Control Techniques Dynamics Limited

CT Dynamics is a British company renowned for its innovations in the industrial servo, aerospace and defence markets. Founded some 40 years ago it has developed a leading position by combining two of the UK's best servo companies: Moore Reed and the Powerotor Division of Evershed and Vignoles. CT Dynamics' experience in the field of servo and rotating components provides a strong base from which to develop cost effective solutions for a spectrum of applications from machine tools, mechanical handling, pick and place machinery - through to specialised mechanisms and actuators for the avionics industry.

CT Dynamics is a member of the Emerson group of the USA. This gives the company access to a vast engineering design resource in the USA, in the UK and in mainland Europe. As a result CT Dynamics offers continuous advances in product range, backed with the expertise and flexibility to meet the demands of your applications - now and in the future.

Introduction

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

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

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

There are four basic motor types, each for different drives.

UM, SL and DM motors are for 400/440V nominal AC drive supply voltage and are the subject of this UM, SL and DM Unimotor manual.

EZ motors have identical mechanical construction and feedback options, but support a different winding to suit 220V nominal AC drives and are the subject of a separate EZ servo motor manual.

UM, SL and DM Motors

UM Motor

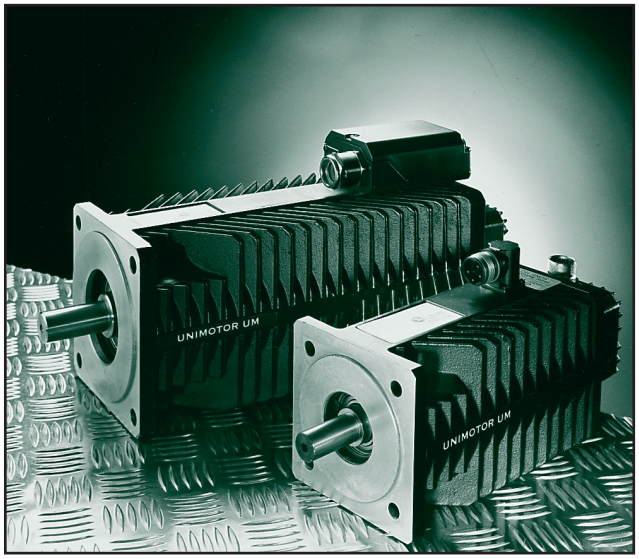
The UM motor has been primarily designed to operate with the Unidrive.

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

SL Motor

The SL version is a UM motor fitted with special **SLM technology** electronic feedback that operates with Control Techniques' M'Ax and MultiAx drives. This motor-drive combination offers extremely high resolution, for superb system speed control. High resolution is essential for many system applications where speed and position errors must be miniscule.

The feedback comprises of a special Sincos encoder and **SLM** electronics, both contained within the standard UM outline. The encoder has a memory programmed with all the essential motor characteristics necessary to automatically set all M'Ax parameters, giving an instant 'Plug and Play' capability.



DM Motor

The DM motor is suitable for use with the DigitAx drive. The stator connections to U and V are interchanged to match the DigitAx.

Accessories

Other options

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

Forced air-cooling - customer-fitted fan blown boxes specially designed to fit the range of motors, can directly enhance motor performance. (Not suitable for SL).

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

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

Heat Transfer from Radially Finned Motor Housings

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

For a motor to give a performance that requires minimal de-rating, it must be designed so that it can be mounted in a number of orientations. The Unimotor's finned design ensures that the motors can be mounted horizontally or vertically without significant effect on heat transfer. CT Dynamics' engineers derived the optimal fin thickness and spacing using a specially designed computational fluid dynamics (CFD) model.

Figure 1

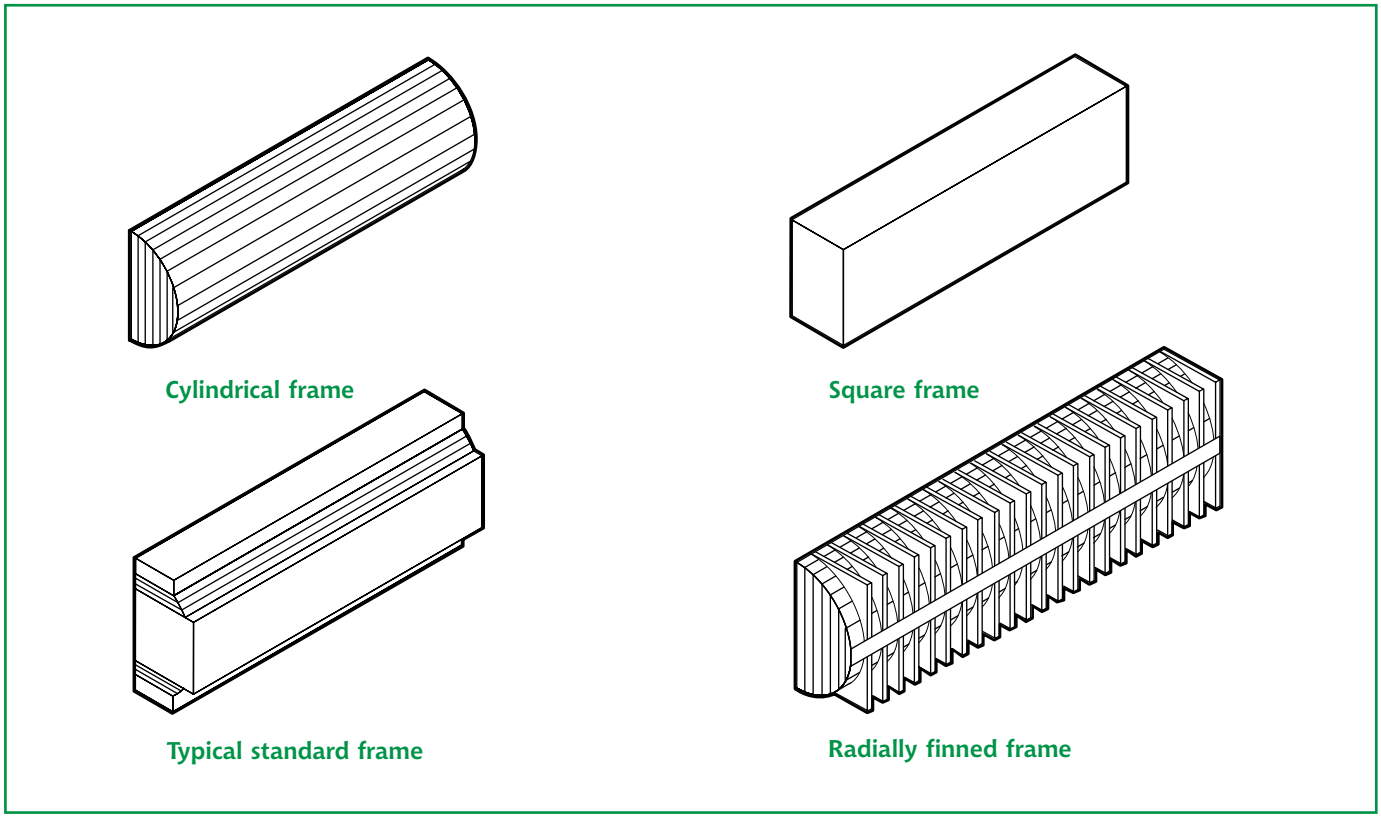


Figure 1. Naturally ventilated motors usually have a relatively smooth frame surface. The frame is cylindrical or square, or a combination of the two. The above illustrations show half cross sections of the various motor types as used in the CFD model

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

Finned Motors - Designed for Horizontal and Vertical Orientation

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

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

Figure 2

95mm Diameter Frame

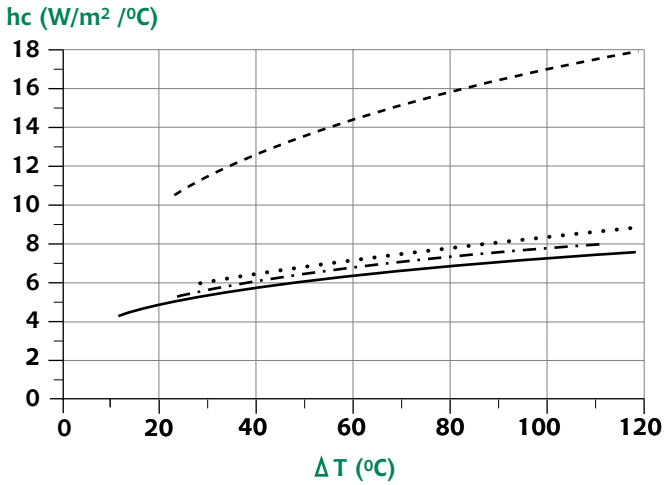


Figure 3

190mm Diameter Frame

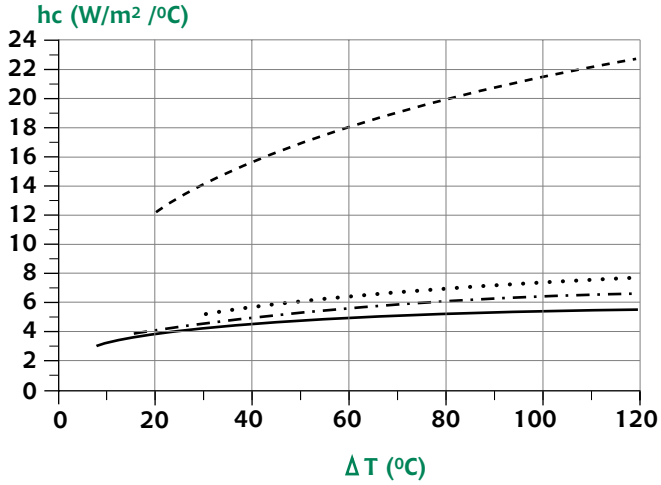
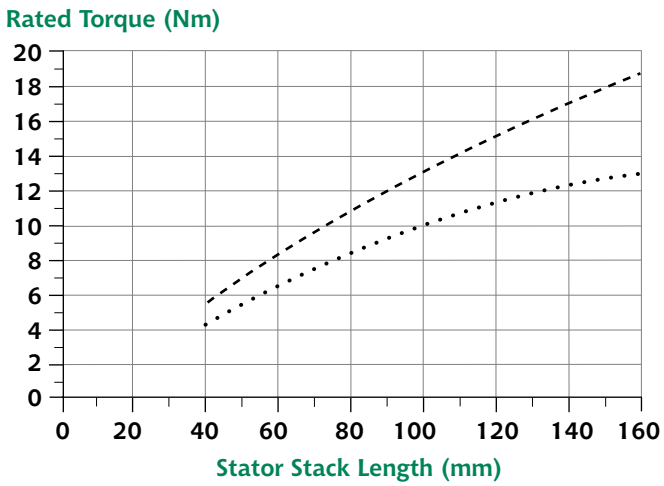


Figure 4

142mm Diameter Frame

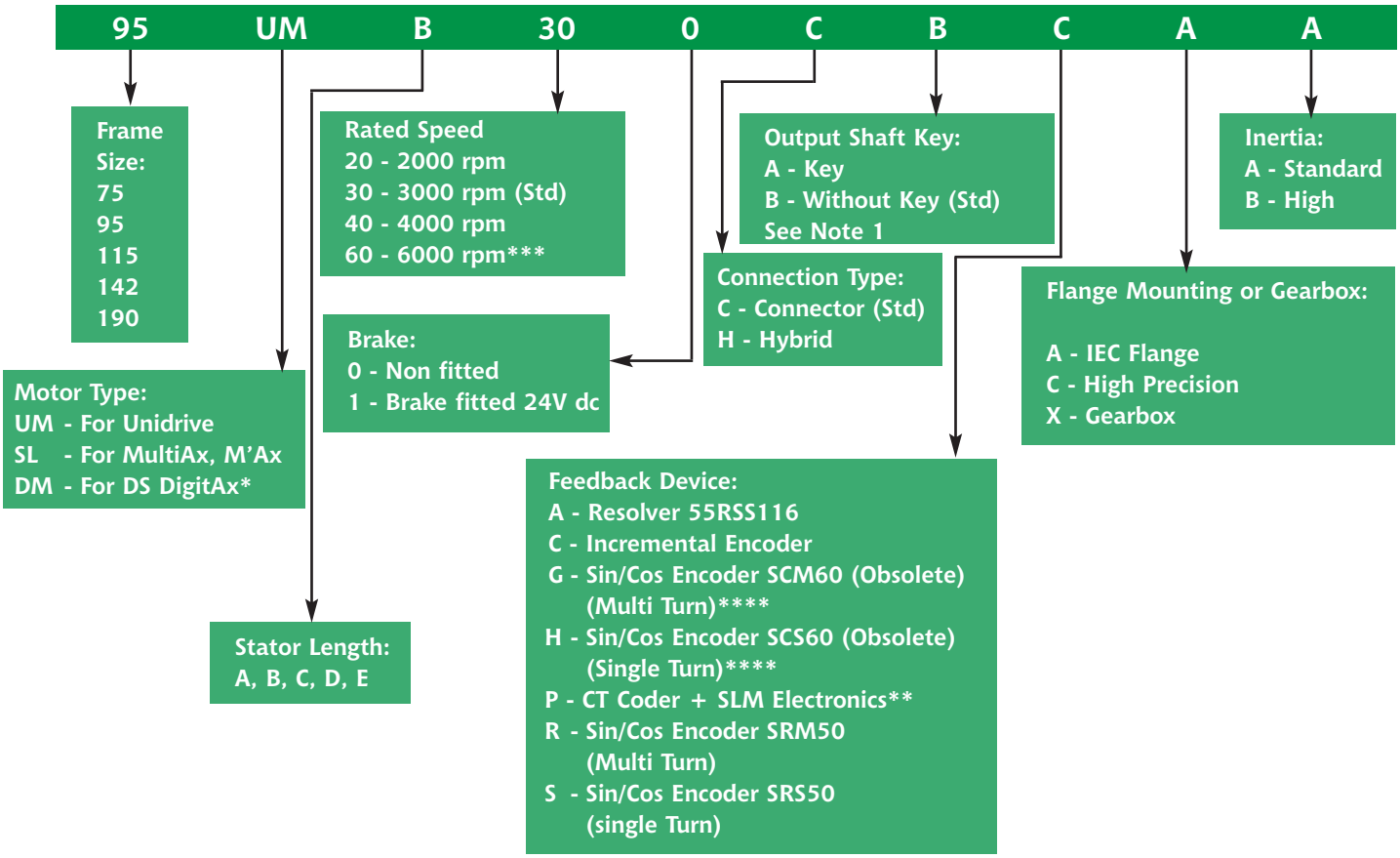


Key

- Finned
- Standard
- Square
- Cylindrical

Ordering Information

Use the information given in the illustration below to create an order code for a Unimotor. The top line is an example of an order reference. CT Dynamics recommends that you order the required mating connectors at the time of placing your motor order. For further details turn to cables. See also the grid overleaf, which gives standard and optional features available for each motor. If you are unsure which motor you need see *'Selecting the Correct Motor*.



