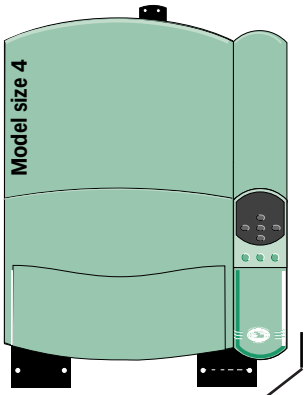
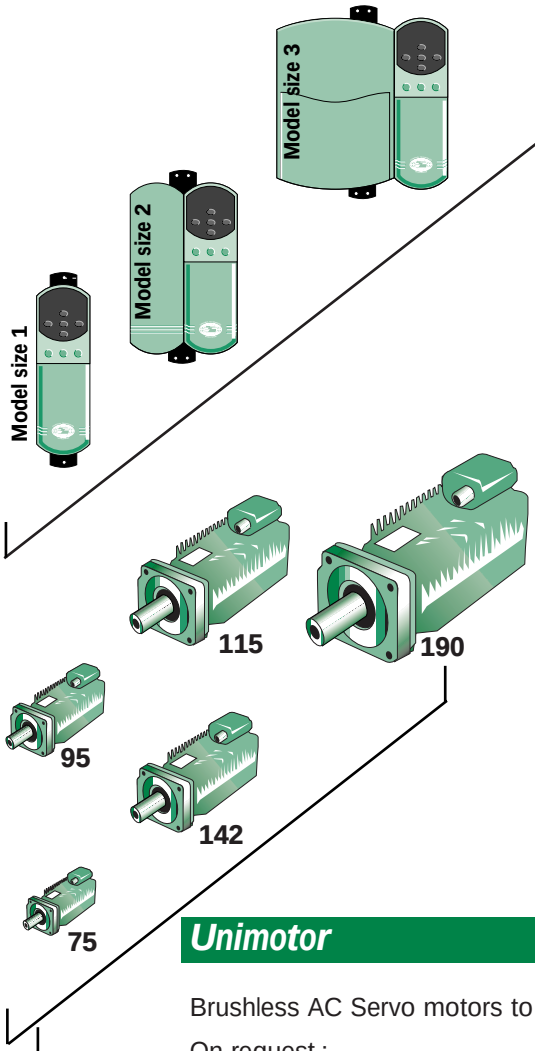
Unidrive Servo & Unimotor product data

The performance matched AC Servo solution for all applications

Unidrive Servo & Unimotor

The complete multi purpose Servo package with high flexibility & functionality





Power Range 380-480V

Size 1 - 0.75 to 4kW
Size 2 - 5.5 to 11kW
Size 3 - 15 to 37kW
Size 4 - 45 to 110kW
Size 5 - >110kW
Line regeneration capability

Motion Intelligence

UD70 - Applications module
UD78 - High performance servo
UD50 - Extended I/O
UD51 - 2nd Encoder
Unisoft - Programming software
SYPT - Systems programming tool
CTSS - Servo sizing software tool

Connectivity

UD73 - Profibus DP
UD74 - Interbus S
UD77 - DeviceNet
UD75 - CT Net
UD76 - Modbust +
UD71 - RS232/485
HMI - Operator Interfaces

Feedback

Standard - Encoder
UD53 - Resolver
UD52 - Sin/cos encoder

Unimotor

Brushless AC Servo motors to 70Nm

On request :

- Brushless >70NM-1850Nm
- Asynchronous >70NM-2500Nm

Motor accessories: - cables, fan cowlings, brakes, planetary geared motors

drive overview

Unidrive

The Unidrive is an advanced AC drive for use with AC brushless permanent magnet servo motors. The Unidrive's set up can be easily and quickly changed from the on-board keypad, a remote keypad, or through *UniSoft*, a Windows™ based configuration software tool.

Sizes

There are five physical sizes comprising 26 different models ranging from 1NM to 2500 NM*. The drive is designed for stand alone as well as coordinated systems applications. There are hundreds of configurable functions in 20 logically organised menus. All functions are factory defaulted to typical values to facilitate easy set-up.

Parameters

The Unidrive's most commonly used parameters are stored in Menu 0. This menu is defaulted with those parameters which are typically accessed, but the user may map any of the drive's other parameters to this menu for easier access. This approach means easy access for those parameters the user selects.

Flexibility

In addition Unidrive has many other of embedded configurable functions which are easily adapted for virtually any application. Some of these configurable functions include items such as assignable I/O, autotune, encoder feedback, frequency and direction pulse signal input and output, axis limit control, ratio control, electronic holding brake, S-ramps, position control and many others.

Technology

Many of these important product features would not be possible without the use of advanced technology in the Unidrive. The drive employs advanced microprocessor technology which controls all drive functions including input to the inverter ASIC (Application Specific Integrated Circuit) which synthesises an adjustable carrier frequency PWM (Pulse Width Modulation) output. The ASIC output controls the IGBT (Insulated Gate Bipolar Transistor) inverter section. All printed circuit boards are manufactured using surface mount technology.

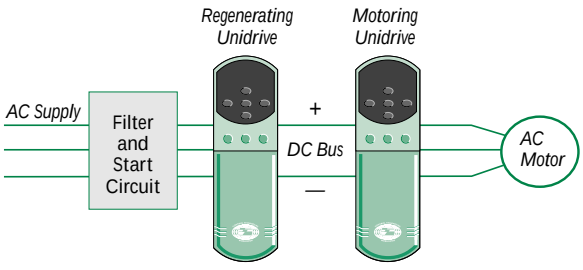
Regeneration

The Regeneration mode is used for four-quadrant operation. A Drive can be operated in Regeneration mode only when it is connected to other Drive(s) operating in one of the other (motoring) modes.

Regeneration mode allows the following:

- AC supply to be fed from the Regeneration Drive to the Drive(s) that are controlling the motor
- Regenerated power to be returned to the AC supply by the Regeneration Drive instead of being dissipated in braking resistors

Regeneration Module Control Mode ▼



* For ratings above 65NM please consult your local Drive/Application centre

Key Features

General Features

- Coast & Ramp to Stop modes
- 8 Preset speeds & Ramps
- 3 Skip frequencies
- S Ramp
- Motorised potentiometer
- Internal braking transistor as standard
- Encoder input as standard
- Programmable security code
- Bright two line LED display

Advanced Features

- Position control
- Digital lock
- Mains dip ride through
- Frequency slaving
- Catch a spinning motor
- Programmable logic functions
- Orientation

Performance Features

- 336µs speed loop sample time
- 176µs current loop sample time
- 16 bit speed loop
- 12 bit current loop
- Dynamic injection/braking
- Fast current loop with PI control

Flexibility Features

- Speed reference selector
- Full I/O programmability
- Unisoft
- Well structured menu system
- Encoder I/P
- Programmable logic functions
- Configurable menu zero
- Programmable thresholds
- Resolver feedback
- Sin/cos feedback
- High speed communications
- Applications module
- High performance module

Ease of Use Features

- Macros
- Bright two line LED display
- Cloning module
- Unisoft

Maintenance Features

- Clock
- Full internal protection & diagnostics
- Last ten trips stored
- Programmable security code
- Common control board
- Pluggable terminals

Menu Overview

Introduction

The Unidrive's more than 700 parameters 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.

Menu zero

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

Categories:

0.0	Configuration
0.01 – 0.02	Speed limits
0.03 – 0.06	Ramps
	Speed reference selection
	Current limit
0.07- 0.09	PID gains (closed loop)
0.10 – 0.13	Monitoring
0.14 – 0.17	Jog reference
	Ramp mode selector
	Stop and torque mode selectors
0.18 – 0.19	S-ramp
0.20 – 0.23	Skip bands
0.24 – 0.26	Analogue input modes
0.27 – 0.34	Miscellaneous
0.35	Keypad reference monitoring
0.36 – 0.38	Serial communications
	Parameter displayed at power up
0.39 – 0.41	Spinning motor
	Autotune
	PWM switching frequency
0.42 – 0.47	Motor parameters
0.48	Operating mode selection
0.49 – 0.50	Status information

Menu 1	*Frequency / speed reference selection*
	Frequency / speed limits
	Skip frequencies / speeds
Menu 2	*Acceleration and deceleration ramps*
	Ramp selection, enable selected
	Braking mode selection
	S-ramp
Menu 3	*Speed indications*
	Speed loop PID gain
	Speed sensing thresholds
	Frequency slaving
	Hard speed reference
	Encoder set up
Menu 4	*Current monitoring*
	Current limiting in speed control
	Current loop gains
	Torque control
	Motor protection
Menu 5	*Motor monitoring*
	Motor ratings
	Autotune
	PWM switching frequency
Menu 6	*Drive sequencer*
	Auto-start
	AC supply loss
	Jog time
	Limit switches
	Injection braking
	Synchronise to a spinning motor
	Keypad enable
	Run-time log
	Electricity cost
Menu 7	*Analogue I/O*
	Temperatures
Menu 8	*Digital I/O*
Menu 9	*Programmable logic*
	Motorised potentiometer
	Binary-sum logic
Menu 10	*Status and diagnostic information*
	Process generated trips
	UD78 power supply indicator
Menu 11	*Menu 0 assignments*
	Scale factors
	Initial parameters displayed
	Serial communications
	Drive information
Menu 12	*Programmable comparators*
Menu 13	*Position control*
Menu 14	*PID controller*
Menu 15	*Regeneration*
Menu 16	*Small Option Module*
Menu 17	*Large Option Module*
Menu 18	*User parameters LOM*
Menu 19	*User LOM*
Menu 20	*UD70 only*

introduction to macros

Unidrive operation can be simplified by using pre-configured application macros. These macros are held in the internal memory of the drive and are user selectable.

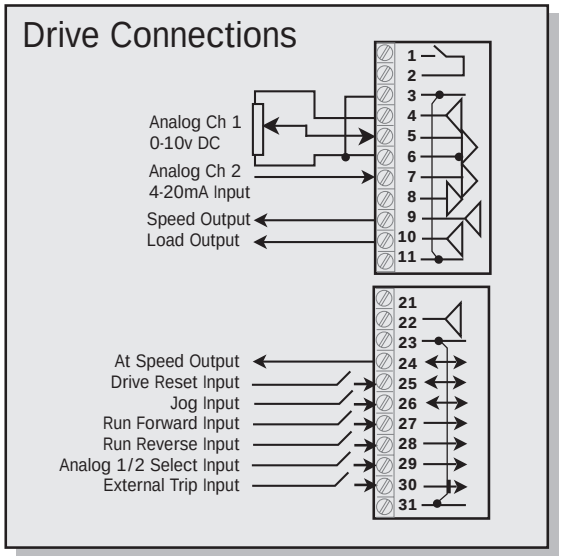
Macro summary

Macro	Function
0	Default mode
1	Easy mode
2	Motorised potentiometer
3	Preset speeds
4	Torque control
5	PID macro
6	Axis Limit control
7	Hoist control/brake release
8	Digital Lock

When a Macro is not enabled, the drive operates in a default configuration (EURO USA)

Macro 1 – Easy Mode

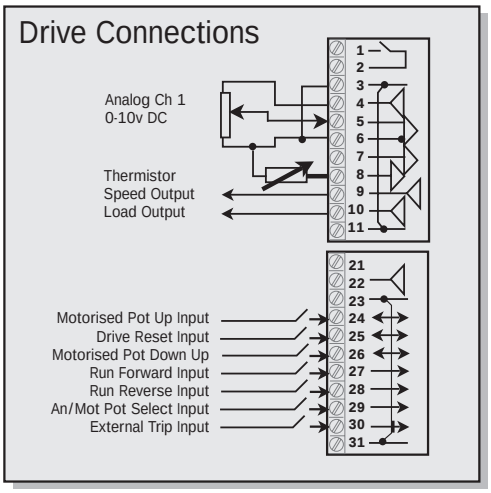
Easy mode defines the most commonly used features with only 10 parameters. These parameters are numbered 0.01 to 0.10

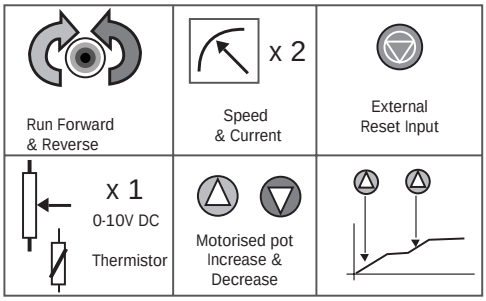


Menu 0 Parameter	Param.	Description
0.01	1.07	Minimum Speed
0.02	1.06	Maximum Speed
0.03	2.11	Acceleration time
0.04	2.21	Deceleration time
0.05	1.14	Reference select
0.06	4.07	Current limit
0.07	3.10	Proportional gain
0.08	3.11	Integral gain
0.09	3.12	Derivation gain
0.10	3.02	Speed feedback

Macro 2 – Motorised Potentiometer

With this function it is possible to emulate a motorised potentiometer within the Unidrive by simply supplying two logic input signals to increase or decrease the “potentiometer”. The output of the “potentiometer” may be routed to control any of the drive’s non-bit parameters such as speed, torque or current limit. The function may be configured to reset upon power cycling or to memorise its value.

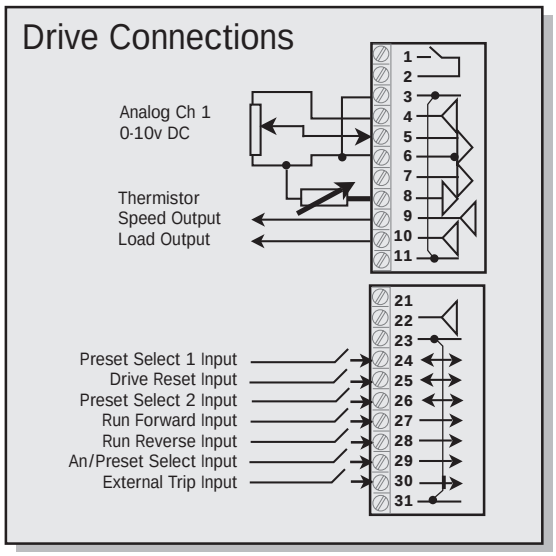


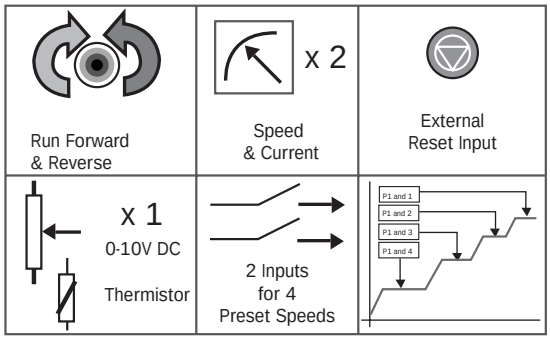


Macro 3 – Preset Speeds

By using this macro up to four preset frequencies / speeds can be used. Preset values must be programmed into individual parameters. Frequency / speed selection is done by activating terminal 29 and putting a binary combination on terminals 24 and 26.

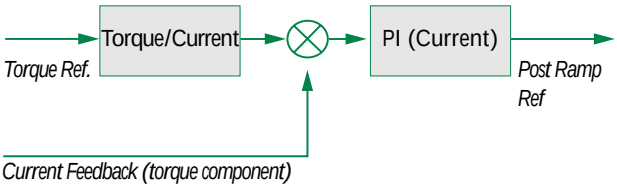
Terminal 24	Terminal 26	Speed
Open	Open	As set in Pr 0.25
Open	Closed	As set in Pr 0.26
Closed	Open	As set in Pr 0.27
Closed	Closed	As set in Pr 0.28

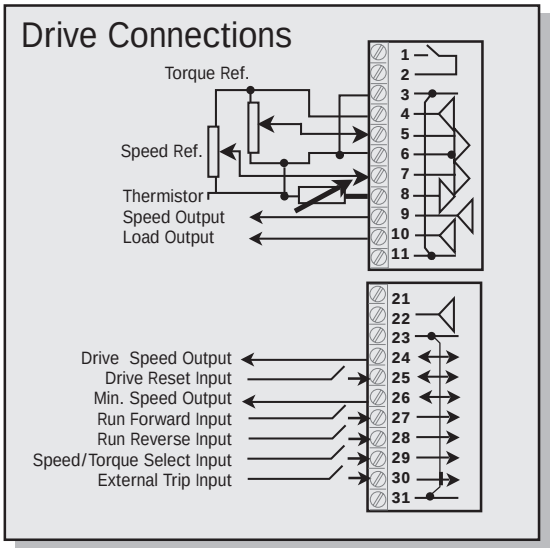


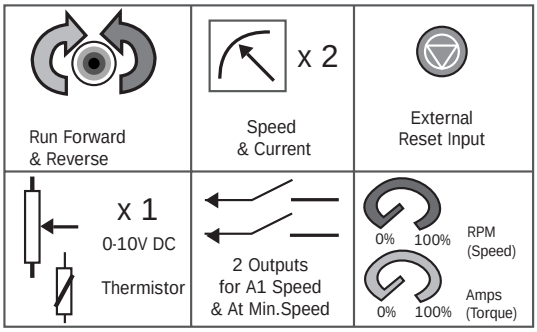


Macro 4 – Torque control

When this macro is selected a drive can be operated in Speed or Torque control by using terminal 29.
If in Speed control mode, speed is maintained independent of load within the limits of the drive. In Torque control mode the drive will attempt to reach the speed set point but only with the torque available as defined by the torque reference signal.

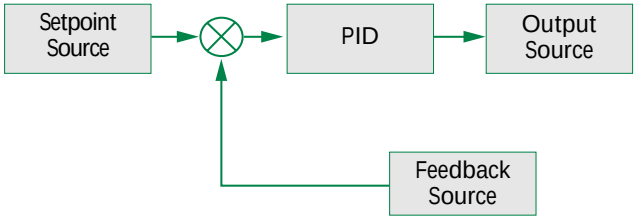


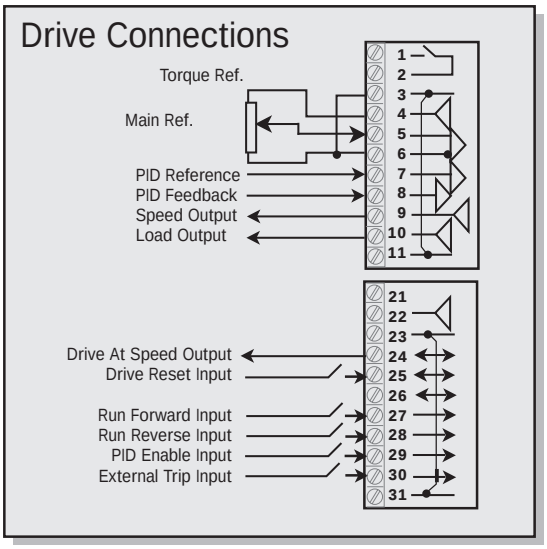


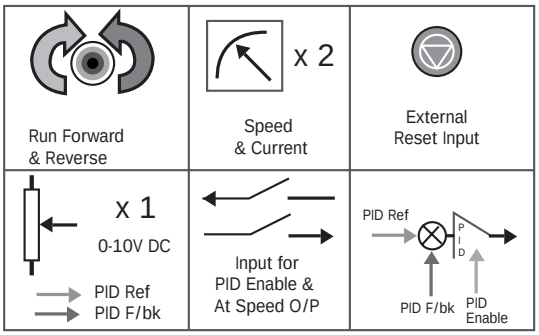


Macro 5 – PID control

This macro configures the drive to control a motor with reference to PID control signal. In PID control, the error resulting from differences between the PID feedback and PID reference is passed through a limiter, a scaling stage and finally the error is added to the frequency / speed signal.

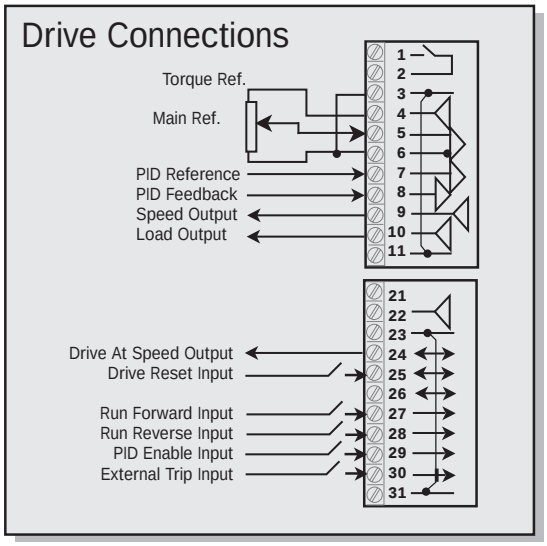


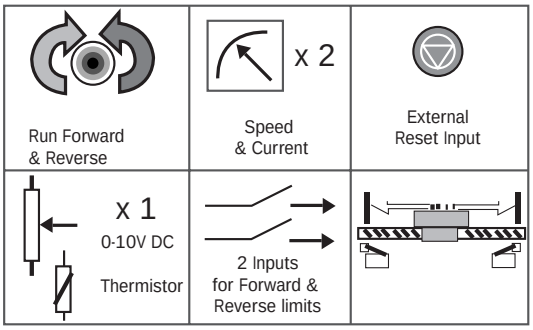




Macro 6 – Axis Limit control

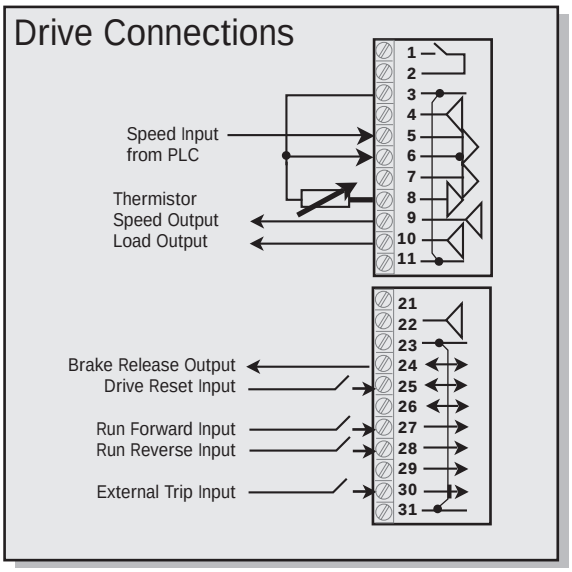
Using this macro enables two digital inputs to be re-programmed so providing limit switch lockout for axis position control systems. The drive would normally be run from a +/- 10v reference and controlled forward / backwards from this. If a limit switch level is reached the drive will be forced to stop independent of the speed setting.

