CONTROL TECHNIQUES
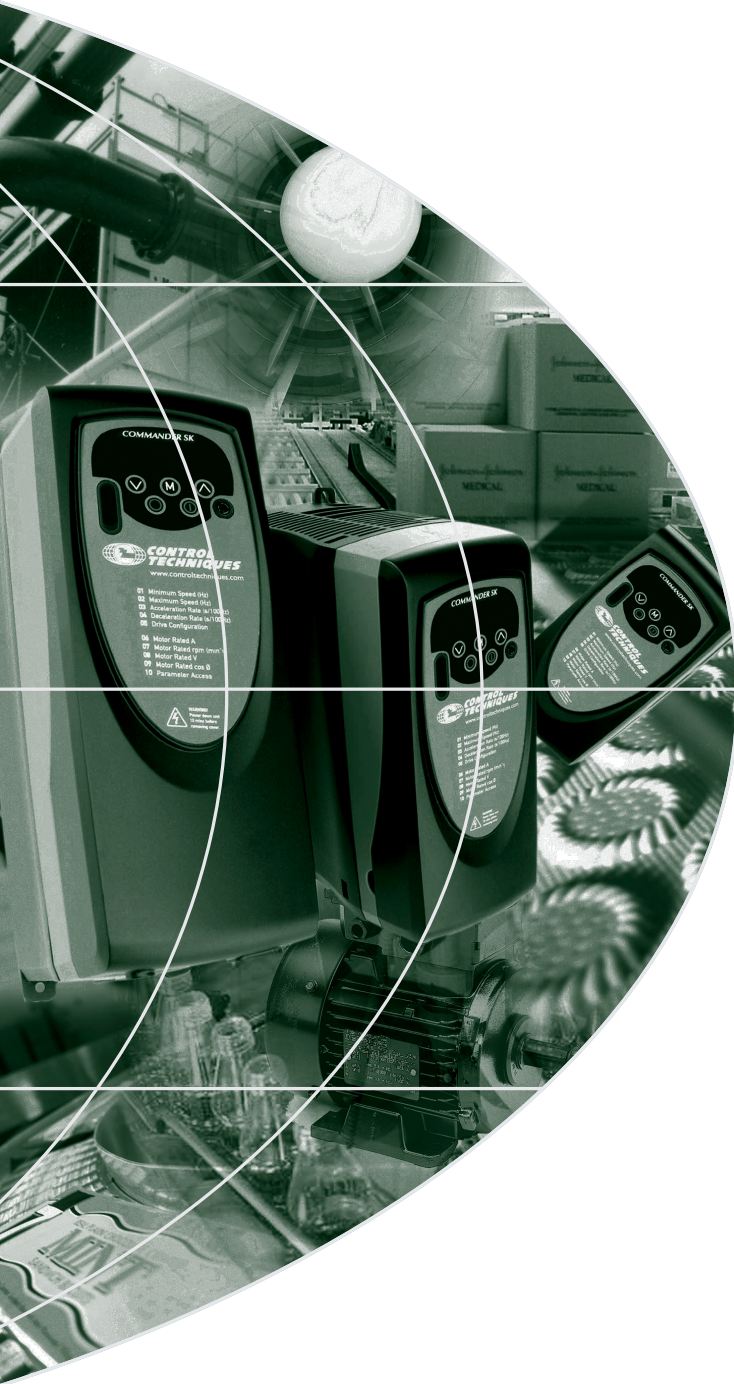
www.controltechniques.com

Commander SK

AC Variable speed drive for
3 phase induction motors.
0.25kW to 4kW,
0.33hp to 5hp

Product Data

www.controltechniques.com
???
HELP
www.controltechniques.com

Issue: 1

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional 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 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 content of the guide without notice.

Drive software version

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

If there is any doubt, please contact your local Control Techniques Drive Centre or Distributor.

Contents

1. Product Overview

1.1 Overview

Commander SK is the benchmark in simple and compact AC variable speed drives for use with three phase AC induction motors.

Responding to Customer Driven Priorities

Since its formation in 1973, Control Techniques has become a specialist dedicated to the design, manufacture and supply of AC and DC drives, servos and drive systems, and drive systems, with nearly 2 million drives commissioned to date. This dedication to understanding and satisfying customers needs ensures that we produce a range of world class products all designed to meet the varying application requirements of industry. In response to customer driven properties for a simple, easy to use, general purpose open loop inverter, Control Techniques have developed Commander SK.

Commander SK

The Commander SK is a simple and easy to use AC drive for use with AC induction motors. Sensorless vector mode or V/Hz mode is fully selectable by the user.

Sizes

There are three physical sizes comprising 15 different models. The input voltage ranges are single phase input, 200 to 240V, three phase input, 200 to 240V, three phase input 380 to 480V and are power dependent.

Simple to Use

Reducing complexity and cost is what Commander SK is all about. Commander SK, the benchmark in simple and compact AC drives, ensures a trouble free installation and rapid commissioning. The drive's first 10 parameters which are shown on the front cover are all that are required for 90% of applications.

Technology

Many of the features of Commander SK would not be possible without the use of advanced technology. The SK drive employs state of the art microprocessor technology which controls all drive functions. The drive incorporates 2 microprocessors, a DSP (Digital Signal Processor) which synthesises an adjustable carrier frequency PWM (Pulse Width Modulation) output controlling the IGBT (Insulated Gare Bipolar Transistor) inverter section and a microcontroller which handles the user interface functions. All printed circuit boards are manufactured using surface mount technology ensuring high quality and reliability.

1. Product Overview

1.2 General Features

- Minimum motor noise with maximum drive protection via unique intelligent Thermal Management (ITM)

- Modbus RTU RS485 serial communications as standard on all sizes

- Complies with power drive systems standard EN 61800-3 for the second environment 'Industrial sites' with its integral EMC filter

- Small enough to fit – big enough to use – plenty of space for cabling

- Plug-in fieldbus option modules that include: Profibus-DP, DeviceNet, CANopen, Interbus and Ethernet

- The mains dip ride-through feature gives maximum protection against expensive process stoppages and minimises product wastage, breakages and downtime

- Advanced parameters easily accessible if added flexibility and functionality are required

- Commander SK's advanced parameters give the user, via CTSoft and PC serial communications, access to advanced features such as:
  - PID Controller
  - kW hour meter
  - 8 preset speeds
  - Motorised potentiometer
  - Second motor map
  - Logic functions (and, or, timers etc)
  - Increased output frequency resolution (0.001 Hz) and lots more

- With true space vector modulation – open loop vector control, full motor torque is achieved down to 1 Hz

- Rugged, industrial 40°C ambient rating for applications where operating conditions are hot and tough

- IP20 rating for added protection

- Fast, accurate drive to drive parameter transfer and storage with the SmartStick option – saves time and money

- Coast & Ramp to Stop modes

- Programmable security code

'Simple to Install'

- Mounting can be either by screwing on to a backplate or clicking into the DINrail mounting bracket (sizes A and B only)

- Large easy access, power terminals

- Sprung control terminals for fast installation

- Quick installation with convenient cable management

- Power and control connections shown on the plastic inner cover

- Conduit entry directly onto solid metal gland plate option

- Commander SK up to 4 kW, fits 200mm deep cubicles

'Ease of Use' Features

- Only 10 parameters in level 1 menu covering over 90% of applications

- Multi-lingual 'Getting Started Guide' for fastest set-up

- No spin autotune for fast drive/motor optimisation

Further Information

See our website **www.ControlTechniques.com** for the Advanced User Guide and application examples.

1. Product Overview

1.3 Options and Flexibility

Functionality at your fingertips allows Commander SK to be configured to integrate into your machine or process easily and cost effectively.

	Order Code	Description	
Remote Keypad	SK-Keypad Remote	Remote panel mounting LED display to IP54 (NEMA 12) with additional function key	
	SM-Keypad Plus	Remote panel mounting LCD multilingual text keypad display to IP54 (NEMA 12) with additional help key. A PC software tool enables you to set up your own text lines)	
Parameter Storage	SmartStick	Upload drive parameters to the SmartStick for storage or for easy setup of identical drives or downloading to replacement drives	
Fieldbuses	SM-PROFIBUS DP	PROFI BUS	
	SM-DeviceNet	DeviceNet	
	SM-CANopen	CANopen	
	SM-INTERBUS	INTERBUS	
	SM-Ethernet	**Ethernet TCP/IP**	
Extra I/O	SM-I/O Lite	Additional I/O (1 x AI (± 10V bi-polar or 4-20mA), 1 x AO (0-10V or 4-20 mA), 3 x DI and 1 x Relay) as well as a speed reference input to connect a standard incremental encoder for accurate speed holding	
	SM-I/O Timer	As per SM-I/O Lite but with the addition of a Real Time Clock for scheduling drive running	
	SM-PELV	Isolated I/O to NAMUR NE37 specifications for chemical industry applications – from February 2005	
Software	CTSoft	Software for your PC or Laptop which allows you to commission and store parameter settings. Use with CT Comms Cable	FREE SOftware
	CT Comms Cable	Cable with isolation RS232 to RS485 converter. For connecting PC/Laptop to the drive when using CTSoft or SyPTLite	
PLC Functions	SyPTLite	Software for your PC or Laptop which allows you to program PLC functions within the drive. Use LogicStick with CT Comms Cable	FREE SOftware
	LogicStick	The LogicStick plugs into the front of the drive and enables you to program PLC functions within the drive	
Power Hardware	Additional EMC Filters	These additional filters are designed to operate together with the drive's own integral EMC filter in areas of sensitive equipment	
	Braking Resistors	For heavy or repetitive braking or deceleration duties	
	Gland Cover Size A, B or C	Bottom metal gland plate cover for installations using conduit entry	
	Top Cover Size A, B or C	Top cover for NEMA 1 installations	

2. Technical Data

The model code is made up of the following sections making it easy to order and cross reference to the ratings of the drive. The model code and serial number can be found on the rating label at the side of the drive.

Model code explanation

```
SK⌐  A⌐  ⌐1⌐  ⌐2⌐  XXXXX
```

Drive kilowatt

Drive voltage

Number of input phases: 1 =
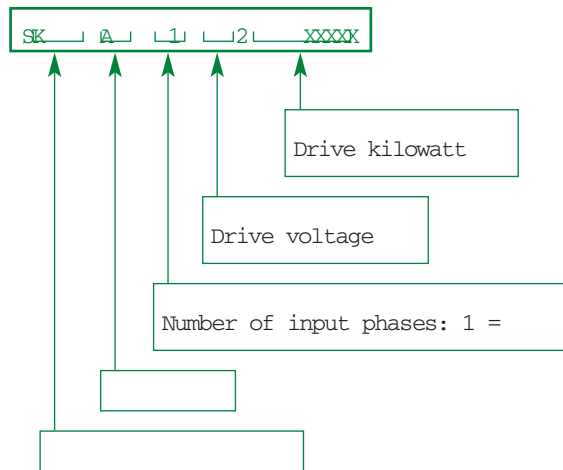
2.1 Commander SK 200V units

Ratings

MODEL	SKA12				SKBD2			SKCD2	
	00025	00037	00055	00075	00110	00150		00220	
					1ph	3ph	1ph	3ph	1ph	3ph
AC supply voltage and frequency	Single phase 200 to 240V ±10% 48Hz to 62Hz				Single or 3 phase 200 to 240V ±10% 48Hz to 62Hz					
Input displacement factor (cosØ)									
Nominal motor power (kW)	0.25	0.37	0.55	0.75	1.1	1.5		2.2	
Nominal motor power (hp)	0.33	0.50	0.75	1.0	1.5	2.0		3.0	
Output voltage and frequency	3 phase, 0 to drive rating (240), 0 to 1500Hz									
100% RMS output current (A)	1.7	2.2	3.0	4.0	5.2	7.0		9.6	
150% overload current for 60s (A)	2.6	3.3	4.5	6	7.8	10.5		14.4	
Typical full load input current (A)	4.3	5.8	8.1	10.5	14.2	6.7	17.4	8.7	23.2	11.9
Maximum continuous input current (A)						9.2		12.6		17
Typical inrush current (A) (<10mS)	17.9				8.9			6.0	
Drive power losses at 230Vac at 3kHz switching frequency (W)									
Weight (kg/lb)									
Internal EMC filter	Yes									
DC bus terminals	No				Yes					
Din rail mounting	Yes							No		

2. Technical Data

Cables

MODEL	SKA12				SKBD2				SKCD2	
	00025	00037	00055	00075	00110		00150		00220	
					1ph	3ph	1ph	3ph	1ph	3ph
Recommended input supply fuse (A)	6	10	16		20	16	25	16	32	20
Control cable (mm²)	≥0.5				≥ 0.5					
(AWG)	20				20					
Recommended input cable (mm²)	1.0			1.5	2.5	1.5	2.5	1.5	4.0	2.5
(AWG)	16			14	12	14	12	14	10	12
Recommended motor cable (mm²)	1.0				1.0				1.5	
(AWG)	16				16				14	
Recommended brake resistor cable (mm²)	1.0				1.0				1.5	
(AWG)	16				16				14	

Braking Resistor

MODEL	SKA12				SKBD2		SKCD2
	00025	00037	00055	00075	00110	00150	00220
Minimum braking resistor value (Ω)	68				28		28
Recommended braking resistor value (Ω)	200			150	100		50
Resistor peak power rating (kW)	0.9			1.1	1.7		3.4
Maximum braking current (A)	6.1				14.8		14.8

Cooling Fan

MODEL	SKA12				SKBD2		SKCD2
	00025	00037	00055	00075	00110	00150	00220
Cooling fan fitted	No				Yes		No
Air flow (feet³/minute)					TBA		
(m³/minute)							

2. Technical Data

2.2 Commander SK 400V units

Ratings

MODEL	SKB34					SKC34		
	00037	00055	00075	00110	00150	00220	00300	00400
AC supply voltage and frequency	3 phase 380 to 480V ±10% 48Hz to 62Hz							
Input displacement factor (cosØ)								
Nominal motor power (kW)	0.37	0.55	0.75	1.1	1.5	2.2	3.0	4.0
Nominal motor power (hp)	0.5	0.75	1.0	1.5	2.0	3.0	3.0	5.0
Output voltage and frequency	3 phase, 0 to drive rating (480), 0 to 1500Hz							
100% RMS output current (A)	1.3	1.7	2.1	2.8	3.8	5.1	7.2	9.0
150% overload current for 60s (A)	2	2.6	3.2	4.2	5.7	7.7	10.8	13.5
Typical full load input current (A)	1.7	2.5	3.1	4	5.2	7.3	9.5	11.9
Maximum continuous input current (A)*	2.5	3.1	3.75	4.6	5.9	9.6	11.2	13.4
Typical inrush current (A) (<10mS)	17.9					11.9		
Drive power losses at 400Vac at 3kHz switching frequency (W)	TBA					TBA		
Weight (kg/lb)								
Internal EMC filter	Yes							
DC bus terminals	Yes							
Din rail mounting	Yes					No		

*For 3ph input only at 2% negative phase sequence

Cables

MODEL	SKB34					SKC34		
	00037	00055	00075	00110	00150	00220	00300	00400
Recommended input supply fuse (A)	TBA	TBA	10			16		20
Control cable (mm²)			≥0.5			≥0.5		
(AWG)			20			20		
Recommended input cable (mm²)			1.0			1.5		2.5
(AWG)			16			14		12
Recommended motor cable (mm²)			1.0			1.0		1.5
(AWG)			16			16		14
Recommended brake resistor cable (mm²)			1.5			1.5		
(AWG)			14			14		

2. Technical Data

Braking Resistor

MODEL	SKB34					SKC34		
	00037	00055	00075	00110	00150	00220	00300	00400
Minimum braking resistor value (Ω)**	100					100	55	
Recommended braking resistor value (Ω)	200					200	150	100
Resistor peak power rating (kW)*	3.4					3.4	4.6	6.9
Maximum braking current (A)	8.3					8.3	15.1	

Cooling Fan

MODEL	SKB34					SKC34		
	00037	00055	00075	00110	00150	00220	00300	00400
Cooling fan fitted	No			Yes		Yes		
Air flow (feet^3/minute)				TBA				
(m^3/minute)								

3. Drive Voltage Levels

3.1 Input voltage

Single Phase Tolerance

200V to 240V ±10%

48Hz to 62Hz

Three Phase 200V Tolerance

200V to 240V ±10%

48Hz to 62Hz

Phase imbalance 3% (between phases) or 2% negative phase sequence (IEC 146-1-1 Immunity class C)

Three Phase 400V Tolerance

380V to 480V ±10%

48Hz to 62Hz

Phase imbalance 3% (between phases) or 2% negative phase sequence (IEC 146-1-1 Immunity class C)

3.2 Voltage levels

Condition	200V drives	400V drives
Over Voltage trip level (OV)	415	830
Braking level	390	780
Rated upper level (AC mains +10% x 1.4142)	373	747
Rated lower level (AC mains -10% x 1.4142)	255	484
*Under Voltage reset level	215	425
Under Voltage trip level	175	330
Standard ramp voltage	375	Eur: 750 N America: 750

3.3 Lower supply voltages

It will be possible to run the drives on lower supply voltages than those specified above (up to -20%) but only with de-rating of the product. Running a 400V product on a 230V single phase supply (at a very much reduced output power) is possible on frame sizes B & C.

On products without a DC bus choke (up to 4kW), the maximum supply capacity connected to the drive without using external line chokes will be 5kA short circuit current.

4. Mechanical Installation

4.1 Size A Dimensions
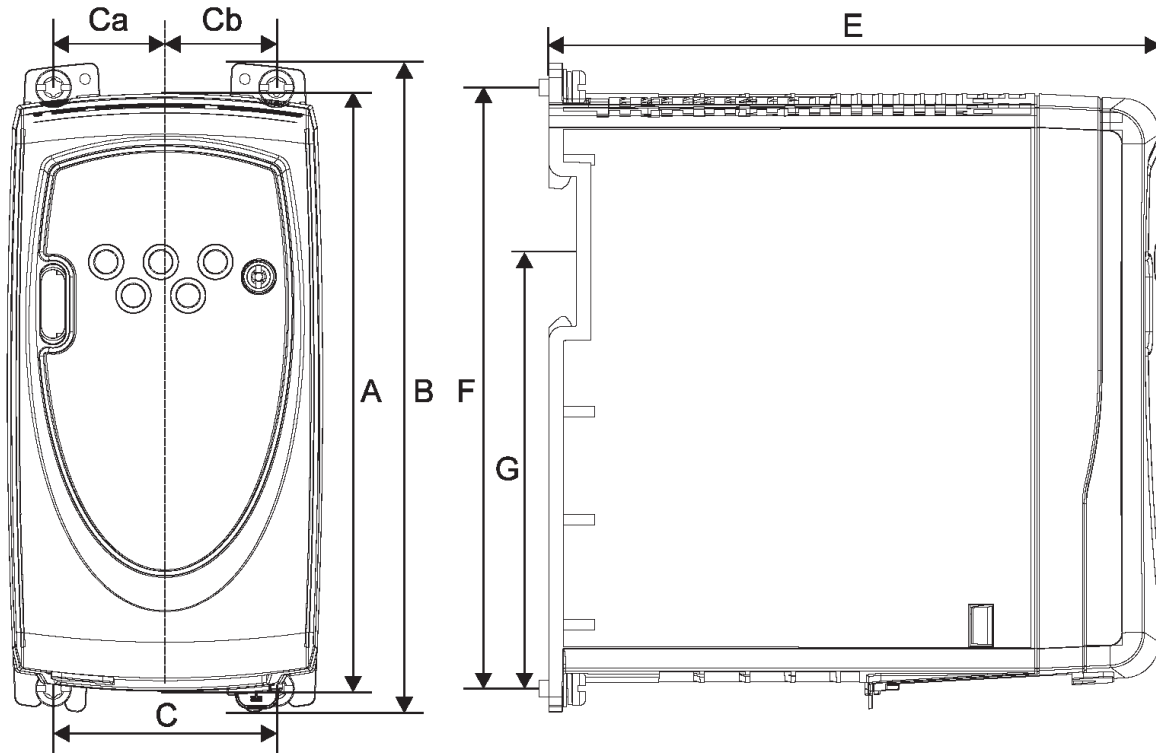
Drive Size	A		B		C		Ca		Cb	
	mm	in	mm	in	mm	in	mm	in	mm	in
A	140	5.51	154	6.06	53	2.09	26.5	1.04	26.5	1.04

Drive Size	D		E		F		G*	
	mm	in	mm	in	mm	in	mm	in
A	75	2.95	145	5.71	143	5.63	86.3	3.40

On size A, the mounting feet are equal distance from the centre line of the drive.

