microDRIVE | MP

Datasheet

Version 1.1
Updated 20/03/26

Hargrave
Technologies

hargravetechnologies.com

Contents

01 Safety

This is not the sort of safety page you skip!

We take the utmost care in development and assurance of our products, but power electronics have inherent risk. Used improperly, there is risk of fire, serious injury and damage to property.

Please read this datasheet carefully prior to integration.

Motor controllers channel substantial power. Fault currents can exceed 1 kA and while extremely rare, major failures can result in fire. Design your vehicle accordingly. ESCs should be fused from batteries and isolated from flammable components.

Always ensure you are connecting the motor controller with the correct polarity. Failure to do so can result in a fire.

Never exceed the rated voltage of the motor controller. Failure to do so can result in premature failure or a fire.

micro**DRIVE** MP is rated for submersion in fresh water at 1 m (3ft) depth for 30 minutes. Exceeding this can result in unit failure.

Do not attempt to disassemble or modify the product in any way. Doing so will void your warranty and more importantly, cause damage that results in a failure.

This controller will regeneratively brake by default. Synchronous rectification must be turned off to use it with a one-way power source.

Do not extend the leads beyond recommended values (3m) without consulting Hargrave. This may result in insufficient capacitance and subsequent failure.

While there are multiple fail safes in place, it should be assumed that a powered ESC can start a motor at any time. Take appropriate precautions.

microDRIVE MP is the medium power unit in our DRIVE Series, optimized for minimum weight in a rugged package, ready for any challenge.

With a modern communications and telemetry suite and advanced environmental protection, microDRIVE MP is ready to tackle the most demanding VTOL and fixed wing platforms.

02 At a Glance

15 - 60 V
INPUT VOLTAGE

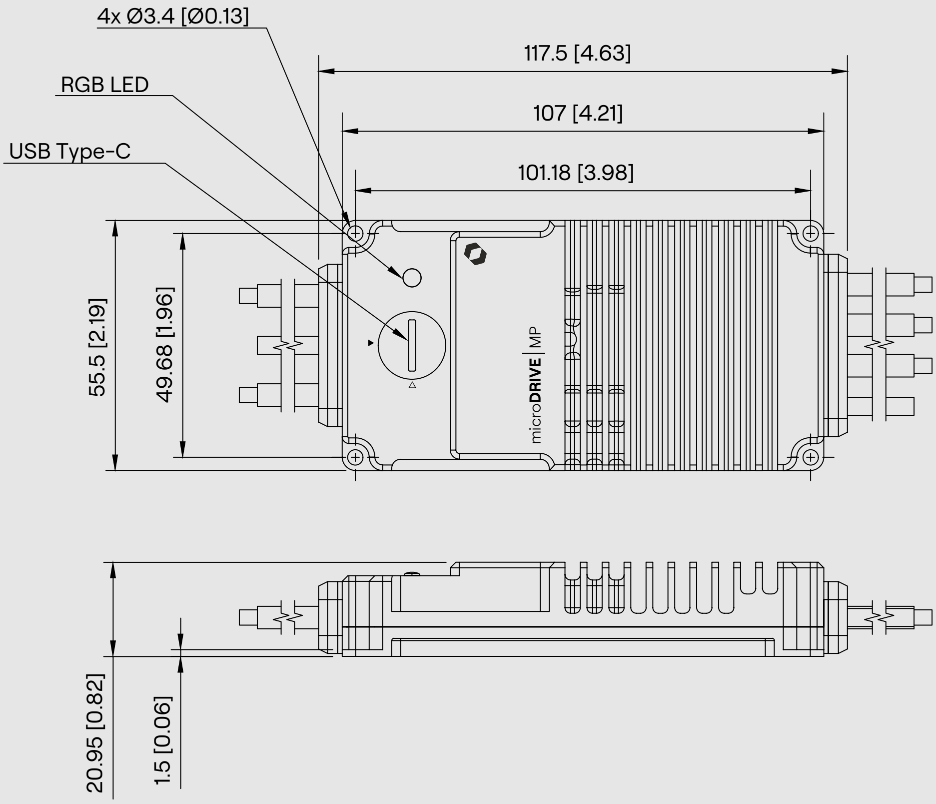
120 A
CONTINUOUS CURRENT

FOCAL
+ TRAPEZOIDAL

DroneCAN
+ ARINC 825, DSHOT, PWM

175 g
BASE WEIGHT

IP67
PROTECTION



Looking for the CAD?

Click below to find the new microDRIVE MP CAD:

hrgve.tech/uD-MP_CAD

All dimensions in mm [inches].

