

Technical Manual

TWS-9S1P-135-NCM Module



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Notice: please read the following information carefully before installing the module.

1. Transportation and Storage

1.1 Transportation Requirements

During transportation, it should be protected from severe vibration, shock, sun and rain, and should not be inverted to ensure that short circuits will not occur. During the loading and unloading process, it should be handled gently to prevent falling, rolling, heavy pressure and inverted.

1.2 Storage Requirements

The module is stored in an incompletely charged state, typically around 40%. Products storage environment requirements are as follows:

- Storage temperature: storage time < 3 months, then stored at -30 °C ~ 55 °C, 40% SOC conditions; storage time > 3 months, then 0 °C ~ 25 °C, 40% SOC storage.
- Storage humidity: humidity is 2% ~ 90% RH, it is recommended to store in the range of not more than 85% RH.
- Storage environment: The product should be stored in a clean, ventilated and cool environment, avoiding direct sunlight, high temperature, corrosive gas, severe vibration, mechanical shock and heavy pressure; away from heat source; altitude is less than 1,500 meters, atmospheric pressure is 86 kPa~ 106 kPa.
- Maintenance: In a dry and ventilated environment, recharge is required once every 1 month during storage; the maintenance test method during product storage is as follows.
- Under normal temperature conditions, the product is charged and discharged once every one month with standard charging. If the module is expected to be stored for more than 30 days, the SOC will be adjusted to 40% after the charging is completed.

2. Precaution for charging and discharging

2.1 Precaution for charging

- The charging current should not be higher than the maximum value described in this specification. If the current is higher than the recommended one, it could bring about a series of problems, such as charging and discharging performance, mechanical property and safety, or even leads to overheat and leakage.
- The charging voltage should not be higher than the maximum value described in this specification. If the voltage is higher than the maximum value, it could bring about a series of problems, such as charging and discharging performance, mechanical property and safety, or even leads to overheat and leakage.
- The battery module should better be charged under the absolute charging temperature of 0 °C ~ 55 °C.

- Properly connect the terminals of positive and negative of the batteries. The reversal charging is forbidden. If the polarity is reversed, the battery module will be damaged and safety problem may occur.

2.2 Precaution for discharging

- The discharging current should not be higher than the maximum value described in cell specification. Discharging with a higher current may result in the capacity fade and over-heat, even smoke or black material ejected from the case.
- The battery should be discharged under the absolute discharging temperature of -20 °C ~ 55 °C.
- During normal usage, the battery management system should be applied to avoid over discharging. Once over discharging happens, the battery will be damaged or safety problem may occur.
- What should be paid attention to is that the battery can be in the state of over discharging because of self-discharging during the long time storage. To avoid over discharging, the battery should be charged according to a fixed schedule, keep the battery within the 10% ~ 40% SOC.

3. Precaution for the design of battery pack/case

- Battery pack/case should have enough mechanical strength to make sure that the battery inside would avoid mechanical shock.
- Customers should have a detailed design of BMS, assess system features, frameworks, system data, format and other related information, and establish battery management file.
- The cooling issue of the battery pack/case should be fully considered. Each cell shall be working in identical temperature which is to ensure each cell is working in the same condition, with the proper temperature management by the cooling / warming system. Proper temperature management system is customers' responsibility. Overheating damages to cells or battery modules caused by battery pack/case thermal design problem, TWS will not assume responsibility for such quality assurance.
- Battery pack/case design should be full considered about the battery waterproof and dustproof problem, battery pack/case must meet the relevant national standards for water and dust levels. Cell or battery module damage due to water, dust problems caused (such as corrosion, rust, etc.), TWS will not assume responsibility for such quality assurance.

