Capacitor temperature characteristic evaluation test

AMQ

IoT, 5G, and automotive electronics carry many electronic components such as capacitors and resistors. These device performances are temperature-dependent, which makes temperature reliability test a must.

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>3 at a time sense pair measurement (end of measurement cable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement interval</td>
<td>0.1 minute to 15 minutes for at least 2 minutes (rinse)</td>
</tr>
<tr>
<td>Measurement range</td>
<td>Measured frequency 0.2 to 1 MHz Diameter 300 to 10,000 mm Width 0.5 to 100 mm</td>
</tr>
</tbody>
</table>

Electromigration/Inductor evaluation

AEM

Multi-layer chip inductors used for IoT, 5G, and in-vehicle applications are subject to damage due to disconnection caused by electric currents and heat generated over long-term use. Supplying a constant current to the conductor coil at a high temperature allows service life evaluation.

<table>
<thead>
<tr>
<th>Number of ranges</th>
<th>3 ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting range</td>
<td>0 ≤ 100 mA/0.1 or 100mA/1000mA</td>
</tr>
<tr>
<td>Setting resolution</td>
<td>0.001mA</td>
</tr>
<tr>
<td>Rated current @25°C</td>
<td>10 to 100mA</td>
</tr>
<tr>
<td>Output current accuracy</td>
<td>±0.5% FS (≤ 100mA)</td>
</tr>
<tr>
<td>Output current range</td>
<td>100 mA range</td>
</tr>
</tbody>
</table>

Conductor resistance evaluation test (joint reliability test)

AMR

This system improves reliability of products by measuring the disconnection caused by the deformation in substrates due to changes in the ambient environment or by the strain between self-heat generation and the ambient environment.

<table>
<thead>
<tr>
<th>Application system</th>
<th>Direct electric current measurement system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel configuration</td>
<td>Standard 40 channels (maximum 280 channels per rack)</td>
</tr>
<tr>
<td>Reference measurement range</td>
<td>1×10⁻³ to 1×10⁶</td>
</tr>
</tbody>
</table>

Digital + Communication

High-speed and high-bandwidth communication

Memory Flash

CPU SSD RF

LiDAR, mill-wave sensor, CCD, biometrics, motion sensors, location sensors

Al(Cloud)

High-performance computer

High-capacity storage

Key devices

Semi-conductors

(Memory device, flash memory and power device, FPGA and RF device)

Sensor

(CMOS, LiDAR, current sensor and G3)

Parts

(Capacitor, inductor and resistor)

Changes in environmental factors

DC high voltage and large current

Increased self-heat generation

(Device miniaturization, FOWLP and 3D mounting)

Guaranteed device performance under a wide range of temperatures

ESPEC CORP., https://www.espec.co.jp/english
3-5-6, Tenjinbash, Kita-ku, Osaka 530-8550, Japan
Tel: 81-6-6358-4759 Fax: 81-6-6358-1453

LEAF No.20200205 Ke3B02L00 (The contents of this page are current as of March, 2020.)
Specifications, external appearance and other descriptions are subject to change without notice due to product improvements. We apologize in advance for the inconvenience.
**Electronic devices and components used in vehicles**

**Increased power devices**

While the demand for energy is growing worldwide, the climate crisis also became global attention. It has now become essential to not just to produce electricity efficiently, but also to use it safely, with long-term stability.

This trend led to the rise of alternative energy sources, such as wind and solar. On the application side, in the fields of hybrid and electric vehicles, and inverter-based appliances (such as air conditioners, refrigerators, and washing machines), the development of more energy-efficient products became a necessity to win the consumer’s attention.

**Problems with mounting in-vehicle devices and electronic components**

In-vehicle devices should maintain reliability under a wide range of temperature/humidity environments.

- EVs and electronic-based design require higher voltages. *Electrification, including EV, ADAS (Advanced Driver-Assistance Systems), and internet connectivity, has contributed to a significant increase in the number of electronic components in a vehicle.*
- Higher efficiency requires a higher voltage, which will lead to more evaluations in such conditions.

**Issue 1: Measures against insulation and discharge under high voltage**

It is important to provide measures against failures caused by discharges or short-circuits between substrates under different environments.

- Insulation evaluation under high voltage

**Issue 2: Reliability under a wide range of temperature and humidity**

- Temperature characteristic evaluation and reliability under high temperature or constant temperature/humidity

**Issue 3: Improved noise immunity due to higher switching frequencies**

- Capacitors and other electronic components are mounted in control circuits. Power cycle tests are conducted to improve the reliability of products.

**Communication PCBs and electronic components**

**Reliability evaluation of IoT/5G devices**

IoT/5G will increase the amount of data to allow remote operation, multi-communication, and ADAS (Advanced driver-assistance systems) for vehicles. 5G base stations require higher voltage, therefore devices generate more heat. From a safety standpoint, it is critical to have stable and reliable operations under such conditions, which will require more evaluation tests.

- Increased self-heat generation due to the use of higher voltages and high-capacity data transfer in communication base stations
- Increase in capacity to transfer tera or even peta level of data throughout the network requires high energy.
- Data processing in high-speed communication age means increase in self-heat generation from devices.

