CONTROL TECHNIQUES

www.controltechniques.com

User Guide

Unidrive SP

Elevator Solution

Universal Variable Speed AC Drive for induction and servo motors

Part Number: 0471-0073-01
Issue: 1

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

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 a Control Techniques Drive Centre.

SM-ELV software version

The software version and identity number for the SM-ELV option module can be viewed in Pr **0.28** [1] (Pr **20.01**) software version and Pr **0.29** [1] (Pr **20.02**) software identity number.

If there is any doubt, contact a Control Techniques Drive Centre.

Environmental statement

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

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

Nevertheless, when the products eventually reach the end of their useful life, they 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. Control Techniques' 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.

Issue Number: 1

How to use this guide

This user guide provides detailed information on the SM-ELV, elevator solution software used with Unidrive SP and the SM-Applications / SM-Applications Lite Solutions Module.

The information is in logical order, taking the user through the features of the software to set-up and optimisation.

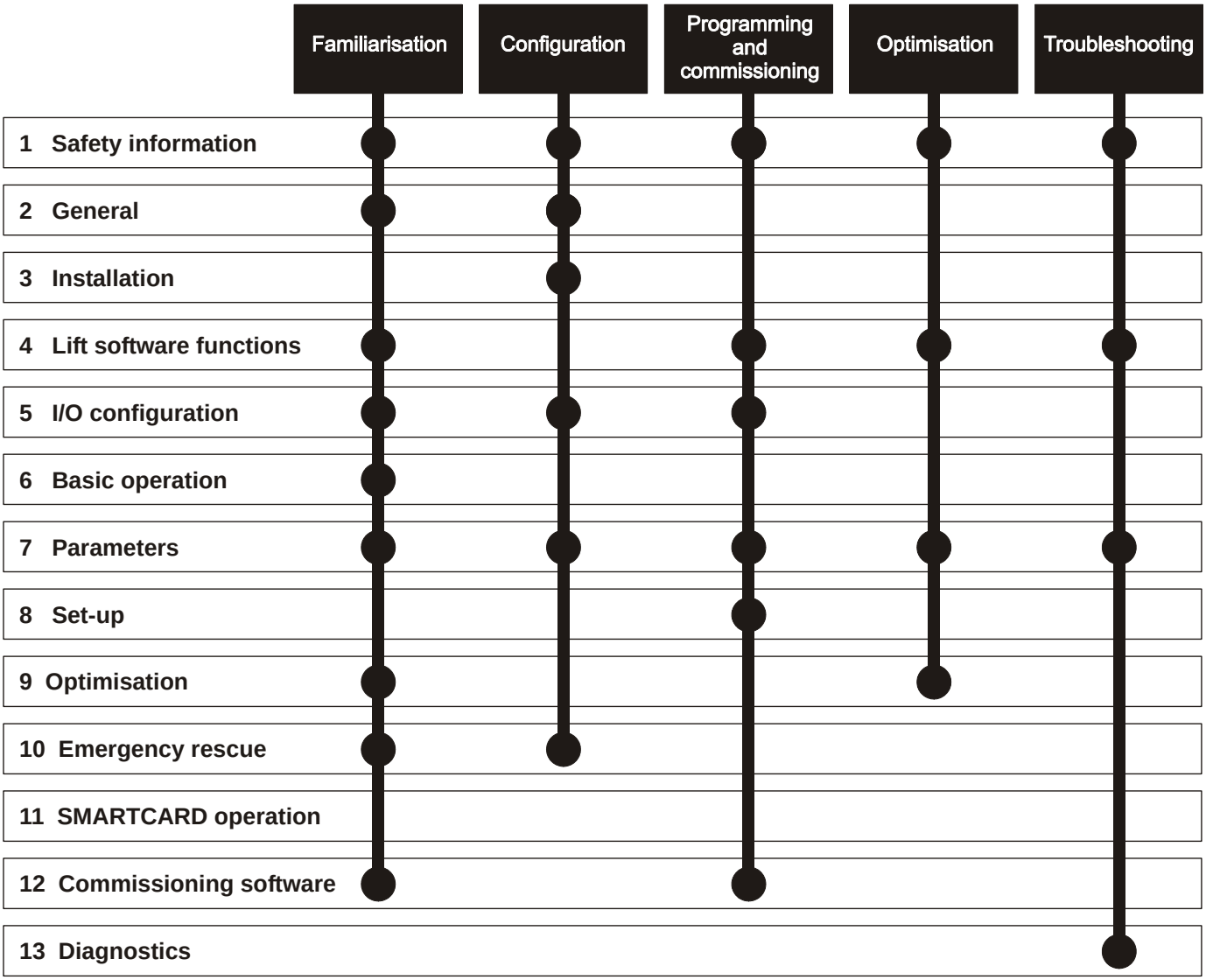
NOTE

There are specific safety warnings in Chapter 1 *Safety Information* . It is essential that the warnings are observed and the information considered when working with or designing a system using the Unidrive SP.

NOTE

This manual should be read in line with the *Unidrive SP User Guide*.

The following map of the user guide helps in finding the correct sections for the task you wish to complete:



Contents

Declaration of Conformity (Size 1 to 3)

Control Techniques Ltd
The Gro
Newtown
Powys
UK
SY16 3BE

SP1201	SP1202	SP1203	SP1204			
SP2201	SP2202	SP2203				
SP3201	SP3202					

SP1401	SP1402	SP1403	SP1404	SP1405	SP1406	
SP2401	SP2402	SP2403	SP2404			
SP3401	SP3402	SP3403				

SP3501	SP3502	SP3503	SP3504	SP3505	SP3506	SP3507

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

EN 50178	Electronic equipment for use in power installations
EN 61800-3	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
EN 50081-2	Electromagnetic compatibility. Generic emission standard. Industrial environment
EN 50082-2	Electromagnetic compatibility. Generic immunity standard. Industrial environment
EN 61000-3-2[1]	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
EN 61000-3-3	Electromagnetic compatibility (EMC). Limits. Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <= 16 A

[1] These products are for professional use, and power input exceeds 1kW for all models, so no limits apply.

These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

W. Drury
Executive Vice President, Technology
Newtown

Date: 22nd July 2004

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

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SP4201	SP4202	SP4203			
SP4401	SP4402	SP4403			
SP5401	SP5402				
SP4601	SP4602	SP4603	SP4604	SP4605	SP4606
SP5601	SP5602				

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

EN 61800-5-1	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments

These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

Executive Vice President, Technology

Newtown

Date: 17th January 2005

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

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Control Techniques Ltd
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SP6401 SP6402

SP6601 SP6602

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

EN 61800-5-1	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments

These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

Executive Vice President, Technology

Newtown

Date: 17th January 2005

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

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Control Techniques Ltd
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SY16 3BE

SP8411	SP8412	SP8413	SP8414	

SP9411	SP9412	SP9413	SP9414	SP9415	

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

EN 61800-5-1*	Adjustable speed electrical power drive systems - safety requirements - electrical, thermal and energy
EN 61800-3	Adjustable speed electrical power drive systems. EMC product standard including specific test methods
EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments

*Clause 5.2.3.8 of EN 61800-5-1:2003 (breakdown of components test) has been amended to eliminate the 30A ground (earth) fuse, in accordance with the draft edition 2 of IEC 61800-5-1

These products comply with the Low Voltage Directive 73/23/EEC, the Electromagnetic Compatibility (EMC) Directive 89/336/EEC and the CE Marking Directive 93/68/EEC.

Executive Vice President, Technology
Newtown

Date: 11th October 2005

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

1 Safety Information

1.1 Warnings, Cautions and Notes

WARNING

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

CAUTION

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

NOTE

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

1.2 Electrical safety - general warning

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive.

Specific warnings are given at the relevant places in this User Guide.

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard.

The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this User Guide carefully.

The STOP and SECURE DISABLE functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

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

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

The SECURE DISABLE function has been approved[1] as meeting 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. **The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.**

[1]Independent approval by BGIA has been given.

1.4 Environmental limits

Instructions in this User Guide regarding transport, storage, installation and use of the drive must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

1.5 Compliance with regulations

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

Within the European Union, all machinery in which this product is used must comply with the following directives:

98/37/EC: Safety of machinery.
89/336/EEC: Electromagnetic Compatibility.
95/16/EC: Lifts Directive.

1.6 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations. Ensure the motor shaft is not exposed.

Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the drive to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

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

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive should not be relied upon.

It is essential that the correct value is entered in parameter **0.46** motor rated current. This affects the thermal protection of the motor.

1.7 Adjusting parameters

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

1.8 Warnings

WARNING

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

WARNING

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

Fuses
The AC supply to the drive must be fitted with suitable protection against overload and short-circuits. The *Unidrive SP User Guide* shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

The **ground loop impedance** must conform to the requirements of local safety regulations.

The drive must be grounded by a connection capable of carrying the prospective fault current until the protective device (fuse, etc.) disconnects the AC supply.

The ground connections must be inspected and tested at appropriate intervals.

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

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

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

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

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

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

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

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

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

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

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

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

Do not change **parameter values** without careful consideration; incorrect values may cause damage or a safety hazard.

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

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

Pr **0.46** *Motor rated current* must be set correctly to avoid a risk of fire in the event of motor overload.

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

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

Secure disable inhibits the operation of the drive, this includes inhibiting braking. If the drive is required to provide both braking and secure disable in the same operation (e.g. for emergency stop) then a safety timer relay or similar device must be used to ensure that the drive is disabled a suitable time after braking. The braking function in the drive is provided by an electronic circuit which is not fail-safe. If braking is a safety requirement, it must be supplemented by an independent fail-safe braking mechanism.

A **rotating autotune** will cause the motor to accelerate up to $^{2}/_{3}$ base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The run signal must be removed before the drive can be made to run at the required reference.
The drive can be stopped at any time by removing the run signal or removing the drive enable.

The short low speed and normal low speed autotune tests will rotate the motor by up to 2 revolutions in the direction selected, regardless of the reference provided. The minimal movement test will move the motor through an angle defined by Pr **5.38**.

Once complete the motor will come to a standstill. The run signal must be removed before the drive can be made to run at the required reference.

The drive can be stopped at any time by removing the run signal or removing the Drive Enable.

Encoder phase angle (servo mode only)

With drive software version V01.08.00 onwards, the encoder phase angles in Pr **3.25** and Pr **21.20** are cloned to the SMARTCARD when using any of the SMARTCARD transfer methods.

With drive software version V01.05.00 to V01.07.01, the encoder phase angles in Pr **3.25** and Pr **21.20** are only cloned to the SMARTCARD when using either Pr **0.30** set to Prog (2) or Pr **xx.00** set to 3yyy.

This is useful when the SMARTCARD is used to back-up the parameter set of a drive but caution should be used if the SMARTCARD is used to transfer parameter sets between drives.

Unless the encoder phase angle of the servo motor connected to the destination drive is known to be the same as the servo motor connected to the source drive, an autotune should be performed or the encoder phase angle should be entered manually into Pr **3.25** (or Pr **21.20**). If the encoder phase angle is incorrect the drive may lose control of the motor resulting in an O.SPd or Enc10 trip when the drive is enabled.

With drive software version V01.04.00 and earlier, or when using software version V01.05.00 to V01.07.01 and Pr **xx.00** set to 4yyy is used, then the encoder phase angles in Pr **3.25** and Pr **21.20** are not cloned to the SMARTCARD. Therefore, Pr **3.25** and Pr **21.20** in the destination would not be changed during a transfer of this data block from the SMARTCARD.

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

SECURE DISABLE function

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

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

If the **control circuits** are to be connected to other circuits classified as Safety Extra Low Voltage (SELV) (e.g. to a personal computer), an additional isolating barrier must be included in order to maintain the SELV classification.

To avoid the **risk of fire** when the drive is surface mounted with the braking resistor fitted, the back plate should be a non-flammable material.

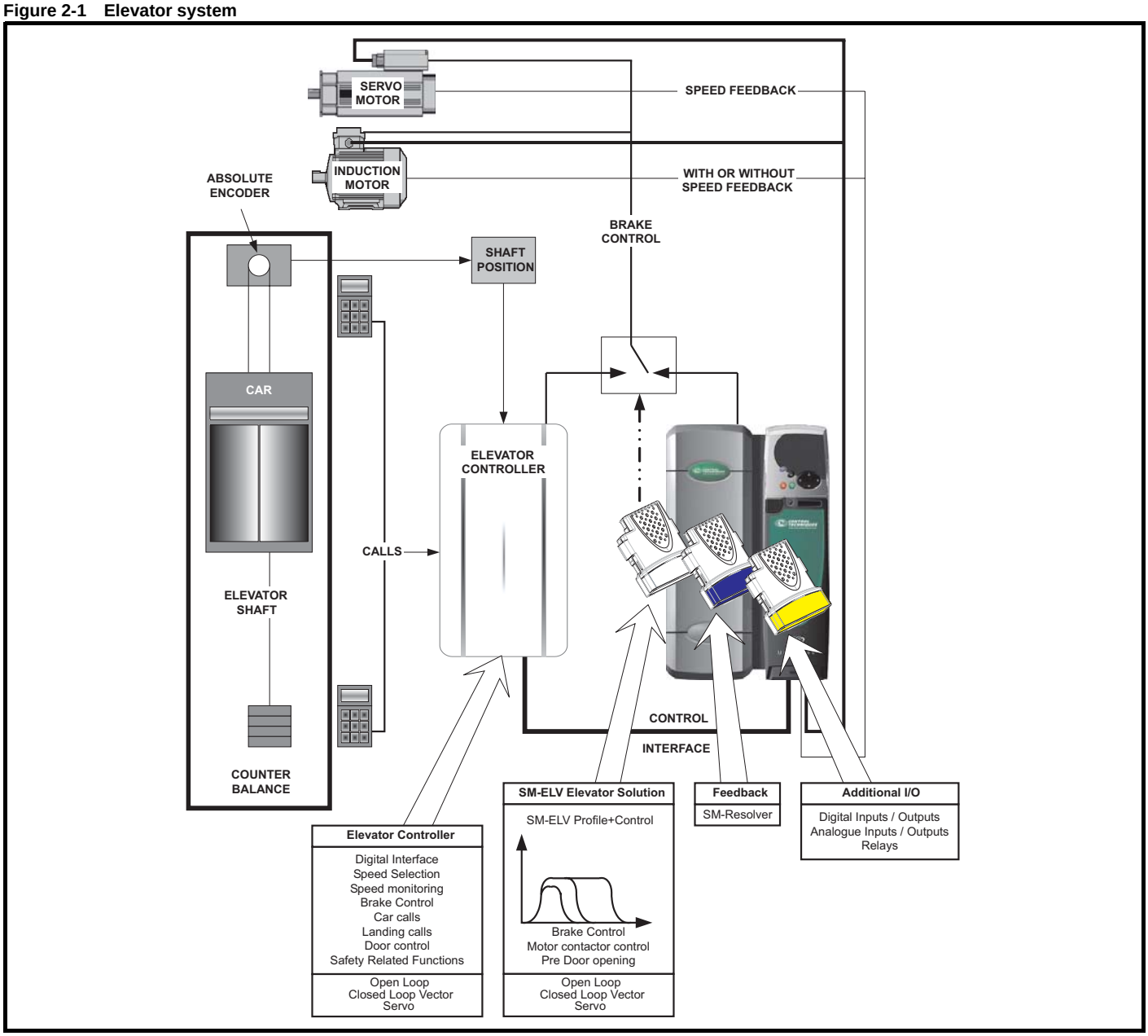
Overload protection

When an external braking resistor is used, it is essential that an overload protection device is incorporated in the braking resistor circuit; this is described in the *Unidrive SP User Guide.*

2 General

The Unidrive SP is a high performance drive making it an excellent choice for elevator applications. Figure 2-1 following shows the Unidrive SP incorporated into an elevator system using the SM-ELV and where required an SM-I/O Plus can also be added to increase the drive's I/O capability. In addition other Solutions Modules can be fitted to further increase the Unidrive SP capability (e.g. SM-Resolver etc.).

Figure 2-1 Elevator system



2.1 Elevator system - Unidrive SP and elevator controller

The Unidrive SP elevator solution (SM-ELV) software incorporates a travel profile calculator and special operating level designed for elevators. This software has additional features allowing it to be used for both geared and gearless elevators.

The elevator software is introduced through either the SM-Applications or SM-Applications Lite Solutions Module and special software.

The SM-Applications would be used where additional features are required, e.g. larger DPL programs, extended user memory, RS485, CT-Net or extended I/O.

The Unidrive SP elevator drive is controlled by a digital interface from the elevator controller as shown in Figure 2-1. The elevator controller software interprets the calls and produces the speed and direction signals for the Unidrive SP.

The elevator controller provides all the safety related functions in this system configuration, including the optional brake control in place of the Unidrive SP.

2.2 SM-ELV operating mode

The Unidrive SP plus SM-ELV software creates a velocity motion profile, which includes elevator application specific functions. It can be used for both geared and gearless elevators operating in either Open Loop, Closed Loop Vector or Servo mode. Brushless synchronous motors with encoders (Incremental or Absolute) / resolvers and induction motors with or without encoders (Incremental or Absolute) / resolvers can be controlled.

The following operating modes can be selected through the SM-ELV elevator software installed in the SM-Applications or SM-Applications Lite:

1. Pr **0.16**[3] (Pr **20.13**) = 0 Direct-to-floor positioning disabled (Creep-to-floor active)

2. Pr **0.16**[3] (Pr **20.13**) = 1 Direct-to-floor positioning with Stop signal via analogue input 1 (T.5)
3. Pr **0.16**[3] (Pr **20.13**) = 2 Direct-to-floor positioning with Stop signal via analogue input 2 (T.7)
4. Pr **0.16**[3] (Pr **20.13**) = 3 Direct-to-floor positioning with Stop signal via analogue input 3 (T. 8)
5. Pr **0.16**[3] (Pr **20.13**) = 4 Direct-to-floor positioning with disable the speed signals (controlling)

2.3 Features

The following Elevator functions are provided within the SM-ELV (SM-Applications, SM-Applications Lite and Elevator software). The SM-ELV software provides positioning controls associated with elevators e.g. creep-to-floor and direct-to-floor with complete positioning control, multiple speed selection and brake control as listed in Table 2-1.

The external lift controller evaluates the elevator signals and elevator calls, and from these generates travel commands to the Unidrive SP. The SM-ELV generates and modifies the required profile for travel.

NOTE

A number of settings are necessary in order to use this software. To simplify this a default feature is included which allows standard settings for the initial run. (Refer to Pr **18.50** *Default settings.*)

NOTE

Positioning with creep-to-floor is used in most applications. Therefore creep-to-floor has been selected as the default setting for the elevator software Pr **0.16**[3] (Pr **20.13**) = 0.

Direct-to-floor positioning mode is enabled through Pr **0.16**[3] (Pr **20.13**) as detailed in section 2.2 *SM-ELV operating mode* on page 13.

NOTE

The external lift controller handles all the specific functions related to the safety aspects of the elevator.

To assist with the set-up and commissioning of the elevator there are also various commissioning software tools as detailed :

1. CT Soft - Allows parameter adjustment and upload / download features.
2. CT Scope - Allows speed / current profiles to be monitored during operation. Waveforms can be saved to file.
3. Lift - SP is designed specifically for lifts with various set-up features, parameter adjustment upload / download, commissioning screens, and oscilloscope features.

For more detailed information refer to Chapter 12 *Commissioning software tools* .

Table 2-1 Features

Elevator software features	Advantages
Text display with elevator terms	Commissioning without User Guide is possible
Dedicated Unidrive Menu 0	Simplified operation with reduced parameter sets
Conventional data input units (mm/s, mm/s^2,)	No calculation required to set-up the elevator drive
10 speed binary selections	Flexible interface, with range of speed reference values to optimise elevator performance
6 speed priority selections	
7 speed priority selection with additional SM-I/O Plus option module	
2 speed thresholds	Applicable for the functions like pre door opening or over speed monitoring
Creep-to-floor positioning	Standard operation using creep to floor positioning (default)
Direct-to-floor positioning	Opitmised operation for high speed elevators positioning direct to floor with no creep
Speed profile with separately adjustable jerk, acceleration and deceleration	Separate optimisation for the start characteristic, travel, deceleration and positioning (stop)
Variable speed loop gains for start, travel and positioning (stop)	Optimisation of the load for the elevator during start, travel and positioning (stop)
Acceleration feed forward control and load measurement	Movement quality optimisation of the load behaviour, and positioning accuracy
Deceleration and stopping distance calculation	If the speed or profile are changed then the deceleration or stop distance will change. The elevator controller can compensate for these changes.
Floor sensor correction	Reduction of necessary speeds to ensure correct floor level
Rapid stop	Allows a separate rapid stop deceleration
Start optimiser	To overcome static friction or difficult starting problems a start optimiser function is available
Position controller	High ride comfort for start with gearless elevators
Short distance landing	For short floor distance travel
Motor contactor control	Output contactor control can be carried in the SM-ELV
Load direction - Rescue operation	Load direction is measured during each travel and is available for rescue operation to determine the direction to travel with least load saved at each power down
Integrated brake control	Simplified elevator brake control interface
Following error detection	Includes both speed error (Trip 70) and position error (Trip 71) detection. Protection against motor and feedback cable break, loss of feedback, incorrect parameter setting
Thermal protection	Thermal protection is introduced to prevent the Unidrive SP and SM-ELV operating with temperatures below 0°C, with a Trip 73 being generated.
Motor fluxed detection	Protection provided to ensure motor is fully magnetised at start, Trip 76 generated if not.
Motor phase loss detection	Protection provided to detect motor phase loss with Trip 77 generated where motor phase loss is present.

2.4 Identification

The SM-ELV Solutions Module consists of either an SM-Applications or an SM-Applications Lite with the elevator software.

The elevator software version and identity number can be verified in the following parameters:

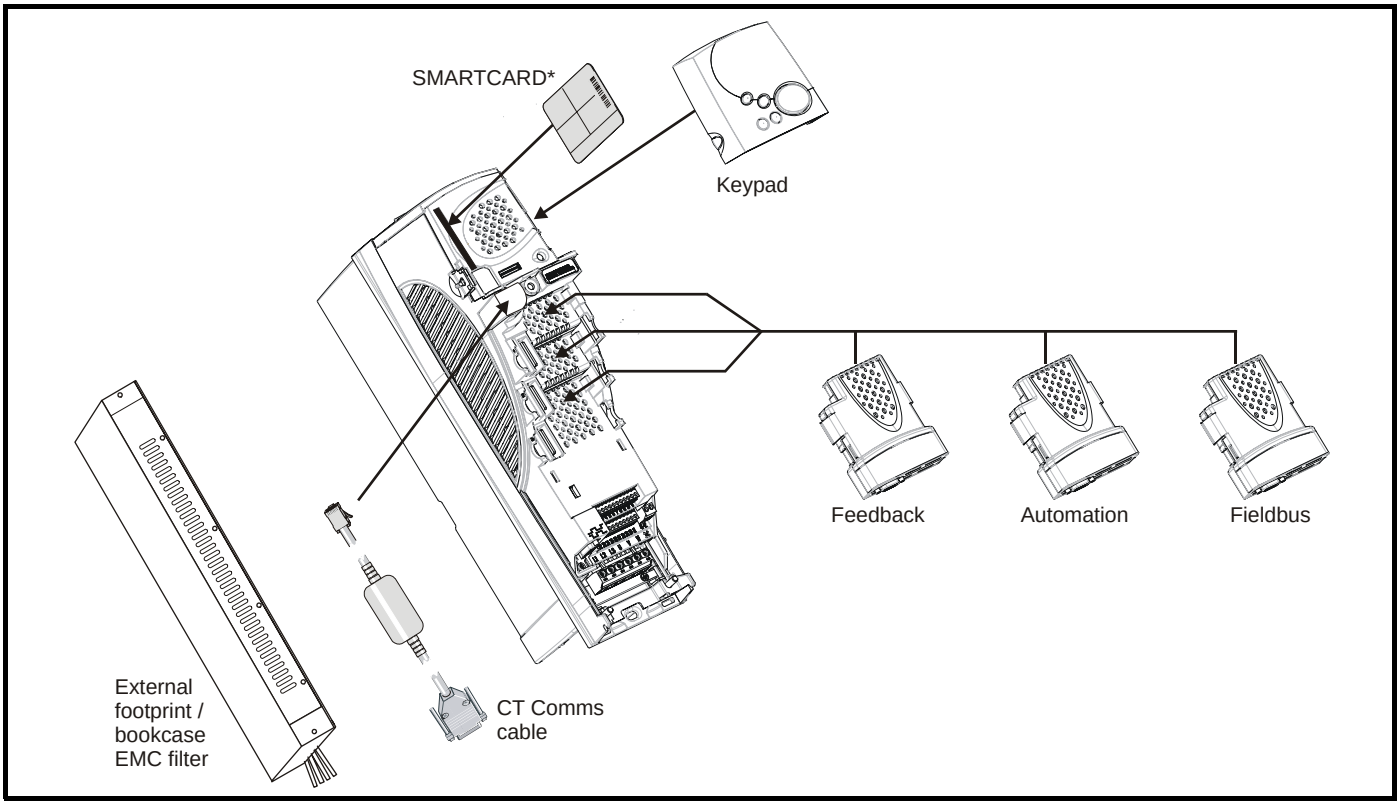
The software version is displayed in Pr **0.28** [1] (Pr **20.01**) *software Version* in the form of xx.xx.

The software identity number is displayed in Pr **0.29** [1] (Pr **20.02**) *Software identity number* in the form of xx.xx.

To verify the lift software is running, monitor Pr **0.29** [1] (Pr **20.02**). This should toggle every 1s between 10614 and -10614.

2.5 Additional options

Figure 2-2 Options available with Unidrive SP



* A SMARTCARD is provided with the Unidrive SP as standard.

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

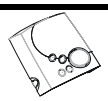
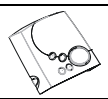
Table 2-2 Solutions Module identification

Type	Solutions Module	Colour	Name	Further Details
Feedback		Light Blue	SM-Resolver	**Resolver interface** Feedback interface for resolvers. Simulated quadrature encoder outputs
		N/A	15-way D-type converter	**Drive encoder input converter** Provides screw terminal interface for encoder wiring and spade terminal for shield

Table 2-2 Solutions Module identification

Type	Solutions Module	Colour	Name	Further Details
Automation		Yellow	SM-I/O Plus	**Extended I/O interface** Increases the I/O capability by adding the following to the existing I/O in the drive: • Digital inputs x 3 • Digital I/O x 3 • Analogue inputs (voltage) x 2 • Analogue output (voltage) x 1 • Relay x 2
		Dark Green	SM-Applications	**Applications Processor (with CTNet)** 2nd processor for running pre-defined and /or customer created application software with CTNet support
		White	SM-Applications Lite	**Applications Processor** 2nd processor for running pre-defined and /or customer created application software
		Dark Yellow	SM-I/O Lite	**Additional I/O** 1 x Analogue input (± 10V bi-polar or current modes) 1 x Analogue output (0-10V or current modes) 3 x Digital input and 1 x Relay
Fieldbus		Pink	SM-CAN	**CAN option** CAN adapter for communications with the Unidrive SP
		Light Grey	SM-CANopen	**CANopen option** CANopen adapter for communications with the Unidrive SP
		Beige	SM-Ethernet	**Ethernet option** 10 base-T / 100 base-T; Supports web pages, SMTP mail and multiple protocols: DHCP IP addressing; Standard RJ45 connection

Table 2-3 Keypad identification

Type	Keypad	Name	Further Details
Keypad		SM-Keypad	**LED keypad option** Keypad with a LED display
		SM-Keypad Plus	**LCD keypad option** Keypad with an alpha-numeric LCD display with Help function (preferred option with additional keypad custom elevator text)

3 Installation

3.1 Mechanical Installation

CAUTION

The Unidrive SP must be powered down before fitting or removing the SM-ELV. If an SM-Resolver, SM-I/O Plus or any other Solutions Module are required, they also have to be installed while the Unidrive SP is powered down. Failure to do so may result in damage to the product

Figure 3-1 Unidrive SP Solution Module slots

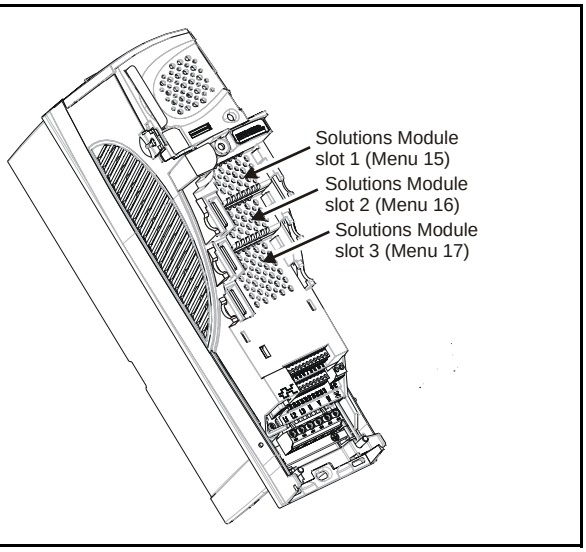
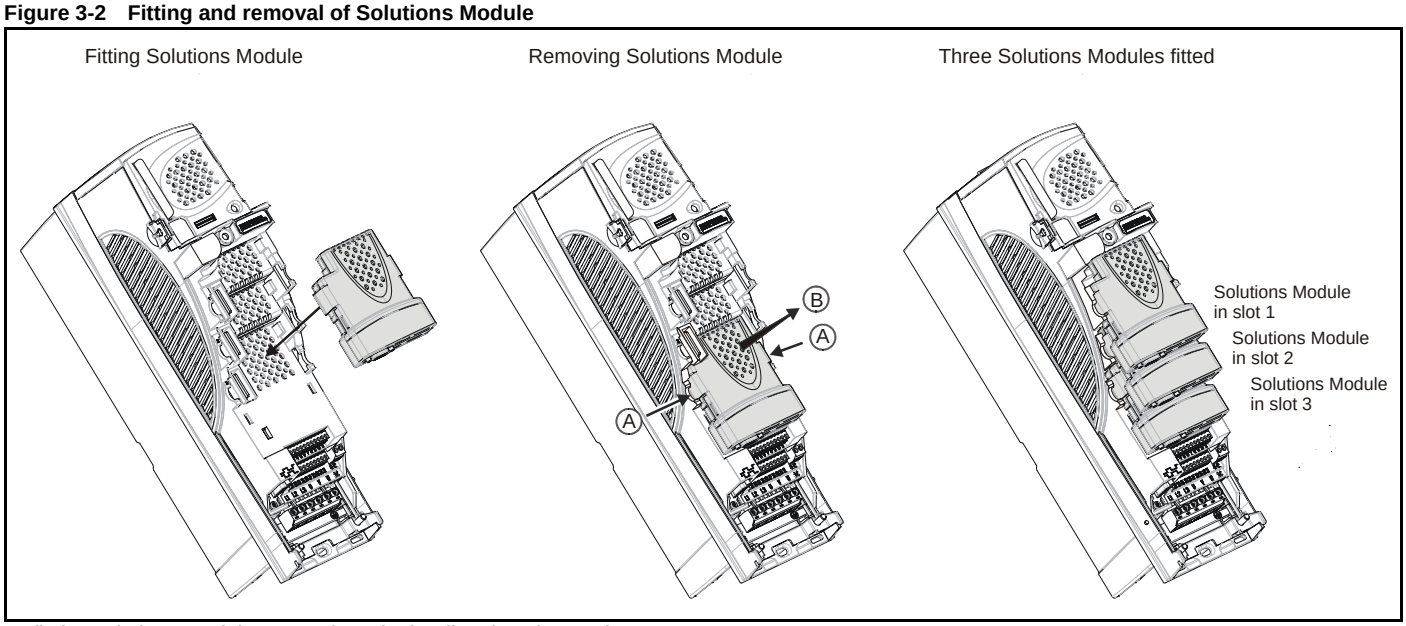


Figure 3-2 Fitting and removal of Solutions Module



To fit the Solutions Module, press down in the direction shown above until it clicks into place.

To remove the Solutions Module, press inwards at the points shown (A) and pull in the direction shown (B).

The drive has the facility for all three Solutions Module slots to be used at the same time, as illustrated.

NOTE

It is recommended that the Solutions Module slots are used in the following order: slot 3, slot 2 and slot 1.

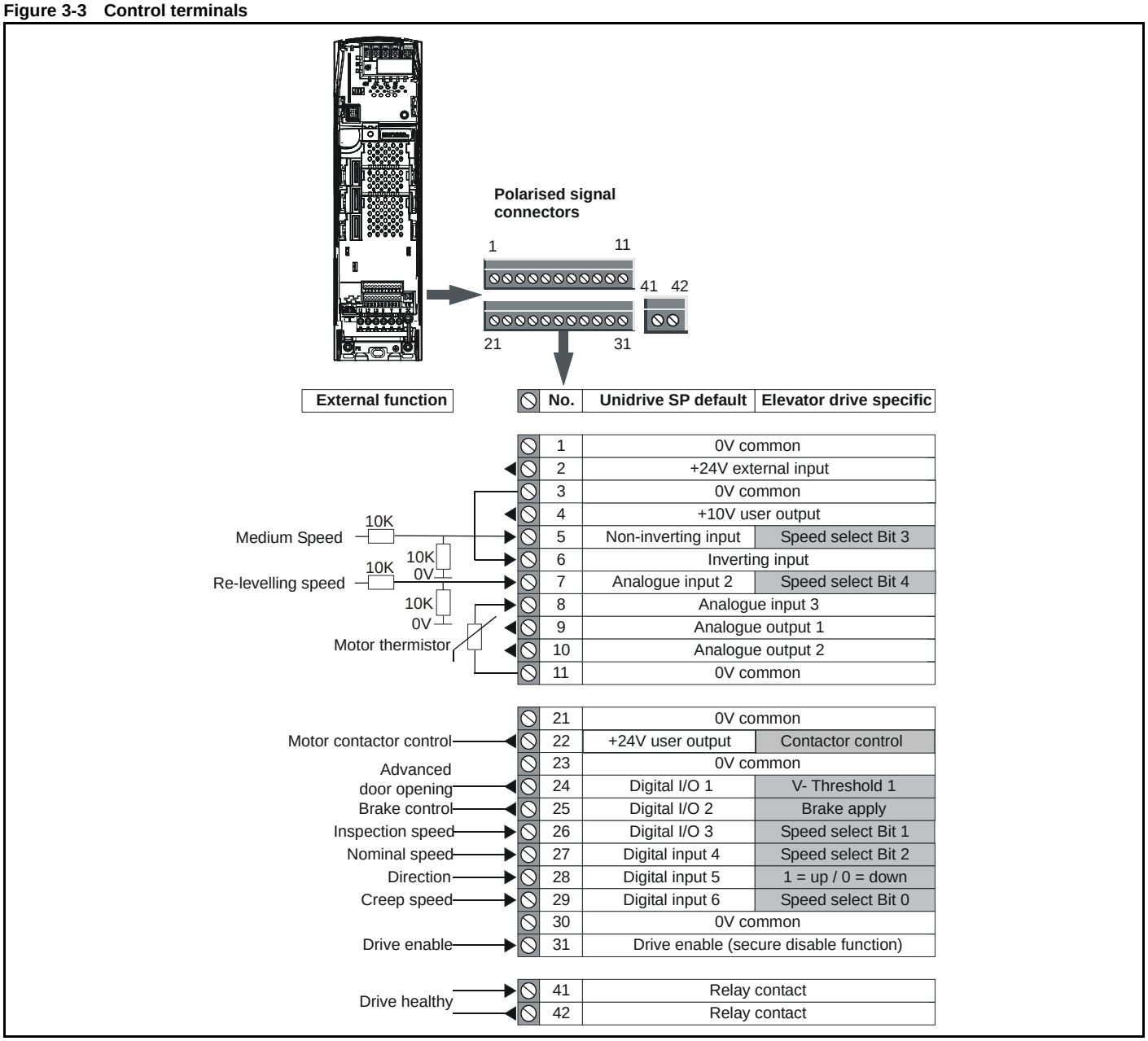
CAUTION

Installation of the Unidrive SP drive should follow all recommendations detailed in the current *Unidrive SP User Guide.*

3.2 Control connections

The following diagram shows the control terminals of the Unidrive SP in both its default conditions and when reconfigured for the elevator control using the SM-ELV Solutions Module.

Figure 3-3 Control terminals



The control terminal set-up shown above is the default configuration for the elevator software however this can be re-configured if required. The control terminal set-up can be re-configured through Menu 7 (Analogue I/O) and Menu 8 (Digital I/O, Relays). More detailed information on the associated parameters can be found in Chapter 5 *I/O configuration* and the *Unidrive SP User Guide*.

NOTE

The elevator set-up for Unidrive SP uses positive logic as default. This can be set-up to operate in negative logic through Pr **8.29**, however in negative logic the Drive enable, Relay outputs and 24V output remain in positive logic.

3.3 Encoder connections

Figure 3-4 Location of encoder connector

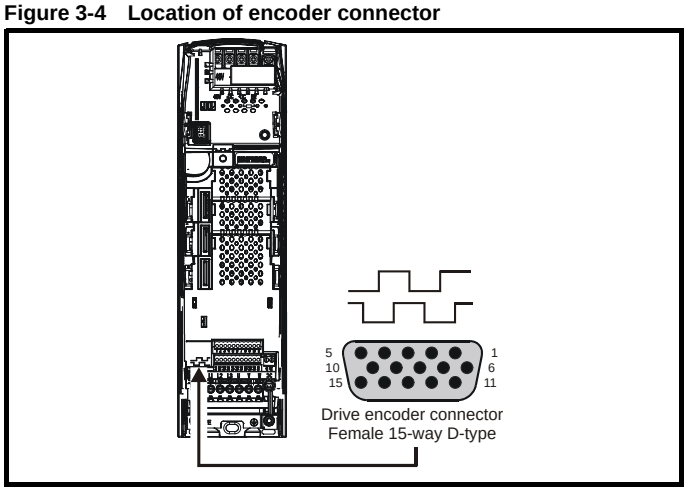


Table 3-1 Encoder types

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

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

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

NOTE

SC.SErVO encoders can also be used, however these can only be connected to the SM-Universal Encoder Plus option module which supports the SinCos encoder type with commutation signals.

Table 3-2 Drive encoder connector details

Terminal	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	Simulated encoder Aout, Fout**			U			Simulated encoder Aout, Fout**					
8	Simulated encoder Aout\, Fout**			U\			Simulated encoder Aout\, Fout**					
9	Simulated encoder Bout, Dout**			V			Simulated encoder Bout, Dout**					
10	Simulated encoder Bout\, Dout**			V\			Simulated encoder Bout\, Dout**					
11				W					Encoder input - Clock (output)			
12				W\					Encoder input - Clock\ (output)			
13	+V***											
14	0V common											
15	th****											

* Marker pulse is optional

** Simulated encoder output only available in open-loop

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

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

NOTE

SSI encoders typically have maximum baud rate of 500kB (refer to encoder data sheet). When a SSI only encoder is used for speed feedback with a closed loop vector or 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.

3.4 Position feedback devices and connection

The following section covers the recommended screen and grounding connections for position feedback devices. These recommendations should be followed closely to prevent noise being induced onto the position feedback resulting in instability issues.

Shielding considerations are important for PWM drive installations due to the high voltages and currents present in the output circuit with a very wide frequency spectrum, typically from 0 to 20 MHz. Position feedback inputs are liable to be disturbed if careful attention is not given to managing the cable shields.

3.4.1 Cable shield requirements

- Feedback cable shields should be connected at drive terminal to 0V
- Feedback cable shield should be connected at encoder to 0V
- It is recommended that the shielded cable should be run in a continuous length to the terminal, to avoid the injection of noise at intermediate pigtails and to maximize the shielding benefit. (Note: due to emissions from high power cables (e.g. drive output) the feedback cable should not be run in parallel lengths with these for >1m at <300mm apart)
- The shield connections ("pigtails") to the drive and encoder should be kept as short as possible.

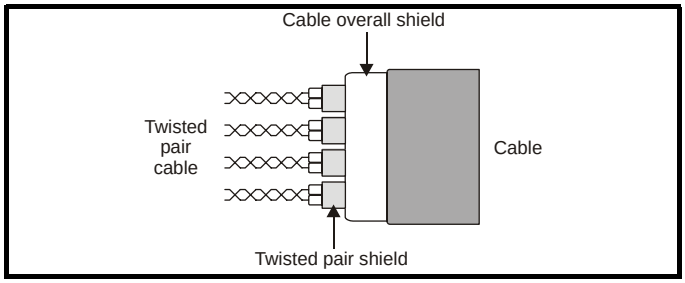
WARNING

Connecting the cable shield to ground at both ends carries the risk that an electrical fault might cause excessive power current to flow in the cable shield and overheat the cable. There must be an adequately rated safety ground connection between the motor / encoder and the drive.

Recommended cable

The recommended cable for feedback signals is a twisted pair, shielded with an overall shield as shown in Figure 3-5

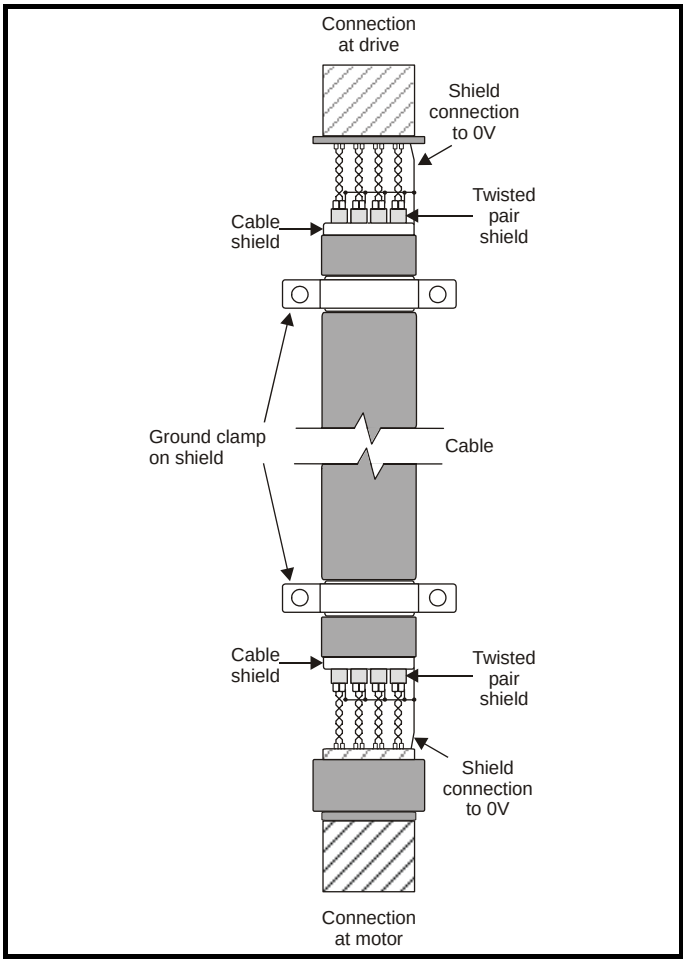
Figure 3-5 Feedback cable, twisted pair



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

The following diagram shows the recommended arrangements for the cable screening and grounding.

Figure 3-6 Feedback cable connections



In addition to the above connections shown in Figure 3-6 if it is found that there is still noise being passed to the encoder / resolver input it is possible to make a connection directly from 0V of the feedback device input at the drive to ground.

The ground connection can be connected directly to the grounding clamp / bracket as shown in the following.

