JL2, JL3, JL4, JK4, JK5, JK6 without brake |
| Article # 15100105 | Motor connector for the Bucher motor series JH2, JH3, JH4, JH5, JL2, JL3, JL4, JK4, JK5, JK6 with brake |



**Note!**

The motor cable with the SC mating connector matching the Bucher motor series JH can be obtained from Bucher Automation AG. It is confectioned with the matching motor mating connector and can be ordered by the following order reference:

**Without Brake:**

KAY_0626_xxxx

**With Brake:**

KAY_0624_xxxx

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

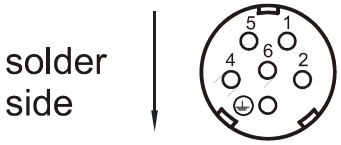
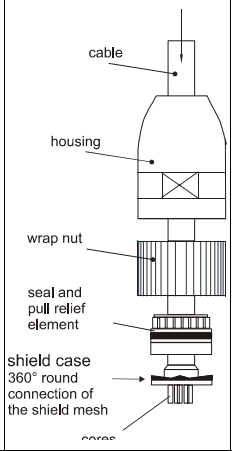
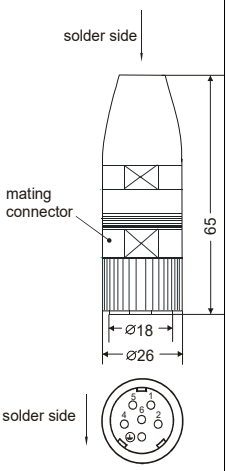



**Fig. 15: View on the SC series mating connector of the motor (internal thread M23)**

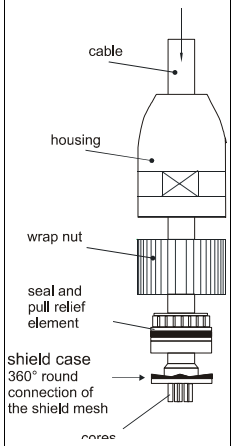
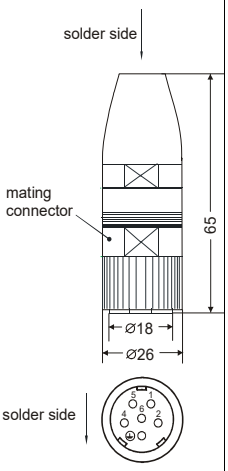
## Cable Specification of the Motor Power Cable with Mating Connector SC for JetMove 105

For connection without motor holding brake

<table>
<tr><th colspan="4">Motor Power Cable KAY_0626_xxxx</th></tr>
<tr><td>Terminals of the JetMove 105</td><td colspan="2">Shield</td><td>Mating connector of the motor (female, solder side)</td></tr>
<tr><td>4 x 1.0 mm$^2$<br>The wires are equipped with wire end ferrules.</td><td>Shielded, highly flexible 4-wire cable with PE.</td><td>
</td><td>
</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>X1.U2</td><td>1</td><td>Phase 1</td><td>1</td></tr>
<tr><td>X1.V2</td><td>2</td><td>Phase 2</td><td>5</td></tr>
<tr><td>X1.W2</td><td>3</td><td>Phase 3</td><td>2</td></tr>
<tr><td>X1.PE</td><td>Yellow-green</td><td>PE 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 KAY_0624_xxxx | | | |
|---|---|---|---|
| **Terminals of the JetMove 105** | **Shield** | | **Mating connector of the motor (female, solder side)** |
| 7 x 1.0 $mm^2$<br>The wires are equipped with wire end ferrules. | Shielded, highly flexible 6-wire cable with PE. |  |  |
|  | Connect both sides of the shield with the greatest possible surface area! Use metallized housing only! | | |
| **Pin** | **Wire Number** | **Signal** | **Pin** |
| X1.U2 | 1 | Phase 1 | 1 |
| X1.V2 | 2 | Phase 2 | 5 |
| X1.W2 | 3 | Phase 3 | 2 |
| X1.PE | Yellow-green | PE conductor |  |
| X62.2 | 5 | Brake + | 6 |
| X62.1 | 4 | Brake - | 4 |

Dimensions of the motor mating connector are specified in millimeters.

### 7.3.5 Motor Cable Permanently Fixed to the Motor

The motor cable is used for the variant “Motor with screw clamping terminals and cables with male connectors” on page 51.

## Specification of the Motor Power Cable without Mating Connector

For connection without motor holding brake

<table>
<tr><th colspan="3">Motor Power Cable Fixed to the Motor</th></tr>
<tr><th>Terminals of the JetMove 105</th><th>Shield</th><th>Motor</th></tr>
<tr><td rowspan="2">7 x 1.0 mm$^2$<br><br>The wires are equipped with wire end ferrules.</td><td colspan="2">Shielded, highly flexible 6-wire cable with PE.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td>Connect shield with the greatest possible surface area!</td></tr>
<tr><th>Pin</th><th>Wire Number</th><th>Signal</th></tr>
<tr><td>X1.U2</td><td>1</td><td>Phase 1</td></tr>
<tr><td>X1.V2</td><td>2</td><td>Phase 2</td></tr>
<tr><td>X1.W2</td><td>3</td><td>Phase 3</td></tr>
<tr><td>X1.PE</td><td>Yellow-green</td><td>PE conductor</td></tr>
</table>

For connection with motor holding brake

| Motor Power Cable Fixed to the Motor | | |
|---|---|---|
| **Terminals of the JetMove 105** | **Shield** | **Motor** |
| 7 x 1.0 $mm^2$<br>The wires are equipped with wire end ferrules. | Shielded, highly flexible 6-wire cable with PE.<br> | |
|  | | Connect shield with the greatest possible surface area! |
| **Pin** | **Wire Number** | **Signal** |
| X1.U2 | 1 | Phase 1 |
| X1.V2 | 2 | Phase 2 |
| X1.W2 | 3 | Phase 3 |
| X1.PE | Yellow-green | PE conductor |
| X62.2 | 4 | Brake + |
| X62.1 | 5 | Brake - |

# 7.4 Brush-Type DC Motor

## Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 $mm^2$ with bootlace ferrules and plastic sleeve: 0.25 - 1 $mm^2$
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

## Specification of the Motor Cable

- Cable cross-sectional area of up to 2 * 1.0 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 25 m

| Motor connection | | |
|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Specification** |
| U2 | Motor phase + | Motor cable |
| V2 | Motor phase - | Motor cable |
| BALLAST | Ballast Resistor | An optional ballast resistor can be connected between this terminal and ground. |
| PE | PE conductor | The PE conductor is connected to the enclosure. |

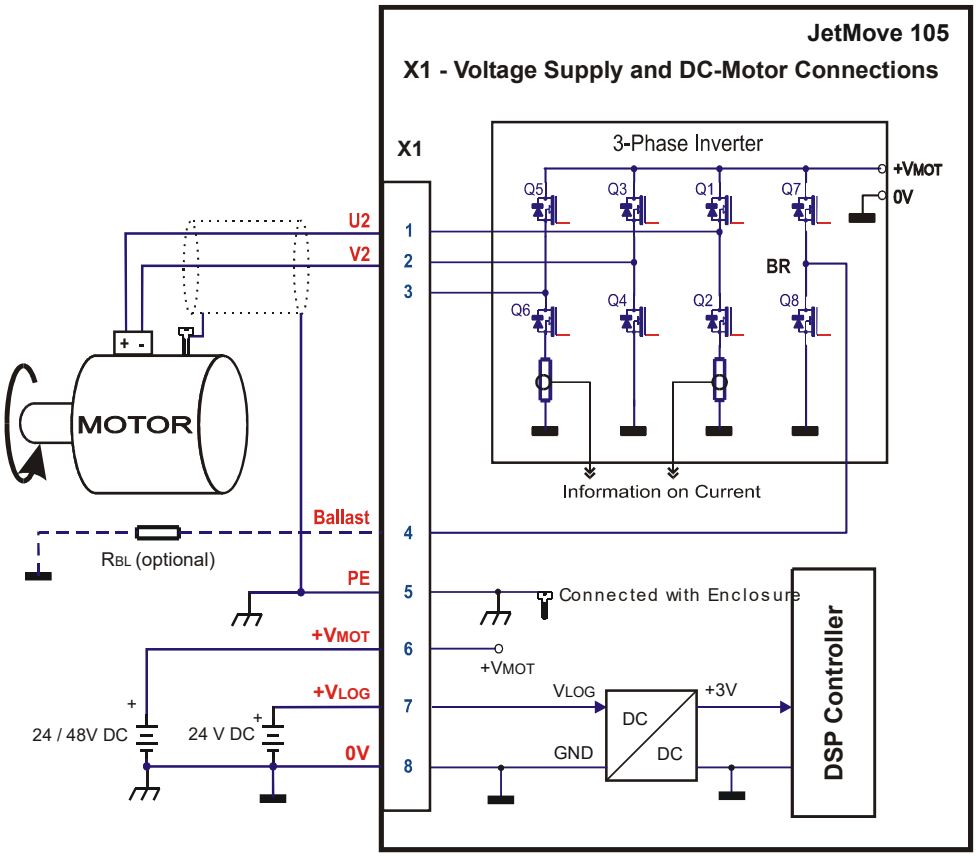



**Fig. 16: X1 - DC motor connection**

**Important!**

Alternative measures to avoid malfunctions of the control system and the motor:

- The brake has to be operated through a separately shielded brake line.