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

* Available with resolver feedback only

** Available for SL motors only (D = SLM1 E = SLM2)

*** Not available for some motors

**** Replaced by R or S types

Standard & Optional Features

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

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

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

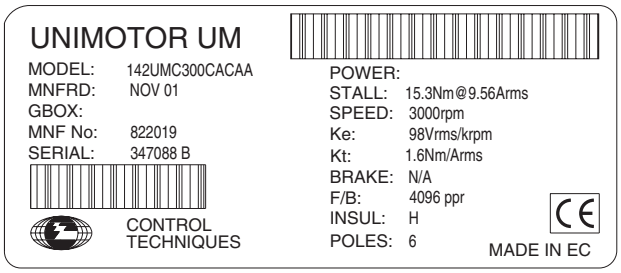
*[1] The DM Motor type has resolver feedback only.

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

Mechanical Precision Class 'R' Option

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

Nameplate


UNIMOTOR UM
MODEL: 142UMC300CACAA
MNFRD: NOV 01
GBOX:
MNF No: 822019
SERIAL: 347088 B
CONTROL TECHNIQUES
POWER:
STALL: 15.3Nm@9.56Arms
SPEED: 3000rpm
Ke: 98Vrms/krpm
Kt: 1.6Nm/Arms
BRAKE: N/A
F/B: 4096 ppr
INSUL: H
POLES: 6
CE
MADE IN EC

Performance Definitions

Class H - UL and CSA recognised Insulation System
Class H is a classification of the temperature rating of the motor winding insulation system.

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

All UM, DM and SL motors have identical insulation systems complying with class H temperature rating irrespective of Δt_{max}.

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

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

Δt_{max} temperatures are allocated to CTD motors as follows:

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

Δt_{max} = 125ºC, is applicable to UM and DM motors fitted with resolver feedback.
Rating corresponds to a Class H winding rating of 180ºC
For this higher Δt_{max}, a larger winding current is possible, and hence a larger torque rating.

Winding Thermal Time Constant (tc) seconds
The thermal time constant of the winding with respect to the stator temperature as referenced in the exponential temperature rise given by the formulae: -

Winding temperature at time t seconds = $T1\ (1 - e^{-t/tc})$
Where T1 is final winding temperature
And t_c = thermal time constant (seconds)

Note that temp = 63.2% of T1 when $t = t_c$

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

UM and DM motor windings are ultimately protected by thermistor devices located in the winding overhangs. These thermistors must be connected to the appropriate drive inputs via the motor feedback signal connector. (For pin allocations of signal connectors, refer to section 5)

The improved thermal modelling of the SL motor by the M'Ax and MultiAx drive software renders the need for thermistors to be unnecessary.

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

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

As with rated torque, the ultimate limiting factor is winding temperature rise:
Δtmax = maximum winding temperature rise above ambient.
= 100ºC or 125ºC according to motor type

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

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

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

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

Rated torque
This is the continuously rated torque at full rated speed.

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

Rated Speed
This is the normal maximum speed for the motor.

The motor speed can be controlled to any speed subject to voltage limits and drive constraints as shown by the Intermittent Zone of the graphs. (see "Speed Limit")
A higher speed motor has fewer winding turns, but requires a higher current to produce the same torque as a similar lower speed motor.

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

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

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

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

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

Voltage Constant (Ke) Volt (rms)/krpm
This is the no-load phase–phase rms voltage generated at the stator when the shaft is rotated at 1000rpm with rotor at 25 deg C.

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

Magnets used on all motors are affected by temperature, such that Kt and Ke reduce with increasing temperature of magnets.
Kt and Ke reduce by 0.1% / ºC for all 75 – 142 motors; and by 0.06% / ºC for 190 motors. Temperature of magnets may be assumed to reach 87% of winding temperature.

Stall Current A rms
Stall Current = (Stall Torque) / Kt (25ºC value)

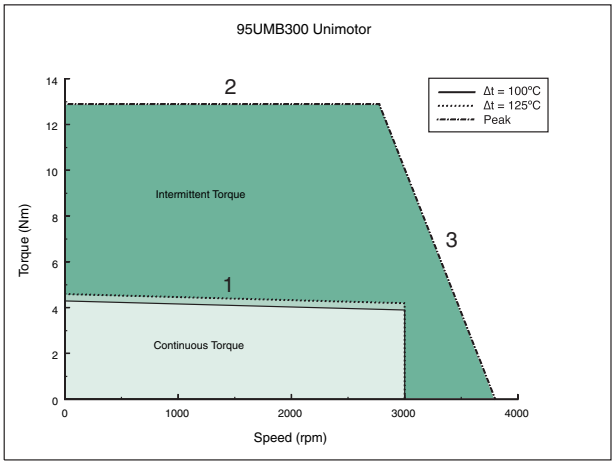
Rated Current A rms
Rated Current = (Rated Torque) / Kt (25ºC value)

How To Use Torque-Speed Curves

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

Limits of operation are shown for three categories; -
1. Continuous (or RMS)
2. Intermittent (short term)
3. Speed limit

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



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

Continuous or RMS Torque Limit (1)
Two levels of continuous operation are shown, one for encoder motors where the maximum permitted winding temperature rise Δt = 100ºC; and one for resolver motors where Δt = 125ºC.

RMS means Root Mean Square (see section 10) and gives the effective continuous torque compatible with repetitive torque sequences. (Most servo applications will have a repeatable sequence of events, e.g. accelerate, run, decelerate, and pause).

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

Intermittent / Peak Torque Limit (2)
Above the Continuous zone is an Intermittent Zone where the motor may be safely operated for short periods of time. Operation within the Intermittent Zone is permissible provided that Δt < 100ºC or Δt < 125ºC, in accordance with the motor type rating.

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

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

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

Speed Limit (3)

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

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

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

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

Motors With 4096 ppr Encoders - Unidrive inhibits Speed demands >3000rpm
Motors With 2048 ppr Encoders - Unidrive inhibits Speed demands >6000rpm

Caution: Because of the high voltages generated, motors should never be back-driven at speeds > rated speed +20% when either connected or disconnected.

Plotting an Operating Point

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

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

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

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

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

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

Motor De-rating

The performance data shown corresponds to 40ºC maximum ambient (surrounding air temperature) and the drive switching frequencies shown in table 1.

Motor type	Switching Frequency
75A to 142E	12kHz
190A to 190D	9kHz

Table 1. Switching Frequencies for Performance Data

Drive supply: 415V, 3 phase nominal.

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

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

Such circumstances include:

- Lower switching frequency setting of the drive, (i.e.< 12khz for 75 – 142mm frame; < 9kHz for 190mm frame), see table 2.
- ambient temperatures >40ºC
- confined space / restricted natural air flow
- inadequate thermal path for motor mounting
- motor mounted to a gearbox
- drive oversize for motor

- For de-rating data, see Table 2
- Most Unidrive nominal current ratings are reduced, for the higher switching frequencies, see Unidrive manuals for de-rating tables.

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

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

Table 2 De-rate factor for drive switching frequency

Motor	12 kHz	9 kHz	6 kHz	4.5 kHz	3 kHz
75A	1	0.99	0.98	0.97	0.96
75B	1	0.99	0.97	0.96	0.95
75C	1	0.98	0.96	0.95	0.94
75D	1	0.98	0.95	0.94	0.93
95A	1	1.00	0.98	0.97	0.95
95B	1	0.99	0.97	0.95	0.93
95C	1	0.99	0.96	0.94	0.91
95D	1	0.98	0.95	0.92	0.89
95E	1	0.97	0.93	0.91	0.88
115A	1	0.99	0.97	0.96	0.94
115B	1	0.98	0.95	0.93	0.91
115C	1	0.97	0.93	0.91	0.89
115D	1	0.96	0.92	0.89	0.86
115E	1	0.95	0.90	0.87	0.84
142A	1	0.99	0.98	0.97	0.96
142B	1	0.98	0.96	0.94	0.91
142C	1	0.97	0.94	0.91	0.87
142D	1	0.97	0.91	0.88	0.84
142E	1	0.96	0.89	0.86	0.81
190A	N/A	1	0.99	0.99	0.98
190B	N/A	1	0.98	0.97	0.95
190C	N/A	1	0.97	0.94	0.91
190D	N/A	1	0.94	0.90	0.85

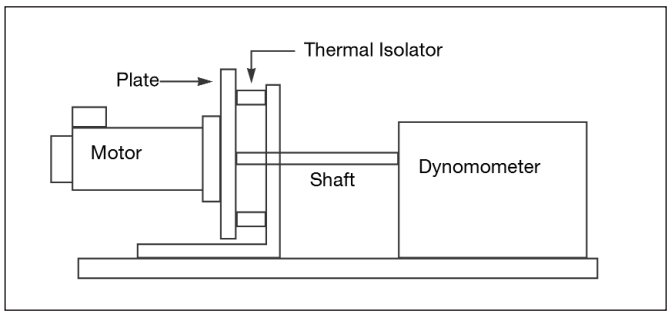
E.g For a 115 UMC with encoder feedback run at 9kHz
Stall torque = 10.5 x 0.97 = 10.2Nm
Rated torque = 9.2 x 0.97 = 8.9Nm

Thermal Test conditions

The tests were carried at an ambient of 25ºC.
The motor under test mounted on a thermally isolated aluminium plate of dimensions as per Table 3 below.

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

Table 3



Specification - UM, SL, DM

Physical

Insulation Class	Class H, BS EN 60034-1.
Insulation System	USR & CNR Class H Electrical Insulation System designated 'CTD/1S/2000/01'.
Dimensional Accuracy	IEC 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, 170ºC switch temperature.
Bearing System	Preloaded ball bearings, metal shielded, high temperature grease.
Electrical Connections	Connector or terminal box for power and brake; connector for feedback devices and thermistor.
Flange Mounting	IEC 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, excluding mounting face, and with mating connectors and cables fitted. Ingress protection : IP65.
Operating Temperature	Specified performance at 0-40˚C ambient.
Storage Temperature	-20˚C to 70˚C.
Insulation Class	H (180˚C) Insulation system UL
Temperature Rise (Winding)	125˚C over ambient of 40˚C Max. 100˚C over ambient of 40˚C Typical.

UNIMOTOR performance specifications
Δt = 100°C, 40°C ambient

Motor Frame Size		75				95				
All versions (rpm)		A	B	C	D	A	B	C	D	E
Continuous Stall Torque	(Nm)	1.2	2.2	3.1	3.9	2.3	4.3	5.9	7.5	9.0
Peak Torque	(Nm)	3.6	6.6	9.3	11.7	6.9	12.9	17.7	22.5	27.0
High Inertia	($kgcm^2$)	1.2	1.6	2.1	2.5	3.5	4.5	5.6	6.7	7.8
Standard Inertia	($kgcm^2$)	0.6	1.0	1.5	1.9	1.4	2.5	3.6	4.7	5.8
Weight	(kg)	3.0	3.7	4.4	5.1	5.0	6.1	7.2	8.3	9.5
Winding Thermal Time Const.	(sec)	81	74	94	100	172	168	183	221	228
Maximum Cogging	(Nm)	0.02	0.03	0.04	0.05	0.03	0.06	0.08	0.10	0.13
Rated Speed: 2000(rpm)			**Kt (Nm/A_{rms}): 2.4**				**Ke (V_{rms}/krpm): 147.0**			
Rated Torque	(Nm)	1.1	2.1	3.0	3.8	2.2	4.0	5.5	6.9	8.2
Continuous Stall Current	(A_{rms})	0.5	1.0	1.3	1.7	1.0	1.8	2.5	3.2	3.8
Rated Power	(kW)	0.23	0.44	0.63	0.80	0.46	0.84	1.15	1.45	1.72
R (ph-ph)	(Ohms)	144	48.2	25.0	15.7	59.0	17.0	9.90	6.00	4.30
L (ph-ph)	(mH)	214	99.2	59.2	44.7	131	54.5	36.5	25.6	18.9
Rated Speed 3000 (rpm)			**Kt (Nm/A_{rms}): 1.6**				**Ke (V_{rms}/krpm): 98.0**			
Rated Torque	(Nm)	1.1	2.0	2.8	3.5	2.0	3.9	5.4	6.8	8.1
Continuous Stall Current	(A_{rms})	0.8	1.4	2.0	2.5	1.5	2.7	3.7	4.7	5.7
Rated Power	(kW)	0.35	0.63	0.88	1.10	0.63	1.23	1.70	2.14	2.54
R (ph-ph)	(Ohms)	60.8	20.1	10.5	7.5	24.5	6.80	4.00	2.50	2.00
L (ph-ph)	(mH)	98.4	41.8	27.6	19.7	57.9	24.3	15.5	10.9	8.50
Rated Speed 4000 (rpm)			**Kt (Nm/A_{rms}): 1.2**				**Ke (V_{rms}/krpm): 73.5**			
Rated Torque	(Nm)	1.0	1.7	2.3	2.9	1.8	3.0	4.0	4.9	5.7
Continuous Stall Current	(A_{rms})	1.0	1.9	2.6	3.3	2.0	3.6	5.0	6.3	7.5
Rated Power	(kW)	0.42	0.71	0.96	1.21	0.75	1.26	1.68	2.05	2.39
R (ph-ph)	(Ohms)	36.8	10.5	6.30	4.20	12.7	4.08	2.10	1.50	1.03
L (ph-ph)	(mH)	54.9	24.8	14.9	10.8	31.5	13.6	8.50	6.30	4.80
Rated Speed 6000 (rpm)			Kt (Nm/Arms): 0.8				Ke (Vrms/krpm): 49.0			
Rated Torque	(Nm)	0.9	1.6	2.1	2.6	1.3	2.1	2.8	3.3	3.7
Continuous Stall Current	(A_{rms})	1.5	2.8	3.9	4.9	2.9	5.4	7.4	9.4	11.3
Rated Power	(kW)	0.57	1.01	1.32	1.63	0.82	1.32	1.76	2.07	2.32
R (ph-ph)	(Ohms)	15.0	5.00	2.66	1.90	5.45	1.82	1.05	0.62	0.48
L (ph-ph)	(mH)	24.0	10.6	6.80	4.80	14.1	6.00	3.80	2.70	2.10

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

Shaded areas indicate preferred types

The information contained in this specification is for guidance only and does not form part of any contract.

CT Dynamics Limited have an ongoing process of development and reserve the right to change the specification without notice.

