EMERSON
Industrial Automation

Technical Data

Unimotor fm

High performance AC brushless servo motor
055 to 250 Frames
0.72 Nm to 136 Nm
(408 Nm Peak)

CONTROL TECHNIQUES

Control Techniques Dynamics Limited

Control Techniques Dynamics is renowned for its innovations in the industrial servo, aerospace and defence markets since 1962 and is a member of the Emerson (USA) group of companies.

Our long experience provides a strong base 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.

Our Research and Development team works closely with leading universities and, using our own proprietary software, designs innovative products for a wide range of demanding environments.

Control Techniques 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.

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055-250 Unimotor fm Technical Data

Unimotor fm is a high performance brushless AC servo motor range matched for use with Control Techniques drives. 'fm' stands for flexible motor, designed to accommodate a wide range of applications. The motors are available in seven frame sizes with various mounting arrangements and motor lengths.

Reliability and innovation

Unimotor fm is designed using a proven development process that prioritises innovation and reliability. This process has resulted in Control Techniques' market leading reputation for both performance and quality.

Matched motor and drive combinations

Control Techniques motors and drives are designed to function as an optimised system. Unimotor fm is the perfect partner for Unidrive SP, Digitax ST and Epsilon EP drives.

Features

Unimotor fm is suitable for a wide range of industrial applications, due to its extensive range of features

- Torque range: from 0.72 Nm to 136 Nm
- Standard and high energy dissipation parking brakes
- Numerous connector variants, e.g. vertical, 90° low profile, 90° rotatable and hybrid box on frame size 250
- Variety of flange possibilities (IEC/NEMA)
- Various shaft diameters; keyed or plain
- IP65 conformance; sealed against water spray and dust when mounted and connected
- Low inertia for high dynamic performance; high inertia option available
- World class performance
- Supported by rigorous testing for performance and reliability
- Optional high peak torque motors; up to 5 times stall torque
- Winding voltages of 400V and 220V
- Rated speeds include 1500 rpm, 2000 rpm, 3000 rpm, 4000 rpm, 6000 rpm and others available

Faster set-up, optimised performance

When a Control Techniques servo drive is connected to a Unimotor fm fitted with a SinCos or Absolute encoder, it can recognise and communicate with the motor to obtain the "electronic nameplate" data. This motor data can then be used to automatically optimise the drive settings. This feature simplifies commissioning and maintenance, ensures consistent performance and saves time.

Accuracy and resolution to suit your application requirements

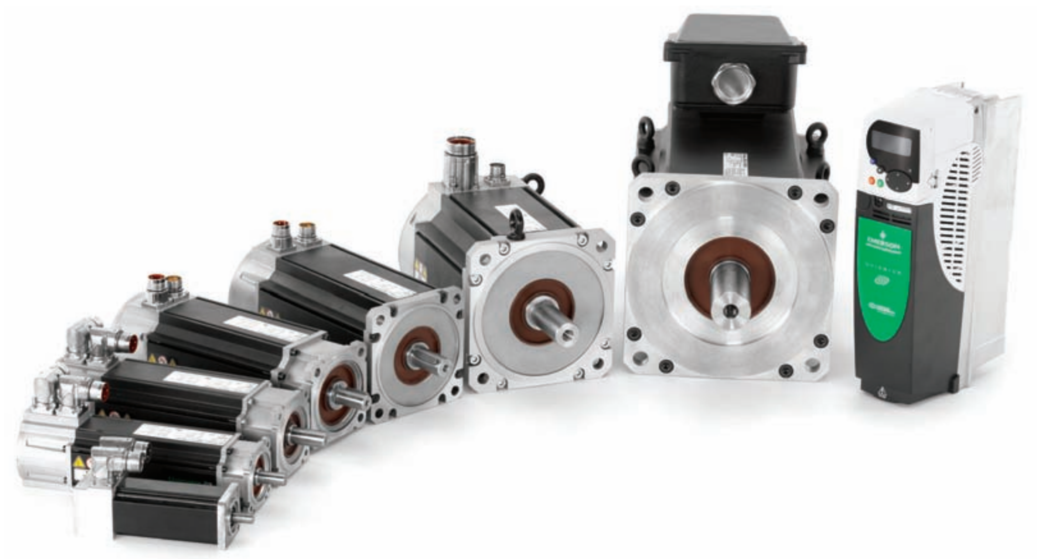
Choosing the right feedback device for your application is critical in getting optimum performance. Unimotor fm has a range of feedback options that offer different levels of accuracy and resolution to suit most applications:

- Resolver: robust for extreme applications and conditions - low accuracy, medium resolution
- Incremental encoder: high accuracy, medium resolution
- Inductive absolute: medium accuracy, medium resolution
- Optical SinCos/Absolute: high accuracy, high resolution
- Single turn and multi-turn: Hiperface (SICK) and EnDAT (Heidenhain) protocols supported

Conformance and standards

FM 30610

RoHS Compliant



Ideal for retrofit

Unimotor fm is an ideal retrofit choice with features to ensure it can integrate easily with your existing servo motor applications. Unimotor fm has been designed so that existing Unimotor customers can easily migrate to the new platform. All connector interface types and mounting dimensions remain the same. If you are planing to retrofit your system, Unimotor fm is the obvious choice.

Custom built motors

As part of our commitment to you, we can design special products to meet your application specific requirements.

Wide range of accessories

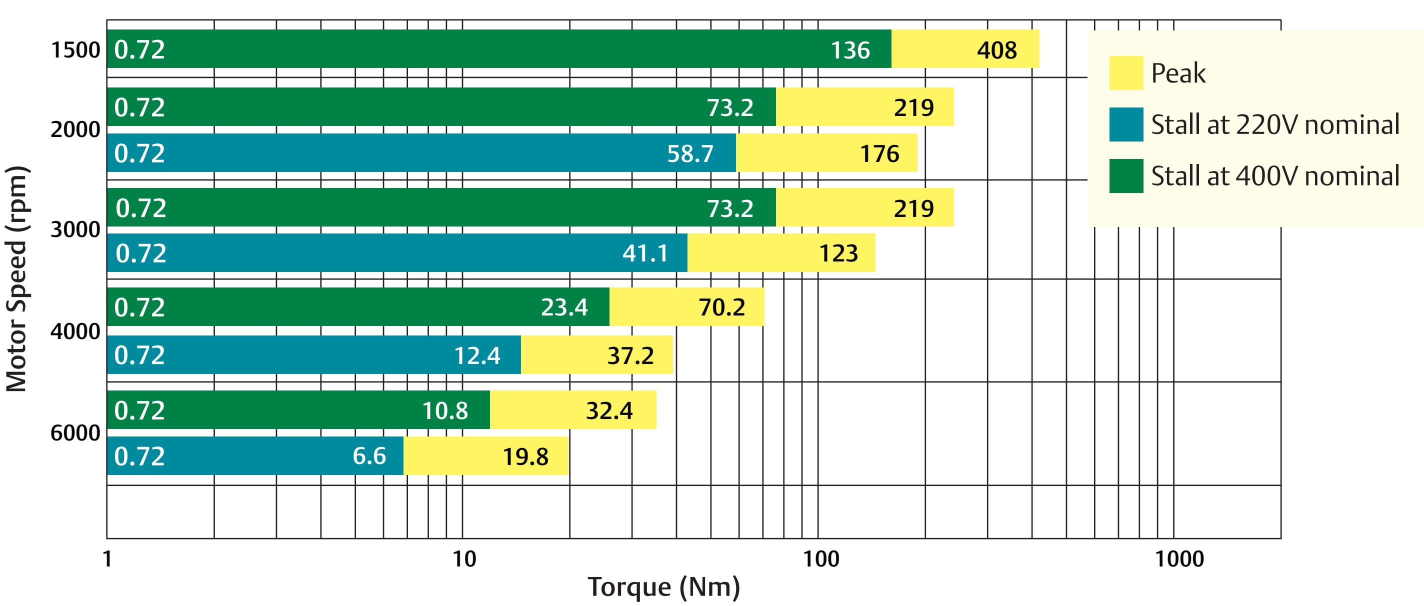
Unimotor fm has a wide range of accessories to meet all your system requirements:

- Feedback and power cables for static and dynamic applications
- Fan boxes
- Gearboxes
- Cable connectors

All around the world, just around the corner

Backed by Control Techniques' world wide support network in 65 countries through 89 subsidiary Drive Centres and resellers.

Torque performance



NB: The selection of drive-motor combinations should be based on duty/load profiles of the application

055-250 Unimotor fm Technical Data

Ordering information

Use the information below in the illustration to create an order code for a **Unimotor** fm
The details in the band are an example of an order reference (Std = Standard selection, Opt = Optional selection)

095	U	2	B	30	1	V
Frame size	Motor voltage	Peak torque selection	Stator length	Winding speed	Brake	Connection type
055	E = 220V	055 frame only	055 frame	055 frame only	055 frame only	055 frame only
075	U = 400V	**2** = Standard peak torque	A	**30** = 3000 rpm	**0** = Not fitted (Std)	**B** = Power and Signal 90° rotatable (Std)
095	250 frame only	075-142 frame only	B	**60** = 6000 rpm	**1** = Parking brake fitted 24Vdc	
115	U = 400V	**2** = Standard peak torque	C	075-190 frame only		**C** = Power 90° rotatable and Signal vertical
142		**P** = High peak torque	075 frame	**10** = 1000 rpm	**X** = Special	
190		190-250 frame only	A	**20** = 2000 rpm	075-190 frame only	**V** = Power and Signal vertical
250		**2** = Standard peak torque	B	**25** = 2500 rpm	**0** = Not fitted (Std)	**X** = Special
			C	**30** = 3000 rpm	**1** = Parking brake fitted 24Vdc	075-190 frame only
			D	**40** = 4000 rpm		**A** = Power and Signal 90° fixed
			095-142 Frame	**45** = 4500 rpm	**5** = High energy dissipation	**B** = Power and Signal 90° rotatable
			A	**50** = 5000 rpm		
			B	**60** = 6000 rpm	**X** = Special	**C** = Power 90° rotatable and Signal vertical
			C	250 frame only	250 frame only	
			D	**10** = 1000 rpm	**0** = Not fitted (Std)	**V** = Power and Signal vertical (Std)
			E	**15** = 1500 rpm	**5** = High energy dissipation	
			190 Frame	**20*** = 2000 rpm		**X** = Special
			A	**25*** = 2500 rpm		250 frame only
			B			**C** = Power 90° rotatable and Signal vertical
			C			
			D			***H** = Power hybrid box and Signal 90° (Std)
			E			
			F			**V** = Power and Signal vertical
			G			
			H			
			250 Frame			
			D*			
			E*			
			F*			

* D and E lengths, winding speed equal and above 2500rpm must use the Hybrid box. F lengths, winding speed equal and above 2000rpm must use the Hybrid box.

** Optional PCD's will have a different register diameter from the standard motors. Please consult Drive Centre or Distributors for details.

*** Available on 190 frame only

	A	CA		A	100		190		
	Output shaft	Feedback device		Inertia	PCD**		Shaft diameter		
	A = Key (Std)	055 frame only		055 frame only	055 frame only				
	B = Plain shaft	**AR** = Resolver		A = Standard	063	Std	09.0	Opt	
	X = Special	**CP** = Incremental Encoder	4096 ppr	075-190 frame only	070	Opt	11.0	A-C	Std
		MP = Incremental Encoder (Std)	2048 ppr	A = Standard			14.0	Max	
		KP = Incremental Encoder	1024 ppr	B = High Inertia	075 frame only				
		EM = Inductive SinCos Multi-turn	EQI 1130	250 frame only	075	Std	11.0	A	Std
		FM = Inductive SinCos Single turn	ECI 1118	A = Standard	080	Opt	14.0	B-D	Std
		TL = Optical SinCos Multi-turn	SKM 36		085	Opt	19.0	Max	
		UL = Optical SinCos Single turn	SKS 36		095 frame only				
		XX = Special			100	Std	14.0	A	Std
		075-142 frame only			098	Opt	19.0	B-E	Std
		AE = Resolver			115	Opt	22.0	Max	
		CA = Incremental Encoder (Std)	4096 ppr		115 frame only				
		MA = Incremental Encoder	2048 ppr		115	Std	19.0	A-C	Std
		KA = Incremental Encoder	1024 ppr		130	Opt	24.0	D-E	Std
		EB = Optical SinCos Multi-turn	EQN 1325		145	Opt	32.0	Max	
		FB = Optical SinCos Single turn	ECN 1313		142 frame only				
		EC = Inductive SinCos Multi-turn	EQI 1331		165	Std	24.0	A-E	Std
		FC = Inductive SinCos Single turn	ECI 1319		149	Opt	32.0	Max	
		RA = Optical SinCos Multi-turn	SRM 50		190 frame only				
		SA = Optical SinCos Single turn	SRS 50		215	Std	32.0	A-H	Std
		XX = Special					42.0	Max	
		190-250 frame only			250 frame only				
		AE = Resolver (Std for 250)			300	Std	48.0	D-F	Std
		CA = Incremental Encoder (Std for 190)	4096 ppr						
		MA = Incremental Encoder***	2048 ppr						
		EB = Optical SinCos Multi-turn	EQN 1325						
		FB = Optical SinCos Single turn	ECN 1313						
		RA = Optical Sincos Multi-turn	SRM 50						
		SA = Optical Sincos Single turn	SRS 50						
		XX = Special							

055-250 Unimotor Technical Data

Performance data

Servo motor for 3 Phase VPWM drives 200-240Vrms

Δt= 100°C winding 40°C maximum ambient. All data subject to +/-10% tolerance

Motor frame size (mm)	055E2			075E2				095E2				
Frame length	A	B	C	A	B	C	D	A	B	C	D	E
Continuous stall torque (Nm)	0.72	1.40	2.11	1.2	2.2	3.1	3.9	2.3	4.3	5.9	7.5	9.0
Standard (2) peak torque selection max (Nm)	2.75	5.50	8.25	3.6	6.6	9.3	11.7	6.9	12.9	17.7	22.5	27.0
High (P) peak torque selection max (Nm)	N/A	N/A	N/A	6	11	15.5	19.5	10.4	19.4	26.6	33.8	40.5
Standard inertia (kgcm²)	0.12	0.23	0.34	0.7	1.2	1.6	2.0	1.8	2.9	4.0	5.1	6.2
High inertia (kgcm²)	N/A	N/A	N/A	1.1	1.5	2.0	2.4	3.7	4.8	5.9	7.0	8.1
Winding thermal time const. (s)	N/A	N/A	N/A	81	74	94	100	172	168	183	221	228
Standard motor weight unbraked (kg)	1.20	1.50	1.80	3.60	4.40	5.20	6.00	5.10	6.30	7.50	8.70	9.90
Standard motor weight braked (kg)	1.60	1.90	2.20	4.10	4.90	5.70	6.50	5.70	6.90	8.70	9.30	10.50
Rated speed 2000 (rpm) Kt (Nm/A) = Ke (V/krpm) =				Kt (Nm/A) = 1.40 Ke (V/krpm) = 85.50								
Rated torque (Nm)	C/D	C/D	C/D	1.1	2.1	3.0	3.8	2.2	4.0	5.5	6.9	8.2
Stall current (A)				0.9	1.6	2.3	2.8	1.7	3.1	4.3	5.4	6.5
Rated power (kW)				0.23	0.44	0.63	0.80	0.46	0.84	1.15	1.45	1.72
R (ph-ph) (Ω)				45.80	15.30	8.52	5.72	20.69	6.24	3.16	2.31	1.71
L (ph-ph) (mH)				74.10	37.71	21.50	16.16	57.84	22.50	13.73	10.79	8.70
Rated speed 3000 (rpm) Kt (Nm/A) = Ke (V/krpm) =	0.74 45.00	0.83 50.50	0.86 52.50	Kt (Nm/A) = 0.93 Ke (V/krpm) = 57.00								
Rated torque (Nm)	0.60	1.20	1.80	1.1	2.0	2.8	3.5	2.0	3.9	5.4	6.8	8.1
Stall current (A)	0.98	1.68	2.46	1.3	2.4	3.4	4.2	2.5	4.7	6.4	8.1	9.7
Rated power (kW)	0.21	0.43	0.64	0.35	0.63	0.88	1.10	0.63	1.23	1.70	2.14	2.54
R (ph-ph) (Ω)	30.00	14.70	9.60	18.90	6.26	3.50	2.38	8.03	2.68	1.35	1.03	0.77
L (ph-ph) (mH)	67.30	43.00	30.90	22.80	14.60	8.75	6.38	22.04	8.70	6.10	4.48	3.99
Rated speed 4000 (rpm) Kt (Nm/A) = Ke (V/krpm) =				Kt (Nm/A) = 0.72 Ke (V/krpm) = 44.00								
Rated torque (Nm)	C/D	C/D	C/D	1.0	1.7	2.3	2.9	1.8	3.0	4.0	4.9	5.7
Stall current (A)				1.7	3.1	4.4	5.5	3.2	6.0	8.2	10.5	12.5
Rated power (kW)				0.42	0.71	0.96	1.21	0.75	1.26	1.68	2.05	2.39
R (ph-ph) (Ω)				12.10	4.05	2.30	1.48	5.15	1.64	0.92	0.62	0.43
L (ph-ph) (mH)				19.60	8.88	5.85	4.20	13.00	7.28	3.80	2.75	2.09
Rated speed 6000 (rpm) Kt (Nm/A) = Ke (V/krpm) =	0.42 25.40	0.42 25.64	0.44 26.84	Kt (Nm/A) = 0.47 Ke (V/krpm) = 28.50								
Rated torque (Nm)	0.48	0.91	1.35	0.9	1.6	2.1	2.6	1.3	2.1	2.8	C/D	C/D
Stall current (A)	1.66	3.33	4.80	2.6	4.7	6.6	8.3	4.9	9.2	12.6		
Rated power (kW)	0.33	0.63	0.99	0.57	1.01	1.32	1.63	0.82	1.32	1.76		
R (ph-ph) (Ω)	9.60	3.80	2.50	5.20	1.77	0.95	0.65	2.01	0.67	0.39		
L (ph-ph) (mH)	21.50	11.10	8.10	8.30	3.70	3.10	1.86	5.40	2.58	1.70		

C/D Consult Drive Centre/Distributor

N/A Not available

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	115E2					142E2					190E2							
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	F	G	H
	3.5	6.6	9.4	12.4	15.3	5.7	10.8	15.3	19.8	23.4	C/D	21.8	C/D	41.1	C/D	58.7	C/D	73.2
	10.5	19.8	28.2	37.2	45.9	17.1	32.4	45.9	59.4	70.2		65.4		123.0		176.0		219.0
	14	26.4	37.6	49.6	61.2	22.8	43.2	61.2	79.2	93.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4.4	6.7	9.0	11.4	13.8	9.0	15.6	22.2	28.8	35.4		48.7		86.4		123.1		161.8
	9.5	11.8	14.1	16.6	18.9	23.3	29.9	36.5	43.1	49.7		93.9		131.6		168.3		207.0
	175	185	198	217	241	213	217	275	301	365		240		242		319		632
	7.80	9.70	11.60	13.50	15.40	10.00	13.30	16.10	18.90	21.70		25.30		33.90		42.50		51.30
	9.00	10.90	12.80	14.70	17.20	12.20	15.00	17.80	19.60	23.40		27.30		35.90		44.50		53.10
	3.2	6.1	8.7	10.8	14.0	5.3	10.3	14.6	18.4	21.3	C/D	20.0	C/D	36.9	C/D	50.4	C/D	C/D
	2.5	4.8	6.8	8.9	11.0	4.1	7.8	11.0	14.2	16.8		15.6		29.4		42.0		
	0.67	1.28	1.82	2.26	2.93	1.11	2.16	3.06	3.85	4.46		4.19		7.73		10.6		
	11.31	2.82	1.51	0.99	0.72	4.28	1.33	0.66	0.45	0.32		0.50		0.15		0.10		
	34.34	14.91	9.89	7.11	5.77	26.74	11.53	7.31	5.55	4.40		7.98		2.50		2.73		
	3.0	5.5	8.1	10.4	12.6	4.9	9.0	12.2	15.8	N/A	C/D	19.2	C/D	33.0	C/D	C/D	C/D	N/A
	3.8	7.1	10.2	13.4	16.5	6.2	11.7	16.5	21.3			23.5		44.2				
	0.94	1.73	2.54	3.27	3.96	1.54	2.83	3.83	4.96			6.03		10.4				
	3.70	1.30	0.73	0.47	0.37	1.90	0.59	0.31	0.22			0.17		0.06				
	15.94	7.23	4.82	3.37	3.49	11.87	5.12	3.35	3.32			2.62		1.26				
	2.5	4.7	6.3	7.5	C/D	3.6	7.0	C/D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4.9	9.2	13.1	17.3		8.0	15.0											
	1.05	1.97	2.64	3.14		1.51	2.93											
	2.07	0.70	0.44	0.29		1.20	0.36											
	8.57	4.34	3.57	2.53		9.45	4.08											
	2.2	4.0	C/D	N/A	N/A	2.9	C/D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	7.5	14.1				12.2												
	1.38	2.51				1.82												
	0.96	0.30				0.49												
	3.43	2.09				3.96												

Stall torque, rated torque and power relate to maximum continuous operation tested in a 20°C ambient at 12kHz drive switching frequency

Control Techniques have an ongoing process of development and reserve the right to change the specification without notice

All other figures relate to a 20°C motor temperature. Maximum intermittent winding temperature is 140°C

055-250 Unimotor Technical Data

Servo motor for 3 Phase VPWM drives 380-480Vrms

Δt= 100°C winding 40°C maximum ambient. All data subject to +/-10% tolerance

Motor frame size (mm)	055U2			075U2				095U2				
Frame length	A	B	C	A	B	C	D	A	B	C	D	E
Continuous stall torque (Nm)	0.72	1.40	2.11	1.2	2.2	3.1	3.9	2.3	4.3	5.9	7.5	9.0
Standard (2) peak torque selection max (Nm)	2.75	5.50	8.25	3.6	6.6	9.3	11.7	6.9	12.9	17.7	22.5	27.0
High (P) peak torque selection max (Nm)	N/A	N/A	N/A	6	11	15.5	19.5	10.4	19.4	26.6	33.8	40.5
Standard inertia (kgcm²)	0.12	0.23	0.34	0.7	1.2	1.6	2.0	1.8	2.9	4.0	5.1	6.2
High inertia (kgcm²)	N/A	N/A	N/A	1.1	1.5	2.0	2.4	3.7	4.8	5.9	7.0	8.1
Winding thermal time const. (s)	N/A	N/A	N/A	81	74	94	100	172	168	183	221	228
Standard motor weight unbraked (kg)	1.20	1.50	1.80	3.60	4.40	5.20	6.00	5.10	6.30	7.50	8.70	9.90
Standard motor weight braked (kg)	1.60	1.90	2.20	4.10	4.90	5.70	6.50	5.70	6.90	8.70	9.30	10.50
Rated speed 2000 (rpm) Kt (Nm/A) = Ke (V/krpm) =				Kt (Nm/A) = 2.40 Ke (V/krpm) = 147.00								
Rated torque (Nm)	C/D	C/D	C/D	1.1	2.1	3.0	3.8	2.2	4.0	5.5	6.9	8.2
Stall current (A)				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) (Ω)				144.00	48.20	25.00	15.70	59.00	17.00	9.90	6.00	4.30
L (ph-ph) (mH)				214.00	99.20	59.20	44.70	202.00	54.50	36.50	25.60	18.90
Rated speed 3000 (rpm) Kt (Nm/A) = Ke (V/krpm) =	0.74 45.00	1.48 89.50	1.58 95.70	Kt (Nm/A) = 1.60 Ke (V/krpm) = 98.00								
Rated torque (Nm)	0.60	1.20	1.80	1.1	2.0	2.8	3.5	2.0	3.9	5.4	6.8	8.1
Stall current (A)	0.98	0.95	1.34	0.8	1.4	2.0	2.5	1.5	2.7	3.7	4.7	5.7
Rated power (kW)	0.21	0.43	0.64	0.35	0.63	0.88	1.10	0.63	1.23	1.70	2.14	2.54
R (ph-ph) (Ω)	30.00	46.00	32.00	60.80	20.10	10.50	7.50	24.50	6.80	4.00	2.50	2.00
L (ph-ph) (mH)	67.30	132.30	103.00	98.40	41.80	27.60	19.70	57.90	24.30	15.50	10.90	8.50
Rated speed 4000 (rpm) Kt (Nm/A) = Ke (V/krpm) =				Kt (Nm/A) = 1.20 Ke (V/krpm) = 73.50								
Rated torque (Nm)	C/D	C/D	C/D	1.0	1.7	2.3	2.9	1.8	3.0	4.0	4.9	5.7
Stall current (A)				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) (Ω)				36.80	10.50	6.30	4.20	12.70	4.08	2.10	1.50	1.03
L (ph-ph) (mH)				54.90	24.80	14.90	10.80	31.50	13.60	8.50	6.30	4.80
Rated speed 6000 (rpm) Kt (Nm/A) = Ke (V/krpm) =	0.74 45.00	0.73 44.30	0.79 47.90	Kt (Nm/A) = 0.80 Ke (V/krpm) = 49.00								
Rated torque (Nm)	0.48	0.91	1.35	0.9	1.6	2.1	2.6	1.3	2.1	2.8	C/D	C/D
Stall current (A)	0.98	1.91	2.68	1.5	2.8	3.9	4.9	2.9	5.4	7.4		
Rated power (kW)	0.33	0.63	0.99	0.57	1.01	1.32	1.63	0.82	1.32	1.76		
R (ph-ph) (Ω)	30.00	11.40	8.00	15.00	5.00	2.66	1.90	5.45	1.82	1.05		
L (ph-ph) (mH)	67.30	33.10	25.70	24.00	10.60	6.80	4.80	14.10	6.00	3.80		

C/D Consult Drive Centre/Distributor

N/A Not available

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	115U2					142U2					190U2							
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	F	G	H
	3.5	6.6	9.4	12.4	15.3	5.7	10.8	15.3	19.8	23.4	9.6	21.8	31.1	41.1	50.6	58.7	66.0	73.2
	10.5	19.8	28.2	37.2	45.9	17.1	32.4	45.9	59.4	70.2	28.8	65.4	93.3	123.0	151.6	176.0	198.0	219.0
	14	26.4	37.6	49.6	61.2	22.8	43.2	61.2	79.2	93.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4.4	6.7	9.0	11.4	13.8	9.0	15.6	22.2	28.8	35.4	29.9	48.7	67.5	86.4	105.0	123.1	142.9	161.8
	9.5	11.8	14.1	16.6	18.9	23.3	29.9	36.5	43.1	49.7	75.1	93.9	112.7	131.6	150.2	168.3	188.1	207.0
	175	185	198	217	241	213	217	275	301	365	217	240	241	242	281	319	476	632
	7.80	9.70	11.60	13.50	15.40	10.00	13.30	16.10	18.90	21.70	21.00	25.30	29.60	33.90	38.20	42.50	46.80	51.30
	9.00	10.90	12.80	14.70	17.20	12.20	15.00	17.80	19.60	23.40	23.00	27.30	31.60	35.90	40.20	44.50	48.80	53.10
	3.2	6.1	8.7	10.8	14.0	5.3	10.3	14.6	18.4	21.3	9.3	20.0	28.4	36.9	43.8	50.4	53.0	54.7
	1.5	2.8	4.0	5.2	6.4	2.4	4.5	6.4	8.3	9.8	4.0	9.1	13.0	17.2	21.1	24.5	27.5	30.5
	0.67	1.28	1.82	2.26	2.93	1.11	2.16	3.06	3.85	4.46	1.90	4.19	5.90	7.73	9.20	10.6	11.1	11.5
	27.80	8.55	4.55	2.96	2.17	12.00	3.60	2.10	1.35	0.98	6.15	1.54	0.83	0.50	0.39	0.30	0.30	0.17
	108.00	40.50	25.70	21.90	17.36	83.00	35.90	18.70	13.60	10.70	52.90	23.55	15.00	8.81	8.68	7.16	6.73	4.63
	3.0	5.5	8.1	10.4	12.6	4.9	9.0	12.2	15.8	18.0	8.7	19.2	25.0	33.0	34.0	35.0	36.0	36.8
	2.2	4.2	5.9	7.8	9.6	3.6	6.8	9.6	12.4	14.7	6.0	13.7	19.4	25.7	31.6	36.7	41.3	45.8
	0.94	1.73	2.54	3.27	3.96	1.54	2.83	3.83	4.96	5.65	2.73	6.03	7.85	10.4	10.7	11.0	11.3	11.6
	12.60	3.86	2.02	1.40	1.10	5.63	1.72	0.94	0.61	0.44	2.73	0.70	0.41	0.22	0.17	0.14	0.13	0.09
	49.30	21.57	13.27	8.60	8.77	37.00	13.30	8.30	6.10	5.77	23.50	10.47	7.35	4.89	3.86	3.60	2.99	2.46
	2.5	4.7	6.3	7.5	8.7	3.6	7.0	8.9	10.7	12.2	7.0	17.5	21.5	29.0	N/A	N/A	N/A	N/A
	3.0	5.5	7.9	10.4	12.8	4.8	9.0	12.8	16.5	19.5	8.0	18.2	25.9	34.2				
	1.05	1.97	2.64	3.14	3.64	1.51	2.93	3.73	4.48	5.11	2.9	7.3	9.0	12.1				
	6.42	2.14	1.16	0.73	0.57	3.12	1.00	0.53	0.35	0.25	1.35	0.38	0.21	0.11				
	26.73	10.20	6.60	4.70	3.90	21.00	7.50	5.67	3.60	3.25	13.21	6.05	3.75	2.40				
	2.2	4.0	C/D	C/D	N/A	2.9	4.5	C/D	C/D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4.4	8.3				7.2	13.5											
	1.38	2.51				1.82	2.83											
	3.10	0.97				1.33	0.46											
	12.30	4.81				9.23	3.44											

Stall torque, rated torque and power relate to maximum continuous operation tested in a 20°C ambient at 12kHz drive switching frequency

Control Techniques have an ongoing process of development and reserve the right to change the specification without notice

All other figures relate to a 20°C motor temperature. Maximum intermittent winding temperature is 140°C

055-250 Unimotor fm Technical Data

Servo motor for 3 Phase VPWM drives 380-480Vrms

Δt= 100°C winding 40°C maximum ambient. All data subject to +/-10% tolerance

Motor frame size (mm)		250U2		
Frame length		D	E	F
Continuous stall torque (Nm)		92	116	136
Standard (2) peak torque selection max (Nm)		276.0	348.0	408.0
High (P) peak torque selection max (Nm)		N/A	N/A	N/A
Standard inertia (kgcm²)		275	337	400
High inertia (kgcm²)		408	502	597
Winding thermal time const. (s)		439	486	608
Standard motor weight unbraked (kg)		57.5	65.5	73.7
Standard motor weight braked (kg)		68.5	76.5	84.5
Speed 1000 (rpm)	Kt (Nm/A) = Ke (V/krpm) =	Kt (Nm/A) = 5.4 Ke (V/krpm) = 323		
Rated speed (rpm)		1000	1000	1000
Rated torque (Nm)		75	92	106
Stall current (A)		17.2	21.7	25.4
Rated power (kW)		7.9	9.6	11.1
R (ph-ph) (Ω)		0.61	0.48	0.34
L (ph-ph) (mH)		22.9	19.1	14.9
Speed 1500 (rpm)	Kt (Nm/A) = Ke (V/krpm) =	Kt (Nm/A) = 3.6 Ke (V/krpm) = 216		
Rated speed (rpm)		1500	1500	1500
Rated torque (Nm)		67	76	84
Stall current (A)		25.8	32.5	38.1
Rated power (kW)		10.5	11.9	13.2
R (ph-ph) (Ω)		0.27	0.21	0.15
L (ph-ph) (mH)		10	8.6	6.6
Speed 2000 (rpm)	Kt (Nm/A) = Ke (V/krpm) =	Kt (Nm/A) = 2.7 Ke (V/krpm) = 162		
Rated speed (rpm)		1500	1500	1500
Rated torque (Nm)		65	73	81
Stall current (A)		34.4	43.4	50.9
Rated power (kW)		10.2	11.5	12.7
R (ph-ph) (Ω)		0.15	0.1	0.08
L (ph-ph) (mH)		5.7	4.2	3.7
Speed 2500 (rpm)	Kt (Nm/A) = Ke (V/krpm) =	Kt (Nm/A) = 2.1 Ke (V/krpm) = 129		
Rated speed (rpm)		1500	1500	1500
Rated torque (Nm)		62	70	77
Stall current (A)		43.0	54.2	63.6
Rated power (kW)		9.7	11	12.1
R (ph-ph) (Ω)		0.09	0.08	0.06
L (ph-ph) (mH)		3.5	3.1	2.6

For the 250 motor frame size, resolver feedback is standard.

The Unimotor fm 250 servo motor has been designed to give greatest motor efficiency up to a rated, or rms, speed of 1500 rpm. The range does include the optional speeds of 2000rpm and 2500rpm. These windings will allow the end user to enter a wider intermittent speed zone as well as the intermittent torque zone on the 250 motor.

These higher speed windings are designed with optimum kt values that allow increased speed without demanding very high currents.

The Unimotor fm 250 is designed for dynamic applications and as such the rms values play an important part in the motor selection for torque and speed.

N/A Not available

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Stall torque, rated torque and power relate to maximum continuous operation tested in a 20°C ambient at 12kHz drive switching frequency

All other figures relate to a 20°C motor temperature. Maximum intermittent winding temperature is 140°C

Control Techniques have an ongoing process of development and reserve the right to change the specification without notice

Performance definitions

Stall torque

This is the maximum torque within the continuous zone at zero speed.

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

Δt max = 100°C over a maximum ambient of 40°C for Unimotor fm.

Stall current

Stall current = Stall torque / kt

Motor label and performance tables quote stall current when motor is at full power in a maximum ambient of 40°C.

Rated speed

This is the maximum speed of the motor within the continuous zone. The motor speed can be controlled to any speed subject to the voltage limits and drive constraints as shown by the intermittent zone on the graph (see speed limits).

Ke voltage constant

This is the phase to phase rms voltage generated at the stator when the shaft is back driven at 1000rpm with the rotor at 20°C.

Kt torque constant

A brushless motor delivers torque proportional to the current, such that torque = kt x current.

Where kt = 0.0165 x ke (at 20°C).

Magnets used on all motors are affected by temperature such that ke and kt reduce with increasing temperatures of the magnets. The reductions depends upon the magnet type and material grade used.

Winding thermal time constant

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

Winding temperature at time **t** seconds = **T0+T1(1-e-t/tc)**

Where **T0** is the initial temperature,**T1** is the final winding temperature and tc = thermal time constant (seconds)

Note that temperature = 63.2% of **T1** when **t=tc**

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

Unimotor fm's windings are ultimately protected by thermistor devices in the winding overhangs. These must be connected to the appropriate drive inputs via the motor feedback signal connector.

Rated power

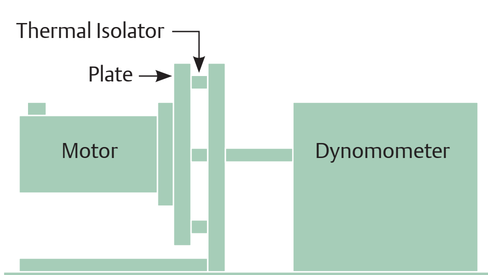
This is the product of the rated speed (radian/sec) and the rated torque (Nm) expressed in Watts (W).

Δt temperature

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

The maximum Δt temperature permitted is 100°C over a maximum ambient of 40°C.
(i.e. a maximum winding temperature of 140°C)

Thermal test conditions



Motor type/frame	Aluminium heatsink plate
055	110 x 110 x 27mm
075-095	250 x 250 x 15mm
115-142	350 x 350 x 20mm
190	500 x 500 x 20mm
250	500 x 500 x 20mm

The performance data shown has been recorded under the following conditions: Ambient temperature 20°C, with the motor mounted on a thermally isolated aluminum plate as shown below.

