

iC2-Micro Frequency Converters

1 Introduction

This operating guide provides necessary information for qualified personnel to install and commission the AC drive. Read and follow the instructions to use the drive safely and professionally.



Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with local and currently valid legislation.

2 Safety

Pay particular attention to the safety instructions and general warnings to avoid the risk of death, serious injury, and equipment or property damage.

 **WARNING** 

HIGH VOLTAGE
AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing.

UNINTENDED START
The motor may start from control panel, I/O inputs, fieldbus, or MyDrive® Insight at any time, when the drive is connected to the AC mains, DC supply, or load sharing.

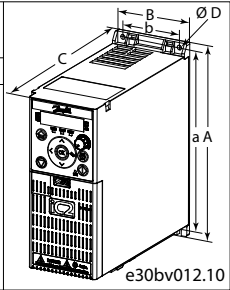
DISCHARGE TIME
The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.
- Stop the motor, disconnect AC mains and permanent magnet type motors, and remove DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully and measure it before performing any service or repair work.
- The minimum waiting time is 4 minutes for MA01c, MA02c, MA01a, MA02a, and MA03a drives, and 15 minutes for MA04a and MA05a drives.

LEAKAGE CURRENT
Leakage currents of the drive exceed 3.5 mA. Make sure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.

3 Installation

3.1 Mechanical Dimensions

Enclosure size	Height [mm (in)]			Width [mm (in)]		Depth [mm (in)] ⁽²⁾	Mounting holes [mm (in)]
	A	A ⁽¹⁾	a	B	b	C	D
MA01c	150 (5.9)	216 (8.5)	140.4 (5.5)	70 (2.8)	55 (2.2)	143 (5.6)	4.5 (0.18)
MA02c	176 (6.9)	232.2 (9.1)	150.5 (5.9)	75 (3.0)	59 (2.3)	157 (6.2)	4.5 (0.18)
MA01a	150 (5.9)	202.5 (8.0)	140.4 (5.5)	70 (2.8)	55 (2.2)	158 (6.2)	4.5 (0.18)
MA02a	186 (7.3)	240 (9.4)	176.4 (6.9)	75 (3.0)	59 (2.3)	175 (6.9)	4.5 (0.18)
MA03a	238.5 (9.4)	291 (11.5)	226 (8.9)	90 (3.5)	69 (2.7)	200 (7.9)	5.5 (0.22)
MA04a	292 (11.5)	365.5 (14.4)	272.4 (10.7)	125 (4.9)	97 (3.8)	244.5 (9.6)	7.0 (0.28)
MA05a	335 (13.2)	396.5 (15.6)	315 (12.4)	165 (6.5)	140 (5.5)	248 (9.8)	7.0 (0.28)



Note: (1) Including decoupling plate. (2) The potentiometer on the local control panel extends 6.5 mm (0.26 in) from the drive.

3.2 Mounting Clearance

Table 1: Minimum Mounting Clearance

Enclosure size	Minimum mounting clearance [maximum temperature 50 °C (122 °F)]
All enclosure sizes	Above and below: 100 mm (3.9 in).
MA01a–MA05a, MA02c	Sides: 0 mm (0 in).
MA01c (natural cooling)	Sides: 0 mm (0 in) for 40 °C (104 °F), 10 mm (0.39 in) and above for 50 °C (122 °F).

3.3 Connecting to Mains and Motor

- Mount the ground wires to the PE terminal.
- Connect motor to terminals U, V, and W.
- Mount mains supply to terminals L1/L, L2, and L3/N (3-phase) or L1/L and L3/N (single-phase) and tighten.
- For required maximum screwing torque, see the back of the terminal cover.

3.4 Load Sharing/Brake

Table 2: Connect Terminals

Load sharing	-UDC and +UDC/+BR
Brake	-BR and +UDC/+BR

- For MA01a, MA02a, and MA03a drives, wire with recommended connector (Ultra-Pod Fully Insulated FASTON Receptacles and Tabs, 521366-2, TE connectivity).
- For other enclosure sizes, mount the wires to the related terminal and tighten. For required maximum screwing torque, see the back of the terminal cover.
- For more details, contact Danfoss or refer to the drive's design guide.

