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100/1508/DC

2009-01-23

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE No. 100: AUDIO, VIDEO AND MULTIMEDIA SYSTEMS AND EQUIPMENT

New work item proposals for “Battery charging interface for small hand-held multimedia devices – Part 1: Specification and Part 2: 2 mm barrel type interface conformance testing"

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Based on the SMB decision given in document CA/1414/RV and SMB/2888A/RV, TC 100 conducts “TC 100 fast standardization procedure” as described in the document 100/1180/INF clause 10.4.

Annex A and B contain the new work item proposals which have been sent to the members of TC 100/AGM (advisory group on management) for approval in accordance with above mentioned procedure.

National Committees are requested to nominate experts for the new works as described in Annex A and B

by 20th of February 2009.

Please address your nomination through the IEC Electronic voting system

Note: This information will be sent also to SC 48B, TC 59 (SC 59L) and TC 61.

Annex A

100/AGM(Secretariat)632

TC 100 NEW WORK ITEM PROPOSAL

	Proposer Finland	Date of proposal 2008-12-15
Document will be discussed in the TC 100/AGM meeting on , agenda item	TC/SC 100/TA 1	Secretariat Japan
Classification according to IEC Directives Supplement, Table 1	Date of circulation 2009-01-19	Closing date for voting 2009-02-20

In accordance with the rules for a test case for a new standardization procedure this proposal is sent to the members of TC 100/AGM for approval and to the National Committees for nomination of experts. All correspondence regarding the subject should be addressed directly to the TC 100 secretary. **This form shall be used for the TC 100 fast procedure only.**

The proposal (to be completed by the proposer)

Title of proposal
Battery charging interface for small hand-held multimedia devices –
Part 1: Specification

☒ Standard ☐ Technical Specification

Scope (as defined in ISO/IEC Directives, Part 2, 6.2.1)
This document defines a charging interface between small hand held multimedia devices and power-supply accessories, specifically chargers. Devices, which could use this standard, for example, are mobile phones, MP-3 players, GPS-navigators, gaming devices, digital cameras, portable radio receivers or small hand-held TV receivers.

Purpose and justification, including the market relevance and relationship to Safety (Guide 104), EMC (Guide 107), Environmental aspects (Guide 109) and Quality assurance (Guide 102) . (attach a separate page as annex, if necessary)
This standard defines the charging interface of different kinds of small hand-held devices so that the same charger device may be used with different kinds of devices.
The purpose of this standard is to increase commonality between chargers for small devices so that same chargers can be used for different devices and for different generation of devices. Later possibility to sell devices without chargers and reduce generation of waste.

Target date	for first CD 2009-06	for IS 2012
Estimated number of meetings 3	Frequency of meetings: 1 per year	Date and place of first meeting: -
Proposed working methods	☒ E-mail	☐ ftp

Relevant documents to be considered

Relationship of project to activities of other international bodies

Liaison organizations

Need for coordination within ISO or IEC

Preparatory work
Ensure that all copyright issues are identified. Check one of the two following boxes
☒ A draft is attached for vote and comment ☐ An outline is attached
We nominate a project leader as follows in accordance with ISO/IEC Directives, Part 1, 2.3.4 (name, address, fax and e-mail): Pekka Talmola, Nokia Oyj, P.O.BOX 4, FI-20521 Turku, Finland,
email: pekka.hk.talmola@nokia.com

Concerns known patented items (see ISO/IEC Directives, Part 2)
☐ yes If yes, provide full information as an annex ☒ no

Name and/or signature of the proposer
Eero Sorri
Group Manager
Finnish National Committee

Comments and recommendations from the TC/SC officers		
1) Work allocation		
☒ Project team	☐ New working group	☐ Existing working group no:
2) Draft suitable for direct submission as		
☐ CD	☐ CDV	☒ Level two TC 100 fast procedure
3) General quality of the draft (conformity to ISO/IEC Directives, Part 2)		
☒ Little redrafting needed	☐ Substantial redrafting needed	☐ no draft (outline only)
4) Relationship with other activities In IEC In other organizations		
Remarks from the TC/SC officers Assessment and allocation of the proposal will be discussed in TC 100 officers by correspondences.		

Elements to be clarified when proposing a new work item

Title

Indicate the subject matter of the proposed new standard.

Indicate whether it is intended to prepare a standard, a technical report or an amendment to an existing standard.

Scope

Give a clear indication of the coverage of the proposed new work item and, if necessary for clarity, exclusions.

Indicate whether the subject proposed relates to one or more of the fields of safety, EMC, the environment or quality assurance.

Purpose and justification

Give details based on a critical study of the following elements wherever practicable.

a) The specific aims and reason for the standardization activity, with particular emphasis on the aspects of standardization to be covered, the problems it is expected to solve or the difficulties it is intended to overcome.

b) The main interests that might benefit from or be affected by the activity, such as industry, consumers, trade, governments, distributors.

c) Feasibility of the activity: Are there factors that could hinder the successful establishment or general application of the standard?

d) Timeliness of the standard to be produced: Is the technology reasonably stabilized? If not, how much time is likely to be available before advances in technology may render the proposed standard outdated? Is the proposed standard required as a basis for the future development of the technology in question?

e) Urgency of the activity, considering the needs of the market (industry, consumers, trade, governments etc.) as well as other fields or organizations. Indicate target date and, when a series of standards is proposed, suggest priorities.

f) The benefits to be gained by the implementation of the proposed standard; alternatively, the loss or disadvantage(s) if no standard is established within a reasonable time. Data such as product volume of value of trade should be included and quantified.

g) If the standardization activity is, or is likely to be, the subject of regulations or to require the harmonization of existing regulations, this should be indicated.

If a series of new work items is proposed, the purpose and justification of which is common, a common proposal may be drafted including all elements to be clarified and enumerating the titles and scopes of each individual item.

Relevant documents

List any known relevant documents (such as standards and regulations), regardless of their source. When the proposer considers that an existing well-established document may be acceptable as a standard (with or without amendments), indicate this with appropriate justification and attach a copy to the proposal.

Cooperation and liaison

List relevant organizations or bodies with which cooperation and liaison should exist.

Preparatory work

Indicate the name of the project leader nominated by the proposer.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

BATTERY CHARGING INTERFACE FOR SMALL HAND HELD MULTIMEDIA DEVICES –

Part 1: Specification

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 6X XXX-1 has been prepared by technical area 1: Terminals for audio, video and data services and content, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/XX/FDIS	100/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 6X XXX series, under the general title *Battery charging interface for small hand held multimedia devices*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date[1] indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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1 The National Committees are requested to note that for this publication the maintenance result date is 2013.

BATTERY CHARGING INTERFACE FOR SMALL HAND HELD MULTIMEDIA DEVICES –

Part 1: Specification

1 Scope

This document defines a charging interface between small hand held multimedia devices and power-supply accessories, specifically chargers. Devices, which could use this standard, for example, are mobile phones, MP-3 players, GPS-navigators, gaming devices, digital cameras, portable radio receivers or small hand-held TV receivers.

There is a choice of two possible interfaces with different electrical and mechanical specifications. The first one is the Micro-USB connector specified originally by the USB Implementers Forum (USB-IF). The second one is a 2 mm barrel type charging interface. The Micro-USB connector includes data communication capabilities in addition to charging, but the 2 mm barrel interface is solely used for charging. The scope does not include the whole charger nor does it include the internal functions of the device. Chargers and devices shall follow the applicable EMC and safety standards. The scope of this document is illustrated in Figure 1.

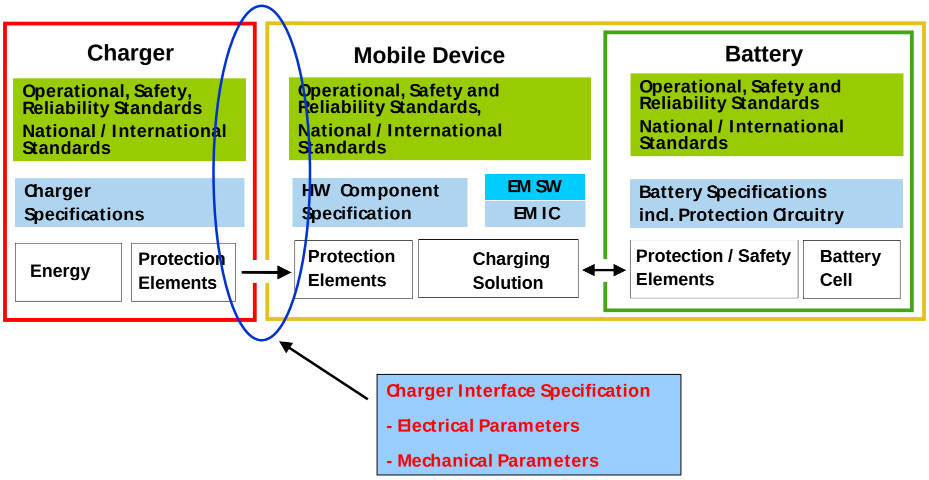

Figure 1 Scope of the charging interface standard

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 6X XXX-2, *Battery charging interface for small handheld multimedia devices – Part 2: 2mm barrel type interface conformance testing*

IEC 60 950-1, *Information technology equipment - Safety - Part 1: General requirements*

IEC 62 368, Audio/Video, *Information and Communication Technology Equipment – Safety - Requirements*

CISPR 13, *Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics - Limits and methods of measurement*

CISPR 20, *Sound and television broadcast receivers and associated equipment - Immunity characteristics - Limits and methods of measurement*

CISPR 22, *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement*

CISPR 24, *Information technology equipment - Immunity characteristics - Limits and methods of measurement*

EN 301489-series (All parts), *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services*

3 Abbreviations

For the purposes of this document, the following abbreviations apply.

