Authors:
Dillon Carey
Aren Hill

Rev 1, Released 07/02/2016

Blurb:

If any issues are found in any data or calculations in this sheet, feel free to leave a comment on the Chief Delphi thread. The mistake will be adressed in a future release.

If anyone has ideas that they would like to see added, also leave a comment in the thread.

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Motor Specifications (listed @12V)

Shortened Name		Free Speed (RPM)	Stall Torque (oz-in)	Stall Current (Amp)	Free Current (Amp)	Power (W)	Stall Torque (N-m)	Weight (lbm)	Power/Weight (W/lbm)
CIM	**CIM**	5330	341.28	131	2.7	337	2.410	2.8	120.4
MiniCIM	**MiniCIM**	5840	199.67	89	3	215	1.410	2.16	99.5
BAG	**BAG Motor**	13180	60.89	41	1.8	149	0.430	0.71	209.9
775	**RS-775-18 (@12V)**	13000	110.46	86.67	1.8	266.6	0.780	0.75	355.5
555	**RS-555**	7750	29.74	0.4	15	41.78	0.210	0.48	87.0
550	**RS-550**	19300	69.39	85	1.4	245.66	0.490		
545	**RS-545-12**	16800	23.61	21	0.9	73.32	0.167		
540	**RS-540-12**	16800	39.48	42	1	122.62	0.279		
395	**RS395-12**	15500	16.68	15	0.5	47.8	0.118	0.21	227.6
390	**RS390-12**	12180	18.85	14.5	0.3	42.44	0.133		
AM PG	**AM PG Motor (no gearbox)**	5325	45.15	22	0.6	44.44	0.319		
AM 9015	**AM 9015**	16000	60.61	63.8	1.2	179.28	0.428	0.5	358.6
FP 00801-0673	**FP 00801-0673**	20770	75.39	108.7	0.82	289.5	0.532		
FP 00968-2719	**FP 00968-2719**	16100	57.49	63	2	171.13	0.406		
FP 00968-9015	**FP 00968-9015**	15600	63.70	70	1.25	183.71	0.450		
FP 00968-9012	**FP 00968-9012**	15600	59.50	63.5	1	171.6	0.420		
FP 00968-9013	**FP 00968-9013**	16700	67.30	75	2	207.78	0.475		
Denso	**Denso Window Motor RH 262100-3030 (fc13-103)**	84	1,501.08	18.6	1.8	23.31	10.600		
775pro	**That one motor**	18700	100.54	134	0.7	347	0.710	0.81	428.4
Throttle	**Denso Throttle Control AE235100-0160**	5300	17.98	7	0.4	17.62	0.127		
393	**VEX 393 Motor (as shipped)**	167	393.68	8	0.62	12.14	2.780		
393 fast	**VEX 393 Motor (high speed)**	267	244.99	8	0.62	12.1	1.730		
CIM + CIM + CIM	**Combiner 1**	5330	1023.849	393	8.1	1008.205	1008.205		
775pro + 775pro + 775	**Combiner 2**	18700	301.632	402	2.1	1042.086	1042.086		

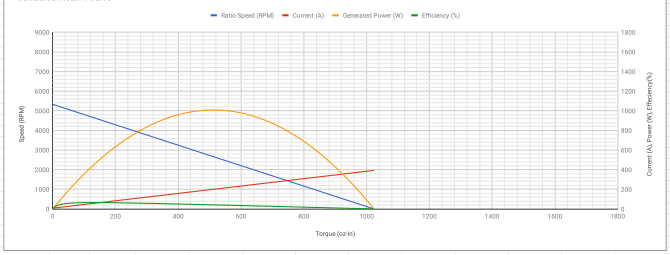
http://www.enertionboards.com/electric-skateboard-parts/190kv-electric-skateboard-motor/?

	Motor	Input Pinion	Driven Gear	Gear Ratio	Ratio Free Speed (RPM)	Ratio Stall Torque (oz-in)	Stall Current (Amp)	Free Current (Amp)	Power (W)
Motor 1	CIM	1	1	1:1	5330	341.283	131	2.7	337
Motor 2	CIM	1	1	1:1	5330	341.283	131	2.7	337
Motor 3	CIM	1	1	1:1	5330	341.283	131	2.7	337
					Sum of Motors:	1023.849	393	8.1	1011

	Motors	Free Speed (RPM)	Stall Torque (oz-in)	Stall Current (A)	Free Current (A)	Power (W)	Stall torque (N*m)
Combined Motor 1	CIM + CIM + CIM	5330	1023.849	393	8.1	1008.205	7.230010381

http://www.chiefdelphi.com/forums/showthread.php?t=123424
http://www.chiefdelphi.com/forums/showpost.php?p=24239&postcount=3

Combined Motor 1 Curve



Combined Motor 1

1023.849

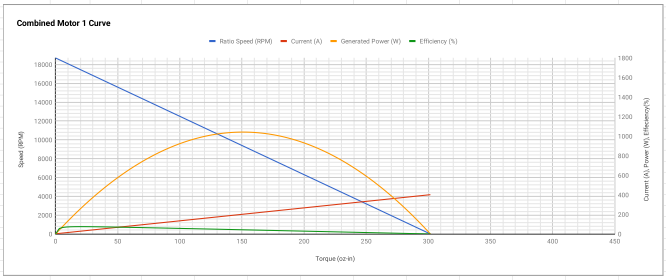
Percentage	Ratio Speed (RPM)	Motor 1 Torque (oz-in)	Motor 2 Torque (oz-in)	Motor 3 Torque (oz-in)	Torque (oz-in)	Motor 1 Current (A)	Motor 2 Current (A)	Motor 3 Current (A)	Current (A)	Supplied Power (W)	Generated Power (W)	Efficiency (%)
0%	0	341.283	341.283	341.283	1023.849	131	131	131	393	4,716	0	0
1%	53.3	337.87	337.87	337.87	1013.61	129.717	129.717	129.717	389.151	4,670	39.925	0.855
2%	106.6	334.457	334.457	334.457	1003.371	128.434	128.434	128.434	385.302	4,624	79.043	1.71
3%	159.9	331.045	331.045	331.045	993.135	127.151	127.151	127.151	381.453	4,577	117.355	2.564
4%	213.2	327.632	327.632	327.632	982.896	125.868	125.868	125.868	377.604	4,531	154.86	3.418
5%	266.5	324.219	324.219	324.219	972.657	124.585	124.585	124.585	373.755	4,485	191.558	4.271
6%	319.8	320.806	320.806	320.806	962.418	123.302	123.302	123.302	369.906	4,439	227.45	5.124
7%	373.1	317.393	317.393	317.393	952.179	122.019	122.019	122.019	366.057	4,393	262.536	5.977
8%	426.4	313.98	313.98	313.98	941.94	120.736	120.736	120.736	362.208	4,346	296.814	6.829
9%	479.7	310.568	310.568	310.568	931.704	119.453	119.453	119.453	358.359	4,300	330.287	7.681
10%	533	307.155	307.155	307.155	921.465	118.17	118.17	118.17	354.51	4,254	362.953	8.532
11%	586.3	303.742	303.742	303.742	911.226	116.887	116.887	116.887	350.661	4,208	394.812	9.383
12%	639.6	300.329	300.329	300.329	900.987	115.604	115.604	115.604	346.812	4,162	425.864	10.233
13%	692.9	296.916	296.916	296.916	890.748	114.321	114.321	114.321	342.963	4,116	456.11	11.083
14%	746.2	293.503	293.503	293.503	880.509	113.038	113.038	113.038	339.114	4,069	485.549	11.932
15%	799.5	290.091	290.091	290.091	870.273	111.755	111.755	111.755	335.265	4,023	514.184	12.781
16%	852.8	286.678	286.678	286.678	860.034	110.472	110.472	110.472	331.416	3,977	542.01	13.629
17%	906.1	283.265	283.265	283.265	849.795	109.189	109.189	109.189	327.567	3,931	569.029	14.476
18%	959.4	279.852	279.852	279.852	839.556	107.906	107.906	107.906	323.718	3,885	595.242	15.323
19%	1012.7	276.439	276.439	276.439	829.317	106.623	106.623	106.623	319.869	3,838	620.649	16.169
20%	1066	273.026	273.026	273.026	819.078	105.34	105.34	105.34	316.02	3,792	645.248	17.015
21%	1119.3	269.614	269.614	269.614	808.842	104.057	104.057	104.057	312.171	3,746	669.044	17.86
22%	1172.6	266.201	266.201	266.201	798.603	102.774	102.774	102.774	308.322	3,700	692.031	18.704
23%	1225.9	262.788	262.788	262.788	788.364	101.491	101.491	101.491	304.473	3,654	714.211	19.548
24%	1279.2	259.375	259.375	259.375	778.125	100.208	100.208	100.208	300.624	3,607	735.584	20.39
25%	1332.5	255.962	255.962	255.962	767.886	98.925	98.925	98.925	296.775	3,561	756.151	21.232
26%	1385.8	252.549	252.549	252.549	757.647	97.642	97.642	97.642	292.926	3,515	775.911	22.074
27%	1439.1	249.137	249.137	249.137	747.411	96.359	96.359	96.359	289.077	3,469	794.868	22.914
28%	1492.4	245.724	245.724	245.724	737.172	95.076	95.076	95.076	285.228	3,423	813.015	23.753
29%	1545.7	242.311	242.311	242.311	726.933	93.793	93.793	93.793	281.379	3,377	830.355	24.592
30%	1599	238.898	238.898	238.898	716.694	92.51	92.51	92.51	277.53	3,330	846.889	25.429
31%	1652.3	235.485	235.485	235.485	706.455	91.227	91.227	91.227	273.681	3,284	862.617	26.266
32%	1705.6	232.072	232.072	232.072	696.216	89.944	89.944	89.944	269.832	3,238	877.537	27.101
33%	1758.9	228.66	228.66	228.66	685.98	88.661	88.661	88.661	265.983	3,192	891.655	27.936
34%	1812.2	225.247	225.247	225.247	675.741	87.378	87.378	87.378	262.134	3,146	904.963	28.769
35%	1865.5	221.834	221.834	221.834	665.502	86.095	86.095	86.095	258.285	3,099	917.464	29.601
36%	1918.8	218.421	218.421	218.421	655.263	84.812	84.812	84.812	254.436	3,053	929.158	30.432
37%	1972.1	215.008	215.008	215.008	645.024	83.529	83.529	83.529	250.587	3,007	940.046	31.261
38%	2025.4	211.595	211.595	211.595	634.785	82.246	82.246	82.246	246.738	2,961	950.128	32.09
39%	2078.7	208.183	208.183	208.183	624.549	80.963	80.963	80.963	242.889	2,915	959.407	32.917
40%	2132	204.77	204.77	204.77	614.31	79.68	79.68	79.68	239.04	2,868	967.875	33.742
41%	2185.3	201.357	201.357	201.357	604.071	78.397	78.397	78.397	235.191	2,822	975.536	34.565
42%	2238.6	197.944	197.944	197.944	593.832	77.114	77.114	77.114	231.342	2,776	982.391	35.387
43%	2291.9	194.531	194.531	194.531	583.593	75.831	75.831	75.831	227.493	2,730	988.44	36.208
44%	2345.2	191.118	191.118	191.118	573.354	74.548	74.548	74.548	223.644	2,684	993.681	37.026
45%	2398.5	187.706	187.706	187.706	563.118	73.265	73.265	73.265	219.795	2,638	998.122	37.843
46%	2451.8	184.293	184.293	184.293	552.879	71.982	71.982	71.982	215.946	2,591	1001.751	38.657
47%	2505.1	180.88	180.88	180.88	542.64	70.699	70.699	70.699	212.097	2,545	1004.573	39.47
48%	2558.4	177.467	177.467	177.467	532.401	69.416	69.416	69.416	208.248	2,499	1006.588	40.28
49%	2611.7	174.054	174.054	174.054	522.162	68.133	68.133	68.133	204.399	2,453	1007.797	41.088
50%	2665	170.642	170.642	170.642	511.926	66.85	66.85	66.85	200.55	2,407	1008.205	41.893
51%	2718.3	167.229	167.229	167.229	501.687	65.567	65.567	65.567	196.701	2,360	1007.801	42.696
52%	2771.6	163.816	163.816	163.816	491.448	64.284	64.284	64.284	192.852	2,314	1006.59	43.496
53%	2824.9	160.403	160.403	160.403	481.209	63.001	63.001	63.001	189.003	2,268	1004.572	44.293
54%	2878.2	156.99	156.99	156.99	470.97	61.718	61.718	61.718	185.154	2,222	1001.748	45.086
55%	2931.5	153.577	153.577	153.577	460.731	60.435	60.435	60.435	181.305	2,176	998.118	45.877
56%	2984.8	150.165	150.165	150.165	450.495	59.152	59.152	59.152	177.456	2,129	993.687	46.664
57%	3038.1	146.752	146.752	146.752	440.256	57.869	57.869	57.869	173.607	2,083	988.443	47.446
58%	3091.4	143.339	143.339	143.339	430.017	56.586	56.586	56.586	169.758	2,037	982.393	48.225
59%	3144.7	139.926	139.926	139.926	419.778	55.303	55.303	55.303	165.909	1,991	975.536	49
60%	3198	136.513	136.513	136.513	409.539	54.02	54.02	54.02	162.06	1,945	967.873	49.769
61%	3251.3	133.1	133.1	133.1	399.3	52.737	52.737	52.737	158.211	1,899	959.402	50.534
62%	3304.6	129.688	129.688	129.688	389.064	51.454	51.454	51.454	154.362	1,852	950.133	51.294
63%	3357.9	126.275	126.275	126.275	378.825	50.171	50.171	50.171	150.513	1,806	940.05	52.047
64%	3411.2	122.862	122.862	122.862	368.586	48.888	48.888	48.888	146.664	1,760	929.16	52.794
65%	3464.5	119.449	119.449	119.449	358.347	47.605	47.605	47.605	142.815	1,714	917.463	53.534
66%	3517.8	116.036	116.036	116.036	348.108	46.322	46.322	46.322	138.966	1,668	904.96	54.267
67%	3571.1	112.623	112.623	112.623	337.869	45.039	45.039	45.039	135.117	1,621	891.651	54.993
68%	3624.4	109.211	109.211	109.211	327.633	43.756	43.756	43.756	131.268	1,575	877.543	55.709
69%	3677.7	105.798	105.798	105.798	317.394	42.473	42.473	42.473	127.419	1,529	862.62	56.416
70%	3731	102.385	102.385	102.385	307.155	41.19	41.19	41.19	123.57	1,483	846.891	57.113
71%	3784.3	98.972	98.972	98.972	296.916	39.907	39.907	39.907	119.721	1,437	830.355	57.798
72%	3837.6	95.559	95.559	95.559	286.677	38.624	38.624	38.624	115.872	1,390	813.012	58.471
73%	3890.9	92.146	92.146	92.146	276.438	37.341	37.341	37.341	112.023	1,344	794.863	59.129
74%	3944.2	88.734	88.734	88.734	266.202	36.058	36.058	36.058	108.174	1,298	775.916	59.774
75%	3997.5	85.321	85.321	85.321	255.963	34.775	34.775	34.775	104.325	1,252	756.154	60.401
76%	4050.8	81.908	81.908	81.908	245.724	33.492	33.492	33.492	100.476	1,206	735.585	61.008
77%	4104.1	78.495	78.495	78.495	235.485	32.209	32.209	32.209	96.627	1,160	714.209	61.595
78%	4157.4	75.082	75.082	75.082	225.246	30.926	30.926	30.926	92.778	1,113	692.027	62.158
79%	4210.7	71.669	71.669	71.669	215.007	29.643	29.643	29.643	88.929	1,067	669.039	62.694
80%	4264	68.257	68.257	68.257	204.771	28.36	28.36	28.36	85.08	1,021	645.253	63.201
81%	4317.3	64.844	64.844	64.844	194.532	27.077	27.077	27.077	81.231	975	620.651	63.671
82%	4370.6	61.431	61.431	61.431	184.293	25.794	25.794	25.794	77.382	929	595.243	64.102
83%	4423.9	58.018	58.018	58.018	174.054	24.511	24.511	24.511	73.533	882	569.028	64.487
84%	4477.2	54.605	54.605	54.605	163.815	23.228	23.228	23.228	69.684	836	542.007	64.817
85%	4530.5	51.192	51.192	51.192	153.576	21.945	21.945	21.945	65.835	790	514.179	65.084
86%	4583.8	47.78	47.78	47.78	143.34	20.662	20.662	20.662	61.986	744	485.554	65.277
87%	4637.1	44.367	44.367	44.367	133.101	19.379	19.379	19.379	58.137	698	456.113	65.379
88%	4690.4	40.954	40.954	40.954	122.862	18.096	18.096	18.096	54.288	651	425.865	65.371
89%	4743.7	37.541	37.541	37.541	112.623	16.813	16.813	16.813	50.439	605	394.811	65.229
90%	4797	34.128	34.128	34.128	102.384	15.53	15.53	15.53	46.59	559	362.95	64.919
91%	4850.3	30.715	30.715	30.715	92.145	14.247	14.247	14.247	42.741	513	330.282	64.396
92%	4903.6	27.303	27.303	27.303	81.909	12.964	12.964	12.964	38.892	467	296.819	63.599
93%	4956.9	23.89	23.89	23.89	71.67	11.681	11.681	11.681	35.043	421	262.538	62.432
94%	5010.2	20.477	20.477	20.477	61.431	10.398	10.398	10.398	31.194	374	227.451	60.762
95%	5063.5	17.064	17.064	17.064	51.192	9.115	9.115	9.115	27.345	328	191.557	58.377
96%	5116.8	13.651	13.651	13.651	40.953	7.832	7.832	7.832	23.496	282	154.856	54.923
97%	5170.1	10.238	10.238	10.238	30.714	6.549	6.549	6.549	19.647	236	117.349	49.774
98%	5223.4	6.826	6.826	6.826	20.478	5.266	5.266	5.266	15.798	190	79.047	41.697
99%	5276.7	3.413	3.413	3.413	10.239	3.983	3.983	3.983	11.949	143	39.927	27.845
100%	5330	0	0	0	0	2.7	2.7	2.7	8.1	97	0	0

