Frame 5 to 6

Power Installation Guide

Commander C200 & C300 Unidrive M / HS

Part Number: 0478-0255-08
Issue: 8

Original Instructions

For the purposes of compliance with the EU Machinery Directive 2006/42/EC, the English version of this manual is the Original Instructions. Manuals in other languages are Translations of the Original Instructions.

Documentation

Manuals are available to download from the following locations: **http://www.drive-setup.com/ctdownloads**

The information contained in this manual is believed to be correct at the time of printing and does not form part of any contract. The manufacturer reserves the right to change the specification of the product and its performance, and the contents of the manual, without notice.

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Control Techniques Ltd operates an Environmental Management System (EMS) that conforms to the International Standard ISO 14001.

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The products covered by this manual comply with European and International regulations on the Restriction of Hazardous Substances including EU directive 2011/65/EU and the Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products.

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Further information on our compliance with REACH can be found at: **http://www.drive-setup.com/reach**

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Contents

1 Safety information 12
1.1 Warnings, Cautions and Notes 12
1.2 Important safety information. Hazards. Competence of designers and installers 12
1.3 Responsibility 12
1.4 Compliance with regulations 12
1.5 Electrical hazards 13
1.6 Stored electrical charge 13
1.7 Mechanical hazards 13
1.8 Access to equipment 13
1.9 Environmental limits 13
1.10 Hazardous environments 13
1.11 Motor 14
1.12 Mechanical brake control 14
1.13 Adjusting parameters 14
1.14 Electromagnetic compatibility (EMC) 14

2 Product information 15
2.1 Introduction 15
2.2 Model number 15
2.3 Nameplate description 16
2.4 Ratings 17
2.5 Drive features 19

3 Mechanical installation 21
3.1 Safety information 21
3.2 Planning the installation 22
3.3 Terminal cover removal 24
3.4 Dimensions and mounting methods 27
3.5 Enclosure for standard drives 31
3.6 Enclosure design and drive ambient temperature 36
3.7 Heatsink fan operation 36
3.8 Enclosing standard drive for high environmental protection 37
3.9 Installation of high IP insert for size 5 39
3.10 Internal braking resistor 41
3.11 External EMC filter 43
3.12 Terminal size and torque settings 45
3.13 Routine maintenance 45

4 Electrical installation 48
4.1 Power and ground connections 49
4.2 AC supply requirements 51
4.3 Supplying the drive with DC 53
4.4 DC bus paralleling 53
4.5 24 Vdc supply 54
4.6 Low voltage operation 56
4.7 Fan power supply 56
4.8 Ratings 57
4.9 Output circuit and motor protection 57
4.10 Braking 60
4.11 Ground leakage 66
4.12 EMC (Electromagnetic compatibility) 67

5 Technical data 82
5.1 Drive technical data 82
5.2 Optional external EMC filters 105

6 UL listing information 107
6.1 UL file reference 107
6.2 Option modules, kits and accessories 107
6.3 Enclosure ratings 107
6.4 Mounting 107
6.5 Environment 108
6.6 Electrical Installation 108
6.7 Motor overload protection and thermal memory retention 108
6.8 Electrical supply 109
6.9 External Class 2 supply 109
6.10 Requirement for Transient Surge Suppression 109
6.11 Group Installation and Modular Drive Systems 109

EU Declaration of Conformity

Control Techniques Ltd
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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant European Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	M100, M101, M200, M201, M300, M400, M600, M700, M701, M702, F300, H300, E200, E300, HS30, HS70, HS71, HS72, M000, RECT
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V, 6 = 690 V
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter (internal choke), D = Inverter, E = 6P Rectifier + Inverter (external choke), N = 18P Rectifier + Inverter, T = 12P Rectifier + Inverter

The model number may be followed by additional characters that do not affect the ratings.

The variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonized standards:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2004+A1:2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4: 2007+A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)
EN 61000-3-3:2013	Electromagnetic compatibility (EMC) - Part 3-3: Limitation of voltage changes, voltage fluctuations and flicker in public, low voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection

EN 61000-3-2:2014 Applicable where input current < 16 A. No limits apply for professional equipment where input power ≥1 kW.

These products comply with the Restriction of Hazardous Substances Directive (2011/65/EU), the Low Voltage Directive (2014/35/EU) and the Electromagnetic Compatibility Directive (2014/30/EU).

G Williams
Vice President, Technology
Date: 15th February 2016

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters.

The drives must be installed only by professional installers who are familiar with requirements for safety and EMC. Refer to the Product Documentation. An EMC data sheet is available giving detailed information. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used.

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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant European Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	C200, C300,
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter with internal choke, E = 6P Rectifier + Inverter (external choke)

The model number may be followed by other characters that do not affect the ratings.

The variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonized standards:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2004+A1:2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4: 2007+A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)
EN 61000-3-3:2013	Electromagnetic compatibility (EMC) - Part 3-3: Limitation of voltage changes, voltage fluctuations and flicker in public, low voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection

EN 61000-3-2:2014 Applicable where input current < 16 A. No limits apply for professional equipment where input power ≥1 kW.

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Jon Holman-White
Director of Research and Development
Date: 9th October 2018

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters.

The drives must be installed only by professional installers who are familiar with requirements for safety and EMC. Refer to the Product Documentation. An EMC data sheet is available giving detailed information. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used.

EU Declaration of Conformity (including 2006 Machinery Directive)

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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant European Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	M300, M400, M600, M700, M701, M702, F300, H300, E200, E300, HS30, HS70, HS71, HS72, M000, RECT
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V, 6 = 690 V
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter (internal choke), D = Inverter, E = 6P Rectifier + Inverter (external choke), N = 18P Rectifier + Inverter, T = 12P Rectifier + Inverter

The model number may be followed by additional characters that do not affect the ratings.

This declaration relates to these products when used as a safety component of a machine. Only the Safe Torque Off function may be used for a safety function of a machine. None of the other functions of the drive may be used to carry out a safety function.

These products fulfil all the relevant provisions of the Machinery Directive 2006/42/EC and the Electromagnetic Compatibility Directive (2014/30/EU).

EC type examination has been carried out by the following notified body:

TUV Rheinland Industrie Service GmbH

Am Grauen Stein

D-51105 Köln

Germany

EC type-examination certificate numbers:

01/205/5270.01/14 dated 2014-11-11

01/205/5387.01/15 dated 2015-01-29

01/205/5383.02/15 dated 2015-04-21

Notified body identification number: 0035

The harmonized standards used are shown below:

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-5-2:2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN ISO 13849-1:2008	Safety of Machinery, Safety-related parts of control systems, General principles for design
EN ISO 13849-2:2008	Safety of machinery, Safety-related parts of control systems. Validation
EN 61800-3: 2004+A1:2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 62061:2005	Safety of machinery, Functional safety of safety related electrical, electronic and programmable electronic control systems

Person authorised to complete the technical file:
P Knight
Conformity Engineer
Newtown, Powys, UK

G. Williams
Vice President, Technology
Date: 15th February 2016
Place: Newtown, Powys, UK

IMPORTANT NOTICE

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters.

The drives must be installed only by professional installers who are familiar with requirements for safety and EMC. Refer to the Product Documentation. An EMC data sheet is available giving detailed information. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used.

EU Declaration of Conformity (including 2006 Machinery Directive)

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This declaration is issued under the sole responsibility of the manufacturer. The object of the declaration is in conformity with the relevant European Union harmonization legislation. The declaration applies to the variable speed drive products shown below:

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	C300
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400 V
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter with internal choke, E = 6P Rectifier + Inverter (external choke)

The model number may be followed by additional characters that do not affect the ratings.

This declaration relates to these products when used as a safety component of a machine. Only the Safe Torque Off function may be used for a safety function of a machine. None of the other functions of the drive may be used to carry out a safety function.

These products fulfil all the relevant provisions of the Machinery Directive (2006/42/EC) and the Electromagnetic Compatibility Directive (2014/30/EU).

EC type examination has been carried out by the following notified body:

TUV Rheinland Industrie Service GmbH

Am Grauen Stein

D-51105 Köln

Germany

EC type-examination certificate numbers:

Frame sizes 1 to 4: 01/205/5383.03/18 dated 2018-08-16

Frame sizes 5 to 9: 01/205/5387.02/18 dated 2018-08-16

Notified body identification number: 0035

The harmonized standards used are shown below:

EN 61800-5-2:2007	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN 61800-5-1:2007 (in extracts)	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2004+A1:2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN ISO 13849-1:2008 + AC:2009	Safety of Machinery, Safety-related parts of control systems, General principles for design
EN 62061:2005 + AC:2010 + A1:2013	Safety of machinery, Functional safety of safety related electrical, electronic and programmable electronic control systems
IEC 61508 Parts 1 - 7:2010	Functional safety of electrical/ electronic/programmable electronic safety-related systems

Person authorised to complete the technical file:
P Knight
Conformity Engineer
Newtown, Powys, UK

Jon Holman-White
Director of Research and Development
Date: 9th October 2018
Place: Newtown, Powys, UK

IMPORTANT NOTICE

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. It is the responsibility of the installer to ensure that the design of the complete machine, including its safety-related control system, is carried out in accordance with the requirements of the Machinery Directive and any other relevant legislation. The use of a safety-related drive in itself does not ensure the safety of the machine. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters. The drive must be installed only by professional installers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all relevant laws in the country where it is to be used. For more information regarding Safe Torque Off, refer to the Product Documentation.

1 Safety information

1.1 Warnings, Cautions and Notes

A Warning contains information which is essential for avoiding a safety hazard.

A Caution contains information which is necessary for avoiding a risk of damage to the product or other equipment.

NOTE A **Note** contains information, which helps to ensure correct operation of the product.

1.2 Important safety information. Hazards. Competence of designers and installers

This guide applies to products which control electric motors either directly (drives) or indirectly (controllers, option modules and other auxiliary equipment and accessories). In all cases the hazards associated with powerful electrical drives are present, and all safety information relating to drives and associated equipment must be observed.

Specific warnings are given at the relevant places in this guide.

Drives and controllers are intended as components for professional incorporation into complete systems. If installed incorrectly they may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury. Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning/start-up and maintenance must be carried out by personnel who have the necessary training and competence. They must read this safety information and this guide carefully.

1.3 Responsibility

It is the responsibility of the installer to ensure that the equipment is installed correctly with regard to all instructions given in this guide. They must give due consideration to the safety of the complete system, so as to avoid the risk of injury both in normal operation and in the event of a fault or of reasonably foreseeable misuse.

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation of the equipment.

1.4 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective ground (earth) connections.

This guide contains instructions for achieving compliance with specific EMC standards.

All machinery to be supplied within the European Union in which this product is used must comply with the following directives:

2006/42/EC Safety of machinery.

2014/30/EU: Electromagnetic Compatibility.

1.5 Electrical hazards

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive. Hazardous voltage may be present in any of the following locations:

- AC and DC supply cables and connections
- Output cables and connections
- Many internal parts of the drive, and external option units

Unless otherwise indicated, control terminals are single insulated and must not be touched.

The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

The STOP and Safe Torque Off functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit.

The drive must be installed in accordance with the instructions given in this guide. Failure to observe the instructions could result in a fire hazard.

1.6 Stored electrical charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.

1.7 Mechanical hazards

Careful consideration must be given to the functions of the drive or controller which might result in a hazard, either through their intended behaviour or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

With the sole exception of the Safe Torque Off function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.

The Safe Torque Off function may be used in a safety-related application. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

The design of safety-related control systems must only be done by personnel with the required training and experience. The Safe Torque Off function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. The system must be subject to a risk assessment to confirm that the residual risk of an unsafe event is at an acceptable level for the application.

1.8 Access to equipment

Access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

1.9 Environmental limits

Instructions in this guide regarding transport, storage, installation and use of the equipment must be complied with, including the specified environmental limits. This includes temperature, humidity, contamination, shock and vibration. Drives must not be subjected to excessive physical force.

1.10 Hazardous environments

The equipment must not be installed in a hazardous environment (i.e. a potentially explosive environment).

1.11 Motor

The safety of the motor under variable speed conditions must be ensured.

To avoid the risk of physical injury, do not exceed the maximum specified speed of the motor.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective, causing a fire hazard. The motor should be installed with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive must not be relied upon. It is essential that the correct value is entered in the Motor Rated Current parameter.

1.12 Mechanical brake control

Any brake control functions are provided to allow well co-ordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

1.13 Adjusting parameters

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

1.14 Electromagnetic compatibility (EMC)

Installation instructions for a range of EMC environments are provided in the relevant Power Installation Guide. If the installation is poorly designed or other equipment does not comply with suitable standards for EMC, the product might cause or suffer from disturbance due to electromagnetic interaction with other equipment. It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the relevant EMC legislation in the place of use.

2 Product information

2.1 Introduction

This guide provides the information necessary to install the following drive models:

Unidrive Mxxx frame 5 to 6

Unidrive HSxx frame 5 to 6

Commander Cxxx frame 5 to 6

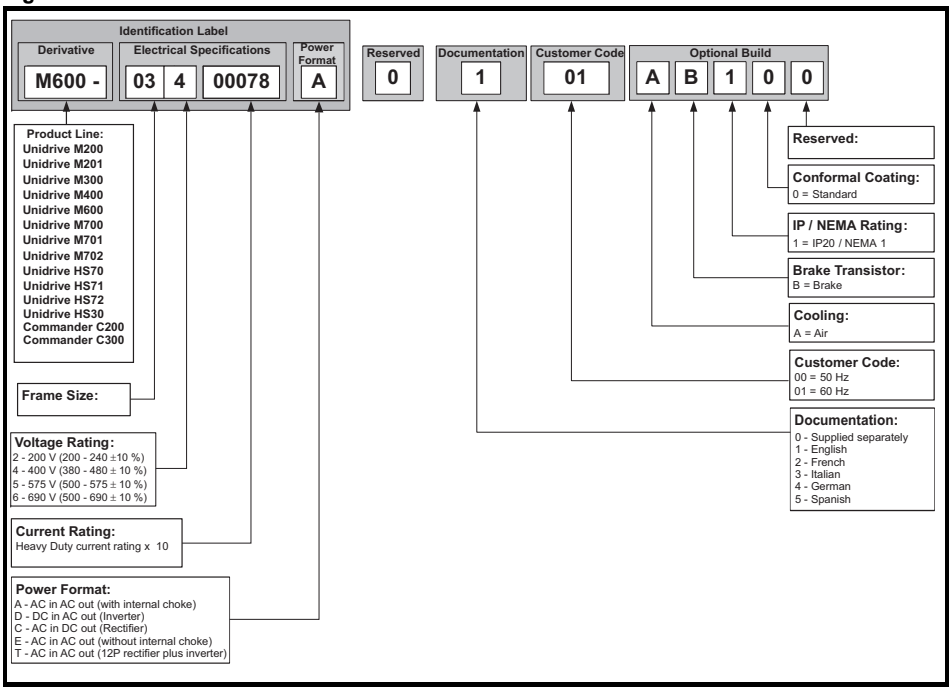
This guide focuses on the drive power section, for example: electrical installation of the supply / motor cables and mechanical installation of the drive.

For information about the drive control section, for example: parameter set up information, control and encoder connections please refer to the *Control User Guide*.

2.2 Model number

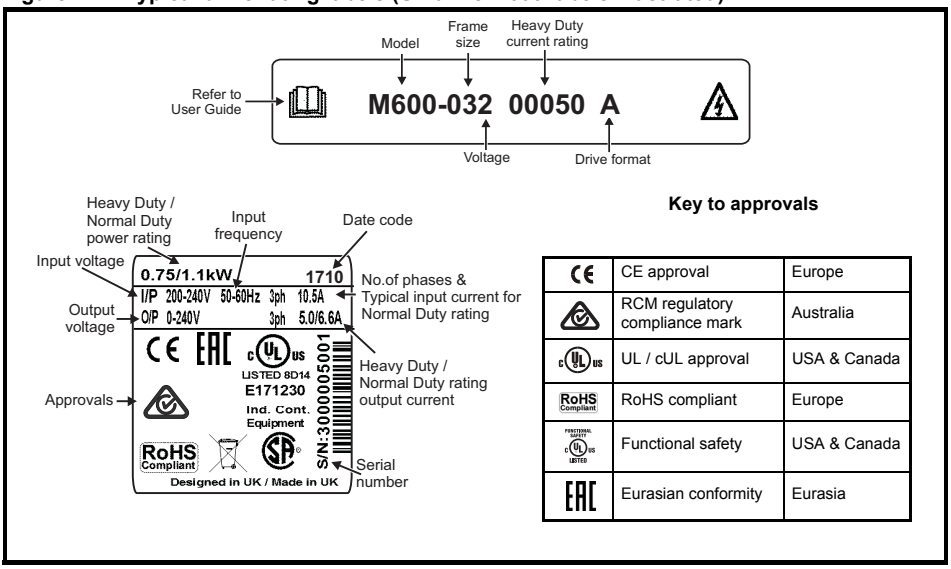
The model numbers for the *Unidrive M/HS* and *Commander* product range are formed as illustrated below:

Figure 2-1 Model number



2.3 Nameplate description

Figure 2-2 Typical drive rating labels (Unidrive M600 labels illustrated)



NOTE

Date code format

The date code is four numbers. The first two numbers indicate the year and the remaining numbers indicate the week of the year in which the drive was built.

Example:

A date code of **1710** would correspond to week 10 of year 2017.

2.4 Ratings

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. The following section shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

NOTE Nominal cables sizes below are based on the cable installation method B2 (ref: IEC60364-5-52:2001) unless otherwise specified, and are provided as a guide only. Ensure cables used suit local wiring regulations.

Table 2-1 200 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse					Nominal cable size				Normal Duty			Heavy Duty		
		IEC		UL			European		USA							
	3ph	Nom	Class	Nom	Class		Input	Output	Input	Output	Max. cont. output current	Nom power @ 230 V	Motor power @ 230 V	Max. cont. output current	Nom power @ 230 V	Motor power @ 230 V
	A	A		A			mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
05200250	31	40	gG	40	CC, J or T*		10	10	8	8	30	7.5	10	25	5.5	7.5
06200330	48.8	63	gG	60	CC, J or T*		16	16	4	4	50	11	15	33	7.5	10
06200440	56.6	63		70			25	25	3	3	58	15	20	44	11	15

Table 2-2 400 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse				Nominal cable size				Normal Duty			Heavy Duty		
		IEC		UL		European		USA							
	3ph	Nom	Class	Nom	Class	Input	Output	Input	Output	Max. cont. output current	Nom power @ 400 V	Motor power @ 460 V	Max. cont. output current	Nom power @ 400 V	Motor power @ 460 V
	A	A		A		mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
05400270	29	40	gG	35	CC, J or T*	6	6	8	8	30	15	20	27	11	20
05400300		40		35		6	6	8	8	31			30	15	
06400350	36	63	gR	40	CC, J or T*	10	10	6	6	38	18.5	25	35	15	25
06400420	46	63		50		16	16	4	4	48	22	30	42	18.5	30
06400470	60	63		70		25	25	3	3	63	30	40	47	22	30

Table 2-3 575 V drive ratings, cable sizes and fuse ratings

Model	Max. cont. input current	Fuse				Nominal cable size				Normal Duty			Heavy Duty		
		IEC		UL		European		USA							
	3ph	Nom	Class	Nom	Class	Input	Output	Input	Output	Max. cont. output current	Nom power @ 575 V	Motor power @ 575 V	Max. cont. output current	Nom power @ 575 V	Motor power @ 575 V
	A	A		A		mm^2	mm^2	AWG	AWG	A	kW	hp	A	kW	hp
05500030	4.3	10	gG	10	CC, J or T*	0.75	0.75	16	16	3.9	2.2	3	3	1.5	2
05500040	5.7	10		10		1	1	14	14	6.1	4	5	4	2.2	3
05500069	9.3	20		20		1.5	1.5	14	14	10	5.5	7.5	6.9	4	5
06500100	13.2	20	gG	20	CC, J or T*	2.5	2.5	14	14	12	7.5	10	10	5.5	7.5
06500150	18.7	32		25		4	4	10	10	17	11	15	15	7.5	10
06500190	24.3	40		30		6	6	10	10	22	15	20	19	11	15
06500230	29.4	50		35		10	10	8	8	27	18.5	25	23	15	20
06500290	37.1	50		40		10	10	6	6	34	22	30	29	18.5	25
06500350	46.9	63		50		16	16	6	6	43	30	40	35	22	30

* These fuses are fast acting.

NOTE Refer to Chapter 5 *Technical data* on page 82 for maximum fuse rating, maximum cable size and peak currents.

Table 2-4 Protective ground cable ratings

Input phase conductor size	Minimum ground conductor size
≤ 10 mm^2	Either 10 mm^2 or two conductors of the same cross-sectional area as the input phase conductor
> 10 mm^2 and ≤ 16 mm^2	The same cross-sectional area as the input phase conductor
> 16 mm^2 and ≤ 35 mm^2	16 mm^2
> 35 mm^2	Half of the cross-sectional area of the input phase conductor

Typical short term overload limits

The maximum percentage overload limit changes depending on the selected motor. Variations in motor rated current, motor power factor and motor leakage inductance all result in changes in the maximum possible overload. Typical values are shown in the table below:

Table 2-5 Typical overload limits

Operating mode	RFC from cold	RFC from 100 %	Open loop from cold	Open loop from 100 %
Normal Duty overload with motor rated current = drive rated current	110 % for 165 s	110 % for 9 s	110 % for 165 s	110 % for 9 s
Heavy Duty overload with motor rated current = drive rated current (size 8 and below)	200 % for 28 s	200 % for 3 s	150 % for 60 s	150 % for 7 s

Generally the drive rated current is higher than the matching motor rated current allowing a higher level of overload than the default setting.

The time allowed in the overload region is proportionally reduced at very low output frequency on some drive ratings.

NOTE The maximum overload level which can be attained is independent of the speed.

Output current

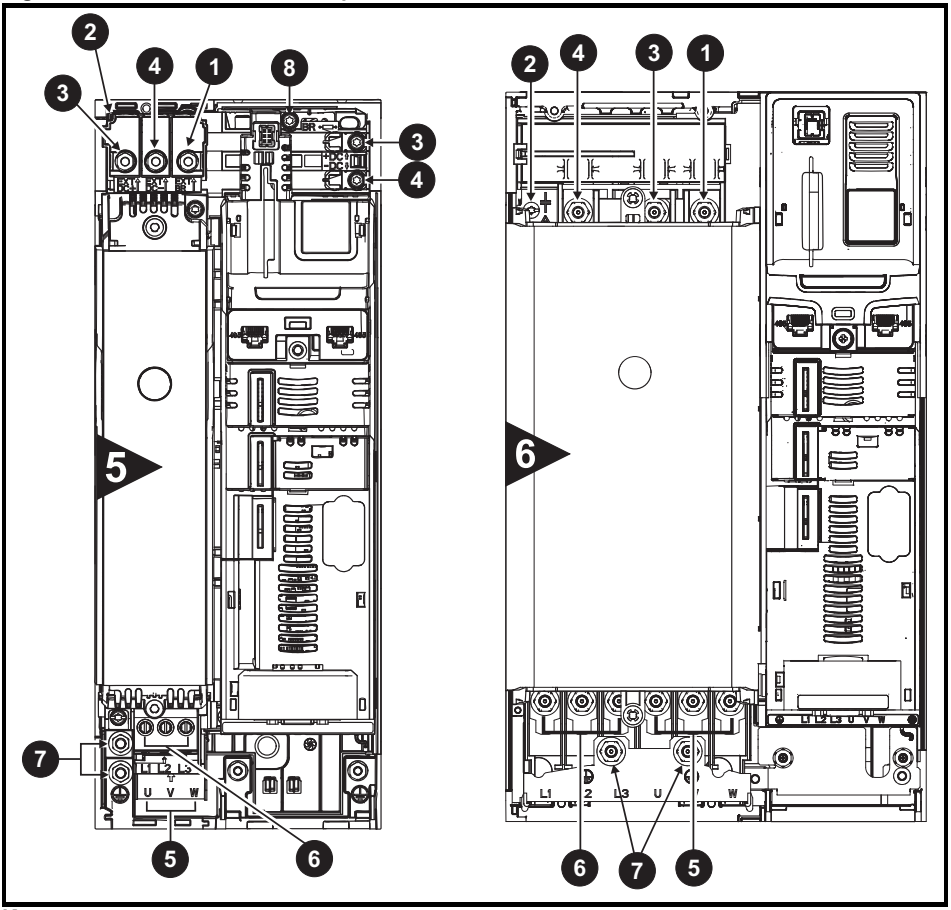
The continuous output current ratings given on the rating label are for maximum 40 °C (104 °F), 1000 m altitude and 3 kHz switching frequency. Derating is required for higher switching frequencies, ambient temperatures >40 °C (104 °F) and higher altitude. For derating information, refer to *section 5.1.2 Power and current ratings (Derating for switching frequency and temperature)* on page 84.

Input current

The input current is affected by the supply voltage and impedance. The input current given on the rating label is the typical input current and is stated for a balanced supply.

2.5 Drive features

Figure 2-3 Features of the drive power section



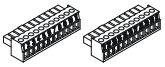
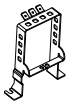
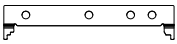
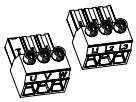
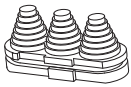
Key

1. Braking terminal (for external brake resistor)
2. Internal EMC filter
3. DC bus +
4. DC bus -
5. Motor connections
6. AC supply connections
7. Ground connections
8. Braking terminal for heatsink mounted brake resistor (size 5 only, M600 and above)

2.5.1 Items supplied with the drive

The drive is supplied with a copy of the *Power Installation Guide* and a copy of the *Control Getting Started Guide*, a safety information booklet, the Certificate of Quality and an accessory kit box including the items shown in Table 2-6.

Table 2-6 Parts supplied with the drive

Description	Size 5	Size 6
Control connectors (1 to 11 and 21 to 31)	 x 1* x 1*	
Control connectors (1 to 13)	x 1**	
Relay connector	x 1	
24 V power supply connector		x 1
Grounding bracket	 x 1	
Surface mounting brackets	 x 2	x 2
Grounding clamp	x 1	x 1
Terminal nuts		M6 x 11
Supply and motor connector	 x 1 x 1	
Finger guard grommets	x 3	 x 2

* Supplied with *Unidrive M700 / M701 / M600* only.

** Supplied with *Unidrive M702* only.

3 Mechanical installation

3.1 Safety information

Follow the instructions

The mechanical and electrical installation instructions must be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the drive and any external option unit, and the way in which they are operated and maintained, comply with the requirements of the Health and Safety at Work Act in the United Kingdom or applicable legislation and regulations and codes of practice in the country in which the equipment is used.

Stored charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.

Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Nidec Industrial Automation or their authorized distributor.

Competence of the installer

The drive must be installed by professional assemblers who are familiar with the requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used.

Enclosure

The drive is intended to be mounted in an enclosure which prevents access except by trained and authorized personnel, and which prevents the ingress of contamination. It is designed for use in an environment classified as pollution degree 2 in accordance with IEC 60664-1. This means that only dry, non-conducting contamination is acceptable.

3.2 Planning the installation

The following considerations must be made when planning the installation:

3.2.1 Access

Access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

The IP (Ingress Protection) rating of the drive is installation dependent. For further information, refer to section 3.8 *Enclosing standard drive for high environmental protection* on page 37.

3.2.2 Environmental protection

The drive must be protected from:

- Moisture, including dripping water or spraying water and condensation. An anti-condensation heater may be required, which must be switched off when the drive is running.
- Contamination with electrically conductive material
- Contamination with any form of dust which may restrict the fan, or impair airflow over various components
- Temperature beyond the specified operating and storage ranges
- Corrosive gasses

NOTE During installation it is recommended that the vents on the drive are covered to prevent debris (e.g. wire off-cuts) from entering the drive.

3.2.3 Cooling

The heat produced by the drive must be removed without its specified operating temperature being exceeded. Note that a sealed enclosure gives much reduced cooling compared with a ventilated one, and may need to be larger and/or use internal air circulating fans.

For further information, refer to section 3.5 *Enclosure for standard drives* on page 31.

3.2.4 Electrical safety

The installation must be safe under normal and fault conditions. Electrical installation instructions are given in Chapter 4 *Electrical installation on page 48*.

3.2.5 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided.

For installation in the USA, a NEMA 12 enclosure is suitable.

