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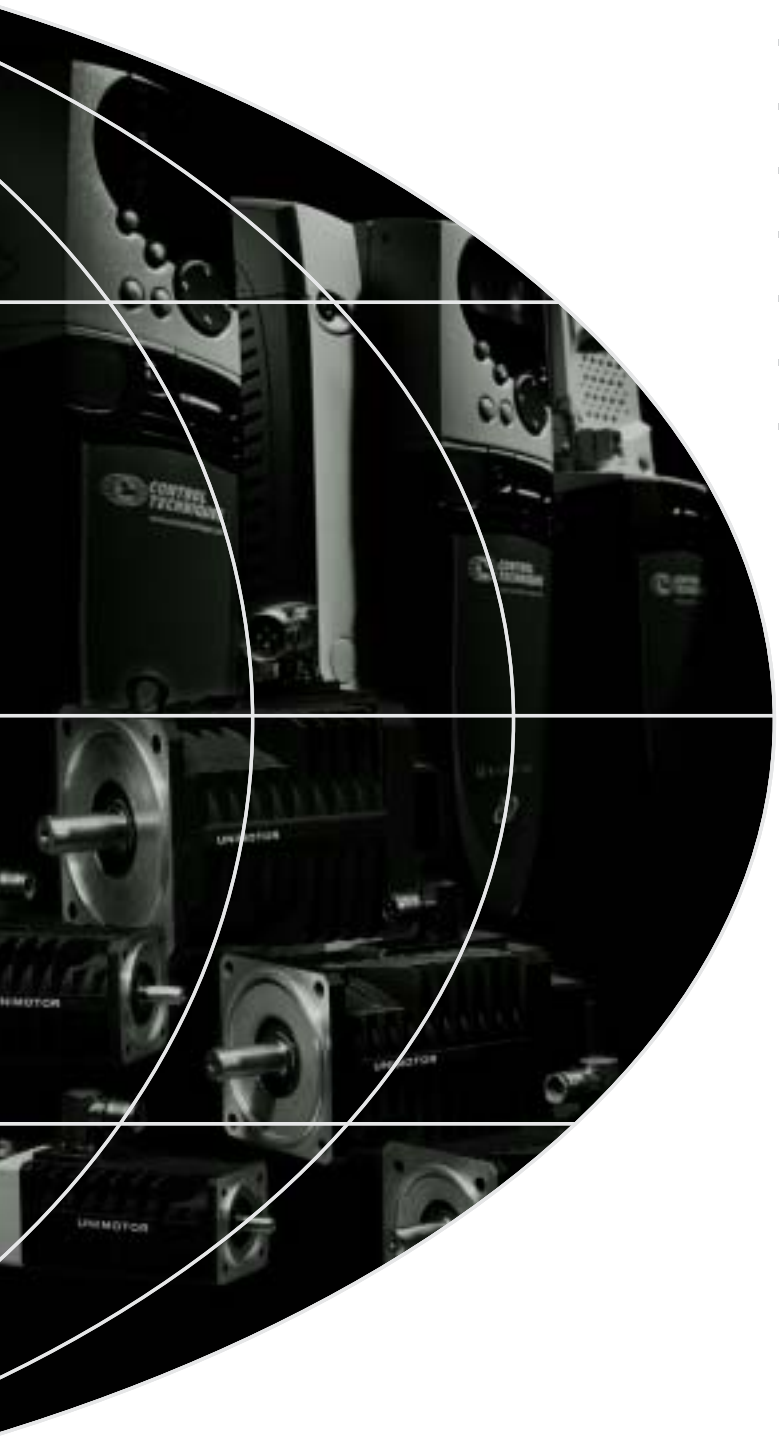

Unidrive SP
Servo & Unimotor

THE BENCHMARK

AC Servo drive 0.75kW to 30 kW

Product Data

Performance matched AC Servo solution for all applications

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Contents

Product Overview

1.1 Unidrive SP Servo Drive

Unidrive range has firmly established the principle of the "Universal AC Drive", with 250,000 units in service around the world.

System integration features are a key strength of the Unidrive. Twenty five percent of Unidrives are fitted with application co-processors (PLC option) and field bus adapters. The application co-processor enables the customer to embed his application PLC programme inside the drive for distributed control systems. Fieldbus connectivity allows integration into centralised control systems.

This strategy to use distributed control is increasingly being adopted by industrial users, but Control Techniques has moved on by introducing the Unidrive SP. This is the new AC drive benchmark for the controls and automation industry.

The Unidrive SP "Solution Platform" is a logical evolution and has a solid foundation:

- Six years of system integrators and end users implementing Unidrive applications
- Six years of manufacturing and refining Unidrive AC drive by listening to users all around the world

Power Features:

The Unidrive SP is now even more a "Universal" drive, with expanded voltage and power range and system integration features.

Global voltage supply

- 200V to 690V ac 50/60Hz
- dc bus connections - for supplying multiple drives
- to allow power sharing/braking
- 48V dc power supply input for machine tool set up and lift rescue applications
- 24VDC backup supply

For higher power systems, Unidrive SP has

- 12-pulse inputs
- at all Unidrive SP ratings the regeneration mode is available
- IP54 capability
- In built EMC filter for small machines
- Internal brake resistor option at 11kW and below

Control Features:

Three Universal option slots that can accommodate application co-processors (PLC options), field bus adapters, additional Universal Encoder interfaces and extended I/O.

On board field bus gateway solutions are possible for implementing sub-LAN systems. Connectivity options include PROFIBUS-DP (12 M bits/sec), DeviceNet, CANopen and INTERBUS.

The new Universal Encoder interface caters for a wide range of feedback signal configurations (14 in total), including Quadrature, SinCos (single and multi-turn, Hiperface and Endat), SSI, Frequency and direction, CW / CCW. These are capable of being backed up by an external power supply.

For machine tool spindle drives, there is an open loop output frequency up to 3kHz (cutting) and in motion transfer to closed loop (tool change positioning).

A SMARTCARD is provided as a simple method of drive parameter upload / download, for low skill maintenance in applications that require minimal down time.

Output contactor elimination is made possible for systems designed to meet EN954-1 category 3 and category 4 by the new Secure Disable feature.

User Interface:

Externally accessible Modbus RTU port as standard, for PC or system connection. This can be used for drive or system monitoring and programming.

Optional remote mountable plain text display, with multi language support. This is field programmable with custom text and alternative languages.

Comprehensive PC based utilities to support parameter management and PLC programming.

For diagnostics, Unidrive SP now has time stamped trip logging.

1.2 Unimotor Servo Motor

The Unimotor range has been developed following extensive research and testing of thermal dynamic theories and practices.

This range is available in five frame sizes 75; 95; 115; 142 and 190mm, in a unique and instantly recognisable finned design that offers extra strength, rigidity and thermal performance. These are important features for high performance servo systems.

Designed to operate on PWM three-phase AC drive outputs with DC link volts up to 750V DC, this range employs a registered UL approved insulation system.

The UM motor has been primarily designed to operate with the Unidrive SP.

Feedback options include resolver; or incremental, sincos single-turn, sincos multi-turn optical encoders.

Other options include:

Gearboxes - motor torque can be extended by a good selection of factory-fitted gearboxes, available to order in a wide variety of options.

Forced air-cooling - customer-fitted fan blown boxes specially designed to fit the range of motors, can directly enhance motor performance.

Custom specials - a range of special adaptations e.g. shaft or feedback type are already designed and may be available where quantities justify.

Cable assemblies - ready made power and signal cables in lengths of 2-100 metres to connect motors to the appropriate drive.

Figure 1-1 Unimotor Range

Product Overview

One of the most important features of an electric motor is its rated torque value per unit of motor volume. To maximise this value, the motor surface must lose heat as efficiently as possible. Additionally, servo motors must provide full torque at zero speed. It is not practical to use a shaft mounted fan for cooling so the motor must keep cool through a combination of natural convection, conduction through the front flange, and radiation.

Figure 1. Naturally ventilated motors usually have a relatively smooth frame surface. The frame is cylindrical or square, or a combination of the two. The above illustrations show half cross sections of the various motor types as used in the CFD model

Adding fins to a surface increases the convective cooling - radiators are an everyday example. Axial fins are common in forced ventilated motors. CT Dynamics has taken this concept a stage further to develop the Unimotor range of servo motors.

For a motor to give a performance that requires minimal de-rating, it must be designed so that it can be mounted in a number of orientations. The Unimotor's finned design ensures that the motors can be mounted horizontally or vertically without significant effect on heat transfer.

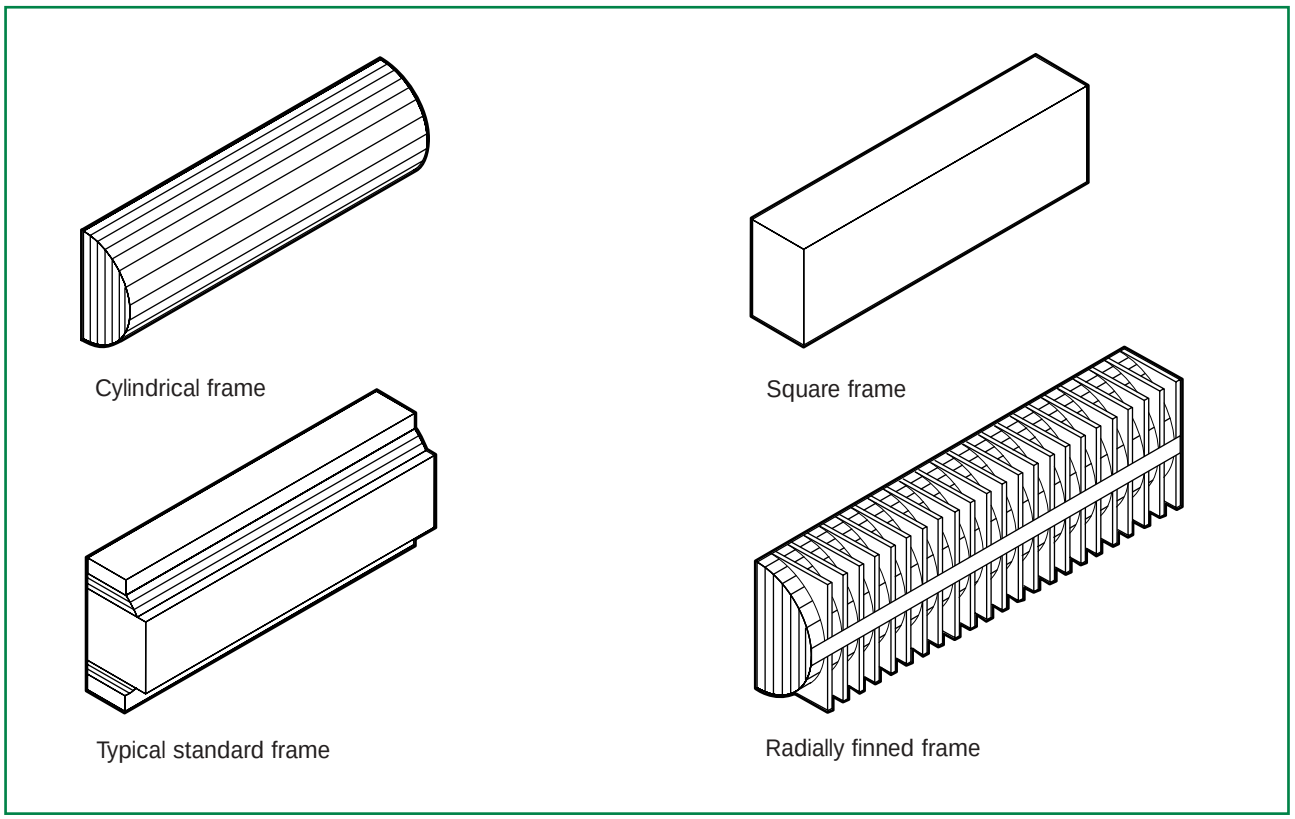


Figure 1-2 Motor Body Construction

Product Overview

Figures 2 and 3 show charts comparing the variation between hC (heat transfer coefficient for convection) with ΔT for the finned motor design against traditional types. The heat transfer coefficient shows a massive 100% to 200% improvement over conventional housings.

Figure 4 compares the rated torque of a range of motors with and without radial finning. The figure takes account of the effect of any additional conductive cooling through the front flange and radiation. The additional convection cooling gives a sizeable increase in torque for the finned motor range.

95mm Diameter Frame

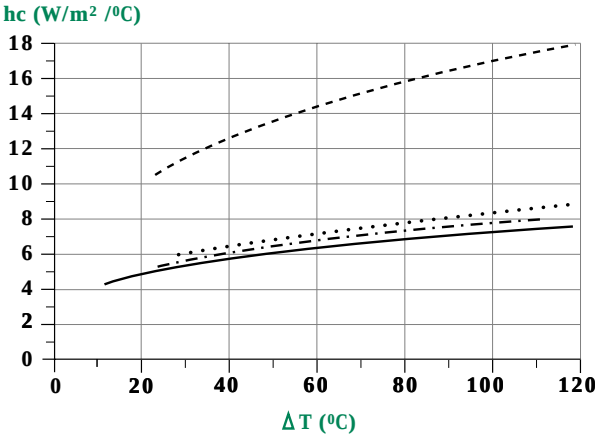


Figure 1-3

142mm Diameter Frame

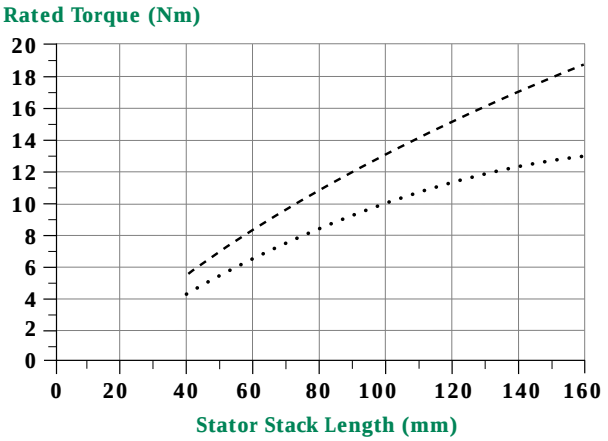


Figure 1-5

190mm Diameter Frame

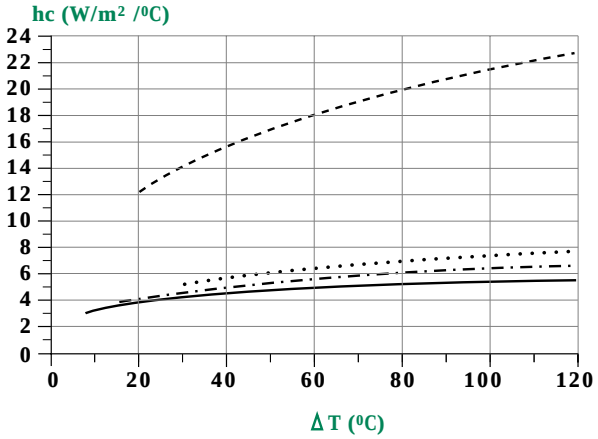
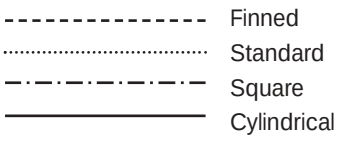


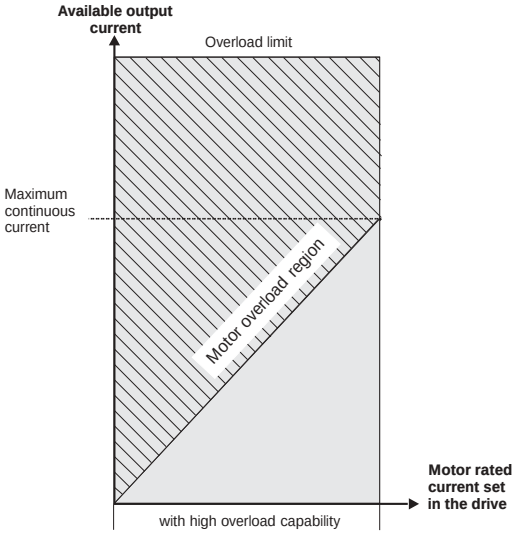
Figure 1-4



2.1 Ratings

The graph below illustrates the drive-motor rating with respect to continuous current rating and short term overload limits.

Figure 2-1 Overload Graph



The thermal protection is set to protect permanent magnet servo motors by default. This is illustrated in Figure 2-2.

Motor I^2t protection defaults are compatible with Permanent magnet servo motors:

Figure 2-2 I^2t Protection

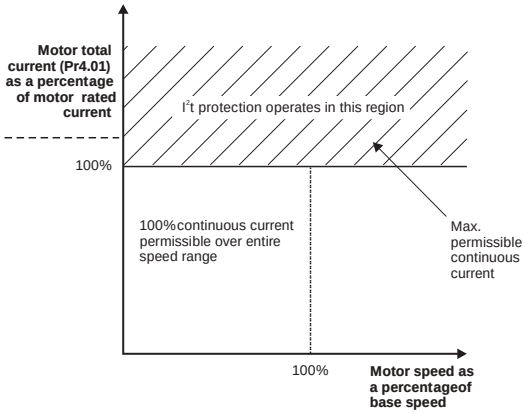


Table 2-1 200V Drive ratings (200V to 240V ±10%)

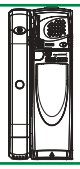
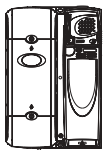
MODEL		SERVO DUTY		
		Maximum continuous output current	Nominal power at 220V	Motor power at 230V
		A	kW	hp
	1201	4.3	0.75	1
	1202	5.8	1.1	1.5
	1203	7.5	1.5	2
	1204	10.6	2.2	3
	2201	12.6	3	3
	2202	17	4	5
	2203	25	5.5	7.5
	3201	31	7.5	10
	3202	42	11	15

Table 2-2 400V Drive ratings (380V to 480V ±10%)

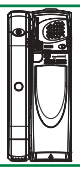
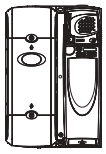
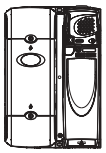
MODEL		SERVO DUTY		
		Maximum continuous output current	Nominal power at 400V	Motor power at 460V
		A	kW	hp
	1401	2.1	0.75	1
	1402	3	1.1	2
	1403	4.2	1.5	3
	1404	5.8	2.2	3
	1405	7.6	3	5
	1406	9.5	4	5
	2401	13	5.5	10
	2402	16.5	7.5	10
	2403	25	11	20
	3401	32	15	25
	3402	40	18.5	30
	3403	46	22	30

Table 2-3 575V Drive ratings (500V to 575V ±10%)

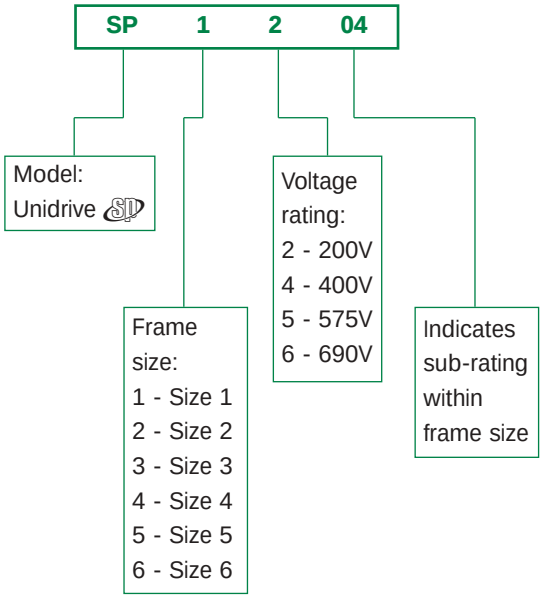
MODEL		SERVO DUTY		
		Maximum continuous output current	Nominal power at 575V	Motor power at 575V
		A	kW	hp
	3501	4.1	2.2	2
	3502	5.4	3	3
	3503	6.1	4	5
	3504	9.5	5.5	7.5
	3505	12	7.5	10
	3506	18	11	15
	3507	22	15	20

The continuous current ratings given are for maximum 40˚C, 1000m altitude and 3.0 kHz switching. De-rating is required for higher switching frequencies, ambient temperature >40˚C and high altitude. For further information refer to section 8 Technical Data.

2.2 Model Number

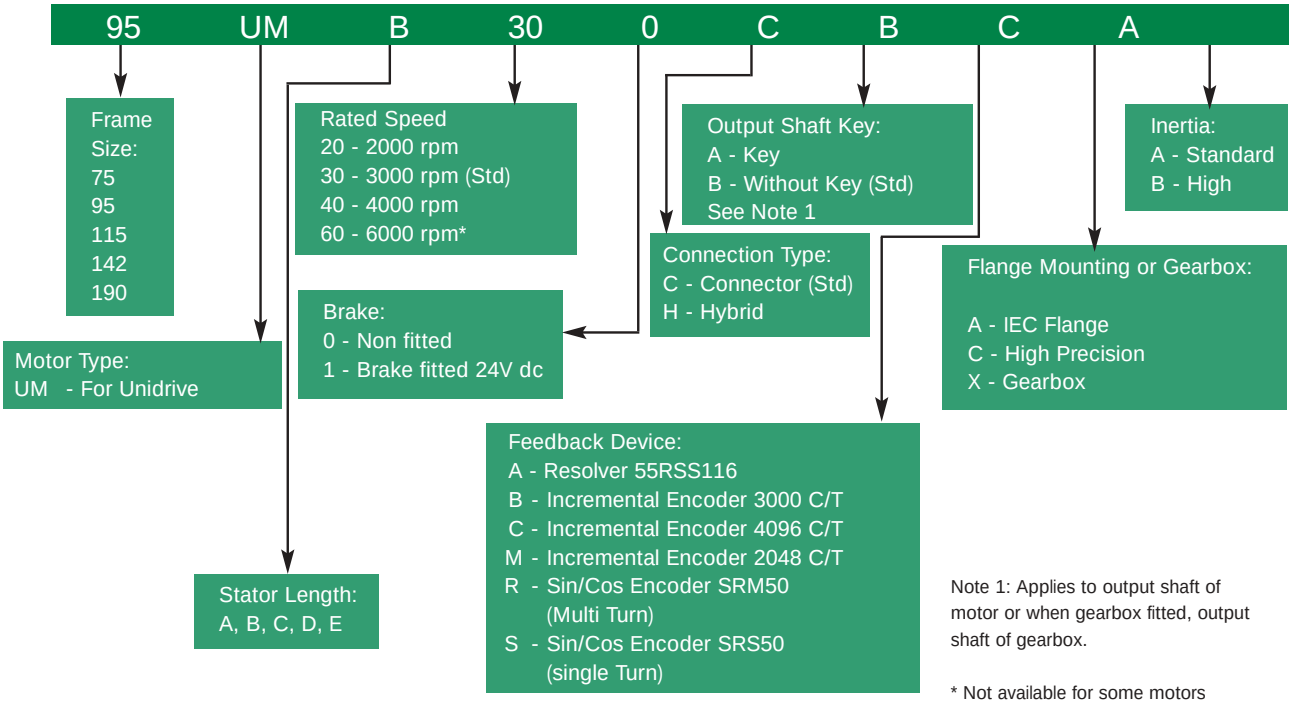
The way in which the model numbers for the Unidrive SP range are formed is illustrated below.

Figure 2-3 Drive Model Number Description



2.3 Motor Model Number

Figure 2-4 Motor Model Number Description



Note 1: Applies to output shaft of motor or when gearbox fitted, output shaft of gearbox.

* Not available for some motors

2.4 Operating Modes

The Unidrive SP is an advanced AC Servo Drive for use with AC Brushless Permanent magnet Servo Motors.

The drive directly controls the speed of the motor using the feedback device to ensure the rotor speed is exactly as demanded. Flux control is not required because the motor is self excited by the permanent magnets which form part of the rotor. Absolute position information is required from the feedback device to ensure the output voltage is accurately matched to the back EMF of the motor. Typically 300% torque down to 0rpm can be achieved with selected motors.

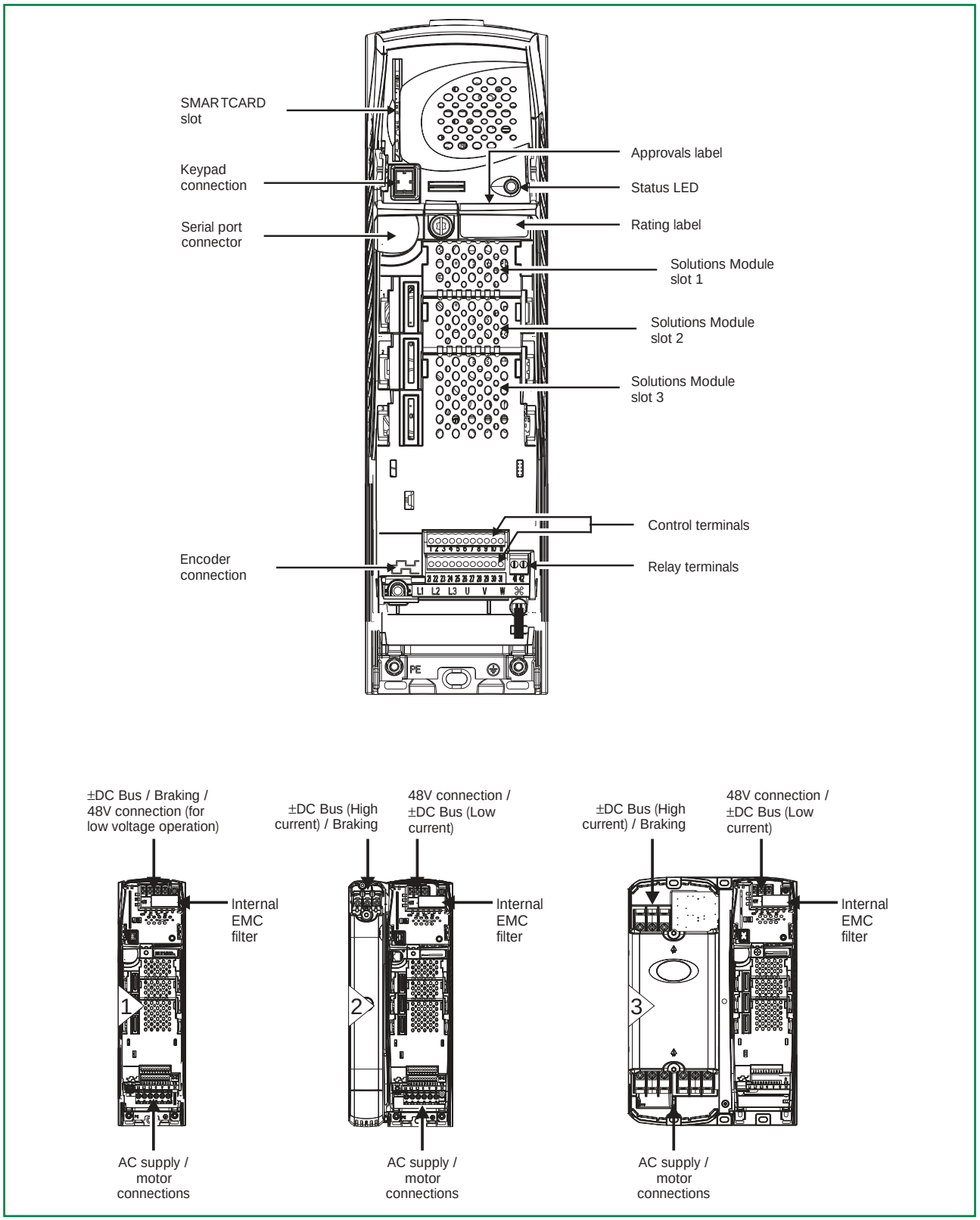
Regen operation allows bi-directional power flow to and from the AC supply. This provides far greater efficiency levels in applications which would otherwise dissipate large amounts of energy in the form of heat in a braking resistor.

The harmonic content of the input current is negligible due to the sinusoidal nature of the waveform when compared to a conventional bridge rectifier or thyristor front end. The power factor (cos Ø) of the drive is also adjustable in the Regen mode.

For more information contact the supplier of the drive.

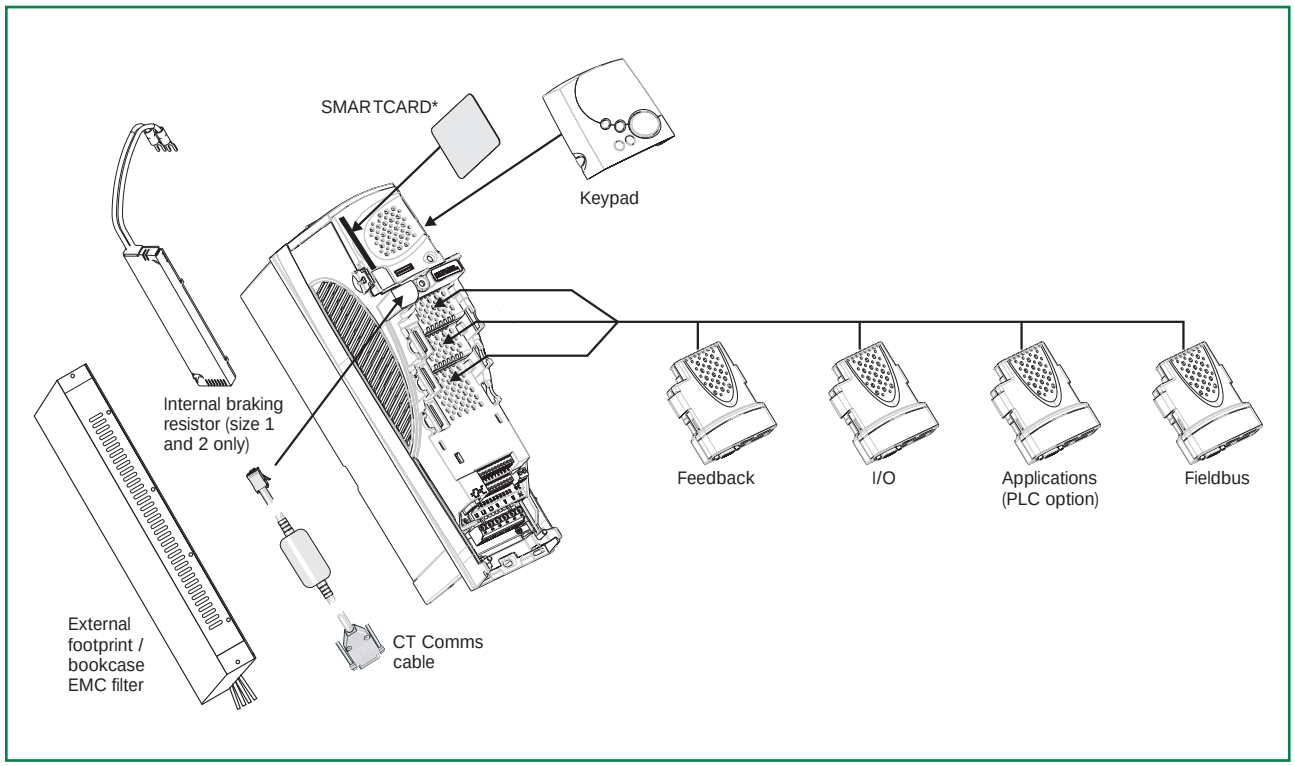
2.5 Drive Features

Figure 2-5 Features of the drive



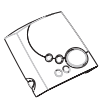
2.6 Options

Figure 2-6 Unidrive SP options



*A SMARTCARD is provided with the Unidrive SP as standard. SMARTCARDs with pre-loaded application set-ups are available from the supplier of the drive. Only one SMARTCARD can be fitted at any one time.

Table 2-4 Solutions Module Identification

TYPE	SOLUTIONS MODULE	COLOUR	NAME	FURTHER DETAILS
Feedback		Light Green	SM-Universal Encoder Plus	**Universal Feedback interface** Feedback interface for the following devices: ● Incremental encoders ● SinCos encoders ● SSI encoders ● EnDat encoders ● Hiperface encoders
		Light Blue	SM-Resolver	**Resolver interface** Feedback interface for resolvers
		Brown	SM-Encoder Plus	**Incremental encoder interface** Feedback interface for incremental encoders
I/O		Yellow	SM-I/O Plus	**Extended I/O interface** Increase the I/O capability by adding the following to the existing I/O in the drive: ● Digital inputs x 3 ● Digital I/O x 3 ● Analog inputs (voltage x 2) ● Analog output (voltage x 1) ● Relay x 2
Applications		Dark Green	SM-Applications	**Applications Processor (with CTNet)** 2nd processor for running pre-defined and/or customer created application software with CTNet support
Fieldbus		Purple	SM-PROFIBUS-DP	**Profibus option** PROFIBUS DP adapter for communications with the Unidrive SP
		Medium Grey	SM-DeviceNet	**DeviceNet option** DeviceNet adapter for communications with the Unidrive SP
		Dark Grey	SM-INTERBUS	**INTERBUS option** INTERBUS adapter for communications with the Unidrive SP
		Light Grey	SM-CANopen	**CAN option** CANopen adapter for communications with the Unidrive SP
Keypad		N/A	SM-Keypad	**LED keypad option** Keypad with LED display
Keypad		N/A	SM-Keypad Plus	**LCD keypad option** Plain text, customisable and remote mountable

2.7 Items Supplied With The Drive

The drive is supplied with a copy of the Unidrive SP User Guide, a CD ROM containing further information, a SMARTCARD, a through-panel mounting bracket and an accessory kit box including the items shown in Figure 2-5.

Figure 2-7 CD ROM file contents

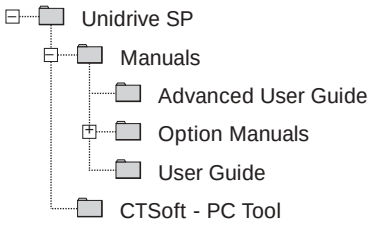


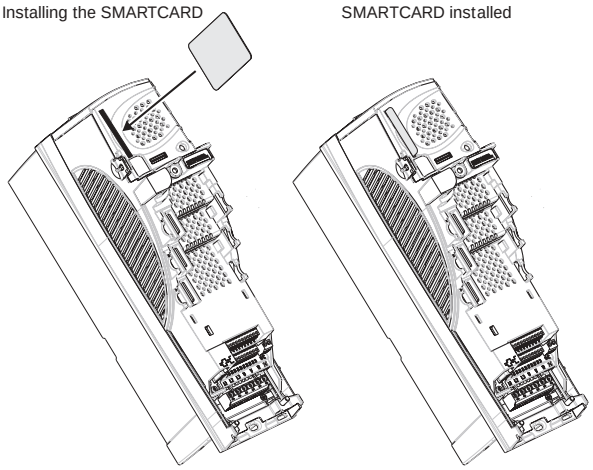
Figure 2-8 CTSoft screen

2.8 SMARTCARD

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

- 'Clone' a complete set of parameters for serial production
- Set up an application as parameter differences from default
- Automatically save all user parameter changes for maintenance purposes
- Load complete motor map parameters

Figure 2-9 Installation of the SMARTCARD



The SMARTCARD is located at the top of the module under the drive display (if fitted) on the left-hand side. Ensure SMARTCARD is inserted with the contacts facing the right-hand side of the drive.

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

Easy Saving and Reading

A single complete set of drive parameters can be saved and read very simply. At this level, no block address is necessary as only block 1 is used. If block 1 already exists it will be over-written.

