EMERSON
Industrial Automation

Technical Data Guide

Digitax ST

AC variable speed drive for servo motors

Part Number: 0475-0002-02
Issue: 2

CONTROL TECHNIQUES

www.controltechniques.com

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the guide, without notice.

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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 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 **11.29** 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).

Environmental statement

Control Techniques is committed to minimising the environmental impacts of its manufacturing operations and of its products throughout their life cycle. To this end, we operate an Environmental Management System (EMS) which is certified to the International Standard ISO 14001. Further information on the EMS, our Environmental Policy and other relevant information is available on request, or can be found at www.greendrives.com.

The electronic variable-speed drives manufactured by Control Techniques have the potential to save energy and (through increased machine/process efficiency) reduce raw material consumption and scrap throughout their long working lifetime. In typical applications, these positive environmental effects far outweigh the negative impacts of product manufacture and end-of-life disposal.

Nevertheless, when the products eventually reach the end of their useful life, they must not be discarded but should instead be recycled by a specialist recycler of electronic equipment. Recyclers will find the products easy to dismantle into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, whilst other parts are secured with conventional fasteners. Virtually all parts of the product are suitable for recycling.

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For current information on how this requirement applies in relation to specific Control Techniques products, please approach your usual contact in the first instance. Control Techniques position statement can be viewed at: http://www.controltechniques.com/REACH

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1 Introduction

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

Digitax ST Base		Green
Digitax ST Indexer		Silver
Digitax ST Plus		Gold
Digitax ST EZMotion		Blue

The Digitax ST Base drive operates in velocity or torque modes and is designed to operate with a centralized 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 synchronized 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.

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 standard EN 61800-5-2 (IEC 61800-5-2).

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

Installation Guide (packed with product)

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

User Guide (CD)

- Designed as a step by step guide to help the user become familiar with the product (FIGS Available).

Technical Data Guide (CD)

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

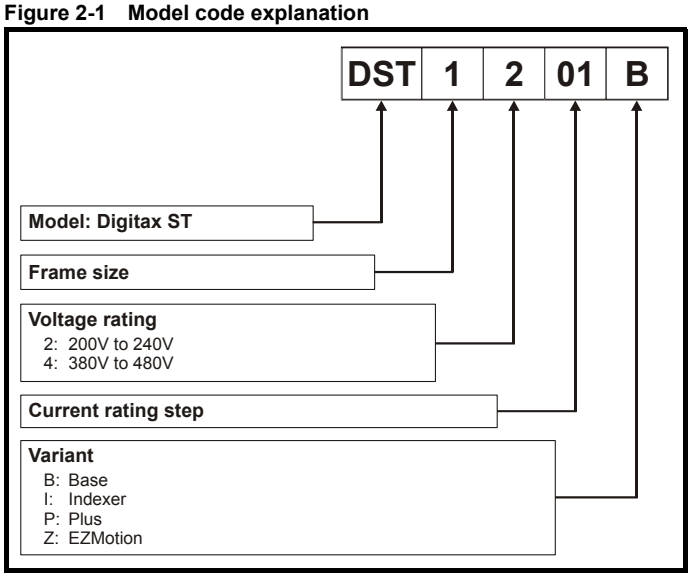
Advanced User Guide (CD)

In-depth parameter descriptions.

2 Product ratings

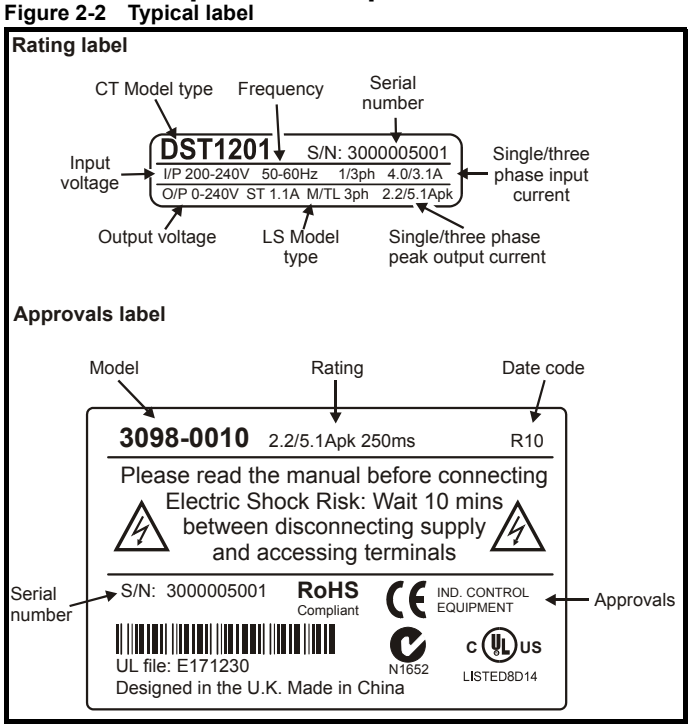
2.1 Model number

Figure 2-1 Model code explanation



2.2 Nameplate description

Figure 2-2 Typical label



2.3 Drive ratings

The drive rating is limited by numerous systems which protect the power stage hardware. (Rectifier, DC bus, inverter)

These systems come into operation under various extremes of operating conditions. (I.e. ambient, supply imbalance, output power.)

2.3.1 Maximum ratings

Table 2-1 Maximum ratings

Model	No of input phases	Nominal current I_n A	Peak current I_{MAX} A
DST1201	1	1.1*	2.2
DST1202	1	2.4*	4.8
DST1203	1	2.9*	5.8
DST1204	1	4.7*	9.4
DST1201	3	1.7	5.1
DST1202	3	3.8	11.4
DST1203	3	5.4	16.2
DST1204	3	7.6	22.8
DST1401	3	1.5	4.5
DST1402	3	2.7	8.1
DST1403	3	4.0	12.0
DST1404	3	5.9	17.7
DST1405	3	8.0	24.0

*The maximum rating information, in Table 2-1 above, for the 200V single phase supply, illustrates a 200% overload capability. When the Digitax ST 120x is used with a single phase supply it is possible to achieve the three phase nominal current rating as long as the single phase peak current rating is observed.

The rating information shown in section 2.4 *Typical pulse duty* on page 5 is based on the limitations of the drive output stage only.

The ratings are based on the following operating conditions:

- Ambient temperature = 40°C
- Altitude = 1000m
- Not exceeding power ratings
- DC bus voltage = 565V for DST140X
- DC bus voltage = 325V for DST120X

The sizing tool should be used to select a drive for a profile or condition that is not given as an example in section 2.4 *Typical pulse duty* .

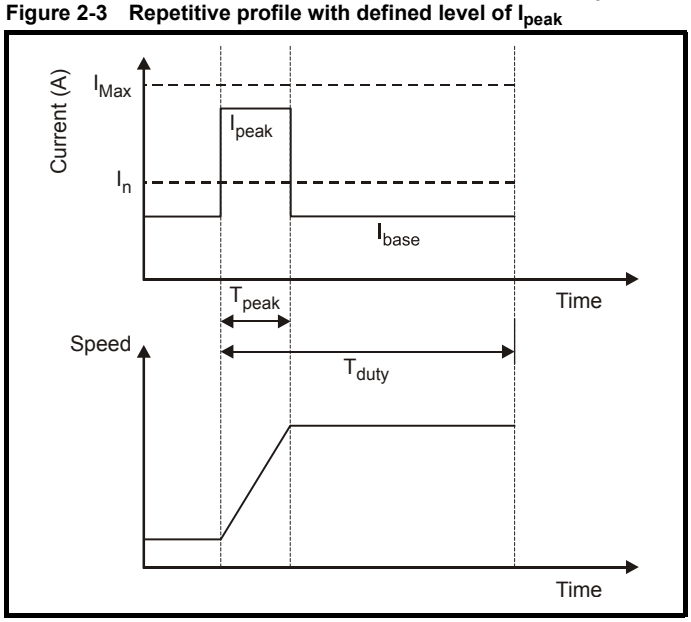
2.4 Typical pulse duty

The following tables give examples of load profiles that indicate the performance of the drive.

The profiles simulate the drive accelerating from standstill to full speed.

2.4.1 Repetitive profile with defined level of I_{peak}

Figure 2-3 Repetitive profile with defined level of I_{peak}



This is a profile with acceleration/deceleration periods where the peak output current from the drive (I_{peak}) is given as a proportion of the nominal current (I_n) for a defined period of time. (T_{peak}).

For example accelerating/decelerating for 10s with a current of 2.0 x I_n.

The ratio between accelerating/decelerating period (T_{peak}) and the total profile period (T_{duty}) is always 1:10.

The profile shows the level of current that can be provided during the running/stopped period when the maximum peak current is used for accelerating/decelerating.

I_{base} is the drive output current during the constant speed segment of the profile.

Table 2-2 Repetitive profile with defined level of I_{peak} at 6kHz switching frequency, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_n for 60s		1.75 x I_n for 40s		2.0 x I_n for 10s		2.5 x I_n for 2s		3.0 x I_n for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.9	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	6.5	12.0	8.0	14.0	8.0	16.0	8.0	20.0	8.0	24.0

Table 2-3 Repetitive profile with defined level of I_{peak} at 8kHz switching frequency, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_n for 60s		1.75 x I_n for 40s		2.0 x I_n for 10s		2.5 x I_n for 2s		3.0 x I_n for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.7	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	4.1	12.0	4.3	14.0	8.0	16.0	8.0	20.0	7.8	24.0

Table 2-4 Repetitive profile with defined level of I_{peak} at 6kHz switching frequency, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

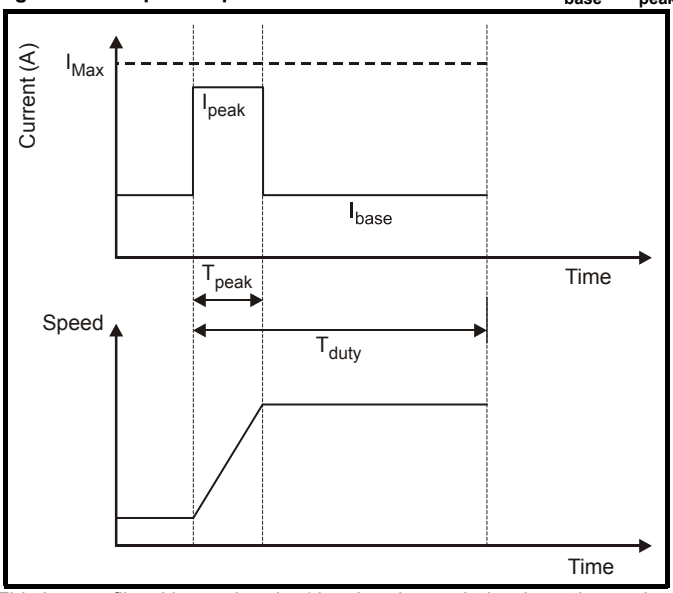
Model	I_n	Overloads									
		1.5 x I_n for 60s		1.75 x I_n for 40s		2.0 x I_n for 10s		2.5 x I_n for 2s		3.0 x I_n for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.9	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	8.0	12.0	8.0	14.0	8.0	16.0	8.0	20.0	8.0	24.0

Table 2-5 Repetitive profile with defined level of I_{peak} at 8kHz switching frequency, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_n for 60s		1.75 x I_n for 40s		2.0 x I_n for 10s		2.5 x I_n for 2s		3.0 x I_n for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.5	8.9	5.0	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	3.6	12.0	3.8	14.0	7.2	16.0	7.3	20.0	6.9	24.0

2.4.2 Repetitive profile with defined ratio between I_{base} to I_{peak}

Figure 2-4 Repetitive profile with defined ratio between I_{base} to I_{peak}



This is a profile with acceleration/deceleration periods where the peak output current from the drive (I_{peak}) is given as a proportion of the base current (I_{base}) for a defined period of time. (T_{peak}).

For example accelerating/decelerating for 10s with a current of 2.0 x I_{base}.

The ratio between accelerating/decelerating period (T_{peak}) and the total profile period (T_{duty}) is always 1:10.

The profile shows the highest I_{base} ratings possible for the given I_{peak}/ I_{base} ratio.