4. Mechanical Installation

4.2 Size B Dimensions
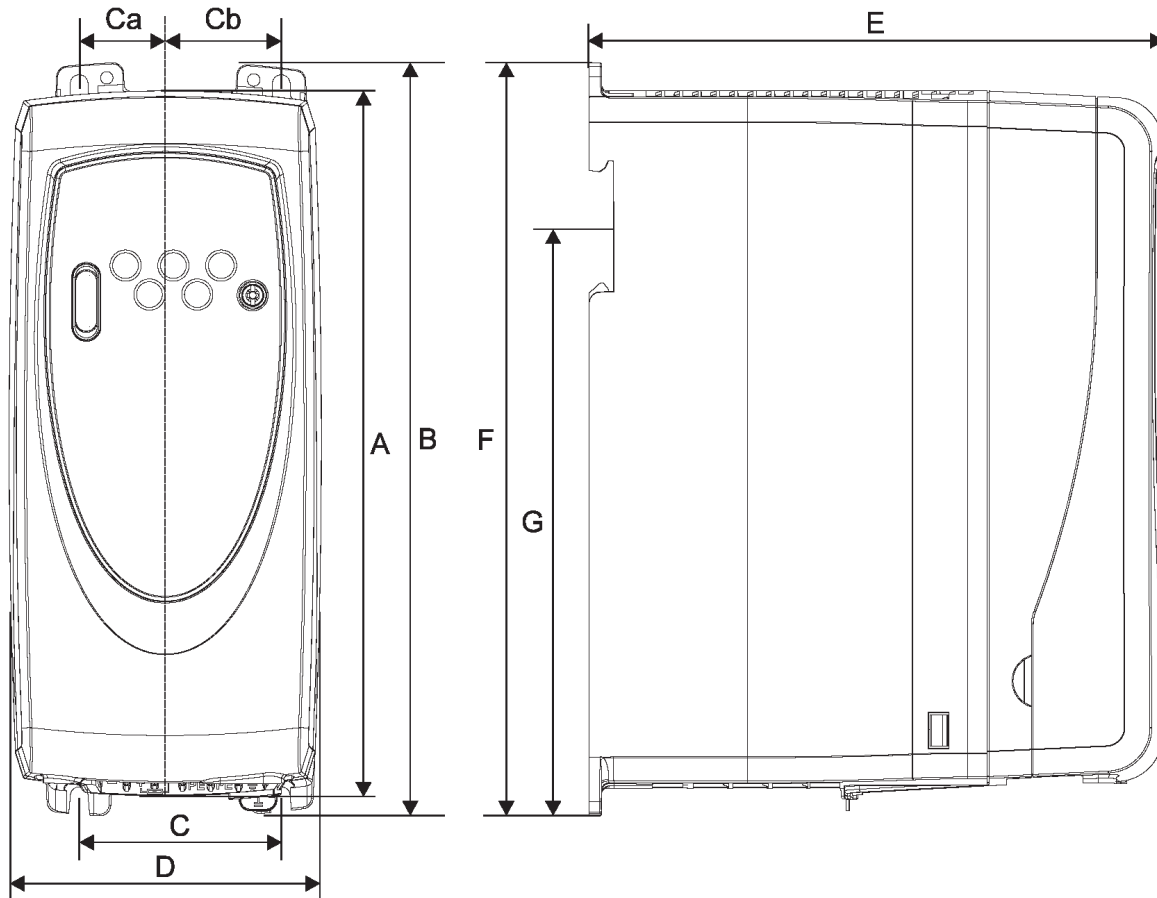
Drive Size	A		B		C		Ca		Cb	
	mm	in	mm	in	mm	in	mm	in	mm	in
B	190	7.48	205	8.07	55	2.17	23.5	0.93	31.5	1.24

Drive Size	D		E		F		G*	
	mm	in	mm	in	mm	in	mm	in
B	85	3.35	156	6.14	194	7.64	155.5	6.12

On size B and C, the mounting feet are not an equal distance from the centre line of the drive, hence the Ca and Cb dimensions.

4. Mechanical Installation

4.3 Size C Dimensions
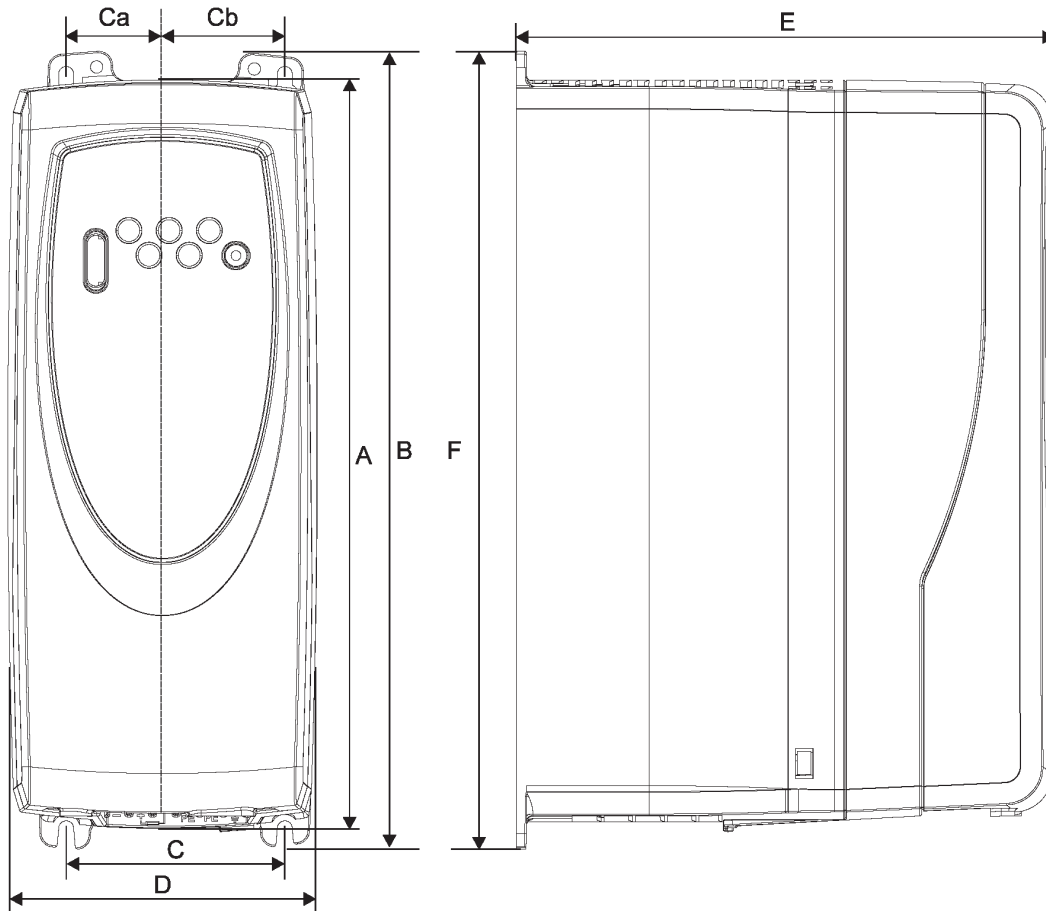
Drive Size	A		B		C		Ca		Cb	
	mm	in	mm	in	mm	in	mm	in	mm	in
C	240	9.45	258	10.16	70.5	2.78	31	1.22	39.5	1.56

Drive Size	D		E		F		G*	
	mm	in	mm	in	mm	in	mm	in
C	100	3.94	173	6.81	244	9.61		

On size B and C, the mounting feet are not an equal distance from the centre line of the drive, hence the Ca and Cb dimensions.

*Size C is not DIN rail mountable.

4. Mechanical Installation

4.4 Mounting Feet

4.5 DIN Rail Mount

5. Electrical Installation

5.1 Power Terminal Connections

Size A
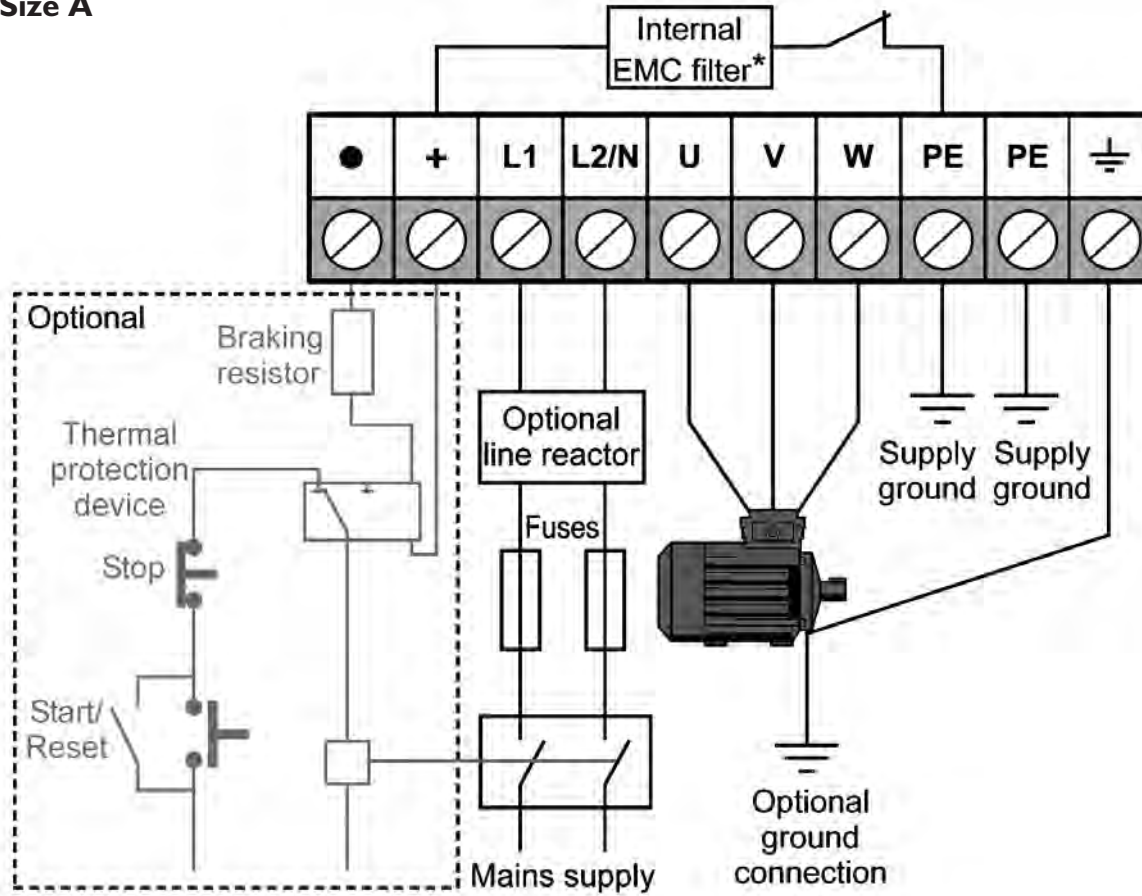
Frame size	Maximum power terminal screw torque
A	0.5 Nm / 4.4 lb in

5. Electrical Installation

Size B and C
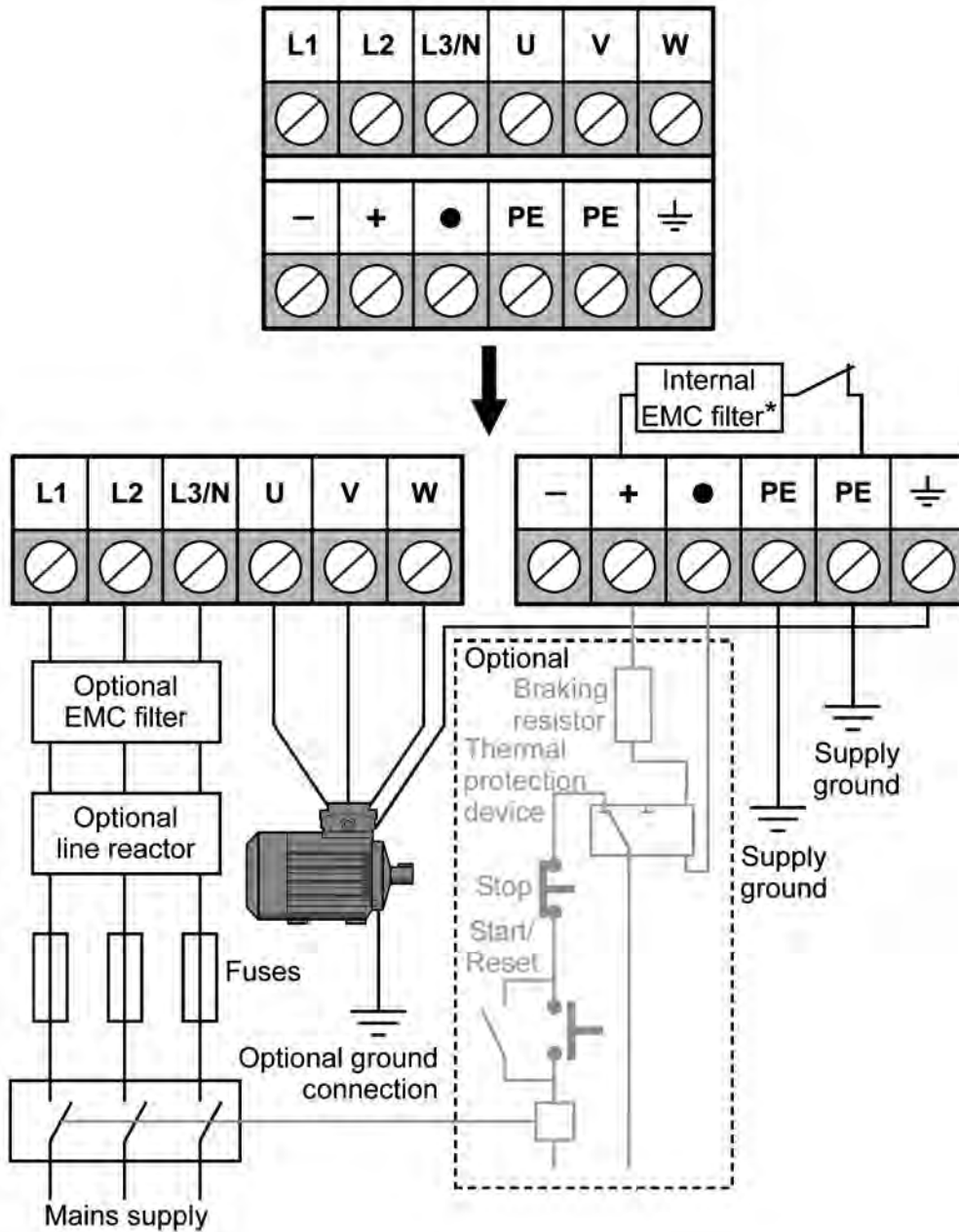
Frame size	Maximum power terminal screw torque
B and C	1.4 Nm / 12.1 lb in

5. Electrical Installation

5.2 Control Connections

T1	T2	T3	T4	T5	T6
0V	Remote speed reference input	+10V output	Local speed reference input	Fault / OK	

Status Relay

0-20mA / 4-20mA

10k (2k min)

0V

B1	B2	B3	B4	B5	B6	B7
Analog output (motor speed)	+24V output	Digital output (zero speed)	Enable/Reset (Not Stop)*	Run Forward (Run)*	Run Reverse (Jog)*	Local/Remote speed reference select

0-10V

+24V � 0V

*USA defaults Pr29 = USA
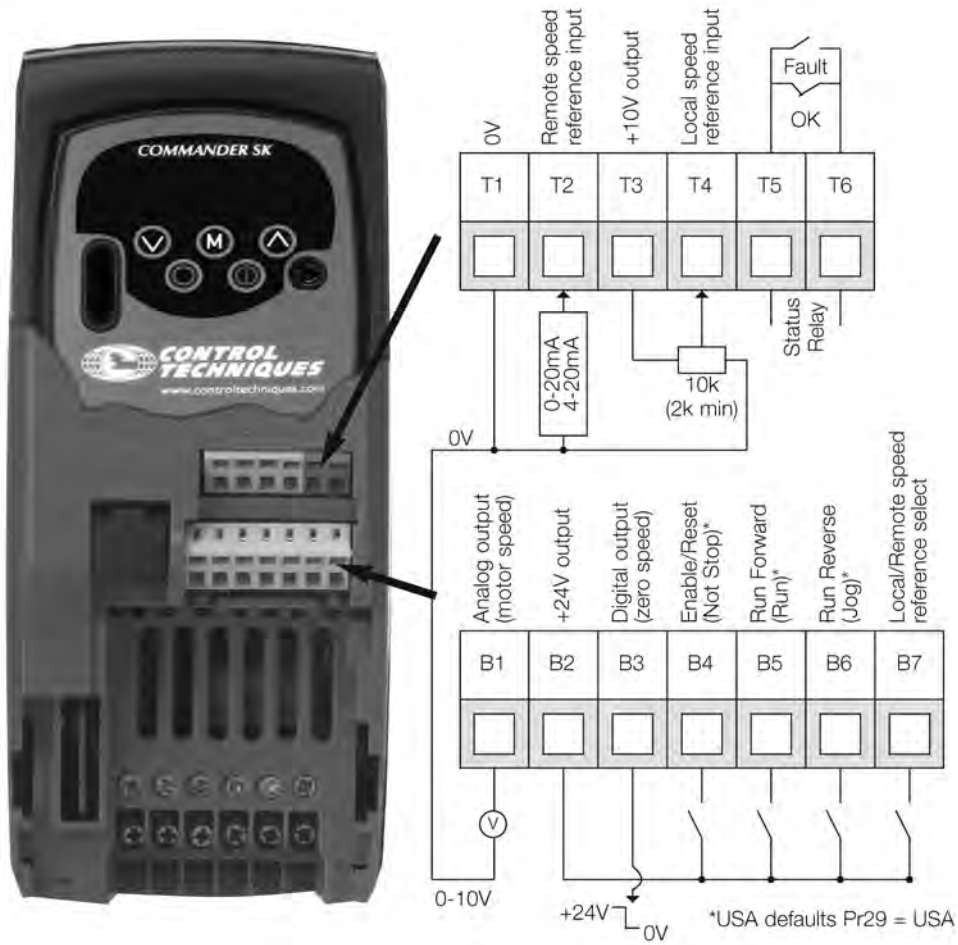
5. Electrical Installation

5.3 I/O Specifications

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

> ⚠️ **WARNING**
>
> If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage (SELV) (e.g. to personal computer), an additional isolating barrier must be included in order to maintain the SELV classification. The optional connecting cable (CT Comms Cable) provides this additional level of isolation (see options pages)

T1	0V common

T2	Analog input 1 (A1), either voltage or current
Voltage : Current input	0 to 10V : mA as parameter range
Parameter range	4-20, 20-4, 0-20, 20-0, 4-.20, 20-.4, Volt
Scaling	Input range automatically scaled to Pr 01 (Minimum set speed) to Pr 02 (Maximum set speed)
Input impedance	200Ω (current) : 100kΩ (voltage)
Resolution	0.1%
Accuracy	± 2%
Sample time	6ms
Absolute maximum voltage range	+35V to -18V with respect to 0V common

T3	+10V reference output
Maximum output current	5mA
Protection	Tolerates continuous short circuit to 0V
Accuracy	± 2%

T4	Analog input 2 (A2), either voltage or digital input
Voltage : Digital input	0 to +10V: 0 to +24V
Scaling (as voltage input)	Input range automatically scaled to Pr 01 Minimum set speed / Pr 02 Maximum set speed
Input impedance	100kΩ (voltage): 6k8 (digital input)
Resolution	0.1%
Accuracy	± 2%
Sample time	6ms
Nominal threshold voltage	+10V (positive logic only)
Absolute maximum voltage range	+35V to -18V with respect to 0V common

5. Electrical Installation

T5 T6	**Status relay - Drive healthy (Normally open)**
Voltage rating	240VAC/30DC
Current rating	2A/6A (resistive)
Contact isolation	1.5kVAC (over voltage category II)
Update time	1.5ms
Operation of contact	OPEN - AC supply removed from drive - AC supply applied to drive with drive in tripped condition CLOSED - AC supply applied to drive with drive in a 'ready to run' or running' condition (not tripped)

Provide fuse or other over-current protection in status relay circuit.

B1	**Analog voltage output - Motor speed**
Voltage output	0 to +10V
Scaling	0V represents 0Hz/rpm output +10V represents the value in Pr 02, maximum set speed
Maximum output current	5mA
Resolution	0.4%
Accuracy	± 5%
Update time	6ms
Protection	Tolerates continuous short circuit to 0V

B2	**+24V output**
Maximum output current	100mA
Protection	Tolerates continuous short circuit to 0V
Accuracy	± 15%

B3	**Digital output - Zero speed**
Voltage range	0 to +24V
Maximum output current	50mA at +24V (current source)
Output impedance	6.8kΩ
Update time	1.5ms
Absolute maximum voltage range	+35V to -1V with respect to 0V common

5. Electrical Installation

NOTE The total available current from the digital output plus the +24V output is 100mA

B4	**Digital Input - Enable/Reset */****	
B5	**Digital Input - Run Forward ****	
B6	**Digital Input - Run Reverse ****	
B7	**Digital Input - Local/Remote speed reference select (A1/A2)**	
Logic	Positive logic only
Voltage range	0 to +24V
Input impedance	6.8kΩ
Sample time	1.5ms
Nominal threshold voltage	+10V
Absolute maximum voltage range	+35V to -18V with respect to 0V common

NOTE If the drives enable terminal is opened, the drives output will be disabled and the motor will coast to a stop.

The drive cannot be re-enabled for a period of time following the opening of the enable terminal.

This period of time is drive size dependant.

Drive size (kW)	Time (s)
<7.5	0.5

6. EMC (Electro-Magnetic Compatibility)

6.1 Integral EMC Filter

6.1.1 Immunity

The drives are designed to meet the following standards in terms of immunity:

STANDARD	DESCRIPTION
EN61000-6-2*	Electromagnetic compatibility - generic immunity standard: industrial environment
EN61800-3	Adjustable speed electrical power drive systems - EMC product standard including specific test methods
IEEE C62.45	Guide on surge testing for equipment connected to low voltage ac power circuits

* The surge test at the control ports will be met provided the 0V is not connected to earth.

6.1.2 Emissions

There are two types of emissions, conducted emissions where the emission levels are measured on the cables connected to the drive with respect to earth, and radiated emissions where the emissions are measured with an antenna.

The drives will meet the Industrial radiated emissions level defined by EN61000-6-4 (previously EN50081-2) & IEC61800-3 providing the drives are mounted correctly in an industrial enclosure following the wiring guidelines that will be provided with the drive. Where practical the single-phase drives will also meet the residential standard EN61000-6-3 (previously EN50081-1).

The levels of conducted emissions achieved depends on motor cable lengths and the filters fitted and are defined in the table below:

STANDARD	TYPE	COMPLIANCE	
		WITHOUT FILTER	WITH FILTER
EN61800-3	Emission + immunity Power Drive Systems	In the second environment with up to 5m cable length at 3kHz switching.	On residential supplies with up to 100m cable length at 3kHz switching.
EN61000-6-3	Emission generic residential	No	To 20m cable length at 3kHz switching.
EN61000-6-4	Emission generic industrial	No	To 100m cable length at 3kHz switching.

In addition, a low earth leakage version of the filter is available for the single phase drives, which offers compliance to EN61000-6-4 at 3kHz with 15m of cable. The internal filter will need to be disconnected when low earth leakage is a requirement.

6. EMC (Electro-Magnetic Compatibility)

6.1.3 Internal EMC filter

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

If the drive is to be used on an IT supply, then the filter must be removed.

