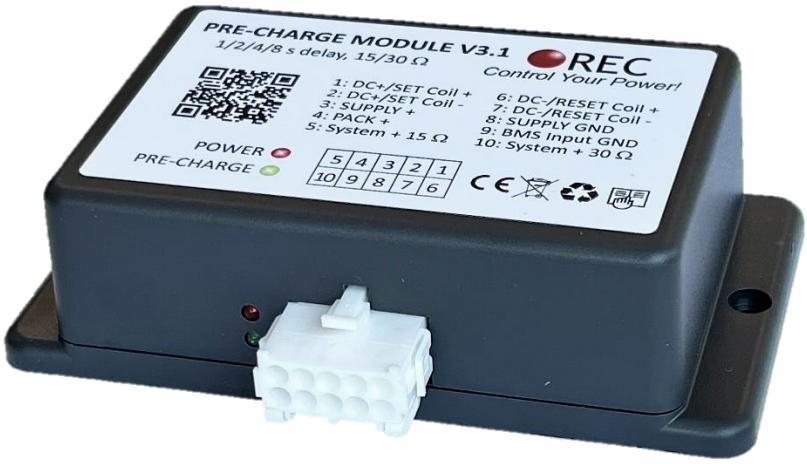
REC PRE-CHARGE UNIT V3.1



REC
Control Your Power!

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Features:

- robust and small design
- low power consumption @ 11-80 V DC
- 1/2/4/8 s DIP switch delay settings (default single coil relay/s 4 s delay)
- up to 120 V, 4.0 A pre-charge
- integrated 15 and 30 Ω power resistor + 10 Ω NTC
- 6.0 A top side coil drive with over-current protection
- single pole or bi-stable latching contactor drive
- reverse polarity protection
- over-voltage protection
- one-year warranty
- **V3.1:** double single pole contactor mode for DC + and DC- control

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General Description:

High input capacitance systems such as inverters, dc-dc converters, etc. can be exposed to large in-rush currents during the initial power up procedure. If appropriate measures are not employed, these currents can overly stress or even damage the system components. The pre-charge unit eliminates high in-rush currents by charging the input capacitor before the main contactor switches on, prolonging lifespan of the contactor and other components dramatically.

Parameters:

Table 1: Pre-charge parameter table.

Parameter	Value	Unit
Supply voltage range V_{CC} – V_{SS}	10 - 80	V
Supply current I_{STBY}	1 @ VCC = 10 V	mA
	2 @ VCC = 30 V	mA
	3 @ VCC = 60 V	mA
	4 @ VCC = 80 V	mA
Battery pack voltage range V_{BAT} - V_{SYS}	10 - 120 V	V
BMS input voltage range	V_{SS} – (V_{SS} + 5.0)	V
BMS input voltage enable threshold	<=(V_{SS} + 0.2)	Ω
BMS input voltage disable threshold	>(V_{SS} + 1.7)	Ω
BMS input current	0.03	mA
Pre-charge resistance output pin 5	15 + NTC 10	Ω
Pre-charge resistance output pin 10	30 + NTC 10	Ω
Pre-charge output voltage $V_{PRECHARGE}$	30 + NTC 10	Ω
Contactors + output coil voltage max	V_{CC} -0.7	V
Contactors + output coil voltage min	V_{CC} -1.0	V
Contactor coil fuse	6.3 slow blow	A
Pre-charge fuse	4.0 slow blow	A
Time delay	1/2/4/8	s
Bi-stable latching relay set/reset time	100/150	ms
Contactors – to VSS resistance	100	mΩ
Dimensions	127x 70.6 x 35.5	mm
Crimps	TE connectivity 795299-1	n.a.
Crimping tool	18-22	AWG
Weight	129	g
IP rating	20	n.a.

Pre-charge description:

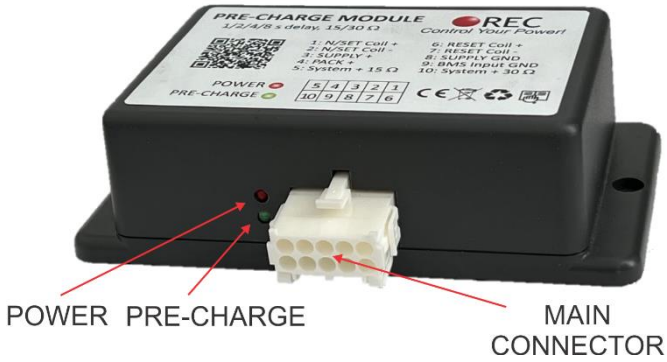

Figure 1: Pre-charge unit description.

Pre-charge connections:

Figure 2: Pre-charge connection description.