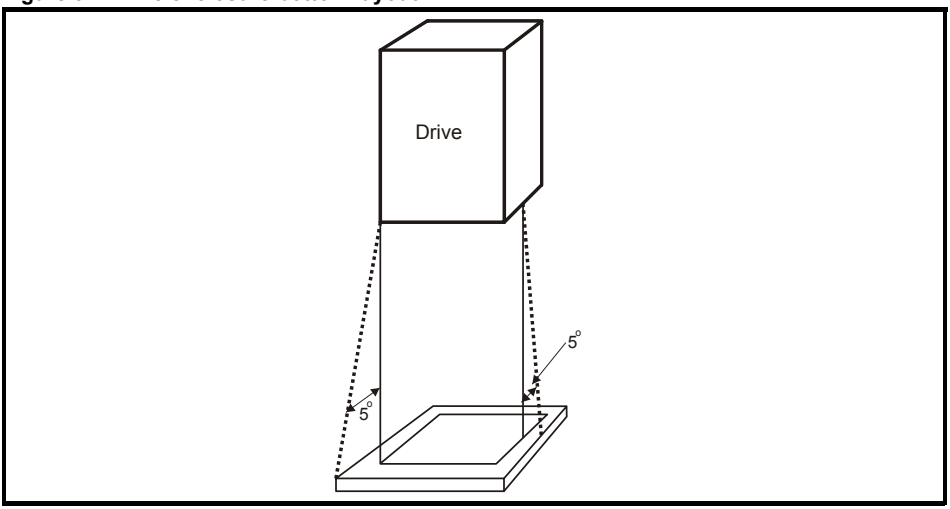
For installation outside the USA, the following (based on IEC 62109-1, standard for PV inverters) is recommended.

Enclosure can be metal and/or polymeric, polymer must meet requirements which can be summarized for larger enclosures as using materials meeting at least UL 94 class 5VB at the point of minimum thickness.

Air filter assemblies to be at least class V-2.

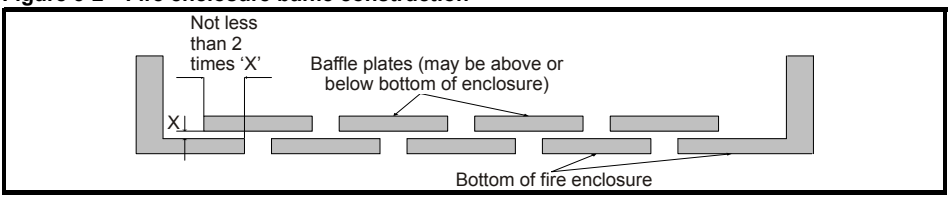
The location and size of the bottom shall cover the area shown in Figure 3-1. Any part of the side which is within the area traced out by the 5° angle is also considered to be part of the bottom of the fire enclosure.

Figure 3-1 Fire enclosure bottom layout



The bottom, including the part of the side considered to be part of the bottom, must be designed to prevent escape of burning material - either by having no openings or by having a baffle construction. This means that openings for cables etc. must be sealed with materials meeting the 5VB requirement, or else have a baffle above. See Figure 3-2 for acceptable baffle construction. This does not apply for mounting in an enclosed electrical operating area (restricted access) with concrete floor.

Figure 3-2 Fire enclosure baffle construction



3.2.6 Electromagnetic compatibility

Variable speed drives are powerful electronic circuits which can cause electromagnetic interference if not installed correctly with careful attention to the layout of the wiring.

Some simple routine precautions can prevent disturbance to typical industrial control equipment.

If it is necessary to meet strict emission limits, or if it is known that electromagnetically sensitive equipment is located nearby, then full precautions must be observed. In-built into the drive, is an internal EMC filter, which reduces emissions under certain conditions. If these conditions are exceeded, then the use of an external EMC filter may be required at the drive inputs, which must be located very close to the drives. Space must be made available for the filters and allowance made for carefully segregated wiring. Both levels of precautions are covered in section 4.12 *EMC (Electromagnetic compatibility) on page 67*.

3.2.7 Hazardous areas

The drive must not be located in a classified hazardous area unless it is installed in an approved enclosure and the installation is certified.

3.3 Terminal cover removal

Isolation device
The AC and / or DC power supply must be disconnected from the drive using an approved isolation device before any cover is removed from the drive or before any servicing work is performed.

Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the AC and / or DC power supply has been disconnected. If the drive has been energized, the power supply must be isolated at least ten minutes before work may continue.

Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Nidec Industrial Automation or their authorized distributor.

3.3.1 Removing the terminal covers

Figure 3-3 Location and identification of terminal covers (size 5 and 6)

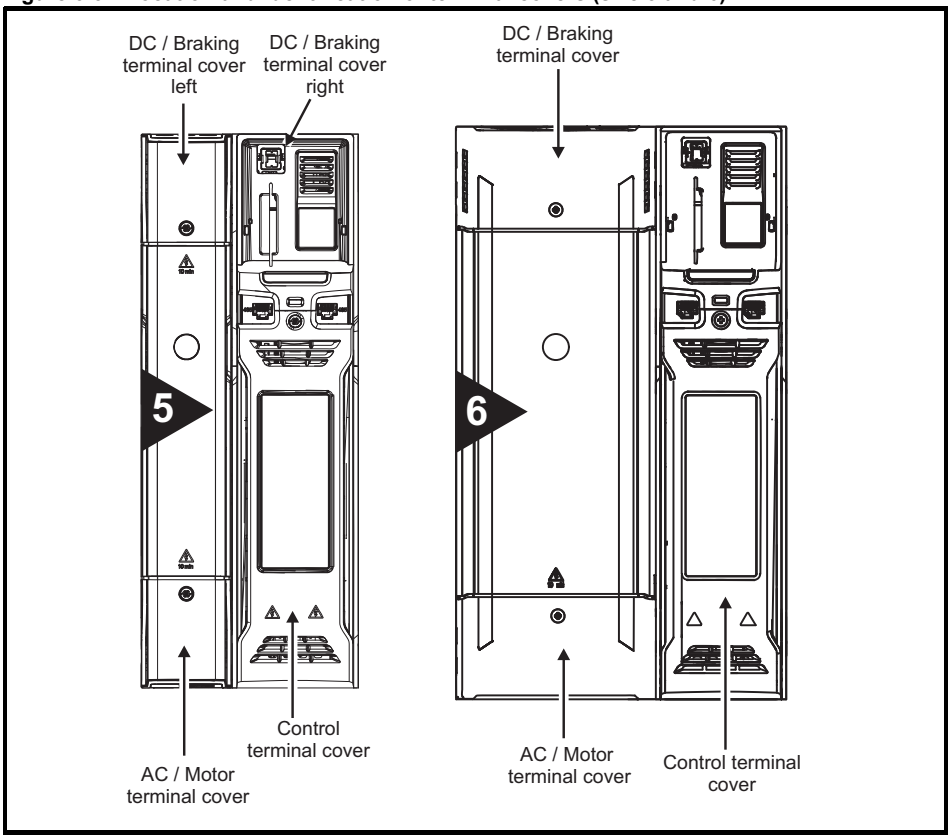
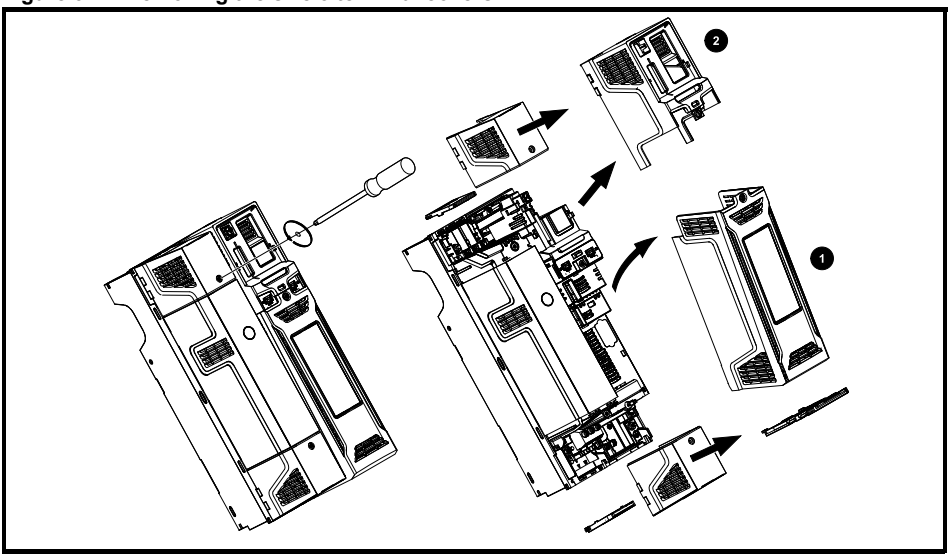


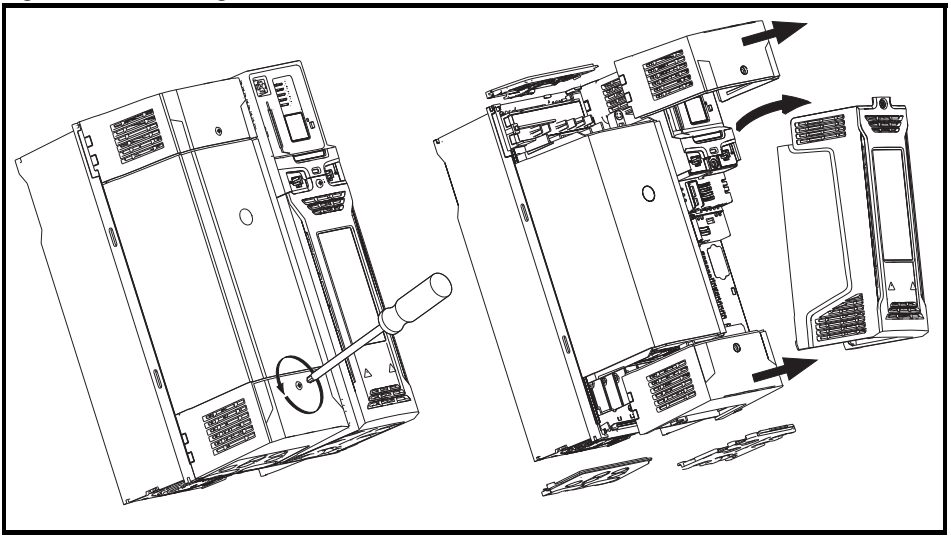
Figure 3-4 Removing the size 5 terminal covers



1. Control terminal cover
2. DC / Braking terminal cover right

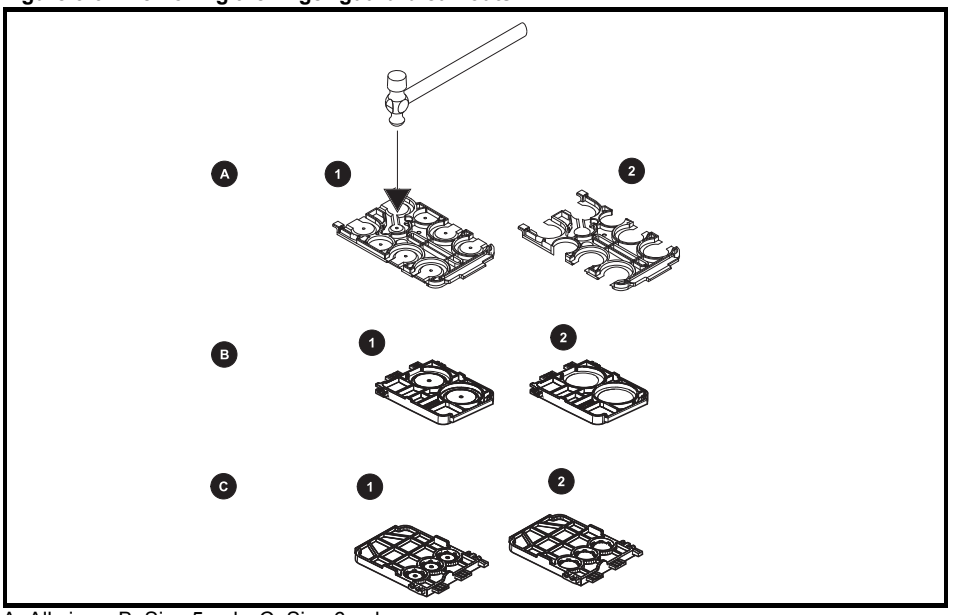
The Control terminal cover must be removed before removal of the DC / Braking terminal cover right. When replacing the terminal covers, the screws should be tightened to a maximum torque of 1 N m (0.7 lb ft).

Figure 3-5 Removing the size 6 terminal covers



3.3.2 Removing the finger-guard and DC terminal cover break-outs

Figure 3-6 Removing the finger-guard break-outs



A: All sizes. B: Size 5 only. C: Size 6 only.

Place finger-guard on a flat solid surface and hit relevant break-outs with hammer as shown (1). Continue until all required break-outs are removed (2). Remove any flash / sharp edges once the break-outs are removed.

3.4 Dimensions and mounting methods

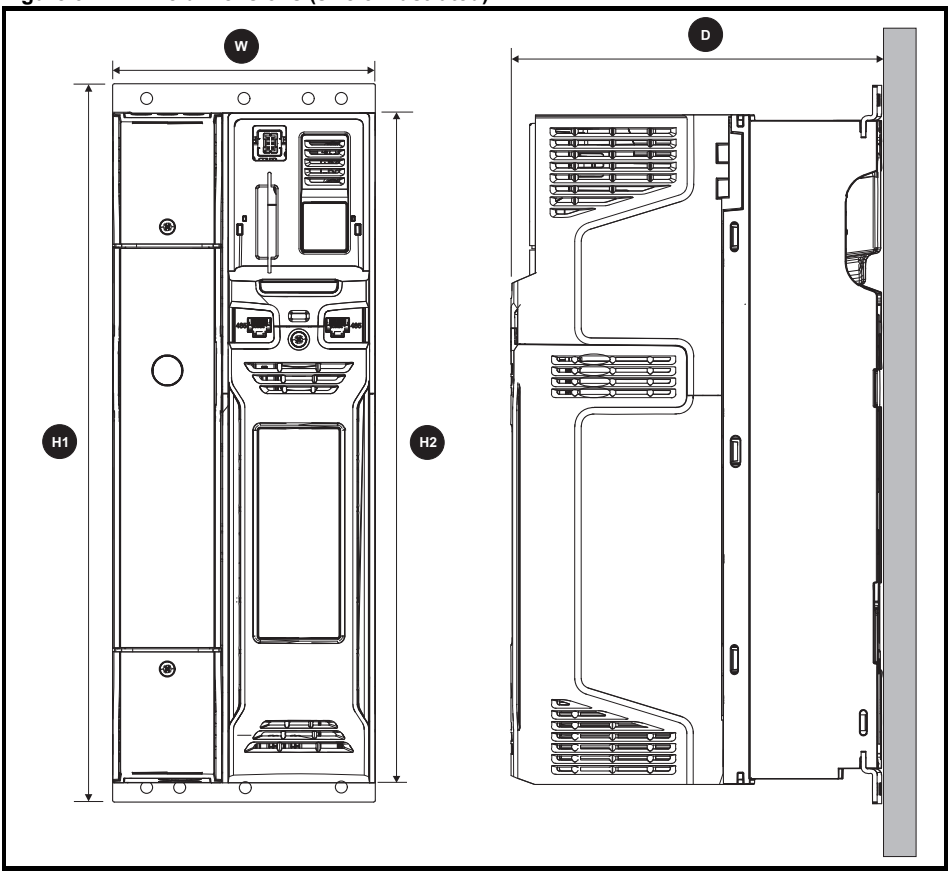
Drive sizes 5 to 6 can be either surface or through-panel mounted. Size 5 can in addition be tile mounted using the appropriate brackets.

WARNING

If the drive has been used at high load levels for a period of time, the heatsink can reach temperatures in excess of 70 °C (158 °F). Human contact with the heatsink should be prevented.

3.4.1 Drive dimensions

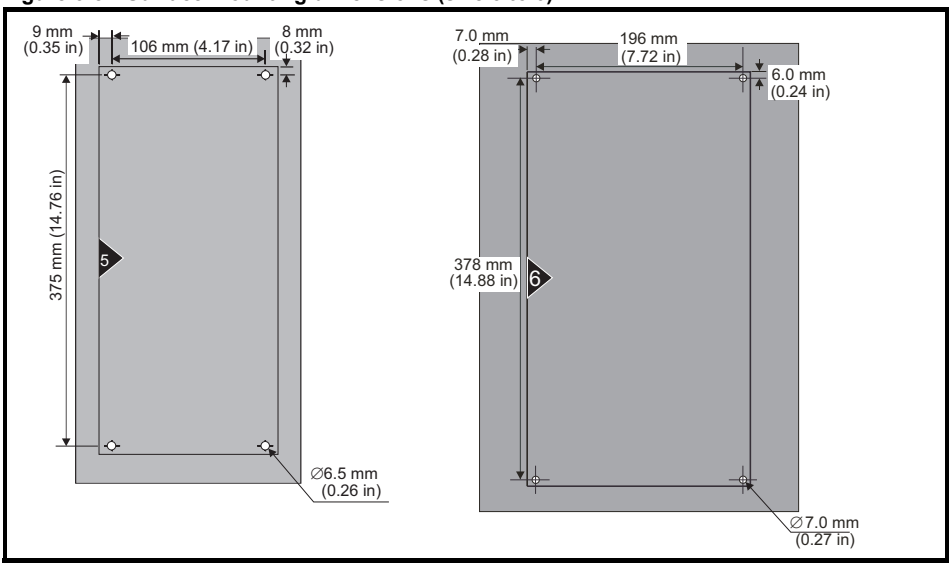
Figure 3-7 Drive dimensions (size 5 illustrated)



Size	H1		H2		W		D	
	mm	in	mm	in	mm	in	mm	in
5	391	15.39	365	14.37	143	5.63	200	7.87
6					210	8.27	227	8.94

3.4.2 Surface mounting

Figure 3-8 Surface mounting dimensions (size 5 to 6)



NOTE The outer holes in the mounting braket are to be used for surface mounting see Table 3-1 for further information.

3.4.3 Through-panel mounting

The drive can be through panel mounted using appropriate brackets.

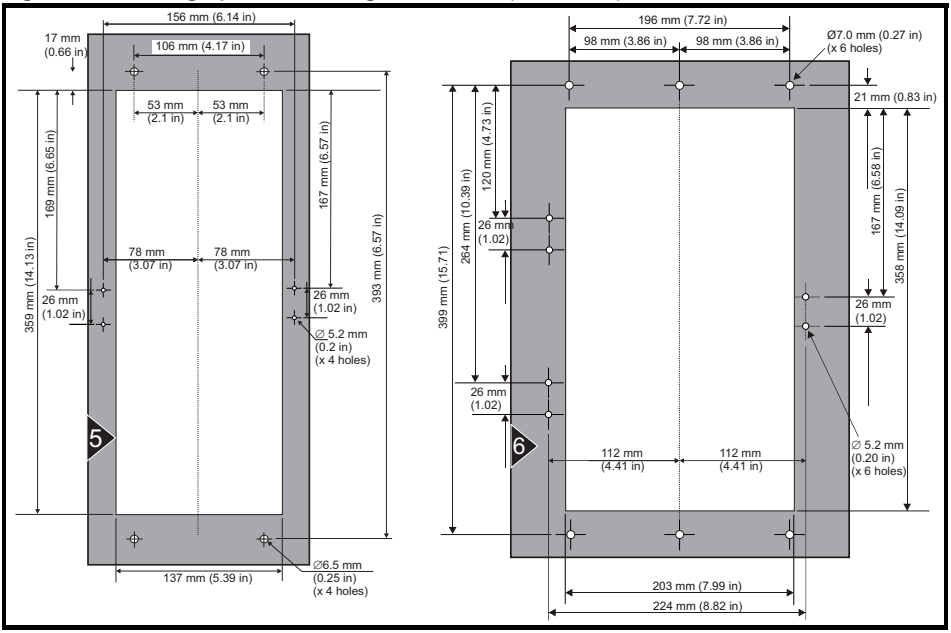
The through panel mounting kit is not supplied with the drive and can be purchased separately, below are the relevant part numbers:

Size	CT part number
5	3470-0067
6	3470-0055

WARNING

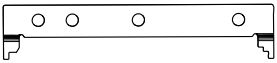
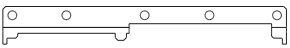
If the drive has been used at high load levels for a period of time, the heatsink can reach temperatures in excess of 70 °C (158 °F). Human contact with the heatsink should be prevented.

Figure 3-9 Through-panel mounting dimensions (size 5 to 6)



3.4.4 Mounting brackets

Table 3-1 Mounting brackets

Frame size	Surface mounting kit (supplied with drive)	Qty	Through-panel mounting kit (option)	Qty
5	 Hole size: 6.5 mm (0.26 in)	x 2*	Hole size: 5.5 mm (0.22 in)	x 2
				x 1
6	 Hole size: 6.5 mm (0.26 in)	x 2*	Hole size: 5.2 mm (0.21 in)	x 3
				x 1

* Surface mounting brackets are also used when through panel mounting, see section 3.8 *Enclosing standard drive for high environmental protection* on page 37 for further details.

NOTE A retrofit kit is available for *Unidrive M/HS* size 5 and 6 that allows surface mounting of the drive in applications previously using Unidrive SP. The part number of the size 5 kit is 3470-0066. The part number of the size 6 kit is 3470-0074.

3.4.5 Tile mounting

Drive size 5 can be tile mounted where limited mounting space is available. The drive is mounted sideways with the side panel against the mounting surface. The tile mounting kit is not supplied with the drive, it can be purchased separately using the following part number:

Size	CT part number
5	3470-0073

3.5 Enclosure for standard drives

Figure 3-10 Recommended spacing between the drives

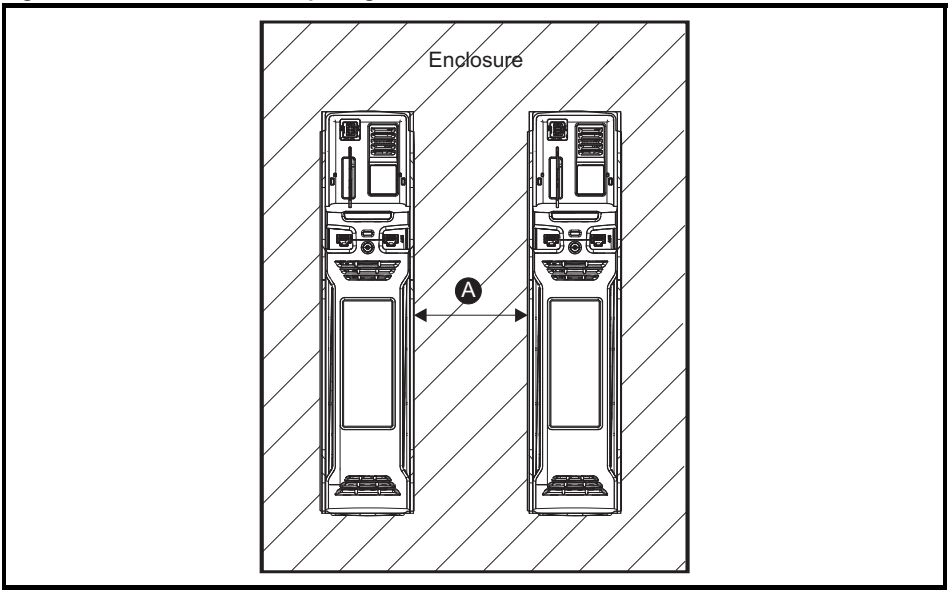


Table 3-2 Spacing required between the drives (without high IP bung)

Drive Size	Spacing (A)	
	40 °C	50 °C*
5	0 mm (0.00 in)	30 mm (1.18 in)
6	0 mm (0.00 in)	

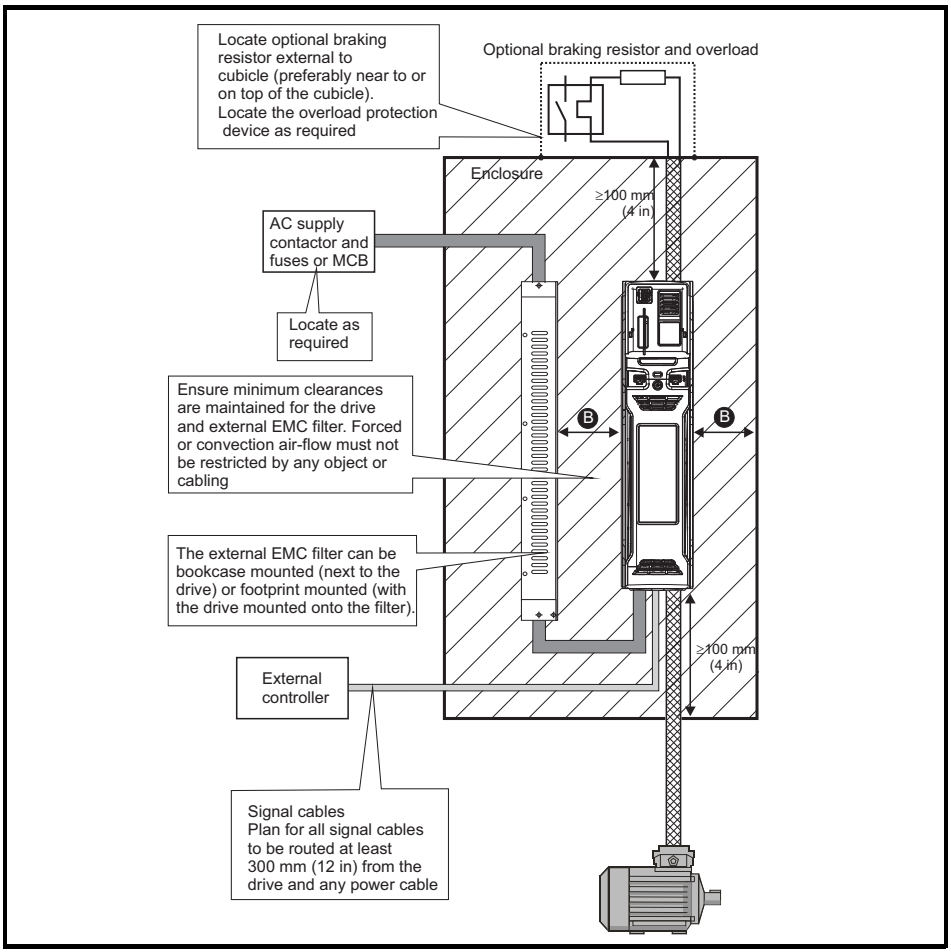
* 50 °C derating applies, refer to Table 5-6 *Maximum permissible continuous output current @ 50 °C (122 °F)* on page 86.

NOTE When through-panel mounted, ideally drives should be spaced 30 mm (1.18 in) to maximize panel stiffness.

3.5.1 Enclosure layout

Please observe the clearances in the diagram below taking into account any appropriate notes for other devices / auxiliary equipment when planning the installation.

Figure 3-11 Enclosure layout



NOTE For EMC compliance:

1. When using an external EMC filter, one filter is required for each drive.
2. Power cabling must be at least 100 mm (4 in) from the drive in all directions

Table 3-3 Spacing required between drive / enclosure and drive / EMC filter

Drive Size	Spacing (B)
5	30 mm (1.18 in)
6	

3.5.2 Enclosure sizing

1. Add the dissipation figures from section 5.1.3 *Power dissipation* on page 87 for each drive that is to be installed in the enclosure.
2. If an external EMC filter is to be used with each drive, add the dissipation figures from section 5.2.1 *EMC filter ratings* on page 105 for each external EMC filter that is to be installed in the enclosure.
3. If the braking resistor is to be mounted inside the enclosure, add the average power figures from for each braking resistor that is to be installed in the enclosure.
4. Calculate the total heat dissipation (in Watts) of any other equipment to be installed in the enclosure.
5. Add the heat dissipation figures obtained above. This gives a figure in Watts for the total heat that will be dissipated inside the enclosure.

Calculating the size of a sealed enclosure

The enclosure transfers internally generated heat into the surrounding air by natural convection (or external forced air flow); the greater the surface area of the enclosure walls, the better is the dissipation capability. Only the surfaces of the enclosure that are unobstructed (not in contact with a wall or floor) can dissipate heat.

