モバイルコンピューティング推進コンソーシアム
Mobile Computing Promotion Consortium

MCPC TR-023

Mobile Equipment Safety Design Guideline

Version 2.00(E)

September 1, 2017

Mobile Computing Promotion Consortium
Technical Committee

Change history

Date	Version	Details
September 1, 2017	2.00(E)	English translation version of TR-023 Ver2.00

Notice

This Guideline is the translation from MCPC TR-023 only for the benefit of English readers. The original version of MCPC TR-023 shall be the official specifications in its interpretation, construction and understanding.

Published and copyrights owned by:

Mobile Computing Promotion Consortium (MCPC)
Hasegawa Green Building,
5-12 Shiba-Koen 3-chome, Minato-ku, Tokyo, 105-0011 Japan

TEL：+81-3-5401-1935
FAX: +81-3-5401-1937
EMAIL: office@mcpc-jp.org
WEB SITE: http://www.mcpc-jp.org

Confidentiality

The MCPC Rules and the MCPC IPR Policy Shall Apply.

Disclaimer

This document is intended to provide standard specifications and recommended specifications, etc. on mobile computing. Mobile Computing Promotion Consortium (hereafter MCPC) shall not be liable for any direct, indirect or consequential damages or infringements to patents or any other rights held by the third parties arising out of using this Specifications. This document shall not be construed to grant (a) license(s) under any rights held by MCPC or the third parties.

How do we distinguish binary, decimal and hexadecimal numbers?

For binary numbers, we append small letter “b” (e.g. 10b)).

For binary numbers, we insert a space after every four bits. (e.g.：1000 0101 0010b).

For hexadecimal numbers, we append small letter “h” (e.g.：FFFFh and 80h).

All other numbers shall be considered to be written in decimal.

Key Words

- “May” means that something is recommended or optional at the free discretion of the vendor.
- “Should” means that although something is not essential, it is strongly recommended. When implementing, the vendor shall take this requirement into consideration and determine whether this is essential or not.
- “Shall” means that something is an essential requirement. For connectivity and specification compliance, the feature must be implemented, and is mandatory.

Trademark Notes

- Company names, product names, service names and the like described in this document are generally trademarked or are registered trademarks of their respective owners.
- In general, the usage of ™ marks, © marks, and ® marks has been omitted in this document.
- In general **“**Inc.,**”** **“**Corporation,**”** **“**Co., Ltd.,**”** have been excluded from company names.

Application note

It is indicating as follows, when indicating a case of the operation on a document. :

Application note : Case-of-the-operation entry

Table of Contents

1. Introduction

This Guideline is intended to clarify the safety standard such as measures against terminal heat in newly designing mobile devices.

The mobile devices in this Guideline mean mobile information terminals such as smart phones, feature phones and tablets (“Smart phones etc.”) that support voice communication and data communication functionalities as standalone. They may be subject to change in case of future technological evolutions.

2. Safety Design of Smart Phones

As Smart Phones etc. are convenient enough to support not only conventional voice and other communications but also variety of software applications as PCs do, they have rapidly penetrated in the market.

Along with the technological evolution of semiconductors, the computing processing power of a device as well as the battery capacity has continued to be larger that has led to adopting high speed charging technologies for higher convenience.

From the usage point of views, “safety in users contact” for Smart Phones etc. is an important element in safety designing. With an increasing heat as part of the energy that is consumed from the higher functionalities and performances as stated above, measures against heat needs to be carefully observed in designing safe contact. Furthermore, sharp edges of the devices that may derive from the miniaturization and diversification of devices also need to be taken care of.