Save a complete set of parameters

- Set Pr **0.30** = 'Prog'
- Press the red reset button

Read a complete set of parameters

- Set Pr **0.30** = 'rEAd'
- Press the red reset button

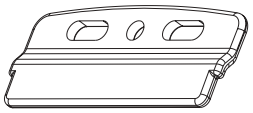
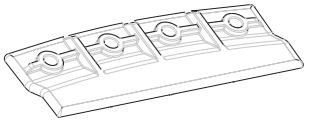
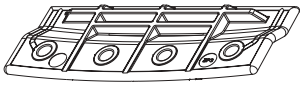
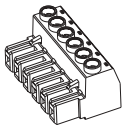
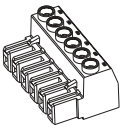
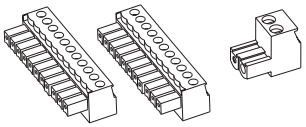
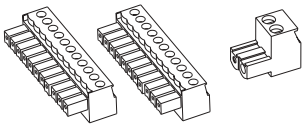
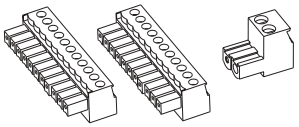
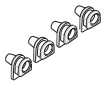
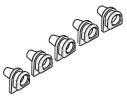
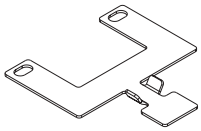
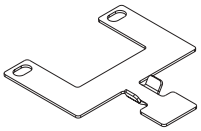
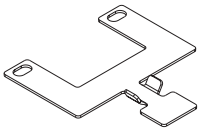
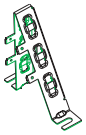
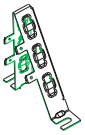
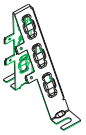
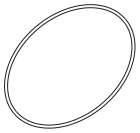
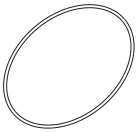
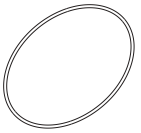
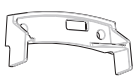
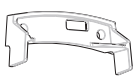
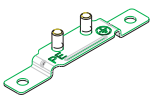
The SMARTCARD can also be used for:

1. Parameter cloning between drives
2. Saving whole drive parameter sets (up to a maximum of 4)
3. Saving parameter set differences from default
4. Storing ladder logic programs

499 data block locations (1 to 499) are available to the user for storing data up to the maximum SMARTCARD capacity of 4kb.

500 data block locations (500 to 999) are read only data blocks for predefined parameter sets or macros. These data blocks cannot be written to by the user.

Figure 2-9 Accessories Supplied with the Undrive SP

SIZE 1	SIZE 2	SIZE 3
Surface mounting brackets x2 	Surface mounting brackets x2 	Surface mounting brackets x2 
Supply and motor connector 	Supply and motor connector 	
Control connectors 	Control connectors 	Control connectors 
48V/DC terminal cover grommets 	48V/DC terminal cover grommets 	48V/DC terminal cover grommets 
Grounding clamp 	Grounding clamp 	Grounding clamp 
Grounding bracket 	Grounding bracket 	Grounding bracket 
Through-panel mounting gasket 	Through-panel mounting gasket 	Through-panel mounting gasket 
UL warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	UL warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover	UL warning label CAUTION Risk of Electric Shock Power down unit 10minutes before removing cover
Through-panel mounting bracket 	Through-panel mounting bracket 	
	Grounding bridge 	

2.9 Motor Performance Definitions

Class H - UL and CSA recognised Insulation System

Class H is a classification of the temperature rating of the motor winding insulation system.

Class H rating has a maximum average winding (copper) wire temperature of 180ºC.

All Unimotors have identical insulation systems complying with class H temperature rating irrespective of Δtmax.

The Insulation System designated “CTD/IS/200/01” is recognised by the Underwriters Laboratories (UL, USA.) and CSA (Canadian Standards Authority) for voltage and material safety compliance.

Δt temperature

Δt temperature is the temperature difference between the copper wires of the motor winding and the ambient air temperature surrounding the motor.

Δtmax temperatures are allocated to Unimotors as follows:

Δtmax = 100ºC, is applicable to all motors fitted with optical encoder feedback due to their maximum operating temperature. Δtmax = 100ºC is a little lower than a Class F winding rating for 40ºC motor ambient air temperature. (Class F has 155ºC max average winding temperature)

Δtmax = 125ºC, is applicable to Unimotors fitted with resolver feedback.
Rating corresponds to a Class H winding rating of 180ºC
For this higher Δtmax, a larger winding current is possible, and hence a larger torque rating.

Winding Thermal Time Constant (tc) seconds

The thermal time constant of the winding with respect to the stator temperature as referenced in the exponential temperature rise given by the formulae: -

Winding temperature at time t seconds = T1 (1 – e –t/tc)
Where T1 is final winding temperature
And tc = thermal time constant (seconds)

Note that temp = 63.2% of T1 when t = tc

A thermal protection trip is provided by the drive, based upon calculations using elapsed time, current measurement, and the parameter settings set by the user.

Unimotor windings are ultimately protected by thermistor devices located in the winding overhangs. These thermistors must be connected to the appropriate drive inputs via the motor feedback signal connector. (For pin allocations of signal connectors, refer to section 4.14)

Stall Torque

This is the maximum continuous torque within the Continuous Zone at zero or low speeds.

Maximum continuous torque ratings may be intermittently exceeded for short periods provided that winding Δtmax temperature is not exceeded.

As with rated torque, the ultimate limiting factor is winding temperature rise:

Δtmax = maximum winding temperature rise above ambient.
= 100ºC or 125ºC according to motor type

For stall conditions, the heating occurs in the copper windings due to I^2R losses, plus some ac ripple current loss due to the drive switching frequency.

Peak torque

This is the maximum torque that can be safely applied to the motor at any time.

Peak current is pre-set by drive parameters (as a percentage of motor stall current rating)

It is imperative that the peak current (= peak torque / Kt) is never exceeded, even for a few milliseconds as partial demagnetisation of the motor magnets could result.

Rated torque

This is the continuously rated torque at full rated speed.

This will be less than stall torque, because as the motor turns, magnetic lines of flux move through the stator laminations creating additional iron losses that increase with speed, also, to a lesser extent, viscous friction losses are added.

Rated Speed

This is the normal maximum speed for the motor.

The motor speed can be controlled to any speed subject to voltage limits and drive constraints as shown by the Intermittent Zone of the graphs. (see “Speed Limit”)

A higher speed motor has fewer winding turns, but requires a higher current to produce the same torque as a similar lower speed motor.

The induced motor voltage at rated speed and no load must be sufficiently less than the supply voltage, to allow for additional voltage across the resistance and inductance of windings as torque (approx = current) is applied.

Rated Power

This is the product of rated speed (radians/sec) and torque (Nm) expressed in Watts (W).

Twice the speed gives twice the output power at the same torque level.

Motor Efficiency

Defined as (power out) /(power in) and expressed as a percentage, motor efficiencies are typically >95% at full power.

At no load and low torque levels, drive waveforms may distort due to poor resolution at low current, causing iron loss, low efficiency and an unexpected motor temperature rise.

Voltage Constant (Ke) Volt (rms)/krpm

This is the phase–phase rms voltage generated at the stator when the shaft is back-driven at 1000rpm with rotor at 25 deg C.

Torque Constant (Kt) Nm/A(rms)

As for a brushed motor, a brushless commutating motor delivers torque proportional to current, such that torque = Kt x current. Where Kt = 0.0165 x Ke (at 25ºC).

Magnets used on all motors are affected by temperature, such that Kt and Ke reduce with increasing temperature of magnets.
Kt and Ke reduce by 0.1% / ºC for all 75 – 142 motors; and by 0.035% / ºC for 190 motors. Temperature of magnets may be assumed to reach 87% of winding temperature.

Stall Current A rms

Stall Current = (Stall Torque) / Kt
Motor label and tables quote stall current when motor is hot.

Rated Current A rms

Rated Current = (Rated Torque) / Kt

2.10 Torque-Speed Curves

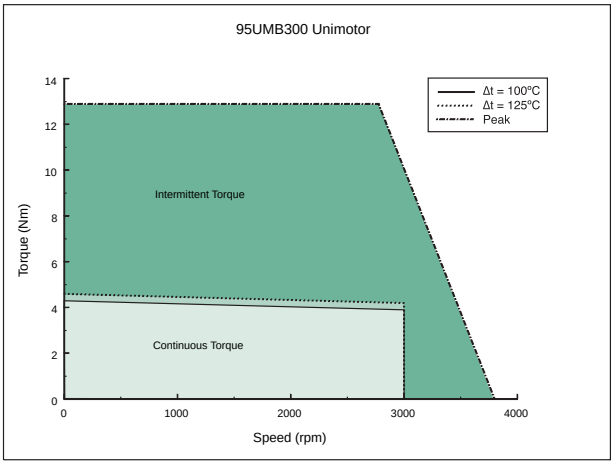
Each torque-speed graph depicts limits of operation for a given motor.

Limits of operation are shown for three categories; -

1. Continuous (or RMS)
2. Intermittent (short term)
3. Speed limit

Circumstances often require de-rating of motor or drive, see “Motor De-rating” and “Test conditions”

Figure 2-10 Typical Torque-Speed Curve



How to use Torque-Speed Graphs
(1) Continuous torque limit
(2) Peak torque limit
(3) Speed limit

Continuous or RMS Torque Limit (1)

Two levels of continuous operation are shown, one for encoder motors where the maximum permitted winding temperature rise Δt = 100ºC; and one for resolver motors where Δt = 125ºC.

RMS means Root Mean Square and gives the effective continuous torque compatible with repetitive torque sequences. (Most servo applications will have a repeatable sequence of events, e.g. accelerate, run, decelerate, and pause).

Continuous / RMS torque level must be in the area depicted Continuous Zone, otherwise the motor will exceed the Δt limit and may overheat.

Intermittent / Peak Torque Limit (2)

Above the Continuous zone is an Intermittent Zone where the motor may be safely operated for short periods of time. Operation within the Intermittent Zone is permissible provided that $\Delta t < 100$ºC or $\Delta t < 125$ºC, in accordance with the motor type rating.

Maximum peak torque is the upper limit of the Intermittent Zone and is given by :-

Peak Torque (max) = 3 x Stall Torque rating for Δt=100ºC

Nb Peak Torque (max) = 2.5 x Stall Torque rating for Δt=100ºC

Periods of a motor’s operating sequence may include frequent excursions into the Intermittent Zone. A very common reason for this is for fast acceleration and deceleration where torque levels approaching peak torque may be required.

Speed Limit (3)

To the right of the graph is a sloping line depicting the maximum motor speed for a 400V drive supply.

This speed limit line is dependent upon the motor winding; the winding current and frequency, and the voltage supply to the drive.

If, at 400V supply, the speed is increased beyond the limit shown, the motor sinusoidal waveform shall have insufficient voltage and will clip and distort, causing inefficiency and higher temperatures. If the distortion is increased further, the drive may loose control of the motor and trip.

For higher supply voltages, motor speed limit increases, and for lower supply voltages, motor speed limit decreases.

Caution: Because of the high voltages generated, motors should never be back-driven at speeds > rated speed +30% when either connected or disconnected.

Plotting an Operating Point

To estimate whether a motor is the correct choice for a given system, it is necessary to calculate or measure the RMS torque and the RMS speed for a given system in its normal continual stop/ start sequenced mode. This Operating Point may be marked on the torque-speed graph.

If RMS torque is below motor rated torque there will be no need to consider RMS speed.

If this point lies well within the Continuous Zone, then the motor is suitable for the application.

The permitted duration of the excursion into the intermittent area will upon the winding thermal time-constant of the motor and the immediate previous thermal history of events (i.e. the motor winding temperature at the beginning of the excursion). In certain circumstances the duration of the excursion can be many minutes because the winding thermal time-constant for larger motors may be quite long. The drive is equipped with suitable software to estimate the thermal effects of the motors activities, based on current and time. It is therefore important that the drive has the correct thermal time-constant value entered as a parameter.

When sizing a motor based upon load calculations for a system, it is advisable to allow for a contingency factor of at least 15%.

All motor performance data is subject to a tolerance of +/- 10%.

Motor De-rating

The performance data shown corresponds to 40ºC maximum ambient (surrounding air temperature) and the drive switching frequencies shown in table 2-5.

Motor type	Switching Frequency
75A to 190D	12kHz

Table 2-5 Switching Frequencies for Performance Data

Drive supply: 415V, 3 phase nominal.

The P.I.D. parameters are set so that the motor draws minimal current at no load. Differential Gain = 0. Proportional and Integral Gains are set for smooth running and minimised speed overshoot under fast acceleration.

Any worsening of the operating conditions means that the motor performance will require de-rating.

Such circumstances include:

- Lower switching frequency setting of the drive, (i.e.< 12khz for 75 – 190mm frame see table 2-7.
- ambient temperatures >40ºC
- confined space / restricted natural air flow
- inadequate thermal path for motor mounting
- motor mounted to a gearbox
- drive oversize for motor

- For de-rating data, see Table 2-7
- Most Unidrive nominal current ratings are reduced, for the higher switching frequencies, see Unidrive manuals for de-rating tables. As a consequence of this, there can be a cost optimisation for the choice of motor-drive match and the choice of switching frequency.

Conversely, lower temperatures or forced air-cooling can improve continuous ratings only (not peak torque).

If heating effects justify the Unidrive autimatically halves the switching frequency (from 6 or12 kHz) to protect the IGBTs. This will increase motor dissipation and allowance should be made if such circumstance is likely.

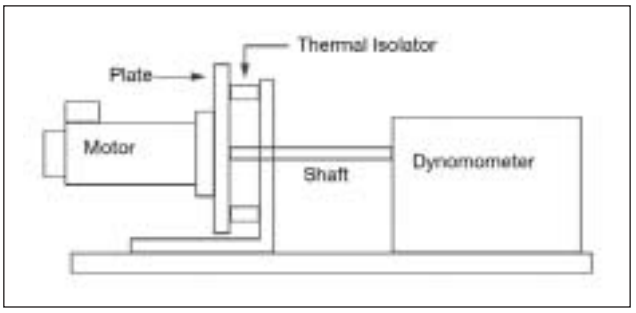
Thermal Test Conditions

The tests were carried at an ambient of 25ºC.

The motor under test mounted on a thermally isolated aluminium plate of dimensions as per Table 2-6 below.

Motor type	Aluminium Heatsink plate
75 – 95 mm	250 x 250 x 15 mm
115 – 142 mm	350 x 350 x 20 mm
190 mm	500 x 500 x 20 mm

Table 2-6 Aluminium Heatsink Sizes



Switching frequency de-rating for UM MOTORS with respect to performance tables.

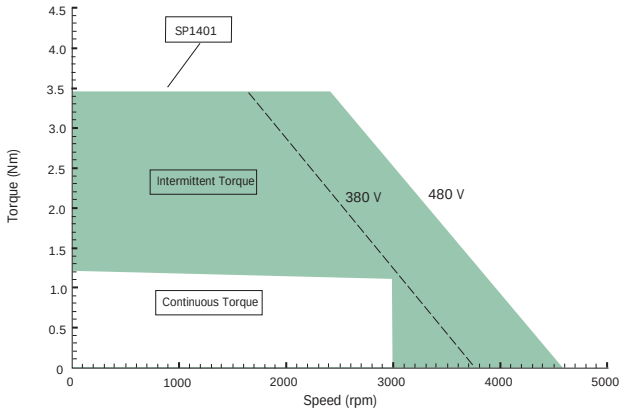
Motor	12 kHz	6 kHz	3 kHz
75A	1	0.98	0.96
75B	1	0.97	0.95
75C	1	0.96	0.94
75D	1	0.95	0.93
95A	1	0.98	0.95
95B	1	0.97	0.93
95C	1	0.96	0.91
95D	1	0.95	0.89
95E	1	0.93	0.88
115A	1	0.97	0.94
115B	1	0.95	0.91
115C	1	0.93	0.89
115D	1	0.92	0.86
115E	1	0.90	0.84
142A	1	0.98	0.96
142B	1	0.96	0.91
142C	1	0.94	0.87
142D	1	0.91	0.84
142E	1	0.89	0.81
190A	1	0.99	0.98
190B	1	0.98	0.95
190C	1	0.97	0.91
190D	1	0.94	0.85

Table 2-7 Motor De-rate factor for drive switching frequency

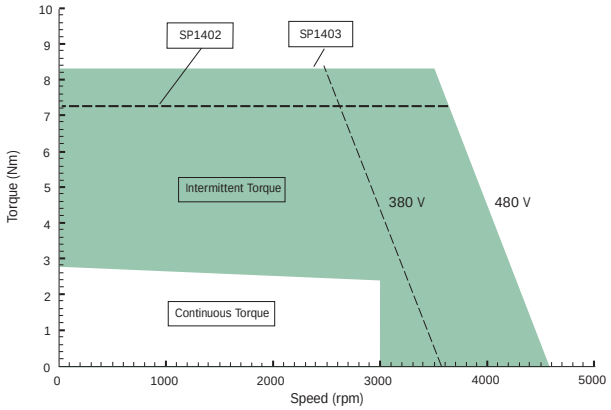
E.g For a 115 UMC with encoder feedback run at 6kHz
Stall torque = 10.5 x 0.93 = 9.77Nm
Rated torque = 9.2 x 0.93 = 8.56Nm

75/3000 RPM

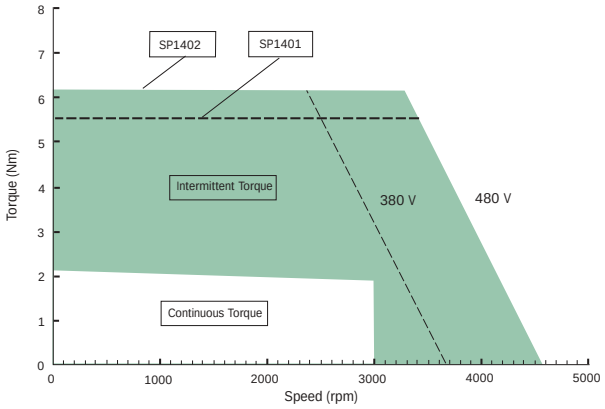
75UMA300 Unimotor



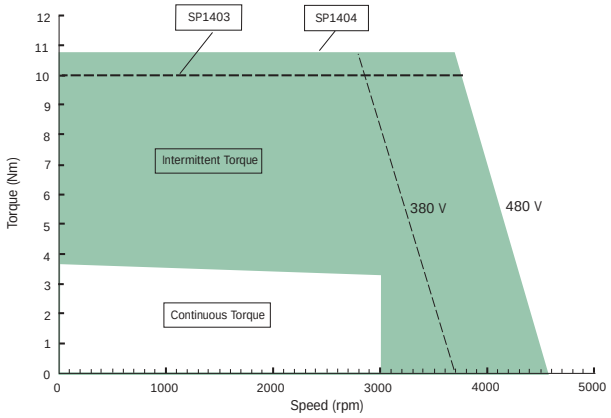
75UMC300 Unimotor



75UMB300 Unimotor



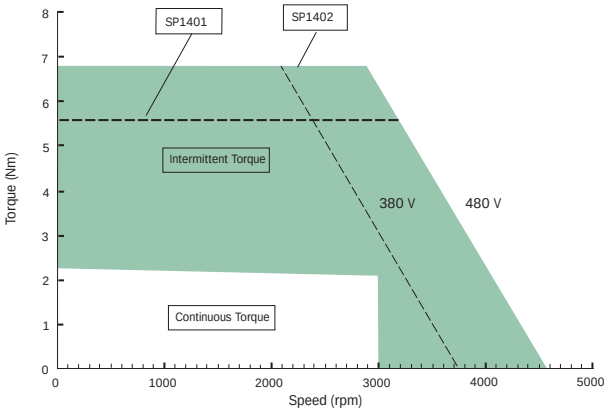
75UMD300 Unimotor



All graphs are at 40˚C ambient and 400Vac drive supply
How to use torque-speed graphs see figure 2-10.

95/3000 RPM

95UMA300 Unimotor



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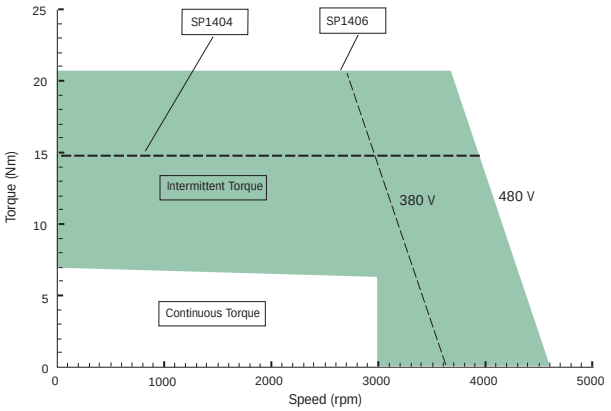

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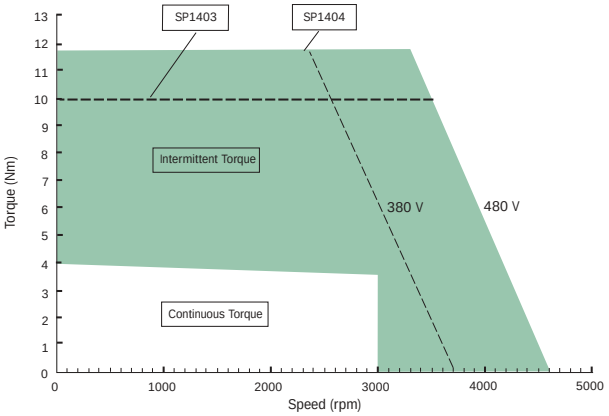
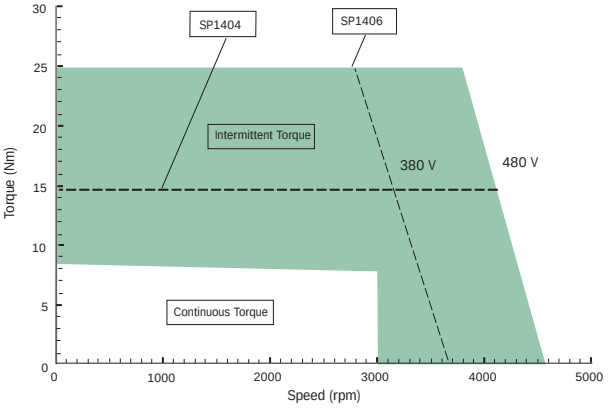
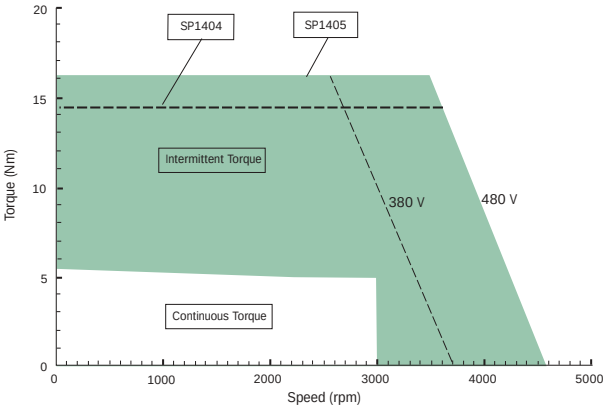


95UME300 Unimotor



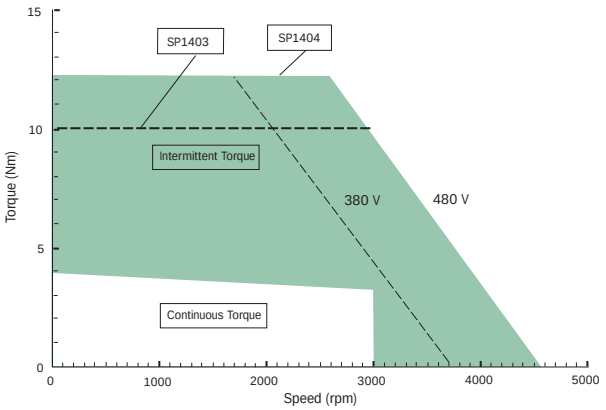
95UMC300 Unimotor



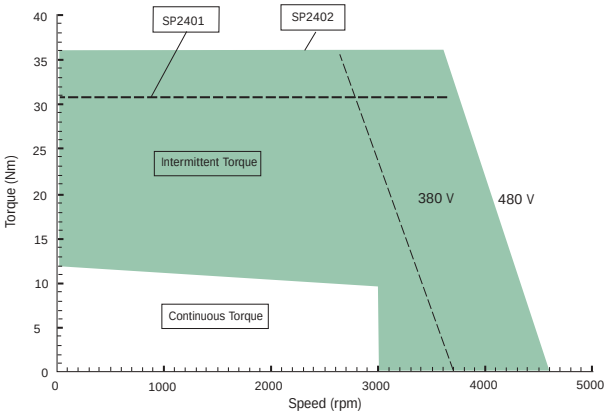
All graphs are at 40˚C ambient and 400Vac drive supply
How to use torque-speed graphs see figure 2-10.

115/3000 RPM

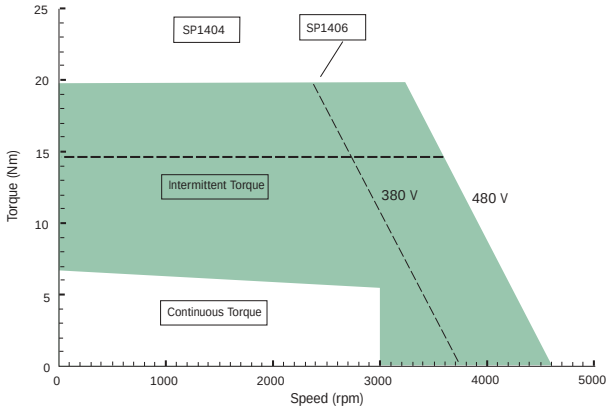
115UMA300 Unimotor



115UMD300 Unimotor



115UMB300 Unimotor



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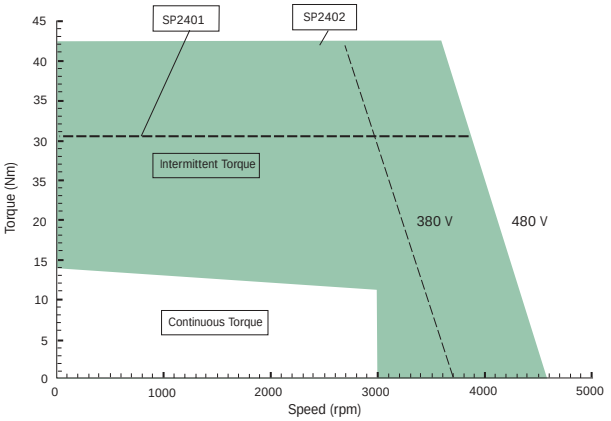

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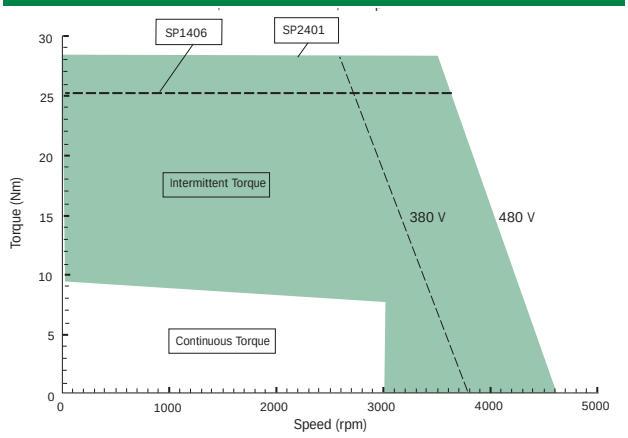
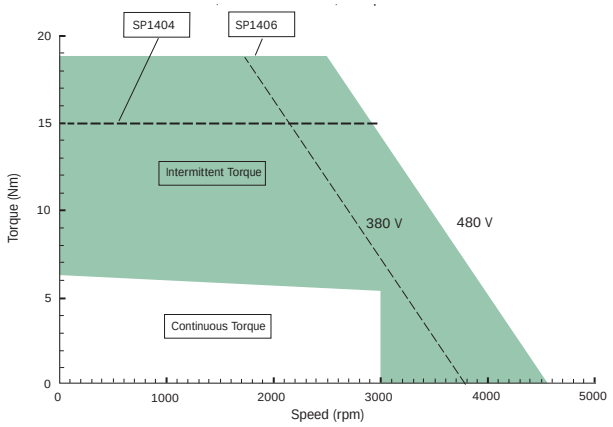


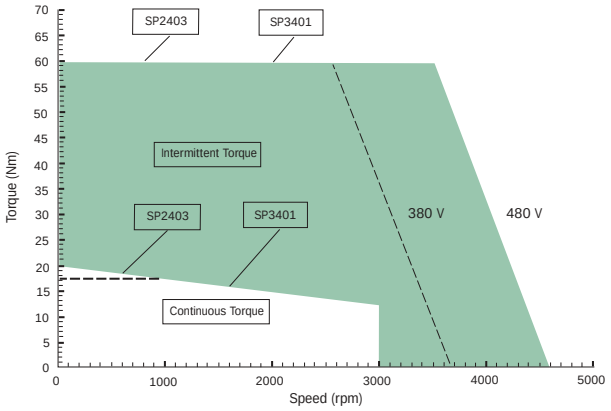
All graphs are at 40˚C ambient and 400Vac drive supply
How to use torque-speed graphs see figure 2-10.

142/3000 RPM

142UMA300 Unimotor



142UMD300 Unimotor



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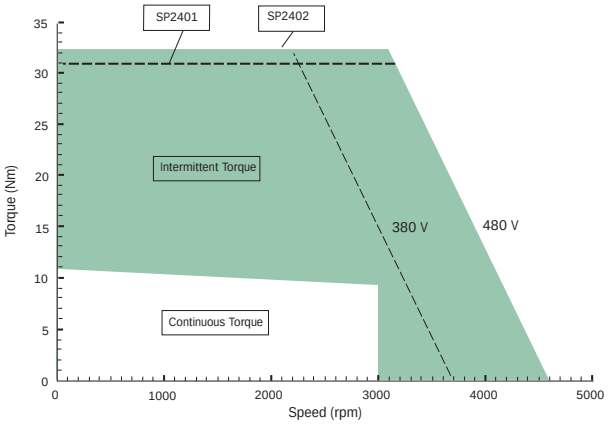

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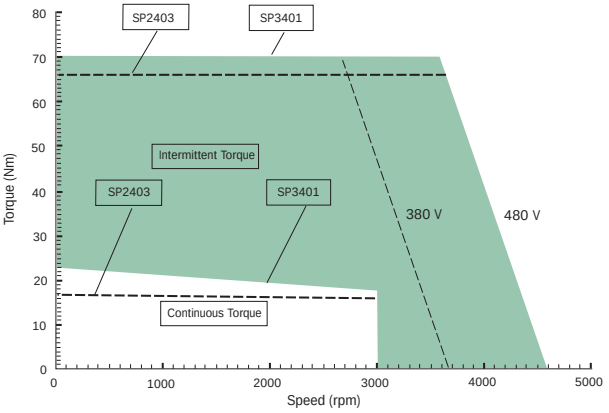
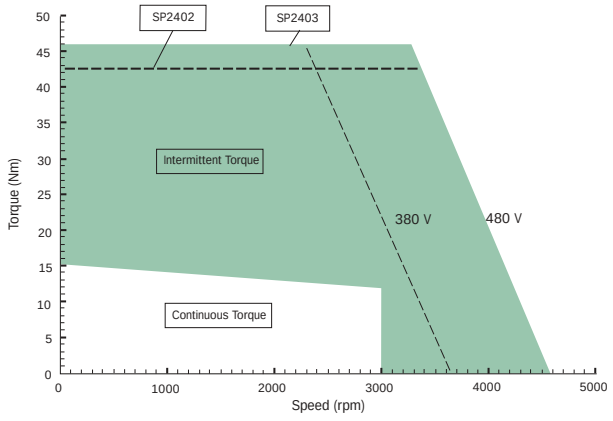


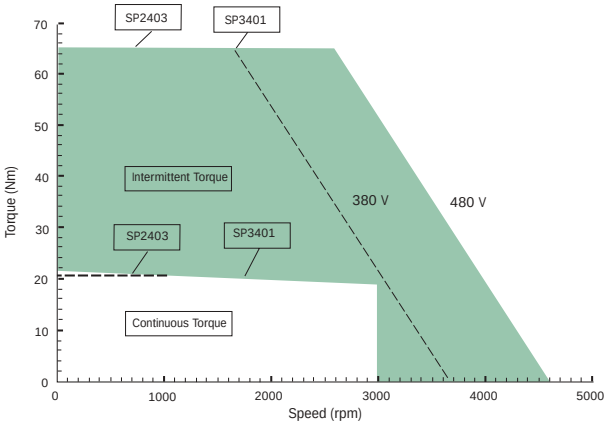
142UMC300 Unimotor



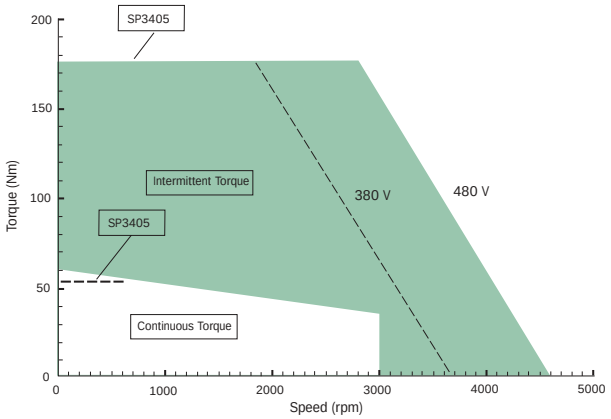
All graphs are at 40˚C ambient and 400Vac drive supply
How to use torque-speed graphs see figure 2-10.

190/3000 RPM

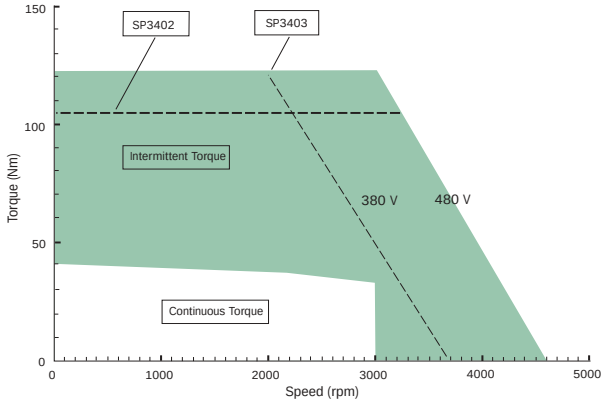
190UMA300 Unimotor



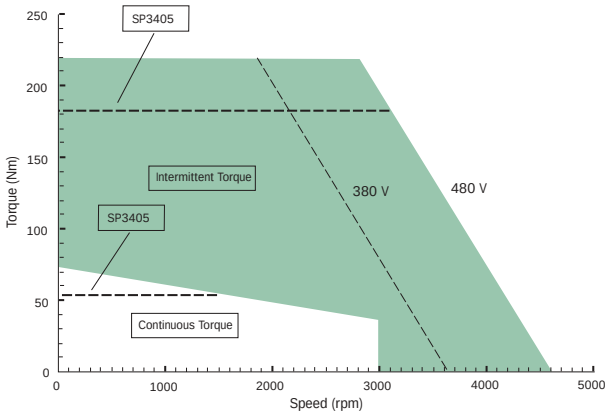
190UMC300 Unimotor



190UMB300 Unimotor



190UMD300 Unimotor



All graphs are at 40˚C ambient and 400Vac drive supply
How to use torque-speed graphs see figure 2-10.

3 Mechanical Features

This chapter describes how to use all mechanical features to install the drive. Key features of this chapter include:

- Through hole mounting
- IP54 as standard
- Enclosure sizing and layout
- Option module fitting
- Terminal location and torque settings

3.1 Removing Drive Terminal Covers

Unidrive SP size 1 is fitted with two terminal covers: Main and 48V/DC terminal covers.
Unidrive SP size 2 is fitted with three terminal covers: Main, 48V/DC, and DC terminal covers.

Unidrive SP size 3 is fitted with four terminal covers: Main, 48V/DC, DC and AC terminal covers.

When the drive is through-panel mounted the main and AC terminal covers for size 3, must be removed in order to provide access to the mounting holes. Once the drive has been mounted, the terminal cover can be replaced.

