

THUNDERSTRUCKMOTORS

Inspiring and Enabling the EV Community

TSM 500 Watt DC-DC Converter



v1.0

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OVERVIEW

Thunderstruck Motors Isolated DC-DC Converters use high voltage battery inputs to create a regulated 13.8V output for vehicle accessory systems including battery charging, lights, and electronics. See Figure 1 for the input voltage ranges supported by different models.

The DC-DC Converters are electrically isolated from input to output for operator and electronic safety. They are capable of 50 Amp output bursts at 12V. Multiple DC-DC converters can be connected in parallel to multiply the output current.

Included Components

The DC-DC Converter ships with short input and output cables terminated with connectors. Matching connectors and wire terminals are provided for vehicle side connections. See the section *Installation and Wiring* for connection details.

SPECIFICATIONS

The ThunderStruck DC-DC Converters are designed for long life and high efficiency when operated within the limits and safety recommendations listed below. If additional information is needed, please contact ThunderStruck Motors.

Operating Limits

The following table lists operating information applicable for each of the DC-DC Converter models in this series.

PARAMETER	UNITS	DESCRIPTION			
		48v	72v	96v	144v
DC-DC Model	Volts	48v	72v	96v	144v
Input Voltage Range	Volts	36 - 75	40 - 90	72 - 135	110 - 180
Output Voltage	Volts	13.8 (no load)			
Output Current	Amps	50 (maximum)			
Maximum Efficiency	%	≥88%			
Moisture Resistance	Rating	IP65			
Operating Temperature	Deg. C	-20 to +60			
Output Voltage	Volts	13.8±0.2 @0A, >12 @50A			
Electrical Isolation	Ohms (Ω)	> 2 Meg Ω			
Water & vibration Resistant		Enclosure is sealed to protect from moisture damage, and is vibration resistant.			
Enable Switch Control		The converter can be controlled by a switch or relay on the enable (green) wire circuit. Connect to pack positive to enable.			
Overheat Protection		Automatically reduces output current when internal temperature reaches 60°C.			
Output Short Circuit Protection		Output shuts down, then auto-resets after the short circuit is corrected.			
Weight	Kg	1.25			

Figure 1 – DC-DC Operating Limits

Electrical and Safety

The ThunderStruck DC-DC converter is isolated between input and output terminals, and between terminals and case. This prevents the DC-DC unit from producing a ground fault from the high voltage pack and is necessary for vehicle equipment and personnel safety. It is sealed from external moisture, but cannot withstand submersion. Do not operate the unit if it has been submerged.

See *Figure 1* for additional information.

Improper installation can damage the DC-DC converter and void the device warranty. Take the following steps protect the device and to promote safety:

- Observe correct polarity when connecting to input and output terminals.
- Never connect the high voltage pack negative terminal to vehicle ground. High voltage wiring must be isolated from structures.
- Use the proper crimping devices for terminals.
- Select wire gauge to meet or exceed the current requirements for each circuit.
- Place fuses in circuits near the largest current source, rated to protect wires from overheating. All branch circuits should be fused where they connect to the battery, heavier gauge wire, or busbars.
- Do not open the component case - there is a risk of electric shock, and the device warranty may be voided.

A circuit that may exceed 50V is considered high voltage. When working with high voltage systems, please follow electrical safety guidelines and regulations, including training, Personal Protective Equipment (PPE), and short circuit prevention practices.

Components connected to a lithium battery must not be allowed to charge or discharge the battery beyond the manufacturer voltage specifications. A Battery Management System (BMS) can be configured to disable the component before battery specifications are compromised.

Without protection, leaving the DC-DC converter enabled for long periods may discharge and damage the high voltage pack.

An external battery maintainer is recommended for the 12v system if the DC-DC converter is not enabled for over a month, or if the 12v system tends to self-discharge over time.

INSTALLATION AND WIRING

The DC-DC converter is installed in a location close to the 12V system battery, with easy access to the high voltage pack, and in a ventilated space with protection from the elements.

