

GENERAL INFORMATION INDEX

How to use this section

This section covers a wide variety of technical data and general reference information. Much of this material is important to sizing considerations and maintenance strategies. Use it to assist you in motor, drive, and system selection.

General Information

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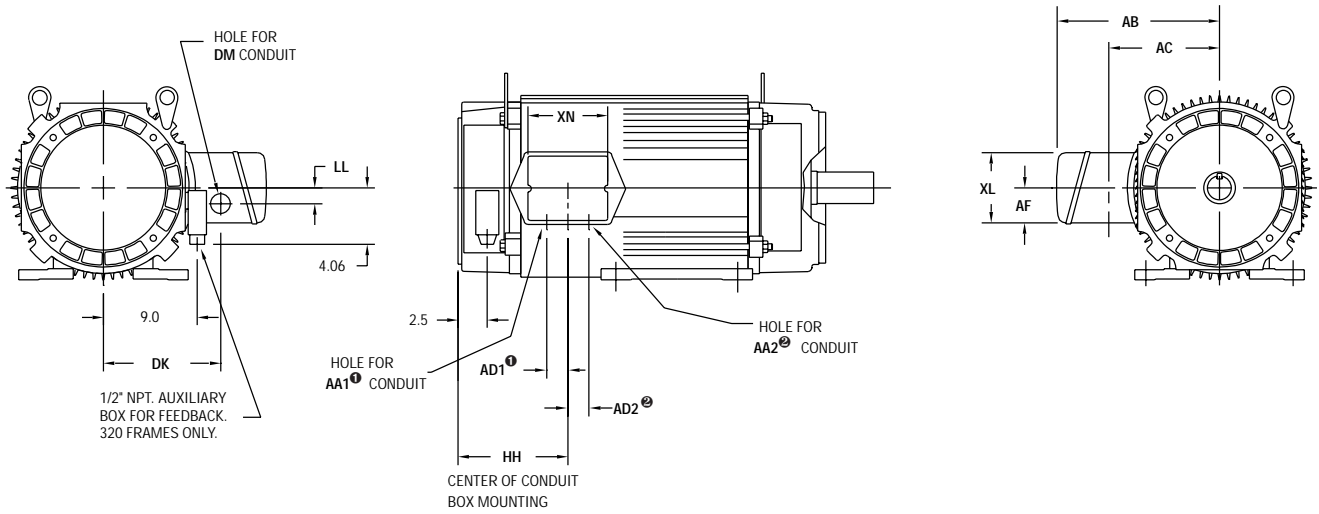
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CONDUIT BOX DIMENSIONS

TERMINATIONS VIA CONDUITS ONLY (MODEL NUMBER CODE TERMINATION OPTIONS 1, 2, E, F)



STANDARD HIGH CAPACITY CONDUIT BOX

FRAME	MAX. CONT. RMS AMPS	AB	AC	XL	AF	HH	AD1 [Ⓛ]	AD2 [Ⓧ]	XN	AA1 [Ⓛ]	AA2 [Ⓧ]	DM	DK	LL
180	65	9.57	7.03	4.00	2.00	4.94	.50	1.68	6.00	1 1/4	3/4	-	-	-
210	103	11.13	7.68	4.75	2.39	5.50	1.12	1.63	6.00	1 1/4	3/4	-	-	-
250	193	14.32	9.38	5.85	3.00	6.31	1.00	2.50	8.00	2 1/2	1/2	-	-	-
280	310	15.75	10.00	8.25	4.13	8.31	2.25	2.25	9.75	3	3	3/4	10.00	2.0
320	533	18.45	13.03	12.76	6.38	11.75	2.88	2.88	12.76	4	4	-	-	-

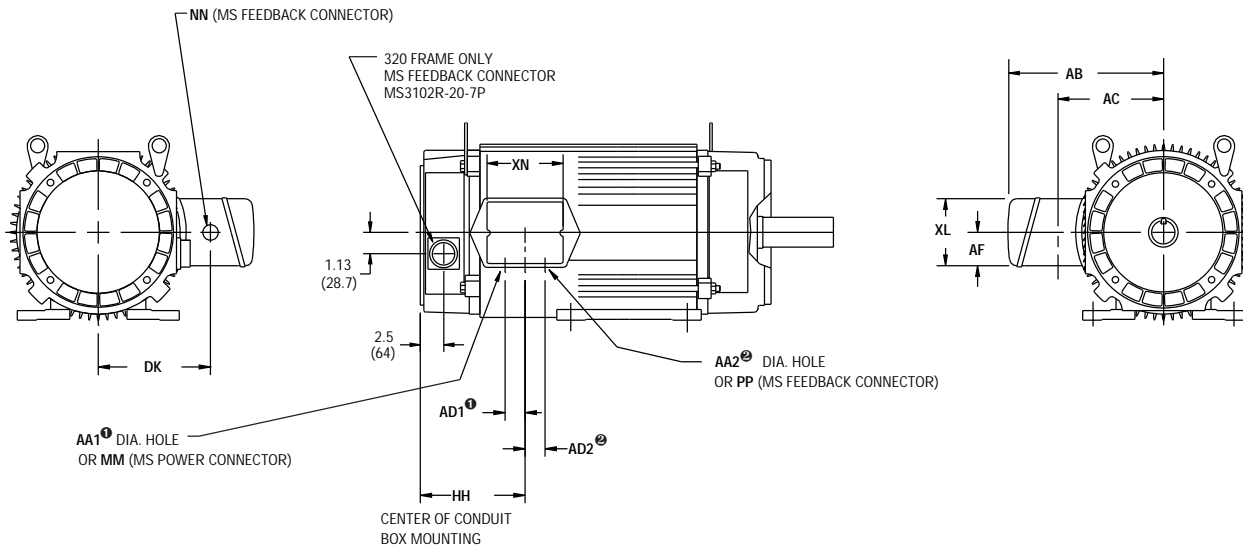
- Ⓛ AA1 and AD1 are for power.
- Ⓧ AA2 and AD2 are for feedback.

