**Customer Project XXXX**

**AC/DC Power Supply**

**Electric test requirement**

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

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1. Introduction

This document specifies the electrical performance testing requirements for AC/DC Charger & Power Supply 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 AC/DC Charger & Power Supply.

1. Testing Equipment

* AC Power Supply (For >1kW Production advise to use Bi-direction AC/DC Power Supply)
* DC Power Supply (For >1kW Production advise to use Bi-direction DC/DC Power Supply)
* Electronic Load (For >1kW Production advise to use Bi-direction DC/DC Power Supply)
* Power Meter
* Standard Current Shunt Resistor
* Multimeter
* Oscilloscope
* High Voltage Differential Probe/Current Probe/Passive Probe
* Loop Stability Analyzer
* High-Voltage Tester
* ESD Tester
* Thermal/Voltage/Current Logger
* Environmental Chamber

1. Electrical Performance Test
   1. Power Supply Performance Test
      1. Efficiency (DOE Level V/VI/VII) & PF Value Test

* **Test Objective**: Measure the Power Supply Efficiency and PF Value meet DOE Level V/VI/VII or not.

Remark: The Power Supply need to do the burn-in test for 10 minutes with full load before do the Efficiency & PF Value Test

* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set the E-load or Bi-direction DC/DC to let product load in 0%/10%/25%/50%/100%.
  3. Measure AC Input Power and PF Value with Power Meter.
  4. Measure DC Output Current and Output Voltage with Multimeter and Shunt resistor.
  5. Calculate the Efficiency and compare it with the DOE Level V/VI/VII standard.
* **Acceptance Criteria**:
  + Efficiency must meet the DOE Level V/VI/VII standard as Spec requirement.
  + PF value needs to meet the Spec requirement (which also will affect the Harmonic Current Emissions for Agency).
    1. Output Voltage-Current (VI Curve) Test
* **Test Objective**: Measure the Power Supply Output Voltage-Current Range.
* **Test Procedure**:
  1. Set AC Power Supply 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use the Logger and Shunt Resistor to measure the output voltage and current.
  3. Set the E-load or Bi-direction DC/DC to let product load from 0% to OCP trigger point.
  4. Draw the Output VI Curve based on measure data.
* **Acceptance Criteria**:
  + The Output VI Curve must meet the SPEC requirements.
  + The Output VI Curve needs to cover all the system statues which customers will apply.
    1. Power Supply Burn-in Thermal Test
* **Test Objective**: Evaluate the performance of the Power Supply at different temperatures.
* **Test Procedure**:
  1. Set AC Power Supply in 85Vac/115Vac/230Vac/265Vac (use 85Vac/115Vac or 230Vac/265Vac if only support 110Vac/230Vac).
  2. Use the E-load or Bi-direction DC-DC to test the Power Supply under full load at different temperatures, such as 0’C, 25°C, 45’C or Special Case.
  3. Measure the Output Voltage, Output Current, Input Power and Power Component Thermal shown in below list at each temperature：

a. Magnetic Component Core & Coil

b. Power MOSFET

c. LDO

d. Input and Output Capacitor

e. RCD absorb circuit

f. Output SR Rectifier

g. PWM IC

h. NTC

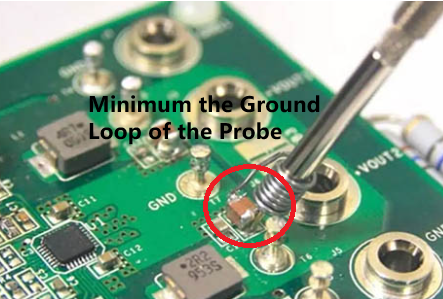
i. Y-Capacitor & X- Capacitor

j. Opto-Coulper

k. Heatsink

l. Housing

* **Acceptance Criteria**:
  + Power Supply must operate normally under each environment’s temperature.
  + All Power Components need to have thermal margin (>30’C Thermal Margin for Datasheet limited) under the burn-in test.
    1. Output Ripple Voltage Test
* **Test Objective**: Measure Output Ripple Voltage to verify meet the SPEC requirement.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use the E-load or Bi-direction DC-DC to make the Power Supply under 0%/10%/50%/100%/special case load.
  3. Use oscilloscope (set the channel bandwidth in 20MHz) and passive probe by using 10uF/0.1uF MLCC capacitor in parallel to filter the high frequency noise.
  4. Passive probe must use Probe Grounding Ring (Minimum the Ground Loop) to test Ripple Voltage. Shown as below Figure:



* **Acceptance Criteria**:
  + Output Ripple Voltage needs to meet SPEC requirement.
  + If no special requirement needs to meet <1%\*Vrate Ripple Voltage (High output voltage such as >100V use <0.5%\*Vrate as ripple voltage criteria).
    1. Output Rise Time/Hold-Up Time Test
* **Test Objective**: Measure the Power Supply Output Hold-up time/Rise Time to verify meet SPEC or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac) and AC Turn-on Phase Angle needs to set to 0’.
  2. Set the E-load or Bi-direction DC-DC to Make Power Supply under full load (guarantee E-load Current Slew rate can up to >1A/us to keep test result satisfied with actual usage).
  3. Use the High Voltage Differential Probe to measure the AC Input Voltage and Output Voltage
  4. Turn on the E-load, measure the duration between AC Input Voltage on to Output Voltage increase up to 90% Vrate as Rise Time.
  5. Set AC Turn off Phase Angle to 0’.
  6. Turn off the AC Power Supply, measure the duration between AC Input Voltage off to Output Voltage decrease down to 90% Vrate as Hold-up Time.
* **Acceptance Criteria**:
  + Output Hold-up Time/Rise Time Test need to meet Spec Requirements.
  + If no special requirement Hold up time needs meet >10ms, Rise-up time needs to <2sec.
    1. Input Inrush Current Test (Cold Test & Hot Test)
* **Test Objective**: Measure the Power Supply Input Inrush Current to verify AC Inrush Current meet SPEC and the bridge rectifier and AC input fuse I2T within the datasheet SPEC or not.
* **Test Procedure**:

**Cold Inrush Test:**

**(Remark: Guarantee the power supply all components temperature is under room temp ± 5’C)**

* 1. Set AC Power Supply in 265Vac (use 132Vac if only support 110Vac) and AC Turn-on Phase Angle set to 90°.
  2. Set the E-load or Bi-direction DC-DC to Make Power Supply under full load and turn on the E-load.
  3. Guarantee the Main Bulk Capacitor are fully discharge. Use the High Voltage Differential Probe and Current Probe to measure the Input Voltage and Input Current with Oscilloscope.
  4. Turn on AC Power Supply, measure the Maximum Inrush Current.
  5. Keep on the same test procedure and do 100 times inrush test and keep on monitoring the Cold Inrush Current.

