Zubax Myxa Datasheet



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Zubax Myxa is an industry-leading high-reliability FOC ESC based on the Telega motor control technology. Myxa is designed for use in propulsion systems of light unmanned aerial vehicles (UAV) of all types (multirotors, fixed-wing, VTOL, etc.), unmanned underwater vehicles (UUV) and unmanned surface vehicles (USV), and is compatible with almost all PMSM and BLDC motors.

The advanced vector control algorithms implemented in Telega make it one of the most energy-efficient sensorless ESCs on the market.

Since its first release in 2018, Myxa has been used in a wide range of unmanned vehicles and other applications and has proven itself to be a highly reliable and robust product.

Features

- Up to 1200 W of continuous power output
- 13–51 V input voltage range (4–12S LiCoO₂ battery)
- Based on Zubax Telega¹ industry-leading energy efficient motor control technology:
 - Energy-efficient sensorless field-oriented control (FOC)
 - Regenerative braking and active freewheeling
 - Self-diagnostics and health status reporting
 - Various control modes: torque, velocity, position, etc.
 - Highly configurable, wide range of tunable parameters
- External motor temperature sensor support
- Software-controllable 5 V BEC (Myxa B only)
- Firmware updatable in-field via CAN
- No soldering required for installation or use
- · Board-level and enclosed versions available
- Flexible interfaces:
 - CAN bus interface:
 - Cyphal/CAN or DroneCAN protocol (depending on the firmware)
 - Dual redundancy for fault tolerance (Myxa B only)
 - Standard RCPWM input



Applications

- UAV propeller and fan drives
- · Pump and propeller drives for UUVs and USVs
- Fuel pump drives for gas turbine engines

¹https://telega.zubax.com

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1 Overview

Zubax Myxa is a highly reliable, industry-leading FOC ESC based on the Zubax Telega motor control technology designed for use in the propulsion systems of various unmanned vehicles and as a fuel pump drive in gas turbine engines. Myxa is one of the most energy-efficient sensorless PMSM/BLDC controllers available on the market.

For information on operating and tuning the device, please refer to the Telega Reference Manual at https://telega.zubax.com. For help with tuning, please reach out at https://forum.zubax.com.

1.1 Quality assurance

Every manufactured device undergoes an automated hardware verification process, the test logs of which can be viewed at https://device.zubax.com/device_info. To facilitate traceability and reduce the risk of counterfeits, every manufactured device stores a strong digital signature to identify its origin.

Additional information about product quality is available upon request from support@zubax.com.

1.2 Models

Two types of Myxa are available:

- Myxa A optimized for cost-sensitive applications
- Myxa B optimized for mission-critical applications

Each Myxa is available in one of three enclosure options, all of which provide conformal coating for the PCB:

- Bare PCB (variant 0) suitable for embedding into tightly-packed systems, possibly with a custom heatsink.
- Polyolefin transparent envelope (variant 1) optimized for systems that have critical mass and dimension constraints but where some protection from the environment is needed. As the heatsink impedes heat dissipation, this option is only recommended for low-power applications.
- Aluminum (variant 2) suitable for systems with higher power demands where the enclosure provides an additional cooling capability, acting as a heatsink.

Further, high-power modifications denoted with the "Z" suffix are available. The model comparison table 1.1 uses the following notation:

- *m* mass.
- IP ingress protection code.
- *P*_{dc} continuous electrical power limit; includes the auxiliary power output, if applicable.
- i_{dc} continuous DC link current limit.
- i_{abc} continuous phase current amplitude limit.
- $i_{abc-peak}$ peak phase current amplitude; duration limited by temperature.
- CAN number of CAN bus interfaces: single or doubly-redundant. The secondary CAN bus shall be disabled if not used.
- BEC auxiliary power output, also known as the battery elimination circuit; i.e., the low-voltage power supply output for external electronics.
- t_{oper} device operating temperature.

