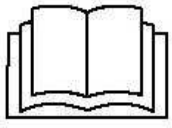
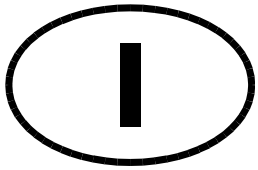
Installation, operation and maintenance manual

	**BEFORE PLACING MINIACTION SERIES SERVO DRIVES INTO SERVICE, CAREFULLY READ THIS INSTALLATION AND OPERATION MANUAL, AND FOLLOW ALL INSTRUCTIONS TO ENSURE MAXIMUM SAFETY**



SERVO DRIVES

MINIACTION SERIES

	If the user effects modifications of mechanical and/or electrical parts supplied by Minimotor s.r.l. and such modifications are not included in these instructions (that is, such modifications are for using this quasi-machine in ways that do not conform to its intended use), Minimotor s.r.l. can no longer be held responsible for meeting the essential safety and health requirements for the supplied materials dealt with in this manual.
	The technical information and drawings contained in these assembly instructions may have been modified at a later time. Therefore, please see the latest versions of the technical drawings.
	Using the machine in ways that do not conform to its intended use, as described in this manual, is strictly prohibited. The technical information and drawings contained in this manual may have been modified at a later time. Therefore, please see the latest versions of the technical drawings or diagrams for the relative component groups or systems.

TABLE OF CONTENTS

1 PREFACE

The purpose of this manual is to provide the information required for installing, using and programming Miniaction series 200, 300, 400, 500 servo drives/inverters.The instructions below for assembling the quasi-machine are intended for the following professionals:

User	The user is the person, agency or company that purchased the machine and plans to use it for the purposes it was designed to fulfil.
User/operator	The user/operator is the person authorised by the user to work with the machine.
Specialised personnel	These are persons who have specifically studied servo drives and who are able to recognise the hazards involved in using them, and can thus avoid such hazards.

These instructions must be made available to all the persons or organisations indicated above.

2 DEFINITIONS

2.1 Quasi-machine

Quasi-machines are defined as assemblies that almost constitute a machine, but individually are unable to fulfil a well-defined application. An actuating system is a quasi-machine. Quasi-machines are exclusively designed to be incorporated into or assembled together with other machines, other quasi-machines or other equipment to constitute a machine that is governed by directive 2006/42/EC.

2.2 Work area

A work area is defined as a protected zone surrounded by safety guards and set aside for operating the machine.

2.3 Authorised personnel

Authorised personnel are defined as a group of suitably instructed persons who are delegated with the task of performing the operations described below.

2.4 Automatic operation

Automatic operation is defined as the operating mode in which the machine independently performs the programmed cycle at normal operating speed inside an area protected with closed safety guards, with start-up executed from the general push-button panel.

2.5 Maintenance and repair

A maintenance and repair operation is defined as a regular check on and/or replacement of machine parts or components that is performed to identify the cause of a malfunction and concludes with restoration of the machine to its original operating condition.

2.6 Improper use

Improper use is defined as using the machine outside the limits laid down in its technical documentation.

Pursuant to the machinery directive (attachment 1 - ESSENTIAL SAFETY REQUIREMENTS point 1.1.1), the following definitions apply:

- A DANGER ZONE is as any area within and/or around machinery in which a person is exposed to a risk to his or her safety or health.
- An EXPOSED PERSON is any person who is completely or partially in a danger zone.
- An OPERATOR is the person or persons who are assigned the task of installing, operating, adjusting, maintaining, cleaning, repairing or moving a machine.

2.7 Potential sources of damage or injury

Note 1 - The term "hazard" can be qualified (classified) according to origin (for example, mechanical hazard, electrical hazard) or according to the nature of the potential damage or injury (such as fire hazard, intoxication hazard, cutting hazard, electric shock hazard).

Note 2 - The "hazard" used in this definition:

- can be permanently present during the prescribed use of the machine (for example, the movement of hazardous moving parts, electrical arcing during welding, noise emissions, high temperature);
- or may appear unexpectedly (such as explosion, crushing hazard/compression) due to involuntary/unexpected start-up, a fall caused by acceleration/deceleration, material expelled by the breakage of a mechanical component, etc.).

2.8 Hazardous situation

A situation in which a person is exposed to at least one hazard. Such exposure may cause damage/injury immediately or after a period of time.

2.9 Residual risk

Risk that persists after safety measures have been taken. Residual risk can be subdivided into:

- Residual risk that persists after safety measures have been put into place by the project designer.
- Residual risk that persists after a full set of safety measures has been taken.

2.10 Safety measures

Safety (protection) measures taken to protect persons from hazards that cannot be reasonably eliminated or from risks that cannot be adequately reduced by protection systems.

2.11 Operating information

Protection measures that consist of a set of communication methods (such as text, words, signs, signals, symbols, diagrams) which are used separately or in combination to impart information to the user.

2.12 Intended use of a machine

The use of a machine in compliance with its operating instructions (information).

2.13 Unintended use of machine (predictable improper use)

The use of a machine in a way that was not intended by the designer, but may result from an unintentional action (behaviour) during its use.

2.14 Protection

A guard or safety device

2.15 Guard

A physical barrier that is designed as an element of a machine and which provides protection.

Note 3 - A guard may operate:

- By itself; it is thus effective only when it is "closed (held in position)", whether it is a movable guard or is a permanent guard that is "firmly fixed (secured in position)".
- In combination with an interlock device - with or without a lock - on the guard; in this case, protection is provided whatever the position of the guard.

Note 4 - Depending on its use, a guard may be called (for example) a bonnet (housing), screen, cover, door or cage.

2.16 Fixed guard

A guard that is fixed in such a way (for example with screws, bolts, welds) that it can be opened or removed only with tools or by destroying the fasteners.

2.17 Movable guard

A guard that can be opened without tools.

2.18 Adjustable guard

A fixed or moveable guard that can be adjusted as a single element or which incorporates an adjustable part/parts. The adjustment remains fixed during a particular operation.

2.19 Guard with interlock

A guard that is associated with an interlock device and works together with the machine's control system to provide the following functions:

- The hazardous functions of the machine that are "affected" by the guard cannot be performed unless the guard is closed;
- If the guard is opened while hazardous functions of the machine are being performed, the latter will shut down;
- When the guard is closed, the hazardous functions of the machine "affected" by the guard may be performed. The hazardous functions of the machine "affected" by the guard cannot started by closing the guard.

2.20 Guard with interlock and lock

A guard that is associated with an interlock device and a lock system, which works together with the machine's control system to provide the following functions:

- The hazardous functions of the machine that are "affected" by the guard cannot be performed unless the guard is closed and locked;
- The guard stays closed and locked until the risk caused by the hazardous functions of the machine that are "affected" by the guard has been eliminated;
- When the guard is closed and locked, the hazardous functions of the machine "affected" by the guard may be performed. The hazardous functions of the machine "affected" by the guard cannot be started by closing and locking the guard.

2.21 Guard with interlock and start-up function/start-up control

A special form (type) of guard with interlock: when it reaches the closed position, it sends a signal that starts the hazardous functions of the machine without the use of an additional (separate) starting device.

2.22 Safety device

A protective device other than a guard.

2.23 Interlock device

A mechanical, electrical or other type of device whose purpose is to prevent the hazardous functions of the machine from being performed under specific conditions (generally unless the guard is closed).

2.24 Enabling device

A manually operated, supplementary device that is used together with a starting control: when permanently actuated, the device allows the machine to operate.

2.25 Hold-down control device

A control device that starts and maintains the hazardous functions of the machine only as long as it is kept in the actuated position.

2.26 Two-hand control device

A control device that requires the simultaneous action of both hands to start and maintain the hazardous functions of the machine, thus providing protection only to the person actuating the device.

2.27 Safety functions

Machine functions that ensure safety. If they malfunction, risk(s) may immediately increase.

2.28 Unexpected or sudden start

A start that generates a hazard because it is unexpected. For example, this may be caused by:

- A start command due to an internal malfunction or an outside influence affecting the control system;
- A start generated by an improper action acting on the starting system or other parts of the machine, such as a sensor or an electrical switching component;
- Restoration of power after an interruption;
- Internal/external influences (such as gravity, wind, self-injection in internal combustion engines) on machine components.

2.29 Hazardous malfunction

A malfunction of the machine or its power supply that generates a hazardous situation.

2.30 Breakdown

The state of an object (component) in which it fails to perform its required function, except during maintenance or other preventive measures, or when such failure is due to the lack of external resources.
Note 5 - a breakdown is often the result of a malfunction in the object itself, but may occur without a malfunction.
Note 6 - in practice, the terms "breakdown" and "malfunction" are often used as synonyms.

2.31 Emergency situation

A hazardous situation that must be signalled and concluded (resolved) as soon as possible

Note 7 - An emergency situation can occur:

- During normal machine operation (for example, it may be due to human interaction or be the result of an outside influence);
- As the result of the malfunction or breakdown of a machine part or component.

2.32 Emergency stop

A function whose purpose is:

- To prevent or reduce existing hazards to persons and/or damage to machinery and/or interference with the work being performed.
- To be activated by the single action of a person.

2.33 Emission value

A numeric value that quantifies an emission generated by the machine (such as noise, vibration, hazardous substances, radiation).

Note 8 - Emission values are part of machine specifications and are used as a basis for evaluating risk.
Note 9 - The term "emission value" should not be confused with "exposure value", which quantifies the exposure of persons to emissions when the machine is operating. Exposure values may be derived from emission values.
Note 10 - It is preferable for emission values to be measured. Their uncertainty is evaluated using normalised standardisation methods, such as comparing similar machines.

2.34 Hazardous breakdown

A breakdown of the machine or its power supply that generates a hazardous situation.

2.35 Explosive atmosphere

A mixture of air and gaseous flammable substances, vapours, fogs or dust under atmospheric conditions in which combustion propagates throughout the unburned mixture after it is ignited.

2.36 Potentially explosive atmosphere

An atmosphere that is susceptible to becoming an explosive atmosphere because of ambient or operating conditions.

2.37 Zones

Zones are work areas that are differentially classified as per regulation EN 60079-10 (CEI 31-30) into explosive atmospheres caused by gases/vapours/fogs.

3 PERSONNEL TRAINING

Provided below are the regulations of reference concerning the information, instruction and training provided to personnel who operate machines/work tools.

Also provided as an attachment is a report on training personnel in the safe operation of the machine dealt with in this Operation and Maintenance Manual.

3.1 Information

From Italian Legis. Decree 81/2008 - Title I - Chapter III, art. 36, paragraphs 1 - 2:

An employer is required to inform each worker regarding:

- The risks to safety and health that are associated with the operations of the company in general, and the protection/prevention measures and activities carried out.
- The specific risks that the worker is exposed to while doing his/her job, and company regulations and rules on safety.
- The hazards associated with the use of dangerous substances and preparations, as specified in the safety info sheets required by applicable law and by good manufacturing practice.

3.2 The use of work tools/equipment

From Italian Legis. Decree 81/2008 - Title III, art. 73, paragraphs 1 - 3:

An employer must ensure that for every work tool/piece of equipment provided, the workers assigned to its use are given full information and instruction on its safe use and regarding:

- the conditions of use of the work tools/equipment, which may be based on conclusions reached through experience with the use of such tools/equipment;
- predictable abnormal situations.

The information and operating instructions must be easy to understand by the workers involved.

3.3 The use of PPE

From Italian Legis. Decree 81/2008 - Title IV - art. 77, paragraph 4, points c - e:

An employer:

- must provide workers with instructions that they can understand;
- must inform workers beforehand regarding the risks against which the PPE provides protection.

While performing their work, workers must use the following Personal Protection Equipment:

PPE	Sign
A sign indicating that protective gloves must be worn (prevents cuts and provides protection against high temperatures)	
A sign indicating that goggles must be worn	

Suitable work clothing must also be worn. Safety guards and safety devices must not be removed unless such removal is required for performing repairs and/or maintenance.

They must be restored as soon as the reasons for their temporary removal no longer exist, and in any case before the machine is operated.

	Using a machine in ways that do not conform to its intended use, as described in this manual, is strictly prohibited

3.4 Instruction

From Italian Legis. Decree 81/2008 - Title I - Chapter III, art. 37, paragraphs 1 - 4 - 6:

The employer must ensure that each worker receives sufficient and adequate instruction on safety and health, with particular reference to his/her job and duties.

Instruction must be given when:

- the worker is hired;
- the worker is transferred or his/her duties are changed;
- new work tools/equipment, new technologies, new substances and/or new hazardous preparations are introduced.

Instruction must be regularly repeated as the risks change; that is, when new risks emerge.

3.5 The use of work tools/equipment

From Italian Legis. Decree 81/2008 - Title III - Chapter I, art. 73, paragraph 4:

An employer must ensure that:

- workers who use work tools/equipment receive adequate training on their use;
- workers who use work tools/equipment which require special knowledge and responsibilities receive adequate, specific training that enables them to use such tools/equipment in a safe, proper manner, which includes protecting other persons from risk.

3.6 The use of PPE

From Italian Legis. Decree 81/2008 - Title IV - Chapter II art. 77, paragraph 4, point h:

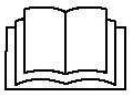
The employer must provide adequate instruction on the correct and practical use of PPE and, if necessary, hold a specific training course on this subject.

3.7 Training

The purpose of training is to enable personnel to understand the correct use of the machine during a period in which the worker is supervised by a trained, qualified operator/conductor and thus fulfils the obligations specified above that are mandated by Ital. Legis. Decree 81/08 (information and instruction).

4 GENERAL INSTRUCTIONS

The assembly instructions for the quasi-machine are considered to be an integral part of the quasi-machine and must be saved for future reference until it is dismantled. The user is informed that the following instructions reflect the technical state of the art when the quasi-machine was marketed. They will remain fully acceptable despite subsequent revisions based on new experience.

