

BULLETIN EST

Series N2300

ELCOM ST™ Brushless DC Servo Motors



Pittman brand ELCOM ST™ slotted brushless DC motors have internal Hall sensor feedback for linear speed-torque characteristics, high starting torque and variable speed control with appropriate drive electronics. These motors were designed for high volume manufacturing and low unit cost as the primary criteria. Modifications to the shaft, winding and mechanical mounting are available for OEM applications. To satisfy unique application requirements, these motors can be supplied as “housed” units or “unhoused” (parts set) units. Standard windings or custom windings with mechanical modifications are available with quick lead times for both prototype and production units. Matching drive electronics from Pittman can be integral or mounted to the rear of the motor.

Construction

- 3 phase slotted stator
- 6 slot lamination design
- 4-pole rotor featuring bonded neodymium iron boron magnets
- Ball bearings standard
- Precision ground hardened stainless steel shafts
- 6-step commutation at 120 electrical degrees
- NEMA 23 mounting configuration

Options

- Shaft modifications
- Shaft mounted pulleys and gears
- Multiple windings
- Electromechanical brakes
- Hewlett-Packard® optical encoders
- Customized versions available in production quantities

Series N2300™

- Available in 4 lengths
- Speeds up to 8,000 RPM
- Continuous torques to 49 oz-in (75 oz-in with Heat sink)
- Encoder resolutions from 96 to 2048 CPR

PITTMAN[®]
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Power Your Ideas™



Get same day shipment of sample motors for models listed in the Pittman Express Catalog (Bulletin PE).

Every Pittman motor is subjected to automated performance testing prior to shipment.

Motor Data

Line No.	Parameter	Symbol	Units	N2311	N2312	N2313	N2314
1 _M	Continuous Torque (Max.) ¹	T _{CSM}	oz-in (N-m)	16.25 (1.14E-01)	26.50 (1.86E-01)	37.73 (2.66E-01)	48.90 (3.44E-01)
1 _{HS}	Continuous Torque (Max.) ²	T _{CSHS}	oz-in (N-m)	26.35 (1.86E-01)	41.68 (2.943E-01)	57.35 (4.049E-01)	74.57 (5.265E-01)
2	Torque @ 0 RPM	T _{stall}	oz-in (N-m)	32.00 (2.19E-01)	70.00 (4.94E-01)	123.32 (8.706E-01)	179.50 (1.26E+00)
3	Friction Torque	T _F	oz-in (N-m)	0.80 (5.65E-03)	1.20 (8.47E-03)	1.4 (9.88E-03)	1.60 (1.13E-02)
4	No Load Speed	S _{NL}	rpm (rad/s)	7250 (759)	7250 (759)	7250 (759)	7250 (759)
5	Rotor Inertia	J _M	oz-in-s ² (kg-m ²)	1.20E-03 (8.47E-07)	1.70E-03 (1.20E-06)	2.000E-03 (1.41E-05)	2.30E-03 (1.62E-06)
6	Electrical Time Constant	τ _E	ms	1.85	2.10	2.07	2.32
7	Mechanical Time Constant	τ _M	ms	13.50	8.50	5.80	4.50
8	Viscous Damping— Infinite Source Impedance	D	oz-in/krpm (N-m/(rad/s))	0.145 (9.79E-06)	0.322 (2.17E-05)	0.577 (3.89E-05)	0.831 (5.61E-06)
9	Damping Constant— Zero Source Impedance	K _d	oz-in/krpm (N-m/(rad/s))	0.013 (8.67E-07)	0.029 (1.95E-06)	0.051 (3.43E-06)	0.075 (4.98E-06)
10	Maximum Winding Temperature	θ _{MAX}	°F (°C)	266 (130)	266 (130)	266 (130)	266 (130)
11 _M	Thermal Impedance ¹	R _{THM}	°C/watt	4.92	4.21	3.60	3.12
11 _{HS}	Thermal Impedance ²	R _{THHS}	°C/watt	1.86	1.68	1.55	1.34
12	Thermal Time Constant	τ _{TH}	min.	13	17	21	24
13	Motor Weight (Mass)	W _M	oz (g)	12.5 (354.4)	18.5 (524.5)	24.5 (694.6)	29.5 (836.3)
14	Motor Constant	K _M	oz-in/√W (N-m/√W)	3.50 (24.7 X 10 ⁻³)	5.30 (37.4 X 10 ⁻³)	6.97 (49.2x10 ⁻³)	8.45 (59.7 X 10 ⁻³)
15	Motor Length	L ₁	in max. (mm max.)	1.53 (38.86)	1.98 (50.34)	2.48 (63.07)	2.98 (75.74)