All dimensions are in inches

NOTE: Conduit box in F1 position with conduit holes facing down is standard mounting. Conduit box can be rotated in 90° steps about its axis and can be mounted on opposite side when specified.

CONDUIT BOX DIMENSIONS

TERMINATION VIA CONDUITS AND MS CONNECTORS (MODEL NUMBER CODE TERMINATION OPTIONS 3, 4)



STANDARD HIGH CAPACITY CONDUIT BOX															
FRAME	MAX. CONT. RMS AMPS	AB	AC	XL	AF	HH	AD1 ①	AD2 ②	XN	AA1 ①	AA2 ②	DK	NN MS connector	MM MS connector	PP MS connector
180	65	9.57 (243,1)	7.03 (178,56)	4.00 (101,6)	2.00 (50,8)	4.94 (125,48)	.50 (12,7)	1.68 (42,67)	6.00 (152,4)	-	-	-	-	MS3102R-32-17P	MS3102R-20-7P
210	103	11.13 (282,7)	7.68 (195,1)	4.75 (120,7)	2.39 (60,7)	5.50 (139,7)	1.12 (28,45)	1.63 (41,4)	6.00 (152,4)	-	-	-	-	MS3102R-36-5P	MS3102R-20-7P
250	193	14.32 (363,7)	9.38 (238,3)	5.85 (148,6)	3.00 (76,2)	6.31 (160,3)	1.00 (25,4)	2.50 (63,5)	8.00 (203,2)	2.92 (74,2)	-	-	-	-	MS3102R-20-7P
280	310	15.75 (400,1)	10.00 (254)	8.25 (209,6)	4.13 (104,9)	8.31 (211,1)	2.25 (57,2)	2.25 (57,2)	9.75 (247,7)	3.63 (92,2)	3.63 (92,2)	8.94 (271,1)	MS3102R-20-7P	-	-
320	533	18.45 (468,6)	13.03 (331)	12.76 (324,1)	6.38 (162,1)	11.75 (298,5)	2.88 (73,2)	2.88 (73,2)	12.76 (324,1)	4.69 (119,1)	4.69 (119,1)	-	-	-	-

- ① AA1 and AD1 are for power.
- ② AA2 and AD2 are for feedback.

All dimensions in () are mm, all others in inches

NOTE: Conduit box in F1 position with conduit holes facing down is standard mounting. Conduit box can be rotated in 90° steps about its axis and can be mounted on opposite side when specified.

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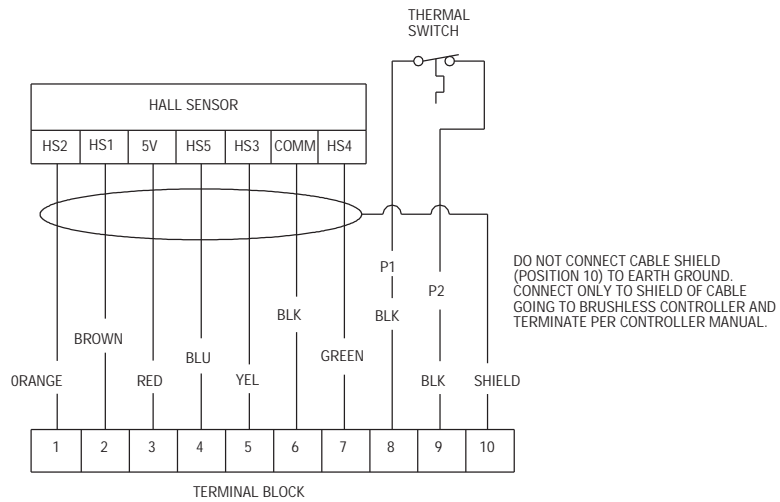
TERMINATIONS

PRIMARY FEEDBACK TERMINATIONS VIA CONDUITS (MODEL NUMBER CODE TERMINATION OPTIONS 1, 2, 7, E, F, G)

