**Customer Project XXXX**

**nSnP**

**Electric test requirement**

|  |  |
| --- | --- |
| **Customer:** | XXX |
| **Project Name:** | xxxx |
| **Inventus Project Number:** | xxxx |
| **Prepared by:** | EE |
| **Checked by:** | EE Manager |
| **Date:** | Mon-DD-YYYY |

*Proprietary Information*

This document and any associated data contain confidential proprietary information that is the property of Inventus Power. Do not disclose to or duplicate for any third parties, in whole or part, except by written permission of Inventus Power.

Contents

[1. Introduction 3](#_Toc201579858)

[2. Testing Equipment 3](#_Toc201579859)

[3. Electrical Performance Tests 3](#_Toc201579860)

[3.1. Cell Voltage detection accuracy test 3](#_Toc201579861)

[3.2. Pack/Battery Voltage detection accuracy test 3](#_Toc201579862)

[3.3. Current detection accuracy test 4](#_Toc201579863)

[3.4. Temperature detection accuracy test 4](#_Toc201579864)

[3.5. Over Voltage Protection test 4](#_Toc201579865)

[3.6. Under Voltage Protection test 5](#_Toc201579866)

[3.7. Over Charge Current test 5](#_Toc201579867)

[3.8. Over Discharge Current test 5](#_Toc201579868)

[3.9. Over Charge Temperature test 6](#_Toc201579869)

[3.10. Over Discharge Temperature test 6](#_Toc201579870)

[3.11. Leakage Current test in different operation mode 6](#_Toc201579871)

[3.12. Internal Power supply test 7](#_Toc201579872)

[3.13. Output power supply test 7](#_Toc201579873)

[3.14. Predischarge circuit test 8](#_Toc201579874)

[3.15. SCP Fuse test 8](#_Toc201579875)

[3.16. PCBA thermal runaway test 8](#_Toc201579876)

[3.17. I2C(SMBUS) communication waveform test 9](#_Toc201579877)

[3.18. CAN communication waveform test 9](#_Toc201579878)

[3.19. RTC Function test 9](#_Toc201579879)

[3.20. EEPROM Function test 10](#_Toc201579880)

[3.21. HALT testing 10](#_Toc201579881)

[3.22. MOSFET on/off logic testing 10](#_Toc201579882)

[3.23. Contactor on/off cycle life testing 10](#_Toc201579883)

[3.24. Shut down mode test 11](#_Toc201579884)

[3.25. charging V-I curve. 11](#_Toc201579885)

[3.26. Short Circuit Testing 11](#_Toc201579886)

[3.27. Short circuit Test (FMEA condition) 12](#_Toc201579887)

[3.28. Heater FEMA test 12](#_Toc201579888)

[3.29. Self-discharge Testing 12](#_Toc201579889)

[3.30. Impedance Testing 12](#_Toc201579890)

[3.31. Burn-in Test in high/low/room Temperature 13](#_Toc201579891)

[3.32. PCBA Cell balance circuit test 13](#_Toc201579892)

[3.33. System/charger match test 13](#_Toc201579893)

[3.34. Reverse connection test 13](#_Toc201579894)

[3.35. LED/LCD display test 14](#_Toc201579895)

[3.36. The inrush current/ spike voltage test when assembly cell+ 14](#_Toc201579896)

[3.37. Unit Cell balance circuit test 14](#_Toc201579897)

[Revision History 15](#_Toc201579898)

1. Introduction

This document specifies the electrical performance testing requirements for s used in various applications, such as electric vehicles, stationary energy storage, and portable electronics. These tests are designed to ensure the safety, reliability, and performance of the s.