03 Specifications

Electrical

PARAMETER (UNIT)		VALUE	NOTES
Nominal Power Supply Voltage	(V)	15 – 60 [4S – 14S]	The recommended operating range for the units.
Absolute Power Supply Voltage	(V)	12 – 63	Breaching absolute limits (including bus voltage ripples) will result in unexpected shutdowns or unit failures.
Rated Phase Current	(A)	120	Indefinitely, refer to **06 Cooling and Performance** for performance data.
Peak Phase Current	(A)	240	Appropriately cooled.
Voltage Measurement Accuracy	(%)	± 5	Input voltage measurement accuracy across the full-scale range.
Current Measurement Accuracy	(%)	± 5	Input current measurement accuracy across the full-scale range.
Decoupling Capacitance	(μF)	985	Integrated capacitor bank for up to 3 m of input lead length.
Precharge		✓	Bulk capacitance has inbuilt precharge to reduce inrush current.
Regenerative Braking		✓	Configurable operation.
Max. Regenerative Current	(A)	120	Indefinitely, appropriately cooled.
Motor Temperature Sensing		✓	NTC or PTC supported, software configurable.
Isolated Serial Input and Output		✓	DShot/PWM are isolated, including telemetry.
Data Logging		✓	Configurable rate, automatic circular logging.
Hardware Self Tests		✓	Unit will test bridge hardware on power up.
Self-Correcting Memory		✓	Use of onboard backups and ECC memory.

Motor Control

PARAMETER (UNIT)		VALUE	NOTES
Minimum Switching Frequency	(kHz)	4	Automatic switching, configurable range.
Maximum Switching Frequency	(kHz)	64	Automatic switching, configurable range.
Commutation Types		FOCAL and Trapezoidal	Configurable motor control algorithm.
Efficiency		Up to 99%	Maximum achievable efficiency.
Maximum RPM (Trapezoidal)	(eRPM)	500,000	2-pole motor speed.
Maximum RPM (FOCAL)	(eRPM)	200,000	2-pole motor speed.
Bi-Directional Drive		✓	Throttle input can be mapped to cover reverse and forward rotation.
Protection Mechanisms		✓	Temperature (Bridge and Motor), Current, Voltage, Demagnetization, RPM.
Propeller Parking		✓	Supports active parking with external hall sensor.
Sensorless Drive		✓	–
Sensored Drive		Optional	Units have hardware capability for hall-effect sensored drive if motor cable is installed. This will become available as a firmware update.
Motor Type		BLDC, PMSM	–

Communications

PARAMETER (UNIT)	VALUE	NOTES
CAN Bus Support	DroneCAN, ARINC 825	CAN FD capable.
CAN Bus Termination	✓	Software-controlled termination resistor.
Telemetry	✓	CAN, Serial and PWM telemetry supported.
Firmware Updates	✓	USB and CAN interfaces are supported.
DShot Support	DShot150 – DShot600	Standard and Bi-Directional DShot supported.
Servo PWM Support	✓	50-499 Hz input frequencies supported.
Input Resolution	10-bit	Resolution on DShot and PWM input signals.

Physical

PARAMETER (UNIT)		VALUE	NOTES
Weight	(g)	175 [6.17 oz]	Base weight only, not including cables.
Operating Temperature	(°C)	-20 – 110 [-4 - 230°F]	Continuous operation above 85°C [185°F] may reduce lifetime of unit.
IP Rating		IP67*	*Internally validated, external certification pending.
Cables		✓	300mm fixed, 10 AWG power and 28 AWG signal cables.
RGB Indication LED		✓	Refer to the Indicators section of the online documentation.
USB		✓	USB Type-C for configuration and log access.
Configuration Tool		✓	USB/CAN access to logs and configuration.
NDAA Compliance		Standard	See **08 Ordering Options** for further details.
Country of Origin		Australia	–
RoHS/REACH Compliance		✓	–

This quick start guide is a helpful starting point for integrating the micro**DRIVE** MP into your system, but by no means exhaustive.

Please read the datasheet and online documentation before full vehicle testing.

04 Quick Start

Wiring

- If using a tethered system or unidirectional power supply for input power, confirm the AFW setting is disabled.
- Check V_{CC} is supplied when using DShot or PWM.

Configurator

Try our guided Quick Start and configure your micro**DRIVE** MP with the Hargrave Configurator Tool at:

configurator.hargravetechnologies.com

All settings are also available over DroneCAN.

Communications

- When using CAN Bus communication, ensure CAN Bus is enabled. The unit will use DroneCAN for control and telemetry. DShot and PWM inputs are disabled. Disabling this setting enables other protocols.
- If using CAN, set the DroneCAN ESC Index as per the flight controller output number. This designates the ESC position within the system/aircraft.
- Set the motor pole pairs setting to match the motor connected, such that mechanical RPM is reported (rather than electrical RPM).
- Enable the CAN terminator on the unit furthest away from flight controller if no other CAN devices are terminating the bus.

Mounting

- Ensure cables are externally strain-relieved for long-term reliability.
- Maximize cable bending radii. Tight bending at the seal may promote water and dust ingress.