	**THE QUASI-MACHINE MUST NOT BE USED, AND NO OPERATION MUST BE PERFORMED ON IT, UNLESS ALL PARTS OF THIS MANUAL HAVE BEEN CAREFULLY READ AND COMPLETELY UNDERSTOOD.**
IN PARTICULAR, ALL PRECAUTIONS SPECIFIED HEREIN FOR COMPLYING WITH SAFETY RULES AND INFORMATION MUST BE TAKEN.	
THE QUASI-MACHINE MUST NOT BE USED FOR A PURPOSE OTHER THAN THE ONE(S) DESCRIBED IN THIS DOCUMENT, AND MINIMOTOR s.r.l. WILL NOT BE RESPONSIBLE FOR BREAKDOWNS, MALFUNCTIONS OR INJURIES IF THIS REQUIREMENT IS NOT COMPLIED WITH.	

To make it easier to read the manual, the following key words and phrases have been used:

	The word "HAZARD" is used when people may suffer serious injury if safety rules are not obeyed or if machine systems are tampered with.
	"BURN HAZARD FROM HOT SURFACES" is used when people may suffer serious injury if safety rules are not obeyed.
	"ELECTRIC SHOCK HAZARD" is used when people may suffer serious injury if safety rules are not obeyed.
	This "USE PPE" indicator means that protective gloves must be worn.
	This "USE PPE" indicator means that goggles must be worn.
	This "PROHIBITED ACTION" indicator means that the relative action may not be performed.

The purpose of safety rules is to establish behaviours and obligations that must be complied with when performing the operations described later on in this document.

These rules constitute the prescribed method of operating the machine in a way that is safe for personnel, tools/equipment and the environment.

5 TECHNICAL DATA SHEET OF THE MACHINE

5.1 Description of the quasi-machine

The Miniaction family of servo drives/inverters is designed to control tri-phase asynchronous electric motors and brushless AC motors (BLAC). The heart of the power section is an intelligent IGBT module (IPM) equipped with protective systems which ensure that the device is reliable and highly efficient, while (among other things) limiting the need for external components. The Miniaction series of the servo drive/inverter quasi-machine for asynchronous and brushless AC motors consists of an aluminium heat dissipater and electronic circuit boards contained in a special plastic*case*.

In particular, Miniaction servo drives/inverters are used to operate asynchronous and/or brushless AC motors by controlling start/stop functions and motor speed, position, and torque, and by performing diagnostic operations, etc. They are also used to manage abnormal conditions by providing complete, real-time diagnostic information (diagnostics are included in the machine into which the servo drive is incorporated) that can be viewed by connecting the system to other instruments (such as an HMI) or by using a "master" device (on versions equipped with a fieldbus).

Servo drives/inverters for asynchronous and brushless AC motors are mainly used in the so-called “second environment”; i.e., heavy industry. Versions are available that run on single-phase 230 V mains power only, and others are available that require 24 VDC auxiliary power.

The control logic consists of 32-bit micro-controllers with a set of instructions that is optimised for speed and is thus ideal for controlling precision motors. With their unique build characteristics, these servo drives can be called "digital" because the entire control process is managed by a program run by the micro-controller. Thanks to these features, the Miniaction servo drive/inverter is a flexible device that is completely reconfigurable using software, which makes it receptive to future improvements made by new technologies.

From the technical/construction standpoint, Miniaction servo drive/inverters are divided into: mains filter (EMC), mains rectifier and voltage balancing stage, power stage with IGBT module, dynamic braking stage, motor control CPU, and a CPU for I/O and fieldbus management. Other components included in these servo drives include resistors, capacitors, components providing both active and passive control, electrolytic filter capacitors, relays and transformers. The section devoted to I/O and fieldbus management includes: optoisolators; connectors for the fieldbus, encoder and I/Os; micro-controllers; and active and passive components in the various electronic circuits.

This quasi-machine is specifically designed for asynchronous and brushless AC motors, and is suitable for inclusion in electrically powered machines.
The device operates on 230 VAC single-phase power and (on certain versions, only) on 24 VDC auxiliary power. When applicable, this auxiliary power is used to feed the control section of the device.

Versions equipped with a fieldbus interface enable a "master" device to send command signals to the device (such as start, stop, motor speed and/or position, parameters for the motor and/or servo drive/inverter, etc.), besides enabling diagnostics to be run (when applicable).

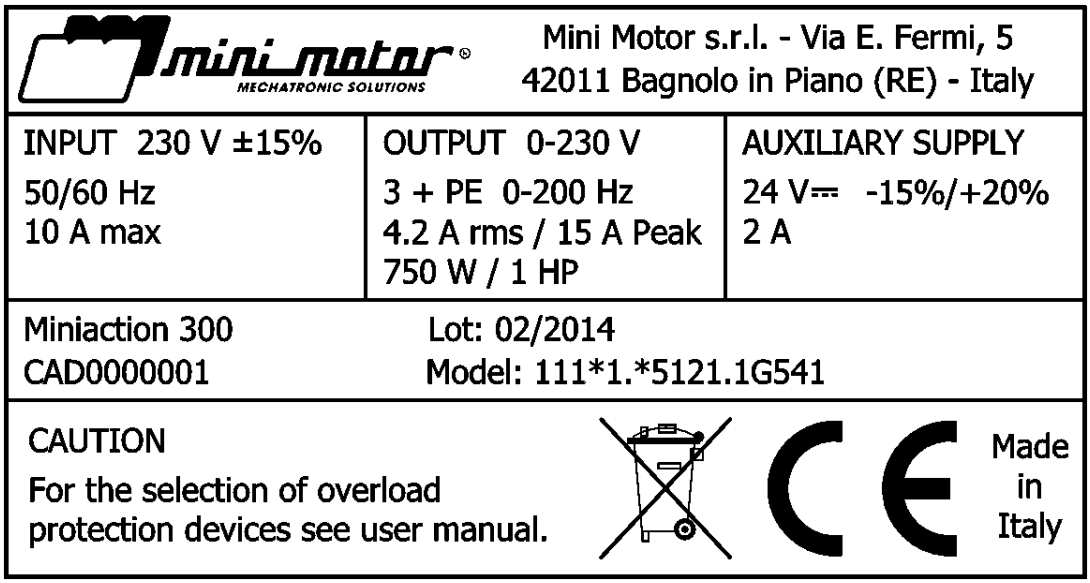
All versions of the Miniaction servo drive/inverter can be connected to an external HMI display (model TTR001) that is used for diagnostics, parametrisation, readout of analogue and/or digital parameters and values, and for sending certain command signals to the device itself.

Operation of the quasi-machine is controlled by micro-controllers, which can be updated with new versions of firmware as necessary. The micro-controllers manage external communication over a fieldbus, and over analogue and digital I/Os, and also control the motor.

Miniaction servo drive/inverters comply with EN 61800-3 (2004) + A1 (2012) electromagnetic compatibility requirements for installation in environment 2 (the "*second environment*", category C3), as long as the conditions in this Installation, Operation and Maintenance Manual are met.

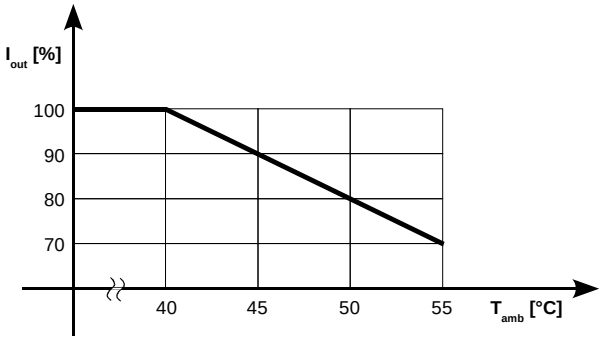
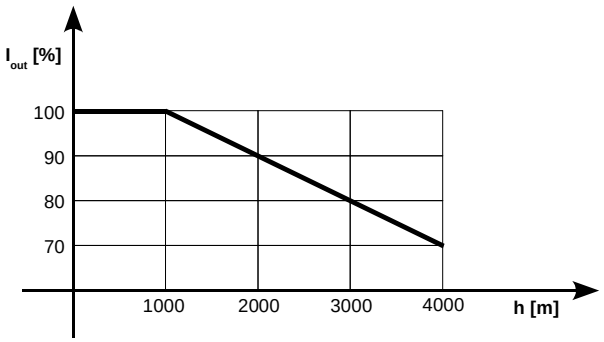
If the quasi-machine malfunctions and/or breaks down, it must be replaced in its entirety because it is not designed to undergo regular or special maintenance.

5.2 Marking


mini_motor
MECHATRONIC SOLUTIONS
Mini Motor s.r.l. - Via E. Fermi, 5
42011 Bagnolo in Piano (RE) - Italy
INPUT 230 V ±15%
50/60 Hz
10 A max
OUTPUT 0-230 V
3 + PE 0-200 Hz
4.2 A rms / 15 A Peak
750 W / 1 HP
AUXILIARY SUPPLY
24 V⎓ -15%/+20%
2 A
Miniaction 300
CAD0000001
Lot: 02/2014
Model: 111*1.*5121.1G541
CAUTION
For the selection of overload
protection devices see user manual.
Made
in
Italy

5.3 Technical specifications

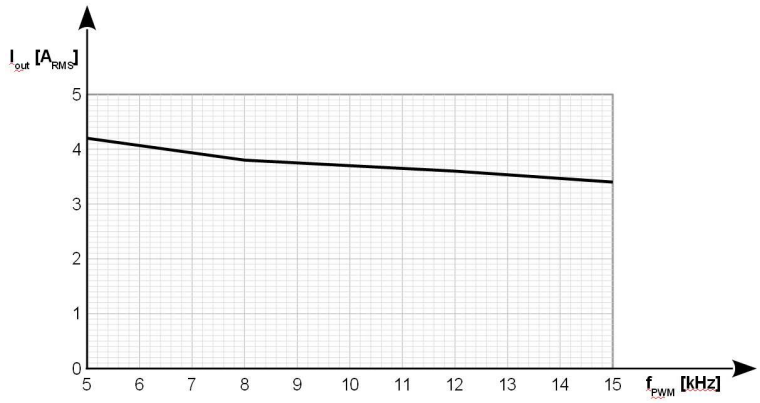
5.3.1 Environmental specifications

Operating temperature	0 to +40°C when operating at full load
	0 to +55°C when operating at derated current
Output current derating as a function of ambient temperature	
Humidity of air during operation	5 to 85% without condensation
Storage temperature	-25 to +55°C
Humidity of air during storage	5 to 95%
Temperature during transport	-25 to +70°C
Humidity of air during transport	5 to 95%
Maximum altitude	1000 m ASL at nominal output current
	4000 m ASL at derated output current
Output current derating as a function of altitude	

5.3.2 Power requirements

Main input voltage	230 VAC ± 15% @ 50/60 Hz, single-phase
Distribution systems allowed	TT, TN (operation with IT systems is allowed only when the built-in mains filter is disabled)
Maximum short-circuit current	5 kA at point of installation
Maximum mains input current	10 A RMS
Auxiliary input voltage	24 VDC -15 to +20%; max. ripple: 5% of nominal value
Maximum auxiliary current	0.2 A (with I/Os disconnected)

5.3.3 Motor output

Output voltage	0 to 230 V, tri-phase
Switching frequency	5/10/15 kHz
	4.2 A DC
	4.2 A RMS with f_{sw} = 5 kHz
	Output current derating as a function of switching frequency according to the following graph: 
Maximum size of asynchronous motor	0.75 kW (shaft rating)
Deliverable active power	1 kW max.
Peak output current	15 A
Protection systems	against phase-to-phase short-circuit, overload, overheating of servo drive, overheating of motor

5.3.4 Dynamic braking output

Type	circuit piloting braking resistor with IGBT
Protection systems	against short-circuit on breaking resistor
Resistance of braking resistor	30 ÷ 150 Ω
Average deliverable power	150 W max.

5.3.5 Encoder input

Type	input for readout of incremental encoder with 5 V differential signals
Maximum input frequency	200 kHz

5.3.6 Resolver input

Type	input for resolver readout
Input for excitation signal	5 kHz

5.3.7 Digital inputs

Type	24 V digital
Max. frequency of input signal	1 kHz

5.3.8 Digital outputs

Type	24 V pnp (current-sourcing) digital outputs
Maximum deliverable power	30 mA
Protection systems	against short-circuit, overload and overheating

5.3.9 Static braking output

Type (Miniaction 300 and 500)	24 V pnp (current-sourcing) digital output
Type (Miniaction 200 and 400)	24 V npn (current-sinking) digital output
Maximum deliverable power	500 mA

5.3.10 Counter input

Type	24 V digital
Max. input current	4.5 mA @ V_{in}=24 V
Input signal frequency range	0 to 100 kHz

5.3.11 0 to 10 V input

Input voltage range	0 to 10 VDC
Input resistance	147 kΩ typ.
Resolution	12 bit

5.3.12 4 to 20 mA input

Input current range	4 to 20 mA DC
Resolution	12 bit

5.3.13 Input for motor temperature sensor

Sensor types	NTC, PTC and thermal trip device
Resolution	12 bit

5.3.14 0 to 10 V output

Output voltage range	0 to 10 V DC
Resolution	10 bit
Maximum deliverable current	10 mA

5.3.15 Reference voltage output

Output voltage	10 V DC (fixed)
Maximum deliverable current	10 mA

5.4 Configurations / order codes

As of the date this manual was published, the following standard configurations were available.