¹Specified at max. winding temperature at 25°C ambient temperature without heat sink.

²Specified at max. winding temperature at 25°C ambient temperature on a 10" x 10" x 0.5" aluminum heat sink.

SERIES N2300

Model N2311 Winding Data (Other windings available upon request)

Line No.	Parameter	Symbol	Units	N2311									
				9.4	12.1	14.8	18.3	23.7	29.0	36.1	46.8	57.5	71.8
16	Reference Voltage	E	V	9.4	12.1	14.8	18.3	23.7	29.0	36.1	46.8	57.5	71.8
17	Torque Constant	K_T	oz-in /A (N-m/A)	1.662 (1.18E-02)	2.161 (1.53E-02)	2.660 (1.88E-02)	3.325 (2.35E-02)	4.322 (3.06E-02)	5.319 (3.77E-02)	6.649 (4.71E-02)	8.644 (6.12E-02)	10.639 (7.54E-02)	13.299 (9.42E-02)
18	Back-EMF Constant	K_E	V/krpm (V/rad/s)	1.229 (1.17E-02)	1.598 (1.53E-02)	1.967 (1.88E-02)	2.458 (2.35E-02)	3.196 (3.05E-02)	3.933 (3.76E-02)	4.917 (4.70E-02)	6.392 (6.10E-02)	7.867 (7.51E-02)	9.833 (9.39E-02)
19	Resistance	R_T	Ω	0.159	0.261	0.407	0.638	1.048	1.627	2.578	4.202	6.566	10.206
20	Inductance	L	mH	0.289	0.488	0.739	1.155	1.952	2.957	4.621	7.809	11.830	18.484
21	No Load Current	I_{NL}	A	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
22 _M	Max. Continuous Current	I_{CSM}	A	9.741	7.609	6.090	4.866	3.795	3.046	2.420	1.896	1.516	1.216
22 _{HS}	Max. Continuous Current	I_{CSHS}	A	15.847	12.379	9.907	7.916	6.174	4.956	3.937	3.084	2.467	1.979

Model N2312 Winding Data (Other windings available upon request)

Line No.	Parameter	Symbol	Units	N2312									
				16.7	21.6	26.4	32.9	42.6	52.4	65.3	84.8	104.2	130.1
23	Reference Voltage	E	V	16.7	21.6	26.4	32.9	42.6	52.4	65.3	84.8	104.2	130.1
24	Torque Constant	K_T	oz-in /A (N-m/A)	3.023 (2.14E-02)	3.930 (2.78E-02)	4.836 (3.43E-02)	6.045 (4.28E-02)	7.859 (5.57E-02)	9.673 (6.85E-02)	12.091 (8.56E-02)	15.718 (1.11E-01)	19.346 (1.37E-01)	24.182 (1.71E-01)
25	Back-EMF Constant	K_E	V/krpm (V/rad/s)	2.235 (2.13E-02)	2.906 (2.77E-02)	3.576 (3.42E-02)	4.470 (4.27E-02)	5.811 (5.55E-02)	7.152 (6.83E-02)	8.940 (8.54E-02)	11.623 (1.11E-01)	14.305 (1.37E-01)	17.881 (1.71E-01)
26	Resistance	R_T	Ω	0.233	0.382	0.597	0.935	1.538	2.386	3.781	6.162	9.630	14.969
27	Inductance	L	mH	0.485	0.819	1.241	1.939	3.278	4.965	7.758	13.110	19.859	31.030
28	No Load Current	I_{NL}	A	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
29 _M	Max. Continuous Current	I_{CSM}	A	8.698	6.794	5.437	4.345	3.389	2.720	2.161	1.693	1.354	1.086
29 _{HS}	Max. Continuous Current	I_{CSHS}	A	13.789	10.772	8.620	6.888	5.372	4.312	3.426	2.683	2.147	1.722