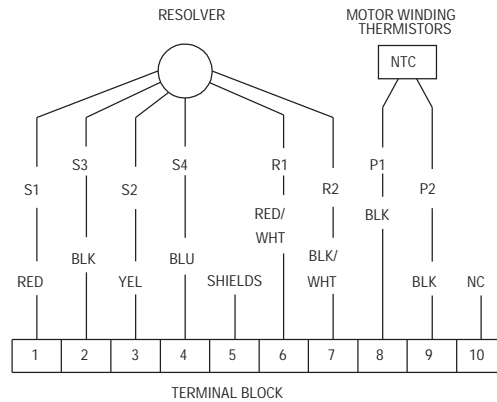
PRIMARY FEEDBACK DEVICES/THERMAL SENSOR

- 0[●] = Hall Sensors/thermal switch
- 2 or 5[●] = Resolver/NTC thermistor

MOTOR WITH HALL SENSOR

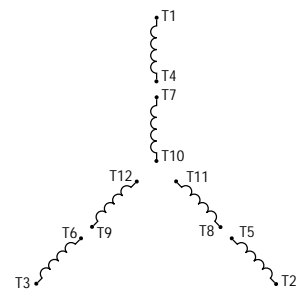


MOTOR WITH RESOLVER



● Model number code designation

TERMINATIONS



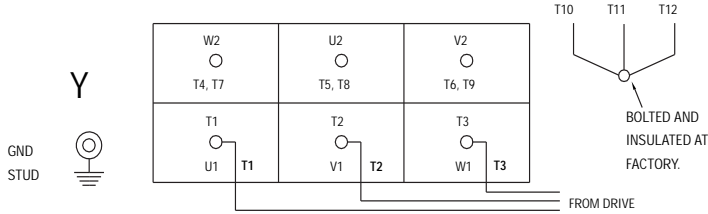
A
MOTORS

MOTOR POWER TERMINATIONS TO TERMINAL BLOCKS[Ⓢ] VIA CONDUITS (MODEL NUMBER CODE TERMINATION OPTIONS E, F, G)

WINDING CONNECTION[Ⓢ]

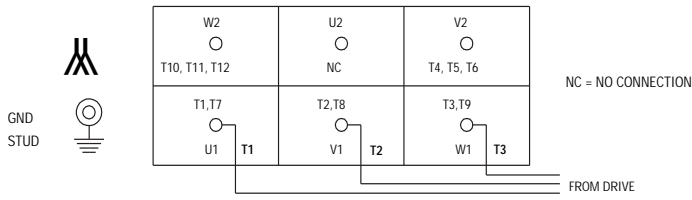
12 LEAD MOTOR POWER CONNECTIONS

3 1 WYE CONNECTION LOW SPEED



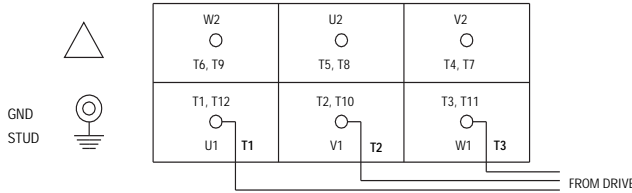
From Drive	Line Connections	Connect Together
T1	T1	T4-T7
T2	T2	T5-T8
T3	T3	T6-T9
		T10-T11-T12 (See diagram at left)

4 2 WYE CONNECTION MED-HIGH SPEED



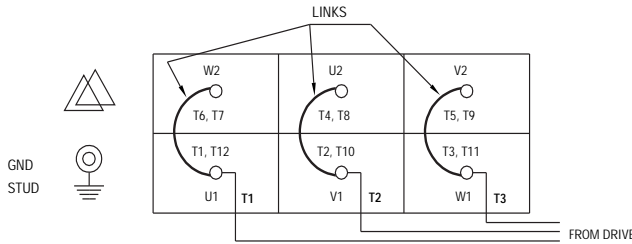
From Drive	Line Connections	Connect Together
T1	T1-T7	T10-T11-T12
T2	T2-T8	T4-T5-T6
T3	T3-T9	

1 1 DELTA CONNECTION MEDIUM SPEED



From Drive	Line Connections	Connect Together
T1	T1-T12	T6-T9
T2	T2-T10	T5-T8
T3	T3-T11	T4-T7

2 2 DELTA CONNECTION HIGH SPEED



From Drive	Line Connections	Connect Together
T1	T1-T7-T6-T12	NA
T2	T2-T8-T4-T10	
T3	T3-T9-T5-T11	

Ⓢ Power terminal block located in conduit box. These designations are molded into the power terminal block for reference.

W2	U2	V2
U1	V1	W1

Ⓢ Model number code designation.