Figure 3-1 Location and removal of terminal covers

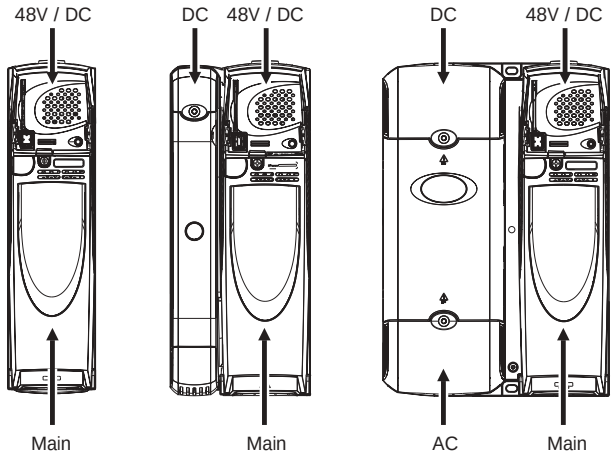


Figure 3-2 Removing the size 1 terminal covers

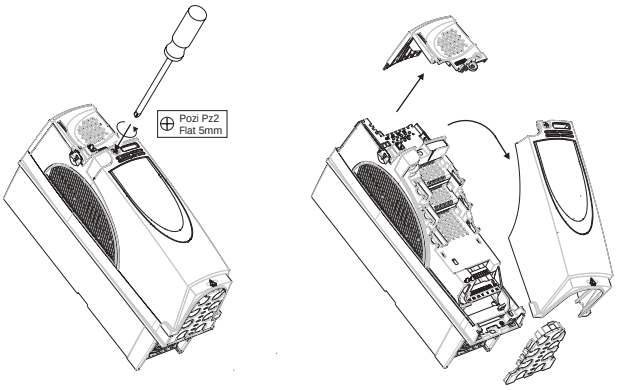


Figure 3-3 Removing the size 2 terminal covers

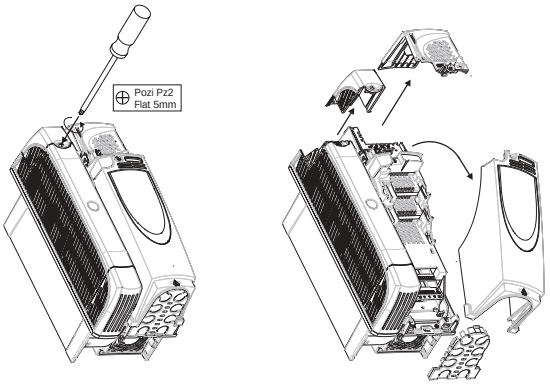
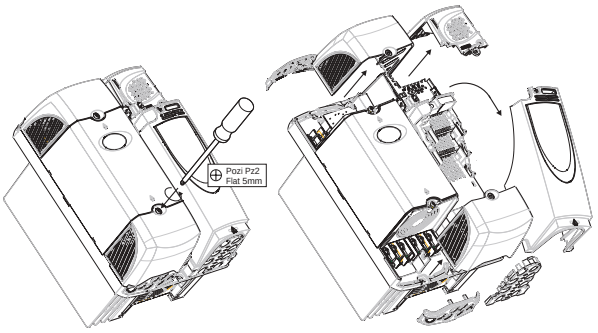


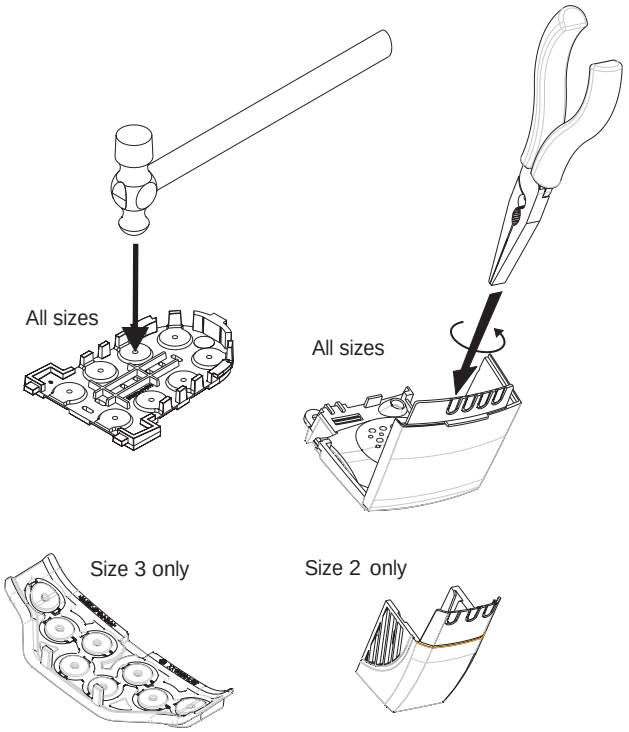
Figure 3-4 Removing the size 3 terminal covers



To remove a terminal cover, undo the screw and lift the terminal cover off as shown in the diagrams above. The main terminal cover must be removed first before the 48V/DC terminal cover can be removed.

REMOVING THE FINGER-GUARD AND DC TERMINAL COVER BREAK-OUTS

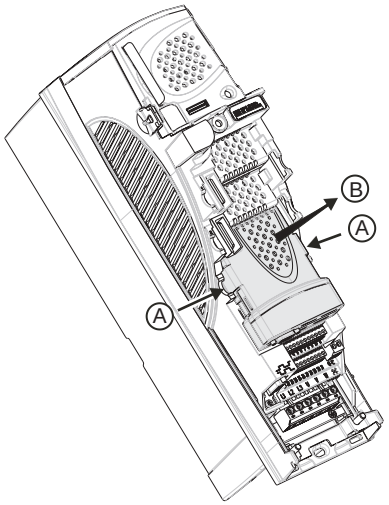
Figure 3-5 Removing the finger-guard and dc terminal cover break-outs



3.2 Keypad And Option Module Fitting / Removal

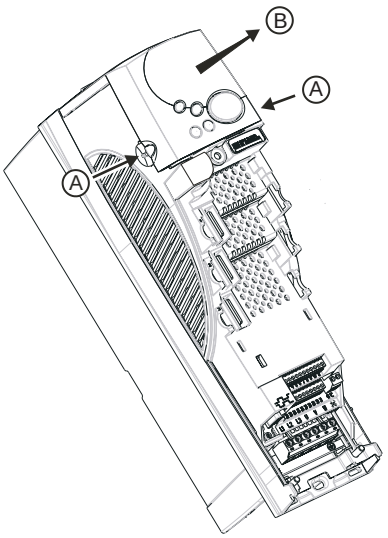
NOTE Power down the drive before fitting / removing the Modules. Failure to do so may result in damage to the product.

Figure 3-6 Fitting and removal of an option module



To fit, press down in the direction shown above until it clicks into place. The drive has the facility for all three universal option module slots to be used at the same time.

Figure 3-7 Fitting and removal of a keypad



To fit, align the keypad and press gently in the direction shown until it clicks into position. To remove, whilst pressing the tabs inwards (A), gently lift the keypad in the direction indicated (B).

NOTE Only the LED keypad can be fitted / removed whilst the drive is powered up and running a motor, providing that the drive is not operating in keypad mode.

3.3 Drive Dimensions & Mounting Methods

Unidrive SP can be either surface or through panel mounted using the appropriate brackets.
The following drawings show the dimensions of the drive and mounting holes for each method to allow a back plate to be prepared.

Figure 3-8 Surface mounting the size 1 drive

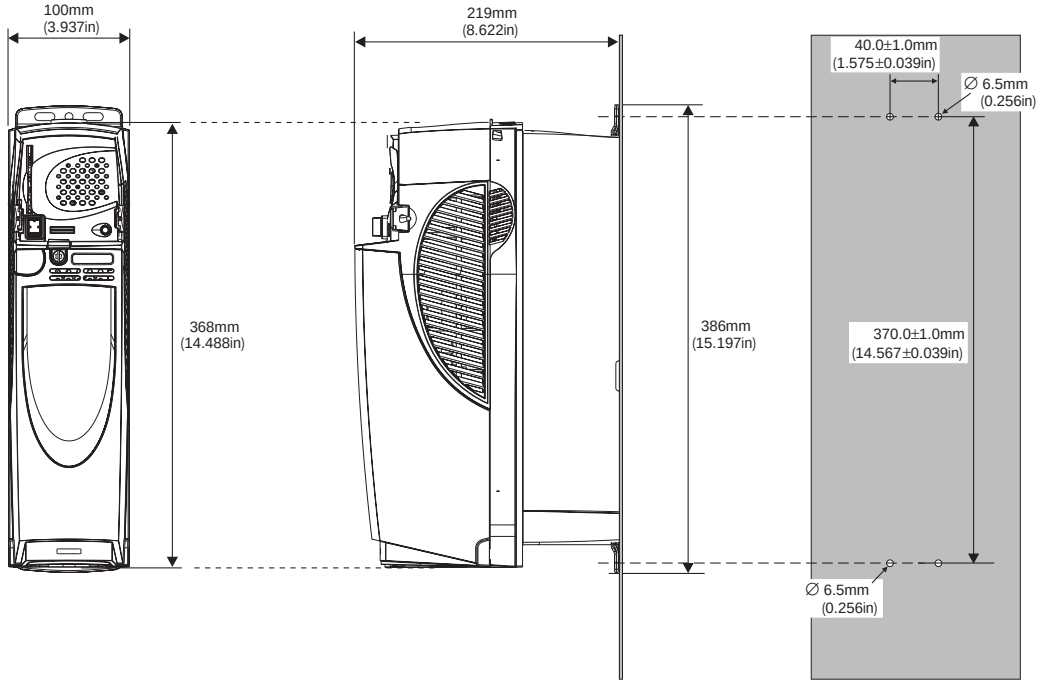


Figure 3-9 Surface mounting the size 2 drive

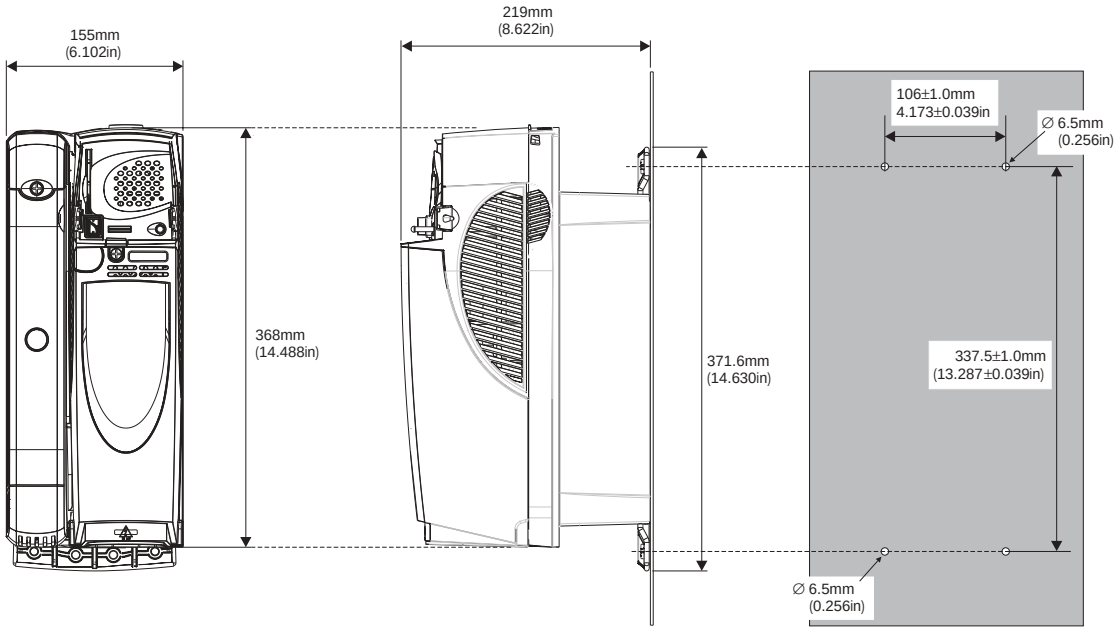


Figure 3-10 Surface mounting the size 3 drive

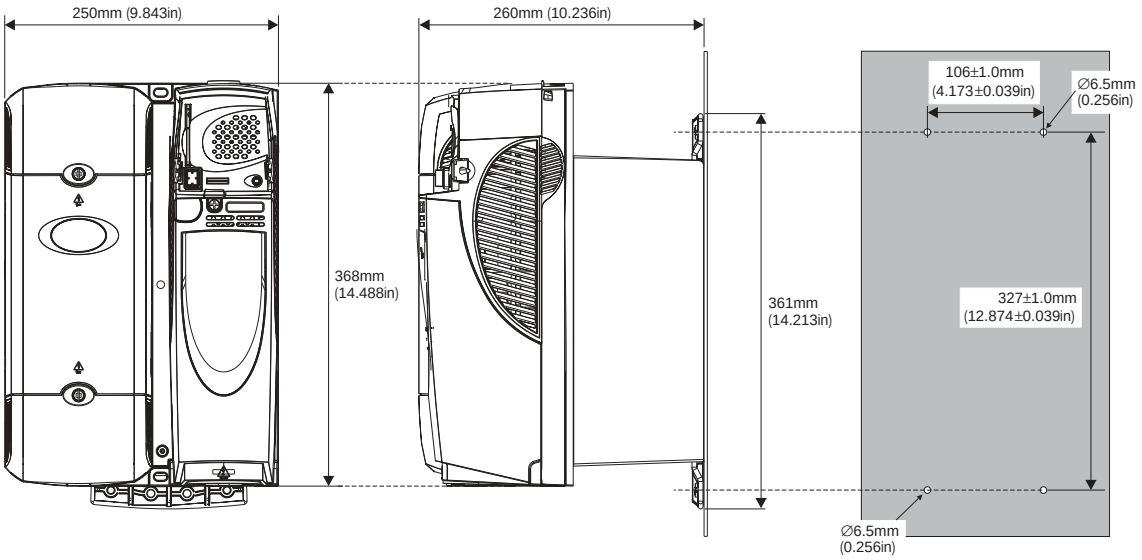
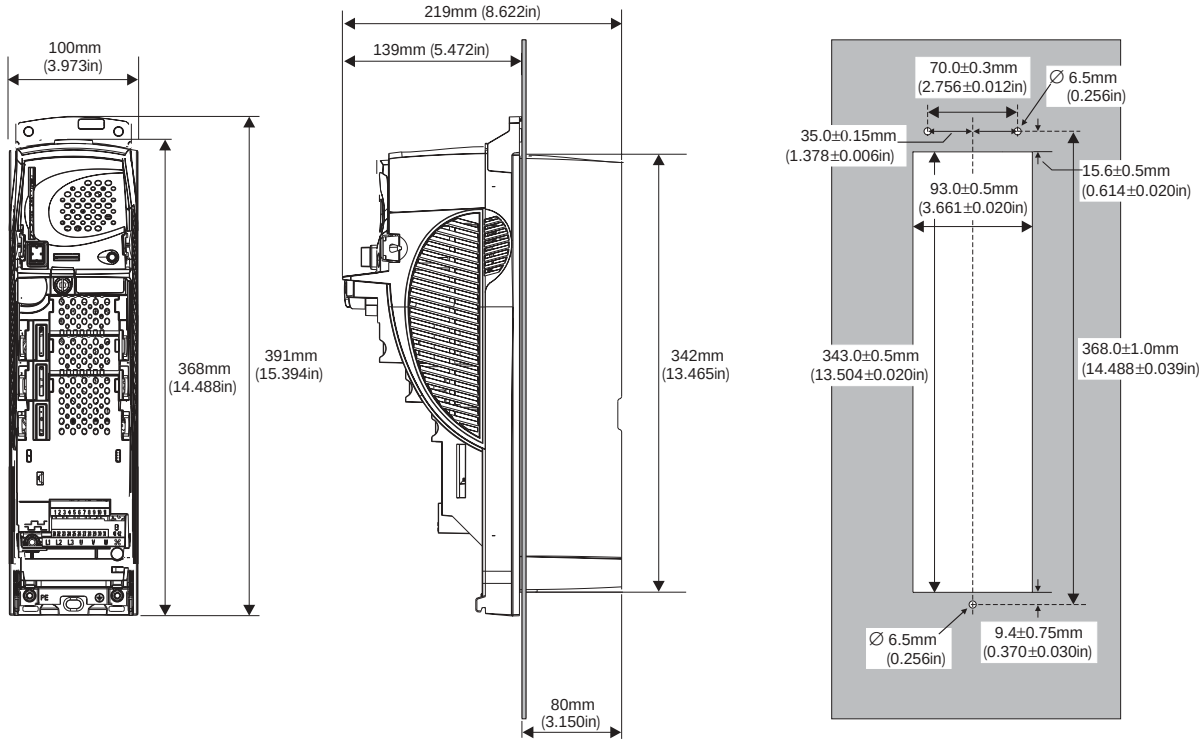


Figure 3-11 Through panel mounting the size 1 drive



Mechanical Features

Figure 3-12 Through panel mounting the size 2 drive

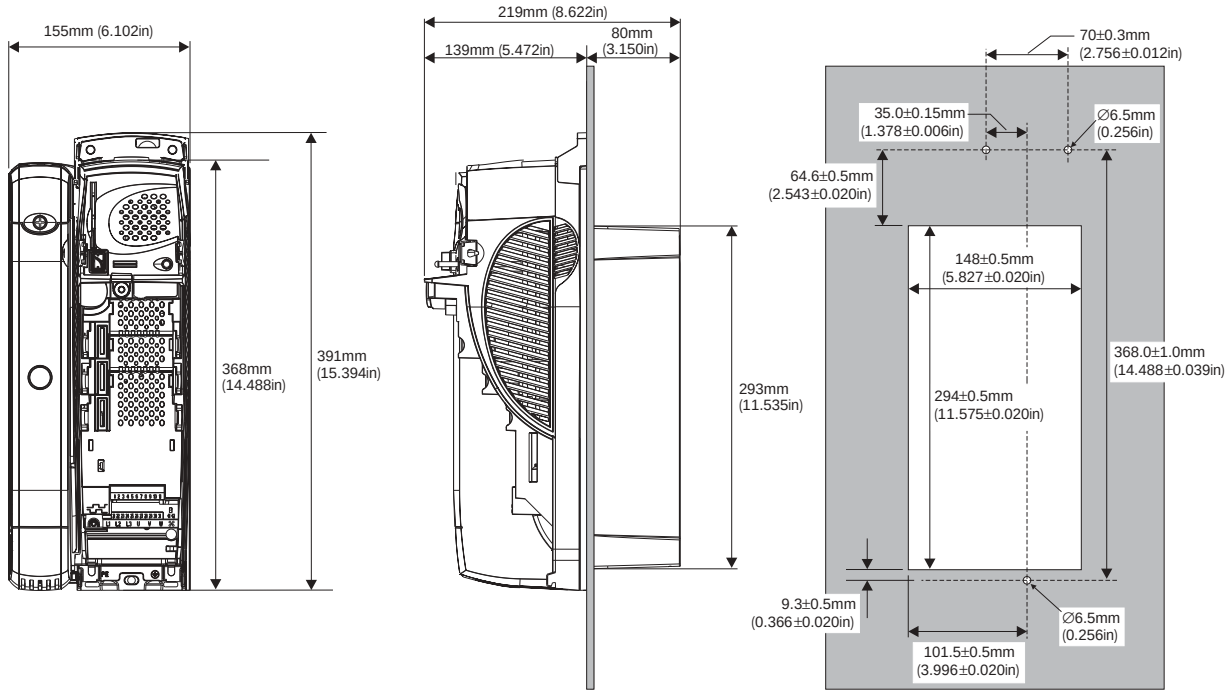
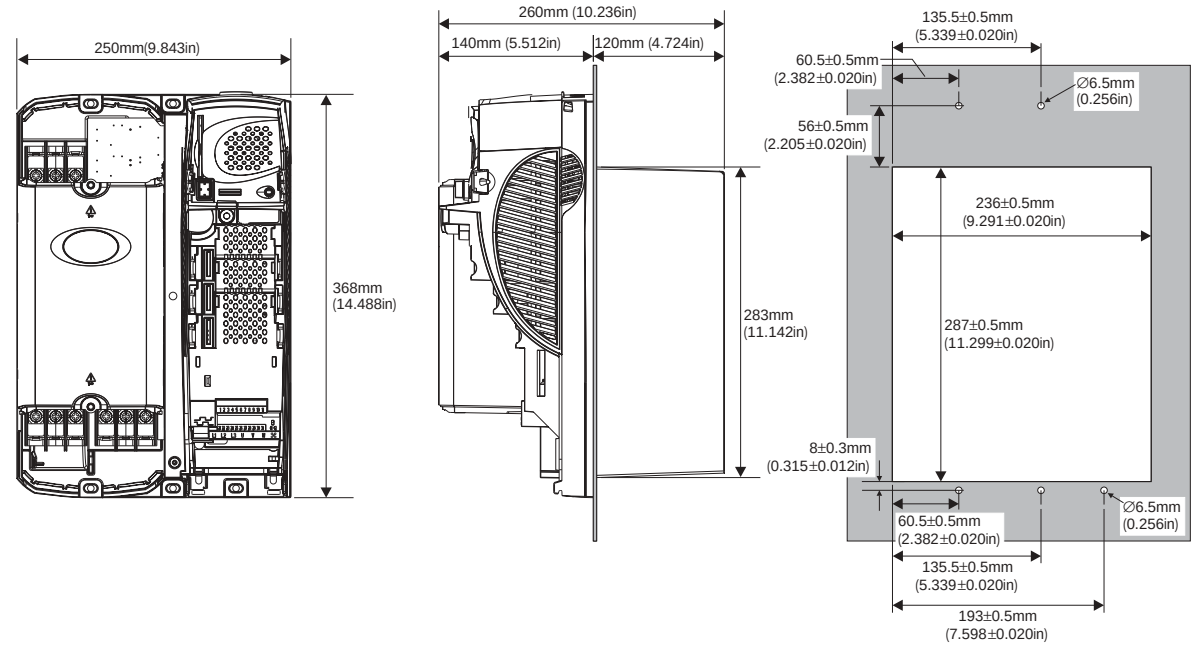
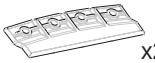
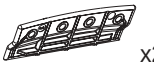


Figure 3-13 Through panel mounting the size 3 drive



NOTE: In order to achieve IP54 rating for through-panel mounting, the IP54 insert (supplied as standard) must be fitted. Additionally, the gasket provided should be fitted between the drive and the backplate to ensure a good seal for the cubicle. If the heatsink mounted braking resistor is to be used with the drive through-panel mounted, please refer to section 3.7 Heatsink braking resistor on page 21 prior to mounting the drive. For further information refer to section 3.5 IP rating.

Table 3-1 Mounting brckets

Model size	Surface	Through-panel	Hole size
1	 x2	 x1	6.5mm (0.256in)
2	 x2	 x1	6.5mm (0.256in)
3	 x2	x1	6.5mm (0.256in)

3.4 Motor Mechanical Dimensions

Figure 3-14 Outline Drawings - Frame Sizes 75 - 142

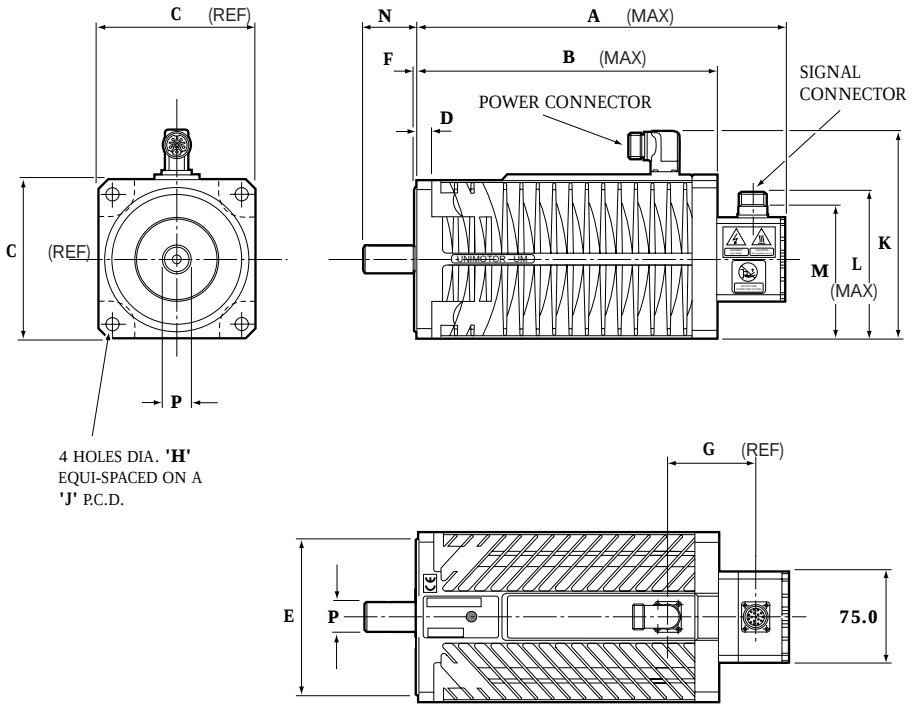


Table 3-2 Dimensions - Frame Sizes 75 - 142

FRAME SIZE	75				95					115					142				
Dimension / Length suffix	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
A Length Overall (Unbraked)	211	241	271	301	222	252	282	312	342	242	272	302	332	362	225	255	285	315	345
A Length Overall (Braked)	241	271	301	331	252	282	312	342	372	272	302	332	362	392	285	315	345	375	405
B Body Length (Unbraked)	146	176	206	236	157	187	217	247	277	177	207	237	267	297	160	190	220	250	280
B Body Length (Braked)	176	206	236	266	187	217	247	277	307	207	237	267	297	327	220	250	280	310	340
C Flange Square			75.0				95.0					115.0					142.0		
D Flange Thickness			7.0				9.0					11.0					12.3		
E Register Diameter			60.0 (J6)				80.0 (J6)					95.0 (J6)					130.0 (J6)		
F Register Length			2.4				2.9					2.9					3.4		
G Power to Connect C/L			61.0				62.5					66.0					80.0		
G_1 Front Flange to power C/L (Unbraked)	116	146	176	203	125	155	185	215	245	141	171	201	231	261	111	141	171	201	231
G_1 Front Flange to power C/L (Braked)	146	176	206	236	155	185	215	245	275	171	201	231	261	291	171	201	231	261	291
H Fixing Holes Diameter			5.8 (H14)				7.0 (H14)					10.0 (H14)					12.0 (H14)		
J Fixing Hole p.c.d.			75.0				100.0					115.0					165.0		
K Overall Height			126.0				146.0					166.0					193.0		
L Signal Connector Height (UM)			107.0				117.0					127.0					140.0		
M Signal Connector Height (SL)			88.0				98.0					108.0					121.0		
N Shaft Length (front)	23.0	30.0	30.0	30.0	30.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
P Shaft Diameter (front)	11.0	14.0	14.0	14.0	14.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Shaft Key Dimensions (option A)																			
R Key Length	14.0	22.0	22.0	22.0	22.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
S Key Height	12.4	15.9	15.9	15.9	15.9	21.4	21.4	21.4	21.4	21.4	21.4	21.4	26.9	26.9	26.9	26.9	26.9	26.9	26.9
T Key to Shaft End	3.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
V Key Width	4.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Figure 3-15 Outline Drawing - Frame Size 190

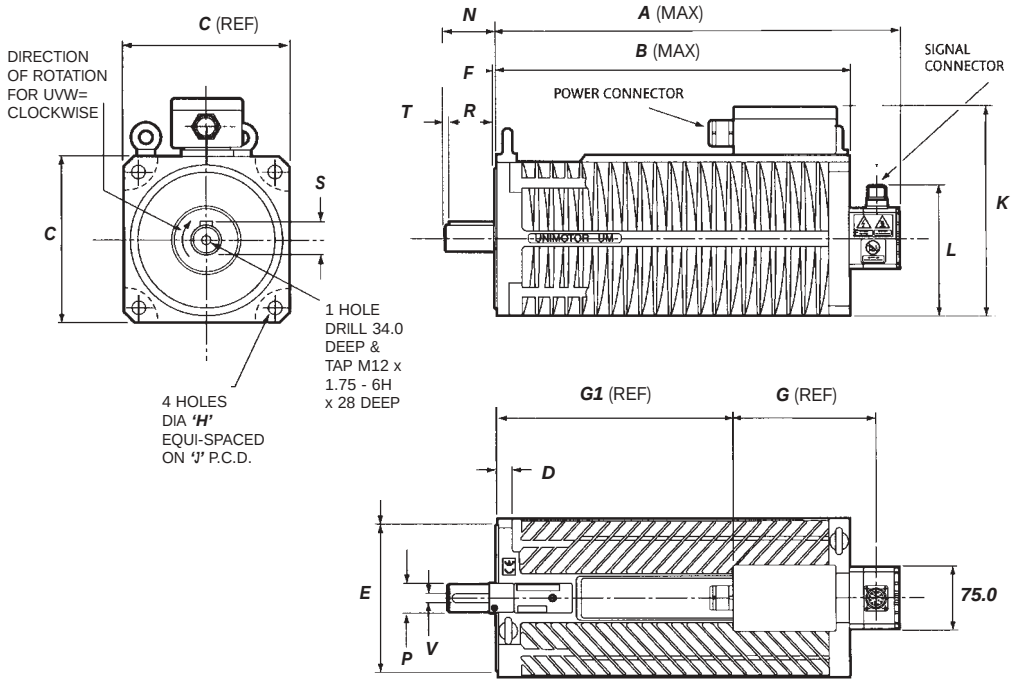


Table 3-3 Dimensions - Frame Size 190

Dimension / Length suffix		A	B	C	D
A	Length Overall (Unbraked)	273	327	381	435
A	Length Overall (Braked)	327	381	435	489
B	Body Length (Unbraked)	210	264	318	372
B	Body Length (Braked)	264	318	372	425
C	Flange Square	190.0			
D	Flange Thickness	14.5			
E	Register Diameter	180.0 (J6)			
F	Register Length	4.0			
G	Terminal Box to Power Connect C/L	173.0			
G_1	Terminal Box to Front Flange (Unbraked)	69	123	177	231
G_1	Terminal Box to Front Flange (Braked)	123	177	231	285
H	Fixing Holes Diameter	14.5 (H14)			
J	Fixing Hole p.c.d.	215.0			
K	Overall Height	256.0			
L	Signal Connector Height	161.1			
N	Shaft Length (front)	58.0			
P	Shaft Diameter (front)	32.0			
Shaft Output Key Dimensions (option A)					
R	Shaft Key Length	49.0			
S	Shaft Key Height	35.0			
T	Shaft Key to Shaft End	3.1			
V	Shaft Key Width	10.0			

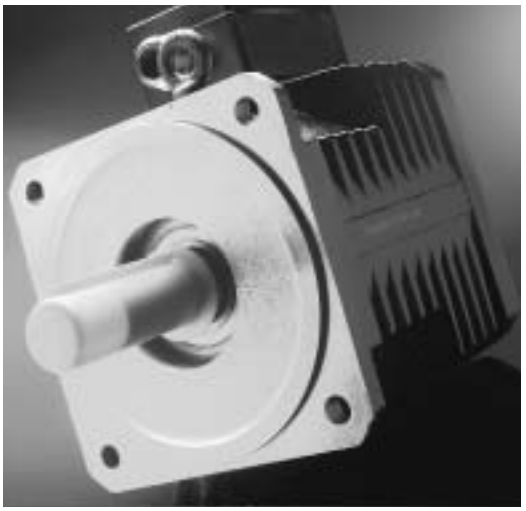


Figure 3-16 Outline Drawing - Frame Size 75 – 142 Hybrid Box

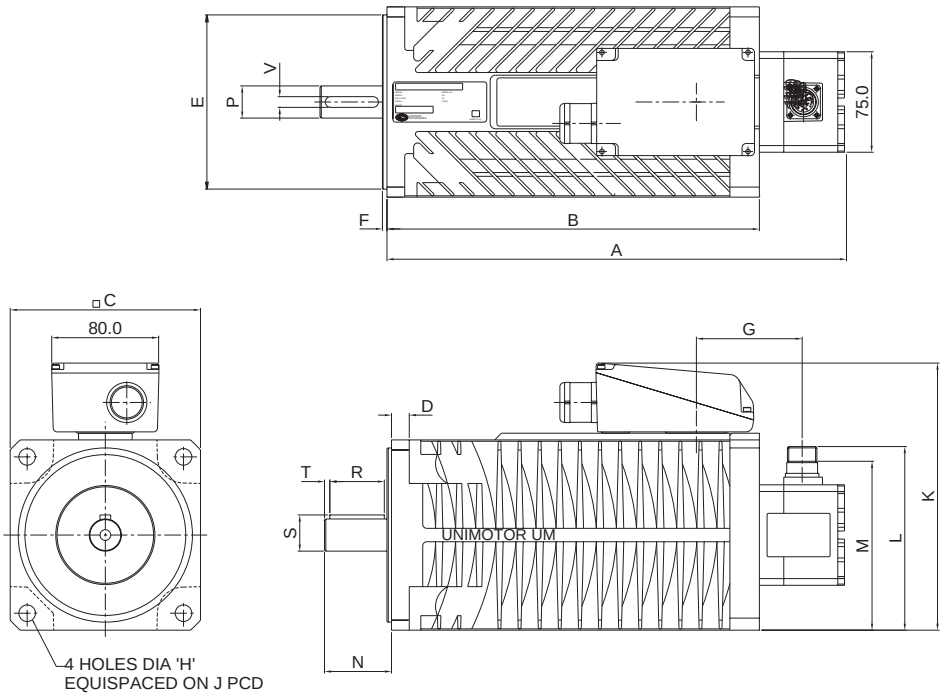


Figure 3-17 Outline Drawing - Frame Size 190 Hybrid Box

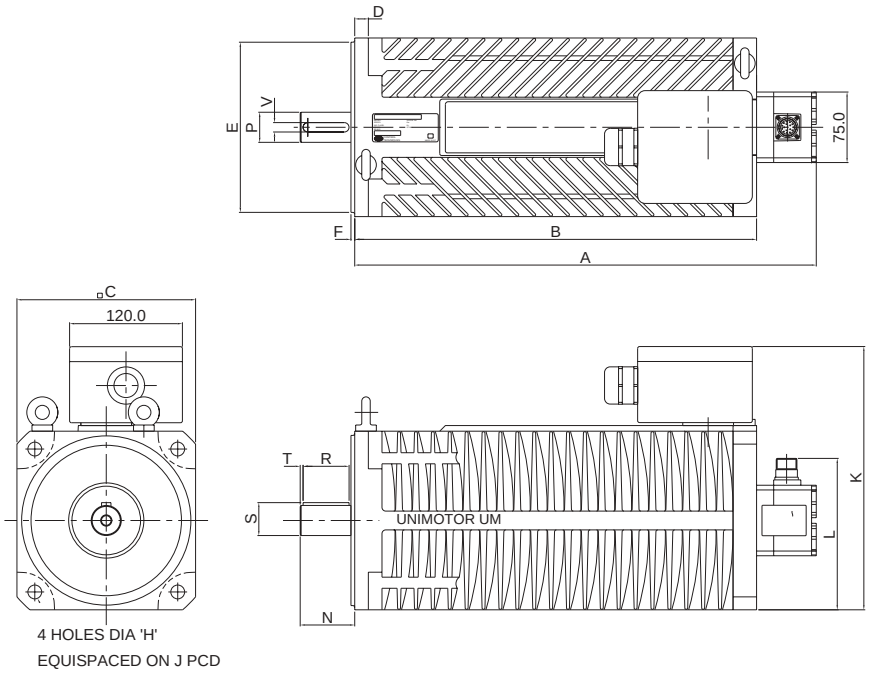


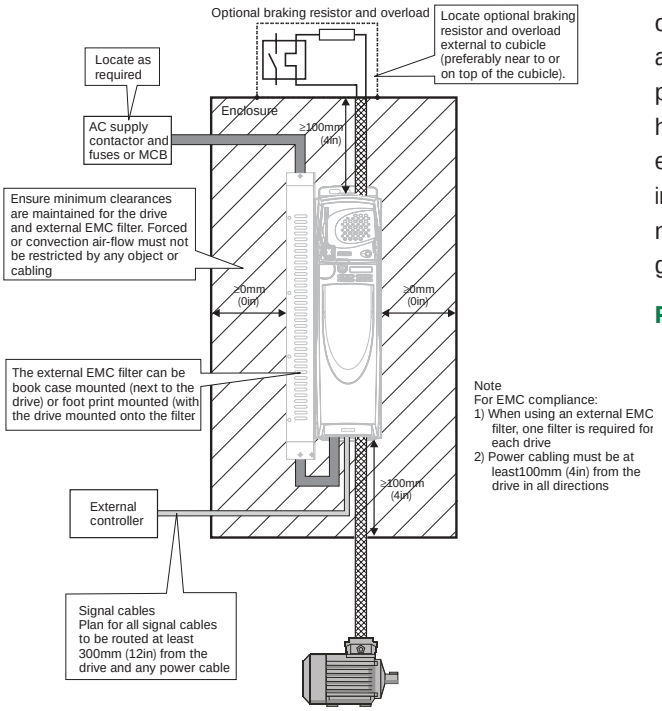
Table 3-4 All Dimensions as per page 1 with the exception of Dim 'K'

FRAME SIZE	75	95	115	142	190
Dim K	136.0	155.0	175.0	202.0	260.0

3.5 Drive Enclosure Layout

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

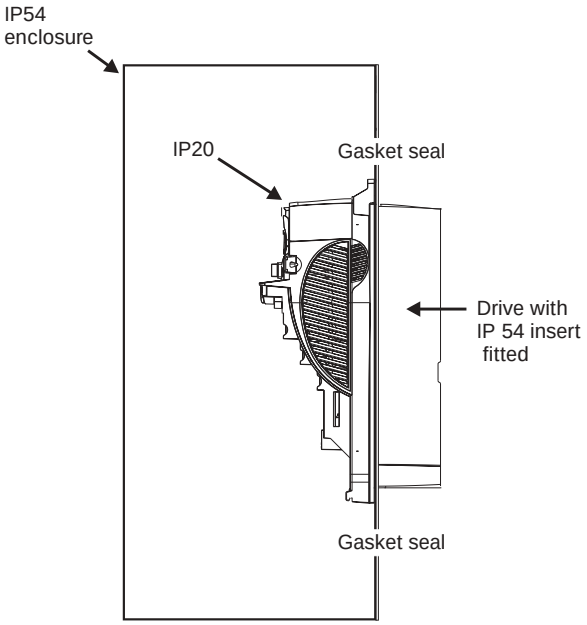
Figure 3-18 Enclosure layout



3.6 IP Rating (Ingress Protection)

The Unidrive SD is rated to IP20 pollution degree 2 (dry, non-conductive contamination only). However, it is possible, provided some current de-rating is applied, to configure the drive to achieve IP54 rating at the rear of the heatsink for through-panel mounting. This allows the front of the drive along with various switchgear to be housed in an IP54 enclosure with the heatsink protruding through the panel to the external environment. Thus, the majority of the heat generated by the drive is dissipated outside the enclosure maintaining a reduced ambient temperature inside the enclosure. This also relies on a good seal being made between the heatsink and the backplate using the gasket provided.

