maxon

maxon UAV propulsion system.
Safe and efficient.

Ready for take-off

The new maxon UAV propulsion system portfolio

- → Safe flight missions
- → Robust and reliable design
- → Unrivaled product lifetime
- → High performance and efficiency
- → System optimization for longer flight times
- → Thoroughly tested propulsion system
- → Customizable

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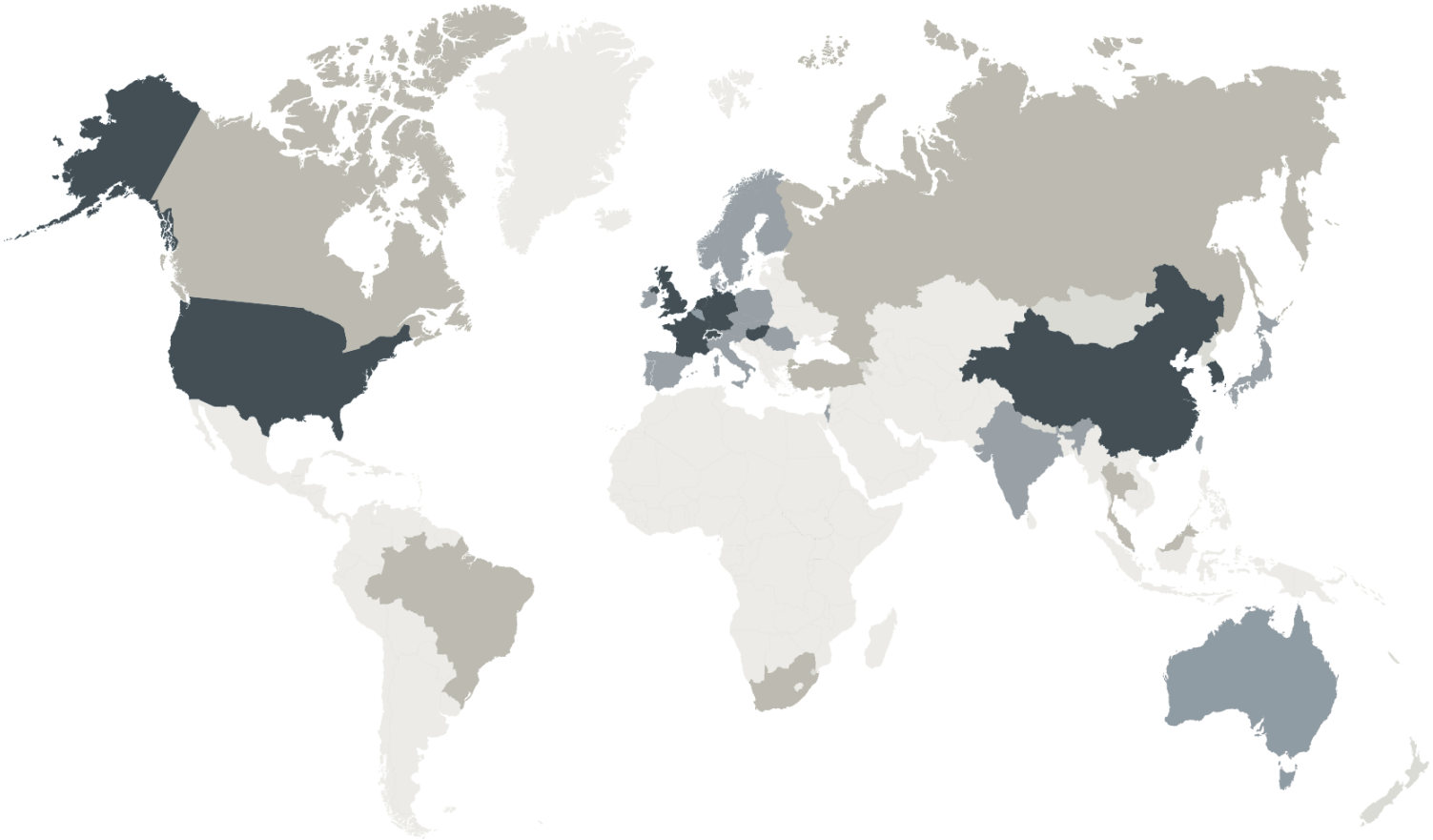


Propulsion System Overview

maxon actively supports UAV manufacturers with their ambitious designs, up to certification.
Our UAV product portfolio offers matched combinations of motors, ESCs and propellers, for optimized propulsion systems providing maximum efficiency and reliability. Hence, operational safety and flight time are maximized, and costs of ownership dramatically cut down.
maxon is continuously enhancing its portfolio to offer customers an extensive range of solutions.

Maximal performance and efficiency

Designed for the highest safety and reliability

Unmatched lifetime, maintenance free

Motor

maxon's portfolio of BLDC UAV flat motors consists of outer runner motors with segmented magnets and high-temperature windings. Optimized air flow cooling and lightweight aviation-grade aluminum parts provide not only excellent performance, but also maximum environmental protection.
At maxon, safety is uncompromised: the maintenance-free motors with shielded bearing systems were specifically designed for extreme durability and maximum reliability in professional UAVs.

ESC

The maxon electronic speed controller (ESC) uses a sensorless closed-loop control algorithm that is still unrivaled on the UAV market. Individual calibration and advanced parameter settings ensure optimal field-oriented control (FOC) for each motor, with minimum power losses.
The hardware is supported by the intuitive studio software, allowing the operator to commission and monitor relevant parameters and data to find the best setup. A complete set of documentation including validation data is provided.

Propeller

To complete the propulsion system, maxon partners with leading propeller manufacturers. For the best propulsion system, all elements need to be considered and optimally matched. Therefore, the maxon UAV products are tested and paired with high-quality propellers.
Simulations at system level are available for optimizations.

High performance and efficiency

Our UAV products are developed for minimum power consumption. All components – motor, ESC and propeller – are optimally matched to achieve optimum efficiency in the overall propulsion system.
Only then can the flight and operating times be maximized by getting the most out of the battery.

Quality you can rely on

UAV manufacturers benefit from maxon's mature quality system, proven and certified in the medical (ISO13485) and aerospace (EN9100) industries, among others.
We offer sustainability and stability, combined with efficient configuration management and traceability of parts.
All maxon products rely on standardized designs, manufacturing processes and testing, to assure top repeatability between parts.
Best-in-class product documentation is available for each product, with reliable and verified performance data based on real tests.

Designed for utmost safety and unrivaled lifetime

Drawing on its Aerospace heritage, maxon has developed its own internal quality procedures and tests, as well as dedicated test equipment for analyzing each component of the propulsion system.
Any new UAV component undergoes a series of qualification tests before release, assuring utmost safety.
The lifetime is verified on a test rig that simulates extreme UAV roll-and-pitch movements during operation. Well over 1 million test cycles have been achieved, reflecting lifetimes without precedent on the market, even on the most ambitious flight missions.

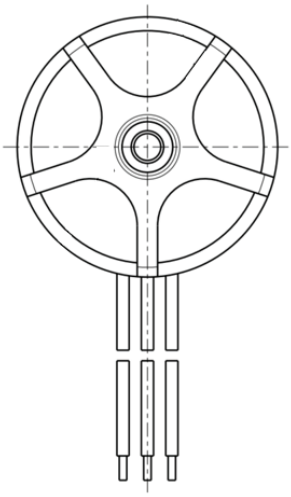
We fit your projects
For details, contact :
aerospace@maxongroup.com