Model N2313 Winding Data (Other windings available upon request)

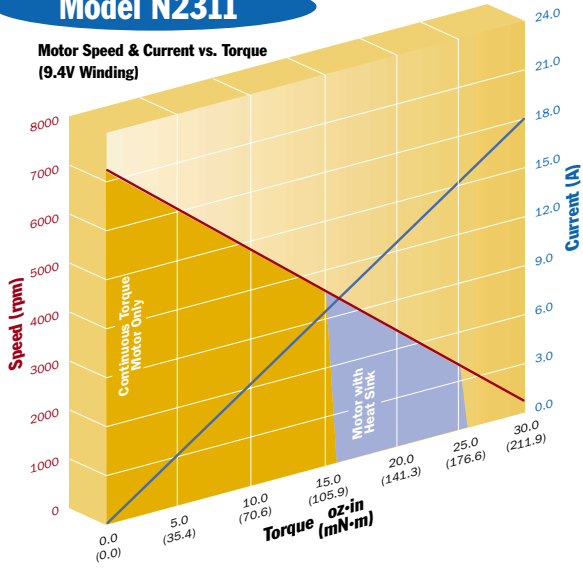
Line No.	Parameter	Symbol	Units	N2313									
				24.8	32.1	39.4	49.1	63.7	78.3	97.7	126.9	156.1	195.0
30	Reference Voltage	E	V	24.8	32.1	39.4	49.1	63.7	78.3	97.7	126.9	156.1	195.0
31	Torque Constant	K_T	oz-in /A (N-m/A)	4.534 (3.21E-02)	5.894 (4.17E-02)	7.255 (5.14E-02)	9.068 (6.42E-02)	11.789 (8.35E-02)	14.509 (1.03E-01)	18.137 (1.28E-01)	23.578 (1.67E-01)	29.019 (2.06E-01)	36.274 (2.57E-01)
32	Back-EMF Constant	K_E	V/krpm (V/rad/s)	3.353 (3.20E-02)	4.359 (4.16E-02)	5.364 (5.12E-02)	6.705 (6.40E-02)	8.717 (8.32E-02)	10.729 (1.02E-01)	13.411 (1.28E-01)	17.434 (1.66E-01)	21.457 (2.05E-01)	26.882 (2.56E-01)
33	Resistance	R_T	Ω	0.300	0.491	0.767	1.201	1.974	3.064	4.855	7.913	12.365	19.222
34	Inductance	L	mH	0.615	1.040	1.575	2.462	4.160	6.302	9.846	16.640	25.206	39.385
35	No Load Current	I_{NL}	A	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
36 _M	Max. Continuous Current	I_{CSM}	A	8.297	6.481	5.187	4.144	3.232	2.595	2.061	1.615	1.292	1.036
36 _{HS}	Max. Continuous Current	I_{CSHS}	A	12.648	9.880	7.907	6.318	4.927	3.955	3.142	2.461	1.969	1.579

Model N2314 Winding Data (Other windings available upon request)