The relation between the DC electrical power and the AC electrical power is described by the drive power transfer equation introduced in the Telega Reference Manual:

$$P_{\rm dc} = u_{\rm dc} \, i_{\rm dc} \approx \frac{3}{2} \left(u_q \, i_q + u_d \, i_d \right) \approx \omega \, \tau = P_{\rm mechanical}$$

Муха		т	$L \times W \times H$	IP	P _{dc}	<i>i</i> dc	i _{abc}	i _{abc-peak}	toper	CAN	BEC
model		gram	millimeter		watt	ampere	ampere	ampere	°C		
A0	board-level	26	$55\times35\times19$	IP10	850 ^a	32	37 ^a	50	-40-+85	1	no
A0Z	board-level	28	$55\times35\times19$	IP10	1200 ^a	40	45 ^a	50	-40-+105	1	no
Al	polyolefin envelope	27	$55\times 36\times 20$	IP31	400	32	37	50	-40 - +85	1	no
A2	aluminum enclosure	55	$57\times 38\times 24$	IP31	850	32	37	50	-40 - +85	1	no
A2Z	aluminum enclosure	57	$57\times 38\times 24$	IP31	1200	40	45	50	-40-+105	1	no
B0	board-level	26	$55\times35\times20$	IP10	850 ^a	32	37 ^a	50	-40 - +85	2	yes
B0Z	board-level	28	$55\times35\times20$	IP10	1200 ^a	40	45 ^a	50	-40-+105	2	yes
B1	polyolefin envelope	27	$55\times 36\times 21$	IP31	400	32	37	50	-40 - +85	2	yes
B2	aluminum enclosure	55	$57\times 38\times 24$	IP31	850	32	37	50	-40 - +85	2	yes
B2Z	aluminum enclosure	57	$57\times 38\times 24$	IP31	1200	40	45	50	-40-+105	2	yes

Table 1.1: Characteristics per model

^a Assuming the junction-to-environment thermal impedance is not higher than in the aluminum enclosure models; otherwise, the power is limited by temperature. Refer to section 1.6.1.

1.3 Absolute maximum ratings

Stresses that exceed the limits specified in this section may cause permanent damage to the device. Proper operation of the device within the limits specified in this section should not be assumed.

At high power levels, the voltage control mode may cause the phase current to exceed the limit specified in this section, which may lead to a stall and possibly permanent damage to the controller and/or the motor. It is therefore recommended to either avoid the use of the voltage control mode in high-power applications, or to configure a smooth voltage setpoint ramp. More information on this topic is available in the Telega Reference Manual.

Symbol	Parameter	Min	Max	Unit
$u_{\rm dc}$	Supply voltage	-0.3	+56	V
P _{dc-peak}	Peak DC power		2000	W
<i>i_{abc}</i>	Phase current amplitude	-53	+53	A
toper	Operating temperature (device)	-40	+105	°C
	Aux pin input voltage	-0.3	+7	V
	CAN H/L input voltage	-58	+58	V

Table 1.2: Absolute maximum ratings

1.4 Environmental conditions

Refer to table 1.1 for model-specific parameters.

Parameter	Note	Min	Max	Unit		
Storage temperature (ambient)		-40	50	°C		
Operating humidity		0	100	%RH		
Operating altitude above mean sea level (MSL) 10 k						
Table 1.3: Environmental conditions						

1.5 Reliability and safety

Contact Zubax Robotics for additional information about reliability and safety.

Parameter	Тур	Unit
Replacement life	8	year
Operational service life	10 000	hour
Mean time to failure (MTTF)	150 000	hour

Table 1.4: Reliability characteristics

1.6 Mechanical characteristics

Refer to table 1.1 for model-specific parameters.

Regardless of the enclosure option, the PCB is always finished with conformal coating **Taerosol PRF 202** or equivalent. This ensures that the PCB has strong protection against moisture, dust, and aggressive chemicals.

The mechanical load per connector shall not exceed 3 N to avoid damage to the PCB.

All dimensions are given in millimeters.



Figure 1.1: Drawing of Myxa A0/B0



Figure 1.2: Drawing of Myxa A0Z/B0Z

1.6.1 Thermal interface

The power limit specified in table 1.1 for the board-level models (devoid of a heatsink) is based on the assumption that the junction-to-environment thermal impedance is not higher than in the aluminum enclosure models; otherwise, the power is limited by temperature. Therefore, to achieve the maximum power specified in the table, the end application should provide an adequate thermal interface between the PCB and the external heatsink. Usage without the heatsink is possible at a reduced power level.

The aluminum enclosure models require forced air cooling to achieve the maximum power; forced air cooling may or may not be required for a custom heatsink depending on its design.

The geometry of the thermal interface of the PCB is given in figure 1.4. The heatsink and the PCB should be separated by 1 mm thermal pads. Contact Zubax Robotics for additional guidance on the thermal interface design.