Table 2-6 Repetitive profile with defined ratio between I_{base} to I_{peak} at 6kHz switching frequency, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_{base} for 60s		1.75 x I_{base} for 40s		2.0 x I_{base} for 10s		2.5 x I_{base} for 2s		3.0 x I_{base} for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.9	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	8.0	12.0	8.0	14.0	8.0	16.0	8.0	20.0	8.0	24.0

Table 2-7 Repetitive profile with defined ratio between I_{base} to I_{peak} at 8kHz switching frequency, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_{base} for 60s		1.75 x I_{base} for 40s		2.0 x I_{base} for 10s		2.5 x I_{base} for 2s		3.0 x I_{base} for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.9	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	7.2	10.8	7.2	12.6	8.0	16.0	8.0	20.0	8.0	24.0

Table 2-8 Repetitive profile with defined ratio between I_{base} to I_{peak} at 6kHz switching frequency, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_{base} for 60s		1.75 x I_{base} for 40s		2.0 x I_{base} for 10s		2.5 x I_{base} for 2s		3.0 x I_{base} for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.9	10.3	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	8.0	12.0	8.0	14.0	8.0	16.0	8.0	20.0	8.0	24.0

Table 2-9 Repetitive profile with defined ratio between I_{base} to I_{peak} at 8kHz switching frequency, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

Model	I_n	Overloads									
		1.5 x I_{base} for 60s		1.75 x I_{base} for 40s		2.0 x I_{base} for 10s		2.5 x I_{base} for 2s		3.0 x I_{base} for 0.25s	
		I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}	I_{base}	I_{peak}
	A										
DST1201	1.7	1.7	2.6	1.7	3.0	1.7	3.4	1.7	4.3	1.7	5.1
DST1202	3.8	3.8	5.7	3.8	6.7	3.8	7.6	3.8	9.5	3.8	11.4
DST1203	5.4	5.4	8.1	5.4	9.5	5.4	10.8	5.4	13.5	5.4	16.2
DST1204	7.6	7.6	11.4	7.6	13.3	7.6	15.2	7.6	19.0	7.6	22.8
DST1401	1.5	1.5	2.3	1.5	2.6	1.5	3.0	1.5	3.8	1.5	4.5
DST1402	2.7	2.7	4.1	2.7	4.7	2.7	5.4	2.7	6.8	2.7	8.1
DST1403	4.0	4.0	6.0	4.0	7.0	4.0	8.0	4.0	10.0	4.0	12.0
DST1404	5.9	5.9	8.9	5.6	9.8	5.9	11.8	5.9	14.8	5.9	17.7
DST1405	8.0	7.2	10.8	6.8	11.9	7.6	15.2	7.6	19.0	7.6	22.8

2.5 Continuous rating

Table 2-10 Continuous rating with no overload, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	I_n	6kHz		8kHz		12kHz	
		I_{cont} at 150Hz	I_{cont} at 0Hz	I_{cont} at 150Hz	I_{cont} at 0Hz	I_{cont} at 150Hz	I_{cont} at 0Hz
	A						
DST1201	1.7	1.7					
DST1202	3.8	3.8					
DST1203	5.4	5.4					
DST1204	7.6	7.6					
DST1401	1.5	1.5					
DST1402	2.7	2.7					
DST1403	4.0	4.0					
DST1404	5.9	5.9					4.2
DST1405	8.0	8.0			7.0	7.9	5.0

Table 2-11 Continuous rating with no overload, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

Model	I_n	6kHz		8kHz		12kHz	
		I_{cont} at 150Hz	I_{cont} at 0Hz	I_{cont} at 150Hz	I_{cont} at 0Hz	I_{cont} at 150Hz	I_{cont} at 0Hz
	A						
DST1201	1.7	1.7					
DST1202	3.8	3.8					
DST1203	5.4	5.4					
DST1204	7.6	7.6					
DST1401	1.5	1.5					
DST1402	2.7	2.7					
DST1403	4.0	4.0					3.4
DST1404	5.9	5.9			5.4		3.4
DST1405	8.0	8.0	7.5	8.0	6.2	6.4	4.0

NOTE

The power available from a rectifier may limit these figures.

The drive will automatically reduce the output switching frequency so that the highest possible output current can be supported without a thermal trip.

This allows the drive to support the highest possible current at standstill while operating at a higher switching frequency under normal running conditions.

This feature can be disabled using drive Pr **5.35**, see the *Advanced User Guide* for further details.

2.6 Maximum power ratings

For the models shown, the protection systems limit the output rating of the drive.

The ratings are based on the following operating conditions:

- Ambient temperature = 40°C
- Altitude = 1000m

Table 2-12 Maximum rectifier power, ≤230Vac supply for DST120X and ≤400Vac supply for DST140X

Model	No. of Input phases	Power at supply voltage	
		Without line reactor	With line reactor
		kW	kW
DST1201	1	0.329	
DST1202	1	0.714	
DST1203	1	0.864	
DST1204	1	1.391	
DST1201	3	0.51	
DST1202	3	1.13	
DST1203	3	1.61	
DST1204	3	1.77	1.98
DST1401	3	0.77	
DST1402	3	1.36	
DST1403	3	2.04	
DST1404	3	2.93	2.99
DST1405	3	2.77	3.05

Table 2-13 Maximum rectifier power, ≤240Vac supply for DST120X and ≤480Vac supply for DST140X

Model	No. of Input phases	Power at supply voltage	
		Without line reactor	With line reactor
		kW	kW
DST1201	1	0.394	
DST1202	1	0.857	
DST1203	1	1.03	
DST1204	1	1.66	
DST1201	3	0.609	
DST1202	3	1.35	
DST1203	3	1.92	
DST1204	3	2.12	2.38
DST1401	3	0.924	
DST1402	3	1.63	
DST1403	3	2.44	
DST1404	3	3.51	3.58
DST1405	3	3.32	3.65

2.6.1 DC bus design

Parallel connections

The power limit of the rectifier must be adhered to for all combinations of drives in parallel. In addition to this If the total rated bus power required exceeds the capability of 1 x Digitax ST rectifier then two or more Digitax ST's can be connected with the AC & DC in parallel. If the AC supply is connected to more than one drive in a parallel DC bus application, balancing of the current in the input stage of each drive must be considered.

Using DC bus chokes makes the current in the rectifier diodes of each drive the same, so providing a solution to sharing.

There are many possible combinations for paralleling drives through the DC bus connections. Table 2-14 gives details of the internal capacitance for each drive and the additional capacitance which can be powered from the drive. The capacitance must incorporate its own soft-start circuit. All Digitax ST drives incorporate this feature.

Table 2-14 DC Bus data

Drive	Internal DC bus capacitance (µF)	Maximum additional DC bus capacitance which can be connected (µF)
DST1201	440	1760
DST1202	880	1320
DST1203	880	1320
DST1204	1320	880
DST1401	220	660
DST1402	220	660
DST1403	220	660
DST1404	220	660
DST1405	220	660

NOTE

For additional details regarding DC bus paralleling please contact the supplier of the drive.

2.7 Maximum drive losses

Table 2-15 Maximum drive losses

Model	6kHz	8kHz	12kHz
	W	W	W
DST1201	64	65	69
DST1202	79	82	88
DST1203	102	109	122
DST1204	107	110	118
DST1401	79	87	101
DST1402	77	81	90
DST1403	124	142	177
DST1404	127	143	175
DST1405	150	169	207

2.8 Motor cable size and maximum lengths

Table 2-16 Motor cable size and maximum lengths

Model	Output cable	Output cable	6kHz	8kHz	12kHz
	mm^2	AWG	m	m	m
DST1201	0.75	24	50		
DST1202		22			
DST1203		20			
DST1204		18			
DST1401		24			
DST1402					
DST1403		22			
DST1404		20			
DST1405		18			

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.

- 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 6kHz.

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

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

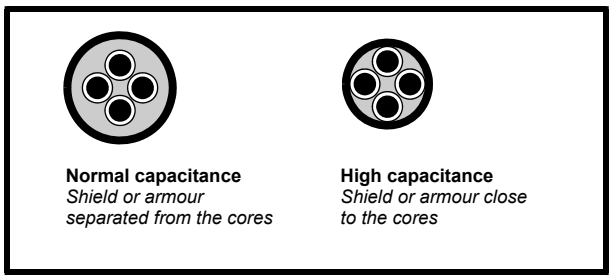
The terminals are suitable for both solid and stranded wires.

High-capacitance cables

The maximum cable length is reduced from that shown in Table 2-16 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 2-5 shows how to identify the two types.)

Figure 2-5 Cable construction influencing the capacitance



The cable used for Table 2-16 is shielded and contains four cores. Typical capacitance for this type of cable is 130pF/m (i.e. from one core to all others and the shield connected together).

2.8.1 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 500Vac 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 10m:

- AC supply voltage exceeds 500V
- DC supply voltage exceeds 670V
- Operation of 400V drive with continuous or very frequent sustained braking

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.

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.

2.9 Braking

The internal braking resistor can be used with the drive even though its resistance is lower than the minimum resistance values given in Table 2-18, because of the following reasons.

- The braking resistor overload protection function in the drive is set up to limit the power dissipated in the resistor.
- The braking resistor is fitted with a thermistor which will trip the drive if the resistor is too hot.
- The power rating of the resistor is only 50W

CAUTION

The internal braking resistor for Digitax ST is installed with a thermistor which must be connected to the drive whenever the internal braking resistor in installed.

If an external resistor is used with the drive, its resistance must be equal to or greater than the value given in Table 2-18.

Table 2-17 Internal braking resistor data

Parameter		
Part number	1299-0001	
DC resistance at 25°C	70Ω	
Peak instantaneous power over 1ms at nominal resistance	200V	400V
	2.2kW	8.7kW
Average power over 60s	50W	

CAUTION

Braking resistor overload protection parameter settings
Failure to observe the following information may damage the resistor.

The drive's software contains an overload protection function for a braking resistor. On Digitax ST this function is enabled at default to protect the internally mounted resistor. Below are the parameter settings.

Parameter		200V drive	400V drive
Full power braking time	Pr **10.30**	0.06	0.01
Full power braking period	Pr **10.31**	2.6	1.7

For more information on the braking resistor software overload protection, see Pr **10.30** and Pr **10.31** full descriptions in the *Advanced User Guide*.

If the internally mounted braking resistor is to be used at more than half of its average power rating then the drive's cooling fan must be at full speed, controlled by setting Pr **6.45** to On (1).

Table 2-18 Minimum resistance and power ratings

Model	Minimum resistance* Ω	Peak power rating kW	Continuous power rating kW	Average power for 0.25s kW
DST1201	23	6.6	0.5	1.6
DST1202			1.2	3.5
DST1203			1.6	4.9
DST1204	16	9.3	2.3	7.0
DST1401	111	5.5	0.8	2.3
DST1402			1.4	4.1
DST1403	75	8.1	2.0	6.1
DST1404	28	21.7	3.0	9.0
DST1405			4.1	12.2

* Resistor tolerance: ±10%

2.10 AC input ratings

Table 2-19 Drive input ratings

Model	No of input phases	Typical input current A	Maximum continuous input current A
DST1201	1		4.0
DST1202	1		7.6
DST1203	1		9.0
DST1204	1		13.4
DST1201	3	3.1	3.5
DST1202	3	6.4	7.3
DST1203	3	8.6	9.4
DST1204	3	11.8	13.4
DST1401	3	2.6	2.8
DST1402	3	4.2	4.3
DST1403	3	5.9	6.0
DST1404	3	7.9	8.0
DST1405	3	9.9	9.9

Inrush current

The drive will have an inrush current during power-up, the peak inrush is limited to the value shown below:

DST120X 18 A peak

DST140X 35 A peak

NOTE

The inrush current for all drives after a brown-out can be larger than the power-up inrush.

2.10.1 Supply requirements

Table 2-20 Supply requirements

Model	Voltage	Frequency range
DST120X	200V to 240V ±10% single phase	48Hz to 65Hz
DST120X	200V to 240V ±10% three phase*	48Hz to 65Hz
DST140X	380V to 480V ±10% three phase*	48Hz to 65Hz

*Maximum supply in-balance: 2% negative phase sequence (equivalent to 3% voltage in-balance between phases).

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

2.10.2 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 600V may have grounding at any potential, i.e. neutral, centre or corner (“grounded delta”)
- Supplies with voltage above 600V 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.

WARNING

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 2-21.
For instructions on removal, refer to the *Digitax ST Installation Guide*. For details of ground fault protection contact the supplier of the drive.

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

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

Table 2-21 Behavior of the drive in the event of a motor circuit ground (earth) fault with an IT supply

Drive size	Internal filter only	External filter (with internal)
0 (200V)	May not trip – precautions required	Drive trips on fault
0 (400V)	Drive trips on fault	Drive trips on fault

2.10.3 Line reactors

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

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

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

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

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

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

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

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

Reactor current ratings

Continuous current:
Not less than the continuous input current rating of the drive.

Repetitive peak current:
Not less than three times the continuous input current rating of the drive.

2.10.4 Input inductor calculation

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

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

Where:

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

2.11 DC drive voltage levels

2.11.1 Control 24Vdc supply

The 24Vdc input has three main functions:

- 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 or serial communications to continue to operate.
- It can be used to supplement the drive's own internal 24V when multiple SM-I/O Plus modules are being used and the current drawn by these modules is greater than the drive can supply. (If too much current is drawn from the drive, the drive will initiate a 'PS.24V' trip)
- It can be used to commission the drive when line power supply voltages are not available, as the display operates correctly. However, the drive will be in the UV trip state unless either line power supply is reapplied or low voltage DC operation is enabled, therefore diagnostics may not be possible. (Power down save parameters are not saved when using the 24V back-up power supply input.)

The working voltage range of the 24V power supply is shown in Table 2-22.

Table 2-22 Control supply voltage levels

Condition	Value
Maximum continuous operating voltage	30.0V
Minimum continuous operating voltage	19.2V
Nominal operating voltage	24.0V
Minimum start up voltage	21.6V
Maximum power supply requirement at 24V	60W
Recommended fuse	3 A, 50Vdc

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

2.11.2 Low voltage DC operation

The drive can be operated from low voltage DC supplies, nominally 24Vdc (control) and 48Vdc (power). The low voltage DC power operating mode is designed either, to allow for motor operation in an emergency back-up situation following failure of the AC supply, for example in robotic arm applications; or to limit the speed of a servo motor during set-up of equipment, for example a robot cell.

The working voltage range of the low voltage DC power supply is shown in Table 2-23.

Table 2-23 Low voltage DC levels

Condition	Value
Minimum continuous operating voltage	36V
Minimum start up voltage	40V
Nominal continuous operating voltage	48V to 72V
Maximum braking IGBT turn on voltage	63V to 95V
Maximum over voltage trip threshold	69V to 104V

2.11.3 High voltage DC levels

Table 2-24 High voltage DC levels

Condition	DST120X V	DST140X V
Undervoltage trip level	175	330
Undervoltage reset level*	215	425
Overvoltage trip level	415	830
Braking level	390	780
Maximum continuous voltage level for 15s	400	800

* These are the absolute minimum DC voltages that the drive can be supplied with. If the drive is not supplied with at least this voltage, it will not reset out of a UV trip at power-up.

