

2025

MD520

Quick Start Guide

IE2
SIL3
Safety Integrity Level



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INTRODUCTION

The MD520 series AC drive is a general-purpose high-performance vector control AC drive designed to control and regulate the speed and torque of three-phase AC asynchronous motors and permanent magnet synchronous motors. It can be used to drive textile machines, paper machines, wire drawing machines, machine tools, packaging machines, food machines, fans, water pumps, and other automated production equipment.

This quick start guide describes the safety features, wiring, commissioning, and basic parameter Settings.

List of documentation for MD520 drive

Additionally, to this quick start guide, please refer to the following documentation.

Document name	Contents	Download link
MD520_Commissioning Guide_EN_C01_19011715	Describes the commissioning procedure of MD520.	 Link
MD520_Hardware Guide_EN_B01_19011713	Describes the hardware features of MD520.	 Link
MD520_Installation Guide_EN_B01_19011714	Provides detailed information about the installation of MD520.	 Link
MD520_Quick Installation and Commissioning Guide_EN_B01_19011712	Provides a quick description of MD520 installation and commissioning procedures.	 Link

Document name	Contents	Download link
MD520_Function Guide_EN_B03_19011717	Provides the description about MD520 functions and troubleshooting.	 Link
MD520_Parameter Guide_EN_A02_19012397	Provides detailed description about MD520 parameters.	 Link
MD520_Communication Guide_EN_B02_19011716	Provides detailed information about the communication interfaces of MD520.	 Link
MD520_Safety Function Guide_EN_A03_19011795_20221011	Provides information related to MD520's STO functional safety function.	 Link

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1. Fundamental Safety Instructions

1.1 Safety Precautions.

This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe personal injuries, or equipment damage. "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the precautions that need to be followed; they just supplement the safety precautions. Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty. Inovance shall take no responsibility for any personal injuries or property damage caused by improper use.

1.2 Safety Levels and Definitions.



Indicates that failure to comply with the notice will result in death or severe personal injuries.



Indicates that failure to comply with the notice may result in death or severe personal injuries.



Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage

1.3 General Safety Instructions.

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.

Unpacking	
	• Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking. • Do not install the equipment if you find water seepage or missing or damaged components upon unpacking. • Do not install the equipment if you find the packing list does not conform to the equipment you received.
	• Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the Package by following the unpacking sequence. Do not strike the package violently. • Check whether there is damage, rust, or injuries on the Surface of the equipment and equipment accessories before unpacking. • Check whether the Package contents are consistent with the packing list before unpacking.

Storage and Transportation



- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminals block are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation



- The equipment must be operated only by professionals with electrical knowledge.



- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electrical shock.
- When installing the equipment in a closed environment (such as cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply will result in a fire.



- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.
- When using drive's STO functional safety function observe strictly the installation requirements, like pollution degree, maximum ambient temperature, vibration, EMC.

Wiring



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment, and wait for at least the time designated on the equipment warning label before further operations because residual voltage exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply will result in an electric shock.



- Do not connect the input power supply to the output of the equipment. Failure to comply will result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and the motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at both ends.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.



- During, wiring follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply will damage the equipment or the internal circuits of the equipment.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.
- When using drive's STO functional safety function, connect to STO1/STO2 inputs only the control wires coming from the machine's safety circuit(s).

Power-on



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.



- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation



- The equipment must be operated only by professionals. Failure to comply will result in death or personal injuries.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply will result in an electric shock.



- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.
- Before maintenance, cut off all power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply will result in an electric shock.



- Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injuries or equipment damage.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace the quick-wear parts of the equipment according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal



- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death.
- Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

1.4 Safety Labels.

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Signs		Description
T1 to T12 models		• Read through the safety instructions before operating the equipment. Failure to comply may result in equipment damage, personal injuries, or even death. • Do not touch terminals or remove the cover while the power is on or within 10 minutes after the power is turned off. Failure to comply may result in an electric shock.

2. Environment.

When installing MD520 drive please observe the environmental conditions described in table 1 below, for a long life and safe operation.

Table 1. Environmental conditions in the installation location of MD520 drive.

Installation location	Indoors
Grid overvoltage	Overvoltage Class III (OVC III)
Temperature	Installation/Operation: -10°C to $+50^{\circ}\text{C}$ (-10°C to $+40^{\circ}\text{C}$: no derating; above $+40^{\circ}\text{C}$: derate 1.5% for every additional 1°C) Storage/Transportation: -20°C to $+60^{\circ}\text{C}$
Humidity	Below 95% RH, non-condensing
Environment	Pollution degree: 2 or below
Altitude	≤ 1000 m: No de-rating Above 1000 m: Derate 1% for every additional 100 m Above 2000 m (0.4 - 3 kW models): consult INOVANCE Above 3000 m (3.7 kW and above models): consult INOVANCE

3. Product model list, frames and dimensions.

The following table below lists the MD520 drive models and frames.

Table 2. MD520 drive models and frames.

Frame	Three Phase 380–480 V models	Three Phase 200–240 V models	Single Phase 200-240 V models
T1	MD520-4T0.4B(S) MD520-4T0.7B(S) MD520-4T1.1B(S) MD520-4T1.5B(S) MD520-4T2.2B(S) MD520-4T3.0B(S)	MD520-2T0.4B(S) MD520-2T0.7B(S) MD520-2T1.1B(S) MD520-2T1.5B(S)	-
T2	MD520-4T3.7B(S) MD520-4T5.5B(S)	MD520-2T2.2B(S) MD520-2T3.7B(S)	MD520-2S0.4B(S) MD520-2S0.7B(S) MD520-2S1.5B(S) MD520-2S2.2B(S)
T3	MD520-4T7.5B(S) MD520-4T11B(S)	MD520-2T5.5B(S)	-
T4	MD520-4T15B(S)	MD520-2T7.5B(S)	-
T5	MD520-4T18.5(B)(S)(-T) MD520-4T22(B)(S)(-T)	MD520-2T11(B)(S)(-T)	-
T6	MD520-4T30(B)(S) MD520-4T37(B)(S)	MD520-2T15(B)(S) MD520-2T18.5(B)(S)	-
T7	MD520-4T45(B)(S) MD520-4T55(B)(S)	MD520-2T22(B)(S) MD520-2T30(B)(S)	-
T8	MD520-4T75(B)(S) MD520-4T90(S) MD520-4T110(S)	MD520-2T37(B)(S) MD520-2T45(S) MD520-2T55(S)	-
T9	MD520-4T132(S) MD520-4T160(S)	MD520-2T75(S)	-
T10	MD520-4T200(S)(-L) MD520-4T220(S)(-L)	MD520-2T90(S) MD520-2T110(S)	-
T11	MD520-4T250(S)(-L) MD520-4T280(S)(-L)	MD520-2T132(S)	-
T12	MD520-4T315(S)(-L) MD520-4T355(S)(-L) MD520-4T400(S)(-L)	MD520-2T160(S) MD520-2T200(S)	-

Notes:

- (B): with built-in braking unit
- (S): with safe torque off (STO) function
- (-T): with built-in DC reactor
- (-L): with built-in output reactor (dV/dt filter)

4. External dimensions and mounting dimensions of MD520 drives.

4.1 Dimensions of T1 to T4 frames models.

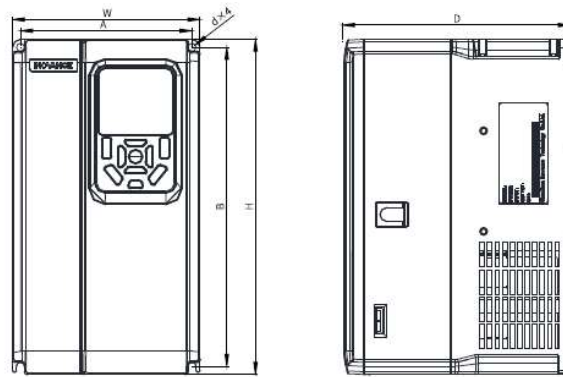


Figure 1. External dimensions and mounting dimensions of T1 to T4 frames models.

