Power Installation Guide

Power Module Frame 12

Universal Variable Speed AC Drive

Part Number 0478-0613-06 Issue 6

Compliance Information

Manufacturer: Nidec Control Techniques Limited ("we", "our")
Registered office: The Gro, Newtown, Powys, SY16 3BE United Kingdom
Registered in: England and Wales, company registration number 01236886
Manufacturer's EU Authorised Representative: Nidec Netherlands B.V., Kubus 155, 3364 DG Sliedrecht, the Netherlands, registered at the Dutch Trade Register under number 33213151; Tel. +31 (0)184 420 555, info.nl@mail.nidec.com

Original instructions

With reference to the UK Supply of Machinery (Safety) Regulations 2008 and the EU Machinery Directive 2006/42/EC, the English version of this Manual constitutes the original instructions. Manuals published in other languages are translations of the original instructions and the English language version of this Manual prevails over any other language version in the event of inconsistency.

Documentation and user software tools

Manuals, datasheets and software that we make available to users of our products can be downloaded from: **http://www.drive-setup.com**
Manuals may be accompanied by an Errata list. This will be located alongside the manuals if applicable.

Warranty and liability

The contents of this Manual are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs, specifications or performance of our products at any time without notice. For full details of the warranty terms applicable to the product, contact the supplier of the product.

In no event and under no circumstances shall we be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosion, or failures due to operation outside the published ratings for the product, nor shall we be liable for consequential and incidental damages of any kind.

Environmental management

We operate an Environmental Management System which complies with the requirements of ISO 14001:2015. Further information on our Environmental Statement can be found at: **http://www.drive-setup.com/environment**.

Restriction and control of hazardous substances

The products covered by this Manual comply with the following legislation and regulations on the restriction and control of hazardous substances:

UK Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
UK REACH etc. (Amendment etc.) (EU Exit) Regulations 2020, European Union REACH Regulation EC 1907/2006
EU restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) - Directive 2011/65/EU
EC Regulation 1907/2006 on the Registration, Evaluation, authorisation, and restriction of Chemicals (REACH)
Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products 2016/07/01
U.S. Environmental Protection Agency ("EPA") regulations under the Toxic Substances Control Act ("TSCA")
MEPC 68/21 / Add.1, Annex 17, Resolution MEPC.269(68) 2015 Guidelines for the development of the inventory of hazardous materials

The products covered by this Manual do not contain asbestos.

Further information on REACH and RoHS can be found at: **http://www.drive-setup.com/environment**.

Conflict minerals

With reference to the Conflict Minerals (Compliance) (Northern Ireland) (EU Exit) Regulations 2020, the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act and Regulation (EU) 2017/821 of the European Parliament and of the European Council:

We have implemented due diligence measures for responsible sourcing, we conduct conflict minerals surveys of relevant suppliers, we continually review due diligence information received from suppliers against company expectations and our review process includes corrective action management. We are not required to file an annual conflict minerals disclosure. Nidec Control Techniques Limited is not an issuer as defined by the U.S. SEC.

Disposal and recycling (WEEE)

The products covered by this Manual fall within the scope of the UK Waste Electrical and Electronic Equipment Regulations 2013, EU Directive 2012/19/EU amended by EU Directive 2018/849 (EU) on Waste Electrical and Electronic Equipment (WEEE).

When electronic products reach the end of their useful life, they must not be disposed of along with domestic waste but should be recycled by a specialist recycler of electronic equipment. Our products are designed to be easily dismantled into their major component parts for efficient recycling. Most materials used in our products are suitable for recycling.

Our product packaging is of good quality and can be re-used. Smaller products are packaged in strong cardboard cartons which have a high recycled fibre content. Cartons can be re-used and recycled. Polythene, used in protective film and bags for the ground screws, can be recycled. When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

Contents

1 Safety information 10
1.1 Warnings, Cautions and Notes 10
1.2 General information 10
1.3 Responsibility 10
1.4 Compliance with regulations 10
1.5 Electrical hazards 10
1.6 Stored electrical charge 10
1.7 Mechanical hazards 10
1.8 Access to equipment 10
1.9 Environmental limits 10
1.10 Hazardous environments 10
1.11 Motor 11
1.12 Mechanical brake control 11
1.13 Adjusting parameters 11
1.14 Electromagnetic compatibility (EMC) 11

2 Product information 12
2.1 Drive software version 12
2.2 Model number 12
2.3 Nameplate description 13
2.4 Ratings 14
2.5 Product features 16

3 Mechanical installation 21
3.1 Safety information 21
3.2 Planning the installation 22
3.3 Lifting the Power Module 23
3.4 Cubicle assembly 23
3.5 Cubicle fitting kits 23
3.6 Dimensions 24
3.7 Typical drive and incomer layout 25
3.8 Input and output wiring kits 26
3.9 Tools required for installation 27
3.10 Cubicle roof plate (VX25) 28
3.11 Installing cubicle door ventilation 30
3.12 Installation of power module into cubicle 31
3.13 Terminal cover removal 47
3.14 External EMC filter 48
3.15 Electrical terminals 50
3.16 Terminal sizes and torque settings 51
3.17 Routine maintenance 51
3.18 Replacement of serviceable parts 51
3.19 Short Circuit Current Rating (SCCR) label 52

4 Electrical Installation 53
4.1 Power connections 54
4.2 Fitting line reactors 54
4.3 Output short circuit protection 55
4.4 Motor overload protection 55
4.5 Use of a residual current device (RCD) 55
4.6 Supply requirements 56
4.7 Cable sizes and fuse ratings 58
4.8 Output circuit and motor protection 61
4.9 Input and output cables 62
4.10 Braking 62
4.11 Ground leakage 64
4.12 EMC (Electromagnetic compatibility) 65

5 Technical data 71
5.1 Drive technical data 71
5.2 Optional external EMC filters 76
5.3 Charging capacitance 77

6 UL Information 78

UK Declaration of Conformity

1. Product range

Unidrive-M, Commander, Digitax HD and derivative products. Adjustable speed AC motor drives, including option modules and accessories.

2. Name and address of the manufacturer

Nidec Control Techniques Ltd
The Gro
Newtown
Powys
SY16 3BE
UK

Registered in England and Wales. Company Reg. No. 01236886
Telephone: 00 44 1686 612000
E mail: cthoadmin@mail.nidec.com
Web: www.controltechniques.com

3. Responsibility

This declaration is issued under the sole responsibility of the manufacturer.

4. Object of the declaration

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	C200, C300, M100, M101, M200, M201, M300, M400, M600, M608, M700, M701, M702, M708, M709, M750, M751, M753, M754, M880, M881, M882, M888, M889, E300, E301, F300, F600, H300, HS30, HS70, HS71, HS72, M000, RECT
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12
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 with internal choke, D = Inverter, E = 6P Rectifier + Inverter, T = 12P Rectifier + Inverter

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

Accessories (may not be suitable for every drive listed above)

Category	Description
Option modules	SI-Applications Compact, SI-Applications Plus, SI- BACnet IP, SI-CANopen V2, SI-CiA417, SI-DeviceNet, SI-DCP, SI-Encoder V2, SI-EtherCAT, SI-Ethernet, SI-Interbus 500kBd, SI-Interbus 2MBd, SI-IO, SI-IO 24 Plus, SI-Powerlink, SI-PROFIBUS, SI-PROFINET V2, SI-PROFINET RT, SI-Option mounting kit, SI-Universal Encoder, Encoder breakout kit, PTi210, PTi210 V2, SI-Safety, SI-SLM, SI-Varan, MCi200, MCi200 V2, MCi210, MCi210 V2, MiS210, MiS250, KI-485 Adaptor, AI-485 Adaptor, AI-485 Adaptor 24V, AI-Backup adaptor, AI-Smart adaptor
Control pods	Mxxx-STANDARD011100A0100, Mxxx-MASTER11100A0100, M000-FOLLOWER011100A0100 Where Mxxx denotes M600, M700, M701, M702, HS70, HS71 or HS72
Displays, keypads and other accessories	KI-Keypad, KI-Keypad RTC, KI-HOA keypad RTC, KI-Compact Display, KI-Compact 485 adaptor, Remote Keypad (LCD), Remote Keypad RTC, CI-Keypad, CI-485 Adaptor, Capacitor module M75C, External DC cable connection kit, Multi axis kit (standard – with and without SI option mounting kit fitted), Cable grommet kit, External EMC filter, Fan replacement kit, Input inductor, Vent kit, Compact brake resistor kit, External brake resistor 20/40 or 80 ohm, Digitax HD to Uni M panel mounted & through hole mounted DC bus paralleling kits

5. Declaration

The object of the declaration is in conformity with the relevant UK statutory requirements:

Electrical Equipment (Safety) Regulations 2016
Electromagnetic Compatibility Regulations 2016
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

The Ecodesign for Energy-Related Products Regulations 2021 No. 745:

6. References to the relevant designated British standards

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

EN 61800-5-1:2007 + A1:2017 + A11: 2021	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
BS EN 61800-3: 2018	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
BS EN 61000-6-2: 2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
BS EN 61000-6-4: 2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
BS EN 61000-3-2:2019+A1:2021	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)
EN 61000-3-3:2013+A1:2019 + A2:2021	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 61000-3-12: 2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ? 75 A per phase.

7. Responsible person

Jon Holman-White
Vice President of Research and Development
Nidec Control Techniques Ltd
Date: 13th February 2025
Newtown, Powys, UK.

1-000-022-213 Rev.00.30

EU Declaration of Conformity

1. Product range

Unidrive-M, Commander, Digitax HD and derivative products, adjustable speed AC motor drives, including option modules and accessories.

2. Name and address of the manufacturer and authorised representative

Manufacturer

Nidec Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

Registered in England and Wales. Company Reg. No. 01236886
Telephone: 00 44 1686 612000
E mail: cthoadmin@mail.nidec.com
Web: www.controltechniques.com

Authorised representative:

Nidec Netherlands B.V.
Kubus 155
3364 DG Sliedrecht
Netherlands.

3. Responsibility

This declaration is issued under the sole responsibility of the manufacturer.

4. Object of the declaration

Variable speed drives

Model number	Interpretation	Model Number nomenclature aaaa - bbc ddddde
aaaa	Basic series	C200, C300, M100, M101, M200, M201, M300, M400, M600, M608, M700, M701, M702, M708, M709, M750, M751, M753, M754, M880, M881, M882, M888, M889, E300, F300, F600, H300, HS30, HS70, HS71, HS72, M000, RECT
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12
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 with internal choke, D = Inverter, E = 6P Rectifier + Inverter, T = 12P Rectifier + Inverter

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5. Declaration

The object of the declaration is in conformity with the relevant European Union harmonisation legislation.

Low Voltage Directive (2014/35/EU)

Electromagnetic Compatibility Directive (2014/30/EU)

Restriction of Hazardous Substances Directive (2011/65/EU and 2015/863/EU)

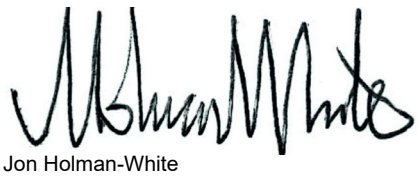
Regulation 2019/1781 of directive 2009/125/EC (Energy related products)

6. References to the relevant harmonised EN standard

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

EN 61800-5-1:2007 + A1:2017 + A11: 2021	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2018	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61000-6-2:2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4: 2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2019+A1:2021	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)
EN 61000-3-3:2013+A1:2019 + A2:2021	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 61000-3-12: 2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and . 75 A per phase.

7. Responsible person



Jon Holman-White

Vice President, Research and Development

Nidec Control Techniques Ltd

Date: 13th February 2025

Newtown, Powys, UK.

1-000-022-213 Rev 00.30

EU Declaration of Conformity (Machinery Directive)

1. Product model

Unidrive-M, Digitax HD and derivative products incorporating a Safe Torque Off (STO) function used as a safety component of a machine. Only the Safe Torque Off function may be used as a safety component of a machine.

2. Name and address of the manufacturer and authorised representative

Manufacturer

Nidec Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

Registered in England and Wales. Company Reg. No. 01236886
Telephone: 00 44 1686 612000
E mail: cthoadmin@mail.nidec.com
Web: www.controltechniques.com

Authorised representative:

Nidec Netherlands B.V.
Kubus 155
3364 DG Sliedrecht
Netherlands.

3. Responsibility

This declaration is issued under the sole responsibility of the manufacturer.

4. Object of the declaration

Variable speed drives

Model number	Interpretation	Model Number nomenclature aaaa - bbc ddddde
aaaa	Basic series	M600, M700, M701, M702, M608, M708, M709, CSD1, HS70, HS71, HS72, E200, E300, E301, M880, M881, M882, M889, F300, F600, H300, M751, M753, M750, M754
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12
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 with internal choke, D = Inverter, E = 6P Rectifier + Inverter, T = 12P Rectifier + Inverter

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

(Refer to the Revision List: 01_205_5270_03_22_RL_2022_08_24.docx).

5. Declaration

The safety function STO within the Unidrive-M series fulfills the requirements of SIL 3 of EN 61800-5-2 / EN 61508 and Cat 4 / PLe of EN ISO 1384901 and can be used in safety related applications up to these safety levels and in the application area of EN IEC 62061:2021.

Further it can be used for electric passenger and goods lifts within the scope of EN 81-20, clause 5.9.2.5.4 d) as a SIL 3 drive control featuring a defined interface for stopping of the drive by a means of static elements.

The object of the declaration is in conformity with the following European Union harmonisation legislation:

Machinery Directive (2006/42/EC)
Electromagnetic Compatibility Directive (2014/30/EU)

Type examination has been carried out by the following notified body:

TUV Rheinland Industrie Service GmbH, Am Grauen Stein, D-51105 Köln, Germany
Notified body identification number: 0035

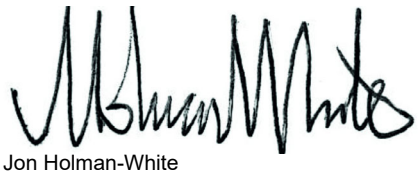
EC type-examination certificate number: 01/205/5270.03/22 dated 2022-08-26, valid until 2027-08-26.

6. References to the relevant harmonised EN standard

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

EN 61800-5-2:2017	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN 61800-5-1:2007 + A1: 2017 + A11: 2021, 4.3, 5.2.3.8, 5.2.6	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN ISO 13849-1:2015	Safety of Machinery, Safety-related parts of control systems, General principles for design
EN 61508 Parts 1 - 7:2010	Functional safety of electrical/ electronic/programmable electronic safety-related systems

7. Responsible person



Jon Holman-White
Vice President, Research and Development
Nidec Control Techniques Ltd
Date: 13th February 2025
Newtown, Powys, UK.

1-000-022-217 Rev.00.16

1 Safety information

1.1 Warnings, Cautions and Notes

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

WARNING

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

CAUTION

NOTE

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

1.2 General information

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 during installation, 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 double insulated and PELV. The user should connect 0 V to ground.

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

Neither the STOP or the STO function of the drive does 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 hazard.

1.6 Stored electrical charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the supply has been disconnected. If the drive has been energized, the 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.

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 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

This guide provides the information necessary to install and commission the Power Module Frame 12.

The power module is intended to be installed into the cubicle by the system integrator using the standard engineering accessories (SEA's). The SEA's are listed in Table 2-5 on page 17.

The power module is constructed from a kit of the following sub-assemblies which can be ordered individually. See Table 2-7 on page 18.

- Inverter
- Rectifier
- Power Control PCB
- SMPS assembly
- Fan assembly

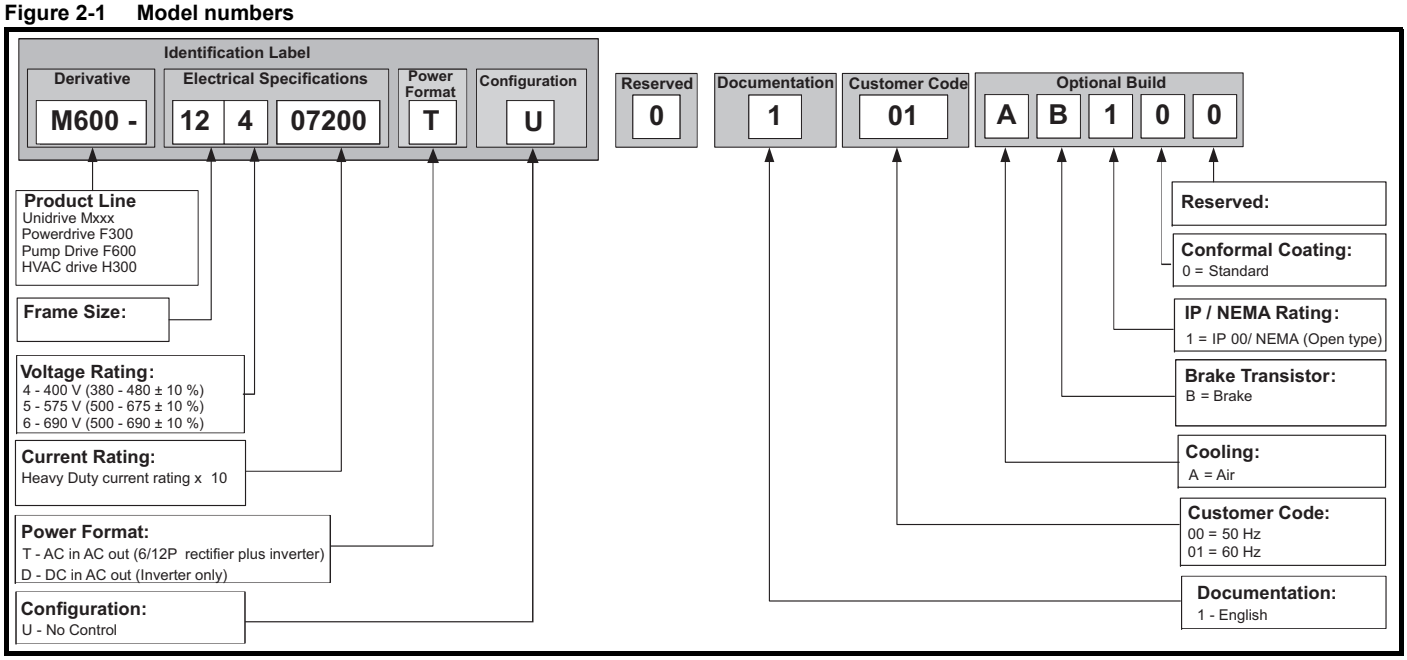
2.1 Drive software version

If this drive is to be connected to an existing system or machine, all drive software versions should be verified to confirm the same functionality as drives of the same model already present. This may also apply to drives returned from a Control Techniques Service Centre or Repair Centre. If there is any doubt, please contact the supplier of the product. The software version of the drive can be checked by looking at Pr **11.029** and Pr **11.034**. This takes the form of xx.yy.zz where Pr **11.029** displays xx.yy and Pr **11.034** displays zz. (e.g. for software version 01.01.00, Pr **11.029** = 1.01 and Pr **11.034** displays 0).

2.2 Model number

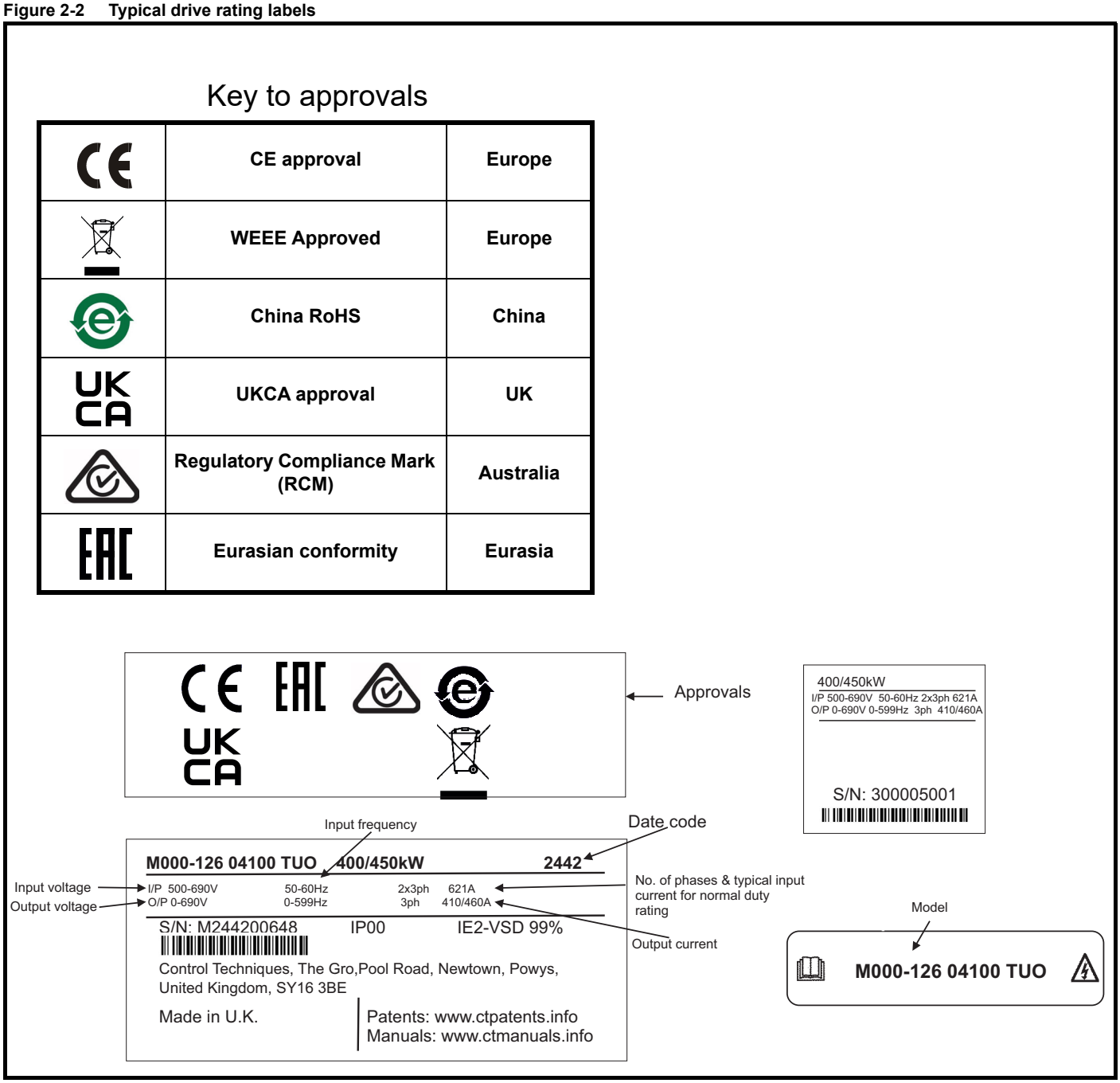
The way in which the model numbers are formed is illustrated below.

Figure 2-1 Model numbers



2.3 Nameplate description

Figure 2-2 Typical drive rating labels



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 1910 would correspond to week 10 of year 2019.

2.4 Ratings

The continuous current ratings given are for maximum 40 °C (104 °F),1000 m altitude and 2 kHz switching frequency. Derating is required for higher switching frequencies, higher ambient temperatures and high altitude. For further information, refer to section 5 *Technical data*, *Power and current ratings (Derating for switching frequency and temperature)*.

NOTE

With regard to Table 2-1 to Table 2-4, derating is applied to all drives at low output frequencies. Please contact the supplier of the drive for more information if the application requires significant torque, at or close to zero speed for extended periods of time or if prolonged periods of overload (> 100 %) are required.

Table 2-1 400 V drive ratings at 40 °C (104 °F) 12 pulse (380 V to 480 V ±10 %)

Model (T/D)	Normal Duty				Heavy Duty			
	Maximum continuous current	Peak current	Nominal power at 400 V	Nominal power at 460 V	Maximum continuous output current	Peak current	Nominal power at 400 V	Nominal power at 460 V
	A	A	kW	hp	A	A	kW	hp
12404800	608	668	315	500	480	672	250	400
12405660	660	726	355	550	566	792	315	450
12406600	755	831	400	650	660	924	355	550
12407200	865	952	500	700	720	1008	400	600

Table 2-2 575 V drive ratings at 40 °C (104 °F) 12 pulse (500 V to 575 V ±10 %)

Model (T/D)	Normal Duty				Heavy Duty			
	Maximum continuous current	Peak current	Nominal power at 575 V	Nominal power at 575 V	Maximum continuous output current	Peak current	Nominal power at 575 V	Nominal power at 575 V
	A	A	kW	hp	A	A	kW	hp
12503150	360	396	250	350	315	441	250	350
12503600	410	451	300	400	360	504	250	350
12504100	460	506	330	450	410	574	300	400
12504600	510	561	370	500	460	644	330	450

Table 2-3 690 V drive ratings at 40 °C (104 °F) 12 pulse (500 V to 690 V ±10 %)

Model (T/D)	Normal Duty				Heavy Duty			
	Maximum continuous current	Peak current	Nominal power at 690 V	Nominal power at 690 V	Maximum continuous output current	Peak current	Nominal power at 690 V	Nominal power at 690 V
	A	A	kW	hp	A	A	kW	hp
12603150	360	396	355	450	315	441	280	400
12603600	410	451	400	500	360	504	355	450
12604100	460	506	450	600	410	574	400	500
12604600	510	561	500	650	460	644	450	600

2.4.1 Normal duty and Heavy duty overload ratings

The drive is rated for different levels of overload.

1. **Normal duty.**
   The Normal duty rating gives 110 % overload for the times stated in Table 2-4. For applications which use Self ventilated (TENV/TEFC) induction motors and require a low overload capability, and full torque at low speeds is not required (e.g. fans, pumps).

2. **Heavy Duty.**
   The Heavy duty rating gives 140 % overload for the times stated in Table 2-4. For constant torque applications, applications which require a high overload capability, or full torque is required at low speeds (e.g. winders, hoists).

2.4.2 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 for RFC and open loop (OL) modes:

Table 2-4 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 180 s	110 % for 10 s	110 % for 180 s	110 % for 10 s
Heavy Duty overload with motor rated current = drive rated current	140 % for 60 s	140 % for 10 s	140 % for 60 s	140 % for 10 s

NOTE

There are certain overload restrictions at 2 kHz switching frequency for the 12406600 and 12407200 drive ratings. Refer to section 5.1.1 for details.

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.

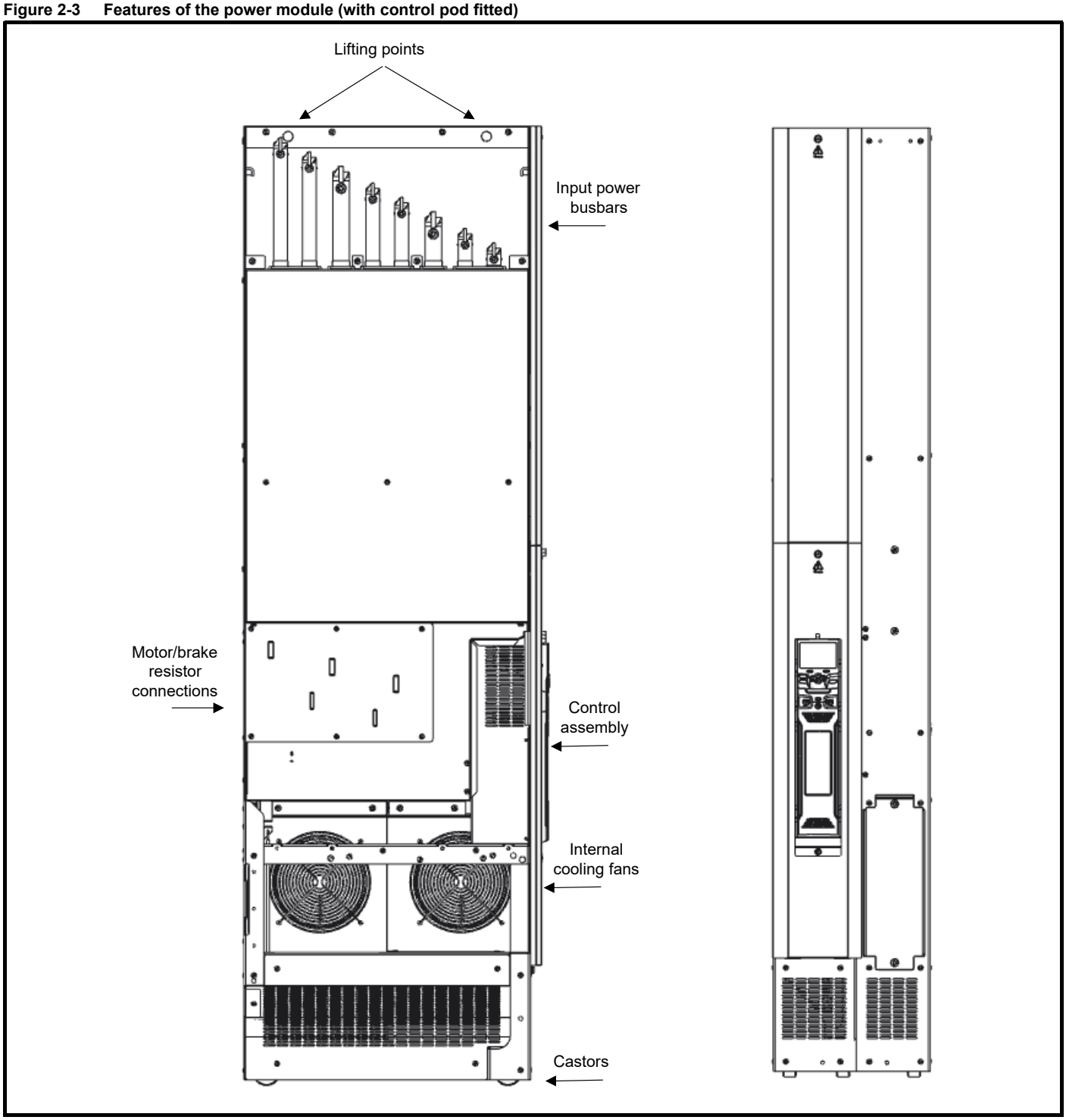
NOTE

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

2.5 Product features

The power module is to be installed into a cubicle. It can be transported using the lifting trolley or can be wheeled using the castors.

Figure 2-3 Features of the power module (with control pod fitted)



NOTE

The power module is supplied without a control pod. The drive derivative, e.g. M700, is achieved by fitting the appropriate control pod.

2.5.1 Standard Engineering Accessories

The Power Module Frame 12 has been designed to be installed in a cubicle. The standard engineering accessories listed in Table 2-5 are readily available to be used with Rittal VX25 and TS8 cubicle ranges.

The drive can be installed in other manufacturers cubicles but the accessories listed in Table 2-5 may not fit. Therefore if a non-Rittal cubicle is used the installation is the responsibility of the system designer.

To facilitate the installation of the power module into a cubicle, one, or more of the following kits are required.