3 Drive dimensions

WARNING

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 3-1 Dimensions

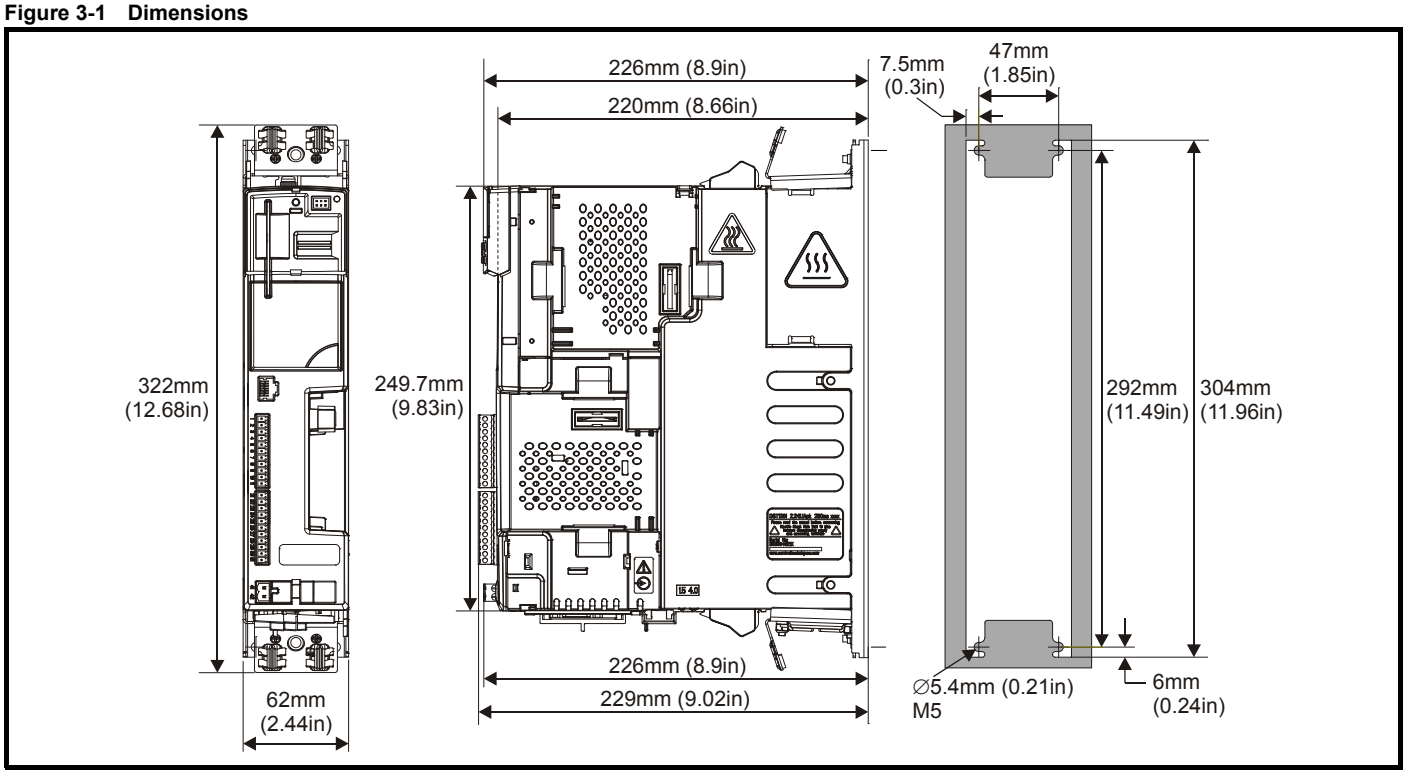
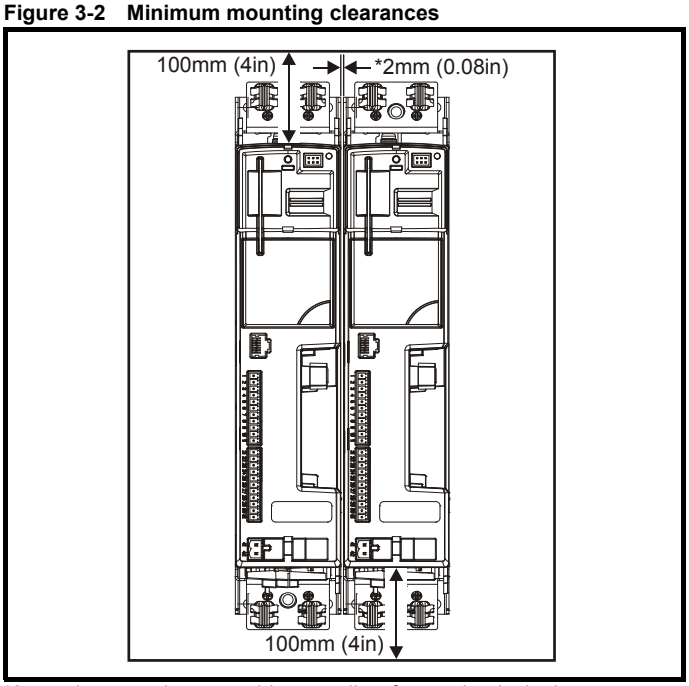


Table 3-1 Torque settings

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%

Figure 3-2 Minimum mounting clearances

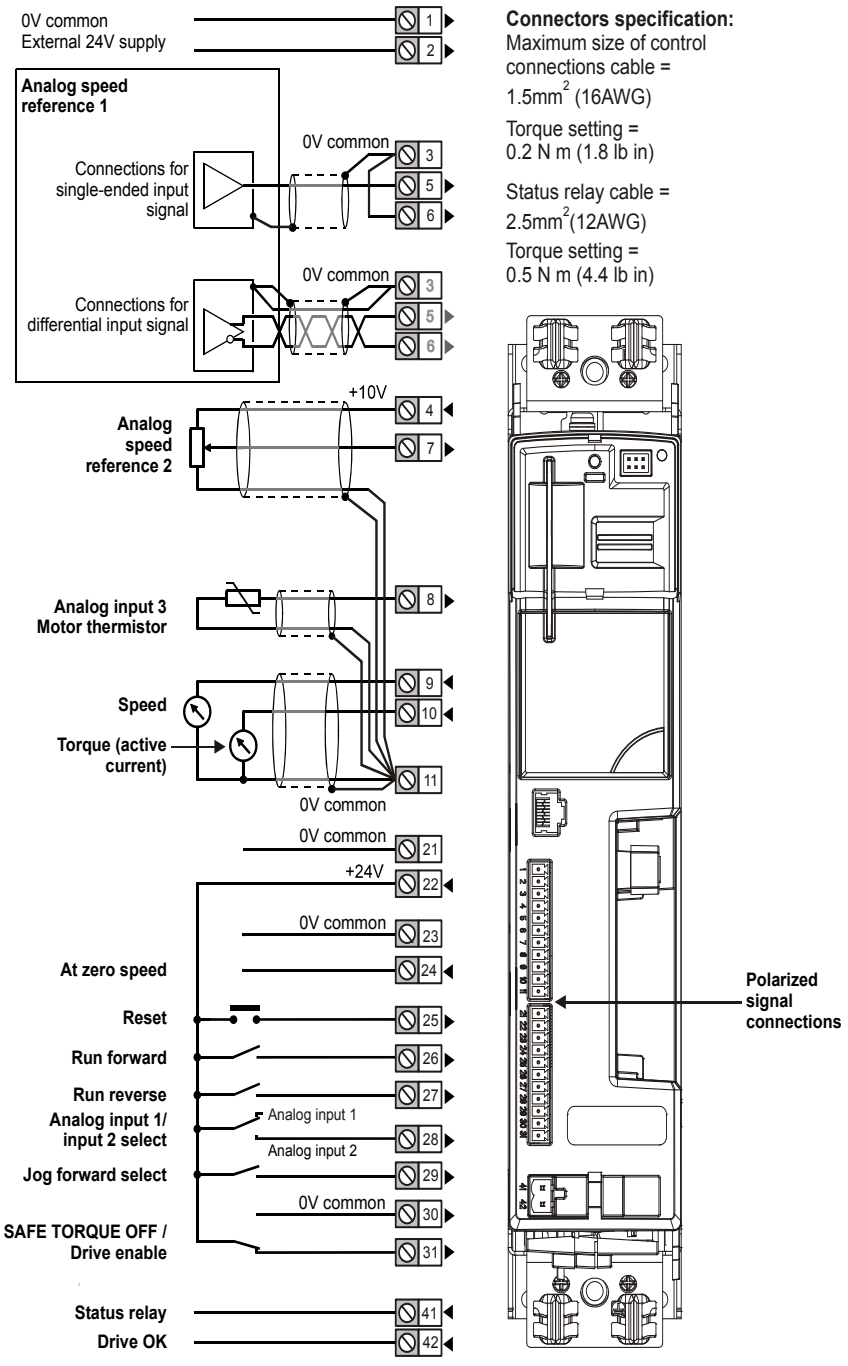


*2mm clearance between drives to allow for mechanical tolerance.

4 I/O Specification

4.1 Control terminals

Figure 4-1 Default terminal functions



1	0V common
Function	**Common connection for all external devices**

2	+24V external input
Function	**To supply the control circuit without providing a supply to the power stage**
Nominal voltage	+24.0Vdc
Minimum continuous operating voltage	+19.2Vdc
Maximum continuous operating voltage	+30.0Vdc
Minimum start-up voltage	21.6Vdc
Recommended power supply	60W 24Vdc nominal
Recommended fuse	3A, 50Vdc

3	0V common
Function	**Common connection for all external devices**

4	+10V user output
Function	**Supply for external analog devices**
Voltage tolerance	±1%
Maximum output current	10mA
Protection	Current limit and trip @ 30mA

	Precision reference Analog input 1
5	Non-inverting input
6	Inverting input
Default function	**Frequency/speed reference**
Type of input	Bipolar differential analog (For single-ended use, connect terminal 6 to terminal 3)
Full scale voltage range	±9.8V ±1%
Absolute maximum voltage range	±36V relative to 0V
Working common mode voltage range	±13V relative to 0V
Input resistance	100kΩ ±1%
Resolution	16-bit plus sign (as speed reference)
Monotonic	Yes (including 0V)
Dead band	None (including 0V)
Jumps	None (including 0V)
Maximum offset	700μV
Maximum non linearity	0.3% of input
Maximum gain asymmetry	0.5%
Input filter bandwidth single pole	~1kHz
Sampling period	250μs with destinations as Pr **1.36**, Pr **1.37** or Pr **3.22**.

7	Analog input 2
Default function	Frequency/speed reference
Type of input	Bipolar single-ended analog voltage or unipolar current
Mode controlled by...	Pr **7.11**
Operating in Voltage mode	
Full scale voltage range	±9.8V ±3%
Maximum offset	±30mV
Absolute maximum voltage range	±36V relative to 0V
Input resistance	>100kΩ
Operating in current mode	
Current ranges	0 to 20mA ±5%, 20 to 0mA ±5%, 4 to 20mA ±5%, 20 to 4mA ±5%
Maximum offset	250μA
Absolute maximum voltage (reverse bias)	−36V max
Absolute maximum current	+70mA
Equivalent input resistance	≤200Ω at 20mA
Resolution	10 bit + sign
Sample period	250μs when configured as voltage input with destinations as Pr **1.36**, Pr **1.37**, Pr **3.22** or Pr **4.08**.

8	Analog input 3
Default function	Motor thermistor input (PTC)
Type of input	Bipolar single-ended analog voltage, unipolar current or motor thermistor input
Mode controlled by...	Pr **7.15**
Operating in Voltage mode (default)	
Voltage range	±9.8V ±3%
Maximum offset	±30mV
Absolute maximum voltage range	±36V relative to 0V
Input resistance	>100kΩ
Operating in current mode	
Current ranges	0 to 20mA ±5%, 20 to 0mA ±5%, 4 to 20mA ±5%, 20 to 4mA ±5%
Maximum offset	250μA
Absolute maximum voltage (reverse bias)	−36V max
Absolute maximum current	+70mA
Equivalent input resistance	≤200Ω at 20mA
Operating in thermistor input mode	
Internal pull-up voltage	<5V
Trip threshold resistance	3.3kΩ ±10%
Reset resistance	1.8kΩ ±10%
Short-circuit detection resistance	50Ω ±30%
Resolution	10 bit + sign
Sample period	250μs when configured as voltage input with destinations as Pr **1.36**, Pr **1.37**, Pr **3.22** or Pr **4.08**.

T8 analog input 3 has a parallel connection to terminal 15 of the drive input encoder connector.

9	Analog output 1
10	Analog output 2
Terminal 9 default function	SPEED output signal
Terminal 10 default function	Motor active current
Type of output	Bipolar single-ended analog voltage or unipolar single ended current
Mode controlled by...	Pr **7.21** and Pr **7.24**
Operating in Voltage mode (default)	
Voltage range	±9.6V ±5%
Maximum offset	100mV
Maximum output current	±10mA
Load resistance	1kΩ min
Protection	35mA max. Short circuit protection
Operating in current mode	
Current ranges	0 to 20mA ±10% 4 to 20mA ±10%
Maximum offset	600µA
Maximum open circuit voltage	+15V
Maximum load resistance	500Ω
Resolution	10-bit (plus sign in voltage mode)
Update period	250µs when configured as a high speed output with sources as Pr **4.02**, Pr **4.17**, Pr **3.02** or Pr **5.03**. 4ms when configured as any other type of output or with all other sources.

