LEROY SOMER®

This manual is to be given to the end user

C E

U N I D R I V E SP

Universal variable speed drive

Short form guide

General Information

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

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

Drive software version

This product is supplied with the latest software version. If this drive is to be connected to an existing system or machine, all drive software versions should be verified to confirm the same functionality as drives of the same model already present. This may also apply to drives returned from LEROY-SOMER. If there is any doubt please contact the supplier of the product.

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

Environmental statement

LEROY-SOMER is committed to minimising the environmental impacts of its manufacturing operations. To this end, we operate an Environmental Management System (EMS) which is certified to the International Standard ISO 14001.

The electronic variable-speed drives manufactured by LEROY-SOMER have the potential to save energy and (through increased machine/process efficiency) reduce raw material consumption and scrap throughout their long working lifetime.

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

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.

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

REACH legislation

EC Regulation 1907/2006 on the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) requires the supplier of an article to inform the recipient if it contains more than a specified proportion of any substance which is considered by the European Chemicals Agency (ECHA) to be a Substance of Very High Concern (SVHC) and is therefore listed by them as a candidate for compulsory authorisation.

For current information on how this requirement applies in relation to specific LEROY-SOMER products, please approach your usual contact in the first instance.

Contents

1 Safety Information

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.

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.

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 / start-up 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 SAFE TORQUE OFF functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

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

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.

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The SAFE TORQUE OFF function has been approved by BGIA as meeting the requirements of the following standards, for the prevention of unexpected starting of the drive:

EN 61800-5-2:2007   SIL 3

EN ISO 13849-1:2006 PL e

EN 954-1:1997   Category 3

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

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.

Access

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

Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. For further information, refer to section 3.1 *Fire protection* on page 17.

Compliance with regulations

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

This User Guide contains instruction for achieving compliance with specific EMC standards.

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

2006/42/EC: Safety of machinery.
2004/108/EC: Electromagnetic Compatibility.

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 installed with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive 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.

Mechanical brake control

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

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.

Electrical installation

Electric shock risk

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

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

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

Stored charge

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

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2 Product Information

2.1 Ratings

Fuses

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

2.1.1 SPz & size 1 to 3 ratings

Table 2-1 200V ratings

Model	Max. cont. input current		Fuse		Cable size EN60204		Cable size UL508C		Normal Duty			Heavy Duty		
	1ph	3ph	IEC gG	UL	Input	Output	Input	Output	Max. cont. output current	Nom power @ 220V	Motor power @ 230V	Max. cont. output current	Nom power @ 220V	Motor power @ 230V
	A	A	A	A	mm²	mm²	AWG	AWG	A	kW	hp	A	kW	hp
SPz1M/TL SP0201	5.0	3.6	6	10	0.75	0.75	16	24				2.2	0.37	0.5
SPz1.2M/TL SP0202	7.6	5.6	10	10	1	0.75	16	22				3.1	0.55	0.75
SPz1.5M/TL SP0203	9.6	6.9	12	16	1.5	0.75	14	20				4.0	0.75	1.0
SPz2M/TL SP0204	13.5	8.9	16	20	2.5	0.75	12	18				5.7	1.1	1.5
SPz2.5M/TL SP0205	17.4	12.3	20	20	4	0.75	12	18				7.5	1.5	2.0
SP1.5TL SP1201		9.5	10	10	1.5	1.0	14	18	5.2	1.1	1.5	4.3	0.75	1.0
SP2TL SP1202		11.3	12	15	1.5	1.0	14	16	6.8	1.5	2.0	5.8	1.1	1.5
SP2.5TL SP1203		16.4	20	20	4.0	1.0	12	14	9.6	2.2	3.0	7.5	1.5	2.0
SP3.5TL SP1204		19.1	20	20	4.0	1.5	12	14	11	3.0	3.0	10.6	2.2	3.0
SP4.5TL SP2201		18.1	20	20	4.0	2.5	12	14	15.5	4.0	5.0	12.6	3.0	3.0
SP5.5TL SP2202		22.6	25	25	4.0	4.0	10	10	22	5.5	7.5	17	4.0	5.0
SP8TL SP2203		28.3	32	30	6.0	6.0	8	8	28	7.5	10	25	5.5	7.5
SP11TL SP3201		43.1	50	45	16	16	6	6	42	11	15	31	7.5	10
SP16TL SP3202		54.3	63	60	25	25	4	4	54	15	20	42	11	15

Table 2-2   400V ratings

Model	Max. cont. input current		Fuse		Cable size				Normal Duty			Heavy Duty		
					EN60204		UL508C							
	1ph	3ph	IEC gG	UL	Input	Output	Input	Output	Max. cont. output current	Nom power @ 400V	Motor power @ 460V	Max. cont. output current	Nom power @ 400V	Motor power @ 460V
	A	A	A	A	mm²	mm²	AWG	AWG	A	kW	hp	A	kW	hp
SPz1T SP0401		2.3	4	10	0.75	0.75	16	24				1.3	0.37	0.5
SPz1.2T SP0402		2.8	4	10	0.75	0.75	16	24				1.7	0.55	0.75
SPz1.5T SP0403		3.3	6	10	0.75	0.75	16	24				2.1	0.75	1.0
SPz2T SP0404		4.4	6	10	0.75	0.75	16	22				3.0	1.1	1.5
SPz2.5T SP0405		5.7	8	10	0.75	0.75	16	20				4.2	1.5	2.0
SP1.5T SP1401		4.8	8	8	1.0	1.0	16	22	2.8	1.1	1.5	2.1	0.75	1.0
SP2T SP1402		5.8	8	8	1.0	1.0	16	20	3.8	1.5	2.0	3.0	1.1	1.5
SP2.5T SP1403		7.4	8	10	1.0	1.0	16	18	5.0	2.2	3.0	4.2	1.5	2.0
SP3.5T SP1404		10.6	12	15	1.5	1.0	14	16	6.9	3.0	5.0	5.8	2.2	3.0
SP4.5T SP1405		11	12	15	1.5	1.0	14	14	8.8	4.0	5.0	7.6	3.0	5.0
SP5.5T SP1406		13.4	16	15	2.5	1.5	14	14	11	5.5	7.5	9.5	4.0	5.0
SP8T SP2401		17	20	20	4.0	2.5	12	14	15.3	7.5	10	13	5.5	10
SP11T SP2402		21.4	25	25	4.0	4.0	10	10	21	11	15	16.5	7.5	10
SP16T SP2403		27.6	32	30	6.0	6.0	8	8	29	15	20	25	11	20
SP20T SP2404		27.6	32	30	6.0	6.0	8	8				29	15	20
SP22T SP3401		36.2	40	40	10	10	6	6	35	18.5	25	32	15	25
SP27T SP3402		42.7	50	45	16	16	6	6	43	22	30	40	18.5	30
SP33T SP3403		53.5	63	60	25	25	4	4	56	30	40	46	22	30

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Table 2-3   575V ratings

Model	Max. cont. input current		Fuse		Cable size				Normal Duty			Heavy Duty		
					EN60204		UL508C		Max. cont. output current	Nom power @ 575V	Motor power @ 575V	Max. cont. output current	Nom power @ 575V	Motor power @ 575V
	1ph	3ph	IEC gG	UL	Input	Output	Input	Output						
	A	A	A	A	mm²	mm²	AWG	AWG	A	kW	hp	A	kW	hp
SP3.5TM SP3501		6.7	8	10	1.0	1.0	16	18	5.4	3.0	3.0	4.1	2.2	2.0
SP4.5TM SP3502		8.2	10	10	1.0	1.0	16	16	6.1	4.0	5.0	5.4	3.0	3.0
SP5.5TM SP3503		11.1	12	15	1.5	1.0	14	14	8.4	5.5	7.5	6.1	4.0	5.0
SP8TM SP3504		14.4	16	15	2.5	1.5	14	14	11	7.5	10	9.5	5.5	7.5
SP11TM SP3505		18.1	20	20	4.0	2.5	12	14	16	11	15	12	7.5	10
SP16TM SP3506		22.2	25	25	4.0	4.0	10	10	22	15	20	18	11	15
SP22TM SP3507		26.0	32	30	6.0	6.0	8	8	27	18.5	25	22	15	20

2.1.2   Size 4 to 6 ratings

Table 2-4   200V ratings

Model	Max. cont. input current	Fuse option 1			Fuse option 2 semi. fuse in series with HRC fuse or breaker		Cable size				Normal Duty			Heavy Duty		
							EN60204		UL508C		Max. cont. output current	Nom power @ 220V	Motor power @ 230V	Max. cont. output current	Nom power @ 220V	Motor power @ 230V
	3ph	IEC Class	North America Ferraz HSJ	HRC IEC class gG UL class J	IEC class aR	Input	Output	Input	Output						
	A	A	A	A	A	mm²	AWG	mm²	AWG	A	kW	hp	A	kW	hp
SP22TL SP4201	68.9	100	90	90	160	25	3	25	3	68	18.5	25	56	15	20
SP27TL SP4202	78.1	100	100	100	160	35	3	35	3	80	22	30	68	18.5	25
SP33TL SP4203	99.9	125	125	125	200	70	1	70	1	104	30	40	80	22	30
SP40TL SP5201	142	200	175	160	200	95	2/0	95	2/0	130	37	50	105	30	40
SP50TL SP5202	165	250	225	200	250	120	4/0	120	4/0	154	45	60	130	37	50

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Table 2-5 400V ratings

Model	Max. cont. input current 3ph	Fuse option 1 IEC Class	Fuse option 1 North America Ferraz HSJ	Fuse option 2 semi. fuse in series with HRC fuse or breaker HRC IEC class gG UL class J	Fuse option 2 IEC class aR	Cable size EN60204 Input	EN60204 Output	UL508C Input	UL508C Output	Normal Duty Max. cont. output current	Normal Duty Nom power @ 400V	Normal Duty Motor power @ 460V	Heavy Duty Max. cont. output current	Heavy Duty Nom power @ 400V	Heavy Duty Motor power @ 460V
	A	A	A	A	A	mm²	AWG	mm²	AWG	A	kW	hp	A	kW	hp
SP40T SP4401	62.3	80	80	80	160	25	3	25	3	68	37	50	60	30	50
SP50T SP4402	79.6	110	110	100	200	35	2	35	2	83	45	60	74	37	60
SP60T SP4403	97.2	125	125	125	200	70	1	70	1	104	55	75	96	45	75
SP75T SP5401	131	200	175	160	200	95	2/0	95	2/0	138	75	100	124	55	100
SP100T* SP5402*	156	250	225	200	250	120	4/0	120	4/0	168	90	125	156	75	125
SP120T* SP6401*	241	315	300	250	315	2 x 70	2 x 2/0	2 x 70	2 x 2/0	205	110	150	180	90	150
SP150T* SP6402*	258	315	300	300	350	2 x 120	2 x 4/0	2 x 120	2 x 4/0	236	132	200	210	110	150

Table 2-6 575V ratings

Model	Max. cont. input current 3ph	Fuse option 1 IEC Class	Fuse option 1 North America Ferraz HSJ	Fuse option 2 semi. fuse in series with HRC fuse or breaker HRC IEC class gG UL class J	Fuse option 2 IEC class aR	Cable size EN60204 Input	EN60204 Output	UL508C Input	UL508C Output	Normal Duty Max. cont. output current	Normal Duty Nom power @ 575V	Normal Duty Motor power @ 575V	Heavy Duty Max. cont. output current	Heavy Duty Nom power @ 575V	Heavy Duty Motor power @ 575V
	A	A	A	A	A	mm²	AWG	mm²	AWG	A	kW	hp	A	kW	hp
SP33TH SP4603	35.1	63	60	50	125	10	8	10	8	36	22	30	27	18,5	25
SP40TH SP4604	41	63	60	50	125	16	6	16	6	43	30	40	36	22	30
SP50TH SP4605	47.9	63	60	63	125	16	6	16	6	52	37	50	43	30	40
SP60TH SP4606	56.9	80	60	63	125	25	4	25	4	62	45	60	52	37	50
SP75TH SP5601	82.6	125	100	90	160	35	2	35	2	84	55	75	63	45	60
SP100TH SP5602	94.8	125	100	125	160	50	1	50	1	99	75	100	85	55	75
SP120TH* SP6601*	138	200	200	200	200	2 x 50	2 x 1	2 x 50	2 x 1	125	90	125	100	75	100
SP150TH* SP6602*	156	200	200	200	200	2 x 50	2 x 1	2 x 50	2 x 1	144	110	150	125	90	125

Table 2-7 690V ratings

Model	Max. cont. input current	Fuse option 1		Fuse option 2 semi. fuse in series with HRC fuse or breaker		Cable size EN60204		Cable size UL508C		Normal Duty			Heavy Duty		
	3ph	IEC Class	North America Ferraz HSJ	HRC IEC class gG UL class J	IEC class aR	Input	Output	Input	Output	Max. cont. output current	Nom power @ 690V	Motor power @ 690V	Max. cont. output current	Nom power @ 690V	Motor power @ 690V
	A	A	A	A	A	mm²	AWG	mm²	AWG	A	kW	hp	A	kW	hp
SP22TH SP4601	26.5	63	60	32	125	4	10	4	10	22	18.5	25	19	15	20
SP27TH SP4602	28.8	63	60	40	125	6	8	6	8	27	22	30	22	18.5	25
SP33TH SP4603	35.1	63	60	50	125	10	8	10	8	36	30	40	27	22	30
SP40TH SP4604	41	63	60	50	125	16	6	16	6	43	37	50	36	30	40
SP50TH SP4605	47.9	63	60	63	125	16	6	16	6	52	45	60	43	37	50
SP60TH SP4606	56.9	80	60	63	125	25	4	25	4	62	55	75	52	45	60
SP75TH SP5601	82.6	125	100	90	160	35	2	35	2	84	75	100	63	55	75
SP100TH SP5602	94.8	125	100	125	160	50	1	50	1	99	90	125	85	75	100
SP120TH* SP6601*	138	200	200	200	200	2 x 50	2 x 1	2 x 50	2 x 1	125	110	150	100	90	125
SP150TH* SP6602*	156	200	200	200	200	2 x 50	2 x 1	2 x 50	2 x 1	144	132	175	125	110	150

* Derating is applied to these drives at low output frequencies. Please contact the supplier of the drive for more information if the application requires significant torque, at or close to zero speed for extended periods of time or if prolonged periods of overload (>100%) are required.

Short term overload limits

The maximum percentage overload limit changes depending on the selected motor. Variations in motor rated current, motor power factor and motor leakage inductance all result in changes in the maximum possible overload. Typical values are shown in the table below:

Table 2-8 SPz & size 2 to size 5

Operating mode	CL from cold	CL from 100%	OL from cold	OL from 100%
Normal Duty overload with motor rated current = drive rated current	110% for 165s	110% for 9s	110% for 165s	110% for 9s
Heavy Duty overload with motor rated current = drive rated current	175% for 40s	175% for 5s	150% for 60s	150% for 8s
Heavy Duty overload with a typical 4 pole motor	200% for 28s	200% for 3s	175% for 40s	175% for 5s

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Table 2-9   Size 6

Operating mode	CL from cold	CL from 100%	OL from cold	OL from 100%
Normal Duty overload with motor rated current = drive rated current	110% for 165s	110% for 9s	110% for 165s	110% for 9s
Heavy Duty overload with motor rated current = drive rated current	150% for 60s	150% for 8s	129% for 97s	129% for 15s

Generally the drive rated current is higher than the matching motor rated current allowing a higher level of overload than the default setting as illustrated by the example of a typical 4 pole motor.

The time allowed in the overload region is proportionally reduced at very low output frequency on some drive ratings.

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

2.2   Nameplate description

See Figure 3-8 for location of rating labels.

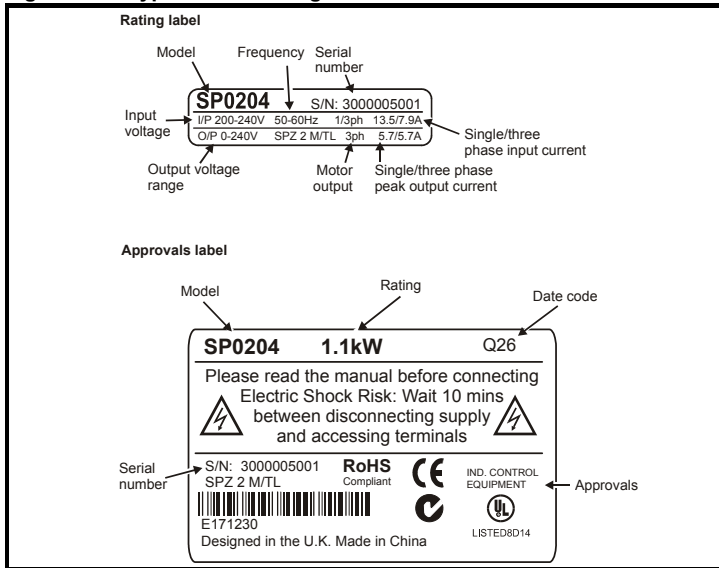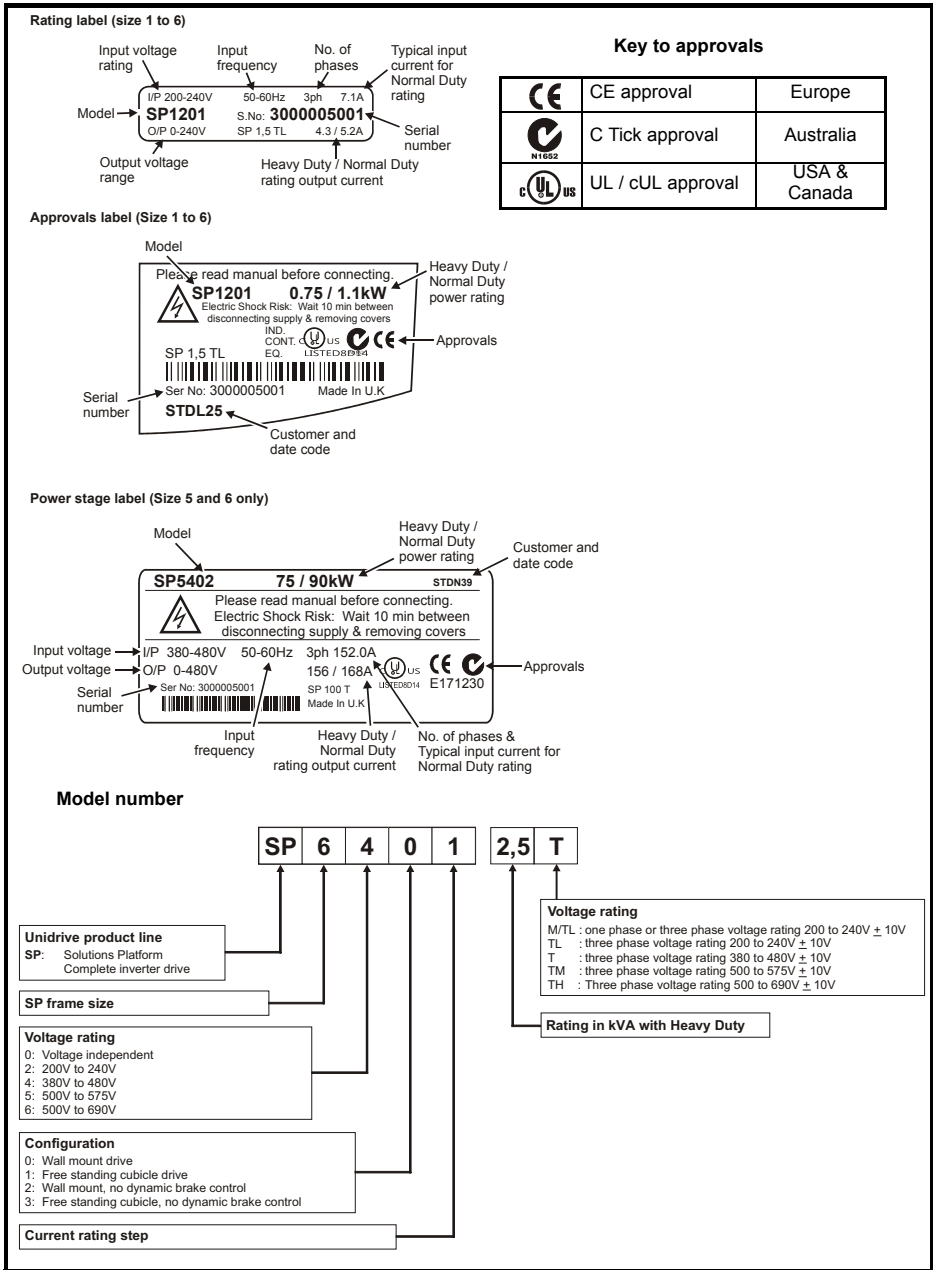**Figure 2-1   Typical drive rating labels for SPz**

Rating label

Model   Frequency   Serial number

SP0204   S/N: 3000005001

Input voltage   I/P 200-240V   50-60Hz   1/3ph   13.5/7.9A

O/P 0-240V   SPZ 2 M/TL   3ph   5.7/5.7A   Single/three phase input current

Output voltage range   Motor output   Single/three phase peak output current

Approvals label

Model   Rating   Date code

SP0204   1.1kW   Q26

Please read the manual before connecting
Electric Shock Risk: Wait 10 mins between disconnecting supply and accessing terminals

Serial number   S/N: 3000005001   RoHS Compliant   CE   IND. CONTROL EQUIPMENT   Approvals
SPZ 2 M/TL

E171230
Designed in the U.K. Made in China   LISTED8D14

Figure 2-2   Typical drive rating labels for size 1 to 6

Rating label (size 1 to 6)

Key to approvals

CE	CE approval	Europe	
C N1652	C Tick approval	Australia	
cULus	UL / cUL approval	USA & Canada	

Approvals label (Size 1 to 6)

Power stage label (Size 5 and 6 only)

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Output current

The continuous output current ratings given on the rating label are for maximum 40°C (104°F), 1000m altitude and 3.0 kHz switching. Derating is required for higher switching frequencies, ambient temperatures >40°C (104°F) and higher altitude. For derating information, refer to the *Unidrive SP User Guide*.

Input current

The input current is affected by the supply voltage and impedance. The input current given on the rating label is the typical input current and is stated for a balanced supply.
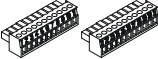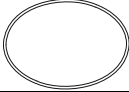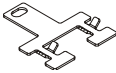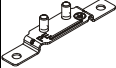
2.3 Options / Accessories

Figure 2-3   Drive features and options

SMARTCARD*

Keypad
SM-Keypad
SM-Keypad Plus

15-way D-type converter

Internal braking resistor (SPz & size 1 to 2 only)

SM slot 1
SM slot 2
SM slot 3

CT Comms cable

External footprint / bookcase EMC filter

Feedback
SM-Universal Encoder Plus
SM-Resolver
SM-Encoder Plus
SM-Encoder Output Plus

Fieldbus
SM-PROFIBUS-DP-V1
SM-DeviceNet
SM-INTERBUS
SM-CAN
SM-CANopen
SM-SERCOS
SM-Ethernet
SM-LON
SM-EtherCAT

SLM
SM-SLM

Automation
(I/O Expansion)
SM-I/O Plus
SM-I/O Lite
SM-I/O Timer
SM-I/O PELV
SM-I/O 120V
SM-I/O 32
SM-I/O 24V Protected

(Applications)
SM-Applications
SM-Applications Lite
SM-Applications Lite V2
SM-EZMotion
SM-Applications Plus
SM-Register
SM-Safety

* Part supplied with drive.

Table 2-10 Parts supplied with the drive

Description	SPz	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6
Control connectors							
Relay connector							
UL warning label				CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover			
Grounding bracket							
Through panel mounting gasket							
Through panel mounting bracket							
Surface mounting brackets							
Top surface mounting brackets							
Nylon washers		M6		M6		M8 M6	
Sealing clips							
Mounting screws	M4x10					M8x20	
Grounding clamp							
Ground cable bridge							
DC terminal cover grommets							
Ferrite ring							
Supply and motor connector							
Ground fixing screws	M6x12						
Fan supply connector							
IP54 gasket							
IP54 insert							

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⚠️ **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.

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

⚠️ **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**	The weights of the size 4, 5 and 6 drives are as follows:
	    Size 4: 30 kg (66 lb)
	    Size 5: 55 kg (121 lb)
	    Size 6: 75 kg (165 lb)
	
	Use appropriate safeguards when lifting these models

NOTE	When replacing the terminal covers the screws should be tightened with a maximum torque of 1 N m (0.7 lb ft).

3.1   Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided.

For installation in the USA, a NEMA 12 enclosure is suitable.

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

Enclosure can be metal and/or polymeric, polymer must meet requirements which can be summarized for larger enclosures as using materials meeting at least UL 94 class 5VB at the point of minimum thickness.

Air filter assemblies to be at least class V-2.

The location and size of the bottom shall cover the area shown in Figure 3-1. Any part of the side which is within the area traced out by the 5° angle is also considered to be part of the bottom of the fire enclosure.

Figure 3-1 Fire enclosure bottom layout
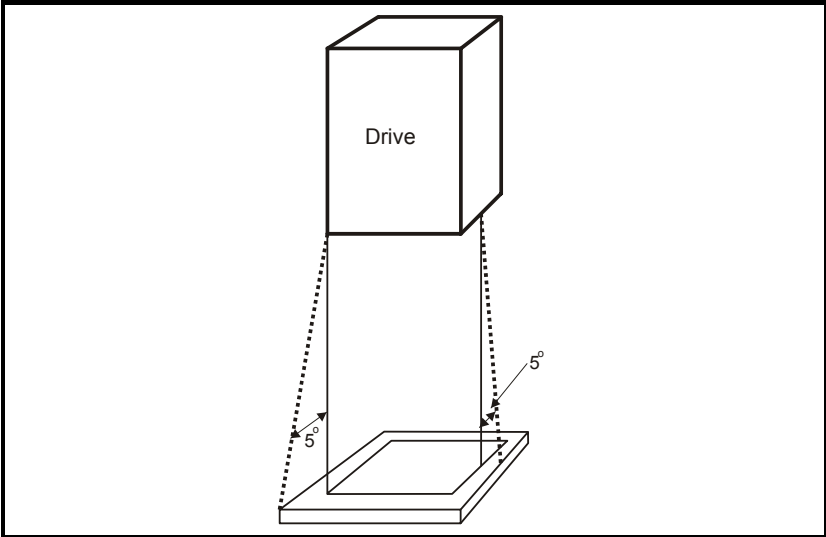
The bottom, including the part of the side considered to be part of the bottom, must be designed to prevent escape of burning material - either by having no openings or by having a baffle construction. This means that openings for cables etc. must be sealed with materials meeting the 5VB requirement, or else have a baffle above.

See Figure 3-2 for acceptable baffle construction. This does not apply for mounting in an enclosed electrical operating area (restricted access) with concrete floor.

Figure 3-2 Fire enclosure baffle construction
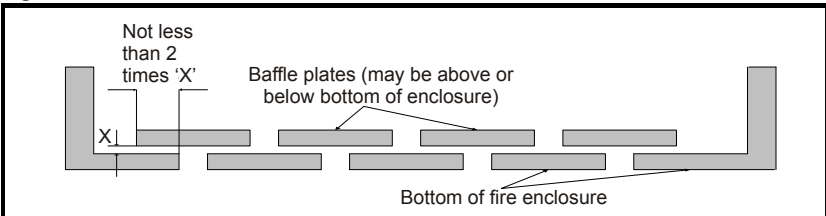
3.2 Mounting methods

Unidrive SP size 1 to 6 can be either surface or through-panel mounted using the appropriate brackets. SPz can only be surface mounted.

⚠ **WARNING**

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.

NOTE

In order to achieve IP54 rating (NEMA 12) for through-panel mounting, an IP54 insert must be installed (size 1 and 2). Derating applies when the IP54 insert is installed. Additionally, the gasket provided should be installed between the drive and the backplate to ensure a good seal for the enclosure. If the heatsink mounted braking resistor is to be used with the drive through-panel mounted, refer to the *Braking Resistor Installation Sheet* supplied with the resistor prior to mounting the drive. For further information refer to the *Unidrive SP User Guide*.

