CONTROL TECHNIQUES

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Technical Data

Commander SK

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

Part Number: 0472-0002-02
Issue: 2

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.

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Issue:2

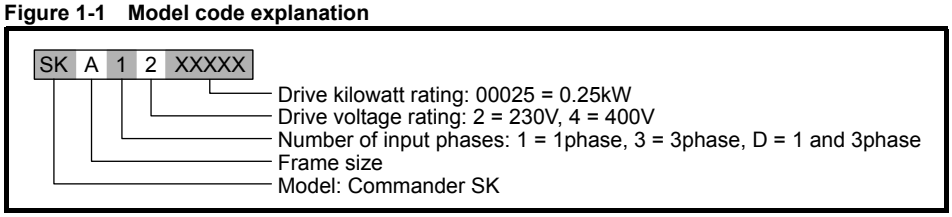
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1 Technical data

Figure 1-1 Model code explanation



1.1 Commander SK 200V units

Table 1-1 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 (cos∅)	>0.97									
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	
Weight (kg)	0.95		1.0		1.3		1.4		2.1	
Weight (lb)	2.1		2.2		2.9		3.1		4.6	
Internal EMC filter	Yes									
DC bus terminals	No				Yes					
Din rail mounting	Yes								No	

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

Table 1-2 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	16	10	20	16	25	20
Control cable	(mm^2)	≥0.5				≥0.5					
	(AWG)	20				20					
Recommended input cable	(mm^2)	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	(mm^2)	1.0				1.0				1.5	
	(AWG)	16				16				14	
Recommended brake resistor	(mm^2)	1.0				1.0				1.5	
	(AWG)	16				16				14	

Table 1-3 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

Table 1-4 Cooling fan

MODEL		SKA12				SKBD2		SKCD2
		00025	00037	00055	00075	00110	00150	00220
Cooling fan fitted		No				Yes		Yes
Air flow	($feet^3$/minute)					3.8		
	(m^3/minute)					0.4		

1.2 Commander SK 400V units

Table 1-5 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 (cos∅)	>0.97							
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		
Weight (kg)	1.2			1.3		2.1		
Weight (lb)	2.7			2.9		4.6		
Internal EMC filter	Yes							
DC bus terminals	Yes							
Din rail mounting	Yes					No		

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

Table 1-6 Cables

MODEL		SKB34					SKC34		
		00037	00055	00075	00110	00150	00220	00300	00400
Recommended input supply fuse	(A)	6				10	16		
Control cable	(mm^2)	≥0.5					≥0.5		
	(AWG)	20					20		
Recommended input cable	(mm^2)	1.0					1.5		2.5
	(AWG)	16					14		12
Recommended motor cable	(mm^2)	1.0					1.0		1.5
	(AWG)	16					16		14
Recommended brake resistor cable	(mm^2)	1.5					1.5		
	(AWG)	14					14		

Table 1-7 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	

Table 1-8 Cooling fan

MODEL		SKB34					SKC34		
		00037	00055	00075	00110	00150	00220	00300	00400
Cooling fan fitted		No			Yes		Yes		
Air flow	($feet^3$/minute)				3.8				
	(m^3/minute)				0.4				

2 Derating curves and losses

2.1 Derating curves

NOTE

The de-rating curves are based on the results of heatruns that are carried out to measure temperatures at various key points (components) within the drive at different switching frequencies / loads /ambient temperatures: These key points are things like:

- Heatsink
- Bridge rectifier
- IGBTs
- DC bus capacitors
- Various electrolytic capacitors
- Various resistors
- etc.

It is not always the heatsink temperature that is the limiting factor for the de-rating curves.

At 3 and 6kHz, the limiting factor tends to be capacitor temperatures.

At 12 and 18kHz, the limiting factor tends to be the heatsink temperature.

At 3 and 6kHz, operating outside the de-rating curves will cause some of the capacitors within the drive to run outside of their maximum operating temperature and this could lead to the drives design operating lifetime being reduced.

At 12 and 18kHz, operating outside the de-rating curves will cause the heatsink temperature to increase and may cause the drive to trip on Oht2. If the auto-switching frequency change is enabled (Pr **5.35** = 0 [by default]), the drive will automatically decrease the switching frequency when the heatsink temperature rises above pre-determined levels to reduce the heatsink temperature. When the drive switches down the switching frequency, the drives display will flash 'hot'.

It is important that operating within these de-rating curves is observed.