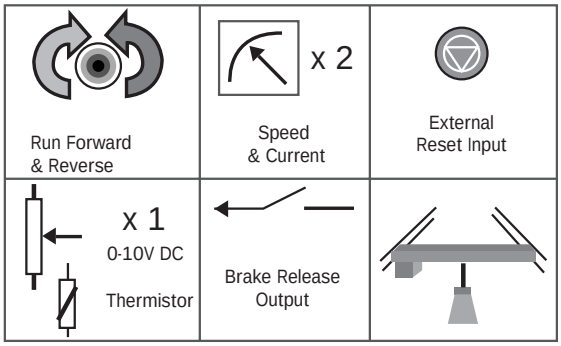




Macro 7 – Brake control

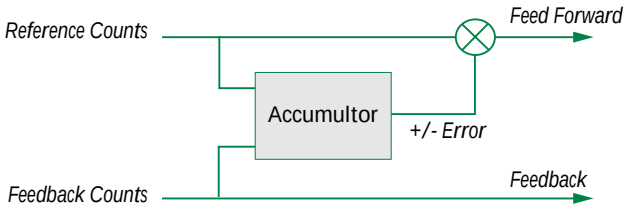
This macro essentially allows the control of an external brake. The brake is released when the drive is running and there is current in the motor.

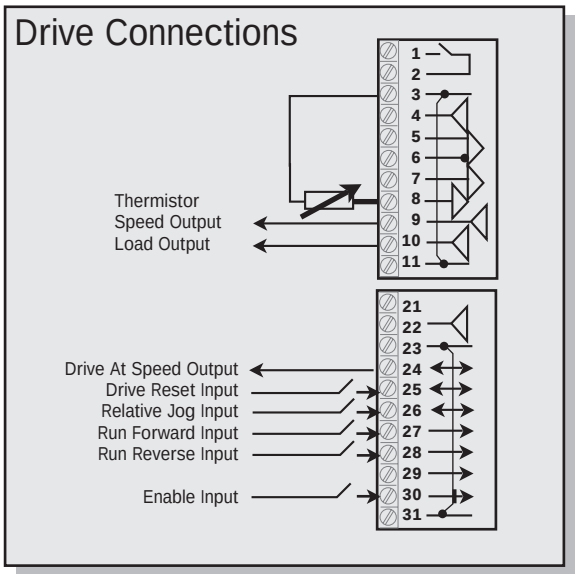


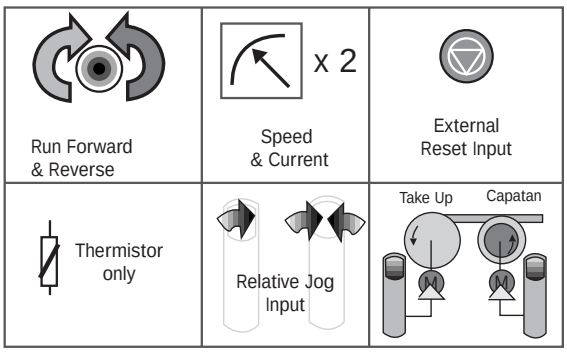


Macro 8 – Digital Lock

The digital lock macro enables a drive to be operated so that it will lock two motor shafts together pulse for pulse.







drive technical specifications

AC supply requirements

380V to 480V ±10%, 3-phase, 48 to 62 Hz
Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases)

Line reactors

When one of the following model sizes...
UNI 1401, UNI 1402, UNI 1403, UNI 1404
....is used on an AC supply of 175kVA or larger, it is recommended that a line reactor of 2% reactance is included between the AC supply and the Drive. Model sizes 1405 and larger have an internal dc-bus choke.

A line reactor reduces the risk of damage to the Drive resulting from severe disturbances on the supply network.

Temperature, humidity and cooling method

Ambient temperature range:
–10°C to 50°C (14°F to 122°F). Output current de-rating may apply at high ambient temperatures.
Cooling method: Natural convection
Maximum humidity: 95% non-condensing at 40°C (104°F)
Storage temperature range: –40°C to 50°C (–40°F to 122°F)
Maximum storage time: 12 months

Altitude

Altitude range: 0 to 4000m (13000 ft), subject to the following conditions:
1000m to 4000m (330 feet to 13000 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100m (330 ft)

Vibration

Maximum vibration: ≤0.5g as specified in IEC 68–2–61; 1982

Ingress protection

Gland plate(s) not fitted: IP00
Gland plate(s) fitted; cable glands not fitted: IP10
Cable-glands fitted; glands fitted: IP40, NEMA 1

Accuracy and Resolution

The following data applies to the Drive only; it does not include the performance of the source of the control signals.
Output-frequency accuracy: ≤ ±0.1%
Output-frequency resolution: ≤ ± 0.01 RPM

Starts per hour

By electronic control: unlimited
By interrupting the AC supply:
model sizes 1 and 2: ≤ 20, model sizes 3 and 4: ≤ 10

Power and Current ratings

40°C (104°F) ambient	Nominal rating		Maximum permissible continuous output current					Nominal AC supply current
Model	@380V	@460V	3kHz †	4.5kHz	6kHz	9kHz	12kHz	
UNI 1401	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A	3.1 A
UNI 1402	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A	3.2 A
UNI 1403	1.5 kW	2.0 HP	3.8 A	3.8 A	3.8 A	3.8 A	3.8 A	5.5 A
UNI 1404	2.2 kW	3.0 HP	5.6 A	5.6 A	5.6 A	5.6 A	4.5 A	8.4 A
UNI 1405	4.0 kW	5.0 HP	9.5 A	9.5 A	8.5 A	7.0 A	5.5 A	9.5 A
UNI 2401	5.5 kW	7.5 HP	12.0 A	12.0 A	12.0 A	12.0 A	11.7 A	13.7 A
UNI 2402	7.5 kW	10.0 HP	16.0 A	16.0 A	16.0 A	14.2 A	11.7 A	16.3 A
UNI 2403	11.0 kW	15.0 HP	25.0 A	21.7 A	18.2 A	14.2 A	11.7 A	24.3 A
UNI 3401	15.0 kW	25.0 HP	34.0 A	34.0 A	34.0 A	28.0 A	23.0 A	34.0 A
UNI 3402	18.5 kW	30.0 HP	40.0 A	40.0 A	37.0 A	28.0 A	23.0 A	39.0 A
UNI 3403	22.0 kW	30.0 HP	46.0 A	46.0 A	40.0 A	32.0 A	26.6 A	46.0 A
UNI 3404	30.0 kW	40.0 HP	60.0 A	47.0 A	40.0 A	32.0 A	26.7 A	59.0 A
UNI 3405	37.0 kW	50.0 HP	70.0 A	56.0 A	46.0 A	35.0 A	28.0 A	74.0 A
UNI 4401	45.0 kW	75.0 HP	96.0 A	96.0 A	88.0 A	70.0 A		96.0 A
UNI 4402	55.0 kW	100.0 HP	124.0 A	104.0 A	88.0 A	70.0 A		120.0 A
UNI 4403	75.0 kW	125.0 HP	156.0 A	124.0 A	105.0 A	80.0 A		151.0 A
UNI 4404	90.0 kW	150.0 HP	180.0 A	175.0 A	145.0 A	110.0 A		173.0 A
UNI 4405	110.0 kW	150.0 HP	202.0 A	175.0 A	145.0A	110.0 A		190.0 A
UNI 5401	160.0 kW	200.0 HP	300.0 A					240.0 A

† *Peak current: up to 175% of the rated current for 4 seconds*
† *Factory setting*

Dissipation

Model	Nominal rating		Maximum total power dissipation				
	@380V	@460V	3kHz	4.5kHz	6kHz	9kHz	12kHz
UNI 1401	0.75kW	1.0HP	80 W	80 W	90 W	90 W	90 W
UNI 1402	1.1kW	1.5HP	90 W	90 W	100 W	100 W	110 W
UNI 1403	1.5kW	2.0HP	100 W	110 W	110 W	120 W	130 W
UNI 1404	2.2kW	3.0HP	130 W	130 W	140 W	150 W	150 W
UNI 1405	4.0kW	5.0HP	180 W	190 W	190 W	190 W	170 W
UNI 2401	5.5kW	7.5HP	210 W	230 W	250 W	280 W	310 W
UNI 2402	7.5kW	10HP	270 W	290 W	310 W	320 W	310 W
UNI 2403	11.0kW	15HP	400 W	380 W	360 W	330 W	310 W
UNI 3401	15.0kW	25HP	570 W	620 W	670 W	660 W	630 W
UNI 3402	18.5kW	30HP	660 W	720 W	730 W	660 W	630 W
UNI 3403	22.0kW	30HP	730 W	800 W	770 W	730 W	700 W
UNI 3404	30.0kW	40HP	950 W	830 W	790 W	740 W	710 W
UNI 3405	37.0kW	50HP	1090 W	990 W	920 W	850 W	800 W
UNI 4401	45kW	75HP	1460 W	1610 W	1630 W	1530 W	
UNI 4402	55kW	100HP	1910 W	1780 W	1670 W	1560 W	
UNI 4403	75kW	125HP	2370 W	2130 W	2030 W	1860 W	
UNI 4404	90kW	150HP	2640 W	2890 W	2700 W	2470 W	
UNI 4405	110kW	150HP	2970 W	2910 W	2720 W	2490 W	
UNI 5401	160kW	200HP	5000 W				

50°C (122°F) ambient	Maximum permissible continuous output current				
Model	3kHz	4.5kHz	6kHz	9kHz	12kHz
UNI 1401	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A
UNI 1402	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A
UNI 1403	3.8 A	3.8 A	3.8 A	3.8 A	3.3 A
UNI 1404	5.6 A	5.6 A	5.1 A	4.0 A	3.3 A
UNI 1405	6.9 A	5.9 A	5.1 A	4.0 A	3.3 A
UNI 2401	12.0 A	12.0 A	12.0 A	11.6 A	9.7 A
UNI 2402	16.0 A	16.0 A	14.7 A	11.6 A	9.7 A
UNI 2403	20.0 A	17.3 A	14.7 A	11.6 A	9.7 A
UNI 3401	34.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3402	40.0 A	34.0 A	28.0 A	21.0 A	17.9 A
UNI 3403	44.0 A	36.0 A	31.0 A	24.0 A	20.6 A
UNI 3404	44.0 A	36.0 A	31.0 A	24.0 A	20.9 A
UNI 3405	50.0 A	41.0 A	34.0 A	26.0 A	23.0 A
UNI 4401	95.0 A	85.0 A	75.0 A	60.0 A	
UNI 4402	105.0 A	85.0 A	75.0 A	60.0 A	
UNI 4403	135.0 A	105.0 A	85.0 A	65.0 A	
UNI 4404	180.0 A	150.0 A	125.0 A	95.0 A	
UNI 4405	190.0 A	150.0 A	125.0 A	95.0 A	

Frequencies and speed

PWM switching frequency:

3kHz nominal (selectable up to 12kHz)

Maximum speed
30 000 RPM

Speed regulation: 0.01%

Dynamic Braking

Resistor Connections

The external braking resistor should be connected to the Unidrive terminals labelled (+) and (-) on the terminal strip on Unidrive size 1 & 2 or the stud connections on Unidrive size 3 & 4. The resistor *must* be thermally protected in the unlikely event that the braking transistor fails. This thermal device must either disconnect the input AC power to the Inverter or disconnect the resistor from the circuit. Please contact the a Drive Centre for additional application information.

Custom Resistor Values

The resistor ohmic value is based on the torque required to stop the motor (and connected load) in the time dictated by the application. The first equation to be solved is the torque required knowing the required stop time.

$$T = \frac{J \times N}{t_d \times 307} \text{ (Ft - Lb) or } T = \frac{2\pi J \times N}{t_d \times 60} \text{ (Nm)}$$

Where:

J = *Total Inertia (Lb-Ft² or Kgm²)*
N = *Motor Max. Speed (RPM)*
t_d = *Decel Time (Sec.)*
T = *Torque (Ft-Lb or Nm)*

The torque required must be equal or less than 1.5 x motor/drive capability.

$$HP_{(brake)} = \frac{T \times N}{5250} \text{ or } P_{(kW)} = \frac{T \times N}{30}$$

The ohmic value of the resistor can now be calculated using the following formula:

$$R = \frac{(V_b)^2}{HP_{(brake)} \times 746} \text{ or } R = \frac{(V_b)^2}{P_{(kW)}}$$

Where:

V_b = *Bus voltage level when braking*
= *750 VDC*

Minimum Values

The calculated minimum ohmic value is limited by the braking transistor supplied in the Unidrive being used. The following is a list of the minimum values.

MODEL	MINIMUM VALUE
Unidrive Size 1	40 Ohms
Unidrive Size 2	40 Ohms
Unidrive Size 3	10 Ohms
Unidrive Size 4	5 Ohms

Average Power Dissipation

The average power dissipated in the resistor for intermittent operation is then simply the number of watts dissipated per stop times the duty cycle (D).

Where:

$$D = \frac{t_d}{t_d + t_{off}}$$

In order to use this formula for average power dissipation, the brake resistor must be off long enough for the temperature of the resistor to return to ambient temperature between braking cycles. Also, the maximum on time (or decel time) should not exceed the peak capabilities of the power resistor. Typically, a power resistor has the capability of dissipating 10 times rated wattage for 5 to 10 seconds.

Peak Power Rating

The peak power handling ability of the resistor must meet or exceed the following:

$$PPK = (Vb)^2/R$$

drive technical specifications

Protection

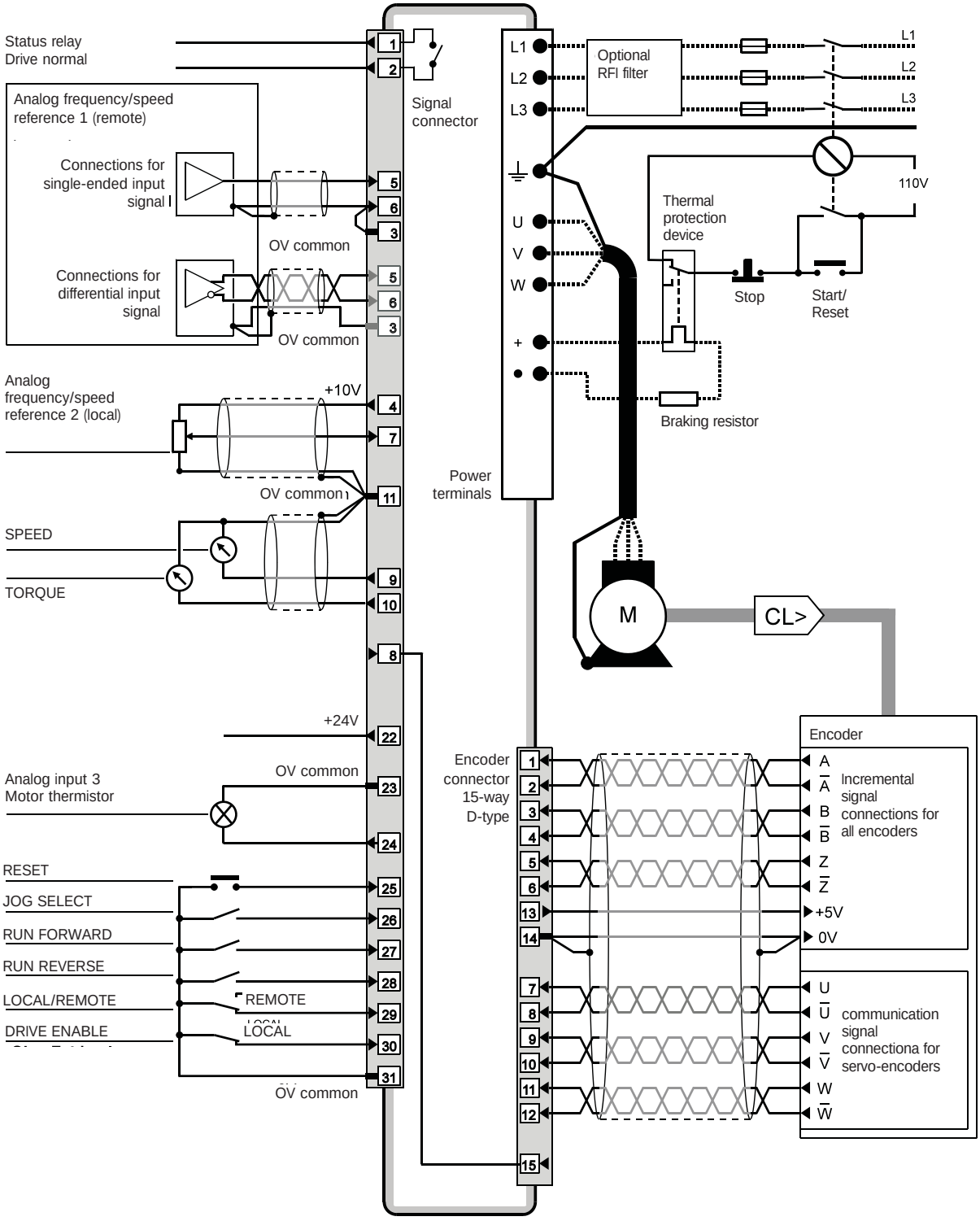
DC Bus Undervoltage Trip	350 VDC
DC Bus Overvoltage Trip	830 VDC
MOV Voltage Transient Protection (Line to Line & Line to Ground)	160 Joules, 1400 Volts Clamping
Drive Overload Trip	Current overload value is exceeded. Programmable to allow up to 175% of Drive Current for one minute.
Instantaneous Overcurrent Trip	215% of Drive rated current
Phase Loss Trip	DC bus ripple threshold exceeded
Overtemperature Trip	Drive heatsink temperature exceeds 95°C
Short Circuit Trip	Protects against output phase fault
Ground Fault Trip	Protects against output phase to ground fault
Motor Thermal Trip	Electronically protects the motor from overheating due to Loading conditions

Control Inputs and Outputs

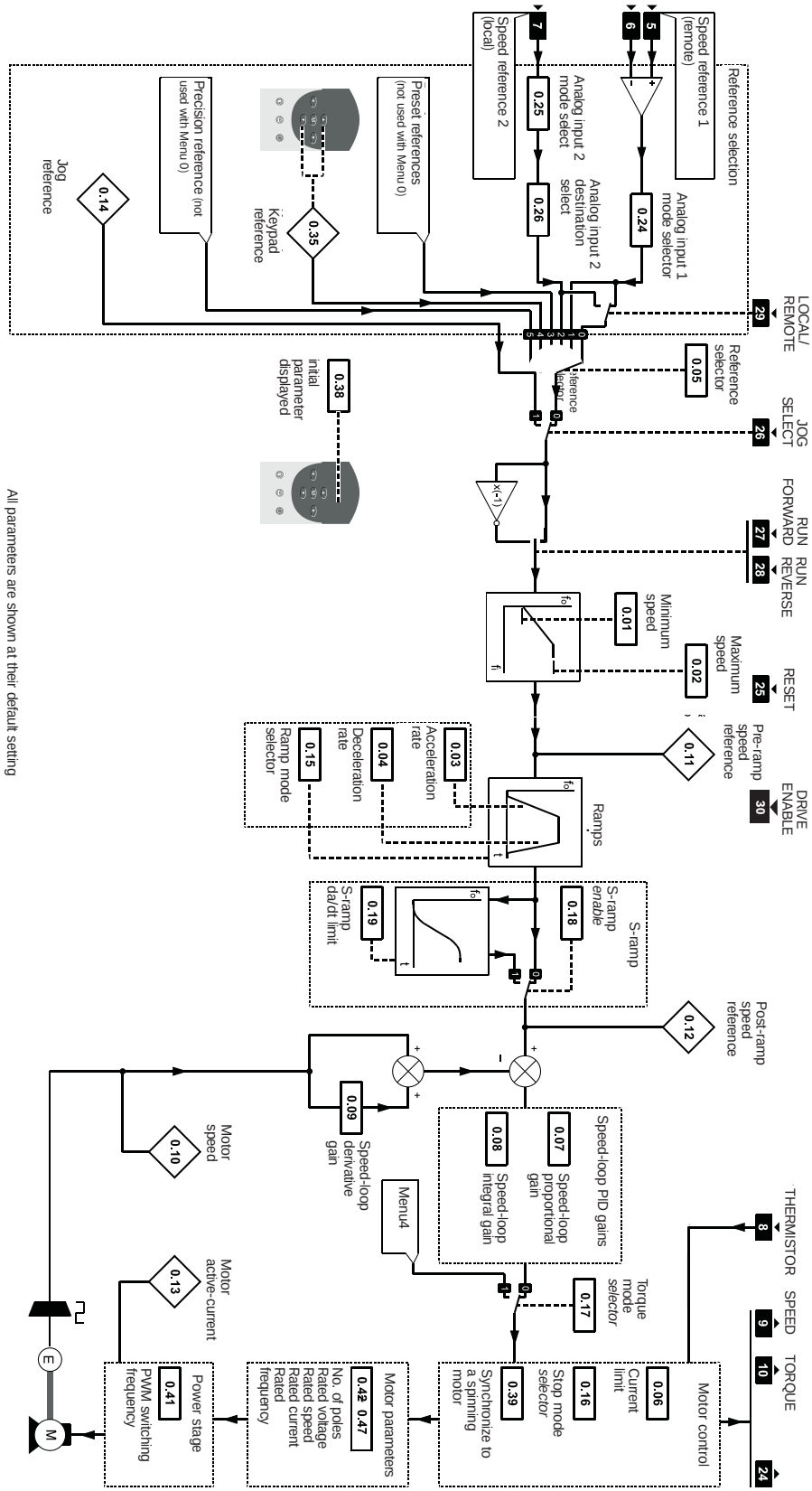
TERMINAL	I/O TYPE & FUNCTION	RATING
1	Status Relay 1 Dry contact output pole 1/2 *Drive OK* (default)	Normally open contacts 5A, 240 VAC resistive
2	Status Relay 1 Dry contact output pole 2/2	
3	Circuit Common 0 VDC Analogue reference	
4	+10 VDC User supply for external analogue signal device	± 1% Voltage tolerance 10 mA output current (current limit protected)
5	Analogue Input 1 (non-inverting input) Programmable Differential Analogue Input *Analogue Speed Reference 1* (default)	Bipolar ±10 VDC 100kΩ input impedance 12-bit plus sign resolution, ≤ 2mS sampling period OL <45 Oμs C.L. Programmable Differential Analogue Input
6	Analogue Input 1 (inverting input)	
7	Analogue Input 2 Programmable Single-ended Analogue Input *Analogue Speed Reference 2* (default)	Programmable: ±10 VDC (default), 4-20mA, 20-4mA, 0-20mA inputs, 100kΩ input impedance 10-bit plus sign resolution ≤ 2mS sampling period
8	Motor Thermistor Input Programmable Single-ended Analogue Input	
9	Analogue Output 1 Programmable Single-ended Analogue Output *Output Frequency* (open loop default) *Speed Feedback* (closed loop default) Short circuit protected	Programmable: ±10 VDC @ 10mA (max) (default) 4-20mA, or 0-20mA 1kΩ minimum load resistance 10-bit plus sign resolution, 8mS update period
10	Analogue Output 2 Programmable Single-ended Analogue Output *Torque Output* (default)	
11	Circuit Common 0 VDC Analogue reference	
21	OV Common	
22	+24 VDC User Supply	Voltage Tolerance: ±10% Nominal Output: 200 mA Overload Output: 240 mA with current foldback protection
23	Circuit Common 0 VDC Digital reference	
24	Programmable Logic I/O F1 Output: *At speed* (open loop) *At zero speed* (closed loop)	Output Mode: User-defined: Negative or positive logic *Negative logic* (default) Push-pull output, 0 - +24 VDC 100mA max output, 120mA overload current Input Mode: User-defined: Positive logic (V > +15 VDC) or negative logic (V < +5 VDC) (default) Voltage range: 0 - +24 VDC 3.2 mA max load at +24 VDC
25	Programmable Logic I/O F2 Input: *Drive reset* (default)	
26	Programmable Logic I/O F3 Input: *Jog* (default)	
27	Programmable Logic Input F4 Latched *Run Forward* (default)	User-defined: Positive logic (V > +15 VDC) or negative logic (V < +5 VDC) (default) Voltage range: 0 - +24VDC, 3.2 mA max load @ +24 VDC
28	Programmable Logic Input F5 Latched *Run Reverse* (default)	
29	Programmable Logic Input F6 *Local (default)/Remote*	
30	Logic Input: *Drive Enable* (closed loop) *External Trip* (open loop)	
31	Circuit Common 0 VDC digital reference	

