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CHAPTER FOUR

4 Step Motors

Recommended Drive/Motor Systems

We recommend you use the following motors with drives listed in the *Recommended Drive Type* column.

Motor Model Number	Drive Type Recommended	Motor Model Number	Drive Type Recommended
OS2HA-xxFLY (series)	GT-U5	RS42B-xxS10 (series)	GT-L8
OS21A-xxFLY (series)	GT-U5	RE42B-xxS10 (series)	GT-L8
OS22A-xxFLY (series)	GT-U5		
		RS42B-xxP10 (parallel)	GT-L8
OS2HA-xxL10 (series)	GT-U5	RE42B-xxP10 (parallel)	GT-L8
OS21A-xxL10 (series)	GT-U5		
OS22A-xxL10 (series)	GT-U5	TS31B-xxS10 (series)	GT-L5
		TS32B-xxS10 (series)	GT-L8
OS2HA-xxFLY (parallel)	GT-U8	TS33B-xxS10 (series)	GT-L8
OS21A-xxFLY (parallel)	GT-U8		
OS22A-xxFLY (parallel)	GT-U8	TS31B-xxP10 (parallel)	GT-L8
		TS32B-xxP10 (parallel)	GT-L8
OS2HA-xxL10 (parallel)	GT-U8	TS33B-xxP10 (parallel)	GT-L8
OS21A-xxL10 (parallel)	GT-U8		
OS22A-xxL10 (parallel)	GT-U8	TS41B-xxS10 (series)	GT-L8
		TS42B-xxS10 (series)	GT-L8
OS2HB-xxFLY (series)	GT-L5	TS43B-xxS10 (series)	GT-L8
OS21B-xxFLY (series)	GT-L5		
OS22B-xxFLY (series)	GT-L5	TS41B-xxP10 (parallel)	GT-L8
		TS42B-xxP10 (parallel)	GT-L8
OS2HB-xxL10 (series)	GT-L5	TS43B-xxP10 (parallel)	GT-L8
OS21B-xxL10 (series)	GT-L5		
OS22B-xxL10 (series)	GT-L5	ES21B-xxR10 (series)	GT-L5
		ES22B-xxR10 (series)	GT-L5
OS2HB-xxFLY (parallel)	GT-L5	ES23B-xxR10 (series)	GT-L5
OS21B-xxFLY (parallel)	GT-L5		
OS22B-xxFLY (parallel)	GT-L5	ES21B-xxR10 (parallel)	GT-L5
		ES22B-xxR10 (parallel)	GT-L5
OS2HB-xxL10 (parallel)	GT-L5	ES23B-xxR10 (parallel)	GT-L5
OS21B-xxL10 (parallel)	GT-L5		
OS22B-xxL10 (parallel)	GT-L5	ES31B-xxR10 (series)	GT-L5
		ES32B-xxR10 (series)	GT-L5
RS31B-xxS10 (series)	GT-L5	ES33B-xxR10 (series)	GT-L5
RS32B-xxS10 (series)	GT-L8		
RS33B-xxS10 (series)	GT-L8	ES31B-xxR10 (parallel)	GT-L5
		ES32B-xxR10 (parallel)	GT-L8
RS31B-xxP10 (parallel)	GT-L8	ES33B-xxR10 (parallel)	GT-L8
RS32B-xxP10 (parallel)	GT-L8		
RS33B-xxP10 (parallel)	GT-L8		

Equivalent to:
(ZETA57-51S)
(ZETA57-83S)
(ZETA57-102S)

(ZETA57-51P)
(ZETA57-83P)
(ZETA57-102P)

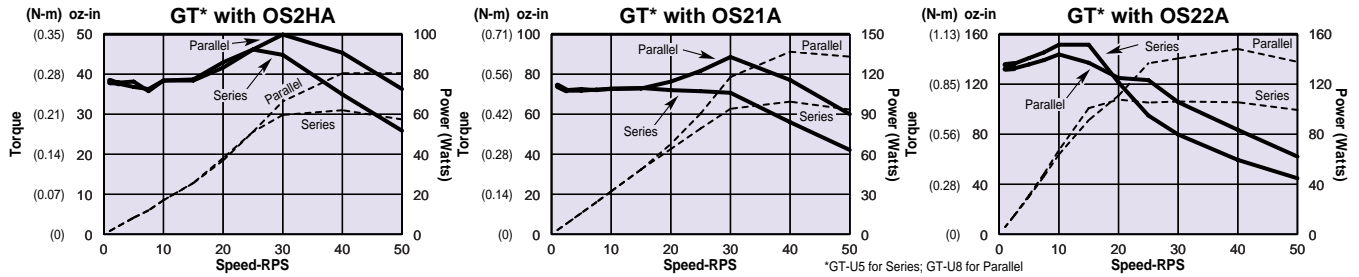
(ZETA83-62S)
(ZETA83-93S)
(ZETA83-135S)

(ZETA83-62P)
(ZETA83-93P)
(ZETA83-135P)

