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Installation Guide

Digitax ST

Part Number: 0475-0000-07
Issue: 7

Original Instructions

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

Documentation

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

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

Warranty and Liability

In no event and under no circumstances shall the manufacturer 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. The manufacturer is not liable for consequential and incidental damages. Contact the supplier of the dive for full details of the warranty terms.

Environmental policy

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

Further information on our Environmental Policy can be found at: **http://www.drive-setup.com/environment**

Restriction of Hazardous Substances (RoHS)

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

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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. Control Techniques products are designed to be easily dismantled into their major component parts for efficient recycling. The majority of materials used in the product are suitable for recycling.

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

Registered Office

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

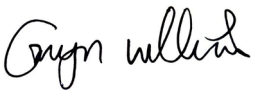
Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

DST1201	DST1202	DST1203	DST1204	
DST1401	DST1402	DST1403	DST1404	DST1405

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

EN 61800-5-1:2007	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3:2004	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2:2005	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-4:2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
EN 61000-3-2:2006	Electromagnetic compatibility (EMC), Limits, Limits for harmonic current emissions (equipment input current <16A per phase)
EN 61000-3-3:2008	Electromagnetic compatibility (EMC), Limits, Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <16A

EN 61000-3-2:2006 Applicable where input current <16A. No limits apply for professional equipment where input power >1kW.
These products comply with the requirements of the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU, the Low Voltage Directive 2006/95/EC and the Electromagnetic Compatibility Directive 2004/108/EC.



G. Williams
VP Technology, Newtown
Date: 8th July 2015

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete end products or systems. Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters. The drives must be installed only by professional assemblers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the User Guide. An EMC Data Sheet is also available giving detailed EMC information.

Declaration of Conformity (including 2006 Machinery Directive)

Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

This declaration applies to the Unidrive SP and Digitax ST variable speed drive product ranges, comprising model numbers composed as shown below.:

SP*(ab)cdef* Valid characters:		**DST*abcde*** Valid characters:	
ab	Absent or MD	*a*	1
c	0 1 2 3 4 5 6 7 8 9	*b*	2 4
d	2 4 5 6	*c*	0
e	0 1 2 3	*d*	1 2 3 4 5
f	1 2 3 4 5 6 7	*e*	B I P Z E

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

These products fulfil all the relevant provisions of Directive 2006/42/EC (The Machinery Directive). They also fulfil all the relevant provisions of Directives 2004/108/EC (The EMC Directive) and 2006/95/EC (The Low Voltage Directive).

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

IFA

Alte Heerstraße 111

53757 Sankt Augustin

Germany.

Notified Body identification number: 0121

EC type-examination certificate number: IFA 1001123

The schedule attached to the certificate specifies the product model numbers which have been subjected to type examination.

The harmonized standards used are shown below:

DIN EN 61800-5-1:2008	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy
DIN EN 61800-5-2:2008	Adjustable speed electrical power drive systems. Safety requirements. Functional
DIN EN ISO 13849-1:2008	Safety of machinery. Safety-related parts of control systems. General principles for design
DIN EN ISO 13849-2:2008	Safety of machinery. Safety-related parts of control systems. Validation

Person authorized to compile the technical file:

C Hargis

Chief Engineer

Address as above



G.Williams

VP Technology

Date: 8th July 2015

Place: Newtown, Powys. UK

IMPORTANT NOTICE

These drive products are intended to be used with appropriate motors, sensors, electrical protection components and other equipment to form complete systems. It is the responsibility of the installer to ensure that the design of the complete machine, including its safety-related control system, is carried out in accordance with the requirements of the Machinery Directive and any other relevant legislation. The use of a safety-related drive in itself does not ensure the safety of the machine.

Compliance with safety and EMC regulations depends upon installing and configuring inverters correctly. The inverters must be installed only by professional assemblers who are familiar with requirements for safety and EMC. The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the Installation Guide.

1 Safety Information

1.1 Warnings, Cautions and Notes



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



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

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

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

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

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

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

1.3 Responsibility

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

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

1.4 Compliance with regulations

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

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

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

2006/42/EC Safety of machinery.

2014/30/EU: Electromagnetic Compatibility.

1.5 Electrical hazards

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

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

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

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

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

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

1.6 Stored electrical charge

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

1.7 Mechanical hazards

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

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

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

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

1.8 Access to equipment

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

1.9 Environmental limits

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

1.10 Hazardous environments

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

1.11 Motor

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

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

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

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

1.12 Mechanical brake control

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

1.13 Adjusting parameters

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

1.14 Electromagnetic compatibility (EMC)

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

2 Introduction

The Digitax ST family of servo drives are available with five levels of intelligence:

- Digitax ST Base
- Digitax ST Indexer
- Digitax ST Plus
- Digitax ST EZMotion
- Digitax ST EtherCAT

The Digitax ST Base drive operates in velocity or torque modes and is designed to operate with a centralised motion controller or as a standalone drive.

The Digitax ST Indexer drive performs point-to-point motion profiling including relative, absolute, rotary plus, rotary minus, registration and homing motion. The Digitax ST Indexer will operate as a single standalone system controller. Alternatively, the Digitax ST Indexer can form part of a distributed system where commands are sent over a fieldbus or through digital input/output signals.

The Digitax ST Plus drive offers all the features available on the Digitax ST Indexer drive with the addition of performing complex motion as a single axis or synchronised to a reference axis. This offers digital lock and electronic camming via a virtual master reference.

The Digitax ST EZMotion drive is part of the Motion Made Easy family of servo drives and allows the user to create programs to sequence motion, I/O control, and other machine operations in one environment. Digitax ST EZMotion also supports advanced functions such as a Position Capture Object, Multiple Profile Summation, Queuing, and Program Multitasking.

The Digitax ST EtherCAT drive offers onboard EtherCAT allowing the product to be connected to an EtherCAT network as a slave device. It can be used in a variety of applications, including those requiring accurate synchronization and precise motion control.

All variants provide a Safe Torque Off function. This function is identical to that referred to as "SECURE DISABLE" in the Control Techniques Unidrive SP product range. The name has been changed in accordance with draft standard pr EN 61800-5-2 (future IEC 61800-5-2, EN 61800-5-2).

Four documentation guides are available for Digitax ST, these cover all variants:

All guides are available for download at: **http://www.drive-setup.com/ctdownloads**.

Installation Guide (packed with product)

- Designed to be used by an "Electrician/Wireman" installing the drive (FIGS Available).

Technical Data Guide

- Designed as a reference guide for experienced drive users (FIGS Available).

User Guide

- Designed as a step by step guide to help the user become familiar with the product, and as a reference guide for experienced drive users (FIGS Available).

Advanced User Guide

- In-depth parameter descriptions.

2.1 Drive software version

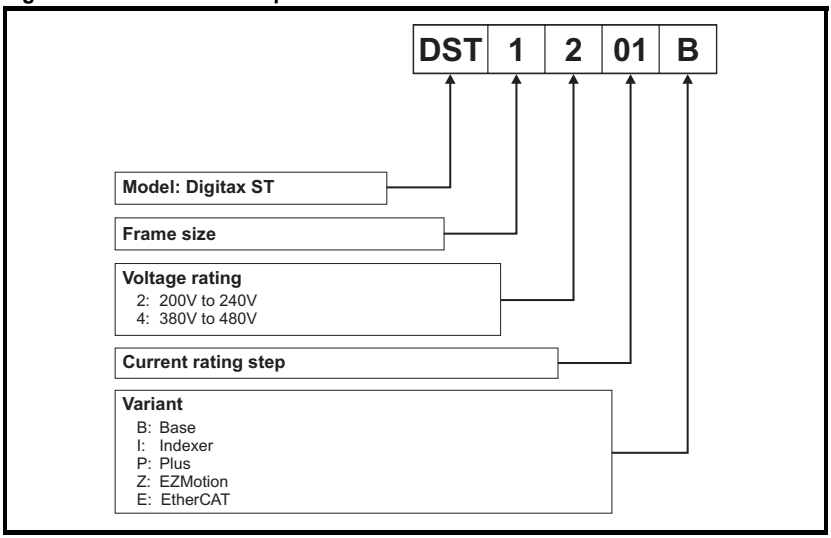
This product is supplied with the latest software version. If this drive is to be connected to an existing system or machine, all drive software versions should be verified to confirm the same functionality as drives of the same model already present. This may also apply to drives returned from an Nidec Industrial Automation 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 **11.29** and Pr **11.34**. This takes the form of xx.yy.zz where Pr **11.29** displays xx.yy and Pr **11.34** displays zz. (e.g. for software version 01.01.00, Pr **11.29** = 1.01 and Pr **11.34** displays 0).

2.2 Drive model numbers

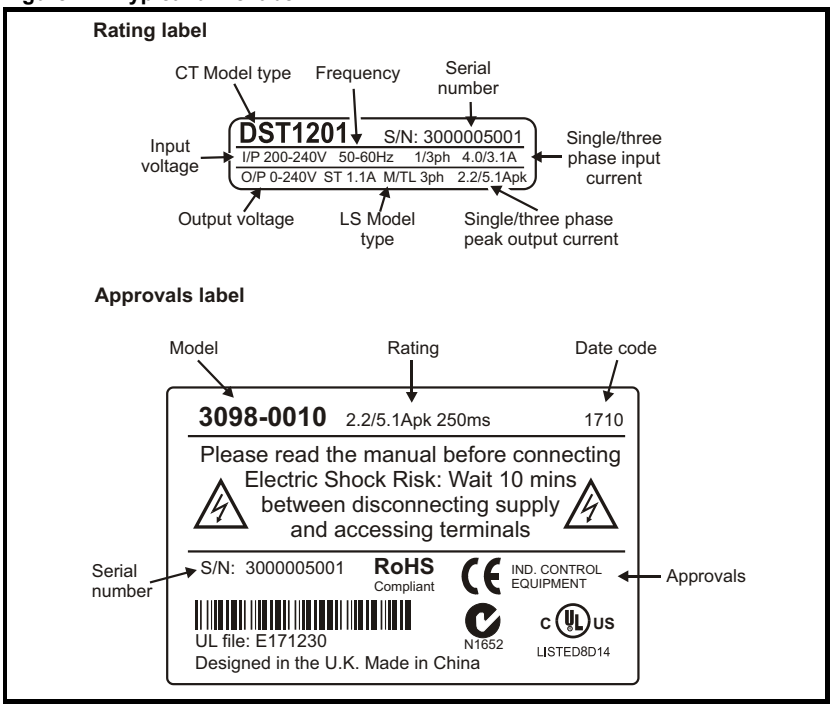
Each drive variant and rating has a unique model number.