All circuits should be protected by fuses located near the batteries (both high voltage and 12v). If junction busses are used, branch fuses may be located there assuming the buss circuit is fused at the pack. Fuse Amp rating should be selected based on the branch circuit wire gauge, to prevent currents capable of causing wire overheating or fire.

Output connections may carry high current, so care must be taken when selecting wire gauge and crimping terminal connections. Crimping tools designed for the wire size and terminal style must be used. Poor connections are a common cause of failures, and can lead to overheated connectors, degraded performance, and fire hazards.

Dimensions and Connectors

The information shown in Figure 1 is intended to assist in the installation process. Units shown are metric (mm). Cooling fins should be kept at least 50 mm from any surface, and the space should be vented, unless large enough for unventilated cooling, e.g. a vehicle trunk space. Avoid mounting the DC-DC converter with its long axis aligned vertically, which could restrict airflow around cooling fins.

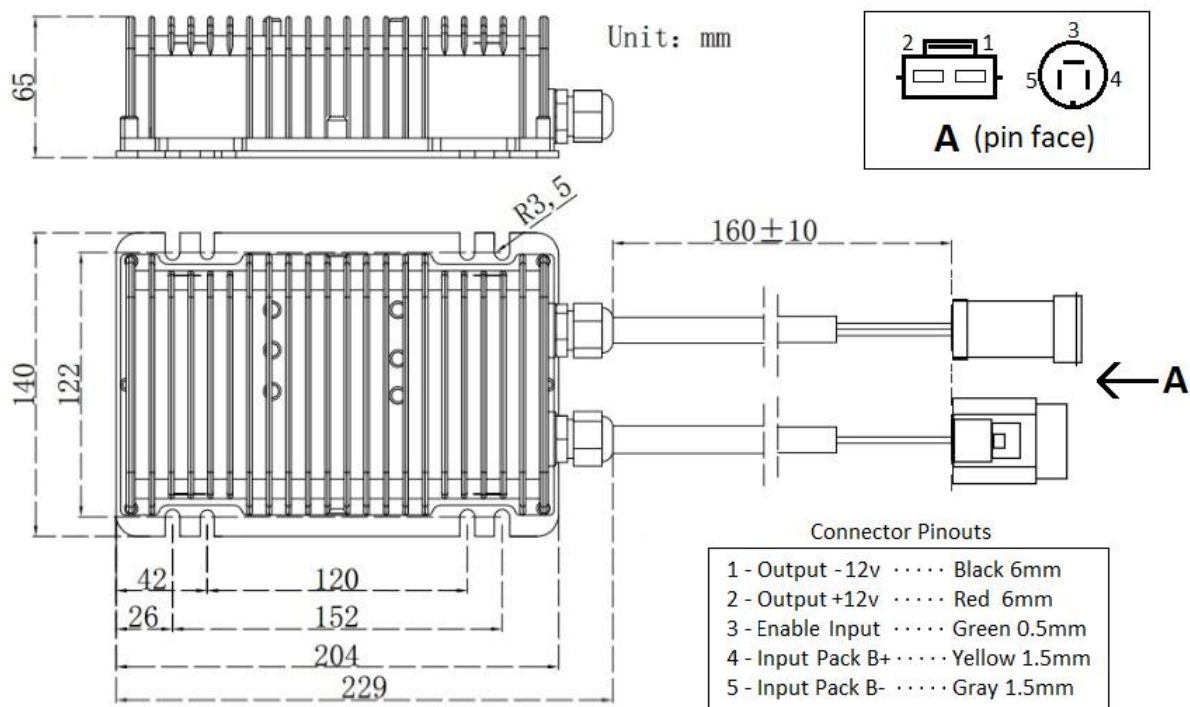


Figure 2 – Mechanical Drawing and Connector Pinout Information

Typical Circuit Design

The following circuit diagram shows how the DC-DC may be used in an electric vehicle system along with a device like the MCU. To keep the diagram simple, only DC-DC circuit fuses are shown.