Speed/Torque Curves

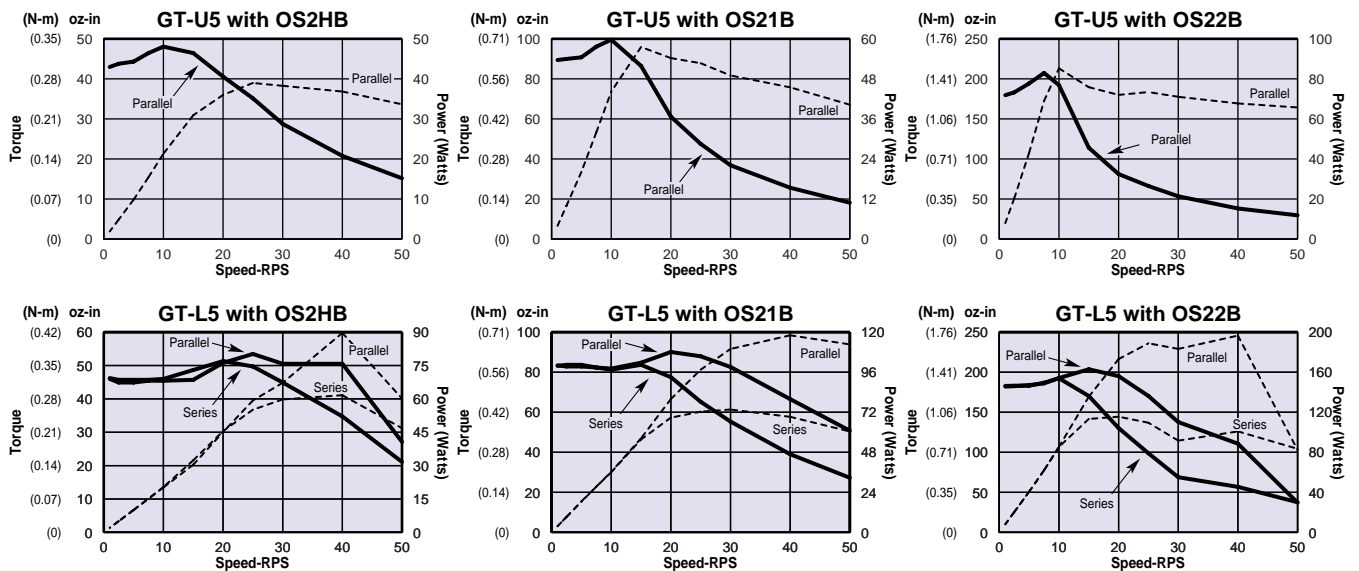
O Series Motors, "A" Windings

Size 23 Frame

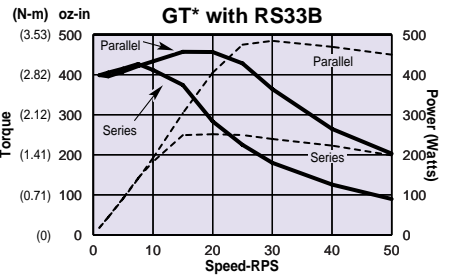
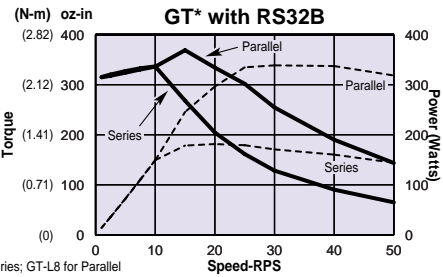
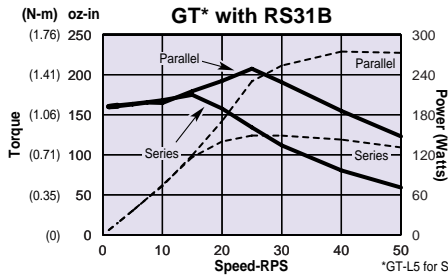
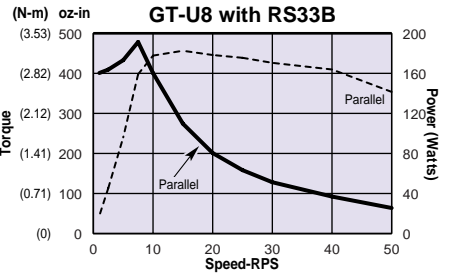
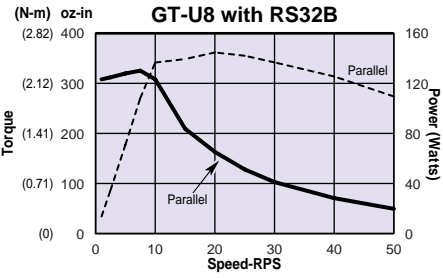
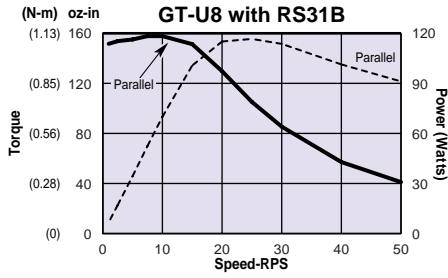


O Series Motors, "B" Windings

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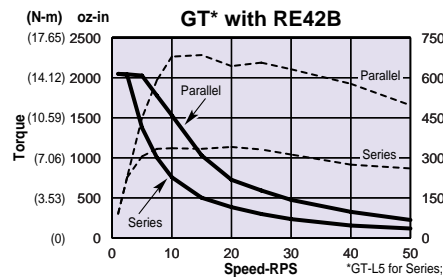
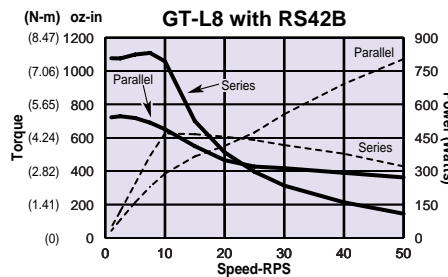
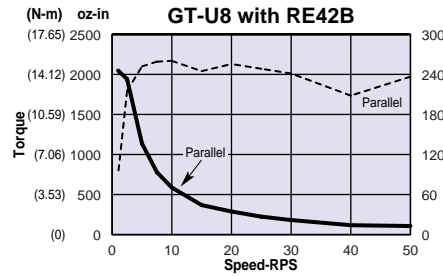
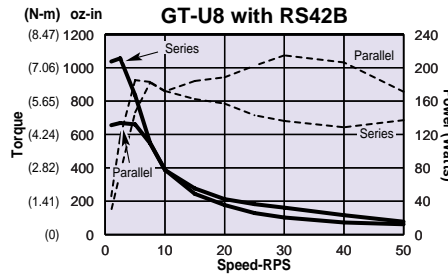


**R Series Motors,
Size 34 Frame**



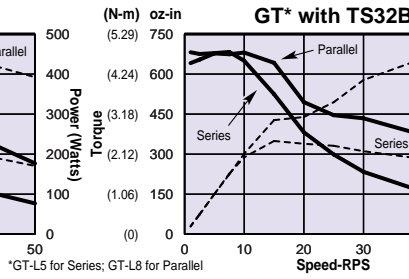
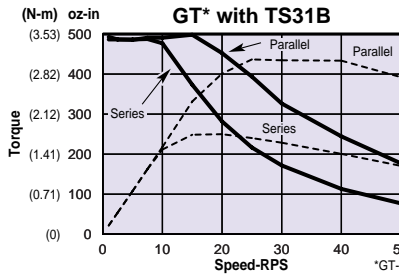
*GT-L5 for Series; GT-L8 for Parallel