Figure 3-19 Example of IP Rating layout



In order to achieve the higher IP rating at the rear of the heatsink, it is necessary to seal a heatsink vent by fitting the IP54 insert.
Unimotor range is designed to IP65 as standard (excludes front shaft seal).

3.7 EMC Filters

An internal EMC filter is provided as standard with Unidrive SP. It is adequate for most industrial applications. It conforms to EN61800-3 (second environment) when motor cable length does not exceed 4 metres.

For installations where it is deemed necessary, Control Techniques provide a range of additional external EMC filters. These have all been assessed for conformance with the EMC directive, by testing to the appropriate international standards.

The EMC characteristics of the drive products make an important contribution to the compliance of end products and installations. All drive products have been subject to EMC testing in representative installations. EMC data sheets are available for Unidrive SP. These list the harmonised standards complied with and give recommended installation techniques and further information on EMC behaviour in typical situations.

The additional external EMC filters can be surface-mounted only. Mount the external EMC filter following the guidelines in the Unidrive SP User Guide.

Figure 3-20 Footprint mounting the external EMC filter

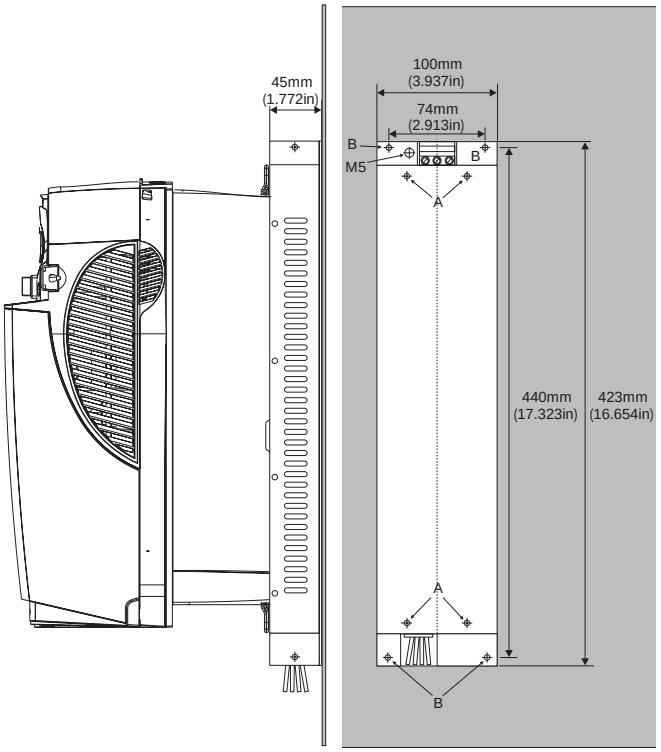
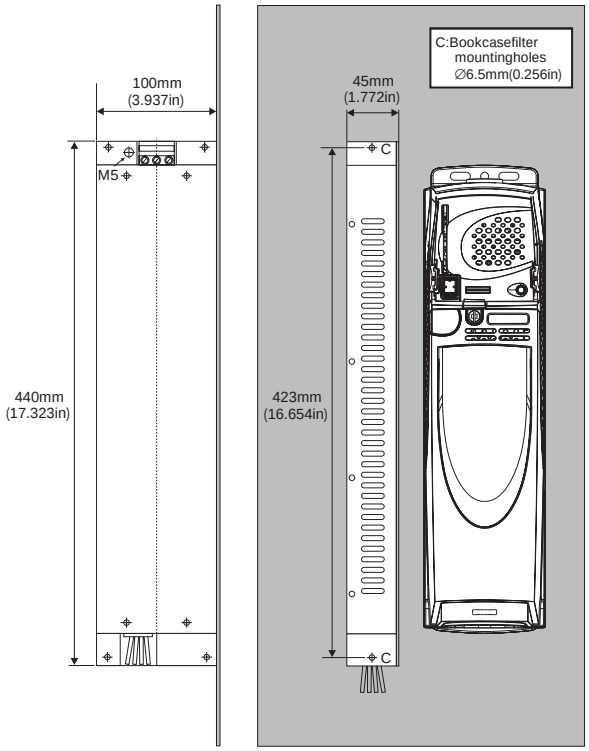


Figure 3-21 Bookcase mounting the EMC filter



3.8 Heatsink Mounted Braking Resistor

The Unidrive SP size 1 and 2 have been designed with an optional space-saving heatsink mounted resistor. The resistor is housed in an insulating cover in order to maintain the IP20 rating of the drive, and is located within the heatsink fins of the drive. When the heatsink mounted resistor is used, an external thermal protection device is not required as the resistor is designed such that it will fail safely under fault conditions.

When though-hole mounting the Unidrive SP, the heatsink mounted braking resistor conforms to the IP54 protection rating.

Figure 3-22 Fitting of the heatsink mounted braking resistor on size 1

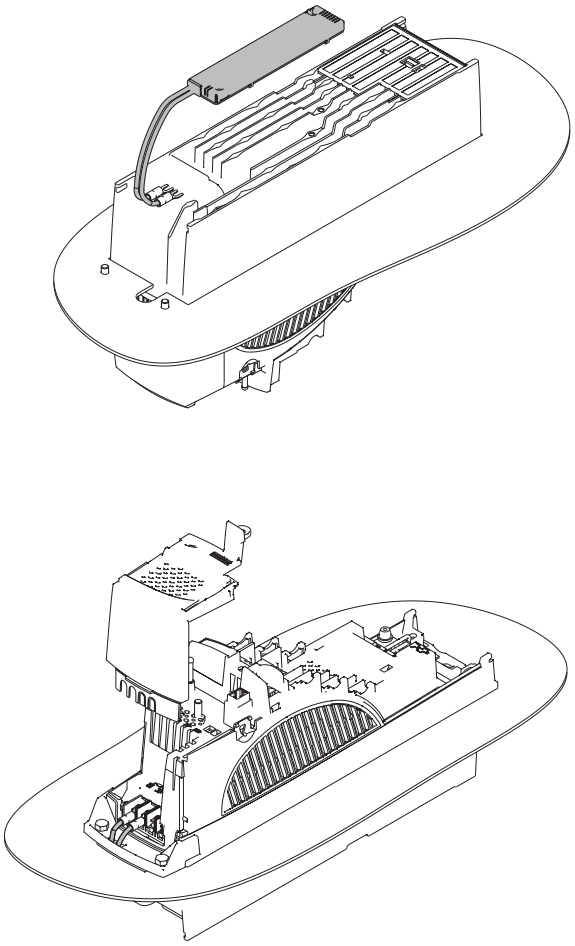
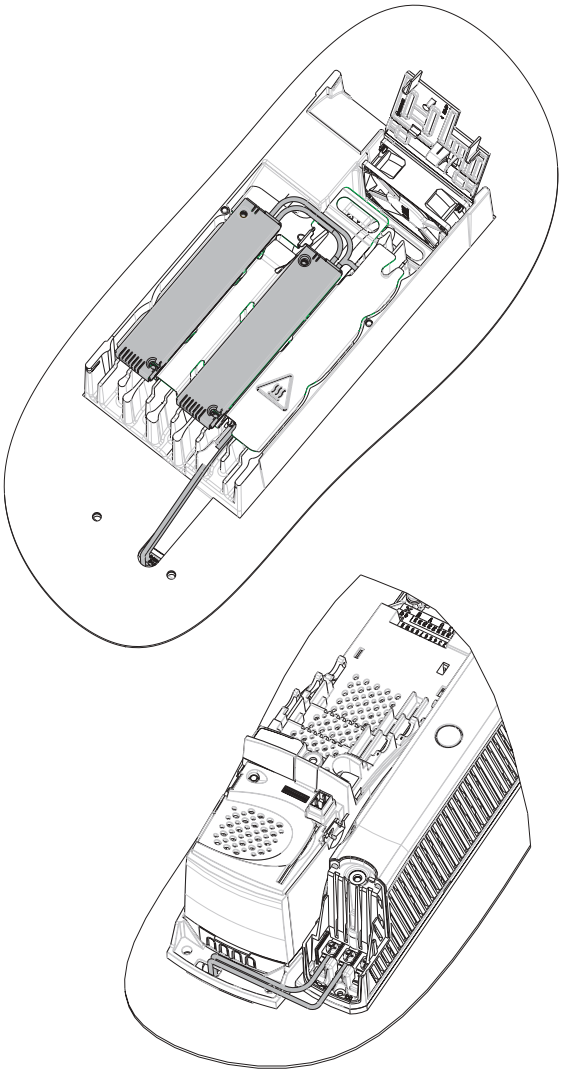


Figure 3-23 Fitting of the heatsink mounted braking resistors on size 2



4 Electrical Features

Many cable management features are now incorporated. Key features include:

- SECURE DISABLE function
- Internal EMC filter (for short and long cables)
- EMC compliance with shielding / grounding accessories
- Product rating, fusing and cabling information
- Brake resistor details (selection / ratings)

4.1 Power Connections

Figure 4-1 Unidrive SP size 1 power connections

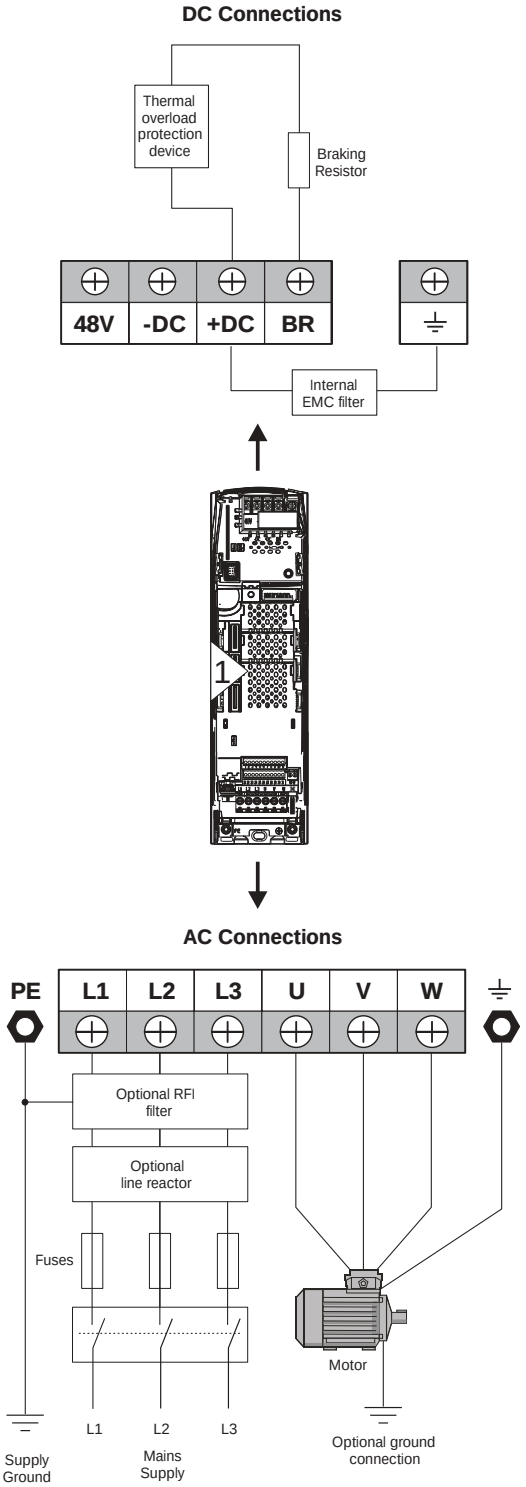


Figure 4-2 Unidrive SP size 2 power connections

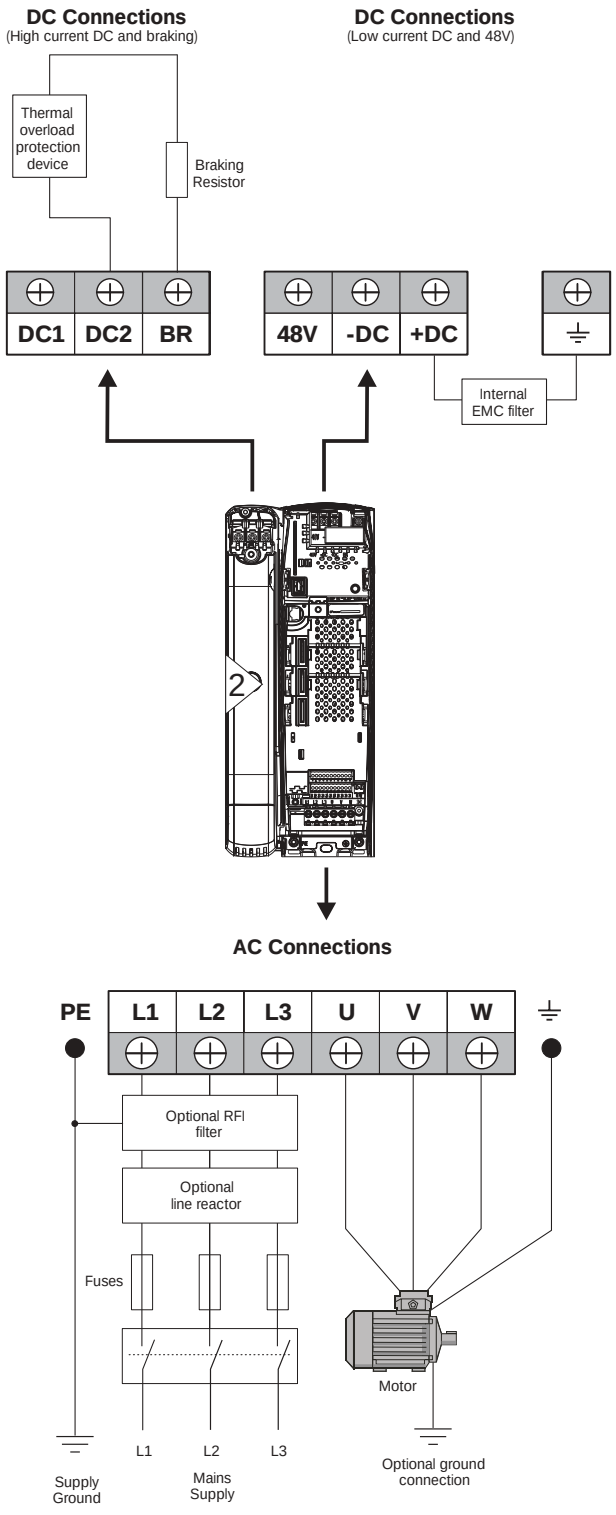
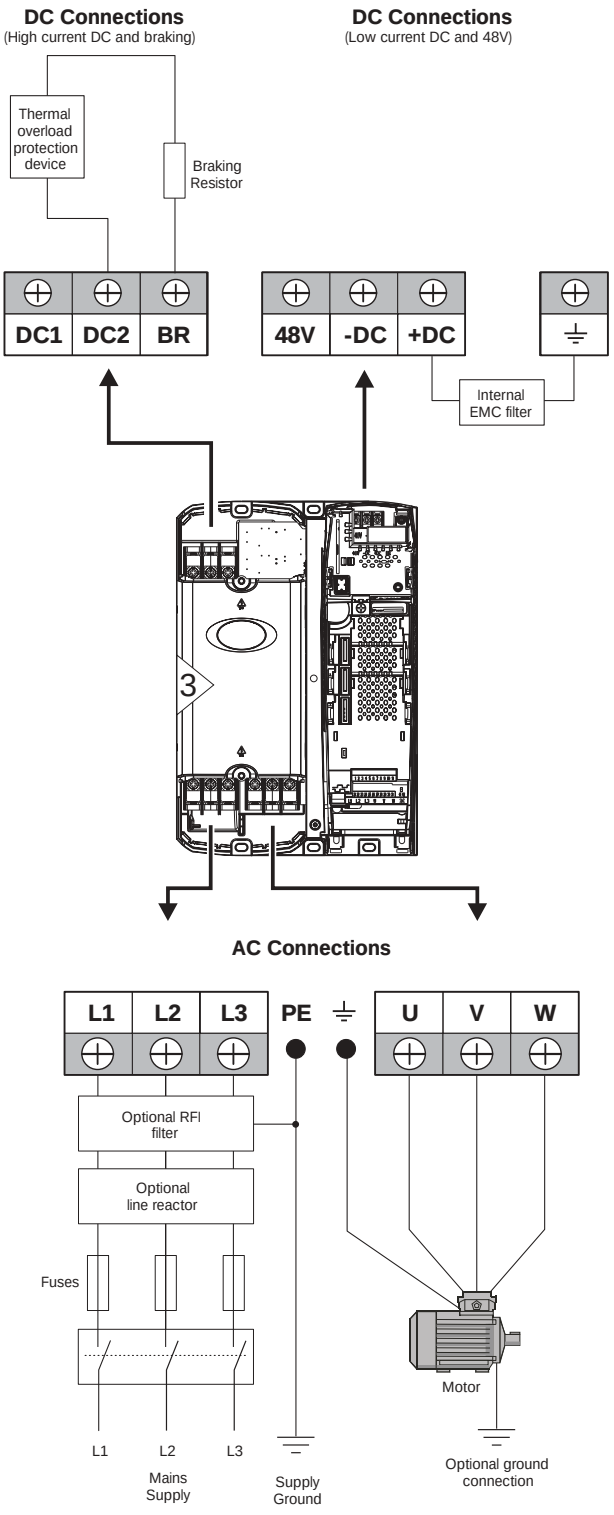


Figure 4-3 Unidrive SP size 3 power connections



4.2 AC Supply Range

- Voltage:
  SPX20X 200V to 240V ±10%
  SPX40X 380V to 480V ±10%
  SPX50X 500V to 575V ±10%
- Number of phases: 3
- Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases).
- Frequency range: 48 to 65 Hz
- Maximum supply fault current: 5kA

Supply types

Drives rated for supply voltage up to 575V are suitable for use with any supply type, i.e. TN-S, TN-C-S, TT, IT, with grounding at any potential, i.e. neutral, centre or corner ("grounded-delta").

For grounded-delta supplies exceeding 430V some special grounding requirements apply to fast data ports. Further information is given with the port descriptions.

NOTE When the Unidrive SP is used with ungrounded (IT) supplies, the internal EMC filter must be removed.

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.

4.3 Supplying The Drive With DC/DC Bus Parallelling

The drive may be supplied with DC instead of 3 phase AC. For further information please refer to the supplier of your drive.

The connecting of the DC bus between several drives is typically used to:

- Return energy from a drive which is being overhauled by the load to a second motoring drive.
- Allow the use of one braking resistor to dissipate regenerative energy from several drives.

There are limitations to the combinations of drives which can be used in this configuration. For application data, contact the supplier of the drive.

4.4 24V Back-up Power Supply Input

The 24Vdc input on the Unidrive SP has two main functions.

- It can be used to supplement the drives own internal 24V when multiple SM-Universal Encoder Plus, SM-Encoder Plus or SM-I/O Plus modules are being used and the current drawn by these modules are greater than the drive can supply. (If too much current is drawn from the drive, the drive will initiate a 'PS.24V' trip).
- It can be used as a back-up power supply to keep the control circuits of the drive powered up when the mains supply is removed. This allows fieldbus modules, application modules or encoders to continue to operate.

4.5 48V Back-up Power Supply Operation

The Unidrive SP can be operated from low voltage DC supplies, nominally 24Vdc and 48Vdc. The 48Vdc low voltage operating mode is designed to allow for motor operation in an emergency back-up situation following failure of the AC supply, for example in elevators, or to limit the speed of a servo motor during commissioning of equipment, for example a robot cell.

For application data, contact the supplier of the drive.

4.6 Ratings

Table 4-1 Input current, fuse and cable size ratings (European)

Model	Typical input current A	Maximum continuous input current A	Fuse rating IEC gG A	Cable size EN60204	
				Input mm^2	Output mm^2
SP1201	7.1	9.5	10	1.5	1
SP1202	9.2	11.3	12	1.5	1
SP1203	12.5	16.4	20	4	1
SP1204	15.4	19.1	20	4	1.5
SP2201	13.4	18.1	20	4	2.5
SP2202	18.2	22.6	25	4	4
SP2203	24.2	28.3	32	6	6
SP3201	35.4	43.1	50	16	16
SP3202	46.8	54.3	63	25	25
SP1401	4.1	4.8	6	1	1
SP1402	5.1	5.8	6	1	1
SP1403	6.8	7.4	8	1	1
SP1404	9.3	10.6	12	1.5	1
SP1405	10	11	12	1.5	1
SP1406	12.6	13.4	16	2.5	1.5
SP2401	15.7	17	20	4	2.5
SP2402	20.2	21.4	25	4	4
SP2403	26.6	27.6	32	6	6
SP3401	34.2	36.2	40	10	10
SP3402	40.2	42.7	50	16	16
SP3403	51.3	53.5	63	25	25
SP3501	5	6.7	8	1	1
SP3502	6	8.2	10	1	1
SP3503	7.8	11.1	12	1.5	1
SP3504	9.9	14.4	16	2.5	1.5
SP3505	13.8	18.1	20	4	2.5
SP3506	18.2	22.2	25	4	4
SP3507	22.2	26	32	6	6

Table 4-2 Input current, fuse and cable size ratings (USA)

Model	Typical input current A	Maximum continuous input current A	Fuse rating A	Cable size UL508C	
				Input AWG	Output AWG
SP1201	7.1	9.5	10	14	18
SP1202	9.2	11.3	15	14	16
SP1203	12.5	16.4	20	12	14
SP1204	15.4	19.1	20	12	14
SP2201	13.4	18.1	20	12	14
SP2202	18.2	22.6	25	10	10
SP2203	24.2	28.3	30	8	8
SP3201	35.4	43.1	45	6	6
SP3202	46.8	54.3	60	4	4
SP1401	4.1	4.8	6	18	22
SP1402	5.1	5.8	6	16	20
SP1403	6.8	7.4	10	16	18
SP1404	9.3	10.6	15	14	16
SP1405	10	11	15	14	14
SP1406	12.6	13.4	15	14	14
SP2401	15.7	17	20	12	14
SP2402	20.2	21.4	25	10	10
SP2403	26.6	27.6	30	8	8
SP3401	34.2	36.2	40	6	6
SP3402	40.2	42.7	45	6	6
SP3403	51.3	53.5	60	4	4
SP3501	5	6.7	10	16	18
SP3502	6	8.2	10	16	16
SP3503	7.8	11.1	15	14	14
SP3504	9.9	14.4	15	14	14
SP3505	13.8	18.1	20	12	14
SP3506	18.2	22.2	25	10	10
SP3507	22.2	26	30	8	8

The recommended cable sizes above are only a guide. Refer to local wiring regulations for the correct size of cables. In some cases a larger cable is required to avoid excessive voltage drop.

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

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

An MCB (miniature circuit breaker) or MCCB (moulded case circuit breaker) with type C tripping characteristics and the same rating as the fuse(s), may be used in place of the fuse(s), on condition that the fault current clearing capacity is sufficient for the installation.

Fuse Types

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

- Europe: Type gG HRC industrial fuses to IEC60269 (BS88)
- USA: Class CC fuses

4.7 Output Circuit And Motor Protection

The output circuit has fast-acting electronic short-circuit protection which limits the fault current to typically no more than five times the rated output current, and interrupts the current in about 20µs. No additional short-circuit protection devices are required.

The drive provides overload protection for the motor and its cable. For this to be effective, the motor rated current must be set to suit the motor. There is also provision for the use of a motor thermistor to prevent over-heating of the motor, e.g. due to loss of cooling.

Cable types and lengths

Since capacitance in the motor cable causes loading on the output of the drive, ensure the cable length does not exceed the values given in Table 4-3, Table 4-4 and Table 4-5.

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

- AC supply to external EMC filter (when used)
- AC supply (or external EMC filter) to drive
- Drivetomotor
- Drive to braking resistor

Table 4-3 Maximum motor cable lengths (200V drives)

<table>
<tr><th colspan="7">200V Nominal AC supply voltage</th></tr>
<tr><th rowspan="2">Model</th><th colspan="6">Maximum permissible motor cable length for each of the following frequencies</th></tr>
<tr><th>3kHz</th><th>4kHz</th><th>6kHz</th><th>8kHz</th><th>12kHz</th><th>16kHz</th></tr>
<tr><td>SP1201</td><td colspan="3">65m (210ft)</td><td rowspan="10">75m (245ft)</td><td rowspan="10">50m (165ft)</td><td rowspan="9">37m (120ft)</td></tr>
<tr><td>SP1202</td><td colspan="3">100m (330ft)</td></tr>
<tr><td>SP1203</td><td colspan="2">130m (425ft)</td><td rowspan="9">100m (330ft)</td></tr>
<tr><td>SP1204</td><td rowspan="7">200m (660ft)</td><td rowspan="7">150m (490ft)</td></tr>
<tr><td>SP2201</td></tr>
<tr><td>SP2202</td></tr>
<tr><td>SP2203</td></tr>
<tr><td>SP3201</td><td rowspan="2"></td></tr>
<tr><td>SP3202</td></tr>
</table>

Table 4-4 Maximum motor cable lengths (400V drives)

<table>
<tr><th colspan="7">400V Nominal AC supply voltage</th></tr>
<tr><th rowspan="2">Model</th><th colspan="6">Maximum permissible motor cable length for each of the following frequencies</th></tr>
<tr><th>3kHz</th><th>4kHz</th><th>6kHz</th><th>8kHz</th><th>12kHz</th><th>16kHz</th></tr>
<tr><td>SP1401</td><td colspan="3">65m (210ft)</td><td rowspan="12">75m (245ft)</td><td rowspan="12">50m (165ft)</td><td rowspan="11">37m (120ft)</td></tr>
<tr><td>SP1402</td><td colspan="3">100m (330ft)</td></tr>
<tr><td>SP1403</td><td colspan="2">130m (425ft)</td><td rowspan="11">100m (330ft)</td></tr>
<tr><td>SP1404</td><td rowspan="9">200m (660ft)</td><td rowspan="9">150m (490ft)</td></tr>
<tr><td>SP1405</td></tr>
<tr><td>SP1406</td></tr>
<tr><td>SP2401</td></tr>
<tr><td>SP2402</td></tr>
<tr><td>SP2403</td></tr>
<tr><td>SP3401</td><td rowspan="3"></td></tr>
<tr><td>SP3402</td></tr>
<tr><td>SP3403</td></tr>
</table>

Table 4-5 Maximum motor cable lengths (575V drives)

575V Nominal AC supply voltage						
Model	Maximum permissible motor cable length for each of the following frequencies					
	3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
SP3501	200m (660ft)	150m (490ft)	100m (330ft)	75m (245ft)	50m (165ft)	
SP3502						
SP3503						
SP3504						
SP3505						
SP3506						
SP3507						

- Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.
- The default switching frequency is 3kHz.

The maximum cable length is reduced from that shown in Table 4-3, Table 4-4 and Table 4-5 if high capacitance motor cables are used.

4.8 Braking

Braking occurs when the drive is decelerating the motor, or is preventing the motor from gaining speed due to mechanical influences. During braking, energy is returned to the drive by the motor.

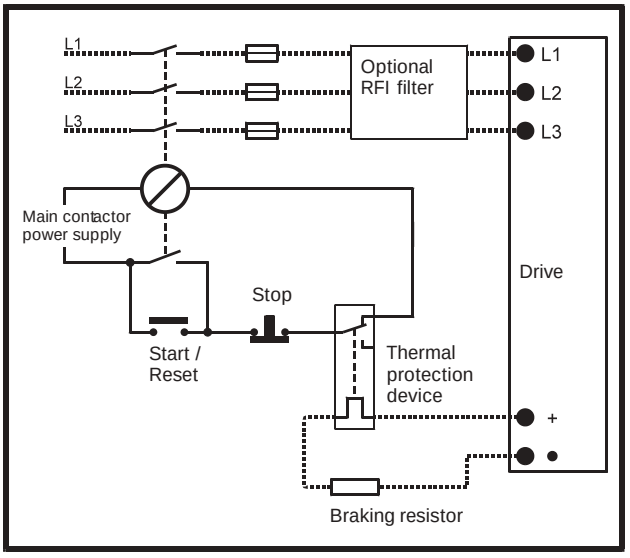
When the motor is being braked by the drive, the maximum regenerated power that the drive can absorb is equal to the power dissipation (losses) of the drive.
When the regenerated power is likely to exceed these losses, the DC bus voltage of the drive increases. Under default conditions, the drive brakes the motor under PI control, which extends the deceleration time as necessary in order to prevent the DC bus voltage from rising above a user defined set-point.

If the drive is expected to rapidly decelerate a load, or to hold back an overhauling load, a braking resistor must be fitted.

Thermal protection circuit for the braking resistor

The thermal protection circuit must disconnect the AC supply from the drive if the resistor becomes overloaded due to a fault. Figure 4-6 shows a typical circuit arrangement.

Figure 4-6 Typical protection circuit for a braking resistor



Minimum resistances and power ratings

Table 4-6 Minimum resistance values and peak power rating for the braking resistor at 40ºC

Model	Minimum Resistance Ω	Instantaneous Power Rating kW
SP1201 to SP1203	40	3.8
SP1204	27	5.6
SP2201	15	10
SP2202		
SP2203		
SP3201		
SP3202		
SP1401 to SP1404	75	8.1
SP1405 to SP1406	53	11.4
SP2401	30	20
SP2402		
SP2403		
SP3401		
SP3402		
SP3403		
SP3501		
SP3502		
SP3503		
SP3504		
SP3505		
SP3506		
SP3507		

(104ºF)

*Resistor tolerance: -0%

4.9 Heatsink Mounted Braking Resistor

A resistor has been especially designed to be mounted within the heatsink of Unidrive SP (sizes 1 and 2). The design of the resistor is such that no thermal protection circuit is required, as the device will fail safely under fault conditions. On Unidrive SP sizes 1 and 2, the in built software overload protection is set up at default for the designated heatsink mounted resistor. Table 4-7 provides the resistor data for each drive rating.

Table 4-7 Heatsink mounted braking resistor data

Parameter	Size 1	Size 2
DC resistance at 25ºC	75Ω	37.5Ω
Peak instantaneous power over 1ms at nominal resistance	8kW	16kW
Average power over 60 sec.	100W	200W

4.10 EMC (Electro-Magnetic Compatibility)

An internal EMC filter is provided as standard with Unidrive SP. It is adequate for most industrial applications. It conforms to EN61800-3 (second environment) when motor cable length does not exceed 4 metres.

The requirements for EMC are divided into three levels in the following three sections:

General requirements for all applications, to ensure reliable operation of the drive and minimise the risk of disturbing nearby equipment. The immunity standards specified in the technical Section will be met, but no specific emission standards. Note also the special requirements given in Surge immunity of control circuits - long cables and connections outside a building for increased surge immunity of control circuits where control wiring is extended.

Requirements for meeting the EMC standard for power drive systems, IEC61800-3 (EN61800-3).

Requirements for meeting the generic emission standards for the industrial environment, IEC61000-6-4, EN61000-6-4, EN50081-2.