11	0V common
Function	**Common connection for all external devices**

21	0V common
Function	**Common connection for all external devices**

22	+24V user output (selectable)
Terminal 22 default function	+24V user output
Programmability	Can be switched on or off to act as a fourth digital output (positive logic only) by setting the source Pr **8.28** and source invert Pr **8.18**
Nominal output current	200mA (including all digital I/O)
Maximum output current	240mA (including all digital I/O)
Protection	Current limit and trip

23	0V common
Function	**Common connection for all external devices**

24	Digital I/O 1
25	Digital I/O 2
26	Digital I/O 3
Terminal 24 default function	AT ZERO SPEED output
Terminal 25 default function	DRIVE RESET input
Terminal 26 default function	RUN FORWARD input
Type	Positive or negative logic digital inputs, positive or negative logic push-pull outputs or open collector outputs
Input / output mode controlled by...	Pr **8.31**, Pr **8.32** and Pr **8.33**
Operating as an input	
Logic mode controlled by...	Pr **8.29**
Absolute maximum applied voltage range	±30V
Impedance	6kΩ
Input thresholds	10.0V ±0.8V
Operating as an output	
Open collector outputs selected	Pr **8.30**
Nominal maximum output current	200mA (total including terminal 22)
Maximum output current	240mA (total including terminal 22)
Nominal working voltage range	0V to +24V
Sample / Update period	250µs when configured as an input with destinations as Pr **6.35** or Pr **6.36**. 600µs when configured as an input with destination as Pr **6.29**. 4ms in all other cases.

27	Digital Input 4
28	Digital Input 5
29	Digital Input 6
Terminal 27 default function	RUN REVERSE input
Terminal 27 special function	High Speed Freeze input (with destination set as Pr **8.40**)
Terminal 28 default function	Analog INPUT 1 / INPUT 2 select
Terminal 29 default function	JOG SELECT input
Type	Positive or negative logic digital inputs
Logic mode controlled by...	Pr **8.29**
Voltage range	0V to +24V
Absolute maximum applied voltage range	±30V
Impedance	6kΩ
Input thresholds	10.0V ±0.8V
Sample / Update period	1µs when T27 (Digital Input 4) destination is Pr **8.40**. 250µs with destinations as Pr **6.35** or Pr **6.36**. 600µs with destination as Pr **6.29**. 4ms in all other cases.

30	0V common
Function	**Common connection for all external devices**

31	SAFE TORQUE OFF/drive enable
Type	Positive logic only digital input
Voltage range	0V to +24V
Absolute maximum applied voltage	±30V
Thresholds	15.5V ±2.5V
Response time	Nominal: 8ms Maximum: 20ms

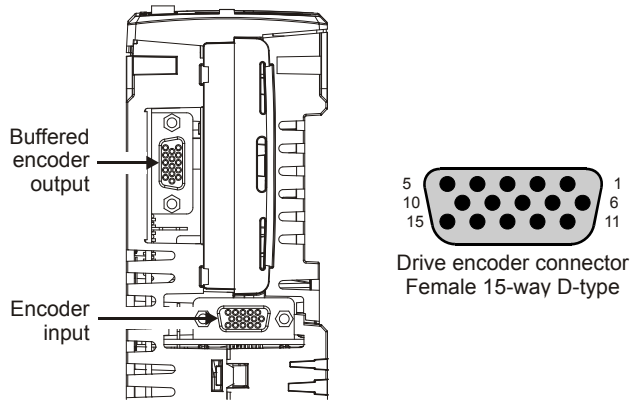
The drive enable terminal (T31) provides a SAFE TORQUE OFF function. The SAFE TORQUE OFF function has been approved by BGIA as meeting the requirements of the following standards, for the prevention of unexpected starting of the drive:EN 61800-5-2:2007 SIL 3, EN ISO 13849-1:2006PL e, EN 954-1:1997Category 3
The SAFE TORQUE OFF function may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

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

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

4.2 Encoder terminals

Figure 4-2 Location of encoder connectors on underside of drive



4.2.1 Encoder In connections

Table 4-1 Encoder types

Setting of Pr 3.38	Description
Ab (0)	Quadrature incremental encoder with or without marker pulse
Fd (1)	Incremental encoder with frequency pulses and direction, with or without marker pulse
Fr (2)	Incremental encoder with forward pulses and reverse pulses, with or without marker pulse
Ab.SErVO (3)	Quadrature incremental encoder with UVW commutation signals, with or without marker pulse Encoder with UVW commutation signals only (Pr **3.34** set to zero)*
Fd.SErVO (4)	Incremental encoder with frequency pulses and direction with commutation signals**, with or without marker pulse
Fr.SErVO (5)	Incremental encoder with forward pulses and reverse pulses with commutation signals**, with or without marker pulse
SC (6)	SinCos encoder without serial communications
SC.HiPEr (7)	Absolute SinCos encoder with HiperFace serial communications protocol (Stegmann)
EndAt (8)	Absolute EndAt serial communications encoder (Heidenhain)
SC.EndAt (9)	Absolute SinCos encoder with EnDat serial communications protocol (Heidenhain)
SSI (10)	Absolute SSI only encoder
SC.SSI (11)	Absolute SinCos encoder with SSI

* This feedback device provides very low resolution feedback and should not be used for applications requiring a high level of performance

** The U, V & W commutation signals are required with an incremental type encoder when used with a servo motor. The UVW commutation signals are used to define the motor position during the first 120° electrical rotation after the drive is powered-up or the encoder is initialized.

Table 4-2 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											

* Marker pulse is optional

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

NOTE

SSI encoders typically have maximum baud rate of 500kBaud. When a SSI only encoder is used for speed feedback with a servo motor, a large speed feedback filter (Pr **3.42**) is required due to the time taken for the position information to be transferred from the encoder into the drive. The addition of this filter means that SSI only encoders are not suitable for speed feedback in dynamic or high-speed applications.

Specifications

Feedback device connections

Ab, Fd, Fr, Ab.SErVO, Fd.SErVO and Fr.SErVO encoders

1	**Channel A, Frequency or Forward inputs**
2	**Channel A\, Frequency\ or Forward\ inputs**
3	**Channel B, Direction or Reverse inputs**
4	**Channel B\, Direction\ or Reverse\ inputs**

Type	EIA 485 differential receivers
Maximum input frequency	500kHz
Line loading	<2 unit loads
Line termination components	120Ω (switchable)
Working common mode range	+12V to –7V
Absolute maximum applied voltage relative to 0V	±25V
Absolute maximum applied differential voltage	±25V

5	**Marker pulse channel Z**
6	**Marker pulse channel Z**
7	**Phase channel U**
8	**Phase channel U**
9	**Phase channel V**
10	**Phase channel V**
11	**Phase channel W**
12	**Phase channel W**

Type	EIA 485 differential receivers
Maximum input frequency	512kHz
Line loading	32 unit loads (for terminals 5 and 6) 1 unit load (for terminals 7 to 12)
Line termination components	120Ω (switchable for terminals 5 and 6, always in circuit for terminals 7 to 12)
Working common mode range	+12V to –7V
Absolute maximum applied voltage relative to 0V	+14V to -9V
Absolute maximum applied differential voltage	+14V to -9V

SC, SC.HiPEr, EndAt, SC.EndAt, SSI and SC.SSI encoders

1	**Channel Cos***
2	**Channel Cosref***
3	**Channel Sin***
4	**Channel Sinref***

Type	Differential voltage
Maximum Signal level	1.25V peak to peak (sin with regard to sinref and cos with regard to cosref)
Maximum input frequency	See Table 4-3
Maximum applied differential voltage and common mode voltage range	±4V

For the SinCos encoder to be compatible with Digitax ST, the output signals from the encoder must be a 1V peak to peak differential voltage (across Sin to Sinref and Cos to Cosref).

The majority of encoders have a DC offset on all signals. A number of encoder manufactures typically have a 2.5Vdc offset. The Sinref and Cosref are a flat DC level at 2.5Vdc and the Cos and Sin signals have a 1V peak to peak waveform biased at 2.5Vdc.

Encoders are available which have a 1V peak to peak voltage on Sin, Sinref, Cos and Cosref. This results in a 2V peak to peak voltage seen at the drive's encoder terminals. It is not recommended that encoders of this type are used with Digitax ST, and that the encoder feedback signals should meet the above parameters (1V peak to peak).

Resolution: The sinewave frequency can be up to 500kHz but the resolution is reduced at high frequency. Table 4-3 shows the number of bits of interpolated information at different frequencies and with different voltage levels at the drive encoder port. The total resolution in bits per revolution is the ELPR plus the number of bits of interpolated information. Although it is possible to obtain 11 bits of interpolation information, the nominal design value is 10 bits.

* Not used with EndAt and SSI communications only encoders.

Table 4-3 Feedback resolution based on frequency and voltage level

Volt/Freq	1kHz	5kHz	50kHz	100kHz	200kHz	500kHz
1.2	11	11	10	10	9	8
1.0	11	11	10	9	9	7
0.8	10	10	10	9	8	7
0.6	10	10	9	9	8	7
0.4	9	9	9	8	7	6

5	**Data****
6	**Data****
11	**Clock*****
12	**Clock*****

Type	EIA 485 differential transceivers
Maximum frequency	2MHz
Line loading	32 unit loads (for terminals 5 and 6) 1 unit load (for terminals 11 and 12)
Working common mode range	+12V to –7V
Absolute maximum applied voltage relative to 0V	+14V to -9V
Absolute maximum applied differential voltage	+14V to -9V

** Not used with SC encoders.

*** Not used with SC and SC.HiPEr encoders.

14	**0V common**

15	**Motor thermistor input**
This terminal is connected internally to terminal 8 of the signal connector. Connect only one of these terminals to a motor thermistor. Analog input 3 must be in thermistor mode, Pr **7.15** = th.SC (7), th (8) or th.diSP (9).	

4.2.2 Buffered encoder output

NOTE

The buffered encoder output is sourced from the drive encoder input and can be any incremental type or any SINCOS type (Note: - No output is available if EndAt only or SSI communications only encoders are used). If a SINCOS is used as the source the buffered output is derived from the zero crossings of the sine waves and does not include interpolated information. The buffered encoder output provides an output with minimal delay from the drive encoder input (maximum delay is 0.5µs). If the source encoder does not have a marker pulse, then no marker pulse can be obtained from the buffered encoder output.

Table 4-4 Encoder output types

Setting of Pr 3.54	Description
Ab (0)	Quadrature outputs
Fd (1)	Frequency and direction outputs
Fr (2)	Frequency and reverse outputs
Ab.L (3)	Quadrature outputs with marker lock
Fd.L (4)	Frequency and direction outputs with marker lock

Table 4-5 Buffered encoder connections

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				

*Available when marker pulse input connected

1	**A, F**
2	**A\, F**
3	**B, D, R**
4	**B\, D\, R**
5	**Z**
6	**Z**

Type	EIA 485 differential transmitter
Max frequency	512 KHz
Max load capability	31 units
Working common mode range	+12V to -7V
Absolute maximum applied voltage relative to 0V	+14V to -14V

14	**0V common**

4.2.3 Digitax ST Plus additional connections

Figure 4-3 Digitax ST Plus terminals view

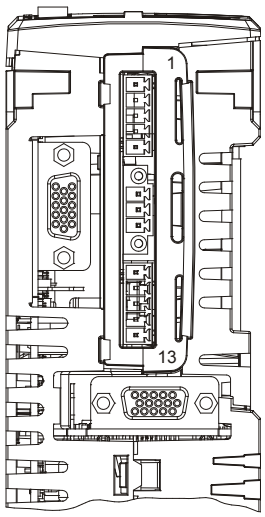
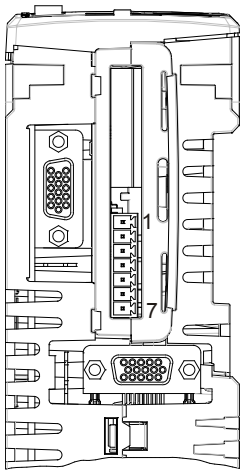


Table 4-6 Digitax ST Plus connector details

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	CTNet A	CTNet data line
7	CTNet Shield	Shield connection for CTNet
8	CTNet B	CTNet data line
9	0V	0V connection for digital I/O
10	DIO	Digital input 0
11	DI1	Digital input 1
12	DO0	Digital output 0
13	DO1	Digital output 1

4.2.4 Digitax ST EZMotion additional connections

Figure 4-4 Digitax ST EZMotion terminals view



1	**0V common**
Function	**Common connection for Digital I/O**

2	**Input 1**
3	**Input 2**
4	**Input 3**
5	**Input 4**
Input turn on voltage	15Vdc ± 0.5Vdc
Input voltage range	0Vdc to +24Vdc
Maximum input voltage	+ 30Vdc

6	**Output 1**
7	**Output 2**
Output voltage	Depends on 24Vdc supply
Maximum output current	20mA total for both outputs

4.3 Serial communications connections

The drive has a serial communications port (serial port) as standard supporting 2 wire EIA485 communications. Please see Table 4-7 for the connection details for the RJ45 connector.

Figure 4-5 Location of the RJ45 serial comms connector

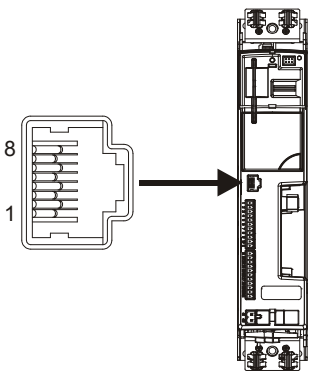


Table 4-7 Connection details for RJ45 connector

Pin	Function
1	120Ω Termination resistor
2	RX TX
3	Isolated 0V
4	+24V (100mA)
5	Isolated 0V
6	TX enable
7	RX\ TX\
8	RX\ TX\ (if termination resistors are required, link to pin 1)
Shield	Isolated 0V

The communications port applies a 2 unit load to the communications network.