The current sensing accuracy on the micro**DRIVE** MP is sensitive to external magnetic fields. With this in mind, its important to **NOT** mount the MP:

- Directly to a ferrous material like steel.
- Within approximately 30 mm [1.2 in] of strong external magnetic fields.

Doing any of the above will affect current sensing accuracy and may impede over-current protection systems.

If any of these are unavoidable in your case, please consult the Hargrave Technologies team for assistance and advice.

Protection Systems

Activation of protection mechanisms may cause unexpected system responses, including motor shut down. It is important you understand these behaviors and configure them for your system. You can find more information on **07 Protection Systems**.

05 Integration

Unidirectional Power Supplies

If you are using the inverter with a power source that is not able to sink current, such as a unidirectional power supply, it is **critical** that you disable synchronous rectification. This is to prevent regenerative braking from causing damage to the controller or power supply.

Capacitance

Sufficient input capacitance is essential for reliable operation of any motor controller. It's important that you measure that there is enough capacitance in your specific application.

To do this, install the motor controller in it's intended use application and apply the maximum load the unit will see in service. Measure the voltage ripple at the input terminals to the motor controller. The ripple should not exceed 5% of the bus voltage.

Please contact **Hargrave** if you have any concerns about the capacitance in your application.

Signal Isolator Supply

micro**DRIVE** MP requires a 3.3 - 18 V source alongside the signal. The power is used for the onboard isolation, providing galvanic isolation from the power ground for increased noise immunity. Ground connections should be star connected at the flight computer wherever possible.

Power Sequencing

- CAN is available when $V_{BUS} > V_{MIN}$.
- DShot/PWM is enabled 140 ms after $DSHOT_{V+}$ present AND $V_{BUS} > V_{MIN}$.
- Powering down V_{DShot} should not be used as a make-safe, as the isolator may be powered by the DShot/PWM signal.
- Do not switch the isolated PSU by severing the Signal GND connection.

Port and Pin Electrical Tolerances

PORT/PIN	MAX. CURRENT (mA)	ABS. MAX. VOLTAGE (V)	ABS. MIN. VOLTAGE (V)	PASSIVE LOADING
Main Bus (V_{BUS})	—	63	- 0.4	—
Motor Phases	—	V_{BUS} + 0.6	- 0.4	—
$DSHOT_{V+}$ In	30	Sig_GND + 18	Sig_GND + 3.3	—
CAN_H, CAN_L	115, Differential Mode	CAN_GND + 12	CAN_GND - 12	Switchable 120 Ohm termination when powered.
CAN_GND	—	Bus_GND + 0.6	Bus_GND - 0.7	—
UART RX	10	Sig_GND + 5.5	Sig_GND - 0.3	Pulled to 3.3 V via 5.1k resistor.
TLM	10	Sig_GND + 5.5	Sig_GND - 0.3	Open drain, pulled to 3.3 V via 5.1k resistor.
SIG	10	Sig_GND + 5.5	Sig_GND - 0.3	Pulled to 3.3 V via 5.1k resistor. Bidirectional DShot response driven with output impedance of 120 Ohms.
HALL A, B, C	1	Bus_GND + 5.5	Bus_GND - 0.2	Pulled to 3.3 V via 2.7k resistor.
NTC	0.33	Bus_GND + 3.3	Bus_GND	—
5 V Out	20	5.25	4.75	—

Mounting

The micro**DRIVE** MP offers 4 mounting holes to secure the unit to your application. These are best suited to M3 socket head bolts. Ensure you use a tightening torque appropriate to the fastener and mounting material you are using.

The micro**DRIVE** MP is primarily designed for use in aerial vehicles; vibration isolation of the unit, particularly in land-based applications, will increase the longevity of the unit.

Ensure there is appropriate mechanical strain relief on all cables attached to the unit. This will reduce the chance of cable joints failing, and improve the reliability of the sealing.

Ingress Protection

The micro**DRIVE** MP is rated to IP67 (IEC 60529:2013).

For water ingress, this allows for immersion in 1 m [3 ft] of water for 30 minutes. Exceeding this could result in damage or failure of the unit.

For dust ingress, the unit is placed under vacuum for up to 8 hours in a dust filled chamber to draw dust in. No dust ingress can be observed.

Any Questions?

We're here to help. Reach out directly to our engineering team at:

contact@hargravetechnologies.com

Thermal Management

The micro**DRIVE** MP is offered with an integrated housing that fulfills the thermal management requirements for the unit in most applications. To achieve the full 120 A phase current rating in this configuration, the heatsink will require at least 12 m/s airflow parallel to the heatsink.

Motor Selection

A motor controller is only one part of a larger propulsion system. To achieve peak performance, it is important to select an appropriate motor for your load. The loaded KV of the motor should result in the motor reaching maximum required operational speed at minimum bus voltage. This ensures the peak load on controller occurs near 100% motor duty cycle, where the controller is the most efficient.