UNIMOTOR performance specifications
Δt = 100ºC, 40ºC ambient

115					142					190			
A	B	C	D	E	A	B	C	D	E	A	B	C	D
3.5	6.6	9.4	12.4	15.3	6.3	10.8	15.3	19.8	23.4	21.8	41.1	58.7	73.2
10.5	19.8	28.2	36.0	45.9	18.9	32.4	45.9	59.4	70.2	65.4	123.3	176.1	219.6
9.7	12.0	14.3	16.6	18.8	21.6	28.0	34.3	40.7	47.0	93.5	140.5	187.5	234.5
3.2	5.5	7.8	10.0	12.3	7.8	14.1	20.5	26.8	33.1	50.0	97.0	144.0	191.0
6.5	8.2	9.9	11.6	13.2	10.9	13.2	15.5	17.8	26.0	26.0	33.0	40.0	48.0
175	185	198	217	241	213	217	275	301	365	240	242	319	632
0.06	0.10	0.14	0.18	0.21	0.09	0.16	0.23	0.30	0.35	0.30	0.54	0.72	0.99
3.2	6.1	8.7	10.8	13.1	5.9	10.3	14.6	18.4	21.3	20.0	36.9	50.4	54.7
1.5	2.8	4.0	5.0	6.4	2.7	4.5	6.4	8.3	9.8	9.1	17.2	24.5	30.5
0.67	1.28	1.82	2.26	2.74	1.24	2.16	3.06	3.85	4.46	4.19	7.73	10.6	11.5
27.8	8.55	4.55	2.96	2.17	12.5	3.60	2.10	1.35	0.98	1.80	0.56	0.33	0.23
94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	28.1	13.0	8.90	6.30
3.0	5.5	8.1	10.4	12.6	5.4	9.0	12.2	15.8	18.0	19.2	33.0	35.0	36.8
2.2	4.2	5.9	7.5	9.6	4.0	6.8	9.6	12.4	14.7	13.6	25.7	36.7	45.8
0.94	1.73	2.54	3.27	3.96	1.70	2.83	3.83	4.96	5.65	6.03	10.4	11.0	11.6
12.6	3.86	2.02	1.40	1.10	5.63	1.72	0.94	0.61	0.42	0.79	0.30	0.14	0.09
43.1	18.6	11.4	8.60	7.40	31.0	13.3	8.30	6.10	4.80	13.2	6.11	3.60	2.46
2.5	4.7	6.3	7.5	8.7	3.6	7.0	8.9	10.7	12.2				
3.0	5.5	7.9	10.0	12.8	5.3	9.0	12.8	16.5	19.5				
1.05	1.97	2.64	3.14	3.64	1.51	2.93	3.73	4.48	5.11				
6.91	2.14	1.16	0.73	0.57	3.12	1.00	0.53	0.35	0.24				
23.5	10.2	6.60	4.70	3.90	17.6	7.50	4.70	3.60	2.70				
2.2	4.0	5.1			2.90	4.5							
4.4	8.3	11.8			7.90	13.5							
1.38	2.51	3.20			1.82	2.83							
3.28	0.97	0.50			1.42	0.46							
15.54	4.81	2.94			7.72	3.44							

UNIMOTOR performance specifications with Resolver Feedback
Δt = 125°C, 40°C ambient

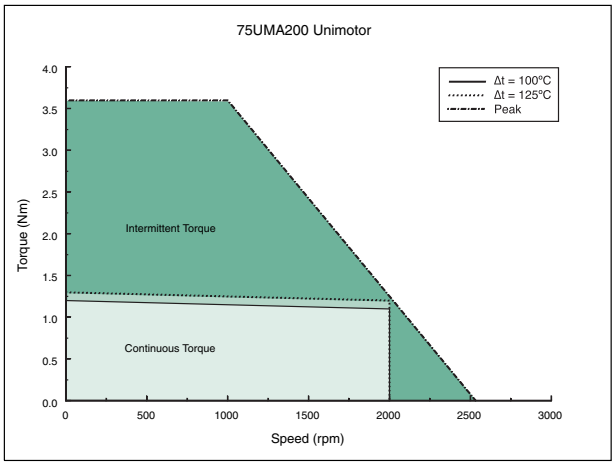
Motor Frame Size		75				95				
All versions (rpm)		A	B	C	D	A	B	C	D	E
Continuous Stall Torque	(Nm)	1.3	2.4	3.4	4.4	2.5	4.6	6.5	8.3	10.0
Peak Torque	(Nm)	3.6	6.6	9.3	11.7	6.9	12.9	17.7	22.9	27.0
High Inertia	($kgcm^2$)	1.2	1.6	2.1	2.5	3.5	4.5	5.6	6.7	7.8
Standard Inertia	($kgcm^2$)	0.6	1.0	1.5	1.9	1.4	2.5	3.6	4.7	5.8
Weight	(kg)	3.0	3.7	4.4	5.1	5.0	6.1	7.2	8.3	9.5
Winding Thermal Time Const.	(sec)	81	74	94	100	172	168	183	221	228
Maximum Cogging	(Nm)	0.02	0.03	0.04	0.05	0.03	0.06	0.08	0.10	0.13
Rated Speed: 2000(rpm)			Kt (Nm/Arms): 2.4				Ke (Vrms/krpm): 147			
Rated Torque	(Nm)	1.2	2.3	3.3	4.2	2.3	4.3	6.0	7.6	9.1
Continuous Stall Current	(A_{rms})	0.6	1.0	1.5	1.9	1.1	2.0	2.7	3.5	4.2
Rated Power	(kW)	0.25	0.48	0.69	0.88	0.48	0.90	1.26	1.59	1.91
R (ph-ph)	(Ohms)	144	48.2	25.0	15.7	59.0	17.0	9.90	6.00	4.30
L (ph-ph)	(mH)	214	99.2	59.2	44.7	131	54.5	36.5	25.6	18.9
Rated Speed 3000 (rpm)			**Kt (Nm/A_{rms}): 1.6**				**Ke (V_{rms}/krpm): 98.0**			
Rated Torque	(Nm)	1.2	2.2	3.1	3.9	2.2	4.2	5.9	7.5	9.0
Continuous Stall Current	(A_{rms})	0.8	1.5	2.2	2.8	1.6	2.9	4.1	5.2	6.3
Rated Power	(kW)	0.38	0.69	0.97	1.23	0.69	1.32	1.85	2.36	2.83
R (ph-ph)	(Ohms)	60.8	20.1	10.5	7.50	24.5	6.80	4.00	2.50	2.00
L (ph-ph)	(mH)	98.4	41.8	27.6	19.7	57.9	24.3	15.5	10.9	8.50
Rated Speed 4000 (rpm)			**Kt (Nm/A_{rms}): 1.2**				**Ke (V_{rms}/krpm): 73.5**			
Rated Torque	(Nm)	1.1	1.9	2.6	3.3	2.0	3.2	4.4	5.5	6.6
Continuous Stall Current	(A_{rms})	1.1	2.0	2.9	3.7	2.1	3.9	5.5	7.0	8.4
Rated Power	(kW)	0.46	0.80	1.09	1.38	0.84	1.34	1.84	2.30	2.76
R (ph-ph)	(Ohms)	36.8	10.5	6.30	4.20	12.7	4.08	2.10	1.50	1.03
L (ph-ph)	(mH)	54.9	24.8	14.9	10.8	31.5	13.6	8.50	6.30	4.80
Rated Speed 6000 (rpm)			Kt (Nm/Arms): 0.8				Ke (Vrms/krpm): 49.0			
Rated Torque	(Nm)	1.0	1.8	2.4	3.0	1.7	2.7	3.7	4.8	5.9
Continuous Stall Current	(A_{rms})	1.7	3.0	4.3	5.5	3.2	5.8	8.2	10.4	12.5
Rated Power	(kW)	0.63	1.13	1.51	1.88	1.07	1.70	2.32	3.02	3.71
R (ph-ph)	(Ohms)	15.0	5.00	2.66	1.90	5.45	1.82	1.05	0.62	0.48
L (ph-ph)	(mH)	24.0	10.6	6.80	4.80	14.1	6.00	3.80	2.70	2.10

UNIMOTOR performance specifications with Resolver Feedback
Δt = 125ºC, 40ºC ambient

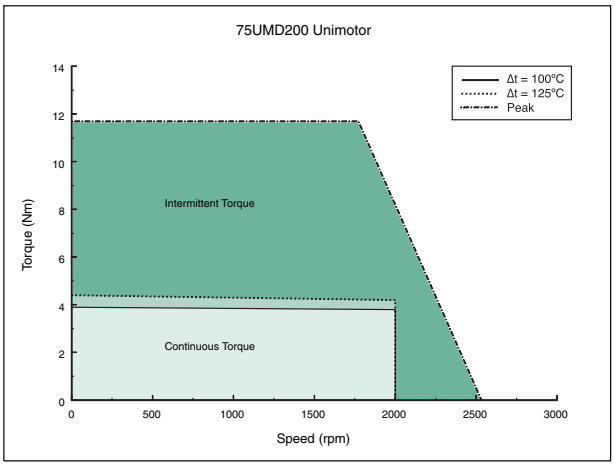
115					142					190			
A	B	C	D	E	A	B	C	D	E	A	B	C	D
4.0	7.3	10.5	13.9	17.6	7.3	12.5	17.7	22.9	27.0	23.2	43.2	62.8	78.0
10.5	19.8	28.2	36.0	45.9	18.9	32.4	45.9	59.4	70.2	65.4	123.3	176.1	219.6
9.7	12.0	14.3	16.6	18.8	21.6	28.0	34.3	40.7	47.0	93.5	140.5	187.5	234.5
3.2	5.5	7.8	10.0	12.3	7.8	14.1	20.5	26.8	33.1	50.0	97.0	144.0	191.0
6.5	8.2	9.9	11.6	13.2	10.9	13.2	15.5	17.8	26.0	26.0	33.0	40.0	48.0
175	185	198	217	241	213	217	275	301	365	240	242	319	632
0.06	0.10	0.14	0.18	0.21	0.09	0.16	0.23	0.30	0.35	0.30	0.54	0.72	0.99
3.7	6.8	9.8	12.3	15.5	6.8	12.0	17.0	21.4	24.9	20.8	38.1	53.0	60.0
1.7	3.1	4.4	5.8	7.4	3.1	5.3	7.4	9.6	11.3	9.7	18.0	26.2	32.5
0.77	1.42	2.05	2.58	3.25	1.42	2.51	3.56	4.48	5.22	4.36	8.0	11.1	12.6
27.8	8.55	4.55	2.96	2.17	12.5	3.60	2.10	1.35	0.98	1.80	0.56	0.33	0.23
94.6	40.5	25.7	18.6	14.7	58.0	29.8	18.7	13.6	10.7	28.1	13.0	8.90	6.30
3.3	6.2	9.2	11.9	14.7	6.3	10.5	14.2	18.4	21.0	20.1	36.2	38.3	40.2
2.5	4.6	6.6	8.7	11.0	4.6	7.9	11.1	14.4	16.9	14.5	27.0	39.3	48.8
1.04	1.95	2.89	3.74	4.62	1.98	3.30	4.46	5.78	6.60	6.31	11.4	12.0	12.6
12.6	3.86	2.02	1.40	1.10	5.63	1.72	0.94	0.61	0.42	0.79	0.30	0.14	0.09
43.1	18.6	11.4	8.60	7.40	31.0	13.3	8.30	6.10	4.80	13.2	6.11	3.60	2.46
2.9	5.4	7.3	8.6	10.0	4.2	8.2	10.4	12.5	14.2				
3.4	6.1	8.8	11.6	14.7	6.1	10.5	14.8	19.1	22.5				
1.21	2.26	3.06	3.60	4.19	1.76	3.43	4.36	5.24	5.95				
6.91	2.14	1.16	0.73	0.57	3.12	1.00	0.53	0.35	0.24				
23.5	10.2	6.60	4.70	3.90	17.6	7.50	4.70	3.60	2.70				
2.7	4.7	6.1			3.6	5.7							
5.0	9.2	13.2			4.5	7.2							
1.70	2.95	3.83			2.26	3.58							
3.28	0.97	0.50			1.42	0.46							
15.54	4.81	2.94			7.72	3.44							

75/2000 RPM

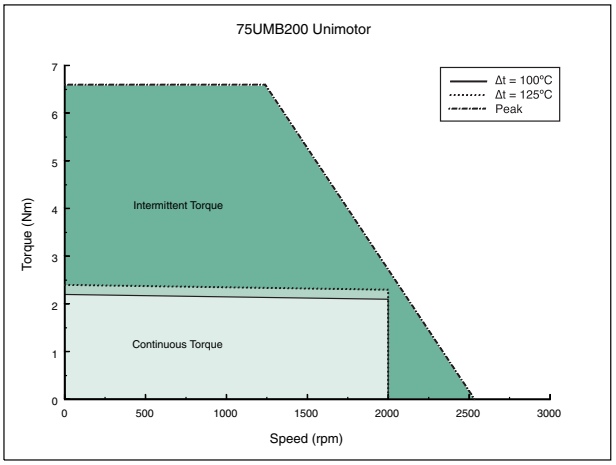
75UMA200 Unimotor



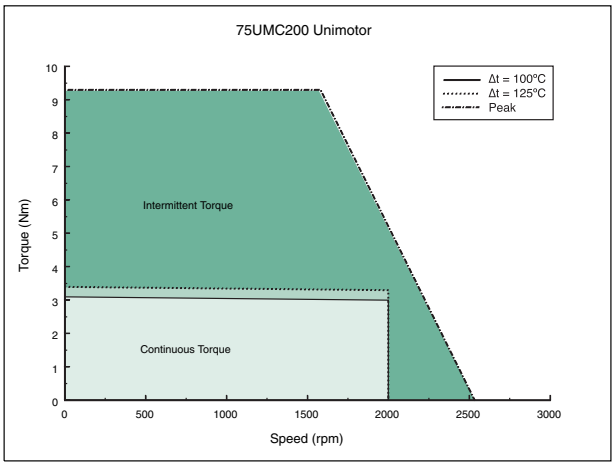
75UMD200 Unimotor



75UMB200 Unimotor



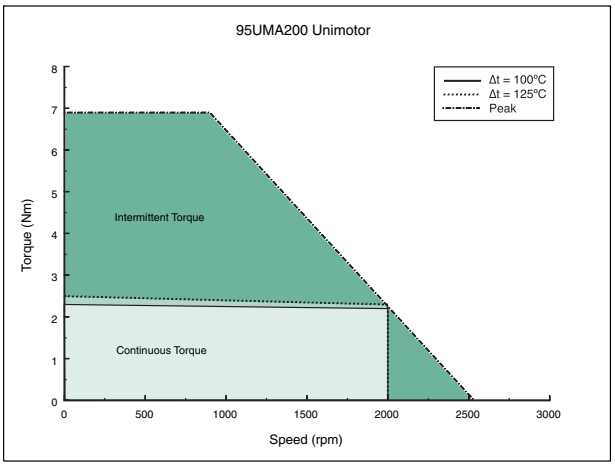
75UMC200 Unimotor



All figures are at 40˚C ambient

95/2000 RPM

95UMA200 Unimotor



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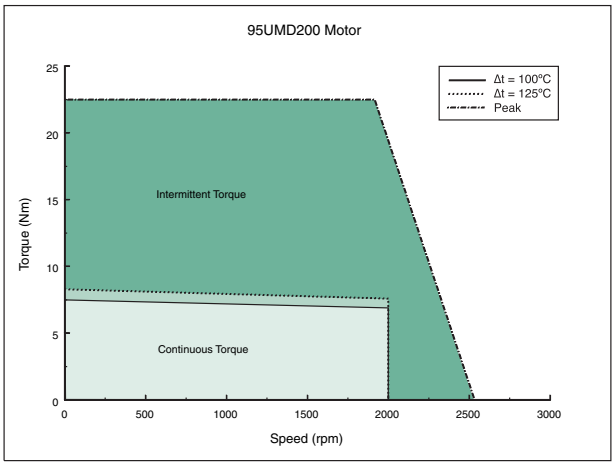