B
DRIVES

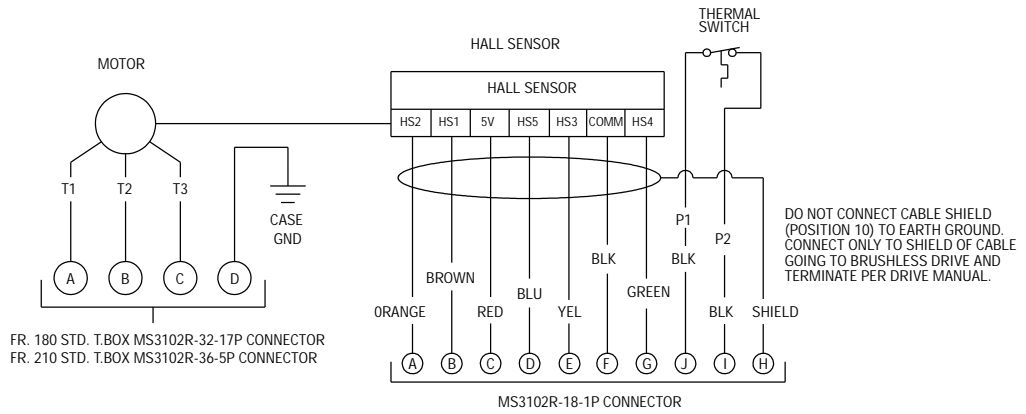
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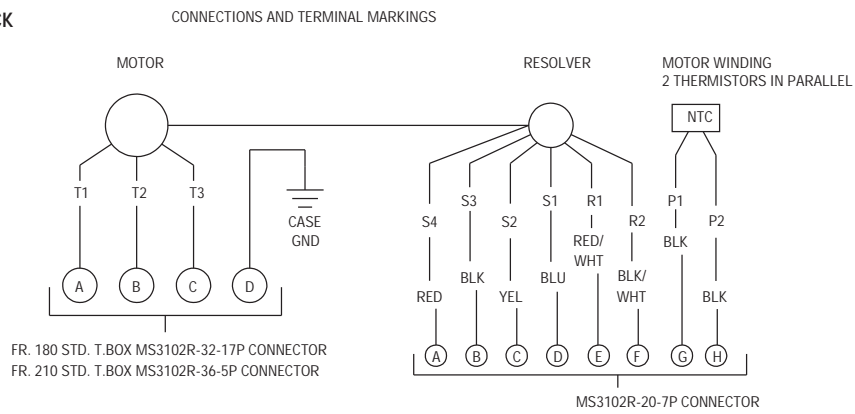
TERMINATIONS

MOTOR POWER AND PRIMARY FEEDBACK TERMINATIONS VIA MS CONNECTORS (MODEL NUMBER CODE TERMINATION OPTIONS 3, 4, 8)

HALL SENSORS (PRIMARY FEEDBACK DEVICE) AND THERMAL SWITCH



RESOLVER (PRIMARY FEEDBACK DEVICE) AND THERMISTOR



NOTE: MS connector pin outs and mating connector information on page 129.

TERMINATIONS

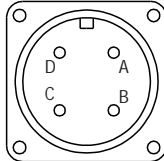
A
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MOTOR POWER AND PRIMARY FEEDBACK MS CONNECTOR PIN OUTS (MODEL NUMBER CODE TERMINATION OPTIONS 3, 4, 8)

MOTOR

FRAME 180 WITH STANDARD HIGH CAPACITY CONDUIT BOX

MS3102R-32-17P

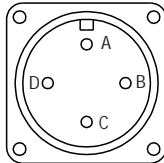


Standard pinouts - all series

CONNECTOR PIN	FUNCTION
A	T1
B	T2
C	T3
D	GROUND

FRAME 210 WITH STANDARD HIGH CAPACITY CONDUIT BOX

MS3102R-36-5P



Suggested mating connector and clamp

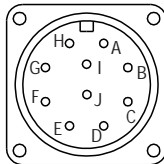
FRAME	MATING CONNECTOR	CLAMP
180	MS3106F-32-17S	MS3057-20A
210	MS3106F-36-5S	MS3057-24A

B
DRIVES

PRIMARY FEEDBACK DEVICES

HALL SENSOR

MS3102R-18-1P



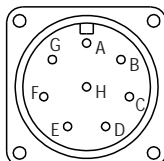
Standard pinouts - all series

CONNECTOR PIN	HALL SENSOR	RESOLVER
A	HS2	S4
B	HS1	S3
C	5V	S2
D	HS5	S1
E	HS3	R1
F	COMM	R2
G	HS4	THERMISTOR
H	SHIELD	THERMISTOR
I	THERMAL	NA
J	THERMAL	NA

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RESOLVER

MS3102R-20-7P



Suggested mating connector and clamp

FEEDBACK	MATING CONNECTOR	CLAMP
HALL SENSOR	MS3106F-18-1S	MS3057-10A
RESOLVER	MS3106F-20-7S	MS3057-12A

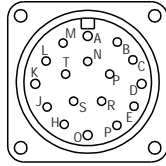
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SECONDARY FEEDBACK MS CONNECTOR PIN OUTS^① (MODEL NUMBER CODE SECONDARY FEEDBACK OPTIONS A, B)

SECONDARY FEEDBACK
CONNECTOR

MS3102E20-29P



SECONDARY FEEDBACK	
CONNECTOR PIN	ENCODER
A	CASE GND
B	N/C
C	S1 (U)
D	S2 (V)
E	S3 (W)
F	N/C
G	ENCODER A
H	ENCODER \bar{A}
J	ENCODER B
K	ENCODER \bar{B}
L	ENCODER Z
M	ENCODER \bar{Z}
N	$\bar{S1}$ (U)
P	$\bar{S2}$ (V)
R	$\bar{S3}$ (W)
S	ENCODER + V dc
T	ENCODER V dc RTN

Suggested mating connector and clamp

CONNECTOR WITH CABLE CLAMP
MS310GF-2029S

- ① E320 frame motors have this MS connector mounted on the motor rather than the conduit box. See Conduit Box Dimensions page 124.

