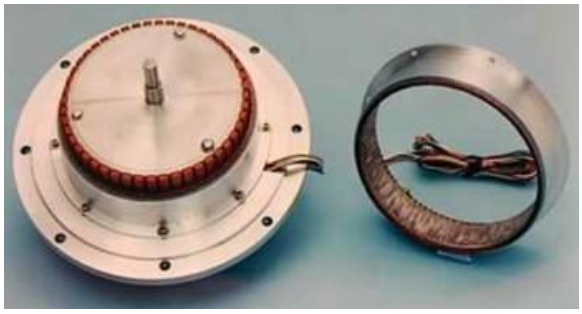
FRONTGRADE

THE ELECTRONICS BACKBONE BEHIND MISSION-CRITICAL SYSTEMS

Zero Cog Motors



Constant-reluctance brushless DC motor built that delivers ultra-smooth, jitter-free rotation for pointing, tracking, and scanning systems

Frontgrade's Zero Cogging Brushless DC Motor is a constant-reluctance motor built with smooth, toothless laminations instead of conventional slotted stator laminations — a design that removes cogging torque at the source rather than masking it with control-loop software. The result is perfectly smooth rotation with sinusoidal back-Electro-Motive Force (EMF) and a linear torque-to-current response, even at the crawl speeds where conventional brushless motors introduce jitter, noise, and positioning error. Backed by decades of flight-proven heritage in space and defense programs, it's built for pointing, tracking, and scanning mechanisms where motion smoothness translates directly into pointing accuracy and image quality.

Frontgrade offers a variety of models that provide configuration flexibility across 2-phase and 3-phase windings, redundant or non-redundant winding sets, and internal-rotor or external-rotor mounting; a wide size/torque range to fit different mechanism envelopes, high-temperature magnet options; low-outgassing materials for space and optical cleanliness requirements; and decades of flight-proven heritage.

FEATURES:

- Zero cogging torque, by design — eliminated through geometry, not software
- Sinusoidal back-EMF purity: ~2.5% 3rd harmonic, ~0.3% 5th harmonic
- Linear torque-to-current across full operating range
- Low winding inductance for fast response and higher control

APPLICATIONS:

- Reaction wheels for attitude control and determination systems
- Solar array drive mechanisms
- Gimbal and EO/IR turret pointing
- Radar antenna positioners
- Robotic arm joints deployable mechanisms
- optical fine-positioning stages
- Missile seeker and fin actuation
- Reflector and antenna pointing

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Part Number	Peak / Continuous Torque (in-lb)	Peak / Continuous Power (W)	Motor Constant (Km)	Friction Torque (in-lb)	Rotational Inertia (in-oz-sec^2)	Mass (lbs)	Size (L x H x W, inches)
16445	5.7/4	20/9.8	1.28	0.10	0.000124	0.14	1.000 X 0.3148 X 1.400
16574	10.5/7.5	33/17	1.83	0.22	0.000154	0.21	1.000 X 0.150 X 1.420
16559	9.84/6.4	27/11	1.90	0.045	0.000332	0.11	1.500 X 0.550 X 0.900
16460	11/7.3	24.3/10.7	2.2	0.09	0.00078	0.18	1.500 X 0.550 X 1.150
16591	19.5/13	39/17	3.12	0.09	0.00078	0.18	1.500 X 0.550 X 1.150
16382	7/3	15/3	1.80	0.10	0.000514	0.13	1.648 X 0.872 X 0.900
16404	7/3	15/3	1.80	0.10	0.000514	0.13	1.649 X 1.000 X 0.900
16406	7/3	15/3	1.80	0.10	0.000514	0.13	1.649 X 1.000 X 0.900
16326	39/24	28/11	7.38	1.25	0.0094	0.92	1.937 X 0.3937 X 1.800
16400	39/24	28/11	7.38	1.25	0.0094	0.92	1.937 X 0.3937 X 1.800
16578	29/20	43/20	4.50	0.20	0.00375	0.22	2.500 X 1.548 X 0.900
16550	29/20	43/20	4.50	0.20	0.00375	0.22	2.500 X 1.548 X 0.900
16596	29/20	43/20	4.50	0.20	0.00375	0.22	2.500 X 1.548 X 0.900
16353	29/20	43/20	4.50	0.20	0.00375	0.22	2.500 X 1.548 X 0.900
16354	29/20	43/20	4.50	0.20	0.00375	0.22	2.500 X 1.548 X 0.900
16498	66/40	68/25	7.98	0.40	0.0075	0.36	2.500 X 1.548 X 1.150
16527	37/25	43/20	5.64	0.40	0.0075	0.45	2.500 X 1.548 X 1.150
16548	37/25	43/20	5.64	0.40	0.0075	0.45	2.500 X 1.548 X 1.150
16302	37/25	43/20	5.64	0.40	0.0075	0.45	2.500 X 1.548 X 1.150