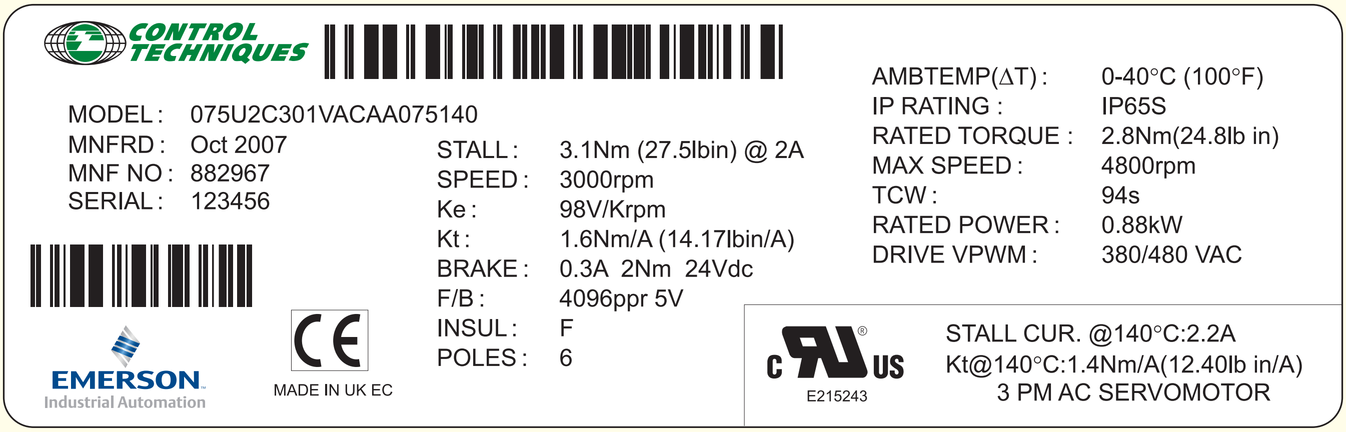
Thermal protection

Thermistor protection (145°C for 075-250 frame sizes and 150°C for 055 frame size) is built into the motor windings and gives an indication of serious overheating problems. The installer must connect the thermistor to the drive. Failure to do so will invalidate the motor warranty in respect of a burnt out winding.

Environmental conditions

Any liquids or gases that may come into contact with the motor must be checked to ensure compliance with the appropriate international standards.

Nameplate



Model	This is the full part number of the fm motor.
MNFRD	This is the date that the motor was manufactured.
MNF NO	This is the works order for the motor.
SERIAL	This is the serial number of the motor.
STALL	This is the full motor stall torque at the stall current.
SPEED	This is the rated speed of the motor.
Ke	This is the AC volts per 1000rpm with the motor at 20°C.
Kt	Value shown is for the motor magnet temperature at 20°C.
BRAKE	This gives the current, the rated torque and the operating voltage if the brake is fitted. N/A if the brake is not fitted.
F/B	This gives the feedback device count and working voltage, or the feedback type.
INSUL	Winding are built to class F standard (155°C).
POLES	Number of poles: 075 to 142 have 6 poles = 3 pole pairs 055 and 190 have 8 poles = 4 pole pairs 250 have 10 poles = 5 pole pairs
AMBTEMP (ΔT)	This is the ambient temperature range / (delta) winding temperature increase above ambient (at full rating).

IP RATING	Ingress protection rating = IP65S (excludes the front shaft seal).
RATED TORQUE	This is the continuous torque at full rated speed.
MAX SPEED	The max speed shown will be the lowest one of these three factors: 1. Maximum drive voltage. 2. Maximum encoder speed. 3. Maximum mechanical speed. The max speed is not to be considered for field weakening.
TCW	This is the thermal time constant of the windings with respect to the stator temperature.
RATED POWER	This is the rated power of the motor.
DRIVE VPWM	This indicates that the motor is for use with a Voltage Pulse Width Modulation drive with a supply voltage as shown.
CE	CE (Conformite Europeenne) mark. A declaration of incorporation is contained within the Unimotor fm Installation Guide that accompanies each motor.
c US	The UL symbol together with the "E215243" file number indicates full motor recognition by Underwriters Laboratory (UL) in USA and by Canadian Standards Authority (CSA) in Canada.

Standard (2) peak torque

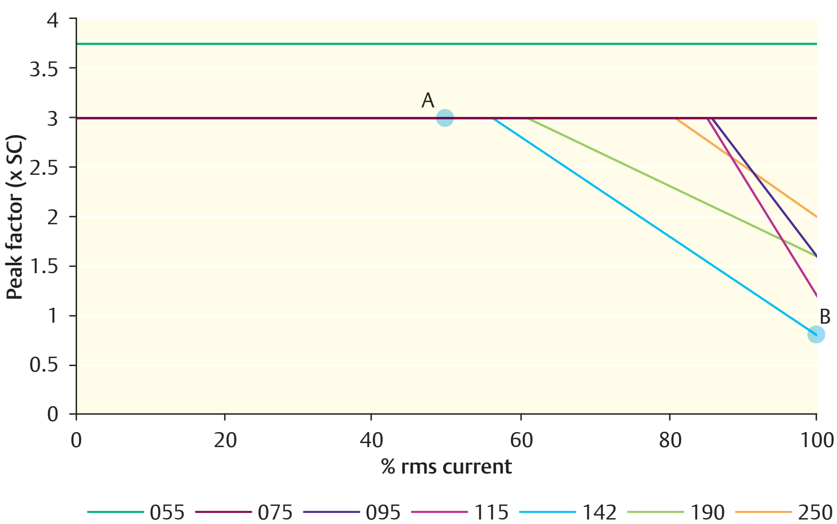
Unimotor fm has two levels of peak torque available within the range, standard peak torque (code 2) and the high peak torque range (code P).

Peak torque is normally calculated as 3 times the stall torque of the motor, this is referred to as the peak torque factor. On some of the frame sizes the peak torque factor of 3 times can not be achieved up to the full 100% rms current.

Below is the graph that shows the standard peak torque factor for each frame size.

To use this graph correctly the percentage of rms current must be calculated and then that level checked against the graph. The correct peak torque factor that applies to the % rms current can then be used to calculate the new peak torque level.

Peak torque defined for a maximum period of 250ms,
RMS 3000 rpm, Δmax = 100°C, 40°C ambient.
SC = stall current



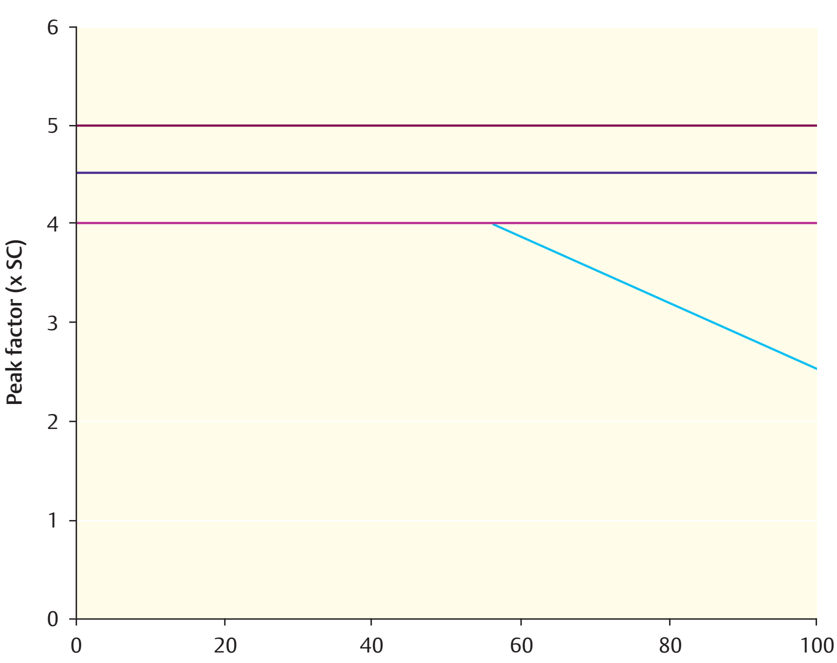
As shown left the 055 and 075 peak torque factors are not affected by the reduced levels and remain constant across the complete range, whereas the 142 motor starts to drop at the 57% point.

An example would be with a 142 motor where the rms current is 50%; the peak torque factor would be 3 times stall torque (point A). But if the rms current were to be calculated at a level of 100% the peak torque factor would equal to the stall torque (point B).

Unimotor fm	% rms	Peak factor @ 100% rms
055	100	3.8
075	100	3.0
095	88	2.0
115	86	1.5
142	57	1.0
190	60	2.0
250	80	2.5

High (P) peak torque

Peak torque defined for a maximum period of 250ms,
RMS 3000 rpm, Δmax = 100°C, 40°C ambient.
SC = stall current



If the rms value reduces the peak torque to a level where the motor is not acceptable then the high peak torque motor may be an option. The graph shows the increased peak torque factor available on the 075 to 142 range.

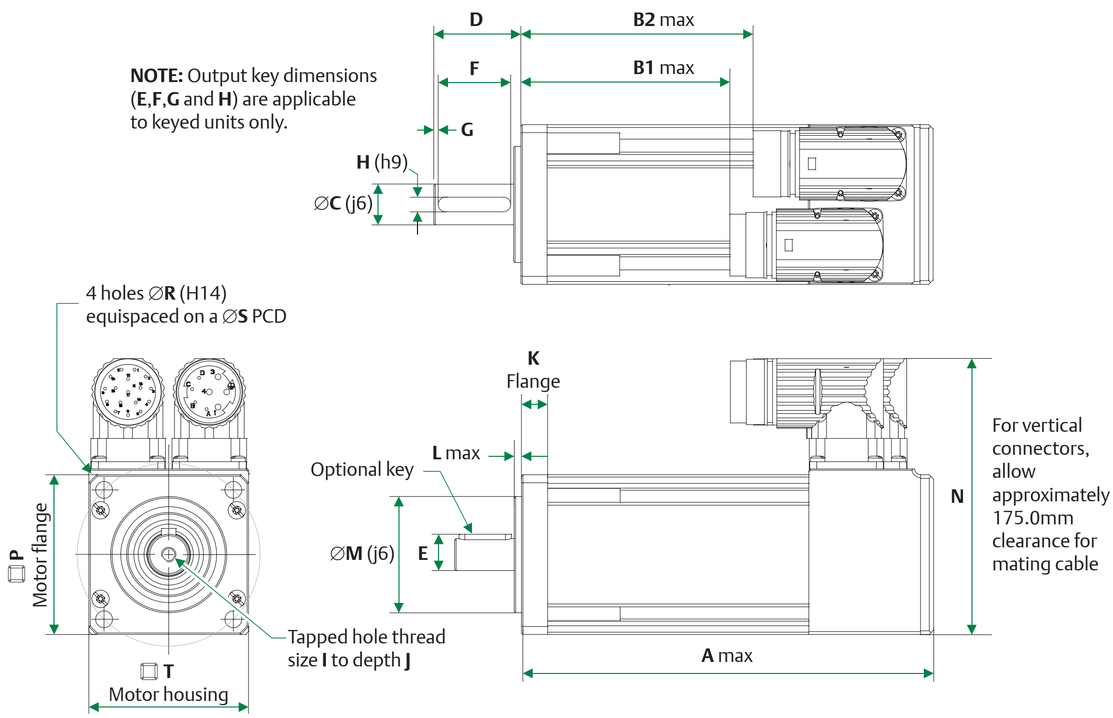
As shown above the peak factor for the 075 increases to 5 times, the 095 increases to 4.5 times, the 115 increases to 4 times across the complete range whereas the 142 now shows an increase up to 4 times until the 57% point where it starts dropping to 2.5 times at 100%

Unimotor fm	% rms	Peak factor @ 100% rms
075	100	5.0
095	100	4.5
115	100	4.0
142	57	2.5

075 095 115 142

055-250 Unimotor fm Technical Data

Dimensions (mm) Frame size 055



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length			Braked length			Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hold PCD	Motor housing	Mounting bolts
	A	B1	B2	A	B1	B2	K	L	M (j6)	N	P	R (H14)	S	T	
055A	118.0	48.0	56.0	158.0	88.0	96.0									
055B	142.0	72.0	80.0	182.0	112.0	120.0	9.0	2.5	40.0	96.0	55.0	5.8	63.0	55.0	M5
055C	166.0	96.0	104.0	206.0	136.0	144.0									

Vertical connectors dimension (mm)

Note all dimensions shown are at nominal

	Unbraked length		Braked length		Power connector	Signal connector
	B1	B2	B1	B2	N	N
055A	75.0	83.0	115.0	123.0	104.0	93.0
055B	99.0	107.0	139.0	147.0	104.0	93.0
055C	123.0	131.0	163.0	173.0	104.0	93.0

Optional connector height (mm)

C type	96.00
V type	105.0

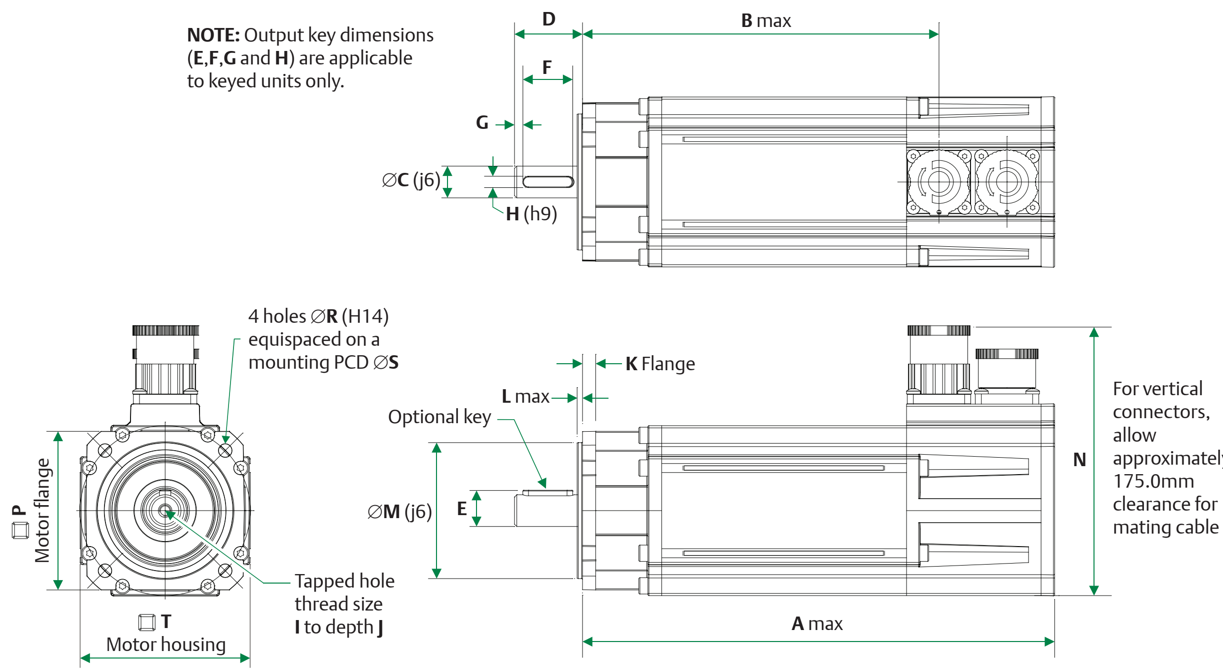
Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D	E	F	G	H (h9)	I	J
9.0 Opt	9.0	20.0	10.2	15.0	1.0	3.0	M4	10.0
11.0 A-C Std	11.0	23.0	12.5	18.0	1.5	4.0	M4	10.0
14.0 Max	14.0	30.0	16.0	25.0	1.5	5.0	M5	12.5

Optional flange dimensions (mm)

PCD code	Front end frame type	Flange thickness	Register length	Fixing hole diameter	Flange square	Fixing hole diameter	Fixing hold PCD	Mounting bolts
		K	L	M (j6)	P	R (H14)	S	
070	Flat	9	3	50	60	5.5	70	M5

Dimensions (mm) Frame size 075



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length		Braked length		Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Mounting bolts
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.1)	R (H14)	S (± 0.4)	T (± 0.45)	
075A	208.2	157.2	253.2	202.2	5.8	2.40	60.0	118.5	70.0	6.10	75.0	75.0	M5
075B	238.2	187.2	283.2	232.2									
075C	268.2	217.2	313.2	262.2									
075D	298.2	247.2	343.2	292.2									

Optional flat flange motor dimensions (mm)

	Unbraked length		Braked length	
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)
075A	192.6	141.6	237.6	186.6
075B	222.6	171.6	267.6	216.6
075C	252.6	201.6	297.6	246.6
075D	282.6	231.6	327.6	276.6

Optional connector height (mm)

Connection type	Overall height
	N (± 1.0)
A	118.0
B	126.0
C	126.0

Optional flange dimensions (mm)

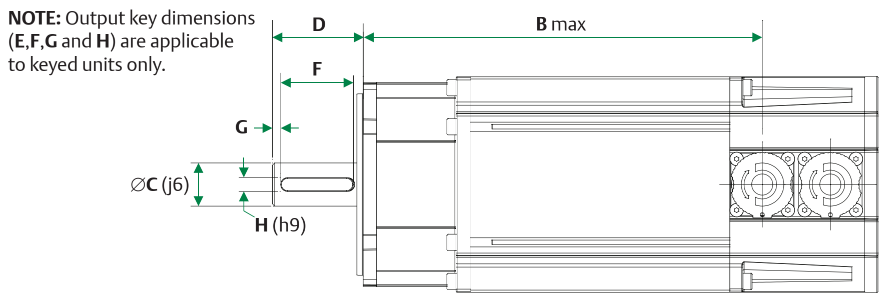
PCD code	Front end frame type	Flange square	Fixing hole PCD	Register diameter	Fixing hole diameter
		P (± 0.1)	S (± 0.4)	M (j6)	R (H14)
075	Extended	70.0	66.7 - 75.0	60.0	6.10
080	Extended	70.0	75.0 - 80.0	60.0	6.10
085	Flat	80.0	85.0	70.0	7.00

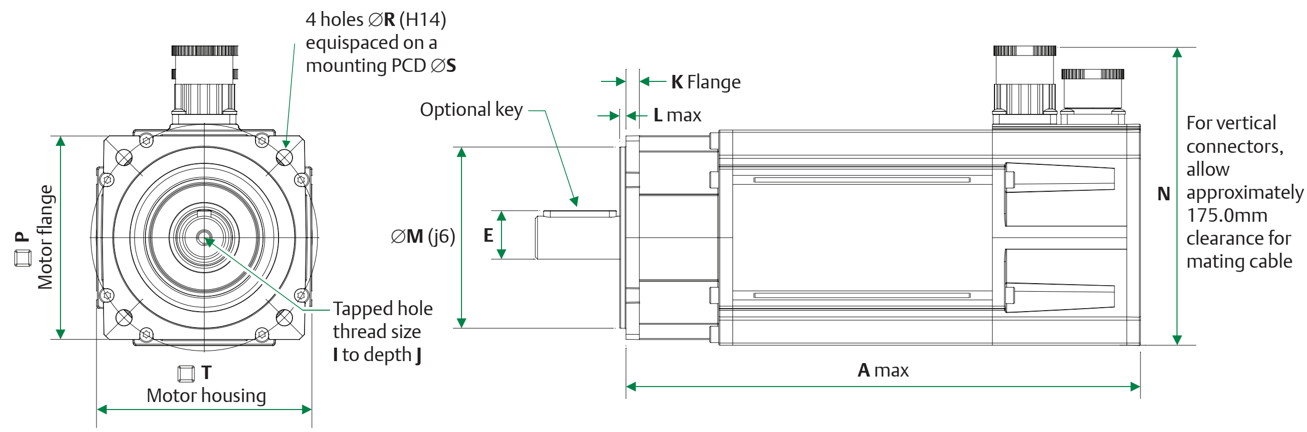
Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
11.0 A Std	11.0	23.0	12.5	14.0	3.6	4.0	M4 x 0.4	11.0
14.0 B-D Std	14.0	30.0	15.9	22.0	3.6	5.0	M5 x 0.8	13.5
19.0 Max	19.0	40.0	21.4	32.0	3.6	6.0	M6 x 1.0	17.0

055-250 Unimotor fm Technical Data

Dimensions (mm) Frame size 095





Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length		Braked length		Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Mounting bolts
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.1)	R (H14)	S (± 0.4)	T (± 0.6)	
095A	226.9	175.9	271.9	220.9									
095B	256.9	205.9	301.9	250.9									
095C	286.9	235.9	331.9	280.9	5.9	2.80	80.0	131.5	90.0	7.0	100.0	95.0	M6
095D	316.9	265.9	361.9	310.9									
095E	346.9	295.9	391.9	340.9									

Optional flat flange motor dimensions (mm)

	Unbraked length		Braked length	
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)
095A	201.8	150.8	246.8	195.8
095B	231.8	180.8	276.8	225.8
095C	261.8	210.8	306.8	255.8
095D	291.8	240.8	336.8	285.8
095E	321.8	270.8	366.8	315.8

Optional connector height (mm)

Connection type	Overall height
	N (± 1.0)
A	131.5
B	139.0
C	139.0

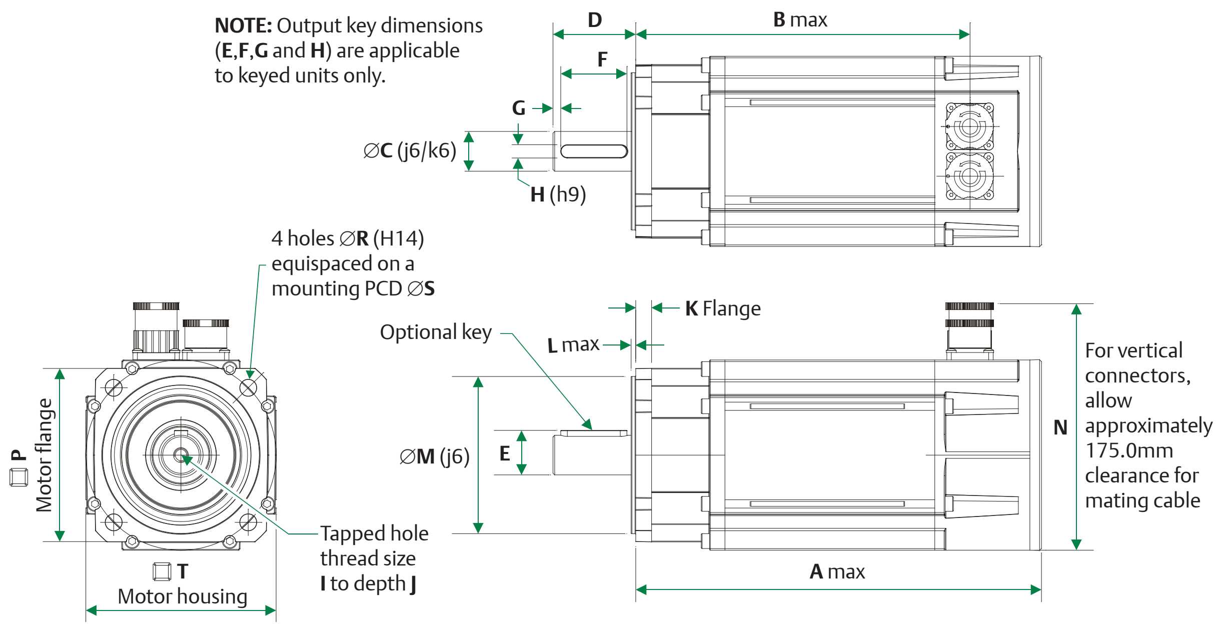
Optional flange dimensions (mm)

PCD code	Front end frame type	Flange square	Fixing hole PCD	Register diameter	Flange thick-ness	Fixing hole diameter
		P (± 0.1)	S (± 0.4)	M (j6)	K (± 0.5)	R (H14)
098	Extended	90.0	98.43	73.0	6.8	7.0
115	Flat	105.0	115.0	95.0	6.8	10.0

Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
14.0 A Std	14.0	30.0	15.9	22.0	3.6	5.0	M5 x 0.8	13.5
19.0 B-E Std	19.0	40.0	21.4	32.0	3.6	6.0	M6 x 1.0	17.0
22.0 Max	22.0	50.0	24.4	40.0	4.6	6.0	M8 x 1.25	20.0

Dimensions (mm) Frame size 115



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length		Braked length		Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Mounting bolts
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.2)	R (H14)	S (± 0.4)	T (± 0.6)	
115A	245.2	202.	290.2	247.0	9.6	2.80	95.0	149.0	105.0	10.0	115.0	115.0	M8
115B	275.2	232.0	320.2	277.0									
115C	305.2	262.0	350.2	307.0									
115D	335.2	292.0	380.2	337.0									
115E	365.2	322.0	410.2	367.0									

Optional flat flange motor dimensions (mm)

	Unbraked length		Braked length	
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)
115A	214.4	171.2	259.4	216.2
115B	244.4	201.2	289.4	246.2
115C	274.4	231.2	319.4	276.2
115D	304.4	261.2	349.4	306.2
115E	334.4	291.2	379.4	336.2

Optional connector height (mm)

Connection type	Overall height
	N (± 1.0)
A	149.0
B	156.5
C	156.5

Optional flange dimensions (mm)

PCD code	Front end frame type	Flange square	Fixing hole PCD	Register diameter	Fixing hole diameter
		P (± 0.2)	S (± 0.4)	M (j6)	R (H14)
130	Flat	130.0	130.0	110.0	10.0
145	Flat	130.0	130.0 – 145.0	110.0	10.0

Output shaft dimensions(mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
19.0 A-C Std	19.0	40.0	21.4	32.0	3.6	6.0	M6 x 1.0	17.0
22.0 Opt	22.0	50.0	24.4	40.0	4.6	6.0	M8 x 1.25	20.0
24.0 D-E Std	24.0	50.0	26.9	40.0	4.6	8.0	M8 x 1.25	20.0
28.0 Opt	28.0	60.0	30.9	50.0	4.6	8.0	M10 x 1.5	23.0
32.0 Max	32.0 (K6)	80.0	34.9	70.0	4.6	10.0	M12 x 1.75	29.0

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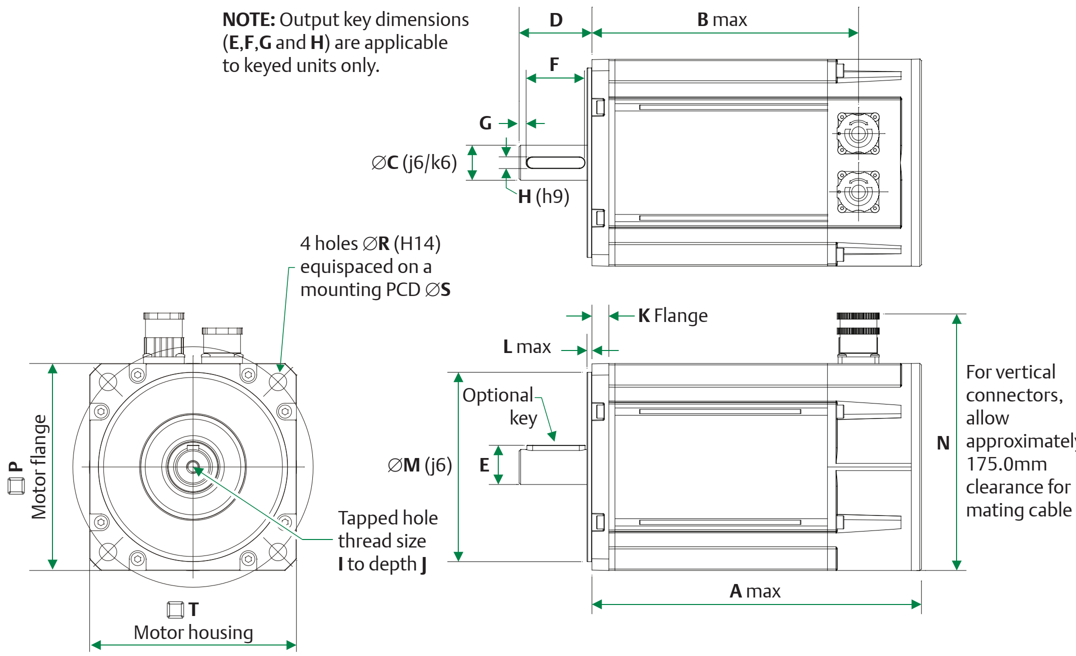
Dimensions (mm) Frame size 142



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length		Braked length		Flange thickness	Register length	Register diameter	Overall height vertical	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Mounting bolts
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.2)	R (H14)	S (± 0.4)	T (± 0.7)	
142A	226.2	183.0	271.2	228.0									
142B	256.2	213.0	301.2	258.0									
142C	286.2	243.0	331.2	288.0	11.6	3.4	130.0	176.0	142.0	12.0	165.0	142.0	M10
142D	316.2	273.0	361.2	318.0									
142E	346.2	303.0	391.2	348.0									

Optional motor flange dimensions (mm)

	Unbraked length		Braked length	
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)
142A	276.4	233.2	321.4	278.2
142B	306.4	263.2	351.4	308.2
142C	336.4	293.2	381.4	338.2
142D	366.4	323.2	411.4	368.2
142E	396.4	353.2	441.4	398.2

Optional connector height (mm)

Connection type	Overall height
	N (± 1.0)
A	176.0
B	183.5
C	183.5

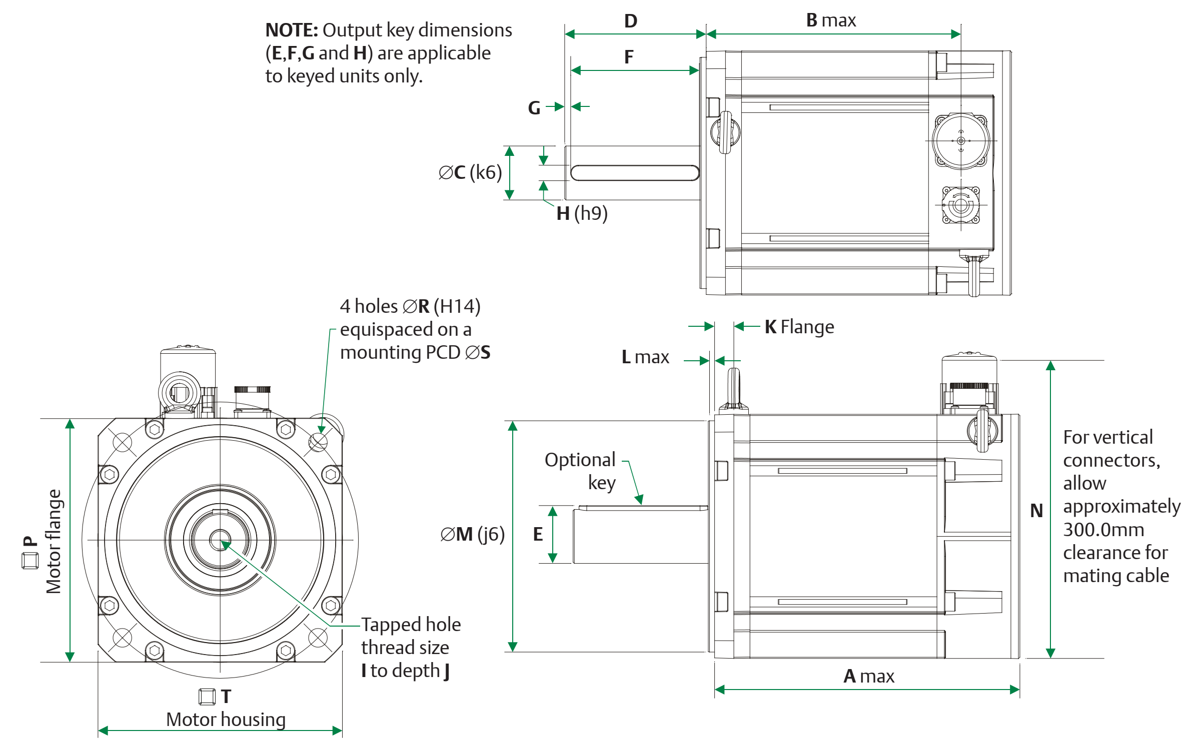
Optional flange dimensions (mm)

PCD code	Front end frame type	Flange square	Fixing hole PCD	Register diameter	Flange thickness	Fixing hole diameter
		P (± 0.2)	S (± 0.1)	M (j6)	K (± 0.5)	R (H14)
149	Extended	140.0	149.23	114.3	11.5	12.0

Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
22.0 Opt	22.0	50.0	24.4	40.0	4.6	6.0	M8 x 1.25	20.0
24.0 A-E Std	24.0	50.0	26.9	40.0	4.6	8.0	M8 x 1.25	20.0
28.0 Opt	28.0	60.0	30.9	50.0	4.6	8.0	M10 x 1.5	23.0
32.0 Max	32.0 (K6)	80.0	34.9	70.0	4.6	10.0	M12 x 1.75	29.0

Dimensions (mm) Frame size 190



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Unbraked length		Braked length		Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Mounting bolts
	A (± 0.9)	B (± 1.0)	A (± 0.9)	B (± 1.0)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.2)	R (H14)	S (± 0.4)	T (± 1.5)	
190A	237.4	198.2	318.2	279.0	15.0	3.90	180.0	232.0	190.0	14.5	215.0	190.0	M12
190B	264.3	225.1	345.2	306.0									
190C	291.3	252.1	372.1	332.9									
190D	318.2	279.0	399.1	359.9									
190E	345.2	306.0	426.0	386.8									
190F	372.1	332.9	453.0	413.8									
190G	399.1	359.9	479.9	440.7									
190H	426.0	386.8	506.9	467.7									

Optional connector height (mm)

Connection type	Overall height
	N (± 1.0)
A	245.0
B	252.5
C	252.5

Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (j6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
28.0 Opt	28.0	60.0	30.9	50.0	4.6	8.0	M10 x 1.5	23.0
32.0 A-H Std	32.0 (k6)	80.0	34.9	70.0	4.6	10.0	M12 x 1.75	29.0
38.0 Opt	38.0 (k6)	80.0	40.9	70.0	4.6	10.0	M12 x 1.75	29.0
42.0 Max	42.0 (k6)	110.0	45.0	100.0	4.6	12.0	M16 x 2.0	37.0

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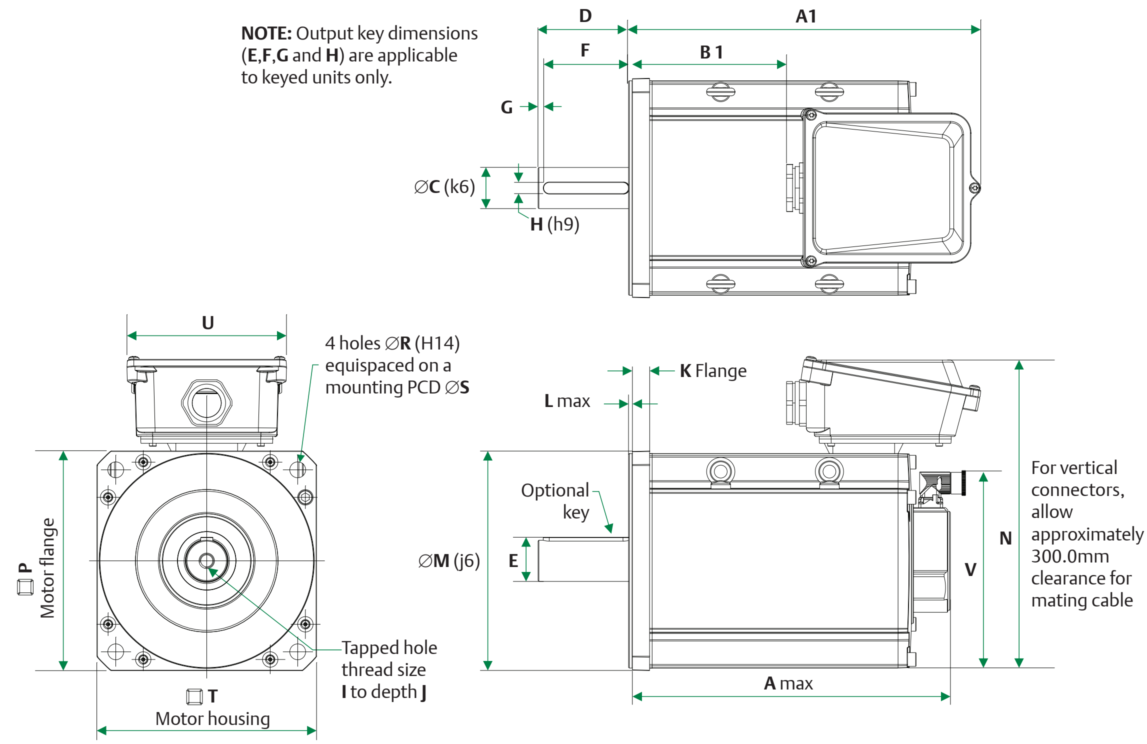
Dimensions (mm) Frame size 250



Standard motor dimension (mm) Note all dimensions shown are at nominal

	Motor Length			Flange thickness	Register length	Register diameter	Overall height	Flange square	Fixing hole diameter	Fixing hole PCD	Motor housing	Hybrid box width	Signal connector height	Mounting bolts
	A (± 1.3)	A1 (± 2.0)	B1 (± 1.3)	K (± 0.5)	L (± 0.1)	M (j6)	N (± 1.0)	P (± 0.6)	R (H14)	S (± 0.4)	T (± 1.0)	U (± 0.4)	V (± 1.0)	
	Unbraked motor													
250D	370.7	406.1	179.7	20.0	4.50	250.0	362.8	256.0	18.5	300.0	249.5	186.0	228.5	M16
250E	400.7	436.1	209.7											
250F	430.7	466.1	239.7											
	Braked motor													
250D	442.5	477.9	251.5											
250E	472.5	507.9	281.5											
250F	502.5	537.9	311.5											

Output shaft dimensions (mm)

	Shaft diameter	Shaft length	Key height	Key length	Key to shaft end	Key width	Tapped hole thread size	Tapped hole depth
	C (k6)	D (± 0.45)	E (± 0.4)	F (± 0.25)	G (± 1.1)	H (h9)	I	J (± 0.4)
38.0 Opt	38.0	80.0	41.0	70.0	4.6	10.0	M12 x 1.75	29.0
42.0 Opt	42.0	110.0	45.0	100.0	6.0	12.0	M16 x 2.0	37.0
48.0 D-F Std	48.0	110.0	51.5	100.0	6.0	14.0	M16 x 2.0	37.0

Optional connector height (mm)

Connection type	Power overall height	Signal overall height
	N (± 1.0)	V (± 1.0)
V	291.5	221.0
C	312.5	221.0

Motor selection

A reliable servo system depends upon the initial system design and correct selection of the motor, feedback, gearbox and drive. To ensure success careful attention should be paid to the following points:

- Speed, acceleration and inertia
- Peak and rms torque
- Motor feedback type
- Gear ratios
- Drive system operational mode
- Thermal effects
- Environmental conditions
- Mechanical restrictions
- Cost of motor-drive combination

It is necessary to estimate the root mean square (rms) torque value of the load. Where the motor has varying duty cycles it may be necessary to consider the worst case only.