4. Technical Parameters of Battery Module

The key parameters of the TWS-9S1P-135-NCM module as below:

NO.	Item	Technical parameters	Remarks
1.	Battery Model	NCM 135 Ah Cell	

2.	Minimum Capacity	135 Ah	@ 0.33 C
3.	Configuration	9S1P	
4.	Nominal Voltage	33.3 V	@ 0.33 C Cell 3.7V
5.	Operating Voltage Range	25.2 V ~ 38.7 V	Cell 2.8 V ~ 4.3 V
6.	Nominal Energy	4,496 kWh	@ 0.33 C
7.	Standard Charge @ 25 °C	0.5 C	Constant current 0.5 C Constant voltage 4.3 V Cut off current 6.75 A
8.	Continuous Charge Rate @ 25 °C	Max. 0.5 C	
9.	Discharge Operation Max Current @ 25 °C	400 A @ 30 s	SOC ≥ 20%
10.	Charge Operation Max Current @ 25 °C	270 A @ 30 s	SOC ≤ 70%
11.	SOC Operating Range	5% ~ 95%	
12.	SOC Transport Range	30% ~ 50%	
13.	Operating Temperature	-20 °C ~ 55 °C (Charge) -30 °C ~ 55 °C (Discharge)	Detailed use conditions need to refer to the charge and discharge window
14.	Storage Temperature	-30 °C ~ 55 °C	Best storage temperature -10 °C ~ 35 °C
15.	Operating Humidity	5% ~ 95 % RH	
16.	Module Weight	23.5 kg ± 0.5 kg	
17.	Dimensions	Length: 490.3 mm Width: 178.1 mm Height: 143.3 mm	Refer drawing for details.

18.	Dielectric Strength	2,700V DC	≤ 5 mA
19.	Factory Test of Insulation Resistance	> 100 MΩ	

5. Warning, Caution and Prohibition in Handling

5.1 Warning

This product must comply with the operating instructions. Any installation, maintenance and use of this product must strictly comply with this specification.

- Modules exist potentially dangerous. Proper protective measures must be taken during operation and maintenance!
- Improper operation of the test described in this specification may result in serious personal injury and property loss!
- Modules must be operated with the right tools and protective equipment!
- Modules maintenance must be performed by people with battery expertise and safety training!
- Failure to comply with the above warning may cause many disasters!

5.2 Caution

- When using the application equipped with the modules, refer to the user's manual before usage. Please read the specific charger manual before charging.
- When the module is not charged after long exposure to the charger, discontinue charging.
- Please check the positive (+) and negative (-) direction before handling.
- When a lead plate or wire is connected to the module for handling, check out insulation not to short-circuit.
- Do not use the module in high static energy environment where the protection device can be damaged.
- The battery must be away from children or pets.
- When module life span shortens after long usage, please exchange to new module
- Do not wear metallic objects (e.g. ring, watch, accessory, etc.) while handling battery module.
- When use modules for an assembly of pack, the "first-in, first-out" (FIFO) principle should be applied.
- Charge time should not be longer than specified in the manual.
- Do not expose the battery to the outside of the operating temperature range specified in

this document.

5.3 Prohibitions

- Do not use different charger.
- Do not charge with more than maximum charge rate.
- Do not disassemble or reconstruct the battery module.
- Do not throw or cause impact.
- Do not pierce a hole in the battery with sharp things (such as nail, knife, pencil, drill).
- Do not use with other batteries or modules.
- Do not solder on battery directly.
- Do not press the battery with overload in assembling process.
- Do not use old and new module together for pack assembling.
- Do not expose the battery to high heat (such as fire).
- Do not put the battery into a microwave or high pressure container.
- Do not use the battery reversed.
- Do not connect positive (+) and negative (-) with conductive materials (such as metal, wire).
- Do not allow the battery to be immersed in or wetted with water or sea-water.
- Do not deform the battery module (e.g. bending the terrace area or the pouch sealing area) without written agreement with the battery manufacturer.

6. Applications of Battery Management System (BMS)

- Customers should configure a BMS which is used for strictly monitoring, management and protection.
- Customers should have a detailed design of BMS, assess system features, frameworks, system data, format and other related information, and establish battery management file.
- The design or framework of BMS must be changed with permission, so as not to affect the performance of battery.
- The BMS shall be able to monitor on each cell's working condition accurately and manage on them separately, to ensure the module's best performance.
- Customers should keep a complete battery operation monitoring data as the reference of responsibility division for product quality. Without complete battery operation monitoring data within system usage period, TWS will not assume responsibility for such quality assurance.
- Avoid over-discharge state. When the battery voltage is lower than 2.0 V, the internal battery may suffer permanent damage, now the quality assurance responsibilities of the product of

TWS failure. When the discharge cut-off voltage is lower than 2.7 V, the energy consumption in the internal system minimize and prolong sleep time before recharging. Customers need to train users to re-charge in the shortest time, to prevent the battery into the over-discharge state.