1. Testing Equipment

* Battery cycler
* Electronic Load
* Multimeter
* Oscilloscope
* High-voltage tester
* Environmental chamber

1. Electrical Performance Tests
   1. Cell Voltage detection accuracy test

* **Test Objective**: Verify the cell voltage detect accuracy whether can meet the SPEC requirement.
* **Test Procedure**:
  1. Connect the PCBA with the analog battery and active the power.
  2. Adjust the analog battery range from 1V to 4.5V.
  3. Measure every cell voltage by multimeter and record the data.
  4. Read cell voltage by communication.
  5. Compare the test result and calculate the tolerance △V.
  6. Should do this test at both low, room and high temperatures
* **Acceptance Criteria**:
  + The cell voltage detect tolerance should be within the datasheet tolerance in full voltage range.
  1. Pack/Battery Voltage detection accuracy test
* **Test Objective**: Verify the Pack/Battery voltage detect accuracy whether can meet the SPEC requirement.
* **Test Procedure**:
  1. Connect the PCBA with the analog battery and active the power.
  2. Adjust the analog battery range from 1V to 4.5V.
  3. Measure pack/battery voltage by multimeter and record the data.
  4. Read pack/battery voltage by communication.
  5. Compare the test result and calculate the tolerance △V.
* **Acceptance Criteria**:
  + The pack/battery voltage detect tolerance should be within the SPEC requirement.
  + If customers haven’t special requirements, the voltage accuracy need to meet △V<=1%.
  1. Current detection accuracy test
* **Test Objective**: Verify the battery pack current detection accuracy whether can meet the SPEC requirement.
* **Test Procedure**:
  1. Connect the battery pack with the E-load to check discharge current accuracy.
  2. Adjust the E-load with 0%,10%,50% 100% loading.
  3. Measure current by Sense and record the data.
  4. Read current by communication.
  5. Compare the test result and calculate the tolerance △I.
  6. The change to charge mode and repeat the above test procedure to check charge current accuracy.
  7. Should do this test at both low, room and high temperatures
* **Acceptance Criteria**:
  + The current detection tolerance should be within the SPEC requirement.
  + If customers haven’t special requirements, the current accuracy needs to meet △I<=1% for full load. △I<=5% for 0% to 100% load.
  1. Temperature detection accuracy test
* **Test Objective**: Verify the battery pack Temperature detection accuracy whether can meet the SPEC requirement.
* **Test Procedure**:
  1. Active the battery pack and read all the NTC temperature by communication.
  2. Measure the ambient temperature.
  3. Compare the test result and calculate the tolerance △T in high, low and room temperature.
  4. Should do this test at both low, room and high temperatures
* **Acceptance Criteria**:
  + The current detection tolerance should be within the SPEC requirement.
  + If customers haven’t special requirements, the voltage accuracy needs to meet △T<=3℃.
  1. Over Voltage Protection test
* **Test Objective**: Verify the battery pack whether can protect when the cell voltage out of the threshold.
* **Test Procedure**:
  1. Connect the battery pack and enter the charge mode.
  2. Adjust the analog battery voltage to trigger the OVP threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage.
  4. Check whether the can protect normally and verify the tolerance of trigger point and delay time.
  5. If with 2nd level OVP function, should disable 1st level OVP function, and do the qualify test for 2nd level OVP function.
* **Acceptance Criteria**:
  + Stop charging when OVP trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within

±10mV(Refer item3.1) and the delay time error <=2S(Refer FW parameter setting). For the PF protection, the delay time should be longer than 10s.

* 1. Under Voltage Protection test
* **Test Objective**: Verify the battery pack whether can protect when the cell voltage out of the threshold.
* **Test Procedure**:
  1. Connect the battery pack and enter the discharge mode.
  2. Adjust the analog battery voltage to trigger the UVP threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage.
  4. Check whether the battery pack can protect normally and verify the tolerance of trigger point and delay time.
  5. If with 2nd level UVP function, should disable 1st level UVP function, and do the qualify test for 2nd level UVP function.
* **Acceptance Criteria**:
  + Stop discharging when UVP trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within

±10mV(Refer item3.1) and the delay time error <=2S(Refer FW parameter setting). For the PF protection, the delay time should be longer than 10s.