Line No.	Parameter	Symbol	Units	N2314									
				32.9	42.6	52.4	65.3	84.8	104.2	130.1	169.0	207.9	259.8
37	Reference Voltage	E	V	32.9	42.6	52.4	65.3	84.8	104.2	130.1	169.0	207.9	259.8
38	Torque Constant	K_T	oz-in /A (N-m/A)	6.046 (4.28E-02)	7.859 (5.57E-02)	9.673 (6.85E-02)	12.091 (8.56E-02)	15.718 (1.11E-01)	19.346 (1.37E-01)	24.182 (1.71E-01)	31.437 (2.23E-01)	38.691 (2.74E-01)	48.364 (3.43E-01)
39	Back-EMF Constant	K_E	V/krpm (V/rad/s)	4.470 (4.27E-02)	5.811 (5.55E-02)	7.152 (6.83E-02)	8.940 (8.54E-02)	11.623 (1.11E-01)	14.305 (1.37E-01)	17.881 (1.71E-01)	23.245 (2.22E-01)	28.609 (2.73E-01)	35.762 (3.41E-01)
40	Resistance	R_T	Ω	0.366	0.600	0.936	1.467	2.411	3.742	5.929	9.664	15.101	23.475
41	Inductance	L	mH	0.842	1.423	2.156	3.368	5.693	8.623	13.474	22.771	34.493	53.895
42	No Load Current	I_{NL}	A	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
43 _M	Max. Continuous Current	I_{CSM}	A	8.068	6.302	5.044	4.030	3.143	2.523	2.004	1.570	1.256	1.007
43 _{HS}	Max. Continuous Current	I_{CSHS}	A	12.334	9.635	7.711	6.161	4.805	3.857	3.064	2.460	1.920	1.540