	Motor	Input Pinion	Driven Gear	Gear Ratio	Ratio Free Speed (RPM)	Ratio Stall Torque (oz-in)	Stall Current (Amp)	Free Current (Amp)	Power (W)
Motor 1	775pro	1	1	1:1	18700	100.544	134	0.7	347
Motor 2	775pro	1	1	1:1	18700	100.544	134	0.7	347
Motor 3	775pro	1	1	1:1	18700	100.544	134	0.7	347
					Sum of Motors:	301.632	402	2.1	1041

	Motors	Free Speed (RPM)	Stall Torque (oz-in)	Stall Current (A)	Free Current (A)	Power (W)
Combined Motor 1	775pro + 775pro + 775pro	18700	301.632	402	2.1	1042.086

http://www.chiefdelphi.com/forums/showthread.php?t=123424
http://www.chiefdelphi.com/forums/showpost.php?p=24239&postcount=3

Combined Motor 1 Curve



Combined Motor 1

301.632

Percentage	Ratio Speed (RPM)	Motor 1 Torque (oz-in)	Motor 2 Torque (oz-in)	Motor 3 Torque (oz-in)	Torque (oz-in)	Motor 1 Current (A)	Motor 2 Current (A)	Motor 3 Current (A)	Current (A)	Supplied Power (W)	Generated Power (W)	Efficiency (%)
0%	0	100.544	100.544	100.544	301.632	134	134	134	402	4,824	0	0
1%	187	99.539	99.539	99.539	298.617	132.667	132.667	132.667	398.001	4,776	41.267	0.864
2%	374	98.533	98.533	98.533	295.599	131.334	131.334	131.334	394.002	4,728	81.699	1.728
3%	561	97.528	97.528	97.528	292.584	130.001	130.001	130.001	390.003	4,680	121.299	2.592
4%	748	96.522	96.522	96.522	289.566	128.668	128.668	128.668	386.004	4,632	160.064	3.456
5%	935	95.517	95.517	95.517	286.551	127.335	127.335	127.335	382.005	4,584	197.997	4.319
6%	1122	94.511	94.511	94.511	283.533	126.002	126.002	126.002	378.006	4,536	235.094	5.183
7%	1309	93.506	93.506	93.506	280.518	124.669	124.669	124.669	374.007	4,488	271.359	6.046
8%	1496	92.5	92.5	92.5	277.5	123.336	123.336	123.336	370.008	4,440	306.788	6.909
9%	1683	91.495	91.495	91.495	274.485	122.003	122.003	122.003	366.009	4,392	341.387	7.773
10%	1870	90.49	90.49	90.49	271.47	120.67	120.67	120.67	362.01	4,344	375.153	8.636
11%	2057	89.484	89.484	89.484	268.452	119.337	119.337	119.337	358.011	4,296	408.08	9.499
12%	2244	88.479	88.479	88.479	265.437	118.004	118.004	118.004	354.012	4,248	440.178	10.362
13%	2431	87.473	87.473	87.473	262.419	116.671	116.671	116.671	350.013	4,200	471.438	11.224
14%	2618	86.468	86.468	86.468	259.404	115.338	115.338	115.338	346.014	4,152	501.869	12.087
15%	2805	85.462	85.462	85.462	256.386	114.005	114.005	114.005	342.015	4,104	531.461	12.949
16%	2992	84.457	84.457	84.457	253.371	112.672	112.672	112.672	338.016	4,056	560.226	13.812
17%	3179	83.452	83.452	83.452	250.356	111.339	111.339	111.339	334.017	4,008	588.157	14.674
18%	3366	82.446	82.446	82.446	247.338	110.006	110.006	110.006	330.018	3,960	615.247	15.536
19%	3553	81.441	81.441	81.441	244.323	108.673	108.673	108.673	326.019	3,912	641.511	16.398
20%	3740	80.435	80.435	80.435	241.305	107.34	107.34	107.34	322.02	3,864	666.933	17.259
21%	3927	79.43	79.43	79.43	238.29	106.007	106.007	106.007	318.021	3,816	691.53	18.121
22%	4114	78.424	78.424	78.424	235.272	104.674	104.674	104.674	314.022	3,768	715.285	18.982
23%	4301	77.419	77.419	77.419	232.257	103.341	103.341	103.341	310.023	3,720	738.215	19.843
24%	4488	76.413	76.413	76.413	229.239	102.008	102.008	102.008	306.024	3,672	760.301	20.704
25%	4675	75.408	75.408	75.408	226.224	100.675	100.675	100.675	302.025	3,624	781.564	21.565
26%	4862	74.403	74.403	74.403	223.209	99.342	99.342	99.342	298.026	3,576	801.994	22.425
27%	5049	73.397	73.397	73.397	220.191	98.009	98.009	98.009	294.027	3,528	821.579	23.285
28%	5236	72.392	72.392	72.392	217.176	96.676	96.676	96.676	290.028	3,480	840.342	24.145
29%	5423	71.386	71.386	71.386	214.158	95.343	95.343	95.343	286.029	3,432	858.259	25.005
30%	5610	70.381	70.381	70.381	211.143	94.01	94.01	94.01	282.03	3,384	875.355	25.865
31%	5797	69.375	69.375	69.375	208.125	92.677	92.677	92.677	278.031	3,336	891.604	26.724
32%	5984	68.37	68.37	68.37	205.11	91.344	91.344	91.344	274.032	3,288	907.033	27.583
33%	6171	67.364	67.364	67.364	202.092	90.011	90.011	90.011	270.033	3,240	921.614	28.441
34%	6358	66.359	66.359	66.359	199.077	88.678	88.678	88.678	266.034	3,192	935.376	29.3
35%	6545	65.354	65.354	65.354	196.062	87.345	87.345	87.345	262.035	3,144	948.304	30.158
36%	6732	64.348	64.348	64.348	193.044	86.012	86.012	86.012	258.036	3,096	960.384	31.016
37%	6919	63.343	63.343	63.343	190.029	84.679	84.679	84.679	254.037	3,048	971.645	31.873
38%	7106	62.337	62.337	62.337	187.011	83.346	83.346	83.346	250.038	3,000	982.057	32.73
39%	7293	61.332	61.332	61.332	183.996	82.013	82.013	82.013	246.039	2,952	991.651	33.587
40%	7480	60.326	60.326	60.326	180.978	80.68	80.68	80.68	242.04	2,904	1000.396	34.443
41%	7667	59.321	59.321	59.321	177.963	79.347	79.347	79.347	238.041	2,856	1008.323	35.299
42%	7854	58.316	58.316	58.316	174.948	78.014	78.014	78.014	234.042	2,809	1015.417	36.155
43%	8041	57.31	57.31	57.31	171.93	76.681	76.681	76.681	230.043	2,761	1021.659	37.01
44%	8228	56.305	56.305	56.305	168.915	75.348	75.348	75.348	226.044	2,713	1027.086	37.865
45%	8415	55.299	55.299	55.299	165.897	74.015	74.015	74.015	222.045	2,665	1031.661	38.718
46%	8602	54.294	54.294	54.294	162.882	72.682	72.682	72.682	218.046	2,617	1035.421	39.572
47%	8789	53.288	53.288	53.288	159.864	71.349	71.349	71.349	214.047	2,569	1038.328	40.424
48%	8976	52.283	52.283	52.283	156.849	70.016	70.016	70.016	210.048	2,521	1040.421	41.277
49%	9163	51.277	51.277	51.277	153.831	68.683	68.683	68.683	206.049	2,473	1041.66	42.128
50%	9350	50.272	50.272	50.272	150.816	67.35	67.35	67.35	202.05	2,425	1042.086	42.98
51%	9537	49.267	49.267	49.267	147.801	66.017	66.017	66.017	198.051	2,377	1041.678	43.83
52%	9724	48.261	48.261	48.261	144.783	64.684	64.684	64.684	194.052	2,329	1040.416	44.679
53%	9911	47.256	47.256	47.256	141.768	63.351	63.351	63.351	190.053	2,281	1038.341	45.529
54%	10098	46.25	46.25	46.25	138.75	62.018	62.018	62.018	186.054	2,233	1035.411	46.376
55%	10285	45.245	45.245	45.245	135.735	60.685	60.685	60.685	182.055	2,185	1031.669	47.223
56%	10472	44.239	44.239	44.239	132.717	59.352	59.352	59.352	178.056	2,137	1027.071	48.069
57%	10659	43.234	43.234	43.234	129.702	58.019	58.019	58.019	174.057	2,089	1021.663	48.914
58%	10846	42.228	42.228	42.228	126.684	56.686	56.686	56.686	170.058	2,041	1015.397	49.757
59%	11033	41.223	41.223	41.223	123.669	55.353	55.353	55.353	166.059	1,993	1008.321	50.601
60%	11220	40.218	40.218	40.218	120.654	54.02	54.02	54.02	162.06	1,945	1000.412	51.442
61%	11407	39.212	39.212	39.212	117.636	52.687	52.687	52.687	158.061	1,897	991.645	52.282
62%	11594	38.207	38.207	38.207	114.621	51.354	51.354	51.354	154.062	1,849	982.069	53.121
63%	11781	37.201	37.201	37.201	111.603	50.021	50.021	50.021	150.063	1,801	971.633	53.957
64%	11968	36.196	36.196	36.196	108.588	48.688	48.688	48.688	146.064	1,753	960.39	54.793
65%	12155	35.19	35.19	35.19	105.57	47.355	47.355	47.355	142.065	1,705	948.287	55.625
66%	12342	34.185	34.185	34.185	102.555	46.022	46.022	46.022	138.066	1,657	935.377	56.457
67%	12529	33.18	33.18	33.18	99.54	44.689	44.689	44.689	134.067	1,609	921.634	57.287
68%	12716	32.174	32.174	32.174	96.522	43.356	43.356	43.356	130.068	1,561	907.029	58.112
69%	12903	31.169	31.169	31.169	93.507	42.023	42.023	42.023	126.069	1,513	891.619	58.937
70%	13090	30.163	30.163	30.163	90.489	40.69	40.69	40.69	122.07	1,465	875.346	59.757
71%	13277	29.158	29.158	29.158	87.474	39.357	39.357	39.357	118.071	1,417	858.269	60.576
72%	13464	28.152	28.152	28.152	84.456	38.024	38.024	38.024	114.072	1,369	840.328	61.389
73%	13651	27.147	27.147	27.147	81.441	36.691	36.691	36.691	110.073	1,321	821.584	62.2
74%	13838	26.141	26.141	26.141	78.423	35.358	35.358	35.358	106.074	1,273	801.976	63.004
75%	14025	25.136	25.136	25.136	75.408	34.025	34.025	34.025	102.075	1,225	781.564	63.806
76%	14212	24.131	24.131	24.131	72.393	32.692	32.692	32.692	98.076	1,177	760.32	64.603
77%	14399	23.125	23.125	23.125	69.375	31.359	31.359	31.359	94.077	1,129	738.21	65.391
78%	14586	22.12	22.12	22.12	66.36	30.026	30.026	30.026	90.078	1,081	715.298	66.174
79%	14773	21.114	21.114	21.114	63.342	28.693	28.693	28.693	86.079	1,033	691.52	66.946
80%	14960	20.109	20.109	20.109	60.327	27.36	27.36	27.36	82.08	985	666.942	67.713
81%	15147	19.103	19.103	19.103	57.309	26.027	26.027	26.027	78.081	937	641.496	68.465
82%	15334	18.098	18.098	18.098	54.294	24.694	24.694	24.694	74.082	889	615.25	69.208
83%	15521	17.092	17.092	17.092	51.276	23.361	23.361	23.361	70.083	841	588.137	69.933
84%	15708	16.087	16.087	16.087	48.261	22.028	22.028	22.028	66.084	793	560.224	70.645
85%	15895	15.082	15.082	15.082	45.246	20.695	20.695	20.695	62.085	745	531.478	71.337
86%	16082	14.076	14.076	14.076	42.228	19.362	19.362	19.362	58.086	697	501.863	72
87%	16269	13.071	13.071	13.071	39.213	18.029	18.029	18.029	54.087	649	471.45	72.638
88%	16456	12.065	12.065	12.065	36.195	16.696	16.696	16.696	50.088	601	440.167	73.232
89%	16643	11.06	11.06	11.06	33.18	15.363	15.363	15.363	46.089	553	408.087	73.786
90%	16830	10.054	10.054	10.054	30.162	14.03	14.03	14.03	42.09	505	375.136	74.273
91%	17017	9.049	9.049	9.049	27.147	12.697	12.697	12.697	38.091	457	341.389	74.687
92%	17204	8.044	8.044	8.044	24.132	11.364	11.364	11.364	34.092	409	306.808	74.995
93%	17391	7.038	7.038	7.038	21.114	10.031	10.031	10.031	30.093	361	271.356	75.144
94%	17578	6.033	6.033	6.033	18.099	8.698	8.698	8.698	26.094	313	235.109	75.084
95%	17765	5.027	5.027	5.027	15.081	7.365	7.365	7.365	22.095	265	197.988	74.673
96%	17952	4.022	4.022	4.022	12.066	6.032	6.032	6.032	18.096	217	160.074	73.715
97%	18139	3.016	3.016	3.016	9.048	4.699	4.699	4.699	14.097	169	121.286	71.697
98%	18326	2.011	2.011	2.011	6.033	3.366	3.366	3.366	10.098	121	81.704	67.426
99%	18513	1.005	1.005	1.005	3.015	2.033	2.033	2.033	6.099	73	41.249	56.36
100%	18700	0	0	0	0	0.7	0.7	0.7	2.1	25	0	0

1-Speed Drivetrain

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)	Speed Loss Constant	Drivetrain Efficiency	# Gearboxes in Drivetrain	# Motors per Gearbox	Total Weight (lbs)	Weight on Driven Wheels	Wheel Dia. (in)	Wheel Coeff
5pro + MiniCIM + CI	#N/A	#N/A	#N/A	#N/A	81%	92%	1	1	280	100%	8	1

*Selecting a combined motor treats it as one motor input

*Selecting a combined motor treats it as one motor input

Driving Gear	Driven Gear			
13	50		1245.502	Weight*CoF
15	48		#N/A	Max newtons at ground
1	1		11.175	Max torque at friction force
1	1		11.175	Max per gearbox input
12.308	<-- Overall Gear Ratio		#N/A	amp per gearbox input
			#N/A	Gearbox output stall torque
			63.23333333	Torque required to spin wheels
Drivetrain Free-Speed	Drivetrain Adjusted Speed		#N/A	Maxed amp draw per motor input
#N/A	#N/A			

1-Speed Drivetrain

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)	Speed Loss Constant	Drivetrain Efficiency	# Gearboxes in Drivetrain	# Motors per Gearbox	Total Weight (lbs)	Weight on Driven Wheels	Wheel Dia. (in)	Wheel Coeff
MiniCIM	5840	1.41	89	3	81%	92%	1	1	280	100%	8	1