# 7.5 2-Phase Stepper Motor

## Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 $mm^2$ with bootlace ferrules and plastic sleeve: 0.25 - 1 $mm^2$
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

## Specification of the Motor Cable

- Cable cross-sectional area of up to 4 * 1.0 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 25 m

| Motor connection | | |
|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Specification** |
| U2 | Motor phase 1+ | Motor cable |
| V2 | Motor phase 1 - | Motor cable |
| W2 | Motor phase 2+ | Motor cable |
| Ballast | Motor phase 2 - | Motor cable |
| PE | PE conductor | The PE conductor is connected to the enclosure. |

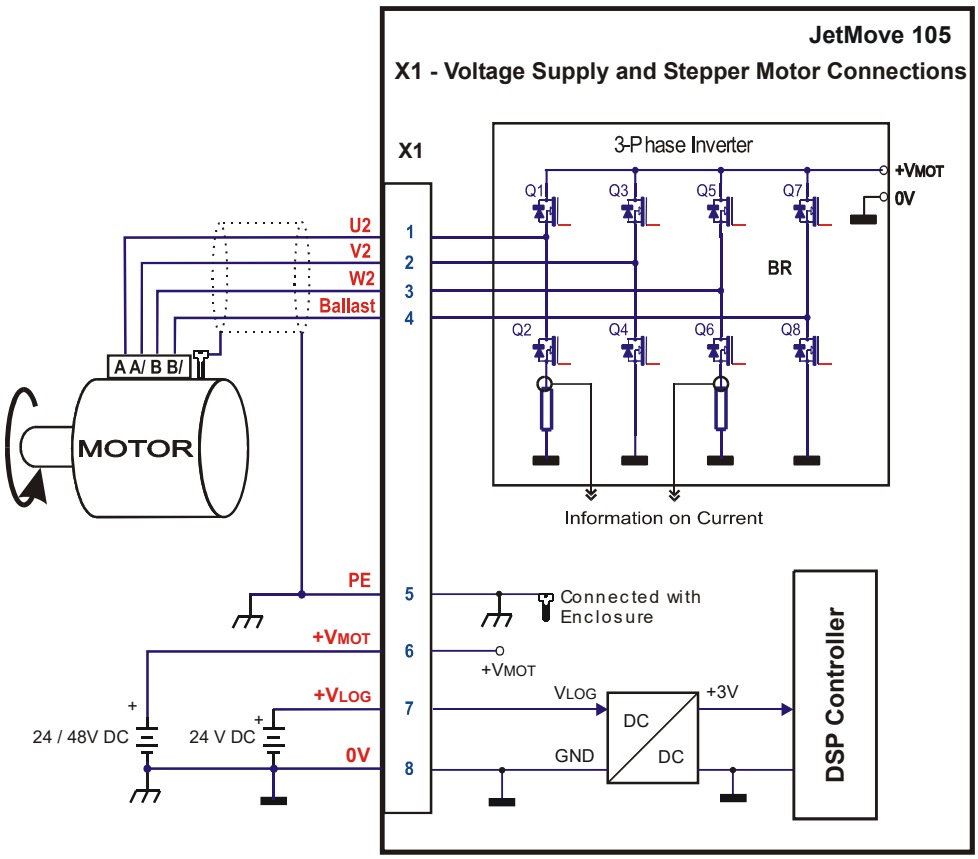



**Fig. 17: X1 - Stepper motor connection**

**Important!**

Alternative measures to avoid malfunctions of the control system and the motor:

- Operate the brake through a separately shielded brake line.

## 7.5.1 Stepper motor control

The stepper motor at the JetMove 105 is controlled by sine-wave commutation (maximum microstep mode). Thus, the noise typical for classic stepper motor controls cannot be heard, not even at lowest speeds.
As any other motor types connected to JetMove amplifiers, the stepper motor is also programmed in millimeters or degrees instead of steps, related to load.

The motor speed can be calculated by the following formula:

$$n = \frac{\frac{60s}{min}}{\frac{360°}{RPM}} \cdot v$$

Speed n in RPM
Speed v in °/s

The JetMove 105 has been designed for bipolar operation, i.e. it is possible to let the current flow through the motor winding in both directions. For this purpose, a bridge connection as shown in Fig. 18 is fit best.

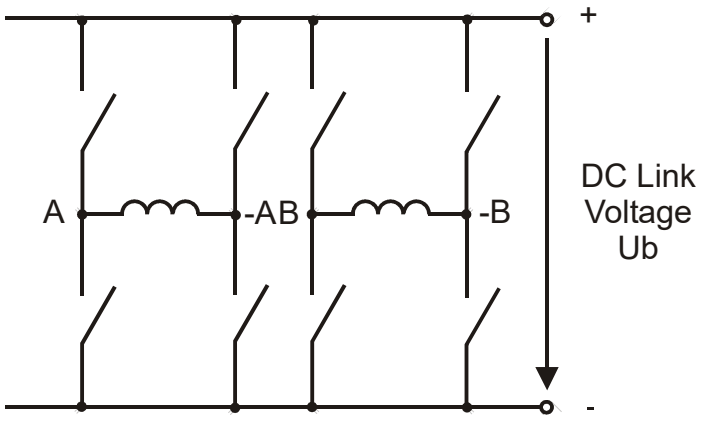



**Fig. 18: Bipolar circuit for 2-phase-stepper motors**

This way it is possible to limit the number of connections between motor control and motor to two per phase (plus PE) with the help of series or parallel connection of the partial windings in or at the motor.

In order to achieve reliable positioning, a defined constant moment must be mustered up to a speed value as high as possible.
This must be achieved by adequate controlling. The procedure applied here is constant current operation with vector control. Constant current operation has been made possible by the development of switching controller technology and by making efficient and fast transistors available. Vector control is made use of within the JetMove 2xx series for servo motor control.

The following entirety of vectors limit constant current operation:

1. Independent of the speed, a certain voltage is needed for having the set current overcome the resistance of the phase. :

$$U_1 = R \cdot I$$

Where:
Continuous rated current I in Ampere [A]
Resistance R per phase in Ohm [$\Omega$]

2. Dependent on the speed, a certain voltage is needed for reversing the polarity of the motor current. This voltage is calculated as follows:

$$U_2 = \omega \cdot L \cdot I$$

Where:
Continuous rated current I in Ampere [A]
Inductivity L per phase in [Vs/A]
Angular velocity $\omega$ in [rad/s]

The angular velocity $\omega$ of a stepper motor is:

$$\omega = 2\pi f = 2\pi \cdot Z_P \cdot \frac{\min}{60s} \cdot n = 2\pi \cdot Z_P \cdot \frac{RPM}{360°} \cdot v$$

Where:
Pole pair number $Z_P$ = 50
Speed n in [RPM]
Angular velocity v in [°/s]

3. When the motor is rotating, the influence of the EMF (Electro-Motive Force) can be realized as well. It is opposed to the operating voltage and decreases the effective voltage during power build-up; power build-up, which is speeded up by the EMF, though.

Theoretically, the motor can be driven to about the same speed which is needed for the vector sum $U_S$ to just compensate the phase voltage. Above this speed, the motor cannot be driven any more.