Table 3. External and mounting dimensions of T1 to T4 frames models.

Frame	Mounting Holes Spacing mm (in.)		External Dimensions mm (in.)			Mounting Holes Diameter mm (in.)	Mass kg (lb)
	A	B	H	W	D		
T1	119 (4.7)	189 (7.5)	200 (7.9)	130 (5.1)	150 (6.0)	Ø5 (0.2)	1.6 (3.5)
T2	119 (4.7)	189 (7.5)	200 (7.9)	130 (5.1)	160 (6.4)	Ø5 (0.2)	2.0 (4.4)
T3	128 (5.0)	238 (9.4)	250 (9.9)	140 (5.5)	168.3 (6.7)	Ø6 (0.2)	3.3 (7.3)
T4	166 (6.5)	266 (10.5)	280 (11.0)	180 (7.1)	169 (6.7)	Ø6 (0.2)	4.3 (9.5)

4.2 Dimensions of T5 to T6 models.

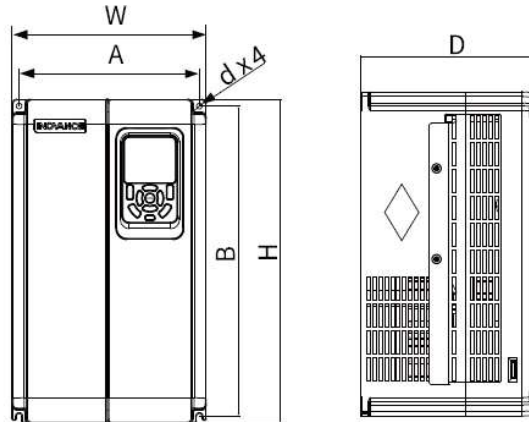


Figure 2. External dimensions and mounting dimensions of T5 to T6 frames models.

Table 4. External and mounting dimensions of T5 to T6 frames models.

Frame	Mounting Holes Spacing mm (in.)		External Dimensions mm (in.)				Mounting Holes Diameter mm (in.)	Mass kg (lb)
	A	B	H	H1	W	D		
T5 (without DC reactor)	195 (7.7)	335 (13.2)	350 (13.8)	-	210 (8.3)	193.4 (7.6)	Ø6 (0.2)	7.6 (16.8)
T5 (-T, with built-in DC reactor)	195 (7.7)	335 (13.2)	350 (13.8)	-	210 (8.3)	193.4 (7.6)	Ø6 (0.2)	10.0 (22.0)
T6	230 (9.1)	380 (15.0)	400 (15.8)	-	250 (9.9)	220.8 (8.7)	Ø7 (0.3)	17.5 (38.6)

4.3 Dimensions of T7 to T9 models.

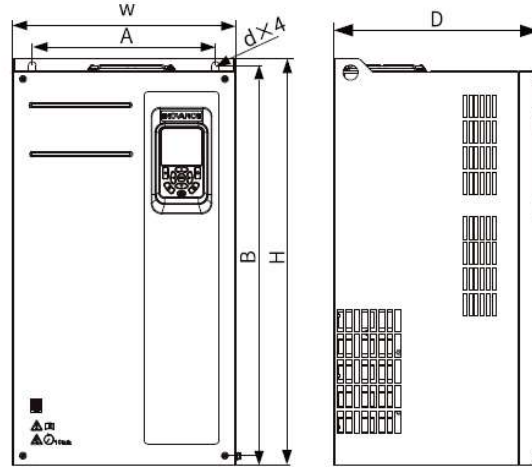


Figure 3. External dimensions and mounting dimensions of T7 to T9 frames models.

Table 5. External and mounting dimensions of T7 to T9 frames models.

Frame	Mounting Holes Spacing mm (in.)		External Dimensions mm (in.)				Mounting Holes Diameter mm (in.)	Mass kg (lb)
	A	B	H	H1	W	D		
T7	245 (9.7)	523 (20.6)	525 (20.7)	542 (21.4)	300 (11.8)	275 (10.8)	Ø10 (0.4)	35 (77.2)
T8	270 (10.6)	560 (22.1)	554 (21.8)	580 (22.9)	338 (13.3)	315 (12.4)	Ø10 (0.4)	51.5 (113.5)
T9	320 (12.6)	890 (35.1)	874 (34.4)	915 (36.1)	400 (15.8)	320 (12.6)	Ø10 (0.4)	85 (187.4)

4.4 Dimensions of T10 to T12 models.

4.4.1 Models without output reactor.

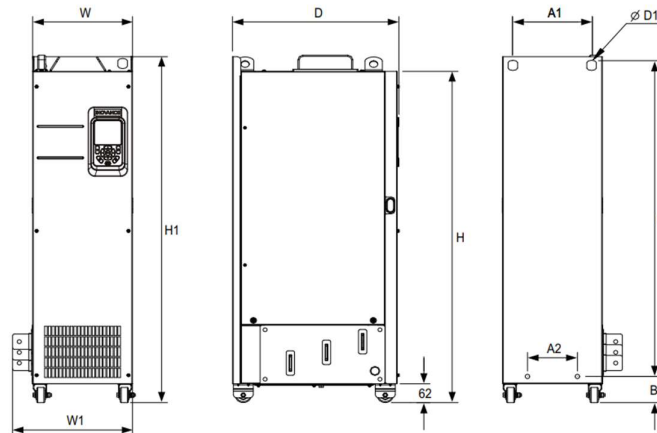


Figure 4. External dimensions and mounting dimensions of T10 to T12 frames models without output reactor.

Table 6. External dimensions and mounting dimensions of T10 to T12 frames models without output reactor.

Frame	Mounting Holes Spacing mm (in.)				External Dimensions mm (in.)					Mounting Holes Diameter mm (in.)	Mass kg (lb)
	A1	A2	B1	B2	H	H1	W	W1	D		
T10	240 (9.5)	150 (5.9)	1035 (40.8)	86 (3.4)	1086 (42.8)	1134 (44.7)	300 (11.8)	360 (14.2)	500 (19.7)	φ13 (0.5)	110 (242.5)
T11	225 (8.9)	185 (7.3)	1175 (46.3)	97 (3.8)	1248 (49.2)	1284 (50.6)	330 (13)	390 (15.4)	545 (21.5)	φ13 (0.5)	155 (341.7)
T12	240 (9.5)	200 (7.9)	1280 (50.4)	101 (4)	1355 (53.4)	1405 (55.4)	340 (13.4)	400 (15.8)	545 (21.5)	φ16 (0.6)	185 (407.9)

4.4.2 Models with output reactor.

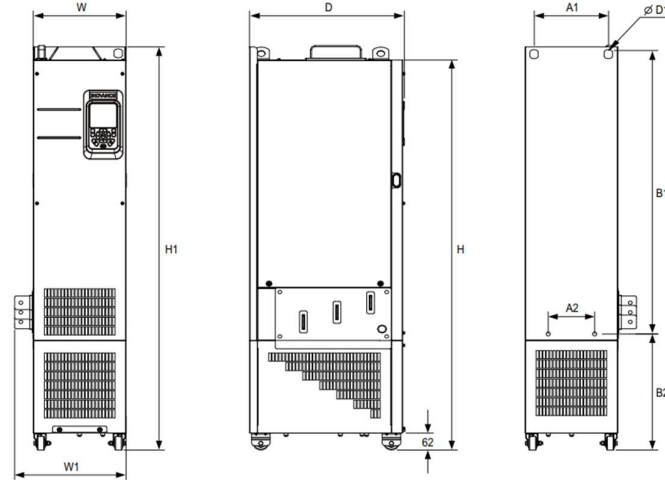


Figure 5. External dimensions and mounting dimensions of T10 to T12 frames models with output reactor.