*Selecting a combined motor treats it as one motor input

*Selecting a combined motor treats it as one motor input

Driving Gear	Driven Gear			
13	50		1245.502	Weight*CoF
15	22		72.035	Max newtons at ground
1	1		24.379	Max torque at friction force
1	1		24.379	Max per gearbox input
5.642	<-- Overall Gear Ratio		1538.821	amp per gearbox input
			7.319	Gearbox output stall torque
			63.23333333	Torque required to spin wheels
Drivetrain Free-Speed	Drivetrain Adjusted Speed		89	Maxed amp draw per motor input
36.1	29.2			

1-Speed Drivetrain

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)	Speed Loss Constant	Drivetrain Efficiency	# Gearboxes in Drivetrain	# Motors per Gearbox	Total Weight (lbs)	Weight on Driven Wheels	Wheel Dia. (in)	Wheel Coeff
CIM + CIM + CIM	5330	7.23	393	8.1	81%	92%	2	1	90	100%	2.5	1

*Selecting a combined motor treats it as one motor input

*Selecting a combined motor treats it as one motor input

Driving Gear	Driven Gear			
12	80		400.340	Weight*CoF
18	48		4655.911	Max newtons at ground
48	30		1.243	Max torque at friction force
1	1		0.622	Max per gearbox input
11.112	<-- Overall Gear Ratio		33.792	amp per gearbox input
	80.33976		73.913	Gearbox output stall torque
			6.3515625	Torque required to spin wheels
Drivetrain Free-Speed	Drivetrain Adjusted Speed		33.792	Maxed amp draw per motor input
5.2	4.2			

1-Speed Drivetrain

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)	Speed Loss Constant	Drivetrain Efficiency	# Gearboxes in Drivetrain	# Motors per Gearbox	Total Weight (lbs)	Weight on Driven Wheels	Wheel Dia. (in)	Wheel Coeff
5pro + 775pro + 775p	18700	2.13	402	2.1	81%	90%	2	1	90	100%	3.25	1

*Selecting a combined motor treats it as one motor input

*Selecting a combined motor treats it as one motor input

Driving Gear	Driven Gear			
12	80		400.340	Weight*CoF
18	48		1321.162	Max newtons at ground
30	24		1.291	Max torque at friction force
1	1		0.645	Max per gearbox input
14.223	<-- Overall Gear Ratio		121.814	amp per gearbox input
			27.265	Gearbox output stall torque
			8.25703125	Torque required to spin wheels
Drivetrain Free-Speed	Drivetrain Adjusted Speed		121.814	Maxed amp draw per motor input
18.6	15.1			

10.98333333

5.719

50.4375

Gears					Sprockets				Pulleys (5MM HTD)		
CIM pinions	3/8ths HEX	1/2" HEX	Bearing Bore	32 DP	#25 Hubbed	#25 Plate	#35 Hubbed	#35 Plate	9mm Wide	15mm Wide	VersaPulleys
11	14	18	48	12	16	32	12	22	18	18	42
12	18	20	54	20	18	34	15	24	24	24	60
13	20	24	60	40	22	36		26	30	30	
14	24	30	64	60		38		28	36	36	
	30	34	66	80		40		30			
	34	36	70			42		32			
	36	40				44		33			
	40	42				48		36			
	42	44				54		42			
	50	48				58		44			
		50				60		48			
		54				64		54			
		60				66		60			
		64				72					
		66									
		70									
		72									
		84									

	Gears					Sprockets				Pulleys (5MM HTD)		
# of teeth	CIM pinions	3/8ths HEX	1/2" HEX	Bearing Bore	32 DP	#25 Hubbed	#25 Plate	#35 Hubbed	#35 Plate	9mm Wide	15mm Wide	VersaPulleys
11	x											
12	x				x			x				
13	x											
14	x	x										
15								x				
16						x						
18		x	x			x				x	x	
20		x	x		x							
22						x			x			
24		x	x						x	x	x	
26									x			
28									x			
30		x	x						x	x	x	
32							x		x			
33									x			
34		x	x				x					
36		x	x				x		x	x	x	
38							x					
40		x	x		x		x					
42		x	x				x		x			x
44			x				x		x			
48			x	x			x		x			
50		x	x									
54			x	x			x		x			
58							x					
60			x	x	x		x		x			x
64			x	x			x					
66			x	x			x					
70			x	x								
72			x				x					
80					x							
84			x									

1-Speed Drivetrain

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)
MiniCIM	5840	1.41	89	3

*Selecting a combined motor treats it as one motor input

Speed Loss Constant	Drivetrain Efficiency
90%	90%

# Gearboxes in Drivetrain	# Motors per Gearbox
2	3

*Selecting a combined motor treats it as one motor input

Total Weight (lbs)	Weight on Driven Wheels
120	120

Wheel Dia. (in)	Wheel Coeff (Static)	Wheel Coeff (Kinetic)
6	1.3	1

Driving Gear	Driven Gear
12	40
40	34
12	32
1	1
7.555555556	<-- Overall Gear Ratio

Drivetrain Free-Speed [ft/s]	Drivetrain Adjusted Speed [ft/s]	
20.2	18.2	MPH
[m/s]	[m/s]	
6.157	5.547	

	Feet	Meters
Set Distance	20	6.096
Time to set Distance	1.52	Seconds
Max Distance	49.81	15.183
Max Velocity	20.21	6.16

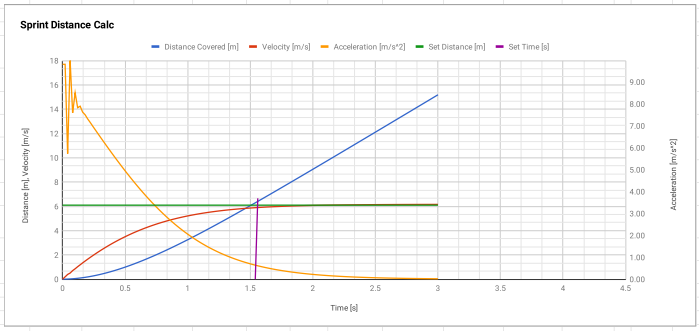
693.888	Weight*Static_CoF [N]
52.874	Max Torque possible @ wheel (no wheel slip)
1.296	Max Torque @ motor Input (no wheel slip)
81.800	Amps per motor input
81.800	Max amp draw per motor input
490.802	Max amp draw Total
12.376	
10.653	Max Torque per Motor input (with gear ratio)
63.92	Max Torque of all drive motors (with gear ratio)

Conversions

1 lbf to N	4.448
1 lbm to Kg	0.4536
1 ft to m	0.3048

Battery Internal Resistance [Ohms]	0.012
Gauge of wire from Battery to PDB [AWG]	6 gauge
Length of wire from Battery to PDB [ft]	1
Resistance from Battery to PDB	0.0004028
Gauge of wire from PDB to Motors [AWG]	12 gauge
Length of wire from PDB to Motors [Ft]	1
Resistance from PDB to Motors	0.001619
Total system resistance [Ohms]	0.0140218

Battery Full Charge [V]	12



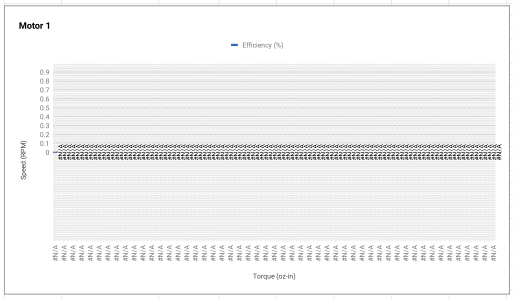
Time Step [s]	Weight [N]	Mass [kg]	Wheel Dia. [m]	Max Torque of Motors [N*m]	Max Torque pre-Slipping [N*m]	Max Torque Slipping [N*m]	Force Limit @ Static COF [N]	Force Limit @ Kinetic COF [N]	Torque Limit_wheel @ Static COF [N*m]	Torque Limit_wheel @ Kinetic COF [N*m]	Torque limit_allMotor @ Kinetic COF [N*m]	Torque limit_1motor @ Kinetic COF [N*m]	Motor RPM @ regain traction [RPM]
0.02	533.76	54.43	0.15	63.92	52.87	40.67	693.89	533.76	52.87	40.67	5.981	0.997	1711.10

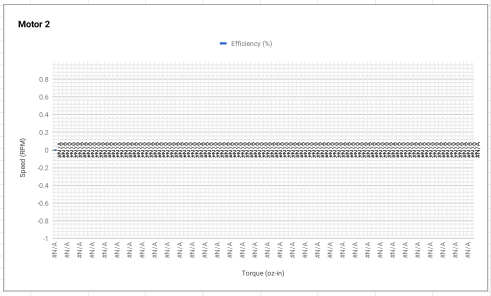
NOTES TO SELF: lower voltage makes quicker time for some reason. should RPM @ motor with no slip take speed loss constant into account?

Time [s]	Torque Output @ Motor [N*m]	Torque Output @ Wheel (no slip calc) [N*m]	Torque Output @ Wheel [N*m]	Force Available @ Ground [N]	Traction Limit [N]	Slipping? [Y/N]	Acceleration [m/s^2]	Velocity [m/s]	RPM @ motor no slip [RPM]	Distance Covered [m]	Amps Drawn [A]	Voltage Used by Drive [V]	Voltage Left [V]	Battery Power Percentage [%]	Set Distance [m]	Set Time [s]
0	1.410	57.528	40.673	533.76	533.76	Y	9.81	0.00	0.00	0.000	490.80	6.88	5.12	0.427	6.096	
0.02	0.582	23.756	23.756	533.76	693.89	N	9.81	0.20	185.70	0.004	198.46	2.78	9.217	0.768	6.096	
0.04	1.014	41.377	41.377	311.76	693.89	N	5.73	0.39	371.39	0.012	345.67	4.85	7.153	0.596	6.096	
0.06	0.771	31.474	31.474	543.01	693.89	N	9.98	0.51	479.85	0.022	262.94	3.69	8.313	0.693	6.096	
0.08	0.865	35.289	35.289	413.04	693.89	N	7.59	0.71	668.77	0.036	294.81	4.13	7.866	0.656	6.096	
0.1	0.796	32.464	32.464	463.11	693.89	N	8.51	0.86	812.47	0.053	271.21	3.80	8.197	0.683	6.096	
0.12	0.803	32.746	32.746	426.04	693.89	N	7.83	1.03	973.59	0.074	273.56	3.84	8.164	0.680	6.096	
0.14	0.775	31.621	31.621	429.73	693.89	N	7.89	1.18	1121.81	0.097	264.16	3.70	8.296	0.691	6.096	
0.16	0.763	31.113	31.113	414.97	693.89	N	7.62	1.34	1271.31	0.124	259.92	3.64	8.355	0.696	6.096	
0.18	0.744	30.346	30.346	408.31	693.89	N	7.50	1.50	1415.68	0.154	253.51	3.55	8.445	0.704	6.096	
0.2	0.728	29.687	29.687	398.24	693.89	N	7.32	1.65	1557.73	0.187	248.01	3.48	8.522	0.710	6.096	
0.22	0.711	28.989	28.989	389.60	693.89	N	7.16	1.79	1696.28	0.223	242.18	3.40	8.604	0.717	6.096	
0.24	0.694	28.310	28.310	380.44	693.89	N	6.99	1.93	1831.83	0.262	236.51	3.32	8.684	0.724	6.096	
0.26	0.677	27.628	27.628	371.52	693.89	N	6.83	2.07	1964.18	0.303	230.81	3.24	8.764	0.730	6.096	
0.28	0.661	26.953	26.953	362.58	693.89	N	6.66	2.21	2093.43	0.347	225.17	3.16	8.843	0.737	6.096	
0.3	0.644	26.280	26.280	353.71	693.89	N	6.50	2.34	2219.58	0.394	219.55	3.08	8.921	0.743	6.096	
0.32	0.628	25.613	25.613	344.89	693.89	N	6.34	2.47	2342.63	0.444	213.98	3.00	9.000	0.750	6.096	
0.34	0.612	24.951	24.951	336.13	693.89	N	6.18	2.60	2462.62	0.496	208.45	2.92	9.077	0.756	6.096	
0.36	0.595	24.295	24.295	327.44	693.89	N	6.02	2.72	2579.56	0.550	202.96	2.85	9.154	0.763	6.096	
0.38	0.580	23.645	23.645	318.83	693.89	N	5.86	2.84	2693.48	0.607	197.53	2.77	9.230	0.769	6.096	
0.4	0.564	23.001	23.001	310.30	693.89	N	5.70	2.96	2804.40	0.666	192.15	2.69	9.306	0.775	6.096	
0.42	0.548	22.364	22.364	301.85	693.89	N	5.55	3.08	2912.35	0.728	186.83	2.62	9.380	0.782	6.096	
0.44	0.533	21.735	21.735	293.49	693.89	N	5.39	3.19	3017.37	0.792	181.58	2.55	9.454	0.788	6.096	
0.46	0.517	21.113	21.113	285.23	693.89	N	5.24	3.29	3119.48	0.857	176.38	2.47	9.527	0.794	6.096	
0.48	0.502	20.500	20.500	277.08	693.89	N	5.09	3.40	3218.71	0.925	171.26	2.40	9.599	0.800	6.096	
0.5	0.488	19.895	19.895	269.02	693.89	N	4.94	3.50	3315.10	0.995	166.20	2.33	9.670	0.806	6.096	
0.52	0.473	19.299	19.299	261.09	693.89	N	4.80	3.60	3408.70	1.067	161.23	2.26	9.739	0.812	6.096	
0.54	0.459	18.712	18.712	253.26	693.89	N	4.65	3.70	3499.53	1.141	156.32	2.19	9.808	0.817	6.096	
0.56	0.444	18.135	18.135	245.56	693.89	N	4.51	3.79	3587.64	1.217	151.50	2.12	9.876	0.823	6.096	
0.58	0.431	17.567	17.567	237.99	693.89	N	4.37	3.88	3673.07	1.295	146.76	2.06	9.942	0.829	6.096	
0.6	0.417	17.010	17.010	230.54	693.89	N	4.24	3.97	3755.87	1.374	142.10	1.99	10.007	0.834	6.096	
0.62	0.403	16.462	16.462	223.22	693.89	N	4.10	4.05	3836.08	1.455	137.53	1.93	10.072	0.839	6.096	
0.64	0.390	15.926	15.926	216.04	693.89	N	3.97	4.13	3913.74	1.538	133.05	1.87	10.134	0.845	6.096	
0.66	0.377	15.400	15.400	209.00	693.89	N	3.84	4.21	3988.90	1.622	128.65	1.80	10.196	0.850	6.096	
0.68	0.365	14.885	14.885	202.10	693.89	N	3.71	4.29	4061.61	1.708	124.35	1.74	10.256	0.855	6.096	
0.7	0.352	14.381	14.381	195.34	693.89	N	3.59	4.36	4131.92	1.795	120.14	1.68	10.315	0.860	6.096	
0.72	0.340	13.888	13.888	188.73	693.89	N	3.47	4.44	4199.88	1.884	116.03	1.63	10.373	0.864	6.096	
0.74	0.329	13.407	13.407	182.26	693.89	N	3.35	4.50	4265.54	1.974	112.00	1.57	10.430	0.869	6.096	
0.76	0.317	12.937	12.937	175.94	693.89	N	3.23	4.57	4328.95	2.065	108.08	1.52	10.485	0.874	6.096	
0.78	0.306	12.478	12.478	169.78	693.89	N	3.12	4.64	4390.16	2.158	104.25	1.46	10.538	0.878	6.096	
0.8	0.295	12.031	12.031	163.76	693.89	N	3.01	4.70	4449.22	2.252	100.51	1.41	10.591	0.883	6.096	
0.82	0.284	11.596	11.596	157.89	693.89	N	2.90	4.76	4506.19	2.347	96.87	1.36	10.642	0.887	6.096	
0.84	0.274	11.172	11.172	152.18	693.89	N	2.80	4.82	4561.12	2.444	93.33	1.31	10.691	0.891	6.096	
0.86	0.264	10.759	10.759	146.61	693.89	N	2.69	4.87	4614.07	2.541	89.89	1.26	10.740	0.895	6.096	
0.88	0.254	10.358	10.358	141.20	693.89	N	2.59	4.93	4665.07	2.640	86.53	1.21	10.787	0.899	6.096	
0.9	0.244	9.969	9.969	135.93	693.89	N	2.50	4.98	4714.20	2.739	83.28	1.17	10.832	0.903	6.096	
0.92	0.235	9.590	9.590	130.82	693.89	N	2.40	5.03	4761.49	2.840	80.12	1.12	10.877	0.906	6.096	
0.94	0.226	9.223	9.223	125.86	693.89	N	2.31	5.08	4807.00	2.941	77.05	1.08	10.920	0.910	6.096	
0.96	0.217	8.867	8.867	121.04	693.89	N	2.22	5.12	4850.79	3.044	74.08	1.04	10.961	0.913	6.096	
0.98	0.209	8.522	8.522	116.37	693.89	N	2.14	5.17	4892.90	3.147	71.19	1.00	11.002	0.917	6.096	
1	0.201	8.188	8.188	111.84	693.89	N	2.05	5.21	4933.38	3.251	68.40	0.96	11.041	0.920	6.096	
1.02	0.193	7.864	7.864	107.45	693.89	N	1.97	5.25	4972.29	3.356	65.70	0.92	11.079	0.923	6.096	
1.04	0.185	7.551	7.551	103.21	693.89	N	1.90	5.29	5009.67	3.462	63.09	0.88	11.115	0.926	6.096	
1.06	0.178	7.249	7.249	99.10	693.89	N	1.82	5.33	5045.58	3.569	60.56	0.85	11.151	0.929	6.096	
1.08	0.170	6.956	6.956	95.13	693.89	N	1.75	5.37	5080.06	3.676	58.11	0.81	11.185	0.932	6.096	
1.1	0.164	6.674	6.674	91.29	693.89	N	1.68	5.40	5113.15	3.784	55.75	0.78	11.218	0.935	6.096	
1.12	0.157	6.401	6.401	87.58	693.89	N	1.61	5.43	5144.91	3.893	53.48	0.75	11.250	0.938	6.096	
1.14	0.150	6.138	6.138	84.00	693.89	N	1.54	5.47	5175.38	4.002	51.28	0.72	11.281	0.940	6.096	
1.16	0.144	5.884	5.884	80.55	693.89	N	1.48	5.50	5204.61	4.112	49.16	0.69	11.311	0.943	6.096	
1.18	0.138	5.639	5.639	77.22	693.89	N	1.42	5.53	5232.63	4.223	47.11	0.66	11.339	0.945	6.096	
1.2	0.132	5.404	5.404	74.01	693.89	N	1.36	5.55	5259.49	4.334	45.14	0.63	11.367	0.947	6.096	
1.22	0.127	5.176	5.176	70.91	693.89	N	1.30	5.58	5285.24	4.445	43.25	0.61	11.394	0.949	6.096	
1.24	0.122	4.958	4.958	67.93	693.89	N	1.25	5.61	5309.91	4.557	41.42	0.58	11.419	0.952	6.096	
1.26	0.116	4.747	4.747	65.06	693.89	N	1.20	5.63	5333.55	4.670	39.66	0.56	11.444	0.954	6.096	
1.28	0.111	4.545	4.545	62.30	693.89	N	1.14	5.66	5356.18	4.783	37.97	0.53	11.468	0.956	6.096	
1.3	0.107	4.350	4.350	59.65	693.89	N	1.10	5.68	5377.86	4.897	36.34	0.51	11.490	0.958	6.096	
1.32	0.102	4.163	4.163	57.09	693.89	N	1.05	5.70	5398.61	5.011	34.78	0.49	11.512	0.959	6.096	
1.34	0.098	3.984	3.984	54.64	693.89	N	1.00	5.72	5418.47	5.125	33.28	0.47	11.533	0.961	6.096	
1.36	0.093	3.811	3.811	52.28	693.89	N	0.96	5.74	5437.48	5.240	31.84	0.45	11.554	0.963	6.096	
1.38	0.089	3.645	3.645	50.01	693.89	N	0.92	5.76	5455.67	5.355	30.45	0.43	11.573	0.964	6.096	
1.4	0.085	3.486	3.486	47.84	693.89	N	0.88	5.78	5473.07	5.471	29.12	0.41	11.592	0.966	6.096	
1.42	0.082	3.333	3.333	45.75	693.89	N	0.84	5.80	5489.71	5.587	27.85	0.39	11.610	0.967	6.096	
1.44	0.078	3.187	3.187	43.74	693.89	N	0.80	5.81	5505.63	5.703	26.62	0.37	11.627	0.969	6.096	
1.46	0.075	3.046	3.046	41.82	693.89	N	0.77	5.83	5520.84	5.820	25.45	0.36	11.643	0.970	6.096	
1.48	0.071	2.911	2.911	39.98	693.89	N	0.73	5.85	5535.39	5.937	24.32	0.34	11.659	0.972	6.096	
1.5	0.068	2.782	2.782	38.21	693.89	N	0.70	5.86	5549.30	6.054	23.24	0.33	11.674	0.973	6.096	
1.52	0.065	2.658	2.658	36.51	693.89	N	0.67	5.87	5562.59	6.171	22.21	0.31	11.689	0.974	6.096	
1.54	0.062	2.540	2.540	34.89	693.89	N	0.64	5.89	5575.29	6.289	21.22	0.30	11.702	0.975	6.096	0
1.56	0.059	2.426	2.426	33.33	693.89	N	0.61	5.90	5587.43	6.407	20.27	0.28	11.716	0.976	6.096	6.66
1.58	0.057	2.318	2.318	31.84	693.89	N	0.58	5.91	5599.03	6.526	19.36	0.27	11.729	0.977	6.096	
1.6	0.054	2.213	2.213	30.41	693.89	N	0.56	5.92	5610.11	6.644	18.49	0.26	11.741	0.978	6.096	
1.62	0.052	2.114	2.114	29.05	693.89	N	0.53	5.94	5620.69	6.763	17.66	0.25	11.752	0.979	6.096	
1.64	0.049	2.018	2.018	27.74	693.89	N	0.51	5.95	5630.79	6.882	16.86	0.24	11.764	0.980	6.096	
1.66	0.047	1.927	1.927	26.49	693.89	N	0.49	5.96	5640.44	7.001	16.10	0.23	11.774	0.981	6.096	
1.68	0.045	1.840	1.840	25.29	693.89	N	0.46	5.97	5649.66	7.120	15.37	0.22	11.784	0.982	6.096	
1.7	0.043	1.756	1.756	24.14	693.89	N	0.44	5.98	5658.46	7.240	14.67	0.21	11.794	0.983	6.096	
1.72	0.041	1.676	1.676	23.05	693.89	N	0.42	5.98	5666.86	7.359	14.00	0.20	11.804	0.984	6.096	
1.74	0.039	1.600	1.600	22.00	693.89	N	0.40	5.99	5674.87	7.479	13.37	0.19	11.813	0.984	6.096	
1.76	0.037	1.527	1.527	21.00	693.89	N	0.39	6.00	5682.53	7.599	12.76	0.18	11.821	0.985	6.096	
1.78	0.036	1.457	1.457	20.04	693.89	N	0.37	6.01	5689.83	7.719	12.17	0.17	11.829	0.986	6.096	
1.8	0.034	1.391	1.391	19.12	693.89	N	0.35	6.02	5696.80	7.840	11.62	0.16	11.837	0.986	6.096	