Calculate the minimum required unobstructed surface area $\mathbf{A_e}$ for the enclosure from:

$$\mathbf{A_e} = \frac{\mathbf{P}}{\mathbf{k}(\mathbf{T_{int}} - \mathbf{T_{ext}})}$$

Where:

$\mathbf{A_e}$	Unobstructed surface area in m^2 (1 m^2 = 10.9 ft^2)
$\mathbf{T_{ext}}$	Maximum expected temperature in ^oC *outside* the enclosure
$\mathbf{T_{int}}$	Maximum permissible temperature in ^oC *inside* the enclosure
P	Power in Watts dissipated by *all* heat sources in the enclosure
k	Heat transmission coefficient of the enclosure material in $W/m^2/^oC$

Example

To calculate the size of an enclosure for the following:

- Two drives operating at the Normal Duty rating
- External EMC filter for each drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40 °C
- Maximum ambient temperature outside the enclosure: 30 °C

For example, if the power dissipation from each drive is 187 W and the power dissipation from each external EMC filter is 9.2 W.

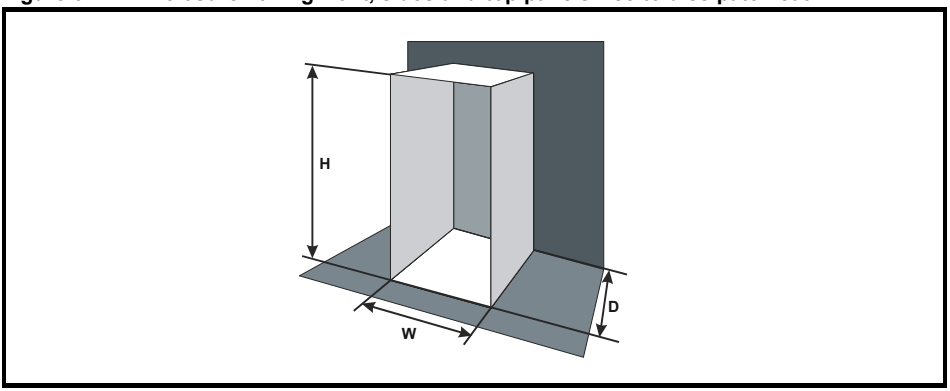
Total dissipation: 2 x (187 + 9.2) =392.4 W

NOTE Power dissipation for the drives and the external EMC filters can be obtained from Chapter 5 *Technical data* on page 82.

The enclosure is to be made from painted 2 mm (0.079 in) sheet steel having a heat transmission coefficient of 5.5 $W/m^2/^oC$. Only the top, front, and two sides of the enclosure are free to dissipate heat.

The value of 5.5 $W/m^2/^oC$ can generally be used with a sheet steel enclosure (exact values can be obtained by the supplier of the material). If in any doubt, allow for a greater margin in the temperature rise.

Figure 3-12 Enclosure having front, sides and top panels free to dissipate heat



Insert the following values:

T_{int}	40 °C
T_{ext}	30 °C
k	5.5
P	392.4 W

The minimum required heat conducting area is then:

$$A_e = \frac{392.4}{5.5(40-30)}$$

= 7.135 m² (77.8 ft²) (1 m^2 = 10.9 ft^2)

Estimate two of the enclosure dimensions - the height (H) and depth (D), for instance. Calculate the width (W) from:

$$W = \frac{A_e - 2HD}{H + D}$$

Inserting **H** = 2 m and **D** = 0.6 m, obtain the minimum width:

$$W = \frac{7.135 - (2 \times 2 \times 0.6)}{2 + 0.6}$$

=1.821 m (71.7 in)

If the enclosure is too large for the space available, it can be made smaller only by attending to one or all of the following:

- Using a lower PWM switching frequency to reduce the dissipation in the drives
- Reducing the ambient temperature outside the enclosure, and/or applying forced-air cooling to the outside of the enclosure
- Reducing the number of drives in the enclosure
- Removing other heat-generating equipment

Calculating the air-flow in a ventilated enclosure

The dimensions of the enclosure are required only for accommodating the equipment. The equipment is cooled by the forced air flow.

Calculate the minimum required volume of ventilating air from:

$$V = \frac{3kP}{T_{int} - T_{ext}}$$

Where:

V Air-flow in m^3 per hour (1 m^3/hr = 0.59 ft^3/min)

T_{ext} Maximum expected temperature in °C *outside* the enclosure

T_{int} Maximum permissible temperature in °C *inside* the enclosure

P Power in Watts dissipated by *all* heat sources in the enclosure

k Ratio of $\frac{P_o}{P_l}$

Where:

P_0 is the air pressure at sea level

P_l is the air pressure at the installation

Typically use a factor of 1.2 to 1.3, to allow also for pressure-drops in dirty air-filters.

Example

To calculate the size of an enclosure for the following:

- Three drives operating at the Normal Duty rating
- External EMC filter for each drive
- Braking resistors are to be mounted outside the enclosure
- Maximum ambient temperature inside the enclosure: 40 °C
- Maximum ambient temperature outside the enclosure: 30 °C

For example, dissipation of each drive: 101 W and dissipation of each external EMC filter: 6.9 W (max).

Total dissipation: 3 x (101 + 6.9) = 323.7 W

Insert the following values:

T_{int} 40 °C

T_{ext} 30 °C

k 1.3

P 323.7 W

Then:

$$\mathbf{V} = \frac{\mathbf{3 \times 1.3 \times 323.7}}{\mathbf{40 - 30}}$$

= 126.2 m^3/hr (74.5 ft^3 /min) (1 m^3/ hr = 0.59 ft^3/min)

3.6 Enclosure design and drive ambient temperature

Drive derating is required for operation in high ambient temperatures

Totally enclosing or through panel mounting the drive in either a sealed cabinet (no airflow) or in a well ventilated cabinet makes a significant difference on drive cooling.

The chosen method affects the ambient temperature value (T_{rate}) which should be used for any necessary derating to ensure sufficient cooling for the whole of the drive.

The ambient temperature for the four different combinations is defined below:

1. Totally enclosed with no air flow (<2 m/s) over the drive
   $T_{rate} = T_{int} + 5$ °C
2. Totally enclosed with air flow (>2 m/s) over the drive
   $T_{rate} = T_{int}$
3. Through panel mounted with no airflow (<2 m/s) over the drive
   T_{rate} = the greater of T_{ext} +5 °C, or T_{int}
4. Through panel mounted with air flow (>2 m/s) over the drive
   T_{rate} = the greater of T_{ext} or T_{int}

Where:

T_{ext} = Temperature outside the cabinet

T_{int} = Temperature inside the cabinet

T_{rate} = Temperature used to select current rating from tables in Chapter 5 *Technical data* on page 82.

3.7 Heatsink fan operation

The drive is ventilated by an internal heatsink mounted fan. The fan housing forms a baffle plate, channelling the air through the heatsink chamber. Thus, regardless of mounting method (surface mounting or through-panel mounting), the installing of additional baffle plates is not required.

Ensure the minimum clearances around the drive are maintained to allow air to flow freely.

The heatsink fan on all sizes is a variable speed fan. The drive controls the speed at which the fan runs based on the temperature of the heatsink and the drive's thermal model system. The maximum speed at which the fan operates can be limited in Pr **06.045**. This could incur an output current derating. Refer to section 3.13.1 *Fan removal procedure* on page 46 for information on fan removal.

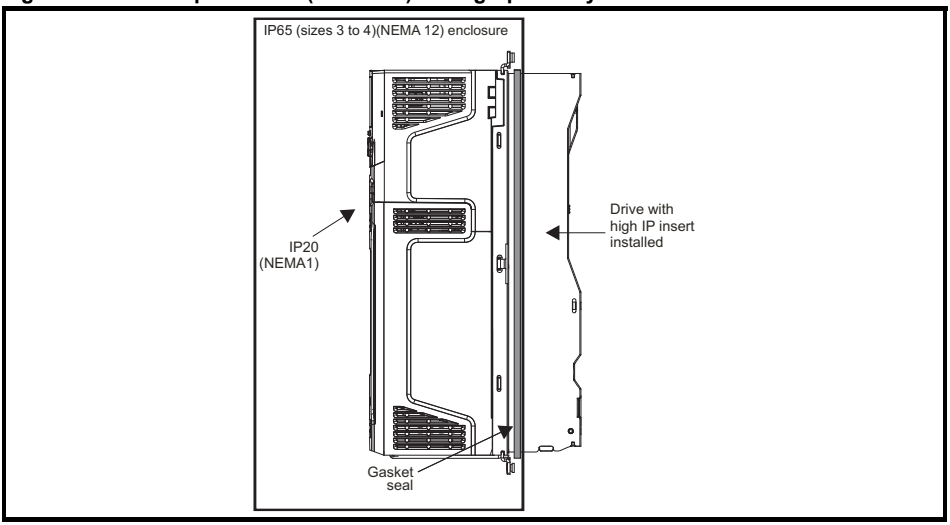
3.8 Enclosing standard drive for high environmental protection

An explanation of environmental protection rating is provided in section 5.1.10 *IP / UL Rating* on page 92.

The standard drive is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP65 rating (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required). Refer to Chapter 5 *Technical data* on page 82.

This allows the front of the drive, along with various switchgear, to be housed in a high IP enclosure with the heatsink protruding through the panel to the external environment. Thus, the majority of the heat generated by the drive is dissipated outside the enclosure maintaining a reduced temperature inside the enclosure. This also relies on a good seal being made between the heatsink and the rear of the enclosure using the gaskets provided.

Figure 3-13 Example of IP65 (NEMA 12) through-panel layout

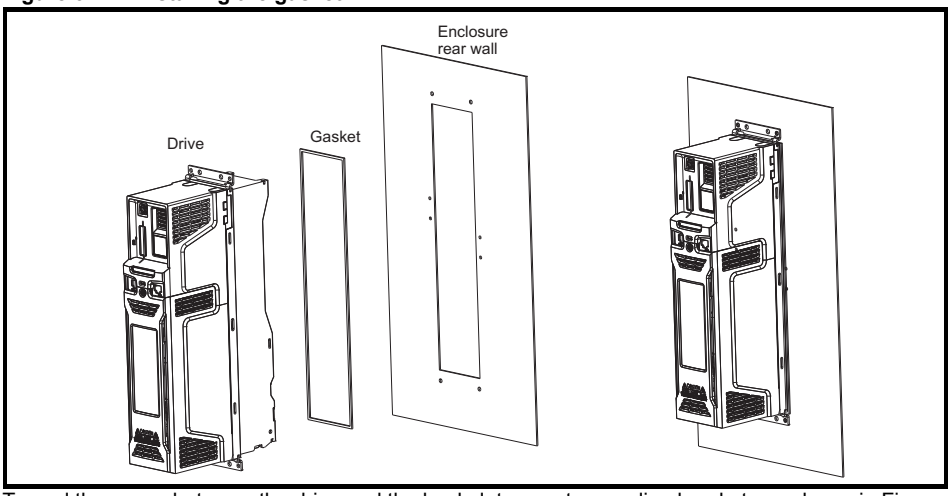


The main gasket should be installed as shown in Figure 3-14.

On drive size 5 in order to achieve the high IP rating at the rear of the heatsink it is necessary to seal a heatsink vent by installing the high IP insert as shown in Figure 3-16 on page 39.

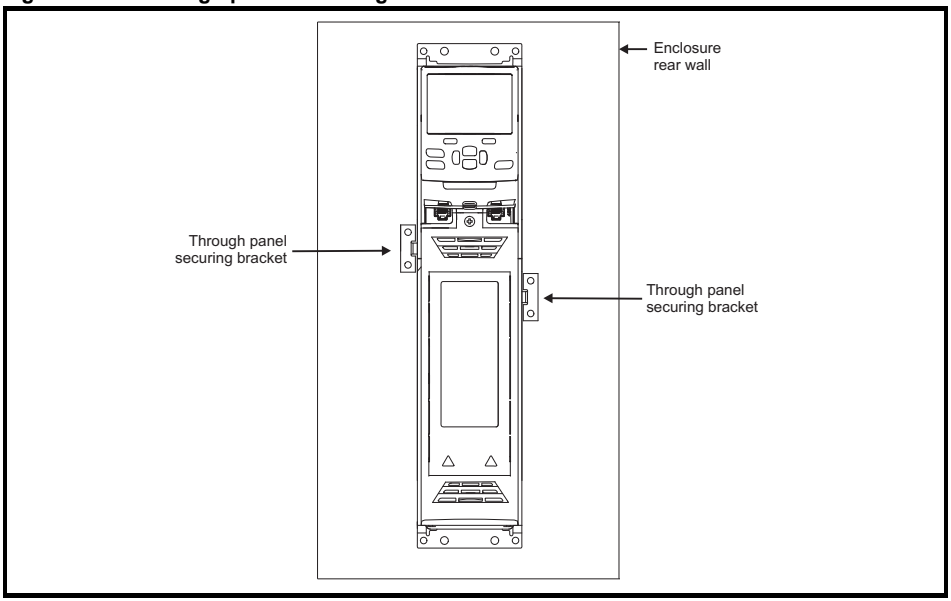
NOTE The heatsink fans have conformal coated PCBs and have sealant at cable entry points. This means that the electronics of the fan are rated to IP54. Dripping, splashing or sprayed water can impede the operation of the fan, therefore if the environment is such that the fan may be subjected to more than occasional dripping or sprayed water while operational, then suitable drip protection covers should be employed

Figure 3-14 Installing the gasket



To seal the space between the drive and the backplate, use two sealing brackets as shown in Figure 3-15.

Figure 3-15 Through panel mounting

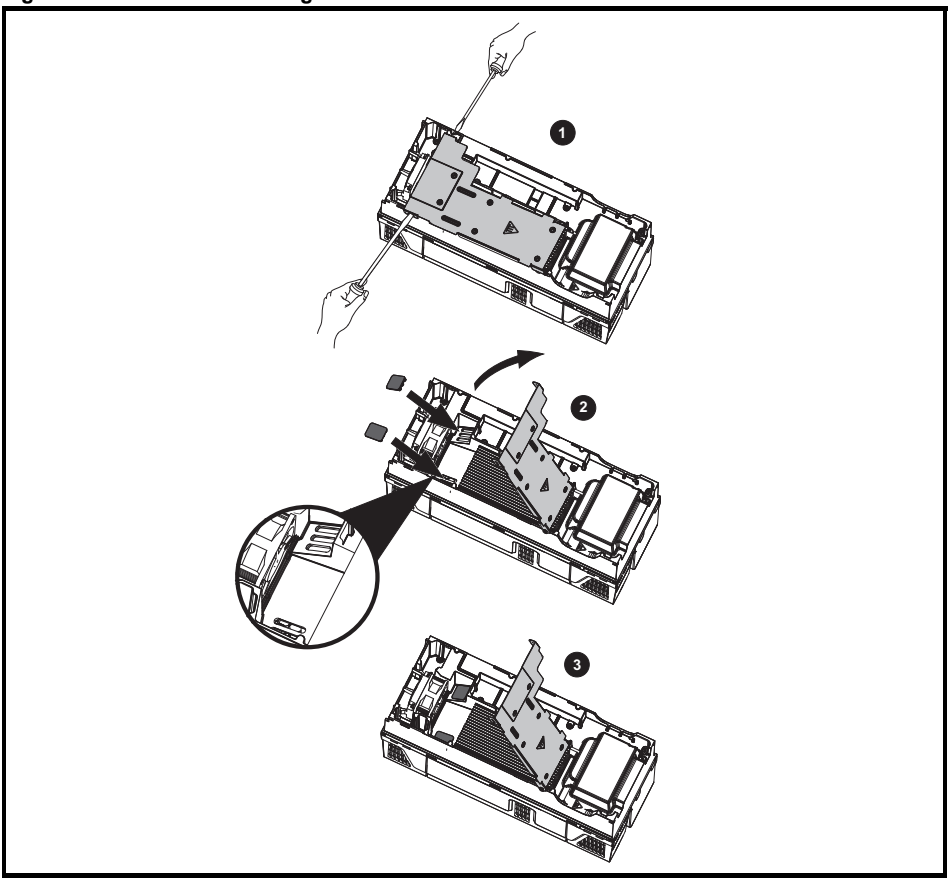


3.9 Installation of high IP insert for size 5

The standard drive is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP65 rating (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required).

On drive size 5, in order to achieve the high IP rating at the rear of the heatsink it is necessary to seal a heatsink vent by installing the high IP insert as shown in Figure 3-16.

Figure 3-16 Installation of high IP insert for size 5



1. To install the high IP insert, firstly place a flat head screwdriver into the slots highlighted (1).
2. Pull the hinged baffle up to expose the ventilation holes, install the high IP inserts into the ventilation holes in the heatsink (2).
3. Ensure the high IP inserts are securely installed by firmly pressing them into place (3).
4. Close the hinged baffle as shown (1).

To remove the high IP insert, reverse the above instructions.

The guidelines in Table 3-4 should be followed.

Table 3-4 Environment considerations

Environment	High IP insert	Comments
Clean	Not installed	
Dry, dusty (non-conductive)	Installed	Regular cleaning recommended
Dry, dusty (conductive)	Installed	
IP65 compliance	Installed	

NOTE A current derating must be applied to the size 5 drive if the high IP insert is installed. Derating information is provided in Table 5-5 *Maximum permissible continuous output current @ 40 °C (104 °F) ambient with high IP insert installed* on page 85. Failure to do so may result in nuisance tripping.

NOTE When designing an IP65 (NEMA 12) enclosure (Figure 3-13 *Example of IP65 (NEMA 12) through-panel layout* on page 37), consideration should be made to the dissipation from the front of the drive.

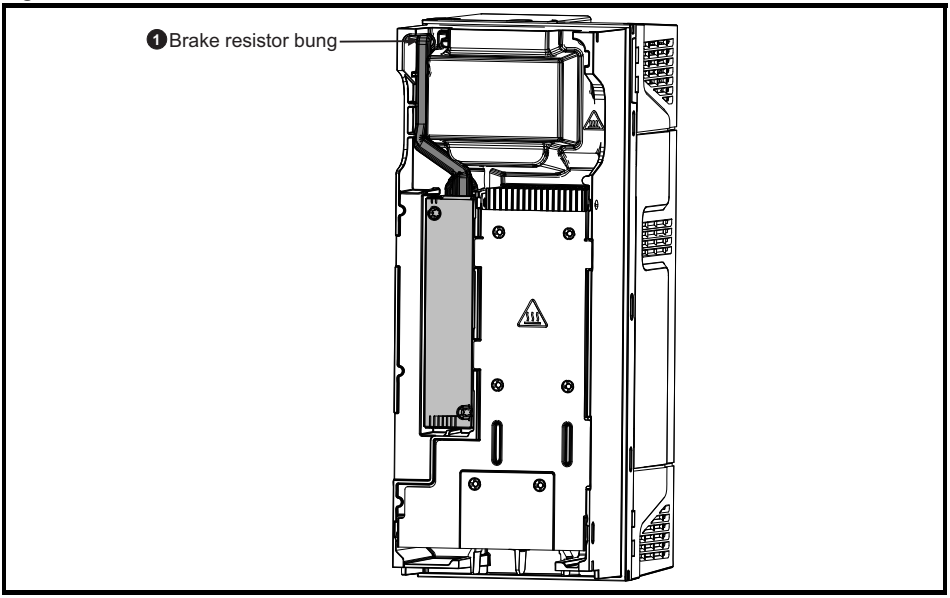
Table 3-5 Power losses from the front of the drive when through-panel mounted

Frame size	Power loss
5	≤ 100 W
6	≤ 100 W

3.10 Internal braking resistor

Size 5 has been designed with an optional space-saving heatsink mounted resistor. The resistor can be installed within the heatsink fins of the drive. When the heatsink resistor is used, an external thermal protection device is not required as the resistor is designed such that it will fail safely under any fault conditions. The in-built software overload protection is set-up at default to protect the resistor. The resistor is rated to IP54 (NEMA 12).

Figure 3-17 Brake resistor installation on size 5

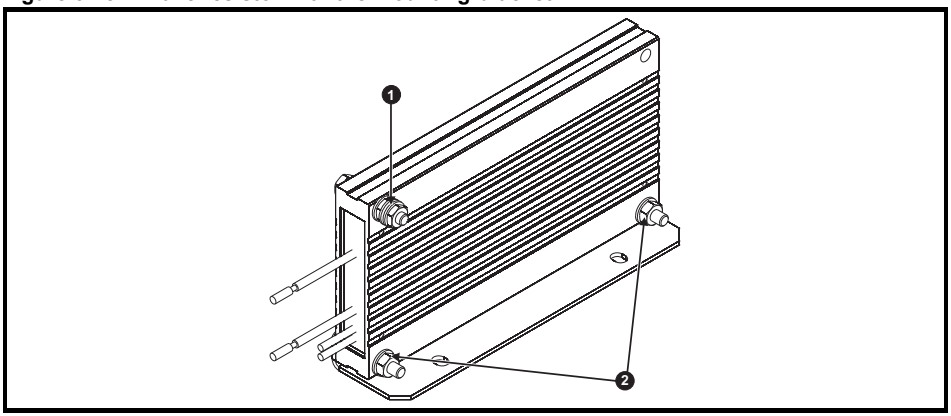


- Remove the terminal covers.
- Remove the brake resistor bung (1) from the hole in the chassis, the closed end of the bung will need to be pierced so that the cable has access to be routed through.
- Feed brake resistor bung onto outer insulation of brake resistor cable. The wider end of the bung should be inserted first. The Narrow end should align with end of insulation.
- Install the braking resistor to the heatsink using the captive screws. The screws should be tightened to a maximum torque of 2 N m (1.5 lb ft).
- Route the cables through the provided hole at the rear of the heatsink as shown in Figure 3-17 and take the cable out from the front side of the drive. Ensure the cables are routed between the fins of the heatsink, and the cables are not trapped between the heatsink fins and the resistor.
- Crimp the cable ends and make appropriate connections. The brake terminals must be tightened to a maximum torque of 2 N m (1.5 lb ft).
- Replace the terminal covers on the drive, tighten to a maximum torque of 1 N m (0.7 lb ft).

3.10.1 External brake resistor

External brake resistors are available for drive sizes 5 to 6. They can be mounted in the enclosure as per mounting recommendation in Figure 3-11 *Enclosure layout* on page 32 using mounting brackets part number 6541-0187. Figure 3-18 shows the brake resistor mounted on the mounting bracket. Two M4 screws and nuts (2) can be used to fix the brake resistor to the mounting bracket. One M4 nut with washer (1) is provided to use for the ground connection. The brake resistor is equipped with a thermal switch, the thermal switch should be integrated in the control circuit by the user.

Figure 3-18 Brake resistor with the mounting bracket



1. Ground connection (1 x M4 nut and washer).
2. Attaching the brake resistor to the mounting bracket (using 2 x M4 screws and nuts).

Figure 3-19 Mounting bracket dimensions

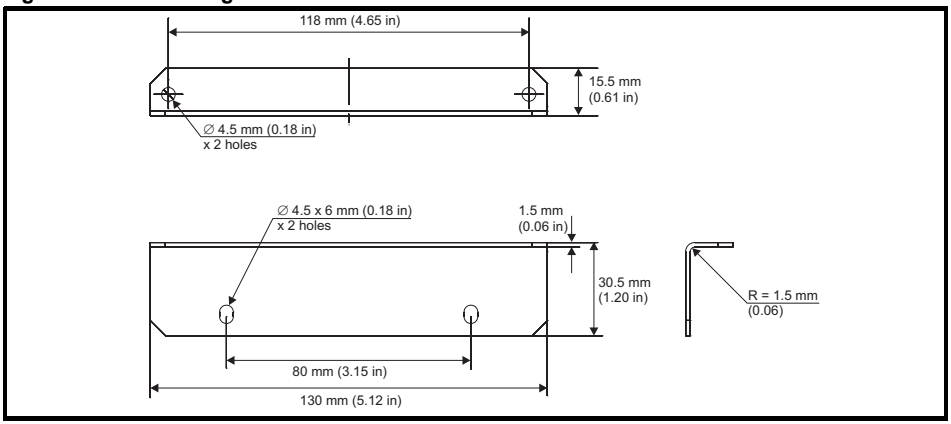
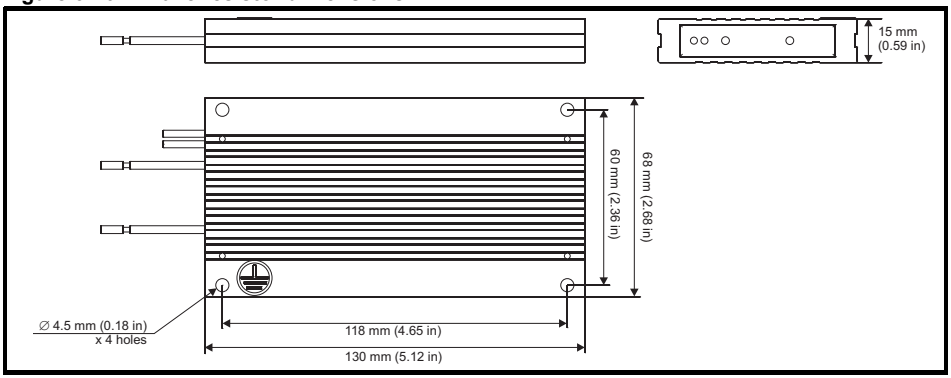


Figure 3-20 Brake resistor dimensions



3.11 External EMC filter

The external EMC filters for sizes 5 to 6 can be footprint or bookcase mounted as shown below.