The internal EMC filter reduces radio-frequency emissions into the mains supply. Where the motor cable is short, it permits the requirements of EN61800-3 to be met for the second environment.

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

6.1.4 Removing the internal EMC filter

Removal and re-fitting of internal EMC filter

A

Tab fully inserted:
EMC filter fitted

B

Tab fully extended:
EMC filter disconnected
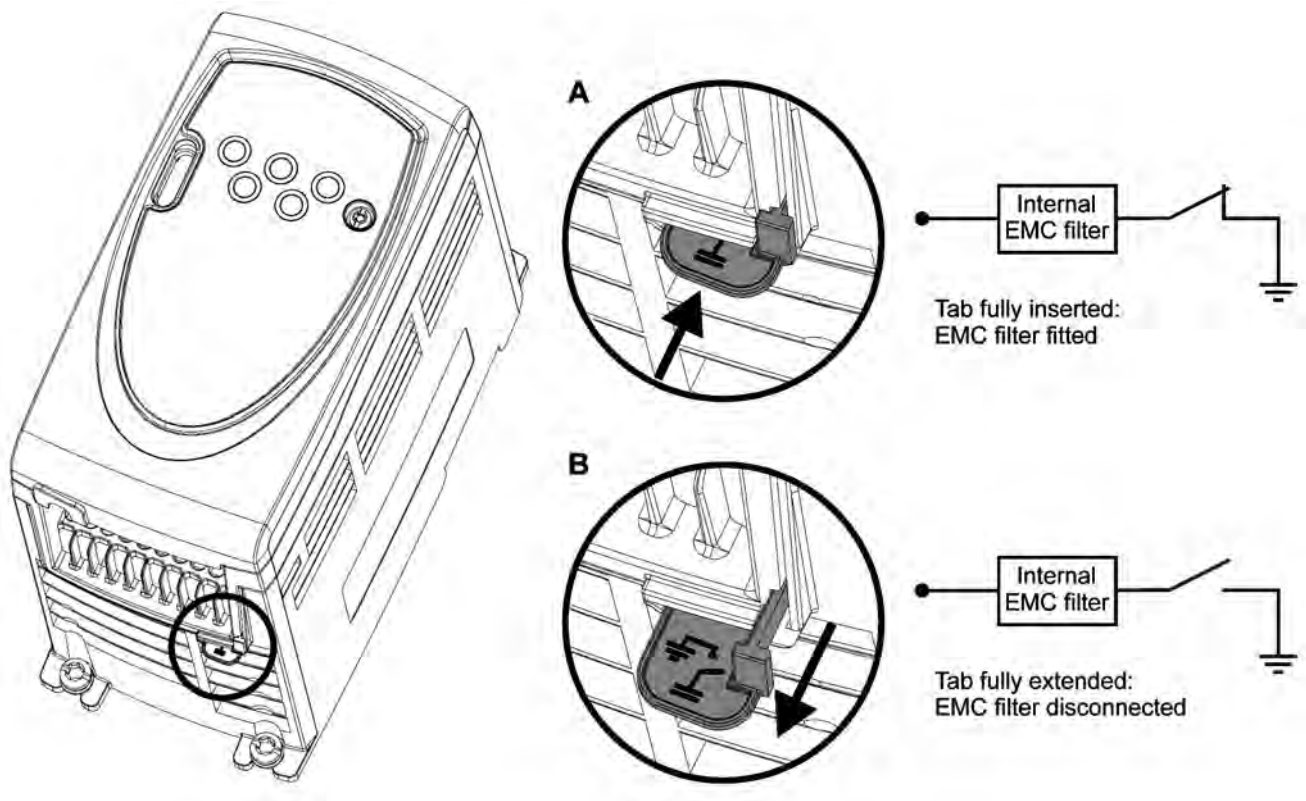
6. EMC (Electro-Magnetic Compatibility)

6.2 Ground Leakage

The ground leakage current level depends upon if the internal EMC filter is fitted or not. The drive is supplied with the filter fitted. Instructions for removal of the internal EMC filter are given in section 6.1.4 *Removing the internal EMC filter*.

With internal EMC filter fitted

30µA DC (10MΩ internal bleed resistor, relevant where DC leakage current is being measured)

Size A

10mA AC at 230V, 50Hz (proportional to supply voltage and frequency)

Size B and C

1 phase 200V drives

20mA AC at 230V, 50Hz (proportional to supply voltage and frequency)

3 phase 200V drives

8mA AC at 230V, 50Hz (proportional to supply voltage and frequency)

3 phase 400V drives

8.2mA AC at 415V, 50Hz (proportional to supply voltage and frequency)

NOTE The above leakage currents are just the leakage currents of the drive with the internal

EMC filter connected and do not take into account any leakage currents of the motor or motor cable.

With internal EMC filter removed

<2mA

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

> ⚠️ **WARNING** When the internal EMC filter is fitted, the leakage current is high. In this case, a permanent fixed ground connection must be provided using two independent conductors each with a cross-section equal to or exceeding that of the supply conductors. The drive is provided with two ground terminals to facilitate this. The purpose is to prevent a safety hazard occurring if a connection is lost.

6.2.1 Use of earth (ground) leakage circuit breakers (ELCB) / residual current device (RCD)

There are three common types of ELCB/RCD:

Type AC - detects AC fault currents

Type A - detects AC and pulsating DC fault currents (provided the DC current reaches zero at least once every half cycle)

Type B - detects AC, pulsating DC and smooth DC fault currents

● Type AC should never be used with drives

● Type A can only be used with single phase drives

● Type B must be used with three phase drives

6.3 EMC Filter Dimensions

Dimensions

Filter / Drive Size	Width mm (inch)	Height mm (inch)	Depth mm (inch)	Overall depth (drive + filter) mm (inch)
A	75 (2.95)	190 (5.50)	40 (1.57)	185 (7.28)
B	85 (3.35)	240 (9.45)	40 (1.57)	196 (7.72)
C	100 (3.93)	290 (11.42)	40 (1.57)	213 (8.36)

Input and output connections are on the bottom of the filter units for easy connection to the drives power terminals.
The enclosure for the filter is to IP20.

7. AC Line Reactor Value

7.1 Line Reactors

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

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

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

A line reactor should be connected in each phase of the supply. Each drive should have its own line reactor. Three individual reactors or a single three phase reactor can be used. Single phase drives only require one single phase line reactor.

Severe disturbances may be caused by the following factors:

● Power factor correction equipment connected close to the drive

● Large DC drives having no or inadequate line reactors connected to the supply

● Direct-on-line started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20%.

● Supply capacity exceeds 200kVA

● Fault current exceeds 5kA

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

Low power drives may also be susceptible to disturbance when connected to supplies with high rated capacity.

NOTE RFI filters (for EMC purposes) do not give adequate protection against these conditions.

Drives used with	Reactor part number	Input phases	Inductance	Continuous rms Current	Peak Current	Weight	Dimensions		
			mH	A	A	Kg	L	D	H
SKA1200025	4402-0224	1	2.25	6.5	13	13	72	65	90
SKA1200037	4402-0224	1	2.25	6.5	13	13	72	65	90
SKA1200055	4402-0225	1	1.0	15.1	30.2	30.2	82	75	100
SKA1200075	4402-0225	1	1.0	15.1	30.2	30.2	82	75	100
Size B&C	TBA								

7. AC Line Reactor Value

7.2 Reactor current ratings

Continuous current:

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

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive.

Voltage fluctuation (Flicker) standard EN61000-3-3 (IEC61000-3-3):

Those models that fall within the scope of EN61000-3-3, as stated in the declaration of Conformity, conform to the requirements for manual switching,

i.e. the voltage dip caused when a drive at room temperature is switched on is within the permitted limits.

The drive does not of itself cause periodic voltage fluctuation in normal operation. The installer must ensure that the control of the drive is such that periodic fluctuations in supply current do not infringe the flicker requirements where applicable. Note that large periodic load fluctuations in the frequency range of between 1Hz and 30Hz are particularly inclined to cause irritating lighting flicker and are subject to stringent limits under EN61000-3-3.

8. Motor Cable Lengths

Drive frame size frequency	Maximum motor cable length meters (feet)			
	At 3kHz switching	At 6kHz	At 12kHz	At 18kHz
A	75 (246)			
B	100 (328)		TBA	
C	100 (328)			

The capacitive loading of the drive by the motor cable means that the cable length limits shown in table 8.1 must be observed. Failure to do so can result in spurious OI.AC tripping of the drive. If longer cable lengths are required, consult your local Drive Centre or Distributor.

The maximum cable lengths were measured using cable with capacitance of 130pF/m.

This capacitance was measured by taking one phase as one node and the screen (shield) and earth (ground) (if any) as the other node, then measuring the capacitance between the two points.

9. General Data

9.1 Protection Ratings

9.1.1 IP rating

IP20

First digit: Protection against contact and ingress of foreign bodies

2 - Protection against medium size foreign bodies $\varnothing$> 12mm (finger)

Second digit: Protection against ingress of water

0 - No protection

9.1.2 NEMA rating

Commander SK sizes A to C

NEMA 1 with optional NEMA 1 kit

9.1.3 NEMA Type 1 enclosure rating

Enclosures are intended for indoor use, primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.

9.2 Input phase imbalance

3% between phases or 2% negative phase sequence.

9.3 Ambient temperature

Rated ambient temperature is 40°C (104°F) at 3kHz switching frequency.

Operation up to 55°C (131°F) with de-rating.
(see de-rating curves for further information)

9.4 Storage temperature

The storage temperature range shall be from -40 to +60°C (-40 to +140°F) for 12 months maximum.

9.5 Altitude

Rated
altitude: 1000m (3250 ft)

Reduce the normal full load current by 1% for every 100m (325 ft) above 1000m (3250 ft) up to a maximum of 3000m (9750 ft).

9.6 Humidity

Maximum relative humidity 95% (non-condensing)

9.7 Storage humidity

93%, 40°C, 4 days

9.8 Pollution degree

Designed for operation in Pollution degree 2 environments (dry, non-conductive contamination only)

9.9 Vibration

9.9.1 Random

Standard: In accordance with IEC68-2-64 and IEC68-2-36: Test Fh

Severity: 1.0 m2/s3 (0.01g2/Hz) ASD from 5 to 20Hz, -3dB/octave from 20 to 200Hz

Duration: 30 minutes in each of 3 mutually perpendicular axes

9.9.2 Sinusiodal

Standard: IEC68-2-6: Test Fc

Frequency
range: 2 to 500Hz

Severity: 3.5mm peak displacement from 2 to 9Hz
$10m/s^2$ peak displacement from 9 to 200Hz
$15/s^2$ peak displacement from 200 to 500Hz

Sweep
rate: 1 octave/minute

Duration: 15 minutes in each of 3 mutually perpendicular axes

9.9.3 Bump

Standard: IEC68-2-29: Test Eb

Severity: 18g, 6ms, half sine

Number
of bumps: 600 (100 in each direction of axes)

9. General Data

9.10 Output frequency range

0 to 1500Hz

9.11 Starts per hour

Electric starts

With the supply permanently connected the number of electronic motor starts per hour is only limited by motor and drive thermal limits.

Power starts

The number of starts by connection of the ac supply is limited. The start up circuit will allow for three consecutive starts at 3-second intervals on initial power up. Exceeding the rated number of starts per hour, presented in the table below, could result in damage to the start up circuit.

Drive frame size	Maximum AC line starts per hour evenly spaced in time
A, B & C	20

9.12 Start-up time

The soft-start circuit will charge the dc bus and SMPS outputs and stabilise to allow the control processor to start operation in the following times:-

Drive frame size	Maximum time taken to charge DC bus and SMPS outputs to stabilise
A, B & C	<1s

9.13 Serial communications

Modbus RTU

9.14 Switching frequencies

The software allows for the following switching frequencies:

3, 6, 12, 18kHz

9.15 Harmonics

The Commander SK industrial AC variable speed drives are classified as class A professional equipment as defined in BS EN61000-3-2: 1995. Drives with input power equal to or below 1kW that do not meet the requirements of EN61000-3-2 are to be corrected, to ensure compliance, at the point of installation using suitable AC line chokes.

Displacement factor better than 0.98. Displacement factor is defined as the phase difference between the fundamental components of voltage and current (cos $\emptyset$).

All odd harmonics will be present in the input current with the amplitude of each diminishing as the frequency gets higher. The actual level of the harmonic currents depends on the source impedance of the supply connected to the drive, and whether the drive has a DC link choke fitted. The level of harmonic content is given by the Distortion factor, which is defined as:

$$\text{Distortion factor} = \frac{\text{r.m.s. value of fundamental current}}{\text{r.m.s. value of total current}}$$

For single-phase drives without a DC link choke the Distortion factor will be typically 0.5, for three phase drives without a choke it will be 0.6, while for drives with a DC link choke it will be typically between 0.7 to 0.9.

Power factor is defined as:

Power factor = Displacement factor * Distortion factor

Since Displacement factor is approaching unity, the input power factor to the drives will be approximately equal to the Distortion factor.

10. Supply Types

Commander SK is suitable for use with any supply type, i.e. TN-S, TN-C-S, TT, IT, with a grounding at any potential, i.e. neutral, centre or corner ('grounded-delta').

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.

10.1 AC supply requirements

Single phase drives

Single phase - Between one phase and neutral of a star connected three phase supply.

- Between two phases of a three phase supply.

Three phase models

Three-phase star or delta supply of the correct voltage.

Dual rated models

Any of the above supplies can be used.

10.2 Safety

> **⚠ 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**
>
> **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 Control Techniques or their authorized distributor.

> **⚠ 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).

10. Supply Types

10.3 Cables

Recommended cable sizes are given in section 2. They are only a guide; refer to local wiring regulations for correct size of cables. In some cases, a larger cable size is required to avoid excessive voltage drop.

Use 105°C (221°F) (UL 60/75°C temp rise) PVC-insulated cable with copper conductors having a suitable voltage rating, for the following power connectors:

● AC supply to external EMC filter (when used)

● AC supply (or external EMC filter) to drive

● Drive to motor

● Drive to braking resistor

Motor cables

The recommended output cable sizes assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used, programmed with the correct motor rated voltage.

10.4 Fuses

The AC supply to the drive must be fitted with suitable protection against overload and short circuits. Tables in section 2 show the recommended fuse ratings. Failure to observe this requirement will cause risk of fire.

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

An MCB (miniature circuit breaker) or MCCB (moulded case circuit breaker) with type C tripping characteristics maybe used in place of fuses as long

as the fault clearing capacity is sufficient for the installation.

Fuse types

Europe: Type gG HRC fuses complying with EN60269 parts 1 and 2 (BS88)

USA: Bussman Limitron KTK series, class CC fast acting fuses up to 30A, class J above 30A.

10.5 Ground connections

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

The ground loop impedance must conform to the requirements of local safety regulations. The ground connections must be inspected and tested at appropriate intervals.

Use of RCDs - residual current device

There are three common types of RCD/ELCB

Type AC - detects AC fault currents

Type A - detects AC and pulsating DC fault currents (provided the DC current reaches zero at least once every half cycle)

Type B - detects AC, pulsating DC, and smooth DC fault currents

● Type AC should never be used with inverter drives

● Type A can only be used with single phase drives

● Type B must be used with three phase drives.

It is recommended that only Type B RCDs be used with inverter drives.

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

11. Programming Parameters

11.1 Ten Most Commonly Used Parameters

	Status Display	rd 0.0	Press M
	Parameter Display	01 0.0	Press ∧
	Parameter 02	02 50.0	Press M
Set maximum speed	Existing Max Speed (50.0 Hz)	02 50.0	Press ∨
	New Max Speed (45.0 Hz)	02 45.0	Press M Twice
	Return to Status Display	rd 0.0	END

Stop

Run

01 Minimum Speed (Hz)

03 Acceleration Rate (s/100Hz)
04 Deceleration Rate (s/100Hz)
05 Drive Configuration

06 Motor Rated A
07 Motor Rated rpm (min⁻¹)
08 Motor Rated V
09 Motor Rated cos Ø
10 Parameter Access

11. Programming Parameters

11.2 Keypad and Display

The keypad and display are used for the following:

- Displaying the operating status of the drive
- Displaying a fault or trip code
- Reading and changing parameter values
- Stopping, starting and resetting the drive

Keypad and display

11.2.1 Programming keys

The ⓜMODE key is used to change the mode of operation of the drive.

The ⓐUP and ⓥDOWN keys are used to select parameters and edit their values. In keypad mode, they are used to increase and decrease the speed of the motor.

### 11.2.2 Control keys

The ⓘSTART key is used to start the drive in keypad mode.

The ⓢSTOP/RESET key is used to stop and reset the drive in keypad mode. It can also be used to reset the drive in terminal mode.

11.2.3 Selecting and changing parameters

NOTE This procedure is written from the first power up of the drive and assumes no terminals have been connected, no parameters have been changed and no security has been set.
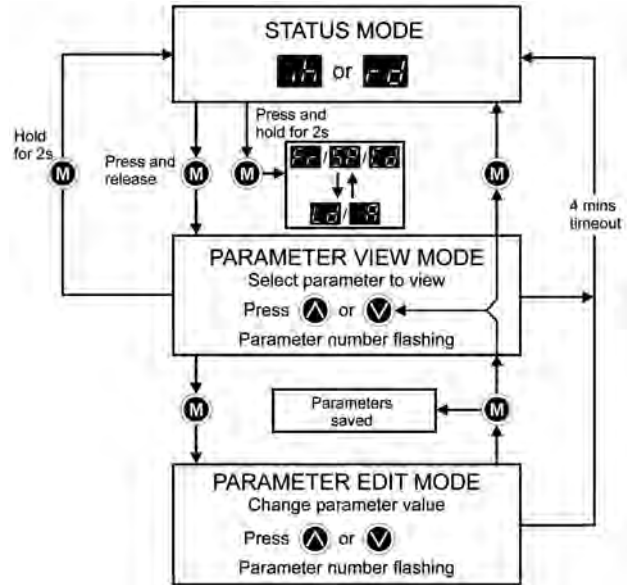
When in Status mode, pressing and holding the ⓜMODE key for 2 seconds will change the display from displaying a speed indication to displaying load indication and vice versa.

Pressing and releasing the ⓜMODE key will change the display from status mode to parameter view mode. In parameter view mode, the left hand display flashes the parameter number and the right hand display shows the value of that parameter.

Pressing and releasing the ⓜMODE key again will change the display from parameter view mode to parameter edit mode. In parameter edit mode, the right hand display flashes the value in the parameter being shown in the left hand display.

Pressing the ⓜMODE key in parameter edit mode will return the drive to the parameter view mode. If the ⓜ MODE key is pressed again then the drive will return to status mode, but if either of the ⓐup or ⓥdown keys are pressed to change the parameter being viewed before the ⓜMODE key is pressed, pressing the ⓜMODE key will change the display to the parameter edit mode again. This allows the user to very easily change between parameter view and edit modes whilst commissioning the drive.

11. Programming Parameters

Status Modes

Left hand display	Status	Explanation
rd	Drive ready	The drive is enabled and ready for a start command. The output bridge is inactive.
ih	Drive inhibited	The drive is inhibited because there is no enable command, or a coast to stop is in progress or the drive is inhibited during a trip reset.
tr	Drive has tripped	The drive has tripped. The trip code will be displayed in the right hand display.
dc	DC injection braking	DC injection braking current is being applied to the motor.

Speed indications

Display Mnemonic	Explanation
Fr	Drive output frequency in Hz
SP	Motor speed in rpm
Cd	Machine speed in customer define units

Load Indications

Display Mnemonic	Explanation
Ld	Load current as a % of motor rated load current
A	Drive output current per phase in A

12.2.4 Saving parameters

Parameters are automatically saved when the ⓜMODE key is pressed when going from parameter edit mode to parameter view mode.

11.2.5 Parameter access

There are 3 levels of parameter access controlled by Pr 10. This determines which parameters are accessible. See Table below.

The setting of the user security Pr 25 determines whether the parameter access is read only (RO) or read write (RW).

Parameter access (Pr 10)	Parameters accessible
L1	Pr 01 to Pr 10
L2	Pr 01 to Pr 60
L3	Pr 01 to Pr 95

11. Programming Parameters

11.2.6 Security codes

Setting a security code allows view only access to all parameters.

A security code is locked into the drive when Pr 25 is set to any other value then 0 and then Loc is selected in Pr 10. On pressing the ⓜMODE key, Pr 10 is automatically

changed from Loc to L1 and Pr 25 will be automatically set to 0 so as not to reveal the security code.

Pr 10 may be changed to L2 or L3 to allow view only access to parameters.

Setting a security code

● Set Pr 10 to L2

● Set Pr 25 to the desired security code e.g. 5

● Set Pr 10 to Loc

● Press the ⓜMODE key

● Pr 10 will now be reset to L1 and Pr 25 will be reset to 0

● The security code will now be locked into the drive

● Security will also be set if the drive is powered down after a security code has been set into Pr 25

Unlocking a security code

● Select parameter to be edited

● Press the ⓜMODE key, the right hand display will flash 'CODE'

● Press the ⓐUP key to start entering the set security code. The left hand display will show 'CO'

● Enter the correct security code

● Press the ⓜMODE key

● If the correct security code had been entered, the right hand display will flash and can now be adjusted

● If the security code has been entered incorrectly, the left hand display will flash the parameter number. The above procedure should be followed again

Re-locking security

When a security code has been unlocked and the required parameter changes made, to re-lock the same security code:

● Set Pr 10 to Loc

● Press the ⓜMODE key

Setting security back to 0 (zero) - no security

● Set Pr 10 to L2

● Go to Pr 25

● Unlock security as described above

● Set Pr 25 to 0

● Press the MODE key

NOTE If a security code has been lost or forgotten, please contact your local drive centre or distributor.