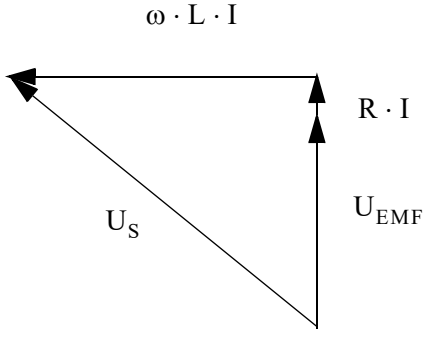



**Fig. 19: Addition of voltage in a synchronous machine**

The maximum phase voltage is calculated out of the DC link voltage as follows:

$$U_S = \frac{+V_{MOT}}{\sqrt{2}}$$

Thus, the maximum speed depends on the operating voltage. For this reason, the operating voltage should, in general, amount to 48 V.

## 7.5.2 Acceleration and deceleration

If a stepper motor without actual position feedback is used, exceeding the maximum possible torque of the motor must by all means be inhibited. Therefore, acceleration and deceleration should be carried out by linear ramps.

A linear ramp results in constant acceleration of motor and load. For this purpose, a constant motor torque is required. The degree of a possible acceleration depends on the available torque.

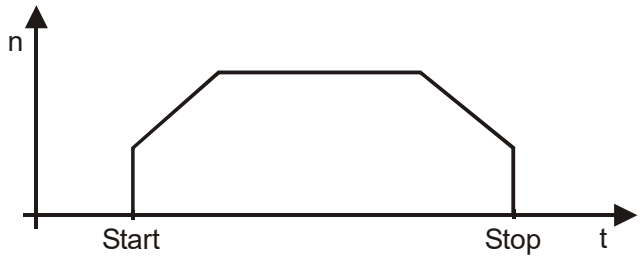



**Fig. 20: Acceleration via linear ramp**

# 7.6 LinMot®

LinMot motor models by NTI AG are typically designed for power supply and encoder feedback in one cable. These cables feature a double shielding with encoder signal lines running within the inner shield. The motor lines and the inner shield are protected by the outer shield.

## Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 $mm^2$ with bootlace ferrules and plastic sleeve: 0.25 - 1 $mm^2$
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

## Specification of the Motor Cable

- Cable size: 4 * 1.0 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 25 m

| Motor Connection | | | |
|---|---|---|---|
| **Terminals X1 on the amplifier side** | **Signal** | **Core Color** | **Specification** |
| U2 | Motor phase 1+ | red | Motor cable |
| V2 | Motor phase 1 - | pink | Motor cable |
| W2 | Motor phase 2+ | blue | Motor cable |
| Ballast | Motor phase 2 - | gray | Motor cable |
| PE | PE conductor | Shield | The PE conductor is connected to the enclosure. |

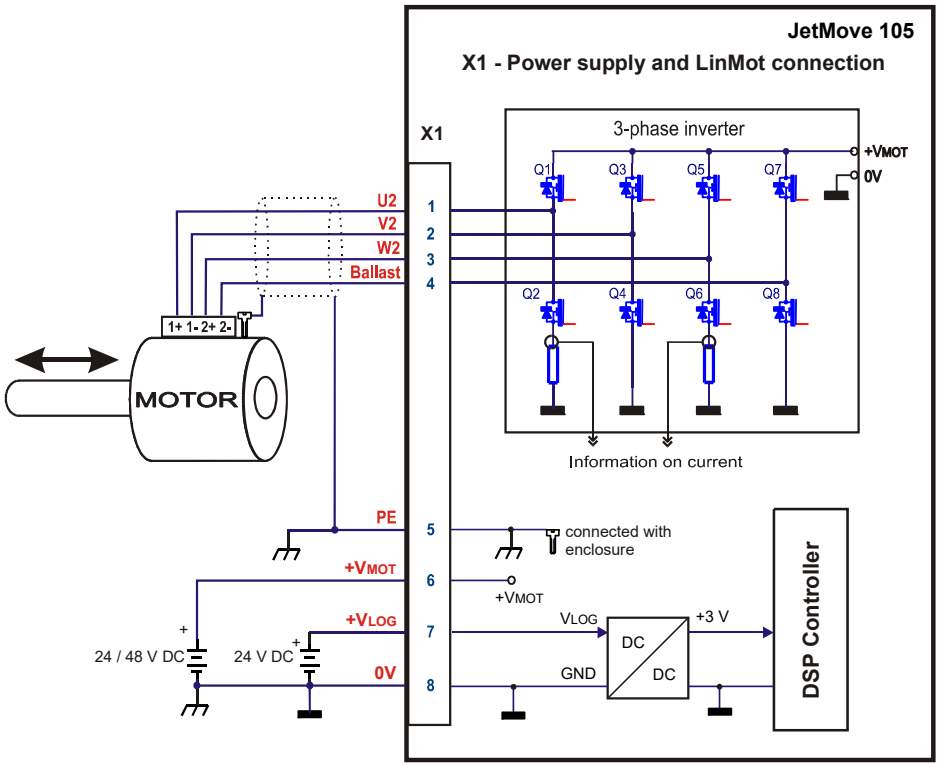
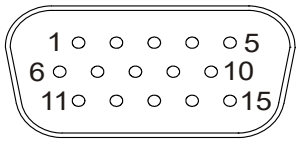
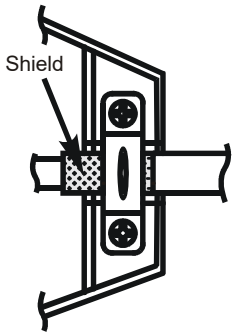



**Fig. 21: X1 - LinMot connection**

## Specification of the Encoder Cable

- Cable cross-sectional area of at least 3 * 0.14 mm²
- with separate shielding
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 25 m

| LinMot Encoder Cable | | |
|---|---|---|
| **JetMove 105 (male SUB-D connector X61)** | **Shield** | **Cable specification** |
| <br>Attaching screws must have a metric thread! | <br>Connect shield with the greatest possible surface area!<br>Use metallized housing only! | Maximum cable length:<br>25 m |
| **Pin** | **Signal** | **Core Color** |
| 5 | Sine | amber |
| 4 | Cosine | green |
| 1 | Voltage output (5 volts) | white |
| 11 | 0 V | inner shield |
| Shield | Shielding | outer shield |



**Note 1!**

**Supply voltage +5 V at the JetMove 105:**
Due to conduction loss, a lower voltage might be supplied to the encoder.



**Note 2!**

**The LinMotor motor cable features double shielding. Do not connect both shields with each other. The inner shield is used as 0 V line. Connect it to 0 V signals only! The outer shield must be connected to the shielding terminal of the Sub-D connector.**

# 7.7 Connection of the Resolver

## 7.7.1 Specification

### Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallized enclosure

### Specification of the Resolver Cable

- Cable cross-sectional area of at least 3 * 2 * 0.14 mm²
- Cores have to be shielded and twisted in pairs and have to be included in an overall shielding
- The shield must be connected to the connector housings on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

## 7.7.2 Resolver Cable With Mating Connector

The pre-fabricated resolver cable is used with the variants “Motor with male connector” on page 50 and “Motor with screw clamping terminals and cables with male connectors” on page 50.



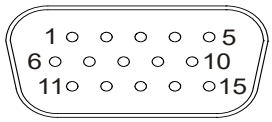
**Note!**

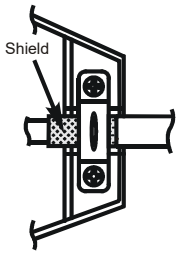
The resolver respectively HIPERFACE mating connector of the synchronous servo motor series JH, JL and JK can be ordered from Bucher Automation AG by supplying the following particulars:

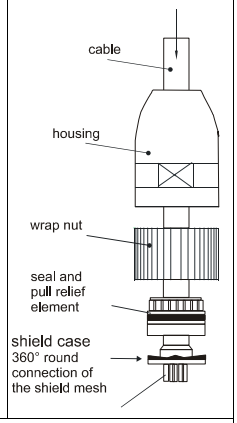
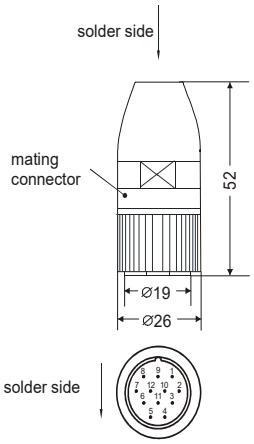
Article # 15100069 Resolver / HIPERFACE

The complete resolver cable connecting the servo amplifier JetMove 105 and the synchronous servo motor series JL1 and JH2 can be obtained from Bucher Automation AG.
The resolver cable can be ordered by submitting the following cable specifications and the respective cable length in cm:

KAY_0623_xxxx For the servo amplifier series JetMove 105

<table>
<tr><th colspan="4">Resolver-Cable of KAY_0623_xxxx</th></tr>
<tr><th>JetMove 105<br>(male SUB-D<br>connector X61)</th><th colspan="2">Shield</th><th>Motor (Resolver)<br>(female, solder<br>side)</th></tr>
<tr><td rowspan="2">

<br>Attaching screws must have a metric thread!</td><td>

<br>3 * 2 * 0.14 mm$^2$</td><td>
</td><td rowspan="2">
</td></tr>
<tr><td colspan="2">Connect shield with the greatest possible surface area!<br>Use metallized housing only!</td></tr>
<tr><th>Pin</th><th>Signal</th><th>Core Color</th><th>Pin</th></tr>
<tr><td>4</td><td>Cosine +</td><td>brown</td><td>1</td></tr>
<tr><td>14</td><td>Cosine -</td><td>White</td><td>2</td></tr>
<tr><td>15</td><td>Sine -</td><td>amber</td><td>3</td></tr>
<tr><td>5</td><td>Sine +</td><td>green</td><td>4</td></tr>
<tr><td>9</td><td>R1 (exciter winding +)</td><td>pink</td><td>5</td></tr>
<tr><td>10</td><td>R2 (exciter winding -)</td><td>gray</td><td>6</td></tr>
<tr><td></td><td>Unassigned</td><td>-</td><td>7 - 12</td></tr>
</table>

Dimensions of the resolver mating connector are specified in millimeters.

## Mating connector of the resolver (solder side)

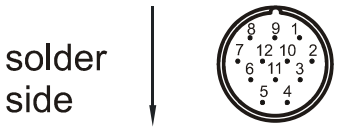
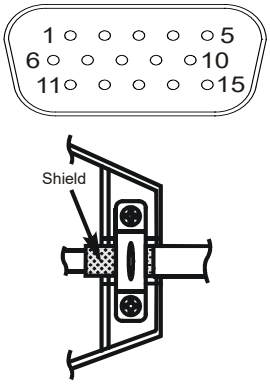



**Fig. 22: RC series mating connector of the resolver (internal thread M23)**

### 7.7.3 Resolver Cable Without Mating Connector

The resolver cable is used for the variant “Motor with screw clamping terminals and cables with male connectors” on page 51.

| Resolver Cable at the Motor | | |
|---|---|---|
| **JetMove 105 (male SUB-D connector X61)** | **Shield** | **Motor (Resolver)** |
|  |  | |
| Attaching screws must have a metric thread! | Connect shield with the greatest possible surface area! Use metallized housing only! | |
| **Pin** | **Signal** | **Core Color** |
| 4 | Cosine + | brown |
| 14 | Cosine - | White |
| 5 | Sine + | amber |
| 15 | Sine - | green |
| 9 | R1 (exciter winding +) | pink |
| 10 | R2 (exciter winding -) | gray |
| | Thermal circuit-breaker | red |
| | Thermal circuit-breaker | blue |

# 7.8 Sin- / Cos-Encoder Connection

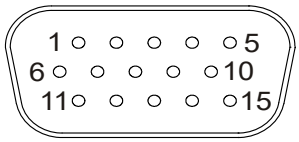
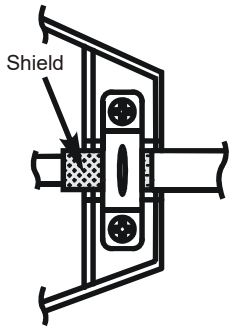
## 7.8.1 Specification

### Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallized enclosure

### Sin-Cos Encoder Cable Specifications

- Cable cross-sectional area of at least 3 * 2 * 0.14 mm² + 2 * 0.25 mm² min.
- 2 * 0.25 mm² must be used for the power supply unit and for GND
- Twisted-pair cables shielded with the all-over shield must be used; the signal lines must also be twisted in pairs:
  Sine + and reference sine
  Cosine + and reference cosine
  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
- Maximum cable length: 50 m

| Sin-Cos Encoder Cable | | |
|---|---|---|
| **JetMove 105 (male SUB-D connector X61)** | **Shield** | **Cable specification** |
| <br>Attaching screws must have a metric thread! | <br>Connect shield with the greatest possible surface area!<br>Use metallized housing only! | Maximum cable length:<br>100 m |
| **Pin** | **Signal** | |
| 5 | Sine + | |
| 15 | Reference sine | |
| 4 | Cosine + | |
| 14 | Reference cosine | |
| 7 | Index + | |
| 8 | Reference index | |
| 1 | Voltage output (5 volts) | $I_{max}$ = 350 mA |
| 6 | Voltage output (24 volts) | $I_{max}$ = 300 mA |
| 11 | 0 V | |



**Note 1!**

**Supply voltage +5 V at the JetMove 105:**
Due to conduction loss, a lower voltage might be supplied to the encoder.

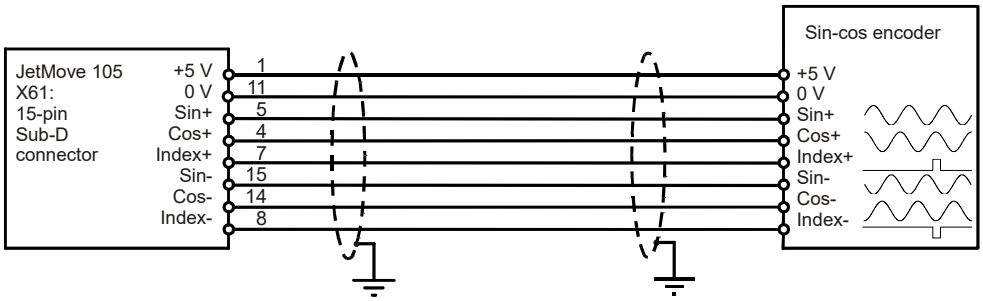



**Fig. 23: Sin/Cos encoder connection**

# 7.9 Connection of the Incremental Encoder

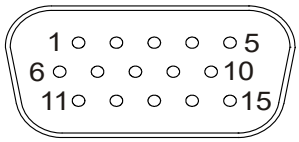
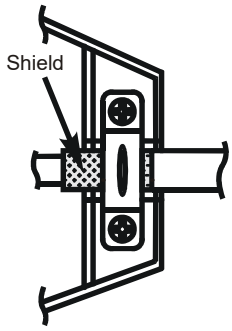
## 7.9.1 Specification

### Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallized enclosure

### Specification of the Incremental Encoder Cable

- Cable cross-sectional area of at least 3 * 2 * 0.14 mm² + 2 * 0.25 mm² min.
- 2 * 0.25 mm² must be used for the power supply unit and for GND
- Twisted-pair cables shielded with the all-over shield must be used; the signal lines must also be twisted in pairs:
  K0 + and K0 -
  K1 + and K1 -
  K2 + and K2 -
  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: 50 m

| Incremental encoder cable | | |
|---|---|---|
| **JetMove 105 (male SUB-D connector X61)** | **Shield** | **Specification of the cable** |
| <br>Attaching screws must have a metric thread! | <br>Connect shield with the greatest possible surface area!<br>Use metallized housing only! | Encoder signal:<br><br>5 V differential signal<br>or<br>5 V single-ended<br><br>Maximum cable length:<br><br>100 m |
| **Pin** | **Signal** | |
| 2 | K1+ | |
| 12 | K1- | |
| 3 | K2 | |
| 13 | K2- | |
| 7 | K0 | |
| 8 | K0- | |
| 1 | Voltage output (5 volts) | $I_{max}$ = 350 mA |
| 6 | Voltage output (24 volts) | $I_{max}$ = 300 mA |
| 11 | 0 V | |



**Note 1!**

**Supply voltage +5 V at the JetMove 105:**
Due to conduction loss, a lower voltage might be supplied to the encoder.



**Note 2!**

**Bus Terminating Resistor**
In case of differential connection, a bus terminating resistor of 120 ohms each must be installed at a cable length of 10 m or more between K0+ and K0-, K1+ and K1-, as well as K2+ and K2-.



**Note 3!**

**Single-ended connection:**
In case of single-ended connection, only signals K0+, K1+ and K2+ are used. Signals K0-, K1- and K2- must not be connected.