Table 7. External dimensions and mounting dimensions of T10 to T12 frames models with output reactor.

Frame	Mounting Holes Spacing mm (in.)				External Dimensions mm (in.)					Mounting Holes Diameter mm (in.)	Mass kg (lb)
	A1	A2	B1	B2	H	H1	W	W1	D	D1	
T10	240 (9.5)	150 (5.9)	1035 (40.8)	424 (16.7)	1424 (56.1)	1472 (58.0)	300 (11.8)	360 (14.2)	500 (19.7)	φ13 (0.5)	160 (352.7)
T11	225 (8.9)	185 (7.3)	1175 (46.3)	435 (17.1)	1586 (62.5)	1622 (63.9)	330 (13.0)	390 (15.4)	545 (21.5)	φ13 (0.5)	215 (474.0)
T12	240 (9.5)	200 (7.9)	1280 (50.4)	432 (17.0)	1683 (66.3)	1733 (68.3)	340 (13.4)	400 (15.8)	545 (21.5)	φ16 (0.6)	245 (540.1)

5. Mounting clearances.

Reserve sufficient clearances as indicated in the clauses below.

5.1 T1 to T9 frames models.

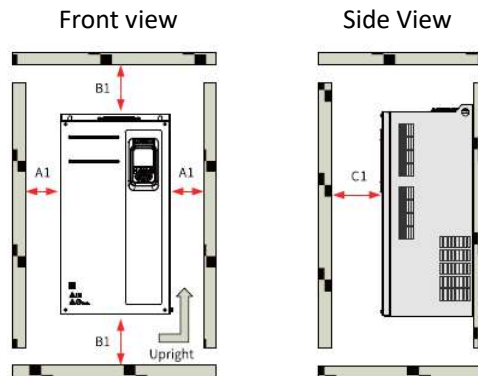


Figure 6. Installation clearances of T1 to T9 frames models.

Table 8. Installation clearances of T1 to T9 frames models.

Rated power	Clearance (mm)		
0.4 kW to 15 kW	A1 ≥ 10	B1 ≥ 100	C1 ≥ 40
18.5 kW to 22 kW	A1 ≥ 10	B1 ≥ 200	C1 ≥ 40
30 kW to 37 kW	A1 ≥ 50	B1 ≥ 200	C1 ≥ 40
45 kW to 160 kW	A1 ≥ 50	B1 ≥ 300	C1 ≥ 40

Note: A1 distances are also applicable to side-by-side mounting.

5.2 T10 to T12 frames models.

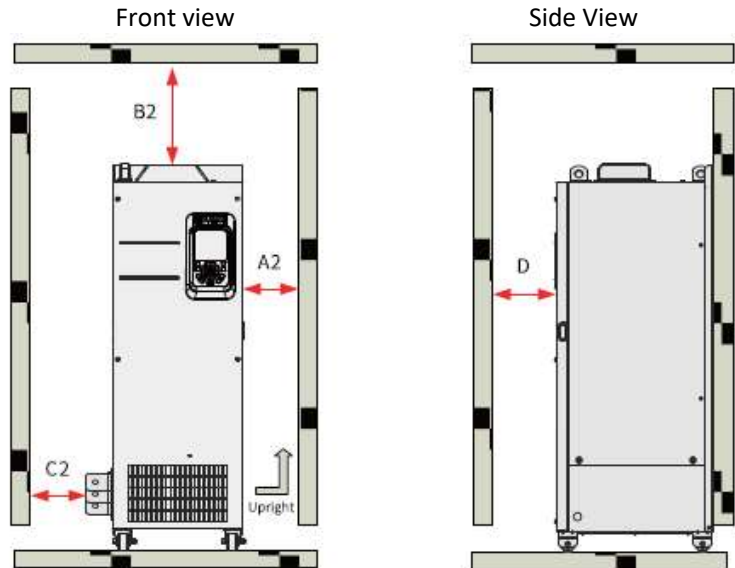


Figure 7. Installation clearances of T10 to T12 frames models.

Table 9. Installation clearances of T10 to T12 frames models.

Rated power	Clearance (mm)			
	A2 ≥ 10	B2 ≥ 250	C2 ≥ 20	D2 ≥ 20
200kW to 400kW				

6. Basic keypad operation.

Figure 8 below shows the keys and status indicators of the built-in keypad of MD520 drive.

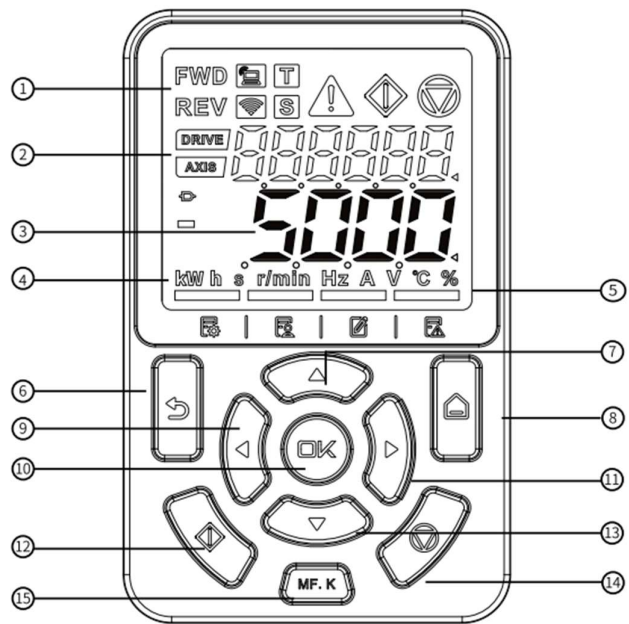


Figure 8. Keys and status indicators of the built-in keypad of MD520 drive.

Table 10 below describes the keys and status indicators of MD520 built-in keypad.

Table 10. Description of keys and status indicators of MD520 built-in keypad.

No.	Component Name	No.	Component Name
1	Status indicators	9	Left shift key
2	Secondary display area	10	OK key (confirm)
3	Primary display area	11	Right shift key
4	Parameter Units indicators	12	RUN key
5	Menu indicators	13	Decrement key
6	Programming key	14	Stop key
7	Increment key	15	Multi-function key
8	Menu key	-	-

Table 11 below describes the functions of the keys of the built-in keypad of MD520 drive.

Table 11. Functions of the keys of built-in keypad of MD520 drive.

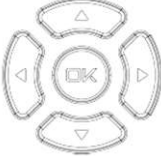
Key	Name	Function description
	Menu key	Pressing and holding this key toggles between the parameter number display and the multi-function display. Under the multi-function display, pressing this key toggles different menus (including the basic menu, user menu, changed (set) parameter menu, and fault list).
	Backward (cancel) key	Goes backward or cancels the setup.
	OK key	Enters or confirms the setup.
	Navigation keys	Under the multi-function display, pressing the left/right shift key toggles the status of display. Under the parameter number display: - Basic menu, user menu, and changed parameter menu: On the monitor page, the up and down keys are used as a keyboard potentiometer, and the left and right keys are used to toggle monitoring variables. On the parameter page, the up and down keys are used to adjust set value, the left and right keys are used to select setting digits, and the OK key is used to confirm the set value. - Fault list: The left and right keys are used to cycle through fault logs.
	Multi-function key	Provides function options for the user to choose from, including command source switchover, switchover between forward and reverse run, and jog.
	RUN key	In the operating panel control mode, starts the AC drive.
	Stop/Fault reset	Stops the AC drive when the AC drive is running. Resets the AC drive upon a fault.