Figure 2-1 Commander SK Size A 0.25kW derating curve

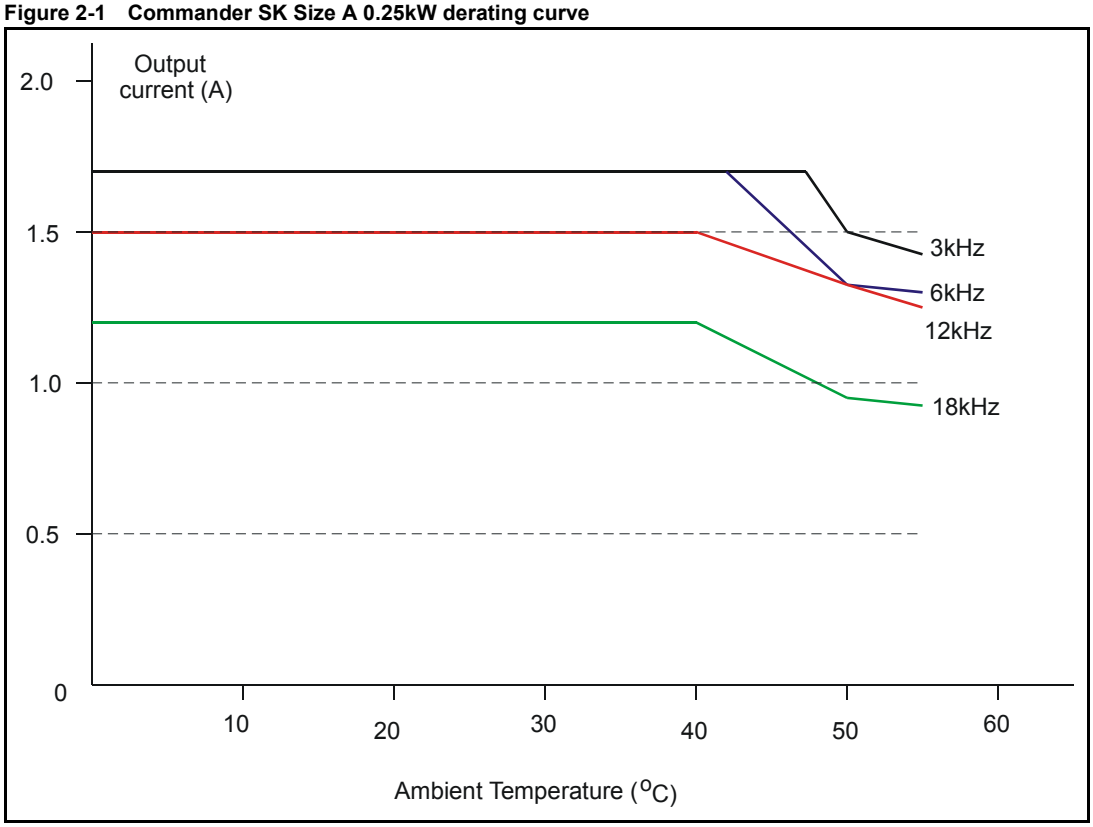


Figure 2-2 Commander SK Size A 0.37kW derating curve

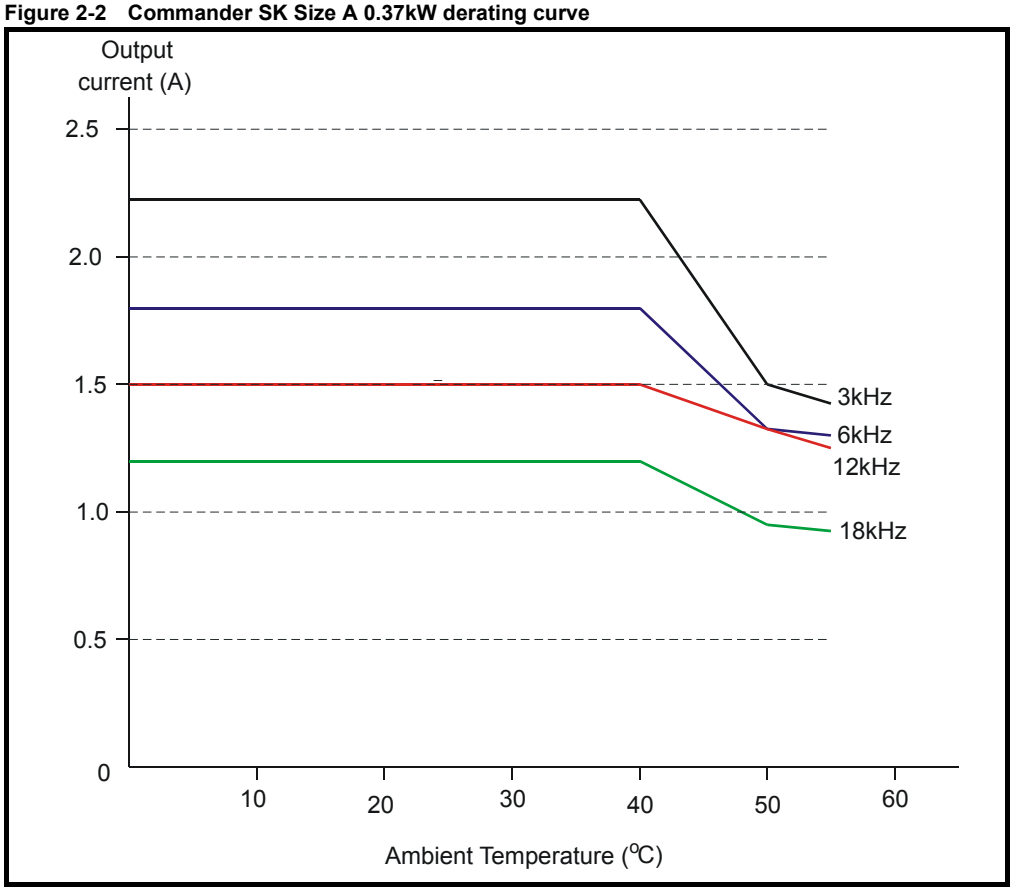


Figure 2-3 Commander SK Size A 0.55kW derating curve

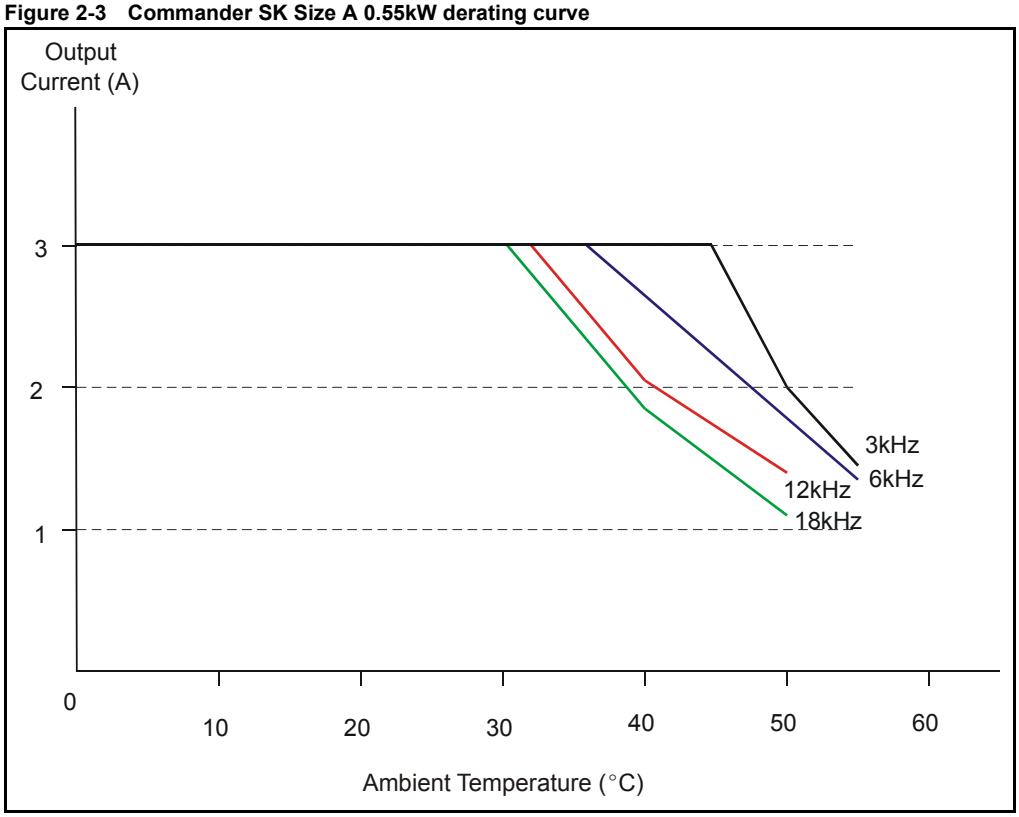
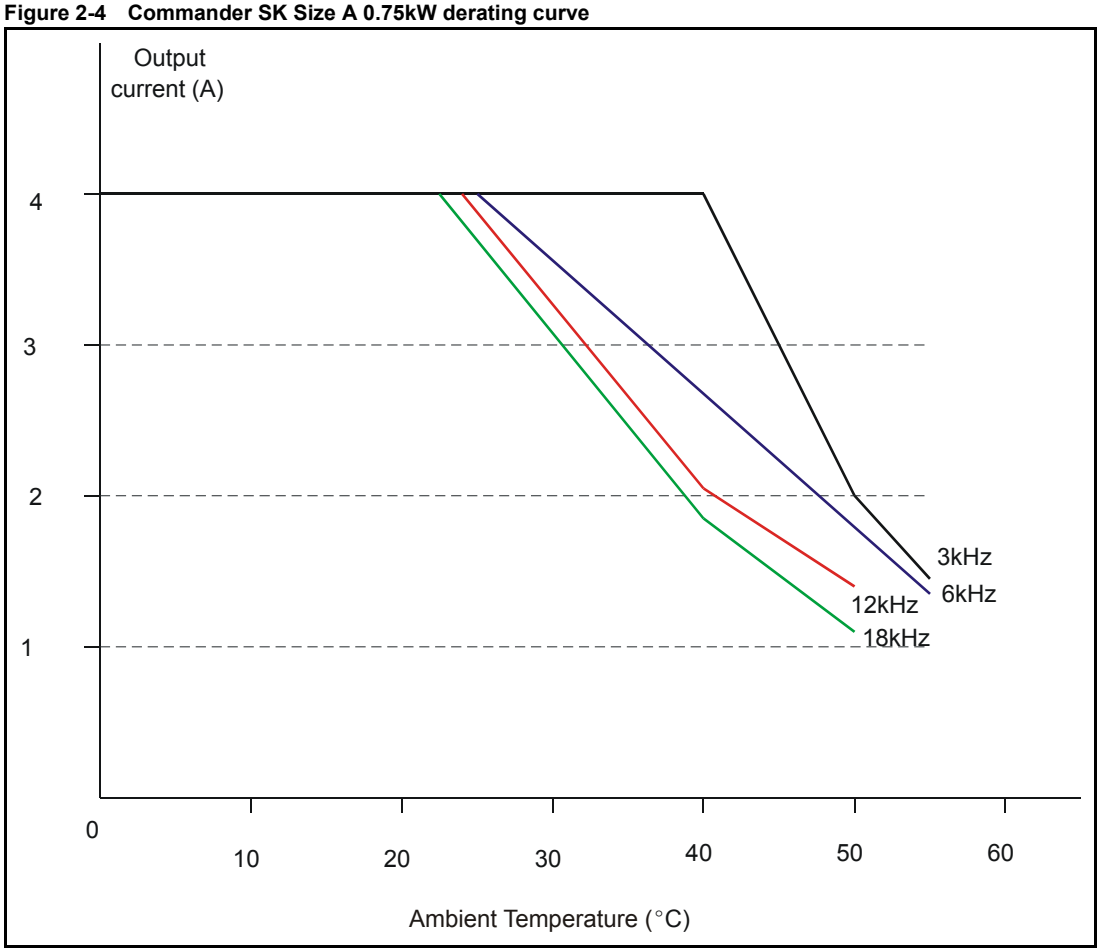


Figure 2-4 Commander SK Size A 0.75kW derating curve



2.2 Drive Losses

The following tables indicate the total drive losses at the de-rating curve points.

Table 2-1 Commander SK size A 0.25kW losses

Ambient Temperature (°C)	Loss (W)			
	3kHz	6kHz	12kHz	18kHz
30	30	32	35	35
40	30	32	35	35
50	29	30	33	32
55	29	29	33	31

Table 2-2 Commander SK size A 0.37kW losses

Ambient Temperature (°C)	Loss (W)			
	3kHz	6kHz	12kHz	18kHz
30	33	33	35	35
40	33	33	35	35
50	29	30	33	32
55	29	29	33	31

Table 2-3 Commander SK size A 0.55kW losses

Ambient Temperature (°C)	Loss (W)			
	3kHz	6kHz	12kHz	18kHz
30	42	46	53	61
40	42	43	44	47
50	35	36	37	38
55	31	33		

Table 2-4 Commander SK size A 0.75kW losses

Ambient Temperature (°C)	Loss (W)			
	3kHz	6kHz	12kHz	18kHz
30	48	50	59	62
40	48	43	44	47
50	35	36	37	38
55	31	33		

3 Drive voltage levels

Condition	200V drives	400V drives
OV trip level	415 Vdc	830 Vdc
Braking level	390 Vdc	780 Vdc
Rated upper level (AC mains +10% x 1.4142)	373 Vdc	747 Vdc
Rated lower level (AC mains -10% x 1.4142)	255 Vdc	484 Vdc
*UV reset level	215 Vdc	425 Vdc
UV trip level	175 Vdc	330 Vdc
Standard ramp voltage	375 Vdc	EUR: 750 Vdc USA: 775 Vdc

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

Output frequency: 0 to 1500Hz

Output voltage: 3 phase, 0 to drive rating (240 or 480Vac maximum set by Pr **08**).