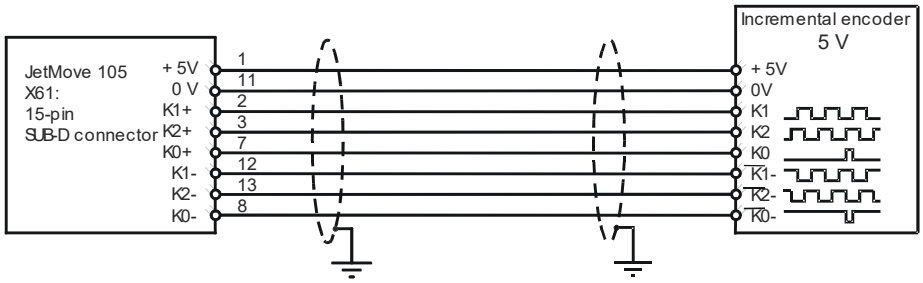
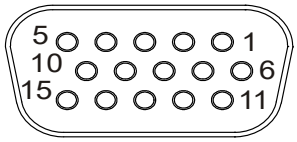


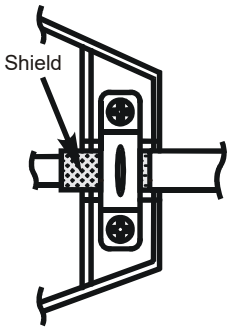

**Fig. 24: Incremental encoder connection**

# 7.10 Digital and Analog Inputs and Outputs

### Specification of the Female Connector for Male Connector X62 (IN / OUT)

- 15-pin high density SUB-D connector (female)
- Metallized enclosure
- For using the analog inputs, shielding is required

<table>
<tr><th colspan="4">Input / Output Cable</th></tr>
<tr><td colspan="2">JetMove 105<br>(female Sub-D<br>connector X62)</td><td>Shield</td><td>Specification<br>of the cable</td></tr>
<tr><td colspan="2">

<br>Attaching screws must have a metric thread!</td><td>
</td><td>If the analog input is used:<br><br>Connect shield with the greatest possible surface area!<br>Use metallized housing only!</td></tr>
<tr><td>Pin</td><td>Signal</td><td>Description</td><td>Specification</td></tr>
<tr><td>1</td><td>0 V</td><td></td><td>*)</td></tr>
<tr><td>2</td><td>Brake</td><td>Contacts for the motor holding brake<br><br>The brake output can be operated either by the control program or by the operating system of the JetMove 105 at release of the motor current.<br><br>The JetMove 105 is equipped with an internal freewheeling diode.</td><td>The internal semiconductor switch connects the $+V_{LOG}$ with the output pin.<br><br>$I_{max}$ = DC 0.5 A<br><br>Contact: N/O<br><br>These connections are only for devices having got the same reference to ground as the power supply of the logic.</td></tr>
<tr><td>3</td><td>Analog input+</td><td>Analog signal</td><td>0 - 10 V to pin 4</td></tr>
<tr><td>4</td><td>Analog input-</td><td>Reference of the analog signal</td><td>not connected with 0 V of the motion system</td></tr>
</table>

| | | | |
|---|---|---|---|
| 5 - 6 | 0 V | Ground | *) |
| 7 - 9 | Reserved | | Do not use |
| 10 | 0 V | Ground | *) |
| 11 | Hardware enable for the power supply of the motor (input) | • At this input, a high signal is necessary for power supply of the motor. (This signal must have been applied before carrying out the software enable)<br>• A low signal de-energizes the motor immediately. | • DC 20 ... 30 V<br>• Input resistance: 3 KOhm<br>• Operating point: < 4 V low, > 14 V high |
| 12 | Reference switch (input) | • Depending on the parameter setting, this input is used for reference run | • DC 20 ... 30 V<br>• Input resistance: 3 KOhm<br>• Operating point: < 4 V low, > 14 V high<br><br>NC or NO contact |
| 13 | Positive limit switch (input) | • Depending on the parameter setting, this input is used as a positive limit switch. | • DC 20 ... 30 V<br>• Input resistance: 3 KOhm<br>• Operating point: < 4 V low, > 14 V high<br><br>NC or NO contact |
| 14 | Negative limit switch (input) | • Depending on the parameter setting, this input is used as a negative limit switch. | • DC 20 ... 30 V<br>• Input resistance: 3 KOhm<br>• Operating point: < 4 V low, > 14 V high<br><br>NC or NO contact |
| 15 | Digital input | • Depending on the parameter setting, this input can be used for quick stop, position capture or referencing without stop. | • DC 20 ... 30 V<br>• Input resistance: 3 KOhm<br>• Operating point: < 4 V low, > 14 V high |

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

# 7.11 JX2 System Bus

The JetMove 105 is interlinked with the controller, additional JetMove amplifiers, or Bucher peripheral modules by means of the JX2 system bus. The system bus input BUS-IN is a 9-pin male Sub-D connector, and the bus output BUS-OUT is a 9-pin female Sub-D connector.

## 7.11.1 JX2 System Bus Cable Specification

### Specification of Connectors

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

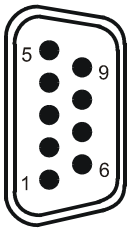
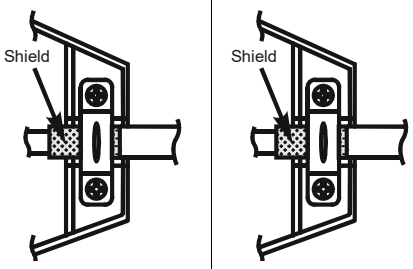
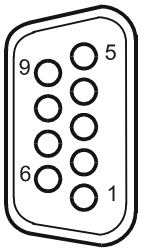
**On the BUS-IN (X18) side**
- 9-pin female SUB-D connector
- Metallized enclosure

### System Bus Cable Specification

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

| System Bus Cable - Technical Data | | |
|---|---|---|
| **Description** | **Description** | |
| Querschnitt / Wire cross section | 1 MBaud: | 0.25 - 0.34 $mm^2$ |
| | 500 kBaud: | 0.34 - 0.50 $mm^2$ |
| | 250 kBaud: | 0.34 - 0.60 $mm^2$ |
| | 125 kBaud: | 0.50 - 0.60 $mm^2$ |
| Cable capacitance | 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 | |
| Shield | Complete shielding, no paired shielding | |
| Twisting | Core pair CL and CH twisted | |

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

| System Bus Cable of Cable Confection # 0530 | | |
|---|---|---|
| | **Shield** | |
|  |  |  |
| **BUS-OUT** | Connect shield with the greatest possible surface area!<br>Use metallized housing only! | **BUS-IN** |
| **Pin** | **Signal** | **Pin** |
| 1 | CMODE0 | 1 |
| 2 | CL | 2 |
| 3 | GND | 3 |
| 4 | CMODE1 | 4 |
| 5 | TERM | 5 |
| 6 | Unassigned | 6 |
| 7 | CH | 7 |
| 8 | Unassigned | 8 |
| 9 | Do not connect | 9 |