3.4.2 Grounding hardware

The Unidrive SP is supplied with a grounding bracket, and sizes 1 to 3 with a grounding clamp, to facilitate EMC compliance. They provide a convenient method for direct grounding of cable shields without the use of "pig-tails". Cable shields can be bared and clamped to the grounding bracket using metal clips or clamps[1] (not supplied) or cable ties. Note that the shield must in all cases be continued through the clamp to the intended terminal on the drive, in accordance with the connection details for the specific signal.

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

See Figure 3-7 and Figure 3-8 for details on fitting the grounding clamp.

See Figure 3-9 for details on fitting the grounding bracket.

Figure 3-7 Fitting of grounding clamp (size 1 and 2)

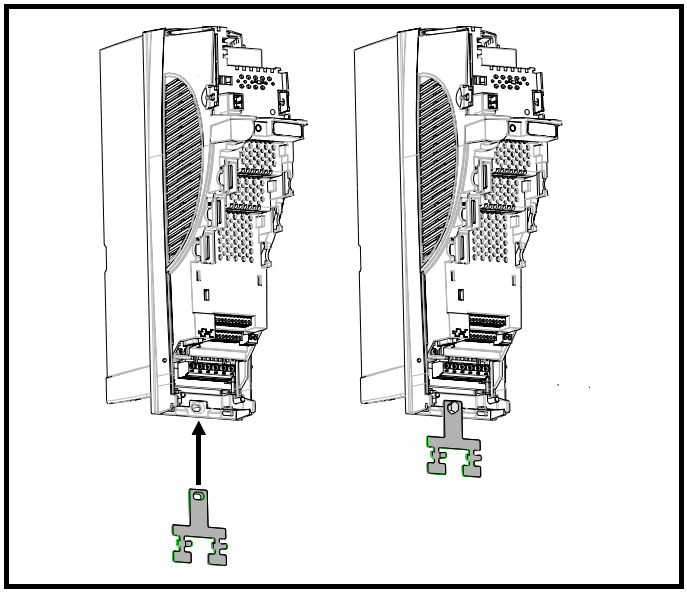


Figure 3-8 Fitting of grounding clamp (size 3)

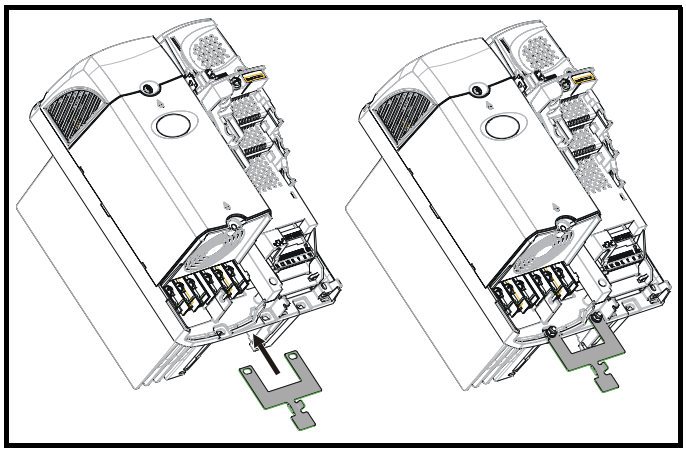
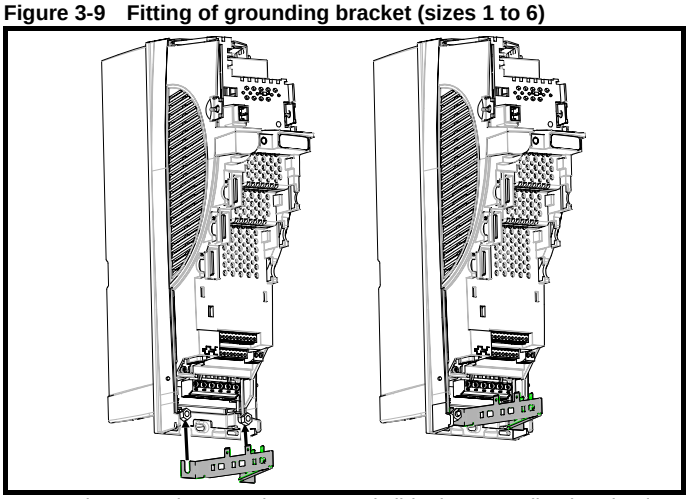


Figure 3-9 Fitting of grounding bracket (sizes 1 to 6)



Loosen the ground connection nuts and slide the grounding bracket in the direction shown. Once in place, re-tighten the ground connection nuts.

WARNING

On Unidrive SP size 1 and 2, the grounding bracket is secured using the power ground terminal of the drive. Ensure that the supply ground connection is secure after fitting / removing the grounding bracket. Failure to do so will result in the drive not being grounded.

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

When a Unidrive SP size 4 or 5 is through-panel mounted, the grounding link bracket must be folded upwards. A screw can be used to secure the bracket or it can be located under the mounting bracket to ensure that a ground connection is made. This is required to provide a grounding point for the grounding bracket as shown in Figure 3-9.

Figure 3-10 Grounding link bracket in its surface mount position (as supplied)

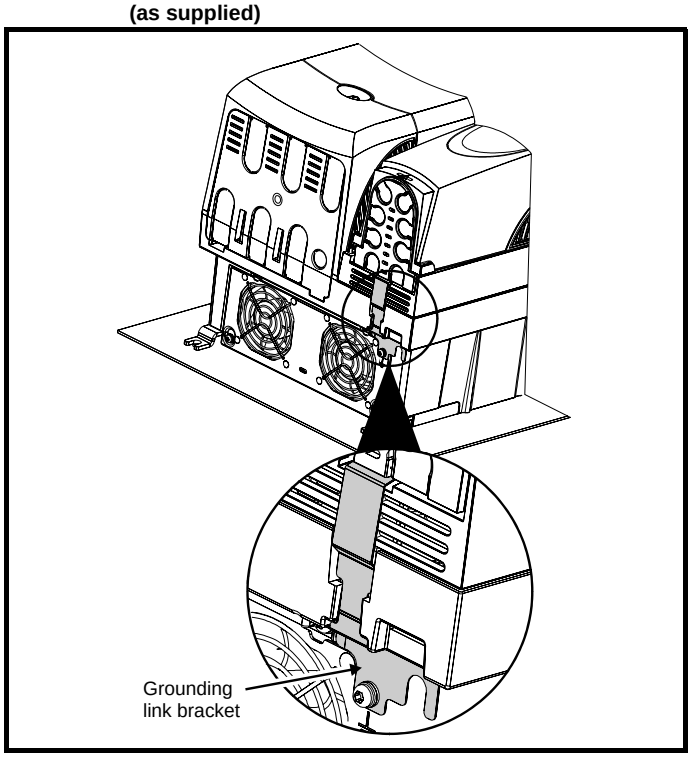
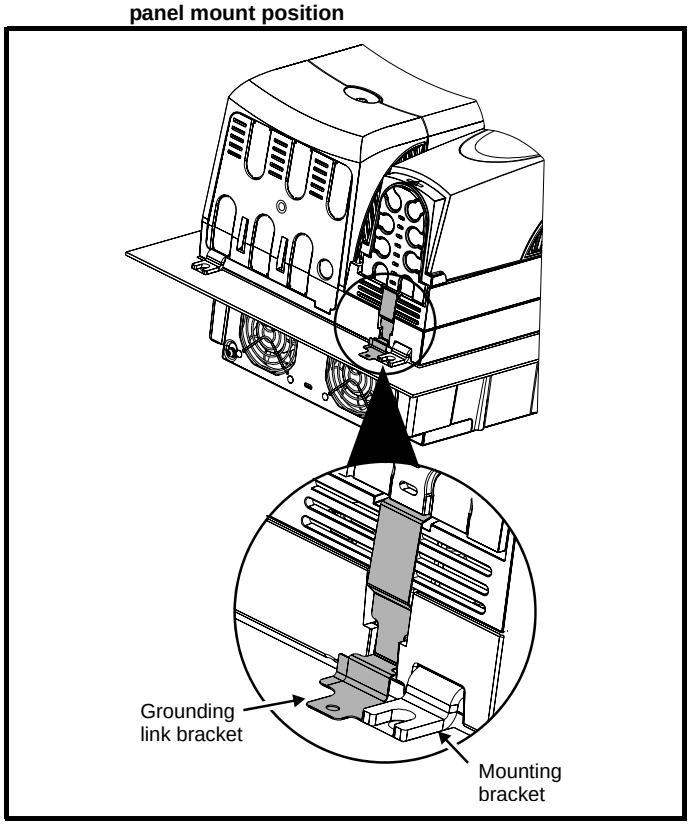


Figure 3-11 Grounding link bracket folded up into its through-panel mount position

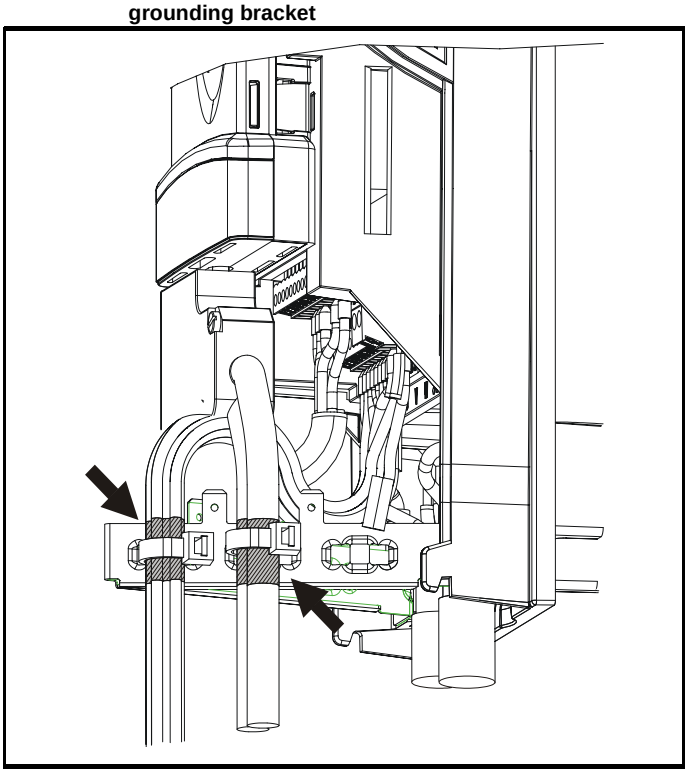


If the control wiring is to leave the enclosure, it must be shielded and the shield(s) clamped to the drive using the grounding bracket as shown in Figure 3-12. Remove the outer insulating cover of the cable to ensure the shield(s) make contact with the bracket, but keep the shield(s) intact until as close as possible to the terminals

NOTE

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

Figure 3-12 Grounding of signal cable shields using the grounding bracket



3.5 Configuring the feedback device (Closed Loop Vector and Servo)

It is possible to use different encoder types. The following settings must be performed and are dependent on the operating mode and encoder type.

3.5.1 Restrictions

Although Pr **3.34** can be set to any value from 0 to 50,000 there are restrictions on the values actually used by the drive. These restrictions are dependent on the Unidrive SP software version as follows:

Software version V01.06.01 and later

Table 3-3 Restrictions of drive encoder lines per revolution

Position feedback device	Equivalent Lines per revolution used by the drive
Ab, Fed, Fr., Ab.SErVO, Fd.SErVO, Fr.SerVO, SC	The drive uses the value in Pr **3.34**.
SC.HiPEr, SC.EndAt, SC.SSI (rotary encoders)	If Pr **3.34** ≤1, the drive uses the value of 1. If 1< Pr **3.34** <32,768, the drive uses the value in Pr **3.34** rounded down to nearest value that is a power of 2. If Pr **3.34** ≥32,768, the drive uses the value of 32,768.
SC.HiPEr, SC.EndAt, SC.SSI (linear encoders)	The drive uses the value in Pr **3.34**.

Software version V01.06.00 and earlier

Table 3-4 Restrictions of drive encoder lines per revolution

Position feedback device	Equivalent Lines per revolution used by the drive
Ab, Fd, Fr	If Pr **3.34** <2, the drive uses the value of 2. If 2≤ Pr **3.34** .≤16,384, the drive uses the value in Pr **3.34.** If Pr **3.34** >16,384, the drive uses the value in Pr **3.34** rounded down to nearest value divisible by 4.
Ab.SErVO, Fd.SErVO, Fr.SErVO	If Pr **3.34** ≤2, the drive uses the value of 2. If 2< Pr **3.34** <16,384, the drive uses the value in Pr **3.34** rounded down to nearest value that is a power of 2. If Pr **3.34** ≥16,384, the drive uses the value of 16,384.
SC, SC.HiPEr, SC.EndAt, SC.SSI	If Pr **3.34** ≤2, the drive uses the value of 2. If 2< Pr **3.34** <32,768, the drive uses the value in Pr **3.34** rounded down to nearest value that is a power of 2. If Pr **3.34** ≥32,768, the drive uses the value of 32,768.

At power-up Pr **3.48** is initially zero, but is set to one when the drive encoder and any encoders connected to any Solutions Modules have been initialized. The drive cannot be enabled until this parameter is one.

Encoder initial is at ion will occur as follows:

- At drive power-up
- When requested by the user via Pr **3.47**
- When trips PS.24V, Enc1 to Enc8, or Enc11 to Enc17 are reset
- The encoder number of lines per revolution (Pr **3.34**) or the number of motor poles (Pr **5.11** and Pr **21.11**) are changed (software version V01.08.00 and later).

Initial is at ion causes an encoder with communications (SSI, Anted, Preface) to be re-initialized and auto-configuration to be performed if selected. After initial is at ion Ab.SErVO, Fd.SErVO and Fr.SErVO encoders will use the UVW commutations signals to give position feedback for the first 120° (electrical) of rotation when the motor is restarted.

3.5.2 Closed loop vector mode

The following table details parameters required to configure both encoders and resolver feedback, with the resolver being connected via an SM-Resolver.

The following settings are for simple Basic encoders and if absolute encoders are used, refer to the *Unidrive SP User Guide* for detailed setup information, or section 3.5.3 *Servo mode* on page 24 where some additional examples are given.

Table 3-5 Closed loop vector feedback set-up

Feedback	Pr Setting	Default	Note
Encoder	Pr **3.26** = drv	drv	Speed feedback selector (drive)
	Pr **3.34** = ...	1024	Drive encoder lines per revolution
	Pr **3.36** = ...	5V	Drive encoder supply voltage: 5V(0) / 8V(1) / 15V(2)
	Pr **3.38** = Ab	Ab	Drive encoder type: Ab(0) Incremental encoder
	Pr **3.39** = 0 /1 /2	1	If encoder supply voltage is 8V or 15V then set drive encoder termination selection Pr **3.39** = 0
SinCos	Pr **3.26** = drv	drv	Speed feedback selector (drive)
	Pr **3.34** = …	1024	Drive encoder lines per revolution
	Pr **3.36** = …	5V	Drive encoder supply voltage: 5V(0) / 8V(1) / 15V(2)
	Pr **3.38** = SC	Ab	Encoder type SC = SinCos encoder with no serial communication
Resolver	Pr **3.26** = Slot2	drv	Speed feedback selector via Slot 2 = parameter adjustment in Menu 16
	Pr **3.40** = 0	1	Disable drive encoder error detection
	Pr **x.11** = …	0	Resolution
	Pr **x.13** = …	2:1	Resolver excitation: 3:1(0), 2:1(1 or 2)

3.5.3 Servo mode

The following section covers the set-up of both absolute encoders and a resolver (absolute).

If the required feedback device is not covered in this section, refer to the *Unidrive SP User Guide* for further detailed information.

Table 3-6 Servo feedback set-up

Feedback	Pr Setting	Default	Note
Encoder	Pr **3.25** = …		Encoder phase angle
	Pr **3.26** = drv	drv	Speed feedback selector (drive)
	Pr **3.34** = …	1024	Drive encoder lines per revolution
	Pr **3.36** = …	5V	Drive encoder supply voltage: 5V(0) / 8V(1) / 15V(2)
	Pr **3.38** = Ab.Servo	Ab.Servo	Encoder type Ab.Servo(3)
	Pr **3.39** = 0 /1 /2	1	If encoder supply voltage 8V and 15V then set drive encoder termination selection Pr **3.39** = 0
SinCos	Pr **3.25** = …		Encoder phase angle
	Pr **3.26** = drv	drv	Speed feedback selector (drive)
	Pr **3.33** = …	16	Drive encoder turn bits
	Pr **3.34** = …	1024	Drive encoder lines per revolution
	Pr **3.35** = …	0	Drive encoder single turn comms resolution
	Pr **3.36** = …	5V	Drive encoder supply voltage: 5V(0) / 8V(1) / 15V(2)
	Pr **3.37** = …	300	Drive encoder comms baud rate (Not used for type SC.HiPEr)
	Pr **3.38** = SC.HiPEr	Ab.Servo	Encoder type: SC.HiPEr Stegmann
	Pr **3.38** = SC.EndAt	Ab.Servo	SC.EndAt Heidenhain
	Pr **3.38** = SC.SSI	Ab.Servo	SC.SSI
	Pr **3.40** = 3	1	Encoder feedback error detection level. 3 provides wire break detect and phase error detection for SC.xx encoders.
	Pr **3.41** = 1/0	0	Drive encoder auto-configuration / SSI binary format select
Resolver	Pr **3.25** = …		Encoder phase angle, if known
	Pr **3.26** = Slot2	drv	Speed feedback selector via Slot 2 parameter adjustment in Menu 16
	Pr **3.40** = 0	1	Disable drive encoder error detection
	Pr **x.11** =	0	Resolution
	Pr **x.13** = 2 :1	2:1	Resolver excitation: 3:1(0), 2:1(1 or 2)

NOTE

x = 15 (Slot 1), 16 (Slot 2) or 17 (Slot 3)

NOTE

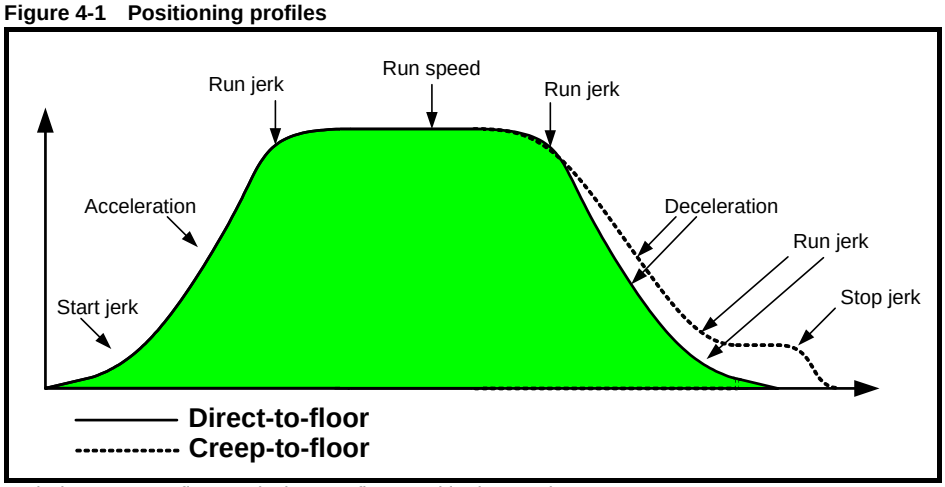
If a Resolver is being used with the SM-Resolver and an "EnC2" trip is displayed, ensure Pr **3.40** = 0, which disables the error detection on the drives main 15 way D-type encoder input.

4 Lift software functions

There are two different positioning profiles that can be selected when operating with the SM-ELV elevator software:

1. **Creep-to-floor positioning**
2. **Direct-to-floor positioning**

Figure 4-1 Positioning profiles



Both the Creep-to-floor and Direct-to-floor positioning modes are covered in detail in the following sections along with additional features which can further enhance the Unidrive SP SM-ELV elevator control solution.

Optimisation of the different segments of the velocity profile are available in addition to start optimisation, peak curve operation, short distance landing and rapid stop as detailed later in this guide.
Variable speed and current loop gains are available which will allow optimised performance, these being configurable for the start, travel and positioning (stop).
Peak curve operation - Short distance landing is available in instances where the floor distance is smaller than the braking time distance, ensuring a constant stopping distance.
Brake operation can be set-up to either be controlled from the Unidrive SP and the SM-ELV software or from the elevator controller (Brake control derived in SM-ELV software).
Output contactor control is also available through the Unidrive SP and the SM-ELV software.
Floor sensor correction can be applied which will provide the following additional benefits

1. Accuracy of the direct-to-floor positioning can be increased if the sensor is detected shortly before reaching the intended stop position.
2. A quasi direct-to-floor positioning mode using creep speed positioning can be realised if the sensor is detected before creep speed would be activated.
3. A distance controlled positioning at creep speed can be realised, if the sensor is detected during positioning.

Load direction for rescue operation is available which measures both the load and indicates the direction, this being a feature which can be used for rescue operation to indicate the rescue direction with least load. At each power down the results are saved in the SM-ELV.
Inertia compensation is available which will allow the acceleration torque to be dynamically optimised.
Load measurement will allow load dependant compensation to be applied using a load measuring transducer.
Pre door opening is available which allows the user to define a frequency / speed at which door opening begins.

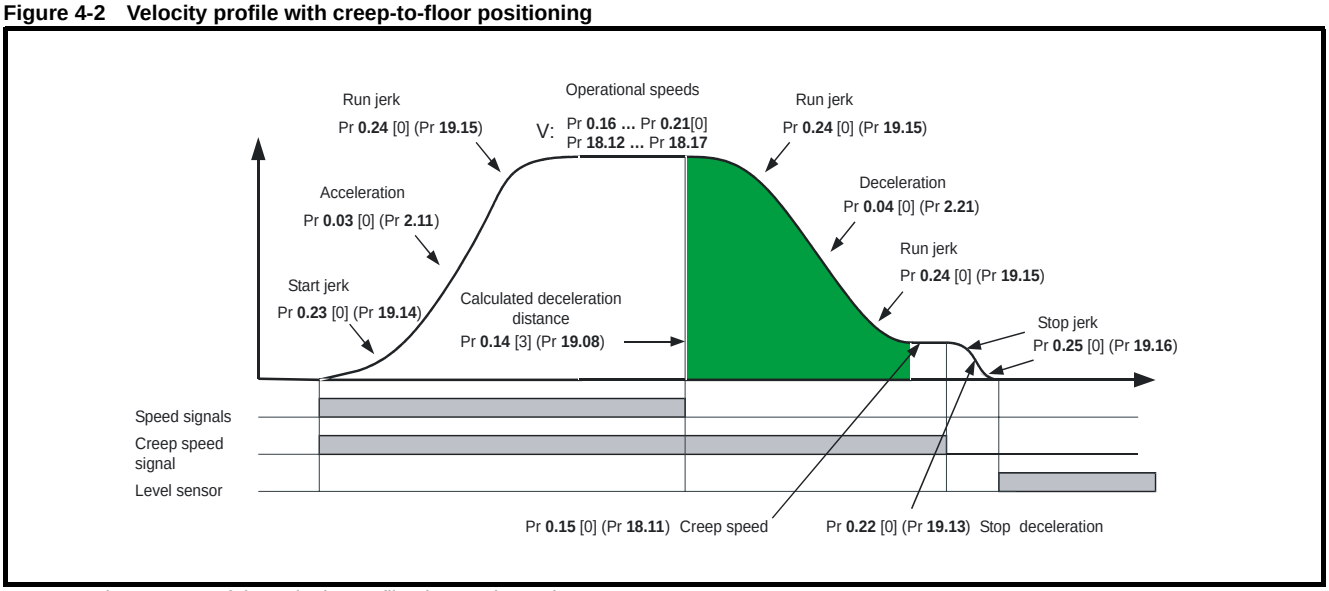
4.1 Creep-to-floor positioning

Positioning with creep-to-floor is used in most applications and is therefore selected as the **default setting** for the SM-ELV software Pr **0.16**[3] (Pr **20.13**) = 0.

The speed is applied according to the selected floor distance, and the elevator controller controls the start, travel, deceleration, switches to the creep-to-floor speed and then positions (stops) at the floor.

The elevator controller selects speeds depending on the distance called for by selecting the appropriate binary or priority speed configured in the Unidrive SP and SM-ELV software.

Figure 4-2 Velocity profile with creep-to-floor positioning



For several segments of the velocity profile shown above there are independent parameters available for example for the Acceleration and Jerk with which the performance can be optimised.

In addition to controlling the velocity profile, the required deceleration distance Pr **0.14**[3] (Pr **19.08**), dependent upon the speed and profile settings, is calculated and displayed in mm for the activated speed in Pr **0.14**[3] (Pr **19.08**).

The deceleration distance depends on the load, as it is not possible to control the distance.

The measured deceleration distance is displayed after every travel in Pr **0.15**[3] (Pr **19.10**) in mm.

NOTE

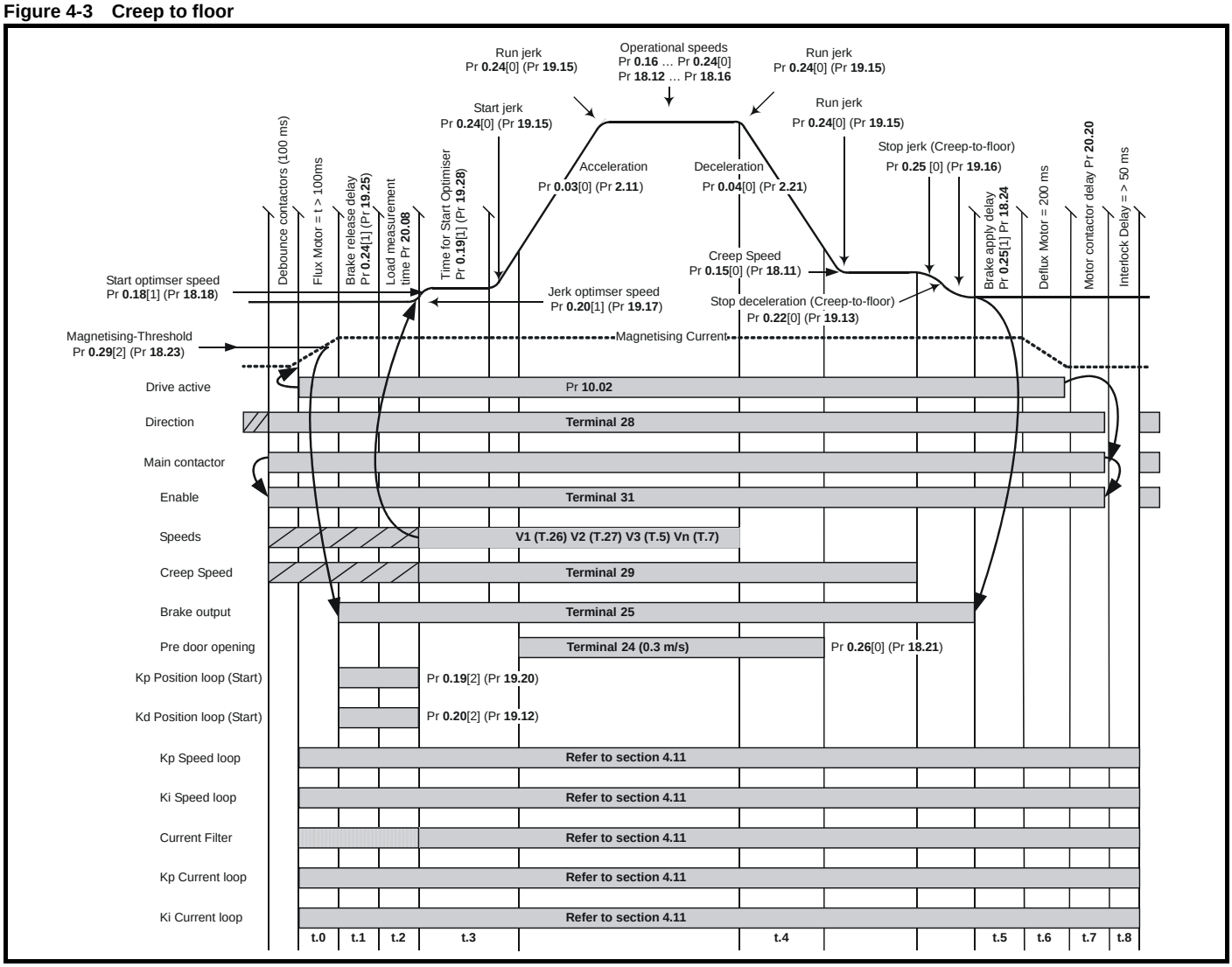
From SM-ELV software version 1.12 onwards the deceleration distances for all speeds are displayed in Pr **2.13** to Pr **2.18** and Pr **2.23** to Pr **2.25**.

Speed (mm/s)	Pr **18.12**	Pr **18.13**	Pr **18.14**	Pr **18.15**	Pr **18.16**	Pr **18.17**	Pr **20.02**	Pr **20.23**	Pr **20.24**
Deceleration distance (cm)	Pr **2.13** Pr **0.31** [3]	Pr **2.14** Pr **0.32** [3]	Pr **2.15** Pr **0.33** [3]	Pr **2.16** Pr **0.34** [3]	Pr **2.17** Pr **0.35** [3]	Pr **2.18** Pr **0.36** [3]	Pr **2.23** Pr **0.37** [3]	Pr **2.24** Pr **0.51** [3]	Pr **2.25** Pr **0.52** [3]

The real time demand on the elevator control system is low due to the positioning with creep-to-floor. With a typical cycle time of the elevator controller (5 ... 20 ms) and the elevator drive (8 ms) the minimal positioning distance with creep speed is calculated as:

- The max creep speed distance is:
  Positioning distance [m] $\geq$ **$V_{Nominal}$ [m/s] * 30 ms**
- The stop accuracy is:
  Accuracy [mm] $\leq$ **$V_{creep\ speed}$ [m/s] * 30 ms**
- The time required for creep speed is:
  Time creep speed [s]= positioning distance [m] / $V_{creep\ speed}$ [m/s]

Figure 4-3 Creep to floor



NOTE

Pr **0.29**[2] Pr **18.23** is used to adjust the magnetisation current threshold level for both Open Loop and Closed Loop Vector operation, the Deflux motor level is fixed at 200ms as shown above.

For servo operation Pr **0.29**[2] Pr **18.23** the magnetisation current threshold parameter is not required, this parameter can now be used to define the time taken to deflux the synchronous motor.

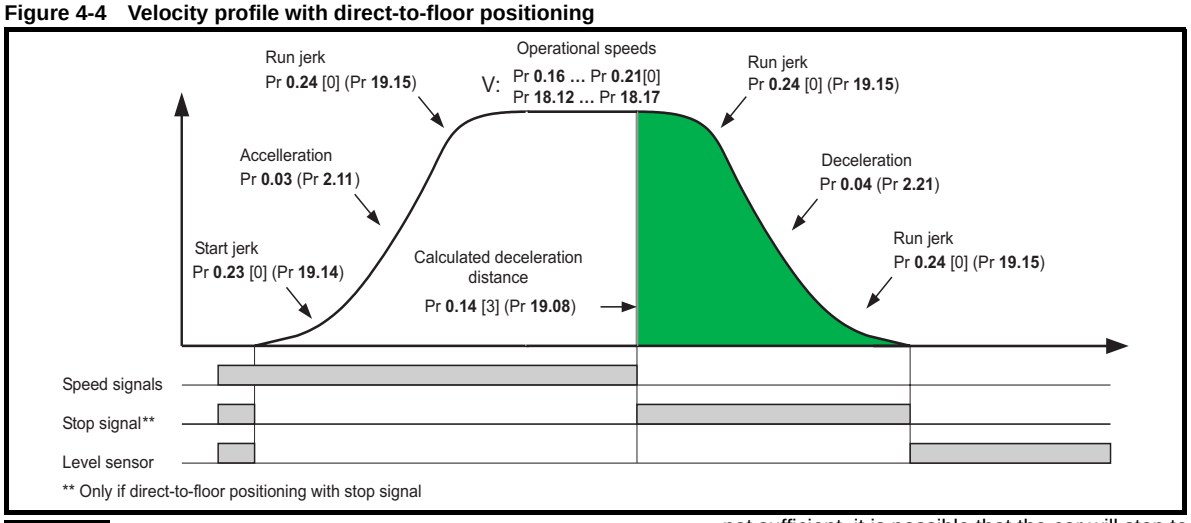
4.2 Direct-to-floor positioning

For some applications, especially high-speed elevators and long travel distance elevators direct-to-floor positioning control is often used with this overcoming inherent delays normally associated with creep-to-floor elevators.

With direct-to-floor positioning the speed is applied according to the selected floor distance. As a function of the distance to the desired final position, the elevator controller will disable the speed signal, and direct deceleration to the target position will take place. Creep speed positioning is not executed nor required. The following graph shows the characteristics of this motion profile:

Direct to floor positioning should only be used on elevating up to 1m/s due to the accuracy, above 1m/s floor sensor correction should be enabled also.

Figure 4-4 Velocity profile with direct-to-floor positioning



NOTE

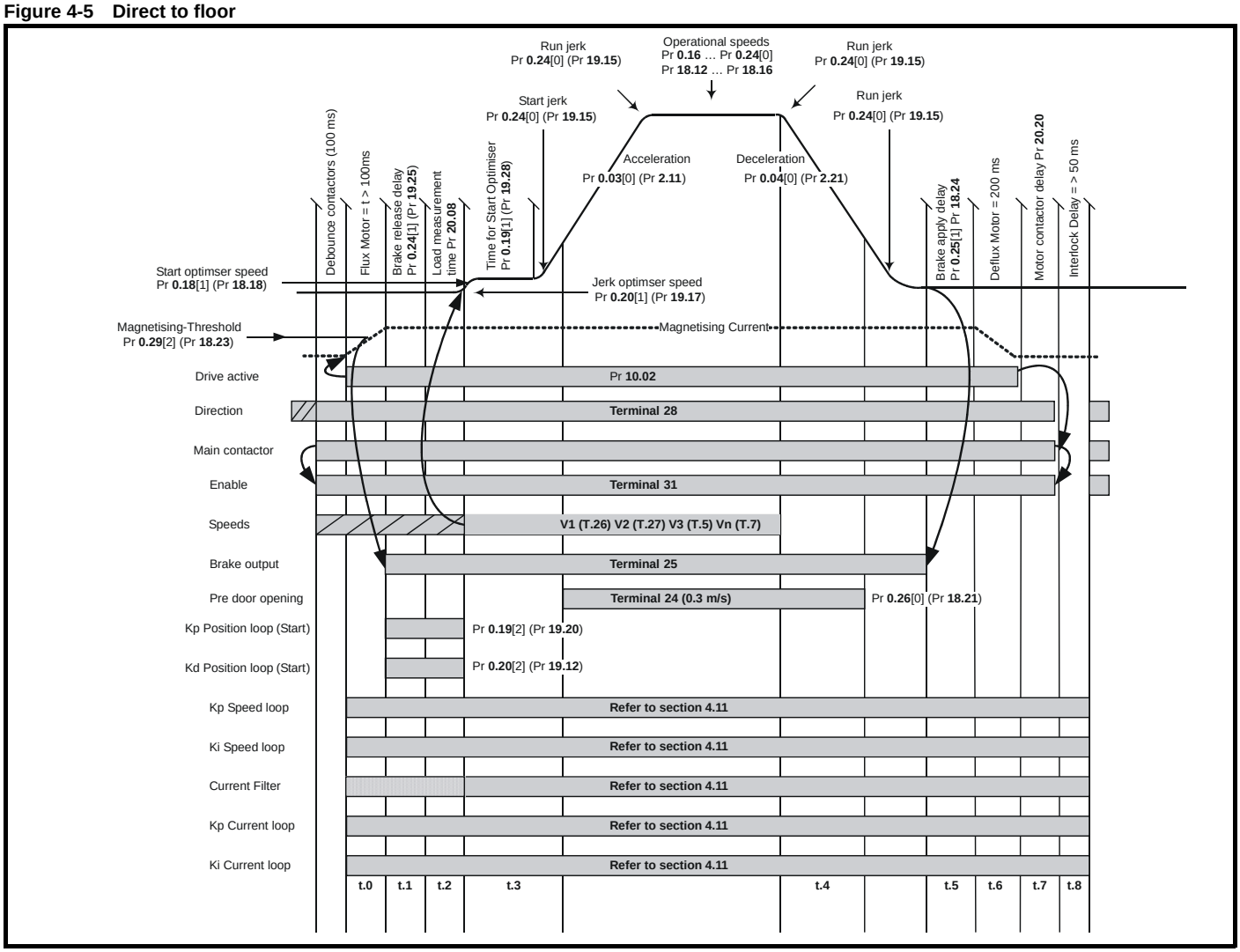
Direct to floor is enabled with Pr **20.13**

For several of the positioning profile segments different parameters are available for example Acceleration and their associated Jerks, with which the performance of the direct-to-floor can be optimised. The relevant parameters are as shown above.

To go directly to the target, the deceleration is dependent on the required stopping distance. The maximum deceleration is limited by Pr **0.04**[0] (Pr **2.21**) stop deceleration. If the correction of the deceleration rate is not sufficient, it is possible that the car will stop too late and hence overshoot the floor level.

The direct to floor positioning mode, uses as a reference the selected speed and profile settings to calculate and display the deceleration distance in Pr **0.14**[3] (Pr **19.08**) in mm, calculated deceleration distance. The deceleration distance is controlled to this value independent of the load. The actual distance moved is displayed in Pr **0.15**[3] (Pr **19.10**) in mm.

Figure 4-5 Direct to floor



NOTE

Pr **0.29**[2] Pr **18.23** is used to adjust the magnetisation current threshold level for both Open Loop and Closed Loop Vector operation, the Deflux motor level is fixed at 200ms as shown above.

For servo operation Pr **0.29**[2] Pr **18.23** the magnetisation current threshold parameter is not required, this parameter can now be used to define the time taken to deflux the synchronous motor.

4.3 Selection of positioning mode

The direct-to-floor / creep-to-floor positioning modes are enabled with parameter Pr **0.16**[3] (Pr **20.13**). The following settings can be selected:

Pr **0.16**[3] (Pr **20.13**) = 0 Direct-to-floor positioning disabled. Creep-to-floor active

Pr **0.16**[3] (Pr **20.13**) = 1 Direct-to-floor positioning with Stop signal via analogue input 1 (T.5)

Pr **0.16**[3] (Pr **20.13**) = 2 Direct-to-floor positioning with Stop signal via analogue input 2 (T.7)

Pr **0.16**[3] (Pr **20.13**) = 3 Direct-to-floor positioning with Stop signal via analogue input 3 (T. 8)

Pr **0.16**[3] (Pr **20.13**) = 4 Direct-to-floor positioning with disable the speed signals (controlling)

4.4 Position accuracy

The deceleration distance is calculated from the activated speed. If the speed signal is deactivated (Pr **0.16** [3], (Pr **20.13**) = 4), or the stop signal is activated (Pr **0.16** [3] (Pr **20.13**) = 1...3) the calculated deceleration distance will be controlled independent of the load level.

At higher travel speeds the actual position at which the car will stop is highly dependent on the time when deceleration begins. For example, if the I/O read cycle time of the drives inputs is 1ms, and if the cycle time of the elevator controller is 1ms the position accuracy is:

Accuracy [mm] = $V_{nominal}$ [m/s] * 2 mm.

Because of this, the usage of direct-to-floor positioning is limited to about 1m/s. At higher speeds, additional distance control for accurate stopping should be used. (Additional floor sensor correction can be used to control the final distance moved, see section 4.5 *Floor sensor correction* on page 29).

NOTE

From SM-ELV software version 1.12 onwards the deceleration distances for all speeds are displayed in Pr **2.13** to Pr **2.18** and Pr **2.23** to Pr **2.25**.

4.5 Floor sensor correction

Independent of the selected profile additional floor sensor correction can be utilised. Improved accurate distance correction is possible if a floor sensor can be detected in the range of 50-500mm before the flush or level with floor target position.

Floor sensor correction should be used with direct-to-floor positioning control on elevators with speeds in excess of 1m/s. This ensures maximum accuracy.

To enable floor sensor correction, the following parameters should be set up:

Pr **0.17**[3] (Pr **19.42**)

Pr **0.19**[3] (Pr **20.14**)

Pr **0.20**[3] (Pr **18.19**)

Given this:

- Rope slip can be compensated (as long as the normal stopping distance is short without the additional compensation provided by the direct-to-floor positioning mode).
- A quasi direct-to-floor positioning can be realised if the additional sensor is detected before positioning at creep speed, (creep-to-floor positioning mode).
- Floor sensor correction can be utilised if detected during the positioning travel at creep speed, in the creep-to-floor positioning mode.

NOTE

The floor sensor correction or the distance controlled creep speed can only be used in closed loop or servo mode. In open loop mode, a normal deceleration with the programmed ramp can only be implemented.

NOTE

If the floor sensor enable Pr **0.17**[3] (Pr **19.42**) = 0 all values concerning floor sensors can be checked for correct operation. All measured values, which are required for the floor sensor, for example the deceleration distance, time from the floor sensor and the speed at floor sensor are displayed and can be checked. This means, that all functions of the floor sensor correction can be proofed, prior to being enabled.

The floor sensor correction uses as a reference, the floor sensor target distance defined by the user in Pr **0.20**[3] (Pr **18.19**) in mm. The floor sensor target distance is controlled independent of the load. The remaining distance to the floor sensor in mm is displayed Pr **0.21**[3] (Pr **18.09**). Additionally, Pr **0.23**[3] (Pr **20.05**) displays the time from floor sensor active to the stop, and Pr **0.22**[3] (Pr **19.09**) displays the speed at the floor sensor correction activation.