Figure 3-21 Footprint mounting the EMC filter

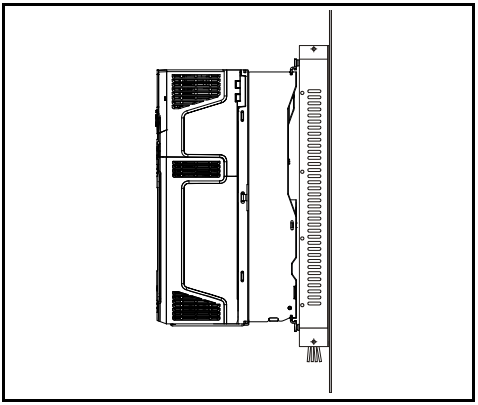
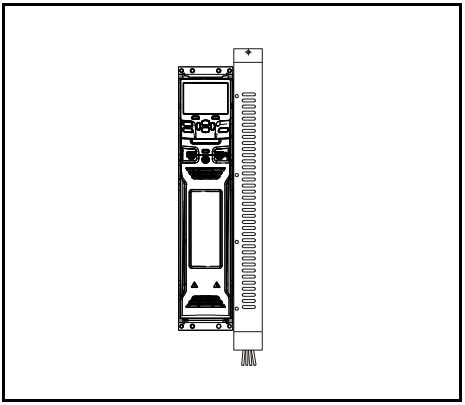


Figure 3-22 Bookcase mounting the EMC filter



3.11.1 Optional external EMC filters

Table 3-6 EMC filter cross reference

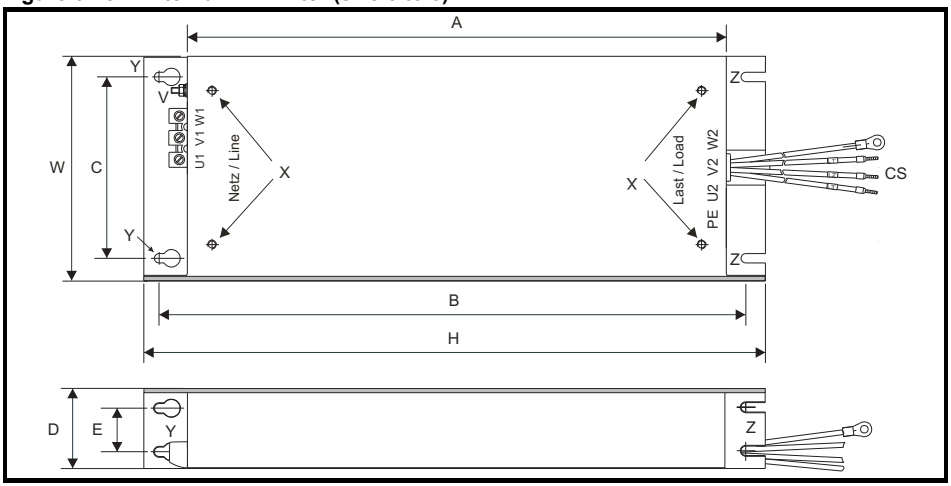
Model	CT part number
200 V	
05200250	4200-0312
06200330 to 06200440	4200-2300
400 V	
05400270 to 05400300	4200-0402
06400350 to 06400470	4200-4800
575 V	
05500030 to 05500069	4200-0122
06500100 to 06500350	4200-3690

3.11.2 EMC filter ratings

Table 3-7 Optional external EMC filter details

CT part number	Maximum continuous current		Voltage rating		IP rating	Power dissipation at rated current		Ground leakage		Discharge resistors
	@ 40 °C (104 °F)	@ 50 °C (122 °F)	IEC	UL		@ 40 °C (104 °F)	@ 50 °C (122 °F)	Balanced supply phase-to-phase and phase-to-ground	Worst case	
	A	A	V	V		W	W	mA	mA	MΩ
4200-0312	31	28.5	250	300	20	20	17	2.0	80	1.68
4200-2300	55	51	250	300		41	35	4.2	69	
4200-0402	40	36.8	528	600		47	40	18.7	197	
4200-4800	63	58	528	600		54	46	11.2	183	
4200-0122	12	11	760	600		9	9	15.2	285	
4200-3690	42	39	760	600		45	39	12	234	

Figure 3-23 External EMC filter (size 5 to 6)



V: Ground stud

X: Threaded holes for footprint mounting of the drive

Y: Footprint mounting hole diameter

Z: Bookcase mounting slot diameter. CS: Cable size

Table 3-8 Size 5 external EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V/X	Y/Z	CS
4200-0312	395 mm (15.55 in)	425 mm (16.73 in)	106 mm (4.17 in)	60 mm (2.36 in)	33 mm (1.30 in)	437 mm (17.2 in)	143 mm (5.63 in)	M6	6.5 mm (0.26 in)	10 mm^2 (8 AWG)
4200-0402										
4200-0122										2.5 mm^2 (14 AWG)

Table 3-9 Size 6 external EMC filter dimensions

CT part number	A	B	C	D	E	H	W	V/X	Y/Z	CS
4200-2300	392 mm (15.43 in)	420 mm (16.54 in)	180 mm (7.09 in)	60 mm (2.36 in)	33 mm (1.30 in)	434 mm (17.09 in)	210 mm (8.27 in)	M6	6.5 mm (0.26 in)	16 mm^2 (6 AWG)
4200-4800										
4200-3690										

3.11.3 EMC filter torque settings

Table 3-10 Optional external EMC Filter terminal data

CT part number	Power connections		Ground connections	
	Max cable size	Max torque	Ground stud size	Max torque
4200-0122	6 mm^2 (8 AWG)	1.8 N m (1.4 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-0312	6 mm^2 (8 AWG)	1.8 N m (1.4 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-0402	6 mm^2 (8 AWG)	1.8 N m (1.4 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-2300	16 mm^2 (6 AWG)	2.3 N m (1.70 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-4800	16 mm^2 (6 AWG)	2.3 N m (1.70 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-3690	16 mm^2 (6 AWG)	2.3 N m (1.70 lb ft)	M6	5.0 N m (3.7 lb ft)

Table 3-11 Fastener details for drive footprint mounting on external EMC filter

Type	Size 5 and 6
Screw specification	Property class 8.8. standard metric, coarse thread
Thread size	M6
Length (mm)	12
Washer	Helical spring, split spring or conical spring
Torque (N m)	10.0

3.12 Terminal size and torque settings

Table 3-12 Drive control and relay terminal data

Model	Connection type	Torque setting
All	Plug-in terminal block	0.5 N m (0.4 lb ft)

Table 3-13 Drive power terminal data

Frame size	AC and motor terminals		DC and braking		Ground terminal	
	Recommended	Maximum	Recommended	Maximum	Recommended	Maximum
5	Plug-in terminal block		T20 Torx (M4) / M4 Nut (7 mm AF)		M5 Nut (8 mm AF)	
	1.5 N m (1.1 lb ft)	1.8 N m (1.3 lb ft)	1.5 N m (1.1 lb ft)	2.5 N m (1.8 lb ft)	2.0 N m (1.4 lb ft)	5.0 N m (3.7 lb ft)
6	M6 Nut (10 mm AF)					
	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)

3.13 Routine maintenance

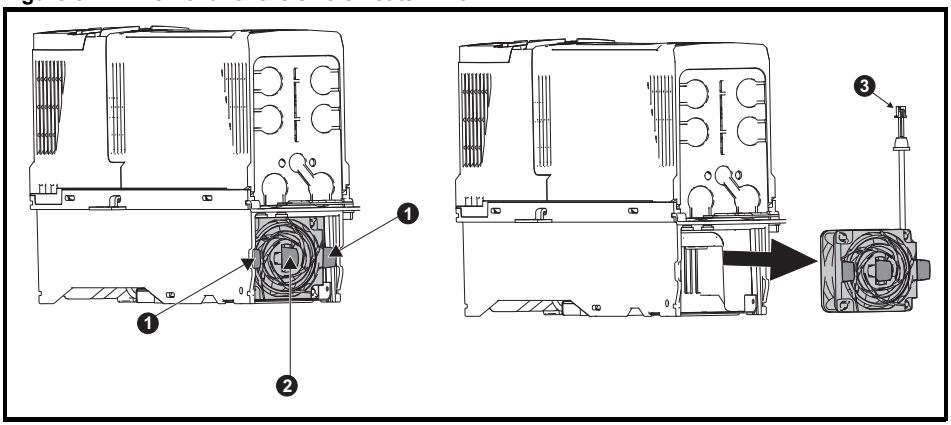
The drive should be installed in a cool, clean, well ventilated location. Contact of moisture and dust with the drive should be prevented.

Regular checks of the following should be carried out to ensure drive / installation reliability are maximized:

Environment	
Ambient temperature	Ensure the enclosure temperature remains at or below maximum specified
Dust	Ensure the drive remains dust free – check that the heatsink and drive fan are not gathering dust. The lifetime of the fan is reduced in dusty environments.
Moisture	Ensure the drive enclosure shows no signs of condensation
Enclosure	
Enclosure door filters	Ensure filters are not blocked and that air is free to flow
Electrical	
Screw connections	Ensure all screw terminals remain tight
Crimp terminals	Ensure all crimp terminals remains tight – check for any discoloration which could indicate overheating
Cables	Check all cables for signs of damage

3.13.1 Fan removal procedure

Figure 3-24 Removal of the size 5 heatsink fan

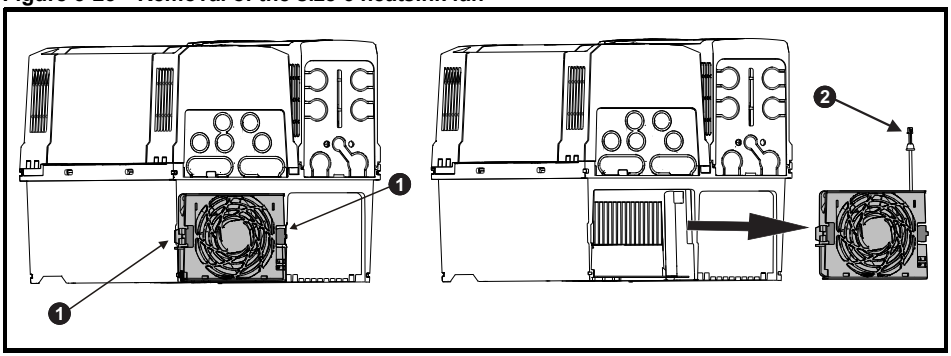


Ensure the fan cable is disconnected from the drive prior to attempting fan removal.

- Press the two tabs inwards (1) to release the fan from the drive frame.
- Using the central fan tab (2), withdraw the fan assembly from the drive housing.
- Depress and hold the locking release on the fan cable lead (3).
- With the locking release depressed, take hold of the fan supply cable and carefully pull to separate the connectors.

Replace the fan by reversing the above instructions.

Figure 3-25 Removal of the size 6 heatsink fan

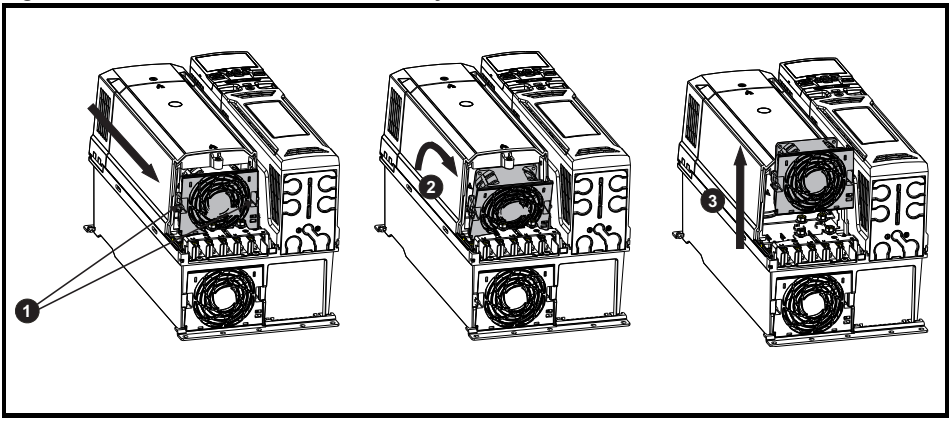


- Press the tabs (1) inwards to release the fan assembly from the underside of the drive.
- Use the tabs (1) to withdraw the fan by pulling it away from the drive.
- Depress and hold the locking release on the fan cable lead (2).
- With the locking release depressed, take hold of the fan supply cable and carefully pull to separate the connectors.

Replace the fan by reversing the above instructions.

NOTE If the drive is surface mounted using the outer holes on the mounting bracket, then the heatsink fan can be replaced without removing the drive from the backplate.

Figure 3-26 Removal of the size 6 auxiliary fan



- Press the tabs (1) inwards to release the fan assembly from the drive mid cover.
- Use the tabs (1) to withdraw the fan from the drive by pulling the fan assembly forward and tilting it at a slight angle (2).
- Pull the fan assembly up and away from the drive (3).
- Depress and hold the locking release on the fan cable lead.
- With the locking release depressed, take hold of the fan supply cable and carefully pull to separate the connectors.

Replace the fan by reversing the above instructions.

Figure 3-27 Fan part numbers

Model	Heatsink fan part number	Auxiliary fan part number
Size 5	3251-0245	N/A
Size 6	3251-0030	3251-0030

4 Electrical installation

Electric shock risk
The voltages present in the following locations can cause severe electric shock and may be lethal:
AC supply cables and connections
DC and brake cables, and connections
Output cables and connections
Many internal parts of the drive, and external option units
Unless otherwise indicated, control terminals are single insulated and must not be touched.

Isolation device
The AC and / or DC power supply must be disconnected from the drive using an approved isolation device before any cover is removed from the drive or before any servicing work is performed.

STOP function
The STOP function does not remove dangerous voltages from the drive, the motor or any external option units.

Safe Torque Off function
The Safe Torque Off function does not remove dangerous voltages from the drive, the motor or any external option units.

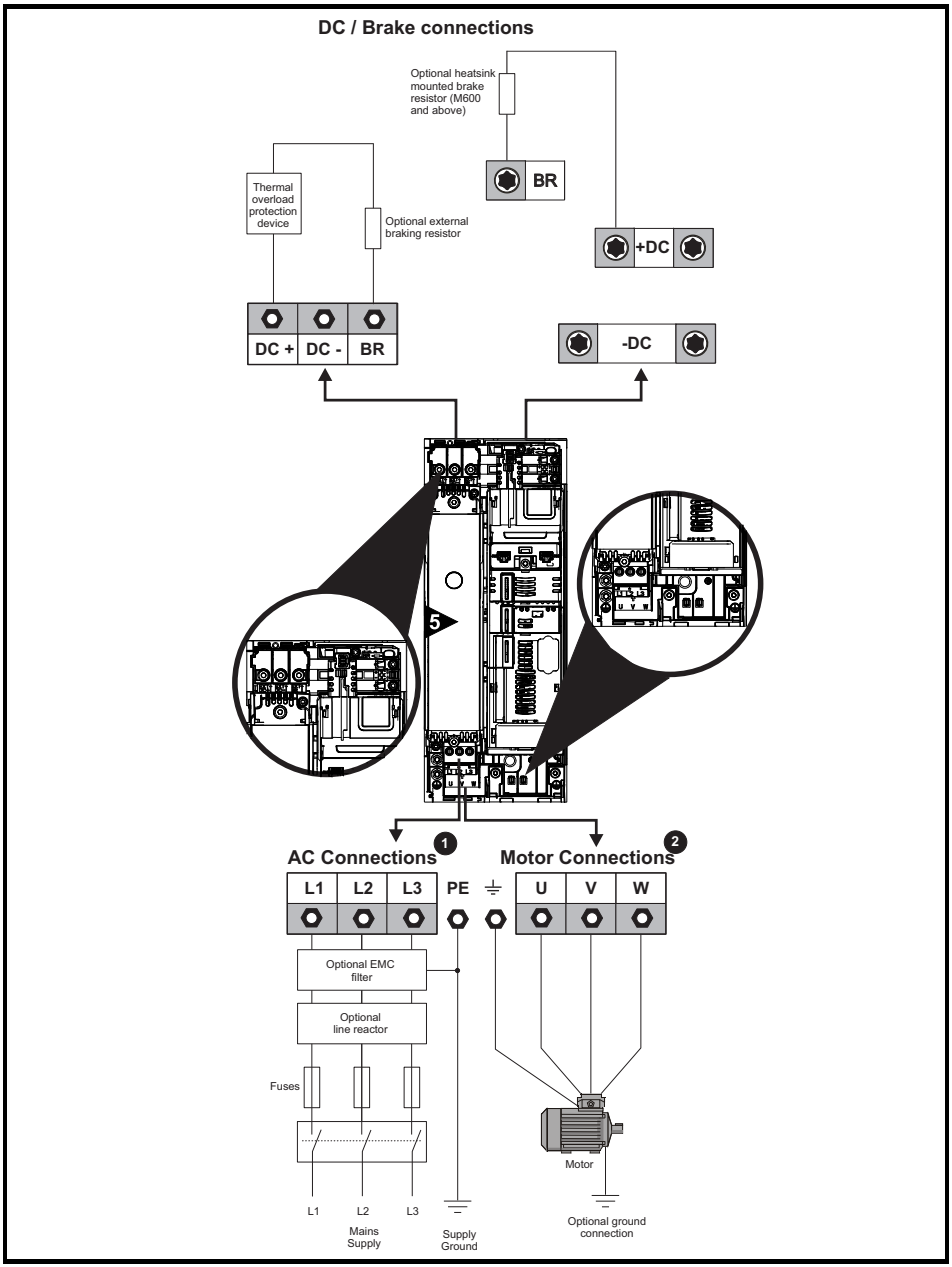
Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the AC and / or DC power supply has been disconnected. If the drive has been energized, the AC and / or DC power supply must be isolated at least ten minutes before work may continue. Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge, or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, consult Nidec Industrial Automation or their authorized distributor.

Equipment supplied by plug and socket
Special attention must be given if the drive is installed in equipment which is connected to the AC supply by a plug and socket. The AC supply terminals of the drive are connected to the internal capacitors through rectifier diodes which are not intended to give safety isolation. If the plug terminals can be touched when the plug is disconnected from the socket, a means of automatically isolating the plug from the drive must be used (e.g. a latching relay).

Permanent magnet motors
Permanent magnet motors generate electrical power if they are rotated, even when the supply to the drive is disconnected. If that happens then the drive will become energized through its motor terminals. If the motor load is capable of rotating the motor when the supply is disconnected, then the motor must be isolated from the drive before gaining access to any live parts.

4.1 Power and ground connections

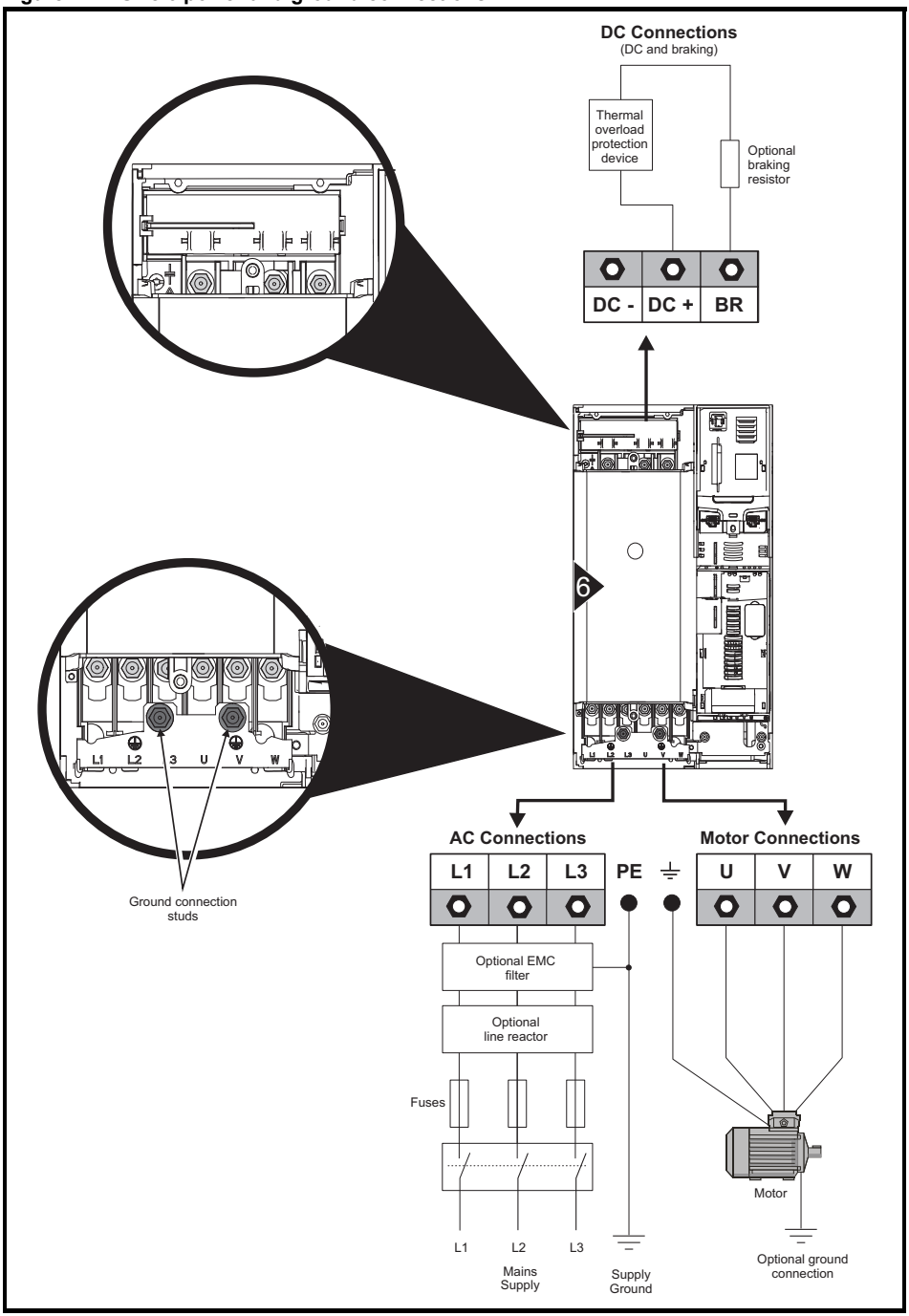
Figure 4-1 Size 5 power and ground connections



The upper terminal block (1) is used for AC supply connection.

The lower terminal block (2) is used for Motor connection.

Figure 4-2 Size 6 power and ground connections



4.1.1 Ground connections

Electrochemical corrosion of grounding terminals
Ensure that grounding terminals are protected against corrosion i.e. as could be caused by condensation.

The drive must be connected to the system ground of the AC supply. The ground wiring must conform to local regulations and codes of practice.

NOTE For further information on ground cable sizes, refer to Table 2-4 *Protective ground cable ratings* on page 18.

On size 5, the supply and motor ground connections are made using the M5 studs located near the plug-in power connector. Refer to Figure 4-1.
On a size 6, the supply and motor ground connections are made using the M6 studs located above the supply and motor terminals. Refer to Figure 4-2.

The ground loop impedance must conform to the requirements of local safety regulations.
The drive must be grounded by a connection capable of carrying the prospective fault current until the protective device (fuse, etc.) disconnects the AC supply.
The ground connections must be inspected and tested at appropriate intervals.

4.2 AC supply requirements

AC supply voltage:
200 V drive: 200 V to 240 V ±10 %
400 V drive: 380 V to 480 V ±10 %
575 V drive: 500 V to 575 V ±10 %

Number of phases: 3

Maximum supply imbalance: 2 % negative phase sequence (equivalent to 3 % voltage imbalance between phases).

Frequency range: 45 to 66 Hz

For UL compliance only, the maximum supply symmetrical fault current must be limited to 100 kA

Table 4-1 Supply fault current used to calculate maximum input currents

Model	Symmetrical fault level (kA)
All	100

4.2.1 Supply types

All drives are suitable for use on any supply type i.e TN-S, TN-C-S, TT and IT.

Supplies for size 6 drives with voltage up to 600 V may have grounding at any potential, i.e. neutral, centre or corner (“grounded delta”). Supplies for size 5 drives (internal EMC filter fitted) with voltage up to 480 V may have grounding at any potential, i.e. neutral, centre or corner (“grounded delta”).

Supplies with voltage above 600 V may not have corner grounding

Drives are suitable for use on supplies of installation category III and lower, according to IEC 60664-1, this means they may be connected permanently to the supply at its origin in a building, but for outdoor installation additional over-voltage suppression (transient voltage surge suppression) must be provided to reduce category IV to category III.

A ground fault in the supply has no effect in any case. If the motor must continue to run with a ground fault in its own circuit then an input isolating transformer must be provided and if an EMC filter is required it must be located in the primary circuit.

Unusual hazards can occur on ungrounded supplies with more than one source, for example on ships. Contact the supplier of the drive for more information.

If an SI-Applications Plus module is installed in the drive, then the drive must not be used on a corner-grounded or centre-grounded delta supply if the supply voltage is above 300 V. If this is required, please contact the supplier of the drive for more information.

4.2.2 Supplies requiring line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network.

Where line reactors are to be used, reactance values of approximately 2 % are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop.

For all drive ratings, 2 % line reactors permit drives to be used with a supply unbalance of up to 3.5 % negative phase sequence (equivalent to 5 % voltage imbalance between phases).

Severe disturbances may be caused by the following factors, for example:

- Power factor correction equipment connected close to the drive.
- Large DC drives having no or inadequate line reactors connected to the supply.
- Across the line (DOL) started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20 %.

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity.

When required, each drive must have its own reactor(s). Three individual reactors or a single three-phase reactor should be used.

Reactor current ratings

The current rating of the line reactors should be as follows:

Continuous current rating:

Not less than the continuous input current rating of the drive

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive

Table 4-2 2 % line reactors

Drive model number	Voltage rating V	Line reactor designation	CT Part number	Line reactor current rating A	Inductance mH	Weight kg	Length mm	Width mm	Height mm
05200250	200	INL2008	4401-0226	32	0.26	3.30	156	60	145
06200330	200	INL2004	4401-0146	48.8	0.17	4.8	156	75	145
06200440	200	INL2005	4401-0147	56.6	0.15	4.9	156	120	130
05400270	400	INL4013	4401-0236	32	0.48	4.9	156	75	145
05400300	400	INL4013	4401-0236	32	0.48	4.9	156	75	145
06400350	400	INL4006	4401-0154	36.5	0.4	8	206	140	200
06400420	400	INL4007	4401-0155	46.2	0.32	9	206	140	200
06400470	400	INL4008	4401-0156	60.6	0.24	11	255	125	195
05500030	575	INL5007	4401-0242	4.3	4.92	1.4	80	75	130
05500040	575	INL5008	4401-0243	6.8	3.11	1.8	156	70	125
05500069	575	INL5009	4401-0244	11.4	1.89	3.2	156	60	145
06500100	575	INL5001	4401-0157	13.2	1.6	3.5	156	60	145
06500150	575	INL5002	4401-0158	18.7	1.13	4.9	156	75	145
06500190	575	INL5003	4401-0159	24.3	0.87	6	206	95	200
06500230	575	INL5004	4401-0160	29.4	0.72	7.4	206	130	200
06500290	575	INL5005	4401-0161	37.1	0.57	11	230	130	210
06500350	575	INL5006	4401-0223	47	0.48	12.5	230	130	210

4.2.3 Input inductor calculation

To calculate the inductance required (at **Y** %), use the following equation:

$$\mathbf{L} = \frac{\mathbf{Y}}{\mathbf{100}} \times \frac{\mathbf{V}}{\sqrt{\mathbf{3}}} \times \frac{\mathbf{1}}{\mathbf{2\pi f I}}$$

Where:

I = drive rated input current (A)
L = inductance (H)
f = supply frequency (Hz)
V = voltage between lines

4.3 Supplying the drive with DC

All drive sizes have the option to be powered from an external DC power supply. Refer to section 4.1 *Power and ground connections* on page 49 to identify the location of DC supply connections.

4.4 DC bus paralleling

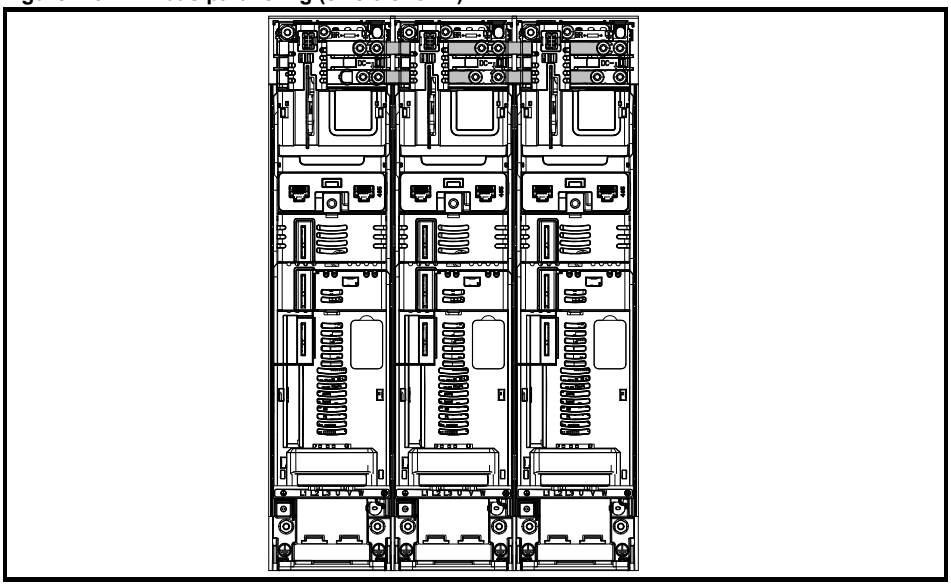
DC bus paralleling using standard cable / busbars is supported by all frame sizes.

On frame sizes 5 and 6, terminal and enclosure design enables the DC bus of a number of drives to be connected together using pre-made busbars. The diagram below shows how the busbar links connect the DC bus of several drives together.

The connecting of the DC bus between several drives is typically used to:

1. Return energy from a drive which is being overhauled by the load to a second motoring drive.
2. Allow the use of one braking resistor to dissipate regenerative energy from several drives.

Figure 4-3 DC bus paralleling (size 3 shown)



There are limitations to the combinations of drives which can be used in this configuration.

For application data, contact the supplier of the drive.

NOTE The DC bus paralleling kit is not supplied with the drive but available to order from the supplier of the drive.

Table 4-3 DC bus paralleling kit part numbers

Size	CT part number
5	3470-0068
6	3470-0063

4.5 24 Vdc supply

The 24 Vdc supply connected to control terminals 1 & 2* provides the following functions:

- It can be used to supplement the drive's own internal 24 V supply when multiple option modules are being used and the current drawn by these module is greater than the drive can supply.
- It can be used as a back-up power supply to keep the control circuits of the drive powered up when the line power supply is removed. This allows any fieldbus modules, application modules, encoders or serial communications to continue to operate.
- It can be used to commission the drive when the line power supply is not available, as the display operates correctly. However, the drive will be in the Under voltage trip state unless either line power supply or low voltage DC operation is enabled, therefore diagnostics may not be possible. (Power down save parameters are not saved when using the 24 V back-up power supply input).
- If the DC bus voltage is too low to run the main SMPS in the drive, then the 24 V supply can be used to supply all the low voltage power requirements of the drive. *Low Under Voltage Threshold Select* (06.067) must also be enabled for this to happen.