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Part Number	Peak / Continuous Torque (in-lb)	Peak / Continuous Power (W)	Motor Constant (Km)	Friction Torque (in-lb)	Rotational Inertia (in-oz-sec^2)	Mass (lbs)	Size (L x H x W, inches)
16311	66/40	68/25	7.98	0.40	0.0075	0.45	2.500 X 1.548 X 1.150
16565	37/25	43/20	5.64	0.40	0.0075	0.45	2.500 X 1.548 X 1.150
16455	148/85	120/40	13.5	0.80	0.015	0.70	2.500 X 1.548 X 1.650
16327	234/152	171/72	17.89	1.20	0.0225	1.14	2.500 X 1.548 X 2.150
16524	234/152	171/72	17.89	1.20	0.0225	1.12	2.500 X 1.548 X 2.150
16581	145/93	30/12	26.55	1.75	0.0554	1.94	3.000 X 1.875 X 2.200
16317	66/40	76/28	7.55	0.23	0.00977	0.32	3.125 X 2.250 X 0.950
16332	167/100	98/35	16.86	0.75	0.054	1.10	3.500 X 2.570 X 1.650
16331	778/307	190/30	56.48	2.25	0.1621	3.10	3.500 X 2.570 X 3.690
16526	140/90	98/41	14.14	0.75	0.027	0.54	3.500 X 2.570 X 1.150
16560	140/90	98/41	14.14	0.75	0.027	0.54	3.500 X 2.570 X 1.150
16449	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16575	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16409	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16227	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16361	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16363	312/200	171/70	23.9	0.75	0.054	1.15	3.500 X 2.570 X 1.650
16470	700/450	319/132	39.19	1.5	0.11	2.00	3.500 X 2.570 X 2.650
16525	312/200	171/70	23.9	0.75	0.054	1.15	3.625 X 2.570 X 1.650

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16451	147/66	101/20	14.6	0.6	0.045	1.00	3.750 X 2.860 X 1.350
16450	147/66	101/20	14.6	0.6	0.045	1.00	3.750 X 2.860 X 1.350
16539	263/118	172/35	20.0	1.10	0.075	1.70	3.750 X 2.860 X 1.900
16228	381/180	154/34	30.74	2.0	0.078	1.88	4.375 X 2.500 X 1.255
16316	636/370	187/63	46.50	1.9	0.197	1.50	5.000 X 4.056 X 1.650
16523	162/125	88.5/53	17.22	1.0	0.0625	0.48	5.399 X 4.455 X 0.900
16577	360/250	153/74	29.14	1.0	0.125	0.87	5.399 X 4.455 X 1.150
16381	360/250	153/74	29.14	1.0	0.125	0.87	5.399 X 4.455 X 1.150
16543	200/130	95/41	20.57	1.0	0.125	0.90	5.399 X 4.455 X 1.150
16544	200/130	95/41	20.57	1.0	0.125	0.90	5.399 X 4.455 X 1.150
16211	360/220	155/58	29.0	2.0	0.22	1.70	5.399 X 4.455 X 1.530
16314	360/220	155/58	29.0	2.0	0.22	1.70	5.399 X 4.455 X 1.530
16280	360/220	155/58	29.0	2.0	0.22	1.70	5.399 X 4.455 X 1.530
16367	360/220	155/58	29.0	2.0	0.22	1.70	5.399 X 4.455 X 1.530
16308	418/265	98/39	42.26	6.0	0.26	2.60	5.399 X 4.455 X 1.650
16290	1000/600	326/116	55.73	2.4	0.31	2.08	5.399 X 4.455 X 1.900
16461	530/345	182/77	39.35	2.4	0.31	2.08	5.399 X 4.455 X 1.900
16312	615/400	200/84.4	43.54	2.75	0.46	3.10	5.399 X 4.455 X 2.100
16369	1700/1030	500/184	76.2	3.8	0.50	3.30	5.399 X 4.455 X 2.650