Figure 2-1 Model code explanation



2.3 Drive nameplate description

Figure 2-1 Typical drive label



NOTE **Date code format**

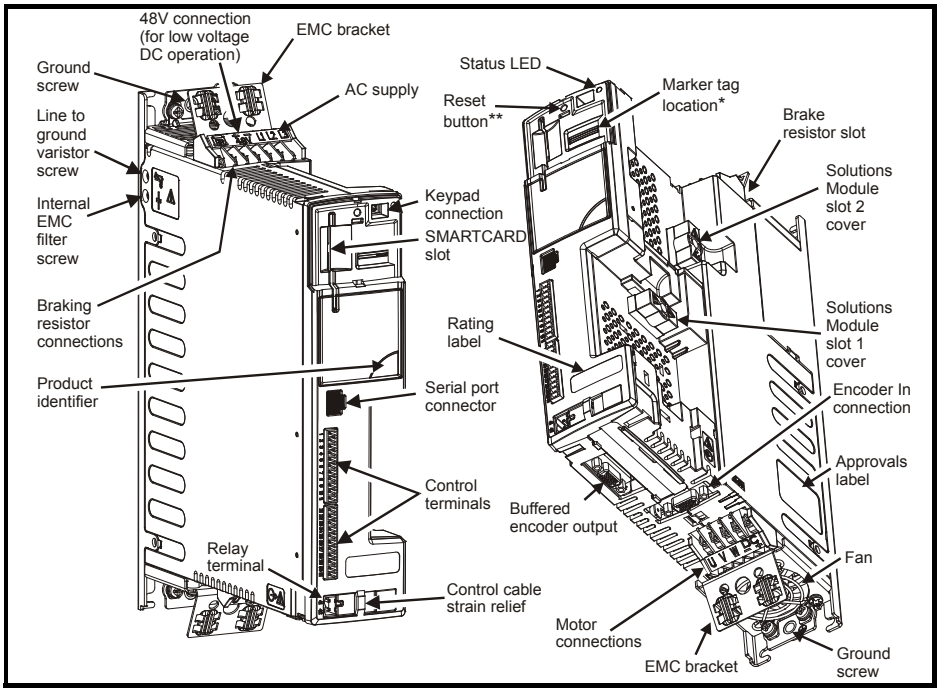
The date code is four numbers. The first two numbers indicate the year and the remaining numbers indicate the week of the year in which the drive was built.

Example:

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

2.4 Features of the drive

Figure 2-2 Features of the drive



* The Marker Tag (as shown in Figure 2-2 above), is where markers can be placed to identify a particular drive which can prove beneficial where several Digitax ST drives are located in the same panel.

** A drive reset can be performed even when a keypad is not installed, by pressing the recessed reset button.

NOTE The drive is supplied with a SMARTCARD installed. Do not remove until after first power-up, as defaults are stored on the SMARTCARD.

WARNING Be aware of possible live terminals when inserting the SMARTCARD.

WARNING Static precautions must be observed when removing the Solutions Module slot covers.

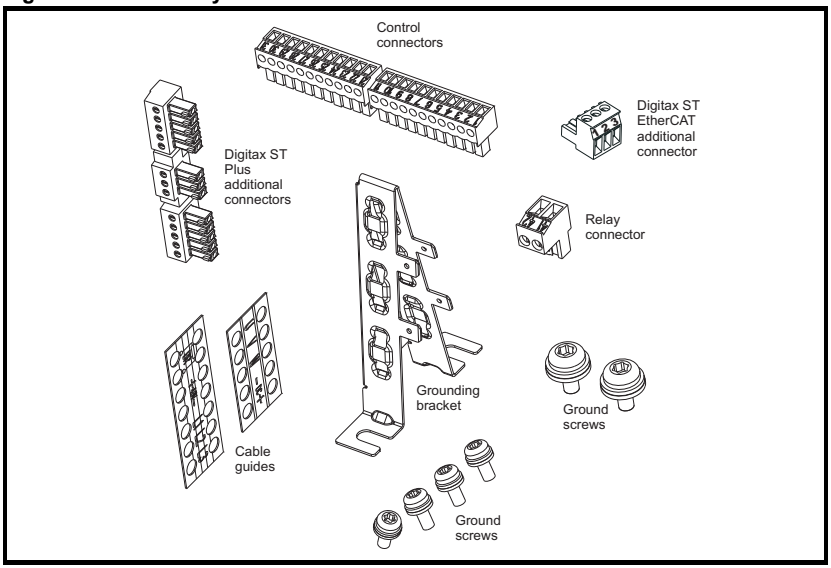
2.5 Items supplied with the drive

The drive is supplied with the following items:

- Installation Guide
- SMARTCARD
- Safety Information booklet
- Certificate of Quality

An accessory box containing the items illustrated in Figure 2-3 is also provided.

Figure 2-3 Accessory box contents



NOTE If the embedded Solutions Module is removed, the warranty for the drive will be void.

3 Mechanical Installation

Safety information



Follow the instructions

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



Stored charge

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

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



Competence of the installer

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

3.1 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.

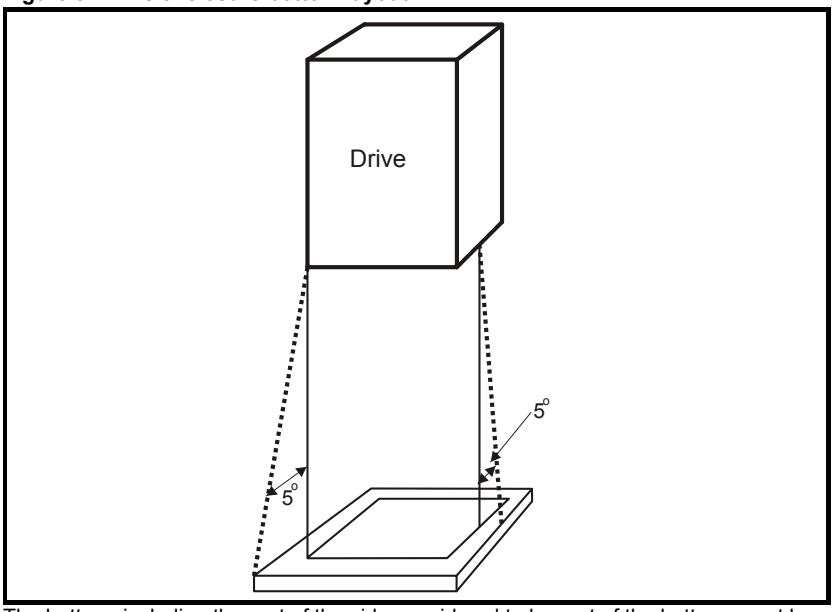
For installation outside the USA, the following (based on IEC 62109-1, standard for PV inverters) is recommended.

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.

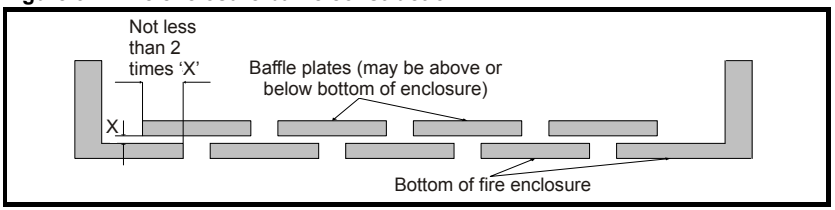
Figure 3-1 Fire enclosure bottom layout



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 Drive dimensions

Enclosure

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

The drive complies with the requirements of IP20 as standard.

