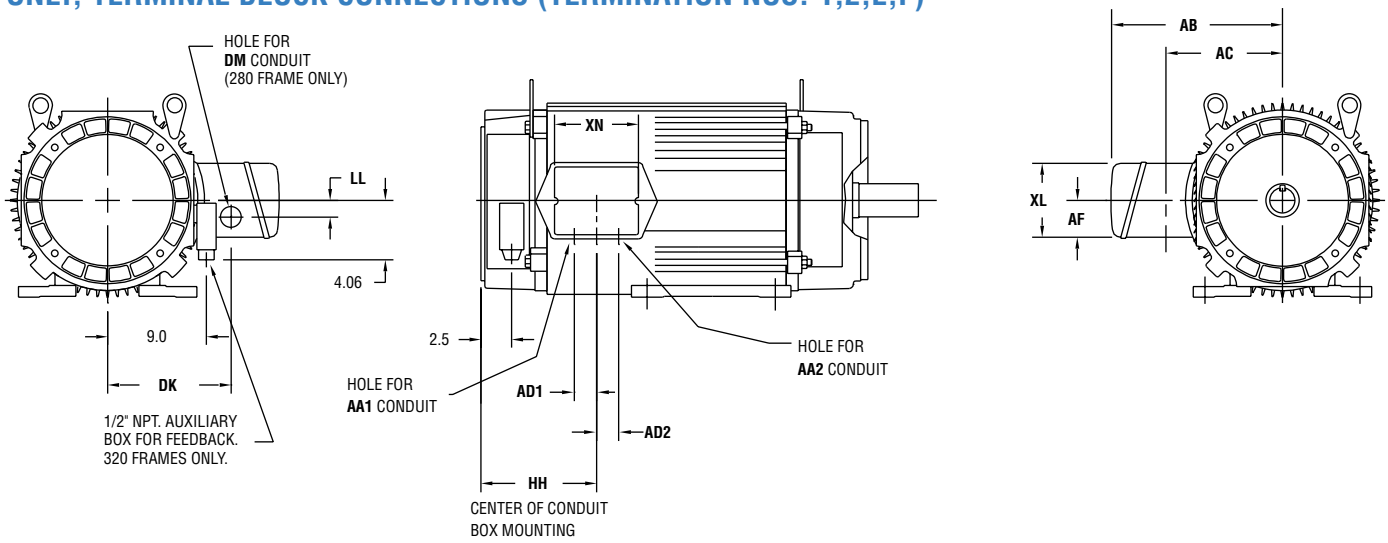
CONDUIT BOX - TERMINATION VIA CONDUITS ONLY, TERMINAL BLOCK CONNECTIONS (TERMINATION NOS. 1,2,E,F)



	STANDARD HIGH CAPACITY CONDUIT BOX													
FRAME	MAX. CONT. RMS AMPS	AB	AC	XL	AF	HH	AD1	AD2	XN	AA1 △1 △2	AA2 △1	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 △3	–	–	–
210	103	11.13	7.68	4.75	2.39	5.50	1.12	1.63	6.00	1 1/4	3/4 △3	–	–	–
250	193	14.32	9.38	5.85	3.00	6.31	1.00	2.50	8.00	2 1/2	1/2 △3	–	–	–
280	310	15.75	10.00	8.25	4.13	8.31	2.25	2.25	9.75	3	3 △2	3/4 △3	10.00	2.0
320	533	18.45	13.03	12.76	6.38	11.75	2.88	2.88	12.76	4	4 △2	–	–	–

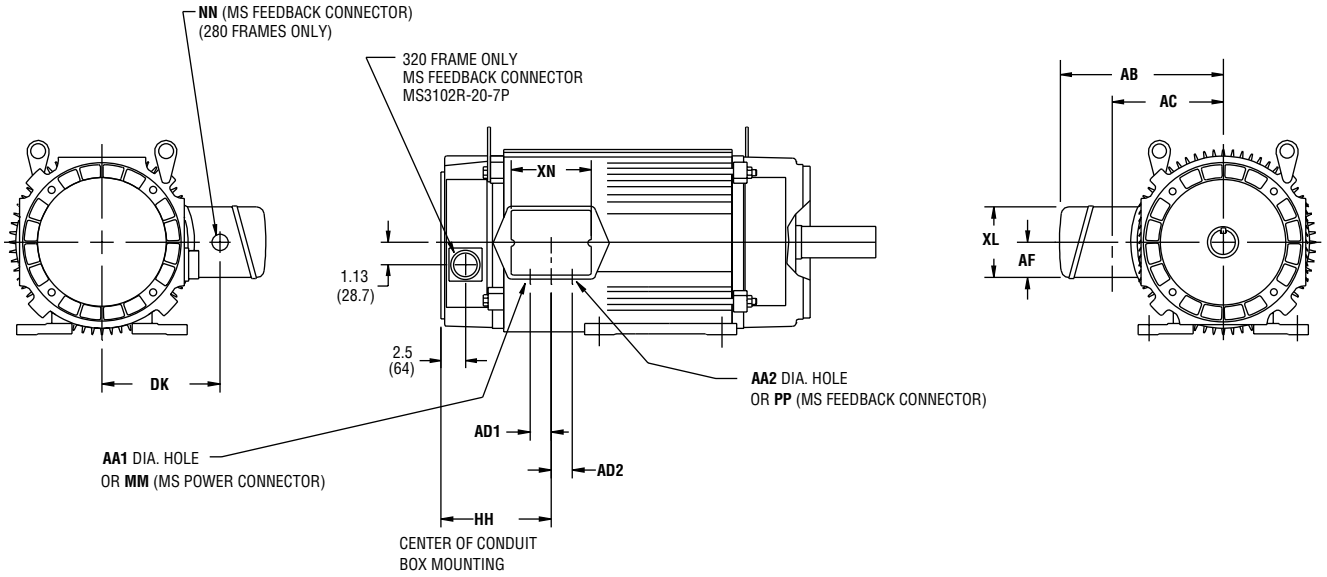
△1 Conduit box in F1 position with conduit holes facing down is standard mounting. Conduit box can be rotated in 90° steps about its axis and can be mounted on opposite side (F2) when specified.