Table 2: Pre-charge pinout.

Pin	Tab	Single pole contactor connection	Bi-stable latching contactor connection
1	DC+/SET COIL +	Contactor coil +	DC+/Bi-stable latching contactor SET coil +
2	DC+/SET COIL -	Contactor coil -	DC+/Bi-stable latching contactor SET coil -
3	SUPPLY +	Supply positive 10 – 80 V	Supply positive 10 – 80 V
4	PACK +	Battery pack + (10 – 120 V)	Battery pack + (10 – 120 V)
5	SYSTEM + 15 Ω	System side + pre-charge 15 Ω	System side + pre-charge 15 Ω
6	DC-/RESET COIL +	-	DC-/Bi-stable latching contactor RESET coil +
7	DC-/RESET COIL -	-	DC-Bi-stable latching contactor RESET coil -
8	SUPPLY GND	Supply GND	Supply GND
9	BMS Input GND	BMS input – pull down to Supply GND	BMS input – pull down to Supply GND
10	SYSTEM + 30 Ω	System side + pre-charge 30 Ω	System side + pre-charge 30 Ω

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System Overview:

Figure 3 shows the integration of the pre-charge unit in a typical 24 V battery power system, using REC 1Q BMS with an internal relay control. Only the connections relevant to the pre-charge unit operation are shown. 15 Ω pre-charge output is used in conjunction with 24 V single coil power contactor. After the battery pack is connected to SUPPLY + and SUPPLY GND internal pre-charge slowly charges the input capacitor and powers the POWER red LED. Unit enters standby mode lowering its consumption until the BMS input GND is pulled down to SUPPLY GND. Then the internal DIP switches are read (see Table 4 for detail settings description). Single or double contactors may be used to connect the DC link.

Single coil contactor/s

In case of single coil contactor/s DIP switch setting, the DC- (RESET COIL) is engaged first and pre-charge transistor turns ON. When the pre-charge timeouts, SET coil is powered constantly ON to enable DC+ connection and the pre-charge transistor inside the unit is turned OFF.
When the BMS input GND is released, DC+/SET COIL and DC-/RESET COIL are both turned OFF.

Bi-stable latching contactor

In case of a bi-stable latching relay DIP switch mode DC+/SET COIL is turned ON for a period of 100 ms for engaging bi-stable latching relay. Then the pre-charge transistor inside the unit is turned OFF. When the BMS input GND is released, DC-/RESET COIL is powered for 150 ms to turn the bi-stable relay/contactor OFF.

Figures 3 - 7 show typical system integrations.