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

Figure 4-7 Fitting of grounding clamp & bracket

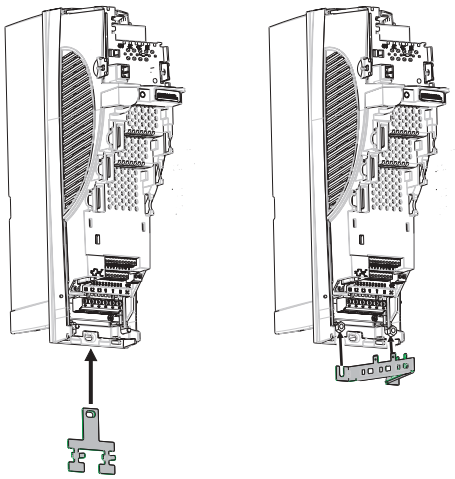
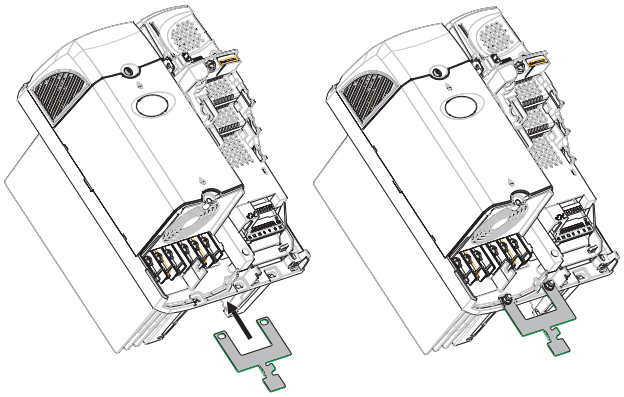


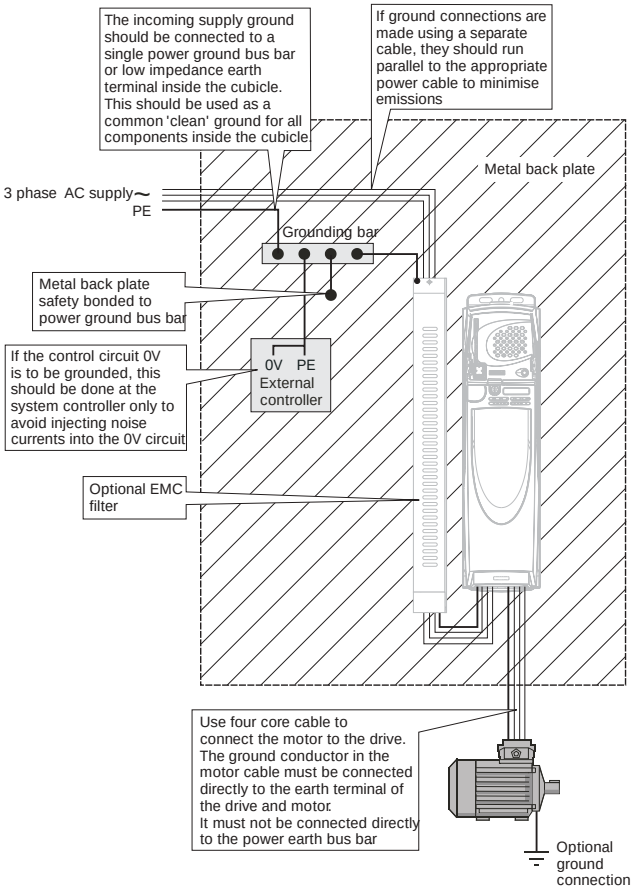
Figure 4-8 Fitting of grounding clamp (size 3)



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

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

Figure 4-9 General EMC enclosure layout showing earth / ground connections



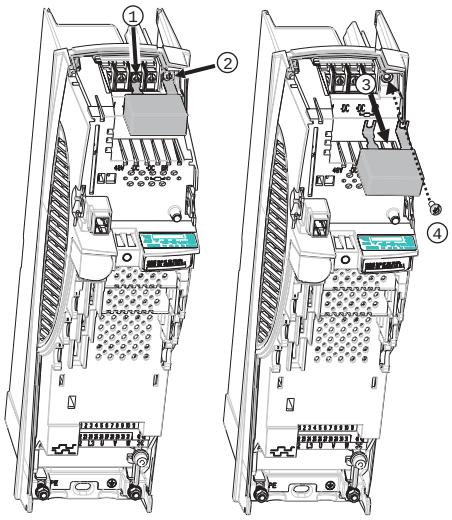
4.11 Internal EMC Filter

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

If the drive is used on an IT supply or part of a regen system then the internal EMC filter must be removed.

The internal EMC filter reduces radio-frequency emission into the mains supply. Where the motor cable in 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 motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the earth leakage current of 28mA is unacceptable or the above conditions are true. See Figure 4-10 for details of removing and fitting the internal EMC filter.

Figure 4-10 Removal of internal EMC filter



4.12 Control Connections

Table 4-8 The Unidrive SP control connections consist of:

Function	Qty	Programmability	Terminals
Differential analog input	1	Destination, offset, offset trim,invert, scaling	5,6
Single ended analog input	2	Mode, offset, scaling, invert, destination	7,8
Analog output	2	Source, mode, scaling,	9,10
Digital input	3	Destination, invert, logic select	27,28,29
Digital input / output	3	Input / output mode select, destination / source, invert logic select	24,25,26
Relay	1	Source, invert	41,42
Drive enable (Secure Disable)	1		31
+10V User output	1		4
+24V User output	1	Source, source invert	22
0V common	6		1, 3, 11, 21, 23, 30
+24V External input	1		2

Destination parameter - indicates the parameter which is being controlled by the terminal

Source parameter - indicates the parameter being output by the terminal

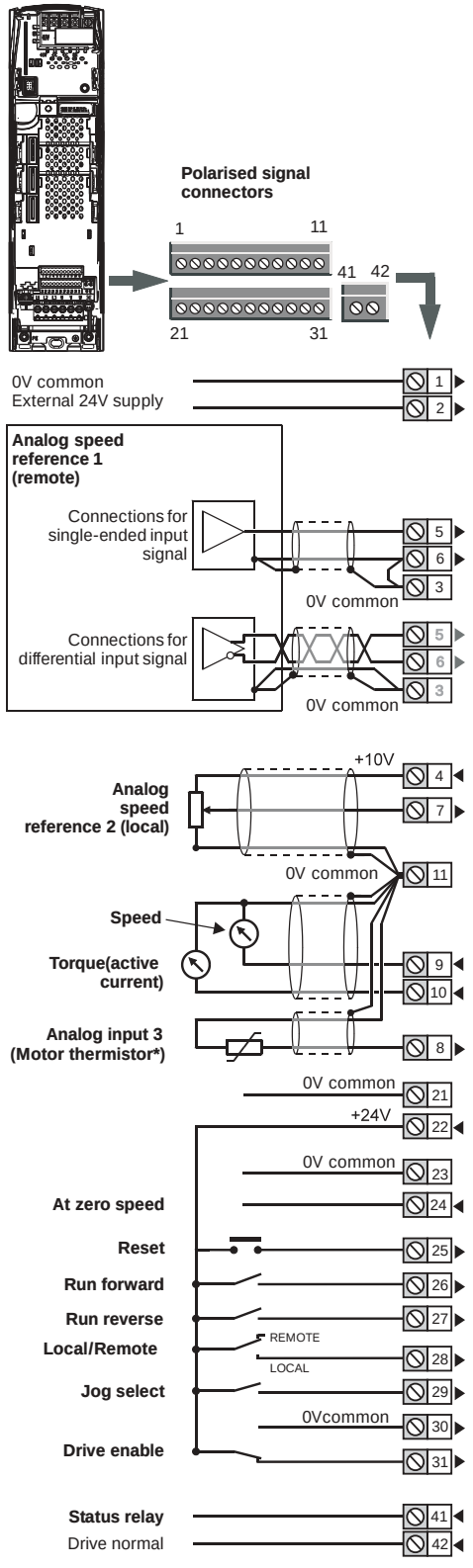
Mode parameter

analog - indicates the mode of operation of the terminal, i.e. voltage 0-10V, current 4-20mA etc.

digital - indicates the mode of operation of the terminal, i.e. positive / negative logic (the Drive Enable terminal is fixed in positive logic), open collector.

All analog terminal functions can be programmed in menu 7
All digital terminal functions can be programmed in menu 8

Figure 4-11 Default terminal functions



* Analog input 3 can be configured as a motor thermistor input.

Control terminal specification

1	0V common
Function	Common connection for all external devices

2	+24V external input
Function	To supply the control circuit without providing a supply to the power stage
Nominal voltage	+24.0Vdc
Minimum continuous operating voltage	+19.2Vdc
Maximum continuous operating voltage	+30.0Vdc
Minimum start-up voltage	21.6Vdc
Recommended power supply	60W 24Vdc nominal

3	0V common
Function	Common connection for all external devices

4	+10V user output
Function	Supply for external analog devices
Voltage tolerance	±1%
Nominal output current	10mA
Protection	Current limit and trip @ 30mA

Electrical Features

	Precision reference Analog input 1
5	Non-inverting input
6	Inverting input

Default function	Remote speed reference
Type of input	Bipolar differential analog (For single-ended use, connect terminal 6 to terminal 3)
Voltage range	±9.8V ±1%
Absolute maximum voltage range	±13V relative to 0V ±36V differential
Input resistance	100kΩ
Resolution	16-bit plus sign (as speed reference)
Sampling period	250µs with destination as Pr 1.36, Pr 1.37 or Pr 3.19 (4ms for all other destinations)

7	Analog input 2

Default function	Local speed reference
Type of input	Bipolar single-ended analog voltage or unipolar current
Mode controlled by...	Parameter 7.11
Operating in Voltage mode	
Voltage range	±9.8V ±3%
Abs. Max Voltage Range	±36V relative to 0V
Input Impedance	>100kΩ
Operating in Current mode	
Current ranges	0 to 20mA 20 to 0mA 4 to 20mA 20 to 4mA
Absolute maximum voltage (reverse bias)	-36V max
Absolute max current	70mA
Equivalent input resistance	≤200Ω at 20mA
Common to all modes	
Resolution	10 bit + Sign
Sample period	250µs in voltage mode with destination as Pr 1.36, Pr 1.37 or Pr 3.19 (4ms for all other destinations or any destination in current mode)

8	Analog input 3

Default Function	Not configured
Type of input	Bipolar single-ended analog voltage, unipolar current or motor thermistor input
Mode controlled by...	Parameter 7.15
Operating in Voltage mode	
Voltage range	±10V
Absolute maximum voltage range	±36V relative to 0V
Input resistance	>100kΩ
Operating in current mode	
Current ranges	0 to 20mA 20 to 0mA 4 to 20mA 20 to 4mA
Absolute maximum voltage (reverse bias)	-36V max
Absolute maximum current	70mA
Equivalent input resistance	≤200Ω at 20mA
Operating in thermistor input mode	
Internal pull-up voltage	<5V
Trip threshold resistance	3.3kΩ ±10%
Reset resistance	1.8kΩ ±10%
Short-circuit detection resistance	50Ω ±30%
Common to all modes	
Resolution	10 bit + Sign
Sample period	250µs in voltage mode with destination as Pr 1.36, Pr 1.37 or Pr 3.19 (4ms for all other destinations, or any destination in current mode)

Electrical Features

9	Analog output 1
10	**Analog output 2**
Terminal 9 default function	SPEED output signal
Terminal 10 default function	Motor active current
Type of output	Bipolar single-ended analog voltage or unipolar current
Mode controlled by...	Parameter 7.21 & 7.22
Operating in Voltage mode	
Voltage range	±8.8V ±5%
Maximum output current	±10mA short circuit protected
Load resistance	1kΩ min
Protection	35mA max Short circuit protection
Operating in current mode	
Current ranges	0 to 20mA ±10% 4 to 20mA ±10%
Maximum open circuit voltage	+15V
Maximum load resistance	600Ω
Common to all modes	
Resolution	10-bit (plus sign in voltage mode)
Update period	4ms

11	0V common
Function	Common connection for all external devices

21	0V common
Function	Common connection for all external devices

22	+24V user output (selectable)
Programmability	Can be switched on or off by setting the source Pr 8.28 and source invert Pr 8.16
Nominal output current	200mA (including all digital I/O)
Maximum output current	240mA (including all digital I/O)
Protection	Current limit and trip

23	0V common
Function	Common connection for all external devices

Electrical Features

24	24 Digital I/O 1
25	25 Digital I/O 2
26	26 Digital I/O 3

Terminal 24 default function	AT ZERO SPEED output
Terminal 25 default function	DRIVE RESET input
Terminal 26 default function	RUN FORWARD input
Type	Positive or negative logic digital inputs, or negative logic push-pull or open collector outputs
Input/output. mode controlled by...	Pr 8.31, 8.32 and 8.33
Operating as an input	
Logic mode controlled by...	Pr 8.29
Absolute maximum applied voltage range	±30V
Load	>2mA @ 15Vdc
Input thresholds	10.0V ±0.8V
Operating as an output	
Open collector outputs selected	Pr 8.30
Nominal maximum output current	200mA (total including terminal 22)
Maximum output current	240mA (total including terminal 22)
Common to all modes	
Voltage range	0V to +24V
Sample / Update period	4ms or 250µs when configured as limit switch inputs

27	Digital Input 4
28	Digital Input 5
29	Digital Input 6

Terminal 27 default function	RUN REVERSE input
Terminal 28 default function	LOCAL / REMOTE SELECT input
Terminal 29 default function	JOG SELECT input
Type	Negative or positive logic digital inputs
Logic mode controlled by...	Pr 8.29
Voltage range	0V to +24V
Absolute maximum applied voltage range	±30V
Load	>2mA @ 15V
Input thresholds	10.0V ±0.8V
Sample / Update period	4ms or 250µs when configured as limit switch inputs

30	0V common
Function	Common connection for all external devices

31	Drive enable (SECURE DISABLE function)
Type	Positive logic digital input%
Voltage range	0V to +24V
Absolute maximum applied voltage	±30V
Thresholds	18.5V ±0.5V
Sample period	<1µs

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

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

4.13 Drive Feedback Connections

Figure 4-12 Location of encoder connector

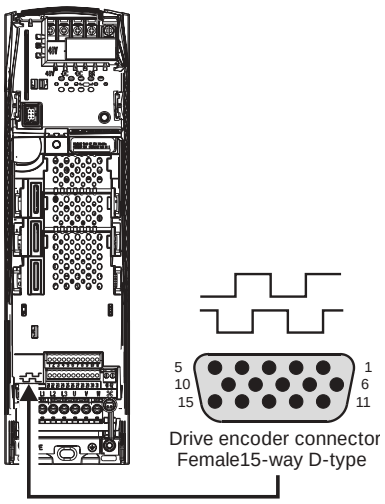


Table 4-9 Drive encoder connector details

Terminal	Ab (Pr 3.38 = 0)	Fd (Pr 3.38 = 1)	Fr (Pr 3.38 = 2)	Ab.SErVO (Pr 3.38 = 3)	Fd.SErVO (Pr 3.38 = 4)	Fr.SErVO (Pr 3.38 = 5)	SC (Pr 3.38 = 6)	SC.HiPEr (Pr 3.38 = 7	EndAt (Pr 3.38 = 8)	SC.EndAt (Pr 3.38 = 9)	SSI (Pr 3.38 = 10)
1	A	F	F	A	F	F	Sin	Sin	Sin		
2	A\	F\	F\	A\	F\	F\	Sinref	Sinref	Sinref		
3	B	D	R	B	D	R	Cos	Cos	Cos		
4	B\	D\	R\	B\	D\	R\	Cosref	Cosref	Cosref		
5	Z*							Data			
6	Z*							Data\			
7	Aout (Fout)**			U			Aout (Fout)**				
8	Aout (Fout)**			U\			Aout (Fout\)**				
9	Bout (Dout)**			V			Bout (Dout)**				
10	Bout (Dout)**			V\			Bout (Dout\)**				
11				W					Clock		
12				W\					Clock\		
13	+V***										
14	0V										
15	th****										

* Marker pulse is optional, more often used in servo mode

** Simulated encoder output only available in open-loop

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

**** Terminal 15 is a parallel connection to T8 analog input 3. This can be used as a thermistor input.

Electrical Features

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

Figure 4-10 Encoder types

Encoder	Description
Ab Pr 3.38 = 0	Quaderature incremental encoder with or without marker pulse
Fd Pr 3.38 = 1	Incremental encoder with frequency pulses and direction, with or without marker pulse
Fr Pr 3.38 = 2	Incremental encoder with forward pulses and reverse pulses, with or without marker pulse
Ab.SErVO Pr 3.38 = 3	Quaderature incremental encoder with commutation signals, with or without marker pulse
Fd.SErVO Pr 3.38 = 4	Incremental encoder with frequency pulses and direction with commutation signals, with or without marker pulse
Fr.SErVO Pr 3.38 = 5	Incremental encoder with forward pulses and reverse pulses with commutation signals, with or without marker pulse
SC Pr 3.38 = 6	SinCos encoder without serial communications
SC.HiPEr Pr 3.38 = 7	Absolute SinCos encoder using Stegmann EI485 serial communications protocol (HiperFace)
EndAt Pr 3.38 = 8	Absolute EnDat only encoder
SC. EndAt Pr 3.38 = 9	Absolute SinCos encoder using EnDat serialcommunications protocol
SSI Pr 3.38 = 10	Absolute SSI only encoder

Specifications

Feedback device connections Ab, Fd, Fr, Ab.SErVO and Fd.SErVO and Fr.SErVO encoders

1	Channel A, Frequency or Forward inputs
2	Channel A\, Frequency\ or Forward\ inputs
3	Channel B, Direction or Reverse inputs
4	Channel B\, Direction\ or Reverse\ inputs
5	Marker pulse channel Z
6	Marker pulse channel Z\
7	Phase channel U
8	Phase channel U\
9	Phase channel V
10	Phase channel V\
11	Phase channel W
12	Phase channel W\

Type	EIA 485 differential receivers
Maximum input frequency	512kHz*
Line loading	<2 unit loads (for terminals 1 to 4) 32 unit loads (for terminals 5 & 6) 1 unit load (for terminals 7 to 12)
Line termination components	120Ω
Working common mode range	+12V to -7V
Absolute max applied voltage relative to 0V	±14V
Absolute max applied differential voltage	±14V

*With Ab or AB.SErVO encoders the limit is 410kHz.

Electrical Features

SC, SC.HiPEr, EndAt, SC.EndAt and SSI encoders

1	Channel Sin*
2	Channel Sinref*
3	Channel Cos*
4	Channel Cosref*

Type	Differential voltage
Maximum signal level	1.25V peak to peak
Maximum input frequency	115kHz
Maximum applied differential voltage	±4V

For the SinCos encoder to be compatible with Unidrive SP, the output signals from the encoder must be a 1V peak to peak differential voltage (across Sin to Sinref and Cos to Cosref).

The majority of encoders have a DC offset on all signals. Stegmann and Heidenhain encoders typically have a 2.5Vdc offset. The Sinref and Cosref are a flat DC level at 2.5Vdc and the Cos and Sin signals have a 1V peak to peak waveform biased at 2.5Vdc.

Encoders are available which have a 1V peak to peak voltage on Sin, Sinref, Cos and Cosref. This results in a 2V peak to peak voltage seen at the drives encoder terminals. It is not recommended that encoder's of this type are used with Unidrive SP, and that the encoder feedback signals should meet the above parameters (1V peak to peak biased at 2.5Vdc).

*Not used with EndAt and SSI encoders.

SC, SC.HiPEr, EndAt, SC.EndAt and SSI encoders

5	Data**
6	Data**
11	Clock***
12	Clock***

Type	EIA 485 differential transceivers
Maximum frequency	2MHz
Line loading	32 unit loads (for terminals 5 & 6) 1 unit load (for terminals 11 & 12)
Working common mode range	+12V to -7V
Absolute max applied voltage relative to 0V	±14V
Absolute max applied differential voltage	±14V

** Not used with SC encoders.

*** Not used with SC and SC.HiPEr encoders.

Frequency slaving outputs (open loop) Ab, Fd, Fr, SC, SC.HiPEr, EndAt, SC.EndAt and SSI encoders

7	Frequency slaving out channel A
8	Frequency slaving out channel A\
9	Frequency slaving out channel B
10	Frequency slaving out channel B\

Type	EIA 485 differential transceivers
Maximum output frequency	512kHz
Working common mode range	+12V to -7V
Absolute max applied voltage relative to 0V	±14V
Absolute max applied differential voltage	±14V

Common to all Encoder types

13	Encoder supply voltage
Supply voltage	5V, 8V, or 15V
Maximum output current	300mA for 5V and 8V 200mA for 15V

The voltage terminal 13 is controlled by Pr 3.36. The default for this parameter is 5V (0) but this can be set to 8V (1) or 15V (2). Setting the encoder voltage supply too high for the encoder could result in damage to the feedback device.
The termination resistors should be disabled if the outputs from the encoder are higher than 5V.

14	0V common

15	Motor thermistor input

This terminal is connected internally to terminal 8 of the signal connector. Connect only one of these to a motor thermistor. Analog input 3 must be in thermistor mode, Pr 7.15 = th.SC (7), th (8) or th.diSP (9).

4.14 Motor Feedback Devices

The Unimotor offers selection of feedback types suitable for use with the Unidrive SP as detailed.

Feedback type should be chosen to suit the particular application, and the table 4-10 summarises the considerations.

Table 4-10 Feedback selection

Feedback type	Motor Δt °C	Feedback Resolution	Positional Accuracy	Absolute / Non- Volatile?	Multi-turn available?	Comments
Resolver	125	1.3 arc min 16384/ rev	40 min spread	Yes	No	Use with Unidrive SP & SM-Resolver for high temp /harsh environment
Incremental optical encoder 4096 ppr in quadrature	100	1.3 arc min 16384/ rev	+/-60 sec	No	No	Suits most applications. Low speed control down to 1rpm 300kHz b/w
Incremental optical encoder 2048 ppr in quadrature	100	2.6 arc min 8192 / rev	+/-60 sec	No	No	Suits most applications. Low speed control down to 1rpm 300kHz b/w
Sincos optical encoder 1024 cycles/rev	100	0.3 arc sec $2.097x10^6$ / rev $1x10^5$ / rev best in practice	+/-52 sec	Yes	Yes	Use for high resolution with Unidrive SP Analogue signal to drive is susceptible to noise distortion. Low speed control below 1rpm Better stability when load / motor inertia match is poor. Multi-turn counts 0 to 4096 max

Feedback Types

1) Resolver
A passive wound component device consisting of stator and rotor elements excited from an external source provided by the SM-Resolver module, (Typically 6Vac, 6kHz).

Two outputs from the stator are 6kHz signals, such that the amplitude of each corresponds to the sine and cosine angle of the motor shaft.

This is a robust absolute device of medium accuracy, capable of withstanding high temperature. Motors fitted with resolvers are rated to higher torque value than for the other feedback devices.

2) Incremental Encoder
This high accuracy device has good resolution and is a standard choice for most drives.

Position is determined by counting steps or pulses. Two sequences of pulses in quadrature are used so that direction sensing may be determined and 4 x (pulses per rev) may be used for resolution.

Commutation tracks are required to determine a coarse absolute position during motor start to synchronise the drive waveform to the rotor shaft position. The first commutation transition defines the motor commutation position.

A marker pulse occurring once per rev is used to zero the position count.

Position information is volatile – i.e. absolute position is lost when the drive or motor are powered down.

3) Sincos Single Turn
An absolute encoder system with high resolution, that employs a combination of absolute, sine and cosine and incremental techniques.

4) Sincos Multi-Turn
Optional for the Sincos encoder, the encoder has additional ability to count complete turns of the motor shaft (non-volatile). This is very useful feature for many types of machine where a “start-up set reference sequence” is undesirable.

Terminology

Absolute / Non-volatile
This means available position information is not lost when drive power removed, even if the shaft position is rotated with the power off.

Commutation
As with commutating brushed dc motors, all brushless ac permanent magnet motors require commutation information to enable the drive to synchronise with the rotor of the motor.

To ensure optimum torque at all rotor positions both when stationary, and at speed, the drive is required to maintain motor current in phase with the peak of the motor’s sinusoidal waveform. The drive must therefore know the position of the rotor with respect to the stator at all times.

Ideally, all feedback devices are aligned with the motor stator during assembly. For those feedback devices that are not aligned, the Unidrive SP has an Encoder Phasing Test that automatically creates a Phase Position (Phase Offset) value).

Commutation Phase Offset
Most drives, including the Unidrive, provide for a “Phase Offset” adjustment and a means of setting this to match a motor with a different commutation setting.

All UM motor feedback devices are set to match the Unidrive definition of zero offset, so that the drives may operate with zero phase offset adjustment, thus allowing interchange of motors between drives without further adjustment.

Note that not all drives have the same zero offset definition.

Encoders & Encoder Housing – Mechanical Construction

The encoder shaft is directly coupled to the motor shaft. The encoder body is mounted on a flexible, but torsionally rigid, mount. This, together with a specially developed high temperature plastic shield provides a thermal barrier to the motor.

An aluminium housing covers the end of the encoder and permits heat generated by the encoder to dissipate to the air. Viton seals are used between each mechanical interface and the whole assembly is rated to IP 65.

Incremental Encoder

Three basic variants of the incremental encoders are fitted to match the motor specification and commutation: 4096 ppr (pulses per revolution)- 6 pole; 2048 ppr - 6 pole; and 4096 ppr - 8 pole.

The incremental encoder is the only feedback type that can be used directly with the Unidrive without the use of a small options module.

For all UM with motors the commutation position is set to match the Unidrive SP definition of zero offset with sufficient accuracy to permit operation with any Unidrive with commutation offset parameter set to zero.

Features

- High resolution to 16384 counts with x4 logic (i.e. 4096 x 4 = 16384) for excellent speed and position control
- EIA422 digital differential line drivers suitable for cable lengths to 100m
- Digital - for reduced noise susceptibility
- No phase correction required for long cables (resolvers may require phase angle correction depending on cable lengths and motor speeds)
- Phase and quadrature tracks (4096 or 2048 ppr)
- Marker pulse
- Commutation tracks to match motor
- Encoder remains operative at 120ºC (100ºC maximum for full performance)
- Directly compatible with Control Techniques' Unidrive

Incremental Tracks

At constant rotational speed, viewed facing the front of the motor and in clockwise rotation.

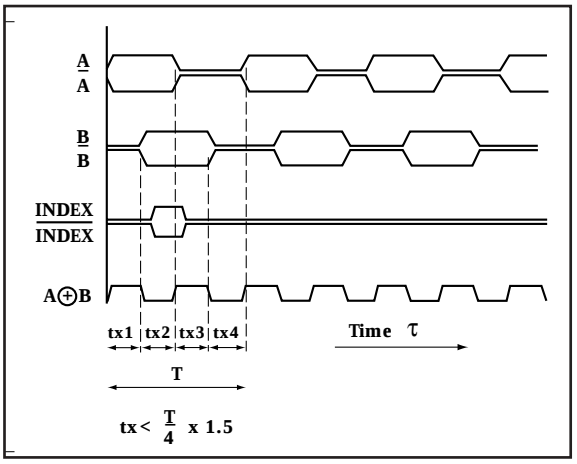


Figure 4-13 Incremental Quadrature Signals

Incremental Encoder Specification

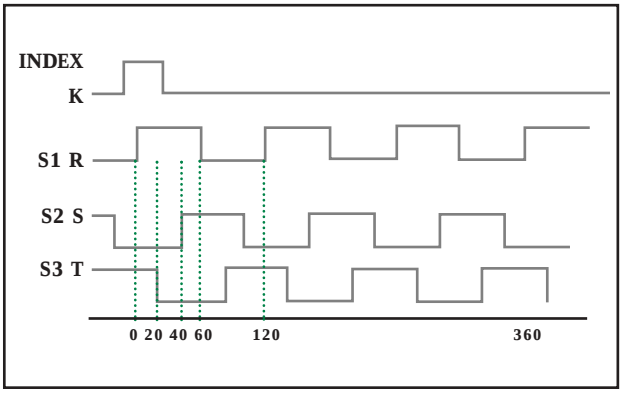
Outputs	Two true and complement square wave signals in quadrature True and complement index reference pulse Three true and complement commutation signals
Output interface	To EIA422 specification (see encoder connections)
Pulses / rev	4096 ppr for 2,000 rpm and 3,000 rpm motors (16,384 counts per turn) 2048 ppr for motors above 3,000rpm (8,192 counts per turn)
Max. output frequency	300 kHz
Max. encoder shaft speed	9,000 rpm (mechanical limit)
Commutation signals	3 tracks each 3 ppr on 6 pole motors (frame size 75mm to 142mm) or, 3 tracks each 4 ppr on 8 pole motors (frame size 190mm)
Operating voltage range	5.0 volts ± 10%
Operating current	50 mA - 150 mA, maximum no-load; 300 mA max. at 300 kHz with RS 422 loads

Commutation Outputs

The diagram below shows commutation outputs for 6 pole commutation (3 pole pairs). The 3 phase motor sinusoidal power from the drive runs synchronously with motor speed at N/2 cycles per revolution;

where, N = number of poles.

Thus, a 6 pole motor has 3 electrical power cycles per revolution. For 8 pole motors, the encoder commutation tracks will give 4 pulses per revolution. Note that the direction sense is reversed if the polarity of S2 track is inverted.



N.B. Inverse signals are not shown

Figure 4-14 Commutation Output Showing Relationship With Index

EIA422 Outputs

Applicable to each of the six outputs.

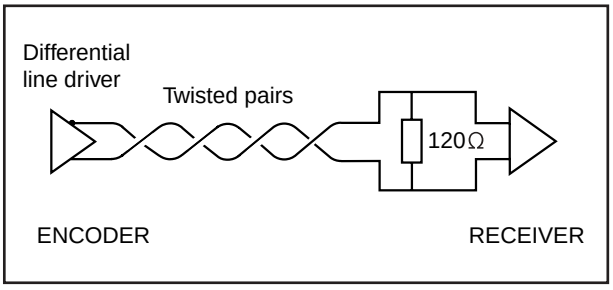


Figure 4-15 EIA422 Interface

Incremental Encoder Connections

The figure below shows the pin allocation of the 17 pin Unimotor signal connector (incremental feedback).

The signal cable must comprise of 8 twisted pair in an overall screen, with ideally the thermistor pair also screened. Each twisted pair is allocated to a signal and its complement (inverse). The +5 Volts and 0 Volt pair should be 1.0 mm2 cross section conductor to avoid voltage drop on long cables. The overall screen must be braided (not foil), for flexibility. It is important to have correct screen connection at both motor and drive ends.

Control Techniques recommend the use of ready-made and tested cables for reliable and fast installation.

Table 4-11 Signal Connector Incremental Encoders (17 pin)

Connector size 1 for all motors

Function	Pin
Thermistor, PTC	1
Thermistor, PTC return	2
Screen	3
S1	4
S1 inverse	5
S2	6
S2 inverse	7
S3	8
S3 inverse	9
CH A	10
Index	11
Index inverse	12
CH A inverse	13
CH B	14
CH B inverse	15
+5V dc	16
0V	17

Unidrive speed restriction

For 4096 ppr encoders, Unidrive will not permit input speed demands greater than 6000rpm.

Synchronising two encoder systems

A Unidrive SP SM-Encoder Plus Option Module enables the host system to achieve synchronisation with an external encoder system. For further details refer to Control Techniques Technical Support.

Sincos SRS50 & SRM50 Encoders

Features

- Absolute encoder
- 1024 sin & cosine cycles per turn
- High resolution to 2 million counts per turn
- Very high accuracy
- 8 wire connection
- Choice of single or multi-turn
- Built-in non-linearity corrections
- 8V operation
  (set UD52 parameter # 16.15 = 1 for 8V)

Functional Description

A true absolute encoder requires encoding of the disc data in such a way that position can be read to the full accuracy in any condition – notably at switch on - and at speed. In this case, a high frequency data line would be required to transmit high-resolution information at high shaft speeds. This can be expensive and the sincos system is an excellent compromise.

The Sincos system can be considered as a mixture of an incremental encoder and an absolute encoder.

It is configured to give an absolute position via EIA485 digital link, plus sine and cosine analogue 1024 cycles per rev waveforms via twisted-wire pairs.

The absolute encoder inside the SRS/SRM50 determines 0 – 32767 counts of position. Every eight steps of this represent one quadrant of the 1024 sine wave. (i.e. 1024 x 4 x 8 = 32768).

At start-up, when the shaft is stationary, absolute position is transmitted as serial digital data to the Unidrive SP from which the absolute position can be determined by use of the digital count and by some interpolation of the 1024 sine and cosine waveforms to give a finer resolution (figure 4-16).

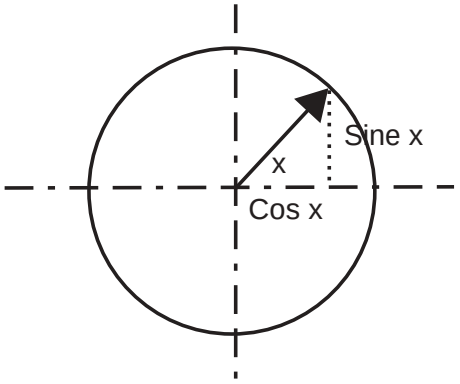


Figure 4-16 SinCos Cycle

The Unidrive SP pre-loads a quadrant counter with a quadrant count derived from the absolute count and, once loaded, there is no further requirement to digitally read the absolute position from the encoder until a power-down situation occurs.

As the shaft turns, the counter increments or decrements according to quadrant information easily derived from the sine and cosine analogue waveforms. Additional resolution is obtained from the tangent of x of a single cycle of the 1024 cycles per rev waveforms (figure 4-16).

SinCos Multi-Turn

The SRM50 encoder has additional mechanical gearing and sensors to permit absolute, non-volatile counting of turns to a total of 0 - 4095 turns.

N.B. at 4095 next turn will be 0; conversely at 0 a reverse turn will indicate 4095).

Turns are counted even when power is switched off.

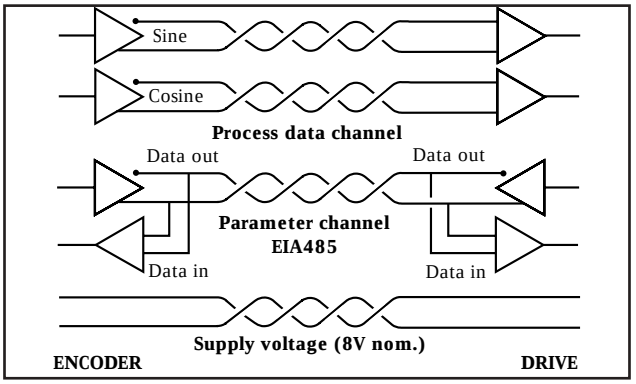


Figure 4-17 SinCos Multi-turn Schematic Diagram

Electrical Features

SRS50 & SRM50 Specification

Sine & cosine analogue outputs	1024 per rev
Rotor Inertia	10 gcm2
Max angular acceleration	0.2 rad/s2
Operating torque	0.2 Nm
Code progression with clockwise rotation viewed on end of motor	Ascending
SRM50 multi-turn counts	4096
Positional accuracy seconds of arc	+/-52
Max frequency for sine wave channels	200 kHz
Maximum working speed for position calculation	6000 rpm
Bearing service life	3.6 x 109 revs
Working temperature range	-20.+115°C
Working voltage	7 –12 V
Recommended voltage	8V
Max no load operating current	80mA
Data channel	EIA485

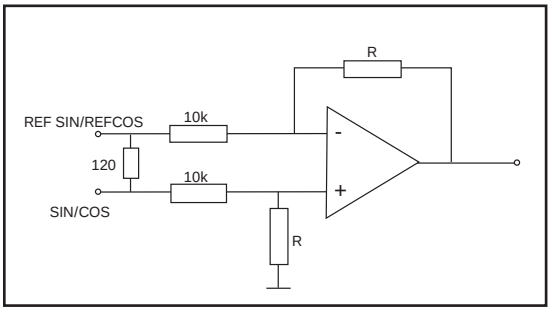


Figure 4-18 Recommended Receiver Circuit for Sine and Cosine Signals

Commutation

The encoder position relative to the motor shaft has been set for all Unimotors.

Table 4-12 Signal Connector for SinCos (12 pin)

Function	Pin
Ref cosine	1
+EIA485	2
-EIA485	3
Cosine	4
Sine	5
Ref sine	6
Motor thermistor	7
Motor thermistor return	8
Screen	9
0V	10
Not Connected	11
8v dc	12

Resolver

Consisting of a stator and a rotor, the resolver continuously measures the angular position of the motor rotor. A resolver is typically more robust than an encoder, but gives lower accuracy.

Arranged in the stator are an excitation winding and two windings, mechanically offset by 90°. The rotor winding (2 pole) is housed in the rotor. An excitation signal of approximately 7.5 kHz is linked without direct contact via the excitation winding into the rotor winding. The excitation signal induces voltages of equal frequency into the stator windings. The amplitudes of the induced voltages are proportional to the cosine and sine respectively of the rotor angle. With the aid of electronic circuits, these signals enable the rotor position to be measured absolutely over one motor revolution (for commutation); the value of the motor speed to be derived by digital or analogue means, and incremental signals for positioning guidance to be created via encoder simulation.

The resolver itself contains no electronic components and can withstand high temperature environments. A resolver is the ideal reliable transmitter for use in harsh environmental conditions. The resolver rotor is mounted directly on the motor shaft, so giving a robust and accurate measurement system for velocity and position signals.

