FASTON Terminal Current Limits

Applicable Specifications

Standards of the FASTON Terminals used in RoboteQ products are based on UL-310 Temperature Rise and Current Requirements.

UL-310 defines the safety standard for electrical quick-connect terminals.

UL-310 Specification for Continuous and Intermittent Current

Note RoboteQ motor controllers use Series 250 size FASTON Terminals and our literature states that the published current limits of our controllers is considering the use of 10 AWG wires.

The UL-310 Standard defines Continuous Current as the maximum allowable current that should be applied to a given receptacle and wire combination that does not exceed a rise in temperature greater than 30°C

The UL-310 Standard defines Intermittent Current as the maximum allowable current that should be applied to a given receptacle and wire combination that does not exceed a rise in temperature greater than 85°C during a specific time period. The time period is a one hour cycle consisting of 45 minutes on and 15 minutes off.

Current Limit Simulation Test

The highest possible current that may be applied to any FASTON Terminals based on published current ratings of all RoboteQ controllers is 120A. The highest continuous current rating of this is given as 40A per motor channel on a three channel controller. This means that if all three motor channels are outputting 40A, there will be a 120A draw on the VBAT FASTON Tabs. A resistive load and high current power supply was used to simulate this condition. 40A was applied to all three motor channels simultaneously for a period of 45 minutes. Applicable temperatures were measured at the beginning of the test before current was applied. Then, temperatures were measured again at the end of the 45 minute period and the change in temperature was calculated.

In the test setup the following conditions were assumed as per the recommendations in our documentation:

- The motor controller was mounted to an aluminum block and thermal paste was used between the controller heatsink and the block. This was to simulate mounting the controller to a metallic chassis for proper heat transfer.
- Both VMOT (to Batt+) and GND (to Batt-) have two FASTON Terminals available. Both respective terminals were used, allowing the current to be shared across both.
- The test was performed in open air and ambient temperature of 25°C.

Intermittent Current Test Results & Conclusions

Terminals:	Starting Temp:	Ending Temp:	Absolute Temp Δ:	Actual FASTON Δ:
VMOT	25.9 °C	85.3 °C	59.4 °C	45.5 °C
Motor Out	25.9 °C	60.5 °C	34.6 °C	20.7 °C
Chassis	25.9 °C	39.8 °C	13.9 °C	-

The Absolute Temperature Delta refers to the total temperature change of the system. Actual FASTON Delta refers to the temperature change of the terminals alone (Actual FASTON Δ = Absolute FASTON Δ – Absolute Chassis Δ).

It can be observed that the change in temperature after applying 120A to the complete system meets the requirements as defined by the UL-310 Intermittent Current Requirements.

Continuous Current Test Results and Conclusions

After the initial test at 120A for 45 minutes, the controller was then tested to determine at which maximum current value the FASTON Terminals would meet the UL-310 continuous current specification. This was found to be at 100A maximum current on the VMOT and GND FASTON Terminals. At this current the temperature change data is as follows:

Terminals:	Starting Temp:	Ending Temp:	Absolute Temp Δ:	Actual FASTON Δ:
VMOT	30 °C	65 °C	35 °C	24 °C
Motor Out	30 °C	51 °C	21 °C	10 °C
Chassis	27 °C	38 °C	11 °C	-

After the designated time period of 45 minutes and subtracting the heatsink temperature, it can be observed that the temperature change on the FASTON Terminals was well below 30 °C.

In the case of this experiment, 33.3A was applied to all three motor channels continuously for 45 minutes to achieve 100A continuous current draw on the VMOT terminals. This same draw on the VMOT terminals can also be achieved by applying different current to each motor channel individually or by not using all three motor channels at once.

Practical Considerations

The intermittent current test applied the full published current limit and full duty cycle to all three motor channels continuously for 45 minutes. In typical applications this will not happen. Generally not all motors will be operating at once, so the actual current draw on VMOT would be less than 120A. Additionally, in most applications it is not likely that all three motors will be operating at full duty cycle, so the period of time in which high current is drawn on VMOT would be less.

Additionally, practical battery logic must be taken into consideration. Using the above test as an example, it would require multiple large batteries to be able to deliver 120A continuously for 45 minutes. In most applications, the charge time of batteries would last much less than 45 minutes if 120A was being drawn continuously.

In the untypical cases where the conditions of this test are replicated, with the use of a high powered regulated supply for example, the temperature change of the FASTON Terminals can easily be reduced further by:

- Soldering the FASTON Connecter to the FASTON Tab. This would reduce the resistance at the terminal.

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- Applying basic thermal regulation techniques such as using a fan to blow air across the terminals to increase heat dissipation.

Summary

The published maximum current for RoboteQ motor controllers that use FASTON Terminals does meet the requirements of UL-310 Intermittent Current Standards. This is as long as the recommended connection and mounting techniques are used to allow for proper heat dissipation.

Specifically, applying 120A continuously to the VMOT FASTON Terminals does meet the UL-310 Intermittent Current Standards, and applying 100A continuously to the VMOT FASTON Terminals does meet the Continuous Current Standards.

All in all, the maximum current that can be drawn on FASTON Terminals is strictly related to the thermal characteristics of the system. If further heat dissipation is needed to reduce the temperature rise at the FASTON Terminals during high power operation, then additional heat dissipation techniques may be used such as air or liquid cooling.