You can find more information about selecting an appropriate motor for your micro**DRIVE** MP at:

hargravetechnologies.com

Input Signals

The micro**DRIVE** MP supports several communications protocols:

- DShot
- Bidirectional DShot
- PWM
- DroneCAN

To maintain effective command of your motor controller, it is important to ensure good signal integrity. Do not route signal lines alongside bus or other high power, high noise wires.

You can find the appropriate pinout for your unit in the Pinouts section in **09 Pinouts**.

06 Cooling and Performance

Many factors influence the final performance of an ESC in any real world use. This section is intended to provide a simplified method of evaluating ESC performance based on the most critical factors. Results from this method should be considered indicative only.

Desired Phase Current

It is important to make the distinction between bus current and phase current. Motor controllers are rated based on phase current, as this is the primary factor in thermal load.

Our ESCs vary motor speed by changing the phase voltage. For a given input power, dropping phase voltage requires boosting the phase current.

You can estimate the instantaneous phase current required using:

$$I_{\text{phase}} = P_{\text{bus}} \times \frac{KV}{\text{RPM}}$$

where:

P_{bus}	= Expected Bus Power.	(W)
KV	= Loaded* Motor KV.	(rpm/V)
RPM	= Operational RPM.	(rpm)

**Motor manufacturers typically report unloaded KV, whereas loaded KV should be used. Note this is often substantially different to unloaded KV.*

Allowable Temperature Rise

The allowable temperature rise for your application is given by:

$$\text{Allowable } \Delta T = T_{limit} - T_{\text{amb}}$$

We recommend a T_{limit} of 85°C [185°F] for long term reliability

Up to 110°C [230°F] is available for short term use.

Required Airflow

The calculated allowable temperature rise can be used with the below graph to determine the velocity of the cooling airflow over the unit needed to achieve your desired continuous phase current.

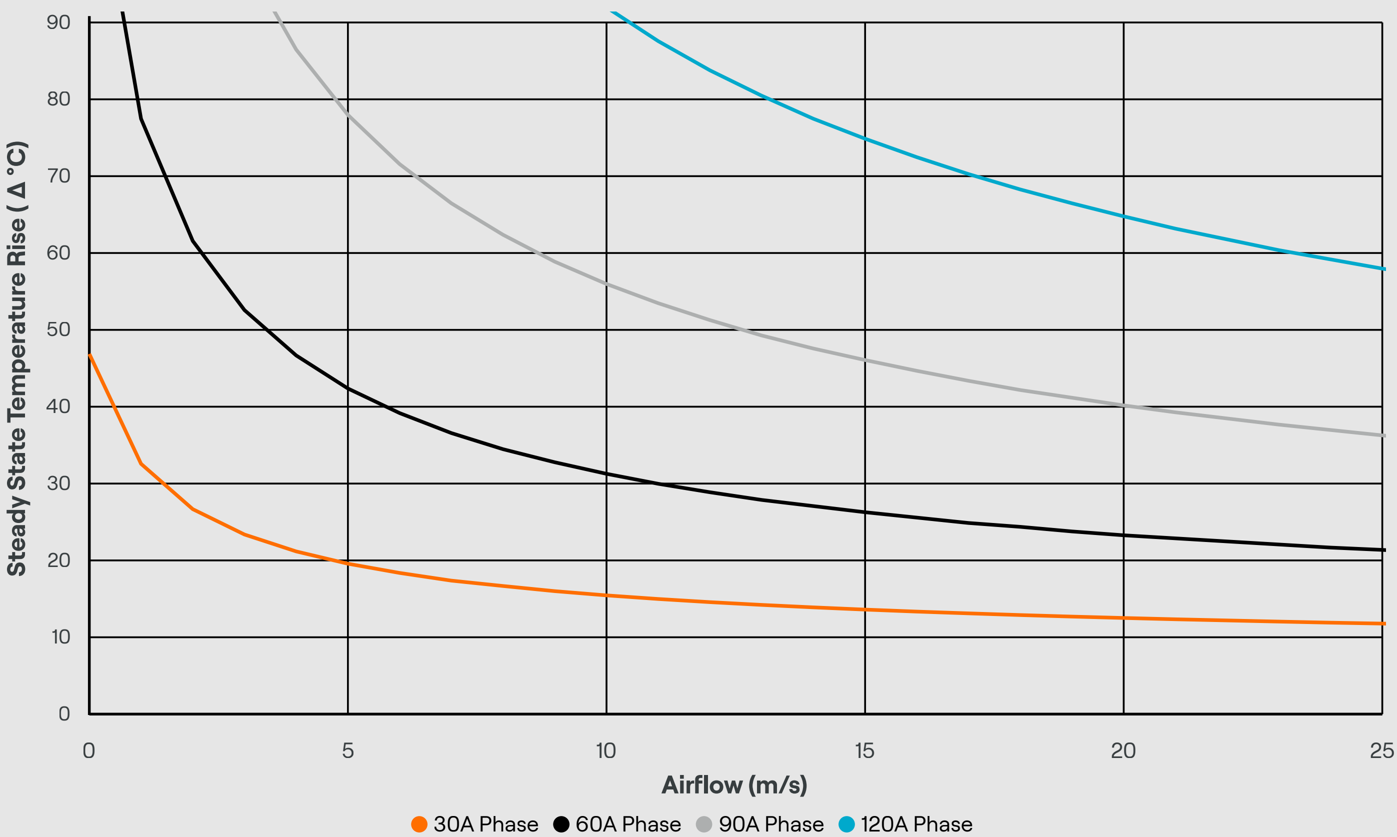
If running at voltages below 60 V, use the Airflow vs Voltage Modifier graph to determine the reduction factor needed for the required cooling airflow.