DC power wires not shown. Figure 1.3: Drawing of Myxa A2/B2/A2Z/B2Z







2 Functional description

The description of the motor control functions of the device is provided in the Telega reference manual. This document focuses on the hardware-related aspects of the device only. Refer to table 1.1 for model-specific parameters.

2.1 Power supply and voltage source inverter (VSI)

The main power is supplied via the 100 mm-long 1.5 mm^2 copper wires attached to the 3.5 mm gold-plated bullet male connectors. No other power inputs are required for the device to function.

The motor phases are connected to the female board-mounted 3.5 mm bullet right-angle connectors. The force applied to the connectors should not exceed the limit stated in section 1.6.

The VSI is equipped with phase current sensor amplifiers with two gain levels managed by the automatic gain control (AGC) algorithm.

V
W
ns
°C
°C
mΩ
μF
μF
μF
r

Table 2.1: Power supply and voltage source inverter (VSI) characteristics

2.1.1 Buffer capacitance and DC voltage ripple

The switching-induced peak-to-peak DC voltage ripple should not exceed 1.5 V or 5% of the DC bus voltage, whichever is greater, to avoid stability hazards, overheating, excessive energy loss, and electromagnetic interference. To manage the ripple, the motor controller is equipped with DC link buffer capacitance that is sufficient for most applications with low-impedance power supply networks.

If the controller is powered via long leads or from a high-impedance power supply network, additional capacitance may need to be introduced next to the device to manage the voltage ripple. Refer to the Telega Reference Manual for additional information on the subject.

2.1.2 Regenerative braking

While braking, the device transfers energy from the motor to the power supply network in a process known as regenerative braking. If the resistance of the power supply network is high, the regenerative energy transfer may lead to the supply voltage increasing beyond the device's safe operating limits.

The internal resistance of traction batteries is generally sufficiently low to ensure safe absorption of the recovered energy. Problems may arise if the device is powered by a source where the input impedance is high, such as a laboratory power supply, for instance. In this case, it is advised to use an electronic load or a large capacitor connected in parallel with the power supply as protection against overvoltage.

2.2 Communication interfaces

Interface	Connector name	Section	Connector type
CAN	CAN1 (2 connectors)	2.2.1	JST SM04B-GHS
CAN	CAN2 (2 connectors)	2.2.1	JST SM04B-GHS
UART, SWD	Dronecode debug port	2.2.3	JST SM06B-SRSS-TB
USB	USB	2.2.4	USB 2.0 Micro-B
RCPWM, analog, thermistor, etc.	Auxiliary I/O	2.2.2	JST SM04B-GHS



Figure 2.1: Front-side connector placement



Figure 2.2: Dronecode debug port placement

2.2.1 CAN bus

The device is equipped with a single (Myxa A) or doubly-redundant (Myxa B) ISO 11898-2 CAN 2.0B interface. Each CAN interface has two standard UCANPHY Micro connectors joined in parallel, thus eliminating the need for the external T-connectors. Termination resistors are not included.

The secondary CAN bus interface (CAN2) can only be used with redundant CAN bus configurations. With non-redundant CAN bus configurations, only the primary CAN bus connectors (CAN1) should be used with the secondary CAN2 bus connectors being left unconnected. In the case of Myxa A, only the CAN1 interface is available.

The device does not consume power from the CAN bus. BEC-enabled configurations can deliver the power to the CAN bus via the CAN bus connectors if the software is configured accordingly.

Parameter	Min	Тур	Max	Unit
Bit rate	125		1000	Kbps
Differential output voltage, dominant	1.5		5.1	V
Bus power rail voltage	-0.1	5.0	5.5	V
Inter-connector current pass-through	-1		1	А
Contact pair resistance		30	50	mΩ

Table 2.2: CAN bus interface characteristics

Pin no.	Туре	Function	Comment
1	Power	Auxiliary power output	Section 2.3
2	Input/output	CAN high	
3	Input/output	CAN low	
4	Ground	Ground	

Table 2.3: CAN bus connector pinout



Figure 2.3: Connection of CAN nodes in redundant and non-redundant configurations

2.2.2 Auxiliary I/O

Myxa is equipped with an Auxiliary I/O interface available on a dedicated connector. This interface can be used to supply RCPWM control signal, voltage level control, motor temperature measurement, and other auxiliary functions. Refer to the Telega Reference Manual for detailed information on the Auxiliary I/O interface.