Type	Fieldbus	Motor type	Encoder type	I/O	Static braking	Dynamic braking
Miniaction 300	RS485 Modbus	Brushless + Asynchronous, tri-fase	Incremental, with 5 V differential linedriver outputs on ch. ABUVW + resolver	17 x InD 5 x OutD 2 x InA 1 x OutA	X	X
Miniaction 200	RS485 Modbus	Brushless + Asynchronous, tri-fase	Incremental, with 5 V differential linedriver outputs on ch. ABUVW + resolver	4 x InD 1 x OutD 2 x InA 1 x OutA	X	X
Miniaction 400	RS485 Modbus	Tri-phase asynchronous	-	4 x InD 1 x OutD 2 x InA 1 x OutA	X	-
Miniaction 500	RS485 Modbus	Tri-phase asynchronous	Incremental, with 5 V differential linedriver outputs on ch. AB	17 x InD 5 x OutD 2 x InA 1 x OutA	X	-

5.5 Accessories

Miniaction servo drives/inverters are supplied with a complete set of removable power and I/O connectors (where applicable). These connectors can be ordered separately, as can the other accessories not included with the servo drive. The following is a list of codes to be used when placing orders

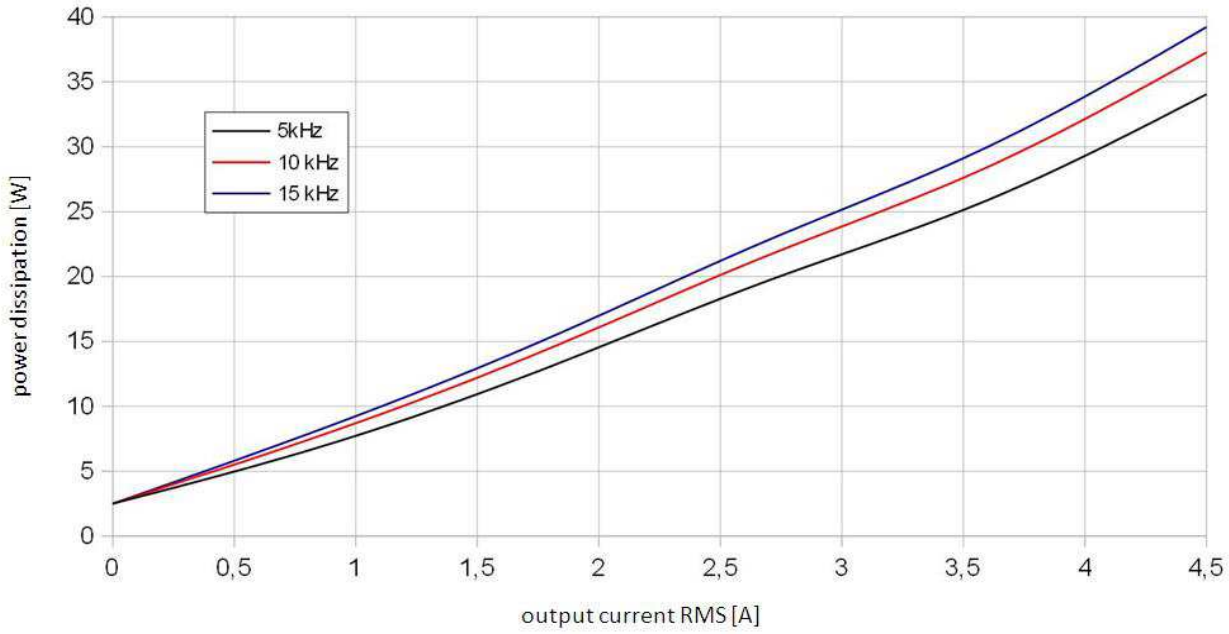
Article	Order code
Operator interface TTR001	TTR001
Connector for 24 VDC power and I/O (8x2) for code no. Miniaction 300/500	CNN066
I/O connector (9x2) for for code no. Miniaction 300/500	CNN067
Connector for 24 VDC power and I/O (8x1) for Miniaction 200/400	CNN068
I/O connector (9x2) for code no. Miniaction 200/400	CNN069
USB-RS485 adapter	http://www.brainboxes.com/product/us-324/1-port-rs422-485-usb-to-serial-adapter

5.6 Heat

Because of the imperfect nature of electronic components, a servo drive dissipates a certain quantity of electric power as heat during operation. This phenomenon results in an increase in the temperature of the components, especially those in the power section, and must be taken into consideration when the capacity of the cooling system for the electrical panel is determined.

The amount of power dissipation depends not only on the effective value of the output current delivered, but also on the switching frequency of the PWM signals. The graph below, which applies to all versions of the device, shows the total heat dissipation of the servo drive as a function of effective output current; the three different curves show data obtained at three different switching frequencies. Note that:

- If output current varies over time, the average power dissipation must not be calculated from the average current only, but also by including instantaneous power dissipation.
- Power dissipation strongly depends on the switching frequency of the servo drive.
- The power dissipated from the braking resistors must be determined separately.
- Power dissipation depends relatively little on the power factor of the load; rather, it is mainly associated with the absolute value of the output current. In other words, power dissipation is not directly associated with the active power delivered to the load.



Since the current that can be delivered by the servo drive depends on ambient temperature, a cooling system must be provided in order to prevent a reduction in actual deliverable current, when necessary.

5.7 Electromagnetic compatibility (EMC)

These servo drives/inverters comply with IEC 61800-3 2004-12 requirements for installation in environment 2 (the "second environment", category C3), as long as the following conditions are met.

- The connection between servo drive and motor is made using an adequately sized, shielded cable.
- The shield is securely connected to earth on both sides using a low RF impedance connection.
- The type and size of the motor are suited to the servo drive.
- The servo drive is placed into service by professional technicians according to the instructions contained in this manual.

	The built-in filter ensures compliance with 61800-3 only if a single servo drive is operating. Simultaneous operation of a number of servo drives could increase the generated noise level, and the emission levels mandated by the standard could be exceeded. In this case, an additional filter may be necessary.
	These servo drives are not designed to operate in a home environment (the "first environment" as per IEC 61800-3). If it is operated in these conditions, an additional mains filter will probably be required.
	The built-in mains filter can be disabled if excessive current loss to earth is generated by the filter. In this case, an external low-loss mains filter is usually required.

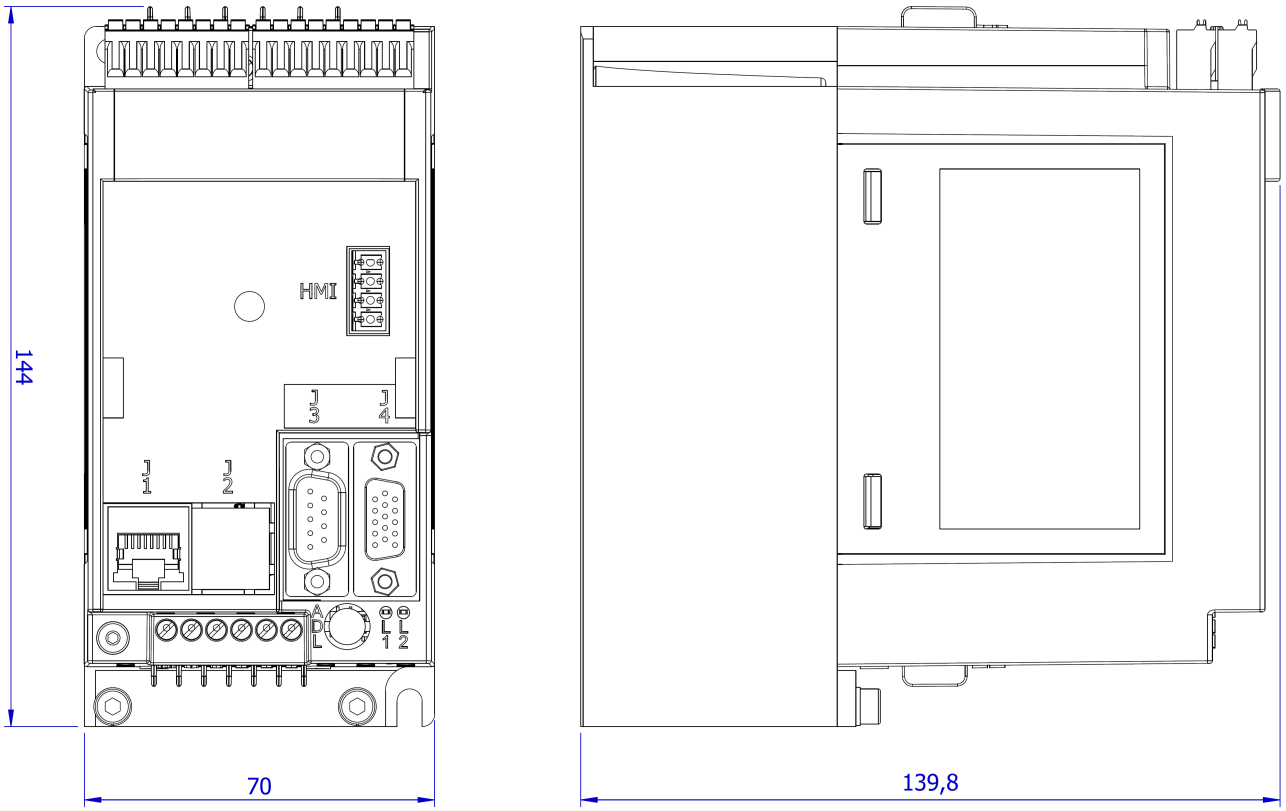
5.8 Mechanical specifications

5.8.1 Weight

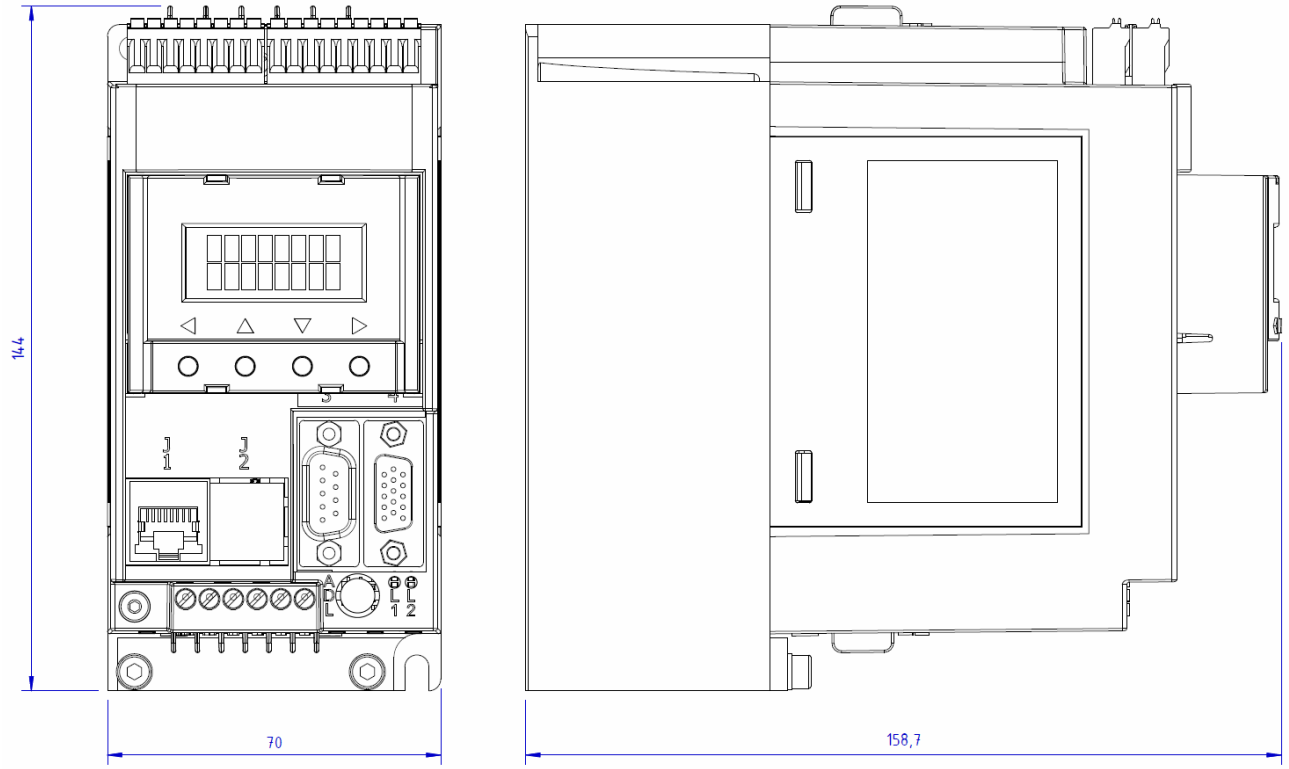
The following table lists the approximate weights of the various models, with all removable connectors installed:

Type	Weight (Kg)
Miniaction 300	1.0
Miniaction 400	1.0
Miniaction 200	1.0
Miniaction 500	1.0

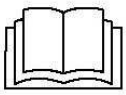
5.8.2 External dimensions without operator interface



5.8.3 External dimensions with operator interface TTR001



6 USES OF THE MACHINE

	The quasi-machine is designed to operate automatically only after it has been incorporated into another machine. When operating the machine in the manual mode, the safety instructions contained in this manual must be followed to the letter.
	Some user-accessible connections and many internal parts in the servo drive carry high voltage and can thus electrocute upon contact. Be especially careful not to touch the power terminals or the motor/dynamic brake connection.
	A motor is a static generator. Its speed of rotation is translated into electrical potential. The motor generates dangerously high voltage at speeds as low as 300 RPM.
	Always make sure that personnel working on the machine are qualified and fully informed about the risks they are exposed to, as well as about the precautions they must take to avoid these risks.
	Avoid contact with the metal surfaces on the servo drive, because they can get very hot during operation. Painful burns may result!
	The use of Miniaction servo drives is authorised only after the operating area of the final machinery is officially classified and only after a check is made to verify its level of safety, which must be consistent with the safety level of the device.