**R Series Motors,
Size 42 Frame**

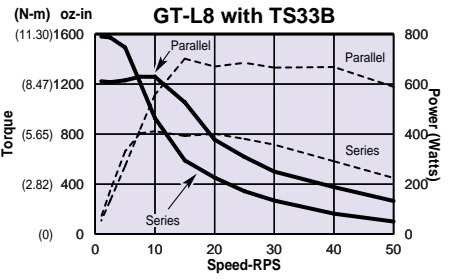


*GT-L5 for Series; GT-L8 for Parallel

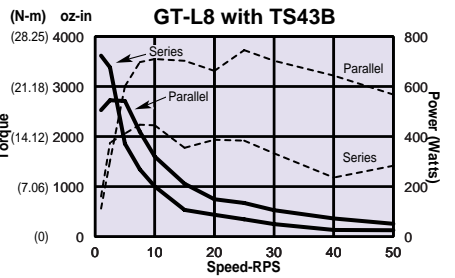
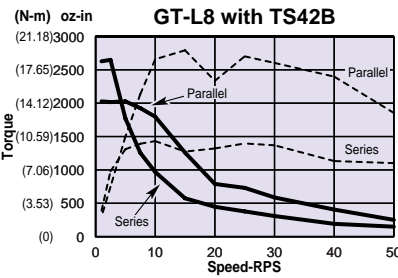
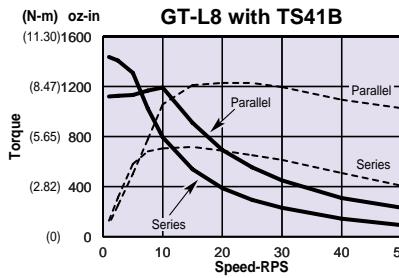
**T Series Motors,
Size 34 Frame**



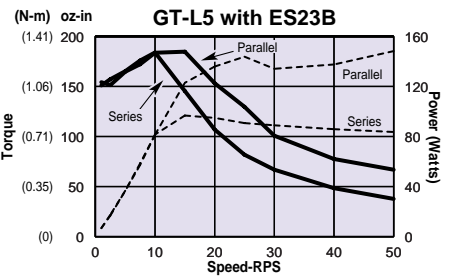
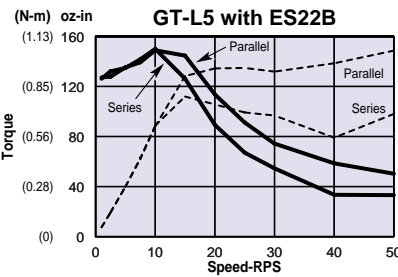
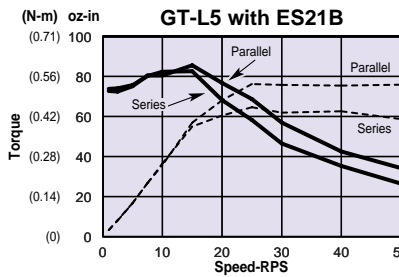
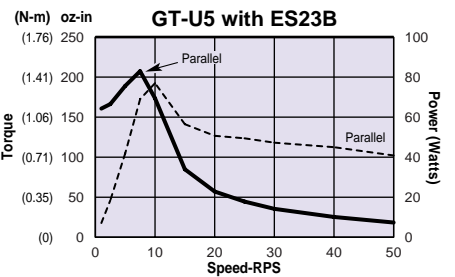
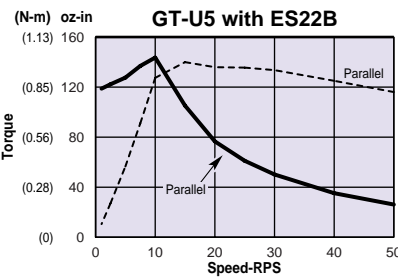
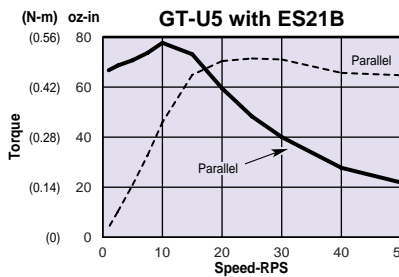
*GT-L5 for Series; GT-L8 for Parallel



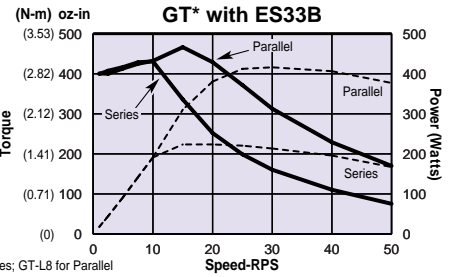
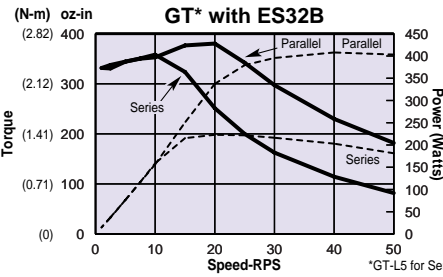
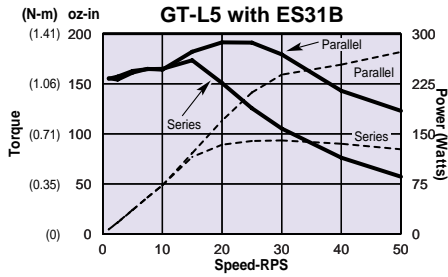
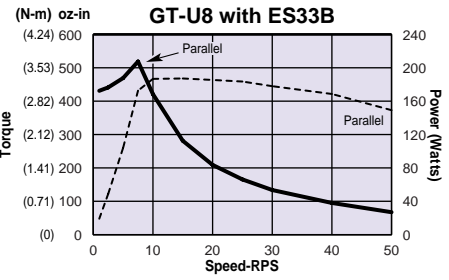
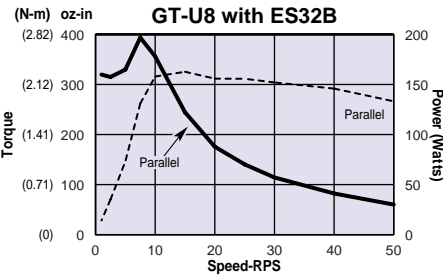
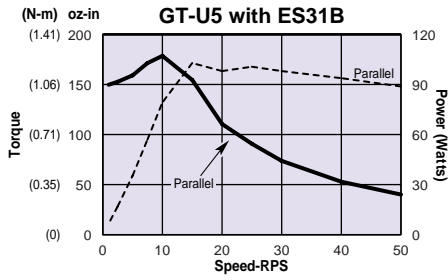
**T Series Motors,
Size 42 Frame**



**E Series Motors,
Size 23 Frame**



**E Series Motors,
Size 34 Frame**



*GT-L5 for Series; GT-L8 for Parallel

Specifications

O Series Motors with “A” Windings (75VDC Motors)