Minimum number of connections are 2, 3, 7 and shield. Shielded cable must be used at all times.

4.3.1 Isolation of the serial communications port

The serial communications port is double insulated and meets the requirements for SELV in IEC61800-5-1.

WARNING In order to meet the requirements for SELV in IEC60950 (IT equipment) it is necessary for the control computer to be grounded. Alternatively, when a lap-top or similar device is used which has no provision for grounding, an isolation device must be incorporated in the communications lead.

An isolated serial communications lead has been designed to connect the drive to IT equipment (such as lap-top computers), and is available from the supplier of the drive. See below for details:

Table 4-8 Isolated serial comms lead details

Part number	Description
4500-0087	CT EIA232 Comms cable
4500-0096	CT USB Comms cable

The “isolated serial communications” lead has reinforced insulation as defined in IEC60950 for altitudes up to 3,000m.

NOTE

When using the CT EIA232 Comms cable the available baud rate is limited to 19.2k baud.

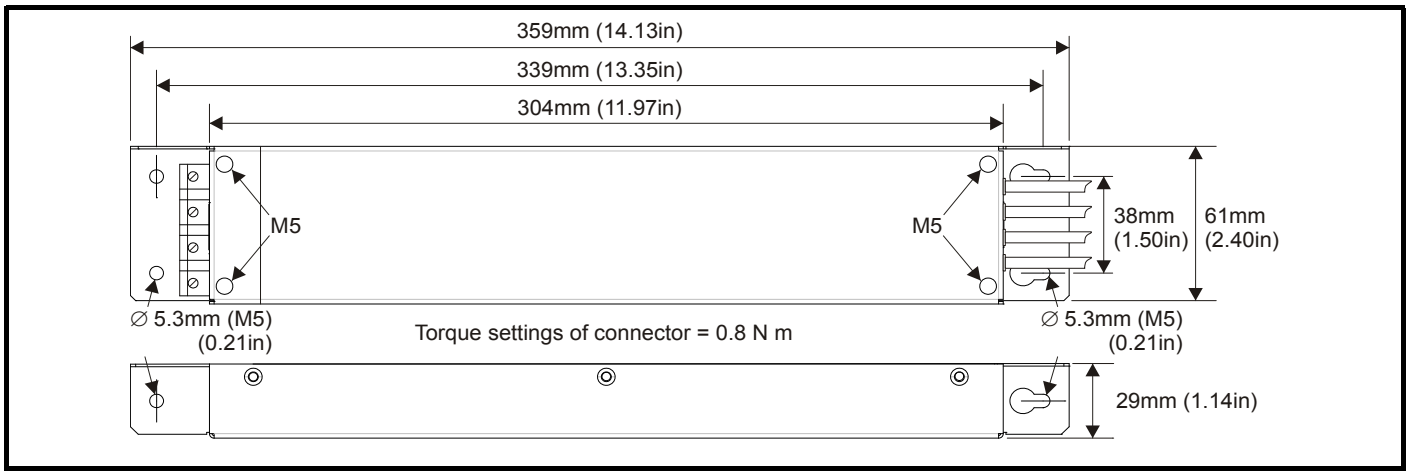
5 EMC filters

5.1 External EMC filter rating

Table 5-1 External EMC filter ratings

Used with	Number of phases	Filter part number		Maximum continuous current		Power losses at rated current	IP rating	Weight		Operational leakage current	Worst case leakage current	Filter terminal tightening torque	
		CT	Schaffner	@40°C (104°F) A	@50°C (122°F) A	W		Kg	lb	mA	mA	Nm	lb ft
DST120X	1	4200-6000	FS23072-19-07	19	17.3	11	20	1.2	2.64	29.5	56.9	0.8	0.6
DST120X	3	4200-6001	FS23073-17-07	17	15.5	13		1.2	2.64	8	50	0.8	0.6
DST140X	3	4200-6002	FS23074-11-07	11	10	10		1.2	2.64	16	90	0.8	0.6

Figure 5-1 External EMC filter dimensions



5.2 Internal and external conducted emissions conformity

Table 5-2 Immunity compliance

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

Table 5-3 DST120X (200V) emission compliance (single and three phase drives

Motor cable length (m)	Switching frequency (kHz)				
	3	4	6	8	12
Using internal filter:					
0 to 7	E2U				
7 to 9	E2U				E2R
9 to 11	E2U		E2R		
>11	E2R				
Using external filter:					
0 to 20	R			I	
20 to 100	I				

Table 5-4 DST140X (400V) emission compliance

Motor cable length (m)	Switching frequency (kHz)				
	3	4	6	8	12
Using internal filter:					
0 to 6	E2U			E2R	
6 to 12	E2U		E2R		
12 to 14	E2U	E2R			
>14	E2R				
Using external filter:					
0 to 20	R			I	
20 to 70	I				
70 to 100	I	Do not use			

Key to Table 5-3 and Table 5-4

(shown in decreasing order of permitted emission level):

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

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

I Industrial generic standard EN 61000-6-4:2007
EN 61800-3:2004 first environment restricted distribution (The following caution is required by EN 61800-3:2004)

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

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

EN 61800-3:2004 defines the following:

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

IEC 61800-3:2004 and EN 61800-3:2004

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

Power drive systems are categorized C1 to C4:

Category	Definition	Corresponding code used above
C1	Intended for use in the first or second environments	R
C2	Not a plug-in or movable device, and intended for use in the first environment only when installed by a professional, or in the second environment	I
C3	Intended for use in the second environment, not the first environment	E2U
C4	Rated at over 1000V or over 400A, intended for use in complex systems in the second environment	E2R

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

NOTE

Where the drive is incorporated into a system with rated input current exceeding 100A, the higher emission limits of EN 61800-3:2004 for the second environment are applicable, and no filter is then required.

NOTE

Operation without an external filter is a practical cost-effective possibility in an industrial installation where existing levels of electrical noise are likely to be high, and any electronic equipment in operation has been designed for such an environment. This is in accordance with EN 61800-3:2004 in the second environment, with restricted distribution. There is some risk of disturbance to other equipment, and in this case the user and supplier of the drive system must jointly take responsibility for correcting any problem which occurs.

6 Options

All Solutions Modules are color-coded in order to make identification easy. The following table shows the color-code key and gives further details on their function.

Table 6-1 Solutions Module identification

Type	Solutions Module	Color	Name	Further Details
Feedback		Light Green	SM-Universal Encoder Plus	**Universal Feedback interface** Feedback interface for the following devices: **Inputs** • Incremental encoders • SinCos encoders • SSI encoders • EnDat encoders **Outputs** • Quadrature • Frequency and direction • SSI simulated outputs
		Light Blue	SM-Resolver	**Resolver interface** Feedback interface for resolvers. Simulated quadrature encoder outputs
		Brown	SM-Encoder Plus	**Incremental encoder interface** Feedback interface for incremental encoders without commutation signals. No simulated encoder outputs available
		Dark Brown	SM-Encoder Output Plus	**Incremental encoder interface** Feedback interface for incremental encoders without commutation signals. Simulated encoder output for quadrature, frequency and direction signals
		N/A	15-way D-type converter	**Drive encoder input converter** Provides screw terminal interface for encoder wiring and spade terminal for shield
		N/A	Single ended encoder interface (15V or 24V)	**Single ended encoder interface** Provides an interface for single ended ABZ or UVW encoder signals, such as those from hall effect sensors. 15V and 24V versions are available.
Automation (I/O Expansion)		Yellow	SM-I/O Plus	**Extended I/O interface** Increases the I/O capability by adding the following to the existing I/O in the drive: • Digital inputs x 3 • Digital I/O x 3 • Analog inputs (voltage) x 2 • Analog output (voltage) x 1 • Relay x 2
		Yellow	SM-I/O 32	**Extended I/O interface** Increase the I/O capability by adding the following to the existing I/O in the drive: • High speed digital I/O x 32 • +24V output
		Dark Yellow	SM-I/O Lite	**Additional I/O** 1 x Analog input (±10V bi-polar or current modes) 1 x Analog output (0-10V or current modes) 3 x Digital input and 1 x Relay
		Dark Red	SM-I/O Timer	**Additional I/O with real time clock** As per SM-I/O Lite but with the addition of a Real Time Clock for scheduling drive running
		Turquoise	SM-I/O PELV	**Isolated I/O to NAMUR NE37 specifications** For chemical industry applications 1 x Analog input (current modes) 2 x Analog outputs (current modes) 4 x Digital input / outputs, 1 x Digital input, 2 x Relay outputs
		Olive	SM-I/O 120V	**Additional I/O conforming to IEC 61131-2 120Vac** 6 digital inputs and 2 relay outputs rated for 120Vac operation
		Cobalt Blue	SM-I/O 24V Protected	**Additional I/O with overvoltage protection up to 48V** 2 x Analog outputs (current modes) 4 x Digital input / outputs, 3 x Digital inputs, 2 x Relay outputs

Table 6-1 Solutions Module identification

Type	Solutions Module	Color	Name	Further Details
Automation (Applications)		Golden brown	SM-Register	**Applications Processor** 2nd processor for running position capture functionality with CTNet support.
Fieldbus		Purple	SM-PROFIBUS-DP-V1	**Profibus option** PROFIBUS DP adapter for communications with the drive
		Medium Grey	SM-DeviceNet	**DeviceNet option** Devicenet adapter for communications with the drive
		Dark Grey	SM-INTERBUS	**Interbus option** Interbus adapter for communications with the drive
		Pink	SM-CAN	**CAN option** CAN adapter for communications with the drive
		Light Grey	SM-CANopen	**CANopen option** CANopen adapter for communications with the drive
		Red	SM-SERCOS	**SERCOS option** Class B compliant. Torque velocity and position control modes supported with data rates (bit/sec): 2MB, 4MB, 8MB and 16MB. Minimum 250µsec network cycle time. Two digital high speed probe inputs 1µsec for position capture
		Beige	SM-Ethernet	**Ethernet option** 10 base-T / 100 base-T; Supports web pages, SMTP mail and multiple protocols: DHCP IP addressing; Standard RJ45 connection
		Pale Green	SM-LON	**LonWorks option** LonWorks adapter for communications with the drive
		Brown Red	SM-EtherCAT	**EtherCAT option** EtherCAT adapter for communications with the drive
SLM		Orange	SM-SLM	**SLM interface** The SM-SLM allows SLM feedback to be connected directly to the Digitax ST drive and allows operation in either of the following modes: • Encoder only mode • Host mode

Table 6-2 Keypad identification

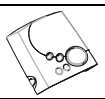
Type	Keypad	Name	Further Details
Keypad		Digitax ST Keypad	**LED keypad option** Keypad with a LED display
		SM-Keypad Plus	**Remote keypad option** Keypad with an alpha-numeric LCD display with Help function

Table 6-3 Other options

Type	Option	Name	Further details
EMC		EMC Filters	These additional filters are designed to operate together with the drive's own integral EMC filter in areas of sensitive equipment
Communications		CT Comms cable	Cable with isolation RS232 to RS485 converter. For connecting PC/Laptop to the drive when using the various interface softwares (e.g. CTSoft)
		CTSoft	Software for PC or Laptop which allows the user to commission and store parameter settings
		SyPTLite	Software for PC or Laptop which allows the user to program PLC functions within the drive
Internal braking resistor		Braking resistor	Optional braking resistor 70R 50W
SMARTCARD		SMARTCARD	Standard feature that enables simple configuration of parameters in a variety of ways

7 General data

Table 7-1

Type	Details
Weight	2.1 kg (4.6 lb)
IP Rating	IP20
Ambient operating temperature	Ambient temperature operating range: 0°C to 50°C (32°F to 122°F) Output current derating must be applied at ambient temperatures >40°C (104°F)
Minimum temperature at power up	-15°C (5°F), the supply must be cycled when the drive has warmed up to 0°C (32°F).
Storage temperature	-40°C (-40°F) to +50°C (122°F) for long term storage, or to +70°C (158°F) for short term storage. Storage time is 2 years. Electrolytic capacitors in any electronic product have a storage period after which they require reforming or replacing. The DC bus capacitors have a storage period of 10 years. The low voltage capacitors on the control supplies typically have a storage period of 2 years and are thus the limiting factor. Low voltage capacitors cannot be reformed due to their location in the circuit and thus may require replacing if the Digitax ST is stored for a period of 2 years or greater without power being applied. It is therefore recommended that the Digitax ST drives are powered up for a minimum of 1 hour after every 2 years of storage. This process allows the Digitax ST to be stored for a further 2 years.
Altitude	Altitude range: 0 to 3,000m (9,900 ft), subject to the following conditions: 1,000m to 3,000m (3,300 ft to 9,900 ft) above sea level: derate the maximum output current from the specified figure by 1% per 100m (330 ft) above 1,000m (3,300 ft) For example at 3,000m (9,900ft) the output current of the drive would have to be derated by 20%.
Operating humidity	Maximum relative humidity 95% non-condensing
Storage humidity	Maximum relative humidity 93%
Vibration	**Bump Test** Testing in each of three mutually perpendicular axes in turn. Referenced standard: IEC 60068-2-29: Test Eb: Severity: 18g, 6ms, half sine No. of Bumps: 600 (100 in each direction of each axis) **Random Vibration Test** Testing in each of three mutually perpendicular axes in turn. Referenced standard: IEC 60068-2-64: Test Fh: Severity: 1.0 m^2/s^3 (0.01 g^2/Hz) ASD from 5 - 20 Hz -3 dB/octave from 20 to 200 Hz Duration: 30 minutes in each of 3 mutually perpendicular axes **Sinusoidal Vibration Test** Testing in each of three mutually perpendicular axes in turn. Referenced standard: IEC 60068-2-6: Test Fc: Frequency range: 2* to 500 Hz Severity: 3.5 mm peak displacement from 2* to 9 Hz 10 m/s^2 peak acceleration from 9 to 200 Hz 15 m/s^2 peak acceleration from 200 to 500 Hz Sweep rate: 1 octave/minute Duration: 15 minutes in each of 3 mutually perpendicular axes * or lowest achievable on an electromagnetic shaker
Speed resolution	Preset speed reference: 0.1rpm Precision speed reference: 0.001rpm Analog input 1: 16bit plus sign Analog input 2: 10bit plus sign
Current /Torque resolution	10bit plus sign
Current/Torque accuracy	2%
Output speed range	Speed range: 0 to 40,000 rpm
Starts per hour	By electronic control: unlimited By interrupting the AC supply: ≤60 (equally spaced)
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: 4s
Acoustic noise	Fan at high speed: 65dB Fan at low speed: 53dB
Toxic materials	Digitax ST meets EU directive 2002-95-EC (RoHS compliance)