3. Considerations in Designing

3.1 Heat Considerations in Designing

The safety measures against the heat of Smart Phones etc. shall be designed to the following heat sources. Furthermore the other heat sources than the following list should be carefully observed in thermal design and assessment in consideration not only of single functionality operation but also of probable concurrent multiple functionality operations.

i. Heat generation by CPU

Smart Phones etc. have capabilities to support higher load processing for video recording with a high resolution camera and high-definition game applications. In view of dynamic fluctuation of heat generation at CPUs in response to the load of tasks, they shall be required to secure their safety at the maximum load condition.

ii. Heat generation by Wireless Communication Circuits

A power amplifier that amplifies the signals of voice and other communications is a major heat source at Smart Phones etc. An operation condition of a power amplifier varies in accordance with the distance from a base station and an instruction from a base station such as the speed of uplink data communications. The safety shall be secured under the maximum load conditions as set out in a radio standard.

iii. Heat generation by Power Supply and Power Charging Circuit

Smart Phones etc. have different voltage and current specifications per functional block for which a power supply IC that integrate multiple power circuits are used. Therefore, the electric current for a power supply IC itself increases when multiple functional blocks are activated concurrently. As a battery charging circuit is controlled its charging current in accordance with a battery charging status (voltage), heat generation conditions change accordingly.

3.2 Designing Considerations for Sharp Edges on Devices

For the Sharp Edges on Smart Phones etc., in addition to the normal user accessible areas, possible sharp edges that caused by manufacturing defects or minor user handling faults etc. shall also need to be taken into consideration.

i. Sharp edges at normally contactable areas

All contactable areas including but not limited to a case, a cover cap, a SIM slot, a SD card slot, a battery pack and a battery lid shall be taken care of irrespective frequencies and purposes of a contact.

ii. Sharp edges by manufacturing defects

Sharp edges that are caused by manufacturing faults include burrs by forming defects and round machining defects at a corner area. With an adhesive failure, the edges of a metal decoration panel that normally do not expose may expose, too. The risks for sharp edge occurrences at manufacturing processes shall be identified by FMEA etc. and fully addressed.

iii. Sharp edges caused by minor user handling faults

The sharp edges that caused by damages by a fall, a mechanical shock or a compression stress etc. shall require calling user's attention with instruction manuals. Furthermore, cracks, scratches, dents, ruptures and decoration panel detachments that that are expected by a stress for normal uses shall be taken into consideration in design that prevents an easy exposure of sharp edges.

Glasses that are generally used for a mobile equipment display can naturally expose sharp edges caused by damages and breakages due to falls etc. The issues that cannot properly be addressed with design may alternatively be thoroughly warned by an instruction manual etc.

4. Considerations for Temperature Measurement

For temperature measurement, infrared thermometer (infrared thermography) based non-contact temperature measurement and thermocouple based non-contact temperature measurement are recommended. The temperature measurement by an infrared thermography for example is to detect infrared energy from a target object and show an image of a surface temperature distribution. For an accurate measurement however, use of a device that can correct a radiation rate to the target material property and condition and adoption of surface treatment materials of which radiation rate is known shall be required.

In case of using a contact temperature measurement with a thermocouple, an enough care shall be taken for an accurate measurement with a proper attention to the connection between a temperature measurement point and a thermocouple and an effect of an wire.

Furthermore when measuring temperatures inside a thermostatic oven, the wind from convection and a blower may chill a target object that prevents an accurate temperature measurement. Proper measures such as placing a surrounding shield shall be taken to protect a target object from wind.

Please note that the above descriptions are general aspects. For a real measurement, a measurement environment and an accuracy and property of a measurement device shall be taken into consideration for a precise measurement.

5. Safety Standards

This Guideline stipulates “essential standards” that must be fulfilled and “recommendable standards” that are highly recommended to be fulfilled for higher safety.

5.1 Standard for Low Temperature Burn

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Test environment temperature	35 degree Celsius (°C)	Refer to Appendix C-1 for cautions in test environment temperature/
2	Terminal state	Setting and operation of the max load conditions at temperature rise	Refer to Appendix C-2 for cautions in the max load conditions at temperature rise.
3	Measurement method	Measure the contact part temperature under continuous body contact with the max heat point.	The ways to contact human bodies are assumed as ones under normal usages.
4	Standard (Essential)	The temperatures and duration for human body contact shall be under the following range in each material; ■Metal ・51°C for 1 minute, 48°C for 10 minutes, 43°C for 8 hours ■Glass and Ceramic ・56°C for 1 minute, 48°C for 10 minutes, 43°C for 8 hours ■Others (Resin etc.) ・60°C for 1 minute, 48°C for 10 minutes, 43°C for 8 hours	**[ISO13732-1]**
5	Standard (Recommended)	The temperatures and duration for human body contact shall be under the following range in each	–

		material; ■Materials independent ・51°C for 1 minute, 48°C for 10 minutes, 43°C for 8 hours	