Figure 3-3 New ingress protective label

Ingress protective labels
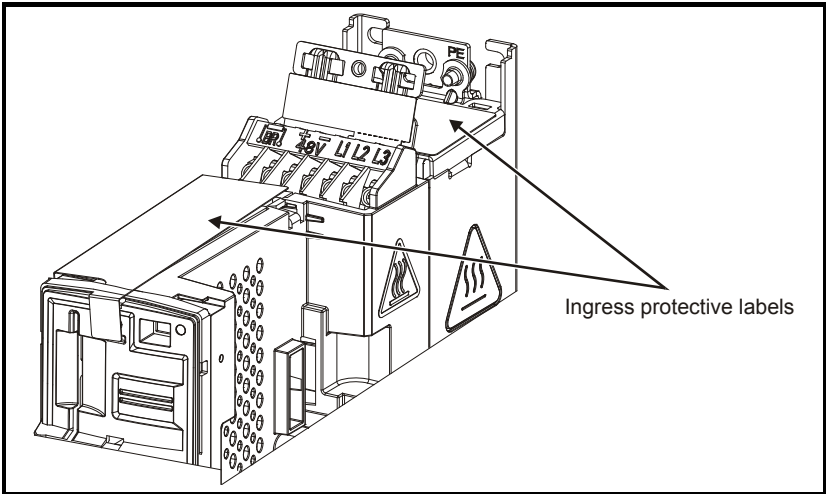
NOTE

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

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3.3   Drive dimensions
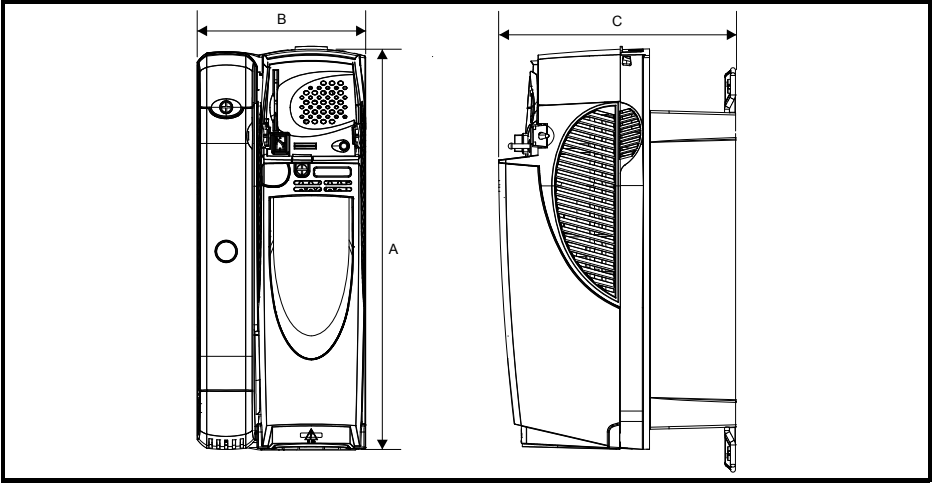
Size	A		B		C	
	mm	in	mm	in	mm	in
SPz	322	12.677	62	2.441	226	8.898
1	368	14.488	100	3.937	219	8.622
2	368	14.488	155	6.102	219	8.622
3	368	14.488	250	9.843	260	10.236
4	510	20.079	310	12.205	298	11.732
5	820	32.283	310	12.205	298	11.732
6	1131	44.528	310	12.205	298	11.732

3.4 Surface mounting
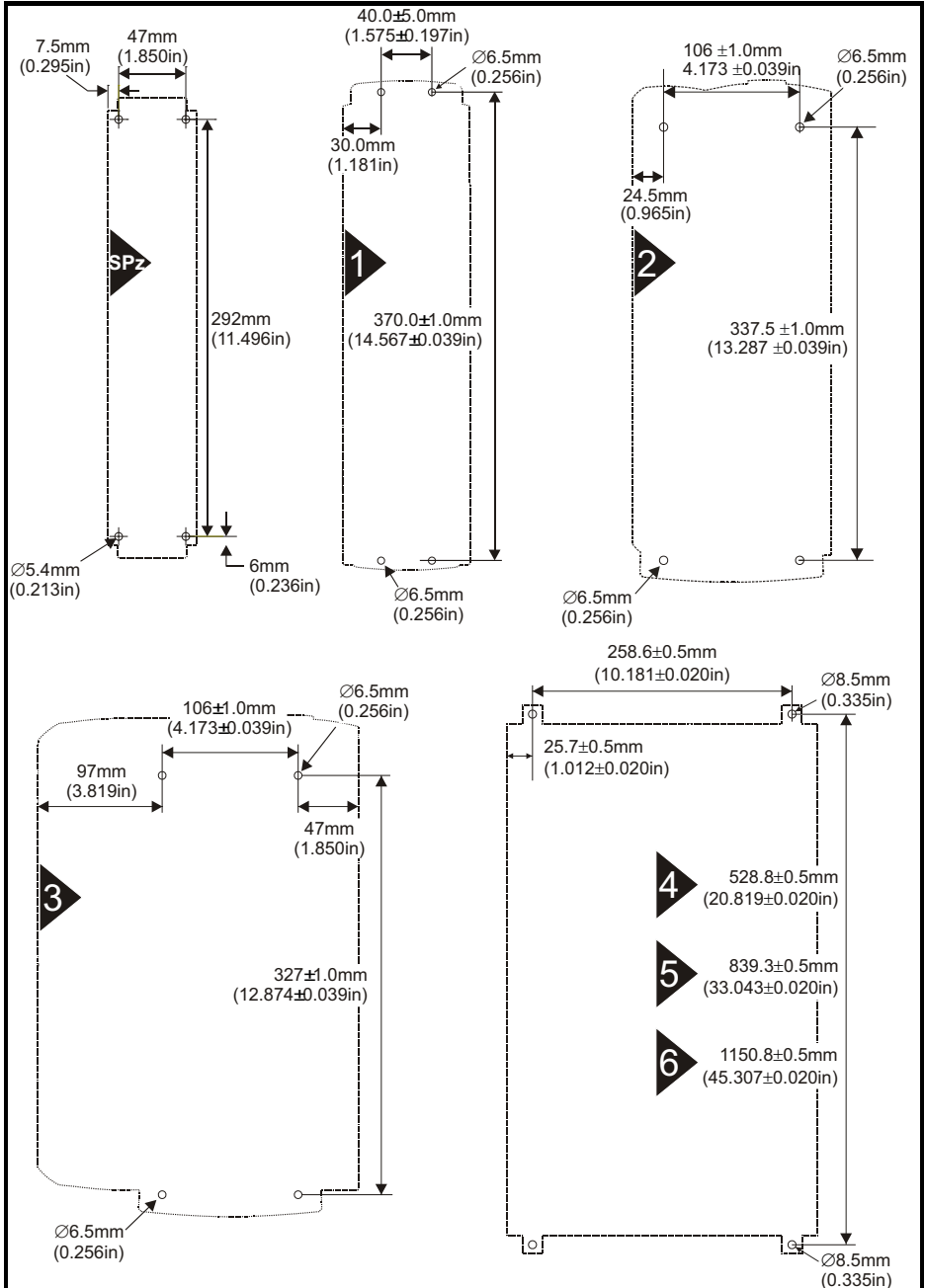
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3.5   Through-panel mounting
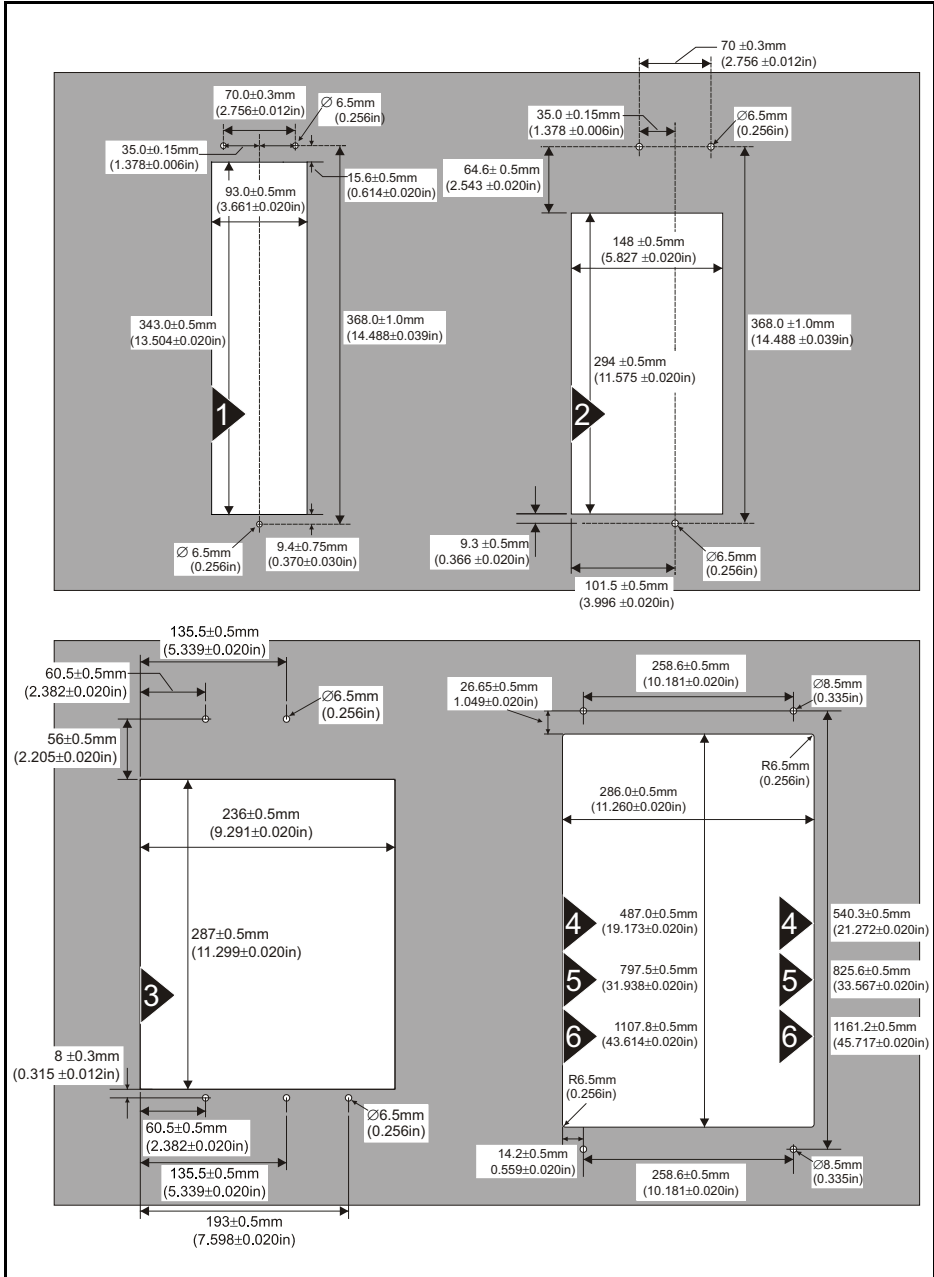
Size 1 to 3 only: When the drive is through-panel mounted, the main terminal cover(s) must be removed in order to provide access to the mounting holes.

3.6 Enclosure

Enclosure Layout

Please observe the clearances in the diagram below taking into account any appropriate notes for other devices / auxiliary equipment when planning the installation.

Figure 3-4 Enclosure layout

Optional braking resistor and overload

Locate optional braking resistor and overload external to cubicle (preferably near to or on top of the cubicle).

Enclosure

AC supply contactor and fuses or MCB

≥100mm

Ensure minimum clearances are maintained for the drive and external EMC filter. Forced or convection air-flow must not be restricted by any object or cabling

Ⓐ SPz & Size 1:≥ 0mm
   Size 2 to 6: ≥30mm

The external EMC filter can be bookcase mounted (next to the drive) or footprint mounted (with the drive mounted onto the filter).

Note
For EMC compliance:
1) When using an external EMC filter, one filter is required for each drive
2) Power cabling must be at least 100mm (4in) from the drive in all directions
3) Ensure direct metal contact at drive and filter mounting points (any paint must be removed)

External controller

≥100mm

Signal cables
Plan for all signal cables to be routed at least 300mm from the drive and any power cable

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3.7 Fitting of IP54 insert
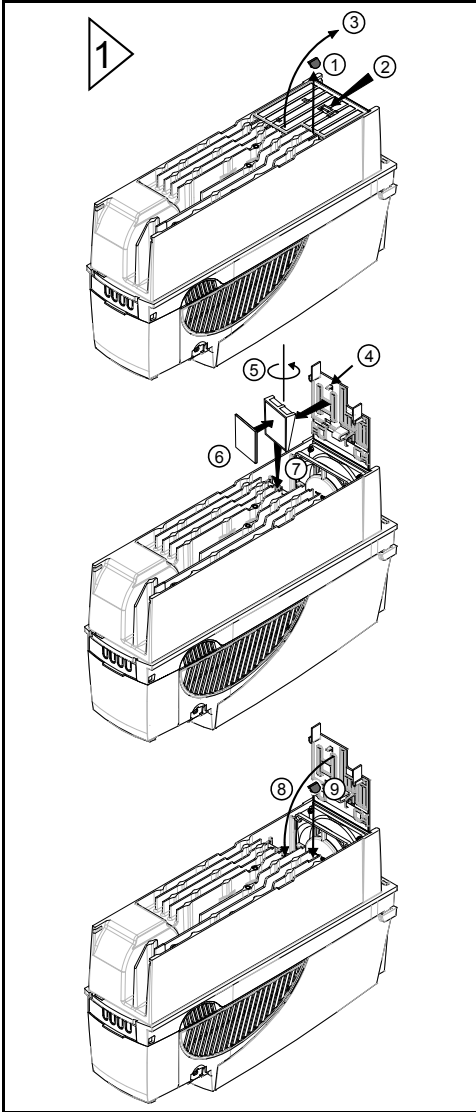
6. The gasket can be found in the accessories box.
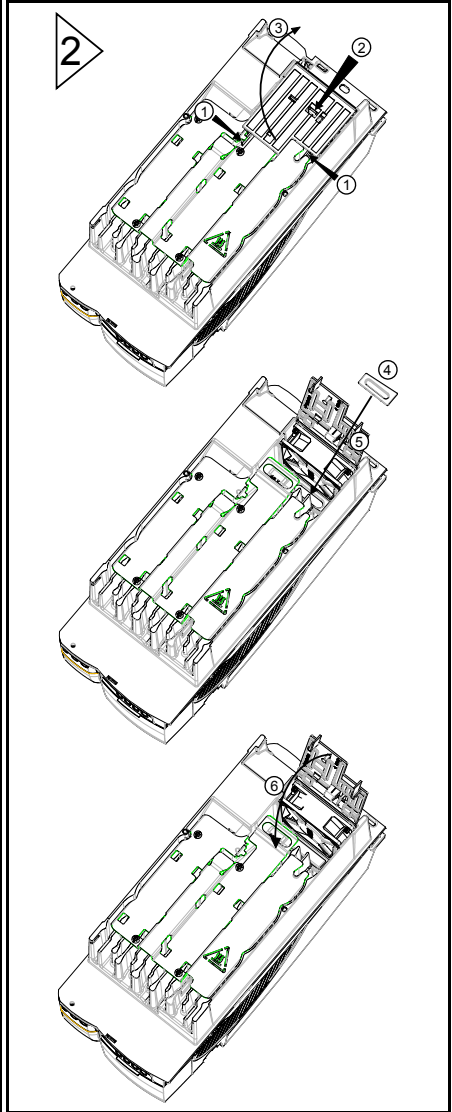
4. The IP54 insert can be found in the accessories box.

3.8 EMC filters

3.8.1 Internal filter

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

If the drive is part of a regen system or is a Unidrive SP size 3 to 6 on an IT supply then the internal EMC filter must be removed.

The internal EMC filter reduces radio-frequency emission into the line power supply. Where the motor cable is short, it permits the requirements of EN61800-3:2004 to be met for the second environment - for further information see the *Unidrive SP User Guide*. For longer motor cables the filter continues to provide a useful reduction in emission level, and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the ground leakage current (on 400V, 50Hz supply) of 28mA for sizes 0 to 3 and 56mA for sizes 4 to 6 is unacceptable or the above conditions are true.

Figure 3-5 Removal of SPz internal EMC filter
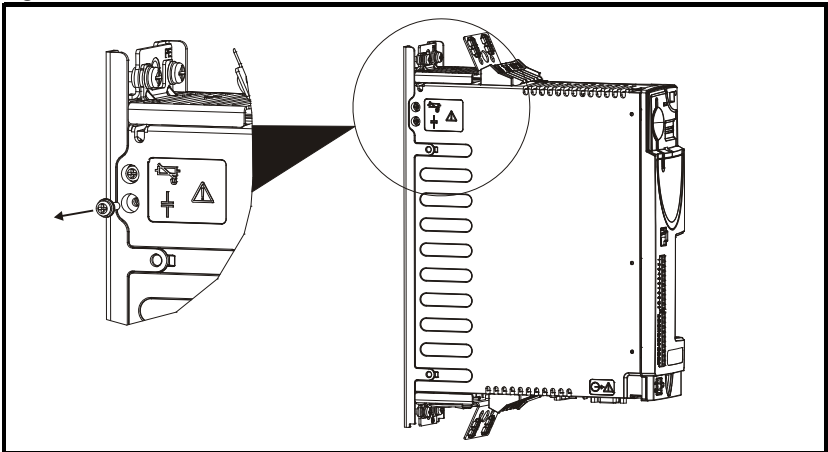
Figure 3-6 Removal of Size 1 to 3 internal EMC filters

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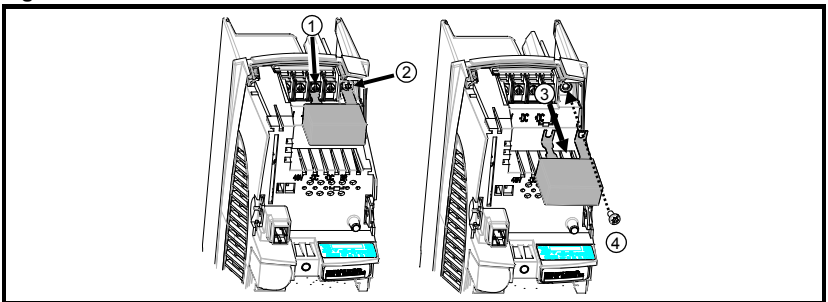
Figure 3-7 Removal of Size 4 to 6 internal EMC filters
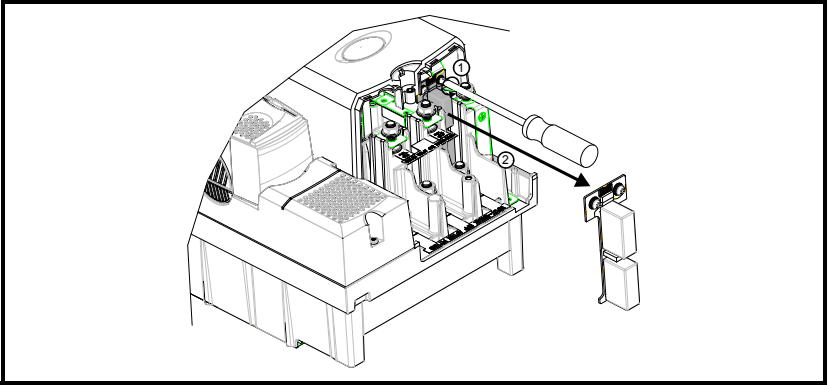
3.8.2 External filter

| Model	Schaffner				Epcos				
	No.	L1, L2, L3		⏚		No.	L1, L2, L3		⏚	
1 ph										
SPz1M/TL SP0201	FS23072-19-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	4mm² 12AWG	0.8 N.m (0.6 lb ft)					
SPz1.2M/TL SP0202										
SPz1.5M/TL SP0203										
SPz2M/TL SP0204										
SPz2.5M/TL SP0205										
3 ph										
SPz1M/TL SP0201	FS23073-17-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	4mm² 12AWG	0.8 N.m (0.6 lb ft)					
SPz1.2M/TL SP0202										
SPz1.5M/TL SP0203										
SPz2M/TL SP0204										
SPz2.5M/TL SP0205										
SPz1T SP0401	FS23074-11-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	4mm² 12AWG	0.8 N.m (0.6 lb ft)					
SPz1.2T SP0402										
SPz1.5T SP0403										
SPz2T SP0404										
SPz2.5T SP0405										
SP1.5TL SP1201	FS6008-10-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A10-R207	4mm² 12AWG	0.6 N.m (0.4 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP2TL SP1202										
SP2.5TL SP1203	FS6008-16-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A16-R207	4mm² 12AWG	0.6 N.m (0.4 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP3.5TL SP1204										
SP1.5T SP1401	FS6008-10-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A10-R207	4mm² 12AWG	0.6 N.m (0.4 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP2T SP1402										
SP2.5T SP1403										
SP3.5T SP1404										
SP4.5T SP1405	FS6008-16-07	4mm² 12AWG	0.8 N.m (0.6 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A16-R207	4mm² 12AWG	0.6 N.m (0.4 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP5.5T SP1406										

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Model	Schaffner					Epcos				
	No.	L1, L2, L3			⏚	No.	L1, L2, L3			⏚
SP4.5TL SP2201 SP5.5TL SP2202 SP8TL SP2203	FS6008-32-07	10mm^2 8AWG	2 N.m (1.5 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A32-R207	10mm^2 8AWG	1.35 N.m (1.0 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP8T SP2401 SP11T SP2402 SP16T SP2403 SP20T SP2404	FS6008-32-07	10mm^2 8AWG	2 N.m (1.5 lb ft)	M5	3.5 N.m (2.6 lb ft)	B84143-A32-R207	10mm^2 8AWG	1.35 N.m (1.0 lb ft)	M5	3.0 N.m (2.2 lb ft)
SP11TL SP3201 SP16TL SP3202	FS6008-75-07	16mm^2 6AWG	2.2 N.m (1.6 lb ft)	M6	3.9 N.m (2.9 lb ft)	B84143-A75-R207	16mm^2 6AWG	2.2 N.m (1.6 lb ft)	M6	5.1 N.m (3.8 lb ft)
SP22T SP3401 SP27T SP3402 SP33T SP3403	FS6008-62-07	16mm^2 6AWG	2.2 N.m (1.6 lb ft)	M6	3.9 N.m (2.9 lb ft)	B84143-A75-R207	16mm^2 6AWG	2.2N.m (1.6 lb ft)	M6	5.1 N.m (3.8 lb ft)
SP3.5TM SP3501 SP4.5TM SP3502 SP5.5TM SP3503 SP8TM SP3504 SP11TM SP3505 SP16TM SP3506 SP22TM SP3507	FS6008-30-07	16mm^2 6AWG	2.2 N.m (1.6 lb ft)	M6	3.9 N.m (2.9 lb ft)	B84143-A30-R207	16mm^2 6AWG	2.2 N.m (1.6 lb ft)	M6	5.1 N.m (3.8 lb ft)

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Model	Schaffner				Epcos				
	No.	L1, L2, L3		⏚	No.	L1, L2, L3			⏚
SP22TL SP4201	FS6008-101-35	50mm² 0AWG	8 N.m (5.9 lb ft)	M10	25 N.m (18.4 lb ft)	B84143-A101-R207	50mm² 0AWG	6.8 N.m (5.0 lb ft)	M10	10 N.m (7.4 lb ft)
SP27TL SP4202										
SP33TL SP4203										
SP40T SP4401										
SP50T SP4402										
SP60T SP4403										
SP22TH SP4601	FS6008-58-53	25mm² 4AWG	2.3 N.m (1.7 lb ft)	M6	3.9 N.m (2.9 lb ft)	B84143-A58-R207	50mm² 0AWG	6.8 N.m (5.0 lb ft)	M10	10 N.m (7.4 lb ft)
SP27TH SP4602										
SP33TH SP4603										
SP40TH SP4604										
SP50TH SP4605										
SP60TH SP4606										
SP40TL SP5201	FS6008-164-40	95mm² 4/0AWG	20 N.m (14.7 lb ft)	M10	25 N.m (18.4 lb ft)	B84143-A165-R207	95mm² 4/0AWG	20 N.m (14.7 lb ft)	M10	10 N.m (7.4 lb ft)
SP50TL SP5202										
SP75T SP5401										
SP100T* SP5402*										
SP75TH SP5601	FS6008-95-35	50mm² 0AWG	8 N.m (5.9 lb ft)	M10	25 N.m (18.4 lb ft)	B84143-A95-R207	95mm² 4/0AWG	20 N.m (14.7 lb ft)	M10	10 N.m (7.4 lb ft)
SP100TH SP5602										
SP120T* SP6401*	FS6008-260-99			M10	25 N.m (18.4 lb ft)	B84143-A260-S207			M10	10 N.m (7.4 lb ft)
SP150T* SP6402*										
SP120TH* SP6601*	FS6008-160-99			M10	25 N.m (18.4 lb ft)	B84143-A0160-S207			M10	10 N.m (7.4 lb ft)
SP150TH* SP6602*										

The external EMC filters for SPz and sizes 1 to 3 can be footprint or bookcase mounted. The external EMC filters for sizes 4 to 6 are designed to be mounted above the drive.
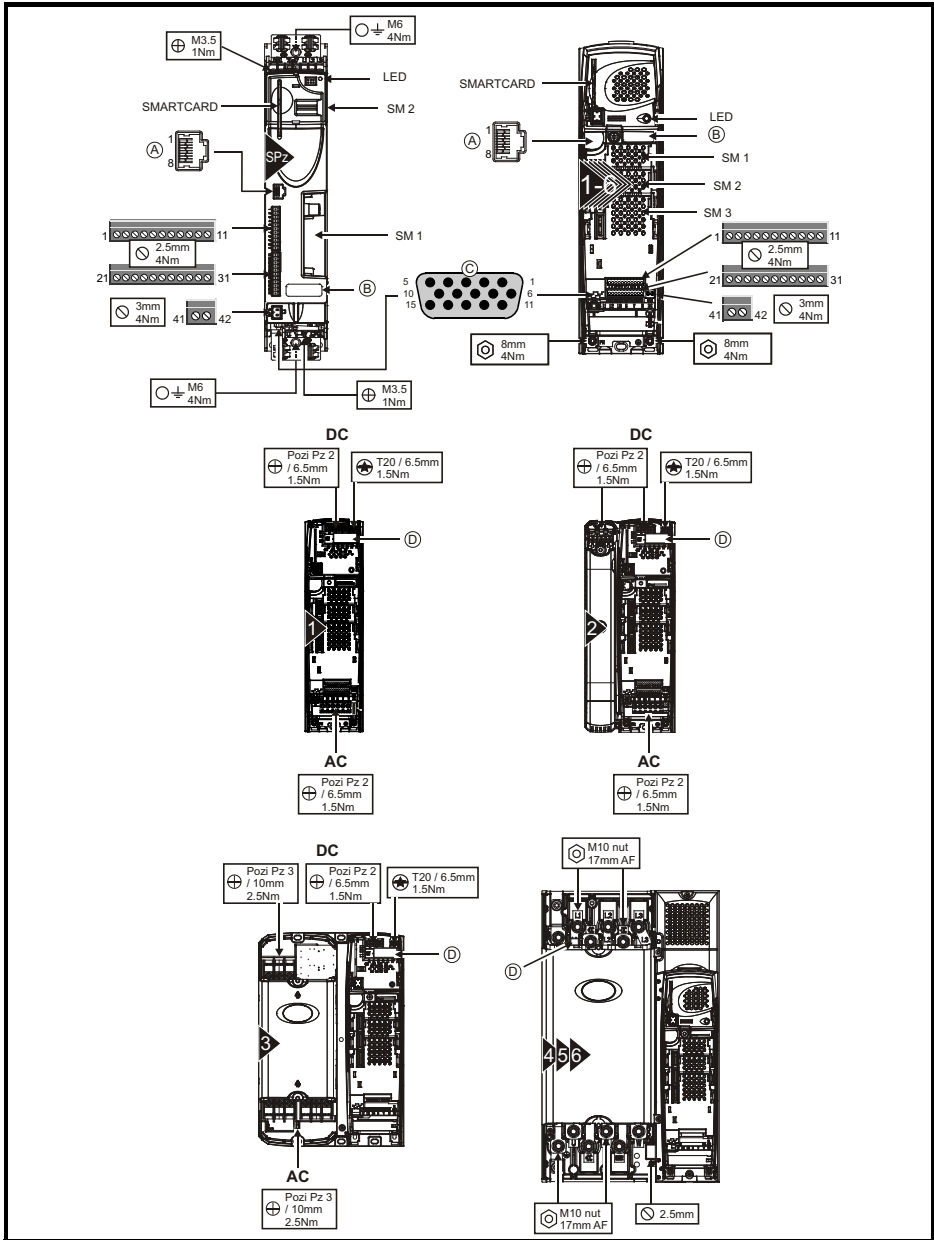
⚠️ **WARNING** To avoid a fire hazard and maintain validity of the UL listing, adhere to the specified tightening torques for the power and ground terminals.

For further information refer to the *Unidrive SP User Guide*.

3.9 Drive features

Figure 3-8 Features of the SPz to size 6 drive

A. Serial comms   B. Rating label

C. Encoder   D. Internal EMC filter

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4 Electrical Installation

> ⚠ **WARNING**
>
> **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.

> ⚠ **WARNING**
>
> **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.

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

> ⚠ **WARNING**
>
> **SAFE TORQUE OFF function**
> The **SAFE TORQUE OFF** function does not remove dangerous voltages from the drive, the motor or any external option units.

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

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

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

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Issue: a   www.leroy-somer.com

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4.1 Supply types

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

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

Supplies with voltage above 600V may not have corner grounding

Drives are suitable for use on supplies of installation category III and lower, according to IEC60664-1. This means they may be connected permanently to the supply at its origin in a building, but for outdoor installation additional over-voltage suppression (transient voltage surge suppression) must be provided to reduce category IV to category III.

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

4.2 Ratings

See section 2.1 *Ratings* on page 8.

Maximum continuous input current

The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with high imbalance. The value stated for the maximum continuous input current would only be seen in one of the input phases. The current in the other two phases would be significantly lower.

The values of maximum input current are stated for a supply with a 2% negative phase-sequence imbalance and rated at the maximum supply fault current given in section 2.1 *Ratings* on page 8.

The recommended cable sizes in section 2.1 *Ratings* on page 8 are only a guide. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

NOTE   The recommended output cable sizes in section 2.1 *Ratings* on page 8 assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against over-load, the drive must be programmed with the correct motor rated current.

NOTE   UL listing is dependent on the use of the correct type of UL-listed fuse, and applies when symmetrical short-circuit current does not exceed 5kA for sizes 1 to 3.

⚠ **WARNING**

Fuses
The AC supply to the drive must be installed with suitable protection against overload and short-circuits. section 2.1 *Ratings* on page 8 shows recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

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

An MCB (miniature circuit breaker) or MCCB (moulded-case circuit-breaker) with type C may be used in place of fuses for size 1 to 3 under the following conditions:

- The fault-clearing capacity must be sufficient for the installation
- For frame sizes 2 and 3, the drive must be mounted in an enclosure which meets the requirements for a fire enclosure

See Chapter 11 *UL Listing Information* on page 125 for UL listing requirements.