Figure 3-3 Dimensions

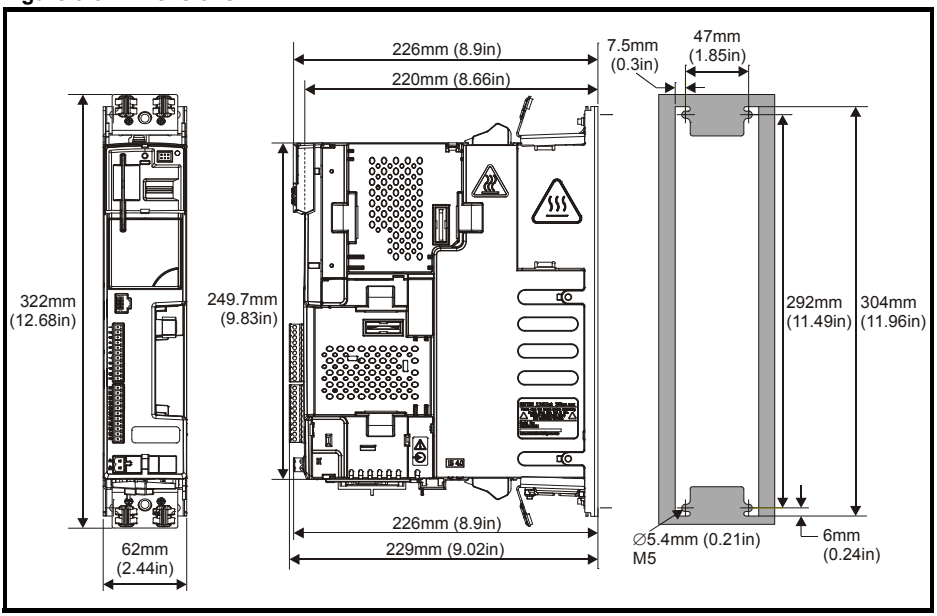
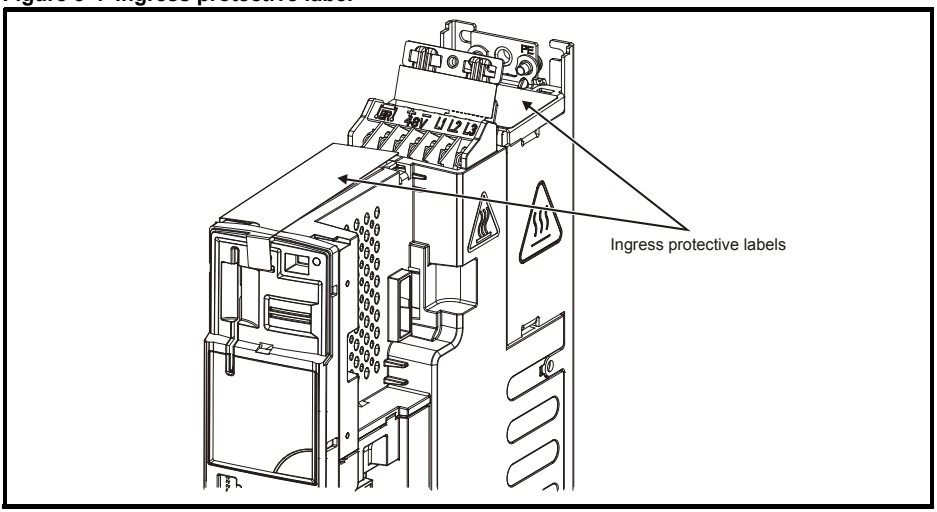
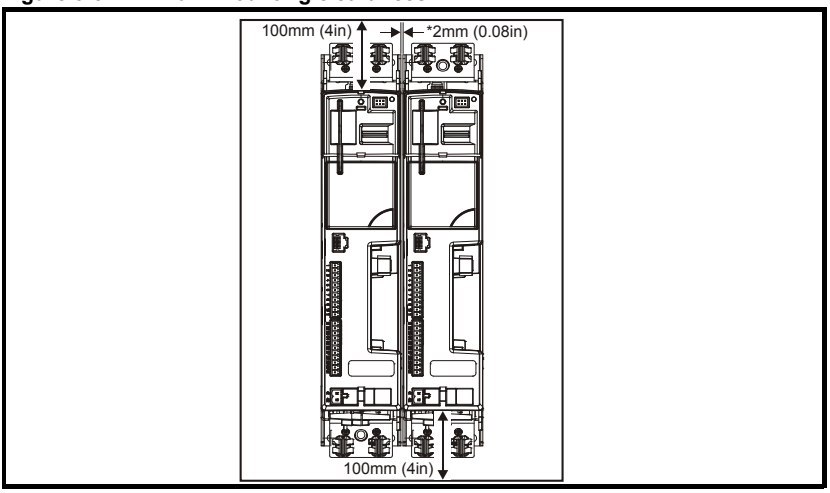


Figure 3-4 Ingress protective label



NOTE The ingress protective labels (shown on Figure 3-4 above) should remain in place while the drive is mounted, and until all the electrical wires have been connected. The labels should be removed before first power up.

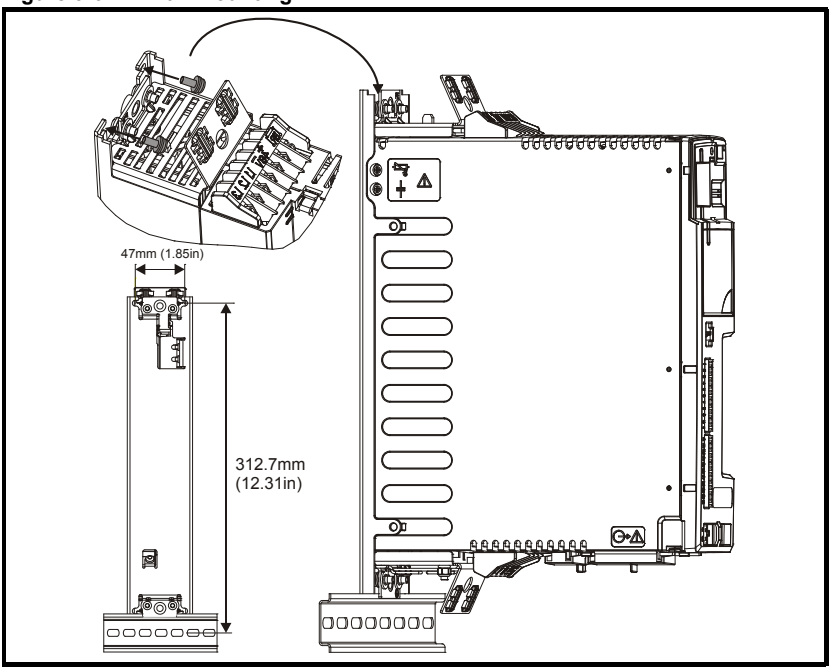
Figure 3-5 Minimum mounting clearances



NOTE *2 mm clearance between drives to allow for mechanical tolerance.
If Solutions Modules are installed, a larger clearance between drives will be required if access to the modules is needed without removing the drive.

Digitax ST can be mounted using a DIN rail, either fixed at the top or the bottom of the drive (as illustrated in Figure 3-6). Two screws are required to fix the drive to the backplate at the opposite end to the DIN rail.

Figure 3-6 DIN rail mounting

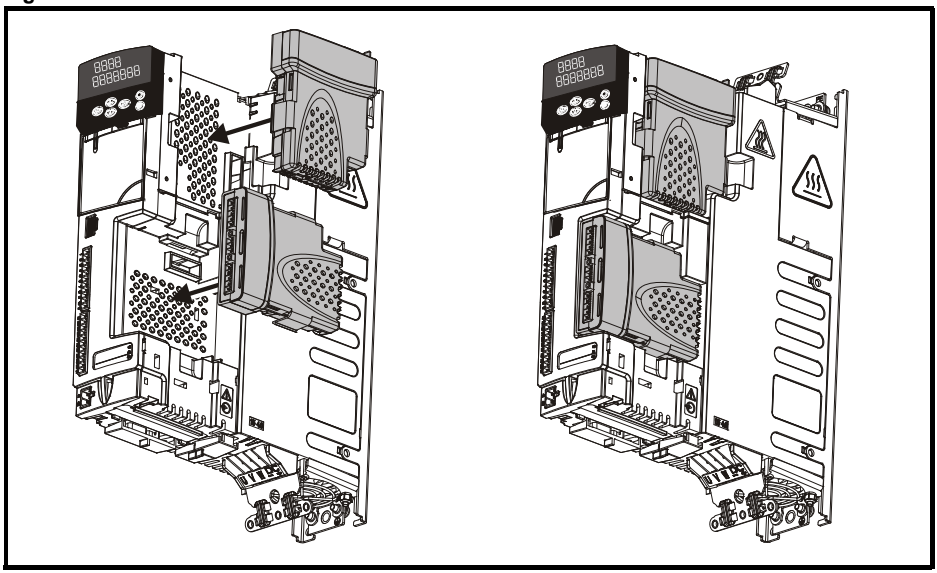


3.3 Solutions Module / keypad installation / removal

CAUTION

Power down the drive before installing / removing the Solutions Module. Failure to do so may result in damage to the product.

Figure 3-7 Installation of a Solutions Module

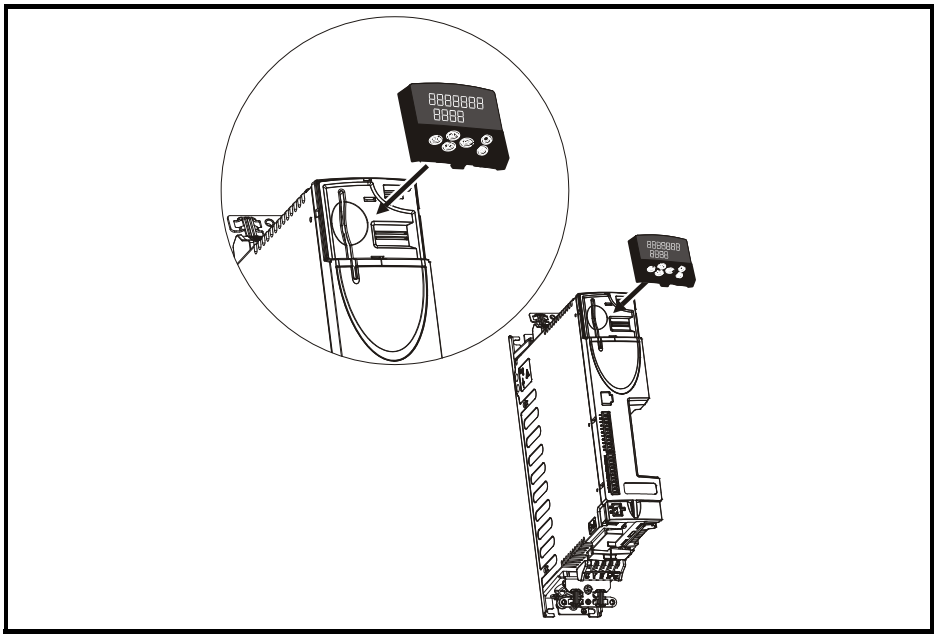


NOTE The protective tab from the Solutions Module slot must be removed before attempting to install a Solutions Module.

WARNING

Be aware of possible live terminals when installing the keypad.