SECONDARY FEEDBACK DEVICE SPECIFICATIONS

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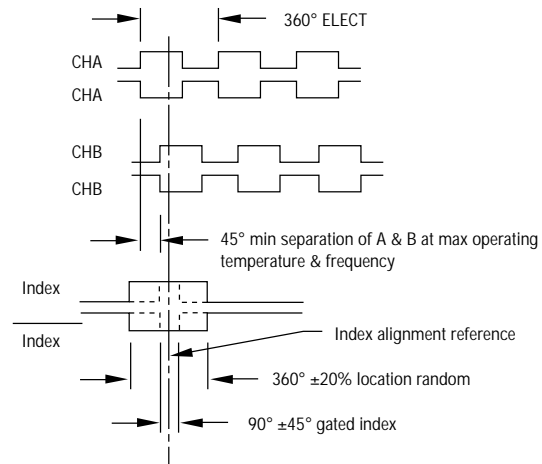
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SECONDARY FEEDBACK DEVICE. . . OPTIONAL ENCODER See SECONDARY FEEDBACK in Model Number Code to designate this standard option. In addition to a factory installed encoder, an option for encoder mounting provisions only is available. See page 132.

Typical output @ 25°C

Parameter	A	B
Pulses per revolution	600	1024
Type	Incremental	
Supply voltage	+5VDC $\pm 5\%$ @270 mA nominal	
Output format	Dual channel quadrature and index with complements	
Output type	Line drivers (26LS31 for data and connections)	
Minimum edge separation	45° (channels A & B)	
Output frequency	300 kHz (all channels)	

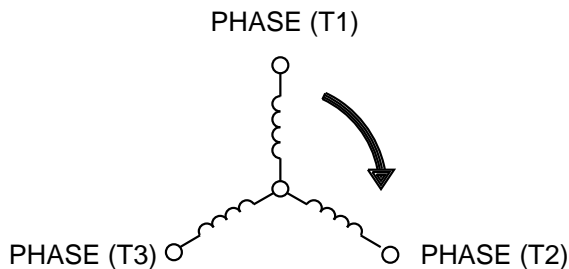
For counterclockwise motor rotation viewed from opposite drive end.



NOTE:
Commutation output available, contact factory

PHASING DIAGRAM. . . ALL MOTORS This is the phasing diagram for counterclockwise motor rotation viewed from opposite the drive end. This is the same phasing reference used for both primary and secondary feedback devices

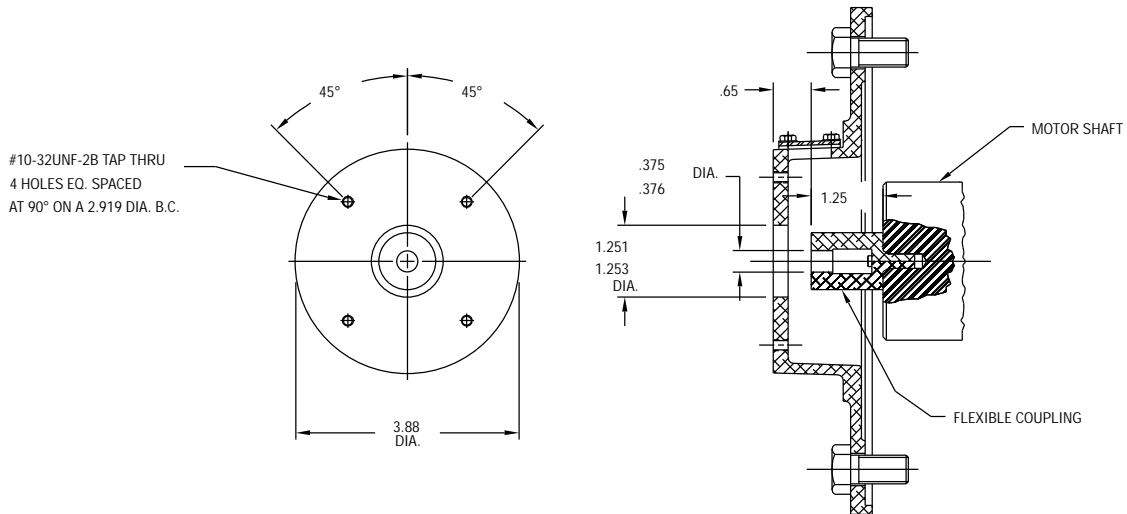
MOTOR WINDING CONFIGURATION



SECONDARY FEEDBACK DEVICE MOUNTING

SECONDARY FEEDBACK . . . ENCODER MOUNTING PROVISIONS TO MOUNT NEMA SIZE 25 ENCODER.

See SECONDARY FEEDBACK in Model Number Code to designate this standard option.



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BLOWER MOTOR DATA (DPBV MOTORS)

Model Number ^❶	Frame ^❷	Blower Size	HP	AC Voltage	Supply	Amps
F182	182T	2	1/10	115	Single Phase	1.0
F184	184T					
F213	213T	3	1/3	200-230, 460	Three Phase	.8-75, .5
F215	215T					
F254	254T					
F256	256T					
F259	259T	8	1/2	200-230, 460	Three Phase	2.1-2.0, 1.0
F287	287TZ	9	3/4	200-230, 460	Three Phase	2.7-2.6, 1.3
F288	288TZ					
F28C	2812TZ					
F328	328TZ	10	1 1/2	200-230, 460	Three Phase	4.9-4.6, 2.3
F32B	3211TZ					
F32D	3213TZ					
F504	504T	12	1 1/2	200-230, 460	Three Phase	4.9-4.6, 2.3
F506	506T					
F508	508T					
E182	182TZ	2	1/10	115	Single Phase	1.0
E183	182TZ					
E184	184TZ					
E213	213TZ	3	1/3	200-230, 460	Three Phase	.8-75, .5
E215	215TZ					
E218	218TZ					
E254	254TZ					
E256	256TZ					
E258	S259TZ	8	1/2	200-230, 460	Three Phase	2.7-2.6, 1.3
E259	259TZ					
E328	328TZ	10	1 1/2	200-230, 460	Three	4.9-4.6, 2.3
E32B	3211TZ					
E32D	3213TZ					

