TR150 and TR170 Quick Guide

BAS-SVX58B-EN

September 2016

BAS-SVX58B-EN

Contents

1 Introduction

1.1 Purpose of the Quick Guide

The quick guide provides information for safe installation and commissioning of the frequency converter.

The quick guide is intended for use by qualified personnel. Read and follow the quick guide to use the frequency converter safely and professionally, and pay particular attention to the safety instructions and general warnings. Keep this quick guide available with the frequency converter at all times.

1.2 Additional Resources

The technical documentation is available in electronic form on the documentation CD that is shipped with the product, or in print at the local Trane sales office. It is also available online at:
www.trane.com/vfd

Trane Drive Utility (TDU) support
Download the software from *www.trane.com/vfd*.

During the installation process of the software, enter CD key 52314600. A license key is not required for basic operation. For advanced features, enter license key 11131111.

The latest software does not always contain the latest updates for frequency converters. Contact the local sales office for the latest frequency converter updates (in the form of *.upd files), or download the frequency converter updates from *www.tranedrives.com*.

1.3 Document and Software Version

The quick guide is regularly reviewed and updated. All suggestions for improvement are welcome.

Edition	Remarks	Software version
BAS-SVX58B-EN	Update to new software version	2.90

1.4 Certificates and Approvals

Certification		IP20
EC Declaration of Conformity	CE	✓
UL Listed	c UL us	✓
RCM		✓

Table 1.1 Certificates and Approvals

The frequency converter complies with UL 508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the product-specific *design guide*.

1.5 Disposal

Equipment containing electrical components must not be disposed of together with domestic waste.
It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

2 Safety

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2.1 Safety Symbols

The following symbols are used in this document:

⚠WARNING

Indicates a potentially hazardous situation that could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that can result in damage to equipment or property.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the personnel must be familiar with the instructions and safety measures described in this guide.

2.3 Safety

⚠WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- **Only qualified personnel must perform installation, start-up, and maintenance.**

⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. Start the motor with an external switch, a fieldbus command, an input reference signal from the local control panel (LCP), via remote operation using MCT 10 software, or after a cleared fault condition.

To prevent unintended motor start:

- **Disconnect the frequency converter from the mains.**
- **Press [Off/Reset] on the LCP before programming parameters.**
- **Ensure that the frequency converter is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.**

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- **Stop the motor.**
- **Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
- **Disconnect or lock PM motor.**
- **Wait for the capacitors to discharge fully. The minimum duration of waiting time is specified in *Table 2.1*.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.**

Voltage [V]	Power range [kW (hp)]	Minimum waiting time (minutes)
3x200	0.25–3.7 (0.33–5)	4
3x200	5.5–11 (7–15)	15
3x400	0.37–7.5 (0.5–10)	4
3x400	11–90 (15–125)	15
3x600	2.2–7.5 (3–10)	4
3x600	11–90 (15–125)	15

Table 2.1 Discharge Time

⚠WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly can result in death or serious injury.

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

⚠WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this manual.**

⚠CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the frequency converter can result in serious injury when the frequency converter is not properly closed.

- **Ensure that all safety covers are in place and securely fastened before applying power.**

2.4 Motor Thermal Protection

Set *parameter 1-90 Motor Thermal Protection* to *[4] ETR trip 1* to enable the motor thermal protection function.

3 Installation

3.1 Mechanical Installation

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3.1.1 Side-by-side Installation

The frequency converter can be mounted side-by-side but requires the clearance above and below for cooling.

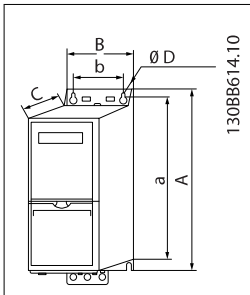
		Power [kW (hp)]			Clearance above/below [mm (in)]
Size	**IP class**	**3x200–240 V**	**3x380–480 V**	**3x525–600 V**	
TR150					
H1	IP20	0.25–1.5 (0.33–2)	0.37–1.5 (0.5–2)	–	100 (4)
H2	IP20	2.2 (3)	2.2–4 (3–5)	–	100 (4)
H3	IP20	3.7 (5)	5.5–7.5 (7.5–10)	–	100 (4)
H4	IP20	5.5–7.5 (7.5–10)	11–15 (15–20)	–	100 (4)
H5	IP20	11 (15)	18.5–22 (25–30)	–	100 (4)
H6	IP20	15–18.5 (20–25)	30–45 (40–60)	18.5–30 (25–40)	200 (7.9)
H7	IP20	22–30 (30–40)	55–75 (70–100)	37–55 (50–70)	200 (7.9)
H8	IP20	37–45 (50–60)	90 (125)	75–90 (100–125)	225 (8.9)
H9	IP20	–	–	2.2–7.5 (3–10)	100 (4)
H10	IP20	–	–	11–15 (15–20)	200 (7.9)
TR170					
H2	IP20	1.5 (2)	1.5(2)	–	100 (4)

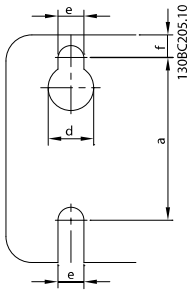
Table 3.1 Clearance Required for Cooling

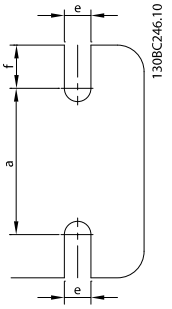
NOTICE

With IP21/NEMA Type1 option kit mounted, a distance of 50 mm (2 in) between the units is required.

3.1.2 Frequency Converter Dimensions







Enclosure		Power [kW (hp)]			Height [mm (in)]			Width [mm (in)]		Depth [mm (in)]	Mounting hole [mm (in)]			Maxi-mum weight
Size	IP class	3x 200–240 V	3x 380–480 V	3x 525–600 V	A	A[1)]	a	B	b	C	d	e	f	kg (lb)
TR150														
H1	IP20	0.25–1.5 (0.33–2)	0.37–1.5 (0.5–2)	–	195 (7.7)	273 (10.7)	183 (7.2)	75 (3.0)	56 (2.2)	168 (6.6)	9 (0.35)	4.5 (0.18)	5.3 (0.21)	2.1 (4.6)
H2	IP20	2.2 (3)	2.2–4.0 (3–5)	–	227 (8.9)	303 (11.9)	212 (8.3)	90 (3.5)	65 (2.6)	190 (7.5)	11 (0.43)	5.5 (0.22)	7.4 (0.29)	3.4 (7.5)
H3	IP20	3.7 (5)	5.5–7.5 (7.5–10)	–	255 (10.0)	329 (13.0)	240 (9.4)	100 (3.9)	74 (2.9)	206 (8.1)	11 (0.43)	5.5 (0.22)	8.1 (0.32)	4.5 (9.9)
H4	IP20	5.5–7.5 (7.5–10)	11–15 (15–20)	–	296 (11.7)	359 (14.1)	275 (10.8)	135 (5.3)	105 (4.1)	241 (9.5)	12.6 (0.50)	7 (0.28)	8.4 (0.33)	7.9 (17.4)
H5	IP20	11 (15)	18.5–22 (25–30)	–	334 (13.1)	402 (15.8)	314 (12.4)	150 (5.9)	120 (4.7)	255 (10)	12.6 (0.50)	7 (0.28)	8.5 (0.33)	9.5 (20.9)
H6	IP20	15–18.5 (20–25)	30–45 (40–60)	18.5–30 (25–40)	518 (20.4)	595 (23.4)/635 (25) (45 kW)	495 (19.5)	239 (9.4)	200 (7.9)	242 (9.5)	–	8.5 (0.33)	15 (0.6)	24.5 (54)
H7	IP20	22–30 (30–40)	55–75 (70–100)	37–55 (50–70)	550 (21.7)	630 (24.8)/690 (27.2) (75 kW)	521 (20.5)	313 (12.3)	270 (10.6)	335 (13.2)	–	8.5 (0.33)	17 (0.67)	36 (79)
H8	IP20	37–45 (50–60)	90 (125)	75–90 (100–125)	660 (26)	800 (31.5)	631 (24.8)	375 (14.8)	330 (13)	335 (13.2)	–	8.5 (0.33)	17 (0.67)	51 (112)
H9	IP20	–	–	2.2–7.5 (3–10)	269 (10.6)	374 (14.7)	257 (10.1)	130 (5.1)	110 (4.3)	205 (8)	11 (0.43)	5.5 (0.22)	9 (0.35)	6.6 (14.6)
H10	IP20	–	–	11–15 (15–20)	399 (15.7)	419 (16.5)	380 (15)	165 (6.5)	140 (5.5)	248 (9.8)	12 (0.47)	6.8 (0.27)	7.5 (0.30)	12 (26.5)
TR170														
H2	IP20	1.5 (2)	1.5 (2)	–	227 (8.9)	303 (11.9)	212 (8.3)	90 (3.5)	65 (2.6)	190 (7.5)	11 (0.43)	5.5 (0.22)	7.4 (0.29)	3.4 (7.5)

1) Including decoupling plate

The dimensions are only for the physical units.

NOTICE

When installing in an application, allow space above and below the units for cooling. The amount of space for free air passage is listed in *Table 3.1*.

Table 3.2 Dimensions

3.2 Electrical Installation

3.2.1 Electrical Installation in General

3

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper conductors are required. 75 °C (167 °F) is recommended. For TR170 drives operating in ambients over 50 °C (122 °F), copper conductors rated 80 °C (176 °F) or higher are recommended.

Power [kW (hp)]				Torque [N · m (in-lb)]					
Enclosure size	IP class	3x200–240 V	3x380–480 V	Mains	Motor	DC connection	Control terminals	Ground	Relay
TR150									
H1	IP20	0.25–1.5 (0.33–2)	0.37–1.5 (0.5–2)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H2	IP20	2.2 (3)	2.2–4.0 (3–5)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H3	IP20	3.7 (5)	5.5–7.5 (7.5–10)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H4	IP20	5.5–7.5 (7.5–10)	11–15 (15–20)	1.2 (11)	1.2 (11)	1.2 (11)	0.5 (4)	0.8 (7)	0.5 (4)
H5	IP20	11 (15)	18.5–22 (25–30)	1.2 (11)	1.2 (11)	1.2 (11)	0.5 (4)	0.8 (7)	0.5 (4)
H6	IP20	15–18.5 (20–25)	30–45 (40–60)	4.5 (40)	4.5 (40)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	22–30 (30–40)	55 (70)	10 (89)	10 (89)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	–	75 (100)	14 (124)	14 (124)	–	0.5 (4)	3 (27)	0.5 (4)
H8	IP20	37–45 (50–60)	90 (125)	24 (212)[1)]	24 (212)[1)]	–	0.5 (4)	3 (27)	0.5 (4)
TR170									
H2	IP20	1.5 (2)	1.5 (2)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)

Table 3.3 Tightening Torques for Enclosure Sizes H1–H8, 3x200–240 V & 3x380–480 V

Power [kW (hp)]			Torque [N · m (in-lb)]					
Enclosure size	IP class	3x525–600 V	Mains	Motor	DC connection	Control terminals	Ground	Relay
TR150								
H9	IP20	2.2–7.5 (3–10)	1.8 (16)	1.8 (16)	Not recommended	0.5 (4)	3 (27)	0.6 (5)
H10	IP20	11–15 (15–20)	1.8 (16)	1.8 (16)	Not recommended	0.5 (4)	3 (27)	0.6 (5)
H6	IP20	18.5–30 (25–40)	4.5 (40)	4.5 (40)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	37–55 (50–70)	10 (89)	10 (89)	–	0.5 (4)	3 (27)	0.5 (4)
H8	IP20	75–90 (100–125)	14 (124)/24 (212)[2)]	14 (124)/24 (212)[2)]	–	0.5 (4)	3 (27)	0.5 (4)

Table 3.4 Tightening Torques for Enclosure Sizes H6–H10, 3x525–600 V

1) Cable dimensions >95 mm²

2) Cable dimensions ≤95 mm²

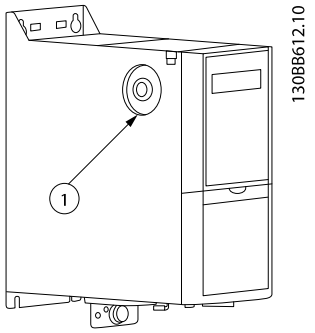
3.2.2 IT Mains

⚠CAUTION

IT Mains

Installation on isolated mains source, that is, IT mains. Ensure that the supply voltage does not exceed 440 V (3x380–480 V units) when connected to mains.

On IP20, 200–240 V, 0.25–11 kW (0.33–15 hp) and 380–480 V, IP20, 0.37–22 kW (0.5–30 hp) units, open the RFI switch by removing the screw on the side of the frequency converter when at IT grid.



1	EMC screw

Illustration 3.1 IP20, 200–240 V, 0.25–11 kW (0.33–15 hp), IP20, 0.37–22 kW (0.5–30 hp), 380–480 V

On 400 V, 30–90 kW (40–125 hp) and 600 V units, set *parameter 14-50 RFI Filter* to *[0] Off* when operating in IT mains.

For IP54, 400 V, 0.75–18.5 kW (1–25 hp) units, the EMC screw is inside the frequency converter, as shown in *Illustration 3.2*.

NOTICE

If reinserted, use only M3x12 screw.

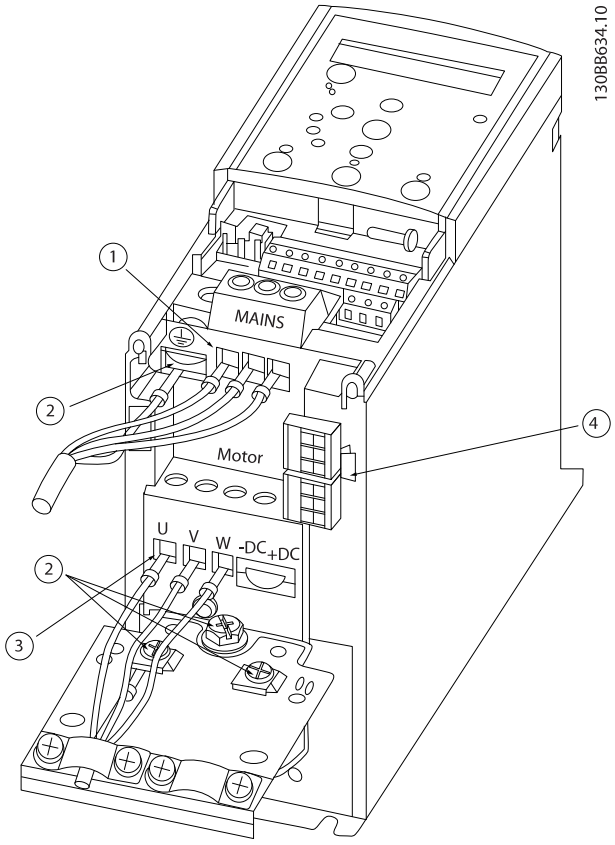
3.2.3 Connecting to Mains and Motor

The frequency converter is designed to operate all standard 3-phase asynchronous motors. For maximum cross-section on cables, see *chapter 6.3 General Technical Data*.

- Use a shielded/armored motor cable to comply with EMC emission specifications and connect this cable to both the decoupling plate and the motor.
- Keep the motor cable as short as possible to reduce the noise level and leakage currents.
- For further details on mounting the decoupling plate, see *TR150 Decoupling Plate Mounting Instruction*.
- Also see *EMC-Correct Installation in the TR150 and TR170 Design Guide*.

1. Mount the ground cables to the ground terminal.
2. Connect the motor to terminals U, V, and W, and then tighten the screws according to the torques specified in *chapter 3.2.1 Electrical Installation in General*.
3. Connect the mains supply to terminals L1, L2, and L3, and then tighten the screws according to the torques specified in *chapter 3.2.1 Electrical Installation in General*.