△2 Power

△3 Feedback

All dimensions are in inches

CONDUIT BOX - TERMINATION VIA MS CONNECTORS OR TERMINAL BLOCKS WHERE APPLICABLE (TERMINATION NOS. 3,4)



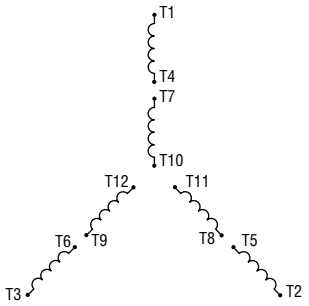
		STANDARD HIGH CAPACITY CONDUIT BOX													
FRAME	MAX. CONT. RMS AMPS	AB	AC	XL	AF	HH	AD1	AD2	XN	AA1 △1 △2	AA2 △1	DK	NN △3 MS connector	MM △2 MS connector	PP △3 MS connector
180	65	9.57 (243,1)	7.03 (178.56)	4.00 (101,6)	2.00 (50,8)	4.94 (125,48)	.50 (12,7)	1.68 (42,67)	6.00 (152.4)	–	–	–	–	MS3102R-32-17P	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 Conduit box in F1 position with conduit holes and MS connectors 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.

△2 Power

△3 Feedback

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



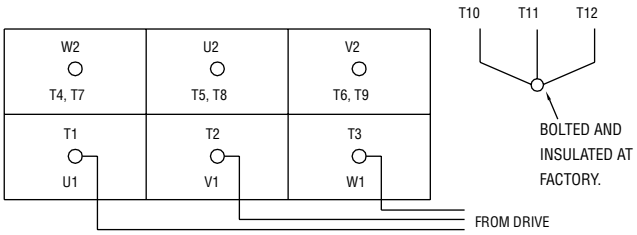
MOTOR POWER CONNECTIONS TO POWER TERMINAL BLOCK △1 (TERMINATION NOS. E,F,G)

WINDING CONNECTION △2 | **12 LEAD MOTOR POWER CONNECTIONS**

3 1 WYE CONNECTION LOW SPEED

Y

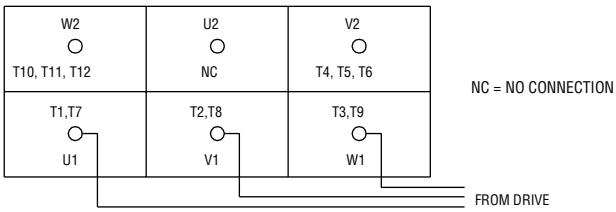
GND STUD



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

4 2 WYE CONNECTION MED-HIGH SPEED

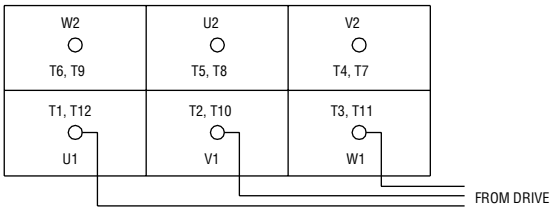
GND STUD



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

1 1 DELTA CONNECTION MEDIUM SPEED

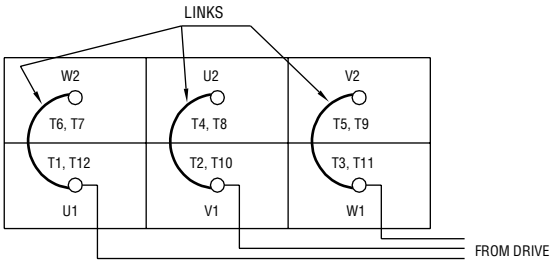
GND STUD



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

2 2 DELTA CONNECTION HIGH SPEED

GND STUD



From Drive	Connect Together
T1-T7-T6-T12 T2, T8-T4-T10 T3-TT9-T5-T11	—

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

W2	U2	V2
U1	V1	W1

△2 Model number code designation.