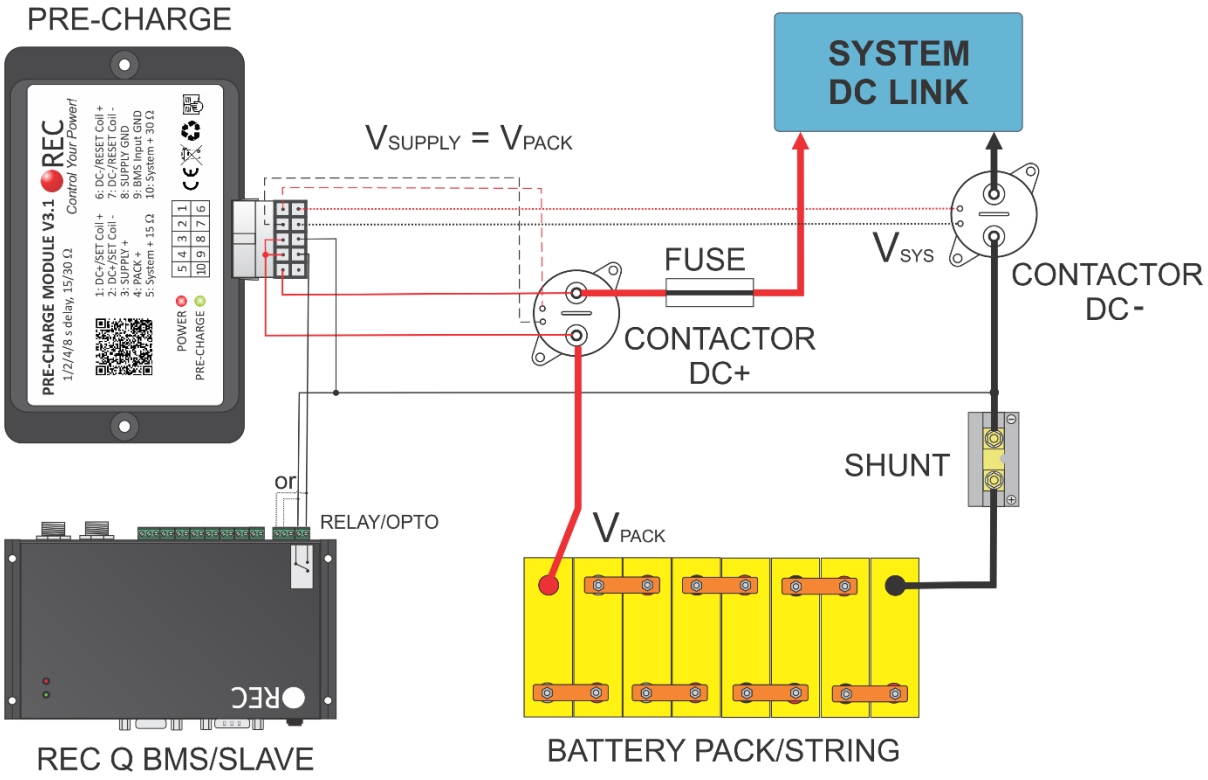


Figure 3: Typical pre-charge unit connection using battery pack as a pre-charge unit power supply and 15 Ω output.

When no power consumption is required, BMS input GND may be connected to SUPPLY GND and SUPPLY + can bi wired through the BMS internal relay. Only when the BMS turns on the internal relay, pre-charge unit is powered. This can only be used in case of the single coil contactor/s with the same coil voltage as the battery pack. See Figure 4.

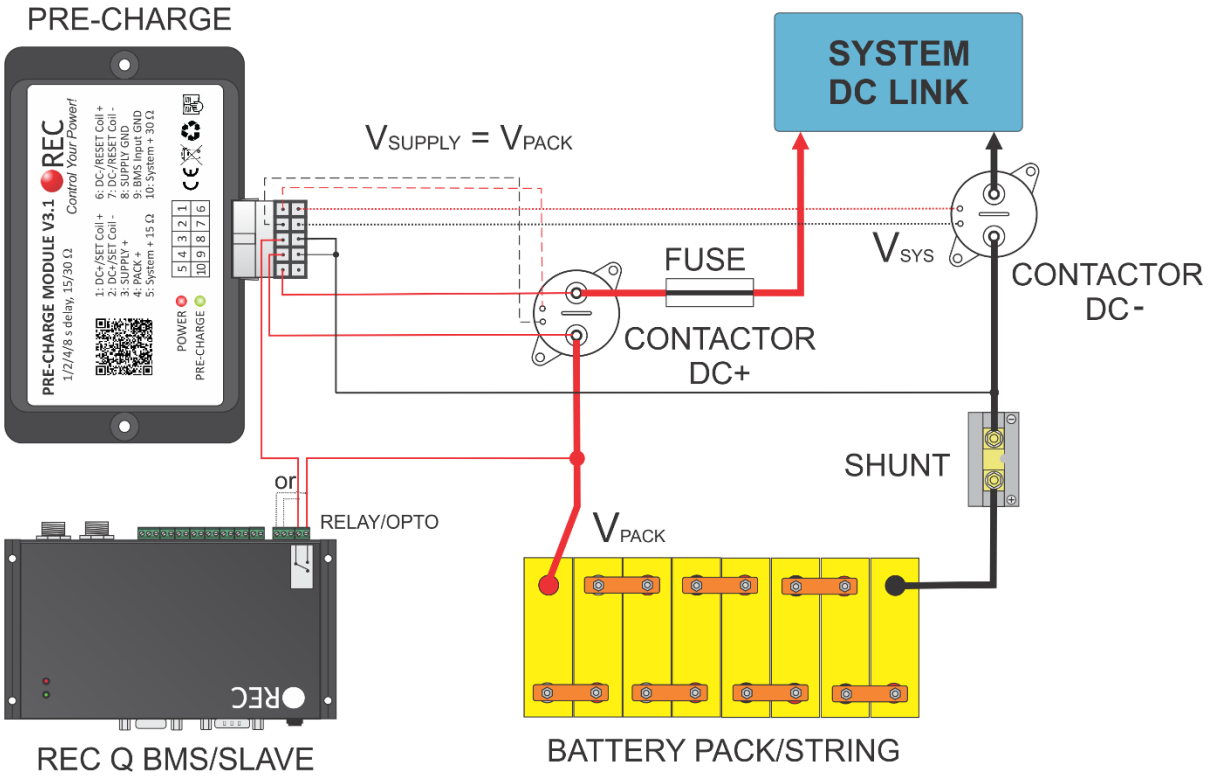


Figure 4: Pre-charge unit connection using battery pack as a pre-charge unit power supply and 15 Ω output without power consumption when the BMS' internal relay is off.