NOTE: There are no terminals numbered 12, 13...., 20 on the Unidrive

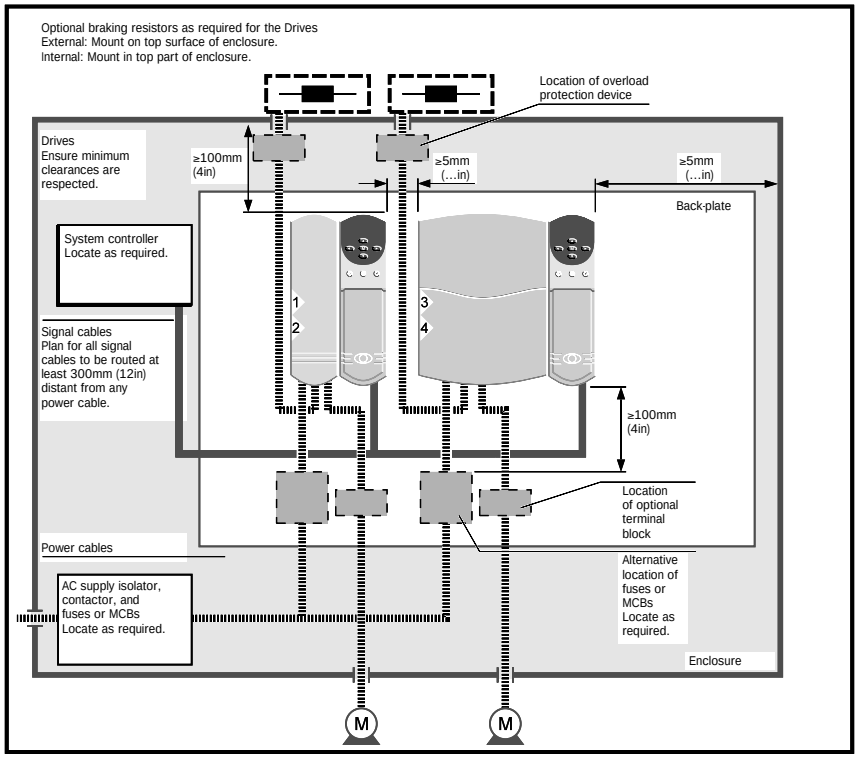
Typical power and default signal connections for speed control in terminal mode



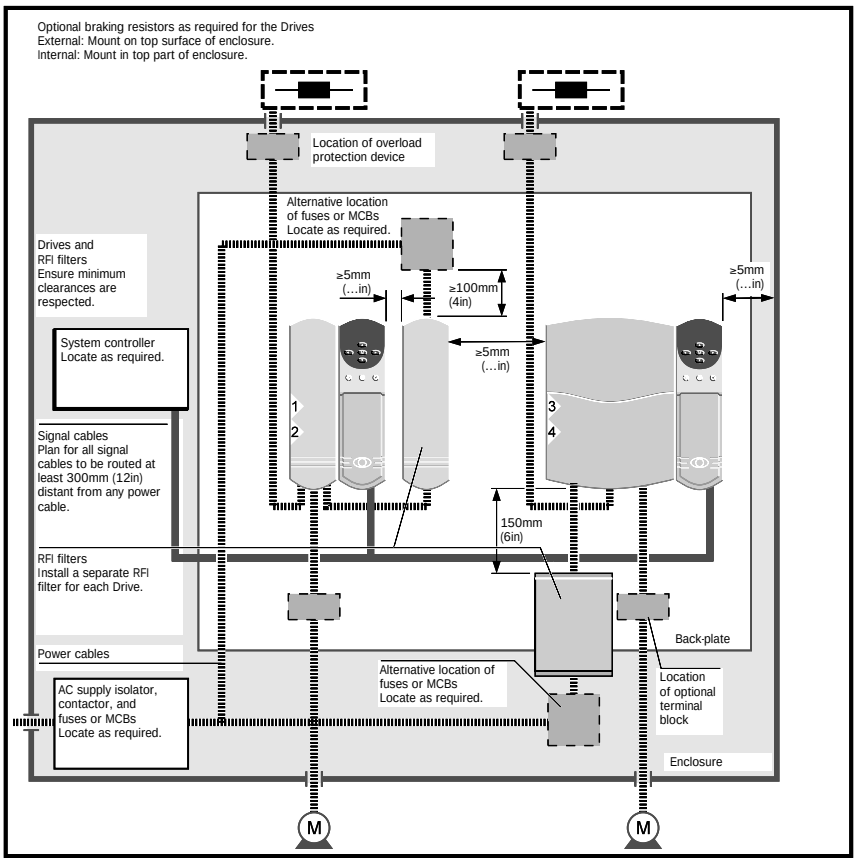
Menu 0 logic diagram



Panel Wiring Guidelines for Routine EMC Precautions



Panel Wiring Guidelines for Compliance with EMC Emission Standards

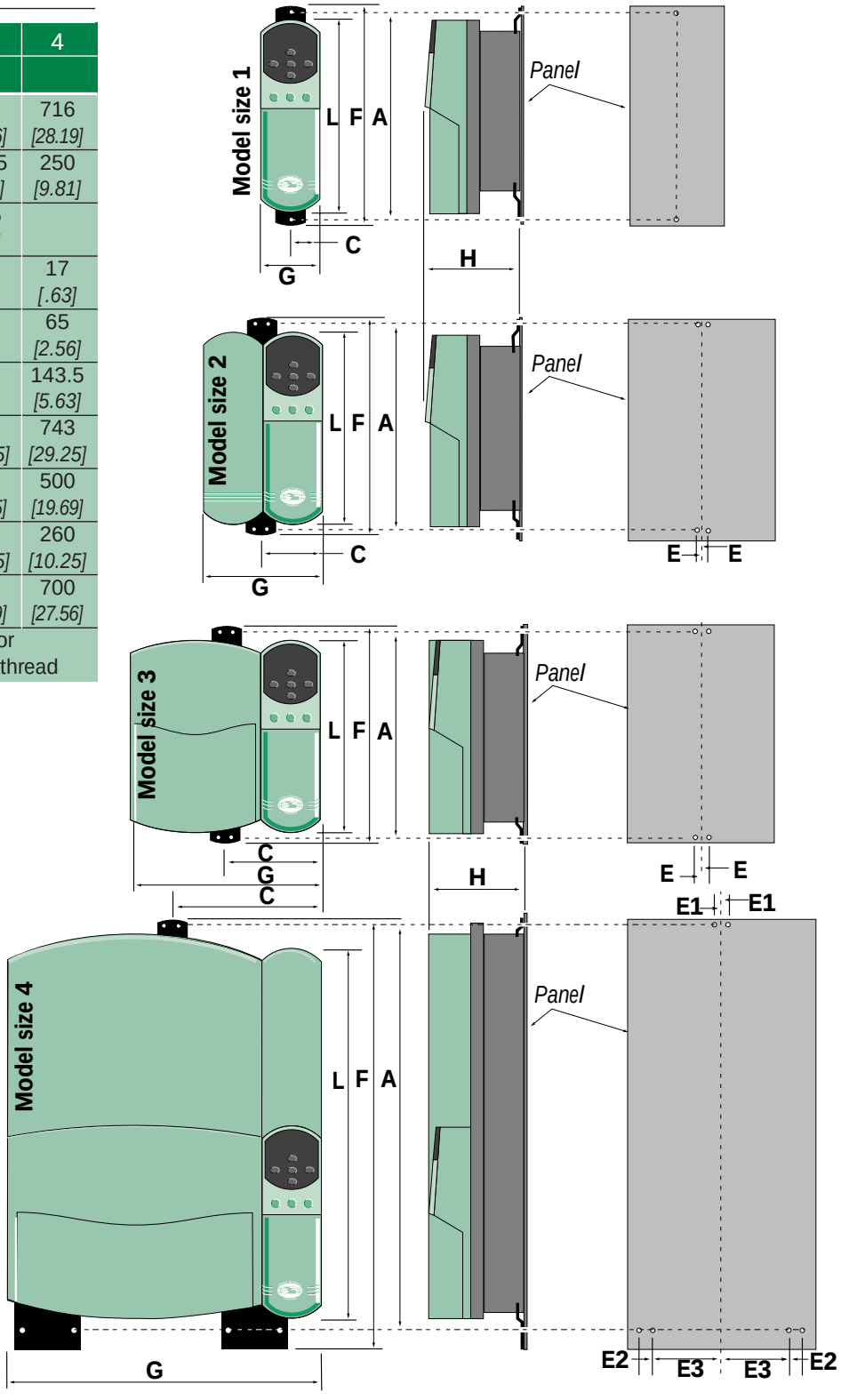


① *Consult Drive Centre for Filter details.*

Surface Mounting

Model Size	1	2	3	4
Dimension ①				
A	345 *[13.56]*	345 *[13.56]*	345 *[13.56]*	716 *[28.19]*
C	47.5 *[1.88]*	95 *[3.75]*	187.5 *[7.38]*	250 *[9.81]*
E		16.5 *[.63]*	16.5 *[.63]*	
E1				17 *[.63]*
E2				65 *[2.56]*
E3				143.5 *[5.63]*
F	368 *[14.25]*	368 *[14.25]*	368 *[14.25]*	743 *[29.25]*
G	95 *[3.75]*	190 *[7.50]*	375 *[14.75]*	500 *[19.69]*
H	200 *[7.88]*	200 *[7.88]*	260 *[10.25]*	260 *[10.25]*
L	335 *[13.19]*	335 *[13.19]*	335 *[13.19]*	700 *[27.56]*
Mounting hole diam.	6.5 *[.16]* clearance or $^1/_4$ UNF M6 thread			

① *Dimensions in mm and [inches].*

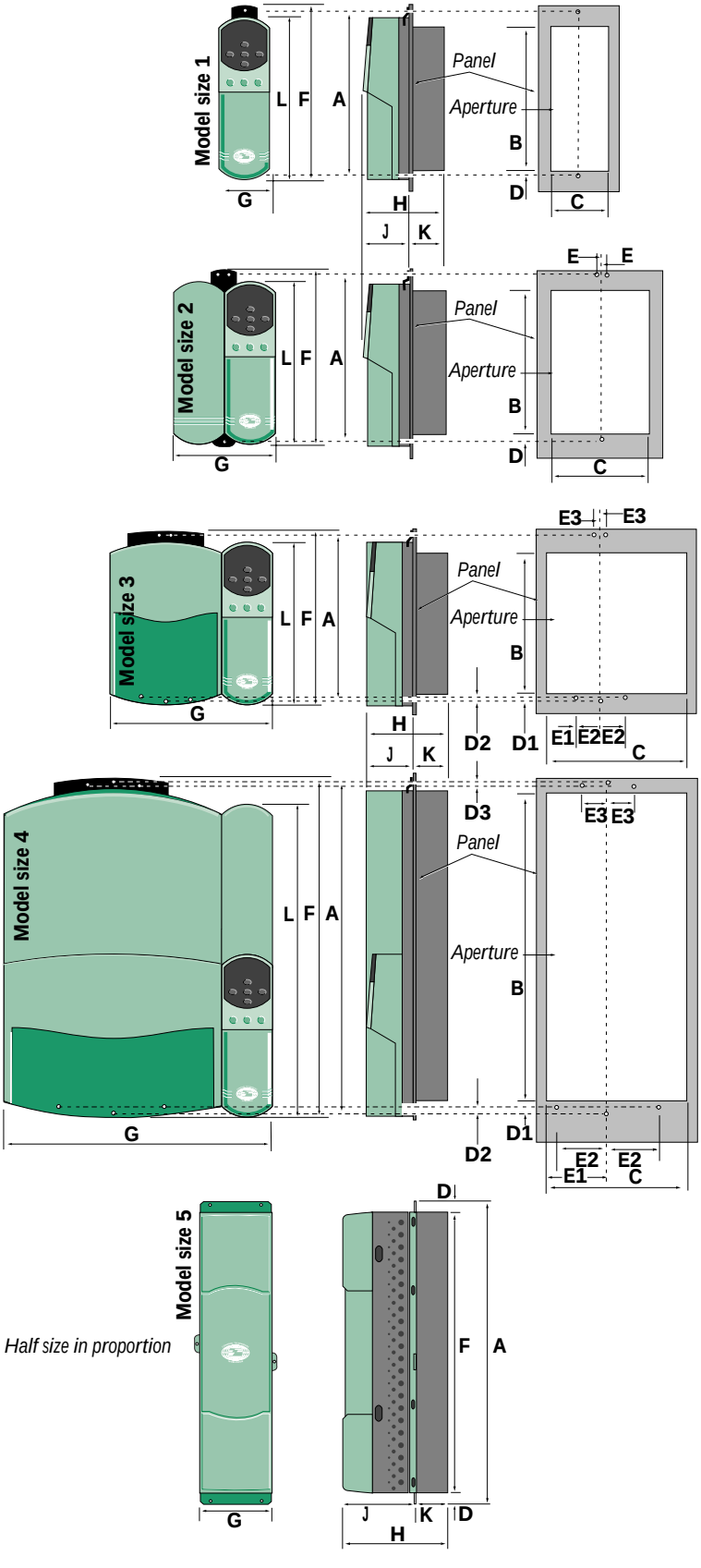


Through-panel Mounting

Model Size	1	2	3	4
Dimension ①				
A	345 *[13.56]*	345 *[13.56]*	345 *[13.56]*	717.5 *[28.25]*
B	295 *[11.63]*	295 *[11.63]*	287 *[11.31]*	650 *[25.56]*
C	86.5 *[3.38]*	182 *[7.19]*	358 *[14.13]*	482 *[19]*
D	*13 (0.5)*	*13 (0.5)*		
D1			16 *[.63]*	17 *[.63]*
D2			7 *[.25]*	7.5 *[.31]*
D3				3.5 *[.13]*
E		16.5 *[.13]*		
E1			131.5 *[5.19]*	192 *[7.56]*
E2			69 *[2.69]*	130 *[5.13]*
E3			16.5 *[.63]*	65 *[2.56]*
F	364 *[14.31]*	364 *[14.31]*	364 *[14.31]*	743 *[29.25]*
G	95 *[3.75]*	190 *[7.50]*	375 *[14.75]*	500 *[19.69]*
H	200 *[7.88]*	200 *[7.88]*	260 *[10.25]*	260 *[10.25]*
J ②	120 *[7.88]*	120 *[7.88]*	120 *[10.25]*	120 *[10.25]*
K ③	80 *[3.13]*	80 *[3.13]*	140 *[5.50]*	140 *[5.50]*
L	335 *[13.19]*	335 *[13.19]*	335 *[13.19]*	700 *[27.56]*
Mounting hole diam.	6.5 *[.16]* clearance or M6 1/4 UNF thread			

① *Dimensions in mm and [inches].*
② *Plus thickness of gasket.*
③ *Minus thickness of gasket*

Model Size	5
Dimension ①	
A	1319 *[51 15/16]*
D	35.5 *[1 7/16]*
F	1248 *[49 1/8]*
G	315 *[12 3/8]*
H	484 *[19]*
J	340 *[13 1/16]*
K	144 *[5 11/16]*



Half size in proportion

Motor cable

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 2-3.

Nominal AC supply voltage	400V		480V	
Model	Maximum cable length* (PWM switching frequency at 3kHz)			
	m	ft	m	ft
UNI1401	65	210	50	160
UNI1402	100	330	75	250
UNI1403	130	430	100	330
UNI1404	200	660	150	490
UNI1405	300	990	250	820
UNI2401-UNI2403	300	990	300	990
UNI3401-UNI3405	200	660	120	410
UNI4401-UNI4405	200	660	120	410

** Cable lengths in excess of the specified values may be used only when special techniques are adopted; refer to the supplier of the Drive.*

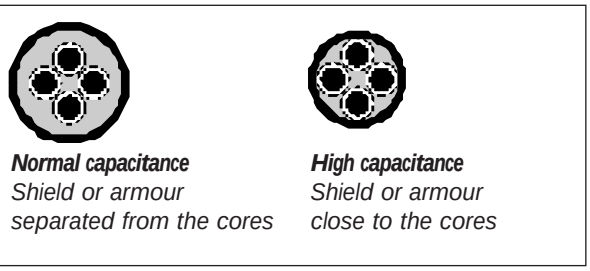
The maximum cable length is reduced from that shown in the table under the following conditions:

- ***PWM switching frequency exceeding 3kHz in model sizes 3 and 4***

  The maximum cable length is reduced in proportion to the increase in PWM switching frequency, eg. at 9kHz, the maximum length is $^1/_3$ of that shown.

- ***High capacitance cables***

  Most cables have an insulating jacket between the cores and the armour or shield; these cables have a low capacitance and are recommended. Cables that do not have an insulating jacket tend to have high capacitance; if a cable of this type is used, the maximum cable length is half that quoted in the table. (figure 2-1 shows shows how to identify the two types.)



Normal capacitance
Shield or armour separated from the cores

High capacitance
Shield or armour close to the cores

Cable & Fuse Recommendations

FUSES and CABLES					
CATALOGUE NUMBER	AC Supply Cables		Motor Cables		Fuse ① Rating
	mm2	AWG	mm2	AWG	Amps
UNI1401	1.5	16	1.5	16	6
UNI1402	2.5	14	2.5	14	10
UNI1403	2.5	14	2.5	14	10
UNI1404	2.5	14	2.5	14	10
UNI1405	2.5	14	2.5	14	16
UNI2401	2.5	14	2.5	14	16
UNI2402	4.0	10	4.0	10	35
UNI2403	4.0	10	4.0	10	20
UNI3401	6	8	6	8	40
UNI3402	10	6	10	6	50
UNI3403	10	6	10	6	60
UNI3404	16	4	16	4	70
UNI3405	25	4	25	4	80
UNI4401	35	2	35	2	100
UNI4402	35	2	35	2	125
UNI4403	50	2/0	50	2/0	160
UNI4404	70	2/0	70	2/0	200
UNI4405	95	3/0	95	3/0	250
①UNI5401	95	3/0	95	3/0	450

① *Use Fuse class RK1 or similar HRC fuse.*

Weights

Model size	kg	lb
1	4	8.8
2	8	17
3	22	49
4	70	154
*5	102	224

**Power Module only*

Enclosure Guidelines

Heat Dissipation in a Sealed Enclosure

If possible, locate heat-generating equipment in the lower part of the enclosure to encourage internal convection. Otherwise, use a taller enclosure or install stirrer fans.

The enclosure must be of adequate size to maintain sufficient cooling of the drive when it is installed inside a sealed enclosure. Heat generated by all the equipment in the enclosure must be taken into account. To calculate the minimum acceptable size of an enclosure, use the following procedure:

Calculate the minimum required surface area Ae *for the enclosure from:*

$$A^e = \frac{P}{k(Ti - Tamb)}$$

Where:

Tamb	*Maximum ambient temperature in °C external to the enclosure.*
Ae	*Unobstructed heat-conducting are in mm^2.*
k	*Heat transmission coefficient of the enclosure material.*
Ti	*Maximum permissible operating temperature in °C.*
P	*Power in watts dissipated by all heat sources in the enclosure.*

Example:

To calculate the size of an enclosure for model UNI 1403 (1.5kW, 2HP).

The following conditions are assumed:

The Drive is surface-mounted inside the enclosure.

Only the top, front, and two sides of the enclosure are free to dissipate heat.

The enclosure is made from painted 2mm (.079in) sheet steel.

Maximum external air temperature: 30°C (86°F).