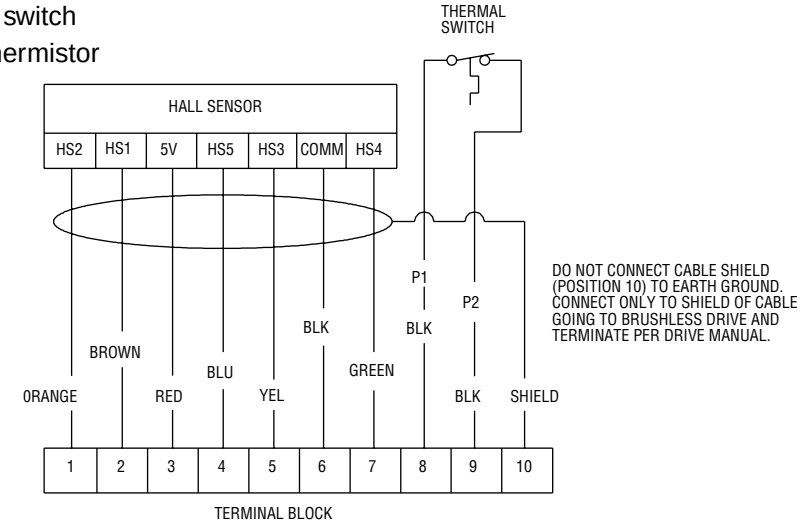
CONDUIT BOX – TERMINATION VIA CONDUITS ONLY, TERMINAL BLOCK CONNECTIONS FOR MOTOR (TERMINATION NOS. 1,2,7,E,F,G) AND:

PRIMARY FEEDBACK DEVICES/THERMAL SENSOR

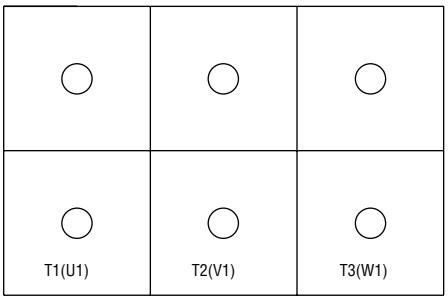
0△ = Hall sensors/thermal switch

2 or 5△ = Resolver/NTC thermistor

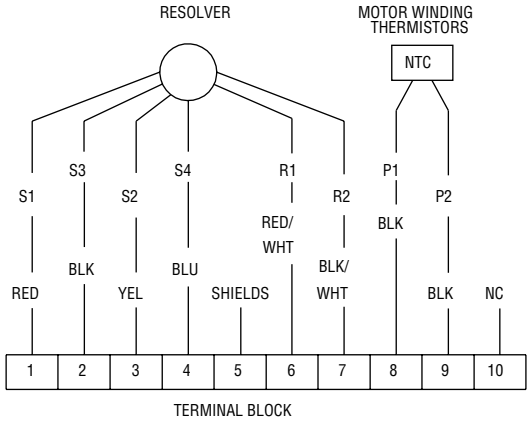
MOTOR WITH HALL SENSOR



MOTOR POWER TERMINAL BLOCK



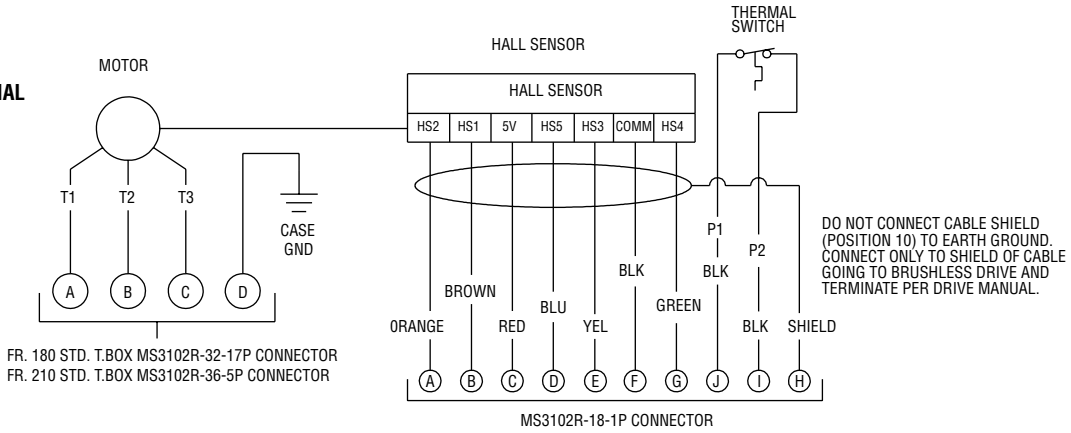
MOTOR WITH RESOLVER



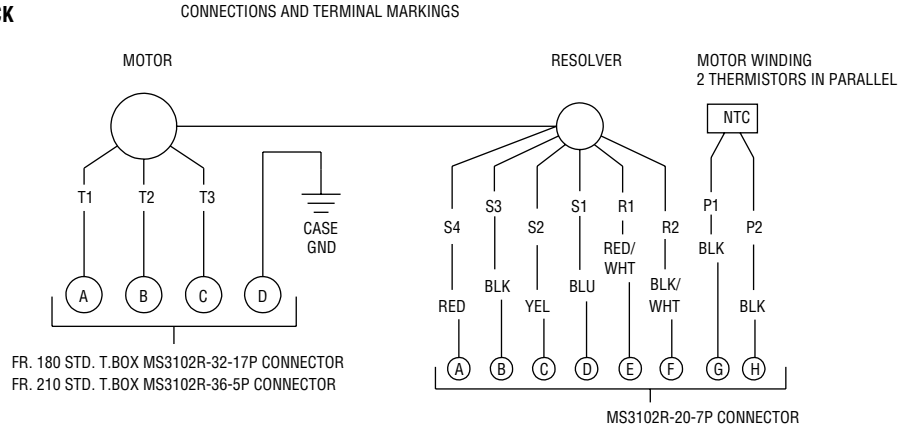
△ Model number code designation

CONDUIT BOX – TERMINATION VIA MS CONNECTORS FOR MOTOR (TERMINATION NOS. 3,4,8) AND:

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 61.