NOTE On size 6, the power 24 Vdc supply (terminals 51, 52) must be connected to enable the 24 V dc supply to be used as a backup supply, when the line power supply is removed. If the power 24 Vdc supply is not connected none of the above mentioned functions can be used, "Waiting For Power Systems" will be displayed on the keypad and no drive operations are possible. The location of the power 24 Vdc can be identified from Figure 4-4 *Location of the 24 Vdc power supply connection on size 6* on page 56

Table 4-4 24 Vdc Supply connections

Function	Size 5	Size 6
Supplement the drive's internal supply	Terminal 1, 2*	Terminal 1, 2*
Back-up supply for the control circuit	Terminal 1, 2*	Terminal 1, 2* 51, 52

* Terminal 9 on *Unidrive M702* and *Unidrive HS72*

The working voltage range of the control 24 V power supply is as follows:

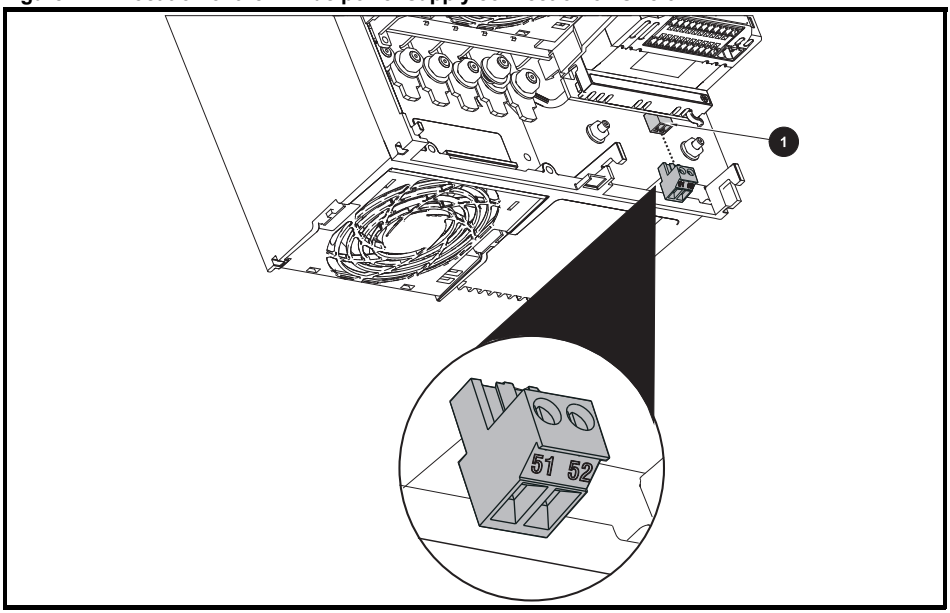
1	**0V common**
2	**+24 Vdc**
Nominal operating voltage	24.0 Vdc
Minimum continuous operating voltage	19.2 V
Maximum continuous operating voltage	28.0 V
Minimum start up voltage	21.6 V
Maximum power supply requirement at 24 V	40 W
Recommended fuse	3 A, 50 Vdc

Minimum and maximum voltage values include ripple and noise. Ripple and noise values must not exceed 5 %.

The working range of the 24 V power supply is as follows:

51	**0V common**
52	**+24 Vdc**
Size 6 only	
Nominal operating voltage	24.0 Vdc
Minimum continuous operating voltage	18.6 Vdc
Maximum continuous operating voltage	28.0 Vdc
Minimum startup voltage	18.4 Vdc
Maximum power supply requirement	40 W
Recommended fuse	4 A @ 50 Vdc

Figure 4-4 Location of the 24 Vdc power supply connection on size 6



1. 24 Vdc power supply connection

4.6 Low voltage operation

With the addition of a 24 Vdc power supply to supply the control circuits, the drive is able to operate from a low voltage DC supply with a range from 24 Vdc to the maximum DC volts. It is possible for the drive to go from operating on a normal line power supply voltage to operating on a much lower supply voltage without interruption.

Going from low voltage operation to normal mains operation requires the inrush current to be controlled. This may be provided externally. If not, the drive supply can be interrupted to utilise the normal soft starting method in the drive.

To fully exploit the new low voltage mode of operation, the under voltage trip level is now user programmable. For application data, contact the supplier of the drive.

The working voltage range of the low voltage DC power supply is as follows:

Minimum continuous operating voltage:	26 V
Minimum start up voltage:	32 V
Maximum over voltage trip threshold:	230 V drives: 415 V
	400 V drives: 830 V
	575 V drives: 990 V

4.7 Fan power supply

The fans installed on all drive sizes are supplied internally by the drive.

4.8 Ratings

See section 2.4 *Ratings* on page 17.

Maximum continuous input current

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with high imbalance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2 % negative phase-sequence imbalance and rated at the maximum supply fault current given in section 2.4 *Ratings* on page 17.

The nominal cable sizes given in section 2.4 *Ratings* on page 17 are only a guide. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

NOTE The nominal output cable sizes in section 2.4 *Ratings* on page 17 assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against over-load, the drive must be programmed with the correct motor rated current.

Fuses

The AC supply to the drive must be installed with suitable protection against overload and short-circuits. Nominal fuse ratings are shown in section 2.4 *Ratings* on page 17. Failure to observe this requirement will cause risk of fire.

A fuse or other protection must be included in all live connections to the AC supply.

Fuse types

The fuse voltage rating must be suitable for the drive supply voltage.

4.8.1 Main AC supply contactor

The recommended AC supply contactor type for size 5 and 6 is AC1.

4.9 Output circuit and motor protection

The output circuit has fast-acting electronic short-circuit protection which limits the fault current to typically no more than five times the rated output current, and interrupts the current in approximately 20 µs. No additional short-circuit protection devices are required.

The drive provides overload protection for the motor and its cable. For this to be effective,

Rated Current (**00.046**) must be set to suit the motor.

Rated Current (**00.046**) must be set correctly to avoid a risk of fire in the event of motor overload.

There is also provision for the use of a motor thermistor to prevent over-heating of the motor, e.g. due to loss of cooling.

4.9.1 Motor cable types

Since capacitance in the motor cable causes loading on the output of the drive, ensure the cable length does not exceed the values given in Table 5-24 *Maximum motor cable lengths* on page 98.

Use 105 °C (221 °F) (UL 60/75 °C temp rise) PVC-insulated cable with copper conductors having a suitable voltage rating, for the following power connections:

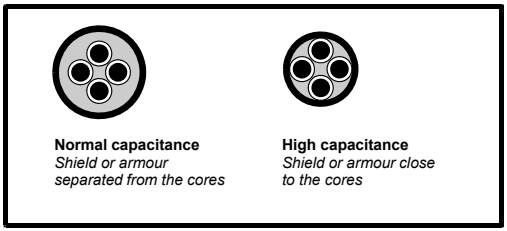
- AC supply to external EMC filter (when used)
- AC supply (or external EMC filter) to drive
- Drive to motor
- Drive to braking resistor

4.9.2 High-capacitance / reduced diameter cables

The maximum cable length is reduced from that shown in Table 5-24 *Maximum motor cable lengths* on page 98 if high capacitance or reduced diameter motor cables are used.

Most cables have an insulating jacket between the cores and the armor or shield; these cables have a low capacitance and are recommended. Cables that do not have an insulating jacket tend to have high capacitance; if a cable of this type is used, the maximum cable length is half that quoted in the tables, (Figure 4-5 shows how to identify the two types).

Figure 4-5 Cable construction influencing the capacitance



The maximum motor cable lengths specified in section 5.1.22 *Maximum motor lengths and types* is shielded and contains four cores. Typical capacitance for this type of cable is 130 pF/m (i.e. from one core to all others and the shield connected together).

4.9.3 Motor winding voltage

The PWM output voltage can adversely affect the inter-turn insulation in the motor. This is because of the high rate of change of voltage, in conjunction with the impedance of the motor cable and the distributed nature of the motor winding.

For normal operation with AC supplies up to 500 Vac and a standard motor with a good quality insulation system, there is no need for any special precautions. In case of doubt the motor supplier should be consulted. Special precautions are recommended under the following conditions, but only if the motor cable length exceeds 10 m:

- AC supply voltage exceeds 500 V
- DC supply voltage exceeds 670 V, i.e regenerative / AFE supply.
- Operation of 400 V drive with continuous or very frequent sustained braking
- Multiple motors connected to a single drive

For multiple motors, the precautions given in section 4.9.4 *Multiple motors* should be followed.

For the other cases listed, it is recommended that an inverter-rated motor be used taking into account the voltage rating of the inverter. This has a reinforced insulation system intended by the manufacturer for repetitive fast-rising pulsed voltage operation.

Users of 575 V NEMA rated motors should note that the specification for inverter-rated motors given in NEMA MG1 section 31 is sufficient for motoring operation but not where the motor spends significant periods braking. In that case an insulation peak voltage rating of 2.2 kV is recommended.

If it is not practical to use an inverter-rated motor, an output choke (inductor) should be used. The recommended type is a simple iron-cored component with a reactance of about 2 %. The exact value is not critical. This operates in conjunction with the capacitance of the motor cable to increase the rise-time of the motor terminal voltage and prevent excessive electrical stress.

4.9.4 Multiple motors

Open-loop only

If the drive is to control more than one motor, one of the fixed V/F modes should be selected (Pr **05.014** = Fixed or Squared). Make the motor connections as shown in Figure 4-6 and Figure 4-7. The maximum motor cable lengths specified in section 5.1.22 *Maximum motor lengths and types* on page 98 apply to the sum of the total cable lengths from the drive to each motor.

It is recommended that each motor is connected through a protection relay since the drive cannot protect each motor individually. For 人 connection, a sinusoidal filter or an output inductor must be connected as shown in Figure 4-7, even when the cable lengths are less than the maximum permissible. For high DC voltages or when supplied by a regen system, a sinusoidal filter is recommended. For details of filter or inductor sizes refer to the supplier of the drive.

Figure 4-6 Preferred chain connection for multiple motors

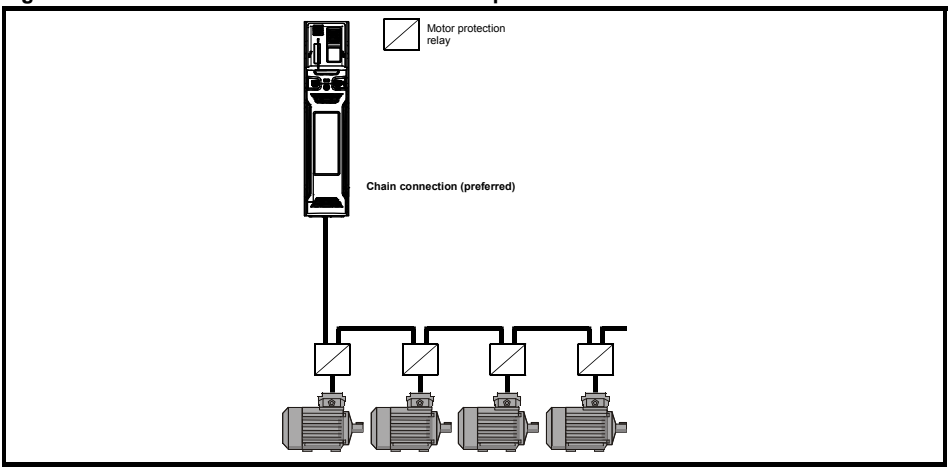
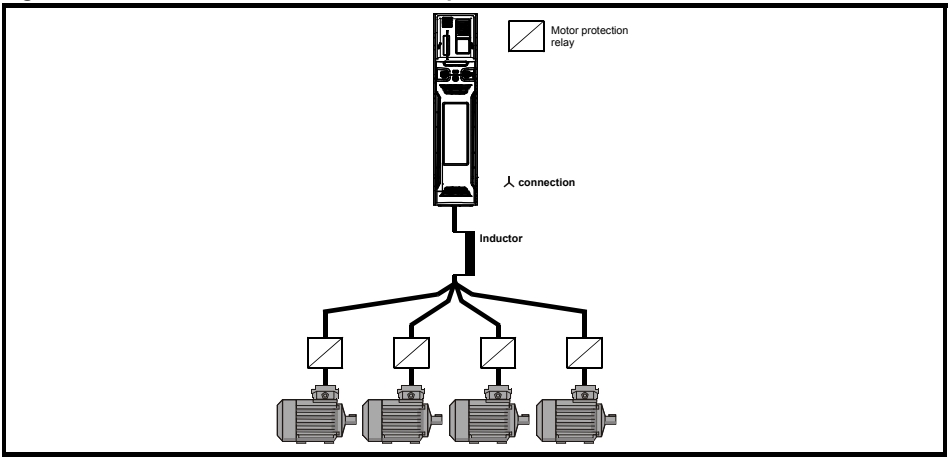


Figure 4-7 Alternative connection for multiple motors



4.9.5 人 / Δ motor operation

The voltage rating for 人 and Δ connections of the motor should always be checked before attempting to run the motor.

The default setting of the motor rated voltage parameter is the same as the drive rated voltage, i.e.

400 V drive 400 V rated voltage
230 V drive 230 V rated voltage

A typical 3 phase motor would be connected in 人 for 400 V operation or Δ for 230 V operation, however, variations on this are common e.g. 人 690 V Δ 400 V.

Incorrect connection of the windings will cause severe under or over fluxing of the motor, leading to a very poor output torque or motor saturation and overheating respectively.

4.9.6 Output contactor

If the cable between the drive and the motor is to be interrupted by a contactor or circuit breaker, ensure that the drive is disabled before the contactor or circuit breaker is opened or closed. Severe arcing may occur if this circuit is interrupted with the motor running at high current and low speed.

A contactor is sometimes required to be installed between the drive and motor for safety purposes.

The recommended motor contactor is the AC3 type.

Switching of an output contactor should only occur when the output of the drive is disabled.

Opening or closing of the contactor with the drive enabled will lead to:

1. OI ac trips (which cannot be reset for 10 seconds)
2. High levels of radio frequency noise emission
3. Increased contactor wear and tear

The Drive Enable terminal when opened provides a Safe Torque Off function. This can in many cases replace output contactors.

For further information see the *Control User Guide*.

4.10 Braking

High temperatures
Braking resistors can reach high temperatures. Locate braking resistors so that damage cannot result. Use cable having insulation capable of withstanding high temperatures.

Braking occurs when the drive is decelerating the motor, or is preventing the motor from gaining speed due to mechanical influences. During braking, energy is returned to the drive from the motor.

When motor braking is applied by the drive, the maximum regenerated power that the drive can absorb is equal to the power dissipation (losses) of the drive.

When the regenerated power is likely to exceed these losses, the DC bus voltage of the drive increases. Under default conditions, the drive brakes the motor under PI control, which extends the deceleration time as necessary in order to prevent the DC bus voltage from rising above a user defined set-point.

If the drive is expected to rapidly decelerate a load, or to hold back an overhauling load, a braking resistor must be installed.

Table 4-5 shows the default DC voltage level at which the drive turns on the braking transistor. However the braking resistor turn on and the turn off voltages are programmable with *Braking IGBT Lower Threshold* (06.073) and *Braking IGBT Upper Threshold* (06.074).

Table 4-5 Default braking transistor turn on voltage

Drive voltage rating	DC bus voltage level
200 V	390 V
400 V	780 V
575 V	930 V

NOTE When a braking resistor is used, Pr **00.015** should be set to Fast ramp mode.

4.10.1 Heatsink mounted braking resistor

A resistor has been especially designed to be mounted within the heatsink of the drive (size 5 only). See section 3.10 *Internal braking resistor* on page 41 for mounting details. The design of the resistor is such that no thermal protection circuit is required, as the device will fail safely under fault conditions. On size 5 the in built software overload protection is set-up at default for the designated heatsink mounted resistor. The heatsink mounted resistor is not supplied with the drive and can be purchased separately.

Table 4-6 provides the resistor data for each drive rating.

NOTE The internal / heatsink mounted resistor is suitable for applications with a low level of regen energy only. See Table 4-6.

Braking resistor overload protection parameter settings
Failure to observe the following information may damage the resistor.
The drive software contains an overload protection function for a braking resistor. On size 5 this function is enabled at default to protect the heatsink mounted resistor. Below are the parameter settings.

Parameter		Size 5	
		200 V drive	400 V drive
Braking resistor rated power	Pr **10.030**	100 W	
Braking resistor thermal time constant	Pr **10.031**	2.0 s	
Braking resistor resistance	Pr **10.061**	38 Ω	

For more information on the braking resistor software overload protection, see Pr **10.030,** Pr **10.031** and Pr **10.061** full descriptions in *section 4.10.3 Braking resistor software overload protection* on page 66.

If the resistor is to be used at more than half of its average power rating, the drive cooling fan must be set to full speed by setting Pr **06.045** to 11.

Table 4-6 Heatsink mounted braking resistor data

Parameter	Size 5
Part number	1299-0003
DC resistance at 25 °C	37.5 Ω
Peak instantaneous power over 1 ms at nominal resistance	16 kW
Average power over 60 s *	100 W
Ingress Protection (IP) rating	IP54
Maximum altitude	2000 m

* To keep the temperature of the resistor below 70 °C (158 °F) in a 30 °C (86 °F) ambient, the average power rating is 100 W. The above parameter settings ensure this is the case.

4.10.2 External braking resistor

Overload protection
When an external braking resistor is used, it is essential that an overload protection device is incorporated in the braking resistor circuit; this is described in *Figure 4-8 on page 65.*

When a braking resistor is to be mounted outside the enclosure, ensure that it is mounted in a ventilated metal housing that will perform the following functions:

- Prevent inadvertent contact with the resistor
- Allow adequate ventilation for the resistor

When compliance with EMC emission standards is required, external connection requires the cable to be armored or shielded, since it is not fully contained in a metal enclosure. See section 3.5.1 *Enclosure layout* on page 32 for further details.

Internal connection does not require the cable to be armored or shielded.

Table 4-7 Minimum resistance values and peak power rating for the braking resistor at 40 °C (104 °F)

Model	Minimum resistance* Ω	Instantaneous power rating kW	Continuous power rating kW
200 V			
05200250	19	8.9	8.6
06200330	10	16.9	12.6
06200440			16.4
400 V			
05400270	38	17.8	16.2
05400300	22	30.8	19.6
06400350	20	33.8	21.6
06400420			25
06400470			32.7
575 V			
05500030	80	12.1	2.6
05500040			4.6
05500069			6.5
06500100	15	64.1	8.7
06500150			12.3
06500190			16.3
06500230			19.9
06500290			24.2
06500350			31.7

* Resistor tolerance: ±10 %. The minimum resistance specified are for stand-alone drive systems only. If the drive is to be used as part of a common DC bus system different values may be required. Contact the supplier of the drive for more information.

For high-inertia loads or under continuous braking, the continuous power dissipated in the braking resistor may be as high as the power rating of the drive. The total energy dissipated in the braking resistor is dependent on the amount of energy to be extracted from the load.

The instantaneous power rating refers to the short-term maximum power dissipated during the on intervals of the pulse width modulated braking control cycle. The braking resistor must be able to withstand this dissipation for short intervals (milliseconds). Higher resistance values require proportionately lower instantaneous power ratings.

In most applications, braking occurs only occasionally. This allows the continuous power rating of the braking resistor to be much lower than the power rating of the drive. It is therefore essential that the instantaneous power rating and energy rating of the braking resistor are sufficient for the most extreme braking duty that is likely to be encountered.

Optimization of the braking resistor requires careful consideration of the braking duty.

Select a value of resistance for the braking resistor that is not less than the specified minimum resistance. Larger resistance values may give a cost saving, as well as a safety benefit in the event of a fault in the braking system. Braking capability will then be reduced, which could cause the drive to trip during braking if the value chosen is too large.

The following external brake resistors are available from the supplier of the drive for sizes 5 and 6.

Table 4-8 External brake resistors (40° C ambient) for drive sizes 5 and 6

Part number	Part desc	Ohmic value Pr10.061	Cont power rating Pr10.030	Max. inst power rating ton = 1 ms	Pulse power 1/120 s (ED 0.8 %)	Pulse power 5/120 s (ED 4.2 %)	Pulse power 10/120 s (ED 8.3 %)	Pulse power 40/120 s (ED 33 %)	Time constant Pr10.031
1220-2201	DBR, 100 W, 20R, 130 x 68, TS	20 Ω	100 W	2.0 MW	2300 W	1000 W	650 W	250 W	20
1220-2401	DBR, 100 W, 40R, 130 x 68, TS	40 Ω	100 W	1.6 MW	1900 W	900 W	610 W	240 W	16
1220-2801	DBR, 100 W, 80R, 130 x 68, TS	80 Ω	100 W	1.25 MW	1500 W	775 W	570 W	230 W	12.5

The brake resistors can be used in a series or parallel to get the required resistance and power depending on the size of the drive as per Table 4-7. The brake resistor is equipped with a thermal switch. The thermal switch should be integrated in the control circuit by the user.

The resistor combinations shown in Table 4-9 can be made using one or more brake resistor(s) from Table 4-8. Pr **10.030**, Pr **10.031** and Pr **10.061** should be set as per information provided in Table 4-8. Refer to description of Pr **10.030**, Pr **10.031** and Pr **10.061** in *section 4.10.3 Braking resistor software overload protection* on page 66 for more information.

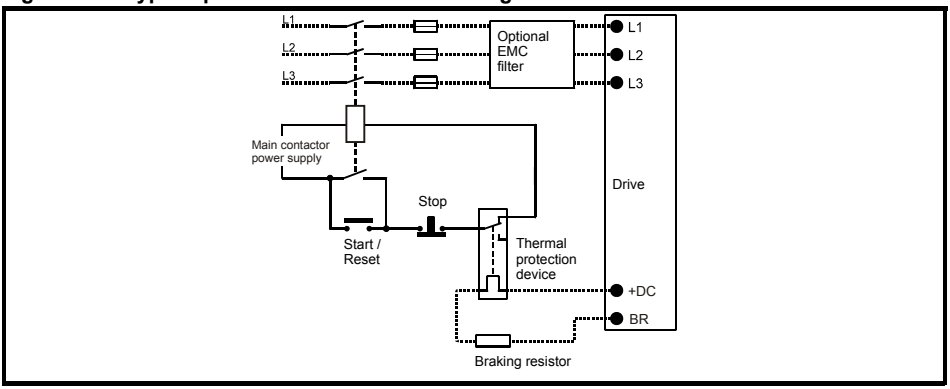
Table 4-9 Resistor combinations

Model	Heavy duty	150 % Peak power	Braking voltage	Resistor Min. value	Resistor combinations
	kW	Ω	Vdc	Ω	Ω
05200250	5.5	19	390	19	1 x 20 = 20 2 x 40 = 20 (when connected in parallel)
05400270	11.0	37	780	38	1 x 40 = 40 2 x 80 = 40 (when connected in parallel)
05400300	15.0	27		22	1 x 40 = 40 2 x 80 = 40 (when connected in parallel)
05500030	1.5	384	930	80	1 x 80 = 80 2 x 40 = 80 (when connected in parallel)
05500040	2.2	263			
05500069	4.0	144			
06200330	7.5	13.3	390	10	2 x 20 = 10 (when connected in parallel) 4 x 40 = 10 (when connected in parallel)
06200440	11.0	9.3			
06400350	15.0	27	780	20	1 x 20 = 20 2 x 40 = 20 (when connected in parallel) 4 x 80 = 20 (when connected in parallel)
06400420	18.5	22			
06400470	22.0	18.4			
06500100	5.5	104	930	15	1 x 20 = 20 2 x 40 = 20 (when connected in parallel) 3 x 40 = 13 (when connected in parallel) 4 x 80 = 20 (when connected in parallel)
06500150	7.5	77			
06500190	11.0	52			
06500230	15.0	39			
06500290	18.5	33			
06500350	22.0	27			

Thermal protection circuit for the braking resistor

The thermal protection circuit must disconnect the AC supply from the drive if the resistor becomes overloaded due to a fault. Figure 4-8 shows a typical circuit arrangement.

Figure 4-8 Typical protection circuit for a braking resistor



See Figure 4-1 on page 49 and Figure 4-2 on page 50 for the location of the +DC and braking resistor connections.

4.10.3 Braking resistor software overload protection

The drive software contains an overload protection function for a braking resistor. In order to enable and set-up this function, it is necessary to enter three values into the drive:

- *Braking Resistor Rated Power* (10.030)
- *Braking Resistor Thermal Time Constant* (10.031)
- *Braking Resistor Resistance* (10.061)

This data should be obtained from the manufacturer of the braking resistors. The braking resistor thermal time constant can be calculated from resistor data sheet values using the following equation:

$$\textbf{Pr 10.031} = \frac{\textbf{Resistor pulse power rating x Braking time}}{\textbf{Resistor continuous power rating}}$$

Pr **10.039** gives an indication of braking resistor temperature based on a simple thermal model. Zero indicates the resistor is close to ambient and 100 % is the maximum temperature the resistor can withstand. A 'Brake Resistor' alarm is given if this parameter is above 75 % and the braking IGBT is active. A Brake R Too Hot trip will occur if Pr **10.039** reaches 100 %, when Pr **10.037** is set to 0 (default value) or 1.

If Pr **10.037** is equal to 2 or 3, a Brake R Too Hot trip will not occur when Pr **10.039** reaches 100 %, but instead the braking IGBT will be disabled until Pr **10.039** falls below 95 %. This option is intended for applications with parallel connected DC buses where there are several braking resistors, each of which cannot withstand full DC bus voltage continuously. With this type of application it is unlikely the braking energy will be shared equally between the resistors because of voltage measurement tolerances within the individual drives. Therefore with Pr **10.037** set to 2 or 3, then as soon as a resistor has reached its maximum temperature the drive will disable the braking IGBT, and another resistor on another drive will take up the braking energy. Once Pr **10.039** has fallen below 95 % the drive will allow the braking IGBT to operate again.

See the *Parameter Reference Guide* for more information on Pr **10.030**, Pr **10.031**, Pr **10.037** and Pr **10.039**.

This software overload protection should be used in addition to an external overload protection device.

4.11 Ground leakage

The ground leakage current depends upon whether the internal EMC filter is installed or not. The drive is supplied with the filter installed. Instructions for removing the internal filter are given in section 4.12.2 *Internal EMC filter* on page 71.

With internal filter installed:

Size 5 to 6: 28 mA* AC at 400 V 50 Hz

30 µA DC with a 600 V DC bus (10 MΩ)

* Proportional to the supply voltage and frequency.

With internal filter removed:

<1 mA

When the internal filter is installed the leakage current is high. In this case a permanent fixed ground connection must be provided, or other suitable measures taken to prevent a safety hazard occurring if the connection is lost.

4.11.1 Use of residual current device (RCD)

There are three common types of ELCB / RCD:

1. AC - detects AC fault currents
2. A - detects AC and pulsating DC fault currents (provided the DC current reaches zero at least once every half cycle)
3. B - detects AC, pulsating DC and smooth DC fault currents
   - Type AC should never be used with drives.
   - Type A can only be used with single phase drives
   - Type B must be used with three phase drives

Only type B ELCB / RCD are suitable for use with 3 phase inverter drives.

If an external EMC filter is used, a delay of at least 50 ms should be incorporated to ensure spurious trips are not seen. The leakage current is likely to exceed the trip level if all of the phases are not energized simultaneously.

4.12 EMC (Electromagnetic compatibility)

The requirements for EMC are divided into three levels in the following three sections:

- section 4.12.3, General requirements for EMC this is for all applications, to ensure reliable operation of the drive and minimise the risk of disturbing nearby equipment. The immunity standards specified in Chapter 5.1.25 *Electromagnetic compatibility (EMC)* on page 101 will be met, but no specific emission standards are applied.
- section 4.12.4, Requirements for meeting the EMC standard for power drive systems, IEC 61800-3 (EN 61800-3:2004+A1:2012).
- section 4.12.5, Requirements for meeting the generic emission standards for the industrial environment, IEC 61000-6-4, EN 61000-6-4:2007+A1:2011.

The recommendations of section 4.12.3 will usually be sufficient to avoid causing disturbance to adjacent equipment of industrial quality. If particularly sensitive equipment is to be used nearby, or in a non-industrial environment, then the recommendations of section 4.12.4 or section 4.12.5 should be followed to give reduced radio-frequency emission.

In order to ensure the installation meets the various emission standards described in:

- The EMC data sheet available from the supplier of the drive
- The Declaration of Conformity at the front of this manual
- Chapter 5 *Technical data* on page 82

The correct external EMC filter must be used and all of the guidelines in section 4.12.3 *General requirements for EMC Ground (earth) connections* on page 73 and section 4.12.5 *Compliance with generic emission standards* on page 76 must be followed.

Table 4-10 Drive and EMC filter cross reference

Model	CT part number
200 V	
05200250	4200-0312
06200330 to 06200440	4200-2300
400 V	
05400270 to 05400300	4200-0402
06400350 to 06400470	4200-4800
575 V	
05500030 to 05500069	4200-0122
06500100 to 06500350	4200-3690

High ground leakage current
When an EMC filter is used, a permanent fixed ground connection must be provided which does not pass through a connector or flexible power cord. This includes the internal EMC filter.