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

4.3 Power connections

Figure 4-1 SPz power connections

SP020X (SPz M/TL) = 200 to 240V±10%
SP040X (SPz T) = 380 to 480V±10%

Connectors specification:
Maximum size of power cable
= 4.0mm²(10AWG)
Torque setting = 1 N m
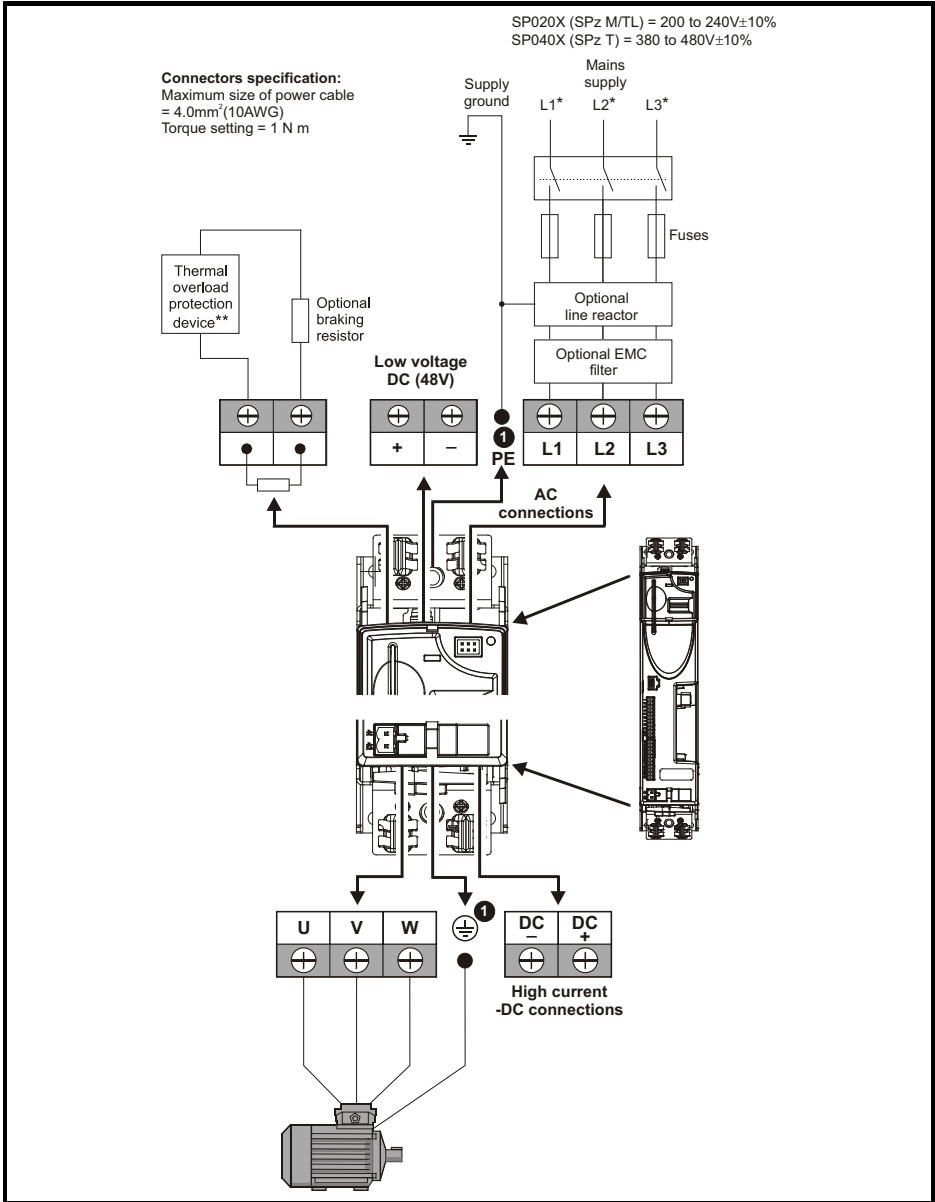
NOTE * When using a 200V drive on a single phase supply, the live and neutral conductors can be connected to any of the AC connections on the drive.

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

1. Maximum torque for ground terminal connections = 4N m (2.95 lb ft).

Figure 4-2 Size 1 to 3 power connections
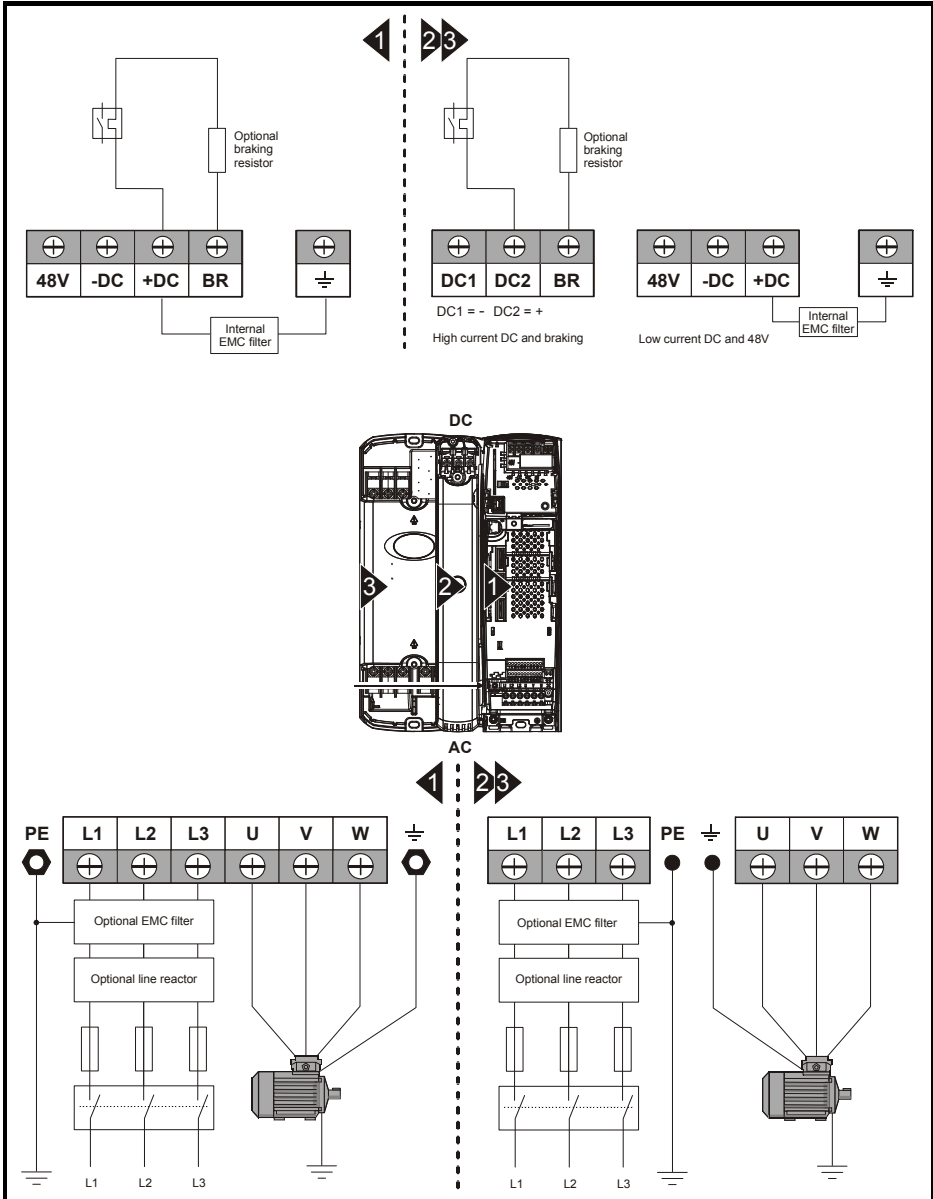
On Unidrive SP size 2 and 3, the high current DC connections must always be used when using a braking resistor, supplying the drive from DC (low voltage DC or high voltage DC) or using the drive in a parallel DC bus system. The low current DC connection is used to connect low voltage DC to the drive internal power supply and to connect the internal EMC filter.

Figure 4-3 Size 4 to 6 power connections
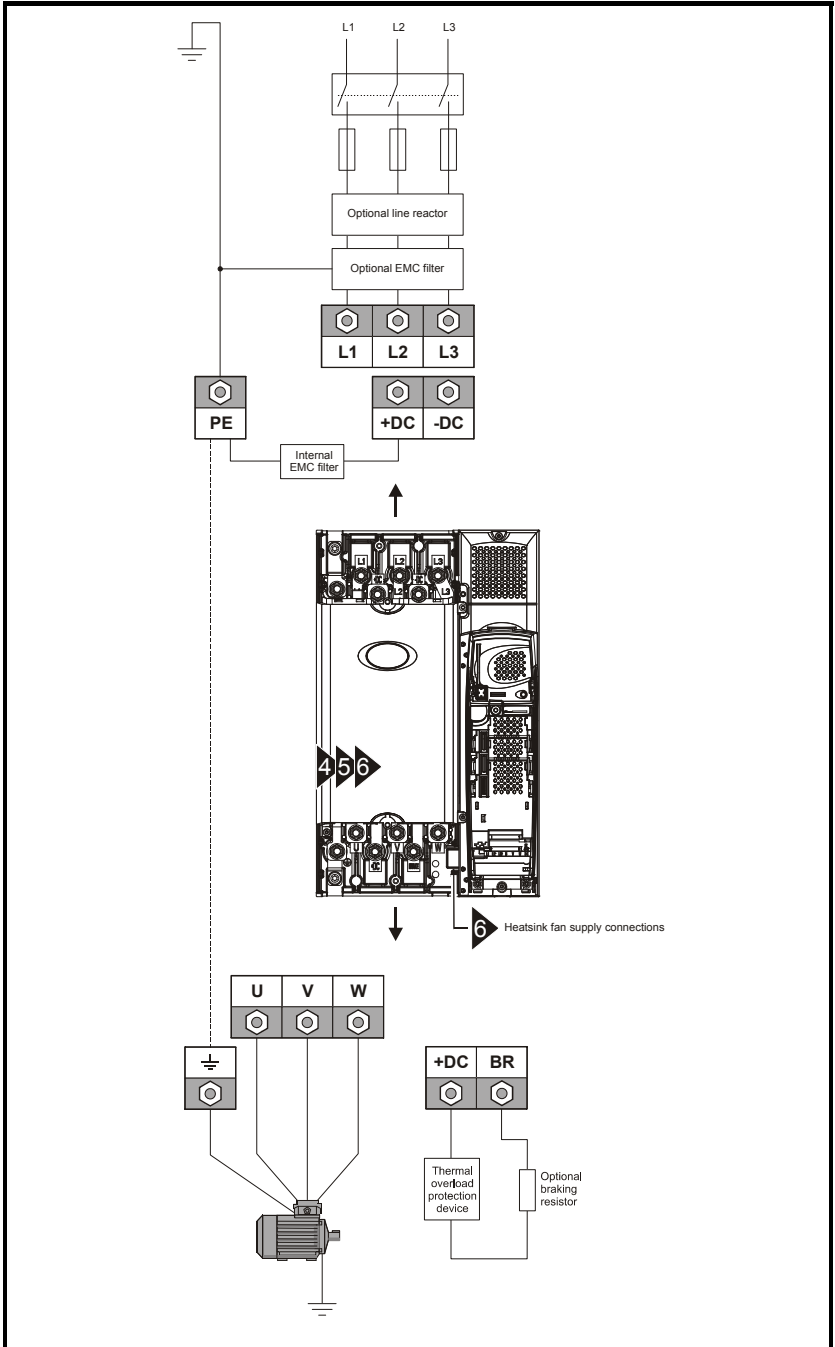
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Optional line reactor

Optional EMC filter

L1 L2 L3

PE

+DC -DC

Internal
EMC filter

4 5 6

6 Heatsink fan supply connections

U V W

+DC BR

Thermal
overload
protection
device

Optional
braking
resistor

Ground connections

<table>
<tr><td>⚠️ WARNING</td><td>Electrochemical corrosion of earthing terminals
Ensure that grounding terminals are protected against corrosion i.e. as could be caused by condensation.</td></tr>
</table>

The drive must be connected to the system ground of the AC supply. The ground wiring must conform to local regulations and codes of practice.

On SPz, the supply and motor ground connections are made using the M6 threaded hole in the metal back plate of the drive located at the top and bottom of the drive.

On size 1, the supply and motor ground connections are made using the M5 studs located either side of the drive near the plug-in power connector.

On size 2, the supply and motor ground connections are made using the grounding bridge that locates at the bottom of the drive.

On size 3, the supply and motor ground connections are made using a M6 nut and bolt that locates in the fork protruding from the heatsink between the AC supply and motor output terminals.

On size 4 to 6, the supply and motor ground connections are made using M10 studs located at the top and bottom of the drive near the input and output power connections.

See Figure 4-4 for details.

<table>
<tr><td>⚠️ WARNING</td><td>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.</td></tr>
</table>

Figure 4-4 Ground connections
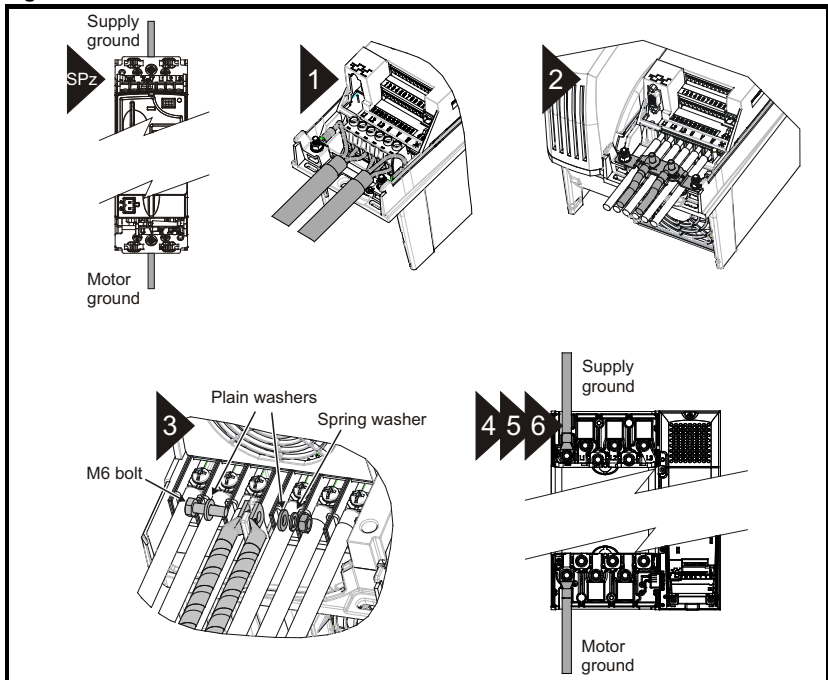
4.4 Braking resistor values (40°C [104°F])

Model	Minimum resistance* Ω	Instantaneous power rating kW
SP0201 to SP0205 SP1M/TL to SP2.5M/TL	35	4.35
SP0401 to SP0405 SP1T to SP 2.5T	105	5.79
SP1201 to SP1203 SP1.5TL to SP2.5TL	43	3.5
SP1204 SP3.5TL	29	5.3
SP1401 to SP1404 SP1.5T to SP3.5T	74	8.3
SP1405 & SP1406 SP4.5T & SP5.5T	58	10.6
SP2201 to SP2203 SP4.5TL to SP8TL	18	8.9
SP2401 to SP2404 SP8T to SP20T	19	33.1
SP3201 & SP3202 SP11TL & SP16TL	5.0	30.3
SP3401 to SP3403 SP22T to SP33T	18	35.5
SP3501 to SP3507 SP3.5TM to SP22TM	18	50.7
SP4201 to SP4203** SP22TL to SP33TL	5.0	30.3
SP4401 & SP4402** SP40T & SP50T	11	55.3
SP4403** SP60T	9	67.6
SP4601 to SP4606** SP22TH to SP60TH	13	95.0
SP5201 & SP5202** SP40TL & SP50TL	3.5	53
SP5401 & SP5402** SP75T & SP100T	7	86.9
SP5601 & SP5602** SP75TH & SP100TH	10	125
SP6401 & SP6402** SP120T & SP150T	5	122
SP6601 & SP6602** SP120TH & SP150TH	10	125

* Resistor tolerance: ±10%.
** The power ratings specified are for a stand-alone drive only. If the drive is part of a common DC bus system different ratings must be used. Contact the supplier of the drive for more information.

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4.5 Encoder connections

Figure 4-5 Encoder
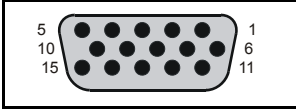
4.5.1 Location of encoder connector (SPz)

Before using the encoder connector on SPz for the first time, the break-out need removing as shown in Figure 4-6.

Figure 4-6 Access to encoder connections
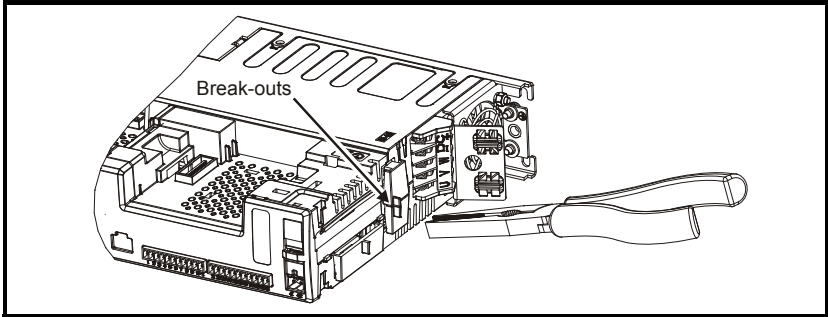
Break-outs

> ⚠ **WARNING**
>
> After removing the break-out, ensure that the ground tab is connected to ground. This will connect 0V of the drive to ground. This is required to enable the drive to meet IP20 when the break-out is removed.

NOTE Do not remove the break-out if the encoder connection is not required.

Figure 4-7 Location of encoder connector (SPz)

Encoder input

Drive encoder connector
Female 15-way D-type
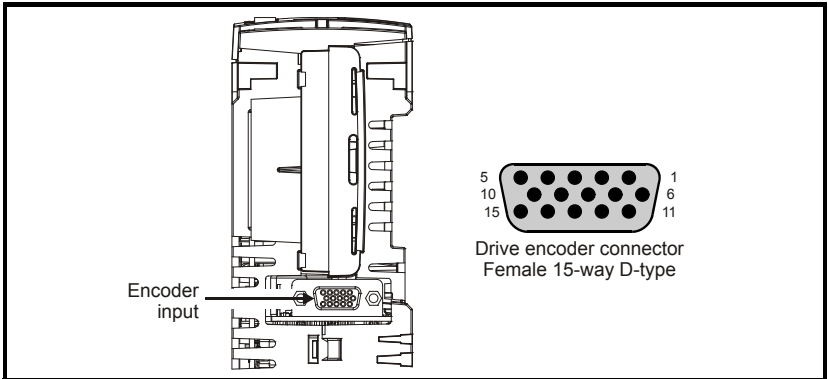
Figure 4-8 Connecting the encoder ground tab to the EMC bracket
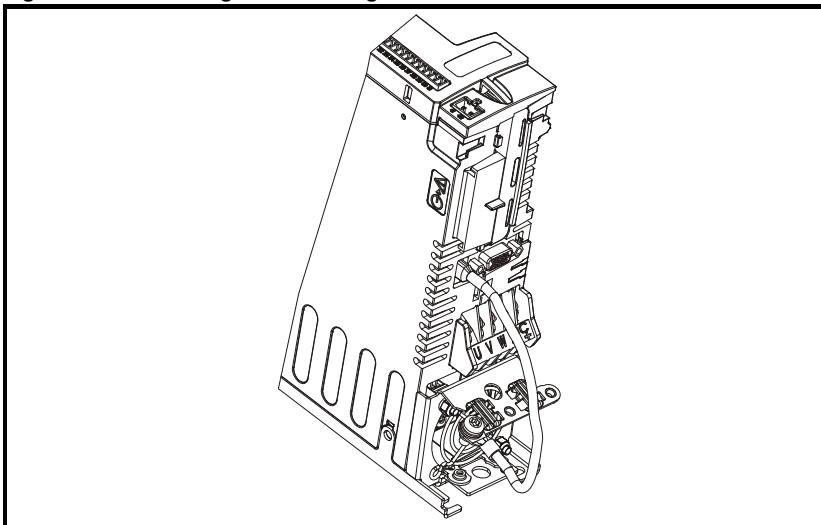
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| NOTE | The size of the connecting cable between the encoder ground tab and the EMC bracket should be equal to the input cable. |

4.5.2   Location of encoder connector (size 1 to 6)

Figure 4-9 Location of encoder connector

5   1
10   6
15   11

Drive encoder connector
Female 15-way D-type
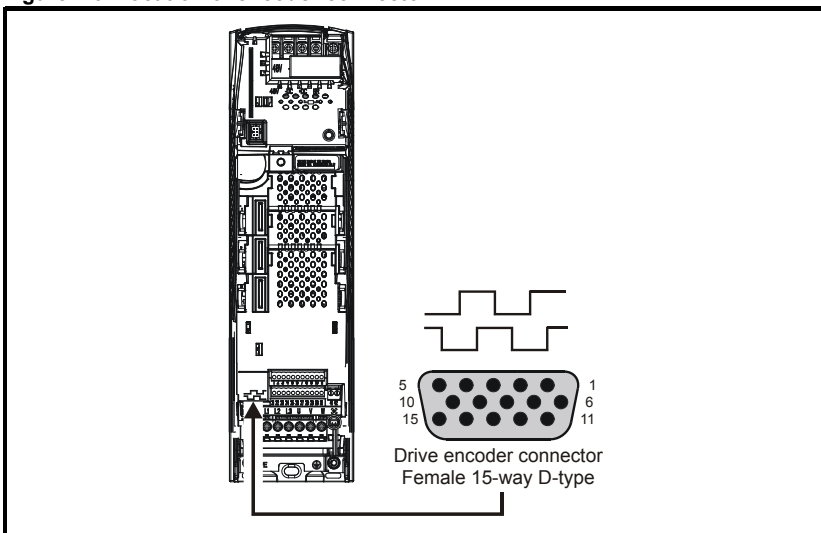
4.5.3 Encoder types

Table 4-1 Encoder types

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

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

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

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Term	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		Cos
2	A\	F\	F\	A\	F\	F\	Cosref	Cosref		Cosref		Cosref
3	B	D	R	B	D	R	Sin	Sin		Sin		Sin
4	B\	D\	R\	B\	D\	R\	Sinref	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 analog input 3. If this is to be used as a thermistor   input, set Pr **7.15** to 'th.sc' (7), 'th' (8) or 'th.diSP' (9).

4.6   Serial communications connections

The Unidrive SP has a serial communications port (serial port) as standard supporting 2 wire EIA485 communications.
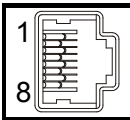
Table 4-2 Connection details for RJ45 connector

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

The communications port applies a 2 unit load to the communications network.
Minimum number of connections are 2, 3, 7 and shield. Shielded cable must be used at all times.

4.7 Shield connections

The following guidelines should be followed to ensure suppression of radio-frequency emission and good noise immunity. It is particularly recommended that the guidelines for the encoder cable be followed closely in order to avoid disturbance to the encoder operation from electrical noise.

Use the grounding bracket and grounding clamp supplied with the drive to terminate the shields at the drive.

Figure 4-10 Grounding of signal cable shields using the grounding bracket
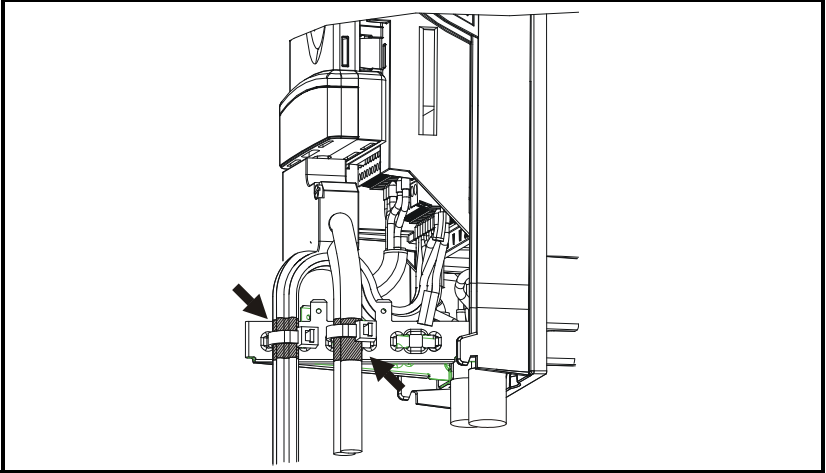
Figure 4-11 Grounding link bracket positions

Grounding link bracket

Mounting bracket
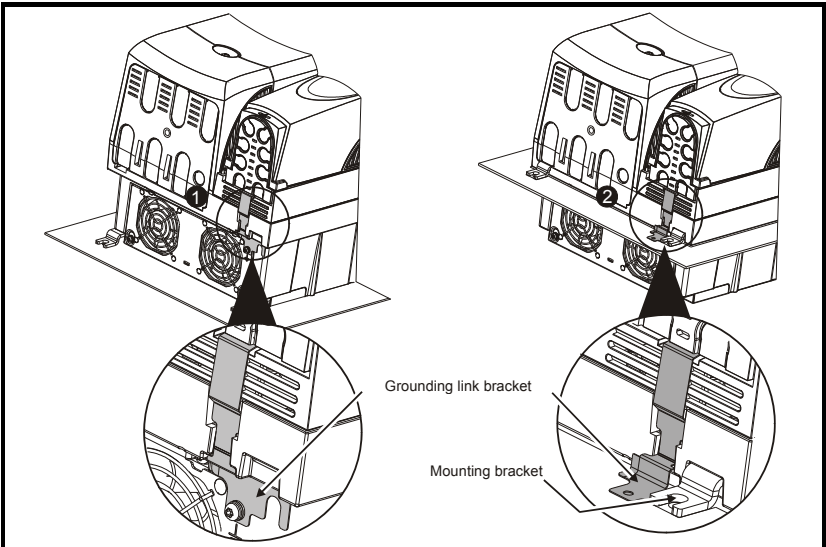
When a Unidrive SP size 4 or 5 is through-panel mounted, the grounding link bracket must be folded upwards.

1. Grounding link bracket in its surface mount position (as supplied)
2. Grounding link bracket folded up into its through-panel mount position

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Motor cable: use a motor cable with an overall shield. Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50mm (2in) long. A full 360° termination of the shield to the terminal housing of the motor is beneficial.

Encoder cable: for best shielding use cable with an overall shield and individual shields on twisted pairs, connect the cable as illustrated in Figure 4-12. Clamp the overall shield to grounded metallic surfaces at both the encoder and the drive.

Brake resistor cable: the optional braking resistor should also be wired with shielded cable. If unshielded wire is required refer to *Unidrive SP User Guide* for guidance.

Control cables: 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. 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.

Figure 4-12 Feedback cable shield connections
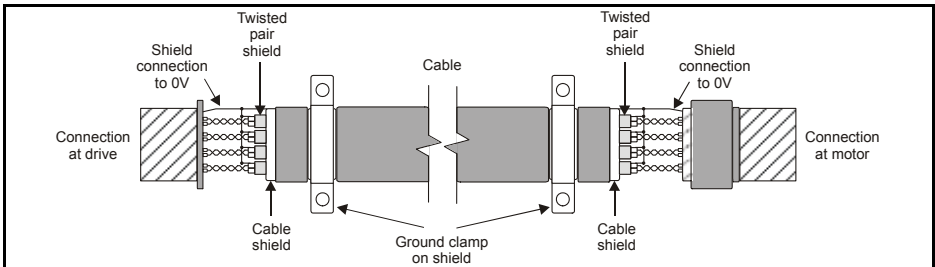
4.8 Control connections

Figure 4-13 Default terminal functions

Polarised signal connectors

Terminal	Function
1	0V
2	+24V input

Analog frequency/speed reference 1

Single-ended signal
- 3 — 0V
- 5 — Non-inverting input
- 6 — Inverting input

Differential signal
- 3 — 0V
- 5 — Non-inverting input
- 6 — Inverting input

Analog frequency/speed reference 2
- 4 — +10V output
- 7 — Analog input 2

Analog input 3 (Motor thermistor)
- 8 — Analog input 3

Speed / frequency
- 9 — Analog output 1
- 10 — Analog output 2

Torque (active current)
- 11 — 0V

- 21 — 0V
- 22 — +24V output (user selectable)
- 23 — 0V

At zero speed — 24 — Digital I/O 1
Reset — 25 — Digital I/O 2
Run forward — 26 — Digital I/O 3
Run reverse — 27 — Digital input 4
Analog input 1/ input 2 select — 28 — Digital input 5 (Analog input 1, Analog input 2)
Jog forward select — 29 — Digital input 6
- 30 — 0V
- 31 — Drive enable (SAFE TORQUE OFF function)*

Drive ok
- 41 — Relay (Overvoltage category II)
- 42 —

*The SAFE TORQUE OFF / Drive enable terminal is a positive logic input only.

NOTE Avoid connecting digital and analog grounds (T21 and T11).

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This chapter introduces the user interfaces, menu structure and security level of the drive.

5.1 Understanding the display

There are two types of keypad available for the Unidrive SP. The SM-Keypad/SPz Keypad has an LED display and the SM-Keypad Plus has an LCD display.

SPz: Only the SPz Keypad can be installed to the drive.

Size 1 to 6: Both the SM-Keypad and SM-Keypad Plus can be installed to the drive.

For all sizes the SM-Keypad Plus can also be remotely mounted on an enclosure door.

5.1.1 SM-Keypad/SPz 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.
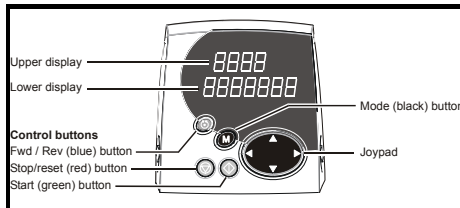
5.1.2 SM-Keypad Plus (LCD)

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 5-1 SM-Keypad

Figure 5-2 SM-Keypad Plus
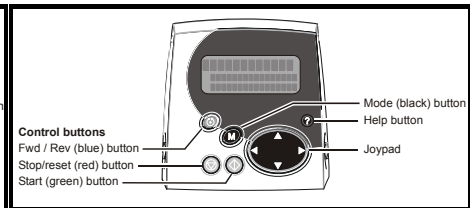
Beware of possible live terminals when attaching the SPz Keypad to the drive.

WARNING

Figure 5-3 SPz Keypad
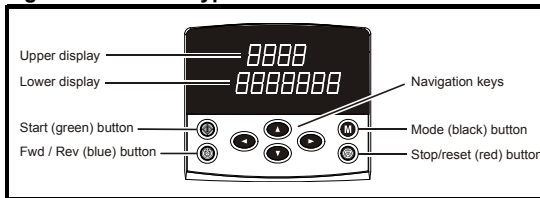
NOTE

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

All keypads 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.

	SM-Keypad / SPz 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

5.2 Keypad operation

5.2.1 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 in this section show the SM-Keypad 7 segment LED display. The examples are 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.

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Figure 5-4   Display modes

Status Mode
(Display not flashing)

`rdY`
`0`

To enter Parameter Mode, press **M** key or ◆

Timeout**

To return to Status Mode, press **M** key

Timeout**   Timeout**

Parameter Mode
(Upper display flashing)

`_0.10_`
`|  0`

When returning to Parameter Mode use the ◆ * keys to select another parameter to change, if required

`_000_`
`|  0`

Temporary Parameter Mode
(Upper display flashing)

Use ◆ * keys to select parameter for editing

`_000_`
`|  0`

To enter Edit Mode, press **M** key

To exit Edit Mode, press **M** key

RO parameter   R/W parameter

`0001`
`_0_`

Edit Mode
(Character to be edited in lower line of display flashing)
Change parameter values using ◆ keys.