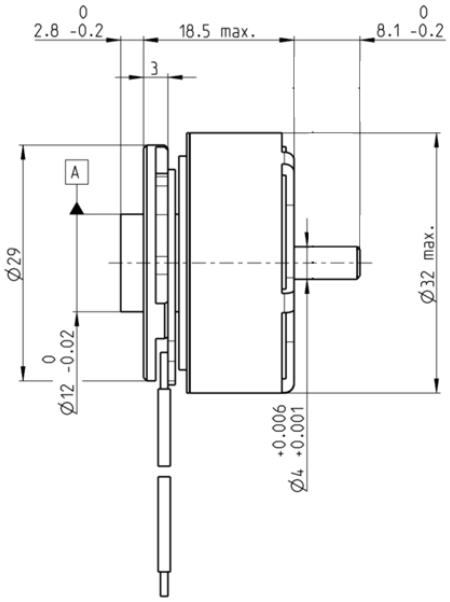
ECX 32 flat UAV

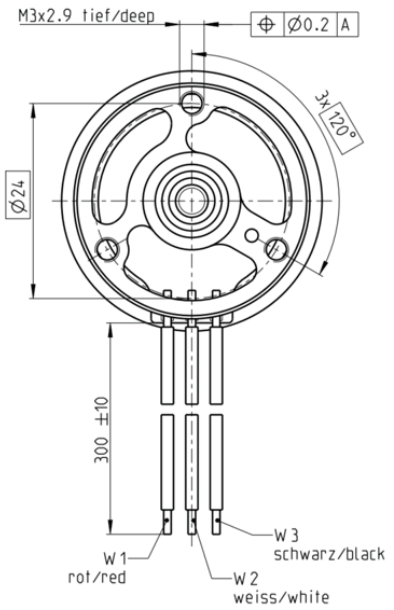
high power to weight ratio

∅32 mm, brushless, up to 1kg thrust

NEW







	Part Number	
	Sensorless	
Motor Data		
Values at nominal voltage		
1 Nominal voltage	V	10
2 No load speed	rpm	7880
3 No load current	mA	372
4 Nominal speed	rpm	6330
5 Nominal torque (max. continuous torque)	mNm	91
6 Nominal current (max. continuous current)	A	7.42
7 Stall torque[1]	mNm	670
8 Stall current	A	55.9
9 Max. efficiency	%	84.6
10 Max. continuous power output	W	105
11 Max. peak power output	W	for t<15s
Characteristics		
12 Terminal resistance phase to phase	Ω	0.179
13 Terminal inductance phase to phase	mH	0.0455
14 Torque constant	mNm/A	12
15 Speed constant	rpm/V	797
16 Speed/torque gradient	rpm/mNm	11.9
17 Mechanical time constant	ms	4.37
18 Rotor inertia	gcm²	35.1

Specifications

Thermal data

19	Thermal resistance housing-ambient[2]	3.77 K/W
20	Thermal resistance winding-housing[2]	3.46 K/W
21	Thermal time constant winding	9.31s
22	Thermal time constant motor	101s
23	Ambient temperature	-40…+100°C
24	Max. winding temperature	+125°C

Mechanical data (preloaded ball bearings)

25	Max. speed	12000 rpm

Other specifications

26	Number of pole pairs	6
27	Number of phases	3
28	Weight of motor (excl. cable)	47.9g
29	Recommended propeller sizes	8"…10"

Values listed in the tables are nominal.

Connection

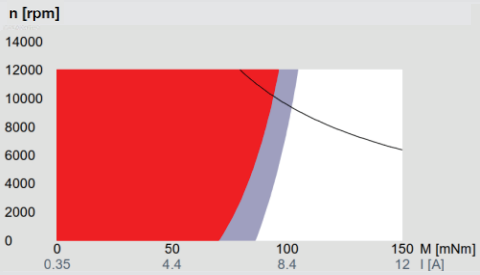
Pin 1 Motor winding 1
Pin 2 Motor winding 2
Pin 3 Motor winding 3

Cable

Connection cable PTFE, L = 300 mm
AWG 20,

[1]Calculation does not include saturation effect
[2]At nominal working point

Operating Range



Comments

Continuous operation
In observation of listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient. = Thermal limit.

Continuous operation
Thermal resistance Rth2 reduced by 50%.

Short term operation
The motor may be briefly overloaded (recurring).

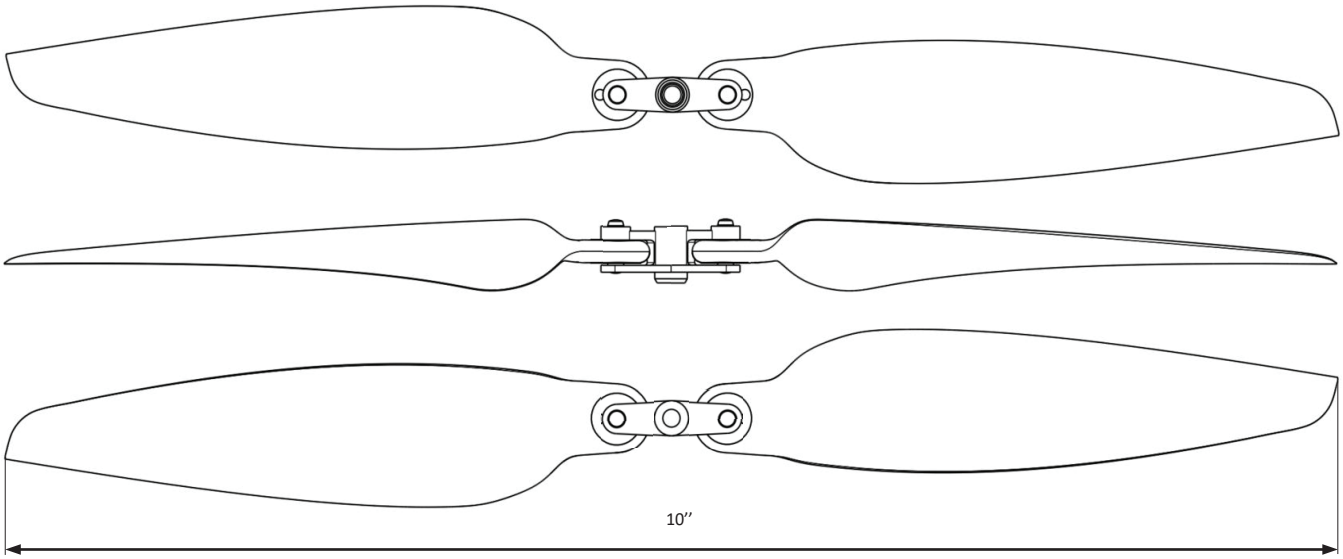
Notes

Please contact aerospace@maxongroup.com

maxon Propeller 10x4.5

propeller recommendation

maxon recommended foldable propeller

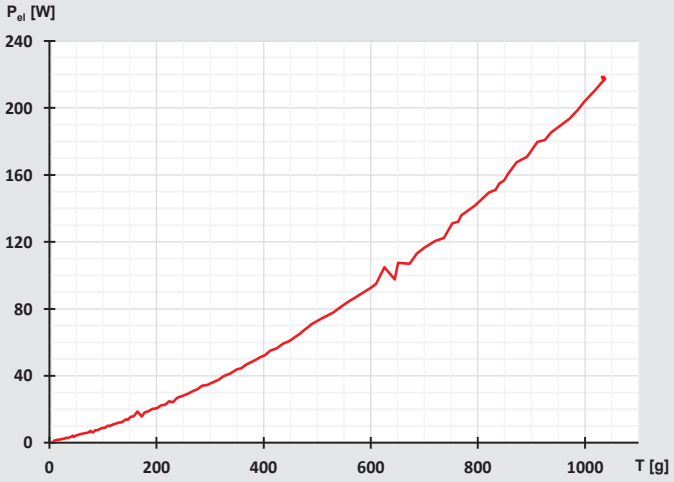


Propeller Specifications

1	Diameter	10'' (254.0 mm)
2	Pitch	4.5''(114.3 mm)
3	Weight of Propeller	14 g
4	Max. speed	10'500 rpm
5	Material	reinforced plastic compound blades and aluminum hub

Efficiency Propulsion System

Propulsion system efficiency is indicated by depiction of required amount of electrical power (required by motor) to achieve a certain amount of thrust.



Motor Propeller Combination

Propulsion System Performance Table

Based on measured data @ **16.8V** ESC supply voltage.

Speed [rpm]	Current [A]	Torque [mNm]	Thrust [g]	el. Power [W]	Efficiency [g/W]
continuous operation					
1200	0.1	6.9	9	2.1	4.2
1600	0.2	4.3	28	2.9	9.5
1800	0.2	5.6	27	3.0	8.9
2000	0.2	6.9	35	3.8	9.2
2400	0.3	10.6	53	5.2	10.3
2800	0.4	13.5	77	7.2	10.7
3000	0.5	15.3	90	8.5	10.6
3400	0.7	19.6	118	11.5	10.2
3800	0.9	25.2	150	15.5	9.6
4000	1.0	26.8	168	17.6	9.6
4400	1.4	34.3	211	23.2	9.1
4800	1.8	40.8	257	30.1	8.5
5000	2.0	45.0	283	34.2	8.3
5400	2.5	53.4	340	42.8	7.9
5800	3.2	62.9	400	54.0	7.4
6000	3.5	67.6	431	59.4	7.3
6400	4.3	76.9	490	71.7	6.8
6800	5.2	88.9	570	88.0	6.5
7000	5.7	93.7	605	96.1	6.3
7400	6.9	106.4	690	116.4	5.9
7800	8.2	117.6	768	137.3	5.6
short term operation					
8000	9.0	125.2	823	150.0	5.5
8400	10.6	138.9	904	177.0	5.1
8800	12.3	153.4	993	204.7	4.8
9000	13.0	157.7	1019	217.5	4.7