Never exceed the maximum peak torque ratings.

Calculate the rms load torque at the motor and ensure that this is less than the motor rated torque. An additional allowance should be made on the load for inefficiencies and tolerance.

Choose a suitable motor within the size limitations of the installation. The frame size and motor speed may be selected using the performance data. Look for the rated torque at the appropriate temperature.

Checklist of operating details

Complete this checklist to help select which Unimotor fm best suits your application requirements.

Torque speed

- What motor operating speed do you require (rpm)?
  - 500
  - 1000
  - 2000
  - 3000
  - 4000
  - 6000
  - Other (non standard speed)
- What is the rms torque?
  Decide on switching frequencies for the drive, and derate motor or drive accordingly
- If the ambient temperature is above 40°C, apply a derating factor. If the motor is mounted to a hot interface; or interfaced with a low thermal mass; or high thermal resistance; apply a derating factor. Torque ratings of motors are stated in controlled conditions mounted on a reference front plate. Details can be found in the *Performance data* selection
- Inertia mismatch (ratio of the motor inertia to load inertia reflected to motor shaft) can be as high as 3:1 for acceleration rates of 1000 rad/s² for a typical system. Larger mismatches or acceleration can be tolerated with a rigid mechanical system and high resolution feedback
- Do you require a brake?

Motor mounting

- Does the motor fit the machine?
  Make allowances for cables and connections.
- Do you require an output key?
  - Output key
  - Plain shaft

  NB. When a gearbox is fitted, this choice applies to the gearbox o/p shaft, as supplied by Control Techniques Dynamics.

Feedback

- Do you want an encoder or resolver?
  - Incremental
  - Sincos Multi turn
    - Stegmann Hiperface
    - Heidenhain EnDat
    - Inductive absolute
    - High accuracy
  - Sincos Single turn
    - Stegmann Hiperface
    - Heidenhain EnDat
    - Inductive
    - High accuracy
  - Resolver

Electrical connections

- Connectors
  - Power and Signal 90° fixed
  - Power and Signal 90° rotatable
  - Power 90° rotatable and Signal vertical
  - Power and Signal vertical

Other options

- Do you require a gearbox?
  - Yes
  - No
- Many other customer special motors are made by Control Techniques Dynamics Limited.
  For further details, contact us.

055-250 Unimotor *fm* Technical Data

Points to consider

Torque and temperature

- The maximum allowable temperature of the motor windings or feedback device should not be exceeded. The windings have a thermal time constant ranging from 90 seconds to over an hour. Dependent upon motor temperature the motor can be overdriven for shorter periods without exceeding the temperature limitations. The motor winding thermal time constant should be set-up in the drive; this parameter is used for thermal shock (I^2t) calculations within the drive
- The motor winding thermal time constant should be large in comparison with the medium term periods of high rms torque
- Ensure that the drive's features, such as switching frequency, waveforms, peak and continuous currents are suitable for the application. Low switching frequencies of the drive will require motor derating
- Torque estimates should include friction and acceleration (and hence inertia) calculations
- Consider the motor cooling effects; for example, is the conductive thermal path adequate? Is the motor mounted on a gearbox or heat source?
- Ensure that the motor and drive can meet the short term peak torque requirements

Braking

- The installation may require static parking brake

Inertia

- Ensure that the motor has correct inertia matching to suit the acceleration requirements. Consider inertia load matching especially for acceleration levels above 1000 rad/s². Motors with larger frame diameters have higher inertia. Higher inertia rotor options are available

Environmental conditions

- Other environmental factors, such as vibration, pressure, shock,heat and hazardous zones should be considered

Cables

- The cable lengths required for the installation should be considered. For maximum cable length, see *Maximum cable length* in the *Cable* section. Compliance with both Safety and EMC regulations should be ensured
- Ensure motor is mounted firmly and properly earthed. Screen all cables to reduce system noise and EMC

Feedback

- To achieve an efficient system it is necessary to ensure stiff mechanical connections and couplings to all rotating parts, so that a high servo bandwidth can be achieved. This will improve stability and enable higher servo gains to be set, ensuring higher accuracy and positional repeatability
- High resolution feedbacks will increase stability and allow greater acceleration or inertia mismatch

Bearing loads

- Check the radial and axial loadings are within the limits of the motor

Calculating load torque

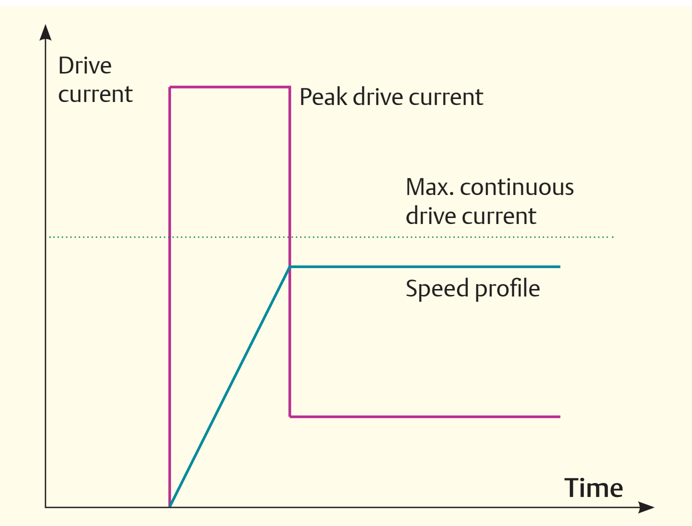
In any application, the load consists of various torque loads plus acceleration and decelerations of inertia.

Constant torque periods

Periods where a torque is maintained at constant or near constant motor speeds.

Acceleration and deceleration

Torque is required to achieve acceleration and deceleration. Acceleration times of less than one second can often be achieved using peak torque capability of the drive and motor.



Note

Peak drive current may be set by drive control to the motors continuous current rating. If this is required, check that it is within the drives capability. Medium periods of up to 200% over current are often acceptable for the motor, provided that the heating effects are not too rapid and that the motor thermal time constant is long in comparison.

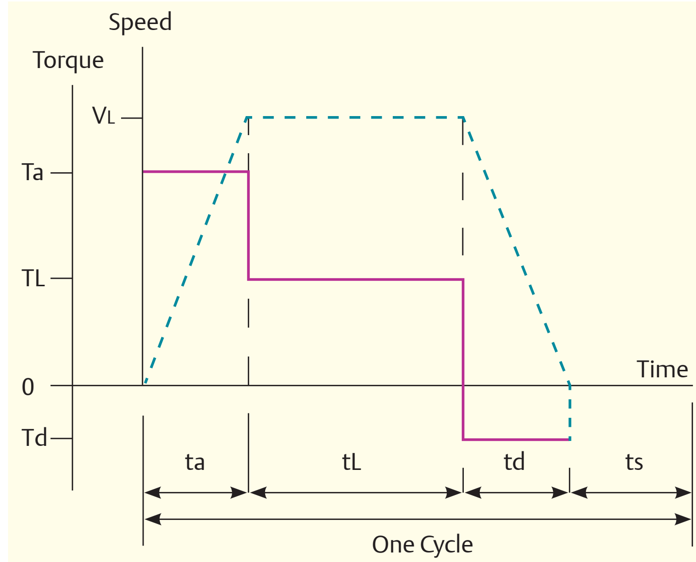
Inertia formula and accelerating or decelerating torques:

Inertial loads on a common shaft may be added together. Inertial loads may be reflected from the output of a reduction gearbox to the motor by dividing the output ratio by the square of the ratio.

Total inertia = reflected inertial load at motor + motor inertia

rms torque for a repetitive duty cycle:

Draw a graph of torque (T) against time for one complete repetitive cycle of events (or choose the worst case of various events). Make the torque axis vertical. On the same graph, draw the speed profile against time for one cycle.



From the above speed-torque diagram calculate the rms torque using the formula:

$$\text{Trms} = \sqrt{\frac{\text{Ta}^2 \times \text{ta} + \text{TL}^2 \times \text{tL} + \text{Td}^2 \times \text{td} \times \text{Ts}^2 \times \text{ts}}{\text{ta} + \text{tL} + \text{td} + \text{ts}}}$$

Where:

Ta = Acceleration Torque (Nm)
TL = Load torque (Nm)
Td = Deceleration torque (Nm)
ta = Acceleration Time (s)
Ts = Dwell torque (Nm=0)
tL = On load running time (s)
td = Deceleration time (s)
ts = Dwell time (s)
VL = Full load speed (rpm)

Example

In an application where the torque speed profile is as above with **Ta** = 20Nm, **TL** = 5Nm, **Td** = -10Nm, **ta** = 20ms, **tL** = 5s, **td** = 30ms, **ts** = 3s, **VL** = 3000rpm, **Ts** = 0
calculate the rms torque for this application.

$$\text{Trms} = \sqrt{\frac{20^2 \times 0.02 + 5^2 \times 5 + 10^2 \times 0.03 \times 0^2 \times 3}{0.02 + 5 + 0.03 + 3}}$$

$$\text{Trms} = \sqrt{\frac{136}{8.05}}$$

Trms = 4.11Nm

15% tolerance required hence the rms torque for this application = **4.73Nm**

Understanding motor heating effects

During operation, the motor is subjected to heating effects from several sources. Some of these are obvious; others obscure. Whilst the motor specification allows for most of these heating effects, others depend on the application. This section examines some of the causes of motor heating.

Motor copper losses

Motor copper loss is a product of the rms current squared and the resistance of the motor windings. It includes ripple currents, determined by the switching frequency of the drive and the inductance of the motor. The inductance of the winding is generally low, so that the maximum drive frequencies should be selected commensurate with drive heating losses. Data in this manual is for switching frequencies as stated in the performance data section. If lower frequencies are used, motor performance is reduced.

Motor copper loss also includes losses arising from waveform distortions of either the drive or motor or both. The motor's back EMF waveform is sinusoidal and of low harmonic distortion. If lower frequencies are used, the drive current has higher distortion and hence the motor performance is reduced.

Motor current depends on the torque demanded by the load at any instant. This is normally given by the motor torque constant (Kt) in Nm/A. Although regarded as a constant, Kt decreases slightly when the motor is at maximum temperature.

The Ke for a brushless three phase motor is always quoted Volts(rms) per Krpm, since the motor back emf is sinusoidal.

Motor iron losses

Motor iron loss is a heating effect produced in the motor laminations. It is caused by the rotating magnetic field cutting through the laminations, the higher the speed the higher the losses. For this reason the motor stall torque is greater than the motor rated torque at speed.

Iron loss depends on the strength of the magnetic field and type of laminations material.

Friction and windage

The bearings, oil seals and the air resistance to rotor speed cause internal friction. Its effect is relatively small and is included in the data provided.

Thermal protection

An incorrect system set up can give rise to excessive motor temperatures. This can be guarded against by the use of the motor thermistor protection facility.

Servo motor/drive system faults

Common but often unnoticed causes of motor overheating can be created by:

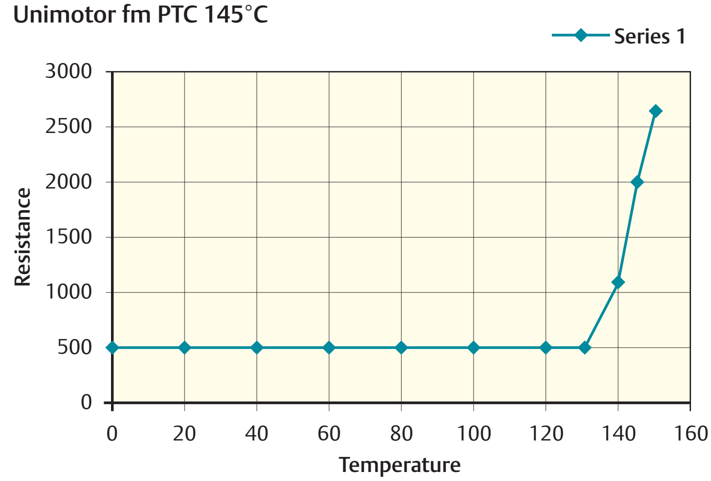
- Instability (self induced oscillation) within the overall servo feedback system
- Incorrect parameter settings in the drive protection system, for example peak current, and I^2t (thermal protection calculation for the drive)

Thermistor protection

A PTC thermistor rated to 145˚C on the 075 to 250 range, and 155˚C on the 055 range, is built into the motor windings and is used to protect the motor against overheating problems.

The device remains a low resistance until a critical temperature is reached, where it will then switch to a very high resistance. The increase in resistance is measured by the drive and a "th trip" will occur. Only once the motor has cooled can the trip be cleared.

Unimotor fm PTC 145°C



The installer must connect the motor thermistor to the drive to cause motor power shutdown in the event of overheating. It is the installer's responsibility to ensure that this protection facility is properly connected and set at the drive.
Failure to ensure the correct operation of the protection facility invalidates the warranty in respect of a burnt out winding.

Environment and torque derating

The ambient temperature of the environment into which the Unimotor fm is mounted must be considered.

Motor derating

Motor derating

Any adverse operating conditions require that the motor performance be derated. These conditions include; ambient temperature above 40°C, motor mounting position, drive switching frequency or the drive being oversized for the motor.

Ambient temperatures

The ambient temperature around the motor must be taken into account. For ambient temperatures above 40°C the torque must be derated using the following formula as a guideline. (Note: Only applies to 2000/3000rpm motors and assumes copper losses dominate.)

New derated torque = Specified torque x $\sqrt{1 - (\text{Ambient temperature} - 40) / 100}$

For example with an ambient temperature of 76°C the new derated torque will be 0.8 x specified torque.

Mounting arrangements

The motor torque must be derated if:

- The motor mounting surface is heated from an external source, such as a gearbox.
- The motor is connected to a poor thermal conductor.
- The motor is in a confined space with restricted air flow.

Drive switching frequency

Most Unidrive SP and Digitax ST nominal current ratings are reduced for the higher switching frequencies. See the appropriate drive manual for details.

See the table below for the motor derate factors.
These figures are for guidance only.

Note

Only applies to motors up to 3000rpm for frame sizes 055 to 190 and 1500rpm for frame size 250. Assumes copper losses dominate on all frame sizes.

Motor derate factors

Switching frequency	Motor type/frame									
	055	075	095	115		142		190		250
	A-C	A-D	A-E	A-C	D-E	A-C	D-E	A-B	C-H	D-F
3kHz	0.84	0.93	0.88	0.89	0.84	0.87	0.81	0.98	N/A	0.88
4kHz	0.87	0.94	0.91	0.91	0.87	0.91	0.86	0.99	0.55	0.90
6kHz	0.90	0.95	0.93	0.93	0.90	0.94	0.89	0.99	0.77	0.94
8kHz	0.95	0.98	0.97	0.97	0.95	0.97	0.96	1	0.90	0.98
12/16kHz	1	1	1	1	1	1	1	1	1	1

Note

Derate factor is applied to stall torque, rated torque, stall current and rated power.

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Feedback selection

Feedback device part number code	Feedback type	Manufacturer	Encoder supply voltage[1]	Sincos cycles or incremental pulses per revolution	Resolution available to position loop[2&3]	Multi -turn option[1]	Other information[1]	Feedback accuracy[1]	Vibration[1]	Shock Limit[1]
AE	Resolver	API Harrowe	6V rms Excitation 6kHz	1	Medium 16384 (14 bit)	No	Transformation ratio 0.31 Resolver rotor winding 2 pole	Low ±720”	High (not stated by supplier)	High (not stated by supplier)
CA MA KA	Incremental Encoder	SICK	5V	4096 2048 1024	Medium 16384 (14 bit) 8192 (13 bit) 4096 (12 bit)	No	Quadrature tracks	High ±60”	Medium 20g (10 - 2000 Hz) (to BS EN 60068-2-6)	Medium 100g per 10ms (to BS EN 60068-2-27)
EC (Multi-turn) FC (Single turn)	Inductive absolute encoder	Heidenhain	7-10V	32	Medium Absolute position 524288 (19 bits)	Yes 4096 revs (12 bits)	EnDat serial comms	Medium ±280”	Medium 10g (55-2000Hz) (to IEC60 068-2-6)	Medium 100g 6ms (to IEC60 068-2-27)
RA (Multi-turn) SA (Single turn)	Sincos optical encoder	SICK	7-12V	1024	High 1.04x10^6 (20 bits)	Yes 4096 revs (12 bits)	Hiperface	High For sin/cos Integral non-linearity ±45” For sin/cos Differential nonlinearity ±7” (Total accuracy ±52”)	Medium 20g (10-2000 Hz) (to BS EN 60068-2-6)	Medium 100g per 10ms (to BS EN 60068-2-27)
EB (Multi-turn) FB (Single turn)	Sincos optical encoder	Heidenhain	3.6-14V	2048	Very High 2.08x10^6 (21 bits)	Yes 4096 revs (12 bits)	EnDat Serial comms	Very High ±20” (Differential non linearity ±1% signal period)	Medium 15g (55-2000Hz) (to IEC60 068-2-6)	Medium 100g 6ms (to IEC 60 068-2-27)
AR	Resolver	LTN RE-15	7V Excitation 5kHz	1	Medium 16384 (14 bit)	No	Transformation ratio 0,5 ±10 % Resolver rotor winding 2 pole	Low ±600”	High 50g (10 to 500 Hz)	Medium 100g (11ms)
KP MP CP	Incremental Encoder	Hengstler F14	5V	1024 2048 4096	Medium 4096 (12 bit) 8192 (13 bit) 16384 (14 bit)	No		Medium ±150”	Low 2,5g (5 to 2000 Hz)	Medium 100g (11 ms)
KR MR	Incremental encoder	Renco R35i	5V	1024 2048	Medium 4096 (12 bit) 8192 (13 bit)	No	Mainly for Unimotor M2 (60Vdc) version	Medium ±150”	Medium 10g (200 to 2000 Hz)	Medium 50g (11ms)
EM (Multi-turn) FM (Single turn)	Inductive absolute encoder	Heidenhain EQI1130 ECI1118	5V	16	Medium 2.62x10^5 (18 bits)	Yes 4096 revs (12 bits)	EnDat Serial comms	Medium ±480”	Medium 30g (55 to 2000 Hz) (EN 60 068-2-6)	Medium 100g (6ms) (EN 60 068-2-27)
TL (Multi-turn) UL (Single turn)	Sincos optical encoder	Sick/ Stegmann SKM36 SKS36	7 - 12V	128	Medium 1.31x10^5 (17 bit)	Yes 4096 revs (12 bits)	Hiperface	High ±52”	Medium 50 g (10 to 2000 Hz) (EN 60 068-2-6)	Medium 100 g (6ms) (EN 60 068-2-27)
TM (Multi-turn) UM (Single turn)	Sincos optical encoder	Heidenhain EQN1125 ECN1113	3,6 - 14V	512	Medium 5.24x10^5 (19bit)	Yes 4096 revs (12 bits)	EnDat Serial comms	HIgh ±60”	Medium 20g (55 to 2000 Hz) (EN 60068-2-6)	Medium 100g (6ms) (EN 60068-2-27)

[1] The information is supplied by the feedback device manufacturer and relates to it as a standalone device. The values may change when mounted into the motor and connected to a drive. These values have not been verified by Control Techniques Dynamics.

[2] The output from the resolver is an analogue output. The resolution is defined by the analogue to digitial converter used. The value shown is when the resolver is used in conjunction with the SM-Resolver.

[3] The sin and cosine outputs from the Sincos optical encoders are analogue outputs. With Unidrive SP and Digitax ST the resolutions quoted above are when the encoder type is set to either SC Endat or SC Hiper depending on the encoder.

Feedback terminology

Accuracy

Accuracy is the measure of the difference between the expected position and actual measured value. Rotary feedback accuracy is usually given as an angle representing the maximum deviation from the expected position. Linear feedback accuracy is usually given as a distance representing the maximum deviation from the expected. Generally, as accuracy increases the cost of the feedback device increases.

Absolute encoder

Absolute encoders output unique information for each mechanical measured position. With the motor shaft or plate in any position when the drive is turned on the feedback device will always be able to sense a unique position and transmit this value to the drive. For an absolute single turn rotary encoder these unique positions will be over one revolution.

When power is removed from the encoder and the shaft or plate moves the device will know its current position when the power is restored.

A non-absolute feedback mechanism must start from a known position, such as the index or marker pulse.

Bit

A bit is short for **B**inary Dig**it**. It is the smallest unit of information in a machine/drive. A single bit has a binary value of either 0 or 1. These bits do not normally exist on their own, but usually in groups. The larger the number of bits in a group the larger the amount of information that is available and thus the higher the resolution. This group can be converted to decimal using binary arithmetic. The group of bits can be converted to decimal by starting at the right most bit and multiplying each successive bit to the left by two. So for example a 12 bit number would give a decimal equivalent of 4,096 and a 19 bit number would give a decimal equivalent of 524,288.

Commutation

All brushless AC permanent magnet motors require commutation information to enable the drive to synchronise the stator flux field with the rotor of the motor.

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

Commutation phase offset

Most drives, including the Unidrive SP, provide a "Phase Offset" adjustment as a means of correctly setting the commutation position.

For feedback devices that are not aligned, the Unidrive SP has an Encoder Phasing Test (Autotune) (Pr **5.12**) that automatically creates a Phase Offset value (Encoder phase angle) (Pr **3.25**).

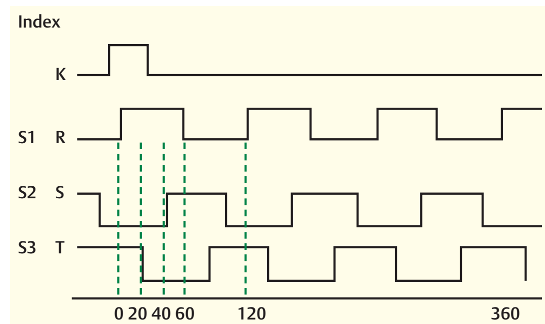
All FM motor feedback devices are set to match the Unidrive SP definition of zero phase offset, so that the drive may operate with zero phase offset adjustment, thus allowing interchange of motors between drives without further adjustment.

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

Commutation outputs

Commutation outputs are used on devices that are non-absolute. For AC Synchronous 3 phase motors there are 3 commutation output signal channels from the feedback device, for example S1, S2 and S3.

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



Where N = number of poles. For example a 6 pole motor the encoder commutation tracks will output 3 pulses per channel per revolution and for an 8 pole motor the encoder commutation tracks will give 4 pulses per channel per revolution.

The commutation signals allow the drive to operate the motor at 'switch on' with only a small possible reduction in efficiency and torque in the motor. The best way to explain this is to use an example where an encoder is connected to a motor with 6 poles.

On power up the drive would look at the S1, S2 and S3 signals to determine where the stator is relative to the rotor or magnetic plate. This would give a known position that is within 60° electrical of an electrical cycle (20° mechanical). During this initial period, the drive assumes that it is in the middle of this 60° unknown region. So the worse case error of this is 30° electrical (10° mechanical), which equates to a drop of 13.4% in the rated torque when 100% current is delivered into the motor winding. When the drive is commanded to move the motor position, the stator is energized causing the plate or rotor to move. While the rotor or plate is moving, the drive detects that a signal switch (edge detection) has occurred on one of the commutation channels (S1, S2 or S3). At this point the drive knows exactly where it is in the electrical cycle and adjusts the field orientation to compensate for the error. At this point the drive switches over to using only the incremental signals for commutation and the commutation channels are no longer used.

Electronic nameplate

Available on some feedback devices the electronic nameplate provides the facility to electronically store information about the motor and feedback device. This information can then automatically be used to configure the drive for operation.

Environment	The environment is the external conditions that physically surround the Feedback device. The main factors that affect the feedback device are temperature and mechanical shock and vibration. Motors are designed to allow the feedback devices to be within their operational temperature limits. Generally it is assumed that there is free air movement around the motor. If the motor is positioned where there is little or no airflow or it is connected to a heat source such as a gearbox. This can cause the air temperature around the feedback device to be operating outside its recommended operating temperature and can lead to problems. Mechanical shock and vibration tends to be transmitted from the load, through the motor shaft and into the feedback device. This should be considered when the motor and feedback device are being specified for the application.
Position	The defined position is the location in a coordinate system which is usually in two or more dimensions. For a rotary feedback device this is defined as the location within one revolution. If it is a multi-turn device it is the location within one revolution plus the location within a number of rotations. For a linear feedback device this is defined as the distance from a known point.
Resolution	The resolution of a feedback device is the smallest change in position or angle that it can detect in the quantity that it is measuring. Feedback resolution of the system is a function of the type of feedback device used and drive receiving the information. Generally, as the resolution of the feedback device increases the level of control that can be used in the servo system increases. As with accuracy, as the resolution of the device increases the cost increases.
Resolver	A passive wound device consisting of a stator and rotor elements excited from an external source, such as an SM-Resolver, the resolver produces two output signals that correspond to the sine and cosine angle of the motor shaft. This is a robust absolute device of low accuracy, capable of withstanding high temperature and high levels of vibration. Positional information is absolute within one turn - i.e. position is not lost when the drive is powered down.
Incremental encoder	An electronic device using an optical disc. The position is determined by counting steps or pulses. Two sequences of pulses in quadrature are used so the direction sensing may be determined and 4 x (pulses per rev) may be used for resolution in the drive. A marker pulse occurs once per revolution and is used to zero the position count. The encoder also provides commutation signals, which are required to determine the absolute position during the motor phasing test. This device is available in 4096, 2048 and 1024 ppr version. Positional information is non absolute - i.e. position is lost when the drive is powered down.
SinCos/ Absolute Encoders	Types available are: Optical or Inductive - which can be single or multi-turn.
1) Optical	An electronic device using an optical disc. An absolute encoder with high resolution that employs a combination of absolute information, transmitted via a serial link, and sine/cosine signals with incremental techniques.
2) Inductive	An electronic device using inductively coupled PCBs. An absolute encoder with medium resolution that employs a combination of absolute information, transmitted via a serial link, and sine/cosine signals with incremental techniques. This encoder can be operated with the drive using either sine/consine or absolute (serial) values only. Positional information is absolute within 4096 turns - i.e. position is not lost when the drive is powered down.
Multi-turn	As previous but with extra gear wheels included so that the output is unique for each shaft position and the encoder has the additional ability to count complete turns of the motor shaft up to 4096 revolutions.
Serial Interface	Serial communication is available on some feedback devices. It is the process of sending data one bit at one time, sequentially, over a communication channel. The specification normally used to define this method of communication is the EIA485 specification. These can be synchronous, which means that they operate with additional clock channels. The main advantage of synchronous data transmission is that it can operate at high speed. A disadvantage is that if the receiver goes out of synchronisation it can take time for it to resyncronise and data may be lost. Note that not all serial interfaces use the clock channels. Serial interface communication allows data to be sent and received from the feedback device. In addition to the position and speed data other information can be sent such as multi-turn count, absolute position and diagnostic information.
Synchronous	If something is synchronous it means that events are coordinated in time. For serial interfaces this means that clock channels are used.
Asynchronous	If something is asynchronous it means that events are not coordinated in time. For serial interfaces this means that clock channels are not used.
Speed	Speed is the rate of change in position which can be either angular or linear traveled per unit of time. For rotational motors this is usually defined as revolutions per minute (RPM).
Volatile	Stored information will be lost when power is removed.
Non volatile	Stored information will not be lost when power is removed.

Brake specification

Unimotor fm may be ordered with an internal rear mounted spring applied parking brake. The brake works on a fail safe principle: the brake is active when the supply voltage is switched off and the brake is released when the supply voltage is switched on.

The standard parking brake, noted by the 1 code in the part number, consists of spring applied plates operating onto a fibre plate. The high energy parking brake, noted by the 5 code in the part number, consists of spring applied plates operating onto a fibre plate that is mounted onto an aluminum disc. This arrangement allows for more energy to be dissipated while braking, as the heat is transferred into the aluminium disc, which in turn gives a high braking torque.

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

Note.

Shunting the brake with an external diode to avoid switching peaks increases the release time considerably. This is usually required to protect solid state switches, or to reduce arcing at the brake relay contacts (Diode 1N4001 recommended)

SAFETY NOTE

The Fail-Safe Brake is for use as a holding brake with the motor shaft stationary.

Do NOT use it as a dynamic brake, except for emergencies such as a mains supply failure.

Motor frame	Supply volts	Input power	Static torque		Release time	Moment of inertia	Backlash
			Standard brake (1)	High energy brake (5)			
Size	Vdc	Watts	Nm	Nm	ms nom	kgcm² *	Degrees**
055	24	6.3	1.8	N/A	22	0.03	0.75
075	24	6.3	2	2.2	22	0.07	1.03
095	24	16	11	12.2	60	0.39	0.94
115	24	16	11	12.2	60	0.44	0.56
142	24	19.5	18	22	75	0.54	0.56
190 (A-D)	24	25	38	42	95	3.07	0.77
190 (E-H)	24	25	60	67	120	4.95	0.77
250	24	62	N/A	135	252	16.37	0.77

*Note 1 kgcm² = 1x10-4kgm² **Backlash figure will increase with time

- ➜ The brakes are intended for parking duty and are not for dynamic or safety use
- ➜ Refer to your Drive Centre or Distributor if your application requires dynamic braking in emergency conditions
- ➜ To provide protection to the brake control circuit it is recommended that a diode is connected across the output terminals of the solid state or relay contacts devices
- ➜ Larger torque brakes are available as an option. Contact your Drive Centre or Distributor for details
- ➜ Figures are shown at 20°C brake temperature. Apply the derate factor of 0.7 to the standard brake torque figures if motor temperature is above 100°C. A derate factor of 0.9 applies to the high energy brake if motor temperature is above 100°C
- ➜ The brake will engage when power is removed

Bearing Life

When selecting a motor some consideration must be made to the loading that the required application will put on the motor shaft. All shaft loads are transferred to the motor's bearing system, so a poorly selected motor could result in premature bearing failure.

Maximum axial and radial load

The following graphs show the Unimotor fm in terms of bearing strength. It has to be noted that the graphs are based on theoretical calculation, and that the bearing life of the motor is affected by the following:

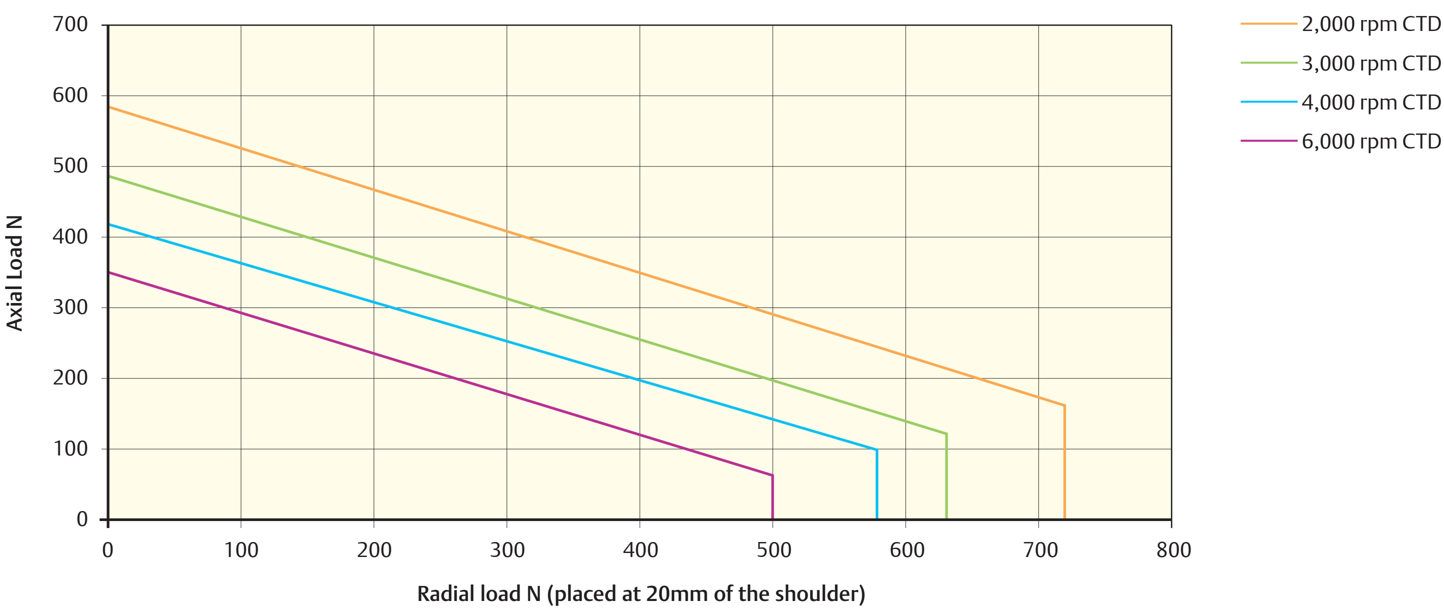
- Speed
- Radial load applied to the bearings
- Axial load applied to the bearings
- Shock and vibration (external shock/vibration applied to the motor)
- Bearing temperature
- Bearing cleanliness
- Motor mounting to the application

The loads in the following graphs have been calculated using ISO 281 calculation L10(h). The loads and speeds used are considered to be constant throughout the life of the bearing.