6.1 Limitations on use

	Never use the servo drive unless the case is completely assembled.
	The operating temperature range of the servo drive is 0 to 55°C; the range in which it can operate at nominal current (without derating) is 0 to 40°C.

6.2 Warnings regarding use

	Using the quasi-machine in ways that do not conform to its intended use, as described in this manual, is strictly prohibited. The technical information and drawings contained in this manual may have been modified at a later time. Therefore, please see the latest versions of the technical drawings or diagrams for the groups or systems comprising the quasi-machine. Revisions, if available, may be requested directly from the manufacturer.

7 RESIDUAL RISKS

	Internally, the servo drive contains capacitors that store dangerous voltage for at least 10 minutes after shut-off. Before performing any operation, make sure the servo drive has been free from mains voltage for at least 10 minutes and that the motor is stopped.
	Certain components in the servo drive (such as the heat dissipater and the shells on the connectors) are made of highly conductive materials. It is vital to make a secure connection to the protective (PE - protective earth) connector using the contact provided.
	Miniaction servo drives must be isolated from their power source before any maintenance is performed and during the maintenance procedure itself.
	Since the quasi-machine may be extremely hot when it is operating or after shut-off, be very careful not to touch it at these times; or, be sure to wear special protection and to take full precautions while handling it.
	When the final machine is designed, suitable safety measures must be provided that prevent possible contact with hot surfaces.
	Metal parts and sharp surfaces may cause cuts and lacerations. Pay special attention and wear appropriate personal protection equipment when contacting such surfaces.

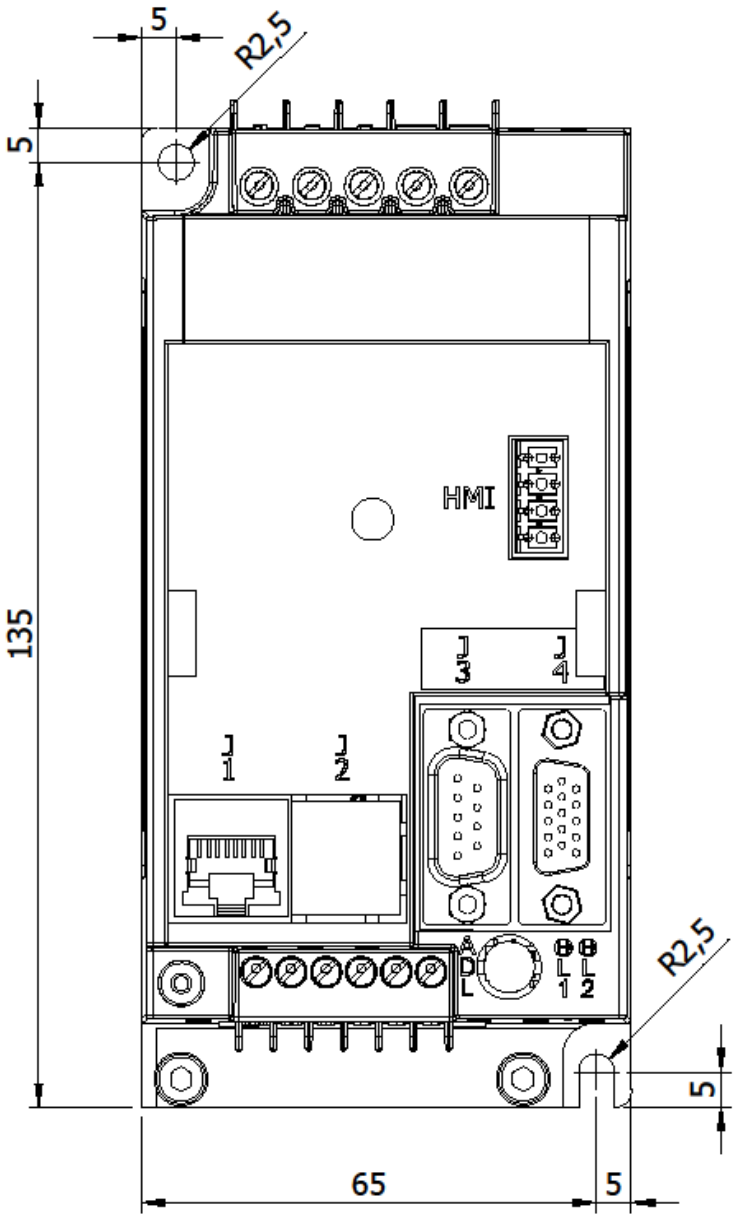
8 INSTALLATION AND PLACEMENT INTO SERVICE

8.1 Preliminary operations

- Check the device and make sure it (and its components) is in good condition.
- Check that all documentation required for installation is available.

8.2 Positioning and mounting

The device must be solidly fastened to the metal wall of the electrical panel using two M5 screws. If vibration occurs during operation, install retention washers (grover or Belleville) or apply threadlocker paste. The figure shows the front view and the recommended drilling scheme.



Since the servo drive heats up during operation, at least 100 mm of obstacle-free space must be left at the top and bottom to allow air to flow uniformly around the device.

The electrical panel must also be able to dissipate this heat without allowing the temperature to rise excessively. A common solution is to install cooling fans or an air conditioner. Filters should be installed to prevent dust from entering and possibly degrading the performance of the heat dissipater. The cooling system must be adequately sized to handle the total amount of dissipated heat.

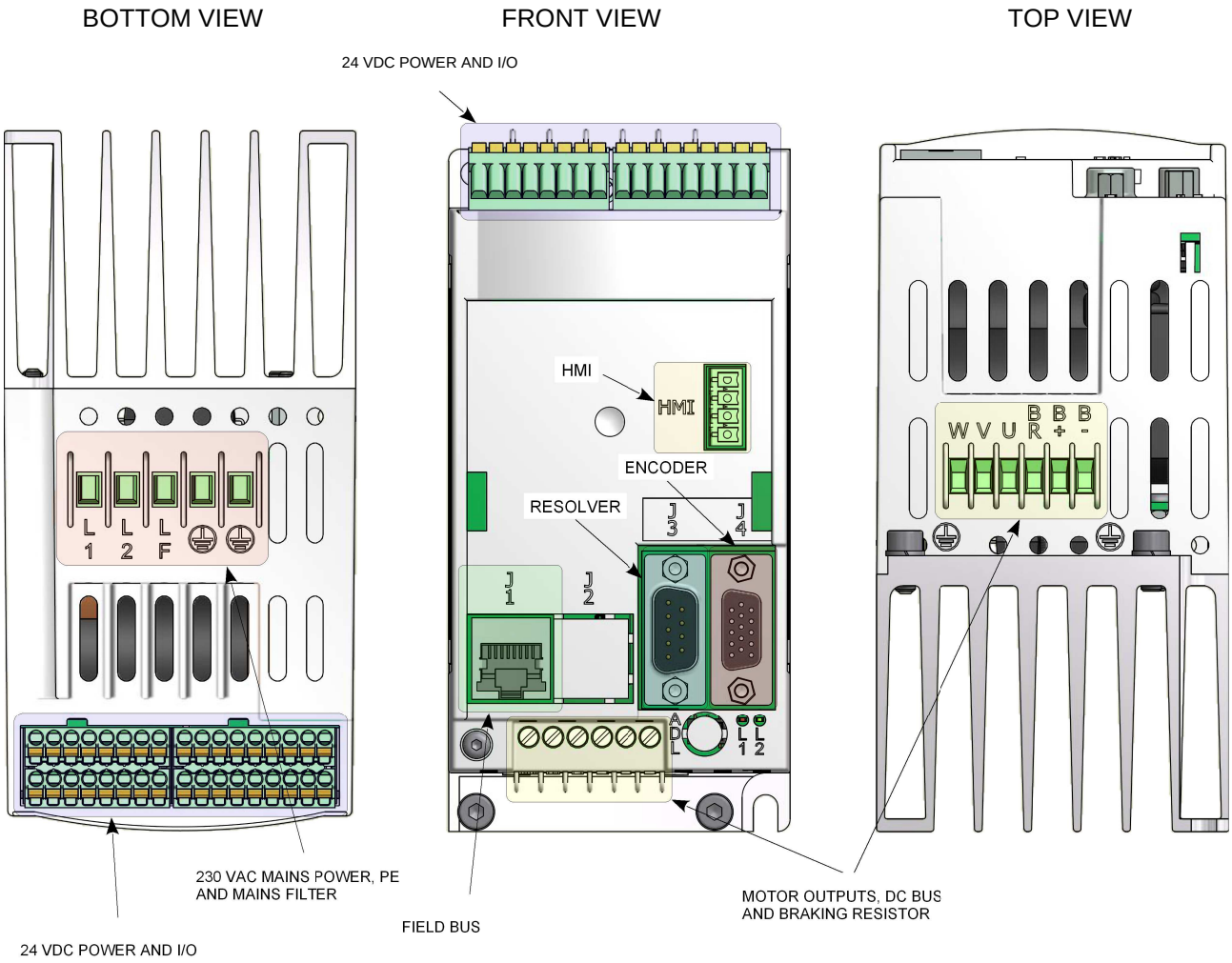
8.3 Electrical connections

The devices described in this manual are equipped with screw-type terminal strips for the high-voltage connections (mains power, motor outputs, bus voltage, braking resistor, PE protective conductor). On the other hand, the low-voltage connections (24 V power, I/Os) are made with removable connectors.

The locations of the connectors and terminal strips in the various models are shown in the sub-sections below.

8.3.1 Connections on MINIACTION 300 and MINIACTION 500

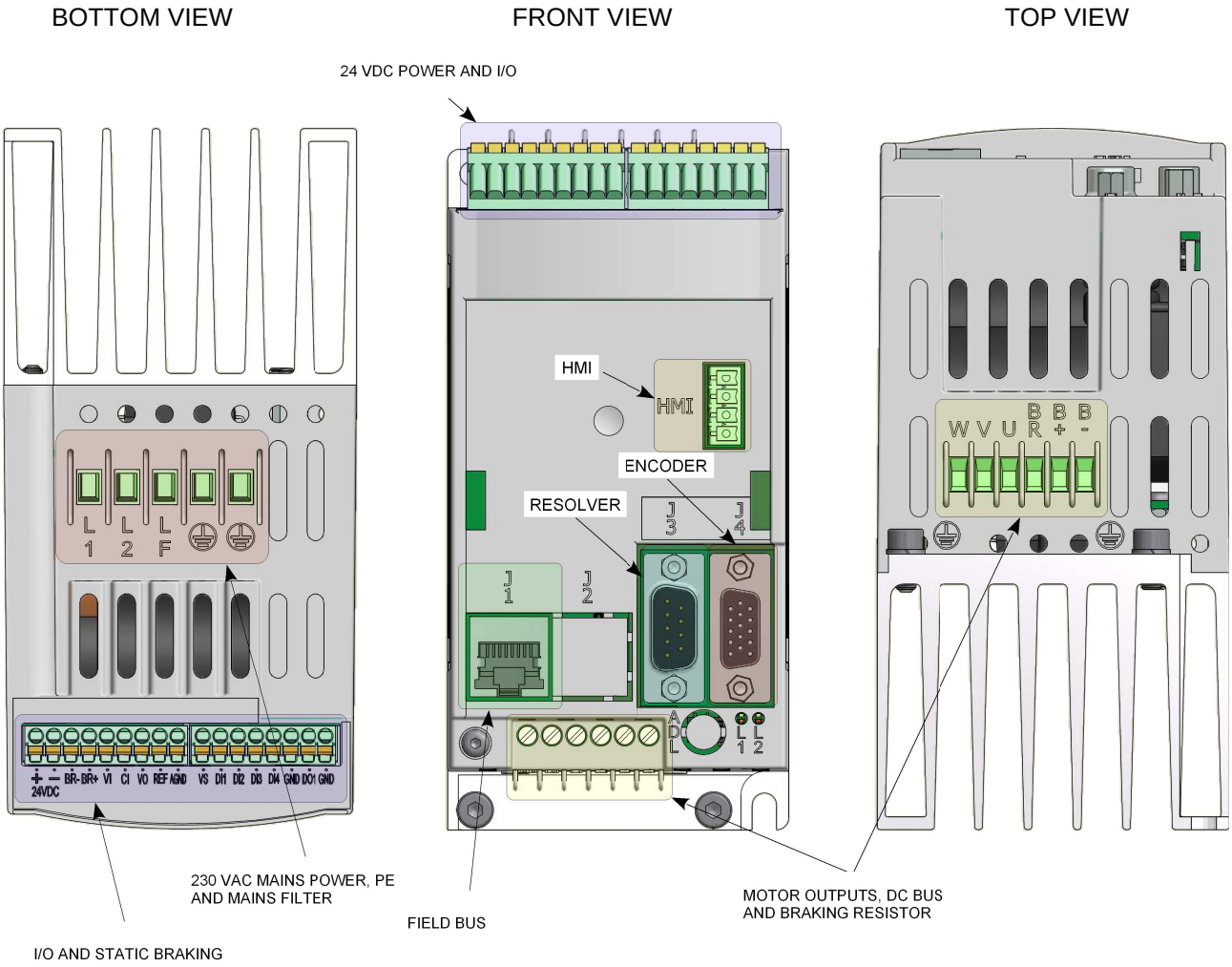
The following image shows the arrangement of connectors and terminal strips:



The Miniaction 300 is also equipped with a stage for piloting the braking resistor.