 **NOTICE** 

Voltage levels of up to 850 V DC may occur between terminals +UDC/+BR and -UDC. Not short-circuit protected.

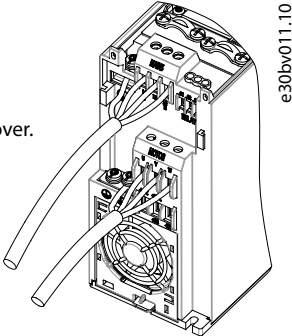


Illustration 1: Mounting of Ground Cable, Mains, and Motor Wires

3.5 Control Terminals

- All control cable terminals are located underneath the terminal cover in front of the drive.
- See the back of the terminal cover for outlines of control terminals and switches.

 **NOTICE** 

Remove the terminal cover with a screwdriver, see *illustration 2*.

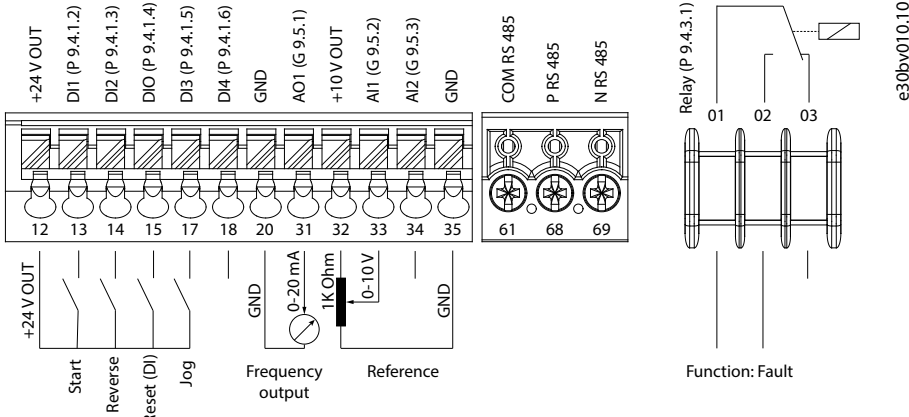


Illustration 3: Overview of Control Terminals in PNP-configuration with Factory Setting (Speed Control Mode)

3.6 RJ45 Port and RS485 Termination Switch

The drive has an RJ45 port which complies with Modbus 485 protocol.

The RJ45 port is used for connecting:

- External control panel (Control Panel 2.0 OP2).
- PC tool (MyDrive® Insight) via an adapter option.

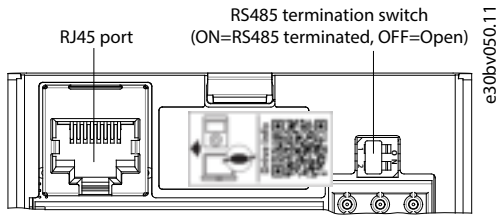


Illustration 4: RJ45 Port and RS485 Termination Switch

 **NOTICE** 

- The RJ45 port supports up to 3 m (9.8 ft) of shielded CAT5e cable which is **NOT** used to directly connect the drive to a PC. Failure to follow this notice causes damage to the PC.
- If the drive is at the end of the fieldbus, set the RS485 termination switch to ON.
- Do not operate RS485 termination switch when the drive is powered on.