The following factors have been taken into consideration when calculating the loads:

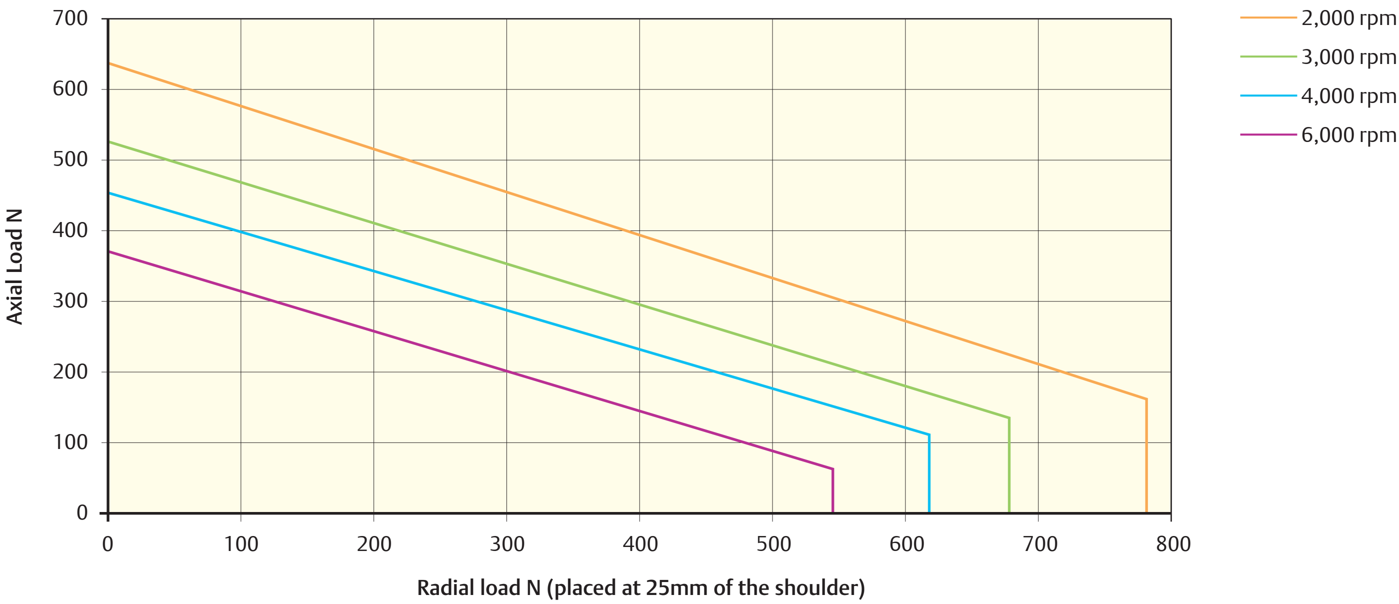
- 90% reliability
- Radial load applied on the output shaft away from the shoulder and constant. The distance can be read on the different graphs
- Axial load going toward the motor and constant
- Load factor of 1: no vibration applied to the motor
- Temperature of the bearing: 100°C max
- Grease clean

Radial load vs. axial load on 75U2



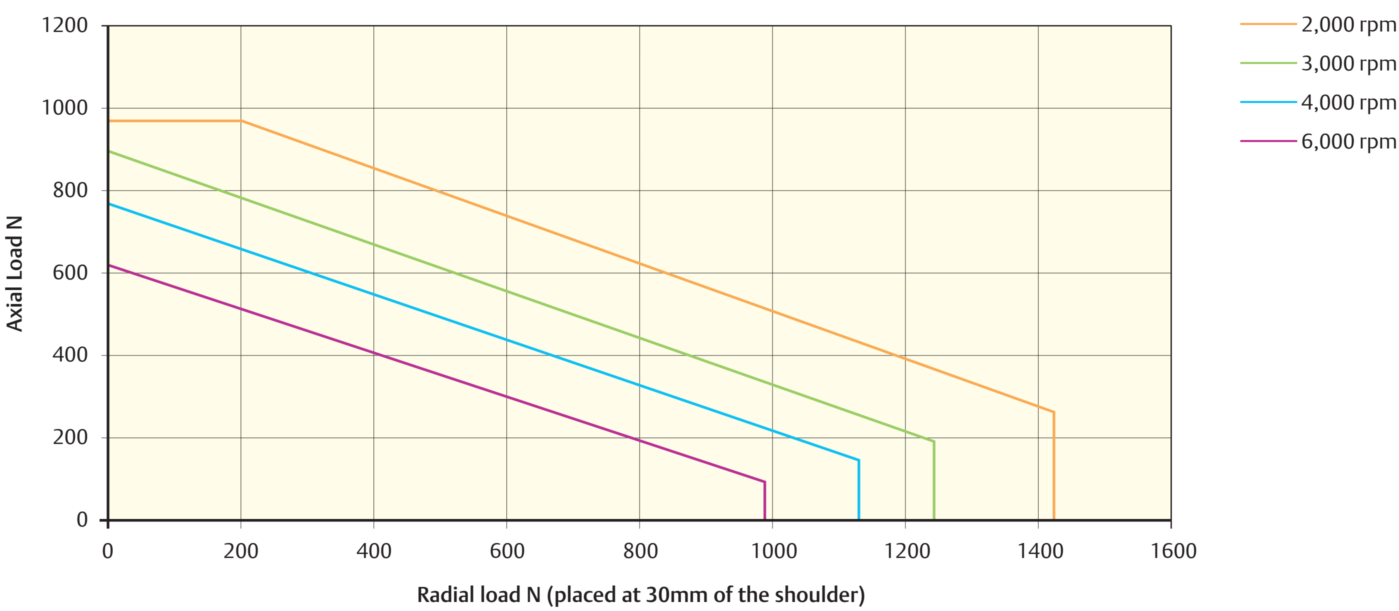
75U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 948 N

Radial load vs. axial load on 95U2



95U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 866 N

Radial load vs. axial load on 115U2



115U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 965 N

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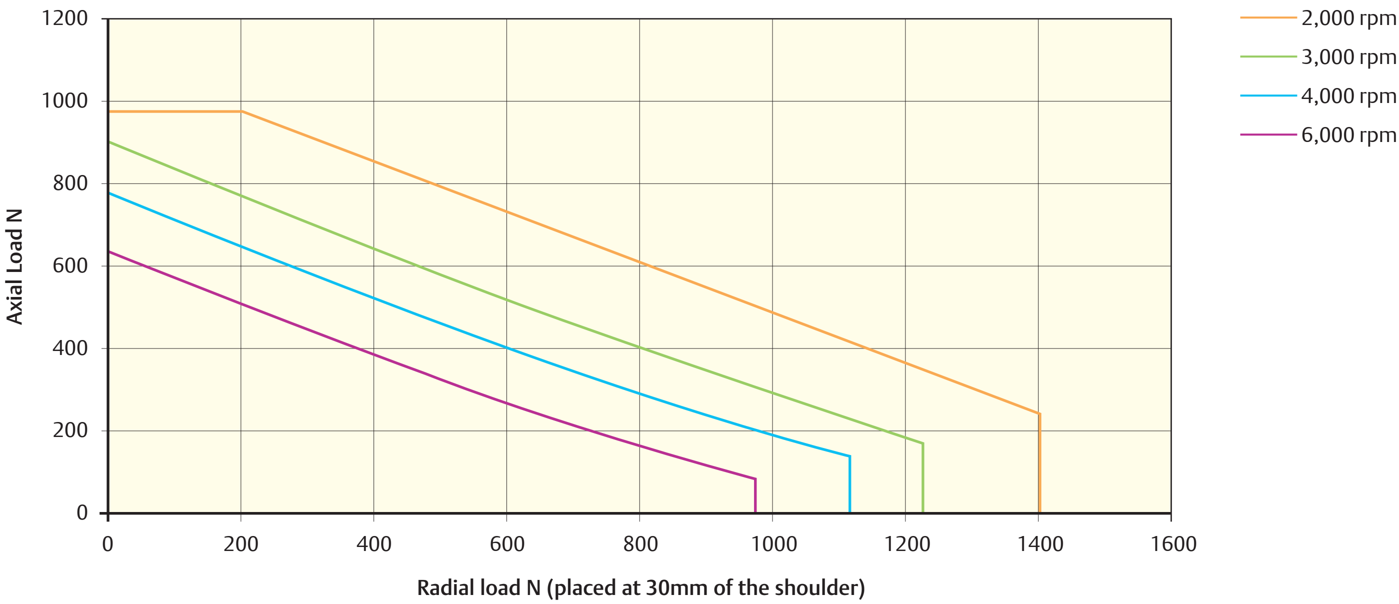
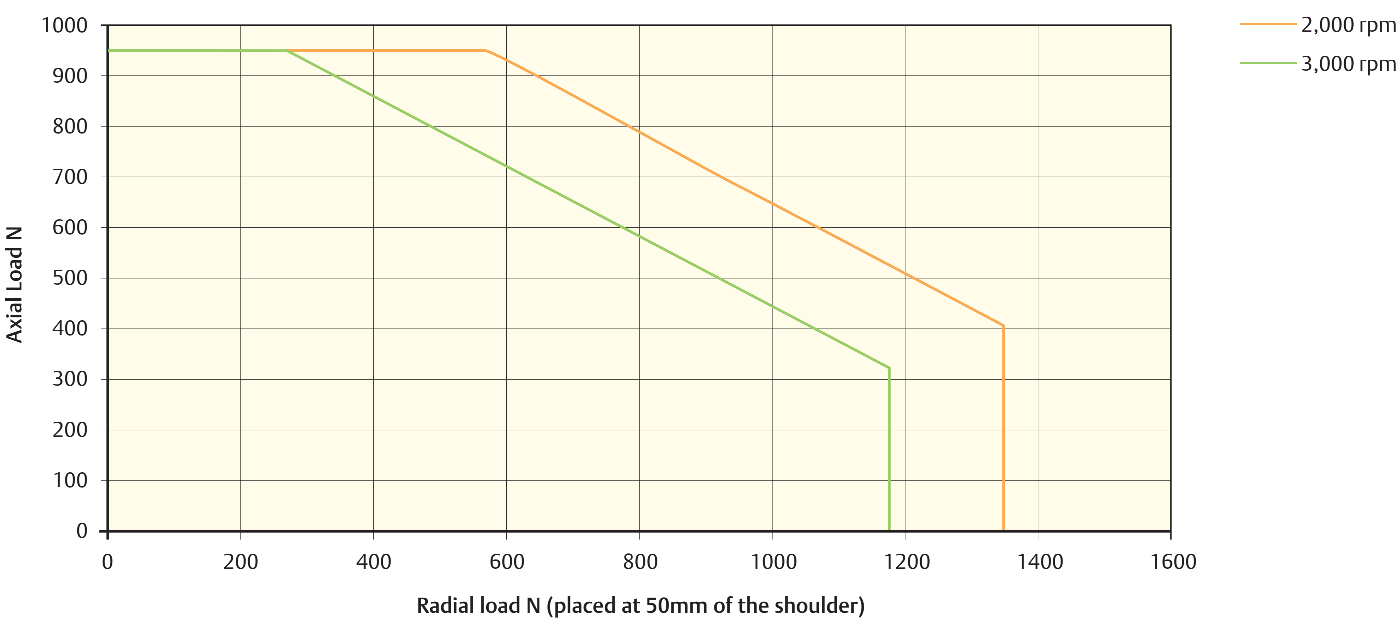
Radial load vs. axial load on 142U2



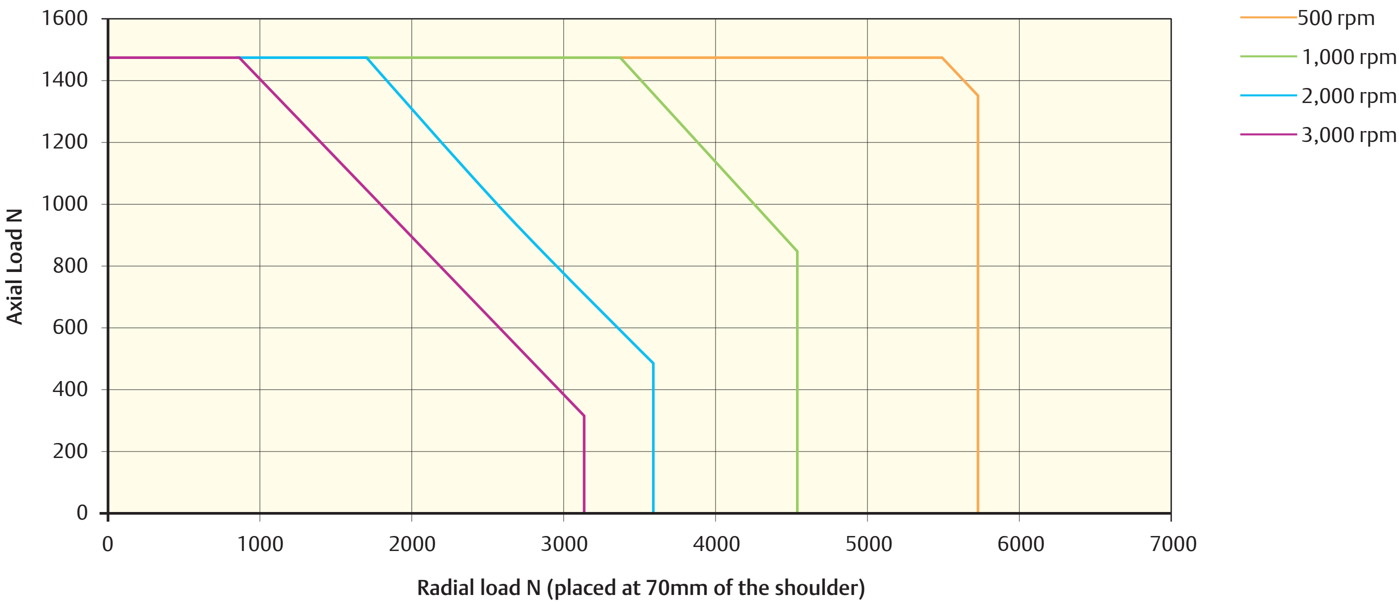
142U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 965 N

Radial load vs. axial load on 190U2



190U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 945 N

Radial load vs. axial load on 250U2



250U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1). Do not exceed a maximum axial load of 1471 N

It can be seen on some graphs (example Figure 5) that the curve line becomes horizontal. This is due to the axial pushing load on the shaft (see *Shaft push back load*). This limit should not be exceeded in case the shaft moves.

Output shaft strength

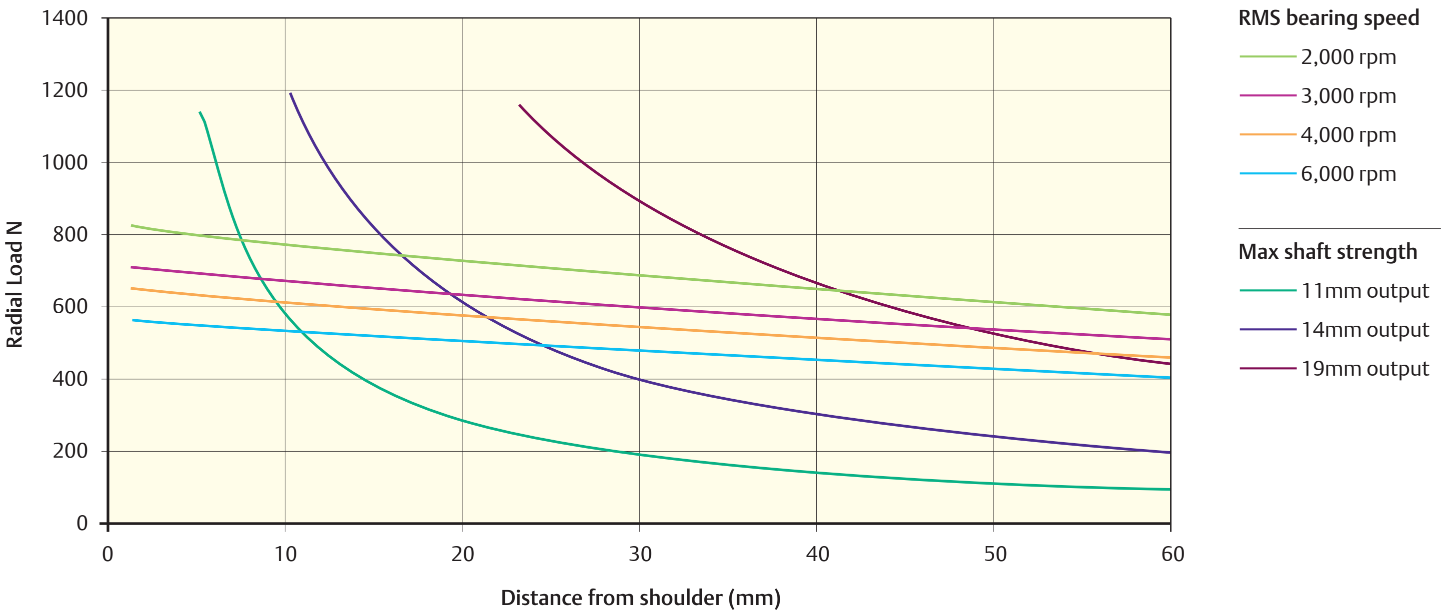
The maximum output shaft that can be machined on the motor is determined by the inner diameter of the bearings. The bearing sizes on Unimotor fm motors have increased in comparison with the Unimotor UMs and this allows a larger output shaft to be machined. Larger output shafts mean stronger output shafts.

The following graphs show this improvement.

The loads in the following graphs have been theoretically calculated. The following factors were taken into consideration:

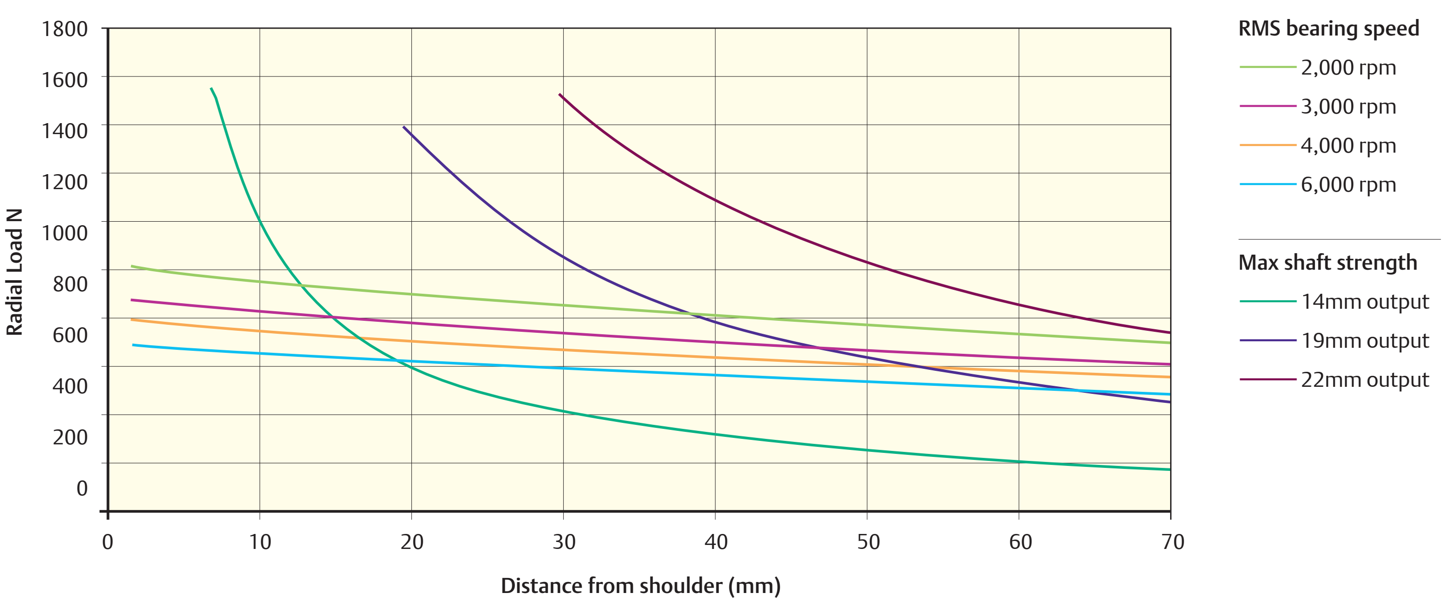
- 90% reliability (for bearing life only)
- Radial load applied on the output shaft away from the shoulder and constant. The distance can be read on the different graphs.
- Axial load going toward the motor and constant.
- Load factor of 1: no vibration applied to the motor (for bearing life only).
- Temperature of the bearing: 100°C max.
- Grease clean (for bearing life only).
- Torque alternating (for shaft strength only).

Comparison shaft strength on 75U2



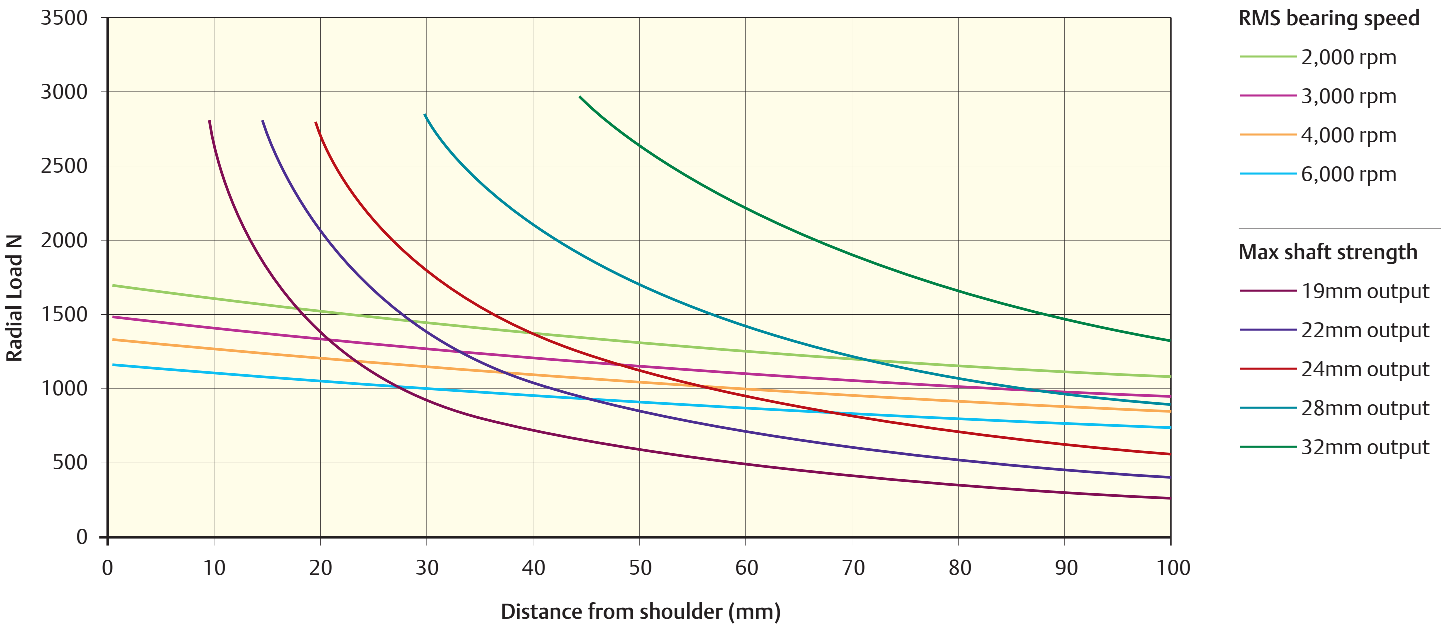
75U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

Comparison shaft strength on 95U2



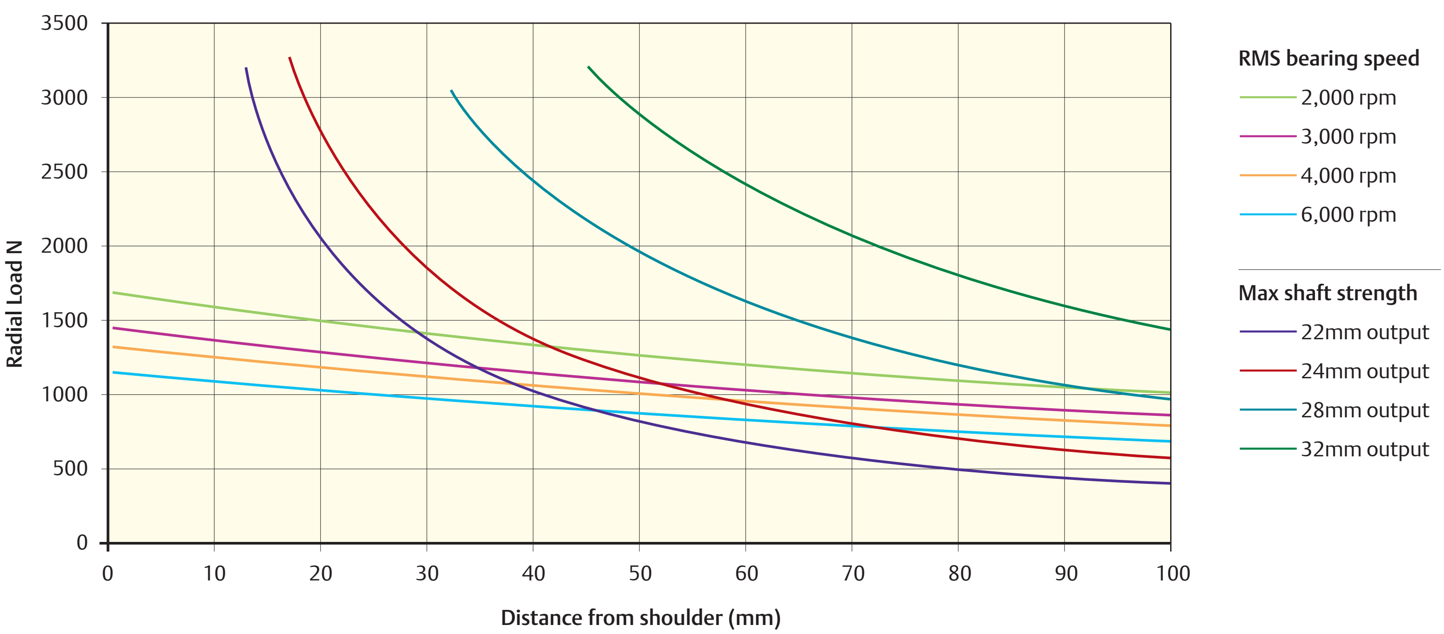
95U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

Comparison shaft strength on 115U2



115U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

Comparison shaft strength on 142UM and 142U2



142U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

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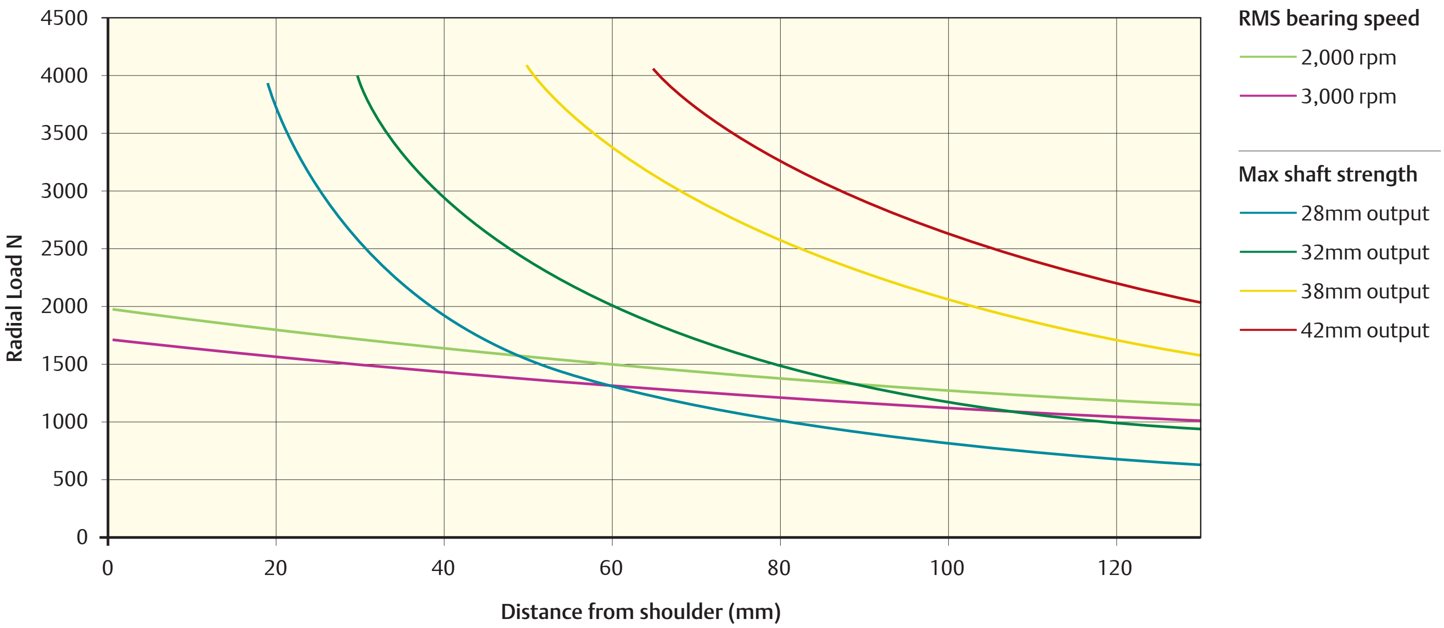
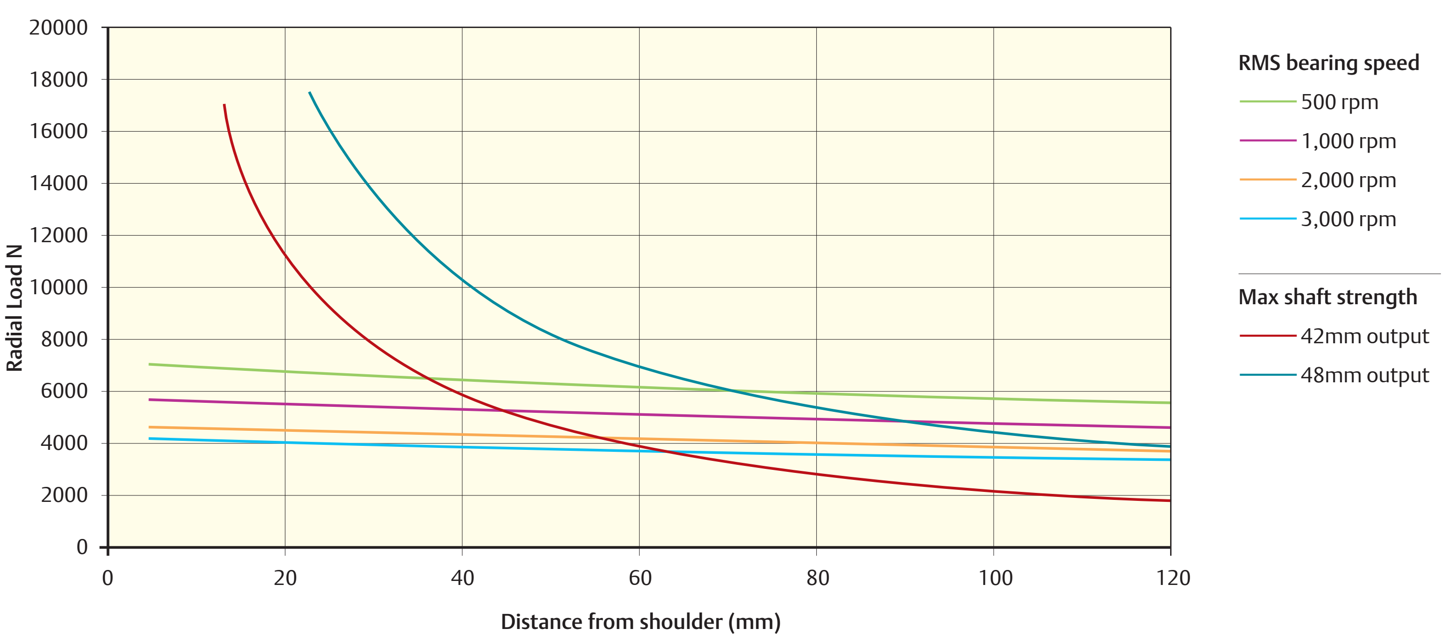
Comparison shaft strength on 190U2



190U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

Comparison shaft strength on 250U2



250U2 L $_{10(h)}$ Bearing life for 20,000 hours (reliability 90%, load factor of 1)

Shaft push back load

The minimum pushing load needed to move the rotor relative to the bearings.

The table (right) shows the minimum push back force on Unimotor fm.

It has to be noted that the loads given in the aside above are minimum.

Motor	Push back force (N)
075	948
095	866
115	965
142	965
190	945
250	1471

Motor and signal cables

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

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

The cables are made to order in lengths from 1m to 50m/100m.

Cable range for motor-drive combination

- Unimotor fm U2 to Unidrive classic / Unidrive SP
- Unimotor fm E2 to Unidrive classic low voltage / Unidrive SP low voltage
- EZ to Epsilon or EN
- Unimotor fm to Digitax ST / Unidrive SP size 0

Power cable variants

- Phase conductors 1.0mm² (10A) to 16mm² (70A)
- With and without brake wire pairs
- Motor end connector
- Motor end Ferrules for Hybrid box
- Drive end is tailored to suit the drive and can be ferrules or ring terminals

Cable features

- For dynamic performance PUR outer sheath for oil resistance and dynamic performance. The PUR jacket has excellent abrasion, chemical and ozone resistance, low smoke, low halogen flame retardant construction suitable for internal and external industrial environments.
- OFS outer sheath for oil resistance and static performance.
- Complies with DESINA coding - Orange for power, Green for signal
- Power cable and plugs UL recognised
- Optimum noise immunity
- Encoder cable has low volt drop for long cable lengths and separately screened thermistor wires.
- No need for crimp and insertion / removal tools
- Production build gives quality and price benefits
- Power cables with and without brake wires
- Cable assembly type identification label
- Brake wires are separately shielded within the power cable

Power – PUR Basic cable types

Phase & conductor size (current rating Cenlec EN60204.1)	Unimotor fm power plug size	Current rating	Overall cable diameter (mm)	
			No brake	Braked
G – 1.5mm² (16A)	055-142 size 1	30A sockets	8.5	10.8
A – 2.5mm² (22A)			10.0	12.6
B – 4.0mm² (30A)	055 -142 size 1 190 size 1.5	30A sockets 53A sockets	11.7	14.1
C – 6.0mm² (39A)	190 size 1.5	70A sockets	17.4	17.4
D – 10.0mm² (53A)			20.4	20.4
E – 16.0mm² (70A)			23.4	23.4

Note

- Minimum bend radius = 10x dia long chain, 7.5x dia short chain. Bending life 10,000,000 cycles
- Maximum accelaration = 20m/s²
- Temperature rating -10°C to +80°C

Power – OFS basic cable types

Phase & conductor size (current rating Cenlec EN60204.1)	Unimotor fm power plug size	Current rating	Overall cable diameter (mm)	
			No brake	Braked
H – 1.0 mm² (10A)	055-142 size 1	30A sockets	TBA	TBA

Note

- Minimum bend radius = 15x dia long chain
- Maimum accelaration = 6m/s²
- Temperature rating -10°C to +60°C

Signal – PUR basic cable types

Cable type	Cable code	Overall cable diameter (mm)
Encoder / Sincos Heidenhain	SIBA	10.9
Resolver / Sincos Sick|Stegmann	SRBA/SSBA	9.6
Encoder	SIBL	8.5

Note

- Minimum bend radius = 10x dia long chain 7.5x dia short chain. Bending life 10,000,000 cycles
- Maximum accelaration SRBA/SSBA = 20m/s²
SIBA/SIBL = 10m/s²
- Temperature rating -10°C to +80°C

Signal – OFS basic cable types

Cable type	Cable code	Overall cable diameter (mm)
Encoder	SICA	
Resolver / Sincos Sick|Stegmann	SRCA/SSCA	

Note

- Minimum bend radius = 15x dia long chain
- Maimum accelaration = 6m/s²
- Temperature rating -10°C to +60°C

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Cable information

PS	B	A		A	A	015
Cable type	Jacket	Phase & ground: conductor size		Connection details drive end	Connection details motor end	Cable length
PS= Power (Standard)	**B** = PUR	**G** = 1.5mm^2	**16A**	**A** = **Unidrive** (Size 1-2) Ferrules	**A** = 055 -142 **Unimotor** power connector	Min = 002 (2m)
PB = Power (with brake)		**A** = 2.5mm^2	**22A**	**B** = **Unidrive** (Size 3-4) Ring terminals		Max = 100
		B = 4.0mm^2	**30A**	**C** = 6 way power extension connector (055-142 **Unimotor** male pins)	**B** = 190 -250 **Unimotor** power connector	
		C* = 6.0mm^2	**39A**			
		D* = 10.0mm^2	**53A**	**F** = **Unidrive** (1-2) Ferrules	**J** = 250 hybrid ferrules	
		E* = 16.0mm^2	**70A**	**G** = **Unidrive** (3-4) Ring terminals	**X** = Cut end	
				H = **Digitax** ST and SP0		
				X = Cut end		

* Ring terminals for Drive studs only

Cable type

PS for motor without brakes, PB for motors with brake.