Table 12 below describes the functions of the status indicators of the built-in keypad of MD520 drive.

Table 12. Functions of the status indicators of the built-in keypad of MD520 drive.

Status Indicator		Indication description
FWD REV	The FWD indicator is steady ON.	Forward RUN.
	The REV indicator is steady ON.	Reverse RUN.
	The FWD and REV indicators blink.	Switchover between forward and reverse RUN and viceversa.
	The Local/Remote indicator is steady OFF.	Local (keypad) control.
	The Local/Remote indicator is steady ON.	Terminal control.
	The Local/Remote indicator blinks slowly.	Communication control.
	The Local/Remote indicator blinks fast.	Custom control.
	The Torque control indicator is steady ON.	Torque control.
	The Speed control indicator is steady ON.	Speed control.
	The Fault indicator is steady ON.	Fault present.
	The Fault indicator is steady OFF.	No fault.
	The RUN indicator is steady ON.	The drive is in RUN state.
	The Stop indicator is steady ON.	The drive is in Stop state.
	The Connector indicator is steady ON.	Displayed in the primary display area is a connector variable.
	The Connector indicator is steady OFF.	Displayed in the primary display area is not a connector variable.
	The Minus Sign indicator is steady ON.	The value displayed in the primary display area is negative.
	The Minus Sign indicator is steady OFF.	The value displayed in the primary display area is positive.
	Operating cursor 1 is steady ON.	The main display area is active.
	Operating cursor 2 is steady ON.	The secondary display area is active.
kW h s r/min Hz A V °C %	One of the Parameter Unit indicators is steady ON.	The value displayed in the primary display area is the unit that is ON.
	Indicator 1 is steady ON.	The primary display area shows the basic menu.
	Indicator 2 is steady ON.	The primary display area shows the user menu.
	Indicator 3 is steady ON.	The primary display area shows the changed parameter menu.
	Indicator 4 is steady ON.	The primary display area shows the fault menu.

Figures 9 and 10 below show the procedures to view and modify the value set in a parameter.

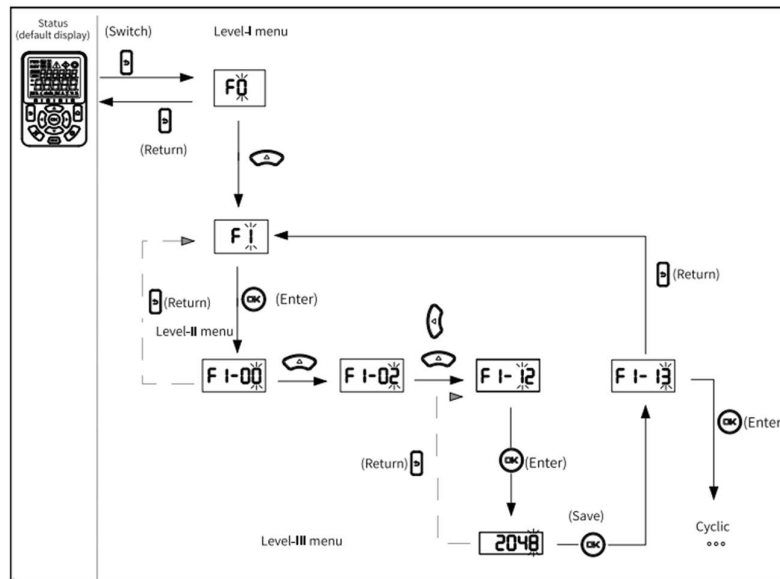


Figure 9. How to view the value set in a parameter.

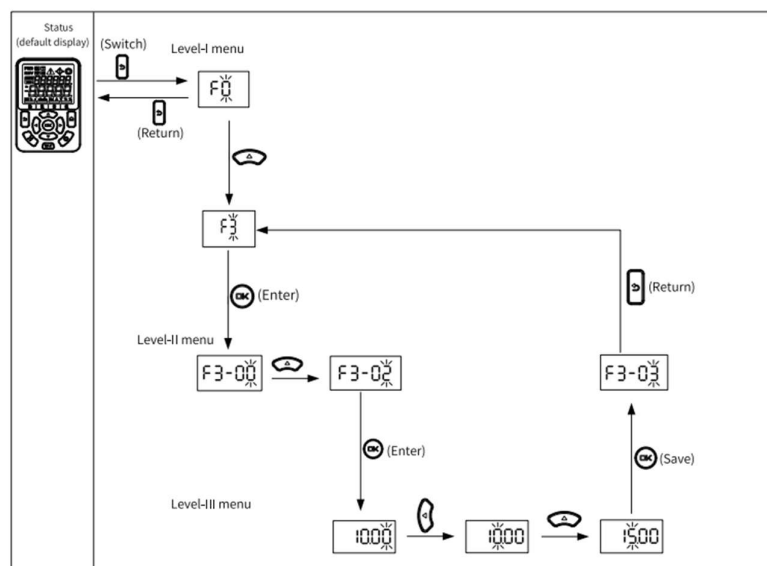


Figure 10. How to edit/modify the value set in a parameter.

7. Wiring diagram.

Figure 11 below depicts the wiring diagram of MD520.