* 1. Over Charge Current test
* **Test Objective**: Verify the Battery pack whether can protect when overcharge current occur.
* **Test Procedure**:
  1. Connect the Battery pack and enter the charge mode.
  2. Increase charge current to trigger the OCC threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage (Vgs of CHG\_MOS).
  4. Check whether the Battery pack can protect normally and verify the tolerance of trigger point and delay time.
  5. Use the max current which won’t trigger protection to do a long-time test. And record the temperature of the cell and power components.
* **Acceptance Criteria**:
  + Stop charging when OCC trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within

1%(Refer item3.3) and the delay time error <=1S(Refer FW parameter setting) .

* + check the voltage derating for the components which are attached in the main power circuit.
  + calculating the SOA derating of the MOSFE based on the testing waveform
  1. Over Discharge Current test
* **Test Objective**: Verify the Battery pack whether can protect when over discharge current occur.
* **Test Procedure**:
  1. Connect the Battery pack and enter the charge mode.
  2. Increase charge current to trigger the OCD threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage(Vgs of DSG\_MOS).
  4. Check whether the Battery pack can protect normally and verify the tolerance of trigger point and delay time.
  5. Use the max current which won’t trigger protection to do a long time test. And record the temperature of the cell and power components.
* **Acceptance Criteria**:
  + Stop discharging when OCD trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within
  + 1%(Refer item3.3) and the delay time error <=1S(Refer FW parameter setting)
  + Check the voltage derating for the components which are attached in the main power circuit.
  + calculating the SOA derating of the MOSFE based on the testing waveform
  1. Over Charge Temperature test
* **Test Objective**: Verify the Battery pack whether can protect when over charge temperature occur.
* **Test Procedure**:
  1. Connect the Battery pack and enter the charge mode.
  2. Use the variable resistance box replace the NTC and adjust the resistor to trigger the OTC threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage (Vgs of CHG\_MOS and VNTC).
  4. Check whether the Battery pack can protect normally and verify the tolerance of trigger point and delay time.
* **Acceptance Criteria**:
  + Stop charging when OTC trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within

±3℃ and the delay time error <=2S（Refer FW parameter list setting）.

* 1. Over Discharge Temperature test
* **Test Objective**: Verify the Battery pack whether can protect when over discharge temperature occur.
* **Test Procedure**:
  1. Connect the Battery pack and enter the discharge mode.
  2. Use the variable resistance box replace the NTC and adjust the resistor to trigger the OTD threshold.
  3. Use the Oscilloscope to catch the protection waveform of the current and voltage (Vgs of DSG\_MOS and VNTC).
  4. Check whether the BBU can protect normally and verify the tolerance of trigger point and delay time.
* **Acceptance Criteria**:
  + Stop discharging when OTD trigger and the protection point can meet the SPEC requirement.
  + If customers haven’t special requirements, the protection threshold tolerance should be within

±3℃ and the delay time error <=2S（Refer FW parameter list setting）.

* 1. Leakage Current test in different operation mode
* **Test Objective**: Verify the Battery pack leakage current in different operation modes to check the battery shelf-life data.
* **Test Procedure**:
  1. Connect the Battery pack with analog battery and series the ampere meter in the battery bus.
  2. And then place the sample in high, low and room temperature.
  3. Measure the leakage current in different modes (Active/Sleep/ship mode/Shutdown mode).
  4. Record the test data.
  5. Should do this test at both low, room and high temperatures of storage temperature.
* **Acceptance Criteria**:
  + The leakage current in different modes can meet the SPEC requirement.
  + The leakage current of the battery pack at Low/Normal/High temperature is the same when in the same operation mode.
  + The self-discharge rate of the battery pack(Include cell self-discharge) in sleep mode/ship mode should be lower than 2% per month.
  + The leakage current of PCBA for shutdown mode should be lower than 20uA.
  + The leakage current of PCBA for sleep/ship mode should be lower than 600uA.
  1. Internal Power supply test
* **Test Objective**: Verify the battery pack internal power output voltage and ripple.
* **Test Procedure**:
  1. Active the battery pack and enter normal mode.
  2. Use the oscilloscope to catch the startup and shutdown sequence waveform of input voltage, output voltage and enable voltage.
  3. And then load with different load (0%/50%/100%), use the voltage meter to record the voltage
  4. Measure the output ripple voltage by oscilloscope probe with grounding ring.
  5. Record the test waveform and data.
  6. Record the V-I curve
* **Acceptance Criteria**:
  + The output voltage ripple tolerance should be within 1%.
  + The voltage should be output voltage ±2% during the whole V-I curve
  + The audio noise should be lower than 24dB(In lab test).Should do the test in meeting room, should not hear any audio noise.
  1. Output power supply test
* **Test Objective**: Verify the basic DC/DC power supply’s functionality and reliability.
* **Test Procedure**:
  1. Measure the ripple voltage waveform of DC/DC output voltage at no Load and Full Load.
  2. Measure the Voltage and current waveform of DC/DC inductor at Full Load.
  3. Measure V out-I out curve of the DC/DC. Change I out from no Load to Full Load
  4. Do the dynamic load test. Load transit to be 90% from 10%. Duty cycle is 50%, frequency is 1kHz.
  5. Do the over current and short circuit test
  6. Do the capacitance load test, the power supply can start with a given capacitance load.
  7. Measure the standby power.
  8. Measure the loop stability with PSM 2200