**Hot Inrush Test:**

**(Remark: Guarantee the power supply has been do the 10 minutes burn in test to keep on do the hot inrush test)**

* 1. Keep the same procedure as cold inrush test and use the oscilloscope to monitor the Inrush Current
  2. Do 100 times Hot Inrush Test (1sec AC on and 3sec AC off) and monitor the Hot Inrush Current.
* **Acceptance Criteria**:
  + Input Inrush Current needs to meet Spec Requirements.
  + If no special requirement, Input Cold/Hot Inrush Current needs to follow below requirement.

|  |  |  |  |
| --- | --- | --- | --- |
| Critical components | Rating | Measured  (Cold Inrush) | Measured  (Hot Inrush) |
| Bridge | Datasheet Spec | >50% Margin | >10% Margin |
| Fuse | Datasheet Spec | >80% Margin | >10% Margin |
| Grid SR MOSFET (if existed) | Datasheet Spec | >50% Margin | >10% Margin |
| PFC Bridgeless MOSFET (if existed) | Datasheet Spec | >50% Margin | >10% Margin |
| Current Sensor as Hall or Current Resistor (if existed) | Datasheet Spec | >50% Margin | >10% Margin |

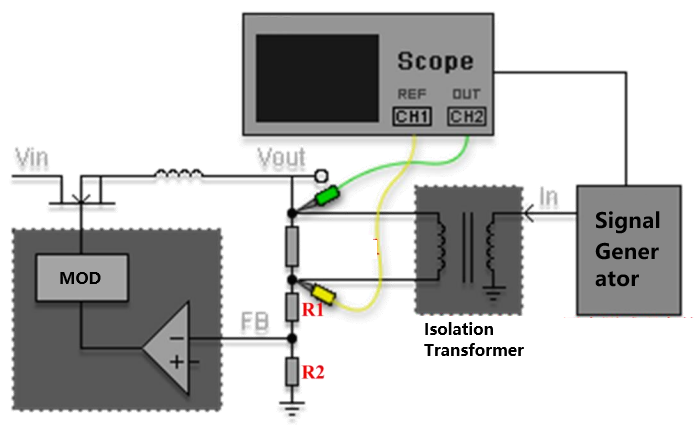
* + 1. Load Linear Regulation/Line Linear Regulation Test
* **Test Objective**: Measure the Power Supply Line Linear Regulation/Load Linear Regulation to verify Line Linear Regulation/Load Linear Regulation meet SPEC or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/25%/50%/75%/100% load.
  3. Use Multimeter to measure Output Voltage for 0%/25%/50%/75%/100% load in 115V/230V.
  4. Draw the Output Voltage Curve and analysis the Load Linear Regulation.
  5. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/100% load.
  6. Set AC Power Supply product input to 85V/115V/230V/265V.
  7. Use Multimeter to measure Output Voltage for 85V/115V/230V/265V in 0%/100% load condition.
  8. Draw the Output Voltage Curve and analysis the Line Linear Regulation
* **Acceptance Criteria**:
  + Load Linear Regulation/Line Linear Regulation needs to meet Spec Requirements.
  + If no special requirement, both Load Linear Regulation and Line Linear Regulation needs to <0.5%.
    1. Output Capacitive Load Capacity Test
* **Test Objective**: Measure the Power Supply Line Output Capacitive Load Capacity meet SPEC or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/25%/50%/75%/100% load.
  3. Use Oscilloscope/Passive Probe/Current Probe to measure Output Voltage/Output Current for 0%/25%/50%/75%/100% load in 115V/230V.
  4. Use a Rated Output Capacitor in parallel with E-load or Bi-direction DC-DC.
  5. Turn on the AC Power Supply and measure the output voltage and current.
* **Acceptance Criteria**:
  + Output Capacitive Load Capacity needs to meet Spec Requirements.
  + If no special requirement, Output Capacitive Load Capacity test needs power up normal < 2 sec with rated output capacitive load. The Maximum output capacitor can be calculated by the formula below:
    1. Power Supply Low Temperature Boot-Up Test
* **Test Objective**: Test the Power Supply Low Temperature Boot-Up Test meet SPEC or not.
* **Test Procedure**:
  1. Set the Power Supply in Temperature Oven under Low Temperature (use -20’C for testing if not SPEC requirement) for 2 hours.

Remark: Guarantee the power supply has been totally cool down to environmental temperature use logger to measure the Input and Output Capacitor Temperature)

* 1. Set AC Power Supply in 85Vac/265Vac (use 85Vac/132Vac or 185Vac/265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 100% load.
  3. Use Oscilloscope/Passive Probe/Current Probe to measure Output Voltage/Output Current for 100% load in 85Vac/265Vac.
  4. Turn on the AC Power Supply and measure the output voltage and current.
* **Acceptance Criteria**:
  + The Power Supply Low Temperature Boot-Up Test needs to meet Spec Requirements.
  + If no special requirement, Power Supply needs power up normally < 2 sec with 100% output load.
    1. Power Supply Loop Stability Analysis Test
* **Test Objective**: Measure the Power Supply Loop Stability Result and Verify the Power Supply have enough Loop Stability margin or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/50%/100% load.
  3. Use the Loop Stability Analyzer and connect the analyzer with power Supply by below instructions, shown as below figure.
  4. Configure the Analyzer as the Gain/Phase Margin Measurement, test the Power Supply Gain/Phase Margin in 0%/50%/100% load under 115V/230Vac input condition.
  5. Draw the Gain/Phase vs Frequency Curve and analyze the Gain/Phase Margin.



* **Acceptance Criteria**:
  + Gain/Phase Margin needs to meet Spec Requirements.
  + If no special requirement, Gain Margin needs to have >6dB margin (Under 180°Phase change), Phase Margin needs to have >45°margin (Under 0dB Gain change), the Zero-Cross Frequency needs to <1/10 design switching Frequency.