1.82	0.033	1.327	1.327	18.25	693.89	N	0.34	6.02	5703.46	7.960	11.08	0.16	11.845	0.987	6.096
1.84	0.031	1.266	1.266	17.41	693.89	N	0.32	6.03	5709.81	8.081	10.58	0.15	11.852	0.988	6.096
1.86	0.030	1.208	1.208	16.61	693.89	N	0.31	6.04	5715.86	8.202	10.09	0.14	11.859	0.988	6.096
1.88	0.028	1.152	1.152	15.85	693.89	N	0.29	6.04	5721.64	8.322	9.63	0.13	11.865	0.989	6.096
1.9	0.027	1.099	1.099	15.12	693.89	N	0.28	6.05	5727.16	8.443	9.18	0.13	11.871	0.989	6.096
1.92	0.026	1.048	1.048	14.42	693.89	N	0.26	6.05	5732.42	8.565	8.76	0.12	11.877	0.990	6.096
1.94	0.025	1.000	1.000	13.76	693.89	N	0.25	6.06	5737.44	8.686	8.35	0.12	11.883	0.990	6.096
1.96	0.023	0.954	0.954	13.12	693.89	N	0.24	6.06	5742.22	8.807	7.97	0.11	11.888	0.991	6.096
1.98	0.022	0.910	0.910	12.52	693.89	N	0.23	6.07	5746.79	8.928	7.60	0.11	11.893	0.991	6.096
2	0.021	0.868	0.868	11.94	693.89	N	0.22	6.07	5751.14	9.050	7.25	0.10	11.898	0.992	6.096
2.02	0.020	0.827	0.827	11.38	693.89	N	0.21	6.08	5755.30	9.171	6.91	0.10	11.903	0.992	6.096
2.04	0.019	0.789	0.789	10.86	693.89	N	0.20	6.08	5759.26	9.293	6.59	0.09	11.908	0.992	6.096
2.06	0.018	0.752	0.752	10.35	693.89	N	0.19	6.09	5763.03	9.415	6.29	0.09	11.912	0.993	6.096
2.08	0.018	0.717	0.717	9.87	693.89	N	0.18	6.09	5766.64	9.537	5.99	0.08	11.916	0.993	6.096
2.1	0.017	0.684	0.684	9.41	693.89	N	0.17	6.09	5770.07	9.658	5.71	0.08	11.920	0.993	6.096
2.12	0.016	0.652	0.652	8.98	693.89	N	0.16	6.10	5773.35	9.780	5.45	0.08	11.924	0.994	6.096
2.14	0.015	0.622	0.622	8.56	693.89	N	0.16	6.10	5776.47	9.902	5.19	0.07	11.927	0.994	6.096
2.16	0.015	0.593	0.593	8.16	693.89	N	0.15	6.10	5779.45	10.025	4.95	0.07	11.931	0.994	6.096
2.18	0.014	0.565	0.565	7.78	693.89	N	0.14	6.11	5782.29	10.147	4.72	0.07	11.934	0.994	6.096
2.2	0.013	0.539	0.539	7.42	693.89	N	0.14	6.11	5784.99	10.269	4.50	0.06	11.937	0.995	6.096
2.22	0.013	0.514	0.514	7.07	693.89	N	0.13	6.11	5787.57	10.391	4.29	0.06	11.940	0.995	6.096
2.24	0.012	0.490	0.490	6.74	693.89	N	0.12	6.12	5790.03	10.513	4.09	0.06	11.943	0.995	6.096
2.26	0.011	0.467	0.467	6.43	693.89	N	0.12	6.12	5792.38	10.636	3.90	0.05	11.945	0.995	6.096
2.28	0.011	0.445	0.445	6.13	693.89	N	0.11	6.12	5794.62	10.758	3.72	0.05	11.948	0.996	6.096
2.3	0.010	0.424	0.424	5.84	693.89	N	0.11	6.12	5796.75	10.881	3.54	0.05	11.950	0.996	6.096
2.32	0.010	0.404	0.404	5.57	693.89	N	0.10	6.12	5798.78	11.003	3.38	0.05	11.953	0.996	6.096
2.34	0.009	0.385	0.385	5.31	693.89	N	0.10	6.13	5800.72	11.126	3.22	0.05	11.955	0.996	6.096
2.36	0.009	0.367	0.367	5.06	693.89	N	0.09	6.13	5802.56	11.248	3.07	0.04	11.957	0.996	6.096
2.38	0.009	0.350	0.350	4.82	693.89	N	0.09	6.13	5804.32	11.371	2.93	0.04	11.959	0.997	6.096
2.4	0.008	0.334	0.334	4.60	693.89	N	0.08	6.13	5806.00	11.493	2.79	0.04	11.961	0.997	6.096
2.42	0.008	0.318	0.318	4.38	693.89	N	0.08	6.13	5807.60	11.616	2.66	0.04	11.963	0.997	6.096
2.44	0.007	0.303	0.303	4.18	693.89	N	0.08	6.14	5809.12	11.739	2.53	0.04	11.964	0.997	6.096
2.46	0.007	0.289	0.289	3.98	693.89	N	0.07	6.14	5810.57	11.862	2.41	0.03	11.966	0.997	6.096
2.48	0.007	0.275	0.275	3.79	693.89	N	0.07	6.14	5811.96	11.984	2.30	0.03	11.968	0.997	6.096
2.5	0.006	0.263	0.263	3.61	693.89	N	0.07	6.14	5813.28	12.107	2.19	0.03	11.969	0.997	6.096
2.52	0.006	0.250	0.250	3.45	693.89	N	0.06	6.14	5814.54	12.230	2.09	0.03	11.971	0.998	6.096
2.54	0.006	0.238	0.238	3.28	693.89	N	0.06	6.14	5815.73	12.353	1.99	0.03	11.972	0.998	6.096
2.56	0.006	0.227	0.227	3.13	693.89	N	0.06	6.14	5816.88	12.476	1.90	0.03	11.973	0.998	6.096
2.58	0.005	0.217	0.217	2.98	693.89	N	0.05	6.14	5817.97	12.598	1.81	0.03	11.975	0.998	6.096
2.6	0.005	0.206	0.206	2.84	693.89	N	0.05	6.15	5819.00	12.721	1.72	0.02	11.976	0.998	6.096
2.62	0.005	0.197	0.197	2.71	693.89	N	0.05	6.15	5819.99	12.844	1.64	0.02	11.977	0.998	6.096
2.64	0.005	0.187	0.187	2.58	693.89	N	0.05	6.15	5820.93	12.967	1.57	0.02	11.978	0.998	6.096
2.66	0.004	0.179	0.179	2.46	693.89	N	0.05	6.15	5821.83	13.090	1.49	0.02	11.979	0.998	6.096
2.68	0.004	0.170	0.170	2.34	693.89	N	0.04	6.15	5822.69	13.213	1.42	0.02	11.980	0.998	6.096
2.7	0.004	0.162	0.162	2.23	693.89	N	0.04	6.15	5823.50	13.336	1.36	0.02	11.981	0.998	6.096
2.72	0.004	0.155	0.155	2.13	693.89	N	0.04	6.15	5824.28	13.459	1.29	0.02	11.982	0.998	6.096
2.74	0.004	0.147	0.147	2.03	693.89	N	0.04	6.15	5825.02	13.582	1.23	0.02	11.983	0.999	6.096
2.76	0.003	0.140	0.140	1.93	693.89	N	0.04	6.15	5825.73	13.705	1.17	0.02	11.984	0.999	6.096
2.78	0.003	0.134	0.134	1.84	693.89	N	0.03	6.15	5826.40	13.828	1.12	0.02	11.984	0.999	6.096
2.8	0.003	0.127	0.127	1.76	693.89	N	0.03	6.15	5827.04	13.952	1.07	0.01	11.985	0.999	6.096
2.82	0.003	0.121	0.121	1.67	693.89	N	0.03	6.15	5827.65	14.075	1.01	0.01	11.986	0.999	6.096
2.84	0.003	0.116	0.116	1.59	693.89	N	0.03	6.16	5828.23	14.198	0.97	0.01	11.986	0.999	6.096
2.86	0.003	0.110	0.110	1.52	693.89	N	0.03	6.16	5828.79	14.321	0.92	0.01	11.987	0.999	6.096
2.88	0.003	0.105	0.105	1.45	693.89	N	0.03	6.16	5829.32	14.444	0.88	0.01	11.988	0.999	6.096
2.9	0.002	0.100	0.100	1.38	693.89	N	0.03	6.16	5829.82	14.567	0.84	0.01	11.988	0.999	6.096
2.92	0.002	0.095	0.095	1.31	693.89	N	0.02	6.16	5830.30	14.690	0.80	0.01	11.989	0.999	6.096
2.94	0.002	0.091	0.091	1.25	693.89	N	0.02	6.16	5830.76	14.813	0.76	0.01	11.989	0.999	6.096
2.96	0.002	0.087	0.087	1.19	693.89	N	0.02	6.16	5831.19	14.937	0.72	0.01	11.990	0.999	6.096
2.98	0.002	0.083	0.083	1.14	693.89	N	0.02	6.16	5831.61	15.060	0.69	0.01	11.990	0.999	6.096
3	0.002	0.079	0.079	1.08	693.89	N	0.02	6.16	5832.00	15.183	0.66	0.01	11.991	0.999	6.096