If the Stop distance is too low, or the floor sensor signal given at too high a speed, it is possible that the car may not stop smoothly and a hard stop will occur (Figure 4-6 - profile (3))

The floor sensor correction is activated based upon the settings of Pr **0.19**[3] (Pr **20.14**) which is used to set-up the source for the external floor sensor correction signal:

1. Pr **0.19**[3] (Pr **20.14**) = 0 Floor sensor correction disabled
2. Pr **0.19**[3] (Pr **20.14**) = 1 Floor sensor correction = Analogue input 1
3. Pr **0.19**[3] (Pr **20.14**) = 2 Floor sensor correction = Analogue input 2
4. Pr **0.19**[3] (Pr **20.14**) = 3 Floor sensor correction = Analogue input 3
5. Pr **0.19**[3] (Pr **20.14**) = 4 Distance controlled stopping distance

4.5.1 Floor sensor correction, Analogue input

Conditions 1, 2, or 3: (Pr **0.19**[3] (Pr **20.14**) = 1,2 or 3 (Figure 4-6 - profile (2))

When the floor sensor correction signal is activated, the floor sensor target distance is controlled independant of load. Because of direct deceleration from a higher speed, the real time demand on the control system is high and dependent upon the parameter settings and I/O speed. For example, if the cycle time of the elevator controller is 1ms, and the drives inputs are also 1ms the position accuracy is:

Accuracy [mm] = $v_{\text{speed at floor sensor active (Pr 19.09)}}$ [m/s] * 2 mm

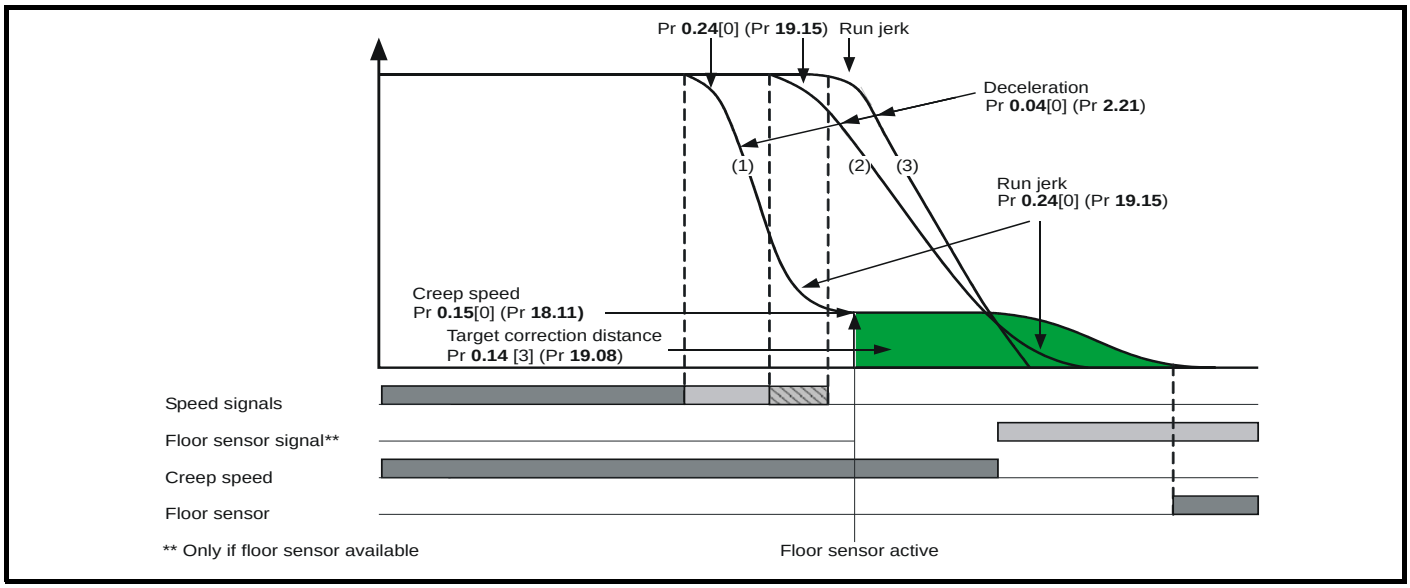
It should be noted that the floor sensor correction signal should be activated instantaneously at that position which is Pr **0.20**[3] (Pr **18.19**) floor sensor target distance away from the floor sensor in **mm**.

The stop signal can be used for all speeds. The creep speed signal can be deactivated at any time after the floor sensor correction signal is activated.

NOTE

If the creep speed signal is still active at standstill the motor will accelerate to creep speed.

Figure 4-6 Floor sensor correction profiles



4.5.2 Distance controlled creep speed

Condition 4: (Pr **0.19**[3] (Pr **20.14**) = 4 (Figure 4-6 - profile (1))

If the creep speed signal is deactivated, the controlled stopping distance in Pr **0.20**[3] (Pr **18.19**) will be active. The relevant profile parameters are Pr **0.22**[0] (Pr **19.13**) deceleration, and Pr **0.25**[0] (Pr **19.16**) stop jerk (creep-to-floor). In this case, because the deceleration is from creep speed, the real time demand to the elevator controller is low. For example if the cycle time of the elevator controller is 10ms and the elevator drive 1ms, the accuracy can be calculated and the stop accuracy would be:

Accuracy [mm] <= $v_{creep\ speed}$ [m/s] * 11 mm

4.5.3 Deceleration and stopping distance calculation

If the speed or profile parameters are changed then the deceleration and stopping distances will change. The elevator controller can compensate for these changes by recalculating the final deceleration to achieve the floor sensor correction distance through a “learn” if this is possible. However to reach the target distance, profile parameters are limited for deceleration to 2 x Pr **0.04**[0] (Pr **2.21**) and the jerk to a maximum value of Pr **0.25**[0] (Pr **19.16**). If the stop distance is too low or the floor sensor signal was given at too high a speed the car may not be able to stop smoothly and therefore a hard stop will be implemented. To change the parameters in the elevator controller correctly, the drive calculates the deceleration and stop distances and displays them in the following parameters:

Table 4-1 Floor sensor correction parameters

Parameter	Distance controlled creep speed	Direct-to-floor
Pr **0.17**[3] (Pr **19.42**)	Floor sensor correction enable = 1	
Pr **0.19**[3] (Pr **20.14**)	Source for floor sensor correction	
Pr **0.22**[3] (Pr **19.09**)	N/A	Speed at floor sensor correction activation in mm/s
Pr **0.20**[3] (Pr **18.19**)	Floor sensor correction target distance	
Pr **0.29**[3] (Pr **19.05**)	Stopping distance (from V_1 to V = 0) in mm	Stopping distance in mm
Pr **0.14**[3] (Pr **19.08**)	Calculated deceleration distance from V_{set} to V_1 in mm	Calculated deceleration distance from V_{set} to 0 in mm
Pr **0.15**[3] (Pr **19.10**)	Measured deceleration distance from V_{set} to V_1	Measured deceleration distance from V_{set} to 0 in mm
Pr **0.21**[3] (Pr **18.09**)	Remaining floor sensor distance	
Pr **0.23**[3] (Pr **20.05**)	Time from floor sensor active	

The profile parameters and the creep speed setting are used for calculating distances. At default settings, the creep speed in Pr **0.15**[0] (Pr **18.11**) is used. This assignment can be changed through Pr **20.12** creep speed parameter.

NOTE

At completion of the floor sensor correction, Pr **0.21**[3] (Pr **18.09**) = 0 (±1), Pr **18.10** the reference selector should be 1810 (no reference selected).

NOTE

The point at which the floor sensor signal (Analogue input 1 (T.5) input 2 (T.7) or input 3 (T.8) if Pr **0.19**[3] (Pr **20.14**) = 1, 2 or 3) becomes active is usually between 50 and 500mm prior to the floor level (above 500mm the accuracy at the floor level will be reduced).

NOTE

If Pr **0.19**[3] (Pr **20.14**) = 4 then the distance controlled creep speed is selected, here the floor sensor correction signal is activated during the creep speed.

Figure 4-7 Distance controlled creep speed - floor sensor correction

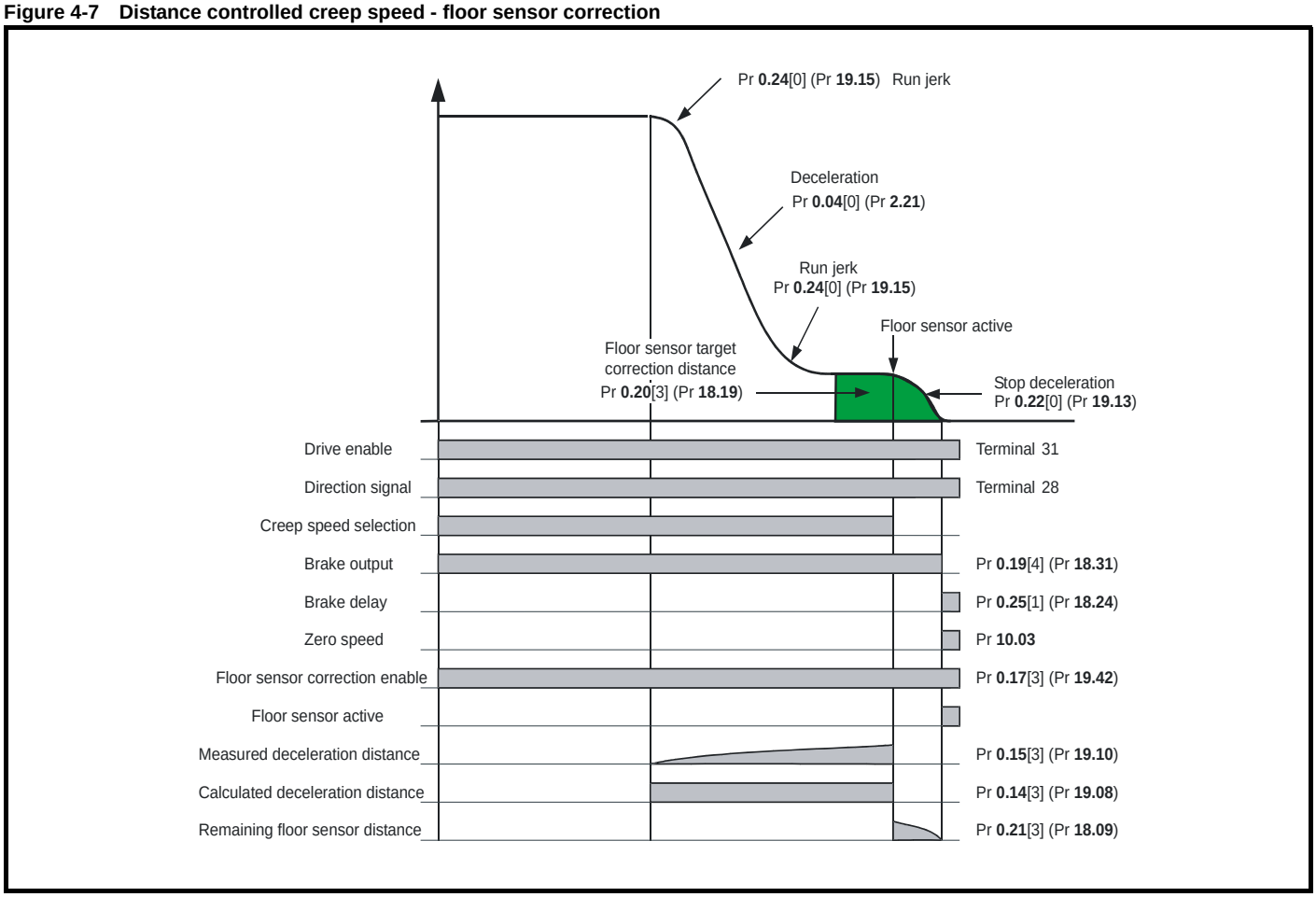
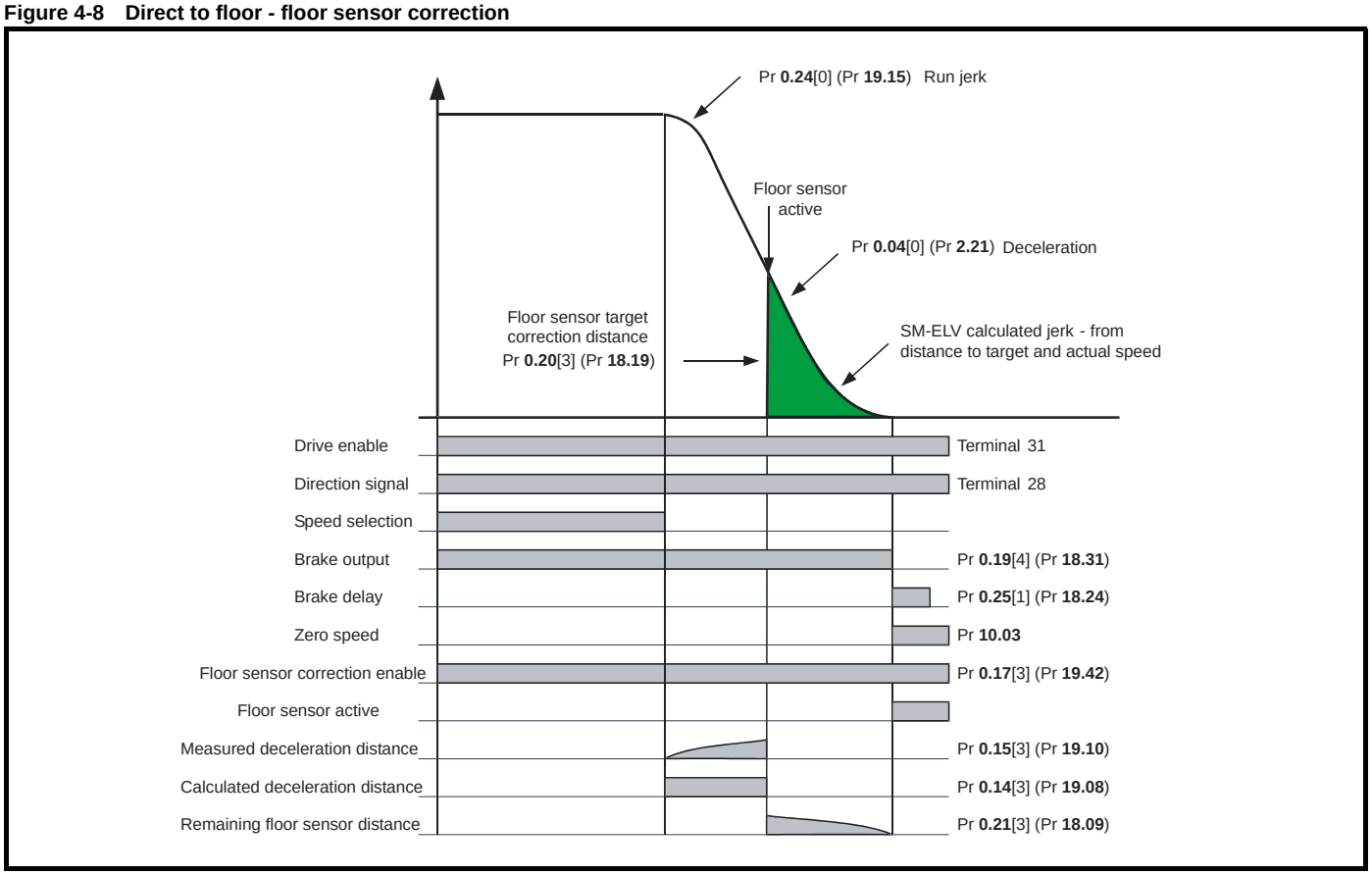


Figure 4-8 Direct to floor - floor sensor correction



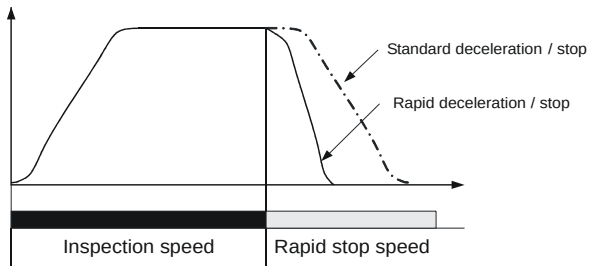
4.6 Rapid stop

A rapid stop function has been introduced with software version 1.10 onwards which is enabled by setting Pr **19.49** = 1. The rapid stop feature is available mainly for commissioning and inspection of the elevator, providing the following features:

- Offers user defined Rapid stop profile
- Provides faster stopping, rather than following the standard deceleration and jerks that may be too long during commissioning and inspection.
- Can overcome hard stops and be less aggressive during short movements during commissioning and installation.

If rapid stop is enabled, when selecting a speed with the value of 0 mm/s for the deceleration, the deceleration rate in Pr **21.05** is selected which is available for the rapid stop deceleration only (Closed Loop in m/s^2 /Open Loop in cm/s^2). The deceleration jerk is set to 200 ms in order to run as smoothly as possible.

Figure 4-9 Rapid stop



4.7 Start optimiser

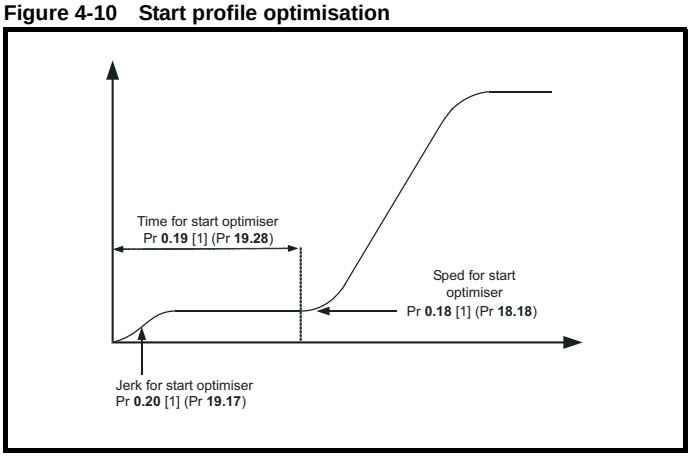
To overcome static friction in the elevator arrangement or to overcome starting difficulties a start optimiser function is available.

This function is activated by setting the start optimisation time in Pr **0.19**[1] (Pr **19.28**) > 0. Also a target speed for the start optimiser must be set in Pr **0.18**[1] (Pr **18.18**) > 0, along with the start optimiser jerk in Pr **0.20**[1] (Pr **19.17**).

Table 4-2 Softstart parameters

Parameter	Function	Detail
Pr **0.18** [1] (Pr **18.18**)	Target speed in mm/s for start optimisation	Setting between 2...5mm/s.
Pr **0.19** [1] (Pr **19.28**)	Time in ms for start optimisation	Setting between 500 to 800ms.
Pr **0.20** [1] (Pr **19.17**)	Jerk in mm/s^3 for starting optimisation	Setting from 10 up to 20 (must be less than the acceleration jerk in Pr **0.22**) smaller values will provide smoother but slower acceleration.

Figure 4-10 Start profile optimisation



NOTE

If the target speed set in Pr **0.18**[1] (Pr **18.18**) is not reached during the time defined in Pr **0.19**[1] (Pr **19.28**) there will be a continuous transition to the nominal acceleration.

4.8 Peak curve operation

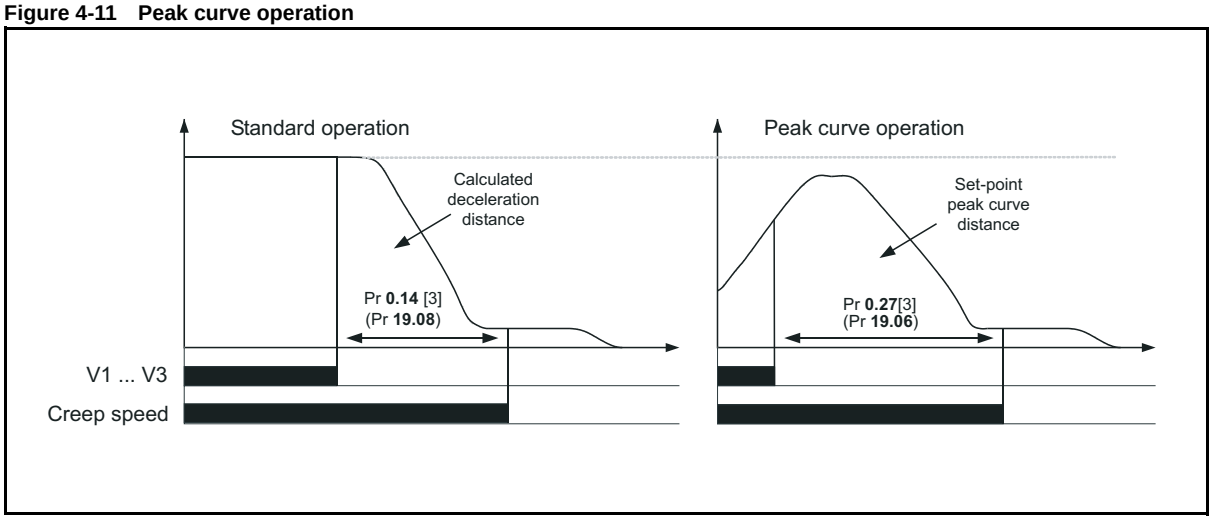
This function guarantees a constant stopping distance, independent of the moment when the signal to stop occurs. This allows the use of a single speed for different floor levelling distances. Peak curve operation modifies the maximum operating speed to ensure that the required distance is achieved and floor level is reached. The peak curve operation can be used during both Creep-to-floor operation and Distance controlled creep speed (Floor sensor correction mode).

The peak curve operation is enabled by setting Pr **0.27** [1] (Pr **18.47**) = 1 (Default = 0).

Depending on the speed when the speed signal is disabled, 3 different results can occur:

- If the final speed is achieved there is no influence on the speed profile.
- If there is increasing or constant acceleration, braking occurs with the normal profile parameters in a calculated time.
- During deceleration and the transition to a stop, the profile parameters are automatically adjusted.

Figure 4-11 Peak curve operation



The reference speed before and after speed reduction is used as the calculation base for the controlled stopping distance.

The Set-point peak curve distance is calculated from the profile parameters and displayed in Pr **0.27**[3] (Pr **19.06**). This value is equivalent to the deceleration distance for the applied speed.

The deceleration distance is measured during peak curve operation and displayed in Pr **0.28**[3] (Pr **19.07**).

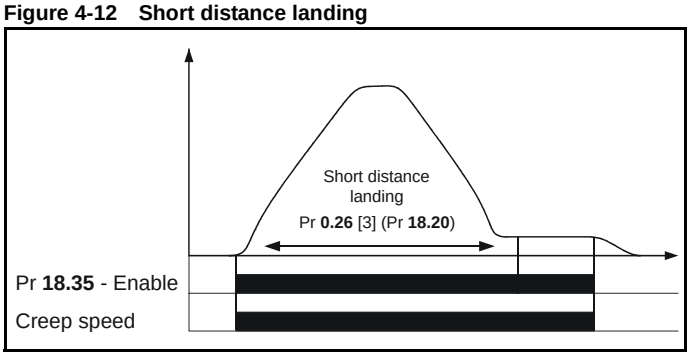
4.9 Short distance landing

If the floor distance is smaller than the braking time distance from the selected speed, then the peak curve operation cannot be used. This is the case if the floor distance is less than 0.7 m for example. For such small floor distance, the elevator software function provides the short distance landing with real distance control. Short distance landing is enabled with Pr **18.35** via an additional digital input.

The short distance is defined in Pr **18.20** and enabled with a digital input from the elevator controller at the floor level (less then 0.7m)

The control signals for creep speed and short distance landing must be applied simultaneously. The speed profile is internally calculated in order that the creep speed is reached after the short distance Pr **0.26**[3] (Pr **18.20**). If the creep speed command is disabled, the elevator drive stops the car with the set deceleration.

Figure 4-12 Short distance landing

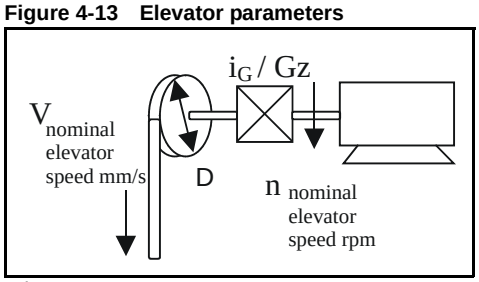


4.10 Nominal elevator rpm calculation and adjustment

The ratio of nominal elevator rpm Pr **0.13**[0] (Pr **18.29**) to nominal elevator speed Pr **0.14**[0] (Pr **18.30**) is as follows. The nominal elevator rpm Pr **0.13**[0] (Pr **18.29**) is defined by the mechanical conditions as follows:

Pr **0.13**[0] (Pr **18.29**) [$n_{Nominal}$] = Pr **0.14**[0] (Pr **18.30**) [$v_{Nominal}$] * i_G * Z * 60 / (Ω * D * GZ)

Figure 4-13 Elevator parameters



Where:

n	Nominal elevator speed rpm	Pr **0.13**[0] (Pr **18.29**) in min_{-1}
V	Nominal elevator speed mm/s	Pr **0.14**[0] (Pr **18.30**) in mm/s
Z	Roping (1, 2, 3 or 4)	Pr **0.14**[1] (Pr **20.10**) (1=1:1 / 2=2:1 / 3=3:1 / 4=4:1)
D	Sheave Diameter	Pr **0.15**[1] (Pr **19.29**) in mm
i_g	Gear Ratio Numerator	Pr **0.16**[1] (Pr **19.30**)
GZ	Gear Ratio Denominator	Pr **0.17**[1] (Pr **19.27**)

After adjustment of the above parameters, the calculated nominal elevator rpm is displayed in Pr **0.13**[1] (Pr **18.03**) in rpm. With **software version 01.10** onwards the value of Pr **0.13**[0] (Pr **18.29**) can be set up automatically by setting Pr **19.31** = 1. The calculations are exact, however manual adjustment is possible and can be achieved by changing the value of Pr **0.13**[0] (Pr **18.29**) as follows:

If the speed of the elevator is too high, the nominal rpm Pr **0.13**[0] (Pr **18.29**) should be reduced.

If the speed of the elevator is too low, the nominal rpm Pr **0.13**[0] (Pr **18.29**) should be increased.

4.11 Variable Gains - selection / optimisation

The following variable gains can be used for optimisation of the speed loop (Kp and Ki) gains, current loop (Kp and Ki) gains and current loop filter.

There are three settings for the variable gains, one being constant, one having a user determined transition time and the third having a profile / travel determined transition time, the options are determined by which version of lift software you are operating with.

Constant (standard Unidrive SP) gains are available with all SM-ELV software versions.
User determined transition time
variable speed loop gains for Start and Travel can be activated by setting Pr **0.21**[2] (Pr **18.48**) = On as detailed following.

Profile / travel determined transition time = Software version V1.07 and later. These variable speed loop / current loop gains and current loop filter are enabled by setting Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = On as detailed following.

The following sections cover in more detail the variable speed loop and current loop gain settings along with a variable current loop filter. These can be configured for the Start, Travel and Positioning (Stop) or just start; dependant upon the mode being implemented and SM-ELV software version, detailed as follows. The variable gains will operate in either Direct-to-floor or Creep-to-floor

Table 4-3 Variable gains

Mode	Active	SM-ELV S/W	Transition mode
Constant Speed loop gains Pr **18.48** = 0	Whole profile		N/A
Separate Speed loop gains Pr **18.48** = 1, Pr **19.48** = 0	Start, Travel		Pr **19.11** > 0 transition time ms
Separate Speed loop, Current loop gains, Current demand filter Pr **18.48** = 1, Pr **19.48** =1	Start, Travel, Positioning (stop)	V1.07 onwards	Speed controlled transition time.
Separate Speed loop, Current loop gains, Current demand filter Pr **18.48** = 1, Pr **19.48** =1	Start, Travel, Positioning (stop)	V1.13 onwards	Acceleration Pr **19.11** = 0 Speed controlled transition time Pr **19.11** > 0 = transition time ms Deceleration Pr **20.30** = 0 Speed controlled transition time Pr **20.30** > 0 = transition time ms

4.11.1 Constant gains

Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = OFF

Following are the standard speed and current loop optimisation parameters which are only destinations in the variable gain set-up and written to from the SM-ELV software, Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = OFF.

If Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = OFF constant gains are used and can be adjusted in the parameters as shown in Table 4-4.

Table 4-4 Constant speed / current loop gains
Pr **0.21**[2] (Pr **18.48**)**,** Pr **19.48** = OFF

Parameter			Detail
Speed loop	Pr **0.07** (Pr **3.10**)	P- Gain	Higher values improve the smooth running and the stiffness. Values recommended between 0.100 (Incremental Encoder) and 0.500 (SinCos)
	Pr **0.08** (Pr **3.11**)	I - Gain	Higher values will decrease the effect of the load with smaller values reducing the overshoot of the speed loop. Usually adjust the value between 1.00 and 5.00
	Pr **0.09** (Pr **3.12**)	D - Gain	Operates as a feed forward term in the speed loop. Increased values will reduce overshoot in the speed loop. However this is normally not used and set to 0
	Pr **3.42**	Speed feedback filter in ms	Used with high inertia loads and high gains to smooth the torque demand and prevent latch up effects of the speed loop.
Current loop	(Pr **4.13**)	P - Gain	This value should be derived from the stationary auto tune and may require adjustment if acoustic noise or current instability is present: ± 50
	(Pr **4.14**)	I - Gain	This value should be derived from the stationary auto tune and may require adjustment if acoustic noise or current instability is present: ± 100
	Pr **0.14**[2] (Pr **4.12**)	Torque demand filter in ms	Acts in the speed loop output, reducing acoustic noise caused by high-speed loop gains. Typical values are between 0 and 5

NOTE

The speed loop Kp and Ki gains in Pr **0.07** (Pr **3.10**) and Pr **0.08** (Pr **3.11**) are for display only when variable gains are selected with Pr **0.21**[2] (Pr **18.48**) and Pr **19.48**, and therefore cannot be modified. The values in Pr **0.07** (Pr **3.10**) and Pr **0.08** (Pr **3.11**) show the active speed loop gain. When the variable gains are inactive the values in Pr **0.07** (Pr **3.10**) and Pr **0.08** (Pr **3.11**) can be modified as normal.

4.11.2 Seperate speed loop gains

Pr **0.21**[2] (Pr **18.48**) = On, Pr **19.48** = OFF

When using planetary gearboxes it is advisable to separate the speed loop gains for Start and Travel. This can be activated by setting Pr **0.21**[2] (Pr **18.48**) = On and offers various speed loop gain settings for travel Pr **0.23**[2] (Pr **18.25**) / Pr **0.24**[2] (Pr **18.26**) and Start Pr **0.25**[2] (Pr **18.27**) / Pr **0.26**[2] (Pr **18.28**), along with a programmable current loop filter for start and travel as shown in Table 4-5 .

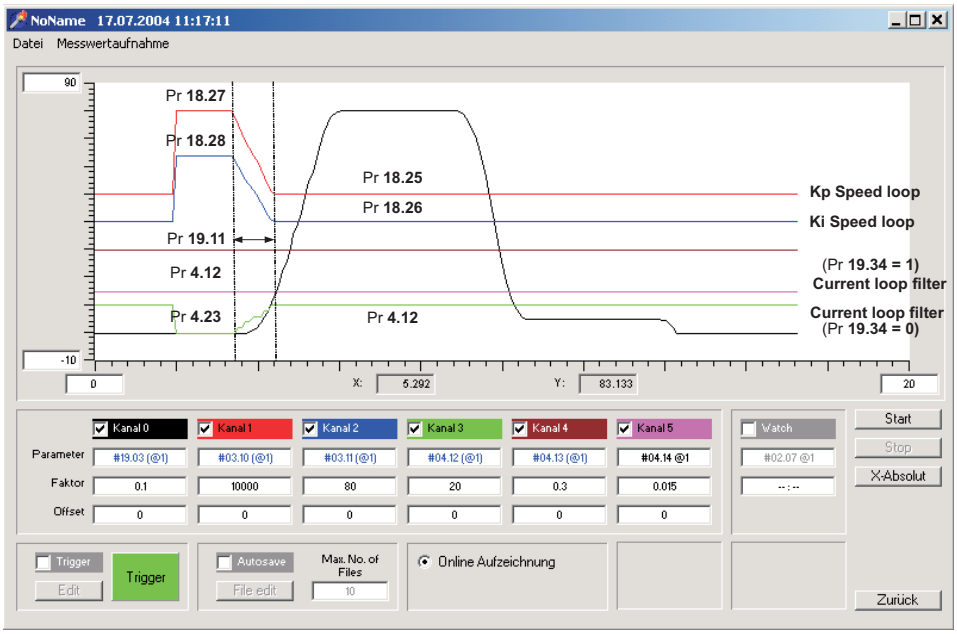
These parameters are switched depending on the transition time, set-up by the user. Pr **0.22**[2] (Pr **19.11**) defines the transition time between start and travel for the P and I speed loop gains and current loop filter. The transition time should be set-up to avoid switching vibrations / instability. For Start the speed loop gains can be up to 2 to 3 times the setting required for the Travel, this equating to a reduction of the position error at brake opening to between 1/4 and 1/9.

The following parameters are available for optimising the speed loop gains, and current loop filter.

Table 4-5 Variable gains Pr **0.21**[2] ,Pr **18.48** = On, Pr **19.48** = OFF

Parameter	Function	Detail
Pr **0.23**[2] (Pr **18.25**)	Speed loop P gain - Travel	Increasing value improves true running and rigidity. Set values between 1000 (encoder) and 5000 (SinCos)
Pr **0.24**[2] (Pr **18.26**)	Speed loop I gain - Travel	Increasing value reduces deviation. Reducing value reduces overshooting. Approx. 10...40% of Pr **0.23**[2] (Pr **18.25**)
Pr **0.25**[2] (Pr **18.27**)	Speed loop P gain - Start	Increasing value improves rigidity. Set values between 2000 (encoder) and 10000 (SinCos)
Pr **0.26**[2] (Pr **18.28**)	Speed loop I gain - Start	Increasing value reduces angle deviation and jolting at start. Approx. 30 – 80% of Pr **0.25**[2] (Pr**18.27**)
Pr **0.22**[2] (Pr **19.11**)	Gain transition time in ms	Changeover time for the speed loop gains from start to travel setting, beginning with the start
Pr **0.14**[2] (Pr **04.12**)	Current filter Travel	Current loop output filter. Reduces control noise by fine adjustment of torque demand.
Pr **0.13**[2] (Pr **04.23**)	Current filter Start	Reduces control noise at the start, only if Pr **19.34** = 0, otherwise Pr **4.12** applies also for start.
Pr **0.15**[2] (Pr **19.34**)	Current filter Fixed	Activates fixed current filter for start and travel
Pr **0.38**[0] (Pr **4.13**)	Current loop P gain	Fixed Kp gain
Pr **0.39**[0] (Pr **4.14**)	Current loop I gain	Fixed Ki gain

Figure 4-14 Start to travel variable gains



4.11.3 Seperate speed loop and current loop gains and current demand filter, SM-ELV V1.07 onwards

Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = On

With this procedure each travel section can be allocated its own gain setting. This procedure is used with critical lifts where the above procedure is not sufficient or if gains are necessary for the positioning (stop) that are different from those required for constant travel, and start.

The transfer between the gains is controlled either linearly with the speed or using a user defined transition time in Pr **19.11** and Pr **20.30**.

The transfer of the gains linearly with speed in enabled by setting both Pr **19.11** and Pr **20.30** = 0 to enable user defined transition times enter values in Pr **19.11** and Pr **20.30**.

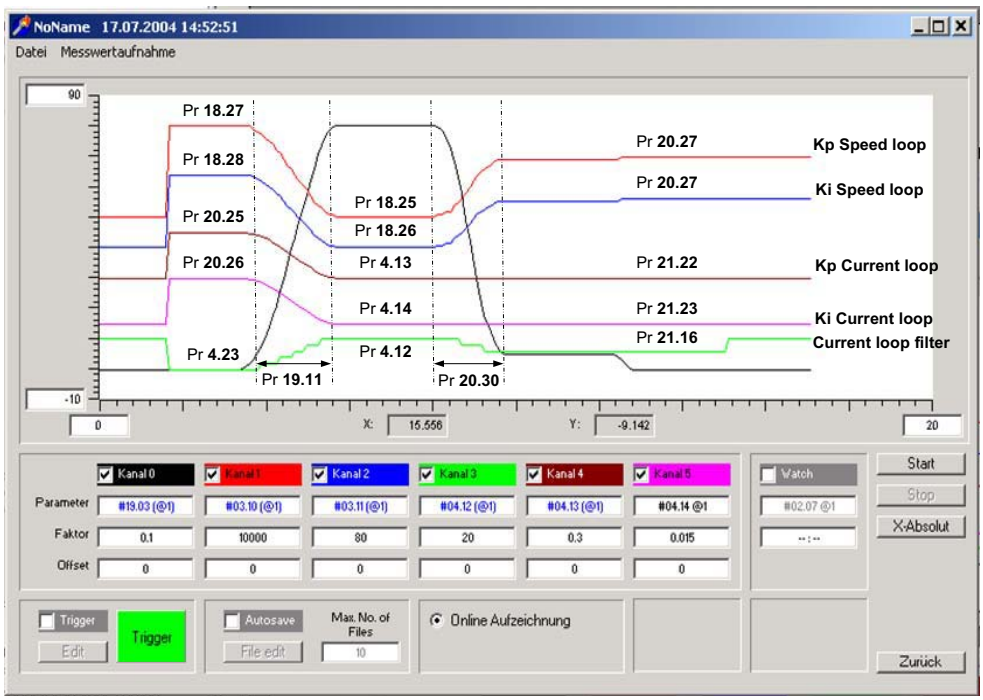
The following settings are used:

Table 4-6 Variable gains Pr **0.21**[2] (Pr **18.48**), Pr **19.48** = On

Function	Start	Travel	Positioning
Speed Loop P gain	Pr **18.27**	Pr **18.25**	Pr **20.27**
Speed Loop I gain	Pr **18.28**	Pr **18.26**	Pr **20.28**
Current Loop filter	Pr **04.23**	Pr **04.12**	Pr **21.16**
Current Loop P gain	Pr **20.25**	Pr **04.13**	Pr **21.22**
Current Loop I gain	Pr **20.26**	Pr **04.14**	Pr **21.23**
Transition time Start	Pr **19.11**	N/A	N/A
Transition time Stop	N/A	N/A	Pr **20.30**

Also refer to Figure 4-15 which details all parameters associated to the set-up and adjustment of the variable gains.

Figure 4-15 Start, travel, positioning variable gains



4.12 Position controller for start

With both gearless lifts and planetary gears a position controller is particularly suitable for the start, this prevents any movement of the motor during brake opening. The position controller is made up of both a Proportional and Derivative term.

This feature will attempt to hold the car in position during opening of the brake and is only active whilst the brake is being opened. Once the motor starts the position controller then becomes inactive.

This position controller has the same objective as the separate travel and start variable gains but works independently of these. The two procedures, Position controller for start and Variable gains can however be used at the same time. However, under normal circumstances the variable gains should be sufficient to eliminate any jerk during opening of the brake.

When setting the P gain, Pr **0.19**[2] (Pr **19.20**) to > 0 the car is always pulled back into position during opening the brake. The maximum detectable position error is determined by the level of Pr **0.19**[2] (Pr **19.20**). Settings from 3 up to 30 are recommended.

The D gain Pr **0.20**[2] (Pr **19.12**) counteracts a detectably quick change of position. Settings from 10 up to 100 are recommended. This helps the P position control and performs more minor compensation procedures with slight deviations. The set values are limited by the stiffness of the speed loop gains, which are determined essentially by the speed feedback device being used (SinCos encoders being far superior (higher resolution) to standard incremental encoders or resolvers).

NOTE

The position controller for start only operates if a speed has been selected (Pr **0.28**[0] Pr **18.10** > 1810). The position controller is operating when the display shows “run”, and a speed is selected (Pr **0.28**)[0] (Pr **18.10**) >1810). If STOP is displayed, the position controller is not operating as no speed is being selected.

4.13 Error detection

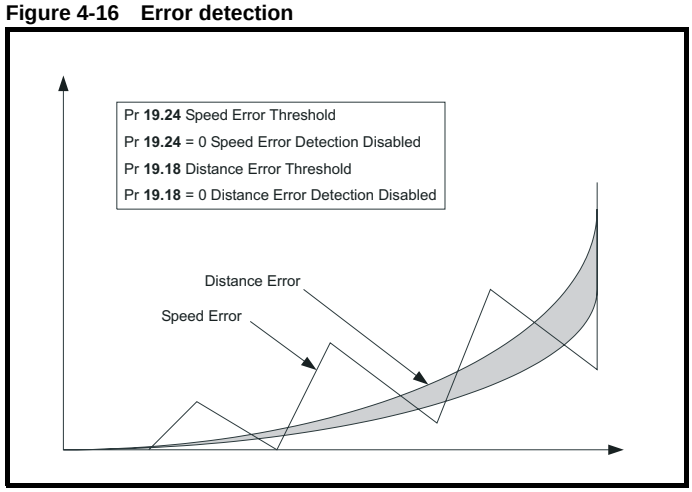
The following speed and distance error detection features are used to protect against the following possible failure modes:

Table 4-7 Position controller parameters

Parameter	Function	Detail
Pr **0.19**[2] (Pr **19.20**)	Start P gain	Values > 0 cause the position to be held when opening the brake. Greater values reduce the jerk when transferring the load. Recommended values are between 3 and 30.
Pr **0.20**[**2**] (Pr **19.12**)	Start D gain	Values > 0 cause the position to change quickly when opening the brake and thus reduce the jerk when transferring the load. Recommended values are between 10 and 100.

- Errors in the motor connection and phase co-ordination
- Errors in the encoder connection and encoder functionality
- Errors in the motor model including feedback phase angle (brushless synchronous motors)

Figure 4-16 Error detection



4.13.1 Open loop

Speed Error Detection (Trip 70)

For open loop mode the error detection is activated once the drive reaches current limit operation with the trip being generated after the time defined in Pr 19.24 (2s default). Pr 19.24 is used to define the allowable time to operate in current limit, high values will result in the detection being disabled.

4.13.2 Closed loop

Speed Error Detection (Trip 70)

The speed error is calculated from the difference between the ramp speed Pr **19.03** and to the actual speed of the motor in Pr **19.02**.

The speed error is compared with the user setting of the allowable threshold set in Pr **0.26**[4] (Pr **19.24**). If the threshold is exceeded for more than 100msec a Trip 70 is generated by the SM-ELV elevator software.

The speed error during one travel is displayed in Pr **0.25**[4] (Pr **18.07**) independent of the activation of the speed error detection. The display is reset to 0 at each start. The Speed error detection can be disabled by setting Pr **0.26**[4] (Pr **19.24**) = 0.

Distance Error Detection (Trip 71)

The distance error is the integral of the difference between the ramp speed Pr **19.03** and the actual speed of the motor Pr **19.02**.

The distance error is compared with an allowable threshold set in Pr **0.28**[4] (Pr **19.18**). If the distance error exceeds the user defined threshold, a Trip 71 is generated.

The distance error during one travel is displayed in Pr **0.27**[4] (Pr **18.06**) independent of the activation of the error detection. The display is reset to 0 at each start.

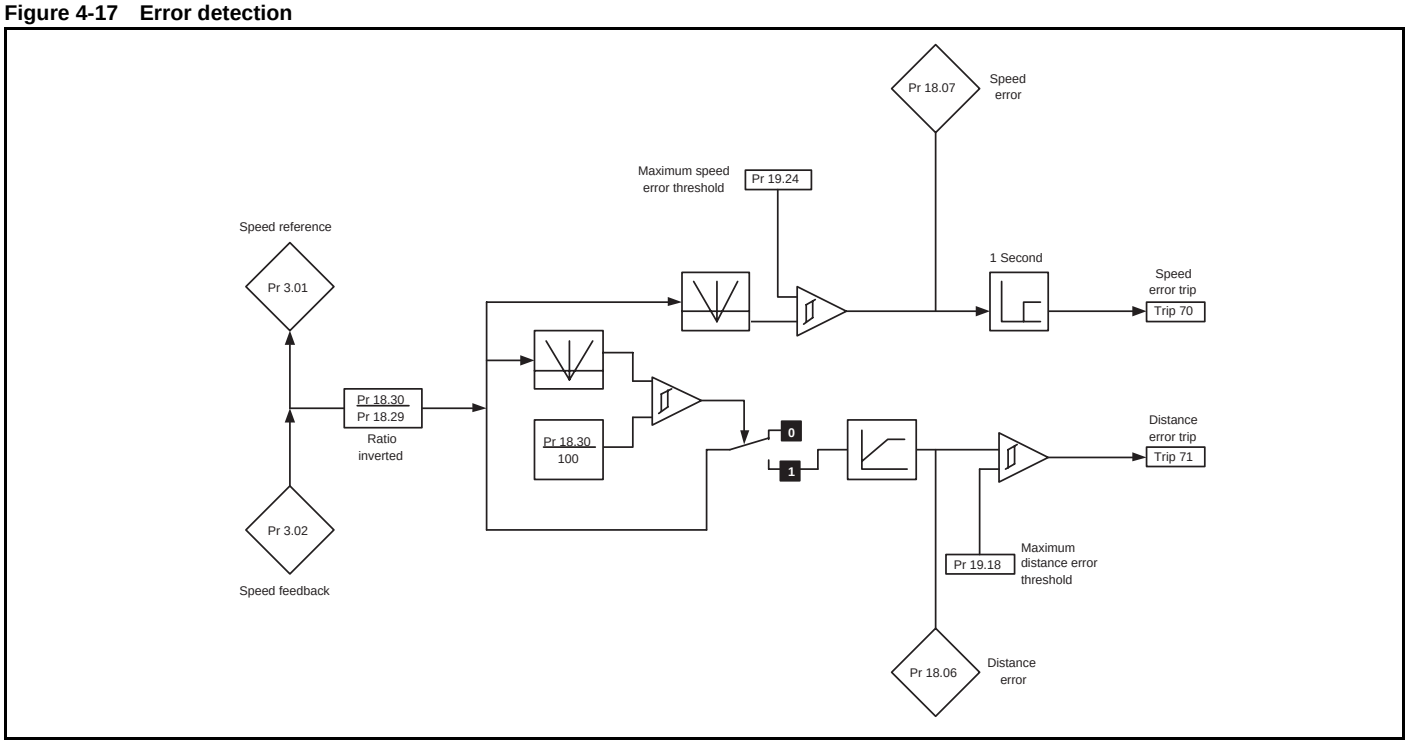
The distance error detection can be disabled by setting Pr **0.28**[4] (Pr **19.18**) = 0 (maximum distance error threshold).