Insert the following values:

Ti =	*40°C*
Tamb =	*30°C*
k =	*5.5 (typical for painted 2mm (.079in) sheet steel)*
P =	*100 at 3kHz (see pages 18 &19)*

Note:

It is essential to include any other heat sources in the value of P.

The minimum required heat conducting area is then:

$$A^e = \frac{100}{5.5(40 - 30)} = 1.81m^2$$

Estimate two of the enclosure dimensions — the height (H) and depth (D), for instance. Calculate the width (W) from:

$$W = \frac{Ae - 2HD}{H + D}$$

Inserting H = D = 0.5m, obtain the minimum width:

$$W = \frac{1.81 - (2 \times 0.5 \times 0.5)}{0.5 + 0.5} = 0.81m$$

Heat Dissipation in a Ventilated Enclosure

If a high ingress protection rating is not required, the enclosure may be smaller. A ventilating fan can be used to exchange air between the inside and outside of the enclosure.

To calculate the volume of ventilating air, use the following equation:

$$V = \frac{3.1P}{Ti - Tamb}$$

Where V = Air-flow in m^3 per hour.

Example:

P =	*100*
Ti =	*40°C*
Tamb =	*30°C*

Then:

$$V = \frac{3.1 \times 73}{40 - 30} = 31m^3 / hr$$

electro magnetic compatibility (EMC) & radio frequency interference (RFI)

Electromagnetic compatibility (EMC) conducted emission

This is a summary of the EMC performance of the Drive. For full details, refer to the Unidrive EMC Data Sheet which can be obtained from a Drive Centre or distributor listed on the back cover.

Immunity

Compliance with immunity standards does not depend on installation details. The Drive meets EN50082–2 (generic immunity standard for the industrial environment) and the following specifications from the IEC1000–4 group (derived from IEC801):

Part 2, Electrostatic discharge: Level 3

Part 3, Radio frequency field: Level 3

Part 4, Transient burst: Level 4 at the control terminals

Part 4 Transient burst:
Level 4 at the control terminals
Level 3 at the power terminals

Part 5, Surge (at the AC supply terminals):
Level 4 line-to-ground
Level 3 line-to-line (as specified by EN50082–2 informative annex)

Part 6, Conducted radio frequency:
Level 3

Emission

Compliance with emission standards depends on rigorous adherence to the installation guidelines, including the use of the specified RFI filter in the AC supply circuit. Compliance also depends on the PWM switching frequency used in the output stage of the Drive, and the length of the motor cable. For full details, refer to the Unidrive EMC Data Sheet which can be obtained from a Drive Centre or distributor listed at the end of this Product Data Guide.

electro magnetic compatibility (EMC) & radio frequency interference (RFI)

RFI Filter Ratings

Type	Part number	Max. continuous current	Power dissipation at rated current	Ingress protection	Max. ambient temperature at rated current	Case temperature rise at rated current
A	4200-0010	10A	25W	IP20	50°C (122°F)	<30°C (86°F)
B	4200-0027	27A	40W	IP20	50°C (122°F)	<40°C (104°F)
C	4200-1051	50A	60W	IP00	50°C (122°F)	<40°C (104°F)
D	4200-1071	75A	100W	IP00	50°C (122°F)	<40°C (104°F)
E	4200-1111	110A	120W	IP00	50°C (122°F)	<40°C (104°F)
F	4200-1171	170A	150W	IP00	40°C (104°F)	<55°C (131°F)
G	4200-1302	300A	300W	IP00	50°C (122°F)	<40°C (104°F)

Main Ratings

* Above 40°C (104°F), the current rating is reduced by 1.6A/°C (0.88A/°F)

AC Supply Ratings

Voltage (phase-to-phase and phase-to-ground): 480V +10%

AC supply frequency: 48 to 62 Hz

Ground Leakage Current

The ground-leakage current, phase-to-phase and phase-to-ground, when the AC supply is 400V at 50Hz is as follows:

CONDITION	A	B	C to G
Balanced	5.6mA	7.4mA	55mA
One phase disconnected	41mA	57.9mA	350mA

For other AC supply voltages and currents, scale the value of leakage current proportionally.

Discharge Resistors

A and *B*: 330 KΩ internally between phases, with the star point connected by a 1M resistor to ground.

C to *G*: 10 MΩ internally between each phase and ground.

Maximum Current Overload

150% of rated current for 60 seconds.

Overall Dimensions

Filter type	Dimension		
	H	W	D
A	396mm 15 9/16 in	50mm 1 15/16 in	113mm 4 7/16 in
B	396mm 15 9/16 in	75mm 2 15/16 in	113mm 4 7/16 in
C	330mm 13 in	190 mm 7 1/2 in	145mm 5 11/16 in
D	330mm 13 in	190mm 7 1/2 in	145mm 5 11/16 in
E	440mm 17 5/16 in	200mm 7 7/8 in	145mm 5 11/16 in
F	490mm 19 1/4 in	200mm 7 7/8 in	145mm 5 11/16 in
G	380mm 14 5/16 in	495mm 19 1/2 in	250mm 9 13/16 in

Weights

FILTER TYPE	kg	lb
A	2	5
B	2.7	6
C	7.4	16
D	8	18
E	12.3	27
F	16	35
G	35	77

motor overview

Introducing Unimotor

Unimotor is a new range of brushless AC servo motors from Control Techniques. They are three phase, 6 or 8 pole, permanent magnet motors exhibiting a sinusoidal back EMF characteristic. The motors supply high torque with either low or high rotor inertia and minimal cogging torque.

The unique 'finned' motor housing is a high-strength aluminium alloy casting, that improves heat dissipation by conduction, radiation and convection. The single-piece integral construction permits accurate bearing to housing alignment and maintains air gap concentricity. This arrangement optimises torque output and reduces cogging torque. The compact design gives increased torsional stiffness. Laminations and coils are optimised both for high efficiency and to provide low harmonic distortion in the airgap flux. Combined with the high energy magnets, and a choice of rotor inertia, these features provide superb dynamic performance to suit all requirements.

The integral housing and front flange design increases thermal dissipation and improves sealing (IP65 standard, when mounted and connected).

Standard Features

- Unique 'finned' design - high thermal dissipation
- Encoder for high precision feedback integral commutation
- PTC thermistors for thermal monitoring and overload protection
- Low inertia is standard for fast acceleration
- IEC mounting flange
- Plain shaft is standard (non keyed)
- IP65 standard (when connected) - sealed against water spray and dust
- Low cogging torque & THD (Total Harmonic Distortion)
- Rotor assembly balanced to ISO 1940 grade 6
- High standard of mechanical design and precision manufacture - for improved performance and quality
- Winding insulation is to Class H
- Bearing system designed for prolonged motor life
- Modular construction
- UL approval under application
- CE marked

Optional Features

- Absolute encoder - 4096 multi-turns
- Resolver feedback for high temperature applications
- Sine/Cosine encoder for high resolution - consult factory for availability
- High inertia option
- NEMA mounting flange
- Output key to shaft
- 'Tropicalised' motor option, - electrical components are sealed against humid conditions
- Optional dimensional accuracy to DIN 42955 Class R
- Gearbox options
- Stainless steel shaft option
- Brake
- Fan Cowlings

motor technical specification

Specification

Physical

Insulation Class	Class H, BS EN 60034-1.
Dimensional Accuracy	IEC 72-1, 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, 170˚C switch temperature.
Bearing System	Preloaded ball bearings.
Electrical Connections	Connector or terminal box for power and brake; connector for feedback devices and thermistor.
Flange Mounting	IEC 72-1 as standard/ NEMA MG-7 optional.
Output Shaft	Plain shaft as standard. Output key is optional (to IEC 72-1).

Environmental

Ingress Protection	Motor fitted with mating connector and cable: IP65. Speed up to 3000RPM: IP65. Speed above 3000RPM: IP54.
Operating Temperature	Specified performance at 40˚C ambient.
Storage Temperature	-20˚C to 70˚C.
Insulation Class	H (180˚C)
Temperature Rise	125˚C over ambient of 40˚C Max. 100˚C over ambient of 40˚C Typical.
Relative Humidity	90% Non condensing

Ordering Information

Use the information given in the illustration below to create an order code for a Unimotor. The details in the blue band are an example of an order reference.

ORDER REFERENCE EXAMPLE

95	UM	B	30	0	C	B	C	A	B

Frame Size:
75
95
115
142
190

Motor Type:
UM - Unimotor
SL - Speed Loop Control

Stator Length:
A, B, C, D, E

Rated Speed (Standard):
30 - 3000 rpm
20 - 2000 rpm
40 - 4000 rpm ***

Brake:
0 - Non fitted
1 - Brake fitted 24V dc

Feedback Device:
C - Incremental Encoder
D - CT Coder + SL Electronics**
G - Sin/Cos Encoder SCM60 (multi-turn)
H - Sin/Cos Encoder SCS60 (single turn)
A - Resolver 55RSS116

Connection Type:
C - Connection
H - Hybrid
T - Terminal*

Output Shaft Key:
B - Standard without Key
A - With Key

Flange Mounting
A - IEC, B - NEMA

Inertia:
A - Standard
B - High

* Available with resolver feedback only.
** Available for SL Motors only.
*** Other speeds are available on special request

ΔT 100˚C, 40˚ Ambient with Encoder Feedback

Motor Frame Size	75				95				
All Versions (rpm)	A	B	C	D	A	B	C	D	E
Continuous Stall (Nm)	1.2	2.1	2.8	3.6	2.3	3.9	5.5	6.9	8.4
Peak (Nm)	3.5	6.2	8.4	10.8	6.8	11.7	16.4	20.7	25.1
High ($kgcm^2$)	1.2	1.6	2.1	2.5	3.5	4.5	5.6	6.7	7.8
Standard ($kgcm^2$)	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
Thermal Time Constant (sec)	1315	1431	1500	1587	1422	1618	1800	1997	2178
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 (Nm/A_{rms}): 2.4**				**Ke (V_{rms}/krpm): 147.0**				
Rated Torque (Nm)	1.1	1.9	2.6	3.4	2.1	3.7	5.1	6.5	7.8
Continuous Stall Current (A_{rms})	0.49	0.86	1.16	1.50	0.95	1.63	2.28	2.88	3.49
Rated Power (kW)	0.23	0.40	0.55	0.71	0.44	0.77	1.06	1.37	1.64
R (ph-ph) (Ohms)	172.55	56.14	28.80	19.88	52.00	16.50	8.79	5.81	4.25
L (ph-ph) (mH)	243.1	106.4	67.9	49.3	138.9	64.9	41.2	29.6	23.2
Rated Speed: 3000(rpm)	**Kt (Nm/A_{rms}): 1.6**				**Ke (V_{rms}/krpm): 98.0**				
Rated Torque (Nm)	1.1	1.9	2.5	3.3	2.1	3.6	5.0	6.3	7.6
Continuous Stall Current (A_{rms})	0.73	1.29	1.74	2.25	1.42	2.45	3.41	4.32	5.23
Rated Power (kW)	0.34	0.60	0.80	1.03	0.66	1.13	1.56	1.99	2.40
R (ph-ph) (Ohms)	73.44	23.42	13.88	8.67	24.92	7.51	4.12	2.75	1.92
L (ph-ph) (mH)	109.2	47.7	31.5	22.8	63.5	28.5	18.3	13.2	10.3
Rated Speed: 4000(rpm)	**Kt (Nm/A_{rms}): 1.2**				**Ke (V_{rms}/krpm): 73.5**				
Rated Torque (Nm)	1.0	1.8	2.2	2.7	1.8	2.8	3.7	4.5	5.3
Continuous Stall Current (A_{rms})	0.98	1.73	2.33	3.00	1.88	3.23	4.50	5.70	6.90
Rated Power (kW)	0.42	0.76	0.91	1.14	0.77	1.16	1.54	1.89	2.24
R (ph-ph) (Ohms)	43.66	14.17	7.70	4.60	13.80	4.40	2.40	1.70	1.20
L (ph-ph) (mH)	61.7	27.2	18.1	12.7	35.9	16.1	10.1	7.6	5.8

Note: $1kgcm^2 = 1x10^{-4}\ kgm^2$
Note 2: All performance data is subject to a tolerance of ±10%

servo motor technical specification

115					142					190			
A	B	C	D	E	A	B	C	D	E	A	B	C	D
4.1	6.7	9.5	12.0	14.1	6.3	10.8	15.3	19.8	23.4	21.8	41.1	58.7	73.2
12.2	20.0	28.4	35.9	42.4	18.9	32.4	45.9	59.4	70.2	66.4	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
1436	1614	1792	1980	2158	2093	2316	2548	2700	3003	3220	3645	3960	4500
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
3.7	6.0	8.6	10.8	12.8	5.9	10.3	14.6	18.4	21.3	20.0	36.9	50.4	54.7
1.69	2.78	3.94	4.99	5.89	2.63	4.50	6.38	8.25	9.75	9.10	17.20	24.50	30.50
0.77	1.26	1.79	2.26	2.68	1.23	2.15	3.05	3.85	4.47	4.19	7.73	10.56	11.46
27.80	8.55	4.55	2.96	2.17	13.40	4.00	2.10	1.35	0.98	1.90	0.67	0.39	0.24
94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	18.8	8.60	5.90	4.10
3.3	5.5	7.7	9.7	11.4	5.4	9.0	12.2	15.8	18.0	19.2	33.0	35.0	36.8
2.53	4.16	5.91	7.48	8.83	3.94	6.75	9.56	12.38	14.63	13.60	25.70	36.70	45.80
1.05	1.72	2.43	3.05	3.59	1.70	2.83	3.82	4.95	5.65	6.03	10.37	10.99	11.56
12.55	3.86	2.02	1.34	1.10	6.00	1.82	0.94	0.59	0.44	0.89	0.32	0.20	0.13
43.1	18.6	11.4	8.6	7.4	31.0	13.3	8.3	6.1	4.8	9.24	4.28	3.29	2.48
2.8	4.4	6.0	7.0	7.7	3.6	7.0	8.9	10.7	12.2				
3.38	5.55	7.88	9.98	11.78	5.25	9.00	12.75	16.50	19.50				
1.17	1.85	2.53	2.94	3.24	1.51	2.94	3.73	4.49	5.09				
6.91	2.14	1.16	0.73	0.57	3.35	1.00	0.53	0.35	0.24				
23.5	10.2	6.6	4.7	3.9	17.6	7.5	4.7	3.6	2.7				

ΔT 125˚C, 40˚ Ambient with Resolver Feedback only

Motor Frame Size		75				95				
All versions (rpm)		A	B	C	D	A	B	C	D	E
Continuous Stall Torque	(Nm)	1.3	2.3	3.1	4.0	2.6	4.4	6.1	7.8	9.4
Peak Torque	(Nm)	3.9	6.9	9.3	12.0	7.8	13.2	18.3	23.4	28.2
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
Thermal Time Constant	(sec)	1315	1431	1500	1587	1422	1618	1800	1997	2178
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 (Nm/A_{rms}): 2.4**				**Ke (V_{rms}/krpm): 147.0**			
Rated Torque	(Nm)	1.2	2.1	2.9	3.7	2.3	4.1	5.6	7.2	8.7
Continuous Stall Current	(A_{rms})	0.54	0.96	1.29	1.67	1.08	1.83	2.54	3.25	3.92
Rated Power	(kW)	0.25	0.44	0.61	0.77	0.48	0.86	1.17	1.51	1.82
R (ph-ph)	(Ohms)	172.55	56.14	28.80	19.88	52.00	16.50	8.79	5.81	4.25
L (ph-ph)	(mH)	243.1	106.4	67.9	49.3	138.9	64.9	41.2	29.6	23.2
Rated Speed 3000 (rpm)			**Kt (Nm/A_{rms}): 1.6**				**Ke (V_{rms}/krpm): 98.0**			
Rated Torque	(Nm)	1.2	2.1	2.8	3.6	2.3	4.0	5.5	7.0	8.5
Continuous Stall Current	(A_{rms})	0.81	1.44	1.94	2.50	1.63	2.75	3.81	4.88	5.88
Rated Power	(kW)	0.38	0.66	0.88	1.13	0.72	1.26	1.73	2.20	2.67
R (ph-ph)	(Ohms)	73.44	23.42	13.88	8.67	24.92	7.51	4.12	2.75	1.92
L (ph-ph)	(mH)	109.20	47.70	31.50	22.80	63.50	28.50	18.30	13.20	10.30
Rated Speed 4000 (rpm)			**Kt (Nm/A_{rms}): 1.2**				**Ke (V_{rms}/krpm): 73.5**			
Rated Torque	(Nm)	1.1	2.0	2.4	3.0	2.0	3.1	4.1	5.0	5.9
Continuous Stall Current	(A_{rms})	1.08	1.92	2.58	3.33	2.17	3.67	5.08	6.50	7.83
Rated Power	(kW)	0.46	0.84	1.01	1.26	0.84	1.30	1.72	2.09	2.47
R (ph-ph)	(Ohms)	43.66	14.17	7.70	4.60	13.80	4.40	2.40	1.70	1.20
L (ph-ph)	(mH)	61.70	27.20	18.10	12.70	35.90	16.10	10.10	7.60	5.80

Note: $1kgcm^2 = 1x10^{-4}\ kgm^2$
Note 2: All performance data is subject to a tolerance of ±10%

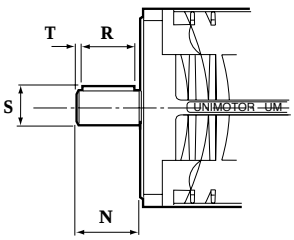
Shaded areas indicate preferred types.

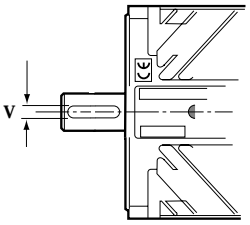
servo motor technical specification

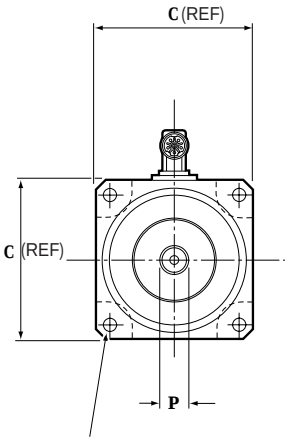
	115					142					190			
	A	B	C	D	E	A	B	C	D	E	A	B	C	D
	4.6	7.6	10.8	13.7	16.2	7.3	12.5	17.7	22.9	27.0	23.2	43.2	62.8	78.0
	13.8	22.8	32.4	41.1	48.6	21.9	37.5	53.1	68.7	81.0	69.6	129.6	188.4	234.0
	9.7	12.0	14.3	16.6	18.8	21.6	28.0	34.3	40.7	47.0	93.5	141	187.5	234.5
	3.2	5.5	7.8	10.0	12.3	7.8	14.1	20.5	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	20.5	26.0	33.0	40.0	48.0
	1436	1614	1792	1980	2158	2093	2316	2548	2700	3003	3220	3645	3960	4500
	0.06	0.10	0.14	0.18	0.21	0.09	0.16	0.23	0.30	0.35	0.34	0.60	0.80	1.10
	4.3	7.0	9.9	12.5	14.8	6.8	12.0	17.0	21.4	24.9	20.8	38.1	53.0	60.0
	1.92	3.17	4.50	5.71	6.75	3.04	5.21	7.38	9.54	11.25	9.67	18.00	26.20	32.50
	0.90	1.47	2.07	2.62	3.10	1.42	2.51	3.56	4.48	5.21	4.36	7.98	11.10	12.56
	27.80	8.55	4.55	2.96	2.17	13.40	4.00	2.10	1.35	0.98	1.90	0.67	0.39	0.24
	94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	18.80	8.60	5.90	4.10
	3.8	6.3	8.9	11.2	13.2	6.3	10.5	14.2	18.4	21.0	20.1	36.2	38.3	4.2
	2.88	4.75	6.75	8.56	10.13	4.56	7.81	11.06	14.31	16.88	14.5	27.0	39.3	48.8
	1.19	1.98	2.80	3.52	4.15	1.98	3.30	4.46	5.78	6.60	6.31	11.37	12.03	12.63
	12.55	3.86	2.02	1.34	1.10	6.00	1.82	0.94	0.59	0.44	0.89	0.32	0.20	0.13
	43.10	18.60	11.40	8.60	7.40	31.00	13.30	8.30	6.10	4.80	9.24	4.28	3.29	2.48
	3.2	5.1	7.0	8.1	8.9	4.2	8.2	10.4	12.5	14.2				
	3.83	6.33	9.00	11.42	13.50	6.08	10.42	14.75	19.08	22.50				
	1.34	2.14	2.93	3.39	3.73	1.76	3.43	4.36	5.24	5.95				
	6.91	2.14	1.16	0.73	0.57	3.35	1.00	0.53	0.35	0.24				
	23.50	10.20	6.60	4.70	3.90	17.60	7.50	4.70	3.60	2.70				

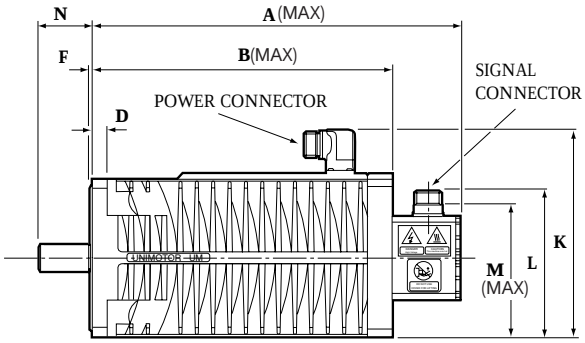
Outline Drawings - Frame Sizes 75 - 142

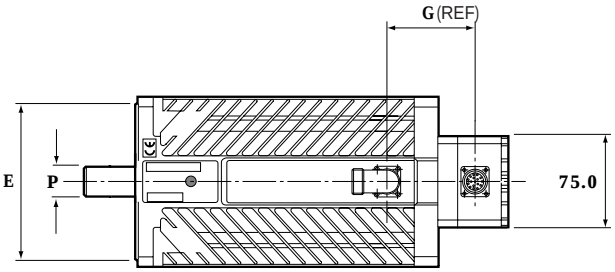
Shaft Key Detail
(Option A)