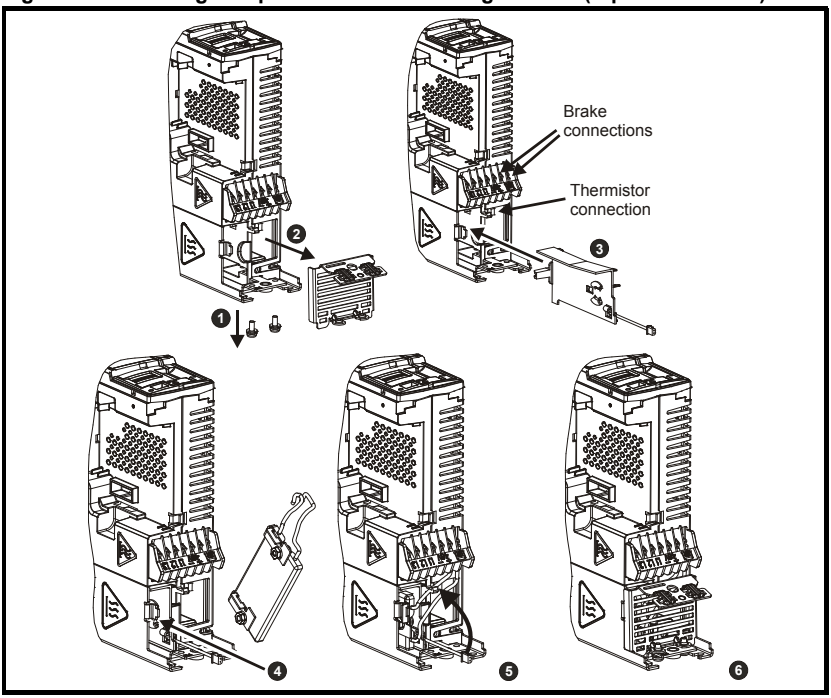
Figure 3-8 Installation of a keypad



3.4 Braking

3.4.1 Optional internal braking resistor

Figure 3-9 Installing an optional internal braking resistor (top view of drive)



1. Remove screws.
2. Remove grill.
3. Fit the braking resistor shield.
4. Fit the optional internal braking resistor in the slot provided (note the angle).
5. Electrically connect the braking resistor and thermistor (connections shown in Figure 4-1 on page 27).
6. Refit the grill and mounting screws by reversing the procedure in points 1 and 2.

3.4.2 Optional external braking resistor

If using an external braking resistor, the following Warning must be adhered to:

WARNING

Braking resistor: High temperatures and overload protection
Braking resistors can reach high temperatures. Locate braking resistors so that damage cannot result. Use cable having insulation capable of withstanding the high temperatures.

3.5 Terminal torque settings

Table 3-1 Torque settings

Terminals	Torque setting*
Power terminals	1.0 N m (12.1 lb in)
Control terminals	0.2 N m (1.7 lb in)
Status relay terminals	0.5 N m (4.5 lb in)
Ground terminals	4 N m (35 lb in)
Small ground terminal screws	2 N m (17.7 lb in)

*Torque tolerance = 10 %

Table 3-2 Plug-in terminal block maximum cable sizes

Model size	Terminal block description	Max cable size
All	11 way control connectors	1.5 mm^2 (16 AWG)
All	2 way relay connector	2.5 mm^2 (12 AWG)

3.6 Routine maintenance

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

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

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

3.7 External EMC filter

There are three variants of external EMC filters available for the drive.

Table 3-3 Drive EMC filter details

Drive	No. of phases	CT part no.	Schaffner part no.
DST120X	1	4200-6000	FS23072-19-07
DST120X	3	4200-6001	FS23073-17-07
DST140X	3	4200-6002	FS23074-11-07

Figure 3-10 Bookcase mounting

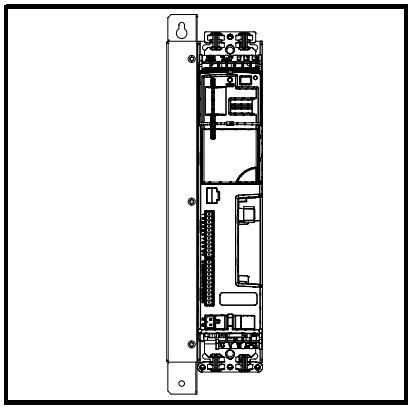


Figure 3-11 Footprint mounting

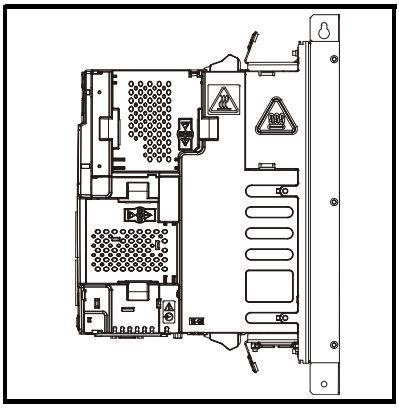


Figure 3-12 Optional external EMC filter dimensions (all variants)

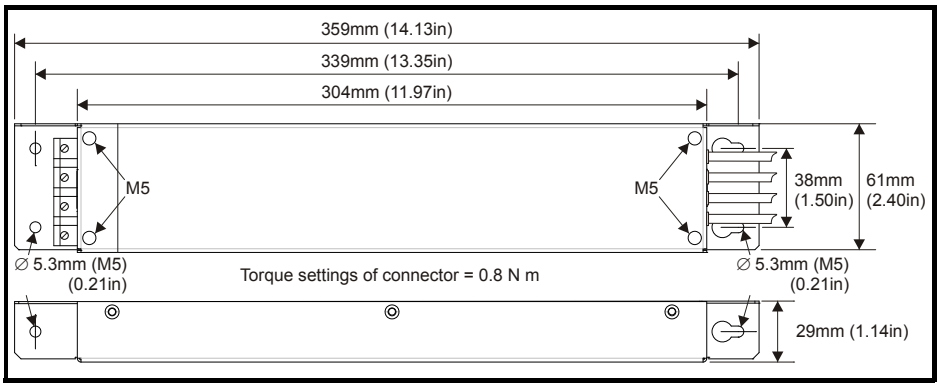


Figure 3-12 shows a 3 phase filter. For a single phase filter, there are only 3 input terminals (L1, N, ground) and 3 output cables (L1, N, ground).

4 Electrical Installation

Many cable management features have been incorporated into the product and accessories, this chapter shows how to optimize them. Key features include:

- Internal EMC filter
- EMC compliance with shielding / grounding accessories
- Product rating, fusing and cabling information



Electric shock risk
The voltages present in the following locations can cause severe electric shock and may be lethal:

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

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



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



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



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



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



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



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

4.1 Supply types

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

Supplies with voltage up to 600 V may have grounding at any potential, i.e. neutral, centre or corner (“grounded delta”)

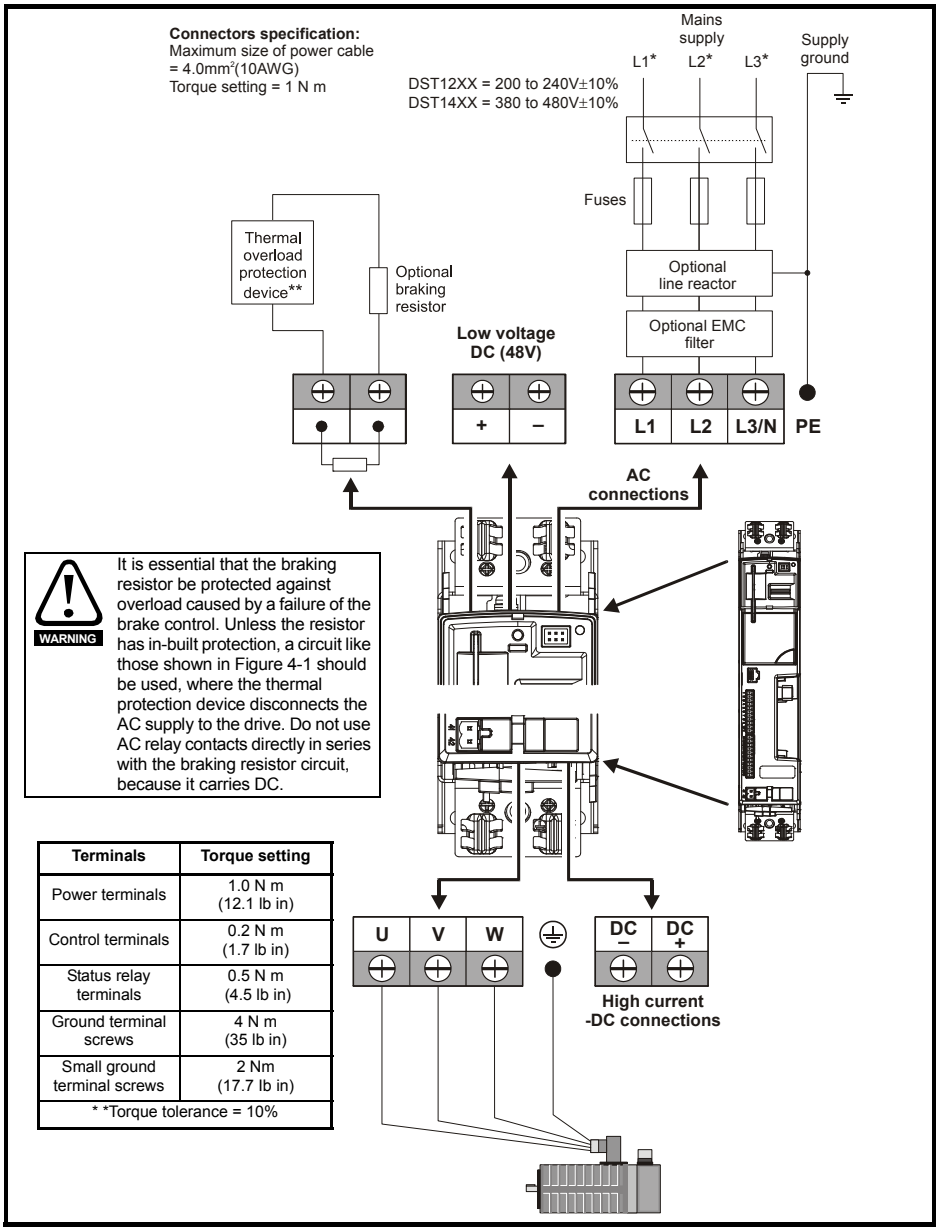
Supplies with voltage above 600 V may not have corner grounding

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

NOTE If the drive is to be used on an IT (ungrounded) supply, refer to the *Digitax ST User Guide* for more information.