Speak to us

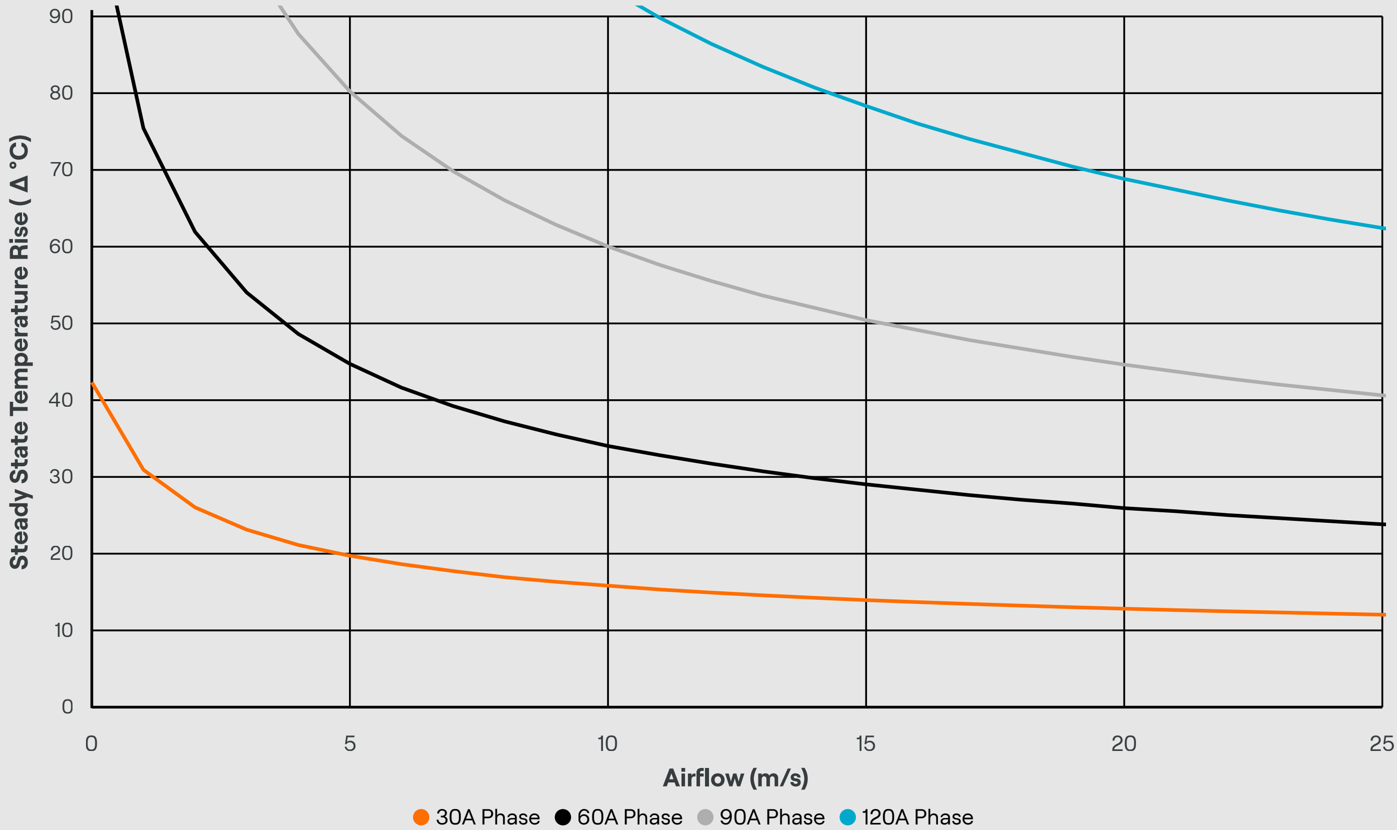
For any questions about performance in specific applications, reach out to our engineering team at:

contact@hargravetechnologies.com

Steady State Temperature Rise vs Airflow, 60V Bus, Trapezoidal

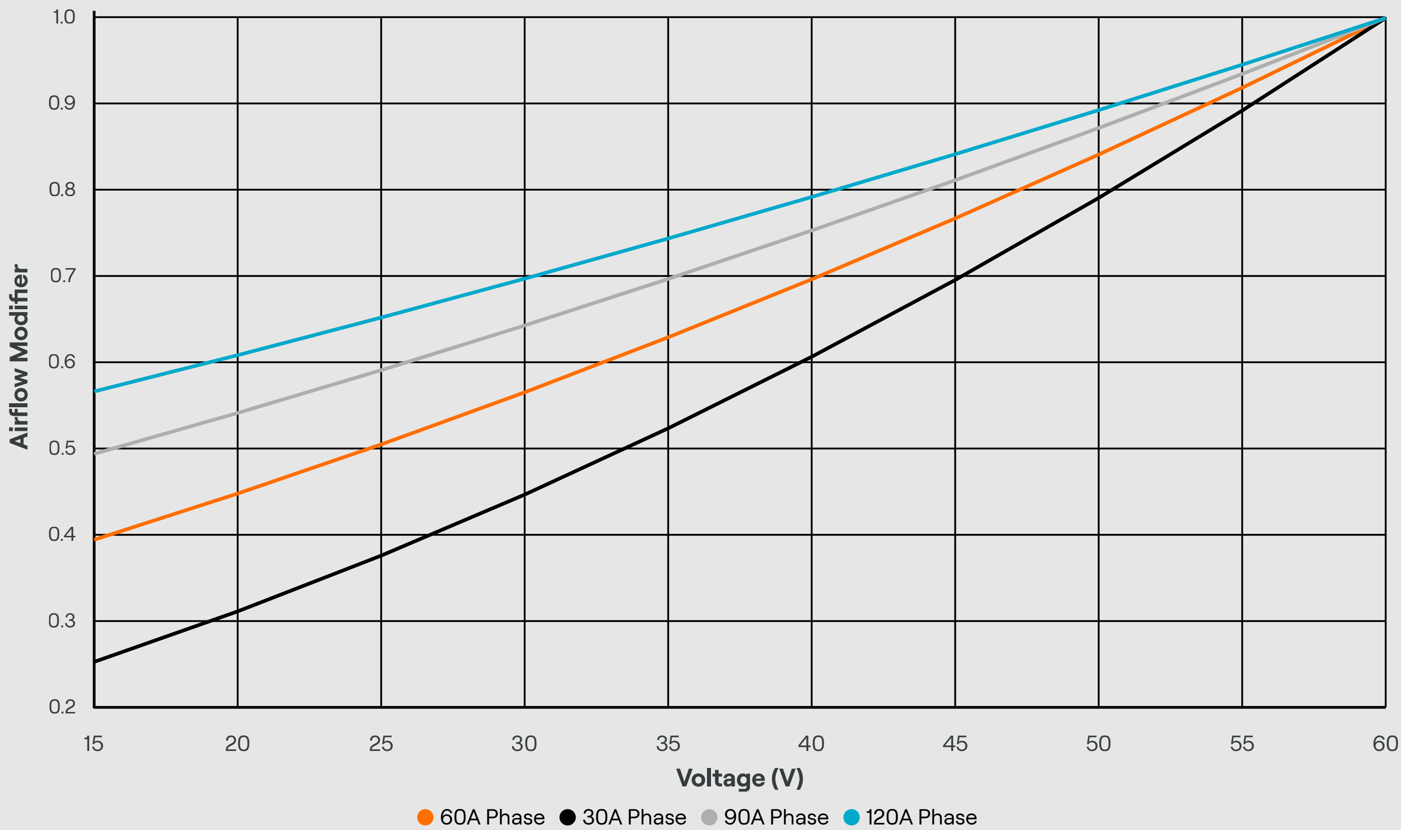


Steady State Temperature Rise vs Airflow, 60V Bus, FOCAL



If your system is operating at less than 60V, you can use the multiplier below to determine the reduction in the cooling airflow needed.

Airflow vs Voltage Modifier



Steady-State Temperature Response

If further detailed analysis is needed, the model shown below demonstrates the steady state temperature response of the micro**DRIVE** MP as a function of the Airflow Velocity, Bus Voltage and Phase Current.

$$T_{ss} = \frac{(aI_{phase}{}^{2}) + (bVI_{phase})}{\sqrt{v_o}} + T_{amb}$$

where:

T_{ss}	=	Steady State Temperature Rise	(°C)
I_{phase}	=	Phase Current in Amps	(A)
V	=	Bus Voltage in Volts	(V)
v_0	=	Freestream velocity of the cooling air	(m/s)
T_{amb}	=	Ambient Temperature	

Trapezoidal

a = 1.384 x 10^{-2}

b = 1.043 x 10^{-2}

FOCAL

a = 1.367 x 10^{-2}

b = 1.205 x 10^{-2}

In high temperature ranges, this model predicts unit temperature to within ± 5°.