Jacket

B is for a PUR sheath and is the standard selection.

Conductor size

Select the conductor size according to the motor's stall current. Cables of 6mm^2 and above will be fitted with ring terminals only. Ratings are for individual cables (not lashed together) in free air temperature up to 40°C - make allowances as appropriate.

Connection detail drive end

Select the correct drive end connection for the drive in use.

Connection detail motor end

Select the correct motor end connection for the motor in use.

Length

Numbers represent the required cable length in metres.

SI	B	A	A	A	015
Cable type	Jacket	Special options		Connection details motor end	Cable length
SI = Incremental Encoder	**B** = PUR	**A** = Standard cable		**A** = **Unimotor** Encoder connector	Min = 002 (2m)
SR = Resolver		**E** = Twisted screened SS cable		**B** = **Unimotor** Resolver connector	Max = 100* 10m for SIBL
SS = Sin/Cos Encoder		**L** = 8.5mm dia SI cable		**C** = **Unimotor** Sin/Cos connector (Sick|Stegmann)	
				E = 17 way extension connector	
				F = 90° **Unimotor** Encoder connector	
				G = 90° **Unimotor** Resolver connector	
				H = 90° **Unimotor** Sin/Cos connector (Sick|Stegmann)	
				N = **Unimotor** Sin/Cos connector (Heidenhain)	
				O = 90° **Unimotor** Sin/Cos connector (Heidenhain)	
				X = Cut end	

Connection details drive end
A = **Digitax ST/Unidrive** /**Epsilon EP** Encoder 15 pin connector
B = Resolver / Sin/Cos Ferrules
F = **Epsilon** Encoder 26 pin connector
G = Extension connector male pins
H = **Digitax ST/Unidrive** Sin/Cos 15 pin connector
X = Cut end

*100m on incremental only if +5V tolerance can be maintained

Cable type

Choose the cable type to match the feedback device.

Jacket

B is for a PUR sheath and is the standard selection.

Special options

A is for standard cable. L is for the low cost 8.5mm incremental cable.

Connection detail drive end

Select the correct drive end connection for the drive in use.

Connection detail motor end

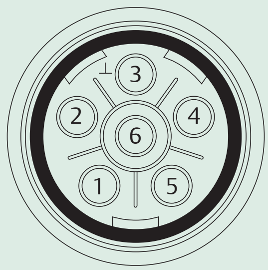
Select the correct motor end connection for the motor feedback device in use.

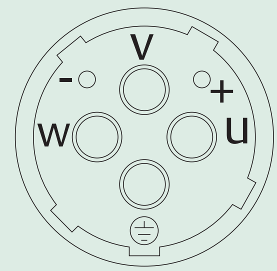
Length

Numbers represent the required cable length in metres.

Motor connector details

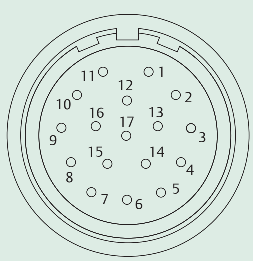
Power plug

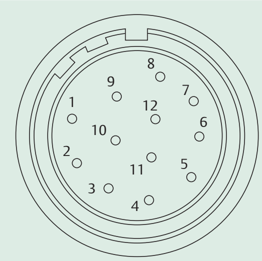




	055 -142 with brake	055 -142 without brake		190 -250 with brake	190 -250 without brake
Pin	**Function**	**Function**	**Pin**	**Function**	**Function**
1	Phase U (R)	Phase U (R)	U	Phase U (R)	Phase U (R)
2	Phase V (S)	Phase V (S)	V	Phase V (S)	Phase V (S)
3	Ground	Ground	⏚	Ground	Ground
4	Phase W (T)	Phase W (T)	W	Phase W (T)	Phase W (T)
5	Brake		+	Brake	
6	Brake		-	Brake	
Shell	Screen	Screen	Shell	Screen	Screen

Signal plug





	Incremental encoder (CP, MP, KP, CA, MA, KA)	Heidenhain Sin/Cos encoders (EM, FM, EC, FC, EB, FB)	Resolver (AR, AE)	Sick|Stegmann Sin/Cos encoders (TL, UL, RA, SA)
Pin	**Function**	**Function**	**Function**	**Function**
1	Thermistor	Thermistor	Excitation High	REF Cos
2	Thermistor	Thermistor	Excitation Low	+ Data
3		Screen (Optical encoder only)	Cos High	- Data
4	S1		Cos Low	+ Cos
5	S1 Inverse		Sin High	+Sin
6	S2		Sin Low	REF Sin
7	S2 Inverse		Thermistor	Thermistor
8	S3	+ Clock	Thermistor	Thermistor
9	S3 Inverse	- Clock		Screen
10	Channel A	+ Cos		0 Volts
11	Index	+ Data		-
12	Index Inverse	- Data		+ V
13	Channel A Inverse	- Cos		
14	Channel B	+ Sin		
15	Channel B Inverse	- Sin		
16	+ V	+ V		
17	0 Volts	0 Volts		
Body	Screen	Screen		Screen

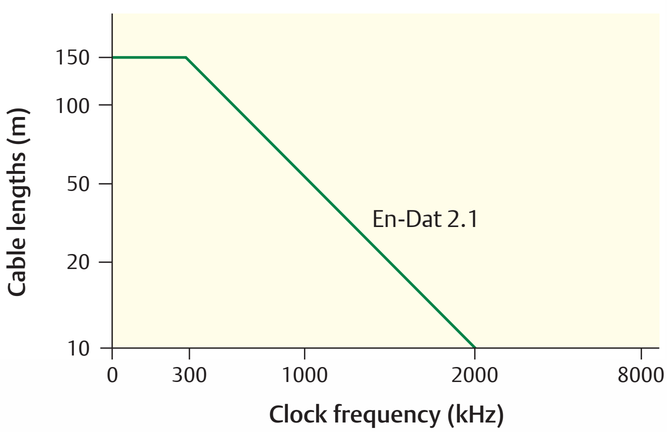
Maximum cable length

Due to the volt drop down the power lines within the feedback cable, each feedback device has a maximum length restriction placed upon it.

Maximum recommended length

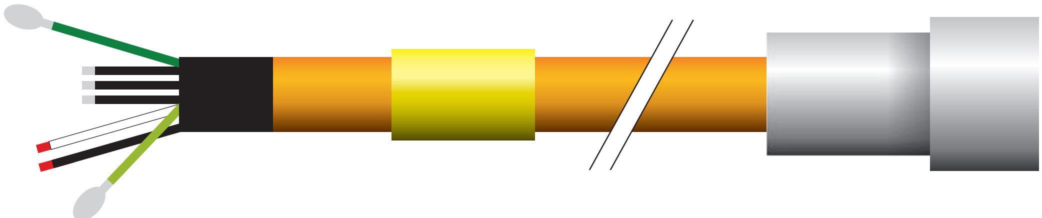
Cable types	Maximum cable length		
	Resolver	Sick | Stegmann	Heidenhain
SIBA Incremental		CA/MA/KA 50m	
SRBA Resolver	AE 100m		
SSBA Sincos		RA/SA 100m	EC/FC 40m EB/FB 10m
SSBE Sincos Twisted pair		RA/SA 100m	EC/FC 80m EB/FB 20m
SIBA Incremental		CA/MA 10m	

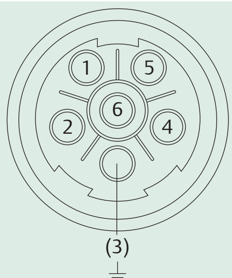
With EnDat 2.1 communication the clock frequency is variable from 100kHz to 2MHz. As long cable runs and high clock frequencies increase the signal run time, due to the propagation delay within the cable, the drive centre must ensure that the correct cable length is used.

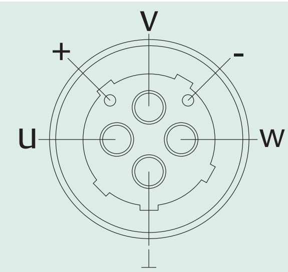


Power cable range

Power cable with brake 055 to 190

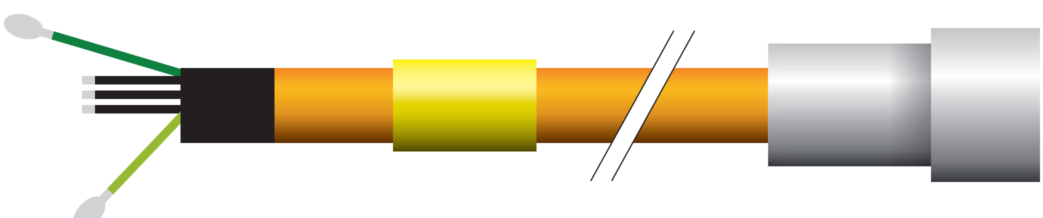


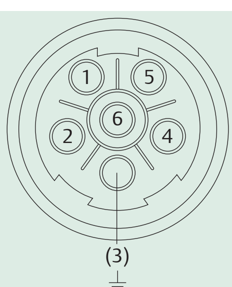


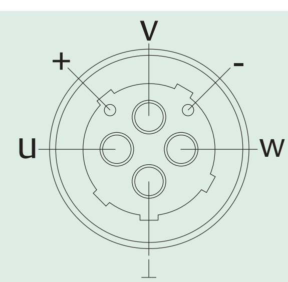


	055 -142 with brake		190 -250 with brake
Pin	**Function**	**Pin**	**Function**
1	Phase U (R)	U	Phase U (R)
2	Phase V (S)	V	Phase V (S)
3	Ground	⏚	Ground
4	Phase W (T)	W	Phase W (T)
5	Brake	+	Brake
6	Brake	-	Brake
Shell	Screen	Shell	Screen

Power cable without brake PSBxABxxx







	055 -142 without brake		190 -250 without brake
Pin	**Function**	**Pin**	**Function**
1	Phase U (R)	U	Phase U (R)
2	Phase V (S)	V	Phase V (S)
3	Ground	⏚	Ground
4	Phase W (T)	W	Phase W (T)
5		+	
6		-	
Shell	Screen	Shell	Screen

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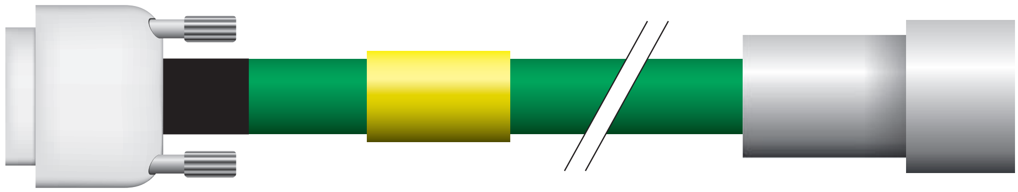
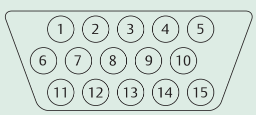
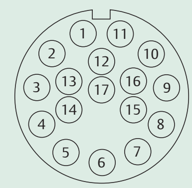
Signal cable Incremental Encoders SIBAAAxxx or SIBLAAxxx



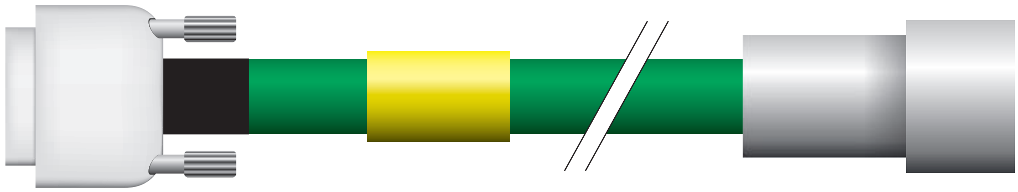
Incremental cable:

SSIBAxxxx, dia 10.9mm, length 50m max

SIBLxxxx, dia 8.5mm, length 10m max

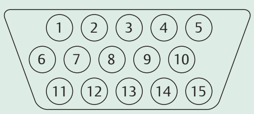
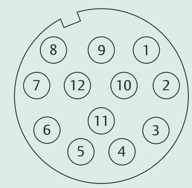
15-way drive connections		17-way motor encoder plug	
			
Pin	**Colour**	**Pin**	**Function**
Body	White	1	Thermistor 0V
15	Brown	2	Thermistor Signal
-	-	3	Screen
7	Green	4	S1
8	Yellow	5	S1 Inverse
9	Grey	6	S2
10	Pink	7	S2 Inverse
11	Black	8	S3
12	Purple	9	S3 Inverse
1	Grey/Pink Band	10	Channel A
5	White/Green Band	11	Index
6	Brown/Green Band	12	Index Inverse
2	Red/Blue Band	13	Channel A Inverse
3	Red(0.38mm²)	14	Channel B
4	Blue(0.38mm²)	15	Channel B Inverse
13	Red(1.0mm²)	16	+Volts
14	-	17	0Volts + Thermistor
Body	Screen	Body	Screen

Signal cable Sincos SSBxHCxxx for Stegmann Encoders

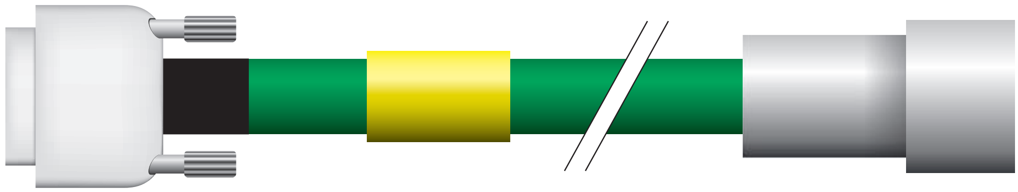


Incremental cable:

SSBAxxxxx, dia 9.6mm, length 100m max

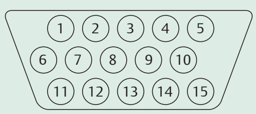
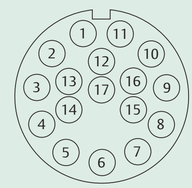
15-way drive connections		17-way motor encoder plug	
			
Pin	Colour	Pin	Function
2	Red	1	REF Cos
5	Blue	2	+ Data
6	**Violet**	3	- Data
1	Orange	4	+ Cos
3	Brown	5	+Sin
4	Black	6	REF Sin
14	Yellow	7	Thermistor
15	Green	8	Thermistor
Body	Screen	9	Screen
14	Blue/White(0.5mm²)	10	0 Volts
	-	11	-
13	Red/White(0.5mm²)	12	+ V
Body	Screen	Body	Screen

Signal cable Sincos SSBxHCxxx for Heidenhain Encoders

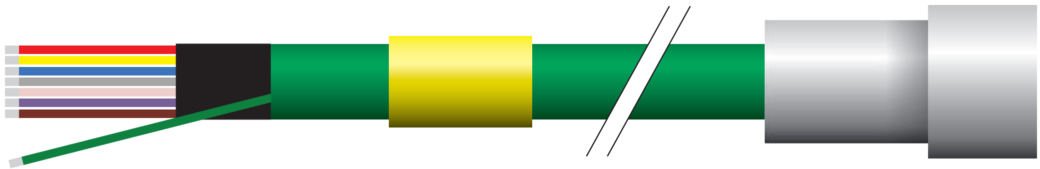


Sincos cable:

SSBAxxxxx, dia 9.6mm, length 80m EC/FC, max 10m EB/FB max

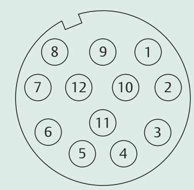
15-way drive connections		17-way motor encoder plug	
			
Pin	**Colour**	**Pin**	**Function**
14	Yellow	1	Thermistor
15	Green	2	Thermistor
		3	
7		4	
8		5	
9		6	
10		7	
11	Yellow / White	8	+Clock
12	Black / White	9	-Clock
1	Orange	10	+Cos
5	Blue	11	+Data
6	Violet	12	-Data
2	Red	13	-Cos
3	Brown	14	+Sin
4	Black	15	-Sin
13	Red / White (0.5mm)	16	+Volts
14	Blue / White (0.5mm)	17	0 Volts
Body	Screen	**Body**	Screen

Signal cable Resolver SRBxBBxxx



Resolver cable:

SRBAxxxxx, dia 9.6mm, length 100m max

Drive connections		12-way motor encoder plug	
SM-Resolver			
Pin	**Colour**	**Pin**	**Function**
13	Red (0.38mm²)	1	Excitation high
14	Orange	2	Excitation low
11	Blue (0.38mm²)	3	Cos high
12	Violet	4	Cos low
10	Brown	5	Sin high
9	Black	6	Sin low
	Yellow	7	Thermistor
	Green	8	Thermistor
		9	
		10	
		11	
		12	
Body	Screen	Body	Screen

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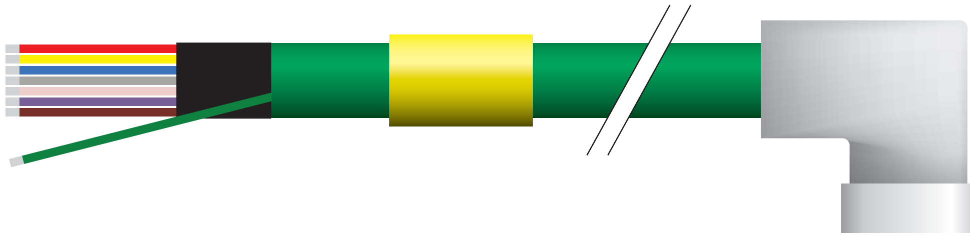
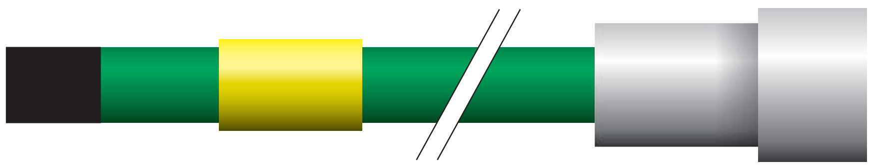
Other options of motor or drive connections are available. Below are some examples, or contact Control Techniques Dynamics Limited for details.

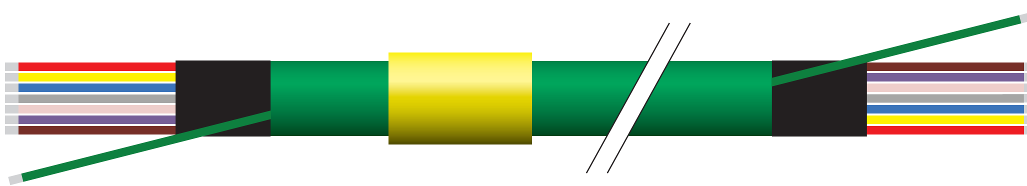
Right angle motor connectors



Cut end cables



UM terminal/hybrid box cables



Selecting connector kits

Control Techniques Dynamics can supply a full range of connectors for the U2/E2 motors. The tables below show the connector kits and spare sockets that are available.

Power connectors		
Single connector type	CTD connector part no	Spare sockets
055-142 Power (30A)	IM/0039/KI	IM/0047/KI
190 Power (4mm² cable : 53A)	IM/0053/KI	IM/0056/KI
190 Power (>6mm² cable : 70A)	IM/0054/KI	IM/0057/KI
Brake	-	IM/0048/KI

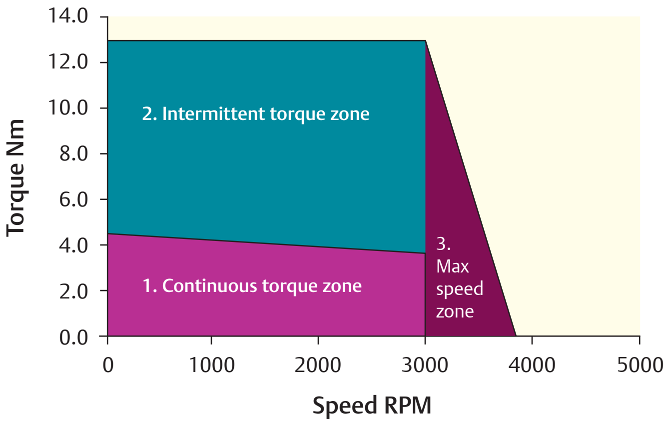
Signal connectors		
Single connector type	CTD connector part no	Spare sockets
Encoder/Sincos (Heidenhain)	IM/0022/KI	IM/0049/KI
Resolver/Sincos (Sick|Stegmann)	IM/0023/KI	IM/0049/KI
Resolver/Sincos(Sick|Stegmann) 90°	IM/0033KI/01	IM/0049/KI
Encoder/Sincos (Heidenhain) 90°	IM/0033/KI/02	IM/0049/KI

Power/signal type	CTD part no
055 -142 Power + Encoder/Sincos (Heidenhain)	IM/0012/KI
055 -142 Power + Resolver/Sincos (Sick|Stegmann)	IM/0011/KI

Performance graphs

The torque speed graph depicts the limits of operation for a given motor. The limits of operation are shown for three categories.

Torque/speed graph



1. Continuous or rms torque zone

This area gives the effective continuous or rms torque available for repetitive torque sequences. Continuous or rms torque must be within this area otherwise the motor may overheat and cause the system to trip out.

2. Intermittent or peak torque zone

Above the continuous zone is the intermittent zone where the motor may be safely operated for short periods of time. Operation within the intermittent zone is permissible provided that the defined peak torque limit is not exceeded. On some frame sizes the peak torque factor of 3 x stall current only applies up to a certain percentage level of rms current before it starts to reduce.
Please refer to the *Standard (2) peak torque* section for details.

Maximum peak torque is the upper limit of the intermittent zone and must never be exceeded, to do so will damage the motor.

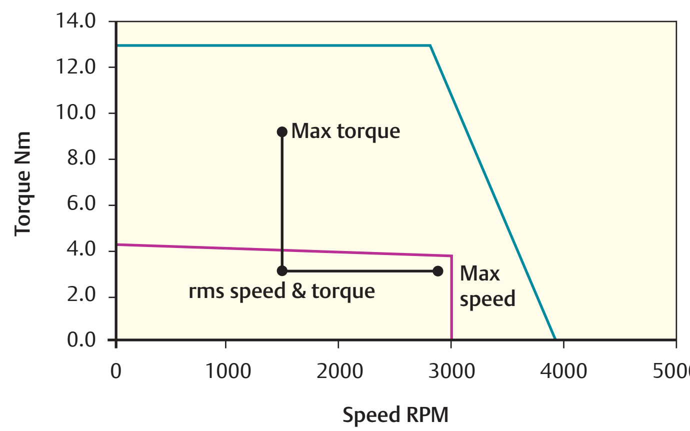
3. Maximum speed zone

To the right of the graph is a sloping line depicting the maximum motor speed when using a 200V/400V drive supply. The speed limit line is dependent upon the motor windings, and the voltage supplied to the drive. Operation within the maximum speed zone is permissible as long as the maximum speed limit is not exceeded. If the speed is increased beyond the limit shown, the motors sinusoidal waveform would have insufficient voltage and will clip and distort, causing inefficiency and higher temperature. If the distortion increases further, the drive may loose control of the motor and trip.

Plotting an operating point.

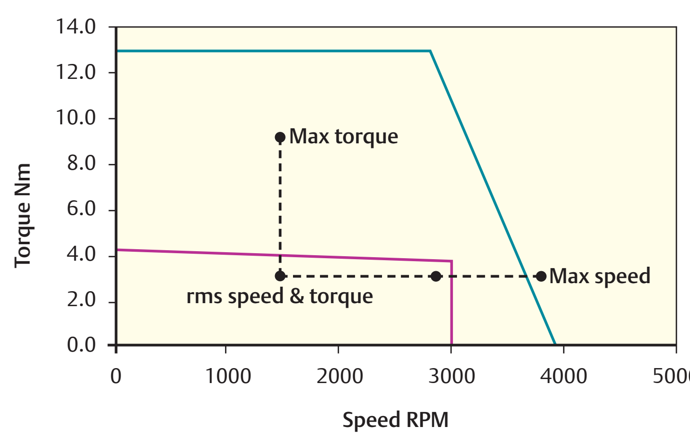
To estimate whether a motor is the correct choice for a given system, it is necessary to calculate or measure the rms torque and the rms speed for a given system in its normal continual stop/start sequenced mode. These operating points may be plotted on the torque speed graph. As shown in the first graph below, if the rms speed and torque point lies well within the continuous zone, then the motor is suitable for the application. The second graph below shows the max speed has increased to 3900rpm and this is now outside the safe area and another speed motor must be selected.

Torque/speed graph



Max torque =10Nm: Max speed = 2900 rms torque =3Nm: rms speed = 1500

Torque/speed graph



Max torque =10Nm: Max speed = 3900 rms torque =3Nm: rms speed = 1500

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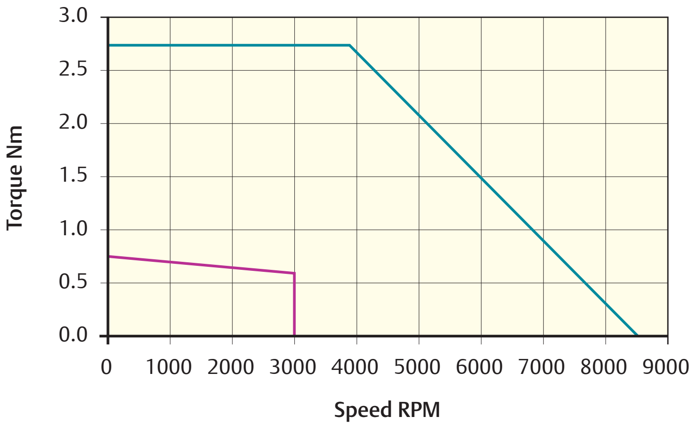
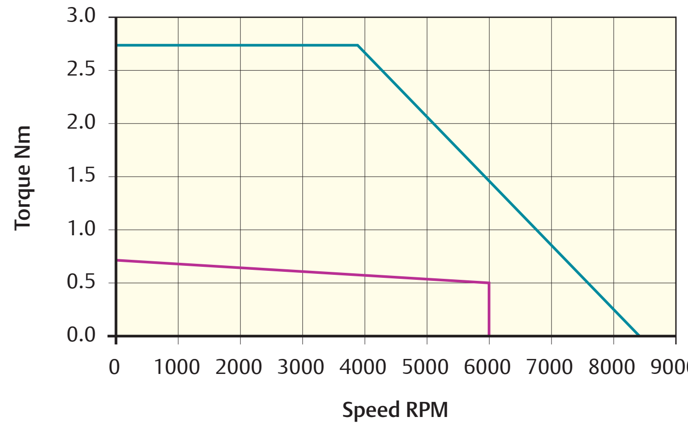
055U2A3000



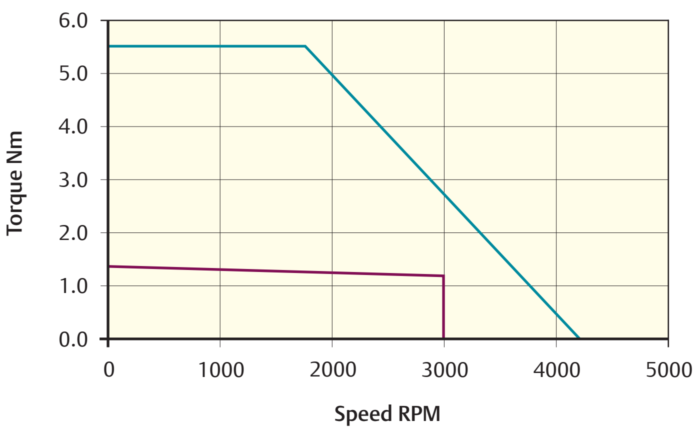
Peak torque (Nm) = **2.8** Stall torque (Nm) = **0.7** Rated torque (Nm) = **0.6**

055U2A6000



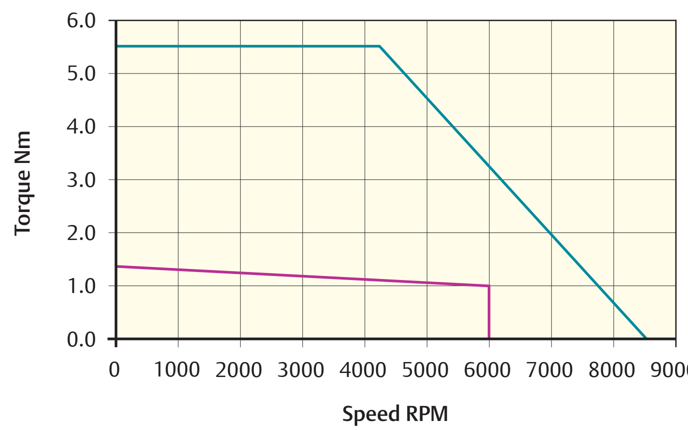
Peak torque (Nm) = **2.8** Stall torque (Nm) = **0.7** Rated torque (Nm) = **0.5**

055U2B3000



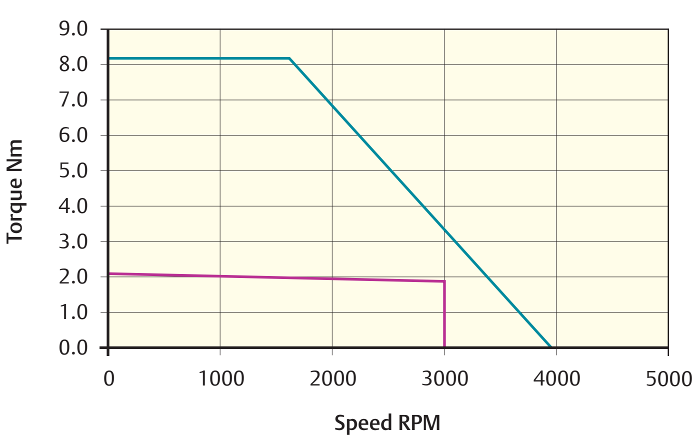
Peak torque (Nm) = **5.5** Stall torque (Nm) = **1.4** Rated torque (Nm) = **1.2**

055U2B6000



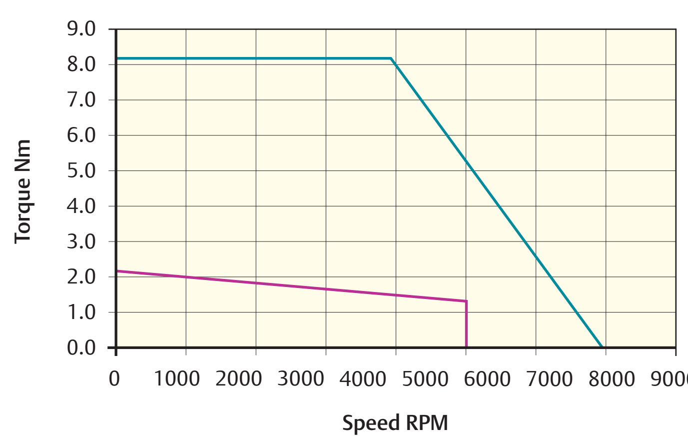
Peak torque (Nm) = **5.5** Stall torque (Nm) = **1.4** Rated torque (Nm) = **0.9**

055U2C3000



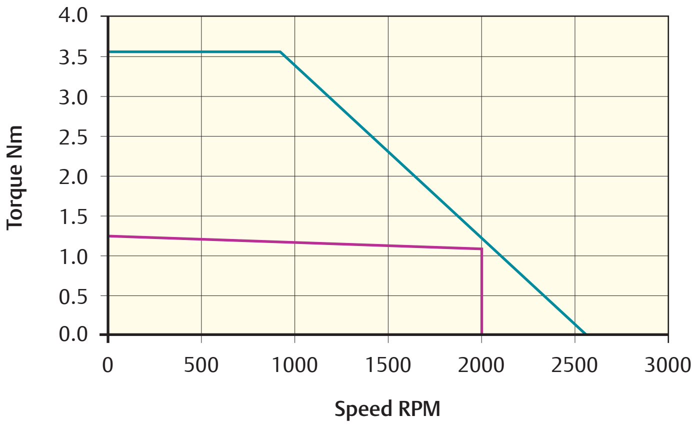
Peak torque (Nm) = **8.3** Stall torque (Nm) = **2.1** Rated torque (Nm) = **1.8**

055U2C6000



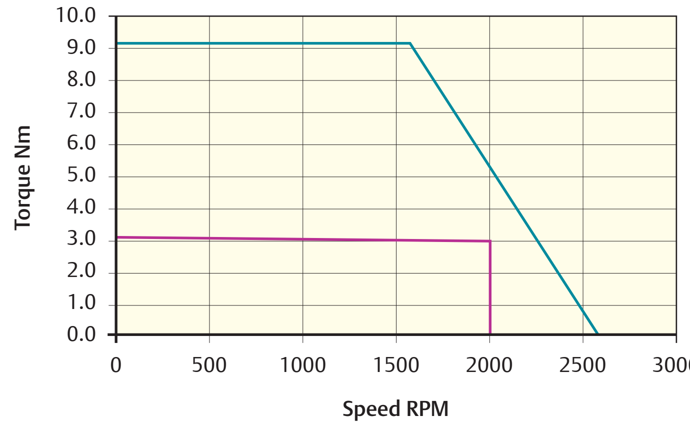
Peak torque (Nm) = **8.3** Stall torque (Nm) = **2.1** Rated torque (Nm) = **1.4**

075U2A2000



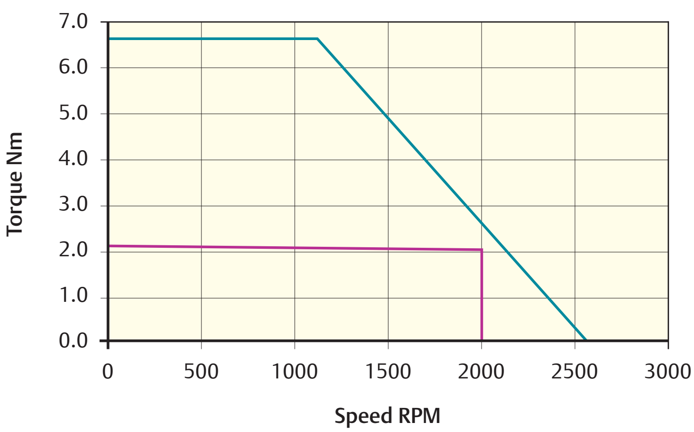
Peak torque (Nm) = **3.6** Stall torque (Nm) = **1.2** Rated torque (Nm) = **1.1**

075U2C2000



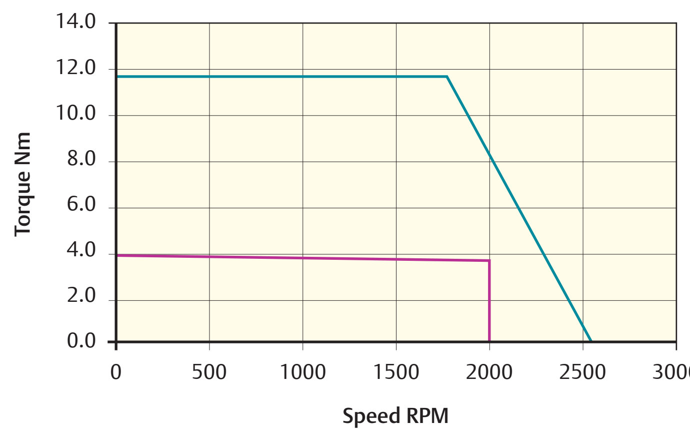
Peak torque (Nm) = **9.3** Stall torque (Nm) = **3.1** Rated torque (Nm) = **3.0**