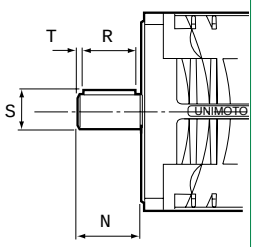


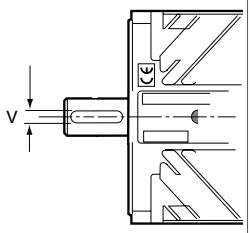
Dimensions - Frame Sizes 75 - 142

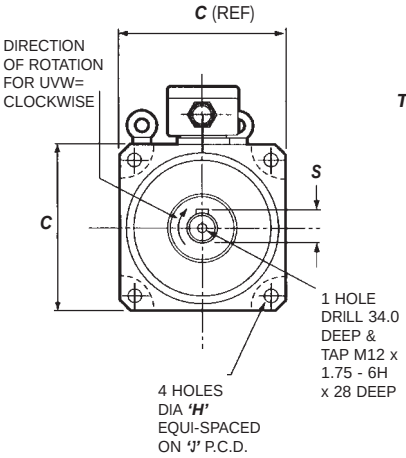
FRAME SIZE	75				95					115					142				
Dimension / Length suffix	A	B	C	D	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
A Length Overall (Unbraked)	211	241	271	301	222	252	282	312	342	242	272	302	332	362	225	255	285	315	345
A Length Overall (Braked)	241	271	301	331	252	282	312	342	372	272	302	332	362	392	285	315	345	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

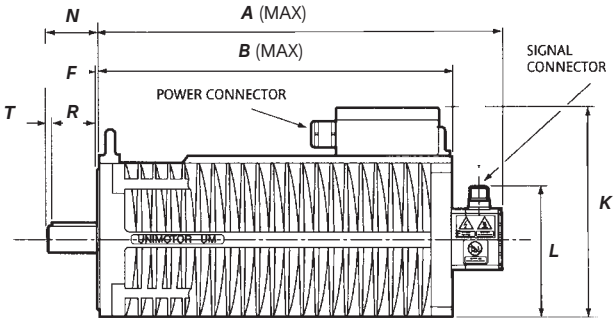
Outline Drawings - Frame Size 190

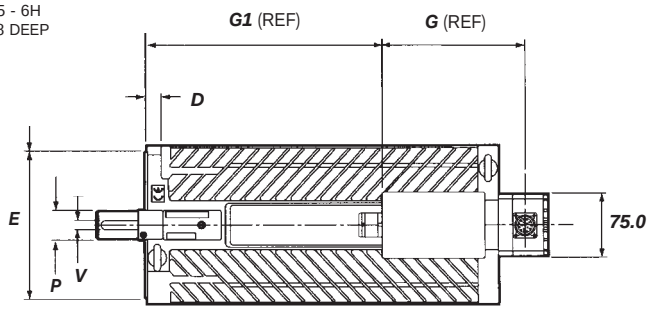
Shaft Key Detail
(Option A)





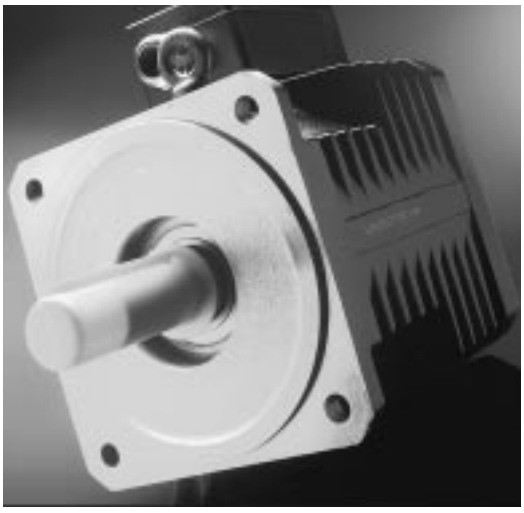






Dimensions - Frame Size 190

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			



Accessories

Control Techniques offers a number of products, which add power, flexibility and value to the Unimotor range:

Cable Assemblies and Connectors

Control Techniques' cable assemblies simplify motor connection and reduce installation time. Made to order in lengths up to 100 metres, they have a PUR sheath for high resistance to oil, grease and solvents and have an excellent dynamic performance. CSA and UL approved.

Accessories also available from your local Control Techniques Drive Centre

Planetary Gearmotors

Gearmotors deliver greater torque output whilst maintaining high standards of precision and reliability. They may be mounted in any orientation and are available with single or double stage gearbox options.

Fan Cowlings

Fan cowlings force cool air through the fins on the Unimotor housing to increase torque output by up to 70%. Available to fit all motor frame sizes, the units may be retrofitted and maximise power density in tight spaces.

For further information on planetary gearmotors and fan cowlings please contact your local Drive Centre

Cable Assemblies

Characteristics - 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 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 connections of the motor to the drive.

Control Techniques' 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 3m to 100m and are available for all standard Unimotor options.

Features

- UL and CSA approved
- Power and signal cables available
- No need for crimp and insertion / removal tools
- Production build gives quality and price benefits
- Compatible with Unimotor and Unidrive
- Optimum noise immunity
- Oil resistant PVC signal cable for industrial environments and some dynamic applications
- PUR power cable for oil resistance and long life dynamic applications
- Brake wires are separately shielded within power cable
- Thermistor wire pair is separately shielded in signal cable
- Encoder power pair each 1mm^2 conductors in signal cable for low volt drop
- Braided screen for greater flexibility and wear
- Power cables with or without brake
- Shielded brake supply wires
- Cable assembly type identification label

Applications

- For general applications choose PVC type. This has good all round performance.
- Use PUR for high dynamic applications where cable is frequently in motion.
- Use PUR for machine tools where the cable is sprayed with coolant fluid.
- 2.5 mm^2 conductors are applicable to all motors in the range to 142 frame size.
- 4.0mm^2 conductors are applicable to 190 frame sizes.

PUR Power Cables

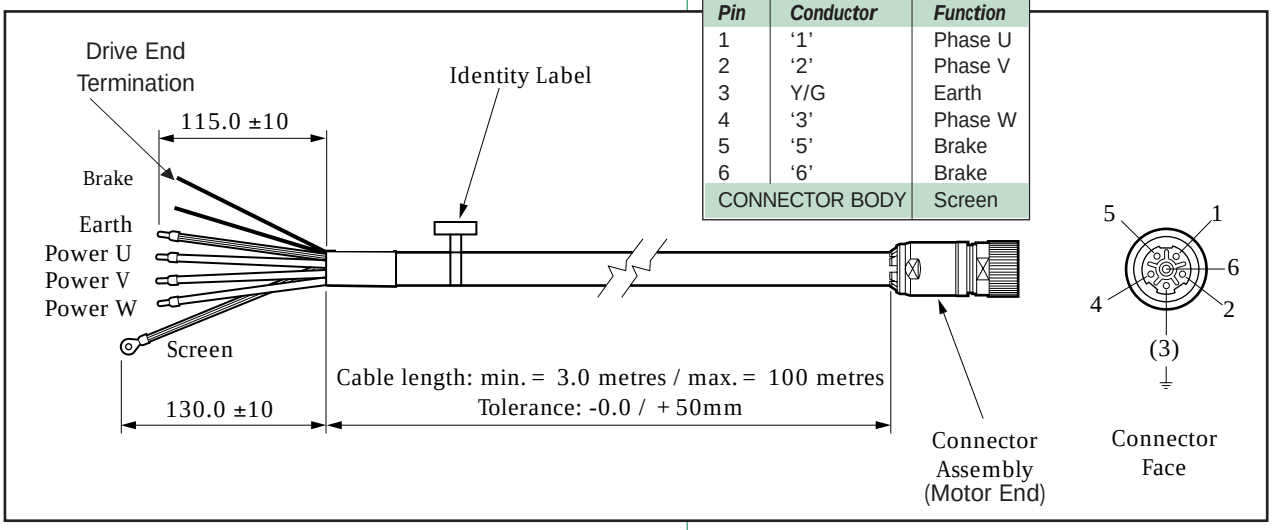
Specification - Shielded Power Cable Options 2.5mm²

Cable Description	***(2.5mm²) PUR Shielded Power, without Brake***	***(2.5mm²) PUR Shielded Power, with Brake***
Cable Type	PSBA--	PBBA--
Power Conductors	4 x 2.5mm²	4 x 2.5mm²
Brake Supply Wires	-	1 x (2x1) mm²
Conductor Type	Copper stranded to DIN VDE 0295 Class 6, IEC 228 Class 6, CEI 20-29 Class 6; 147 x 0.15mm;13 AWG	
Insulation Material	PET - complies: VDE 0250 part 1 tab 4	
Core Identification	Black, printed white: U, VV, WWW, GY	
Brake Signal Pair Brake Conductors	-	Copper stranded 19 x 0.25mm
Brake Insulation	-	PET - complies: VDE 0250 part 1 tab 4
Brake Pair Shield	-	Tinned copper spiralled covering ≥90%
Brake Core Identification	-	Black and white
Taping	-	Soft tape
Shield	Tinned copper braid covering ≥85%	Tinned copper braid covering ≥85%
Shield Diameter	10.5mm	10.5mm
Outer Jacket	Polyurethane complies: VDE 025-818 black	Polyurethane complies: VDE 025-818 black
Outer Jacket Diameter	12.8 mm± 4%	12.8 mm ± 4%
Voltage (power)	600 V / 1000 V	600 V / 1000 V
Voltage (brake pair)	-	250 V
Dielectric Strength (power)	3000 V	3000 V
Dielectric Strength (brake pair)	-	1000V
Insulation Resistance (power)	>10 MOhm/km	>10 MOhm/km
Capacitance (phase - phase)	110 pf/m	110 pf/m
Capacitance (phase - screen)	190 pf/m	190 pf/m
Bending Radius (min)	10 x diameter, dynamic laying (150 mm)	
Speed (max)	180 m/min	180 m/min
Acceleration (max)	7 m/s²	7 m/s²
Bending Life (min)	5 million cycles	5 million cycles
Operating Temperature	-10°C to + 80°C	-10°C to + 80°C
Storage Temperature	-30°C to + 80°C	-30°C to + 80°C
Pulling Strength (max, dynamic)	20 N/mm²	20 N/mm²
Pulling Strength (max, fixed)	50 N/mm²	50 N/mm²
Weight	160 kg/km	160 kg/km

Specification - Shielded Power Cable Options 4.0 mm²

Cable Description	***(4.0 mm²) PUR Shielded Power, without Brake***	***(4.0 mm²) PUR Shielded Power, with Brake***
Cable Type	PSBB--	PBBB--
Power Conductors	4 x 4.0mm²	4 x 4.0mm²
Brake Supply Wires	-	1 x (2x1) mm²
Conductor Type	Copper stranded to DIN VDE 0295 Class 6, IEC 228 Class 6, CEI 20-29 Class 6; 245 x 0.15mm; 11 AWG	
Insulation Material	PET - complies: VDE 0250 part 1 tab 4 NFC & CEI	
Core Identification	Black, printed white: U, VV, WWW, G/Y	
Brake Signal Pair		
Brake Conductors Brake Insulation Brake Pair Shield	- - -	Copper stranded 19 x 0.25mm PET Tinned copper spiralled covering ≥ 90%
Brake Core Identification	-	Black and white
Taping	-	Soft tape
Shield	Tinned copper braid covering ≥85%	Tinned copper braid covering ≥85%
Shield Diameter	11.3 mm	
Outer Jacket	Polyurethane complies: VDE 025 - 818, black	
Outer Jacket Diameter	14.4 mm± 4%	
Voltage (power)	600 V / 1000 V	
Voltage (brake pair)	-	250 V
Dielectric Strength (power)	3000 V	3000 V
Dielectric Strength (brake pair)	-	1000 V
Insulation Resistance (power)	>10 MOhm/km	>10 MOhm/km
Capacitance (phase - phase)	120 pf/m	120 pf/m
Capacitance (phase - screen)	200 pf/m	
Bending Radius (min) Speed (max)	10 x diameter, dynamic laying (150 mm) 180 m/min	 180 m/min
Acceleration (max)	7 m/s²	7 m/s²
Bending Life (min)	5 million cycles	5 million cycles
Operating Temperature	-10°C to + 80°C	-10°C to + 80°C
Storage Temperature	-30°C to + 80°C	-30°C to + 80°C
Pulling Strength (max, dynamic)	20 N/mm²	20 N/mm²
Pulling Strength (max, fixed)	50 N/mm²	50 N/mm²
Weight	230 kg/km	230 kg/km

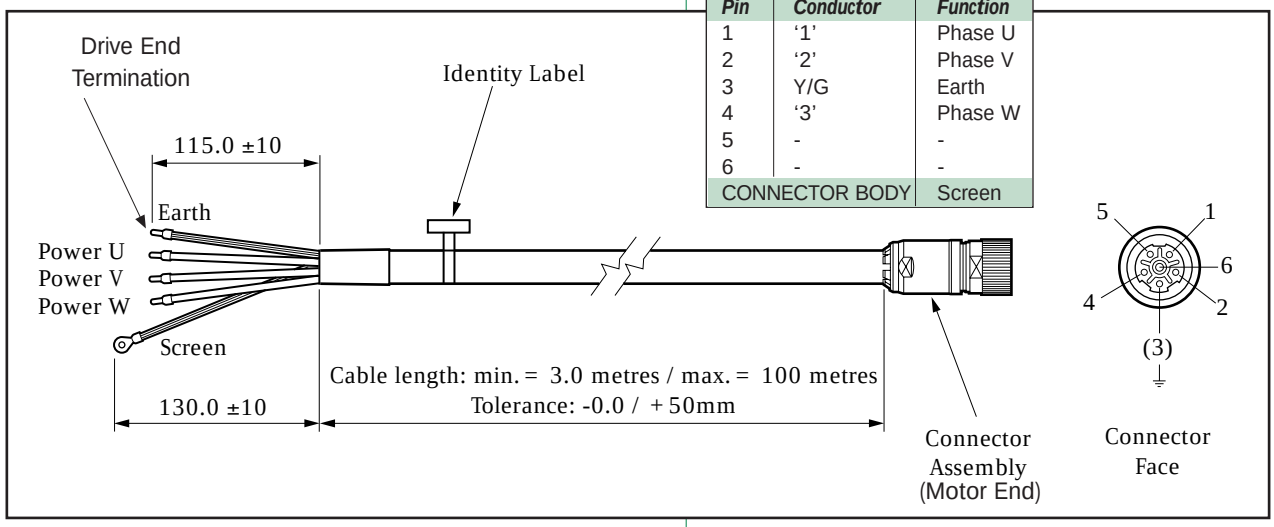
Outline Drawing - Power Cable With Brake



Power Cable Connections - with Brake

Pin	Conductor	Function
1	'1'	Phase U
2	'2'	Phase V
3	Y/G	Earth
4	'3'	Phase W
5	'5'	Brake
6	'6'	Brake
CONNECTOR BODY		Screen

Outline Drawing - Power Cable Without Brake



Power Cable Connections - without Brake

Pin	Conductor	Function
1	'1'	Phase U
2	'2'	Phase V
3	Y/G	Earth
4	'3'	Phase W
5	-	-
6	-	-
CONNECTOR BODY		Screen

Ordering Information - Power Cables

Use the information on the following chart to create an order code. The top line is an example of an order code.

PB	B	B	B	095

Insulator:
B - PUR

Cable Length (metres):
Min - 003 (3 metres)
Max - 100 (100 metres)

Cable Type:
PS - Power (Standard)
PB - Power (With brake)

Conductor Size:
A - 4x 2.5mm2 conductor (75A - 190A)
B - 4x 4.0mm2 conductor (190B - 190D)

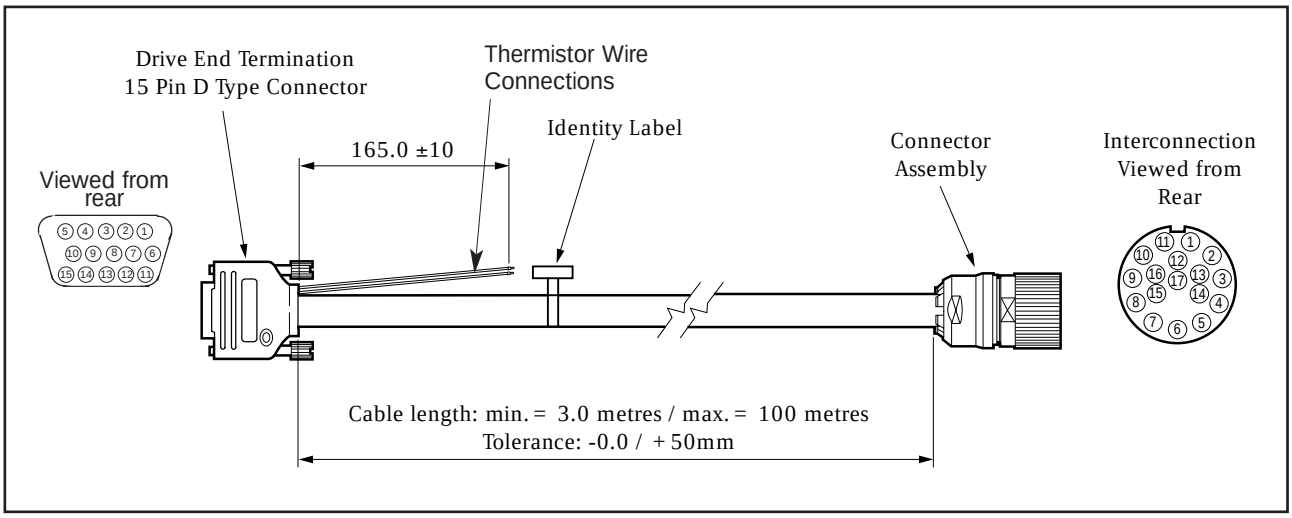
Connector Types:
A - Ferrule ends at Drive, Inter-connectron at Motor (not 190)
B - Ferrule ends at Drive, unfinished cut end at Motor
C - Ferrule ends at Drive and Motor for hybrid or terminal box
X - Cable only

Signal Cable

Specification - Shielded Signal Cable Incremental, PVC or PUR

Cable Description	***PVC/PUR Shielded Signal - Incremental***
Cable Type	SIAA--
Encoder Supply Conductors	1 x (2 x 1.0mm^2)
Conductor Type	Tinned copper stranded to DIN VDE 0295 Class 5, IEC 228 Class 5
Insulation Material	Polypropylene 1.75 mm dia. ± 0.1mm
Core Identification	Red, Blue
Screened Thermistor Wires Thermistor Wires	Tinned Copper stranded, 1 x (2 x 0.34 mm^2)
Thermistor Insulation	Polypropylene 1.25 mm dia. ± 0.1mm
Thermistor Screen	Aluminium foil covering ≥ 100%
Encoder Signal Wires Signal Wires	Tinned copper stranded, 6 x (2 x 0.34mm^2)
Insulation Material	Polypropylene 1.25 mm dia. ± 0.1mm
Core Identification	To DIN 47100 (pairs numbered 2 - 7)
Shield	Tinned copper braid covering ≥85%
Shield Diameter	8.5mm (nominal)
Outer Jacket	black
Outer Jacket Diameter	10.9 ±4%
Voltage	30 V RMS
Dielectric Strength	1500 V
Insulation Resistance	≥5000 MOhm/km
Capacitance (phase - phase) Supply Conductors Thermistor Wires Signal Wires	 80 pf/m 100 pf/m 70 pf/m
Capacitance (phase - screen) Supply Conductors Thermistor Wires Signal Wires	 150 pf/m 180 pf/m 125 pf/m
Bending Radius (min)	10 x diameter
Speed (max)	120m/min
Acceleration (max)	4 m/s^2
Bending Life	5 million cycles
Operating Temperature	-10˚C to +80˚C
Storage Temperature	-30˚C to +80˚C
Pulling Strength (max. dynamic)	20 N/mm^2
Pulling Strength (max. fixed)	35 N/mm^2
Weight	200 kg/km

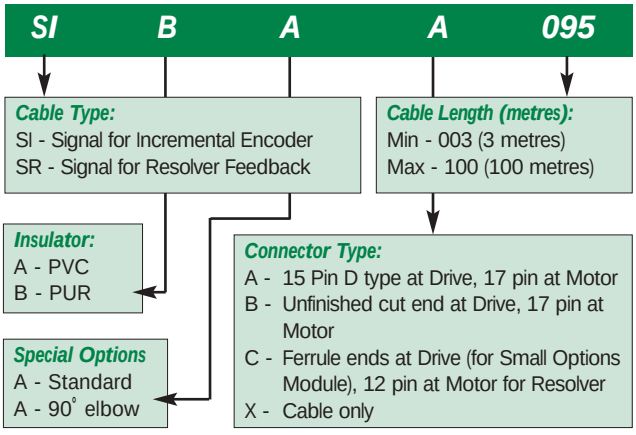
Outline Drawing - Signal Incremental Cable



'D' Type Connector			17 pin Interconnectron Connector		
Pin	Colour	Function	Pin	Colour	Function
1	Grey/Pink Band	Channel A	1	White	Thermistor
2	Red/Blue Band	Channel A Inverse	2	Brown	Thermistor Rtn
3	Red (0.34mm^2)	Channel B	3	-	Not Used
4	Blue (0.34mm^2)	Channel B Inverse	4	Green	S1
5	White/Green Band	Index	5	Yellow	S1 Inverse
6	Brown/Green Band	Index Inverse	6	Grey	S2
7	Green	S1	7	Pink	S2 Inverse
8	Yellow	S1 Inverse	8	Black	S3
9	Grey	S2	9	Purple	S3 Inverse
10	Pink	S2 Inverse	10	Grey/Pink Band	Channel A
11	Black	S3	11	White/Green Band	Index
12	Purple	S3 Inverse	12	Brown/Green Band	Index Inverse
13	Red (1.0mm^2)	+5 Volts dc	13	Red/Blue Band	Channel A Inverse
14	Blue (1.0mm^2)	0 Volts	14	Red (0.34mm^2)	Channel B
15	-	Not Used	15	Blue (0.34mm^2)	Channel B Inverse
-	White	Thermistor	16	Red (1.0mm^2)	+5 Volts dc
-	Brown	Thermistor Rtn	17	Blue (1.0mm^2)	0 Volts
BODY	Thermistor screen & overall screen		BODY	To overall screen	

Ordering Information - Signal Cables

Use the information given on the following chart to create an order code for signal cables. The top line is a typical example.