AC	Alternating current
C	Capacitance F
CDN	Coupling and decoupling network
Crest factor	Current peak value/current RMS value
dB	Decibel
dB(mW)	Power in dB compare to 1 mW
DC	Direct current
EMC	Electromagnetic Compatibility
ESR	Effective series resistance Ω
F	Frequency in Hz
f_{Ichar}	Charging current change frequency Hz
GND	Ground
I	Current A
I_{char}	Charging current A
I_{max}	Maximum current A
I_{peak}	Peak current A
L	Inductance H
N	Newton
R	Resistance Ω
RMS	Root mean square
Slew rate (V or I)	Value change/changing time
USB	Universal Serial Bus
USB-IF	USB Implementers Forum
Micro-USB	Micro-USB, a USB interface using the small connector
V	Voltage V
V_{char}	Charging voltage

$V_{max\text{-}out}$	Maximum output voltage
V_{out}	Output voltage
$V_{p\text{-}p}$	Volt peak to peak
V_{ripple}	Ripple voltage

4 EMC and Safety

Although this specification is defining just the interface between a charger and a device the chargers and devices shall follow the applicable EMC and safety standards. For the chargers the following EMC and safety standards apply:

IEC 60 950-1, *Information technology equipment - Safety - Part 1: General requirements*

IEC 62 368, Audio/Video, *Information and Communication Technology Equipment – Safety - Requirements*

CISPR 13, *Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics - Limits and methods of measurement*

CISPR 20, *Sound and television broadcast receivers and associated equipment - Immunity characteristics - Limits and methods of measurement*

CISPR 22, *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement*

CISPR 24, *Information technology equipment - Immunity characteristics - Limits and methods of measurement*

EN 301489-series (All parts), *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services*

5 Micro-USB charging interface

5.1 General

The Micro-USB is a connector specifically developed by the USB Forum to address the market of mobile phones and other similar portable devices where the small size and mechanical durability of the interface is essential. In other respects the Micro-USB connector meets all the electrical requirements of the USB 2.0 specification and associated device classes, including the capability for battery charging.

The purpose of this chapter is to give the required references to the USB Implementers Forum documentation so that the USB charging can be implemented as an optional part of the charging interface specified in this IEC-standard.

5.2 References

The following USB Implementers Forum references are specifying the Micro-USB interface for charging.

USB Battery Charging Specification, http://www.usb.org/developers/devclass_docs#approved, USB-IF [1]

The On-The-Go and Embedded Host supplement to the USB 2.0 specification, http://www.usb.org/developers/onthego, USB-IF [2]

Universal Serial Bus Specification, Revision 2.0, http://www.usb.org/developers/docs/, USB-IF [3]

Micro-USB Cables and Connectors Specification Revision 1.01, April 4, 2007, USB-IF [4]

6 2 mm barrel interface

6.1 General electrical specifications for 2 mm barrel interface

6.1.1 General

Section 6 specifies the 2 mm barrel type electrical and mechanical charging interface between devices and power-supply accessories, specifically chargers. It also defines the charger-identification process of these devices.

The two-wire 2 mm barrel interface has a single voltage/current window, but depending on the capabilities of the charger, two types of chargers can be identified:

1. Standard chargers

   A standard charger may have a wide output current range and the current may change with other parameters. When the output voltage is between 2,0 V and 4,65 V, the recommended minimum output current is 300 mA.

2. Special chargers

   Special chargers may take charging energy for example from a solar cell or hand-operated generator. Charging conditions have a great impact on the charging current, the waveform of the charging current is unknown and charging can even be stopped from time to time. Battery charging time may vary considerably. The minimum current can be smaller than the 300 mA recommendation for standard chargers, but shall be more than 90 mA when the voltage is between 2,0 V and 4,65 V.

6.1.2 Charger output capacitance

The capacitance in charger output causes charging current spikes when the charger's load is changing. Low-capacitance values are recommended if possible. Maximum charger output filter capacitor size is 1000 μF (20% tolerance allowed) if the charger $V_{max\text{-}out}$ is less than 7 V. For output voltages of 7,0 V – 9,3 V, the maximum capacitance value decreases linearly so that for a 9,3 V charger, the maximum output capacitance is 700 μF(20% tolerance allowed). The maximum capacitance value is illustrated in

Figure 2.

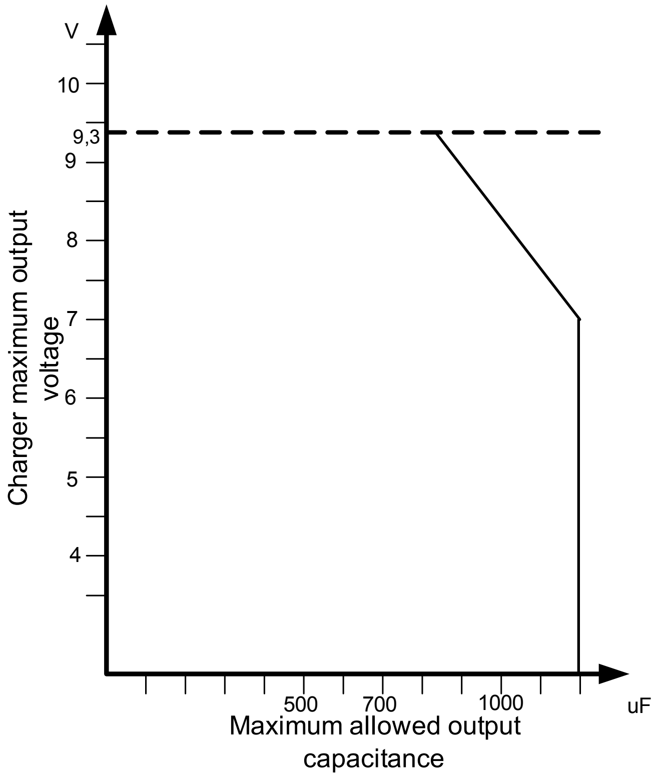

Figure 2 Maximum allowed charger output capacitance

6.1.3 Maximum voltage and current values

Table 1 gives the maximum limits for voltage and current values and settling times. These limits apply to all conditions.

Table 1 Limits for maximum voltage and settling time

Parameter	Limit
Maximum charger output overshoot	16 V
Maximum reverse voltage at charger output	1 V
Maximum time for standard charger to achieve steady state value (V and I) +- 10% after load change	10 ms
Maximum duration of charging current overshoot peak value greater than 1,1 A	5 ms

Limits are also valid for a damaged (single fault) charger and these voltage and current limits must be double insured, meaning that if the general charging voltage control system fails, there must be a backup limiter inside the charger. The maximum charging current overshoot is shown in Figure 3.

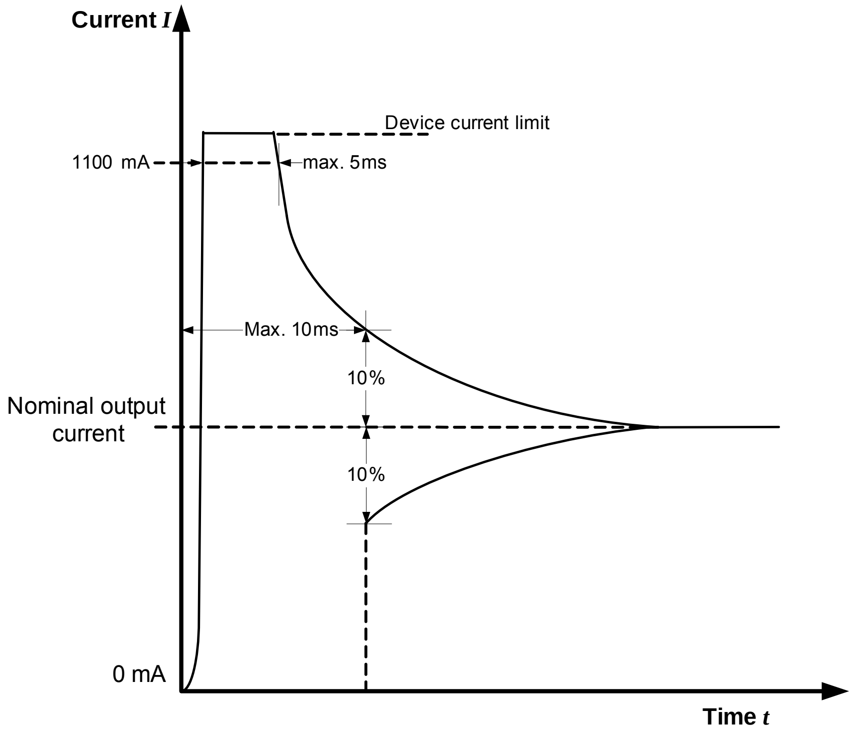

Figure 3 Maximum duration of charging current overshoot

6.1.4 Maximum output ripple voltage

The maximum allowed output ripple voltage with maximum output current of the charger (note that the charger maximum output current shall be less than the maximum specified in the standard) in constant current mode is 300 mV RMS for output voltages V_{out} between 2,5 V and 5,5 V.