4.13.3 Thermal

Temperature (Trip 73)

The SM-ELV software monitors the drive temperatures if these exceed the lower limit set in Pr **70.81** (default 0°C, maximum -10°C) a Trip 73 will be generated. This trip is present to protect the drive when starting in cold conditions.

Figure 4-17 Error detection



4.13.4 Motor error detection

In addition to the speed and distance error detection used to ensure correct operation, there are an additional two error detection features that are available for the motor connected to the elevator drive.

The two additional error detection features being (1) Motor Fluxed Detection and (2) Motor Phase Loss Detection. As with the speed and distance error detection there are trips associated,

Motor fluxed detection (Trip 76)

The motor fluxed error detection should be used to detect whether the motor is sufficiently magnetised, and can also be used for example to detect if there is a fault in the motor contactors at the output of the drive (contactors not closing).

This feature is available for induction motors operating in either Open loop or Closed loop vector.

The motor flux level can be viewed in Pr **20.07** Motor flux level, with the error detection level being determined by Pr **0.29** [2] (Pr **18.23**) the Motor magnetised threshold. Once the threshold has been reached the motor is then correctly magnetised and Pr **0.18** [4] (Pr **18.43**) Motor magnetised will change to ON.

If the motor magnetised threshold Pr **0.29** [2] (Pr **18.23**) is not reached 2s after T.31 is closed (motor contactor) a Trip 76 will be generated.

Motor Phase Loss Detection (Trip 77)

This error detection is used to detect a motor phase loss at the output of the drive to the motor.

The phase loss trip generated is a Trip 77 and will become active after 200ms of a motor phase loss.

The error detection is enabled with Pr **19.43** Phase Loss Detection Enable.

4.14 Brake control

4.14.1 Brake control provided by the SM-ELV

The Brake output signal generated from the SM-ELV software is available from control terminal 25 on the Unidrive SP. The parameter setup for this function is Pr **8.22** = Pr **18.31**. The control and timing sequence for the brake is shown in the following control diagrams (Figure 4-18 on page 40, Figure 4-19 on page 40).

The brake apply delay can be adjusted in Pr **0.25**[1] (Pr **18.24**) and the brake release delay in Pr **0.24**[1] (Pr **19.25**).

If the Unidrive SP trips at any stage the brake control becomes inactive and the brake will be forced to close by the elevator controller.

Table 4-8 Unidrive SP brake control

No	Sequence	Terminal
1	The elevator controller applies both the direction and speed signals.	T.28, 26, 27, 29 = 24V
2	The elevator controller closes the motor contactor and enables the elevator drive.	T.31 = 24V
3	The SM-ELV software de-bounces the input signals (100ms) and enables the inverter output.	
4	The Unidrive SP controls the magnetisation of the motor and opens the brake.	T.25 = 24V
5	The Unidrive SP holds zero speed until both the brake-release delay and load measurement times have elapsed. The SM-ELV then starts the profile.	
6	The elevator controller removes the speed signals.	T.28, 26,27,29 = 0V
7	After the motor has stopped the SM-ELV (or elevator controller) applies the brake.	T.25 = 0V
8	After the brake-apply delay the motor is demagnetised and the drive output is disabled.	
9	The elevator controller or SM-ELV removes the drive enable and opens the motor contactor(s)	T.31 = 0V

4.14.2 Brake control provided by the elevator controller

If the elevator controller is required to control the brake this has to be configured through Pr **8.22** = Pr **18.43**. This setting changes the function of Terminal 25 output to now be "motor magnetised" indication. Only once the motor is magnetised can the elevator controller release the motor's brake. The control sequence is as follows:

Table 4-9 Elevator controller brake control

No	Sequence	Terminal
1	The elevator controller applies drive enable without a speed command.	T.31 = 24V
2	The Unidrive SP magnetises the motor and sets the digital output active when the motor is fully magnetised.	T.25 = 24V
3	The elevator controller releases the brake and waits for brake release delay.	
4	After brake release delay the elevator controller applies the direction and speed signals.	T.28, 26, 27, 29 = 24V
5	After the motor has stopped and the floor level sensor is active the elevator controller deactivates the direction and speed signals.	T.28, 26, 27, 29 = 0V
6	The elevator controller applies the brake.	
7	After the brake apply delay the elevator controller opens the motor contactor and disables the Unidrive SP output.	T.31 = 0V

NOTE

It is recommended to set the brake release delay, Pr **0.24**[1] (Pr **19.25**) to a non-zero minimum value (=100).

If the elevator controller removes the drive enable, the brake will be applied at that point, and the motor contactor will also be opened shortly afterwards.

Figure 4-18 Creep to floor brake control

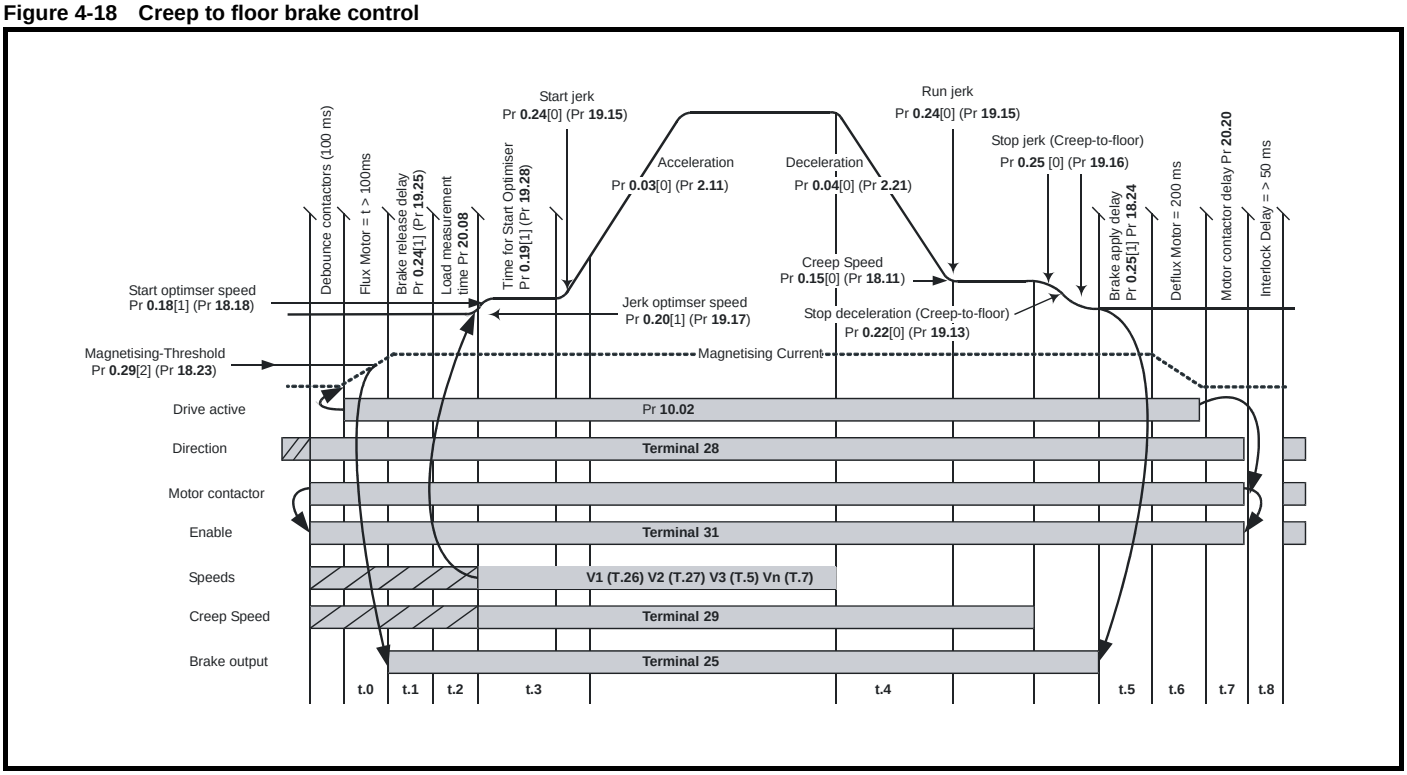
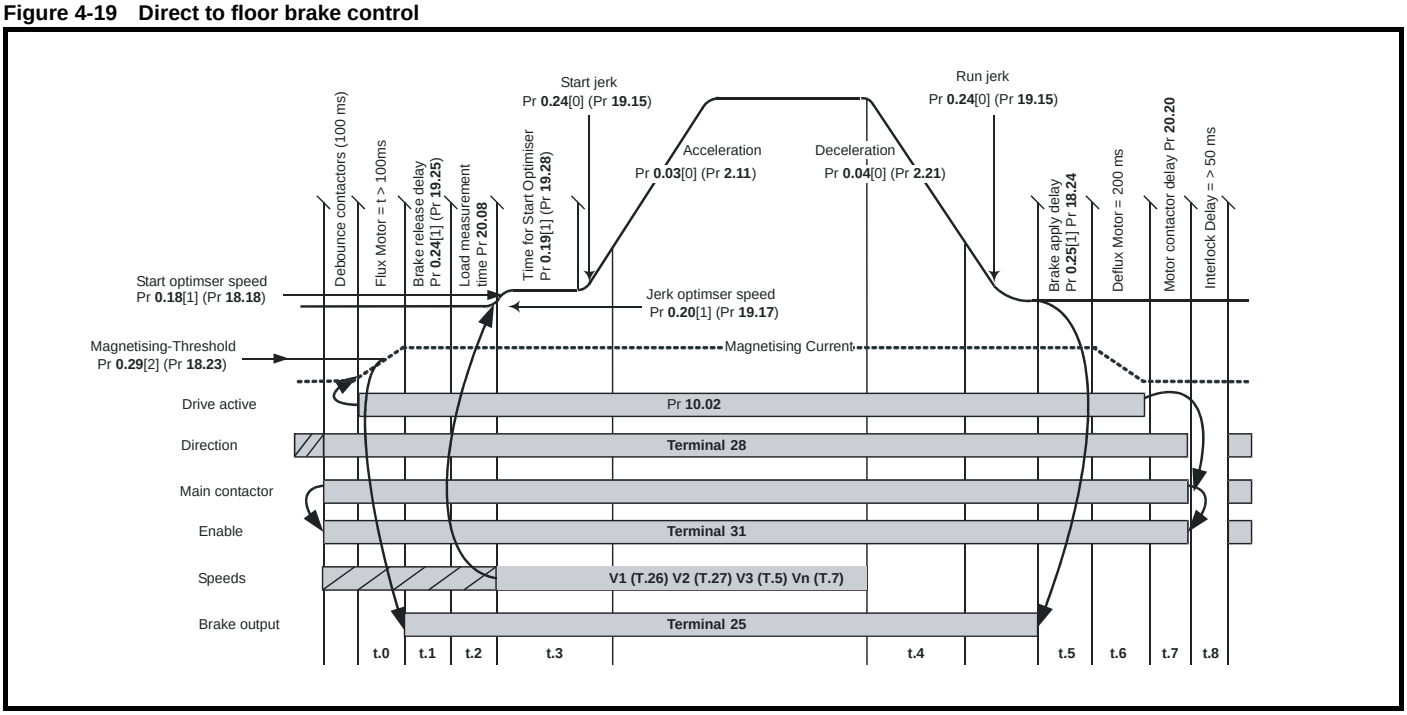


Figure 4-19 Direct to floor brake control



4.15 Switching motor contactors on output of drive

WARNING

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

A recommended motor contactor to be fitted between the drive and motor for safety purposes can be a AC3 type.

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

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

The Drive Enable terminal (T31) when opened provides a SECURE DISABLE (SD)function. This can in many cases replace one of the standard two output contactors.

The SD function provides a means for preventing the drive from generating torque in the motor, with a very high level of integrity. It is suitable for incorporation into a safety system for a machine. It is also suitable for use as a conventional drive enable input.

The SD function makes use of the special property of an inverter drive with an induction motor, which is that torque cannot be generated

without the continuous correct active behavior of the inverter circuit. All credible faults in the inverter power circuit cause a loss of torque generation.

The SD function is fail-safe, so when the SD input is disconnected the drive will not operate the motor, even if a combination of components within the drive has failed. Most component failures are revealed by the drive failing to operate. SD is also independent of the drive firmware.

This meets the requirements of EN954-1 category 3 for the prevention of operation of the motor.[1]

[1] Independent approval by BGIA has been given.

SD can be used to eliminate electro-mechanical contactors, including special safety contactors, which would otherwise be required for safety applications.

WARNING

To maintain category 3 according to EN954-1 the drive must be located inside an enclosure with degree of protection at least IP54.

Switching the motor contactor(s) when the control unit output is released may lead to high amounts of excess voltage because of the high level of inductivity, especially with gearless lift motors. This may lead to the relay contacts being destroyed, coil damage in the motor, false tripping in the converter or interference to the speed feedback signals.

4.15.1 Contactor control

The software enable of the Unidrive SP is delayed by approximately 100ms after the drive enable at terminal T.31 to allow for debouncing the motor contactor(s). This prevents any spurious trip during start due to arcing of motor contactor(s).

When ending a normal travel, the controller output is also delayed internally until the brake closing time has expired. The delay between the internal controller and opening the motor contactor is shown in Pr **0.26**[1] (Pr **20.20**) in ms. Negative values mean the motor contactor is opened on enable, which must be prevented. With negative delays the brake closing time Pr **0.25**[1] (Pr **18.24**) should be reduced by at least the time displayed in Pr **0.26**[1] (Pr **20.20**). The ideal value for Pr **0.26**[1] (Pr **20.20**) is 50 to 100ms. Then even with normal travel the motor contactor will open without current present on the motor. If the motor contactor is controlled by the drive there is no need to check Pr **0.26**[1] Pr **20.20**.

If during an inspection the safety circuit and motor contactor are opened by the controller (during travel), the safety circuit is open; therefore the release circuit on T. 31 should be opened immediately. This should be opened by an additional quick relay (finder) or other suitable measure (descent delay < 4 ms) in order to prevent the controller output being turned on when power is flowing. In addition the motor coil should also be protected by suitable voltage limiters (varistors).

4.15.2 Contactor configuration

To ensure the motor contactor(s) are closed before the drive is enabled, auxiliary contacts on the motor contactor(s) should be used. The auxiliary contacts should be connected in series with the drives secure disable (T.31) as shown following.

The following Figure 4-20 and Figure 4-21 show the two options for connections of the auxiliary contacts when using either a single or dual output motor contactors.

Figure 4-20 Dual output motor contactor configuration

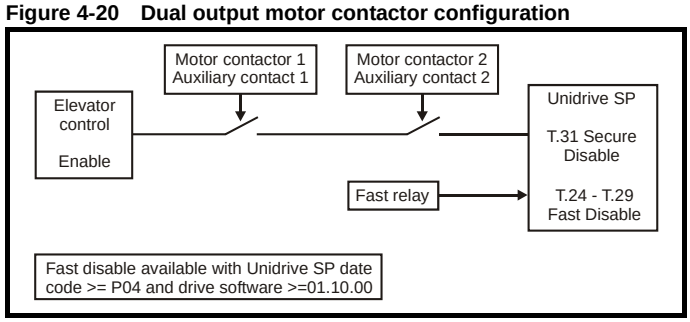
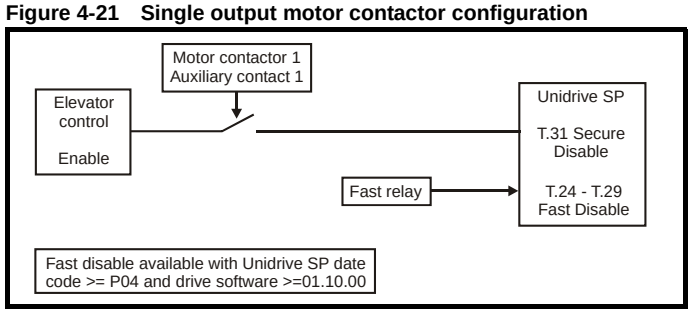


Figure 4-21 Single output motor contactor configuration



4.15.3 Motor contactor control (from V1.09)

From V1.09 SM-ELV software the motor contactor can be controlled by the relay on T.41 to T.42 of the Unidrive SP. To set up this function the relay source Pr **8.27** should be configured to Pr **19.32**. This is done in such a way that it is triggered optionally, i.e. it does not have to be used.

A pre-requisite for the motor contactor to be controlled correctly is for the auxiliary closing contact to be looped into the release circuit on the converter that is connected to T.31. The subsequent processing control is triggered as before by the release signal on terminal T.31.

The motor contactor is controlled in accordance with the following principle:

1. Closing the motor contactor: If there has been a start command (selection of a speed with a direction signal or selection of a direction with two direction signals), and the relay answering signal is not yet active.
2. Opening the motor contactor: If the power in the motor has reduced and the converter is blocked.

4.15.4 Enable circuit

The software enable of the drives output is delayed by approximately 100ms (de-bouncing contactors) after the drive enable is applied to T.31. Spurious trips (e.g. OI.AC) which could be caused due to "chatter" of the motor contactor are prevented by this inherent delay.

The control of the motor contactor should be carried out with no current flowing to the motor to prevent the above issues, arcing during opening (too soon) or closing (too late) resulting in OI.AC trips.

Therefore the parallel controlled release for opening the drive's enable should occur before the motor contactors open. The technical data from the contactor manufacturer should be reviewed for the correct timing for the contactor control. Normally with the very fast interlock of the drive's output (few microseconds), and the switching time of the main contactors which could be a few milliseconds, the opening of the motor contactor(s) should naturally be at zero current.

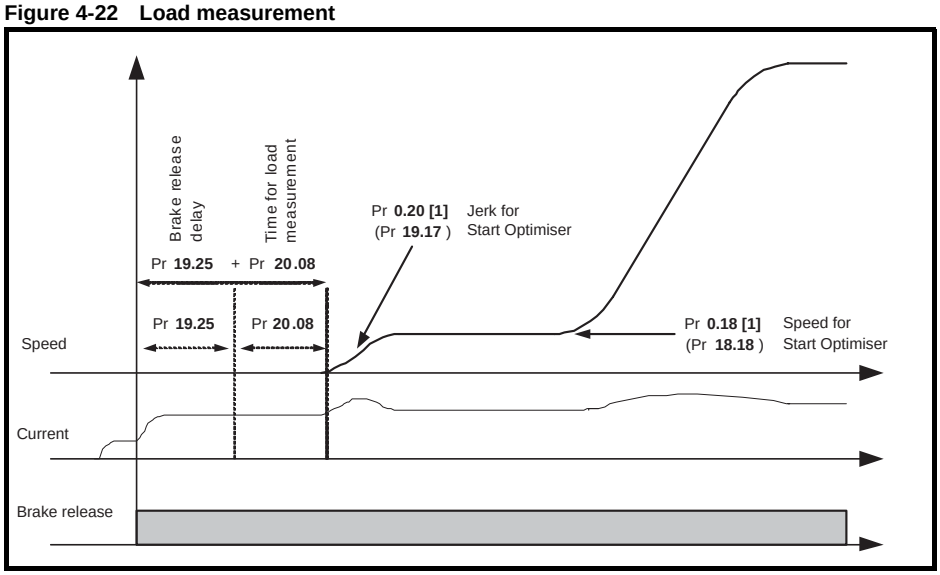
With this circuitry the safety chain can directly switch the motor contactors. (Adherence to this circuit the motor contactor can be controlled at inspection mode by the protective circuit.)

4.16 Lift software compensation

4.16.1 Load measurement for evacuation

The load difference between the car and the counterweight is measured and displayed in Pr **20.19** as a % of the nominal torque (Mn) after the brake release delay Pr **0.24**[1] (Pr **19.25**) and time for load measure Pr **20.08** has elasped.

Figure 4-22 Load measurement



To disable load measurement set Pr **20.08** “time for load measurement” to zero.

The measurement duration is user definable and is set in Pr **20.08** in ms. This measurement duration is set at 200ms as default with this being sufficient for determining the load direction. Measuring times of 500 ms are however recommended for an accurate measurement. The measurement duration if set to be longer will result in more accurate results. This does result in a longer time required for the measurement and therefore should be considered for when planning / setting up for the application.

This load measurement can be used both for determining the preferred direction for evacuation and also to generate an overload signal.

To start the evacuation the load measured when the brake was last opened is saved so that it is safe if there is a power cut and its direction is displayed in Pr **19.37** Load Direction. This signal should be sent to the elevator controller using a programmable digital output (Pr **8.xx** = **19.37**).

NOTE

A load cell is required from the lift shaft as an analogue signal to Analogue Input 2 for the feature.

The elevator controller creates the direction for torque, which would normally be done by the elevator drive in normal operation. For initial torque compensation a slow speed should be applied.

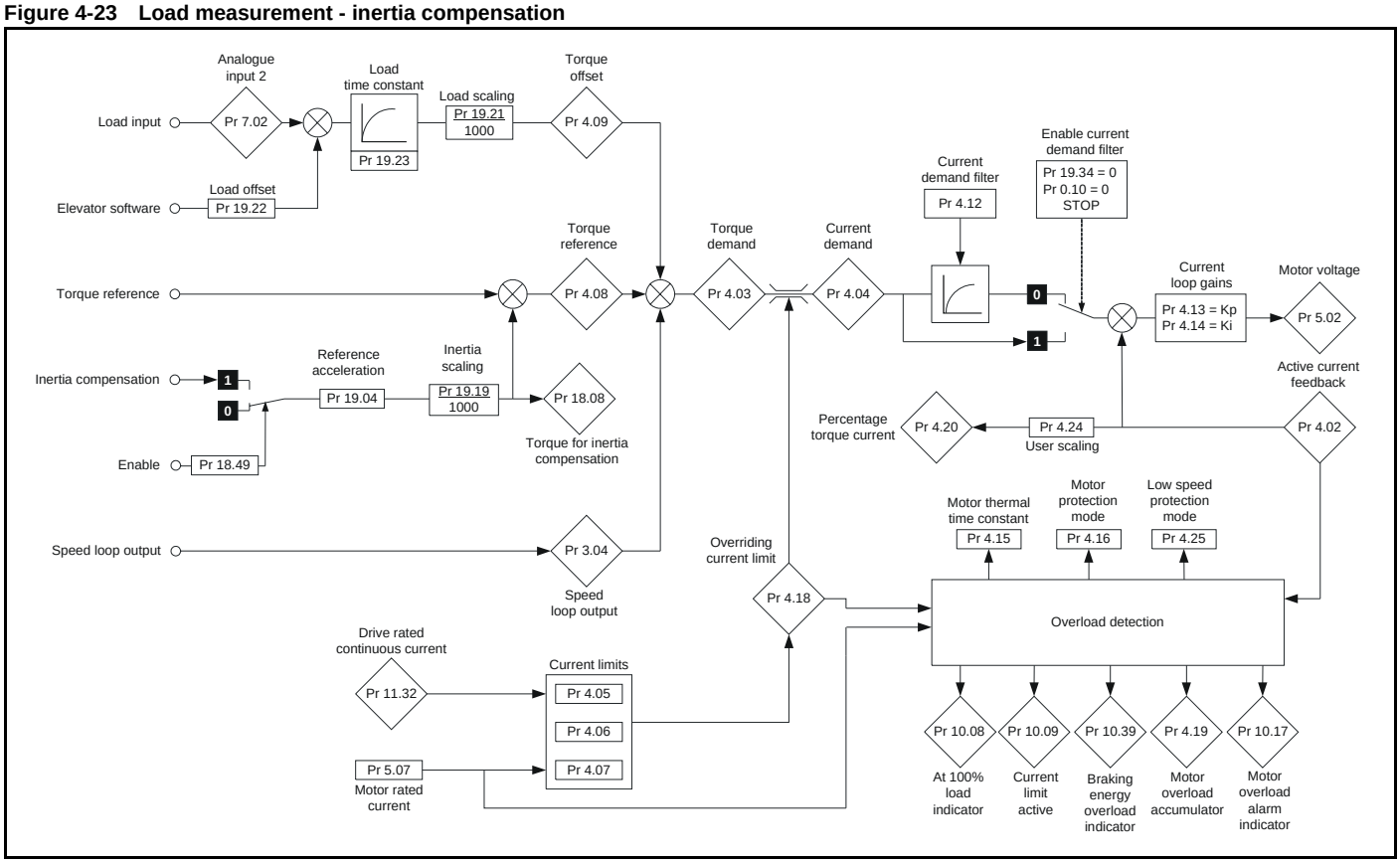
The load measurement feature also allows load dependent torque compensation to be applied using Pr **4.08**. For this a load measuring

transducer can be used that provides a ±10V signal that is proportional to load.

Overload display

The overload bit Pr **19.36** is created by comparing the measured load value of Pr **20.19** with the overload threshold that is set in Pr **20.18** as a % of nominal torque (Mn).

Figure 4-23 Load measurement - inertia compensation



4.16.2 Inertia compensation

Inertia compensation can be implemented to overcome system inertia and high speed loop gains (required due to no inertia compensation) resulting in motor noise. Implementing the inertia compensation can allow speed loop gains to be reduced.

The inertia compensation feature allows the acceleration torque in Pr **4.08** to be dynamically optimised. Adjustment of the inertia compensation can be implemented through Pr **0.27**[2] (Pr **19.19**) with this being adjusted with half load present in the elevator car.

The inertia compensation is applied through Pr **4.08** and after the feature has been enabled with Pr **0.28**[2] (Pr **18.49**) = 1 (as shown in Figure 4-23).

The setting of the inertia compensation scaling Pr **0.27**[2] (Pr **19.19**) should be adjusted so that the speed controller output Pr **3.04** is nearly constant after the brake has opened and also during both the starting and stopping.

The inertia compensation scaling Pr **0.27**[2] (Pr **19.19**) can be calculated from the mechanical data as follows:

Pr **0.27**[2] (Pr **19.19**) = 1000 * (J_G * i) / (M_N * R)

- J_G Inertia of the system in kgm^2 apply to the motor shaft
- M_N Rated motor torque in Nm
- R Radius of the sheave in m
- i Gear ratio

5 I/O configuration

The functions of all terminals of the Unidrive SP except terminal 31 are configurable with the elevator software. The following configurations and parameters shown are at their default settings.

Table 5-1 Input / output settings

Terminal		I/O	I/O Status	Associated parameters
Function	**No.**			
"DOWN"	28	Input	Pr **18.44**	Down direction input
"UP"		Input	Pr **19.44**	Up (available with 2 direction signals, Pr **19.26 = 1**)
Short distance		Input	Pr **18.35**	Adjust distance in Pr **18.20**
Speed select Bit 0	29	Input	Pr **18.36**	Adjust speed in Pr **0.15**[0] (Pr **18.11**)
Speed select Bit 1	26	Input	Pr **18.37**	Adjust speed in Pr **0.16**[0] (Pr **18.12**)
Speed select Bit 2	27	Input	Pr **18.38**	Adjust speed in Pr **0.17**[0] (Pr **18.13**)
Speed select Bit 3	5	Input	Pr **18.39**	Adjust speed in Pr **0.18**[0] (Pr **18.14**)
Speed select Bit 4	7	Input	Pr **18.40**	Adjust speed in Pr **0.19**[0] (Pr **18.15**)
Speed select Bit 5		Input	Pr **18.41**	Adjust speed in Pr **0.20**[0] (Pr **18.16**)
Speed select Bit 6		Input	Pr **19.41**	Adjust speed in Pr **0.21**[0] (Pr **18.17**)
Additional speed 2		Input	Pr **20.22**	Adjust speed in Pr **0.31**[0] (Pr **20.22**)
Additional speed 3		Input	Pr **20.23**	Adjust speed in Pr **0.32**[0] (Pr **20.23**)
Additional speed 4		Input	Pr **20.24**	Adjust speed in Pr **0.33**[0] (Pr **20.24**)
Brake	25	Output	Pr **18.31**	Apply time Pr **0.25**[1] (Pr **18.24**) Release time Pr Pr **0.24**[1] (Pr **19.25**)
Threshold V1	24	Output	Pr **18.32**	Adjust threshold in Pr **0.26**[0] **(**Pr **18.21)**
Threshold V2		Output	Pr **18.33**	Adjust threshold in Pr **0.27**[0] (Pr **18.22**)
Motor magnetised		Output	Pr **18.43**	Threshold for induction motors Pr **0.29**[2] (Pr **18.23**)

Source and destination parameters are used for configuration of I/O control terminals to specific functions. The status of each of the control terminals can be monitored via parameters in the drive (helpful for diagnostics and troubleshooting), for further information refer to the latest *Unidrive SP User Guide.*

Control terminals inputs can also be manipulated using additional parameters e.g. inverted with a dedicated bit parameter, as detailed following.

Terminals 24 to 26 are either digital inputs or outputs with these being configured via drive parameters (Menu 8).

Table 5-2 shows an overview of the I/O configuration parameters.

Table 5-2 Input / output configuration parameters

Terminal		I/O	Source or destination		Invert		I/O Setup	
Description	**No.**	**Status**		**Default**		**Default**		**Default**
Digital I/O 1	24	Pr **8.01**	Pr **8.21**	Pr **18.32**	Pr **8.11**	OFF	Pr **8.31**	On = Output
Digital I/O 2	25	Pr **8.02**	Pr **8.22**	Pr **18.31**	Pr **8.12**	OFF	Pr **8.32**	On = Output
Digital I/O 3	26	Pr **8.03**	Pr **8.23**	Pr **18.37**	Pr **8.13**	OFF	Pr **8.33**	OFF = Input
Digital Input 4	27	Pr **8.04**	Pr **8.24**	Pr **18.38**	Pr **8.14**	OFF	Only input	
Digital Input 5	28	Pr **8.05**	Pr **8.25**	Pr **18.44**	Pr **8.15**	OFF	Only input	
Digital Input 6	29	Pr **8.06**	Pr **8.26**	Pr **18.36**	Pr **8.16**	OFF	Only input	
Analogue input 1	5	Pr **7.01**	Pr **7.10**	Pr **18.39**	Pr **7.09**	OFF	Only input	
Analogue input 2	7	Pr **7.02**	Pr **7.14**	Pr **18.40**	Pr **7.13**	OFF	Only input	
Analogue input 3	8	Pr **7.03**	Pr **7.18**	Pr **00.00**	Pr **7.17**	OFF	Only input	
Drive Relay	41, 42	Pr **8.07**	Pr **8.27**	Pr **10.01**	Pr **8.17**	OFF	Relay output	
24V User output	22	Pr **8.08**	Pr **8.28**	Pr **00.00**	Pr **8.18**	On	Only output	
Drive enable	31	Pr **8.09**	Hardware input, not configurable				Only input	

NOTE

The elevator set-up for **Unidrive SP uses positive logic** as default. This can be set-up to operate in negative logic through Pr **8.29**, however in negative logic the Drive enable, Relay outputs and 24V output remain in positive logic.

NOTE

If motor contactor control is required on T.22 as an output Pr **8.28** must be set to Pr **19.32** motor contactor control output in the SM-ELV software.

5.1 Speed selection

The speed selection can be binary (up to 10 speeds) or priority (up to 6 speeds). The priority speeds can also be increased further by introducing an SM-I/O Plus option module. The default setting for the speed selection is binary selection.

Binary selection allows a wider range of speeds to be selected, with selection of binary or priority speed selection being dependant on the lift controller, and user requirements.

Table 5-3 Binary Speed Selection

Description	Binary Selection				Preset speed	Display
	Bit 0	Bit 1	Bit 2	Bit 3	Setup parameter	Selected = Pr 18.10
	T. 29	T. 26	T. 27	T. 5		
Zero speed	0	0	0	0	-	**1810**
V1 (Creep Speed)	1	0	0	0	Pr **0.15**[0] (Pr **18.11**)	**1811**
V2 (Inspection)	0	1	0	0	Pr **0.16**[0] (Pr **18.12**)	**1812**
V3 (Nominal 1)	1	1	0	0	Pr **0.17**[0] (Pr **18.13**)	**1813**
V4 (Medium 1)	0	0	1	0	Pr **0.18**[0] (Pr **18.14**)	**1814**
V5 (Re-leveling)	1	0	1	0	Pr **0.19**[0] (Pr **18.15**)	**1815**
V6 (Medium 2)	0	1	1	0	Pr **0.20**[0] (Pr **18.16**)	**1816**
V7 (Additional 1)	1	1	1	0	Pr **0.21**[0] (Pr **18.17**)	**1817**
V8 (Additional 2)	0	0	0	1	Pr **0.31**[0] (Pr **20.22**)	**2022**
V9 (Additional 3)	1	0	0	1	Pr **0.32**[0] (Pr **20.23**)	**2023**
V10 (Additional 4)	0	1	0	1	Pr **0.33**[0] (Pr **20.24**)	**2024**

To switch to priority speed selection (1 of n), set Pr **0.21**[1] (Pr **18.42**) = On.

Table 5-4 Priority Speed Selection '1 of n'

Description	Priority Selection '1 of n'						Preset Speed	
	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Setup parameter	Selected = Pr 18.10
	T. 29	T. 26	T. 27	T. 5	T. 7	T. 8		
Zero Speed	0	0	0	0	0	0	-	**1810**
V1 (Creep Speed)	1	0	0	0	0	0	Pr **0.15**[0] (Pr **18.11**)	**1811**
V2 (Inspection)	x	1	0	0	0	0	Pr **0.16**[0] (Pr **18.12**)	**1812**
V3 (Nominal 1)	x	x	1	0	0	0	Pr **0.17**[0] (Pr **18.13**)	**1813**
V4 (Medium 1)	x	x	x	1	0	0	Pr **0.18**[0] (Pr **18.14**)	**1814**
V5 (Re-levelling)	x	x	x	x	1	0	Pr **0.19**[0] (Pr **18.15**)	**1815**
V6 (Medium 2)	x	x	x	x	x	1	Pr **0.20**[0] (Pr **18.16**)	**1816**

5.2 Direction control

The direction control can be configured for a single direction input allowing both Up and Down or dual direction inputs as detailed.

Table 5-5 Direction inputs

Mode	Elevator direction	Terminal status	Invert Pr 18.45	T.28 Function
Single direction input Pr **19.26 = 0**	UP	T.28 = ON	OFF	Pr **8.24 =** Pr **18.38** Nominal speed select
	DOWN	T.28 = OFF		
Dual direction input Pr **19.26 = 1**	DOWN	T.27 = ON		Pr **8.24 =** Pr **19.44** Up direction
	UP	T.28 = ON		

Terminal 27 in the Dual direction input control cannot be used as the Nominal speed selection. If another input is to be configured for the Nominal speed selection this must be programmed to operate Pr **18.38** (destination).

NOTE

This change is only activated after a reset of the SM-ELV software.

(To reset the SM-ELV software, set Pr **x.00** = 1070 and then press the reset button on the keypad of the Unidrive SP.)

The applied direction is controlled during the travel. If there is a change of the demanded direction, the elevator will be stopped and the brake will be applied. If the demanded direction remains the same, the travel can be continued at any time. The opposite direction will only be accepted if the motor contactor has opened T.31 (Secure Disable), with this disabling the drive.

5.3 Advanced door opening

From the default settings of the SM-ELV elevator software there is an advanced door opening feature available. This is configured in the software and output on T.24 (V-Threshold 1).

The advanced door opening is configured to allow the speed at which the advanced door opening is active, this being adjustable through Pr **0.26**[0] (Pr **18.21**). If required the output on T.24 can also be inverted with Pr **8.11**.

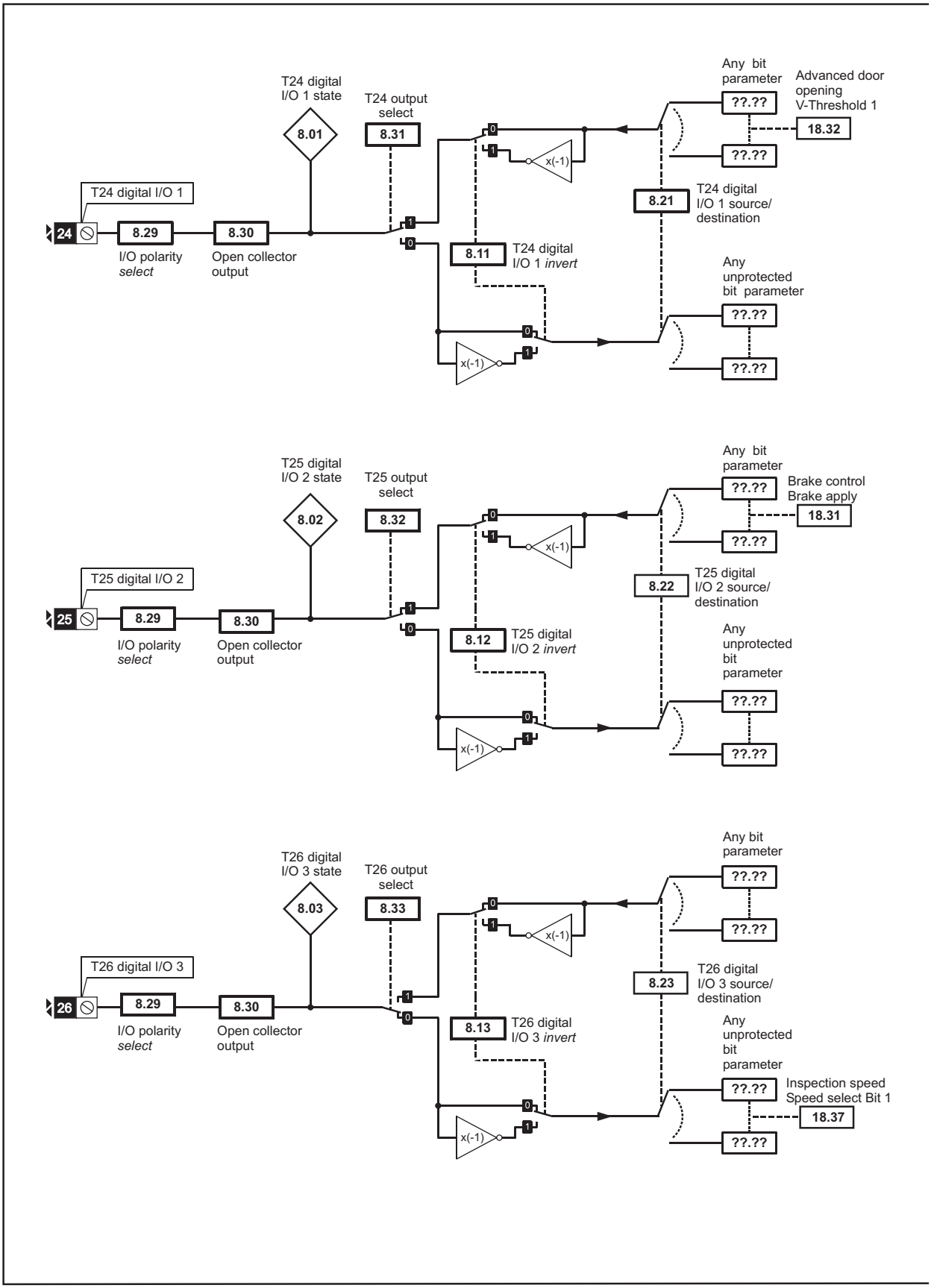
The status of the advanced door opening can be viewed in Pr **18.32**.