Notes

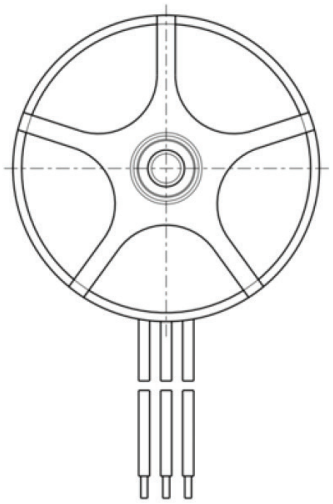
Please contact aerospace@maxongroup.com

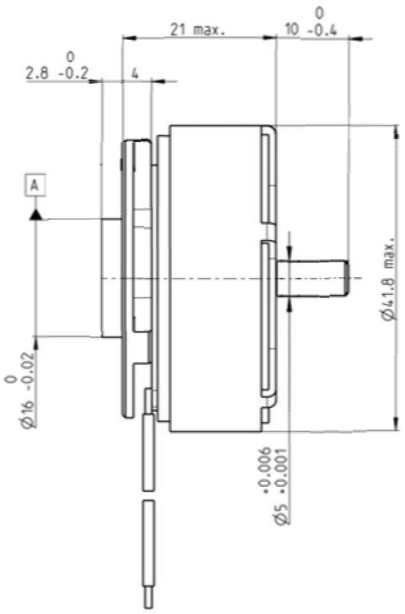
ECX 42 flat UAV

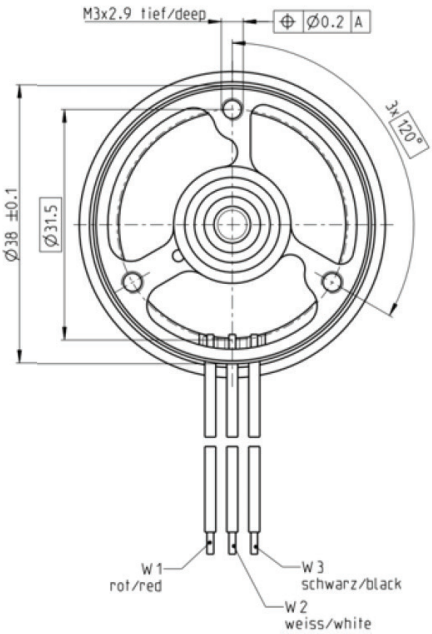
high power to weight ratio

∅42 mm, brushless, up to 2.3kg thrust

NEW







			Sensorless	Part Number
Motor Data				
	Values at nominal voltage			
1	Nominal voltage	V	18	
2	No load speed	rpm	7760	
3	No load current	mA	340	
4	Nominal speed	rpm	6160	
5	Nominal torque (max. continuous torque)	mNm	223	
6	Nominal current (max. continuous current)	A	8.8	
7	Stall torque[1]	mNm	1790	
8	Stall current	A	191	
9	Max. efficiency	%	91.6	
10	Max. continuous power output	W	148	
11	Max. peak power output	W		for t<15s
	Characteristics			
12	Terminal resistance phase to phase	Ω	0.0944	
13	Terminal inductance phase to phase	mH	0.127	
14	Torque constant	mNm/A	22	
15	Speed constant	rpm/V	435	
16	Speed/torque gradient	rpm/mNm	1.87	
17	Mechanical time constant	ms	2.64	
18	Rotor inertia	gcm²	135	

Specifications

Thermal data

19	Thermal resistance housing-ambient[2]	3.26 K/W
20	Thermal resistance winding-housing[2]	3.47 K/W
21	Thermal time constant winding	22.6s
22	Thermal time constant motor	181s
23	Ambient temperature	-40…+100°C
24	Max. winding temperature	+125°C

Mechanical data (preloaded ball bearings)

25	Max. speed	12000 rpm

Other specifications

26	Number of pole pairs	8
27	Number of phases	3
28	Weight of motor (incl. cable)	88.6g
29	Recommended propeller sizes	13"…15"

Values listed in the tables are nominal.

Connection

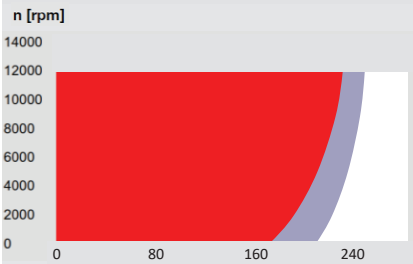
Pin 1 Motor winding 1
Pin 2 Motor winding 2
Pin 3 Motor winding 3

Cable

Connection cable PTFE

[1]Calculation does not include saturation effect
[2]At nominal working point

Operating Range



Comments

Continuous operation
In observation of listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient. = Thermal limit.

Continuous operation
Thermal resistance Rth2 reduced by 50%.

Short term operation
The motor may be briefly overloaded (recurring).

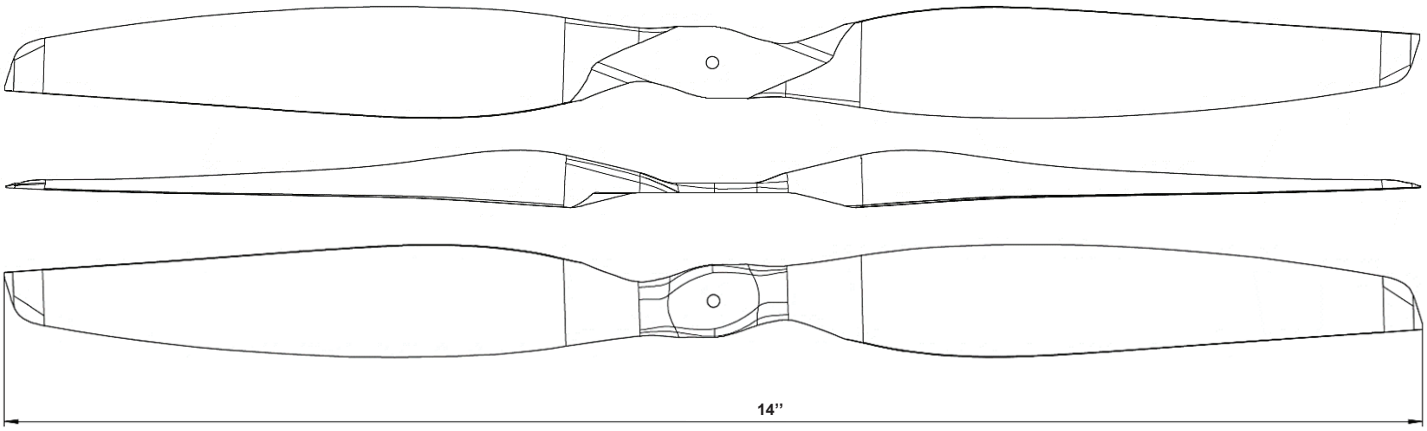
Notes

Motor in development
Please contact aerospace@maxongroup.com

Propeller 14x4.5

propeller recommendation

maxon recommended propeller

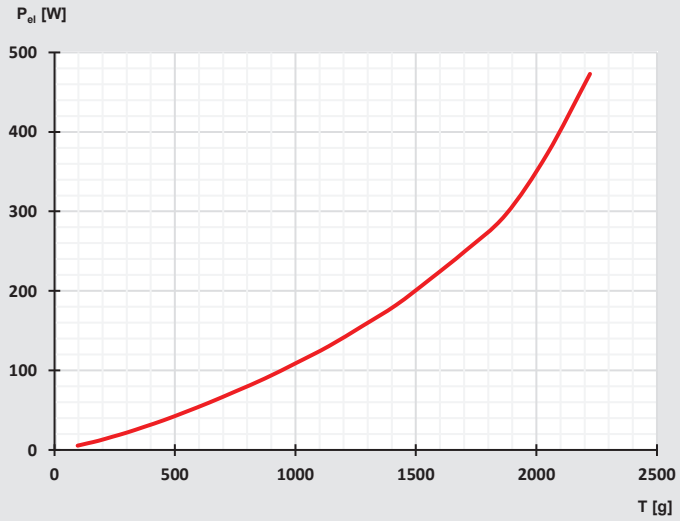


Propeller Specifications

1	Diameter	14'' (355.6 mm)
2	Pitch	4.5''(114.3 mm)
3	Weight of Propeller	18 g
4	Max. speed	10'500 rpm
5	Material	carbon and glass fiber, polyurethane, epoxy

Efficiency Propulsion System

Propulsion system efficiency is indicated by depiction of required amount of electrical power (required by motor) to achieve a certain amount of thrust.