4.2 Power terminal connections

Figure 4-1 Power terminal connections



WARNING

It is essential that the braking resistor be protected against overload caused by a failure of the brake control. Unless the resistor has in-built protection, a circuit like those shown in Figure 4-1 should be used, where the thermal protection device disconnects the AC supply to the drive. Do not use AC relay contacts directly in series with the braking resistor circuit, because it carries DC.

Terminals	Torque setting
Power terminals	1.0 N m (12.1 lb in)
Control terminals	0.2 N m (1.7 lb in)
Status relay terminals	0.5 N m (4.5 lb in)
Ground terminal screws	4 N m (35 lb in)
Small ground terminal screws	2 Nm (17.7 lb in)
* *Torque tolerance = 10%	

NOTE * When using a 200 V drive on a single phase supply, the live and neutral conductors can be connected to any of the AC connections on the drive.

** This is not required if the optional internal braking resistor is used.

4.3 Ratings

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

Table 4-1 Fuse ratings and cable sizes

Model	No of input phases	Typical input current A	Maximum continuous input current A	Fuse rating		Cable size			
				IEC class gG	Class CC	Input		Output	
						mm^2	AWG	mm^2	AWG
DST1201	1		4.0	6	10	0.75	16	0.75	24
DST1202	1		7.6	10	10	1	16	0.75	22
DST1203	1		9.0	16	15	2.5	14	0.75	20
DST1204	1		13.4	16	20	2.5	12	0.75	18
DST1201	3	3.1	3.5	6	10	0.75	16	0.75	24
DST1202	3	6.4	7.3	10	10	1	16	0.75	22
DST1203	3	8.6	9.4	16	15	2.5	14	0.75	20
DST1204	3	11.8	13.4	16	20	2.5	12	0.75	18
DST1401	3	2.6	2.8	4	10	0.75	16	0.75	24
DST1402	3	4.2	4.3	6	10	0.75	16	0.75	24
DST1403	3	5.9	6.0	8	10	0.75	16	0.75	22
DST1404	3	7.9	8.0	10	10	1	16	0.75	20
DST1405	3	9.9	9.9	12	15	1.5	14	0.75	18
Control cable						≥0.5	20		

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
- When operating in ambient >45 °C UL 75 °C cable should be used.

Cable sizes are given for guidance only and may be changed depending on the application and the method of installation of the cables.

The mounting and grouping of cables affect their current capacity, in some cases a larger cable is required to avoid excessive temperature or voltage drop.

Input cable sizes should generally be regarded as a minimum, since they have been selected for co-ordination with the recommended fuses.

Output cable sizes assume that the maximum motor current matches that of the drive.

Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor.

To ensure that the motor and cable are protected against overload, the drive must be programmed with the correct motor rated current.

The terminals are designed for a maximum cable size of 4.0 mm^2 (minimum 0.2 mm^2/24 AWG).

Where more than one cable per terminal is used the combined diameters should not exceed the maximum.

The terminals are suitable for both solid and stranded wires.

An MCB (miniature circuit breaker) may be used in place of fuses under the following conditions:

- The fault-clearing capacity must be sufficient for the installation
- The I^2T rating of the MCB must be less than or equal to that of the fuse rating listed above

For a parallel DC bus system the maximum AC input fusing is shown in Table 4-2 below.

Table 4-2 Maximum AC input fusing

Model	Fuse Rating IEC class gG	Fuse Rating Class CC	Input cable size	
	A	A	mm^2	AWG
All	20	20	4.0	12

NOTE Refer to the supplier of your drive for further information regarding DC bus paralleling.

4.4 Ground connections

WARNING

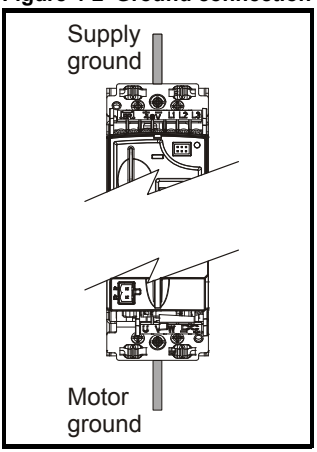
Electrochemical corrosion of earthing terminals
Ensure that grounding terminals are protected against corrosion i.e. as could be caused by condensation.

The drive must be connected to the system ground of the AC supply. The ground wiring must conform to local regulations and codes of practice.
The supply and motor ground connections are made using the M6 threaded hole in the metal back plate of the drive located at the top and bottom of the drive. See Figure 4-2 for details.

WARNING

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

Figure 4-2 Ground connection



4.5 Ground leakage

The ground leakage current depends upon whether the internal EMC filter is installed. The drive is supplied with the filter installed. Instructions for removing the internal filter are given in Figure 4-3.

With the internal EMC filter fitted the ground leakage current is as follows:

Table 4-3 Ground leakage current with internal EMC filter installed

Model	3 phase Star ground	3 phase Delta ground	1 phase
	mA		
DST120X at 220V	4	10	3
DST140X at 400V	12	40	

NOTE The above leakage current is just the leakage current of the drive with the internal EMC filter connected and does not take into account any leakage currents of the motor or motor cable.

With internal EMC filter removed the ground leakage current = <1 mA.

NOTE In both cases, there is an internal voltage surge suppression device connected to ground. Under normal circumstances, this carries negligible current.



When the internal EMC filter is installed, the leakage current is high. In this case, a permanent fixed ground connection must be provided with a cross sectional area equal to 10 mm^2.

4.5.1 Use of residual current device (RCD)

There are three common types of ELCB / RCD:

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



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

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

4.6 EMC

4.6.1 Internal EMC filter

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

Special attention is required when using a DST120X model on an ungrounded supply (IT supply). In the event of a ground fault in the motor circuit the drive may not trip and the filter could be overstressed. In this case, either the filter must be removed or additional independent motor ground fault protection must be provided.

The internal EMC filter reduces radio-frequency emissions into the mains supply. Where the motor cable is short, it permits the requirements of EN 61800-3:2004 to be met for

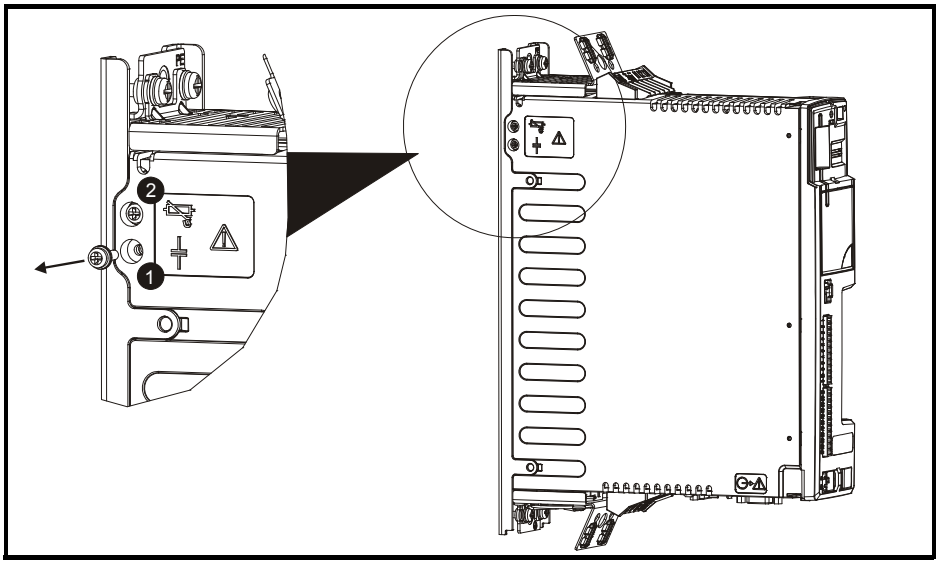
the second environment.

For longer motor cables, the filter continues to provide a useful reduction in emission level, and when used with any length of shielded cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the ground leakage current is unacceptable or the above conditions are true.

WARNING

The supply must be disconnected before removing the internal EMC filter or line to ground varistor screws.

Figure 4-3 Removing the internal EMC filter and line to ground varistors



1. Internal EMC filter. Remove the bottom screw as shown.
2. Line to ground varistors. Remove the top screw as shown.

NOTE The line to ground varistors should only be removed in special circumstances.

4.6.2 Further EMC precautions

Further EMC precautions are required if more stringent EMC emission requirements apply:

- Operation in the first environment of EN 61800-3:2004
- Conformity to the generic emission standards
- Equipment which is sensitive to electrical interference operating nearby

In this case it is necessary to use:

- The optional external EMC filter
- A shielded motor cable, with shield clamped to the grounded metal panel
- A shielded control cable, with shield clamped to the grounded metal panel via the grounding bracket

NOTE It is not necessary to remove the external EMC filter when using an IT supply.