- With improved noise immunity, devices are now used in wider range of environments:
  - Devices that were previously used in refrigerators, and washing machines; the development of more energy-efficient products became a necessity to win the consumer’s attention.

**Electronic devices and components**

- **Capacitors and other electronic components are mounted in control circuits for IoT, 5G and in-vehicle devices. Capacitors are used in communication circuits and control boards. Reliability evaluation under high temperature is especially important for in-vehicle applications.**

---

*Contact us for the test voltage.*

**High-voltage insulation evaluation**

Since in-vehicle devices and 5G base stations use high voltage, insulation deterioration caused by changes in the ambient environments will greatly affect the reliability of products. Insulation reliability evaluation is critically important.

**Power cycle test (power device)**

- Component resistance evaluation test
- Temperature characteristic evaluation test
- Electromigration evaluation test
- Conductor resistance evaluation test

**Reverse bias test (power device)**

- Reverse bias test (power device)
- Capacitor leakage current evaluation test
- Capacitor temperature characteristic evaluation test
- Capacitor leakage current evaluation test

**Capacitor leakage current evaluation test**

- AMI-C

**Channel configuration**

- Standard 25 channels (maximum 150 channels per rack)
- Test control unit: 5ch, 25ch
- Resistance measurement range: 0 to 10Ω, 0 to 10kΩ (when applying 100 V)
- Voltage application range: 100V / 500V / 1000V / 2500V

* Contact us for the test voltage.

---

**Reliability evaluation of IoT/5G devices**

- RBS-PST
- HTRB
- HTGB
- H3TRB
- AMI

**Capacitor leakage current evaluation test**

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### Issue 1: Measures against insulation and discharge under high voltage

It is important to provide measures against failures caused by discharges or short-circuits between substrates under different environments.

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power cycle test (power device)</td>
<td>Continuous mode: Control the temperature and amount of cooling water to achieve the device temperature setting while Ice is turned ON or OFF. Inching mode: Use Ice repeatedly for setting time.</td>
</tr>
<tr>
<td>Reverse bias test (power device)</td>
<td>Test control unit: 5ch, 25ch. Test voltage: 0 to 2 kV or 2 kV to 3 kV. Temperature control: In-vehicle test under condition type: 100°C or 30°C.</td>
</tr>
</tbody>
</table>

### Issue 2: Reliability under a wide range of temperature and humidity

Temperature characteristic evaluation and reliability under high temperature or constant temperature/humidity.

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-voltage insulation evaluation</td>
<td>AMI, AMQ, AEM, AMI-C. Voltage application range: 500V/1000V/1500V. Resistance: 2 x 10^10 to 1 x 10^13 (when applying 100 V).</td>
</tr>
<tr>
<td>Capacitor leakage current evaluation test</td>
<td>AMI-C. Voltage application range: Standard 25 channels (maximum 150 channels per rack). Test control unit: 5ch, 25ch. Resistance measurement range: 2 x 10^10 to 1 x 10^13 (when applying 100 V).</td>
</tr>
</tbody>
</table>

### Issue 3: Improved noise immunity due to higher switching frequencies

- Communication PCBs and electronic components

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Conductor resistance evaluation test

Reverse bias test (power device)

High-voltage insulation evaluation

Capacitor leakage current evaluation test

Temperature characteristic evaluation and reliability under high temperature

Contact us for the test voltage.
Reliability Evaluation supporting the basis of IoT, 5G and the mobility field

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AMQ

IoT, 5G and automotive electronics carry many electronic components such as capacitors and resistors. These device performances are temperature-dependent, which makes temperature reliability test a must.

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<thead>
<tr>
<th>Measurement method</th>
<th>3-5 minute per measurement (total measurement cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement interval</td>
<td>1 minute to 15 minute (variable in 1 minute increments)</td>
</tr>
<tr>
<td>Measurement range</td>
<td>Measured frequency: 20Hz – 1MHz, Dielectric loss angle: 0.0001 – 10.0000, Impedance: 10Ω – 100MΩ</td>
</tr>
</tbody>
</table>

Output current (10 A system)

<table>
<thead>
<tr>
<th>Number of ranges</th>
<th>3 ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting range:</td>
<td>0 – 100mA, 0 – 1,000mA, 0 – 10,000mA</td>
</tr>
<tr>
<td>Setting resolution:</td>
<td>0.001mA, 1mA</td>
</tr>
<tr>
<td>Output accuracy:</td>
<td>±0.1% F.S, ±0.1% F.S, ±0.1% F.S</td>
</tr>
</tbody>
</table>

| Setting range: | 0 – 100mA, 0 – 1,000mA, 0 – 10,000mA |
| Setting resolution: | 0.001mA, 1mA |
| Output accuracy: | ±0.1% F.S, ±0.1% F.S, ±0.1% F.S |

Application system: Direct electric current measurement system
Channel configuration: Standard 40 channels (maximum 280 channels per rack)
Resistor measurement range: 1Ω – 5 × 10^10Ω

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High-speed and high-baudrate communication
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