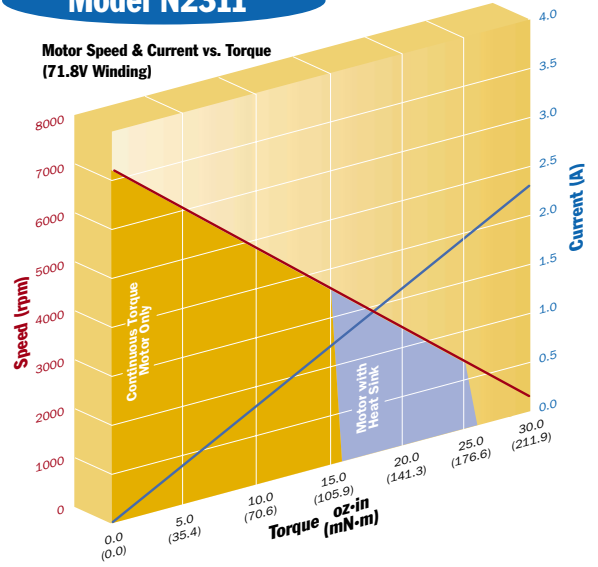
Model N2311

**Motor Speed & Current vs. Torque
(9.4V Winding)**



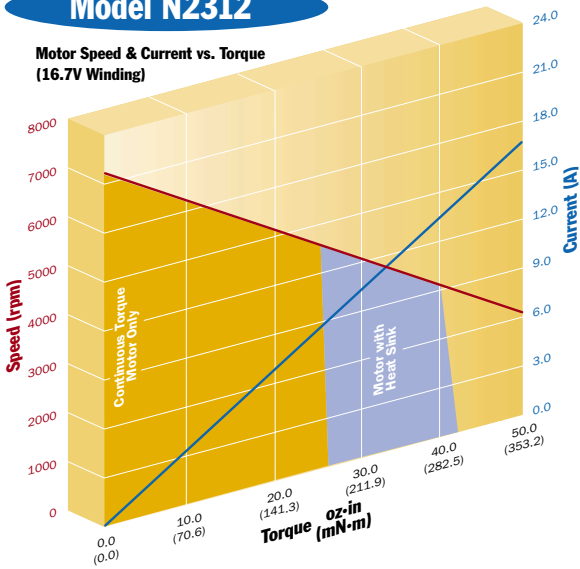
Model N2311

**Motor Speed & Current vs. Torque
(71.8V Winding)**



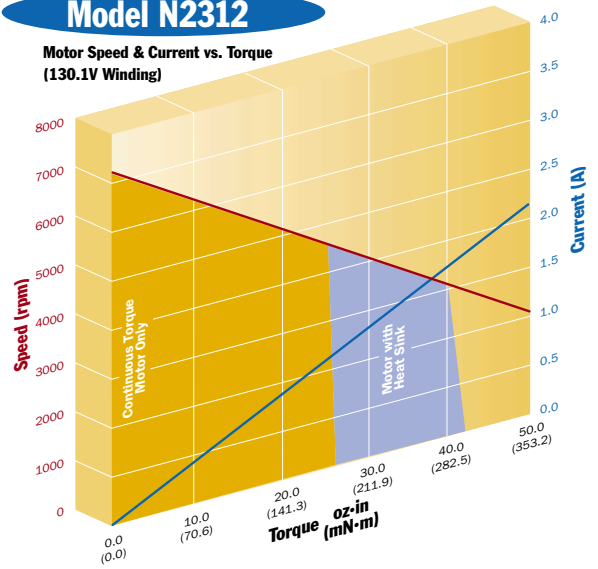
Model N2312

**Motor Speed & Current vs. Torque
(16.7V Winding)**



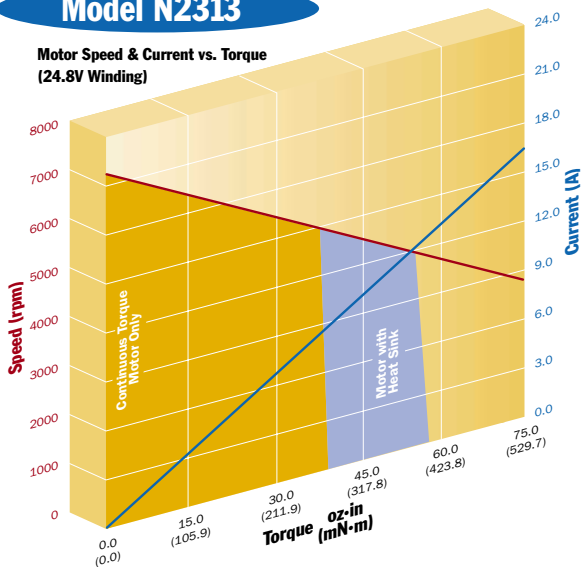
Model N2312

**Motor Speed & Current vs. Torque
(130.1V Winding)**



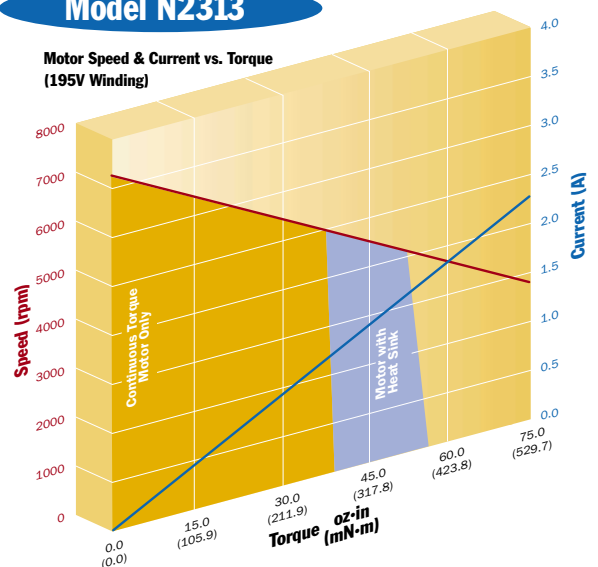
Model N2313

**Motor Speed & Current vs. Torque
(24.8V Winding)**



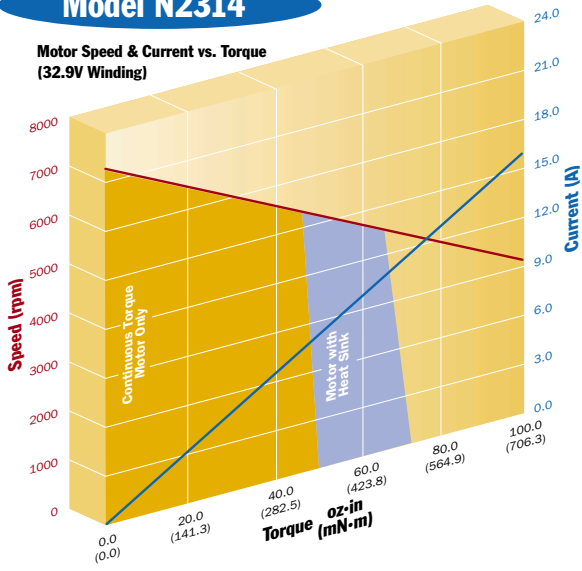
Model N2313

**Motor Speed & Current vs. Torque
(195V Winding)**



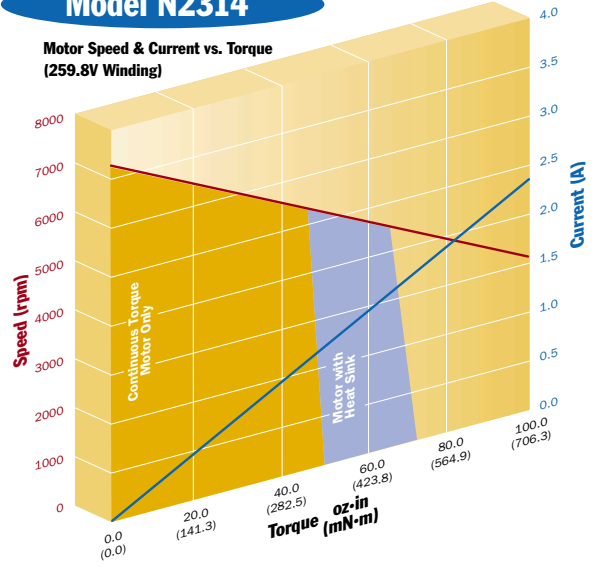
Model N2314