Low DC bus operation (Pr 6.10)

0 Low DC bus operation disabled

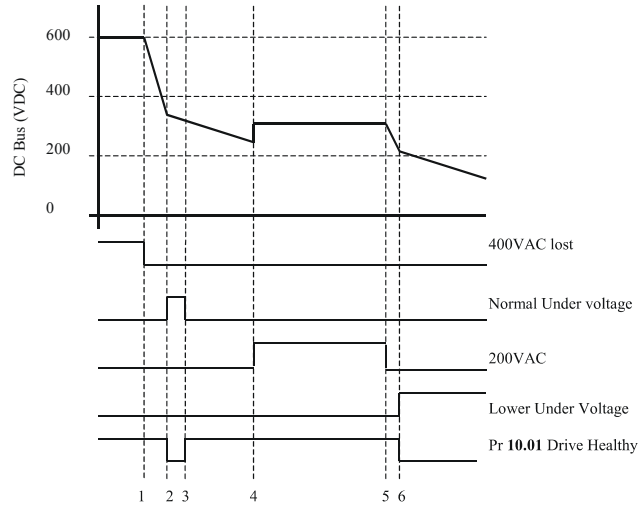
1 Low DC bus operation enabled

The Low DC bus operation is designed to enable 3 phase 400VAC (medium voltage) Commander SKs to be run off a single phase 200VAC (low voltage) supply in the event of a primary 400VAC supply failure.

When the primary supply fails, the back up supply can be switched in. This will allow the drive to control the motor at a reduced power, for example to move an elevator up or down to the next floor.

There is no de-rating as such when low DC bus operation is enabled however the power will be limited by the reduced voltage and ripple generated on the DC bus of the drive.

Figure 3-1 Low DC bus operation



1. The mains AC supply is removed.
2. The drive trips UU. Power down parameters are saved
3. After the down parameters are saved the UU trip is cleared. Drive will operate normally with the lower UU level set.
4. Back up AC supply is applied.
5. Back up AC supply is removed.
6. Drive trips UU. Power down parameter are not saved.

Note If the DC voltage is greater than 425VDC after 3 the UU level will return to normal.

When Pr **6.10** is enabled and the DC bus voltage is less than 330VDC, the drives display will flash LoAC (Low AC) to indicate that it is running off the low voltage back up supply.

NOTE

This mode is designed for use with a backup power supply and not for using a 400VAC (medium voltage) Commander SK in a 200VAC (low voltage) application. As shown in the above diagram, the drives power down save parameters are saved at point 2. If the drive was to be used on a 200VAC supply, the DC bus will never fall through point 2 and power down save parameters will not be saved.

Low DC bus operation voltage levels (Pr 6.10 enabled)

>425VDC - normal operation

<330VDC - LoAC operation

<230VDC - UV trip

3.1 Input voltage

3.1.1 Single phase

200V to 240V ±10%

48Hz to 62Hz

3.1.2 Three phase 200V

200V to 240V ±10%

48Hz to 62Hz

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

3.1.3 Three phase 400V

380V to 480V ±10%

48Hz to 62Hz

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

It is 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 DC bus design

Table 4-1 Commander SK 200V units DC bus data

Model	DC Bus Capacitance μF	DC bus inductance mH	Inrush resistance Ω at 25°C
SKA1200025	330		22
SKA1200037	390		22
SKA1200055	660		22
SKA1200075	780		22
SKBD200110	940		44
SKBD200150	1410		44
SKCD200220	1880		66

Table 4-2 Commander SK 400V units DC bus data

Model	DC Bus Capacitance μF	DC bus inductance mH	Inrush resistance Ω at 25°C
SKB3400037	165		44
SKB3400055	165		44
SKB3400075	165		44
SKB3400110	195		44
SKB3400150	235		44
SKC3400220	470		66
SKC3400300	470		66
SKC3400400	470		66

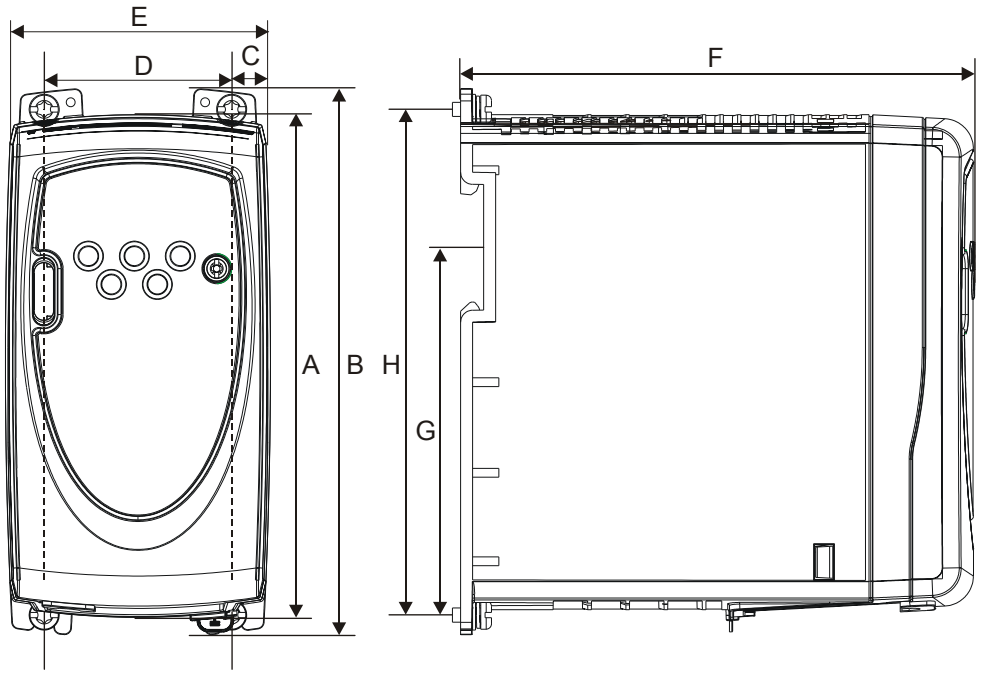
Table 4-3 Inrush resistor

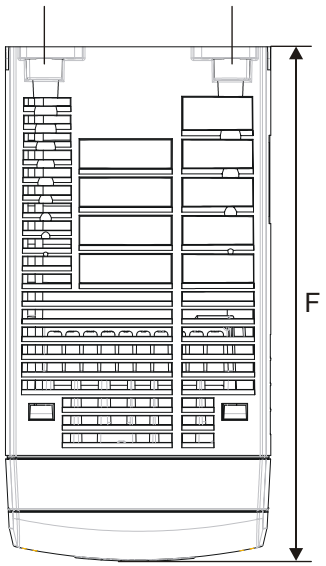
Frame	Voltage	Power Rating (kW)	Inrush Resistor (Ω)	Number in series	Effective Inrush Resistance (Ω)	Pk Inrush Current (A)
A	200	0.25	22	1	22	17.9
A	200	0.37	22	1	22	17.9
A	200	0.55	22	1	22	17.9
A	200	0.75	22	1	22	17.9
B	200	1.1	22	2	44	8.9
B	200	1.5	22	2	44	8.9
B	400	0.37	22	2	44	17.9
B	400	0.55	22	2	44	17.9
B	400	0.75	22	2	44	17.9
B	400	1.1	22	2	44	17.9
B	400	1.5	22	2	44	17.9
C	200	2.2	22	3	66	6.0
C	400	2.2	22	3	66	11.9
C	400	3	22	3	66	11.9
C	400	4	22	3	66	11.9

5 Mechanical installation

5.1 Mechanical dimensions

Figure 5-1 Size A mounting dimensions





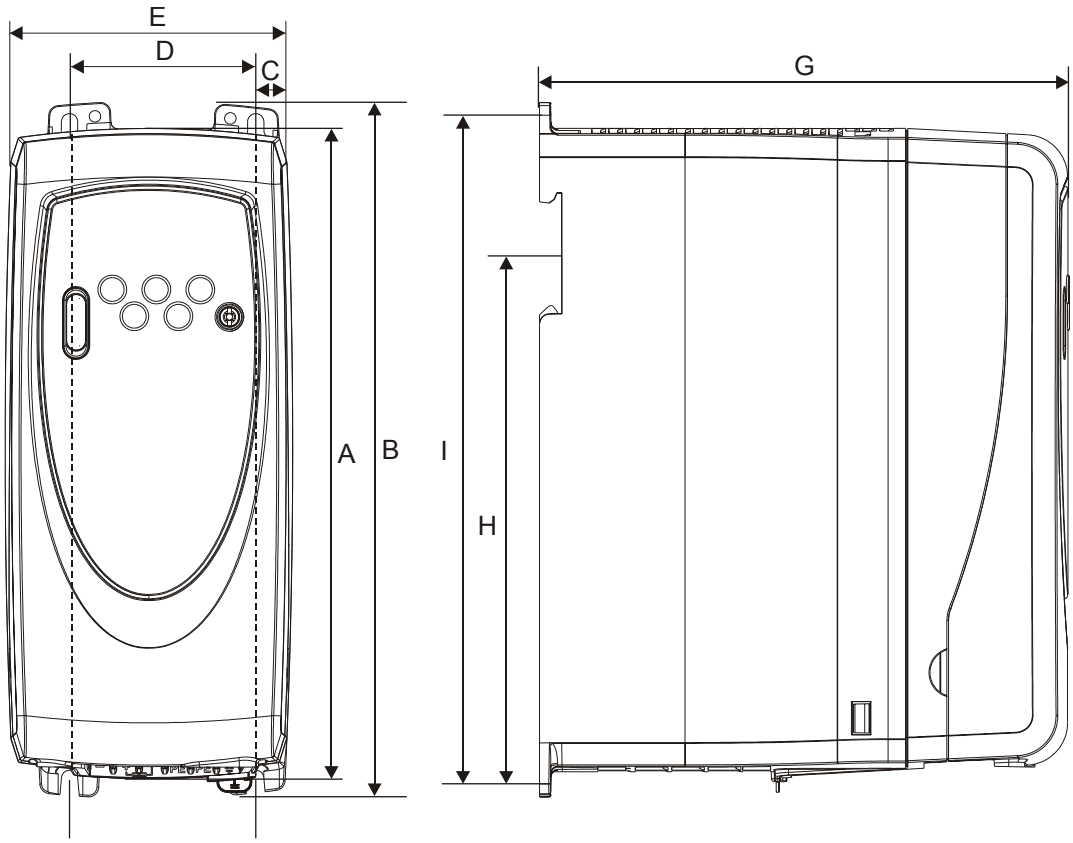
Dimension	mm	in
A	140	5.51
B	154	6.06
C	11	0.43
D	64	2.52
E	75	2.95
F	145	5.7
G	104	4.1
H	143	5.63