Table 2-5 Standard Engineering Accessories

Area of drive / cubicle	Part number	Description
Input/Output wiring connections	6772-0006-01	VX25/TS8 AC input wiring kit
	6772-0007-02	VX25/TS8 output wiring kit
	6772-0008-01	VX25/TS8 earth kit
	6772-0014-00	Output busbar pass-through kit
	6772-0012-00	DC input busbar kit
	6772-0016-00	VX25/TS8 DC input wiring kit (No fuse holders)
	6772-0032-00	VX25/TS8 DC input wiring kit (IEC fuse holders)
	6772-0033-00	VX25/TS8 DC input wiring kit (UL fuse holders)
Cubicle fitting kit	6772-0009-02	VX25 fitting kit
	6772-0010-00	TS8 fitting kit
	Rittal part 4595.000	VX25/TS8 Wall bracket
AFE filter/fitting kit	6772-0022-00	AFE filter fitting kit VX25/TS8
	6772-0020-01	AFE filter/drive divide kit
	4200-6326-02	400 V AFE filter
	4200-0037-00	575 / 690 V AFE filter
Lifting and ramp	6500-0158-01	Frame 12 ramp
	6500-0159-02	Pallet truck kit
Cubicle ventilation	Rittal part 9681.846	VX25 roof plate
	Rittal part 3240.200	VX25/TS8 Outlet filter with mat
	Rittal part 3172.200	Spare outlet filter mats (Qty.5)

NOTE

To ensure that installation accessories are available together, Table 2-5 must be considered and the required parts ordered when raising an order for the Power Module Frame 12.

It is not recommended to install cables directly to the drive's busbars due to the unwanted force this applies to internal drive components. The input wiring kit is supplied with air baffles which must be fitted to prevent warm air recirculating around the cubicle which raises the cubicle temperature causing unnecessary stress on the drive and cubicle components.

Failure to use the wiring kits may invalidate the drive's warranty.

NOTE

The following instructions are available online. Some of these require additional components to be ordered, details of which are in the respective instruction.

VX25/TS8 fitting kit
VX25/TS8 Output pass-through busbar kit
VX25/TS8 lifting kit
VX25/TS8 AFE fitting kit
Lifting kit and ramp

2.5.2 Power module and sub assembly part numbers

Table 2-6 Power module part numbers

Voltage rating	Part number	Description	Version
400 V	M000-12404800TU0100AB100	12404800T	AC-AC
	M000-12405660TU0100AB100	12405660T	
	M000-12406600TU0100AB100	12406600T	
	M000-12407200TU0100AB100	12407200T	
	M000-12404800DU0100AB100	12404800D	DC-AC
	M000-12405660DU0100AB100	12405660D	
	M000-12406600DU0100AB100	12406600D	
	M000-12407200DU0100AB100	12407200D	
575 V	M000-12503150TU0100AB100	12503150T	AC-AC
	M000-12503600TU0100AB100	12503600T	
	M000-12504100TU0100AB100	12504100T	
	M000-12504600TU0100AB100	12504600T	
	M000-12503150DU0100AB100	12503150D	DC-AC
	M000-12503600DU0100AB100	12503600D	
	M000-12504100DU0100AB100	12504100D	
	M000-12504600DU0100AB100	12504600D	
690 V	M000-12603150TU0100AB100	12603150T	AC-AC
	M000-12603600TU0100AB100	12603600T	
	M000-12604100TU0100AB100	12604100T	
	M000-12604600TU0100AB100	12604600T	
	M000-12603150DU0100AB100	12603150D	DC-AC
	M000-12603600DU0100AB100	12603600D	
	M000-12604100DU0100AB100	12604100D	
	M000-12604600DU0100AB100	12604600D	

Table 2-7 Sub assembly part numbers (for repair and service)

Voltage rating	Part number	Description
All	M000-FANBOX0000000000000	Fan assembly
400 V	M000-124SMPS000000000000	400 V SMPS assembly
	M000-124INVERTER00000000	400 V Inverter assembly
	M000-124RECTIFIER0000000	400 V Rectifier assembly *
	M000-12404800INVCONTROL0	400 V / 480 A UF25K Power control PCB
	M000-12405660INVCONTROL0	400 V / 566 A UF25K Power control PCB
	M000-12406600INVCONTROL0	400 V / 660 A UF25K Power control PCB
	M000-12407200INVCONTROL0	400 V / 720 A UF25K Power control PCB
575 V	M000-125SMPS000000000000	575 V SMPS assembly
	M000-125INVERTER00000000	575 V Inverter assembly
	M000-125RECTIFIER0000000	575 V Rectifier assembly *
	M000-12503150INVCONTROL0	575 V / 315 A UF25K Power control PCB
	M000-12503600INVCONTROL0	575 V / 360 A UF25K Power control PCB
	M000-12504100INVCONTROL0	575 V / 410 A UF25K Power control PCB
	M000-12504600INVCONTROL0	575 V / 460 A UF25K Power control PCB

Voltage rating	Part number	Description
690 V	M000-126SMPS000000000000	690 V SMPS assembly
	M000-126INVERTER00000000	690 V Inverter assembly
	M000-126RECTIFIER0000000	690 V Rectifier assembly *
	M000-12603150INVCONTROL0	690 V / 315 A UF25K Power control PCB
	M000-12603600INVCONTROL0	690 V / 360 A UF25K Power control PCB
	M000-12604100INVCONTROL0	690V / 410 A UF25K Power control PCB
	M000-12604600INVCONTROL0	690 V / 460 A UF25K Power control PCB

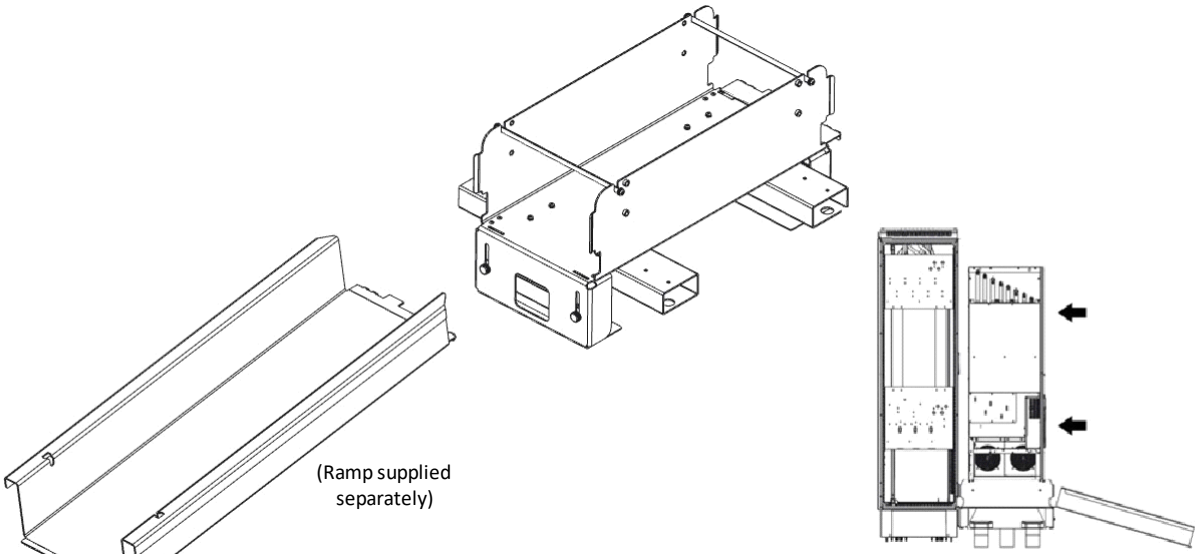
* Required on AC-AC drive variants.

2.5.3 Lifting kit

To aid the installation of the power module into the cubicle there are two types of accessory.

1. Lifting kit - This includes a transport cradle for transporting the power module using a pallet truck. Part number 6500-0159-02. A detailed set of instructions for the lifting kit are available online.

Figure 2-4 Lifting kit

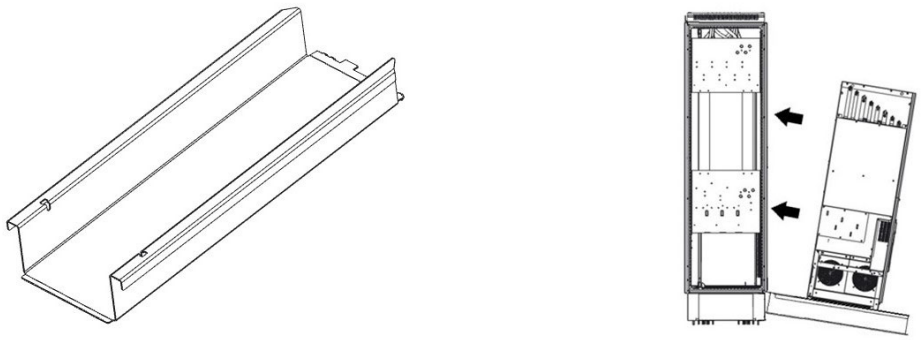


WARNING

The lifting kit is designed for use with the drive only. Do not attempt to use the AFE filter with this kit.

2. Frame 12 ramp - The ramp attaches directly to the cubicle allowing the power module to be pushed into the cubicle. Part number 6500-0158-01.

Figure 2-5 Frame 12 ramp



A risk assessment is to be carried out on the use of the ramp. There may be safety related information that needs to be included depending on the result of the assessment.

3 Mechanical installation

This chapter describes how to use all mechanical details to install the power module. Key features of this chapter include cubicle installation, terminal location and torque settings.

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.

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

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 supply must be isolated for 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 Control Techniques or their authorized distributor.

Protection of equipment prior to installation
If the equipment is not to be installed immediately, it must be protected from moisture and dust. It is recommended that the equipment remains in its packaging prior to installation to protect it from mechanical damage, moisture and dust.

Isolation device
The 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.

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 installation location must be complied with.

3.2.2 Environmental protection

The drive must be protected from:

- Moisture, including dripping water or spraying water and condensation.
- 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

If the drive is correctly installed the drive's internal fan provides sufficient cooling. Ensure that the internal baffles (Figure 3-16) are installed to prevent the recirculation of hot air. Vents at the front and top of the cubicle are mandatory (Figure 3-12 and Figure 3-13). The vents at the front of the cubicle must be fitted with filters which need replacing periodically.

3.2.3 Electrical safety

The installation must be safe under normal and fault conditions. Electrical installation instructions are given in Chapter 4 *Electrical Installation* on page 53.

3.2.4 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.

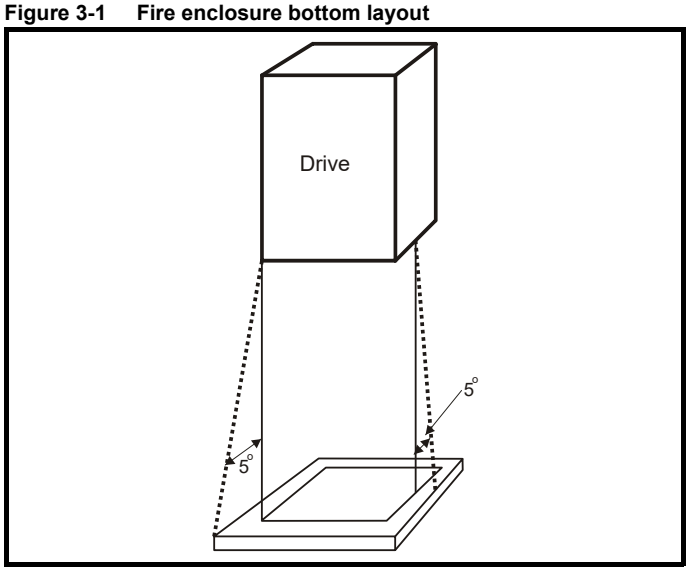
For installation outside the USA, the following (based on IEC 62109-1, standard for PV inverters) is recommended.

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.

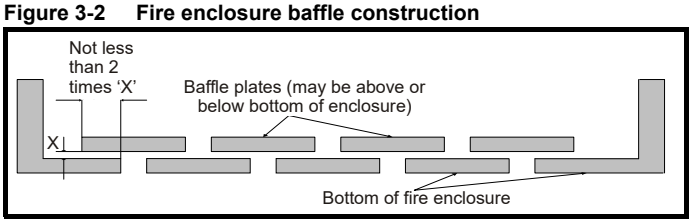
Figure 3-1 Fire enclosure bottom layout



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



3.2.5 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 supply, which must be located as close to the drive as possible.

3.2.6 Hazardous areas

The drive must not be located in a classified hazardous area.

WARNING

Hot surfaces
Care must be taken when opening the cubicle door as some components may be hot to the touch even after the 10 minutes discharge time.

WARNING

Component IP ratings
The Power Module is rated to IP00. This must be taken into consideration when the cubicle doors are open.

3.2.7 Drive to cubicle installation

The product shall be mounted inside a cubicle using the recommended cubicle fitting kit. The kit contains the required parts to ensure that the drive is mounted correctly. The cubicle fitting kit instructions are available on line.

This installation guide contains details on how to secure the cubicle to a solid wall or vertical surface. The use of wall brackets and the cubicle fitting kit ensure that the installation is secured rigidly and safely.

It is the responsibility of the installer to ensure proper safe installation ensuring that the floor and wall are capable of supporting the cubicle.

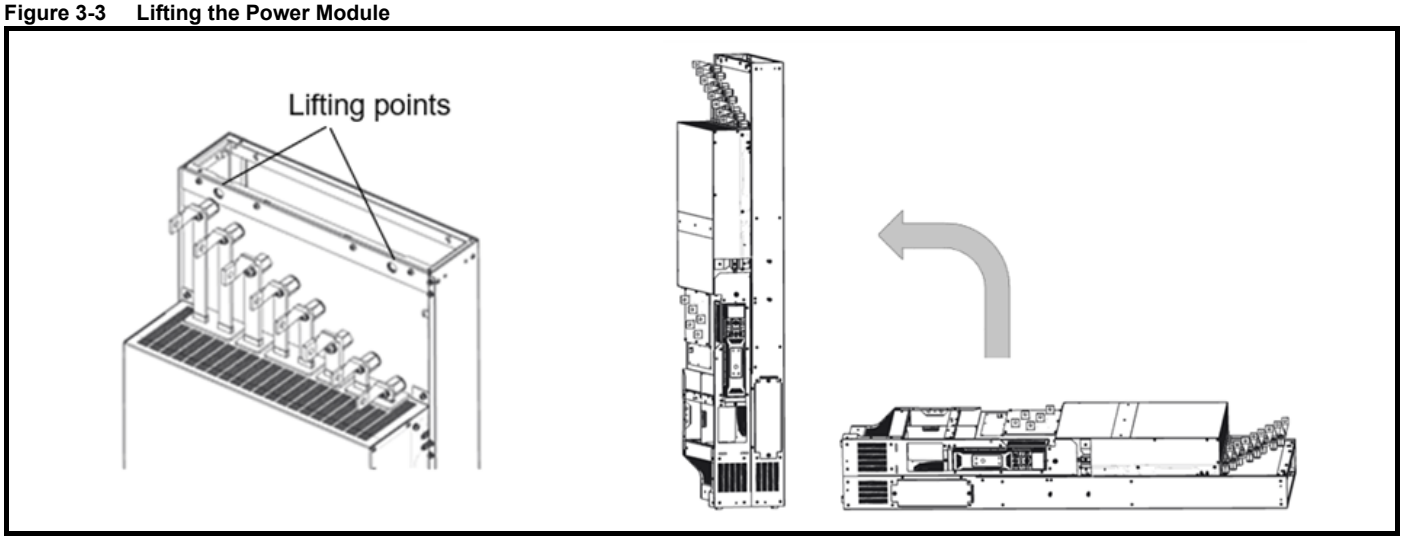
3.3 Lifting the Power Module

WARNING

Lifting and handling
Always lift the drive by the lifting points using appropriate lifting equipment. Care must be taken when lifting as the Power Module could overbalance if not lifted correctly. Always wear safety shoes.

When removing the Power Module from the packaging, connect bow shackles rated to at least 150 kg (331 lbs) to the two lifting points, shown in Figure 3-3 and slowly raise drive to a vertical position. Ensure that care is taken to ensure the Power Module does not tip over when resting it into its vertical position.

Figure 3-3 Lifting the Power Module



3.4 Cubicle assembly

Table 3-1 below highlights the main steps which should be taken to prepare the cubicle for drive installation. The order of the steps is recommended but is not mandatory.

Table 3-1 Cubicle preparation for drive installation

	Step 1	Step 2	Step 3
Process	**Installing the Cubicle Fitting kit** It is recommended to install the Cubicle Fitting kit first so that no other component is present which may obstruct the installation. The fitting kit should be installed as per the instructions which are available online.	**Install the input/output cable wiring kits** The input and output wiring kits can be installed as per the instructions on page 31. Ensure that the supplied baffles are also fitted. The wiring kits are specific for VX25 and TS8. Once the wiring kits are fitted the cables may be connected.	**Install the venting points** The cubicle requires two door vents to draw air into the fans and a roof vent to allow air to exhaust.
Part number	VX25: 6772-0009-01 TS8: 6772-0010-00	Input kit: 6772-0006-01 Output kit: 6772-0006-01 Earthing kit: 6772-0008-01	Door filter: *3240-200 Roof vent: * 9681.846 *Rittal part number
Reason for fitting	The fitting kit contains mechanical parts which will secure the drive to the inside of the cubicle. This allows the drive to slide into the cubicle correctly and holds it safe and secure.	The wiring kits provide mechanical connections points for supply and motor cable. The drive can be removed without disturbing the cable connections. The air baffles are crucial to prevent warm air recirculation.	To allow proper ventilation of drive. If either the roof vent or door vents are not fitted the warm air will remain in the cubicle and the drive will overheat.

NOTE

In some cases the drive is supplied on site pre-installed into the cubicle. To connect the supply and motor cables the drive must be removed.

3.5 Cubicle fitting kits

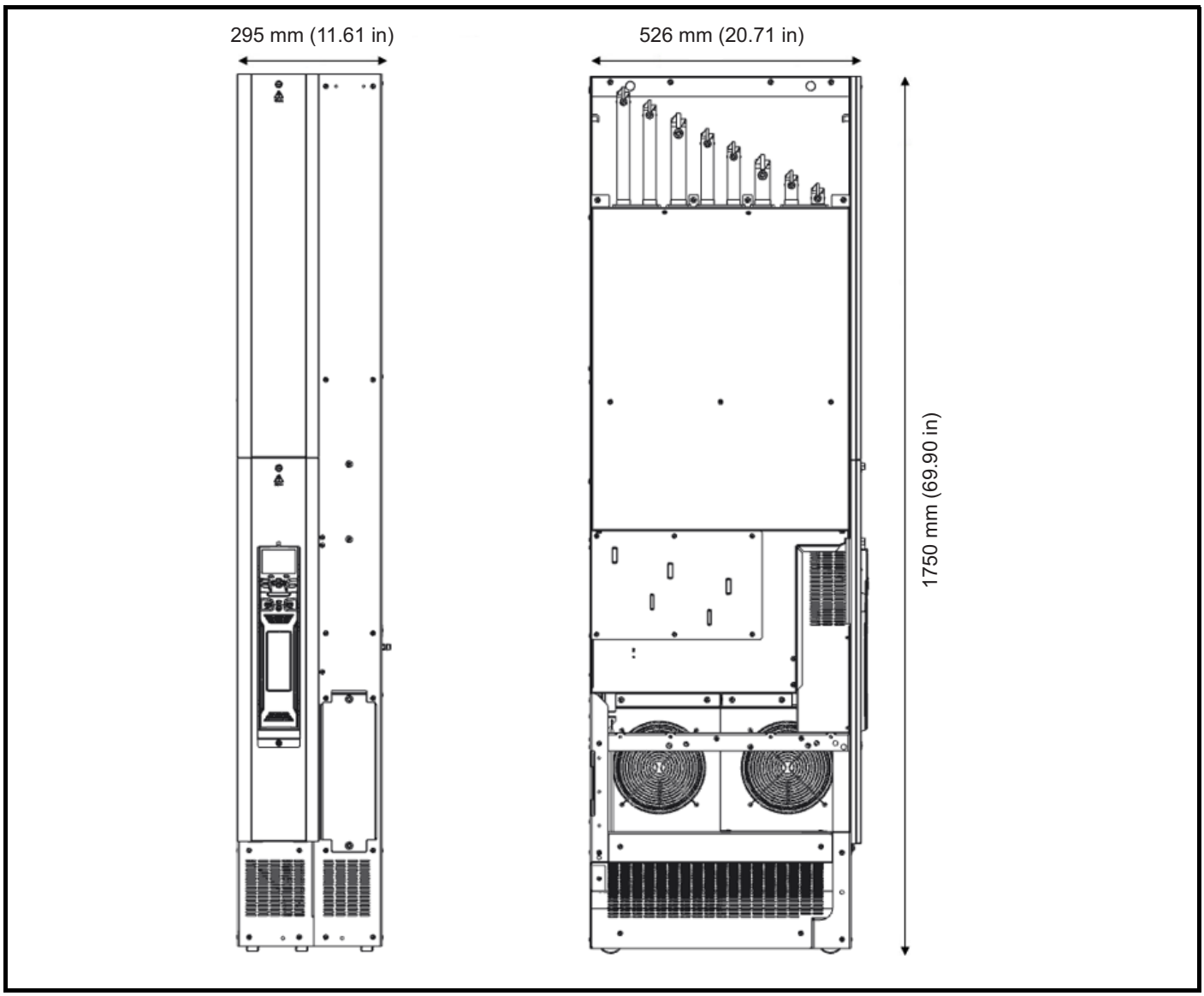
The cubicle fitting kits contain the mechanical fittings to allow the drive to be installed into the cubicle. The instructions for the fitting kits are available online. Refer to Table 3-2 below for details of the fitting kit part numbers.

Table 3-2 Fitting kit part numbers

Fitting kit part number fitting kit type	Instruction part number
VX25 400 mm	0478-0642-01
VX25 800 mm	0478-0651-01
TS8 400 mm	0478-0643-01

3.6 Dimensions

Figure 3-4 Power Module dimensions (shown in mm)

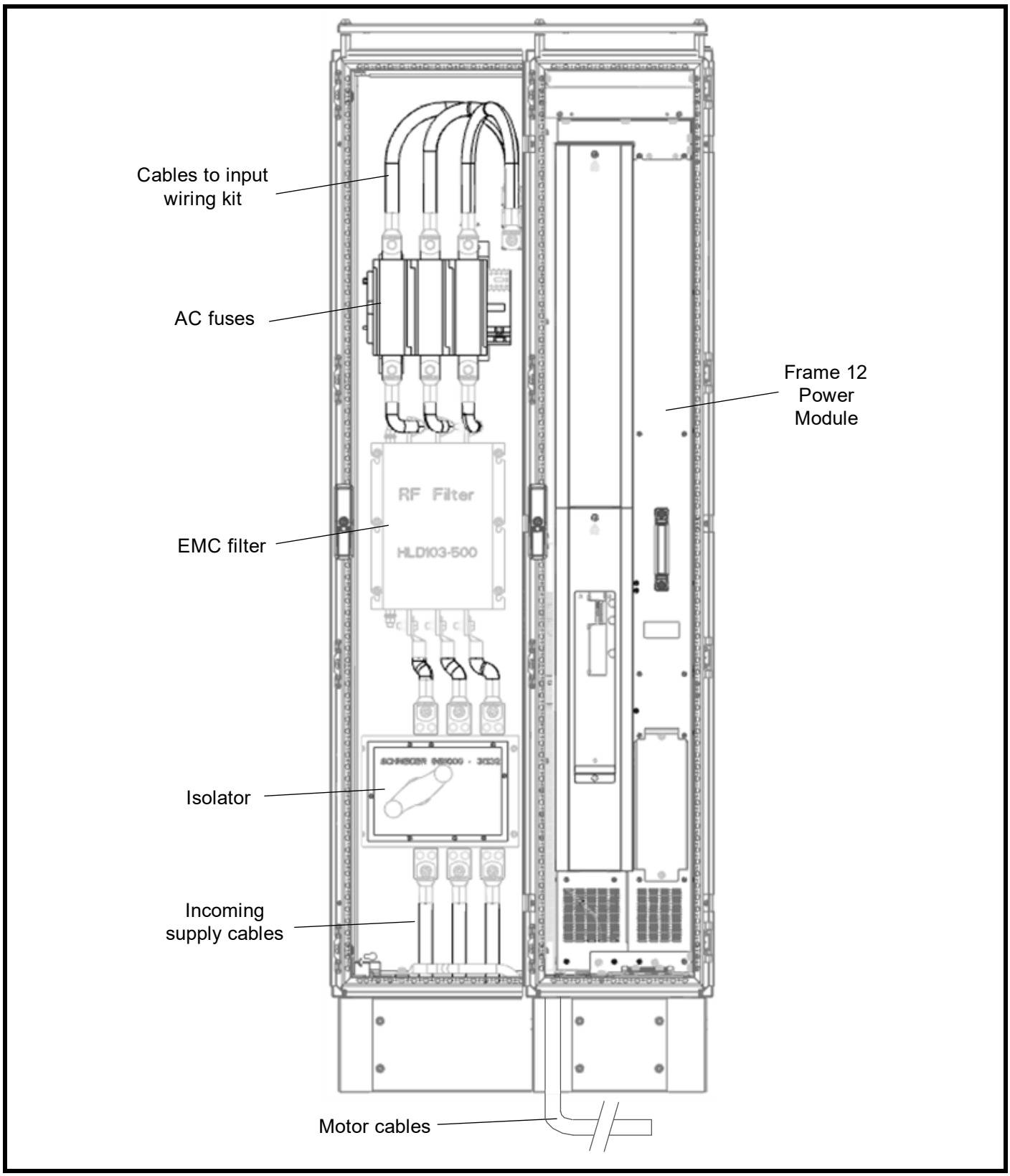


The Power Module is designed to be installed into a 400 mm (15.75 in) (W) x 600 mm (23.62 in) (D) x 2000 mm (78.74 in) (H) cubicle. This provides sufficient space for the drive to be installed with the wiring kits and accessories. Alternatively, a 800 mm (31.50 in) (W) x 600 mm (23.62 in) (D) x 2000 mm (78.74 in) (H) cubicle can be used.

3.7 Typical drive and incomer layout

Figure 3-5 shows a typical drive and incomer layout with the incomer cubicle and associated components on the left and the drive on the right. The drive and incomer are installed into 400 mm cubicles and connected together.

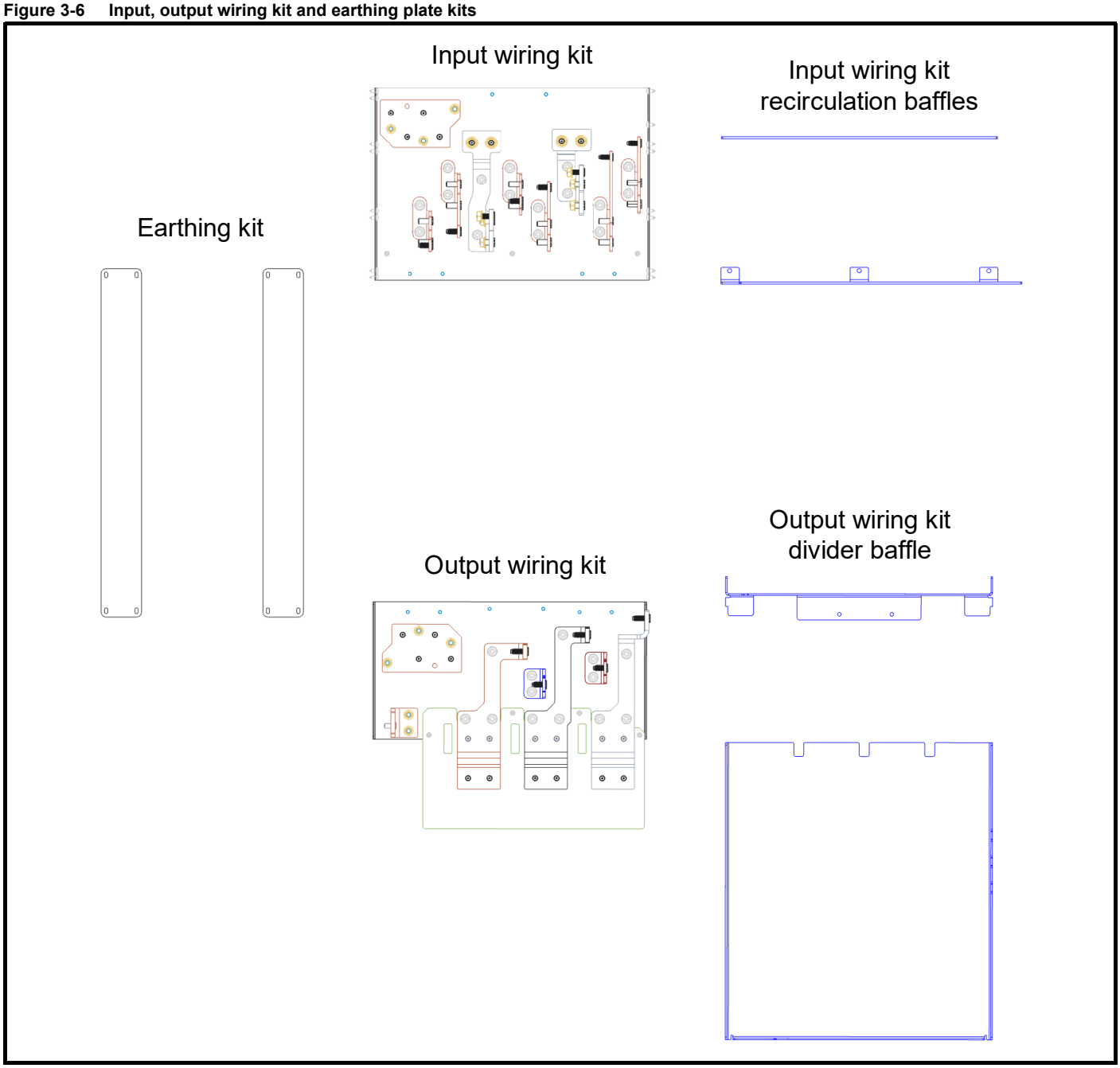
Figure 3-5 Power module and incomer



3.8 Input and output wiring kits

The input and output wiring kits and earthing plate kit are supplied as separate parts.

Figure 3-6 Input, output wiring kit and earthing plate kits



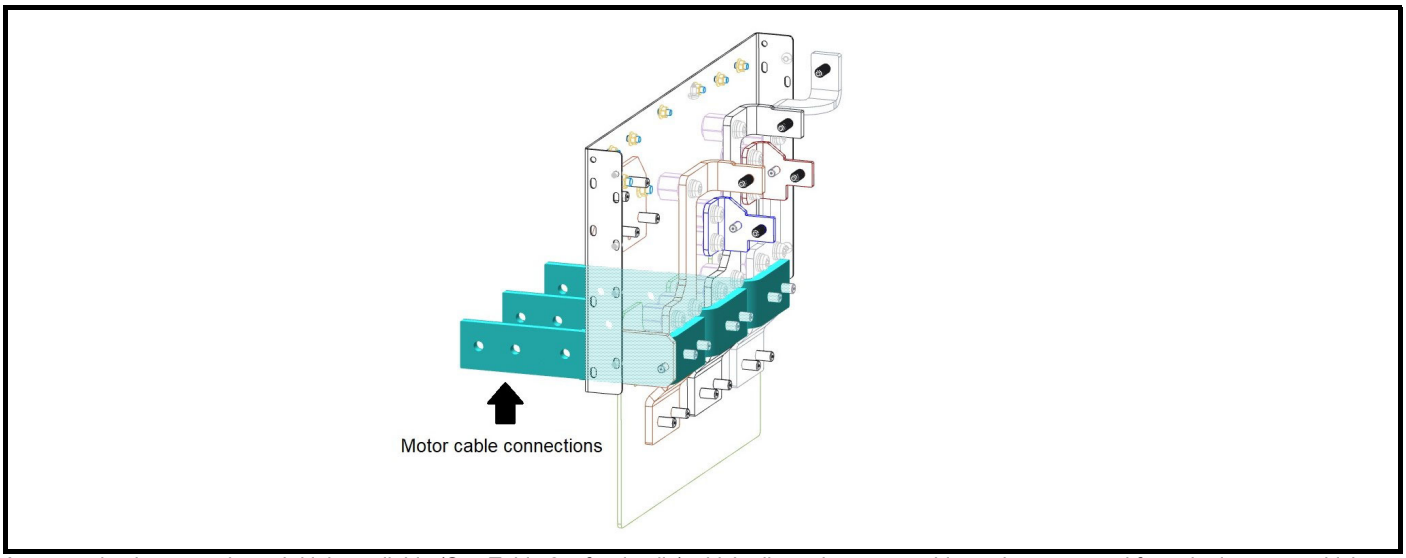
NOTE

The input wiring kit is supplied without +/- DC terminals. If these are required they must be ordered separately and fitted to the wiring kit prior to installation. See Table 2-5 for more information.