The maximum acceptable output peak-to-peak ripple voltage is separated to four frequency ranges. A sum of ripple voltages over the full frequency range 0 MHz to 1 MHz is 800 $mV_{p\text{-}p}$. Ripple voltage shall be measured using 0 kΩ – 6 kΩ resistive load.

Note that charging voltage, including ripple, shall never have peak values outside the V/I window (see section 6.2.1) for charger output.

Maximum ripple voltages V_{ripple} for different frequency ranges are given in Table 2. Maximum peak to peak ripple voltage is shown in Figure 4.

Table 2 Maximum ripple voltage in different frequency ranges

Frequency range	Maximum ripple voltage (peak to peak)
f < 20 Hz	200 $mV_{p\text{-}p}$
20 Hz ≤ f < 200 Hz	200 $mV_{p\text{-}p}$
200 Hz ≤ f < 20 kHz	200 $mV_{p\text{-}p}$
20 kHz ≤ f < 1 MHz	400 $mV_{p\text{-}p}$

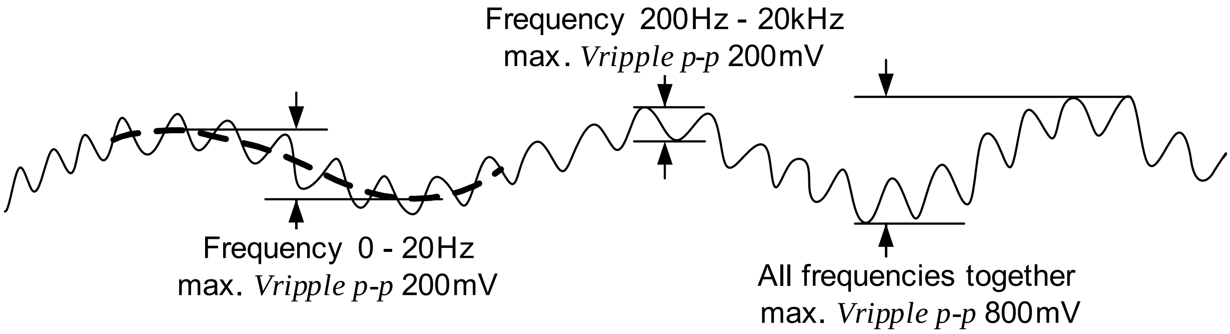

Figure 4 Maximum peak-to-peak ripple voltage

6.1.5 High frequency voltage components at the charger output

The charger shall not cause more high frequency voltage components at the charger output than specified in Table 3 and Figure 5 when connected to an artificial load specified in Annex A and measured with coupling/decoupling network as specified in Annex B.

Table 3 Maximum conducted interference

Frequency range	Maximum high frequency voltage components
1 MHz – 80 MHz	-40 dB(mW) to -65 dB(mW) linear slope
80 MHz – 150 MHz	-65 dB(mW)

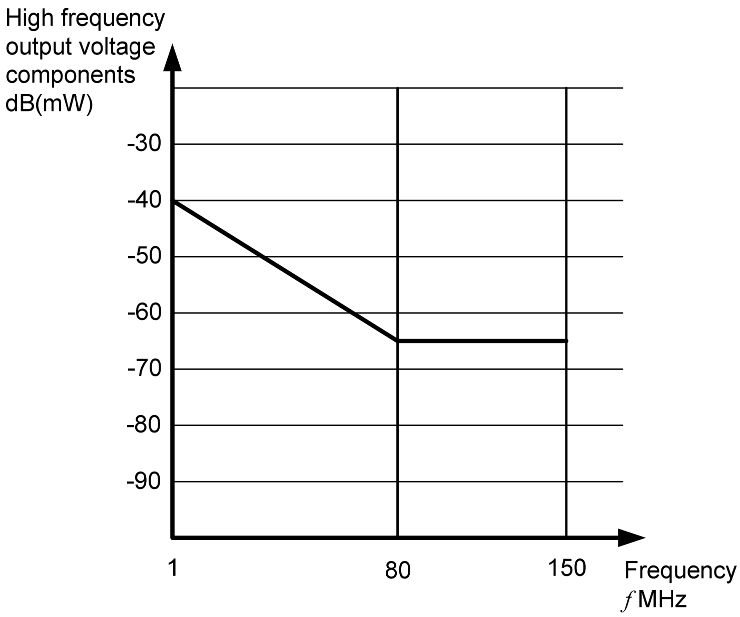

Figure 5 Maximum high frequency output voltage components

6.1.6 Leakage current of AC chargers

Maximum leakage current from AC mains to the mobile device through the charger is 5 µA when measured as specified in IEC 60 950-1.

6.2 Electrical specification for 2 mm barrel type chargers

6.2.1 Charging voltage/current window

The minimum recommended charging current is 300 mA for standard chargers when the voltage is between 2,0 V and 4,65 V. Special chargers may operate below this limit but shall have a minimum charging current of 90 mA. During charging, the current and voltage values at the interface shall not exceed the charging window shown in Figure 6. This means that the charger shall operate inside the window and the devices shall accept all chargers which operate inside the window.

The only case when the charging voltage is allowed to exceed the charging current/voltage window is in a load change situation (see 6.1.3).

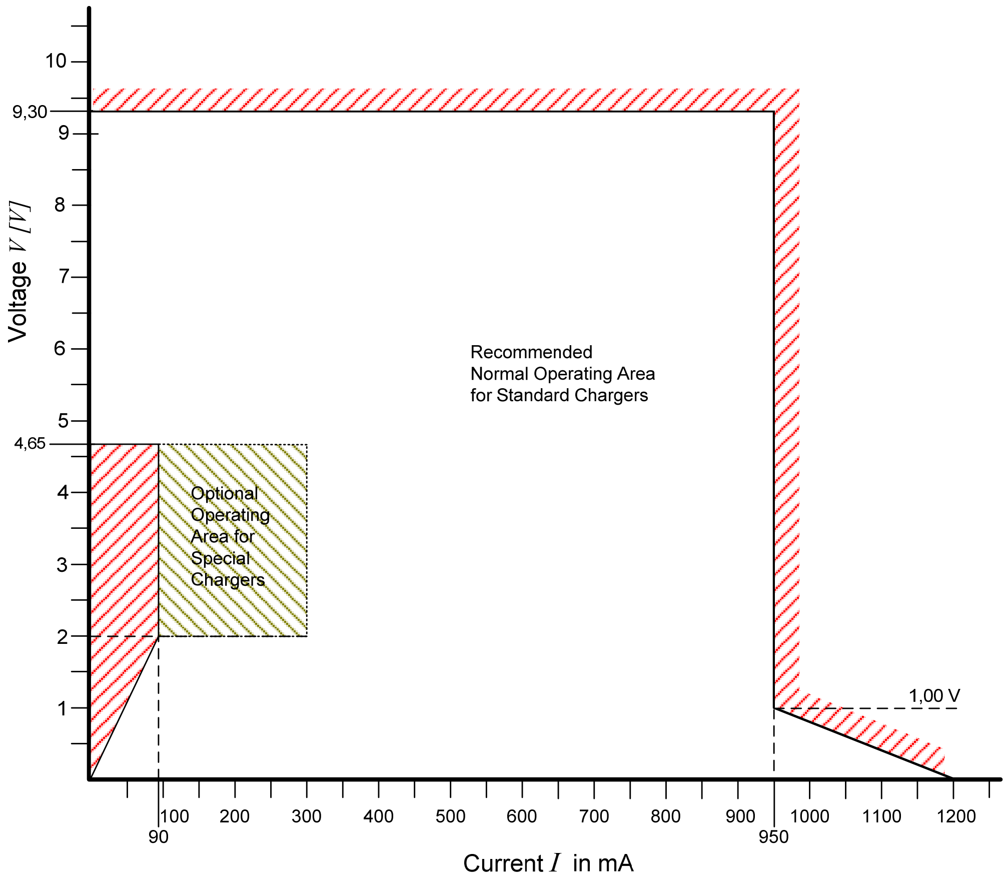

Figure 6 Charging current/voltage window for 2 mm barrel type chargers

6.2.2 Current linearity for standard chargers

Maximum current fluctuation under stable temperature conditions is 30 % when the charger output voltage varies from 3,5 V to 4,6 V (for example 500 mA - 0,3 x 500 mA = 350 mA) when input voltage and ambient temperature stay constant. Example of the current linearity specification is shown in Figure 7.