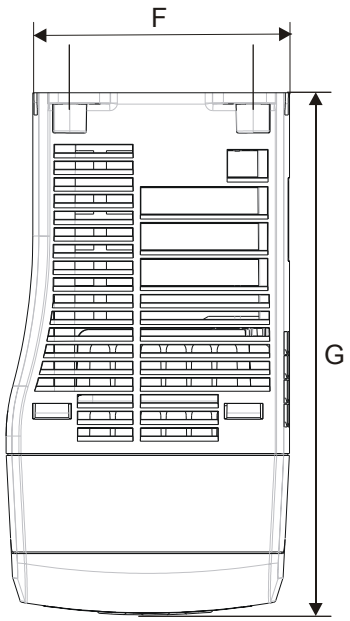
Holesize 4 x M4

NOTE

If DIN rail mounting is used in an installation where the drive is to be subjected to shock or vibration, it is recommended that the bottom mounting screws are used to secure the drive to the back plate. If the installation is going to be subjected to heavy shock and vibration, then it is recommended that the drive is surface mounted rather than DIN rail mounted

Figure 5-2 Size B mounting dimensions





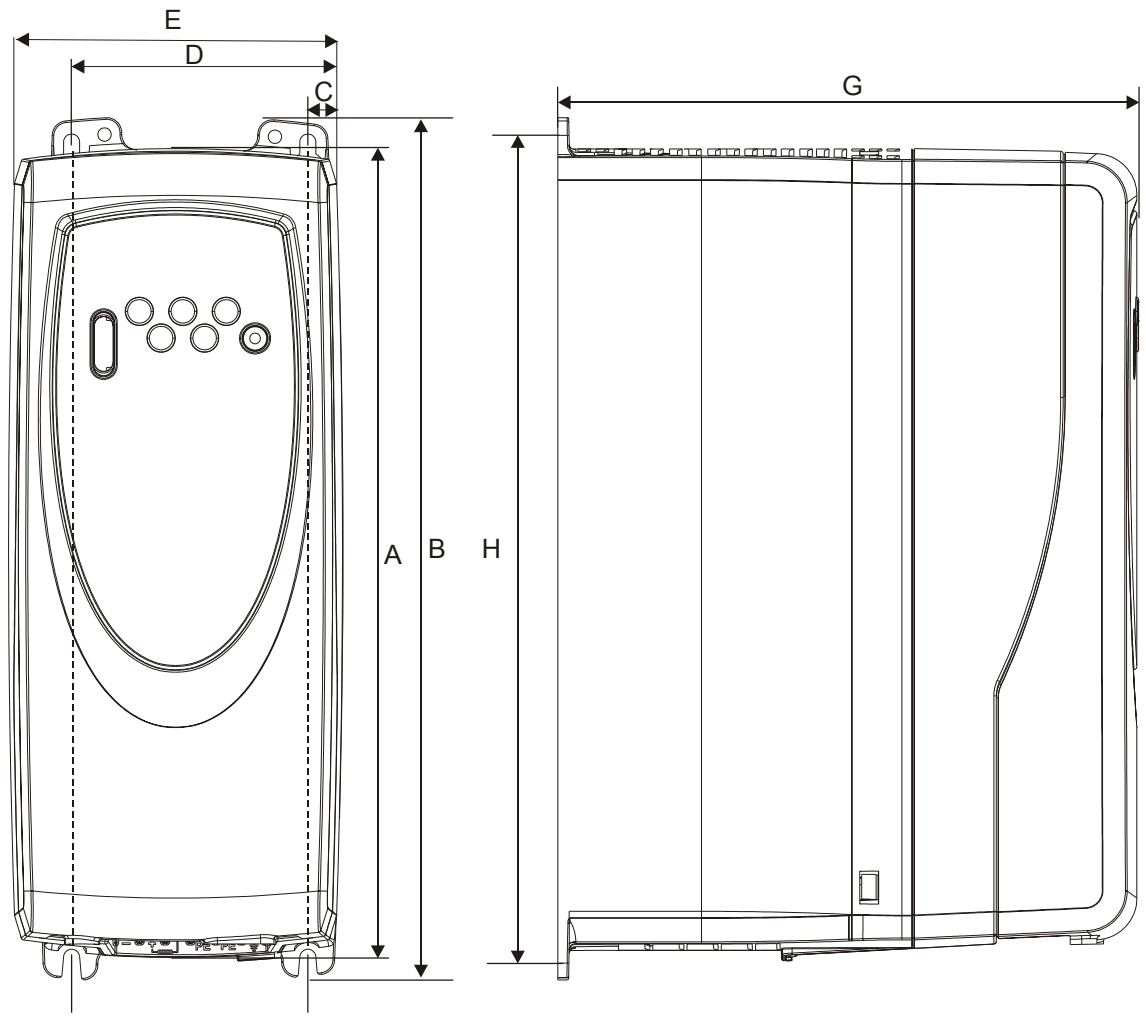
Dimension	mm	in
A	190	7.48
B	205	8.07
C	10.9	0.43
D	23.5	0.93
E	85	3.35
F	77	3
G	156	6.15
H	155.5	6.1
I	194	7.64

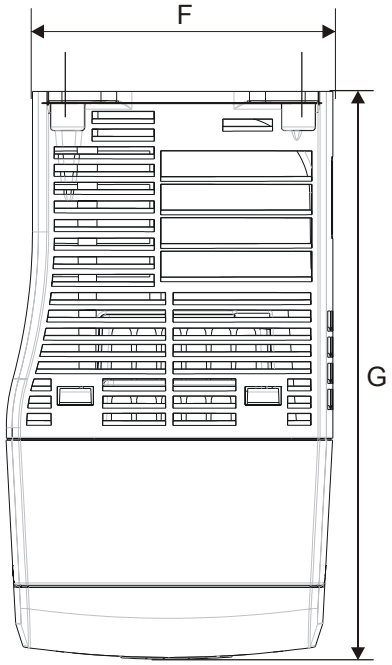
Holesize 4 x M4

NOTE

If DIN rail mounting is used in an installation where the drive is to be subjected to shock or vibration, it is recommended that the bottom mounting screws are used to secure the drive to the back plate. If the installation is going to be subjected to heavy shock and vibration, then it is recommended that the drive is surface mounted rather than DIN rail mounted

Figure 5-3 Size C mounting dimensions





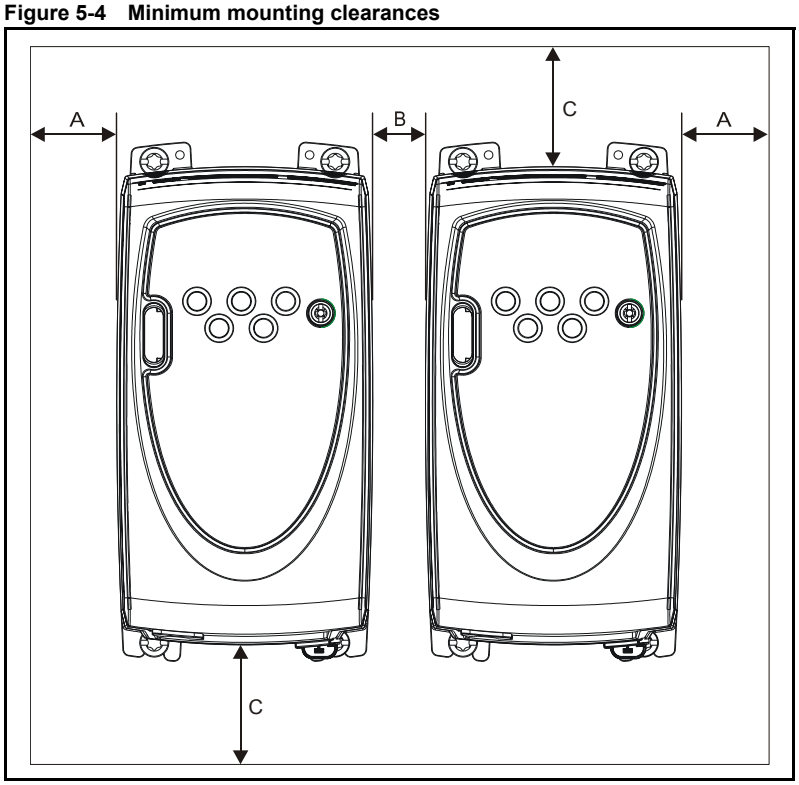
Dimension	mm	in
A	240	9.45
B	258	10.16
C	10.4	0.41
D	81.1	3.2
E	100	3.94
F	91.9	3.62
G	173	6.8
H	244	9.61

Holesize 4 x M4

Size C is not DIN rail mountable.