# 8 Status Monitoring

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

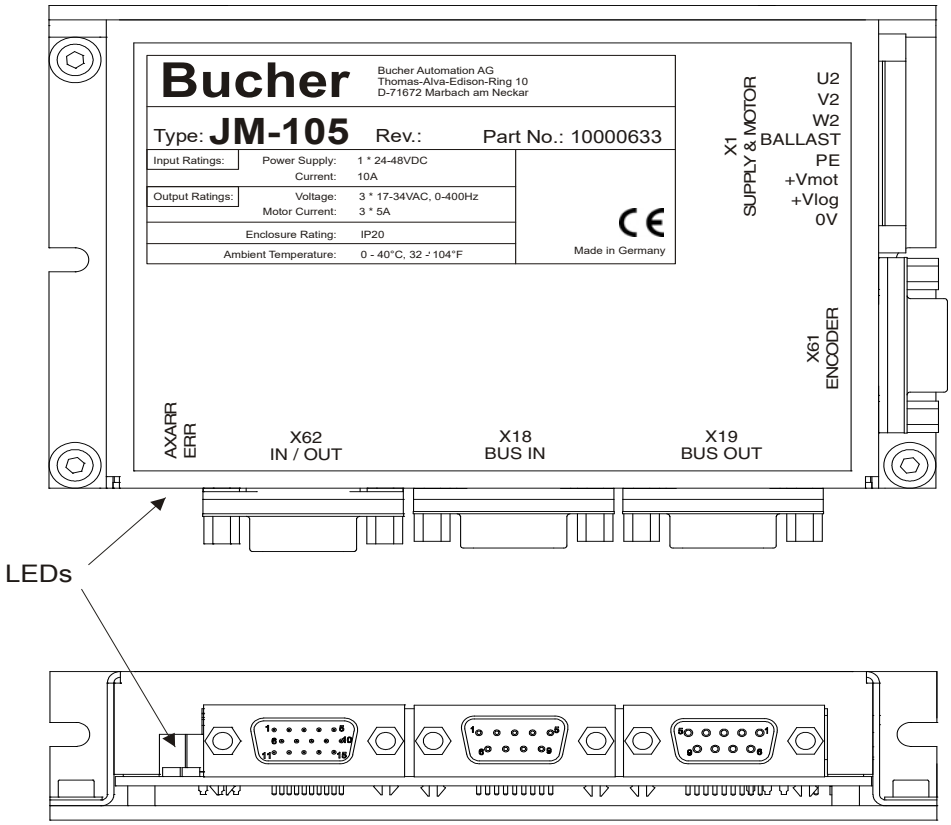



**Fig. 25: Status monitoring LEDs at the JetMove 105**

| JetMove 105 - LEDs | | | |
|---|---|---|---|
| **LED** | **Color** | **State** | **Description** |
| **OS is active:** | | | |
| AXARR | Green | Is lit | Axis is standing still (RPM = 0) |
| ERR | Red | Is lit | An error has occurred. The control unit of the servo amplifier is locked, error can be acknowledged. |
| **Boot Phase:** | | | |
| AXARR | Green | Off | |
| ERR | Red | Is lit for 1 s | The OS is being checked. |
| **OS Update:** | | | |
| AXARR | Green | Flashing | The OS is being programmed. |
| ERR | Red | Is lit | OS update is active. |



**Note!**

The ERR display of the output stage indicates the operating and fault conditions of the digital servo amplifier JetMove 105. The different fault conditions are displayed in Motion Setup in JetSym.

# 9 Diagnostics

## 9.1 Error Messages



**Note!**

The ERR display of the output stage indicates the operating and fault conditions of the digital servo amplifier JetMove 105. The different fault conditions are displayed in Motion Setup.

| Error Message Table - JetMove 105 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Response to faults** | **Troubleshooting** |
| **F 00** | Hardware error | Internal hardware defect | – Immediate motor power disable | – Separate the drive controller from the power lines<br>– Return the amplifier for repair |
| **F03** | Motor cable breakage<br>(this error occurs as of hardware revision 2A.) | The motor cable is broken.<br><br>Be careful:<br>The motor cable is tested when the servo controller is enabled for the first time | – Immediate motor power disable | – Check the motor cable connections<br>– Acknowledge failure |
| **F 04** | Overvoltage in the DC link | A DC link voltage of >60 V has been detected | – Immediate motor power disable | – Check input voltage supply<br>– If the motor is used as generator, reduce the regenerating power.<br>– Acknowledge failure |
| **F 05** | Over-current | The output current has been greater than 2.5 x the rated current or ground fault during operation | – Immediate motor power disable | – Check cable and motor for a short circuit and ground fault<br>– Check current control parameters. If necessary, correct parameters.<br>– Acknowledge failure |

| Error Message Table - JetMove 105 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Response to faults** | **Troubleshooting** |
| **F 07** | Amplifier overtemperature | The amplifier has reached the maximum temperature | – Immediate motor power disable | – Let the amplifier cool down<br>– After cooling down, acknowledge failure<br>– Reduce power of the motion system |
| **F 09** | Encoder failure | Encoder breakage or initialization error | – Immediate motor power disable | – For extended diagnostics purposes use Motion Setup<br>– Check the encoder line and all plug-in connections<br>– Acknowledge failure |
| **F 10** | Overspeed | The actual shaft speed has exceeded a value of 1.25 x maximum speed | – Immediate motor power disable | – Check motor and encoder connections<br>– Check speed controller parameters. If necessary, modify parameters<br>– Acknowledge failure |
| **F 11** | Current overrange | A current temporarily too high has been detected | – Immediate motor power disable | – Reduce $K_p$ of the current controller by 10 ... 20 %<br>– Acknowledge failure |
| **F 12** | Ground fault | One or several phases of the motor cable or inside the motor have a ground fault | – Immediate motor power disable | – Check the motor cable and the motor<br>– Acknowledge failure |
| **F 15** | The hardware enable is missing | The software enable is given without a hardware enable | – Immediate motor power disable | – Disable the drive by means of the software<br>– Acknowledge failure |
| **F 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<br>– Acknowledge failure<br>– Return the axis to a position within the software travel limits (monitoring of software limit switches is re-enabled automatically at entering this range) |

| Error Message Table - JetMove 105 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Response to faults** | **Troubleshooting** |
| **F 18** | Hardware limit switch has been actuated | One hardware limit switch has tripped | – Stop at max. current (max. torque) | – Check target position<br>– Check reference position<br>– Acknowledge failure<br>– Return the axis to a position within the 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. (default: 10 V) | – Stop with emergency deceleration ramp | – Check the supply voltage<br>– Check the parameter "$U_{ZK}$ min. trip"<br>– Acknowledge failure |
| **F 21** | Overvoltage DC link voltage | The DC link voltage has exceeded the set maximum value (default: 60 V) | – Stop with emergency deceleration ramp | – Check the supply voltage<br>– In generator operation reduce braking power<br>– Acknowledge failure |
| **F 22** | Drive stalled | The drive could not overcome the n = 0 threshold within the time limit specified by the parameter "blocking-triping time" | – Immediate servo controller disable | – Eliminate the cause of stalling<br>– Acknowledge failure |
| **F 23** | Tracking error | The tracking error has exceeded the limit defined in the parameter "tracking error limit" for the time specified in "tracking window time" | – Stop with emergency deceleration ramp | – Check the drive mechanism<br>– Check steepness of acceleration/ deceleration ramps and amplifier parameters in relation to the parameters "tracking error limit" and "tracking error window time"<br>– Acknowledge failure |

| Error Message Table - JetMove 105 | | | | |
|---|---|---|---|---|
| **Error number** | **Type of error** | **Description** | **Response to faults** | **Troubleshooting** |
| **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” on page 35 | – Immediate motor power disable | – Let the motor cool down<br>– Acknowledge failure<br>– Check the configuration of nominal motor current, overload factor and motor time constant<br>– Reduce the average load of the motor |
| **F 38** | Asymmetric encoder signal | The amplitudes of the analog sine-cosine signals are not identical. | – Immediate motor power disable | – Check wiring or encoder signals<br>– Acknowledge failure |
| **F 39** | Error at commutation finding | Measuring the commutation offset could not be completed with results being guaranteed. | – Immediate motor power disable | – Check parametering<br>– Check wiring or encoder signal<br>– Acknowledge failure |
| **F 40** | Overload of motor holding brake | The internal semiconductor switch signals overload (current >> 0.5 A). | – Stop with emergency deceleration ramp | – Check wiring or motor holding brake<br>– Acknowledge failure |
| **F 43** | Communication error | Termination after a max. number of lost cyclic data transmissions | – Stop with emergency stop ramp | – Check the communication connection |
| **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 |

## 9.2 Alarms

If the ERR LED is flashing, one or several alarms have been detected. To find the root cause, check the alarms in the Motion Setup, or through querying by means of motion instructions in the application program.