8.3.2 Connections on MINIACTION 200 and MINIACTION 400

The following image shows the arrangement of connectors and terminal strips:



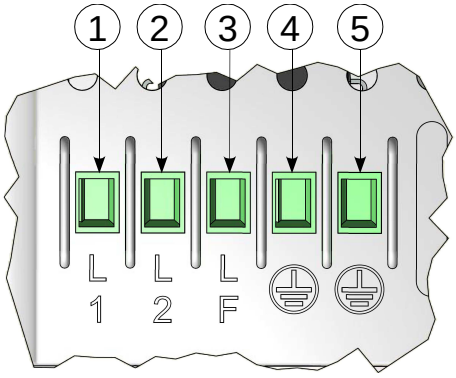
The Miniaction 200 is also equipped with a stage for piloting the braking resistor.

8.4 Mains power and EMI filter

Miniaction servo drives are powered by 230 VAC mains power and are equipped with a mains filter.

	Because of the large capacitance inside the device, all power connections must be made or disconnected only after the mains power has been removed for at least 10 minutes.

These connections are made on the 5-pole terminal strip located at the top of the case (see image). The terminal strip is the same on all versions of the product family.



230 VAC mains power and EMI filter	
labelling	**signal**
L1	230 VAC mains - phase 1
L2	230 VAC mains – phase 2
LF	EMI filter - connection to PE
	PE
	PE

These devices are designed to operate with TT or TN distribution networks. The following image shows the recommended connection scheme:

	For safety reasons, the device must always operate with the PE connection in place. Otherwise, there is a risk of electric shock! The PE connection must be made using the dedicated terminal and not merely with screws.

The specifications of the cables to be used for wiring are as follows:

Minimum cross-section of rigid conductor	1.5 mm^2
Maximum cross-section of rigid conductor	4.0 mm^2
Minimum cross-section of flexible conductor	1.5 mm^2
Maximum cross-section of flexible conductor	2.5 mm^2

The screw-down contacts on the terminal strip must be tightened with a flat-head screwdriver (head width: 3.5 mm); the recommended tightening torque is 0.55 Nm ±10%.

The device and its power cables must be protected against overload and short-circuit by a suitable protection device. Since the input current is strongly distorted by the rectifier, and its effective value may thus be significantly higher than the output current, the protection devices must be chosen carefully.

If a malfunction occurs, the input current may contain a significant continuous component; if fuses are not used to provide protection, a type-B protection device must be used.

	An inadequate overload protection device might not trip, which would be hazardous to persons and property. Also, the device might trip for no good reason.

	Make sure that the maximum short-circuit current at the power input terminals on the device is less than 5 kA; otherwise, use adequate limiting devices (such as fuses).

If fuses are used to protect the servo drive, they must be correctly sized to guarantee that the drive and its input power conductors are protected. If 10x38 mm class gG cartridge-type fuses are used, the minimum size for guaranteeing operation at full power is 12 A. The size of fuses of a higher nominal current must not exceed 20 A: if a malfunction occurs, the maximum short-circuit current the drive can handle may be exceeded.

If bus voltage and/or voltage on the dynamic braking resistor is/are connected, a short-circuit occurring in the circuitry located after the connection could damage the rectifier bridge. To provide protection, use fuses with an I^2t value lower than 90 A^2s. Using 10X38 class gR cartridge fuses with a nominal current rating of 12 A will protect the servo drive in this case as well.

If short-circuit protection is provided by partial-range fuses (such as class aR), overload protection must be provided in other ways (for example, with circuit breakers).
If the servo drive is to be used to build a machine, see standard EN 60204-1 for further information on sizing criteria.

	The fuses used for protection must correctly sized to provide protection against short-circuit and overload. The cut-off rating of the fuses must not be lower than the maximum specified short-circuit current.

The servo drive includes an EMI mains filter for reducing conducted emissions. This filter is designed to comply with IEC 61800-3 standards (second environment, installation category C3). If the servo drive is installed as described in this manual, the filter is generally adequate for its purpose. The filter can be enabled and disabled, as desired. To enable it, use a short piece of cable to short-circuit pins 3 (LF) and 4 (PE) on the input terminal strip.

The EMI filter creates a significantly large discharge current toward earth. In applications where such current may cause problems (such as overly slow tripping of differential switches), the user may disable the internal mains filter. However, this will result in a significant increase in conducted emissions from the device, and an external EMI filter will generally be necessary. In this case, or if different emission levels are required (for example, because of different regulations, a different installation category, etc.), the user is solely

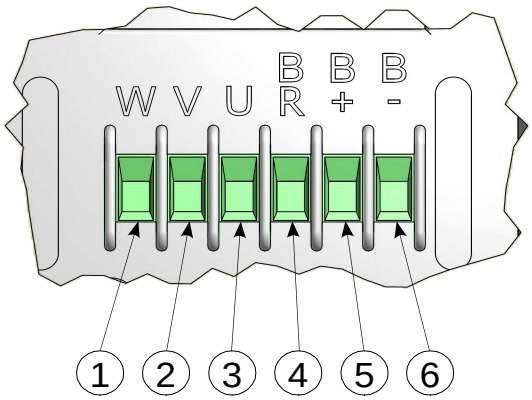
responsible for choosing the filter.

	The EMI filter creates a significantly large discharge current toward earth. To prevent the risk of electrocution by touching exposed metal parts (such as the heat dissipater), do not apply power to the servo drive unless the PE connection is correctly connected.

Installing a group of multiple devices causes an increase in the level of generated noise, and the emission levels mandated by the applicable standards may be exceeded as a result. A supplementary external filter may be necessary in this situation. Given the extremely variable operating conditions in question (number of servo drives, length of cables, total current values, required insertion loss), the user is responsible for choosing this filter.

8.5 Motor, braking resistor and DC bus connections

These connections are made on the 6-pole terminal strip provided. The following illustration shows its pin configuration.



Motor, braking resistor and DC bus	
labelling	**signal**
W	motor terminal - phase W
V	motor terminal - phase V
U	motor terminal - phase U
BR	terminal for braking resistor
B+	bus voltage - positive
B-	bus voltage - negative

The specifications of the cables to be used for wiring are as follows:

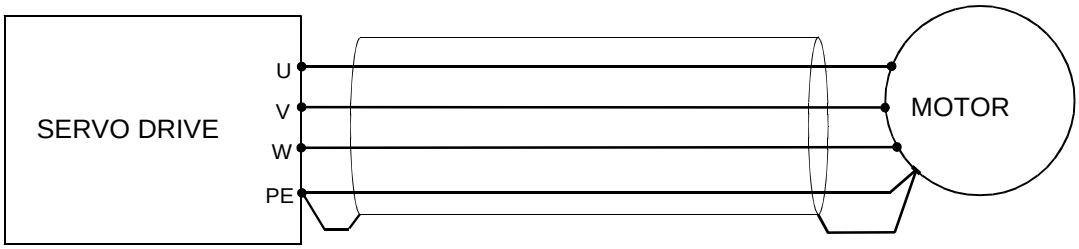
Minimum cross-section of rigid conductor	0.75 mm^2
Maximum cross-section of rigid conductor	2.5 mm^2
Minimum cross-section of flexible conductor	0.75 mm^2
Maximum cross-section of flexible conductor	2.5 mm^2

The screw-down contacts on the terminal strip must be tightened with a flat-head screwdriver (head width: 3.5 mm) or with a Phillips head screwdriver (size PH 0); the recommended tightening torque is 0.55 Nm ±10%.

The conductors must be correctly sized to handle the maximum current. If the servo drive is installed in the electrical panel of a machine, remember that standard EN 60204-1 does not allow the use of cables with a cross-section smaller than 0.75 mm^2 on the inside of housings and smaller than 1.0 mm^2 on the outside (0.75 mm^2 for multicore cables). To connect the motor, a shielded multicore cable with a cross-section of 0.75 mm^2 may be an excellent choice in most applications.

	The cross-section of the conductors used to connect bus and braking resistor voltages must be large enough to handle the maximum short-circuit voltage on the input power terminals of the servo drive.

8.5.1 Motor connection



The motor is connected as shown in the following figure:

Due to the high noise levels generated by PWM modulation on the motor outputs, the use of shielded cable is strongly recommended for connecting motors. The shield must be connected to earth on both sides using a low-impedance connection (such as a metal cam). Using an unshielded cable or a shielded cable whose shield is not connected to earth may generate EMC problems and interference with nearby devices.

As a safety measure, the motor must be securely connected to a PE using a cable. Do not rely solely on the electrical conductivity of the machinery frame.

The direction of motor rotation depends on the order in which the phases (U, V and W) are connected. To reverse the rotation of an asynchronous motor, simply invert two phases. On a brushless motor, incorrect phase connection can cause unpredictable operation and possible injury/damage to persons/property.

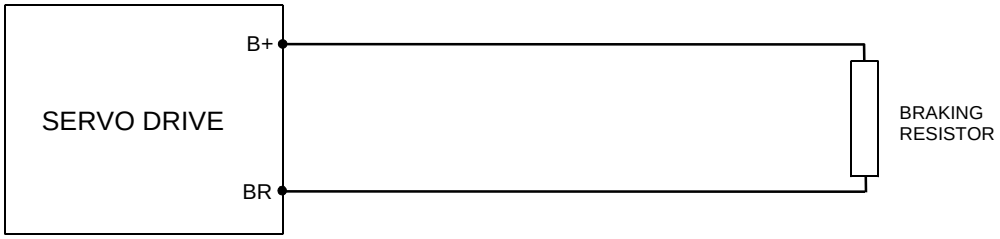
The motor cables are significant sources of noise. Keep them as far away as possible from signal cables,which will prevent possible deterioration of the signals.

8.5.2 Dynamic braking resistor connection

Some versions of this servo drive/inverter are equipped with a stage for piloting a resistor used to generate dynamic braking. This function is useful when the motor must be abruptly decelerated during operation (for example, during an emergency stop or due to the action of cams controlling operation). When a motor is abruptly braked, a flow of electric power is generated and directed into the servo drive. This energy is stored in the bus capacitors, which increases their voltage. If a dynamic braking stage is not included, the servo drive will be disabled and an error code will be generated when bus voltage reaches the safety threshold. To overcome this problem, the device incorporates an electronically controlled IGBT that is activated when a pre-set voltage threshold is exceeded, thus dissipating the energy of the external braking resistor in a controlled manner.

	Remember that the servo drive must be programmed with the correct parameters when a braking resistor is used. The use of incorrect parameters could damage the resistor and/or servo drive, besides causing a risk of fire.

The recommended connection scheme is shown in the following diagram:



The use of an external braking resistor could damage the servo drive if a short-circuit occurs. Use protection devices that can limit current value I^2t (see the previous paragraph for an explanation of this subject).

8.5.3 Bus voltage connection

Bus voltage is available on the terminal strip (contacts B+ and B-) for connecting a servo drive battery in parallel, if desired. This connection is advantageous from the standpoint of power dissipation in the braking resistors, because a portion of the power generated during braking can be used by another servo drive instead of being dissipated in the braking resistor.

Using this type of connection is essential for ensuring that the power fed to all the servo drives involved is connected and/or cut off at the same time, thus preventing them from overload.

	When connecting multiple servo drive/inverters to a common bus, be sure to observe the polarity of the bus voltage; otherwise, damage to the servo drives and/or a fire hazard may occur.

	When connecting multiple servo drive/inverters to a common bus, the power on all the devices must be switched on/off at the same time; otherwise, damage to the servo drives and/or a fire hazard may occur.

	When multiple servo drive/inverters are connected to a common bus and the power to an individual device is switched off, it will continue to be electrically live. Do not touch the terminal strips or perform any maintenance on the device, due to the risk of electrocution.

	When multiple servo drive/inverters are connected to a common bus and the power to an individual device is switched off, it will continue to be electrically live and therefore able to start the motor. Do not perform any mechanical maintenance, due to the risk of injury/damage to persons/property.

If a short-circuit occurs when a bus connection is made, damage to the servo drive may occur. Use protection devices that can limit current value I^2t (see the previous paragraph for an explanation of this subject).

8.6 24 V auxiliary and I/O power

This family of servo drive/inverters can be equipped with one or more connectors for connecting 24 V auxiliary power (where required) and I/Os (if present). The following paragraphs describe the pin configuration of the connectors.

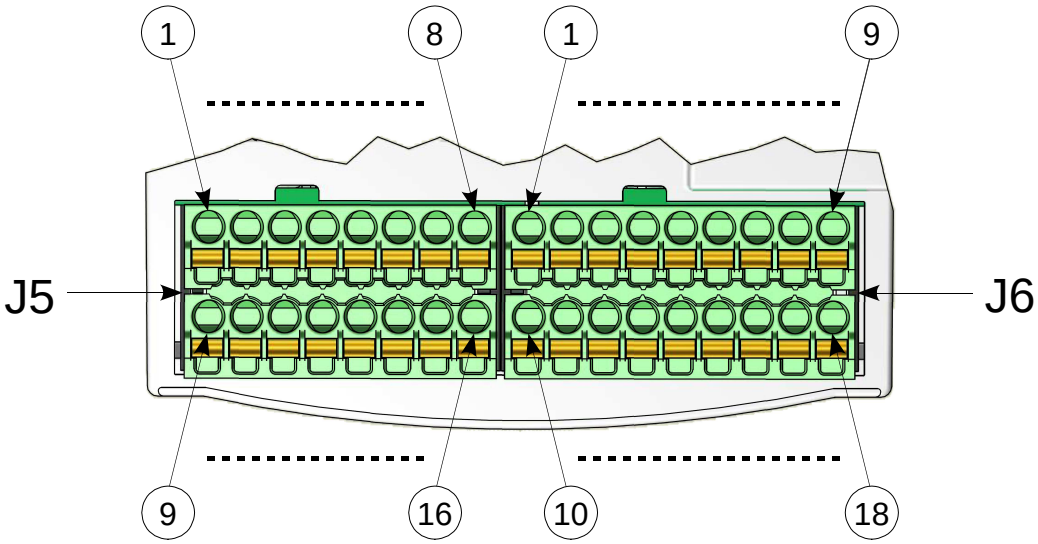
All versions of the servo drive use removable spring-loaded connectors. The acceptable cross-sections of the cables used for wiring are as follows:

Minimum cross-section of rigid conductor	0.20 mm^2
Maximum cross-section of rigid conductor	1.5 mm^2
Minimum cross-section of flexible conductor	0.20 mm^2
Maximum cross-section of flexible conductor	1.5 mm^2
Minimum cross-section of flexible conductor with terminal	0.25 mm^2
Maximum cross-section of flexible conductor with terminal	0.75 mm^2

Use a flat-head screwdriver to wire the connector. Insert the edge of the head into the orange cavity and press to open the contact. At the same time, insert the cable. Use a screwdriver with a 2.5 mm flat head.