* **Acceptance Criteria**:
  + Output voltage ripple voltage waveform Lower than 1% voltage
  + The peak current of inductor should be lower than 0.8\*I\_sat in the datasheet of inductor.
  + The voltage should be output voltage±2% and the audio noise should be lower than 24dB(Should not hear any audio noise in meeting room) during the whole V-I curve.
  + The output voltage should be output voltage ±10% during the dynamic load test.
  + The over current should set between 1.2times to 2.0times. The thermal rise of all the components should meet component’s requirements during short circuit test. And should not find any component damaged during short circuit test.
  + The capacitance load should meet the requirements from customer fist. If no requirement from customer, should meet 50uF/W.
  + The phase margin must be greater than 45°, Profit margin should be greater than 10dB.
  1. Predischarge circuit test
* **Test Objective**: Evaluate the performance of the predischarge function with customer input capacitor and light load condition.
* **Test Procedure**:
  1. Test the inrush current and output voltage waveform at full temperature range of the product with the capacitance and light load condition provided by customer.
  2. Started up the predischarge circuit with short circuit.
* **Acceptance Criteria**:
  + The battery should start up and ready to discharge without any fault.
  + There are no components damaged with 100 times short circuit test.
  1. SCP Fuse test
* **Test Objective**: Evaluate the performance of the SCP Fuse function can operate with no danger situation
* **Test Procedure**:
  1. Active the battery pack and enter normal mode.
  2. Use the oscilloscope to catch VGS voltage of the SCP driver MOSFET and the voltage of SCP fuse
  3. Measure the blow-up time at 2nd protection voltage. 4.25x7V
* **Acceptance Criteria**:
  + The blow-up time should be met with the SCP FUSE datasheet.
  1. PCBA thermal runaway test
* **Test Objective**: Evaluate the performance of the thermal Fuse function can operate with no danger situation
* **Test Procedure**:
  1. Heat up the cell thermal fuse to its break temperature and check if the circuit will trigger and blow up the SCP FUSE.
  2. Do the single fault for one DSG MOSFET.
  3. Add the rating load after MOSFET is damaged
  4. Record MOSFET, cell and thermal fuse temperature until the thermal rise of components decrease to room temperature.
* **Acceptance Criteria**:
  + The circuit will trigger and blow up the SCP FUSE.
  + The triggered temperature of the thermal fuse should be within the spec of thermal fuse.
  + No fire can be saw during the whole test.
  1. I2C(SMBUS) communication waveform test
* **Test Objective**: Verify the battery pack communication waveform whether it can meet the IIC criteria.
* **Test Procedure**:
  1. Active the battery pack and enter normal mode.
  2. Use the oscilloscope to catch SDA &SCL waveform while communicating.
  3. Check the waveform of logic level, rise time, fall time whether can meet IIC criteria.
* **Acceptance Criteria**:
  + Standard mode：Trise≤1us，Tfall≤300ns.