❶ See POWERTEC Model Number Codes beginning on page 6, or PACTORQ Model Number Codes beginning on page 53.

❷ NEMA Frame Designation. See POWERTEC motor dimensions beginning on page 26, or PACTORQ motor dimensions beginning on page 60.

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BRAKE SPECIFICATIONS

STANDARD DC HOLDING DISC BRAKES

The holding brake is a standard option and is designed to provide a static holding torque to the motor shaft with the brake coil de-energized. The brake must be released (coil energized) prior to commanding motor rotation as determined by its dropout time. **The holding brake is limited to applying holding torque to a non-rotating motor and *must not* be used to stop a motor. In addition, the seller is not responsible for safety or any liability due to the delay time from between the time the brake coil voltage is removed and the torque is developed by the brake to prevent any further motor/load rotation.**

Model Number Prefix	Static Holding Torque (lb-ft.)		Voltage (VDC)	Current (Amps)	Inertia (ft-lb-sec ²)	Pull-in Time [ⓐ] (msec)	Drop-out Time [ⓑ] (msec)	Max. Speed [ⓒ] (RPM)	Weight Adder (lb)
	TENV	DPBV							
F140 (all)	3	3	100						Consult Factory
	6	6							
	10	10							
F180 (all)	15	15	100						Consult Factory
	35	35							
F210 (all)	30	30	100	0.39	0.0005	110	60	5000	15
	50	50	100	0.39	0.0005	110	60	5000	15
F250 (all)	90	90	100	0.81	0.0009	200	110	4000	44
	150	150							
	300	300							
F280 (all)	150	150	100	0.81	0.0009	200	110	4000	44
	300	300	100	1.57	0.0022	260	155	3800	80
	375	375							
F320 (all)	300	300	100	2.04	0.0100	340	215	3200	160
	375	375							
	600	600							
E182	30	30	100	.39	.0005	110	60	5000	15
E183	30	50							
E184	30	75							
E213	90	90	100	.81	.0009	200	110	4000	44
E215	90	150							
E218	90	150							
E254	300	300	100	1.57	.0022	260	155	3800	80
E256	300	300							
E258	300	300							
E259	300	375							
E28A	450	450							
E28C	450	600	100	2.04	.0100	340	215	3200	160
E328	750	750	100	3.79	.0267	450	300	2900	260
E32B	750	900							
E32D	750	1200							

- ⓐ Pull-in time is the normal brake armature plate pick-up time once voltage is applied (torque release).
- ⓑ Drop-out time is the normal brake armature plate drop-out time once voltage is removed (torque applied).
- ⓒ Max. speed is the mechanical limiting speed of the brake.

NOTE:

1. All voltage and current values have a ±10% tolerance.
2. See individual motor dimensional drawings for motor with brake length adder.
3. Motor with brake may be mounted horizontally or vertically.
4. See "Special Options" on page 135.

BRAKE SPECIFICATIONS

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SPECIAL OPTIONS, DC HOLDING DISC BRAKES

The following are available as special options. Please contact the factory at (803) 328-1888. **It is important to note that safety and liability issues associated with specifying and applying these options are the responsibility of the buyer.**

1. A manual release. The standard brake does not have a manual release.
2. Brakes with different Static Holding Torque ratings.
3. A rectifier module to convert 115 VAC to 90-100 VDC (mounted remotely and customer wired).

SPECIAL OPTIONS, AC HOLDING DISC BRAKES

In addition to the standard DC brake, AC brakes are available as a special option. Specifications must be finalized with the factory at (803) 328-1888. Prior to calling for a quotation, please prepare the following specifications for review with the factory. **It is important to note that safety and liability issues associated with specifying and applying the brake are the responsibility of the buyer.**

- Static holding torque rating
- Voltage (coil voltage)
- Frequency
- Brake enclosure rating — standard, dust tight, waterproof, or explosion proof
- Orientation — horizontal or vertical mounting, above or below the motor
- Manual release required?
- Modifications required, such as interlocking switches, space heaters, etc.
- Holding or stopping duty. If stopping, provide specifications
- Space limitations or mechanical design considerations