UNIMOTOR Brushless Servo Motors

Connector Accessories

Control Techniques offers a range of connector accessories to suit the power and signal connection requirements of Unimotor UM and SL. Connector assembly kits, which include the power, signal connectors and their crimp sockets may be ordered, alternatively, individual connector assemblies may be ordered.

Power and Signal Connector Packs

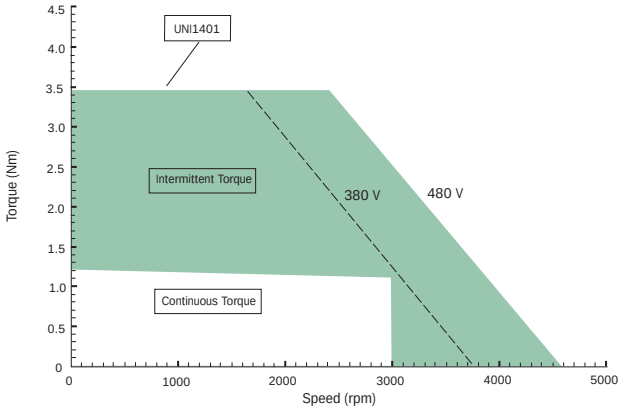
Description	Pack Content	Use For	Order Ref.
17 Way Plug Pack	1 x 17 way signal plug 17 x crimp sockets 1 x 6 way power plug 6 x crimp sockets	Power & signal connection to UM Motors with incremental encoder feedback	IM/0012/KI
5 Way Plug Pack	1 x 5 way solder plug 1 x 6 way power plug 6 x crimp sockets	Power & signal connection to SL Motors with CT Coder and SL electronics	IM/0024/KI
12 Way Plug Pack	1 x 12 way signal plug 12 x crimp sockets 1 x 6 way power plug 6 x crimp sockets	Power & signal connection to UM Motors with resolver feedback	IM/0011/KI

Individual Connector Packs

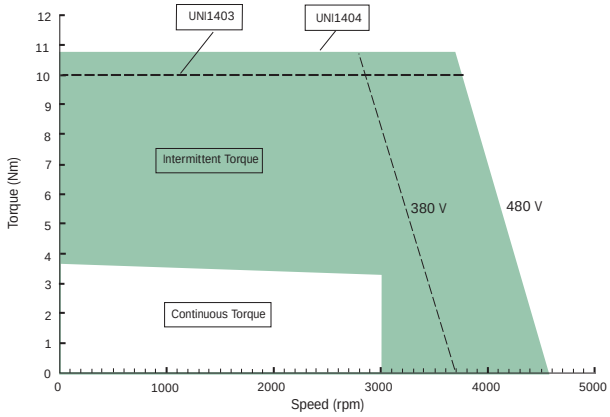
Description	Pack Content	Use For	Order Ref.
6 Way Power Plug	1 x 6 way power plug 6 x crimp sockets	Power Connection to UM & SL Motors	IM/0021/KI
17 Way Signal Plug	1 x 17 way signal plug 17 x crimp sockets	Signal connection to UM Motors with incremental encoder feedback	IM/0022/KI
12 Way Signal Plug	1 x 12 way signal plug 12 x crimp sockets	Signal connection to UM Motors with resolver feedback	IM/0023/KI
5 Way Signal Plug	1 x 5 way solder plug	SL Motors with CT Coder and SL electronics	7580029

torque speed curves & tables

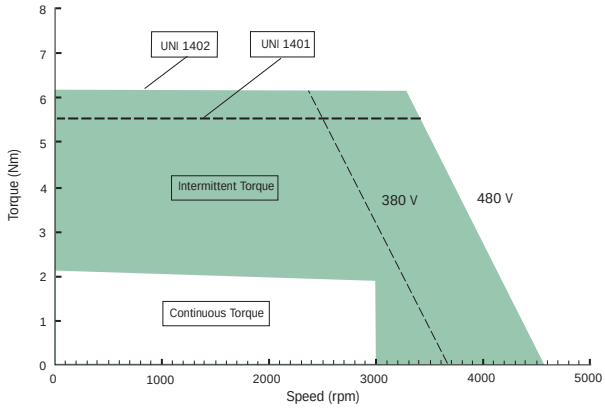
75UMA300 Unimotor



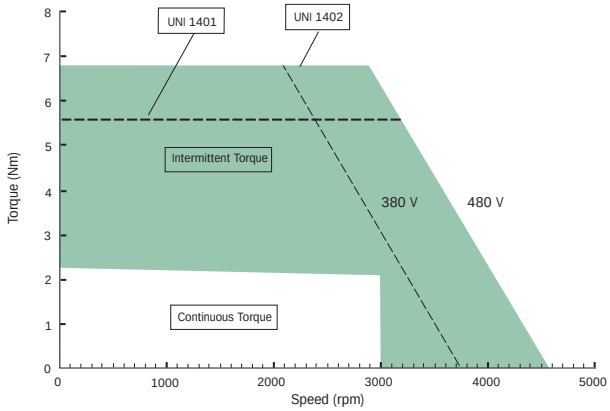
75UMD300 Unimotor



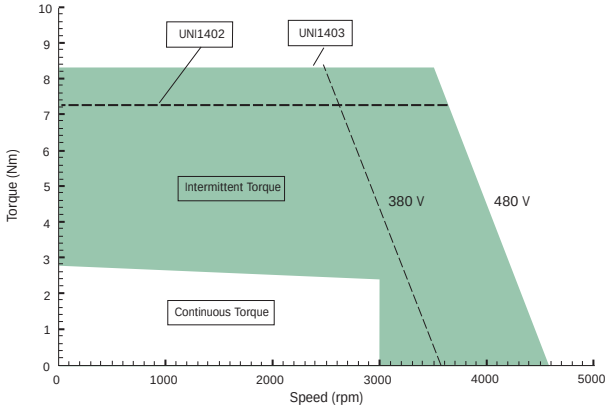
75UMB300 Unimotor



95UMA300 Unimotor



75UMC300 Unimotor



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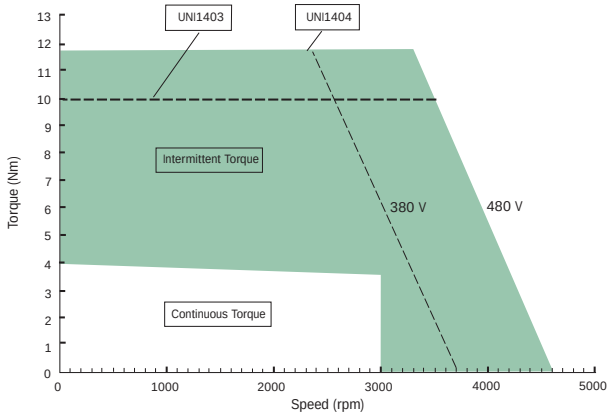
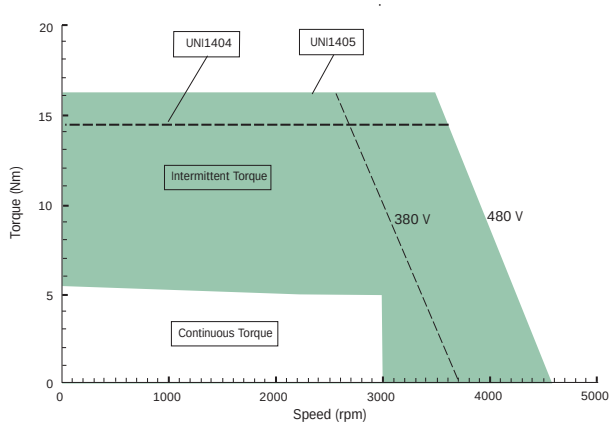


torque speed curves & tables

95UMC300 Unimotor



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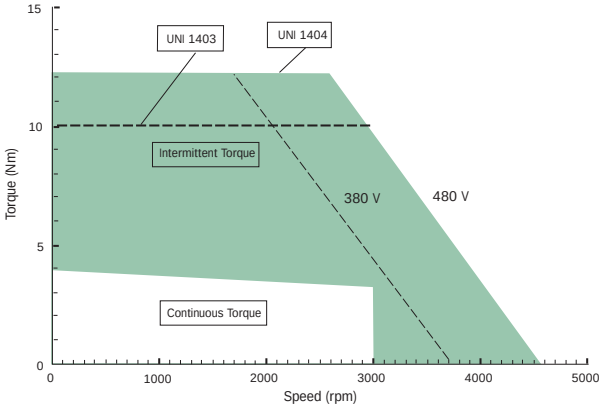
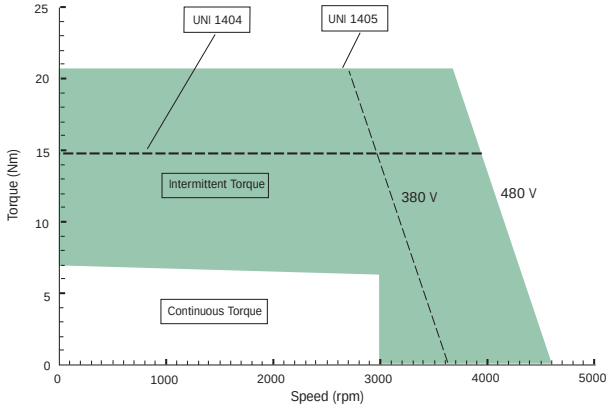


95UMD300 Unimotor



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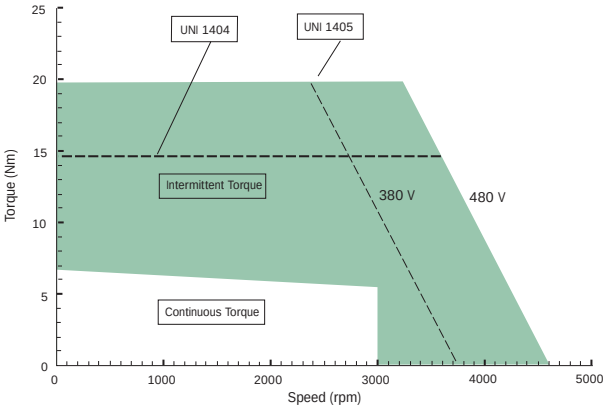
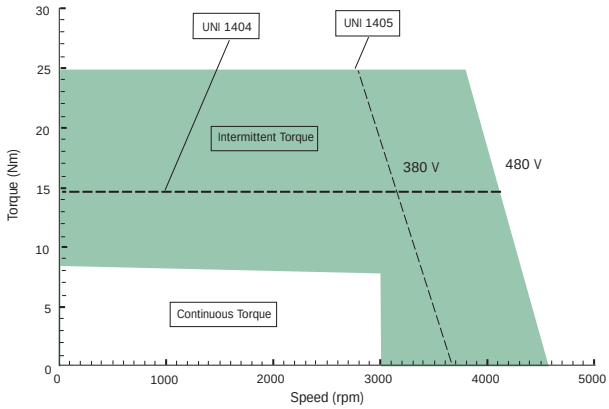
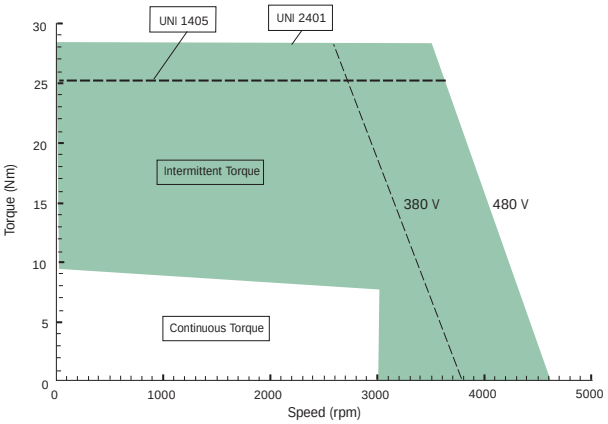


95UME300 Unimotor

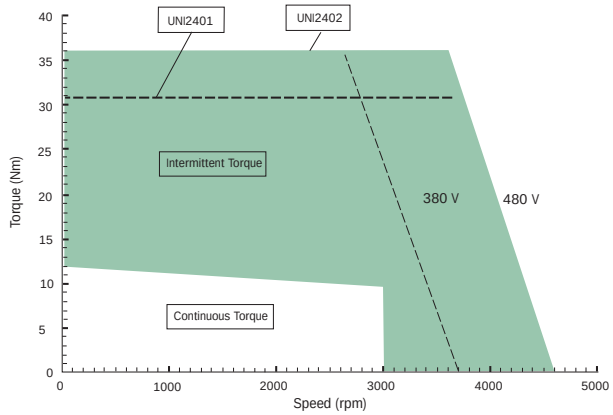


115UMC300 Unimotor

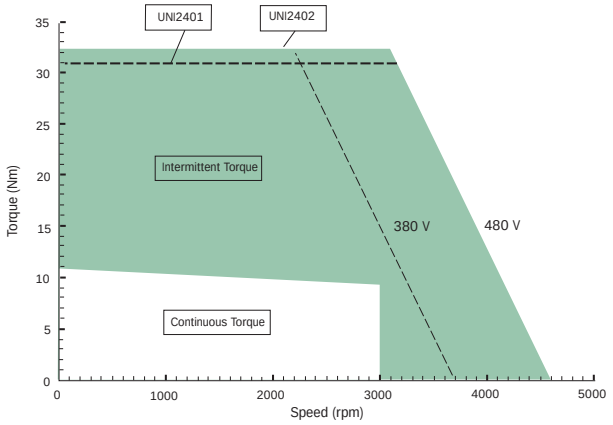


torque speed curves & tables

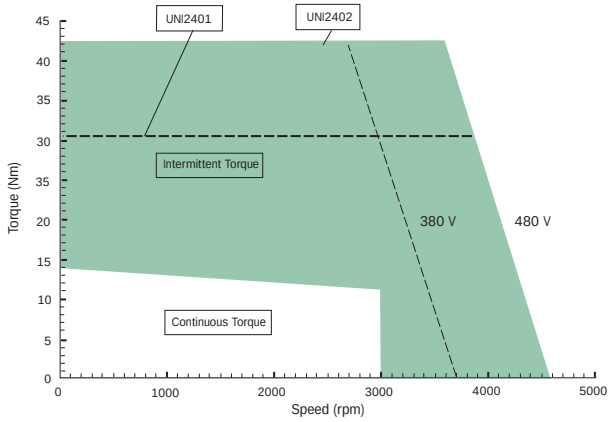
115UMD300 Unimotor



142UMB300 Unimotor



115UME300 Unimotor



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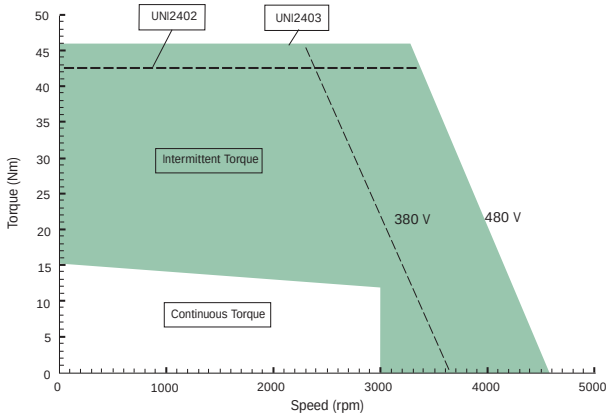

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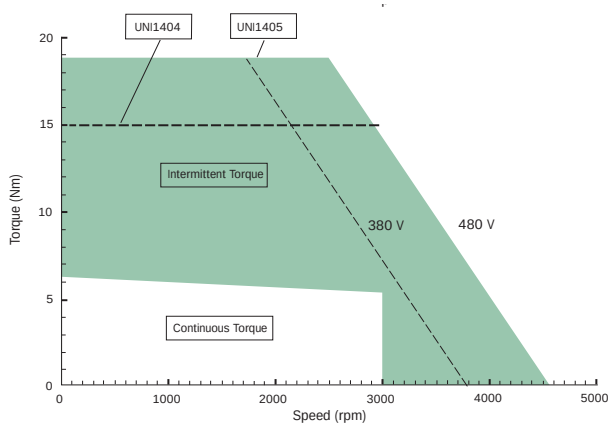

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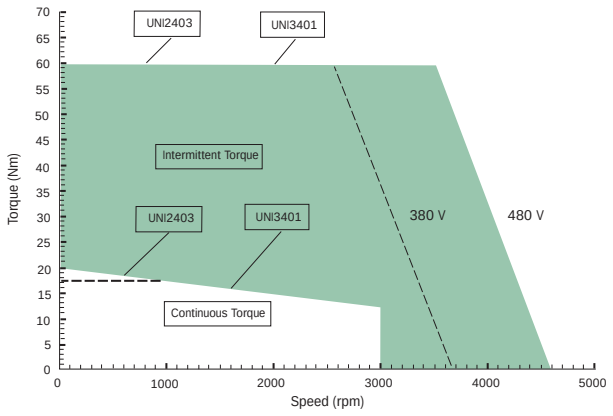
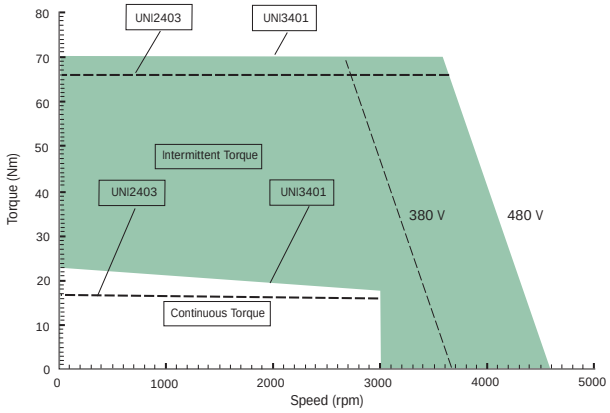
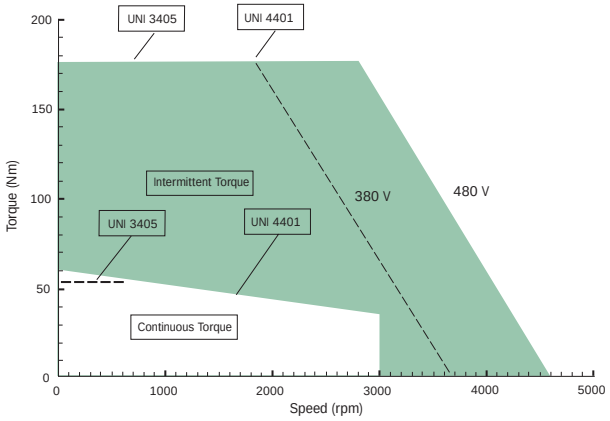


torque speed curves & tables

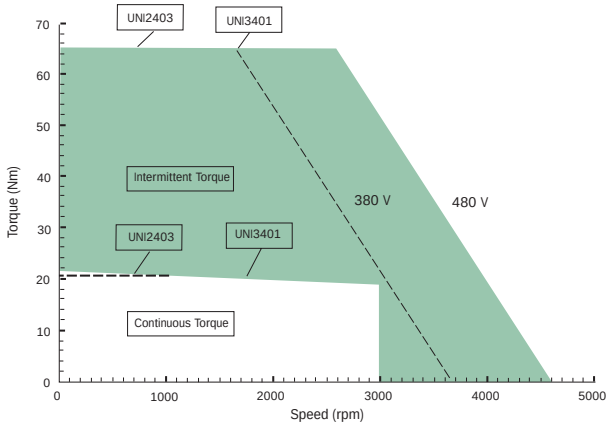
142UME300 Unimotor



190UMC300 Unimotor



190UMA300 Unimotor



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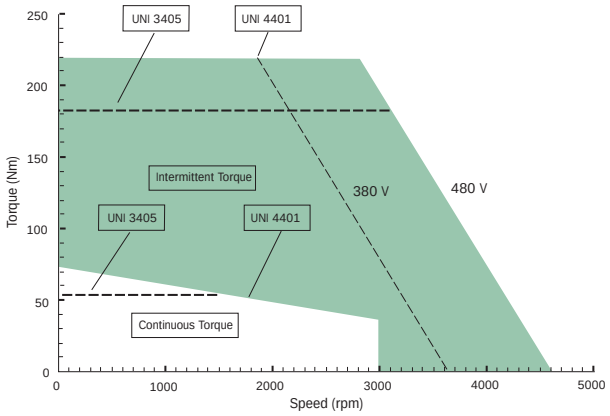
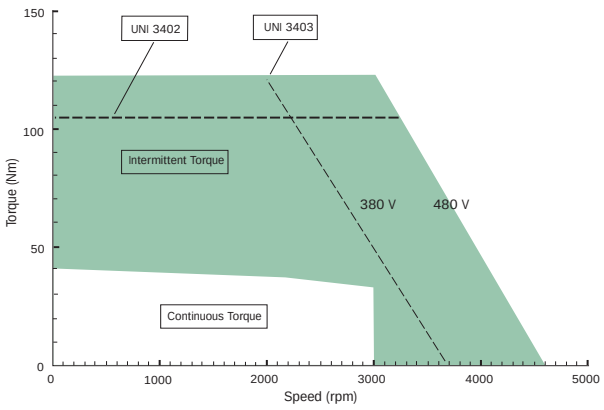


190UMB300 Unimotor



UNIMOTOR Brushless Servo Motors

The time for which the stated overloads can be acheived will vary with the drive/motor combination used. Please consult technical manual for further details.