# 10 Wiring Diagrams

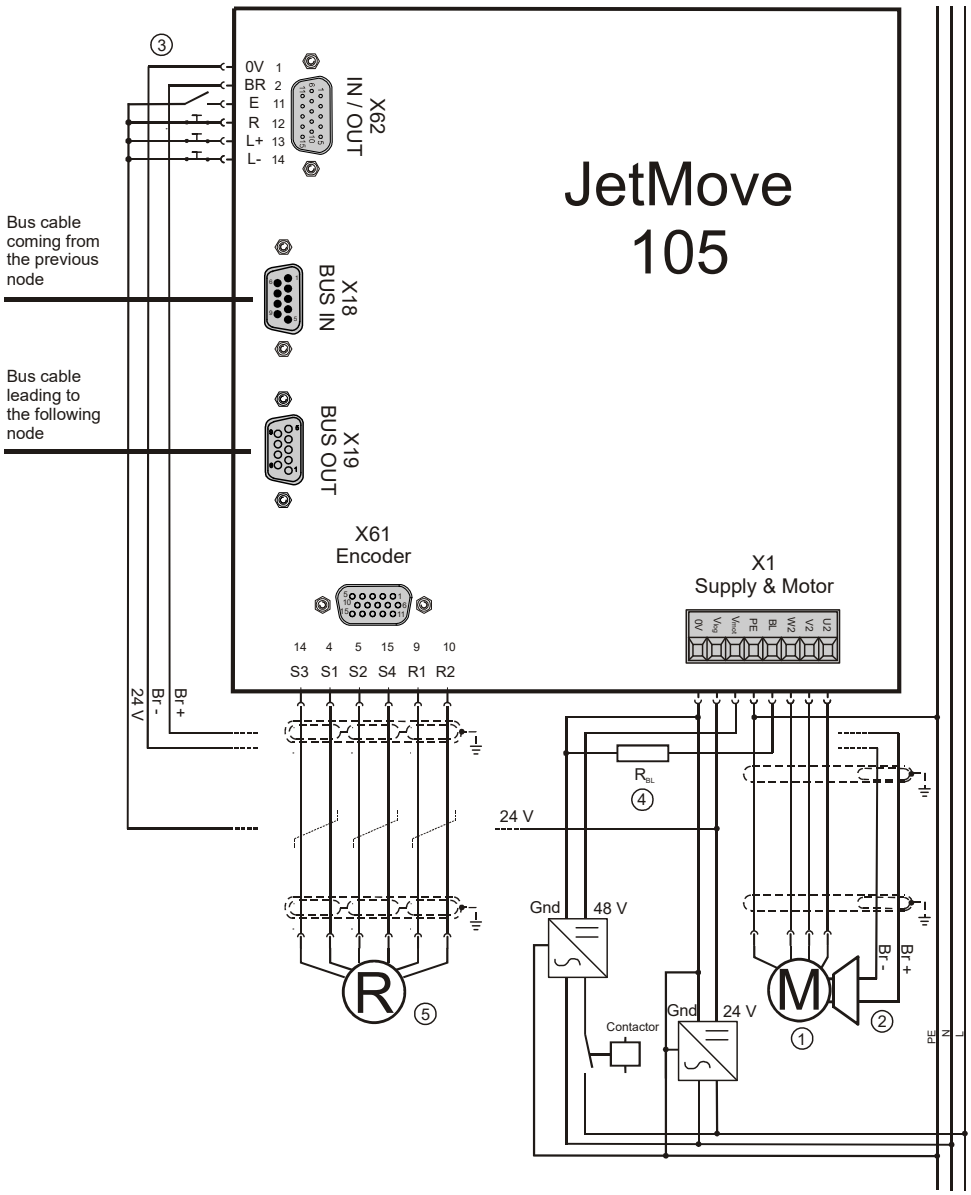



**Fig. 26: Wiring diagram - JetMove 105**

See also chapter 7 "Description of Connections", page 39.

## Key to the Wiring Diagram:

| | |
|---|---|
| **1** | Motor |
| **2** | Motor holding brake (option) |
| **3** | If a motor holding brake is used, an external free-wheeling diode must be installed. |
| **4** | Ballast resistor |
| **5** | Position encoder (resolver or Sin/Cos encoder) |

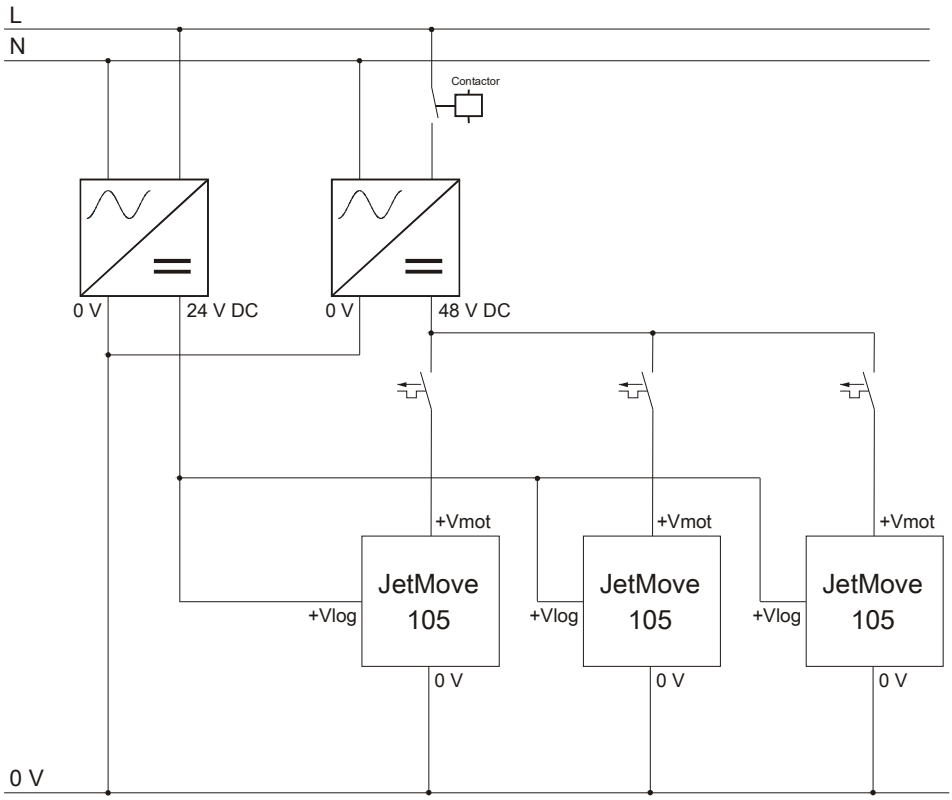



**Fig. 27: Usage of short-circuit breakers when several JetMove 105 are connected.**

The short-circuit breakers must be rated at the cross-section of the installed cables.

# 11 Ordering Information

## 11.1 List of Documentation

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

### Programming



**jetmove_2xx_at_jetcontrol_bi_xxxx_user_information.pdf**
Register description and parametering example
Item # 60866114

## 11.2 Device

| Designation | Description | Item # |
|---|---|---|
| JM-105 | Digital Servo Amplifier | 10000633 |
| Replacement for motor connector | 8-pin male connector, 3.5 mm pitch, threaded<br>Phoenix ordering information:<br>MC 1.5/ 8-STF-3.5 (1847181) | 60872945 |
| L_3x100UH/6A | Motor line reactor to be mounted on the DIN rail, screwing connection | 60873577 |
| L_4X100UH/8A | 4-phasige Motorleitungsdrossel für Schrittmotor, Hutschienenmontage, Schraubanschluss | 60888109_ 00 |

# 11.3 Motor power cable with mating connector SC

**Connecting cables for Bucher motors without brake:**

The power cable for motors without brake of the designation KAY_0626_xxxx can be ordered in the following standard lengths in meters:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 | 6.5 |
| 7 | 7.5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 20 | 22 | 24 | 25 | 30 | 50 | | | | | | | |

The order reference xxxx designates the length in cm.
For example: A resolver cable of 5 meters length has got the designation KAY_0626_0500.

**Connecting cables for Bucher motors with brake:**

The power cable for motors with brake of the designation KAY_0626_xxxx can be ordered in the following standard lengths in meters:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 | 6.5 |
| 7 | 7.5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 20 | 22 | 24 | 25 | 30 | 50 | | | | | | | |

The order reference xxxx designates the length in cm.
For example: A resolver cable of 5 meters length has got the designation KAY_0624_0500.

## 11.4 Resolver Cable

The resolver cable of the designation KAY_0623_xxxx can be ordered in the following standard lengths in meters:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 | 6.5 |
| 7 | 7.5 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 20 | 22 | 24 | 25 | 30 | 50 | | | | | | | |

The order reference xxxx designates the length in cm.
A resolver cable of 5 meters length has got the designation KAY_0623_0500.

## 11.5 System Bus Cable

JX2Bucher system bus connecting cable:

| | | |
|---|---|---|
| Length 0.2 m: | Cable confection # 0530 0.2m | Article # 10309001 |
| Length 0.5 m: | Cable confection # 0530 0.5m | Article # 10309002 |
| Length 1.0 m | Cable confection # 0530 1.0m | Article # 10309003 |
| Length 1.5 m | Cable confection # 0530 1.5m | Article # 10309004 |
| Length 2.0 m | Cable confection # 0530 2.0m | Article # 10309006 |
| Length 2.5 m | Cable confection # 0530 2.5m | Article # 10309016 |
| Length 3.0 m | Cable confection # 0530 3.0m | Article # 10309015 |
| Length 4.0 m | Cable confection # 0530 4.0m | Article # 10309007 |
| Length 5.0 m | Cable confection # 0530 5.0m | Article # 10309008 |

Other lengths can be obtained on request.