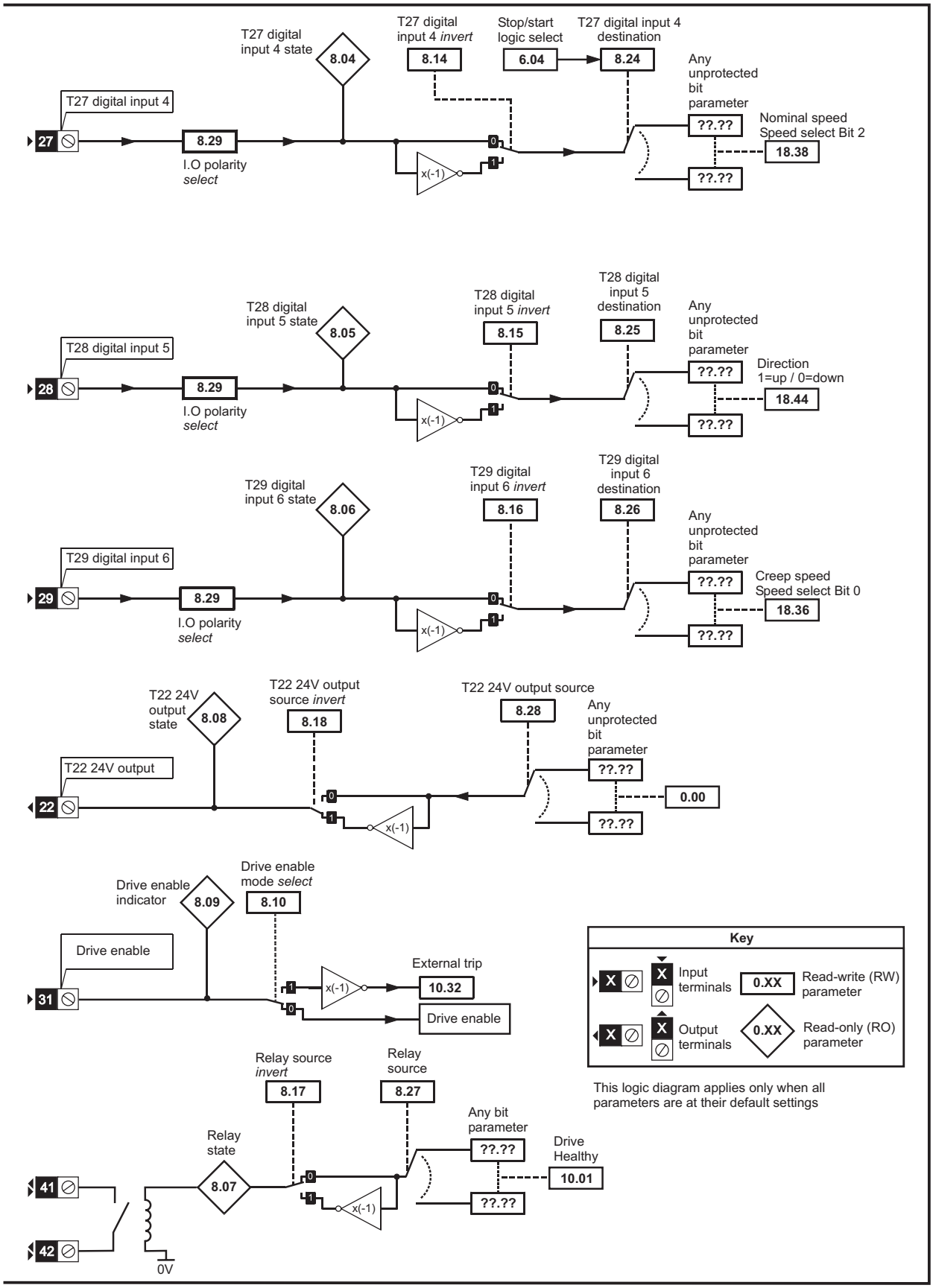
Table 5-6 Advanced door opening parameters

Feature	Parameter		Default
Advanced door opening speed	Pr **0.26**[0] (Pr **18.21**)	± 32000 mm/s	800 mm/s
Advanced door opening invert	Pr **8.11**	OFF(0) or On(1)	OFF(0)
Advanced door opening status	Pr **18.32**	OFF(0) or On(1)	N/A

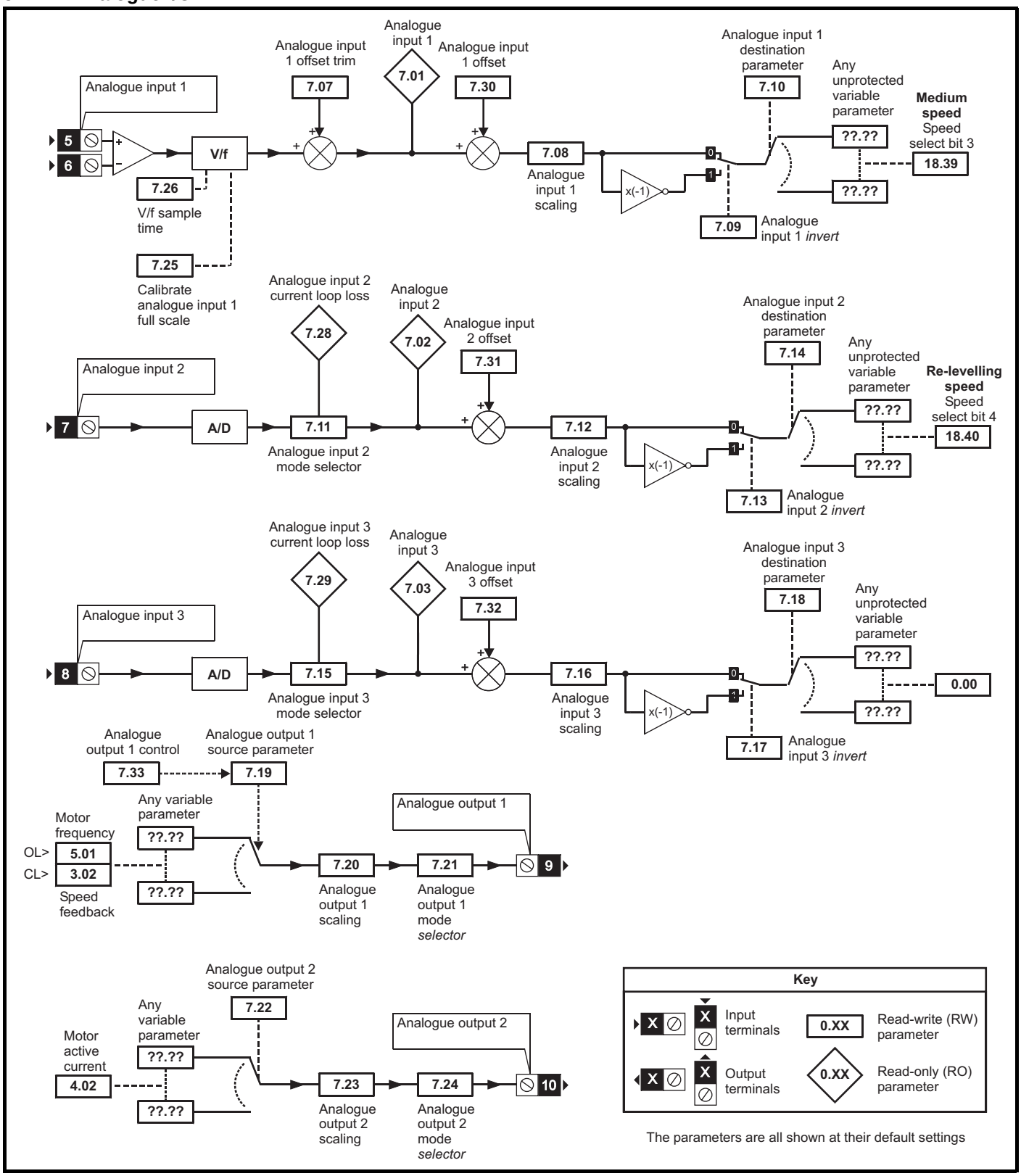
5.4 Logic diagrams

5.4.1 Digital I/O




T27 digital input 4 state
8.04
T27 digital input 4 invert
8.14
Stop/start logic select
6.04
T27 digital input 4 destination
8.24
Any unprotected bit parameter
??.??
Nominal speed Speed select Bit 2
18.38
??.??
T27 digital input 4
27
8.29
I.O polarity select
x(-1)
T28 digital input 5 state
8.05
T28 digital input 5 invert
8.15
T28 digital input 5 destination
8.25
Any unprotected bit parameter
??.??
Direction 1=up / 0=down
18.44
??.??
T28 digital input 5
28
8.29
I.O polarity select
x(-1)
T29 digital input 6 state
8.06
T29 digital input 6 invert
8.16
T29 digital input 6 destination
8.26
Any unprotected bit parameter
??.??
Creep speed Speed select Bit 0
18.36
??.??
T29 digital input 6
29
8.29
I.O polarity select
x(-1)
T22 24V output state
8.08
T22 24V output source invert
8.18
T22 24V output source
8.28
Any unprotected bit parameter
??.??
0.00
??.??
T22 24V output
22
x(-1)
Drive enable indicator
8.09
Drive enable mode select
8.10
Drive enable
31
x(-1)
External trip
10.32
Drive enable
Key
Input terminals
Output terminals
0.XX
Read-write (RW) parameter
Read-only (RO) parameter
This logic diagram applies only when all parameters are at their default settings
Relay source invert
8.17
Relay source
8.27
Any bit parameter
??.??
Drive Healthy
10.01
??.??
Relay state
8.07
41
42
0V
x(-1)

5.4.2 Analogue I/O



The parameters are all shown at their default settings

6 Basic operation

6.1 Understanding the display

There are two keypads available for the Unidrive SP. The SM-Keypad has an LED display and the SM-Keypad Plus has an LCD display. Both keypads can be fitted to the drive but the SM-Keypad Plus can also be remotely mounted on an enclosure door.

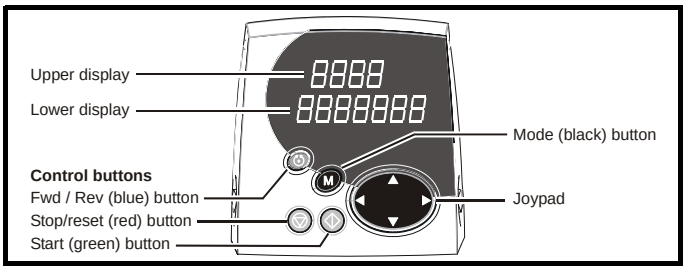
6.1.1 SM-Keypad (LED)

The display consists of two horizontal rows of 7 segment LED displays.

The upper display shows the drive status or the current menu and parameter number being viewed.

The lower display shows the parameter value or the specific trip type.

Figure 6-1 SM-Keypad



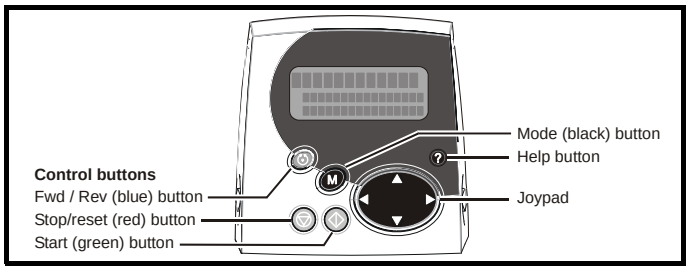
6.1.2 SM-Keypad Plus (LCD)

The display consists of three lines of text.

The top line shows the drive status or the current menu and parameter number being viewed on the left, and the parameter value or the specific trip type on the right.

The lower two lines show the parameter name or the help text.

Figure 6-2 SM-Keypad Plus



NOTE The red stop button is also used to reset the drive.

Both the SM-Keypad and the SM-Keypad Plus can indicate when a SMARTCARD access is taking place or when the second motor map is active (menu 21). These are indicated on the displays as follows.

Table 6-1 Keypad, Keypad Plus indication

	SM-Keypad	SM-Keypad Plus
SMARTCARD access taking place	The decimal point after the fourth digit in the upper display will flash.	The symbol 'CC' will appear in the lower left hand corner of the display
Second motor map active	The decimal point after the third digit in the upper display will flash.	The symbol 'Mot2' will appear in the lower left hand corner of the display

6.2 Keypad operation

6.2.1 Control buttons

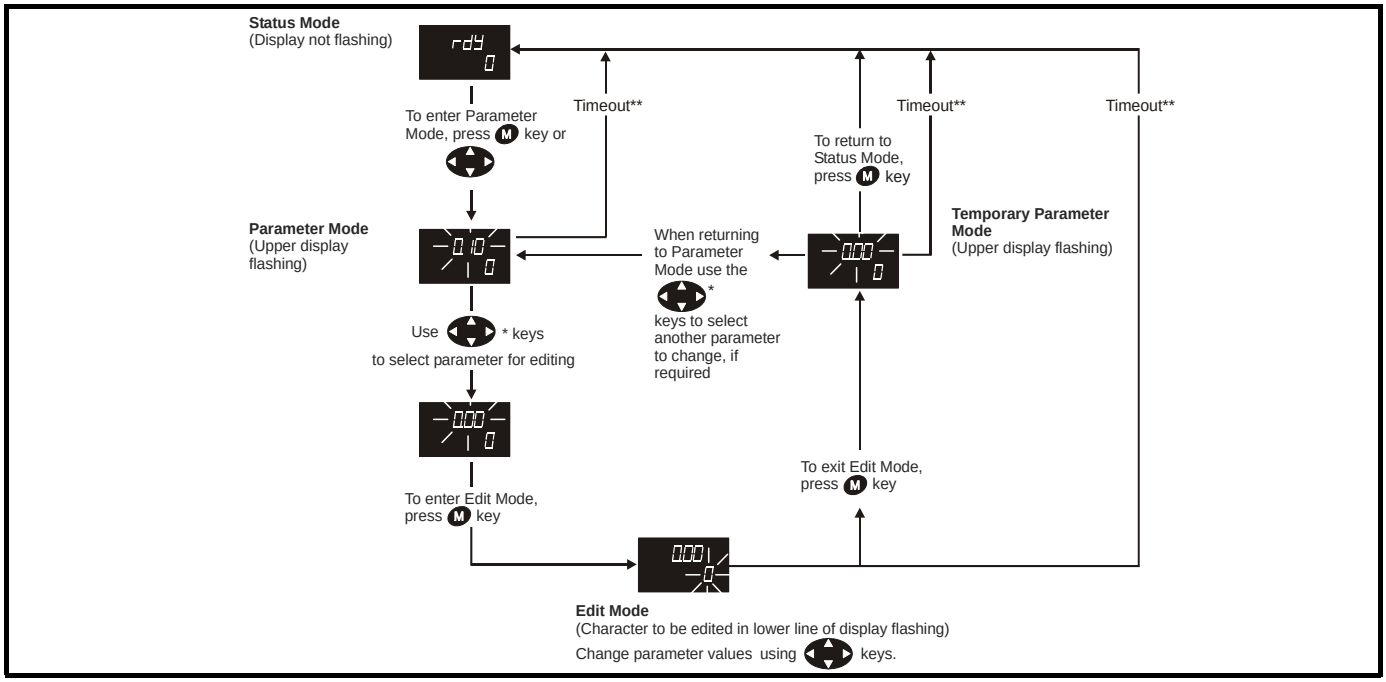
The keypad consists of:

1. Joypad - used to navigate the parameter structure and change parameter values.
2. Mode button - used to change between the display modes – parameter view, parameter edit, status.
3. Three control buttons - used to control the drive if keypad mode is selected.
4. Help button (SM-Keypad Plus only) - displays text briefly describing the selected parameter.

The Help button toggles between other display modes and parameter help mode. The up and down functions on the joypad scroll the help text to allow the whole string to be viewed. The right and left functions on the joypad have no function when help text is being viewed.

The display examples shown is for the SM-Keypad 7 segment LED display (this is the same for the SM-Keypad Plus except that the information displayed on the lower row on the SM-Keypad is displayed on the right hand side of the top row on the SM-Keypad Plus).

Figure 6-3 SM-Keypad display



* can only be used to move between menus if L2 access has been enabled (Pr **0.49**). Refer to section 6.13 on page 58.
Timeout defined by Pr **11.41 (default value = 240s).

Figure 6-4 Mode examples

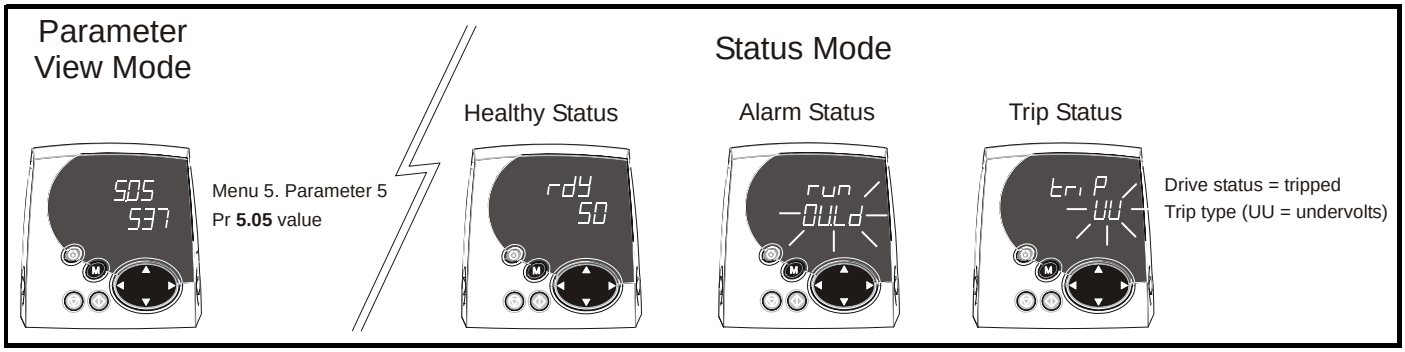
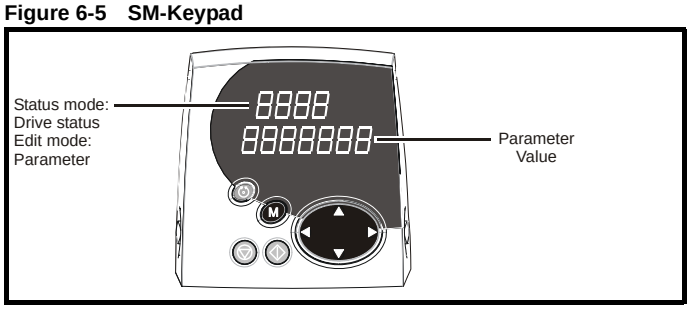


Figure 6-5 SM-Keypad



WARNING

Do not change parameter values without careful consideration; incorrect values may cause damage or a safety hazard.

NOTE

When changing the values of parameters, make a note of the new values in case they need to be entered again.

NOTE

For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved. Refer to section 7.7 *Saving parameters* on page 48.

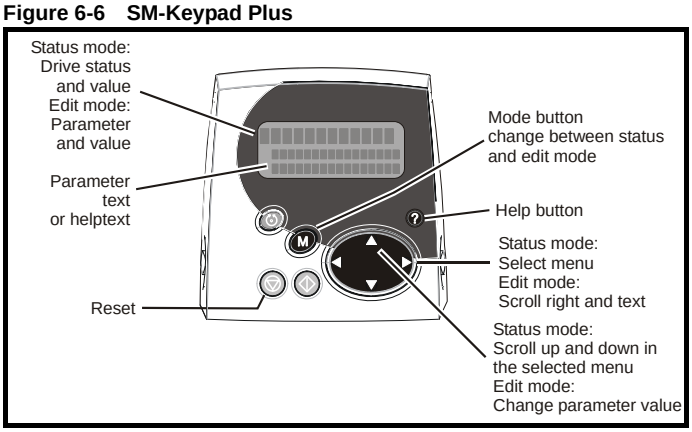
6.3 SM-Keypad Plus

The following information covers the SM-Keypad Plus with alpha numeric LCD display and additional Help feature.

The following section details displaying and adjusting the elevator drive parameters

6.3.1 SM-Keypad and SM-Keypad Plus function details

Figure 6-6 SM-Keypad Plus



NOTE

The SM Keypad Plus LCD display is recommended for use with the SM-ELV software with this providing help text in addition to the parameter descriptions.

NOTE

When using the SM-Keypad Plus LCD display with the SM-ELV elevator software it is recommended that the keypad custom elevator text is programmed into the SM-Keypad Plus LCD display. The custom elevator text will provide detailed information on specific lift parameters on the display which would not normally be available with the standard keypad software.

6.4 Operation

Figure 6-7 SM-Keypad Plus display at power up

Status	Display
Initialising	Keypad Plus Initialising Ver: 01.00.00
Only on first power up	Keypad Plus READING DATABASE Drive ■■■■■■■■■■
Only on first power up	Keypad Plus PROGRAMMING FLASH Drive ■■■■■■■■■■
Display Operating mode	inh SErVO Operating mode
If the drive has tripped the display is flashing. Refer to Chapter 13 *Diagnostics*	trip Enc3
Initialising finished Drive ready	0.10 0.0 Motor speed

Figure 6-8 Select parameter

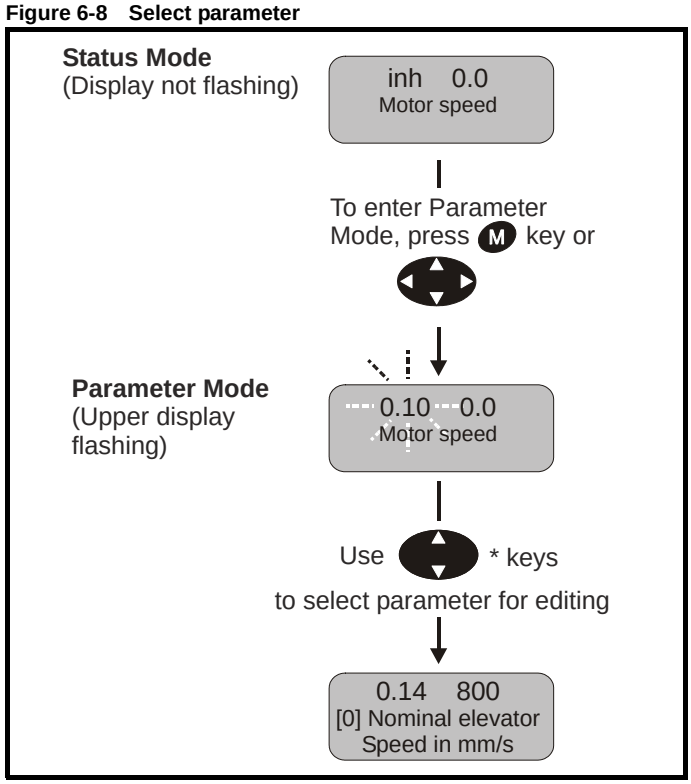


Figure 6-9 Edit parameter

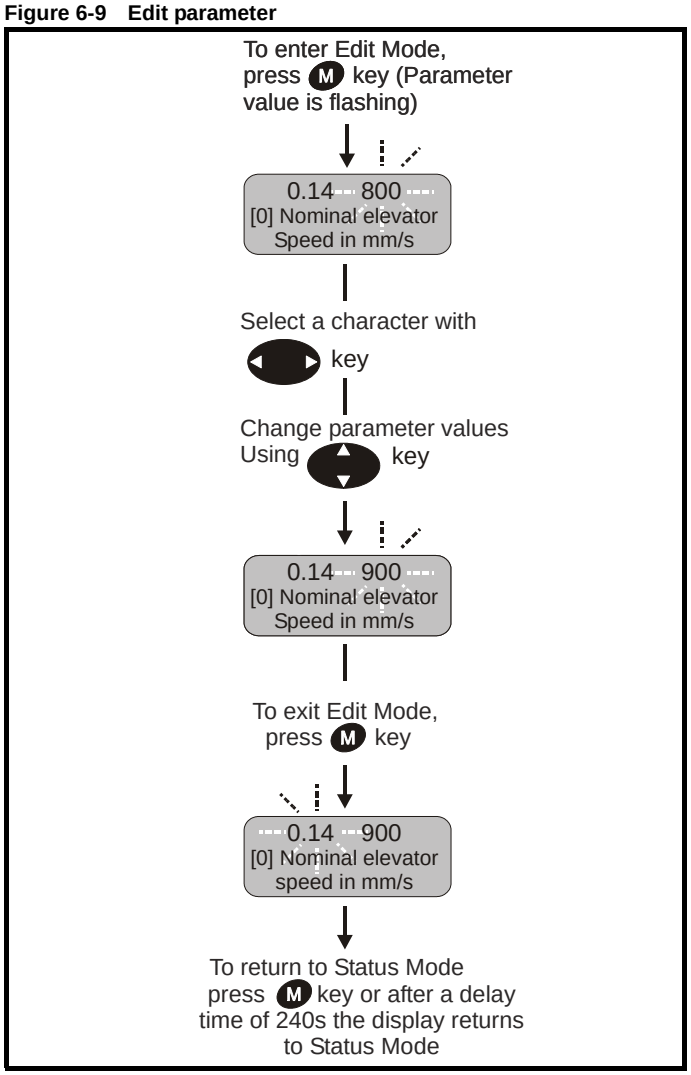
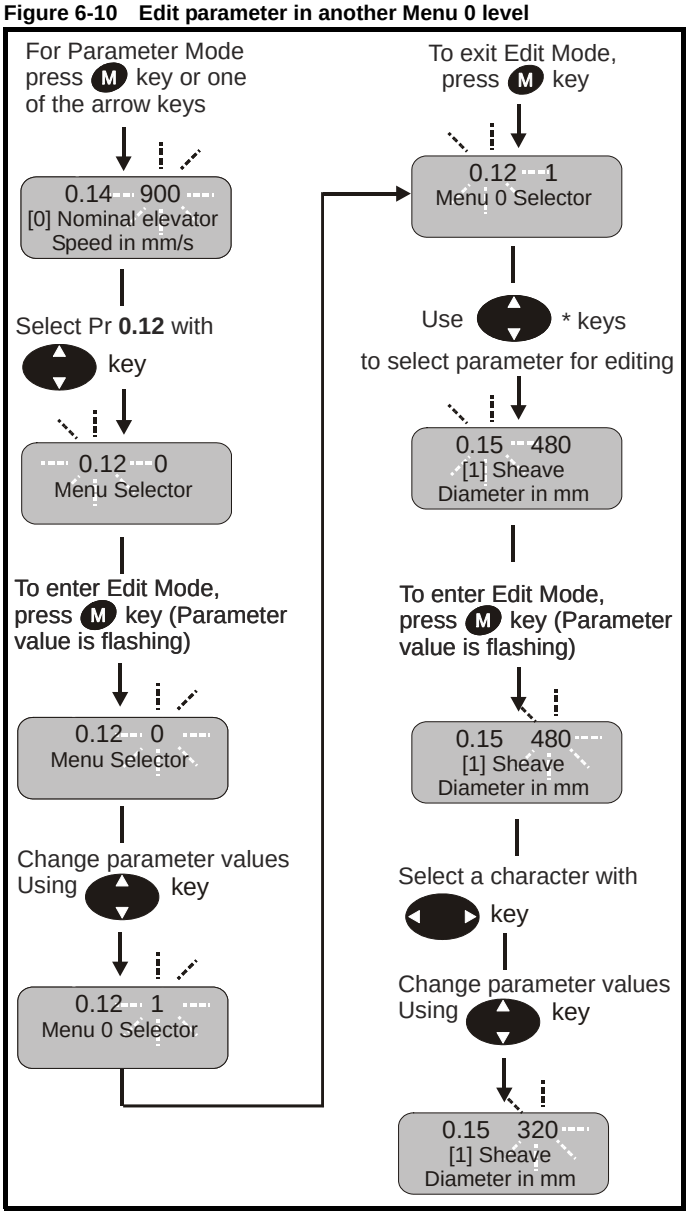


Figure 6-10 Edit parameter in another Menu 0 level

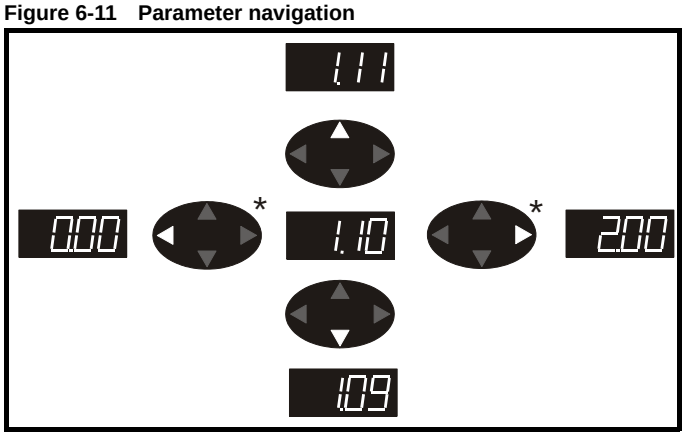


6.5 Menu structure

The drive parameter structure consists of menus and parameters.

The drive initially powers up so that only menu 0 can be viewed. The up and down arrow buttons are used to navigate between parameters and once level 2 access (L2) has been enabled (see Pr **0.49**) the left and right buttons are used to navigate between menus. For further information, refer to section 7.10 *Parameter access level and security* on page 49.

Figure 6-11 Parameter navigation



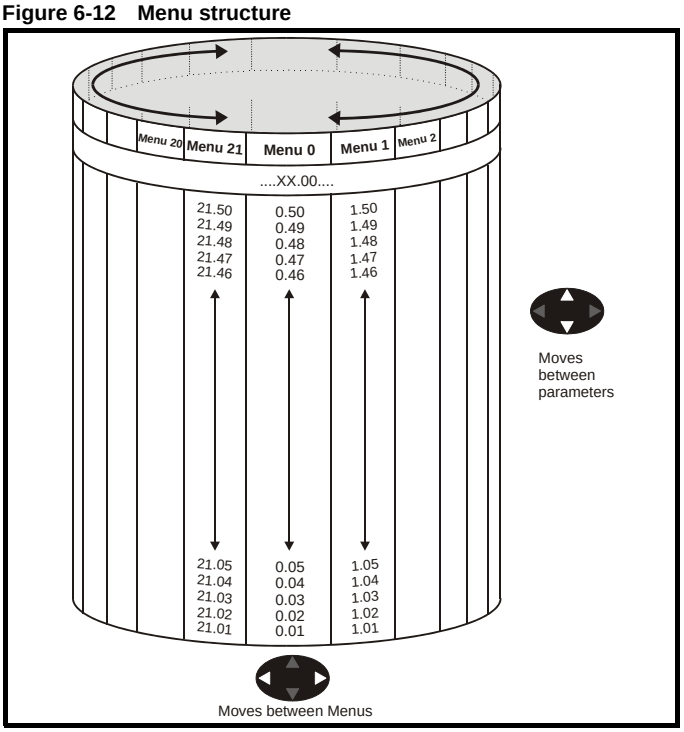
* can only be used to move between menus if L2 access has been enabled (Pr **0.49**). Refer to section 7.10 *Parameter access level and security* on page 49.

The menus and parameters will roll over in both directions.

i.e. if the last parameter is displayed, a further press will cause the display to rollover and show the first parameter.

When changing between menus the drive remembers which parameter was last viewed in a particular menu and thus displays that parameter.

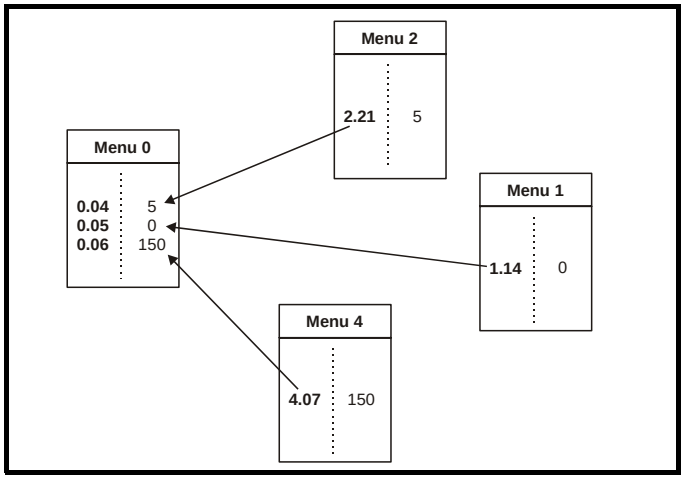
Figure 6-12 Menu structure



6.6 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive.
Appropriate parameters are cloned from the advanced menus into menu 0 and thus exist in both locations.

Figure 6-13 Menu 0 Cloning



6.7 Advanced menus

The advanced menus consist of groups or parameters appropriate to a specific function or feature of the drive. Menus 0 to 22 can be viewed on both keypads. Menus 40 and 41 are specific to the SM-Keypad Plus (LCD). Menus 70 to 91 can be viewed with an SM-Keypad Plus (LCD) only when an SM-Applications or SM-Applications Lite is fitted.

Menu	Description	LED	LCD
0	Commonly used basic set up parameters for quick / easy programming	✓	✓
1	Frequency / speed reference	✓	✓
2	Ramps	✓	✓
3	Slave frequency, speed feedback and speed control	✓	✓
4	Torque and current control	✓	✓
5	Motor control	✓	✓
6	Sequencer and clock	✓	✓
7	Analogue I/O	✓	✓
8	Digital I/O	✓	✓
9	Programmable logic, motorised pot and binary sum	✓	✓
10	Status and trips	✓	✓
11	General drive set-up	✓	✓
12	Threshold detectors and variable selectors	✓	✓
13	Position control	✓	✓
14	User PID controller	✓	✓
15, 16, 17	Solutions Module set-up	✓	✓
18	Application menu 1	✓	✓
19	Application menu 2	✓	✓
20	Application menu 3	✓	✓
21	Second motor parameters	✓	✓
22	Additional Menu 0 set-up	✓	✓
40	Keypad configuration menu	X	✓
41	User filter menu	X	✓
70	PLC registers	X	✓
71	PLC registers	X	✓
72	PLC registers	X	✓
73	PLC registers	X	✓
74	PLC registers	X	✓
75	PLC registers	X	✓
85	Timer function parameters	X	✓
86	Digital I/O parameters	X	✓
88	Status parameters	X	✓
90	General parameters	X	✓
91	Fast access parameters	X	✓

6.7.1 Display messages

The following tables indicate the various possible mnemonics which can be displayed by the drive and their meaning.

Trip types are not listed here but can be found in Chapter 13 *Diagnostics* on page 82 if required.

Table 6-2 Alarm indications

Lower display	Description
br.rS	Braking resistor overload
Braking resistor I^2t accumulator (Pr **10.37**) 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 'Oh2' if the temperature continues to rise (see the 'Oh2' trip). or • The ambient temperature around the control PCB is approaching the over temperature threshold (see the 'O.CtL' trip).	
OVLd	Motor overload
The motor I^2t accumulator in the drive has reached 75% of the value at which the drive will be tripped and the load on the drive is >100%	

Table 6-3 Status indications

Upper display	Description	Drive output stage
ACUU	AC Supply loss	Enabled
The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor.		
***Auto tunE**	Autotune in progress	Enabled
The autotune procedure has been initialised. *'Auto' and 'tunE' will flash alternatively on the display.		
dEC	Decelerating	Enabled
The drive is decelerating the motor.		
inh	Inhibit	Disabled
The drive is inhibited and cannot be run. The drive enable signal is not applied to terminal 31 or Pr **6.15** is set to 0.		
rdY	Ready	Disabled
The drive is ready to be run.		
run	Running	Enabled
The drive is running.		
StoP	Stop or holding zero speed	Enabled
The drive is holding zero speed. Regen> The drive is enabled but the AC voltage is too low, or the DC bus voltage is still rising or falling.		
triP	Trip condition	Disabled
The drive has tripped and is no longer controlling the motor. The trip code appears on the lower display.		

Table 6-4 Solutions Module and SMARTCARD status indications on power-up

Lower display	Description
boot	A parameter set is being transferred from the SMARTCARD to the drive during power-up.
cArd	The drive is writing a parameter set to the SMARTCARD during power-up. For further information, please refer to section 11.2.3 *Auto saving parameter changes (Pr 11.42 = Auto (3))* on page 66.
loAding	The drive is writing information to a Solutions Module.

6.8 Programming parameters from the SMARTCARD

The Unidrive SP and SM-ELV option module can be programmed with a parameter set loaded to a SMARTCARD from an existing system (Unidrive SP and SM-ELV option module). Or the parameter set for an existing system can be saved to the SMARTCARD.

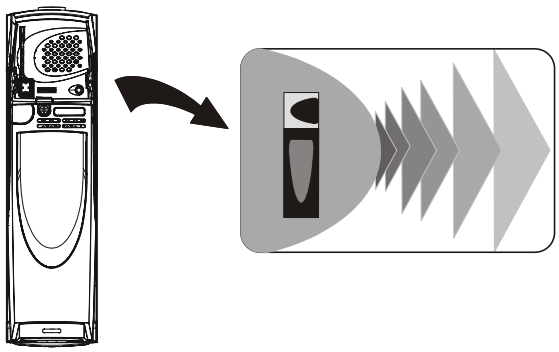
Programming the Unidrive SP and SM-ELV option module with a parameter set from an existing system will configure system to operate in the same mode as the system which the parameter set was copied from, for further details on the parameters copied refer to Chapter 11 *SMARTCARD operation* on page 76.

6.8.1 SMARTCARD parameter setting

To program the drive with the SMARTCARD using the drive keypad

1. Save drive parameters to the SMARTCARD data block:

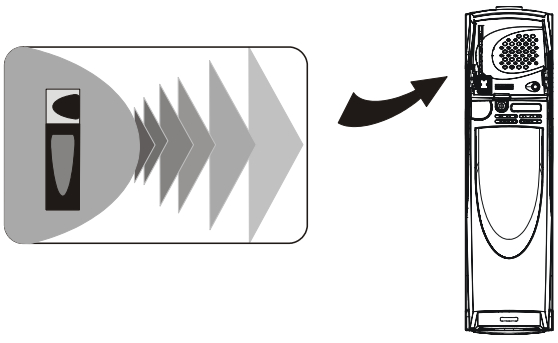
- Erase data block x by Pr **0.00** = 700x (x = Number - 7001 for data block 1)
- Action / Reset by pressing the Reset-Button
- Save data block x by Pr **0.00** = 400x (x = Number - 4001 for data block 1)
- Action / Reset by pressing the Reset-Button
- If trip C.Chg (179) the Data Block is already used, carry out erase as described above.



1. Pr **0.00** = 700x
2. Action / Reset-Button
3. Pr **0.00** = 400x
4. Action / Reset-Button

2. Program drive parameters from SMARTCARD data block

- Select data block x with Pr **0.00** = 600x (x = Number - 6001 for data block 1)
- Action / Reset by pressing the Reset-Button
- Save Parameters by setting Pr **0.00** = 1000
- Action / Reset by pressing the Reset-Button
- trip C.rtg (186) indicate, that the source data block was created from a drive with a different power rating. Motor data and current limit will not be programmed. Manual adjustment is required:
  - Pr **0.06**: Current Limit 175...250
  - Pr **0.41**: Switching Frequency 6 - 16 kHz
  - Pr **0.46**: Motor current



1. Pr **0.00** = 600x
2. Action / Reset-Button
3. Pr **0.00** = 1000
4. Action / Reset-Button

Programming the drive with a data block from the SMARTCARD will set the operation mode, motor and encoder feedback parameters along with the basic parameters for the elevator drive. After the SMARTCARD parameter set has been programmed to the drive set up can continue directly to section 8.4 *First start with empty car* , assuming all relevant elevator parameters and configuration have been set-up.

6.9 Changing the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters. (Pr **0.49** *Security status* and Pr **0.34** *User security code* are not affected by this procedure.)

Procedure

Use the following procedure only if a different operating mode is required:

1. Ensure the drive is not enabled, i.e. terminal 31 is open or Pr **6.15** is Off (0)
2. Enter either of the following values in Pr **0.00**, as appropriate:
   1253 (Europe, 50Hz AC supply frequency)
   1254 (USA, 60Hz AC supply frequency)
3. Change the setting of Pr **0.48** as follows:

0.48 setting		Operating mode
	1	Open-loop
	2	Closed-loop Vector
	3	Closed-loop Servo
	4	Regen (See the *Unidrive SP Regen Installation Guide* for more information about operating in this mode)

The figures in the second column apply when serial communications are used.

4. Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

6.10 Saving parameters

When changing a parameter in Menu 0, the new value is saved when pressing the M Mode button to return to parameter view mode from parameter edit mode.

If parameters have been changed in the advanced menus or menu 0[1], menu 0[2], menu 0[3], menu 0[4], then the change will not be saved automatically. A save function must be carried out.

Procedure

Enter 1000* in Pr. **xx.00**

Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

*If the drive is in the under voltage trip state or is being supplied from a low voltage DC supply, a value of 1001 must be entered into Pr **xx.00** to perform a save function.

6.11 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drive's memory. (Pr **0.49** and Pr **0.34** are not affected by this procedure.)

Procedure

1. Ensure the drive is not enabled, i.e. terminal 31 is open or Pr **6.15** is Off (0)
2. Enter 1233 (EUR 50Hz settings) or 1244 (USA 60Hz settings) in Pr **xx.00**.
3. Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

6.12 Restoring Lift software defaults

All parameters used for the Elevator software can be set back to the default values at any stage by setting Pr **18.50** = Off.

This will automatically set the following parameters listed to their default values and carry out a save, with all previous parameters adjustments being over written.

6.13 Parameter access level and security

The parameter access level determines whether the user has access to menu 0 only or to all the advanced menus (menus 1 to 21) in addition to menu 0.

The User Security determines whether the access to the user is read only or read write.

Both the User Security and Parameter Access Level can operate independently of each other as shown in the table below:

Parameter Access Level	User Security	Menu 0 status	Advanced menus status
L1	Open	RW	Not visible
L1	Closed	RO	Not visible
L2	Open	RW	RW
L2	Closed	RO	RO

RW = Read / write access RO = Read only access

The default settings of the drive are Parameter Access Level L1 and user Security Open, i.e. read / write access to Menu 0 with the advanced menus not visible.

6.13.1 Access level

The access level is set in Pr **0.49** and allows or prevents access to the advanced menu parameters.

String	Value	Effect
L1	0	Access to menu 0 only
L2	1	Access to all menus (menu 0 to menu 21)

The Access Level can be changed through the keypad even if the User Security has been set.

6.13.2 User Security

The User Security, when set, prevents write access to any of the parameters (other than Pr. **0.49** and Pr **11.44** *Access Level*) in any menu.

Setting User Security

Enter a value between 1 and 999 in Pr **0.34** and press the M button; the security code has now been set to this value. In order to activate the security, the Access level must be set to Loc in Pr **0.49**. When the drive is reset, the security code will have been activated and the drive returns to Access Level L1. The value of Pr **0.34** will return to 0 in order to hide the security code. At this point, the only parameter that can be changed by the user is the Access Level Pr **0.49**.

Unlocking User Security

Select a read write parameter to be edited and press the M button, the upper display will now show CodE. Use the arrow buttons to set the security code and press the M button.

With the correct security code entered, the display will revert to the parameter selected in edit mode.

If an incorrect security code is entered the display will revert to parameter view mode.

To lock the User Security again, set Pr **0.49** to Loc and press the reset button.

Disabling User Security

Unlock the previously set security code as detailed above. Set Pr **0.34** to 0 and press the M button. The User Security has now been disabled,

and will not have to be unlocked each time the drive is powered up to allow read / write access to the parameters.

6.13.3 Lift software security code protection (Pr 20.15)

Access to Menu 0 parameters (Pr **0.12** = 1 to 4) is only allowed:

a) If the security code in Pr **20.15** = 0, (default)

b) If the setting of Pr **xx.00** corresponds to the drive security code.

By setting the security code in Pr **20.15** ≠ 0, it will lock the access to the lift parameter sets available in Menu 0 (Pr **0.12** = 1 to 4). Only personnel who know the security code will be able to access these.

6.14 Displaying parameters with non-default values only

By entering 12000 in Pr **xx.00**, the only parameters that will be visible to the user will be those containing a non-default value. This function does not require a drive reset to become active. In order to deactivate this function, return to Pr **xx.00** and enter a value of 0.

Please note that this function can be affected by the access level enabled, refer to section 6.13 *Parameter access level and security* for further information regarding access level.

6.15 Displaying destination parameters only

By entering 12001 in Pr **xx.00**, the only parameters that will be visible to the user will be destination parameters. This function does not require a drive reset to become active. In order to deactivate this function, return to Pr **xx.00** and enter a value of 0.

Please note that this function can be affected by the access level enabled, refer to section 6.13 *Parameter access level and security* for further information regarding access level.

6.16 Serial communications

6.16.1 Introduction

The Unidrive SP has a standard 2-wire EIA485 interface (serial communications interface) which enables all drive set-up, operation and monitoring to be carried out with a PC or PLC if required. Therefore, it is possible to control the drive entirely by serial communications without the need for a SM-keypad or other control cabling. The drive supports two protocols selected by parameter configuration:

- Modbus RTU
- CT ANSI

Modbus RTU has been set as the default protocol, as it is used with the PC-tools commissioning software as provided on the CD ROM.

The serial communications port of the drive is a RJ45 socket, which is isolated from the power stage and the other control terminals.

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

EIA232 to EIA485 Communications

An external EIA232 hardware interface such as a PC cannot be used directly with the 2-wire EIA485 interface of the drive. Therefore a suitable converter is required.

A suitable EIA232 to EIA485 converter is the Control Techniques isolated CT Comms cable (CT Part No. 4500-0087)

When using the above converter or any other suitable converter with the Unidrive SP, it is recommended that no terminating resistors be connected on the network. It may be necessary to 'link out' the terminating resistor within the converter depending on which type is used. The information on how to link out the terminating resistor will normally be contained in the user information supplied with the converter.

6.16.2 Serial communications set-up parameters

The following parameters need to be set according to the system requirements.

0.35 {11.24}	**Serial mode**									
RW	Txt								US	
⇳	AnSI (0) rtU (1)				⇨	rtU (1)				

This parameter defines the communications protocol used by the 485 comms port on the drive. This parameter can be changed via the drive keypad, via a Solutions Module or via the comms interface itself. If it is changed via the comms interface, the response to the command uses the original protocol. The master should wait at least 20ms before send a new message using the new protocol. (Note: ANSI uses 7 data bits, 1 stop bit and even parity; Modbus RTU uses 8 data bits, 2 stops bits and no parity.)

Comms value	String	Communications mode
0	AnSI	ANSI
1	rtU	Modbus RTU protocol
2	Lcd	Modbus RTU protocol, but with an SM-Keypad Plus only

ANSIx3.28 protocol

Full details of the CT ANSI communications protocol are the *Unidrive SP Advanced User Guide*.