◆ * Can only be used to move between menus if L2 access has been enabled (Pr **0.49**). Refer to section 5.11 *Parameter access level and security* on page 52.
Timeout defined by Pr **11.41 (default value = 240s).

Figure 5-5   Mode examples

Parameter View Mode

`505`
`537`

Menu 5. Parameter 5
Pr **5.05** value

Status Mode

Healthy Status

`rdY`
`50`

Alarm Status

`rUn`
`_0ULd_`

Trip Status

`tri P`
`_UU_`

Drive status = tripped
Trip type (UV = undervolts)
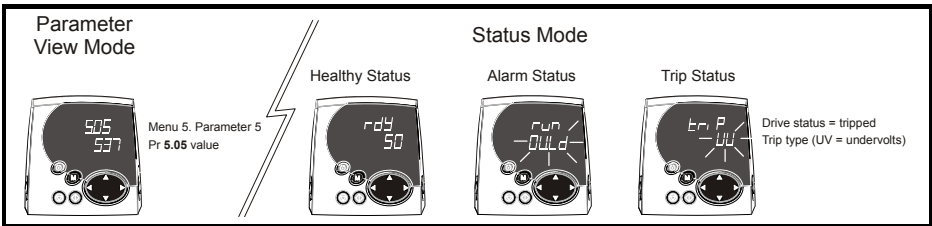
> ⚠ **WARNING**
> Do not change parameter values without careful consideration; incorrect values may cause damage or a safety hazard.

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 5.7 *Saving parameters* on page 51.

5.3 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive.

Appropriate parameters are copied from the advanced menus into menu 0 and thus exist in both locations.

For further information, refer to Chapter 6 *Basic parameters (Menu 0)* on page 55.

Figure 5-6   Menu 0 copying
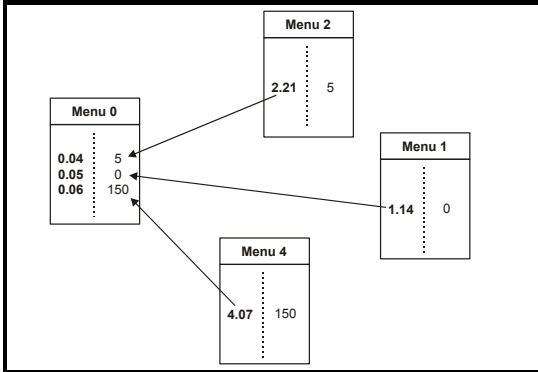
5.4 Menu structure

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 5.11 *Parameter access level and security* on page 52.

Figure 5-7   Menu structure
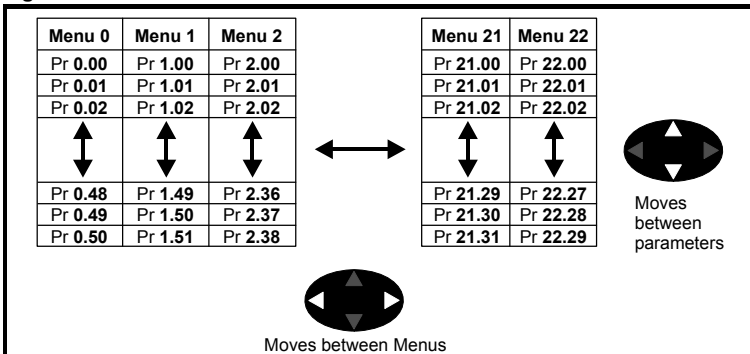
The menus and parameters roll over in both directions.

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.

5.5 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 is installed.

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	Analog I/O	✓	✓
8	Digital I/O	✓	✓
9	Programmable logic, motorized 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	✓

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SM-Keypad Plus set-up menus

Table 5-1 Menu 40 parameter descriptions

Parameter		Range($\updownarrow$)
40.00	Parameter 0	0 to 32767
40.01	Language selection	English (0), Custom (1), French (2), German (3), Spanish (4), Italian (5)
40.02	Software version	999999
40.03	Save to flash	Idle (0), Save (1), Restore (2), Default (3)
40.04	LCD contrast	0 to 31
40.05	Drive and attribute database upload was bypassed	Updated (0), Bypass (1)
40.06	Browsing favourites control	Normal (0), Filter (1)
40.07	Keypad security code	0 to 999
40.08	Communication channel selection	Disable (0), Slot1 (1), Slot2 (2), Slot3 (3), Slave (4), Direct (5)
40.09	Hardware key code	0 to 999
40.10	Drive node ID (Address)	0 to 255
40.11	Flash ROM memory size	4Mbit (0), 8Mbit (1)
40.19	String database version number	0 to 999999
40.20	Screen saver strings and enable	None (0), Default (1), User (2)
40.21	Screen saver interval	0 to 600
40.22	Turbo browse time interval	0 to 200ms

Table 5-2 Menu 41 parameter descriptions

Parameter		Range($\updownarrow$)
41.00	Parameter 0	0 to 32767
41.01 to 41.50	Browsing filter source F01 to F50	Pr **0.00** to Pr **391.51**
41.51	Browsing favourites control	Normal (0), Filter (1)

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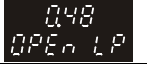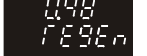
Changing the operating mode returns all parameters to their default value, including the motor parameters. (Pr **0.49** *Security status* and Pr **0.34** *User security code* are not affected by this procedure.)

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:

Pr 0.48 setting		Operating mode
`0.48` `OPEn LP`	1	Open-loop
`0.48` `CL UECt`	2	Closed-loop Vector
`0.48` `SErUO`	3	Closed-loop Servo
`0.48` `rE9En`	4	Regen

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).

5.7 Saving parameters

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

If parameters have been changed in the advanced menus, 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 48V back-up supply, a value of 1001 must be entered into Pr **xx.00** to perform a save function.

5.8 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).

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5.9 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 5.11 *Parameter access level and security* for further information regarding access level.

5.10 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 5.11 *Parameter access level and security* for further information regarding access level.

5.11 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 22) 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.

5.11.1 Access Level

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

L1 access selected - Menu 0 only visible

| Pr 0.00 |
| Pr 0.01 |
| Pr 0.02 |
| Pr 0.03 |
| |
| |
| Pr 0.49 |
| Pr 0.50 |

L2 access selected - All parameters visible

Pr 0.00	Pr 1.00	....	Pr 21.00	Pr 22.00
Pr 0.01	Pr 1.01	....	Pr 21.01	Pr 22.01
Pr 0.02	Pr 1.02	....	Pr 21.02	Pr 22.02
Pr 0.03	Pr 1.03	....	Pr 21.03	Pr 22.03
		....		
		....		
Pr 0.49	Pr 1.49	....	Pr 21.30	Pr 22.28
Pr 0.50	Pr 1.50	....	Pr 21.31	Pr 22.29
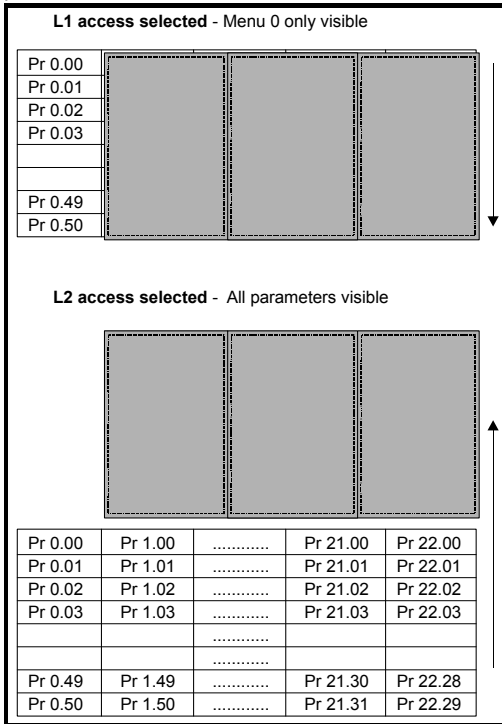
5.11.2 Changing the Access Level

The Access Level is determined by the setting of Pr **0.49** as follows:
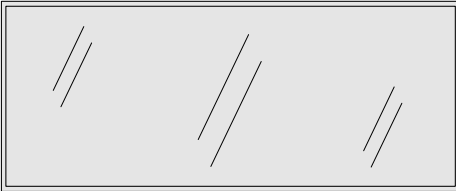
String	Value	Effect
L1	0	Access to menu 0 only
L2	1	Access to all menus (menu 0 to menu 22)

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

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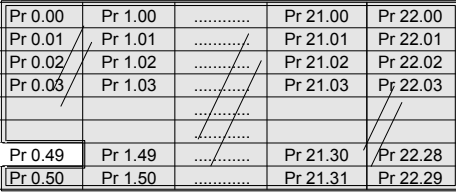
5.11.3 User Security

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.

User security open - All parameters: Read / Write access

Pr 0.00	Pr 1.00	....	Pr 21.00	Pr 22.00
Pr 0.01	Pr 1.01	....	Pr 21.01	Pr 22.01
Pr 0.02	Pr 1.02	....	Pr 21.02	Pr 22.02
Pr 0.03	Pr 1.03	....	Pr 21.03	Pr 22.03
		....		
		....		
Pr 0.49	Pr 1.49	....	Pr 21.30	Pr 22.28
Pr 0.50	Pr 1.50	....	Pr 21.31	Pr 22.29

User security closed - All parameters: Read Only access (except Pr **0.49** and Pr **11.44**)

Pr 0.00	Pr 1.00	....	Pr 21.00	Pr 22.00
Pr 0.01	Pr 1.01	....	Pr 21.01	Pr 22.01
Pr 0.02	Pr 1.02	....	Pr 21.02	Pr 22.02
Pr 0.03	Pr 1.03	....	Pr 21.03	Pr 22.03
		....		
		....		
Pr 0.49	Pr 1.49	....	Pr 21.30	Pr 22.28
Pr 0.50	Pr 1.50	....	Pr 21.31	Pr 22.29

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 Basic parameters (Menu 0)

Parameter		Range(⇳) OL	VT	SV	Default(⇨) OL	VT	SV	Type
0.00	xx.00 {x.00}	0 to 32,767			0			RW
0.01	Minimum reference clamp {1.07}	±3,000.0Hz	±SPEED_LIMIT_MAX Hz/rpm		0.0			RW
0.02	Maximum reference clamp {1.06}	0 to 3,000.0 Hz	SPEED_LIMIT_MAX Hz/rpm		EUR> 50.0 USA> 60.0	EUR> 1,500.0 USA> 1800.0	3,000.0	RW
0.03	Acceleration rate {2.11}	0.0 to 3,200.0 s/100Hz	0.000 to 3,200.000 s/1,000rpm		5.0	2.000	0.200	RW
0.04	Deceleration rate {2.21}	0.0 to 3,200.0 s/100Hz	0.000 to 3,200.000 s/1,000rpm		10.0	2.000	0.200	RW
0.05	Reference select {1.14}	A1.A2 (0), A1.Pr (1), A2.Pr (2), Pr (3), Pad (4), Prc (5)			A1.A2 (0)			RW
0.06	Current limit {4.07}	0 to Current_limit_max %			165.0	175.0		RW
0.07	OL> Voltage mode select {5.14}	Ur_S (0), Ur (1), Fd (2), Ur_Auto (3), Ur_I (4), SrE (5)			Ur_I (4)			RW
	CL> Speed controller P gain {3.10}		0.0000 to 6.5535 1/rad s⁻¹			0.0300	0.0100	RW
0.08	OL> Voltage boost {5.15}	0.0 to 25.0% of motor rated voltage			SPz to size 6: 3.0 Size 4 & 5: 2.0 Size 6: 1.0			RW
	CL> Speed controller I gain {3.11}		0.00 to 655.35 1/rad			0.10	1.00	RW
0.09	OL> Dynamic V/F {5.13}	OFF (0) or On (1)			0			RW
	CL> Speed controller D gain {3.12}		0.00000 to 0.65535 (s)			0.00000		RW
0.10	OL> Estimated motor speed {5.04}	±180,000 rpm						RO
	CL> Motor speed {3.02}		±Speed_max rpm					RO
0.11	OL & VT> Drive output frequency {5.01}	±Speed_freq_max Hz						RO
	SV> Drive encoder position {3.29}			0 to 65,535 1/2¹⁶ths of a revolution				RO
0.12	Total motor current {4.01}	0 to Drive_current_max A						RO
0.13	OL & VT> Motor active current {4.02}	±Drive_current_max A						RO
	SV> Analog input 1 offset trim {7.07}			±10.000 %			0.000	RW
0.14	Torque mode selector {4.11}	0 to 1	0 to 4		Speed control mode (0)			RW
0.15	Ramp mode select {2.04}	FASt (0) Std (1) Std.hV (2)	FASt (0) Std (1)		Std (1)			RW
0.16	OL> T28 and T29 auto-selection disable {8.39}	OFF (0) or On (1)			0			RW
	CL> Ramp enable {2.02}	OFF (0) or On (1)			On (1)			RW
0.17	OL> T29 digital input destination {8.26}	Pr 0.00 to Pr 21.51			Pr 6.31			RW
	CL> Current demand filter time constant {4.12}		0.0 to 25.0 ms			0.0		RW
0.18	Positive logic select {8.29}	OFF (0) or On (1)			On (1)			RW
0.19	Analog input 2 mode {7.11}	0-20 (0), 20-0 (1), 4-20tr (2), 20-4tr (3), 4-20 (4), 20-4 (5), VOLt (6)			th (8)			RW
0.20	Analog input 2 destination {7.14}	Pr 0.00 to Pr 21.51			Pr 1.37			RW
0.21	Analog input 3 mode {7.15}	0-20 (0), 20-0 (1), 4-20tr (2), 20-4tr (3), 4-20 (4), 20-4 (5), VOLt (6), th.SC (7), th (8), th.diSp (9)			VOLt (6)			RW
0.22	Bipolar reference select {1.10}	OFF (0) or On (1)			OFF (0)			RW

Parameter		Range(⇕) OL	VT	SV	Default(⇨) OL	VT	SV	Type
0.23 Jog reference	{**1.05**}	0 to 400.0 Hz	0 to 4000.0 rpm		0.0			RW
0.24 Pre-set reference 1	{**1.21**}	±Speed_limit_max rpm			0.0			RW
0.25 Pre-set reference 2	{**1.22**}	±Speed_limit_max rpm			0.0			RW
0.26 OL> Pre-set reference 3	{**1.23**}	±Speed_ freq_max Hz/rpm			0.0			RW
CL> Overspeed threshold	{**3.08**}		0 to 40,000 rpm			0		RW
0.27 OL> Pre-set reference 4	{**1.24**}	±Speed_ freq_max Hz/rpm			0.0			RW
CL> Drive encoder lines per revolution	{**3.34**}		0 to 50,000			1024	4096	RW
0.28 Keypad fwd/rev key enable	{**6.13**}	OFF (0) or On (1)			OFF (0)			RW
0.29 SMARTCARD parameter data	{**11.36**}	0 to 999			0			RO
0.30 Parameter copying	{**11.42**}	nonE (0), rEAd (1), Prog (2), AutO (3), boot (4)			nonE (0)			RW
0.31 Drive rated voltage	{**11.33**}	200 (0), 400 (1), 575 (2), 690 (3) V						RO
0.32 Maximum Heavy Duty current rating	{**11.32**}	0.00 to 9999.99A						RO
0.33 OL> Catch a spinning motor	{**6.09**}	0 to 3			0			RW
VT> Rated rpm autotune	{**5.16**}		0 to 2			0		RW
0.34 User security code	{**11.30**}	0 to 999			0			RW
0.35 Serial comms mode	{**11.24**}	AnSI (0), rtu (1), Lcd (2)			rtU (1)			RW
0.36 Serial comms baud rate	{**11.25**}	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8) Modbus RTU only, 115200 (9) Modbus RTU only			19200 (6)			RW
0.37 Serial comms address	{**11.23**}	0 to 247			1			RW
0.38 Current loop P gain	{**4.13**}	0 to 30,000			All voltage ratings: 20	200V drive: 75 400V drive: 150 575V drive: 180 690V drive: 215		RW
0.39 Current loop I gain	{**4.14**}	0 to 30,000			All voltage ratings 40	200V drive: 1000 400V drive: 2000 575V drive: 2400 690V drive: 3000		RW
0.40 Autotune	{**5.12**}	0 to 2	0 to 4	0 to 6	0			RW
0.41 Maximum switching frequency	{**5.18**}	3 (0), 4 (1), 6 (2), 8 (3), 12 (4), 16 (5) kHz			3 (0)		6 (2)	RW
0.42 No. of motor poles	{**5.11**}	0 to 60 (Auto to 120 pole)			0 (Auto)		6 POLE (3)	RW
0.43 OL & VT> Motor rated power factor	{**5.10**}	0.000 to 1.000			0.850			RW
SV> Encoder phase angle	{**3.25**}			0.0 to 359.9°			0.0	RW
0.44 Motor rated voltage	{**5.09**}	0 to AC_voltage_set_max V			200V drive: 230 400V drive: EUR> 400, USA> 460 575V drive: 575 690V drive: 690			RW
0.45 OL & VT> Motor rated full load speed (rpm)	{**5.08**}	0 to 180,000 rpm	0.00 to 40,000.00 rpm		EUR> 1,500 USA> 1,800	EUR> 1,450.00 USA> 1,770.00		RW
SV> Motor thermal time constant	{**4.15**}			0.0 to 400.0			20.0	RW
0.46 Motor rated current	{**5.07**}	0 to Rated_current_max A			Drive rated current [**11.32**]			RW
0.47 Rated frequency	{**5.06**}	0 to 3,000.0 Hz	0 to 1,250.0 Hz		EUR> 50.0 USA> 60.0			RW
0.48 Operating mode selector	{**11.31**}	OPEn LP (1), CL VECt (2), SErVO (3), rEgEn (4)			OPEn LP (1)	CL VECt (2)	SErVO (3)	RW
0.49 Security status	{**11.44**}	L1 (0), L2 (1), Loc (2)						RW
0.50 Software version	{**11.29**}	1.00 to 99.99						RO
0.51 Action on trip detection	{**10.37**}	0 to 15			0			RW

Key:

OL	Open loop	{X.XX}	Copied advanced parameter
CL	Closed loop vector and Servo	RW	Read/write: can be written by the user
VT	Closed loop vector	RO	Read only: can only be read by the user
SV	Servo		

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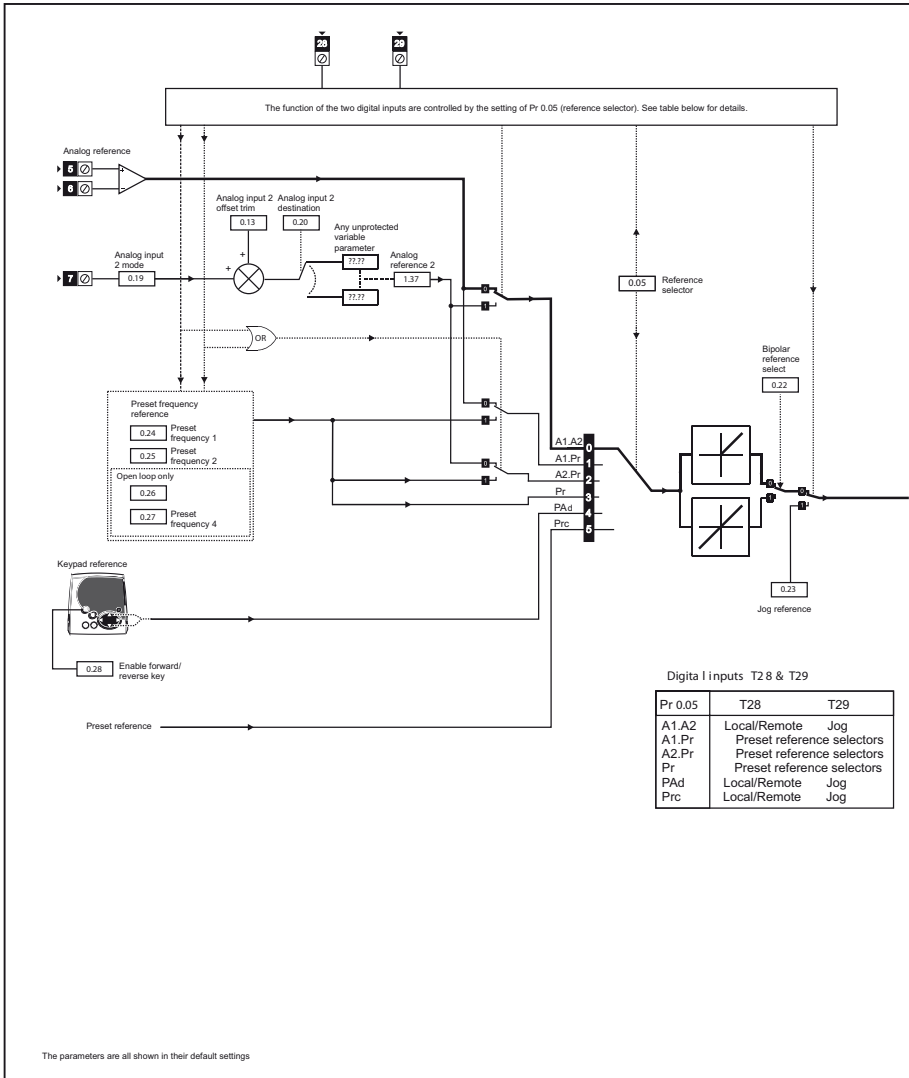Advanced
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Figure 6-1   Menu 0 logic diagram

The function of the two digital inputs are controlled by the setting of Pr 0.05 (reference selector). See table below for details.

Analog reference

Analog input 2 offset trim — 0.13
Analog input 2 destination — 0.20
Analog input 2 mode — 0.19

Any unprotected variable parameter — ??.??

Analog reference 2 — 1.37

Reference selector — 0.05

Bipolar reference select — 0.22

Preset frequency reference
0.24 — Preset frequency 1
0.25 — Preset frequency 2

Open loop only
0.26 — Preset frequency 3
0.27 — Preset frequency 4

A1.A2   0
A1.Pr   1
A2.Pr   2
Pr   3
PAd   4
Prc   5

Keypad reference

0.28 — Enable forward/reverse key

Preset reference

0.23 — Jog reference

Digital inputs T28 & T29

Pr 0.05	T28	T29
A1.A2	Local/Remote	Jog
A1.Pr	Preset reference selectors	
A2.Pr	Preset reference selectors	
Pr	Preset reference selectors	
PAd	Local/Remote	Jog
Prc	Local/Remote	Jog

The parameters are all shown in their default settings

Key:

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Input		Connected to ground / off		Summing junction
	Output		Invert		Limit
	Input or output programmable		AND		Comparator
0.XX	RW parameter		OR	Σ	Sum
0.XX	RO parameter		NOR	X.XX	Selector controlled by Pr x.xx

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OL> FREQUENCY
CL> SPEED
9

TORQUE
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AT ZERO SPEED
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Analog outputs

Digital output

Motor control

0.06 Current limit

0.14 Torque mode selector

0.33 OL> Catch a spinning motor
VT> Motor full load rated speed autotune
CL>

0.17 Current demand filter time constant

Maximum frequency/ speed clamp
0.02

Minimum frequency/ speed clamp
0.01

Ramp enable
0.16

Closed loop only

OL>

CL>

Ramps

Motor parameters
0.42 – 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
SV> Motor thermal time constant

CL>

CL > Speed-loop PID gains

0.07 Speed-loop proportional gain

0.08 Speed-loop integral gain

0.03 Acceleration rate

0.04 Deceleration rate

0.15 Ramp mode selector

0.09 Speed-loop derivative gain

OL> Motor-voltage control

0.07 Voltage mode selector

0.10 Estimated motor speed

0.08 Boost voltage

0.09 Dynamic V/f select

L1 L2 L3 **Drive**

Motor speed
0.10

0.27 Drive encoder ppr

0.26 Overspeed threshold

Power stage

0.41 PWM switching frequency

0.11 Drive output frequency

OL & VT> Motor active current

0.13 **0.12** Total motor current

Magnetising current

U V W   BR

15 way sub-D connector

Resistor optional

	Volts to frequency conversion		∫	Integrate
V/f				
A/D	Analog to digital conversion		d/dt	Differentiate
	Modulus			Relay
	Comparator with hysteresis		0V	
x.xx	Switch controlled by Pr **x.xx**			

7 Running the motor

This chapter takes the new user through all the essential steps to running a motor for the first time, in each of the possible operating modes.

⚠️ **WARNING**

Ensure that no damage or safety hazard could arise from the motor starting unexpectedly.

⚠️ **CAUTION**

The values of the motor parameters 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 Pr **0.46** *Motor rated current*. This affects the thermal protection of the motor.

⚠️ **CAUTION**

If the keypad mode has been used previously, ensure that the keypad reference has been set to 0 using the ⬆️⬇️ buttons as if the drive is started using the keypad it will run to the speed defined by the keypad reference (Pr **1.17**).

⚠️ **WARNING**

If the intended maximum speed affects the safety of the machinery, additional independent over-speed protection must be used.

7.1 Quick start Connections

7.1.1 Basic requirements

This section shows the basic connections which must be made for the drive to run in the required mode. For minimal parameter settings to run in each mode please see the relevant part of section 7.2 *Quick Start / start-up* on page 64.

Table 7-1   Minimum control connection requirements for each control mode

Drive control method	Requirements
Terminal mode	Drive Enable Speed reference Run forward or run reverse command
Keypad mode	Drive Enable
Serial communications	Drive Enable Serial communications jumper (link)

Table 7-2   Minimum control connection requirements for each mode of operation

Operating mode	Requirements
Open loop and RFC mode	Induction motor
Closed loop vector mode	Induction motor with speed feedback
Closed loop servo mode	Permanent magnet motor with speed and position feedback

Figure 7-1   Minimum connections to get the motor running in any operating mode (SPz)

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Terminal	Encoder connections		
1	A	F	Cos
2	A\	F\	Cos\
3	B	D	Sin
4	B\	D\	Sin\
5	Z		Data
6	Z\		Data\
7	U	Fout	Aout	Fout	Aout
8	U\	Fout\	Aout\	Fout\	Aout\
9	V	Dout	Bout	Dout	Bout
10	V\	Dout\	Bout\	Dout\	Bout\
11	W		Clk
12	W\		Clk\
13	+V		+V
14	0V		0V
15	Th		Th

Serial communications port

Encoder connector 15 way D-type

Induction motor

Servo motor (permanent magnet)

Braking resistor (optional)

Fuses

0V

+10V

Speed reference input

24V

RUN FWD

RUN REV

DRIVE ENABLE

Terminal Mode

Keypad Mode

SPz Keypad

Pr **0.05** =PAd (4)

Open loop

RFC

Closed loop vector

Servo

A $\overline{A}$
B $\overline{B}$
Z $\overline{Z}$ ①

A $\overline{A}$
B $\overline{B}$
U $\overline{U}$
V $\overline{V}$
W $\overline{W}$
Z $\overline{Z}$ ①

① Marker pulse optional

② Thermal overload for braking resistor to protect against fire risk. This must be wired to interrupt the AC supply in the event of a fault. This is not required if the optional internal braking resistor is used

Figure 7-2 Minimum connections to get the motor running in any operating mode (size 1 to 3)

Figure 7-3   Minimum connections to get the motor running in any operating mode (size 4 to 6)

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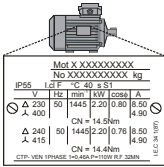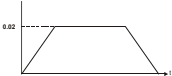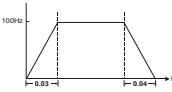Advanced parameters

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L3 L2 L1

Fuses

L1 L2 L3

Serial communications port

Terminal	Encoder connections			
1	A		F	Cos
2	A\		F\	Cos\
3	B		D	Sin
4	B\		D\	Sin\
5			Z	Data
6			Z\	Data\
7	U	Fout	Aout	Fout	Aout
8	U\	Fout\	Aout\	Fout\	Aout\
9	V	Dout	Bout	Dout	Bout
10	V\	Dout\	Bout\	Dout\	Bout\
11	W			Clk
12	W\			Clk\
13	+V		+V	
14	0V		0V	
15	Th		Th	

Encoder connector
15 way D-type

5 1
10 6
15 11

U V W

24V External supply

Fan supply - size 6 only

+DC   BRAKE

Induction motor

Servo motor (permanent magnet)

Braking resistor (optional)

②

U V W

E

U V W

E

Open loop

RFC

Closed loop vector

Servo

A Ā
B B̄
Z Z̄ ①

A Ā
B B̄
U Ū
V V̄
W W̄
Z Z̄ ①

Terminals:
1
2
3 — 0V
4 — +10V
5 — Speed reference input
6
7
8
9
10
11

21
22 — 24V
23
24
25
26 — RUN FWD
27 — RUN REV
28
29
30
31 — DRIVE ENABLE

Terminal Mode

Keypad Mode

SM-Keypad / SM-Keypad Plus. Optional item, must be fitted for keypad mode.

Pr **0.05** =PAd (4)

① Marker pulse optional

② Thermal overload for braking resistor to protect against fire risk. This must be wired to interrupt the AC supply in the event of a fault. This is not required if the optional internal braking resistor is used

7.2   Quick Start / start-up
7.2.1   Open loop

Action	Detail	
Before power-up	Ensure: • The drive enable signal is not given (terminal 31) • Run signal is not given • Motor is connected	
Power-up the drive	Verify that Open Loop mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 50. If a motor thermistor is not connected and the drive trips on 'th' set Pr **0.21** = VOLt and press the red reset button. Ensure: • Drive displays 'inh' If the drive trips, see Chapter 10 *Diagnostics* on page 113. SPz only: If no internal braking resistor is installed then the drive will trip 'br.th'. If no internal braking resistor is required then set Pr **0.51** to 8 to disable the trip.	
Enter motor nameplate details	Enter: • Motor rated frequency in Pr **0.47** (Hz) • Motor rated current in Pr **0.46** (A) • Motor rated speed in Pr **0.45** (rpm) • Motor rated voltage in Pr **0.44** (V) - check if ⅄ or △ connection	
Set maximum frequency	Enter: • Maximum frequency in Pr **0.02** (Hz)	
Set accel. / decel. rates	Enter: • Acceleration rate in Pr **0.03** (s/100Hz) • Deceleration rate in Pr **0.04** (s/100Hz) (If braking resistor installed, set Pr **0.15** = FAST. Also ensure Pr **10.30** and Pr **10.31** are set correctly, otherwise premature 'It.br' trips may be seen.)	