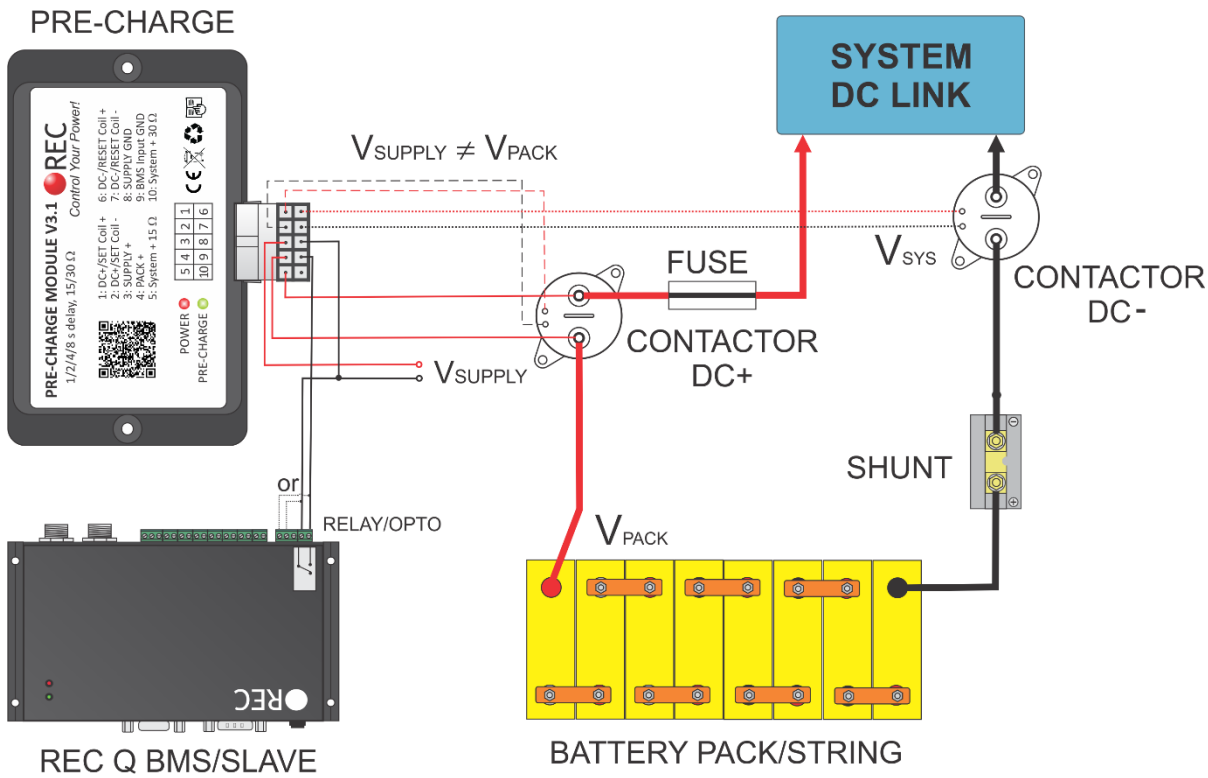


Figure 5: Typical pre-charge unit connection using separate supply source as a pre-charge unit power supply and 15 Ω output.