	Size 23 Frame		
	OS2HA	OS21A	OS22A
Static torque			
oz-in (Nm)	37 (0.26)	66 (0.47)	133 (0.94)
Rotor inertia			
oz-in ² (kg-cm ²)	0.386 (0.070)	0.656 (0.119)	1.390 (0.253)
Drive Current (Apk)(Arms)			
Series	2.65 (1.9)	3.3 (2.3)	3.8 (2.7)
Parallel	5.3 (3.7)	6.6 (4.7)	7.5 (5.3)
Phase Inductance (mH)			
Series	1.7	1.8	2.8
Parallel	0.4	0.4	0.7
Detent Torque			
oz-in (Nm)	2.5 (0.018)	4.0 (0.028)	7.0 (0.049)
Bearings Information			
Thrust Load			
lb (kg)	13 (5.9)	13 (5.9)	13 (5.9)
Radial Load			
lb (kg)	20 (9.1)	20 (9.1)	20 (9.1)
End Play (Reversing load equal to 1 lb)			
in (mm)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)
Radial Play (Per 0.5 lb load)			
in (mm)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)
Motor Weight			
lb (kg)	1 (0.45)	1.5 (0.68)	2.5 (1.14)
Certifications			
UL recognized	Pending	Pending	Pending
CE (LVD)	Yes	Yes	Yes
CE (EMC & LVD)	No	No	No

**O Series Motors with “B” Windings (170VDC Motors)
R Series Motors**

Parameters	Size 23 Frame			Size 34 Frame			Size 42 Frame	
	OS2HB	OS21B	OS22B	RS31B	RS32B	RS33B	RS42B	RE42B
Static torque**								
oz-in (Nm)	43 (0.30)	82 (0.58)	155 (1.09)	133 (0.93)	267 (1.87)	392 (2.74)	985 (6.90)	1907 (13.35)
Rotor inertia								
oz-in ² (kg-cm ²)	0.39 (0.07)	0.66 (0.12)	1.39 (0.25)	3.02 (0.55)	6.56 (1.20)	9.65 (1.77)	61.76 (11.30)	61.76 (11.30)
Drive Current (Apk)(Arms)**								
Series	1.5 (1.0)	1.8 (1.3)	2.2 (1.5)	2.3 (1.6)	2.8 (2.0)	3.4 (2.4)	6.1 (4.3)	3.4 (2.4)
Parallel	3.0 (2.1)	4.0 (2.8)	4.0 (2.8)	4.6 (3.3)	5.6 (4.0)	6.9 (4.9)	12.0 (8.5)	7.2 (5.1)
Phase Inductance (mH)***								
Series	8.6	12	16.6	9.4	11.6	9.6	8.2	42.6
Parallel	2.2	3	4.2	2.4	2.9	2.4	2.1	10.7
Drive Bus Voltage (VDC)	170	170	170	170	170	170	170	170
Detent Torque								
oz-in (Nm)	2.5 (0.02)	4.0 (0.03)	7.0 (0.05)	8.8 (0.06)	18.0 (0.13)	27.0 (0.19)	41.7 (0.35)	81.0 (0.57)
Bearings Information								
Thrust Load								
lb (kg)	13 (5.9)	13 (5.9)	13 (5.9)	180 (81.6)	180 (81.6)	180 (81.6)	400 (182)	400 (182)
Radial Load								
lb (kg)	20 (9.1)	20 (9.1)	20 (9.1)	35 (15.9)	35 (15.9)	35 (15.9)	140 (63.6)	140 (63.6)
End Play (Reversing load equal to 1 lb)								
in (mm)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)
Radial Play (Per 0.5 lb load)								
in (mm)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)
Motor Weight								
lb (kg)	1 (0.5)	1.5 (0.7)	2.5 (1.1)	3.2 (1.5)	5.3 (2.4)	7.6 (3.5)	18.2 (8.3)	18.2 (8.3)
Certifications								
UL recognized	No	No	No	Yes	Yes	Yes	Yes	Yes
CE (LVD)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CE (EMC & LVD)*	No	No	No	*	*	*	*	*

T Series Motors

Parameters	Size 34 Frame			Size 42 Frame		
	TS31B	TS32B	TS33B	TS41B	TS42B	TS43B
Static torque**						
oz-in (N-m)	455 (3.19)	647 (4.53)	1525 (10.68)	1332 (9.32)	2515 (17.61)	3479 (24.35)
Rotor inertia						
oz-in ² (kg-cm ²)	7.80 (1.43)	14.67 (2.68)	21.89 (4.01)	30.22 (5.53)	59.68 (10.92)	88.51 (16.20)
Drive Current (Apk)(Arms)**						
Series	3.3 (2.3)	3.1 (2.2)	5.6 (4.0)	6.4 (4.5)	6.7 (4.7)	6.9 (4.9)
Parallel	6.7 (4.7)	6.2 (4.4)	12.0 (8.5)	12.0 (8.5)	12.0 (8.5)	12.0 (8.5)
Drive Bus Voltage (VDC)	170	170	170	170	170	170
Phase Inductance (mH)***						
Series	10.3	10.3	13.6	15.8	22.0	30.7
Parallel	2.6	2.6	3.4	3.9	5.5	7.7
Detent Torque						
oz-in (Nm)	18 (0.13)	36 (0.25)	54 (0.38)	42 (0.30)	84 (0.59)	106 (0.75)
Bearings Information						
Thrust Load						
lb (kg)	305 (139)	305 (139)	305 (139)	404 (184)	404 (184)	404 (184)
Radial Load						
lb (kg)	65 (30)	65 (30)	110 (50)	125 (57)	110 (50)	110 (50)
End Play (Reversing load equal to 1 lb)						
in (mm)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)
Radial Play (Per 0.5 lb load)						
in (mm)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)
Motor Weight						
lb (kg)	5.0 (2.3)	8.4 (3.8)	11.9 (5.4)	11.0 (5.0)	18.4 (8.4)	25.7 (11.7)
Certifications						
UL recognized	Yes	Yes	Yes	Yes	Yes	Yes
CE (LVD)	Yes	Yes	Yes	Yes	Yes	Yes
CE (EMC & LVD)*	*	*	*	*	*	*