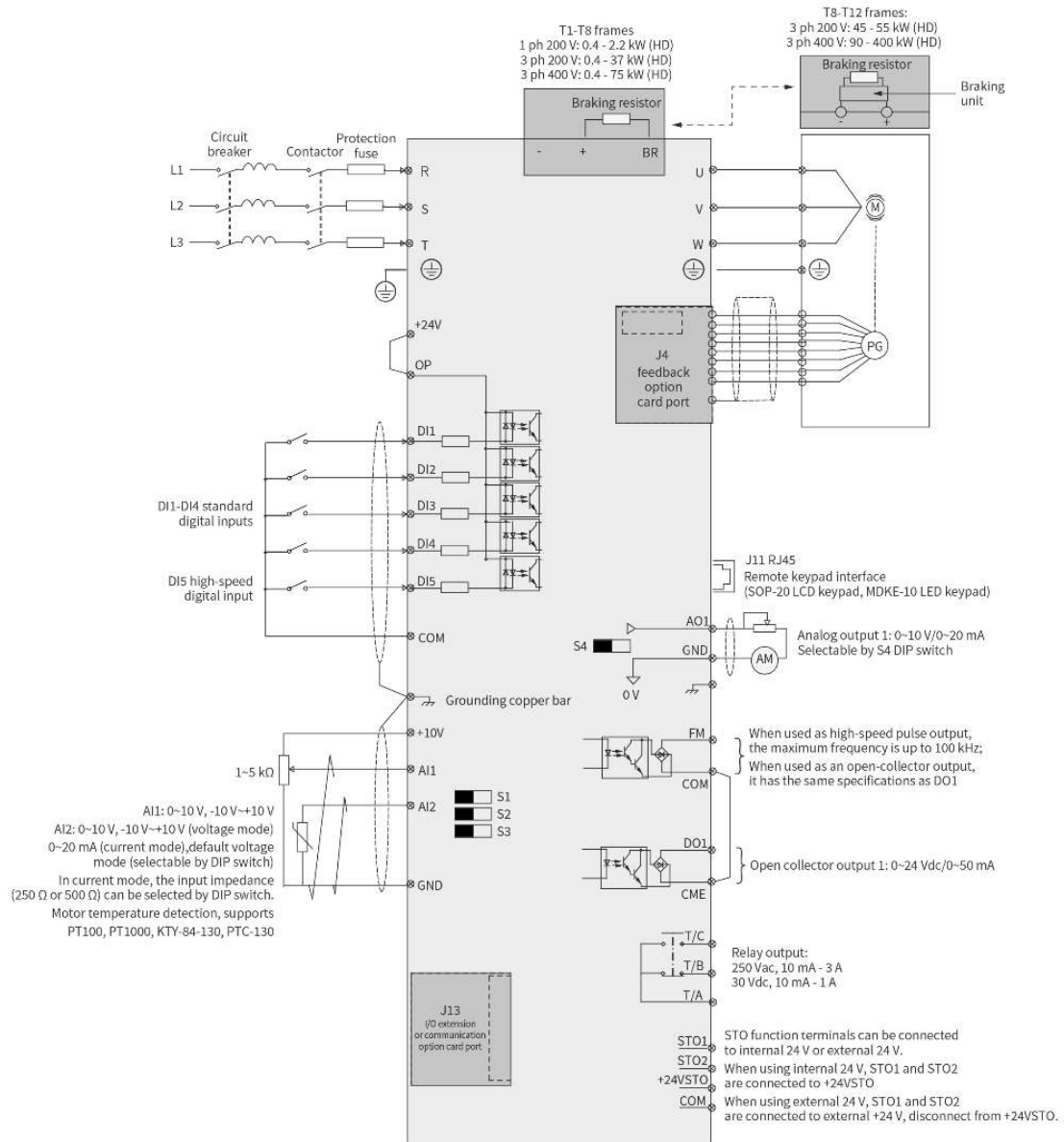


Figure 11. Wiring diagram of MD520.

Table 13 below describes the main circuit (power) terminals of MD520 drive.

Table 13. Main circuit terminals.

Terminal(s)	Function	Description
R, S, T	Three-phase power supply input terminals (4T and 2T models)	Connected to AC three-phase power supply.
L/L1, N/L2	Single-phase power supply input terminals (2S models)	Connected to AC single-phase power supply.
(+), (-)	Positive and negative terminals of DC bus	Connected to an external braking unit, regenerative converter, or other drives in common DC bus architecture.
(+), BR	Braking resistor connection terminals	Connected to the braking resistor of models with built-in braking unit: 4T up to/including 75 kW, 2T up to/including 37 kW and all 2S models.
U, V, W	Output terminals	Connected to a three-phase motor.
	Grounding terminals (PE)	Used for protective grounding.

Figure 12 below shows the control circuit terminals layout.

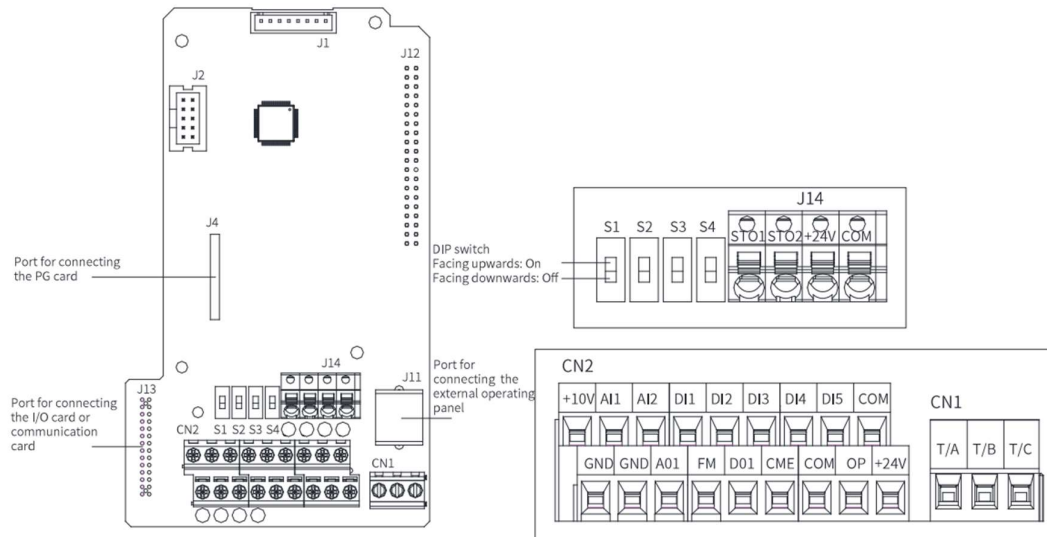


Figure 12. Control circuit terminals layout.

Table 14 below describes the control circuit terminals of MD520.

Table 14. Control circuit terminals of MD520.

Type	Terminal(s)	Function	Description
Power supply	+10V-GND	+10V reference voltage	Provides +10V reference voltage to a potentiometer or another external device. Maximum output current: 10 mA. Normally used to supply a potentiometer with an impedance between 1 k Ω and 5 k Ω .
	+24V-COM	+24V power supply	Provides +24V supply to an external device. Normally used to supply digital inputs/outputs and/or external sensors. Maximum output current: 200 mA.
Analog inputs	AI1-GND	Analog input 1	Range: 0 to 10VDC, -10VDC to +10VDC Input impedance: 22 k Ω
	AI2-GND	Analog input 2	Range: -10VDC to +10VDC, or 0-20 mA, selectetable by the switch S2 on the control board. Input impedance: 22 k Ω (voltage mode) or 500 Ω /250 Ω (current mode, impedance set by switch S3). By setting switch S1, allows the connection of temperature detection devices: PT100, PT1000, KTY-84-130, PTC-130.
Digital inputs	DI1-COM	Digital input 1	Isolated inputs by optocoupler. Maximun frequency: 100 Hz. NPN/PNP selection by jumper J1. Input impedance: 1.39 k Ω +I22
	DI2-COM	Digital input 2	
	DI3-COM	Digital input 3	
	DI4-COM	Digital input 4	
	DI5-COM	Digital input 5	
Analog outputs	AO1-GND	Analog output	Selection voltage or current by switch S4. Maximum impedance of the load in current mode is 500 Ω . Output voltage range: 0-10 V Output current range: 0-20 mA
Pulse outputs	FM-COM	Pulse output	The terminal function is set by F5-00 (FM terminal output selection). When the terminal is used for high-speed pulse output, the maximum frequency is 100 kHz. When the terminal is used for collector open output, it has the same specifications as DO1 digital output.

Table 14. Control circuit terminals of MD520 (continued).

Type	Terminal(s)	Function	Description
STO function	STO1-COM	Digital input channel 1 STO	By turning these signals off, STO function becomes active, leading to a safe uncontrolled stop (Category 0). Complies to SIL 3, PL e safety levels.
	STO2-COM	Digital input channel 2 STO	
	+24V-COM	+24VDC power supply for STO	Dedicated power supply for STO inputs.
Digital outputs	DO1-CME	Digital output 1	NPN/PNP transistor digital output. Maximum output voltage: 24 V Maximum output current: 50 mA
Relay outputs	T/A-T/B	Normally closed contact relay	Contact driving capacity: 250 VAC, 3 A, $\cos\phi = 0.4$ 30 VDC, 1 A
	T/A-T/C	Normally open contact relay	
Auxiliary ports	J13	Extension card port	Provides the interface to optional cards, such as bus communication and I/O expansion card.
	J2	Feedback card port	Provides the interface to optional cards for connecting feedback resolver/encoder.
	J11	Port for external operating panel	Allows to connect and external/remote operating panel.
DIP switches	S1	AI2 input set for temperature detection	When set to ON, configures the analog input for the connection of a temperature detection device.
	S2	AI2 input mode selection	To select if the analog input signal is voltage (OFF) or current (ON).
	S3	AI2 input impedance in current mode	To set the input impedance in current mode: 500 Ω (ON) or 250 Ω (OFF).
	S4	AO1 output mode selection	To select if the analog output generates a voltage (OFF, default) or current signal (ON).