5.2 Minimum mounting clearances

Figure 5-4 Minimum mounting clearances



Drive size	A		B		C	
	mm	in	mm	in	mm	in
A	10	0.39	0	0	100	3.94
B (≤0.75kW)			10	0.39		
B (≥1.1kW)			0	0		
C						

6 EMC filters

EMC filters are available as optional extra parts where required.

Table 6-1 EMC filters

Used with	Number of phases	Filter part number		Filter type		Mounting		Max motor cable length (m)
		CT	Schaffner	Standard	Low leakage	Footprint	Side	
SKA1200025 and SKA1200037	1	4200-6122	FS6512-12-07	Y		Y	Y	50m
		4200-6123	FS6512-12-07-LL		Y	Y	Y	30m
SKA1200055 and SKA1200075	1	4200-6122	FS6512-12-07	Y		Y	Y	75m
		4200-6123	FS6512-12-07-LL		Y	Y	Y	30m
SKBD200110 to SKBD200150	1	4200-6212	FS6513-20-07	Y		Y	Y	
		4200-6214	FS6513-20-07-LL		Y	Y	Y	
SKBD200110 to SKBD200150	3	4200-6213	FS6513-10-07	Y		Y	Y	
		4200-6215	FS6513-10-07-LL		Y	Y	Y	
SKB3400037 to SKB3400150	3	4200-6213	FS6513-10-07	Y		Y	Y	
		4200-6215	FS6513-10-07-LL		Y	Y	Y	
SKCD200220	1	4200-6310	FS6514-24-07	Y		Y	Y	
		4200-6312	FS6514-24-07-LL		Y	Y	Y	
SKCD200220	3	4200-6311	FS6514-14-07	Y		Y	Y	
		4200-6217	FS6514-14-07-LL		Y	Y	Y	
SKC3400220 to SKC3400400	3	4200-6311	FS6514-14-07	Y		Y	Y	
		4200-6217	FS6514-14-07-LL		Y	Y	Y	

6.1 Filter data

Table 6-2 EMC filter data

Used with	Number of phases	Filter part number		Power losses at rated current	IP rating	Weight		Operational leakage current	Worst case leakage current	Filter terminal tightening torque		Filter current rating
		CT	Schaffner	W		Kg	lb	mA	mA	Nm	lb ft	A
SKA1200025 to SKA1200075	1	4200-6122	FS6512-12-07	4.1	20	0.42	0.9	25.7	49.5	0.8	0.6	12
		4200-6123	FS6512-12-07-LL	6.7	20	0.44	1.0	2.5	5	0.8	0.6	12
SKBD200110 to SKBD200150	1	4200-6212	FS6513-20-07	11.2	20	0.57	1.3	25.7	50	0.8	0.6	20
		4200-6214	FS6513-20-07-LL	12.8	20	0.64	1.4	3.6	7	0.8	0.6	20
SKBD200110 to SKBD200150	3	4200-6213	FS6513-10-07	7.5	20	0.63	1.4	40	137.2	0.8	0.6	10
		4200-6215	FS6513-10-07-LL	7.5	20	0.63	1.4	3	18.3	0.8	0.6	10
SKB3400037 to SKB3400150	3	4200-6213	FS6513-10-07	7.5	20	0.63	1.4	40	137.2	0.8	0.6	10
		4200-6215	FS6513-10-07-LL	7.5	20	0.63	1.4	3	18.3	0.8	0.6	10
SKCD200220	1	4200-6310	FS6514-24-07	16.2	20	0.84	1.9	25.7	50	0.8	0.6	24
		4200-6312	FS6514-24-07-LL	18.5	20	0.91	2.0	3.6	7	0.8	0.6	24
SKCD200220	3	4200-6311	FS6514-14-07	11.8	20	0.75	1.7	40	137.2	0.8	0.6	14
		4200-6217	FS6514-14-07-LL	11.8	20	0.74	1.6	3	18.3	0.8	0.6	14
SKC3400220 to SKC3400400	3	4200-6311	FS6514-14-07	11.8	20	0.75	1.7	40	137.2	0.8	0.6	14
		4200-6217	FS6514-14-07-LL	11.8	20	0.74	1.6	3	18.3	0.8	0.6	14

6.2 Conformity

Table 6-3 Conformity

Used with	Number of phases	Motor cable length m	Filter and switching frequency											
			Internal				Standard				Low leakage			
			3kHz	6kHz	12kHz	18kHz	3kHz	6kHz	12kHz	18kHz	3kHz	6kHz	12kHz	18kHz
SKA1200025 and SKA1200037	1	5	E2U	E2U	E2R	E2R	R	I	I	I	R	I	I	I
		10	E2U	E2R	E2R	E2R	R	I	I	I	R	I	I	I
		20	E2R				R	I	I	I	I			
		30	E2R				I				I			
		50	E2R				I							
SKA1200055 and SKA1200075	1	5	E2U	E2U	E2R	E2R	R	I	I	I	R	I	I	I
		10	E2U	E2R	E2R	E2R	R	I	I	I	R	I	I	I
		20	E2R				R	I	I	I	I			
		30	E2R				I				I			
		50	E2R				I							
		75	E2R				I	I	I	E2U				
SKBD200110 to SKBD200150	1	5												
		15												
		20												
		50												
		80												
SKBD200110 to SKBD200150	3	5												
		15												
		20												
		50												
		80												
SKB3400037 to SKB3400150	3	5												
		15												
		20												
		50												
		80												
SKCD200110	1	5												
		15												
		20												
		50												
		80												
SKCD200110	3	5												
		15												
		20												
		50												
		80												
SKC3400220 to SKC3400400	3	5												
		15												
		20												
		50												
		80												

Key to Table 6-3 *Conformity*

The requirements are listed in descending order of severity, so that if a particular requirement is met then all requirements listed after it are also met.

	Standard	Description	Frequency range	Limits	Application
R	EN 61000-6-3 (previously EN 50081-1)	Generic emission standard for the residential commercial and light - industrial environment	0.15 - 0.5MHz limits decrease linearly with log frequency	66-56dBµV quasi peak 56-46dBµV average	AC supply lines
			0.5 - 5MHz	56dBµV quasi peak 46dBµV average	
			5 - 30MHz	60dBµV quasi peak 50dBµV average	
	EN 61800-3 IEC 61800-3	Product standard for adjustable speed power drive systems	Requirements for the first environment[1], with unrestricted distribution		
I	EN 61000-6-4 (previously EN 50081-2)	Generic emission standard for the industrial environment	0.15 - 0.5MHz	79dBµV quasi peak 66dBµV average	AC supply lines
			0.5 -30MHz	73dBµV quasi peak 60dBµV average	
	EN 61800-3 IEC 61800-3	Product standard for adjustable speed power drive systems	Requirements for the first environment[1] with restricted distribution[2]		
E2U	EN 61800-3 IEC 61800-3	Product standard for adjustable speed power drive systems	Requirements for the second environment with unrestricted distribution		
E2R	EN 61800-3 IEC 61800-3	Product standard for adjustable speed power drive systems	Requirements for the second environment with restricted distribution[2]		
	Operation in this condition is not recommended				
1	The first environment is one where the low voltage supply network also supplies domestic premises				
2	When distribution is restricted, drives are available only to installers with EMC competence				



CAUTION

This caution applies where the drive is used in the first environment according to EN 61800-3.
This is a product of the restricted distribution class according to IEC 61800-3. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