Relays and terminals on enclosure sizes H1–H5

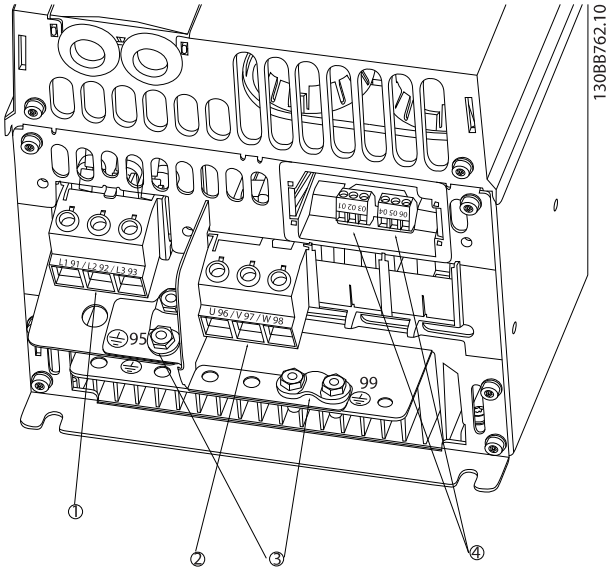


1	Mains
2	Ground
3	Motor
4	Relays

Illustration 3.2 Enclosure Sizes H1–H5
IP20, 200–240 V, 0.25–11 kW (0.33–15 hp)
IP20, 380–480 V, 0.37–22 kW (0.5–30 hp)

3

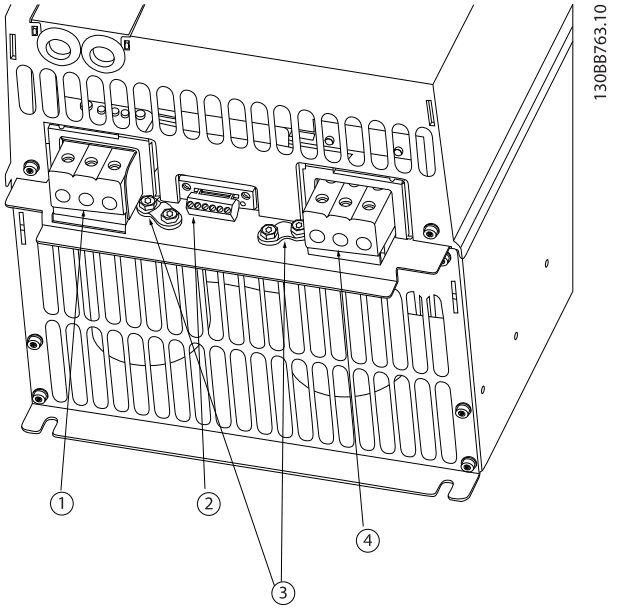
Relays and terminals on enclosure size H6



1	Mains
2	Motor
3	Ground
4	Relays

Illustration 3.3 Enclosure Size H6
IP20, 380–480 V, 30–45 kW (40–60 hp)
IP20, 200–240 V, 15–18.5 kW (20–25 hp)
IP20, 525–600 V, 22–30 kW (30–40 hp)

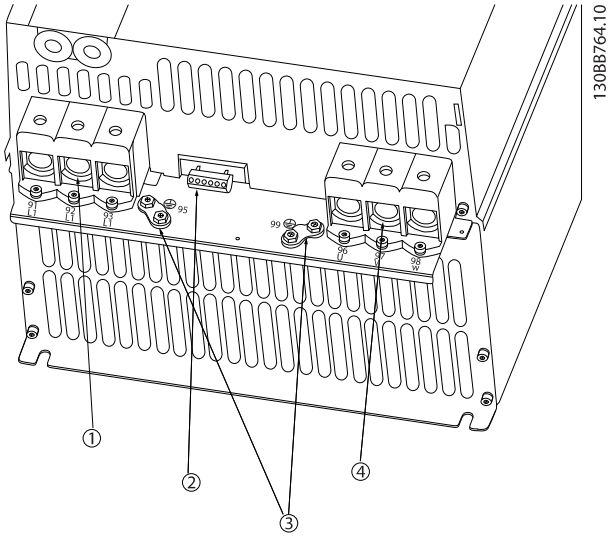
Relays and terminals on enclosure size H7



1	Mains
2	Relays
3	Ground
4	Motor

Illustration 3.4 Enclosure Size H7
IP20, 380–480 V, 55–75 kW (70–100 hp)
IP20, 200–240 V, 22–30 kW (30–40 hp)
IP20, 525–600 V, 45–55 kW (60–70 hp)

Relays and terminals on enclosure size H8



1	Mains
2	Relays
3	Ground
4	Motor

Illustration 3.5 Enclosure Size H8
IP20, 380–480 V, 90 kW (125 hp)
IP20, 200–240 V, 37–45 kW (50–60 hp)
IP20, 525–600 V, 75–90 kW (100–125 hp)

Connecting to mains and motor for enclosure size H9

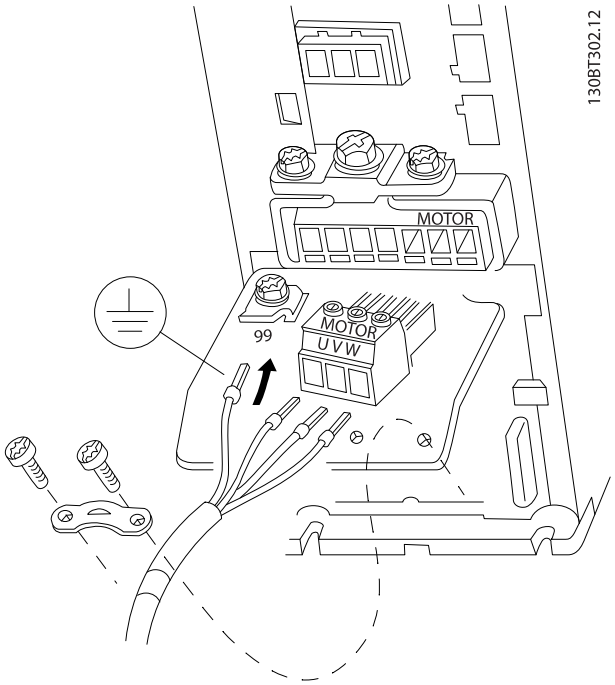


Illustration 3.6 Connecting the Frequency Converter to the Motor, Enclosure Size H9
IP20, 600 V, 2.2–7.5 kW (3–10 hp)

Complete the following steps to connect the mains cables for enclosure size H9. Use the tightening torques described in *chapter 3.2.1 Electrical Installation in General*.

1. Slide the mounting plate into place and tighten the 2 screws as shown in *Illustration 3.7*.

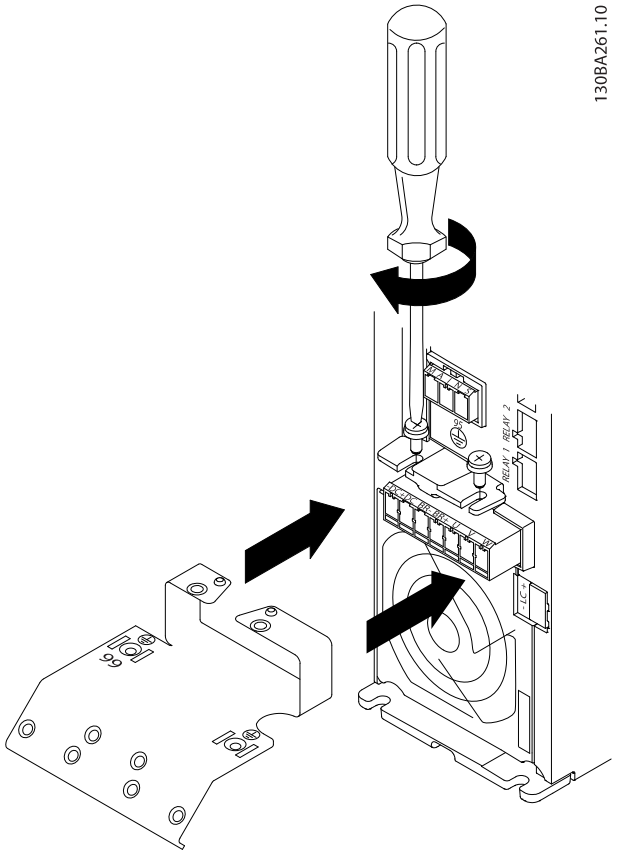


Illustration 3.7 Mounting the Mounting Plate

3

2. Mount the ground cable as shown in *Illustration 3.8*.

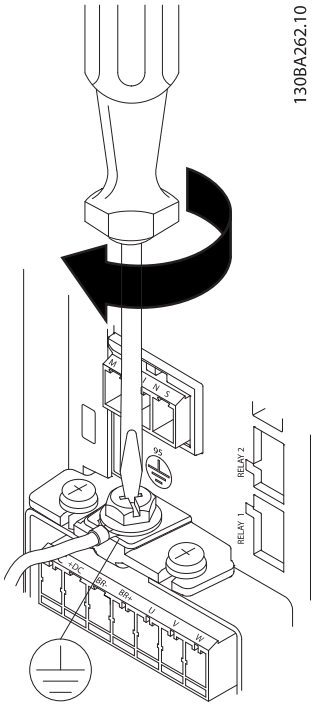


Illustration 3.8 Mounting the Ground Cable

3. Insert the mains cables to the mains plug and tighten the screws as shown in *Illustration 3.9*.

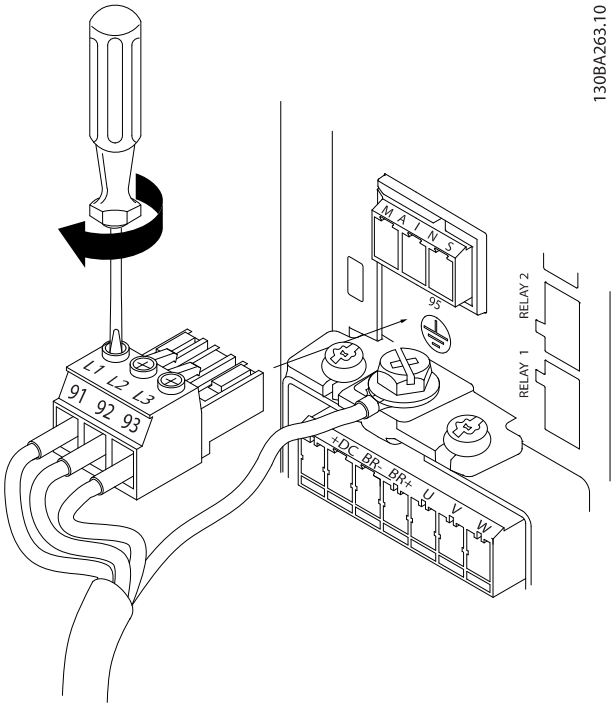


Illustration 3.9 Mounting the Mains Plug

4. Mount the support bracket across the mains cables and tighten the screws as shown in *Illustration 3.10*.

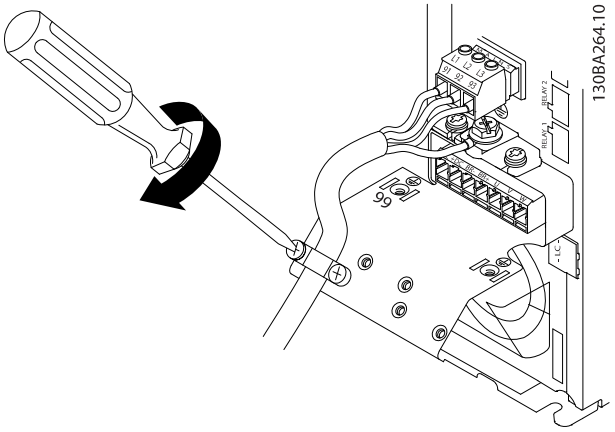


Illustration 3.10 Mounting the Support Bracket

Relays and terminals on enclosure size H10

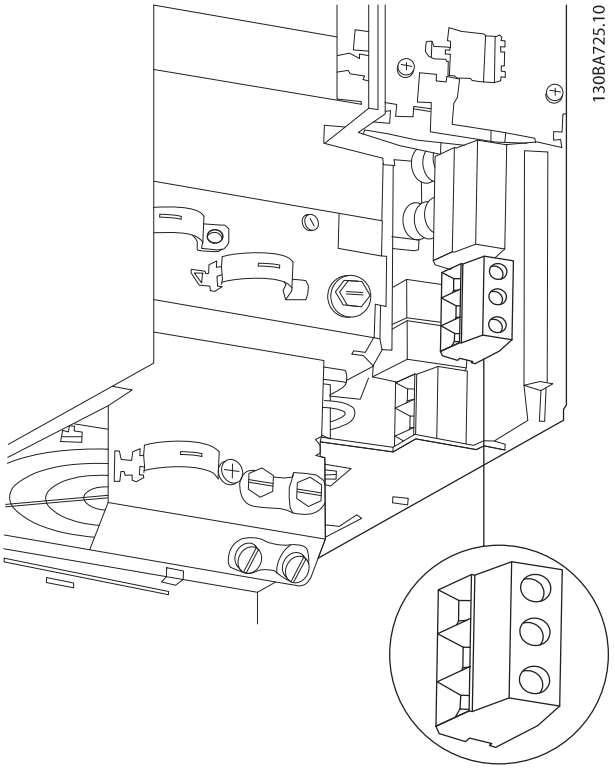


Illustration 3.11 Enclosure Size H10
IP20, 600 V, 11–15 kW (15–20 hp)

3.2.4 Fuses and Circuit Breakers

Branch circuit protection
To prevent fire hazards, protect the branch circuits in an installation - switch gear, machines, and so on - against short circuits and overcurrent. Follow national and local regulations.

Overcurrent protection
Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to local and national regulations. Circuit breakers and fuses must be designed for protection in a circuit capable of supplying a maximum of 100000 A_{rms} (symmetrical), 480 V maximum.

UL/Non-UL compliance
To ensure compliance with UL or IEC 61800-5-1, use the circuit breakers or fuses listed in *Table 3.5*.
Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10000 A_{rms} (symmetrical), 480 V maximum.

NOTICE

In the event of malfunction, failure to follow the protection recommendation may result in damage to the frequency converter.