WARNING

a) The recirculation and divider baffles are part of the input and output wiring kits. Omitting these wiring kits will lead to improper ventilation and possible overheating of the drive.
b) Failure to fit the input and output wiring kit could lead to cable tension on the busbars which could displace them internally

Figure 3-7 Output busbar pass through kit



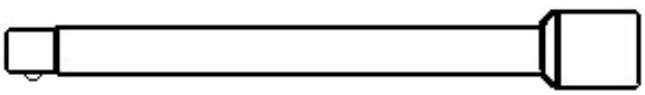
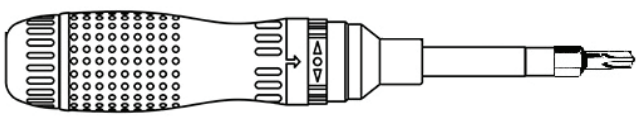
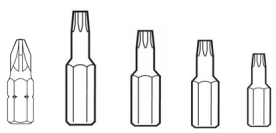
An output busbar pass through kit is available (See Table 2-5 for details) which allows the motor cables to be connected from the incomer cubicle as opposed to the drive cubicle. This kit is intended to improve cable routing and simplify installation.

An installation guide detailing parts required and fitting instructions is available online.

3.9 Tools required for installation

The tools required for installing the power module into the cubicle are shown in Figure 3-8.

Figure 3-8 Tools required for installation

Torque wrench	Socket size
	17 mm (0.67 in) 13 mm (0.51 in) 10 mm (0.39 in) 
Socket extension bar	**Length**
	500 mm (19.69 in)
Torque driver	**Bit size**
	PZ2 T40 T30 T25 T20 

3.9.1 Torx driver sizes by fastener

Table 3-3 Torx driver bit sizes by fastener

Description	Torx driver size
M5 x 12 double SEM torx screw	T25
M6 x 16 double SEM torx screw	T30
M6 x 20 double SEM torx screw	T30
M8 x 16 double SEM torx screw	T40
Multi-tooth screw 5.5 x 13 mm (Rittal screw)	T25

3.10 Cubicle roof plate (VX25)

3.10.1 Stand-alone applications

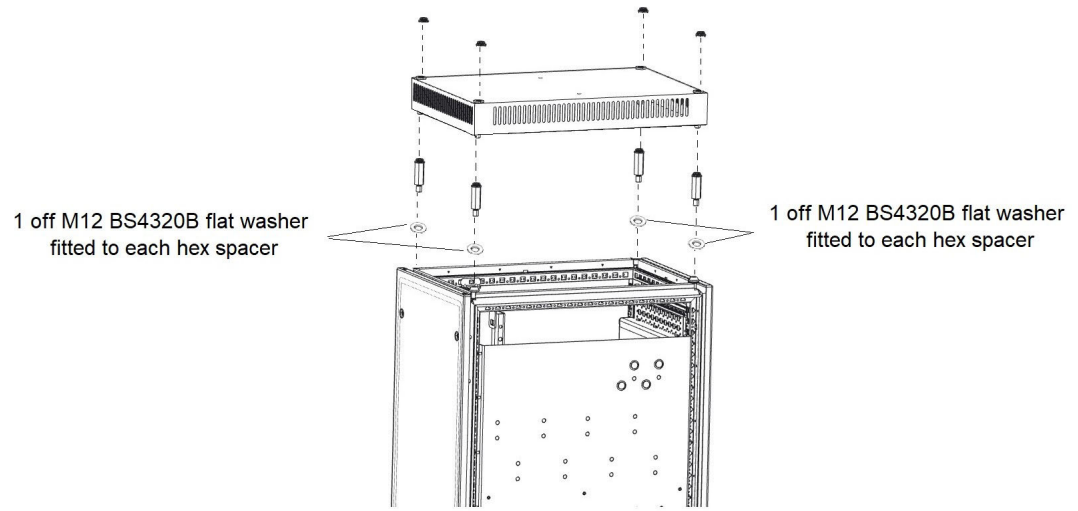
To allow sufficient air flow, the VX25 roof plate (9681.846) must be fitted to the top of the cubicle. For stand-alone applications where attaching the cubicle to a fixed surface is not required the roof plate can be fitted as supplied.

Remove the standard top plate and fit the roof plate fittings as shown in Figure 3-9. Tighten 4 off M12 hex spacers to 20 Nm (177 lb in).

NOTE

The VX25 roof plate is rated to IP21

Figure 3-9 Fitting the VX25 roof plate

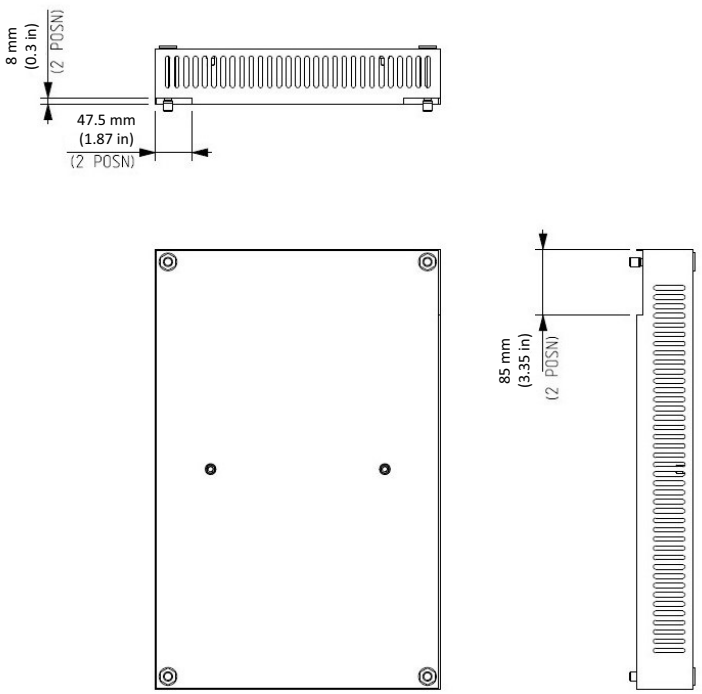


3.10.2 Fastening the cubicle to a fixed structure

It may be a requirement to fasten the cubicle to a fixed surface for applications where shock and vibration may be present.

This requires a modification of the VX25 roof plate to allow the Rittal wall brackets (4595.000) to be fitted. Figure 3-10 shows a modified VX25 roof plate.

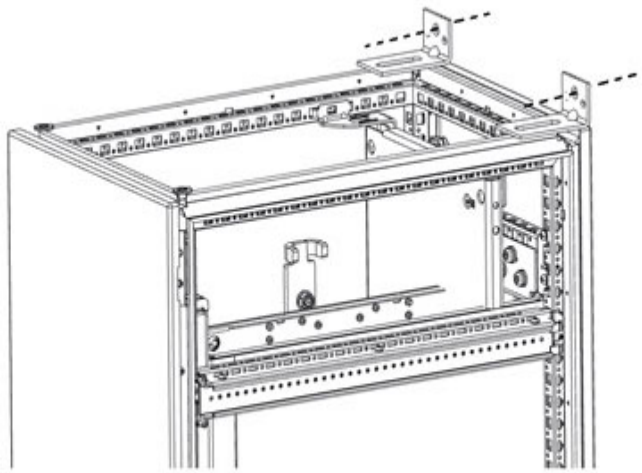
Figure 3-10 Modification details of VX25 roof plate to allow fitting of wall brackets



3.10.3 Fitting wall brackets to fixed surface

With the cubicle in the desired position mark the holes, drill the holes and fasten the wall brackets to the fixed surface as shown in Figure 3-11

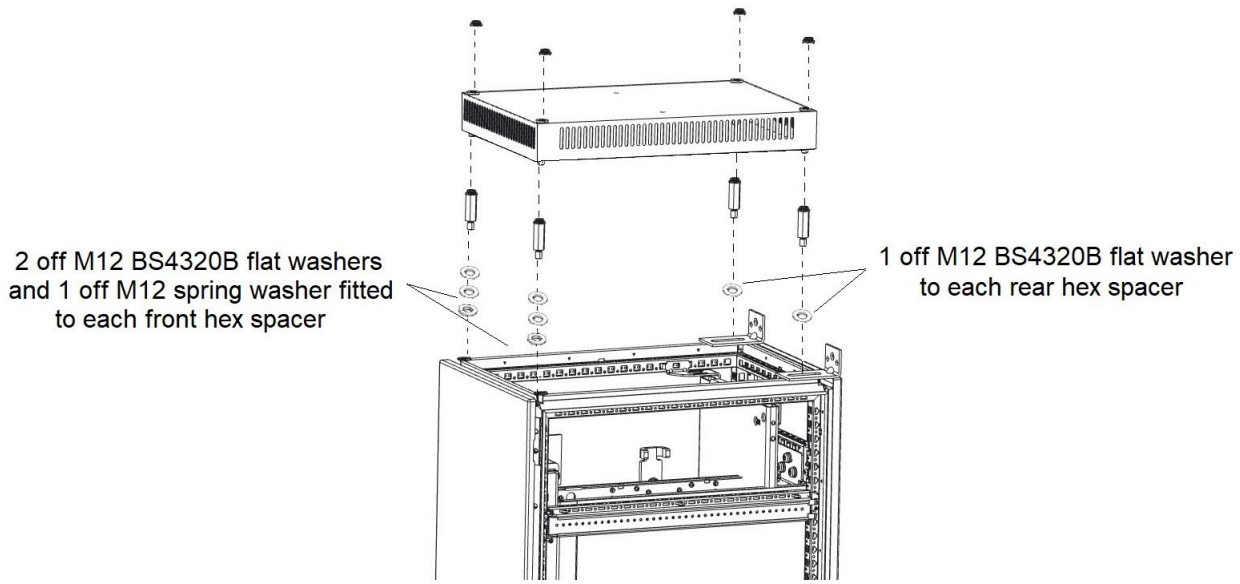
Figure 3-11 Fitting the wall brackets



3.10.4 Fitting the washers

Fit 6 off M12 BS4320B flat washers and 2 off M12 spring washers as shown in Figure 3-12. Tighten 4 off M12 hex spacers to 60 Nm (531 lb in).

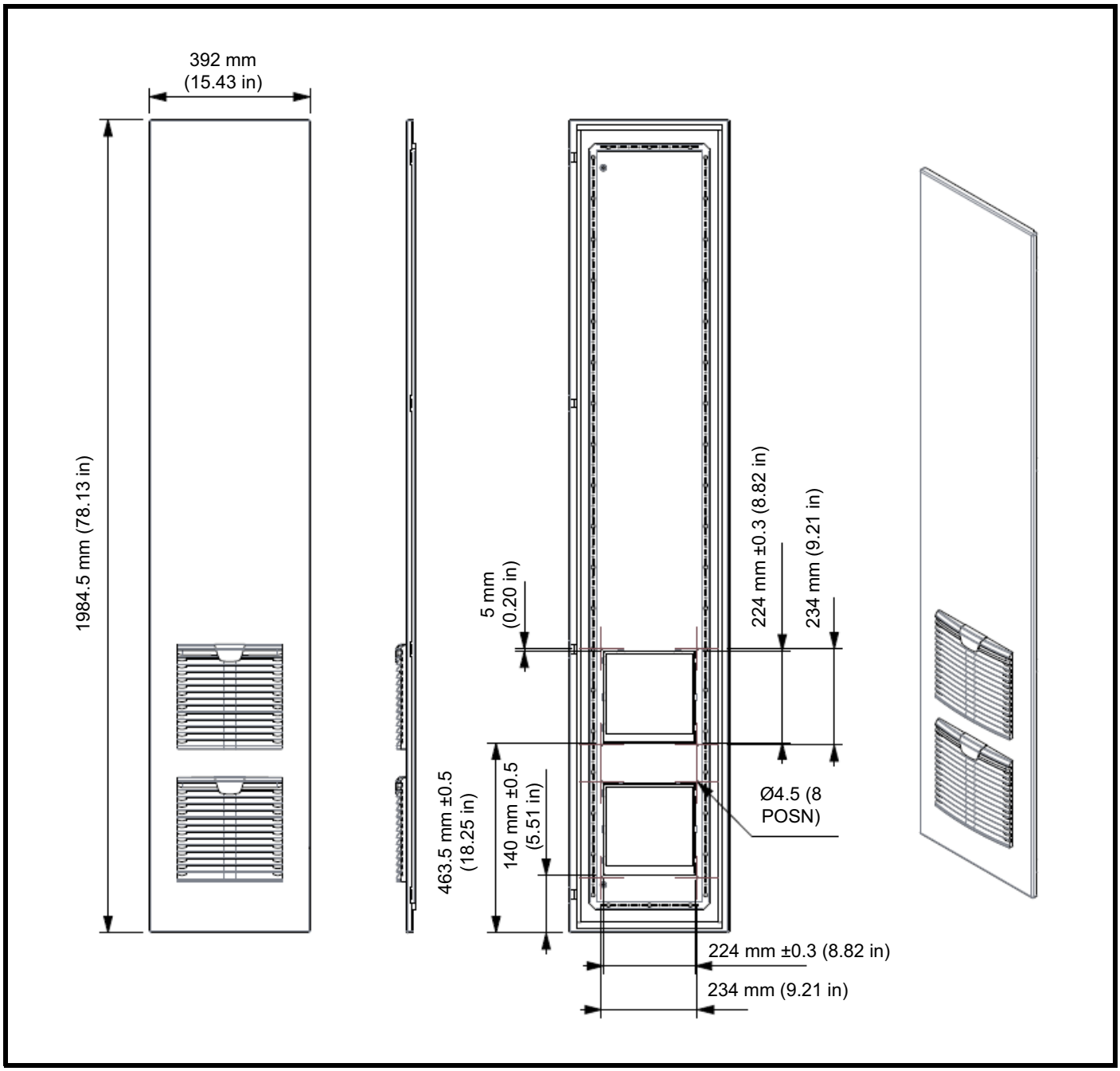
Figure 3-12 Preparing to fit the roof plate



3.11 Installing cubicle door ventilation

To ensure proper ventilation of the cubicle, two door vents and filter (Rittal part number 3420.200) must be fitted to the cubicle door. See Table 2-5 for details.

Figure 3-13 Installing door vents



NOTE

The door vents are critical to the correct operation of the drives cooling fans and therefore must be installed.

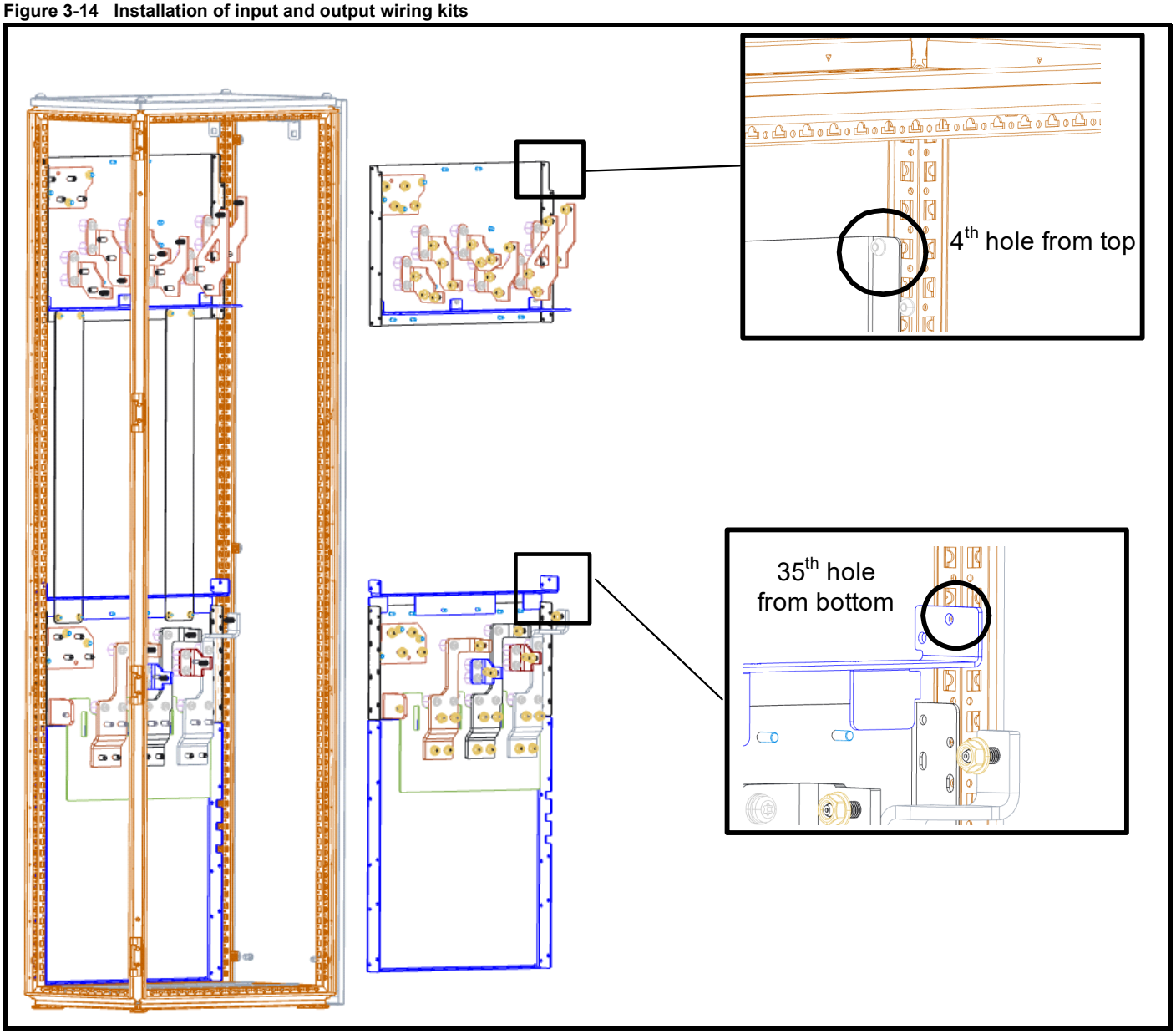
3.12 Installation of power module into cubicle

Prior to drive installation into the cubicle the input, output and earthing kits must be fitted. This will allow the cables to be installed in advance of drive installation and can remain in place in the event of drive removal.

The cubicle fitting kit must also be installed prior to drive installation. The instructions for installing the cubicle fitting kit can be found online.

Install input and output wiring terminal kits to the cubicle as defined in the specified dimensions below.

Figure 3-14 Installation of input and output wiring kits



NOTE

The input wiring kit (6772-0006-01) is supplied with the left side air recirculation baffle pre-fitted. Refer to the Fitting Kit installation sheet for instructions on how to fit the right side recirculation baffle

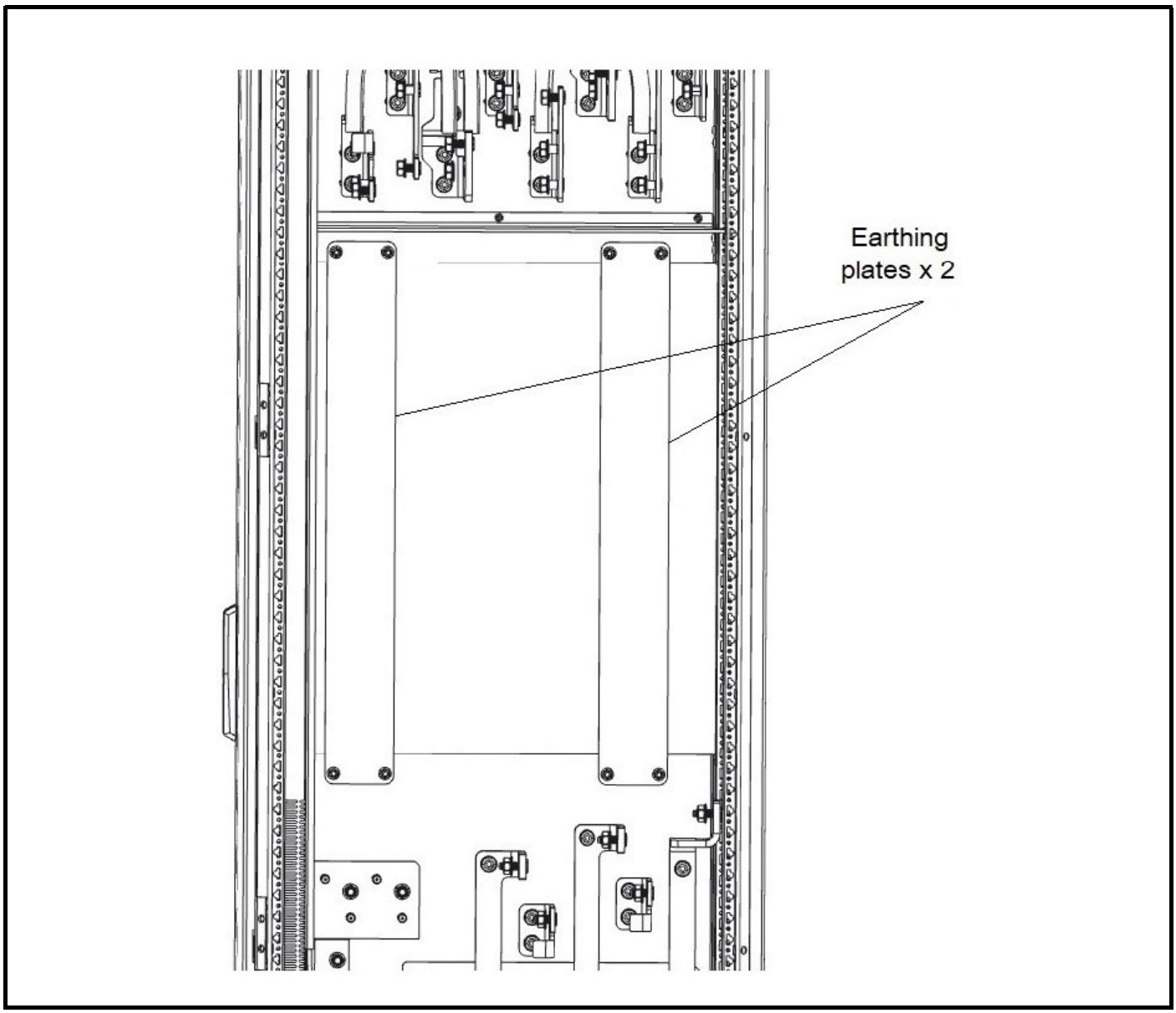
The Output wiring kit is also supplied with an air baffle to ensure that warm air is directed up through the drive to the air vent.

Install earthing plates between the wiring kits.

Fasten using 8 off M6 nuts and tighten to 6 Nm (53.1 lb in).

Figure 3-15 Installation of earthing plates

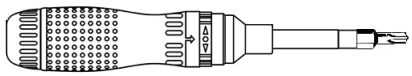
Tools required	
	 10 mm (0.39 in)

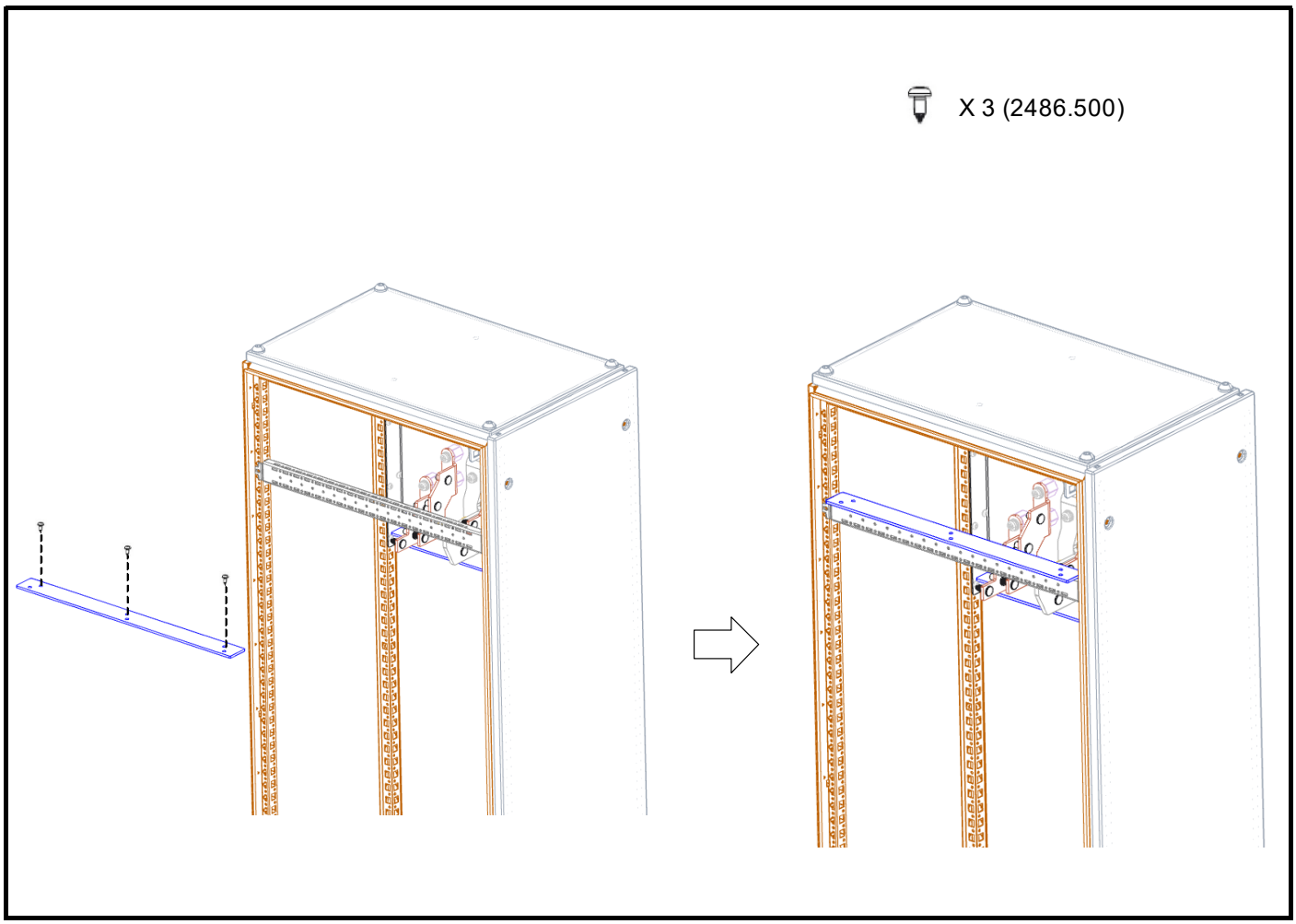


Install recirculation baffles to upper right side

Insert 3 of Rittal multi-tooth 2486.500 screws in right baffle and tighten to 6 Nm (53.1 lb in).

Figure 3-16 Installation of recirculation baffles

Tools required	
	 T25



CAUTION

Care must be taken to prevent the fasteners from falling into the cubicle.

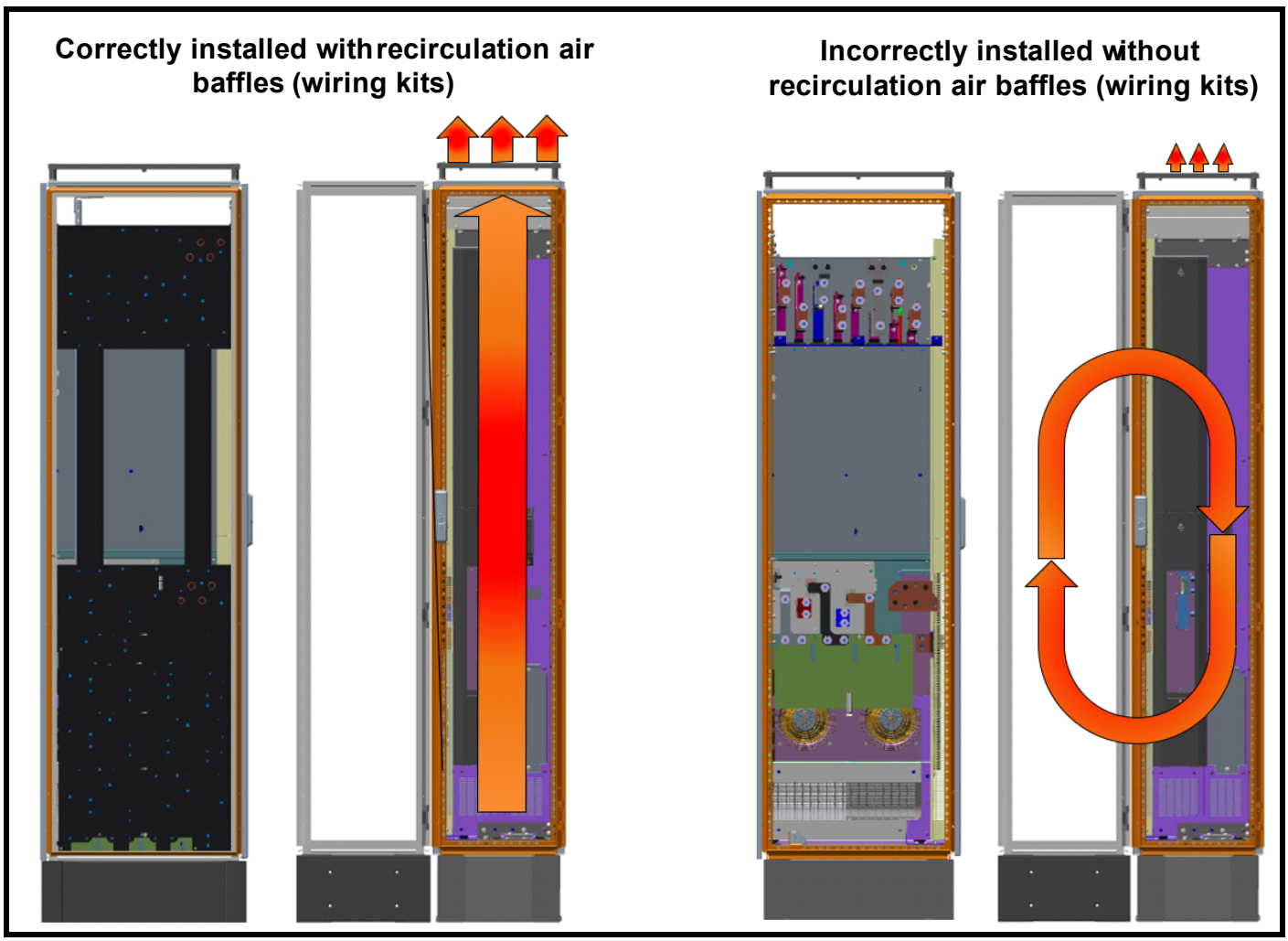
NOTE

The left side recirculation baffle is supplied pre-fitted to the Input wiring kit (part number 6772-0006-01).

