LEROY SOMER®

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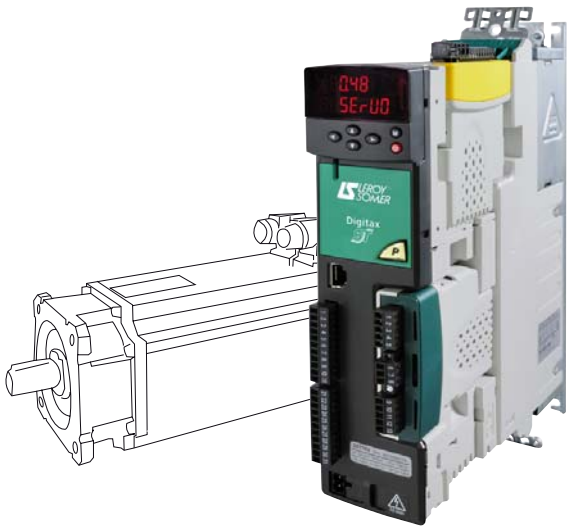
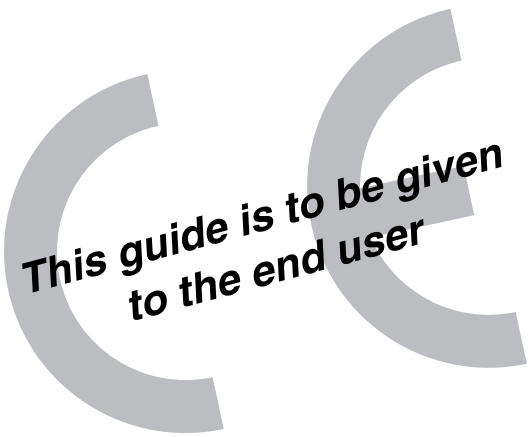
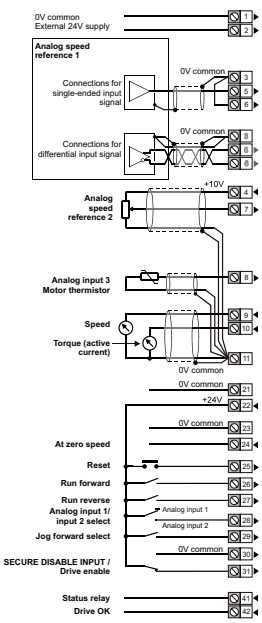



# Digitax ST

# Variable speed drive for servomotors

## Technical data guide

## 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.



## Drive software version

This product is supplied with the latest version of software. If this product is to be used in a new or existing system with other drives, there may be some differences between their software and the software in this product. These differences may cause this product to function differently. This may also apply to drives returned from a LEROY-SOMER Service Centre.

The software version of the drive can be checked by looking at Pr **11.29** (or Pr **0.50**) and Pr **11.34**. The software version takes the form of zz.yy.xx, where Pr **11.29** displays zz.yy and Pr **11.34** displays xx, i.e. for software version 01.01.00, Pr **11.29** would display 1.01 and Pr **11.34** would display 0.

If there is any doubt, contact LEROY-SOMER.

## Environmental statement

LEROY-SOMER 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.

The electronic variable-speed drives manufactured by LEROY-SOMER 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 can very easily be dismantled into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, while other parts are secured with conventional screws. Virtually all parts of the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Large products are packed in wooden crates, while smaller products come in strong cardboard cartons which themselves have a high recycled fibre content. If not re-used, these containers can be recycled. Polythene, used on the protective film and bags for wrapping product, can be recycled in the same way. LEROY-Somer's packaging strategy favours easily-recyclable materials of low environmental impact, and regular reviews identify opportunities for improvement.

When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

# Contents

# 1 Introduction

Three different configurations of the Digitax ST servo drive are available:

- Digitax ST Base
- Digitax ST Indexer
- Digitax ST Plus

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.

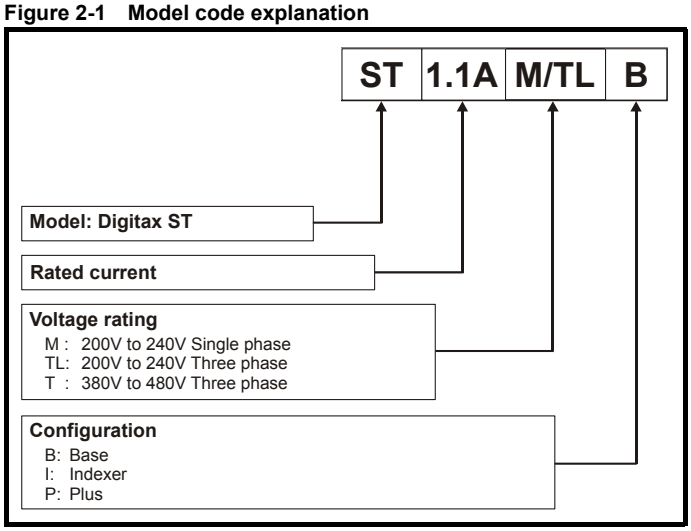
The Digitax ST Plus drive offers the option of executing complex movements on a single axis or synchronised movements in relation to a reference axis. It also offers synchronisation and electronic cam functions with management of the virtual master.

All configurations offer a SECURE DISABLE INPUT function . (Refer to the *Installation guide*, paragraph 1)

# 2 Product ratings

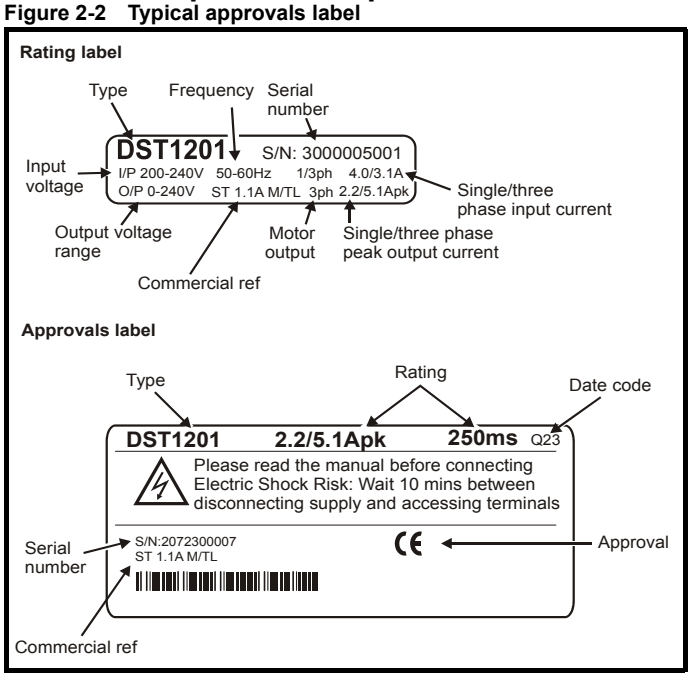
## 2.1 Model number

**Figure 2-1 Model code explanation**




## 2.2 Nameplate description

**Figure 2-2 Typical approvals 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 | |
|---|---|---|---|---|---|
| | | 1ph | 3ph | 1ph | 3ph |
| ST 1.1A M/TL | 1 or 3 | 1.1 | 1.7 | 2.2 | 5.1 |
| ST 2.4A M/TL | 1 or 3 | 2.4 | 3.8 | 4.8 | 11.4 |
| ST 2.9A M/TL | 1 or 3 | 2.9 | 5.4 | 5.8 | 16.2 |
| ST 4.7A M/TL | 1 or 3 | 4.7 | 7.6 | 9.4 | 22.8 |
| ST 1.5A T | 3 | | 1.5 | | 4.5 |
| ST 2.7A T | 3 | | 2.7 | | 8.1 |
| ST 4.0A T | 3 | | 4.0 | | 12.0 |
| ST 5.9 A T | 3 | | 5.9 | | 17.7 |
| ST 8.0A T | 3 | | 8.0 | | 24.0 |

The rating information shown in section 2.4 *Typical pulse duty* 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 stated in Table 2-12 on page 9
- DC bus voltage = 565V for ST X.XA T
- DC bus voltage = 325V for ST X.XA M/TL

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* .