4 Programming

4.1 Control Panel

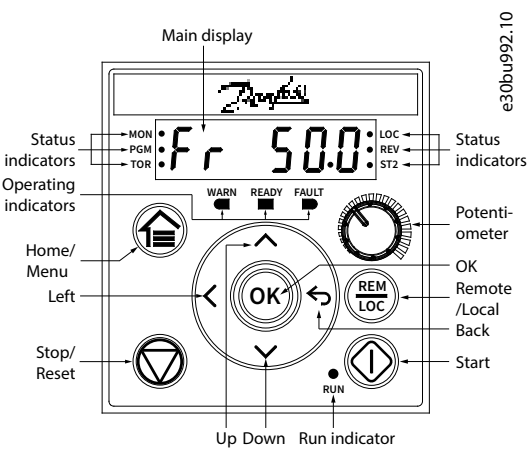


Illustration 5: Indicators and Operation Keys

Table 4: Status and Operating Indicator Lights

Name	Function	Name	Function
MON	On Shows the drive status.	REV	On The drive is in reverse direction. Off The drive is in forward direction.
PGM	On The drive is in programming status.	ST2	Refer to <i>Table 6 Multiple Setups Indicator Lights</i> .
TOR	On The drive is in torque mode. Off The drive is in speed mode.	WARN	Steadily lit when a warning occurs.
LOC	On The drive is in local mode. Off The drive is in remote mode.	READY	Steadily lit when the drive is ready.
		FAULT	Flashes when a fault occurs.

Table 3: Operation Keys and Potentiometer

Name	Function
Home/Menu	(1) Toggles between status display and main menu. (2) Long press to access the shortcut menu for quickly reading and editing parameters.
Up/Down	Switches status/parameter group/parameter numbers and tunes the parameter values.
Left	Moves the cursor 1 bit to the left.
Back	Navigates to the previous step in the menu structure or cancels the setting during tuning parameter values.
OK	Confirms the operation.
Remote/Local	Toggles between remote and local mode.
Start	Starts the drive in local mode.
Stop/Reset	Stops the drive in local mode, or resets the drive to clear a fault.
Potentiometer	Changes the reference value when the reference value is selected as potentiometer.

Table 5: Run Indicator Lights

Name	Function
RUN	On The drive is in normal operation.
	Off The drive has stopped.
	Flash In the motor-stopping process; or the drive received a <i>RUN</i> command, but no frequency output.

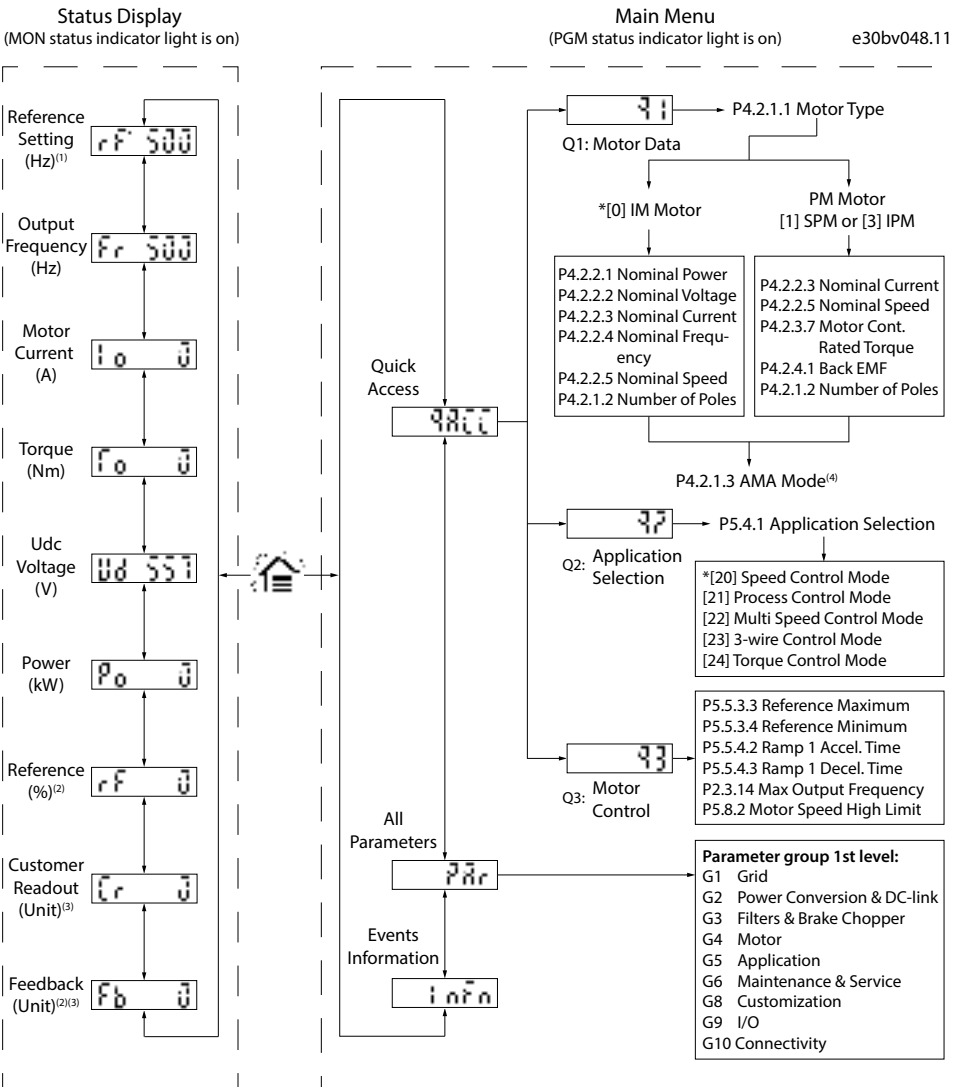
Table 6: Multiple Setups Indicator Lights