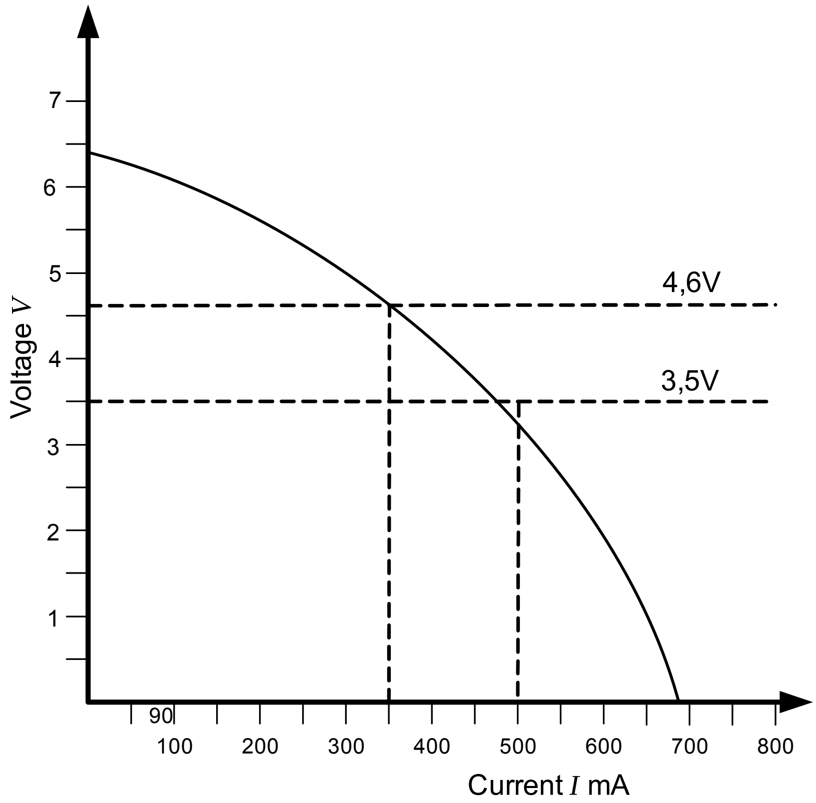

Figure 7 Current linearity specification example

6.2.3 Charging voltage rise time for special chargers

Special chargers do not have a time limit on how fast the charger must achieve the steady state value (V and I) after load change. The charger must provide a minimum charging current according to 6.2.1, even if the voltage is rising slowly.

6.2.4 Current linearity recommendation for special chargers

Following the current linearity recommendations yields the best results between chargers and devices, thus good current linearity should be the goal when designing 2 mm barrel chargers. However, following this recommendation is not mandatory due to the structure of a specific charger.

Charging current linearity is divided into two parts, based on the charging current change frequency. For $f_{Ichar} \leq$ ½ Hz, the maximum allowed current slew rate is 0,28 x I_{char} A/sec as shown in Figure 9. For f_{Ichar} > ½ Hz, the maximum charge current crest factor is < 1,14. This is illustrated in Figure 8. Crest factor is defined as:

$$Crest\ factor = \frac{I_{peak}}{I_{rms}}$$

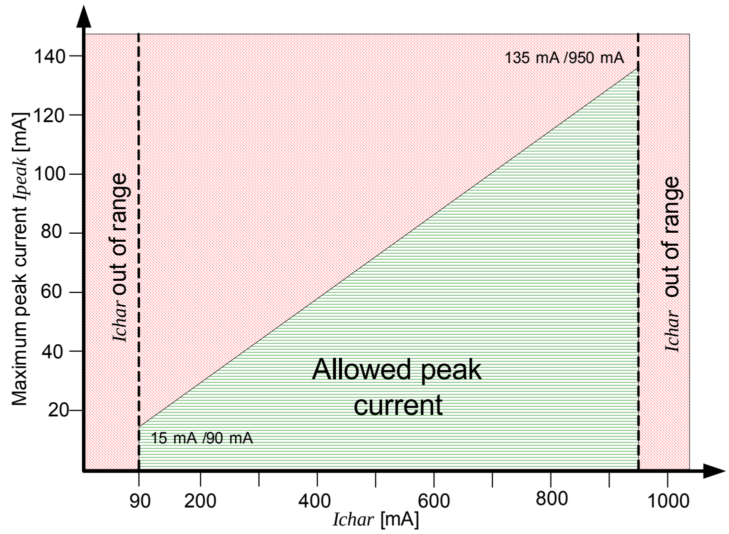

Figure 8 Maximum allowed charging current peaks (crest factor) f_{Ichar} > ½ Hz

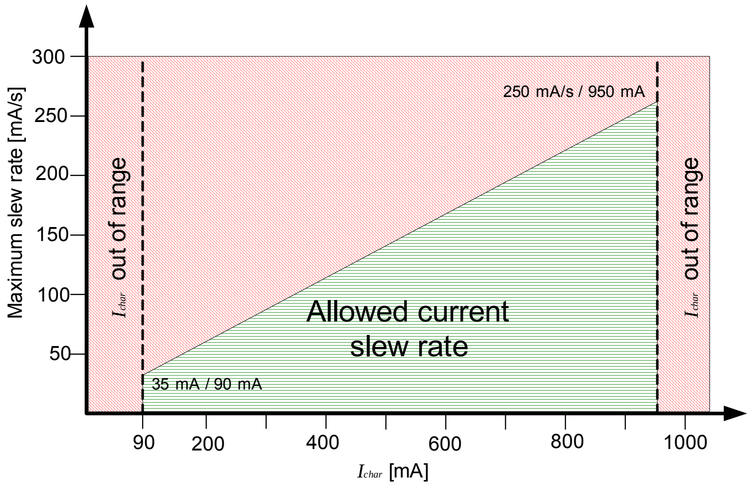

Figure 9 Maximum allowed charging current slew rate $f_{Ichar} \leq$ ½ Hz

6.3 Accessories connected between the 2 mm barrel charger and the mobile device

6.3.1 Accessory interfaces

An accessory (for example a desk stand) connected between the charger and the device shares energy with that device while taking energy for its own needs. The sharing policy varies based on the type of accessory and the operating conditions. The accessory must always provide an interface to the device that meets this 2-mm barrel interface specification, but a current allowance of 100 mA is given for the accessory, lowering the recommended minimum current from 300 mA to 200 mA. The interface is indicated with dashed lines in Figure 10.

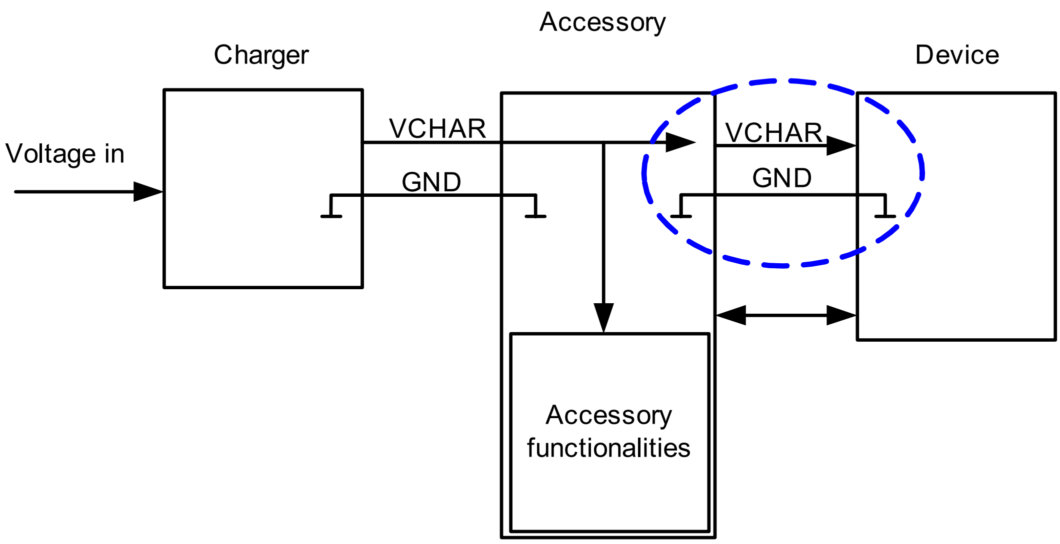

Figure 10 Accessory/device interface

6.3.2 Electrical specifications for accessories

Accessories connected between the charger and the mobile device and having direct contact with charging lines (for example, a desk stand), must not disturb the charging or charger identification. Minimum, maximum and typical values for accessory contacts are given in Table 4.

Table 4 Electrical specification for accessory contacts

Description	Minimum	Typical	Maximum	Unit
Ground lead resistance with contacts	0		0,05	Ω
Positive lead resistance	0	0,2	0,40	Ω
Capacitance between charging lines	0		4,0	µF

Even if the accessory is powered by a standard charger, it doesn't need to fulfill the current linearity specification for constant current type chargers (see 6.2.2).

6.3.3 Booting up the mobile device when connected to an accessory

While the device is booting up, the accessory connected between the charger and the device must not limit the charging current between the two. Also, it must be possible to boot up the device when there is an accessory connected between the charger and the device and the device's battery is totally empty.

For example an accessory may have current consumption I_{max} = 10mA as long as the charging voltage V_{char} is below 3,5 V and when the device is booting up.

6.3.4 Charger identification

An accessory connected between the charger and the device must not prevent the device from identifying the charger type correctly. For example if the accessory is connected to the charger and the device, which is powered on, is later connected to the accessory, the power consumption of the accessory may result in the wrong charger identification. The accessory must limit its power consumption (or use some other method) so that there is a minimum

5,5 V charging voltage available in the charging interface for the mobile device during the first 300 ms after the mobile device is connected to the accessory.