* + 1. Transition Respond/Dynamic Load Test
* **Test Objective**: Evaluate the Power Supply Transition Respond/Dynamic Load performance and verify the result can meet the SPEC requirement or not.
* **Test Procedure**:

**Use high slew rate E-load to do this test:**

* 1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC Step Load as 10%-90%/10%-50%/20%-80% or Special Load Condition.
  3. Set E-load or Bi-direction DC-DC the Slew Period as 10ms/1ms, Duty Cycle as 50%. Also need to confirm the E-load slew rate >1A/us to keep test result satisfied with actual usage.
  4. The oscilloscope (set the channel bandwidth in 20MHz) and passive probe by using 10uF/0.1uF MLCC capacitor in parallel to filter the high frequency noise.
  5. Passive probe must use Probe Grounding Ring (Minimum the Ground Loop) to do Transition Respond/Dynamic Load test. Shown as below Figure:
  6. Turn on the E-load in 10%-90%/10%-50%/20%-80% or Special Load Condition in 115V/230V AC condition. Use the Oscilloscope/Passive Probe/Current Probe to measure the output voltage and output current.

**Use a mechanical switch to do this test:**

* 1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC Step Load as 5% load to do this test.
  3. Use the Oscilloscope/Passive Probe/Current Probe to measure the output voltage and output current.
  4. Connect the E-load or Bi-direction DC-DC with the mechanical switch in series.
  5. Turn on and turn off the mechanical switch about 2 seconds period and measure the output voltage and output current.
  6. Draw the Curve of output voltage and output current and analyze the overshoot and undershoot of output voltage.

A close-up of a circuit board

AI-generated content may be incorrect.

A screenshot of a graph

AI-generated content may be incorrect.

* **Acceptance Criteria**:
  + Transition Respond/Dynamic Load needs to meet the Spec requirement.
  + If no special requirement, the Overshoot and Undershoot Voltage needs to control < 10%\*Vrate Output Voltage.
    1. Audible Noise Test:
* **Test Objective**: Evaluate the Power Supply produce audio noise or not and verify the result can meet the SPEC requirement or not.
* **Test Procedure**:
  1. The audio Noise Test needs to follow the IEC61672-1 standard and test in semi-anechoic room.
  2. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  3. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/50%/100% load.
  4. Use the decibelmeter to test the Power Supply Hearable Noise, and the distance between the decibelmeter and Power Supply is 50cm(typical) by following IEC61672-1 standard.
  5. Test six directions of the Power Supply and record the Maximum Noise Level as test result.
  6. Do the hearable noise test under 0%/10%/50%/100% load in 115V/230V AC conditions.
* **Acceptance Criteria**:
  + The Hearable Noise Test needs to meet the Spec requirement.
  + If no special requirements, need to follow below test result criteria as IEC61672-1 Grade1 standard. And there should not have any audible noise in the meeting room for Proto-A sample test.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **The Noise Level of EUT (Active Cooling)** | | | | | | |
| **Load** | **Sound Pressure Level(dB)** | | | | | |
| **Grade 1** | | **Grade 2** | | **Grade 3** | |
| **Power < 500W** | **Power ≥ 500W** | **Power < 500W** | **Power ≥ 500W** | **Power < 500W** | **Power ≥ 500W** |
| **20% Rated Load** | 30 | 35 | 35 | 40 | 40 | 45 |
| **50% Rated Load** | 35 | 40 | 40 | 45 | 45 | 50 |
| **Rated Load** | 40 | 45 | 45 | 50 | 50 | 55 |
| Note 1: The sound pressure level corresponds to a reference sound pressure of 20 μPa.  Note 2: The distance between the microphone and the tested product is 50 cm.  Note 3: The audible noise of power supply products without temperature control circuits should meet the requirements of the rated load. | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **The Noise Level of EUT (Passive Cooling)** | | | | | | |
| **Load** | **Sound Pressure Level(dB)** | | | | | |
| **Grade 1** | | **Grade 2** | | **Grade 3** | |
| **Suggest** | **Criteria** | **Suggest** | **Criteria** | **Suggest** | **Criteria** |
| **External Switching Power Supply** | 19 | 22 | 22 | 25 | 25 | 27 |
| **Internal Switching Power Supply** | 25 | 27 | 27 | 30 | 30 | 33 |
| Note 1: The sound pressure level corresponds to a reference sound pressure of 20 μPa.  Note 2: The distance between the microphone and the tested product is 50 cm.  Note 3: The audible noise of power supply products without temperature control circuits should meet the requirements of the rated load. | | | | | | |

* + 1. Power Supply Logical Functional Test (LED/NTC/Voltage Compensation/Load Share/Hot-Swap/IO Signal/etc.)
* **Test Objective**: Evaluate the other functional performance such as LED/NTC/Voltage Compensation/Load Share/Hot-Swap/IO Signal/etc. Verify all this function can meet the SPEC requirement or not.
* **Test Procedure**:
  + **LED Test (if product contains with this feature)**:

1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/100% load.
3. Check LED Status meet IEC60601/IEC60335/IEC62368 standard in or not under normal status.
4. Use manual method (trigger those protection signals or circuit on purpose) to trigger OCP/OVP/OTP protection.
5. Check LED Status meet IEC60601/IEC60335/IEC62368 standard in or not under protection status.
   * **NTC Test (if product contains with this feature):**
6. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
7. Set E-load or Bi-direction DC-DC to make Power Supply under full load.
8. Use Resistor Box and let Resistor Box in parallel with NTC and adjust Resistor Box value to special temperature (such as 100’C).
9. Calculate the total NTC value and confirm NTC parameters meet the theory calculation or not.
   * **Voltage Compensation Circuit Test (if the product contains with this feature):**
10. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
11. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/100% load.
12. Check the Compensation Voltage for Output under 0%/100% load with 115Vac/230Vac AC Input.
13. Verify the Compensation Voltage Range meets the Spec requirements or not (especially for BBU or high output voltage accuracy design).
    * **Load Share Test (if product contains this feature):**
    1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
    2. Set E-load or Bi-direction DC-DC to make Power Supply under 10%/100% load.
    3. Check the Load Share function for Output under 10%/100% load with 115Vac/230Vac AC Input (Use two or more Power Supplies to test this feature).
    4. Use Current probe and Oscilloscope to measure the output current of the Power Supplies, check the load current is shared equally or not under 10%/100% in 115Vac/230Vac AC Input.
    5. Test the E-load switches from 10%-100%/100%-10% in 115Vac/230Vac AC Input. Measure the load current transient respond also can achieved Load-Share function or not.
    6. Verify the test results can meet the SPEC requirements or not.
    * **Hot-Swap Test (if product contains this feature):**
    1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
    2. Set E-load or Bi-direction DC-DC to make Power Supply under full load (Use two or more Power Supplies to test this feature).
    3. Test Hot-Swap function when Power Supply is output in parallel and to insert and remove the one of Power Supply on purpose.
    4. Use Oscilloscope/Passive Probe/Current Probe to measure the Output Voltage/Output Current.
    5. Check Output Voltage/Output Current have any drop under the Hot-swap test. And verify the test results can meet the SPEC requirements or not.
    * **IO Signal Test (if product contains this feature):**
    1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
    2. Set E-load or Bi-direction DC-DC to make Power Supply under full load.
    3. Test IO Signal function as SPEC description, use manual method to test this IO signal circuit.
    4. Use Oscilloscope/Passive Probe to measure the IO Signal Voltage.
    5. Verify the test results can meet the SPEC requirements or not.