	Circuit breaker		Fuse				
	UL	Non-UL	UL				Non-UL
			Bussmann	Bussmann	Bussmann	Bussmann	Max fuse
Power [kW (hp)]			Type RK5	Type RK1	Type J	Type T	Type G
3x200–240 V IP20							
0.25 (0.33)	–	–	FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.37 (0.5)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.75 (1)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
1.5 (2)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
2.2 (3)			FRS-R-15	KTN-R15	JKS-15	JJN-15	16
3.7 (5)			FRS-R-25	KTN-R25	JKS-25	JJN-25	25
5.5 (7.5)			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
7.5 (10)			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
11 (15)			FRS-R-80	KTN-R80	JKS-80	JJN-80	65
15 (20)	Cutler-Hammer EGE3100FFG	Moeller NZMB1-A125	FRS-R-100	KTN-R100	JKS-100	JJN-100	125
18.5 (25)			FRS-R-100	KTN-R100	JKS-100	JJN-100	125
22 (30)	Cutler-Hammer JGE3150FFG	Moeller NZMB1-A160	FRS-R-150	KTN-R150	JKS-150	JJN-150	160
30 (40)			FRS-R-150	KTN-R150	JKS-150	JJN-150	160
37 (50)	Cutler-Hammer JGE3200FFG	Moeller NZMB1-A200	FRS-R-200	KTN-R200	JKS-200	JJN-200	200
45 (60)			FRS-R-200	KTN-R200	JKS-200	JJN-200	200
3x380–480 V IP20							
0.37 (0.5)	–	–	FRS-R-10	KTS-R10	JKS-10	JJS-10	10
0.75 (1)			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
1.5 (2)			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
2.2 (3)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
3 (4)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
4 (5)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
5.5 (7.5)			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
7.5 (10)			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
11 (15)			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
15 (20)			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
18.5 (25)			FRS-R-80	KTS-R80	JKS-80	JJS-80	65
22 (30)			FRS-R-80	KTS-R80	JKS-80	JJS-80	65
30 (40)	Cutler-Hammer EGE3125FFG	Moeller NZMB1-A125	FRS-R-125	KTS-R125	JKS-R125	JJS-R125	80
37 (50)			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	100
45 (60)			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	125
55 (70)	Cutler-Hammer JGE3200FFG	Moeller NZMB1-A200	FRS-R-200	KTS-R200	JKS-R200	JJS-R200	150
75 (100)			FRS-R-200	KTS-R200	JKS-R200	JJS-R200	200
90 (125)	Cutler-Hammer JGE3250FFG	Moeller NZMB2-A250	FRS-R-250	KTS-R250	JKS-R250	JJS-R250	250

	Circuit breaker		Fuse				
	UL	Non-UL	UL				Non-UL
			Bussmann	Bussmann	Bussmann	Bussmann	Max fuse
Power [kW (hp)]			Type RK5	Type RK1	Type J	Type T	Type G
3x525–600 V IP20							
2.2 (3)	–	–	FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3 (4)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3.7 (5)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
5.5 (7.5)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
7.5 (10)			FRS-R-20	KTS-R20	JKS-20	JJS-20	30
11 (15)	–	–	FRS-R-30	KTS-R30	JKS-30	JJS-30	35
15 (20)			FRS-R-30	KTS-R30	JKS-30	JJS-30	35
18.5 (25)	Cutler-Hammer EGE3080FFG	Cutler-Hammer EGE3080FFG	FRS-R-80	KTN-R80	JKS-80	JJS-80	80
22 (30)			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
30 (40)			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
37 (50)	Cutler-Hammer JGE3125FFG	Cutler-Hammer JGE3125FFG	FRS-R-125	KTN-R125	JKS-125	JJS-125	125
45 (60)			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
55 (70)			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
75 (100)	Cutler-Hammer JGE3200FAG	Cutler-Hammer JGE3200FAG	FRS-R-200	KTN-R200	JKS-200	JJS-200	200
90 (125)		–	FRS-R-200	KTN-R200	JKS-200	JJS-200	200

Table 3.5 Circuit Breaker and Fuses

3.2.5 EMC-correct Electrical Installation

General points to be observed to ensure EMC-correct electrical installation:

- Use only shielded/armored motor cables and shielded/armored control cables.
- Ground the shield at both ends.
- Avoid installation with twisted shield ends (pigtails), because it reduces the shielding effect at high frequencies. Use the cable clamps provided.
- Ensure the same potential between the frequency converter and the ground potential of PLC.
- Use star washers and galvanically conductive installation plates.

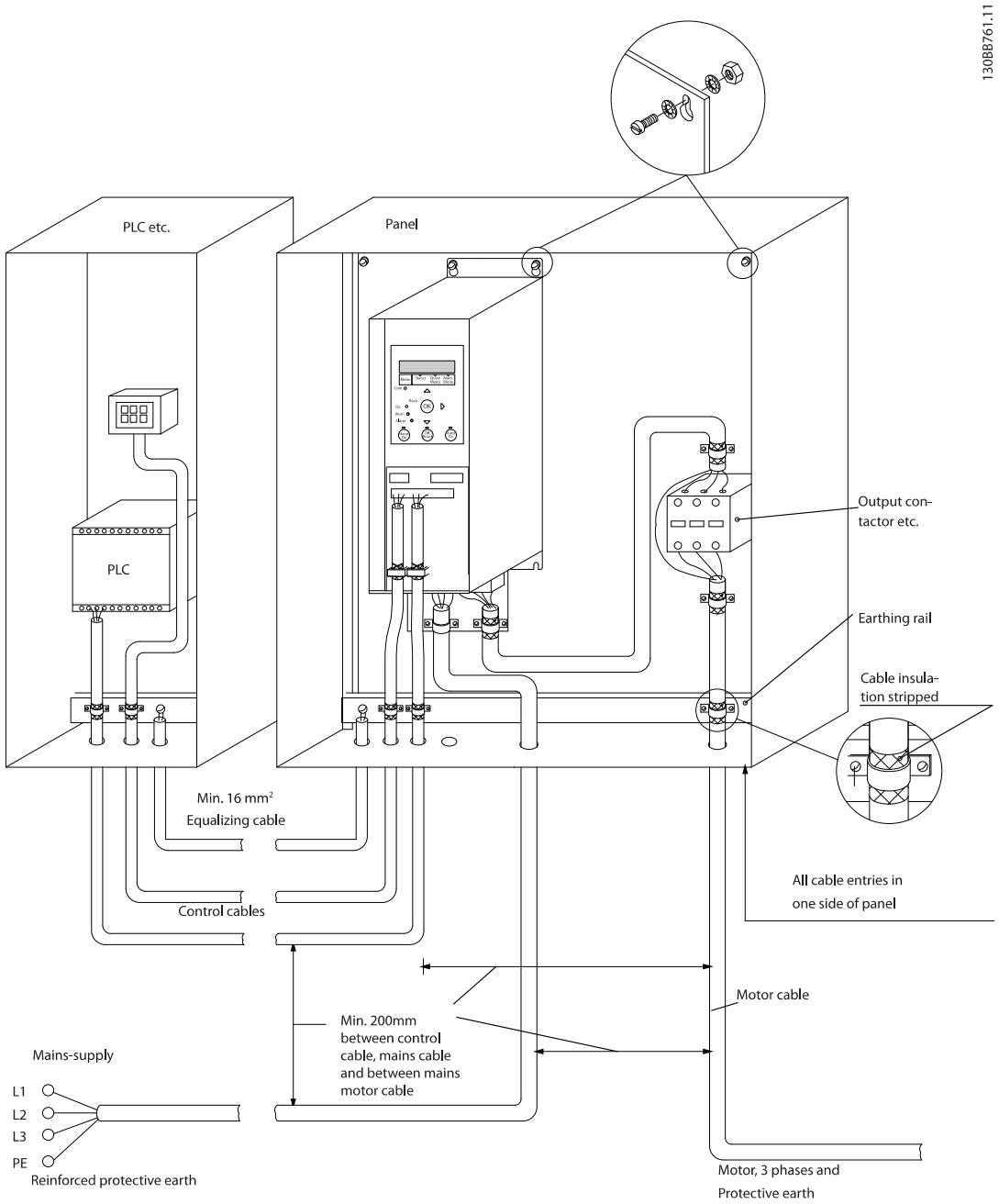


Illustration 3.12 EMC-correct Electrical Installation

3

3.2.6 Control Terminals

Remove the terminal cover to access the control terminals.

Use a flat-edged screwdriver to push down the lock lever of the terminal cover under the LCP, then remove the terminal cover as shown in *Illustration 3.13*.

For IP20 units, remove the front cover after the terminal cover is removed.

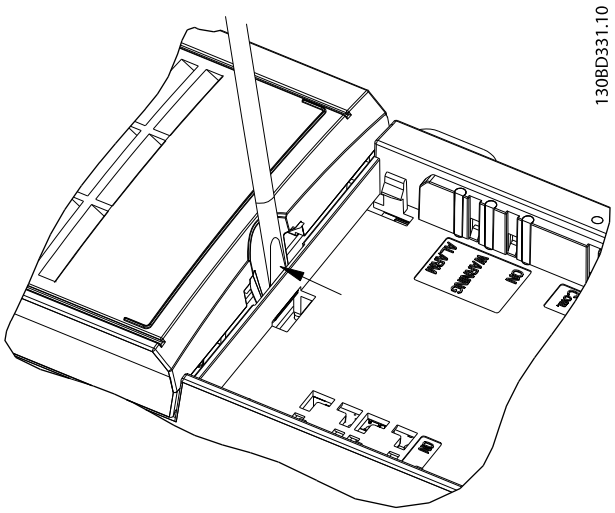


Illustration 3.13 Removing the Terminal Cover

Illustration 3.14 shows all the frequency converter control terminals. Applying start (terminal 18), connection between terminals 12-27, and an analog reference (terminal 53 or 54, and 55) make the frequency converter run.

The digital input mode of terminal 18, 19, and 27 is set in *parameter 5-00 Digital Input Mode* (PNP is default value). Digital input 29 mode is set in *parameter 5-03 Digital Input 29 Mode* (PNP is default value).

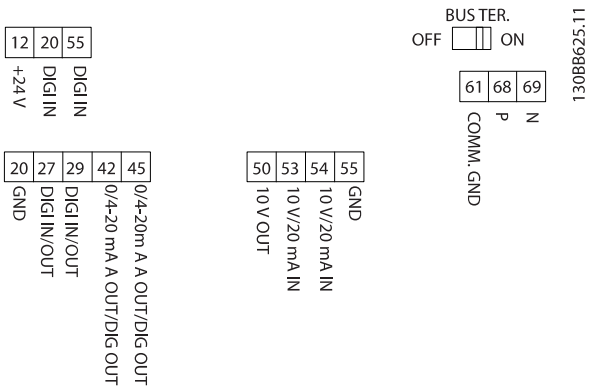


Illustration 3.14 Control Terminals

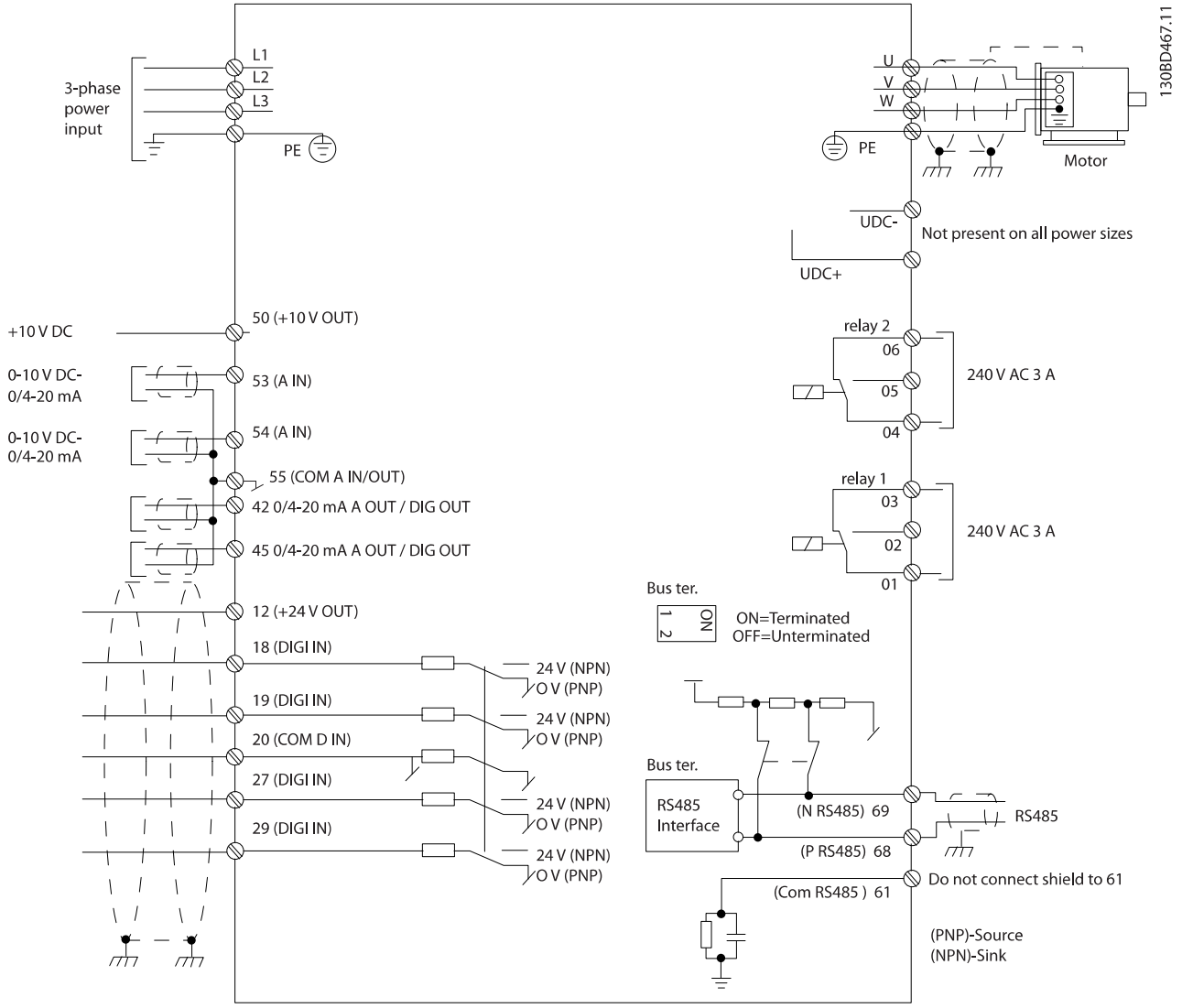


Illustration 3.15 Basic Wiring Schematic Drawing

NOTICE

There is no access to UDC- and UDC+ on the following units:

- **IP20, 380–480 V, 30–90 kW (40–125 hp)**
- **IP20, 200–240 V, 15–45 kW (20–60 hp)**
- **IP20, 525–600 V, 2.2–90 kW (3–125 hp)**
- **IP54, 380–480 V, 22–90 kW (30–125 hp)**

3

3.2.7 Acoustic Noise or Vibration

If the motor or the equipment driven by the motor - for example, a fan - is making noise or vibrations at certain frequencies, configure the following parameters or parameter groups to reduce or eliminate the noise or vibrations:

- *Parameter group 4-6* Speed Bypass*.
- Set *parameter 14-03 Overmodulation* to *[0] Off*.
- Switching pattern and switching frequency *parameter group 14-0* Inverter Switching*.
- *Parameter 1-64 Resonance Dampening*.

4 Programming

4.1 Keypad

The frequency converter can be programmed from the LCP or from a PC via the RS485 COM port by installing the Trane Drive Utility (TDU). Refer to *chapter 1.2 Additional Resources* for more details about the software.

The keypad is divided into 4 functional sections.

A. Display

B. Menu key

C. Navigation keys and indicator lights

D. Operation keys and indicator lights

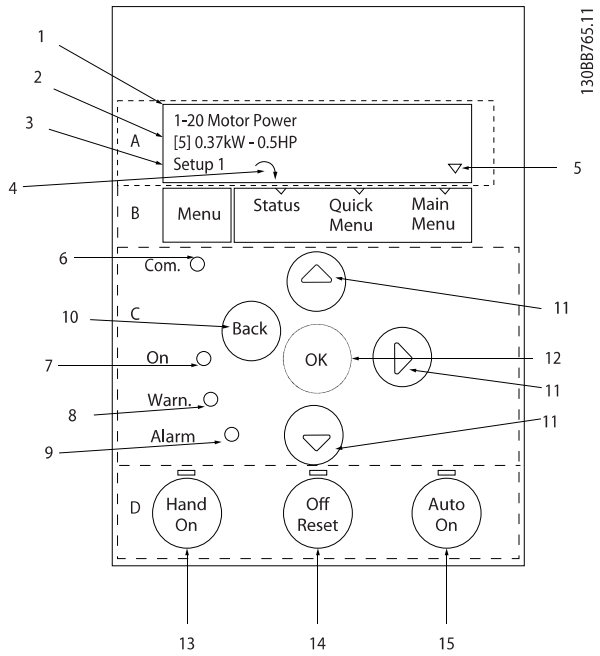


Illustration 4.1 Keypad

A. Display

The LCD-display is illuminated with 2 alphanumeric lines. All data is displayed on the keypad.

