

Specification Approval Sheet

Product No.	MEGOLF12160-12.8V16Ah-A0
File Name	Specification of 4S5P-12.8V16Ah
File Version	V1.0
File No.	PR-WI-RD-002
Controlled No.	
Date	2017-03-16

Draft	Checked	Approval
Customer Approval		

1 Scope

This document describes the Product Specification of the Lithium-ion rechargeable battery supplied by Tempel Group.

2 Specifications

2.1 Battery Specification

No.	Items	Specification	Note
1	Nominal voltage	12.8V	Open Circuit Voltage : 13.2V~13.6V
2	Nominal capacity	16Ah	0.2C
	Minimum capacity	16Ah	
3	Initial impedance	$\leq 200\text{m}\Omega$	AC 1KHz after standard Charge
4	Charge voltage	14.6V	
5	Discharge cut-off voltage	8V	
6	Standard charge current	3.2A	0.2C
7	Max. charge current	5A	
8	Standard discharge current	3.2A	0.2C
9	Max. discharge curren	16A	
10	Peak discharge current	48A	time $\leq 10\text{S}$
11	Operating temperature	0°C ~ +45°C	Charge
		-20°C~ +55°C	Discharge
12	weight	About 2.2kg	
13	Dimension	L*W*H: 168*128*76mm	

2.2 Common Performance

No	Items	Testing method and determinant standard
1	Charge Performance	The standard charge mode: under the temperature of $23\pm 2^{\circ}\text{C}$, charge the battery with the current of 0.2C until the voltage reaches up to 14.6V , then charge with constant voltage until the charge current $\leq 0.02\text{C}$, then stop charging.
2	Discharge Performance	When connecting with load, the battery can supply power. Charge the battery with standard charge mode, then rest for 0.5h , then discharge with 0.2C until the voltage is 8V , and the discharge time is required $\geq 5\text{h}$.
3	High Temperature Characteristics	Standard charge the battery, then put the battery into the constant temperature and humidity oven with $55\pm 2^{\circ}\text{C}$, then discharge with 0.2C to 8V . The discharge time is required $\geq 4.7\text{h}$ (95%) and the battery should no deformation and smoking.
4	Low Temperature Characteristics	Standard charge the battery, then put the battery into the constant temperature and humidity oven with $-20\pm 2^{\circ}\text{C}$, then discharge with 0.2C to 8V . The discharge time is required $\geq 2.5\text{h}$ (50%) and the battery should no deformation and smoking.
5	Cycle Performance	Under the temperature of $23\pm 2^{\circ}\text{C}$, charge the battery with 0.2C , when the voltage reaches up to 14.6V charge with constant voltage until the charge current $\leq 0.02\text{C}$, then stop charging, then rest for 0.5h , then discharge with 0.2C to 8V . Cycle with the above mode, the test shall be terminated when Discharging Capacity $< 80\%$ of Initial Capacity in three consecutive cycles. The cycle life is required ≥ 2000 times.
6	Charged Storage Characteristics	Charge the battery with 0.5C , then shift to charge with constant voltage until the voltage reaches up to 14.6V , when the charge current $\leq 0.02\text{C}$ stop charging; rest under the temperature of $23\pm 2^{\circ}\text{C}$ for 28 days then discharge with 0.5C to 8V . The discharge time is required $\geq 1.8\text{h}$ (90%) .

2.3 Safety Performance

No	Items	Testing method and determinant standard
1	Short Circuit	After charge batteries, place at $20^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for 1h. Short the battery for 10min, the external circuit resistance should be less than $5\text{m}\Omega$. No explosion, No fire .
2	Vibration Test	When charges fully, the fixed cell to will vibrate the table and the clothing from will change to the circulation vibrational frequency by 1Hz rate each minute between 10 Hz 55Hz, the vibration tour will be 1.15mm. The cell will vibrate in each XYZ axis 90 minutes. No leakage, Capacity recovery rate 90% (standby 3hours) .No explosion, No fire .
3	Over-discharge test	Charge the battery. Place at $20^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for 1h, then discharge in $1/3\text{C}$ current at same temperature until some cell's voltage is 0V(if there are electronic protection circuit, remove it temporarily). No explosion, No fire .
4	Over-charge test	Charge in accordance with the following two ways (Choosing one between the two). Charge at 1C current for 90min or until voltage of some single battery reaches 5V (stop test when fulfills either condition).