Figure 2.4: Auxiliary I/O interface schematic

Symbol	Parameter	Note	Min	Тур	Max	Unit
	Low-level input voltage		-0.3	0	1.6	V
	High-level input voltage			3.3	5.5	V
	Low-level output voltage no load			0	0.5	V
	High-level output voltage	no load	2.8	3.3	3.4	V
	Source/sink output current		-10		10	mA
	RCPWM input pull down resistance	iff RCPWM is enabled	15000	20000	25000	Ω
R _{pull}	Strong pull resistance		980	1000	1020	Ω
V _{pull}	Strong pull voltage		3.2	3.3	3.4	V
R _{io}	Auxiliary pin series resistance		196	200	204	Ω
	Contact pair resistance			30	50	mΩ

Table 2.4: Auxiliary I/O characteristics

Pin no.	Туре	Function	Comment
1	Power	Auxiliary power output	Section 2.3
2	Analog/discrete	Auxiliary I/O	RCPWM input or thermistor input
3		Do not connect	Reserved for future use
4	Ground	GND	

Table 2.5: Auxiliary I/O connector pinout

2.2.3 Dronecode debug port

The device features a standard Dronecode debug port. This port accepts the standard Dronecode Mini debug connector (DCD-M)² and provides access to the UART and SWD interfaces for diagnostic purposes. The Dronecode debug port is only accessible on board-level models.

Parameter	Min	Тур	Max	Unit
Low-level input voltage	-0.3	0	1.6	V
High-level input voltage	2.1	3.3	5.5	V
Low-level output voltage		0	0.5	V
High-level output voltage	2.8	3.3		V
Source/sink output current	-10		10	mA

Table 2.6: Dronecode debug port characteristics

Pin no.	Туре	Function	Comment					
1	Power	Power output	Unfused internal 5 V power rail. Not for production use.					
2	Output	UART TX						
3	Input	UART RX	Pulled down with a resistor					
4	Input/Output	SWDIO	Not for production use					
5	Input	SWDCLK	Not for production use					
6	Ground	GND						
Table 2.7: Dronecode Mini debug connector pinout								

2.2.4 USB interface

The USB interface is provided for diagnostics only and should not be used for production purposes.

2.3 Auxiliary power output (BEC)

Myxa B features a software-controllable auxiliary low-voltage power output (BEC) that can be used to power external low-power devices (e.g. camera, GNSS module, flight controller, etc.) via the CAN bus interface connectors and/or the Auxiliary interface connector. Each output is protected from reverse current flow with ideal diodes so that the device is not back-powered from the bus if the main power is disconnected.

CAN1 is equipped with a dedicated ideal diode and current limiter, while CAN2 shares its power output with

²Refer to the Dronecode documentation for more information on standard connectors and communication interfaces.

the Auxiliary interface connector via a separate self-recovery PTC fuse. The PTC fuse may contribute an additional voltage drop under load.

Multiple controllers connected to the same CAN bus will share the load, which provides fault tolerance and an increase in the total available power to other CAN nodes.

Refer to the Telega Reference Manual for further information on configuring this feature.



Figure 2.5: Auxiliary power output (BEC) schematic

Symbol	Parameter	Note	Min	Тур	Max	Unit
V _{power}	Constant voltage (CV) output	no load	4.9	5	5.2	V
	Constant current (CC) output		0.5	0.85	1.1	А
	Continuous total load current				0.25	А
	PTC fuse trip level		0.25		1.0	А
	Voltage ripple				100	mV _{p-p}
	CV/CC mode switch delay			2		$\mu \mathrm{s}$

Table 2.8: Auxiliary power output (BEC) characteristics

2.4 LED indication

Myxa is equipped with four (Myxa A) or five (Myxa B) LEDs that indicate the status of the hardware and software. Their positions are shown in figure 2.6.



The green CAN1 and CAN2 LEDs indicate network traffic through the CAN interfaces. Myxa A does not have a CAN2 LED.

2.4.1

CAN LEDs

2.4.2 VSI-enabled LED

The VSI-enabled LED indicates that the power stage is armed. When enabled, the LED will illuminate in orange.

2.4.3 Gain LED

The Gain LED reflects the status of the AGC of the phase current measurement circuitry. When the LED is on, the gain is low (high power operation); when off, it is high (low power operation). The LED illuminates in orange.

2.4.4 Status RGB LED

The Status RGB LED indicates the current state of the device control logic. Refer to the Telega Reference Manual for a detailed description of the LED states.