8 Diagnostics

The display on the drive gives various information about the status of the drive. These fall into three categories:

- Trip indications
- Alarm indications
- Status indications

WARNING Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter.
If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

Table 8-1 Trip indications

Trip	Diagnosis
br.th	**Braking resistor thermistor temperature monitoring fail**
10	If no brake resistor is installed, set Pr **0.51** (or Pr **10.37**) to 8 to disable this trip. If a brake resistor is installed: Ensure that the braking resistor thermistor is connected correctly Ensure that the fan in the drive is working correctly Replace the braking resistor
C.Acc	**SMARTCARD trip: SMARTCARD Read / Write fail**
185	Check SMARTCARD is installed / located correctly Ensure SMARTCARD is not writing data to data location 500 to 999 Replace SMARTCARD
C.boot	**SMARTCARD trip: The menu 0 parameter modification cannot be saved to the SMARTCARD because the necessary file has not been created on the SMARTCARD**
177	A write to a menu 0 parameter has been initiated via the keypad with Pr **11.42** set to auto(3) or boot(4), but the necessary file on the SMARTCARD has not bee created Ensure that Pr **11.42** is correctly set and reset the drive to create the necessary file on the SMARTCARD Re-attempt the parameter write to the menu 0 parameter
C.bUSY	**SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module**
178	Wait for the Solutions Module to finish accessing the SMARTCARD and then re-attempt the required function
C.Chg	**SMARTCARD trip: Data location already contains data**
179	Erase data in data location Write data to an alternative data location
C.cPr	**SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different**
188	Press the red reset button
C.dAt	**SMARTCARD trip: Data location specified does not contain any data**
183	Ensure data block number is correct
C.Err	**SMARTCARD trip: SMARTCARD data is corrupted**
182	Ensure the card is located correctly Erase data and retry Replace SMARTCARD
C.Full	**SMARTCARD trip: SMARTCARD full**
184	Delete a data block or use different SMARTCARD
cL2	**Analog input 2 current loss (current mode)**
28	Check analog input 2 (terminal 7) current signal is present (4-20mA, 20-4mA)
cL3	**Analog input 3 current loss (current mode)**
29	Check analog input 3 (terminal 8) current signal is present (4-20mA, 20-4mA)
CL.bit	**Trip initiated from the control word (Pr 6.42)**
35	Disable the control word by setting Pr **6.43** to 0 or check setting of Pr **6.42**
C.OPtn	**SMARTCARD trip: Solutions Modules installed are different between source drive and destination drive**
180	Ensure correct Solutions Modules are installed Ensure Solutions Modules are in the same Solutions Module slot Press the red reset button
C.Prod	**SMARTCARD trip: The data blocks on the SMARTCARD are not compatible with this product**
175	Erase all data on the SMARTCARD by setting Pr **xx.00** to 9999 and pressing the red reset button Replace SMARTCARD

Trip	Diagnosis
C.rdo	**SMARTCARD trip: SMARTCARD has the Read Only bit set**
181	Enter 9777 in Pr **xx.00** to allow SMARTCARD Read / Write access Ensure card is not writing to data locations 500 to 999
C.rtg	**SMARTCARD trip: The voltage and/or current rating of the source and destination drives are different**
186	Drive rating dependent parameters (parameters with the RA coding) are likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will not be transferred to the destination drive by SMARTCARDs when the rating of the destination drive is different from the source drive and the file is a parameter file. Drive rating dependent parameters will be transferred if only the current rating is different and the file is a differences from default type file. Press the red reset button Drive rating parameters are:

Parameter	Function
2.08	Standard ramp voltage
4.05/6/7, **21.27/8/9**	Current limits
4.24	User current maximum scaling
5.07, **21.07**	Motor rated current
5.09, **21.09**	Motor rated voltage
5.17, **21.12**	Stator resistance
5.18	Switching frequency
5.23, **21.13**	Voltage offset
5.24, **21.14**	Transient inductance
6.48	Line power supply loss ride through detection level

186	The above parameters will be set to their default values.
C.SLX	**An error has occurred when attempting to transfer a user program from a Solutions Module to a SMARTCARD and vice versa**
172,173,174	See the Digitax ST User Guide for more details
C.TyP	**SMARTCARD trip: SMARTCARD parameter set not compatible with drive**
187	Press the reset button Ensure destination drive type is the same as the source parameter file drive type
dESt	**Two or more parameters are writing to the same destination parameter**
199	Set Pr **xx.00** = 12001 check all visible parameters in the menus for duplication
EEF	**EEPROM data corrupted - Serial comms will timeout with remote keypad on the drive RS485 comms port.**
31	This trip can only be cleared by loading default parameters and saving parameters
Enc1	**Drive encoder trip: Encoder power supply overload**
189	Check encoder power supply wiring and encoder current requirement Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V
Enc2	**Drive encoder trip: Wire break (Drive encoder terminals 1 & 2, 3 & 4, 5 & 6)**
190	Check cable continuity Check encoder cable is plugged into the encoder input port and not the buffered encoder output port (Figure 4-2 *Location of encoder connectors on underside of drive* on page 18) Check wiring of feedback signals is correct Check encoder power is set correctly Replace feedback device If wire break detection on the main drive encoder input is not required, set Pr **3.40** = 0 to disable the Enc2 trip
Enc3	**Drive encoder trip: Phase offset incorrect While running**
191	Check the encoder signal for noise Check encoder shielding Check the integrity of the encoder mechanical mounting Repeat the offset measurement test
Enc4	**Drive encoder trip: Feedback device comms failure**
192	Ensure encoder power supply is correct Ensure baud rate is correct Check encoder wiring Replace feedback device

Trip	Diagnosis
Enc5	**Drive encoder trip: Checksum or CRC error**
193	Check the encoder signal for noise Check the encoder cable shielding With EnDat encoders, check the comms resolution and/or carry out the auto-configuration Pr **3.41**
Enc6	**Drive encoder trip: Encoder has indicated an error**
194	Replace feedback device With SSI encoders, check the wiring and encoder supply setting
Enc7	**Drive encoder trip: Initialisation failed**
195	Re-set the drive Check the correct encoder type is entered into Pr **3.38** Check encoder wiring Check encoder power supply is set correctly Carry out the auto-configuration Pr **3.41** Replace feedback device
Enc8	**Drive encoder trip: Auto configuration on power up has been requested and failed**
196	Change the setting of Pr **3.41** to 0 and manually enter the drive encoder turns (Pr **3.33**) and the equivalent number of lines per revolution (Pr **3.34**) Check the comms resolution
Enc9	**Drive encoder trip: Position feedback selected is selected from a Solutions Module slot which does not have a speed / position feedback Solutions Module installed**
197	Check setting of Pr **3.26** (or Pr **21.21** if the second motor parameters have been enabled)
Enc10	**Drive encoder trip: Phasing failure because encoder phase angle (Pr 3.25 or Pr 21.20) is incorrect**
198	Check the encoder wiring. Perform an autotune to measure the encoder phase angle or manually enter the correct phase angle into Pr **3.25** (or Pr **21.20**). Spurious Enc10 trips can be seen in very dynamic applications. This trip can be disabled by setting the overspeed threshold in Pr **3.08** to a value greater than zero. Caution should be used in setting the over speed threshold level as a value which is too large may mean that an encoder fault will not be detected.
Enc11	**Drive encoder trip: A failure has occurred during the alignment of the analog signals of a SINCOS encoder with the digital count derived from the sine and cosine waveforms and the comms position (if applicable). This fault is usually due to noise on the sine and cosine signals.**
161	Check encoder cable shield. Examine sine and cosine signals for noise.
Enc12	**Drive encoder trip: Hiperface encoder - The encoder type could not be identified during auto-configuration**
162	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
Enc13	**Drive encoder trip: EnDat encoder - The number of encoder turns read from the encoder during auto-configuration is not a power of 2**
163	Select a different type of encoder.
Enc14	**Drive encoder trip: EnDat encoder - The number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.**
164	Select a different type of encoder. Faulty encoder.
Enc15	**Drive encoder trip: The number of periods per revolution calculated from encoder data during auto-configuration is either less than 2 or greater than 50,000.**
165	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.
Enc16	**Drive encoder trip: EnDat encoder - The number of comms bits per period for a linear encoder exceeds 255.**
166	Select a different type of encoder. Faulty encoder.
Enc17	**Drive encoder trip: The periods per revolution obtained during auto-configuration for a rotary SINCOS encoder is not a power of two.**
167	Select a different type of encoder. Faulty encoder.
ENP.Er	**Data error from electronic nameplate stored in selected position feedback device**
176	Replace feedback device

Trip	Diagnosis
Et	**External trip from input on terminal 31**
6	Check terminal 31 signal Check value of Pr **10.32** Enter 12001 in Pr **xx.00** and check for parameter controlling Pr **10.32** Ensure Pr **10.32** or Pr **10.38** (=6) are not being controlled by serial comms
HF01	**Data processing error: CPU address error**
	Hardware fault - return drive to supplier
HF02	**Data processing error: DMAC address error**
	Hardware fault - return drive to supplier
HF03	**Data processing error: Illegal instruction**
	Hardware fault - return drive to supplier
HF04	**Data processing error: Illegal slot instruction**
	Hardware fault - return drive to supplier
HF05	**Data processing error: Undefined exception**
	Hardware fault - return drive to supplier
HF06	**Data processing error: Reserved exception**
	Hardware fault - return drive to supplier
HF07	**Data processing error: Watchdog failure**
	Hardware fault - return drive to supplier
HF08	**Data processing error: Level 4 crash**
	Hardware fault - return drive to supplier
HF09	**Data processing error: Heap overflow**
	Hardware fault - return drive to supplier
HF10	**Data processing error: Router error**
	Hardware fault - return drive to supplier
HF11	**Data processing error: Access to EEPROM failed**
	Hardware fault - return drive to supplier
HF12	**Data processing error: Main program stack overflow**
	Hardware fault - return drive to supplier
HF13	**Data processing error: Software incompatible with hardware**
	Hardware or software fault - return drive to supplier
HF17	**Multi-module system thermistor short circuit or open circuit**
217	Hardware fault - return drive to supplier
HF18	**Multi-module system interconnect cable error**
218	Hardware fault - return drive to supplier
HF19	**Temperature feedback multiplexing failure**
219	Hardware fault - return drive to supplier
HF20	**Power stage recognition: serial code error**
220	Hardware fault - return drive to supplier
HF21	**Power stage recognition: unrecognised frame size**
221	Hardware fault - return drive to supplier
HF22	**Power stage recognition: multi module frame size mismatch**
222	Hardware fault - return drive to supplier
HF23	**Power stage recognition: multi module voltage rating mismatch**
223	Hardware fault - return drive to supplier
HF24	**Power stage recognition: unrecognised drive size**
224	Hardware fault - return drive to supplier

Trip	Diagnosis
HF25	**Current feedback offset error**
225	Hardware fault - return drive to supplier
HF26	**Soft start relay failed to close, soft start monitor failed or braking IGBT short circuit at power up**
226	Hardware fault - return drive to supplier
HF27	**Power stage thermistor 1 fault**
227	Hardware fault - return drive to supplier
HF29	**Control board thermistor fault**
229	Hardware fault - return drive to supplier
HF30	**DCCT wire break trip from power module**
230	Hardware fault - return drive to supplier
It.AC	**Output current overload timed out (I^2t) - accumulator value can be seen in Pr 4.19**
20	Ensure the load is not jammed / sticking Ensure that the motor rated current is not set to zero Check the load on the motor has not changed If seen during an autotune in servo mode, ensure that the motor rated current Pr **0.46** (Pr **5.07**) or Pr **21.07** is current rating of the drive Tune the rated speed parameter Check feedback device signal for noise Check the feedback device mechanical coupling
It.br	**Braking resistor overload timed out (I^2t) – accumulator value can be seen in Pr 10.39**
19	Ensure the values entered in Pr **10.30** and Pr **10.31** are correct Increase the power rating of the braking resistor and change Pr **10.30** and Pr **10.31** If an external thermal protection device is being used and the braking resistor software overload is not required, set Pr **10.30** or Pr **10.31** to 0 to disable the trip
O.CtL	**Drive control board over temperature**
23	Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Check ambient temperature Reduce drive switching frequency
O.ht1	**Power device over temperature based on thermal model**
21	Reduce drive switching frequency Reduce duty cycle Decrease acceleration / deceleration rates Reduce motor load
O.ht2	**Heatsink over temperature**
22	Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
O.ht3	**Drive over-temperature based on thermal model**
27	The drive will attempt to stop the motor before tripping. If the motor does not stop in 10s the drive trips immediately. Check DC Bus ripple Increase ventilation Decrease acceleration / deceleration rates Reduce duty cycle Reduce motor load