NOTE The installer of the drive is responsible for ensuring compliance with the EMC regulations that apply in the country in which the drive is to be used.

4.12.1 Grounding hardware

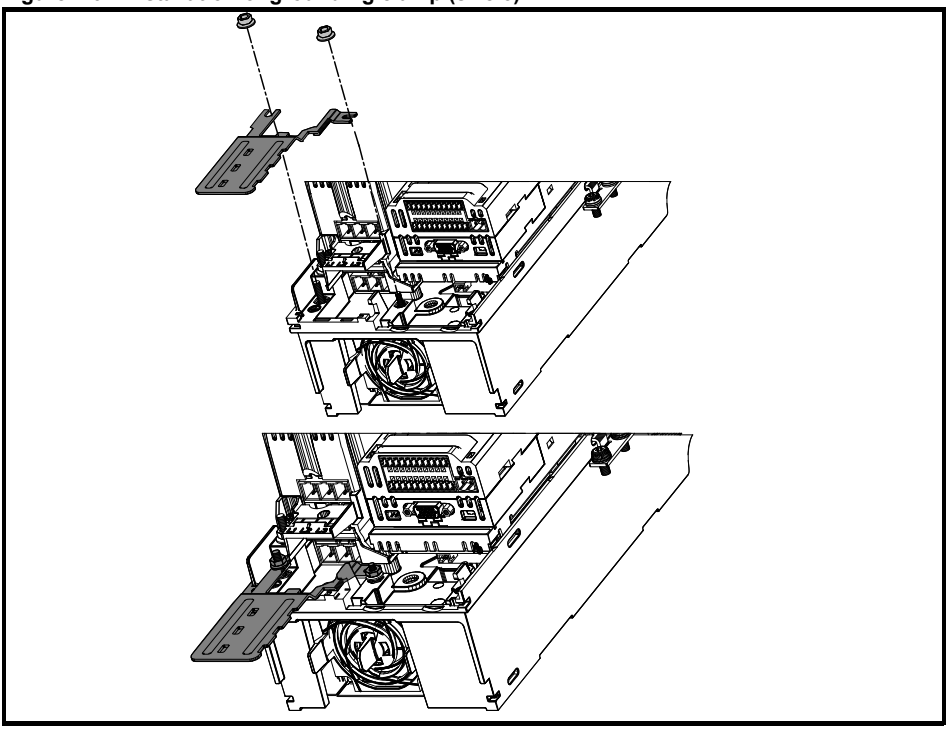
The drive is supplied with a grounding bracket and grounding clamp to facilitate EMC compliance. They provide a convenient method for direct grounding of cable shields without the use of "pig-tails".

Cable shields can be bared and clamped to the grounding bracket using metal clips or clamps[1] (not supplied) or cable ties. Note that the shield must in all cases be continued through the clamp to the intended terminal on the drive, in accordance with the connection details for the specific signal.

[1] A suitable clamp is the Phoenix DIN rail mounted SK14 cable clamp (for cables with a maximum outer diameter of 14 mm).

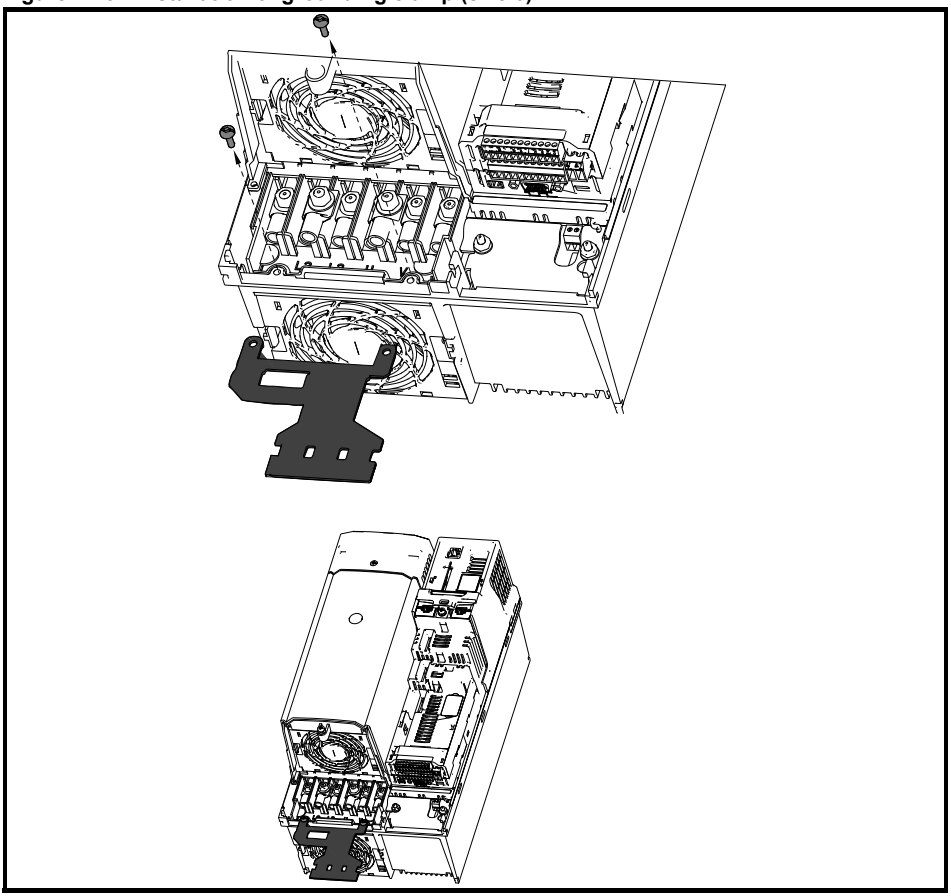
- See Figure 4-9 and Figure 4-10 for details on installing the grounding clamp.
- See Figure 4-11 for details on installing the grounding bracket.

Figure 4-9 Installation of grounding clamp (size 5)



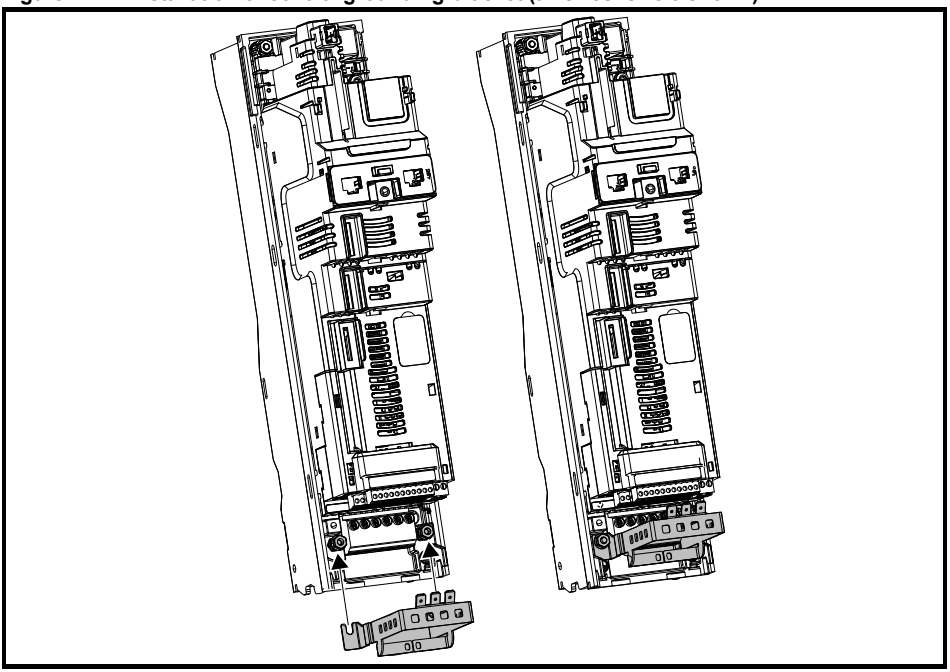
Remove the ground connection nuts and slide the grounding clamp down onto the pillars in the direction shown. Once in place, the ground connection nuts should be tightened with a maximum torque of 2 N m (1.47 lb ft).

Figure 4-10 Installation of grounding clamp (size 6)



The grounding clamp is secured using the provided 2 x M4 x 10 mm fasteners. The fasteners should be tightened with the maximum torque of 2 N m (1.47 lb ft).

Figure 4-11 Installation of control grounding bracket (all sizes -size 3 shown)



Loosen the ground connection nuts and slide the grounding bracket in the direction shown. Once in place, the ground connection nuts should be tightened with a maximum torque of 2 N m (1.47 lb ft).

A faston tab is located on the grounding bracket for the purpose of connecting the drive 0V to ground should the user require to do so.

4.12.2 Internal EMC filter

It is recommended that the internal EMC filter be kept in place unless there is a specific reason for removing it.

If the drive is used with ungrounded (IT) supplies, the internal EMC filter must be removed unless additional motor ground fault protection is installed.
For instructions on removal refer to section 4.12.2. For details of ground fault protection contact the supplier of the drive.

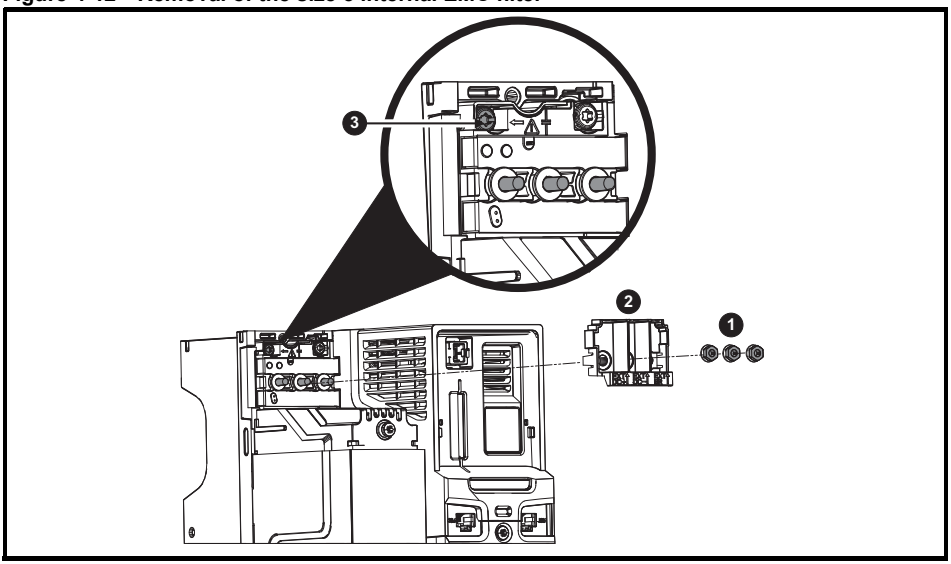
If the drive is used as a motoring drive as part of a regen system, then the internal EMC filter must be removed.

The internal EMC filter reduces radio-frequency emission into the line power supply. Where the motor cable is short, it permits the requirements of EN 61800-3: 2004+A1:2012 to be met for the second environment - see section 4.12.4 *Compliance with EN 61800-3: 2004+A1:2012 (standard for Power Drive Systems)* on page 75 and section 5.1.25 *Electromagnetic compatibility (EMC)* on page 101. For longer motor cables the filter continues to provide a useful reduction in emission levels, and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the instructions given above require it to be removed, or where the ground leakage current of 28 mA for size 5 and 6 is unacceptable. See section 4.12.2 for details of removing and installing the internal EMC filter.

WARNING

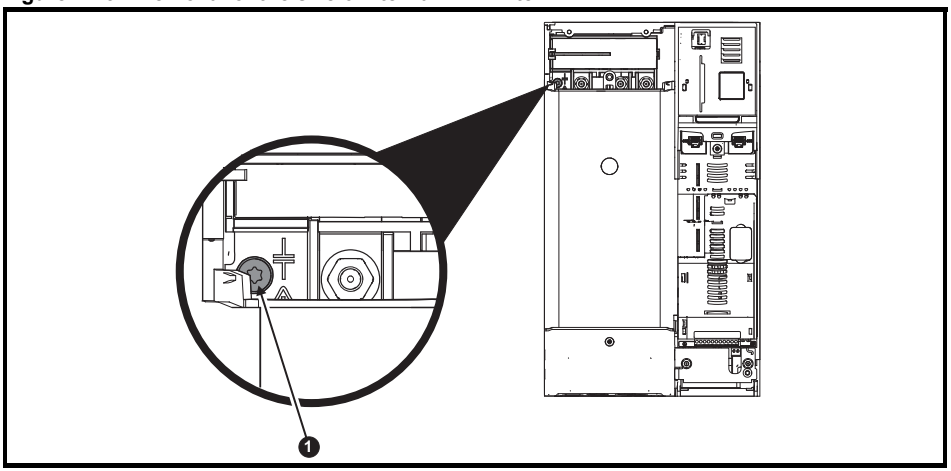
The supply must be disconnected before removing the internal EMC filter.

Figure 4-12 Removal of the size 5 internal EMC filter



Remove the three M4 terminal nuts (1). Lift away the cover (2) to expose the M4 Torx internal EMC filter removal screw. Finally remove the M4 Torx internal EMC filter removal screw (3) to electrically disconnect the internal EMC filter.

Figure 4-13 Removal of the size 6 internal EMC filter



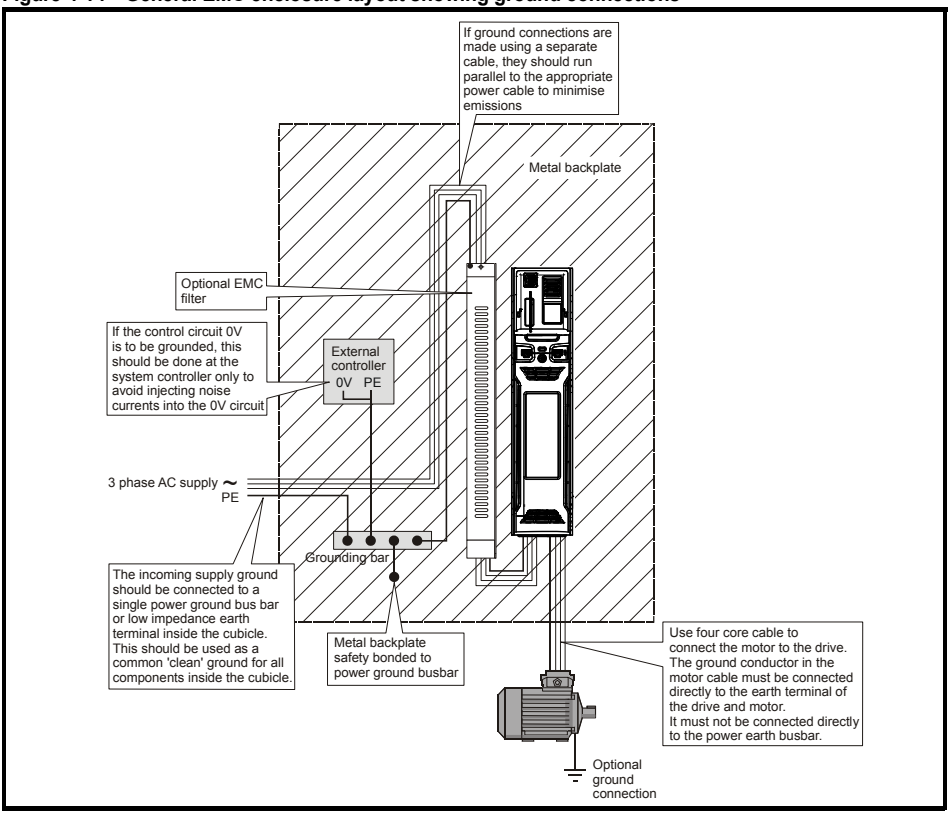
To electrically disconnect the Internal EMC filter, remove the screw as highlighted above (1).

4.12.3 General requirements for EMC Ground (earth) connections

The grounding arrangements should be in accordance with Figure 4-14, which shows a single drive on a back-plate with or without an additional enclosure.

Figure 4-14 shows how to configure and minimise EMC when using unshielded motor cable. However shielded cable is a better option, in which case it should be installed as shown in section 4.12.5 *Compliance with generic emission standards* on page 76.

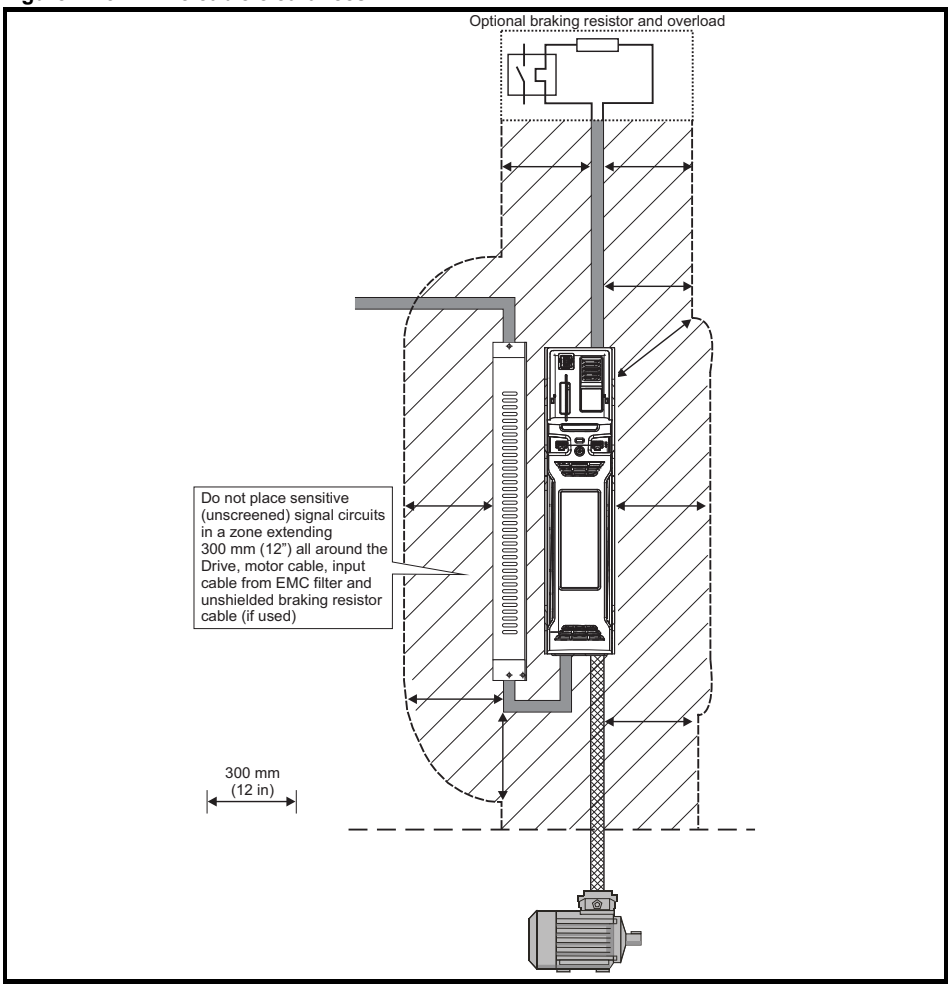
Figure 4-14 General EMC enclosure layout showing ground connections



Cable layout

Figure 4-15 indicates the clearances which should be observed around the drive and related 'noisy' power cables by all sensitive control signals / equipment.

Figure 4-15 Drive cable clearances



NOTE

Any signal cables which are carried inside the motor cable (i.e. motor thermistor, motor brake) will pick up large pulse currents via the cable capacitance. The shield of these signal cables must be connected to ground close to the motor cable, to avoid this noise current spreading through the control system.

4.12.4 Compliance with EN 61800-3: 2004+A1:2012 (standard for Power Drive Systems)

Meeting the requirements of this standard depends on the environment that the drive is intended to operate in, as follows:

Operation in the first environment

Observe the guidelines given in section 4.12.5 *Compliance with generic emission standards* on page 76. An external EMC filter will always be required.

This is a product of the restricted distribution class according to IEC 61800-3:2004

In a residential environment this product may cause radio interference in which case the user may be required to take adequate measures.

Operation in the second environment

In all cases a shielded motor cable must be used, and an EMC filter is required for all drives with a rated input current of less than 100 A.

The drive contains an in-built filter for basic emission control. In some cases feeding the motor cables (U, V and W) once through a ferrite ring can maintain compliance for longer cable lengths.

For longer motor cables, an external filter is required. Where a filter is required, follow the guidelines in section 4.12.5 *Compliance with generic emission standards* .

Where a filter is not required, follow the guidelines given in section 4.12.3 *General requirements for EMC Ground (earth) connections* on page 73.

The second environment typically includes an industrial low-voltage power supply network which does not supply buildings used for residential purposes. Operating the drive in this environment without an external EMC filter may cause interference to nearby electronic equipment whose sensitivity has not been appreciated. The user must take remedial measures if this situation arises. If the consequences of unexpected disturbances are severe, it is recommended that the guidelines in section 4.12.5 *Compliance with generic emission standards* be adhered to.

Refer to section 5.1.25 *Electromagnetic compatibility (EMC)* on page 101 for further information on compliance with EMC standards and definitions of environments.

Detailed instructions and EMC information are given in the *EMC Data Sheet* which is available from the supplier of the drive.

4.12.5 Compliance with generic emission standards

Use the recommended filter and shielded motor cable. Observe the layout rules given in Figure 4-16 and Figure 4-18. Ensure the AC supply and ground cables are at least 100 mm from the power module and motor cable.

Figure 4-16 Supply and ground cable clearance (sizes 5 to 6)

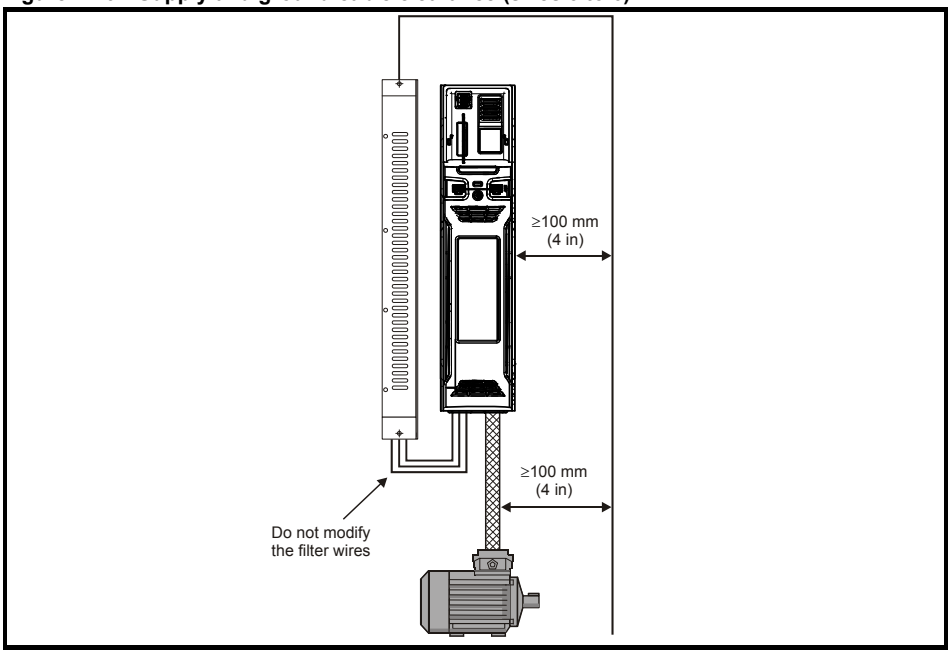
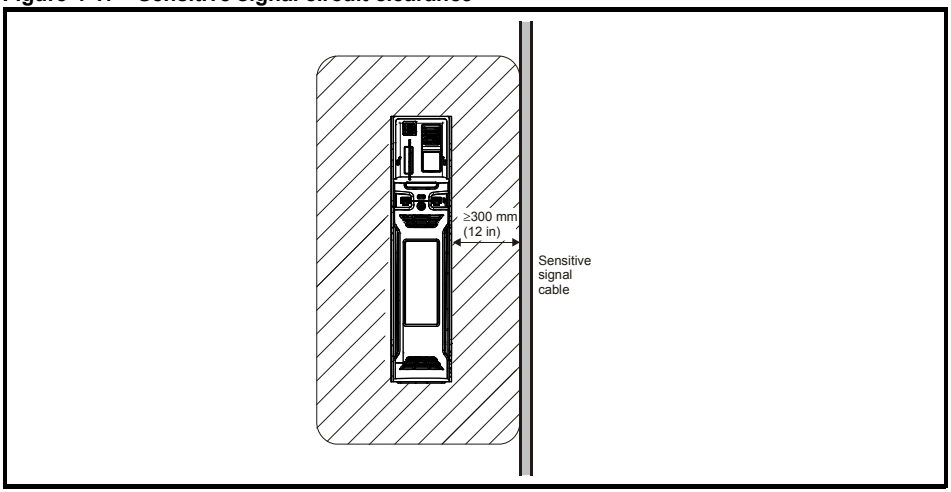
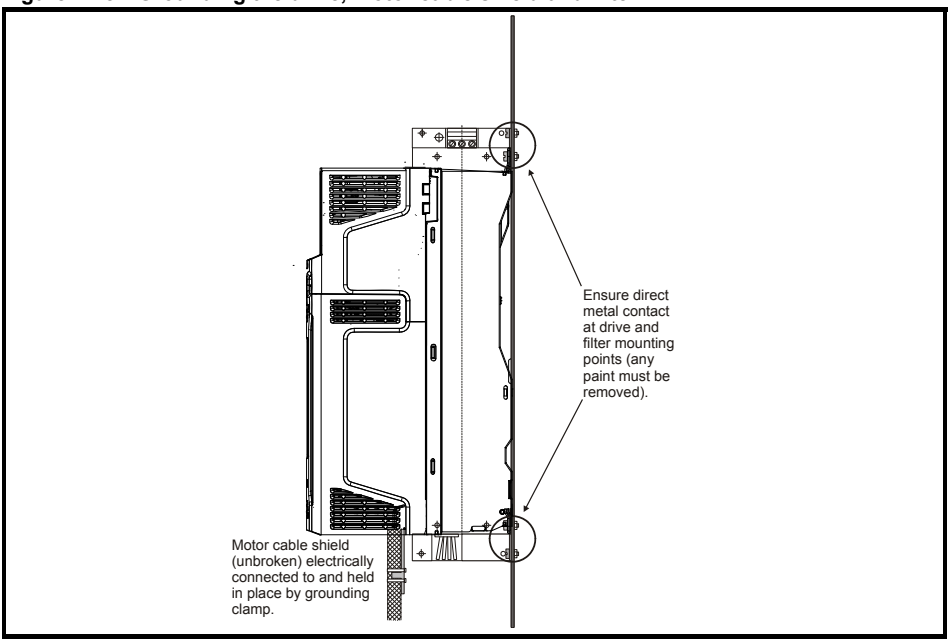


Figure 4-17 Sensitive signal circuit clearance



Avoid placing sensitive signal circuits in a zone 300 mm (12 in) in the area immediately surrounding the power module. Ensure good EMC grounding.

Figure 4-18 Grounding the drive, motor cable shield and filter

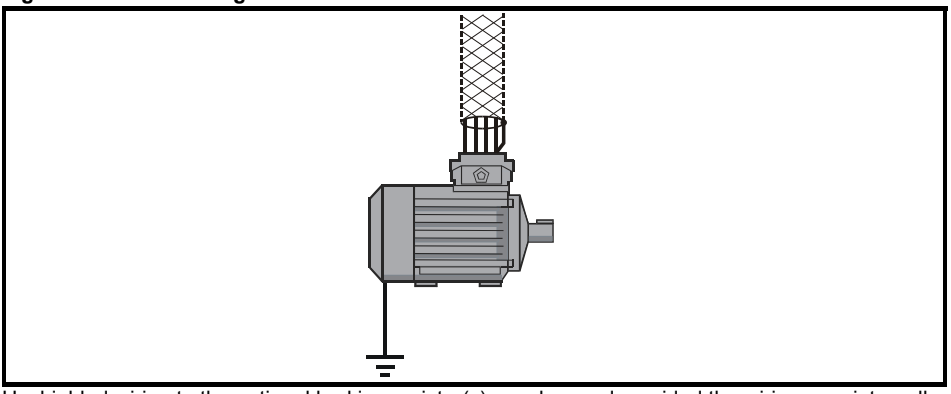


Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) long.

A complete 360° termination of the shield to the terminal housing of the motor is beneficial.