Drive cooling and airflow

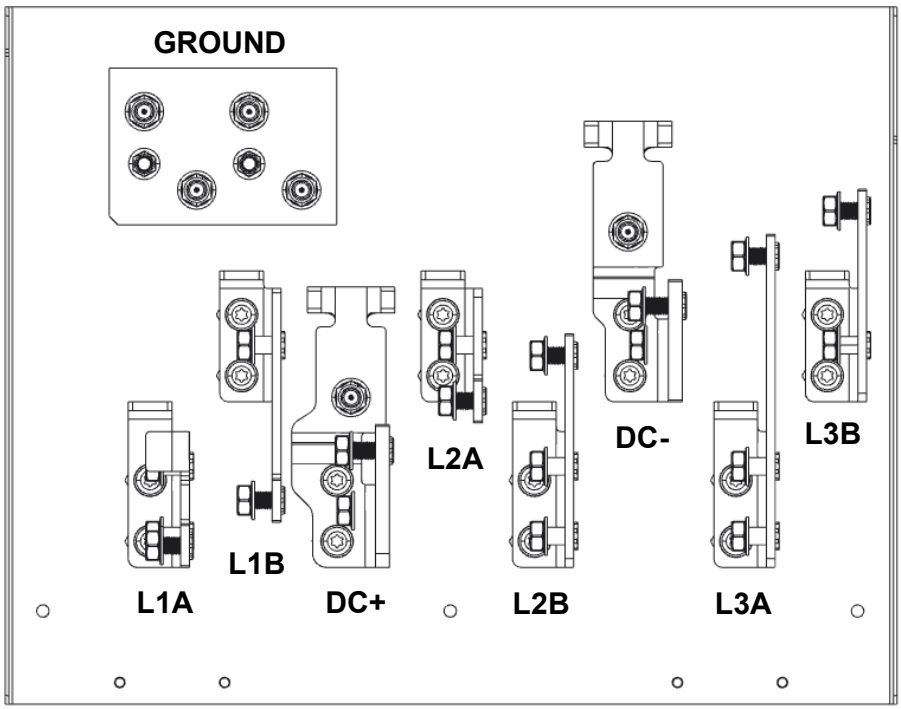
When installed correctly, the airflow will be directed from the bottom of the drive through to the top vent by the internal fans. There will be no recirculation of warm air. If the wiring kits/baffles are not fitted this will cause the warm air to recirculate back into the cubicle raising the temperature and causing over temperature trips. Repeated over temperature trips will cause unnecessary wear on the drive's internal components thus reducing the lifespan of the drive.

Figure 3-17 Power Module Frame 12 air circulation



Input wiring kit terminal identification for 6 and 12 pulse configurations

Figure 3-18 Terminal identification for input wiring kit.

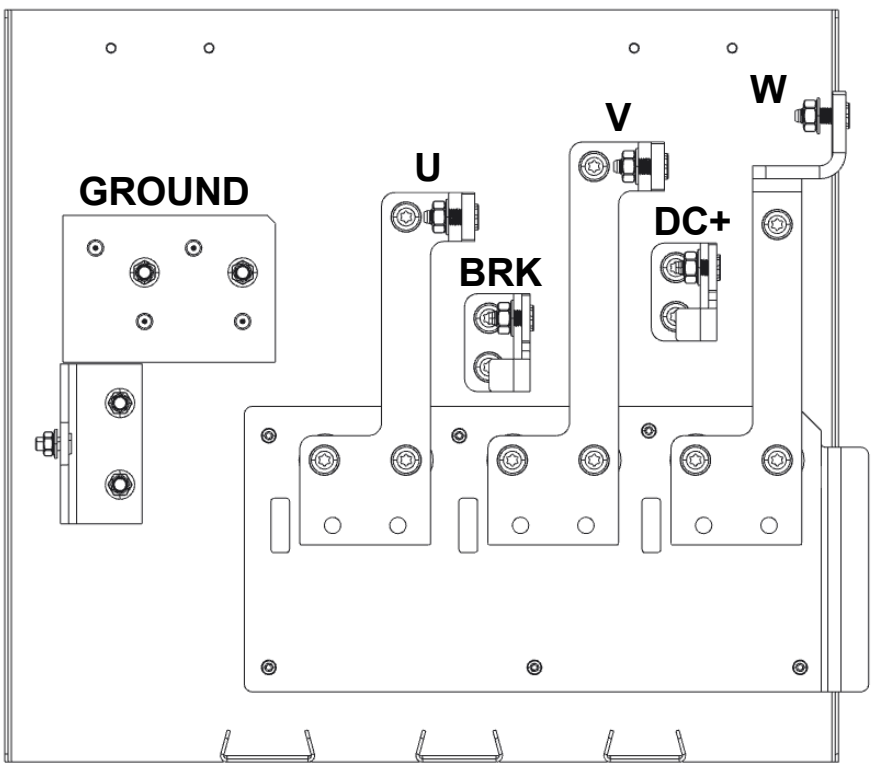


NOTE

The DC+ and DC- busbars are shown for clarity. They are not supplied as part of the input wiring kit but are available as an option. See Table 2-5 for details.

Output wiring kit terminal identification

Figure 3-19 Terminal identification for output wiring kit



Connect input, output and earth cables to wiring terminal kits.

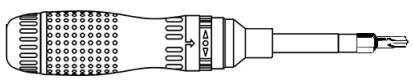
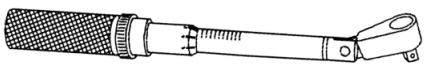
NOTE

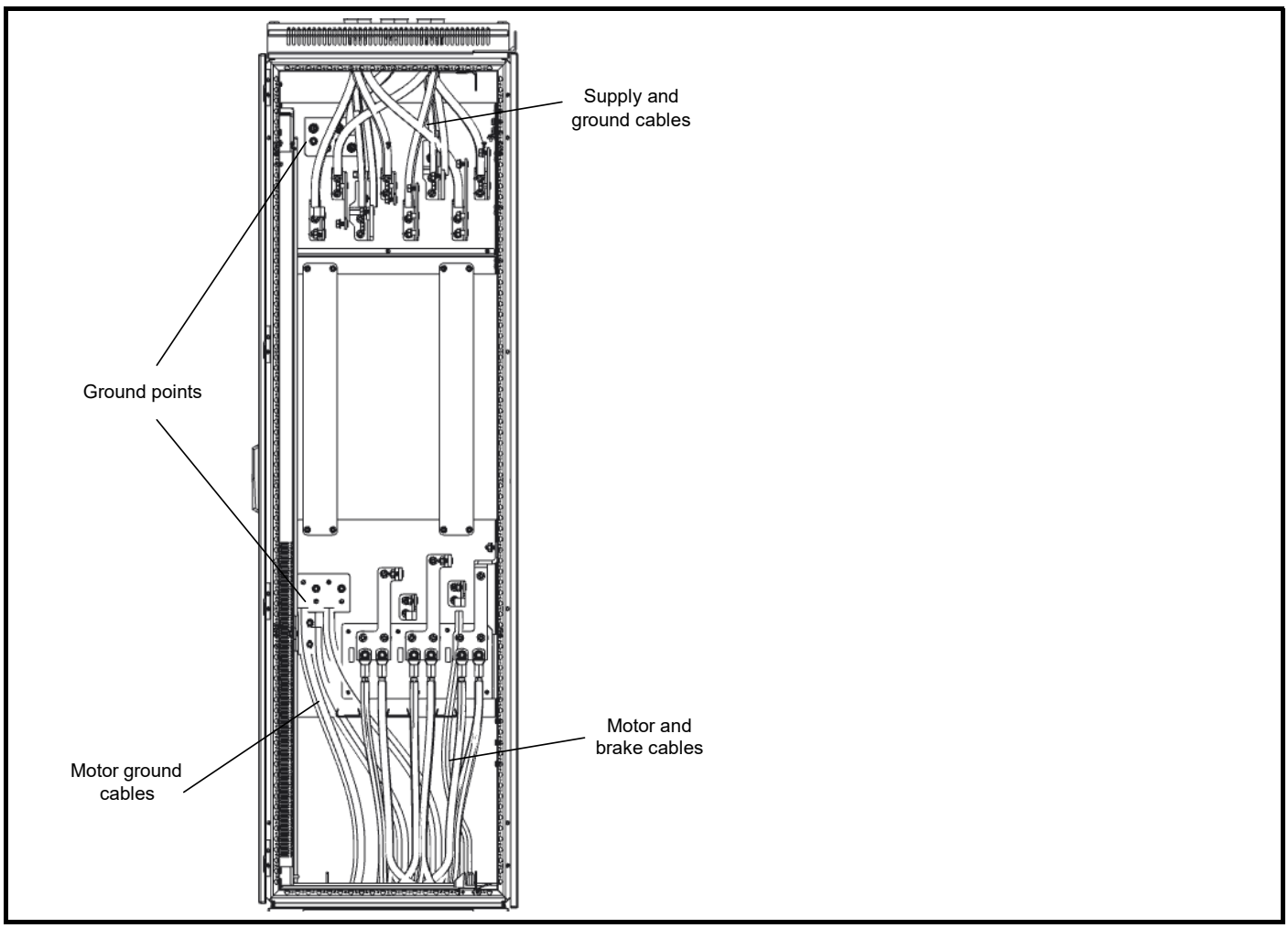
To aid cable installation, the input phase busbars are supplied loose on the input wiring kit.

- Position L3B busbar to the position furthest back on the wiring plate
- Tighten 2 off M8 screws to 12 Nm (106.2 lb in)
- Attach the L3B supply cables using suitably sized ring tongue terminals with M10 nuts
- Tighten the M10 nuts to 30 Nm (265.5 lb in)
- Repeat for each input busbar in turn in order L3A, *(DC-), L2B, L2A, *(DC+), L1B, L1A.

* If the DC +/- busbars are required then the above process should be followed.

Figure 3-20 Connection of input output and ground cables

Tools required			
	 T40		 10 mm (0.39 in)



NOTE

Wiring configurations marked on terminal kit busbars to aid installation.

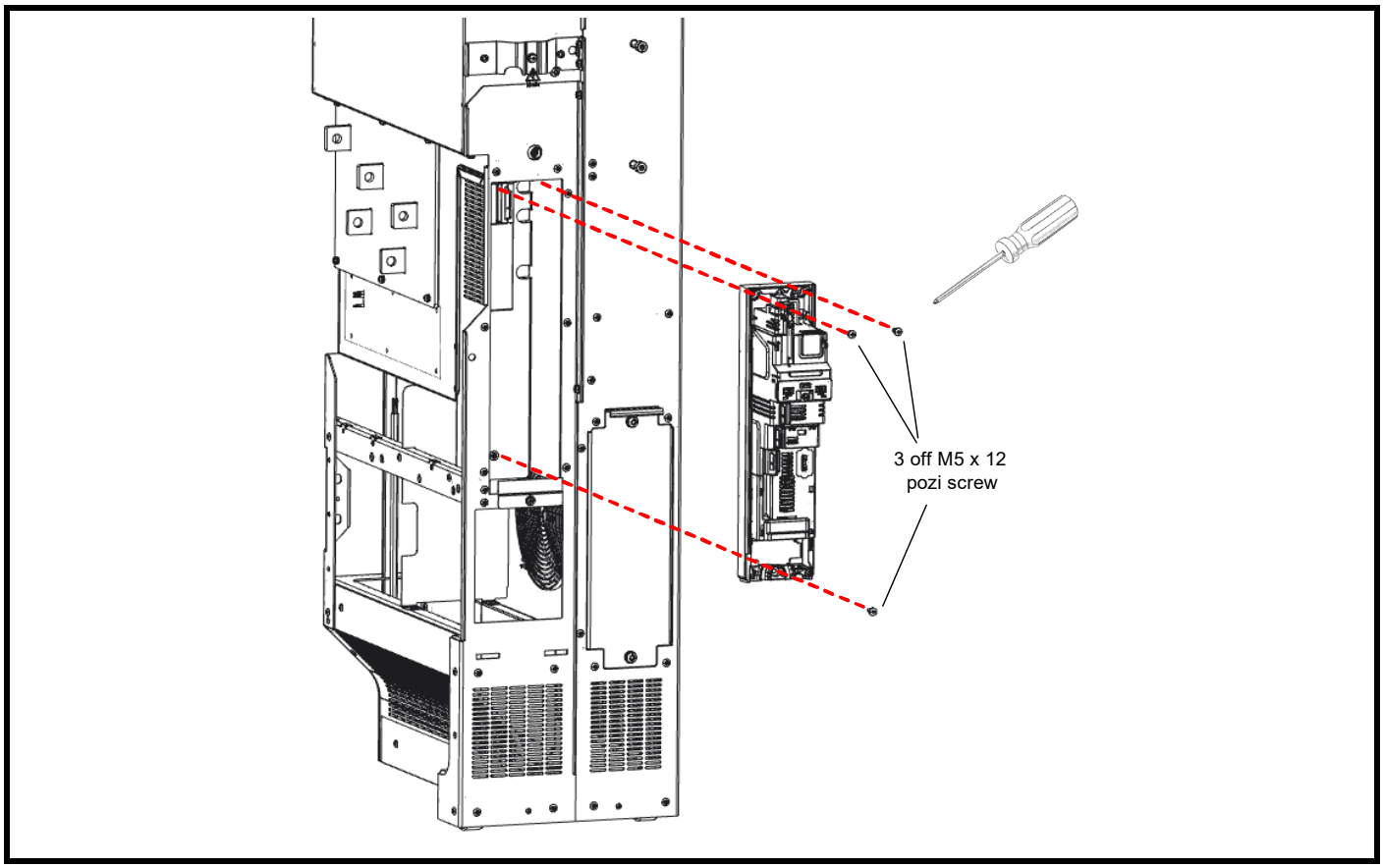
NOTE

Selected roof, glands and associated parts to be fitted at this stage.

Fitting the control module

Using a PZ2 bit, tighten 3 off M5 x 12 screws supplied with the control module to a maximum of 2 Nm to secure the control module to the drive.

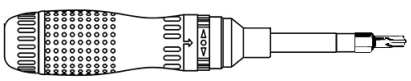
Figure 3-21 Mounting the control pod to the drive

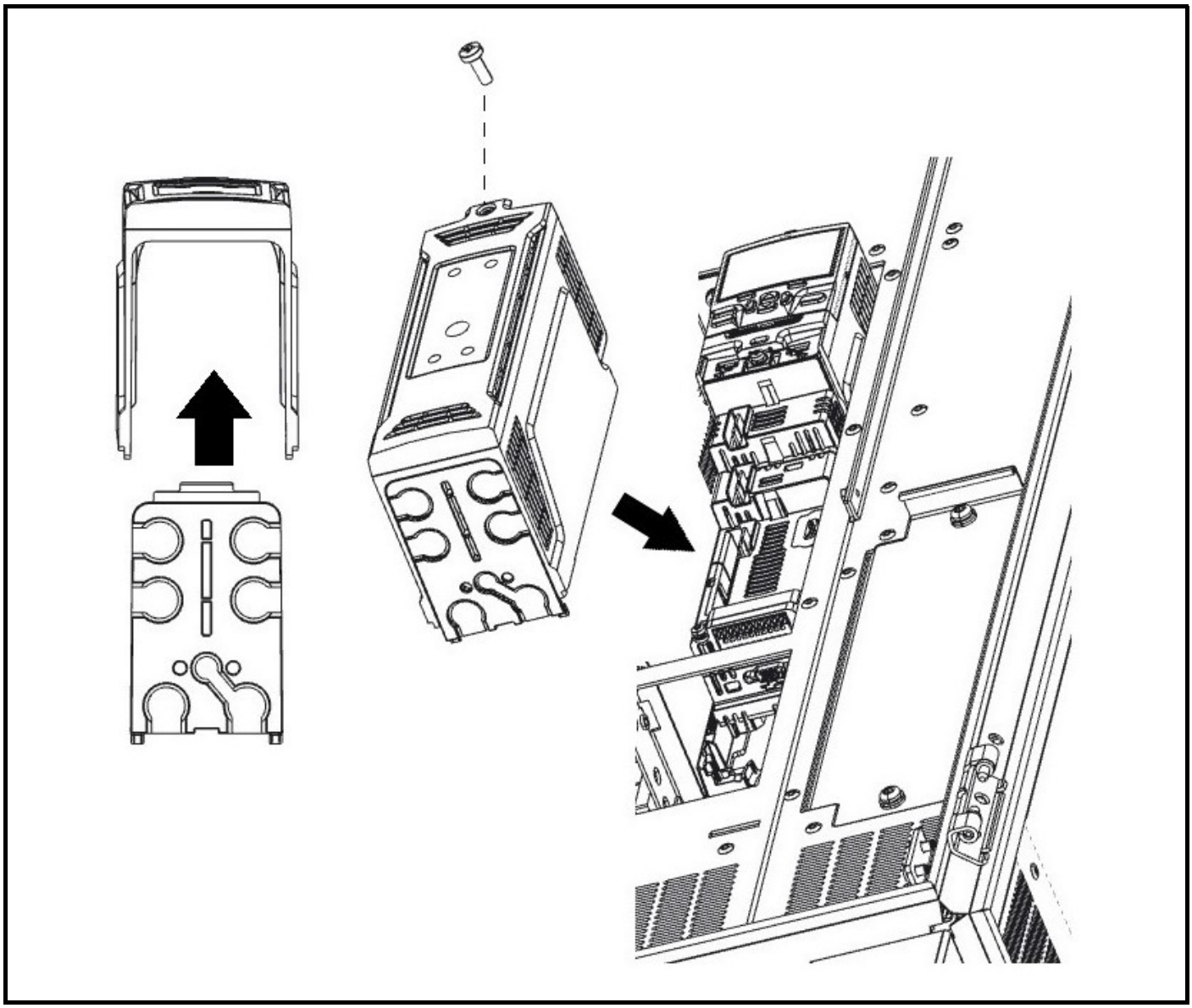


Attach control pod terminal cover and gland plate

Tighten M4 x 12 screw to 2 Nm (17.7 lb in).

Figure 3-22 Attaching control pod terminal cover and gland plate

Tools required	
	 T20



Transporting to the cubicle

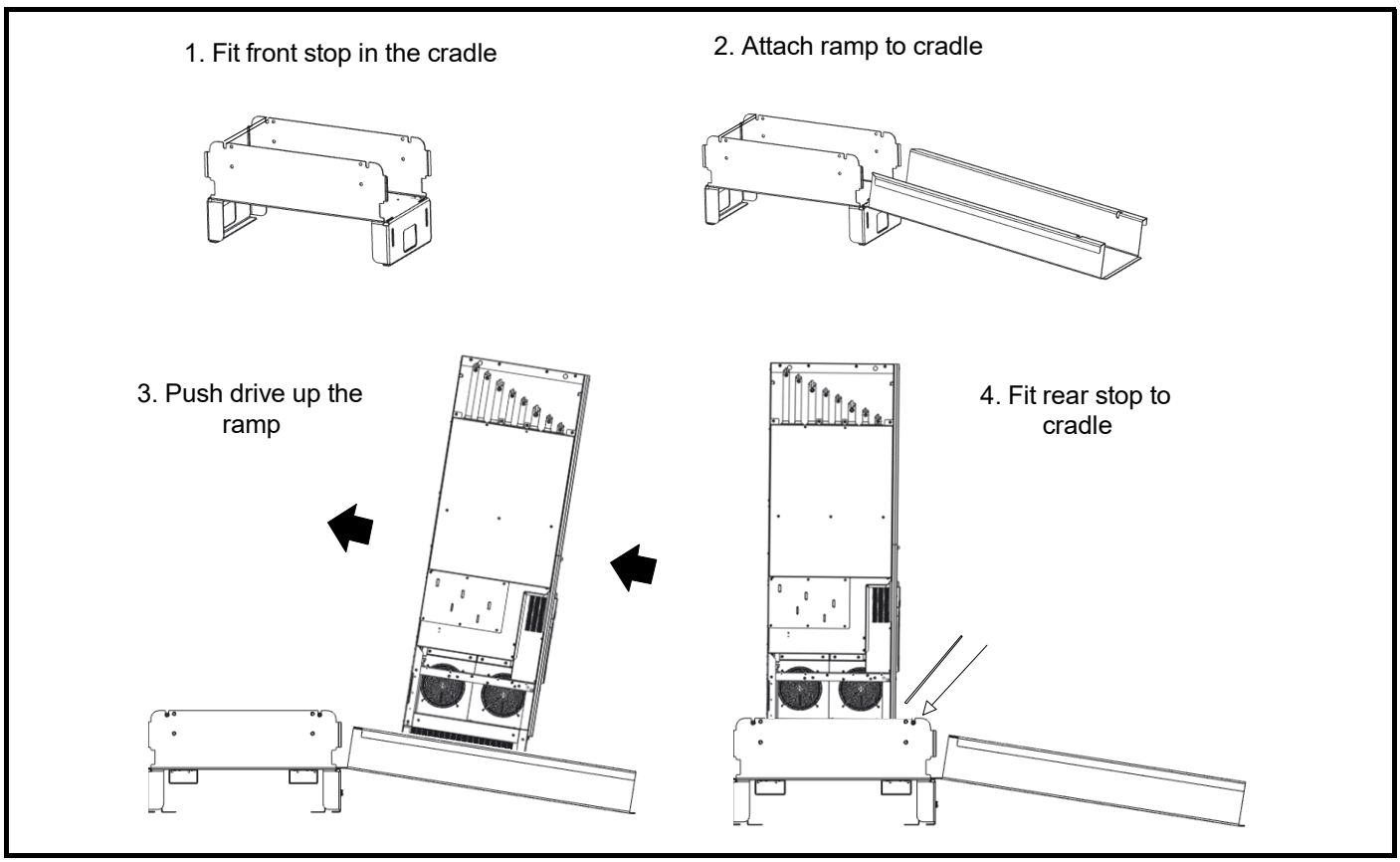
If the power module requires transporting to the cubicle, fit the power module into the cradle. If the power module does not require transportation the ramp can be connected directly to the cubicle. See Figure 3-26 for details.

WARNING

The following instructions are for the safety of the installation personnel. Ensure that these instructions are clearly understood and followed prior to installation of the Power Module. Failure to comply with this information could result in serious injury.

1. Always wear safety shoes when handling the Power Module in or out of the cubicle.
2. It is recommended that gloves are worn to prevent injury to hands and provide better grip when handing the Power Module.
3. The lifting points on the top of the Power Module must be used to prevent the drive tipping over or rolling back down the ramp. Connect a suitably rated chain or lifting strap to the Power Module's lifting points and connect the other end to a fixed surface or structure. Note, if the chain or strap is connected to the cubicle then the cubicle itself must be fixed securely to a solid surface.
4. It is the installers responsibility to assess the potential risks in the installation environment and carry out a risk assessment if deemed necessary prior to installation.
5. Ensure that the cubicle plinth is no higher than 200 mm.
6. Use two persons to perform the drive installation if deemed necessary.
7. If the Power Module must be removed from the cabinet these safety steps must also be followed. Ensure that the drive is fully supported, using two persons if necessary, when the drive is travelling down the ramp.

Figure 3-23 Mounting the drive on the pallet truck lifting kit



WARNING

Push power module slowly up the ramp. Ensure that it is held firmly at all times. The use of gloves is recommended.

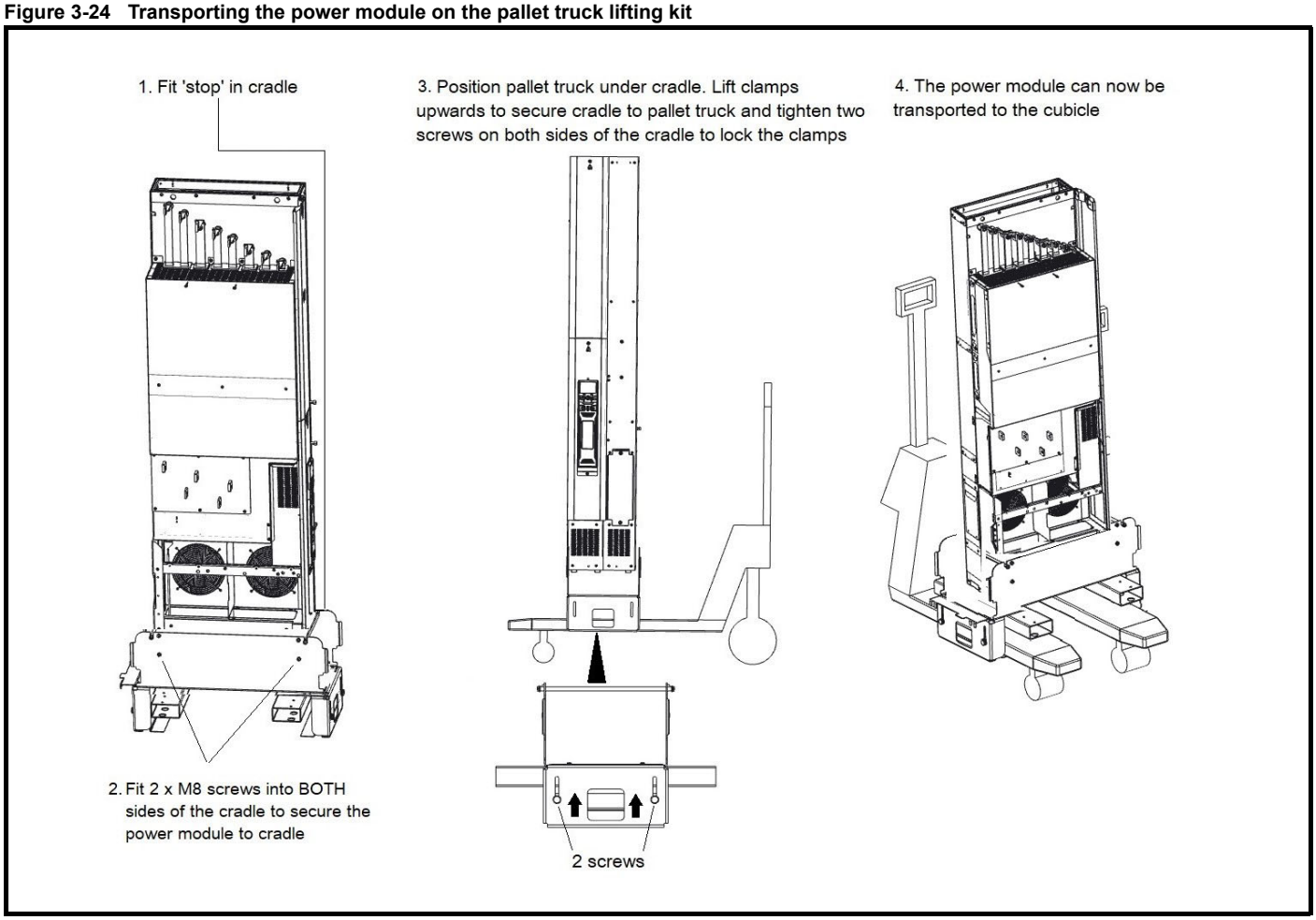
WARNING

Wear safety shoes when transporting the power module.

Wheel the power module into the cubicle

Wheel the power module into the cubicle ensuring alignment of all busbar threaded connections during the final part of movement.

Figure 3-24 Transporting the power module on the pallet truck lifting kit



NOTE

The pallet truck forks are intended to fit underneath the fork supports as shown in part 4 of Figure 3-24.

WARNING

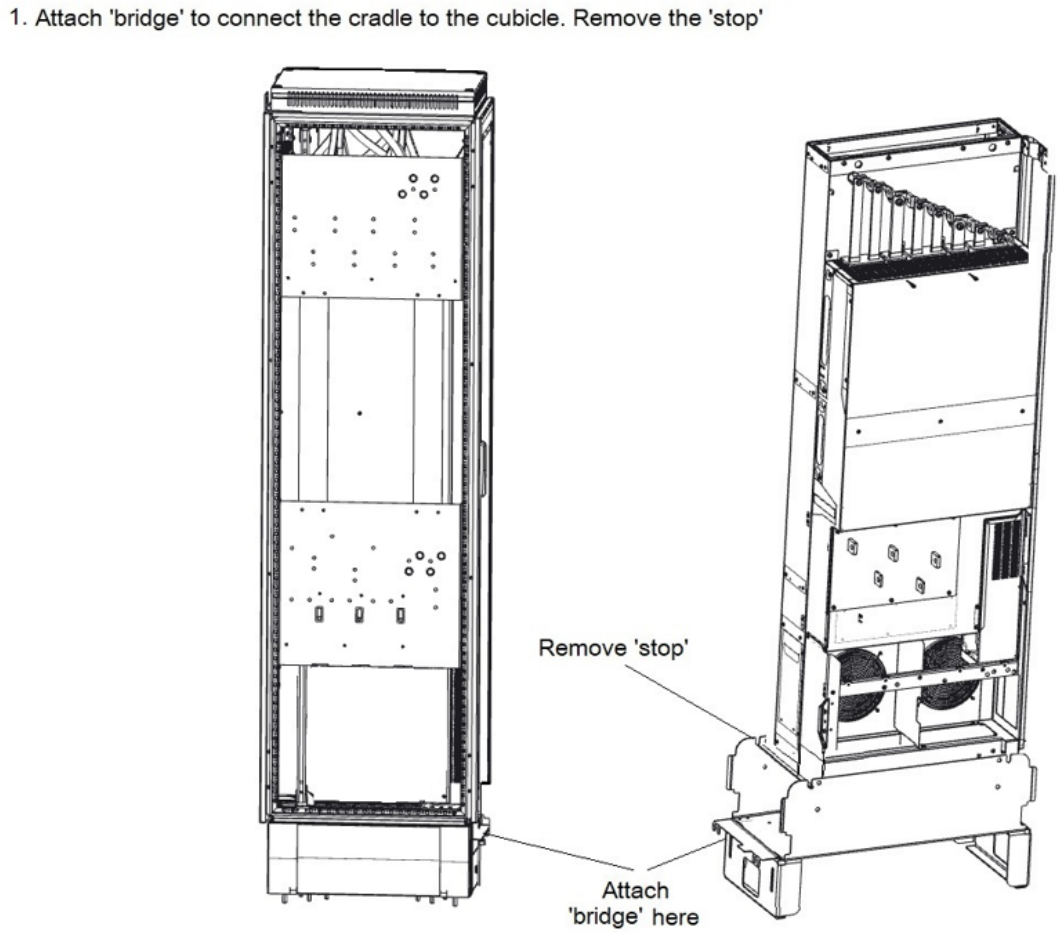
Check that ‘stop’ is firmly located at both ends. Failure to correctly fit the ‘stop’ could cause the power module to fall from the cradle.

WARNING

Ensure that the screws are fitted through the cradle into the power module on both sides and the screws are fitted to the cradle to lock it against the pallet truck forks.