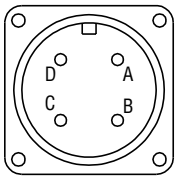
TERMINATIONS

CONDUIT BOX – TERMINATION VIA MS CONNECTORS:

MOTOR

FRAME 180 WITH STANDARD HIGH CAPACITY CONDUIT BOX

MS3102R-32-17P

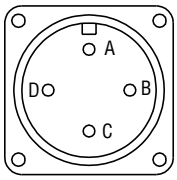


Standard pinouts - all series

CONNECTOR PIN	FUNCTION
A	T1
B	T2
C	T3
D	GROUND

FRAME 210 WITH STANDARD HIGH CAPACITY CONDUIT BOX

MS3102R-36-5P



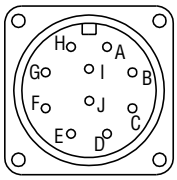
Suggested mating connector and clamp

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

PRIMARY FEEDBACK DEVICES

HALL SENSOR

MS3102R-18-1P

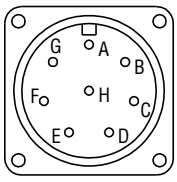


Standard pinouts - all series

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	
J	THERMAL	

RESOLVER

MS3102R-20-7P



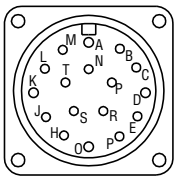
Suggested mating connector and clamp

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

CONDUIT BOX – TERMINATION VIA MS CONNECTORS FOR ENCODER (SECONDARY FEEDBACK DEVICE) [1]

SECONDARY FEEDBACK CONNECTOR

MS3102E20-29P



SECONDARY FEEDBACK	
CONNECTOR PIN	**ENCODER**
A	CASE GND
B	N/C
C	S1 (U) [2]
D	S2 (V) [2]
E	S3 (W) [2]
F	N/C
G	ENCODER A
H	ENCODER $\overline{A}$
J	ENCODER B
K	ENCODER $\overline{B}$
L	ENCODER Z
M	ENCODER $\overline{Z}$
N	$\overline{S1}$ (U) [2]
P	$\overline{S2}$ (V) [2]
R	$\overline{S3}$ (W) [2]
S	ENCODER + V dc
T	ENCODER V dc RTN

Suggested mating connector and clamp

CONNECTOR WITH CABLE CLAMP
MS310GF-20-29S

[1] E320 frame motors only have this MS connector mounted on the motor rather than the conduit box. See Terminations drawing, page 56.

[2] Optional commutation tracks.

FEEDBACK DEVICES

Primary Feedback Devices	Secondary Feedback Devices
Hall sensors • Commutation signals • Speed feedback channels Resolver, transmitter type • Commutation signals • Analog position information • Velocity data	Digital Optical Encoders • Digital position • Velocity data • Commutation output available, contact factory

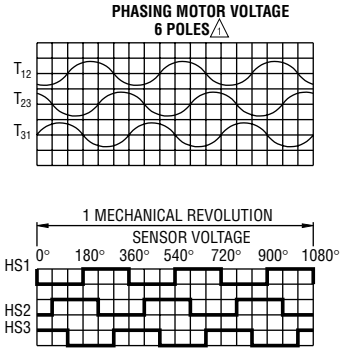
A selection of feedback configurations is available. Options include motors equipped with primary only, primary and secondary, and secondary feedback only. Described below are the specifications. The primary and secondary feedback devices can be factory installed by Pacific Scientific on the motor of your choice. Secondary feedback (optical encoder) mounting provisions only are also an option. See page 66.

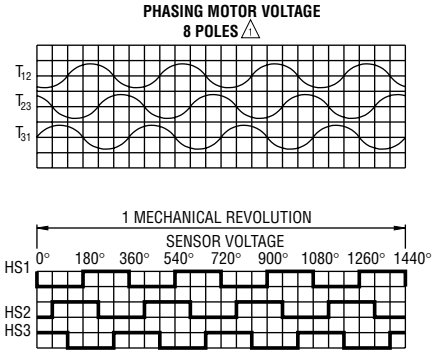
PRIMARY FEEDBACK DEVICES. . .

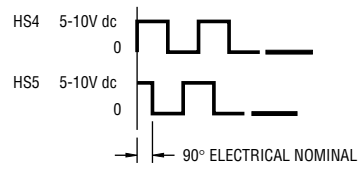
See PRIMARY FEEDBACK in Model Number Code to designate this standard option. Hall Sensors are furnished in combination with a Thermal Switch. See page 69.