Features

- Absolute position
- No loss of feedback information during fast transient disturbances
- Robust construction
- High temperature motor operation - to 165°C
- ± 15 mins of arc accuracy

Electrical Features

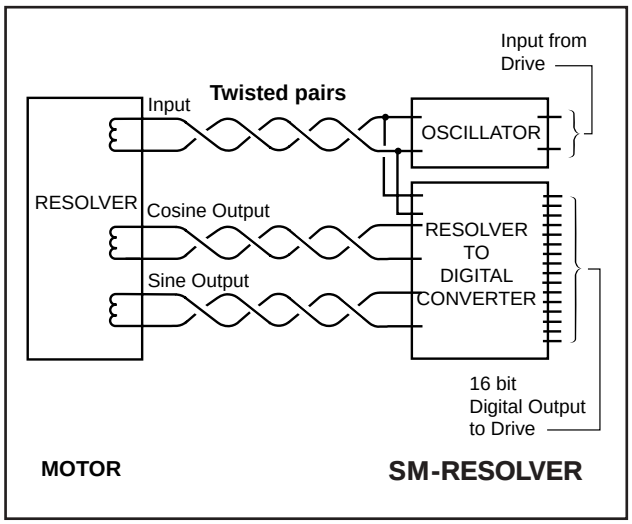


Figure 4-19 Resolver Schematic Diagram

Specification

Voltage	6V
Frequency	7.5 kHz
Primary	Rotor
No. of poles	2
Transformation ratio	0.28 ± 10%
Phase shift	-7° nom
Primary current	40 mA nom
Input power	120 mW max
Electrical error	± 15 mins (standard)
Total null volts	30.0 mV max
Impedances	Zro 73+j129 nom
	Zso 116+j159 nom
	Zss 95+j162 nom
Temperature range	-55°C to 155°C
Rotor inertia	20 x 10-6 kgm2

Commutation

Resolvers are factory set for correct commutation position, and should require no additional adjustment. However, it is necessary to set the drive correctly by running the resolver phase check routine.

Table 4-13 Signal Connector Resolver

(12 pin) signal connector size 1 for all motors

Function	Pin
Excitation (high)	1
Excitation (low)	2
Cosine (high)	3
Cosine (low)	4
Sine (high)	5
Sine (low)	6
Thermistor, ptc	7
Thermistor, ptc return	8
Not used	9
Not used	10
Not used	11
Not used	12

4.15 Serial communications connections

The Unidrive SP has a serial communications port (serial port) as standard. Please see Table 4-5 for the connection details for the RJ45 connector.

NOTE In order to meet the requirements for SELV in IEC60950 (IT equipment) it is necessary for the control computer to be grounded. Alternatively, when a lap-top or similar device is used which has no provision for grounding, an isolation device must be incorporated in the communications lead.

Figure 4-20 RJ45 serial communications connector

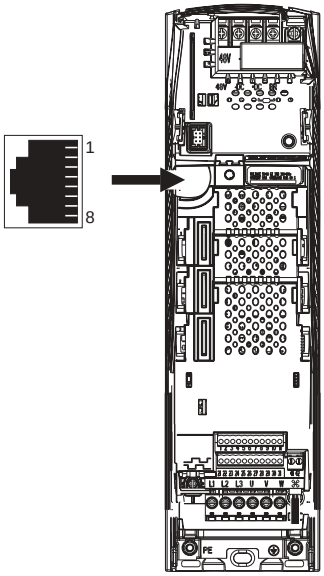


Table 4-14 Connection details for RJ45 connector

Isolation of the serial communications port

Pin	Function
1	termination resistor
2	RXTX
3	0V
4	+24V
5	not used
6	TX enable
7	RX\TX\
8	linked to pin 7

The serial communications port of the Unidrive SP is double insulated and meets the requirements for SELV in EN50178.

An isolated serial communications lead has been designed to connect the Unidrive SP to IT equipment (such as lap-top computers), and is available from the supplier of the drive. See below for details:

Table 4-15 Isolated serial comms lead details

Part number	Description
4500-0079	SM-Comms Cable

The “isolated serial communications” lead has reinforced insulation as defined in IEC60950 for altitudes up to 3,000m.

4.16 Secure Disable

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

The SD function makes use of the special property of an inverter drive with an induction motor, which is that torque cannot be generated without the continuous correct active behaviour of the inverter circuit. All credible faults in the inverter power circuit cause a loss of torque generation.

The SD function is fail-safe, so when the SD input is disconnected the drive will not operate the motor, even if a combination of components within the drive has failed. Most component failures are revealed by the drive failing to operate. SD is also independent of the drive firmware. This meets the requirements of EN954-1 category 3 for the prevention of operation of the motor.[1]

[1] Independent approval pending.

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

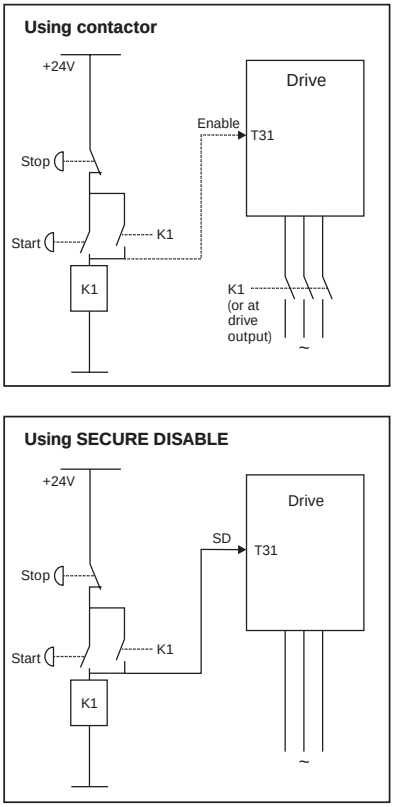
NOTE The design of safety-related control systems must only be done by personnel with the required training and experience. The SD function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. The system must be subject to a risk assessment to confirm that the residual risk of an unsafe event is at an acceptable level for the application.

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

NOTE SD does not provide electrical isolation. The supply to the drive must be disconnected by an approved isolation device before gaining access to power connections.

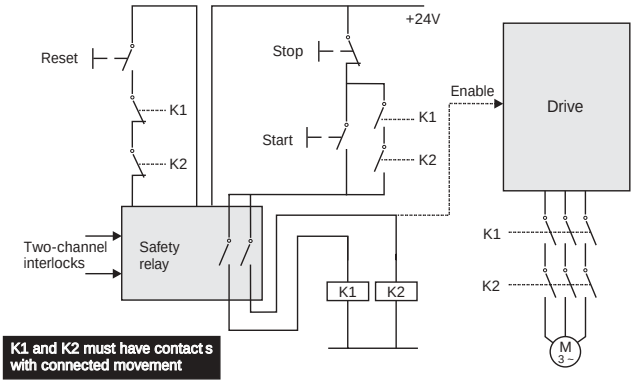
The following diagrams illustrate how the SD input can be used to eliminate contactors and safety contactors from control systems. Please note these are provided for illustration only, every specific arrangement must be verified for suitability in the proposed application.

Figure 4-21 Start / stop control EN954-1 category B - replacement of contactor



In the second example, illustrated in Figure 4-22 and Figure 4-23, a conventional high-integrity system which uses two safety contactors with auxiliary contacts with connected movement is replaced by a single Secure Disable system. This arrangement meets EN954-1 category 3.

Figure 4-22 Category 3 interlock using electromechanical safety contactors



In the conventional system, a contactor failure in the unsafe direction is detected the next time the safety relay is reset. Since the drive is not part of the safety system it has to be assumed that AC power is always available to drive the motor, so two contractors in series are required in order to prevent the first failure from causing an unsafe event (i.e. the motor driven).

With Secure Disable there are no single faults in the drive which can permit the motor to be driven. Therefore it is not necessary to have a second channel to interrupt the power connection, nor a fault detection circuit.

It is important to note that a single short-circuit from the Enable input (SD) to a DC supply of approximately +24V would cause the drive to be enabled. For this reason, Figure 4-16 shows the wire from the Enable input to the safety relay as “protected wiring” so that the possibility of a short circuit from this wire to the DC supply can be excluded, as specified in prEN 954-2. The wiring can be protected by placing it in a segregated cable duct or other enclosure, or by providing it with a grounded shield.

If the use of protected wiring is not acceptable, so that the possibility of this short circuit must be allowed for, then a relay must be used to monitor the state of the Enable input, together with a single safety contactor to prevent operation of the motor after a fault. This is illustrated in Figure 4-24.

NOTE The auxiliary relay K2 must be located in the same enclosure and close to the drive, with its coil connected as closely as possible to the drive enable (SD) input.

NOTE on the use of servo motors and other permanent-magnet motors

When the drive is disabled through Secure Disable, a possible (although highly unlikely) failure mode is for two power devices in the inverter circuit to conduct incorrectly. With an induction motor this does not generate torque, but with a permanent-magnet motor there is a transient alignment torque, i.e. the motor may briefly try to rotate by up to 180º electrical. It will not rotate continuously. This possible failure mode must be allowed for in the machine design.

As explained in section 3, the drive is capable of active braking through the motor, but this is not a high-integrity function. Where braking is desirable, such as in an emergency stop function, but the actual safety function is the removal of power from the motor, a time delay is required between instructing the drive to stop and then disabling it.

A fail-safe time delay relay can be used for this function, as shown in Figure 4-25. Safety relay ranges such as those from Pilz GmbH include relay expansion units with a delay feature. In this arrangement the drive brakes as soon as the gate is opened, and is disabled securely after the delay relay de-energises.

It must be emphasised that if braking is itself a safety requirement, i.e. if the braking does not operate then there is an unacceptable risk of injury, then a fail-safe brake must be provided, such as a mechanical brake with electrical hold-off.

Figure 4-23 Category 3 interlock using Secure Disable with protected wiring

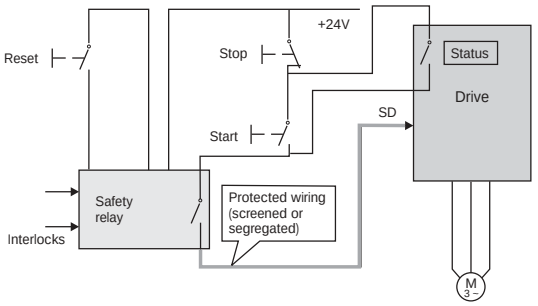


Figure 4-24 Use of contactor and relay to avoid the need for protected wiring

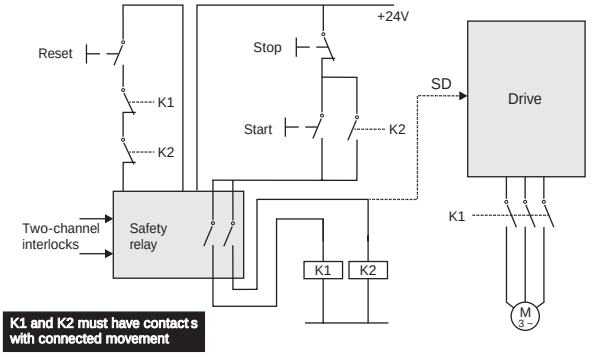
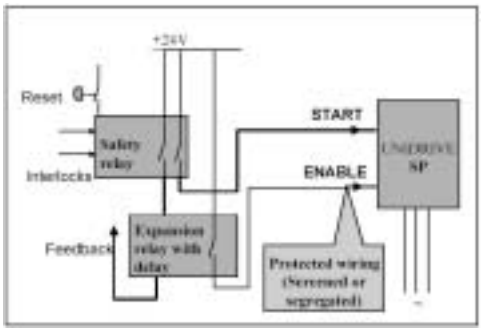


Figure 4-25 Provision of electronic braking for rapid stop



For further information on the secure disable function refer to the “Guide To The Unidrive SP Secure Disable Function”.

Menu Zero Overview

5 Menu Zero Overview

5.1 Single Line Descriptions

This menu holds parameters that are quick access duplicates of the most used advanced parameters.

0.00	Configuration	Default parameter at power up
0.01	Basic	Speed Clamps
	Setup	Acceleration / Deceleration
		Reference Selector
		Symmetrical Current
0.09		Speed Loop gains
0.10	Monitoring	Speed
		Total Current
0.13		Analogue Input 1 Offset Trim
0.14	Advanced	Torque Mode
	Setup	Ramp Mode
0.17		Current Loop Filter
0.18	I/O Set-Up	Positive Logic Select
		Analogue Input 2&3 Configure
0.21		Bipolar Reference Select
0.22	Speed Refs.	Jog, Preset 1&2 References
0.28	OR Encoder	Overspeed Threshold
		Encoder Lines
		Keypad Fwd/Rev Key Enable
0.29	Smart Card	Parameter Data
0.30		Parameter Cloning
0.31	Drive Rating	Rated Voltage
0.32		Rated Current
0.33	Misc. Set Up	
0.34	Security	User Security code
0.35	Serial	Comms Mode
		Comms Baud Rate
0.37		Comms Address
0.38	Motor	Current Loop Gains
		Autotune
		Switching Frequency
0.47		Motor Parameters
0.48	Drive Mode	Drive Operating Mode
	Security	Security Status
0.50	Firmware	Drive Firmware Version

Menu zero - Programmability

- 0.11 to 0.30 ⩾ programmable
- 20 parameters to tailor menu zero by:
  - industry
  - customer
  - distributor
  - country
- SMARTCARD Functionality

6. Advanced Menu Parameters Overview

Unidrive SP has more than 1000 parameters that are organised so that similar parameters are grouped within the same menu For example, Menu 1 holds the parameters associated with the selection of a speed reference. Menu 2 holds parameters associated with the selection of acceleration and deceleration rates, etc.

6.1 Menu Features

MENU 1 - FREQUENCY / SPEED REFERENCE
Frequency / speed limits
Skip frequencies / speeds
Jog

MENU 2 - RAMPS
Ramp selection
Ramp enable selected
Ramp hold
Braking mode selection
S-ramp

MENU 3 - FREQUENCY SLAVING, SPEED FEEDBACK AND SPEED CONTROL
Speed loop PID gain
Speed sensing thresholds
Frequency slaving
Hard speed reference
Encoder set up

MENU 4 - TORQUE AND CURRENT CONTROL
Current limiting in speed control
Current loop gains
Torque control
Motor protection

MENU 5 - MOTOR CONTROL
Motor set up
Voltage boost
Autotune
PWM switching frequency
Slip compensation
Field weakening

MENU 6 - SEQUENCER AND CLOCK
AC supply loss
Jog time
Limit switches
Injection braking
Synchronise to a spinning motor
Keypad keys enable
Run-time log
Electricity cost
Sequencer controls
Power up / Run time timers

MENU 7 - ANALOG I/O
Drive temperature indicators
Analog input configuration
Analog output configuration

MENU 8 - DIGITAL I/O
Digital input configuration
Digital output configuration
Relay configuration

MENU 9 - PROGRAMMABLE LOGIC, MOTORISED POT AND BINARY SUM
Logical function (x2) configuration
Motorised potentiometer
Binary sum logic

MENU 10 - STATUS AND TRIPS
Drive status indicators
Process generated trips
Trip log with time stamp (x10)
Braking resistor protection
Auto restart

MENU 11 - GENERAL DRIVE SET-UP
Initial parameters displayed
Serial communications
Drive information
Smart card information
Select motor 2 parameters

MENU 12 - THRESHOLD DETECTORS AND VARIABLE SELECTORS
Threshold detector (x2) configuration
Variable selector (x2) configuration

MENU 13 - POSITION CONTROL

MENU 14 - USER PID CONTROLLER

Advanced Menu Parameters Overview

MENUS 15, 16 AND 17 - OPTION MODULE SET-UP

The following manuals are also available providing full information on the various option modules and advanced product use:

Unidrive SP User Guide
Unidrive SP Advanced User Guide
SM-Applications User Guide
SM-I/O Plus User Guide
SM-Universal Encoder Plus User Guide
SM-PROFIBUS-DP Advanced User Guide
SM-DeviceNet Advanced User Guide
SM-Resolver User Guide
SM-INTERBUS User Guide
SM-CANopen User Guide

MENU 18 - APPLICATION MENU 1

Power-down saved integer (x1)
Read-only integer (x9)
Read-write integer (x20)
Read-write bit (x20)

MENU 19 - APPLICATION MENU 2

Power-down saved integer (x1)
Read-only integer (x9)
Read-write integer (x20)
Read-write bit (x20)

MENU 20 - APPLICATION MENU 3

Read-write integer (x20)
Read-write long integer (x20)

MENU 21 - SECOND MOTOR PARAMETERS

Motor set up
Speed clamps
Speed loop gains
Current loop gains
Ramps

7 Diagnostics

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

- Trip indications
- Alarm indications
- Status indications

7.1 Trip Indications

If the drive trips, the output of the drive is disabled so that the drive stops controlling the motor. The upper display indicates that a trip has occurred and the lower display shows the trip.

Trips are listed alphabetically in Table 7-1 based on the trip indication shown on the drive display.

If a display is not used, the drive LED Status indicator will flash if the drive has tripped. Refer to Figure 7-2.

The trip indication can be read in Pr10.20 providing a trip number.

NOTE Trips beginning with a number (indicating module X of a multi-module drive) are given at the end of Table 7-1 where the number is replaced with an X (1 •X •8).

Figure 7-1 Keypad status modes

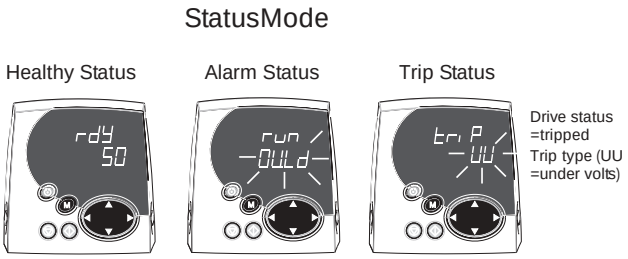


Figure 7-2 Location of the status LED

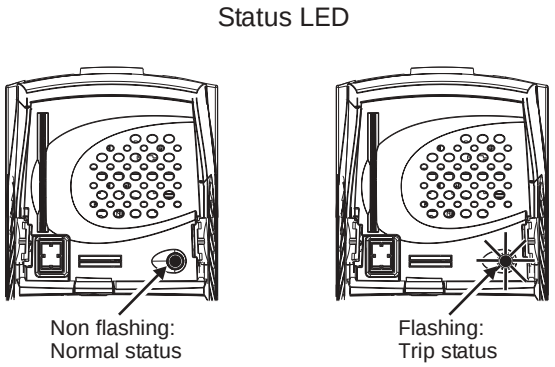


Table 7-1 Trip indications

TRIP	DIAGNOSIS
C.Acc	SMARTCARD trip: SMARTCARD Read / Write fail
C.Chg	SMARTCARD trip: Data location already contains data
C.Cpr	SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different
C.dat	SMARTCARD trip: Data location specified does not contain any data
C.Err	SMARTCARD trip: SMARTCARD data is corrupted
C.Full	SMARTCARD trip: SMARTCARD full
CL2	Analog input 2 current loss (current mode)
CL3	Analog input 3 current loss (current mode)
CL.bit	Trip initiated from the control word (Pr 6.42): Disable the control word by setting Pr 6.43 to 0 or check of setting Pr 6.42
C.Optn	SMARTCARD trip: Option modules fitted are different between source drive and destination drive
C.rdo	SMARTCARD trip: SMARTCARD has the Read only bit set
C.rtg	SMARTCARD trip: SMARTCARD attempting to change the destination drive ratings
C.Typ	SMARTCARD trip: SMARTCARD parameter set not compatible with drive no drive rating paramaters have been transferred
DESt	Two or more parameters are writing to the same destination parameter
EEF	EEPROM data corrupted - Drive mode becomes open loop and serial comms will timeout with remote keypad on the drive
Enc1	Drive encoder trip: Encoder power supply overload
Enc2	Drive encoder trip: Wire break

Diagnostics

Enc3	Drive encoder trip: UVW phase offset incorrect whilst running
Enc4	Drive encoder trip: Feedback device comms failure
Enc5	Drive encoder trip: Checksum or CRC error
Enc6	Drive encoder trip: Encoder has indicated an error
Enc7	Drive encoder trip: Initialisation failed
Enc8	Drive encoder trip: Auto configuration on power up has been requested and failed
Enc9	Drive encoder trip: Position feedback selected is selected from a option module bay which does not have a speed / position feedback option fitted
ENP.Er	Data error from electronic nameplate stored in selected position feedback device
Et	External trip from input on terminal 31
It.AC	Output current overload timed out (I^2t) - accumulator value can be seen in Pr4.19
It.br	Braking resistor overload timed out (I^2t) – accumulator value can be seen in Pr10.39
O.CtL	Drive control board over temperature
O.ht1	Power device over temperature based on thermal model
O.ht2	Heatsink over temperature based on thermal model
O.ht3	DC link component over temperature based on thermal model
OI.AC	Instantaneous output over current detected: peak output current greater than 225%
OI.br	Braking transistor over current detected: short circuit protection for the braking transistor activated
O.Ld1	Digital output overload: total current drawn from 24V supply and digital outputs exceeds 200mA
OV	DC link voltage has exceeded the peak level or the maximum continuous level for 30 seconds
O.SPd	Motor speed has exceeded the over speed threshold
PAd	Keypad has been removed when the drive is receiving the speed reference from the keypad
Ph	AC voltage input phase loss or large supply imbalance detected
PS	Internal power supply fault
PS.10V	10V user power supply current greater than 10mA
PS.24V	24V internal power supply overload
rS	Failure to measure resistance during autotune or when starting in open loop vector mode 0 or 3
SCL	Drive RS485 serial comms loss to remote keypad
SLX.dF	Option module bay X trip: Option module type fitted in bay X changed
SLX.Er	Option module bay X trip: Option module in bay X has detected a fault
SLX.HF	Option module bay X trip: Option module X hardware fault
SLX.nF	Option module bay X trip: Option module has been removed
SL.rtd	Option module trip: Drive mode has changed and option module parameter routing is now incorrect
SLX.tO	Option module bay X trip: Option module watchdog timeout
t010	User trip defined in 2 nd processor option module code
t036 to t038	User trip defined in 2 nd processor option module code
t040 to t099	User trip defined in 2 nd processor option module code
t109 to t110	User trip defined in 2 nd processor option module code
t119 to t120	User trip defined in 2 nd processor option module code
t129 to t130	User trip defined in 2 nd processor option module code
t139 to t140	User trip defined in 2 nd processor option module code
t149 to t150	User trip defined in 2 nd processor option module code
t159 to t170	User trip defined in 2 nd processor option module code
t172 to t177	User trip defined in 2 nd processor option module code
t198	User trip defined in 2 nd processor option module code
t216 to t219	User trip defined in 2 nd processor option module code
th	Motor thermistor trip
thS	Motor thermistor short circuit
tunE	Autotune stopped before completion
tunE1	Position feedback did not change during the autotune
tunE2	Position feedback direction incorrect during autotune

tunE3	Drive encoder commutation signals connected incorrectly during an autotune
tunE4	Drive encoder U commutation signal fail during an autotune
tunE5	Drive encoder V commutation signal fail during an autotune
tunE6	Drive encoder W commutation signal fail during an autotune
tunE7	Motor number of poles set incorrectly
UFlt	Multi module drive: Unidentified fault
UV	DC link under voltage threshold reached
X.Oht2	Multi module drive: Heatsink over temperature detected by module X
X.OI.AC	Multi module drive: Instantaneous output over current detected by module X – peak output current greater than 225%
X.OI.br	Multi module drive: Braking IGBT over current detected in module X
X.OV	Multi module drive: DC link voltage has exceeded the peak level or the maximum continuous level for 30 seconds on
X.PH	Multi module drive: Phase loss trip on module X
X.PS	Internal power supply fault detected on module X

Table 7-2 Serial communications look-up table

No.	Trip	No.	Trip	No.	Trip
1	UU	33	RS	187	C.Typ
2	OU	34	Pad	188	C.cpr
3	OI.AC	35	CL.bit	189	EnC1
4	OI.br	36 to 38	t036 to t038	190	EnC2
5	PS	39	L.SYNC	191	EnC3
6	Et	40 to 99	t040 to t099	192	EnC4
7	O.SPd	100		193	EnC5
8	PS.10V	101 to 108	X.PH	194	EnC6
9	PS.24V	109 to 110	t109 to t110	195	EnC7
10	t010	111 to 118	X.OI.AC	196	EnC8
11	tunE1	119 to 120	t119 to t120	197	EnC9
12	tunE2	121 to 128	X.Oht2	198	t198
13	tunE3	129 to 130	t129 to t130	199	DESt
14	tunE4	131 to 138	1.PS to 8.PS	200	SL1.HF
15	tunE5	139 to 140	t139 to t140	201	SL1.tO
16	tunE6	141 to 148	X.OIBr	202	SL1.Er
17	tunE7	149 to 150	t149 to t150	203	SL1.nF
18	tunE	151 to 158	X.OV	204	SL1.dF
19	It.br	159 to 160	t159 to t160	205	SL2.HF
20	It.AC	161 to 168	t161 to t168	206	SL2.tO
21	O.ht1	169 to 170	t169 to t170	207	SL2.Er
22	O.ht2	171	UFLt	208	SL2.nF
23	O.CtL	172 to 177	t172 to t177	209	SL2.dF
24	Th	178	EnP.Er	210	SL3.HF
25	ThS	179	C.Chg	211	SL3.tO
26	O.Ld1	180	C.Optn	212	SL3.Er
27	O.ht3	181	C.RdO	213	SL3.nF
28	CL2	182	C.Err	214	SL3.dF
29	CL3	183	C.dat	215	SL.rtd
30	SCL	184	C.FULL	216 to 219	t216 to 219
31	EEF	185	C.Acc	220 to 230	HF20 to HF30
32	PH	186	C.rtg		

The trips can be grouped into the following categories:

Table 7-3 Trip categories

Category	Trips	Comments
Self resetting trips	UU	Under voltage trip cannot be reset by the user, but is automatically reset by the drive when the supply voltage is with specification.
Phase loss	PH	The drive stops before tripping provided the drive motoring power is suitably reduced after 500ms of detecting phase loss
Non-important trips	Old1, cL2, cL3, SCL	If parameter 10.37 is 1 or 3 the drive will stop before tripping.
Normal trips	All other trips	Can be reset after 1.0s
Normal trips with extended reset	OI.AC, OI.Br, x.OIAC, x.OIBr	Can be reset after 10.0s
EEF trip	EEF	Cannot be reset unless a code to load defaults is first entered in parameter xx.00 or parameter 11.43.
Non-resettable trips	HF20 to HF30, SL1.HF, SL2.HF, SL3.HF	Cannot be reset. Requires the drive to be powered down.

7.2 Alarm Indications

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

Table 7-4 Alarm indications

LOWER DISPLAY	DESCRIPTION
br.rS	Breaking resistor overload
	Breaking resistor I^2t accumulator (Pr 10.37) in the drive has reached 75.0% of the value at which the drive will trip and the braking IGBT is active.
Hot	Heatsink or control board or inverter IGBT over temperature alarms are active
	• The drive heatsink temperature has reached a threshold and will trip 'Oh2' if the temperature continues to rise Or • The ambient temperature around the control PCB is approaching the over temperature threshold (see the 'O.CtL' trip).
OVLd	Motor overload
	The motor I^2t accumulator in the drive has reached 75% of the value at which the drive will be tripped and the load on the drive is > 100%

7.3 Status Indications

Table 7-5 Status indications

UPPER DISPLAY	DESCRIPTION	DRIVE OUTPUT STAGE
ACUU	AC Supply loss	Enabled
	The drive has detected that the AC supply has been lost and is attempting to maintain the DC bus voltage by decelerating the motor	
***Auto tunE**	Autotune in progress	
	The autotune procedure has been initialised • 'Auto' and 'tunE' will flash alternatively on the display	
dc	DC applied to the motor	Enabled
	The drive is applying DC injection braking	
dEC	Decelerating	Enabled
	The drive is decelerating the motor	
inh	Inhibit	Disabled
	The drive is inhibited and cannot be run. The drive enable signal is not applied to terminal 31 or Pr 6.15 is set to 0	
POS	Positioning	Enabled
	The drive is positioning/ orientating the motor shaft	
rdY	Ready	Disabled
	The drive is ready to run	
run	Running	Enabled
	The drive is running	
SCAn	Scanning	Enabled
	OL> The drive is searching for the motor frequency when synchronising to a spinning motor	
StoP	Stop or holding zero speed	Enabled
	The drive is holding the motor at zero speed	
triP	Trip condition	Disabled
	The drive has tripped and is no longer controlling the motor. The trip code appears on the upper display	

Table 7-6 Option module and SMARTCARD status indications

LOWER DISPLAY	DESCRIPTION
boot	A parameter set is being transferred from the SMARTCARD to the drive during power-up.
cArd	The drive is writing a parameter set to the SMARTCARD during power-up.
loAding	The drive is writing information to an option module

8. Technical Data

8.1 Drive

POWER AND CURRENT RATINGS

Table 8-1 Maximum permissible continuous output current @40ºC (104° F) ambient

MODEL	SERVO DUTY							
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies					
	kW	HP	3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
SP1201	0.75	1	4.3					
SP1202	1.1	1.5	5.8					
SP1203	1.5	2	7.5					
SP1204	2.2	3	10.6					
SP2201	3	3	12.6					
SP2202	4	5	17					
SP2203	5.5	7.5	25					
SP3201	7.5	10	31					
SP3202	11	15	42					
SP1401	0.75	1	2.1					
SP1402	1.1	2	3.0					
SP1403	1.5	3	4.2					4.0
SP1404	2.2	3	5.8					
SP1405	3	5	7.6					
SP1406	4	5	9.5			9.4	7.1	5.6
SP2401	5.5	10	13					
SP2402	7.5	10	16.5					
SP2403	11	20	25					
SP3401	15	25	32					
SP3402	18.5	30	40					
SP3403	22	30	46					
SP3501	2.2	2	4.1					
SP3502	3	3	5.4					
SP3503	4	5	6.1					
SP3504	5.5	7.5	9.5					
SP3505	7.5	10	12					
SP3506	11	15	18					
SP3507	15	20	22					

Table 8-2 Maximum permissible continuous output current @40ºC (104° F) with IP54 insert and standard fan fitted

MODEL	SERVO DUTY							
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies					
	kW	HP	3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
SP1201	0.75	1	4.3					
SP1202	1.1	1.5	5.8					5.7
SP1203	1.5	2	7.5				6.8	5.7
SP1204	2.2	3	10.3	9.8	8.9	8	6.6	5.3
SP2201	3	3						
SP2202	4	5						
SP2203	5.5	7.5						
SP1401	0.75	1	2.1					
SP1402	1.1	2	3					2.2
SP1403	1.5	3	4.2				3.1	2.2
SP1404	2.2	3	5.8		5.6	4.6	3.1	2.2
SP1405	3	5						
SP1406	4	5	8	7.1	5.6	4.6	3.1	
SP2401	5.5	10						
SP2402	7.5	10						
SP2403	11	20						

Table 8-3 Losses @40ºC (104° F)

MODEL	Drive losses (W) taking into consideration any current de-rating for the given conditions							
	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
	kW	HP						
SP1201	0.75	1	69	72	76	81	90	99
SP1202	1.1	1.5	80	83	88	93	104	114
SP1203	1.5	2	93	96	102	108	121	133
SP1204	2.2	3	116	120	128	136	153	170
SP2201	3	3						
SP2202	4	5						
SP2203	5.5	7.5						
SP3201	7.5	10						
SP3202	11	15						
SP1401	0.75	1	61	65	73	81	96	111
SP1402	1.1	2	69	74	83	92	110	129
SP1403	1.5	3	79	85	96	108	131	150
SP1404	2.2	3	94	102	116	130	146	150
SP1405	3	5						
SP1406	4	5	128	139	161	181	182	184
SP2401	5.5	10						
SP2402	7.5	10						
SP2403	11	20						
SP3401	15	25						
SP3402	18.5	30						
SP3403	22	30						
SP3501	2.2	2						
SP3502	3	3						
SP3503	4	5						
SP3504	5.5	7.5						
SP3505	7.5	10						
SP3506	11	15						
SP3507	15	20						

Table 8-4 Losses @40ºC (104° F) with IP54 insert and standard fan fitted

MODEL	Drive losses (W) taking into consideration any current de-rating for the given conditions							
	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
	kW	HP						
SP1201	0.75	1	69	72	76	81	90	99
SP1202	1.1	1.5	80	83	88	93	104	114
SP1203	1.5	2	93	96	102	108	121	133
SP1204	2.2	3	116	120	128	136	153	170
SP2201	3	3						
SP2202	4	5						
SP2203	5.5	7.5						
SP1401	0.75	1	61	65	73	81	96	111
SP1402	1.1	2	69	74	83	92	110	129
SP1403	1.5	3	79	85	96	108	131	150
SP1404	2.2	3	94	102	116	130	146	150
SP1405	3	5						
SP1406	4	5	128	139	161	181	182	
SP2401	5.5	10						
SP2402	7.5	10						
SP2403	11	20						

Table 8-5 Power losses from the front of the drive when through-panel mounted

FRAME SIZE	POWER LOSS
1	≤50W
2	≤75W
3	≤100W

Technical Data

AC SUPPLY REQUIREMENTS

Voltage:

SPX20X 200V to 240V ±10%
SPX40X 380V to 480V ±10%
SPX50X 500V to 575V ±10%

Number of phases: 3

Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases).

Frequency range: 48 to 65 Hz

Table 8-6 Maximum supply fault current

FRAME SIZE	SYMMETRICAL FAULT LEVEL (kA)
1,2,3	5

START UP TIME

This is the time taken from the moment of applying power to the drive, to the drive being ready to run the motor:

Unidrive SP (Size 1 to 3): 4s

STARTS PER HOUR

By electronic control: unlimited

By interrupting the AC supply:

Unidrive SP (Sizes 1 to 3): •20 (equally spaced)

TEMPERATURE, HUMIDITY AND COOLING METHOD

Ambient temperature range:

0ºC to 50ºC (32ºF to122ºF). Output current de-rating must be applied at ambient temperatures >40ºC (104ºF).

Minimum temperature at power-up: -15ºC (5ºF)

Cooling method: Forced convection

Maximum humidity: 95% non-condensing at 40ºC (104ºF)

STORAGE

-40ºC (104ºF) to +50ºC (122ºF)

ALTITUDE

Altitude range: 0 to 3,000m (9,900 ft), subject to the following conditions:

1,000m to 3,000m (3,300 ft to 9,900 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100m (330 ft) above 1,000m (3,300 ft)

For example at 3,000m (9,900ft) the output current of the drive would have to be de-rated by 20%.

IP RATING (INGRESS PROTECTION)

The Unidrive SP is rated to IP20 pollution degree 2 (dry, non-conductive contamination only). However, it is possible to configure the drive to achieve IP54 rating at the rear of the heatsink for through-panel mounting (some current derating is required).

In order to achieve the high IP rating at the rear of the heatsink with Unidrive SP size 1 and 2, it is necessary to seal a heatsink vent by fitting the IP54 insert. For strict compliance with IP54 rating the heatsink fan must be replaced with an IP54 rated fan. Contact the supplier of the drive for details. Fitting of the IP54 insert and/or IP54 rated fan requires output current de-rating to be applied, see Table 8-2 and Table 8-4.