Action	Detail	
Autotune	Unidrive SP is able to perform either a stationary or a rotating autotune. The motor must be at a standstill before an autotune is enabled. A rotating autotune should be used whenever possible so the measured value of power factor of the motor is used by the drive.	

| | **WARNING** 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. |

| | • A stationary autotune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. A stationary autotune measures the stator resistance of the motor and the voltage offset in the drive. These are required for good performance in vector control modes. A stationary autotune does not measure the power factor of the motor so the value on the motor nameplate must be entered into Pr **0.43**. | |

Autotune (continued):

• A rotating autotune should only be used if the motor is uncoupled. A rotating autotune first performs a stationary autotune before rotating the motor at $^2/_3$ base speed in the direction selected. The rotating autotune measures the power factor of the motor.

To perform an autotune:
• Set Pr **0.40** = 1 for a stationary autotune or set Pr **0.40** = 2 for a rotating autotune
• Close the Drive Enable signal (terminal 31). The drive will display 'rdY'.
• Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the autotune.
• Wait for the drive to display 'rdY' or 'inh', and for the motor to come to a standstill.

If the drive trips, see Chapter 10 *Diagnostics* on page 113.

Remove the drive enable and run signal from the drive.

Save parameters	Enter 1000 in Pr **xx.00**
	Press the red 🔴 reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)

| Run | Drive is now ready to run | |

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7.2.2 RFC mode
Induction motor

Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 31) • Run signal is not given • Motor and feedback device are connected	
Power-up the drive	Verify that Closed Loop mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 50. If a motor thermistor is not connected and the drive trips on 'th' set Pr **0.21** = VOLt and press the red reset button. Ensure: • Drive displays 'inh' If the drive trips, see Chapter 10 *Diagnostics* on page 113. SPz only: If no internal braking resistor is installed then the drive will trip 'br.th'. If no internal braking resistor is required then set Pr **0.51** to 8 to disable the trip.	
Select RFC mode and disable encoder wire-break trip	• Set Pr **3.24** = 1 to select RFC mode • Set Pr **3.40** = 0	
Enter motor nameplate details	Enter: • Motor rated frequency in Pr **0.47** (Hz) • Motor rated current in Pr **0.46** (A) • Motor rated speed (base speed - slip speed) in Pr **0.45** (rpm) • Motor rated voltage in Pr **0.44** (V) - check if 人 or △ connection	
Set maximum speed	Enter: • Maximum speed in Pr **0.02** (rpm)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **0.03** (s/1000rpm) • Deceleration rate in Pr **0.04** (s/1000rpm) (If braking resistor installed, set Pr **0.15** = FAST. Also ensure Pr **10.30** and Pr **10.31** are set correctly, otherwise premature 'It.br' trips may be seen.)	

Action	Detail	
Autotune	Unidrive SP is able to perform either a stationary or a rotating autotune. The motor must be at a standstill before an autotune is enabled. A stationary autotune will give moderate performance whereas a rotating autotune will give improved performance as it measures the actual values of the motor parameters required by the drive.	

WARNING

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.

- A stationary autotune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. The stationary autotune measures the stator resistance and transient inductance of the motor. These are used to calculate the current loop gains, and at the end of the test the values in Pr **0.38** and Pr **0.39** are updated. A stationary autotune does not measure the power factor of the motor so the value on the motor nameplate must be entered into Pr **0.43**.
- A rotating autotune should only be used if the motor is uncoupled. A rotating autotune first performs a stationary autotune before rotating the motor at $^2/_3$ base speed in the direction selected. The rotating autotune measures the stator inductance of the motor and calculates the power factor.

To perform an autotune:
- Set Pr **0.40** = 1 for a stationary autotune or set Pr **0.40** = 2 for a rotating autotune
- Close the Drive Enable signal (terminal 31). The drive will display 'rdY'
- Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the autotune.
- Wait for the drive to display 'rdY' or 'inh', and for the motor to come to a standstill

If the drive trips, see Chapter 10 *Diagnostics* on page 113.
Remove the drive enable and run signal from the drive.

Save parameters	Enter 1000 in Pr **xx.00**
	Press the red ⊚ reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)

Run	Drive is now ready to run	

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7.2.3 Closed loop vector mode

Induction motor with incremental encoder feedback

For simplicity only an incremental quadrature encoder will be considered here. For information on setting up one of the other supported speed feedback devices, refer to *Setting up a feedback device* in the *Unidrive SP User Guide*.

Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 31) • Run signal is not given • Motor and feedback device are connected	
Power-up the drive	Verify that Closed Loop mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 50. If a motor thermistor is not connected and the drive trips on 'th' set Pr **0.21** = VOLt and press the red reset button. Ensure: • Drive displays 'inh' If the drive trips, see Chapter 10 *Diagnostics* on page 113. SPz only: If no internal braking resistor is installed then the drive will trip 'br.th'. If no internal braking resistor is required then set Pr **0.51** to 8 to disable the trip.	

Set motor feedback parameters	**Incremental encoder basic set-up**
	Enter:
	• Drive encoder type in Pr **3.38** = Ab (0): Quadrature encoder
	• Encoder power supply in Pr. **3.36** = 5V (0), 8V (1) or 15V (2)
	
	⚠ **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device.
	
	• Drive encoder Lines Per Revolution (LPR) in Pr **3.34** (set according to encoder)
	• Drive encoder termination resistor setting in Pr. **3.39**:
	    0 = A-A\, B-B\, Z-Z\ termination resistors disabled
	    1 = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled
	    2 = A-A\, B-B\, Z-Z\ termination resistors enabled	

Enter motor nameplate details	Enter: • Motor rated frequency in Pr **0.47** (Hz) • Motor rated current in Pr **0.46** (A) • Motor rated speed (base speed - slip speed) in Pr **0.45** (rpm) • Motor rated voltage in Pr **0.44** (V) - check if Y or Δ connection	
Set maximum speed	Enter: • Maximum speed in Pr **0.02** (rpm)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **0.03** (s/1000rpm) • Deceleration rate in Pr **0.04** (s/1000rpm) (If braking resistor installed, set Pr **0.15** = FAST. Also ensure Pr **10.30** and Pr **10.31** are set correctly, otherwise premature 'It.br' trips may be seen.)	

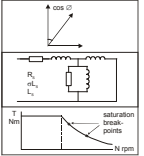| Action	Detail	
Autotune	Unidrive SP is able to perform either a stationary or a rotating autotune. The motor must be at a standstill before an autotune is enabled. A stationary autotune will give moderate performance whereas a rotating autotune will give improved performance as it measures the actual values of the motor parameters required by the drive.	
	⚠ WARNING 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.	
	• A stationary autotune can be used when the motor is loaded and it is not possible to uncouple the load from the motor shaft. The stationary autotune measures the stator resistance and transient inductance of the motor. These are used to calculate the current loop gains, and at the end of the test the values in Pr **0.38** and Pr **0.39** are updated. A stationary autotune does not measure the power factor of the motor so the value on the motor nameplate must be entered into Pr **0.43**. • A rotating autotune should only be used if the motor is uncoupled. A rotating autotune first performs a stationary autotune before rotating the motor at $^2/_3$ base speed in the direction selected. The rotating autotune measures the stator inductance of the motor and calculates the power factor. **To perform an autotune:** • Set Pr **0.40** = 1 for a stationary autotune or set Pr **0.40** = 2 for a rotating autotune • Close the Drive Enable signal (terminal 31). The drive will display 'rdY' • Close the run signal (terminal 26 or 27). The lower display will flash 'Auto' and 'tunE' alternately, while the drive is performing the autotune. • Wait for the drive to display 'rdY' or 'inh', and for the motor to come to a standstill If the drive trips, see Chapter 10 *Diagnostics* on page 113. Remove the drive enable and run signal from the drive.	
Save parameters	Enter 1000 in Pr **xx.00**	
	Press the red ⊚ reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)	
Run	Drive is now ready to run	

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7.2.4 Servo

Permanent magnet motor with a speed and position feedback device

For simplicity only an incremental quadrature encoder with commutation outputs will be considered here. For information on setting up one of the other supported speed feedback devices, refer to *Setting up a feedback device* in the *Unidrive SP User Guide*.
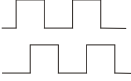
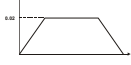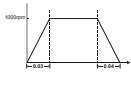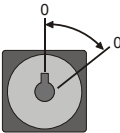| Action	Detail	
Before power-up	Ensure: • Drive Enable signal is not given (terminal 31) • Run signal is not given • Motor is connected • Feedback device is connected	
Power-up the drive	Verify that Servo mode is displayed as the drive powers up. If the mode is incorrect see section 5.6 *Changing the operating mode* on page 50. If a motor thermistor is not connected and the drive trips on 'th' set Pr **0.21** = VOLt and press the red reset button. Ensure: • Drive displays 'inh' If the drive trips, see Chapter 10 *Diagnostics* on page 113. SPz only: If no internal braking resistor is installed then the drive will trip 'br.th'. If no internal braking resistor is required then set Pr **0.51** to 8 to disable the trip.	

Set motor feedback parameters	**Incremental encoder basic set-up**
	Enter:
	• Drive encoder type in Pr. **3.38** = Ab.SErVO (3): Quadrature encoder with commutation outputs
	• Encoder power supply in Pr. **3.36** = 5V (0), 8V (1) or 15V (2)
	
	⚠ **CAUTION** Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device.
	
	• Drive encoder Pulses Per Revolution in Pr. **3.34** (set according to encoder)
	• Drive encoder termination resistor setting in Pr. **3.39**:
	    0 = A-A\, B-B\, Z-Z\ termination resistors disabled
	    1 = A-A\, B-B\, termination resistors enabled, Z-Z\ termination resistors disabled
	    2 = A-A\, B-B\, Z-Z\ termination resistors enabled	

Enter motor nameplate details	Enter: • Motor rated current in Pr **0.46** (A) • Number of poles in Pr **0.42**	
Set maximum speed	Enter: • Maximum speed in Pr **0.02** (rpm)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in Pr **0.03** (s/1000rpm) • Deceleration rate in Pr **0.04** (s/1000rpm) (If braking resistor installed, set Pr **0.15** = FAST. Also ensure Pr **10.30** and Pr **10.31** are set correctly, otherwise premature 'It.br' trips may be seen.)	

Action	Detail	
Autotune	⚠ **WARNING** The normal low speed test will rotate the motor by up to 2 revolutions in the direction selected, regardless of the reference provided. 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. • The motor must be uncoupled from the load before attempting this autotune. • The normal low speed test will rotate the motor by up to 2 rotations in the direction selected and the drive measures the encoder phase angle and updates the value in Pr **3.25**. This test also measures the stator resistance, and inductance of the motor. These are used to calculate the current loop gains, and at the end of the test the values in Pr **0.38** and Pr **0.39** are updated. This test takes approximately 20s to complete. **To perform an autotune:** • Set Pr **0.40** = 2 • Close the run signal (terminal 26 or 27). • Close the Drive Enable signal (terminal 31). The lower display will flash 'Auto' and 'tunE' alternatively, while the drive is performing the test. • Wait for the drive to display 'rdy' or 'inh', and for the motor to come to a standstill. If the drive trips, see Chapter 10 *Diagnostics* on page 113. Remove the drive enable and run signal from the drive.	0 ⟍ 0
Save parameters	Enter 1000 in Pr **xx.00** Press the red 🔴 reset button or toggle the reset digital input (ensure Pr **xx.00** returns to 0)	
Run	Drive is now ready to run	

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8 SMARTCARD

8.1 Introduction

This is a standard feature that enables simple configuration of parameters in a variety of ways. The SMARTCARD can be used for:
- Parameter copying between drives
- Saving whole drive parameter sets
- Saving 'differences from default' parameter sets
- Storing Onboard PLC programs
- Automatically saving all user parameter changes for maintenance purposes
- Loading complete motor map parameters

SPz
When inserting the SMARTCARD, always ensure that ST SPz arrow points upwards.

Size 1 to 6
The SMARTCARD is located at the top of the module under the drive display (if installed) on the left-hand side. Ensure the SMARTCARD is inserted with the SP1-9 arrow pointing upwards.

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 copied 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 copied 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 copied 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.

⚠ WARNING	Be aware of possible live terminals when inserting or removing the SMATRTCARD

Figure 8-1 Installation of the SMARTCARD
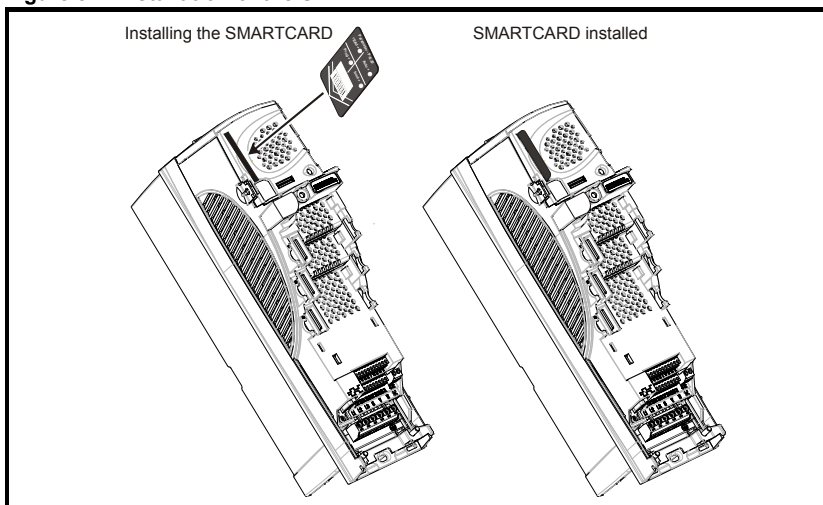
Installing the SMARTCARD   SMARTCARD installed

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The SMARTCARD is located at the top of the module under the drive display (if installed) on the left-hand side.

SPz: Ensure the SMARTCARD is inserted with the contacts facing the left-hand side of the drive.

Size 1 to 6: Ensure the SMARTCARD is inserted with the contacts facing the right-hand side of the drive.

Easy saving and reading

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. The drive can support SMARTCARDs with a capacity of between 4kB and 512kB.

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

Figure 8-2 Basic SMARTCARD operation
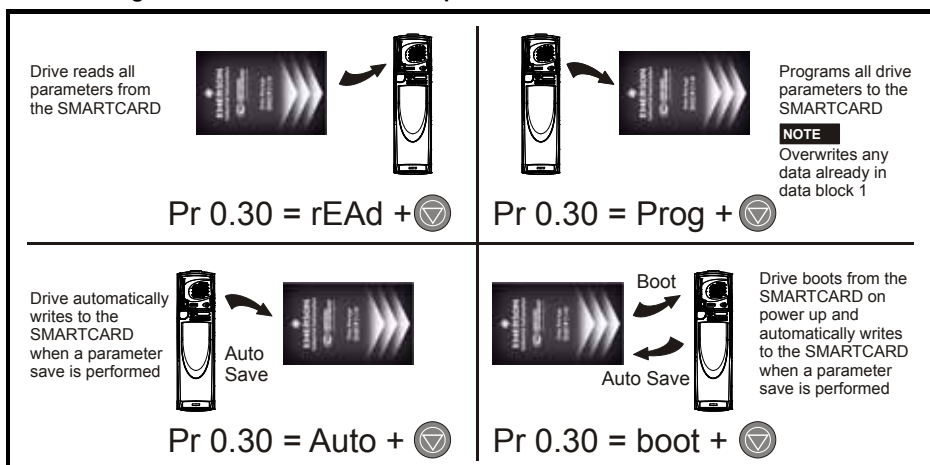
Drive reads all parameters from the SMARTCARD

Pr 0.30 = rEAd + ⊙

Programs all drive parameters to the SMARTCARD

NOTE

Overwrites any data already in data block 1

Pr 0.30 = Prog + ⊙

Drive automatically writes to the SMARTCARD when a parameter save is performed

Auto Save

Pr 0.30 = Auto + ⊙

Boot

Auto Save

Drive boots from the SMARTCARD on power up and automatically writes to the SMARTCARD when a parameter save is performed

Pr 0.30 = boot + ⊙

Table 8-1 SMARTCARD data blocks

Data block	Type	Example use
1 to 499	Read/Write	Application set-ups
500 to 999	Read only	Macros

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.

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.

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 8-1 for restrictions on block numbers.

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

9 Advanced parameters

Figure 9-1 shows the overall block diagram of the drive.

Figure 9-1   Overall block diagram of the drive

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9.1 Menu 1: Frequency / speed reference

Figure 9-2 Menu 1 logic diagram

Pr 1.49	Pr 1.50	Reference being used
1	1	Analog reference 1
1	>1	Preset reference defined by Pr **1.50**
2	1	Analog reference 2
2	>1	Preset reference defined by Pr **1.50**
3	x	Preset reference defined by Pr **1.50**
4	x	Keypad reference
5	x	Precision reference

Key

▶ Input terminals	**0.XX**	Read-write (RW) parameter
◀ Output terminals	◇ 0.XX	Read-only (RO) parameter

The parameters are all shown in their default settings

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9.2 Menu 2: Ramps

Figure 9-3 Menu 2 logic diagram

Acceleration rate select bits

2.34	2.33	2.32

0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

Key

X ⊘ / X ⊘	Input terminals	0.XX Read-write (RW) parameter
X ⊘ / X ⊘	Output terminals	0.XX Read-only (RO) parameter

The parameters are all shown at their default settings

Acceleration rate selector
2.10

Acceleration rates 1 ~ 8

2.11	Acceleration rate 1
2.12	Acceleration rate 2
2.13	Acceleration rate 3
2.14	Acceleration rate 4
2.15	Acceleration rate 5
2.16	Acceleration rate 6
2.17	Acceleration rate 7
2.18	Acceleration rate 8

0
1
2
3
4
5
6
7
8
9

Preset reference selected *indicator* 1.50

1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8

Jog acceleration rate 2.19

Jog selected *indicator* 1.13

Reverse accel. rate   Forward accel. rate

N   N
t   t

Acceleration

Ramp control

| 2.03 | Ramp hold |
| 2.04 | Ramp mode select* |

Pre-ramp speed reference 1.03

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Deceleration rate select bits

	2.37	2.36	2.35
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
6	1	0	1
7	1	1	0
8	1	1	1

Deceleration rate selector

2.20

Deceleration rates 1 ~ 8

2.21	Deceleration rate 1
2.22	Deceleration rate 2
2.23	Deceleration rate 3
2.24	Deceleration rate 4
2.25	Deceleration rate 5
2.26	Deceleration rate 6
2.27	Deceleration rate 7
2.28	Deceleration rate 8

1.50 Preset reference selected *indicator*

1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8

2.29 Jog deceleration rate

1.13 Jog selected *indicator*

Forward Decel. rate

Reverse Decel. rate

N t

N t

Deceleration

Current control Menu 4 (Open-loop only)

2.02 Ramp *enable* (Closed- loop only)

Ramps always enabled in Open-loop

Ramp control

2.06	S-Ramp enable**
2.07	S-Ramp acceleration limit
2.08	Standard ramp voltage*

Post-ramp reference

2.01

d/dt 2.38

Inertia compensation torque (Closed-loop only)

9.3 Menu 3: Frequency slaving, speed feedback and speed control

Figure 9-4   Menu 3 Open-loop logic diagram

Figure 9-5   Menu 3 Closed loop logic diagram

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Speed controller
gain select

3.16

Speed loop gains

3.10 (Kp1)

3.11 (Ki1)

3.13 (Kp2)

3.14 (Ki2)

Speed
error

3.03

Speed
controller
output

3.04

Menu 4

(Kd1)   (Kd2)

Speed controller
differential
feedback gains

3.12   **3.15**

Speed feedback

3.02

Zero speed
threshold

3.05

At zero speed
indicator

10.03

Bipolar reference
select

1.10

At or below min.
speed *indicator*

10.04

Minimum
speed

1.07   +5min⁻¹

Max reference clamp

1.06   +20%   **0**

Overspeed trip
(O.SPd)

Overspeed threshold

3.08   **1**

3.08 >0

Pre ramp
reference

1.03

At speed
lower limit

3.06

Below at-speed
window *indicator*

10.05

At speed
indicator

10.06

NOR

3.09

Absolute at-speed
detect mode

3.07

At speed
upper limit

10.07

Above at-speed
window *indicator*

Key		
X ⊘ Input terminals	**0.XX**	Read-write (RW) parameter
X ⊘ Output terminals	0.XX	Read-only (RO) parameter

The parameters are all shown at their default settings

9.4 Menu 4: Torque and current control

Figure 9-6   Menu 4 Open loop logic diagram
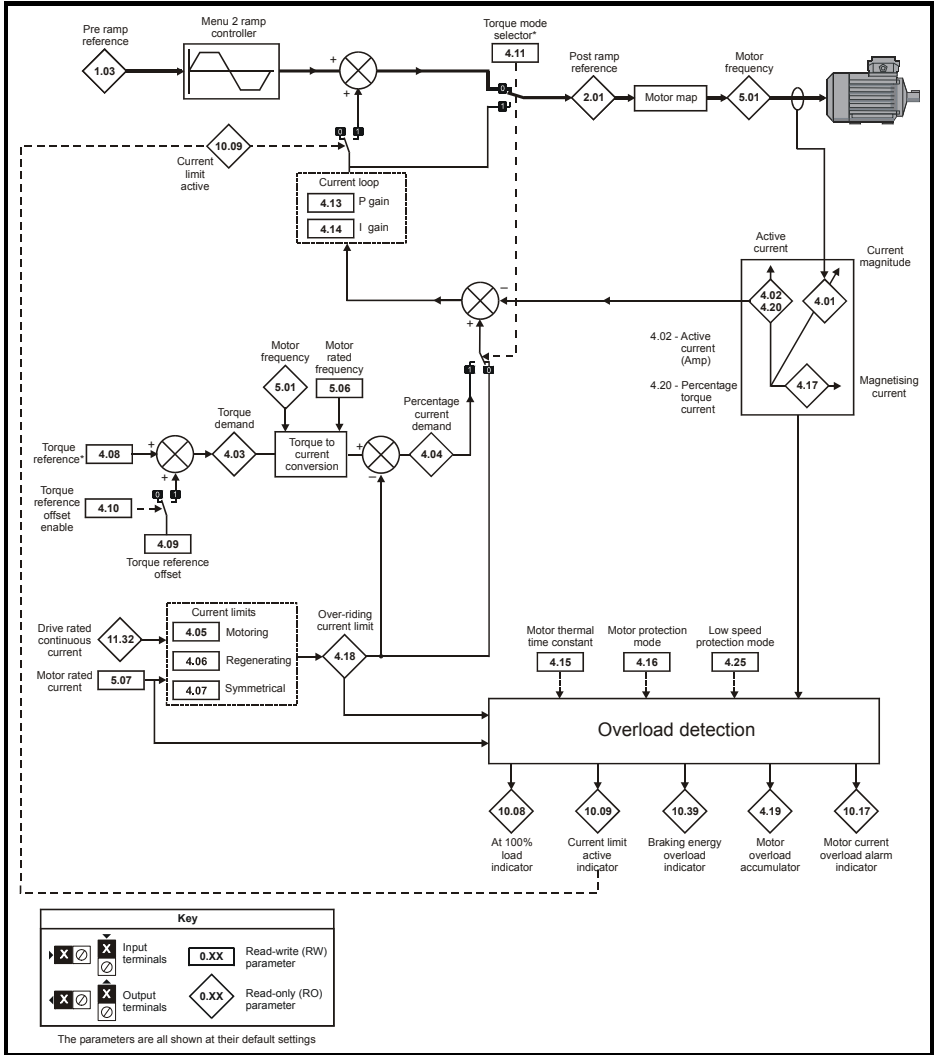
Figure 9-7   Menu 4 Closed-loop vector logic diagram
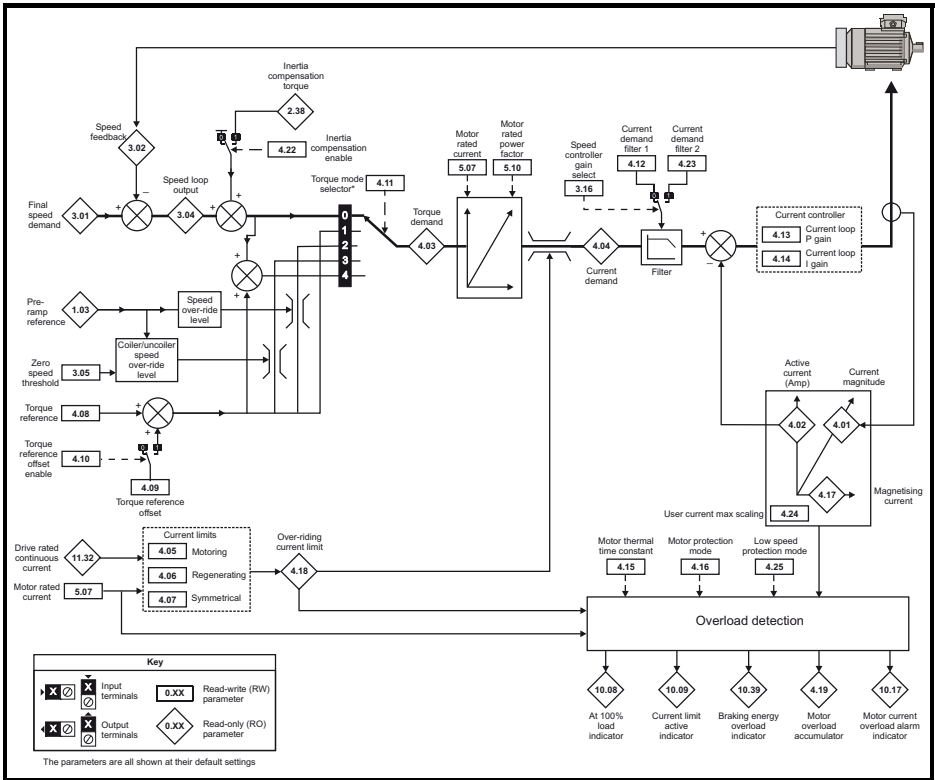
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Figure 9-8   Menu 4 Servo logic diagram

The parameters are all shown at their default settings
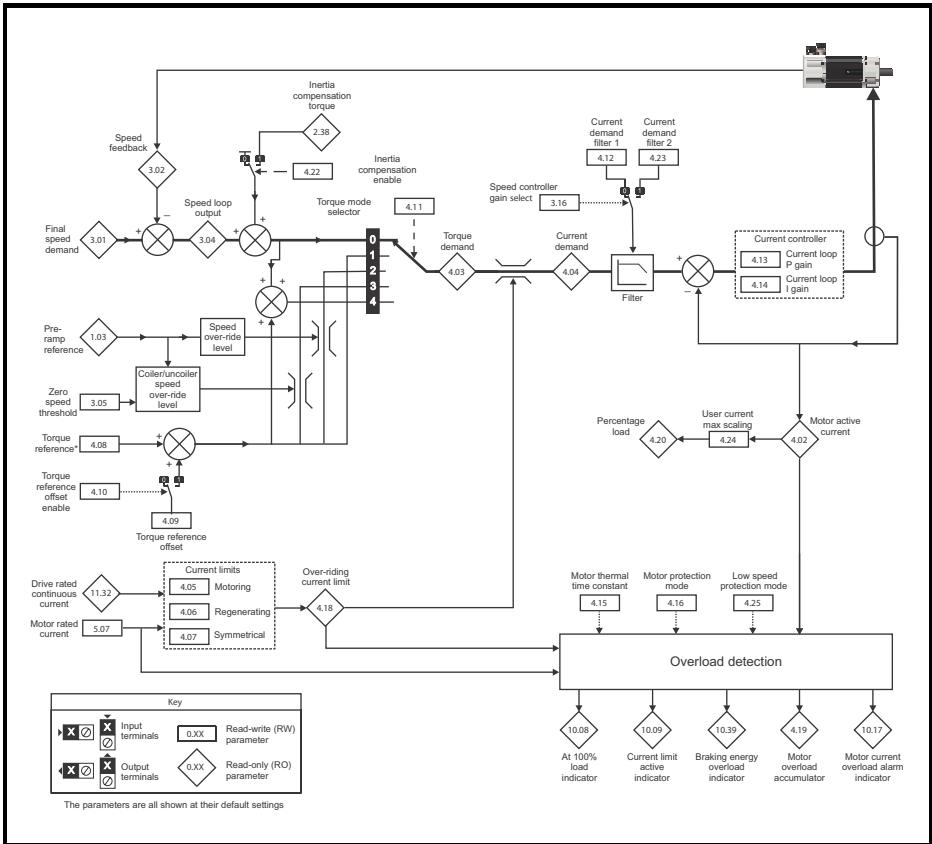
9.5 Menu 5: Motor control

Figure 9-9   Menu 5 Open-loop logic diagram

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Figure 9-10   Menu 5 Closed-loop logic diagram

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DC bus
voltage

5.05

Voltage reference

Modulator

| 5.18 | Maximum switching frequency |
| 5.35 | Disable auto switching frequencychange |

U

V

W

Flux Controller

| 5.09 | Motor rated voltage |
| 5.21 | Field gain reduction |

Closed-Loop Vector

| 5.13 | Dynamic V/f / flux optimisation enable |
| 5.16 | Motor full load rated speed optimiser enable |

Servo

| 5.22 | High speed servo mode enable |

5.02 Output voltage

Output
power

Power calculation (V x 1)

5.03

Motor active
current

Motor
current
magnitude

4.02

4.01

4.17

Motor magnetising
current

9.6 Menu 6: Sequencer and clock

Figure 9-11   Menu 6 logic diagram

9.7   Menu 7: Analog I/O

Figure 9-12   Menu 7 logic diagram
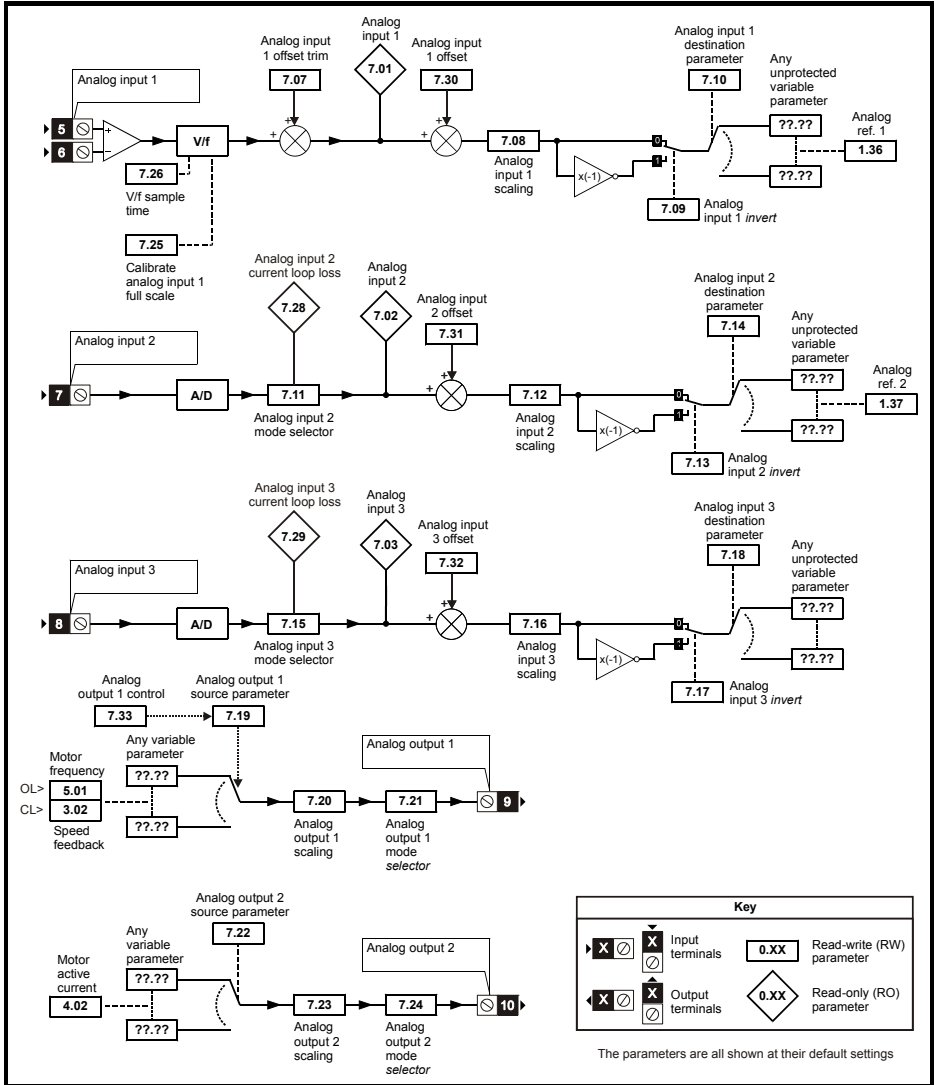
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9.8　Menu 8: Digital I/O

Figure 9-13　Menu 8 logic diagram

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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 **??.??**

Run reverse **6.32**

??.??