Hall Sensors

Note: This is the phasing as supplied with the designated motor winding connection. If the winding connections are changed from those initially furnished, refer to the motor manual.







Number of speed channels in quadrature: 2

Parameter	Units	Value
Commutation outputs:		See phasing diagram
No. of poles No. of phases Output volts, max.	 volts	6 and 8 3 DC Supply
Power supply required	volts mA	5 - 10V dc 75 mA max

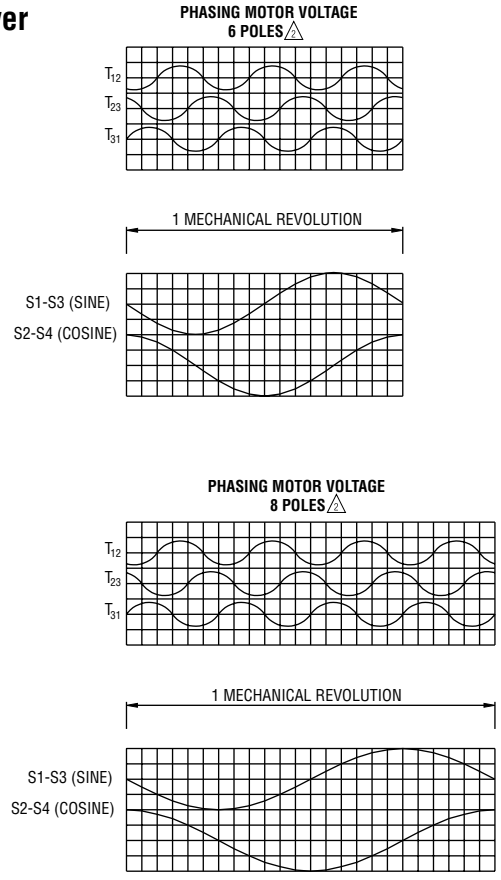
△ For counterclockwise motor rotation viewed from opposite drive end.

POLES	SPEED FEEDBACK CHANNELS P.P.R.
6	45
8	60

PRIMARY FEEDBACK DEVICE. . .

See PRIMARY FEEDBACK in Model Number Code to designate this standard option. The resolver is furnished in combination with an NTC Thermistor. See page 69.

Resolver

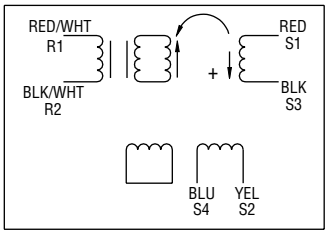


Typical output @ 25°C

Parameter	Units	2	5 △1
Frame size		37	49
Type		Transmitter	Transmitter
Primary		Rotor	Rotor
Speeds		1	1
Input voltage	V_{RMS}	8	8
Frequency	kHz	6.5	6.5
Input current, max.	mA	68	85
Input power, nom	mW	404	510
Transformation ratio		0.5	0.5
Phase shift	Degrees	-3	-5
Impedences:			
ZRO	ohms	87+j82	84+j59
ZRS	ohms	82+j79	83+j59
ZSO	ohms	298+j519	905+j1860
ZSS	ohms	278+j497	885+j850
DC resistances:			
Stator	ohms	42	195
Rotor	ohms	57	62
Null voltage	mV	45	30
Max. electrical error	Minutes	20	20
Output voltage	Vrms	4	4
Weight	lb	1	2.43

△1 Type 5 is used in all 280 and 320 frame motors that have an optional brake or a special rear shaft (opposite drive end) extension.

△2 For counterclockwise motor rotation viewed from opposite drive end.



Polarities when resolver rotation is CCW, viewed from opposite drive end.

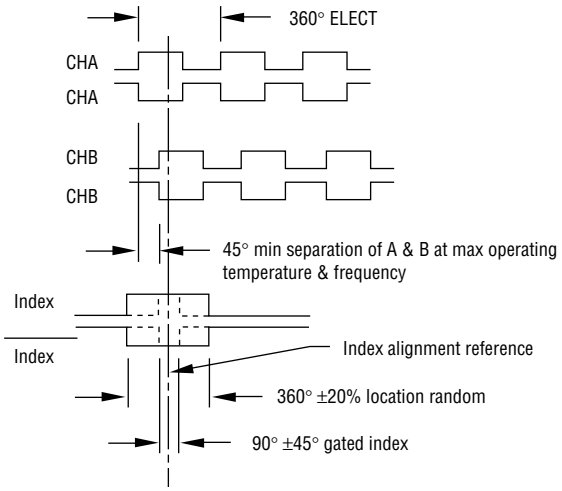
SECONDARY FEEDBACK DEVICE. . . OPTIONAL ENCODER

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 66.

Typical output @ 25°C

Parameter	A	B
Pulses per revolution	**600**	**1024**
Type	Incremental	
Supply voltage	+5V dc ±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.