Motor Propeller Combination

Propulsion System Performance Table

Based on simulated data @ **28.95V** ESC supply voltage.

Speed [rpm]	Current [A]	Torque [mNm]	Thrust [g]	el. Power [W]	Efficiency [g/W]
continuous operation					
1700	0.2	18	97	6	17.0
2000	0.3	26	140	9	16.0
2300	0.4	34	183	12	15.5
2600	0.6	44	241	17	14.3
2900	0.8	54	300	22	13.6
3200	1.0	67	375	29	12.7
3500	1.3	80	453	38	12.1
3800	1.7	96	544	48	11.3
4100	2.1	112	642	60	10.7
4400	2.6	130	754	74	10.2
4700	3.2	150	873	90	9.7
5000	3.9	171	1004	110	9.2
5300	4.6	194	1139	131	8.7
5600	5.6	217	1278	156	8.2
5900	6.5	241	1418	182	7.8
short term operation					
6200	7.7	265	1558	215	7.3
6500	9.0	291	1705	250	6.8
6800	10.7	319	1872	296	6.3
7100	13.6	348	2045	372	5.5
7400	17.3	378	2222	473	4.7

Notes

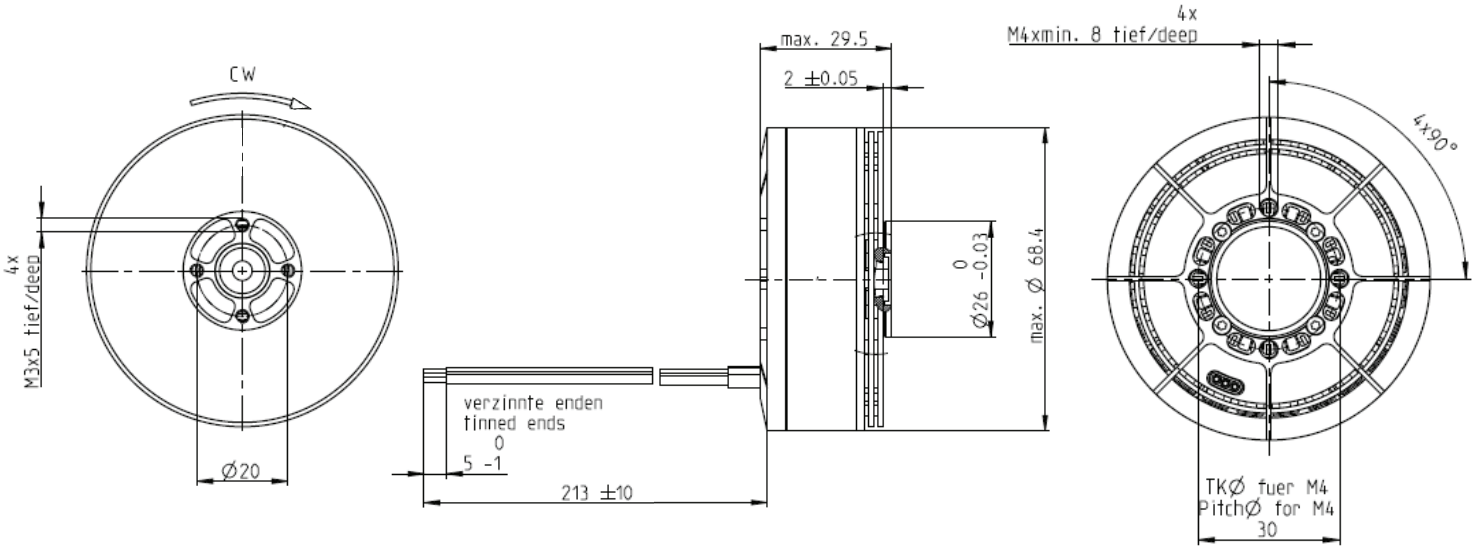
Please contact aerospace@maxongroup.com

EC 69 flat UAV

∅69 mm, brushless, up to 8.4kg thrust

NEW

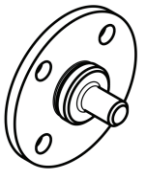
designed for professional UAV applications



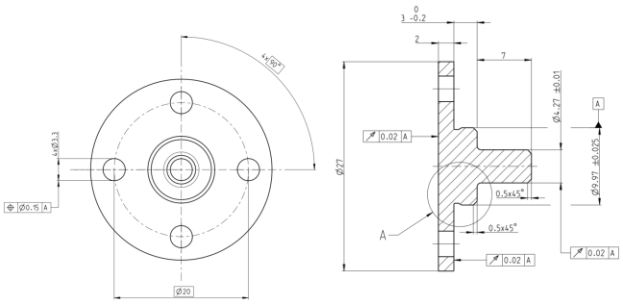
			Part Number	
		Sensorless	688848	725770
Motor Data				
	Values at nominal voltage (with propeller)			
1	Nominal voltage	V	24	36
2	No load speed	rpm	8110	5690
3	No load current	mA	1950	709
4	Nominal speed	rpm	6680	4860
5	Nominal torque (max. continuous torque)	mNm	1270	1390
6	Nominal current (max. continuous current)	A	41.8	21.2
7	Stall torque[1]	mNm	4720	4780
8	Stall current	A	608	292
9	Max. efficiency	%	89.6	90.8
10	Max. continuous power output	W	490	620
11	Max. peak power output	W	1100	1480
	Characteristics			
12	Terminal resistance phase to phase	Ω	0.0395	0.123
13	Terminal inductance phase to phase	mH	0.0174	0.0799
14	Torque constant	mNm/A	28	59.9
15	Speed constant	rpm/V	342	159
16	Speed/torque gradient	rpm/mNm	0.482	0.328
17	Mechanical time constant	ms	3.74	2.54
18	Rotor inertia	gcm²	740	740
19	Thermal resistance housing-ambient	K/W	0.158	0.222
20	Thermal resistance winding-housing	K/W	1.01	0.781
21	Thermal time constant winding	s	7.96	10.4
22	Thermal time constant motor	s	21.3	29.9

maxon Accessories

propeller adapter



The adapter is designed for mounting the maxon recommended propeller



Motor Specifications

	Thermal data	
23	Ambient temperature	-20 … +50 °C
24	Max. winding temperature	+155°C
	Mechanical data (preloaded ball bearings)	
25	Max. speed	8000 rpm
	Other specifications	
26	Number of pole pairs	14
27	Number of phases	3
28	Weight of motor (incl. 210 mm cable)	269 g
29	Recommended propeller sizes	18"…22"

Values listed in the tables are nominal.

Connection

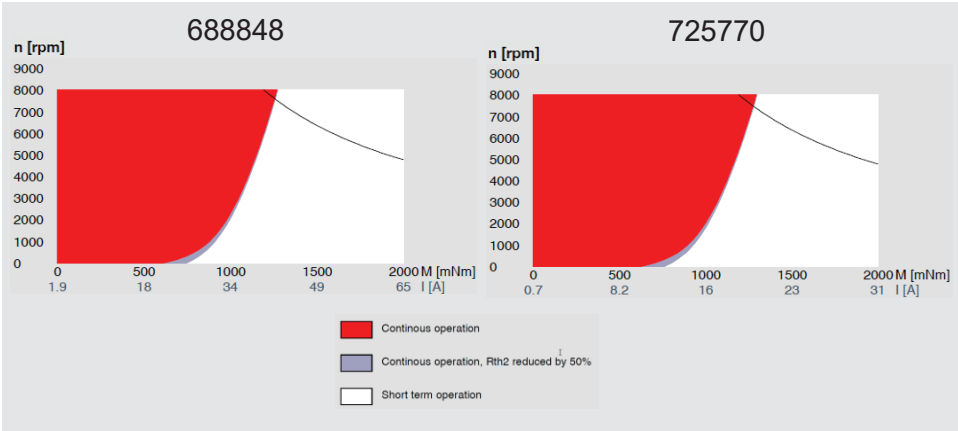
Pin 1 Motor winding 1
Pin 2 Motor winding 2
Pin 3 Motor winding 3