	Name	Free Speed (RPM)	Stall Torque (oz-in)	Stall Current (Amp)	Free Current (Amp)	Power (W)
Motor 1	775pro + 775pro + CIM	#N/A	#N/A	#N/A	#N/A	#N/A
Motor 2	775pro + 775pro + CIM	#N/A	#N/A	#N/A	#N/A	#N/A





Motor 1

Percentage	Speed (RPM)	Torque (oz-in)	Current (A)	Supplied Power (W)	Generated Power (W)	Efficiency (%)	Voltage
0%	#N/A	#N/A	#N/A	#N/A	#N/A	0	52
1%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
2%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
3%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
4%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
5%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
6%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
7%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
8%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
9%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
10%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
11%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
12%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
13%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
14%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
15%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
16%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
17%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
18%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
19%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
20%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
21%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
22%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
23%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
24%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
25%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
26%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
27%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
28%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
29%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
30%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
31%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
32%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
33%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
34%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
35%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
36%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
37%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
38%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
39%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
40%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
41%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
42%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
43%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
44%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
45%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
46%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
47%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
48%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
49%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
50%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
51%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
52%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
53%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
54%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
55%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
56%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
57%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
58%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
59%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
60%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
61%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
62%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
63%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
64%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
65%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
66%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
67%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
68%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
69%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
70%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
71%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
72%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
73%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
74%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
75%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
76%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
77%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
78%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
79%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
80%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
81%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
82%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
83%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
84%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
85%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
86%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
87%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
88%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
89%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
90%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
91%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
92%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
93%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
94%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
95%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
96%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
97%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
98%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
99%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
100%	#N/A	#N/A	#N/A	#N/A	#N/A	0	

Motor 2

Percentage	Speed (RPM)	Torque (oz-in)	Current (A)	Supplied Power (W)	Generated Power (W)	Efficiency (%)	Voltage
0%	#N/A	#N/A	#N/A	#N/A	#N/A	0	52
1%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
2%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
3%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
4%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
5%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
6%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
7%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
8%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
9%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
10%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
11%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
12%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
13%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
14%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
15%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
16%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
17%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
18%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
19%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
20%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
21%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
22%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
23%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
24%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
25%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
26%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
27%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
28%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
29%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
30%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
31%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
32%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
33%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
34%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
35%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
36%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
37%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
38%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
39%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
40%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
41%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
42%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
43%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
44%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
45%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
46%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
47%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
48%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
49%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
50%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
51%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
52%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
53%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
54%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
55%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
56%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
57%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
58%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
59%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
60%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
61%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
62%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
63%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
64%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
65%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
66%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
67%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
68%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
69%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
70%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
71%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
72%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
73%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
74%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
75%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
76%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
77%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
78%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
79%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
80%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
81%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
82%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
83%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
84%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
85%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
86%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
87%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
88%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
89%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
90%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
91%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
92%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
93%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
94%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
95%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
96%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
97%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
98%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
99%	#N/A	#N/A	#N/A	#N/A	#N/A	0	
100%	#N/A	#N/A	#N/A	#N/A	#N/A	0	

Center to Center Calculator:

CC = ((N1 + N2) / P) + O

N1 = Gear 1 Tooth Count

N2 = Gear 2 Tooth Count

P = Dimetral Pitch

O = Extra Offset (FIRST norm is +.003)

O = 0.001 [in]

Option	N1	N2	P	CC [in]	Reduction
1	12	60	32	1.126	5:1
2	12	64	32	1.189	5.33:1
3	48	48	20	2.401	1:1
4	14	36	20	1.251	2.57:1
5	42	54	20	2.401	1.29:1

*Note: VexPro 11 and 13 tooth have 12 and 14 tooth CC distances respectively

Gears

11

12

13

14

18

20					
24					
30					
34					
36					
40					
42					
44					
48					
50					
54					
60					
64					
66					
70					
72					
80					
84					

VEXpro Center to Center Distance Calc		
	pitch (mm)	Profile
Tooth Pitch	5	HTD
Belth Width (mm)	9	
Driver Pulley Teeth	24	
Driven Pulley Teeth	24	
Ratio:	1:1	
Pitch diameter check		
Pulley Teeth	pitch diameter	
18	1.128	

Teeth on belt	Center distance (in)
60	3.544
70	4.528
80	5.512
90	6.497
100	7.481
104	7.875
110	8.465
120	9.449
130	10.434
140	11.418
150	12.402
160	13.386
170	14.371
180	15.355
190	16.339
200	17.323
225	19.784
250	22.245
85	6.004

VEXpro Center to Center Distance Calc		
	pitch (mm)	Profile
Tooth Pitch	5	HTD
Belth Width (mm)	9	
Driver Pulley Teeth	24	
Driven Pulley Teeth	18	
Ratio:	0.75:1	
Pitch diameter check		
Pulley Teeth	pitch diameter	
24	1.504	

Teeth on belt	Center distance (in)
60	3.834
70	4.82
80	5.805
90	6.789
100	7.774
104	8.168
110	8.758
120	9.743
130	10.727
140	11.712
150	12.696
160	13.68
170	14.665
180	15.649
190	16.633
200	17.618
225	20.078
250	22.539

VEXpro Center to Center Distance Calc		
	pitch (mm)	Profile
Tooth Pitch	5	HTD
Belth Width (mm)	9	
Driver Pulley Teeth	24	
Driven Pulley Teeth	24	
Ratio:	1:1	
Pitch diameter check		
Pulley Teeth	pitch diameter	
24	1.504	

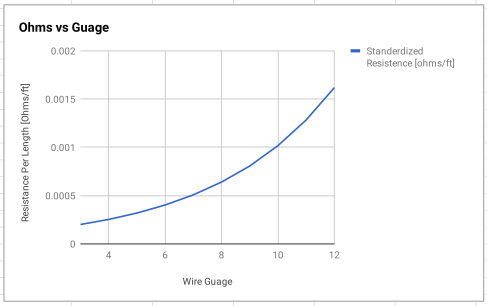
Teeth on belt	Center distance (in)
60	3.544
70	4.528
80	5.512
90	6.497
100	7.481
104	7.875
110	8.465
120	9.449
130	10.434
140	11.418
150	12.402
160	13.386
170	14.371
180	15.355
190	16.339
200	17.323
225	19.784
250	22.245

c/Gates-1300-5MGT-09-PowerGrip-GT3 from Royal supply

9	15	Toggle Column
18	18	18
24	24	24
30	30	30
36	36	36
42	42	42
60	60	60

Battery Number	Supplier	Weight [lbs]	Size [in]	Amp hours	Life Expectancy (@ 80% discharge)	Internal Resistance [Milliohms]	Max Discharge Current for 5 sec [A]	Link
MK ES17-12	mkbattery	13.82	7.1 x 3.0 x 6.6	17	225 cycles	10	720	http://www.mkbattery.com/images/ES17-12.pdf
NP18-12	Enersys	13.6	7.13 x 3.0 x 6.58	17.2		11		http://www.alliedelec.com/search/productdetail.aspx?SKU=70111506#tab=specs
SLA-12V18	Battery Mart		7.13 x 2.99 x 6.57	18				http://www.batterymart.com/p-12v-18ah-sealed-lead-acid-battery-1.html
SP12-18	Sigma	12.65	7.13 x 3.0 x 6.59	18				http://www.batterysharks.com/SigmasTek-SP12-18-NB-p/sp12-18_b12-18.htm
UB12180	Universal Battery	13.5	7.13 x 2.99 x 6.57	18 (@ 20 hr rate)				http://www.batterysolutionsinc.com/ub12180-12-volt-1800-amp-hour-p-7531.html
SLA1116	Power Patrol							
WKA12-18NB	Werker Battery							
PS-12180 NB	Power Sonic							
NP18-12B	Yuasa							
LC-RD-1217	Panasonic							
BSL1116	Interstate Batteries							
NP18-12BFR	Enersys							
NP18-12B	Enersys							

Name	Gauge	Resistence per [ohms]	Length	Unit	Standerdized Resistence [ohms/ft]	Note	Link
3 gauge	3	0.2009	1000	ft	0.0002009	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
4 gauge	4	0.2533	1000	ft	0.0002533	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
5 gauge	5	0.3195	1000	ft	0.0003195	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
6 gauge	6	0.4028	1000	ft	0.0004028	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
7 gauge	7	0.508	1000	ft	0.000508	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
8 gauge	8	0.6405	1000	ft	0.0006405	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
9 gauge	9	0.807	1000	ft	0.000807	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
10 gauge	10	1.018	1000	ft	0.001018	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
11 gauge	11	1.284	1000	ft	0.001284	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html
12 gauge	12	1.619	1000	ft	0.001619	@77°C	http://www.interfacebus.com/AWG-table-of-different-wire-gauge-resistance.html



	free speed (rpm)	stall torque (in-lbs)	Stall current (A)	# of motors
CIM	5330	21.33015688	131	1

Gearing

Stage	Pinion	Spur	Ratio
VP	6	19	3.166666667
VP	6	19	3.166666667
VP	6	19	3.166666667
Sprocket	1	1	1
n/a	1	1	1

Ratio	31.75462963

Combined motor

free speed (rpm)	stall torque (in-lbs)	Stall current (A)
167.8495407	677.3312315	131
	56.44426929	

Arm Spec

Length (in)	Weight (lb)	Torque (in-lb)
36	15	540

% stall	Speed (rpm)	degrees traveled	Time to travel(s)
79.72%	34.03207038	360	1.763

	free speed (rpm)	stall torque (in-lbs)	Stall current (A)	# of motors
MiniCIM	5840	88.947	89	1
		3.152	9.9756 ft lbs	
		1.9758		

Gearing

Stage	Pinion	Spur	Ratio
VP	1	50	50
n/a	1	1.5	1.5
n/a	1	1	1
n/a	1	1	1
n/a	12	36	3

Ratio	225

Combined motor

free speed (rpm)	stall torque (in-lbs)	Stall current (A)
25.95555556	20013.075	89
	1667.75625	

Arm Spec

Length (in)	Weight (lb)	Torque (in-lb)
1	20	20

% stall	Speed (rpm)	degrees traveled	Time to travel(s)
0.10%	25.92961696	360	2.314

	free speed (rpm)	stall torque (in-lbs)	Stall current (A)	# of motors
775pro	18700	6.283988125	134	1

Gearing

Stage	Pinion	Spur	Ratio
VP	1	9	9
n/a	1	9	9
n/a	20	84	4.2
n/a	18	36	2
n/a	1	1	1

Ratio	680.4

Combined motor

free speed (rpm)	stall torque (in-lbs)	Stall current (A)
27.48383304	4275.62552	134
	356.3021267	

Arm Spec

Length (in)	Weight (lb)	Torque (in-lb)
36	5	180

% stall	Speed (rpm)	degrees traveled	Time to travel(s)
4.21%	26.32678832	90	0.570
	5.641279828		

	free speed (rpm)	stall torque (in-lbs)	Stall current (A)	# of motors
775pro	18700	6.283988125	134	1

Gearing

Stage	Pinion	Spur	Ratio
VP	1	10	10
n/a	1	9	9
n/a	20	84	4.2
n/a	16	36	2.25
n/a	1	1	1

Ratio	850.5

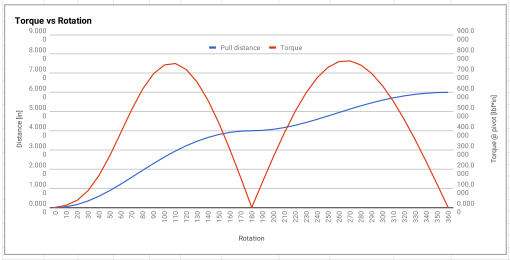
Combined motor

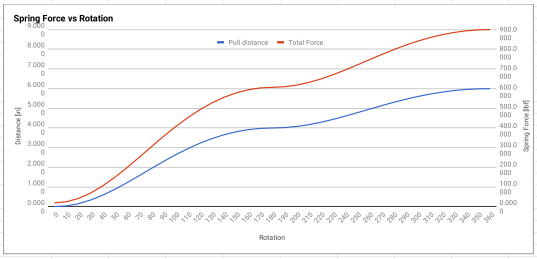
free speed (rpm)	stall torque (in-lbs)	Stall current (A)
21.98706643	5344.5319	134
	445.3776584	

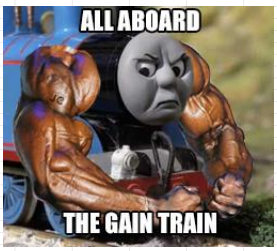
Arm Spec

Length (in)	Weight (lb)	Torque (in-lb)
36	10	360

% stall	Speed (rpm)	degrees traveled	Time to travel(s)
6.74%	20.50604919	110	0.894

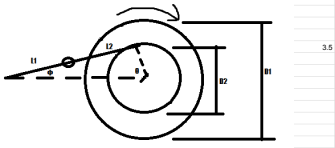






Variable	L_1	L_2	D_1	D_2	K	F_pre
Unit	in	in	in	in	lbf/in	lbf
Value	4	3	1	4	150	20

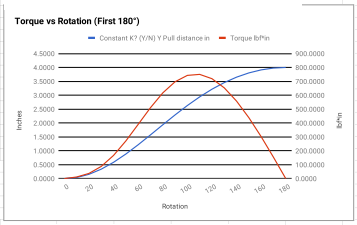
Constant K? (Y/N)
Y



3.5

First 180° of rotation

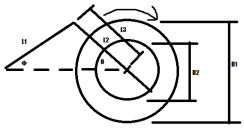
Theta	Theta	X of pivot	Y of pivot	Phi	Phi	Third Angle	Third Angle	Pull distance	Total Force	Torque vector	Torque	Var K
degrees	Radians	in	in	Radians	Degrees	Degrees	Radians	in	lbf	lbf	lbf*in	lbf/in
0	0.0000	0	0	0	0.0000	180.0000	3.1416	0.0000	20.0000	0.0000	0.0000	0.0000
10	0.1745	0.0304	0.3473	0.0496	2.8438	167.1562	2.9174	0.0390	25.8508	0.2223	11.4930	138.8889
20	0.3491	0.1206	0.6840	0.0979	5.6079	154.3921	2.6947	0.1541	43.1176	0.4322	37.2717	277.7778
30	0.5236	0.2679	1.0000	0.1433	8.2132	141.7868	2.4746	0.3397	70.9619	0.6186	87.7926	416.6667
40	0.6981	0.4679	1.2856	0.1847	10.5826	129.4174	2.2588	0.5870	108.0461	0.7725	166.9401	555.5556
50	0.8727	0.7144	1.5321	0.2207	12.6427	117.3573	2.0483	0.8841	152.6220	0.8882	271.1048	694.4444
60	1.0472	1.0000	1.7321	0.2500	14.3258	105.6742	1.8444	1.2177	202.6505	0.9628	390.2293	833.3333
70	1.2217	1.3160	1.8794	0.2718	15.5741	94.4259	1.6480	1.5730	255.9455	0.9970	510.3645	972.2222
80	1.3963	1.6527	1.9696	0.2852	16.3422	83.6578	1.4601	1.9355	310.3273	0.9939	616.8562	1111.1111
90	1.5708	2.0000	2.0000	0.2898	16.6015	73.3985	1.2810	2.2918	363.7694	0.9583	697.2113	1250.0000
100	1.7453	2.3473	1.9696	0.2852	16.3422	63.6578	1.1110	2.6301	414.5163	0.8962	742.9456	1388.8889
110	1.9199	2.6840	1.8794	0.2718	15.5741	54.4259	0.9499	2.9411	461.1576	0.8134	750.1782	1527.7778
120	2.0944	3.0000	1.7321	0.2500	14.3258	45.6742	0.7972	3.2177	502.6505	0.7154	719.1700	1666.6667
130	2.2689	3.2856	1.5321	0.2207	12.6427	37.3573	0.6520	3.4553	538.2945	0.6068	653.2572	1805.5556
140	2.4435	3.5321	1.2856	0.1847	10.5826	29.4174	0.5134	3.6512	567.6728	0.4912	557.6450	1944.4444
150	2.6180	3.7321	1.0000	0.1433	8.2132	21.7868	0.3803	3.8038	590.5771	0.3712	438.3898	2083.3333
160	2.7925	3.8794	0.6840	0.0979	5.6079	14.3921	0.2512	3.9129	606.9331	0.2486	301.7143	2222.2222
170	2.9671	3.9696	0.3473	0.0496	2.8438	7.1562	0.1249	3.9782	616.7354	0.1246	153.6588	2361.1111
180	3.1416	4.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000	620.0000	0.0000	0.0000	2500.0000