Illustration 4.1 describes the information that can be read from the display.

1	Parameter number and name.
2	Parameter value.
3	Set-up number shows the active set-up and the edit set-up. If the same set-up acts as both active and edit set-up, only that set-up number is shown (factory setting). When active and edit set-up differ, both numbers are shown in the display (set-up 12). The number flashing, indicates the edit set-up.
4	Motor direction is shown to the bottom left of the display – indicated by a small arrow pointing either clockwise or counterclockwise.
5	The triangle indicates if the keypad is in Status, Quick Menu, or Main Menu.

Table 4.1 Legend to *Illustration 4.1*, Part I

B. Menu key

Press [Menu] to select among Status, Quick Menu, or Main Menu.

C. Navigation keys and indicator lights

6	Com. LED: Flashes during bus communication.
7	Green LED/On: Control section is working correctly.
8	Yellow LED/Warn.: Indicates a warning.
9	Flashing Red LED/Alarm: Indicates an alarm.
10	[Back]: For moving to the previous step or layer in the navigation structure.
11	[▲] [▼] [►]: For navigating among parameter groups and parameters, and within parameters. They can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings.

Table 4.2 Legend to *Illustration 4.1*, Part II

D. Operation keys and indicator lights

13	[Hand On]: Starts the motor and enables control of the frequency converter via the keypad. ***NOTICE*** ***[2] Coast inverse* is the default option for *parameter 5-12 Terminal 27 Digital Input*. If there is no 24 V supply to terminal 27, [Hand On] does not start the motor. Connect terminal 12 to terminal 27.**
14	[Off/Reset]: Stops the motor (Off). If in alarm mode, the alarm is reset.
15	[Auto On]: The frequency converter is controlled either via control terminals or serial communication.

Table 4.3 Legend to *Illustration 4.1*, Part III

4

4.2 Set-up Wizard

The built-in wizard menu guides the installer through the set-up of the frequency converter in a clear and structured manner for open-loop applications, closed-loop applications, and quick motor settings.

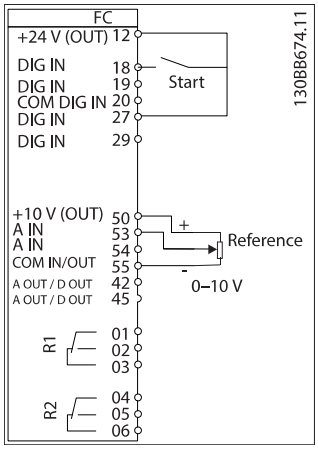


Illustration 4.2 Frequency Converter Wiring

The wizard is displayed after power-up until any parameter has been changed. The wizard can always be accessed again through the quick menu. Press [OK] to start the wizard. Press [Back] to return to the status view.

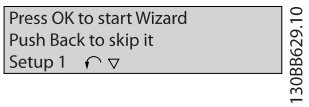


Illustration 4.3 Start-up/Quit Wizard

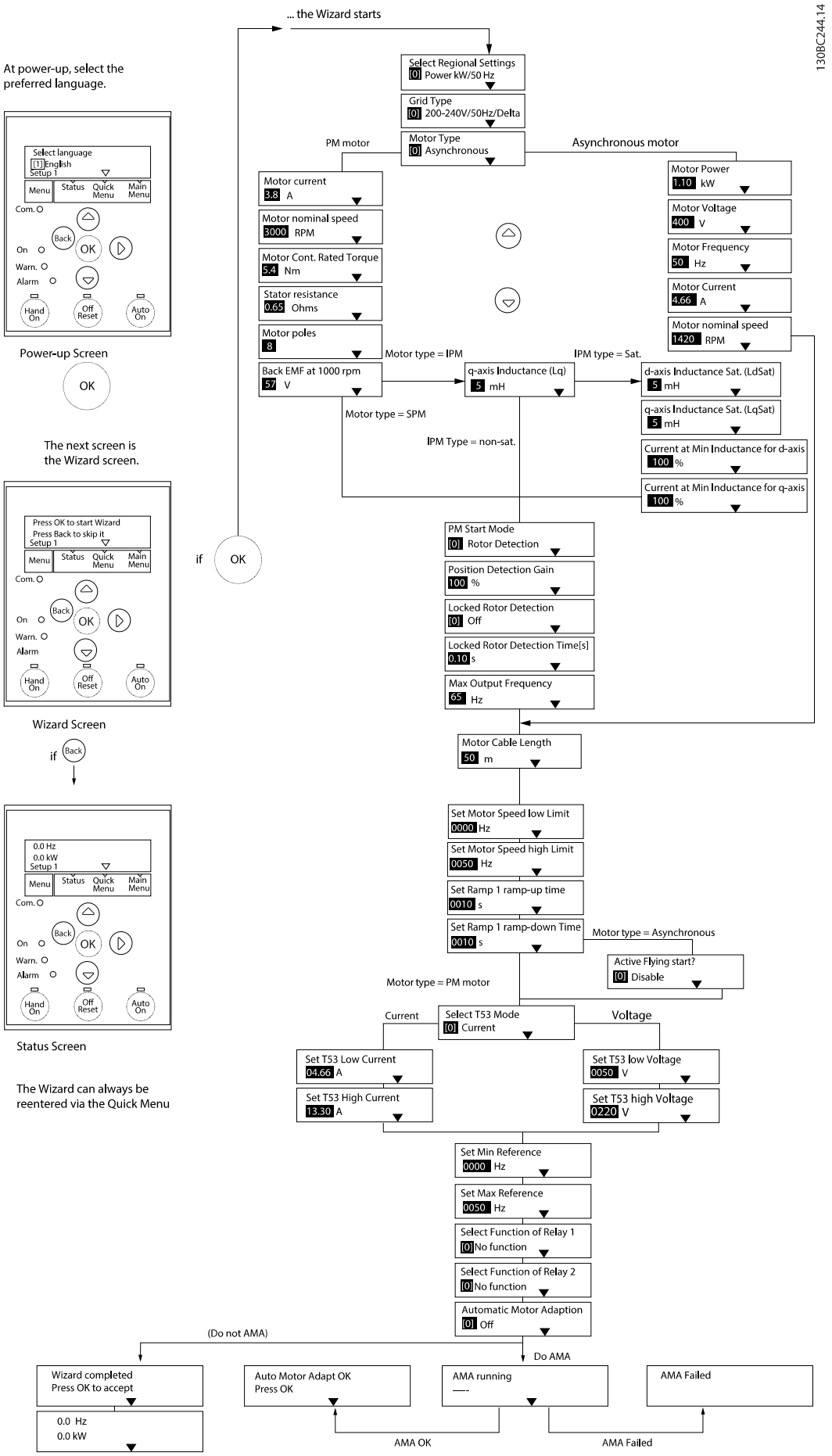


Illustration 4.4 Set-up Wizard for Open-loop Applications

4

Set-up Wizard for Open-loop Applications

Parameter	Option	Default	Usage
Parameter 0-03 Regional Settings	*[0] International* *[1] US*	*[0] International*	–
Parameter 0-06 GridType	*[0] 200–240 V/50 Hz/IT-grid* *[1] 200–240 V/50 Hz/Delta* *[2] 200–240 V/50 Hz* *[10] 380–440 V/50 Hz/IT-grid* *[11] 380–440 V/50 Hz/Delta* *[12] 380–440 V/50 Hz* *[20] 440–480 V/50 Hz/IT-grid* *[21] 440–480 V/50 Hz/Delta* *[22] 440–480 V/50 Hz* *[30] 525–600 V/50 Hz/IT-grid* *[31] 525–600 V/50 Hz/Delta* *[32] 525–600 V/50 Hz* *[100] 200–240 V/60 Hz/IT-grid* *[101] 200–240 V/60 Hz/Delta* *[102] 200–240 V/60 Hz* *[110] 380–440 V/60 Hz/IT-grid* *[111] 380–440 V/60 Hz/Delta* *[112] 380–440 V/60 Hz* *[120] 440–480 V/60 Hz/IT-grid* *[121] 440–480 V/60 Hz/Delta* *[122] 440–480 V/60 Hz* *[130] 525–600 V/60 Hz/IT-grid* *[131] 525–600 V/60 Hz/Delta* *[132] 525–600 V/60 Hz*	Size related	Select the operating mode for restart after reconnection of the frequency converter to mains voltage after power-down.

Parameter	Option	Default	Usage
Parameter 1-10 Motor Construction	**[0] Asynchron* *[1] PM, non-salient SPM* *[2] PM, salient IPM, non Sat.* *[3] PM, salient IPM, Sat.*	*[0] Asynchron*	Setting the parameter value might change these parameters: • *Parameter 1-01 Motor Control Principle.* • *Parameter 1-03 Torque Characteristics.* • *Parameter 1-08 Motor Control Bandwidth.* • *Parameter 1-14 Damping Gain.* • *Parameter 1-15 Low Speed Filter Time Const.* • *Parameter 1-16 High Speed Filter Time Const.* • *Parameter 1-17 Voltage filter time const.* • *Parameter 1-20 Motor Power.* • *Parameter 1-22 Motor Voltage.* • *Parameter 1-23 Motor Frequency.* • *Parameter 1-24 Motor Current.* • *Parameter 1-25 Motor Nominal Speed.* • *Parameter 1-26 Motor Cont. Rated Torque.* • *Parameter 1-30 Stator Resistance (Rs).* • *Parameter 1-33 Stator Leakage Reactance (X1).* • *Parameter 1-35 Main Reactance (Xh).* • *Parameter 1-37 d-axis Inductance (Ld).* • *Parameter 1-38 q-axis Inductance (Lq).* • *Parameter 1-39 Motor Poles.* • *Parameter 1-40 Back EMF at 1000 RPM.* • *Parameter 1-44 d-axis Inductance Sat. (LdSat).* • *Parameter 1-45 q-axis Inductance Sat. (LqSat).* • *Parameter 1-46 Position Detection Gain.* • *Parameter 1-48 Current at Min Inductance for d-axis.* • *Parameter 1-49 Current at Min Inductance for q-axis.* • *Parameter 1-66 Min. Current at Low Speed.* • *Parameter 1-70 PM Start Mode.* • *Parameter 1-72 Start Function.* • *Parameter 1-73 Flying Start.* • *Parameter 1-80 Function at Stop.* • *Parameter 1-82 Min Speed for Function at Stop [Hz].* • *Parameter 1-90 Motor Thermal Protection.* • *Parameter 2-00 DC Hold/Motor Preheat Current.* • *Parameter 2-01 DC Brake Current.* • *Parameter 2-02 DC Braking Time.* • *Parameter 2-04 DC Brake Cut In Speed.* • *Parameter 2-10 Brake Function.* • *Parameter 4-14 Motor Speed High Limit [Hz].* • *Parameter 4-19 Max Output Frequency.* • *Parameter 4-58 Missing Motor Phase Function.* • *Parameter 14-65 Speed Derate Dead Time Compensation.*

Parameter	Option	Default	Usage
Parameter 1-20 Motor Power	0.12–110 kW/0.16–150 hp	Size related	Enter the motor power from the nameplate data.
Parameter 1-22 Motor Voltage	50–1000 V	Size related	Enter the motor voltage from the nameplate data.
Parameter 1-23 Motor Frequency	20–400 Hz	Size related	Enter the motor frequency from the nameplate data.
Parameter 1-24 Motor Current	0.01–10000.00 A	Size related	Enter the motor current from the nameplate data.
Parameter 1-25 Motor Nominal Speed	50–9999 RPM	Size related	Enter the motor nominal speed from the nameplate data.
Parameter 1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when *parameter 1-10 Motor Construction* is set to options that enable permanent magnet motor mode. ***NOTICE*** **Changing this parameter affects the settings of other parameters.**
Parameter 1-29 Automatic Motor Adaption (AMA)	See *parameter 1-29 Automatic Motor Adaption (AMA)*.	Off	Performing an AMA optimizes motor performance.
Parameter 1-30 Stator Resistance (Rs)	0.000–99.990 Ω	Size related	Set the stator resistance value.
Parameter 1-37 d-axis Inductance (Ld)	0.000–1000.000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor datasheet. The d-axis inductance cannot be found by performing an AMA.
Parameter 1-38 q-axis Inductance (Lq)	0.000–1000.000 mH	Size related	Enter the value of the q-axis inductance.
Parameter 1-39 Motor Poles	2–100	4	Enter the number of motor poles.
Parameter 1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-line RMS back EMF voltage at 1000 RPM.
Parameter 1-42 Motor Cable Length	0–100 m	50 m	Enter the motor cable length.
Parameter 1-44 d-axis Inductance Sat. (LdSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *parameter 1-37 d-axis Inductance (Ld)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-45 q-axis Inductance Sat. (LqSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *parameter 1-38 q-axis Inductance (Lq)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at start.
Parameter 1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.
Parameter 1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20–100% of this parameter, the inductances are linearly approximated due to *parameter 1-37 d-axis Inductance (Ld)*, *parameter 1-38 q-axis Inductance (Lq)*, *parameter 1-44 d-axis Inductance Sat. (LdSat)*, and *parameter 1-45 q-axis Inductance Sat. (LqSat)*.
Parameter 1-70 PM Start Mode	*[0] Rotor Detection* *[1] Parking*	*[1] Parking*	Select the PM motor start mode.