Fast mode：Trise≤300ns，Tfall≤300ns

* + Logic level: VH≥0.7VDD, VL≤0.3VDD.
  1. CAN communication waveform test
* **Test Objective**: Verify the battery pack communication waveform whether it can meet the CAN criteria.
* **Test Procedure**:
  1. Active the battery pack and enter normal mode.
  2. Use the oscilloscope to catch CANH-CANL, CANH-GND, CANL-GND waveform while communicating.
  3. Check the waveform of logic level, rise time, fall time whether can meet CAN criteria.
  4. Connect the battery packs in parallel with the max parallel allow qty.
  5. Repeat step d to f.
* **Acceptance Criteria**:

|  |  |  |
| --- | --- | --- |
|  |  | **spec** |
| **Descent time** | **CANH to CANL** | **20~400ns** |
| **Rise time** | **CANH to CANL** | **20~200ns** |
| **Dominant** | **CANH to CANL** | **1.5~3V** |
| **Recessive** | **CANH to CANL** | **-0.5~0.05V** |
|  |  |  |
| **Dominant** | **CANH To GND** | **2.75~4.5V** |
| **CANL To GND** | **0.5~2.25V** |
| **Recessive** | **CANH To GND** | **2~3V** |
| **CANL To GND** | **2~3V** |

* 1. RTC Function test
* **Test Objective**: Verify the RTC Function Performance.
* **Test Procedure**:
  1. Write the clock calendar by IIC command.
  2. Check the time after writing success.
  3. Catch the communication waveform while writing/reading.
  4. Record the test waveform and data.
* **Acceptance Criteria**:
  + The time error should be less than 2S.
  + The communication waveform should meet IIC criteria.
  1. EEPROM Function test
* **Test Objective**: Verify the EEPROM Function Performance.
* **Test Procedure**:
  1. Write EEPROM data by IIC command.
  2. Read the data by command.
  3. Catch the communication waveform while writing/reading.
  4. Record the test waveform and data.
* **Acceptance Criteria**:
  + Can read the data correctly.
  + The communication waveform should meet IIC criteria.
  1. HALT testing
* **Test Objective**: Evaluate PCBA operation temperature range
* **Test Procedure**:
  1. Put the PCBA into an oven and increase AMT from 80℃ to 120℃ and loading the rating current or 20A min.
  2. Use the oscilloscope to capture the GS waveform of DSG&CHG MOSFET.
  3. Rise the temperature every 10℃ from 80℃. And each temperature should test for at least 10 minutes.
  4. If you find the temperature protection, shield this NTC, then continue this test.
* **Acceptance Criteria**:
  + No fires were found.
  + The driver voltage of MOSFET should be higher than 8V.
  + MOSFET drivers should be normal during the whole test.
  1. MOSFET on/off logic testing
* **Test Objective**: Evaluate PCBA MOSFET on/off logic to meet with the document below.