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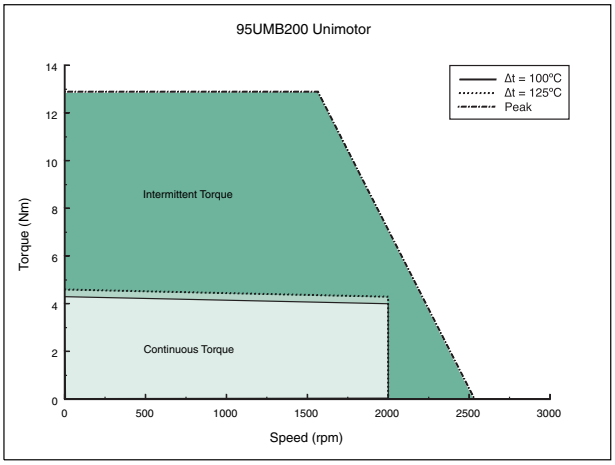

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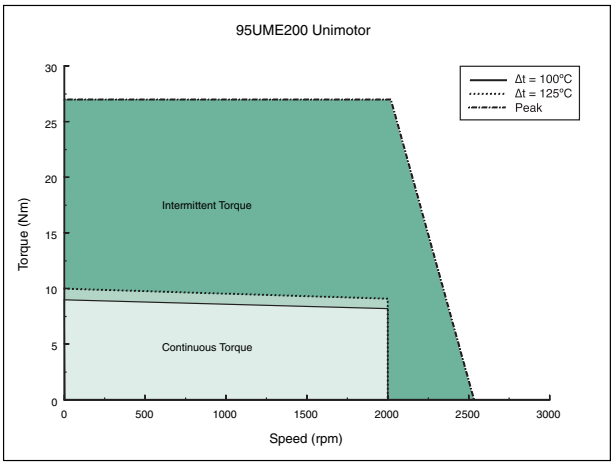

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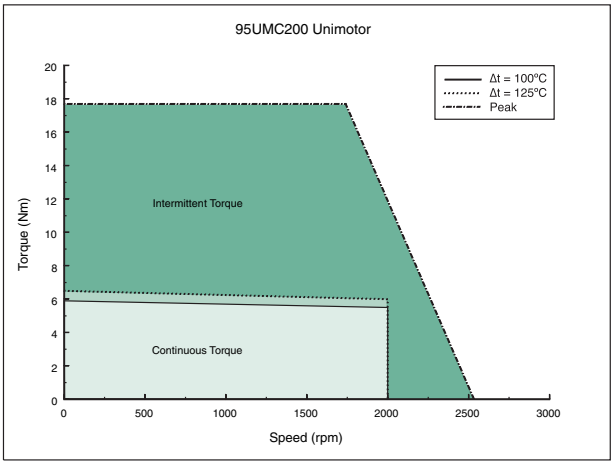
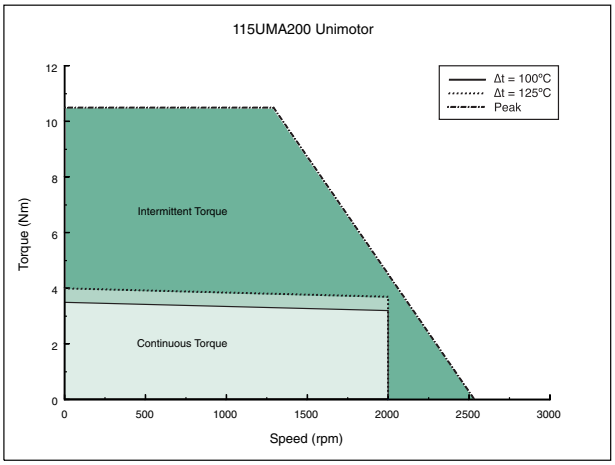


All figures are at 40˚C ambient

115/2000 RPM

115UMA200 Unimotor



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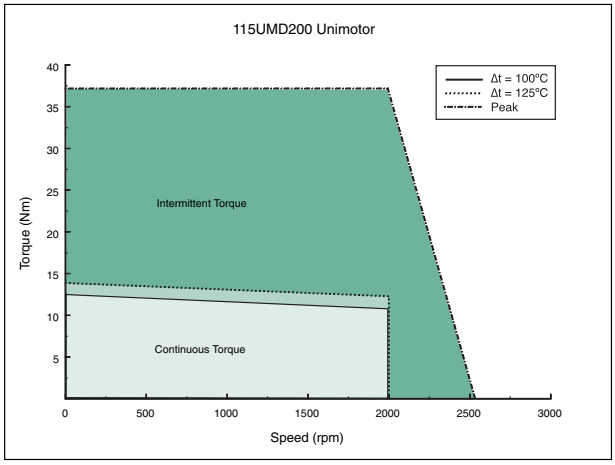
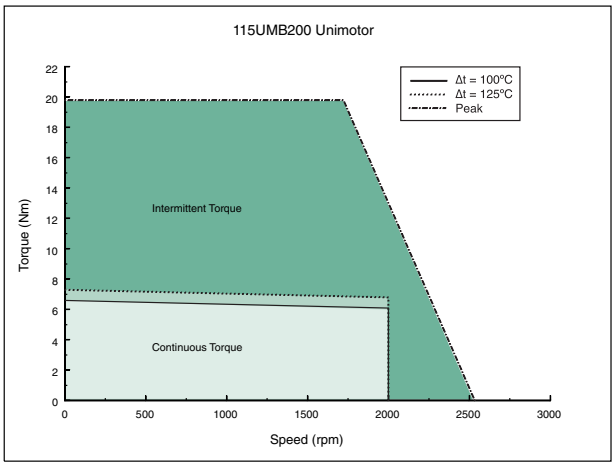


115UMB200 Unimotor



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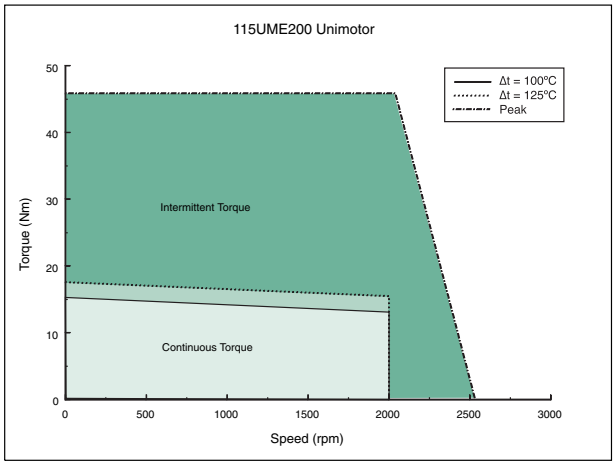

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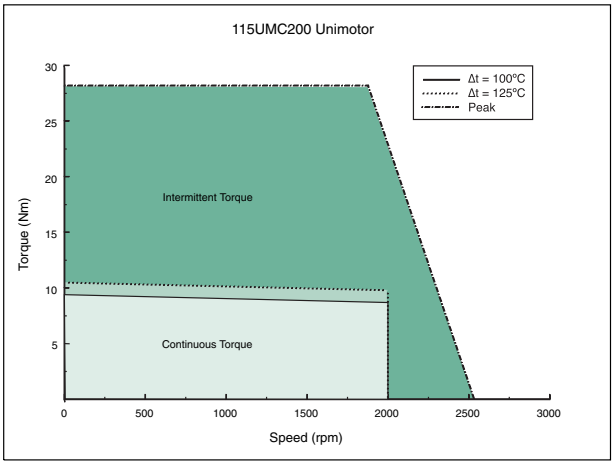
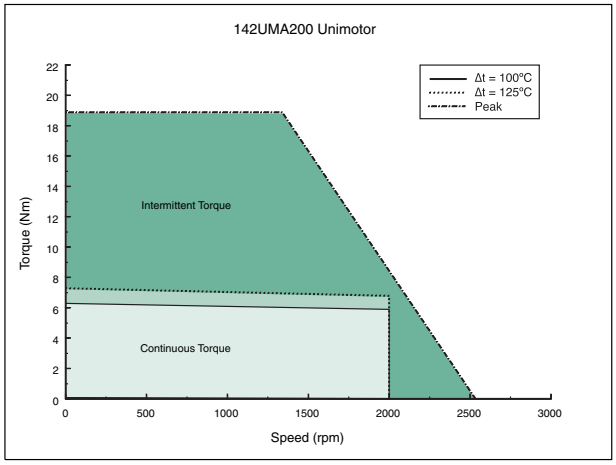