6.4 Charger identification method for the 2 mm barrel interface

6.4.1 Charger voltage measurement

When a charger is connected to the device, the device will start the charger recognition procedure by checking the charger voltage with 1 mA to 5 mA current. Identification is based on measured average voltage and waveform: voltage from 4,65 V to 9,3 V is identified as a 2-mm barrel interface charger. The charger should fulfill the voltage window specified here and shown in Figure 11 for the charger identification process.

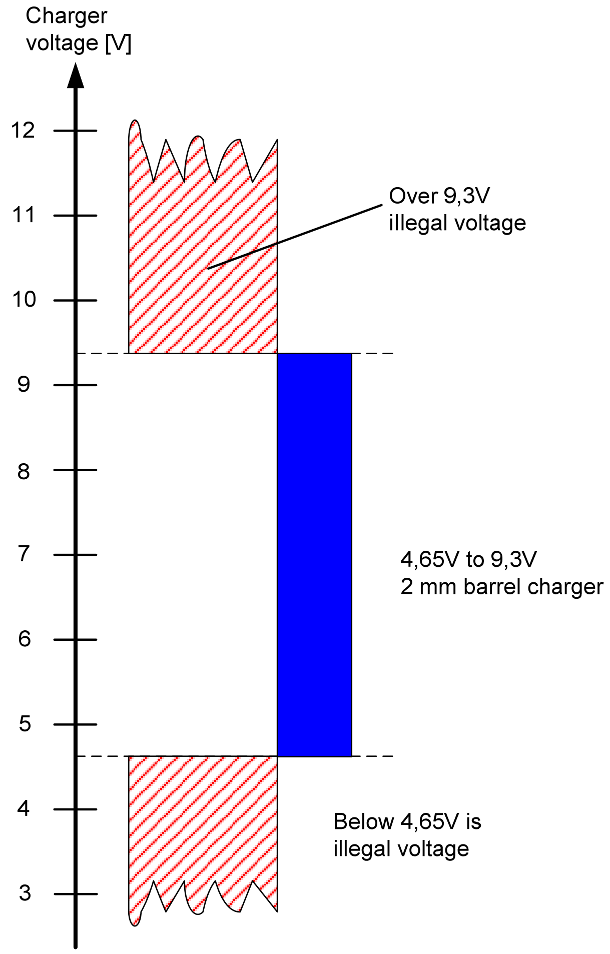

Figure 11 Charger identification voltages

6.5 Mechanical specification of the 2 mm barrel interface

6.5.1 Mechanical dimensions

Mechanical dimensions of the 2 mm barrel charging interface plug are given in Figure 12.

Mechanical dimensions of the plug outer molding are given in Figure 13.

Mechanical dimensions of the 2 mm barrel charging interface receptacle are given in Figure 14.

6.5.2 Charging voltage polarity

The charging voltage positive terminal is connected to the center pin and the ground is connected to the outer surface of the plug.

6.5.3 Durability

Durability: 6000 cycles. The 2 mm barrel interface plug and receptacle have to fulfill all the electrical and mechanical specifications after 6000 insertion/extraction cycles unless otherwise specified.

6.5.4 Insertion Force

15 N maximum after 6000 insertion/extraction cycles.

6.5.5 Extraction Force

5 N - 15 N between 0 and 3000 insertion/extraction cycles.

3 N - 15 N between 3000 and 6000 insertion/extraction cycles.

6.5.6 Insertion/Extraction Forces with measurement Gauge

The purpose of the test Gauge measurements is to ensure proper working of the Plug inner terminal. Test Gauge diameter shall be 0,5mm $^{+0.005/-0.0}$

Insertion Force: 0 N - 10 N after 2 insertion/extraction cycles

Extraction Force: Over 1,5 N after 2 insertion/extraction cycles

Over 0,5 N after 6000 insertion/extraction cycles

6.5.7 Mechanical strength of the Plug

The 2 mm charging plug shall break with 30 N - 70 N force when bending is applied according the Figure 15.