075U2B2000



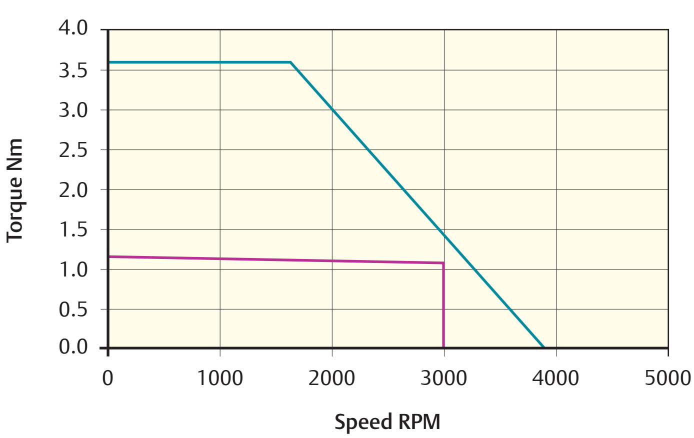
Peak torque (Nm) = **6.6** Stall torque (Nm) = **2.2** Rated torque (Nm) = **2.1**

075U2D2000



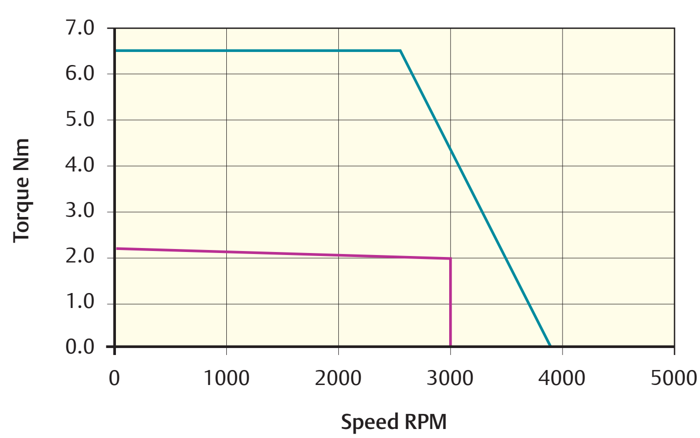
Peak torque (Nm) = **11.7** Stall torque (Nm) = **3.9** Rated torque (Nm) = **3.8**

075U2A3000



Peak torque (Nm) = **3.6** Stall torque (Nm) = **1.2** Rated torque (Nm) = **1.1**

075U2B3000



Peak torque (Nm) = **6.6** Stall torque (Nm) = **2.2** Rated torque (Nm) = **2.0**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

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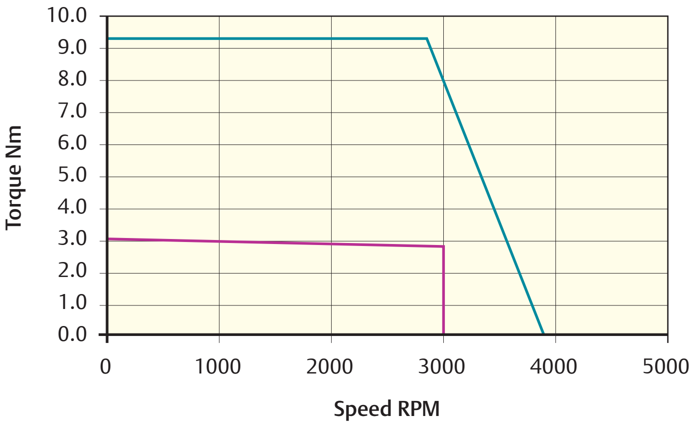
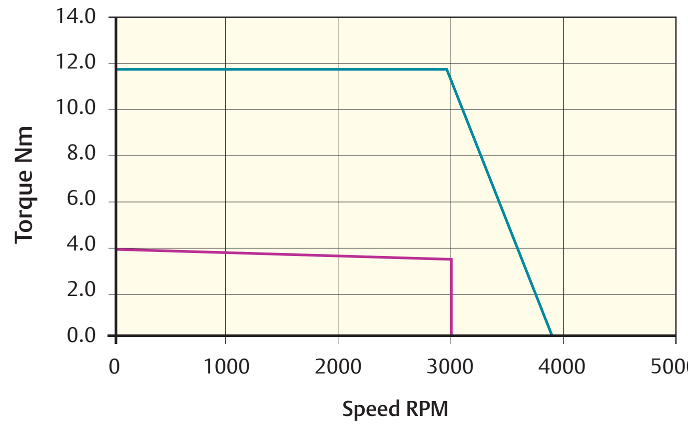
075U2C3000



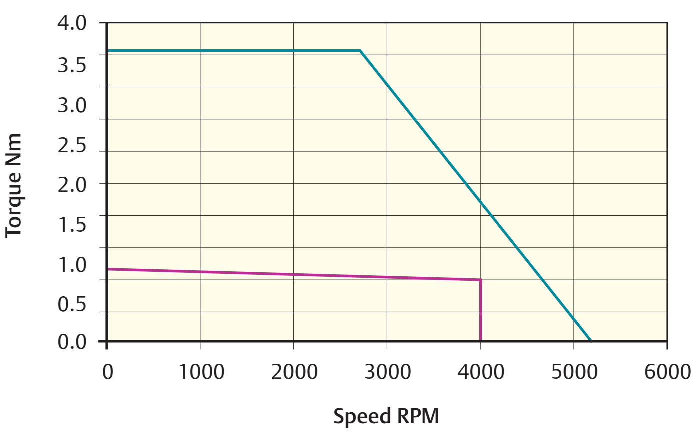
Peak torque (Nm) = **9.3** Stall torque (Nm) = **3.1** Rated torque (Nm) = **2.8**

075U2D3000



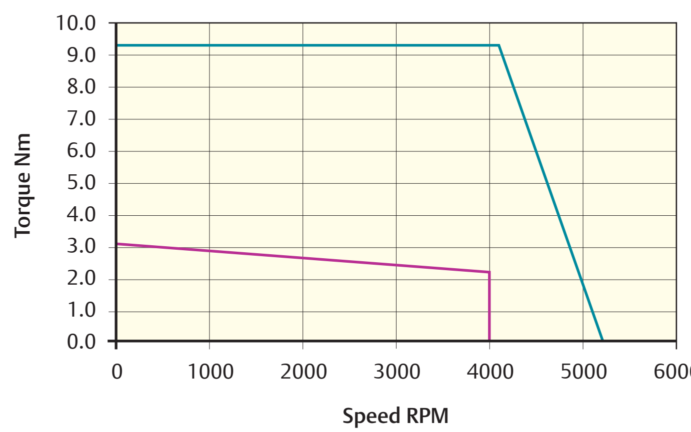
Peak torque (Nm) = **11.7** Stall torque (Nm) = **3.9** Rated torque (Nm) = **3.5**

075U2A4000



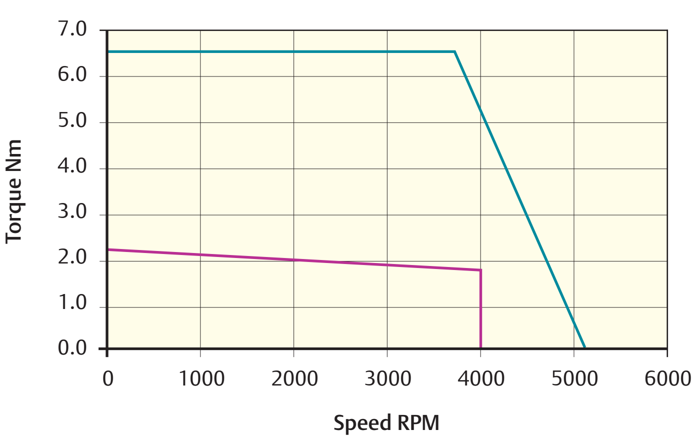
Peak torque (Nm) = **3.6** Stall torque (Nm) = **1.2** Rated torque (Nm) = **1.0**

075U2C4000



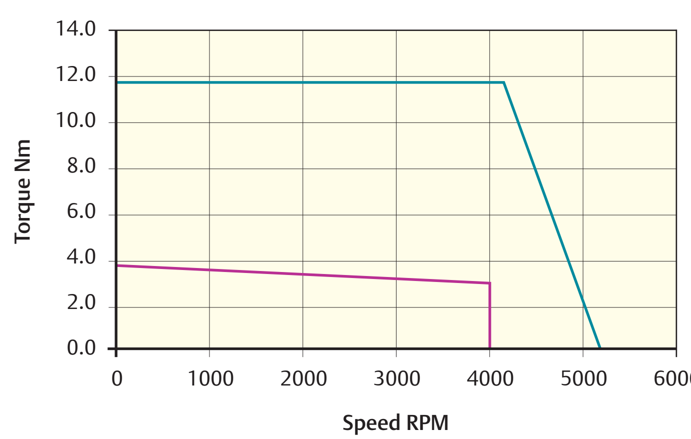
Peak torque (Nm) = **9.3** Stall torque (Nm) = **3.1** Rated torque (Nm) = **2.3**

075U2B4000



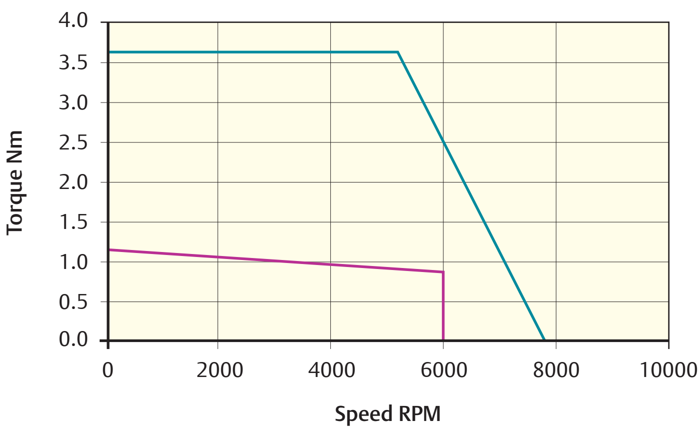
Peak torque (Nm) = **6.6** Stall torque (Nm) = **2.2** Rated torque (Nm) = **1.7**

075U2D4000



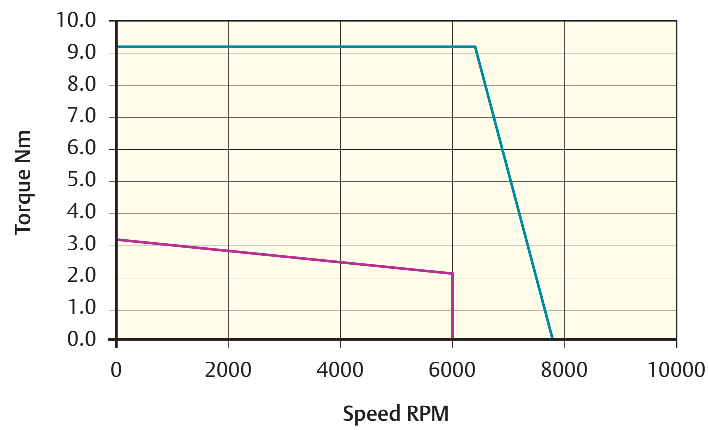
Peak torque (Nm) = **11.7** Stall torque (Nm) = **3.9** Rated torque (Nm) = **2.9**

075U2A6000



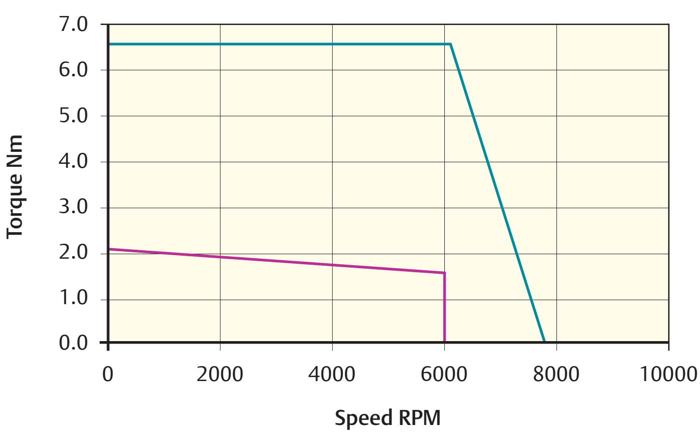
Peak torque (Nm) = **3.6** Stall torque (Nm) = **1.2** Rated torque (Nm) = **0.9**

075U2C6000



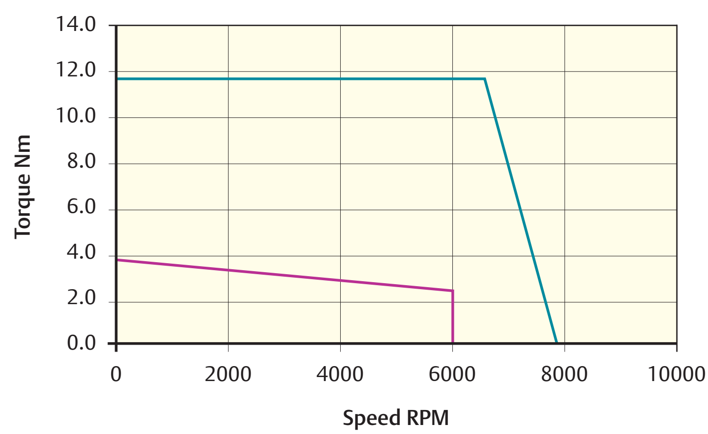
Peak torque (Nm) = **9.3** Stall torque (Nm) = **3.1** Rated torque (Nm) = **2.1**

075U2B6000



Peak torque (Nm) = **6.6** Stall torque (Nm) = **2.2** Rated torque (Nm) = **1.6**

075U2D6000

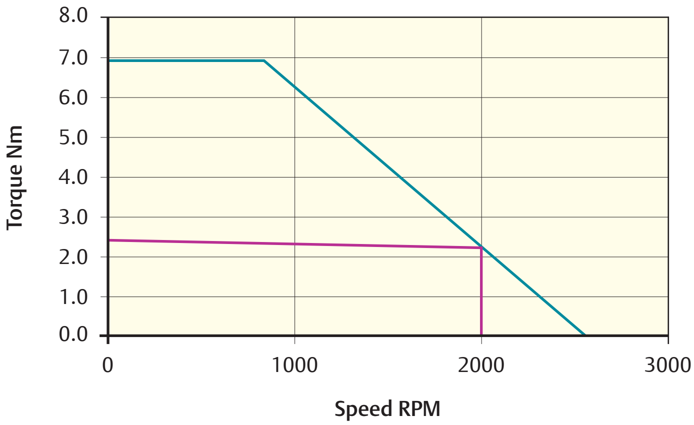


Peak torque (Nm) = **11.7** Stall torque (Nm) = **3.9** Rated torque (Nm) = **2.6**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

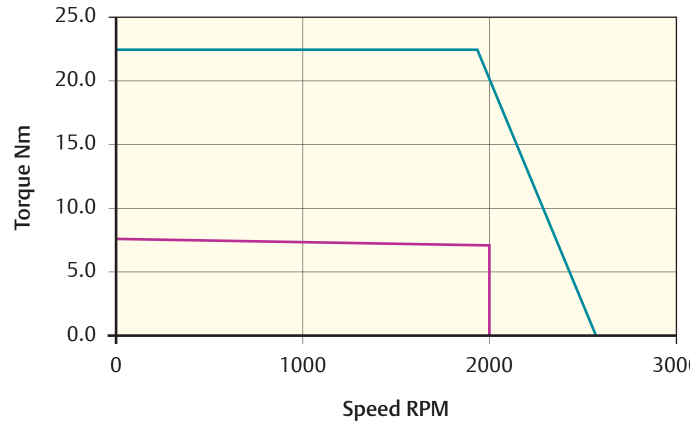
055-250 Unimotor fm Technical Data

095U2A2000



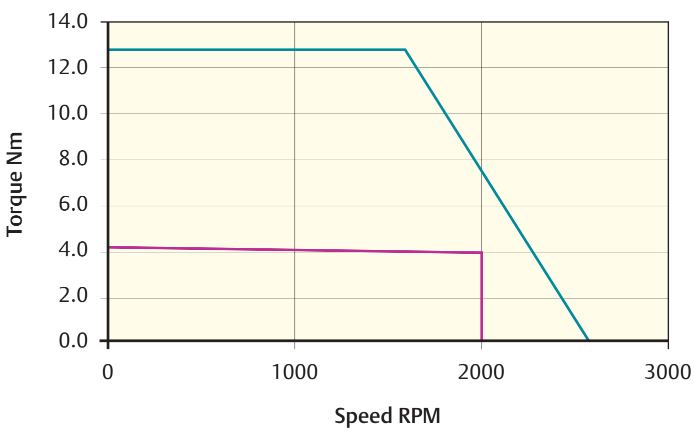
Peak torque (Nm) = **6.9** Stall torque (Nm) = **2.3** Rated torque (Nm) = **2.2**

095U2D2000



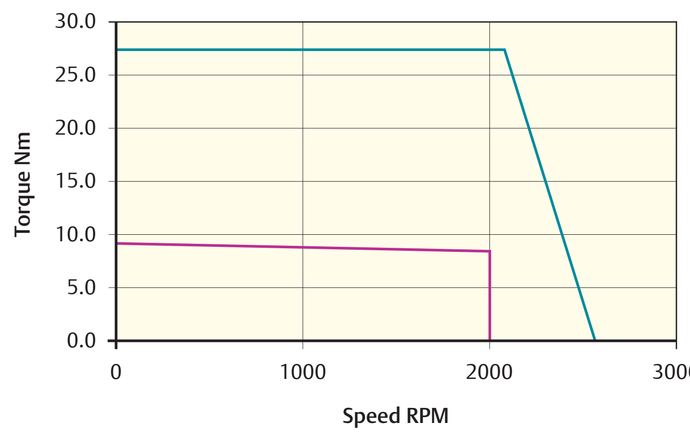
Peak torque (Nm) = **22.5** Stall torque (Nm) = **7.5** Rated torque (Nm) = **6.9**

095U2B2000



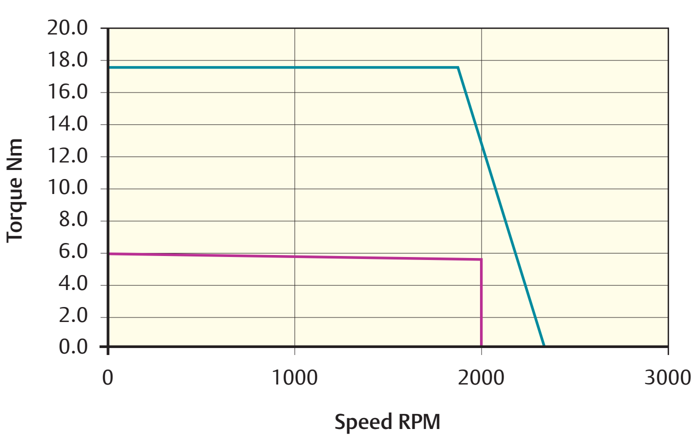
Peak torque (Nm) = **12.9** Stall torque (Nm) = **4.3** Rated torque (Nm) = **4.0**

095U2E2000



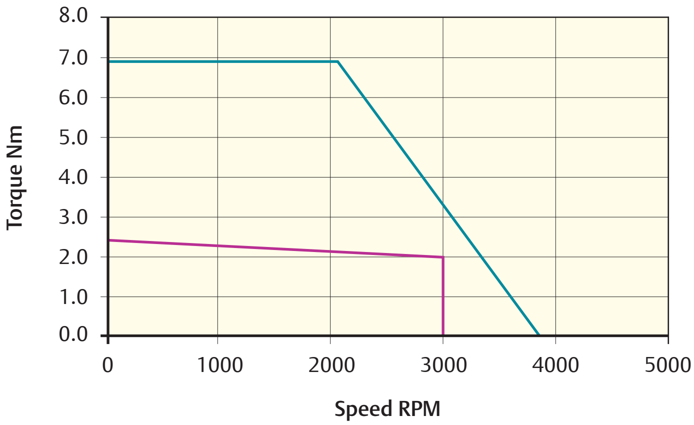
Peak torque (Nm) = **27.0** Stall torque (Nm) = **9.0** Rated torque (Nm) = **8.2**

095U2C2000



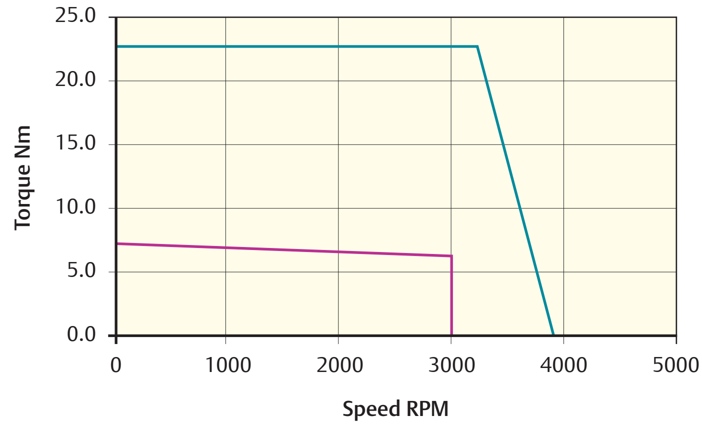
Peak torque (Nm) = **17.7** Stall torque (Nm) = **5.9** Rated torque (Nm) = **5.5**

095U2A3000



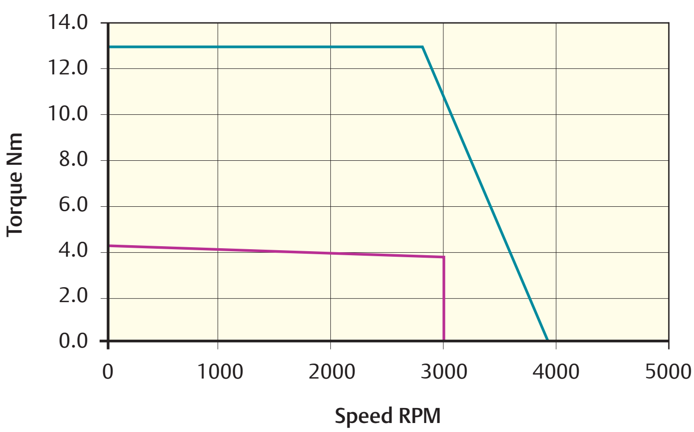
Peak torque (Nm) = **6.9** Stall torque (Nm) = **2.3** Rated torque (Nm) = **2.0**

095U2D3000



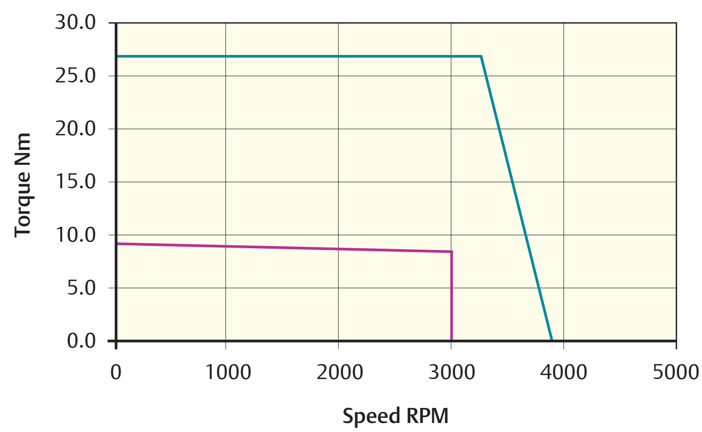
Peak torque (Nm) = **22.5** Stall torque (Nm) = **7.5** Rated torque (Nm) = **6.8**

095U2B3000



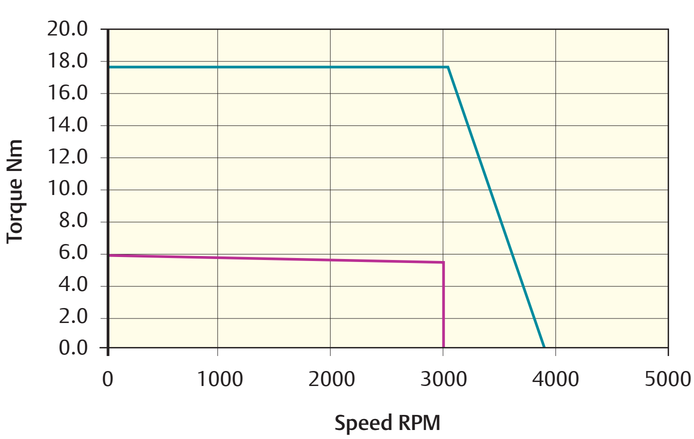
Peak torque (Nm) = **12.9** Stall torque (Nm) = **4.3** Rated torque (Nm) = **3.9**

095U2E3000



Peak torque (Nm) = **27.0** Stall torque (Nm) = **9.0** Rated torque (Nm) = **8.1**

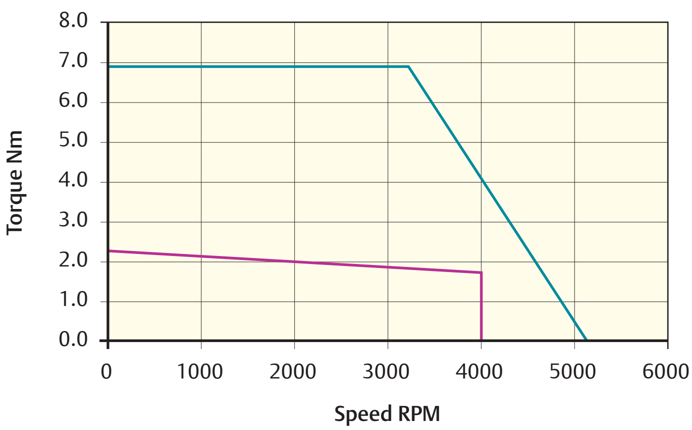
095U2C3000



Peak torque (Nm) = **17.7** Stall torque (Nm) = **5.9** Rated torque (Nm) = **5.4**

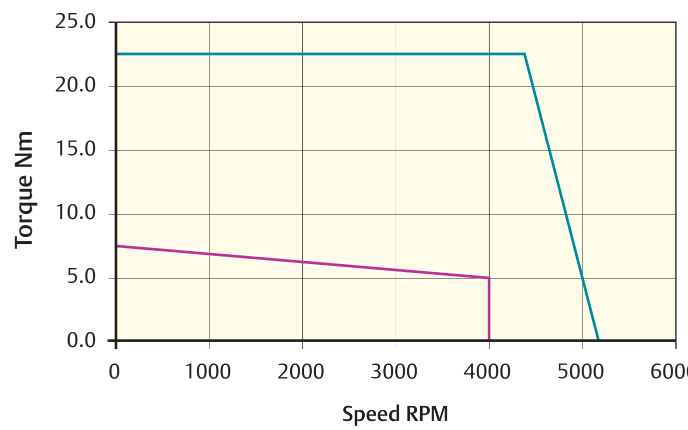
■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

095U2A4000



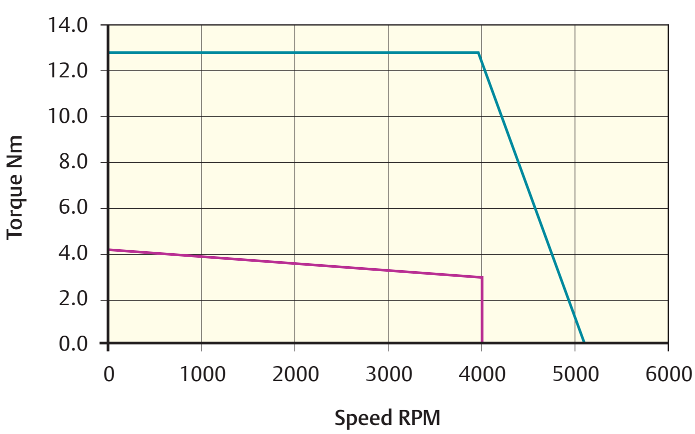
Peak torque (Nm) = **6.9** Stall torque (Nm) = **2.3** Rated torque (Nm) = **1.8**

095U2D4000



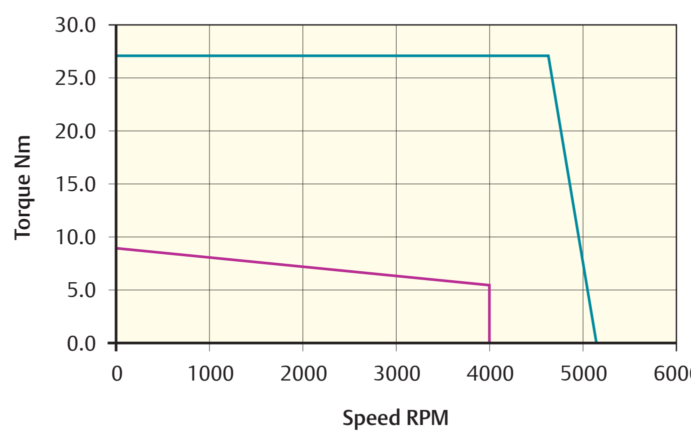
Peak torque (Nm) = **22.5** Stall torque (Nm) = **7.5** Rated torque (Nm) = **4.9**

095U2B4000



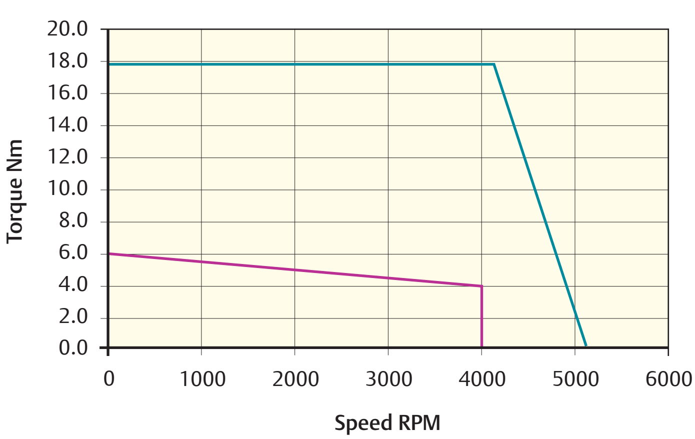
Peak torque (Nm) = **12.9** Stall torque (Nm) = **4.3** Rated torque (Nm) = **3.0**

095U2E4000



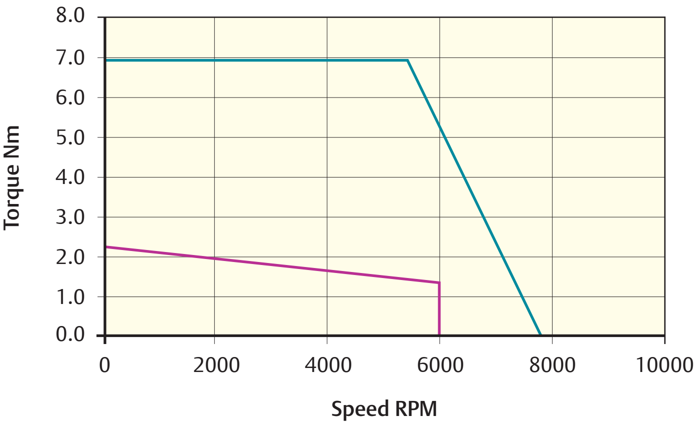
Peak torque (Nm) = **27.0** Stall torque (Nm) = **9.0** Rated torque (Nm) = **5.7**

095U2C4000



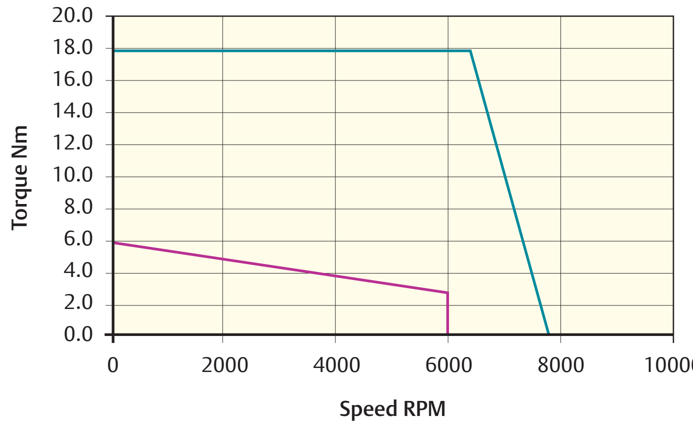
Peak torque (Nm) = **17.7** Stall torque (Nm) = **5.9** Rated torque (Nm) = **4.0**

095U2A6000



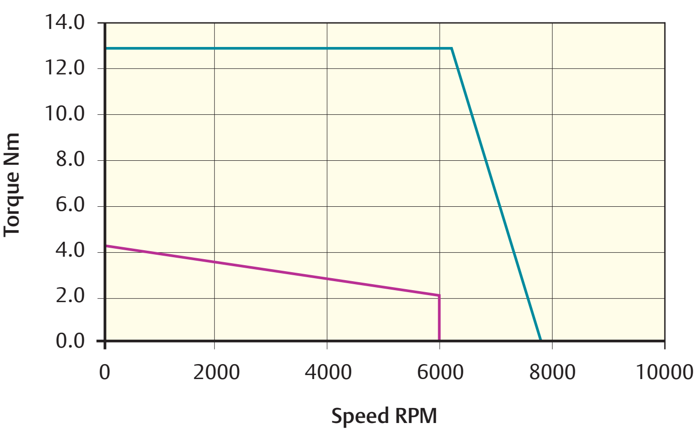
Peak torque (Nm) = **6.9** Stall torque (Nm) = **2.3** Rated torque (Nm) = **1.3**

095U2C6000



Peak torque (Nm) = **17.7** Stall torque (Nm) = **5.9** Rated torque (Nm) = **2.8**

095U2B6000

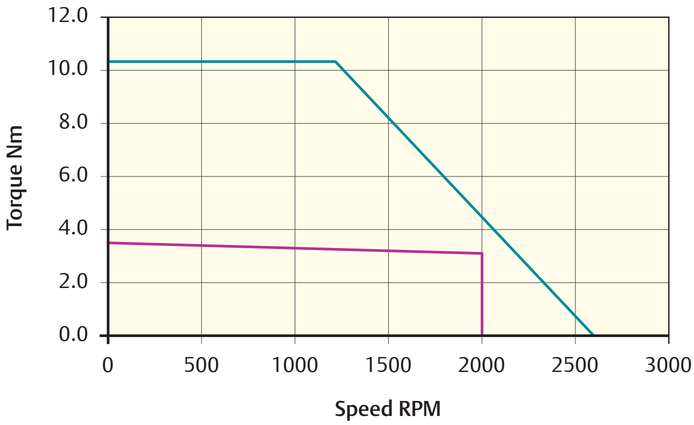


Peak torque (Nm) = **12.9** Stall torque (Nm) = **4.3** Rated torque (Nm) = **2.1**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

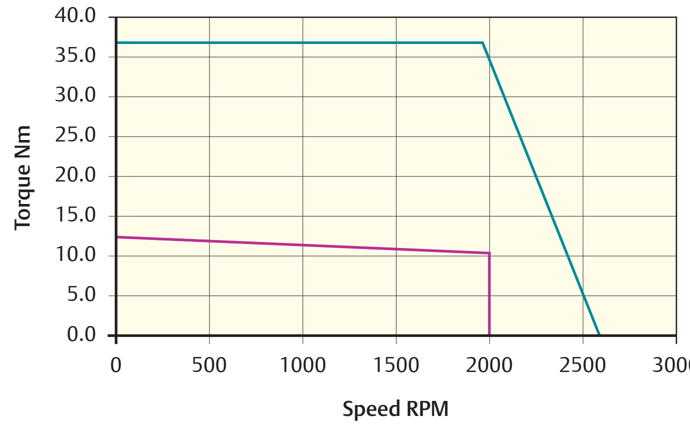
055-250 Unimotor fm Technical Data

115U2A2000



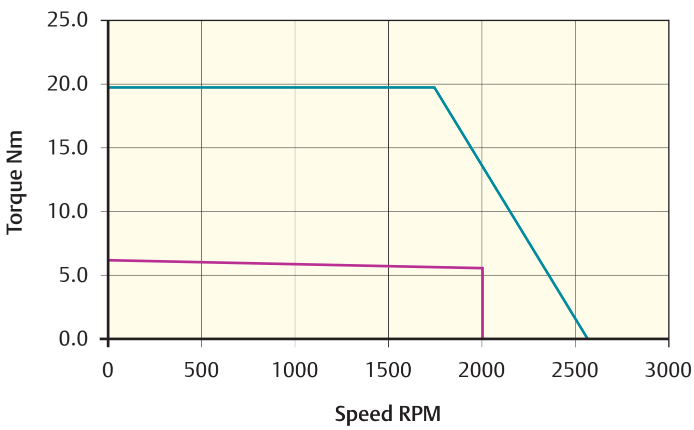
Peak torque (Nm) = **10.5** Stall torque (Nm) = **3.5** Rated torque (Nm) = **3.2**