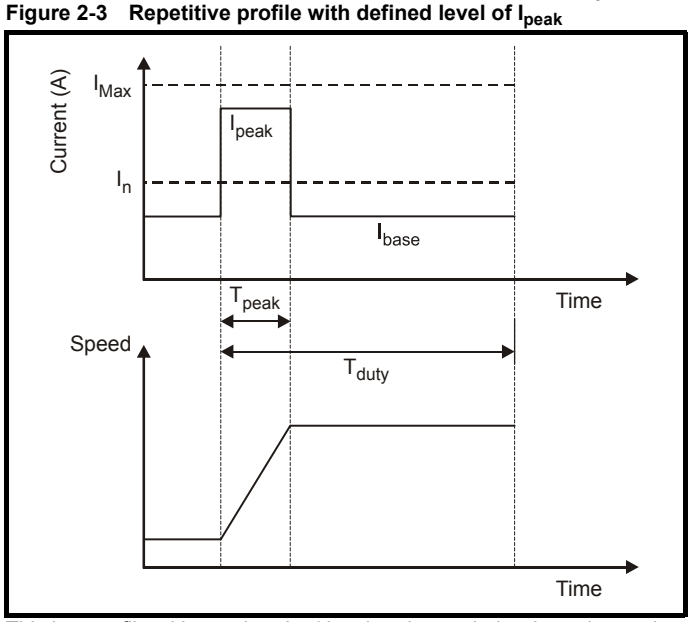
## 2.4 Typical pulse duty

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 ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.9 | 8.9 | 5.9 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 6.5 | 12.0 | 6.8 | 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 ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 4.4 | 8.9 | 4.4 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 1.8 | 12.0 | 3.2 | 14.0 | 6.9 | 16.0 | 7.0 | 20.0 | 7.3 | 24.0 |

**Table 2-4 Repetitive profile with defined level of $I_{peak}$ at 6kHz switching frequency, ≤240Vac supply for ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

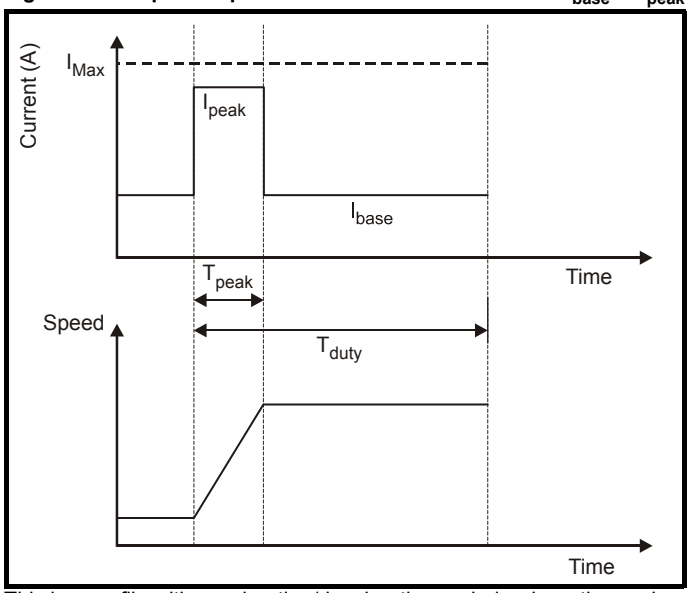
| Model | $I_n$ | Overloads | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.5 x $I_n$ for 60s | | 1.75 x $I_n$ for 40s | | 2.0 x $I_n$ for 10s | | 2.5 x $I_n$ for 2s | | 3.0 x $I_n$ for 0.25s | |
| | | $I_{base}$ | $I_{peak}$ | $I_{base}$ | $I_{peak}$ | $I_{base}$ | $I_{peak}$ | $I_{base}$ | $I_{peak}$ | $I_{base}$ | $I_{peak}$ |
| | A | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.9 | 8.9 | 5.9 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 5.5 | 12.0 | 5.8 | 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 ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 3.6 | 8.9 | 3.6 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.6 | 17.7 |
| ST 8.0A T | 8.0 | 1.3 | 12.0 | 2.5 | 14.0 | 5.8 | 16.0 | 6.2 | 20.0 | 6.1 | 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 ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.9 | 8.9 | 5.9 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 7.6 | 11.4 | 7.6 | 13.3 | 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 ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.6 | 8.4 | 5.6 | 9.8 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 6.0 | 9.0 | 6.0 | 10.5 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |

**Table 2-8 Repetitive profile with defined ratio between $I_{base}$ to $I_{peak}$ at 6kHz switching frequency, ≤240Vac supply for ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.9 | 8.9 | 5.9 | 10.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 7.2 | 10.8 | 7.2 | 12.6 | 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 ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

| 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 | | | | | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | 2.6 | 1.7 | 3.0 | 1.7 | 3.4 | 1.7 | 4.3 | 1.7 | 5.1 |
| ST 2.4A M/TL | 3.8 | 3.8 | 5.7 | 3.8 | 6.7 | 3.8 | 7.6 | 3.8 | 9.5 | 3.8 | 11.4 |
| ST 2.9A M/TL | 5.4 | 5.4 | 8.1 | 5.4 | 9.5 | 5.4 | 10.8 | 5.4 | 13.5 | 5.4 | 16.2 |
| ST 4.7A M/TL | 7.6 | 7.6 | 11.4 | 7.6 | 13.3 | 7.6 | 15.2 | 7.6 | 19.0 | 7.6 | 22.8 |
| ST 1.5A T | 1.5 | 1.5 | 2.3 | 1.5 | 2.6 | 1.5 | 3.0 | 1.5 | 3.8 | 1.5 | 4.5 |
| ST 2.7A T | 2.7 | 2.7 | 4.1 | 2.7 | 4.7 | 2.7 | 5.4 | 2.7 | 6.8 | 2.7 | 8.1 |
| ST 4.0A T | 4.0 | 4.0 | 6.0 | 4.0 | 7.0 | 4.0 | 8.0 | 4.0 | 10.0 | 4.0 | 12.0 |
| ST 5.9A T | 5.9 | 5.3 | 8.0 | 5.3 | 9.3 | 5.9 | 11.8 | 5.9 | 14.8 | 5.9 | 17.7 |
| ST 8.0A T | 8.0 | 5.6 | 8.4 | 5.6 | 9.8 | 6.4 | 12.8 | 6.8 | 17.0 | 6.8 | 20.4 |

## 2.5 Continuous rating

**Table 2-10 Continuous rating with no overload, ≤230Vac supply for ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| Model | $I_n$ | 6kHz | | 8kHz | | 12kHz | |
|---|---|---|---|---|---|---|---|
| | | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz |
| | A | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | | | | | |
| ST 2.4A M/TL | 3.8 | 3.8 | | | | | |
| ST 2.9A M/TL | 5.4 | 5.4 | | | | | |
| ST 4.7A M/TL | 7.6 | 7.6 | | | | | |
| ST 1.5A T | 1.5 | 1.5 | | | | | |
| ST 2.7A T | 2.7 | 2.7 | | | | | |
| ST 4.0A T | 4.0 | 4.0 | | | | | 3.8 |
| ST 5.9A T | 5.9 | 5.9 | | | 5.0 | 5.9 | 3.1 |
| ST 8.0A T | 8.0 | 8.0 | 6.0 | 8.0 | 4.6 | 5.8 | 2.8 |