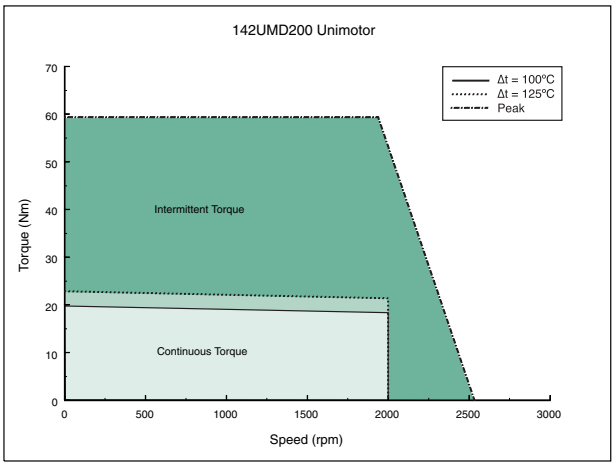
All figures are at 40˚C ambient

142/2000 RPM

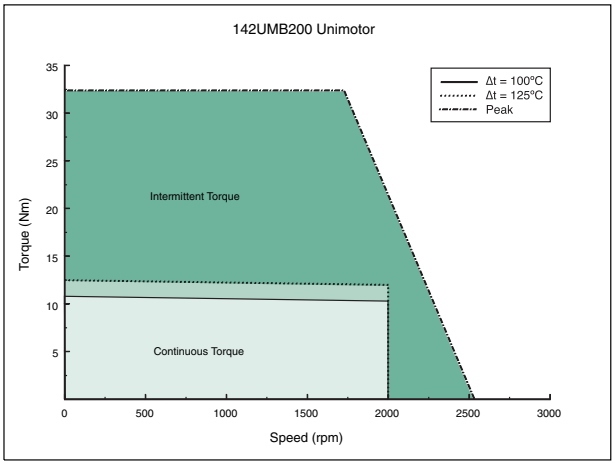
142UMA200 Unimotor



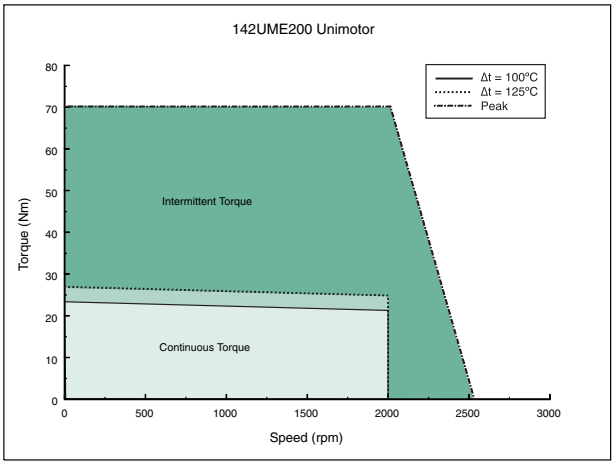
142UMD200 Unimotor



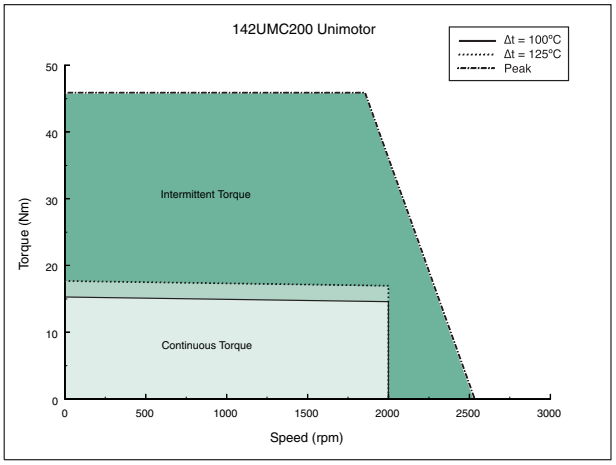
142UMB200 Unimotor



142UME200 Unimotor



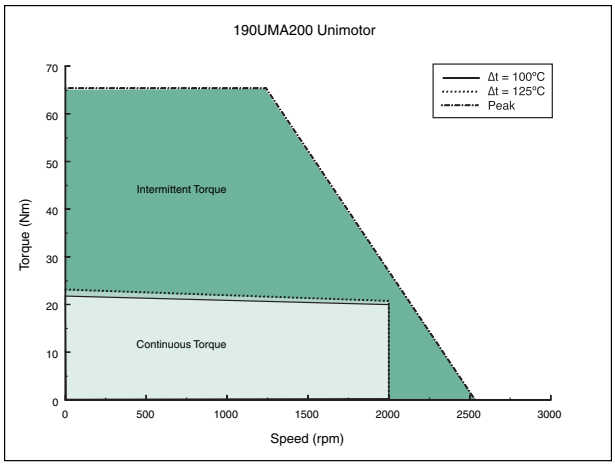
142UMC200 Unimotor



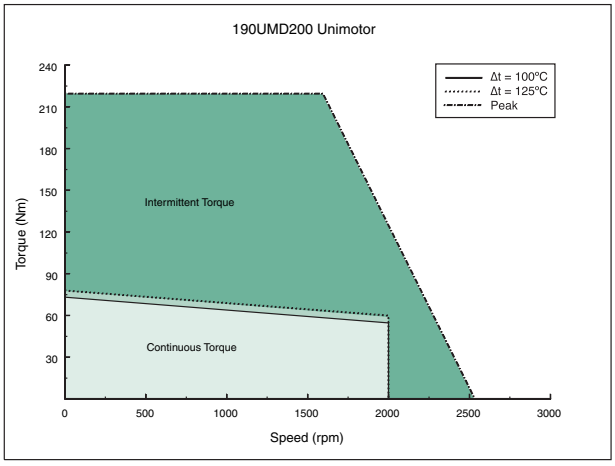
All figures are at 40˚C ambient

190/2000 RPM

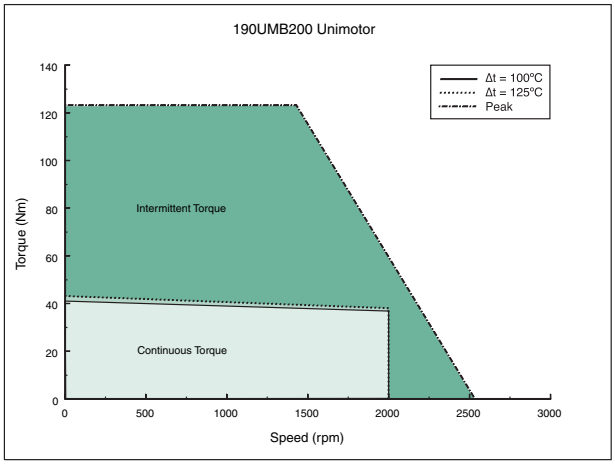
190UMA200 Unimotor



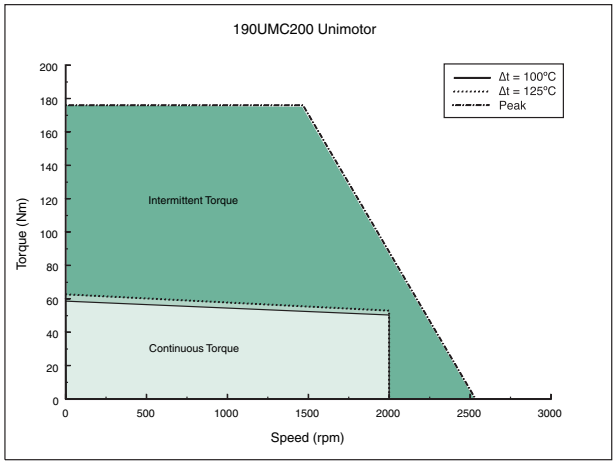
190UMD200 Unimotor



190UMB200 Unimotor



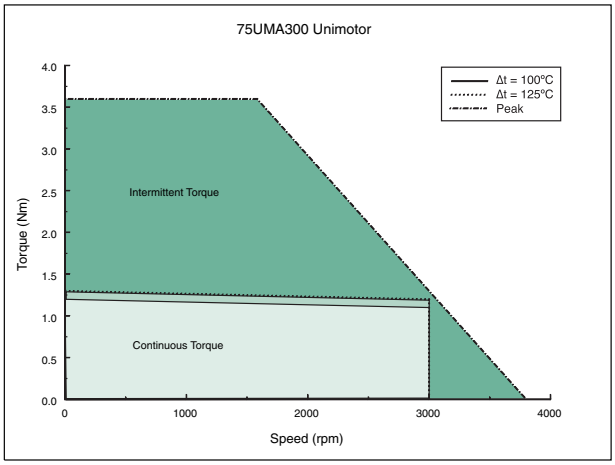
190UMC200 Unimotor



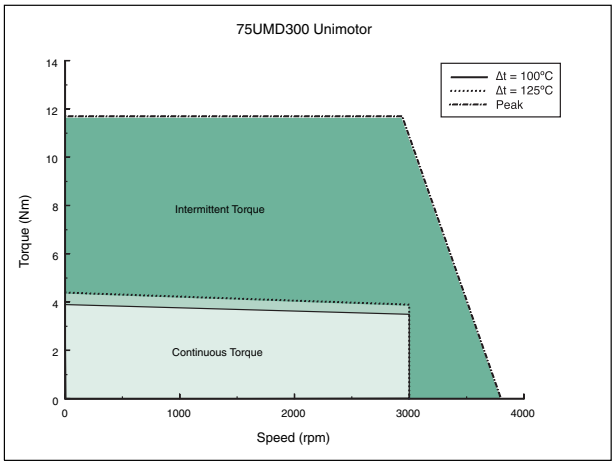
All figures are at 40˚C ambient

75/3000 RPM

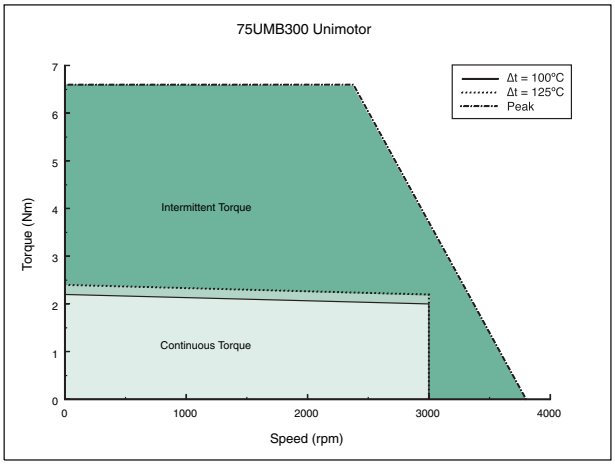
75UMA300 Unimotor



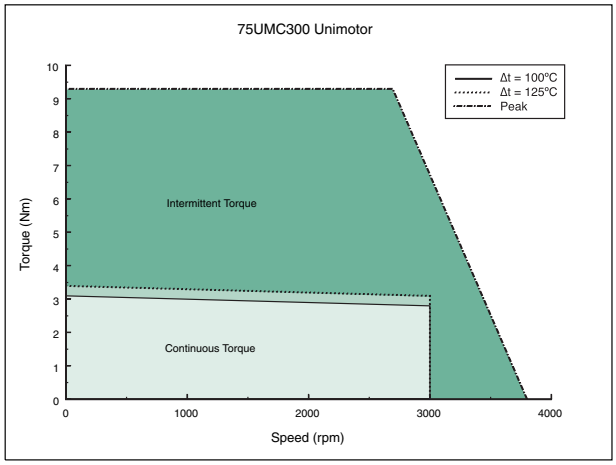
75UMD300 Unimotor



75UMB300 Unimotor



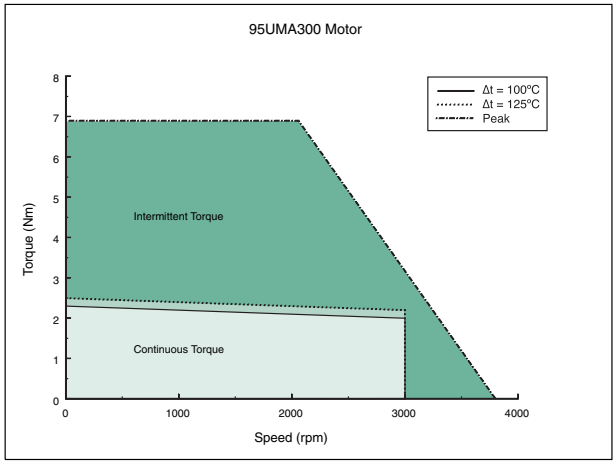
75UMC300 Unimotor



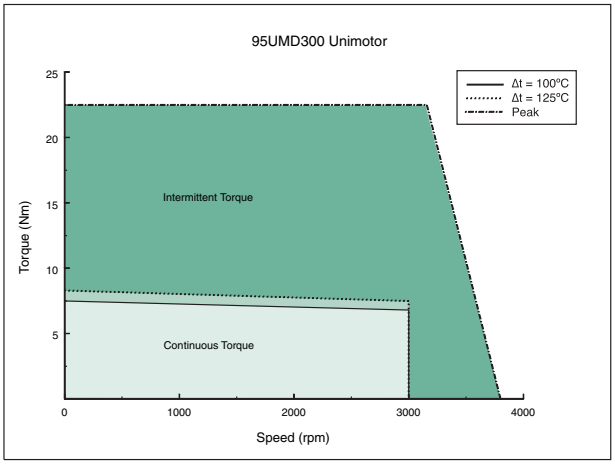
All figures are at 40˚C ambient

95/3000 RPM

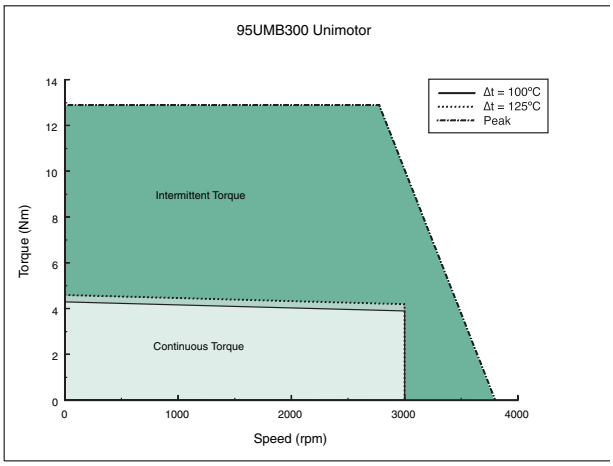
95UMA300 Unimotor



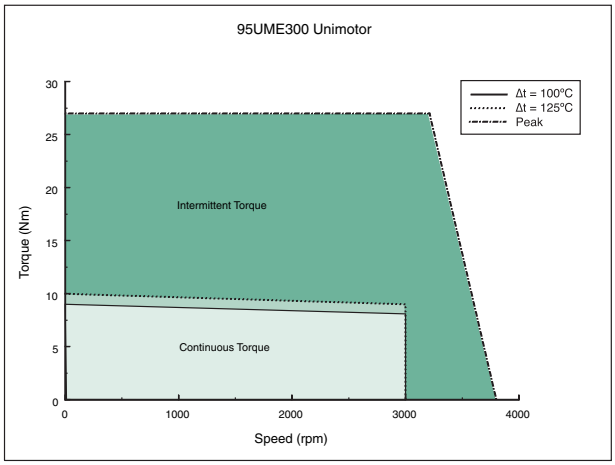
95UMD300 Unimotor



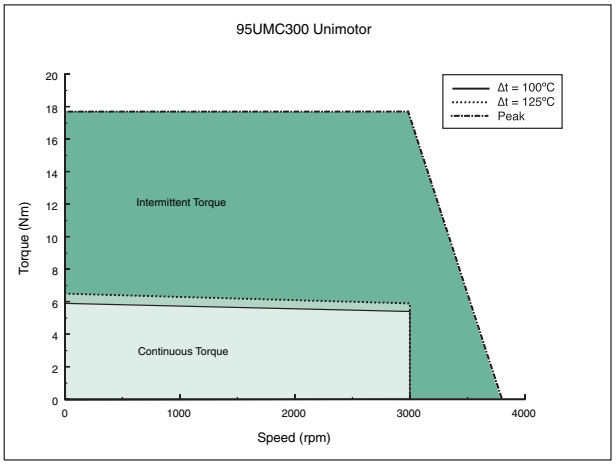
95UMB300 Unimotor



95UME300 Unimotor



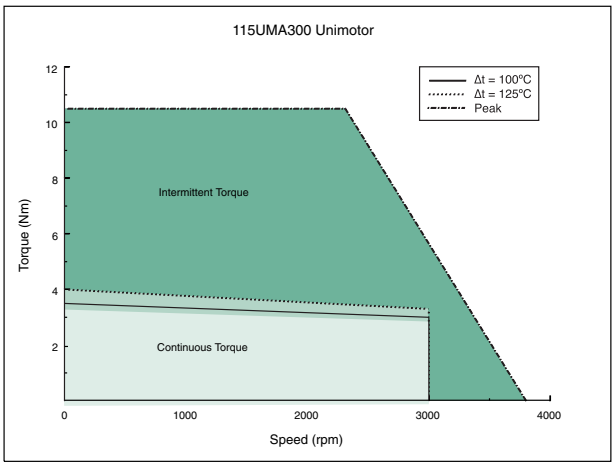
95UMC300 Unimotor



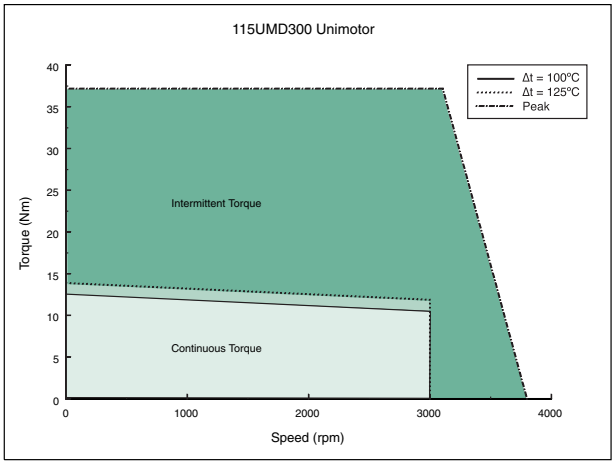
All figures are at 40˚C ambient

115/3000 RPM

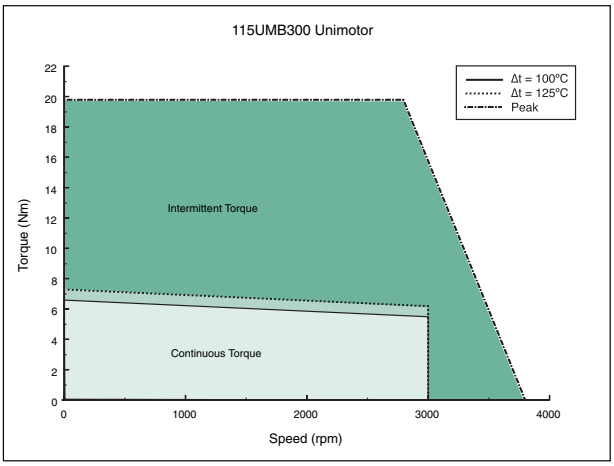
