## Cyclone 500-watt motor with internal controller

CW rotation		
Full Throttle Power (Drain Brain)	Power (PowerTap)	Efficiency
90	0	0.09
160	72	45.09
200	115	57.59
250	150	60.09
320	220	68.89
380	266	70.09
420	310	73.89
480	350	72.99
530	375	70.89
600	430	71.79
650	460	70.89
700 780	500 535	71.49 68.69
820	544	66.39
860	560	65.19
890	535	60.19
CW rotation		
Half Throttle		
Power (Drain Brain)	Power (PowerTap)	Efficiency
46	_0	0.09
100	52	52.09
160 230	100 150	62.59 65.29
280	185	66.19
320	207	64.79
360		63.69
	229	
	229 244	56.79
430 460	229 244 251	
430	244	54.69
430 460 510 CCW rotation Full Throttle Power (Drain Brain)	244 251 268 Power (PowerTap)	56.79 54.69 52.59 Efficiency
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95	244 251 268 Power (PowerTap) 0	54.69 52.59 Efficiency 0.09
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175	244 251 268 Power (PowerTap) 0 70	54.69 52.59 Efficiency 0.09 40.09
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260	244 251 268 Power (PowerTap) 0 70 169	54.69 52.59 Efficiency 0.09 40.09 65.09
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330	244 251 268 Power (PowerTap) 0 70 169 234	54.69 52.59 Efficiency 0.09 40.09 65.09 70.99
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380	244 251 268 Power (PowerTap) 0 70 169 234 289	54.69 52.59 Efficiency 0.09 40.09 65.09 70.99 76.19
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440	244 251 268 Power (PowerTap) 0 70 169 234 289 320	54.69 52.59 Efficiency 0.09 40.09 65.09 76.19 72.79
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 440 450	244 251 268 Power (PowerTap) 0 70 169 234 289 320 345	54.69 52.59 Efficiency 0.09 40.09 65.09 76.19 72.79 76.79
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440 450 500	244 251 268 Power (PowerTap) 0 70 169 234 289 320 345 379	54.69 52.59 Efficiency 0.09 40.09 65.09 76.19 72.79 76.79 75.89
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 440 450 500	Power (PowerTap)  Power (PowerTap)  0  70  169  234  289  320  345  379  426	54.69 52.59 Efficiency 0.09 40.09 65.09 76.19 72.79 76.79 75.89 76.19
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440 450 500	244 251 268 Power (PowerTap) 0 70 169 234 289 320 345 379	54.69 52.59 Efficiency 0.09 40.09 76.19 76.79 76.79 76.79 76.79 76.79
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440 450 500 560 630	244 251 268 Power (PowerTap) 70 169 234 289 320 345 379 426 450	54.69 52.59 Efficiency 0.09 40.09 65.09 70.99 76.19 72.79 75.89 76.19 71.49
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 175 260 330 380 440 450 500 500 630 700 775 830	244 251 268 Power (PowerTap) 0 70 169 234 239 345 345 500 508	54.6% 52.5% Efficiency 0.0% 65.0% 70.9% 76.1% 72.7% 76.1% 71.4% 71.4% 72.0%
430 460 510 CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440 450 560 560 630 700 775	Power (PowerTap) 0 0 0 169 234 289 320 345 379 426 450 508	54.6% 52.5% Efficiency 0.0% 65.0% 70.9% 76.1% 72.7% 76.1% 71.4% 71.4% 72.0%
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 175 260 330 380 440 450 500 500 630 630 700 775 800 700 775 800 CCW rotation Half Throttle	244 251 268 Power (PowerTap) 0 70 70 289 323 345 349 450 500 558 585 572	54.69 52.59 Efficiency 0.09 40.09 76.19 72.79 75.89 76.19 71.49 72.09 70.59 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 15 15 260 330 380 440 450 560 560 630 700 775 830 900  CCW rotation Half Throttle	Power (PowerTap)  0 0 169 234 289 320 345 379 426 450 500 558 585 572	54,69 52.59 Efficiency 0.09 65.09 76.19 72.79 76.79 75.89 76.19 71.49 72.09 70.59 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 95 260 330 380 440 450 500 700 775 800 900 CCW rotation Half Throttle Power (Drain Brain)	Power (PowerTap)  70  70  169  320  345  375  426  450  558  555  572	54.6° 52.5° Efficiency 0.0° 40.0° 70.9° 76.1° 72.7° 75.8° 76.1° 71.4° 72.0° 70.5° 63.6° Efficiency 0.0°