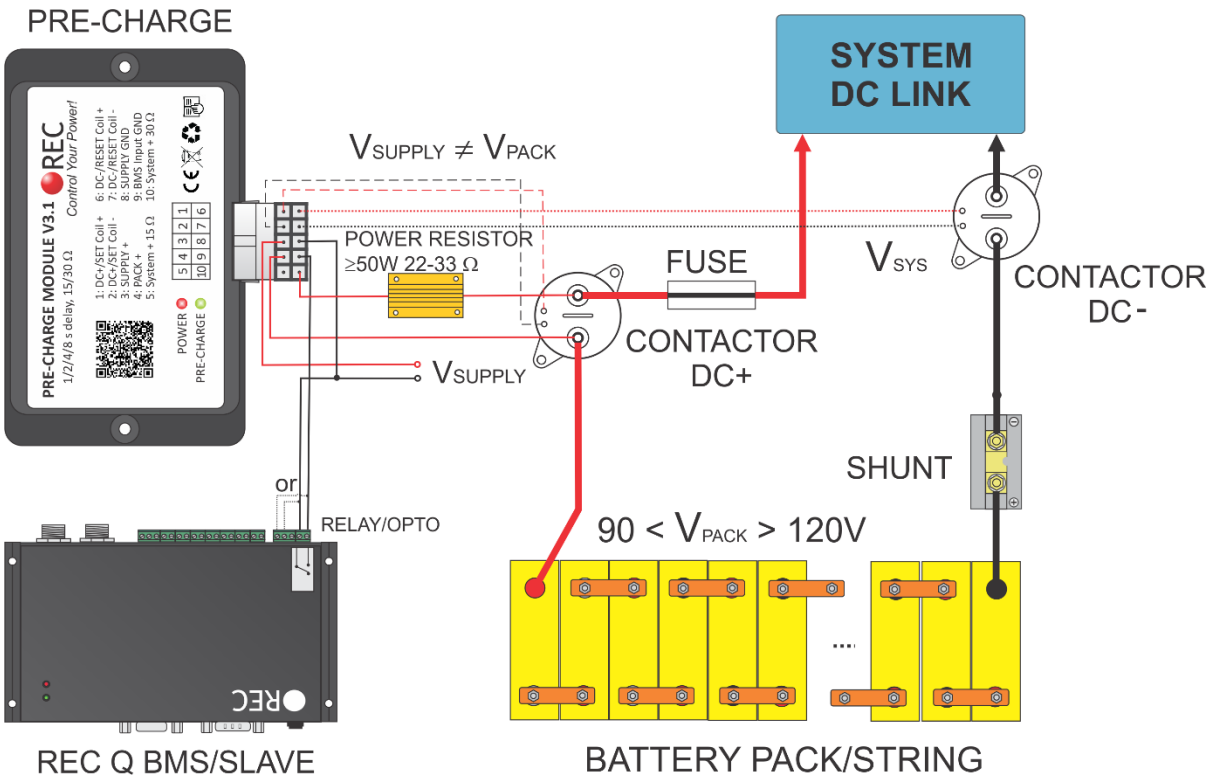


Figure 6: Typical pre-charge unit connection using separate supply source as a pre-charge unit power supply and 30 Ω output with additional external power resistor for higher battery pack voltages.