**Table 2-11 Continuous rating with no overload, ≤240Vac supply for ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

| Model | $I_n$ | 6kHz | | 8kHz | | 12kHz | |
|---|---|---|---|---|---|---|---|
| | | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz | $I_{cont}$ at 0Hz | $I_{cont}$ at 150Hz |
| | A | | | | | | |
| ST 1.1A M/TL | 1.7 | 1.7 | | | | | |
| ST 2.4A M/TL | 3.8 | 3.8 | | | | | |
| ST 2.9A M/TL | 5.4 | 5.4 | | | | | |
| ST 4.7A M/TL | 7.6 | 7.6 | | | | | |
| ST 1.5A T | 1.5 | 1.5 | | | | | |
| ST 2.7A T | 2.7 | 2.7 | | | | | |
| ST 4.0A T | 4.0 | 4.0 | | | | | 3.0 |
| ST 5.9A T | 5.9 | 5.9 | 5.4 | 5.9 | 4.2 | 4.7 | 2.3 |
| ST 8.0A T | 8.0 | 8.0 | 5.0 | 7.3 | 3.8 | 4.7 | 2.2 |

**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 ST X.XA M/TL and ≤400Vac supply for ST X.XA T**

| Model | No. of Input phases | Power at supply voltage | |
|---|---|---|---|
| | | Without line reactor | With line reactor |
| | | kW | kW |
| ST 1.1A M/TL | 1 | 0.329 | |
| ST 2.4A M/TL | 1 | 0.714 | |
| ST 2.9A M/TL | 1 | 0.864 | |
| ST 4.7A M/TL | 1 | 1.391 | |
| ST 1.1A M/TL | 3 | 0.51 | |
| ST 2.4A M/TL | 3 | 1.13 | |
| ST 2.9A M/TL | 3 | 1.61 | |
| ST 4.7A M/TL | 3 | 1.77 | 1.98 |
| ST 1.5A T | 3 | 0.77 | |
| ST 2.7A T | 3 | 1.36 | |
| ST 4.0A T | 3 | 2.04 | |
| ST 5.9A T | 3 | 2.93 | 2.99 |
| ST 8.0A T | 3 | 2.77 | 3.05 |

**Table 2-13 Maximum rectifier power, ≤240Vac supply for ST X.XA M/TL and ≤480Vac supply for ST X.XA T**

| Model | No. of Input phases | Power at supply voltage | |
|---|---|---|---|
| | | Without line reactor | With line reactor |
| | | kW | kW |
| ST 1.1A M/TL | 1 | 0.394 | |
| ST 2.4A M/TL | 1 | 0.857 | |
| ST 2.9A M/TL | 1 | 1.03 | |
| ST 4.7A M/TL | 1 | 1.66 | |
| ST 1.1A M/TL | 3 | 0.609 | |
| ST 2.4A M/TL | 3 | 1.35 | |
| ST 2.9A M/TL | 3 | 1.92 | |
| ST 4.7A M/TL | 3 | 2.12 | 2.38 |
| ST 1.5A T | 3 | 0.924 | |
| ST 2.7A T | 3 | 1.63 | |
| ST 4.0A T | 3 | 2.44 | |
| ST 5.9A T | 3 | 3.51 | 3.58 |
| ST 8.0A T | 3 | 3.32 | 3.65 |

The sizing tool should be used to select a drive for conditions not given in this manual.

### 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, the ST 2.9A M/TL, ST 4.7A M/TL, ST 4.0A T, ST 5.9A T and ST 8.0A T need to have an input impedance of 2%.

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**

| Model | Internal DC bus capacitance | Additional capacitance which can be connected |
|---|---|---|
| | µF | µF |
| ST 1.1A M/TL | 440 | 2640 |
| ST 2.4A M/TL | 880 | 3960 |
| ST 2.9A M/TL | 880 | 3080 |
| ST 4.7A M/TL | 1320 | 2640 |
| ST 1.5A T | 220 | 440 |
| ST 2.7A T | 220 | 1100 |
| ST 4.0A T | 220 | 1320 |
| ST 5.9A T | 220 | 1320 |
| ST 8.0A T | 220 | 1320 |

## 2.7 Maximum drive losses

**Table 2-15 Maximum drive losses**

| Model | 6kHz | 8kHz | 12kHz |
|---|---|---|---|
| | W | W | W |
| ST 1.1A M/TL | 64 | 65 | 69 |
| ST 2.4A M/TL | 79 | 82 | 88 |
| ST 2.9A M/TL | 102 | 109 | 122 |
| ST 4.7A M/TL | 107 | 110 | 118 |
| ST 1.5A T | 79 | 87 | 101 |
| ST 2.7A T | 77 | 81 | 90 |
| ST 4.0A T | 124 | 142 | 177 |
| ST 5.9A T | 127 | 143 | 175 |
| ST 8.0A T | 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 |
| ST 1.1A M/TL | 0.75 | 24 | 50 | | |
| ST 2.4A M/TL | | 22 | | | |
| ST 2.9A M/TL | | 20 | | | |
| ST 4.7A M/TL | | 18 | | | |
| ST 1.5A T | | 24 | | | |
| ST 2.7A T | | | | | |
| ST 4.0A T | | 22 | | | |
| ST 5.9A T | | 20 | | | |
| ST 8.0A T | | 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.

The terminals are designed for a maximum cable size of $4.0mm^2$ (minimum 26 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.

## 2.9 Braking

**Table 2-17 Internal braking resistor data**

| Parameter | | |
|---|---|---|
| Part number | 1299-0001-00 | |
| 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 | |

**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 |
|---|---|---|---|---|
| ST 1.1A M/TL | 23 | 6.6 | 0.5 | 1.6 |
| ST 2.4A M/TL | | | 1.2 | 3.5 |
| ST 2.9A M/TL | | | 1.6 | 4.9 |
| ST 4.7A M/TL | 16 | 9.3 | 2.3 | 7.0 |
| ST 1.5A T | 111 | 5.5 | 0.8 | 2.3 |
| ST 2.7A T | | | 1.4 | 4.1 |
| ST 4.0A T | 75 | 8.1 | 2.0 | 6.1 |
| ST 5.9A T | 28 | 21.7 | 3.0 | 9.0 |
| ST 8.0A T | | | 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 |
|---|---|---|---|
| ST 1.1A M/TL | 1 | | 3.1 |
| ST 2.4A M/TL | 1 | | 6.4 |
| ST 2.9A M/TL | 1 | | 8.6 |
| ST 4.7A M/TL | 1 | | 11.8 |
| ST 1.1A M/TL | 3 | 3.1 | 3.5 |
| ST 2.4A M/TL | 3 | 6.4 | 7.3 |
| ST 2.9A M/TL | 3 | 8.6 | 9.4 |
| ST 4.7A M/TL | 3 | 11.8 | 13.4 |
| ST 1.5A T | 3 | 2.6 | 2.8 |
| ST 2.7A T | 3 | 4.2 | 4.3 |
| ST 4.0A T | 3 | 5.9 | 6.0 |
| ST 5.9A T | 3 | 7.9 | 8.0 |
| ST 8.0A T | 3 | 9.9 | 9.9 |

### 2.10.1 Supply requirements

**Table 2-20 Supply requirements**

| Model | Voltage | Frequency range |
|---|---|---|
| ST X.XA M/TL | 200V to 240V ±10% single phase | 48Hz to 65Hz |
| ST X.XA M/TL | 200V to 240V ±10% three phase* | 48Hz to 65Hz |
| ST X.XA T | 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 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

## 2.11 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 2-21.

**Table 2-21 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 2-22.

**Table 2-22 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 2-23 High voltage DC levels**

| Condition | ST X.XA M/TL<br>V | ST X.XA T<br>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**