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 157 250 330 380 440 450 560 560 630 700 775 830 900  CCW rotation Half Throttle Power (Drain Brain) Power (Drain Brain) 100 100 100 100 100 100 100 100 100 10	Power (PowerTap) 0 109 294 289 325 379 426 450 500 508	54.69 52.59 Efficiency 0.09 40.09 65.09 76.19 76.79 75.89 76.19 71.49 72.09 63.69 Efficiency 0.09 50.09
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 95 260 330 380 440 450 500 500 775 800 900  CCW rotation Half Throttle Power (Drain Brain) 48 100	244 251 268  Power (PowerTap) 0 70 169 234 289 320 345 379 426 450 450 500 90 Power (PowerTap) 0 0 50 9	54.69 52.59  Efficiency 0.09 65.09 70.99 76.19 72.79 76.79 75.88 76.19 71.49 71.49 72.09 70.59 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 175 260 330 380 440 450 500 500 630 700 775 830 900  CCW rotation Half Throttle Power (Drain Brain) 48 100 145 230	Power (PowerTap)  70  70  70  70  70  70  70  70  70  7	54.6° 52.5°  Efficiency 0.0° 60.0° 70.9° 76.1° 77.4° 71.4° 71.4° 71.0° 0.0° 50.0° 64.8° 66.5°
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 95 175 260 330 380 440 450 560 560 630 700 775 875 875 875 875 875 875 875 875 875	Power (PowerTap)  70  70  169  289  340  345  379  426  450  500  500  60  70  60  70  70  70  70  70  70	54.69 52.59  Efficiency 0.00 40.09 65.09 76.19 72.79 75.89 76.17 71.49 72.09 70.59 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 15 25 26 330 380 440 450 500 500 630 700 775 830 900  CCW rotation Half Throttle Power (Drain Brain) 48 100 145 230 275 330	Power (PowerTap)  0  70  109  324  289  325  345  379  426  450  500  558  585  572  Power (PowerTap)  0  94  153  190  224	54.69 52.59  Efficiency 0.09 40.09 65.09 70.99 76.19 77.79 76.79 70.59 63.69  Efficiency 0.09 64.89 66.59 69.19
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 175 260 330 380 440 450 560 560 630 7005 757 757 759 900  CCW rotation Half Throttle Power (Drain Brain) 48 100 450 230 380 380	Power (PowerTap)  70  70  169  289  320  345  379  426  450  508  585  587  Power (PowerTap)  0  0  0  10  10  10  10  10  10  10	54.69 52.59  Efficiency 0.00 65.00 76.19 72.79 75.89 76.19 71.49 72.00 70.59 63.69  Efficiency 0.00 64.88 66.59 69.11 66.79
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 15 25 26 330 380 440 450 500 500 630 700 775 830 900  CCW rotation Half Throttle Power (Drain Brain) 48 100 145 230 275 330	Power (PowerTap) 0 70 169 324 289 325 379 426 450 500 558 585 572  Power (PowerTap) 0 94 153 190 220 260	54.69 52.59 Efficiency 0.09 40.09 76.19 72.79 75.89 76.19 71.49 72.09 70.59 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 157 250 330 380 440 450 560 560 700 775 830 900  CCW rotation Half Throttle Power (Drain Brain) 48 100 145 230 275 330 380 450	Power (PowerTap)  70  70  169  289  320  345  379  426  450  508  585  587  Power (PowerTap)  0  0  0  10  10  10  10  10  10  10	Efficiency 0.09 40.09 65.09 76.19 76.79 76.79 76.79 76.79 76.79 76.39 76.19 71.49 71.49 71.49 72.05 63.69
430 450 510  CCW rotation Full Throttle Power (Drain Brain) 175 260 330 380 440 450 560 560 7005 775 755 900  CCW rotation Half Throttle Power (Drain Brain) 145 230 380 450 380 450 530 530 530	Power (PowerTap)  70 70 169 234 289 325 345 379 426 450 558 585 585 572  Power (PowerTap) 0 0 0 20 266 327	Efficiency 0.0' 40.0' 65.0' 70.9' 76.1' 71.4' 71.4' 72.0' 50.0' 63.6'  Efficiency 64.8' 66.5' 69.1' 66.7' 68.4' 63.6'



tes: Ine curves should generally be concave downward. Vanation from this is no doubt due to errors in my measurement equipment.

Efficiency was measured by comparing energy drawn from the battery according to a Cycle Analyst and comparing that to energy sent to the rear wheel of the bicycle as read from a PowerTap hub.

Motor power passes through the bottom bracket to a 51t chainring and then directly to a 34t sprocket on a left crank.

Torque then passes through the bottom bracket to a 51t chainring and then directly to a 34t sprocket on the rear wheel.

Efficiency of the two-stage chain and sprocket drive is probably around 88%, so actual motor/controller efficiency is about 13% greater.