Attach the bridge between the cradle and the cubicle

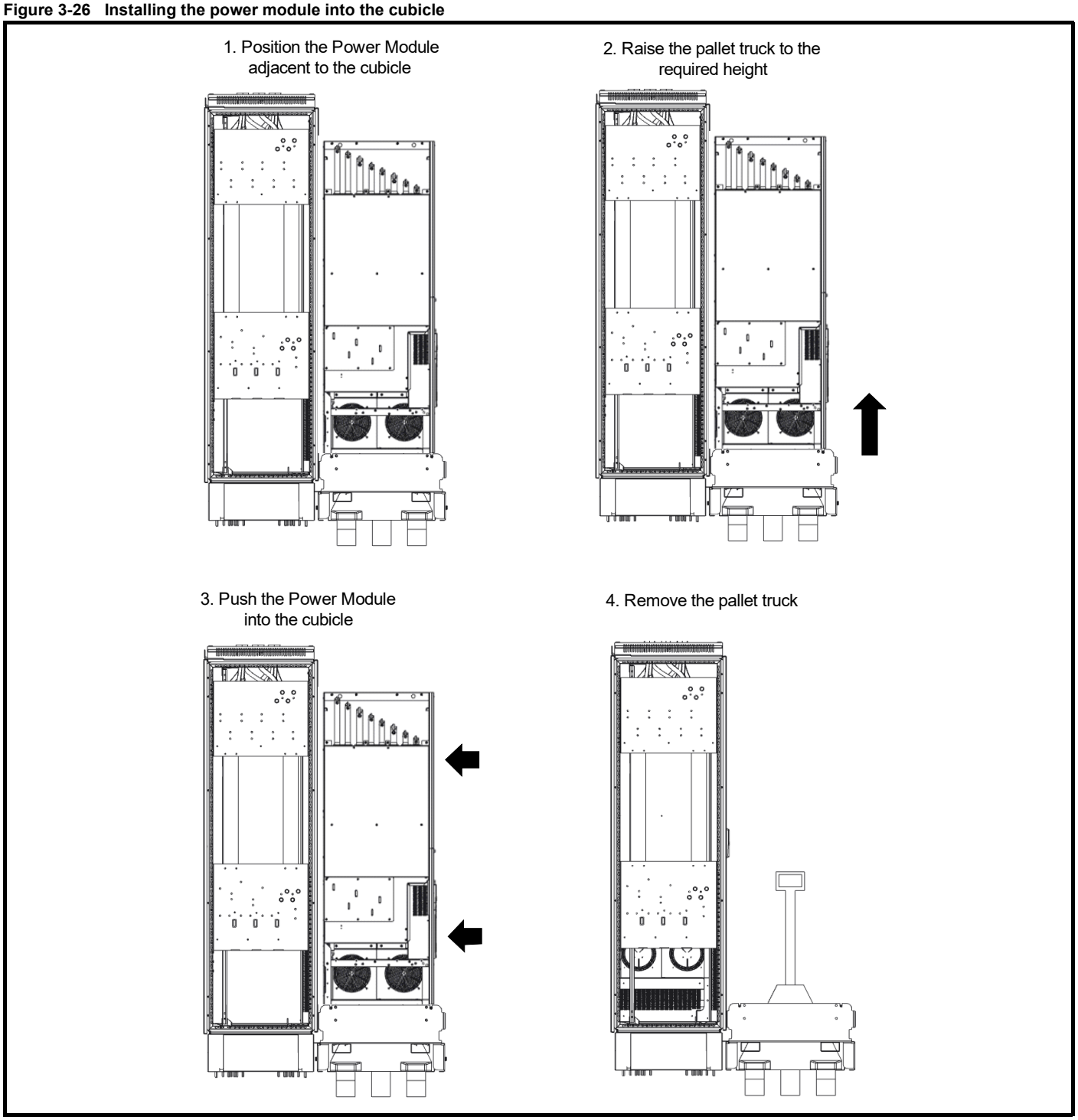
Figure 3-25 Bridge attachment and removal of stop



Fit the power module into the cubicle

Ensure terminal busbar alignment is correct.

Figure 3-26 Installing the power module into the cubicle



WARNING Keep fingers clear of front of cubicle when sliding power module.

CAUTION Ensure correct alignment of busbars when locating power module to prevent damage to threads.

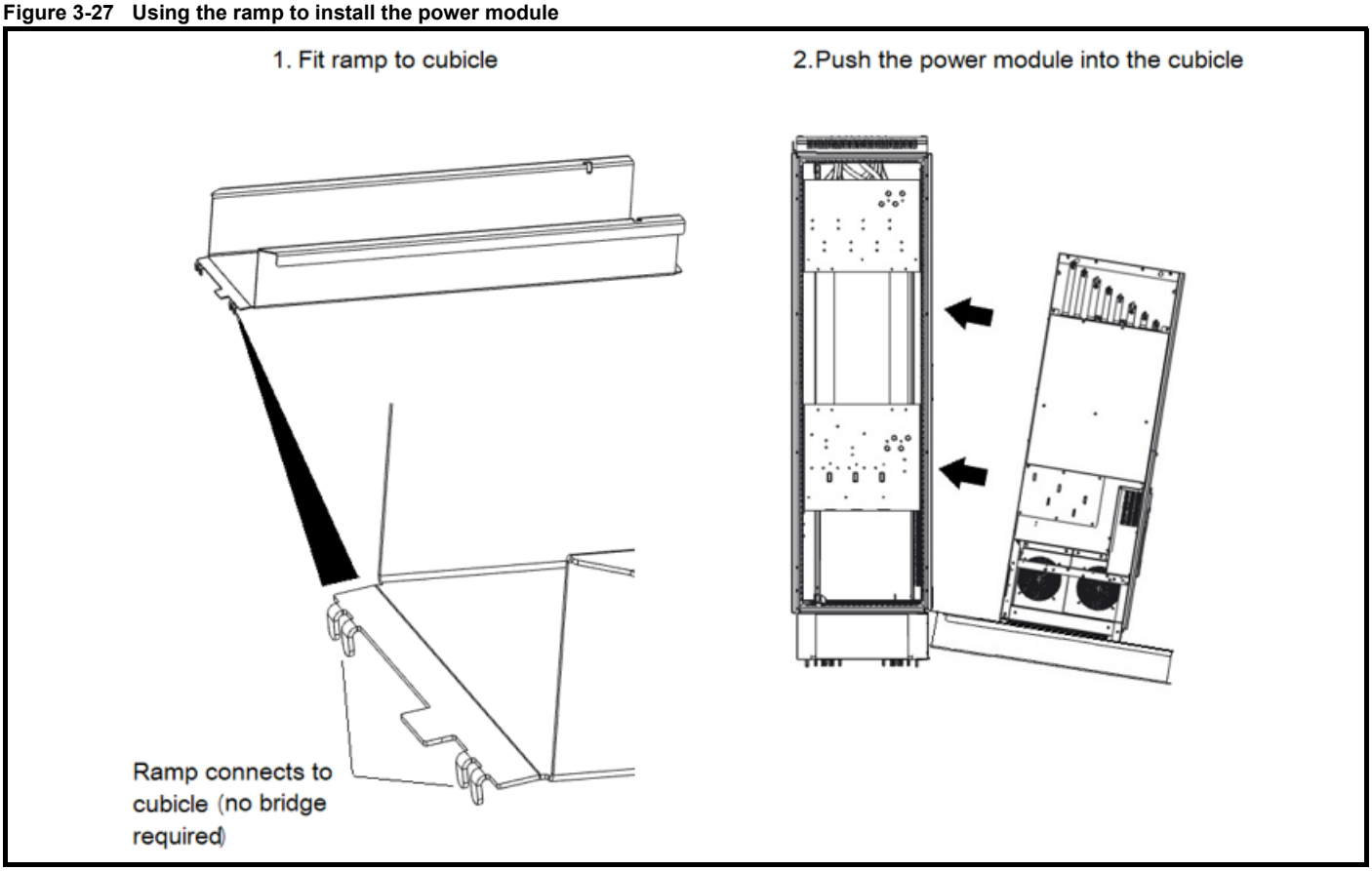
Installing the cubicle using the ramp only

Ensure terminal busbar alignment is correct.

NOTE

The ramp will connect to cubicles with a plinth height of no more than 200 mm.

Figure 3-27 Using the ramp to install the power module



WARNING

Push power module slowly up the ramp. Ensure that it is held firmly at all times. The use of gloves is recommended.

WARNING

Always wear safety shoes when transporting the power module.

WARNING

Keep fingers clear of front of cubicle when sliding power module.

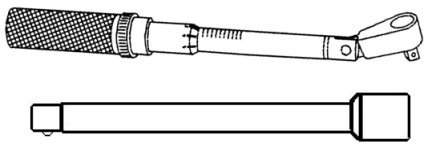
CAUTION

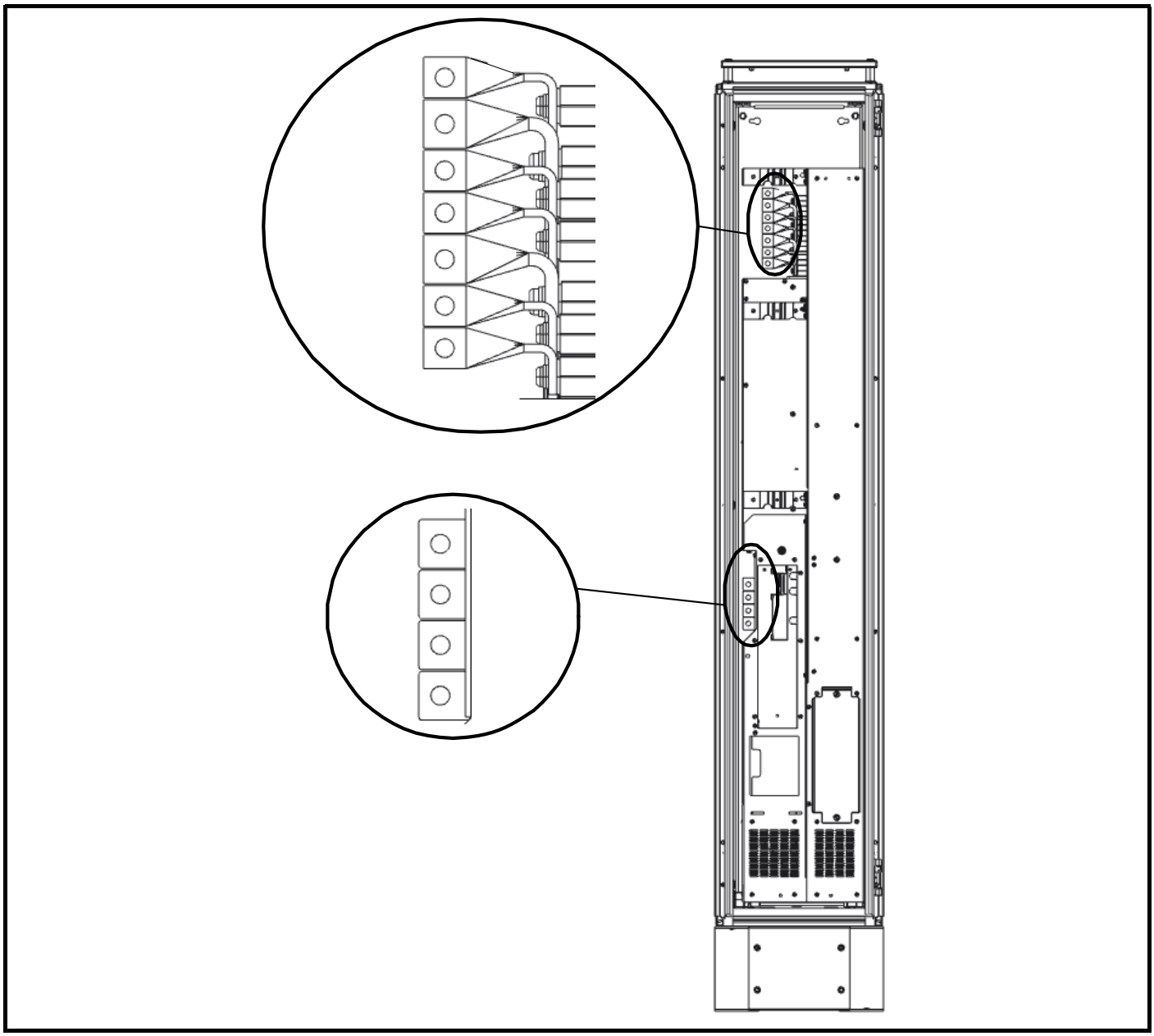
Ensure correct alignment of busbars when locating power module to prevent damage to threads.

Power terminals and ground connections

Fit 15 x M10 nuts to the drive power terminals and ground connections. See Figure 3-20 for location of ground connections.
Tighten loosely to ensure that alignment of terminals is achieved.

Figure 3-28 Fitting the nuts to the power terminals

Tools required	
	 17 mm (0.67 in)



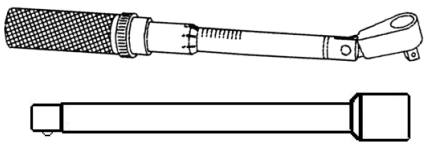
CAUTION

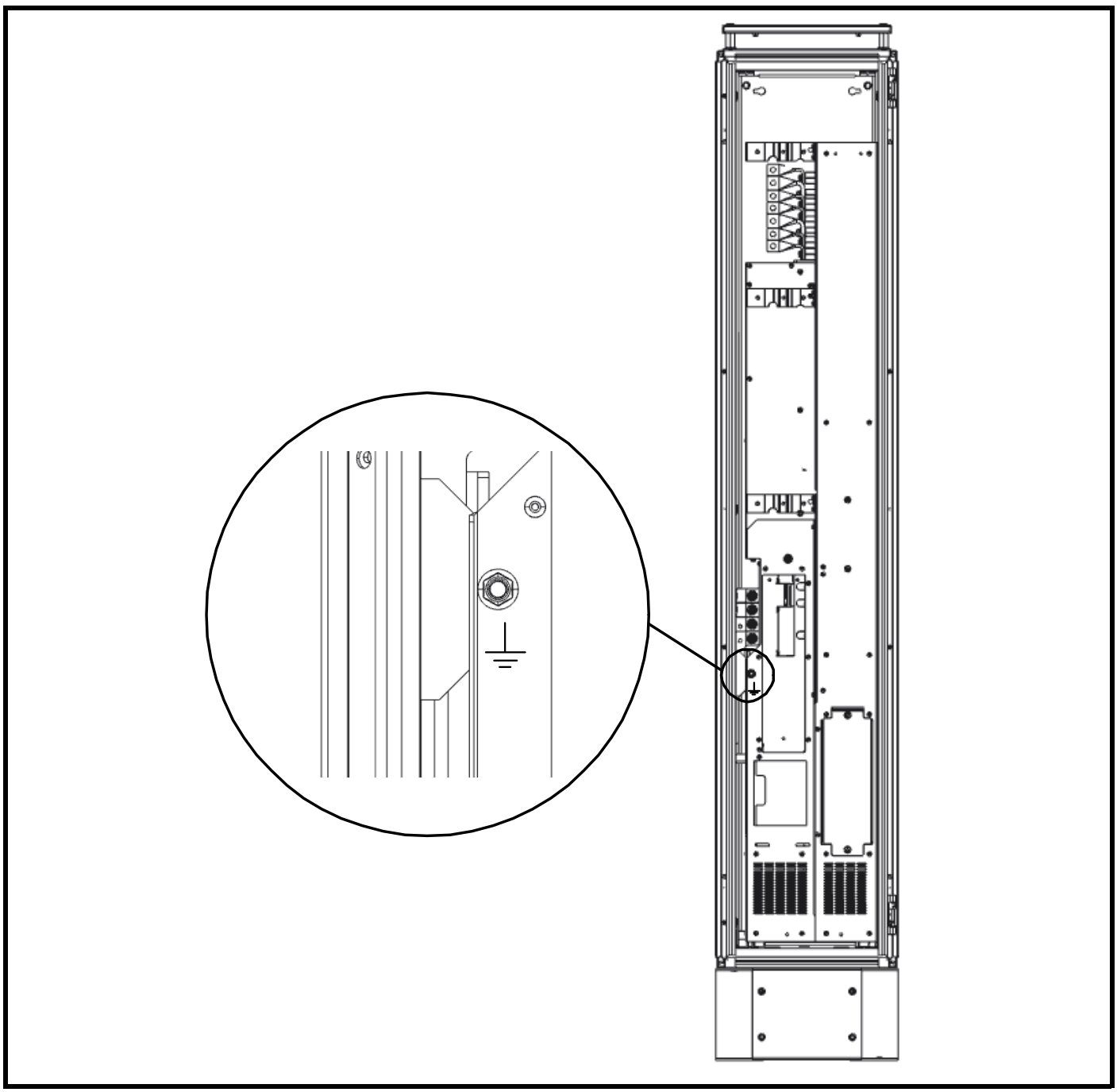
Care must be taken to prevent the fasteners from falling into the cubicle.

Connecting the chassis of the power module to ground

With the power module in the cubicle, fit M8 nut over ground stud and tighten to 12 Nm (106.2 lb in). This connects the chassis of the power module to ground.

Figure 3-29 Grounding the power module to the cubicle

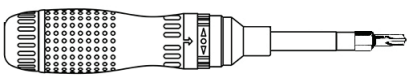
Tools required	
	 13 mm (0.51 in)

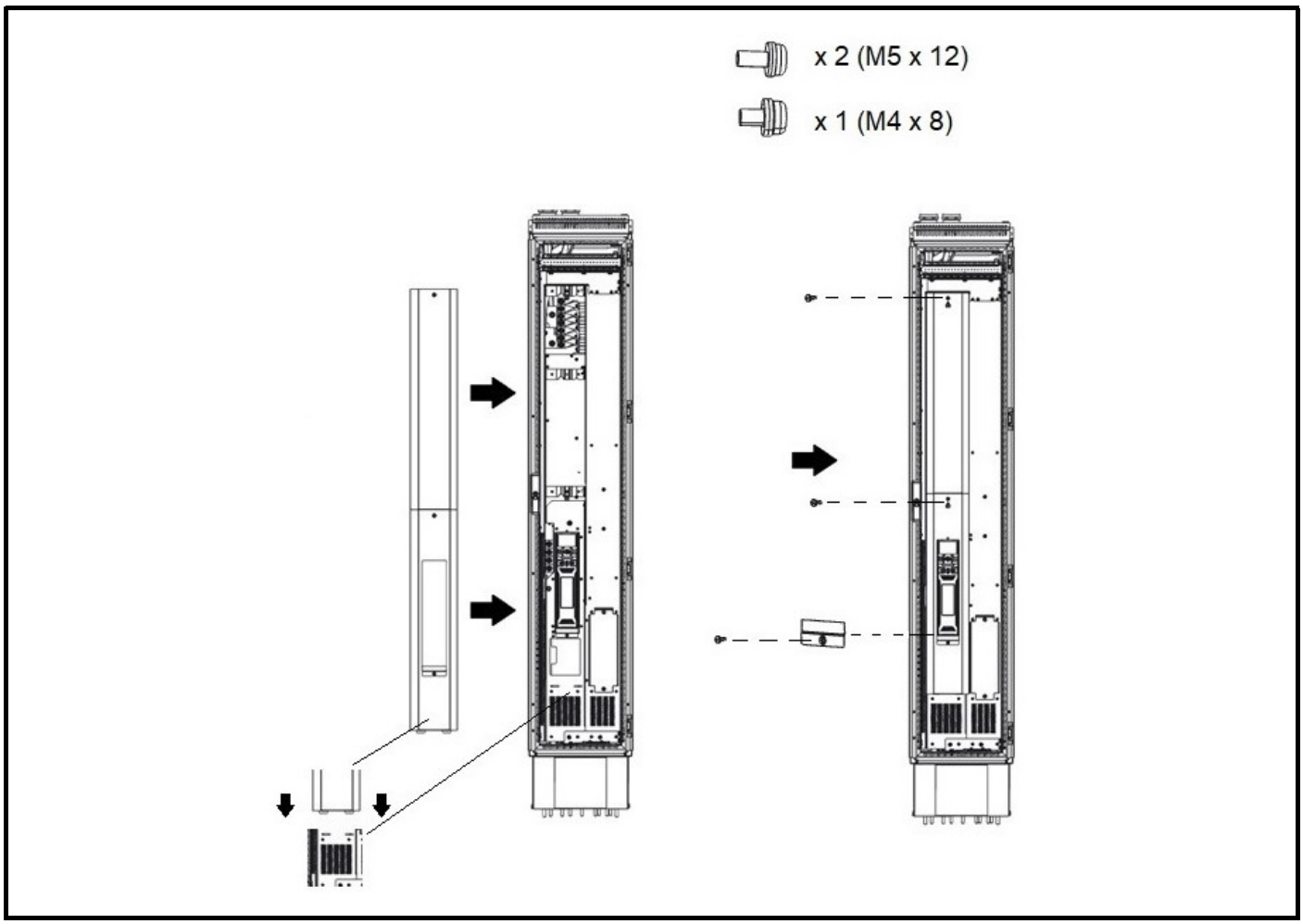


Attach the terminal covers

Attach terminal covers and fit 2 off M5 x 12 screws. Tighten to 4 Nm (35.4 lb in). Insert the control pod panel and fit one M4 x 8 screw. Tighten to 2 Nm (17.7 lb in).

Figure 3-30 Attach terminal covers

Tools required	
	



3.13 Terminal cover removal

WARNING

Isolation of the cubicle
The supply must be disconnected from the drive using the supply isolator before any cover is removed from the drive or before any servicing work is performed.

WARNING

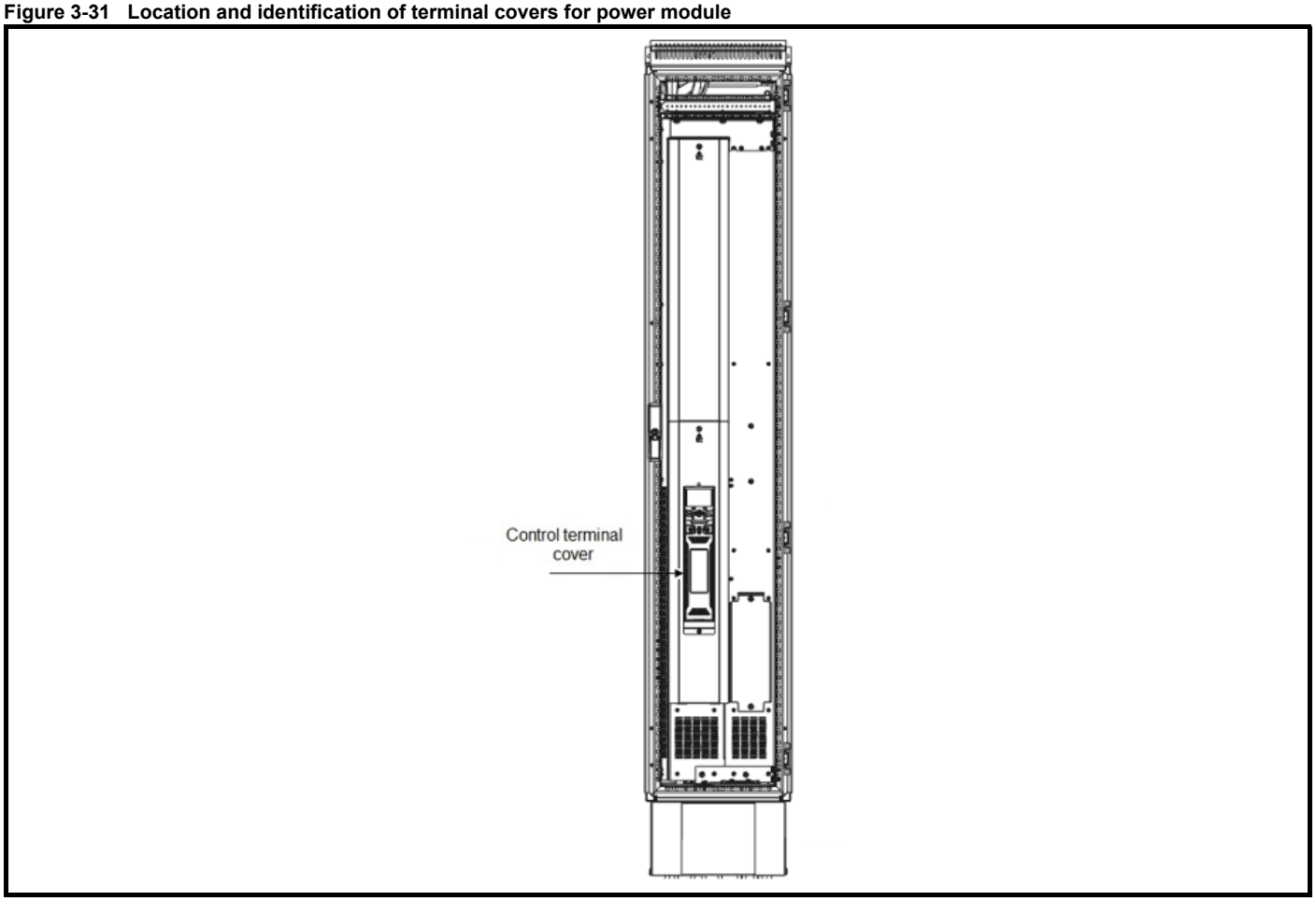
Stored charge
The drive contains capacitors that remain charged to a potentially lethal voltage after the supply has been disconnected. If the drive has been energized, the supply must be isolated at least ten minutes before work may commence.
Normally, the capacitors are discharged by an internal resistor. 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 Control Techniques or their authorized distributor.

3.13.1 Removing the drive control terminal covers

The power module control terminals are fitted with terminal covers. The terminal covers must be removed to gain access to the control terminals.

NOTE
Refer to the relevant control user guide for details on the control terminal layout, functionality and option modules.

Figure 3-31 Location and identification of terminal covers for power module



3.14 External EMC filter

To provide customers with a degree of flexibility, external EMC filters have been sourced from two manufacturers: Schaffner and Block. Filter details for each drive rating are provided in the tables below.

NOTE

If an external EMC filter is to be installed, it must be installed in an incomer cabinet.

Table 3-4 External EMC filter details

Drive	Schaffner		Block	
	Part number	Weight	Part number	Weight
400 V				
12404800, 12405660 12406600, 12407200	FN 3311-1000-99-C16-R55	5.5 kg (12.1 lb)	HLD 103-500/1000	22.5 kg (49.6 lb)
575 V				
12503150, 12503600 12504100, 12504600	FN3311HV-1000-99-C18-R55	6.1 kg (13.4 lb)		
690 V				
12603150, 12603600 12604100, 12604600	FN3311HV-1000-99-C18-R55	6.1 kg (13.4 lb)		

Figure 3-32 Schaffner external EMC filter

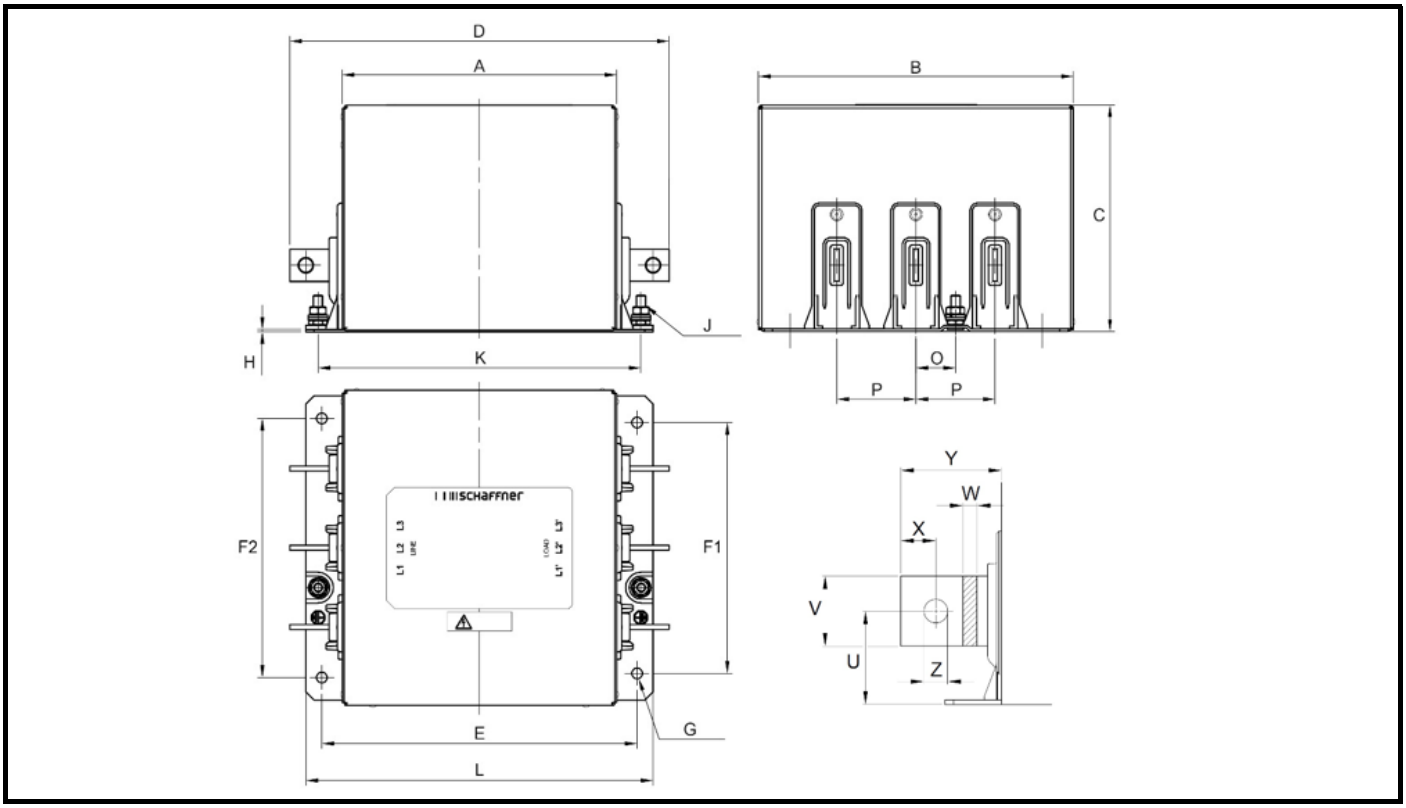


Table 3-5 Schaffner External EMC filter dimensions

Part number	Drive voltage rating	Units	A	B	C	D	E	F1	F2	G	H	J	K	L	O	P	U	V	W	X	Y	Z
FN 3311-1000-99-C16-R55	400 V	mm	190	220	140	305	220	180	185	Ø 9	2.5	M8	225	245	30	59	53	40	8	20	58	Ø 13.5
		in	7.48	8.66	5.51	12	8.66	7.08	7.28	Ø 0.35	0.10		8.86	9.65	1.18	2.32	2.09	1.57	0.31	0.79	2.28	0.53
FN3311HV-1000-99-C18-R55	575 / 690 V	mm	190	290	140	305	220	250	255	Ø 9	2.5	M8	225	245	29.5	59	53	40	8	20	57.5	Ø 13.5
		in	7.48	11.42	5.51	12	8.66	9.84	10.04	Ø 0.35	0.10		8.86	9.65	1.16	2.32	2.09	1.57	0.31	0.79	2.26	0.53