Cable

Connection winding wire direct, L = 213 mm silicone insulated

[1]Calculation does not include saturation effect
[2]At nominal working point

Operating Range



Notes

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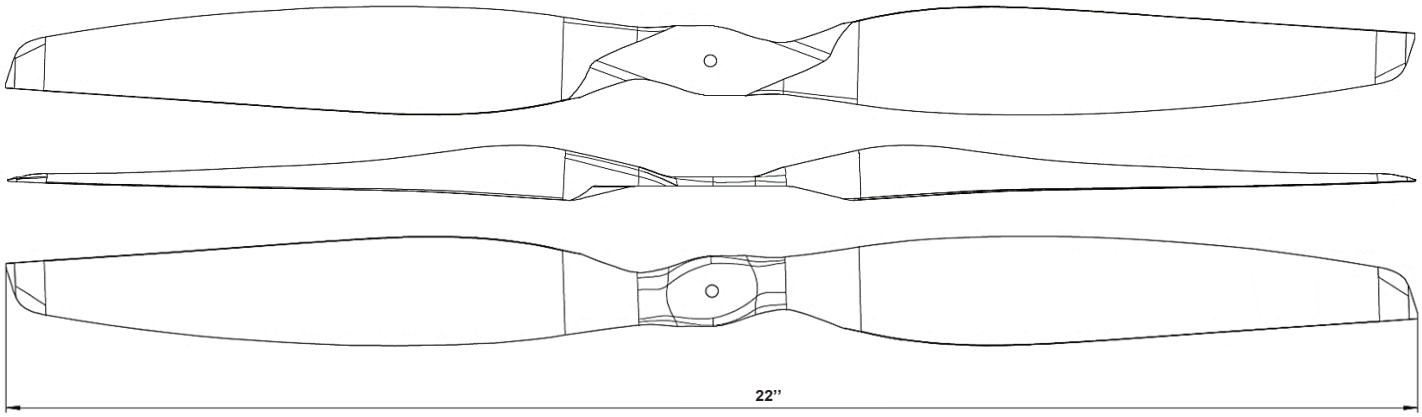
Propeller 22x7.4

propeller recommendation

maxon recommended propeller for EC 69 flat



Propeller Specifications

1	Diameter	22'' (558.8 mm)
2	Pitch	7.4'' (188.0 mm)
3	Weight of Propeller	44 g
4	Max. recommended speed	8200 rpm
5	Material	carbon and glass fiber, polyurethane, epoxy

Motor Propeller Combination

Propulsion System Performance Table

688848

Based on measured data in hover flight condition. @ **33.6V** ESC supply voltage.

Speed [rpm]	Current [A]	Torque [mNm]	Thrust [g]	el. Power [W]	Efficiency [g/W]
continuous operation					
1100	0.5	86	234	18	13.2
1400	0.9	132	396	31	12.8
1600	1.3	169	529	42	12.5
1800	1.7	213	689	58	11.9
2000	2.3	265	889	77	11.6
2200	2.9	315	1058	99	10.7
2400	3.7	369	1287	125	10.3
2600	4.6	421	1467	154	9.5
2800	5.9	509	1782	197	9.1
3000	7.1	575	2044	239	8.6
3200	8.8	670	2389	295	8.1
3400	10.4	744	2655	348	7.6
3600	12.4	826	2981	416	7.2
3800	14.5	906	3282	486	6.8
4000	17.3	1029	3702	583	6.4
4200	20.9	1167	4237	702	6.0
short term operation					
4400	24.1	1277	4595	810	5.7
4600	27.6	1377	4975	927	5.4
4800	32.9	1540	5519	1107	5.0
5000	36.7	1622	5847	1234	4.7
5200	45.6	1860	6663	1534	4.3

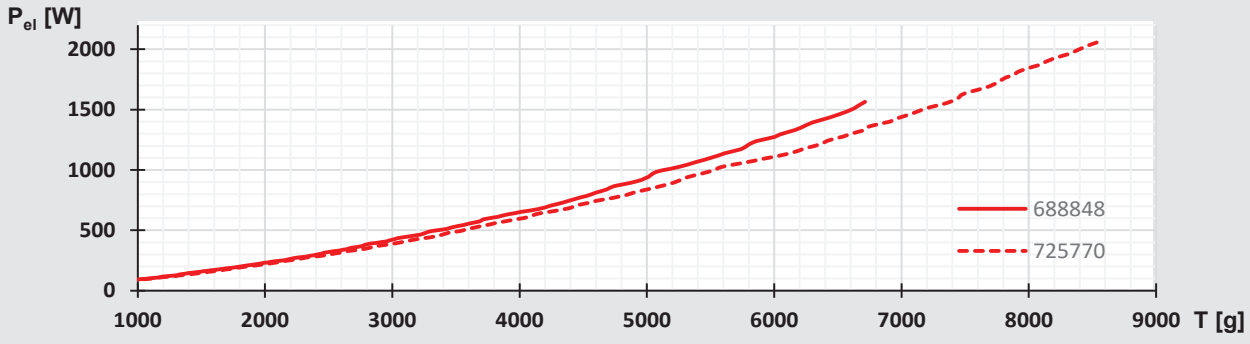
725770

Based on measured data in hover flight condition. @ **52.2V** ESC supply voltage.

Speed [rpm]	Current [A]	Torque [mNm]	Thrust [g]	el. Power [W]	Efficiency [g/W]
continuous operation					
1100	0.4	88	226	19	12.1
1400	0.6	134	386	31	12.6
1600	0.8	171	518	42	12.4
1800	1.1	216	679	56	12.1
2000	1.4	262	856	73	11.8
2200	1.8	316	1047	94	11.1
2400	2.3	370	1264	118	10.7
2600	2.9	441	1516	149	10.2
2800	3.5	503	1739	182	9.6
3000	4.2	577	2014	222	9.1
3200	5.1	653	2297	268	8.6
3400	6.2	741	2624	321	8.2
3600	7.2	822	2929	377	7.8
3800	8.8	948	3376	460	7.3
4000	10.1	1024	3654	525	7.0
4200	11.6	1126	4051	607	6.7
4400	13.7	1250	4481	714	6.3
short term operation					
4600	15.5	1356	4894	811	6.0
4800	17.9	1484	5298	934	5.7
5000	20.9	1648	5903	1090	5.4
5200	24.0	1815	6455	1254	5.1
5400	27.1	1936	6938	1415	4.9
5600	30.6	2090	7443	1597	4.7
5800	35.1	2232	7963	1832	4.3
5880	38.9	2384	8462	2029	4.2

Efficiency Propulsion System

Propulsion system efficiency is indicated by depiction of required amount of electrical power (required by motor) to achieve a certain amount of thrust.

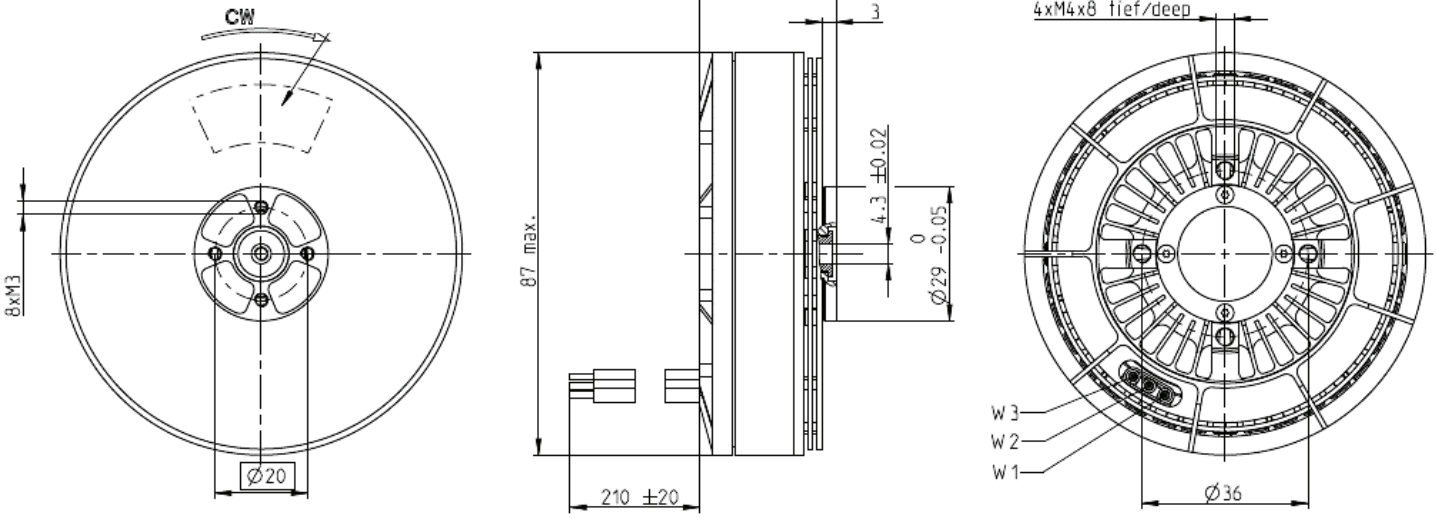


EC 87 flat UAV

∅87 mm, brushless, up to 9kg thrust

NEW

designed for professional UAV applications



	Part Number
	Sensorless
	668415

Motor Data			
Values at nominal voltage			
1 Nominal voltage	V	24	
2 No load speed	rpm	3420	
3 No load current	mA	862	
4 Nominal speed	rpm	2640	
5 Nominal torque (max. continuous torque)	mNm	1760	
6 Nominal current (max. continuous current)	A	23.6	
7 Stall torque[1]	mNm	17900	
8 Stall current	A	269	
9 Max. efficiency	%	89.2	
10 Max. continuous power output	W	620	
11 Max. peak power output	W	1460	(for $t<\tau_w$, see line 21)
Characteristics			
12 Terminal resistance phase to phase	Ω	0.0891	
13 Terminal inductance phase to phase	mH	0.048	
14 Torque constant	mNm/A	66.4	
15 Speed constant	rpm/V	144	
16 Speed/torque gradient	rpm/mNm	0.193	
17 Mechanical time constant	ms	3.52	
18 Rotor inertia	gcm²	1740	