The application of this motor controller must be managed to ensure the steady state temperature above the ambient does not exceed the temperature limit. This can be done by increasing the airflow over the unit, changing the operating voltage of the system or reducing the phase current requirement of the application.

Transient Temperature Response

The transient response of the system can be determined using the provided second order system below.

$$\frac{d^2T}{dt^2} + 2\zeta\omega_n\frac{dT}{dt} + \omega_n{}^2T = \omega_n{}^2T_{ss}$$

where:

T	=	Instantaneous Temperature as a function of *t* Time (s)	(°C)
T_{ss}	=	Steady-State Temperature, calculated from previous sections.	(°C)
ζ	=	23.66 $\times v_o{}^{-0.57}$	
ω_n	=	0.086	(rad/s)
v_0	=	Freestream velocity of the cooling air	(m/s)

07 Protection Systems

PROTECTION NAME	DEFAULT THRESHOLD	DEFAULT BEHAVIOR	RESET REQUIREMENTS
Bridge Over Temperature	Bridge temperature exceeded 100°C [212°F] during operation. Threshold is configurable.	Unit will reduce maximum output duty cycle to 50%. Behavior is configurable.	Bridge temperature drops to 5°C [9°F] below configured threshold.
Over Voltage	Bus voltage exceeded 63 V. Threshold is configurable.	Unit will shut down drive to motor. Behavior is configurable.	Bus voltage drops to below the threshold.
Under Voltage	Bus voltage dropped to below 15 V. Threshold is configurable.	Unit will not intervene. Behavior is configurable.	Bus voltage rises above the threshold.
Over Bus Current	Bus current exceeds 150 A during operation. Threshold is configurable.	Unit will limit maximum output duty cycle while running at threshold.	Bus current drops to below threshold.
Over Phase Current	Phase current exceeds 200 A during operation. Threshold is configurable.	Unit will limit maximum output duty cycle while running at threshold.	Phase current drops to below threshold.
Loss of Signal	No signal detected for over 500 ms (regardless of protocol). Period is configurable.	Unit will shut down drive to motor.	Signal regained, and 0% throttle supplied to resume drive.
Loss of Arming	No arming detected for over 5000ms. Period is configurable.	Unit will shut down drive to motor.	Arming regained, and if require zero throttle is set, 0% throttle supplied to resume drive.
Motor Saturation	Motor saturation detected while driving under load.	Unit will limit the maximum output duty cycle while running at saturation limit.	Automatic reset occurs once saturation clears.
Too Low RPM	KV is incorrectly selected (too low) for current bus voltage.	Maximum RPM to motor is reduced.	Correct KV and voltage combination used.
Onboard Memory Corruption	Firmware or settings was detected to be corrupt upon power on.	Unit is locked out.	Connect to configuration tool for reset options.
Motor Over Temperature (requires motor temperature sensor)	Motor temperature exceeded 120°C [248°F] during operation.	No action. Configurable to limit duty cycle.	Motor temperature dropped below configured limit.

08 Ordering Options

SKU	CABLE LENGTH	NDAA COMPLIANT	MOTOR SIGNAL CABLE
105692	300mm	✓	✓

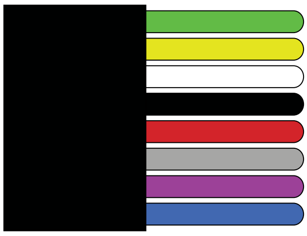
The secret is in the source

All Hargrave Technologies products are engineered, manufactured and tested in Australia from first class components. Australia is classed as a domestic source under Title III of the United States Defense Production Act.

Because of this, we can produce units that are compliant with the United States National Defense Authorization Act 2023 – generally required for suppliers to United States Government agencies. All variations of micro**DRIVE** MP are NDAA compliant, with all legislated components sourced outside of the NDAA “countries of concern”, including the People’s Republic of China. It is also EO13981-compliant.

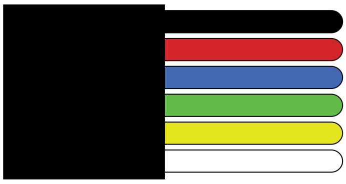
09 Pinouts

Control Signal - Bare Wire



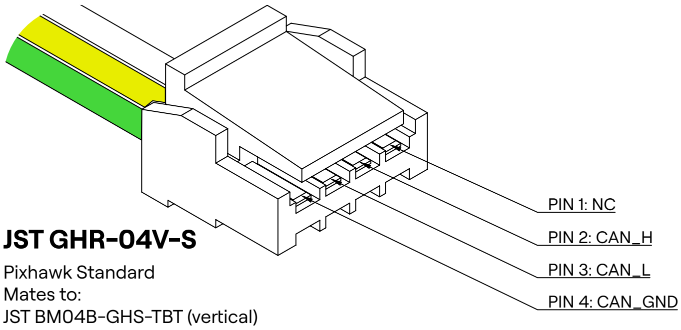
GREEN	CAN_GND
YELLOW	CAN_L
WHITE	CAN_H
BLACK	DSHOT_GND
RED	DSHOT_V+
GREY	DSHOT
PURPLE	DSHOT_TLM
BLUE	RXD