* **Acceptance Criteria**:
  + All these features need to meet the SPEC requirement.
  + If no special requirement, all these features need to follow below requirements:
  1. The LED Test needs to follow below requirements:

|  |  |
| --- | --- |
| LED Color | Agency Requirement (IEC60601) |
| Red | Indicate Fault Mode- need operator handles these issues immediately |
| Yellow | Indicate Warning Mode- need operator handles these issues carefully |
| Green | Indicate Normal Mode- All function is well and Ready to use |
| Other Color | Define by the Manufacturer or User |

* 1. The NTC Test indicates temperature needs to control in ± 3℃ tolerance.
  2. The Voltage Compensation Circuit Test needs to be controlled in ±0.5%\*Vout tolerance range.
  3. The Load Share needs to control in ±10%\*Irate tolerance range.
  4. The Hot-Swap Test needs to control the 5%\* Vout and 10%\*Irate current Undershoot or Overshoot.
  5. The IO Signal Test needs to meet theory calculation.
     1. Power Supply Communication Test (SMBus/I2C/CAN/RS232/RS485/etc.)
* **Test Objective**: Evaluate the Power Supply Communication Circuit meets the standards requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/50%/100% load.
  3. Use oscilloscope and passive probe to measure the communication line waveform such as SDA/SCL waveform.
  4. Measure the Rise Time/Fall Time of the communication line and verify they meet the communication line protocol standards or not.
* **Acceptance Criteria**:
  + The Communication Test needs to meet the protocol standards (SMBus/I2C/CAN/RS232/RS485/etc.)

I2C standard:

|  |  |  |
| --- | --- | --- |
| **I2C SPEC** | | |
| **SPEC** | | **Tolerance Range** |
| **Voltage Level** | High Level | ≥0.7\*VDD |
| Low Level | ≤0.3\*VDD |
| **Standard** | Rise time | ≤1us |
| Fall time | ≤300ns |
| **Fast** | Rise time | ≤300ns |
| Fall time | ≤300ns |

CAN standard:

|  |  |  |
| --- | --- | --- |
| **CAN/CAN Open/CAN FD SPEC** | | |
| **SPEC** | | **Tolerance Range** |
| **Transmitter** | CANH to CANL | 1.5-3V |
| CANH To GND | 2.75-4.5V |
| CANL To GND | 0.5-2.25V |
| **Receiver** | CANH to CANL | -0.5-0.05V |
| CANH To GND | 2-3V |
| CANL To GND | 2-3V |
| **Fall time** | CANH to CANL | 20-400ns |
| **Rise time** | CANH to CANL | 20-200ns |

* 1. Power Supply Protection Test
     1. Output OCP/Short Circuit (SC) Functional Protection Test
* **Test Objective**: Evaluate the Power Supply Output OCP/Short Circuit (SC) Functional Protection meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 85Vac/265Vac (use 85Vac or 265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/passive probe/current probe to measure the output voltage/current.
  4. Set the E-load or Bi-direction to make the Power Supply trigger OCP protection.
  5. Measure the Voltage and Current of the Output for OCP protection.
  6. Use the Switch to short circuit of the output on purpose.
  7. Measure the Voltage and Current of the Output for Short Circuit protection.
* **Acceptance Criteria**:
  + The Short Circuit Input Power needs to meet <2W when do the durative short circuit test.
  + The Output OCP/Short Circuit Functional Protection needs to meet the SPEC requirement.
  + If no special requirements, the OCP protection need to control < 160%\*Irate and >120%\*Irate , the Short Circuit protection needs to guarantee the tolerance of the power component (MOSFET/Diodes) have >50% margin.
    1. Input voltage UVP/OVP Functional Protection Test
* **Test Objective**: Evaluate the Power Supply Input voltage UVP/OVP Functional Protection meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/passive probe/current probe to measure the AC Input Voltage/Current.
  4. Adjust AC Power Supply Voltage to make the Power Supply trigger input UVP/OVP protection.
  5. Measure the AC Input Voltage for input UVP/OVP protection.
* **Acceptance Criteria**:
  + The Input voltage UVP/OVP Functional Protection needs to meet the SPEC requirement.
  + If no special requirements, the UVP protection needs to control 70%-80%\*Vmin and the OVP protection needs to control 120%-130%\*Vmax, also OVP/UVP needs to guarantee the tolerance of the power component (MOSFET/Diodes) have >20% margin.
    1. The OTP/UTP Functional Protection Test
* **Test Objective**: Evaluate the Power Supply Output OTP/UTP Functional Protection meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/passive probe/current probe to measure the output voltage/current.
  4. Use manual method (trigger those protection signals or circuit on purpose) to trigger OTP/UTP protection.
  5. Calculate the total NTC value and confirm OTP/UTP protection meet the theory calculation or not.
* **Acceptance Criteria**:
  + The OTP/UTP Functional Protection needs to meet the SPEC requirement.
  + If no special requirements, the OTP/UVP protection needs to control in ± 3℃ tolerance by theory calculation.
    1. AC Input/DC Output Durative ON/OFF Test
* **Test Objective**: Evaluate the Power Supply AC Input/DC Output Durative ON/OFF test meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use the time relay to do the AC Input Durative ON/OFF Test for 10000 times or Special requirement (5sec period/50% duty) in 0%/10%/100% load for 115V/230V AC condition.
  4. Verify the Power Supply output function after the AC Input Durative ON/OFF Test finished.
  5. Use the time relay to do the DC Output Durative ON/OFF Test for 10000 times or Special requirement (5sec period/50% duty) in 0%/10%/100% load for 115V/230V AC condition.
  6. Verify the Power Supply output function after the DC Output Durative ON/OFF Test finished.
* **Acceptance Criteria**:
  + The AC Input/DC Output Durative ON/OFF Test needs to meet the SPEC requirement.
  + If no special requirements, the AC Input/DC Output Durative ON/OFF Test needs to guarantee no functional damaged after ON/OFF Test.
    1. Isolation Magnetic Component (Transformer) Normal and FMEA Overstress Test
* **Test Objective**: Evaluate the Power Supply Isolation Magnetic Component (Transformer) Normal and FMEA Overstress test meets the Agency Requirement or not.
* **Test Procedure**:

**Normal Mode Test**:

* 1. Set AC Power Supply in 85Vac/265Vac (use 85Vac or 265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under Maximum Output Current (before trigger OCP current).
  3. Set the Power Supply in Maximum environment temperature + 5’C degree to do this test.
  4. Use Logger to monitor the Isolation Magnetic Component temperature (transformer core and wires temperature).
  5. Do the thermal burn in test and monitor the thermal rise of Isolation Magnetic Component.