* **Test Procedure**:
  1. Test the MOSFET on/off logic based on the” Test process for MOSFET on off logic.pptx”.
* **Acceptance Criteria**:
  + The MOSFE on/off logic should meet with the” Test process for MOSFET on off logic.pptx”.
  1. Contactor on/off cycle life testing
* **Test Objective**: Evaluate contactor life time data with max load.
* **Test Procedure**:
  1. Active the battery pack and enter normal mode.
  2. Measure the DCR for the contactor and record as R1
  3. Charge the battery pack to be full
  4. Set the load to be the max continuous current
  5. Send the command to turn off the contactor with the max continuous current.
  6. Reset the battery pack and repeat step “c” and “d” for 100 times,
  7. Measure the DCR for the contactor and record as R2
* **Acceptance Criteria**:
  + (R2-R1)/R1 should less than 10%.
  1. Shut down mode test
* **Test Objective**: Evaluate the PCBA can enter shutdown mode in different method
* **Test Procedure**:
  1. Sent shutdown command to the PCBA with no signal
  2. Set the cell voltage less than shut down voltage with no signal
  3. Sent shutdown command to the PCBA with CHG/DSG signal
  4. Set the cell voltage less than shut down voltage with CHG/DSG signal
  5. After the PCBA enters shutdown mode, active the PCBA by charge voltage or button or signal
* **Acceptance Criteria**:
  + The PCBA should enter shutdown, and all power supply should be off.
  + The PCBA needs to be active by charge voltage or button or signal after shutdown.
  1. charging V-I curve.
* **Test Objective**: Evaluate the PCBA charge voltage range
* **Test Procedure**:
  1. Set the battery voltage to the lowest working voltage
  2. Let the battery enter charge mode and start charging
  3. If the battery can be charged, then stop.
  4. Increase the battery voltage 100mV higher.
  5. Let the battery enter charge mode and start charging
  6. Repeat step b c d
* **Acceptance Criteria**:
  + The battery PCBA can be charged from 1.55V/cell to full charge.
  1. Short Circuit Testing
* **Test Objective**: Evaluate the safety and performance of the battery pack under short circuit conditions.
* **Test Procedure**:
  1. Connect the positive and negative terminals of the battery pack with a wire <5mOHM.
  2. Monitor the temperature, voltage, and current of the battery pack during the test.
  3. If the customer has parallel requirements we need to do a parallel short circuit test too.
  4. If the first 5 short circuit test result is ok then need to do Short circuit test at output (>100 times short at 1 unit)
  5. Need do the charge and discharge burn in test after 100 times short circuit test. If the battery pack with AUX power output, should also do the burn in test for the AUX power. Make sure all the functions are normal after short circuit test.
* **Acceptance Criteria**:
  + The battery pack should not catch fire or explode during short circuit.
  + The battery pack should be able to recover to its normal state after a short circuit.
  + Calculate the power loss and the result shouldn’t exceed the MOS rating (VDS/Temperature rising).
  1. Short circuit Test (FMEA condition)
* **Test Objective**: Evaluate the safety and performance of the battery pack under FMEA short circuit conditions.
* **Test Procedure**:
  1. FMEA the discharge MOSFET of the battery (short the DS of discharge MOSFET)
  2. Connect the positive and negative terminals of the battery pack with a wire <5mOHM.
  3. Monitor the temperature, voltage, and current of the battery pack during the test.
  4. Turn on the switch for short circuit test
* **Acceptance Criteria**:
  + The battery pack should not catch fire or explode during short circuit.
  + The Fuse should be cut off in safety. The max interrupt current of the Fuse should be higher than1.2times max short circuit current.
  1. Heater FEMA test
* **Test Objective**: Evaluate the safety and performance of HW heater protection at FMEA condition.
* **Test Procedure**:
  1. FMEA the heater circuit short all the power MOSFET
  2. Using a DC supply to power up the heater
  3. Heating up the cell until all the thermal fuse series in the heater is broken.
  4. Monitor the cell and the thermal fuse temperature during the test

Note: for NMC cell the cell temperature should not higher than 110℃ for more than 1min