8.6.1 Connections on the MINIACTION 300 and MINIACTION 500

This version is equipped with two removable connectors (J5 and J6) for wiring 24 V auxiliary power and 24 V analogue and digital I/Os. The following is the pin configuration of the connectors:

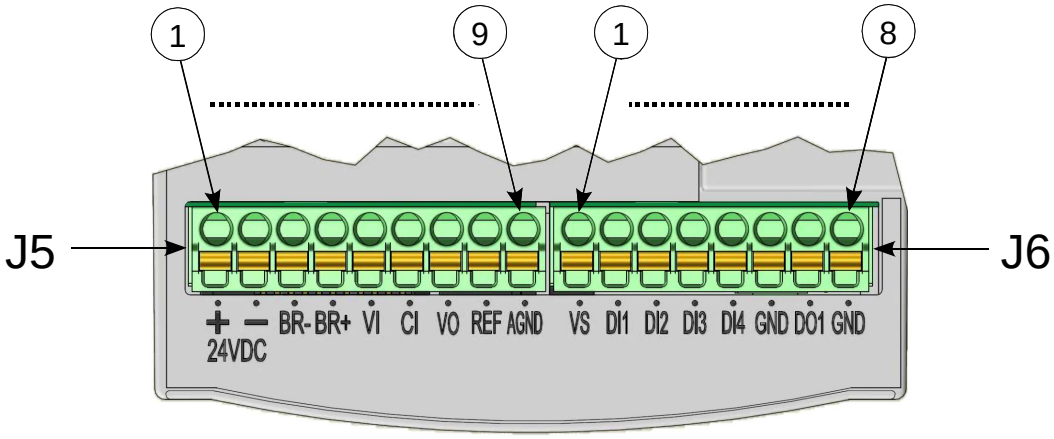


24 V and I/O power			
connector J5		connector J6	
pin	signal	pin	signal
1	24 VDC power: positive side	1	digital output #1
2	24 VDC power: negative side	2	digital output #2
3	earth on analogue I/Os	3	digital output #3
4	0 to 10 V input	4	digital output #4
5	reserved	5	digital output #5
6	reserved	6	digital input #1
7	dynamic braking output: positive side	7	digital input #2
8	dynamic braking output: negative side/dig.	8	digital input #3
9	digital counter input	9	digital input #4
10	earth on digital I/Os	10	digital input #13
11	0 to 10 V output	11	digital input #12
12	10 V reference voltage output	12	digital input #11
13	4 to 20mA input	13	digital input #10
14	digital input #16	14	digital input #9
15	digital input #15	15	digital input #8
16	digital input #14	16	digital input #7
		17	digital input #6
		18	digital input #5

8.6.2 Connections on the MINIACTION 200 and MINIACTION 400

This version is equipped with two removable connectors (J5 and J6) for connecting analogue and digital I/Os.

Unlike other versions, 24 V auxiliary power on this version is used only for motor braking. The control logic is powered directly from the 230 VAC mains. The following is the pin configuration of the connectors:



24 V and I/O power					
connector J5			connector J6		
pin	labelling	signal	pin	labelling	signal
1	24 VDC +	24 VDC power: positive side	1	VS	24 V power for sensors
2	24 VDC -	24 VDC power: negative side	2	DI1	digital input #1
3	BR-	dynamic braking output: negative side	3	DI2	digital input #2
4	BR+	dynamic braking output: positive side	4	DI3	digital input #3
5	VI	0 to 10 V input	5	DI4	digital input #4
6	CI	4 to 20mA input	6	GND	earth on digital I/Os
7	VO	0 to 10 V output	7	DO1	digital output #1
8	REF	10 V reference voltage output	8	GND	earth on digital I/Os
9	AGND	earth on analogue I/Os			

8.6.3 24 V power for sensors

Some versions of the servo drive/inverter require 24 VDC auxiliary power to operate the control logic, I/Os and other peripherals (such as an encoder). The servo drive will not operate without 24 VDC even though it is being powered by 230 VAC.

	For maximum safety, the auxiliary power must be supplied by a PELV power supply with its chassis earth terminal connected to earth (preferably only at one point, to prevent earth loops).

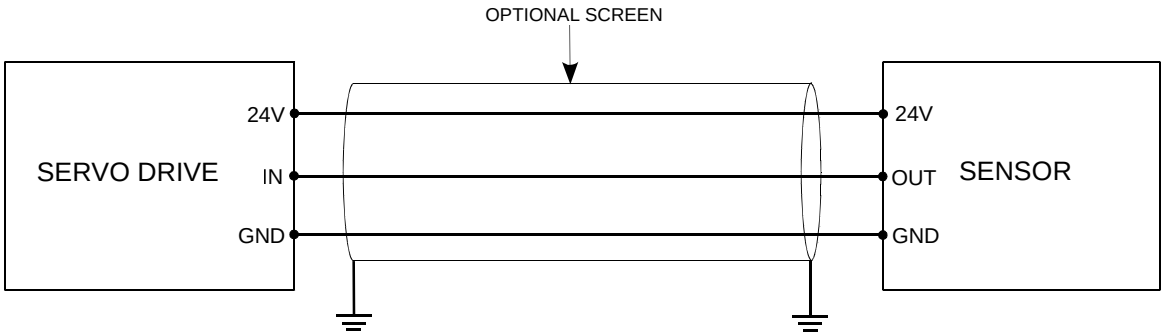
The auxiliary voltage must be stable and within the limits of the servo drive (see the paragraph on this subject). If this voltage is outside prescribed limits, the servo drive may be damaged.

	Check the polarity of the auxiliary power before connecting the servo drive; otherwise, it may be damaged.

8.6.4 24 V digital inputs

Some versions of the servo drive/inverter are equipped with a certain number of 24 V general-purpose digital inputs. These inputs are typically used to acquire data from sensors with a digital output (such as photocells, limit switches, etc.), which are very common in industry.

An example of how a sensor is connected is shown in the following figure. In most applications, ordinary unshielded cable can be used for the wiring.



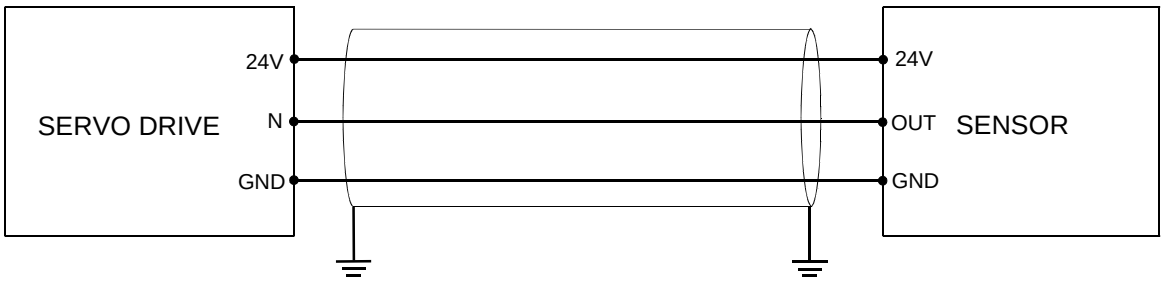
However, if the operating environment is affected by significant electrical noise, or if the distances to be crossed are significant, the use of shielded cable may be necessary. In this case, the shield must be connected to earth on both sides, preferably with a low-impedance connection such as a metal cam. The shield is completely ineffective if it is left floating.

Signal quality may be further improved by keeping the cables as far away as possible from noise sources such as power cables, inverters, power supplies, relays, etc.

	Check sensor polarity before connection. Inverted polarity can damage the sensor and/or servo drive.

8.6.5 Counter input

Some versions of the servo drive/inverter are equipped with a high-speed digital input for use as a counter. It accepts 24 V digital signals and can acquire signals with a maximum frequency of 100 KHz. The recommended connection scheme is shown in the following figure:



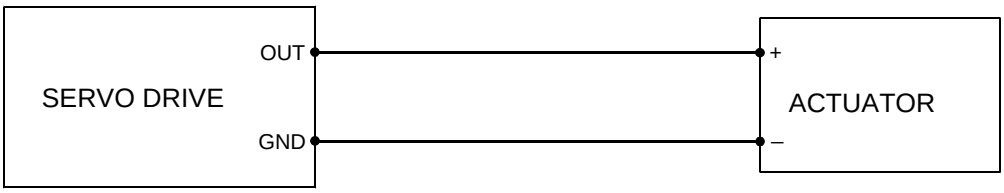
Since the input stage has a relatively wide passband to allow acquisition of high frequency signals, it is particularly susceptible to electrical interference. Therefore, be sure to use shielded cable to make the connections. In this case, the shield must be connected to earth on both sides, preferably with a low-impedance connection such as a metal cam. The shield is completely ineffective if it is left floating.

	Check sensor polarity before connection. Inverted polarity can damage the sensor and/or servo drive.

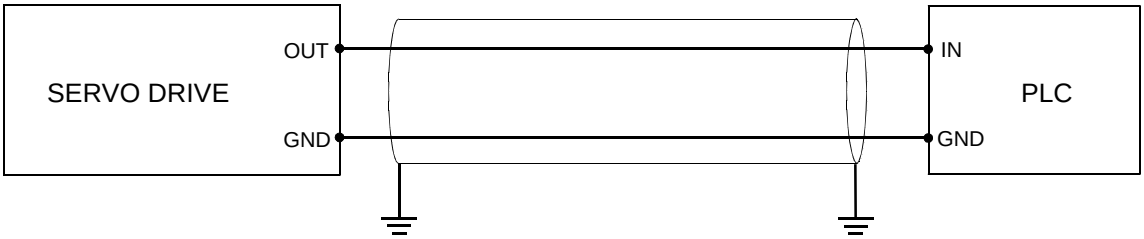
8.6.6 24 V digital outputs

Some versions of the servo drive/inverter are equipped with a certain number of general-purpose 24 V digital outputs. They are typically used for piloting 24 V actuators (such as solenoid valves, relay or contactor coils, light bulbs, etc.) or to generate digital signals (for example, for communicating with a PLC).

A sample actuator connection is shown in the following figure. In most applications, ordinary unshielded cable can be used for the wiring, unless it is a source of interference for nearby devices.



If a digital signal must be generated for communicating with another device (such as a PLC, shown in the example), the recommended connection scheme is as follows:

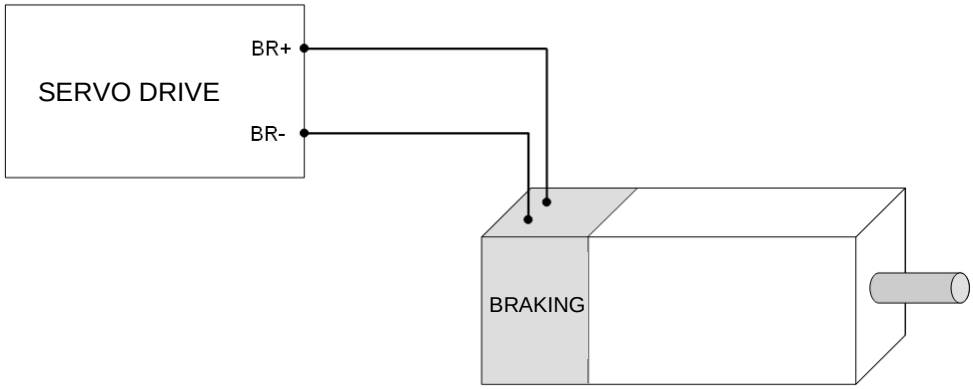


In this case, since there is greater likelihood of electrical interference problems, use shielded cable to make the connections. The shield must be connected to earth on both sides, preferably with a low-impedance connection such as a metal cam. The shield is completely ineffective if it is left floating.

8.6.7 Dynamic braking output

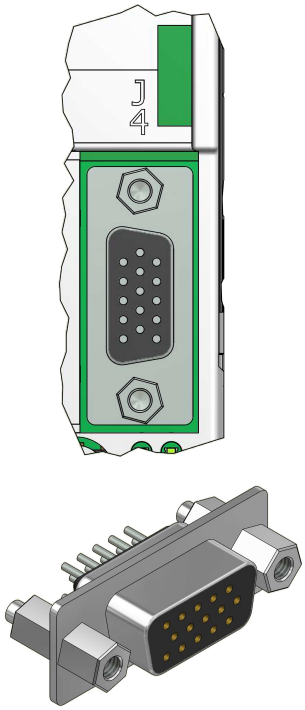
Some versions of the servo drive/inverter are equipped with a digital output for controlling 24 V motor braking.

A sample motor braking connection is shown in the following figure. In most applications, ordinary unshielded cable can be used for the wiring, unless it is a source of interference for nearby devices.