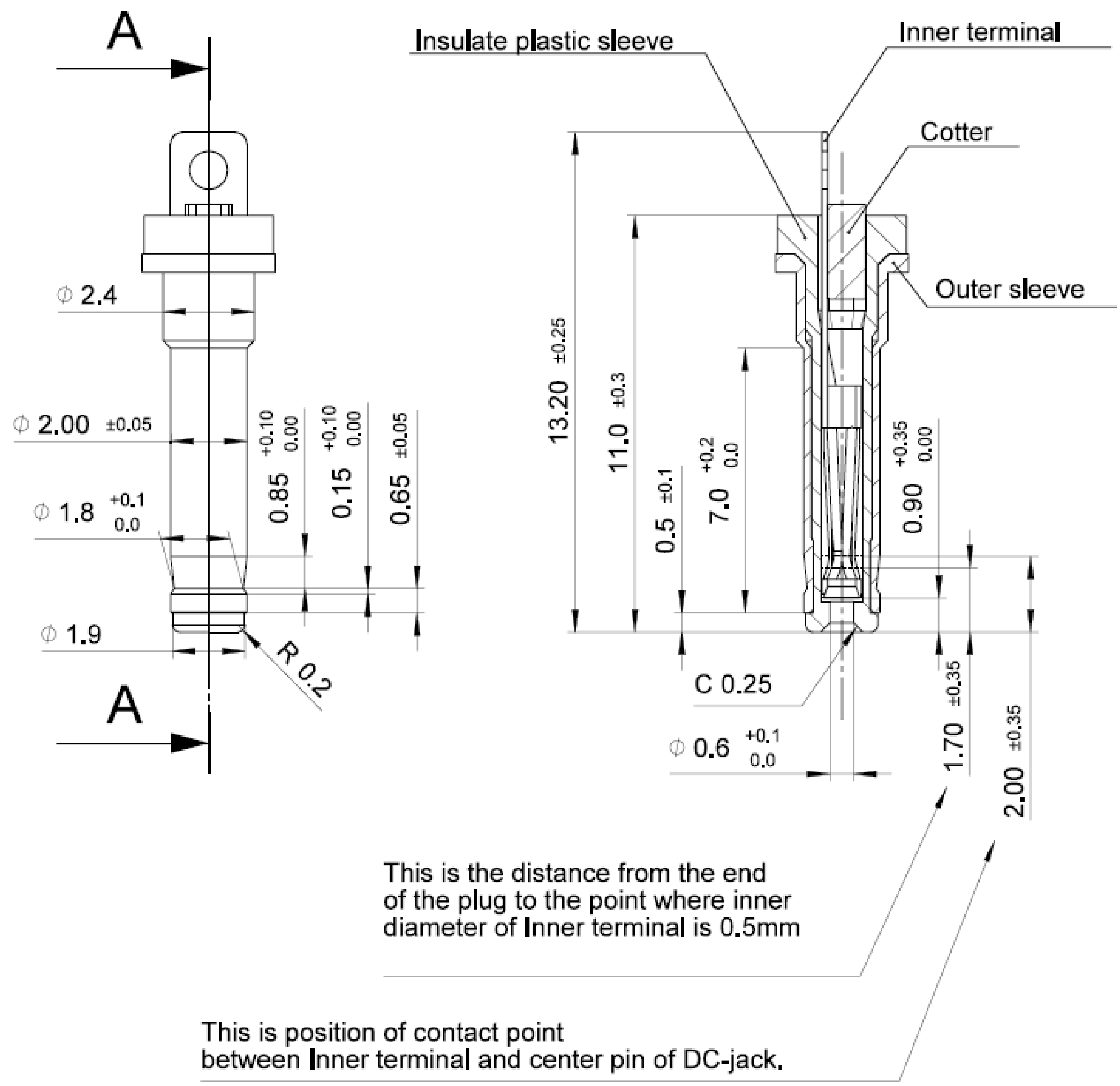

Figure 12 Detail dimensions for 2 mm barrel charging plug

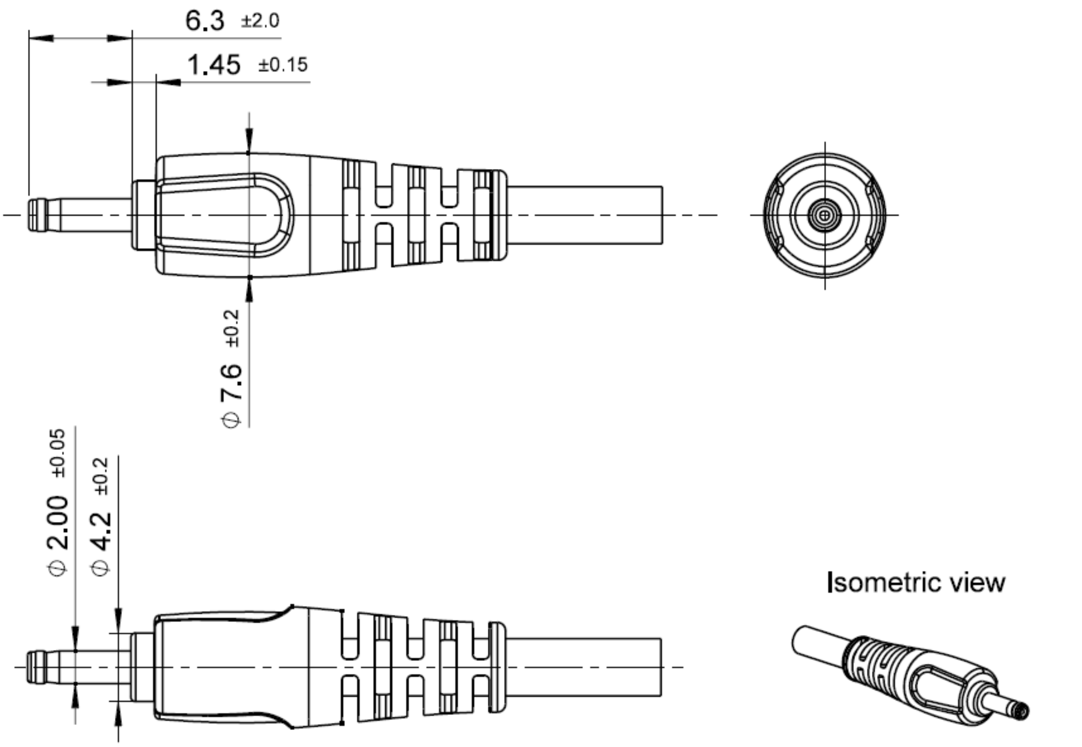

Figure 13 Outer molding dimensions for 2 mm barrel charging plug

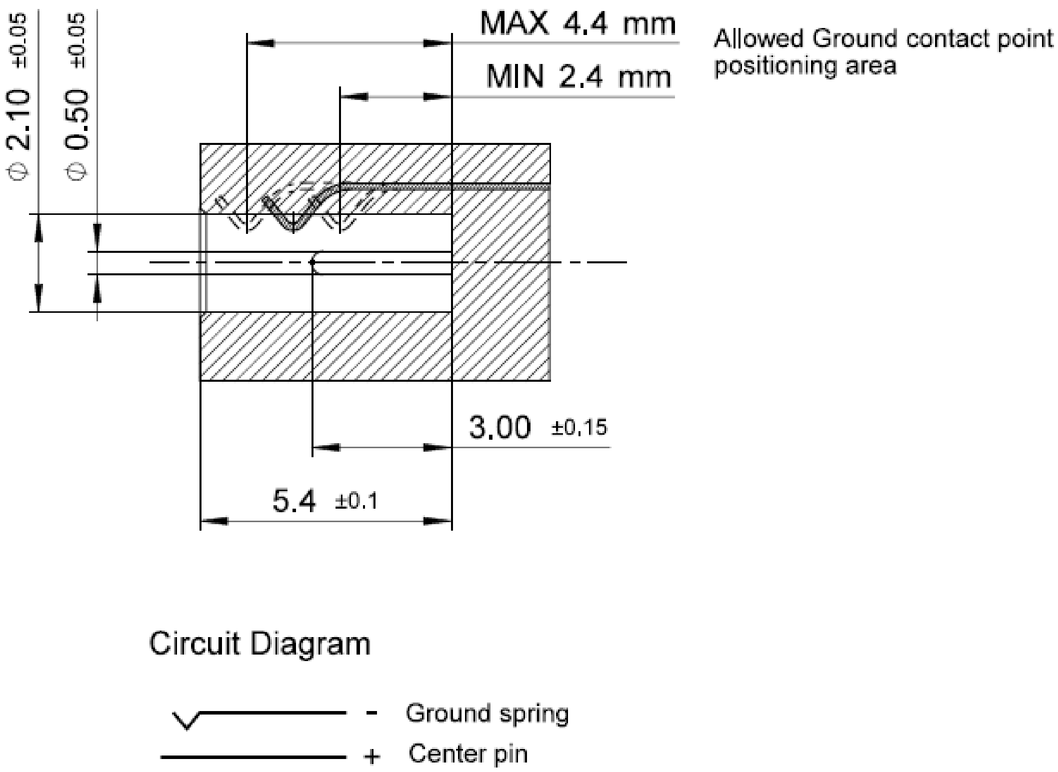

Figure 14 Dimensions for 2 mm barrel charging receptacle

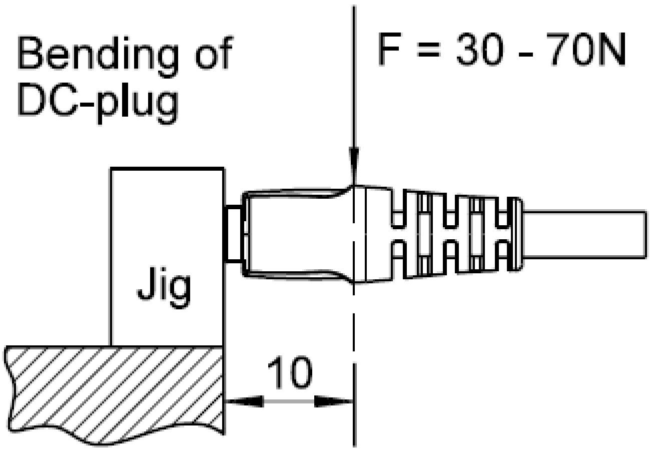

Figure 15 Bending durability

Annex A
Artificial load
(Normative)

A.1 Artificial load

The artificial load, which is used in measuring the conducted interference, is shown in Figure A1.

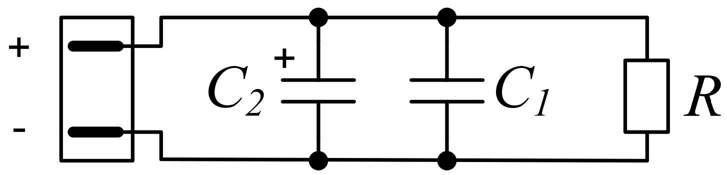

Figure A.1. Artificial load

The component values in the artificial load circuit:

- R value is selected so that charger output is 4,50 V.
- C1 = 4400 μF – 6000 μF, low ESR(<0,5Ω).
- C2 = 1 nF, ceramic capacitor.

Annex B
Coupling decoupling network
(Normative)

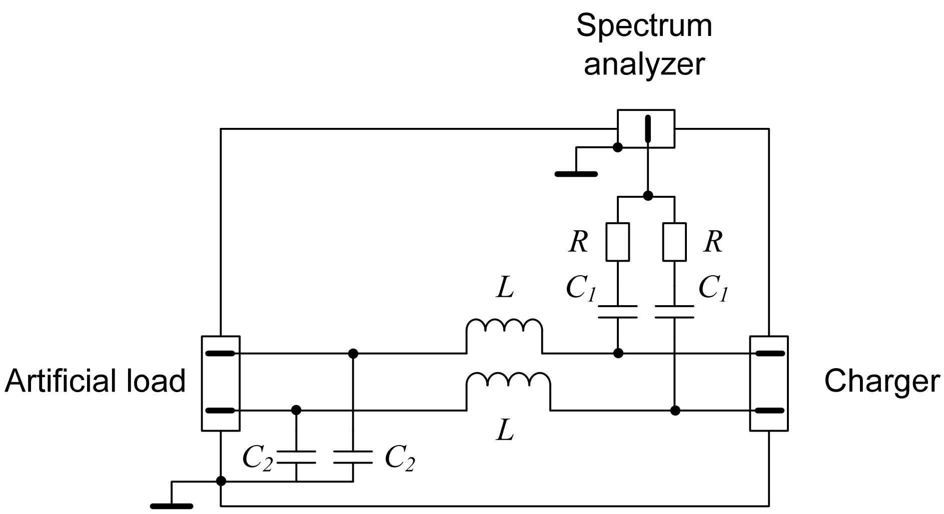

Figure B 1. Coupling decoupling network

The component values in the coupling decoupling circuit:

- R = 200 Ω
- C1 = 10 nF
- C2 = 47 nF
- L ≥ 280 µH at 150 kHz

Bibliography

[1] USB Battery Charging Specification, http://www.usb.org/developers/devclass_docs#approved, USB-Implementers Forum

[2] The On-The-Go and Embedded Host supplement to the USB 2.0 specification, http://www.usb.org/developers/onthego, USB-Implementers Forum

[3] Universal Serial Bus Specification, Revision 2.0, http://www.usb.org/developers/docs/, USB-Implementers Forum

[4] Micro-USB Cables and Connectors Specification Revision 1.01, April 4, 2007, USB-Implementers Forum

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Annex B

100/AGM(Secretariat)633

TC 100 NEW WORK ITEM PROPOSAL

	Proposer Finland	Date of proposal 2008-12-15
Document will be discussed in the TC 100/AGM meeting on , agenda item	TC/SC 100/TA 1	Secretariat Japan
Classification according to IEC Directives Supplement, Table 1	Date of circulation 2009-01-19	Closing date for voting 2009-02-20

In accordance with the rules for a test case for a new standardization procedure this proposal is sent to the members of TC 100/AGM for approval and to the National Committees for nomination of experts. All correspondence regarding the subject should be addressed directly to the TC 100 secretary. **This form shall be used for the TC 100 fast procedure only.**

The proposal (to be completed by the proposer)

Title of proposal

Battery charging interface for small hand held multimedia devices – Part 2: 2 mm barrel type interface conformance testing

☒ Standard	☐ Technical Specification

Scope (as defined in ISO/IEC Directives, Part 2, 6.2.1)

This part of the IEC 6X XXX provides the conformance testing rules and guidelines for equipment built to meet the 2 mm barrel type charging interface specified in the IEC 6X XXX-1.

Purpose and justification, including the market relevance and relationship to Safety (Guide 104), EMC (Guide 107), Environmental aspects (Guide 109) and Quality assurance (Guide 102) . (attach a separate page as annex, if necessary)

The purpose of this standard is to increase commonality between chargers for small devices so that same chargers can be used for different devices and for different generation of devices. Later possibility to sell devices without chargers and reduce generation of waste.

This standard specifies the conformance testing procedures for 2 mm barrel type charging interface specified in IEC 6X XXX-1.

Target date	for first CD 2009-06	for IS 2012
Estimated number of meetings 3	Frequency of meetings: 1 per year	Date and place of first meeting: -
Proposed working methods	☒ E-mail	☐ ftp

Relevant documents to be considered

Relationship of project to activities of other international bodies

Liaison organizations	**Need for coordination within ISO or IEC**

Preparatory work

Ensure that all copyright issues are identified. Check one of the two following boxes

☒ A draft is attached for vote and comment ☐ An outline is attached

We nominate a project leader as follows in accordance with ISO/IEC Directives, Part 1, 2.3.4 (name, address, fax and e-mail):

Pekka Talmola, Nokia Oyj, P.O.BOX 4, FI-20521 Turku, Finland,
email: pekka.hk.talmola@nokia.com

Concerns known patented items (see ISO/IEC Directives, Part 2) ☐ yes If yes, provide full information as an annex ☒ no	**Name and/or signature of the proposer** Eero Sorri Group Manager Finnish National Committee

Comments and recommendations from the TC/SC officers		
1) Work allocation		
☒ Project team	☐ New working group	☐ Existing working group no:
2) Draft suitable for direct submission as		
☐ CD	☐ CDV	☒ Level two TC 100 fast procedure
3) General quality of the draft (conformity to ISO/IEC Directives, Part 2)		
☒ Little redrafting needed	☐ Substantial redrafting needed	☐ no draft (outline only)
4) Relationship with other activities In IEC In other organizations		
Remarks from the TC/SC officers Assessment and allocation of the proposal will be discussed in TC 100 officers by correspondences.		

Elements to be clarified when proposing a new work item

Title

Indicate the subject matter of the proposed new standard.

Indicate whether it is intended to prepare a standard, a technical report or an amendment to an existing standard.

Scope

Give a clear indication of the coverage of the proposed new work item and, if necessary for clarity, exclusions.

Indicate whether the subject proposed relates to one or more of the fields of safety, EMC, the environment or quality assurance.

Purpose and justification

Give details based on a critical study of the following elements wherever practicable.

a) The specific aims and reason for the standardization activity, with particular emphasis on the aspects of standardization to be covered, the problems it is expected to solve or the difficulties it is intended to overcome.

b) The main interests that might benefit from or be affected by the activity, such as industry, consumers, trade, governments, distributors.

c) Feasibility of the activity: Are there factors that could hinder the successful establishment or general application of the standard?

d) Timeliness of the standard to be produced: Is the technology reasonably stabilized? If not, how much time is likely to be available before advances in technology may render the proposed standard outdated? Is the proposed standard required as a basis for the future development of the technology in question?

e) Urgency of the activity, considering the needs of the market (industry, consumers, trade, governments etc.) as well as other fields or organizations. Indicate target date and, when a series of standards is proposed, suggest priorities.

f) The benefits to be gained by the implementation of the proposed standard; alternatively, the loss or disadvantage(s) if no standard is established within a reasonable time. Data such as product volume of value of trade should be included and quantified.

g) If the standardization activity is, or is likely to be, the subject of regulations or to require the harmonization of existing regulations, this should be indicated.

If a series of new work items is proposed, the purpose and justification of which is common, a common proposal may be drafted including all elements to be clarified and enumerating the titles and scopes of each individual item.

Relevant documents

List any known relevant documents (such as standards and regulations), regardless of their source. When the proposer considers that an existing well-established document may be acceptable as a standard (with or without amendments), indicate this with appropriate justification and attach a copy to the proposal.

Cooperation and liaison

List relevant organizations or bodies with which cooperation and liaison should exist.

Preparatory work

Indicate the name of the project leader nominated by the proposer.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

BATTERY CHARGING INTERFACE FOR SMALL HAND HELD MULTIMEDIA DEVICES –

Part 2: 2 mm barrel type interface conformance testing

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 6X XXX-2 has been prepared by technical area 1: Terminals for audio, video and data services and content, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/XX/FDIS	100/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 6X XXX series, under the general title *Battery charging interface for small hand held multimedia devices*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date[1] indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

1 The National Committees are requested to note that for this publication the maintenance result date is 2013.

BATTERY CHANRGING INTERFACE FOR SMALL HAND HELD MULTIMEDIA DEVICES –

Part 2: 2 mm barrel type interface conformance testing

1 Scope

This part of the IEC 6XXXX provides the conformance testing rules and guidelines for equipment built to meet the 2 mm barrel type charging interface specified in the 6XXXX-1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 6XXXX-2, *Battery charging interface for small handheld multimedia devices – Part 2: 2 mm barrel type interface conformance testing*

IEC 60950-1, *Information technology equipment - Safety - Part 1: General requirements*

3 Abbreviations

For the purposes of this document, the following abbreviations apply.

AC	Alternating current
C	Capacitance F
CDN	Coupling and decoupling network
Crest factor	Current peak value/current RMS value
dB	Decibel
dB(mW)	Power in dB compare to 1 mW
DC	Direct current
EMC	Electromagnetic Compatibility
ESR	Effective series resistance Ω
f	Frequency in Hz
f_{Ichar}	Charging current change frequency Hz
GND	Ground
I	Current A
I_{char}	Charging current A
I_{max}	Maximum current A
I_{peak}	Peak current A
L	Inductance H
N	Newton
R	Resistance Ω
RMS	Root mean square

Slew rate (V or I)	Value change/changing time
USB	Universal Serial Bus
USB-IF	USB Implementers Forum
Micro-USB	Micro-USB, a USB interface using the small connector
V	Voltage V
V_{char}	Charging voltage
$V_{max\text{-}out}$	Maximum output voltage
V_{out}	Output voltage
$V_{p\text{-}p}$	Volt peak to peak
V_{ripple}	Ripple voltage

4 Test conditions for the 2 mm barrel charging interface

4.1 General test conditions

4.1.1 General

The general test conditions are set out below. Manufacturers should note that the actual conditions of use could be more stringent.

Tests conducted using this conformance document do not replace EMC, ESD, safety, type approval, or any tests set by legislation in the chargers or devices using the charging interface specified in IEC 6X XXX-1. The purpose of the conformance testing is to achieve good interoperability between different chargers and devices.

4.1.2 Temperature

All measurements shall be made at normal room temperature 18°C – 25°C, unless some other temperature is specified.

4.1.3 Voltage

All tests are performed under nominal operating voltage as defined by the manufacturer.

5 General electrical testing of 2 mm barrel type chargers

5.1 Maximum voltage and current values

5.1.1 Test purpose

The purpose of this test is to verify that charger complies with the requirements of settling time, minimum voltage and maximum voltage limits specified in IEC 6X XXX-1 section 6.1.3.

5.1.2 Requirements

- Maximum charger output overshoot shall be less than or equal to 16 V.
- Maximum reverse voltage at charger output shall be less than or equal to 1 V.
- Maximum time to achieve steady state value for voltage and current (±10 % tolerance) after load change (”no load”/”normal load”) shall be less than or equal to 10 ms. Note that this test is valid only for standard chargers.
- Maximum duration of charging current overshoot peak value greater than 1,1 A shall be less than or equal to 5 ms.

Maximum duration of charging current overshoot is shown in Figure 1.

5.1.3 Test equipment

The following equipment is required to perform the test:

- Oscilloscope;
- 6 kΩ load as “no load”;
- 3,0 V current sink type of load with 1,1 A current limit as “normal load”;
- AC power source (if charger is AC powered);
- DC power source (if charger is made for car environment).

5.1.4 Method of test

Proceed as follows:

a) Set oscilloscope to measure voltage and current from charger output.

b) Set the output of AC or DC power source to nominal value.

c) Measure the voltage and current values when the 6 kΩ load and 3,0 V load (a load, which results 3,0 V charging voltage) are interchanged with a fast electronic switch (switching time less than 100 μs) at the charger output.

Repeat the test using minimum and maximum supply voltages specified to the charger (recommendation for AC powered chargers is nominal voltage ± 20 percent).