Setting drive back to default values

● Set Pr 10 to L2

● Set Pr 29 to EUR and press the ◉Stop/Reset key. This loads 50Hz default parameters

or

● Set Pr 29 to USA and press the ◉Stop/Reset key. This loads 60Hz default parameters

11. Programming Parameters

11.3 Parameters Level 1 and 2

Parameters are grouped together into appropriate subsets as follows:

Level 1

Pr 01 to Pr 10: Basic drive set-up parameters

Level 2

Pr 11 to Pr 12: Drive operation set-up parameters

Pr 15 to Pr 21: Reference parameters

Pr 22 to Pr 29: Display / keypad configuration

Pr 30 to Pr 33: System configuration

Pr 34 to Pr 36: Drive user I/O configuration

Pr 37 to Pr 42: Motor configuration (non-standard set-up)

Pr 43 to Pr 44: Serial communications configuration

Pr 45: Drive software version

Pr 46 to Pr 51: Mechanical brake configuration

Pr 52 to Pr 54: Fieldbus configuration

Pr 55 to Pr 58: Drive trip log

Pr 61 to Pr 70: User definable parameter area

Level 3

Pr 71 to Pr 80: User definable parameter set-up

Pr 81 to Pr 95: Drive diagnostics parameters

These parameters can be used to optimise the set-up of the drive for the application.

11.3.1 Parameter descriptions - Level 1

No	Function	Range	Defaults	Type
01	Minimum set speed	0 to Pr 02 Hz	0.0	RW

Used to set the minimum speed at which the motor will run in both directions.

(0V reference or minimum scale current input represents the value in Pr 01)

No	Function	Range	Defaults	Type
02	Maximum set speed	0 to 1500 Hz	50.0	RW

Used to set the maximum speed at which the motor will run in both directions.

If Pr 02 is set below Pr 01, Pr 01 will be automatically set to the value of Pr 02. (+10V reference or full scale current input represents the value in Pr 02)

NOTE The output speed of the drive can exceed the value set in Pr 02 due to slip compensation and current limits.

No	Function	Range	Defaults	Type
03	Acceleration rate	0 to 3200.0 s/100Hz	5.0	RW
04	Deceleration rate		10.0	

Sets the acceleration and deceleration rate of the motor in both directions in seconds/100Hz.

NOTE If one of the standard ramp modes is selected (see Pr 30), the deceleration rate could be extended automatically by the drive to prevent over voltage (OU) trips if the load inertia is too high for the programmed deceleration rate.

No	Function	Range	Defaults	Type
05	Drive configuration	AI.AV, AV.Pr, AI.Pr, Pr, PAd, E.Pot, tor, Pid, HUAC	AI.AV	RW

The setting of Pr 05 automatically sets up the drives configuration.

NOTE A change to Pr 05 is set by pressing the Ⓜ MODE key on exit from parameter edit mode. The drive must be disabled, stopped or tripped for a change to take place. If Pr 05 is changed while the drive is running, when the Ⓜ MODE key is pressed on exit from parameter edit mode, Pr 05 will change back to its previous value.

In all of the settings below, the status relay is set up as a drive healthy relay:

Configuration	Description
AI.AV	Voltage and current input
AV.Pr	Voltage input and 3 preset speeds
AI.Pr	Current input and 3 preset speeds
Pr	4 preset speeds
PAd	Keypad control
E.Pot	Electronic motorised potentiometer control
tor	Torque control operation
Pid	PID control
HUAC	Fan and pump control

11. Programming Parameters

Pr 05 = AI.AV

Pr 05 = PAd

T4	B7	Reference selected
0	0	AI
0	I	Preset 2
I	0	Preset 3
I	I	Preset 4
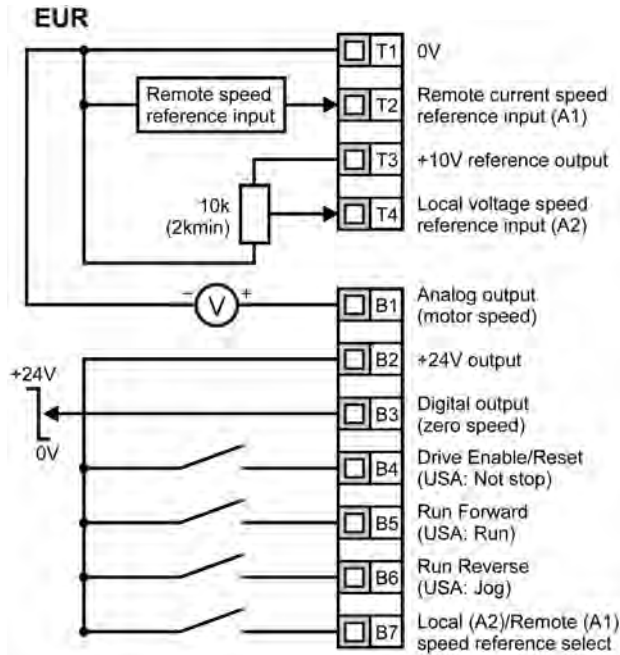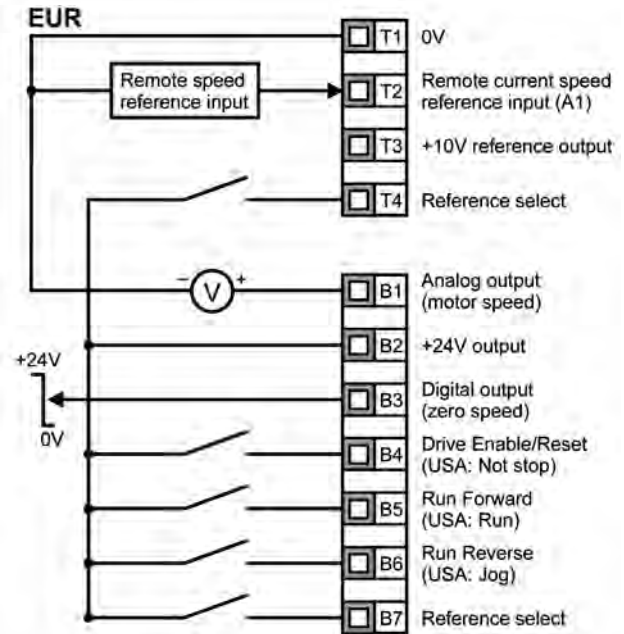
Pr 05 = AV.Pr

T4	B7	Reference selected
0	0	AI
0	I	Preset 2
I	0	Preset 3
I	I	Preset 4

11. Programming Parameters
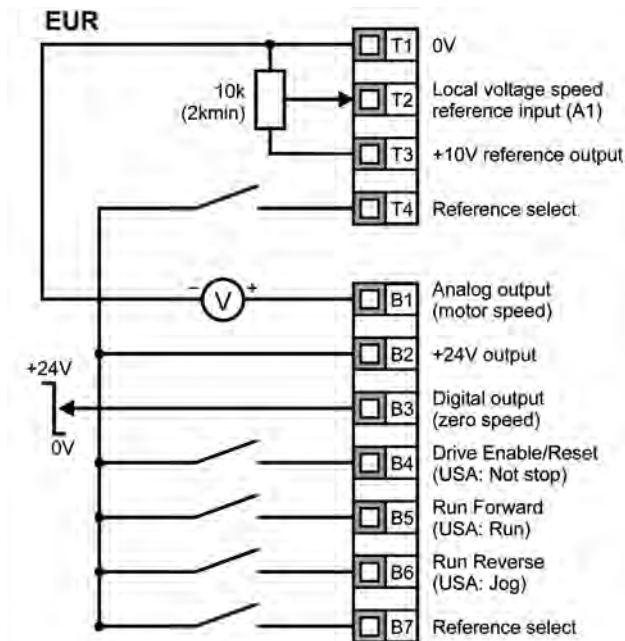
Pr 05 = Pr
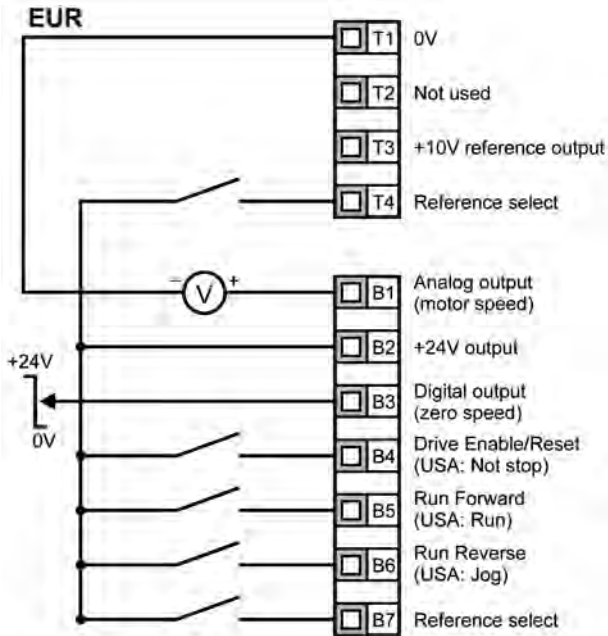
T4	B7	Reference selected
0	0	A1
0	1	Preset 2
1	0	Preset 3
1	1	Preset 4

Pr 05 = PAd
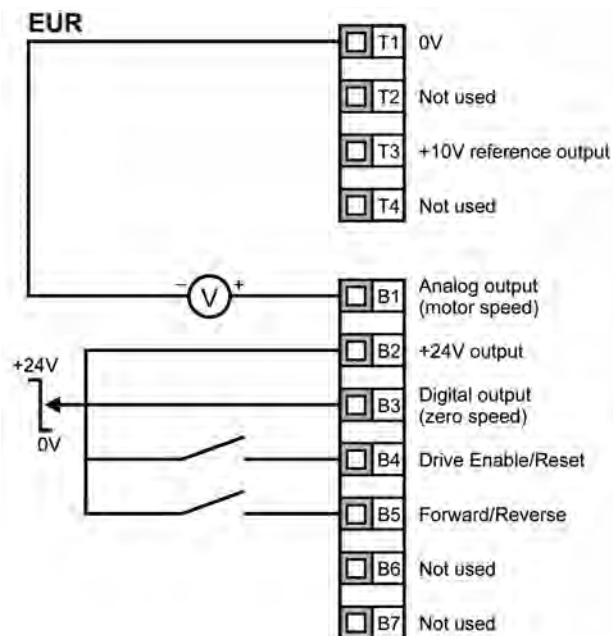
Pr 05 = E.Pot
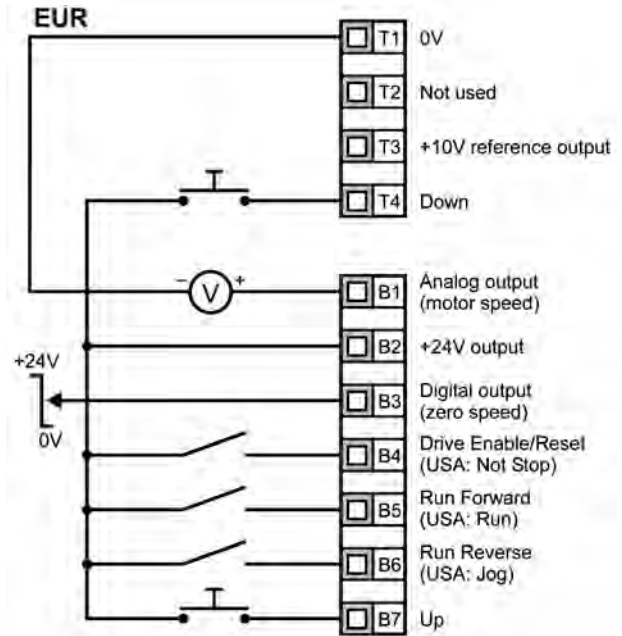
When Pr 05 is set to PAd to implement a forward/reverse switch, see the Commander SK Advanced User Guide.

When Pr 05 is set to E.Pot, the following parameters are made available for adjustment:

● Pr 61: Motorised pot up/down rate (s/100%)

● Pr 62: Motorised pot bipolar select (0 = unipolar, 1 = bipolar)

● Pr 63: Motorised pot mode: 0 = zero at power-up, 1 = last value at power-up, 2 = zero at power-up and only change when drive is running, 3 = last value at power-up and only change when drive is running

11. Programming Parameters

Pr 05 = tor

EUR
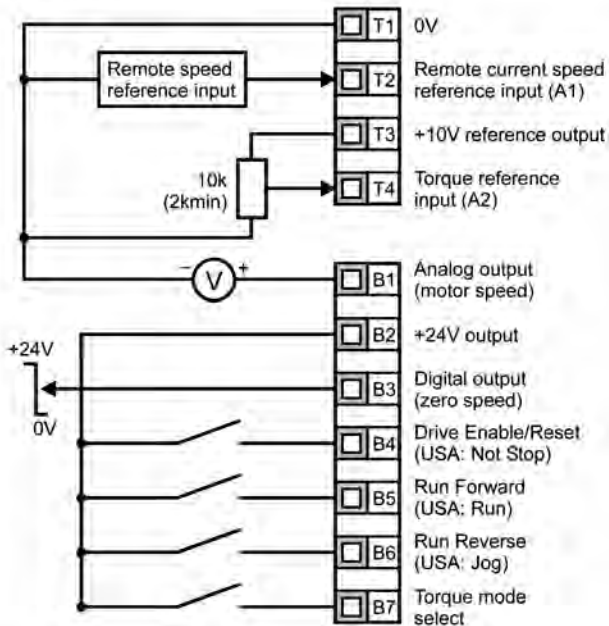
When Pr 05 is set to Pid, the following parameters

- Pr 61: PID proportional gain
- Pr 62: PID integral gain
- Pr 63: PID feedback invert
- Pr 64: PID high limit (%)
- Pr 65: PID low limit (%)
- Pr 66: PID output (%)

Pr 05 = Pid

EUR
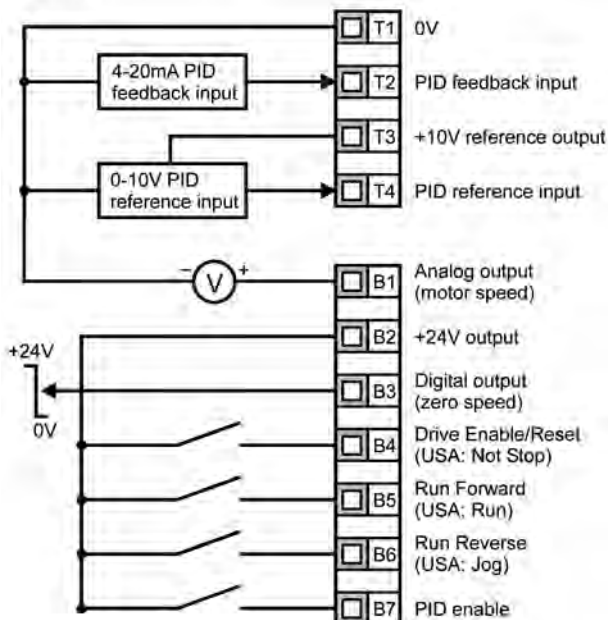
WARNING When torque mode is selected and the drive is connected to an unloaded motor, the motor speed may increase rapidly to the maximum speed (Pr 02 +20%)

11. Programming Parameters

PID Logic Diagram
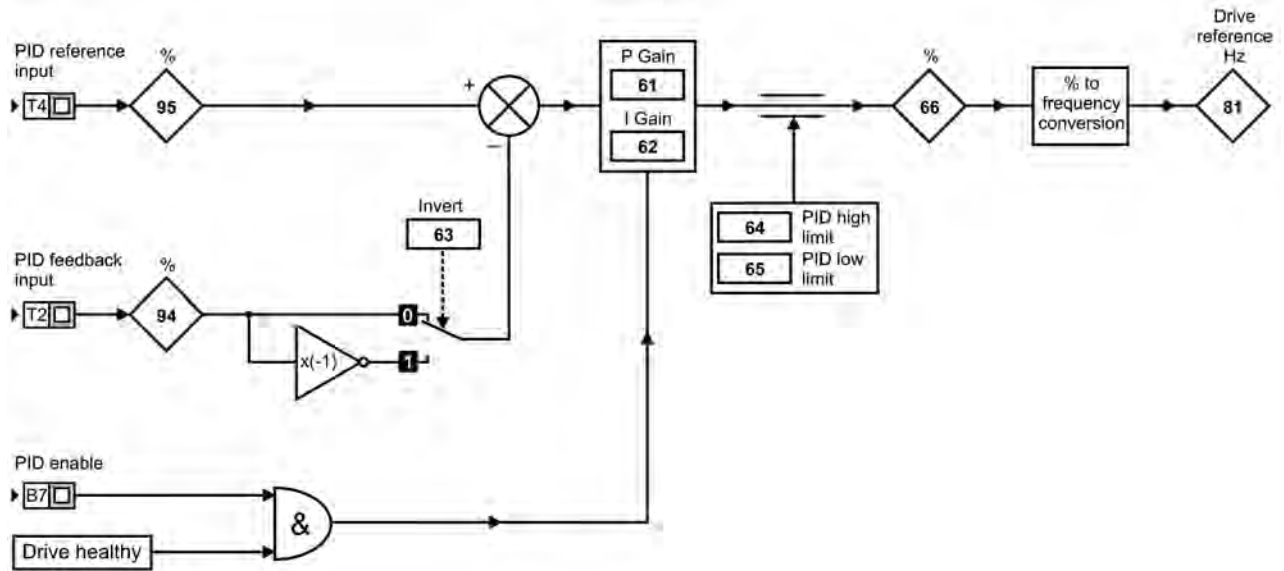
Figure 11.3.10 Pr 05 = HUAC terminal configuration
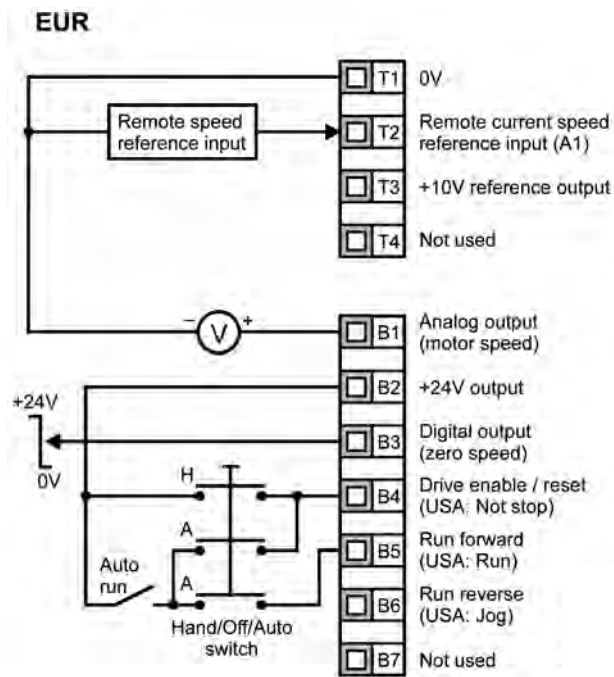
11. Programming Parameters

No	Function	Range	Defaults	Type
06	Motor rated current	0 to Drive rated current A	Drive rating	RW

Enter the motor current rating (taken from the motor name plate).

The drive rated current is the 100% RMS output current value of the drive. This value can be set to a lower value but not to a higher value than the drive rated current.

No	Function	Range	Defaults	Type
07	Motor rated speed	0 to Drive 9999 rpm	EUR: 1500, USA: 1800	RW

Enter the rated full load speed of the motor (taken from the motor name plate).

The motor rated speed is used to calculate the correct slip speed for the motor.

NOTE A value of zero entered into Pr 07 means slip compensation is disabled.

NOTE If the full load speed of the motor is above 9999rpm, enter a value of 0 in Pr 07. This will disable slip compensation as values greater then 9999 cannot be entered into this parameter.

No	Function	Range	Defaults	Type
08	Motor rated voltage	0 to 240, 0 to 480 V	EUR: 230/400 USA: 230/460	RW

Enter the motor rated voltage (taken from the motor name plate).

This is the voltage applied to the motor at base frequency.

NOTE If the motor is not a standard 50 or 60Hz motor, see Pr 39 and adjust accordingly.

No	Function	Range	Defaults	Type
09	Motor Power Factor	0 to 1	0.85	RW

Enter the motor rated power factor cos φ (taken from the motor name plate).

No	Function	Range	Defaults	Type
10	Parameter Access	L1, L2, L3 Loc	L1	RW

L1: Level 1 access - only the first 10 parameters can be accessed

L2: Level 2 access - All parameters from 01 to 60 can be accessed

L3: Level 3 access - All parameters from 01 to 95 can be accessed

Loc: Used to lock a security code in the drive.

Parameter descriptions - Level 2

No	Function	Range	Defaults	Type
11	Start/Stop logic select	0 to 6	EUR: 0, USA: 5	RW

11. Programming Parameters

Pr 11	Terminal B4	Terminal B5	Terminal B6	Latching
0	Enable	Run Forward	Run Reverse	No
1	Not Stop	Run Forward	Run Reverse	Yes
2	Enable	Run	Forward / Reverse	No
3	Not Stop	Run	Forward / Reverse	Yes
4	Not Stop	Run	Jog	Yes
5	User programmable	Run Forward	Run Reverse	No
6	User Programmable	User Programmable	User Programmable	User Programmable

A change to Pr 11 is set by pressing the Ⓜ MODE key on exit from parameter edit mode.

The drive must be disabled, stopped or tripped for a change to take place. If Pr 11 is changed while the drive is running, when the Ⓜ MODE key is pressed on exit from parameter edit mode, Pr 11 will change back to its previous value.

No	Function	Range	Defaults	Type
12	Brake enable	diS, rEL, d IO, USEr	diS	RW

diS: Mechanical brake software disabled

rEL: Mechanical brake software enabled. Brake control via relay T5 & T6. The digital output on terminal B3 is automatically programmed as a drive healthy output.

d IO: Mechanical brake software enabled. Brake control via digital output B3. The relay output on terminals T5 and T6 are automatically programmed as a drive healthy output.

USEr: Mechanical brake software enabled. Brake control to be programmed by user. The relay and digital output are not programmed. The user should programme the brake control to either the digital output or relay. The output not programmed to the brake control can be programmed to indicate the required signal. (See Commander SK Advanced User Guide.)

NOTE A change to Pr 12 is set by pressing the Ⓜ MODE key on exit from parameter edit mode. The drive must be disabled, stopped or tripped for a change to take place. If Pr 12 is changed while the drive is running, when the Ⓜ MODE key is pressed on exit from parameter edit mode, Pr 12 will change back to its previous value.