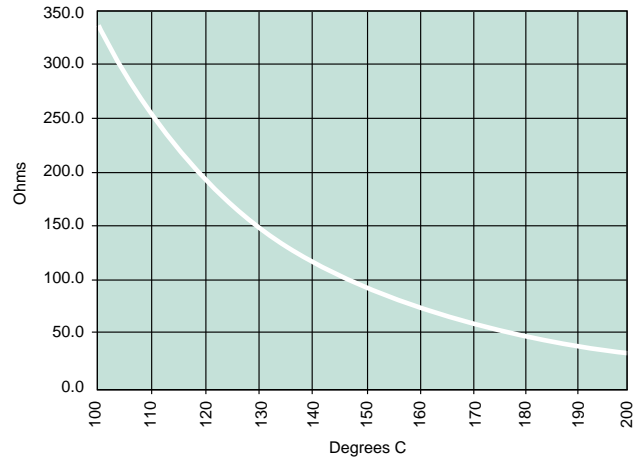
THERMAL PROTECTION

NTC THERMAL SENSOR (THERMISTOR)

Winding Temp. (Degrees C)	NTC Resistance (Ohms)	Winding Temp. (Degrees C)	NTC Resistance (Ohms)
-40	168,250.0	90	458.9
-30	88,500.0	100	340.0
-20	48,535.0	110	255.6
-10	27,665.0	120	194.7
0	16,325.0	130	150.5
10	9,950.0	140	117.4
20	6,245.0	150	92.7
30	4,028.5	160	74.0
40	2,663.5	170	59.6
50	1,801.5	180	48.4
60	1,244.0	190	39.7
70	876.0	200	32.8
80	629.0		

NOTES:

- The NTC thermal sensor (thermistor) is used in conjunction with resolver primary feedback. A PTC thermal sensor is also available.
- The NTC thermal sensor consists of two (10kΩ @ +25°C) Negative Temperature Coefficient thermistors, mounted so as to sense the temperature of the three stator phase windings. The two NTCs are wired in parallel, connected to terminals P1 (8) and P2 (9) in the motor terminal box.
- The over-temperature threshold for totally enclosed motors is 145°C (104.2 Ω). The over-temperature threshold for drip-proof, blower ventilated motors is 130°C (150.5 Ω). Operation above these temperatures will cause damage to the motor.



THERMAL SWITCH (THERMOSTAT)

The Thermal Switch is normally closed and rated as follows:

Maximum current, breaking:

- 12A, 120VAC
- 8A, 240VAC
- 2A, 24VDC

Continuous current:

- 2A at all the above voltages

DE-RATING

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Motors are rated on their ability to dissipate heat. Two environmental factors that affect the motor's ability to dissipate heat are altitude and ambient temperature. These factors apply equally to both TENV and DPBV motors. In addition, de-rating is cumulative. See note below.

ALTITUDE DE-RATING^o

Air gets thinner at increasing altitudes above sea level. As pressure drops, the rate of heat removal by any form of convection cooling is reduced and it becomes more difficult to cool a motor. POWERTEC and PACTORQ motors are rated in accordance with NEMA Standard MG1-14.04.

The motors are rated for operation at altitudes from sea level up to 3300 feet (1000 meters). Above 3300 feet, the motors torque and power rating must be de-rated to allow for the reduced cooling effect. See the de-rating curve in Figure 1. Find the altitude at which the motor will be used on the horizontal axis and find the corresponding de-rating factor directly above it where the vertical axis intersects the curve.

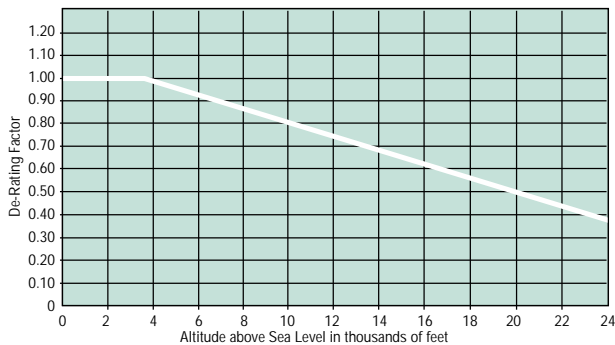


FIGURE 1

For example, the de-rating factor at 7000 feet is about 0.9. A motor rated at 30 HP up to 3300 feet is de-rated to 27 HP at 7000 feet. Below sea level use the standard motor rating. For altitudes above 24,000 feet consult our Application Engineering Group.

CAUTION! De-rating is cumulative. First de-rate for altitude, then for temperature.

AMBIENT TEMPERATURE DE-RATING^o

The motor must be installed in a clean, dry, and well-ventilated area away from extreme heat sources. The air temperature surrounding the motor should be a maximum of 40°C (104°F). For higher ambient temperatures, the motor must be de-rated.

POWERTEC and PACTORQ motors are rated in accordance with NEMA Standard MG1-12.43. See Figure 2. Find the appropriate ambient temperature for the motor on the horizontal axis and find the corresponding de-rating factor directly above it where the vertical axis intersects the curve.

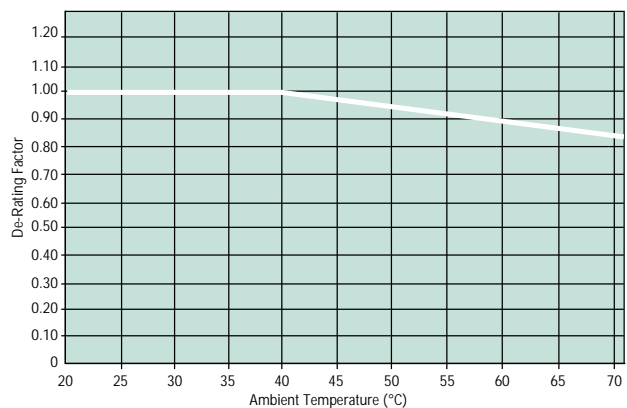


FIGURE 2

For example, the de-rating factor at 58°C ambient is about 0.9. A motor rated at 30 HP up to 40°C ambient is de-rated to 27 HP at 58°C.