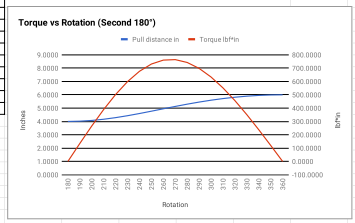


Variable	L_3
Unit	in
Value	1

Second 180° of rotation

Theta	Theta	X of pivot	Y of pivot	Phi	Phi	Third Angle	Third Angle	Pull distance	Total Force	Torque vector	Torque	Var K
degrees	Radians	in	in	Radians	Degrees	Degrees	Radians	in	lbf	lbf	lbf*in	lbf/in
180	3.1416	1.0000	0.0000	0.0000	0.0000	180.0000	3.1416	4.0000	620.0000	0.0000	0.0000	2500.0000
190	3.3161	1.0152	0.1736	0.0434	2.4881	167.5119	2.9236	4.0190	622.8445	0.2162	134.6820	2638.8889
200	3.4907	1.0603	0.3420	0.0856	4.9051	155.0949	2.7069	4.0750	631.2435	0.4211	265.8267	2777.7778
210	3.6652	1.1340	0.5000	0.1253	7.1808	142.8192	2.4927	4.1653	644.8021	0.6043	389.6743	2916.6667
220	3.8397	1.2340	0.6428	0.1614	9.2473	130.7527	2.2821	4.2859	662.8911	0.7575	502.1630	3055.5556
230	4.0143	1.3572	0.7660	0.1927	11.0410	118.9590	2.0762	4.4313	684.6876	0.8750	599.0785	3194.4444
240	4.1888	1.5000	0.8660	0.2182	12.5039	107.4961	1.8762	4.5949	709.2313	0.9537	676.4205	3333.3333
250	4.3633	1.6580	0.9397	0.2371	13.5871	96.4129	1.6827	4.7699	735.4886	0.9937	730.8865	3472.2222
260	4.5379	1.8264	0.9848	0.2488	14.2529	85.7471	1.4966	4.9495	762.4216	0.9972	760.3223	3611.1111
270	4.7124	2.0000	1.0000	0.2527	14.4775	75.5225	1.3181	5.1270	789.0525	0.9682	763.9968	3750.0000
280	4.8869	2.1736	0.9848	0.2488	14.2529	65.7471	1.1475	5.2968	814.5161	0.9117	742.6281	3888.8889
290	5.0615	2.3420	0.9397	0.2371	13.5871	56.4129	0.9846	5.4540	838.0947	0.8330	698.1713	4027.7778
300	5.2360	2.5000	0.8660	0.2182	12.5039	47.4961	0.8290	5.5949	859.2313	0.7372	633.4521	4166.6667
310	5.4105	2.6428	0.7660	0.1927	11.0410	38.9590	0.6800	5.7168	877.5239	0.6288	551.7557	4305.5556
320	5.5851	2.7660	0.6428	0.1614	9.2473	30.7527	0.5367	5.8180	892.7044	0.5113	456.4691	4444.4444
330	5.7596	2.8660	0.5000	0.1253	7.1808	22.8192	0.3983	5.8974	904.6098	0.3878	350.8305	4583.3333
340	5.9341	2.9397	0.3420	0.0856	4.9051	15.0949	0.2635	5.9543	913.1513	0.2604	237.8020	4722.2222
350	6.1087	2.9848	0.1736	0.0434	2.4881	7.5119	0.1311	5.9886	918.2868	0.1307	120.0494	4861.1111
360	6.2832	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.0000	920.0000	0.0000	0.0000	5000.0000



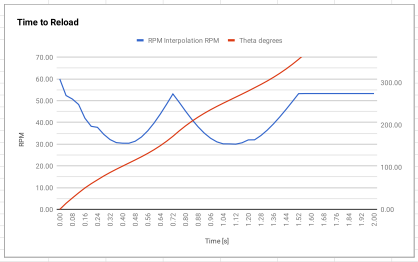


Time to reload

Gearbox Input	Free Speed (RPM)	Stall Torque (N*m)	Stall Current (Amp)	Free Current (Amp)
CIM	5330	2.41	131	2.7

Ratio	Effeciency [%]	Time Interval
100	82	0.04

Time to Reload
1.56



Theta	Torque	Torque	Torque @ motor	RPM @ motor	RPM
degrees	lbf*in	N*m	N*m	RPM	RPM
0	0.00	0.00	0.000	5330.00	53.30
10	11.49	1.30	0.016	5294.98	52.95
20	37.27	4.21	0.051	5216.43	52.16
30	87.79	9.92	0.121	5062.48	50.62
40	166.94	18.86	0.230	4821.31	48.21
50	271.10	30.63	0.374	4503.90	45.04
60	390.23	44.09	0.538	4140.91	41.41
70	510.36	57.66	0.703	3774.84	37.75
80	616.86	69.69	0.850	3450.34	34.50
90	697.21	78.77	0.961	3205.49	32.05
100	742.95	83.94	1.024	3066.13	30.66
110	750.18	84.75	1.034	3044.09	30.44
120	719.17	81.25	0.991	3138.58	31.39
130	653.26	73.80	0.900	3339.42	33.39
140	557.64	63.00	0.768	3630.77	36.31
150	438.39	49.53	0.604	3994.16	39.94
160	301.71	34.09	0.416	4410.63	44.11
170	153.66	17.36	0.212	4861.78	48.62
180	0.00	0.00	0.000	5330.00	53.30
190	134.68	15.22	0.186	4919.60	49.20
200	265.83	30.03	0.366	4519.98	45.20
210	389.67	44.03	0.537	4142.60	41.43
220	502.16	56.73	0.692	3799.83	38.00
230	599.08	67.68	0.825	3504.51	35.05
240	676.42	76.42	0.932	3268.84	32.69
250	730.89	82.57	1.007	3102.87	31.03
260	760.32	85.90	1.048	3013.18	30.13
270	764.00	86.32	1.053	3001.98	30.02
280	742.63	83.90	1.023	3067.10	30.67
290	698.17	78.88	0.962	3202.56	32.03
300	633.45	71.57	0.873	3399.77	34.00
310	551.76	62.34	0.760	3648.71	36.49
320	456.47	51.57	0.629	3939.07	39.39
330	350.83	39.64	0.483	4260.96	42.61
340	237.80	26.87	0.328	4605.38	46.05
350	120.05	13.56	0.165	4964.19	49.64
360	0.00	0.00	0.000	5330.00	53.30

Time	Theta	RPM next lower Theta	Theta next higher	RPM next Higher Theta	RPM Interpolation
s	degrees	RPM	degrees	RPM	RPM
0.00	0.00	53.30	0	53.30	60.00
0.04	14.40	52.95	20	52.16	52.38
0.08	26.97	52.16	30	50.62	50.78
0.12	39.16	50.62	40	48.21	48.26
0.16	50.74	45.04	50	41.41	41.97
0.20	60.82	41.41	70	37.75	38.23
0.24	69.99	41.41	70	37.75	37.75
0.28	79.05	37.75	80	34.50	34.54
0.32	87.34	34.50	90	32.05	32.13
0.36	95.05	32.05	100	30.66	30.73
0.40	102.43	30.66	110	30.44	30.46
0.44	109.74	30.66	110	30.44	30.44
0.48	117.04	30.44	120	31.39	31.36
0.52	124.57	31.39	130	33.39	33.31
0.56	132.56	33.39	140	36.31	36.15
0.60	141.24	36.31	150	39.94	39.73
0.64	150.77	39.94	160	44.11	43.87
0.68	161.30	44.11	170	48.62	48.39
0.72	172.92	48.62	180	53.30	53.12
0.76	185.66	53.30	190	49.20	49.29
0.80	197.49	49.20	200	45.20	45.25
0.84	208.35	45.20	210	41.43	41.46
0.88	218.30	41.43	220	38.00	38.02
0.92	227.43	38.00	230	35.05	35.08
0.96	235.85	35.05	240	32.69	32.73
1.00	243.70	32.69	250	31.03	31.07
1.04	251.16	31.03	260	30.13	30.16
1.08	258.40	31.03	260	30.13	30.14
1.12	265.63	30.13	270	30.02	30.02
1.16	272.84	30.02	280	30.67	30.65
1.20	280.19	30.67	290	32.03	31.98
1.24	287.87	30.67	290	32.03	32.02
1.28	295.55	32.03	300	34.00	33.97
1.32	303.70	34.00	310	36.49	36.44
1.36	312.45	36.49	320	39.39	39.32
1.40	321.89	39.39	330	42.61	42.53
1.44	332.09	42.61	340	46.05	45.97
1.48	343.13	46.05	350	49.64	49.57
1.52	355.02	49.64	360	53.30	53.25
1.56	367.80	53.30	370	53.30	53.30
1.60	380.60	53.30	390	53.30	53.30
1.64	393.39	53.30	400	53.30	53.30
1.68	406.18	53.30	410	53.30	53.30
1.72	418.97	53.30	420	53.30	53.30
1.76	431.76	53.30	440	53.30	53.30
1.80	444.56	53.30	450	53.30	53.30
1.84	457.35	53.30	460	53.30	53.30
1.88	470.14	53.30	480	53.30	53.30
1.92	482.93	53.30	490	53.30	53.30
1.96	495.72	53.30	500	53.30	53.30
2.00	508.52	53.30	510	53.30	53.30
2.04	521.31	53.30	530	53.30	53.30
2.08	534.10	53.30	540	53.30	53.30
2.12	546.89	53.30	550	53.30	53.30
2.16	559.68	53.30	560	53.30	53.30
2.20	572.48	53.30	580	53.30	53.30
2.24	585.27	53.30	590	53.30	53.30
2.28	598.06	53.30	600	53.30	53.30
2.32	610.85	53.30	620	53.30	53.30
2.36	623.64	53.30	630	53.30	53.30
2.40	636.44	53.30	640	53.30	53.30
2.44	649.23	53.30	650	53.30	53.30
2.48	662.02	53.30	670	53.30	53.30

2.52	674.81	53.30	680	53.30	53.30
2.56	687.60	53.30	690	53.30	53.30
2.60	700.40	53.30	710	53.30	53.30
2.64	713.19	53.30	720	53.30	53.30
2.68	725.98	53.30	730	53.30	53.30
2.72	738.77	53.30	740	53.30	53.30
2.76	751.56	53.30	760	53.30	53.30
2.80	764.36	53.30	770	53.30	53.30
2.84	777.15	53.30	780	53.30	53.30
2.88	789.94	53.30	790	53.30	53.30
2.92	802.73	53.30	810	53.30	53.30
2.96	815.52	53.30	820	53.30	53.30
3.00	828.32	53.30	830	53.30	53.30
3.04	841.11	53.30	850	53.30	53.30
3.08	853.90	53.30	860	53.30	53.30
3.12	866.69	53.30	870	53.30	53.30
3.16	879.48	53.30	880	53.30	53.30
3.20	892.28	53.30	900	53.30	53.30
3.24	905.07	53.30	910	53.30	53.30
3.28	917.86	53.30	920	53.30	53.30
3.32	930.65	53.30	940	53.30	53.30
3.36	943.44	53.30	950	53.30	53.30
3.40	956.24	53.30	960	53.30	53.30
3.44	969.03	53.30	970	53.30	53.30
3.48	981.82	53.30	990	53.30	53.30
3.52	994.61	53.30	1000	53.30	53.30
3.56	1007.40	53.30	1010	53.30	53.30
3.60	1020.20	53.30	1030	53.30	53.30
3.64	1032.99	53.30	1040	53.30	53.30
3.68	1045.78	53.30	1050	53.30	53.30
3.72	1058.57	53.30	1060	53.30	53.30
3.76	1071.36	53.30	1080	53.30	53.30
3.80	1084.16	53.30	1090	53.30	53.30
3.84	1096.95	53.30	1100	53.30	53.30
3.88	1109.74	53.30	1110	53.30	53.30
3.92	1122.53	53.30	1130	53.30	53.30
3.96	1135.32	53.30	1140	53.30	53.30

Variable	H
Unit	in
Value	5

MUST BE LESS THAN THAN OR EQUAL TO 7

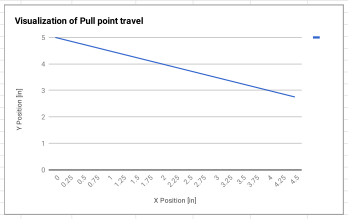
Define Y position of pull point based on x position

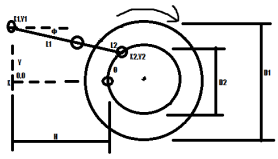
Equation: Y = -5+x*0.5 (you have to copy and past this formula into Y, replace X with B85)

X1	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5
Y1	5	4.875	4.75	4.625	4.5	4.375	4.25	4.125	4	3.875	3.75	3.625	3.5	3.375	3.25	3.125	3	2.875	2.75

Theta	Theta	X2	Y2
degrees	Radians	in	in
0	0.0000	9.0000	0.0000
10	0.1745	9.9392	-0.1736
20	0.3491	9.7588	-0.3420
30	0.5236	9.4641	-0.5000
40	0.6981	9.0642	-0.6428
50	0.8727	8.5712	-0.7660
60	1.0472	8.0000	-0.8660
70	1.2217	7.3681	-0.9397
80	1.3963	6.6946	-0.9848
90	1.5708	6.0000	-1.0000
100	1.7453	5.3054	-0.9848
110	1.9199	4.6319	-0.9397
120	2.0944	4.0000	-0.8660
130	2.2689	3.4288	-0.7660
140	2.4435	2.9358	-0.6428
150	2.6180	2.5359	-0.5000
160	2.7925	2.2412	-0.3420
170	2.9671	2.0608	-0.1736
180	3.1416	2.0000	0.0000

X1	Y1
in	in
0	5





Y1 = #NUM!

(L1+L2)^2 = (X2-X1)^2 + (Y2-Y1)^2

Y1 = Y2 - SQRT((L1+L2)^2 - (X2-X1)^2)

X1 = X2 - SQRT((L1+L2)^2 - (Y2-Y1)^2) Y1 = 5-X1*0.5

X1 = X2 - SQRT((L1+L2)^2 - (Y2-(5-X1*0.5))^2)

Coeffecient of friction list

Polycarbonate to steel	0.32	http://www.dep.uminho.pt/np/2001_03.pdf

	free speed (rpm)	stall torque (in-lbs)	Stall current (A)	# of motors
775pro	18700	6.283988125	134	1

Gearing

Stage	Pinion	Spur	Ratio
VP	1	10	10
VP	1	10	10
VP	1	1	1
Sprocket	1	1	1
n/a	1	1	1
		Ratio	100

STALL TORQUE	0.7100	N*M
FREE SPEED	18700.0000	RPM
REDCUTION	100.0000	Ratio
DIA	1.7500	in
DIA METRIC	0.0445	m
ROBOT MASS	110.0000	lbm
ROBOT MASS METRIC	49.8300	kg
EFFECIENCY	0.8500	%
PULL IN AMOUNT	3.0000	Ft
PULL IN METRIC	0.9144	m
HORIZONTAL PULL OFFSET	1	Ft
HORIZONTAL PULL OFFSET METRIC	0.3048	m
STARTING VERTICAL DISTANCE	10	Ft
STARTING VERTICAL DISTANCE METRIC	3.048	m
MINIMUM VERTICAL DISTANCE	2.1336	m
PULL VECTOR	8.130102354	DEGREES
VECTOR WEIGHT MULTIPLIER	1.010152545	
WEIGHT	488.334	N
ADJUSTED WEIGHT	493.2918327	N
NORMAL VECTOR FORCE	0.1414213562	
NORMAL FORCE	69.06085658	N
COEFFECIENT OF FRICTION	0.32	
FORCE OF FRICTION	22.0994741	N
TOTAL FORCE REQUIRED	515.3913	N
TORQUE @ DRUM	60.3496	N*M
NEEDED @ DRUM	22.9091	N*M
AMOUNT OF TORQUE USED	0.3796	%
SPEED OF MOTOR	11601.3454	RPM
CIRCUMFRENCE OF DRUM	0.1396	M
# OF REVS NEEDED @ DRUM	6.5481	REVS
# OF REVES NEEDED @ MOTOR	654.8089	REVS
TIME TO HANG	3.3865	S
AMP DRAW	50.8673647	AMPS

	free speed (rpm)	tall torque (in-lbs	Stall current (A)	# of motors
775pro	18700	6.283988125	134	1