OUTPUT FREQUENCY / SPEED RANGE

Closed-loop speed range: 0 to 40,000rpm

Closed-loop frequency range: 0 to 1250Hz

OVERALL DIMENSIONS

H Height including surface mounting brackets
W Width
D Projection forward of panel when surface mounted
F Projection forward of panel when through-panel mounted
R Projection rear of panel when through-panel mounted

Table 8-7 Overall drive dimensions

MODEL FRAME SIZE	DIMENSION				
	H	W	D	F	R
1	368mm (14.488in)	100mm (3.973in)	219mm (8.622in)	139mm (5.472in)	≤80mm (3.150in)
2		155mm (6.102in)			
3		250mm (9.843in)	260mm (10.236in)	140mm (5.512in)	≤120mm (4.724in)

WEIGHTS

Table 8-8 Overall drive weights

MODEL	kg	lb
SP1201, SP1202, SP1203, SP1204	5	11
SP2201, SP2202, SP2203	7	15.4
SP3201, SP3202	15	33.1
SP1401, SP1402, SP1403, SP1404	5	11
SP1405, SP1406	5.8	12.8
SP2401, SP2402, SP2403	7	15.4
SP3401, SP3402, SP3403	15	33.1
SP3501, SP3502, SP3503, SP3504 SP3505, SP3506, SP3507	15	33.1

Ratings

Table 8-9 Input current, fuse and cable size ratings (European)

Model	Typical input current A	Maximum continuous input current A	Fuse rating IEC gG A	Cable size EN60204	
				Input mm^2	Output mm^2
SP1201	7.1	9.5	10	1.5	1
SP1202	9.2	11.3	12	1.5	1
SP1203	12.5	16.4	20	4	1
SP1204	15.4	19.1	20	4	1.5
SP2201	13.4	18.1	20	4	2.5
SP2202	18.2	22.6	25	4	4
SP2203	24.2	28.3	32	6	6
SP3201	35.4	43.1	50	16	16
SP3202	46.8	54.3	63	25	25
SP1401	4.1	4.8	6	1	1
SP1402	5.1	5.8	6	1	1
SP1403	6.8	7.4	8	1	1
SP1404	9.3	10.6	12	1.5	1
SP1405	10	11	12	1.5	1
SP1406	12.6	13.4	16	2.5	1.5
SP2401	15.7	17	20	4	2.5
SP2402	20.2	21.4	25	4	4
SP2403	26.6	27.6	32	6	6
SP3401	34.2	36.2	40	10	10
SP3402	40.2	42.7	50	16	16
SP3403	51.3	53.5	63	25	25
SP3501	5	6.7	8	1	1
SP3502	6	8.2	10	1	1
SP3503	7.8	11.1	12	1.5	1
SP3504	9.9	14.4	16	2.5	1.5
SP3505	13.8	18.1	20	4	2.5
SP3506	18.2	22.2	25	4	4
SP3507	22.2	26	32	6	6

Table 8-10 Input current, fuse and cable size ratings (USA)

Model	Typical input current A	Maximum continuous input current A	Fuse rating A	Cable size UL508C	
				Input AWG	Output AWG
SP1201	7.1	9.5	10	14	18
SP1202	9.2	11.3	15	14	16
SP1203	12.5	16.4	20	12	14
SP1204	15.4	19.1	20	12	14
SP2201	13.4	18.1	20	12	14
SP2202	18.2	22.6	25	10	10
SP2203	24.2	28.3	30	8	8
SP3201	35.4	43.1	45	6	6
SP3202	46.8	54.3	60	4	4
SP1401	4.1	4.8	6	18	22
SP1402	5.1	5.8	6	16	20
SP1403	6.8	7.4	10	16	18
SP1404	9.3	10.6	15	14	16
SP1405	10	11	15	14	14
SP1406	12.6	13.4	15	14	14
SP2401	15.7	17	20	12	14
SP2402	20.2	21.4	25	10	10
SP2403	26.6	27.6	30	8	8
SP3401	34.2	36.2	40	6	6
SP3402	40.2	42.7	45	6	6
SP3403	51.3	53.5	60	4	4
SP3501	5	6.7	10	16	18
SP3502	6	8.2	10	16	16
SP3503	7.8	11.1	15	14	14
SP3504	9.9	14.4	15	14	14
SP3505	13.8	18.1	20	12	14
SP3506	18.2	22.2	25	10	10
SP3507	22.2	26	30	8	8

INRUSH CURRENT

The Unidrive SP will have an inrush current during power-up, the peak inrush is limited to the value shown below:

SP120X	18A (peak)
SP140X	35A (peak)
SP220X	12A (peak)
SP240X	24A (peak)
SP320X	8A (peak)
SP340X	14A (peak)
SP350X	18A (peak)

MAXIMUM MOTOR CABLE LENGTHS

Table 8-11 Maximum motor cable (200V drives)

<table>
<tr><th colspan="7">200V Nomial AC supply voltage</th></tr>
<tr><th rowspan="2">Model</th><th colspan="6">Maximum permissible motor cable length for each of the following frequencies</th></tr>
<tr><th>3kHz</th><th>4kHz</th><th>6kHz</th><th>8kHz</th><th>12kHz</th><th>16kHz</th></tr>
<tr><td>SP1201</td><td colspan="4">65m (210ft)</td><td rowspan="10">50m (165ft)</td><td rowspan="9">37m (120ft)</td></tr>
<tr><td>SP1202</td><td colspan="3">100m (330ft)</td><td rowspan="9">75m (245ft)</td></tr>
<tr><td>SP1203</td><td colspan="2">130m (425ft)</td><td rowspan="9">100m (330ft)</td></tr>
<tr><td>SP1204</td><td rowspan="8">200m (660ft)</td><td rowspan="8">150m (490ft)</td></tr>
<tr><td>SP2201</td></tr>
<tr><td>SP2202</td></tr>
<tr><td>SP2203</td></tr>
<tr><td>SP3201</td><td></td></tr>
<tr><td>SP3202</td></tr>
</table>

Table 8-12 Maximum motor cable lengths (400V drives)

<table>
<tr><th colspan="7">400V Nomial AC supply voltage</th></tr>
<tr><th rowspan="2">Model</th><th colspan="6">Maximum permissible motor cable length for each of the following frequencies</th></tr>
<tr><th>3kHz</th><th>4kHz</th><th>6kHz</th><th>8kHz</th><th>12kHz</th><th>16kHz</th></tr>
<tr><td>SP1401</td><td colspan="4">65m (210ft)</td><td rowspan="13">50m (165ft)</td><td rowspan="12">37m (120ft)</td></tr>
<tr><td>SP1402</td><td colspan="3">100m (330ft)</td><td rowspan="12">75m (245ft)</td></tr>
<tr><td>SP1403</td><td colspan="2">130m (425ft)</td><td rowspan="12">100m (330ft)</td></tr>
<tr><td>SP1404</td><td rowspan="11">200m (660ft)</td><td rowspan="11">150m (490ft)</td></tr>
<tr><td>SP1405</td></tr>
<tr><td>SP1406</td></tr>
<tr><td>SP2401</td></tr>
<tr><td>SP2402</td></tr>
<tr><td>SP2403</td></tr>
<tr><td>SP3401</td><td></td></tr>
<tr><td>SP3402</td></tr>
<tr><td>SP3403</td></tr>
</table>

Table 8-13 Maximum motor cable (575V drives)

<table>
<tr><th colspan="7">575V Nomial AC supply voltage</th></tr>
<tr><th rowspan="2">Model</th><th colspan="6">Maximum permissible motor cable length for each of the following frequencies</th></tr>
<tr><th>3kHz</th><th>4kHz</th><th>6kHz</th><th>8kHz</th><th>12kHz</th><th>16kHz</th></tr>
<tr><td>SP3501</td><td rowspan="9">200m (660ft)</td><td rowspan="9">150m (490ft)</td><td rowspan="9">100m (330ft)</td><td rowspan="9">75m (245ft)</td><td rowspan="9">50m (165ft)</td><td rowspan="9"></td></tr>
<tr><td>SP3502</td></tr>
<tr><td>SP3503</td></tr>
<tr><td>SP3504</td></tr>
<tr><td>SP3505</td></tr>
<tr><td>SP3506</td></tr>
<tr><td>SP3507</td></tr>
</table>

- Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the drive.
- The default switching frequency is 3kHz for Open-loop and Closed-loop vector, and 6kHz for Servo.

BRAKING RESISTOR VALUES

Table 8-14 Minimum resistance values and peak power rating for the braking resistor at 40ºC (104ºF)

Model	Minimum Resistance Ω	Instantaneous Power Rating kW
SP1201 to SP1203	40	3.8
SP1204	27	5.6
SP2201	15	10
SP2202		
SP2203		
SP3201		
SP3202		
SP1401 to SP1404	75	8.1
SP1405 to SP1406	53	11.4
SP2401	30	20
SP2402		
SP2403		
SP3401		
SP3402		
SP3403		
SP3501		
SP3502		
SP3503		
SP3504		
SP3505		
SP3506		
SP3507		

ELECTROMAGNETIC COMPATIBILITY (EMC)

This is a summary of the EMC performance of the drive. For full details, refer to the Unidrive SP EMC Data Sheet which can be obtained from the supplier of the drive.

Table 8-15 Immunity

Standard	Type of Immunity	Test Specification	Application	Level
IEC61000-4-2 EN61000-4-2	Electrostatic discharge	6kV contact discharge 8kV air discharge	Module enclosure	Level 3 (industrial)
IEC61000-4-3 EN61000-4-3	Radio frequency radiated field	10V/m prior to modulation 80 - 1000MHz 80% AM (1kHz) modulation	Module enclosure	Level 3 (industrial)
IEC61000-4-4 EN61000-4-4	Fast transient burst	5/50ns 2kV transient at 5kHz repetition frequency via coupling clamp	Control lines	Level 4 (industrial harsh)
		5/50ns 2kV transient at 5kHz repetition frequency by direct injection	Power lines	Level 3 (industrial)
IEC61000-4-5 EN61000-4-5	Surges	Common mode 4kV 1.2/50µs waveshape	AC Supply lines: line to earth	Level 4
		Differential mode 2kV 1.2/50µs waveshape	AC Supply lines: line to line	Level 3
		Lines to earth	Signal ports to earth	Level 2
IEC61000-4-6 EN61000-4-6	Conducted radio frequency	10V prior to modulation 0.15 - 80MHz 80% AM (1kHz) modulation	Control and power lines	Level 3 (industrial)
EN50082-1 IEC61000-6-1 EN61000-6-1	Generic immunity standard for the residential, commercial and light - industrial environment			Complies
EN50082-2 IEC61000-6-2 EN61000-6-2	Generic immunity standard for the industrial environment			Complies
EN61800-3 IEC61800-3 EN61800-3	Product standard for adjustable speed power drive systems (immunity requirements)		Meets immunity requirements for first and second environments	
IEC61000-4-11 EN61000-4-11	Voltage dips and interruptions	-30% 10ms +60% 100ms -60% 1s <-95% 5s	AC power ports	

EMISSION

The drive contains an in-built filter for basic emission control. An additional optional external filter provides further reduction of emission. The requirements of the following standards are met, depending on the motor cable length as stated in Table 8-16.

Table 8-16 Emission

Motor cable length (m)	0 to 4	4 to 10	10 to 20	20 to 100
In-built filter	E2U	E2R		
In-built filter and ferrite rings fitted	E2U		E2R	
External filter	R			I

KEY (shown in decreasing order of permitted emission level):

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

E2U EN 61800-3 second environment, unrestricted distribution

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

NOTE This is a product of the restricted distribution class according to IEC61800-3. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

R Residential generic standard EN 50081-1 (EN 61000-6-3) EN 61800-3 first environment unrestricted distribution

8.2 External EMC Filter

In order to provide our customers with a degree of flexibility, external EMC filters have been sourced from two manufacturers: Schaffner & Epcos.

The filters from either manufacturer can be purchased through the supplier of the drive or directly from the filter manufacturer. Filter details for each drive rating are provided in the tables below.

Table 8-17 Filter details

Drive	Filter Type	Schaffner			Epcos		
		Manufacturer part no.	CT part no.	Weight	Manufacturer part no.	CT part no.	Weight
SP1201	Footprint or Bookcase	FS6008-10-07	4200-6118	1.35kg (3.0lb)	B84143-A10-R207	4200-6121	2.1kg (4.6lb)
SP1202							
SP1203		FS6008-16-07	4200-6119	1.4kg (3.1lb)	B84143-A16-R207	4200-6120	
SP1204							
SP2201	Footprint or Bookcase	FS6008-32-07	4200-6210	2.0kg (4.4lb)	B84143-32-R207	4200-6211	3.3kg (7.3lb)
SP2202							
SP2203							
SP3201	Footprint or Bookcase	FS6008-75-07	4200-6307		B84143-75-R207	4200-6306	5.1kg (11.2lb)
SP3202							
SP1401	Footprint or Bookcase	FS6008-10-07	4200-6118	1.35kg (3.0lb)	B84143-A10-R207	4200-6121	2.1kg (4.6lb)
SP1402							
SP1403							
SP1404							
SP1405							
SP1406		FS6008-16-07	4200-6119	1.4kg (3.1lb)	B84143-A16-R207	4200-6120	
SP2401	Footprint or Bookcase	FS6008-32-07	4200-6210	2.0kg (4.4lb)	B84143-32-R207	4200-6211	3.3kg (7.3lb)
SP2402							
SP2403							
SP3401	Footprint or Bookcase	FS6008-62-07	4200-6305	3.45kg (7.6lb)	B84143-75-R207	4200-6306	5.1kg (11.2lb)
SP3402							
SP3403							
SP3501	Footprint or Bookcase						
SP3502							
SP3503							
SP3504							
SP3505							
SP3506							
SP3507							

8.3 UL Listing Information

The Control Techniques UL file number is E171230. Confirmation of UL listing can be found on the UL website: www.ul.com.

Common UL Information

Conformity

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

- The drive is installed in a type 1 enclosure, or better, as defined by UL50
- Class 1 60/75˚C (140/167˚F) copper wire only is used in the installation
- The ambient temperature does not exceed 40˚C (104˚F) when the drive is operating
- The terminal tightening torques specified in the Unidrive SP User Guide
- If the drive control stage is supplied by an external power supply (+24V), the external power supply must be a UL Class 2 power supply

Motor Overload Protection

The drive provides motor overload protection. The overload protection level is 150% of full-load current (FLC) of the drive in open loop mode and 175% of full-load current (FLC) of the drive in closed loop vector or servo modes. It is necessary for the motor rated current be entered into Pr **0.46** (or Pr **5.07**) for the protection to operate correctly. The protection level may be adjusted below 150% if required. Refer to the Unidrive SP User Guide for information on setting the drive current limits and motor thermal protection.

Overspeed Protection

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

Power dependant UL information

Unidrive SP Size 1

Conformity

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

- The correct UL-listed class CC fast acting fuses, e.g. Bussman Limitron KTK series, Gould Amp-Trap ATM series or equivalent, are used in the AC supply

AC supply specification

The Unidrive SP is suitable for use in a circuit capable of delivering not more than 5000rms symmetrical Amperes at 264Vac rms maximum (200V drives) and 528Vac rms maximum (400V drives).

Maximum continuous output current

The drive models are listed as having the maximum continuous output currents (FLC) shown in Table 8-18 and Table 8-19 (see Table 8-1 for details)

Table 8-18 Maximum continuous output current (200V drives)

Model	FLC (A) Normal Duty
SP1201	5.2
SP1202	6.8
SP1203	9.6
SP1204	11

Table 8-19 Maximum continuous output current (400V drives)

Model	FLC (A) Normal Duty
SP1401	2.8
SP1402	3.8
SP1403	5
SP1404	6.9
SP1406	11

Safety label

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

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

NOTE UL listing for all other sizes applied for. Contact the supplier of the drive for further information.

8.4 Unimotor

Physical

Insulation Class	Class H, BS EN 60034-1.
Insulation System	USR & CNR Class H Electrical Insulation System designated 'CTD/1S/2000/01'.
Dimensional Accuracy	IEC 60072-1, Class N (normal class), Class R (precision class) is optional.
Degree of Balance	Rotor balanced to ISO 1940 (BS 6861) G 6.3 (half key convention to ISO 8821).
Temperature Monitoring	PTC thermistor, 170ºC switch temperature.
Bearing System	Preloaded ball bearings, metal shielded, high temperature grease.
Electrical Connections	Connector or terminal box for power and brake; connector for feedback devices and thermistor.
Flange Mounting	IEC 60072-1 as standard / NEMA MG-7 optional.
Output Shaft	Plain shaft as standard. Output key is optional (to IEC 60072-1).

Environmental

Ingress Protection	Motor, excluding mounting face, and with mating connectors and cables fitted. Ingress protection : IP65S.
Operating Temperature	Specified performance at 0-40˚C ambient.
Storage Temperature	-20˚C to 70˚C.
Insulation Class	H (180˚C) Insulation system. UL recognised label on rear cover indicates CTD/IS/2000/02 insulation system, UL number E214439.
Temperature Rise (Winding)	125˚C over ambient of 40˚C Max. 100˚C over ambient of 40˚C Typical.

This chart shows the standard and optional features available with each motor.

Table 8-20 Standard and Optional Features

Description	Order Ref.	Refers to	Unimotor Frame Size				
			75	95	115	142	190
Motor Type	UM	Unimotor	●	●	●	●	●
Stator Length	A		■	■	■	■	■
	B		■	■	■	■	■
	C		■	■	■	■	■
	D		■	■	■	■	■
	E		N/A	■	■	■	N/A
Rated Speed	10	1000 RPM	▲	▲	▲	▲	▲
	20	2000 RPM	■	■	■	■	●
	30	3000 RPM	●	●	●	●	■
	40	4000 RPM	■	■	■	■	▲
	60	6000 RPM	■	■	▲	▲	N/A
Brake	0	Non fitted	●	●	●	●	●
	1	Fitted 24V DC	■	■	■	■	■
Connection Type	C	Connector, rotatable	●	●	●	●	●
	H	Hybrid (Power terminal box)	▲	▲	▲	▲	▲
Output Shaft Key	A	With key	■	■	■	■	■
	B	Without key	●	●	●	●	●
Feedback Device	C	Incremental encoder	●	●	●	●	●
	R	SIN/COS encoder SRM50 (Multi)	■	■	■	■	■
	S	SIN/COS encoder SRS50 (Single)	■	■	■	■	■
	A	Resolver 55RSS116	■	■	■	■	■
Flange Mounting	A	IEC Flange (no gearbox)	●	●	●	●	●
	X	Gearbox	▲	▲	▲	▲	▲
Inertia	A	Standard	●	●	●	●	●
	B	High	■	■	■	■	■

Use the codes in the Order Ref. column to build your order code. Choose one reference from each of the description categories.

● - Standard Feature
■ - Standard Option
▲ - Limited Availability Option
N/A - Not Available

Mechanical Precision Class ‘R’ Option
Option available on any motor: shaft/front flange to IEC 72-1, Class ‘R’ (Precision Class)

Table 8-21 Unimotor Performance Specifications T = 100˚C, 40˚C ambient

Motor Frame Size		75				95				
All versions (rpm)		A	B	C	D	A	B	C	D	E
Continuous Stall Torque	(Nm)	1.2	2.2	3.1	3.9	2.3	4.3	5.9	7.5	9.0
Peak Torque	(Nm)	3.6	6.6	9.3	11.7	6.9	12.9	17.7	22.5	27.0
High Inertia	($kgcm^2$)	1.2	1.6	2.1	2.5	3.5	4.5	5.6	6.7	7.8
Standard Inertia	($kgcm^2$)	0.6	1.0	1.5	1.9	1.4	2.5	3.6	4.7	5.8
Weight	(kg)	3.0	3.7	4.4	5.1	5.0	6.1	7.2	8.3	9.5
Winding Thermal Time Const.	(sec)	81	74	94	100	172	168	183	221	228
Maximum Cogging	(Nm)	0.02	0.03	0.04	0.05	0.03	0.06	0.08	0.10	0.13
Rated Speed: 2000(rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**2.4/2.1** **147/129**				**2.4/2.1** **147/129**		
Rated Torque	(Nm)	1.1	2.1	3.0	3.8	2.2	4.0	5.5	6.9	8.2
Cont. Stall Current (hot)	(A_{rms})	0.6	1.0	1.5	1.9	1.1	2.0	2.8	3.6	4.3
Rated Power	(kW)	0.23	0.44	0.63	0.80	0.46	0.84	1.15	1.45	1.72
R (ph-ph) (cold)	(Ohms)	144	48.2	25.0	15.7	59.0	17.0	9.90	6.00	4.30
L (ph-ph)	(mH)	214	99.2	59.2	44.7	131	54.5	36.5	25.6	18.9
Rated Speed 3000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**1.6/1.4** **98/85.8**				**1.6/1.4** **98/85.8**		
Rated Torque	(Nm)	1.1	2.0	2.8	3.5	2.0	3.9	5.4	6.8	8.1
Cont. Stall Current (hot)	(A_{rms})	0.9	1.6	2.2	2.8	1.6	3.1	4.2	5.4	6.4
Rated Power	(kW)	0.35	0.63	0.88	1.10	0.63	1.23	1.70	2.14	2.54
R (ph-ph) (cold)	(Ohms)	60.8	20.1	10.5	7.5	24.5	6.80	4.00	2.50	2.00
L (ph-ph)	(mH)	98.4	41.8	27.6	19.7	57.9	24.3	15.5	10.9	8.50
Rated Speed 4000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**1.2/1.1** **73.5/64.4**				**1.2/1.1** **73.5/64.4**		
Rated Torque	(Nm)	1.0	1.7	2.3	2.9	1.8	3.0	4.0	4.9	5.7
Cont. Stall Current (hot)	(A_{rms})	1.1	2.1	3.0	3.7	2.2	4.1	5.6	7.1	8.6
Rated Power	(kW)	0.42	0.71	0.96	1.21	0.75	1.26	1.68	2.05	2.39
R (ph-ph) (cold)	(Ohms)	36.8	10.5	6.30	4.20	12.7	4.08	2.10	1.50	1.03
L (ph-ph)	(mH)	54.9	24.8	14.9	10.8	31.5	13.6	8.50	6.30	4.80
Rated Speed 6000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**0.8/0.7** **49.0/42.9**				**0.8/0.7** **49.0/42.9**		
Rated Torque	(Nm)	0.9	1.6	2.1	2.6	1.3	2.1	2.8	3.3	3.7
Cont. Stall Current (hot)	(A_{rms})	1.7	3.1	4.4	5.6	3.3	6.1	8.4	10.7	12.8
Rated Power	(kW)	0.57	1.01	1.32	1.63	0.82	1.32	1.76	2.07	2.32
R (ph-ph) (cold)	(Ohms)	15.0	5.00	2.66	1.90	5.45	1.82	1.05	0.62	0.48
L (ph-ph)	(mH)	24.0	10.6	6.80	4.80	14.1	6.00	3.80	2.70	2.10

Note 1: All data subject to +/- 10% tolerance.

Note 2: $1kgcm^2 = 1x10^{-4}\ kgm^2$

Cold = Motor windings at 25°C

Hot = Motor at continuous full rating in 40°C ambient

Technical Data

115					142					190			
A	B	C	D	E	A	B	C	D	E	A	B	C	D
3.5	6.6	9.4	12.4	15.3	6.3	10.8	15.3	19.8	23.4	21.8	41.1	58.7	73.2
10.5	19.8	28.2	36.0	45.9	18.9	32.4	45.9	59.4	70.2	65.4	123.3	176.1	219.6
9.7	12.0	14.3	16.6	18.8	21.6	28.0	34.3	40.7	47.0	93.5	140.5	187.5	234.5
3.2	5.5	7.8	10.0	12.3	7.8	14.1	20.5	26.8	33.1	50.0	97.0	144.0	191.0
6.5	8.2	9.9	11.6	13.2	10.9	13.2	15.5	17.8	26.0	26.0	33.0	40.0	48.0
175	185	198	217	241	213	217	275	301	365	240	242	319	632
0.06	0.10	0.14	0.18	0.21	0.09	0.16	0.23	0.30	0.35	0.30	0.54	0.72	0.99
		2.4/2.1 147/129					**2.4/2.1 147/129**				**2.4/2.3 147/138**		
3.2	6.1	8.7	10.8	13.1	5.9	10.3	14.6	18.4	21.3	20.0	36.9	50.4	54.7
1.7	3.1	4.5	5.9	7.3	3.0	5.1	7.3	9.4	11.1	9.6	18.2	26.0	32.4
0.67	1.28	1.82	2.26	2.74	1.24	2.16	3.06	3.85	4.46	4.19	7.73	10.6	11.5
27.8	8.55	4.55	2.96	2.17	12.5	3.60	2.10	1.35	0.98	1.80	0.56	0.33	0.23
94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	28.1	13.0	8.90	6.30
		1.6/1.4 98.0/85.8					**1.6/1.4 98.0/85.8**				**1.6/1.5 98.0/92.3**		
3.0	5.5	8.1	10.4	12.6	5.4	9.0	12.2	15.8	18.0	19.2	33.0	35.0	36.8
2.5	4.7	6.7	8.9	10.9	4.5	7.7	10.9	14.1	16.7	14.5	27.3	39.0	48.6
0.94	1.73	2.54	3.27	3.96	1.70	2.83	3.83	4.96	5.65	6.03	10.4	11.0	11.6
12.6	3.86	2.02	1.40	1.10	5.63	1.72	0.94	0.61	0.42	0.79	0.30	0.14	0.09
43.1	18.6	11.4	8.60	7.40	31.0	13.3	8.30	6.10	4.80	13.2	6.11	3.60	2.46
		1.2/1.1 73.5/64.4					**1.2/1.1 73.5/64.4**						
2.5	4.7	6.3	7.5	8.7	3.6	7.0	8.9	10.7	12.2	▲	▲	▲	N/A
3.3	6.3	8.9	11.8	14.6	6.0	10.3	14.6	18.8	22.3				
1.05	1.97	2.64	3.14	3.64	1.51	2.93	3.73	4.48	5.11				
6.91	2.14	1.16	0.73	0.57	3.12	1.00	0.53	0.35	0.24				
23.5	10.2	6.60	4.70	3.90	17.6	7.50	4.70	3.60	2.70				
		0.8/0.7 49.0/42.9					**0.8/0.7 49.0/42.9**						
2.2	4.0	5.1	▲	N/A	2.90	4.5	▲	▲	N/A				
5.0	9.4	13.4			9.0	15.4							
1.38	2.51	3.20			1.82	2.83							
3.28	0.97	0.50			1.42	0.46							
15.54	4.81	2.94			7.72	3.44							

▲ Consult factory

N/A Not available

Table 8-22 Unimotor Performance Specifications With Resolver Feedback T = 125˚C, 40˚C ambient

Motor Frame Size		75				95				
All versions (rpm)		A	B	C	D	A	B	C	D	E
Continuous Stall Torque	(Nm)	1.3	2.4	3.4	4.4	2.5	4.6	6.5	8.3	10.0
Peak Torque	(Nm)	3.3	6.0	8.5	11.0	6.3	11.5	16.3	20.8	25.0
High Inertia	($kgcm^2$)	1.2	1.6	2.1	2.5	3.5	4.5	5.6	6.7	7.8
Standard Inertia	($kgcm^2$)	0.6	1.0	1.5	1.9	1.4	2.5	3.6	4.7	5.8
Weight	(kg)	3.0	3.7	4.4	5.1	5.0	6.1	7.2	8.3	9.5
Winding Thermal Time Const.	(sec)	81	74	94	100	172	168	183	221	228
Maximum Cogging	(Nm)	0.02	0.03	0.04	0.05	0.03	0.06	0.08	0.10	0.13
Rated Speed: 2000(rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**2.4/2.1** **147/126**				**2.4/2.1** **147/126**		
Rated Torque	(Nm)	1.2	2.3	3.3	4.2	2.3	4.3	6.0	7.6	9.1
Cont. Stall Current (hot)	(Arms)	0.6	1.2	1.7	2.1	1.2	2.2	3.2	4.0	4.9
Rated Power	(kW)	0.25	0.48	0.69	0.88	0.48	0.90	1.26	1.59	1.91
R (ph-ph) (cold)	(Ohms)	144	48.2	25.0	15.7	59.0	17.0	9.90	6.00	4.30
L (ph-ph)	(mH)	214	99.2	59.2	44.7	131	54.5	36.5	25.6	18.9
Rated Speed 3000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**1.6/1.4** **98.0/84.0**				**1.6/1.4** **98.0/84.0**		
Rated Torque	(Nm)	1.2	2.2	3.1	3.9	2.2	4.2	5.9	7.5	9.0
Cont. Stall Current (hot)	(Arms)	0.9	1.8	2.5	3.2	1.8	3.4	4.7	6.1	7.3
Rated Power	(kW)	0.38	0.69	0.97	1.23	0.69	1.32	1.85	2.36	2.83
R (ph-ph) (cold)	(Ohms)	60.8	20.1	10.5	7.50	24.5	6.80	4.00	2.50	2.00
L (ph-ph)	(mH)	98.4	41.8	27.6	19.7	57.9	24.3	15.5	10.9	8.50
Rated Speed 4000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**1.2/1.0** **73.5/63.0**				**1.2/1.0** **73.5/63.0**		
Rated Torque	(Nm)	1.1	1.9	2.6	3.3	2.0	3.2	4.4	5.5	6.6
Cont. Stall Current (hot)	(Arms)	1.3	2.3	3.3	4.3	2.4	4.5	6.3	8.1	9.7
Rated Power	(kW)	0.46	0.80	1.09	1.38	0.84	1.34	1.84	2.30	2.76
R (ph-ph) (cold)	(Ohms)	36.8	10.5	6.30	4.20	12.7	4.08	2.10	1.50	1.03
L (ph-ph)	(mH)	54.9	24.8	14.9	10.8	31.5	13.6	8.50	6.30	4.80
Rated Speed 6000 (rpm)		**Kt nom/ hot (Nm/A)** **Ke nom/ hot (V/krpm)**		**0.8/0.7** **49.0/42.0**				**0.8/0.7** **49.0/42.0**		
Rated Torque	(Nm)	1.0	1.8	2.4	3.0	1.7	2.7	3.7	4.8	5.9
Cont. Stall Current (hot)	(Arms)	1.9	3.5	5.0	6.4	3.6	6.7	9.5	12.1	14.6
Rated Power	(kW)	0.63	1.13	1.51	1.88	1.07	1.70	2.32	3.02	3.71
R (ph-ph) (cold)	(Ohms)	15.0	5.00	2.66	1.90	5.45	1.82	1.05	0.62	0.48
L (ph-ph)	(mH)	24.0	10.6	6.80	4.80	14.1	6.00	3.80	2.70	2.10

Note 1: All data subject to +/- 10% tolerance.
Note 2: $1kgcm^2 = 1x10^{-4}\ kgm^2$

Cold = Motor windings at 25°C
Hot = Motor at continuous full rating in 40°C ambient

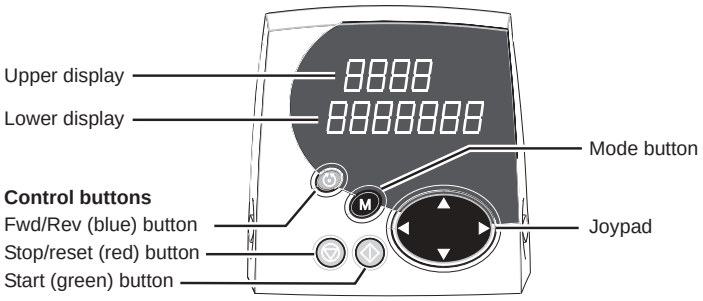
Technical Data

115					142					190			
A	B	C	D	E	A	B	C	D	E	A	B	C	D
4.0	7.3	10.5	13.9	17.6	7.3	12.5	17.7	22.9	27.0	23.2	43.2	62.8	78.0
10.0	18.3	26.3	34.8	44.0	18.3	31.3	44.3	57.3	67.5	58.0	108.0	157.0	195.0
9.7	12.0	14.3	16.6	18.8	21.6	28.0	34.3	40.7	47.0	93.5	140.5	187.5	234.5
3.2	5.5	7.8	10.0	12.3	7.8	14.1	20.5	26.8	33.1	50.0	97.0	144.0	191.0
6.5	8.2	9.9	11.6	13.2	10.9	13.2	15.5	17.8	26.0	26.0	33.0	40.0	48.0
175	185	198	217	241	213	217	275	301	365	240	242	319	632
0.06	0.10	0.14	0.18	0.21	0.09	0.16	0.23	0.30	0.35	0.30	0.54	0.72	0.99
		2.4/2.1 147/126					**2.4/2.1 147/126**				**2.4/2.3 147/138**		
3.7	6.8	9.8	12.3	15.5	6.8	12.0	17.0	21.4	24.9	20.8	38.1	53.0	60.0
1.9	3.5	5.1	6.8	8.6	3.5	6.1	8.6	11.1	13.1	10.4	19.3	28.0	34.8
0.77	1.42	2.05	2.58	3.25	1.42	2.51	3.56	4.48	5.22	4.36	8.0	11.1	12.6
27.8	8.55	4.55	2.96	2.17	12.5	3.60	2.10	1.35	0.98	1.80	0.56	0.33	0.23
94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	28.1	13.0	8.90	6.30
		1.6/1.4 98.0/84.0					**2.4/2.1 98.0/84.0**				**1.6/1.5 98.0/91.5**		
3.3	6.2	9.2	11.9	14.7	6.3	10.5	14.2	18.4	21.0	20.1	36.2	38.3	40.2
2.9	5.3	7.7	10.1	12.8	5.3	9.1	12.9	16.7	19.7	15.5	28.9	42.0	52.2
1.04	1.95	2.89	3.74	4.62	1.98	3.30	4.46	5.78	6.60	6.31	11.4	12.0	12.6
12.6	3.86	2.02	1.40	1.10	5.63	1.72	0.94	0.61	0.42	0.79	0.30	0.14	0.09
43.1	18.6	11.4	8.60	7.40	31.0	13.3	8.30	6.10	4.80	13.2	6.11	3.60	2.46
		1.2/1.0 73.5/63.0					**1.2/1.0 73.5/63.0**						
2.9	5.4	7.3	8.6	10.0	4.2	8.2	10.4	12.5	14.2	▲	▲	▲	N/A
3.9	7.1	10.2	13.5	17.1	7.1	12.2	17.2	22.3	26.3				
1.21	2.26	3.06	3.60	4.19	1.76	3.43	4.36	5.24	5.95				
6.91	2.14	1.16	0.73	0.57	3.12	1.00	0.53	0.35	0.24				
23.5	10.2	6.60	4.70	3.90	17.6	7.50	4.70	3.60	2.70				
		0.8/0.7 49.0/42.0					**0.8/0.7 49.0/42.0**						
2.7	4.7	6.1	▲	N/A	3.6	5.7	▲	▲	N/A				
5.8	10.6	15.3			10.6	18.2							
1.70	2.95	3.83			2.26	3.58							
3.28	0.97	0.50			1.42	0.46							
15.54	4.81	2.94			7.72	3.44							

▲ Consult factory

N/A Not available

9.1 LED Keypad And Display



The Unidrive SP LED keypad and display is rated to IP 20.

CONTROL BUTTONS

The keypad consists of :
1. Joypad
2. One mode button
3. Three control buttons

The joypad is used to navigate the parameter structure and change parameter values.
The mode button is used to change between the display modes – parameter view, parameter edit, status.
The three control buttons are used to control the drive if keypad mode is selected.

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

DISPLAY

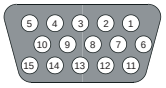
The display consist of two horizontal rows of 7 segment displays.
The upper display shows the drive status or the current menu and parameter number being viewed.
The lower display shows the parameter value or the specific trip type.

NOTE The LED keypad and display can be fitted / removed whilst the drive is powered up and running a motor, providing that the drive is not operating in keypad mode.

9.2 SM Option Modules

All Unidrive SP option modules are colour-coded in order to make identification easy. The following table shows the option module, colour-code, description and terminal details.