Figure 13 below shows how to make the wiring of the digital inputs in source (PNP) mode.

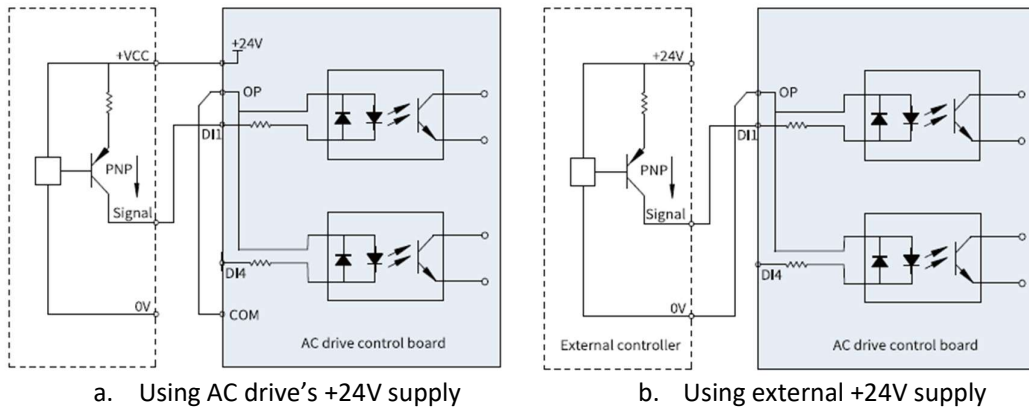


Figure 13. Wiring of the digital inputs in source (PNP) mode.

Figure 14 below shows how to make the wiring of the digital inputs in sink (NPN) mode.

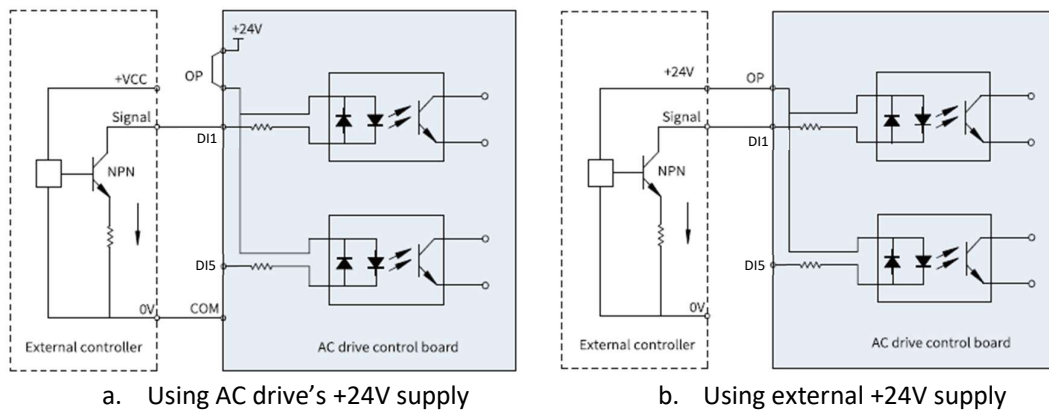


Figure 14. Wiring of the digital inputs in sink (NPN) mode.

In case of using feedback (encoder, resolver) option cards please refer to the corresponding user guide. When using MD38PGMD encoder option card, it is very important to set the J6 jumper according to the supply voltage of the encoder (5 VDC or 15 VDC); a wrong setting could cause malfunction or even damage the encoder.

8. Step by Step start-up procedure.

Please follow below procedure in order to set up the MD520 drive. Before applying power to the drive ensure that the AC drive model is suitable for the power supply voltage available on the installation. We recommend for a quick start to prove the installation and the initial running of the motor, to use the simple V/f control mode. At a later stage, the user –depending on the application requirements- may elect to use higher functionality of SVC (open loop vector control) or FVC (closed loop vector control).

8.1 Steps common to all control modes.

Step 1. Restore parameters to factory default.

Set parameter FP-01=1 in order to restore the drive parameters to factory default. When setting FP-01=1, all parameters are restored except load type (heavy/light) selection (F0-29), motor parameters (F1-XX), frequency resolution (F0-22) and maximum frequency (F0-10). By setting FP-01=503 all parameters are set to factory default, without exception.

Step 2. Set load type selection (F0-29; 0: Heavy duty; 1: Normal duty), frequency resolution (F0-22; 1: 0.1 Hz; 2: 0.01 Hz), maximum frequency (F0-10, in Hz), frequency upper limit (F0-12, in Hz) and frequency lower limit (F0-14, in Hz).

Step 3. Set operation (RUN) command source by setting parameter F0-02 (0: LED operating panel/LCD operating panel/Software; 1: Terminals; 2: Communication).

Step 4. Set the main frequency setpoint source by setting parameter F0-03 (0: Digital setting F0-08, nonretentive at power failure; 1: Digital setting F0-08, retentive at power failure; 2: AI1; 3: AI2; 4: AI3; 5: Pulse reference in DI5; 6: Multi-reference; 7: Simple PLC; 8: PID; 9: Communication).

Step 5. Set the motor control mode by parameter F0-01 (0: SVC; 1: FVC; 2: V/f).

Step 6. Set the acceleration and deceleration times in parameters F0-17 and F0-18. If more than one acceleration/deceleration time is required, refer to parameters F8-03 to F8-08.

Step 7. Set motor parameters: F1-00 (motor type; 0 or 1: induction; 2: PM synchronous), F1-01 (rated power), F1-02 (rated voltage), F1-03 (rated current), F1-04 (rated frequency) and F1-05 (rated speed).

Step 8. Configure the digital and analog inputs by parameters F4-XX.

Step 9. Configure the digital and analog outputs by parameters F5-XX.

Depending on the motor type and control mode, please follow the relevant clauses indicated in the table 15 below.

Table 15. Relevant clauses for each motor type and control mode.

Motor type	Control mode	Relevant clauses & sequence
Induction motor	V/f control	8.2 -> 8.9
	Sensorless vector control (SVC)	8.3 -> 8.4 -> 8.8 -> 8.9
	Feedback vector control (FVC)	8.3 -> 8.5 -> 8.8 -> 8.9
PM synchronous motor	Sensorless vector control (SVC)	8.3 -> 8.6 -> 8.8 -> 8.9
	Feedback vector control (FVC)	8.3 -> 8.7 -> 8.8 -> 8.9

8.2 When using V/f control for induction motor.

Only in case of using **V/f control for induction motor** (F1-00=0 or 1, F0-01=2), perform these steps:

Step 10. Optionally the V/f characteristic can be set in parameters F3-00 to F3-08.

Step 11. If braking resistor is used set F3-10=0 and F3-23=0.

Note: V/f control can be useful to test easily that the drive is able to run the motor.

8.3 When using vector control modes.

Only in case of using **vector control modes**, perform this step.

Step 12. Set the values of the speed loop P gains (F2-00, F2-03) to a low value (not higher than 10), to avoid system instability. This should be done if the motor is not coupled to the load. Later the values of these gains can be increased to tune the drive to the required performance.

8.4 When using sensorless vector control (SVC) for induction motor.

In case of using **sensorless vector control (SVC) for induction motor** (F1-00=0 or 1, F0-01=0).

Step 13. Perform motor auto-tuning:

If the motor cannot be decoupled from the load, perform static auto-tuning (F1-37=1 or 3). F1-37=3 is able to perform a complete identification of the motor parameters without moving the motor.

If the motor can be decoupled from the load, perform dynamic auto-tuning (F1-37=2).

After setting parameter F1-37, we must give RUN command to the drive.

8.5 When using closed loop vector control (FVC) for induction motor.

In case of using **closed loop vector control (FVC) for induction motor** (F1-00=0 or 1, F0-01=1).