115UMA300 Unimotor



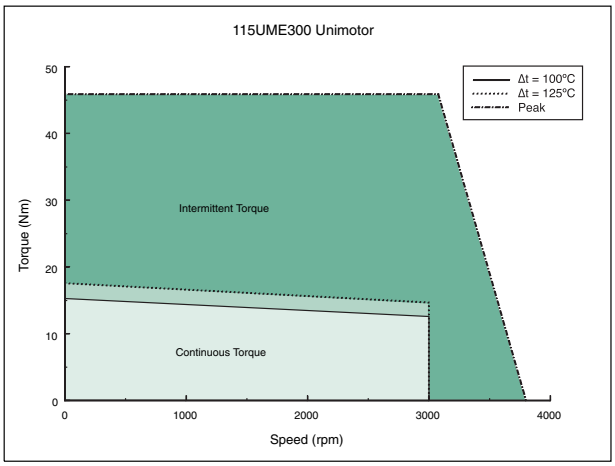
115UMD300 Unimotor



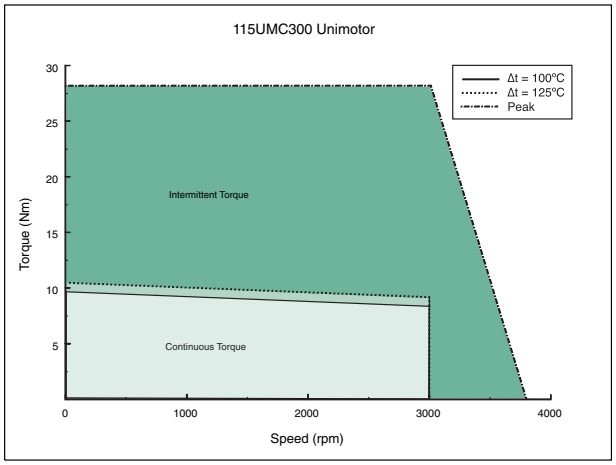
115UMB300 Unimotor



115UME300 Unimotor



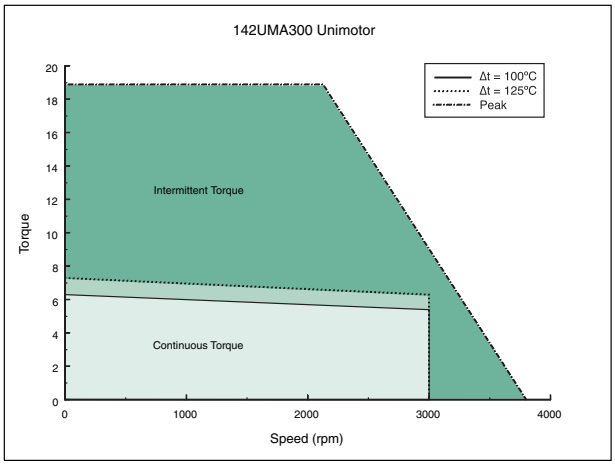
115UMC300 Unimotor



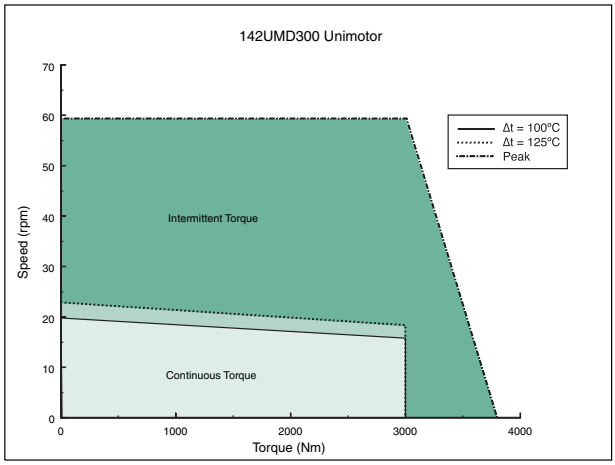
All figures are at 40˚C ambient

142/3000 RPM

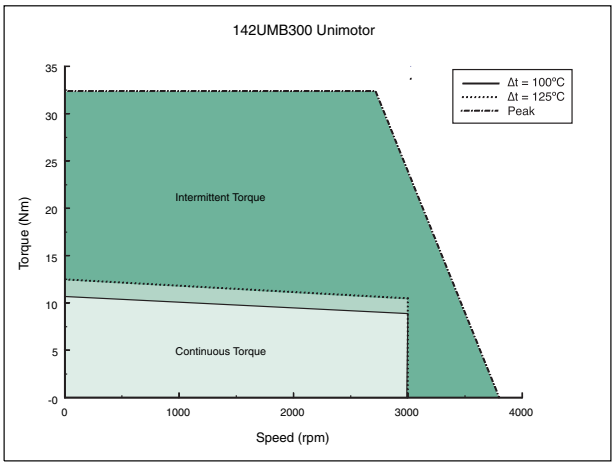
142UMA300 Unimotor



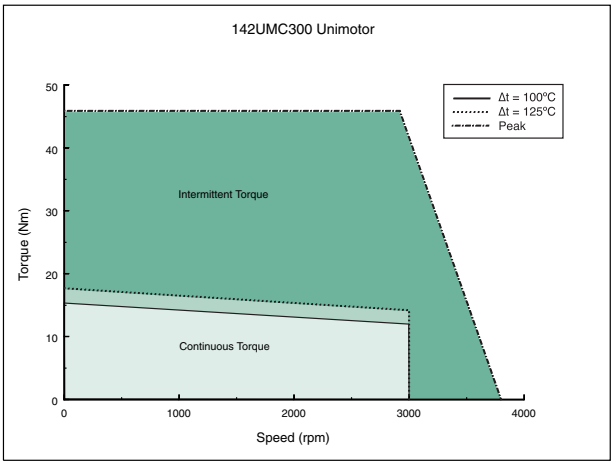
142UMD300 Unimotor



142UMB300 Unimotor



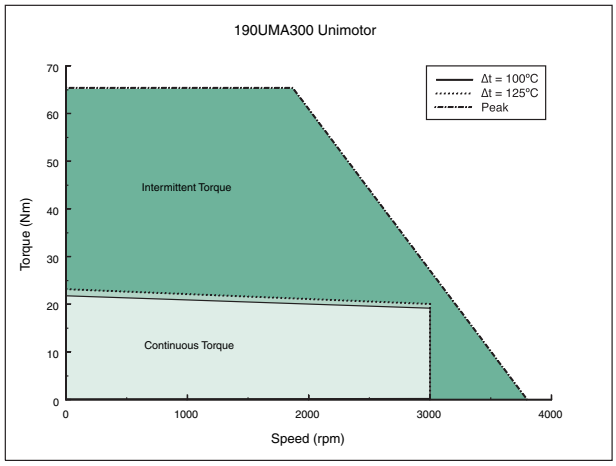
142UMC300 Unimotor



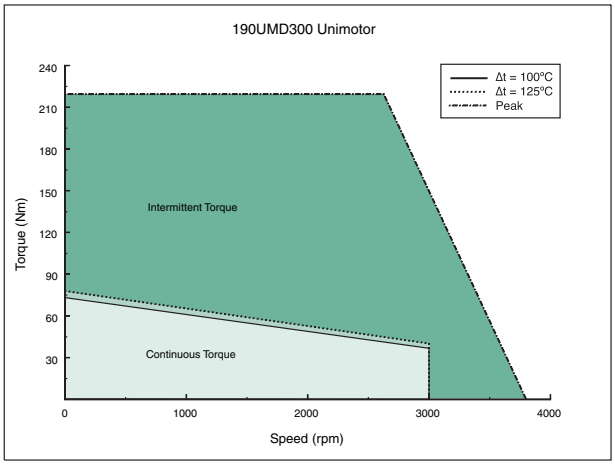
All figures are at 40˚C ambient

190/3000 RPM

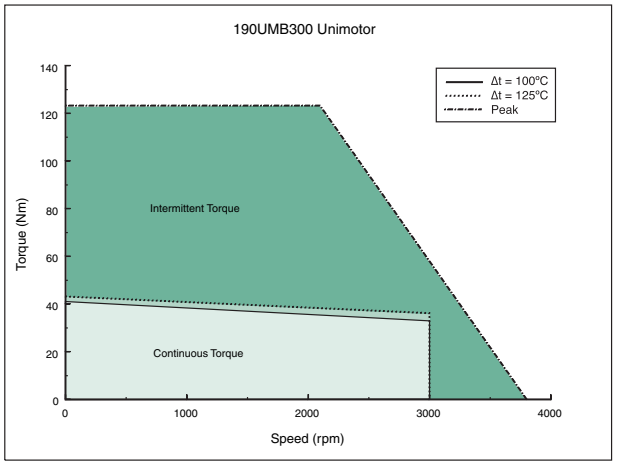
190UMA300 Unimotor



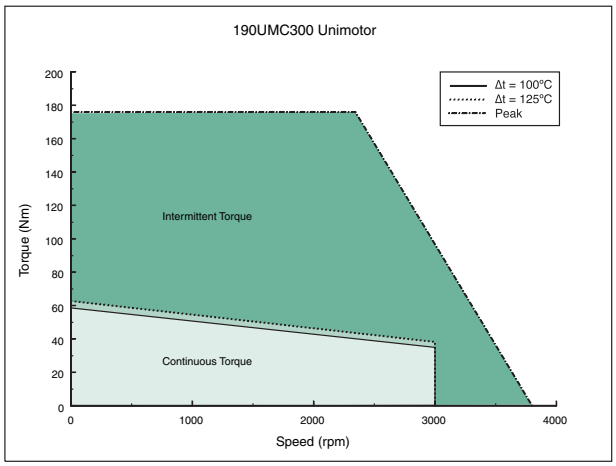
190UMD300 Unimotor



190UMB300 Unimotor



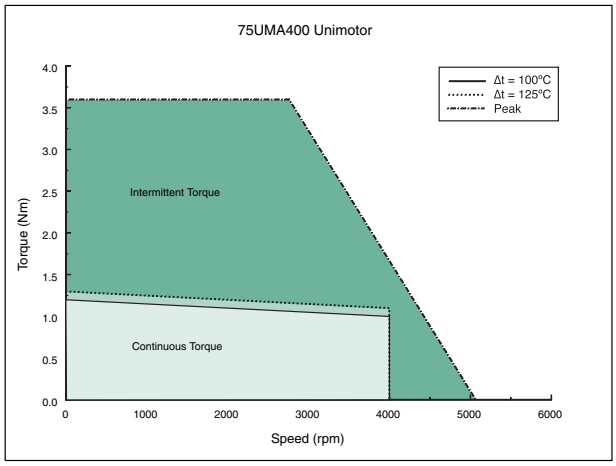
190UMC300 Unimotor



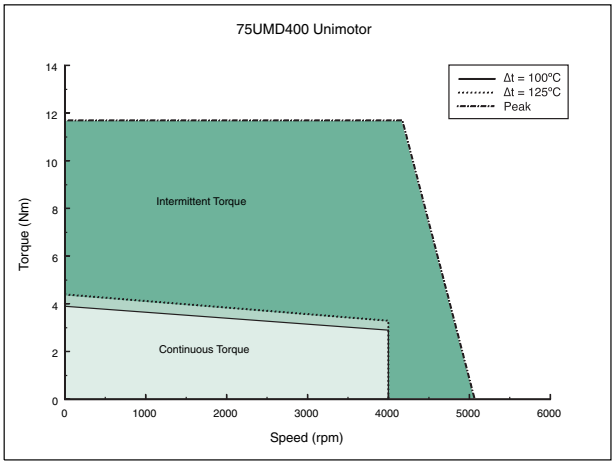
All figures are at 40˚C ambient

75/4000 RPM

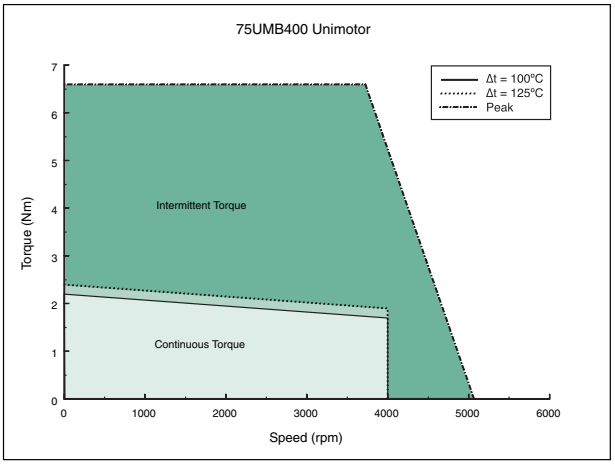
75UMA400 Unimotor



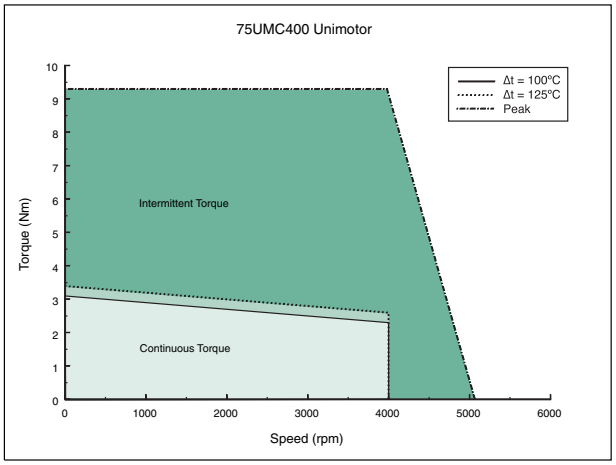
75UMD400 Unimotor



75UMB400 Unimotor



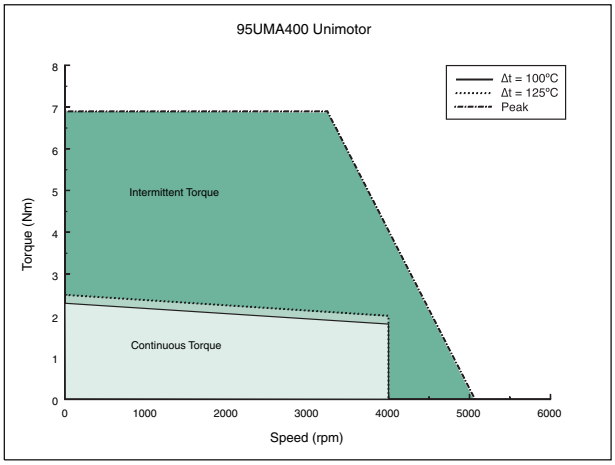
75UMC400 Unimotor



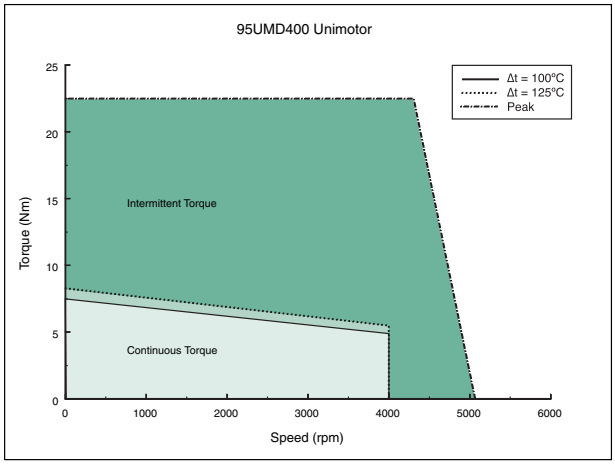
All figures are at 40˚C ambient

95/4000 RPM

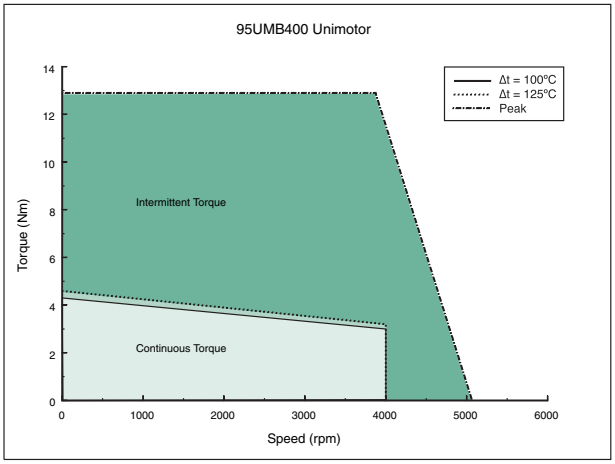
95UMA400 Unimotor



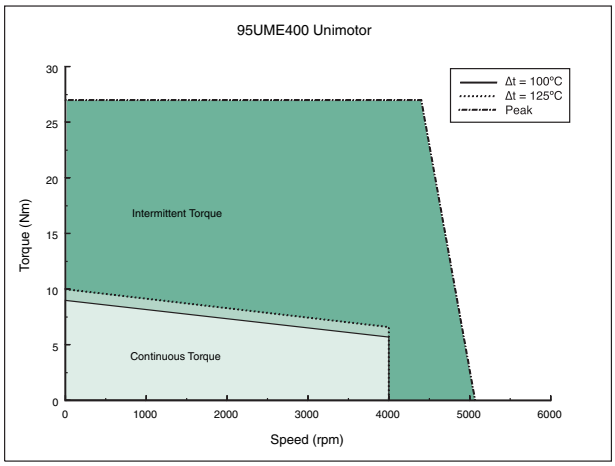
95UMD400 Unimotor



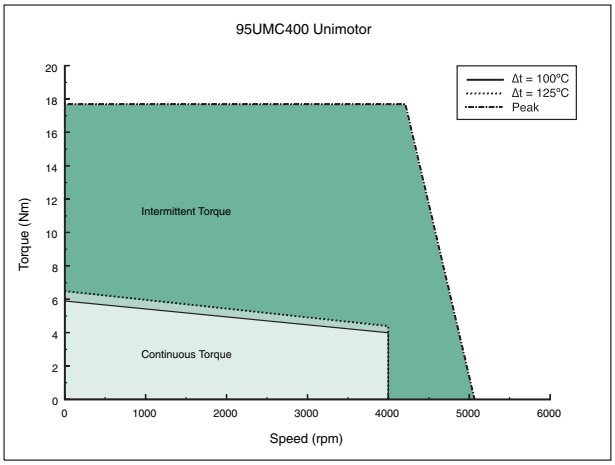
95UMB400 Unimotor



95UME400 Unimotor