8.6.8 Incremental encoder

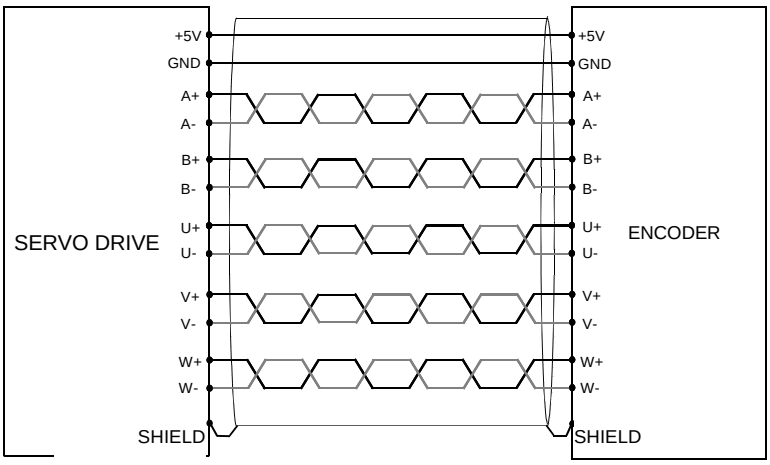
An encoder is used as a feedback device for reading and controlling motor position and speed. These servo drives are equipped with a peripheral device that can acquire data from incremental digital encoders which are powered by 5 VDC and have differential output signals. Differential outputs offer greater noise rejection than common single-ended outputs. When brushless motors are used, the initial position of the rotor must also be known. Thus, the encoder must also be equipped with three Hall-effect sensors. A removable type of connector is used on the encoder. The pin configuration and a diagram of the connector is shown in the following image.



Incremental encoder	
pin	**signal**
1	temperature sensor - pin 1
2	temperature sensor - pin 2
3	+5 VDC
4	GND
5	earth
6	A+ channel
7	B+ channel
8	Hall U+
9	Hall V+
10	Hall W+
11	A- channel
12	B- channel
13	Hall U-
14	Hall V-
15	Hall W-

The interface for the Hall sensors is only provided on versions that can also pilot brushless motors. Carefully check the signal polarity before connecting the encoder; otherwise, the motor could rotate uncontrollably. The result would a risk of electrical and/or mechanical damage to the system.

A sample connection is shown in the following image. If only an asynchronous motor can be piloted, the Hall

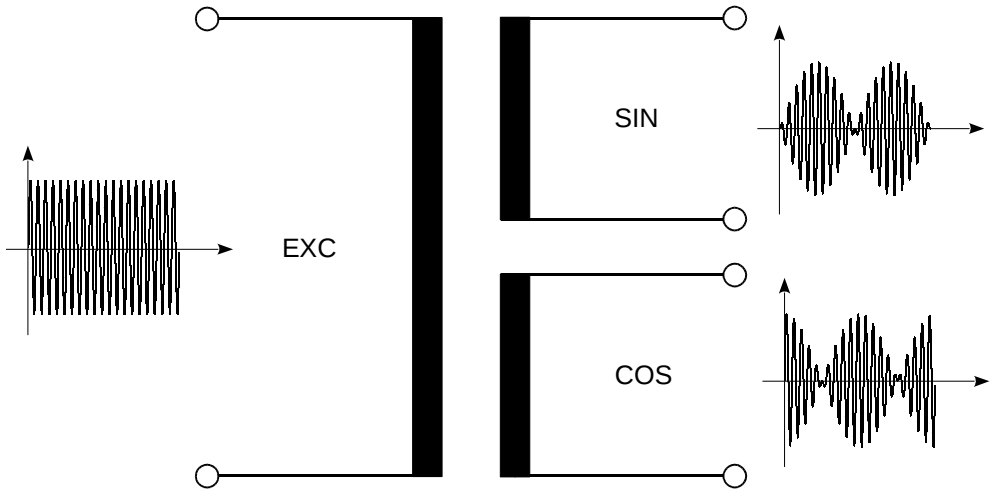


sensors are not included.

Shielded cable must be used for the wiring, and the shield on the end of the cable on the servo drive side must be soldered directly to the shell of the connector. Connect the other end of the shield to the encoder housing, when possible.
Since differential signals are involved, each pair of signals (such as U+ and U-) must be carried with a twisted pair. The cross-section of the power conductors must be properly sized to prevent excessive voltage drops. Conductors with a larger cross-section may be necessary when the wiring extends over great distances. See the technical documentation supplied by the manufacturer of the encoder for further information.

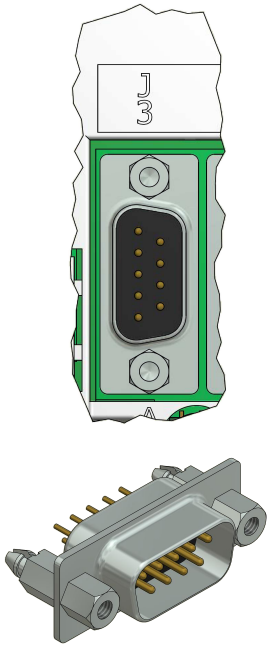
8.6.9 Resolver

Some versions of the servo drive are equipped with a peripheral unit for data acquisition called a resolver, which is used as a feedback device for reading and controlling motor position and speed. The schematic diagram of this transducer is shown in the following figure:



The resolver operates as follows: the servo drive generates a sinusoidal excitation signal with a constant frequency (10 KHz) and amplitude. The resolver has two output coils that generate two sinusoidal signals at the same frequency as the excitation signal, but with an amplitude that depends on the mechanical angle between rotor and stator. By measuring the two instantaneous amplitudes, the position of the rotor can be determined in a way that is completely similar to the method used in a digital encoder.

A removable type of connector is used on the resolver. The pin configuration and a diagram of the connector is shown in the following image.

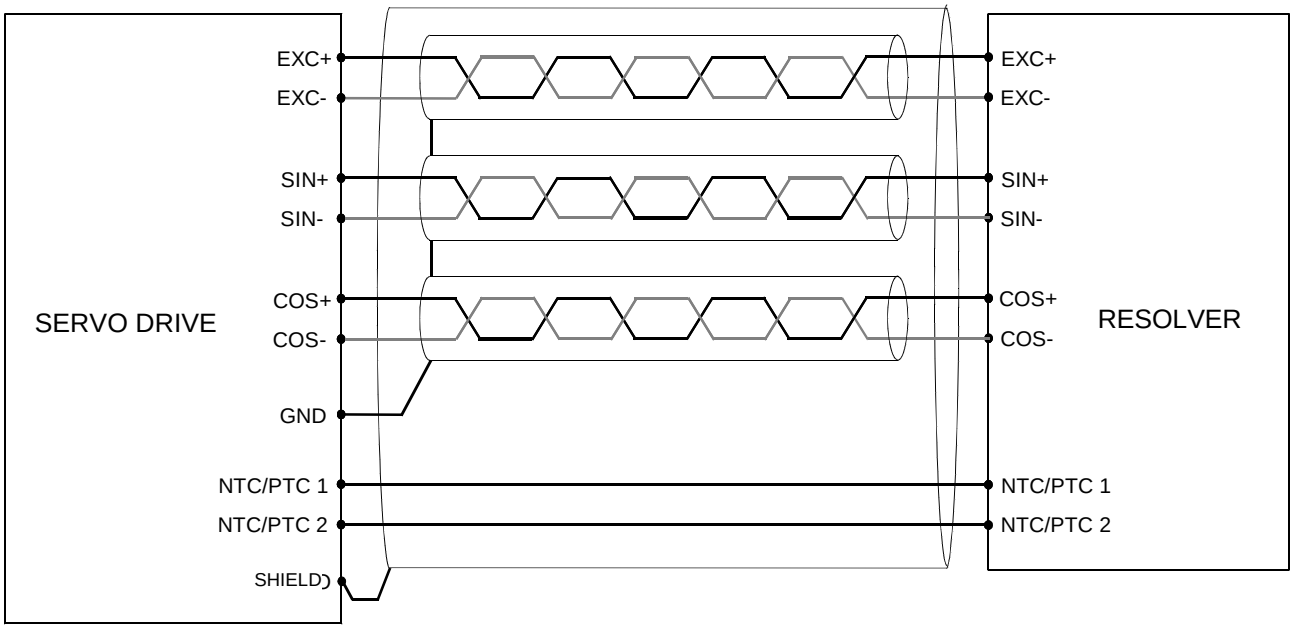


Resolver	
pin	**signal**
1	GND
2	SIN+
3	SIN-
4	EXC-
5	EXC+
6	COS-
7	temperature sensor - pin 1
8	temperature sensor - pin 2
9	COS+

Connections for a motor temperature sensor (see the relative paragraph) are also provided on pins 1 and 2. Shielded cable must be used for this connection, which must be made with three pairs of twisted conductors; also, each pair must be individually shielded. The internal shields must be earthed (GND, pin 1 on the connector), while the external shield must be earthed to the metal shell of the connector on the servo drive side, only.

Since analogue signals are sent by the resolver, they are prone to electrical interference. Be sure to position the cable far away from sources of noise (such as power cables, inverters, switching power supplies, contactors, motors, etc.). If excessive interference occurs in the feedback signal, the motor may behave uncontrollably.

The recommended connection scheme for the resolver is shown in the following image:



8.6.10 Motor temperature sensor

The servo drive is equipped with an input for reading temperature sensors, which are often installed inside the windings to protect them in case of overheating. This peripheral device is designed to acquire data from three different types of sensors:

- NTC - resistors whose resistance decreases as temperature increases
- PTC - resistors whose resistance increases as temperature increases
- Bi-metal switches, which open when a temperature threshold is exceeded

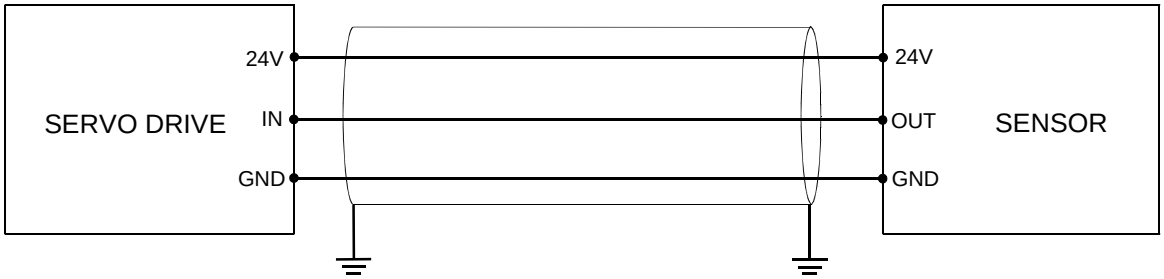
The polarisation current is delivered directly by the servo drive. All that is required is to connect the sensor and program the servo drive correctly. Since these sensors are not polarised, the two terminals can be inverted with no adverse effects whatsoever.

The servo drive must be programmed with the correct parameters for the sensor; otherwise, an incorrect temperature will be detected. This could negatively affect the operation of the thermal protection system, with resulting risk of damaging the motor.

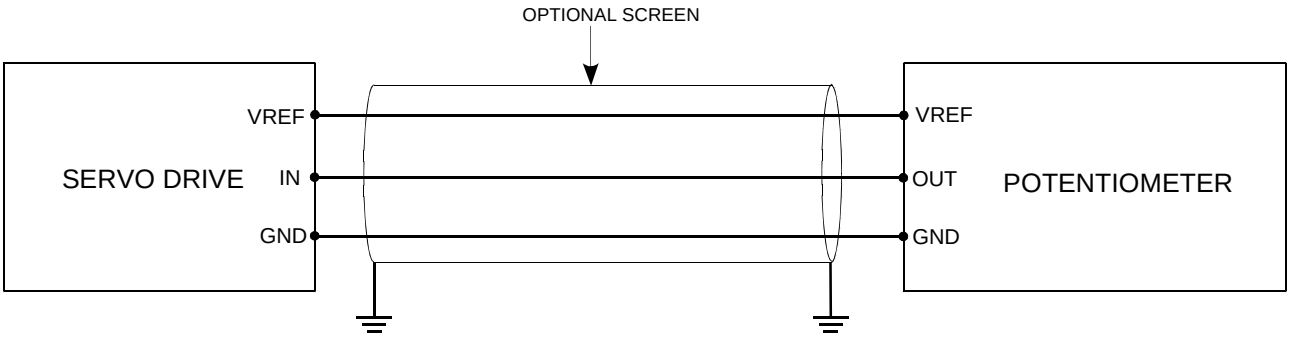
8.6.11 0 to 10 V analogue input and 10 V reference generator

Some versions of the servo drive/inverter are equipped with an analogue input stage for 0 to 10 V signals. Since potentiometers and potentiometer-type position sensors are commonly used, a fixed 10 V voltage is generated for polarizing them.

The recommended connection scheme for a sensor is shown in the following figure:



A potentiometer, on the other hand, is connected as follows:



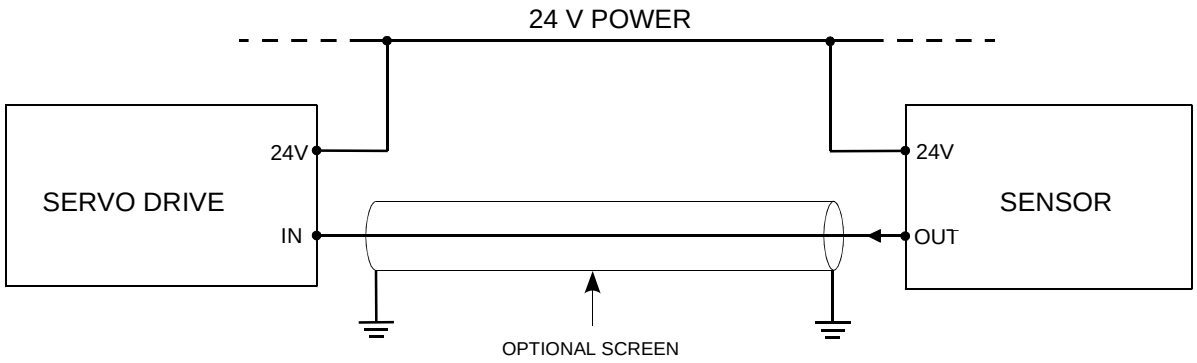
In both cases, shielded cable should be used for connection.