**FMEA Mode Test:**

* 1. Keep the same procedure as normal test to monitor the Magnetic Component temperature.
  2. Use manual method to do the single FEMA for the key component. (such as MOSFET/transformer winding/current shunt resistor/NTC or etc.)
  3. Do the thermal burn in test and monitor the thermal rise of Isolation Magnetic Component.
* **Acceptance Criteria**:
  + The Isolation Magnetic Component (Transformer) Normal and FMEA Overstress Test needs to meet the SPEC requirement.
  + If no special requirements, the Isolation Magnetic Component (Transformer) Normal and FMEA Overstress Test needs to meet below requirement.

|  |  |  |
| --- | --- | --- |
| Isolation Magnetic Component (Transformer) Normal and FMEA Overstress Test | Agency Requirement (IEC60601/IEC60335/IEC62368) | |
| Winding Wire Class | Maximum  Thermal('C) |
| Class A | 140 |
| Class E | 155 |
| Class B | 165 |
| Class F | 180 |
| Class H | 200 |

* + 1. Output OVP/OTP/Short Circuit (SC) FMEA Protection Test
* **Test Objective**: Evaluate the Power Supply Output OVP FMEA Protection FMEA Protection meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply in 85Vac/265Vac (use 85Vac or 265Vac if only support 115Vac/230Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/passive probe/current probe to measure the output voltage/current.
  4. Use manual method to do the single FEMA for the key component. (such as Opto-Coupler/TL431/NTC/Thermal NTC/Sense Resistor or etc.)
  5. Measure the Voltage and Current of Output in OVP/OTP/Short Circuit (SC) FMEA condition.
* **Acceptance Criteria**:
  + The Output OVP FMEA Protection needs to meet the SPEC requirement.
  + If no special requirements, the Output Voltage needs to control < 110%\*Vrate Overshoot and guarantee no component explosion and flammable under OVP/OTP/Short Circuit (SC) FMEA condition.
    1. Input and Output Connector Single FMEA Test
* **Test Objective**: Evaluate the Power Supply Input and Output Connector Single FMEA Test meets the SPEC requirement or not.
* **Test Procedure**:
  1. Set AC Power Supply input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use manual method to do the single FEMA for the component have damaged risk and any connector Pin distance which <3mm.
  4. Turn on the AC Power in 115V/230V condition and make the power supply in 0%/10%/100% load.
  5. Use oscilloscope/passive probe to measure the output voltage.
  6. Check about the phenomenon of the Power Supply and record the output voltage.
* **Acceptance Criteria**:
  + The Input and Output Connector Single FMEA Test needs to meet the SPEC requirement.
  + If no special requirements, the Input and Output Connector Single FMEA Test needs to control < 110%\*Vrate Overshoot and guarantee no component explosion and flammable under Single FMEA condition.
  1. Power Supply Tolerance Analysis Test
     1. Magnetic Components Stress Verification Test
* **Test Objective**: Evaluate the Magnetic Components stress margin meets the tolerance analysis or not.
* **Test Procedure**:

**Room Temp Test**:

* 1. Set AC Power Supply input in 85Vac/265Vac (use 132Vac or 265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/high voltage differential probe/current probe to measure the Magnetic Components Voltage (VL) and Current (IL) (Transformer/Inductor/etc.).
  4. Measure the Magnetic Components Voltage and Current in 0%/10%/100% load in 85V/265V.
  5. Calculate the magnetic induction intensity and electric current density for each Magnetic Components (Transformer/Inductor/etc.) in room temperature.

**High Temp Test:**

* 1. Keep the same procedure as room temp and set the product in maximum usage temperature + 5’C degree environment.
  2. Measure the Magnetic Components Voltage and Current in 0%/10%/100% load in 85V/265V.
  3. Calculate the magnetic induction intensity and electric current density for each Magnetic Components (Transformer/Inductor/etc.) in high temperature.
* **Acceptance Criteria**:
  + All those Magnetic Component stress tests need to meet the SPEC requirement in room and high temperature.
  + If no special requirements, All Magnetic Component stress need to satisfy below requirement in room and high temperature.
    - * 1. The Ferrite Core (Such as PC40/PC44/PC47/PC95), need to control magnetic induction intensity B Value Under 0.3T.
        2. The Sendust Core (Such as FeSiAl/FeNi), needs to control magnetic induction intensity B Value Under 0.6-0.8T (depend on the core material selection).
        3. The High ui Value core for common mode choke (Such as R7K/R10K/R12K) control magnetic induction intensity B Value Under 0.3T(calculate the B value by the leakage inductor of CM Choke).
        4. The Active Cooling, the current density needs to be controlled in <8A/mm^2 for application.
        5. The Passive Cooling, the current density needs to be controlled in <4.5A/mm^2 for application.
    1. Power Component (MOSFET/SiCFET/GaNFET) Stress Verification Test
* **Test Objective**: Evaluate the Power Component stress meets the tolerance analysis or not.
* **Test Procedure**:
  1. Set AC Power Supply input in 85Vac/265Vac (use 132Vac or 265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/high voltage differential probe/current probe to measure the Power Voltage (Vds) and Current (Ids).
  4. Measure the Power Voltage (Vds) and Current (Ids) Waveform in 0%/10%/100% load in 85V/265V.
  5. Calculate the Peak Current/RMS Current/Peak Voltage/Power Consumption for each Power Components.
* **Acceptance Criteria**:
  + All those Power Component stress need to meet the SPEC requirement.
  + If no special requirements, All Power Component stress need to satisfy below requirement.
    - * 1. The Peak Current/The RMS Current needs to have >20% margin compared to datasheet illustrated.
        2. The Peak Voltage needs to have >20% margin compared to datasheet illustrated.
        3. The Power Consumption needs to meet the tolerance analysis and total component surface temperature needs to control in 120’C.
    1. Power Component (MOSFET/SiCFET/GaNFET) Gate Driving Capacity (Rise-time/Fall-time/Deadtime) Test
* **Test Objective**: Evaluate Power Component (MOSFET/SiCFET/GaNFET) Gate Driving Capacity (Rise-time/Fall-time/Deadtime) meets the tolerance analysis or not.
* **Test Procedure**:
  1. Set AC Power Supply Input in 85Vac/115Vac/230Vac/265Vac (use 85Vac -132Vac or 185Vac -265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/Passive probe/High Voltage Differential Probe to measure the Power Component Driver Waveform.
  4. Measure the Power Components Gate Driving Voltage (Vgs) and Power Voltage (Vds) in 0%/10%/100% load in 85V/265V.
* **Acceptance Criteria**:
  + All those Power Component (MOSFET/SiCFET/GaNFET) Gate Driving Capacity (Rise-time/Fall-time/Deadtime) need to meet the SPEC requirement.
  + If no special requirements, All Power Component Gate Driving Capacity need to satisfy below requirement.
    - * 1. The Rise Time (Vgs) needs to be 50-500ns to avoid too much thermal rise.
        2. The Fall Time (Vgs) needs to be 50-200ns to avoid too much thermal rise.
        3. The Deadtime for Half-bridge MOSFET application needs to be 50-200ns to avoid too much thermal rise.
    1. Protection Component (eFuse/Fuse/PTC) Stress Verification Test
* **Test Objective**: Evaluate Protection Component (eFuse/Fuse/PTC) stress meets the tolerance analysis or not.
* **Test Procedure**:
  1. Set AC Power Supply Input in 85Vac/265Vac (use 132Vac or 265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use oscilloscope/Passive probe/High Voltage Differential Probe to measure Protection Component Waveform.
  4. Measure the Protection Component(eFuse/Fuse/PTC) Voltage (Vprotection) and Current (Iprotection) in 0%/10%/100% load in 85V/265V.
* **Acceptance Criteria**:
  + All those Protection Component (eFuse/Fuse/PTC) stress need to meet the SPEC requirement.
  + If no special requirements, All Protection Component (eFuse/Fuse/PTC) need to satisfy below requirement.
    - * 1. The Protection Component I2T Value needs to have >23%\* I2Trated.
        2. The Protection Component Peak Voltage and RMS Current need to have >20% margin for rated voltage and current.
    1. Auxiliary Power Circuit (Flyback Auxiliary Winding/DC-DC circuit) Tolerance Verification Test
* **Test Objective**: Evaluate Auxiliary Power Circuit (Flyback Auxiliary Winding/DC-DC circuit) Output Voltage/Current meets the tolerance analysis or not.
* **Test Procedure**:
  1. Set AC Power Supply Input in 85Vac/115Vac/230Vac/265Vac (use 85Vac -132Vac or 185Vac -265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use Oscilloscope/Passive Probe/High Voltage Differential Probe to measure Auxiliary Power Circuit Waveform.
  4. Measure the Auxiliary Power Circuit Output Voltage and Current in 0%/10%/100% load in 85V/115V/230V/265V.
* **Acceptance Criteria**:
  + Auxiliary Power Circuit Output Voltage and Current need to meet the SPEC requirement.
  + If no special requirements, Auxiliary Power Circuit Output Voltage and Current need to satisfy below requirement.
    - * 1. Output Voltage needs to > Vpwm\_min + 3V and < Vpwm\_min - 3V to cover PWM IC VCC Support Range.
        2. Output Current Rate current needs to > 120% \* PWM IC maximum current consumption.
        3. Output Current Voltage Ripple needs < 1%\*Vauxiliary as general.
    1. Passive Thermal Circuit (Absorb RC/RCD/etc.) Stress Verification Test
* **Test Objective**: Evaluate the Stress of Passive Thermal Circuit meet the tolerance analysis or not.
* **Test Procedure**:
  1. Set AC Power Supply Input in 85Vac/115Vac/230Vac/265Vac (use 85Vac -132Vac or 185Vac -265Vac if only support 110Vac/220Vac).
  2. Set E-load or Bi-direction DC-DC to make Power Supply under 0%/10%/100% load.
  3. Use Oscilloscope/Passive Probe/High Voltage Differential Probe to measure Passive Thermal Circuit Waveform.
  4. Measure the Passive Thermal Circuit Voltage and Current in 0%/10%/100% load in 85Vac/115Vac/230Vac/265Vac.
* **Acceptance Criteria**:
  + Passive Thermal Circuit Voltage and Current need to meet the SPEC requirement.
  + If no special requirements, Passive Thermal Circuit Voltage Output Voltage and Current need to satisfy below requirement.
    - * 1. Passive Thermal Circuit stress voltage and current need to have >20% margin of the Maximum voltage and current shown in the datasheet.
        2. Passive Thermal Circuit durative power consumption needs < 1W limit for each component if using passive cooling
        3. If using active cooling, Passive Thermal Circuit durative power consumption needs to have >20% thermal rise margin for component limitation.
        4. For Pulse power consumption, need to have >20% thermal rise margin for component limitation shown in datasheet.
  1. Power Supply Agency Test
     1. The Air-distance/Creepage Distance Verification Test.
* **Test Objective**: Verify the Air-distance/Creepage Distance of the Power supply meet the Agency Standard or not (IEC62368/IEC60335/IEC60601/UL1012/UL1310/etc.).
* **Test Procedure**:
  1. Check the L/N distance before Fuse and L/N to Protection Earth distance meet Agency Standard or not.
  2. Check the Primary to Secondly Component (Transformer/Inductor/Opto-Coupler/Isolation Driver/etc.) meet Agency Standard or not.

Remark: Take care of Transformer/Inductor which need to consider the distance between the footprint to the winding meet agency requirement or not.

* 1. Check the Primary and Secondly Component to Protection Earth distance Agency Standard or not.

Remark:

1. All the Y-CAP need to consider as a functional isolation component in mostly agency standard, it can be considered as reinforce isolation component in IEC62368 in special case for Y1-cap.