- Charging at low temperature is forbidden (including standard charge, fast charge, emergency charge and regenerative charge), or it may reduce the capacity. Battery management system should ensure the cell operating according to the temperature protocol (refer to cell specification); otherwise the TWS does not assume responsibility for quality assurance.

7. Battery Module Structure

7.1 Overview of Module Structure

- Pole welding method: laser welding
- Group Technology: welding
- Thermal management: natural cooling
- Mounting hole: 4 × φ 8.2 round hole
- Equipotential design

7.2 Dimensions and External Surface Requirements

The design of the TWS module is shown as below. The module consists of 9 batteries in series, consisting of an end plate, a side plate, a wire harness isolation plate, an FPC, and an upper cover. The FPC is responsible for collecting the battery voltage and temperature while the module is working. Customers shall have a good understanding on the FPC data and use them properly to ensure the best performance of the module. The upper cover of the module can protect the battery and the insulation. Appearance requirements: The appearance of the assembly has no obvious processing or bumping flaws, no crack on the surface, and no burrs on the weld.



Figure 1, Schematic diagram of the TWS module

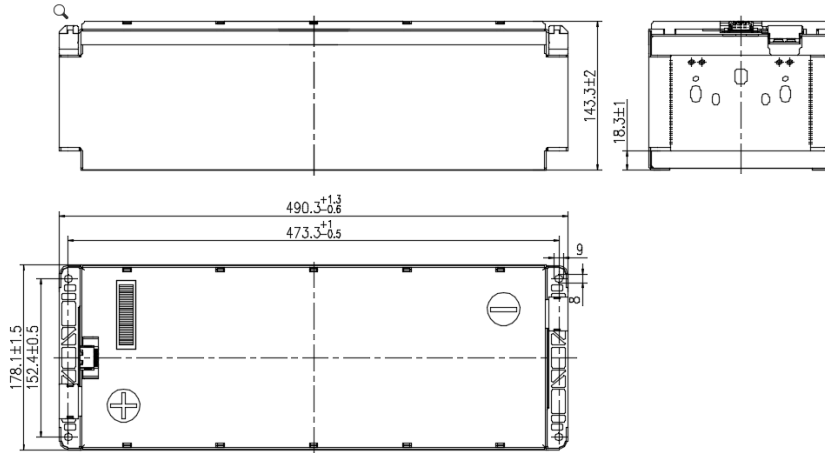


Figure 2, TWS NCM module size chart

7.3 Module Connection Requirements

M6 bolts/nuts with strength class ≥ 8.8 must be selected for the fixing of the module. The bolt length should be selected according to the Pack design and should meet the requirements of anti-loose. The installation torque requirement of the bolt is 8 ± 1 N·m, using signs or re-examination. Ensure that all bolts are locked and recheck 6 N·m.

The high-voltage (HV) connection of the module is recommended to be fixed with M5 hex flange bolts with strength class ≥ 4.8 . The recommended tightening torque is 5 N·m, and the re-check torque is 4 N·m. After the output poles are connected, the output pole protection is required. Cover protection, soft connection is recommended for high-voltage connection of modules. The functional surface of soft connection is recommended to be protected by nickel. The surface should not have burrs, stains, corrosion, wrinkles and other undesirable phenomena. The joints should not have holes or delamination, hardness ≥ 60 HV, flatness ≤ 0.2 mm.

7.4 Interface definition

8. Interface definition (IMSA)13065B-2-16A-TR		
1	V1	Battery 1 +
2	V3	Battery 3 +
3	V5	Battery 5 +
4	V8	Battery 8 +

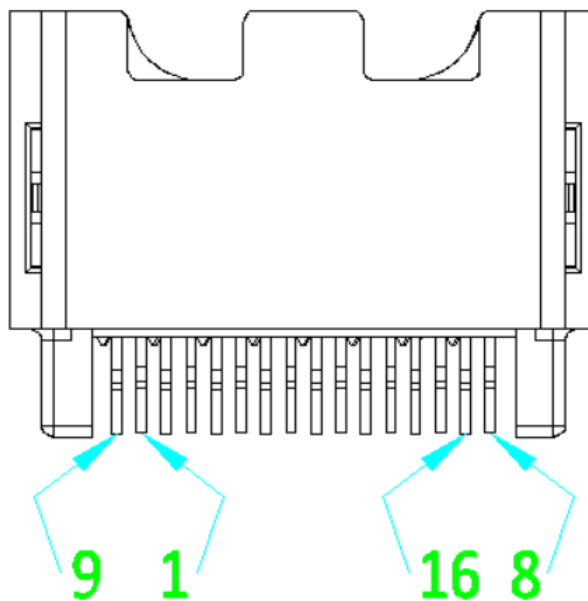
5	V6	Battery 6 +
6	V4	Battery 4 +
7	NTC1+	Temperature 1
8	NTC1-	Temperature 1
9	V9	Battery 9 +
10	NTC2+	Temperature 2
11	NTC2-	Temperature 2
12	V7	Battery 7 +
13	NTC3+	Temperature 3
14	NTC3-	Temperature 3
15	V2	Battery 2 +
16	V0	Battery 1 -

Figure 3, Interface definition (TWS-9S1P-135-NCM module)

8.1 Module Connector Model

Interface	Connector socket model (module side)	Connector plug type	Connector pin type
	(IMSA) 13065B-2-16A-TR	(IMSA) 13065S-2-16A-TR	IPS-13065T-01A-T

8.2 Connector schematic



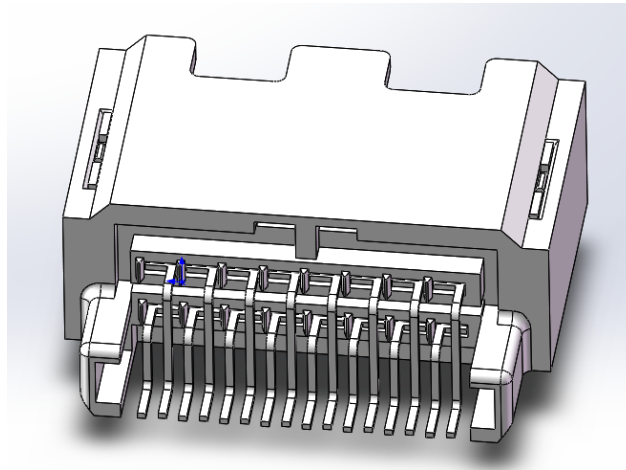


Figure 4, Connector socket diagram

9. Standard Experiment Condition

Unless otherwise stated, all tests in this specification are performed under the following environmental conditions:

Temperature: 25 ± 3 °C

Humidity: $65\% \pm 20\%$ RH

10. Notes and Statements

10.1 Notes

This product must comply with the operating instructions. Any installation, maintenance and use of this product must strictly comply with the relevant safety regulations.

- Do not store or use at high temperatures, and must be kept away from heat. These environments above the safe temperature range can cause significant degradation in the performance and life of the product, and even cause serious consequences such as burning and explosion.
- Storage and use in environments with high static or high electromagnetic radiation is prohibited. Otherwise, the electronic components in this product may be damaged, which may cause safety hazards.
- Do not get wet or even soak in water. Otherwise, it may cause internal short circuit, loss of function or abnormal chemical reaction of the product, and cause fire, smoke, explosion and other accidents.
- If you find any abnormalities in smoking, fever, discoloration or deformation, or in use, storage, transportation and service, you should contact the professional department immediately to further observe and control the risks.
- Do not discard discarded products in fire or in hot furnaces. Waste batteries should be

recycled and recycled by professional agencies or organizations.

- It is forbidden to press heavy objects on the product or stack them on each other.
- Although the module is not a high-pressure energy storage device, non-professionals and improper operation and use may still cause serious consequences such as burning and explosion. The installation and maintenance of the battery system must be operated by professional technicians. The use must strictly abide by the relevant safety regulations; non-professionals are strictly prohibited to install, repair battery systems and abuse.

10.2 Statements

- The right to interpretation this specification belongs to JIANGSU TWS TECHNOLOGY LIMITED.
- This specification is subject to changes with reference to the update on cell specification and TWS's technology update.

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