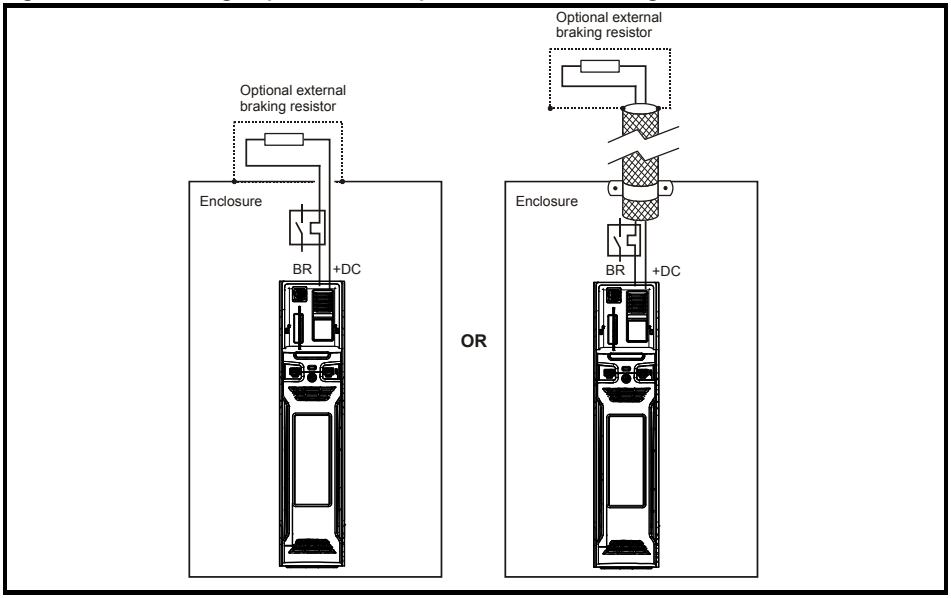
From an EMC consideration it is irrelevant whether the motor cable contains an internal (safety) ground core, or if there is a separate external ground conductor, or where grounding is through the shield alone. An internal ground core will carry a high noise current and therefore it must be terminated as close as possible to the shield termination.

Figure 4-19 Grounding the motor cable shield



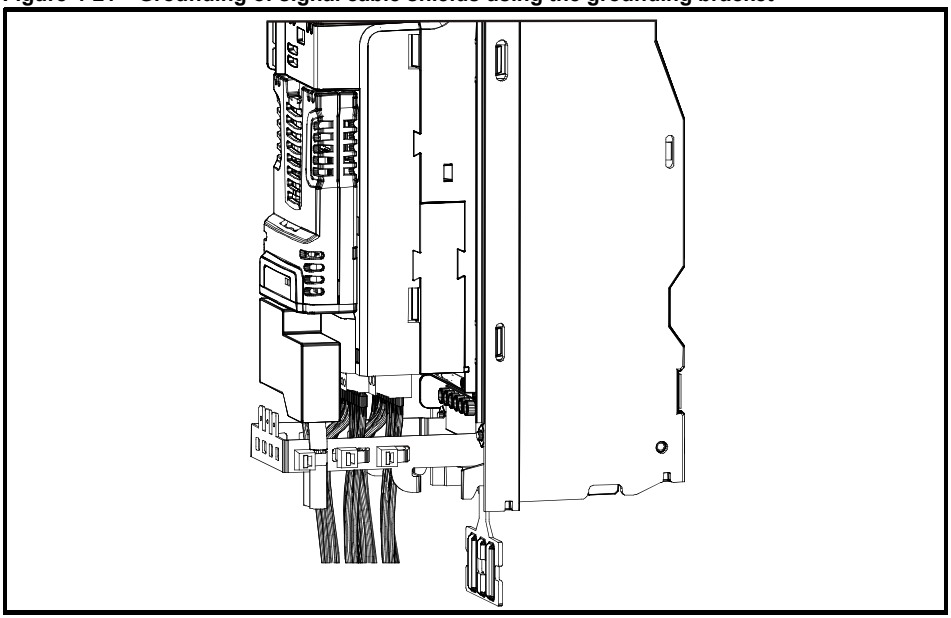
Unshielded wiring to the optional braking resistor(s) may be used provided the wiring runs internally to the enclosure. Ensure a minimum spacing of 300 mm (12 in) from the signal wiring and the AC supply wiring to the external EMC filter. If this condition cannot be met then the wiring must be shielded.

Figure 4-20 Shielding requirements of optional external braking resistor



If the control wiring is to leave the enclosure, it must be shielded and the shield(s) clamped to the drive using the grounding bracket as shown in Figure 4-21. Remove the outer insulating cover of the cable to ensure the shield(s) make direct contact with the bracket, but keep the shield(s) intact until as close as possible to the terminals. Alternatively, wiring may be passed through a ferrite ring, part number 3225-1004.

Figure 4-21 Grounding of signal cable shields using the grounding bracket



4.12.6 Variations in the EMC wiring

Interruptions to the motor cable

The motor cable should ideally be a single length of shielded or armored cable having no interruptions. In some situations it may be necessary to interrupt the cable, as in the following examples:

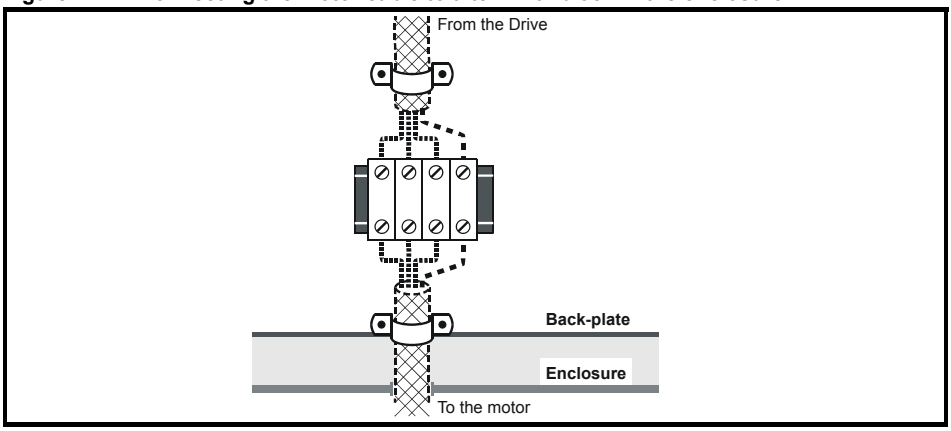
- Connecting the motor cable to a terminal block in the drive enclosure
- Installing a motor isolator / disconnect switch for safety when work is done on the motor

In these cases the following guidelines should be followed.

Terminal block in the enclosure

The motor cable shields should be bonded to the back-plate using uninsulated metal cable-clamps which should be positioned as close as possible to the terminal block. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3 m (12 in) away from the terminal block.

Figure 4-22 Connecting the motor cable to a terminal block in the enclosure



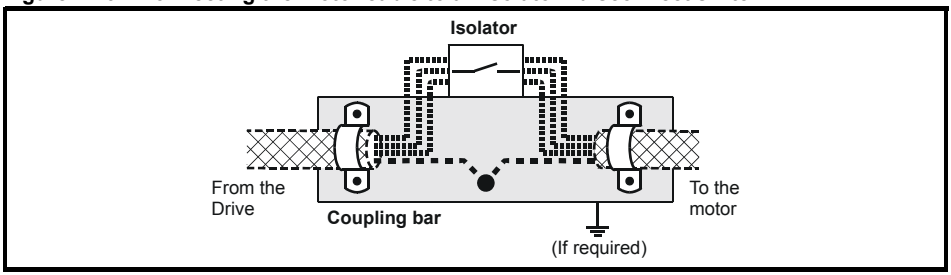
Using a motor isolator / disconnect-switch

The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal coupling-bar is recommended; conventional wire is not suitable.

The shields should be bonded directly to the coupling-bar using uninsulated metal cable-clamps. Keep the length of the exposed power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3 m (12 in) away.

The coupling-bar may be grounded to a known low-impedance ground nearby, for example a large metallic structure which is connected closely to the drive ground.

Figure 4-23 Connecting the motor cable to an isolator / disconnect switch



Surge immunity of control circuits - long cables and connections outside a building

The input/output ports for the control circuits are designed for general use within machines and small systems without any special precautions.

These circuits meet the requirements of EN 61000-6-2:2005 (1 kV surge) provided the 0 V connection is not grounded.

In applications where they may be exposed to high-energy voltage surges, some special measures may be required to prevent malfunction or damage. Surges may be caused by lightning or severe power faults in association with grounding arrangements which permit high transient voltages between nominally grounded points. This is a particular risk where the circuits extend outside the protection of a building.

As a general rule, if the circuits are to pass outside the building where the drive is located, or if cable runs within a building exceed 30 m, some additional precautions are advisable. One of the following techniques should be used:

1. Galvanic isolation, i.e. do not connect the control 0 V terminal to ground. Avoid loops in the control wiring, i.e. ensure every control wire is accompanied by its return (0 V) wire.
2. Shielded cable with additional power ground bonding. The cable shield may be connected to ground at both ends, but in addition the ground conductors at both ends of the cable must be bonded together by a power ground cable (equipotential bonding cable) with cross-sectional area of at least 10 mm^2, or 10 times the area of the signal cable shield, or to suit the electrical safety requirements of the plant. This ensures that fault or surge current passes mainly through the ground cable and not in the signal cable shield. If the building or plant has a well-designed common bonded network this precaution is not necessary.
3. Additional over-voltage suppression - for the analog and digital inputs and outputs, a zener diode network or a commercially available surge suppressor may be connected in parallel with the input circuit as shown in Figure 4-24 and Figure 4-25.

If a digital port experiences a severe surge its protective trip may operate (I/O Overload trip). For continued operation after such an event, the trip can be reset automatically by setting Pr **10.034** to 5.

Figure 4-24 Surge suppression for digital and unipolar inputs and outputs

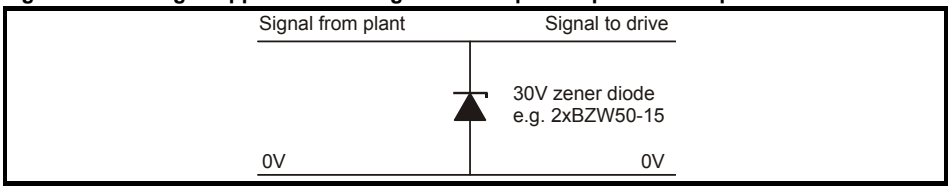
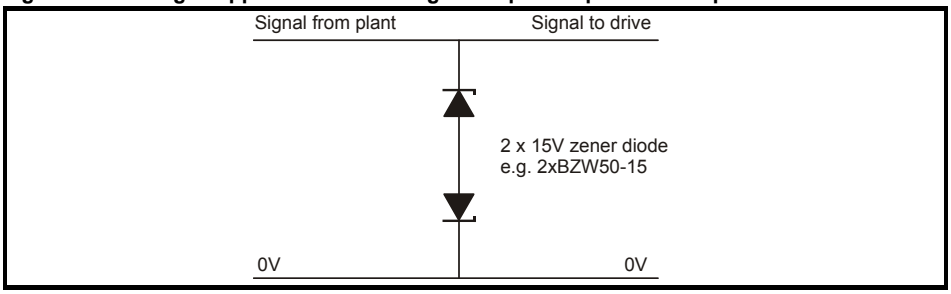


Figure 4-25 Surge suppression for analog and bipolar inputs and outputs



Surge suppression devices are available as rail-mounting modules, e.g. from Phoenix Contact:

Unipolar TT-UKK5-D/24 DC
Bipolar TT-UKK5-D/24 AC

These devices are not suitable for encoder signals or fast digital data networks because the capacitance of the diodes adversely affects the signal. Most encoders have galvanic isolation of the signal circuit from the motor frame, in which case no precautions are required. For data networks, follow the specific recommendations for the particular network.

5 Technical data

5.1 Drive technical data

5.1.1 Power and current ratings

For a full explanation of 'Normal Duty' and 'Heavy Duty' refer to the *Control User Guide*.

The continuous current ratings given are for maximum 40 °C (104 °F), 1000 m altitude and 3 kHz switching frequency. Derating is required for higher switching frequencies, ambient temperature >40 °C (104 °F) and high altitude. For further information, refer to Chapter 5.1.2 *Power and current ratings (Derating for switching frequency and temperature)* on page 84.

Table 5-1 200 V drive ratings (200 V to 240 V ±10 %)

Model	Normal Duty				Heavy Duty				
	Max cont output current	Nominal power at 230 V	Motor power at 230 V	Peak current	Max cont output current	Open loop peak current	RFC peak current	Nominal power at 230 V	Motor power at 230 V
	A	kW	hp	A	A	A	A	kW	hp
05200250	30	7.5	10	33	25	37.5	50	5.5	7.5
06200330	50	11	15	55	33	49.5	66	7.5	10
06200440	58	15	20	63.8	44	66	88	11	15

Table 5-2 400 V drive ratings (380 V to 480 V ±10 %)

Model	Normal Duty				Heavy Duty				
	Max cont output current	Nominal power at 400 V	Motor power at 460 V	Peak current	Max cont output current	Open loop peak current	RFC peak current	Nominal power at 400 V	Motor power at 460 V
	A	kW	hp	A	A	A	A	kW	hp
05400270	30.0	15.0	20.0	33.0	27.0	40.5	54.0	11.0	20.0
05400300	31.0	15.0	20.0	34.1	30.0	45.0	60.0	15.0	20.0
06400350	38.0	18.5	25.0	41.8	35.0	52.5	70.0	15.0	25.0
06400420	48.0	22.0	30.0	52.8	42.0	63.0	84.0	18.5	30.0
06400470	63.0	30.0	40.0	69.3	47.0	70.5	94.0	22.0	30.0

Table 5-3 575 V drive ratings (500 V to 575 V ±10 %)

Model	Normal Duty				Heavy Duty				
	Max cont output current	Nominal power at 575 V	Motor power at 575 V	Peak current	Max cont output current	Open loop peak current	RFC peak current	Nominal power at 575 V	Motor power at 575 V
	A	kW	hp	A	A	A	A	kW	hp
05500030	3.9	2.2	3	4.3	3	4.5	6	1.5	2
05500040	6.1	4	5	6.7	4	6	8	2.2	3
05500069	10	5.5	7.5	11	6.9	10.3	13.8	4	5.0
06500100	12	7.5	10	13.2	10	15	20	5.5	7.5
06500150	17	11	15	18.7	15	22.5	30	7.5	10
06500190	22	15	20	24.2	19	28.5	38	11	15
06500230	27	18.5	25	29.7	23	34.5	46	15	20
06500290	34	22	30	37.4	29	43.5	58	18.5	25
06500350	43	30	40	47.3	35	52.5	70	22	30

5.1.2 Power and current ratings (Derating for switching frequency and temperature)

Table 5-4 Maximum permissible continuous output current @ 40 °C (104 °F) ambient

Model	Normal Duty									Heavy Duty								
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies							Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies						
	kW	hp	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	kW	hp	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V																		
05200250	7.5	10	30					27.6	23.7	5.5	7.5	25				24.8	21.5	18.8
06200330	11	15	50					42.3	24.5	7.5	10	33.0					32	27
06200440	15	20	58				53	42.3	32.5	11	15	44.0				40	33	27.3
400 V																		
05400270	15	20	30			25.8	22.2	17.1	13.5	11	20	27	25.4	23.7	20.3	17.6	13.8	11.1
05400300	15	20	31			30.7	26.4	18.3	14.1	15	20	30		27.9	24	21	14.9	12.2
06400350	18.5	25	38					31	24.3	15	25	35				30	23	18.5
06400420	22	30	48				41	31	24.5	18.5	30	42			35	30	23	18.5
06400470	30	40	63		57	48	41	31	24.5	22	30	47	46	42	35	30	23	18.5
575 V																		
05500030	2.2	3.0	3.9							1.5	2.0	3.0						
05500040	4.0	5.0	6.1							2.2	3.0	4.0						
05500069	5.5	7.5	10							4.0	5.0	6.9						
06500100	7.5	10	12							5.5	7.5	10						
06500150	11	15	17						14.8	7.5	10	15						11.6
06500190	15	20	22					20.5	15	11	15	19					15.4	11.6
06500230	18.5	25	27				26.2	20	16	15	20	23				20	15.4	12.8
06500290	22	30	34			31	26.2	20	16.8	18.5	25	29			23.8	20	15.4	12.8
06500350	30	40	43		39.6	31	26.2	20	16.8	22	30	35	34	29.8	23.8	20	15.4	13

Table 5-5 Maximum permissible continuous output current @ 40 °C (104 °F) ambient with high IP insert installed

Model	Normal Duty							Heavy Duty						
	Maximum permissible continuous output current (A) for the following switching frequencies							Maximum permissible continuous output current (A) for the following switching frequencies						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V														
05200250	25.5	25.2	24.9	24.3	23.7	22.5	21.6	25.0		24.8	24.3	23.8	22.5	20.0
400 V														
05400270	17.1	15.6	14.4	12.6	11.4	9.6	8.7	17.3	15.7	14.6	12.7	11.3	9.7	8.6
05400300	19.8	19.5	18.9	17.7	16.4	14.0	11.8	19.8	19.5	18.9	17.7	16.2	13.8	11.7
575 V														
05500030	3.9							3.0						
05500040	6.1							4.0						
05500069	10.0							6.9						

Table 5-6 Maximum permissible continuous output current @ 50 °C (122 °F)

Model	Normal Duty							Heavy Duty						
	Maximum permissible continuous output current (A) for the following switching frequencies							Maximum permissible continuous output current (A) for the following switching frequencies						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V														
05200250	30				29.7	25.2	21.6	25				23	19.8	17.3
06200330	50				49	38	30	33					29	24.6
06200440	58			56	49	38	30.2	44			41	36	29	24.6
400 V														
05400270	25.5			23.6	20.4	15.6	12.3	24	23.5	21.6	18.6	16.2	12.7	10
05400300	25.5			23.6		15.9	12.3	24			21.9	19.2	13.8	10.5
06400350	38				37	28	21.4	35			32	27	21	16.5
06400420	48			43	36.5	27.4	21.4	42		38	32	27	21	16.5
06400470	63	58	52	43	37	28	21.4	47	42	38	32	27	21	16.5
575 V														
05500030	3.9							3.0						
05500040	6.1							4.0						
05500069	10							6.9						
06500100	12							10						
06500150	17						13.4	15					14	10.3
06500190	22					17.8	13.4	19					14	10.3
06500230	27				23.5	17.8	15	23			21.6	19	14	11.5
06500290	34			28.2	23.5	18	15	29		27.3	22	19	14	11.6
06500350	43.0	41.7	36.1	28	23.7	18	15	35	31.2	27.3	21.8	19	14	11.6

NOTE 55 °C ratings are available on request.

5.1.3 Power dissipation

Table 5-7 Losses @ 40° C (104° F) ambient

Model	Normal Duty									Heavy Duty								
	Nominal rating		Drive losses (W) taking into account any current derating for the given conditions							Nominal rating		Drive losses (W) taking into account any current derating for the given conditions						
	kW	hp	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	kW	hp	2 Khz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V																		
05200250	7.5	10	280	291	302	324	344	356	342	5.5	7.5	236	245	254	272	288	284	287
06200330	11	15	375	394	413	452	490	480	485	7.5	10	264	277	290	316	342	382	386
06200440	15	20	442	463	484	528	522	481	486	11	15	350	366	382	417	410	388	392
400 V																		
05400270	15	20	295	324	353	356	355	359	362	11	20	276	276	282	285	290	301	304
05400300	15	20	297	332	367	434	441	417	424	15	20	307	322	333	352	374	372	376
06400350	18.5	25	378	417	456	532	613	652	645	15	25	354	389	424	498	496	502	507
06400420	22	30	469	515	561	657	651	646	650	18.5	30	413	455	497	487	486	495	500
06400470	30	40	616	656	659	650	646	643	649	22	30	462	500	496	487	486	495	500
575 V																		
05500030	2.2	3	82	92	102	121	142	183	223	1.5	2	73	82	91	108	126	162	198
05500040	4	5	120	135	150	180	209	269	328	2.2	3	84	94	104	124	145	187	228
05500069	5.5	7.5	173	194	215	260	302	388	474	4	5	136	153	170	204	236	304	371
06500100	7.5	10	191	215	239	287	334	430	525	5.5	7.5	166	187	208	249	291	374	457
06500150	11	15	253	284	315	376	438	563	569	7.5	10	236	265	294	351	410	501	506
06500190	15	20	325	362	399	484	569	575	580	11	15	284	317	350	418	496	501	506
06500230	18.5	25	391	448	505	596	682	689	696	15	20	343	382	421	508	523	641	648
06500290	22	30	534	623	712	810	822	830	839	18.5	25	456	533	610	628	635	641	648
06500350	30	40	675	798	836	813	823	831	840	22	30	550	546	624	622	627	633	640

Table 5-8 Losses @ 40°C (104° F) ambient with high IP insert installed

Model	Normal Duty							Heavy Duty						
	Drive losses (W) taking into consideration any current derating for the given conditions							Drive losses (W) taking into consideration any current derating for the given conditions						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V														
05200250	188	194	201	212	222	240	262	186	195	201	214	226	247	256
400 V														
05400270	118	118	119	124	132	152	183	127	120	123	129	137	162	187
05400300	140	159	174	200	225	268	304	152	159	176	210	239	295	310
575 V														
05500030	32	42	52	71	92	133	173	23	32	41	58	76	112	148
05500040	70	85	100	130	159	219	278	34	44	54	74	95	137	178
05500069	123	144	165	210	252	338	424	86	103	120	154	186	254	321

Table 5-9 Losses @ 50° C (122° F) ambient

Model	Normal Duty							Heavy Duty						
	Drive losses (W) taking into account any current derating for the given conditions							Drive losses (W) taking into account any current derating for the given conditions						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
200 V														
05200250	280	291	302	324	341	325	312	236	245	254	272	268	261	264
06200330	375	394	413	452	480	431	594	264	277	290	316	342	346	352
06200440	442	463	484	510	483	432	451	350	366	382	389	369	341	353
400 V														
05400270	251	275	300	326	326	328	330	245	255	257	262	268	277	274
05400300	244	273	302	334	395	362	370	245	258	286	321	342	345	323
06400350	378	417	456	532	597	589	568	354	389	424	455	446	458	452
06400420	469	515	561	589	580	571	568	413	455	450	445	437	452	446
06400470	616	604	601	582	583	581	567	462	457	449	445	437	452	446
575 V														
05500030	82	92	102	121	142	183	223	73	82	91	108	126	162	198
05500040	120	135	150	180	209	269	328	84	94	104	124	145	187	228
05500069	173	194	215	260	302	388	474	136	153	170	204	236	304	371
06500100	191	215	239	287	334	430	525	166	187	208	249	291	374	457
06500150	253	284	315	376	438	563	515	236	265	294	351	410	466	449
06500190	325	362	399	482	569	500	519	284	317	350	418	496	455	449
06500230	391	448	505	596	612	613	652	343	382	421	478	497	583	582
06500290	534	623	712	737	737	747	749	456	533	573	581	603	583	587
06500350	675	774	763	734	742	748	750	550	501	573	568	595	576	571

Table 5-10 Power losses from the front of the drive when through-panel mounted

Frame size	Power loss
5	≤ 100 W
6	≤ 100 W

5.1.4 Temperature, humidity and cooling method

Ambient temperature operating range:

- 20 °C to 55 °C (- 4 °F to 131 °F).

Output current derating must be applied at ambient temperatures >40 °C (104 °F).

Cooling method: Forced convection

Maximum humidity: 95 % non-condensing at 40 °C (104 °F)

5.1.5 Supply requirements

AC supply voltage:

200 V drive: 200 V to 240 V ±10 %
400 V drive: 380 V to 480 V ±10 %
575 V drive: 500 V to 575 V ±10 %

Number of phases: 3

Maximum supply imbalance: 2 % negative phase sequence (equivalent to 3 % voltage imbalance between phases).

Frequency range: 45 to 66 Hz

For UL compliance only, the maximum supply symmetrical fault current must be limited to 100 kA

5.1.6 Line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network.

Where line reactors are to be used, reactance values of approximately 2 % are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop.

For all drive ratings, 2 % line reactors permit drives to be used with a supply unbalance of up to 3.5 % negative phase sequence (equivalent to 5% voltage imbalance between phases).

Severe disturbances may be caused by the following factors, for example:

- Power factor correction equipment connected close to the drive.
- Large DC drives having no or inadequate line reactors connected to the supply.
- Across the line (DOL) started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20 %.

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity.

When required, each drive must have its own reactor(s). Three individual reactors or a single three-phase reactor should be used.

Reactor current ratings

The current rating of the line reactors should be as follows:

Continuous current rating:

Not less than the continuous input current rating of the drive

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive

Table 5-11 2 % line reactors

Drive model number	Voltage rating	Line reactor designation	CT Part number	Line reactor current rating	Inductance	Weight	Length	Width	Height
	V			A	mH	kg	mm	mm	mm
05200250	200	INL2008	4401-0226	32	0.26	3.30	156	60	145
06200330	200	INL2004	4401-0146	48.8	0.17	4.8	156	75	145
06200440	200	INL2005	4401-0147	56.6	0.15	4.9	156	120	130
05400270	400	INL4013	4401-0236	32	0.48	4.9	156	75	145
05400300	400	INL4013	4401-0236	32	0.48	4.9	156	75	145
06400350	400	INL4006	4401-0154	36.5	0.4	8	206	140	200
06400420	400	INL4007	4401-0155	46.2	0.32	9	206	140	200
06400470	400	INL4008	4401-0156	60.6	0.24	11	255	125	195
05500030	575	INL5007	4401-0242	4.3	4.92	1.4	80	75	130
05500040	575	INL5008	4401-0243	6.8	3.11	1.8	156	70	125
05500069	575	INL5009	4401-0244	11.4	1.89	3.2	156	60	145
06500100	575	INL5001	4401-0157	13.2	1.6	3.5	156	60	145
06500150	575	INL5002	4401-0158	18.7	1.13	4.9	156	75	145
06500190	575	INL5003	4401-0159	24.3	0.87	6	206	95	200
06500230	575	INL5004	4401-0160	29.4	0.72	7.4	206	130	200
06500290	575	INL5005	4401-0161	37.1	0.57	11	230	130	210
06500350	575	INL5006	4401-0223	47	0.48	12.5	230	130	210

5.1.7 Motor requirements

No. of phases: 3

Maximum voltage:

200 V drive: 240 V
400 V drive: 480 V
575 V drive: 575 V

5.1.8 Storage

-40 °C (-40 °F) to +55 °C (131 °F) for long term storage, or to +70 °C (158 °F) for short term storage.

Storage time is 2 years.

Electrolytic capacitors in any electronic product have a storage period after which they require reforming or replacing.

The DC bus capacitors have a storage period of 10 years.

The low voltage capacitors on the control supplies typically have a storage period of 2 years and are thus the limiting factor.

Low voltage capacitors cannot be reformed due to their location in the circuit and thus may require replacing if the drive is stored for a period of 2 years or greater without power being applied.

It is therefore recommended that drives are powered up for a minimum of 1 hour after every 2 years of storage. This process allows the drive to be stored for a further 2 years.

5.1.9 Altitude

Altitude range: 0 to 3,000 m (9,900 ft), subject to the following conditions:

1,000 m to 3,000 m (3,300 ft to 9,900 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100 m (330 ft) above 1,000 m (3,300 ft)

For example at 3,000 m (9,900 ft) the output current of the drive would have to be de-rated by 20 %.

5.1.10 IP / UL Rating

The drive is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP65 rating (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required).

In order to achieve the high IP rating at the rear of the heatsink with drive size 5 it is necessary to seal a heatsink vent by installing the high IP insert.

The IP rating of a product is a measure of protection against ingress and contact to foreign bodies and water. It is stated as IP XX, where the two digits (XX) indicate the degree of protection provided as shown in Table 5-12

Table 5-12 IP Rating degrees of protection

First digit		Second digit	
Protection against foreign bodies and access to hazardous parts		Protection against ingress of water	
0	Non-protected	0	Non-protected
1	Protected against solid foreign objects of 50 mm ∅ and greater (back of a hand)	1	Protected against vertically falling water drops
2	Protected against solid foreign objects of 12.5 mm ∅ and greater (finger)	2	Protected against vertically falling water drops when enclosure tilted up to 15 °
3	Protected against solid foreign objects of 2.5 mm ∅ and greater (tool)	3	Protected against spraying water
4	Protected against solid foreign objects of 1.0 mm ∅ and greater (wire)	4	Protected against splashing water
5	Dust-protected (wire)	5	Protected against water jets
6	Dust-tight (wire)	6	Protected against powerful water jets
7	-	7	Protected against the effects of temporary immersion in water
8	-	8	Protected against the effects of continuous immersion in water

Table 5-13 UL enclosure ratings

UL rating	Description
Type 1	Enclosures are intended for indoor use, primarily to provide a degree of protection against limited amounts of falling dirt.
Type 12	Enclosures are intended for indoor use, primarily to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids.