Parameter	Option	Default	Usage
Parameter 1-73 Flying Start	*[0] Disabled* *[1] Enabled*	*[0] Disabled*	Select *[1] Enabled* to enable the frequency converter to catch a motor spinning due to mains drop-out. Select *[0] Disabled* if this function is not required. When this parameter is set to *[1] Enabled*, *parameter 1-71 Start Delay* and *parameter 1-72 Start Function* are not functional. *Parameter 1-73 Flying Start* is active in VVC+ mode only.
Parameter 3-02 Minimum Reference	-4999.000–4999.000	0	The minimum reference is the lowest value obtainable by summing all references.
Parameter 3-03 Maximum Reference	-4999.000–4999.000	50	The maximum reference is the lowest obtainable by summing all references.
Parameter 3-41 Ramp 1 Ramp Up Time	0.05–3600.00 s	Size related	If asynchronous motor is selected, the ramp-up time is from 0 to rated *parameter 1-23 Motor Frequency*. If PM motor is selected, the ramp-up time is from 0 to *parameter 1-25 Motor Nominal Speed*.
Parameter 3-42 Ramp 1 Ramp Down Time	0.05–3600.00 s	Size related	For asynchronous motors, the ramp-down time is from rated *parameter 1-23 Motor Frequency* to 0. For PM motors, the ramp-down time is from *parameter 1-25 Motor Nominal Speed* to 0.
Parameter 4-12 Motor Speed Low Limit [Hz]	0.0–400.0 Hz	0 Hz	Enter the minimum limit for low speed.
Parameter 4-14 Motor Speed High Limit [Hz]	0.0–400.0 Hz	100 Hz	Enter the maximum limit for high speed.
Parameter 4-19 Max Output Frequency	0.0–400.0 Hz	100 Hz	Enter the maximum output frequency value. If *parameter 4-19 Max Output Frequency* is set lower than *parameter 4-14 Motor Speed High Limit [Hz]*, *parameter 4-14 Motor Speed High Limit [Hz]* is set equal to *parameter 4-19 Max Output Frequency* automatically.
Parameter 5-40 Function Relay	See *parameter 5-40 Function Relay*.	*[9] Alarm*	Select the function to control output relay 1.
Parameter 5-40 Function Relay	See *parameter 5-40 Function Relay*.	*[5] Drive running*	Select the function to control output relay 2.
Parameter 6-10 Terminal 53 Low Voltage	0.00–10.00 V	0.07 V	Enter the voltage that corresponds to the low reference value.
Parameter 6-11 Terminal 53 High Voltage	0.00–10.00 V	10 V	Enter the voltage that corresponds to the high reference value.
Parameter 6-12 Terminal 53 Low Current	0.00–20.00 mA	4 mA	Enter the current that corresponds to the low reference value.
Parameter 6-13 Terminal 53 High Current	0.00–20.00 mA	20 mA	Enter the current that corresponds to the high reference value.
Parameter 6-19 Terminal 53 mode	*[0] Current* *[1] Voltage*	*[1] Voltage*	Select if terminal 53 is used for current or voltage input.
Parameter 30-22 Locked Rotor Detection	*[0] Off* *[1] On*	*[0] Off*	–
Parameter 30-23 Locked Rotor Detection Time [s]	0.05–1 s	0.10 s	–

Table 4.4 Set-up Wizard for Open-loop Applications

4

Set-up Wizard for Closed-loop Applications

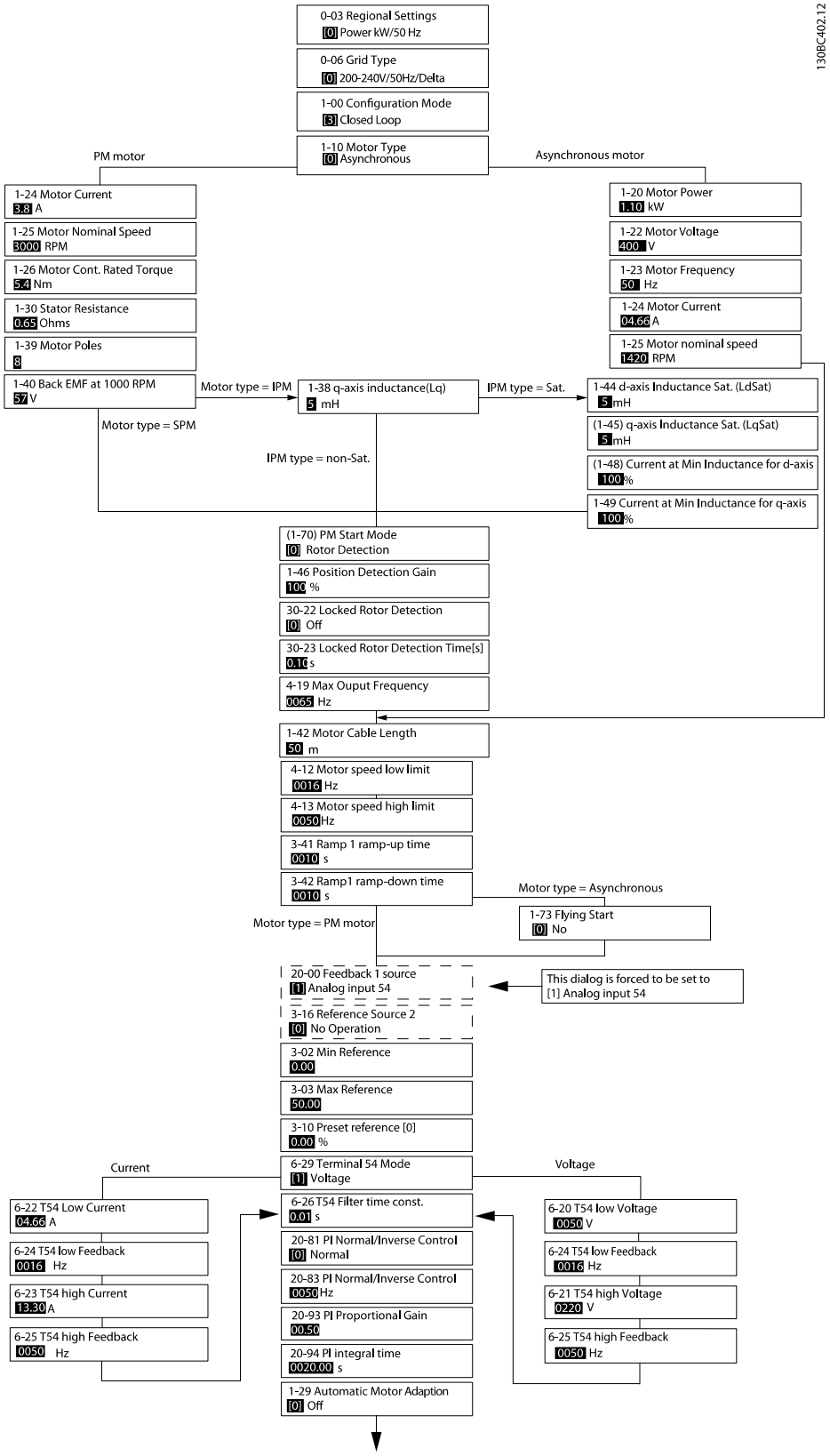


Illustration 4.5 Set-up Wizard for Closed-loop Applications

Parameter	Range	Default	Usage
Parameter 0-03 Regional Settings	*[0] International* *[1] US*	*[0] International*	–
Parameter 0-06 GridType	[0]–[132] see *Table 4.4*.	Size selected	Select the operating mode for restart after reconnection of the frequency converter to mains voltage after power-down.
Parameter 1-00 Configuration Mode	*[0] Open loop* *[3] Closed loop*	*[0] Open loop*	Select *[3] Closed loop*.

4

Parameter	Range	Default	Usage
Parameter 1-10 Motor Construction	**[0] Asynchron* *[1] PM, non-salient SPM* *[2] PM, salient IPM, non Sat.* *[3] PM, salient IPM, Sat.*	*[0] Asynchron*	Setting the parameter value might change these parameters: • *Parameter 1-01 Motor Control Principle.* • *Parameter 1-03 Torque Characteristics.* • *Parameter 1-08 Motor Control Bandwidth.* • *Parameter 1-14 Damping Gain.* • *Parameter 1-15 Low Speed Filter Time Const.* • *Parameter 1-16 High Speed Filter Time Const.* • *Parameter 1-17 Voltage filter time const.* • *Parameter 1-20 Motor Power.* • *Parameter 1-22 Motor Voltage.* • *Parameter 1-23 Motor Frequency.* • *Parameter 1-24 Motor Current.* • *Parameter 1-25 Motor Nominal Speed.* • *Parameter 1-26 Motor Cont. Rated Torque.* • *Parameter 1-30 Stator Resistance (Rs).* • *Parameter 1-33 Stator Leakage Reactance (X1).* • *Parameter 1-35 Main Reactance (Xh).* • *Parameter 1-37 d-axis Inductance (Ld).* • *Parameter 1-38 q-axis Inductance (Lq).* • *Parameter 1-39 Motor Poles.* • *Parameter 1-40 Back EMF at 1000 RPM.* • *Parameter 1-44 d-axis Inductance Sat. (LdSat).* • *Parameter 1-45 q-axis Inductance Sat. (LqSat).* • *Parameter 1-46 Position Detection Gain.* • *Parameter 1-48 Current at Min Inductance for d-axis.* • *Parameter 1-49 Current at Min Inductance for q-axis.* • *Parameter 1-66 Min. Current at Low Speed.* • *Parameter 1-70 PM Start Mode.* • *Parameter 1-72 Start Function.* • *Parameter 1-73 Flying Start.* • *Parameter 1-80 Function at Stop.* • *Parameter 1-82 Min Speed for Function at Stop [Hz].* • *Parameter 1-90 Motor Thermal Protection.* • *Parameter 2-00 DC Hold/Motor Preheat Current.* • *Parameter 2-01 DC Brake Current.* • *Parameter 2-02 DC Braking Time.* • *Parameter 2-04 DC Brake Cut In Speed.* • *Parameter 2-10 Brake Function.* • *Parameter 4-14 Motor Speed High Limit [Hz].* • *Parameter 4-19 Max Output Frequency.* • *Parameter 4-58 Missing Motor Phase Function.* • *Parameter 14-65 Speed Derate Dead Time Compensation.*

Parameter	Range	Default	Usage
Parameter 1-20 Motor Power	0.09–110 kW	Size related	Enter the motor power from the nameplate data.
Parameter 1-22 Motor Voltage	50–1000 V	Size related	Enter the motor voltage from the nameplate data.
Parameter 1-23 Motor Frequency	20–400 Hz	Size related	Enter the motor frequency from the nameplate data.
Parameter 1-24 Motor Current	0–10000 A	Size related	Enter the motor current from the nameplate data.
Parameter 1-25 Motor Nominal Speed	50–9999 RPM	Size related	Enter the motor nominal speed from the nameplate data.
Parameter 1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when *parameter 1-10 Motor Construction* is set to options that enable permanent magnet motor mode. ***NOTICE*** **Changing this parameter affects the settings of other parameters.**
Parameter 1-29 Automatic Motor Adaption (AMA)		Off	Performing an AMA optimises motor performance.
Parameter 1-30 Stator Resistance (Rs)	0–99.990 Ω	Size related	Set the stator resistance value.
Parameter 1-37 d-axis Inductance (Ld)	0.000–1000.000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor datasheet. The d-axis inductance cannot be found by performing an AMA.
Parameter 1-38 q-axis Inductance (Lq)	0.000–1000.000 mH	Size related	Enter the value of the q-axis inductance.
Parameter 1-39 Motor Poles	2–100	4	Enter the number of motor poles.
Parameter 1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-line RMS back EMF voltage at 1000 RPM.
Parameter 1-42 Motor Cable Length	0–100 m	50 m	Enter the motor cable length.
Parameter 1-44 d-axis Inductance Sat. (LdSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *parameter 1-37 d-axis Inductance (Ld)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-45 q-axis Inductance Sat. (LqSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *parameter 1-38 q-axis Inductance (Lq)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at start.
Parameter 1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.
Parameter 1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20–100% of this parameter, the inductances are linearly approximated due to *parameter 1-37 d-axis Inductance (Ld)*, *parameter 1-38 q-axis Inductance (Lq)*, *parameter 1-44 d-axis Inductance Sat. (LdSat)*, and *parameter 1-45 q-axis Inductance Sat. (LqSat)*.
Parameter 1-70 PM Start Mode	*[0] Rotor Detection* *[1] Parking*	*[1] Parking*	Select the PM motor start mode.
Parameter 1-73 Flying Start	*[0] Disabled* *[1] Enabled*	*[0] Disabled*	Select *[1] Enabled* to enable the frequency converter to catch a spinning motor in, for example, fan applications. When PM is selected, this parameter is enabled.

Parameter	Range	Default	Usage
Parameter 3-02 Minimum Reference	-4999.000–4999.000	0	The minimum reference is the lowest value obtainable by summing all references.
Parameter 3-03 Maximum Reference	-4999.000–4999.000	50	The maximum reference is the highest value obtainable by summing all references.
Parameter 3-10 Preset Reference	-100–100%	0	Enter the setpoint.
Parameter 3-41 Ramp 1 Ramp Up Time	0.05–3600.0 s	Size related	Ramp-up time from 0 to rated *parameter 1-23 Motor Frequency* for asynchronous motors. Ramp-up time from 0 to *parameter 1-25 Motor Nominal Speed* for PM motors.
Parameter 3-42 Ramp 1 Ramp Down Time	0.05–3600.0 s	Size related	Ramp-down time from rated *parameter 1-23 Motor Frequency* to 0 for asynchronous motors. Ramp-down time from *parameter 1-25 Motor Nominal Speed* to 0 for PM motors.
Parameter 4-12 Motor Speed Low Limit [Hz]	0.0–400.0 Hz	0.0 Hz	Enter the minimum limit for low speed.
Parameter 4-14 Motor Speed High Limit [Hz]	0.0–400.0 Hz	100 Hz	Enter the minimum limit for high speed.
Parameter 4-19 Max Output Frequency	0.0–400.0 Hz	100 Hz	Enter the maximum output frequency value. If *parameter 4-19 Max Output Frequency* is set lower than *parameter 4-14 Motor Speed High Limit [Hz]*, *parameter 4-14 Motor Speed High Limit [Hz]* is set equal to *parameter 4-19 Max Output Frequency* automatically.
Parameter 6-20 Terminal 54 Low Voltage	0.00–10.00 V	0.07 V	Enter the voltage that corresponds to the low reference value.
Parameter 6-21 Terminal 54 High Voltage	0.00–10.00 V	10.00 V	Enter the voltage that corresponds to the high reference value.
Parameter 6-22 Terminal 54 Low Current	0.00–20.00 mA	4.00 mA	Enter the current that corresponds to the low reference value.
Parameter 6-23 Terminal 54 High Current	0.00–20.00 mA	20.00 mA	Enter the current that corresponds to the high reference value.
Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	-4999–4999	0	Enter the feedback value that corresponds to the voltage or current set in *parameter 6-20 Terminal 54 Low Voltage*/ *parameter 6-22 Terminal 54 Low Current*.
Parameter 6-25 Terminal 54 High Ref./Feedb. Value	-4999–4999	50	Enter the feedback value that corresponds to the voltage or current set in *parameter 6-21 Terminal 54 High Voltage*/ *parameter 6-23 Terminal 54 High Current*.
Parameter 6-26 Terminal 54 Filter Time Constant	0.00–10.00 s	0.01	Enter the filter time constant.
Parameter 6-29 Terminal 54 mode	*[0] Current* *[1] Voltage*	*[1] Voltage*	Select if terminal 54 is used for current or voltage input.
Parameter 20-81 PI Normal/ Inverse Control	*[0] Normal* *[1] Inverse*	*[0] Normal*	Select *[0] Normal* to set the process control to increase the output speed when the process error is positive. Select *[1] Inverse* to reduce the output speed.
Parameter 20-83 PI Start Speed [Hz]	0–200 Hz	0 Hz	Enter the motor speed to be attained as a start signal for commencement of PI control.
Parameter 20-93 PI Proportional Gain	0.00–10.00	0.01	Enter the process controller proportional gain. Quick control is obtained at high amplification. However, if amplification is too high, the process may become unstable.
Parameter 20-94 PI Integral Time	0.1–999.0 s	999.0 s	Enter the process controller integral time. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action.
Parameter 30-22 Locked Rotor Detection	*[0] Off* *[1] On*	*[0] Off*	–

Parameter	Range	Default	Usage
Parameter 30-23 Locked Rotor Detection Time [s]	0.05–1.00 s	0.10 s	–

Table 4.5 Set-up Wizard for Closed-loop Applications

Motor set-up

The motor set-up wizard guides users through the needed motor parameters.

Parameter	Range	Default	Usage
Parameter 0-03 Regional Settings	*[0] International* *[1] US*	0	–
Parameter 0-06 GridType	[0]–[132] see *Table 4.4.*	Size related	Select the operating mode for restart after reconnection of the frequency converter to mains voltage after power-down.

Parameter	Range	Default	Usage
Parameter 1-10 Motor Construction	**[0] Asynchron* *[1] PM, non-salient SPM* *[2] PM, salient IPM, non Sat.* *[3] PM, salient IPM, Sat.*	*[0] Asynchron*	Setting the parameter value might change these parameters: • *Parameter 1-01 Motor Control Principle.* • *Parameter 1-03 Torque Characteristics.* • *Parameter 1-08 Motor Control Bandwidth.* • *Parameter 1-14 Damping Gain.* • *Parameter 1-15 Low Speed Filter Time Const.* • *Parameter 1-16 High Speed Filter Time Const.* • *Parameter 1-17 Voltage filter time const.* • *Parameter 1-20 Motor Power.* • *Parameter 1-22 Motor Voltage.* • *Parameter 1-23 Motor Frequency.* • *Parameter 1-24 Motor Current.* • *Parameter 1-25 Motor Nominal Speed.* • *Parameter 1-26 Motor Cont. Rated Torque.* • *Parameter 1-30 Stator Resistance (Rs).* • *Parameter 1-33 Stator Leakage Reactance (X1).* • *Parameter 1-35 Main Reactance (Xh).* • *Parameter 1-37 d-axis Inductance (Ld).* • *Parameter 1-38 q-axis Inductance (Lq).* • *Parameter 1-39 Motor Poles.* • *Parameter 1-40 Back EMF at 1000 RPM.* • *Parameter 1-44 d-axis Inductance Sat. (LdSat).* • *Parameter 1-45 q-axis Inductance Sat. (LqSat).* • *Parameter 1-46 Position Detection Gain.* • *Parameter 1-48 Current at Min Inductance for d-axis.* • *Parameter 1-49 Current at Min Inductance for q-axis.* • *Parameter 1-66 Min. Current at Low Speed.* • *Parameter 1-70 PM Start Mode.* • *Parameter 1-72 Start Function.* • *Parameter 1-73 Flying Start.* • *Parameter 1-80 Function at Stop.* • *Parameter 1-82 Min Speed for Function at Stop [Hz].* • *Parameter 1-90 Motor Thermal Protection.* • *Parameter 2-00 DC Hold/Motor Preheat Current.* • *Parameter 2-01 DC Brake Current.* • *Parameter 2-02 DC Braking Time.* • *Parameter 2-04 DC Brake Cut In Speed.* • *Parameter 2-10 Brake Function.* • *Parameter 4-14 Motor Speed High Limit [Hz].* • *Parameter 4-19 Max Output Frequency.* • *Parameter 4-58 Missing Motor Phase Function.* • *Parameter 14-65 Speed Derate Dead Time Compensation.*

Parameter	Range	Default	Usage
Parameter 1-20 Motor Power	0.12–110 kW/0.16–150 hp	Size related	Enter the motor power from the nameplate data.
Parameter 1-22 Motor Voltage	50–1000 V	Size related	Enter the motor voltage from the nameplate data.
Parameter 1-23 Motor Frequency	20–400 Hz	Size related	Enter the motor frequency from the nameplate data.
Parameter 1-24 Motor Current	0.01–10000.00 A	Size related	Enter the motor current from the nameplate data.
Parameter 1-25 Motor Nominal Speed	50–9999 RPM	Size related	Enter the motor nominal speed from the nameplate data.
Parameter 1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when *parameter 1-10 Motor Construction* is set to options that enable permanent magnet motor mode. ***NOTICE*** **Changing this parameter affects the settings of other parameters.**
Parameter 1-30 Stator Resistance (Rs)	0–99.990 Ω	Size related	Set the stator resistance value.
Parameter 1-37 d-axis Inductance (Ld)	0.000–1000.000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor datasheet. The d-axis inductance cannot be found by performing an AMA.
Parameter 1-38 q-axis Inductance (Lq)	0.000–1000.000 mH	Size related	Enter the value of the q-axis inductance.
Parameter 1-39 Motor Poles	2–100	4	Enter the number of motor poles.
Parameter 1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-line RMS back EMF voltage at 1000 RPM.
Parameter 1-42 Motor Cable Length	0–100 m	50 m	Enter the motor cable length.
Parameter 1-44 d-axis Inductance Sat. (LdSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *parameter 1-37 d-axis Inductance (Ld)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-45 q-axis Inductance Sat. (LqSat)	0.000–1000.000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *parameter 1-38 q-axis Inductance (Lq)*. However, if the motor supplier provides an induction curve, enter the induction value, which is 200% of the nominal current.
Parameter 1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at start.
Parameter 1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.
Parameter 1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20–100% of this parameter, the inductances are linearly approximated due to *parameter 1-37 d-axis Inductance (Ld)*, *parameter 1-38 q-axis Inductance (Lq)*, *parameter 1-44 d-axis Inductance Sat. (LdSat)*, and *parameter 1-45 q-axis Inductance Sat. (LqSat)*.
Parameter 1-70 PM Start Mode	*[0] Rotor Detection* *[1] Parking*	*[1] Parking*	Select the PM motor start mode.
Parameter 1-73 Flying Start	*[0] Disabled* *[1] Enabled*	*[0] Disabled*	Select *[1] Enabled* to enable the frequency converter to catch a spinning motor.
Parameter 3-41 Ramp 1 Ramp Up Time	0.05–3600.0 s	Size related	Ramp-up time from 0 to rated *parameter 1-23 Motor Frequency*.

Parameter	Range	Default	Usage
Parameter 3-42 Ramp 1 Ramp Down Time	0.05–3600.0 s	Size related	Ramp-down time from rated *parameter 1-23 Motor Frequency* to 0.
Parameter 4-12 Motor Speed Low Limit [Hz]	0.0–400.0 Hz	0.0 Hz	Enter the minimum limit for low speed.
Parameter 4-14 Motor Speed High Limit [Hz]	0.0–400.0 Hz	100.0 Hz	Enter the maximum limit for high speed.
Parameter 4-19 Max Output Frequency	0.0–400.0 Hz	100.0 Hz	Enter the maximum output frequency value. If *parameter 4-19 Max Output Frequency* is set lower than *parameter 4-14 Motor Speed High Limit [Hz]*, *parameter 4-14 Motor Speed High Limit [Hz]* is set equal to *parameter 4-19 Max Output Frequency* automatically.
Parameter 30-22 Locked Rotor Detection	*[0] Off* *[1] On*	*[0] Off*	–
Parameter 30-23 Locked Rotor Detection Time [s]	0.05–1.00 s	0.10 s	–

Table 4.6 Motor Set-up Wizard Settings

Changes made

The changes made function lists all parameters changed from default settings.

- The list shows only parameters that have been changed in the current edit set-up.
- Parameters that have been reset to default values are not listed.
- The message *Empty* indicates that no parameters have been changed.

Changing parameter settings

1. To enter the Quick Menu, press the [Menu] key until the indicator in the display is placed above Quick Menu.
2. Press [▲] [▼] to select the wizard, closed-loop set-up, motor set-up, or changes made.
3. Press [OK].
4. Press [▲] [▼] to browse through the parameters in the Quick Menu.
5. Press [OK] to select a parameter.
6. Press [▲] [▼] to change the value of a parameter setting.
7. Press [OK] to accept the change.
8. Press either [Back] twice to enter Status, or press [Menu] once to enter the Main Menu.

The main menu accesses all parameters

1. Press the [Menu] key until the indicator in the display is placed above Main Menu.
2. Press [▲] [▼] to browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. Press [▲] [▼] to browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. Press [▲] [▼] to set/change the parameter value.

4.3 Parameter List

- **0-** Operation / Display**
  - **0-0* Basic Settings**
    - 0-01 Language
    - 0-03 Regional Settings
    - 0-04 Operating State at Power-up
    - 0-06 GridType
    - 0-07 Auto DC Braking
  - **0-1* Set-up Operations**
    - 0-10 Active Set-up
    - 0-11 Programming Set-up
    - 0-12 Link Setups
  - **0-3* LCP Custom Readout**
    - 0-30 Custom Readout Unit
    - 0-31 Custom Readout Min Value
    - 0-32 Custom Readout Max Value
    - 0-37 Display Text 1
    - 0-38 Display Text 2
    - 0-39 Display Text 3
  - **0-4* LCP Keypad**
    - 0-40 [Hand on] Key on LCP
    - 0-42 [Auto on] Key on LCP
    - 0-44 [Off/Reset] Key on LCP
  - **0-5* Copy/Save**
    - 0-50 LCP Copy
    - 0-51 Set-up Copy
  - **0-6* Password**
    - 0-60 Main Menu Password
    - 0-61 Access to Main Menu w/o Password
- **1-** Load and Motor**
  - **1-0* General Settings**
    - 1-00 Configuration Mode
    - 1-01 Motor Control Principle
    - 1-03 Torque Characteristics
    - 1-06 Clockwise Direction
    - 1-08 Motor Control Bandwidth
  - **1-1* Motor Selection**
    - 1-10 Motor Construction
    - 1-14 Damping Gain
    - 1-15 Low Speed Filter Time Const.
    - 1-16 High Speed Filter Time Const.
    - 1-17 Voltage filter time const.
  - **1-2* Motor Data**
    - 1-20 Motor Power
    - 1-22 Motor Voltage
    - 1-23 Motor Frequency
    - 1-24 Motor Current
    - 1-25 Motor Nominal Speed
    - 1-26 Motor Cont. Rated Torque
    - 1-29 Automatic Motor Adaption (AMA)
  - **1-3* Adv. Motor Data**
    - 1-30 Stator Resistance (Rs)
    - 1-33 Stator Leakage Reactance (X1)
    - 1-35 Main Reactance (Xh)
    - 1-37 d-axis Inductance (Ld)
    - 1-38 q-axis Inductance (Lq)
    - 1-39 Motor Poles
  - **1-4* Adv. Motor Data II**
    - 1-40 Back EMF at 1000 RPM
    - 1-42 Motor Cable Length
    - 1-43 Motor Cable Length Feet
    - 1-44 d-axis Inductance Sat. (LdSat)
    - 1-45 q-axis Inductance Sat. (LqSat)
    - 1-46 Position Detection Gain
    - 1-48 Current at Min Inductance for d-axis
    - 1-49 Current at Min Inductance for q-axis
  - **1-5* Load Indep. Setting**
    - 1-50 Motor Magnetisation at Zero Speed
    - 1-52 Min Speed Normal Magnetising [Hz]
    - 1-55 U/f Characteristic - U
    - 1-56 U/f Characteristic - F
  - **1-6* Load Depen. Setting**
    - 1-62 Slip Compensation
    - 1-63 Slip Compensation Time Constant
    - 1-64 Resonance Dampening
    - 1-65 Resonance Dampening Time Constant
    - 1-66 Min. Current at Low Speed
  - **1-7* Start Adjustments**
    - 1-70 PM Start Mode
    - 1-71 Start Delay
    - 1-72 Start Function
    - 1-73 Flying Start
  - **1-8* Stop Adjustments**
    - 1-80 Function at Stop
    - 1-82 Min Speed for Function at Stop [Hz]
    - 1-88 AC Brake Gain
  - **1-9* Motor Temperature**
    - 1-90 Motor Thermal Protection
    - 1-93 Thermistor Source
- **2-** Brakes**
  - **2-0* DC-Brake**
    - 2-00 DC Hold/Motor Preheat Current
    - 2-01 DC Brake Current
    - 2-02 DC Braking Time
    - 2-04 DC Brake Cut In Speed
    - 2-06 Parking Current
    - 2-07 Parking Time
  - **2-1* Brake Energy Funct.**
    - 2-10 Brake Function
    - 2-16 AC Brake, Max current
    - 2-17 Over-voltage Control
- **3-** Reference / Ramps**
  - **3-0* Reference Limits**
    - 3-02 Minimum Reference
    - 3-03 Maximum Reference
  - **3-1* References**
    - 3-10 Preset Reference
    - 3-11 Jog Speed [Hz]
    - 3-14 Preset Relative Reference
    - 3-15 Reference 1 Source
    - 3-16 Reference 2 Source
    - 3-17 Reference 3 Source
  - **3-4* Ramp 1**
    - 3-41 Ramp 1 Ramp Up Time
    - 3-42 Ramp 1 Ramp Down Time
  - **3-5* Ramp 2**
    - 3-51 Ramp 2 Ramp Up Time
    - 3-52 Ramp 2 Ramp Down Time
  - **3-8* Other Ramps**
    - 3-80 Jog Ramp Time
    - 3-81 Quick Stop Ramp Time
- **4-** Limits / Warnings**
  - **4-1* Motor Limits**
    - 4-10 Motor Speed Direction
    - 4-12 Motor Speed Low Limit [Hz]
    - 4-14 Motor Speed High Limit [Hz]
    - 4-18 Current Limit
    - 4-19 Max Output Frequency
  - **4-4* Adj. Warnings 2**
    - 4-40 Warning Freq. Low
    - 4-41 Warning Freq. High
  - **4-5* Adj. Warnings**
    - 4-50 Warning Current Low
    - 4-51 Warning Current High
    - 4-54 Warning Reference Low
    - 4-55 Warning Reference High
    - 4-56 Warning Feedback Low
    - 4-57 Warning Feedback High
    - 4-58 Missing Motor Phase Function
  - **4-6* Speed Bypass**
    - 4-61 Bypass Speed From [Hz]
    - 4-63 Bypass Speed To [Hz]
    - 4-64 Semi-Auto Bypass Set-up
- **5-** Digital In/Out**
  - **5-0* Digital I/O mode**
    - 5-00 Digital Input Mode
    - 5-03 Digital Input 29 Mode
  - **5-1* Digital Inputs**
    - 5-10 Terminal 18 Digital Input
    - 5-11 Terminal 19 Digital Input
    - 5-12 Terminal 27 Digital Input
    - 5-13 Terminal 29 Digital Input
  - **5-3* Digital Outputs**
    - 5-34 On Delay, Digital Output
    - 5-35 Off Delay, Digital Output
  - **5-4* Relays**
    - 5-40 Function Relay
    - 5-41 On Delay, Relay
    - 5-42 Off Delay, Relay
  - **5-5* Pulse Input**
    - 5-50 Term. 29 Low Frequency
    - 5-51 Term. 29 High Frequency
    - 5-52 Term. 29 Low Ref./Feedb. Value
    - 5-53 Term. 29 High Ref./Feedb. Value
  - **5-9* Bus Controlled**
    - 5-90 Digital & Relay Bus Control
- **6-** Analog In/Out**
  - **6-0* Analog I/O Mode**
    - 6-00 Live Zero Timeout Time
    - 6-01 Live Zero Timeout Function
    - 6-02 Fire Mode Live Zero Timeout Function
  - **6-1* Analog Input 53**
    - 6-10 Terminal 53 Low Voltage
    - 6-11 Terminal 53 High Voltage
    - 6-12 Terminal 53 Low Current
    - 6-13 Terminal 53 High Current
    - 6-14 Terminal 53 Low Ref./Feedb. Value
    - 6-15 Terminal 53 High Ref./Feedb. Value
    - 6-16 Terminal 53 Filter Time Constant
    - 6-19 Terminal 53 mode
  - **6-2* Analog Input 54**
    - 6-20 Terminal 54 Low Voltage
    - 6-21 Terminal 54 High Voltage
    - 6-22 Terminal 54 Low Current
    - 6-23 Terminal 54 High Current
    - 6-24 Terminal 54 Low Ref./Feedb. Value
    - 6-25 Terminal 54 High Ref./Feedb. Value
    - 6-26 Terminal 54 Filter Time Constant
    - 6-29 Terminal 54 mode
  - **6-7* Analog/Digital Output 45**
    - 6-70 Terminal 45 Mode
    - 6-71 Terminal 45 Analog Output
    - 6-72 Terminal 45 Digital Output
    - 6-73 Terminal 45 Output Min Scale
    - 6-74 Terminal 45 Output Max Scale
    - 6-76 Terminal 45 Output Bus Control
  - **6-9* Analog/Digital Output 42**
    - 6-90 Terminal 42 Mode
    - 6-91 Terminal 42 Analog Output
    - 6-92 Terminal 42 Digital Output
    - 6-93 Terminal 42 Output Min Scale
    - 6-94 Terminal 42 Output Max Scale
    - 6-96 Terminal 42 Output Bus Control
    - 6-98 Drive Type
- **8-** Comm. and Options**
  - **8-0* General Settings**
    - 8-01 Control Site
    - 8-02 Control Source
    - 8-03 Control Timeout Time
    - 8-04 Control Timeout Function
  - **8-3* FC Port Settings**
    - 8-30 Protocol
    - 8-31 Address
    - 8-32 Baud Rate
    - 8-33 Parity / Stop Bits
    - 8-35 Minimum Response Delay
    - 8-36 Maximum Response Delay
    - 8-37 Maximum Inter-char delay
  - **8-4* FC MC protocol set**
    - 8-42 PCD Write Configuration
    - 8-43 PCD Read Configuration
  - **8-5* Digital/Bus**
    - 8-50 Coasting Select
    - 8-51 Quick Stop Select
    - 8-52 DC Brake Select
    - 8-53 Start Select
    - 8-54 Reversing Select
    - 8-55 Set-up Select
    - 8-56 Preset Reference Select
  - **8-7* BACnet**
    - 8-70 BACnet Device Instance
    - 8-72 MS/TP Max Masters
    - 8-73 MS/TP Max Info Frames
    - 8-74 "I am" Service
    - 8-75 Intialisation Password
    - 8-79 Protocol Firmware version
  - **8-8* FC Port Diagnostics**
    - 8-80 Bus Message Count
    - 8-81 Bus Error Count
    - 8-82 Slave Messages Rcvd
    - 8-83 Slave Error Count
    - 8-84 Slave Messages Sent
    - 8-85 Slave Timeout Errors
    - 8-88 Reset FC port Diagnostics
  - **8-9* Bus Feedback**
    - 8-94 Bus Feedback 1
    - 8-95 Bus Feedback 2
- **13-** Smart Logic**
  - **13-0* SLC Settings**
    - 13-00 SL Controller Mode
    - 13-01 Start Event
    - 13-02 Stop Event
    - 13-03 Reset SLC
  - **13-1* Comparators**
    - 13-10 Comparator Operand
    - 13-11 Comparator Operator
    - 13-12 Comparator Value
  - **13-2* Timers**
    - 13-20 SL Controller Timer
  - **13-4* Logic Rules**
    - 13-40 Logic Rule Boolean 1
    - 13-41 Logic Rule Operator 1
    - 13-42 Logic Rule Boolean 2
    - 13-43 Logic Rule Operator 2
    - 13-44 Logic Rule Boolean 3
  - **13-5* States**
    - 13-51 SL Controller Event
    - 13-52 SL Controller Action
- **14-** Special Functions**
  - **14-0* Inverter Switching**
    - 14-01 Switching Frequency
    - 14-03 Overmodulation
    - 14-07 Dead Time Compensation Level
    - 14-08 Damping Gain Factor
    - 14-09 Dead Time Bias Current Level
  - **14-1* Mains On/Off**
    - 14-10 Mains Failure
    - 14-11 Mains Voltage at Mains Fault
    - 14-12 Function at Mains Imbalance
  - **14-2* Reset Functions**
    - 14-20 Reset Mode
    - 14-21 Automatic Restart Time
    - 14-22 Operation Mode
    - 14-23 Typecode Setting
    - 14-27 Action At Inverter Fault
    - 14-28 Production Settings
    - 14-29 Service Code
  - **14-3* Current Limit Ctrl.**
    - 14-30 Current Lim Ctrl, Proportional Gain
    - 14-31 Current Lim Ctrl, Integration Time
    - 14-32 Current Lim Ctrl, Filter Time
  - **14-4* Energy Optimising**
    - 14-40 VT Level
    - 14-41 AEO Minimum Magnetisation
    - 14-44 d-axis current optimization for IPM

14-5* Environment
14-50 RFI Filter
14-51 DC-Link Voltage Compensation
14-52 Fan Control
14-53 Fan Monitor
14-55 Output Filter
14-6* Auto Derate
14-61 Function at Inverter Overload
14-63 Min Switch Frequency
14-64 Dead Time Compensation Zero Current Level
14-65 Speed Derate Dead Time Compensation
14-9* Fault Settings
14-90 Fault Level
15- Drive Information**
15-0* Operating Data
15-00 Operating hours
15-01 Running Hours
15-02 kWh Counter
15-03 Power Up's
15-04 Over Temp's
15-05 Over Volt's
15-06 Reset kWh Counter
15-07 Reset Running Hours Counter
15-3* Alarm Log
15-30 Alarm Log: Error Code
15-31 InternalFaultReason
15-4* Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-44 Ordered TypeCode
15-45 Actual Typecode String
15-46 Drive Ordering No
15-48 LCP Id No
15-49 SW ID Control Card
15-50 SW ID Power Card
15-51 Drive Serial Number
15-53 Power Card Serial Number
15-59 Filename
15-9* Parameter Info
15-92 Defined Parameters
15-97 Application Type
15-98 Drive Identification
16- Data Readouts**
16-0* General Status
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference [%]
16-03 Status Word
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5 Warnings and Alarms

Fault number	Alarm/ warning bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
2	16	Live zero error	X	X	–	Signal on terminal 53 or 54 is less than 50% of the value set in *parameter 6-10 Terminal 53 Low Voltage*, *parameter 6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage*, or *parameter 6-22 Terminal 54 Low Current*. See also parameter group *6-0* Analog I/O Mode*.
4	14	Mains ph. loss	X	X	X	Missing phase on the supply side or too high voltage imbalance. Check the supply voltage. See *parameter 14-12 Function at Mains Imbalance*.
7	11	DC over volt	X	X	–	Intermediate circuit voltage exceeds the limit.
8	10	DC under volt	X	X	–	Intermediate circuit voltage drops below voltage warning low-limit.
9	9	Inverter overload	X	X	–	More than 100% load for a long time.
10	8	Motor ETR over	X	X	–	Motor is too hot due to more than 100% load for a long time. See *parameter 1-90 Motor Thermal Protection*.
11	7	Motor th over	X	X	–	Thermistor or thermistor connection is disconnected. See *parameter 1-90 Motor Thermal Protection*.
13	5	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	2	Earth Fault	–	X	X	Discharge from output phases to ground.
16	12	Short Circuit	–	X	X	Short circuit in motor or on motor terminals.
17	4	Ctrl. word TO	X	X	–	No communication to frequency converter. See parameter group *8-0* General Settings*.
24	50	Fan Fault	X	X	–	The heat sink cooling fan is not working (only on 400 V, 30–90 kW units).
30	19	U phase loss	–	X	X	Motor phase U is missing. Check the phase. See *parameter 4-58 Missing Motor Phase Function*.
31	20	V phase loss	–	X	X	Motor phase V is missing. Check the phase. See *parameter 4-58 Missing Motor Phase Function*.
32	21	W phase loss	–	X	X	Motor phase W is missing. Check the phase. See *parameter 4-58 Missing Motor Phase Function*.
38	17	Internal fault	–	X	X	Contact the local Trane supplier.
44	28	Earth Fault	–	X	X	Discharge from output phases to ground, using the value of *parameter 15-31 Alarm Log Value* if possible.
46	33	Control Voltage Fault	–	X	X	Control voltage is low. Contact the local Trane supplier.
47	23	24 V supply low	X	X	X	24 V DC supply may be overloaded.
50		AMA calibration failed	–	X	–	Contact the local Trane supplier.
51	15	AMA Unom,Inom	–	X	–	The setting of motor voltage, motor current, and motor power is wrong. Check the settings.
52	–	AMA low Inom	–	X	–	The motor current is too low. Check the settings.
53	–	AMA big motor	–	X	–	The motor is too big to perform AMA.
54	–	AMA small mot	–	X	–	The motor is too small to perform AMA.
55	–	AMA par. range	–	X	–	The parameter values found from the motor are outside the acceptable range.
56	–	AMA user interrupt	–	X	–	The AMA has been interrupted by the user.

Fault number	Alarm/ warning bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
57	–	AMA timeout	–	X	–	Try to start the AMA again a number of times, until the AMA is carried out. ***NOTICE*** **Repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.**
58	–	AMA internal	X	X	–	Contact the local Trane supplier.
59	25	Current limit	X	–	–	The current is higher than the value in *parameter 4-18 Current Limit*.
60	44	External Interlock	–	X	–	External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing [Reset] button on the LCP).
66	26	Heat sink Temperature Low	X	–	–	This warning is based on the temperature sensor in the IGBT module (on 400 V, 30–90 kW (40–125 hp) and 600 V units).
69	1	Pwr. Card Temp	X	X	X	The temperature sensor on the power card exceeds the upper or lower limits.
70	36	Illegal FC configuration	–	X	X	The control card and power card are not matched.
79	–	Illegal power section configuration	X	X	–	Internal fault. Contact the local Trane supplier.
80	29	Drive initialised	–	X	–	All parameter settings are initialized to default settings.
87	47	Auto DC Braking	X		–	The frequency converter is auto DC braking.
95	40	Broken Belt	X	X	–	Torque is below the torque level set for no load, indicating a broken belt. See parameter group *22-6* Broken Belt Detection*.
126	–	Motor Rotating	–	X	–	High back EMF voltage. Stop the rotor of the PM motor.
200	–	Fire Mode	X	–	–	Fire mode has been activated.
202	–	Fire Mode Limits Exceeded	X	–	–	Fire mode has suppressed 1 or more warranty voiding alarms.
250	–	New sparepart	–	X	X	The power or switch mode power supply has been exchanged (on 400 V, 30–90 kW (40–125 hp) and 600 V units). Contact the local Trane supplier.
251	–	New Typecode	–	X	X	The frequency converter has a new type code (on 400 V, 30–90 kW (40–125 hp) and 600 V units). Contact the local Trane supplier.

Table 5.1 Warnings and Alarms

6 Specifications

6.1 Mains Supply

6.1.1 3x200–240 V AC

Frequency converter	TR150							
	PK25	PK37	PK75	P1K5	P2K2	P3K7	P5K5	P7K5
Typical shaft output [kW]	0.25	0.37	0.75	1.5	2.2	3.7	5.5	7.5
Typical shaft output [hp]	0.33	0.5	1.0	2.0	3.0	5.0	7.5	10.0
Protection rating IP20	H1	H1	H1	H1	H2	H3	H4	H4
Maximum cable size in terminals (mains, motor) [mm^2 (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)
Output current								
40 °C (104 °F) ambient temperature								
Continuous (3x200–240 V) [A]	1.5	2.2	4.2	6.8	9.6	15.2	22.0	28.0
Intermittent (3x200–240 V) [A]	1.7	2.4	4.6	7.5	10.6	16.7	24.2	30.8
Maximum input current								
Continuous 3x200–240 V) [A]	1.1	1.6	2.8	5.6	8.6/ 7.2	14.1/ 12.0	21.0/ 18.0	28.3/ 24.0
Intermittent (3x200–240 V) [A]	1.2	1.8	3.1	6.2	9.5/ 7.9	15.5/ 13.2	23.1/ 19.8	31.1/ 26.4
Maximum mains fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*							
Estimated power loss [W], Best case/typical[1)]	12/ 14	15/ 18	21/ 26	48/ 60	80/ 102	97/ 120	182/ 204	229/ 268
Weight enclosure protection rating IP20 [kg (lb)]	2.0 (4.4)	2.0 (4.4)	2.0 (4.4)	2.1 (4.6)	3.4 (7.5)	4.5 (9.9)	7.9 (17.4)	7.9 (17.4)
Efficiency [%], best case/ typical[2)]	97.0/ 96.5	97.3/ 96.8	98.0/ 97.6	97.6/ 97.0	97.1/ 96.3	97.9/ 97.4	97.3/ 97.0	98.5/ 97.1
Output current								
50 °C (122 °F) ambient temperature								
Continuous (3x200–240 V) [A]	1.5	1.9	3.5	6.8	9.6	13.0	19.8	23.0
Intermittent (3x200–240 V) [A]	1.7	2.1	3.9	7.5	10.6	14.3	21.8	25.3

Table 6.1 3x200–240 V AC, 0.25–7.5 kW (0.33–10 hp)

1) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.3.12 Ambient Conditions.

Frequency converter	TR150							TR170
	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P1K5
Typical shaft output [kW]	11.0	15.0	18.5	22.0	30.0	37.0	45.0	1.5
Typical shaft output [hp]	15.0	20.0	25.0	30.0	40.0	50.0	60.0	2.0
Protection rating IP20	H5	H6	H6	H7	H7	H8	H8	H2
Maximum cable size in terminals (mains, motor) [mm^2 (AWG)]	16 (6)	35 (2)	35 (2)	50 (1)	50 (1)	95 (0)	120 (4/0)	4 (10)
Output current								
40 °C (104 °F) ambient temperature								
Continuous (3x200–240 V) [A]	42.0	59.4	74.8	88.0	115.0	143.0	170.0	6.8
Intermittent (3x200–240 V) [A]	46.2	65.3	82.3	96.8	126.5	157.3	187.0	7.5
Maximum input current								
Continuous 3x200–240 V) [A]	41.0/ 38.2	52.7	65.0	76.0	103.7	127.9	153.0	5.6
Intermittent (3x200–240 V) [A]	45.1/ 42.0	58.0	71.5	83.7	114.1	140.7	168.3	6.2
Maximum mains fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*							
Estimated power loss [W], Best case/ typical[1)]	369/ 386	512	697	879	1149	1390	1500	48/ 60
Weight enclosure protection rating IP20 [kg (lb)]	9.5 (20.9)	24.5 (54)	24.5 (54)	36.0 (79.4)	36.0 (79.4)	51.0 (112.4)	51.0 (112.4)	3.4 (7.5)
Efficiency [%], best case/ typical[2)]	97.2/ 97.1	97.0	97.1	96.8	97.1	97.1	97.3	97.6 97.0
Output current								
50 °C (122 °F) ambient temperature								**70 °C (158 °F)**
Continuous (3x200–240 V) [A]	33.0	41.6	52.4	61.6	80.5	100.1	119	6.8
Intermittent (3x200–240 V) [A]	36.3	45.8	57.6	67.8	88.6	110.1	130.9	7.5

Table 6.2 3x200–240 V AC, 11–45 kW (15–60 hp)

1) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.3.12 Ambient Conditions.

6.1.2 3x380–480 V AC

Frequency converter	TR150										TR170
	PK37	PK75	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5	P11K	P15K	P1K5
Typical shaft output [kW]	0.37	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11.0	15.0	1.5
Typical shaft output [hp]	0.5	1.0	2.0	3.0	4.0	5.0	7.5	10.0	15.0	20.0	2.0
Protection rating IP20	H1	H1	H1	H2	H2	H2	H3	H3	H4	H4	H2
Maximum cable size in terminals (mains, motor) [mm^2 (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)	4 (10)
Output current - 40 °C (104 °F) ambient temperature											
Continuous (3x380–440 V)[A]	1.2	2.2	3.7	5.3	7.2	9.0	12.0	15.5	23.0	31.0	3.7
Intermittent (3x380–440 V) [A]	1.3	2.4	4.1	5.8	7.9	9.9	13.2	17.1	25.3	34.0	4.1
Continuous (3x441–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2	11.0	14.0	21.0	27.0	3.4
Intermittent (3x441–480 V) [A]	1.2	2.3	3.7	5.3	6.9	9.0	12.1	15.4	23.1	29.7	3.7
Maximum input current											
Continuous (3x380–440 V) [A]	1.2	2.1	3.5	4.7	6.3	8.3	11.2	15.1	22.1	29.9	3.5
Intermittent (3x380–440 V) [A]	1.3	2.3	3.9	5.2	6.9	9.1	12.3	16.6	24.3	32.9	3.9
Continuous (3x441–480 V) [A]	1.0	1.8	2.9	3.9	5.3	6.8	9.4	12.6	18.4	24.7	2.9
Intermittent (3x441–480 V) [A]	1.1	2.0	3.2	4.3	5.8	7.5	10.3	13.9	20.2	27.2	3.2
Maximum mains fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*										
Estimated power loss [W], best case/typical[1)]	13/15	16/21	46/57	46/58	66/83	95/118	104/131	159/198	248/274	353/379	46/57
Weight enclosure protection rating IP20 [kg (lb)]	2.0 (4.4)	2.0 (4.4)	2.1 (4.6)	3.3 (7.3)	3.3 (7.3)	3.4 (7.5)	4.3 (9.5)	4.5 (9.9)	7.9 (17.4)	7.9 (17.4)	3.3/ (7.3)
Efficiency [%], best case/typical[2)]	97.8/97.3	98.0/97.6	97.7/97.2	98.3/97.9	98.2/97.8	98.0/97.6	98.4/98.0	98.2/97.8	98.1/ 97.9	98.0/ 97.8	97.7/97.2
Output current - 50 °C (122 °F) ambient temperature											**70 °C (158°F)**
Continuous (3x380–440 V) [A]	1.04	1.93	3.7	4.85	6.3	8.4	10.9	14.0	20.9	28.0	3.7
Intermittent (3x380–440 V) [A]	1.1	2.1	4.07	5.4	6.9	9.2	12.0	15.4	23.0	30.8	4.07
Continuous (3x441–480 V) [A]	1.0	1.8	3.4	4.4	5.5	7.5	10.0	12.6	19.1	24.0	3.4
Intermittent (3x441–480 V) [A]	1.1	2.0	3.7	4.8	6.1	8.3	11.0	13.9	21.0	26.4	3.7

Table 6.3 3x380–480 V AC, 0.37–15 kW (0.5–20 hp), Enclosure Sizes H1–H4

1) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.3.12 Ambient Conditions.