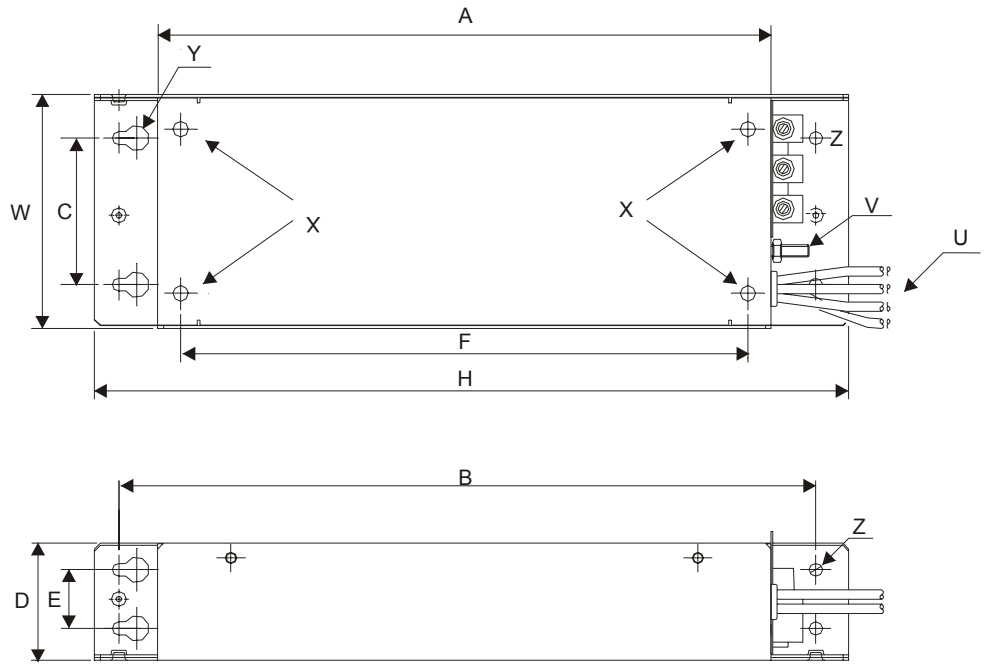
NOTE

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

NOTE

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

Table 6-4 EMC filter dimensions



V: Ground stud:
X:Threaded holes for footprint mounting of the drive
Y: Footprint mounting holes ∅
Z: Bookcase mounting holes ∅

CT part no.	Schaffner part no.	A	B	C	D	E	F	H	U	V	W	X	Y	Z
4200-6122	FS6512-12-07	155mm (6.10in)	183.5mm (7.22in)	45mm (1.77in)	40mm (1.57in)	20mm (0.78in)	144mm (5.66in)	203mm (7.99in)	16 AWG	M4	75mm (2.95in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6123	FS6512-12-07-LL	155mm (6.10in)	183.5mm (7.22in)	45mm (1.77in)	40mm (1.57in)	20mm (0.78in)	144mm (5.66in)	203mm (7.99in)	16 AWG	M4	75mm (2.95in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6212	FS6513-20-07	209mm (8.22in)	237.7mm (9.35in)	50mm (1.96in)	40mm (1.57in)	20mm (0.78in)	193.5mm (7.61in)	257.2mm (10.12in)	14 AWG	M4	80mm (3.15in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6214	FS6513-20-07-LL	209mm (8.22in)	237.7mm (9.35in)	50mm (1.96in)	40mm (1.57in)	20mm (0.78in)	193.5mm (7.61in)	257.2mm (10.12in)	14 AWG	M4	80mm (3.15in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6213	FS6513-10-07	209mm (8.22in)	237.7mm (9.35in)	50mm (1.96in)	40mm (1.57in)	20mm (0.78in)	193.5mm (7.61in)	257.2mm (10.12in)	14 AWG	M4	80mm (3.15in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6215	FS6513-10-07-LL	209mm (8.22in)	237.7mm (9.35in)	50mm (1.96in)	40mm (1.57in)	20mm (0.78in)	193.5mm (7.61in)	257.2mm (10.12in)	14 AWG	M4	80mm (3.15in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6310	FS6514-24-07	260mm (10.23in)	288.5mm (11.35in)	65mm (2.55in)	45mm (1.77in)	20mm (0.78in)	244mm (9.60in)	308mm (12.12in)	12 AWG	M4	94mm (3.70in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6312	FS6514-24-07-LL	260mm (10.23in)	288.5mm (11.35in)	65mm (2.55in)	45mm (1.77in)	20mm (0.78in)	244mm (9.60in)	308mm (12.12in)	12 AWG	M4	94mm (3.70in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6311	FS6514-14-07	260mm (10.23in)	288.5mm (11.35in)	65mm (2.55in)	45mm (1.77in)	20mm (0.78in)	244mm (9.60in)	308mm (12.12in)	16 AWG	M4	94mm (3.70in)	M4	8.7mm (0.34in)	4.5mm (0.17in)
4200-6217	FS6514-14-07-LL	260mm (10.23in)	288.5mm (11.35in)	65mm (2.55in)	45mm (1.77in)	20mm (0.78in)	244mm (9.60in)	308mm (12.12in)	16 AWG	M4	94mm (3.70in)	M4	8.7mm (0.34in)	4.5mm (0.17in)

7 AC line reactor values

Table 7-1 AC line reactor values

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	0.8	72	65	90
SKA1200037	4402-0224	1	2.25	6.5	13	0.8	72	65	90
SKA1200055	4402-0225	1	1.0	15.1	30.2	1.1	82	75	100
SKA1200075	4402-0225	1	1.0	15.1	30.2	1.1	82	75	100
SKBD200110	4402-0225	1	1.0	15.1	30.2	1.1	82	75	100
SKBD200150	4402-0226	1	0.5	26.2	52.4	1.5	82	90	105
SKCD200220	4402-0226	1	0.5	26.2	52.4	1.5	82	90	105
SKBD200110	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKBD200150	4402-0228	3	1.0	15.4	47.4	3.8	150	90	150
SKCD200220	4402-0228	3	1.0	15.4	47.4	3.8	150	90	150
SKB3400037	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKB3400055	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKB3400075	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKB3400110	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKB3400150	4402-0227	3	2.0	7.9	15.8	3.5	150	90	150
SKC3400220	4402-0228	3	1.0	15.4	47.4	3.8	150	90	150
SKC3400300	4402-0228	3	1.0	15.4	47.4	3.8	150	90	150
SKC3400400	4402-0228	3	1.0	15.4	47.4	3.8	150	90	150

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.

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.

7.3 Input line reactors for harmonics standards EN61000-3-2 and IEC61000-3-2

The following input line reactors allow the Commander SK 0.25 - 0.55kW drives to conform to harmonic standards EN61000-3-2 and IEC61000-3-2.

Table 7-2 Input line reactors for harmonics standards EN61000-3-2 and IEC61000-3-2

Drive	Reactor part number	Drive power de-rating	Input power	Inductance	Continuous rms current
			W	mH	
SKA12200025	4400-0239	None	374	4.5	2.4
SKA12200037	4400-0238	None	553	9.75	3.2
SKA12200055	4400-0237	18%	715	16.25	4.5

EN61000-3-2 and IEC61000-3-2 applies to equipment with a supply voltage of 230VAC and a line current up to 16A, single or three phase. Professional equipment with rated input power exceeding 1kW has no limits - this applies to the 0.75kW drive.

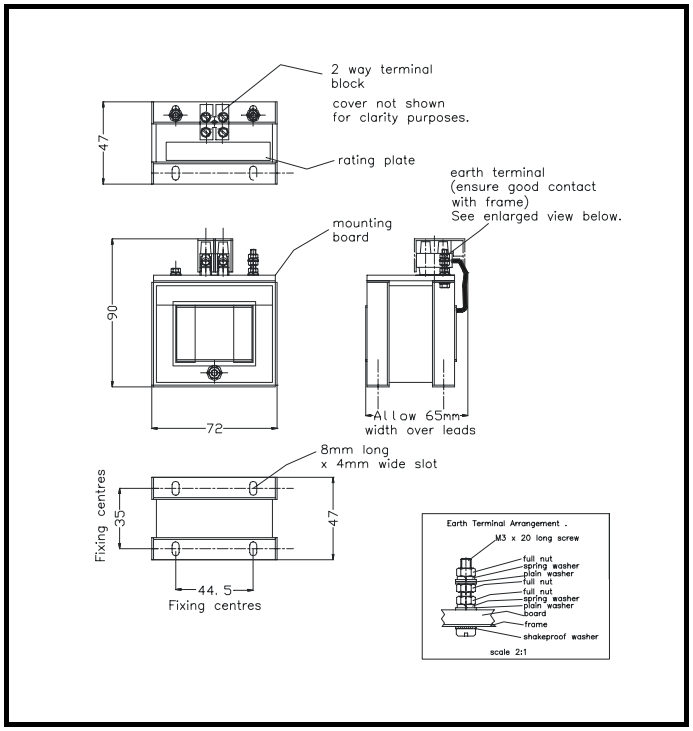
Further information on EN61000-3-2 and IEC61000-3-2 is included on the EMC data sheets available from your local Control Techniques drive centre or distributor.

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

Those models which 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.

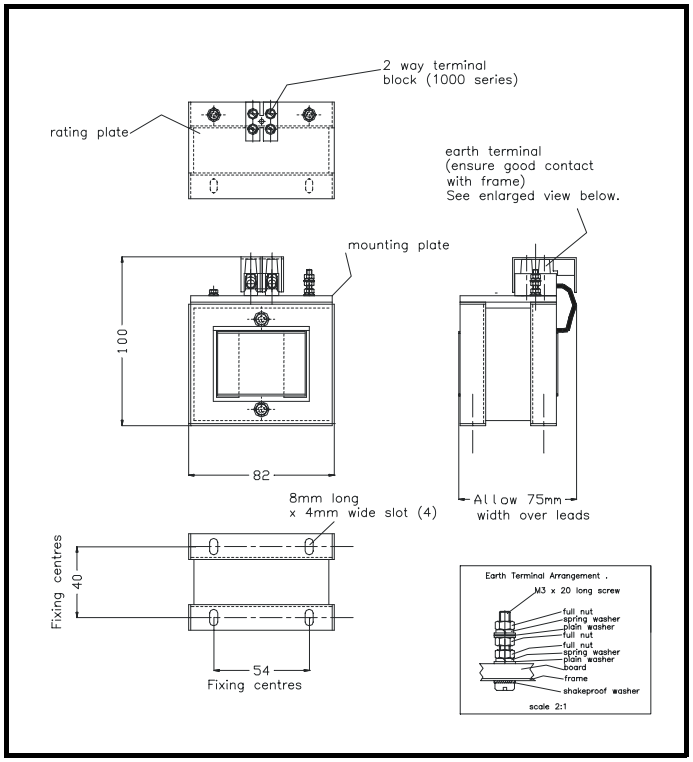
The drive does not of itself cause periodic voltage fluctuation in normal operation. The installer must ensure that the control of the drive is such that periodic fluctuations in supply current do not infringe the flicker requirements where applicable. Note that large periodic load fluctuations in the 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.