Gearing

Stage	Pinion	Spur	Ratio
VP	1	7	7
VP	1	10	10
VP	1	1	1
Sprocket	1	1	1
n/a	1	1	1
		Ratio	70

STALL TORQUE	0.7100	N*M
FREE SPEED	18700.0000	RPM
REDCUTION	70.0000	Ratio
DIA	1.1250	in
DIA METRIC	0.0286	m
ROBOT MASS	140.0000	lbm
ROBOT MASS METRIC	63.4200	kg
EFFECIENCY	0.8500	%
PULL IN AMOUNT	5.0000	Ft
PULL IN METRIC	1.524	m
HORIZONTAL PULL OFFSET	1	Ft
HORIZONTAL PULL OFFSET METRIC	0.3048	m
STARTING VERTICAL DISTANCE	7	Ft
STARTING VERTICAL DISTANCE METRIC	2.1336	m
MINIMUM VERTICAL DISTANCE	0.6096	m
PULL VECTOR	26.56505118	DEGREES
VECTOR WEIGHT MULTIPLIER	1.118033989	
WEIGHT	621.516	N
ADJUSTED WEIGHT	694.8760126	N
NORMAL VECTOR FORCE	0.4472135955	
NORMAL FORCE	277.950405	N
COEFFECIENT OF FRICTION	0.1	
FORCE OF FRICTION	27.7950405	N
TOTAL FORCE REQUIRED	722.6711	N
TORQUE @ DRUM	42.2447	N*M
NEEDED @ DRUM	20.6503	N*M
AMOUNT OF TORQUE USED	0.4888	%
SPEED OF MOTOR	9558.9507	RPM
CIRCUMFRENCE OF DRUM	0.0898	M
# OF REVS NEEDED @ DRUM	16.9765	REVS
# OF REVES NEEDED @ MOTOR	1188.3569	REVS
TIME TO HANG	7.4591	S
AMP DRAW	65.50270614	AMPS

Arens robot

0.7100	N*M	STALL TORQUE
18750.0000	RPM	FREE SPEED
35.0000		Reduction
1.1250	in	DIA
0.0286	M	DIA METRIC
100.0000	lbm	ROBOT WEIGHT
45.3000	kg	ROBOT WEIGHT METRIC
0.8500	%	Efficiency
3.0000	Ft	lift amount
0.9144	M	PULL IN METRIC
21.1225	N*M	@ DRUM
12.6856	N*M	NEEDED @ DRUM
0.6006	%	AMOUNT OF TORQUE USED
7489.2720	RPM	SPEED OF MOTOR
0.0898	M	CIRCUMFRENCE OF DRUM
10.1859	REVS	# OF REVS NEEDED @ DRUM
356.5071	REVS	# OF REVES NEEDED @ MOTOR
2.8561	S	TIME TO HANG

	free speed (rpm)	stall torque (N*m	Stall current (A)	# of motors
775pro	18700	0.710	134	1

Wheel List			
Brand	Diameter [in]	Width [in]	Weight [lbm]
Colson	5	1.25	0.55

Gearing

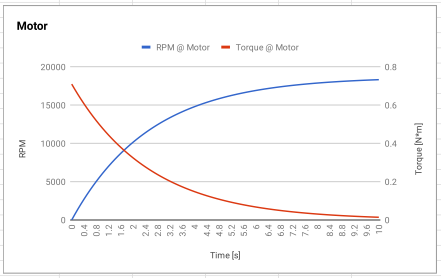
Stage	Pinion	Spur	Ratio
VP	12	24	2
VP	1	1	1
VP	1	1	1
Sprocket	1	1	1
n/a	1	1	1
		Ratio	2

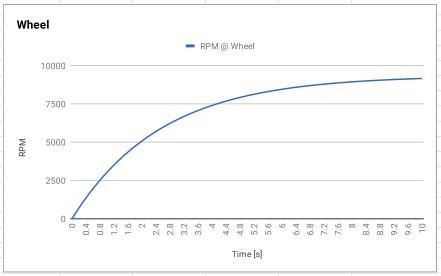
Wheel

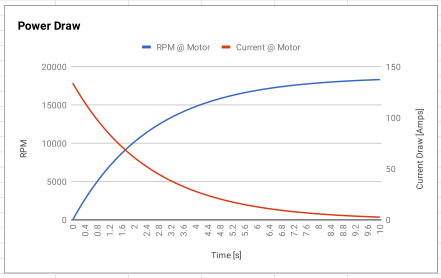
Diameter [in]	Width [in]	Weight [lbm]	I [in^2 * lbm]
5	1.25	0.55	0.107421875
[m]	[m]	[kg]	I [m^2 * kg]
0.127	0.03175	0.24948	0.000031436429

Time Step
0.1

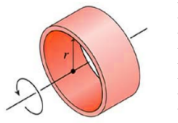
Time	RPM @ Motor	speed @ Motor	Torque @ Motor	Current @ Motor	RPM @ Wheel	speed @ Wheel	Torque @ Wheel	Angular Accel
[s]	[RPM]	[rad/s]	[N*m]	[Amps]	[RPM]	[rad/s]	[N*m]	Rad/s^2
0	0	0	0.71	134	0	0	1.42	22585.26242
0.1	718.9112311	4517.052484	0.6827044399	128.8484436	359.4556156	2258.526242	1.36540888	21716.98441
0.2	1410.184315	8860.449367	0.6564582426	123.8949359	705.0921574	4430.224683	1.312916485	20882.08687
0.3	2074.881784	13036.86674	0.6312210659	119.1318632	1037.440892	6518.43337	1.262442132	20079.28651
0.4	2714.025325	17052.72404	0.6069541187	114.5519041	1357.012662	8526.362021	1.213908237	19307.34936
0.5	3328.597342	20914.19392	0.5836201009	110.148019	1664.298671	10457.09696	1.167240202	18565.08892
0.6	3919.542477	24627.2117	0.5611831466	105.9134389	1959.771238	12313.60585	1.122366293	17851.36427
0.7	4487.76905	28197.48455	0.5396087687	101.8416549	2243.884525	14098.74228	1.079217537	17165.07838
0.8	5034.150464	31630.50023	0.5188638059	97.92640844	2517.075232	15815.25011	1.037727612	16505.17636
0.9	5559.526545	34931.5355	0.4989163718	94.16168144	2779.763272	17465.76775	0.9978327436	15870.64392
1	6064.704831	38105.66429	0.4797358059	90.54168731	3032.352415	19052.83214	0.9594716118	15260.50573
1.1	6550.461815	41157.76543	0.4612926263	87.06086186	3275.230908	20578.88272	0.9225852525	14673.82397
1.2	7017.544139	44092.53023	0.4435584846	83.71385483	3508.772069	22046.26511	0.887169691	14109.69686
1.3	7466.669739	46914.4696	0.4265061222	80.49552165	3733.33487	23457.2348	0.8530122444	13567.25732
1.4	7898.528952	49627.92106	0.4101093285	77.40091553	3949.264476	24813.96053	0.8202186571	13045.67156
1.5	8313.785575	52237.05537	0.3943429006	74.42527983	4156.892788	26118.52769	0.7886858012	12544.13788
1.6	8713.077885	54745.88295	0.3791826043	71.56404082	4356.538943	27372.94148	0.7583652087	12061.88539
1.7	9097.019622	57158.26003	0.3646051373	68.81280057	4548.509811	28579.13001	0.7292102747	11598.17283
1.8	9466.200929	59477.89459	0.3505880931	66.16733024	4733.100465	29738.9473	0.7011761861	11152.28744
1.9	9821.189264	61708.35208	0.3371099263	63.62356356	4910.594632	30854.17604	0.6742198527	10723.54388
2	10162.53027	63853.06086	0.3241499203	61.1775906	5081.265133	31926.53043	0.6482998407	10311.28312
2.1	10490.7486	65915.31748	0.3116881547	58.82565172	5245.374301	32957.65874	0.6233763093	9914.871503
2.2	10806.34876	67898.29178	0.2997054747	56.56413185	5403.174382	33949.14589	0.5994109494	9533.699713
2.3	11109.81585	69805.03172	0.2881834623	54.38955486	5554.907926	34902.51586	0.5763669246	9167.181862
2.4	11401.61631	71638.4681	0.2771044074	52.29857829	5700.808157	35819.23405	0.5542088147	8814.75459
2.5	11682.19867	73401.41901	0.2664512806	50.28798817	5841.099333	36700.70951	0.5329025612	8475.87619
2.6	11951.99418	75096.59425	0.2562077074	48.35469408	5975.997092	37548.29713	0.5124154149	8150.025784
2.7	12211.41756	76726.59941	0.2463579428	46.49572442	6105.708781	38363.2997	0.4927158856	7836.702519
2.8	12460.86755	78293.93991	0.236886847	44.70822182	6230.433776	39146.96996	0.473773694	7535.424794
2.9	12700.72757	79801.02487	0.2277798622	42.98943879	6350.363786	39900.51244	0.4555597245	7245.729525
3	12931.36631	81250.17078	0.2190229905	41.33673342	6465.683153	40625.08539	0.438045981	6967.171433
3.1	13153.13826	82643.60506	0.2106027719	39.7475654	6576.56913	41321.80253	0.4212055438	6699.322353
3.2	13366.38431	83983.46953	0.202506264	38.21949208	6683.192157	41991.73477	0.405012528	6441.770584
3.3	13571.43224	85271.82365	0.1947210219	36.75016469	6785.71612	42635.91183	0.3894420438	6194.120251
3.4	13768.59721	86510.6477	0.1872350791	35.33732479	6884.298606	43255.32385	0.3744701583	5955.9907
3.5	13958.18228	87701.84584	0.1800369293	33.97880075	6979.091142	43850.92292	0.3600738587	5727.015908
3.6	14140.47886	88847.24902	0.1731155084	32.67250441	7070.239431	44423.62451	0.3462310169	5506.843926
3.7	14315.76715	89948.61781	0.1664601778	31.41642792	7157.883574	44974.3089	0.3329203556	5295.136336
3.8	14484.31657	91007.64507	0.1600607077	30.2086406	7242.158286	45503.82254	0.3201214153	5091.567727
3.9	14646.38621	92025.95862	0.1539072617	29.047286	7323.193104	46012.97931	0.3078145233	4895.825202
4	14802.22516	93005.12366	0.1479903815	27.93057904	7401.112582	46502.56183	0.295980763	4707.60789
4.1	14952.07298	93946.64524	0.1423009725	26.85680327	7476.036488	46973.32262	0.2846019451	4526.62649
4.2	15096.15997	94851.97054	0.1368302898	25.82430822	7548.079986	47425.98527	0.2736605796	4352.60282
4.3	15234.70762	95722.4911	0.1315699244	24.83150687	7617.353812	47861.24555	0.2631398489	4185.269395
4.4	15367.92889	96559.54498	0.126511791	23.87687322	7683.964443	48279.77249	0.2530235819	4024.369011
4.5	15496.02853	97364.41878	0.1216481146	22.95893994	7748.014265	48682.20939	0.2432962292	3869.654355
4.6	15619.20345	98138.34965	0.1169714197	22.0762961	7809.601727	49069.17483	0.2339428393	3720.887618
4.7	15737.64299	98882.52718	0.1124745177	21.22758502	7868.821493	49441.26359	0.2249490353	3577.840137
4.8	15851.52917	99598.0952	0.1081504966	20.41150217	7925.764587	49799.0476	0.2163009932	3440.292038
4.9	15961.03707	100286.1536	0.1039927101	19.62679318	7980.518535	50143.07681	0.2079854203	3308.031899
5	16066.335	100947.76	0.09999476751	18.8722519	8033.167498	50473.88	0.199989535	3180.85643
5.1	16167.5848	101583.9313	0.09615052358	18.14671853	8083.792401	50791.96564	0.1923010472	3058.570151
5.2	16264.94211	102195.6453	0.0924540695	17.44907791	8132.471057	51097.82265	0.184908139	2940.985101
5.3	16358.55658	102783.8423	0.08889972357	16.77825769	8179.278288	51391.92116	0.1777994471	2827.920544
5.4	16448.57208	103349.4264	0.08548202251	16.13322678	8224.286042	51674.71322	0.170964045	2719.202691
5.5	16535.12699	103893.267	0.0821957131	15.51299374	8267.563496	51946.63349	0.1643914262	2614.664437
5.6	16618.35435	104416.1999	0.07903574405	14.91660521	8309.177173	52208.09993	0.1580714881	2514.145099
5.7	16698.38207	104919.0289	0.07599725827	14.34314452	8349.191035	52459.51444	0.1519945165	2417.490171
5.8	16775.33317	105402.5269	0.07307558541	13.7917302	8387.666587	52701.26346	0.1461511708	2324.551089
5.9	16849.32593	105867.4371	0.07026623466	13.26151471	8424.662966	52933.71857	0.1405324693	2235.184999
6	16920.47408	106314.4741	0.06756488785	12.75168306	8460.23704	53157.23707	0.1351297757	2149.254539
6.1	16988.88698	106744.325	0.06496739284	12.26145161	8494.443489	53372.16252	0.1299347857	2066.627628
6.2	17054.66978	107157.6506	0.0624697571	11.79006683	8527.334889	53578.82528	0.1249395142	1987.177264
6.3	17117.92359	107555.086	0.06006814159	11.33680419	8558.961797	53777.54301	0.1201362832	1910.781325
6.4	17178.74565	107937.2423	0.05775885487	10.90096698	8589.372827	53968.62114	0.1155177097	1837.322387
6.5	17237.22944	108304.7068	0.05553834741	10.48188529	8618.614721	54152.35338	0.1110766948	1766.687536
6.6	17293.46485	108658.0443	0.05340320615	10.07891496	8646.732426	54329.02213	0.1068064123	1698.768204
6.7	17347.53832	108997.7979	0.05135014921	9.691436612	8673.769162	54498.89896	0.1027002984	1633.459993
6.8	17399.53297	109324.4899	0.04937602092	9.318854653	8699.766485	54662.24495	0.09875204185	1570.662521
6.9	17449.52871	109638.6224	0.04747778691	8.960596403	8724.764355	54819.31121	0.09495557383	1510.279263
7	17497.60239	109940.6783	0.04565252947	8.616111195	8748.801196	54970.33913	0.09130505894	1452.217406
7.1	17543.82791	110231.1217	0.04389744304	8.284869532	8771.913954	55115.56087	0.08779488608	1396.387705
7.2	17588.27631	110510.3993	0.04220982995	7.966362272	8794.138155	55255.19964	0.0844196599	1342.704347
7.3	17631.01592	110778.9402	0.04058709622	7.660099849	8815.507958	55389.47008	0.08117419243	1291.084816
7.4	17672.11242	111037.1571	0.03902674759	7.365611517	8836.056211	55518.57856	0.07805349518	1241.449769
7.5	17711.629	111285.4471	0.03752638571	7.082444627	8855.814498	55642.72354	0.07505277142	1193.722914
7.6	17749.62638	111524.1917	0.03608370442	6.810163933	8874.813188	55762.09583	0.07216740884	1147.830892
7.7	17786.16297	111753.7578	0.03469648622	6.54835092	8893.081484	55876.87892	0.06939297243	1103.703164
7.8	17821.29493	111974.4985	0.03336259886	6.296603165	8910.647466	55987.24923	0.06672519772	1061.271902
7.9	17855.07627	112186.7528	0.03207999207	6.054533714	8927.538133	56093.37642	0.06415998413	1020.471886
8	17887.55889	112390.8472	0.03084669439	5.82177049	8943.779447	56195.42361	0.06169338877	981.2404051
8.1	17918.79275	112587.0953	0.02966081016	5.59795572	8959.396373	56293.54765	0.05932162032	943.5171565
8.2	17948.82583	112775.7987	0.0285205166	5.382745387	8974.412915	56387.89937	0.0570410332	907.2441576
8.3	17977.70431	112957.2476	0.027424061	5.175808696	8988.852154	56478.62378	0.05484812201	872.3656541
8.4	18005.47257	113131.7207	0.02636975804	4.976827573	9002.736285	56565.86035	0.05273951607	838.8280356
8.5	18032.1733	113299.4863	0.02535598717	4.78549617	9016.086648	56649.74315	0.05071197434	806.5797524
8.6	18057.84753	113460.8023	0.02438119017	4.601520398	9028.923763	56730.40113	0.04876238033	775.5712368
8.7	18082.53473	113615.9165	0.0234438687	4.424617473	9041.267363	56807.95825	0.0468877374	745.7548265
8.8	18106.27284	113765.0675	0.02254258204	4.254515484	9053.13642	56882.53374	0.04508516408	717.0846917
8.9	18129.09835	113908.4844	0.02167594485	4.090952972	9064.549177	56954.2422	0.04335188971	689.5167645
9	18151.04635	114046.3878	0.02084262506	3.933678532	9075.523177	57023.19388	0.04168525011	663.0086711
9.1	18172.15058	114178.9895	0.02004134178	3.782450421	9086.075288	57089.49475	0.04008268356	637.5196668
9.2	18192.44346	114306.4934	0.0192708634	3.637036192	9096.221728	57153.24671	0.03854172681	613.0105733
9.3	18211.95619	114429.0955	0.01853000564	3.497212332	9105.978095	57214.54777	0.03706001128	589.4437185