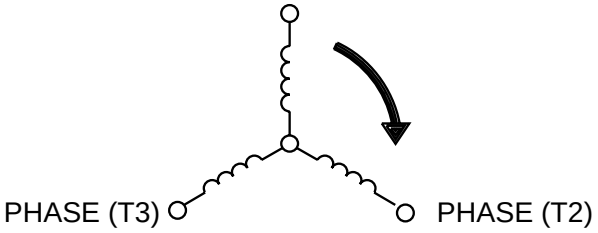


NOTE:
Commutation output available, contact factory

PHASING DIAGRAM. . . ALL MOTORS

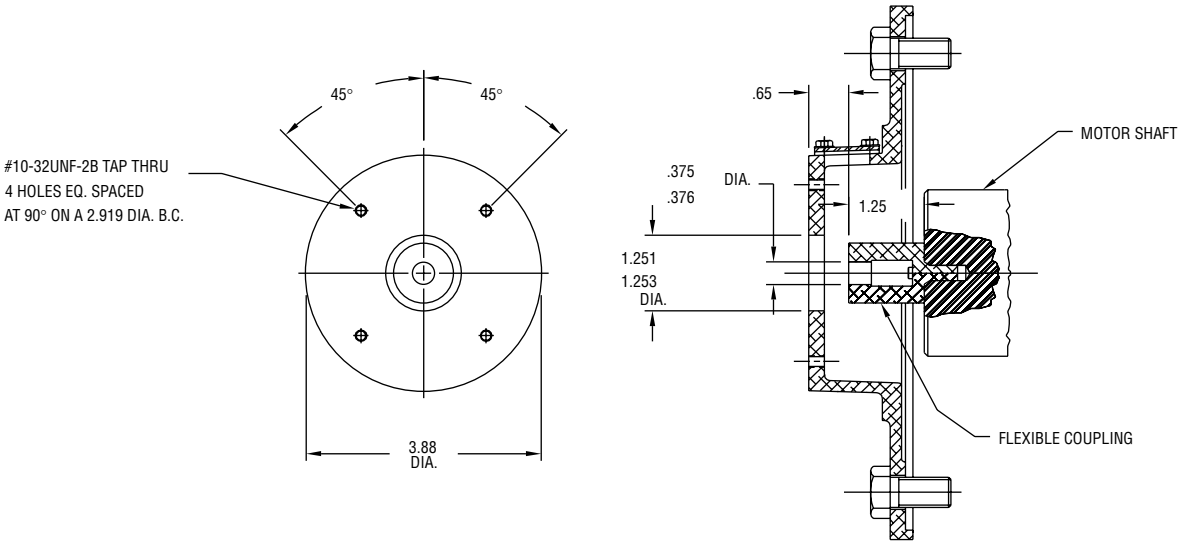
This is the phasing diagram for counterclockwise motor rotation viewed from opposite the drive end. This is the same phasing reference used for both primary and secondary feedback devices

MOTOR WINDING CONFIGURATION



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

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



BLOWER MOTOR DATA (FOR DPBV MOTORS)

Model ⚠1 Number	NEMA ⚠2 Frame	Size	HP	Voltage	Amps	Supply 50/60HZ
E182	E182TZ	2	1/10	115	1.0	single phase
E183	ES184TZ					
E184	E184TZ					
E213	E213TZ	3	1/3	200-230 or 460	.8-.75 .5	three phase
E215	E215TZ					
E218	E218TZ					
E254	E254TZ					
E256	E256TZ					
E258	ES259TZ	8	1/2	200-230 or 460	2.1-2.0 1.0	three phase
E259	EL259TZ					
E28A	E2810TZ	9	3/4	200-230 or 460	2.7-2.6 1.3	three phase
E28C	E2812TZ					
E328	E328TZ	10	1 1/2	200-230 or 460	4.9-4.6 2.3	three phase
E32B	E3211TZ					
E32D	E3213TZ					

⚠1 See selection overview, page 3.

⚠2 For reference: NEMA frame assignment ratings.

HOLDING DISC BRAKE (DC)

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 first be released (coil energized) prior to commanding motor rotation, as determined by its drop out time. **The holding brake is limited to applying holding torque to a non-rotating motor and must not be used in applications 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	Static Holding Torque (lb-ft.)		Voltage (V dc)	Current (Amps)	Inertia (ft-lb-sec^2)	Pull-in Time (msec) ⚠1	Drop-out Time (msec) ⚠2	Max. Speed (RPM) ⚠3	Weight Adder (lb)
	TENV	DPBV							
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	100	2.04	.0100	340	215	3200	160
E28C	450	600							
E328	750	750	100	3.79	.0267	450	300	2900	260
E32B	750	900							
E32D	750	1200							

⚠1 Pull-in time is the typical brake armature plate pick-up time once voltage is applied (torque released).
⚠2 Drop-out time is the typical brake armature plate drop-out time once voltage is removed (torque applied).
⚠3 Maximum speed is the mechanicall speed limit 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” below.

Special Options… Holding Disc Brake (DC)

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 115V ac to 90 - 100V dc (mounted remotely and customer wired).

Special Options… Holding Disc Brake (AC)

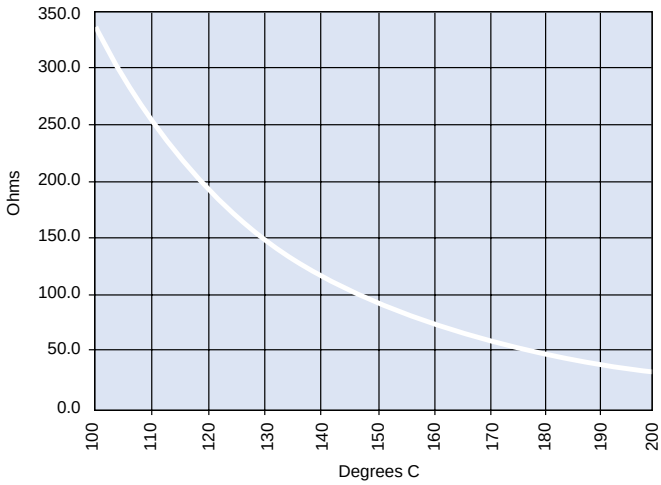
In addition to the standard DC brake, AC brakes are available as a special option. Specifications must be finalized with the factory at (803) 328-1888. Prior to calling for a quotation, please prepare the following specifications for review with the factory. **It is important to note that safety and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

NTC THERMAL SENSOR

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:
1. The NTC thermal sensor (thermistor) is used in conjunction with resolver primary feedback. A PTC thermal sensor is also available.
2. The NTC thermal sensor consists of two NTC thermistor probes, mounted so as to sense the temperature of the three stator phase windings. The probes are wired in a parallel circuit, connected to terminals P1 (8) and P2 (9) in the motor terminal box.
3. The over-temperature threshold for totally enclosed motors is 145 degrees (104.2 ohms). The over-temperature threshold for drip-proof, blower ventilated motors is 130 degrees (150.5 ohms). Operation above these temperatures will cause damage to the motor.



THERMAL SWITCH (THERMOSTAT) (WHEN SPECIFIED)

The Thermal Switch is normally closed and rated as follows:

Maximum current, break: 12A, 120V ac
8A, 240V ac
2A, 24V dc

Continuous current: 2A at all the above voltages.

DE-RATING

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

ALTITUDE DE-RATING ⚠

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 gets more difficult to cool a motor. 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 motor's 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 its vertical axis intersects the curve.

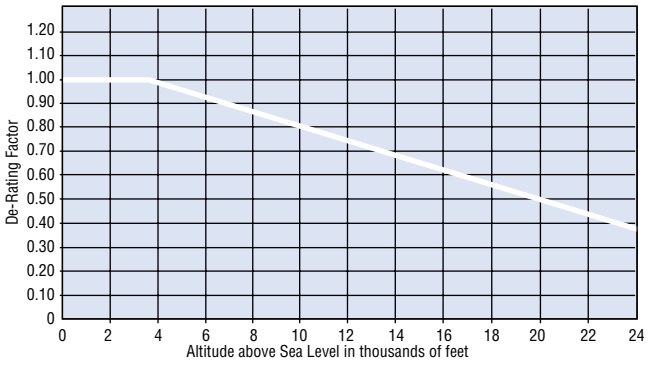


FIGURE 1

For example, the de-rating factor at 7000 feet is about .9. A motor rated at 30 lb-ft. up to 3300 feet is de-rated to 27 lb-ft. at 7000 feet. Below sea level use the standard motor rating, but for altitudes above 24,000 feet consult our Application Engineering Group, at (803) 328-1888.

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

AMBIENT TEMPERATURE DE-RATING ⚠

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. PACTORQ motors are rated in accordance with NEMA Standard MG1-12.43

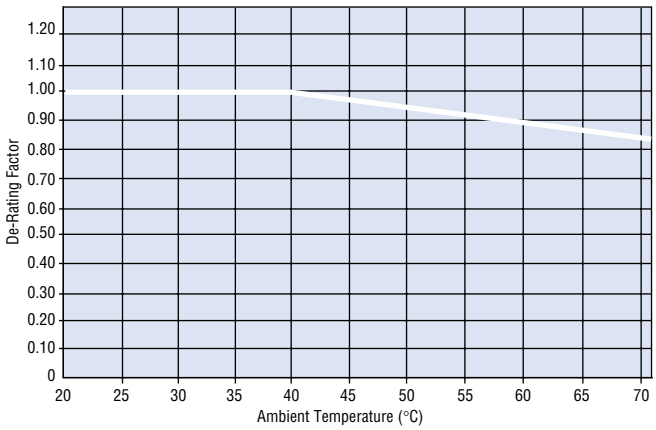


FIGURE 2

See Figure 2. De-rating applies to the continuous duty area of the torque-speed curve. It does not diminish the peak torque rating except to the extent that the RMS torque must be within the continuous duty area. See page 76. Find the appropriate ambient temperature for the motor on the horizontal axis and find the corresponding de-rating factor directly above it where its vertical axis intersects the curve.

BEARINGS AND SHAFT LOADING

BEARINGS

Long life electric motor quality ball bearings have honed and polished raceways, are double shielded and may be relubricated (see page 72). 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 won't turn. The drive end is preloaded and the opposite drive 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 primary and optional secondary feedback device (optional encoder).