E Series Motors

Parameters	Size 23 Frame			Size 34 Frame		
	ES21-xxR10 (ZETA57-51)	ES22-xxR10 (ZETA57-83)	ES23-xxR10 (ZETA57-102)	ES31-xxR10 (ZETA83-62)	ES32-xxR10 (ZETA83-93)	ES33-xxR10 (ZETA83-135)
Static torque						
oz-in (N-m)	65 (0.46)	125 (0.88)	145 (1.02)	145 (1.02)	300 (2.12)	380 (2.68)
Rotor inertia						
oz-in ² (kg-cm ²)	0.546 (0.100)	1.10 (0.201)	1.69 (0.309)	3.47 (0.635)	6.76 (1.24)	10.47 (1.92)
Phase Inductance (mH)						
Series	mH (small signal*)	17.37	18.5	17	10	9.2
	mH (large signal**)	26.3	26.86	24.6	14.44	13.89
Parallel	mH (small signal*)	4.34	4.62	4.25	2.5	2.3
	mH (large signal**)	6.57	6.71	6.15	3.61	3.47
Bearings Information						
Thrust Load						
lb (kg)	25 (11.3)	25 (11.3)	25 (11.3)	50 (22.6)	50 (22.6)	50 (22.6)
Radial Load						
lb (kg)	15 (6.8)	15 (6.8)	15 (6.8)	25 (11.3)	25 (11.3)	25 (11.3)
End Play (Reversing load equal to 1 lb)						
in (mm)	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)
Radial Play (Per 0.5 lb load)						
in (mm)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)	0.0008 (0.020)
Motor Weight (Motor + Cable + Connector)						
lb (kg)	1.6 (0.7)	2.4 (1.1)	3.2 (1.5)	3.8 (1.7)	5.1 (2.3)	8.3 (3.8)
Motor Cable Wire Size						
AWG (mm ²)	24 (0.25)	24 (0.25)	24 (0.25)	22 (0.34)	22 (0.34)	22 (0.34)

All motors: R10 cable length = 10 ft (3 m); flying leads (no connector) on end.

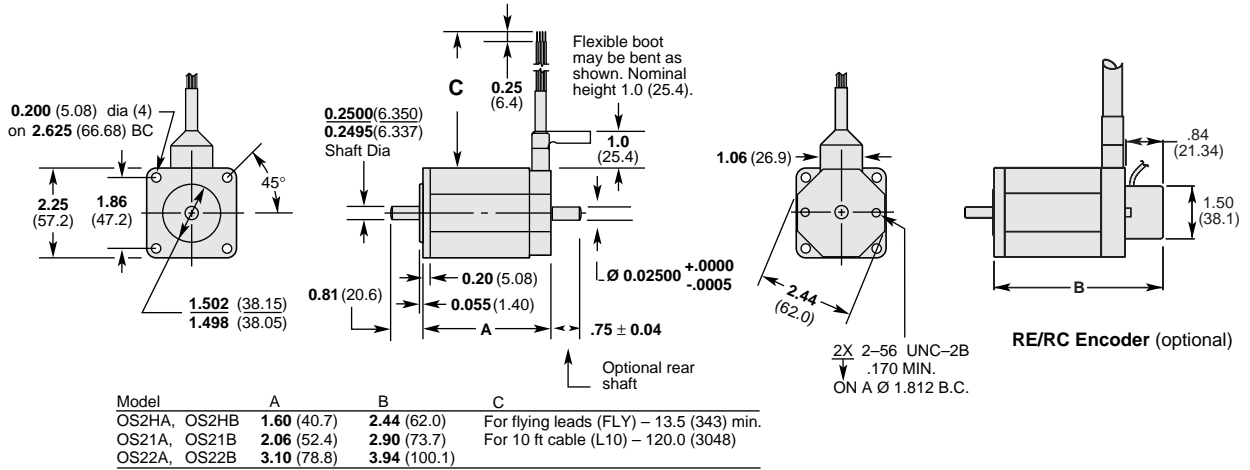
* Small Signal Inductance is found by using an inductance bridge or meter.

** Large Signal Inductance is found by measuring actual generator AC flux linkage and generator short circuit current under dynamic conditions.

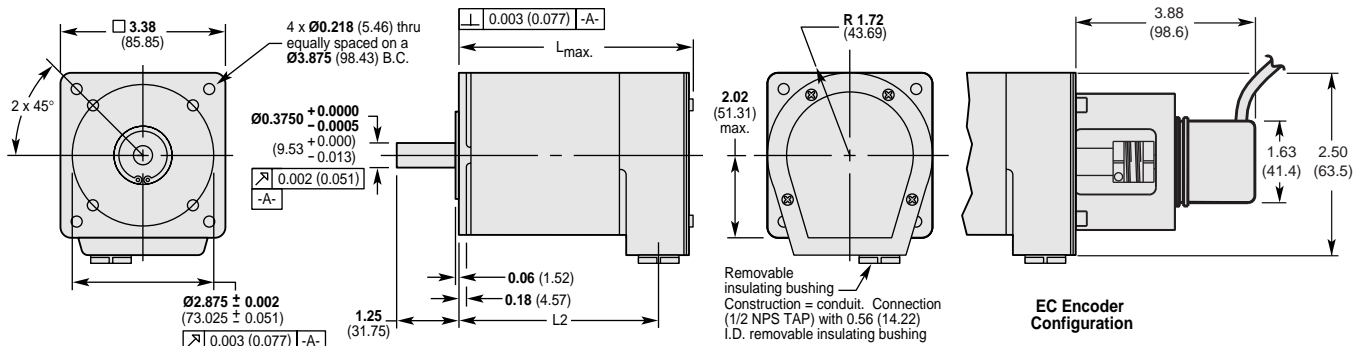
Dimensions

Dimensions in inches (mm)