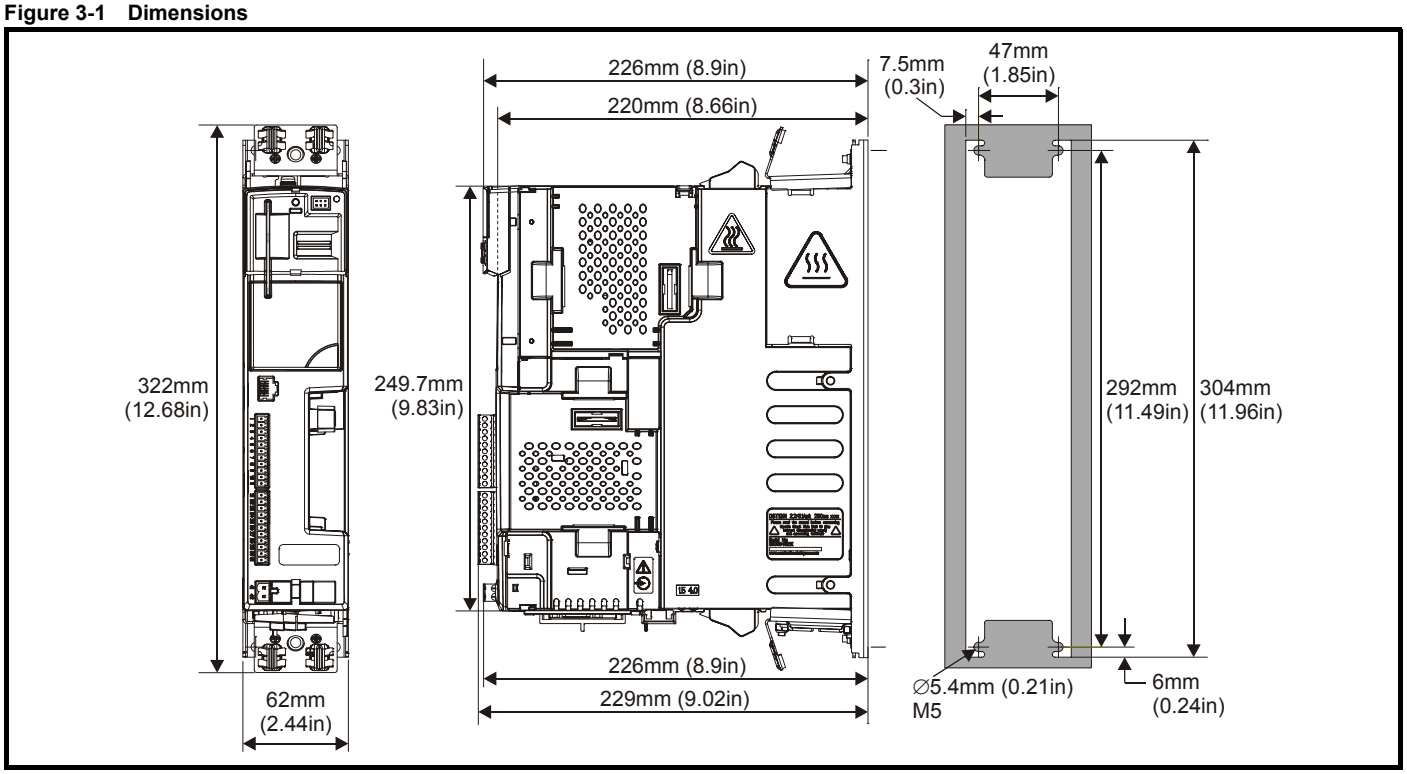
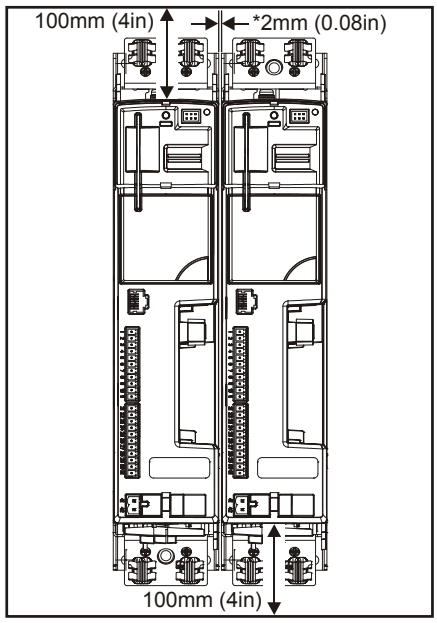



**Table 3-1 Torque settings**

| 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) |

*Torque tolerance = 10%

**Figure 3-2 Minimum mounting clearances**

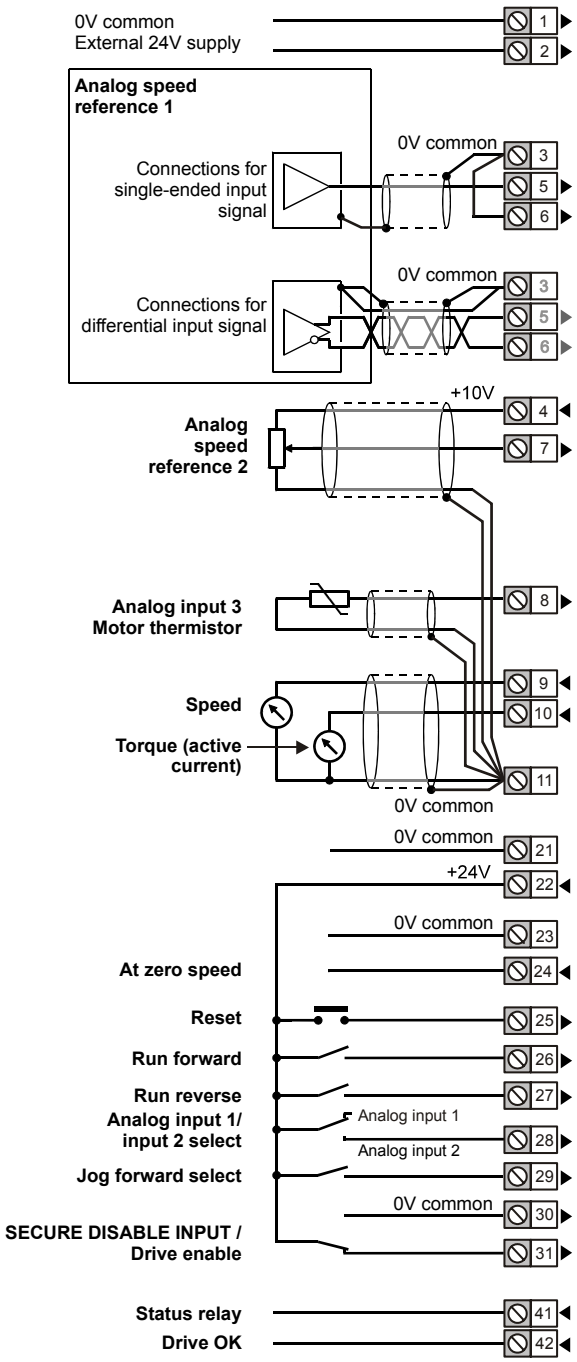



*2mm clearance between drives to allow for mechanical tolerance.

# 4 I/O Specification

## 4.1 Control terminals

**Figure 4-1 Default terminal functions**

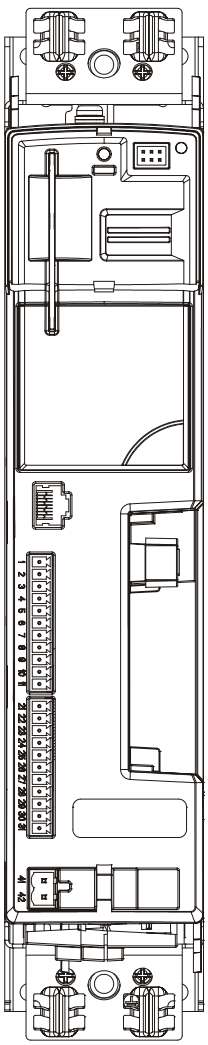



**Connectors specification:**
Maximum size of control connections cable = 1.5mm$^2$ (16AWG)

Torque setting = 0.2 N m (1.8 lb in)

Status relay cable = 2.5mm$^2$(12AWG)

Torque setting = 0.5 N m (4.4 lb in)



| 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%<br>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 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 | 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 | SECURE DISABLE INPUT/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<br>Maximum: 20ms |

The drive enable terminal (T31) provides a SECURE DISABLE INPUT function. The SECURE DISABLE INPUT function meets the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive. It may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity.