MCU configuration is required for the circuit shown. In the MCU user interface, enter:

set out5 -lvc

(this enables the DC-DC Converter only if low voltage cells are NOT found)

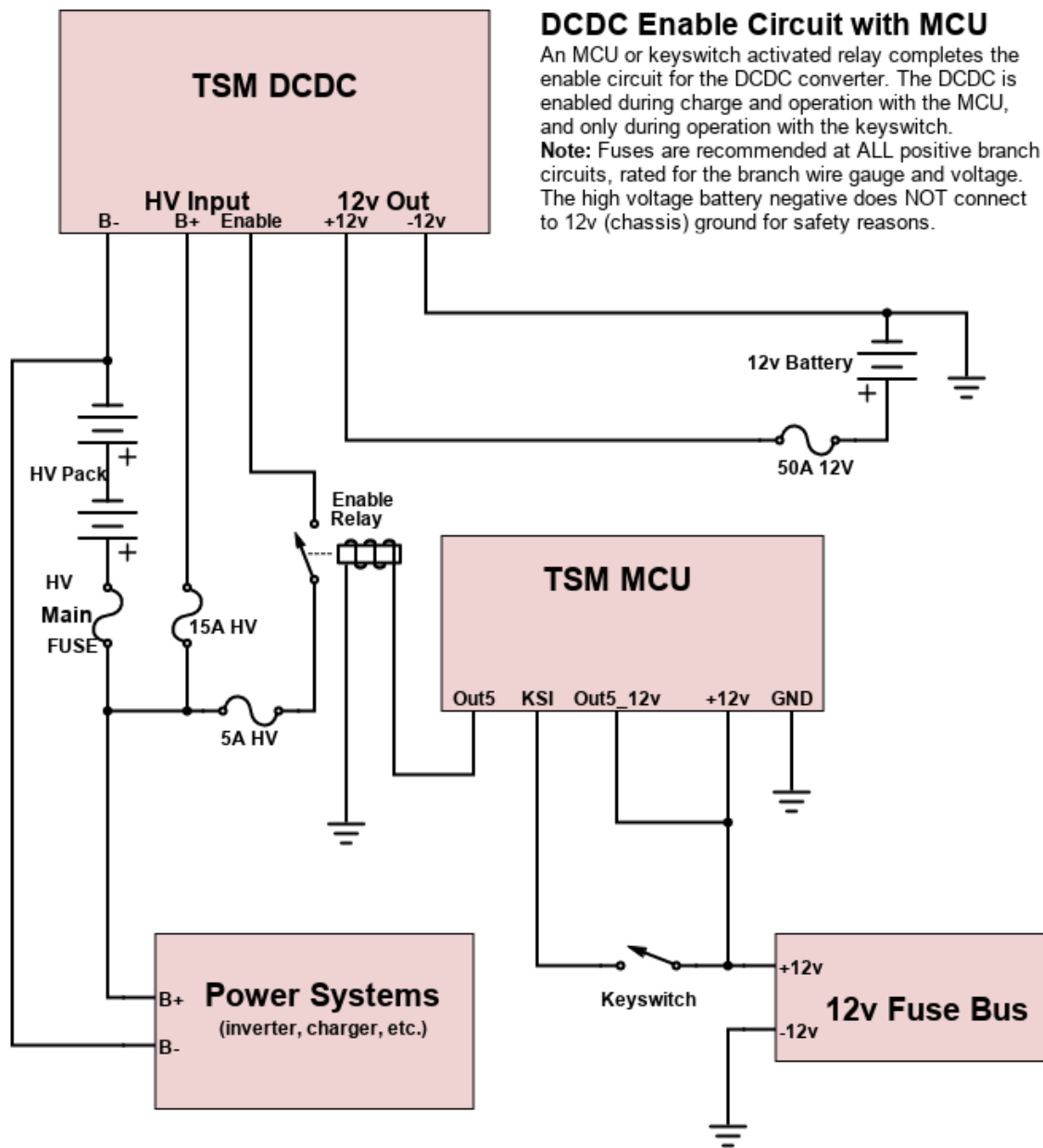


Figure 3 – Typical EV circuit with DC-DC and MCU

CONFIGURATION

The DC-DC Converter is factory configured to maintain output voltage while the high voltage pack is within the range stated in the *Specifications* section.

Operation is automatic once the enable connection is made to the high voltage pack positive. No other controls or settings are possible with this device. Opening the case is hazardous because of capacitive discharge, and may void the product warranty. Product and software upgrades are not provided.

OPERATION

The DC-DC enable circuit is used to activate and deactivate the device. When deactivated, the output circuit is disabled. See Figure 3 for a wiring example using the Thunderstruck MCU Out5 output.

To activate the enable circuit, connect the enable (green) wire circuit to the high voltage battery positive. This is typically handled by either a relay operated by a 12v circuit or by a manual switch.

With the DC-DC Converter installed in the vehicle system, test by observing the output voltage rise after the enable circuit has been activated. Output voltage should match the specifications listed in Figure 1. Note that the regulated voltage is reduced as the output current approaches maximum.

APPLICATION OPTIONS

The DC-DC with MCU solution shown in Figure 3 is an automated solution activating the DC-DC Converter during both charge and vehicle operation conditions.

In addition to this application, it is possible to control the DC-DC Converter using a manually operated switch or relay. This can be accomplished by replacing the MCU Out5 circuit with a manual switch rated at 12v, or by replacing the entire enable relay circuit with a switch rated for pack voltage.

All switches and relays controlling the high voltage enable circuit must have contacts rated at or above the system voltage. This is essential to prevent premature wear on contacts, which can

lead to the relay welding shut. This kind of failure leaves your DC-DC system enabled even when the enable control circuit is turned off.

DIAGNOSTICS

If the DC-DC converter does not operate after installation, please check Figure 4 below for suggested remedies. No fault codes are displayed by the DC-DC converter. If the DC-DC converter does not operate after accidental miswiring, then the suggested remedies may not help. Please contact ThunderStruck Motors if you are unable to resolve the issue.

Problem	Cause	Remedy	Recommendation
No output from DC-DC	Enable circuit disconnected	Use switch, relay, or other device to enable.	Use an automatic control.
No output from DC-DC	No High Voltage at input	Test and repair high voltage connections, replace fuse	
Output at DC-DC, but 12v battery won't charge	Blown fuse, Bad connection, Faulty 12v battery	Test and repair connections, replace fuse or battery.	
Pack discharging when vehicle OFF	Enable always connected	Add switch or relay. Check for faulty relay or switch.	Use an automatic control like the MCU
Low voltage DC-DC output	Wire gauge too small, Poor connections, current draw too high	Correct wire gauge for output current. Rework connections.	Limit accessory loads to less than DC-DC maximum output
Hot or burned connections.	Dirty or loose connector terminals	Replace damaged wire and terminals	Use correct crimp tool. Solder terminals for best results.

Figure 4 – DC-DC Troubleshooting

HARDWARE VERSIONS

ThunderStruck DC-DC Converters sold before the year 2022 used a single rectangular connector including both input and output circuits. Figure 5 below shows a connection diagram along with pinouts for the earlier model connector.

The 2022 and later DC-DC Converters are designed with the input and output connectors separated as shown above in Figure 2.

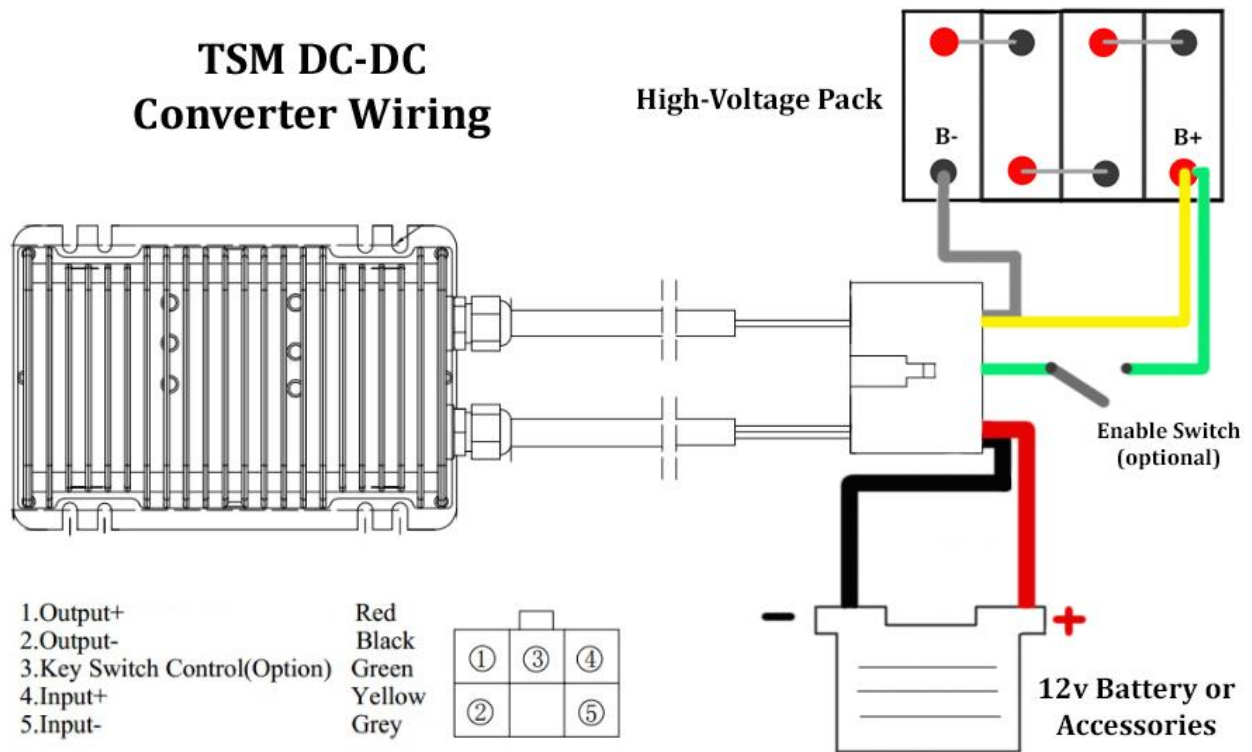


Figure 5 – DC-DC Converter Pinouts prior to 2022

WARRANTY AND SUPPORT

ThunderStruck Motors offers a high level of support and warranty consideration for anyone purchasing our products. The DIY industry invites participants of all skill levels, and our goal is to meet their needs with tolerance, understanding and flexibility as our way of contributing to success of the electric transportation movement.

Warranty

The Thunderstruck DC-DC Converter is guaranteed against operational and material defects for one year after the device purchase date. The recommended first point of contact for warranty consideration is the company which sold the product. If purchased directly from ThunderStruck Motors, please use the contact information below.

Because the customer is responsible for the device installation and wiring, the product warranty does not cover errors such as incorrect wiring connections or device placement, exceeding voltage limits, physical damage to any part of the unit, or any device failure caused by misuse or modification by the customer.

Support

Customers purchasing products directly from ThunderStruck Motors have access to support for instruction and troubleshooting needed during product installation and operation. Customers purchasing from vendors selling our products receive support first from the vendor and then from ThunderStruck Motors if the vendor is unsuccessful or unresponsive.

Contact Us

e-mail: connect@thunderstruck-ev.com

Phone: 707.578.7973

Text: 707.582.0799

Hours: M-F 9AM to 5PM - Pacific Time

Website: <https://www.thunderstruck-ev.com/contact.html>

ThunderStruck Motors
2985 Dutton Ave. Ste 3
Santa Rosa, CA 95407

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