MAXIMUM SHAFT RADIAL LOADING

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

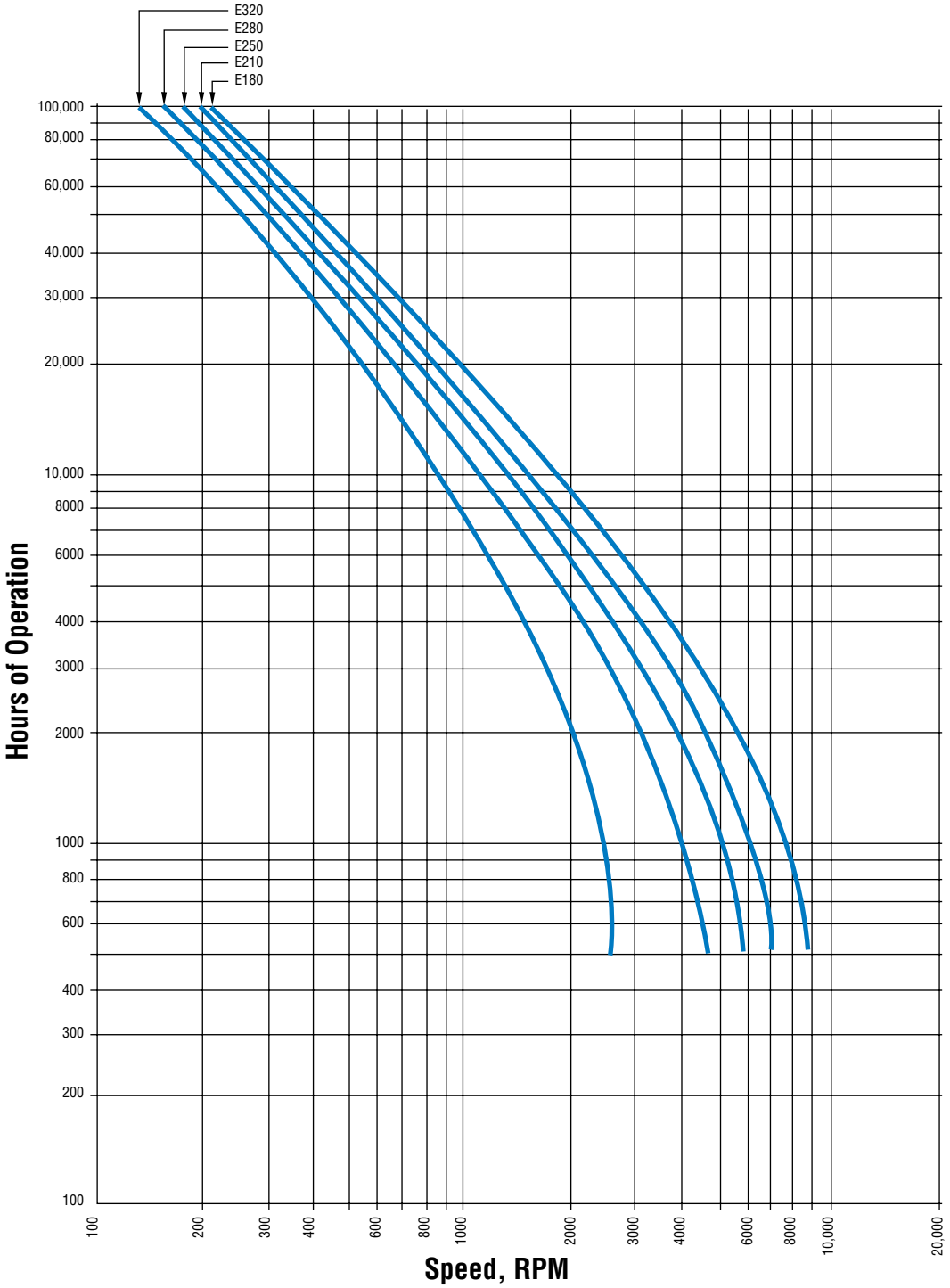
Model Number	Shaft Diameter (in.)	Bearing #	Max. Radial Load (lbs.) for 20,000 Hrs. L_{10} Life @ 1750 RPM ⚠1	Max. Radial Load (lbs.) for 40,000 Hrs. L_{10} Life @ 1750 RPM ⚠1	Min. Sheave Diameter(in.) ⚠1
E180 (all)	1.375	209	440	352	4.40
E213	1.625	211	600	480	6.50
E215, E218	2.125	M211	1100	880	6.00
E254	2.125	313	1100	880	6.00
E256	2.375	313	1350	1080	9.60
E258, E259	2.375	313	1350	1080	9.60
E28A, E28C	3.785	315	1800	1440	12.00
E328 ⚠2	3.25	6222	1500	1200	21.6
E32B ⚠2	3.625	6222	1400	1120	30.9
E32D ⚠2	4.125	6222	1300	1040	41.5

⚠1 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.

⚠2 Model numbers 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.

PACTORQ BEARING RELUBRICATION INTERVALS

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.



SEALING

TOTALLY ENCLOSED, NON-VENTILATED (TENV) MOTORS

TENV motors may be specified with IP44 or IP56 IEC ratings. See the individual frame size Model Number Code.

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

MOTOR SEALING

IP44

- **4** — Protection against liquid splashed from any direction
- **5** — 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

- 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

- **5** — Protection against strong jets of water
- **6** — 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.