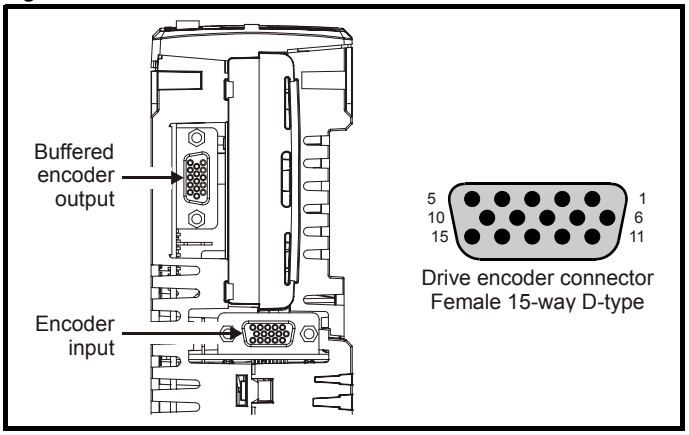
| 41<br>42 | Relay contacts |
|---|---|
| **Default function** | **Drive OK indicator** |
| Contact voltage rating | 240Vac, Installation over-voltage category II |
| Contact maximum current rating | 2A AC 240V<br>4A DC 30V resistive load<br>0.5A DC 30V inductive load (L/R = 40ms) |
| Contact minimum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

**WARNING**

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<br>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)<br>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)<br>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

**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**

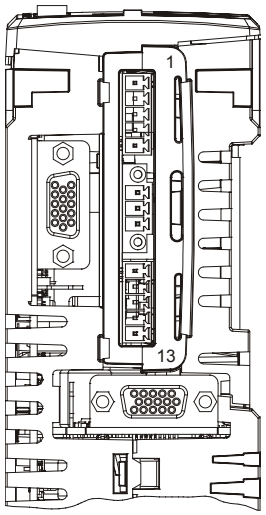



**Table 4-6 Digitax ST Plus connector details**

| Terminal | Function | Description |
|---|---|---|
| 1 | 0V SC | 0V connection for EIA-RS485 port |
| 2 | RX\ | EIA-RS485 negative receive line (Input) |
| 3 | RX | EIA-RS485 positive receive line (Input) |
| 4 | TX\ | EIA-RS485 negative transmit line (Output) |
| 5 | TX | EIA-RS485 positive transmit line (Output) |
| 6 | Channel A | CTNet |
| 7 | Shielded | Connection of shielding via CTNet |
| 8 | Channel B | CTNet |
| 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 |

## 4.3 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 4-4 Location of the RJ45 serial comms connector**

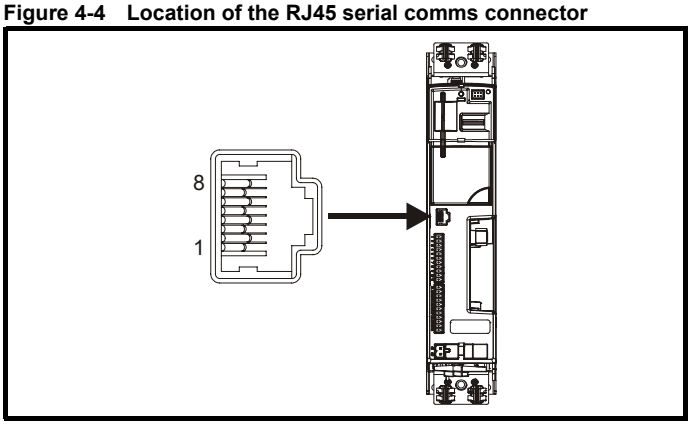



**Table 4-7 Connection details for RJ45 connector**

| 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 |
|---|---|
| CT -COMMS Cable | Double insulated RS232/RS485 Cable |
| USB/485 Converter | USB/RS484 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.

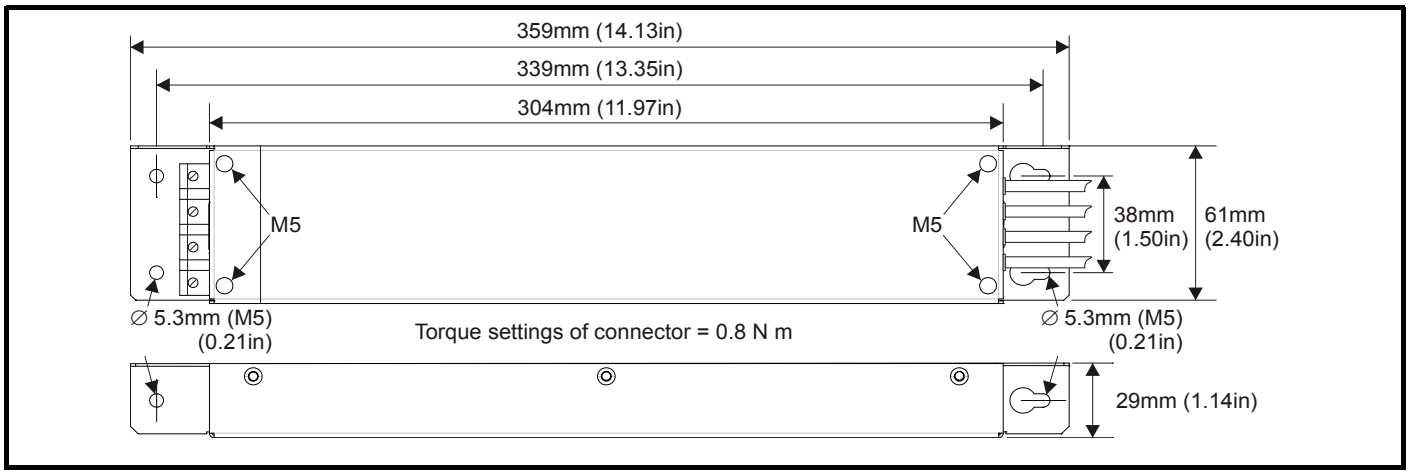
# 5 EMC filters

## 5.1 External EMC filter rating

**Table 5-1 External EMC filter ratings**

| Used with | Number of phases | Filter part number | Power losses at rated current | IP rating | Weight | | Operational leakage current | Worst case leakage current | Filter terminal tightening torque | | Filter current rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | W | | Kg | lb | mA | mA | Nm | lb ft | A |
| ST X.XA M/TL | 1 | FS23072-19-07 | 11 | 20 | 1.2 | 2.64 | 29.48 | 56.85 | 0.8 | 0.6 | 19 |
| ST X.XA M/TL | 3 | FS23073-17-07 | 13 | 20 | 1.2 | 2.64 | 8 | 50 | 0.8 | 0.6 | 17 |
| ST X.XA T | 3 | FS23074-11-07 | 10 | 20 | 1.2 | 2.64 | 16 | 90 | 0.8 | 0.6 | 11 |

**Figure 5-1 External EMC filter dimensions**




## 5.2 Internal and external conducted emissions conformity

**Table 5-2 Conformity with internal filter**

| Used with | No of phases | Motor cable length | Filter and switching frequency | | |
|---|---|---|---|---|---|
| | | | Internal | | |
| | | m | 6kHz | 8kHz | 12kHz |
| ST X.XA M/TL | 1 | | | | |
| ST X.XA M/TL | 1 | | | | |
| ST X.XA M/TL | 3 | 0 to 7 | E2U | E2U | E2U |
| ST X.XA M/TL | 3 | 7 to 9 | E2U | E2U | E2R |
| ST X.XA M/TL | 3 | 9 to 50 | E2R | E2R | E2R |
| ST X.XA T | 3 | 0 to 6 | E2U | E2R | E2R |
| ST X.XA T | 3 | 6 to 50 | E2R | E2R | E2R |

**Table 5-3 Conformity with external filter**

| Used with | No of phases | Motor cable length | Filter and switching frequency | | |
|---|---|---|---|---|---|
| | | | External | | |
| | | m | 6kHz | 8kHz | 12kHz |
| All | 1 or 3 | 0 to 20 | R | I | I |
| All | 1 or 3 | 20 to 50 | I | I | I |

**Key to Table 5-2 and Table 5-3**

(shown in decreasing order of permitted emission level):

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

E2U EN 61800-3 second environment, unrestricted distribution

I Industrial generic standard EN 50081-2 (EN 61000-6-4) EN 61800-3 first environment restricted distribution (The following caution is required by EN 61800-3)

**CAUTION** 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 50081-1 (EN 61000-6-3) EN 61800-3 first environment unrestricted distribution

EN 61800-3 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.