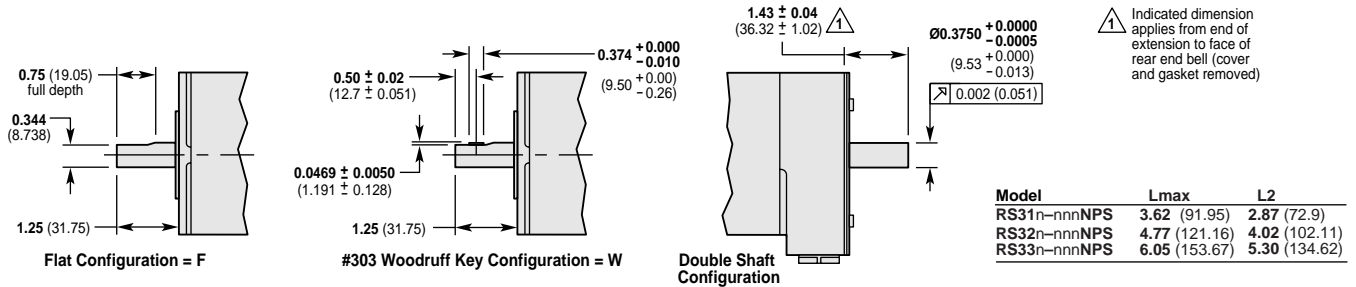
O Series Motors, Size 23 Frame



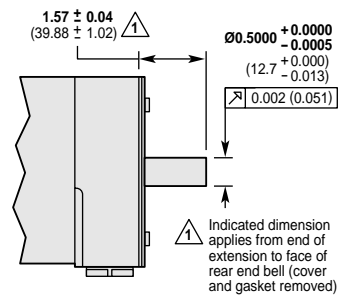
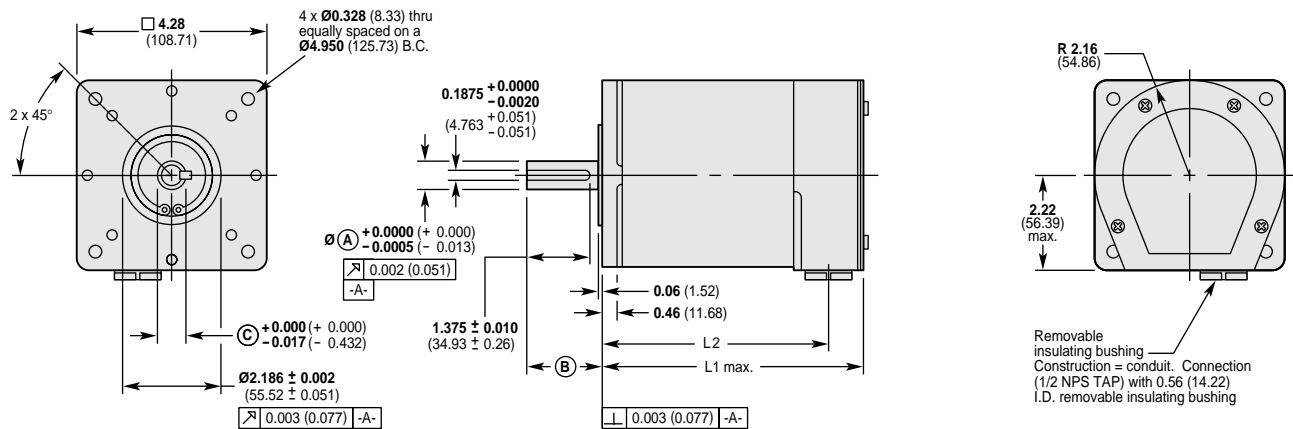
R Series Motors, Size 34 Frame



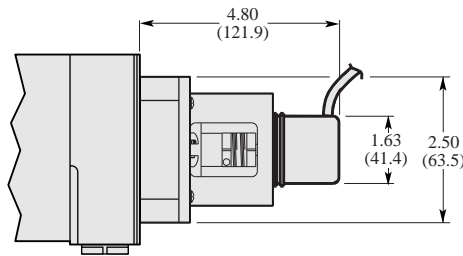
Standard Front Shaft Configurations



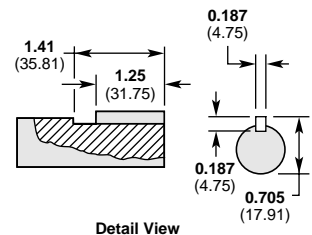
R Series Motors, Size 42 Frame



Double Shaft Configuration



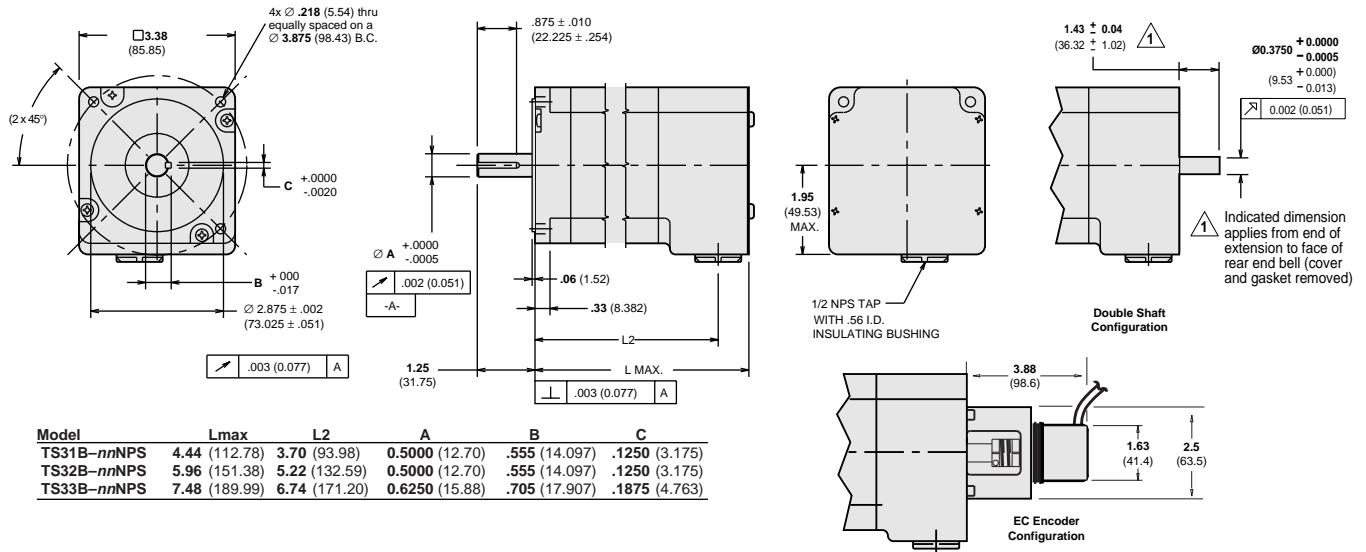
EC Encoder Configuration



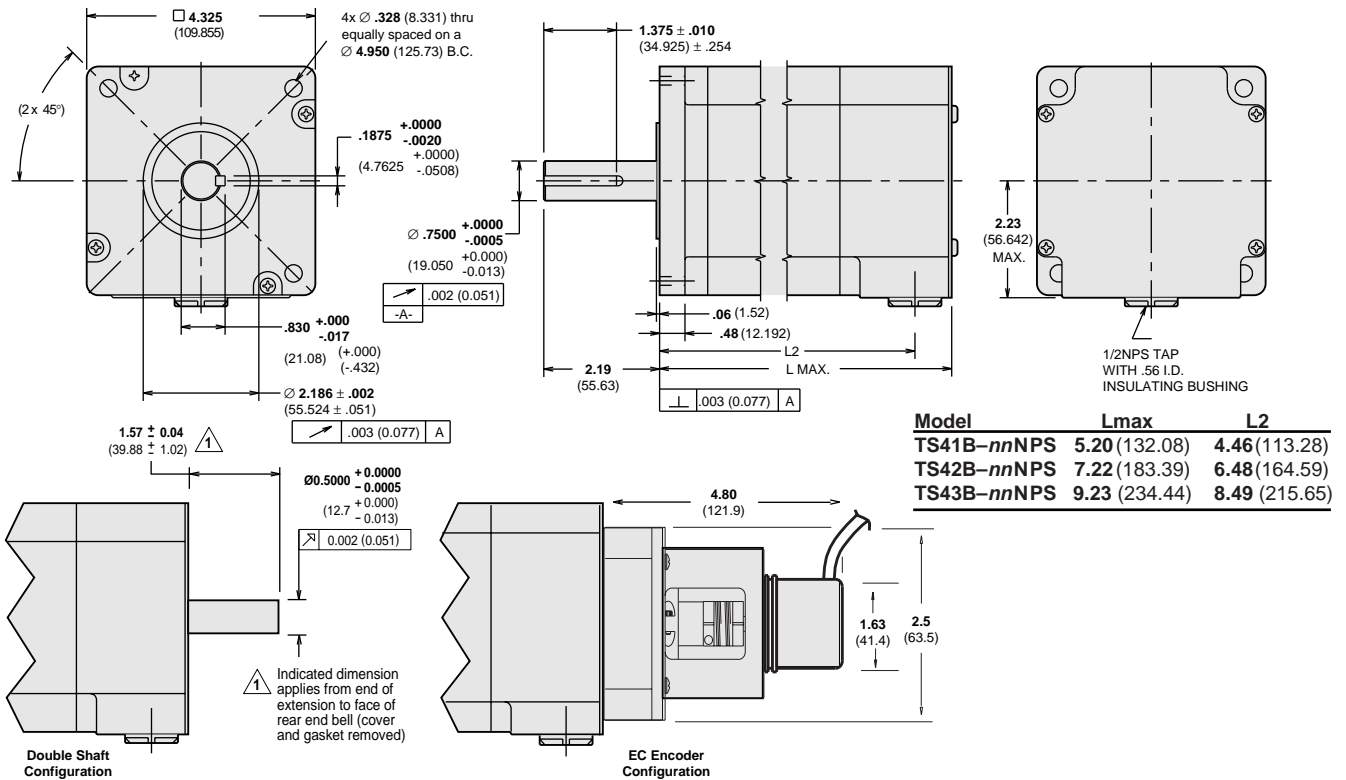
Detail View

Model	Lmax	L2	A	B	C
RS42n-nnnNPS	8.04 (204.22)	7.29 (185.17)	0.625 (15.87)	2.19 (55.63)	0.705 (17.91)
RE42n-nnnNPS	8.04 (204.22)	7.29 (185.17)	0.625 (15.87)	2.19 (55.63)	0.705 (17.91)
RE43n-nnnNPS	10.56 (268.23)	9.81 (249.18)	0.75 (19.05)	2.19 (55.63)	0.83 (21.09)

T Series Motors, Size 34 Frame

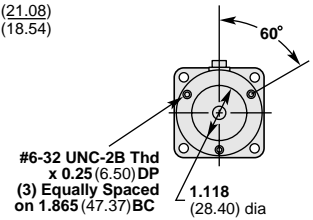
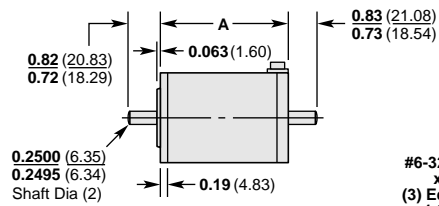
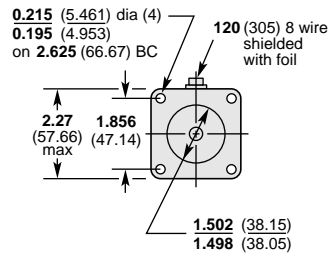


T Series Motors, Size 42 Frame



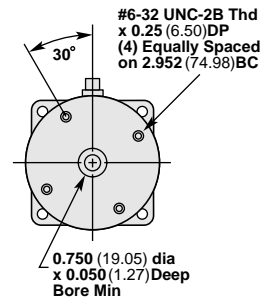
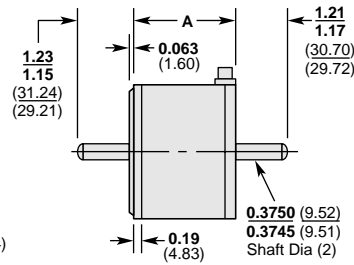
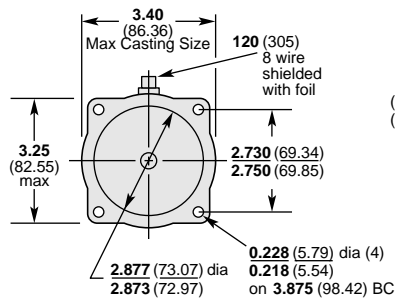
E Series Motors, Size 23 Frame

Model	A
ES21B	2.0 (50.23)
ES22B	3.1 (75.23)
ES23B	4.0 (101.6)



E Series Motors, Size 34 Frame

Model	A
ES31B	2.5 (62.0)
ES32B	3.7 (93.98)
ES33B	5.2 (129.0)



Step Motor Wiring

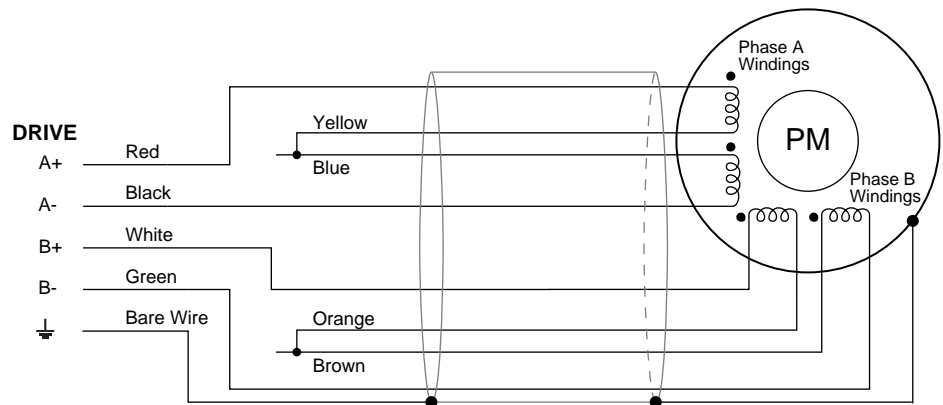
O Motors and E Motors

O and E motors can be wired in series or parallel. The following cabling options are available:

Motor	Option	Description of Option:	Cable Length:
O	-FLY	Regular construction with 8 flying leads,	12 inches (0.3 m)
	-L10	Regular construction with LVD cable,	10 feet (3 m)
E	-R10	Regular construction, cable, with flying leads	10 feet (3 m)