Figure 3-33 Block external EMC filter

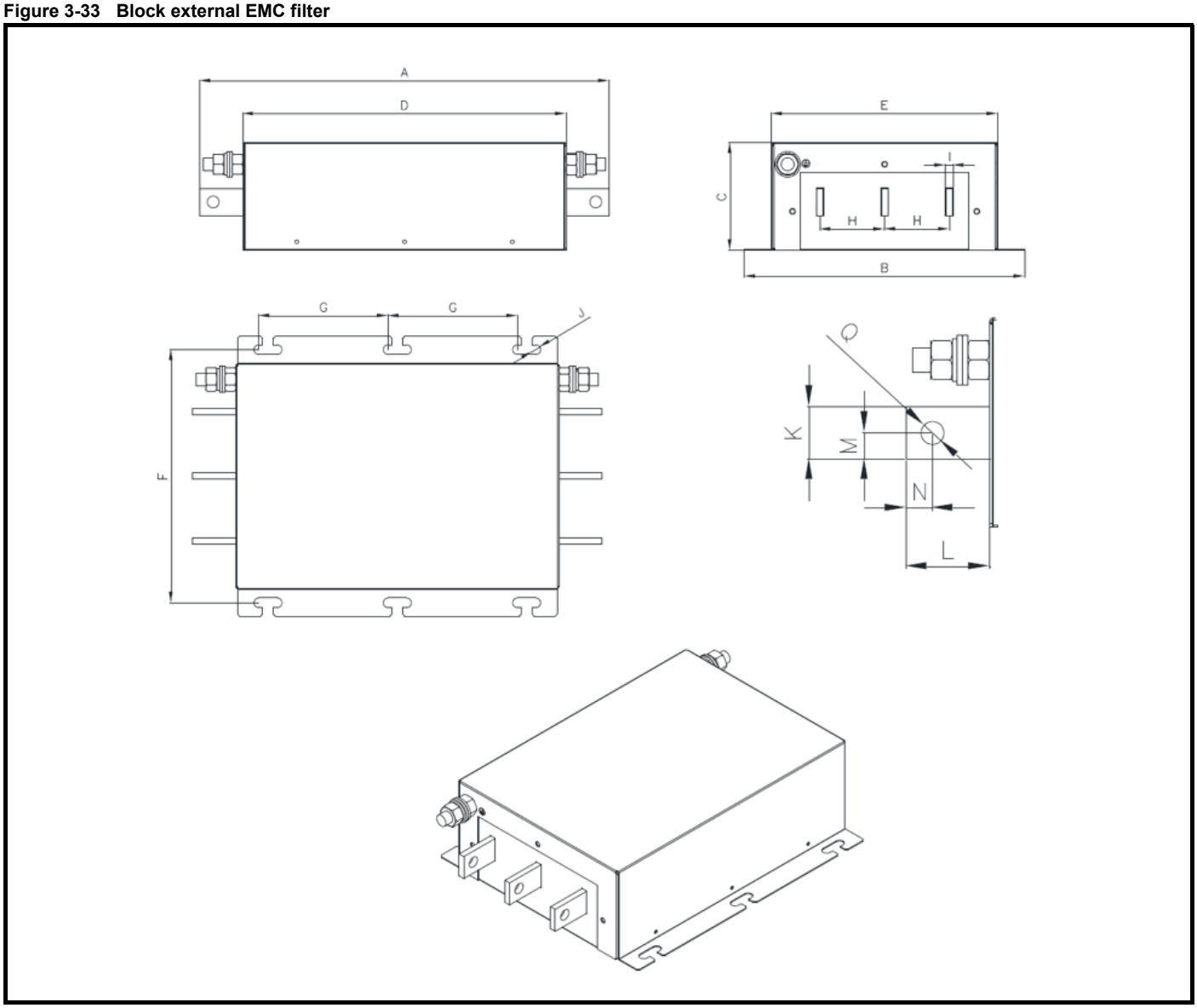


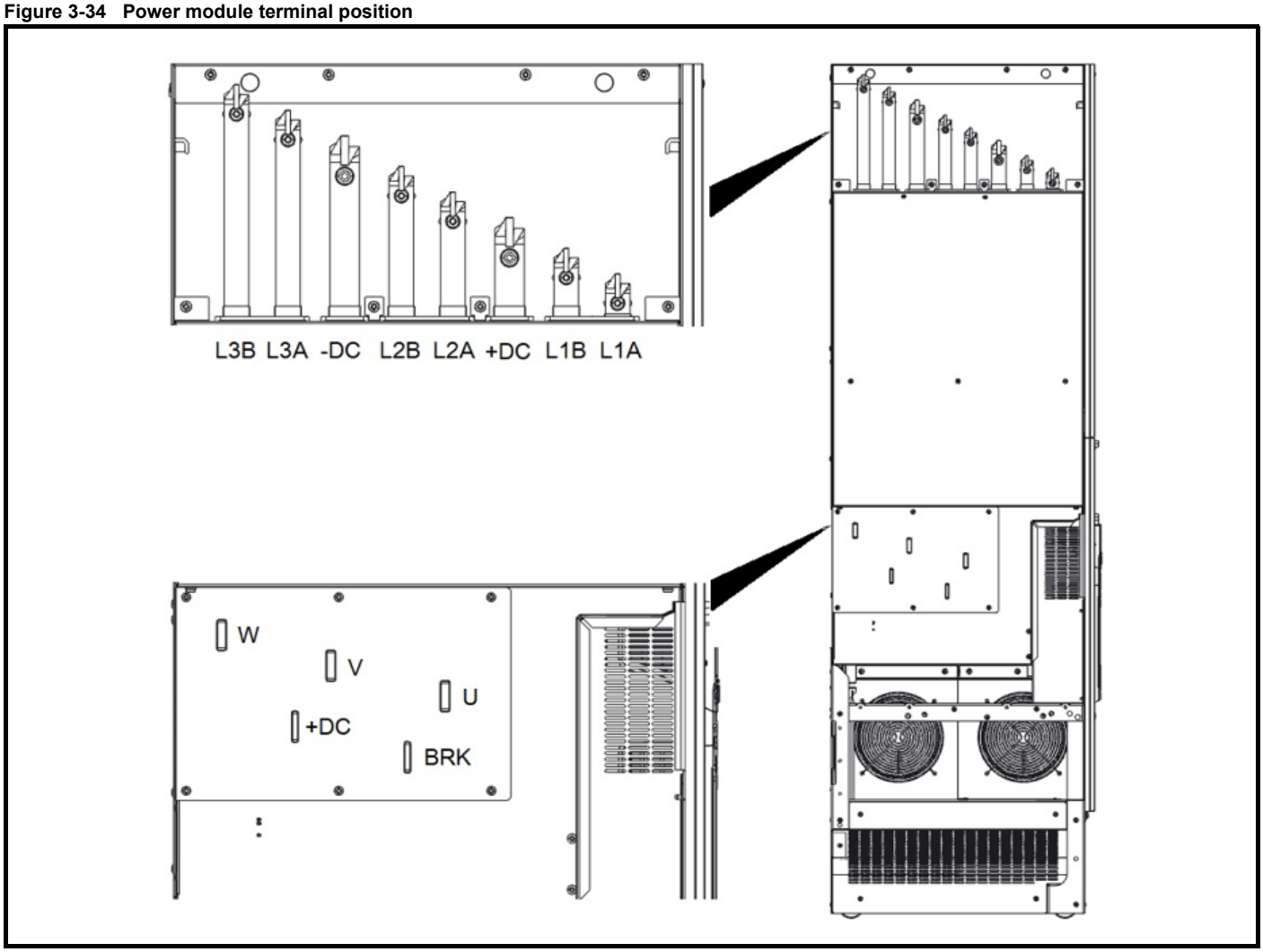
Table 3-6 Block external EMC filter dimensions

Part number	Units	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Q
HLD 103-500/1000	mm	460	280	130	350	230	255	145	60	8	M8	40	55	20	20	Ø 14
	in	18.11	11.02	5.11	13.78	9.06	10.04	5.71	2.36	0.31		1.57	2.17	0.79	0.79	Ø 0.55

3.15 Electrical terminals

3.15.1 Power module terminals

Figure 3-34 Power module terminal position



3.16 Terminal sizes and torque settings

WARNING

To avoid a fire hazard, adhere to the specified tightening torques for the power and ground terminals. Refer to the following tables.

Table 3-7 Drive control and relay terminal data

Terminal	Connection size	Torque setting
Control module status relay	Plug-in terminal block	0.5 Nm (3.5 lb in)
Control and 24 V back up supply	Plug-in terminal block	0.2 Nm (1.77 lb in)
Motor terminals (U, V, W)	3 x M10 x 17 AF nut	30 Nm (265.5 lb in)
Brake (DC+, BRK)	2 x M10 x 17 AF nut	30 Nm (265.5 lb in)
Earth (ground)	1 x M8 x 13 AF nut	12 Nm (106.2 lb in)
L1A/B, L2A/B, L3A/B, DC+, DC-	8 x M10 x 17 AF nut	30 Nm (265.5 lb in)

Table 3-8 Schaffner external EMC filter terminal data

Part number	Power connections	Ground connections	
	Max torque	Ground stud size	Max torque
FN 3311-1000-99-C16-R55	93 Nm (823.12 lb in)	M8	9 Nm (79.6 lb in)

Table 3-9 Block external EMC filter terminal data

Part number	Power connections	Ground connections	
	Max torque	Ground stud size	Max torque
HLD 103-500/1000	30 Nm (265.5 lb in)	M12	30 Nm (265.5 lb in)

WARNING

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 Control Techniques or their authorized distributor.

3.17 Routine maintenance

The drive should be installed in a 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.
Electrical	
Screw connections	Ensure all screw terminals remain tight.
Crimp terminals	Ensure all crimp terminals remain tight – check for any discoloration which could indicate overheating.
Cables	Check all cables for signs of damage.

3.18 Replacement of serviceable parts

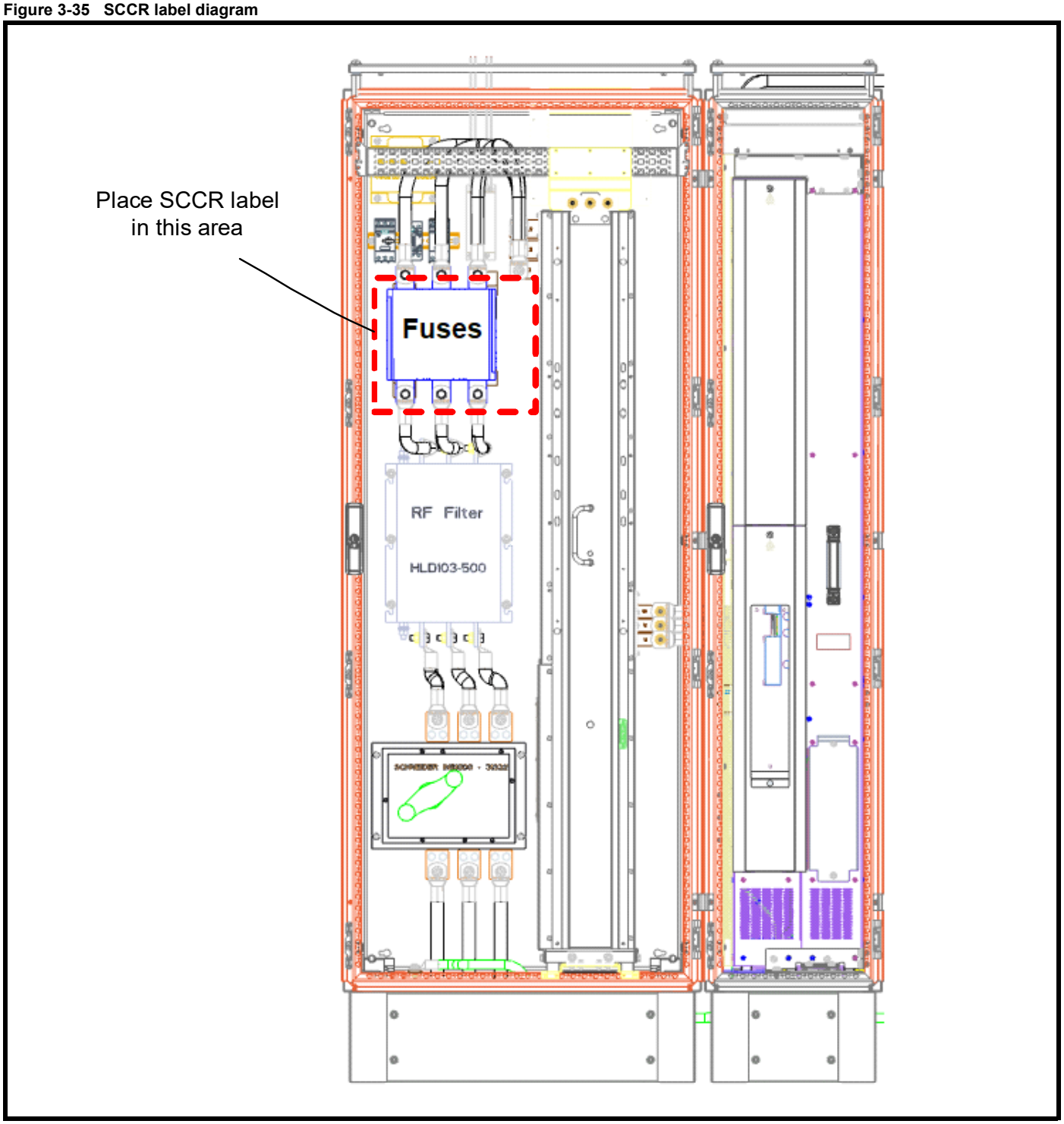
The drives main components are made up of serviceable sub-assemblies (Inverter, rectifier, SMPS, Power control PCB, fans). Instructions for removal and replacement can be found in the *Frame 12 Service Guide*.

3.19 Short Circuit Current Rating (SCCR) label

A SCCR label is supplied with the drive and should be fitted on or as close to the drives fuses as possible. This provides the installer with the details on the short circuit current rating of the drive and is a requirement for UL/CSA approved applications.

See Figure 3-35 for details on positioning the label

Figure 3-35 SCCR label diagram



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.

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 Control Techniques or their authorized distributor.

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

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller 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.

Le déclenchement du dispositif de protection du circuit de dérivation peut être dû à une coupure qui résulte d'un courant de défaut. Pour limiter le risque d'incendie ou de choc électrique, examiner les pièces porteuses de courant et les autres éléments du contrôleur et les remplacer s'ils sont endommagés. En cas de grillage de l'élément traversé par le courant dans un relais de surcharge, le relais tout entier doit être remplacé.

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.

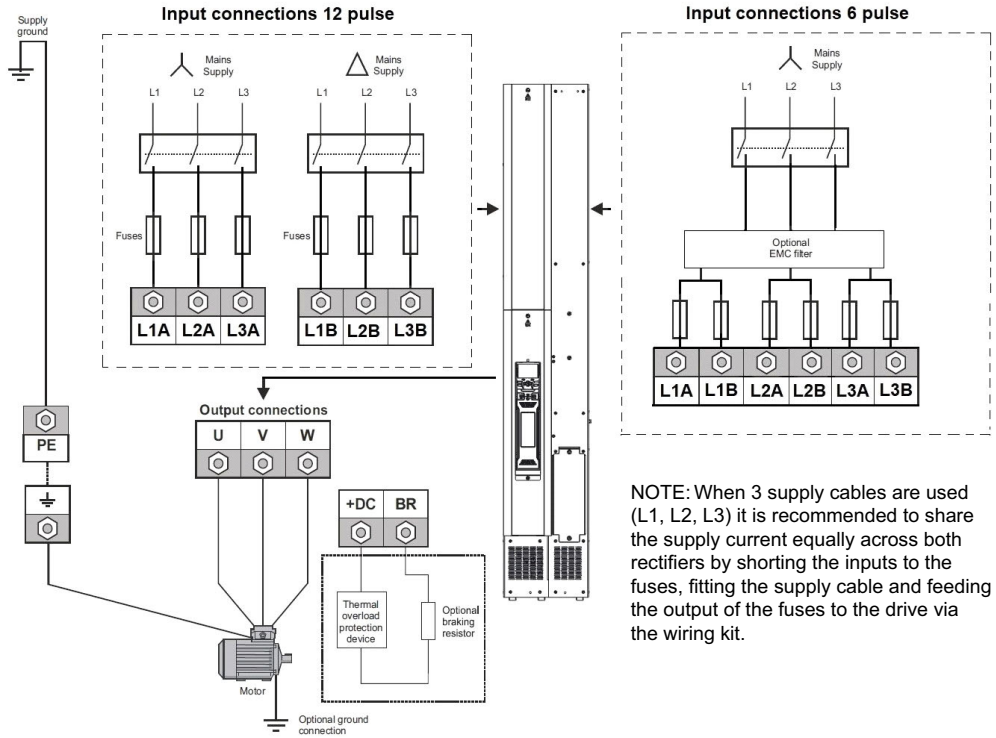
Fuses
The AC supply to the drive must be installed with suitable protection against overload and short circuits. Table 4-7 to Table 4-9 show the recommended fuse ratings.
Failure to observe this requirement will increase the risk of fire.

Isolation device
The AC 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.

4.1 Power connections

4.1.1 AC and DC and brake connections

Figure 4-1 Power Module Frame 12 power connections



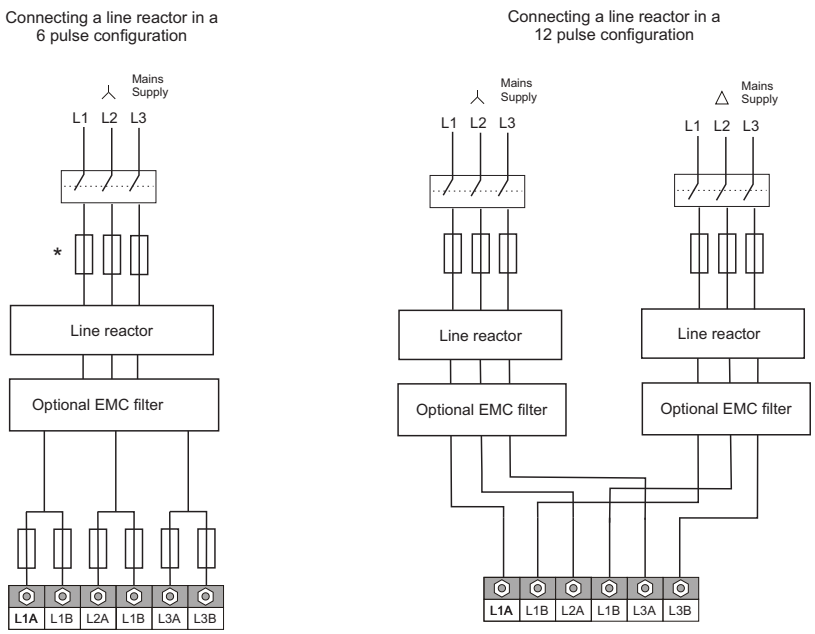
4.2 Fitting line reactors

Frame 12 has been designed to operate without line reactors (See section 4.6.4 for further details.) For low harmonic applications or if the conditions to avoid line reactors are not met refer to Figure 4-2 for details on the line reactor connections.

NOTE

The drive requires 6 fuses. The additional fuses shown in Figure 4-2 are to provide line side protection for the line reactors.

Figure 4-2 Line reactor connections



NOTE

* The fuses upstream of the line reactors may be omitted if correctly rated switchgear / MCBs are installed. Where 3 fuses / MCBs are used, the current rating should be twice that of the fuse rating shown in Table 4-8 to Table 4-10.

4.3 Output short circuit protection

The drive modules are provided with 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.

4.4 Motor overload protection

The drive modules are provided with overload protection for the motor and the motor cable.

For this to be effective, the drive overload protection parameter 'Rated Current (Pr **00.046**)' must be set to the rated motor current as marked on the motor rating plate. For details of how to adjust the drive parameters, refer to the Unidrive M700, M701, M702 Control User Guide. CT Part Number: 0478-0353.

WARNING

Parameter Pr **05.007** '*Motor Rated Current*' must be set correctly to avoid a risk of fire in the event of motor overload.

4.5 Use of a residual current device (RCD)

There are three common types of ELCB / RCD:

- AC - detects AC fault currents
- A - detects AC and pulsating DC fault currents (provided the DC current reaches zero at least once every half cycle)
- B - detects AC, pulsating DC and smooth DC fault currents

Type AC should not be used with variable speed drives.

Type A can only be used with single phase drives

Type B is the only type suitable for use with three phase, variable speed drives

WARNING

RCD types
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 prevent spurious tripping. The leakage current is likely to exceed the trip level if all phases are not energized simultaneously.

NOTE

RCD's with trip levels of less than 100 mA are not supported with this product.

4.6 Supply requirements

4.6.1 AC to AC operation (AC supply to AC motor)

Table 4-1 AC Supply voltage ranges

AC supply voltage	
400 V drive	380 V to 480 V ±10 %
575 V drive	500 V to 575 V ±10 %
690 V drive	500 V to 690 V ±10 %

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 and the appropriate fuses selected.

4.6.2 Types of AC supply configuration

Table 4-2 shows the permitted types of AC supply configuration as well as the altitude limits. The drive is rated up to a maximum of 3000 m above sea level. This is due to the thinner air having an effect of drive cooling and clearance limits between conductive parts being affected at higher altitudes.

The types of AC supply and the altitude limit, shown in metres, can be used.

Table 4-2 Types of AC supply

Voltage rating	400 V	575 V	690 V
Star (Y) connected supply			
Earth system: any TN, TT, neutral earthed	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Earth system: IT (floating supply)	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Delta connected supply			
Earth system: any TN, TT, corner earthed	✓ (up to 2000 m)	✓ (up to 2000 m)	✘
Earth system: IT (floating supply)	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Centre of one side of delta grounded	✓ (up to 2000 m)	N/A	✘
Corner earthed (grounded) in regen mode	✘	✘	✘

4.6.3 Supply types

Drives rated for supply voltage up to 575 V are suitable for use with any supply type, i.e. TN-S, TN-C-S, TT, IT, with grounding at any potential, i.e. neutral, centre or corner ("grounded-delta"). Grounded delta supplies > 575 V are not permitted.

See Table 4-2 for maximum altitude.

Drives are suitable for use on supplies of installation category III and lower, according to IEC60664-1. 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.

Operation with IT (ungrounded) supplies:
Special attention is required when using internal or external EMC filters with ungrounded supplies, because in the event of a ground (earth) fault in the motor circuit the drive may not trip and the filter could be over-stressed. In this case, either the filter must not be used (removed) or additional independent motor ground fault protection must be provided. Refer to Table 4-3.
For details of ground fault protection contact the supplier of the drive.

Table 4-3 Behaviour of the drive in the event of a motor circuit ground (earth) fault with an IT supply

Internal filter only	External filter (in addition to internal filter)
May not trip – precautions required • Remove the EMC filter • Use ground leakage relay	May not trip – precautions required • Do not use EMC filter • Use ground leakage relay

4.6.4 Line reactors

The Power Module Frame 12 input has two rectifiers to enable 6 pulse or 12 pulse operation as standard. The rectifier and DC link are designed such that an external input line reactor may not be required for single drives.

6 pulse operation is created by connecting the inputs of the two rectifiers to a 3 phase 3 wire (+ PE) supply. See Figure 4-1 for further information.

Lower harmonics 12 pulse operation is created by feeding the two rectifiers with two secondary windings; one Δ and one Y.

For 6 pulse operation

- In systems where the supply transformer is smaller than 2 MVA it is possible to operate without a line reactor by installing cables greater than 15 metres in length from the transformer to the drive. If the cable length is less than 15 metres or if the transformer is larger than 2 MVA then input reactors must be used.
- From a harmonics emission perspective, at public low-voltage system, there are no compliance requirements in IEC61000-3-12 for drives rated at over 75 A.
- Input line reactors (INL's) may be installed to reduce the total input RMS current and the harmonics content. If an input line reactor is required, a standard 1 % reactor can be sourced locally. Should the harmonics requirement be strict, an active front end is recommended.
- Laboratory measurements have been performed using a low impedance transformer (1 MVA Dyn11 2.45 %) with approximately 25 metres of cable from transformer to power distribution (PD2) panel and 30 metres of cable from PD2 to point of load. The results with a 500 kVA load indicated < 7 % THDv at the point of load and THDv < 2 % at the PD2 when the THDi =~ 57 %.

For 12 Pulse operation

- For 12 pulse operation, a phase shift Ddy transformer, an equivalent isolating transformer, an auto transformer type, such as the Line Interphase Transformer (LIT), or other partial power differential types are available.
- In this operation mode, not only are the harmonics reduced but also the input stage stresses. As a result, the DC capacitors lifetime is greatly extended.

For individual harmonic data for the above conditions listed above please refer to the EMC datasheet.

If current harmonic compliance is required to IEEE519 an active front end solution is recommended.

4.6.5 24 Vdc supply

The 24 Vdc supply connected to control terminals 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 modules is greater than the drive can supply. In this case the drive will produce a PSU 24V trip.

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, encoder or serial communications to continue to operate.

NOTE

Power down save parameters are not saved when using the 24 V back-up power supply input

Table 4-4 24 Vdc supply connections

Function	Terminal numbers	Terminal location
Supplement the drive's internal supply	Terminal 1, 2*	Unidrive M control pod
Back-up supply for the control circuit	Terminal 1, 2, 51, 52	Power Module Frame 12

* Terminal 9 on *Unidrive M702*

Table 4-5 Working range of the control 24 Vdc power supply

1	**0 V 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 startup voltage	21.6 V
Maximum power supply requirement at 24 V	40 W
Recommended fuse	3 A, 50 Vdc

Table 4-6 Working range of the 24 Vdc power supply

51	**0 V common**
52	**+24 Vdc**
Nominal operating voltage	24.0 Vdc
Minimum continuous operating voltage	18.6 V
Maximum continuous operating voltage	28.0 V
Minimum startup voltage	18.4 V
Maximum power supply requirement at 24 V	40 W
Recommended fuse	3 A, 50 Vdc

NOTE

If the 24 Vdc supply is connected to terminals 1 and 2, but not to terminals 51 and 52, a Waiting for Power Systems' message will be displayed on the keypad. The location of the power 24 Vdc can be identified from Figure 4-3 and Figure 4-4.

Figure 4-3 Location of the 24 Vdc power connection on the control module

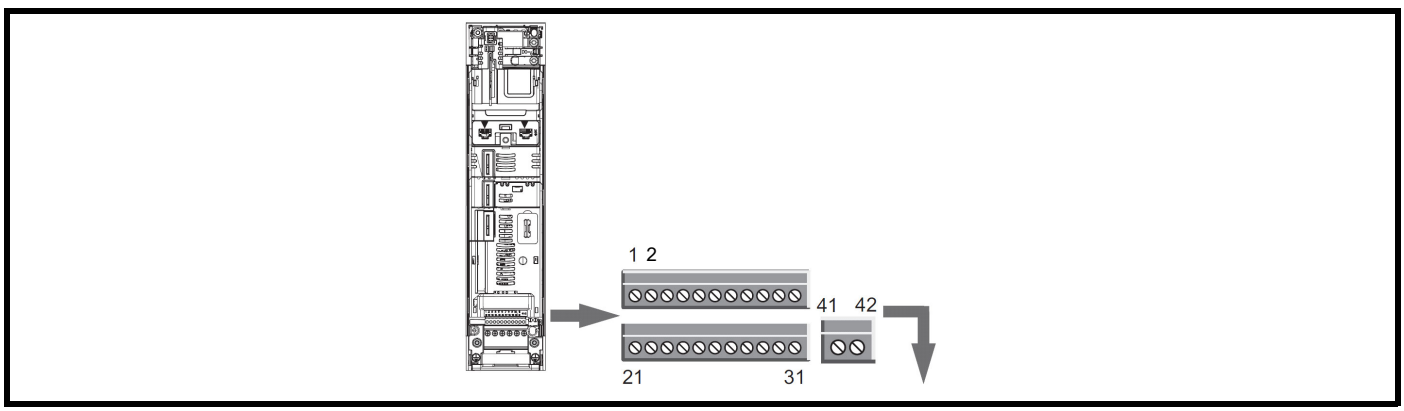
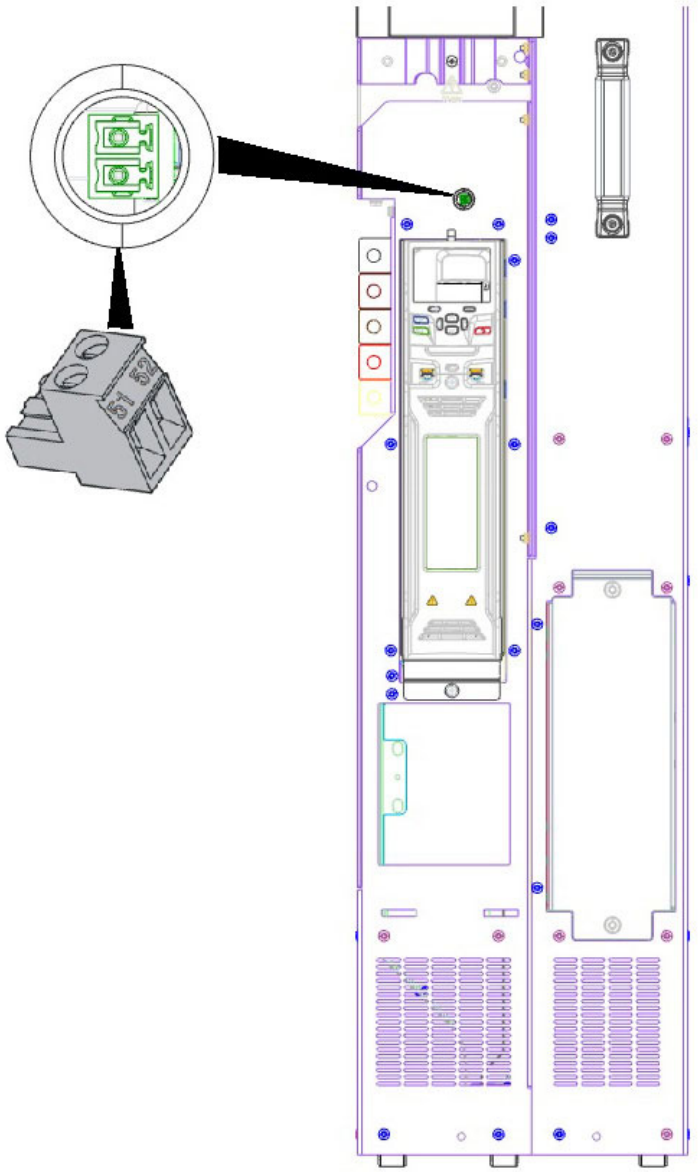


Figure 4-4 Location of the 24 Vdc power supply connection on the Power Module Frame 12



4.7 Cable sizes and fuse 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 poor 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 supply fault current given in section 6.