**NOTE**

Where the drive is incorporated into a system with rated input current exceeding 100A, the higher emission limits of EN 61800-3 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 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**<br>Feedback interface for the following devices:<br>**Inputs**<br>• Incremental encoders<br>• SinCos encoders<br>• SSI encoders<br>• EnDat encoders<br>**Outputs**<br>• Quadrature<br>• Frequency and direction<br>• SSI simulated outputs |
| |  | Light Blue | SM-Resolver | **Resolver interface**<br>Feedback interface for resolvers.<br>Simulated quadrature encoder outputs |
| |  | Brown | SM-Encoder Plus | **Incremental encoder interface**<br>Feedback interface for incremental encoders without commutation signals.<br>No simulated encoder outputs available |
| |  | N/A | 15-way D-type converter | **Drive encoder input converter**<br>Provides screw terminal interface for encoder wiring and spade terminal for shield |
| Automation (I/O Expansion) |  | Yellow | SM-I/O Plus | **Extended I/O interface**<br>Increases the I/O capability by adding the following to the existing I/O in the drive:<br>• Digital inputs x 3<br>• Digital I/O x 3<br>• Analog inputs (voltage) x 2<br>• Analog output (voltage) x 1<br>• Relay x 2 |
| |  | Yellow | SM-I/O 32 | **Extended I/O interface**<br>Increase the I/O capability by adding the following to the existing I/O in the drive:<br>• High speed digital I/O x 32<br>• +24V output |
| |  | Dark Yellow | SM-I/O Lite | **Additional I/O**<br>1 x Analog input (±10V bi-polar or current modes)<br>1 x Analog output (0-10V or current modes)<br>3 x Digital input and 1 x Relay |
| |  | Dark Red | SM-I/O Timer | **Additional I/O with real time clock**<br>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**<br>For chemical industry applications<br>1 x Analog input (current modes)<br>2 x Analog outputs (current modes)<br>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**<br>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**<br>2 x Analog outputs (current modes)<br>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 |
|---|---|---|---|---|
| Fieldbus |  | Purple | SM-PROFIBUS-DP | **Profibus option**<br>PROFIBUS DP adapter for communications with the drive |
| |  | Medium Grey | SM-DeviceNet | **DeviceNet option**<br>Devicenet adapter for communications with the drive |
| |  | Dark Grey | SM-INTERBUS | **Interbus option**<br>Interbus adapter for communications with the drive |
| |  | Pink | SM-CAN | **CAN option**<br>CAN adapter for communications with the drive |
| |  | Light Grey | SM-CANopen | **CANopen option**<br>CANopen adapter for communications with the drive |
| |  | Red | SM-SERCOS | **SERCOS option**<br>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**<br>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**<br>LonWorks adapter for communications with the drive |

**Table 6-2 Keypad identification**

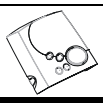
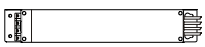
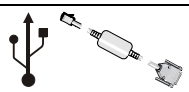
| Type | Keypad | Name | Further Details |
|---|---|---|---|
| Keypad |  | Digitax ST Keypad | **LED keypad option**<br>Keypad with a LED display |
| |  | SM-Keypad Plus | **Remote keypad option**<br>Keypad with an alpha-numeric LCD display with Help function |

**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)<br>Output current derating must be applied at ambient temperatures >40°C (104°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 |
| **Altitude** | Altitude range: 0 to 3,000m (9,900 ft), subject to the following conditions:<br>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)<br>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**<br>Testing in each of three mutually perpendicular axes in turn.<br>Referenced standard: IEC 60068-2-29: Test Eb:<br>Severity: 18g, 6ms, half sine<br>No. of Bumps: 600 (100 in each direction of each axis)<br>**Random Vibration Test**<br>Testing in each of three mutually perpendicular axes in turn.<br>Referenced standard: IEC 60068-2-64: Test Fh:<br>Severity: 1.0 $m^2/s^3$ (0.01 $g^2/Hz$) ASD from 5 - 20 Hz<br>-3 dB/octave from 20 to 200 Hz<br>Duration: 30 minutes in each of 3 mutually perpendicular axes<br>**Sinusoidal Vibration Test**<br>Testing in each of three mutually perpendicular axes in turn.<br>Referenced standard: IEC 60068-2-6: Test Fc:<br>Frequency range: 2* to 500 Hz<br>Severity: 3.5 mm peak displacement from 2* to 9 Hz<br>10 $m/s^2$ peak acceleration from 9 to 200 Hz<br>15 $m/s^2$ peak acceleration from 200 to 500 Hz<br>Sweep rate: 1 octave/minute<br>Duration: 15 minutes in each of 3 mutually perpendicular axes<br>* or lowest achievable on an electromagnetic shaker |
| **Speed resolution** | Preset speed reference: 0.1rpm<br>Precision speed reference: 0.001rpm<br>Analog input 1: 16bit plus sign<br>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** | 60 starts per hour 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<br>Fan at low speed: 53dB |
| **Toxic materials** | Digitax ST meets EU directive 2002-95-EC (RoHS compliance) |

# 8 Diagnostics

**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 Leroy Somer distributor for repair.

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

**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.<br>If a brake resistor is installed:<br>Ensure that the braking resistor thermistor is connected correctly<br>Ensure that the fan in the drive is working correctly<br>Replace the braking resistor |
| **C.Acc** | **SMARTCARD trip: SMARTCARD Read / Write fail** |
| **185** | Check SMARTCARD is installed / located correctly<br>Ensure SMARTCARD is not writing data to data location 500 to 999<br>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<br>Ensure that Pr **11.42** is correctly set and reset the drive to create the necessary file on the SMARTCARD<br>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<br>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<br>Erase data and retry<br>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<br>Ensure Solutions Modules are in the same Solutions Module slot<br>Press the red reset button |