If the motor is to be used at 7000 feet and 58°C ambient it will need to be cumulatively de-rated. An altitude de-rating of 0.9 results in a 27 HP rating (see previous example). The cumulative ambient temperature de-rating of 0.9 results in a 24 HP rating.

SEALING - TOTALLY ENCLOSED NON-VENTILATED MOTORS

TENV motors may be specified with IP44 or IP56 IEC ratings. See the individual frame size Model Number Codes for POWERTEC motors beginning on page 6, or PACTORQ motors beginning on page 53.

NEMA MG-1 section 5 and IEC Publication 529 Classification of Degrees of Protection of Enclosures provides a system for rating and specifying motors based on the degree of protection required by the application. IEC, however, does not specify degrees of protection against risk of explosions or moisture conditions (produced by condensation, for example). Consult the factory Application Engineering Group, at (803) 328-1888, if there are any uncertainties about motor sealing.

SPECIFICATION IDENTIFICATION

IP44

Protection against liquid splashed from any direction

Protection against contact with live or moving parts inside the enclosure by tools, wires or such objects of thickness greater than 1 mm. Protection against ingress of small foreign bodies

MOTOR SEALING

- Motors are fully gasketed with solid covers over all openings
- Gaskets between frame and terminal box - and between terminal box and terminal box cover
- Corrosion resistant zinc hardware is used

IP56

Protection against strong jets of water

Complete protection against contact with live or moving parts inside the enclosure. Protection against harmful deposits of dust.

- Sealed per above plus RTV sealant is used on both sides of all gaskets, between the frame to bracket fits, and around the flange of the optional encoder and brake end cover.
- Shaft slinger used on single or special double shaft extensions.
- Motors are intended to run with the drain (weep) holes open. The standard location for weep holes is at the lowest portion of the housing between the frame and end bells at both ends of the motor.

BEARINGS AND SHAFT LOADING

BEARINGS

Long life electric motor heavy duty ball bearings have honed and polished raceways, are double shielded, and may be relubricated. Cooler rotor and shaft temperatures in the brushless motor (compared to other types of motors) insure longer bearing and grease life. The grease is suitable for operation over a wide temperature range.

Both bearings are in rugged steel inserts (lower thermal expansion than aluminum) that are cast into the aluminum end bells. The outer bearing races will not turn. The drive end is preloaded and the rear end is held by a retainer clamp to minimize axial end play. This permits both horizontal and vertical motor mounting and reliable operation of the optional secondary feedback device (optional encoder).

MAXIMUM SHAFT RADIAL LOADING

- Heavy Duty Ball Bearings
- Standard Shaft Extension
- Radial Load Centered at Tip of Shaft

Model Number Prefix	Shaft Diameter (in.)	Bearing #	20,000 Hour L ₁₀ Life Max. Radial Load (lbs.) [ⓐ]	40,000 Hour L ₁₀ Life Max. Radial Load (lbs.) [ⓐ]	Min. Sheave Diameter (in.) [ⓐ]
F140 (all)	0.875	205	180	144	2.40
F182, F184	1.125	207	280	224	4.60
F213, F215	1.375	209	440	352	4.40
F254, F256	1.625	211	600	480	6.50
F259	2.125	M211	1100	880	6.00
F287	2.125	313	1100	880	6.00
F288, F28A	2.375	313	1350	1080	9.60
F328, F32B, F32D	2.875	315	1800	1440	12.00
F504 [ⓑ]	3.250	6222	1600	1280	NA
F506 [ⓑ]	3.625	6222	1600	1280	NA
F508 [ⓑ]	4.125	6222	1600	1280	NA
E180 (all)	1.375	209	440	352	4.40
E213	1.625	211	600	480	6.50
E215, E218	2.125	M211	1100	880	6.00
E254	2.125	313	1100	880	6.00
E256, E258, E259	2.375	313	1350	1080	9.60
E28A, E28C	3.785	315	1800	1440	12.00
E328 [ⓑ]	3.250	6222	1500	1200	21.6
E32B [ⓑ]	3.625	6222	1400	1120	30.9
E32D [ⓑ]	4.125	6222	1300	1040	41.5

ⓐ If the radial load exceeds the Max. Radial Load, or the sheave diameter is too small, roller bearings are required. Contact the factory for assistance.

ⓑ Model numbers F504, F506, F508, E328, E32B and E32D with standard ball bearings are recommended for direct-coupled service only. Belt drives with these motors require roller bearings. Contact the factory for assistance.

A

MOTORS

B

DRIVES

C

PRE-ENGINEERED DRIVE SYSTEMS

D

GENERAL INFORMATION

BEARING RELUBRICATION INTERVALS

POWERTEC and PACTORQ motors are lubricated with Chevron "SRI" grease. The relubrication intervals suggested below are conservative with respect to the Chevron grease and can be exceeded in many applications.