WARNING

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. Table 4-7 shows the recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

Table 4-7 400 V drive input current, fuse rating and cable size

Model (T/D)	Typical input current	Maximum continuous input current	Fuse (6 per drive)				Nominal cable size (European) mm²				Nominal cable size (USA)		
			IEC		UL/USA		Input 6 pulse	Input 12 pulse	Output	Cable type (input & output)	Input 6 pulse	Input 12 pulse	Output
		3 ph	Nom	Class	Nom	Class							
	A	A	A		A		mm²	mm²	mm²		AWG/kcmil	AWG/kcmil	AWG/kcmil
12404800	476	674	550	aR	600	Class J fuse (HSJ600) Up to 42 kA SCCR Semiconductor fuse A70QS600-4K Up to 100 kA SCCR	4 x 120	2 x 120	3 x 150	XLPE/EPR	4 x 250 Kcmil (127 mm²)	2 x 250 Kcmil (127 mm²)	4 x 250 Kcmil (127 mm²)
12405660	537	759					4 x 150	2 x 150	4 x 120		4 x 300 Kcmil (152 mm²)	2 x 300 Kcmil (152 mm²)	4 x 300 Kcmil (152 mm²)
12406600	605	855							3 x 185		4 x 400 Kcmil (152 mm²)	2 x 400 Kcmil (203 mm²)	4 x 350 Kcmil (177 mm²)
12407200	756	1069					4 x 185	2 x 185	4 x 185		4 x 500 Kcmil (253 mm²)	2 x 500 Kcmil (253 mm²)	4 x 500 Kcmil (253 mm²)

Table 4-8 575 V drive input current, fuse rating and cable size

Model (T/D)	Typical input current	Maximum continuous input current	Fuse (6 per drive)				Nominal cable size (European) mm²				Nominal cable size (USA)		
			IEC		UL/USA		Input 6 pulse	Input 12 pulse	Output	Cable type (input & output)	Input 6 pulse	Input 12 pulse	Output
		3 ph	Nom	Class	Nom	Class							
	A	A	A		A		mm²	mm²	mm²		AWG/kcmil	AWG/kcmil	AWG/kcmil
12503150	263	372	400	aR	600	Semiconductor fuse A70QS600-4K Up to 100 kA SCCR	2 x 150	1 x 150	1 x 185	XLPE/EPR	4 x 3/0 AWG (85 mm²)	2 x 3/0 AWG (85 mm²)	4 x 1/0 AWG (53.5 mm²)
12503600	316	446					2 x 185	1 x 185	1 x 240		4 x 3/0 AWG (85 mm²)	2 x 3/0 AWG (85 mm²)	4 x 2/0 AWG (67.4 mm²)
12504100	347	491					2 x 240	1 x 240	2 x 150		4 x 4/0 AWG (107.2 mm²)	2 x 4/0 AWG (107.2 mm²)	4 x 3/0 AWG (85 mm²)
12504600	389	550					2 x 240	1 x 240	2 x 150		4 x 250 Kcmil (127.2 mm²)	2 x 250 Kcmil (127.2 mm²)	4 x 4/0 AWG 107.2 mm²)

Table 4-9 690 V drive input current, fuse rating and cable size

Model (T/D)	Typical input current	Maximum continuous input current	Fuse (6 per drive)				Nominal cable size (European) mm²				Nominal cable size (USA)		
			IEC		UL/USA		Input 6 pulse	Input 12 pulse	Output	Cable type (input & output)	Input 6 pulse	Input 12 pulse	Output
		3 ph	Nom	Class	Nom	Class							
	A	A	A		A		mm²	mm²	mm²		AWG/kcmil	AWG/kcmil	AWG/kcmil
12603150	311	440	400	aR	600	Semiconductor fuse A70QS600-4K Up to 100 kA SCCR	2 x 150	1 x 150	1 x 185	XLPE/EPR	4 x 3/0 AWG (85 mm²)	2 x 3/0 AWG (85 mm²)	4 x 1/0 AWG (53.5 mm²)
12603600	351	496					2 x 185	1 x 185	1 x 240		4 x 3/0 AWG (85 mm²)	2 x 3/0 AWG (85 mm²)	4 x 2/0 AWG (67.4 mm²)
12604100	394	558					2 x 185	2 x 240	2 x 150		4 x 4/0 AWG (107.2 mm²)	2 x 4/0 AWG (107.2 mm²)	4 x 3/0 AWG (85 mm²)
12604600	438	620					2 x 240	1 x 240	2 x 150		4 x 250 Kcmil (127.2 mm²)	2 x 250 Kcmil (127.2 mm²)	4 x 4/0 AWG (107.2 mm²)

WARNING

Fuses
The input AC supply cabling to the drive must be protected with HRC fuses or circuit breaker in addition to the semiconductor fuses listed above. Failure to observe this requirement will cause the risk of fire.

NOTE

Cable sizes are from IEC60364-5-52:2009 table B.52.3 with correction factor for 40 °C ambient of 0.91 (from table B52.14) for cable installation method B2 C (single core on a wooden wall).

Cable size may be reduced if a different installation method is used, or if the ambient temperature is lower.

The recommended cable sizes above 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.

NOTE

Cable sizes indicated are XLPR/EPR insulated.

NOTE

The recommended output cable sizes assume that the motor maximum current matches that of the drive's normal duty rating. 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 overload, the drive must be programmed with the correct motor rated current.

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

NOTE

Fuse types

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

The recommended IEC class fuses for Power Module Frame 12 are:

- 400 V - Mersen Protistor size 30 Part number PC30UD69V550TF
- 575 V / 690 V - Mersen Protistor size 30 Part number PC30UD69V400TF

Ground connections

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.

Grounding conductor shall be the same size as the supply conductor. The supply conductor refers to the sum on a phase conductor, for example L1A + L1B.

4.7.1 Main AC supply contactor

The recommended AC supply contactor type is AC1.

Fuse types

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

4.8 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, Pr **00.046** *Motor rated current* must be set to suit the motor.

WARNING

Pr **00.046** *Motor rated current* 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.

4.8.1 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
- 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 4.8.2 *Multiple motors* should be followed.

For the other cases listed, it is recommended that an inverter-rated motor be used. 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.

4.8.2 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** = Fd or SrE). Make the motor connections as shown in Figure 4-5 and Figure 4-6. The maximum cable lengths in Table 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 ⅄ connection, a sinusoidal filter or an output inductor must be connected as shown in Figure 4-6, even when the cable lengths are less than the maximum permissible. For details of inductor sizes refer to the supplier of the drive.

Figure 4-5 Preferred chain connection for multiple motors

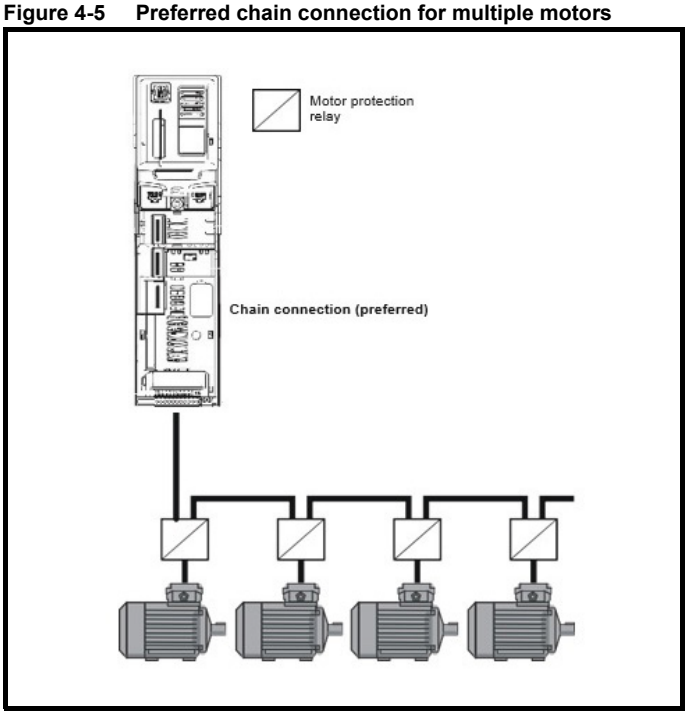
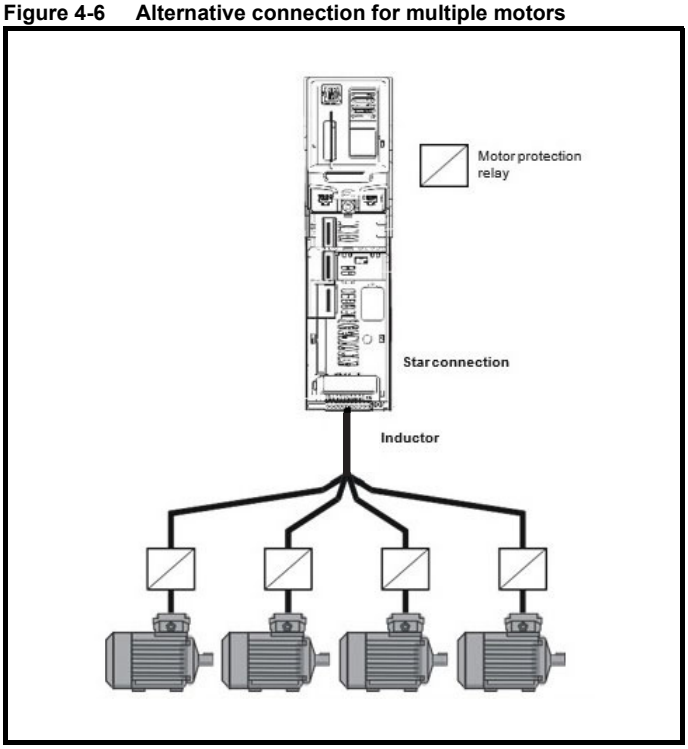


Figure 4-6 Alternative connection for multiple motors



4.8.3 ⅄ / Δ motor operation

The voltage rating for ⅄ 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

A typical 3 phase motor would be connected in ⅄ for 400 V operation or Δ for 200 V operation, however, variations on this are common e.g. ⅄ 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.

4.8.4 Output contactor

WARNING

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 (T31) when opened provides a function. This can in many cases replace output contactors.

4.9 Input and output cables

4.9.1 Cable types and lengths

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 4-10.

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
- 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 closed-loop vector and 6 kHz for servo.

Table 4-10 Maximum cable lengths

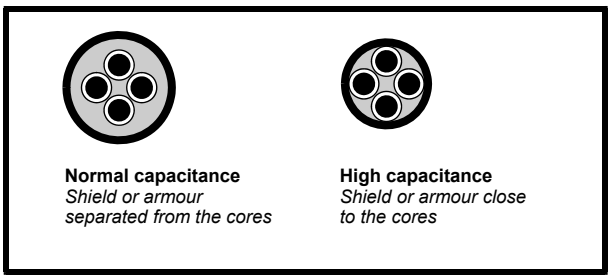
Model	Voltage rating	Maximum Permissible motor cable length				
		2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
All	400 / 575 / 690 V	250 m (820 ft)	250 m (820 ft)	187 m (614 ft)	125 m (410 ft)	93 m (305 ft)

High-capacitance cables

The maximum cable length is reduced from that shown in Table 4-12 if high capacitance 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 4-7 Cable construction influencing the capacitance



The cable used for Table 4-12 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).

4.10 Braking

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 the motor is being braked 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 4-11 shows the DC voltage level at which the drive turns on the braking transistor.

Table 4-11 Braking transistor turn on voltage

Drive voltage rating	DC bus voltage levels
400 V	780 V
575 V	930 V
690 V	1120 V

NOTE

When a braking resistor is used, Pr **02.004** should be set to FASt ramp mode.

WARNING

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.

4.10.1 Braking resistor

WARNING

Overload protection
When a 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 63.

Ensure that the braking resistor 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.

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

Minimum resistances and power ratings

Table 4-12 Minimum resistance values and peak power rating for the braking resistor at 40 °C (104 °F)

Voltage range	Minimum resistance* Ω	Instantaneous Power Rating (kW)	Average Power for 60 s (kW)
400 V	2.9	234	209
575 / 690 V	6.2	224	202

* Resistor tolerance: ±10 %

NOTE

Connections from the brake resistor should be kept separate.
The resistor tolerance should not be more than ±10 % and the resistor should be matched to within ±5 %.

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 essential, though, 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.

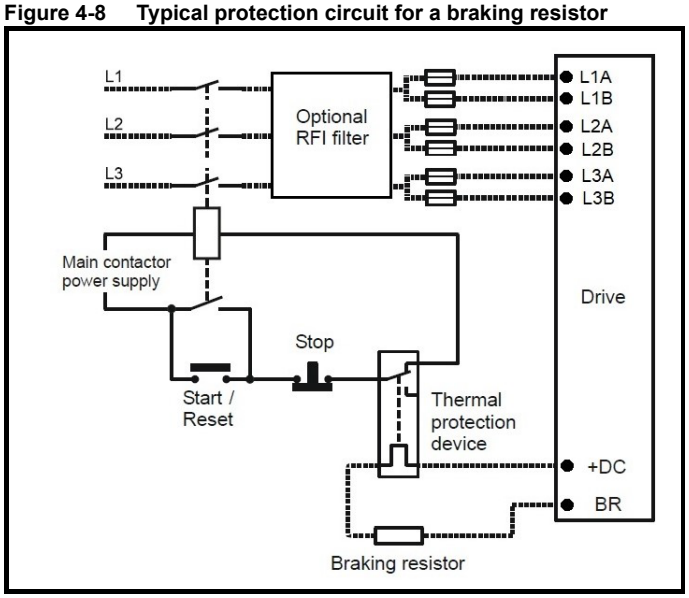
Optimization of the braking resistor requires a careful consideration of the braking duty.

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.

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



4.10.2 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 two values into the drive:

- Resistor short-time overload time (Pr **10.030**)
- Resistor minimum time between repeated short-time overloads (Pr **10.031**)

This data should be obtained from the manufacturer of the braking resistors.

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 *Unidrive M Control User 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 is dependant on whether the internal EMC filter is fitted or not. The drive is supplied with the filter installed.

Instructions for removing the internal filter are given in section 4.12.4 *Disconnection of the internal EMC filter and line to earth varistors* on page 67.

With internal filter installed:

18 mA* AC at 400 V 50 Hz

* Proportional to the supply voltage and frequency.

With internal filter removed: < 63 mA

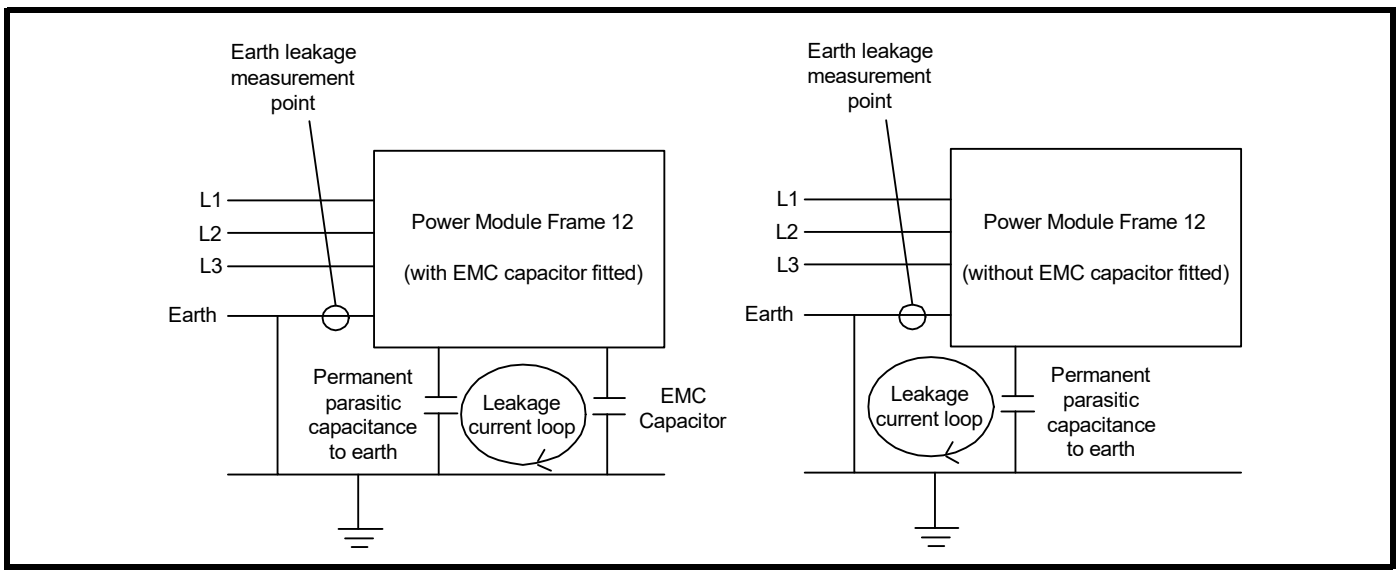
NOTE

The internal EMC filter and internal voltage surge protection devices are disabled when the disconnect screw is removed.

NOTE

As the construction of the Frame 12 differs to that of other frame sizes it has a higher leakage current without an EMC filter fitted than it does with an EMC filter fitted. Refer to Figure 4-9.

Figure 4-9 Leakage current loop with and without EMC filter fitted



4.12 EMC (Electromagnetic compatibility)

4.12.1 Immunity

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 4-13 Immunity compliance

Standard	Type of immunity	Test specification	Application	Level
IEC 61000-4-2	Electrostatic discharge	6 kV contact discharge 8 kV air discharge	Module enclosure	Level 3 (industrial)
IEC 61000-4-3	Radio frequency radiated field	Prior to modulation: 10 V/m 80 - 1000 MHz 3 V/m 1.4 - 2.0 GHz 1 V/m 2.0 - 2.7 GHz 80 % AM (1 kHz) modulation	Module enclosure	Level 3 (industrial)
IEC 61000-4-4	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)
IEC 61000-4-5	Surges	Common mode 4 kV 1.2 / 50 µs wave shape	AC supply lines: line to earth	Level 4
		Differential mode 2 kV	AC supply lines: line to line	Level 3
		Common mode 1 kV	Control lines	(Note:1)
IEC 61000-4-6	Conducted radio frequency	10 V prior to modulation 0.15 - 80 MHz 80 % AM (1 kHz) modulation	Control and power lines	Level 3 (industrial)
IEC 61000-4-11	Voltage dips, short interruptions & variations	All durations	AC supply lines	
IEC 61000-4-8	Power frequency magnetic field	1700 A/m RMS. 2400 A/m peak (2.1 mT RMS 3 mT peak) continuous at 50 Hz	Module enclosure	Exceeds level 5 (Note: 2)
IEC 61000-6-1	Generic immunity standard for the residential, commercial and light - industrial environment			Complies
IEC 61000-6-2	Generic immunity standard for the industrial environment			Complies
IEC 61800-3	Product standard for adjustable speed power drive systems (immunity requirements)		Meets immunity requirements for first and second environments	

Note: 1 - Applies to ports where connections may exceed 30 m length. Special provisions may be required in some cases, see additional information below

Note: 2 - Limited by test equipment capability

Unless stated otherwise, immunity is achieved without any additional measures such as filters or suppressors. To ensure correct operation, the wiring guidelines specified in this Installation Guide must be followed. All inductive components such as relays, contactors, electromagnetic brakes must be fitted with appropriate suppression.

4.12.2 Conducted Emissions

Radio frequency emission in the range from 150 kHz to 30 MHz is generated by the switching action of the main power devices (IGBTs) and is mainly conducted out of the equipment through the electrical power wiring.

Switching frequency

Conducted emissions increase with switching frequency. The switching frequency should be chosen to optimise the balance between motor losses and electromagnetic emissions. A switching frequency of 2 kHz to 3 kHz is the most appropriate for low conducted emissions.

Motor cable length

Conducted emissions increase with the length of the motor cable. The drive should be placed as close to the motor as possible and the length of the motor cable should be kept to a minimum.

Screened motor cable

Use either four-core cable or shielded (screened) cable to connect the variable speed drive to the motor. Most types of shielded cable can be used provided that the cable has an overall screen that is continuous for its entire length. For example, steel wire armoured cable is acceptable.

Ground (earth) connections

The motor cable ground conductor (or shield) must be terminated at the output terminal wiring plate.

Cable layout

The input and output cables should be kept separate. A separation of at least 100 mm is recommended.

Sensitive signal circuits should be routed away from the drive module. A minimum separation of 300 mm (12 in) is recommended.

Any signal cables which are carried inside the motor cable (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 noise current spreading through the control system.

Internal EMC filter

The drive contains a cost-effective internal EMC filter which gives a reduction of about 30 dB in the level of conducted emission at the supply terminals.

With the internal EMC filter connected, the drive meets the conducted radio-frequency emission limits in EN/ IEC 61800-3, Equipment Category C3 for motor cable lengths up to 5.5 m, at a switching frequency of 2 kHz.

For longer motor cables the filter continues to provide a useful reduction in emission level. 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 is used in all applications unless the ground leakage current is unacceptable, or the power drive system is installed on an ungrounded (IT) supply.

Ground leakage current due to internal EMC filter

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.

Use of EMC filters on ungrounded (IT) supplies

When the drive is used with ungrounded (IT) supplies the internal EMC filter must be removed unless additional motor ground fault protection is installed.

Instructions showing how to disconnect the EMC filter are shown below.

Unusual hazards can occur on ungrounded supplies with more than one source, for example on ships. For details of ground fault protection contact the supplier of the drive.

4.12.3 Compliance with EN/ IEC 61800-3 (EMC standard for Power Drive Systems)

External EMC filters

With both the internal and external EMC filters connected, the power drive system is capable of meeting the conducted radio-frequency emission limits in EN/ IEC 61800-3, Equipment Category C3 for motor cable lengths up to 100 m, at a switching frequency of 2 kHz.

The filter should be mounted as close as possible to the drive module, ideally on the same earthing plate or back panel.

The interconnecting cables should be kept as short as possible. A good quality radio frequency ground must exist between the drive module and the filter.

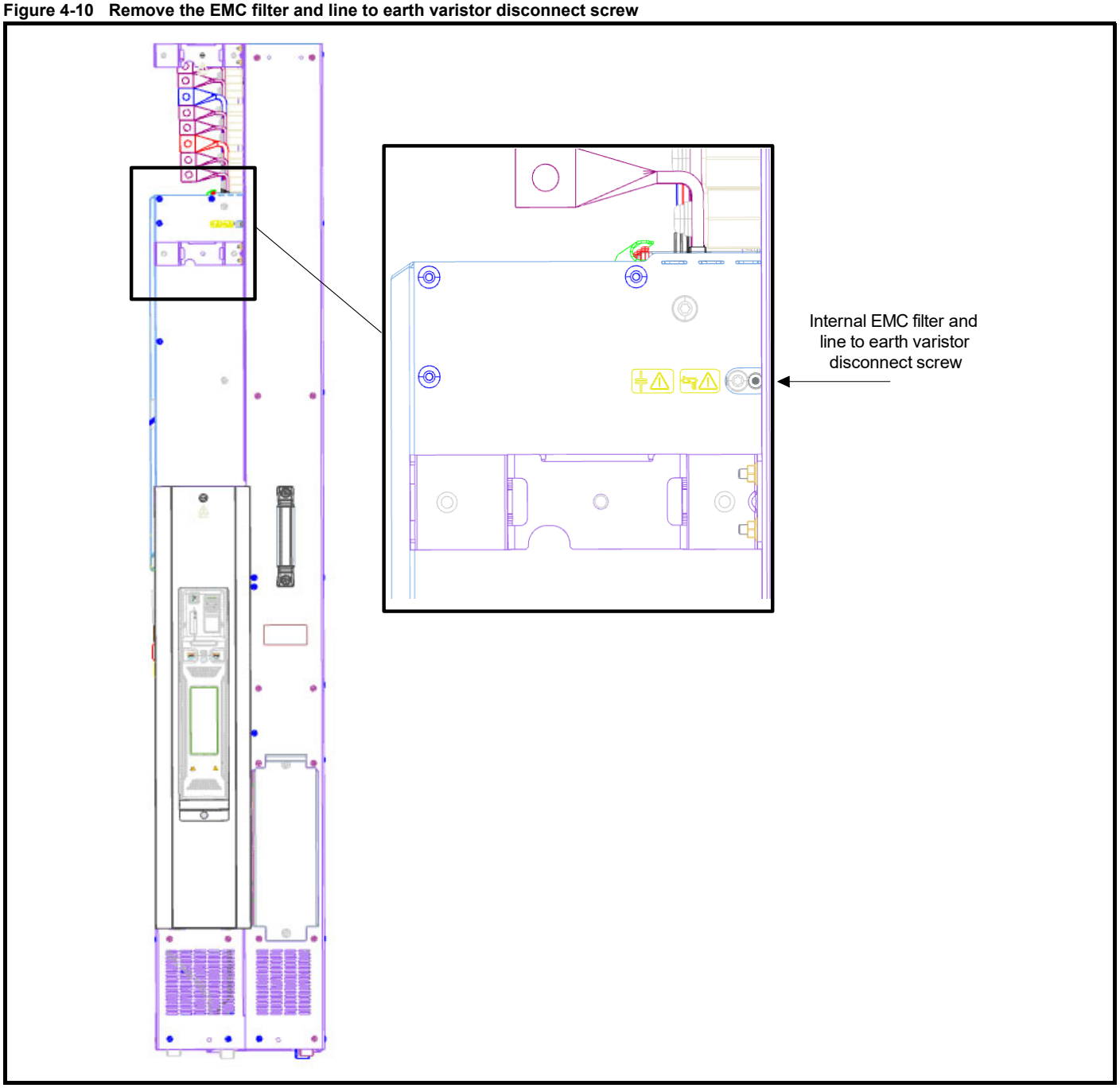
For further details on external EMC filters refer to section 3.14 *External EMC filter*.

4.12.4 Disconnection of the internal EMC filter and line to earth varistors

The power module is fitted with an internal EMC filter and three line to earth varistors. These can be disconnected by removing the screw as shown in Figure 4-10.

1. Remove the screw using a T20 torx bit.
2. If the filter and line to earth varistors are to be connected, insert the screw and tighten to 2 Nm (17.7 lb in)

Figure 4-10 Remove the EMC filter and line to earth varistor disconnect screw



CAUTION

Ensure care is taken when removing the screws to avoid the risk of the screw falling into the power module.

4.12.5 General requirements for EMC

Ground (earth) connections

If ground connections are made using a separate cable, they should run parallel to the appropriate power cable to minimize emissions.

The incoming supply ground should be connected to the earth/ground terminal inside the enclosure.

Use four core cable to connect the motor to the drive. The ground conductor in the motor cable must be connected directly to the earth/ground terminal of the drive and motor. It must not be connected directly to the power earth/ground busbar.

Cable layout

Do not place sensitive (unscreened) signal circuits in a zone extending 300 mm (12 in) all around the drive, motor cable, input cable from EMC filter and unscreened braking resistor cable (if used).

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.

Feedback device cable shielding

Shielding considerations are important for PWM drive installations due to the high voltages and currents present in the output (motor) circuit with a very wide frequency spectrum, typically from 0 to 20 MHz.

The following guidance is divided into two parts:

1. Ensuring correct transfer of data without disturbance from electrical noise originating either within the drive or from external sources.
2. Additional measures to prevent unwanted emission of radio frequency noise. These are optional and only required where the installation is subject to specific requirements for radio frequency emission control.

To ensure correct transfer of data, observe the following:
Resolver connections:

- Use a cable with an overall shield and twisted pairs for the resolver signals.
- Connect the cable shield to the drive 0 V connection by the shortest possible link ("pigtail").
- It is generally preferable not to connect the cable shield to the resolver. However, in cases where there is an exceptional level of common-mode noise voltage present on the resolver body, it may be helpful to connect the shield there. If this is done then it becomes essential to ensure the absolute minimum length of "pigtails" at both shield connections, and possibly to clamp the cable shield directly to the resolver body and to the drive grounding bracket.
- The cable should preferably not be interrupted. If interruptions are unavoidable, ensure the absolute minimum length of "pigtail" in the shield connections at each interruption.

Encoder connections:

- Use a cable with the correct impedance.
- Use a cable with individually shielded twisted pairs.
- Connect the cable shields to 0 V at both the drive and the encoder, using the shortest possible links ("pigtails").
- The cable should preferably not be interrupted. If interruptions are unavoidable, ensure the absolute minimum length of "pigtail" in the shield connections at each interruption. Preferably, use a connection method which provides substantial metallic clamps for the cable shield terminations.

The above applies where the encoder body is isolated from the motor and where the encoder circuit is isolated from the encoder body. Where there is no isolation between the encoder circuits and the motor body, and in case of doubt, the following additional requirement must be observed to provide the best possible noise immunity.

- The shields must be directly clamped to the encoder body (no pigtail) and to the drive grounding bracket. This may be achieved by clamping of the individual shields or by providing an additional overall shield which is clamped.

NOTE

The recommendations of the encoder manufacturer must also be adhered to for the encoder connections.

NOTE

In order to guarantee maximum noise immunity for any application double shielded cable as shown should be used.

In some cases single shielding of each pair of differential signals cables, or a single overall shield with individual shield on the thermistor connections is sufficient. In these cases all the shields should be connected to ground and 0 V at both ends.

Figure 4-11 and Figure 4-12 illustrate the preferred construction of cable and the method of clamping. The outer sheath of the cable should be stripped back enough to allow the clamp to be installed. The shield must not be broken or opened at this point. The clamps should be installed close to the drive or feedback device, with the ground connections made to a ground plate or similar metallic ground surface.

Figure 4-11 Feedback cable, twisted pair

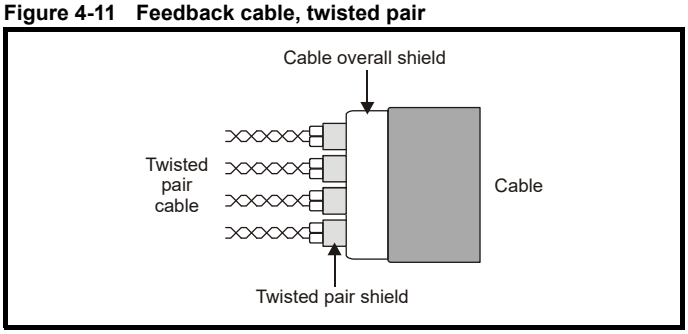
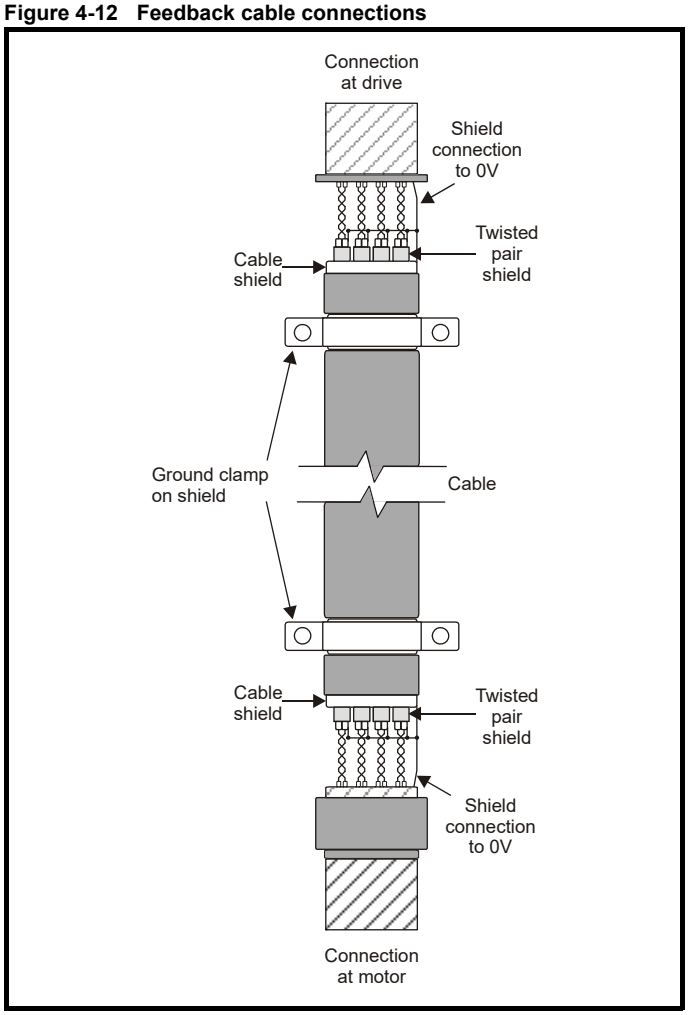


Figure 4-12 Feedback cable connections



To ensure suppression of radio frequency emission, observe the following:

- Use a cable with an overall shield.
- Clamp the overall shield to grounded metallic surfaces at both the encoder and the drive, as illustrated in Figure 4-12 above.

4.12.6 Compliance with EN 61800-3 (standard for Power Drive Systems)

External EMC filters

With both the internal and external EMC filters connected, the power drive system is capable of meeting the conducted radio-frequency emission limits in EN/ IEC 61800-3, Equipment Category C3 for motor cable lengths up to 100 m, at a switching frequency of 2 kHz.

The filter should be mounted as close as possible to the drive module, ideally on the same earthing plate or back panel.

The interconnecting cables should be kept as short as possible. A good quality radio frequency ground must exist between the drive module and the filter.

4.12.7 Compliance with generic emission standards

Use the recommended filter and shielded motor cable. Ensure the AC supply and ground cables are at least 100 mm from the drive and motor cable.