2. All the Air-distance and Creepage need to have the agency certification (TUV/VDE certification)

* **Acceptance Criteria**:
  + The Air-distance/Creepage Distance need to meet the Spec and Agency requirement.
  + If no special requirements, Air-distance/Creepage Distance need to meet below request:
    - * 1. The Air-distance between primary-secondly needs to >3.5mm
        2. The Creepage between primary-secondly needs to >6.5mm, for transformer needs to >8mm
        3. The Air-distance between primary-earth needs to >2.5mm
        4. The Creepage between primary-earth needs to >3.5mm
    1. Isolation Voltage/Hi-Pot Test
* **Test Objective**: Verify the Isolation Voltage/Hi-Pot meet the Agency Standard or not (IEC62368/IEC60335/IEC60601/UL1012/UL1310/etc.).
* **Test Procedure**:
  1. Check each Component Certificated Isolation Voltage between Primary-Secondly/Primary-Protection Earth/ Secondly-Protection Earth meet the Agency requirement or not (Transformer/Inductor/Opto-Coupler/Isolation Driver/etc.).

Remark: Take care of Transformer/Inductor which need to consider the winding material using Triple isolation wire meet the agency or not.

* 1. The Hi-pot test environment should be in a dark room without obvious light.
  2. Short circuit all primary connector port as primary input, Short circuit all Secondly connector port as secondly input.
  3. Apply the Hi-Pot Voltage between Primary-Secondly as Spec requested and do the Hi-Pot Test.
  4. If exist Protection Earth Input port, Short Circuit all the Protection Earth Input port as Earth.
  5. Apply the Hi-Pot Voltage between Primary-Earth as Spec requested and do the Hi-Pot Test.
* **Acceptance Criteria**:
  + The Isolation Voltage/Hi-Pot test need to meet the Spec and Agency requirement.
  + If no special requirements, he Isolation Voltage/Hi-Pot test need to meet below request:
    - * 1. All the Isolation component isolation voltage need to >3000V
        2. The Hi-Pot test needs to apply >3000V/60sec for primary-secondly, 1500V/60sec for primary to earth.
        3. The Test Unit cannot have any electric arc during the Hi-Pot test (the Hi-pot test environment should be in a dark room without obvious light)
    1. AC Leakage Current Test
* **Test Objective**: Verify the AC Leakage Current meet the Agency Standard or not (IEC62368/IEC60335/IEC60601/UL1012/UL1310/etc.).
* **Test Procedure**:
  1. Set AC Power Supply Input in 265Vac (use 132Vac if only support 110Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use AC Leakage Current tester to measure AC Leakage Current.
  4. Measure the normal AC leakage current and the FEMA AC leakage current between Primary-Secondly and Primary-Earth. (if the protection earth is existed)
* **Acceptance Criteria**:
  + The AC Leakage Current needs to meet the SPEC and Agency requirement.
  + If no special requirements, the AC Leakage Current needs to satisfy below requirement.
    - * 1. The normal AC leakage current needs <100uA for Primary-Secondly (Touch Current).
        2. The FEMA AC leakage current needs <500uA for Primary-Secondly (Touch Current).
        3. The normal AC leakage current needs <500uA for Primary-Earth (Earth Leakage Current).
        4. The FEMA AC leakage current needs <1mA for Primary-Earth (Earth Leakage Current).
    1. Surge Test
* **Test Objective**: Verify the Surge Test meet the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 265Vac (use 132Vac if only support 110Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use the Surge tester to do the Surge Test (needs to do 0'/90'/180'/270' Phase with 8us/20us Standard).
  4. After finishing the test, verify if the Power Supply function is compiled or not.
* **Acceptance Criteria**:
  + The Surge Test needs to meet the SPEC and Agency requirements.
  + If no special requirements, The Surge Test needs to satisfy below requirement.
    - * 1. The Surge Voltage between L/N to Earth is 2kV/8us/20us (Common Mode).
        2. The Surge Voltage between L to N is 1kV/8us/20us (Different Mode).
    1. ESD Test
* **Test Objective**: Verify the ESD Test meet the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 230Vac (use 115Vac if only support 110Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use the ESD tester to do the Contact/Air ESD Discharge for Power Supply.

Remark: For the connector or housing which is metal and can be contacted by human hand, need to apply Contact ESD discharge standard. For the other place which cannot be touched, needs to apply Air ESD discharge standard.

* 1. After finishing the test, verify if the Power Supply function is compiled or not.
* **Acceptance Criteria**:
  + The ESD Test needs to meet the SPEC and Agency requirements.
  + If no special requirements, The ESD test needs to satisfy below requirement.
    - * 1. For Contact ESD discharge, needs to apply 9.6kV/10 times for Positive and Negative for each test position.
        2. For Air ESD discharge, needs to apply 18kV/10 times for Positive and Negative for each test position.
    1. Conducted/Radiated Emission Test
* **Test Objective**: Verify the Conducted/Radiated Emissions Test meet the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use Dummy Load to make Power Supply under 0%/10%/100% load.
  3. Do the Conduct Emission Test in Conduct EMC Test Field by following IEC61000 standard.
  4. Do the Radiated Emission Test in Radiated EMC Test Field by following IEC61000 standard.

Remark: All Conducted/Radiated Emission test needs to confirm agency standard applied, such as EN55032/EN60601/FCC 15/CISPR.

* **Acceptance Criteria**:
  + The Conducted/Radiated Emission Test needs to meet the SPEC and Agency requirements.
  + If no special requirements, the Conducted/Radiated Emission Test needs to satisfy below requirement.
    - * 1. Conducted Emission Test needs to meet the Emission limitation of EN55032 and FCC 15 Class B standard.
        2. Radiated Emission Test needs to meet the Emission limitation of EN55032 and FCC 15 Class B standard.
    1. Conducted/Radiated Immunity Test
* **Test Objective**: Verify the Conducted/Radiated Immunity Test meet the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use Dummy Load to make Power Supply under 0%/10%/100% load.
  3. Do the Conduct Immunity Test in Conduct EMC Test Field by following IEC61000 standard.
  4. Do the Radiated Immunity Test in Radiated EMC Test Field by following IEC61000 standard.

Remark: All Conducted/Radiated Immunity test needs to confirm agency standard applied, such as EN55032/EN60601/FCC 15/CISPR.