Step 14. Set the encoder/feedback related parameters (F1-27 and F1-28, described in table 16). To be able to check if the encoder/feedback detection is correct, configure to 1 bit 0 of parameter A9-09. Turn the motor by hand in both rotation directions, to check that the value indicated in parameter U0-29 is correct (positive value when the motor is rotated counterclockwise). Alternatively, we can rotate the motor using the drive in V/f or SVC control modes, the latter only if the auto-tuning process (step 13) has been performed. The value of parameter U0-29 should be almost equal to that of parameter U0-19.

Table 16. Encoder/feedback related parameters.

Parameter	Description	Settings
F1-27	Encoder resolution (pulses or periods/turn). In case of resolver feedback type there is no need to set this parameter.	Range: 1 – 65535 Default: 1024
F1-28	Encoder/feedback type.	Range: 0: A/B/Z incremental quadrature; 1: Serial (23 bit); 2: Resolver; 3: External input; 4: Incremental SinCos Default: 1

Step 15. Perform motor auto-tuning:

If the motor cannot be decoupled from the load, perform static auto-tuning (F1-37=1 or 3). F1-37=3 is able to perform a complete identification of the motor parameters without moving the motor.

If the motor can be decoupled from the load, perform dynamic auto-tuning (F1-37=2).

After setting parameter F1-37, we must give RUN command to the drive.

8.6 When using sensorless vector control (SVC) for PM synchronous motor.

In case of using **sensorless vector control (SVC) for PM synchronous motor** (F1-00=2, F0-01=0).

Step 16. Set the back EMF voltage parameter (F1-20) to a value close to the real value. When the value is not known precisely, it is recommended to set a value lower than the real value. If a value too high is set, the output current of the drive will be too high, causing overcurrent trips and eventually could damage the motor.

Step 17. Perform motor auto-tuning:

If the motor cannot be decoupled from the load, perform static auto-tuning (F1-37=11 or 13). F1-37=13 is able to perform a complete identification of the motor parameters without moving the motor (except the back EMF voltage, parameter F1-20).

If the motor can be decoupled from the load, perform dynamic auto-tuning (F1-37=12).

After setting parameter F1-37, we must give RUN command to the drive.

8.7 When using closed loop vector control (FVC) for PM synchronous motor.

In case of using **closed loop vector control (FVC) for PM synchronous motor** (F1-00=2, F0-01=1).

Step 18. Set the encoder/feedback related parameters (F1-27 and F1-28, described in table 16). To be able to check if the encoder/feedback detection is correct, configure to 1 bit 0 of parameter A9-09. Turn the motor by hand in both rotation directions, to check that the value indicated in parameter U0-29 is correct (positive value when the motor is rotated counterclockwise). Alternatively, we can rotate the motor using the drive in SVC control mode, only if the auto-tuning process (step 17) has been performed. The value of parameter U0-29 should be almost equal to that of parameter U0-19.

Step 19. Set the back EMF voltage parameter (F1-20) to a value close to the real value. When the value is not known precisely, it is recommended to set a value lower than the real value. If a value too high is set, the output current of the drive will be too high, causing overcurrent trips and eventually could damage the motor.

Step 20. Perform motor auto-tuning:

If the motor cannot be decoupled from the load, perform static auto-tuning (F1-37=11 or 13). F1-37=13 is able to perform a complete identification of the motor parameters without moving the motor (except the back EMF voltage, parameter F1-20).

If the motor can be decoupled from the load, perform dynamic auto-tuning (F1-37=12).

After setting parameter F1-37, we must give RUN command to the drive.

8.8 Steps common to all vector control modes.

Step 21. Once the motor has been coupled to the load, tune the speed loop gains (F2-00, F2-01, F2-03, F2-04) in order to obtain the desired/required performance, without having oscillation and/or too high overshoot during acceleration/deceleration or load changes.

Step 22. If required, change the settings of the torque limits for both motoring (F2-09, F2-10) and regenerating conditions (F2-11, F2-12).

8.9 Additional parameter settings applicable to all control modes.

If the drive has to control a motor that is already rotating at start, we may have to set parameters F6-00 to F6-04.

The stop mode can be set in parameter F6-10 (=0: controlled deceleration; =1: coast to stop).

To activate the output phase loss detection (Error 13) before startup, please set parameter F9-13=11.

To define the behavior of the drive in case of power loss, refer to parameters F9-59 to F9-62.

For external process PID control refer to parameters FA-00 to FA-27 and F8-49 to F8-52. Please consult a dedicated technical bulletin for setting external process PID control in MD520.

9. Concise list of parameter groups.

Table 17 below lists the parameter groups with a short description. For more detailed information refer to the “MD520_Function Guide_EN_A00_19011717” listed in the clause “**List of documentation for MD520 drive**” at the beginning of this document.

Table 17. Parameter groups description.

Parameter group	Description
F0	Standard parameters
F1	Motor parameters
F2	Vector control parameters
F3	V/f control parameters
F4	Input terminals
F5	Output terminals
F6	Start/Stop control
F7	Keypad operation and LED display parameters
F8	Auxiliary function parameters
F9	Fault and protection parameters
FA	PID function parameters
FB	Wobble function, fixed length and count
FC	Multi-reference and simple PLC function
FD	Communication Parameters
FE	User-defined Parameters
FP	User parameters
A0	Torque control and limit parameters
A1	Virtual DI/DO Parameters
A2	Motor 2 nameplate and learning parameters 1
A5	Control optimization parameters
A6	AI curve setting parameters
A7	Brake control parameters
A8	Point-to-Point communication parameters (master-slave)
A9	Motor parameters 1
AC	AI/AO correction
AF	Process data objects address mapping parameters
B8	Motor 2 control, protection, and vector parameters 1
B9	Motor 2 vector control parameters 2
U0	Monitoring parameters

10. Troubleshooting.

The AC drive MD520 is equipped with a set of protection functions in order to protect the motor, the electrical installation, the machine and/or the drive itself. When the AC drive detects any failure, changes to the alarm state, removes RUN status, and indicates the alarm code in the LED display of the keypad. In order to be able to reset the AC drive from the alarm state, we should first solve the cause of the failure, and then press the Stop/Fault reset key.

10.1 Display of Alarms and Faults.

When a fault occurs during running, the AC drive stops output immediately, the fault indicator becomes steady on, and the contact of the fault relay changes state. The operating panel displays the fault code (example: E023.1). Figure 15 below shows the fault display in MD520 LED keypad.

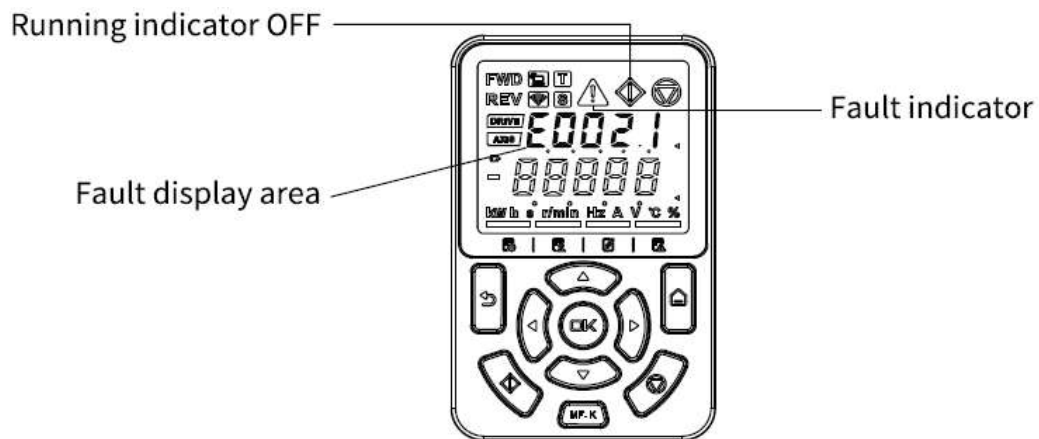


Figure 15. Faults display in MD520 LED keypad.