4.6.3 Recommended cable management

Figure 4-4 Drive cable clearances

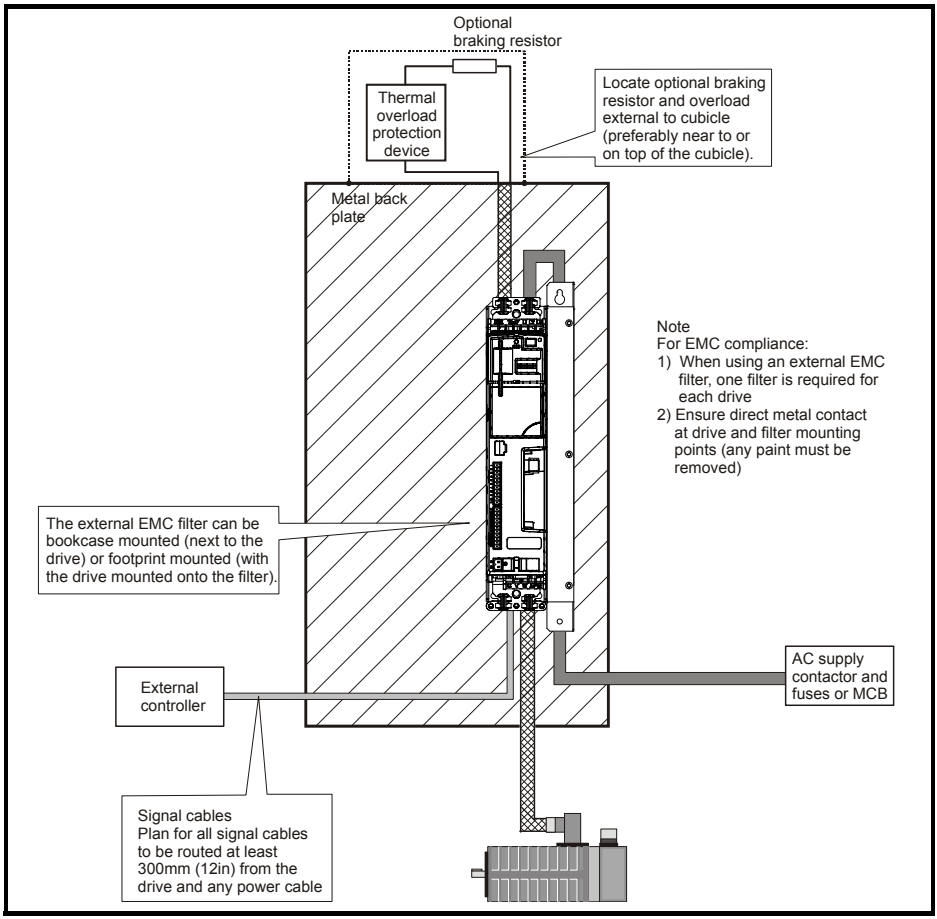
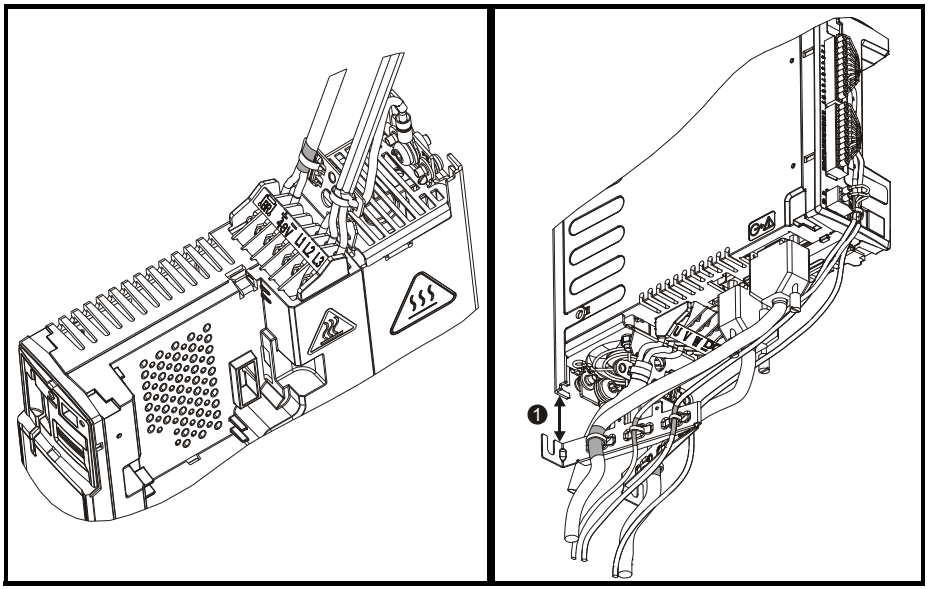


Figure 4-5 Grounding bracket at the top of drive **Figure 4-6 Grounding bracket at the bottom of drive**

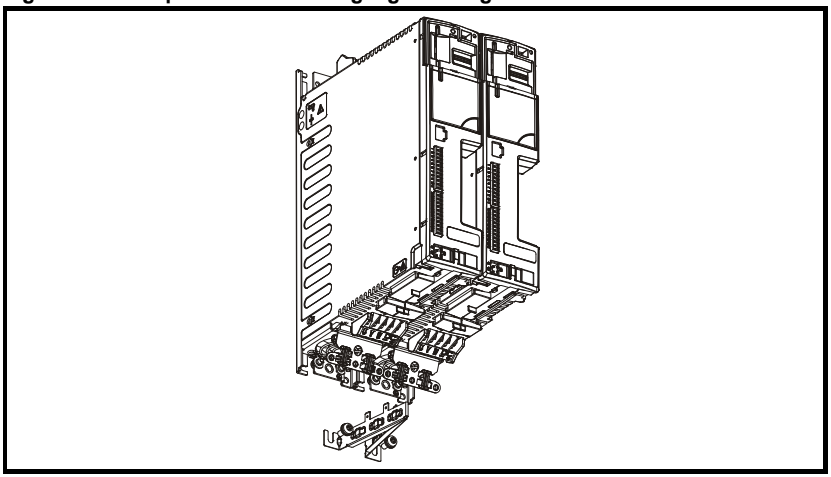


Grounding bracket and drive to be directly connected to a grounded backplate.

NOTE 1. The distance for EMC (shown in Figure 4-6 above) from the drive is as follows:
200 V drive - Allowance up to 65 mm (2.56 in)
400 V drive - Allowance up to 100 mm (3.94 in)

NOTE The grounding bracket can remain mounted when the drive is removed as follows.

Figure 4-7 Multiple drives with single grounding bracket



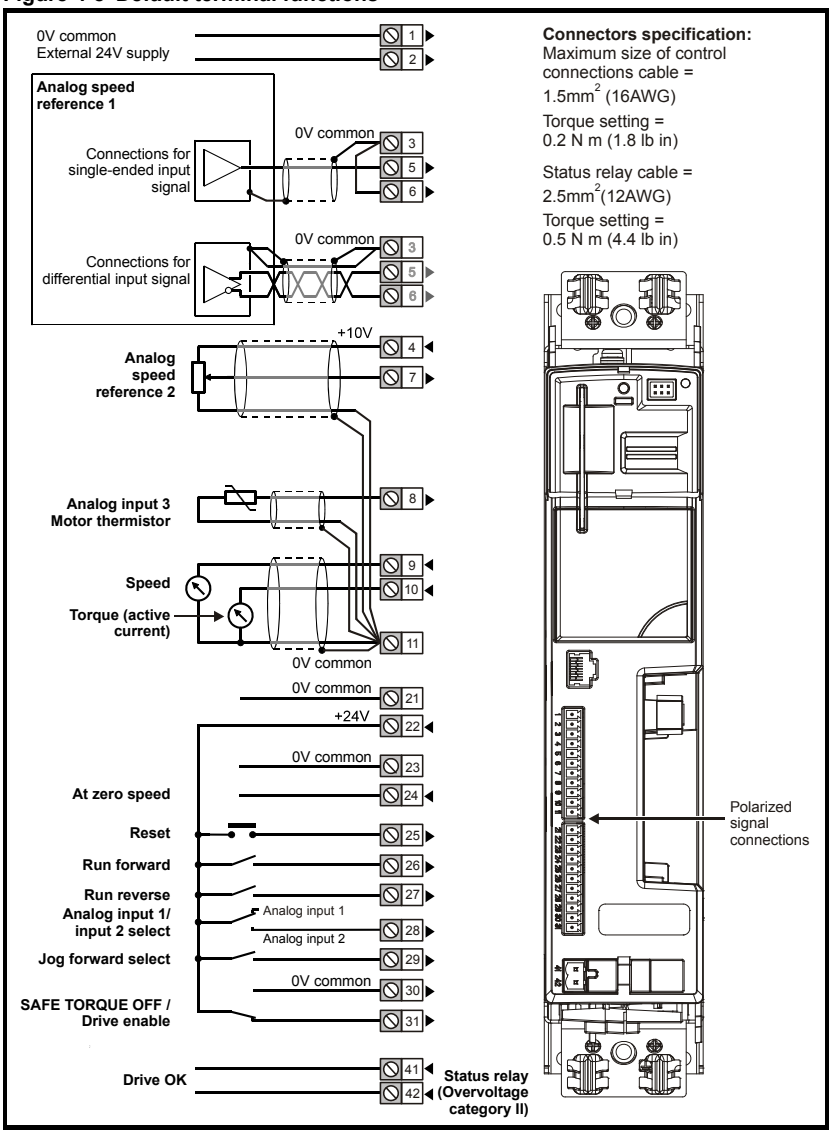
If installing multiple drives, one grounding bracket can be used for two drives.

4.7 Control terminals

WARNING

The control circuits are isolated from the power circuits in the drive by basic insulation (single insulation) only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation (supplementary insulation) rated for use at the AC supply voltage.

Figure 4-8 Default terminal functions



For control terminal specification, refer to the *User Guide*.

NOTE If terminal 31 is used as a *Safe Torque Off* function, the cable must be shielded or segregated.

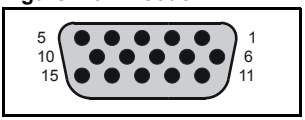
41 42	Relay contacts
Default function	**Drive OK indicator**
Contact voltage rating	240 Vac, Installation over-voltage category II
Contact maximum current rating	2 A AC 240 V 4 A DC 30 V resistive load 0.5 A DC 30 V inductive load (L/R = 40 ms)
Contact minimum recommended rating	12 V 100 mA
Contact type	Normally open
Default contact condition	Closed when power applied and drive OK
Update period	4 ms

WARNING

A fuse or other over-current protection should be installed to the relay circuit.