5.2 Standard for Terminal Failure

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Test environment temperature	25°C	Refer to Appendix C-1 for cautions in test environment temperature/
2	Terminal state	In a power amplifier part and similarly large power consuming parts and the main circuit for proper control of these larger power consuming circuits, the power supply operations on a open/short state to the terminal circuit parts when power is on and a battery charger is connected.	–
3	Measurement method	Inspection of terminal state	–
4	Standard (Essential)	No smoke, fire and melt.	–
5	Standard (Recommended)	The temperature at the maximum heat generation point of a terminal surface shall be measured and the maximum temperature of a terminal surface where a human body may contact shall not exceed 70°C.	–

5.3 Standard for assumable harsh conditions

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Test environment temperature	35°C	Refer to Appendix C-1 for cautions in test environment temperature/
2	Terminal state	Setting and operation of the max load conditions at temperature rise by wrapping a terminal in a blanket etc.	Refer to Appendix C-2 for cautions in the max load conditions at temperature rise.
3	Measurement method	Inspection of terminal state	–
4	Standard (Essential)	No terminal error	–
5	Standard (Recommended)	–	–

5.4 Standard for Fire Prevention

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Standard (Essential)	1.A device shall be designed and manufactured to prevent a fire expansion from the device. 2. There shall have no ignition in the parts of a device. 3. The materials that are used for a product case except for a detachable battery pack shall have the flame resistance grade of HB equivalent or more at the UL standard. 4. The materials that are used for a circuit board (i.e. a board with major parts such as a power supply IC etc. and with a high electric current, except for FPC) shall have the flame resistance grade of V0 equivalent or more at the UL standard. 5. The materials for a battery pack that can be detached by a user shall support V2 equivalent or more at the UL standard. The circuit board with a large current except for FPC shall support a non-inflammable grade with V0 equivalent or more at the UL standard.	**[UL94]**
2	Standard (Recommended)	–	–

5.5 Standard for sharp edges of a device

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Measurement method	Test by a sharp edge tester *The specifications of a sharp edge tester and a test procedure shall be as set forth in the UL1439 standard.	**[UL1439]**
2	Standard (Essential)	A pierced cut on a 2 layer detection tape at external sharp edge testers shall not be produced.	**[UL1439]**
3	Standard (Recommended)	A pierced cut on a 1 layer detection tape at external sharp edge testers shall not be produced.	–

5.6 Standard for power leakage

No.	Item	Specifications	Reference/Source specifications/Remarks
1	Measurement method	Test with the procedures and the text circuits under J6950 * A battery charger shall be a standard option accessory and support the maximum rated charging.	**[JISC6950-1]**
2	Standard (Essential)	The maximum touch current (effective value): 0.25 mA	**[JISC6950-1]**
3	Standard (Recommended)	The maximum touch current (effective value): 0.10 mA	―

Appendix A: Design Considerations for Heat Generation and Temperature Rise Property

The standard items as set forth in the Section 5.1 - 5.4 show the product safety guidelines for a burn and fire risk arising from a thermal energy of Smart Phones etc. In order to reduce anxieties of a user toward heat generation, the following points should also be well into consideration at a design phase.

A-1 Maximum temperature on a case surface

When a human body touches a heated part, the surface temperature decreases rapidly. If the conditions as provided for in 5-1 Item No.4 are fulfilled under such state, a risk for a low temperature burn can be smaller. However if the moment to touch a heat part is high, a user will become a cause for “an anxiety for a burn” and “an anxiety for a terminal failure”. Therefore for heat measures including at a high load state, the maximum temperature under a non-contact state may be observed in designing

A-2 Time for temperature rise at a case surface

A sharp temperature rise at the surface of a case can be a case for “an anxiety for a burn” and “an anxiety for a terminal failure”. Therefore for heat measures including at a high load state, the duration for a temperature rise may be observed in such a designing manner to prevent a sharp temperature rise at a case surface.