See Pr 46 to Pr 51.

No	Function	Range	Defaults	Type
13	Not Used			
14				

No	Function	Range	Defaults	Type
15	Jog reference	0 to 400.0 Hz	1.5	RW

Defines the jog speed

No	Function	Range	Defaults	Type
16	Analog 1 input mode	0-20, 20-0, 4-20, 20-4, 4-.20, 20-.4, VoLt	4-.20	RW

Determines the input on terminal T2

0-20: Current input 0 to 20mA (20mA full scale)

20-0: Current input 20 to 0mA (0mA full scale)

4-20: Current input 4 to 20mA with current loop loss (cL) trip (20mA full scale)

20-4: Current input 20 to 4mA with current loop loss (cL) trip (4mA full scale)

4-.20: Current input 4 to 20mA with no current loop loss (cL) trip (20mA full scale)

20-.4: Current input 20 to 4mA with no current loop loss (cL) trip (4mA full scale)

VoLt: 0 to 10V input

11. Programming Parameters

NOTE In the 4-20 or 20-4mA modes (with current loop loss) the drive will trip on cL1 if the input reference is below 3mA. Also, if the drive trips on cL1, the voltage analog input cannot be selected.

No	Function	Range	Defaults	Type
17	Enable negative preset speeds	OFF (0) or On (1)	OFF (0)	RW

OFF: Direction of rotation controlled by run forward and run reverse terminals

On: Direction of rotation controlled by preset speed values (use run forward terminal)

No	Function	Range	Defaults	Type
18	Preset speed 1	±1500 Hz (Limited by setting of Pr 02 Maximum set speed)	0	RW
19	Preset speed 2			
20	Preset speed 3			
21	Preset speed 4			

Defines preset speeds 1 to 4.

No	Function	Range	Defaults	Type
22	Load display units	Ld, A	Ld	RW

Ld: Active current as a % of motor rated active current

A: Drive output current per phase in A

No	Function	Range	Defaults	Type
23	Speed display units	Fr, SP, Cd	Fr	RW

Fr: Drive output frequency in Hz

SP: Motor speed in rpm

Cd: Machine speed in customer defined units (See Pr 24)

No	Function	Range	Defaults	Type
24	Customer defined scaling	0 to 9.999	.000	RW

Multiplying factor on motor speed (rpm) to give customer defined units.

No	Function	Range	Defaults	Type
25	Security set-up	0 to 999	0	RW

Used to set-up a user security code.

No	Function	Range	Defaults	Type
26	Not used			

No	Function	Range	Defaults	Type
27	Power up keypad reference	0, LASt, PrS1	0	RW

0: keypad reference is zero

LASt: keypad reference is last value selected before the drive was powered down

PrS1: keypad reference is copied from preset speed 1

No	Function	Range	Defaults	Type
28	Parameter cloning	nO, rEAd, Prog, boot	no	RW

nO: do nothing

rEAd: program the drive with the contents of the SmartStick

Prog: program the SmartStick with the current drive settings

boot: SmartStick becomes read only. The contents of the SmartStick will be copied to the drive every time the drive is powered up

Parameter cloning is initiated by pressing the ⓜ MODE key on exit from parameter edit mode after Pr 28 has been set to rEAd, Prog or boot.

NOTE If parameter cloning is enabled when no SmartStick is fitted to the drive, the drive's display will flash FAIL twice before changing back to nO.

No	Function	Range	Defaults	Type
29	Load defaults	nO, Eur, USA	no	RW

nO: defaults are not loaded

Eur: 50Hz default parameters are loaded

USA: 60Hz default parameters are loaded

Default parameters are set by pressing the ⓜ MODE key on exit from parameter edit mode after Pr 29 has been set to Eur or USA.

When default parameters have been set, the display will return to Pr 01 and Pr 10 will be reset to L1.

11. Programming Parameters

NOTE The drive must be in a disabled, stopped or tripped condition to allow default parameters to be set. If default parameters are set while the drive is running, the display will flash FAIL twice before changing back to nO.

No	Function	Range	Defaults	Type
30	Ramp mode select	0 to 3	1	RW

0: Fast ramp selected
1: Standard ramp with normal motor voltage selected
2: Standard ramp with high motor voltage selected
3: Fast ramp with high motor voltage selected

Fast ramp is linear deceleration at programmed rate, normally used when a braking resistor is fitted.

Standard ramp is controlled deceleration to prevent DC bus over-voltage trips, normally used when there is no braking resistor fitted.

If a high motor voltage mode is selected, deceleration rates can be faster for a given inertia but motor temperatures will be higher.

No	Function	Range	Defaults	Type
31	Stopping mode select	0 to 4	1	RW

0: Coast to stop selected
1: Ramp to stop selected
2: Ramp to stop with 1 second DC injection braking
3: DC injection braking with detection of zero speed
4: Time DC injection braking

See the Commander SK Advanced User Guide.

No	Function	Range	Defaults	Type
32	Variable torque select	OFF (0) or On (1)	On (1)	RW

OFF: Fixed linear voltage to frequency ratio (constant torque - standard load)
On: Voltage to frequency ratio dependant on load current (dynamic/variable torque/ load). This gives a higher motor efficiency.

No	Function	Range	Defaults	Type
33	Catch a spinning motor select	0 to 3	0	RW

0: Disabled
1: Detect all frequencies
2: Detect positive frequencies only
3: Detect negative frequencies only

No	Function	Range	Defaults	Type
34	Terminal B7 mode select	dig, th, Fr, Fr.hr	dig	RW

dig: Digital input
th: Motor thermistor input, connect as per diagram below
Fr: Frequency input. See Commander SK Advanced User Guide
Fr.hr: High resolution frequency input. See Commander SK Advanced User Guide
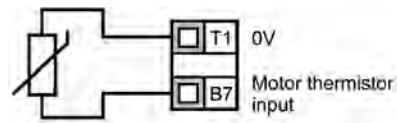
Trip resistance: 3kΩ
Reset resistance 1k8

NOTE If Pr 34 is set to th so that terminal B7 is used as a motor thermistor, the functionality of terminal B7 as set-up with Pr 05, drive configuration, will be disabled.

No	Function	Range	Defaults	Type
35	Digital output function (terminal B3)	n=0, At.SP, Lo.SP, hEAL,Act, ALAr, I.Lt, At.Ld, USEr	n=0	RW

n=0: At zero speed
At.SP: At speed
Lo.SP: At minimum speed
hEAL: Drive healthy
Act: Drive active
ALAr: General drive alarm
I.Lt: Current limit active
At.Ld: At 100% load
USEr: User programmable

11. Programming Parameters

NOTE This parameter is automatically changed by the setting of Pr 12. When Pr 12 automatically controls the setting of this parameter, this parameter cannot be changed.

NOTE See the Commander SK Advanced User Guide. A change to this parameter is only implemented if the drive is disabled, stopped or tripped and the ◉STOP/RESET key is pressed for 1s.

See the Commander SK Advanced User Guide.

No	Function	Range	Defaults	Type
36	Analog output function (terminal B1)	Fr, Ld, A, Por, USEr	Fr	RW

Fr: Voltage proportional to motor speed
Ld: Voltage proportional to motor load
A: Voltage proportional to output current
Por: Voltage proportional to output power
USEr: User programmable

See the Commander SK Advanced User Guide.

NOTE A change to this parameter is only implemented if the drive is disabled, stopped or tripped and the ◉ STOP/RESET key is pressed for 1s.

No	Function	Range	Defaults	Type
37	Maximum switching frequency	3, 6, 12, 18 kHz	3	RW

3: 3kHz
6: 6kHz
12: 12kHz
18: 18kHz

No	Function	Range	Defaults	Type
38	Autotune	0 to 2	0	RW

0: No autotune
1: Non-rotating static autotune
2: Rotating autotune

> ⚠️ **WARNING** When a rotating autotune is selected, the drive will accelerate the motor up to $^2/_3$ maximum speed in Pr 02.

NOTE The motor must be at a standstill before a non-rotating autotune is initiated.

NOTE The motor must be at a standstill and unloaded before a rotating autotune is initiated.

No	Function	Range	Defaults	Type
39	Motor rated frequency	0.0 to 1500.0 Hz	EUR: 50.0, USA: 60.0	RW

Enter the motor rated frequency (taken from the motor name plate).

Defines the voltage to frequency ratio applied to the motor.

No	Function	Range	Defaults	Type
40	Number of poles	Auto, 2P, 4P, 6P, 8P	Auto	RW

Auto: Automatically calculates the number of motor poles from the settings of Pr 07 and Pr 39
2P: Set for a 2 pole motor
4P: Set for a 4 pole motor
6P: Set for a 6 pole motor
8P: Set for an 8 pole motor

No	Function	Range	Defaults	Type
41	Voltage mode selector	0 to 5	Ur I	RW

Ur S: Stator resistance is measured at each time the drive is started
Ur: No measurement is taken
Fd: Fixed boost
Ur A: Stator resistance is measured at first drive enable
Ur I: Stator resistance measured at each power up
SrE: Square law characteristic

In all Ur modes, the drive operates in open loop vector mode.

No	Function	Range	Defaults	Type
42	Low frequency voltage boost	0.0 to 50.0 %	3.0	RW

Determines the boost level when Pr 41 is set to Fd or SrE.

11. Programming Parameters

No	Function	Range	Defaults	Type
43	Serial communications baud rate	2.4, 4.8, 9.6, 19.2, 38.4	19.2	RW

2.4: 2400 baud
4.8: 4800 baud
9.6: 9600 baud
19.2: 19200 baud
38.4: 38400 baud

No	Function	Range	Defaults	Type
44	Serial address	0 to 247	1	RW

Defines the unique address for the drive for the serial interface.

No	Function	Range	Defaults	Type
45	Software version	1.00 to 99.99		RW

Indicates the version of software fitted to the drive.

No	Function	Range	Defaults	Type
46	Brake release current threshold	0 to 200 %	50	RW
47	Brake applied current threshold		10	

Defines the brake release and brake applied current thresholds as a % of motor current.

If the frequency is >Pr 48 and the current is >Pr 46, the brake release sequence is started.

If the current is <Pr 47, the brake is applied immediately.

No	Function	Range	Defaults	Type
48	Brake release frequency	0 to 20.0 Hz	1.0	RW
49	Brake applied frequency		2.0	

Defines the brake release and brake applied frequencies.

If the current is >Pr 46 and the frequency is > Pr 48, the brake release sequence is started.

If the frequency is <Pr 49 and the drive has been commanded to stop, the brake is applied immediately.

No	Function	Range	Defaults	Type
50	Pre-brake release delay	0.0 to 25.0 s	1.0	RW

Defines the time between the frequency and load condition being released. The ramp is held during this time.

No	Function	Range	Defaults	Type
51	Post brake release delay	0.0 to 25.0 s	1.0	RW

Defines the time between the brake being released and the ramp hold being released.

11. Programming Parameters

Pr 52 to Pr 54 appear when a fieldbus option is fitted to the drive.

No	Function	Range	Defaults	Type
52	Fieldbus node address	0 to 255	0	RW

No	Function	Range	Defaults	Type
53	Fieldbus baud rate	0 to 8	0	RW

No	Function	Range	Defaults	Type
54	Fieldbus diagnostics	-128 to +127	0	RW

No	Function	Range	Defaults	Type
55	Last trip			
56	Trip before Pr 55		0	RW
57	Trip before Pr 56			
58	Trip before Pr 57			

Indicates the last 4 trips of the drive.

No	Function	Range	Defaults	Type
59	Drive user program enable	0 to 2	0	RW

The drive user program enable is used to start and stop the drive user program.

0: Stop the drive user program

1: Run the drive user program (trip drive if LogicStick is not fitted). Any out-of-range parameter writes attempted will be limited to the maximum/minimum values valid for that parameter before being written to

2: Run the drive user program (trip drive if LogicStick is not fitted). Any out-of-range parameter writes attempted will cause the drive to trip

No	Function	Range	Defaults	Type
60	Drive user program status	-128 to +127		RO

The drive user program status parameter indicates the actual state of the drive user program.

-n: User program caused a drive trip due to an error condition while running rung n. Note that the rung number is shown on the display as a negative number

0: User program not fitted

1: User program is fitted but stopped

2: User program is fitted and running

No	Function	Range	Defaults	Type
61 to 70	Configurable parameter 1 to configurable parameter 10	As source		

Pr 61 to Pr 70 and Pr 71 to Pr 80 can be used to access and adjust advanced parameters.

EXAMPLE It is desired that Pr 1.29 (Skip frequency 1) is to be adjusted. Set one of the parameters Pr 71 to Pr 80 to 1.29, the value of Pr 1.29 will appear in the corresponding parameter from Pr 61 to Pr 70. I.e. if Pr 71 is set to 1.29, Pr 61 will contain the value of Pr 1.29 where it can be adjusted.

NOTE Some parameters are only implemented if the drive is disabled, stopped or tripped the ◉STOP/RESET key is pressed for 1s.

See Commander SK Advanced User Guide for advanced parameter details.

Parameter descriptions - Level 3

No	Function	Range	Defaults	Type
71 to 80	Pr 61 to Pr 70 set up	0 to Pr 2150		RW

Set Pr 71 to Pr 80 to the required advanced parameter number to be accessed.

The value within these parameters will be displayed in Pr 61 to Pr 70. Pr 61 to Pr 70 can then be adjusted to change the value within a parameter.

See Commander SK Advanced User Guide for further details.

11. Programming Parameters

11.4 Diagnostics and Protective Features

Trip Code	Condition	Possible Causes
UU	DC bus under voltage	Low AC supply voltage Low DC bus voltage when supplied by an external DC power supply
OV	DC bus over voltage	Deceleration rate set too fast for inertia of machine
OI.AC**	Drive output instantaneous over current	Insufficient ramp times Phase to phase or phase to ground short circuit on the drives output Drive requires autotuning to the motor Motor or motor connections changed, re-autotune drive to motor
OI.br**	Braking resistor instantaneous over current	Excessive braking current in braking resistor Braking resistor value too small
O.SPd	Over speed	Excessive motor speed (typically caused by mechanical load driving the motor)
tunE	Auto tune stopped before completion	Run command removed before autotune complete
It.br	I2t on braking resistor	Excessive braking resistor energy
It.AC	I2t on drive output current	Excessive mechanical load High impedance phase to phase or phase to ground short circuit at drive output Drive requires re-autotuning to motor
O.ht1	IGBT over heat based on drives thermal model	Overheat software thermal model
O.ht2	Over heat based on drives heatsink	Heatsink temperature exceeds allowable maximum
th	Motor thermistor trip	Excessive motor temperature
O.Ld1*	User +24V or digital output overload	Excessive load or short circuit on +24V output
cL1	Analog input 1 current mode, current loss	Input current less then 3mA when 4-20 or 20-4mA modes selected
SCL	Serial communications loss time-out	Loss of communication when drive is under remote control
EEF	Internal drive EEPROM failure	Possible loss of parameter values (set default parameters (see Pr 29))
PH	Input phase imbalance or input phase loss	One of the input phases has become disconnected from the drive (applies to 200/400V three phase drives only, not dual rated drives)
rS	Failure to measure motors stator resistance	Motor too small for drive Motor cable disconnected during measurement
C.Err	SmartStick data error	Bad connection or memory corrupt within SmartStick
C.dAt	SmartStick data does not exist	New/empty SmartStick being read
C.Acc	SmartStick read/write fail	Bad connection or faulty SmartStick
C.rtg	SmartStick/drive rating change	Already programmed SmartStick read by a drive of a different rating
O.cL	Overload on current loop input	Input current exceeds 25mA
HFxx trip	Hardware faults	Internal drive hardware fault (see Commander SK Advanced User Guide)

* The Enable/Reset terminal will not reset an O.Ld1 trip. Use the ◉ Stop/Reset key.

** These trips cannot be reset for 10 seconds after they occur.

11. Programming Parameters

11.4.1 Diagnostic parameters

The following read only (RO) parameters can be used as an aid to fault diagnosis on the drive.

No	Function	Range	Type
81	Reference selected	±Pr 02 Hz	RO
82	Pre-ramp reference	±Pr 02 Hz	RO
83	Post-ramp reference	±Pr 02 Hz	RO
84	DC bus voltage	0 to Drive maximum VDC	RO
85	Motor frequency	±Pr 02 Hz	RO
86	Motor voltage	0 to Drive rating V	RO
87	Motor speed	±9999 rpm	RO
88	Motor current	±Drive maximum A	RO
89	Motor active current	±Drive maximum A	RO
90	Digital I/O readword	0 to 95	RO
91	Reference on indicator	OFF (0) or On (1)	RO
92	Reverse selected indicator	OFF (0) or On (1)	RO
93	Jog selected indicator	OFF (0) or On (1)	RO
94	Analog input 1	0 to 100 %	RO
95	Analog input 2	0 to 100 %	RO

11. Programming Parameters

Brake function diagram
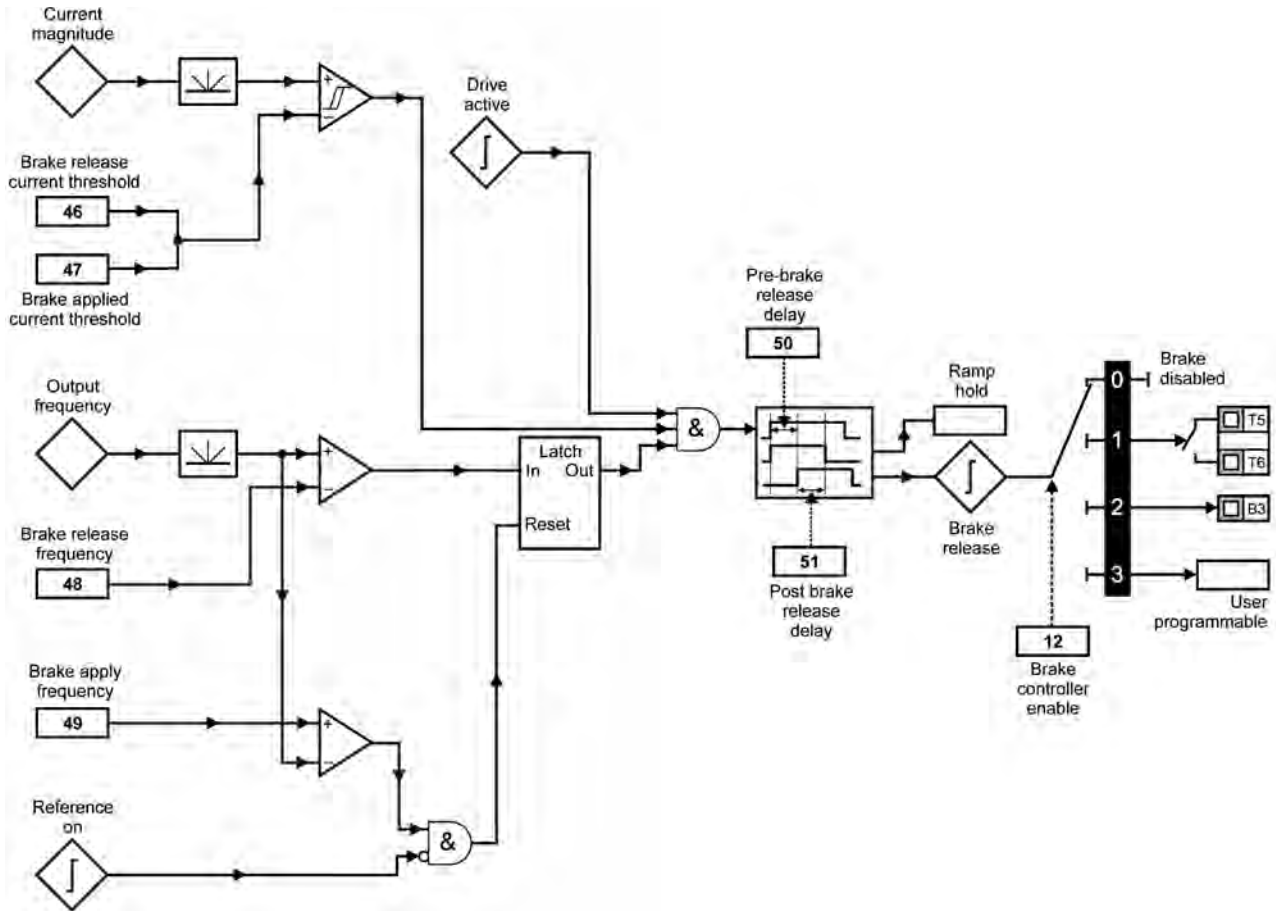
Brake sequence
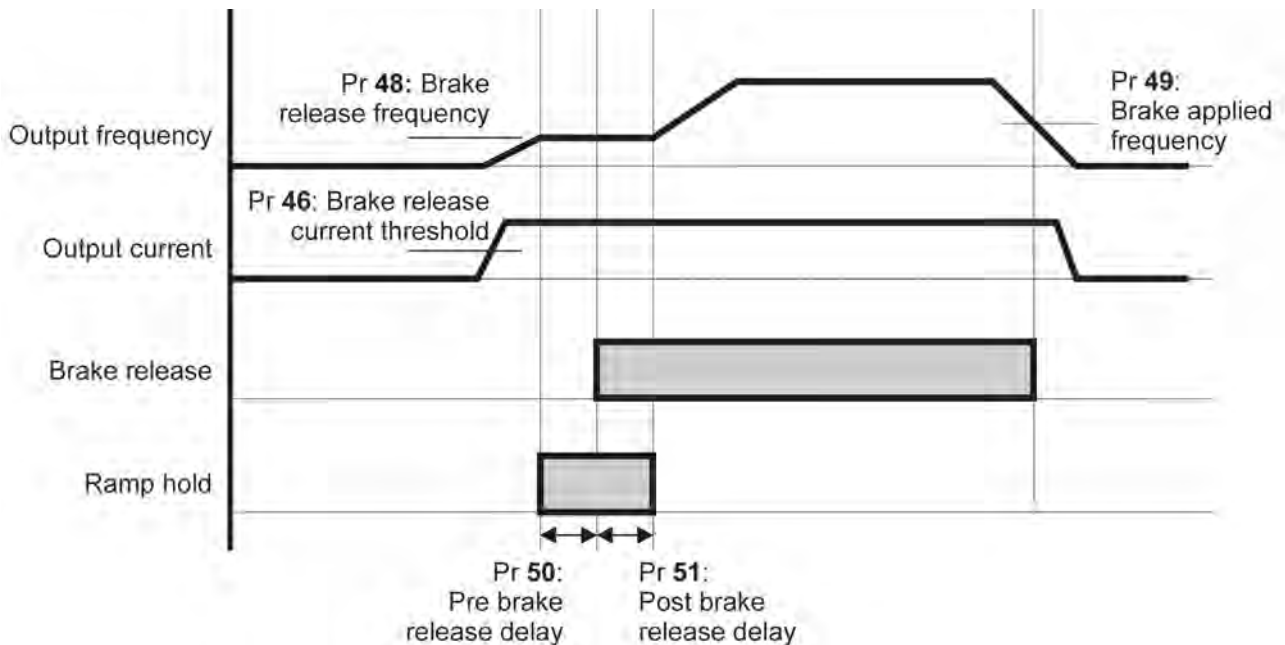
11. Programming Parameters

DC bus voltages

Drive voltage rating	UV Trip	UV Reset	Braking level	OV trip
200V	175	215 *	390	415
400V	330	425 *	780	830

Alarm warnings

Display	Condition	Solution
OUL.d	I x t overload	Reduce motor current
hot	Heatsink/IGBT temperature high	Reduce ambient temperature or reduce motor current
br.rS	Braking resistor overload	See Commander SK Advanced User Guide

Cooling fan control (size B and C only)

As default, the fan is controlled by the drive. If the heatsink temperature is above 60°C or the drive output current is above 75% of the drive rated current, the fan will switch on and run at full speed for a minimum of 10s. After 10s, if the heatsink temperature falls below 60°C or the drive output current falls below 75% of the drive rated current, the fan will switch off. If the temperature remains above 60°C or the drive output current remains above 75% of the drive rated current, the fan will continue running at full speed.