UNIMOTOR/UNIDRIVE COMBINATION (12 kHz SWITCHING FREQUENCY ONLY)

Unimotor Model		75UMA300		75UMB300		75UMC300		75UMD300	
Cont.Stall Torque	(Nm)	1.2		2.1		2.8		3.6	
Rated Speed	(rpm)	3000		3000		3000		3000	
Torque Constant	(Nm/A_{rms})	1.6		1.6		1.6		1.6	
Cont. Stall Current	(A_{rms})	0.8		1.4		1.9		2.5	
Rotor inertia	($Kgcm^2$)	0.6		1.0		1.5		1.9	
Unidrive Model (12kHz)		**UNI1401**	**N/A**	**UNI1401**	**UNI1402**	**UNI1402**	**UNI1403**	**UNI1403**	**UNI1404**
Cont. Current Preset	(#0.46)A	0.8	N/A	1.4	1.4	1.9	1.9	2.5	2.5
Peak Current Preset	(#0.06)%	300	N/A	264	300	258	300	268	300
Motor-Drive Combination (Nm)									
Stall Torque	(Nm)	1.2	N/A	2.1	2.1	2.8	2.8	3.6	3.6
Peak Torque	(Nm)	3.5	N/A	5.5	6.2	7.3	8.4	10.0	10.8

UNIMOTOR/UNIDRIVE COMBINATION (12 kHz SWITCHING FREQUENCY ONLY)

Unimotor Model		95UMA300		95UMB300		95UMC300		95UMD300		95UME300	
Cont.Stall Torque	(Nm)	2.3		3.9		5.5		6.9		8.4	
Rated Speed	(rpm)	3000		3000		3000		3000		3000	
Torque Constant	(Nm/A_{rms})	1.6		1.6		1.6		1.6		1.6	
Cont. Stall Current	(A_{rms})	1.55		2.6		3.67		4.6		5.6	
Rotor inertia	($Kgcm^2$)	1.4		2.5		3.6		4.7		5.8	
Unidrive Model (12kHz)		**UNI1401**	**UNI1402**	**UNI1403**	**UNI1404**	**UNI1404**	**UNI1405**	**UNI1404**	**UNI1405**	**UNI1404**	**UNI1405**
Cont. Current Preset	(#0.46)A	1.55	1.55	2.6	2.6	3.67	3.67	4.6	4.6	5.6	5.6
Peak Current Preset	(#0.06)%	239	300	258	300	270	300	215	300	177	300
Motor-Drive Combination (Nm)											
Stall Torque	(Nm)	2.3	2.3	3.9	3.9	5.5	5.5	6.9	6.9	5.6	5.6
Peak Torque	(Nm)	5.55	6.8	10.0	11.7	14.8	16.5	14.8	20.7	14.8	25.1

UNIMOTOR/UNIDRIVE COMBINATION (12 kHz SWITCHING FREQUENCY ONLY)

Unimotor Model		115UMA300		115UMB300		115UMC300		115UMD300		115UME300	
Cont.Stall Torque	(Nm)	4.1		6.7		9.5		12.0		14.1	
Rated Speed	(rpm)	3000		3000		3000		3000		3000	
Torque Constant	(Nm/A_{rms})	1.6		1.6		1.6		1.6		1.6	
Cont. Stall Current	(A_{rms})	2.74		4.47		6.34		8.0		9.4	
Rotor inertia	($Kgcm^2$)	3.2		5.5		7.8		10.0		12.3	
Unidrive Model (12kHz)		**UNI1403**	**UNI1404**	**UNI1404**	**UNI1405**	**UNI1405**	**UNI2401**	**UNI2401**	**UNI2402**	**UNI2401**	**UNI2402**
Cont. Current Preset	(#0.46)A	2.74	2.74	4.47	4.47	6.34	6.34	8.0	8.0	9.4	9.4
Peak Current Preset	(#0.06)%	245	300	221	300	265	300	265	300	226	300
Motor-Drive Combination (Nm)											
Stall Torque	(Nm)	4.1	4.1	6.7	6.7	9.5	9.5	12.0	12.0	14.1	14.1
Peak Torque	(Nm)	10.0	12.3	14.8	20.1	25.2	28.5	31.8	36.0	31.8	42.3

UNIMOTOR/UNIDRIVE COMBINATION (12 kHz SWITCHING FREQUENCY ONLY)

Unimotor Model		142UMA300		142UMB300		142UMC300		142UMD300		142UME300	
Cont.Stall Torque	(Nm)	6.3		10.8		15.3		19.8		23.4	
Rated Speed	(rpm)	3000		3000		3000		3000		3000	
Torque Constant	(Nm/A_{rms})	1.6		1.6		1.6		1.6		1.6	
Cont. Stall Current	(A_{rms})	4.2		7.2		10.2		13.2		15.6	
Rotor inertia	($Kgcm^2$)	7.8		14.1		20.5		26.8		33.1	
Unidrive Model (12kHz)		**UNI1404**	**UNI1405**	**UNI2401**	**UNI2402**	**UNI2402**	**UNI2403**	**UNI2403**	**UNI3401**	**UNI2403**	**UNI3401**
Cont. Current Preset	(#0.46)A	4.2	4.2	7.2	7.2	10.2	10.2	11.7	13.2	11.7	15.6
Peak Current Preset	(#0.06)%	236	300	295	300	277	300	338	300	377	300
Motor-Drive Combination (Nm)											
Stall Torque	(Nm)	6.3	6.3	10.8	10.8	15.3	15.3	17.5	19.8	17.5	23.4
Peak Torque	(Nm)	14.8	18.9	31.8	32.4	42.3	45.9	59.4	59.4	66.1	70.2

UNIMOTOR/UNIDRIVE COMBINATION (9 kHz SWITCHING FREQUENCY ONLY)

Unimotor Model		190UMA300		190UMB300		190UMC300		190UMD300	
Cont.Stall Torque	(Nm)	21.8		41.1		58.7		73.2	
Rated Speed	(rpm)	3000		3000		3000		3000	
Torque Constant	(Nm/A_{rms})	1.6		1.6		1.6		1.6	
Cont. Stall Current	(A_{rms})	14.5		27.4		39.1		48.8	
Rotor inertia	($Kgcm^2$)	44.8		81.6		118.4		155.1	
Unidrive Model (12kHz)		**UNI2403**	**UNI3401**	**UNI3402**	**UNI3403**	**UNI3405**	**UNI4401**	**UNI3405**	**UNI4401**
Cont. Current Preset	(#0.46)A	14.2	14.5	27.4	27.4	35	39.1	35	48.8
Peak Current Preset	(#0.06)%	306	300	255	300	335	300	349	300
Motor-Drive Combination (Nm)									
Stall Torque	(Nm)	21.3	21.8	41.1	41.1	52.5	58.7	52.5	73.2
Peak Torque	(Nm)	63.9	63.9	120.0	123.3	176.1	176.1	183	219.6

servo sizing software

CTSS (CT Sizing Software) is a new servo-sizing package developed to aid System Design Engineers in identifying the essential input parameters to correctly size a servo application. From a system definition and motion requirement, CTSS performs all calculations required to produce torque and distance profiles and gives motor choice optimised on the basis of cost, length or diameter. The software will specify the appropriate Unimotor, Unidrive and braking resistor power, and will generate a parameter list for download into Unidrive via UniSoft.

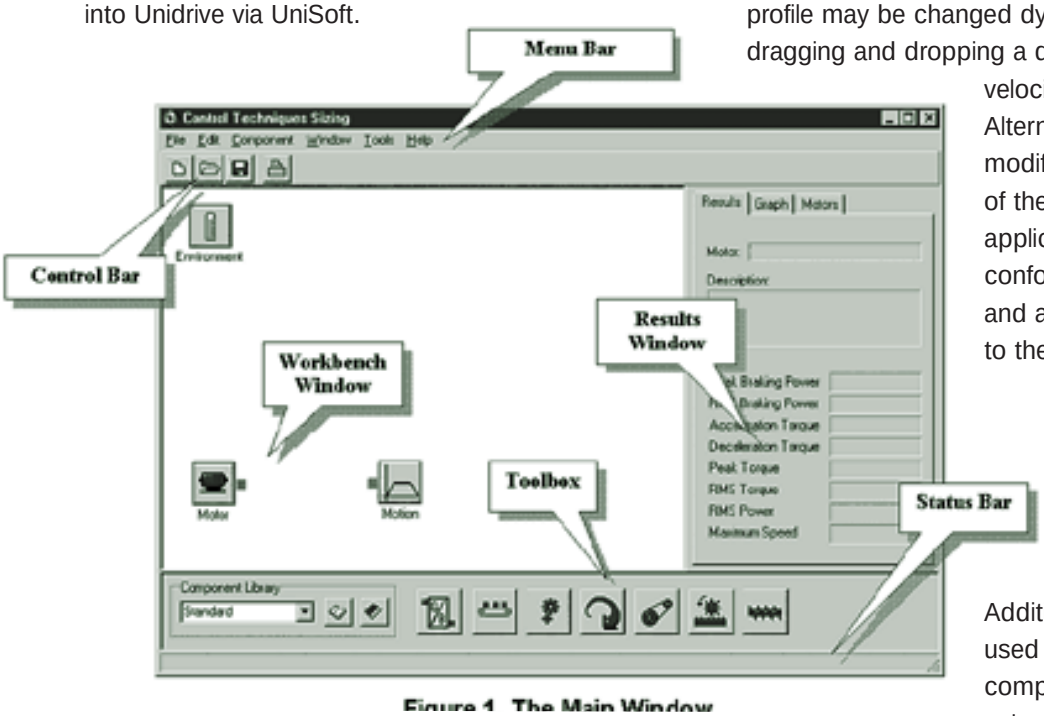


Figure 1 The Main Window

A Windows based program, CTSS allows the engineer to create his application in the Workbench window. Components are dragged and dropped from the Toolbox onto the Workbench and are be linked together using a graphical interface. Component names and properties can be specified and then saved as standard or especially components as required.

The Toolbox contains tabbed pages of application components. Nine main components are provided in the 'Standard' Toolbox page: Gearbox, Lead Screw, Belt & Pulley, Rack & Pinion, Conveyor, Cylinder Drive Feed Roll, Coupling and Miscellaneous Inertia. CTSS allows the user to create any number of Toolbox pages so that he can group together similar components or frequently used combinations.

The components can be dragged from the toolbox into Workbench as required. Each has its own properties sheet, which describes the component, its characteristics and illustrates typical applications. The Component Library provides the option of storage and retrieval of customised components.

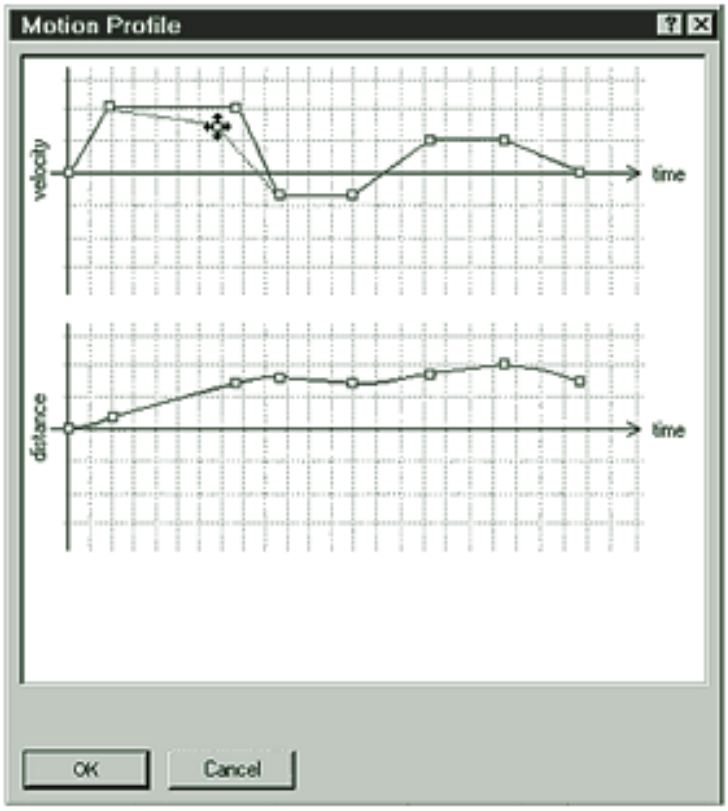
The Results Window displays the motor performance profile and suggests the best motor for the application, according to parameters set. Results of the motion profile may be changed dynamically simply by dragging and dropping a data point on either the velocity or distance traces. Alternatively, the user may simply modify input parameters directly of the components in the application. This window conforms to a data-centric model and always displays data relevant to the userís operations.

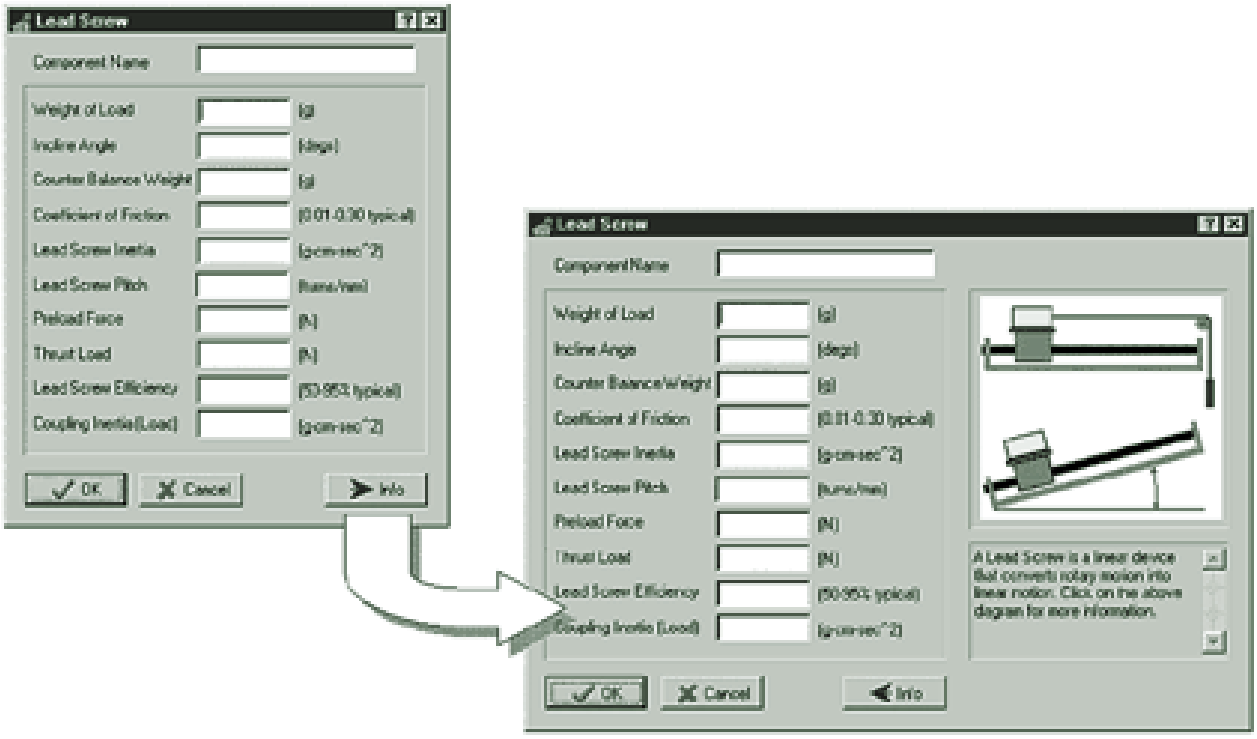
CTSS has a Conversion Tool to assist in changing between units during data entry in the Component Property Pages. Additionally, the Inertia Tool is used extensively when specifying component inertia values. It can calculate inertia for various forms ranging from lead to wood.

A major advantage of CTSS is that it allows engineers to save system designs as files (with a CTS extension). The user may create a Template design file that is used as the basis of future designs. The Design Wizard automates the task of creating a simple application by performing component placement and connection based upon selection in the Wizard pages. The software also allows the creation and storage of notes about an application in the Design File.

CTSS contains details of the full range of Unimotors and Unidrives and can be configured in different languages. To install you will required either Win95 with 12Mb RAM or NT4 with 16Mb RAM.

servo sizing software





UD70 Applications Module

- Easy to use, plug in, drives application module
- Low cost facility to develop application specific programs
- Advanced microprocessor technology providing the flexibility to develop complex applications
- Windows™ based Drive Programming Language ‘toolkit’
- Bi-directional communications with full access to drive parameters
- Real-time calculations for complex time critical applications
- Embedded position controller
- Modbus included as standard

UD70 Applications Module

Features

Task-based architecture allows easy implementation of real-time control operations and fixed timebase calculations. SPEED and ENCODER tasks are synchronised to the drive's internal control loops. Seven separate programmable tasks, listed from highest to lowest priority:

INITIAL	Runs once, immediately after UD70 is reset.
EVENT	Triggered by digital input or the counter/timer unit.
SPEED	Synchronised to internal drive speed loop, runs every 1.38ms or 1.84ms.
ENCODER	Synchronised to internal drive encoder loop, runs every 5.52 or 7.36 ms.
CLOCK	Runs every fixed timebase period, selectable from 5ms to 100ms.
BACKGROUND	Runs when no other tasks are scheduled.
ERROR	Runs when an error occurs, allowing a controlled stop if the error is non-fatal.

- RS485 port - fully configurable. Supports the following modes:
  ANSI protocol as a slave or a master controller, in 2-wire or 4-wire mode, at data rates from 300 bits/sec to 38400 bits/sec.
  MODBUS protocol (ASCII and RTU modes) as a slave only, at data rates from 300 bits/sec to 19200 bits/sec.
  Remote I/O Box high speed protocol. (38400 bits/sec)
- Single character read/write access to the RS485 port buffers. This allows other protocols to be implemented using a DPL program.
- External I/O Box can be connected to the RS485 port. Special high speed I/O Box protocol (38400 bits/sec) can be used to read inputs and update outputs, synchronous with the ENCODER or CLOCK tasks. For multiple I/O Box connections, ANSI mode is supported at reduced data rates of 4800 bits/sec or 9600 bits/sec.
- RS232 port for programming and debugging programs using the DPL Toolkit. Connection only requires a simple one-to-one ribbon cable to connect from a 9-pin PC serial port to the RS232 port.
- High speed read/write access (345 µs or 460 µs) to speed and torque reference within the drive.
- Internal single axis position controller included, which can be synchronised to the SPEED or ENCODER tasks. Absolute positions are stored as 32 bit signed integers. Full marker pulse and freeze pulse support is also implemented. Position control, speed control, digital lock and cam profiling are all supported.
- A 16 bit Counter/Timer unit can be clocked internally (500kHz or 4MHz) or externally (1MHz max.) This provides methods for measuring short time intervals, counting external events, or generating regular fast interrupts using the EVENT task.
- Two high speed TTL digital inputs and one digital output. An input can be used to trigger the EVENT task and perform certain functions when external events occur.
- 400 internal signed 32 bit registers available for use with DPL program, of which 200 are non-volatile. Menu 20 on the Unidrive (50 signed 16 bit parameters) is also non-volatile.

Specifications

- Intel 960 32 bit RISC processor
- 96K of user program FLASH memory
- 8K of user RAM
- 16MHz clock
- RS232 programming port
- RS485 networking por
- Ambient Temperature: -5ºC to +40ºC
- Storage Temperature: -40ºC to +50ºC
- Weight: 134g
- Maximum Altitude: 4000m
- Humidity: +5% to 95% at 40ºC, non-condensing

Rotary Knife

(Example of DPL Code)

```
$VERSION V1.0
$DRIVE UNIDRIVE

$define PITCH% #18.11
$define CIRCUMFERENCE% #18.12
$define CUT_DIST% #18.13
$define MOTOR_ENC_COUNTS% 16384
$define LINE_ENC_COUNTS% #18.14
$define LINE_CIRCUMFERENCE% #18.15
$define GEAR_RATIO% #18.16
$define RE_CALC% #18.31

INITIAL{

; Generate Mod_Sin Array (scaled)

;assign memory space for cam table arrays
DIM sin_array[100]
DIM line%[101]
DIM knife%[101]

;reset program variables
tmr1%=0
sum1=0
sum2=0
index%=0
ang=3.141592654/50

;Create an array with 100 points describing a modified sin
wave
DO
        s=sin(ang*index%)
        sum1=sum1+s
        sin_array[index%]=s1
        sum2=sum2+s1
        index%=index%+1
LOOP WHILE index%<100

index%=0
;scale the mod_sin array so the total distance moved under
the curve is 1.
Do
        sin_array[index%]=sin_array[index%]/s2
        index%=index%+1
LOOP WHILE index%<100

;initialise the cam table
result%=CAMINIT(line%,knife%,101,0,0)

;control registers
_Q32%=0
                ;Reset Control Registers
_Q20%=0

;unidrive set-up parameters
#01.10=1
                ;Enable Bipolar speed ref.
#01.14=3
                ;Select Preset Speed reference.
#01.15=1
                ;Select Preset Speed #1.
#2.02=0
                ;Disable Speed Ramps

;position loop set-up parameters
_Q20%.1=1
        ;Enable Q4 as the PID loop reference
_Q20%.6=1
        ;Enable automatic writing of #91.02
#91.01=3
                ;Enable the use of #91.2 fast write to Preset
Speed #1.
#91.05=1500
                ;Set the maximum resolution speed in rpm of
#91.02

}

BACKGROUND{
top:
;calculate adjustments required for the rotary knife to cut in
the required place
line_scale%=LINE_ENC_COUNTS%/LINE_CIRCUMFERENCE
%
knife_scale%=MOTOR_ENC_COUNTS%*GEAR_RATIO%/CIR
CUMFERENCE%
catch_up_length%=(CIRCUMFERENCE%-PITCH%-
CUT_DIST%)*knife_scale%
pitch_increment_line%=(PITCH%-
CUT_DIST%)*line_scale%/100
pitch_increment_knife%=(PITCH%-
CUT_DIST%)*knife_scale%/100

;calculate the Cam table points to describe the required
motion
IF RE_CALC%=1 THEN
        index%=0
        Do
                line%[index%]=pitch_increment_line%

knife%[index%]=INT(sin_array[index%]*catch_up_length%) +
pitch_increment_knife%
                index%=index%+1
        LOOP WHILE index%<100
        line%[100]=CUT_DIST%
        knife%[100]=CUT_DIST%
        RE_CALC%=0
ENDIF

;Set the speed of the virtual axis for test purposes
v_master%=#18.20

goto top: // main background loop
}

SPEED{
;Increment the c/  required for the virtual master speed.
_Q1%=_Q1%+v_master%
}
```

options

Drive Communications

UD71 Serial Communications Module

- RS232 communications for easy commissioning and drive programming
- RS485 communications for industrial process control

Distributed Applications

- UD70 Modbus Module (19.2 Kbps)
- UD73 Profibus DP Module (1.5 Mbps)
- UD74 Interbus S Module (0.5 Mbps)
- UD76 Modbus+ Module (1 Mbps)
- UD77 DeviceNet (0.5 Mbps)
- UD75 CTNet Module (5 Mbps)
  - Peer to peer communications
  - Distributed control
  - Simplifies high performance industrial applications

Easy Applications

UD78 High Performance Servo Module

- >16 bit analogue input for precise position control
- Accurate tracking of small input signal changes with <150µV deadband
- 24V back-up tracks encoder position when mains loss is experienced
- RS485 communications

Feedback Device

UD50 Extended I/O

- Low cost external control
- 2 N/0 relays
- 3 Digital inputs
- 3 Digital I/0
- 2 Analogue inputs
- 1 Analogue output

UD51 Second Encoder

- Master/Slave capability for multiple drive control (Digital Lock)
- Quadrature or frequency and direction reference
- Freeze input
- Simulated encoder output

UD52 Sin/Cos Encoder

- High precision positioning
- 500,000 ppr
- Single or multi-turn
- Absolute position tracked
- Freeze input

UD53 Resolver Feedback

- Easy expansion of drive for use in rugged and demanding environments
- Simulated encoder output

Drive Set Up

UD55 Cloning Module

- Easy set-up of multiple drives
- Simplifies the transfer of parameters between Drives
- Stores 8 full parameter sets

typical applications

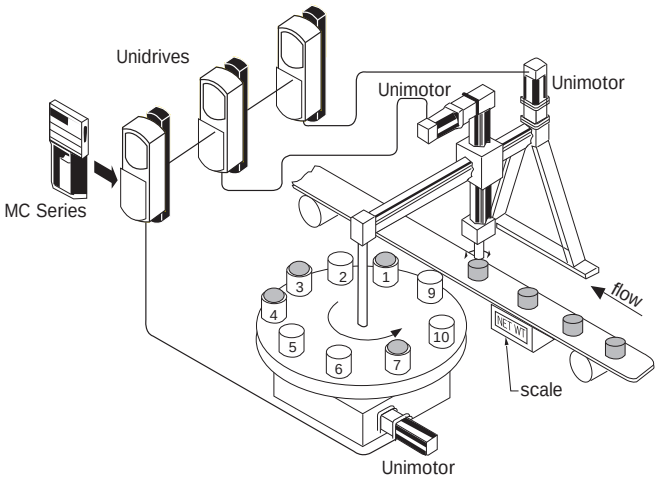
Pick and Place Gantry Control

Objective: Utilise standard products with easy programming for point-to-point position control

Solution: Unidrive with MC204 controller

Operation: MC204 moves all three axes from 3-D position to 3-D position co-ordinates quickly and accutately.