Frequency converter	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	18.5	22.0	30.0	37.0	45.0	55.0	75.0	90.0
Typical shaft output [hp]	25.0	30.0	40.0	50.0	60.0	70.0	100.0	125.0
Protection rating IP20	H5	H5	H6	H6	H6	H7	H7	H8
Maximum cable size in terminals (mains, motor) [mm^2 (AWG)]	16 (6)	16 (6)	35 (2)	35 (2)	35 (2)	50 (1)	95 (0)	120 (250MCM)
Output current - 40 °C (104 °F) ambient temperature								
Continuous (3x380–440 V)[A]	37.0	42.5	61.0	73.0	90.0	106.0	147.0	177.0
Intermittent (3x380–440 V) [A]	40.7	46.8	67.1	80.3	99.0	116.0	161.0	194.0
Continuous (3x441–480 V) [A]	34.0	40.0	52.0	65.0	80.0	105.0	130.0	160.0
Intermittent (3x441–480 V) [A]	37.4	44.0	57.2	71.5	88.0	115.0	143.0	176.0
Maximum input current								
Continuous (3x380–440 V) [A]	35.2	41.5	57.0	70.0	84.0	103.0	140.0	166.0
Intermittent (3x380–440 V) [A]	38.7	45.7	62.7	77.0	92.4	113.0	154.0	182.0
Continuous (3x441–480 V) [A]	29.3	34.6	49.2	60.6	72.5	88.6	120.9	142.7
Intermittent (3x441–480 V) [A]	32.2	38.1	54.1	66.7	79.8	97.5	132.9	157.0
Maximum mains fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*							
Estimated power loss [W], best case/typical[1)]	412/456	475/523	733	922	1067	1133	1733	2141
Weight enclosure protection rating IP20 [kg (lb)]	9.5 (20.9)	9.5 (20.9)	24.5 (54)	24.5 (54)	24.5 (54)	36.0 (79.4)	36.0 (79.4)	51.0 (112.4)
Efficiency [%], best case/typical[2)]	98.1/97.9	98.1/97.9	97.8	97.7	98	98.2	97.8	97.9
Output current - 50 °C (122 °F) ambient temperature								
Continuous (3x380–440 V) [A]	34.1	38.0	48.8	58.4	72.0	74.2	102.9	123.9
Intermittent (3x380–440 V) [A]	37.5	41.8	53.7	64.2	79.2	81.6	113.2	136.3
Continuous (3x441–480 V) [A]	31.3	35.0	41.6	52.0	64.0	73.5	91.0	112.0
Intermittent (3x441–480 V) [A]	34.4	38.5	45.8	57.2	70.4	80.9	100.1	123.2

Table 6.4 3x380–480 V AC, 18.5–90 kW (25–125 hp), Enclosure Sizes H5–H8

1) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.3.12 Ambient Conditions.

6.1.3 3x525–600 V AC

Frequency converter	P2K2	P3K0	P3K7	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	2.2	3.0	3.7	5.5	7.5	11.0	15.0	18.5	22.0	30.0	37	45.0	55.0	75.0	90.0
Typical shaft output [hp]	3.0	4.0	5.0	7.5	10.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0	125.0
Protection rating IP20	H9	H9	H9	H9	H9	H10	H10	H6	H6	H6	H7	H7	H7	H8	H8
Maximum cable size in terminals (mains, motor) [mm² (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	10 (8)	10 (8)	35 (2)	35 (2)	35 (2)	50 (1)	50 (1)	50 (1)	95 (0)	120 (4/0)
Output current - 40 °C (104 ° F) ambient temperature															
Continuous (3x525–550 V) [A]	4.1	5.2	6.4	9.5	11.5	19.0	23.0	28.0	36.0	43.0	54.0	65.0	87.0	105.0	137.0
Intermittent (3x525–550 V) [A]	4.5	5.7	7.0	10.5	12.7	20.9	25.3	30.8	39.6	47.3	59.4	71.5	95.7	115.5	150.7
Continuous (3x551–600 V) [A]	3.9	4.9	6.1	9.0	11.0	18.0	22.0	27.0	34.0	41.0	52.0	62.0	83.0	100.0	131.0
Intermittent (3x551–600 V) [A]	4.3	5.4	6.7	9.9	12.1	19.8	24.2	29.7	37.4	45.1	57.2	68.2	91.3	110.0	144.1
Maximum input current															
Continuous (3x525–550 V) [A]	3.7	5.1	5.0	8.7	11.9	16.5	22.5	27.0	33.1	45.1	54.7	66.5	81.3	109.0	130.9
Intermittent (3x525–550 V) [A]	4.1	5.6	6.5	9.6	13.1	18.2	24.8	29.7	36.4	49.6	60.1	73.1	89.4	119.9	143.9
Continuous (3x551–600 V) [A]	3.5	4.8	5.6	8.3	11.4	15.7	21.4	25.7	31.5	42.9	52.0	63.3	77.4	103.8	124.5
Intermittent (3x551–600 V) [A]	3.9	5.3	6.2	9.2	12.5	17.3	23.6	28.3	34.6	47.2	57.2	69.6	85.1	114.2	137.0
Maximum mains fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*														
Estimated power loss [W], best case/typical[1)]	65	90	110	132	180	216	294	385	458	542	597	727	1092	1380	1658
Weight enclosure protection rating IP54 [kg (lb)]	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	11.5 (25.3)	11.5 (25.3)	24.5 (54)	24.5 (54)	24.5 (54)	36.0 (79.3)	36.0 (79.3)	36.0 (79.3)	51.0 (112.4)	51.0 (112.4)
Efficiency [%], best case/typical[2)]	97.9	97	97.9	98.1	98.1	98.4	98.4	98.4	98.4	98.5	98.5	98.7	98.5	98.5	98.5
Output current - 50 °C (122 °F) ambient temperature															
Continuous (3x525–550 V) [A]	2.9	3.6	4.5	6.7	8.1	13.3	16.1	19.6	25.2	30.1	37.8	45.5	60.9	73.5	95.9
Intermittent (3x525–550 V) [A]	3.2	4.0	4.9	7.4	8.9	14.6	17.7	21.6	27.7	33.1	41.6	50.0	67.0	80.9	105.5
Continuous (3x551–600 V) [A]	2.7	3.4	4.3	6.3	7.7	12.6	15.4	18.9	23.8	28.7	36.4	43.3	58.1	70.0	91.7
Intermittent (3x551–600 V) [A]	3.0	3.7	4.7	6.9	8.5	13.9	16.9	20.8	26.2	31.6	40.0	47.7	63.9	77.0	100.9

Table 6.5 3x525–600 V AC, 2.2–90 kW (3–125 hp), Enclosure Sizes H6–H10

1) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.3.12 Ambient Conditions.

6.2 EMC Emission Test Results

6.2 Special Conditions

6.2.1 Derating for Ambient Temperature and Switching Frequency

Ensure that the ambient temperature measured over 24 hours is at least 5 °C (41 °F) lower than the maximum ambient temperature that is specified for the frequency converter. If the frequency converter is operated at a high ambient temperature, decrease the continuous output current. For derating curve, see *TR150 and TR170 Design Guide*.

6.2.2 Derating for Low Air Pressure and High Altitudes

The cooling capability of air is decreased at low air pressure. For altitudes above 2000 m (6562 ft), contact Trane regarding PELV. Below 1000 m (3281 ft) altitude, derating is not necessary. For altitudes above 1000 m (3281 ft), decrease the ambient temperature or the maximum output current. Decrease the output by 1% per 100 m (328 ft) altitude above 1000 m (3281 ft) or reduce the maximum ambient temperature by 1 °C (33.8 °F) per 200 m (656 ft).

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6.3 General Technical Data

Protection and features

- Electronic motor thermal protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips if there is overtemperature.
- The frequency converter is protected against short circuits between motor terminals U, V, W.
- When a motor phase is missing, the frequency converter trips and issues an alarm.
- When a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the DC-link voltage ensures that the frequency converter trips when the DC-link voltage is too low or too high.
- The frequency converter is protected against ground faults on motor terminals U, V, W.

6.3.1 Mains Supply (L1, L2, L3)

Supply voltage	200–240 V ±10%
Supply voltage	380–480 V ±10%
Supply voltage	525–600 V ±10%
Supply frequency	50/60 Hz
Maximum imbalance temporary between mains phases	3.0% of rated supply voltage
True power factor (λ)	≥0.9 nominal at rated load
Displacement power factor (cosφ) near unity	(>0.98)
Switching on the input supply L1, L2, L3 (power-ups) enclosure sizes H1–H5	Maximum 2 times/minute
Switching on the input supply L1, L2, L3 (power-ups) enclosure sizes H6–H8	Maximum 1 time/minute
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100000 A_{rms} symmetrical Amperes, 240/480 V maximum.

6.3.2 Motor Output (U, V, W)

Output voltage	0–100% of supply voltage
Output frequency	0–200 Hz (VVC^+), 0–400 Hz (u/f)
Switching on output	Unlimited
Ramp times	0.05–3600 s

6.3.3 Cable Length and Cross-section

Maximum motor cable length, shielded/armored (EMC-correct installation)	See *chapter 6.2 EMC Emission Test Results*
Maximum motor cable length, unshielded/unarmored	50 m (164 ft)
Maximum cross-section to motor, mains[1)]	
Cross-section DC terminals for filter feedback on enclosure sizes H1–H3, I2, I3, I4	4 mm^2/11 AWG
Cross-section DC terminals for filter feedback on enclosure sizes H4–H5	16 mm^2/6 AWG
Maximum cross-section to control terminals, rigid wire	2.5 mm^2/14 AWG
Maximum cross-section to control terminals, flexible cable	2.5 mm^2/14 AWG
Minimum cross-section to control terminals	0.05 mm^2/30 AWG

1) See *chapter 6.1.2 3x380–480 V AC* for more information.

6.3.4 Digital Inputs

Programmable digital inputs	4
Terminal number	18, 19, 27, 29
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<5 V DC
Voltage level, logic 1 PNP	>10 V DC
Voltage level, logic 0 NPN	>19 V DC
Voltage level, logic 1 NPN	<14 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ
Digital input 29 as thermistor input	Fault: >2.9 kΩ and no fault: <800 Ω
Digital input 29 as pulse input	Maximum frequency 32 kHz push-pull-driven & 5 kHz (O.C.)

6.3.5 Analog Inputs

Number of analog inputs	2
Terminal number	53, 54
Terminal 53 mode	*Parameter 16-61 Terminal 53 Setting*: 1 = voltage, 0 = current
Terminal 54 mode	*Parameter 16-63 Terminal 54 Setting*: 1 = voltage, 0 = current
Voltage level	0–10 V
Input resistance, R_i	Approximately 10 kΩ
Maximum voltage	20 V
Current level	0/4–20 mA (scalable)
Input resistance, R_i	<500 Ω
Maximum current	29 mA
Resolution on analog input	10 bit

6.3.6 Analog Output

Number of programmable analog outputs	2
Terminal number	42, 45[1)]
Current range at analog output	0/4–20 mA
Maximum load to common at analog output	500 Ω
Maximum voltage at analog output	17 V
Accuracy on analog output	Maximum error: 0.4% of full scale
Resolution on analog output	10 bit

1) Terminals 42 and 45 can also be programmed as digital outputs.

6.3.7 Digital Output

Number of digital outputs	4
Terminals 27 and 29	
Terminal number	27, 29[1)]
Voltage level at digital output	0–24 V
Maximum output current (sink and source)	40 mA
Terminals 42 and 45	
Terminal number	42, 45[2)]
Voltage level at digital output	17 V
Maximum output current at digital output	20 mA
Maximum load at digital output	1 kΩ

1) Terminals 27 and 29 can also be programmed as input.

2) Terminals 42 and 45 can also be programmed as analog output.

The digital outputs are galvanically isolated from the supply voltage (PELV) and other high voltage terminals.

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6.3.8 Control Card, RS485 Serial Communication

Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number	61 common for terminals 68 and 69

6.3.9 Control Card, 24 V DC Output

Terminal number	12
Maximum load	80 mA

6.3.10 Relay Output

Programmable relay output	2
Relay 01 and 02	01–03 (NC), 01–02 (NO), 04–06 (NC), 04–05 (NO)
Maximum terminal load (AC-1)[1)] on 01–02/04–05 (NO) (resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1)] on 01–02/04–05 (NO) (inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 01–02/04–05 (NO) (resistive load)	30 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 01–02/04–05 (NO) (inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1)] on 01–03/04–06 (NC) (resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1)] on 01–03/04–06 (NC) (inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 01–03/04–06 (NC) (resistive load)	30 V DC, 2 A
Minimum terminal load on 01–03 (NC), 01–02 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

1) IEC 60947 parts 4 and 5.

6.3.11 Control Card, 10 V DC Output

Terminal number	50
Output voltage	10.5 V ±0.5 V
Maximum load	25 mA

6.3.12 Ambient Conditions

Enclosure protection rating	IP20, IP54
Enclosure kit available	IP21, TYPE 1
Vibration test	1.0 g
Maximum relative humidity	5–95% (IEC 60721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60721-3-3), coated (standard) enclosure sizes H1–H5	Class 3C3
Aggressive environment (IEC 60721-3-3), non-coated enclosure sizes H6–H10	Class 3C2
Aggressive environment (IEC 60721-3-3), coated (optional) enclosure sizes H6–H10	Class 3C3
Aggressive environment (IEC 60721-3-3), non-coated enclosure sizes I2–I8	Class 3C2
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature[1)]	See maximum output current at 40/50/70 °C (104/122/158 °F) in *chapter 6.1.2 3x380–480 V AC*.
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced performance	-20 °C (-4 °F)
Minimum ambient temperature at reduced performance	-10 °C (14 °F)
Temperature during storage/transport	-30 to +65/70 °C (-22 to +149/158°F)
Maximum altitude above sea level without derating	1000 m (3281 ft)
Maximum altitude above sea level with derating	3000 m (9843 ft)
Derating for high altitude, see *chapter 6.2.2 Derating for Low Air Pressure and High Altitudes*.	
Safety standards	EN/IEC 61800-5-1, UL 508C
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
EMC standards, Immunity	EN 61800-3, EN 61000-3-12, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
Energy efficiency class[2)]	IE2

1) Refer to Special Conditions in the design guide for:

- *Derating for high ambient temperature.*
- *Derating for high altitude.*

2) Determined according to EN 50598-2 at:

- *Rated load.*
- *90% rated frequency.*
- *Switching frequency factory setting.*
- *Switching pattern factory setting.*

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