Modbus RTU protocol

Full details of the CT implementation of Modbus RTU are given in the *Unidrive SP Advanced User Guide*.

Modbus RTU protocol, but with an SM-Keypad Plus only

This setting is used for disabling communications access when the SM-Keypad Plus is used as a hardware key. See the *Unidrive SP Advanced User Guide* for more details.

0.36 {11.25}	**Serial communications baud rate**									
RW	Txt								US	
⇳	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8)*, 115200 (9)*				⇨	19200 (6)				

* only applicable to Modbus RTU mode

This parameter can be changed via the drive keypad, via a Solutions Module or via the comms interface itself. If it is changed via the comms interface, the response to the command uses the original baud rate. The master should wait at least 20ms before send a new message using the new baud rate.

NOTE

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

0.37 {11.23}	**Serial communications address**									
RW	Txt								US	
⇳	0 to 247				⇨	1				

Used to define the unique address for the drive for the serial interface. The drive is always a slave.

Modbus RTU

When the Modbus RTU protocol is used addresses between 0 and 247 are permitted. Address 0 is used to globally address all slaves, and so this address should not be set in this parameter

ANSI

When the ANSI protocol is used the first digit is the group and the second digit is the address within a group. The maximum permitted group number is 9 and the maximum permitted address within a group is 9. Therefore, Pr **0.37** is limited to 99 in this mode. The value 00 is used to globally address all slaves on the system, and x0 is used to address all slaves of group x, therefore these addresses should not be set in this parameter.

6.17 Setting of motor and elevator parameters

Before the initial start, the data for the winch motor and the elevator must be entered. Refer to the motor nameplate and elevator calculations.

Table 6-5 Menu 0 parameters

Parameter		Type	Default	Units		Setting recommendation
				Open LP	Closed LP	
Minimum rpm	Pr **0.01**	RW		min^{-1}	min^{-1}	
Maximum rpm	Pr **0.02**	RW	±32000	min^{-1}	min^{-1}	
Acceleration rate	Pr **0.03**	RW	10.000	cm/s^2	m/s^2	
Deceleration rate	Pr **0.04**	RW	10.000	cm/s^2	m/s^2	
Current limit	Pr **0.06**	RW	Imax / In	0.1% In	0.1% In	
Speed loop P-Gain	Pr **0.07**	RW	32000			0.1000
Speed loop I- Gain	Pr **0.08**	RW	32000			4.00
Motor active current	Pr **0.11**	RO	± Imax	A	A	Torque producing current
Menu 0 selector	Pr **0.12**	RO	4			Ranges between [0], [1], [2], [3], [4]
Nominal elevator rpm *	Pr **0.13**	RW	4000	min^{-1}	min^{-1}	From *Table 4.10 Nominal elevator rpm calculation and adjustment*
Nominal elevator speed	Pr **0.14**	RW	10000	mm/s	mm/s	From *Table 4.10 Nominal elevator rpm calculation and adjustment*
V1 (Creep speed)	Pr **0.15**	RW	10000	mm/s	mm/s	
V2 (Inspection)	Pr **0.16**	RW	10000	mm/s	mm/s	
V3 (Nominal 1)	Pr **0.17**	RW	10000	mm/s	mm/s	
V4 (Medium 1)	Pr **0.18**	RW	10000	mm/s	mm/s	
V5 (Re-levelling)	Pr **0.19**	RW	10000	mm/s	mm/s	
V6 (FAST speed)	Pr **0.20**	RW	10000	mm/s	mm/s	
V7 (Additional 1)	Pr **0.21**	RW	10000	mm/s	mm/s	
Stop- Deceleration	Pr **0.22**	RW	2000	mm/s^2	mm/s^2	Creep to floor only
Start- Jerk	Pr **0.23**	RW	10000	mm/s^3	mm/s^3	
Run- Jerk	Pr **0.24**	RW	10000	mm/s^3	mm/s^3	
Stop- Jerk	Pr **0.25**	RW	800	mm/s^3	mm/s^3	Creep to floor only
Threshold 1	Pr **0.26**	RW	10000	mm/s	mm/s	Pr **18.32** - Setting in Pr **0.26**[0] (Pr **18.21**)
Threshold 2	Pr **0.27**	RW	10000	mm/s	mm/s	Pr **18.33** - Setting in Pr **0.27**[0] (Pr **18.22**)
Speed selector	Pr **0.28**	RO	1818			
Encoder lines	Pr **0.29**	RW	50000	PPR	PPR	Drive encoder input
SMARTCARD modes	Pr **0.30**	RW				
V8 (Additional 2)	Pr **0.31**	RW	10000	mm/s	mm/s	
V9 (Additional 3)	Pr **0.32**	RW	10000	mm/s	mm/s	
V10 (Additional 4)	Pr **0.33**	RW	10000	mm/s	mm/s	
Actual speed	Pr **0.34**	RW	±32000	min^{-1}	min^{-1}	
Serial comms mode	Pr **0.35**	RW		ANSI, RTU	ANSI, RTU	
Serial comms baud rate	Pr **0.36**	RW		Kb	Kb	
Serial address	Pr **0.37**	RW				
Current loop P-Gain	Pr **0.38**	RW	32000			
Current loop I- Gain	Pr **0.39**	RW	32000			
Switching frequency	Pr **0.41**	RW		kHz	kHz	
Motor poles	Pr **0.42**	RW	120			
Power factor/ Encoder phase angle	Pr **0.43**	RW				
Motor voltage	Pr **0.44**	RW	480	V	V	
Nominal rpm / Thermal time constant	Pr **0.45**	RW		min^{-1}	min^{-1}	
Motor current	Pr **0.46**	RW	± Imax	A	A	
Motor frequency	Pr **0.47**	RW	50	Hz	Hz	
Operating mode	Pr **0.48**	RW		OL, VT, SV	OL, VT, SV	
Security status	Pr **0.49**	RW		L1(0), L2(1), Loc(2)	L1(0), L2(1), Loc(2)	
Drive software version	Pr **0.50**	RO				

*The adjustment of the gear ratio and the sheave diameter is done with the nominal elevator rpm. It can be calculated as follows:

Pr **0.13**[0] (Pr **18.29**) [$\mathbf{n_{Nominal}}$] = Pr **0.14**[0] (Pr **18.30**)[$V_{Nominal}$mm/s] *** Gearing * Roping * 60 / (π * D_{sheive}**[mm]**)**

For Synchronous motors only the number of motor poles and the motor current is required. Do not enter the motor data that is greyed out.

For the initial test run, only the motor data and the elevator data that is listed in the examples must be adjusted. For winches with induction motors, with or without encoders, the full motor map must be set.

7 Parameters

7.1 Security code protection

Access to Menu 0 parameters (Pr **0.12** = 1 to 4) is only allowed:

c) If the security code in Pr **20.15** = 0, (default)

d) If the setting of Pr **xx.00** corresponds to the drive security code.

By setting the security code in Pr **20.15** ≠ 0, it will lock the access to the lift parameter sets available in Menu 0 (Pr **0.12** = 1 to 4). Only personnel who know the security code will be able to access these.

7.2 Defaults

All parameters used for the Elevator software can be set back to the default values at any stage by setting Pr **18.50** = OFF (0).

This will automatically set the following parameters to their default values and carry out a save, with all previous parameters adjustments being over written.

7.3 Drive mode change

From SM-ELV software V1.10 the drive parameter settings can be saved during a mode change from, for example; closed loop vector to open loop, during a feedback fault.

The motor, interface and elevator parameters are stored in the non-volatile ram in the SM-ELV module. The configuration can be completely restored after a drive mode change provided the following procedure is followed:

1. Pr **01.00** = 1255 (EUR) or 1256 (US) (change drive mode with standard defaults excluding menus 15 through to 20)
2. Pr **00.48** = Set drive mode
3. Press the reset button -the drive mode change will then be executed

The following parameters are restored after drive mode change:

Pr **2.11**	Pr **2.21**	Pr **4.09**	Pr **5.06**	Pr **5.07**	Pr **5.08**	Pr **5.09**
Pr **5.10**	Pr **5.11**	Pr **5.18**	Pr **8.21**	Pr **8.11**	Pr **8.31**	Pr **8.22**
Pr **8.12**	Pr **8.32**	Pr **8.23**	Pr **8.13**	Pr **8.33**	Pr **8.24**	Pr **8.14**
Pr **8.25**	Pr **8.15**	Pr **8.26**	Pr **8.16**	Pr **8.27**	Pr **8.17**	Pr **12.06**
Pr **12.07**	Pr **12.26**	Pr **12.27**	Pr **7.10**	Pr **7.14**	Pr **7.15**	Pr **11.23**
Pr **11.24**	Pr **11.25**	Pr **21.05**	Pr **21.16**	Pr **21.22**	Pr **21.23**	Pr **21.27**
Pr **21.28**	Pr **21.29**	Pr **21.31**				

NOTE

If the above sequence of setting Pr **01.00** = 1255 (EUR) or 1256 (US) is not executed, the factory default settings will be restored to the drive without saving the application parameter settings.

When the drive mode is changed from open loop to closed loop vector or servo, the following parameters are restored:

Pr **4.12** = current demand filter 1
Pr **4.13** = current controller Kp gain
Pr **4.14** = current controller Ki gain
Pr **xx.10** = encoder lines
Pr **xx.15** = encoder type
Pr **xx.13** = encoder supply voltage
Pr **xx.16** = encoder termination
Pr **3.25** = encoder phase angle (only Servo mode)

Using this function the elevator can be operated without any additional settings after a mode change back to closed loop vector or servo has occurred.

7.4 Lift software status

To verify the Lift software is running, Pr **0.29** [0] (Pr **20.02**). This should toggle every 1s between 10614 and -10614.

7.5 Parameter sets

The following parameter sets Menu 0, 18,19, and 20 are used specifically for the Lift software set-up, optimisation and diagnostics. Additional parameter sets are used in the Unidrive SP to set up the motor map, speed feedback and carrying out the auto tune, for details on these refer to the Unidrive SP User Guide.

Menu zero can be set-up to display either the Basic parameters as shown in Table 6-5 on page 60, or the following parameter sets can also be displayed in Menu zero parameters (Pr **0.13** through to Pr **0.33**), Installation parameters (Pr **0.12**=1), Control parameters (Pr **0.12**=2), Distance parameters (Pr **0.12**=3), or Diagnostics Parameters (Pr **0.12**=4).

7.6 Menu 0 structure

Pr **0.00** to Pr **0.12** and Pr **0.38** to Pr **0.50** are fixed having a single function.

Pr **0.13** to Pr **0.37** can have various functions / parameter sets these being selected by the user.

Menu 0, Pr **0.12**, is changed to select different parameter sets or groups of elevator parameters. After power-up or the saving of parameters, the standard configuration for Pr **0.13** to Pr **0.37** is loaded automatically. By setting Pr **0.12** to the predefined code 1, 2, 3 or 4, other configurations of Pr **0.13** to Pr **0.37** are selected as shown in the following. In this documentation the value of Pr **0.12** is shown in square brackets after the menu zero parameter to indicate which configuration is selected.

For example:

Pr **0.26**[1] of the elevator parameters Pr **0.12** = 1:⇒ Pr **0.26** [1]
To select Pr **0.18** [2]⇒ set Pr **0.12** = 2 and select Pr **0.18**

Figure 7-1 Menu 0 Structure

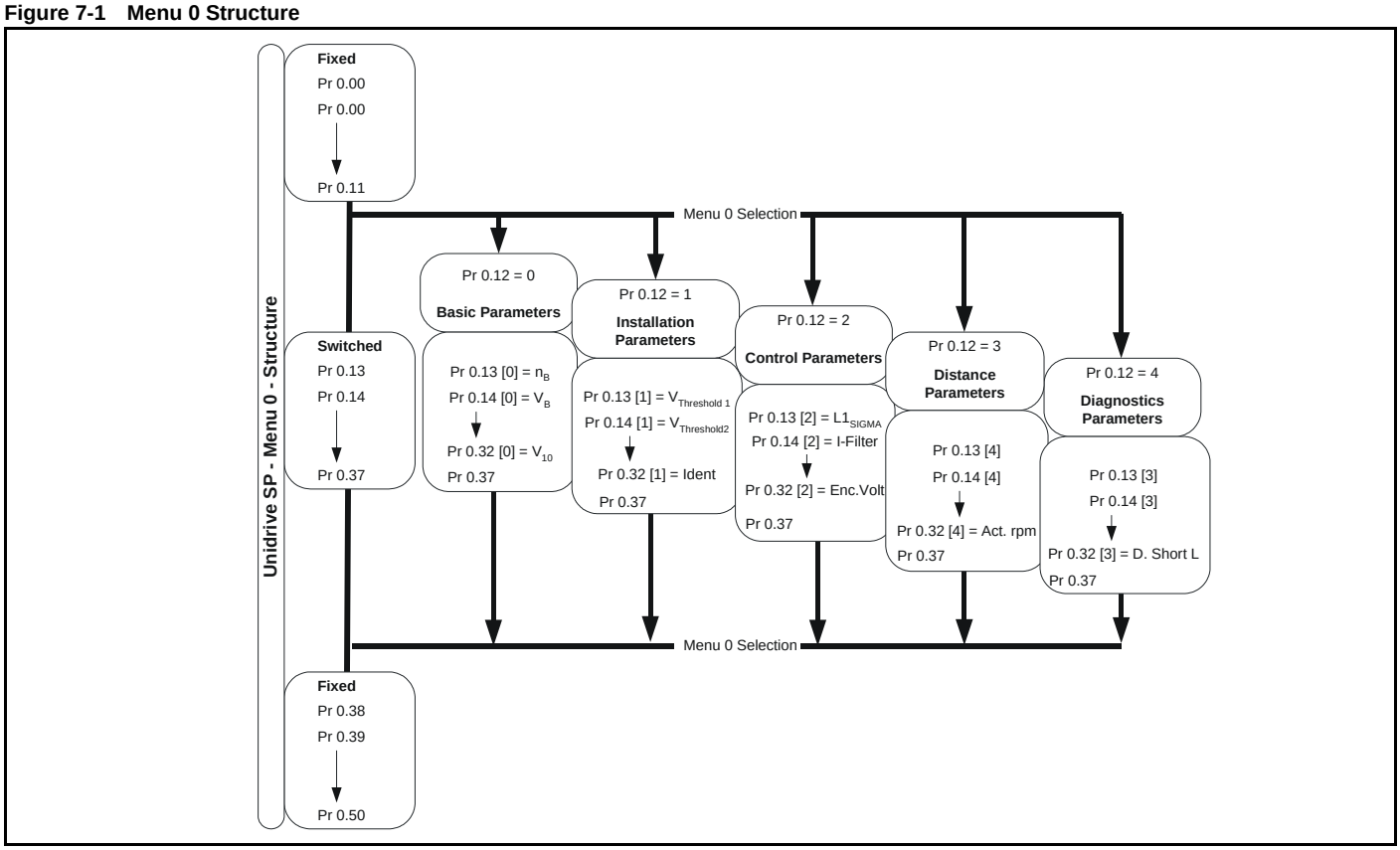
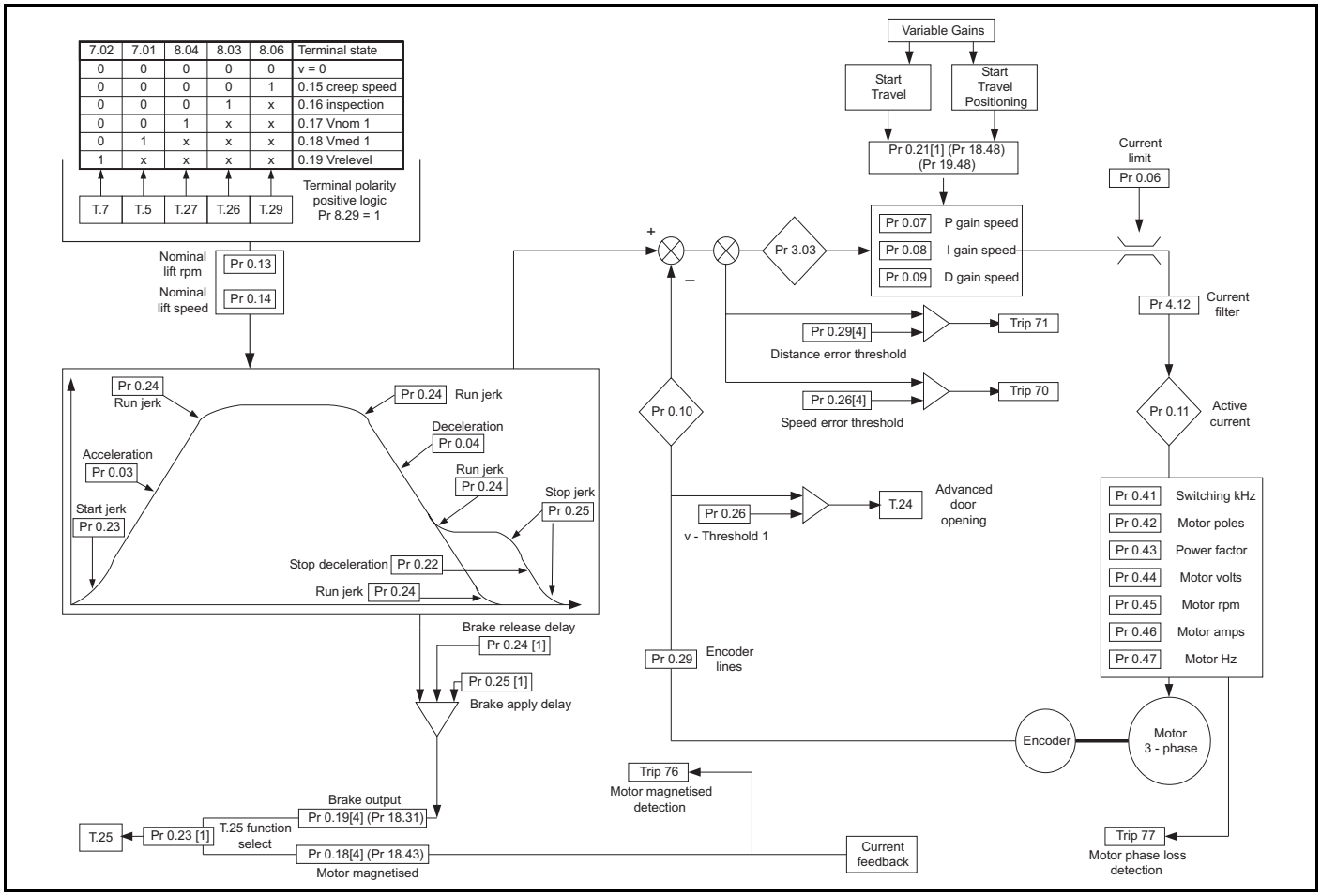


Figure 7-2 Logic overview - Menu 0



7.6.1 Installation parameters - Pr 0.12 = 1

Parameter	Description	Type	Range	Default	Units	Notes
0.13 [1]	Calculated nominal elevator rpm	RO	32000		1/min	Calculated in software (refer to section 4.10 *Nominal elevator rpm calculation and adjustment*)
0.14 [1]	Roping	RW	4	1		**1 : 1** (1), **2 : 1** (2), **3 : 1** (3)
0.15 [1]	Sheave diameter	RW	32767	480	mm	
0.16 [1]	Gear ratio numerator	RW	32767	31		
0.17 [1]	Gear ratio denominator	RW	32767	1		
0.18 [1]	Speed for start optimiser	RW	10000	10	mm/s	Refer to section
0.19 [1]	Time for start optimiser	RW	10000	300	ms	
0.20 [1]	Jerk for start optimiser	RW	10000	10	mm/s^3	
0.21 [1]	Reference selector type	RW	OFF (0) or On (1)	OFF (0)		OFF (0) = Binary selection, On (1) = Priority selection
0.22 [1]	Invert direction	RW	OFF (0) or On (1)	OFF (0)		
0.23 [1]	Function T. 25	RW	20.50	18.31		Pr **18.31**: Brake / Pr **18.43**: Motor flux
0.24 [1]	Brake release delay	RW	32000	1000	ms	
0.25 [1]	Brake apply delay	RW	32000	1000	ms	
0.26 [1]	Motor contactor delay	RO	32000	0	ms	Short (reduce) / Long (increase)
0.27 [1]	Enable peak curve	RW Bit	OFF (0) or On (1)	OFF (0)		On (1): Peak curve enable, OFF (0): peak curve disabled
0.28 [1]	Software Version	RO				SM-ELV software version
0.29 [1]	Identity number	RO	±10614			Changes sign every 1 second “healthy”
0.30 [1]	SMARTCARD parameter cloning	RW				SMARTCARD operation
0.31 [1]	Encoder slot	RW	Drive / Slot	Drive		Pr **3.26**, configure for drive or Solutions Module
0.32 [1]	Single turn comms bit	RW	0 - 32		bits	Pr **3.35**, single turn encoder bits
0.33 [1]	Encoder voltage	RW	5, 8, 15	5	Vdc	Pr **3.36**, encoder supply voltage
0.34 [1]	Encoder type	RW				Pr **3.38**, encoder type
0.35 [1]	Encoder error detection	RO	0 - 7	1		Pr **3.40**, error detection for drive encoder input
0.36 [1]	Auto configuration/ ssi binary/gray	RO	OFF (0) or On (1)	OFF (0)		Pr **3.41**, comms encoder auto-configuration or SSI code
0.37 [1]	Automatic motor nominal rpm	RW	OFF (0) or On (1)	OFF (0)		
0.38 [1]	Rapid stop	RW	OFF (0) or On (1)	OFF (0)		Pr **19.49**, enable for rapid stop
0.39 [1]	Rapid stop deceleration	RW	10.000	2.000	m/s^2	Pr **21.05**, deceleration rate for rapid stop

7.6.2 Control parameters - Pr 0.12 = 2

Parameter	Description	Type	Range	Default	Units	Notes
0.13 [2]	Current demand filter 1	RW	250	0.0	ms	Refer to section 4.11 *Variable Gains - selection / optimisation*
0.14 [2]	Current demand filter 2	R/W	250	0.0	ms	
0.15 [2]	Current demand filter setup	R/W	OFF (0) or On (1)	OFF (0)		OFF (0) at start only, On (1) constant
0.16 [2]	Current loop Kp- gain start	R/W	32767			
0.17 [2]	Current loop Ki- gain start	R/W	32767			
0.18 [2]	Optimise rated speed	RW	OFF (0) or On (1)	On (1)		Enable, Pr **5.16** in Unidrive SP
0.19 [2]	P- gain start locking	RW	1000	0		Refer to section 4.11 *Variable Gains - selection / optimisation*
0.20 [2]	D- gain start locking	RW	30000	0		
0.21 [2]	Variable speed loop gain enable	RW	OFF (0) or On (1)	OFF (0)		**1**: Separate speed controller gains for start and run only (Refer to section 4.11 *Variable Gains - selection / optimisation*)
0.22 [2]	Speed loop gain transition time	RW	32000	500	ms	Refer to section 4.11 *Variable Gains - selection / optimisation*
0.23 [2]	Speed loop Kp - gain run	RW	32767	50		
0.24 [2]	Speed loop Ki - gain run	RW	32767	80		
0.25 [2]	Speed loop Kp - gain start	RW	32767	50		
0.26 [2]	Speed loop Ki - gain start	RW	32767	80		
0.27 [2]	Inertia compensation scaling	RW	32767	1000		
0.28 [2]	Inertia compensation	RW	OFF (0) or On (1)	OFF (0)		Enable (refer to section 4.16.2)
0.29 [2]	Motor magnetised threshold.	RW	990	200	0,1%	
0.30 [2]	Encoder supply voltage / resolver excitation	RW	0 - 2	0		0 = **5V** , 1 = **8V**, 2 = **15V** Resolver: 0 = **3:1** , 1 or 2 = **2:1**
0.31 [2]	Speed loop Kp	RW	32767			Refer to section 4.11 *Variable Gains - selection / optimisation*
0.32 [2]	Speed loop Ki	RW	32767			
0.33 [2]	Current loop filter	RW	25.0		ms	
0.34 [2]	Current loop Kp	RW	32767			
0.35 [2]	Current loop Ki	RW	32767			
0.36 [2]						
0.37 [2]						

7.6.3 Distance Parameters - Pr 0.12 = 3

Parameter	Description	Type	Range	Default	Units	Notes
0.13 [3]	Creep distance measurement	RO	32000	0	mm	
0.14 [3]	Calculated deceleration distance	RO	32000	266	mm	Calculated distance - actual speed to V1 creep speed
0.15 [3]	Measured deceleration distance	RO	32000	0	mm	Measured distance - actual speed to V1 creep speed
0.16 [3]	Direct-to-floor sensor source	RW	4	0		**1 – 3**: Source = Analogue input 1 – 3 / 4 **4**: Controlling
0.17 [3]	Enable Floor sensor correction	RW	OFF (0) or On (1)	OFF (0)		**1** = Floor sensor correction **0** = No floor sensor correction
0.18 [3]	Not used					
0.19 [3]	Floor sensor correction source	RW	4	0		**1**: T.5, **2**: T.7, **3**: T.8, **4**: Controlled stop distance
0.20 [3]	Floor sensor target distance	RW	10000	0	mm	
0.21 [3]	Remaining floor sensor distance	RO	32000	0	mm	
0.22 [3]	Speed at floor sensor activation	RO	10000	0	mm/s	
0.23 [3]	Time from floor sensor activation to stop	RO	32000	0	ms	
0.24 [3]	P-gain following error regulation	RW	32767	0		Recommended values 2...10
0.25 [3]	Following error direct-to-floor regulation	RO	30000	75	mm	
0.26 [3]	Short distance landing	RW	10000	0	mm	
0.27 [3]	Set-point peak curve distance	RO	32000	0	mm	
0.28 [3]	Measured peak curve distance	RO	32000	0	mm	
0.29 [3]	Stopping distance	RO	32000	0	mm	Deceleration distance - creep speed to stop
0.30 [3]	Not used					
0.31 [3]	Deceleration distance V2	RW		26.600	s / 1000 rpm	
0.32 [3]	Deceleration distance V3	RW		73.800	s / 1000 rpm	
0.33 [3]	Deceleration distance V4	RW		3.400	s / 1000 rpm	
0.34 [3]	Deceleration distance V5	RW		3.400	s / 1000 rpm	
0.35 [3]	Deceleration distance V6	RW		3.400	s / 1000 rpm	
0.36 [3]	Deceleration distance V7	RW		3.400	s / 1000 rpm	
0.37 [3]	Deceleration distance V8	RW		0.000	s / 1000 rpm	
0.38 [3]	Current controller Kp	RW		75		
0.39 [3]	Current controller Ki	RW		1000		
0.51 [3]	Deceleration distance V9	RW		0.000	s / 1000 rpm	
0.52 [3]	Deceleration distance V10	RW		0.000	s / 1000 rpm	

7.6.4 Diagnostic parameters - Pr 0.12 = 4

Parameter	Description	Type	Range	Default	Units	Notes
0.13 [4]	Zero speed threshold	RW	250	5	rpm	
0.14 [4]	Not used					
0.15 [4]	Motor voltage at output	RO	800	0	V	
0.16 [4]	Final speed reference	RO	± 32768	0.0	mm/s	(Pr **3.01** in Unidrive SP)
0.17 [4]	Maximum overload	RO	400.0		%In	
0.18 [4]	Motor magnetised	RO	OFF (0) or On (1)	OFF (0)		**1**: Motor magnetised
0.19 [4]	Brake output	RO	OFF (0) or On (1)	OFF (0)		**ON**: Brake released / **OFF**: Brake applied
0.20 [4]	Last trip	RO				
0.21 [4]	Previous trip	RO				
0.22 [4]	Speed controller output	RO	400.0	0.0	%In	
0.23 [4]	Terminal status	RO	11111			T. 24/ 25/ 41/ 28/ 31 (See section 13.2.4)
0.24 [4]	Terminal status	RO	11111			T. 29/ 26/ 27/ 5/ 7 (See section 13.2.4)
0.25 [4]	Speed error	RO	10000	0	mm/s	As Unidrive SP (Pr **3.03**)
0.26 [4]	Maximum speed error threshold	RW	10000	200	mm/s	Setting = 10 x Pr **0.25**[4] > 200 (Trip 70)
0.27 [4]	Distance error	RO	10000	0	mm	
0.28 [4]	Maximum distance error threshold	RW	10000	200	mm	Setting = 10 x Pr **0.27**[4] > 200 (Trip 71)
0.29 [4]	Speed error	RO	± 32768	0.0	rpm	Speed error (Pr **3.03**)
0.30 [4]	Drive encoder speed feedback	RO	± 32768	0.0	rpm	Drive encoder speed feedback (Pr **3.27**)
0.31 [4]	SMARTCARD data previously loaded	RO				
0.32 [4]	SMARTCARD data number	RO				
0.33 [4]	SMARTCARD data type / mode	RO				
0.34 [4]	SMARTCARD data checksum	RO		0		

7.7 Menu 18 parameters

Parameter	Description	Type	Range	Default	Units	Notes
18.01	Not used					
18.02	Deceleration distance					
18.03	Calculated nominal elevator rpm	RO			1/min	
18.04	Terminal status	RO	11111			T. 24/ 25/ 41/ 28/ 31 (See section 13.2.4)
18.05	Terminal status	RO	11111			T. 29/ 26/ 27/ 5/ 7 (See section 13.2.4)
18.06	Maximum distance error	RO			mm	Trip 71
18.07	Maximum speed error	RO			mm/s	Trip 70
18.08	Torque for inertia compensation	RO			0,1%Mn	
18.09	Remaining floor sensor distance	RO			mm	
18.10	Reference value selector	RO			mm.nn	Reference parameter number
18.11	V1 (Creep speed)	R/W	10000	50	mm/s	
18.12	V2 (Inspection speed)	R/W	10000	400	mm/s	
18.13	V3 (Nominal speed)	R/W	10000	800	mm/s	
18.14	V4 (Medium speed)	R/W	10000	100	mm/s	
18.15	V5 (Re-levelling speed)	R/W	10000	100	mm/s	
18.16	V6 (Fast speed)	R/W	10000	100	mm/s	
18.17	V7 (Additional speed 1)	R/W	10000	100	mm/s	
18.18	Speed for start optimizer	R/W	10000	10	mm/s	
18.19	Floor sensor target distance	R/W	10000	0	mm	
18.20	Short distance	R/W	10000	0	mm	
18.21	v- threshold 1	R/W	±32768	300	mm/s	Advanced door opening (default)
18.22	v- threshold 2	R/W	±32768	500	mm/s	
18.23	Motor magnetised threshold.	R/W	990	500	0,1%	
18.24	Brake apply delay	R/W	10000	1000	ms	
18.25	P- Gain run	R/W	32768	100		
18.26	I- Gain run	R/W	32768	100		Refer to section 4.11 *Variable Gains - selection / optimisation*
18.27	P- Gain start	R/W	32768	200		
18.28	I- Gain start	R/W	32768	200		
18.29	Nominal elevator rpm	R/W	4000	1000	1/min	Closed loop / Servo (3000)
18.30	Nominal elevator speed	R/W	10000	800	mm/s	
18.31	Brake output	RO	OFF (0) or On (1)	OFF (0)		**On**: Brake released **OFF**: Brake applied
18.32	1: n < v- threshold 1	RO	OFF (0) or On (1)	On (1)		Advanced door opening (default)
18.33	1: n < v- threshold 2	RO	OFF (0) or On (1)	On (1)		
18.34	Standstill	RO	OFF (0) or On (1)	On (1)		
18.35	Start short distance landing	R/W	OFF (0) or On (1)	OFF (0)		
18.36	Reference Select Bit 1	R/W	OFF (0) or On (1)	OFF (0)		
18.37	Reference Select Bit 2	R/W	OFF (0) or On (1)	OFF (0)		
18.38	Reference Select Bit 3	R/W	OFF (0) or On (1)	OFF (0)		
18.39	Reference Select Bit 4	R/W	OFF (0) or On (1)	OFF (0)		
18.40	Reference Select Bit 5	R/W	OFF (0) or On (1)	OFF (0)		
18.41	Reference Select Bit 6	R/W	OFF (0) or On (1)	OFF (0)		
18.42	Reference selector type	R/W	OFF (0) or On (1)	OFF (0)		**OFF**: Binary / ON: Priority
18.43	Motor magnetised	RO	OFF (0) or On (1)	OFF (0)		**On**: Motor magnetised
18.44	CCW direction	RO	OFF (0) or On (1)	OFF (0)		
18.45	INVERT direction	R/W	OFF (0) or On (1)	OFF (0)		
18.46	Load measurement	R/W	OFF (0) or On (1)	OFF (0)		**ON**: Enable
18.47	Peak curve operation	R/W	OFF (0) or On (1)	OFF (0)		**ON**: Enable
18.48	Switch gain	R/W	OFF (0) or On (1)	OFF (0)		**ON**: Enable
18.49	Enable inertia compensation	R/W	OFF (0) or On (1)	OFF (0)		**ON**: Enable
18.50	Default setting	R/W	OFF (0) or On (1)	On (1)		**ON**: Default setting done

7.8 Menu 19 parameters

Parameter	Description	Type	Range	Default	Units	Notes
19.01	Speed setpoint	RO	±32000		mm/s	
19.02	Actual speed	RO	±32000		mm/s	
19.03	Ramp speed	RO	±32000		mm/s	
19.04	Reference acceleration	RO	±32000		mm/s^2	
19.05	Stopping distance	RO	±32000		mm	
19.06	Set-point peak curve distance	RO	±32000		mm	
19.07	Measured peak curve distance	RO	±32000		mm	
19.08	Calculated deceleration distance	RO	±32000		mm	
19.09	Speed at floor sensor active	RO	±32000		mm/s	
19.10	Measured deceleration distance	RO	±32000		mm	
19.11	Gain transition time	R/W	32768	500	ms	Start to travel gains only
19.12	D-Gain position controller (start)	R/W	32768	0		
19.13	Stop deceleration	R/W	2000	1000	mm/s^2	Creep to floor only
19.14	Start jerk	R/W	10000	500	mm/s^3	
19.15	Run jerk	R/W	10000	1000	mm/s^3	
19.16	Stop jerk	R/W	10000	800	mm/s^3	Creep to floor only
19.17	Jerk for start optimiser	R/W	10000	10	mm/s^3	
19.18	Maximum distance error threshold	R/W	10000	100	mm	Trip 71
19.19	Feedforward acceleration scaling	R/W	32768	1000	0,1%	
19.20	P-Gain position controller (start)	R/W	1000	0		Position controller for start
19.21	Load measurement scaling	R/W	±32768	1000	0,1%	
19.22	Offset load measurement	R/W	±32768	0	0,3125 mV	
19.23	Filter time constant. Load measurement	R/W	±32768	100	ms	
19.24	Maximum speed error threshold	R/W	1000	100	mm/s	Trip 70
19.25	Brake release delay	R/W	10000	1000	ms	Pr **0.24** [1]
19.26	Direction inputs	R/W	1	0		**1** = 2 direction inputs
19.27	Gear ratio denominator	R/W	32768	1		
19.28	Time for start optimiser	R/W	10000	300	ms	
19.29	Sheave Diameter	R/W	32768	480	mm	
19.30	Gear Ratio numerator	R/W	32768	31		
19.31	Automatic motor nominal rpm	R/W	OFF (0) or On (1)	OFF (0)		
19.32	Motor contactor output	R/W	OFF (0) or On (1)	OFF (0)		
19.34	Enable current filter (start)	R/W	OFF (0) or On (1)	OFF (0)		Refer to section 4.11 Pr **4.12** = 0 / constant
19.35	Thermistor display	RO	OFF (0) or On (1)	OFF (0)		
19.36	Overload Output	RO	OFF (0) or On (1)	OFF (0)		**1** = Overload
19.37	Load direction (last measured)	RO	OFF (0) or On (1)	On (1)		**0** = Up **1** = Down
19.38	Emergency rescue status	R/W	OFF (0) or On (1)	OFF (0)		
19.39	Emergency rescue invert	R/W	OFF (0) or On (1)	OFF (0)		
19.41	Reference Select Bit 7	R/W	OFF (0) or On (1)	OFF (0)		
19.42	Floor sensor correction enable	R/W	OFF (0) or On (1)	OFF (0)		Refer to section 4.5
19.43	Enable motor phase loss detection	R/W	OFF (0) or On (1)	OFF (0)		
19.44	CW direction	R/W	OFF (0) or On (1)	OFF (0)		
19.48	Enable multiple gains	R/W	OFF (0) or On (1)	OFF (0)		Refer to section 4.11
19.49	Enable fast stop	R/W	OFF (0) or On (1)	OFF (0)		
19.50	Global warning	RO	OFF (0) or On (1)	OFF (0)		Displays errors during travel

7.9 Menu 20 parameters

Parameter	Description	Type	Range	Default	Units	Notes
20.01	SM-ELV software version	RO				
20.02	Software identity number	RO	±10614	10614		
20.03	Serial comms status word	R/W	±10615	0		
20.04	Serial comms control word	R/W	±10616	0		
20.05	Time from floor sensor active	RO		0	ms	
20.06	Motor Time Constant	RO		0	ms	
20.07	Motor Flux Level	RO		0	0,1A	
20.08	Time for Load measurement	R/W	±10000	200	ms	
20.09	Maximum overload	RO		3	% Mn	
20.10	Roping	R/W	4	1		1 = **1:1**, 2 = **2:1**, 3 = **3:1**, 4 = **4:1**
20.11	Program status	RO		0		
20.12	Creep speed parameter number	R/W	±32768	0		
20.13	Direct-to-Floor Sensor Source	R/W	0...4	0		1: Latching 2: Momentary.
20.14	Floor sensor correction source	R/W	0...4	0		1: T.5 / 2: T.7 / 3: T.8 / 4: controlled stop distance
20.15	Menu 0 Access Code	R/W	±32768	0		0 = No security code active > 0 Access to Pr **0.00**...Pr **0.50**
20.16	Menu 0 Select	R/W	0...4	0		Switch of configuration Pr **0.13** - Pr **0.30** (See section 7.5)
20.17	P-Gain following error regulation	R/W	32768	0		
20.18	Overload Threshold	R/W	±32768	120	%	Load in % of nominal torque (Mn)
20.19	Load measurement value	RO		0	%	
20.20	Motor contactor delay	RO		0	ms	Short (reduce), Long (increase)
20.21	Creep Distance	RO		0	mm	Measured every run
20.22	V8 (Additional speed 2)	R/W		50	mm/s	
20.23	V9 (Additional speed 3)	R/W		400	mm/s	
20.24	V10 (Additional speed 4)	R/W		800	mm/s	
20.25	Current loop Kp start	R/W	30000	150		Refer to section 4.11
20.26	Current loop Ki start	R/W	30000	2000		
20.27	Speed loop Kp positioning (stop)	R/W	30000	100		
20.28	Speed loop Ki positioning (stop)	R/W	30000	100		
20.29	Variable gains speed threshold deceleration	R/W	3000	100	mm/s	
20.30	Variable gains deceleration time	R/W	3000	0	ms	
20.31	UPS maximum power	R/W	3001		W	

7.10 Menu 21 parameters

Parameter	Description	Type	Range	Default	Units	Notes
21.05	Rapid stop rate	R/W	10.000	2.000	m/s^2	Enabled with Pr **19.49** = 1
21.16	Current filter positioning (stop)	R/W	25.0	0.0	ms	Refer to section 4.11
21.22	Current loop Kp positioning (stop)	R/W	30000	150		
21.23	Current loop Ki positioning (stop)	R/W	30000	2000		
21.28	Evacuation current limit full load	R/W	30000	80	%	Only if Pr **19.38** = On
21.29	Evacuation current limit no load	R/W	30000	120	%	
4.23	Current filter start	R/W	25.0	0.0	ms	Refer to section 4.11

NOTE

Pr **20.25** through to Pr **20.28** and Pr **21.16**, Pr **21.22**, Pr **21.23** these parameters are RO until the variable gains are selected through Pr **0.21**[2] (Pr **18.48**) and Pr **19.48** = On, only then do they become R/W allowing the user to adjust.

8 Set-up

For set-up of the elevator, follow the next section and also refer to Chapter 12 *Commissioning software tools* on page 81

Table 8-1 Initial set-up

Initial Configuration and Setup procedure		
Before power up	Motor connections	Make motor connections and ensure these are correct orientation for closed loop operation (Unidrive SP).
	Brake connections & configuration	Connect brake control connections (Unidrive SP or Elevator controller).
	Motor contactor connections & configuration	Connect motor contactor control connections (Unidrive SP or Elevator controller).
	Encoder feedback connections	Connect encoder feedback ensuring correct cable is used and screening / earthing recommendations are followed *(See* Chapter 3 *Installation).*
	Encoder output connections	Fit option module to provide simulated encoder output when operating in closed loop mode.
	Control connections	Make all connections from Elevator controller to Unidrive SP, following control connections *(See* Chapter 3 *Installation).*
Power up Parameter configuration	Control connections	Ensure all control connections required for elevator speed selection are configured, along with brake control and motor contactor control if required (*See Chapter 5 I/O configuration).*
	Motor	Set-up all motor related parameter
	Encoder feedback	Set-up encoder feedback connected to drive along with simulated encoder output if required for Elevator controller.
	Elevator parameters	Set-up elevator parameters for SM-ELV option module *(See* section 4.10 *Nominal elevator rpm calculation and adjustment).*
Auto-tune		An auto-tune should be carried out to set-up the drive to the motor (asynchronous [Open loop and Closed loop vector] or synchronous [Servo]) • Voltage Offset [OL] • Power Factor [OL CL] • Stator Resistance [OL CL SV] • Transient Inductance [OL CL SV] • Stator Inductance [CL] • Phase offset [SV]

For the initial set-up of an elevator adjustment of the control loops for the motor control must be carried out. This is performed by the drive through automatic self-tuning, Auto-tune. During the Auto-tune the elevator must be operated manually, therefore the inspection command has to be provided.

If inspection is active and the drive is not enabled or motor does not run, please refer to Setting of terminal functions.

8.1 Open loop vector - Autotune

Measurement of motor stator parameters

For the Open Loop vector control mode it is necessary to measure the stator resistance and voltage offset which can automatically be carried out by the drive at the start of the motor through a Static Auto-tune Pr **0.40** = 1

To measure the stator resistance and voltage offset

- Pr **0.40** = 1 - start Static Auto-tune.
- Wait until Pr **0.40** = 0 then stop inspection run.
- Save parameters.

8.2 Closed loop vector - Autotune

Static autotune

This measurement is very convenient, because it is performed at standstill with the brake applied. For optimisation of the elevator the drive measures both the stator resistance Pr **5.17** and the transient inductance Pr **5.24**.

- Pr **0.40** = 1 - start inspection speed.
- Wait until Pr **0.40** = 0 then stop inspection speed.

Note setting of Pr **5.17** / Pr **5.24**

- Save parameters.

Automatic current controller autotune

This measurement is very convenient, because it is also performed at standstill with the brake applied. Setting Pr **0.40** = 4 sets up both the integral Pr **0.39** (Pr **4.14**) and proportional Pr **0.38** (Pr **4.13**) current loop gains.

- Pr **0.40** = 4 - start static current controller gain set-up
- Pr **0.38**, Pr **0.39** are changed at start -stop Inspection run

Autotune and motor characteristic measurement

For complete optimisation the drive can measure in addition to the current loop gain setup and stator resistance and stator inductance the motor characteristics.

During this test it is necessary to remove the ropes from the sheave due to the motor having to run for several seconds.