Figure 7-1 Input line reactor 4402-0224



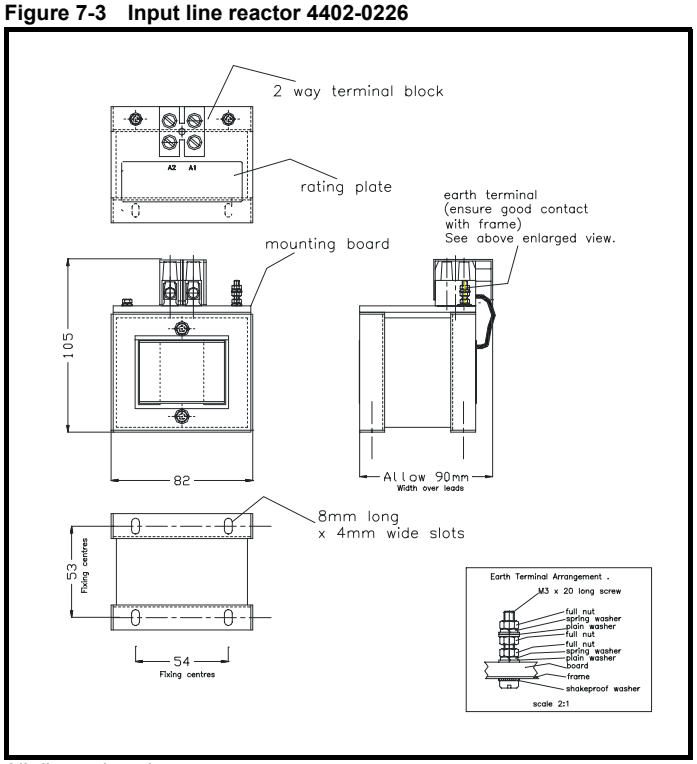
All dimensions in mm

Figure 7-2 Input line reactor 4402-0225



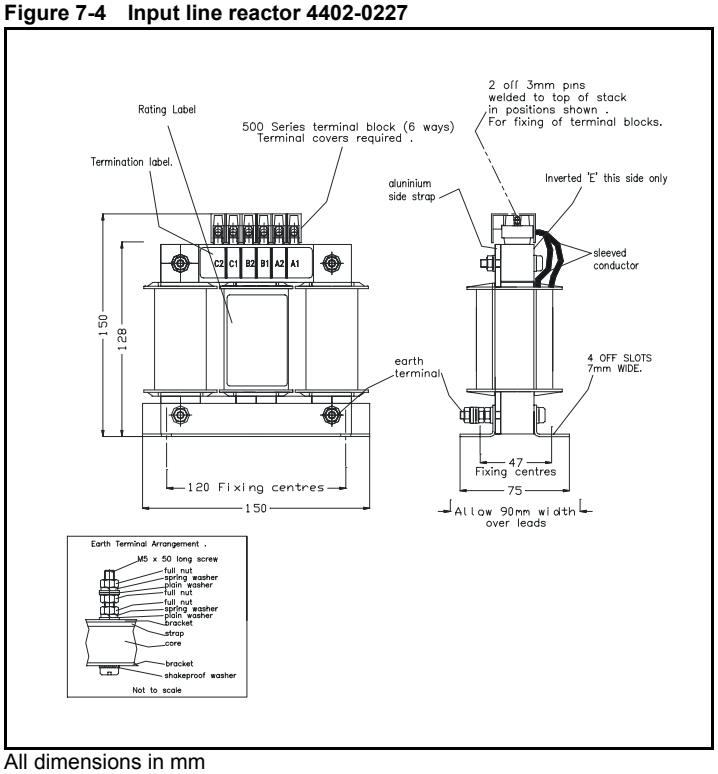
All dimensions in mm

Figure 7-3 Input line reactor 4402-0226



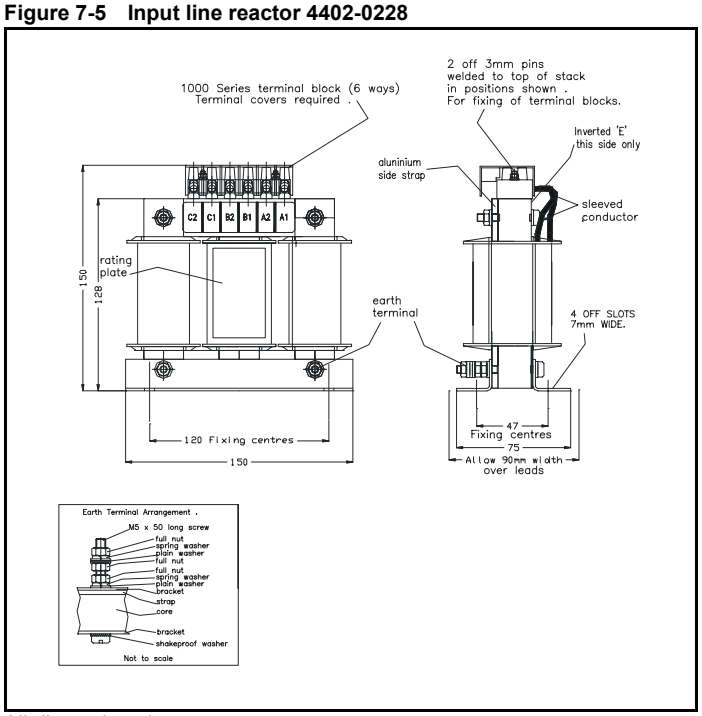
All dimensions in mm

Figure 7-4 Input line reactor 4402-0227



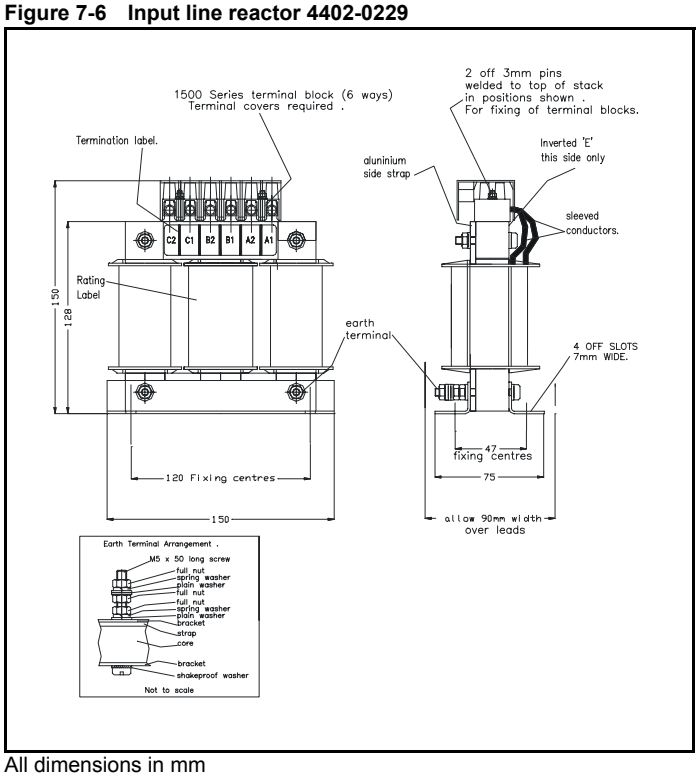
All dimensions in mm

Figure 7-5 Input line reactor 4402-0228



All dimensions in mm

Figure 7-6 Input line reactor 4402-0229



All dimensions in mm

8 Motor cable lengths

Table 8-1 Motor cable lengths

Drive frame size	kW rating	Maximum motor cable length
A	0.25 and 0.37	50m
	0.55 and 0.75	75m
B		100m
C		100m

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 Ratings

9.1.1 IP rating

IP20

- The drive complies with the requirements of IP20 as standard.

IP4X

- The top surface of the drive complies with the requirements of IP4X with the optional top cover fitted.

First digit: Protection against contact and ingress of foreign bodies.

2 - Protection against medium size foreign bodies ∅> 12mm (finger)

Second digit: protection against ingress of water.

0 - No protection

9.2 Input phase imbalance

3% between phases or 2% negative phase sequence.

9.3 Ambient temperature

-10°C (14°F) to 40°C (104°F) at 3kHz

Operation up to 55°C (131°F) with de-rating.

(see de-rating curves for further information)

NOTE

The drive can be powered up and run at a minimum temperature of -10°C (14°F).