for LFP cell the cell temperature should not higher than 130℃ for more than 1min

* **Acceptance Criteria**:
  + The thermal fuse series in the heater should be broken to refer to its datasheet parameter
  + The heating process should be stopped or the temperature keeps on an low level(< the cell protection temperature)
  1. Self-discharge Testing
* **Test Objective**: Determine the self-discharge rate of the battery pack.
* **Test Procedure**:
  1. Charge the battery pack to its full capacity.
  2. Store the battery pack in a room temperature in sleep mode.
  3. Measure the remaining capacity of the battery pack after storage 1 month.
* **Acceptance Criteria**:
  + The self-discharge rate should be less than 2% per month.
  1. Impedance Testing
* **Test Objective**: Measure the internal impedance of the battery pack.
* **Test Procedure**:
  1. Use an impedance analyzer to measure the internal impedance of the battery pack.
  2. Measure the impedance at different frequencies.
* **Acceptance Criteria**:
  + The internal impedance should be within the specified limit.
  + The impedance should not increase significantly with the number of cycles.
  1. Burn-in Test in high/low/room Temperature
* **Test Objective**: Evaluate the performance of the BBU component at different temperatures.
* **Test Procedure**:
  1. Charge and discharge the battery pack at different temperatures, such as -20°C, 0°C, 25°C, and 50°C.
  2. Measure the voltage, current, capacity and key component temperature rising of the BBU at different temperatures.
* **Acceptance Criteria**:
  + The battery pack should be able to operate normally at different temperatures.
  + The capacity of the battery pack should meet the cell spec requirement.
  + The max component rise should be within the derating requirement.
  1. PCBA Cell balance circuit test
* **Test Objective**: Evaluate the performance of the cell balancing circuit functionality and logic.
* **Test Procedure**:
  1. Connect the PCBA with a multi-channel DC power supply.
  2. Change the cell voltage to meet the cell balancing circuit on condition (EX △V>20mV).
  3. Change the cell voltage to meet the cell balancing circuit OFF condition (EX △V<10mV)
  4. Keep the cell balancing circuit ON and test the temperature rise.
* **Acceptance Criteria**:
  + The cell balancing circuit should be turned on based on the voltage condition set in parameter list.
  + The cell balancing circuit should be turned off based on the voltage condition set in parameter list.
  + The temperature rise should be in the range of component datasheet.
  1. System/charger match test
* **Test Objective**: Evaluate the performance of the matching between BMS and system.
* **Test Procedure**:
  1. Connect the BMS system interface to the system.
  2. Test the wake-up function of the BMS combine with system
  3. Test and run at least one cycle of the system working state
  4. Test the sleep and shutdown function of the BMS combined with system
* **Acceptance Criteria**:
  + The BMS can be woken up when it is combined with the system.
  + The BMS can work with the System running for no fault.
  + The BMS can sleep and shutdown when it is installed in the system.
  1. Reverse connection test
* **Test Objective**: Evaluate the performance of the BMS when there is a reverse connection to its output.
* **Test Procedure**:
  1. Using the charger Connect the BMS unit in reverse.
  2. Start the charger
  3. Test the waveform of the CHG/DSG MOSFET output voltage and charge current
* **Acceptance Criteria**:
  + There should not be component break and functional loss after the test.
  1. LED/LCD display test
* **Test Objective**: Evaluate the performance of the LED/LCD display matches the requirements of customer SPEC.
* **Test Procedure**:
  1. Using PCBA of the BMS to test the LED/LCD display.
  2. Check the display state at normal mode and fault mode
* **Acceptance Criteria**:
  + The display state should meet with customer SPEC
  1. The inrush current/ spike voltage test when assembly cell+
* **Test Objective**: Evaluate if there is a current/ spike voltage that will occur on the VCC of the PCBA
* **Test Procedure**:
  1. Test the voltage waveform of PCBA power supply such as 15V 12V 5V 3.3V.
  2. Check if there is a voltage spike when assembly cell+
  3. Test the current waveform on cell+
  4. Check if there is a current spike when assembly cell+
* **Acceptance Criteria**:
  + There should no a voltage or current spike there when assembly cell+.
  1. Unit Cell balance circuit test
* **Test Objective**: Evaluate the performance of the cell balancing circuit functionality and logic.
* **Test Procedure**:
  1. Charge the battery pack to be full.
  2. Discharge one cell for more than 10% capacity
  3. Let the battery pack enter rest statues.
  4. Record each cell voltage information by FW.
  5. Record the thermal rise of cell balance resistors and AFE/Fuel gauge IC.
* **Acceptance Criteria**:
  + The voltage bouncing value should not be higher than 5mV
  + The thermal rise of components should meet the derating requirements.
  + The cell balance should be balanced in a time

0v

Revision History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Revision** | **Description of Change** | **Changed by** | **Approved by** | **Date** |
| X1 | New release | Loring | Kylin/Kyle/CYW/XJJ | Mar.-11-2025 |
| X2 | Add 3.37 Unit Cell balance circuit test | Loring | Kylin/Kyle/CYW/XJJ | Jun-13-2025 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |