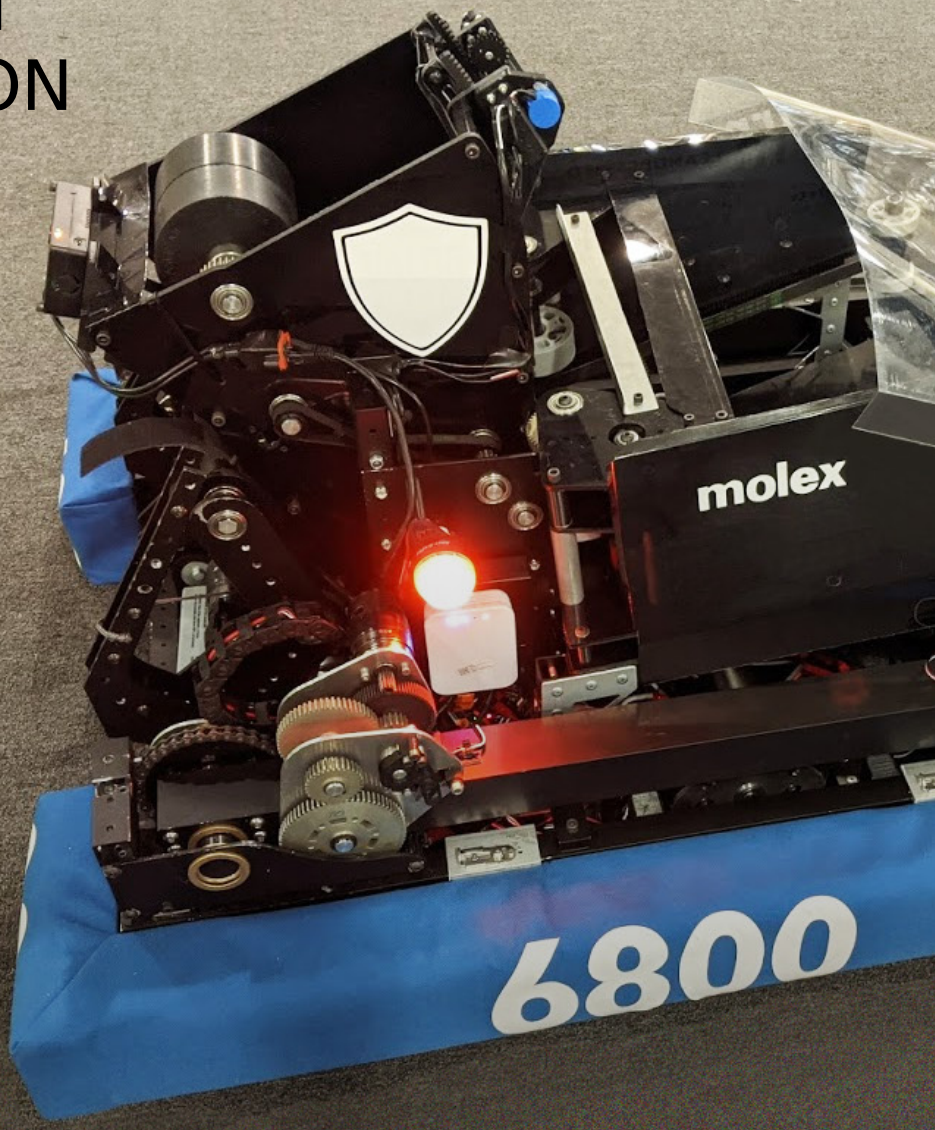
DESIGN GUIDE

FIRST ROBOTICS

FOR INSPIRATION AND RECOGNITION OF SCIENCE AND TECHNOLOGY



FIRST ROBOTICS COMPETITION

FIRST ROBOTICS COMPETITION

FIRST is a robotics competition that pairs students with volunteer mentors, including expert employees from Molex. Molex cables and connectors are intregal components in the start-up kits used by more than 3,000 FIRST teams.

Use this guide to assist in the selection of products to build out the different functions of your robot.

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DESIGN GUIDE

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TEAMS FROM AROUND THE GLOBE COMPETE TO BUILD A WORKING ROBOT. FOR ASSISTANCE WITH THE DESIGN PROCESS, FOLLOW OUR GUIDELINES.

This is a design guide that provides connection recommendations for alternatives that can be used on connection points for FIRST Robotics competition builds. We recommend that all users/participants read the FIRST Robotics Game manual with the requirements for connection systems and submissions for deviation.

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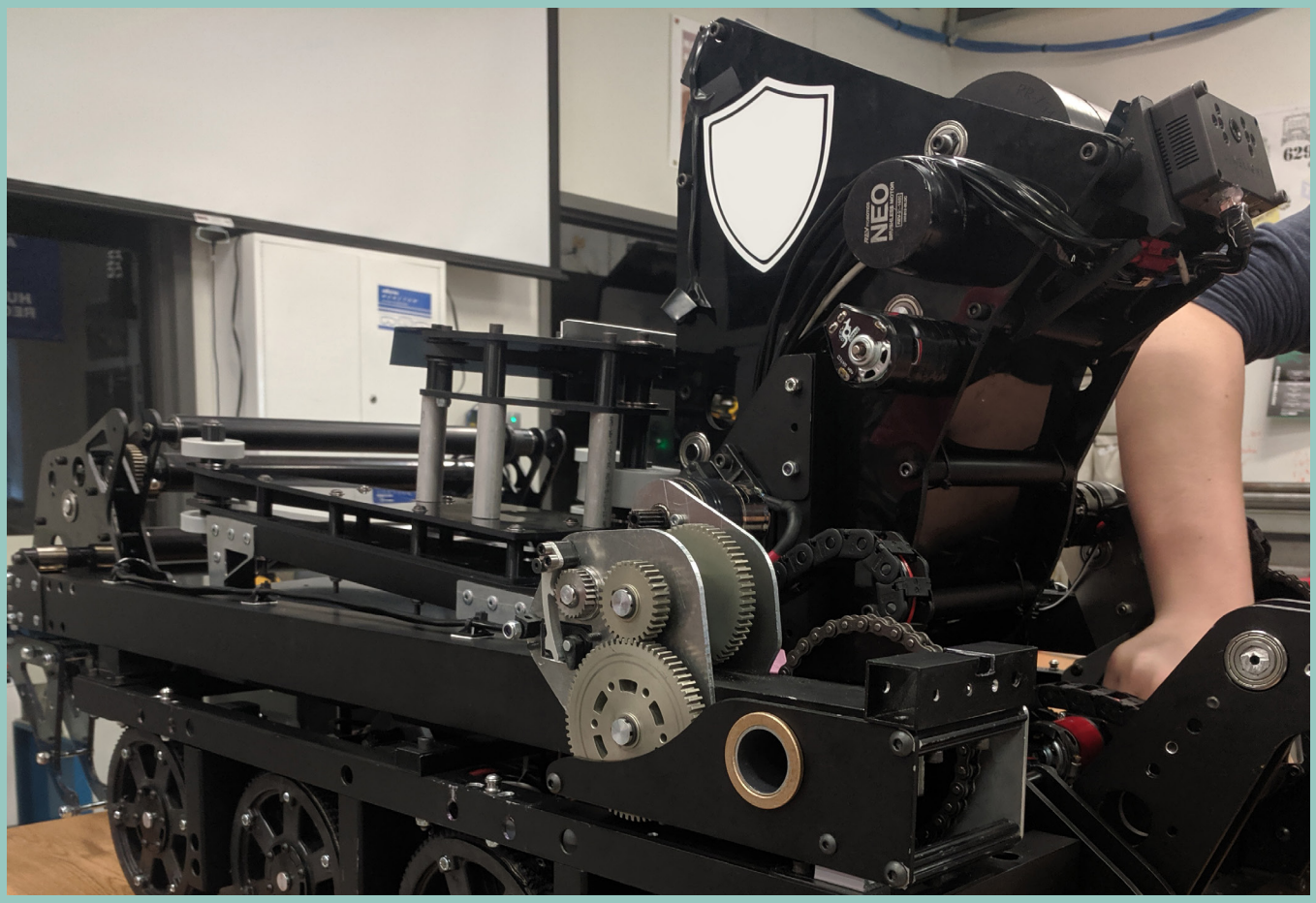
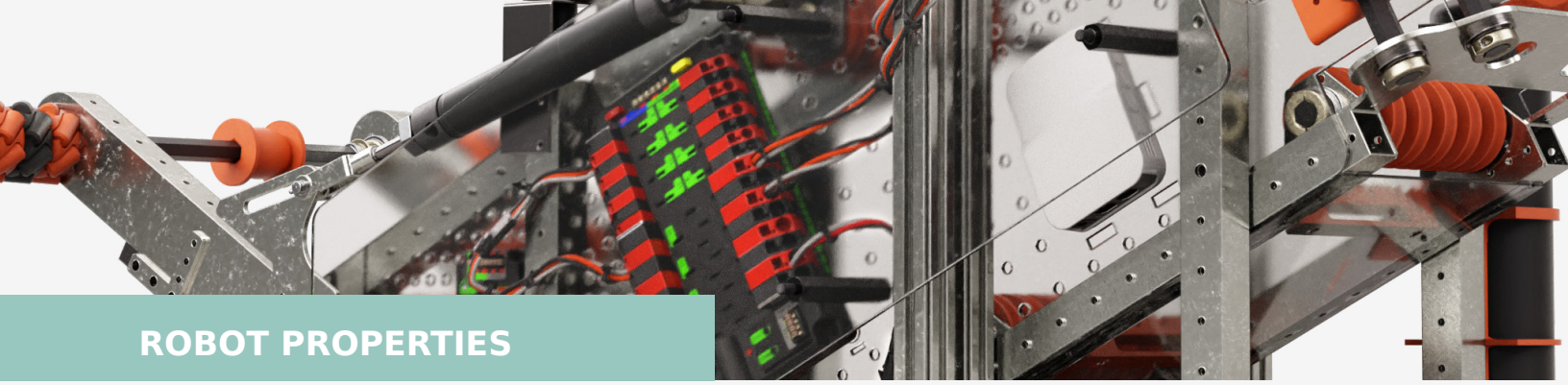
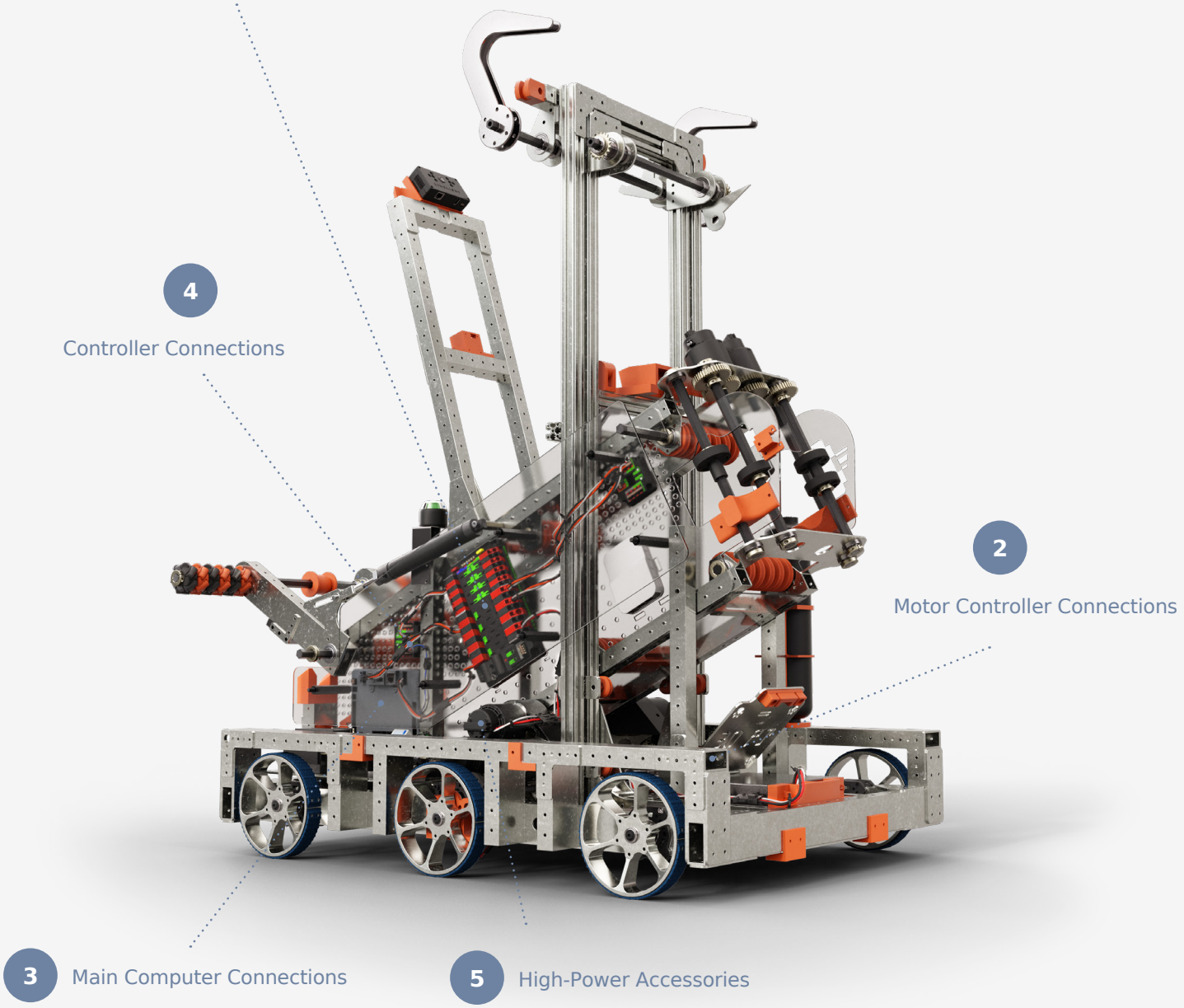
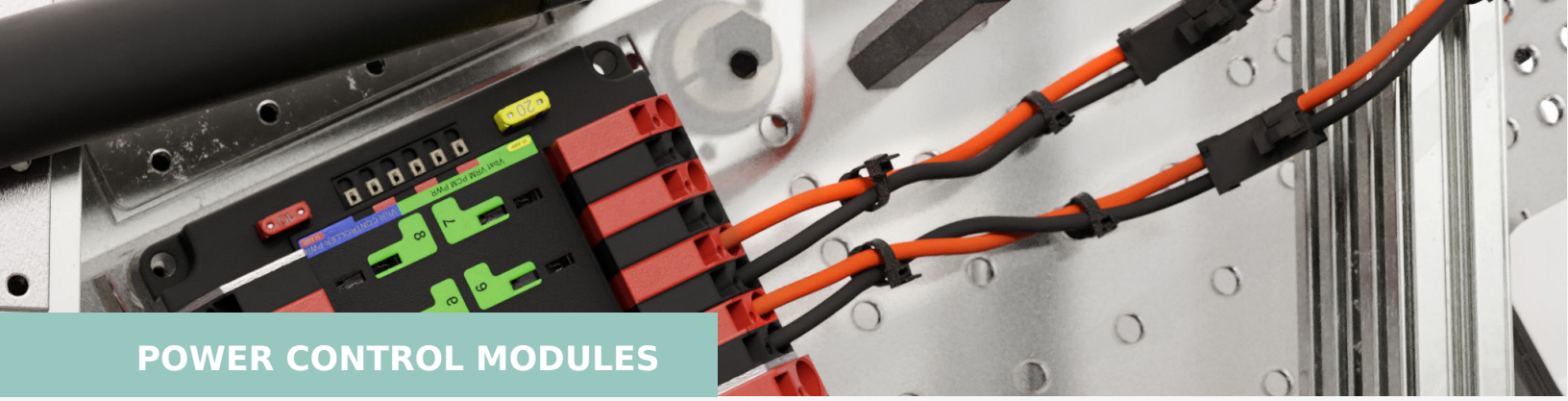




ROBOT PROPERTIES

SELECT BY FUNCTION





POWER CONTROL MODULES

Power control modules may be used from multiple approved companies in the FIRST Robotics guidelines. We typically see these modules using larger wires that range from 8 to 12 AWG. These cables generally have leaded wires but may be updated to allow for wire-to-wire applications.

BASIC

STANDARD .093" CONNECTORS	
Max. Amps	Up to 11.0A
Voltage	600V
Circuits	3
Wire Gauge	12 to 22 AWG
Terminal Part #	02092103/02091104
Digi-Key Connector	19091036/19092036
Digi-Key Pre-Crimped Lead	797582033/797582035
Digi-Key Discrete Cable	2162911031/2162931031

The Standard .093" connectors are connectors that use barrel (round) terminals. They typically have one point of contact and are a very cost-effective solution for wire-to-wire applications.

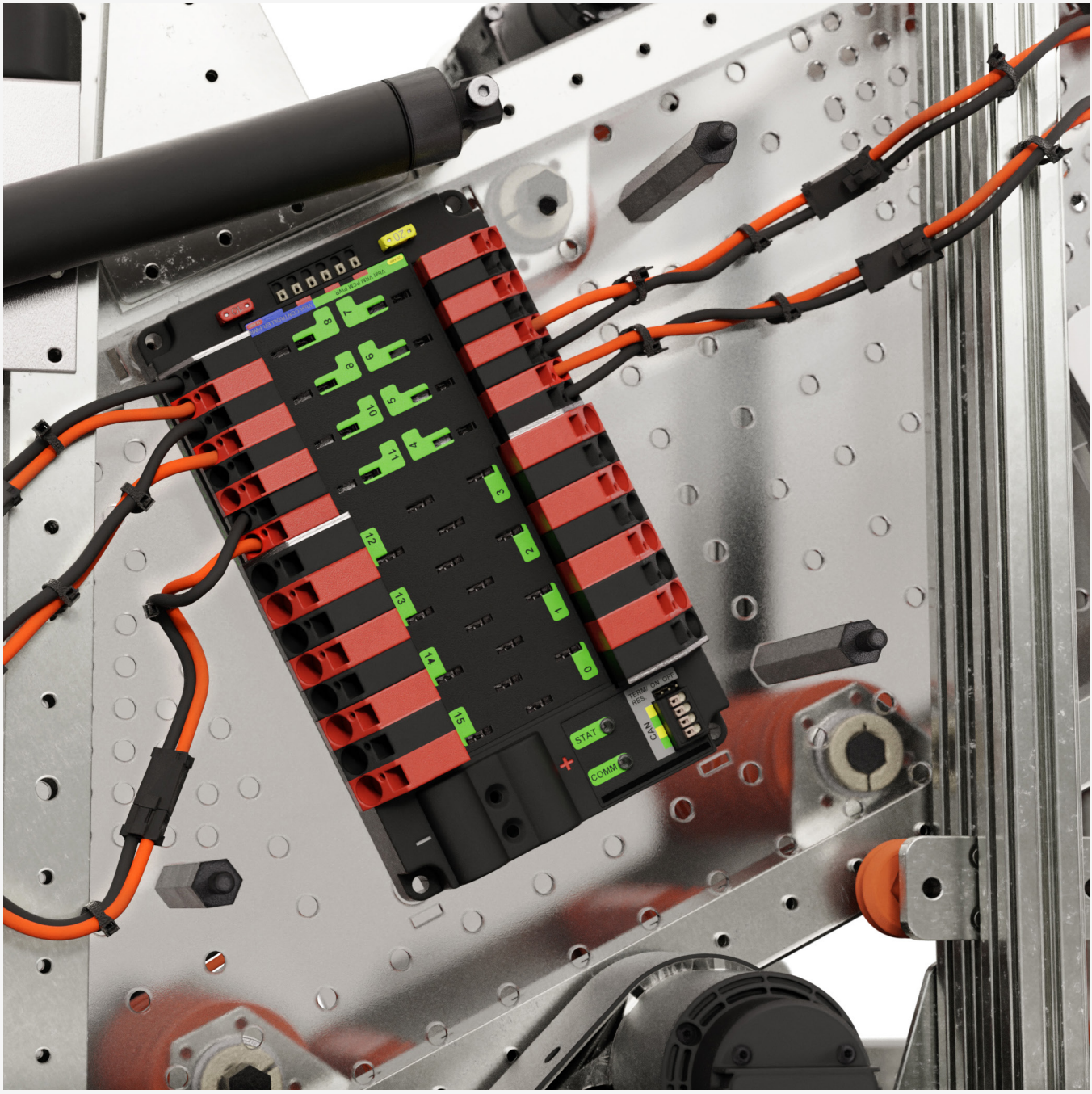
ENHANCED

MEGA-FIT CONNECTORS	
Max. Amps	Mega-Fit
Voltage	600V
Circuits	3
Wire Gauge	12 to 16 AWG
Terminal Part #	768230343/1054170333
Digi-Key Connector	2004561213/2138150103
Digi-Key Pre-Crimped Lead	797582039
Digi-Key Discrete Cable	2164011031

Mega-Fit connectors allow for positive locking and isolated silos. The crimp terminals bring multiple points of contact to help better conduct power.

APPLICATION USAGE ON ROBOT

Mega-Fit Power Connectors



MOTOR CONTROLLER CONNECTIONS

In the FIRST Robotics design requirements, there is a standard connector that is recommended. However, teams may submit documentation for a deviation from this battery connection system. Below are two options that offer superior performance for connections with high amperage and voltage for battery-use applications.

BASIC

SUPER SABRE CONNECTORS	
Max. Amps	Up to 18.0A
Voltage	600V
Circuits	3
Wire Gauge	14 to 20 AWG
Terminal Part #	433750001/431782002
Digi-Key Connector	444412003/436802003
Digi-Key Pre-Crimped Lead	797582041/797582043
Digi-Key Discrete Cable	2160111031

Super Sabre is a wire-to-wire cable system designed to offer superior power in a smaller package. This system is best used in smaller spaces due to its spade-style terminal design.

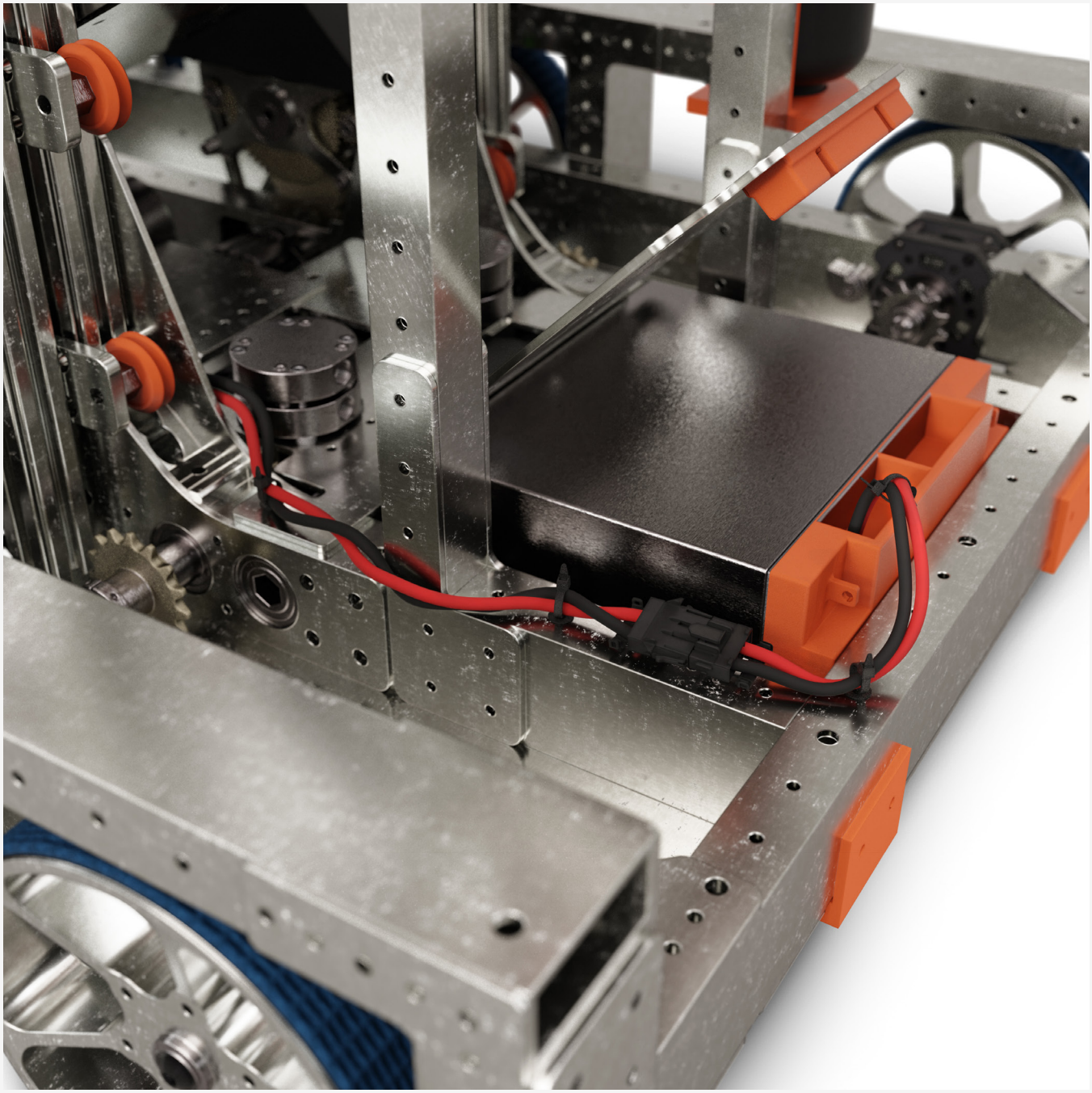
ENHANCED

MINI-FIT SR. CONNECTORS	
Max. Amps	Up to 50.0A
Voltage	600V
Circuits	3
Wire Gauge	8 to 16 AWG
Terminal Part #	428150032/428170032
Digi-Key Connector	428160312/428180312
Digi-Key Pre-Crimped Lead	Not Available
Digi-Key Discrete Cable	369240301

Mini-Fit Sr. connectors are used in high-power applications. This connection system should provide plenty of clearance for voltage and amperage as well as superior vibration performance with a crimpable terminal design.

APPLICATION USAGE ON ROBOT

Mini-Fit Sr. Power Connectors



MAIN COMPUTER CONNECTIONS

Signal connections could have purposes ranging from running the serial peripheral interface (SPI) to connecting to your RoboRio™ (main controller). While many connections in these systems require a stripped wire that is inserted into a terminal block some may have pin headers that can use the Molex SL connection systems. For wire-to-wire applications, we advise adopting a more enhanced connection system.

BASIC

SL STACKABLE LINEAR CONNECTORS	
Max. Amps	Up to 3.0A
Voltage	600V
Circuits	3
Wire Gauge	22 to 30 AWG
Terminal Part #	16020096
Digi-Key Connector	797580003
Digi-Key Pre-Crimped Lead	797580003
Digi-Key Discrete Cable	2162711032

The SL system is a low-cost great connection system that allows for flexibility of AWG with a single terminal design. Students planning on using this should focus on using the Type A options, as they are more compatible with other connectors.

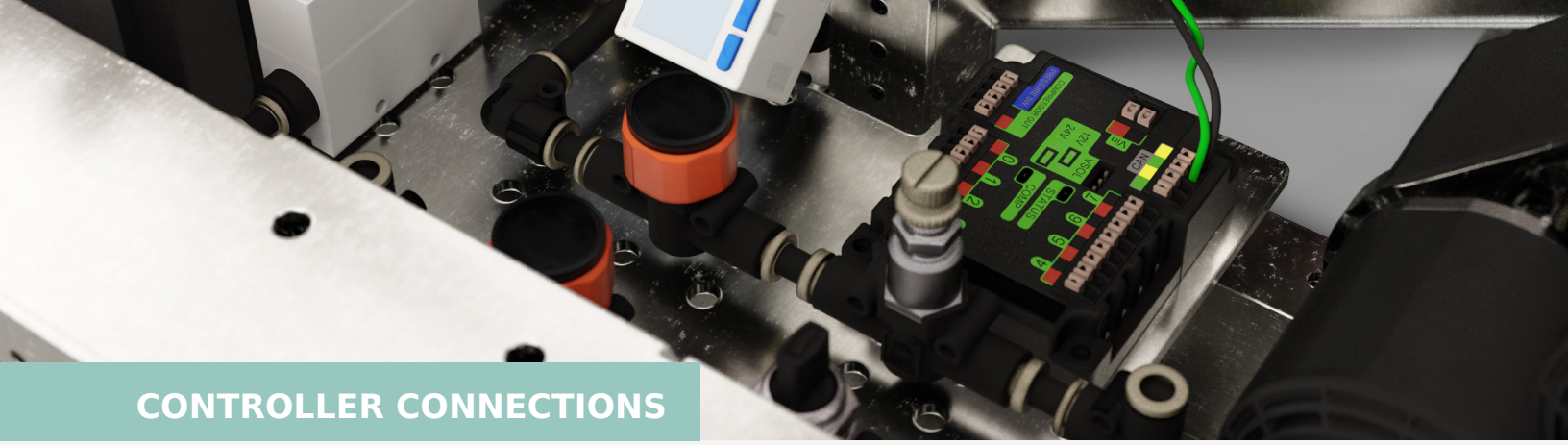
ENHANCED

NANO-FIT CONNECTORS	
Max. Amps	Up to 8.0A
Voltage	250V
Circuits	3
Wire Gauge	20 to 26 AWG
Terminal Part #	2014472400/1053001100
Digi-Key Connector	1053071202
Digi-Key Pre-Crimped Lead	797582129
Digi-Key Discrete Cable	0451300201

Nano-Fit connectors offer a more robust terminal design with multiple points of contact and a wire-to-wire configuration.

APPLICATION USAGE ON ROBOT

Nano-Fit Power Connectors



CONTROLLER CONNECTIONS

There are many approved controller applications running SPI, Canbus, etc. Sending protocols over cables requires that the connectors are suitable to transmit the signals, and we recommend that you use shielded, twisted paid cables for improved performance. Here are some commonly used cable connections that customers use on module add-ons like fans and low-amp power supplies.

BASIC

KK CONNECTORS	
Max. Amps	Up to 3.0A
Voltage	250V
Circuits	3
Wire Gauge	22 to 30 AWG
Terminal Part #	0008500113
Digi-Key Connector	0022012031
Digi-Key Pre-Crimped Lead	797580007
Digi-Key Discrete Cable	Not Available

The KK system uses a simple housing typically used in wire-to-board applications to mate to a friction lock header. It is lower cost and commonly seen on signal boards for fans and other accessories.

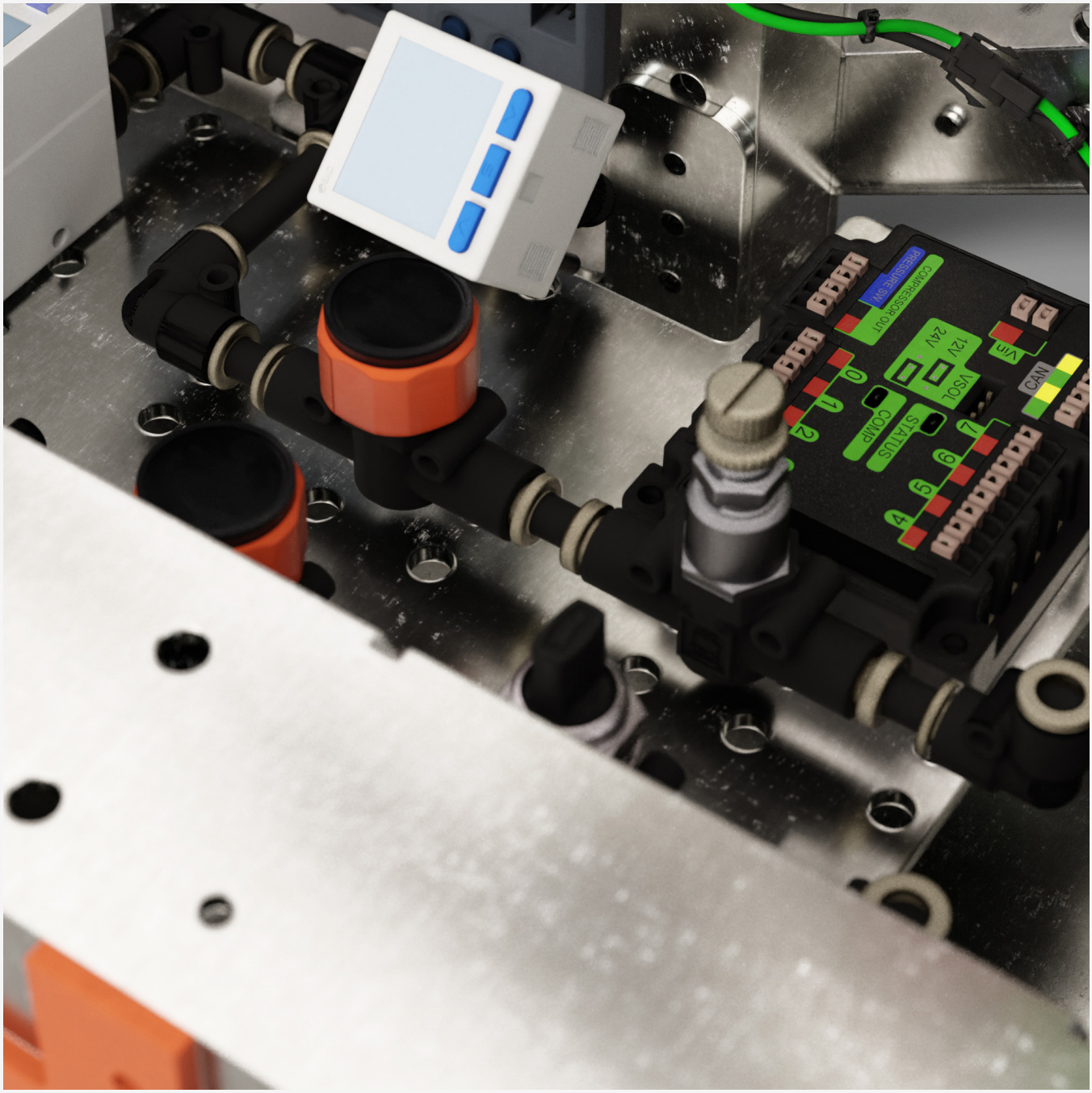
ENHANCED

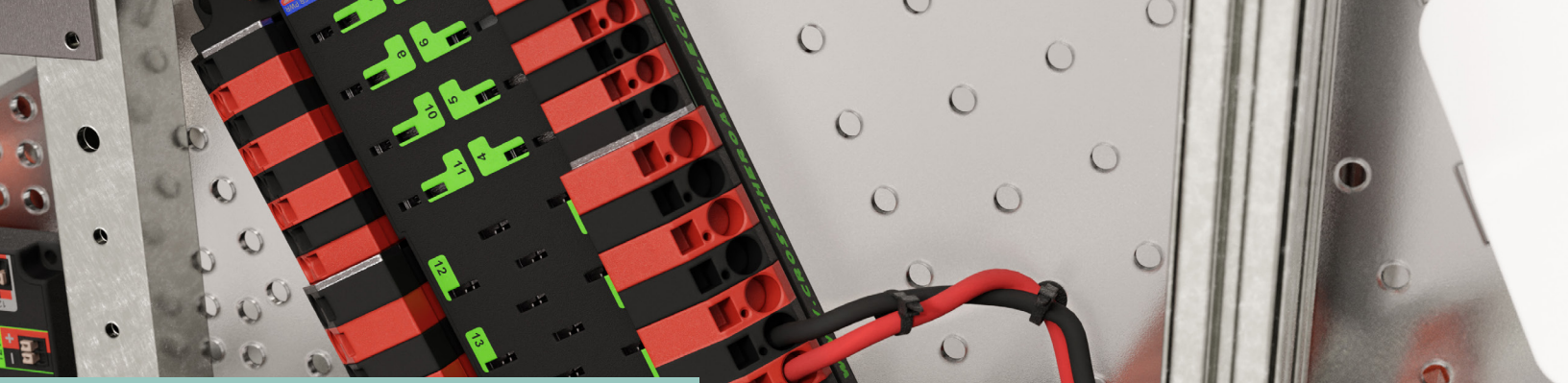
MICRO-FIT CONNECTORS	
Max. Amps	Up to 5.0A
Voltage	600V
Circuits	3
Wire Gauge	12 to 30 AWG
Terminal Part #	0430400007/0430310007
Digi-Key Connector	0436450300/0436400300
Digi-Key Pre-Crimped Lead	797580002
Digi-Key Discrete Cable	1451320503

Micro-Fit connectors are used for mid-range power and signal applications. Due to their positive latch and polarized silos, they are popular in the industry and can be found on most graphics cards and mid-power devices.

APPLICATION USAGE ON ROBOT

Micro-Fit Power Connectors





HIGH-POWER CONNECTORS

High-Power Connections in your robot may have many different requirements. The following connectors allow for high amperage and high voltage that provide safety clearances for building wire-to-wire cable assemblies.

BASIC

MULTI-CAT CONNECTORS	
Max. Amps	Up to 40.0A
Voltage	600V
Circuits	3
Wire Gauge	8 to 18 AWG
Terminal Part #	2018450040/2018460040
Digi-Key Connector	2018410130/2018400030
Digi-Key Pre-Crimped Lead	797582065/797582059
Digi-Key Discrete Cable	451410301/451420301

Multi-Cat connectors are some of the most reliable connectors available. They have more contact points on their terminals in order to provide superior performance in vibration environments.

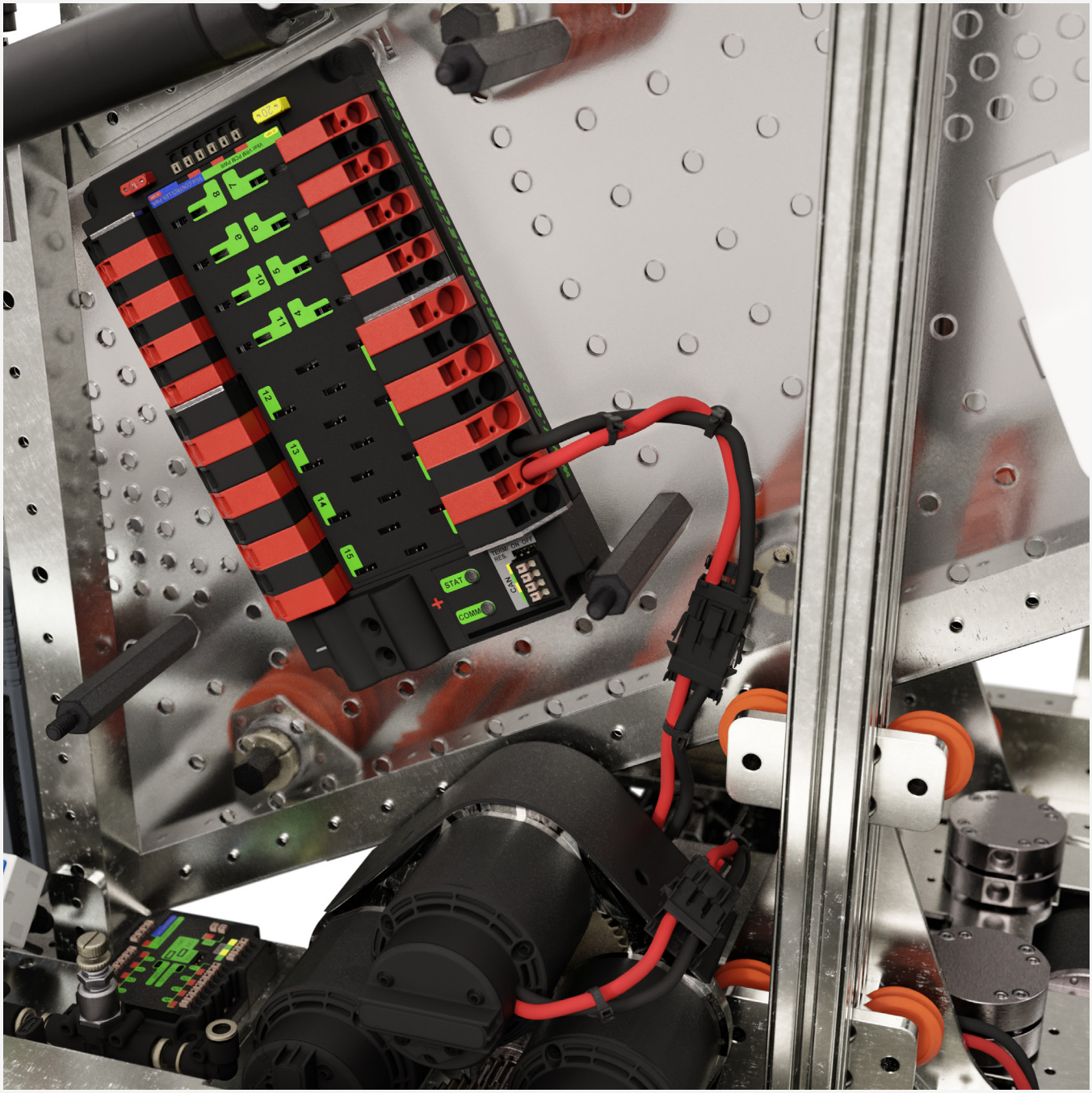
ENHANCED

MINI-FIT SR. CONNECTORS	
Max. Amps	Up to 50.0A
Voltage	600V
Circuits	3
Wire Gauge	8 to 16 AWG
Terminal Part #	428150032/428170032
Digi-Key Connector	428160312/428180312
Digi-Key Pre-Crimped Lead	Not Available
Digi-Key Discrete Cable	369240301

Mini-Fit Sr. connectors are used in high-power applications. This connection system should provide plenty of clearance for voltage and amperage as well as superior vibration performance with a crimpable terminal design.

APPLICATION USAGE ON ROBOT

Mini-Fit Sr. Power Connectors



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