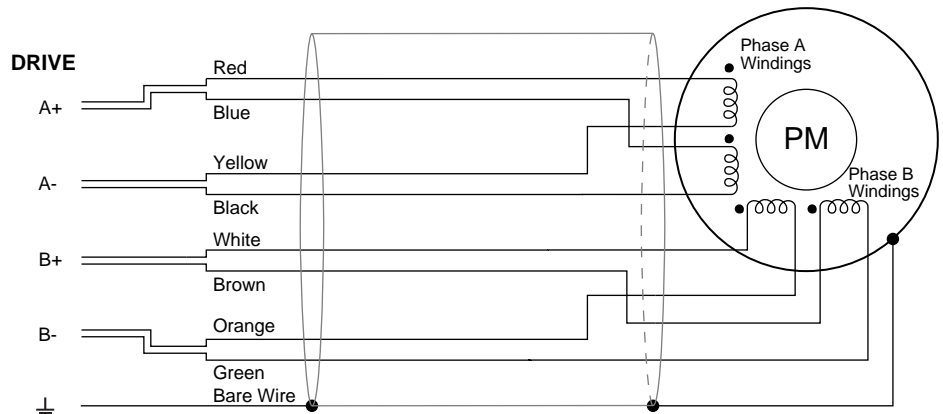
Series Wiring

O or E Motor – Series Wiring



Parallel Wiring

O or E Motor – Parallel Wiring

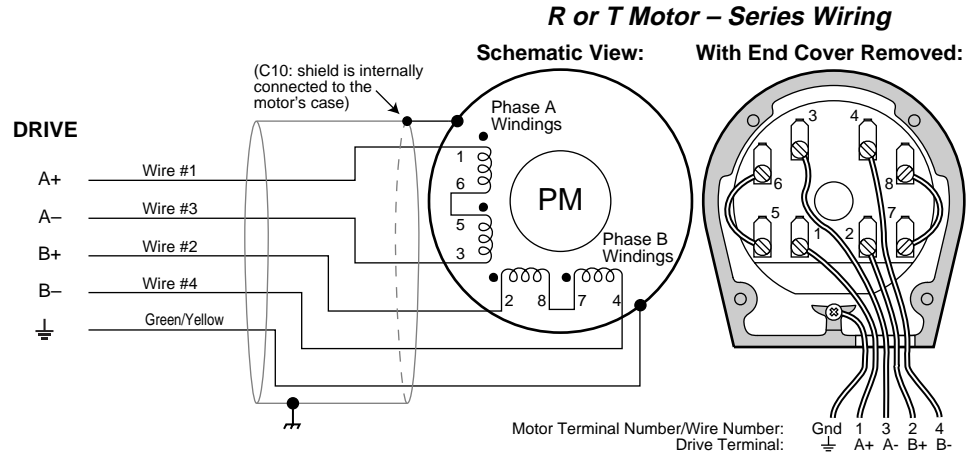


**R Motors and
T Motors**

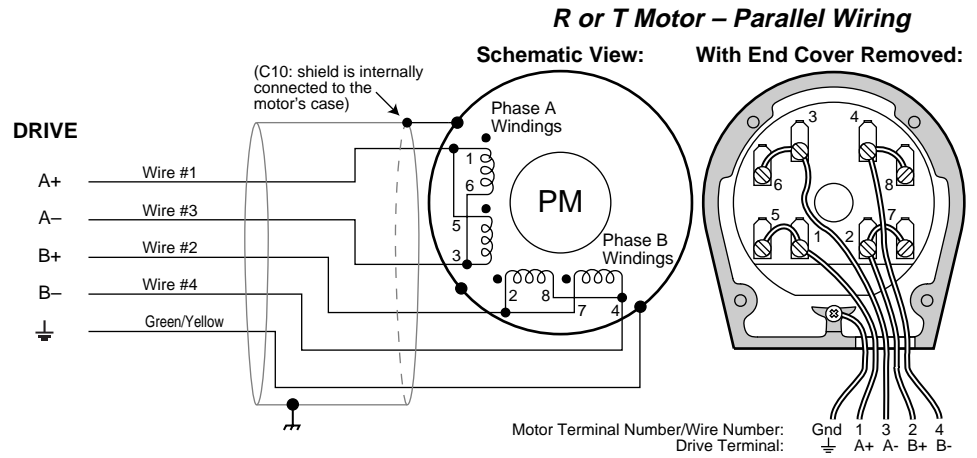
The following cabling options are available for R and T motors:

Option	Description of Option:	Cable Length:
NPS	End bell/terminal board with 1/2" NPS pipe thread	No cable
S10	CE (LVD)/UL, NPS construction, motor wired in series	10 feet (3 m)
P10	CE (LVD)/UL, NPS construction, motor wired in parallel	10 feet (3 m)

Series Wiring



Parallel Wiring



Encoder Information

Encoder Specifications

	-E and -EC Encoders	-RE and -RC Encoders
Mechanical		
Starting Torque at 77°F (25°C)	oz-in 0.5 (Nm) (0.003)	Not applicable Not applicable
Moment of inertia	oz-in sec ² 0.22	4.4 x 10 ⁻⁵
Weight	oz 10 (kg) (0.28)	2 (0.057)
Bearing Life	Revolutions 1x10 ⁹	Not applicable
Max operating speed	3,000 rpm	6,000 rpm
Electrical		
Input power	5VDC±5%, 125mA	5VDC±5%, 135mA
Output format	2 channels (A and B) quadrature Z channel once/rev	2 channels (A and B) quadrature Z channel once/rev
Environmental		
Operating Temperature	32°F to 158°F (0°C to 70°C)	14°F to 185°F (-10°C to 85°C)
Storage Temperature	32°F to 158°F (0°C to 70°C)	-22°F to 230°F (-30°C to 110°C)
Shock	10 G's for 11 msec duration	50 G's for 11 msec duration
Vibration	5 G's at 10 Hz to 2,000 Hz	10 G's at 20 Hz to 2,000 Hz

Encoder Cable – Color Code

-E and -EC option encoders come standard with a 10-foot cable and 25-pin D-connector.

-RE option encoders come standard with 13 inch flying leads.

-RC option encoders come standard with a 10-foot cable.

25-Pin D No. (E/EC only):	Color Code – All Encoders	
	Color:	Description:
1	Brown	Channel A
2	Brown/White	Channel A return
3	Green	Channel B
4	Green/White	Channel B return
5	Orange	Channel Z
6	Orange/White	Channel Z return
7	—	NC
8	Shield	Case ground
9 – 13	—	NC
14	Black	Common
15 – 22	—	NC
23	Red	5VDC
24 – 25	—	NC

Encoder Dimensions

Encoder dimensions are shown in the dimension drawing for each motor.



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