ST2	Off	On	Flash	Flash quickly
Active setup ⁽¹⁾	Setup 1	Setup 2	Setup 1	Setup 2
Programming setup ⁽²⁾	Setup 1	Setup 2	Setup 2	Setup 1

Note:
(1) Select active setup in *parameter P6.6.1 Active Setup*.
(2) Select programming setup in *parameter P6.6.2 Programming Setup*.

4.2 Operation with Control Panel

After the drive is powered up, press the **Home/Menu** key to toggle between status display and main menu. Use the **Up/Down** keys to select items, and press the **OK** key to confirm selection.



Note: (1) Local mode only. (2) Remote mode only. (3) The status is only shown when the corresponding function is enabled.
(4) For AMA execution, refer to *chapter Automatic Motor Adaptation (AMA)*. If *parameter P5.4.3 Motor Control Principle* is set as [0] U/f, no need to execute AMA.

Illustration 6: Operation with Control Panel

4.3 Automatic Motor Adaptation (AMA)

- Via running AMA in VVC+ mode, the drive builds a mathematical model of the motor to optimize compatibility between drive and motor, and thus enhances the motor control performance.
- Some motors may be unable to run the complete version of the test. In that case, select [2] *Enable Reduced AMA in parameter P4.2.1.3 AMA Mode*.
- AMA completes within 5 minutes. For best results, run the following procedure on a cold motor.

Procedure:

- Set motor data according to the motor nameplate.
- If needed, set motor cable length in *parameter P4.2.1.4 Motor Cable Length*.
- Set [1] *Enable Complete AMA* or [2] *Enable Reduced AMA* for *parameter P4.2.1.3 AMA Mode*, the main display shows *To start AMA*, see *illustration 7*.
- Press the **Start** key, the test runs automatically and the main display indicates when it is completed.
- When AMA is completed, press any key to exit and return to normal operation mode.