**Motor Speed & Current vs. Torque
(32.9V Winding)**

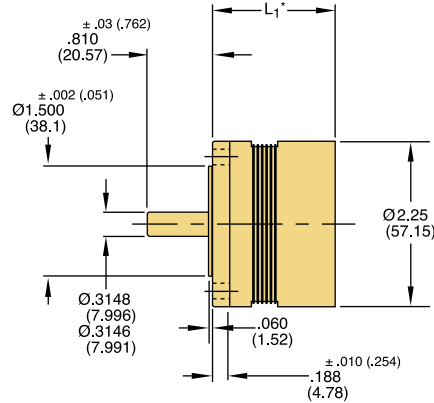
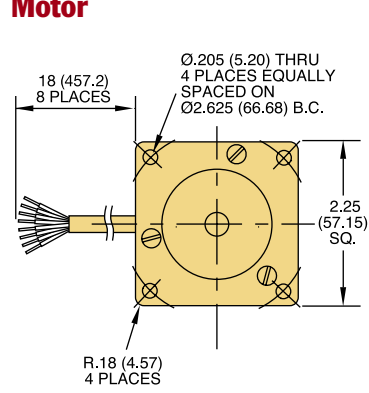


Model N2314

**Motor Speed & Current vs. Torque
(259.8V Winding)**



Motor

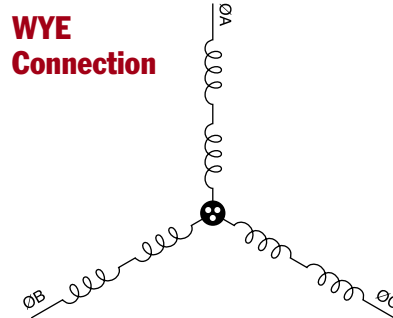


*See line number 15 in data chart

3-Phase Motor Connection Chart

Function	Wire Color
Phase A	Brown
Phase B	Red
Phase C	Orange
Sensor 1	Grey
Sensor 2	Blue
Sensor 3	White
Hall Sensor Power	Violet
Hall Sensor Power Return	Black

- Notes:
- Unless otherwise specified, all tolerances are to be ± 0.005 (.01)
 - All measurements are in inches (mm)



Pittman brushless control electronics are available as an option to make a complete integrated solution for commutation and motor control.