Trip	Diagnosis
OI.AC	**Instantaneous output over current detected**
3	Over current threshold is Kc/0.45 (see the *Digitax ST Advanced User Guide* for Kc values) Acceleration /deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** Has offset measurement test been completed? Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14**
OI.br	**Braking transistor over-current detected: short circuit protection for the braking transistor activated**
4	Check braking resistor wiring Check braking resistor value is greater than or equal to the minimum resistance value Check braking resistor insulation
O.Ld1	**Digital output overload: total current drawn from 24V supply and digital outputs exceeds 200mA**
26	Check total load on digital outputs (terminals 24,25,26)and +24V rail (terminal 22)
O.SPd	**Motor speed has exceeded the over speed threshold**
7	Increase the over speed trip threshold in Pr **3.08** Reduce the speed loop P gain (Pr **3.10**) to reduce the speed overshoot
OV	**DC bus voltage has exceeded the peak level or the maximum continuous level for 15 seconds**
2	Increase deceleration ramp (Pr **0.04**) Decrease braking resistor value (staying above the minimum value) Check nominal AC supply level Check for supply disturbances which could cause the DC bus to rise – voltage overshoot after supply recovery from a notch induced by DC drives. Check motor insulation **Drive voltage rating** / **Peak voltage** / **Maximum continuous voltage level (15s)** 200 / 415 / 400 400 / 830 / 800 If the drive is operating in low voltage DC mode the overvoltage trip level is 1.45 x Pr **6.46**.
PAd	**Keypad has been removed when the drive is receiving the speed reference from the keypad**
34	Instal keypad and reset Change speed reference selector to select speed reference from another source
PH	**AC voltage input phase loss or large supply imbalance detected**
32	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load) **NOTE** Load level must be between 50 and 100% for the drive to trip under phase loss conditions. The drive will attempt to stop the motor before this trip is initiated.
PS	**Internal power supply fault**
5	Remove any Solutions Modules and reset Hardware fault - return drive to supplier
PS.10V	**10V user power supply current greater than 10mA**
8	Check wiring to terminal 4 Reduce load on terminal 4
PS.24V	**24V internal power supply overload**
9	The total user load of the drive and Solutions Modules has exceeded the internal 24V power supply limit. The user load consists of the drive's digital outputs, the SM-I/O Plus digital outputs, the drive's main encoder supply and the SM-Universal Encoder Plus encoder supply. • Reduce load and reset • Provide an external 24V >50W power supply • Remove any Solutions Modules and reset
PSAVE.Er	**Power down save parameters in the EEPROM are corrupt**
37	Indicates that the power was removed when power down save parameters were being saved. The drive will revert back to the power down parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) or power down the drive normally to ensure this trip does or occur the next time the drive is powered up.

Trip	Diagnosis
rS	**Failure to measure resistance during autotune**
33	Check motor power connection continuity
SAVE.Er	**User save parameters in the EEPROM are corrupt**
36	Indicates that the power was removed when user parameters were being saved. The drive will revert back to the user parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) to ensure this trip does or occur the next time the drive is powered up.
SCL	**Drive RS485 serial comms loss to remote keypad**
30	Re-instal the cable between the drive and keypad Check cable for damage Replace cable Replace keypad
SLX.dF	**Solutions Module slot X trip: Solutions Module type installed in slot X changed**
204,209	Save parameters and reset

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Feedback module category** Check value in Pr **15**/**16.50**. The following table lists the possible error codes for the SM-Universal Encoder Plus, SM-Encoder Plus and SM-Resolver. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Trip Description	Diagnostic
0	All	No trip	No fault detected
1	SM-Universal Encoder Plus	Encoder power supply overload	Check encoder power supply wiring and encoder current requirement Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V
	SM-Resolver	Excitation output short circuit	Check the excitation output wiring.
2	SM-Universal Encoder Plus & SM-Resolver	Wire break	Check cable continuity Check wiring of feedback signals is correct Check supply voltage or excitation output level Replace feedback device
3	SM-Universal Encoder Plus	Phase offset incorrect while running	Check the encoder signal for noise Check encoder shielding Check the integrity of the encoder mechanical mounting Repeat the offset measurement test
4	SM-Universal Encoder Plus	Feedback device communications failure	Ensure encoder power supply is correct Ensure baud rate is correct Check encoder wiring Replace feedback device
5	SM-Universal Encoder Plus	Checksum or CRC error	Check the encoder signal for noise Check the encoder cable shielding
6	SM-Universal Encoder Plus	Encoder has indicated an error	Replace encoder
7	SM-Universal Encoder Plus	Initialisation failed	Check the correct encoder type is entered into Pr **15**/**16**/**17.15** Check encoder wiring Check supply voltage level Replace feedback device
8	SM-Universal Encoder Plus	Auto configuration on power up has been requested and failed	Change the setting of Pr **15**/**16**/**17.18** and manually enter the number of turns (Pr **15**/**16**/**17.09**) and the equivalent number of lines per revolution (Pr **15**/**16**/**17.10**)
9	SM-Universal Encoder Plus	Motor thermistor trip	Check motor temperature Check thermistor continuity
10	SM-Universal Encoder Plus	Motor thermistor short circuit	Check motor thermistor wiring Replace motor / motor thermistor
11	SM-Universal Encoder Plus	Failure of the sincos analog position alignment during encoder initialisation	Check encoder cable shield. Examine sine and cosine signals for noise.
	SM-Resolver	Poles not compatible with motor	Check that the correct number of resolver poles has been set in Pr **15**/**16**/**17.15**.
12	SM-Universal Encoder Plus	Encoder type could not be identified during auto-configuration	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
13	SM-Universal Encoder Plus	Number of encoder turns read from the encoder during auto-configuration is not a power of 2	Select a different type of encoder.
14	SM-Universal Encoder Plus	Number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.	Select a different type of encoder. Faulty encoder.
15	SM-Universal Encoder Plus	The number of periods per revolution calculated from encoder data during auto-configuration is either <2 or >50,000.	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.
16	SM-Universal Encoder Plus	The number of comms bits per period for a linear encoder exceeds 255.	Select a different type of encoder. Faulty encoder.
74	All	Solutions Module has overheated	Check ambient temperature Check enclosure ventilation

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X or Digitax ST Plus/Indexer has detected a fault**
202,207,212	**Automation (Applications) module category** Check value in Pr **17.50**. The following table lists the possible error codes for the Digitax ST Plus and Digitax ST Indexer. See the *Diagnostics* section in the Advanced User Guide for more information.

Error Code	Trip Description
39	User program stack overflow
40	Unknown error - please contact supplier
41	Parameter does not exist
42	Attempt to write to a read-only parameter
43	Attempt to read from a write-only parameter
44	Parameter value out of range
45	Invalid synchronisation modes
46	Unused
47	Synchronisation lost with CTSync Master
48	RS485 not in user mode
49	Invalid RS485 configuration
50	Maths error - divide by zero or overflow
51	Array index out of range
52	Control word user trip
53	DPL program incompatible with target
54	DPL task overrun
55	Unused
56	Invalid timer unit configuration
57	Function block does not exist
58	Flash PLC Storage corrupt
59	Drive rejected application module as Sync master
60	CTNet hardware failure. Please contact your supplier
61	CTNet invalid configuration
62	CTNet invalid baud-rate
63	CTNet invalid node ID
64	Digital Output overload
65	Invalid function block parameter(s)
66	User heap too large
67	RAM file does not exist or a non-RAM file id has been specified
68	The RAM file specified is not associated to an array
69	Failed to update drive parameter database cache in Flash memory
70	User program downloaded while drive enabled
71	Failed to change drive mode
72	Invalid CTNet buffer operation
73	Fast parameter initialisation failure
74	Over-temperature
75	Hardware unavailable
76	Module type cannot be resolved. Module is not recognised.
77	Inter-option module comms error with module in slot 1
78	Inter-option module comms error with module in slot 2
79	Inter-option module comms error with module in slot 3
80	Inter-option module comms error with module unknown slot
81	APC internal error
82	Communications to drive faulty

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X or Digitax ST EZMotion has detected a fault**

202,207,212

Automation (EZMotion) module category

Check value in Pr **17.50**. The following table lists the possible error codes for the Digitax ST EZMotion. See the *Diagnostics* section in the SM-Applications Modules and Motion Processors manual for more information.

Error Code	Trip Description
41	Digitax ST parameter access error - Parameter does not exist
42	Digitax ST parameter access error - Parameter is read-only
43	Digitax ST parameter access error - Parameter is write-only
44	Digitax ST parameter access error - Written value out of range
73	Digitax ST database set-up error
74	Module overheat error
101	Invalid configuration error
102	NVM invalid error
103	Power up test failure error
104	Following error
105	Travel limit plus
106	Travel limit minus
107	No program error
108	Motion trajectory error
109	Trajectory update overrun error
120	File corruption error - Consult factory
121	
122	
123	Program error - Buffer overrun
124	Program error - Call stack overflow
125	File corruption error - Consult factory
126	
127	Flash error
128	File corruption error - Consult factory
129	Program error - Illegal command
130	File corruption error - Consult factory
131	
132	
133	
134	
135	Program error - Math addition overflow
136	Program error - Math divide by zero
137	Program error - Math divide operand too large
138	Program error - Math multiplication normalization failed
139	Program error - Math divide operand too large
140	Program error - Overflow
141	Program error - Math subtraction overflow
142	Program error - Math stack overflow
143	File corruption error - Consult factory
144	
145	
146	
147	Program error - Flash memory size exceeded
148	Program error - RAM memory size exceeded
153	File corruption error - Consult factory
154	
155	
156	Program error - Too many wait for instructions
157	File corruption error - Consult factory
158	
159	
160	
161	
162	
163	
164	
165	
166	Program error - EZMotion parameter write out of range
171	Invalid slot 1 selection
172	Invalid slot 2 selection
173	Invalid motion processor
174	File corruption error - Consult factory
175	Module output overload

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Automation (I/O Expansion) module category** Check value in Pr **15/16.50**. The following table lists the possible error codes for the SM-I/O Plus, SM-I/O Lite, SM-I/O Timer, SM-I/O PELV, SM-I/O 120V and SM-I/O 24V Protected. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Reason for fault
0	All	No errors
1	All	Digital output overload
2	SM-I/O Lite, SM-I/O Timer	Analog input 1 current input too high (>22mA) or too low (<3mA)
	SM-I/O PELV, SM-I/O 24V Protected	Digital input overload
3	SM-I/O PELV, SM-I/O 24V Protected	Analog input 1 current input too low (<3mA)
	SM-I/O 24V Protected	Communications error
4	SM-I/O PELV	User power supply absent
5	SM-I/O Timer	Real time clock communication error
74	All	Module over temperature

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Fieldbus module category** Check value in Pr **15**/**16.50**. The following table lists the possible error codes for the Fieldbus modules. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Trip Description
0	All	No trip
52	SM-PROFIBUS-DP-V1, SM-Interbus, SM-DeviceNet, SM-CANOpen	User control word trip
61	SM-PROFIBUS-DP-V1, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS	Configuration error
64	SM-DeviceNet	Expected packet rate timeout
65	SM-PROFIBUS-DP-V1, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS	Network loss
66	SM-PROFIBUS-DP-V1	Critical link failure
	SM-CAN, SM-DeviceNet, SM-CANOpen	Bus off error
69	SM-CAN	No acknowledgement
70	All (except SM-Ethernet)	Flash transfer error
	SM-Ethernet	No valid menu data available for the module from the drive
74	All	Solutions module over temperature
75	SM-Ethernet	The drive is not responding
76	SM-Ethernet	The Modbus connection has timed out
80	All (except SM-SERCOS)	Inter-option communications error
81	All (except SM-SERCOS)	Communications error to slot 1
82	All (except SM-SERCOS)	Communications error to slot 2
83	All (except SM-SERCOS)	Communications error to slot 3
84	SM-Ethernet	Memory allocation error
85	SM-Ethernet	File system error
86	SM-Ethernet	Configuration file error
87	SM-Ethernet	Language file error
98	All	Internal watchdog error
99	All	Internal software error