Do not repair or modify the AC drive by yourself. In case of any fault that cannot be rectified, contact the agent or Inovance for technical support.

10.2 List of fault codes.

Table 18 below describes the error codes of the faults that can be detected by MD520 drive.

Table 18. Error codes in MD520 drive.

Error code and basic description	Error code and basic description
E002.1 Hardware overcurrent	E056.2 IGBT U- short circuit
E002.2 Software overcurrent	E056.3 IGBT U+ short circuit
E005.1 Bus overvoltage	E056.4 IGBT V- short circuit
E008.1 Frequent pre-charge	E056.5 IGBT V+ short circuit
E009.1 Undervoltage	E056.9 Output phase loss
E009.3 Pre-charge fault	E057.1 U phase upper bridge or V phase lower bridge IGBT continuity failure
E010.1 AC drive overload	E057.2 U phase lower bridge or V phase upper bridge IGBT continuity failure
E010.3 AC drive pre-overload	E057.3 V phase upper bridge or W phase lower bridge IGBT continuity failure
E011.1 Motor overload	E057.4 V phase lower bridge or W phase upper bridge IGBT continuity failure
E011.2 Motor pre-overload	E057.5 W phase upper bridge or U phase lower bridge IGBT continuity failure
E012.1 Input phase loss	E057.6 W phase lower bridge or U phase upper bridge IGBT continuity failure
E013.1 E013.2 E013.3 E013.4 Output phase loss	E057.7 UV output end short circuit
E014.1 IGBT overheat	E057.8 VW output end short circuit
E014.2 Module pre overtemperature	E057.9 WU output end short circuit
E015.1 E015.2 External device fault	E058.1 U phase current sensor inversely installed
E017.1 Contactor fault	E058.2 V phase current sensor inversely installed
E018.1 Current detection fault	E058.3 W phase current sensor inversely installed
E019.1 Auto-tuning timeout	E058.4 UV phase sensor incorrectly inserted
E019.2 Auto-tuning interruption	E058.5 VW phase sensor incorrectly inserted
E019.3 Overcurrent during auto tuning	E058.6 WU phase sensor incorrectly inserted
E019.4 Auto-tuning back EMF exception	E059.1 UV phase imbalance
E019.5 Motor type setting error	E059.2 VW phase imbalance
E019.7 No-load current auto-tuning error	E059.3 WU phase imbalance
E020.1 Encoder hardware wire breakage detection	E061.1 Braking unit overload
E020.2 Encoder PPR error	E062.2 Braking transistor continuously active
E020.3 No encoder feedback	E062.3 Braking transistor overcurrent
E020.4 Encoder direction fault	E093.1 Motor rotor locked
E020.5 Encoder feedback speed large fluctuation	E093.2 Motor stall
E020.8 ABZ encoder Z signal loss	E093.4 Current control exception
E020.9 Encoder pulse interference	E094.1 Inconsistency between calculated and set numbers of pole pairs
E021.1 E021.2 E021.3 E021.4 E021.5 EEPROM read-write fault	E094.2 Motor power, voltage, and current matching error
E023.1 Short-to-ground	E094.3 No-load current range error
E026.1 Accumulative running duration reached	E094.4 Inconsistency between mutual inductance, no load current and rated voltage
E027.1 E027.2 E027.3 E027.4 User defined fault	E094.5 Rotor resistance range exception
L028.1 L 028.2 L028.3 L028.4 User defined alarm	E094.7 Mismatch between the numbers of pole pairs of the resolver and synchronous motor
E029.1 Accumulative power on duration reached	E159.1 Auto reset failure
E031.1 PID feedback loss during running	E160.1 Modbus communication fault
E032.1 E032.2 E032.3 E032.4 E032.6 Parameter exception	E161.1 E161.2 CANopen communication fault
E040.1 Pulse-by-pulse current limit fault	E162.1 E162.2 CANlink communication fault
E042.1 Excessive speed deviation	E164.1 Expansion card fault
E043.1 Motor overspeed	E174.1 HDI1 wire breakage
E045.1 E045.2 Motor overtemperature	E174.3 AI1 wire breakage
E047.2 E047.3 E047.4 E047.5 STO fault	E174.4 AI2 wire breakage
E051.1 Pole position auto-tuning error	E174.5 AI3 wire breakage
E055.1 Slave error in master-slave control	

For more detailed information of the alarm codes, and the possible causes and solutions, please consult the guide “MD520_Quick Installation and Commissioning Guide_EN_A00_19011712”.

11. Application of STO function.

When using the STO function of MD520 for the machine safety please observe the environmental conditions (parameters should be within the limits described in chapter 2 of this document), and obey strictly the installation requirements, because the drive becomes a functional safety component of the machine.

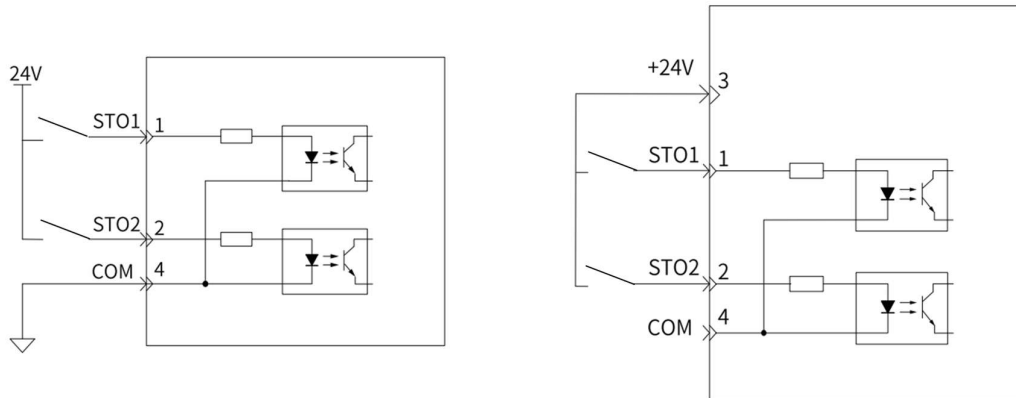
Please observe that STO function prevents safely the current flow to the motor, ensuring that the motor cannot deliver torque, but does not provide electric isolation. So this means that even the STO function is active, the motor terminals voltage could have dangerous voltage.

The following table lists the most relevant specifications of STO function of MD520 drive.

Table 19. Specifications of STO function.

Item	Value
Safety integrity level (SIL)	SIL 3 acc. to IEC 61508
PFH _d	$3.13 \cdot 10^{-9}$, 3.1% of SIL3 acc. to IEC 61508
Category	3, EN ISO 13849-1
Performance level (PL)	PL e, EN ISO 13849-1
MTTF _d	326 years (high)
DC _{avg}	≥ 90% (medium)
Proof test interval (T ₁)	20 years
Hardware fault tolerance (HFT)	1
System capability (SC)	SC3
Application mode	High demand or continuous mode
Response time (nominal voltage)	≤ 20 ms

The specifications of STO function inputs (STO1, STO2) are described in clause 6. The figure below describes examples of the wiring of these inputs.



a. Using external +24V power supply

b. Using internal +24V power supply

Figure 16. Wiring of STO function inputs.

The signals and/or contacts activating the STO function inputs (STO1, STO2) should be controlled by the functional safety devices of the machine, otherwise the machine cannot comply to the functional safety requirements.

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