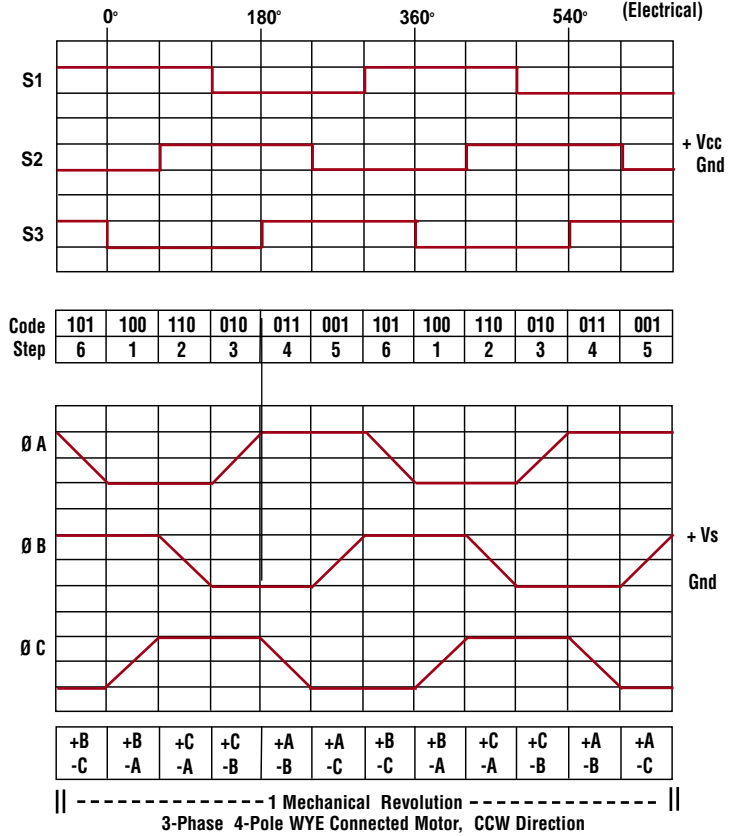
- Power levels from 75 to 350 watts, completely concealed within the motor package. No bulky add-on electronics.
- Signals from a host or control system, controls motor with low level logic signals. Input control lines include: enable, direction, brake, and speed (PWM or analog). Output lines provide include: fault and tachometer (6 PPR) for monitoring.
- Also available is a closed loop speed control that will maintain speed to varying load charges. The adjustable control can either be an internal set point adjustment or an external connection to a host controller or potentiometer.
- Two types of speed control signals are used on the controllers. The internal and rear controller can use a Pulse Width Modulation (PWM) signal, the length or duration of the pulse varies the motor speed. The longer the on time of the pulse, the faster the motors speed. Additionally, the rear controller has an analog signal option. The analog signal is a steady state voltage that is varied in magnitude, the higher the voltage the faster the motor speed.

Other options include:

- 2-wire
 - Single polarity
 - Reversible polarity
- Open loop / closed loop
- Volts: 18 - 48
- Amps: 3 - Max (10 rear option)
- Logic connections
- Inputs
 - Enable
 - Direction
 - Speed - duty cycle (PPM) or analog
 - Brake
- Outputs
 - Tach output (6 PPR)
 - Fault output

	Internal Controller	Rear Controller
Two wire Polarity reversal		x
18-48 volt operation	x	x
10-17 Volt operation		x
2 Amps maximum (4 amps optional)	x	x
10 Amps Maximum		x
PWM speed controller	x	x
Analog speed controller		x
Closed loop speed control		x

Brushless DC Motor Timing Diagram



S 1	Grey
S 2	Blue
S 3	White
ø A	Brown
ø B	Red
ø C	Orange

Specifications subject to change without notice.

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