27 T27 digital input 4

8.29 I.O polarity *select*

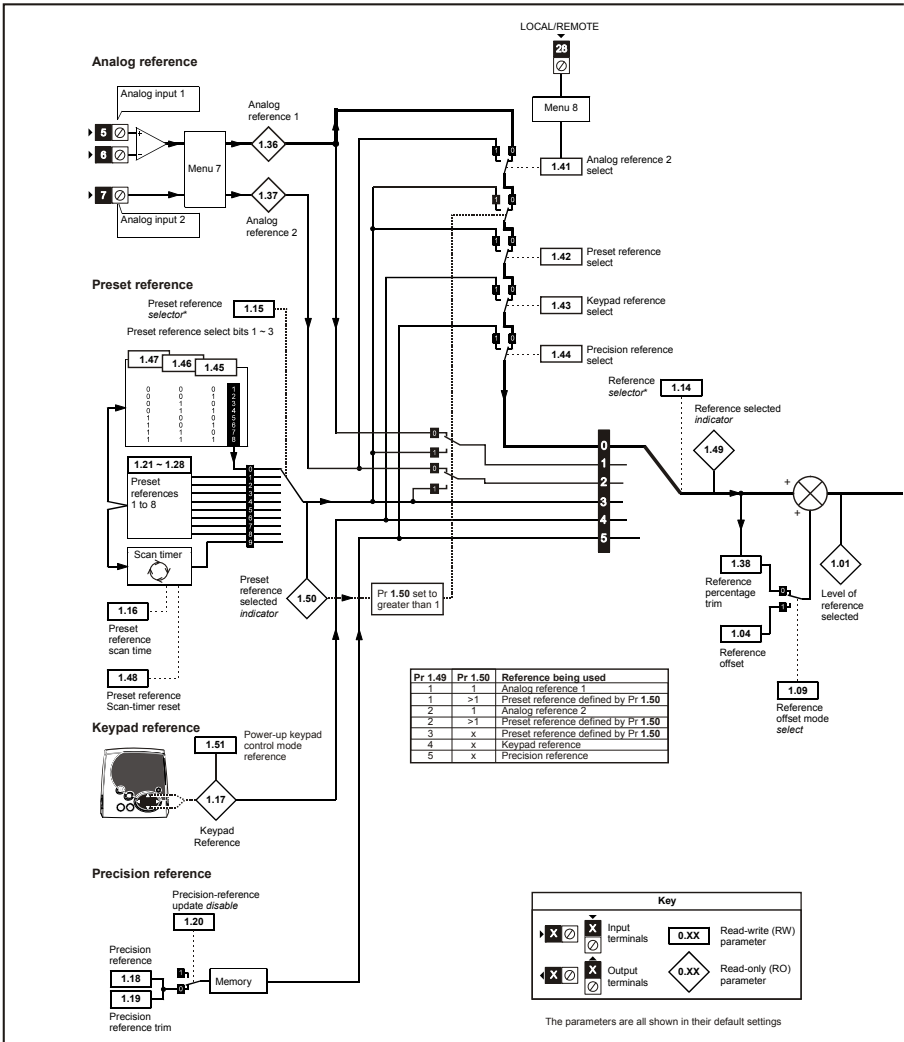x(-1)

8.39 T28 & T29 digital input auto-selection disable*

Reference selector* **1.14**

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 **??.??**

Analogue input 1 / input 2 select **1.41**

??.??

28 T28 digital input 5

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 **??.??**

Jog forward **6.31**

??.??

29 T29 digital input 6

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

??.??

22 T22 24V output

x(-1)

Drive enable indicator **8.09**

Drive enable mode *select* **8.10**

External trip **10.32**

Drive enable

Drive enable

31

x(-1)

Relay source *invert* **8.17**

Relay source **8.27**

Any bit parameter **??.??**

Drive Healthy **10.01**

??.??

Relay state **8.07**

x(-1)

41

42

0V

Key

Input terminals

Output terminals

0.XX Read-write (RW) parameter

0.XX Read-only (RO) parameter

This logic diagram applies only when all parameters are at their default settings

9.9 Menu 9: Programmable logic, motorized pot, binary sum and timers

Figure 9-14 Menu 9 logic diagram: Programmable logic

The parameters are all shown at their default settings
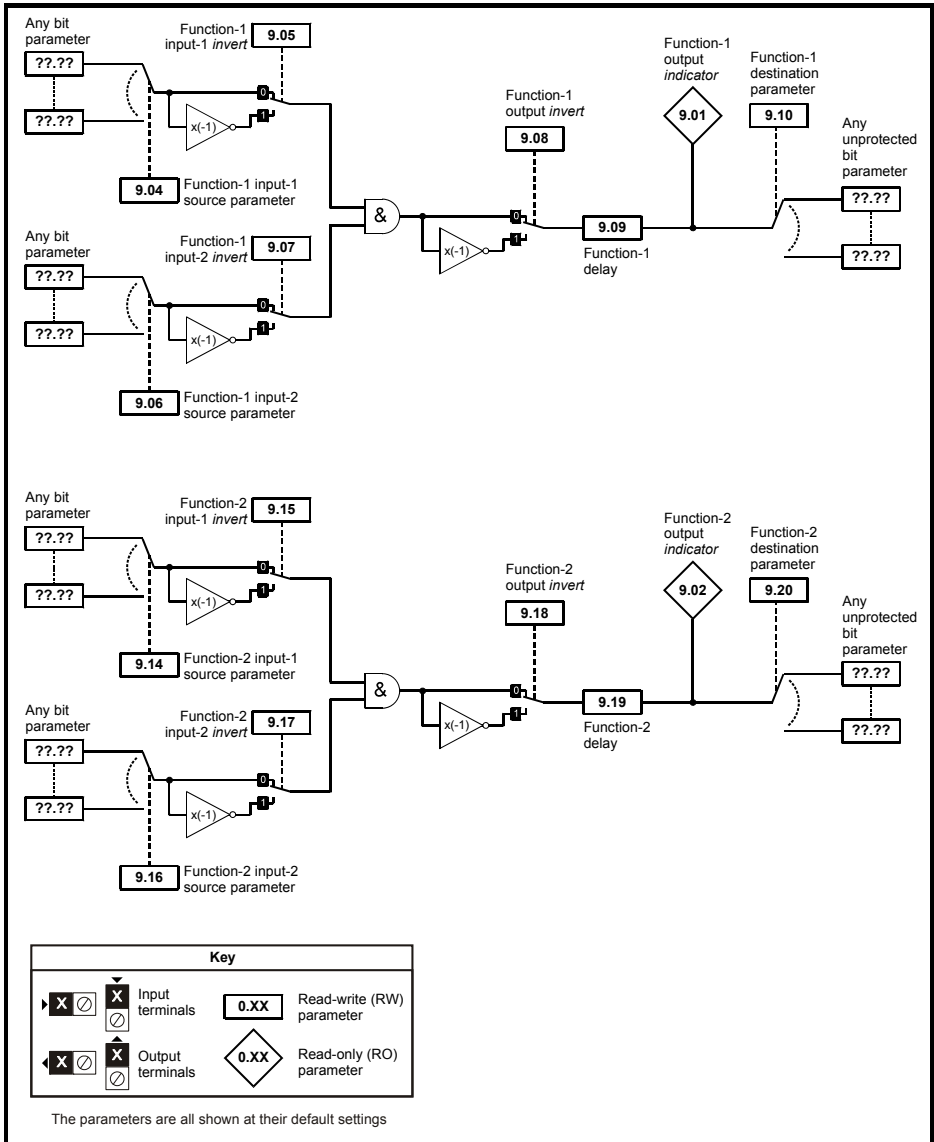
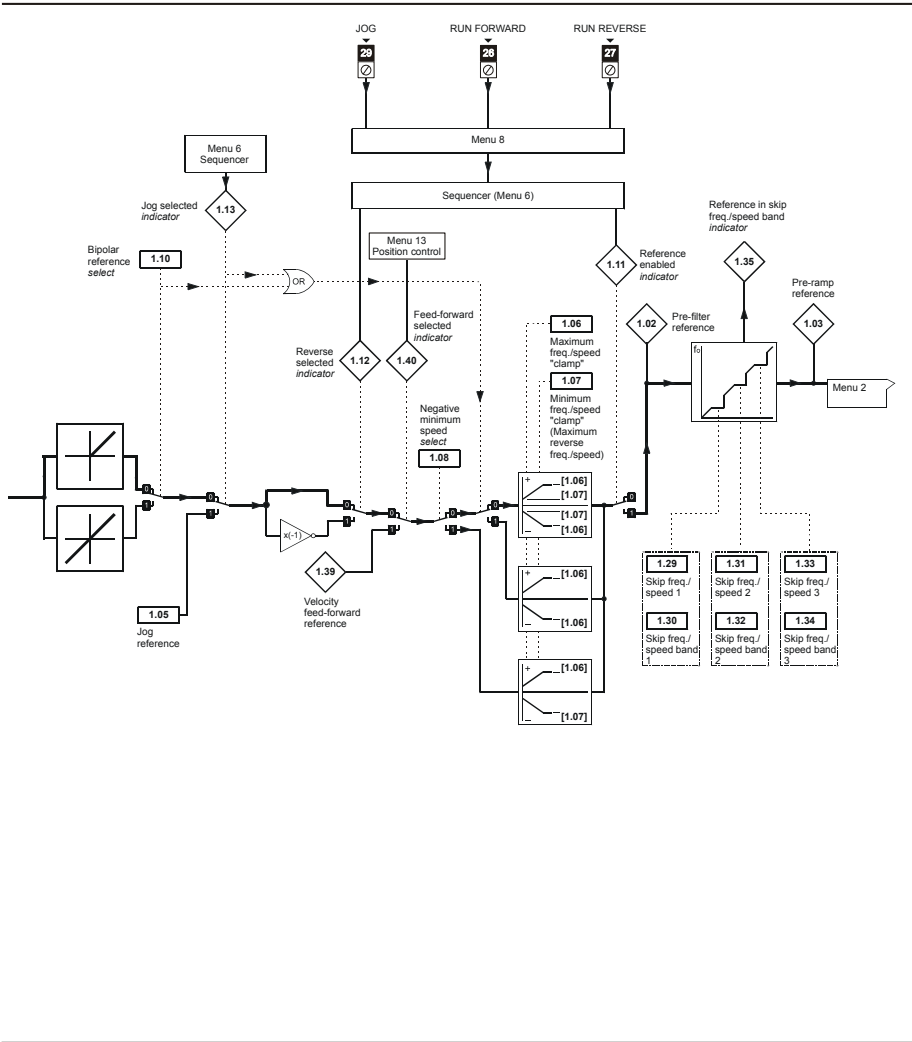**Figure 9-15   Menu 9 logic diagram: Motorized pot and binary sum**
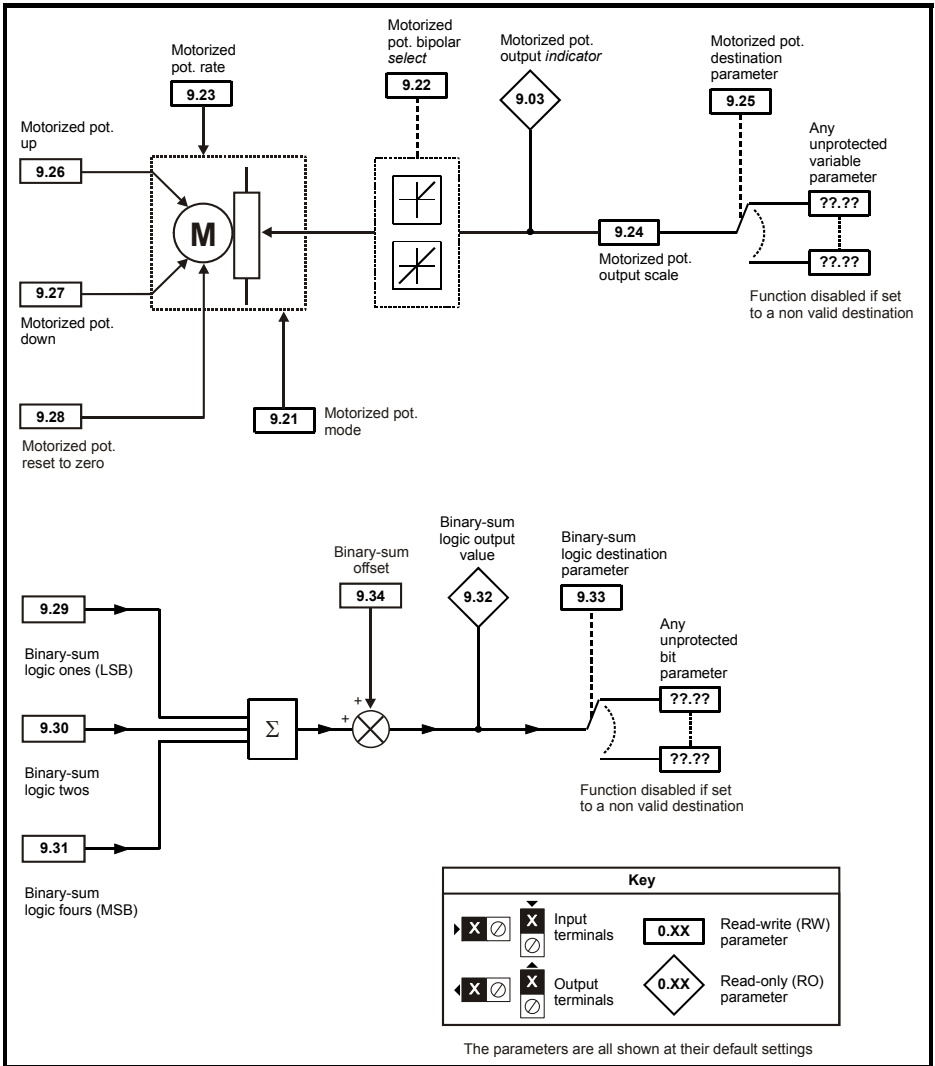
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9.10 Menu 10: Status and trips

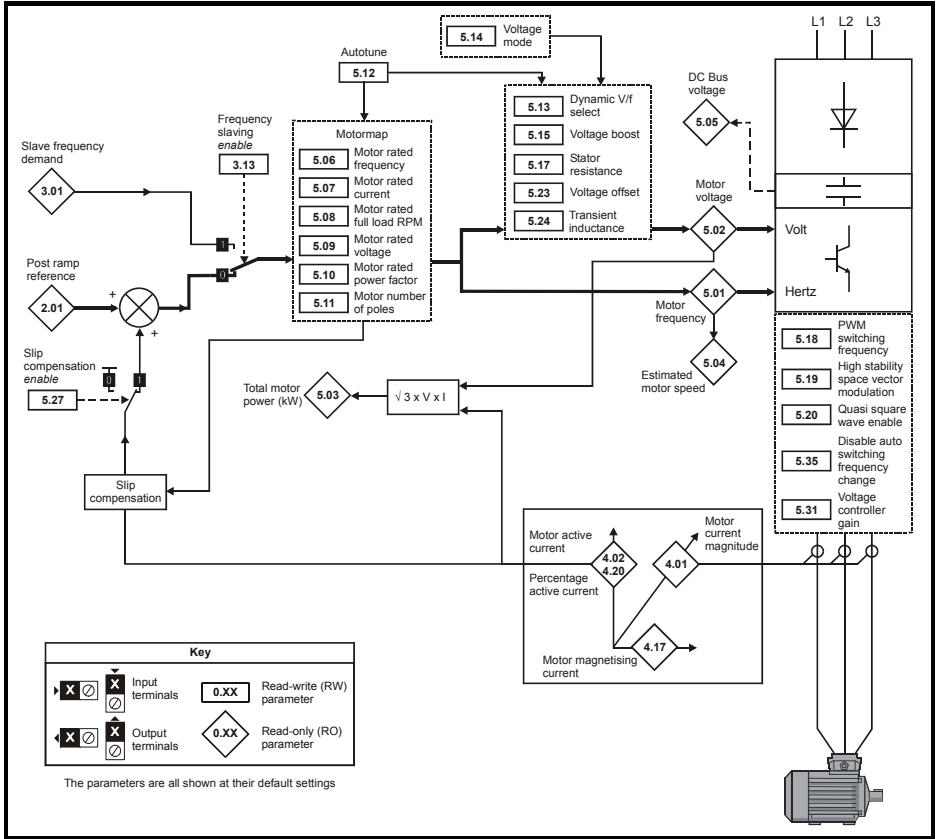| Parameter	
10.01	Drive ok
10.02	Drive active
10.03	Zero speed
10.04	Running at or below minimum speed
10.05	Below set speed
10.06	At speed
10.07	Above set speed
10.08	Load reached
10.09	Drive output is at current limit
10.10	Regenerating
10.11	Braking IGBT active
10.12	Braking resistor alarm
10.13	Direction commanded
10.14	Direction running
10.15	Mains loss
10.16	Under voltage active
10.17	Overload alarm
10.18	Drive over temperature alarm
10.19	Drive warning
10.20	Trip 0
10.21	Trip 1
10.22	Trip 2
10.23	Trip 3
10.24	Trip 4
10.25	Trip 5
10.26	Trip 6
10.27	Trip 7
10.28	Trip 8
10.29	Trip 9
10.30	Full power braking time
10.31	Full power braking period
10.32	External trip
10.33	Drive reset
10.34	Number of auto-reset attempts
10.35	Auto-reset delay
10.36	Hold drive ok until last attempt
10.37	Action on trip detection
10.38	User trip
10.39	Braking energy overload accumulator
10.40	Status word
10.41	Trip 0 time: years.days
10.42	Trip 0 time: hours.minutes
10.43	Trip 1 time
10.44	Trip 2 time
10.45	Trip 3 time
10.46	Trip 4 time
10.47	Trip 5 time
10.48	Trip 6 time
10.49	Trip 7 time
10.50	Trip 8 time
10.51	Trip 9 time

9.11 Menu 11: General drive set-up

Parameter	
11.01	Pr **0.11** set up
11.02	Pr **0.12** set up
11.03	Pr **0.13** set up
11.04	Pr **0.14** set up
11.05	Pr **0.15** set up
11.06	Pr **0.16** set up
11.07	Pr **0.17** set up
11.08	Pr **0.18** set up
11.09	Pr **0.19** set up
11.10	Pr **0.20** set up
11.11	Pr **0.21** set up
11.12	Pr **0.22** set up
11.13	Pr **0.23** set up
11.14	Pr **0.24** set up
11.15	Pr **0.25** set up
11.16	Pr **0.26** set up
11.17	Pr **0.27** set up
11.18	Pr **0.28** set up
11.19	Pr **0.29** set up
11.20	Pr **0.30** set up
11.21	Parameter scaling
11.22	Parameter displayed at power-up
11.23	Serial address
11.24	Serial mode
11.25	Baud rate
11.26	Minimum comms transmit delay
11.28	Drive derivative
11.29	Software version
11.30	User security code
11.31	User drive mode
11.32	Maximum heavy duty current rating
11.33	Drive voltage rating
11.34	Software sub-version
11.35	Number of modules
11.36	SMARTCARD parameter data previously loaded
11.37	SMARTCARD data number
11.38	SMARTCARD data type / mode
11.39	SMARTCARD data version
11.40	SMARTCARD data checksum
11.41	Status mode timeout
11.42	Parameter copying
11.43	Load defaults
11.44	Security status
11.45	Select motor 2 parameters
11.46	Defaults previously loaded
11.47	Drive onboard PLC program enable
11.48	Drive onboard PLC program status
11.49	Drive onboard PLC programming events
11.50	Drive onboard PLC program average scan time
11.51	Drive onboard PLC program first run