For further details, see the Commander SK Advanced User Guide.

12. Options

12.1 Options Overview

All Commander SK Option modules are colour-coded, in order to make identification easy. The following table shows the colour-code key and gives further details on their function.

Type	Option Module	Colour	Order Code	Description	Unidrive SP Compatable
Fieldbus*		Purple	SM-PROFIBUS-DP	PROFIBUS-DP option PROFIBUS-DP adapter for communication with Commander SK	Yes
		Medium Grey	SM-DeviceNet	DeviceNet option DeviceNet adapter for communication with Commander SK	Yes
		Dark Grey	SM-INTERBUS	INTERBUS option INTERBUS adapter for communication with Commander SK	Yes
		Light Grey	SM-CANopen	CANopen option CANopen adapter for communication with Commander SK	Yes
		Beige	SM-Ethernet	Ethernet option Ethernet adapter for communication with Commander SK	Yes
Extended IO*		Dark Yellow	SM-I/O Lite	I/O Lite Increases the I/O capability by adding the following to the existing I/O in the drive: • ±10V bi-polar / 4-20mA Analogue input • 1.0-10V / 4-20mA Analogue output • Digital inputs x 3 • Encoder Speed Reference input (A, /A, B, /B) • Relay x 1	Yes
		Dark Red	SM-I/O Timer	Timer I/O Same features is I/O Lite, but with the addition of a Battery backed-up Real Time Clock.	Yes
		Turquoise	SM-PELV	PELV Isolated digital I/O to NUMUR NE37 (for chemical industry).	Yes
Automation		Black	SmartStick	SmartStick Option Cloning Parameters	No
		White	LogicStick	LogicStick Option PLC functionality using SyPT Lite programming PC software	No
Keypad		N/A	SM-Keypad Plus	LCD Keypad Display Option SM-Keypad Plus (LCD keypad as used on Unidrive SP) Connects to Modbus RTU RJ45 port and can be panel mounted	Yes
		N/A	SK-Keypad Remote	LED Keypad Display Option SK-Keypad Connects to Modbus RTU RJ45 port and can be panel mounted	No

* Only used on sizes B & C (not compatible with size A)

Type	Order Code	Description	Minimum Software version	Unidrive SP Compatable
Software	CTSoft	CTSoft is a complimentary Windows based drive configuration tool designed to enable the complete control and display of all parameters within a Unidrive 6. Functions within CTSoft allow data to be uploaded, viewed and saved, or retrieved from disk, modified and printed. It can be used off-line in the office or on-line in the factory. CTSoft communicates with the Unidrive SP via the computer's serial port to the drive's RS485 port using a communications cable (CT Comms cable). Some of CTSoft's capabilities include: • Remote Upload/Download • Parameter Saving • Drive and SM-Application Reset • Monitor Screens • Multiple Window Display • Project Storage • Block Diagram Animation		Yes
	SyPTLite	SyPTLite is a ladder diagram editor allowing the development of programs for execution on Control Techniques drives and options modules (targets). SyPTLite is designed to be easy to use and makes program development as simple as possible. The features provided are a subset of those in the SyPTPro program editor. SyPTLite programmes are developed using ladder logic, a graphical IEC61131-3 based language widely used to program PLCs. SyPTLite allows a user to "draw" a ladder diagram representing a program. SyPTLite provides a complete environment for the development of ladder diagrams, which can be created then compiled into user programs and downloaded to a target for execution. The run-time operation of the compiled ladder diagram on a target can also be monitored using SyPTLite and facilities are provided to interact with the program on the target by setting new values for target parameters.		Yes
Cable	CT Comms Cable	Using a special RS232 to RS485 converter you can connect the PC to the RJ45 serial port on the front of the drive. A special pre-made cable is available from Control Techniques for this purpose – this same cable is used with other Control Techniques products that use a RJ45 RS485 connector. The RJ45 socket is located under a small flap on the front of the Unidrive SP just below the keypad. The pin-outs of this connector are described in the Unidrive SP User Guide.		Yes
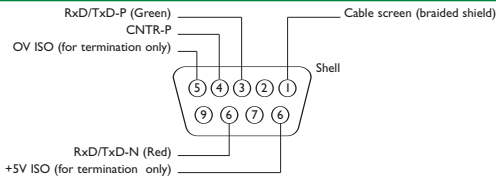
12. Options

12.2 Profibus DP

SM-PROFIBUS-DP Termination

Option Module	Colour	Name	Terminal Information
	Purple	SM-PROFIBUS-DP	RxD/TxD-P (Green) — CNTR-P — OV ISO (for termination only) — Cable screen (braided shield) — Shell — ⑤④③②① ⑨⑥⑦⑥ — RxD/TxD-N (Red) — +5V ISO (for termination only)

Cable	Function	Function	Description
Red	RxD/TxD-N	3	Positive data line
Green	RxD/TxD-P	8	Negative data line
Braided Shield	Screen	Shell	Cable screen

See also the SM-Profibus DP Advanced User Guide (www.controltechniques.com)

SM-PROFIBUS-DP terminal descriptions

The SM-PROFIBUS-DP has a standard 9-way female
D-type connector for the PROFIBUS-DP network.

SM-PROFIBUS-DP - Front View

The terminal functions are given in the Table below.

SM-PROFIBUS-DP connections

D-type terminal	Function	Description
3	RxD/TxD-P	Positive data line (B)
8	RxD/TxD-N	Negative data line (A)
6	+5V ISO	+5V isolated, use only for termination resistors
5	0V ISO	0V isolated, use only for termination resistors
4	CNTR-	P RTS line
1, Shell	Shield	Cable shield connection

We strongly recommend that Profibus-recommended
connectors are used. These connectors accept 2
PROFIBUS-DP cables and have 4 screw terminals inside,
one for each data connection. They also have a shield clamp
arrangement to ensure good shield continuity, and help to
ensure good noise immunity of the PROFIBUS-DP network.

12. Options

12.2.1 SM-PROFIBUS-DP Connectors

The SM-PROFIBUS-DP has been designed to accept the Erbic "vertical" range of PROFIBUS-DP connectors from ERNI. The grey connector (Part No: 103658L) can be used on all nodes in the middle of the PROFIBUS-DP network, and a special yellow termination connector (Part No: 103659L) containing the necessary PROFIBUS-DP termination resistor network is also available.

Some Siemens connectors may also be used with the SM-PROFIBUS-DP. Suitable connectors are Part No: 6GK1 500-0FC00 and Part No: 6GK1 500-0EA02.

For further details visit the PROFIBUS web site at www.profibus.com, and search for "network components".

The figure below illustrates a PROFIBUS-DP connection using an Erbic connector from ERNI.

PROFIBUS-DP network connections

Illustrated connector is
Erbic Part No. 103658L

12.2.2 PROFIBUS-DP cable

PROFIBUS-DP cable has a single twisted pair with overall shielding. PROFIBUS-DP has a specified colour code, and it is strongly recommended that this code is maintained.

PROFIBUS-DP networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Cable specifications and a list of approved manufacturers of cable for use on PROFIBUS-DP networks is available on the Pr ofibus Nutzerorganisation (PNO) web site at www.Pr ofibus.com.

We can only guarantee correct and reliable operation of the SMPROFIBUS-DP if all other equipment installed on the PROFIBUS-DP network (including the network cable) has been approved by the PNO.

PROFIBUS-DP cable colour codes

Cable	Data signal	Terminal	Description
Red	RxD/TxD-P	3	Positive data line (B)
Green	RxD/TxD-N	8	Negative data line (A)
Braided Shield	shield	I, Shell	Cable shield

12. Options

12.3.3 SM-PROFIBUS-DP cable shield connections

The electrical noise immunity of the PROFIBUS-DP network can be increased if the shields of the PROFIBUS-DP cables are grounded at every drive, on their external surfaces before they enter the connector. This precaution is recommended unless there are specific reasons for avoiding grounding.

12.2.4 PROFIBUS-DP network termination

It is very important in high-speed communications networks that the network communications cable is fitted with the specified termination resistor network at each end of the cable. This prevents signals from being reflected back down the cable and causing interference.

Erbic termination connectors are available from ERNI. These terminals (illustrated in the Figure below) have the termination resistor network built in, and only a single pair of terminals for the data wires. Some brands of connectors have a built-in switch that allows the termination resistor network to be enabled or disabled as required.

PROFIBUS-DP network termination
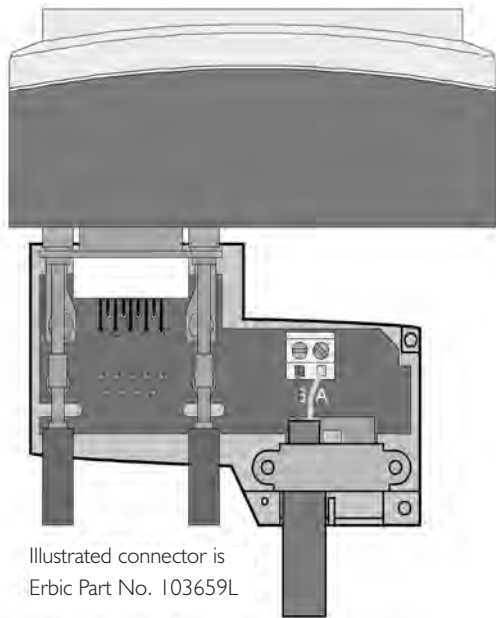
Illustrated connector is
Erbic Part No. 103659L

Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination resistors are not fitted, the noise immunity of the network is greatly reduced.

If too many termination resistor networks are fitted on a PROFIBUS-DP network, the network will be over-loaded, resulting in reduced signal levels. This may cause nodes to miss some bits of information, resulting in transmission errors being reported. If network overload is excessive, the signal levels may be so low that nodes cannot detect any network activity at all.

12.2.5 Maximum network length

The maximum number of nodes that can be connected to a single PROFIBUS-DP network segment is 32. The maximum lengths of cable for a segment depend on the data rate, and are shown in the table below.

Repeaters can be used to extend the network to allow more than 32 nodes to be connected, and/or to extend the maximum length of the PROFIBUS-DP network.

For full details on designing and installing a PROFIBUS-DP network, refer to "Installation Guidelines for Profibus-DP/FMS". This document is available from the Profibus web site at www.profibus.com.,

PROFIBUS-DP maximum network lengths
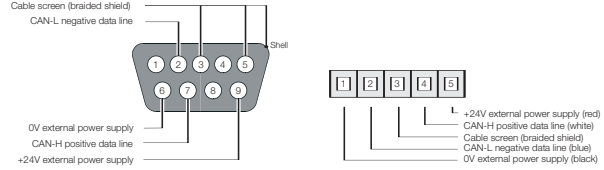
Data rate (bit/s)	Maximum trunk length (m)	Data rate (bit/s)	Maximum trunk length (m)
12M	100	187.5k	1000
6.0M	100	93.75k	1000
3.0M	100	45.45k	1000
1.5M	200	19.2k	1000
500k	400	9.6K	1000

12. Options

12.3 DeviceNet

SM-DeviceNet Termination

Option Module	Colour	Name	Terminal Information
	Grey	SM-DeviceNet	

5-Way Terminal	D-type Terminal	Function	Description
1	6	0V	0V DeviceNet external supply
2	2	CAN-L	Negative data line
3	3,5 shell	Screen	Cable braided screen connection
4	7	CAN-H	Positive data line
5	9	+24V	+24V DeviceNet external supply

See also the SM-DeviceNet Advanced User Guide (www.controltechniques.com)

SM-DeviceNet terminal descriptions

The SM-DeviceNet has a standard DeviceNet 5-way screw terminal block connector for the DeviceNet network. The 9-way male D-type also allows access to the SM-DeviceNet.

SM-PROFIBUS-DP - Front View
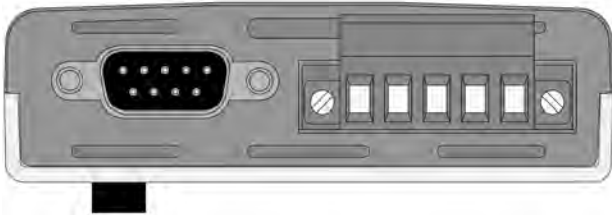
The standard 5-way DeviceNet terminal block connector is numbered from Terminal 1 on the left hand side to Terminal 5 on the right hand side. The terminal functions are given in the table below.

SM-PROFIBUS-DP connections

5-way terminal	D-type terminal	Function	Description
1	6	0V	0V DeviceNet external supply
2	2	CAN-L	Negative data line
3	3,5 Shell	Shield	Cable braided shield connection
4	7	CAN-H	Positive data line
5	9	+24V	+24V DeviceNet external supply

We do not recommend using the D-type connector for connecting to DeviceNet networks, as D-type connectors are not a recognised standard DeviceNet connector.

12. Options

12.3.1 SM-DeviceNet connections

To connect the SM-DeviceNet to the DeviceNet network, make the connections as shown in the diagram below. The length of the "pigtail" shield connection should be kept as short as possible.

Figure 4-2 SM-DeviceNet connections
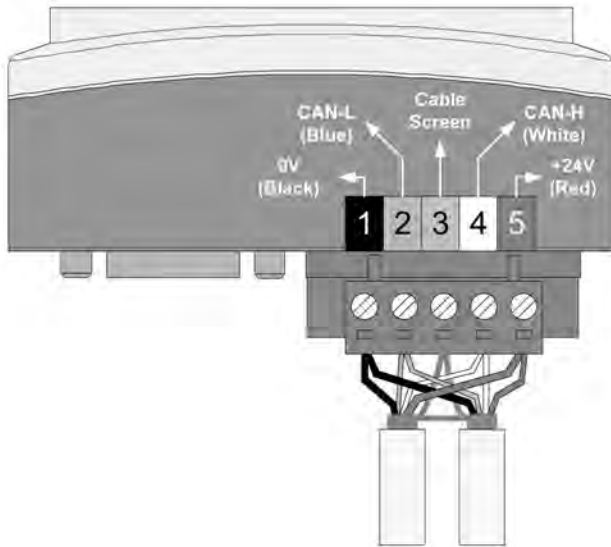
12.3.2 DeviceNet cable

DeviceNet cable has 2 twisted pairs plus overall shielding. DeviceNet has a specified colour code, and it is strongly recommended that this code is maintained. The data wires are white and blue, and the network power supply wires are red and black.

DeviceNet cable colour codes

Cable	Data signal	Terminal	Description
Black	0V	I	0V external power supply
Blue	CAN-L	2	Negative data line
Braided Shield	Shield	3	Cable shield
White	CAN-H	4	Positive data line
Red	+24V	5	+24V external power supply

DeviceNet networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Cable specifications and a list of approved manufacturers of cable for use on DeviceNet networks is available on the Open DeviceNet Vendors Association web site at www.odva.org.

We can only guarantee correct and reliable operation of the SMDeviceNet if all other equipment installed on the DeviceNet network (including the network cable) has been approved by the ODVA.

12. Options

12.3.3 DeviceNet network termination

It is very important in high-speed communications networks that the network communications cable is fitted with the specified termination resistor network at each end of the cable. This prevents signals from being reflected back down the cable and causing interference.

120R 0.25W termination resistors should be fitted across the CAN-H and CAN-L lines at the BOTH ends of the trunk cable run, as shown in the diagram below.

DeviceNet network termination
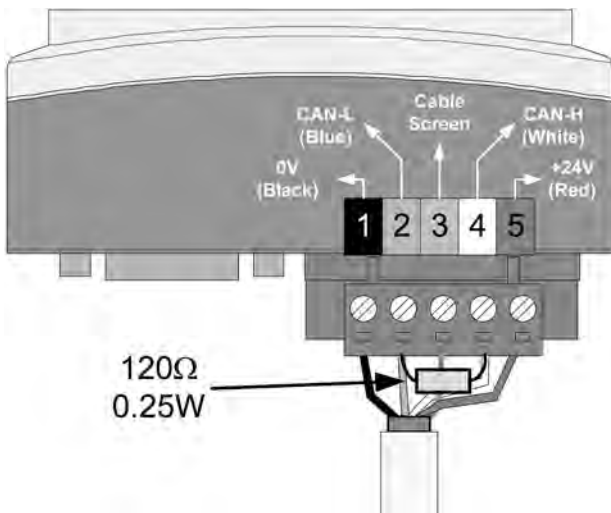
For further details, refer to DN-6.7.2, "DeviceNet Cable System: Planning and Installation Manual", available from the Allen Bradley web site at www.ab.com.

Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination resistors are not fitted, the noise immunity of the network is greatly reduced.If too many termination resistors are fitted on a DeviceNet network, the network will be over-loaded, resulting in reduced signal levels. This may cause nodes to miss some bits of information, resulting in transmission errors being reported. If network overload is excessive, the signal levels may be so low that nodes cannot detect any network activity at all.

12.3.4 SM-DeviceNet cable shield connections

The SM-DeviceNet should be wired with the cable shields isolated from ground at each drive. The cable shields should be linked together at the point where they emerge from the cable, and formed into a short pigtail to be connected to pin 3 on the DeviceNet connector.

The DeviceNet cable can be tie-wrapped to the Grounding Bar to provide strain relief, but the DeviceNet cable shield must kept isolated from ground at each node. The only exception to this is the DeviceNet ground point.

DeviceNet ground point

The DeviceNet cable shield must be grounded AT ONE POINT only, usually near the centre point of the cable run. This is to prevent the cable shield from becoming live in the event of catastrophic failure of another device on the DeviceNet network.

If a Commander SK node is the desired ground point, the shield of one of the DeviceNet cables can be exposed and clamped to the Grounding Bar.

12.3.5 SM-DeviceNet power supply requirements

A comprehensive guide to wiring and sizing a power supply for a DeviceNet network is available from the Allen Bradley web site at www.ab.com. DN-6.7.2 "DeviceNet Cable System: Planning and Installation Manual" provides all necessary details and guidelines to specifying and installing a suitable power supply for a DeviceNet network.

The SM-DeviceNet is powered by the drive, and only the transceiver circuitry is powered by the DeviceNet network power supply. Consequently, the DeviceNet will draw most current when the drive is completely powered down.

The table below shows the typical current drawn from the DeviceNet network power supply when the drive is completely powered down. A factor of 2 should be allowed for in-rush current if the DeviceNet is connected to the DeviceNet network while the drive is powered down.

SM-DeviceNet external power supply current consumption

DeviceNet supply voltage	Typical current
19.2V (24V -20%)	12mA
21.6V (24V -10%)	12mA
24V nominal	13mA
26.4V (24V +10%)	14mA
28.8V (24V+20%)	15mA

12. Options

12.3.5 Maximum network length

The maximum number of nodes that can be connected to a single DeviceNet network segment is 64 nodes. The maximum length of network cable for a DeviceNet network is specified by the Open DeviceNet Vendors Association, and depends on the data rate to be used. Full details of network cable lengths and wiring limitations are available in the Allen Bradley Document Reference DN-6.7.2.
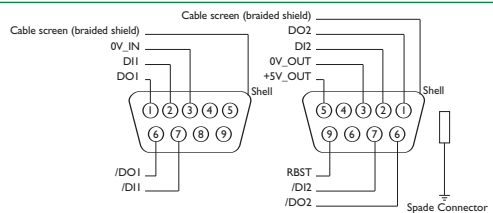
DeviceNet Maximum Network Lengths

Data rate (bits/sec)	Maximum trunk length (m)	Maximum drop length (m)	Max. cumulative drop (m)
125K	500	6	156
250K	250	6	78
500K	100	6	39

12. Options

12.4 Interbus

SM-INTERBUS Termination

Option Module	Colour	Name	Terminal Information
	Dark Grey	SM-INTERBUS	

See also the SMInterbus User Guide (www.controltechniques.com)

SM-INTERBUS terminal descriptions

The SM-INTERBUS has a 9-way male connector for the Remote Bus IN port and a 9- way female connector for the Remote Bus OUT port.

SM-INTERBUS - front view
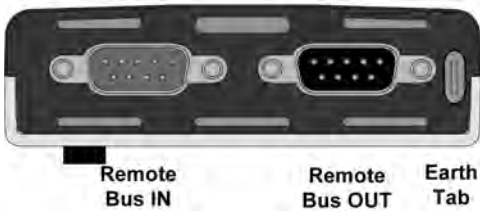
The terminal functions are given in the table below.