* **Acceptance Criteria**:
  + The Conducted/Radiated Immunity Test needs to meet the SPEC and Agency requirements.
  + If no special requirements, the Conducted/Radiated Immunity Test needs to satisfy below requirement.
    - * 1. For the Conducted Immunity Test, apply 3V standard for 150KHz-80MHz by following the IEC61000 standard.
        2. For the Radiated Immunity Test, apply 10V/m standard for 80MHz-1GHz by following the IEC61000 standard.
    1. Harmonic Current Emissions Test
* **Test Objective**: Verify the Harmonic Current Emissions Test meet the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use the Oscilloscope/High Voltage Differential Probe/Current Probe to measure AC input voltage/current.
  4. Do the Harmonic Current Emissions Test by following IEC61000 standard.
* **Acceptance Criteria**:
  + The Harmonic Current Emissions test needs to meet the SPEC and Agency requirements.
  + If no special requirements, the Harmonic Current Emission needs to satisfy below requirement.
    - * 1. The Harmonic Current Emission needs to meet Class A limitation described in IEC61000 standard.

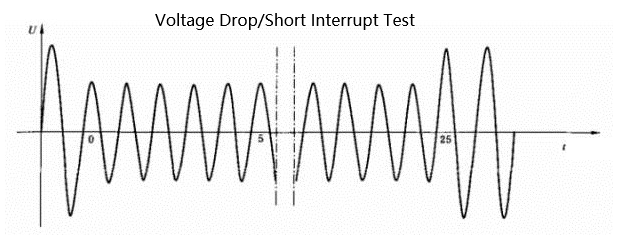
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Class A | Odd | Harmonic Current Limit(A) | Even | Harmonic Current Limit(A) |
| 3 | 2.300 | 2 | 1.080 |
| 5 | 1.140 | 4 | 0.430 |
| 7 | 0.770 | 6 | 0.300 |
| 9 | 0.400 | 8 | 0.230 |
| 11 | 0.330 | 10 | 0.184 |
| 13 | 0.210 | 12 | 0.153 |
| 15 | 0.150 | 14 | 0.131 |
| 17 | 0.132 | 16 | 0.115 |
| 19 | 0.118 | 18 | 0.102 |
| 21 | 0.107 | 20 | 0.092 |
| 23 | 0.098 | 22 | 0.084 |
| 25 | 0.090 | 24 | 0.077 |
| 27 | 0.083 | 26 | 0.071 |
| 29 | 0.078 | 28 | 0.066 |
| 31 | 0.073 | 30 | 0.061 |
| 33 | 0.068 | 32 | 0.058 |
| 35 | 0.064 | 34 | 0.054 |
| 37 | 0.061 | 36 | 0.051 |
| 39 | 0.058 | 38 | 0.048 |
|  |  | 40 | 0.046 |

* + 1. Voltage Dip/Short Interruption Test
* **Test Objective**: Verify the Voltage Dip/Short Interruption Test meets the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use the Oscilloscope/Passive Probe/High Voltage Differential Probe to measure AC Input Voltage/Output Voltage.
  4. Do the Voltage Dip/Short Interruption Test by following IEC61000 standard.
* **Acceptance Criteria**:
  + The Voltage Dip/Short Interruption test result needs to meet the SPEC and Agency requirement.
  + If no special requirements, The Voltage Dip/Short Interruption test result needs to satisfy below requirement.
    - * 1. Voltage Drop Test needs to control <20%\*Voutput change under the test below:

|  |  |
| --- | --- |
| **Voltage Dip Level** | **Duration** |
| 0% Vac | 0.5 Period |
| 0% Vac | 1 Period |
| 40% Vac | 10 Period(50Hz) 12 Period(60Hz) |
| 70% Vac | 25 Period(50Hz) 30 Period(60Hz) |
| 80% Vac | 250 Period(50Hz) 300 Period(60Hz) |

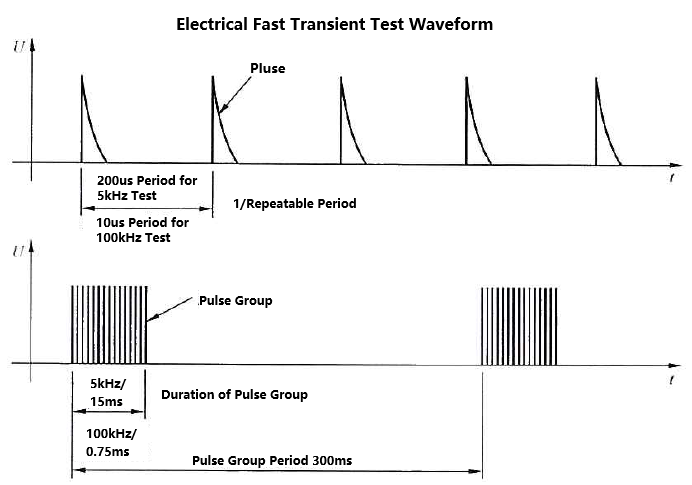
* + - * 1. Short Interruption Test needs to guarantee the Power Supply functional comply under the test below:

|  |  |
| --- | --- |
| **Voltage Dip Level** | **Duration** |
| 0% Vac | 250-300 Period |



* + 1. AC Electrical Fast Transient Test
* **Test Objective**: Verify the AC Electrical Fast Transient Test meets the Agency Standard or not (IEC61000).
* **Test Procedure**:
  1. Set AC Power Supply Input in 115Vac/230Vac (use 115Vac or 230Vac if only support 110Vac/220Vac).
  2. Use Dummy Load to make Power Supply under 100% load.
  3. Use the Oscilloscope/Passive Probe to measure Output Voltage.
  4. Do the AC Electrical Fast Transient Test by following IEC61000 standard.
* **Acceptance Criteria**:
  + The AC Electrical Fast Transient Test needs to meet the SPEC requirement.
  + If no special requirements, the AC Electrical Fast Transient Test needs to satisfy below requirement.
    - * 1. The AC Electrical Fast Transient Test needs to control <20%\*Voutput change under the test below:

|  |  |  |  |
| --- | --- | --- | --- |
| **AC/DC Input Port and Earth Port** | | **Signal Port and Control Port** | |
| **Voltage(kV)** | **Repeatable Frequency(Khz)** | **Voltage(kV)** | **Repeatable Frequency(Khz)** |
|  |
| 2 | 5kHz/100kHz | 1 | 5kHz/100kHz |  |
|  |  |  |  |  |



Revision History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Revision** | **Description of Change** | **Changed by** | **Approved by** | **Date** |
| X1 | New release |  |  | Mon-DD-YYYY |
| X2 | 1. Item 3.4.2 Changed, increase Hi-pot test in the dark room and cannot have any electric arc during the test. | Ted | Kylin | 7-11-2025 |
|  |  |  |  |  |
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