Results: Easy system set up with rapid and accurate positioning.



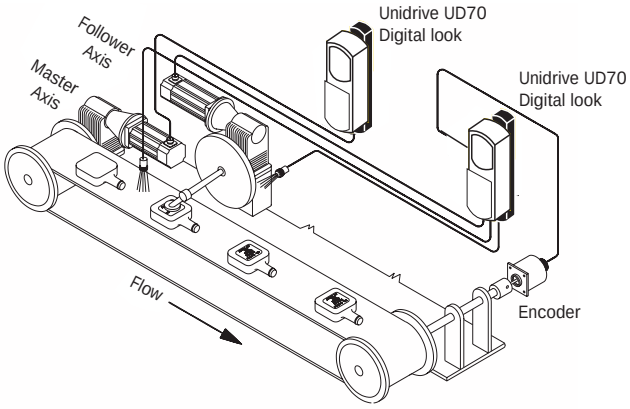
High Speed Label Printing

Objective: Higher throughout, decreased changeover time, better accuracy than mechanical system

Solution: Unidrive with UD70 digital lock

Operation: The UD70 performs a complex cam type profile to insure placing arm and product are always at the same speed.
UD70 compensates for small product to product registration shifts by using a product sensor on the master axis.

Results: Increased accuracy because placement follows product regardless of conveyor speed.



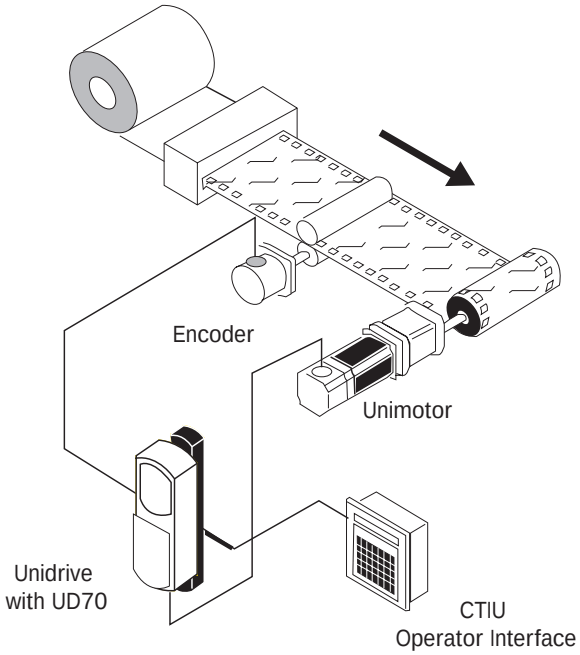
Constant Web Speed Unwind Control with Tension Input

Objective: Precise and constant web speed and position control.

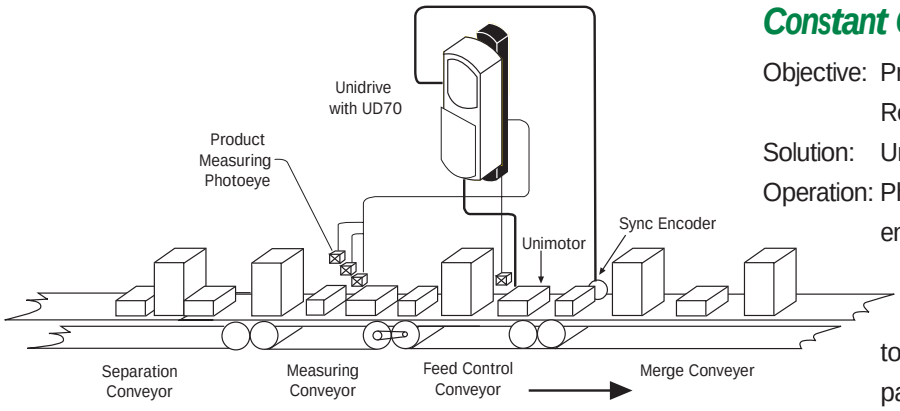
Solution: Unidrive with UD70 winder control.

Operation: UD70 controls the web speed and position based on encoder signal input. As the diameter of the take up roll increases, the Unidrive slows the speed of the Unimotor.

Results: Precise speed regulation and the exact amount of material is wound onto the take up roll.



typical applications



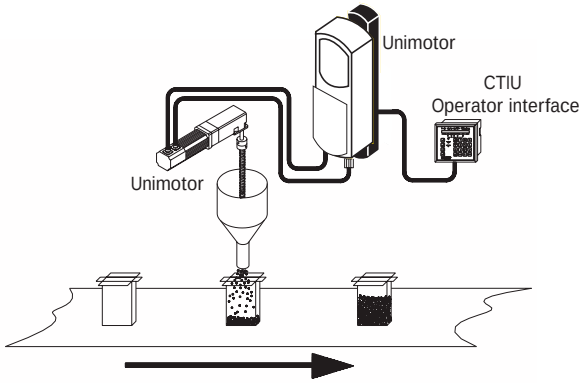
Constant Controller Maintains Constant Gap

Objective: Provide desired “Tail to Head” spacing. Regardless of product length.

Solution: Unidrive with UD70 applications module.

Operation: Photocells trigger the PCM-19 to monitor encoder input for product position, length and height. The UD70 preforms all the calculations required to deliver the product to the merge conveyor at the user defined parameters.

Results: Easy configuration and control of product tail to head or head to head spacing onto a merge conveyor.



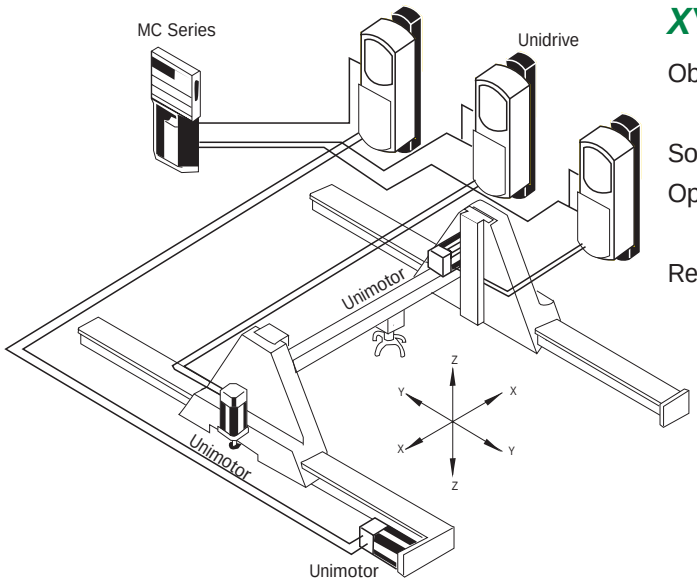
Auger Filler for Dry Material

Objective: Eliminate problems with clutch-brakes.

Solution: Unidrive and UD70 count position control.

Operation: Unidrive indexes exact revolutions for specific volume. Operator only needs to enter user units into CTIU operator interface.

Results: Increased accuracy eliminates overfilling to meet minimum weight requirements. Waste is eliminated.



XYZ Axes Application

Objective: Increase accuracy and performance of multi-axis systems.

Solution: MC204 and Unidrive

Operation: Unidrive read analog signals from multi-axis controller to determine position and speed.

Results: Fast and accurate positioning of all axis.

typical applications

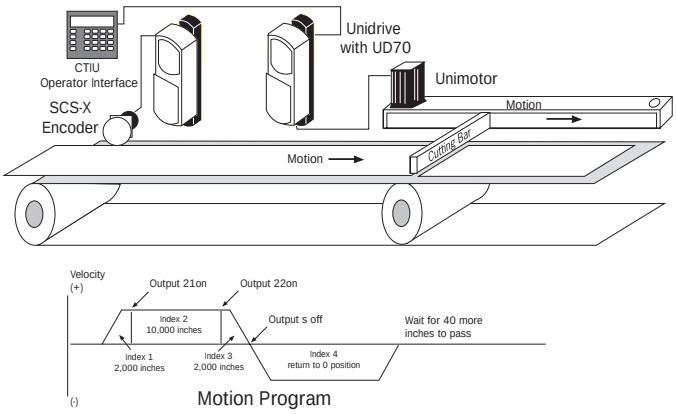
Flying Cut Off - Inline

Objective: Provide an easy method for an operator to enter product cut lengths

Solution: Unidrive with UD70 motion profiler and CTIU operator interface.

Operation: When the correct product length passes, the cut bar is accelerated to match the speed of the product. When speed is matched, an output is activated sending the cutter head down. The operator is able to set the length using the CTIU operator interface.

Results: Easy data entry with fast and accurate cut cycles.



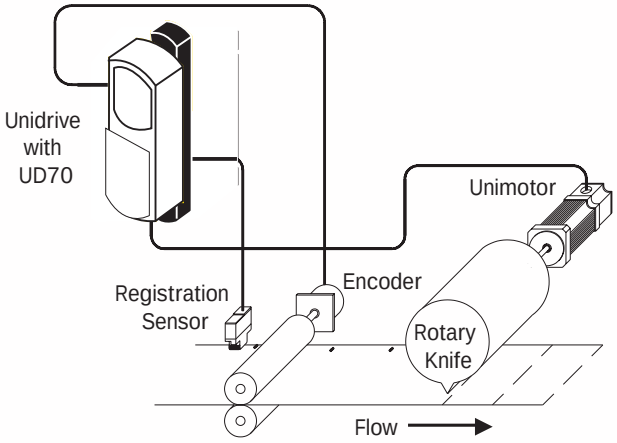
Rotary Cut Off

Objective: Cut material to user specified length and maintain cut on the registration marks.

Solution: Unidrive with UD70 natural profiler.

Operation: the UD70 monitors the encoder position and product registration sensor to insure that the product is cut in the correct position. The UD70 has the capability to learn the exact new length of the product even if the operator enters a length close to the correct length. Any changes to the drive parameters can be made on the fly.

Results: Synchronised system provides fast and accurate cut lengths exactly placed on registration marks.



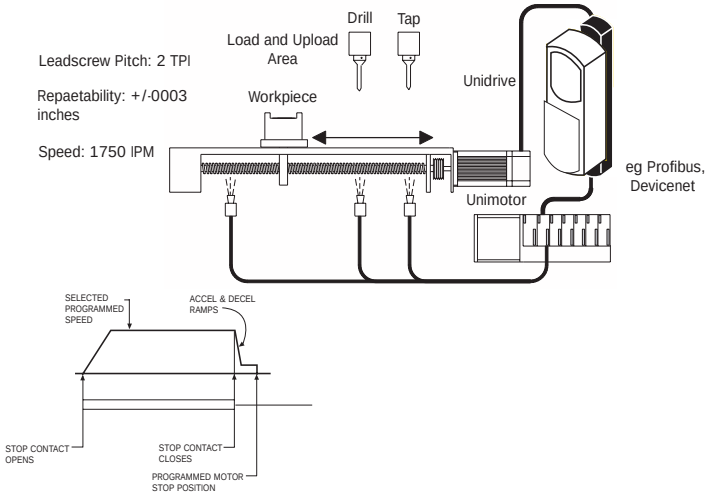
Positioning with a Unidrive

Objective: Increase accuracy and performance and minimize cost.

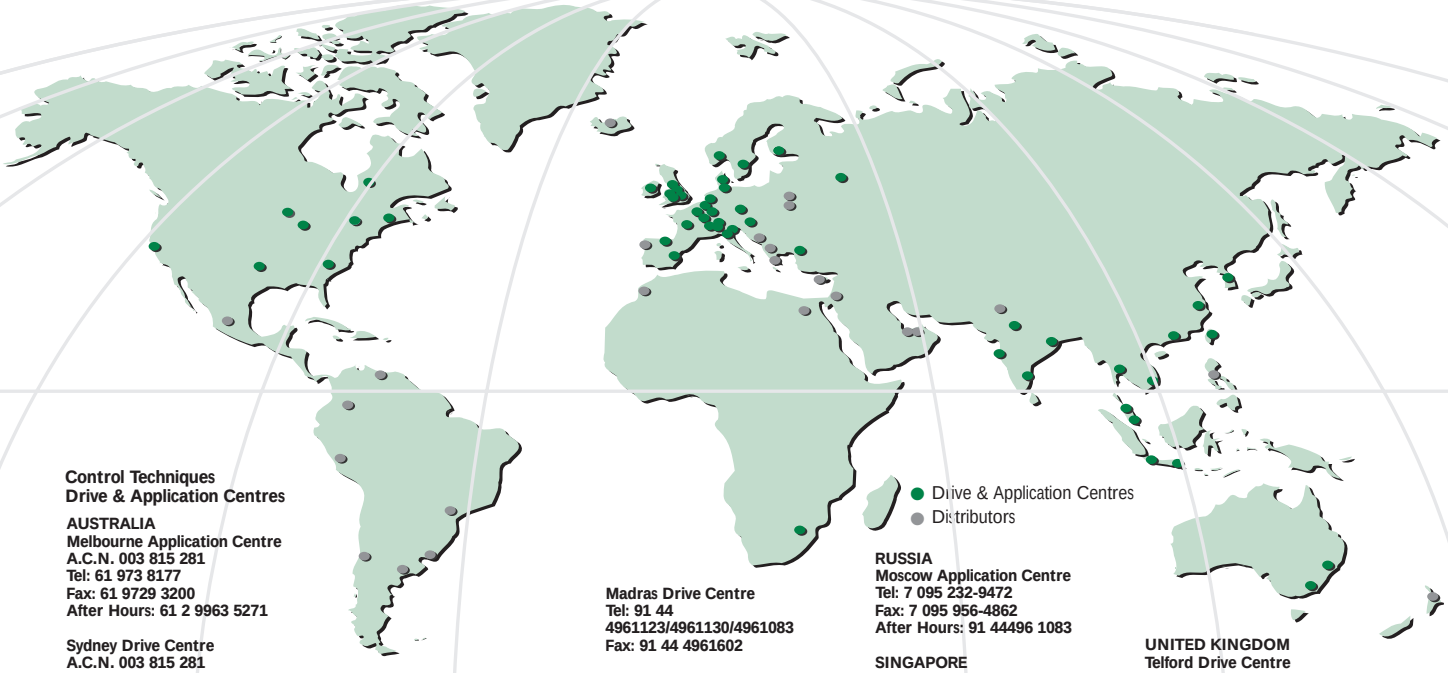
Solution: Unidrive with UD70 positioner

Operation: Proximity switches are placed at the desired drill position. The Unidrive is configured to stop at an exact and consistant deceleration rate.

Results: Fast and accurate positioning of workpiece with system cost minimized.



driving the world...



Control Techniques
Drive & Application Centres

AUSTRALIA
Melbourne Application Centre
A.C.N. 003 815 281
Tel: 61 973 8177
Fax: 61 9729 3200
After Hours: 61 2 9963 5271

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

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

BELGIUM
Brussels Drive Centre
Tel: 32 2725 2721
Fax: 32 2725 4940

CANADA
Toronto Drive Centre
Tel: 1 905 475 4699
Fax: 1 905 475 4694

CHINA
Shanghai Drive Centre
Tel: 86 21 64085747
Fax: 86 21 64083282

CZECH REPUBLIC
Brno Drive Centre
Tel: 420 541 192111
Fax: 420 541 192115
After Hours: 420 603 841983

DENMARK
Århus Application Centre
Tel: 45 8625 5755
Fax: 45 8625 1755
After Hours: 45 4369 6100

Copenhagen Drive Centre
Tel: 45 4369 6100
Fax: 45 4369 6101
After Hours: 45 4369 5100

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

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

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

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

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

Stuttgart Drive Centre
Tel: 49 7156 95560
Fax: 49 7156 955698
After Hours: 49 1714 964777

HOLLAND
Rotterdam Drive Centre
Tel: 31 1844 20555
Fax: 31 1844 20721
After Hours: 31 1844 20555

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

HUNGARY
Budapest Drive Centre
Tel: 361 431 1160
Fax: 361 260 5483

INDIA
Bombay Application Centre
Tel: 91 20 751201/751202/750930
Fax: 91 20 750105
After Hours: 91 44 4984868

Calcutta Application Centre
Tel: 91 33 357 5302/357 5306
Fax: 91 33 357 3435
After Hours: 91 44496 1083

Madras Drive Centre
Tel: 91 44
4961123/4961130/4961083
Fax: 91 44 4961602

New Delhi Application Centre
Tel: 91 11 576 4782
Fax: 91 11 576 4782
After Hours: 91 44 4984868

INDONESIA
Jakarta Drive Centre
Tel: 62 21 4525146
Fax: 62 21 4525142
After Hours: 62 81 687 0443

Surabaya Application Centre
Tel: 62 31 5682775/5623565
Fax: 62 31 5622402
After Hours: 62 81 687 0443

IRELAND
Dublin Drive Centre
Tel: 353 45 433044
Fax: 353 45 433622

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

Vicenza Drive Centre
Tel: 39 0444 396200
Fax: 39 0444 341317

KOREA
Seoul Application Centre
Tel: 82 2 3445 6183/6184/6185
Fax: 82 2 3445 6181
After Hours: 82 23 445 6183
/82 11 732 9676

MALAYSIA
Kuala Lumpur Drive Centre
Tel: 60 3734 9776
Fax: 60 3733 9592
After Hours: 60 12 333 8355

NORWAY
Oslo Application Centre
Tel: 47 32 235100
Fax: 47 32 235101
After Hours: 47 92 22 3292

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

RUSSIA
Moscow Application Centre
Tel: 7 095 232-9472
Fax: 7 095 956-4862
After Hours: 91 44496 1083

SINGAPORE
Singapore Drive Centre
Tel: 65 271 6377
Fax: 65 272 1302

SPAIN
Barcelona Drive Centre
Tel: 34 93 680 1661
Fax: 34 93 680 0903
/34 93 680 0763
/34 93 680 2823
After Hours: 34 610 554540

Bilbao Application Centre
Tel: 34 94 620 3646
Fax: 34 94 681 1406

Valencia Drive Centre
Tel: 34 96 154 2900
Fax: 34 96 153 2906

SWEDEN
Stockholm Application Centre
Tel: 46 8 554 24100
Fax: 46 8 554 24120

SWITZERLAND
Lausanne Application Centre
Tel: 41 21 634 0408
Fax: 41 21 635 8596
After Hours: 41 79 357 8683

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

TAIWAN
Taipei Application Centre
Tel: 886 22325 9555
Fax: 886 22705 9131

THAILAND
Bangkok Drive Centre
Tel: 66 2580 7644
Fax: 66 2591 4559
A/Hours Sales: 66 1443 4095-7
A/Hours Service: 66 1443 4098

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

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

Leeds Drive Centre
Tel: 44 113 2423400
Fax: 44 113 2423892
After Hours: 44 113 2423400

Luton Drive Centre
Tel: 44 1582 567700
Fax: 44 1582 567703
After Hours: 44 1582 567700

Warrington Application Centre
Tel: 44 1925 413537
Fax: 44 1925 242808
After Hours: 44 113 242 3400

USA
Charlotte Application Centre
Tel: 1 704 393 3366
Fax: 1 704 393 0900
After Hours: 1716 692 2442

Chicago Drive Centre
Tel: 1 630 893 5249
Fax: 1 630 893 4156

Cleveland Drive Centre
Tel: 1 440 717 0123
Fax: 1 440 717 0133

Minneapolis Application Centre
Tel: 612 474 1116
Fax: 612 474 8711

Dallas Application Centre
Tel: 1 972 783 1831
Fax: 1 972 783 9978
After Hours: 1800 759 0664

Providence Drive Centre
Tel: 1 401 333 3331
Fax: 1 401 333 6330
After Hours: 1401 333 0080

VIETNAM
Ho Chi Minh Application Centre
Tel: 84 8 842 5157
/84 8 849 1980
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