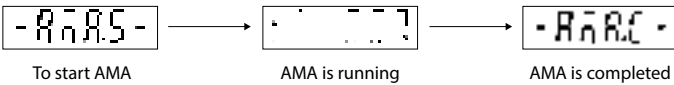


Illustration 7: AMA Status Indications

5 Troubleshooting

Table 7: Warning and Fault Events Summary

Number	Description	Warning	Fault	Trip lock	Cause
2	Live Zero Error	X	X	–	Signal on terminal 33 or 34 is less than 50% of the value set in <i>parameter P9.5.2.3 T33 Low Voltage</i> , <i>parameter P9.5.2.5 T33 Low Current</i> , <i>parameter P9.5.3.3 T34 Low Voltage</i> , and <i>parameter P9.5.3.5 T34 Low Current</i> .
3	No Motor	X	X	–	No motor has been connected to the output of the drive.
4	Mains Phase Loss ⁽¹⁾	X	X	X	Missing phase on the supply side, or the voltage imbalance is too high. Check the supply voltage.
7	DC Over Voltage ⁽¹⁾	X	X	–	DC-link voltage exceeds the limit.
8	DC Under Voltage ⁽¹⁾	X	X	–	DC-link voltage drops below the voltage warning low limit.
9	Inverter Overloaded	X	X	–	More than 100% load for too long.
10	Motor ETR Overtemperature	X	X	–	Motor is too hot due to more than 100% load for too long.
11	Motor Thermistor Overtemperature	X	X	–	Thermistor or thermistor connection is disconnected, or the motor is too hot.
12	Torque Limit	X	X	–	Torque exceeds the value set in either <i>parameter P5.10.1 Motor Torque Limit</i> or <i>parameter P5.10.2 Regenerative Torque Limit</i> .
13	Over Current	X	X	X	Inverter peak current limit is exceeded. If this fault occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
14	Earth fault	X	X	X	Discharge from output phases to ground.
16	Short Circuit	–	X	X	Short circuit in motor or on motor terminals.
17	Control Word Timeout	X	X	–	No communication to the drive.
18	Start Failed	–	X	–	May be caused by a blocked motor.
25	Brake Resistor Short	–	X	X	Brake resistor is short-circuited, thus the brake function is disconnected.
26	Brake Overload	X	X	–	The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.
27	Brake IGBT/Brake chopper Short Circuited	–	X	X	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake Check	–	X	X	Brake resistor is not connected/working.
30	U phase loss	–	X	X	Motor phase U is missing. Check the phase.
31	V phase loss	–	X	X	Motor phase V is missing. Check the phase.
32	W phase loss	–	X	X	Motor phase W is missing. Check the phase.
36	Mains Failure	X	X	–	This warning/fault is only active if the supply voltage to the drive is less than the value set in <i>parameter P2.3.7 Power Loss Controller Limit</i> , and <i>parameter P2.3.6 Power Loss Action</i> is NOT set to <i>[0] No Function</i> .
38	Internal Fault	–	X	X	Contact the local supplier.
40	Overload T15	X	–	–	Check the load connected to terminal 15 or remove short-circuit connection.
46	Gate drive Voltage Fault	–	X	X	–
47	24 V Supply Low	X	X	X	24 V DC may be overloaded.
50	AMA calibration failed	–	X	–	A calibration error has occurred.
51	AMA check U _{nom} and I _{nom}	–	X	–	Wrong setting for motor voltage and/or motor current.
52	AMA low I _{nom}	–	X	–	Motor current is too low. Check the settings.
53	AMA big motor	–	X	–	The power size of the motor is too large for the AMA to operate.
54	AMA small motor	–	X	–	The power size of the motor is too small for the AMA to operate.
55	AMA parameter range	–	X	–	The parameter values of the motor are outside of the acceptable range. AMA does not run.
56	AMA interrupt	–	X	–	The AMA is interrupted.
57	AMA timeout	–	X	–	–
58	AMA internal	–	X	–	Contact the local supplier.
59	Current Limit	X	X	–	The drive is overloaded.
60	External Interlock	–	X	–	External interlock has been activated.
61	Feedback Error	X	X	–	–
63	Mechanical Brake Low	–	X	–	Actual motor current has not exceeded release brake current within start delay time window.
69	Power Card Temp	X	X	X	The cutout temperature of the power card has exceeded the upper limit.
80	Drive Initialized	–	X	–	All parameter settings are initialized to default settings.
87	Auto DC brake	X	–	–	Occurs in IT mains when the drive coasts, and the DC voltage is higher than 830 V for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in <i>parameter P2.3.13 Auto DC Braking</i> .
95	Lost load detected	X	X	–	–
99	Locked Rotor	–	X	–	Rotor is blocked.
126	Motor Rotating	–	X	–	PM motor is rotating when AMA is performed.
127	Back EMF too High	X	–	–	The back EMF of PM motor is too high before starting.
Err. 89	Parameter read only	–	–	–	Parameters cannot be changed.
Err. 95	Not while running	–	–	–	Parameters can only be changed when the motor is stopped.
Err. 96	A wrong password was entered	–	–	–	Occurs when using a wrong password for changing a password-protected parameter.

Note: (1) These faults may be caused by mains distortions. Installing a Danfoss line filter may rectify this problem.