A-3 Partial temperature rise at a case surface

As a sharp temperature rise at partial area of a case surface especially for Smart Phones etc. that are higher in density for parts can be a cause for “an anxiety for a burn” and “an anxiety for a terminal failure”, a design to possibly prevent a local temperature rise may be necessary in heat measures.

Appendix B: Design Considerations at Other Safety Standards

B-1 Design considerations for sharp edges on devices

The safety standard as set out in Section 5.5 is the one to ensure no risk for an injury at a contact under the certain condition (i.e. a pressure and the speed of touch and trace of an edge under the **[UL1439]**). In addition, the sharpness of an edge of a device may be designed with consideration to ensure “no pain at contact” and “no anxiety for an injury”.

As the sense of touch varies on materials of a device case, a sensory evaluation may be applied to check the sense of touch. In case the surface gives pain or an anxiety, an improvement to the surface treatment such as chamfering may be implemented.

In case the characteristics of a product is targeted a specific age group especially for a younger generation that tends to have thinner skins and be weaker to physical stimulations, a special attention shall be paid.

B-2 Design considerations for power leakage

Similarly to the safety standard for a sharp edge on a device, “no pain or numbness on touching”

regarding a leakage current may be observed.

The measures for an output and an electricity leakage on a charger are prevalent. However as the materials, especially metals of a case can influence a sensory leakage power, a sensory evaluation may be applied to check the sensory leakage power and see if it is low enough not to feel a pain and numbness.

B-3 Design considerations for other safety standards

The mobile devices are lately used not only for the traditional voice calls and data communications but also popularly used as a player for an audio and audiovisual content. Thus, safety considerations toward an acoustic energy have become important.

The requirements for the acoustic properties of phone functions are set out in ITU-TP360 and IEEE std.269 (2010), UL60950-1, CAN/CSA-C22.2No.60950-1-07 and the ones when connected with an ear with a headset are in EN60950-1/A12:2011(2nd ed.), EN500332-1/02. In addition, unsafe acoustic level that could be produced by user's erroneous or unintended operations may be avoided in design.

Appendix C: Considerations in Test Procedure for Heat

C-1 Test environment temperature

An ambient temperature at test is set as either 25 degrees Celsius as normal ambient temperature, or 35 degrees Celsius maximum that is as recommended to a user in the instruction manuals of a generic mobile device. In case an instruction manual sets out a higher range of an ambient temperature than this Guideline, the design may have further safety considerations in observing the maximum ambient temperature.

In describing in an instruction manual that continuous or temporary uses in a car under blazing sun or in other high temperature environments such as a bathroom are allowed, a safety check at the maximum ambient temperature that is carried in the instruction manual and an alert for a low temperature burn etc. at a higher temperature may be well observed.

C-2 Maximum load condition at temperature rise

As set forth in the chapter 3, the maximum load condition at temperature rise shall be carefully observed in consideration of not only a single functionality operation condition but also of probable concurrent multiple functionality operations in the main heat sources such as CPU, a radio circuit, a power supply and a battery charger.

Furthermore in view of the utmost attention to user safety, maximum load condition shall be “the maximum load condition for terminal specifications” rather than “the maximum load condition that is expected in use cases”.

Concrete example;

In case of smart phones

Set the brightness of a display at maximum and make the display a power-on state always, measure the temperature rise in operating all of the concurrent operable functionalities such as continuous packet transmissions at the maximum transmission power (toward a simulator), Wi-Fi tethering, a camera function (such as video shooting), video viewing and battery charging etc.

Appendix D: Reference Materials such as Standard Specifications (Normative)

[ISO13732-1]	ISO13732-1：2006 Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces -
[UL94]	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
[UL1439]	UL Standard for Safety Tests for Sharpness of Edges on Equipment
[JISC6950-1]	JIS C6950-1:2012+Addendum1(2014) Information technology equipment – Safety - Part 1: General requirements