Specifications

Thermal data

19	Thermal resistance housing-ambient[2]	0.479 K/W
20	Thermal resistance winding-housing[2]	0.557 K/W
21	Thermal time constant winding	5.41 s
22	Thermal time constant motor	74.1 s
23	Ambient temperature	-20…+50°C
24	Max. winding temperature	+155°C

Mechanical data (preloaded ball bearings)

25	Max. speed	6500 rpm

Other specifications

26	Number of pole pairs	21
27	Number of phases	3
28	Weight of motor (incl. 210 mm cable)	309.5 g
29	Recommended propeller sizes	27"…30"

Values listed in the tables are nominal.

Connection

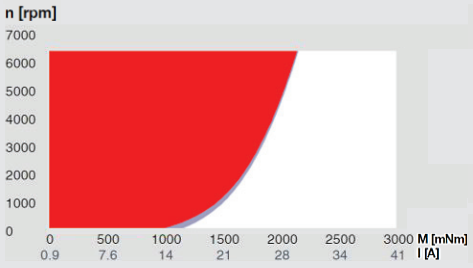
Pin 1 Motor winding 1
Pin 2 Motor winding 2
Pin 3 Motor winding 3

Cable

Connection cable Universal, L = 210 mm
AWG 16, silicone

[1]Calculation does not include saturation effect
[2]At nominal working point

Operating Range



Comments

Continuous operation
In observation of listed thermal resistance (lines 17 and 18) the maximum permissible winding temperature will be reached during continuous operation at 25°C ambient. = Thermal limit.

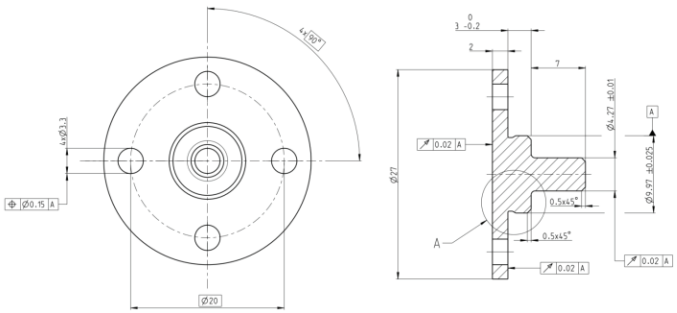
Continuous operation
Thermal resistance Rth2 reduced by 50%.

Short term operation
The motor may be briefly overloaded (recurring).

maxon Accessories

propeller adapter

The adapter is designed for mounting the maxon recommended propeller

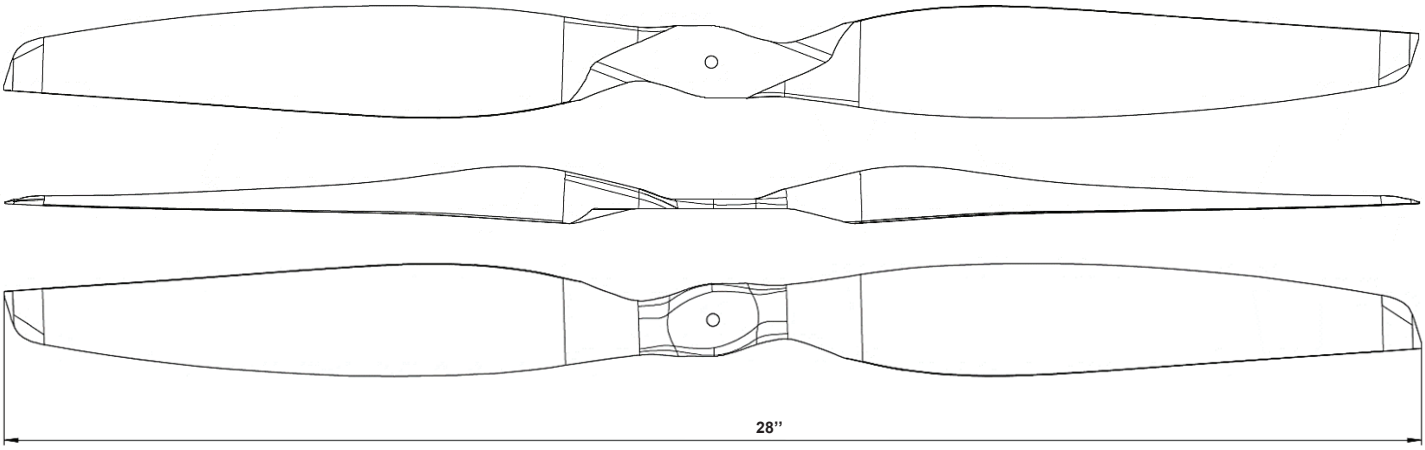


Notes

Please contact aerospace@maxongroup.com

Propeller 28x9.4 propeller recommendation

maxon recommended propeller for optimal hover efficiency combined with EC 87 flat

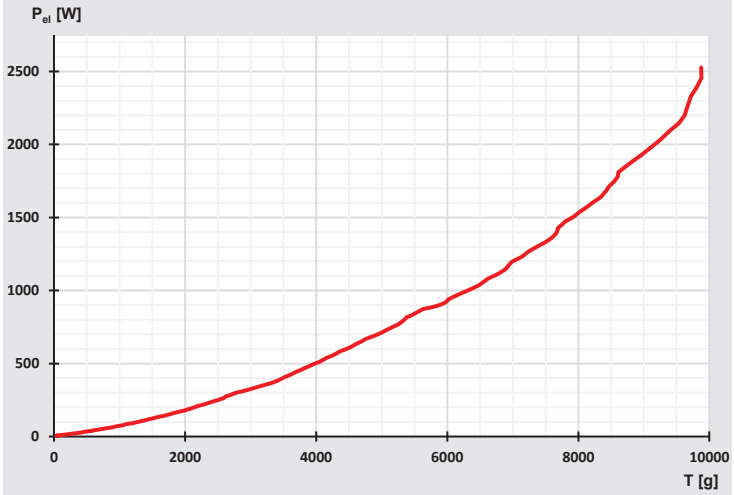


Propeller Specifications

1	Diameter	28'' (711.2 mm)
2	Pitch	9.4'' (238.8 mm)
3	Weight of Propeller	86 g
4	Max. speed	no limitation
5	Material	carbon and glass fiber

Efficiency Propulsion System

Propulsion system efficiency is indicated by depiction of required amount of electrical power (required by motor) to achieve a certain amount of thrust.



Motor Propeller Combination

Propulsion System Performance Table

Based on measured data @ **52.2V** ESC supply voltage.