- Pr **0.40** = 2 - start inspection speed
- Wait until Pr **0.40** = 0 then stop inspection speed

Autotune of rated motor speed

Additional optimisation of the drive and motor can be applied through the rated speed Auto-tune which will setup the correct slip, this should be done with greater then 5/8 load present and at a speed greater than rated frequency/8

During this test it is necessary to remove the ropes from the sheave due to the motor having to run for several seconds.

Activate automatic speed optimiser

- Pr **0.18**[2] = 1 and Save parameters

Note setting of Pr **5.08**

- Save parameters

8.3 Servo - Autotune

The phase angle of magnetic rotor flux relative to the rotor's feedback device angular orientation must be measured, or if given on the motor's nameplate information, must be entered into a drive parameter.

Manual setting of the phase angle parameter for known winches

If the value is known and the connection of the motor phases is U - V - W at the drive, proceed as follows:

- Setting the phase angle
- Set Pr **0.43** = Offset and save parameter

Automatic measurement of the phase angle

If the Offset is not known or the connection of the motor phases is not U - V - W, the value can be measured automatically by the drive at low speed. To get exact values it is necessary to have no load at the motor shaft and remove the ropes from the sheave. If there is low friction it may be sufficient to have a balanced load in the car.

- Activate phasing test
- Pr **0.40** = 2, start inspection speed and maintain
- The motor will turn slowly for about 30 seconds.
- Wait until Pr **0.40** = 0 then stop inspection speed

- If a trip ENC1 occurs
- Swap motor cables U with V at the drive

- Check the offset in Pr **0.43**
- This must have changed, if not, check motor contactor

Autotune - Current Loop - Motor resistance / inductance parameters

- This measurement is very convenient, because this is performed at standstill with the brake applied. Setting Pr **0.40** will set up both the integral Pr **0.39** (Pr **4.14**) and proportional Pr **0.38** (Pr **4.13**) current loop gains and for optimal performance the elevator drive also measures the stator resistance Pr **5.17** and the transient inductance Pr **5.24**.
- Starting measurement
- Pr **0.40** - start inspection speed and maintain.
- The motor will turn slowly for about 30 seconds
- Wait until Pr **0.40** = 0 then stop inspection speed
- Note setting of parameters
- Save parameters

8.4 First start with empty car

Activate the first start:

- Make sure, that Enable (Terminal 31) is connected and Active current is displayed in Pr **0.11**
- Start Inspection and check the Active current display and the shaft rotation
- If status display doesn't change to "run"
- Check logic polarity, terminals and motor conductors

If the motor Active current Pr **0.11** = **0.00**

- Check logic polarity, terminals and motor conductors

If following an error trip (**Trip 70** or **Trip 71**)

- Check motor connections and phase angle

If the motor shaft does not turn

- Check setpoint selection Pr **0.28**[0] (run command applied)

If Pr **0.28**[0] = 1810 instead of 1812:

- Check terminal functions and terminal state

If Trip It.AC occurs

- Check load balance, phase angle and motor connection

If motor turns shortly / stops with current

- Check pole count Pr **0.42** and encoder lines Pr **0.29**

If motor turns opposite direction

- Set: Pr **0.22**[1] (Pr **18.45**) = 1

For closed loop vector / servo and poor motor running

- Check encoder, cable connection and screening

Other trips

- See Chapter 13 *Diagnostics*

If no trip

- Continue with adjustment of speed loop gains

Adjustment of the speed loop (closed loop vector and servo only)

With recommended gain values (→ 3) only a few adjustments will be necessary

Adjustment of the speed loop P-Gain

- Increase Pr **0.07** in steps of 0.01 until noisy or unstable

If it produces continuous noise

- Increase current filter Pr **0.14**[2] from 0 to 1...max. 3 (ms)

If unstable

- Reduce Pr **0.07** to 60% of the instability value

Adjustment of speed loop I- Gain

- Increase Pr **0.08** to 20...50% of 100 * Pr **0.07**

Adjustment of slip compensation (open loop only)

Reduction of V2 Inspection to V1

- Set Pr **0.16** = Pr **0.15**

Enable slip compensation

- Set Pr **5.27** = 1

Start inspection "UP" and "DOWN"

- Measure speed manually with tachometer

"UP" = "DOWN"

If speed "UP" > "DOWN"

- Reduce Pr **0.45** in steps of 1...10

If speed "UP" < "DOWN"

- Increase Pr **0.45** in steps of 1...10

Motor contactor delay adjustment

To prevent over voltages at the motor windings during motor conductor opening, the drive output should be disabled after the brake apply time is completed. The delay between the drive output disable and the opening of the motor conductors is displayed in Pr **0.26**[1] (Pr **20.20**) in ms. A negative value indicates that the motor contactor opened under current flow, which should be prevented. In this case the brake apply time, Pr **18.24**, must be increased, at least, to the value of Pr **0.26**[1] (Pr **20.20**).

- Start normal floor level runs
- Check the measured conductor delay in Pr **0.26**[1] in ms
- Increase Pr **0.25**[1] in ms if a negative values is in Pr **0.26**[1]
- Positive values of 50...100 ms in Pr **0.26**[1] are acceptable.

Adjust deceleration distances:

Check speed selection Pr **18.10** reference value selected

- If not correct, check connections

Check stopping distance V1 Pr **19.05**

- Change V1 (creep speed) Pr **0.15**(Pr **18.11**) or stop jerk level Pr **0.25** (Pr **19.16**)

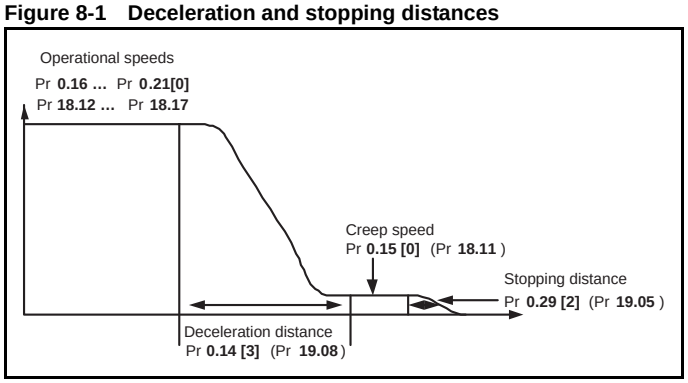
Check deceleration distance Pr **19.08**

- Select speed for deceleration distance via inputs
- Read selected speed in Pr **18.10**
- Read calculated distance in Pr **19.08**
- Change Speed, deceleration Pr **0.04** or Run / jerk Pr **0.24**

Start normal floor levelling runs

- Check the creep distance in Pr **20.21** in mm

Figure 8-1 Deceleration and stopping distances



9 Optimisation

9.1 Open loop vector

Optimise start

Due to limitations with the open loop control, torque generated at zero speed, the timing of the profile and the brake control are essential and therefore have to be adjusted precisely. Furthermore the motor model has to be optimally configured for stator resistance and slip compensation (autotune should be carried out and all motor related parameters setup as accurately as possible).

Jerk at start too high

- Reduce start jerk Pr **0.23** ...300 mm/s^3 (softer)
  and/ or
- Adjust brake release delay Pr **0.24**[1] in ms (500)
- Adjust speed for start optimiser Pr **0.20**[1] e.g.: 10 mm/s
- Adjust time for start optimiser Pr **0.19**[1] in ms (1000)
- Adjust jerk for start optimiser Pr **0.20**[1] e.g.: 50mm/s^3

Jerk or backward rotation when brake releases

- Increase speed for start optimiser Pr **0.20**[1] e.g 50mm/s^3
- Correct the value of stator resistance Pr **5.17** in Ω

Optimise constant speed

Vibrations or overshoot present

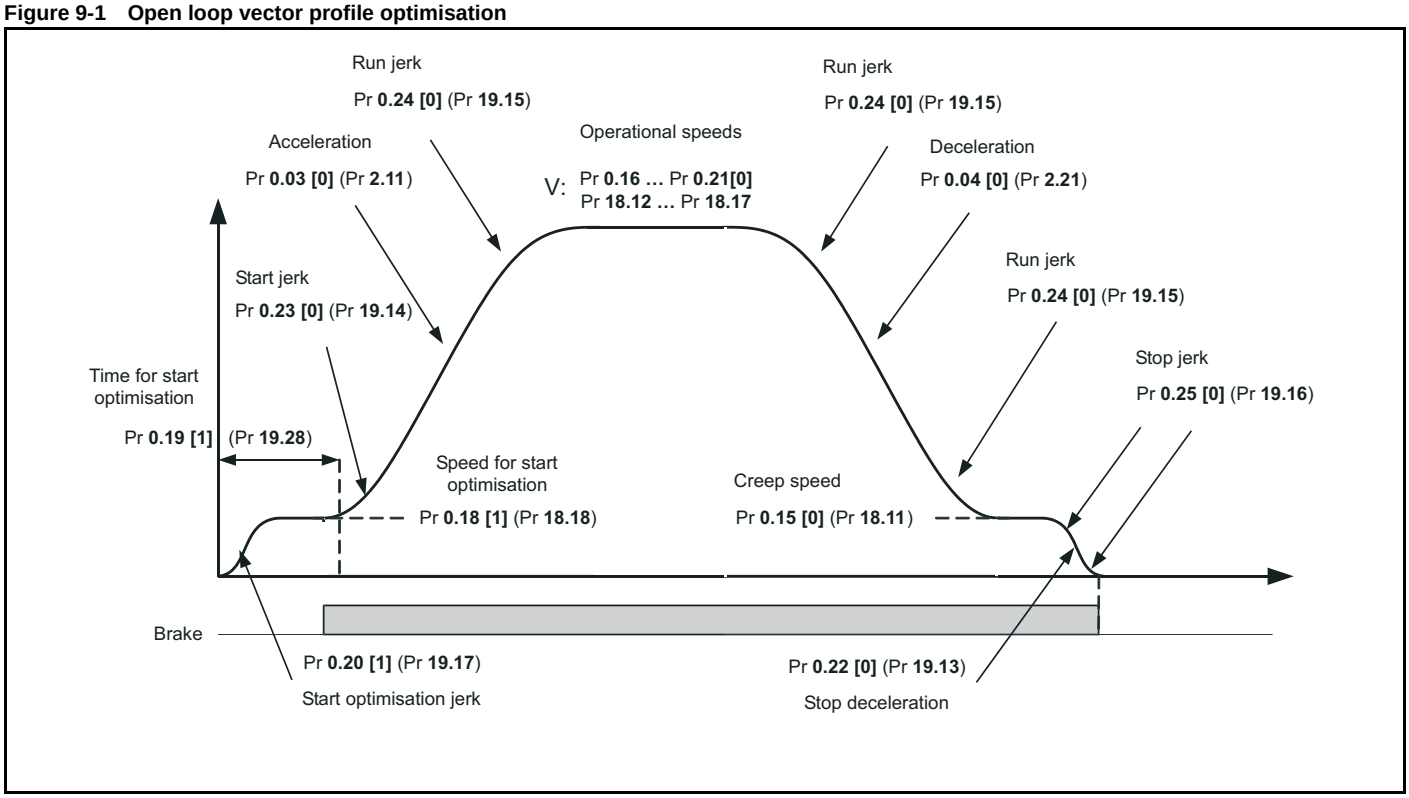
- Reduce slip compensation by increasing Pr **5.08**
- Disable Quasi-square-modulation with Pr **5.20** = 0

Optimise stop

High jerk as the elevator stops

- Reduce stop jerk Pr **0.25** ...500 mm/s^3 (softer)
- Reduce zero speed threshold Pr **3.05** = 0,5 ... 2 Hz

Figure 9-1 Open loop vector profile optimisation



9.2 Closed loop vector and servo

During this step the elevator performance is optimised to ensure the travel speed is correct and comfort level is achieved. The designed speeds and accelerations have to be achieved. In addition to the subjective test of the elevator performance.
It is advisable to use the oscilloscope function included in the PC based software to achieve the best performance and to prevent any issues being overlooked. This oscilloscope will allow all associated drives parameters to be monitored.

Optimise start

If car lurches at start

- Increase brake release delay Pr **0.24**[1] to 2500ms

If motor lurches or rotates uncontrolled

- Activate separate start speed controller Pr **0.21**[2]

Brake release (Pr **18.48**) = 1

- P-Gain start controller Pr **0.25**[1] = 2 x Pr **0.23**[1] (harder)
- I-Gain start controller Pr **0.26**[1] =2 x Pr **0.24**[1] (stiffer)

  and / or

  Enable P-gain position Control: Pr **0.19**[2] (Pr **19.20**) = 3 to 30
  Enable D-gain position Control: Pr **0.20**[2] (Pr **19.12**) = 10 to 100

If jerk is to high at start of profile (ramp)

- Reduce start jerk Pr **0.23.**..300 mm/s^3 (softer)

  and / or
- Activate start optimiser by setting Pr **18.18** > 0
- Set Speed for start optimiser Pr **0.18**[1] e.g.: 10 mm/s
- Set time for start optimiser Pr **0.19**[1] e.g.: 800...1000 ms
- Set jerk for start optimiser Pr **0.20**[1] e.g.: 10...20 mm/s^3

Check elevator starts

- If OK, reduce brake release delay as follows

Adjustment of brake release delay

- Reduce Pr **0.24**[1] to 300ms as long as no lurch at start

Optimise constant speed

Vibration of gearless motors

- Increase I- gain of the current controller Pr **0.38** (max. 10000)
- Increase P- gain of the current controller Pr **0.39** (max. 1000)
- Stop if regulation noise increases

If OIAC trip or instability occurs

- Reduce by 60% (for example) the chosen, P, I, values

Overshoot and undershoot during acceleration

- Reduce run jerk level Pr **0.24**, e.g.: ...500 mm/s^3 (softer)
- Consider increased deceleration distances

  and / or
- Activate inertia compensation Pr **0.28**[2] = **1**

Display speed loop output Pr **0.22**[4] PC based oscilloscope software

- Adjust Pr **0.27**[2], so that Pr **0.22**[4], nearly constant

Optimise positioning stop

Lurch at stop from creep speed

- Reduce stop jerk Pr **0.25** ...500 mm/s^3 (softer)
- Reduce zero speed threshold Pr **3.05** = 2...4 rpm

Unwanted rotation at brake engage

- Increase brake apply delay Pr **0.25**[1]
- Check motor contactor delay to Pr **0.26**[1] > **0**

Following error detection set up

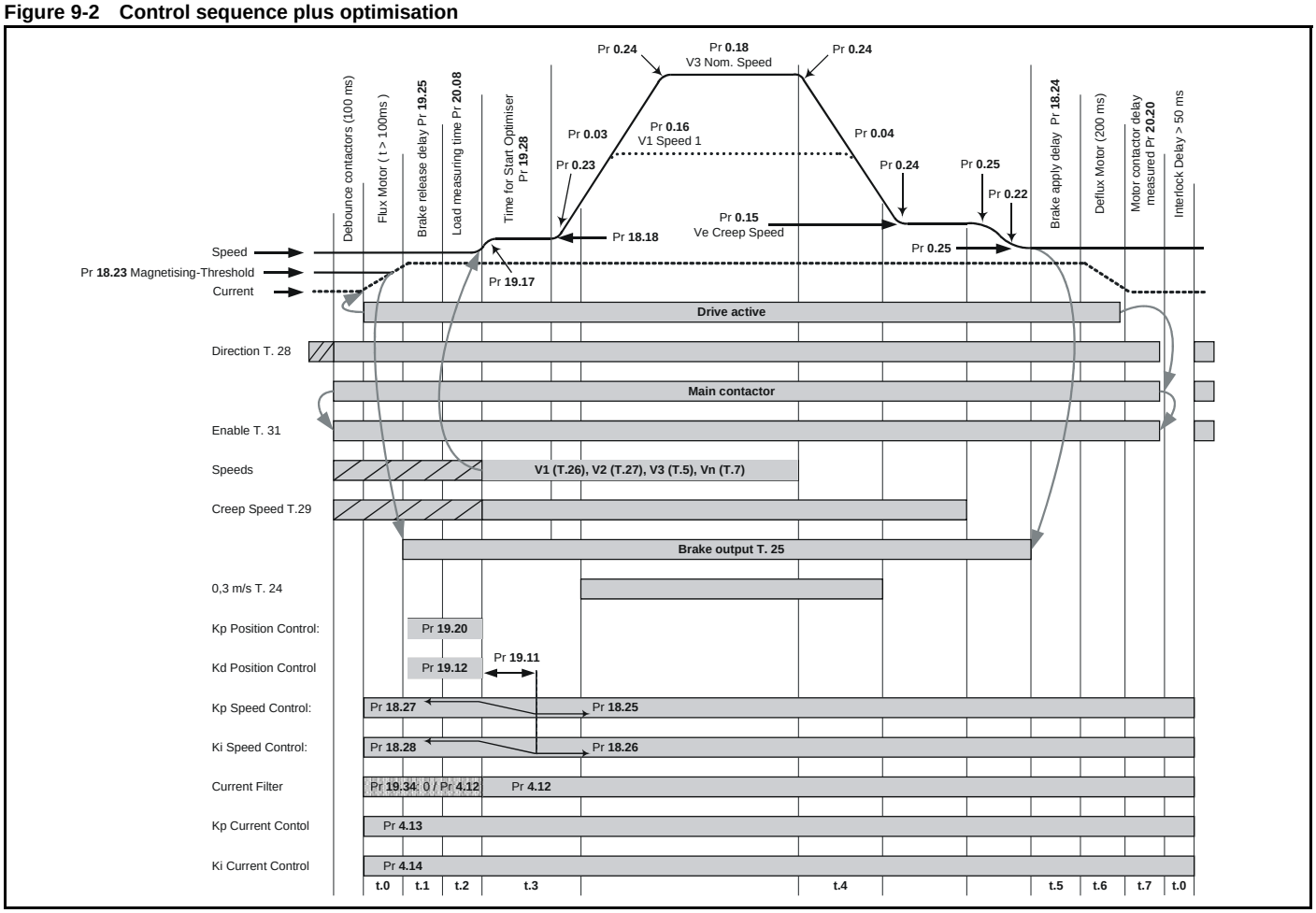
Check speed error of travel Pr **0.25**[4]

- Set max speed error Pr **0.26**[4]= 10x Pr **0.25**[4] (200 mm/s)

Check position error of travel Pr **0.27**[4]

- Set max position error Pr **0.28**[4]= 10x Pr **0.27**[4] (200 mm)

Figure 9-2 Control sequence plus optimisation

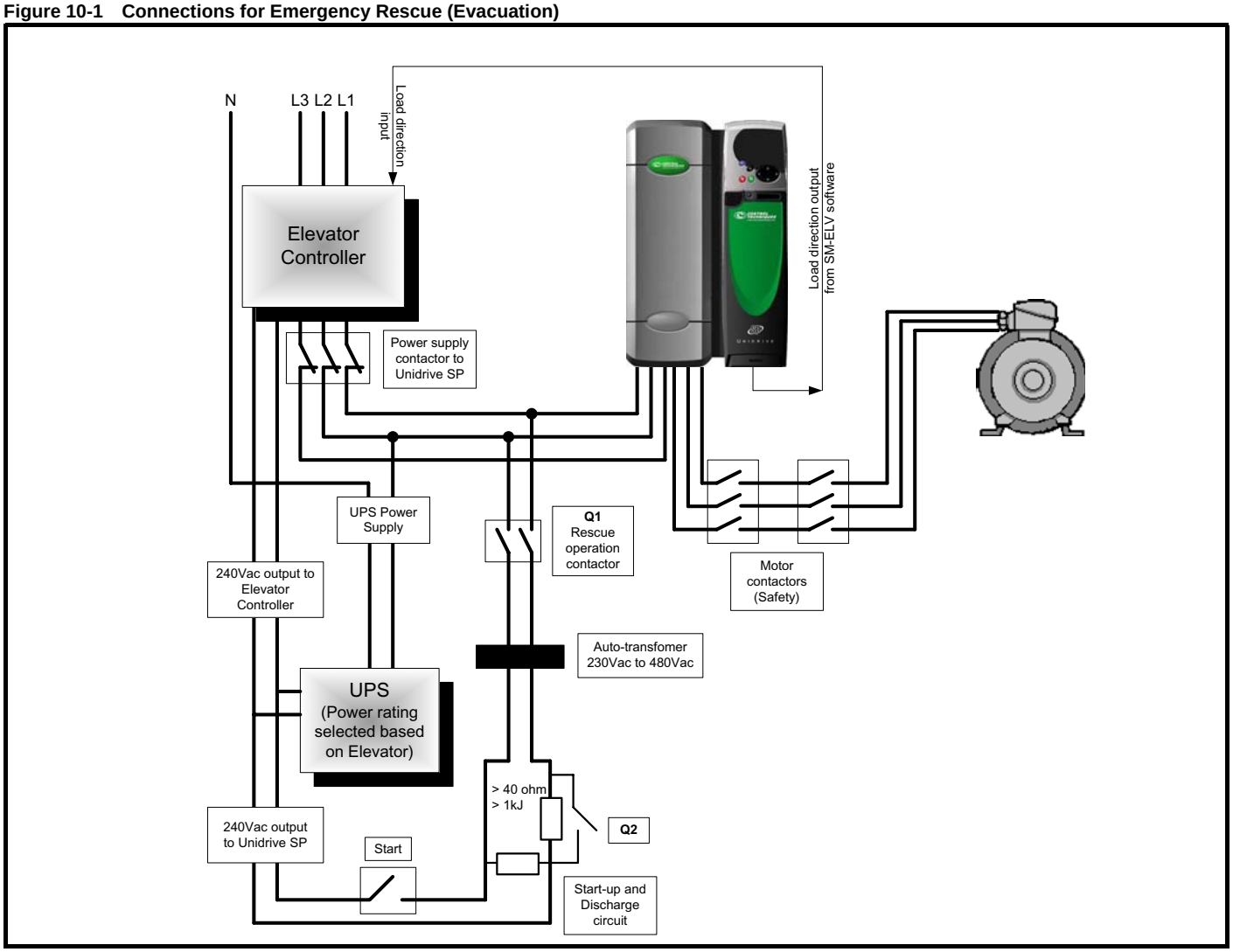


10 Rescue operation

The selection of an appropriate UPS will depend upon the power required for emergency rescue operation of the elevator. This is calculated from the motor power and the other auxiliary electrical loads such as lights, door drives, switchgear etc).

For this calculation please contact your supplier:

Figure 10-1 Connections for Emergency Rescue (Evacuation)



Recommendations for control:

1. An auto transformer can be used, to increase the voltage up to 480Vac from a 230Vac power supply as shown above.
2. Q1 contactor is used to switch on the UPS power supply to the elevator drive.
3. The start signal for the emergency rescue (evacuation) has to be applied by the elevator controller, after the contactor Q2 has been opened enabling the start-up circuit.
4. The contactor Q2 has to be closed 1 s after start of the emergency rescue (evacuation).

NOTE

For Unidrive SP there is also an option to operate with Low Voltage DC (backup operation), this is carried out using an external DC power supply or Batteries. For further detailed information on operation and set-up refer to the Low Voltage DC Operation Installation Guide available for Unidrive SP.

11 SMARTCARD operation

11.1 Introduction

This is a standard feature that enables simple configuration of parameters in a variety of ways. The SMARTCARD can be used for:

- Parameter cloning between drives
- Saving whole drive parameter sets
- Saving 'differences from default' parameter sets
- Automatically saving all user parameter changes for maintenance purposes
- Loading complete motor map parameters

The drive only communicates with the SMARTCARD when commanded to read or write, meaning the card may be "hot swapped".

WARNING

Encoder phase angle (servo mode only)

With drive software version V01.08.00 onwards, the encoder phase angles in Pr **3.25** and Pr **21.20** are cloned to the SMARTCARD when using any of the SMARTCARD transfer methods.

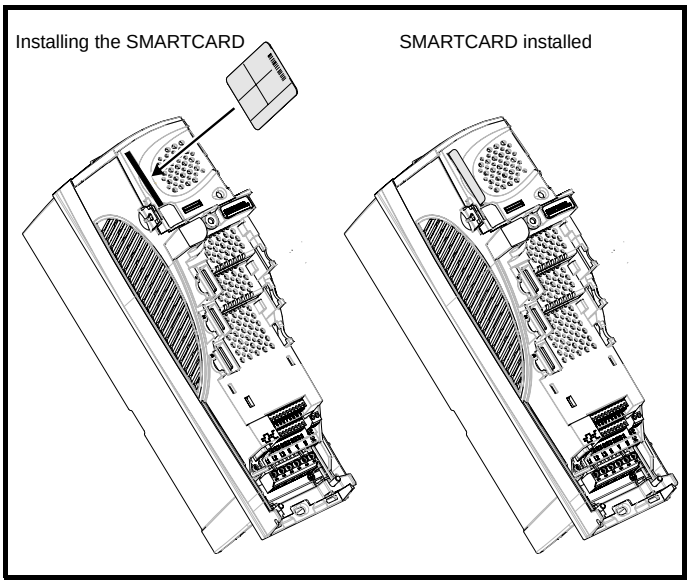
With drive software version V01.05.00 to V01.07.01, the encoder phase angles in Pr **3.25** and Pr **21.20** are only cloned to the SMARTCARD when using either Pr **0.30** set to Prog (2) or Pr **xx.00** set to 3yyy.

This is useful when the SMARTCARD is used to back-up the parameter set of a drive but caution should be used if the SMARTCARD is used to transfer parameter sets between drives.

Unless the encoder phase angle of the servo motor connected to the destination drive is known to be the same as the servo motor connected to the source drive, an autotune should be performed or the encoder phase angle should be entered manually into Pr **3.25** (or Pr **21.20**). If the encoder phase angle is incorrect the drive may lose control of the motor resulting in an O.SPd or Enc10 trip when the drive is enabled.

With drive software version V01.04.00 and earlier, or when using software version V01.05.00 to V01.07.01 and Pr **xx.00** set to 4yyy is used, then the encoder phase angles in Pr **3.25** and Pr **21.20** are not cloned to the SMARTCARD. Therefore, Pr **3.25** and Pr **21.20** in the destination would not be changed during a transfer of this data block from the SMARTCARD.

Figure 11-1 Installation of the SMARTCARD



The SMARTCARD has 999 individual data block locations. Each individual location from 1 to 499 can be used to store data until the capacity of the SMARTCARD is used. With software V01.07.00 and later the drive can support SMARTCARDs with a capacity of between 4kB and 512kB. With software V01.06.02 and earlier the drive can support SMARTCARDs with a capacity of 4kB.

The data block locations of the SMARTCARD are arranged to have the following usage:

Table 11-1 SMARTCARD data blocks

Data Block	Type	Example Use
1 to 499	Read / Write	Application set ups
500 to 999	Read Only	Macros

'Differences from default' parameter sets will be much smaller than whole parameter sets and thus take up a lot less memory as most applications only require a few parameters to be changed from the default setting.

The whole card may be protected from writing or erasing by setting the read-only flag as detailed section 11.2.7 *9888 / 9777 - Setting and clearing the SMARTCARD read only flag* on page 78.

Data transfer to or from the SMARTCARD is indicated by one the following:

- SM-Keypad: The decimal point after the fourth digit in the upper display will flash.
- SM-Keypad Plus: The symbol 'CC' will appear in the lower left hand corner of the display

The card should not be removed during data transfer, as the drive will produce a trip. If this occurs then either the transfer should be reattempted or in the case of a card to drive transfer, default parameters should be loaded.

NOTE

Storing of Menu 20 parameters onto a SMARTCARD and transferring to the drive is not possible with software versions up to V1.13 unless the following sequence is carried out. The issue with Menu 20 parameter downloads from the SMARTCARD to the drive when using the SM-ELV elevator software is due to parameters being set to default values when reading SMARTCARD blocks with differences to default (4xxx).

Following is the required procedure for loading the correct Menu 20 parameters from the SMARTCARD to the drive (V1.13 or earlier).

1. Copy parameter set from first drive Pr **x.00** = 400x + Reset
2. Transfer to second drive
   - Pr **17.13** = 0
     Stops SM-ELV software running during transfer
   - Pr **17.19** = ON
     Reset SM Applications Lite (changes ON to OFF)
   - Pr **x.00** = 600x + Reset
     Program parameters from SMARTCARD to drive with Pr **x.00** = 600x
   - Pr **17.19** = ON
     Reset SM Applications Lite (changes ON to OFF)

This issue will be corrected and released with SM-ELV software version V1.14.

11.2 Transferring data

Data transfer, erasing and protecting the information is performed by entering a code in Pr **xx.00** and then resetting the drive as shown in Table 11-2.

Table 11-2 SMARTCARD codes

Code	Action
2001	Transfer drive parameters as difference from defaults to a bootable SMARTCARD block in data block number 001
3yyy	Transfer drive parameters to a SMARTCARD block number yyy
4yyy	Transfer drive data as difference from defaults to SMARTCARD block number yyy
5yyy	Transfer drive Onboard PLC program to SMARTCARD block number yyy
6yyy	Transfer SMARTCARD data block yyy to the drive
7yyy	Erase SMARTCARD data block yyy
8yyy	Compare drive parameters with block yyy
9555	Clear SMARTCARD warning suppression flag (V01.07.00 and later)
9666	Set SMARTCARD warning suppression flag (V01.07.00 and later)
9777	Clear SMARTCARD read-only flag
9888	Set SMARTCARD read-only flag
9999	Erase SMARTCARD

Where yyy indicates the block number 001 to 999. See Table 11-1 for restrictions on block numbers.

NOTE

If the read only flag is set then only codes 6yyy or 9777 are effective.

11.2.1 Writing to the SMARTCARD

3yyy - Transfer data to the SMARTCARD

The data block contains the complete parameter data from the drive, i.e. all user save (US) parameters except parameters with the NC coding bit set. Power-down save (PS) parameters are not transferred to the SMARTCARD.

With software V01.06.02 and earlier, a save must have been performed on the drive to transfer the parameters from the drive RAM to the EEPROM before the transfer to the SMARTCARD is carried out.

4yyy - Write default differences to a SMARTCARD

The data block only contains the parameter differences from the last time default settings were loaded.

Six bytes are required for each parameter difference. The data density is not as high as when using the 3yyy transfer method as described in the previous section, but in most cases the number of differences from default is small and the data blocks are therefore smaller. This method can be used for creating drive macros. Power-down save (PS) parameters are not transferred to the SMARTCARD.

The data block format is different depending on the software version. The data block holds the following parameters:

Software V01.06.02 and earlier

All user save (US) parameters, except those with the NC (Not Cloned) coding bit set or those that do not have a default value, can be transferred to the SMARTCARD.

Software V01.07.xx

All user save (US) parameters, except those with the NC (Not Cloned) coding bit set or those that do not have a default value, can be transferred to the SMARTCARD. In addition to these parameters all menu 20 parameters (except Pr **20.00**), can be transferred to the SMARTCARD even though they are not user save parameters and have the NC coding bit set.

Software V01.08.00 onwards

All user save (US) parameters including those that do not have a default value (i.e. Pr **3.25** or Pr **21.20** *Encoder phase angle*), but not including those with the NC (Not Cloned) coding bit set can be transferred to the SMARTCARD. In addition to these parameters all menu 20 parameters (except Pr **20.00**), can be transferred to the SMARTCARD even though they are not user save parameters and have the NC coding bit set.

It is possible to transfer parameters between drive with each of the different formats, however, the data block compare function does not work with data produced by different formats.

11.2.2 Reading from the SMARTCARD

6yyy - Read default differences from a SMARTCARD

When the data is transferred back to a drive, using 6yyy in Pr **xx.00**, it is transferred to the drive RAM and the drive EEPROM. A parameter save is not required to retain the data after power-down. Set up data for any Solutions Modules fitted are stored on the card and are transferred to the destination drive. If the Solutions Modules are different between the source and destination drive, the menus for the slots where the Solutions Module categories are different are not updated from the card and will contain their default values after the cloning action. The drive will produce a 'C.Optn' trip if the Solutions Modules fitted to the source and destination drive are different or are in different slots. If the data is being transferred to a drive of a different voltage or current rating a 'C.rtg' trip will occur.

The following rating dependent parameters (RA coding bit set) will not be written to the destination drive and will contain their default values after the cloning action:

Pr **2.08** *Standard ramp voltage*
Pr **4.05** to Pr **4.07** and Pr **21.27** to Pr **21.29** *Current limits*
Pr **4.24**, *User current maximum scaling*
Pr **5.07**, Pr **21.07** *Motor rated current*
Pr **5.09**, Pr **21.09** *Motor rated voltage*
Pr **5.10**, Pr **21.10** *Rated power factor*
Pr **5.17**, Pr **21.12** *Stator resistance*
Pr **5.18** *Switching frequency*
Pr **5.23**, Pr **21.13** *Voltage offset*
Pr **5.24**, Pr **21.14** *Transient inductance*
Pr **5.25**, Pr **21.24** *Stator inductance*
Pr **6.06** *DC injection braking current*
Pr **6.48** *Mains loss ride through detection level*

11.2.3 Auto saving parameter changes (Pr 11.42 = Auto (3))

This setting causes the drive to automatically save any changes made to menu 0 parameters on the drive to the SMARTCARD. The latest menu 0 parameter set in the drive is therefore always backed up on the SMARTCARD. Changing Pr **11.42** to Auto (3) and resetting the drive will immediately save the complete parameter set from the drive to the card, i.e. all user save (US) parameters except parameters with the NC coding bit set. Once the whole parameter set is stored only the individual modified menu 0 parameter setting is updated.

Advanced parameter changes are only saved to the card when Pr **xx.00** is set to a 1000 and the drive reset.

All SMARTCARD trips apply, except ‘C.Chg’. If the data block already contains information it is automatically overwritten.

If the card is removed when Pr **11.42** is set to 3 Pr **11.42** is then automatically set to nonE (0).

11.2.4 8yyy - Comparing the drive full parameter set with the SMARTCARD values

Setting 8yyy in Pr **xx.00**, will compare the SMARTCARD file with the data in the drive. If the compare is successful Pr **xx.00** is simply set to 0. If the compare fails a ‘C.cpr’ trip is initiated.

11.2.5 7yyy / 9999 - Erasing data from the SMARTCARD

Data can be erased from the SMARTCARD either one block at a time or blocks 1 to 499 in one go.

- Setting 7yyy in Pr **xx.00** will erase SMARTCARD data block yyy.
- Setting 9999 in Pr **xx.00** will erase SMARTCARD data blocks 1 to 499

11.2.6 9666 / 9555 - Setting and clearing the SMARTCARD warning suppression flag (V01.07.00 and later)

If the Solutions Modules fitted to the source and destination drive are different or are in different slots the drive will produce a 'C.Optn' trip. If the data is being transferred to a drive of a different voltage or current rating a 'C.rtg' trip will occur. It is possible to suppress these trips by setting the warning suppression flag. If this flag is set the drive will not trip if the Solutions Module(s) or drive ratings are different between the source and destination drives. The Solutions Module or rating dependent parameters will not be transferred.

- Setting 9666 in Pr **xx.00** will set the warning suppression flag
- Setting 9555 in Pr **xx.00** will clear the warning suppression flag

11.2.7 9888 / 9777 - Setting and clearing the SMARTCARD read only flag

The SMARTCARD may be protected from writing or erasing by setting the read only flag. If an attempt is made to write or erase a data block when the read only flag is set, a 'C.rdo' trip is initiated. When the read only flag is set only codes 6yyy or 9777 are effective.

- Setting 9888 in Pr **xx.00** will set the read only flag
- Setting 9777 in Pr **xx.00** will clear the read only flag.

11.3 Data block header information

Each data block stored on a SMARTCARD has header information detailing the following:

- A number which identifies the block (Pr **11.37**)
- The type of data stored in the block (Pr **11.38**)
- The drive mode if the data is parameter data (Pr **11.38**)
- The version number (Pr **11.39**)
- The checksum (Pr **11.40**)
- The read-only flag
- The warning suppression flag (V01.07.00 and later)

The header information for each data block which has been used can be viewed in Pr **11.38** to Pr **11.40** by increasing or decreasing the data block number set in Pr **11.37**.

Software V01.07.00 and later

If Pr **11.37** is set to 1000 the checksum parameter (Pr **11.40**) shows the number of bytes left on the card in 16 byte pages.

If Pr **11.37** is set to 1001 the checksum parameter (Pr **11.40**) shows the total capacity of the card in 16 byte pages. Therefore, for a 4kB card this parameter would show 254.

If Pr **11.37** is set to 1002 the checksum parameter (Pr **11.40**) shows the state of the read-only (bit 0) and warning suppression flags (bit 1).

If there is no data on the card Pr **11.37** can only have values of 0 or 1,000 to 1,002.

Software V01.06.02 and earlier

If Pr **11.37** is set to 1000 the checksum parameter (Pr **11.40**) shows the number of bytes left on the card. If there is no data on the card Pr **11.37** can only have values of 0 or 1,000.

The version number is intended to be used when data blocks are used as drive macros. If a version number is to be stored with a data block, Pr **11.39** should be set to the required version number before the data is transferred. Each time Pr **11.37** is changed by the user the drive puts the version number of the currently viewed data block in Pr **11.39**.

If the destination drive has a different drive mode to the parameters on the card, the drive mode will be changed by the action of transferring parameters from the card to the drive.

The actions of erasing a card, erasing a file, changing a menu 0 parameter, or inserting a new card will effectively set Pr **11.37** to 0 or the lowest file number in the card.

11.4 SMARTCARD parameters

Table 11-3 Key to parameter table coding

RW	Read / Write	RO	Read only	Uni	Unipolar
Bi	Bi-polar	Bit	Bit parameter	Txt	Text string
FI	Filtered	DE	Destination	NC	Not cloned
RA	Rating dependent	PT	Protected	US	User save
PS	Power down save				

11.36 {0.29}	**SMARTCARD parameter data previously loaded**								
RO	Uni					NC	PT	US	
⇳	0 to 999				⇨	0			

This parameter shows the number of the data block last transferred from a SMARTCARD to the drive.

11.37	**SMARTCARD data number**								
RW	Uni					NC			
⇳	0 to 1,002				⇨	0			

This parameter should have the data block number entered for which the user would like information displayed in Pr **11.38**, Pr **11.39** and Pr **11.40**.

11.38	**SMARTCARD data type/mode**								
RO	Txt					NC	PT		
⇳	0 to 18				⇨				

Gives the type/mode of the data block selected with Pr **11.37**:

Pr 11.38	String	Type/mode	Data stored
0	FrEE	Value when Pr **11.37** = 0, 1,000, 1,001 or 1,002	
1		Reserved	
2	3OpEn.LP	Open-loop mode parameters	Data from EEPROM
3	3CL.VECt	Closed-loop vector mode parameters	
4	3SErVO	Servo mode parameters	
5	3rEgEn	Regen mode parameters	
6 to 8	3Un	Unused	
9		Reserved	
10	4OpEn.LP	Open-loop mode parameters	Defaults last loaded and differences
11	4CL.VECt	Closed-loop vector mode parameters	
12	4SErVO	Servo mode parameters	
13	4rEgEn	Regen mode parameters	
14 to 16	4Un	Unused	
17	LAddEr	Onboard PLC program	
18	Option	A Solutions Module file	

11.39	**SMARTCARD data version**								
RW	Uni					NC			
⇳	0 to 9,999				⇨	0			

Gives the version number of the data block selected in Pr **11.37**.

11.40	**SMARTCARD data checksum**								
R0	Uni					NC	PT		
⇳	0 to 65,335				⇨				

Gives the checksum of the data block selected in Pr **11.37**.

11.5 SMARTCARD trips

After an attempt to read, write or erase data to or from a SMARTCARD a trip may occur if there has been a problem with the command. The following trips indicate various problems as detailed in Table 11-4.

Table 11-4 Trip conditions

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>C.Acc</td><td>SMARTCARD trip: SMARTCARD Read / Write fail</td></tr>
<tr><td>185</td><td>Check SMARTCARD is fitted / located correctly
Replace SMARTCARD</td></tr>
<tr><td>C.boot</td><td>SMARTCARD trip: The menu 0 parameter modification cannot be saved to the SMARTCARD because the necessary file has not been created on the SMARTCARD</td></tr>
<tr><td>177</td><td>A write to a menu 0 parameter has been initiated via the keypad with Pr 11.42 set to auto(3) or boot(4), but the necessary file on the SMARTCARD has not bee created
Ensure that Pr 11.42 is correctly set and reset the drive to create the necessary file on the SMARTCARD
Re-attempt the parameter write to the menu 0 parameter</td></tr>
<tr><td>C.bUSY</td><td>SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module</td></tr>
<tr><td>178</td><td>Wait for the Solutions Module to finish accessing the SMARTCARD and then re-attempt the required function</td></tr>
<tr><td>C.Chg</td><td>SMARTCARD trip: Data location already contains data</td></tr>
<tr><td>179</td><td>Erase data in data location
Write data to an alternative data location</td></tr>
<tr><td>C.Cpr</td><td>SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different</td></tr>
<tr><td>188</td><td>Press the red reset button</td></tr>
<tr><td>C.dat</td><td>SMARTCARD trip: Data location specified does not contain any data</td></tr>
<tr><td>183</td><td>Ensure data block number is correct</td></tr>
<tr><td>C.Err</td><td>SMARTCARD trip: SMARTCARD data is corrupted</td></tr>
<tr><td>182</td><td>Ensure the card is located correctly
Erase data and retry
Replace SMARTCARD</td></tr>
<tr><td>C.Full</td><td>SMARTCARD trip: SMARTCARD full</td></tr>
<tr><td>184</td><td>Delete a data block or use a different SMARTCARD</td></tr>
<tr><td>C.Optn</td><td>SMARTCARD trip: Solutions Modules fitted are different between source drive and destination drive</td></tr>
<tr><td>180</td><td>Ensure correct Solutions Modules are fitted
Ensure Solutions Modules are in the same Solutions Module slot
Press the red reset button</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
Ensure card is not writing to data locations 500 to 999</td></tr>
<tr><td>C.rtg</td><td>SMARTCARD trip: SMARTCARD attempting to change the destination drive ratings
No drive rating parameters have been transferred</td></tr>
<tr><td>186</td><td>Press the red reset button
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>5.10, 21.10</td><td>Rated power factor</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>5.25, 21.24</td><td>Stator inductance</td></tr>
<tr><td>6.06</td><td>DC injection braking current</td></tr>
<tr><td>6.48</td><td>Mains 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 red reset button
Ensure destination drive type is the same as the source parameter file drive type</td></tr>
</table>

Table 11-5 SMARTCARD status indications

Lower display	Description	Lower display	Description
boot	A parameter set is being transferred from the SMARTCARD to the drive during power-up.	**cArd**	The drive is writing a parameter set to the SMARTCARD during power-up. For further information, please refer to section 11.2.3 *Auto saving parameter changes (Pr 11.42 = Auto (3))* .

12 Commissioning software tools

For elevator commissioning there are number of PC programs available that allow set-up, monitoring and optimisation of the Unidrive SP:

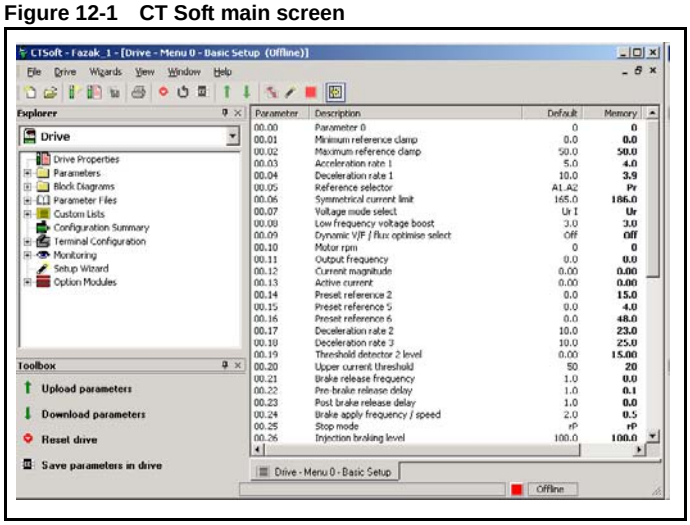
- CT Soft
- CT Scope
- Lift-SP

All of these PC programs will allow the drive to be commissioned via a PC and optimised using the oscilloscope function. Standard parameter files that may be available from previous applications can be downloaded, or the final parameter files uploaded for future applications. Waveforms can be taken during commissioning and also saved.