6 Specifications

Table 8: Mains Supply 1x100–120 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A4	04A8
Typical shaft output [kW (hp)]	0.37 (0.5)	1.1 (1.5)
Enclosure size	MA01c	MA02c
Output current		
Continuous (3x200–240 V) [A]	2.4	4.8
Intermittent (3x200–240 V) [A]	3.6	7.2
Maximum cable size (Mains, motor) [mm²AWG]	4/10	
Maximum input current		
Continuous (1x100–120 V) [A]	11.6	25.6
Intermittent (1x100–120 V) [A]	17.4	38.4
EMC filter type	C4	

Table 9: Mains Supply 1x200–240 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A2	04A2	06A8	09A6
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)
Enclosure size	MA01c	MA01c	MA02c	MA02a
Output current				
Continuous (3x200–240 V) [A]	2.2	4.2	6.8	9.6
Intermittent (3x200–240 V) [A]	3.3	6.3	10.2	14.4
Maximum cable size (Mains, motor) [mm²/AWG]	4/10			
Maximum input current				
Continuous (1x200–240 V) [A]	6.1	11.6	18.7	26.4
Intermittent (1x200–240 V) [A]	8.3	15.6	26.4	37
EMC filter type	C1/C4			

Table 10: Mains Supply 3x200–240 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A4	04A2	07A8	11A0	15A2
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)	3.7 (5.0)
Enclosure size	MA01a	MA01a	MA02a	MA03a	MA03a
Output current					
Continuous (3x200–240 V) [A]	2.4	4.2	7.8	11	15.2
Intermittent (3x200–240 V) [A]	3.6	6.3	11.7	16.5	22.8
Maximum cable size (Mains, motor) [mm²AWG]	4/10				
Maximum input current					
Continuous (3x200–240 V) [A]	3.8	6.7	12.5	17.7	24.3
Intermittent (3x200–240 V) [A]	5.7	8.3	18.8	26.6	35.3
EMC filter type	C4				

Table 11: Mains Supply 3x380–480 V AC (Normal overload 150% for 1 minute)

Frequency converter	01A2	02A2	03A7	05A3	07A2	09A0
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)	3.0 (4.0)	4.0 (5.5)
Enclosure size	MA01a	MA01a	MA01a	MA02a	MA02a	MA02a
Output current						
Continuous (3x380–440 V) [A]	1.2	2.2	3.7	5.3	7.2	9.0
Intermittent (3x380–440 V) [A]	1.8	3.3	5.6	8.0	10.8	13.7
Continuous (3x440–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2
Intermittent (3x440–480 V) [A]	1.7	3.2	5.1	7.2	9.5	12.3
Maximum cable size (Mains, motor) [mm²/AWG]	4/10					
Maximum input current						
Continuous (3x380–440 V) [A]	1.9	3.5	5.9	8.5	11.5	14.4
Intermittent (3x380–440 V) [A]	2.6	4.7	8.7	12.6	16.8	20.2
Continuous (3x440–480 V) [A]	1.7	3.0	5.1	7.3	9.9	12.4
Intermittent (3x440–480 V) [A]	2.3	4.0	7.5	10.8	14.4	17.5
EMC filter type	C2/C4					

Table 12: Mains Supply 3x380–480 V AC (Normal overload 150% for 1 minute)

Frequency converter	12A0	15A5	23A0	31A0	37A0	43A0
Typical shaft output [kW (hp)]	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)
Enclosure size	MA03a	MA03a	MA04a	MA04a	MA05a	MA05a
Output current						
Continuous (3x380–440 V) [A]	12	15.5	23	31	37	43
Intermittent (3x380–440 V) [A]	18	23.5	34.5	46.5	55.5	64.5
Continuous (3x440–480 V) [A]	11	14	21	27	34	40
Intermittent (3x440–480 V) [A]	16.5	21.3	31.5	40.5	51	60
Maximum cable size (Mains, motor) [mm²AWG]	4/10		16/6			

Maximum input current						
Continuous (3x380–440 V) [A]	19.2	24.8	33	42	34.7	41.2
Intermittent (3x380–440 V) [A]	27.4	36.3	47.5	60	49	57.6
Continuous (3x440–480 V) [A]	16.6	21.4	29	36	31.5	37.5
Intermittent (3x440–480 V) [A]	23.6	30.1	41	52	44	53
EMC filter type	C2/C4					