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>SLX.Er</td><td>Solutions Module slot X trip: Solutions Module in slot X has detected a fault</td></tr>
<tr><td>202,207,212</td><td>SLM module category
Check value in Pr 15/16.50. The following table lists the possible error codes for the SM-SLM. See the Diagnostics section in the SM-SLM User Guide for more information.
<table>
<tr><th>Error Code</th><th>Trip Description</th></tr>
<tr><td>0</td><td>No fault detected</td></tr>
<tr><td>1</td><td>Power supply overloaded</td></tr>
<tr><td>2</td><td>SLM version is too low</td></tr>
<tr><td>3</td><td>DriveLink error</td></tr>
<tr><td>4</td><td>Incorrect switching frequency selected</td></tr>
<tr><td>5</td><td>Feedback source selection incorrect</td></tr>
<tr><td>6</td><td>Encoder error</td></tr>
<tr><td>7</td><td>Motor object number of instances error</td></tr>
<tr><td>8</td><td>Motor object list version error</td></tr>
<tr><td>9</td><td>Performance object number of instances error</td></tr>
<tr><td>10</td><td>Parameter channel error</td></tr>
<tr><td>11</td><td>Drive operating mode incompatible</td></tr>
<tr><td>12</td><td>Error writing to the SLM EEPROM</td></tr>
<tr><td>13</td><td>Motor object type incorrect</td></tr>
<tr><td>14</td><td>Digitax ST object error</td></tr>
<tr><td>15</td><td>Encoder object CRC error</td></tr>
<tr><td>16</td><td>Motor object CRC error</td></tr>
<tr><td>17</td><td>Performance object CRC error</td></tr>
<tr><td>18</td><td>Digitax ST object CRC error</td></tr>
<tr><td>19</td><td>Sequencer timeout</td></tr>
<tr><td>74</td><td>Solutions module over temperature</td></tr>
</table></td></tr>
<tr><td>SLX.HF</td><td>Solutions Module slot X trip: Solutions Module X hardware fault</td></tr>
<tr><td>200,205,210</td><td>Ensure Solutions Module is installed correctly
Return Solutions Module to supplier</td></tr>
<tr><td>SLX.nF</td><td>Solutions Module slot X trip: Solutions Module has been removed</td></tr>
<tr><td>203,208,213</td><td>Ensure Solutions Module is installed correctly
Re-instal Solutions Module
Save parameters and reset drive</td></tr>
<tr><td>SL.rtd</td><td>Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect</td></tr>
<tr><td>215</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>SLX.tO</td><td>Solutions Module slot X trip: Solutions Module watchdog timeout</td></tr>
<tr><td>201,206,211</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>t010</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>10</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t038</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>38</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t040 to t089</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>40 to 89</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t099</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>99</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t112 to t160</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>112 to 160</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t168 to t171</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>168 to 171</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
</table>

Trip	Diagnosis
t216	**User trip defined in 2nd processor Solutions Module code**
216	SM-Applications program must be interrogated to find the cause of this trip
th	**Motor thermistor trip**
24	Check motor temperature Check thermistor continuity Set Pr **7.15** = VOLt and reset the drive to disable this function
thS	**Motor thermistor short circuit**
25	Check motor thermistor wiring Replace motor / motor thermistor Set Pr **7.15** = VOLt and reset the drive to disable this function
tunE*	**Autotune stopped before completion**
18	The drive has tripped out during the autotune The red stop key has been pressed during the autotune The SAFE TORQUE OFF signal (terminal 31) was active during the autotune procedure
tunE1*	**The position feedback did not change or required speed could not be reached during the inertia test (see Pr 5.12)**
11	Ensure the motor is free to turn i.e. brake was released. Check feedback device wiring is correct Check feedback parameters are set correctly Check encoder coupling to motor
tunE2*	**Position feedback direction incorrect or motor could not be stopped during the inertia test (see Pr 5.12)**
12	Check motor cable wiring is correct. Check feedback device wiring is correct Swap any two motor phases (closed loop vector only)
tunE3*	**Drive encoder commutation signals connected incorrectly or measured inertia out of range (see Pr 5.12)**
13	Check motor cable wiring is correct. Check feedback device U,V and W commutation signal wiring is correct
tunE4*	**Drive encoder U commutation signal fail during an autotune**
14	Check feedback device U phase commutation wires continuity Replace encoder
tunE5*	**Drive encoder V commutation signal fail during an autotune**
15	Check feedback device V phase commutation wires continuity Replace encoder
tunE6*	**Drive encoder W commutation signal fail during an autotune**
16	Check feedback device W phase commutation wires continuity Replace encoder
tunE7*	**Motor number of poles set incorrectly**
17	Check lines per revolution for feedback device Check the number of poles in Pr **5.11** is set correctly
UP ACC	**Onboard PLC program: cannot access Onboard PLC program file on drive**
98	Disable drive - write access is not allowed when the drive is enabled Another source is already accessing Onboard PLC program - retry once other action is complete
UP div0	**Onboard PLC program attempted divide by zero**
90	Check program
UP OFL	**Onboard PLC program variables and function block calls using more than the allowed RAM space (stack overflow)**
95	Check program
UP ovr	**Onboard PLC program attempted out of range parameter write**
94	Check program
UP PAr	**Onboard PLC program attempted access to a non-existent parameter**
91	Check program
UP ro	**Onboard PLC program attempted write to a read-only parameter**
92	Check program
UP So	**Onboard PLC program attempted read of a write-only parameter**
93	Check program
UP udF	**Onboard PLC program un-defined trip**
97	Check program

Trip	Diagnosis
UP uSEr	**Onboard PLC program requested a trip**
96	Check program
UV	**DC bus under voltage threshold reached**
1	Check AC supply voltage level **Drive voltage rating (Vac)** / **Under voltage threshold (Vdc)** / **UV reset voltage (Vdc)** 200 / 175 / 215V 400 / 330 / 425V

*If a tunE through tunE7 trip occurs, then after the drive is reset the drive cannot be made to run unless it is disabled via the SAFE TORQUE OFF input (terminal 31), drive enable parameter (Pr **6.15**) or the control word (Pr **6.42** and Pr **6.43**).

Table 8-2 Serial communications look-up table

No.	Trip	No.	Trip	No.	Trip
1	UV	90	UP div0	181	C.rdo
2	OV	91	UP PAr	182	C.Err
3	OI.AC	92	UP ro	183	C.dAt
4	OI.br	93	UP So	184	C.FULL
5	PS	94	UP ovr	185	C.Acc
6	Et	95	UP OFL	186	C.rtg
7	O.SPd	96	UP uSEr	187	C.TyP
8	PS.10V	97	UP udF	188	C.cPr
9	PS.24V	98	UP ACC	189	EnC1
10	br.th	99	t099	190	EnC2
11	tunE1	100	Reserved	191	EnC3
12	tunE2	101	t101	192	EnC4
13	tunE3	102	Reserved	193	EnC5
14	tunE4	103	Reserved	194	EnC6
15	tunE5	104	Reserved	195	EnC7
16	tunE6	105	Reserved	196	EnC8
17	tunE7	106	Reserved	197	EnC9
18	tunE	107	Reserved	198	EnC10
19	It.br	108	Reserved	199	dESt
20	It.AC	109	Reserved	200	SL1.HF
21	O.ht1	110	Reserved	201	SL1.tO
22	Reserved	111	Reserved	202	SL1.Er
23	Reserved	112 to 160	t112 to t160	203	SL1.nF
24	th	161	Enc11	204	SL1.dF
25	thS	162	Enc12	205	SL2.HF
26	O.Ld1	163	Enc13	206	SL2.tO
27	O.ht3	164	Enc14	207	SL2.Er
28	cL2	165	Enc15	208	SL2.nF
29	cL3	166	Enc16	209	SL2.dF
30	SCL	167	Enc17	210	SL3.HF
31	EEF	168 to 171	t168 to t171	211	SL3.tO
32	PH	172	C.SL1	212	SL3.Er
33	rS	173	C.SL2	213	SL3.nF
34	PAd	174	C.SL3	214	SL3.dF
35	CL.bit	175	C.Prod	215	SL.rtd
36	SAVE.Er	176	EnP.Er	216	t216
37	PSAVE.Er	177	C.boot	217 to 232	HF17 to HF232
38	t038	178	C.bUSY		
39	Reserved	179	C.Chg		
40 to 89	t040 to t089	180	C.OPtn		

The trips can be grouped into the following categories. It should be noted that a trip can only occur when the drive is not tripped or is already tripped but with a trip with a lower priority number.

Table 8-3 Trip categories

Priority	Category	Trips	Comments
1	Hardware faults	HF01 to HF16	These indicate serious internal problems and cannot be reset. The drive is inactive after one of these trips and the display shows **HFxx**. The Drive OK relay opens and the serial comms will not function.
2	Non-resetable trips	HF17 to HF32, SL1.HF, SL2.HF	Cannot be reset. Requires the drive to be powered down.
3	EEF trip	EEF	Cannot be reset unless a code to load defaults is first entered in Pr **xx.00** or Pr **11.43**.
4	SMARTCARD trips	C.boot, C.Busy, C.Chg, C.OPtn, C.RdO, C.Err, C.dat, C.FULL, C.Acc, C.rtg, C.TyP, C.cpr	Can be reset after 1.0s SMARTCARD trips have priority 5 during power-up
4	supply trips	PS.24V	Can be reset after 1.0s
5	Autotune	tunE, tunE1 to tunE7	Can be reset after 1.0s, but the drive cannot be made to run unless it is disabled via the SAFE TORQUE OFF input (terminal 31), *Drive enable* (Pr **6.15**) or the *Control word* (Pr **6.42** and Pr **6.43**).
5	Normal trips with extended reset	OI.AC, OI.Br, OIAC.P, OIBr.P, OIdC.P	Can be reset after 10.0s
5	Normal trips	All other trips not included in this table	Can be reset after 1.0s
5	Non-important trips	th, thS, Old1, cL2, cL3, SCL	If Pr **10.37** is 1 or 3 the drive will stop before tripping
5	Phase loss	PH	The drive attempts to stop before tripping
5	Drive over-heat based on thermal model	O.ht3	The drive attempts to stop before tripping, but if it does not stop within 10s the drive will automatically trip
6	Self-resetting trips	UV	Under voltage trip cannot be reset by the user, but is automatically reset by the drive when the supply voltage is with specification

Although the UV trip operates in a similar way to all other trips, all drive functions can still operate but the drive cannot be enabled. The following differences apply to the UV trip:

1. Power-down save user parameters are saved when UV trip is activated except when the main high voltage supply is not active (i.e. operating in Low Voltage DC Supply Mode, Pr **6.44** = 1).
2. The UV trip is self-resetting when the DC bus voltage rises above the drive restart voltage level. If another trip is active instead of UV at this point, the trip is not reset.
3. The drive can change between using the main high voltage supply and low voltage DC supply only when the drive is in the under voltage condition (Pr **10.16** = 1). The UV trip can only be seen as active if another trip is not active in the under voltage condition.
4. When the drive is first powered up a UV trip is initiated if the supply voltage is below the restart voltage level and another trip is not active. This does not cause save power down save parameters to be saved at this point.

8.1 Alarm indications

In any mode an alarm flashes alternately with the data displayed when one of the following conditions occur. If action is not taken to eliminate any alarm except "Autotune", "Lt" and "PLC" the drive may eventually trip. Alarms flash once every 640ms except "PLC" which flashes once every 10s. Alarms are not displayed when a parameter is being edited.

Table 8-4 Alarm indications

Lower display	Description
br.rS	Braking resistor overload
Braking resistor I^2t accumulator (Pr **10.39**) in the drive has reached 75.0% of the value at which the drive will trip and the braking IGBT is active.	
Hot	Heatsink or control board or inverter IGBT over temperature alarms are active
• The drive heatsink temperature has reached a threshold and the drive will trip O.ht2 if the temperature continues to rise (see the O.ht2 trip). Or • The ambient temperature around the control PCB is approaching the over temperature threshold (see the O.CtL trip).	
OVLd	Motor overload
The motor I^2t accumulator (Pr **4.19**) in the drive has reached 75% of the value at which the drive will be tripped and the load on the drive is >100%	
Auto tune	Autotune in progress
The autotune procedure has been initialised. 'Auto' and 'tunE' will flash alternatively on the display.	
Lt	Limit switch is active
Indicates that a limit switch is active and that it is causing the motor to be stopped (i.e. forward limit switch with forward reference etc.)	
PLC	Onboard PLC program is running
An Onboard PLC program is installed and running. The lower display will flash 'PLC' once every 10s.	

Drive cooling fan

The drive cooling fan is controlled by the temperature from monitoring points and other actions as follows:

If the "hot" alarm is active or the IGBT temperature (Pr **7.34**) is greater than the upper threshold then the fan will run at full speed. It will continue to run at full speed until the IGBT temperature is below the lower threshold. See the table below for the upper and lower thresholds.

Model	Upper threshold	Lower threshold
DST1201 to DST1204 DST1401 to DST1404	120 ºC	75 ºC
DST1405	145 ºC	90 ºC

If a Solutions Module indicates that it is too hot the fan runs at full speed. The fan will continue to run at full speed for 10 seconds after the Solutions Module has cooled down.

The fan can still be forced to run at full speed at all times if Pr **6.45** is set to one. The fan will continue to run at full speed for 10 seconds after Pr **6.45** has been set to zero.

For all other conditions the fan runs at low speed.

8.2 Status indications

Table 8-5 Status indications

Upper display	Description	Drive output stage
ACUU	AC Supply loss	Enabled
The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor.		
dc	DC applied to the motor	Enabled
The drive is applying DC injection braking.		
dEC	Decelerating	Enabled
The drive is decelerating the motor.		
inh	Inhibit	Disabled
The drive is inhibited and cannot be run. The drive enable signal is not applied to terminal 31 or Pr **6.15** is set to 0.		
POS	Positioning	Enabled
The drive is positioning/orientating the motor shaft.		
rdY	Ready	Disabled
The drive is ready to be run.		
run	Running	Enabled
The drive is running.		
SCAn	Scanning	Enabled
Regen> The drive is enabled and is synchronising to the line.		
StoP	Stop or holding zero speed	Enabled
The drive is holding zero speed.Regen> The drive is enabled but the AC voltage is too low, or the DC bus voltage is still rising or falling.		
triP	Trip condition	Disabled
The drive has tripped and is no longer controlling the motor. The trip code appears on the lower display.		

Table 8-6 Solutions Module and SMARTCARD status indications at power-up

Lower display	Description
boot	A parameter set is being transferred from the SMARTCARD to the drive during power-up. For further information, refer to the *User Guide*.
cArd	The drive is writing a parameter set to the SMARTCARD during power-up. For further information, refer to the *User Guide*.
loAding	The drive is writing information to a Solutions Module.

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