Motor Signal - Bare Wire



BLACK	GND
RED	5V
BLUE	HALL_C
GREEN	HALL_B
YELLOW	HALL_A
WHITE	MOT_NTC

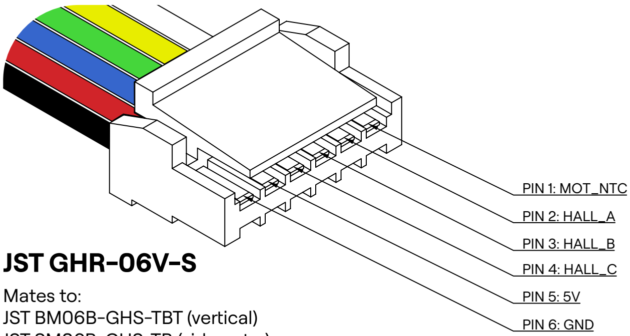
Control Signal - CAN



JST GHR-04V-S

Pixhawk Standard
Mates to:
JST BM04B-GHS-TBT (vertical)
JST SM04B-GHS-TB (side entry)

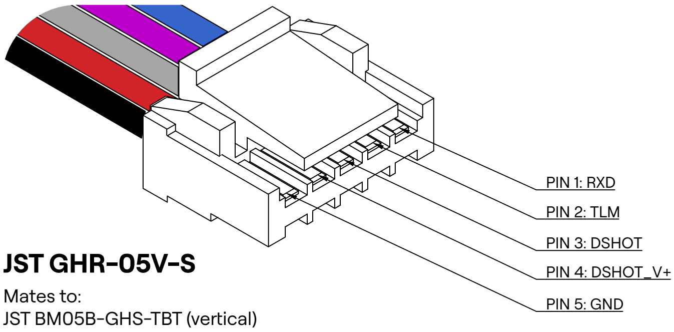
Motor Signal - JST GH



JST GHR-06V-S

Mates to:
JST BM06B-GHS-TBT (vertical)
JST SM06B-GHS-TB (side entry)

Control Signal - DShot



JST GHR-05V-S

Mates to:
JST BM05B-GHS-TBT (vertical)
JST SM05B-GHS-TB (side entry)

10 Powered by GateKEEPER

GateKEEPER is a unified technology core that underpins the next generation of Hargrave Technologies' motor controllers. It encompasses everything we've learnt through over a million flight hours with our development partners and extends it with CAN, sensored drive, extended onboard logging and enhanced current measurement.

Using Gate**KEEPER**, we can share a common hardware and firmware foundation across all of our inverters, so they can all benefit from the diversity and longevity of applications demanded by modern UAS. A flight hour on one Gate**KEEPER** ESC is a flight hour across all Gate**KEEPER** ESCs, allowing us to minimize long term reliability risks across our entire product range.

We can also use Gate**KEEPER** to rapidly develop bespoke controllers specific to your application, with the reliability of an extensively flight-validated core shared with our COTS products.

Response Ready.

Contact us.

Sales

If you'd like to find out more about how you can take off with micro**DRIVE** MP, get in touch with our sales engineers at:

sales@hargravetechnologies.com

Documentation

For a detailed technical overview and operations manual, visit:

docs.hargravetechnologies.com

Technical

For any technical questions, please reach out to your technical contact at Hargrave or email us at:

contact@hargravetechnologies.com

11 Revisions

Revision	Date	Description
1.0	26/02/2026	Initial Release
1.1	20/03/2026	Additional mounting instructions.

12 Disclaimer

This electronic speed controller (ESC) datasheet is provided for informational purposes only. This ESC is designed and intended solely for use in uncrewed aerial vehicles (UAVs) and drones. It is not intended for any other applications in which a malfunction or failure may cause loss of life, injury or property damage, including but not limited to crewed aviation.

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By using Product, you agree that:

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9. Any modifications or alterations made to Product are strictly prohibited and may result in unsafe operation, voiding of warranty, and legal consequences.
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11. It is the responsibility of the user to seek guidance from Hargrave for any applications other than UAVs to determine suitability, compliance, and safety.
12. By using Product, you acknowledge and agree to abide by the terms of this disclaimer. If you do not agree with these terms, you must not use Product for any purpose.

Please consult Hargrave for guidance on the use of Product in applications other than UAVs.