7 Ambient Conditions

Protection rating		IP20/Open Type (IP21/Type 1 conversion kit as an option).
Temperature during operation		-20 °C to 55 °C (-4 °F to 131 °F), -10 °C to 50 °C (14 °F to 131 °F) without derating.
Temperature during storage/transport		-25 °C to 65/70 °C (-13 °F to 149/158 °F).
Relative humidity		5–95%, non-condensing during operation.
Altitude		0–1000 m (3280 ft) without derating.
		1000–4000 m (3280–13123 ft) with derating of 1%/100 m (328 ft).
Contamination level	Storage	IEC 60721-3-1, Class 1C2 (aggressive gases), Class 1S11 (dust/sand).
	Transportation	IEC 60721-3-2, Class 2C2 (aggressive gases), Class 2S5 (dust/sand).
	Operation	IEC 60721-3-3, Class C3 (aggressive gases), Class 3S6 (dust/sand).
Mechanical conditions	Storage	IEC 60721-3-1, Class 1M11.
	Transportation	IEC 60721-3-2, Class 2M4.
	Operation	IEC 60721-3-3, Class 3M11.

8 EMC Compatibility and Motor Cable Length

- Drive with built-in EMC filter fulfills radiated emission C2 limits.
- Drive with non built-in EMC filter fulfills conducted/radiated emission C4 requirements.
- The drive is designed to operate with optimum performance within the maximum motor cable lengths defined in *Table 14 Maximum Motor Cable Length*.

Table 13: EMC Compatibility Motor Cable Length

Drive with built-in EMC filter	Maximum motor cable length (shielded), @4kHz	
	C1 (Conducted)	C2 (Conducted)
	1x200–240 V	5 m (16.4 ft)
	3x400–480 V	–

Table 14: Maximum Motor Cable Length

Maximum motor cable length	Shielded	50 m (164 ft)
	Unshielded	75 m (246 ft)

9 Fuses and Circuit Breakers

iC2-Micro	Non cabinet					Cabinet			
	UL fuse				CE fuse	UL circuit breaker	CE circuit breaker	Test cabinet size [Height x Width x Depth] [mm (in)]	Minimum cabinet volume [L]
kW (hp)	RK1	T	J	CC	gG	ABB MS165 Maximum trip level	Eaton Maximum trip level		
Standard fault current SCCR	5 kA	5 kA			5 kA	5 kA	5 kA		
High fault current SCCR	–	100 kA			–	65 kA	–		
1x100-120 V AC									
0.37 (0.5)	25 A				25 A	25 A	PKZM4-25	500 x 400 x 260	52
1.1 (1.5)	35 A				50 A	42 A	PKZM4-50	(19.7 x 15.7 x 10.2)	
1x200-240 V AC									
0.37–0.75 (0.5–1.0)	25 A				25 A	25 A	PKZM4-25	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52
1.5 (2.0)	35 A				35 A	32 A	PKZM4-32		
2.2 (3.0)	40 A				50 A	42 A	PKZM4-50		
3x200-240 V AC									
0.37–0.75 (0.5–1.0)	15 A				16 A	16 A	PKZM0-16	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52
1.5 (2.0)	30 A				32 A	32 A	PKZM4-32		
2.2–3.7 (3.0–5.0)	40 A				40 A	42 A	PKZM4-40		
3x380-480 V AC									
0.37–1.5 (0.5–2.0)	15 A				16 A	16 A	PKZM0-16	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52
2.2–4.0 (3.0–5.5)	30 A				40 A	32 A	PKZM4-32		
5.5–7.5 (7.5–10)	40 A				40 A	42 A	PKZM4-40		
11–15 (15–20)	60 A				63 A	65 A	PKZM4-63	800 x 400 x 300 (31.5 x 15.7 x 11.8)	96
18.5–22 (25–30)	60 A				80 A	80 A	NZMN1-A80		

10 Technical Documentation

Scan the QR code to access more technical documents for the drive. Or, after scanning the QR code, click **Global English** on the website to select your local region's website, search iC2 to find the documents with your own languages.



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