SM-INTERBUS terminal descriptions

Terminal	Function	Description
IN 1	DO1	Positive Data IN line, connect to DO2
IN 6	/DO1	Negative Data IN line, connect to /DO2
IN 2	DI1	Positive Data OUT line, connect to DI2
IN 7	/DI1	Negative Data OUT line, connect to /DI2
IN 3	0V ISO IN	0V Isolated for Remote Bus IN
IN Shell	Shield	Remote Bus IN Cable Shield
OUT 1	DO2	Positive Data IN line, connect to DO1
OUT 6	/DO2	Negative Data IN line, connect to /DO1
OUT 2	DI2	Positive Data OUT line, connect to DI1
OUT 7	/DI2	Negative Data OUT line, connect to /DI1
OUT 3	0V ISO OUT	0V Isolated for Remote Bus OUT
OUT 5	+5V ISO OUT	+5V Isolated for Remote Bus OUT
OUT 9	RBST	Remote Bus OUT Enable
OUT Shell	Shield	Remote Bus OUT Cable Shield
Ground Tab	Ground	Ground Tab

12. Options

SM-INTERBUS connections

The figure below illustrates an INTERBUS connection using standard D-type connectors with solder connections, and a typical D-type housing available from companies such as RS and Farnell.

INTERBUS network connections
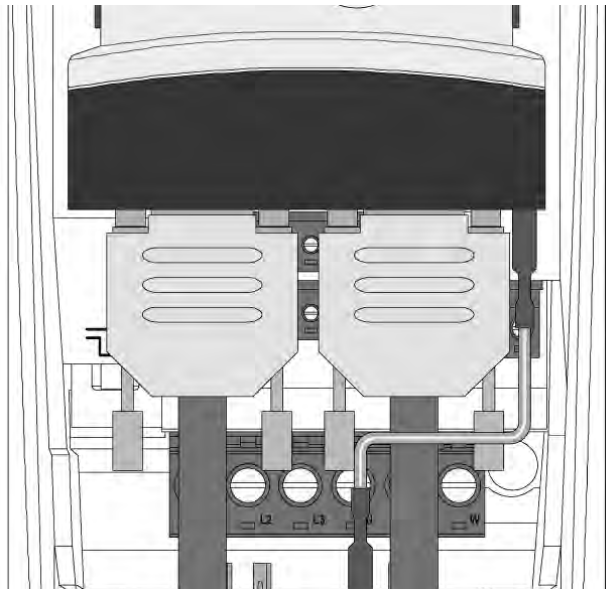
The Ground Tab should be connected to the drives Grounding Bar using a length of 2.5mm^2 Ground cable with a female push-on crimp connector (6.3mm^2 * 0.8mm2 tab size) fitted at the option module end. (Blue crimp connectors are suitable for use with 2.5mm^2 Ground cable.) This link should be kept as short as practicably possible, and should NOT be more than 200mm in length.

13.4.1 INTERBUS cable

INTERBUS cable has three twisted pairs plus overall shielding. The colours normally used on INTERBUS networks are shown below. It is recommended to follow these wiring guidelines as this will make it easier to trace possible wiring errors during system commissioning.

INTERBUS cable colour codes

Cable	Data Signal	D-type	Description
Green	/DO1, /DO2	6	Negative data OUT line
Yellow	DO1, DO2	1	Positive data OUT line
Pink	/DI1, /DI2	7	Negative data IN line
Grey	DI1, DI2	2	Positive data IN line
Brown	0V ISO IN, 0V ISO OUT	3	0V
White	Not used	---	Not used
Shield	Shield	Shell	Cable shield

INTERBUS cable is specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. A list of suppliers approved by the INTERBUS Club is available from the INTERBUS Club web site at www.interbusclub.com.

We can only guarantee correct and reliable operation of the SMINTERBUS if all other equipment installed (including the network cable) has been approved by the INTERBUS Club.

12.4.2 SM-INTERBUS cable shield connections

The Remote Bus IN and Remote Bus OUT cable shields MUST be connected to the shell of the D-type connector. There is no requirement to connect the cable shields to the drives Grounding Bar, or directly to Ground at any other point in the INTERBUS network.

12.4.3 INTERBUS network termination

External termination resistors are not required on INTERBUS networks, as each section of cable is automatically terminated on every INTERBUS node. Ensure that the Ground Tab on the SM-INTERBUS is connected to the drives Grounding Bar.
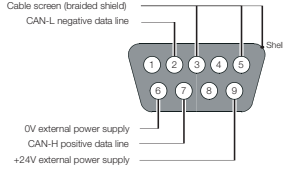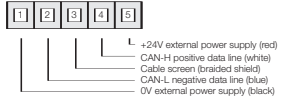
12.4.4 Maximum network length

The maximum length of cable is 400m between Remote Bus nodes. Hence, the maximum total length of the INTERBUS network depends entirely on the number of nodes connected to the network.

12. Options

12.5 CANopen

CANopen Termination

Option Module	Colour	Name	Terminal Information
	Light Grey	SM-CANopen	

See also the SMCANopen User Guide (www.controltechniques.com)

SM-CANopen terminal descriptions

The SM-CANopen has a standard 5-way screw terminal block connector for the CANopen network. The 9-way male D-type may also be used to connect to the SMCANopen. Both are listed in the CANopen specification.

SM-CANopen - front view
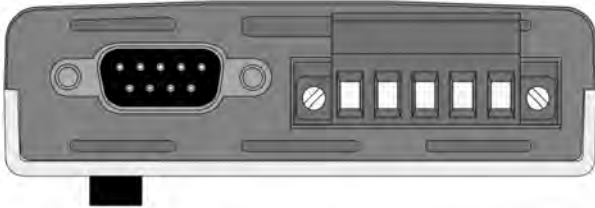
The standard 5-way CANopen terminal block connector is numbered from Terminal 1 on the left hand side to Terminal 5 on the right hand side. The terminal functions are given in the table below.

SM-CANopen terminal descriptions

5-way terminal	D-type terminal		Description
1	6	0V	0V CANopen external supply (optional)
2	2	CAN-L	Negative data line
3	3,5 Shell	Shield	Cable braided shield connection
4	7	CAN-H	Positive data line
5	9	+24V	+24V CANopen external supply (optional)

The external supply terminals provide power for the CAN transceiver circuitry, but do NOT provide power to keep the SM-CANopen operating in the event of the mains power supply loss to the drive. An external supply will simply keep the CAN transceivers powered up and the network load characteristics constant in the event of loss of power to the drive.

12. Options

12.5.1 SM-CANopen connections

To connect the SM-CANopen to the CANopen network, make the connections as shown in the diagram below. The length of the "pigtail" shield connection should be kept as short as possible.

SM-CANopen connections
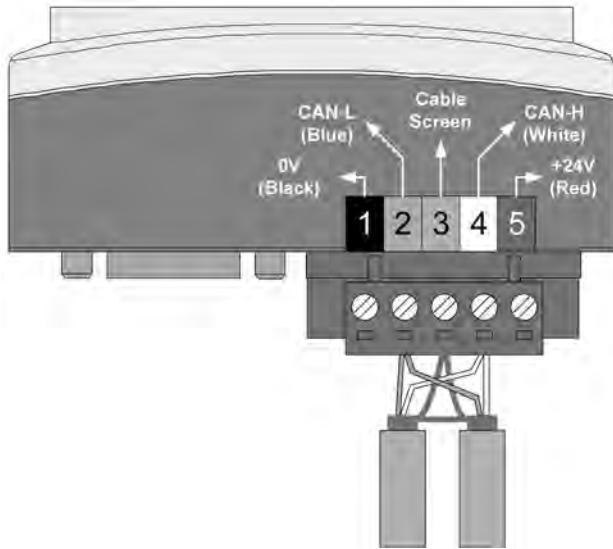
12.5.2 CANopen cable

CANopen cable has a single twisted pair with overall shielding. CANopen has a specified colour code, and it is strongly recommended that this code is maintained.

DeviceNet cable colour codes

Cable	Data signal	Terminal	Description
Blue	CAN-L	2	Negative data line
Braided Shield	Shield	3	Cable shield
White	CAN-H	4	Positive data line

CANopen networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Cable specifications and a list of approved manufacturers of cable for use on CANopen networks is available on the CAN In Automation (CiA) CANopen web site at www.can-cia.de.

We can only guarantee correct and reliable operation of the SMCANopen if all other equipment installed on the CANopen network (including the network cable) has been approved by CAN In Automation.

12.5.3 CANopen network termination

It is very important in high-speed communications networks that the network communications cable is fitted with the specified termination resistor network at each end of the cable. This prevents signals from being reflected back down the cable and causing interference.

120Ω 0.25W termination resistors should be fitted across the CAN-H and CAN-L lines at the BOTH ends of the trunk cable run, as shown in the diagram below.

CANopen network termination
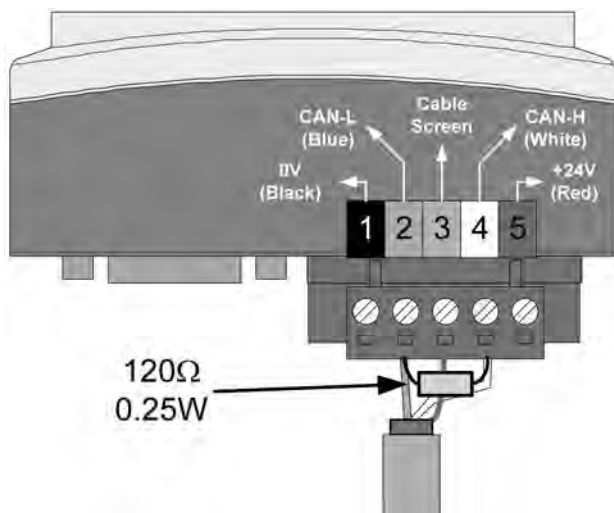
Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination resistors are not fitted, the noise immunity of the network is greatly reduced.

If too many termination resistors are fitted on a CANopen network, the network will be over-loaded, resulting in reduced signal levels. This may cause nodes to miss some bits of information, resulting in transmission errors being reported. If network overload is excessive, the signal levels may be so low that nodes cannot detect any network activity at all.

12.5.4 SM-CANopen cable shield connections

The SM-CANopen should be wired with the cable shields isolated from ground at each Unidrive SP. The cable shields should be linked together at the point where they emerge from the cable, and formed into a short pigtail to be connected to pin 3 on the CANopen connector.

The CANopen cable can be tie-wrapped to the Grounding Bar to provide strain relief, but the CANopen cable shield must kept isolated from ground at each node. The only exception to this is the CANopen ground point.

CANopen ground point

The CANopen cable shield must be grounded AT ONE POINT only, usually near the centre point of the cable run. This is to prevent the cable shield from becoming live in the event of catastrophic failure of another device on the CANopen network.

If a drives node is the desired ground point, the shield of one of the CANopen cables can be exposed and clamped to the Grounding Bar.

12.5.6 Maximum network length

The maximum number of nodes that can be connected to a single CANopen network segment is 32 nodes. The maximum length of network cable for a CANopen network is dependant on the data rate used.

CANopen maximum segment lengths

Date rate (bits/sec)	Maximum network length (m)
1M	30
800K	50
500K	100
250K	250
125K	500
100K	700
50K	1000
20K	2500
10K	5000

12. Options

12.6 Ethernet

Details to be advised

13.7 Extended I/O

The SM-I/O Lite has the following terminals:

1) 0V

2) ±10V / 4-20mA Analogue input

3) 0-10V / 4-20mA Analogue output

4) +24V

5) Digital input

6) Digital input

7) Digital input / Encoder B

8) Encoder B\

9) Encoder A

10) Encoder A\

11) 0V

12) Encoder +5V

13) Relay

14) Relay

If Encoder feedback is required, there are only 2 digital inputs available, otherwise 3 digital inputs are available. One digital output as relay terminals.

Update Rate: 4ms ~ 18ms

Analogue I/O

Voltage input specification:

Range: -10V – +10V

Update Rate: 4ms ~ 18ms

For positive input voltage:
Input impedance: 100k
Accuracy: 2%

For negative input voltage:
Input impedance: 18k
Accuracy: 4%

Resolution:
Programmable 10 bit plus sign or 11 bit plus sign for precision reference.

Current Output specification:

Range: 4 – 20mA (short circuit proof)

Update Rate: 4ms ~ 18ms

Resolution: 0.4%

Accuracy: 5%

Encoder Input specification

● Differential inputs up to 12V

● Will count non differential inputs with connections to just A and B

● Will count F and D signal (F on A, and D on B or B\ depending on polarity of D)

● Maximum input frequency 55kHz Quadrature or 110kHz F & D

● Encoder +5V supply will be at 5.15V to compensate for cable voltage drops, with 250mA short circuit protection

● Update Rate: 4ms ~ 18ms (depending on the total I/O used)

The encoder feedback option is low cost and is not a true quadrature decoder/counter. Operation close to zero speed could lead to miscounting, however an accurate indication of speed and direction will be possible, and measurement of distance will be possible providing there is no operation around zero speed.

12. Options

12.8 Real Time Clock with Extended I/O

The SM-I/O Lite has the following terminals:

1) 0V

2) ±10V / 4-20mA Analogue input

3) 0-10V / 4-20mA Analogue output

4) +24V

5) Digital input

6) Digital input

7) Digital input / Encoder B

8) Encoder B\

9) Encoder A

10) Encoder A\

11) 0V

12) Encoder +5V

13) Relay

14) Relay

If Encoder feedback is required, there are only 2 digital inputs available, otherwise 3 digital inputs are available. One digital output as relay terminals.

Update Rate: 4ms ~ 18ms

Analogue I/O

Voltage input specification:

Range: -10V – +10V

Update Rate: 4ms ~ 18ms

For positive input voltage:
    Input impedance: 100k
    Accuracy: 2%

For negative input voltage:
    Input impedance: 18k
    Accuracy: 4%

Resolution:
    Programmable 10 bit plus sign or 11 bit plus sign for precision reference.

Current Output specification:

Range: 4 – 20mA (short circuit proof)

Update Rate: 4ms ~ 18ms

Resolution: 0.4%

Accuracy: 5%

Encoder Input specification

● Differential inputs up to 12V

● Will count non differential inputs with connections to just A and B

● Will count F and D signal (F on A, and D on B or B\ depending on polarity of D)

● Maximum input frequency 55kHz Quadrature or 110kHz F & D

● Encoder +5V supply will be at 5.15V to compensate for cable voltage drops, with 250mA short circuit protection

● Update Rate: 4ms ~ 18ms (depending on the total I/O used)

The encoder feedback option is low cost and is not a true quadrature decoder/counter. Operation close to zero speed could lead to miscounting, however an accurate indication of speed and direction will be possible, and measurement of distance will be possible providing there is no operation around zero speed.

12. Options

Real Time Clock Specification

SM-Timer I/O will provide the following Real Time Clock features:

- Day light saving mode

- User programmable/adjustable time

- Available time format
  Year – Month – Date – Day of week – Hours (24Hr) – Minutes – Second

- Battery back up
  - There is no indication/warning for battery not fitted, however after a power on reset with no battery, RTC parameters start at 0 except the day of the week which starts at 1. Continuous operation on back up battery for a minimum of 11 years, with no battery low warning/indication

  - Lithium CR2032 batteries capacity range from 200mAh ~ 235mAh

  - RTC chip requires 1.5μA @ 3V for time keeping. Assuming 0.5μA for temperature/tolerance margin RTC will require a 2.0μA @ 3V for time keeping. With a 200mAh battery RTC can operate for (200 x 10^{-3} x 3600) / (2 x 10^{-6}) = 100,000hrs = 11.40 years

  - Battery will not be drained if the module is energised and could stay healthy more than 11 years depending on battery operational lifetime

- Update Rate: < 500ms

12. Options

12.9 SmartStick

Parameter cloning module

The parameter cloning module SmartStick is easy to fit and its operation is simple.

Inserting the SmartStick
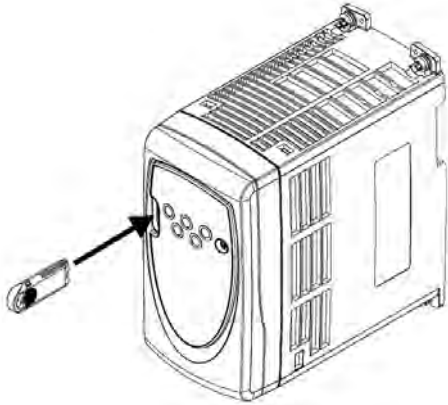
nO: Do nothing

rEAd: program the drive with the current drive settings

Prog: program the SmartStick with the current drive settings

boot: SmartStick becomes read only. The contents of the SmartStick will be copied to the drive every time the drive is powered up

Parameter cloning is initiated by pressing the ⓜ MODE key on exit from parameter edit mode after P 28 has been sent to rEAD, Prog or boot.

NOTE If parameter cloning is enabled when no SmartStick is fitted to the drive, the drive's display will flash FAIL twice before changing back to nO.

12. Options

12.10 LogicStick

The LogicStick provides PLC functionality and is programmed using a PC/laptop with SyPTLite software and a CT Comms Cable connecting lead.

PLC Function Stick

Ordering Code: LogicStick

Description: The LogicStick plugs into the front of the drive and enables you to program PLC functions within the drive.

Use with SyPTLite software and the CT Comms Cable.

- Nano and micro PLCs can be easily replaced by LogicStick

- Memory storage for application or customer specific functionality

- Application Programming using SyPT Lite – IEC1131-3 (Industry Standard Ladder)

Compatibility: Commander SK – all sizes
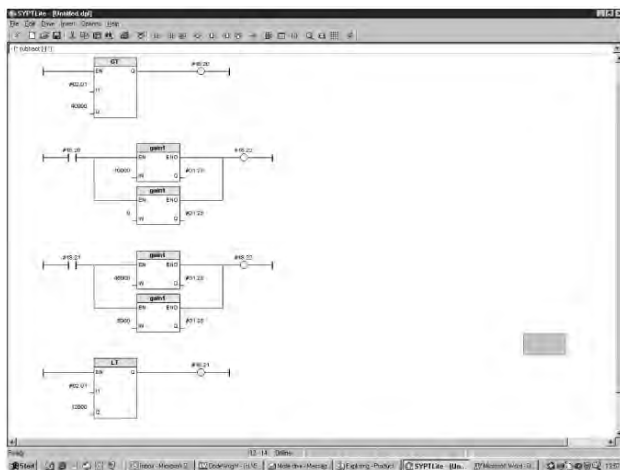
Commander SK

12. Options

12.11 LCD Keypad

The SM-Keypad Plus is a keypad and LCD display option for the Commander SK and Unidrive SP. The LCD display can show the status of the drive, the value and title of the currently selected parameter and also contains an on-line pocket manual of parameter help and trip descriptions. It is also possible to download an alternative user customisable database of parameters and help text to the keypad.

> ⚠️ **WARNING** The SM-Keypad Plus is intended for use only when mounted on a cubicle door. It is not suitable for hand-held use. Operation in any other fashion may cause a hazard, and invalidates the warranty.

Display

The display consits of three lines of text displaying different information depending on the display mode selected as shown below.

Status Mode
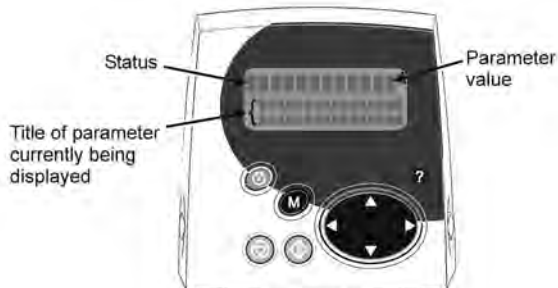
Parameter View Mode
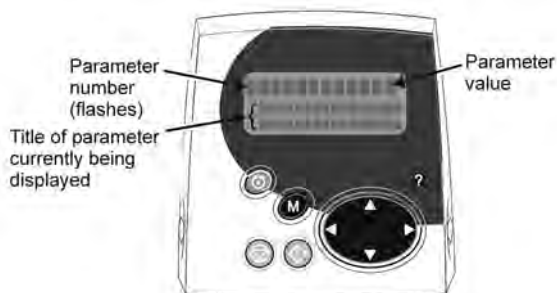
Parameter edit mode
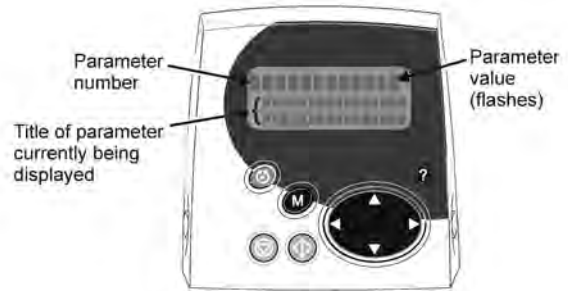
Parameter help mode
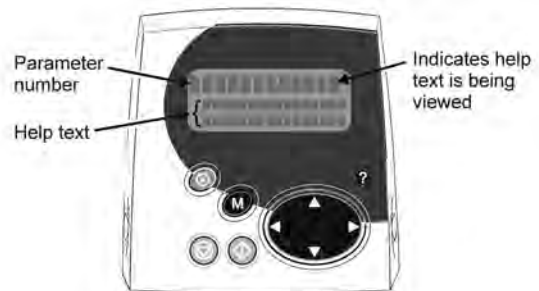
Adjusting the contrast

The contrast of the display can be altered by pressing the left or right arrow keys on the joypad when parameter help text is being displayed.

NOTE If the contrast is adjusted whilst the drive is in keypad control mode, the drive will trip on 'PAd'.

12. Options

Button		Description
Joypad		Navigates between menus and parameters, and changes parameter values.
Mode button	M	Changes between display modes: view, edit, status.
Help button	?	Toggles parameter help on and off when in parameter view mode. Parameter help provides a brief description of the function of the parameter currently selected.
Run button (green)		Runs the drive if keypad control mode is selected*.
Stop/Reset button (red)		Stops the drive in keypad control mode or during autotune*. Resets the drive from a trip. Implementations special Pr x.00 functions once the correct code has been entere.
Fwd/Rev button (blue)		Changes direction in keypad control mode when enabled (Pr 0.28 = On (1))*.