5.1.11 Corrosive gasses

Concentrations of corrosive gases must not exceed the levels given in:

- Table A2 of EN 50178:1998
- Class 3C2 of IEC 60721-3-3

This corresponds to the levels typical of urban areas with industrial activities and/or heavy traffic, but not in the immediate neighborhood of industrial sources with chemical emissions.

Printed Circuit Board & Component Solder technology of M100-400 are conformal coated to survive environments as described by IEC60721-3-3 3C3 and EN60068-2-60 Meth. 4. This corresponds to the levels typical of urban areas with industrial activities and/or heavy traffic and in the immediate neighborhood of industrial sources with chemical emissions.

5.1.12 RoHS compliance

The drive meets EU directive 2011/65/EU for RoHS compliance.

5.1.13 Vibration

Maximum recommended continuous vibration level 0.14 g r.m.s. broad-band 5 to 200 Hz.

NOTE

This is the limit for broad-band (random) vibration. Narrow-band vibration at this level which coincides with a structural resonance could result in premature failure.

Bump Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard:IEC 60068-2-29: Test Eb:
Severity: 18 g, 6 ms, half sine
No. of Bumps: 600 (100 in each direction of each axis)

Random Vibration Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard:IEC 60068-2-64: Test Fh:
Severity: 1.0 m^2/s^3 (0.01 g^2/Hz) ASD from 5 to 20 Hz
-3 dB/octave from 20 to 200 Hz
Duration: 30 minutes in each of 3 mutually perpendicular axes.

Sinusoidal Vibration Test

Testing in each of three mutually perpendicular axes in turn.
Referenced standard: IEC 60068-2-6: Test Fc:
Frequency range: 5 to 500 Hz
Severity: 3.5 mm peak displacement from 5 to 9 Hz
10 m/s^2 peak acceleration from 9 to 200 Hz
15 m/s^2 peak acceleration from 200 to 500 Hz
Sweep rate: 1 octave/minute
Duration: 15 minutes in each of 3 mutually perpendicular axes.

EN 61800-5-1:2007, Section 5.2.6.4. referring to IEC 60068-2-6

Frequency range: 10 to 150 Hz
Amplitude: 10 to 57 Hz at 0.075 mm pk
57 to 150 Hz at 1g p
Sweep rate: 1 octave/minute
Duration: 10 sweep cycles per axis in each of 3 mutually perpendicular axes

5.1.14 Starts per hour

By electronic control: unlimited

By interrupting the AC supply: ≤20 (equally spaced)

5.1.15 Start up time

This is the time taken from the moment of applying power to the drive, to the drive being ready to run the motor:

Sizes 5 and 6 = 2.5 s

For faster start up time a 24V backup supply can be used, see section 4.5 *24 Vdc supply* on page 54.

5.1.16 Output frequency / speed range

***Unidrive Mxxx* models:**

In all operating modes (Open loop, RFC-A, RFC-S) the maximum output frequency is limited to 550 Hz.

***Unidrive HSxx* models:**

In open loop mode the maximum achievable output frequency is 3,000 Hz.

In RFC-A and RFC-S modes, the maximum achievable output frequency is 1,250Hz.

In RFC-S mode the speed is also limited by the voltage constant (Ke) of the motor unless field weakening operation is enabled. Ke is a specific constant for the servo motor being used. It can normally be found on the motor data sheet in V/k rpm (volts per 1,000 rpm).

It is recommended that a minimum ratio of 12:1 is maintained between the switching frequency and the maximum output frequency to maintain the quality of the output waveform. If this minimum ratio is exceeded, extra motor losses will result due to the increased harmonic content of the output waveform.

5.1.17 Accuracy and resolution

Speed:

The absolute frequency and speed accuracy depends on the accuracy of the crystal used with the drive microprocessor. The accuracy of the crystal is 100 ppm, and so the absolute frequency/speed accuracy is 100 ppm (0.01 %) of the reference, when a preset speed is used. If an analog input is used the absolute accuracy is further limited by the absolute accuracy of the analog input.

The following data applies to the drive only; it does not include the performance of the source of the control signals.

Open loop resolution:

Preset frequency reference: 0.1 Hz
Precision frequency reference: 0.001 Hz

Closed loop resolution

Preset speed reference: 0.1 rpm
Precision speed reference: 0.001 rpm
Analog input 1: 11 bit plus sign
Analog input 2: 11 bit plus sign

Current:

The resolution of the current feedback is 10 bit plus sign.

Accuracy: typical 2 %

worst case 5 %

5.1.18 Acoustic noise

The heatsink fan generates the majority of the sound pressure level at 1 m produced by the drive. The heatsink fan is a variable speed fan. The drive controls the speed at which the fan runs based on the temperature of the heatsink and the drive's thermal model system.

Table 5-14 gives the sound pressure level at 1 m produced by the drive when running at maximum normal and heavy duty current and when the heatsink fan is running at minimum speed.

Table 5-14 Acoustic noise data

Size	Max ND operation dBA	Max HD operation* dBA	Min fan speed dBA
5	61.1	56.9	41.9
6	65.3	55.6	48.2

*At 40 °C ambient and 3 kHz switching frequency.

5.1.19 Overall dimensions

H Height including surface mounting brackets
W Width
D Projection forward of panel when surface mounted
F Projection forward of panel when through-panel mounted
R Projection rear of panel when through-panel mounted

Table 5-15 Overall drive dimensions

Size	Dimension				
	H	W	D	F	R
5	391 mm (15.39 in)	143 mm (5.63 in)	200 mm (7.87 in)	135 mm (5.32 in)	67 mm (2.64in)
6	391 mm (15.39 in)	210 mm (8.27 in)	227 mm (8.94 in)	131 mm (5.16 in)	96 mm (3.78 in)

5.1.20 Weights

Table 5-16 Overall drive weights

Size	Model	kg	lb
5	All variants	7.4	16.30
6	All variants	14	30.90

5.1.21 Input current, fuse and cable size ratings

The input current is affected by the supply voltage and impedance.

Typical input current

The values of typical input current are given to aid calculations for power flow and power loss. The values of typical input current are stated for a balanced supply.

Maximum continuous input current

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with bad balance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2 % negative phase-sequence imbalance and rated at the maximum supply fault current given in Table 5-17.

Table 5-17 Supply fault current used to calculate maximum input currents

Model	Symmetrical fault level (kA)
All	100

Fuses

The AC supply to the drive must be installed with suitable protection against overload and short-circuits. Table 5-18, Table 5-19 and Table 5-20 show the recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

Table 5-18 AC Input current and fuse ratings (200 V)

Model	Typical input current	Maximum continuous input current	Maximum overload input current	Fuse rating					
				IEC			UL / USA		
				Nominal	Max	Class	Nominal	Max	Class
	A	A	A	A	A		A	A	
05200250	24	31	52	40	40	gG	40	40	CC, J or T*
06200330	42	48	64	63	63	gG	60	60	CC, J or T*
06200440	49	56	85				60		

Table 5-19 AC Input current and fuse ratings (400 V)

Model	Typical input current	Maximum continuous input current	Maximum overload input current	Fuse rating					
				IEC			UL / USA		
				Nominal	Max	Class	Nominal	Max	Class
	A	A	A	A	A		A	A	
05400270	26	29	52	40	40	gG	35	35	CC, J or T*
05400300	27	30	58						
06400350	32	36	67	63	63	gR	40	60	CC, J or T*
06400420	41	46	80				50		
06400470	54	60	90				60		

Table 5-20 AC Input current and fuse ratings (575 V)

Model	Typical input current	Maximum continuous input current	Maximum overload input current	Fuse rating					
				IEC			UL / USA		
				Nominal	Maximum	Class	Nominal	Maximum	Class
	A	A	A	A	A		A	A	
05500030	4	4	7	10	20	gG	10	10	CC, J or T*
05500040	6	7	9						
05500069	9	11	15	20			20	20	
06500100	12	13	22	20	40	gG	20	30	CC, J or T*
06500150	17	19	33	32			25		
06500190	22	24	41	40			30		
06500230	26	29	50	50	63		35	50	
06500290	33	37	63				40		
06500350	41	47	76	63			50		

* These fuses are fast acting.

NOTE Ensure cables used suit local wiring regulations.

CAUTION

The nominal cable sizes below are only a guide. The mounting and grouping of cables affects their current-carrying capacity, in some cases smaller cables may be acceptable but in other cases a larger cable is required to avoid excessive temperature or voltage drop. Refer to local wiring regulations for the correct size of cables.

Table 5-21 Cable ratings (200 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Max	Install method	Nominal	Max	Install method	Nominal	Max	Nominal	Max
05200250	10	10	B2	10	10	B2	8	8	8	8
06200330	16	25	B2	16	25	B2	4	3	4	3
06200440	25			25			3		3	

Table 5-22 Cable ratings (400 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Max	Install method	Nominal	Max	Install method	Nominal	Max	Nominal	Max
05400270	6	6	B2	6	6	B2	8	8	8	8
05400300										
06400350	10	25	B2	10	25	B2	6	3	6	3
06400420	16			16			4		4	
06400470	25			25			3		3	

Table 5-23 Cable ratings (575 V)

Model	Cable size (IEC) mm^2						Cable size (UL) AWG			
	Input			Output			Input		Output	
	Nominal	Max	Install method	Nominal	Max	Install method	Nominal	Max	Nominal	Max
05500030	0.75	1.5	B2	0.75	1.5	B2	16	16	16	16
05500040	1			1			14		14	
05500069	1.5			1.5			14		14	
06500100	2.5	25	B2	2.5	25	B2	14	3	14	3
06500150	4			4			10		10	
06500190	6			6			10		10	
06500230	10			10			8		8	
06500290							6		6	
06500350	16						6		6	

5.1.22 Maximum motor lengths and types

Since capacitance in the motor cable causes loading on the output of the drive, ensure the cable length does not exceed the values given in Table 5-24.

Use 105 °C (221 °F) (UL 60/75 °C temp rise) PVC-insulated cable with copper conductors having a suitable voltage rating, for the following power connections:

- AC supply to external EMC filter (when used)
- AC supply (or external EMC filter) to drive
- Drive to motor
- Drive to braking resistor

Table 5-24 Maximum motor cable lengths

Model	Maximum permissible motor cable length for each of the following switching frequencies						
	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	12 kHz	16 kHz
Size 5	200 m (660 ft)		150 m (490 ft)	100 m (330 ft)	75 m (245 ft)	50 m (165 ft)	37 m (120 ft)
Size 6							

- Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.
- The default switching frequency is 3 kHz for Open-loop and RFC-A and 6 kHz for RFC-S mode.

The maximum cable length is reduced from that shown in Table 5-24 if high capacitance or reduced diameter motor cables are used, refer to section 4.9.2 *High-capacitance / reduced diameter cables* on page 58

5.1.23 Braking resistor values

Table 5-25 Minimum resistance values and peak power rating for the braking resistor at 40 °C (104 °F)

Model	Minimum resistance * Ω	Instantaneous power rating kW	Continuous power rating kW
200 V			
05200250	19	8.9	8.6
06200330	10	16.9	12.6
06200440			16.4
400 V			
05400270	38	17.8	16.2
05400300	22	30.8	19.6
06400350	20	33.8	21.6
06400420			25
06400470			32.7
575 V			
05500030	80	12.1	2.6
05500040			4.6
05500069			6.5
06500100	15	64.1	8.7
06500150			12.3
06500190			16.3
06500230			19.9
06500290			24.2
06500350			31.7

* Resistor tolerance: ±10 %. The minimum resistance specified are for stand-alone drive systems only. If the drive is to be used as part of a common DC bus system different values may be required. Contact the supplier of the drive for more information.

5.1.24 Torque settings

Table 5-26 Drive control and relay terminal data

Model	Connection type	Torque setting
All	Plug-in terminal block	0.5 N m (0.4 lb ft)

Table 5-27 Drive power terminal data

Frame size	AC and motor terminals		DC and braking		Ground terminal	
	Recommended	Maximum	Recommended	Maximum	Recommended	Maximum
5	Plug-in terminal block		T20 Torx (M4) / M4 Nut (7 mm AF)		M5 Nut (8 mm AF)	
	1.5 N m (1.1 lb ft)	1.8 N m (1.3 lb ft)	1.5 N m (1.1 lb ft)	2.5 N m (1.8 lb ft)	2.0 N m (1.4 lb ft)	5.0 N m (3.7 lb ft)
6	M6 Nut (10 mm AF)		M6 Nut (10 mm AF)		M6 Nut (10 mm AF)	
	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m (4.4 lb ft)	8.0 N m (6.0 lb ft)	6.0 N m(4.4 lb ft)	8.0 N m (6.0 lb ft)

Table 5-28 Plug-in terminal block maximum cable sizes

Frame size	Terminal block description	Max cable size
All	11 way control connectors	1.5 mm^2 (16 AWG)
	2 way relay connector	2.5 mm^2 (12 AWG)
5	3 way AC power connector 3 way motor connector	8 mm^2 (8 AWG)
6	2 way low voltage power 24 V supply connector	1.5 mm^2 (16 AWG)

Table 5-29 External EMC filter terminal data

CT part number	Power connections		Ground connections	
	Max cable size	Max torque	Ground stud size	Max torque
4200-0122	16 mm^2 (6 AWG)	2.3 N m (1.7 lb ft)	M6	4.8 N m (2.8 lb ft)
4200-0312		1.8 N m (1.4 lb ft)		
4200-0402				
4200-2300	16 mm^2 (6 AWG)	2.3 N m (1.70 lb ft)		
4200-4800				
4200-3690				

5.1.25 Electromagnetic compatibility (EMC)

This is a summary of the EMC performance of the drive. For full details, refer to the *EMC Data Sheet* which can be obtained from the supplier of the drive.

Table 5-30 Immunity compliance

Standard	Type of immunity	Test specification	Application	Level
IEC 61000-4-2 EN61000-4-2:2009	Electrostatic discharge	6 kV contact discharge 8 kV air discharge	Module enclosure	Level 3 (industrial)
IEC 61000-4-3 EN61000-4-3:2006+A2:2010	Radio frequency radiated field	10 V/m prior to modulation 80 - 1000 MHz 80 % AM (1 kHz) modulation	Module enclosure	Level 3 (industrial)
IEC61000-4-4 EN61000-4-4:2012	Fast transient burst	5/50 ns 2 kV transient at 5 kHz repetition frequency via coupling clamp	Control lines	Level 4 (industrial harsh)
		5/50 ns 2 kV transient at 5 kHz repetition frequency by direct injection	Power lines	Level 3 (industrial)
IEC61000-4-5 EN61000-4-5:2014	Surges	Common mode 4 kV 1.2/50 μs waveshape	AC supply lines: line to ground	Level 4
		Differential mode 2 kV1.2/50 μs waveshape	AC supply lines: line to line	Level 3
		Lines to ground	Signal ports to ground*	Level 2
IEC61000-4-6 EN61000-4-6:2014	Conducted radio frequency	10V prior to modulation 0.15 - 80 MHz 80 % AM (1 kHz) modulation	Control and power lines	Level 3 (industrial)
IEC61000-4-11 EN61000-4-11:2004	Voltage dips and interruptions	-30 % 10 ms +60 % 100 ms -60 % 1 s <-95 % 5 s	AC power ports	
IEC61000-6-1 EN61000-6-1:2007	Generic immunity standard for the residential, commercial and light - industrial environment			Complies
IEC61000-6-2 EN61000-6-2:2005	Generic immunity standard for the industrial environment			Complies
IEC61800-3 EN 61800-3: 2004+A1:2012	Product standard for adjustable speed power drive systems (immunity requirements)		Meets immunity requirements for first and second environments	

* See section 4.12.6 *Variations in the EMC wiring* on page 79 for possible requirements regarding grounding and external surge protection of the control ports.

Emission

The drive contains an in-built filter for basic emission control. An additional optional external filter provides further reduction of emission. The requirements of the following standards are met, depending on the motor cable length and switching frequency.

Table 5-31 Size 5 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	**3**	**4**	**6**	**8**	**12**	**16**
Using internal filter:							
0 – 2	C3		C4				
Using internal filter and ferrite ring (1 turn – no advantage to 2 turns):							
0 – 2	C3					C4	
0 – 5	C3			C4			
0 – 7	C3		C4				
0 – 10	C3	C4					
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 5-32 Size 5 emission compliance (400 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	**3**	**4**	**6**	**8**	**12**	**16**
Using internal filter:							
0 – 4	C3			C4			
0 – 10	C3	C4					
No advantage to using ferrite ring							
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 5-33 Size 5 emission compliance (575 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	**3**	**4**	**6**	**8**	**12**	**16**
Using internal filter:							
-	C4						
Using internal filter and ferrite ring (2 turns):							
0 – 4	C3			C4			
0 – 2	C3					C4	
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 5-34 Size 6 emission compliance (200 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 2	C3		C4				
Using internal filter and ferrite ring (1 turn – no advantage to 2 turns):							
0 – 2	C3					C4	
0 – 5	C3			C4			
0 – 7	C3		C4				
0 – 10	C3	C4					
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 5-35 Size 6 emission compliance (400 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
0 – 4	C3			C4			
0 – 10	C3	C4					
No advantage to using ferrite ring							
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Table 5-36 Size 6 emission compliance (575 V drives)

Motor cable length (m)	Switching Frequency (kHz)						
	2	3	4	6	8	12	16
Using internal filter:							
-	C4						
Using internal filter and ferrite ring (2 turns):							
0 – 4	C3			C4			
0 – 2	C3					C4	
Using external filter:							
0 – 20	R (C1)	R (C1)	I (C2)	I (C2)	I (C2)	I (C2)	I (C2)
20 – 100	I (C2)	I (C2)	C3	C3	C3	C3	C3

Key (shown in decreasing order of permitted emission level):

E2R EN 61800-3: 2004+A1:2012 second environment, restricted distribution (Additional measures may be required to prevent interference)

E2U EN 61800-3: 2004+A1:2012 second environment, unrestricted distribution

I Industrial generic standard EN 61000-6-4:2007+A1:2011

EN 61800-3: 2004+A1:2012 first environment restricted distribution (The following caution is required by EN 61800-3: 2004+A1:2012)

This is a product of the restricted distribution class according to IEC 61800-3. In a residential environment this product may cause radio interference in which case the user may be required to take adequate measures.

R Residential generic standard EN 61000-6-3:2007+A1:2011
EN 61800-3: 2004+A1:2012 first environment unrestricted distribution

EN 61800-3: 2004+A1:2012 defines the following:

- The first environment is one that includes residential premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for residential purposes.
- The second environment is one that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for residential purposes.
- Restricted distribution is defined as a mode of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives.

IEC 61800-3 and EN 61800-3: 2004+A1:2012

The 2004 revision of the standard uses different terminology to align the requirements of the standard better with the EC EMC Directive.

Power drive systems are categorized C1 to C4:

Category	Definition	Corresponding code used above
C1	Intended for use in the first or second environments	R
C2	Not a plug-in or movable device, and intended for use in the first environment only when installed by a professional, or in the second environment	I
C3	Intended for use in the second environment, not the first environment	E2U
C4	Intended for use in the second environment in a system rated at over 400 A, or in a complex system	E2R

Note that category 4 is more restrictive than E2R, since the rated current of the PDS must exceed 400 A or the supply voltage exceed 1000 V, for the complete PDS.

5.2 Optional external EMC filters

Table 5-37 EMC filter cross reference

Model	CT part number
200 V	
05200250	4200-0312
06200330 to 06200440	4200-2300
400 V	
05400270 to 05400300	4200-0402
06400350 to 06400470	4200-4800
575 V	
05500030 to 05500069	4200-0122
06500100 to 06500350	4200-3690

5.2.1 EMC filter ratings

Table 5-38 Optional external EMC filter details

Part number	Maximum continuous current		Voltage rating		IP rating	Power dissipation at rated current		Ground leakage		Discharge resistors
	@ 40 °C (104 °F)	@ 50 °C (122 °F)	IEC	UL		@ 40 °C (104 °F)	@ 50 °C (122 °F)	Balanced supply phase-to-phase and phase-to-ground	Worst case	
	A	A	V	V		W	W	mA	mA	MΩ
4200-0312	31	28.5	250	300	20	20	17	2.0	80	1.68
4200-2300	55	51	250	300		41	35	4.2	69	
4200-0402	40	36.8	528	600		47	40	18.7	197	
4200-4800	63	58	528	600		54	46	11.2	183	
4200-0122	12	11	760	600		9	9	15.2	285	
4200-3690	42	39	760	600		45	39	12	234	

5.2.2 Overall EMC filter dimensions

Table 5-39 Optional external EMC filter dimensions

Part number	Dimension (mm)						Weight	
	H		W		D			
	mm	inch	mm	inch	mm	inch	kg	lb
4200-0312	437	17.20	143	5.63	60	2.36	5.5	12.13
4200-2300	434	17.09	210	8.27	60	2.36	6.5	14.30
4200-0402	437	17.20	143	5.63	60	2.36	5.5	12.13
4200-4800	434	17.09	210	8.27	60	2.36	6.7	14.80
4200-0122	437	17.20	143	5.63	60	2.36	5.5	12.13
4200-3690	434	17.09	210	8.27	60	2.36	7.0	15.40

5.2.3 EMC filter torque settings

Table 5-40 Optional external EMC Filter terminal data

Part number	Power connections		Ground connections	
	Max cable size	Max torque	Ground stud size	Max torque
4200-0122	16 mm^2 (6 AWG)	2.3 N m (1.7 lb ft)	M6	5.0 N m (3.7 lb ft)
4200-0312		1.8 N m (1.4 lb ft)		
4200-0402				
4200-2300	16 mm^2 (6 AWG)	2.3 N m (1.70 lb ft)		5.0 N m (3.7 lb ft)
4200-4800				
4200-3690				

6 UL listing information

6.1 UL file reference

All products covered by this Guide are UL Listed to both Canadian and US requirements. The UL file reference is: NMMS/7.E171230.

Products that incorporate the Safe Torque Off function have been investigated by UL. The UL file reference is: FSPC.E171230.

6.2 Option modules, kits and accessories

All Option Modules, Control Pods and Installation Kits supplied by Nidec Industrial Automation for use with these drives are UL Listed.

6.3 Enclosure ratings

Open Type

With the exception of free-standing cubicle drives, all models are Open Type as supplied. The drive housing is not rated as a fire enclosure. A separate fire enclosure must be provided.

Type 1

When fitted with a conduit box the drives meet the requirements for UL Type 1. Type 1 enclosures are intended for indoor use, primarily to provide a degree of protection against limited amounts of falling dirt.

Plenum rating with conduit box

When fitted with a conduit box, the drives comply with the requirements in the Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043.

Through-hole mounting

The drives meet the requirements for UL Type 12 when installed inside a Type 12 enclosure with the heatsink through-hole mounted using the sealing kit and the high-IP insert (where provided).

When through-hole mounted, the drives are suitable for use in surrounding air temperatures up to 40 °C.

When the drive is through-panel mounted, the main terminal cover(s) must be removed in order to provide access to the mounting holes. Once the drive has been mounted, the terminal cover(s) can be replaced.

The tightening torque of the securement brackets shall be advised as being 3 N m (26.6 lb.in).

Remote Keypads

Remote keypads are UL Type 12 when installed with the sealing washer and fixing kit provided.

6.4 Mounting

Drives can be mounted directly onto a vertical surface. This is known as 'surface' or 'standard' mounting. Refer to section 3.4.2 *Surface mounting* on page 28 for further information.

Drives can be installed side by side with recommended spacing between them. This is known as 'bookcase' mounting. Refer to section 3.5 *Enclosure for standard drives* on page 31 for further information.

Some drives can be mounted on their side. This is known as 'tile' mounting. Suitable tile mounting kits are available from Nidec Industrial Automation. Refer to section 3.4.5 *Tile mounting* on page 30 for further information.

Drives fitted with a conduit box can be mounted directly onto a wall or other vertical surface without additional protection. Suitable conduit boxes are available from Nidec Industrial Automation.

Some drives may be through-hole mounted. Mounting brackets and sealing kits are available from Nidec Industrial Automation. Refer to section 3.4.3 *Through-panel mounting* on page 29 for further information.

Remote Keypads can be mounted on the outside of a UL Type 12 enclosure. A sealing and mounting kit is provided with the keypad.

6.5 Environment

Drives must be installed in a Pollution Degree 2 environment or better (dry, non-conductive pollution only). All drives are capable of delivering full rated output current at surrounding air temperatures up to 40 °C

Drives with model numbers beginning M100, M101, M200, M201, M300 or M400, with frame sizes 1 to 4 may be operated in surrounding air temperatures up to 50 °C at de-rated current. All other drives, for example M600, M700, M701, M702 etc. may be operated in surrounding air temperatures up to 55 °C at de-rated current.

6.6 Electrical Installation

TERMINAL TORQUE

Terminals must be tightened to the rated torque as specified in the Installation Instructions. Refer to section 3.12 *Terminal size and torque settings* on page 45 for further information.

WIRING TERMINALS

Drives must be installed using cables rated for 75 °C operation, copper wire only.

GROUND CONNECTION INSTRUCTIONS

UL Listed closed-loop connectors sized according to the field wiring shall be used for grounding. Refer to section 4.1.1 *Ground connections* on page 51 for further information.

BRANCH CIRCUIT PROTECTION

The fuses and circuit breakers required for branch circuit protection are contained in the Installation Instructions.

OPENING OF BRANCH CIRCUIT

Opening of the branch-circuit protective device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, the equipment should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local "codes".

6.7 Motor overload protection and thermal memory retention

All drives incorporate internal overload protection for the motor load that does not require the use of an external or remote overload protection device.

The protection level is adjustable and the method of adjustment is provided in the *Control User Guide*. Maximum current overload is dependent on the values entered into the current limit parameters (motoring current limit, regenerative current limit and symmetrical current limit entered as percentage) and the motor rated current parameter (entered in amperes).

The duration of the overload is dependent on motor thermal time constant (variable up to a maximum of 3000 seconds). The default overload protection is set such that the product is capable of 150 % of the current value entered into the motor rated current parameter for 60 seconds.

The drives are provided with user terminals that can be connected to a motor thermistor to protect the motor from high temperature, in the event of a motor cooling fan failure.

The method of adjustment of the overload protection is provided in the Installation Instructions shipped with the product.

All models are provided with thermal memory retention.

6.8 Electrical supply

The drives are suitable for use on a circuit capable of delivering not more than 100,000 RMS Symmetrical Amperes, at rated voltage when protected by fuses as specified in the Installation Instructions.

Some smaller drives are suitable for use on a circuit capable of delivering not more than 10,000 RMS Symmetrical Amperes, at rated voltage when protected by circuit breakers as specified in the Installation Instructions.

6.9 External Class 2 supply

The external power supply used to power the 24 V control circuit shall be marked: "UL Class 2". The power supply voltage shall not exceed 24 Vdc.

6.10 Requirement for Transient Surge Suppression

This requirement applies to drives with rated input voltage = 575 V, Frame Size 7 only.

TRANSIENT SURGE SUPPRESSION SHALL BE INSTALLED ON THE LINE SIDE OF THIS EQUIPMENT AND SHALL BE RATED 575 Vac (PHASE TO GROUND), 575 Vac (PHASE TO PHASE), SUITABLE FOR OVERVOLTAGE CATEGORY III, AND SHALL PROVIDE PROTECTION FOR A RATED IMPULSE VOLTAGE TO WITHSTAND VOLTAGE PEAK OF 6 kV AND A CLAMPING VOLTAGE OF MAXIMUM 2400 V.

6.11 Group Installation and Modular Drive Systems

Drives with DC+ and DC- supply connections, with 230 V or 480 V supply voltage rating, are UL approved for use in modular drive systems as inverters when supplied by the converter sections: Mentor MP25A, 45A, 75A, 105A, 155A or 210A range manufactured by Nidec Industrial Automation.

Alternatively, the inverters may be supplied by converters from the Unidrive-M range manufactured by Nidec Industrial Automation.

In these applications the inverters are required to be additionally protected by supplemental fuses.

Drives have not been evaluated for other Group Installation applications, for example where a single inverter is wired directly to two or more motors. In these applications, additional thermal overload protection is needed. Contact Nidec Industrial Automation for further details.

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