Speed [rpm]	Current [A]	Torque [mNm]	Thrust [g]	el. Power [W]	Efficiency [g/W]
continuous operation					
1100	0.9	286	692	48	14.4
1400	1.7	448	1169	89	13.1
1600	2.4	576	1536	127	12.1
1800	3.4	726	1985	178	11.2
2000	4.6	892	2428	241	10.1
2200	6.1	1052	2922	316	9.3
2400	8.1	1299	3601	422	8.5
2600	10.2	1485	4129	532	7.8
2800	13.3	1756	4893	692	7.1
2900	15.3	1925	5335	796	6.7
3000	16.3	1969	5544	853	6.5
short term operation					
3100	17.7	2151	5999	926	6.5
3200	20.0	2311	6511	1046	6.2
3300	22.5	2509	6943	1174	5.9
3400	25.1	2657	7413	1311	5.7
3500	27.2	2808	7686	1422	5.4
3600	29.9	2901	8098	1561	5.2
3700	33.7	3099	8565	1758	4.9
3800	38.2	3287	9136	1991	4.6
3900	43.6	3484	9678	2277	4.2

Notes

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UAV-ESC 18/8 Data

dual axis electronic speed controller designed for lightweight UAV applications

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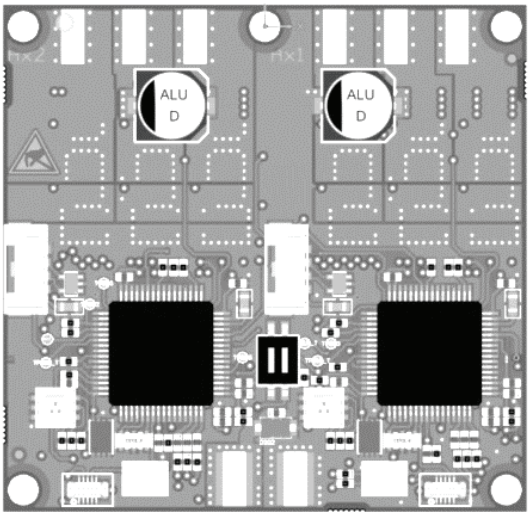

Part Number

Electrical Data			
1 Nominal power supply voltage +V_{cc}	VDC	12.8…17.4	(4S LiPo Battery)
2 Absolute supply voltage +V_{min} / +V_{max}	VDC	10 / 19	
3 Output voltage (max.)	VDC	0.95 x V_{cc}	
4 Output current I_{cont} [1]	A	7	
5 Output current I_{max} [2]	A	15	
6 Pulse width modulation frequency	kHz	25	
7 Commutation			Sensorless, FOC
8 Sampling rate PI current controller	kHz	25	(40µs)
9 Sampling rate PI speed controller (closed loop)	kHz	2.5	(400µs)
10 Max. efficiency	%	>97	
11 Max. speed EC motor (sinusoidal)	rpm	150'000	(1 pole pair)
12 Built-in motor choke		none	
Inputs & Outputs			
13 Digital input «Set Value»	VDC	+2.50…+5.25	(optically isolated), pulse width distortion max. 50 ns
14 Digital output «Speed Monitor e-rpm» [3]	VDC	max. 3.3	4.3kOhm
Connections & Interfaces			
16 BLCD motor			Motor winding 1, 2, 3
17 USB			USB 2.0, full speed
Physical			
18 Dimensions (L x W x H)	mm	48.8 x 47.4 x 8.6	
19 Weight (excl. cable, excl. housing)	g	13.6	
22 Mounting			5 mounting holes diameter 2.4mm
23 Coating			Acota Certonal FC-742, 3M Novec 1700 (basic humidity protection)
Environmental conditions			
24 Standard operating temperature	°C	-30…+60	Temperature range to meet the stated performance data
25 Extended temperature range [4]	°C	+60…+66	Consider derating (Derating -1.1 A/°C)
26 Storage temperature	°C	-40…+85	
27 Operating altitude	m MSL	0…6'000	Altitude in meters above Mean Sea Level
28 Humidity [5]	%	5…90	

[1] Airflow 0 m/s; no additional heat sink; T_A=20°C;

[2] Airflow 0 m/s; no additional heat sink; T_A=20°C; t<1 s

[3] Coming soon

[4] Operation within the extended range is permitted. However, a respective derating (declination of output current I_{cont}) as to the stated values will apply.

[5] Condensation over extended periods or water immersion are not permitted

Notes

Please contact aerospace@maxongroup.com

UAV-ESC 52/30 Data

Electronic speed controller designed for professional UAV applications

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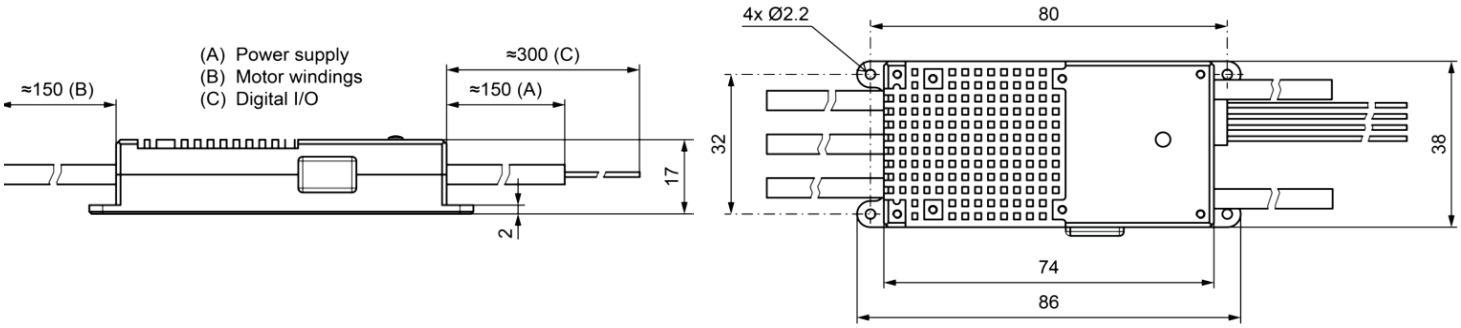
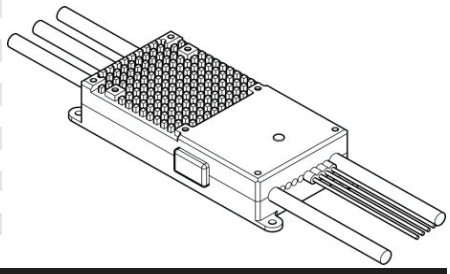


Part Number

654541

Electrical Data			
1 Nominal power supply voltage +V_{cc}	VDC	9…52.2	(3S…12S LiPo Battery)
2 Absolute supply voltage +V_{min} / +V_{max}	VDC	8 / 56	
3 Output voltage (max.)	VDC	0.95 x V_{cc}	
4 Output current I_{cont} [1]	A	30	
5 Output current I_{max} [2]	A	90	
6 Pulse width modulation frequency	kHz	25	
7 Commutation			Sensorless, FOC
8 Sampling rate PI current controller	kHz	25	(40µs)
9 Sampling rate PI speed controller (closed loop)	kHz	2.5	(400µs)
10 Max. efficiency	%	>99	
11 Max. speed EC motor (sinusoidal)	rpm	150'000	(1 pole pair)
12 Built-in motor choke		none	



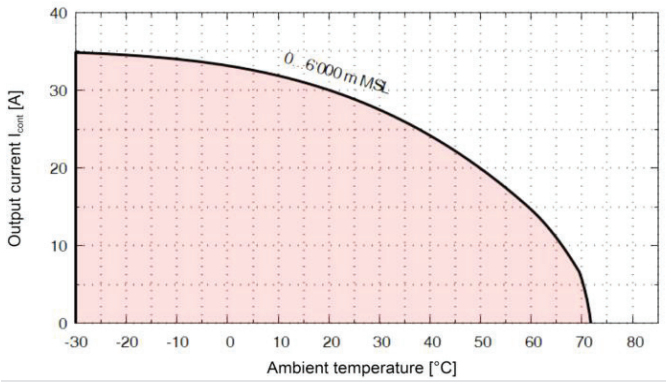
Inputs & Outputs			
13 Digital input «Set Value»	VDC	+2.50…+5.25	(optically isolated), pulse width distortion max. 50 ns
14 Digital output «Speed Monitor e-rpm» [3]	VDC	max. 12	I_L≤15mA; (optically isolated), max. 2.5kHz
15 Analog input «Motor winding temperature» [3]			For use with an NTC resistor; NTC 10kΩ

Connections & Interfaces			
16 BLCD motor			Motor winding 1, 2, 3
17 USB			USB 2.0, full speed

Physical			
18 Dimensions (L x W x H)	mm	86 x 38 x 17	
19 Weight (excl. cable, excl. housing)	g	18	
20 Weight (incl. cable, excl. housing)	g	67	For cable lengths as specified in technical drawing
21 Weight (incl. cable, incl. housing)	g	102	For cable lengths as specified in technical drawing
22 Mounting			4 mounting holes for M2 screws
23 Coating			Acota Certonal FC-742, 3M Novec 1700

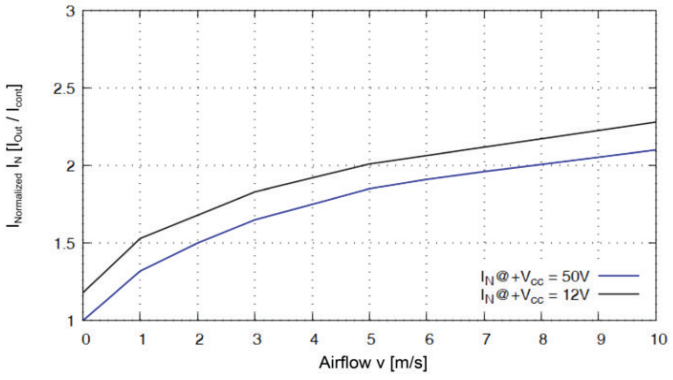
Environmental conditions			
24 Standard operating temperature	°C	-30…+20	Temperature range to meet the stated performance data
25 Extended temperature range	°C	+20…+72	Consider derating
26 Storage temperature	°C	-40…+85	
27 Operating altitude	m MSL	0…6'000	Altitude in meters above Mean Sea Level
28 Humidity [5]	%	5…90	

Derating of Output Current



Operation within the extended range (temperature) is permitted. However, a respective derating (declination of output current I_{cont}) as to the stated values will apply.