Pay close attention while wiring analogue signal cables used for carrying motor speed or motor position reference signals. If excessive interference is picked up, the motor may behave uncontrollably. Be sure to position the cable far away from sources of noise (such as power cables, inverters, switching power supplies, contactors, motors, etc.).

8.6.12 4 to 20 mA analogue input

Some versions of the servo drive/inverter are equipped with an analogue input stage for 4 to 20mA signals. Current output sensors are very commonly used in industry because they are less susceptible to electrical interference than voltage output sensors. As an added advantage, a disconnected cable is easier to diagnose on this type of sensor (due to absence of current).

The most common type has only two contacts: a contact for 24 V power and an output contact. The recommended connection scheme is as follows:



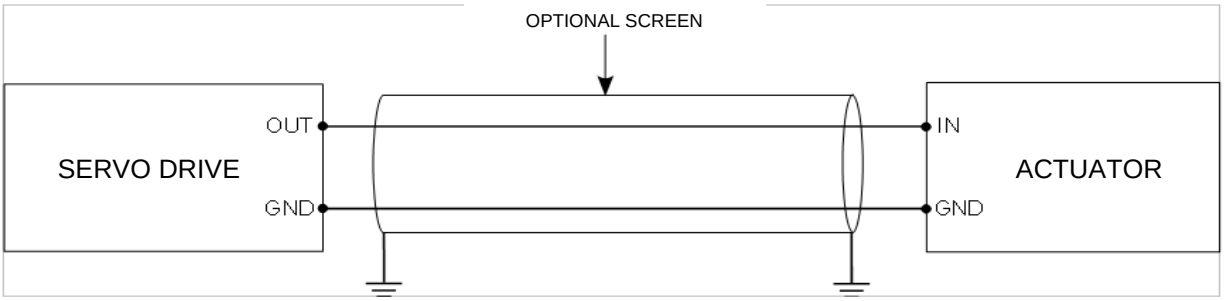
Since 4 to 20 mA signals are inherently resistant to electrical interference, the wiring can be made using common unshielded cable in many cases. However, shielded cable is preferred when the wiring extends over great distances or through particularly unfavourable environments.

Pay close attention while wiring analogue signal cables used for carrying motor speed or motor position reference signals. If excessive interference is picked up, the motor may behave uncontrollably. Be sure to position the cable far away from sources of noise (such as power cables, inverters, switching power supplies, contactors, motors, etc.).

8.6.13 0 to 10 V analogue output

Some versions of the servo drive/inverter are equipped with an analogue output stage for 0 to 10 V signals. This type of interface is normally used to transmit certain measurements (such as motor RPM) in an analogue manner to other devices (such as a PLC).

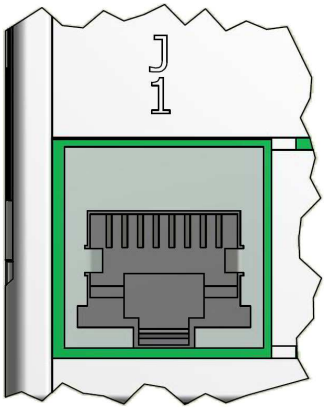
The recommended connection scheme is shown in the following figure:



To prevent signal corruption, a shielded cable should be used.

8.7 Field bus

The servo drive is equipped with an RJ45 connector (J1) on the front panel. The connector is used to connect the device to a MODBUS RTU fieldbus. The pin configuration is shown in the following illustration.



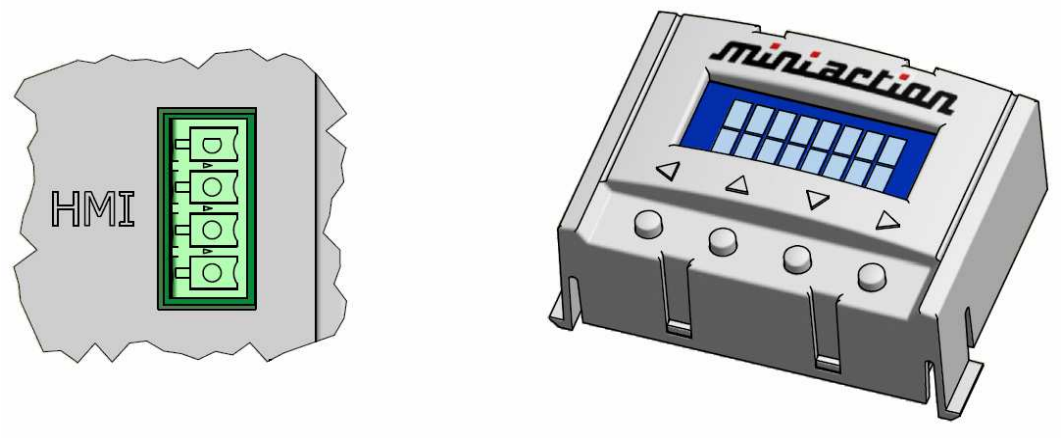
RS485 connector J1	
pin	**signal**
1	DATA+
2	DATA-
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC

An RS485 serial interface is used. To prevent signal reflection, a 120 Ω terminal resistor must be installed on the end of the wired section. CAT 5E Ethernet cable can be used for the wiring. Otherwise, choose a shielded cable with typical impedance of 120 Ω. The shield must be connected to both sides of the connector shell.

See the Operation and Programming Manual for further information.

8.8 Removable operator interface (HMI)

The servo drive is set up to accept a TTR001 removable operator interface, which is used for parameterisation and for reading possible error codes. The interface consists of an 8-character, 2-line alphanumeric display and 4 arrow keys. A special seat is provided at the front of the servo drive for snapping in the interface and its HMI port.



8.8.1 Functions of keys

◄	**Navigation**: Pressing the left arrow key returns the system to the menu on the next higher level. If you are in the main menu, the screen showing the status of the device is displayed. From this screen, you can press the left arrow key to display the firmware version and the model of servo drive. **To modify data:** This key moves the cursor to the digit immediately to the left of the digit currently indicated by the cursor. If the cursor is positioned over the digit on the extreme left, the cursor will not move. A change in progress (that is, a change which has not yet been confirmed) can be cancelled by holding down this key for 1 second.
►	**Navigation:** Pressing the right arrow key moves the system to the menu on the next lower level. The active entry is found on the first line on the LCD and is indicated by the flashing character " > " to the left of the wording. **To modify data:** Holding down this key for at least 1 second causes the system to enter the modification mode for the selected parameter, if it can be modified under current conditions and if you are at a level of access that allows the parameter to be modified. When the cursor appears under the character on farthest right in the field, the system is in the modification mode. Press this key to move the cursor to the digit immediately to the right of the currently indicated digit. If the cursor is positioned over the digit on the extreme right, the cursor will not move. To confirm a change, hold down this key for at least one second.
▲	**Navigation:** Pressing the up arrow key moves the system to the previous item on the current menu. If the system is already positioned on the first item on the menu, pressing the key will have no effect. **To modify data:** This key increases the digit where the cursor is positioned. If the digit reaches the maximum value allowed, the system will try to increase the digit on the immediate left (unless it is also at its maximum value).
▼	**Navigation:** Pressing the down arrow key moves the system to the next item on the main menu. The end of the list of items on the menu is indicated by a line consisting of minus signs -------- . **To modify data:** This key decreases the digit where the cursor is positioned. If the digit reaches the minimum value allowed, the system will try to increase the digit on the immediate left (unless it is also at its minimum value).

9 UPDATING THE FIRMWARE

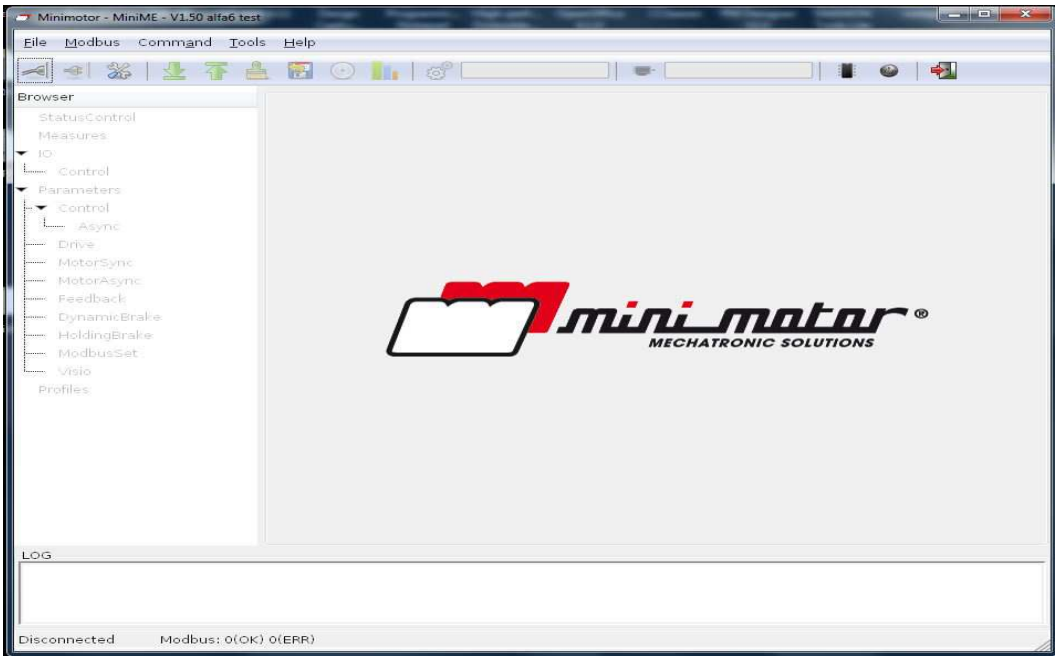
If improvements are made to the Miniaction series of servo drives or additional functions are added to them, they can be updated with a newer firmware version. A PC running Windows XP or later and equipped with a free serial port is required for this operation. Also, the MiniMe dedicated software application must already be installed on the PC. To install this utility, see the guide included with the installation files. If the PC does not have a serial port, a USB – RS485 adapter that supports the Auto-RTS mode can be used.

- Connect connector J1 on the servo drive to the RS485 port on the computer or to the adapter. The length of the connecting cable must not exceed 3 metres.

- Power up the servo drive.

- Run the MiniMe application from the path in which it was installed. The default installation folder is: "C:\Program Files\MiniME\MiniMod.exe".

- When the software is running, the following window will be displayed:

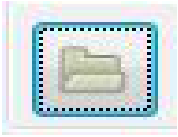


- To proceed with the update, the communication port in the MiniMe software must be programmed. This port connects to the RS485 Modbus interface. Click on the following button to select it:

It's not strictly necessary to enter the ID of the device or to set the communication speed. These parameters only affect the ability of the MiniMe application to reset the device remotely. The update can still be completed as described below.

- Run the firmware update utility by clicking on the  icon on the upper right.

- The following window will appear:

- Using the  button, select the firmware you wish to send to the device.
  If the new firmware has been successfully uploaded into the device by the MiniMe application, the following message will be displayed:**“ Firmware loaded...”**
  The firmware must have the **.mot** extension.

- Now, click on **RUN** to program the device.

- The device must be reset before the firmware can be sent to it.
  The MiniMe program will try to reset the device by sending it a specific command.
  This process can be recognised by the message:“ Try to send reset command...”
  followed by: **“Waiting for syncronization...”.**
  If the modbus communication parameters for the device are not consistent with the communication parameters set on the MiniMe software, or if the device has an obsolete firmware version which does not support a remote reset, it may be necessary at this point to reset the hardware being programmed by shutting off the 24 V auxiliary power and then switching it back on.
  The MiniMe software can communicate through the serial port only if the parity bit is not added.

- After the reset, the MiniMe software will synchronise with the device being updated. This process can be recognised by the message: “ Syncronized.”

- When the MiniMe software programs the device, first the communication baud rate is changed, and then the device is actually programmed. These steps are identified in order by the following messages:
  - "**Sending new baudrate...**"
  - "**Baudrate change successful**"
  - "**Download programming data...**"
  - "**Programming successful in __._ seconds**"

- Firmware updating is now complete. Exit the firmware updating utility by clicking on **CLOSE**.

10 TRANSPORT, PACKING AND LIFTING

10.1 Transport

The quasi-machine must be transported using suitable equipment, and adequate vehicles must be employed to prevent breakage when the machine is handled before storage.

10.2 Packing

Before packing the device for transport, all energy sources must be disconnected. It's important for qualified personnel with specific skills supervise this procedure.

11 STORAGE

The quasi-machine and its components can be stored in the conditions in which it was packed for the period in question, but it must be kept in an enclosed area even though it is packed. Also, cover the quasi-machine adequately to protect it from dust and/or the weather.

To prevent the packing and/or the device from being subjected to excessive stress, do not stack more than 10 servo drives.

The device can be stored at temperatures of 0° to 40°C.

12 MAINTENANCE

12.1 Regular maintenance

Minimotor s.r.l. does not require any regular maintenance to be performed on Miniaction series servo drives. Remember that no component may be removed from the device, since such removal may compromise its level of protection.

12.2 Special maintenance

Minimotor s.r.l. does not recommend that any type of special maintenance be performed on Miniaction series servo drives. Remember that no component may be removed from the device, since such removal may compromise its level of protection.

13 DISPOSAL AND DEMOLITION

This quasi-machine, its systems and component parts are made of both metal and plastic. To demolish the device safely, the components made of plastic and polymers must first be separated from the components made of metal.

Remember that all substances must be disposed of in compliance with *Italian Legislative Decree 152 dated 3 April 2006,* with the Unified Environmental Law (part four) and with the Legislative Decree dated 16 January 2008.