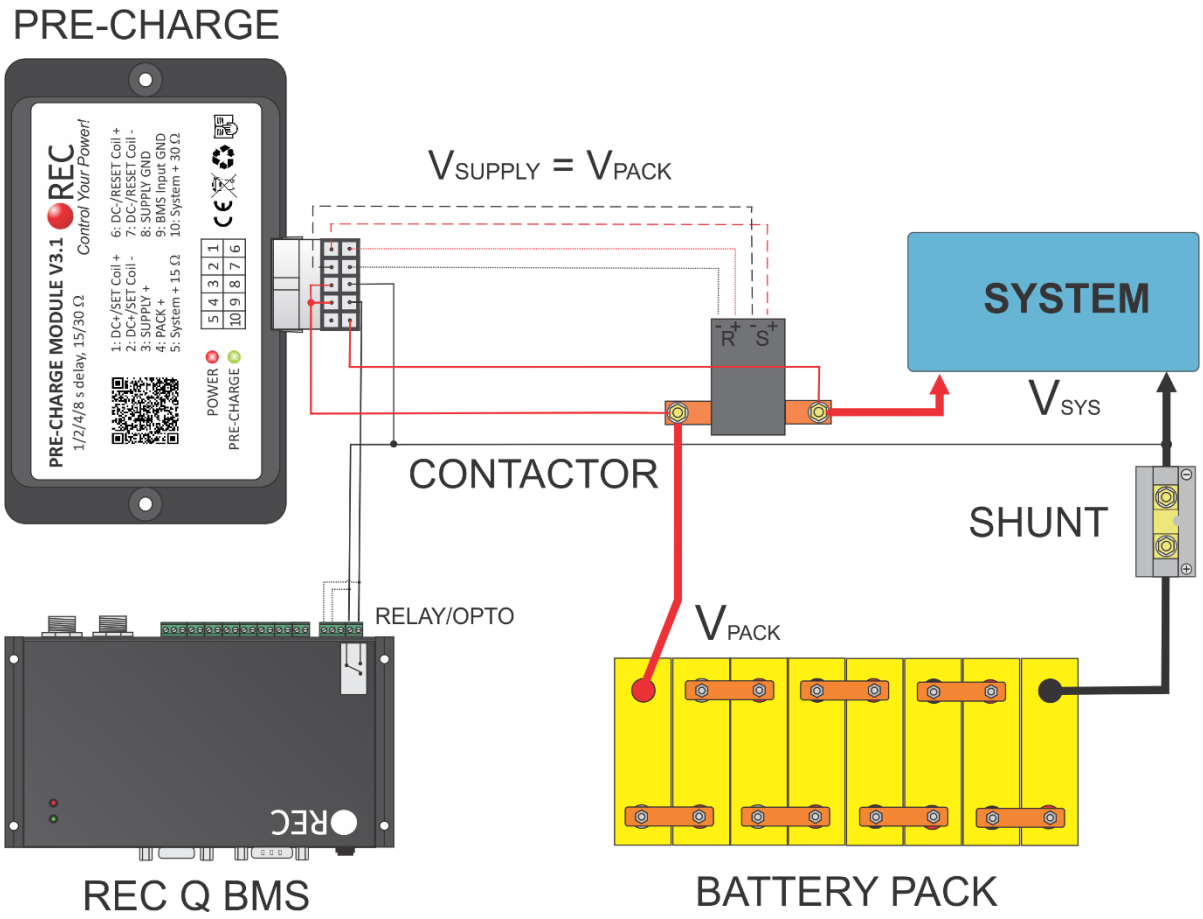


Figure 7: Typical pre-charge unit connection using battery pack as a pre-charge unit power supply and 30 Ω output to drive bi-stable latching relay.

Measuring/Setting Pre-charge Delay:

To set the pre-charge delay properly, system voltage should be measured at the end of pre-charge timer phase. Connect all required connections except the DC+/SET COIL + connection to disable contactor engaging. Enable the pre-charge by pulling BMS Input GND to SUPPLY GND by the BMS or manually. Measure the system voltage @ the system side of the contactor. Before the pre-charge timer ends the system, voltage should rise to at least to 80 % of the battery voltage. If the voltage stays below this value increase the pre-charge delay or use the SYSTEM + 15 Ω output. Pre-charge current should be limited to a maximum value of 4 A (Max battery voltage / pre-charge resistance).

Table 3: Pre-charge resistance selection.

Battery voltage [V]	Battery voltage range[V]	Pre-charge output
12	10 -16	SYSTEM + 15 Ω output
24	21 - 30	SYSTEM + 15 Ω output
48	43 - 67	SYSTEM + 15 Ω output
80	64 -88	SYSTEM + 30 Ω output
80+	90 to 120	SYSTEM + 30 Ω output + external 22-33 Ω 50 W

Please note: Some of the inverters/controllers on the system side may start to work with lower voltage and their power consumption prevent system voltage to rise.

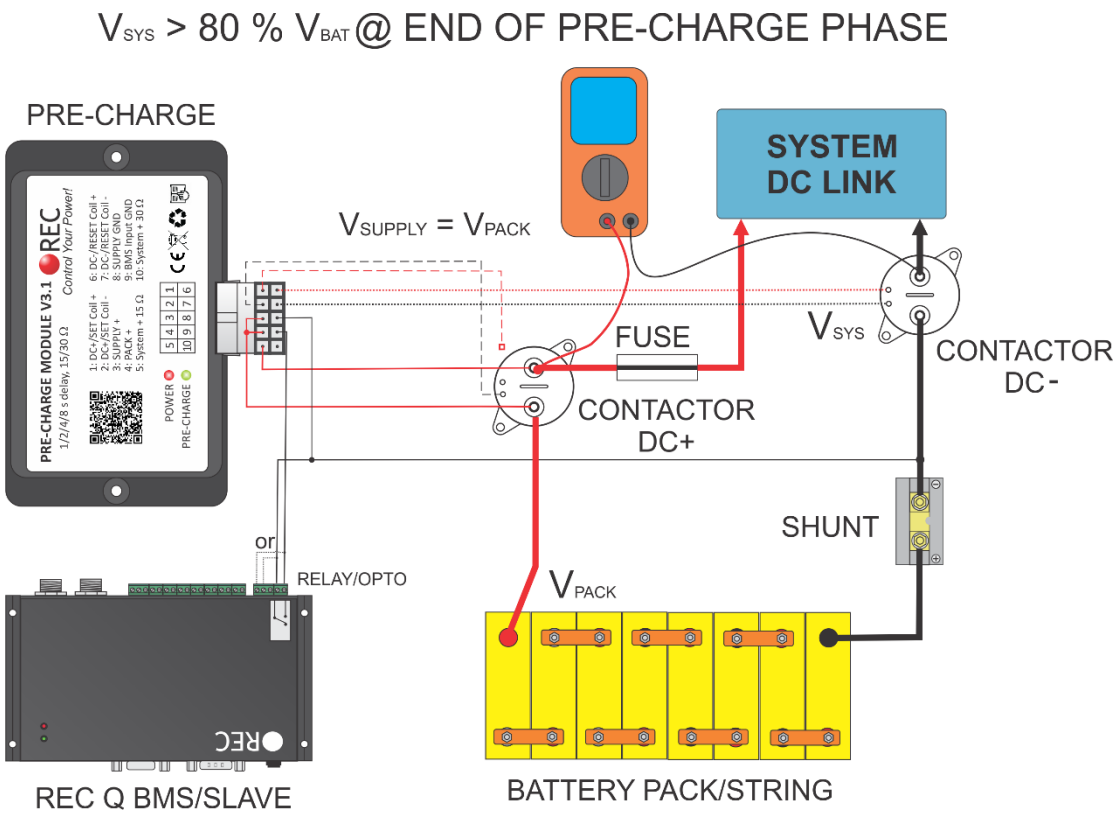


Figure 8: System voltage measuring procedure.