Table 9-1 SM-Universal Encoder Plus Termination

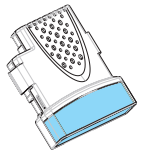
Option module	Colour	Name	Terminal Information
	Light Green	SM-Universal Encoder Plus	SK1  PL2 

Term	Encoder										
	Ab	Fd	Fr	Ab. SErVO	Fd. SErVO	Fr. SErVO	SC	SC HiPEr	SC EndAt	EndAt	SSI
1	A	F	F	A	F	F	Sin	Sin	Sin		
2	A\	F\	F\	A\	F\	F\	Sin\	Sin\	Sin\		
3	B	D	R	B	D	R	Cos	Cos	Cos		
4	B\	D\	R\	B\	D\	R\	Cos\	Cos\	Cos\		
5	Z							Data			
6	Z\							Data\			
7	Aout (Fout)			U				Aout (Fout)			
8	Aout\ (Fout\)			U\				Aout\ (Fout\)			
9	Bout (Dout)			V				Bout (Dout)			
10	Bout\ (Dout\)			V\				Bout\ (Dout\)			
11				W					Clock		
12				W\					Clock\		
13	+V										
14	0V										
15	th										

Term	Input / Encoder outputs					
	Freeze RS485 Input	Freeze +24V Input	Ab Output	Fd Output	SSI Output	Marker Output
1		Freeze				
2	0V					
3			A	F	Data	
4			A\	F\	Data\	
5			B	D	Clock	
6			B\	D\	Clock\	
7	0V					
8	Freeze					Z
9	Freeze\					Z\

Code	Encoder	Type	Description
0	Ab	Incremental only	Quadrature incremental encoder. With or without marker pulse.
1	Fd		Incremental encoder with frequency and direction outputs. With or without marker pulse.
2	Fr		Incremental encoder with forward and reverse outputs. With or without marker pulse.
6	SC		SinCos encoder with no serial communications. No optional marker pulse.
3	Ab.SErVO	Incremental and Commutation (Absolute)	Quadrature incremental encoder with commutation outputs. With or without marker pulse.
4	Fd. SErVO		Incremental encoder with frequency, direction and commutation outputs. With or without marker pulse.
5	Fr. SErVO		Incremental encoder with forward, reverse and commutation outputs. With or without marker pulse.
U,V,W commutation signals are required with an incremental type encoder when used with a servomotor. The UVW commutation signals are used to define the motor position during the first 120º electrical rotation after the drive is powered-up or the encoder is initialised.			
10	SSI	Comms (Absolute)	Absolute SSI only encoder. Additional communications with the encoder is not possible.
8	EndAt		Absolute EndAt only encoder. Additional communications with the encoder is not possible.
7	SC.HiPEr	Incremental plus communications (absolute encoders)	Absolute SinCos encoder using Stegmann 485 comms protocol (HiperFace). The drive checks the position from the sine and cosine waveforms against the internal encoder position using serial communications. If an error occurs the drive trips.
9	SC.EndAt		Absolute SinCos encoder using EndAt comms protocol. The drive checks the position from the sine and cosine waveforms against the internal encoder position using serial communications. If an error occurs the drive trips.

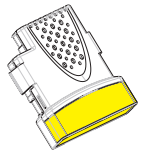
Table 9-2 SM-Resolver Termination

Option module	Colour	Name	Terminal Information
	Light Blue	SM-Resolver	

Terminal	Simulated encoder output connections
1	A
2	A\
3	0V
4	B
5	B\
6	0V
7	Z
8	Z\

Terminal	Resolver connections
9	SIN LOW
10	SIN HIGH
11	COS LOW
12	COS HIGH
13	REF HIGH (excitation)
14	REF LOW (excitation)
15	OV
16	OV
17	OV

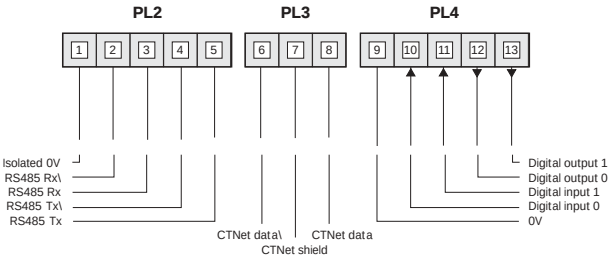
Table 9-3 SM-I/O Plus Termination

Option module	Colour	Name	Terminal Information
	Yellow	SM-I/O Plus	

PL 1	Function
1	0V common (digital)
2	Digital input/output F1
3	Digital input/output F2
4	Digital input/output F3
5	0V common (digital)
6	Digital input F4
7	Digital input F5
8	Digital input F6
9	Analog input 4
10	Analog input 5
11	0V common (analog)
12	Analog output 3
PL 2	**Function**
21	Relay 1 (F7)
22	Relay common
23	Relay 2 (F8)

Options

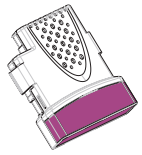
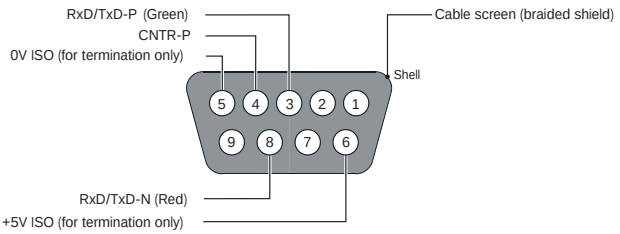
Table 9-4 SM Applications Plus Termination

Option module	Colour	Name	Terminal Information
	Dark green	SM Applications Plus	

PL 2	Function	Description
1	0V SC	0V Connection for RS485 port
2	RX\	EIA-RS485 Receive line (negative). Incoming
3	RX	EIA-RS485 Receive line (positive). Incoming
4	TX\	EIA-RS485 Receive line (negative). Outgoing
5	TX	EIA-RS485 Receive line (positive). Outgoing
PL 3	**Function**	**Description**
6	CTNet data\	CTNet data line (negative)
7	CTNet Shield	Shield connection for CTNet
8	CTNet data	CTNet data line (positive)
PL 4	**Function**	**Description**
9	0V	0V connection for digital I/O
10	DIO	Digital input 0
11	DI1	Digital input 1
12	DO0	Digital input 0
13	DO1	Digital input 1

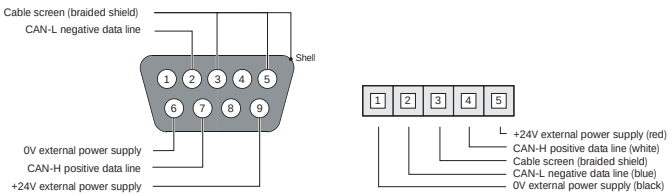
Options

Table 9-5 SM-PROFIBUS-DP Termination

Option module	Colour	Name	Terminal Information
	Purple	SM-PROFIBUS-DP	

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

Table 9-6 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

Options

Table 9-7 SM-INTERBUS-DP Termination

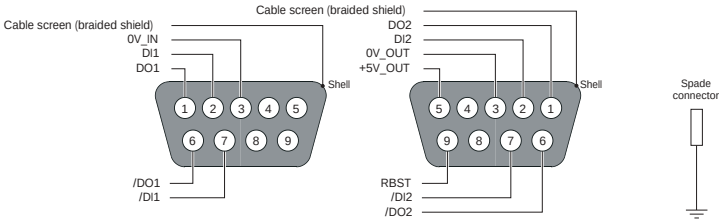
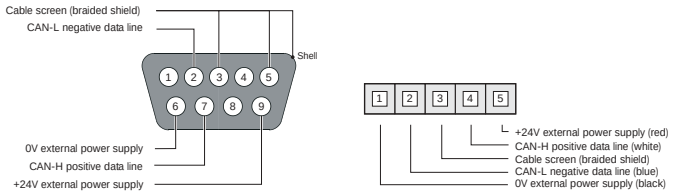
Option module	Colour	Name	Terminal Information
	Dark Grey	SM-INTERBUS-DP	

Table 9-8 SM-CANopen Termination

Option module	Colour	Name	Terminal Information
	Light Grey	SM-CANopen	

The following manuals are also available providing full information on the various option modules and advanced product use:

- Unidrive SP User Guide
- Unidrive SP Advanced User Guide
- SM-Applications User Guide
- SM-I/O Plus User Guide
- SM-Universal Encoder Plus User Guide
- SM-PROFIBUS-DP Advanced User Guide
- SM-DeviceNet Advanced User Guide
- SM-Resolver User Guide
- SM-INTERBUS User Guide
- SM-CANopen User Guide

9.3 Communication 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 lead is available from Control Techniques for this purpose - this same lead is used with other Control Techniques products that use a RJ45 RS485 connector such as the Commander SE.

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.

With this type of connection you can only control the drive and SM-Applications modules that the PC is connected to.

Figure 9-2 Communications Cable

Table 9-10 Isolated serial comms lead details

Part Number	Description
4500-0079	SM-Comms Cable

9.4 Motor Power and Signal Cables

Cables are an important part of a servo system installation. Not only must the noise immunity and integrity of the cabling and connectors be correct, but also SAFETY and EMC regulations must be complied with to ensure successful, reliable and fail-safe operation. One of the most frequent problems experienced by motion systems engineers is incorrect wiring connection of the motor to the drive.

CT Dynamics' ready-made cables mean system installers can avoid the intricate, time consuming assembly normally associated with connecting servo systems. Installation and set-up time are greatly reduced - there is no fiddling with wire connections and crimp tools, and no fault finding.

The cables are made to order in lengths from 2m to 50m /100m.

Figure 9-3 Typical Feedback cable

CABLE RANGE

Cable range for motor-drive combinations:

- UM & Unidrive SP

Power cable variants:

- Phase conductors 1.5mm2 (16A) to 16mm2 (70A)
- With and without brake wire pairs
- Motor end - Connector
- Motor end - Hybrid (power terminal box)
- tailored to suit drive (ferrules; strands; ring terminals)

Signal cable feedback types:

- Incremental
- Resolver
- Sincos
- cable tailored to suit drive (ferrules; connectors)

CABLE FEATURES

- Dynamic performance
- PUR outer sheath for oil resistance and dynamic performance
- Complies with DESINA coding - Orange for power, green for signal
- Power cable and plugs UL recognised
- Optimum noise immunity
- Shielded brake supply wires
- UM Encoder cable has low volt drop for long cable lengths and separately screened thermistor wires
- Brake wires are separately shielded within power cable
- No need for crimp and insertion / removal tools
- Production build gives quality and price benefits
- Braided screen for greater flexibility and wear
- Power cables with or without brake wires
- Cable assembly type identification label

Options

SELECTING POWER CABLES

Cable Type - With reference to power cable ordering chart below.

For motors with brake, choose PB cable type;

For motors without brake wire, choose cable PS type.

Jacket

B - specifies for PUR sheath.

Sheath colour is petrol blue changing to DESINA orange during year 2002.

Conductor Size

Select conductor size according to motor STALL CURRENT.

Include forced cooling performance if applicable.

Ratings are for individual cables (not lashed together) in free air temperatures up to 40 deg.C - make allowances as appropriate.

Connectors

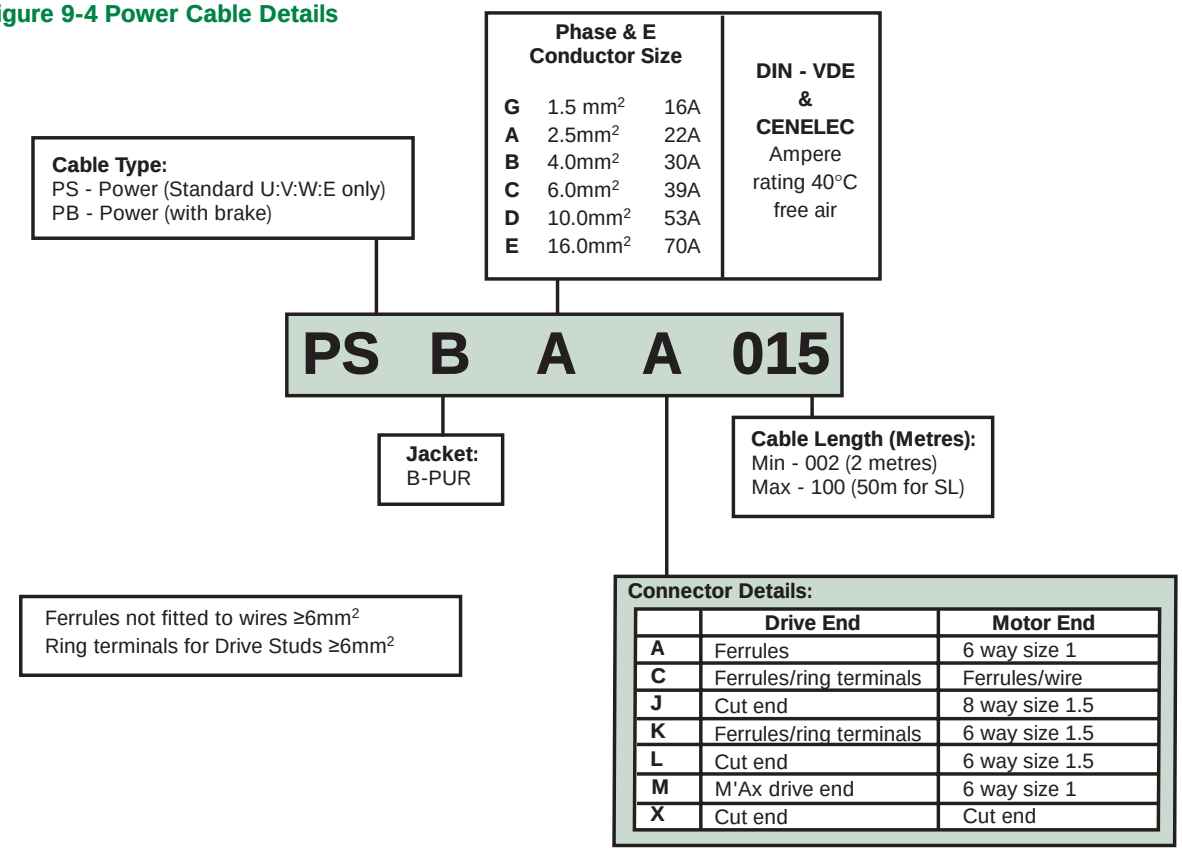
For final letter type, select for motor end (connector size 1 or 1.5; or hybrid terminals) and drive end (Unidrive SP)

X - represents cable only.

Length

Numbers represent the required cable length in metres. N.B. max. length of 50m applies for some systems.

Figure 9-4 Power Cable Details



Options

SELECTING SIGNAL CABLES

With reference to signal cable ordering information chart:
Cable Type
Choose cable type to match feedback device.

Jacket

B – all are PUR jacket.

Sheath colour is petrol blue changing to DESINA green during year 2002.

Options

Select special option:

A - normal for standard straight plug

B - 90-degree elbow plug at motor end

L - special 8.5mm small diameter SI cable for small motors and drives, limited to 10m maximum length only.

Connectors

Cable end terminations must match motor feedback connector and drive type:

A SI cable fitted with Unidrive high density D connector and motor incremental feedback plug, 17 way, maximum length 100m.

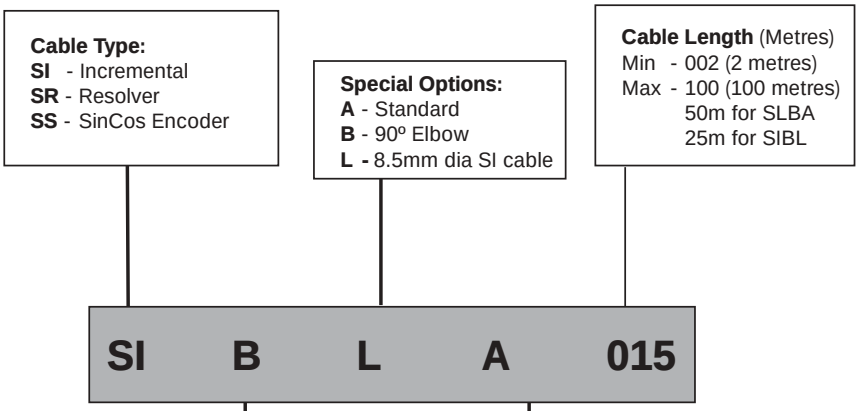
B Any signal cable with no connector at drive end, and appropriate connector at motor end.

C SR or SS cable with standard ferrules to match SM-Resolver and SM-Universal Encoder Plus Option Modules at Unidrive SP end and motor resolver or sincos 12 way plug.

H SI cable for Epsilon or EN drives, with motor incremental feedback plug, 17 way.

X cable only

Figure 9-5 Signal Cable Details



Connector Details:		
	Drive End	**Motor End**
A	15P 'D type' (Unidrive SP)	17 way (SI)
B	Cut end	SI/SR/SS
C	Ferrules (Unidrive SP)	12 way (SR/SS)
E	SI/SR/SS	Cut end
J	15P 'D type' (Unidrive)	17 way chassis recpt. (SI)
L	17 way extension skt.	17 way (SI)
X	Cut end	Cut end

9.5 Fail Safe Parking Brakes

Any Unimotor may optionally be ordered with an internal rear mounted parking brake. The brake works on a fail safe principle: the brake is active when the supply voltage is switched off and the brake is released when the supply voltage is switched on. The table below shows the delay times that occur when the brake is switched on or off. Shunting the brake with an external diode to avoid switching peaks increases the coil's decay time (t_{OUT}) considerably.

If a motor is fitted with a fail safe brake, take care not to expose the motor shaft to excessive torsional shocks or resonances when the brake is engaged or disengaged. Doing so can damage the brake.

SAFETY NOTE: The Fail-Safe Brake is for use as a holding brake with the motor shaft stationary. Do NOT use it as a dynamic brake, except for emergencies such as a mains supply failure.

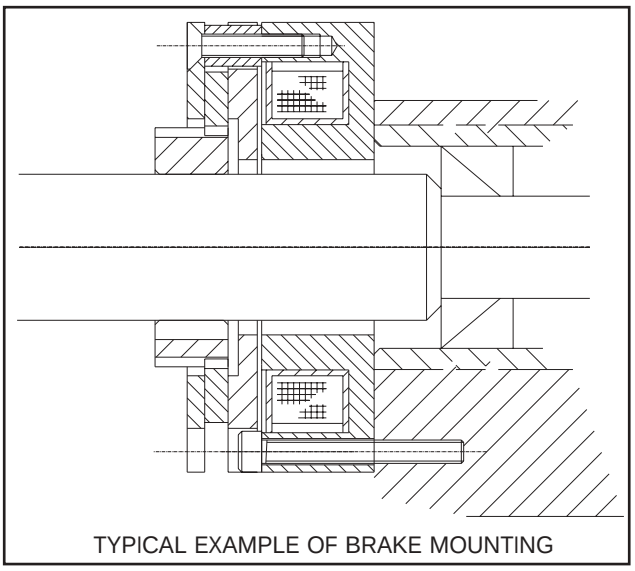


Figure 9-6 Brake Mounting

Table 9-11 Technical Data

MOTOR FRAME SIZE	VOLTS	POWER	STATIC TORQUE	RELEASE TIME (Coil Energised)	BRAKE ON-TIME (Coil de-energising no diode)	BRAKE ON-TIME (Coil de-energising with diode)	INERTIA	BACKLASH
(mm)	DC	W	(Nm)	(ms nominal)	(ms nominal)	(ms nominal)	($kgcm^2$)*	(degrees)
75	24	6.3	2	22	24	100	0.03	0.75
95	24	16	6	30	20	140	0.29	0.75
115	24	16	12	40	10	60	0.49	0.75
142	24	23	20	85	30	200	1.28	0.6
190(A/B)	24	25	40	95	15	85	1.28	0.6
190(C/D)	24	25	60	120	20	150	2.50	0.6

Note that the brake response time is extended when a diode is fitted across the brake coil at the driver (customer) end. This is usually required to protect solid state switches, or to reduce arcing at the relay contacts

* Note 1 kgcm2 = 1x10-4kgm2

SPECIAL BRAKES

Where volumes have justified it, Control Techniques have designed a number of custom products with customer specific brakes.

Please contact Control Techniques if you have a requirement for a special application.

9.6 Fanblown Motor Description

Control Techniques easy to fit fan cowlings provide outstanding performance improvements with power densities not hitherto possible achieved in a small volume. This powerful means of forced convection enables a higher rms torque output for the same motor winding temperature. Cool air from the rear of the motor is channelled through the Unimotor's specially designed fins bringing a substantial increase to rated and stall torque of the motor. Peak torque remains unaffected.

The fan cowlings can be added to new or existing installations, wherever additional power is required.

- Easy to fit - slide on and clamp
- Peak torque is unimpeded
- High power density for installations with limited space
- Encoder motors can run at Δ125ºC rating
  Optimize power where thermal path is restricted, such as gearmotor applications

Figure 9-7 Typical Fan Cool

Specification

- Fan Voltage - 230V ; 0.1A ; 50-60Hz
- Air Direction - from rear to front
- Fan IP Rating - IP20
- Fan Approvals - VDE; UL; CSA
- Motor/Fan Combined Performance - De-rate above 40ºC
- Cooling Air - fluff and fibre free.
  If filter is to be used, performance must be de-rated.

Table 9-12 Fanblown Motor Performance

Motor Type	Stall Torque (Nm)	Rated Torque (Nm) for motor speeds (rpm)			Motor Type	
					Unbraked	Braked
	All Speeds	2000	3000	4000	COWLING ORDER REF.	
75UMA	1.4	1.4	1.4	1.3	75FB01	75FB02
75UMB	2.8	2.8	2.8	2.5	75FB02	75FB03
75UMC	4.3	4.3	4.2	3.8	75FB03	75FB04
75UMD	6.1	5.9	5.7	5.2	75FB04	75FB05
95UMA	2.9	2.7	2.6	2.4	95FB01	95FB02
95UMB	5.7	5.3	5.2	4.3	95FB02	95FB03
95UMC	8.4	8.1	8.0	6.7	95FB03	95FB04
95UMD	11.5	11.0	10.9	9.2	95FB04	95FB05
95UME	14.6	13.9	13.8	12.0	95FB05	95FB06
115UMA	4.8	4.4	4.1	3.8	115FB01	115FB02
115UMB	9.2	8.5	8.2	7.6	115FB02	115FB03
115UMC	14.0	13.2	12.8	11.2	115FB03	115FB04
115UMD	19.3	18.0	17.8	14.7	115FB04	115FB05
115UME	25.7	23.3	22.9	18.9	115FB05	115FB06
142UMA	8.5	8.0	7.5	5.7	142FB01	142FB03
142UMB	15.3	14.9	13.6	11.6	142FB02	142FB04
142UMC	22.5	22.4	20.0	16.7	142FB03	142FB05
142UMD	30.2	30.0	27.4	22.3	142FB04	142FB06
142UME	37.0*	36.0	33.8	28.0	142FB05	142FB07
190UMA	28.8	26.7	25.9	~	190FB01	190FB02
190UMB	55.7	54.2	50.3	~	190FB02	190FB03
190UMC	84.1	73.2	57.8	~	190FB03	190FB04
190UMD	107.6	83.8	65.9	~	190FB04	190FB05

Notes: Torque performances shown are applicable for motors with either encoder or resolver, temperatures taken to $\Delta T = 125°C$.

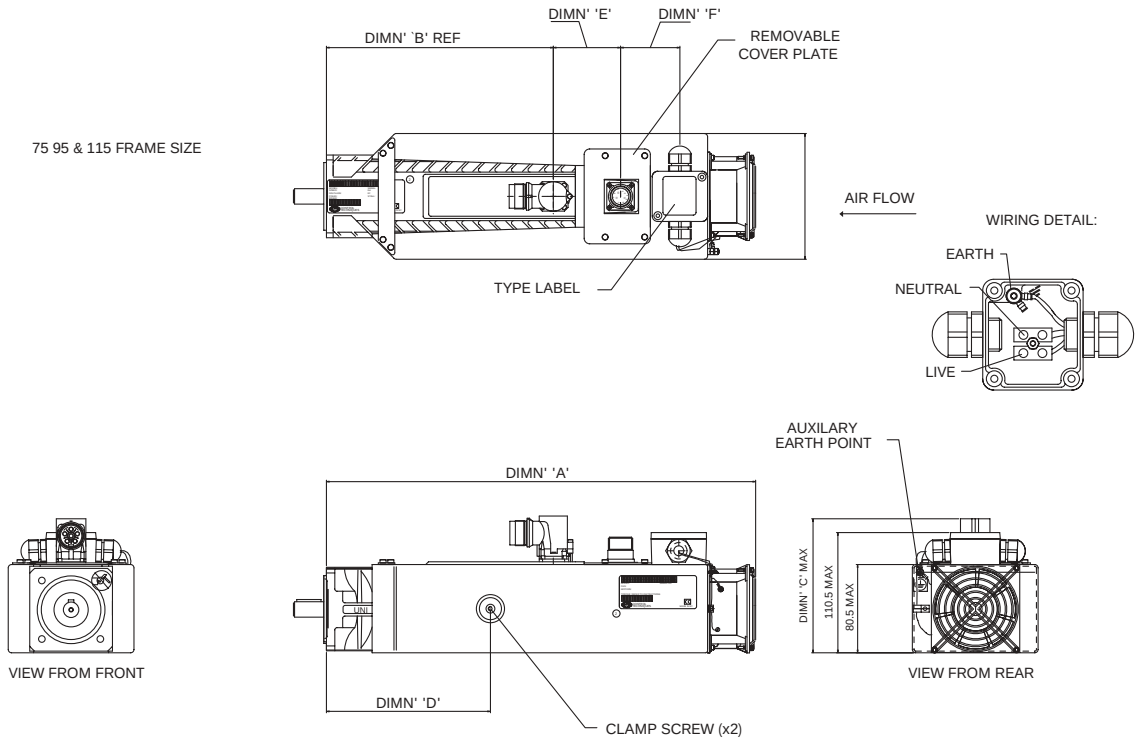
The increase in torque output will require a higher drive current.

* 142UME 400 : maximum continuous stall torque is limited to 28Nm due to connector current limitation.

WARNING: Peak torque values remain as quoted for non fan blown performance.

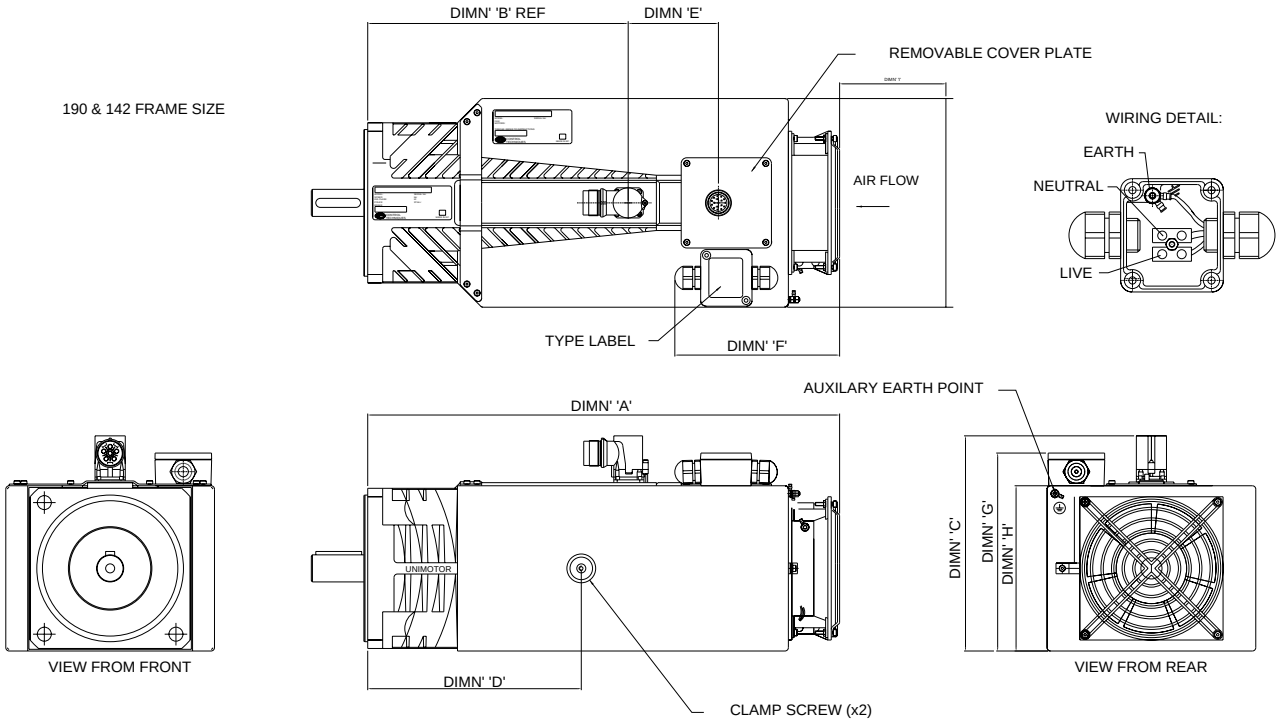
Options

Figure 9-8 Fanblown Motor 75-115 Dimensions



Frame Size		75				95					115				
Dimension/Length suffix		A	B	C	D	A	B	C	D	E	A	B	C	D	e
A	Length Overall (Unbraked)	296	326	356	386	316	346	376	406	436	309	339	369	399	429
A	Length Overall (Braked)	326	356	386	416	346	376	406	436	466	339	369	399	429	459
B	Front Flange to Power C/L (Unbraked)	116	146	176	206	125	155	185	215	245	142	172	202	232	262
B	Front Flange to Power C/L (Braked)	146	175	206	236	155	185	215	245	275	172	202	232	262	292
C	Overall Height	135 max.				157 max					177 max.				
D	Clamp Screw to Front Flange (Unbraked)	97	112	127	142	100	115	130	145	160	128	143	158	173	188
D	Clam Screw to Front Flange (Braked)	112	127	142	157	115	130	145	160	175	143	158	173	188	203
E	Power C/L to Feedback Connector C/L	61.0				62.6					66.0				
F	Connector Box C/L to Fan Termainal Box C/L	53.8				53.8					44.4				
G	Height to Top of Fan Terminal Box	110.5				129.0					150.0				
H	Height to Top of Fan Casing	80.5				100.0					120.0				
I	Air Intake Clearance	40.0				40.0					40.0				
K	Width	115.0				135.0					159.0				

Figure 9-9 Fanblown Motor 142-190 Outline



Frame Size		142					190			
Dimension/Length suffix		A	B	C	D	E	A	B	C	D
A	Length Overall (Unbraked)	303	333	363	393	423	369	423	477	531
A	Length Overall (Braked)	363	393	423	153	483	423	477	531	584
B	Front Flange to Power C/L (Unbraked)	111	141	171	201	231	69	123	177	231
B	Front Flange to Power C/L (Braked)	171	201	231	261	291	123	177	231	285
C	Overall Height	204 max.					259 max			
D	Clamp Screw to Front Flange (Unbraked)	151	166	181	196	211	170	197	224	251
D	Clam Screw to Front Flange (Braked)	181	196	211	226	241	197	224	251	270
E	Power C/L to Feedback Connector C/L	80.0					173.0			
F	Connector Box C/L to Fan Termainal Box C/L	147.0					167.0			
G	Height to Top of Fan Terminal Box	176.0					225.0			
H	Height to Top of Fan Casing	147.0					196.0			
I	Air Intake Clearance	40.0					60.0			
K	Width	187.0					240.0			

9.7 Gearboxes

Although Control Techniques servomotors can operate smoothly at full torque from 1 rpm (sincos - from small fractions of rpm) to full rated speed, the addition of a gearbox can be a useful torque multiplier and can also provide a better match to high inertia loads.

A Gearbox May Help If:-

- Load is high torque, usually below 1000rpm
- Load is high inertia
- Load has unusually high axial or radial loads
- Small overall size with small motor
- Possible cost reduction with smaller motor & drive package
- Space constraints where right angle option or smaller overall package helps

For example: -

- A 1.2Nm 4000rpm motor fitted with 100:1 ratio gearbox gives a continuous torque around 100Nm, albeit at a reduced speed of 40rpm max.
- A 4,000rpm motor with a 4:1 gearbox in certain circumstances may offer a better performance than a 2,000rpm motor alone working at 1000rpm with large inertial load. The motor torque required for the gearbox is 4 times less, whilst the reflected load inertia is reduced by 16 (=ratio^2), so that a better match of motor/load inertia results and greater stability with higher servo gains are possible.

Control Techniques offers a range of gearboxes supplied fitted to any Unimotor (75 to 190 frame sizes).

If required, gearboxes can also be supplied separately.

By following a simple selection procedure, a suitable motor-gearbox combination may be selected from specifications provided in this section.

Gearbox specifications appended to this section are quality planetary gearboxes and include low backlash, standard backlash, single-stage, and two-stage with ratios up to 100:1.

Gearboxes with 90 degree angled output shafts can increase the possible ratio permutations up to 200:1.

The gearbox output shaft can optionally be fitted with key.

The motor-gearbox assembly comprises of the gearbox, an integral gearbox adaptor plate, and a standard CT motor.

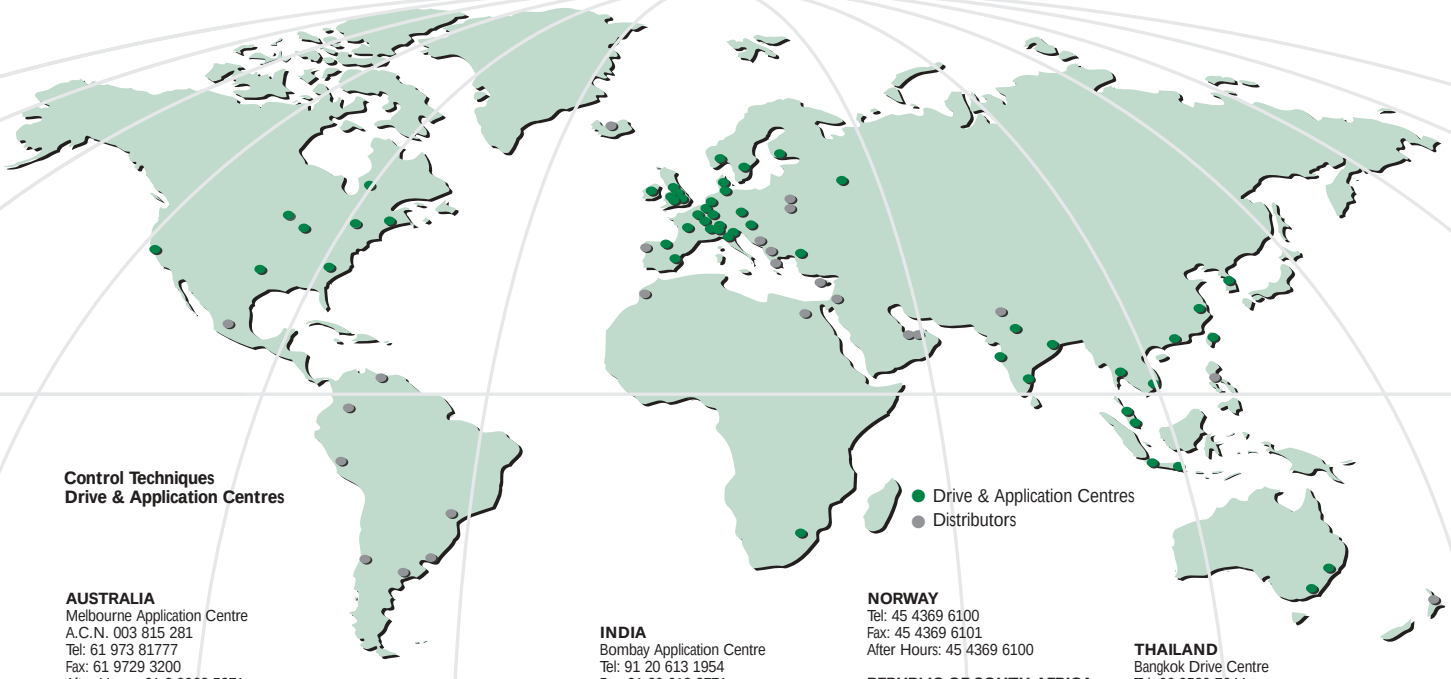
The motor-gearbox assembly is normally supported from the front face / flange of an in-line gear reducer. For a right angled gearbox, the SPK, mounting support is also to the gearbox flange, but for the WT, mounting support is to the gearbox frame .

Features – Gearboxes

- High quality, low backlash, low noise
- Taper bearings (not on the LP)
- Wide selection
- Planetary gearboxes for high efficiency and low inertia
- High strength
- Long service life
- Ratios to 100:1 (200:1 for SPK)
- Lifetime lubrication to suit any mounting attitude
- Gearbox IP64 protection rating
- To suit all 75 to 190 frame Unimotors

Figure 9-10 Typical Geared Motor Assembly

driving the world...



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Telford Drive Centre
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