# Appendices

# Appendix A: Recent revisions

| Chapter | Remarks | Changed | Added | Cleared |
|---|---|---|---|---|
| Page 1 | Title photo with Bucher Automation | ✓ | | |
| 9 | New errors F43 - F45 | | ✓ | |

# Appendix B: Glossary

| | |
|---|---|
| AC | **A**lternating **C**urrent |
| CE | **C**ommunautés **E**uropéenes<br>European Union |
| DC | **D**irect **C**urrent |
| DIN | **D**eutsches **I**nstitut für **N**ormung e.V. |
| DSP | **D**igital **S**ignal **P**rocessor |
| EU | **E**uropean **U**nion |
| EC Low Voltage Directive | To be considered when using electric devices of a rated voltage between 50 and 1,000 V AC and between 75 and 1,500 V DC. |
| Electro-Magnetic Compatibility (EMC) | Definition according to the EMC regulations:<br>"EMC is the ability of a device to function in a satisfactory way in an electro-magnetic environment without causing electromagnetic disturbances itself, which would be unbearable for other devices in this environment." |
| EN | **E**uropäische **N**orm, that is: European Standard |
| ESD | **E**lectro**s**tatic **D**ischarge |
| Hazard analysis | Excerpt from the Machinery Directive:<br>The manufacturer is under an obligation to assess the hazards in order to identify all of those which apply to his machine; he must then design and construct it taking account of his assessment. |
| Hardware enable | Before the axis can be started up by software enable, hardware or pulse enable has to be active. This means that a high signal (24 V) has to be connected to the enable input or inputs (restart lockout). |
| HIPERFACE | **Hi**gh **Per**formance Inter**face**<br>HIPERFACE designates a sensor-transducer system by Sick / Stegmann. The SinCos motor feedback system with the standardised HIPERFACE interface is often used in digital drive technology. Unlike the resolver, the SinCos motor feedback system with HIPERFACE interface contains electronic components. Over several motor rotations, a HIPERFACE will report the absolute position values; this cannot be performed by a resolver. A HIPERFACE is far more precise than a resolver, but also more expensive. |
| IEC | **I**nternational **E**ectrotechnical **C**ommission |
| IGBT | **I**nsulated **G**ate **B**ipolar **T**ransistor |
| IP | **I**nternational **P**rotection |

| | |
|---|---|
| JetMove | JetMove is the product designation of a digital servo amplifier series produced by Bucher Automation AG, e.g. JetMove D203 where<br>– D stands for "Dual", in the sense of controlling two motors<br>– 203 identifies a rated current of 3 A |
| JX2 system bus | The Bucher system bus is a system-bus system with a cable length of max. 200 m, and a data transmission rate of 1 Mbit/s. In addition to this, the JX2 system bus is highly immune to interferences. Therefore, the JX2 system bus is suited to realise field bus applications in a limited space. |
| JetWeb | Control technology comprising control systems, motion systems, user interfaces, visualization devices, remote I/Os and industrial PCs. Programming by means of multitasking and a modern sequence-oriented language. Communication by means of Ethernet TCP/IP and making use of the Web technologies. |
| Motor circuit-breaker | A circuit-breaker with monitoring functions of phases and temperature of a motor. |
| NN | **N**ormal **N**ull, that is "above sea level" |
| PE | **P**rotective **E**arth , resp. "Protective Earth Conductor" |
| Resolver | Feedback unit at a servo motor for determining the absolute position within one revolution. Other than a HIPERFACE, the resolver will not provide any information on how many revolutions the motor has performed so far.<br>A resolver could be envisaged as a transformer; the couplings of its secondary windings (sine and cosine) change in relation to the position of the motor shaft. Basically, a resolver consists of a rotor with one coil and a stator with two coils. The stator windings are displaced by 90° (sine and cosine). The resolver itself does not contain any electronic components. |
| SELV | **S**afe **E**xtra **L**ow **V**oltage:<br>Voltage, which, under all operating conditions will not exceed a peak or DC voltage of 42.4 V. This voltage is either measured between two conductors or between one conductor and earth.<br>The circuit, in which this voltage occurs, must be separated from the mains power supply by a safety isolating transformer or some equivalent. |
| Software Enable | A superordinated controller issues a software command to enable an axis, which causes the motor to be energized. Hardware enable (restart lockage) has to be there before giving the software enable. |
| SUB-D | Type name of a plug-in connector |
| $t_r/t_h$ | **t**ime **r**ise / **t**ime **h**old: "rise time of a pulse / total hold time of a pulse" |

| | |
|---|---|
| $t_r/t_n$ | **t**ime **r**ise / **t**ime **n**ormal: "rise time of a pulse / total duration of a pulse" |
| TN network | Supply network which is solidly earthed in the neutral point and which is equipped with a protective earth conductor. |
| TT network | Supply network which is solidly earthed in the neutral point, yet, which is not equipped with a protective earth conductor. Earthing is carried out by means of a local protective earth. |
| UL | **U**nderwriters **L**aboratories Inc. |
| VDE | **V**erband **d**eutscher **E**lektrotechniker e.V.= Association of German Electrical Engineers |
| DC link voltage | DC circuit within a servo drive on the basis of which the motor currents are generated. |
| $\vartheta_{NAT}$ | Transition temperature, at which the thermal sensor changes by several K within a range of +/- 5 KΩ . |

**Units:**

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

# Appendix C: List of Illustrations

Fig. 1: Shielding of SUB-D connectors in conformity with EMC standards 18
Fig. 2: Shielding of screw terminals to EMC standards 18
Fig. 3: Recommended mounting 21
Fig. 4: Mounting holes in the enclosure 22
Fig. 5: Physical Dimensions - JetMove 105 31
Fig. 6: Block Diagram of Drive Controller Structure 37
Fig. 7: Configuration of the power supply unit for motor operating voltage 39
Fig. 8: Terminal X1 - Recommended inrush current limitation 40
Fig. 9: Terminal X1 - Alternative inrush current limitation 41
Fig. 10: X1 - Supply Voltage 47
Fig. 11: X1 - Servo motor connection 49
Fig. 12: Motor with male connector 50
Fig. 13: Motor with cables and male connectors 50
Fig. 14: Motor with cable and without a male connector 51
Fig. 15: View on the SC series mating connector of the motor (internal thread M23) 52
Fig. 16: X1 - DC motor connection 58
Fig. 17: X1 - Stepper motor connection 60
Fig. 18: Bipolar circuit for 2-phase-stepper motors 61
Fig. 19: Addition of voltage in a synchronous machine 62
Fig. 20: Acceleration via linear ramp 63
Fig. 21: X1 - LinMot connection 65
Fig. 22: RC series mating connector of the resolver (internal thread M23) 68
Fig. 23: Sin/Cos encoder connection 72
Fig. 24: Incremental encoder connection 75
Fig. 25: Status monitoring LEDs at the JetMove 105 80
Fig. 26: Wiring diagram - JetMove 105 87
Fig. 27: Usage of short-circuit breakers when several JetMove 105 are connected. 88

# Appendix D: Index


## A

Accessories 19
Alarms 86

## C

Commissioning
  Safety Instructions 25
Compatible servo motors 34
Connection diagram 87
Contact Assignment
  Motor 48, 57, 59, 64
  Power supply 46
Convection 20

## D

Description of Symbols 6
Dimensions 31
Disposal 13
Drive Controller Specification 38

## E

Earthing procedure 15
Electrical Specification 32
Error Message Table - JetMove 105 82

## I

Information Signs 14
Installation
  Electrical 23
  Mechanical 20
Installation - checking 24
Installation to EMC rules 23
Instructions on EMI 16
Intended Conditions of Use 11

## J

JetMove 105 - LEDs 80

## M

Maintenance 13
Malfunctions 14, 49, 58, 60
Modifications 12
Motor Power Cable
  KAY_0624_xxxx 54
  KAY_0626_xxxx 53
  permanently connected with the motor 55, 56
Motor winding isolation 23
Mounting Orientation 20, 27

## N

Noise immunity 16

## O

Operating Parameters
  Electrical Safety 27
  EMC
    Emitted interference 28
    Immunity to interference 29
  Environment 26
  Mechanical Parameters 27
  Power Rating 26
Oscillating of the motor 49

## P

Personnel Qualification 12
Physical Dimensions 31
PWM frequency 38

## R

Repair 13
Residual Dangers
  Hot surfaces 15, 45
  Mech. force 16
  Potentially explosive atmosphere 15
Resolver Cable
  KAY_0623_xxxx 68
  permanently connected with the motor 69

## S

Scope of delivery 19
Sine/cosine encoder 38

System Bus Cable
Cable confection # 530 79
Specification 78

## T

Technical Specifications 32

## U

Usage Other Than Intended 11

## W

Wiring Diagram 87
Wiring diagrams 87

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