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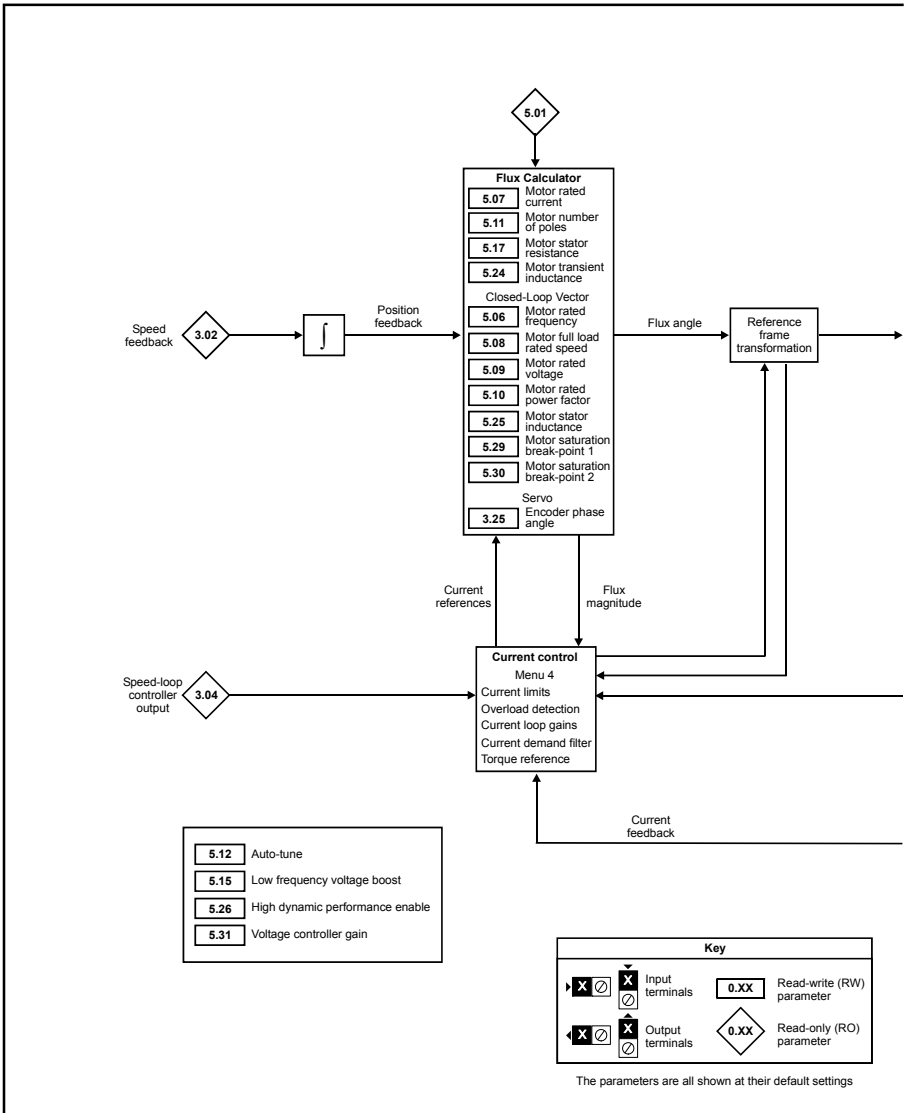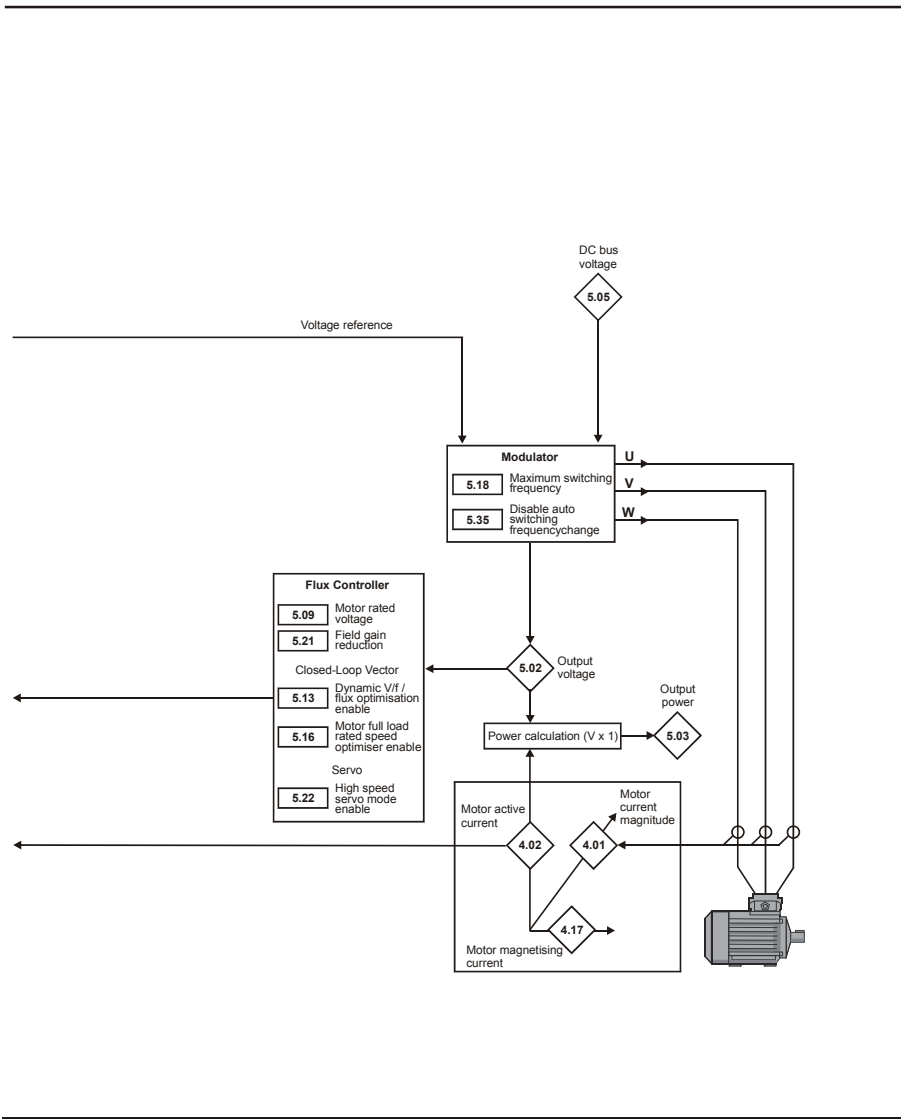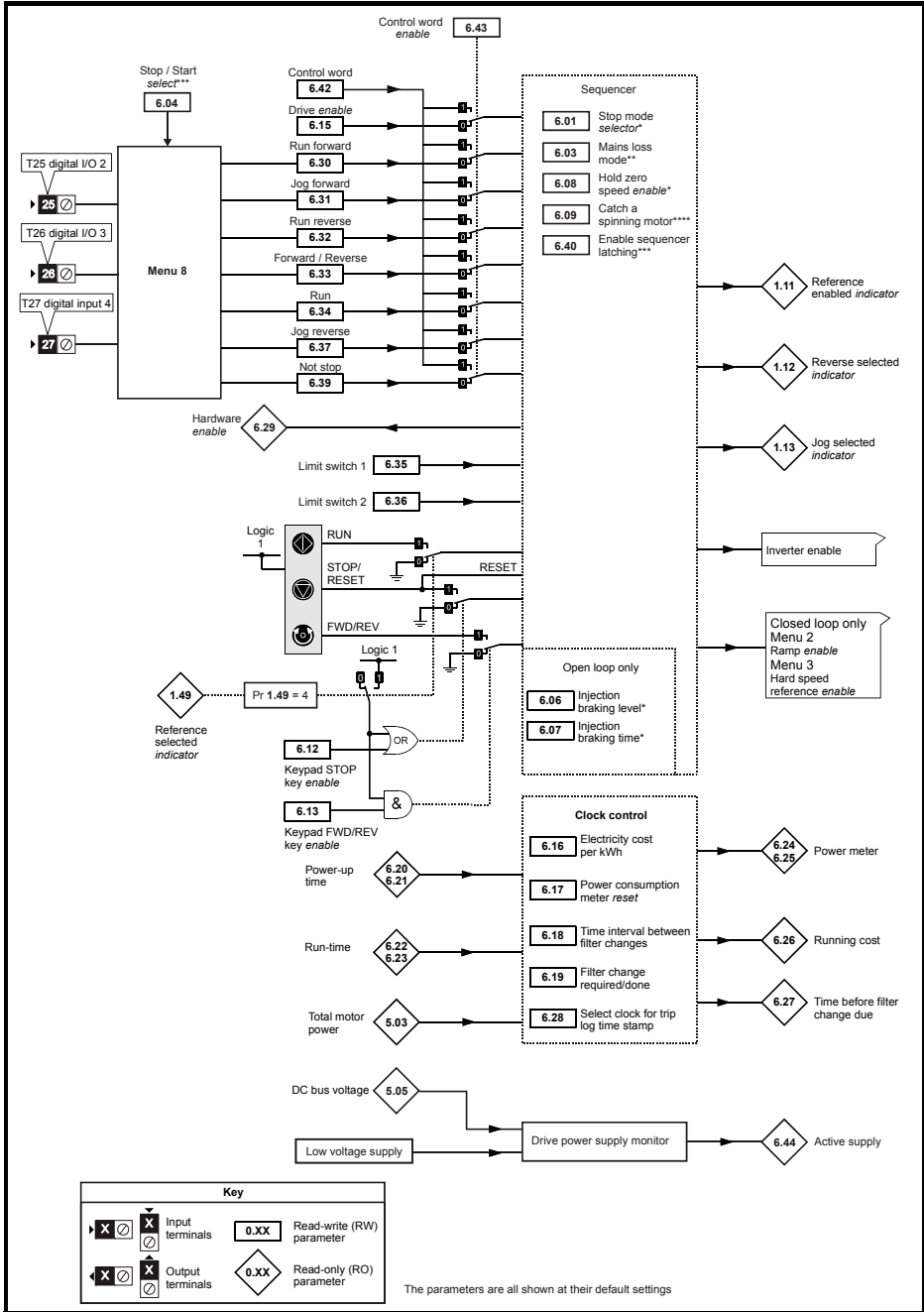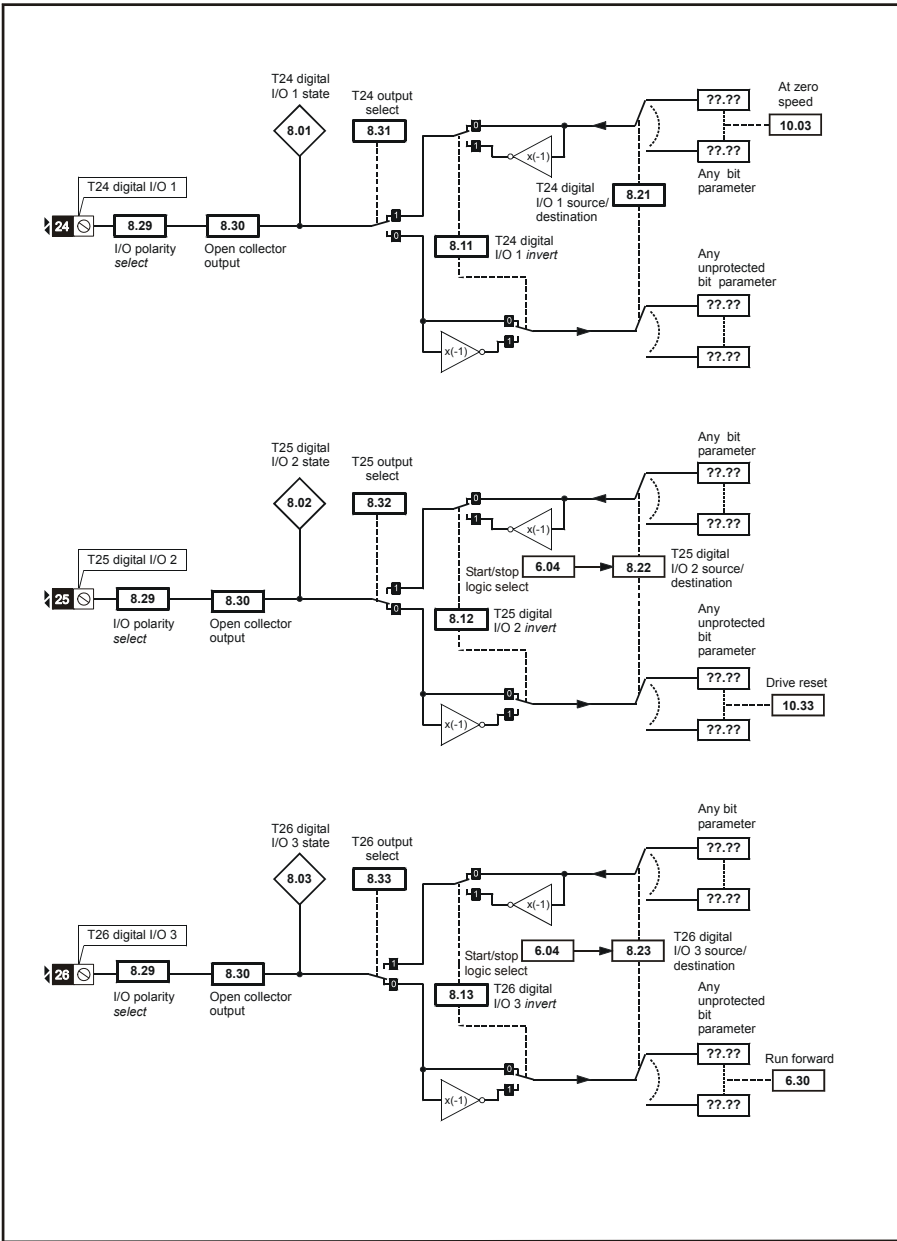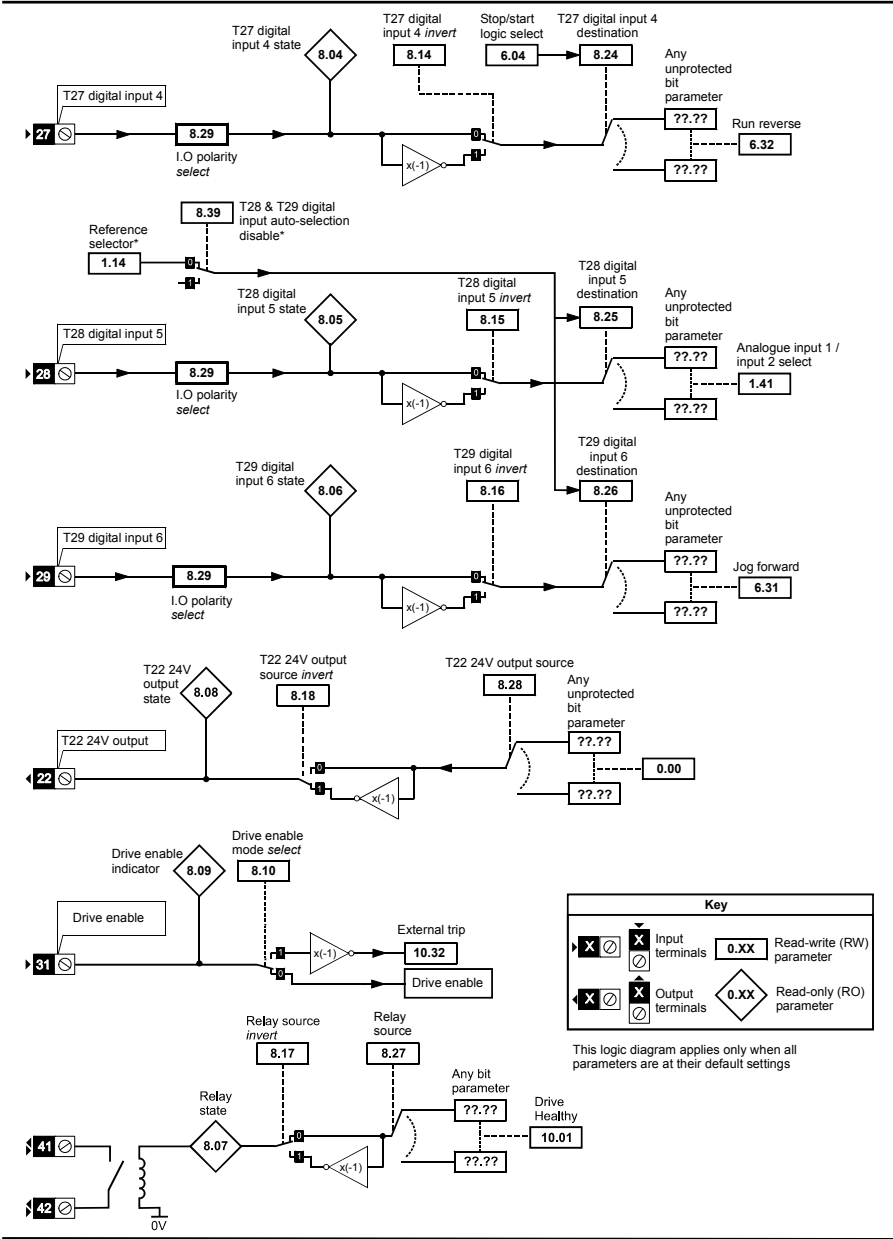## 9.12 Menu 12: Threshold detectors, variable selectors and brake control function

Figure 9-16   Menu 12 logic diagram

Figure 9-17   Menu 12 logic diagram (continued)

Variable Selector 1

Any variable parameter

| ??.?? |

| ??.?? |

Variable selector 1 input 1 scaling

| 12.13 |

| 12.08 | Variable selector 1 input 1 source

Any variable parameter

| ??.?? |

| ??.?? |

Variable selector 1 input 2 scaling

| 12.14 |

| 12.09 | Variable selector 1 input 2 source

| 12.10 | Variable selector 1 mode

| 12.15 | Variable selector 1 control

Variable selector 1 output indicator

⟨ 12.12 ⟩

Variable selector 1 output destination

| 12.11 |

Any unprotected variable parameter

| ??.?? |

| ??.?? |

Variable Selector 2

Any variable parameter

| ??.?? |

| ??.?? |

Variable selector 2 input 1 scaling

| 12.33 |

| 12.28 | Variable selector 2 input 1 source

Any variable parameter

| ??.?? |

| ??.?? |

Variable selector 2 input 2 scaling

| 12.34 |

| 12.29 | Variable selector 2 input 2 source

| 12.30 | Variable selector 2 mode

| 12.35 | Variable selector 2 control

Variable selector 2 output indicator

⟨ 12.32 ⟩

Variable selector 2 output destination

| 12.31 |

Any unprotected variable parameter

| ??.?? |

| ??.?? |

Key

| X ⊘ ▼ X ⊘ | Input terminals | 0.XX | Read-write (RW) parameter |
| X ⊘ ▲ X ⊘ | Output terminals | ◇ 0.XX | Read-only (RO) parameter |

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

Figure 9-18   Open-loop brake function

Figure 9-19 Open-loop brake sequence

Pr **12.44** Brake release frequency

Pr **12.45** Brake apply frequency

Pr **5.01** Output frequency

Pr **12.42** Upper current threshold

Pr **4.01** Current magnitude

Pr **10.02** Drive active

Pr **1.11** Reference on

Pr **12.40** Brake release

Pr **2.03** Ramp hold

1 2 3 4 5 6

Pr **12.46** Pr **12.47**

1. Wait for upper current threshold and brake release frequency
2. Pre-brake release delay
3. Post-brake release delay
4. Wait for brake apply frequency
5. Wait for zero frequency
6. 1s delay as phase 2 of stopping sequence (Pr **6.01**=1,2 or 3)

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

Figure 9-20   Closed-loop brake function

Figure 9-21   Closed-loop brake sequence

Pr **12.45** Brake apply speed

Pr **3.02** Output frequency

Pr **4.01** Current magnitude

Pr **10.02** Drive active

Pr **1.11** Reference on

Pr **12.40** Brake release

Pr **2.03** Ramp hold
Pr **13.10** Position control mode

Pr **6.08** Hold zero speed

1   2   3   4   5

Pr **12.47**   Pr **12.46** Pr **12.48**

1. Wait for motor fluxed (closed-loop vector only)
2. Post-brake release delay
3. Wait for speed threshold
4. Wait for brake apply speed delay
5. Brake apply delay

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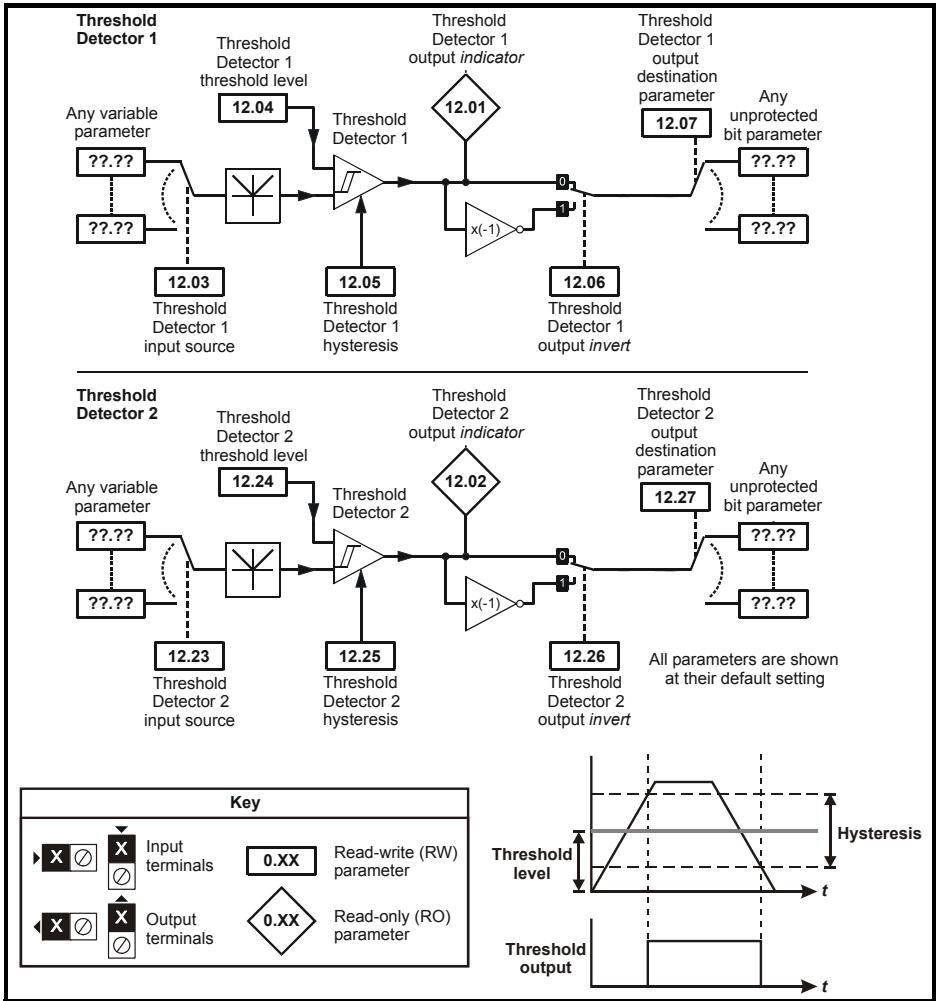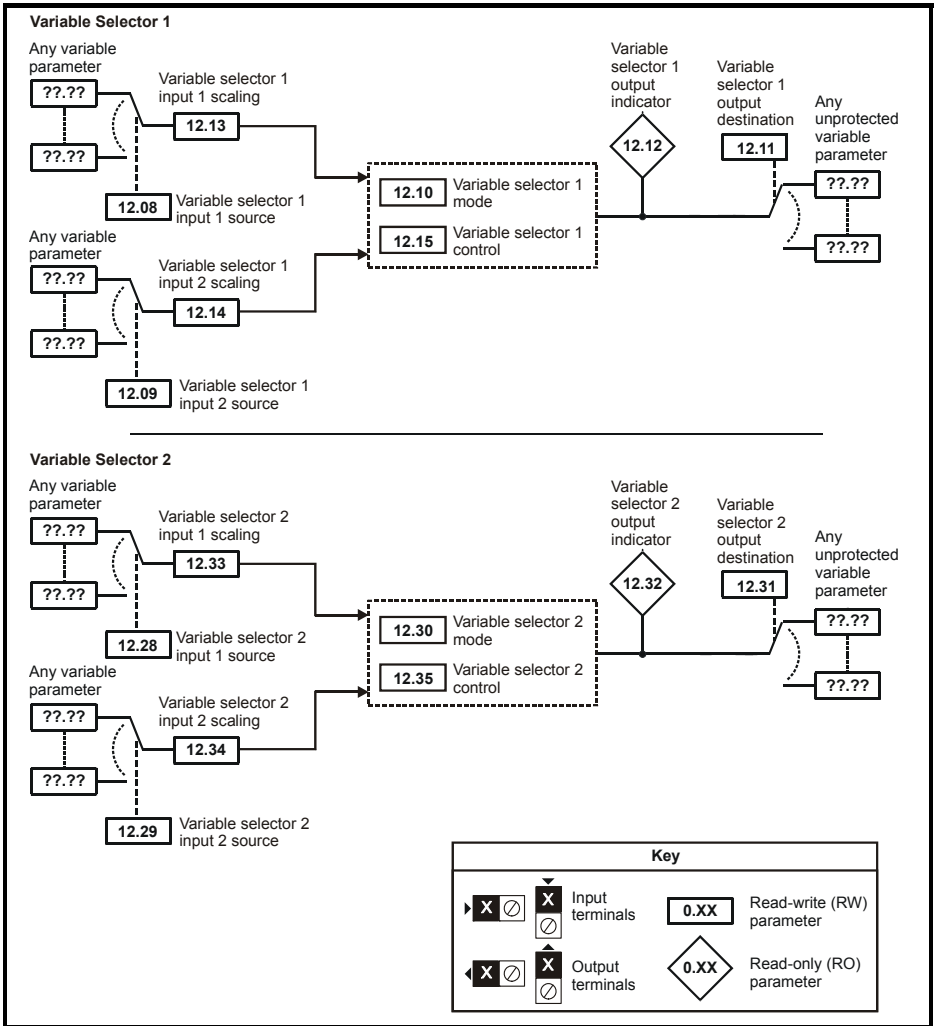Information

9.13 Menu 13: Position control

Figure 9-22 Menu 13 Open-loop logic diagram

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Frequency/speed
reference
selected

1.01

Pre-ramp
reference

1.03

Menu 2
Ramp Control

Post-ramp
reference

2.01

Velocity
feed-
forward

1.39

1.40

Velocity feed
-forward
select

Position
controller
mode*

13.10

13.10 = 1 or 2

Position loop
disabled

0
1
2

+

−

Position loop error

13.01 **13.02** **13.03**

Revolution Position Fine
Position

Position
controller
P gain

13.09

13.12
Position
controller
speed clamp

Key		
X ⊘ / X ⊘ Input terminals	**0.XX**	Read-write (RW) parameter
X ⊘ / X ⊘ Output terminals	**0.XX**	Read-only (RO) parameter
This logic diagram applies only when all parameters are at their default settings		

Figure 9-23 Menu 13 Closed-loop logic diagram
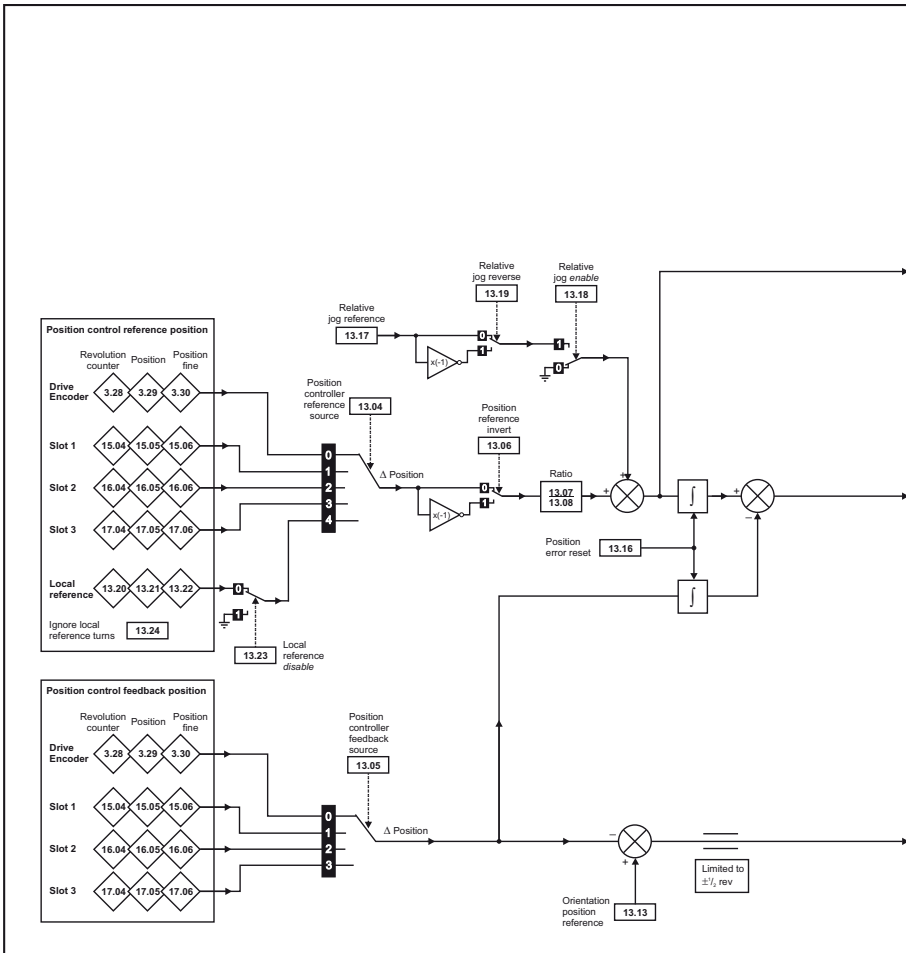
*For more information, refer to Position Modes in the *Unidrive SP User Guide* on the CD Rom supplied with the drive.
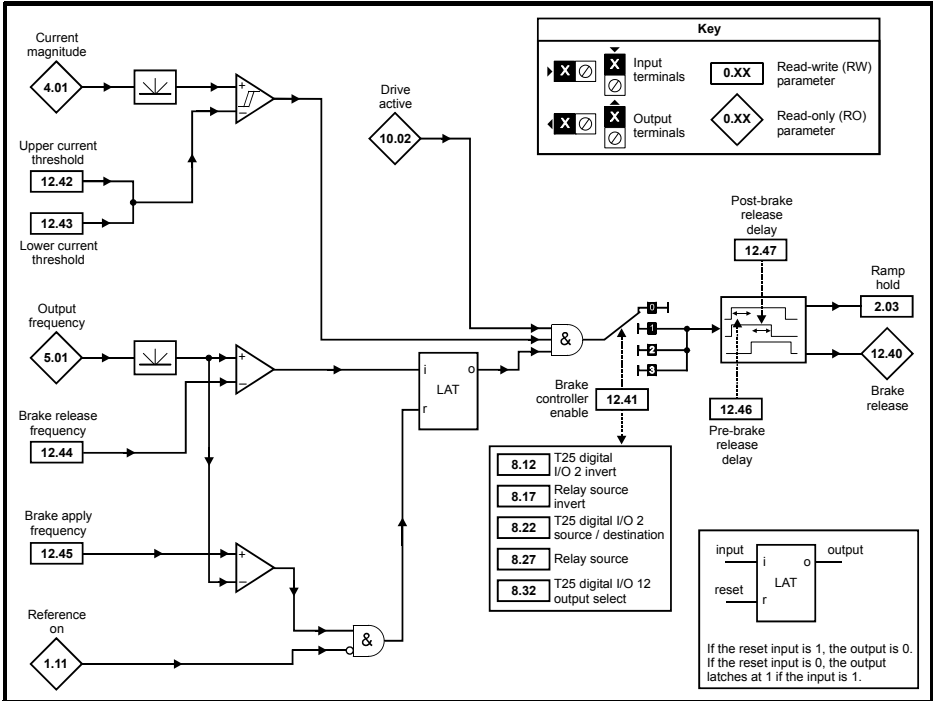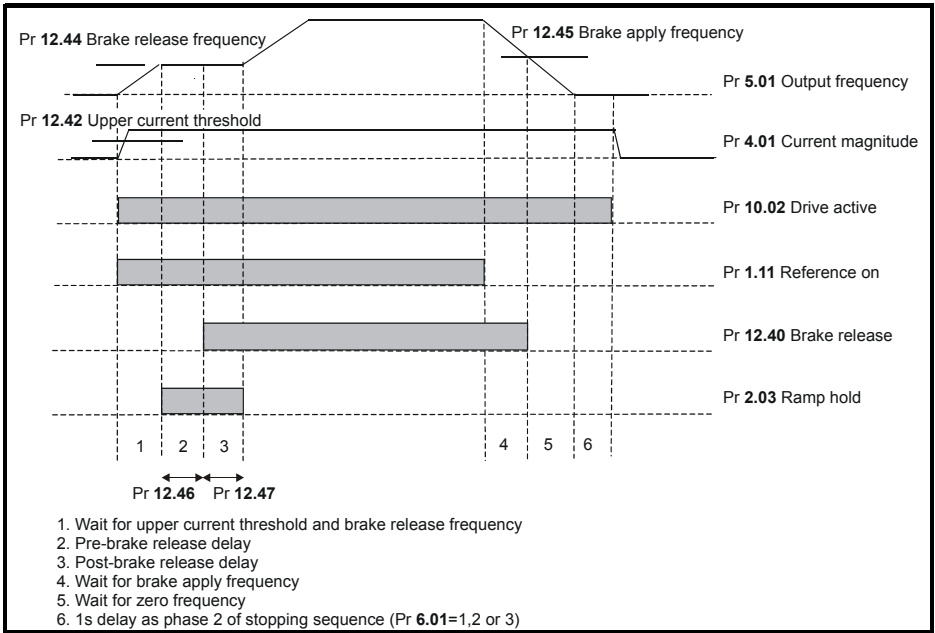
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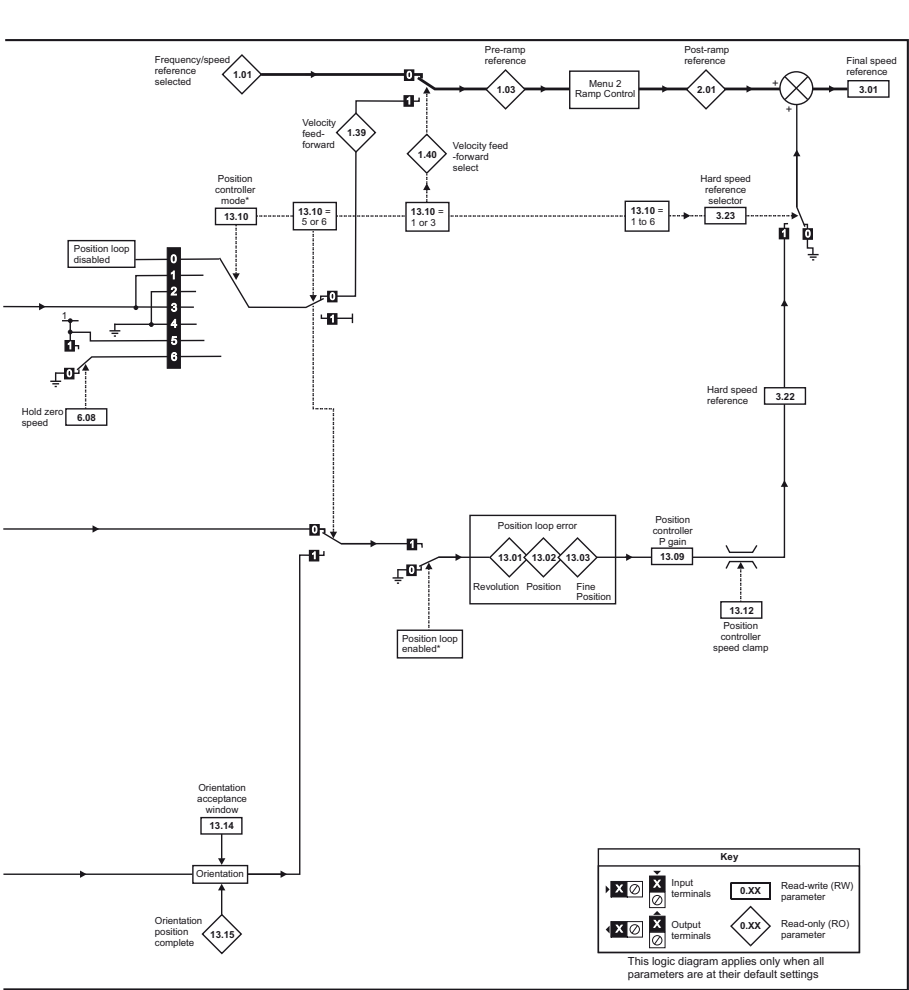
9.14　Menu 14: User PID controller

Figure 9-24　Menu 14 Logic diagram

Main reference
source parameter

14.02

Any variable
parameter

??.??

PID Main
reference

??.??

14.19

PID reference
source parameter

14.03

Any variable
parameter

??.??

PID
reference

??.??

14.20

PID reference
source *invert*

14.05

PID reference
slew-rate limit

14.07

PID
error

14.22

x(-1)

PID feedback
source parameter

14.04

Any variable
parameter

??.??

PID
feedback

??.??

14.21

PID feedback
source *invert*

14.06

x(-1)

PID
enable

14.08

Drive normal
indicator

10.01

&

Any bit
parameter

Logic 1
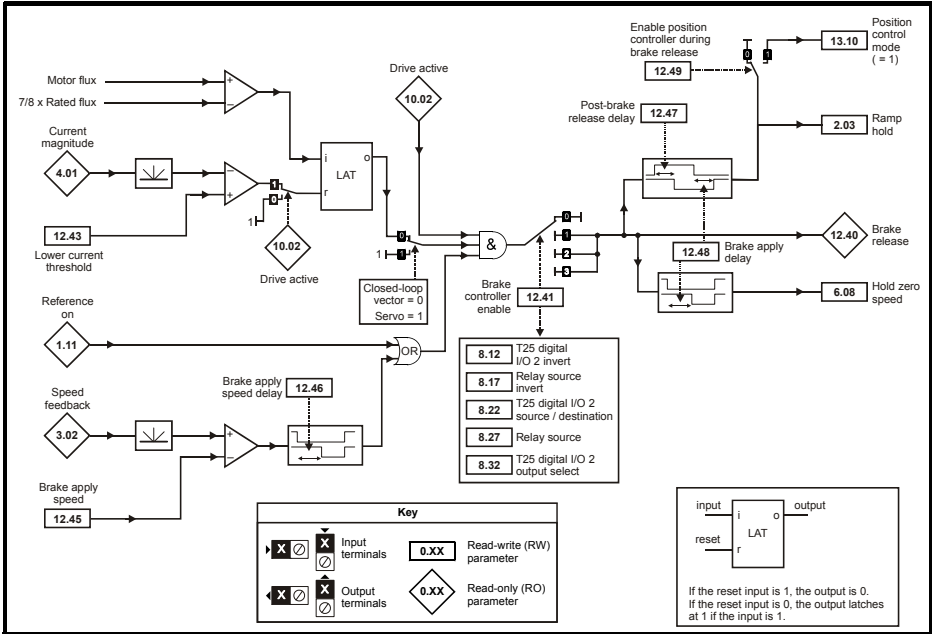
??.??