You can prolong the pre-charge time by changing DIP switches inside the Pre-charge unit without Pre-charge unit power disconnection. Per-charge only requires to be disabled by the BMS input GND. Bellow you can find DIP switch settings description.

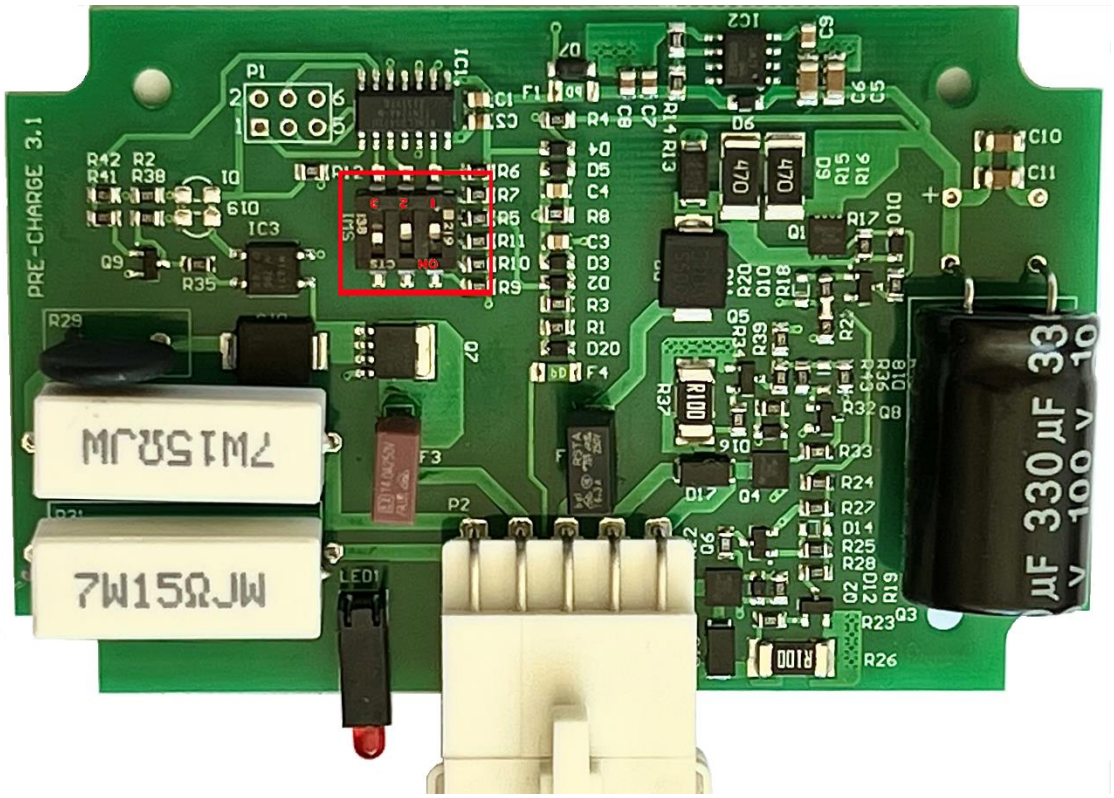
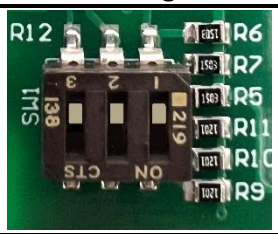
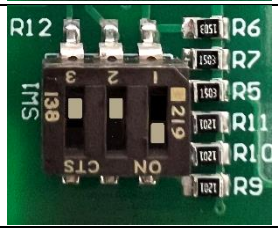


Figure 9: Pre-charge delay DIP switch selector.

Table 3: DIP switch function description.