3 product circuit diagram

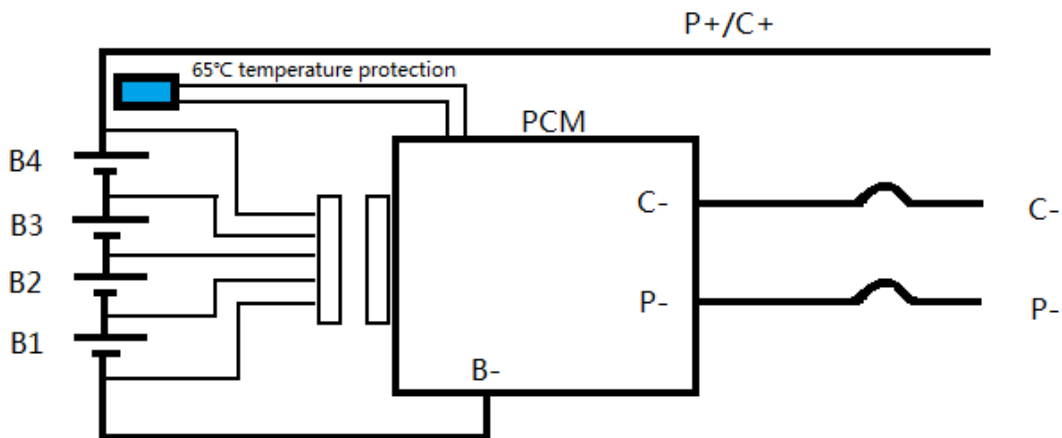


figure 1/1

4 PCM Electrical Characteristic (adjust)

No.	Items	Standard	Remarks
1	Over-charge voltage protection	3.8±0.05V	
2	Over-charge detection delayed time	0.5~2S	
3	Over-charge voltage protection release	3.6±0.1V	
4	Over-discharge voltage protection	2.0±0.1V	
5	Over-charge detection delayed time	10-200mS	
6	Over-discharge voltage protection release	2.3±0.1V	
7	Continuous operating current	≤25A	
8	Temprature protection	65±5°C	
9	Over-current protection	75±10A	Protection release: Cut off load
10	Detection delayed time	10ms (max)	
11	Short-circuit protection		Protection release: Cut off load
12	Mode	Charge balance	
13	Current Consumption	≤200 μ A	
14	Operating Temperature	-40°C--85°C	
15	Storage Temperature	-40°C--125°C	

5 Configuration

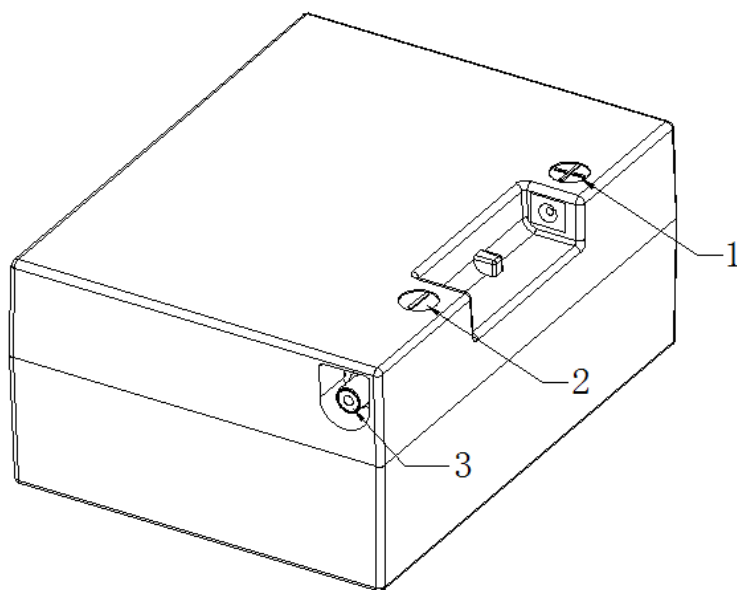


figure2/ 2



figure3/ 3

NO.	interface explanation	
1	Discharge Positive	
2	Discharge Negative	
3	Charge Port	
4	Discharge wire	Length=330mm

6 Test Requirement

6.1 Standard test condition

Battery Pack to be tested should be new battery pack within one month after shipment from our factory and the battery pack should not be cycled more than five times before the test. Unless otherwise specified, test and measurement should be done under these conditions:

Temperature : 15°C~25°C

Relative Humidity : 45%~85%RH

Atmospheric Pressure : 86kPa~106kPa

6.2 Measuring equipment implementation requirements

1. The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.
2. Battery test system should have current accuracy within $\pm 0.1\%$, voltage accuracy within $\pm 0.5\%$ & time accuracy within $\pm 0.1\%$.
3. Temperature measurement accuracy of instruments should be within $\pm 0.5\text{ }^{\circ}\text{C}$.
4. Standard class specified in national standard or more sensitive class, with internal impedance not less than 10 K Ω .
5. Standard class specified in national standard or more sensitive class. Total resistance including ammeter and wire is less than 0.01 Ω .
6. Impedance shall be measured by a sinusoidal alternating current method (AC 1kHz LCR). Resistance is not a constant value according to the change of temperature and state of charge, and related to lead length and capacity.
7. All test equipment and measuring instruments should be passed inspection of calibration organization.

6.3 Appearance Test Standard

There shall be no such defect as scratch, flaw, crack, rust, leakage, or which may adversely affect commercial value of battery.

7 Storage and Shipment Requirement

Item		Criteria
Storage temperature	Short period(less than 1 month)	-10°C~45°C
	Medium period (less than 3 month)	-10°C~35°C
	Long period (more than 3 month)	0°C~30°C
Relative Humidity		≤75% RH
State of Charge		40%~60%

Battery pack must be charged every three months when long term storage, please charge the battery pack with standard charging current for 0.5h~1h to keep 40%~60% state of charge.

8 Warning and Caution

- 1) Do not connect the battery pack's positive (+) and negative (-) poles reversed to charger or load, Do not connect the battery pack to charger's input power source (AC power supply).
- 2) Do not let the battery pack's terminals (+ and -) contact with unnecessary wire or any metal or stored them together, that may cause the battery pack short-circuit.
- 3) Do not drive a nail in battery pack, hit the battery pack with a hammer, stamp on or throw the battery pack.
- 4) Do not disassemble or alter the batteries' outside structure.
- 5) Do not use the battery pack under blazing sun, otherwise may cause battery pack overheating then catch fire or disable.
- 6) Do not put the battery pack into fire or heat the battery pack; do not store the battery pack in high temperature environment
- 7) Do not submerge the battery pack in water or get wet in the rain, keep the battery in shady and cool place when stored.
- 8) Do not charge the battery continuously over 24 hour.
- 9) When charging or discharging the battery pack, if you find any abnormal smell or noise, you must stop the

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charging or discharging at once, and contact the factory.

10) When using the battery pack out of range of 0~50°C, the capacity may decrease, that doesn't mean the battery pack was failure.

9 Product liability

Consumers must comply with the requirements of the specifications strictly using the battery. Due to misuse may cause the battery overheating, fire or explosion, for no operation in accordance with the specification as a result of any accident, +ENERGY not negative any responsibility.

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