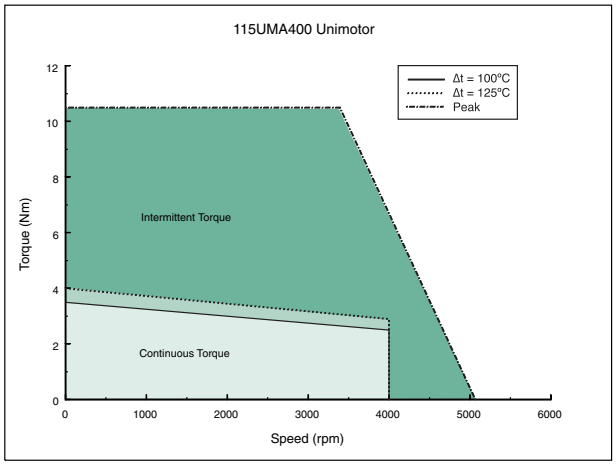
95UMC400 Unimotor



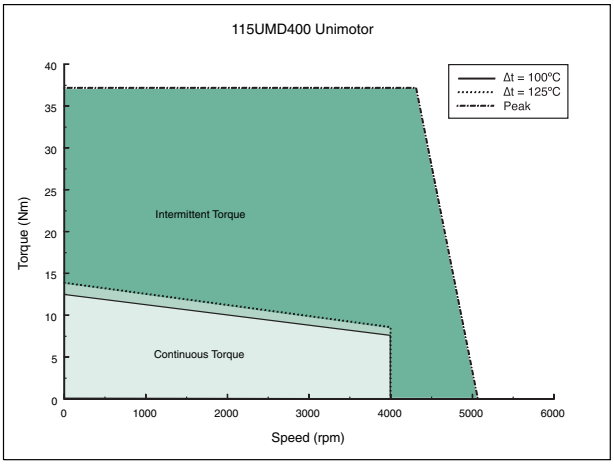
All figures are at 40˚C ambient

115/4000 RPM

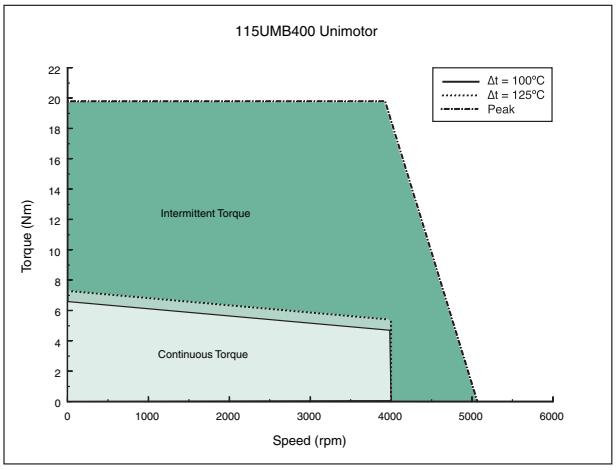
115UMA400 Unimotor



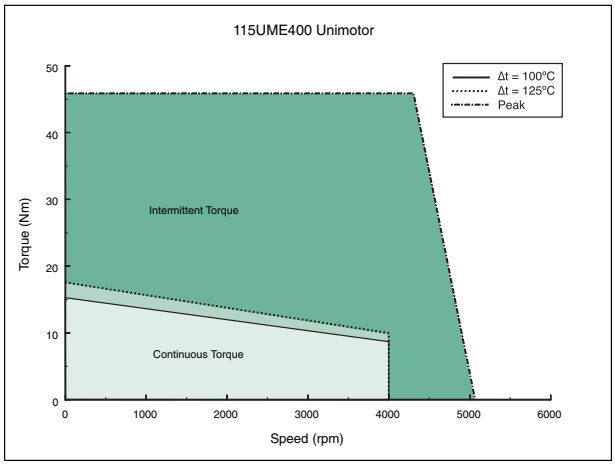
115UMD400 Unimotor



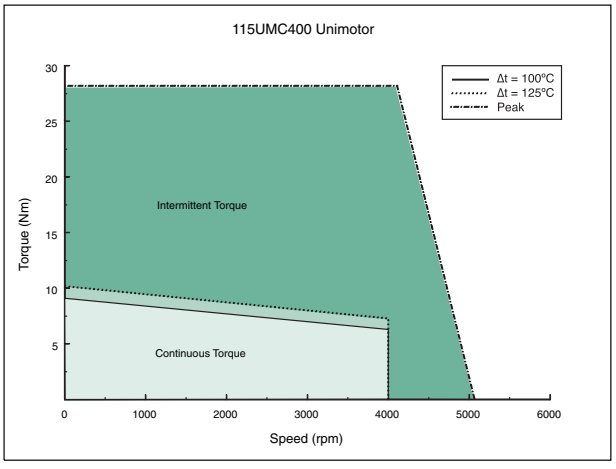
115UMB400 Unimotor



115UME400 Unimotor



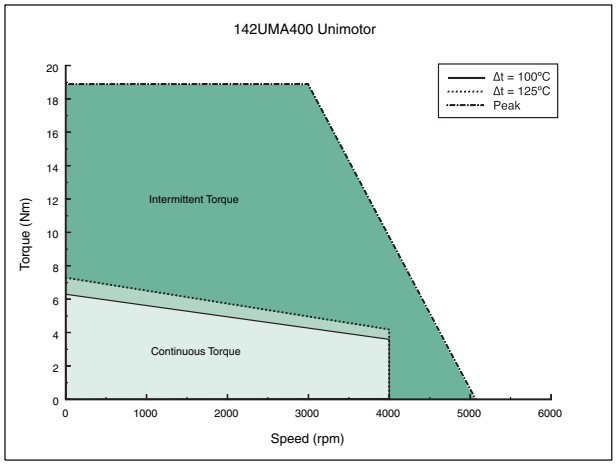
115UMC400 Unimotor



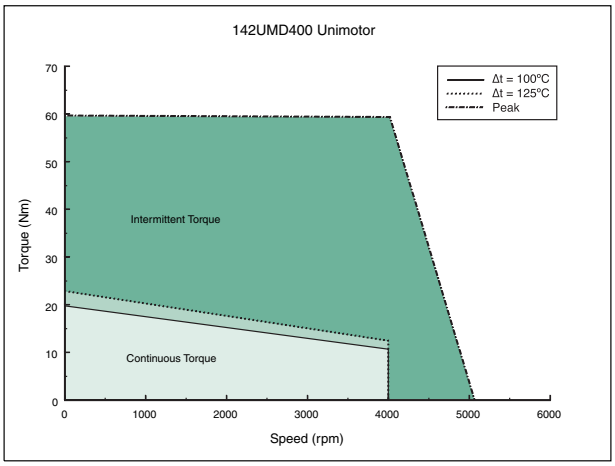
All figures are at 40˚C ambient

142/4000 RPM

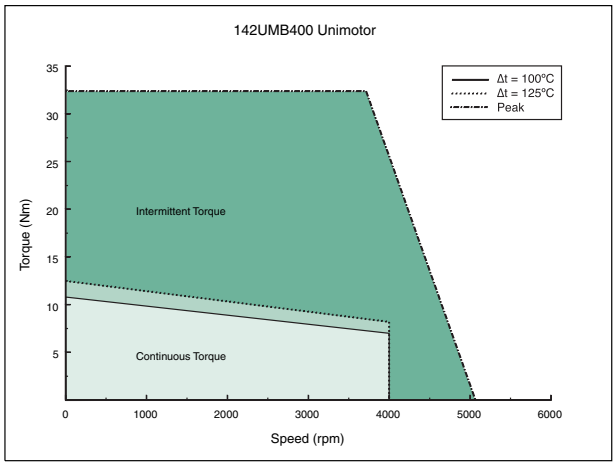
1142UMA400 Unimotor



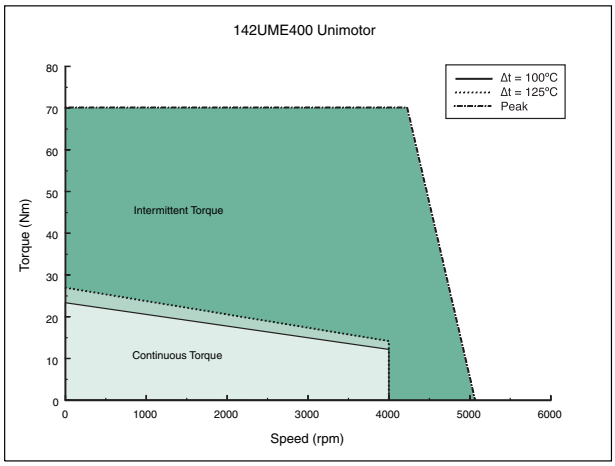
142UMD400 Unimotor



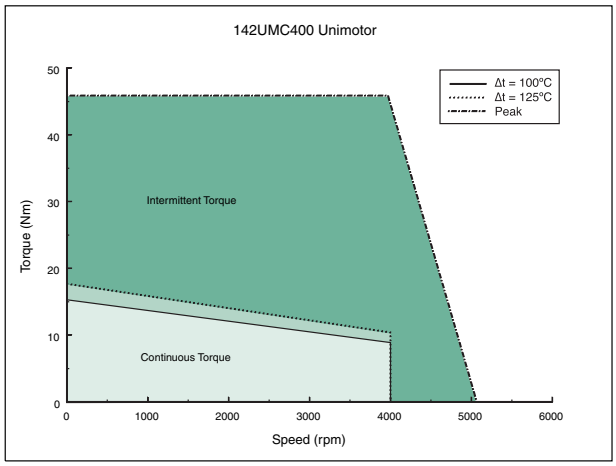
142UMB400 Unimotor



142UME400 Unimotor

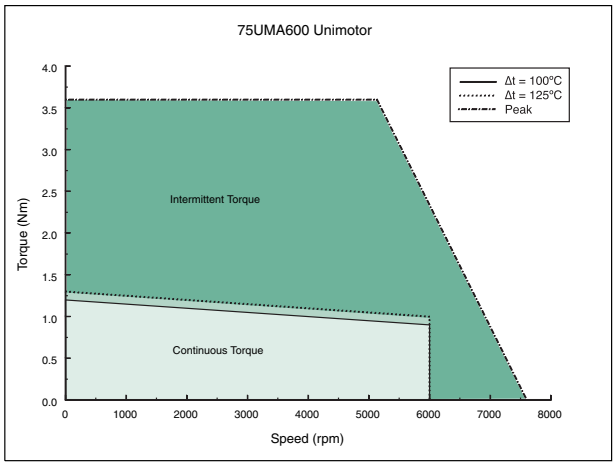


142UMC400 Unimotor

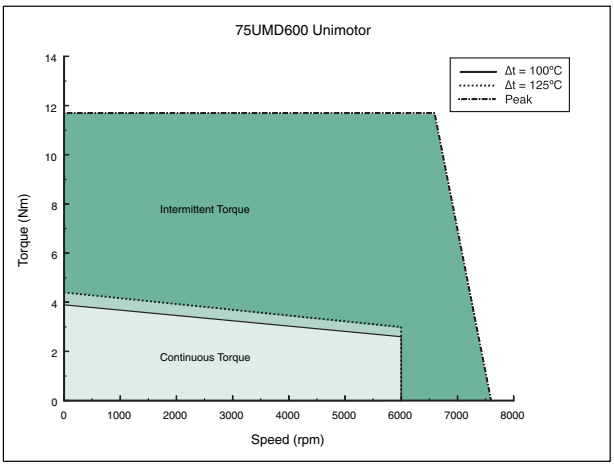


75/6000 RPM

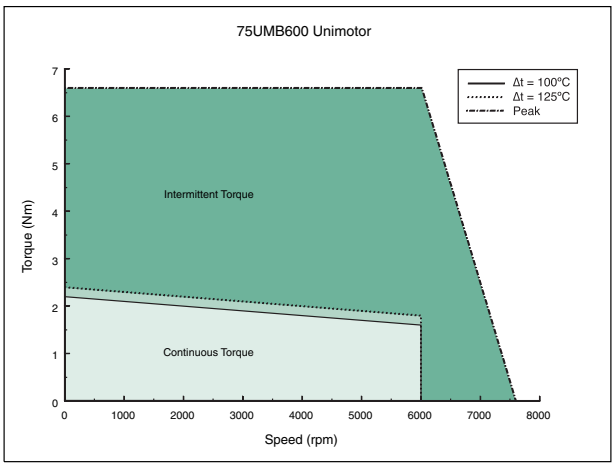
75UMA600 Unimotor



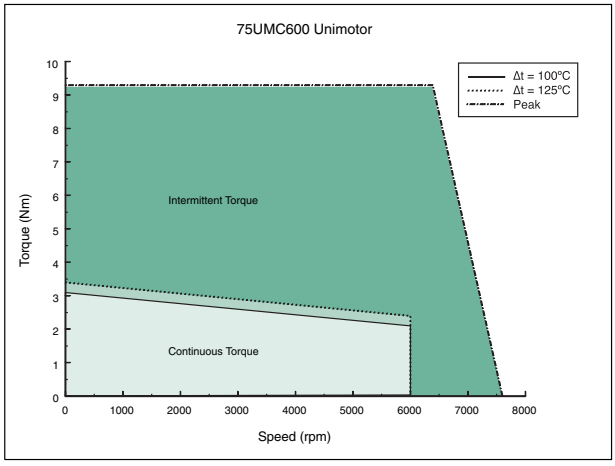
75UMD600 Unimotor



75UMB600 Unimotor



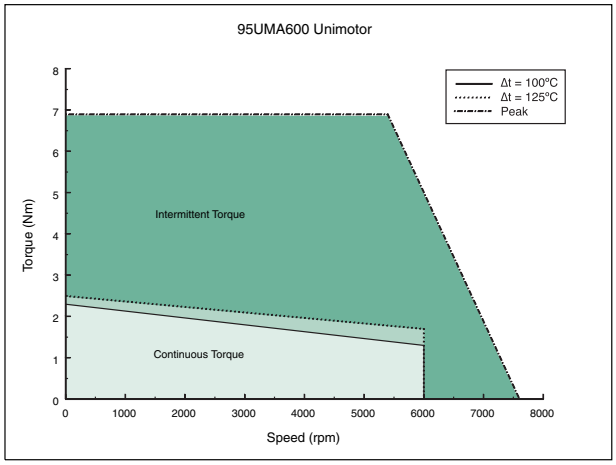
75UMC600 Unimotor



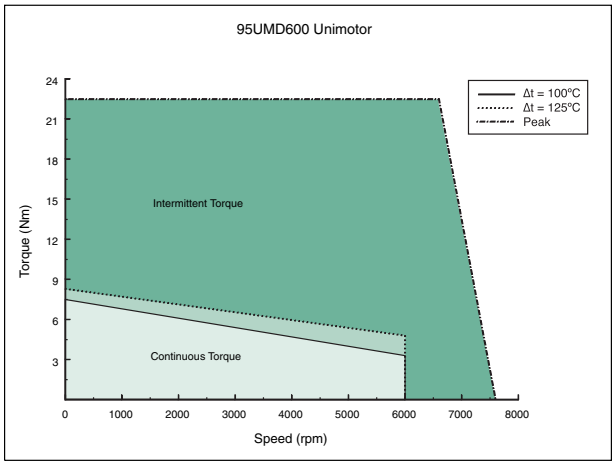
All figures are at 40˚C ambient

95/6000 RPM

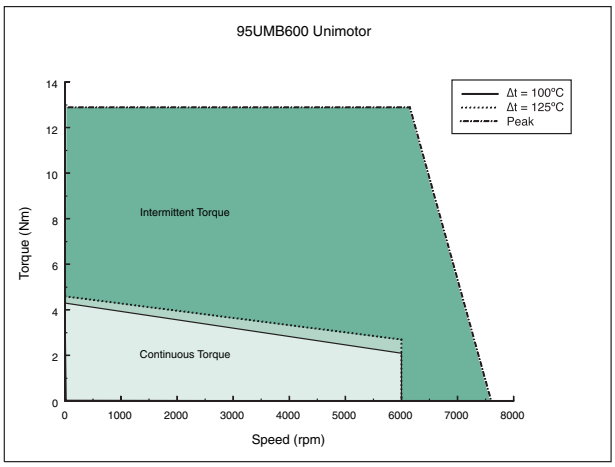
95UMA600 Unimotor



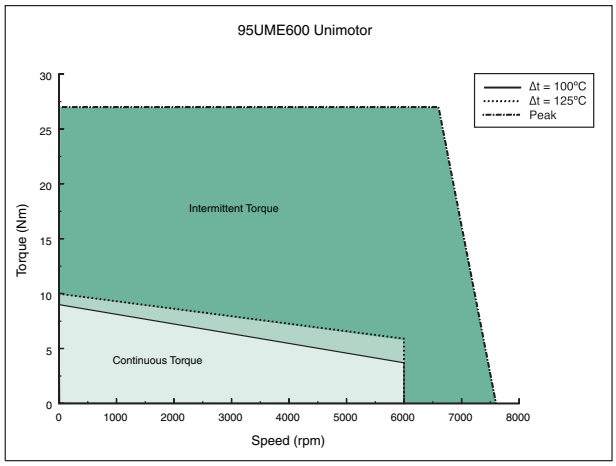
95UMD600 Unimotor



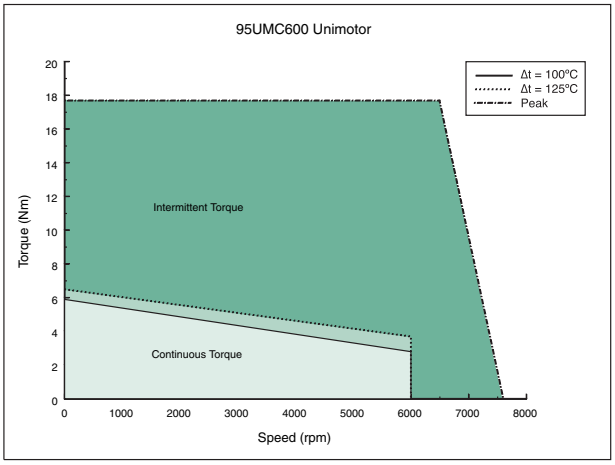
95UMB600 Unimotor



95UME600 Unimotor



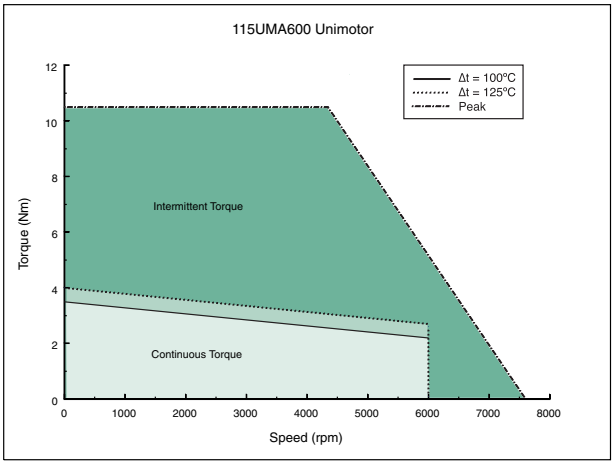
95UMC600 Unimotor



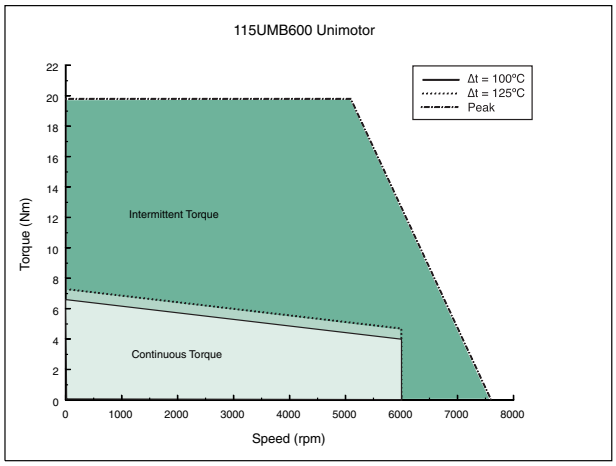