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>C.Prod</td><td>SMARTCARD trip: The data blocks on the SMARTCARD are not compatible with this product</td></tr>
<tr><td>175</td><td>Erase all data on the SMARTCARD by setting Pr xx.00 to 9999 and pressing the red reset button<br>Replace SMARTCARD</td></tr>
<tr><td>C.rdo</td><td>SMARTCARD trip: SMARTCARD has the Read Only bit set</td></tr>
<tr><td>181</td><td>Enter 9777 in Pr xx.00 to allow SMARTCARD Read / Write access<br>Ensure card is not writing to data locations 500 to 999</td></tr>
<tr><td>C.rtg</td><td>SMARTCARD trip: The voltage and/or current rating of the source and destination drives are different</td></tr>
<tr><td>186</td><td>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.<br>Press the red reset button<br>Drive rating parameters are:
<table>
<tr><th>Parameter</th><th>Function</th></tr>
<tr><td>2.08</td><td>Standard ramp voltage</td></tr>
<tr><td>4.05/6/7, 21.27/8/9</td><td>Current limits</td></tr>
<tr><td>4.24</td><td>User current maximum scaling</td></tr>
<tr><td>5.07, 21.07</td><td>Motor rated current</td></tr>
<tr><td>5.09, 21.09</td><td>Motor rated voltage</td></tr>
<tr><td>5.17, 21.12</td><td>Stator resistance</td></tr>
<tr><td>5.18</td><td>Switching frequency</td></tr>
<tr><td>5.23, 21.13</td><td>Voltage offset</td></tr>
<tr><td>5.24, 21.14</td><td>Transient inductance</td></tr>
<tr><td>6.48</td><td>Line power supply loss ride through detection level</td></tr>
</table>
The above parameters will be set to their default values.</td></tr>
<tr><td>C.TyP</td><td>SMARTCARD trip: SMARTCARD parameter set not compatible with drive</td></tr>
<tr><td>187</td><td>Press the reset button<br>Ensure destination drive type is the same as the source parameter file drive type</td></tr>
<tr><td>dESt</td><td>Two or more parameters are writing to the same destination parameter</td></tr>
<tr><td>199</td><td>Set Pr xx.00 = 12001 check all visible parameters in the menus for duplication</td></tr>
<tr><td>EEF</td><td>EEPROM data corrupted - Drive mode becomes open loop and serial comms will timeout with remote keypad on the drive RS485 comms port.</td></tr>
<tr><td>31</td><td>This trip can only be cleared by loading default parameters and saving parameters</td></tr>
<tr><td>Enc1</td><td>Drive encoder trip: Encoder power supply overload</td></tr>
<tr><td>189</td><td>Check encoder power supply wiring and encoder current requirement<br>Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V</td></tr>
<tr><td>Enc2</td><td>Drive encoder trip: Wire break (Drive encoder terminals 1 & 2, 3 & 4, 5 & 6)</td></tr>
<tr><td>190</td><td>Check cable continuity<br>Check wiring of feedback signals is correct<br>Check encoder power is set correctly<br>Replace feedback device<br>If wire break detection on the main drive encoder input is not required, set Pr 3.40 = 0 to disable the Enc2 trip</td></tr>
<tr><td>Enc3</td><td>Drive encoder trip: Phase offset incorrect While running</td></tr>
<tr><td>191</td><td>Check the encoder signal for noise<br>Check encoder shielding<br>Check the integrity of the encoder mechanical mounting<br>Repeat the offset measurement test</td></tr>
<tr><td>Enc4</td><td>Drive encoder trip: Feedback device comms failure</td></tr>
<tr><td>192</td><td>Ensure encoder power supply is correct<br>Ensure baud rate is correct<br>Check encoder wiring<br>Replace feedback device</td></tr>
<tr><td>Enc5</td><td>Drive encoder trip: Checksum or CRC error</td></tr>
<tr><td>193</td><td>Check the encoder signal for noise<br>Check the encoder cable shielding<br>With EnDat encoders, check the comms resolution and/or carry out the auto-configuration Pr 3.41</td></tr>
</table>

| Trip | Diagnosis |
|---|---|
| **Enc6** | **Drive encoder trip: Encoder has indicated an error** |
| **194** | Replace feedback device<br>With SSI encoders, check the wiring and encoder supply setting |
| **Enc7** | **Drive encoder trip: Initialisation failed** |
| **195** | Re-set the drive<br>Check the correct encoder type is entered into Pr **3.38**<br>Check encoder wiring<br>Check encoder power supply is set correctly<br>Carry out the auto-configuration Pr **3.41**<br>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**)<br>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: Servo mode phasing failure because encoder phase angle (Pr 3.25 or Pr 21.20) is incorrect** |
| **198** | Check the encoder wiring.<br>Perform an autotune to measure the encoder phase angle or manually enter the correct phase angle into Pr **3.25** (or Pr **21.20**).<br>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.<br>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.<br>Check encoder wiring.<br>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.<br>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<br>i.e. Pr **5.36** = 0 or Pr **21.31** = 0.<br>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.<br>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.<br>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<br>Check value of Pr **10.32**<br>Enter 12001 in Pr **xx.00** and check for parameter controlling Pr **10.32**<br>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<br>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<br>Tune the rated speed parameter<br>Check feedback device signal for noise<br>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<br>Increase the power rating of the braking resistor and change Pr **10.30** and Pr **10.31**<br>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 |
| **L.SYnC** | **Drive failed to synchronize to the supply voltage in Regen mode** |
| | |
| **O.CtL** | **Drive control board over temperature** |
| **23** | Check enclosure / drive fans are still functioning correctly<br>Check enclosure ventilation paths<br>Check enclosure door filters<br>Check ambient temperature<br>Reduce drive switching frequency |
| **O.ht1** | **Power device over temperature based on thermal model** |
| **21** | Reduce drive switching frequency<br>Reduce duty cycle<br>Decrease acceleration / deceleration rates<br>Reduce motor load |
| **O.ht2** | **Heatsink over temperature** |
| **22** | Check enclosure / drive fans are still functioning correctly<br>Check enclosure ventilation paths<br>Check enclosure door filters<br>Increase ventilation<br>Decrease acceleration / deceleration rates<br>Reduce drive switching frequency<br>Reduce duty cycle<br>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.<br>Check enclosure / drive fans are still functioning correctly<br>Check enclosure ventilation paths<br>Check enclosure door filters<br>Increase ventilation<br>Decrease acceleration / deceleration rates<br>Reduce duty cycle<br>Reduce motor load |

| Trip | Diagnosis |
|---|---|
| **OI.AC** | **Instantaneous output over current detected** |
| **3** | Acceleration /deceleration rate is too short.<br>If seen during autotune reduce voltage boost Pr **5.15**<br>Check for short circuit on output cabling<br>Check integrity of motor insulation<br>Check feedback device wiring<br>Check feedback device mechanical coupling<br>Check feedback signals are free from noise<br>Is motor cable length within limits<br>Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12**<br>Has offset measurement test been completed?<br>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<br>Check braking resistor value is greater than or equal to the minimum resistance value<br>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**<br>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**)<br>Decrease braking resistor value (staying above the minimum value)<br>Check nominal AC supply level<br>Check for supply disturbances which could cause the DC bus to rise – voltage overshoot after supply recovery from a notch induced by DC drives.<br>Check motor insulation<br>**Drive voltage rating** / **Peak voltage** / **Maximum continuous voltage level (15s)**<br>200 / 415 / 400<br>400 / 830 / 800<br>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<br>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<br>Check input voltage levels are correct (at full load)<br>**NOTE**<br>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<br>Hardware fault - return drive to supplier |
| **PS.10V** | **10V user power supply current greater than 10mA** |
| **8** | Check wiring to terminal 4<br>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.<br>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.<br>• Reduce load and reset<br>• Provide an external 24V >50W power supply<br>• 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.<br>The drive will revert back to the power down parameter set that was last saved successfully.<br>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 |
|---|---|
| **SAVE.Er** | **User save parameters in the EEPROM are corrupt** |
| **36** | Indicates that the power was removed when user parameters were being saved.<br>The drive will revert back to the user parameter set that was last saved successfully.<br>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<br>Check cable for damage<br>Replace cable<br>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<br>Check wiring of feedback signals is correct<br>Check supply voltage or excitation output level<br>Replace feedback device |
| 3 | SM-Universal Encoder Plus | Phase offset incorrect while running | Check the encoder signal for noise<br>Check encoder shielding<br>Check the integrity of the encoder mechanical mounting<br>Repeat the offset measurement test |
| 4 | SM-Universal Encoder Plus | Feedback device communications failure | Ensure encoder power supply is correct<br>Ensure baud rate is correct<br>Check encoder wiring<br>Replace feedback device |
| 5 | SM-Universal Encoder Plus | Checksum or CRC error | Check the encoder signal for noise<br>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**<br>Check encoder wiring<br>Check supply voltage level<br>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<br>Check thermistor continuity |
| 10 | SM-Universal Encoder Plus | Motor thermistor short circuit | Check motor thermistor wiring<br>Replace motor / motor thermistor |
| 11 | SM-Universal Encoder Plus | Failure of the sincos analog position alignment during encoder initialisation | Check encoder cable shield.<br>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.<br>Check encoder wiring.<br>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.<br>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.<br>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.<br>Faulty encoder. |
| 74 | All | Solutions Module has overheated | Check ambient temperature<br>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**<br>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 has detected a fault** |
| **202,207,212** | **Automation (I/O Expansion) module category**<br>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**<br>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, SM-Interbus, SM-DeviceNet, SM-CANOpen | User control word trip |
| 61 | SM-PROFIBUS-DP, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS | Configuration error |
| 64 | SM-DeviceNet | Expected packet rate timeout |
| 65 | SM-PROFIBUS-DP, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS | Network loss |
| 66 | SM-PROFIBUS-DP | 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 |