12.1 CT Soft

CT Soft allows a project for an application to be set-up and from this all parameters in the drive can be programmed with either a pre-defined parameter file or configured and saved by the User. The project can be generated manually or through use of the Setup Wizard available.

Figure 12-1 CT Soft main screen



Additional features also available in CT Soft are

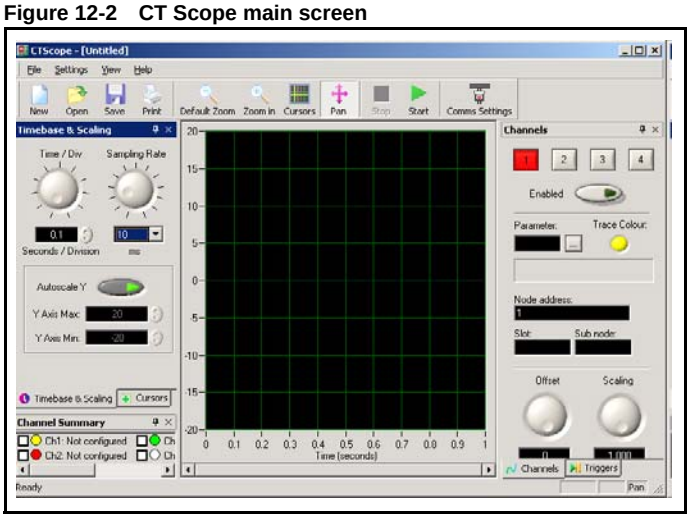
- Drive properties and summary screen
- Detailed parameter differences from default
- Detailed parameter descriptions
- Block diagrams
- Terminal configurations
- Monitoring features
- Option module support and configuration
- Help files

12.2 CT Scope

CT-Scope is a PC based software oscilloscope that includes all features normally associated with an oscilloscope. The oscilloscope features including

- 4 channels
- Adjustable Time-base and Scaling
- Trigger
- Cursors
- Zoom feature
- Save and recall waveforms
- Sampling rate down to 1ms
- Connection via Unidrive SP RJ-45 or via CT-Net
- Single or multiple drives can be monitored simultaneously on CT-Net

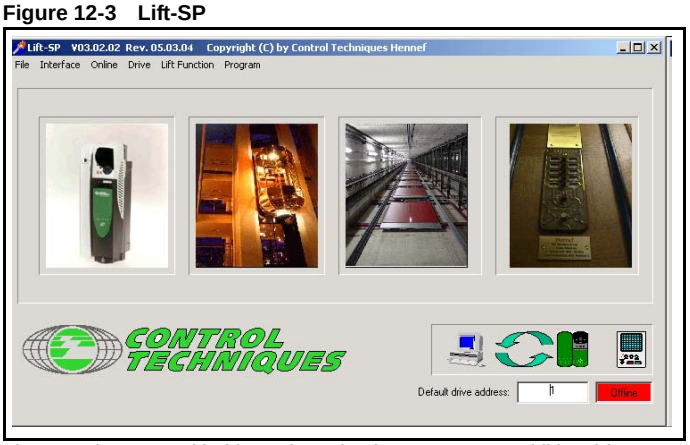
Figure 12-2 CT Scope main screen



12.3 Lift-SP

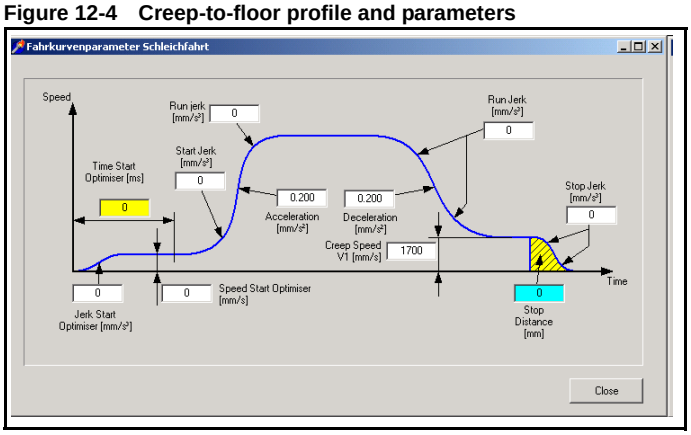
Lift-SP is also a PC based software program that includes both features to allow the Unidrive SP to be set-up (parameter download) and also has an oscilloscope feature included.

Figure 12-3 Lift-SP



There are however with this PC based software program additional features that are specific to the Lift set-up. For example the following screen provides all the required set-up parameters for the creep-to-floor positioning.

Figure 12-4 Creep-to-floor profile and parameters



Other custom screens available for setup include

- Control connections
- Lift installation parameters
- Speed set points
- Creep-to-floor, Direct-to-floor
- Floor sensor control
- Inertia and load compensation
- Error detection
- Current control

13 Diagnostics

13.1 Display

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

- Trip indications
- Alarm indications
- Status indications

WARNING

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

If the drive trips, the output of the drive is disabled so that the drive stops controlling the motor. The lower display indicates that a trip has occurred and the upper display shows the trip. If this is a multi-module drive and a power module has indicated a trip, then the upper display will alternate between the trip string and the module number.

Figure 13-1 Keypad status modes

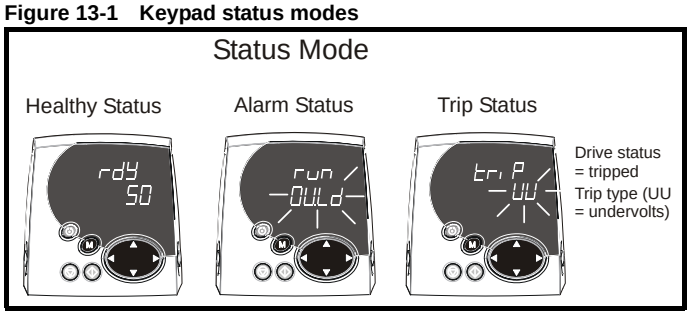
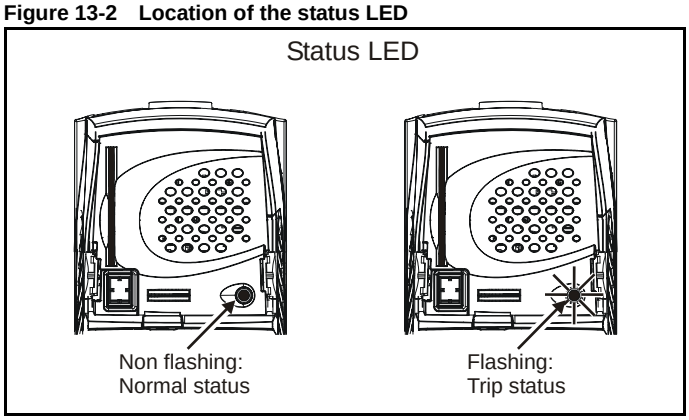


Figure 13-2 Location of the status LED



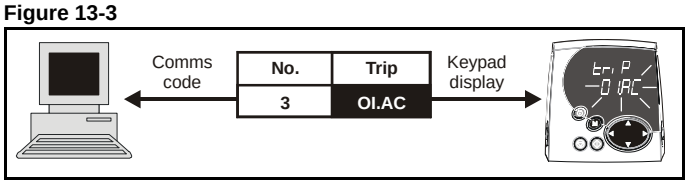
Trips are listed alphabetically in Table 13-1 based on the trip indication shown on the drive display. Refer to Figure 13-1.

If a display is not used, the drive LED Status indicator will flash if the drive has tripped. Refer to Figure 13-2. The trip indication can be read in Pr **10.20** providing a trip number. Trip numbers are listed in numerical order in Table 13-2 so the trip indication can be cross referenced and then diagnosed using Table 13-1.

Example:

1. Trip code 3 is read from Pr 10.20 via serial communications.
2. Checking Table 13-2 shows Trip 3 is an OI.AC trip.

Figure 13-3



3. Look up OI.AC in Table 13-1
4. Perform checks detailed under Diagnosis.

Trip	Diagnosis
OI.AC	**Instantaneous output over current detected: peak output current greater than 225%**
3	Acceleration / deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits for that frame size? Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** (closed loop vector and servo modes only) Has offset measurement test been completed? (servo mode only) Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14** (closed loop vector and servo modes only)

13.2 Elevator specific diagnostics

This section covers specific diagnostics related to the SM-ELV (SM-Applications, SM-Applications Lite) which is required for the Unidrive SP Elevator solution.

13.2.1 Diagnostic parameters - Pr 0.12 = 4

Parameter	Description	Type	Range	Default	Units	Notes
0.13 [4]	Zero speed threshold	RW	250	5	rpm	
0.14 [4]	Not used					
0.15 [4]	Motor voltage	RO	800	-	V	
0.16 [4]	Maximum speed error	RO	32000	-	mm/s	
0.17 [4]	Maximum overload run	RO	400.0	-	%In	
0.18 [4]	Motor magnetised	RO Bit	1	-	-	**1**: Motor magnetised
0.19 [4]	Brake output	RO Bit	1	-	-	**ON**: Brake released / **OFF**: Brake applied
0.20 [4]	Last trip	RO	-	-	-	
0.21 [4]	Previous trip	RO	-	-	-	
0.22 [4]	Speed controller output	RO	400.0	-	%In	
0.23 [4]	Terminal status	RO	11111	-	-	T. 24/ 25/ 41/ 28/ 31 (see section 13.2.4)
0.24 [4]	Terminal status	RO	11111	-	-	T. 29/ 26/ 27/ 5/ 7 (see section 13.2.4)
0.25 [4]	Speed error	RO	10000	-	mm/s	
0.26 [4]	Maximum speed error	RW	10000	200	mm/s	Setting = 10 x Pr **0.25**[4] > 200
0.27 [4]	Distance error	RO	10000	-	mm	
0.28 [4]	Maximum distance error	RW	10000	200	mm	Setting = 10 x Pr **0.27**[4] > 200
0.29 [4]	Speed error	RO	± Pr **0.02**	-	rpm	Drive encoder feedback control in open loop operation
0.30 [4]	Speed feedback	RO	± Pr **0.02**	-	rpm	Drive encoder feedback control in open loop operation

NOTE

If Pr **17.18** = 1 (SM-Applications, SM-Applications Lite watchdog enable) an SLX.tO trip, (Solutions Module watchdog timeout) is displayed after the elevator drive trips. This trip must be reset separately either via the keypad reset button or by setting Pr **xx.00** to 1070.

13.2.2 Error detection

The SM-ELV with the elevator software has both speed and distance error detection, Trip 70 and Trip 71 detailed as follows. If either of these trips occur refer to the following corrective actions.

Table 13-1 Error detection

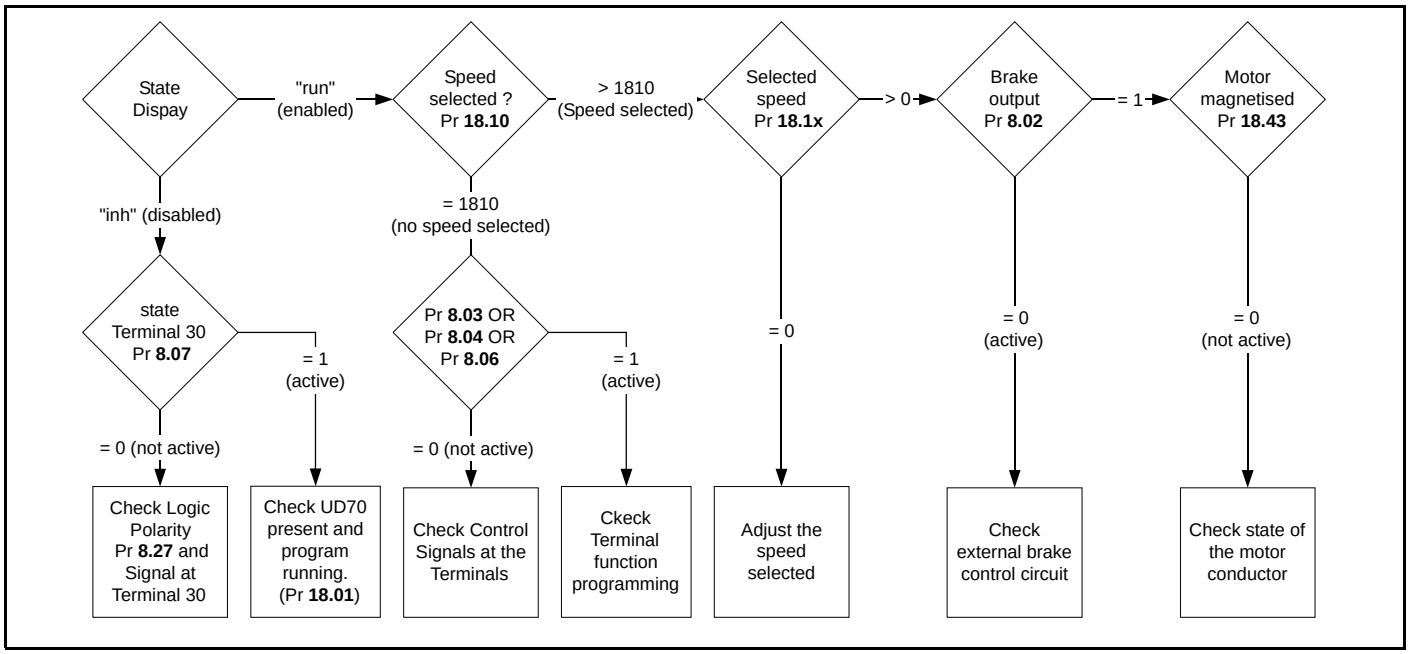
Trip Code	Description	Cause	Corrective actions
Trip 70	Speed error detection	Encoder feedback Motor connections Gain setting	Check motor and encoder connections Check gain settings and phase angle. Increase Threshold Pr **0.29** if necessary. Disable following error detection by setting Pr **0.29** = 0.
Trip 71	Distance error detection	Encoder feedback Motor connections Gain setting	Check motor and encoder connections Check gain setting and phase angle. Increase Threshold Pr **19.18** if necessary. Disable following error detection by setting Pr **19.18** = 0.
Trip 73	Temperature monitoring	Drive temperature is below 0°C (default Pr **70.81**)	If drive temperature is below 0°C a pre heater is required to ensure the minimum temperature is above 0°C
Trip 76	Motor fluxed detection	Motor contactor not closed Incorrect motor map settings	Check timing of any output contactors Ensure motor map is set up correctly
Trip 77	Motor phase loss	Motor phase loss due to intermittent / broken connection	Check all motor connections are secure

In addition to the speed and distance error detection there are also temperature and motor error detection features in the SM-ELV software as detailed above.

13.2.3 Control diagnostics

If the normal run command is applied and the Unidrive SP elevator solution does not start or a trip is generated at this stage, then proceed as follows:

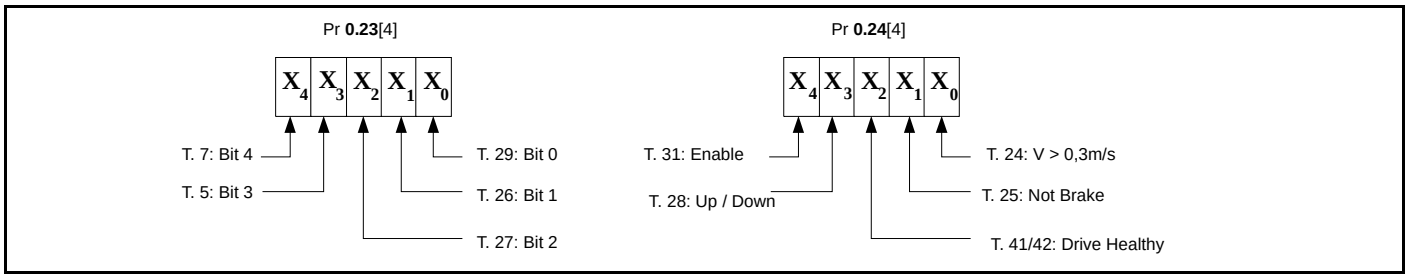
Figure 13-4 Diagnostic control interface



13.2.4 Control terminal status

For analysing the status of the control terminals these are arranged in groups and displayed as follows in Pr **0.23**[4] and Pr **0.24**[4].

Figure 13-5 Control terminal status



13.3 Unidrive SP trip codes

Trip	Diagnosis
C.Acc	**SMARTCARD trip: SMARTCARD Read / Write fail**
185	Check SMARTCARD is fitted / located correctly Replace SMARTCARD
C.bUSY	**SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module**
178	Wait for the Solutions Module to finish accessing the SMARTCARD and then re-attempt the required function
C.Chg	**SMARTCARD trip: Data location already contains data**
179	Erase data in data location Write data to an alternative data location
C.cPr	**SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different**
188	Press the red reset button
C.dAt	**SMARTCARD trip: Data location specified does not contain any data**
183	Ensure data block number is correct

Trip	Diagnosis
C.Err	**SMARTCARD trip: SMARTCARD data is corrupted**
182	Ensure the card is located correctly Erase data and retry Replace SMARTCARD
C.Full	**SMARTCARD trip: SMARTCARD full**
184	Delete a data block or use different SMARTCARD
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 fitted are different between source drive and destination drive**
180	Ensure correct Solutions Modules are fitted Ensure Solutions Modules are in the same Solutions Module slot Press the red reset button
C.rdo	**SMARTCARD trip: SMARTCARD has the Read Only bit set**
181	Enter 9777 in Pr **xx.00** to allow SMARTCARD Read / Write access Ensure card is not writing to data locations 500 to 999
C.rtg	**SMARTCARD trip: SMARTCARD attempting to change the destination drive ratings** **No drive rating parameters have been transferred**
186	Press the red reset button Drive rating parameters are: **Parameter** / **Function** **2.08** Standard ramp voltage **4.05/6/7**, **21.27/8/9** Current limits **4.24** User current maximum scaling **5.07**, **21.07** Motor rated current **5.09**, **21.09** Motor rated voltage **5.10**, **21.10** Rated power factor **5.17**, **21.12** Stator resistance **5.18** Switching frequency **5.23**, **21.13** Voltage offset **5.24**, **21.14** Transient inductance **5.25**, **21.24** Stator inductance **6.06** DC injection braking current **6.48** Mains loss ride through detection level The above parameters will be set to their default values.
C.TyP	**SMARTCARD trip: SMARTCARD parameter set not compatible with drive**
187	Press the reset button Ensure destination drive type is the same as the source parameter file drive type
dESt	**Two or more parameters are writing to the same destination parameter**
199	Set Pr **xx.00** = 12001 check all visible parameters in the menus for duplication
EEF	**EEPROM data corrupted - Drive mode becomes open loop and serial comms will timeout with remote keypad on the drive RS485 comms port.**
31	This trip can only be cleared by loading default parameters and saving parameters
Enc1	**Drive encoder trip: Encoder power supply overload**
189	Check encoder power supply wiring and encoder current requirement Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V
Enc2	**Drive encoder trip: Wire break (Drive encoder terminals 1 & 2, 3 & 4, 5 & 6)**
190	Check cable continuity Check wiring of feedback signals is correct Check encoder power is set correctly Replace feedback device If wire break detection on the main drive encoder input is not required, set Pr **3.40** = 0 to disable the Enc2 trip

Trip	Diagnosis
Enc3	**Drive encoder trip: Phase offset incorrect whilst running**
191	Check the encoder signal for noise Check encoder shielding Check the integrity of the encoder mechanical mounting Repeat the offset measurement test
Enc4	**Drive encoder trip: Feedback device comms failure**
192	Ensure encoder power supply is correct Ensure baud rate is correct Check encoder wiring Replace feedback device
Enc5	**Drive encoder trip: Checksum or CRC error**
193	Check the encoder signal for noise Check the encoder cable shielding With EnDat encoders, check the comms resolution and/or carry out the auto-configuration Pr **3.41**
Enc6	**Drive encoder trip: Encoder has indicated an error**
194	Replace feedback device With SSI encoders, check the wiring and encoder supply setting
Enc7	**Drive encoder trip: Initialisation failed**
195	Re-set the drive Check the correct encoder type is entered into Pr **3.38** Check encoder wiring Check encoder power supply is set correctly Carry out the auto-configuration Pr **3.41** Replace feedback device
Enc8	**Drive encoder trip: Auto configuration on power up has been requested and failed**
196	Change the setting of Pr **3.41** to 0 and manually enter the drive encoder turns (Pr **3.33**) and the equivalent number of lines per revolution (Pr **3.34**) Check the comms resolution
Enc9	**Drive encoder trip: Position feedback selected is selected from a Solutions Module slot which does not have a speed / position feedback Solutions Module fitted**
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. Perform an autotune to measure the encoder phase angle or manually enter the correct phase angle into Pr **3.25** (or Pr **21.20**). Spurious Enc10 trips can be seen in very dynamic applications. This trip can be disabled by setting the overspeed threshold in Pr **3.08** to a value greater than zero. Caution should be used in setting the over speed threshold level as a value which is too large may mean that an encoder fault will not be detected.
Enc11	**Drive encoder trip: A failure has occurred during the alignment of the analogue signals of a SINCOS encoder with the digital count derived from the sine and cosine waveforms and the comms position (if applicable). This fault is usually due to noise on the sine and cosine signals.**
161	Check encoder cable shield. Examine sine and cosine signals for noise.
Enc12	**Drive encoder trip: Hiperface encoder - The encoder type could not be identified during auto-configuration**
162	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
Enc13	**Drive encoder trip: EnDat encoder - The number of encoder turns read from the encoder during auto-configuration is not a power of 2**
163	Select a different type of encoder.
Enc14	**Drive encoder trip: EnDat encoder - The number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.**
164	Select a different type of encoder. Faulty encoder.
Enc15	**Drive encoder trip: The number of periods per revolution calculated from encoder data during auto-configuration is either less than 2 or greater than 50,000.**
165	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.

Trip	Diagnosis
Enc16	**Drive encoder trip: EnDat encoder - The number of comms bits per period for a linear encoder exceeds 255.**
166	Select a different type of encoder. Faulty encoder.
Enc17	**Drive encoder trip: The periods per revolution obtained during auto-configuration for a rotary SINCOS encoder is not a power of two.**
167	Select a different type of encoder. Faulty encoder.
ENP.Er	**Data error from electronic nameplate stored in selected position feedback device**
176	Replace feedback device
Et	**External trip from input on terminal 31**
6	Check terminal 31 signal Check value of Pr **10.32** Enter 12001 in Pr **xx.00** and check for parameter controlling Pr **10.32** Ensure Pr **10.32** or Pr **10.38** (= 6) are not being controlled by serial comms
HF01	**Data processing error: CPU address error**
	Hardware fault - return drive to supplier
HF02	**Data processing error: DMAC address error**
	Hardware fault - return drive to supplier
HF03	**Data processing error: Illegal instruction**
	Hardware fault - return drive to supplier
HF04	**Data processing error: Illegal slot instruction**
	Hardware fault - return drive to supplier
HF05	**Data processing error: Undefined exception**
	Hardware fault - return drive to supplier
HF06	**Data processing error: Reserved exception**
	Hardware fault - return drive to supplier
HF07	**Data processing error: Watchdog failure**
	Hardware fault - return drive to supplier
HF08	**Data processing error: Level 4 crash**
	Hardware fault - return drive to supplier
HF09	**Data processing error: Heap overflow**
	Hardware fault - return drive to supplier
HF10	**Data processing error: Router error**
	Hardware fault - return drive to supplier
HF11	**Data processing error: Access to EEPROM failed**
	Hardware fault - return drive to supplier
HF12	**Data processing error: Main program stack overflow**
	Hardware fault - return drive to supplier
HF13	**Data processing error: Software incompatible with hardware**
	Hardware or software fault - return drive to supplier
HF17	**Multi-module system thermistor short circuit**
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

Trip	Diagnosis
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
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
HF28	**Power stage thermistor 2 fault or internal fan fault (size 3 and larger)**
228	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
HF31	**Aux fan failure from power module**
231	Replace auxiliary fan
HF32	**Power stage - a module has not powered up in a multi-module parallel drive**
232	Check AC power supply
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 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 ≤Heavy Duty current rating of the drive Tune the rated speed parameter (closed loop vector only) Check feedback device signal for noise Check the feedback device mechanical coupling
It.br	**Braking resistor overload timed out (I^2t) – accumulator value can be seen in Pr 10.39**
19	Ensure the values entered in Pr **10.30** and Pr **10.31** are correct Increase the power rating of the braking resistor and change Pr **10.30** and Pr **10.31** If an external thermal protection device is being used and the braking resistor software overload is not required, set Pr **10.30** or Pr **10.31** to 0 to disable the trip
O.CtL	**Drive control board over temperature**
23	Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Check ambient temperature Reduce drive switching frequency
O.ht1	**Power device over temperature based on thermal model**
21	Reduce drive switching frequency Reduce duty cycle Decrease acceleration / deceleration rates Reduce motor load

Trip	Diagnosis
O.ht2	**Heatsink over temperature**
22	Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
O.ht3	**Drive over-temperature based on thermal model**
27	The drive will attempt to stop the motor before tripping. If the motor does not stop in 10s the drive trips immediately. Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce duty cycle Reduce motor load
Oht4.P	**Power module rectifier over temperature or input snubber resistor over temperature (size 4 and above)**
102	Check for supply imbalance Check for supply disturbance such as notching from a DC drive Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
OI.AC	**Instantaneous output over current detected: peak output current greater than 225%**
3	Acceleration /deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits for that frame size? Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** (closed loop vector and servo modes only) Has offset measurement test been completed? (servo mode only) Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14** (closed loop vector and servo modes only)
OI.br	**Braking transistor over-current detected: short circuit protection for the braking transistor activated**
4	Check braking resistor wiring Check braking resistor value is greater than or equal to the minimum resistance value Check braking resistor insulation
O.Ld1	**Digital output overload: total current drawn from 24V supply and digital outputs exceeds 200mA**
26	Check total load on digital outputs (terminals 24,25,26)and +24V rail (terminal 22)
O.SPd	**Motor speed has exceeded the over speed threshold**
7	Increase the over speed trip threshold in Pr **3.08** (closed loop modes only) Speed has exceeded 1.2 x Pr **1.06** or Pr **1.07** (open loop mode) Reduce the speed loop P gain (Pr **3.10**) to reduce the speed overshoot (closed loop modes only)

Trip	Diagnosis
OV	**DC bus voltage has exceeded the peak level or the maximum continuous level for 15 seconds**
2	Increase deceleration ramp (Pr **0.04**) Decrease braking resistor value (staying above the minimum value) Check nominal AC supply level Check for supply disturbances which could cause the DC bus to rise – voltage overshoot after supply recovery from a notch induced by DC drives. Check motor insulation **Drive voltage rating / Peak voltage / Maximum continuous voltage level (15s)** 200 / 415 / 410 400 / 830 / 815 575 / 990 / 970 690 / 1190 / 1175 If the drive is operating in low voltage DC mode the overvoltage trip level is 1.45 x Pr **6.46**.
Ph	**AC voltage input phase loss or large supply imbalance detected**
32	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load) **NOTE** Load level must be between 50 and 100% for the drive to trip under phase loss conditions. The drive will attempt to stop the motor before this trip is initiated.
PS	**Internal power supply fault**
5	Remove any Solutions Modules and reset Check integrity of interface ribbon cables and connections (size 4,5,6 only) Hardware fault - return drive to supplier
PS.10V	**10V user power supply current greater than 10mA**
8	Check wiring to terminal 4 Reduce load on terminal 4
PS.24V	**24V internal power supply overload**
9	The total user load of the drive and Solutions Modules has exceeded the internal 24V power supply limit. The user load consists of the drive's digital outputs, the SM-I/O Plus digital outputs, the drive's main encoder supply and the SM-Universal Encoder Plus encoder supply. • Reduce load and reset • Provide an external 24V >50W power supply • Remove any Solutions Modules and reset
PSAVE.Er	**Power down save parameters in the EEPROM are corrupt**
37	Indicates that the power was removed when power down save parameters were being saved. The drive will revert back to the power down parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) or power down the drive normally to ensure this trip does or occur the next time the drive is powered up.
rS	**Failure to measure resistance during autotune or when starting in open loop vector mode 0 or 3**
33	Check motor power connection continuity
SAVE.Er	**User save parameters in the EEPROM are corrupt**
36	Indicates that the power was removed when user parameters were being saved. The drive will revert back to the user parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) to ensure this trip does or occur the next time the drive is powered up.
SCL	**Drive RS485 serial comms loss to remote keypad**
30	Refit the cable between the drive and keypad Check cable for damage Replace cable Replace keypad
SLX.dF	**Solutions Module slot X trip: Solutions Module type fitted in slot X changed**
204,209,214	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**/**17.50**. The following table lists the possible error codes for the SM-Universal Encoder Plus, SM-Encoder Plus and SM-Resolver. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

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

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Automation (Applications) module category** Check value in Pr **15**/**16**/**17.50**. The following table lists the possible error codes for the SM-Applications and SM-Applications Lite. See the *Diagnostics* section in the relevant Solutions Module 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

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>SLX.Er</td><td>Solutions Module slot X trip: Solutions Module in slot X has detected a fault</td></tr>
<tr><td>202,207,212</td><td>Automation (I/O Expansion) module category
Check value in Pr 15/16/17.50. The following table lists the possible error codes for the SM-I/O Plus, SM-I/O Lite, SM-I/O Timer, SM-PELV and SM-I/O 120V modules. See the Diagnostics section in the relevant Solutions Module User Guide for more information.
<table>
<tr><th>Error code</th><th>Module</th><th>Reason for fault</th></tr>
<tr><td>0</td><td>SM-I/O Lite</td><td>No errors</td></tr>
<tr><td>1</td><td>SM-I/O Lite</td><td>Digital output overload</td></tr>
<tr><td>2</td><td>SM-I/O Lite</td><td>Analogue input 1 current input too high (>22mA) or too low (<3mA)</td></tr>
<tr><td>74</td><td>SM-I/O Lite</td><td>Module over temperature</td></tr>
</table></td></tr>
<tr><td>SLX.Er</td><td>Solutions Module slot X trip: Solutions Module in slot X has detected a fault</td></tr>
<tr><td>202,207,212</td><td>Fieldbus module category
Check value in Pr 15/16/17.50. 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.
<table>
<tr><th>Error code</th><th>Module</th><th>Trip Description</th></tr>
<tr><td>0</td><td>All</td><td>No trip</td></tr>
<tr><td>52</td><td>SM-CANOpen</td><td>User control word trip</td></tr>
<tr><td>61</td><td>SM-CANOpen</td><td>Configuration error</td></tr>
<tr><td>65</td><td>SM-CANOpen</td><td>Network loss</td></tr>
<tr><td></td><td>SM-CAN, SM-CANOpen</td><td>Bus off error</td></tr>
<tr><td>69</td><td>SM-CAN</td><td>No acknowledgement</td></tr>
<tr><td>70</td><td>All (except SM-Ethernet)</td><td>Flash transfer error</td></tr>
<tr><td></td><td>SM-Ethernet</td><td>No valid menu data available for the module from the drive</td></tr>
<tr><td>74</td><td>All</td><td>Solutions Module over temperature</td></tr>
<tr><td>75</td><td>SM-Ethernet</td><td>The drive is not responding</td></tr>
<tr><td>76</td><td>SM-Ethernet</td><td>The Modbus connection has timed out</td></tr>
<tr><td>80</td><td>All</td><td>Inter-option communications error</td></tr>
<tr><td>81</td><td>All</td><td>Communications error to slot 1</td></tr>
<tr><td>82</td><td>All</td><td>Communications error to slot 2</td></tr>
<tr><td>83</td><td>All</td><td>Communications error to slot 3</td></tr>
<tr><td>84</td><td>SM-Ethernet</td><td>Memory allocation error</td></tr>
<tr><td>85</td><td>SM-Ethernet</td><td>File system error</td></tr>
<tr><td>86</td><td>SM-Ethernet</td><td>Configuration file error</td></tr>
<tr><td>87</td><td>SM-Ethernet</td><td>Language file error</td></tr>
<tr><td>98</td><td>All</td><td>Internal watchdog error</td></tr>
<tr><td>99</td><td>All</td><td>Internal software error</td></tr>
</table></td></tr>
<tr><td>SLX.HF</td><td>Solutions Module slot X trip: Solutions Module X hardware fault</td></tr>
<tr><td>200,205,210</td><td>Ensure Solutions Module is fitted correctly
Return Solutions Module to supplier</td></tr>
<tr><td>SLX.nF</td><td>Solutions Module slot X trip: Solutions Module has been removed</td></tr>
<tr><td>203,208,213</td><td>Ensure Solutions Module is fitted correctly
Re-fit Solutions Module
Save parameters and reset drive</td></tr>
<tr><td>SL.rtd</td><td>Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect</td></tr>
<tr><td>215</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>SLX.tO</td><td>Solutions Module slot X trip: Solutions Module watchdog timeout</td></tr>
<tr><td>201,206,211</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>t010</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>10</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
</table>

Trip	Diagnosis
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
t111 to t160	**User trip defined in 2nd processor Solutions Module code**
111 to 160	SM-Applications program must be interrogated to find the cause of this trip
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 Check thermistor continuity Set Pr **7.15** = VOLt and reset the drive to disable this function
thS	**Motor thermistor short circuit**
25	Check motor thermistor wiring Replace motor / motor thermistor Set Pr **7.15** = VOLt and reset the drive to disable this function
tunE*	**Autotune stopped before completion**
18	The drive has tripped out during the autotune The red stop key has been pressed during the autotune The secure disable signal (terminal 31) was active during the autotune procedure
tunE1*	**The position feedback did not change or required speed could not be reached during the inertia test (see Pr 5.12)**
11	Ensure the motor is free to turn i.e. brake was released Check feedback device wiring is correct Check feedback parameters are set correctly Check encoder coupling to motor
tunE2*	**Position feedback direction incorrect or motor could not be stopped during the inertia test (see Pr 5.12)**
12	Check motor cable wiring is correct Check feedback device wiring is correct Swap any two motor phases (closed loop vector only)
tunE3*	**Drive encoder commutation signals connected incorrectly or measured inertia out of range (see Pr 5.12)**
13	Check motor cable wiring is correct Check feedback device U,V and W commutation signal wiring is correct
tunE4*	**Drive encoder U commutation signal fail during an autotune**
14	Check feedback device U phase commutation wires continuity Replace encoder
tunE5*	**Drive encoder V commutation signal fail during an autotune**
15	Check feedback device V phase commutation wires continuity Replace encoder
tunE6*	**Drive encoder W commutation signal fail during an autotune**
16	Check feedback device W phase commutation wires continuity Replace encoder

Trip	Diagnosis
tunE7*	**Motor number of poles set incorrectly**
17	Check lines per revolution for feedback device Check the number of poles in Pr **5.11** is set correctly
UP ACC	**Onboard PLC program: cannot access Onboard PLC program file on drive**
98	Disable drive - write access is not allowed when the drive is enabled Another source is already accessing Onboard PLC program - retry once other action is complete
UP div0	**Onboard PLC program attempted divide by zero**
90	Check program
UP OFL	**Onboard PLC program variables and function block calls using more than the allowed RAM space (stack overflow)**
95	Check program
UP ovr	**Onboard PLC program attempted out of range parameter write**
94	Check program
UP PAr	**Onboard PLC program attempted access to a non-existent parameter**
91	Check program
UP ro	**Onboard PLC program attempted write to a read-only parameter**
92	Check program
UP So	**Onboard PLC program attempted read of a write-only parameter**
93	Check program
UP udF	**Onboard PLC program un-defined trip**
97	Check program
UP uSEr	**Onboard PLC program requested a trip**
96	Check program
UV	**DC bus under voltage threshold reached**
1	Check AC supply voltage level **Drive voltage rating (Vac) / Under voltage threshold (Vdc)** 200 / 175 400 / 350 575 & 690 / 435

*If a tunE through to a tunE 7 trip occurs, then after the drive is reset the drive cannot be made to run unless it is disabled via the Secure Disable input (terminal 31), drive enable parameter (Pr **6.15**) or the control word (Pr **6.42** and Pr **6.43**).

Table 13-2 Serial communications look-up table

No.	Trip	No.	Trip	No.	Trip
1	UV	40 to 89	t040 to t089	189	EnC1
2	OV	90	UP div0	190	EnC2
3	OI.AC	91	UP PAr	191	EnC3
4	OI.br	92	UP ro	192	EnC4
5	PS	93	UP So	193	EnC5
6	Et	94	UP ovr	194	EnC6
7	O.SPd	95	UP OFL	195	EnC7
8	PS.10V	96	UP uSEr	196	EnC8
9	PS.24V	97	UP udF	197	EnC9
10	t010	98	UP ACC	198	EnC10
11	tunE1	99	t099	199	DESt
12	tunE2	101	t101	200	SL1.HF
13	tunE3	102	Oht4.P	201	SL1.tO
14	tunE4	111 to 160	t111 to t160	202	SL1.Er
15	tunE5	161	Enc11	203	SL1.nF
16	tunE6	162	Enc12	204	SL1.dF
17	tunE7	163	Enc13	205	SL2.HF
18	tunE	164	Enc14	206	SL2.tO
19	It.br	165	Enc15	207	SL2.Er
20	It.AC	166	Enc16	208	SL2.nF
21	O.ht1	167	Enc17	209	SL2.dF
22	O.ht2	168 to 175	t168 to t175	210	SL3.HF
23	O.CtL	176	EnP.Er	211	SL3.tO
24	th	178	C.bUSY	212	SL3.Er
25	thS	179	C.Chg	213	SL3.nF
26	O.Ld1	180	C.OPtn	214	SL3.dF
27	O.ht3	181	C.RdO	215	SL.rtd
30	SCL	182	C.Err	216	t216
31	EEF	168 to 175	t168 to t175	214	SL3.dF
32	PH	183	C.dAt	217	HF17
33	rS	184	C.FULL	218	HF18
35	CL.bit	185	C.Acc	219	HF19
36	SAVE.Er	186	C.rtg	220 to 232	HF20 to HF32
37	PSAVE.Er	187	C.TyP		
38	t038	188	C.cPr		

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 13-3 Trip categories

Priority	Category	Trips	Comments
1	Hardware faults	HF01 to HF16	These indicate fatal problems and cannot be reset. The drive is inactive after one of these trips and the display shows **HFxx**. The Drive Healthy relay opens and the serial comms will not function.
2	Non-resetable trips	HF17 to HF32, SL1.HF, SL2.HF, SL3.HF	Cannot be reset. Requires the drive to be powered down.
3	EEF trip	EEF	Cannot be reset unless a code to load defaults is first entered in Pr **xx.00** or Pr **11.43**.
4	SMARTCARD trips	C.boot, C.Busy, C.Chg, C.OPtn, C.RdO, C.Err, C.dat, C.FULL, C.Acc, C.rtg, C.TyP, C.cpr	Can be reset after 1.0s SMARTCARD trips have priority 5 during power-up
4	Encoder power supply trips	PS.24V, EnC1	Can be reset after 1.0s These trips can only override the following priority 5 trips: EnC2 to EnC8 or Enc11 to Enc17
5	Autotune	tunE, tunE1 to tunE7	Can be reset after 1.0s, but the drive cannot be made to run unless it is disabled via the Secure Disable 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.

13.4 Alarm indications

In any mode an alarm flashes alternately with the data displayed on the 2nd row when one of the following conditions occur. If action is not taken to eliminate any alarm except "Autotune" the drive may eventually trip.

Table 13-4 Alarm indications

Lower display	Description
br.rS	Braking resistor overload
Braking resistor I^2t accumulator (Pr **10.37**) in the drive has reached 75.0% of the value at which the drive will trip and the braking IGBT is active.	
Hot	Heatsink or control board or inverter IGBT over temperature alarms are active
• The drive heatsink temperature has reached a threshold and the drive will trip O.ht2 if the temperature continues to rise (see the O.ht2 trip). Or • The ambient temperature around the control PCB is approaching the over temperature threshold (see the O.CtL trip).	
OVLd	Motor overload
The motor I^2t accumulator in the drive has reached 75% of the value at which the drive will be tripped and the load on the drive is >100%	

13.5 Status indications

Table 13-5 Status indications

Upper display	Description	Drive output stage
ACt	Regeneration mode active	Enabled
The regen unit is enabled and synchronised to the supply.		
ACUU	AC Supply loss	Enabled
The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor.		
***Auto tunE**	Autotune in progress	Enabled
The autotune procedure has been initialised. *'Auto' and 'tunE' will flash alternatively on the display.		
dc	DC applied to the motor	Enabled
The drive is applying DC injection braking.		
dEC	Decelerating	Enabled
The drive is decelerating the motor.		
inh	Inhibit	Disabled
The drive is inhibited and cannot be run. The drive enable signal is not applied to terminal 31 or Pr **6.15** is set to 0.		
PLC	Onboard PLC program is running	Not applicable
An Onboard PLC program is fitted and running. The lower display will flash 'PLC' once every 10s.		
POS	Positioning	Enabled
The drive is positioning/orientating the motor shaft.		
rdY	Ready	Disabled
The drive is ready to be run.		
run	Running	Enabled
The drive is running.		
SCAn	Scanning	Enabled
OL> The drive is searching for the motor frequency when synchronising to a spinning motor. Regen> The drive is enabled and is synchronising to the line.		
StoP	Stop or holding zero speed	Enabled
The drive is holding zero speed. Regen> The drive is enabled but the AC voltage is too low, or the DC bus voltage is still rising or falling.		
triP	Trip condition	Disabled
The drive has tripped and is no longer controlling the motor. The trip code appears on the lower display.		

Table 13-6 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.	
cArd	
The drive is writing a parameter set to the SMARTCARD during power-up. For further information, please refer to section 11.2.3 *Auto saving parameter changes (Pr 11.42 = Auto (3))* on page 77.	
loAding	
The drive is writing information to a Solutions Module.	

13.6 Displaying the trip history

The drive retains a log of the last 10 trips that have occurred in Pr **10.20** to Pr **10.29** and the corresponding multi-module drive module number (Pr **6.49** = 1) or the trip time (Pr **6.49** = 0) for each trip in Pr **10.41** to Pr **10.51**. The time of the trip is recorded from the powered-up clock (if Pr **6.28** = 0) or from the run time clock (if Pr **6.28** = 1).

Pr **10.20** is the most recent trip, or the current trip if the drive is in a trip condition (with the module number or trip time stored in Pr **10.41** and Pr **10.42**). Pr **10.29** is the oldest trip (with the module number or trip time stored in Pr **10.51**). Each time a new trip occurs, all the parameters move down one, such that the current trip (and time) is stored in Pr **10.20** (and Pr **10.41** to Pr **10.42**) and the oldest trip (and time) is lost out of the bottom of the log.

If any parameter between Pr **10.20** and Pr **10.29** inclusive is read by serial communications, then the trip number in Table 13.3 *Unidrive SP trip codes* on page 84 is the value transmitted.

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