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16594	92/42.5	10.5/2.23	28.45	0.382	0.133	0.65	6.499 X 5.555 X 0.936
16346	550/260	185/42	40	1.4	0.23	1.15	6.499 X 5.555 X 1.150
16433	550/260	185/42	40	1.4	0.23	1.15	6.499 X 5.555 X 1.150
16303	550/260	53/8.5	40	3	0.23	1.83	6.499 X 5.555 X 1.150
16370	1050/680	290/122	61.5	2.5	0.41	1.85	6.499 X 5.555 X 1.530
16194	560/360	168/69	43.20	2.5	0.41	1.85	6.499 X 5.555 X 1.530
16337	1550/984	395/159	78	3.5	0.58	2.58	6.499 X 5.555 X 1.900
16230	825/531	220/92	55.50	3.5	0.58	2.58	6.499 X 5.555 X 1.900
16466	825/531	220/92	55.50	3.5	0.58	2.58	6.499 X 5.555 X 1.900
16307	1550/984	395/159	78	3.5	0.58	2.90	6.499 X 5.555 X 1.900
16324	1550/984	395/159	78	3.5	0.58	2.90	6.499 X 5.555 X 1.900
16364	1350/853	325/128	75	5.6	0.94	4.10	6.499 X 5.555 X 2.650
16403	400/190	165/38	31.00	2.0	0.30	1.50	6.944 X 6.004 X 1.150
16579	420/253	130/47	36.94	2.0	0.38	1.75	7.499 X 6.500 X 1.150
16471	3370/2100	500/194	150.6	7.5	1.85	9.80	8.188 X 7.2215 X 2.36
16336	3782/1943	382/101	193.5	26.0	4.97	17.20	8.250 X 7.282 X 5.262
16226	1960/1290	360/156	103.0	5.0	1.10	2.70	8.318 X 7.366 X 1.650
16347	960/760	248/155	61.0	2.5	0.56	1.47	8.499 X 7.500 X 1.150
16497	960/760	248/155	61.0	2.5	0.56	1.47	8.499 X 7.500 X 1.250

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16590	960/760	248/155	61.0	2.5	0.56	2.25	8.599 X 7.500 X 1.150
16212	1140/750	248/107	72.4	5.0	1.12	2.80	8.499 X 7.500 X 1.650
16313	2100/1700	431/282	101.6	5.0	1.12	2.80	8.499 X 7.500 X 1.650
16530	18432/9216	2400/600	376.2	4.0	9.28	27.25	9.415 X 6.000 X 3.360
16310	1235/810	289/125	72.55	2.5	1.104	2.10	10.500 X 9.500 X 1.150
16294	1469/734	156/39	117.46	8.0	1.8216	5.30	10.500 X 5.125 X 1.475
16338	3520/2304	537/230	151.90	8.0	2.208	3.60	10.500 X 9.500 X 1.650
16352	3520/2304	537/230	151.90	8.0	2.208	3.60	10.500 X 9.500 X 1.650
16515	1888/1216	310/129	107.23	7.0	2.208	4.20	10.500 X 9.500 X 1.650
16430	3520/2304	537/230	151.90	8.0	2.208	3.60	10.500 X 9.500 X 1.650
16431	3520/2304	537/230	151.90	8.0	2.208	3.60	10.500 X 9.500 X 1.650
16426	7680/4800	993/388	243.7	15.2	4.48	7.00	10.500 X 9.500 X 2.650
16536	4832/3141	666/281	187.3	10.80	3.577	7.30	10.500 X 9.610 X 2.140
16293	2160/1080	162/40	169.97	25.0	5.16	10.20	10.500 X 5.125 X 3.087
16552	1622/811	163/41	126.86	8.80	2.719	5.50	11.500 X 10.500 X 1.602
16551	3025/1512	97/24	307.46	27.50	7.576	13.50	11.500 X 10.500 X 3.226
16333	10387/6720	1200/502	299.80	21.12	7.68	8.40	12.500 X 11.510 X 2.650
16330	10387/6720	1200/502	299.80	21.12	7.68	8.40	12.500 X 11.510 X 2.650
16531	32448/16560	2928/763	599.7	33.2	43.66	55.00	14.000 X 10.000 X 3.455

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16405	12250/5525	637/130	485.3	31.0	25.1	13.48	17.500 X 15.454 X 2.150
16425	16320/7345	1494/303	422.3	35.60	61.192	30.00	20.500 X 11.510 X 1.900

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