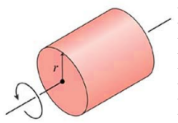


Conversions	
1 lbf to N	4.448
1 lbm to Kg	0.4536
1 ft to m	0.3048



Thin ring or hollow cylinder about its axis

$I = MR^2$



Disk or solid cylinder about its axis

$I = \frac{1}{2}MR^2$

Torque = I * Angular Acceleration

9.4	18230.71877	114546.9843	0.01781762975	3.362763925	9115.359383	57273.49214	0.0356352595	566.7828784										
9.5	18248.76003	114660.3409	0.01713264076	3.233484312	9124.380013	57330.17043	0.03426528152	544.9932219										
9.6	18266.1077	114769.3395	0.01647398579	3.109174784	9133.053849	57384.66975	0.03294797159	524.0412567										
9.7	18282.78845	114874.1478	0.01584065246	2.989644266	9141.394225	57437.07388	0.03168130491	503.8947784										
9.8	18298.82792	114974.9267	0.01523166727	2.874709034	9149.413959	57487.46336	0.03046333454	484.5228203										
9.9	18314.25076	115071.8313	0.01464609419	2.764192424	9157.125379	57535.91564	0.02929218837	465.8956066										
10	18329.08068	115165.0104	0.01408303314	2.657924564	9164.540338	57582.5052	0.02816606628	447.9845058										

doesn't take into account motor efficiency etc.

momentum/time = force momentum/force = time [slug*ft/sec] * [sec^2/slug*ft] = [sec]

Velocity: 16 [ft/sec]
Static CoF: 1.5
Kinetic CoF: 1.2

assume no wheel slip assume wheel slip

weight [lbf]	mass [slug]	Static friction force [lbf]	Kinetic friction force [lbf]	mass momentum [slug*ft/sec]	Static Time to Stop [sec]	Static time to switch direction [sec]	Kinetic time to stop [sec]	Kinetic time to switch direction [sec]
50.00	1.55	80.00	73.00	24.84	0.31	0.62	0.35	0.71
60.00	1.71	96.00	77.00	27.33	0.31	0.62	0.35	0.71
70.00	2.17	112.00	98.00	34.78	0.31	0.62	0.35	0.71
80.00	2.02	128.00	91.00	32.30	0.31	0.62	0.35	0.71
70.00	2.17	112.00	98.00	34.78	0.31	0.62	0.35	0.71
70.00	2.33	128.00	105.00	37.27	0.31	0.62	0.35	0.71
80.00	2.48	128.00	112.00	39.75	0.31	0.62	0.35	0.71
80.00	2.64	136.00	119.00	42.24	0.31	0.62	0.35	0.71
90.00	2.80	144.00	126.00	44.72	0.31	0.62	0.35	0.71
90.00	2.95	160.00	133.00	47.20	0.31	0.62	0.35	0.71
100.00	3.11	160.00	140.00	49.69	0.31	0.62	0.35	0.71
110.00	3.26	176.00	147.00	52.17	0.31	0.62	0.35	0.71
110.00	3.42	176.00	154.00	54.66	0.31	0.62	0.35	0.71
115.00	3.57	184.00	161.00	57.14	0.31	0.62	0.35	0.71
120.00	3.73	192.00	168.00	59.63	0.31	0.62	0.35	0.71
125.00	3.88	200.00	175.00	62.11	0.31	0.62	0.35	0.71
130.00	4.04	208.00	182.00	64.60	0.31	0.62	0.35	0.71
135.00	4.19	216.00	189.00	67.08	0.31	0.62	0.35	0.71
140.00	4.35	224.00	196.00	69.57	0.31	0.62	0.35	0.71
145.00	4.50	232.00	203.00	72.05	0.31	0.62	0.35	0.71
150.00	4.66	240.00	210.00	74.53	0.31	0.62	0.35	0.71

Weight: 100 [lbf]
Static CoF: 1.5
Kinetic CoF: 1.2

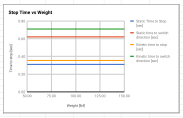
assume no wheel slip assume wheel slip

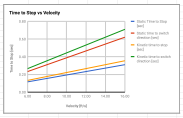
Velocity [ft/s]	mass momentum [slug*ft/sec]	Static Time to Stop [sec]	Static time to switch direction [sec]	Kinetic time to stop [sec]	Kinetic time to switch direction [sec]
8.00	19.63	0.12	0.23	0.13	0.27
8.00	20.19	0.13	0.25	0.14	0.29
8.00	21.74	0.14	0.27	0.15	0.31
7.90	23.29	0.16	0.29	0.17	0.33
8.00	24.84	0.16	0.31	0.18	0.35
8.00	26.40	0.16	0.33	0.19	0.38
8.00	27.95	0.17	0.35	0.20	0.40
9.00	29.50	0.18	0.37	0.21	0.42
10.00	31.06	0.19	0.39	0.22	0.44
10.90	32.61	0.20	0.41	0.23	0.47
11.00	34.16	0.21	0.43	0.24	0.49
12.00	35.71	0.22	0.45	0.26	0.51
12.00	37.27	0.23	0.47	0.27	0.53
12.90	38.82	0.24	0.49	0.28	0.55
13.00	40.37	0.25	0.50	0.29	0.58
13.90	41.93	0.26	0.52	0.30	0.60
14.00	43.48	0.27	0.54	0.31	0.62
14.90	45.03	0.28	0.56	0.32	0.64
15.00	46.58	0.28	0.58	0.33	0.67
15.90	48.14	0.30	0.60	0.34	0.69
16.00	49.69	0.31	0.62	0.35	0.71

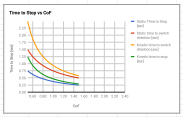
Weight: 100 [lbf]
Velocity: 20 [ft/s]

assume no wheel slip assume wheel slip

Static CoF	Kinetic CoF	mass momentum [slug*ft/sec]	Static Time to Stop [sec]	Static time to switch direction [sec]	Kinetic time to stop [sec]	Kinetic time to switch direction [sec]
1.50	1.30	44.72	0.26	0.52	0.29	0.57
1.45	1.25	44.72	0.26	0.51	0.30	0.60
1.40	1.20	44.72	0.27	0.53	0.30	0.60
1.35	1.15	44.72	0.28	0.55	0.32	0.62
1.30	1.10	44.72	0.29	0.57	0.34	0.66
1.25	1.05	44.72	0.30	0.60	0.36	0.71
1.20	1.00	44.72	0.31	0.62	0.37	0.75
1.15	0.95	44.72	0.32	0.65	0.39	0.78
1.10	0.90	44.72	0.34	0.68	0.41	0.83
1.05	0.85	44.72	0.35	0.71	0.44	0.88
1.00	0.80	44.72	0.37	0.75	0.47	0.93
0.95	0.75	44.72	0.39	0.79	0.49	0.98
0.90	0.70	44.72	0.41	0.83	0.52	1.04
0.85	0.65	44.72	0.44	0.88	0.57	1.13
0.80	0.60	44.72	0.47	0.93	0.62	1.24
0.75	0.55	44.72	0.50	0.99	0.68	1.36
0.70	0.50	44.72	0.53	1.06	0.75	1.49
0.65	0.45	44.72	0.57	1.15	0.83	1.66
0.60	0.40	44.72	0.62	1.24	0.93	1.86
0.55	0.35	44.72	0.68	1.36	1.06	2.13
0.50	0.30	44.72	0.75	1.49	1.24	2.48







Weight-2: 150 [lbf]
Weight-3: 75 [lbf]
Velocity: 20 [ft/s]

assume no wheel slip assume wheel slip

Static CoF	Kinetic CoF	mass momentum-1 [slug*ft/sec]	mass momentum-2 [slug*ft/sec]	mass momentum-3 [slug*ft/sec]	Static Time to Stop-1 [sec]	Static Time to Stop-2 [sec]	Static Time to Stop-3 [sec]	Kinetic time to stop-1 [sec]	Kinetic time to stop-2 [sec]	Kinetic time to stop-3 [sec]
1.50	1.30	#REF!	37.27	27.95	#REF!	0.25	0.25	#REF!	0.25	0.25
1.45	1.25	44.72	37.27	27.95	#REF!	0.26	0.26	#REF!	0.26	0.26
1.40	1.20	44.72	37.27	27.95	#REF!	0.26	0.26	#REF!	0.26	0.26
1.35	1.15	44.72	37.27	27.95	#REF!	0.26	0.26	#REF!	0.26	0.26
1.30	1.10	44.72	37.27	27.95	#REF!	0.26	0.26	#REF!	0.26	0.26
1.25	1.05	44.72	37.27	27.95	#REF!	0.32	0.32	#REF!	0.32	0.32
1.20	1.00	44.72	37.27	27.95	#REF!	0.31	0.31	#REF!	0.31	0.31
1.15	0.95	44.72	37.27	27.95	#REF!	0.32	0.32	#REF!	0.32	0.32
1.10	0.90	44.72	37.27	27.95	#REF!	0.34	0.34	#REF!	0.34	0.34
1.05	0.85	44.72	37.27	27.95	#REF!	0.35	0.35	#REF!	0.35	0.35
1.00	0.80	44.72	37.27	27.95	#REF!	0.37	0.37	#REF!	0.37	0.37
0.95	0.75	44.72	37.27	27.95	#REF!	0.39	0.39	#REF!	0.39	0.39
0.90	0.70	44.72	37.27	27.95	#REF!	0.41	0.41	#REF!	0.41	0.41
0.85	0.65	44.72	37.27	27.95	#REF!	0.44	0.44	#REF!	0.44	0.44
0.80	0.60	44.72	37.27	27.95	#REF!	0.47	0.47	#REF!	0.47	0.47
0.75	0.55	44.72	37.27	27.95	#REF!	0.50	0.50	#REF!	0.50	0.50
0.70	0.50	44.72	37.27	27.95	#REF!	0.53	0.53	#REF!	0.53	0.53
0.65	0.45	44.72	37.27	27.95	#REF!	0.57	0.57	#REF!	0.57	0.57
0.60	0.40	44.72	37.27	27.95	#REF!	0.62	0.62	#REF!	0.62	0.62
0.55	0.35	44.72	37.27	27.95	#REF!	0.68	0.68	#REF!	0.68	0.68
0.50	0.30	44.72	37.27	27.95	#REF!	0.75	0.75	#REF!	0.75	0.75

Name	Bore (in)	Length (in)	QTY Per Robot	Single/Double Acting	Actuations Per Match	Pressure (psi)	Force (lb)	Volume per cylinder (in3)	Total Volume Per Match (in3)	
Catapult piston	0.75	9	4	1	3	60	26.51	3.98	47.8	152in-lbs
HANG	1.0625	30	2	2	1	60	53.2	26.6	106.4	
center the ball	0	0	0	0	0	0	0	0	0.0	
shock release	0	0	0	0	0	60	0	0.00	0.0	
							0	0.00	0.0	

Max Tank Pressure (psi)	120				
Min Tank Pressure (psi)	65				
Required Volume (in3)	168.17		Typical airtanks	Volume (in^3)	
			1	35	black clippard
Air Tank Volume (in3)	35		2	61	Bronco
Required Air Tanks	4.80		3		3.14159
			4		85.14 27.1009266
			5		
			6		

Component	weight (lbs)	qty req	link
574mL clippard tank	0.64	2	ippard.com/part/AVT-PP-35
Pressure gauge	0.1	2	.com/static/specs/nitrainlinepressurereg.pdf
Pressure regulator	0.1	2	.com/static/specs/nitrainlinepressurereg.pdf
Vair compressor	2.39	1	nark.com/Pneumatics-s/398.htm
relief valve	0.011	1	
PCM	0.1375	1	
3 station	0.309	0	
4 station	0.372	1	
5 station	0.435		
6 station	0.506		
Poofs compressor	3	0	as.com/woblpis[illegible]om/templates/pages/product.aspx?id=2724
Double solenoid valve	0.121	4	
Pressure transducer	?	1	2059210.m2749.l2649&ssPageName=STRK%3AMEBIDX%3AIT
release valve	http://www.mcmaster.com/#4379k61/=10roqyb		
	total weight->	5.0745	

high flow solenoids	aster.com/#6124k512/=10j1mes
What 118 used ->	ults.aspx?xmlnum=27823&partnumber=SY5120-5L-N7T
plastic manifold	station-input-nylon-manifold-p-2780-l-en.html
multi tube fitting	aster.com/#5203k943/=10iz0oa

	Common weights					Force	10.0	lb		
						Distance from support	20.00	in		
Link	Item	Weight (lbs/ft)	Yield Stress (psi)	E (modulus of Elas)PSI	I (in^4)	Max deflection (in)	y	Max Stress (psi)	c/I (shows comparitive stress in beams without taking into acount load)	
	.75sqr x .065 alum	0.21	40000	10000000.00	0.0141	-0.19	0.375	5336.72	26.68	
	1x1x.125 Alum	0.5132	40000	10000000.00	0.0570	-0.05	0.5	1755.43	8.78	
	1x1 x .1 Versaframe	0.39	40000	10000000.00	0.0492	-0.05	0.5	2032.52	10.16	
	1x1 x .065 Alum	0.29	40000	10000000.00	0.0356	-0.07	0.5	2809.63	14.05	
	1x1x.04 Versaframe	0.18	40000	10000000.00	0.0236	-0.11	0.5	4231.21	21.16	
	2x1x.065	0.44	40000	10000000.00	0.2272	-0.01	1.00	880.23	4.40	
	2x1x.1 Versaframe	0.656	40000	10000000.00	0.2779	-0.01	1.00	719.77	3.60	
http://www.online	2x2x.065 Alum	0.5637	40000	10000000.00	0.3143	-0.01	1.00	636.32	3.18	
http://www.speed	1" od .065 alum	0.2245	40000	10000000.00	0.0208	-0.13	0.50	4807.69	24.04	
	1" od .049 2024 alum	0.1774	50000	10600000.00	0.0166	-0.15	0.50	6026.31	30.13	
	1" od .028 chromoly	0.29	63100	29700000.00	0.0101	-0.09	0.50	9895.17	49.48	
	1" od .035 chromoly	0.359	63100	29700000.00	0.0124	-0.07	0.50	8085.74	40.43	
	1" od .049 chromoly	0.504	63100	29700000.00	0.0166	-0.05	0.50	6026.31	30.13	
	1" od .058 chromoly	0.5912	63100	29700000.00	0.0191	-0.05	0.50	5232.59	26.16	
	1" od .065 chromoly	0.6576	63100	29700000.00	0.0210	-0.04	0.50	4769.78	23.85	
	1.25" od .065 Alum	0.2846	40000	10000000.00	0.0426	-0.06	0.63	2934.12	14.67	
	1.5" od .065 Alum	0.35	40000	10000000.00	0.0756	-0.04	0.75	1984.60	9.92	
	2" od .065 Alum	0.4647	40000	10000000.00	0.1851	-0.01	1.00	1080.25	5.40	
	1" OD .035 wall carbon	0.072	117480	27557170.00	0.0124	-0.08	0.50	8085.74	40.43	
	1" OD .065 wall carbon	0.171	117480	27557170.00	0.0210	-0.05	0.50	4769.78	23.85	
http://www.rockw	1.25" od .065 Carbon	0.16	117480	27557170.00	0.0426	-0.02	0.63	2934.12	14.67	
	5160 steel		174045	29700000.00	0.1221	-0.01	0.25	409.60	2.05	
	titanium stuff		200000	14400000.00	0.1714	-0.01	0.35	408.33		

area moment of inertia	
Hollow Circle	(pi) * (Do^4-Di^4)/64
Hollow Rectangle	((bo*ho^3) - (bi*h Bending parallel to b side
Hollow Square	(xo^4-xi^4)/12
s = (M*y)/I	
s	yield stress
I	Moment of inertia
y	distanc from center to outside edge
M	Bending Moment