Increase of Output Current



The diagram shows the permissible continuous output current under additional airflow without causing the controller to overheat.
The graph shows the permitted additional output current in relation to the continuous output current as determined according to the “Derating of Output Current”-diagram.

[1] Airflow 0 m/s; no additional heat sink; T_A=20°C;+V_{cc}=52.2V;

[2] Airflow 0 m/s; no additional heat sink; T_A=20°C;+V_{cc}=52.2V; t<25 s

[3] Coming soon

[5] Condensation over extended periods or water immersion are not permitted

Notes

Please contact aerospace@maxongroup.com

Explanation of maxon UAV propulsion system terminology

Dimensional drawings
Presentation of the views according to the projection method E (ISO). 
All dimensions in [mm].

Motor Data

The values were determined for sinusoidal or block commutation.

1 Nominal voltage U_N [Volt]
is the applied voltage between two powered phases in block commutation. All nominal data (lines 2 – 9) refer to this voltage. Lower and higher voltages are permissible, provided that limits are not exceeded.

2 No load speed n_0 [rpm] ±10%
is the speed at which the unloaded motor runs with the nominal voltage applied. It is approximately proportional to the applied voltage.

3 No load current I_0 [mA] ±50%
This is the typical current that the unloaded motor draws when operating at nominal voltage. It increases with rising speed owing to bearing friction and iron losses. No load friction depends heavily on temperature. It decreases in extended operation and increases at lower temperatures.

4 Nominal speed n_N [rpm]
is the speed set for operation at nominal voltage and nominal torque at a motor temperature of 25°C.

5 Nominal torque M_N [mNm]
is the torque generated for operation at nominal voltage and nominal current at a motor temperature of 25°C. It is at the limit of the motor's continuous operation range. Higher torques heat up the winding too much.

6 Nominal current I_N [A]
is the current in the active phase in block commutation that generates the nominal torque at the given nominal speed (= max. permissible continuous load current). The maximum winding temperature is reached at 25°C ambient temperature in continuous operation with I_N. I_N decreases as speed increases due to additional losses in the lamination.

7 Stall torque M_H [mNm]
is the linearly calculated load torque for motors that causes stall at nominal voltage. This torque may be a theoretical value and cannot be achieved due to saturation effects (see page 61 in the maxon catalog 20/21 for further explanations)

8 Stall current I_A [A]
is the quotient from nominal voltage and the motor's terminal resistance. Stall current is equivalent to stall torque. With larger motors, I_A cannot often be reached due to the amplifier's current limits.

9 Max. efficiency η_{max} [%]
is the optimal relationship between input power and output power at nominal voltage. It also doesn't always de- note the optimal operating point.

10 Max. Continuous power [W]
is the max. electrical power the motor can cope with for continuous operation.

11 Max. Peak power [W]
is the max. electrical power the motor can handle for < 15 seconds.

12 Terminal resistance phase to phase R [Ω]
is determined by the resistance at 25 °C between two connections of the standard resolution.

13 Terminal inductance phase to phase L [mH]
is the winding inductance between two connections. It is measured at 1 kHz, sinusoidal.

14 Torque constant k_M [mNm/A]
This may also be referred to as «specific torque» and represents the quotient from generated torque and applicable current.

15 Speed constant k_n [rpm/V]
indicates the theoretical no load speed per volt of applied voltage, disregarding friction losses.

16 Speed/torque gradient
Δ_n/Δ_M [rpm/mNm]
The speed/torque gradient is an indicator of the motor's performance. The smaller the value, the more powerful the motor and consequently the less motor speed varies with load variations. It is based on the quotient of ideal no load speed and ideal stall torque (tolerance ±20%).
The real characteristic curve depends on the speed for EC motors with slotted winding (EC flat and EC-i); it is steeper at high speeds and flatter at slow speeds. The real gradient at nominal voltage can be approximated by a straight line between no load speed and the nominal operating point (see page 61 in the maxon catalog 20/21 for further explanations).

17 Mechanical time constant τ_m [ms]
is the time required for the rotor to accelerate from standstill to 63% of its no load speed.

18 Rotor moment of inertia J_R [gcm²]
is the mass moment of inertia of the rotor, based on the axis of rotation.

19 Thermal resistance housing-ambient R_{th2} [K/W]
and
20 Thermal resistance winding-housing R_{th1} [K/W]
Characteristic values of thermal contact resistance without additional heat sinking. Lines 17 and 18 combined define the maximum heating at a given power loss (load). Thermal resistance R_{th2} is significantly decreased in case of forced heat transfer (ventilation).

21 Thermal time constant winding τ_w [s]
and
22 Thermal time constant motor τ_s [s]
These are the typical reaction times for a temperature change of winding and motor. It can be seen that the motor reacts much more sluggishly in thermal terms than the winding. The values are calculated from the product of thermal capacity and given heat resistances.

23 Ambient temperature [°C]
Operating temperature range. This derives from the heat reliability of the materials used and viscosity of bearing lubrication.

24 Max. winding temperature [°C]
Maximum permissible winding temperature.

25 Max. speed n_{max} [rpm]
is the maximum recommended speed based on thermal and mechanical perspectives. A reduced service life can be expected at higher speeds.

26 Number of pole pairs
Number of north poles of the permanent magnet. The phase streams and commutation signals pass through per revolution p cycles. Servo-controllers require the correct details of the number of pole pairs.

27 Number of phases
All maxon EC motors have three phases.

29 Recommended propeller sizes
For the described motor, maxon recommends a certain range of propeller sizes to best fit the motors operating point.

Propeller Data

maxon recommended propeller for optimal hover efficiency with maxon drone motor and electronic speed controller.

1 Propeller diameter [inch]
Propeller diameter from tip to tip in inches.
(1inch = 25.4mm).

2 Propeller pitch [inch]
is the theoretical displacement a propeller makes in a complete propeller spin of 360° in inches.
(1inch = 25.4mm).

4 Max. speed [rpm]
is the maximum recommended speed of the propeller in rotations per minute.

Electronic Speed Controller (ESC) Data

maxon electronic speed controller designed for professional drone applications. Comprehensive information can be found in the ESC Hardware Reference Document.

1 Nominal power supply voltage $+V_{cc}$ [VDC]
is the recommended supply voltage range for normal ESC operation. For LiPo battery powered applications, it is given in cell numbers (nominal voltage of one cell (1S) is 3.7V).

3 Output voltage (max) [VDC]
the max. possible output voltage for maxon ESCs is 95% ($0.95x+V_{cc}$) of the supply voltage. This limit arises from max. PWM duty cycle at the power stage.

4 Continuous output current I_{cont} [A]
is the continuous output current with no additional heat sink, with no airflow (0m/s), at indicated supply voltage $+V_{cc}$, at 20°C ambient temperature.

5 Max. output current I_{max} [A]
is the max. output current, which can be sustained by the ESC with no additional heat sink, with no airflow (0m/s), at indicated supply voltage $+V_{cc}$, at 20°C ambient temperature during indicated time.

7 Commutation
All maxon ESCs use sinusoidal commutation. This is the most efficient form of field-oriented control (FOC) and requires parameter tuning for optimal motor behavior.

10 Max. efficiency
is the calculated relationship between power input and output. It depends on operating point and load conditions.

11 Max. speed EC motor (sinusoidal)
is the max. electrical speed of the ESC. The indicated value corresponds to a motor with 1 magnetic pole pair. Maxon UAV motors have several pole pairs and the true max. speed is calculated by division of the indicated value with the number of pole pairs (see motor data 24).

25 Extended temperature range [°C]
Operation within the extended range is permitted. However, a respective declination of output current I_{cont} will apply (derating).
Derating values are stated in reduction of current [A] per temperature [°C] or presented as a diagram that shows the max. continuous output current I_{cont} in relation to ambient temperature with no airflow (0m/s). Positive effect of airflow on derating may be presented in separate diagrams.