* Keypad control mode is selected by setting Pr 0.05 = Pad (4)

Panel mounting the SM-Keypad Plus

Fihure 4.1 shows the dimensions if the cut out required to mount the SM-Keypad Plus on a panel or cubicle door.

Panel cut-out
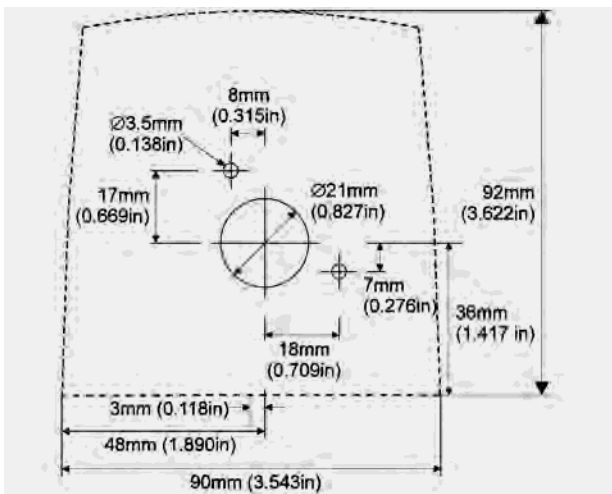
The SM-Keypad Plus is connected to the drive by a straight-through shielded RJ45 to RJ45 cable, from the socket on the rear of the keypad to the RJ45 serial communications connections of the drive. For EMC compliance the cable shield should be clamped to the panel upon which the SM-Keypad Plus is mounted so that it makes a good electrical connection. The maximum cable length allowed is 30m.

The serial communication parameters on the drive must be at the default values as shown below.

12. Options

In order to meet IP54 rating:

- The rubber 'O' ring must be fitted around the RJ45 connection

- The square rubber seal must be fitted around the 6-pin header at the bottom right on the rear of the keypad. For correct fitting of the square rubber seal, ensure that the arrow is pointing up, as shown in Figure 4.2

The required screws and seals are provided in a bag with the SM-Keypad Plus.

Rear of the SM-Keypad Plus and accessories
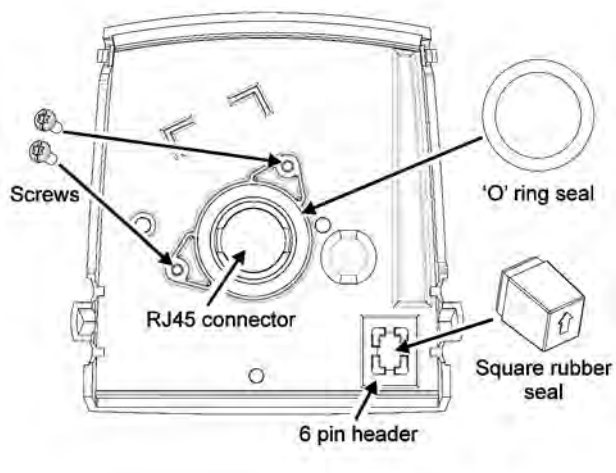
12. Options

12.12 LED Remote Mounting Keypad

Ordering Code: SK-Keypad Remote

Description: Remote panel mounting LED keypad display to IP54 (NEMA12) with additional function key.

- Selectable function key with LED to indicate function selected
  - Hand-Off-Auto, Jog, Reverse, etc
- Connects to the RS485 Modbus RTU port on the drive via a standard RJ45 connector
- Connecting cable (up to 30m)
- Simple panel cut-out – 21mm hole
- Fixed keypad on drive remains active

Compatibility: Commander SK – all sizes

Commander SK
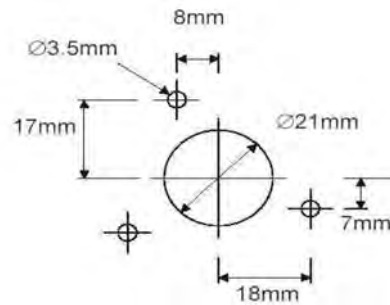
12. Options

12.13 Commissioning Software - CTSoft

Ordering Code: CTSoft (comes free-of-charge with product CD ROM)

Description: Software for your PC or laptop which allows you to commission and store parameter settings.

Use with CT Comms Cable.

- Drive Set Up and Monitoring Software Tool – this one software package handles all key CT drive products
- Upload/download/store parameter set-ups
- Easy set up Wizards

Compatibility:

- Commander SK – all sizes
- Unidrive SP

Commander SK
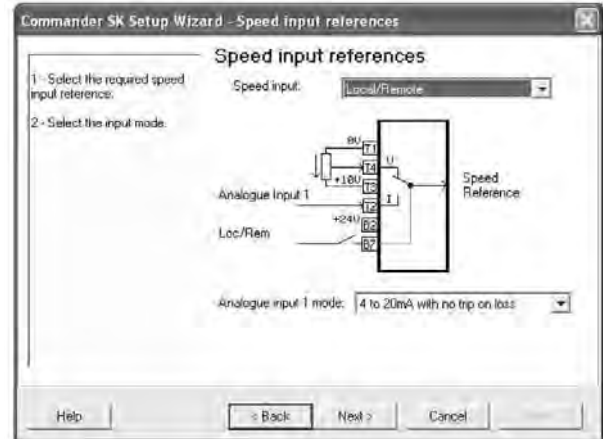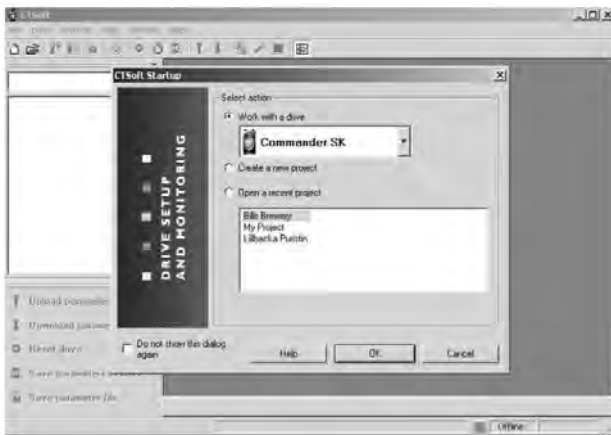
12. Options

12.14 Software for PLC Functionality

Systems Programming Tool and SyPTLite

Overview

- SyPTLite software is an intuitive PC/Laptop tools for PLC programmers used to working with standard IEC61131-3 programming tools.

- SyPTLite is the entrance level programming tool which is delivered free of charge with the Commander SK and can be used straight out of the box for programming in quick ladder logic.

SyPTLite hardware platforms:

1. Commander SK with LogicStick

The Commander SK with the LogicStick option supports a limited ladder programming capability of between 30 and 50 rungs.

The Commander SK provides a single background task in whist to run a ladder diagram. The drive is prioritised toperform its major functions first, e.g. motor control, and will use any remaining processing time to execute the ladder diagram as a background activity.
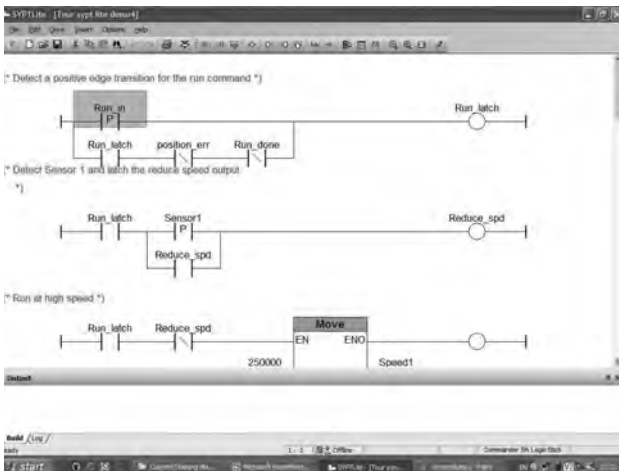
13.15 Communication Cable

The communication cable incorporates an isolated RS232 to RS485 converter so that you can easily connect your PC or laptop to the RJ45 serial port on the front of the drive.

This cable is required if either CTSoft or SyPTLite software is to be used directly with the drive.

The communications protocol used is Modbus RTU.

Figure 9.2 Communications cable

12. Options

12.16 NEMA 1 Top Cover

Ordering Code: EMC Footprint Filters:

- Size A – NEMA 1 Top Cover
- Size B – NEMA 1 Top Cover
- Size C – NEMA 1 Top Cover

Description: These plastic top covers give the drives a NEMA 1 rating when fitted. They are designed to simply clip on to the top of the drive giving additional protection for falling dust or falling water droplets

Compatibility: Commander SK – all sizes

12.17 Gland Metal Bottom Cover

Ordering Code: EMC Footprint Filters:

- Size A – Gland Cover
- Size B – Gland Cover
- Size C – Gland Cover

Description: These metal bottom glanding covers are ideal for Commander SK installations using gland fittings.

Compatibility: Commander SK – all sizes

13. Environmental Statement

Environmental Statement

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

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

Nevertheless, when the products eventually reach the end of their useful life, they can very easily be dismantled into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, while other parts are secured with conventional screws. Virtually all parts of the product are suitable for recycling. Product packaging is of good quality and can be re-used. Large products are packed in wooden crates, while smaller products come in strong cardboard cartons which themselves have a high-recycled fibre content. If not re-used, these containers can be recycled. Polythene, used on the protective film and bags from wrapping product, can be recycled i the same way. Control Techniques' packaging strategy favours easily recyclable materials of low environmental impact, and regular reviews identify opportunities for improvement.

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

14. Standards and Conformity

14.1 Standards

The drive conforms to the following standards.

	Standard	Level/Class
Transport temperature cycle	IEC68-2-14	-40 - +30°C, 5 cycles
Storage humidity	IEC68-2-56	93%, 40°C, 4 days
Storage Condensation	IEC68-2-30	Humidity cycle
Bump (shock) test	IEC68-2-29	18g, 6ms, 100 times/direction for all 6 directions
Random vibration	IEC68-2-64 & IEC68-2-36	$0.01g^2$/Hz 5-20Hz -3dB/octave 20-200Hz 30 min per axis, 3 axes
Free fall test, packaged	IEC68-2-32	to
Impact test for operator-accessible parts (impact hammer test) - could also apply to parts subject to rough treatment during installation or commissioning, e.g. keypad, terminal area & cover	clause 8.2 of EN61010-1	0.5J
Robustness of terminals	EN60947 UL1059 UL486 UL508C	
Swept sinusoidal vibration test	IEC68-2-6	3.5mm 2 – 9Hz 10m/s² 9 – 200Hz 15m/s² 200-500Hz

Note: environmental tests are derived from ETSI EN 300 019-2-2 1999 for public transportation

14.2 Safety

The drive is designed to meet the following standards:

	Standard	Level/Class
Europe:		
To comply with Low Voltage Directive 73/23/EEC by creating a technical File following CT design procedure.	See note 1	–
US:		
Basic safety	UL508C	–
Enclosure category NEMA 1	See note 2	–
International:		
Ingress	IEC60529	IP20

NOTE 1 The safety file procedure applies the EN61800-5-1 (IEC61800-5-1) standard (Electrical and thermal requirements, electrical adjustable speed drive systems)

NOTE 2 The drives require an optional top cover kit to meet the NEMA 1 requirements.

Any operator-accessible parts will conform to EN61010-1 (Safety requirements for electrical equipment for measurement, control, and laboratory use). European installers will apply EN60204-1 to their control panels, so the drive design will be compatible with EN60204-1 (Safety of machinery - electrical equipment of machines).

Driving the world...

Drive & Application Centres

AUSTRALIA
Melbourne Application Centre
A.C.N. 003 815 281
Tel: 613 973 81777
Fax: 613 9729 3200
After Hours: 61 2 9963 5271

Sydney Drive Centre
A.C.N. 003 815 281
Tel: 61 2 9838 7222
Fax: 61 2 9838 7764
After Hours: 61 2 9963 5271

AUSTRIA
Linz Drive Centre
Tel: 43 7229 789480
Fax: 43 7229 7894810
After Hours: 43 7215 3502

BELGIUM
Brussels Drive Centre
Tel: 32 1574 0700
Fax: 32 1574 0799

CANADA
Toronto Drive Centre
Tel: 1 905 201 4699
Fax: 1 905 201 4694
After Hours: 1 800 893 2321

CHINA
Shanghai Drive Centre
Tel: 86 21 5426 0668
Fax: 86 21 5426 0669

Beijing Application Centre
Tel: 86 10 856 31122 ext 820
Fax: 86 10 856 35029

CZECH REPUBLIC
Brno Drive Centre
Tel: 420 541 192111
Fax: 420 541 192115
After Hours: 420 541 192 119

DENMARK
Copenhagen Drive Centre
Tel: 45 4369 6100
Fax: 45 4369 6101
After Hours: 45 4369 6100

FINLAND
Helsinki Drive Centre
Tel: 358 985 2661
Fax: 358 985 26823
After Hours: 358 500 423271

FRANCE
Angouleme Drive Centre
Tel: 33 5 4564 5454
Fax: 33 5 4564 5400

GERMANY
Bonn Drive Centre
Tel: 49 2242 8770
Fax: 49 2242 877277
After Hours: 49 1714 964777

Chemnitz Drive Centre
Tel: 49 3722 52030
Fax: 49 3722 520330
After Hours: 49 1714 964777

Darmstadt Drive Centre
Tel: 49 6251 17700
Fax: 49 6251 177098
After Hours: 49 1714 964777

GREECE
Athens Application Centre
Tel: 0030 210 57 86086/088
Fax: 0030 210 57 86087

HOLLAND
Rotterdam Drive Centre
Tel: 31 184 420555
Fax: 31 184 420721
After Hours: 31 184 420555

HONG KONG
Hong Kong Application Centre
Tel: 852 2979 5271
Fax: 852 2979 5220
After Hours: 852 2979 5271

INDIA
Mumbai Application Centre
Tel: 91 20 612 7956, 612 8415
Fax: 91 20 611 3312

Kolkata Application Centre
Tel: 91 33 2357 5302/2357 5306
Fax: 91 33 2357 3435
After Hours: 91 98 3004 8562

Chennai Drive Centre
Tel: 91 44 2496 1123/
2496 1130/2496 1083
Fax: 91 44 2496 1602
After Hours: 91 44 2496 1083

New Delhi Application Centre
Tel: 91 11 2 576 4782/
91 11 2 581 3166
Fax: 91 11 51 539216

IRELAND
Dublin Drive Centre
Tel: 353 45 448200
Fax: 353 45 433622

ITALY
Milan Drive Centre
Tel: 39 02575 751
Fax: 39 02575 12858
After Hours: 39 02575 751

Vicenza Drive Centre
Tel: 39 0444 396200
Fax: 39 0444 341317
After Hours: 39 02 575 751

KOREA
Seoul Application Centre
Tel: 82 31 703 7169
Fax: 82 31 703 7168
After Hours: 82 31 703 7185

MALAYSIA
Kuala Lumpur Drive Centre
Tel: 603 5634 9776
Fax: 603 5633 9592
After Hours: 60 12 333 8355

POLAND
Warszawa Application Centre
Tel: 48 22 4589 205/4589 206
Fax: 48 22 4589 255

**REPUBLIC OF
SOUTH AFRICA**
Johannesburg Drive Centre
Tel: 27 11 462 1740
Fax: 27 11 462 1941
After Hours: 27 11 462 1740

RUSSIA
Moscow Application Centre
Tel: 7 095 232 9472
Fax: 7 095 956 4862

SINGAPORE
Singapore Drive Centre
Tel: 65 6468 8979
Fax: 65 6468 6982
After Hours: 65 9752 5828/
9636 0323

SPAIN
Barcelona Drive Centre
Tel: 34 93 680 1661
Fax: 34 93 680 0903
/34 93 680 2823
After Hours: 34 610 554540

Bilbao Application Centre
Tel: 34 94 620 3646
Fax: 34 94 681 1406
After Hours: 34 61 055 4547

Valencia Drive Centre
Tel: 34 96 154 2900
Fax: 34 96 153 2906
After Hours: 34 66 642 8514

SWEDEN
Stockholm Application Centre
Tel: 468 554 241 00
Fax: 468 554 241 10
After Hours: 467 044 183 29

SWITZERLAND
Lausanne Application Centre
Tel: 41 21 637 7070
Fax: 41 21 637 7071
After Hours: 41 79 357 8683

Zurich Drive Centre
Tel: 41 56 201 4242
Fax: 41 56 201 4243
After Hours: 41 79 357 8683

TAIWAN
Taipei Application Centre
Tel: 886 22325 9555
Fax: 886 22705 9131
After Hours: 886 92186 6502

THAILAND
Bangkok Drive Centre
Tel: 66 2580 7644
Fax: 66 2591 4559
A/Hours Sales: 66 1443 4095
A/Hours Service: 66 1443 4098

TURKEY
Istanbul Drive Centre
Tel: 90 216 4182420
Fax: 90 216 4182423
After Hours: 90 216 418 2420

UAE
Dubai Application Centre
Tel: 971 4 883 8650
Fax: 971 4 883 8651

UNITED KINGDOM
Telford Drive Centre
Tel: 44 1952 213700
Fax: 44 1952 213701
After Hours: 44 1952 213700

USA
Charlotte Application Centre
Tel: 1 704 393 3366
Fax: 1 704 393 0900
After Hours: 1 800 893 2321

Chicago Application Centre
Tel: 1 630 752 9090
Fax: 1 630 752 9555
After Hours: 1 800 893 2321

Cleveland Drive Centre
Tel: 1 440 717 0123
Fax: 1 440 717 0133
After Hours: 1 800 893 2321

Minneapolis US Headquarters
Tel: 1 952 995 8000
Fax: 1 952 995 8020/8099
After Hours: 1 800 893 2321

Providence Drive Centre
Tel: 1 401 541 7277
Fax: 1 401 541 7266
After Hours: 1 800 893 2321

● Drive & Application Centres
● Distributors

Distributors

ARGENTINA
Euro Techniques SA
Tel: 54 11 4331 7820
Email:
eurotech@eurotechsa.com.ar

BAHRAIN
Iftikhar Electrical Est.
Tel: 973 271 116
Email: ieepower@batelco.com.bh

BRAZIL
ACIEL Comercio e Servicos LTDA
Tel: 55 11 5565 5798
Email: aciel@aciel.com.br

Positronic Sistemas Industrias Ltda.
Tel: 55 11 3832 2738
Email: info@positronic.com.br

CHILE
Ingeniería Y Desarrollo
Techólogio S.A
Tel: 56 (2) 741 9624
Email: idt@idt.cl

COLOMBIA
Sistronic LTDA
Tel: 57 1 410 04 24
Email: jonesdug@colomsat.net.co

CROATIA
Koncar – MES d.d.
Tel: 385 1 366 7273
Email: nabava@koncar-mes.hr

CYPRUS
Acme Industrial Electronic
Services Ltd
Tel: 3572 5 332181
Email: acme@cytanet.com.cy

EGYPT
Samiram
Tel: 202 7603877/202 7605950
Email: corporate@samiram.com

HUNGARY
Control-VH Kft
Tel: 361 431 1160
Email: info@controlvh.hu

ICELAND
Samey ehf
Tel: 354 510 5200
Email: samey@samey.is

INDONESIA
Pt Apikon Indonesia
Tel: 65 6468 8979
Email:
ooiwc@controltechniques.com.my

IRAN
Atiro
Tel: +98 21 855 4210

ISRAEL
Dor Drives Systems Ltd
Tel: 972 3900 7595
Email: info@dor1.co.il

KENYA
Kassam & Bros Co. Ltd
Tel: 2540 2 556 418
650268 557136
Email: kasbro@insightkenya.com

KUWAIT
Saleh Jamal & Company WLL
Tel: 965 483 2358
Email: sjceng@almullagroup.com

LEBANON
Black Box Automation & Control
Tel: 961 1 443773
Email: info@blackboxcontrol.com

MALTA
Mekanika Limited
Tel: 35621 442 039
Email: mfrancica@gasan.com

MEXICO
MELCSA
Tel: 52 5 561 1312
Email: melcsamx@iserve.net.mx

SERVITECK, S.A de C.V
Tel: 52 5 398 3380
Email: servitek@data.net.mx

MOROCCO
Leroy Somer Maroc
Tel: 212 22 354948
Email: lsmaroc@wanadoopro.ma

NEW ZEALAND
Electrade New Zealand
Tel: 64 9525 1753
Email: kevin@electrade.co.nz

PHILIPPINES
Bussbarr Corp.
Tel: 632 776 0066
Email: sales@bussbarr.com.ph

POLAND
APATOR CONTROL Sp, z o.o
Tel: 48 56 6191 207
Email: drives@apator.torun.pl

PORTUGAL
Harker Sumner S.A
Tel: 351 22 947 8090
Email: drives.automation@harker.pt

QATAR
AFI Sitna Technologies
Tel: 974 468 4442
Email: jp33@qatar.net.qa

ROMANIA
Dor Drives International
Tel: 40 21 337 3465
Email: dordrive@zappmobile.ro

SAUDI ARABIA
A. Abunayyan Electric Corp.
Tel: (9661) 477 9111
Email: aec-salesmarketing@
abunayyangroup.com

SLOVAKIA
EMERSON A.S
Tel: +421 32 7700 369
Email: petersk@vuma.sk

SLOVENIA
PS Logatec
Tel: 386 1 750 8510
Email: ps-log@ps-log.si

TUNISIA
SIA Ben Djemaa & CIE
Tel: 216 1 332 923
Email: bendjemaa@planet.tn

URUGUAY
Secoin S.A
Tel: 5982 2093815
Email: secoin@adinet.com.uy

VENEZUELA
Vertix Instrumentos, S.A
Tel: 58 281 267 4115

VIETNAM
N.Duc Thinh
Tel: 84 8 9490633
Email: infotech@nducthinh.com.vn

YUGOSLAVIA
Master Inzenjering d.o.o
Tel: 381 24 551 605
Email: master@eunet.yu

CONTROL TECHNIQUES
www.controltechniques.com