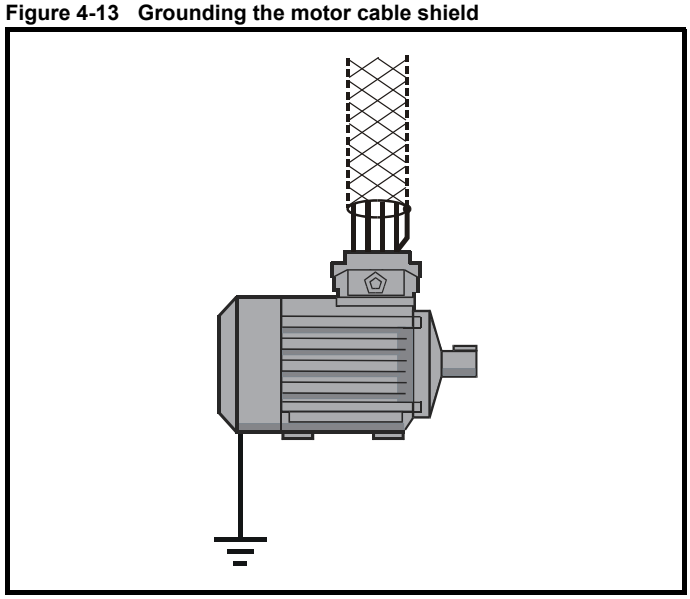
Avoid placing sensitive signal circuits in a zone 300 mm (12 in) all around the drive.

Ensure good EMC grounding.

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

It is unimportant for EMC purposes whether the motor cable contains an internal (safety) ground core, or there is a separate external ground conductor, or 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 4-13 Grounding the motor cable shield

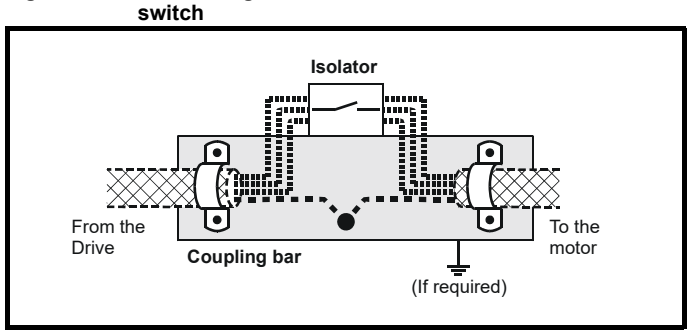


Wiring to the optional braking resistor(s) must be shielded.

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 4-13 above. Remove the outer insulating cover of the cable to ensure the shield(s) make contact with the bracket, making sure to keep the shield(s) intact and as close to the terminals as possible.

Alternatively, wiring may be passed through a ferrite ring, part no. 3225-1004.

Figure 4-14 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 EN61000-6-2 (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 (98.5 ft), 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. Screened cable. 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 mm², 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 4-15 and Figure 4-16. If a digital port experiences a severe surge its protective trip may operate.

For continued operation after such an event, the trip can be reset automatically by setting Pr **10.034** to a value of 5.

Figure 4-15 Surge suppression for digital and unipolar inputs and outputs

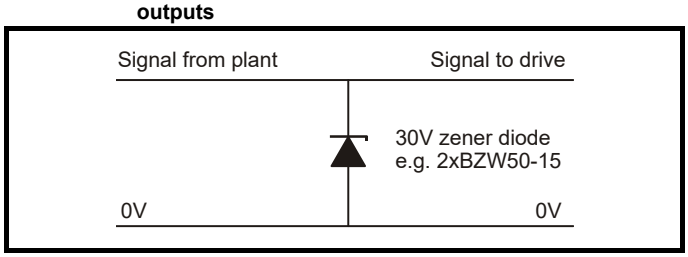
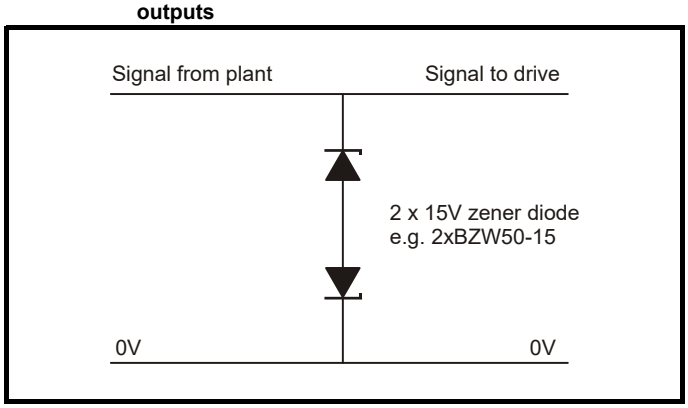


Figure 4-16 Surge suppression for analog and bipolar inputs and outputs



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.

4.12.8 Emissions

AC Supply

The drive modules covered by this Installation Guide are intended to be connected to an industrial supply network with a dedicated distribution transformer, located adjacent to or inside the premises which supplies only industrial customers.

These products are not intended for use in domestic premises or establishments directly connected without an intermediate transformer to a low-voltage power supply network which supplies buildings used for domestic purposes.

WARNING

In a residential environment, these products may cause radio interference in which case supplementary mitigation measures may be required.

Electromagnetic Emission occurs over a wide range of frequencies. The effects are divided into three main categories:

- Low frequency effects, such as supply harmonics and notching.
- High frequency emission below 30 MHz where emission is predominantly by conduction.
- High frequency emission above 30 MHz where emission is predominantly by radiation.

4.12.9 Low Frequency Emissions

Supply voltage notching

The drives do not cause notching of the supply voltage.

Voltage fluctuations and flicker

When running at constant load the drive does not generate voltage fluctuations or flicker. Care must be taken to ensure that the application does not cause the load to vary rapidly, resulting in flicker. Cyclical variations with frequency in the region of 2 Hz to 20 Hz are likely to cause irritating lighting flicker and should be avoided.

When power is first applied the drive draws an inrush current which is lower than the rated input current. This meets the requirements of IEC 61000-3-3.

Common mode harmonic emissions (crosstalk)

The drives generate switching waveforms with frequency components in the audible range as well as the frequency range commonly used by telephone and data systems. The installation instructions include recommendations for segregation and shielding of power and signal cables.

Supply harmonics

The drive input current contains harmonics of the supply frequency. The harmonic levels are affected to some extent by the supply impedance (fault current level).

4.12.10 Radiated Emissions

When installed in a standard metal enclosure according to the wiring guidelines in this Installation Guide, the power drive system is capable of meeting the radiated emission limits required by EN/ IEC 61800-3 (EMC standard for Power Drive Systems) for Equipment Category C3.

Table 4-14 Radiated emissions limits in EN/ IEC 61800-3

Frequency range (MHz)	Category C3	Units
30 - 230	50	dBµV/m Quasi peak
230 - 1000	60	

NOTE

The limits apply at a measuring distance of 10 m. The measurements may be made at 3 m with the limits increased by 10 dB.

Both the internal and external EMC filters must be fitted, and all power and control wiring must be shielded with the shields connected to ground using a good quality RF ground connection. Ungrounded, unscreened cables act as antennae leading to increased levels of radiated emissions.

5 Technical data

5.1 Drive technical data

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

Table 5-1 Maximum permissible continuous output current @ 40 ºC (104 ºF) ambient temperature

Model (T/D)	Normal Duty							Heavy Duty						
	Nominal rating		Maximum Permissible continuous output current (A)					Nominal rating		Maximum permissible continuous output current (A)				
	kW	hp	kHz					kW	hp	kHz				
			2	3	4	6	8			2	3	4	6	8
400 V														
12404800	315	500	608	602	547	444	353	250	400	480	480	456	374	298
12405660	355	550	660	660	614	488	389	315	450	566	566	509	413	328
12406600	400	650	755	747	672	529	423	355	550	660 (2)	627	568	455	363
12407200	500	700	865 (1)	787	709	554	441	400	600	720 (3)	662	597	475	382
575 V														
12503150	250	350	360	360	324	239	202	250	350	315	315	284	206	167
12503600	300	400	410	410	362	266	221	250	350	360	360	314	233	184
12504100	330	450	460	460	397	290	244	300	400	410	410	351	257	205
12504600	370	500	510	510	431	317	265	330	450	460	460	380	279	221
690 V														
12603150	355	450	360	360	324	243	205	280	400	315	315	287	210	170
12603600	400	500	410	410	365	269	225	355	450	360	360	318	233	187
12604100	450	600	460	460	401	294	248	400	500	410	410	351	257	205
12604600	500	650	510	510	436	317	265	450	600	460	460	385	279	225

NOTE

(1) 110 % overload for 10 seconds is available at an ambient temperature of 30 ºC and below. No overload is possible at ambient temperatures above 30 ºC.

(2) 140 % overload for 10 seconds is available at an ambient temperature of 35 ºC and below. Above 35 ºC overload is limited to 125 %.

(3) 140 % overload for 10 seconds is available at an ambient temperature of 30 ºC and below. Above 30 ºC overload is limited to 125 %.

Table 5-2 Maximum permissible continuous output current @ 50 ºC (122 ºF) ambient temperature

Model (T/D)	Normal Duty							Heavy Duty						
	Nominal rating		Maximum Permissible continuous output current (A)					Nominal rating		Maximum permissible continuous output current (A)				
	kW	hp	kHz					kW	hp	kHz				
			2	3	4	6	8			2	3	4	6	8
400 V														
12404800	315	500	608	565	505	407	322	250	400	480	470	427	346	278
12405660	355	550	660	627	568	449	356	315	450	566	526	475	379	306
12406600	400	650	755 (4)	695	618	491	385	355	550	654 (6)	588	528	422	337
12407200	500	700	822 (5)	735	657	510	398	400	600	691 (7)	626	562	439	353
575 V														
12503150	250	350	360	360	304	221	184	250	350	315	315	263	192	154
12503600	300	400	410	410	336	243	201	250	350	360	360	294	212	169
12504100	330	450	460	460	368	269	221	300	400	410	406	323	234	184
12504600	370	500	510	510	399	284	240	330	450	460	442	350	254	202
690 V														
12603150	355	450	360	360	304	221	187	280	400	315	315	266	192	154
12603600	400	500	410	410	336	244	205	355	450	360	360	295	216	169
12604100	450	600	460	460	373	269	225	400	500	410	410	323	238	184
12604600	500	650	510	510	404	289	245	450	600	460	446	354	257	202

NOTE

(4) 110 % overload for 10 seconds is available at an ambient temperature of 40 ºC and below. No overload is possible at ambient temperatures above 40 ºC.

(5) 110 % overload for 10 seconds is available at an ambient temperature of 35 ºC and below. No overload is possible above 35 ºC.

(6) 140 % overload for 10 seconds is available at an ambient temperature of 40 ºC and below. Above 40 ºC overload is limited to 125 % for 10 seconds.

(7) 140 % overload for 10 seconds is available at an ambient temperature of 35 ºC and below. Above 35 ºC overload is limited to 125 % for 10 seconds.

5.1.2 Power dissipation

Table 5-3 Losses @ 40 ºC (104 ºF) ambient

Model (T/D)	Drive losses (W) taking into consideration any current derating for the given conditions									
	Normal Duty					Heavy duty				
	kHz					kHz				
	2	3	4	6	8	2	3	4	6	8
400 V										
12404800	5696	6095	5881	5426	4974	4305	4691	4812	4580	4284
12405660	6308	6811	6716	5981	5440	5231	5666	5425	5046	4657
12406600	7493	7943	7472	6513	5891	6322	6399	6138	5563	5102
12407200	9335	8562	8041	6908	6190	7126	6898	6558	5867	5395
575 V										
12503150	4818	5472	5754	5727	6197	4053	4828	5122	5112	5436
12503600	5127	6073	6242	6126	6513	4498	5354	5486	5516	5716
12504100	5777	6814	6806	6576	7016	5127	6073	6067	5959	6167
12504600	6873	7715	7493	7201	7584	5899	6936	6642	6466	6602
690 V										
12603150	5125	6275	6757	7031	7737	4511	5551	6083	6297	6807
12603600	5829	7102	7519	7617	8275	5125	6275	6646	6807	7257
12604100	7032	8143	8384	8353	9057	5999	7272	7418	7492	7876
12604600	7820	9024	9066	8887	9525	6733	8130	8063	7994	8417

Table 5-4 Losses @ 50 ºC (122 ºF) ambient

Model (T/D)	Drive losses (W) taking into consideration any current derating for the given conditions									
	Normal Duty					Heavy duty				
	kHz					kHz				
	2	3	4	6	8	2	3	4	6	8
400 V										
12404800	5696	5654	5378	4973	4582	4305	4582	4488	4254	4040
12405660	6308	6399	6138	5488	5013	5231	5204	5029	4639	4393
12406600	7493	7258	6780	6019	5388	6250	5927	5651	5155	4771
12407200	8378	7782	7273	6265	5559	6699	6387	6064	5364	4974
575 V										
12503150	4498	5354	5331	5297	5716	3951	4726	4705	4773	5080
12503600	5127	6073	5830	5700	6081	4498	5354	5131	5134	5397
12504100	5777	6814	6338	6182	6513	5127	6014	5626	5535	5716
12504600	6448	7577	6839	6463	6928	5777	6544	6051	5903	6102
690 V										
12603150	5125	6275	6391	6541	7257	4511	5551	5706	5902	6386
12603600	5829	7102	6978	7053	7737	5125	6275	6227	6430	6781
12604100	6555	7952	7670	7617	8275	5829	7102	6738	6919	7177
12604600	7303	8825	8259	8073	8818	6555	7711	7313	7346	7657

5.1.3 Supply requirements

AC Voltage:

400 V drive 380 V to 480 V ±10 %
575 V drive: 500 V to 575 V ±10 %
690 V drive: 500 V to 690 V ±10 %

Number of phases: 3 (6 pulse), 6 (12 pulse)

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

Frequency range: 48 to 65 Hz

5.1.4 Temperature, humidity and cooling method

Ambient temperature operating range:
-20 °C to 40 °C (-4 °F to 104 °F).
Output current derating must be applied at ambient temperatures > 50 °C (122 °F).

Minimum temperature at power-up:
-20 °C (-4 °F), the supply must be cycled when the drive has warmed up to 0 °C (32 °F).

Cooling method: Forced convection

Maximum humidity: 90 % at 50 °C (122 °F). Non-condensing 95 % at 40 °C (104 °F)

Operation with lower AC supplies is possible but the output power from the drive will be reduced. For example, a 400 V drive powered on a 200 V single phase supply will operate but not at the rated output power.

5.1.5 Storage

-40 °C (-40 °F) to +40 °C (104 °F) for long term storage, or to +70 °C (158 °F) for short term storage.

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

The DC bus capacitors within the drive have a storage period of 2 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 30 minutes after every 2 years of storage. This process allows the drive to be stored for a further 2 years.

5.1.6 Altitude

The drive has a limited operating altitude for two reasons:

1. The effect on the drive cooling due to thinner air at higher altitudes.
2. Clearance distances inside the drive have less resistance to breakdown at higher altitudes.

Altitude range (400 V drives): 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 %.
Altitude range (575 V and 600 V drives): 0 to 2000 m (6,560 ft). De-rate the maximum output current between 1000 m and 2000 m as described above.
If a higher operating altitude than is specified is required contact the supplier of the drive.
Refer to section 4.6.2 which covers altitude by type of earthing system used.

5.1.7 IP Rating

The power module is rated to IP00. Once installed in the cubicle the IP rating can be IP21 or IP54 depending on the installation design.

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 5-5.

Table 5-5 IP Rating degrees of protection

First digit		Second digit	
Protection against contact and ingress of foreign bodies		Protection against ingress of water	
0	No protection	0	No protection
1	Protection against large foreign bodies ϕ > 50 mm (large area contact with the hand)	1	Protection against vertically falling drops of water
2	Protection against medium size foreign bodies ϕ > 12 mm (finger)	2	Protection against spraywater (up to 15° from the vertical)
3	Protection against small foreign bodies ϕ > 2.5 mm (tools, wires)	3	Protection against spraywater (up to 60° from the vertical)
4	Protection against granular foreign bodies ϕ > 1 mm (tools, wires)	4	Protection against splashwater (from all directions)
5	Protection against dust deposit, complete protection against accidental contact.	5	Protection against heavy splash water (from all directions, at high pressure)
6	Protection against dust ingress, complete protection against accidental contact.	6	Protection against deckwater (e.g. in heavy seas)
7		7	Protection against immersion
8		8	Protection against submersion

5.1.8 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.

5.1.9 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.

Random Vibration Test

Testing all specimens 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 - 20 Hz

- 3 dB/octave from 20 - 200 Hz

Duration: 30 minutes in each of 3 mutually perpendicular axes.

Shock Bump Test

Testing all specimens together in each of three mutually perpendicular axes in turn.

Referenced standard: IEC 60068-2-29: Test Eb:

Severity: 10 g, 11 ms, half sine

No. of Bumps: 600 (100 in each direction of each axis)

Instrumentation: 3 off additional response accelerometers

Sinusoidal Vibration Test

Testing all specimens together in each of three mutually perpendicular axes in turn.

Referenced standard: In accordance to IEC 60068-2-6: Test Fc.

Severity: 3.5 mm peak displacement from 2 to 8.5 Hz

10 m/s² peak acceleration from 9 to 200 Hz

15 m/s² peak acceleration from 200 to 500 Hz

Sweep Rate: 1 octave/minute

Frequency Range: 2* to 500 Hz (*or lowest achievable on an electromagnetic shaker)

Duration: 15 minutes

5.1.10 Starts per hour

By electronic control: unlimited

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

5.1.11 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:

All variant: 5 s

5.1.12 Output frequency / speed range

Open-loop frequency range: 0 to 599 Hz

Closed-loop speed range: 0 to 40,000 rpm

Closed-loop frequency range: 0 to 550 Hz

5.1.13 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.

The typical accuracy of the current feedback is typically 0 % and worst case 5 %.

5.1.14 Acoustic noise

The cooling fans generate the majority of the acoustic noise produced by the drive. The power modules in the drive contain cooling fans. The power modules control the speed at which the fans run at based on the temperature of the power modules and the drive's thermal model system.

Table 5-6 gives the acoustic noise produced by the drive for the heatsink fan running at the maximum and minimum speeds.

Table 5-6 Acoustic noise data

Max speed dBA	Min speed dBA
73	51

NOTE

These figures are worst case as they include some low-level background noise due to the location of the measurement.

5.1.15 Airflow

Number of fans per drive	Airflow rate per fan (m^3/h)
2	1580

5.1.16 Overall dimensions

H Height
W Width
D Depth

Table 5-7 Overall power module dimensions

Model	Dimension		
	H	W	D
T and D versions	1750 mm (68.9 in)	295 mm (11.6 in)	526 mm (20.7 in)

The drive is designed to be installed in a 2000 mm x 400mm x 600 mm cabinet. This includes space to install two wiring kits.

5.1.17 Weights

Table 5-8 Overall power module weights

Model	kg	lb
T version	130	287
D version	113	249

5.1.18 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 5-10.

Table 5-9 Supply fault current used to calculate maximum input currents

Model	Symmetrical fault level (kA)
All	100

NOTE

Cable sizes are from IEC60364-5-52:2001 table A.52.C with correction factor for 40 °C ambient of 0.87 (from table A52.14) for cable installation method B2 (multicore cable in conduit).

Cable size may be reduced if a different installation method is used, or if the ambient temperature is lower.

The recommended cable sizes above 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.

5.2 Optional external EMC filters

Table 5-10 EMC filter details (all models)

Model (T/D)	Schaffner		Block	
	Part number	Weight	Part number	Weight
400 V				
12404800	FN 3311-1000-99-C16-R55	5.5 kg (12.1 lb)	HLD 103-500/1000	22.5 kg (49.6 lb)
12405660				
12406600				
12407200				
575 V				
12503150	FN3311HV-1000-99-C18-R55	6.1 kg (13.4 lb)		
12503600				
12504100				
12504600				
690 V				
12603150	FN3311HV-1000-99-C18-R55	6.1 kg (13.4 lb)		
12603600				
12604100				
12604600				

Table 5-11 External EMC filter ratings

Part number	Manufacturer	Maximum continuous current (A)		Voltage rating (V)	IP rating	Power dissipation at rated current (W)	Ground leakage (mA)		Discharge resistors
		@40 ºC (104 ºF)	@50 ºC (122 ºF)				Phase to ground leakage (with balanced supply)	1 Phase open circuit	
400 V									
FN 3311-1000-99-C16-R55	Schaffner	1095	1000	530	00	70	61	455	See note 1
HLD 103-500/1000	Block	1100	1000	520	00	130	570	60	Included
575 V									
FN3311HV-1000-99-C18-R55	Schaffner	1000	1000	760	00	70	0.09		
690 V									
FN3311HV-1000-99-C18-R55	Schaffner	1000	1000	760	00	70	0.09		

NOTE

1. 1 M Ω in Y connection between phases

Table 5-12 Optional external EMC Filter dimensions

Part number	Manufacturer	H	W	D
400 V				
FN 3311-1000-99-C16-R55	Schaffner	140 mm (5.51 in)	245 mm (9.65 in)	220 mm (8.67 in)
HLD 103-500/1000	Block	130 mm (5.11 in)	280 mm (11.02 in)	460 mm (18.11 in)
500 V				
FN3311HV-1000-99-C18-R55	Schaffner	305 mm (12.00 in)	290 mm (11.42 in)	140 mm (5.51 in)
690 V				
FN3311HV-1000-99-C18-R55	Schaffner	305 mm (12.00 in)	290 mm (11.42 in)	140 mm (5.51 in)

Table 5-13 Optional external EMC Filter terminal data

Part number	Manufacturer	Power connections	Ground connections	
		Max torque	Ground stud size	Max torque
400 V				
FN 3311-1000-99-C16-R55	Schaffner	93 Nm (823.12 lb in)	M8	9 Nm (79.65 lb in)
HLD 103-500/1000	Block	30 Nm (265.52 lb in)	M12	30 Nm (265.52 lb in)
575 V				
FN3311HV-1000-99-C18-R55	Schaffner	93 Nm (823.12 lb in)	M8	9 Nm (79.65 lb in)
690 V				
FN3311HV-1000-99-C18-R55	Schaffner	93 Nm (823.12 lb in)	M8	9 Nm (79.65 lb in)

5.3 Charging capacitance

The table below shows the drives maximum charging capacitance.

Table 5-14 Maximum charging capacitance values

Voltage	Drive configuration	Maximum charging capacitance (mF)
400 V	AC-AC	153.84
	DC-AC	
	AC-DC (AFE)	
	AC-DC-AC (AFE & inverter)	307.68
575 / 690 V	AC-AC	68.88
	DC-AC	
	AC-DC (AFE)	
	AC-DC-AC (AFE & inverter)	137.76

6 UL Information

Drive variants affected

UL certification only applies to drives rated below 600 Vac.

cUL Listing information

All products covered by this User Guide are cUL Listed to both Canadian and US requirements.

The UL file reference is: NMMS/7 E171230.

Environment

Products must be installed in a Pollution Degree 2 environment or better (dry, non-conductive pollution only).

Drives can deliver full rated output current at surrounding air temperatures up to 40 °C, and derated output up to 50 °C depending on the model number. Refer to section 5 *Technical data*.

Mounting

These products are USL, CNL - Enclosed type Power Conversion Equipment"

Terminal torque

Terminals must be tightened to the rated torque specified. Refer to section 3.16 *Terminal sizes and torque settings*.

Wiring

Wires must be 75 °C rated, Copper wire only.

Ground connections

UL Listed closed-loop connectors (ring terminals) shall be used for ground connections. Refer to section

Overvoltage category

Drives have been evaluated for OVC III

Branch circuit Protection

For installation in the United States or Canada, Branch Circuit Protection must be provided in accordance with the National Electrical Code (NEC), the Canadian Electrical Code and any applicable local or provincial codes. Refer to section 4 *Electrical Installation*.

Solid state short circuit protection

The products incorporate Solid-state short circuit protection.

"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 or the equivalent".

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. Refer to section 4 *Electrical Installation*.

Short circuit current rating (SCCR)

When protected by the specified fuses or circuit breakers, the products are suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, up to the rated voltage of the drive module. Refer to section 4 *Electrical Installation*.

MODEL	Branch Circuit Protection
Mxxx-124 04800	Class J fuse 600 A (HSJ600) - Up to 42 kA
Mxxx-124 05660	
Mxxx-124 06600	
Mxxx-124 07200	
Mxxx-124 04800	R/C Semiconductor Fuse A70QS600-4K - up to 100 kA
Mxxx-124 05660	
Mxxx-124 06600	
Mxxx-124 07200	
Mxxx-125 03150	
Mxxx-125 03600	
Mxxx-125 04100	
Mxxx-125 04600	

Suitable for use on a circuit capable of delivering not more than 100 kA RMS symmetrical amperes, 575 V maximum when protected by semiconductor fuse model no. A70QS600-4K manufactured by Mersen.

Convenient aux circuits non suscepibles de délivrer plus de 100 kA ampères symétriques EFF., maximum 575 V par fusible à semi-conducteur modèle no. A70QS600-4K fabriqué par Mersen.

Model(s): Mxxx-124 04800T, Mxxx-124 05660, Mxxx-124 06600 and Mxxx-124 07200T:

Suitable for use on a circuit capable of delivering not more than 42 kA RMS symmetrical amperes, 480 V maximum when protected by Class J fuse rated 600A.

Convenient aux circuits non suscepibles de délivrer plus de 42 kA ampères symétriques EFF., maximum 480 V avec une protection par fuses de calibre nominal maximal de Class J 600 A.

Motor overload protection

All models incorporate internal overload protection for the motor that is adjustable. Refer to section 4.4 *Motor overload protection*.

All models are provided with thermal memory retention.

The drives are provided with user terminals that can be connected to a motor thermistor. Refer to the Control Connections section in the unidrive M700, 701 and 702 Control User Guide.

External Class 2 supply

If an external power supply is used to power the control circuit, it shall be marked: "UL Class 2". The power supply voltage shall not exceed 24 Vdc.

Regenerative operation

Products can be configured as an AC Regenerative Unit (also known as a Regen drive). Regen operation allows bi-directional power flow to and from the AC supply.

The AC supply voltage must not exceed 600 Volts AC maximum (up to the rated voltage of the drive module)

In these systems the inverter output is connected to the AC supply via a reactor and switching frequency filter. The drives are required to be protected by listed branch fuses as specified in the Unidrive M Regen Design Guide. For grid feed applications, further evaluation may be required to other standards, such as, but not limited to UL1741, CSA C22.2 No. 107.1-01 and IEEE 1547.

Modular drive systems / group installation

Products with DC+ and DC- supply connections are suitable for use in Modular Drive Systems consisting of a single Converter and two or more Inverter sections, where each single inverter is intended to control a single motor.

Modular drive systems / group installation

Products with DC+ and DC- supply connections are suitable for use in Modular Drive Systems consisting of a single Converter and two or more Inverter sections, where each single inverter is intended to control a single motor. Refer to the Unidrive M Modular Installation Guide for details.

Maximum altitude

Refer to Table 6-1 below.

Table 6-1 Types of AC supply

Voltage rating	**400 V**	**575 V**	**690 V**
Star (Y) connected supply			
Earth system: any TN, TT, neutral earthed	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Earth system: IT (floating supply)	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Delta connected supply			
Earth system: any TN, TT, corner earthed	✓ (up to 2000 m)	✓ (up to 2000 m)	✗
Earth system: IT (floating supply)	✓ (up to 3000 m)	✓ (up to 2000 m)	✓ (up to 2000 m)
Centre of one side of delta grounded	✓ (up to 2000 m)	**N/A**	✗
Corner earthed (grounded) in regen mode	✗	✗	✗

Warning Before using this product you must read and understand the safety information within the User Guide at the URL below.	**Avertissement** Avant d'utiliser ce produit, il est impératif de lire et de bien comprendre les consignes de sécurité du Guide de mise en service, disponible à l'adresse ci-dessous.
Avvertenza Prima di utilizzare questo prodotto leggere e assicurarsi di aver compreso le informazioni sulla sicurezza contenute nella Guida dell'utente consultabile all'URL indicato qui sotto.	**Warnung** Bevor Sie dieses Produkt verwenden, müssen Sie die Sicherheitshinweise in der Betriebsanleitung unter der nachstehenden URL lesen und verstehen.
Advertencia Antes de utilizar este producto, debe leer y comprender la información de seguridad de la Guía del usuario en la siguiente URL.	**Предупреждение** Преди да използвате този продукт, трябва да прочетете и разберете информацията за безопасност в ръководството за потребителя на URL адреса по-долу.
Upozorenje Prije upotrebe ovog proizvoda morate pročitati i razumjeti sigurnosne informacije iz Korisničkog vodiča na donjem URL-u.	**Varování** Před použitím tohoto výrobku si musíte na níže uvedené adrese URL přečíst v návodu k použití bezpečnostní informace a porozumět jim.
Προειδοποίηση Πριν από τη χρήση αυτού του προϊόντος, πρέπει να διαβάσετε και να κατανοήσετε τις πληροφορίες ασφαλείας που περιλαμβάνει ο Οδηγός χρήστη στην παρακάτω διεύθυνση.	**Aviso** Antes de utilizar este produto, deve ler e compreender as informações de segurança contidas no guia do utilizador que pode encontrar no URL abaixo.
Advarsel Før du tager dette produkt i brug, skal du have læst og forstået sikkerhedsoplysningerne i brugervejledningen på webadressen nedenfor.	**Figyelem** A termék használata előtt el kell olvasnia és meg kell értenie a Felhasználói útmutatóban található biztonsági információkat az alábbi URL-címen.
Avertizare Înainte de a utiliza acest produs, trebuie să citiți și să înțelegeți informațiile referitoare la siguranță din Ghidul de utilizare de la adresa URL de mai jos.	**Waarschuwing** Vóór gebruik van dit product moet u de veiligheidsinformatie in de Handleiding op de URL hieronder lezen en begrijpen..
Upozornenie Pred použitím tohto produktu si musíte prečítať a porozumieť všetkým bezpečnostným pokynom uvedeným v Používateľskej príručke, ktorú nájdete na nasledujúcej adrese URL.	**Hoiatus** Enne selle toote kasutamise alustamist peate lugema ja mõistma alltoodud URL-aadressil asuvas kasutusjuhendis toodud ohutusalast teavet.
Brīdinājums Pirms šā produkta lietošanas ir jāizlasa un jāizprot informācija par drošību, kas iekļauta lietošanas pamācībā tālāk norādītajā URL.	**Opozorilo** Pred uporabo tega izdelka morate prebrati in razumeti varnostne informacije v navodilih za uporabo na spodnjem spletnem naslovu.
Varoitus Ennen kuin käytät tätä tuotetta, sinun on luettava ja ymmärrettävä turvallisuusohjeet, jotka sisältyvät alla mainitussa verkko-osoitteessa olevaan käyttöoppaaseen.	**Įspėjimas** Prieš pradėdami naudoti šį gaminį perskaitykite ir įsitikinkite, kad supratote saugos informaciją, pateiktą naudotojo vadove, esančiame toliau nurodytu universaliu adresu.
Twissija Qabel ma tuża dan il-prodott inti għandek taqra u tifhem l-istruzzjonijiet ta' sikurezza fi ħdan il-Gwida għall-Utent fil-URL t'isfel.	**Varning** Innan du använder denna produkt måste du läsa och förstå säkerhetsinformationen i användarhandboken på nedanstående URL-adress.
Ostrzeżenie Przed przystąpieniem do użytkowania produktu należy przeczytać ze zrozumieniem informacje dotyczące bezpieczeństwa przedstawione w Podręczniku użytkownika dostępnym pod następującym adresem.	

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