??.??

14.09

Source
not used

Optional PID
enable source
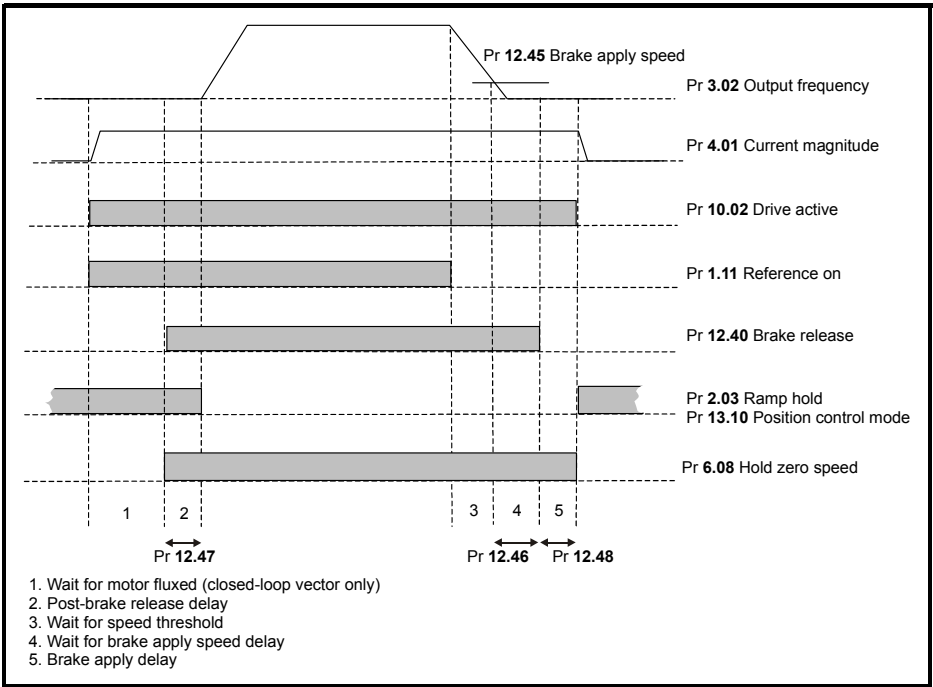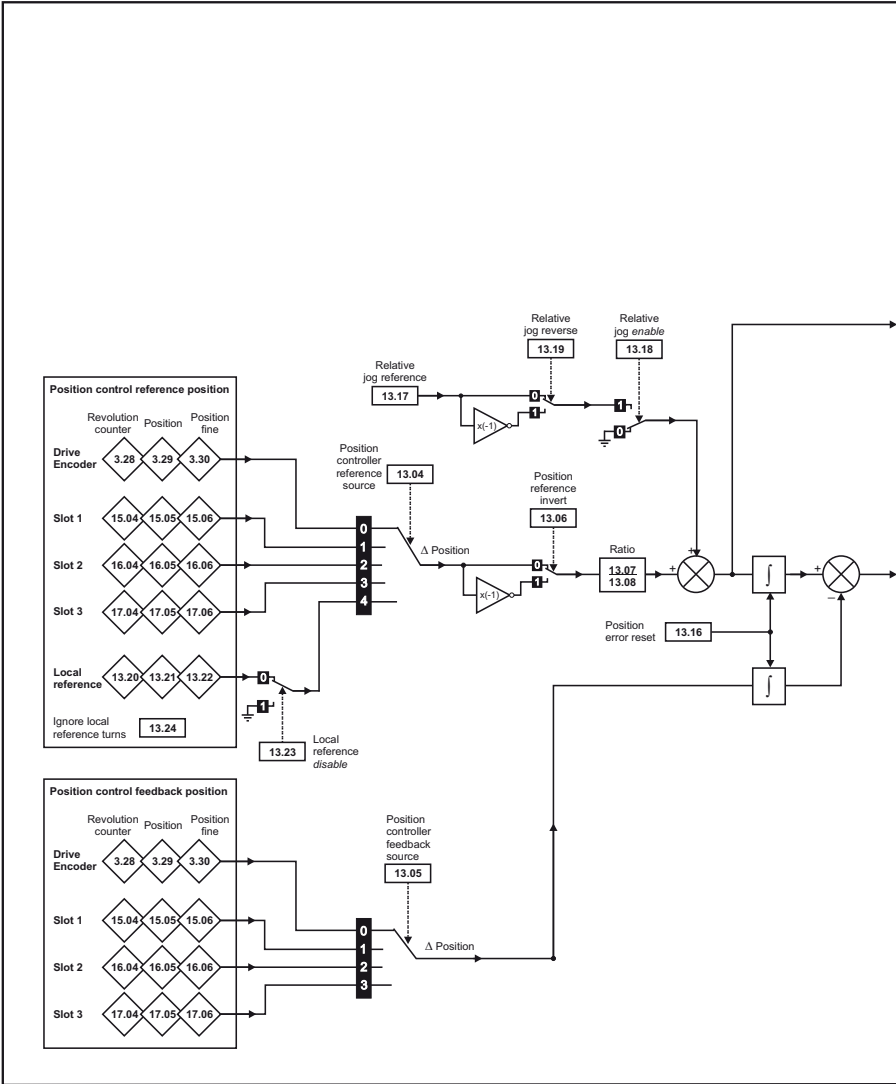parameter

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PID hold
integrator *enable*

14.17

14.10
PID proportional
gain

14.11
PID integral
gain

14.12
PID derivative
gain

14.13 PID output
high limit

14.14 PID output
low limit

14.18 PID symmetrical
limits *enable*

PID controller
output

14.01

PID output
scale factor

14.15

PID output
destination
parameter*

14.16

Any
unprotected
variable
parameter

??.??

??.??

Key			
X ⊘ **X** ⊘	Input terminals	**0.XX**	Read-write (RW) parameter
X ⊘ **X** ⊘	Output terminals	◇ **0.XX**	Read-only (RO) parameter

The parameters are all shown at their default settings

*The PID controller is only controlled if Pr **14.16** is set to a non Pr **xx.00** and unprotected
destination parameter.

9.15 Menus 15, 16 & 17: Solutions Module set-up

Parameters common to all Solutions Modules. Refer to the Solutions Module user guide for more information.

Parameter	
x.01	Solutions Module ID
x.50	Solutions Module error status

Pr x.01	Module
0	No module installed
101	SM-Resolver
102	SM-Universal Encoder Plus
104	SM-Encoder Plus / SM-Encoder Output Plus
201	SM-I/O Plus
203	SM-I/O Timer
204	SM-I/O PELV
205	SM-I/O 24V Protected
206	SM-I/O120V
207	SM-I/O Lite
208	SM-I/O 32
301	SM-Applications
302	SM-Applications Lite
303	SM-EZMotion
304	SM-Applications Plus
305	SM-Applications Lite-V2
306	SM-Safety
401	SM-LON
403	SM-PROFIBUS-DP-V1
404	SM-INTERBUS
406	SM-CAN
407	SM-DeviceNet
408	SM-CANopen
409	SM-SERCOS
410	SM-Ethernet
421	SM-EtherCAT
501	SM-SLM

9.16 Menu 18, 19 & 20: Application menu 1, 2 & 3

Parameter	
18.01 (1) **19.01 (2)**	Power-down saved integer
18.02 - 18.10 (1) **19.02 - 19.10 (2)**	Read-only integer
18.11 - 18.30 (1) **19.11 - 19.30 (2)** **20.01 - 20.20 (3)**	Read-write integer
18.31 - 18.50 (1) **19.31 - 19.50 (2)**	Read-write bit
20.21 - 20.40 (3)	Read-write long integer

9.17 Menu 21: Second motor parameters

Parameter		
21.01	Maximum reference clamp	{0.02}
21.02	Minimum reference clamp	{0.01}
21.03	Reference selector	{0.05}
21.04	Acceleration rate	{0.03}
21.05	Deceleration rate	{0.04}
21.06	Rated frequency	{0.47}
21.07	Rated current	{0.46}
21.08	Rated load rpm	{0.45}
21.09	Rated voltage	{0.44}
21.10	Rated power factor	{0.43}
21.11	Number of motor poles	{0.42}
21.12	Stator resistance	
21.13	Voltage offset	
21.14	Transient inductance (σL_s)	
21.15	Motor 2 active	
21.16	Thermal time constant	{0.45}
21.17	Speed controller Kp gain	{0.07}
21.18	Speed controller Ki gain	{0.08}
21.19	Speed controller Kd gain	{0.09}
21.20	Encoder phase angle	{0.43}
21.21	Speed feedback selector	
21.22	Current controller Kp gain	{0.38}
21.23	Current controller Ki gain	{0.39}
21.24	Stator inductance (L_s)	
21.25	Motor saturation breakpoint 1	
21.26	Motor saturation breakpoint 2	
21.27	Motoring current limit	
21.28	Regen current limit	
21.29	Symmetrical current limit	{0.06}
21.30	Motor volts per 1,000 rpm, K_e	
21.31	Motor pole pitch	

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9.18   Menu 22: Additional Menu 0 set-up

Parameter	
22.01	Pr **0.31** set-up
22.02	Pr **0.32** set-up
22.03	Pr **0.33** set-up
22.04	Pr **0.34** set-up
22.05	Pr **0.35** set-up
22.06	Pr **0.36** set-up
22.07	Pr **0.37** set-up
22.10	Pr **0.40** set-up
22.11	Pr **0.41** set-up
22.18	Pr **0.48** set-up
22.20	Pr **0.50** set-up
22.21	Pr **0.51** set-up
22.22	Pr **0.52** set-up
22.23	Pr **0.53** set-up
22.24	Pr **0.54** set-up
22.25	Pr **0.55** set-up
22.26	Pr **0.56** set-up
22.27	Pr **0.57** set-up
22.28	Pr **0.58** set-up
22.29	Pr **0.59** set-up

10 Diagnostics

Table 10-1 Trip indications

Trip	Diagnosis
br.th	**Internal braking resistor thermistor temperature monitoring fail (SPz only)**
10	If no internal brake resistor is installed, set Pr **0.51** (or Pr **10.37**) to 8 to disable this trip. If an internal brake resistor is installed: • Ensure that the internal braking resistor thermistor is connected correctly • Ensure that the fan in the drive is working correctly • Replace the internal braking resistor
C.Acc	**SMARTCARD trip: SMARTCARD Read / Write fail**
185	Check SMARTCARD is installed / located correctly Replace SMARTCARD
C.boot	**SMARTCARD trip: The menu 0 parameter modification cannot be saved to the SMARTCARD because the necessary file has not been created on the SMARTCARD**
177	A write to a menu 0 parameter has been initiated via the keypad with Pr **11.42** set to auto(3) or boot(4), but the necessary file on the SMARTCARD has not bee created Ensure that Pr **11.42** is correctly set and reset the drive to create the necessary file on the SMARTCARD Re-attempt the parameter write to the menu 0 parameter
C.bUSY	**SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module**
178	Wait for the Solutions Module to finish accessing the SMARTCARD and then re-attempt the required function
C.Chg	**SMARTCARD trip: Data location already contains data**
179	Erase data in data location Write data to an alternative data location
C.cPr	**SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different**
188	Press the red ⊗ reset button
C.dAt	**SMARTCARD trip: Data location specified does not contain any data**
183	Ensure data block number is correct
C.Err	**SMARTCARD trip: SMARTCARD data is corrupted**
182	Ensure the card is located correctly Erase data and retry Replace SMARTCARD
C.Full	**SMARTCARD trip: SMARTCARD full**
184	Delete a data block or use different SMARTCARD
cL2	**Analog input 2 current loss (current mode)**
28	Check analog input 2 (terminal 7) current signal is present (4-20mA, 20-4mA)
cL3	**Analog input 3 current loss (current mode)**
29	Check analog input 3 (terminal 8) current signal is present (4-20mA, 20-4mA)
CL.bit	**Trip initiated from the control word (Pr 6.42)**
35	Disable the control word by setting Pr **6.43** to 0 or check setting of Pr **6.42**
ConF.P	**The number of power modules installed no longer matches the value stored in Pr 11.35**
111	Ensure that all power modules are correctly connected Ensure that all power modules have powered up correctly Ensure that the value in Pr **11.35** matches the number of power modules connected
C.OPtn	**SMARTCARD trip: Solutions Modules installed are different between source drive and destination drive**
180	Ensure correct Solutions Modules are installed Ensure Solutions Modules are in the same Solutions Module slot Press the red ⊗ reset button

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Trip	Diagnosis
C.Prod	**SMARTCARD trip: The data blocks on the SMARTCARD are not compatible with this product**
175	Erase all data on the SMARTCARD by setting Pr **xx.00** to 9999 and pressing the red ⊛ reset button Replace SMARTCARD
C.rdo	**SMARTCARD trip: SMARTCARD has the Read Only bit set**
181	Enter 9777 in Pr **xx.00** to allow SMARTCARD Read / Write access Ensure card is not writing to data locations 500 to 999
C.rtg	**SMARTCARD trip: The voltage and/or current rating of the source and destination drives are different**
186	Drive rating dependent parameters (parameters with the RA coding) are likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will not be transferred to the destination drive by SMARTCARDs when the rating of the destination drive is different from the source drive and the file is a parameter file. However, with software V01.09.00 and later drive rating dependent parameters will be transferred if only the current rating is different and the file is a differences from default type file. Press the red ⊛ reset button Drive rating parameters are:

Parameter	Function
2.08	Standard ramp voltage
4.05/6/7, **21.27/8/9**	Current limits
4.24	User current maximum scaling
5.07, **21.07**	Motor rated current
5.09, **21.09**	Motor rated voltage
5.10, **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.

Trip	Diagnosis
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 while running**
191	Check the encoder signal for noise Check encoder shielding Check the integrity of the encoder mechanical mounting Repeat the offset measurement test
Enc4	**Drive encoder trip: Feedback device comms failure**
192	Ensure encoder power supply is correct Ensure baud rate is correct Check encoder wiring Replace feedback device
Enc5	**Drive encoder trip: Checksum or CRC error**
193	Check the encoder signal for noise Check the encoder cable shielding With EnDat encoders, check the comms resolution and/or carry out the auto-configuration Pr **3.41**
Enc6	**Drive encoder trip: Encoder has indicated an error**
194	Replace feedback device With SSI encoders, check the wiring and encoder supply setting
Enc7	**Drive encoder trip: Initialisation failed**
195	Re-set the drive Check the correct encoder type is entered into Pr **3.38** Check encoder wiring Check encoder power supply is set correctly Carry out the auto-configuration Pr **3.41** Replace feedback device
Enc8	**Drive encoder trip: Auto configuration on power up has been requested and failed**
196	Change the setting of Pr **3.41** to 0 and manually enter the drive encoder turns (Pr **3.33**) and the equivalent number of lines per revolution (Pr **3.34**) Check the comms resolution
Enc9	**Drive encoder trip: Position feedback selected is selected from a Solutions Module slot which does not have a speed / position feedback Solutions Module installed**
197	Check setting of Pr **3.26** (or Pr **21.21** if the second motor parameters have been enabled)
Enc10	**Drive encoder trip: 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 analog signals of a SINCOS encoder with the digital count derived from the sine and cosine waveforms and the comms position (if applicable). This fault is usually due to noise on the sine and cosine signals.**
161	Check encoder cable shield. Examine sine and cosine signals for noise.
Enc12	**Drive encoder trip: Hiperface encoder - The encoder type could not be identified during auto-configuration**
162	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
Enc13	**Drive encoder trip: EnDat encoder - The number of encoder turns read from the encoder during auto-configuration is not a power of 2**
163	Select a different type of encoder.
Enc14	**Drive encoder trip: EnDat encoder - The number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.**
164	Select a different type of encoder. Faulty encoder.

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Trip	Diagnosis
Enc15	**Drive encoder trip: The number of periods per revolution calculated from encoder data during auto-configuration is either less than 2 or greater than 50,000.**
165	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.
Enc16	**Drive encoder trip: EnDat encoder - The number of comms bits per period for a linear encoder exceeds 255.**
166	Select a different type of encoder. Faulty encoder.
Enc17	**Drive encoder trip: The periods per revolution obtained during auto-configuration for a rotary SINCOS encoder is not a power of two.**
167	Select a different type of encoder. Faulty encoder.
ENP.Er	**Data error from electronic nameplate stored in selected position feedback device**
176	Replace feedback device
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 open or short circuit**
217	Hardware fault - return drive to supplier
HF18	**Multi-module system interconnect cable error**
218	Hardware fault - return drive to supplier

Trip	Diagnosis
HF19	**Temperature feedback multiplexing failure, or thermistor is open or short circuit**
219	Hardware fault - return drive to supplier
HF20	**Power stage recognition: serial code error**
220	Hardware fault - return drive to supplier
HF21	**Power stage recognition: unrecognised frame size**
221	Hardware fault - return drive to supplier
HF22	**Power stage recognition: multi module frame size mismatch**
222	Hardware fault - return drive to supplier
HF23	**Power stage recognition: multi module voltage rating mismatch**
223	Hardware fault - return drive to supplier
HF24	**Power stage recognition: unrecognised drive size**
224	Hardware fault - return drive to supplier
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)**
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	**Internal capacitor bank fan failure (size 4 and larger) or a module has not powered up in a multi-module parallel drive**
231	Check the AC or DC power supply to all modules in a multi-module parallel drive If the AC or DC power supply is present then it is a hardware fault - return drive to the supplier
HF32	**Power stage - Identification and trip information serial code error**
232	Hardware fault - return drive to the supplier
It.AC	**Output current overload timed out (I^2t) - accumulator value can be seen in Pr 4.19**
20	Ensure the load is not jammed / sticking 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
L.SYnC	**Drive failed to synchronize to the supply voltage in Regen mode**
39	Refer to the *Diagnostics* chapter in the *Unidrive SP Regen Installation Guide*.
O.CtL	**Drive control board over temperature**
23	Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Check ambient temperature Reduce drive switching frequency

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Trip	Diagnosis
O.ht1	**Power device over temperature based on thermal model**
21	Reduce drive switching frequency Reduce duty cycle Decrease acceleration / deceleration rates Reduce motor load
O.ht2	**Heatsink over temperature**
22	Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
Oht2.P	**Power module heatsink over temperature**
105	Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
O.ht3	**Drive over-temperature based on thermal model**
27	The drive will attempt to stop the motor before tripping. If the motor does not stop in 10s the drive trips immediately. Check enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure 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 enclosure / drive fans are still functioning correctly Check enclosure ventilation paths Check enclosure door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
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)

Trip	Diagnosis
OIAC.P	**Power module over current detected from the module output currents**

104	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
OIbr.P	**Power module braking IGBT over current**
103	Check braking resistor wiring Check braking resistor value is greater than or equal to the minimum resistance value Check braking resistor insulation
OIdC.P	**Power module over current detected from IGBT on state voltage monitoring**
109	Vce IGBT protection activated. Check motor and cable 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)
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**.

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Trip	Diagnosis
OV.P	**Power module DC bus voltage has exceeded the peak level or the maximum continuous level for 15 seconds**

106	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**.

PAd	**Keypad has been removed when the drive is receiving the speed reference from the keypad**
34	Fit keypad and reset Change speed reference selector to select speed reference from another source
PH	**AC voltage input phase loss or large supply imbalance detected**
32	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load) **NOTE** Load level must be between 50 and 100% for the drive to trip under phase loss conditions. The drive will attempt to stop the motor before this trip is initiated.
PH.P	**Power module phase loss detection**
107	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load)
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
PS.P	**Power module power supply fail**
108	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
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.

Trip	Diagnosis
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 installed in slot X changed**
204, 209, 214	Save parameters and reset
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202, 207, 212	Check value in Pr **15**/**16**/**17.50**. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.
SLX.HF	**Solutions Module slot X trip: Solutions Module X hardware fault**
200, 205, 210	Ensure Solutions Module is installed correctly Return Solutions Module to supplier
SLX.nF	**Solutions Module slot X trip: Solutions Module has been removed**
203, 208, 213	Ensure Solutions Module is installed correctly Re-fit Solutions Module Save parameters and reset drive
SL.rtd	**Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect**
215	Press reset. If the trip persists, contact the supplier of the drive.
SLX.tO	**Solutions Module slot X trip: Solutions Module watchdog timeout**
201,206,21 1	Press reset. If the trip persists, contact the supplier of the drive.
t038	**User trip defined in 2nd processor Solutions Module code**
38	SM-Applications program must be interrogated to find the cause of this trip
t040 to t089	**User trip defined in 2nd processor Solutions Module code**
40 to 89	SM-Applications program must be interrogated to find the cause of this trip
t099	**User trip defined in 2nd processor Solutions Module code**
99	SM-Applications program must be interrogated to find the cause of this trip
t101	**User trip defined in 2nd processor Solutions Module code**
101	SM-Applications program must be interrogated to find the cause of this trip
t112 to t160	**User trip defined in 2nd processor Solutions Module code**
112 to 160	SM-Applications program must be interrogated to find the cause of this trip
t168 to t174	**User trip defined in 2nd processor Solutions Module code**
168 to 174	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 SAFE TORQUE OFF signal (terminal 31) was active during the autotune procedure

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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 Ensure that Pr **3.26** is set correctly Check feedback parameters are set correctly Check encoder coupling to motor
tunE2*	**Position feedback direction incorrect or motor could not be stopped during the inertia test (see Pr 5.12)**
12	Check motor cable wiring is correct Check feedback device wiring is correct Swap any two motor phases (closed loop vector only)
tunE3*	**Drive encoder commutation signals connected incorrectly or measured inertia out of range (see Pr 5.12)**
13	Check motor cable wiring is correct Check feedback device U,V and W commutation signal wiring is correct
tunE4*	**Drive encoder U commutation signal fail during an autotune**
14	Check feedback device U phase commutation wires continuity Replace encoder
tunE5*	**Drive encoder V commutation signal fail during an autotune**
15	Check feedback device V phase commutation wires continuity Replace encoder
tunE6*	**Drive encoder W commutation signal fail during an autotune**
16	Check feedback device W phase commutation wires continuity Replace encoder
tunE7*	**Motor number of poles set incorrectly**
17	Check lines per revolution for feedback device Check the number of poles in Pr **5.11** is set correctly
Unid.P	**Power module unidentified trip**
110	Check all interconnecting cables between power modules Ensure cables are routed away from electrical noise sources
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

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Trip	Diagnosis		
UV	**DC bus under voltage threshold reached**		
1	Check AC supply voltage level		
	Drive voltage rating (Vac)	**Under voltage threshold (Vdc)**	**UV reset voltage (Vdc)**
	200	175	215
	400	350	425
	575 & 690	435	590

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", "Lt" and "PLC" the drive may eventually trip. Alarms flash once every 640ms except "PLC" which flashes once every 10s. Alarms are not displayed when a parameter is being edited.

Table 10-2 Alarm indications

Lower display	Description
br.rS	Braking resistor overload
Braking resistor I^{2}t 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^{2}t 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%	
Auto tune	Autotune in progress
The autotune procedure has been initialised 'Auto' and 'tunE' will flash alternatively on the display.	
Lt	Limit switch is active
Indicates that a limit switch is active and that it is causing the motor to be stopped (i.e. forward limit switch with forward reference etc.)	
PLC	Onboard PLC program is running
An Onboard PLC program is installed and running. The lower display will flash 'PLC' once every 10s.	

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Status indications

Table 10-3   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.	
dc	DC applied to the motor	Enabled
	The drive is applying DC injection braking.	
dEC	Decelerating	Enabled
	The drive is decelerating the motor.	
inh	Inhibit	Disabled
	The drive is inhibited and cannot be run. The drive enable signal is not applied to terminal 31 or Pr **6.15** is set to 0.	
POS	Positioning	Enabled
	The drive is positioning/orientating the motor shaft.	
rdY	Ready	Disabled
	The drive is ready to be run.	
run	Running	Enabled
	The drive is running.	
SCAn	Scanning	Enabled
	Regen> The drive is enabled and is synchronising to the line.	
StoP	Stop or holding zero speed	Enabled
	The drive is holding zero speed. Regen> The drive is enabled but the AC voltage is too low, or the DC bus voltage is still rising or falling.	
triP	Trip condition	Disabled
	The drive has tripped and is no longer controlling the motor. The trip code appears on the upper display.	

Table 10-4   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.	
loAding	
The drive is writing information to a Solutions Module.	

11 UL Listing Information

SPz drives have been assessed to meet UL requirements.

Size 1 to 6 drives have been assessed to meet both UL and cUL requirements.

Confirmation of UL listing can be found on the UL website: www.ul.com.

Common UL information

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

- The drive is installed in a type 1 enclosure, or better, as defined by UL50
- The surrounding air temperature does not exceed 40°C (104°F) when the drive is operating
- The terminal tightening torques specified in Figure 3-8 *Features of the SPz to size 6 drive* on page 30.
- If the drive control stage is supplied by an external power supply (+24V), the external power supply must be a UL Class 2 power supply

Motor overload protection
The drive provides motor overload protection. The default overload protection level is no higher than 150% of full-load current (FLC) of the drive in open loop mode and no higher than 175% of full-load current (FLC) of the drive in closed loop vector or servo modes. It is necessary for the motor rated current to be entered into Pr **0.46** (or Pr **5.07**) for the protection to operate correctly. The protection level may be adjusted below 150% if required. Refer to the *Unidrive SP User Guide* for more information. The drive also provides motor thermal protection. Refer to the *Motor thermal protection* section of the *Unidrive SP User Guide*.

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

Power dependant UL information

SPz to size 6

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

Fuses
SPz to size 3
- The correct UL-listed fast acting fuses (class CC or class J up to 30A and class J above 30A), e.g. Bussman Limitron KTK-R series, Ferraz Shawmut ATMR series or equivalent, are used in the AC supply. The drive does not comply with UL if MCBs are used in place of fuses.

For further details on fusing, refer to Table 2-1 in section 2.1 *Ratings* on page 8.

Size 4 to 6
- The UL-listed Ferraz HSJ (High speed J class) fuses are used in the AC supply. The drive does not comply with UL if any other fuses or MCBs are used in place of those stated.

For further details on fusing, refer to Table 2-4 in section 2.1 *Ratings* on page 8.

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Field wiring

SPz to size 4

• Class 1 60/75°C (140/167°F) copper wire only is used in the installation

Size 5 and 6

• Class 1 75°C (167°F) copper wire only is used in the installation

Field wiring connectors

Sizes 4 to 6

• UL listed wire connectors are used for terminating power circuit field wiring, e.g. Ilsco TA series

AC supply specification

The drive is suitable for use in a circuit capable of delivering not more than 100,000rms symmetrical Amperes at 264Vac rms maximum (200V drives), 528Vac rms maximum (400V drives) or 600Vac rms maximum (575V and 690V drives).

Maximum continuous output current

The drive models are listed as having the maximum continuous output currents (FLC) shown in Table 11-1, Table 11-2, Table 11-3 and Table 11-4.

Table 11-1   Maximum continuous output current (200V drives)

Model	FLC (A)	Model	FLC (A)
0201	2.2	2201	15.5
0202	3.1	2202	22
0203	4.0	2203	28
0204	5.7	3201	42
0205	7.5	3202	54
1201	5.2	4201	68
1202	6.8	4202	80
1203	9.6	4203	104
1204	11	5201	130
		5202	154

Table 11-2   Maximum continuous output current (400V drives)

Model	FLC (A)	Model	FLC (A)
0401	1.3	2401	15.3
0402	1.7	2402	21
0403	2.1	2403	29
0404	3.0	2404	29
0405	4.2	3401	35
1401	2.8	3402	43
1402	3.8	3403	56
1403	5.0	4401	68
1404	6.9	4402	83
1405	8.8	4403	104
1406	11	5401	138
		5402	168
		6401	205
		6402	236

Table 11-3   Maximum continuous output current (575V drives)

Model	FLC (A)	Model	FLC (A)
3501	5.4	3505	16
3502	6.1	3506	22
3503	8.3	3507	27
3504	11		

Table 11-4   Maximum continuous output current (690V drives)

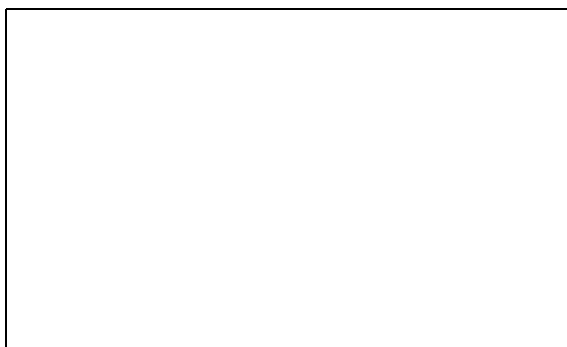| Model	FLC (A)	Model	FLC (A)
4601	22	5601	84
4602	27	5602	99
4603	36	6601	125
4604	43	6602	144
4605	52		
4606	62		

Safety label

The safety label supplied with the connectors and mounting brackets must be placed on a fixed part inside the drive enclosure where it can be seen clearly by maintenance personnel for UL compliance.

The label clearly states "CAUTION Risk of Electric Shock Power down unit 10 minutes before removing cover".

UL listed accessories

- SM-Keypad
- SM-Keypad Plus
- SM-I/O Plus
- SM-I/O Lite
- SM-Ethernet
- SM-CANopen
- SM-Universal Encoder Plus
- SM-Resolver
- SM-Encoder Plus
- SM-Encoder Output Plus
- 15-way D-type converter
- SM-Applications Plus
- SM-SERCOS
- SM-EtherCAT

- SM-PROFIBUS DP-V1
- SM-DeviceNet
- SM-I/O Timer
- SM-I/O 120V
- SM-CAN
- SM-INTERBUS
- SM-Applications Lite
- SM-Applications Lite-V2
- SM-SLM
- SM-Applications
- SM-I/O PELV
- SM-LON
- SM-I/O 24V Protected
- SM-I/O 32

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