| Trip | Diagnosis |
|---|---|
| **SLX.Er** | **Solutions Module slot X trip: Solutions Module in slot X has detected a fault** |
| **202,207,212** | **SLM module category**<br>Check value in Pr **15**/**16.50**. The following table lists the possible error codes for the SM-SLM. For more information, contact LEROY-SOMER. |

| Error Code | Trip Description |
|---|---|
| 0 | No fault detected |
| 1 | Power supply overloaded |
| 2 | SLM version is too low |
| 3 | DriveLink error |
| 4 | Incorrect switching frequency selected |
| 5 | Feedback source selection incorrect |
| 6 | Encoder error |
| 7 | Motor object number of instances error |
| 8 | Motor object list version error |
| 9 | Performance object number of instances error |
| 10 | Parameter channel error |
| 11 | Drive operating mode incompatible |
| 12 | Error writing to the SLM EEPROM |
| 13 | Motor object type incorrect |
| 14 | Digitax ST object error |
| 15 | Encoder object CRC error |
| 16 | Motor object CRC error |
| 17 | Performance object CRC error |
| 18 | Digitax ST object CRC error |
| 19 | Sequencer timeout |
| 74 | Solutions module over temperature |

| | |
|---|---|
| **SLX.HF** | **Solutions Module slot X trip: Solutions Module X hardware fault** |
| **200,205,210** | Ensure Solutions Module is installed correctly<br>Return Solutions Module to supplier |
| **SLX.nF** | **Solutions Module slot X trip: Solutions Module has been removed** |
| **203,208,213** | Ensure Solutions Module is installed correctly<br>Re-instal Solutions Module<br>Save parameters and reset drive |
| **SL.rtd** | **Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect** |
| **215** | Press reset.<br>If the trip persists, contact the supplier of the drive. |
| **SLX.tO** | **Solutions Module slot X trip: Solutions Module watchdog timeout** |
| **201,206,211** | Press reset.<br>If the trip persists, contact the supplier of the drive. |
| **t010** | **User trip defined in 2nd processor Solutions Module code** |
| **10** | SM-Applications program must be interrogated to find the cause of this trip |
| **t038** | **User trip defined in 2nd processor Solutions Module code** |
| **38** | SM-Applications program must be interrogated to find the cause of this trip |
| **t040 to t089** | **User trip defined in 2nd processor Solutions Module code** |
| **40 to 89** | SM-Applications program must be interrogated to find the cause of this trip |
| **t099** | **User trip defined in 2nd processor Solutions Module code** |
| **99** | SM-Applications program must be interrogated to find the cause of this trip |
| **t101** | **User trip defined in 2nd processor Solutions Module code** |
| **101** | SM-Applications program must be interrogated to find the cause of this trip |
| **t112 to t160** | **User trip defined in 2nd processor Solutions Module code** |
| **112 to 160** | SM-Applications program must be interrogated to find the cause of this trip |

| Trip | Diagnosis |
|---|---|
| **t168 to t175** | **User trip defined in 2nd processor Solutions Module code** |
| **168 to 175** | SM-Applications program must be interrogated to find the cause of this trip |
| **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<br>Check thermistor continuity<br>Set Pr **7.15** = VOLt and reset the drive to disable this function |
| **thS** | **Motor thermistor short circuit** |
| **25** | Check motor thermistor wiring<br>Replace motor / motor thermistor<br>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<br>The red stop key has been pressed during the autotune<br>The SECURE DISABLE INPUT 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<br>Check feedback parameters are set correctly<br>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<br>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<br>Replace encoder |
| **tunE5*** | **Drive encoder V commutation signal fail during an autotune** |
| **15** | Check feedback device V phase commutation wires continuity<br>Replace encoder |
| **tunE6*** | **Drive encoder W commutation signal fail during an autotune** |
| **16** | Check feedback device W phase commutation wires continuity<br>Replace encoder |
| **tunE7*** | **Motor number of poles set incorrectly** |
| **17** | Check lines per revolution for feedback device<br>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<br>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 |

| Trip | Diagnosis |
|---|---|
| **UP udF** | **Onboard PLC program un-defined trip** |
| **97** | Check program |
| **UP uSEr** | **Onboard PLC program requested a trip** |
| **96** | Check program |
| **UV** | **DC bus under voltage threshold reached** |
| **1** | Check AC supply voltage level<br>**Drive voltage rating (Vac)** / **Under voltage threshold (Vdc)** / **UV reset voltage (Vdc)**<br>200 / 175 / 215V<br>400 / 350 / 425V |

*If a tunE through tunE trip occurs, then after the drive is reset the drive cannot be made to run unless it is disabled via the SECURE DISABLE INPUT 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 | 40 to 89 | t040 to t089 | 182 | C.Err |
| 2 | OV | 90 | UP div0 | 183 | C.dAt |
| 3 | OI.AC | 91 | UP PAr | 184 | C.FULL |
| 4 | OI.br | 92 | UP ro | 185 | C.Acc |
| 5 | PS | 93 | UP So | 186 | C.rtg |
| 6 | Et | 94 | UP ovr | 187 | C.TyP |
| 7 | O.SPd | 95 | UP OFL | 188 | C.cPr |
| 8 | PS.10V | 96 | UP uSEr | 189 | EnC1 |
| 9 | PS.24V | 97 | UP udF | 190 | EnC2 |
| 10 | br.th | 98 | UP ACC | 191 | EnC3 |
| 11 | tunE1 | 99 | t099 | 192 | EnC4 |
| 12 | tunE2 | 100 | | 193 | EnC5 |
| 13 | tunE3 | 101 | t101 | 194 | EnC6 |
| 15 | tunE5 | 103 | OIbr.P | 196 | EnC8 |
| 16 | tunE6 | 104 | OIAC.P | 197 | EnC9 |
| 17 | tunE7 | 105 | Oht2.P | 198 | EnC10 |
| 18 | tunE | 106 | OV.P | 199 | DESt |
| 19 | It.br | 107 | PH.P | 200 | SL1.HF |
| 20 | It.AC | 108 | PS.P | 201 | SL1.tO |
| 21 | O.ht1 | 109 | OIdC.P | 202 | SL1.Er |
| 24 | th | 112 to 160 | t112 to t160 | 205 | SL2.HF |
| 25 | thS | 161 | Enc11 | 206 | SL2.tO |
| 26 | O.Ld1 | 162 | Enc12 | 207 | SL2.Er |
| 27 | O.ht3 | 163 | Enc13 | 208 | SL2.nF |
| 28 | cL2 | 164 | Enc14 | 209 | SL2.dF |
| 29 | cL3 | 165 | Enc15 | 210 | SL3.HF |
| 30 | SCL | 166 | Enc16 | 211 | SL3.tO |
| 31 | EEF | 167 | Enc17 | 212 | SL3.Er |
| 32 | PH | 168 to 174 | t168 to t174 | 213 | SL3.nF |
| 33 | rS | 175 | C.Prod | 214 | SL3.dF |
| 34 | PAd | 176 | EnP.Er | 215 | SL.rtd |
| 35 | CL.bit | 177 | C.boot | 216 | t216 |
| 36 | SAVE.Er | 178 | C.bUSY | 217 to 232 | HF17 to HF32 |
| 37 | PSAVE.Er | 179 | C.Chg | | |
| 38 | t038 | 180 | C.OPtn | | |
| 39 | L.SYnC | 181 | C.RdO | | |

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<br>SMARTCARD trips have priority 5 during power-up |
| 4 | supply trips | PS.24V | Can be reset after 1.0s |
| 5 | Autotune | tunE, tunE1 to tunE | Can be reset after 1.0s, but the drive cannot be made to run unless it is disabled via the SECURE DISABLE INPUT 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).<br>Or<br>• 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. | |

## 8.2 Status indications

**Table 8-5 Status indications**

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

**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.<br>For further information, refer to the *User Guide*. |
| **loAding** | The drive is writing information to a Solutions Module. |

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