9.4 Storage temperature

-40 to +60°C (-40 to +140°F) for 12 months max

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

Maximum relative 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 Materials

9.10 Vibration

9.10.1 Random

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

Severity: 1.0 m^2/s^3 (0.01g^2/Hz) ASD from 5 to 20Hz, -3dB/octave from 20 to 200Hz

Duration: 30 minutes in each of 3 mutually perpendicular axes.

9.10.2 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

15m/s^2 peak displacement from 200 to 500Hz

Sweep rate: 1 octave/minute

Duration: 15 minutes in each of 3 mutually perpendicular axes.

9.10.3 Bump

Standard: IEC68-2-29: Test Eb

Severity: 18g, 6ms, half sine

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

9.11 Frequency accuracy

0.01%

9.12 Resolution

0.1Hz

9.13 Output frequency range

0 to 1500Hz

9.14 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

9.15 Start-up time

The soft-start circuit must 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

9.16 Serial communications

Modbus RTU

9.17 Switching frequencies

The software allows for the following switching frequencies:

Size A & B: 3, 6, 12, 18kHz

Size C: 3, 6, 12kHz

9.18 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. See 7.2 (Reactor current ratings)

9.19 Acoustic noise

Frame	Power ratings	Condition	Max SPL measurement (dBA)
A	All ratings	N/A	None contributed by drive (no fan).
B	≤0.75kW	N/A	None contributed by drive (no fan).
B	≥1.1kW	rd mode, fan on	50
C	All ratings	rd mode, fan on	53

10 I/O specification

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.

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

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)



WARNING

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	0.1%
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

NOTE

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

B4 **B5** **B6** **B7**	**Digital Input - Enable/Reset */**** **Digital Input - Run Forward **** **Digital Input - Run Reverse **** **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 is disabled and the motor will coast to a stop. The drive will not re-enable for 0.5s after the enable terminal is closed again.

10.1 Drive reset

If the enable terminal is opened, the drive's output is disabled and the motor will coast to a stop. The drive will not re-enable for 1.0s after the enable terminal is closed again.

*Following a drive trip, opening and closing the enable terminal will reset the drive. If the run forward or run reverse terminal is closed, the drive will run straight away.

**Following a drive trip and a reset via the stop/reset key, the enable, run forward or run reverse terminals will need to be opened and closed to allow the drive to run. This ensures that the drive does not run when the stop/reset key is pressed.

The enable, run forward and run reverse terminals are level triggered apart from after a trip where they become edge triggered. See * and ** above.

If the enable and run forward or enable and run reverse terminals are closed when the drive is powered up, the drive will run straight away up to a set speed.

If both the run forward and run reverse terminals are closed, the drive will stop under the control of the ramp and stopping modes set in Pr **30** and Pr **31**

10.2 Sample/update times

The sample/update times shown in the control terminal specification within the *Commander SK Technical Guide* are the default sample/update times for the default terminal set-up. The sample/update time depends on the destination/source parameter of the digital or analog inputs/outputs.

These sample/update times are the sample or update times for the control microprocessor. The actual sample/update time maybe slightly longer due to the design of the Commander SK.

10.3 Task routine times

At the beginning of each menu, there is a single line parameter description and this contains the update rate for each parameter. This time signifies the task routine time in the software that the parameter is updated on. For a background task, the time depends on processor loading i.e. what functions the drive is carrying out and what advanced menus are being used.

Update rate	Microprocessor update time	Comments
2ms	2ms	Updated every 2ms
5ms	5ms	Updated every 5ms
21ms	21ms	Updated every 21ms
128ms	128ms	Updated every 128ms
Reset	N/A	Destination/source parameter changed on a Reset
B	Background	Updated as a background task. Update rate depends on processor loading.
BR	Background read	
BW	Background write	

From practical tests carried out:

Condition	Minimum	Maximum	Average
Time for drive to respond to a run command	4.1ms	5.62ms	5.02ms
Time for the drive to respond to a stop command	2.82ms	3.94ms	3.31ms
Time for the drive to respond to a step change in analog input voltage			7.93ms

11 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.

11.1 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.

11.2 Safety



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.



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.



STOP function

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



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.



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).

11.3 Cables

Recommended cable sizes are given in tables 1-2 & 1-7. 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,

the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against overload, the drive must be programmed with the correct motor rated voltage.

11.4 Fuses

The AC supply to the drive must be fitted with suitable protection against overload and short circuits. Tables 1-2 & 1-7 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.

11.5 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.

11.6 Ground leakage

The ground leakage current depends upon the internal EMC filter is fitted. The drive is supplied with the filter fitted. Instructions for removal of the internal EMC filter are given in Section 4.3.1 of the getting started guide.

With internal EMC filter fitted

Size A

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

Size B and C

1 phase 200V product

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

3-phase 200V product

7mA AC at 230V, 50Hz (proportional to supply voltage and frequency)

3-phase 400V product

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

30uA DC (10Ω)

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

<1mA

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 earth terminals to facilitate this. The purpose is to prevent a safety hazard occurring if the connection is lost.

11.7 Use of earth 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)

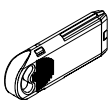
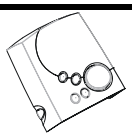
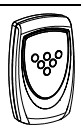
Type B - detects AC, pulsating DC and smooth DC fault currents

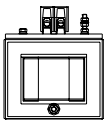
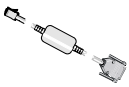
- Type AC should never be used with drives
- Type A can only be used with single phase drives
- Type B must be used with three phase drives

12 Options

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

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

Type	Option	Colour	Name	Further details	Minimum option firmware version	Unidrive SP compatible ?
Fieldbus*		Purple	SM-PROFIBUS-DP	**PROFIBUS-DP option** PROFIBUS-DP adapter for communication with Commander SK	03.00.00	Yes
		Medium Grey	SM-DeviceNet	**DeviceNet option** DeviceNet adapter for communication with Commander SK	03.00.00	Yes
		Dark Grey	SM-INTERBUS	**INTERBUS option** INTERBUS adapter for communication with Commander SK	03.00.00	Yes
		Light Grey	SM-CANopen	**CANopen option** CANopen adapter for communication with Commander SK	03.00.00	Yes
		Beige	SM-Ethernet	**Ethernet option** Ethernet adapter for communication with Commander SK	03.00.00	Yes
Extended IO		Dark Yellow	SM-I/O Lite	**I/O Lite option** Increases the I/O capability by adding the following to the existing I/O in the drive: • ±10V bi-polar / 4-20mA analog input • 1.0-10V / 4-20mA analog 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 option** Same features is I/O Lite, but with the addition of a battery backed-up real time clock.		Yes
		Turquoise	SM-PELV	**PELV option** Isolated digital I/O to NAMUR NE37 (for chemical industry).		Yes
Automation		Black	SmartStick	**SmartStick option** Upload drive parameters to the SmartStick for storage or for easy set-up of identical drives or downloading to replacement drives		No
		White	LogicStick	**LogicStick option** The LogicStick plugs into the front of the drive and enables the user to program PLC functions within the drive. (The LogicStick can also be used as a SmartStick)		No
Keypad			SM-Keypad Plus	**LCD keypad display option** Remote panel mounting LCD multilingual text keypad display to IP54 (NEMA 12) with additional help key	TBA	Yes
			SK-Keypad Remote	**LED keypad display option** Remote panel mounting LED display to IP54 (NEMA 12) with additional function key		No

Type	Option	Colour	Name	Further details	Minimum option firmware version	Unidrive SP compatible ?
EMC			EMC Filters	These additional filters are designed to operate together with the drive's own integral EMC filter in areas of sensitive equipment		No
			AC input line reactors	To reduce supply harmonics		
Cable management			SK-Bracket	Cable management bracket		
			UL type 1 kit	Bottom metal gland plate, top cover and side covers to allow the drive to comply with the requirements of UL type 1		No
Top cover			Top cover kit	The additional top cover kit will increase the environmental protection of the top face to IP4X in vertical direction.		No
Communications			CT Comms cable	Cable with isolation RS232 to RS485 converter. For connecting PC/Laptop to the drive when using CTSoft or SyPTLite		Yes
			CTSoft	Software for PC or Laptop which allows the user to commission and store parameter settings	01.04.00	Yes
			SyPTLite	Software for PC or Laptop which allows the user to program PLC functions within the drive	02.00.07	Yes

12.1 Top cover kit

The Top Cover kit will comprise of a top cover which will clip to the top of the drives plastic housing. This Top Cover will stop falling dirt or debris from entering the electronics through the ventilation slots on the top of the drive. This will allow the top of the drive comply with the requirements of IP4X.

WARNING

When the Top Cover is fitted, the drive must still be mounted in a location which prevents access except by trained and authorised personnel, and which prevents the ingress of harmful contamination. It is designed for use in an environment classified as pollution degree 2 in accordance with IEC 60664-1. This means only dry, non-conducting contamination is acceptable.

12.2 UL Type 1 Kit

The UL Type 1 kit will allow the drive to comply with the requirements of UL Type 1.

The UL Type 1 Kit will comprise of the following parts:

Commander SK Size A

- 1 x Conduit entry kit
- 1 x Top Cover
- 1 x Side Cover

Commander SK Size B

- 1 x Conduit entry kit
- 1 x Top Cover
- 4 x Side Cover

Commander SK size C

- 1 x Conduit entry kit
- 1 x Top Cover
- 5 x Side Cover



0472-0002-02