Settings	DIP 3	DIP 2	DIP 1	Function
	OFF	OFF	OFF	Single pole contactors/relay 1 s pre-charge time
	OFF	OFF	ON	Single pole contactors/relay 2 s pre-charge time

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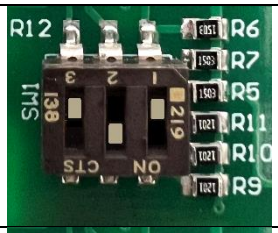
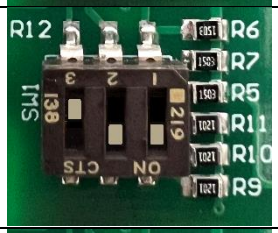
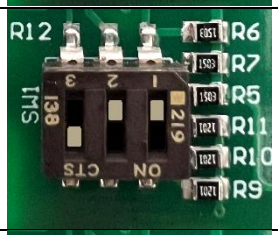
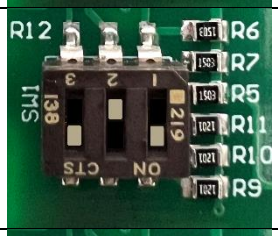
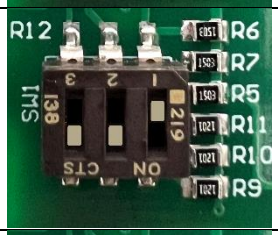
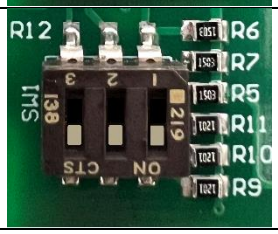
		OFF	ON	OFF	Single pole contactors/relay 4 s pre-charge time*
		OFF	ON	ON	Single pole contactors/relay 8 s pre-charge time
		**ON**	**OFF**	**OFF**	Bi-stable latching contactor/relay 1 s pre-charge time
		ON	OFF	ON	Bi-stable latching contactor/relay 2 s pre-charge time
		ON	ON	OFF	Bi-stable latching contactor/relay 4 s pre-charge time
		ON	ON	ON	Bi-stable latching contactor/relay 8 s pre-charge time

* Default setting

Dimensions:

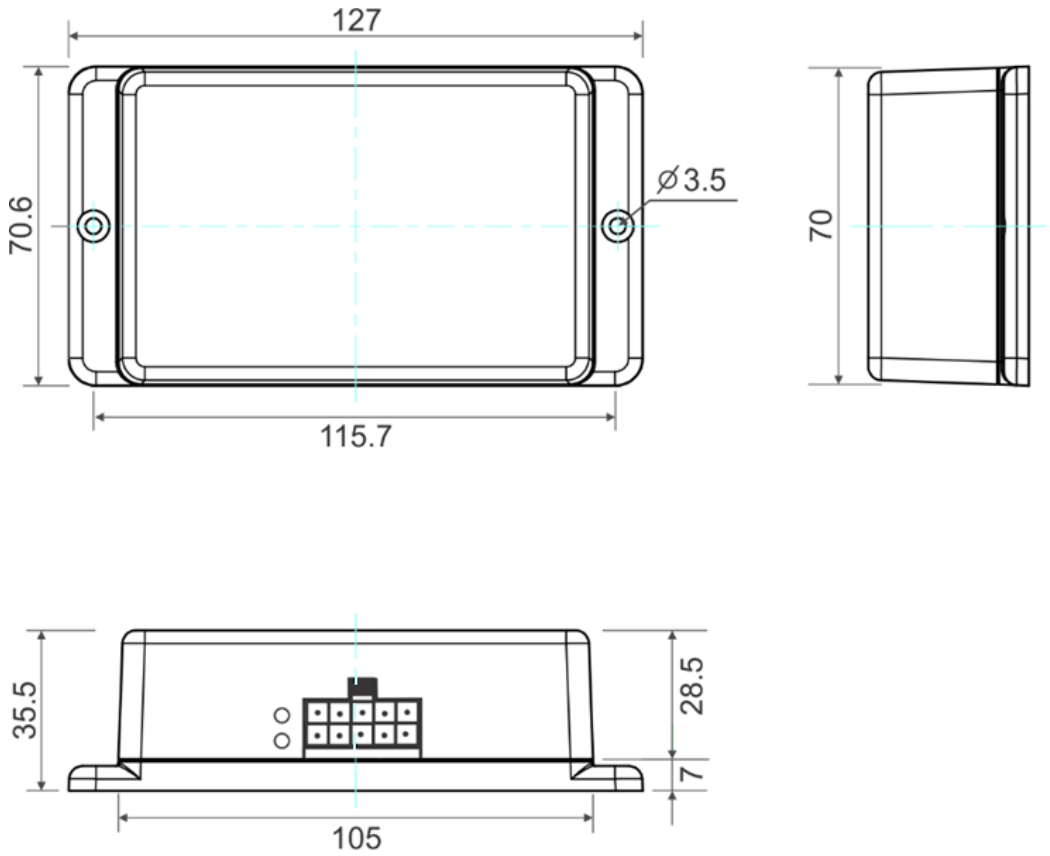


Figure 10: Pre-charge unit dimensions.