115U2D2000



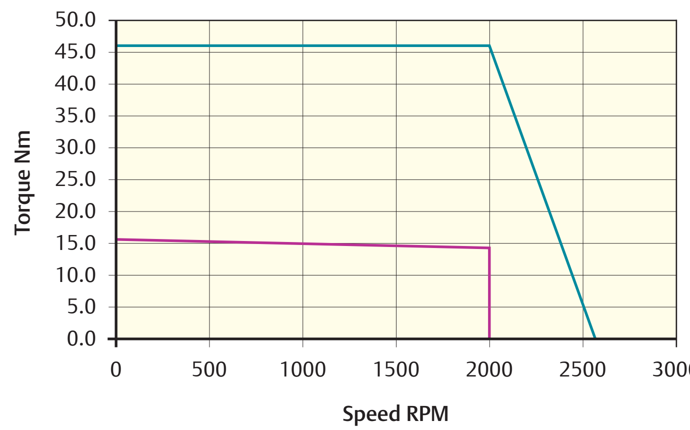
Peak torque (Nm) = **37.2** Stall torque (Nm) = **12.4** Rated torque (Nm) = **10.8**

115U2B2000



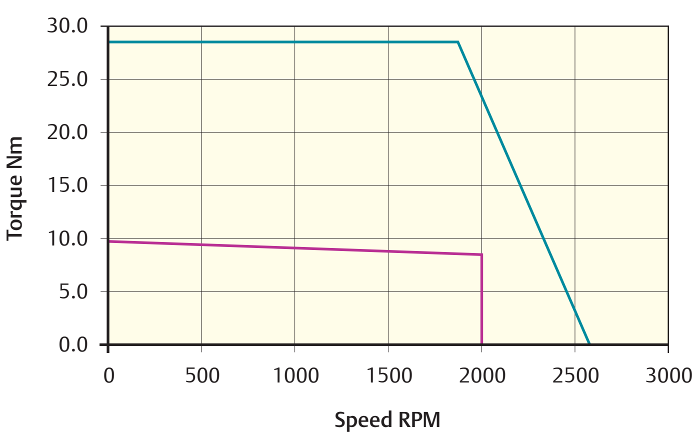
Peak torque (Nm) = **19.8** Stall torque (Nm) = **6.6** Rated torque (Nm) = **6.1**

115U2E2000



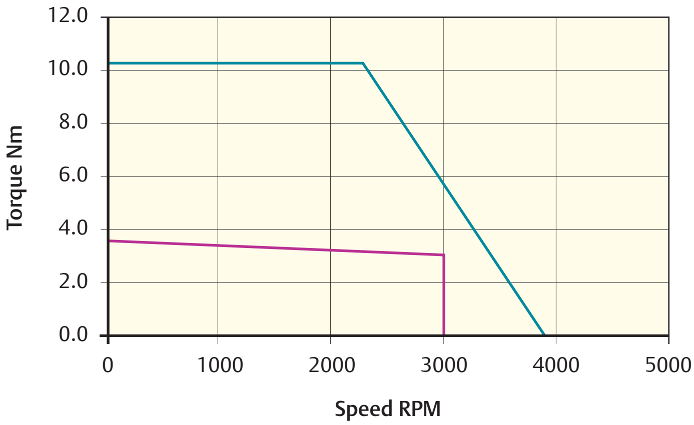
Peak torque (Nm) = **45.9** Stall torque (Nm) = **15.3** Rated torque (Nm) = **14.0**

115U2C2000



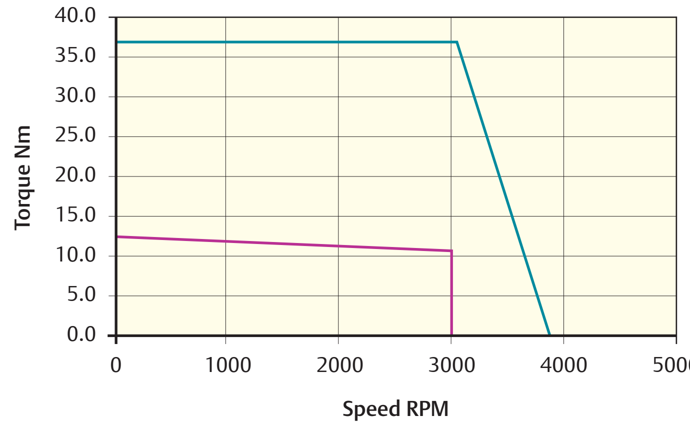
Peak torque (Nm) = **28.2** Stall torque (Nm) = **9.4** Rated torque (Nm) = **8.7**

115U2A3000



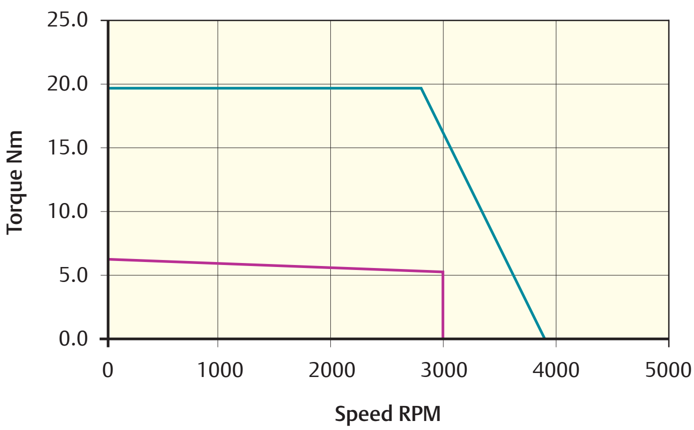
Peak torque (Nm) = **10.5** Stall torque (Nm) = **3.5** Rated torque (Nm) = **3.0**

115U2D3000



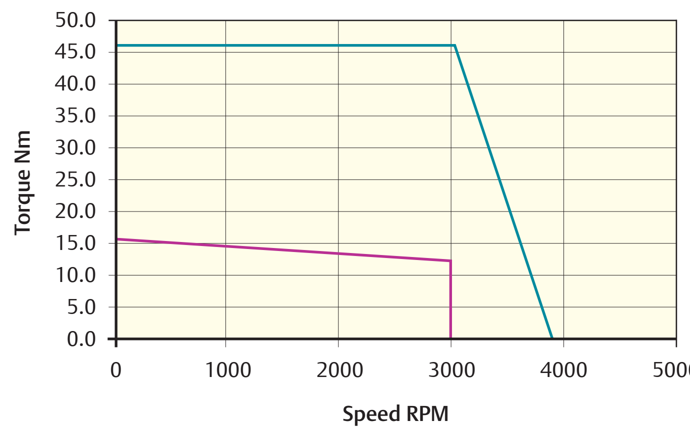
Peak torque (Nm) = **37.4** Stall torque (Nm) = **12.4** Rated torque (Nm) = **10.4**

115U2B3000



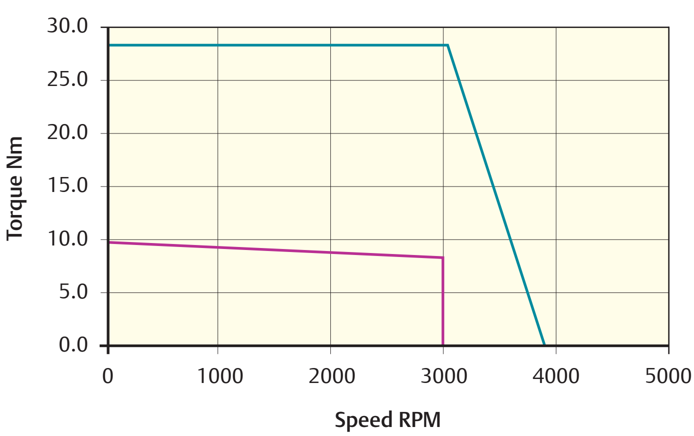
Peak torque (Nm) = **19.8** Stall torque (Nm) = **6.6** Rated torque (Nm) = **5.5**

115U2E3000



Peak torque (Nm) = **45.9** Stall torque (Nm) = **15.3** Rated torque (Nm) = **12.6**

115U2C3000

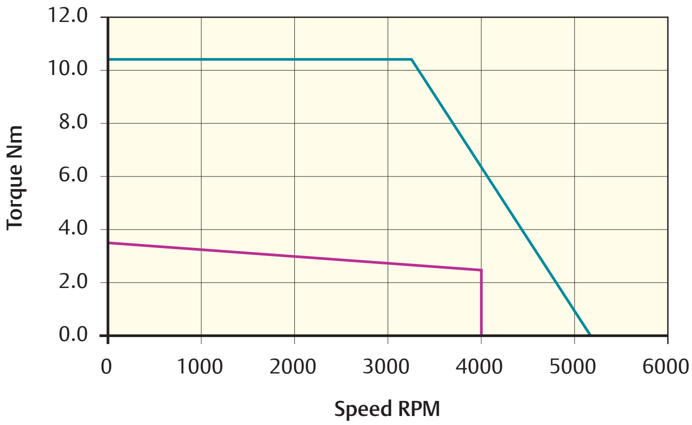


Peak torque (Nm) = **28.2** Stall torque (Nm) = **9.4** Rated torque (Nm) = **8.1**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

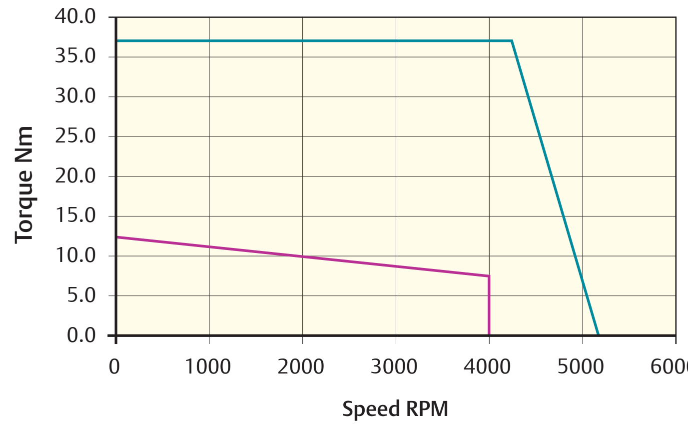
055-250 Unimotor fm Technical Data

115U2A4000



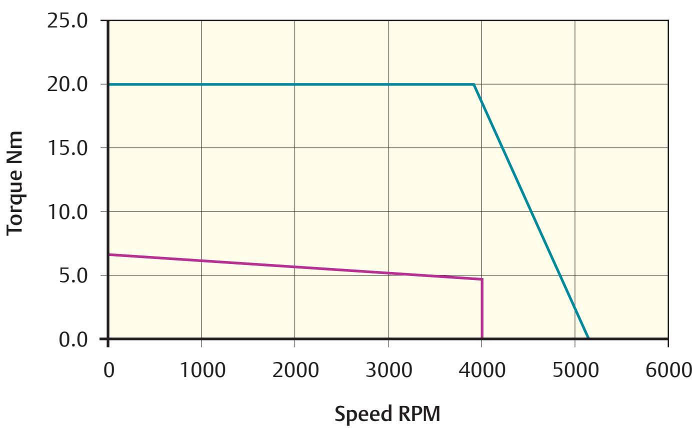
Peak torque (Nm) = **10.5** Stall torque (Nm) = **3.5** Rated torque (Nm) = **2.5**

115U2D4000



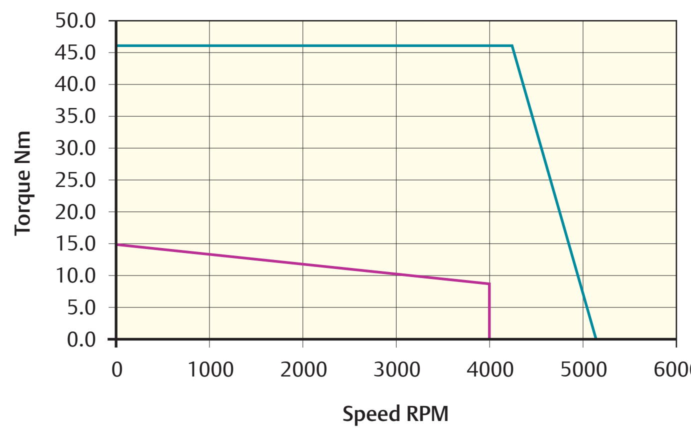
Peak torque (Nm) = **37.2** Stall torque (Nm) = **12.4** Rated torque (Nm) = **7.5**

115U2B4000



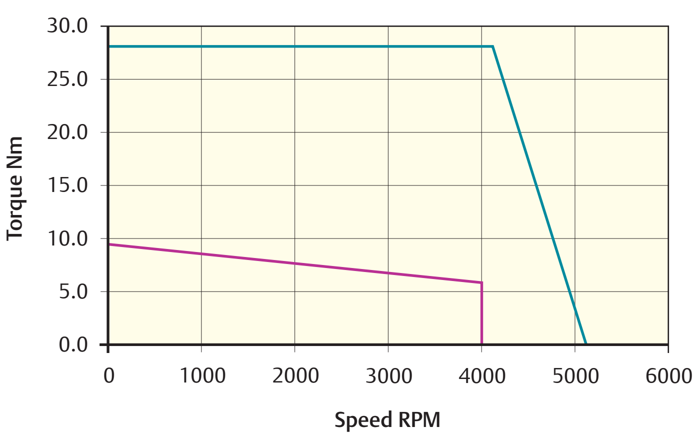
Peak torque (Nm) = **19.8** Stall torque (Nm) = **6.6** Rated torque (Nm) = **4.7**

115U2E4000



Peak torque (Nm) = **45.9** Stall torque (Nm) = **15.3** Rated torque (Nm) = **8.7**

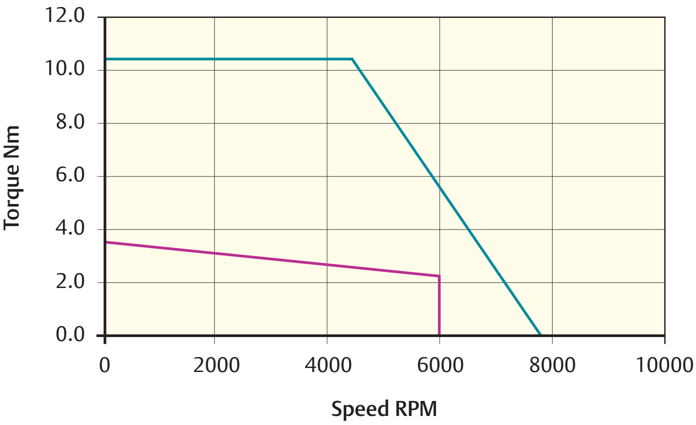
115U2C4000



Peak torque (Nm) = **28.2** Stall torque (Nm) = **9.4** Rated torque (Nm) = **6.3**

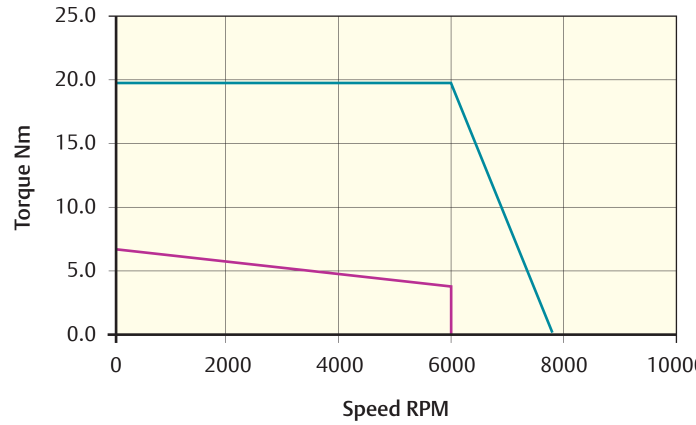
■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

115U2A6000



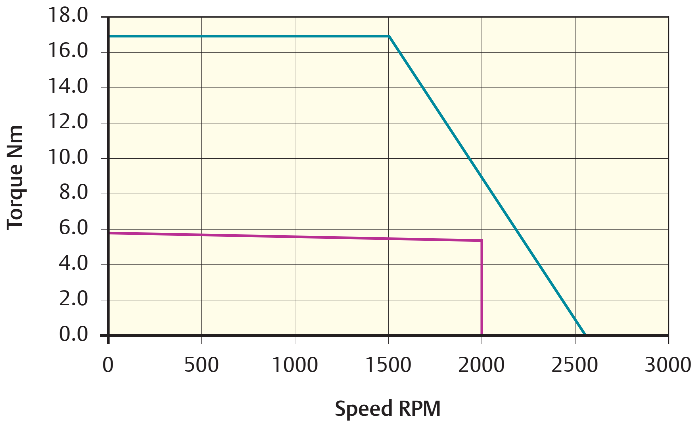
Peak torque (Nm) = **10.5** Stall torque (Nm) = **3.5** Rated torque (Nm) = **2.2**

115U2B6000



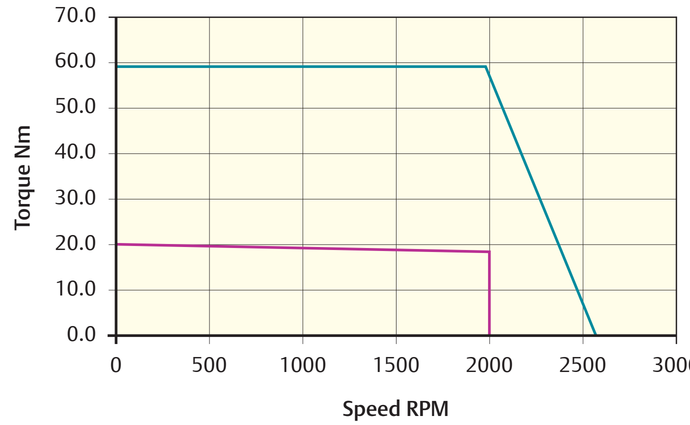
Peak torque (Nm) = **19.8** Stall torque (Nm) = **6.6** Rated torque (Nm) = **4.0**

142U2A2000



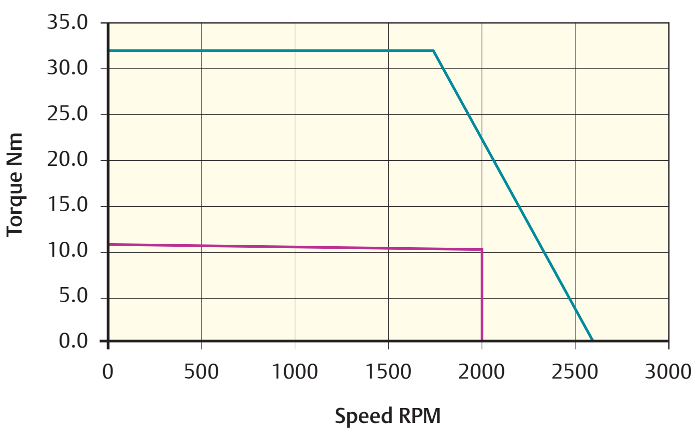
Peak torque (Nm) = **17.1**   Stall torque (Nm) = **5.7**   Rated torque (Nm) = **5.3**

142U2D2000



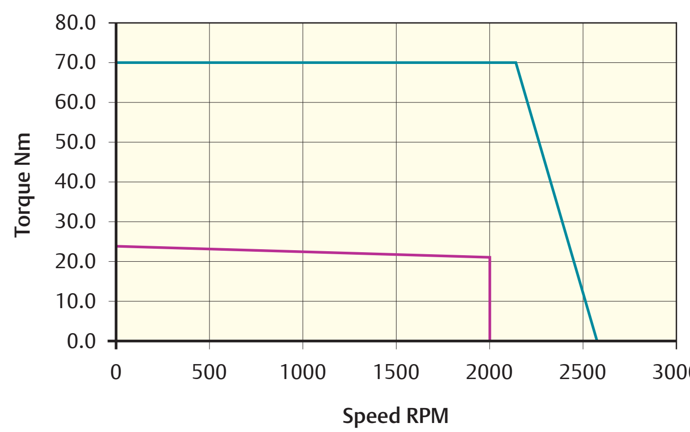
Peak torque (Nm) = **59.4**   Stall torque (Nm) = **19.8**   Rated torque (Nm) = **18.4**

142U2B2000



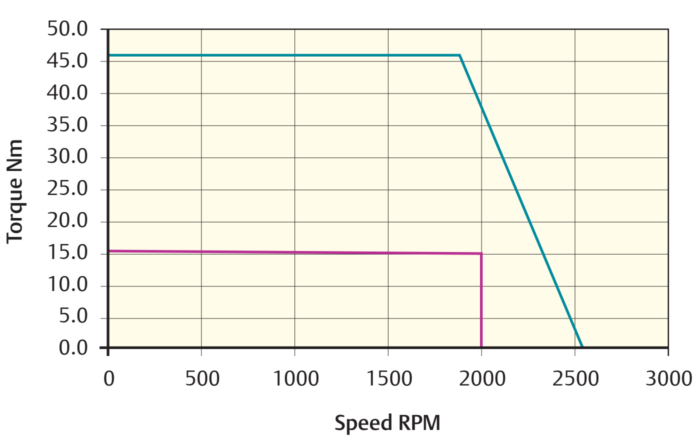
Peak torque (Nm) = **32.4**   Stall torque (Nm) = **10.8**   Rated torque (Nm) = **10.3**

142U2E2000



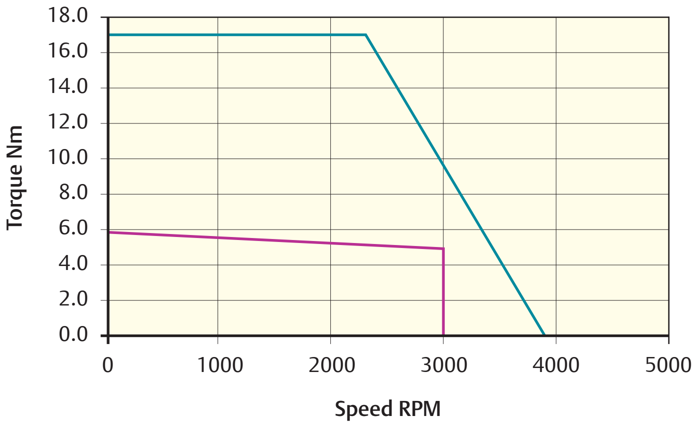
Peak torque (Nm) = **70.4**   Stall torque (Nm) = **23.4**   Rated torque (Nm) = **21.3**

142U2C2000



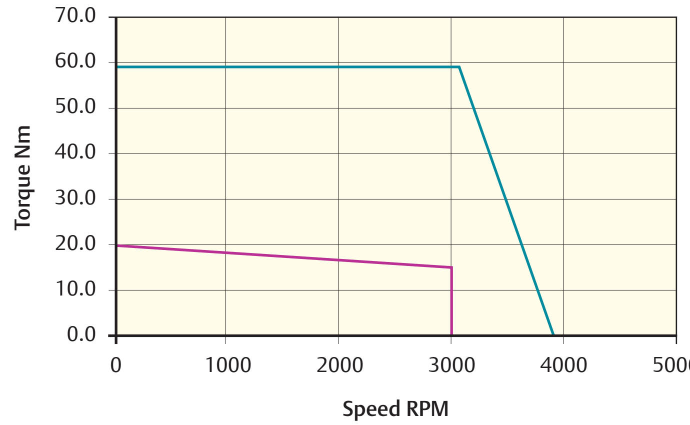
Peak torque (Nm) = **45.9**   Stall torque (Nm) = **15.3**   Rated torque (Nm) = **14.6**

142U2A3000



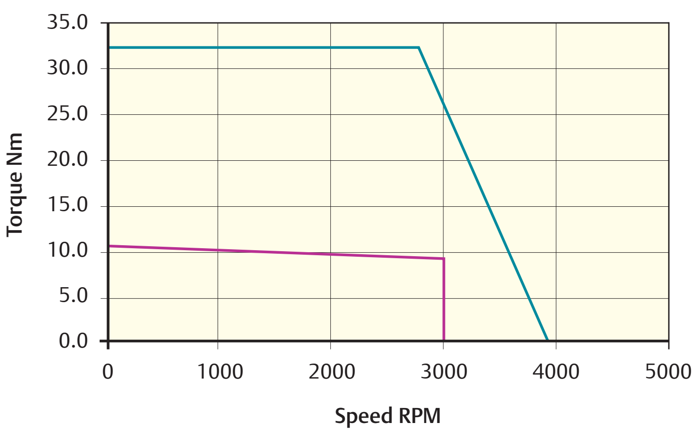
Peak torque (Nm) = **17.1** Stall torque (Nm) = **5.7** Rated torque (Nm) = **4.9**

142U2D3000



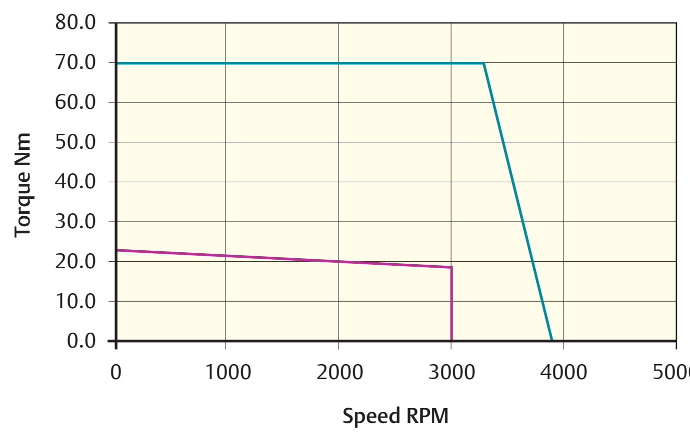
Peak torque (Nm) = **59.4** Stall torque (Nm) = **19.8** Rated torque (Nm) = **15.8**

142U2B3000



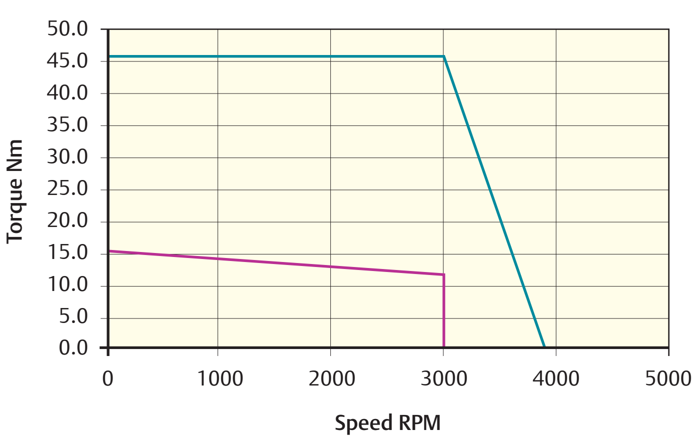
Peak torque (Nm) = **32.4** Stall torque (Nm) = **10.8** Rated torque (Nm) = **9.0**

142U2E3000



Peak torque (Nm) = **70.2** Stall torque (Nm) = **23.4** Rated torque (Nm) = **18.0**

142U2C3000

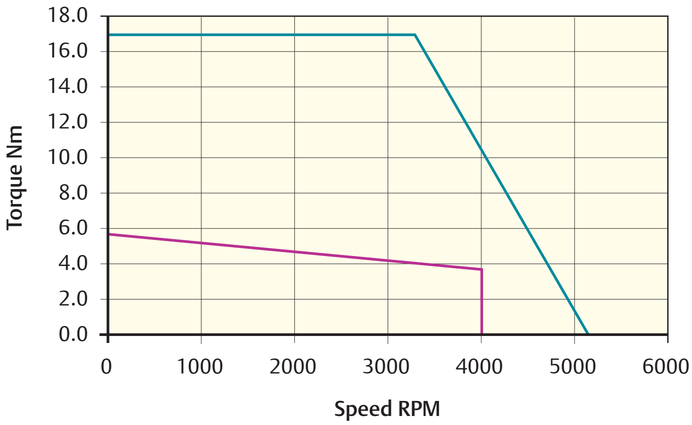


Peak torque (Nm) = **45.9** Stall torque (Nm) = **15.3** Rated torque (Nm) = **12.2**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

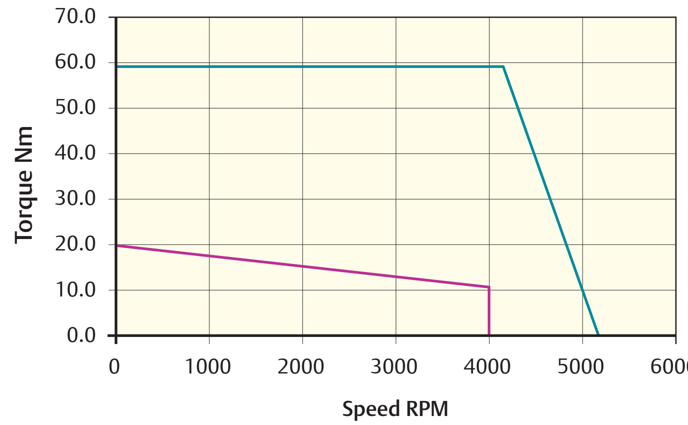
055-250 Unimotor Technical Data

142U2A4000



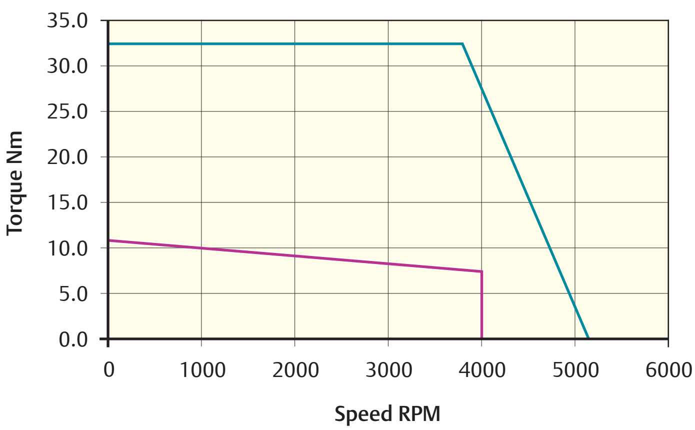
Peak torque (Nm) = **17.1** Stall torque (Nm) = **5.7** Rated torque (Nm) = **3.6**

142U2D4000



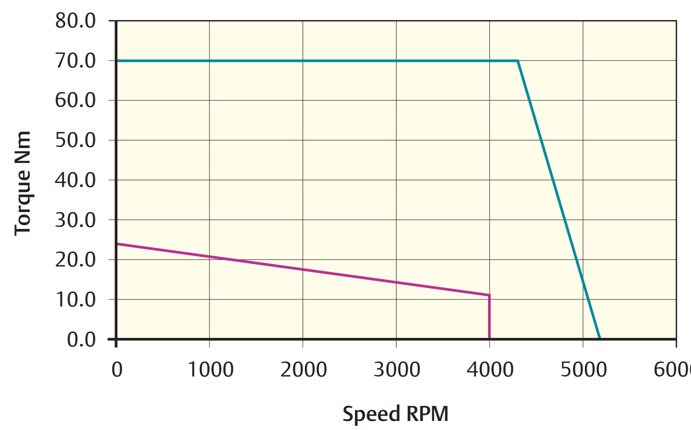
Peak torque (Nm) = **59.4** Stall torque (Nm) = **19.8** Rated torque (Nm) = **10.7**

142U2C4000



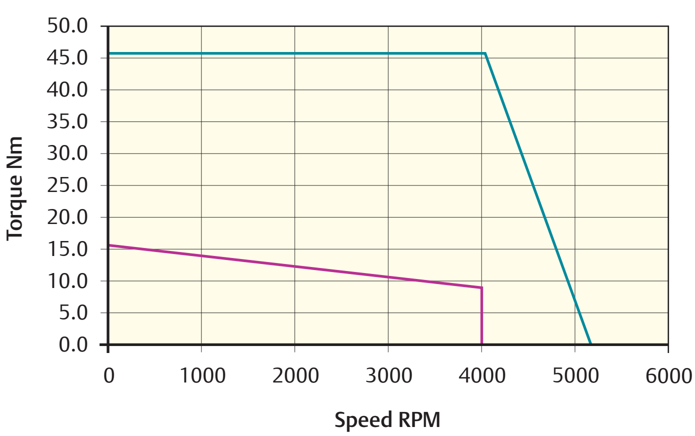
Peak torque (Nm) = **32.4** Stall torque (Nm) = **10.8** Rated torque (Nm) = **7.0**

142U2E4000



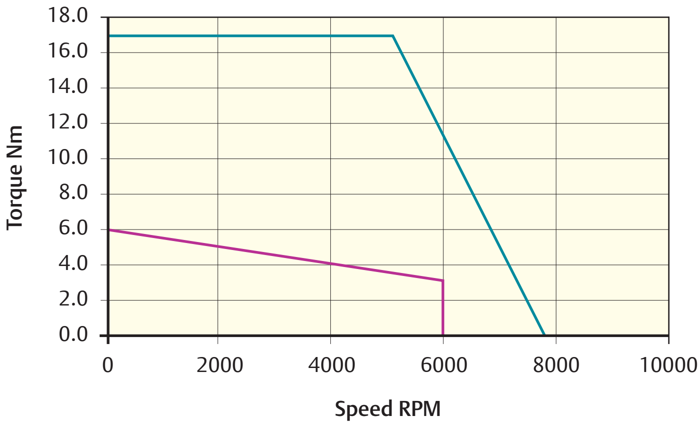
Peak torque (Nm) = **9.3** Stall torque (Nm) = **3.1** Rated torque (Nm) = **2.3**

142U2C4000



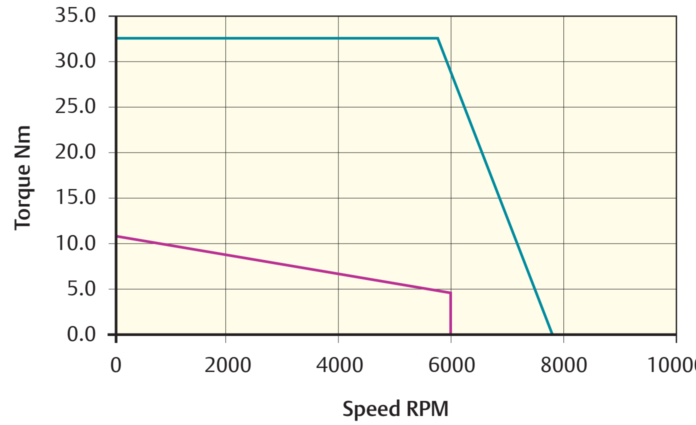
Peak torque (Nm) = **45.9** Stall torque (Nm) = **15.3** Rated torque (Nm) = **8.9**

142U2A6000



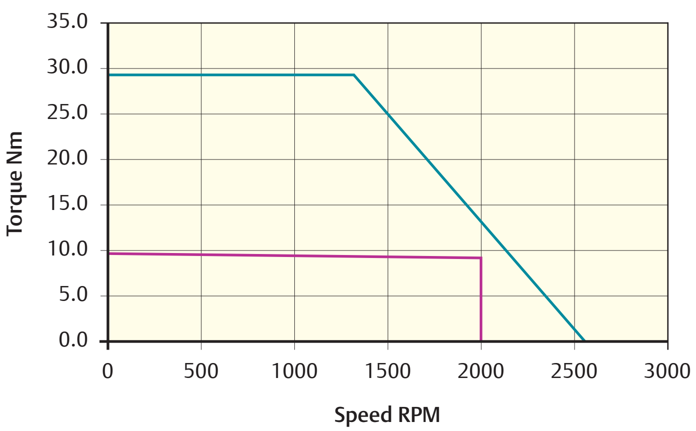
Peak torque (Nm) = **17.1** Stall torque (Nm) = **5.7** Rated torque (Nm) = **2.9**