4.8 Encoder connections

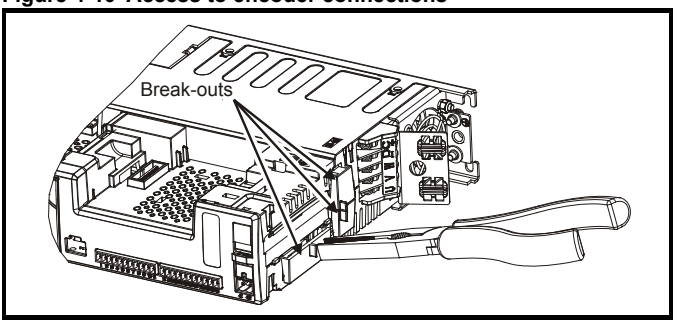
Figure 4-9 Encoder



4.8.1 Location of encoder connector

Before using the encoder connectors for the first time, the break-outs need removing as shown in Figure 4-10.

Figure 4-10 Access to encoder connections

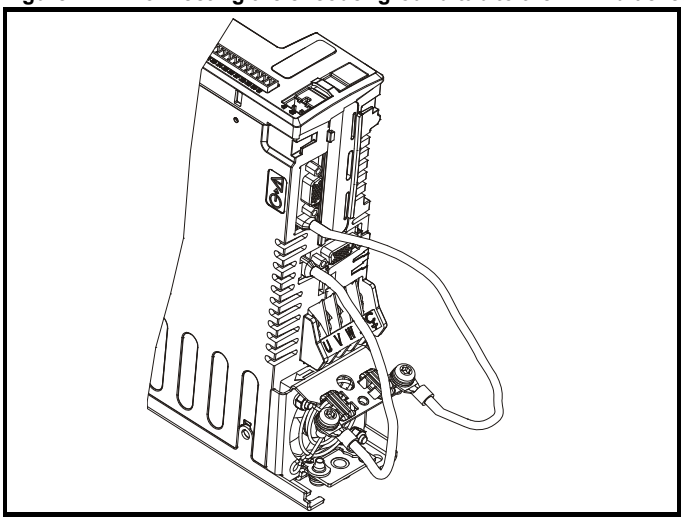


WARNING

After removing the break-out, ensure that the ground tab is connected to ground (see Figure 4-11). This will connect 0V of the drive to ground. This is required to enable the drive to meet IP20 when the break-out is removed.

NOTE Do not remove break-out if the connections are not required.

Figure 4-11 Connecting the encoder ground tab to the EMC bracket

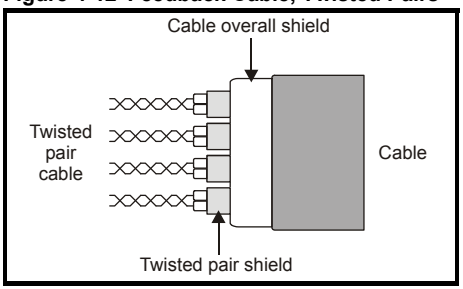


NOTE The size of the connecting cable between the encoder ground tab and the EMC bracket should be equal to the input cable.

Recommended cable

The recommended cable for feedback signals are shielded twisted pairs, shielded with an overall shield as shown in Figure 4-12.

Figure 4-12 Feedback Cable, Twisted Pairs



Using this type of cable also allows for the connection of the outer shield to ground and the inner shields to 0V alone at both drive and encoder end, when required.

NOTE Ensure that feedback cables are kept as far away as possible from power cables and avoid parallel routing.

Figure 4-13 Feedback cable connections

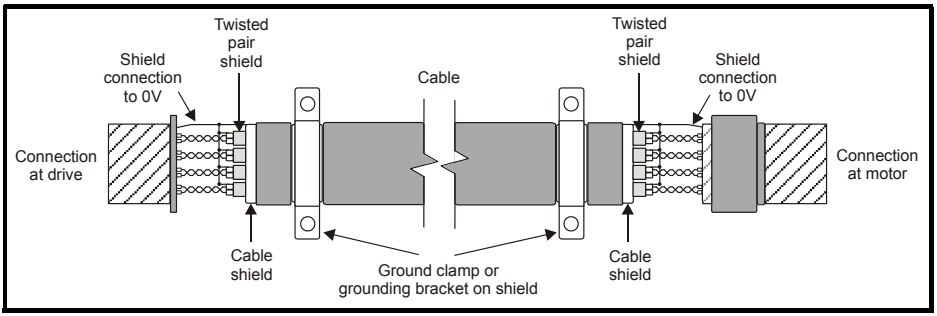
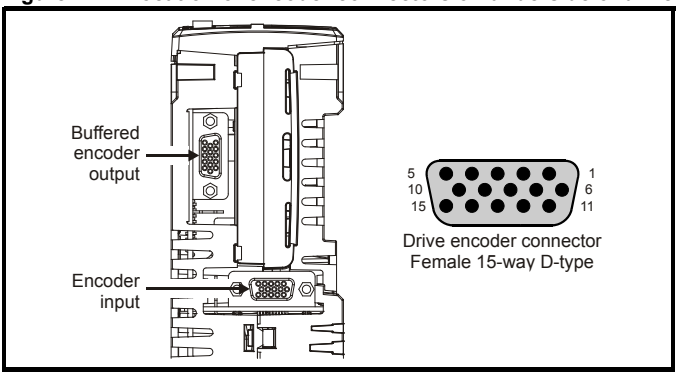


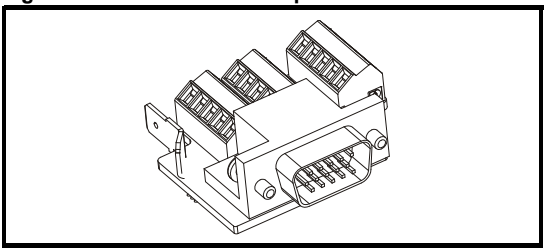
Figure 4-14 Location of encoder connectors on underside of drive



Drive encoder input converter connector

A 15-way D-type converter is available to provide a screw terminal interface for encoder wiring, and a spade terminal for the shield.

Figure 4-15 Drive encoder input converter connector



WARNING

If using the Drive Encoder Input Converter connector, the Single Ended Encoder Interface or the ERN1387 Encoder Interface protection to at least IP2X must be provided for the connector.

Table 4-4 Encoder In connector details

Term.	Setting of Pr 3.38											
	Ab (0)	**Fd** (1)	**Fr** (2)	**Ab.SErVO** (3)	**Fd.SErVO** (4)	**Fr.SErVO** (5)	**SC** (6)	**SC.HiPEr** (7)	**EndAt** (8)	**SC.EndAt** (9)	**SSI** (10)	**SC.SSI** (11)
1	A	F	F	A	F	F	Cos			Cos		Cos
2	A\	F\	F\	A\	F\	F\	Cosref			Cosref		Cosref
3	B	D	R	B	D	R	Sin			Sin		Sin
4	B\	D\	R\	B\	D\	R\	Sinref			Sinref		Sinref
5	Z*							Encoder input - Data (input/output)				
6	Z*							Encoder input - Data\ (input/output)				
7				U								
8				U\								
9				V								
10				V\								
11				W					Encoder input - Clock (output)			
12				W\					Encoder input - Clock\ (output)			
13	+V**											
14	0V common											
15	th***											
Shell	0V common											

* Marker pulse is optional

** The encoder supply is selectable through parameter configuration to 5 Vdc, 8 Vdc and 15 Vdc

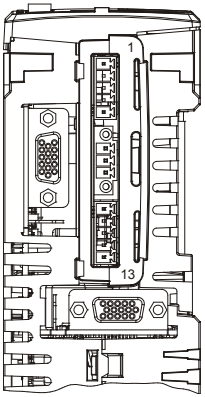
*** Terminal 15 is a parallel connection to T8 analog input 3. If this is to be used as a thermistor input, ensure that Pr **7.15** is set to 'th.sc' (7), 'th' (8) or 'th.diSP' (9)

Table 4-5 Simulated encoder output connector details

Term.	Setting of Pr 3.54				
	Ab (0)	**Fd (1)**	**Fr (2)**	**Ab.L (3)**	**Fd.L (4)**
1	A	F	F	A	F
2	A\	F\	F\	A\	F\
3	B	D	R	B	D
4	B\	D\	R\	B\	D\
5	Z*				
6	Z*				
14	0V				
Shell	0V common				

Digitax ST Plus additional connections

Figure 4-16 Digitax ST Plus terminals view



Connector specification:

Maximum size cable = 1.5mm^2

Torque = 0.2 N m (1.8 lb in)

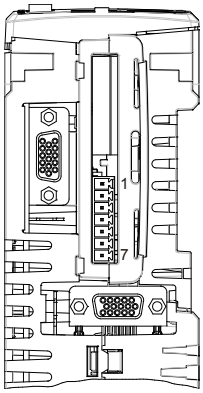
The terminals are numbered from terminal 1 at the top, to terminal 13 at the bottom as per the orientation shown in Figure 4-16. The terminal functions are given in Table 4-6:

Table 4-6 Digitax ST Plus connector details

Terminal	Function	Description
1	0V SC	0V connection for EIA-RS485 port
2	/RX	EIA-RS485 Receive line (negative). Incoming.
3	RX	EIA-RS485 Receive line (positive). Incoming.
4	/TX	EIA-RS485 Transmit line (negative). Outgoing.
5	TX	EIA-RS485 Transmit line (positive). Outgoing.
6	Fieldbus Type A	Fieldbus Type data line
7	Fieldbus Type Shield	Shield connection for Fieldbus Type
8	Fieldbus Type B	Fieldbus Type data line
9	0V	0V connection for digital I/O
10	DI0	Digital input 0
11	DI1	Digital input 1
12	DO0	Digital output 0
13	DO1	Digital output 1

Digitax ST EZMotion additional connections

Figure 4-17 Digitax ST EZMotion terminals view



Connector specification:

Maximum size cable = 1.5mm^2

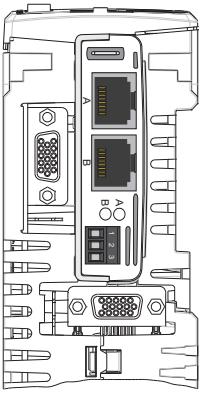
Torque = 0.2 N m (1.8 lb in)

Table 4-7 Digitax EZMotion connector details

Terminal	Function	Description
1	0V common	0V common connection for digital I/O
2	Input 1	Digital input 1
3	Input 2	Digital input 2
4	Input 3	Digital input 3
5	Input 4	Digital input 4
6	Output 1	Digital output 1
7	Output 2	Digital output 2

Digitax ST EtherCAT additional connections

Figure 4-18 Digitax ST EtherCAT terminals view



Connector specification:

Maximum size cable = 1.5mm^2

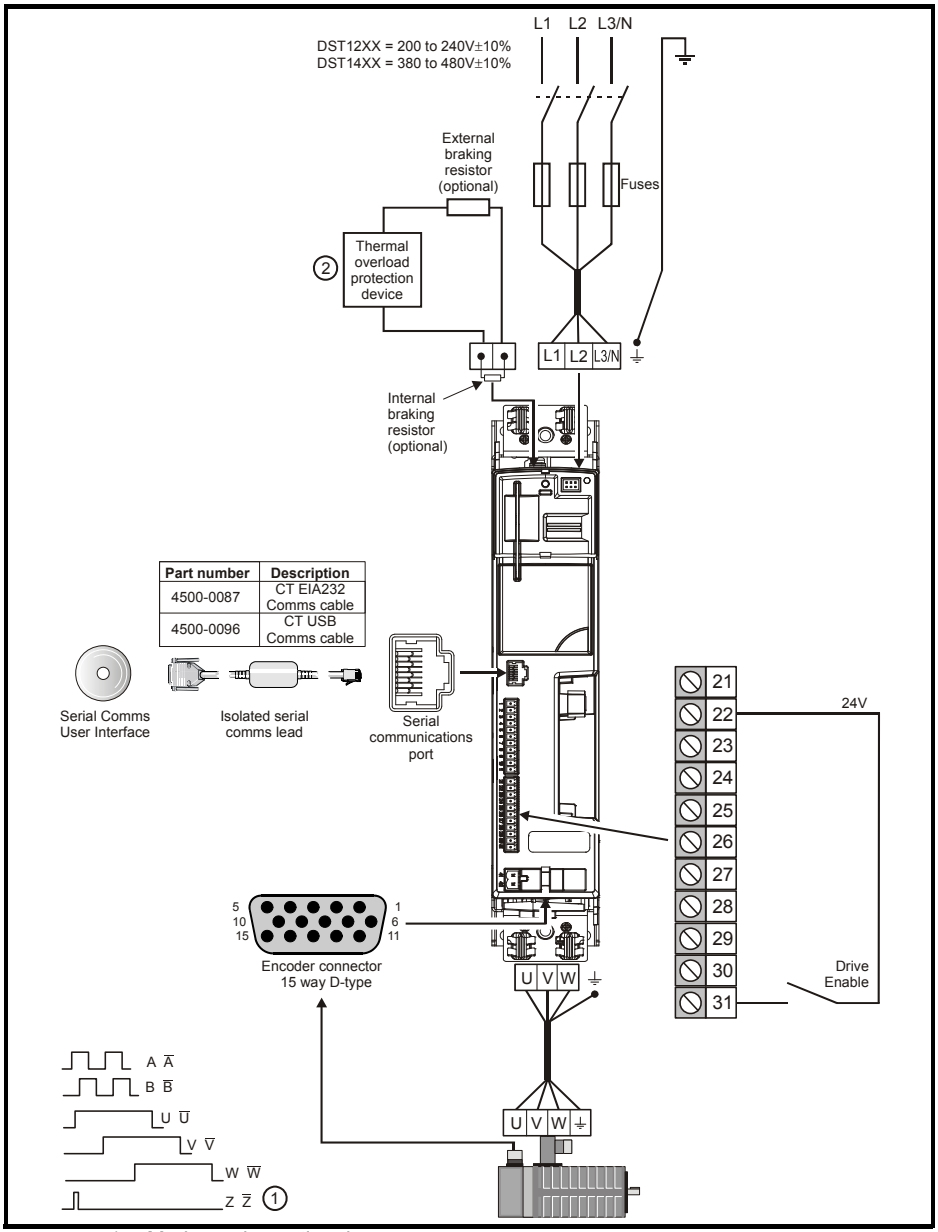
Torque = 0.2 N m (1.8 lb in)

Table 4-8 Digitax EtherCAT connector details

Terminal	Function (A - IN)	Terminal	Function (B - OUT)	Digital Inputs	Function
1	Transmit +	1	Transmit +	1	0V Common
2	Transmit -	2	Transmit -	2	Digital input 0
3	Receive +	3	Receive +	3	Digital input 1
4	Not used	4	Not used		
5	Not used	5	Not used		
6	Receive -	6	Receive -		
7	Not used	7	Not used		
8	Not used	8	Not used		

4.9 Recommended simple start-up

Figure 4-19 Recommended simple start-up via serial communications



1. Marker pulse optional
2. Thermal overload for external braking resistor to protect against fire risk. This must be wired to interrupt the AC supply in the event of a fault. This is not required if the optional internal braking thermistor can be connected internally.

5 UL Listing Information

5.1 UL information

Digitax ST drives have been assessed to comply with both ULus and cUL requirements.

The Control Techniques UL file number is E171230. Confirmation of UL listing can be found on the UL website: www.ul.com

5.1.1 Conformity

The drive conforms to UL listing requirements only when the following are observed:

- Class 1 60/75 °C (140/167 °F) copper wire only is used in the installation
- The surrounding air temperature does not exceed 45 °C (113 °F) when the drive is operating
- The terminal tightening torques specified in Figure 4-1 in Chapter 4 *Electrical Installation* on page 25 are used.
- The drive is installed in a type 1 enclosure, or better, as defined by UL50. The drive has a UL 'opentype' enclosure rating.
- The correct UL listed class CC fast acting fuses e.g. Bussman Limitron KTK series, Gould Amp-Trap ATM series or equivalent are used in the AC supply. The drive does not comply with UL if MCBs are used in place of fuses. For further information on fusing refer to Table 4-1 *Fuse ratings and cable sizes* on page 28.
- If the drive control stage is supplied by an external power supply (+24V), the external power supply must be a UL Class 2 power supply.

5.1.2 AC supply specification

The drive is suitable for use in a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes at 264 Vac RMS maximum (200 V drives), 528 Vac RMS maximum (400 V drives).

5.1.3 Motor overload protection

All models incorporate an internal overload protection model for the motor load that does not require the use of an external or remote overload protection device. Overload protection is provided at 105 % the FLA of the device. The duration of the overload is dependent on the motor's thermal time constant (a value up to 3000 seconds that is able to be entered into the drive - default value is 89 seconds). Refer to 'Menu 4 advanced parameter descriptions' in the *Digitax ST Advanced User Guide* for further information.

5.1.4 Overspeed protection

The drive provides overspeed protection. However, it does not provide the level of protection afforded by an independent high integrity overspeed protection device.

5.1.5 Maximum continuous output current

The drive models are listed as having the maximum continuous output currents (FLC) shown in Table 5-1 and Table 5-2 (see the *User Guide* for further information).

Table 5-1 Maximum continuous output current (200 V drives)

Model	FLC (A)
DST1201	1.7
DST1202	3.8
DST1203	5.4
DST1204	7.6

Table 5-2 Maximum continuous output current (400 V drives)

Model	FLC(A)
DST1401	1.5
DST1402	2.7
DST1403	4.0
DST1404	5.9
DST1405	8.0

5.1.6 Common DC bus

The drive can also be used with common DC bus for UL applications as follows: -

Drives can be connected so as to have a common DC bus from a single feed. The power rating of the main fed drive shall not be exceeded. Fusing is not required between the DC bus fed drives, only the main supplied drive is required to be fused (for fuse values see Table 4-2). The maximum capacitance to be connected together for the 480 Vac drives is 880 μF and for the 230 Vac drives is 2200 μF (the capacitance includes the mains supplied drive).

5.1.7 DC Supplied drive

The drive can also have DC feed for UL applications as follows: -

Supply connected to -DC and +DC terminals.

Table 5-3 DC fusing

Model	Volts DC nominal	Fuse current rating	R/C JFHR2 fuse manufacturer, type, Amps	
DST1201	340	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25
DST1202	340	32	Ferraz, 6,9xx CP GRC, 32	Siba URZ14x51 gR 690, 40
DST1203	340	40	Ferraz, 6,9xx CP GRC, 40	Siba URZ14x51 gR 690, 40
DST1204	340	50	Ferraz, 6,9xx CP GRC, 50	Siba URZ14x51 gR 690, 50
DST1401	680	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25
DST1402	680	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25
DST1403	680	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25
DST1404	680	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25
DST1405	680	25	Ferraz, 6,9xx CP GRC, 25	Siba URZ14x51 gR 690, 25

NOTE In the table above, Ferraz xx may be 00 (fuse with no trip indicator installed) or 21 (fuse installed with trip indicator).

5.1.8 UL listed accessories

- Digitax ST Keypad
- Digitax ST Braking resistor
- SM-Keypad Plus
- SM-I/O Plus
- SM-Ethernet
- SM-CANopen
- SM-Universal Encoder Plus
- SM-Resolver
- SM-Encoder Plus
- SM-I/O Lite
- SM-I/O 120V
- SM-LON
- SM-Applications Plus
- 15-way D-type converter
- SM-Encoder Output Plus
- SM-LON
- SM-PROFIBUS-DP-V1
- SM-DeviceNet
- SM-I/O Timer
- SM-CAN
- SM-INTERBUS
- SM-Applications Lite
- SM-Applications Lite V2
- SM-SLM
- SM-Applications
- SM-I/O PELV
- SM-I/O 24V Protected
- SM-I/O 32
- SM-SERCOS
- SM-I/O Lite
- SM-EtherCAT



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