All figures are at 40˚C ambient

115/6000 RPM

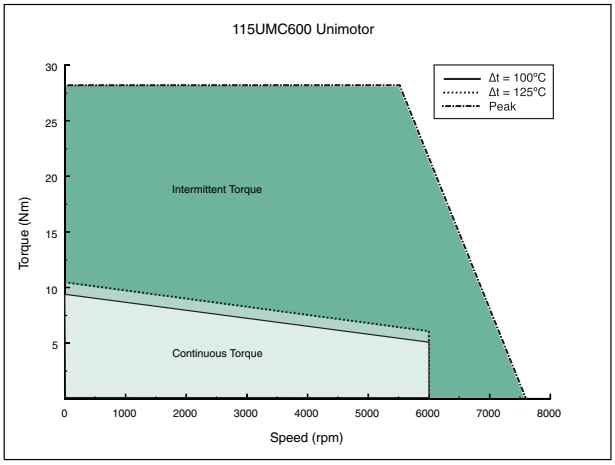
115UMA600 Unimotor



115UMB600 Unimotor



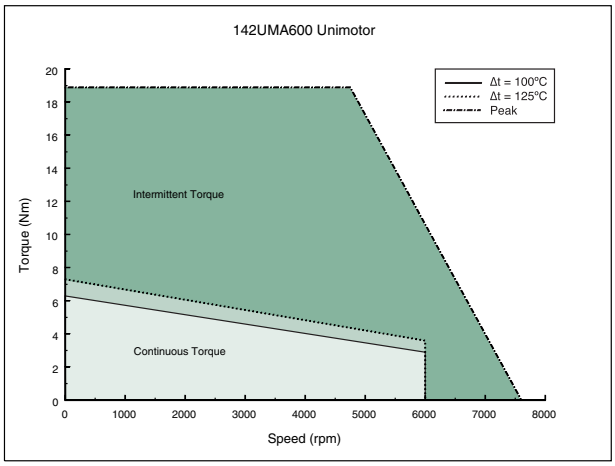
115UMC600 Unimotor



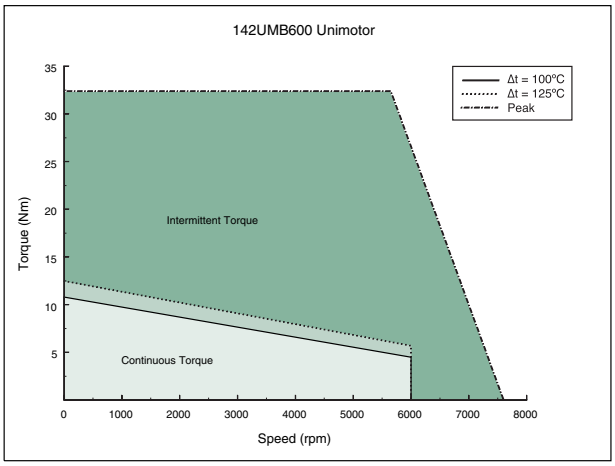
All figures are at 40˚C ambient

142/6000 RPM

142UMA600 Unimotor

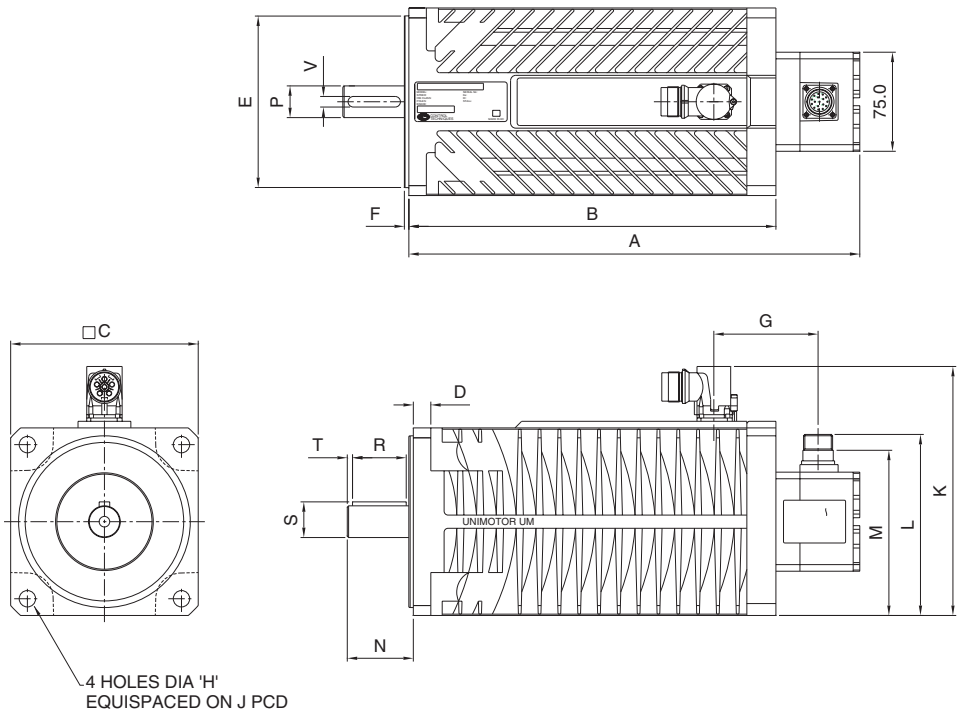


142UMB600 Unimotor



All figures are at 40˚C ambient

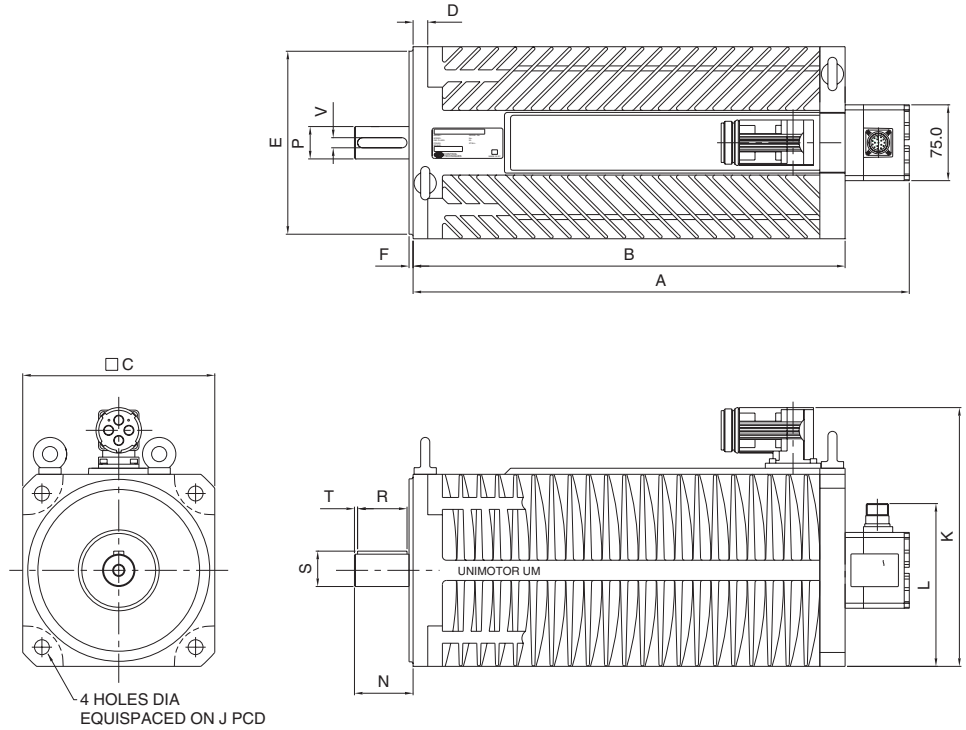
Outline Drawings - Frame Sizes 75 - 142



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				
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
Typical Weight (Kg)																			
Low Inertia	2.6	3.4	4.2	5.0	4.1	5.2	6.5	7.7	8.9	5.7	7.6	9.3	11.1	12.9	8.1	11	13.7	16.4	19.2
Low Inertia (braked)	3.1	3.9	4.7	5.5	5.0	6.1	7.4	8.6	9.8	6.6	8.5	10.2	12	13.8	10.4	13.3	16.0	18.7	21.5
High Inertia	2.9	3.7	4.5	5.3	4.7	5.8	7.1	8.3	9.5	6.9	8.8	10.5	12.3	14.1	9.8	12.7	15.4	18.0	20.8
High Inertia (braked)	3.4	4.2	5.0	5.8	5.6	6.7	8.0	9.2	10.4	7.8	9.7	11.4	13.2	15.0	12.1	15.0	17.7	20.4	23.2

Outline Drawing - Frame Size 190



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			
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(K6)			
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			
Typical Weight (Kg)					
Low Inertia		21.0	29.5	38.0	46.5
Low Inertia (braked)		23.3	31.8	40.5	49.0
High Inertia		23.0	31.5	40.0	48.5
High Inertia (braked)		25.6	34.1	43.0	51.5