142U2B6000



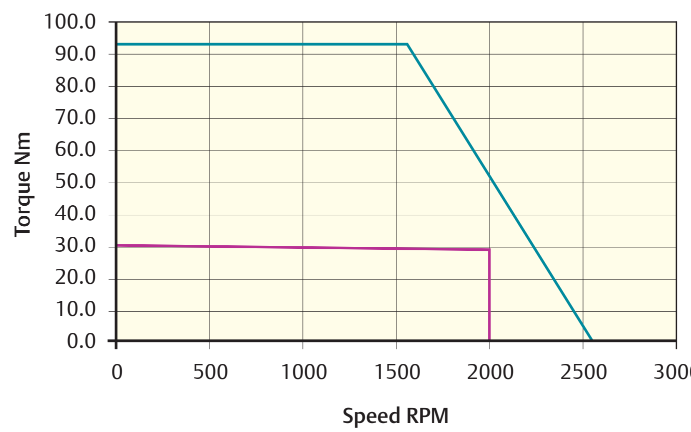
Peak torque (Nm) = **32.4** Stall torque (Nm) = **10.8** Rated torque (Nm) = **4.5**

190U2A2000



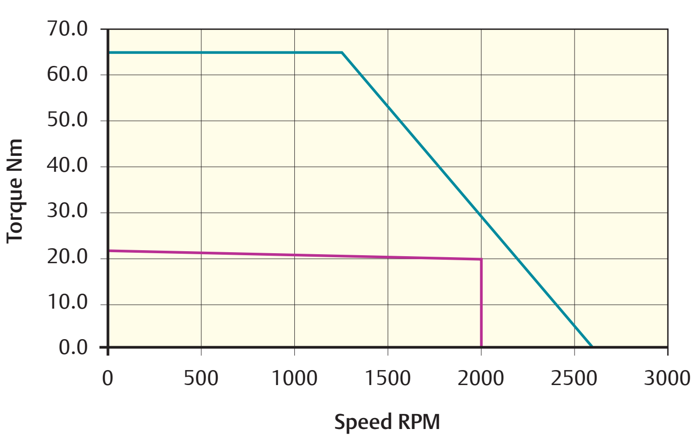
Peak torque (Nm) = **28.2** Stall torque (Nm) = **9.6** Rated torque (Nm) =9.3

190U2C2000



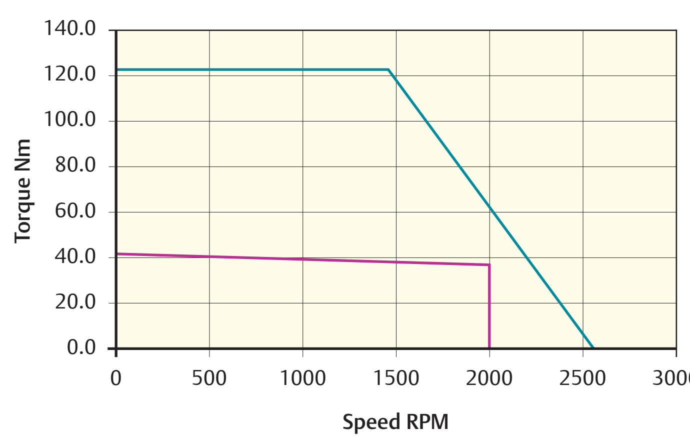
Peak torque (Nm) = **93.3** Stall torque (Nm) = **31.1** Rated torque (Nm) = **28.4**

190U2B2000



Peak torque (Nm) = **65.4** Stall torque (Nm) = **21.8** Rated torque (Nm) = **20.0**

190U2D2000

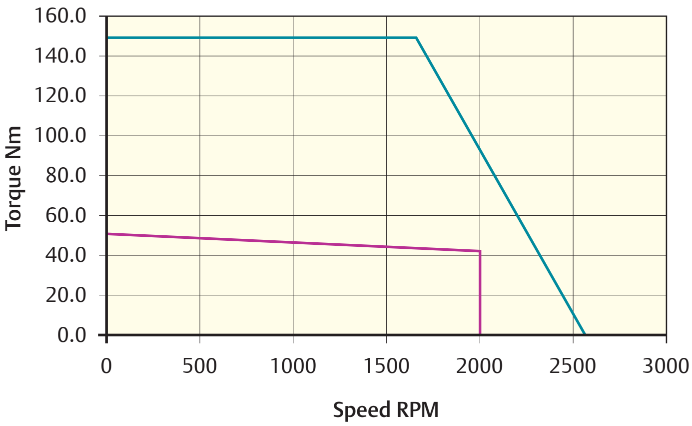


Peak torque (Nm) = **123.3** Stall torque (Nm) = **41.1** Rated torque (Nm) = **36.9**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

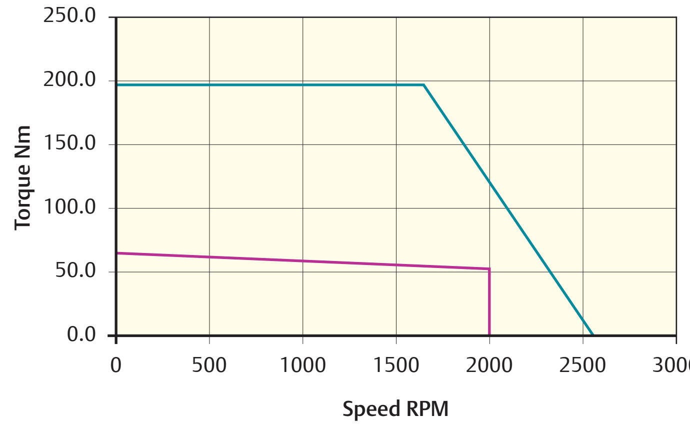
055-250 Unimotor fm Technical Data

190U2E2000



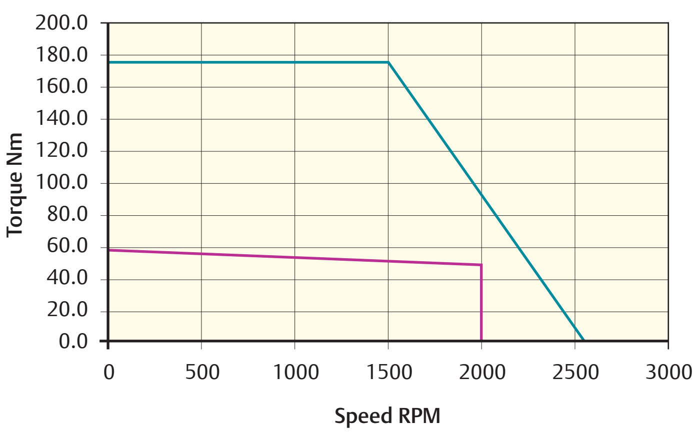
Peak torque (Nm) = **151.6** Stall torque (Nm) = **50.6** Rated torque (Nm) = **43.8**

190U2G2000



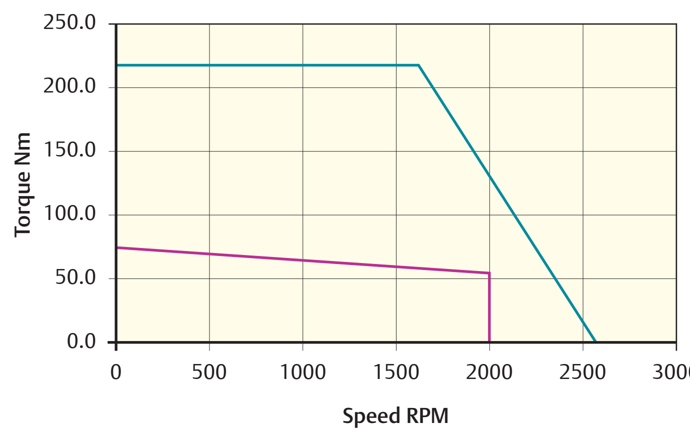
Peak torque (Nm) = **198.0** Stall torque (Nm) = **66.0** Rated torque (Nm) = **53.0**

190U2F2000



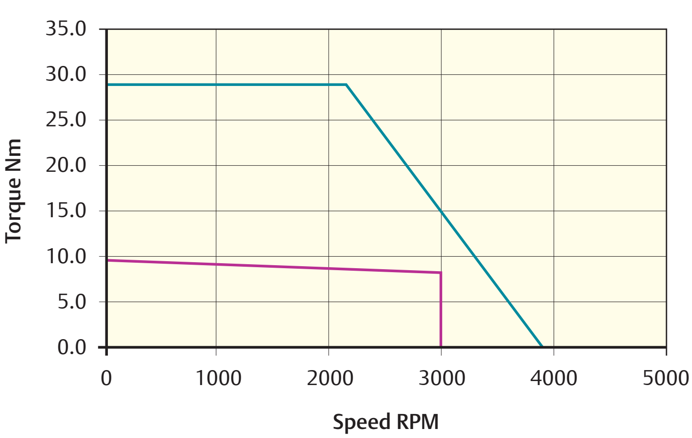
Peak torque (Nm) = **176.1** Stall torque (Nm) = **58.7** Rated torque (Nm) = **50.4**

190U2H2000



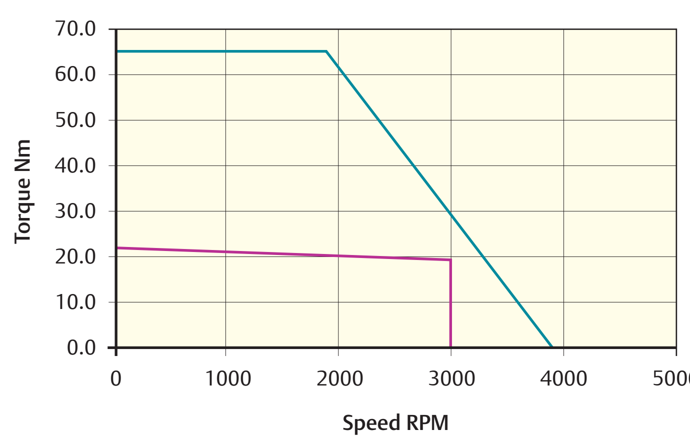
Peak torque (Nm) = **219.6** Stall torque (Nm) = **73.2** Rated torque (Nm) = **54.7**

190U2A3000



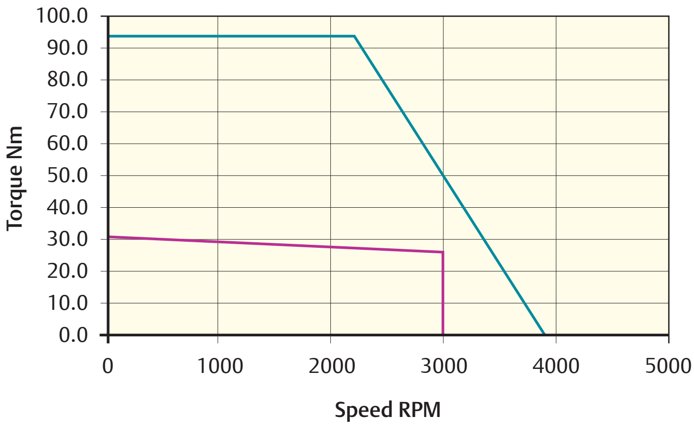
Peak torque (Nm) = **28.8** Stall torque (Nm) = **9.6** Rated torque (Nm) = **8.7**

190U2B3000



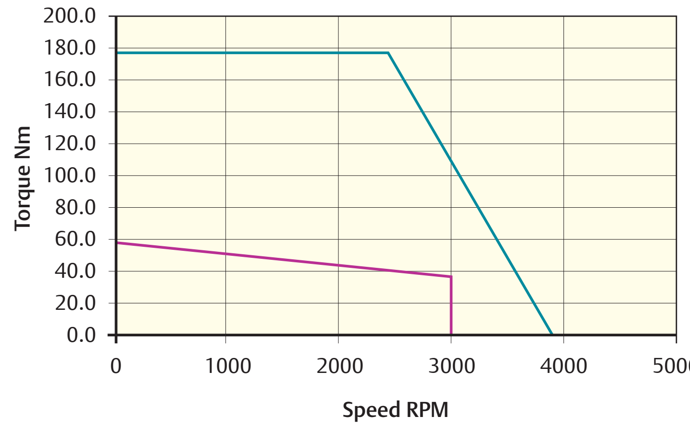
Peak torque (Nm) = **65.4** Stall torque (Nm) = **21.8** Rated torque (Nm) = **19.5**

190U2C3000



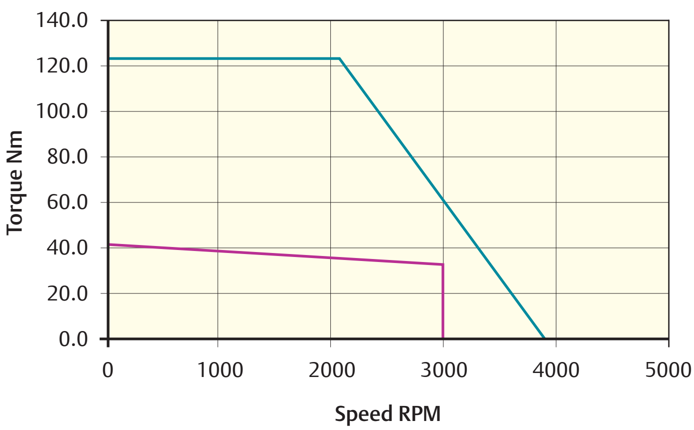
Peak torque (Nm) = **93.3** Stall torque (Nm) = **31.1** Rated torque (Nm) = **25.0**

190U2F3000



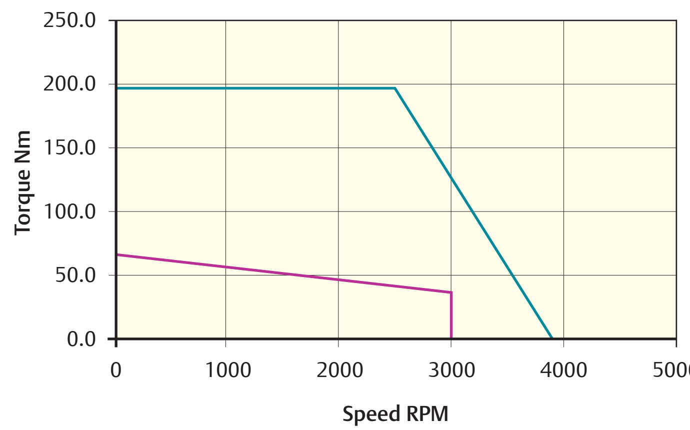
Peak torque (Nm) = **176.1** Stall torque (Nm) = **58.7** Rated torque (Nm) = **35.0**

190U2D3000



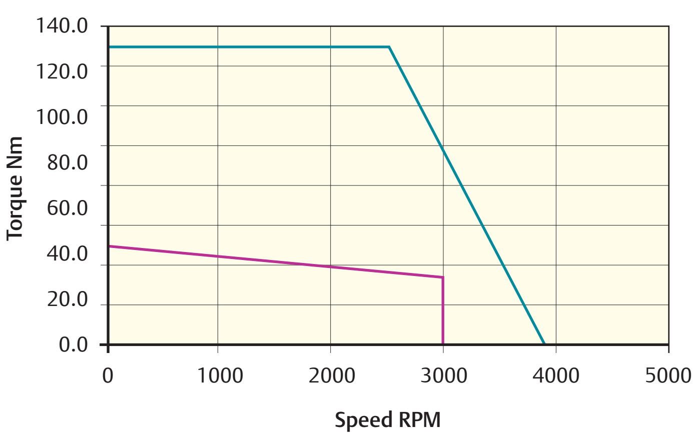
Peak torque (Nm) = **123.3** Stall torque (Nm) = **41.1** Rated torque (Nm) = **33.0**

190U2G3000



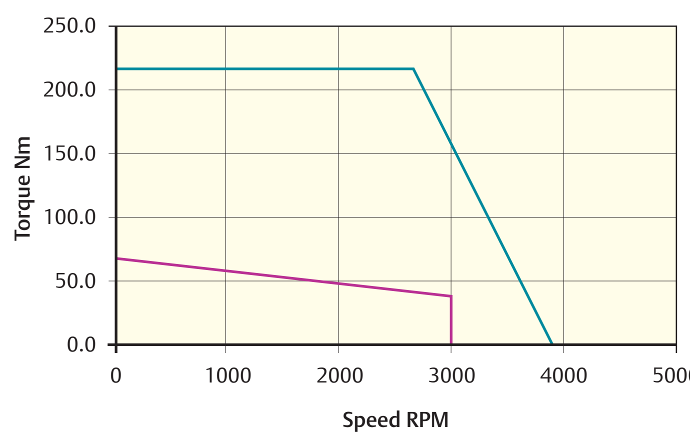
Peak torque (Nm) = **198.0** Stall torque (Nm) = **66.0** Rated torque (Nm) = **36.0**

190U2E3000



Peak torque (Nm) = **151.6** Stall torque (Nm) = **50.6** Rated torque (Nm) = **34.0**

190U2H3000

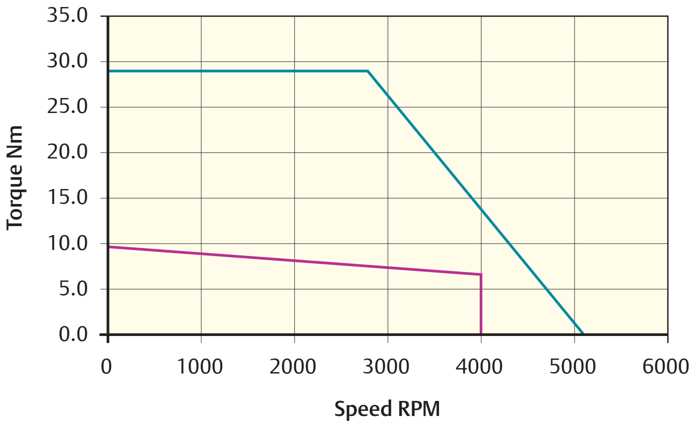


Peak torque (Nm) = **219.6** Stall torque (Nm) = **73.2** Rated torque (Nm) = 36.8

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

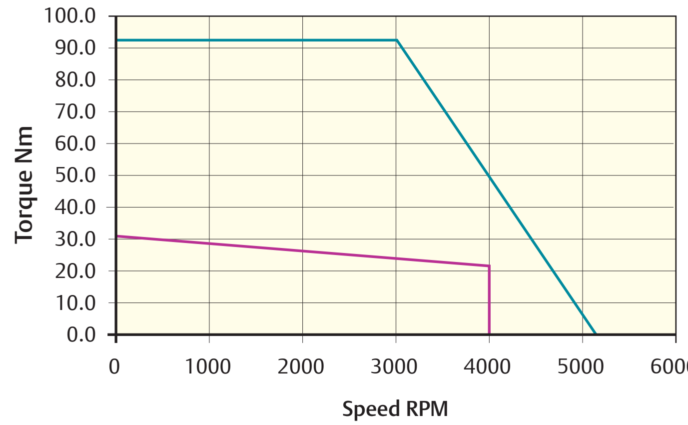
055-250 Unimotor fm Technical Data

190U2A4000



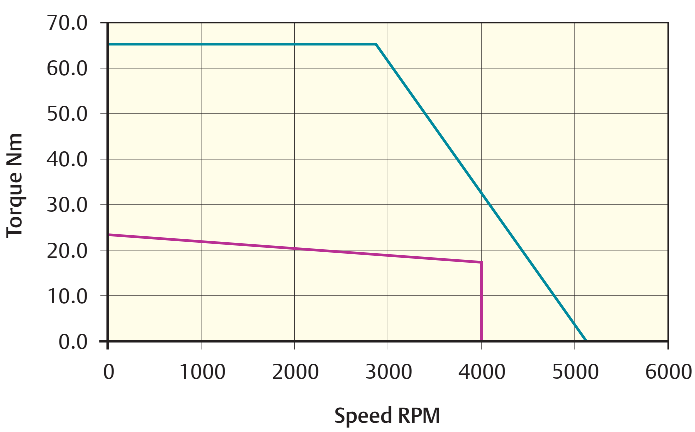
Peak torque (Nm) = **28.8** Stall torque (Nm) = **9.6** Rated torque (Nm) = **7.0**

190U2C4000



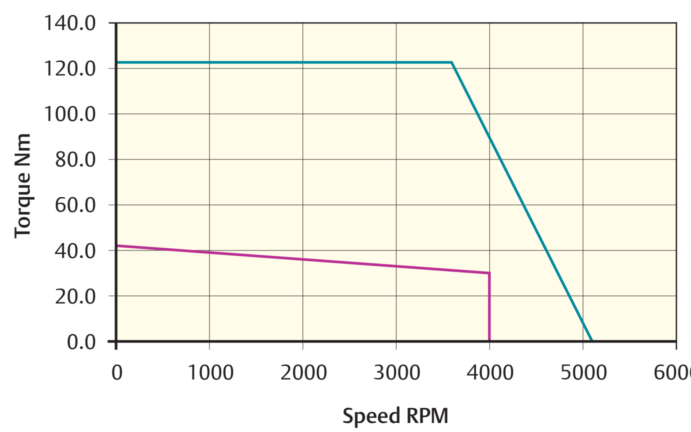
Peak torque (Nm) = **93.3** Stall torque (Nm) = **31.1** Rated torque (Nm) = **21.5**

190U2B4000



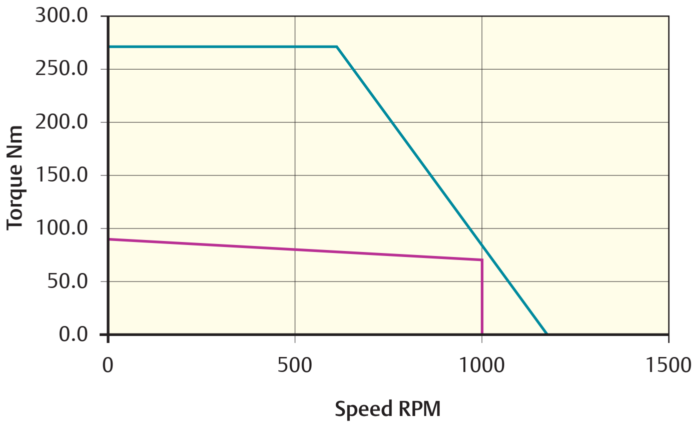
Peak torque (Nm) = **65.4** Stall torque (Nm) = **21.8** Rated torque (Nm) = **17.5**

190U2D4000



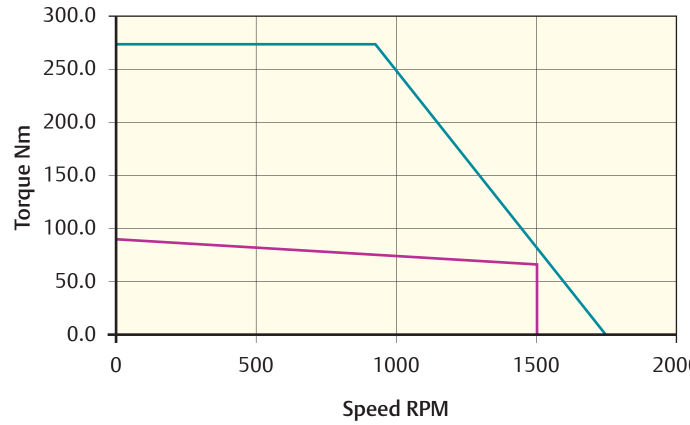
Peak torque (Nm) = **123.3** Stall torque (Nm) = **41.1** Rated torque (Nm) = **29.0**

250U2D1000



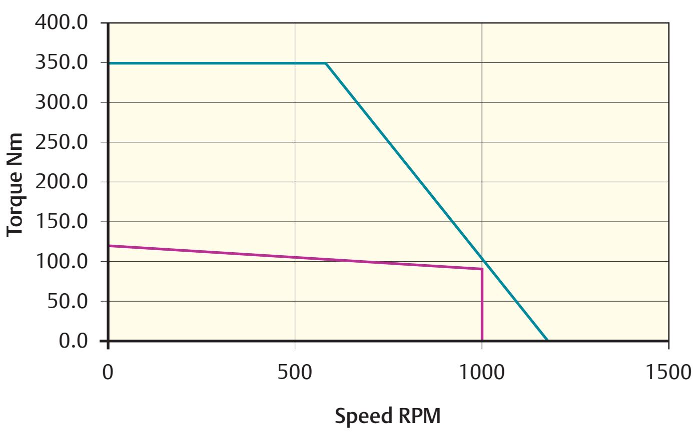
Peak torque (Nm) = **276.0** Stall torque (Nm) = **92.0** Rated torque (Nm) = **75.0**

250U2D1500



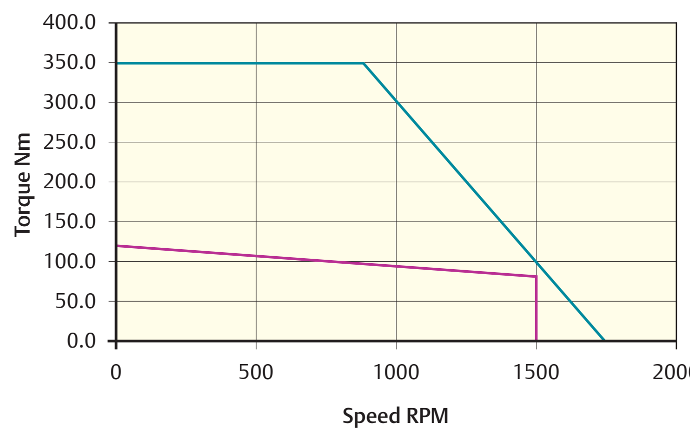
Peak torque (Nm) = **276.0** Stall torque (Nm) = **92.0** Rated torque (Nm) = **67.0**

250U2E1000



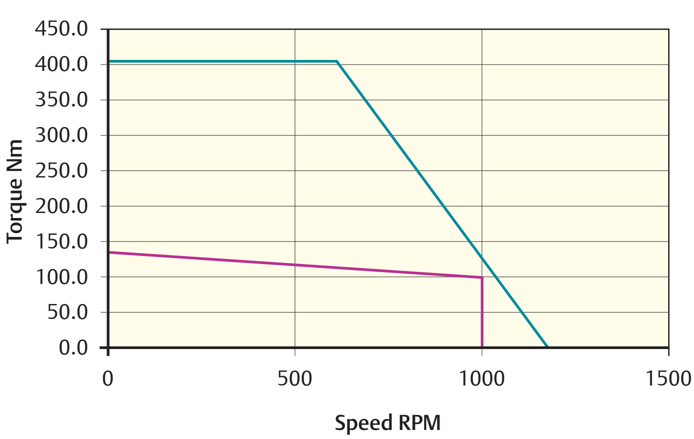
Peak torque (Nm) = **348.0** Stall torque (Nm) = **116.0** Rated torque (Nm) = **92.0**

250U2E1500



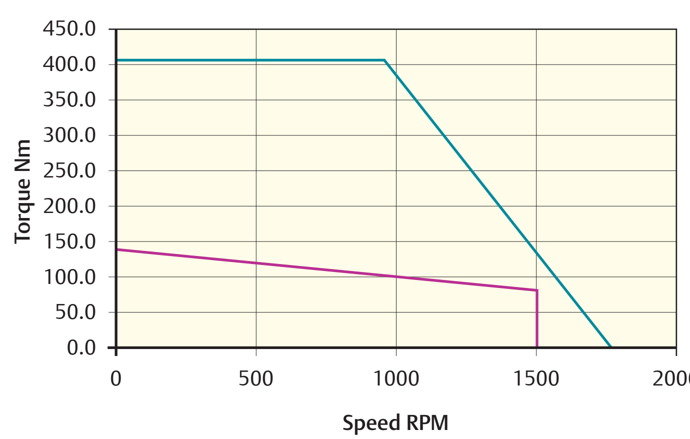
Peak torque (Nm) = **348.0** Stall torque (Nm) = **116.0** Rated torque (Nm) = **76.0**

250U2F1000



Peak torque (Nm) = **408.0** Stall torque (Nm) = **136.0** Rated torque (Nm) = **106.0**

250U2F1500

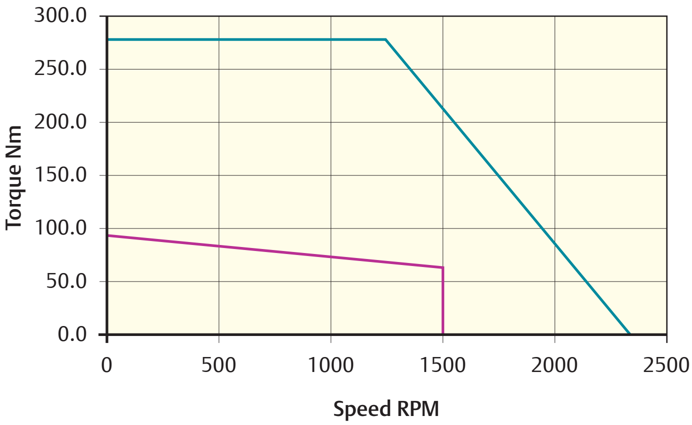


Peak torque (Nm) = **408.0** Stall torque (Nm) = **136.0** Rated torque (Nm) = **84.0**

■ **Continuous zone** ■ **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

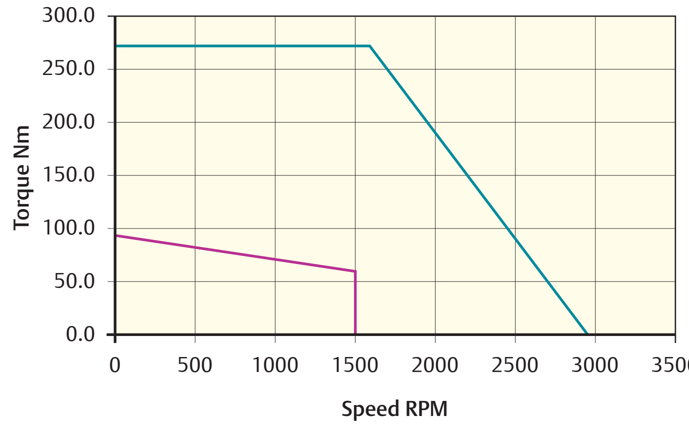
055-250 Unimotor fm Technical Data

250U2D2000



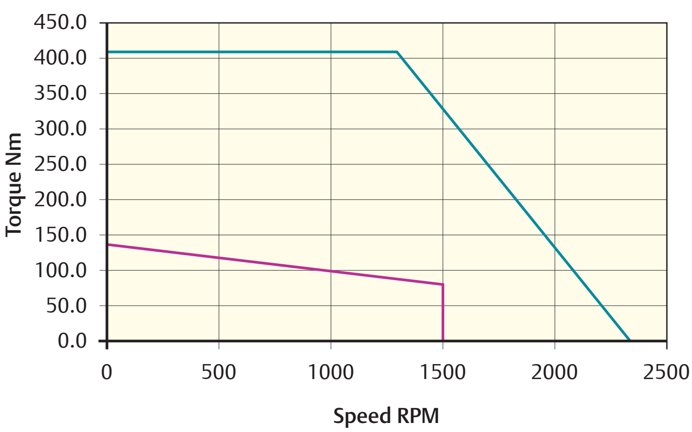
Peak torque (Nm) = **276.0** Stall torque (Nm) = **92.0** Rated torque (Nm) = **65.0**

250U2D2500



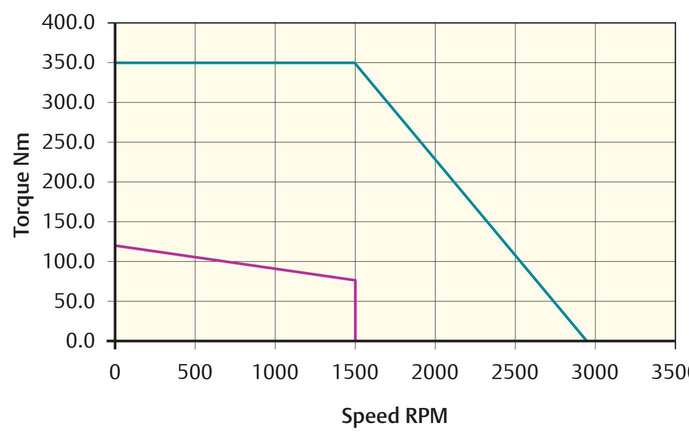
Peak torque (Nm) = **276.0** Stall torque (Nm) = **92.0** Rated torque (Nm) = **62.0**

250U2E2000



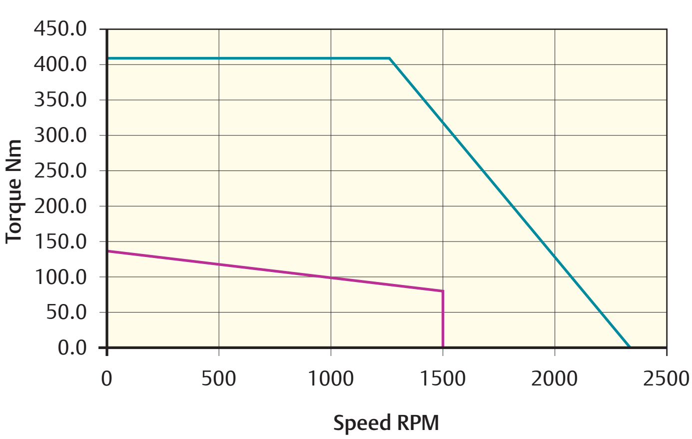
Peak torque (Nm) = **348.0** Stall torque (Nm) = **116.0** Rated torque (Nm) = **73.0**

250U2E2500



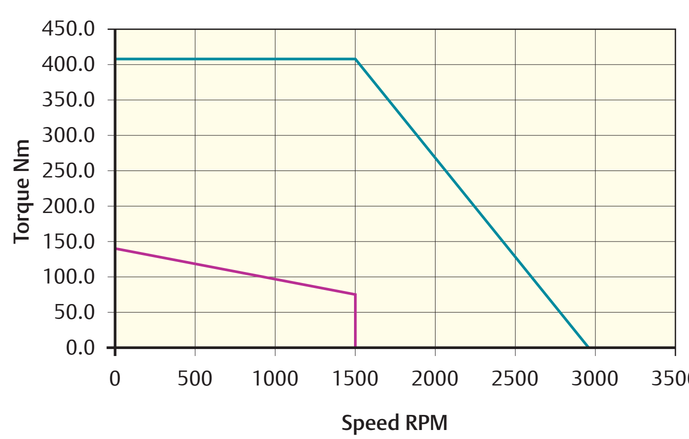
Peak torque (Nm) = **348.0** Stall torque (Nm) = **116.0** Rated torque (Nm) = **70.0**

250U2F2000



Peak torque (Nm) = **408.0** Stall torque (Nm) = **136.0** Rated torque (Nm) = **81.0**

250U2F2500



Peak torque (Nm) = **408.0** Stall torque (Nm) = **136.0** Rated torque (Nm) = **77.0**

Continuous zone **Intermittent zone** *All graphs are a 40°C ambient and 400V drive supply*

Low voltage directive 2006/95/EC

Note: Machinery Directive 89/392/EEC amended to 98/37/EC specifically excludes electric motors. Unimotor fm conforms to Low Voltage Directive 2006/95/EC.

EN 60034 **General requirements for rotating electrical machinery**

EN 60034-1	Duty: S1 Continuous Storage: -15°C to +40°C Operating: Min ambient 0°C; max ambient 40°C Less than 1000m altitude Relative humidity: 90% non condensing
EN 60034-5	Degree of Ingress protection: IP65 (when mounted and connected)
EN 60034-6	Method of cooling: free circulation, free convection
EN 60034-7	Flange mounted: horizontally or vertically
EN 60034-8	Terminal markings: U V W
EN 60034-11	Thermal protection: PTC thermistor, 145°C on 075-250 motors Thermal protection: PTC thermistor, 150°C on 055 motors
EN 60034-18	Insulation system: Class F 600V, UL number E214439 on 075-250 motors Insulation system: Class F 600V, UL number E68554 on 055 motors
EN 60034-25	The design and performance of motors specifically designed for converter supply

EN 60072 **Dimensions and output for rotating electrical machines**

EN 60072-1	Type N (Customer variants)

ISO1940-1 **Balancing: to G6.3, (ISO8821 half key convention)**

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the guide, without notice.

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DRIVING THE WORLD...

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