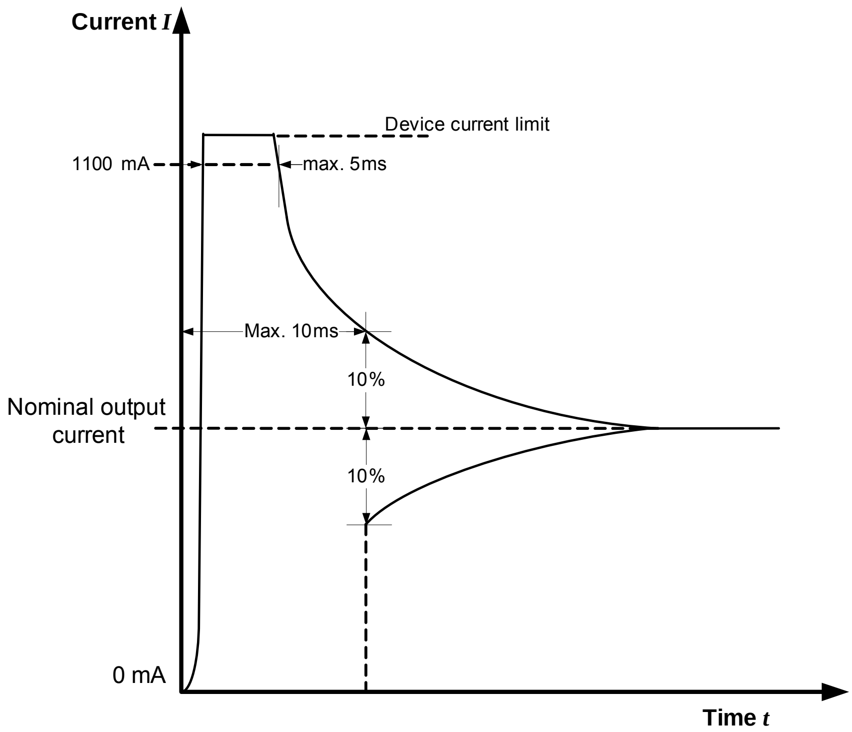

Figure 1 – Maximum duration of charging current overshoot

5.2 Maximum output ripple voltage

5.2.1 Test purpose

The purpose of this test is to verify that the charger complies with the requirements of ripple voltage specified in IEC 6X XXX-1 section 6.1.4.

5.2.2 Requirements

Maximum ripple voltages for different frequency ranges are given in Table 1.

Table 1 Maximum ripple voltage in different frequency ranges

Frequency range	Maximum ripple voltage (peak to peak)
$f < 20$ Hz	200 mV_{p-p}
20 Hz $\leq f <$ 200 Hz	200 mV_{p-p}
200 Hz $\leq f <$ 20 kHz	200 mV_{p-p}
20 kHz $\leq f <$ 1 MHz	400 mV_{p-p}

The maximum allowed output ripple voltage with maximum output current in constant current mode is 300 mV RMS for output voltages V_{out} between 2,5 V and 5,5 V.

A sum of ripple voltages over the full frequency range 0 MHz to 1 MHz is 800 mV_{p-p}.

During the test all the measured *V* and *I* values shall be within the voltage / current window of the charger interface.

Maximum peak to peak ripple voltage is shown in Figure 2.

5.2.3 Test equipment

The following equipment is required to perform the test:

- Oscilloscope which offers the possibility of selecting a measured frequency band;
- Variable resistive load 0 kΩ - 6 kΩ. Maximum stray capacitance of ripple test load (e.g. on-line testing) is 2 μF;
- AC power source (if charger is AC powered);
- DC power source (if charger is designed for car environment).

5.2.4 Method of test

Proceed as follows:

a) Set the output of AC or DC power source to nominal value. Connect charger to power supply and to variable load.

b) Set the oscilloscope to measure voltage from charger's output. Connect charger to variable load and set the load as 6 kΩ.

c) Set the oscilloscope to measure ripple voltage peak-to-peak value from frequency band 0 Hz - 20 Hz. Reduce resistance slowly until the output voltage is 1,5 V. Find the highest peak-to-peak value between maximum voltage and 1,5 V.

d) Set the oscilloscope to measure ripple voltage peak-to-peak value from frequency band 20 Hz - 200 Hz. Reduce resistance slowly until the output voltage is 1,5 V. Find the highest peak-to-peak value between maximum voltage and 1,5 V.

e) Set the oscilloscope to measure ripple voltage peak-to-peak value from frequency band 200 Hz - 20 kHz. Reduce resistance slowly until the output voltage is 1,5 V. Find the highest peak-to-peak value between maximum voltage and 1,5 V.

f) Set the oscilloscope to measure ripple voltage peak-to-peak value from frequency band 20 kHz - 1 MHz. Reduce resistance slowly until the output voltage is 1,5 V. Find the highest peak-to-peak value between maximum voltage and 1,5 V.

g) Set the variable resistance so that output voltage is 5,5 V. Remove frequency band limitations from the oscilloscope. Set the oscilloscope to measure the root mean square (RMS) value of ripple voltage. Decrease resistance slowly so that the output voltage is 2,5 V. Find the largest RMS value between 5,5 V and 2,5 V.

Repeat the test c) – g) using minimum and maximum supply voltages specified to charger (recommendation for AC-powered chargers is nominal voltage ± 20 percent). Repeat test in minimum and maximum temperatures specified to charger.

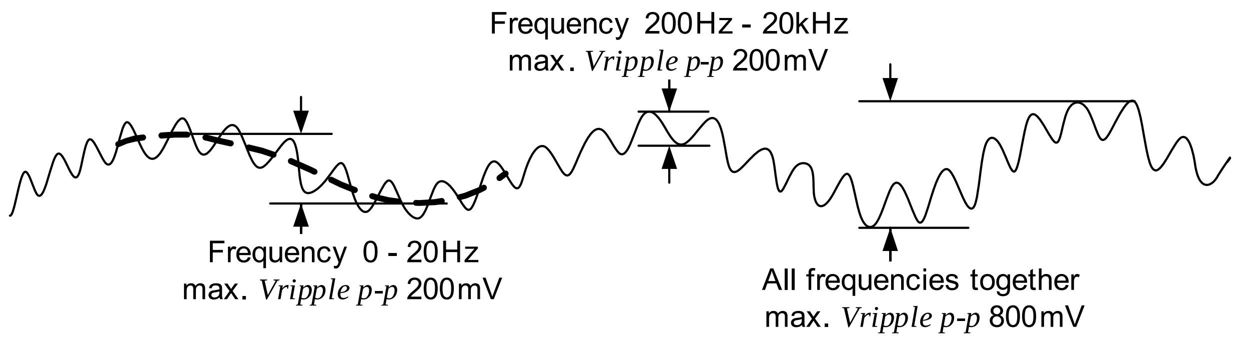

Figure 2 – Maximum peak-to-peak ripple voltage

5.3 High frequency voltage components at the charger output

5.3.1 Test purpose

The purpose of this test is to verify that the charger complies with the requirements for high frequency voltage components at the charger output specified in IEC 6X XXX-1 section 6.1.5.

5.3.2 Requirements

The charger shall not cause more high frequency voltage components at the charger output than specified in Table 2 and Figure 3 when connected to an artificial load specified in Annex A of IEC 6X XXX-1 and measured with coupling/decoupling network specified in Annex B of IEC 6X XXX-1.

Table 2 Maximum high frequency voltage components at the charger output

Frequency range	Maximum high frequency voltage components
1 MHz – 80 MHz	-40 dB(mW) to -65 dB(mW) linear slope
80 MHz – 150 MHz	-65 dB(mW)

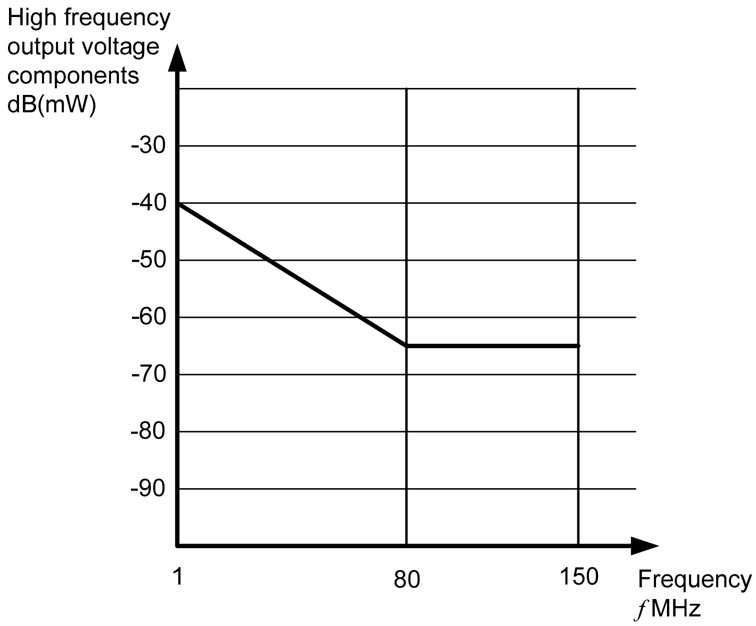

Figure 3 Maximum high frequency output voltage components

5.3.3 Equipment

The following equipment is required to perform the test:

- Shielded room to avoid any external interference;
- Spectrum analyzer;
- Coupling and Decoupling Network (CDN) specified in Annex A of IEC 6X XXX-1.
- Artificial load working as standard device charging interface. The artificial load is specified in Appendix A of IEC 6X XXX-1.

5.3.4 Method of test

The test set up is shown in Figure 4.

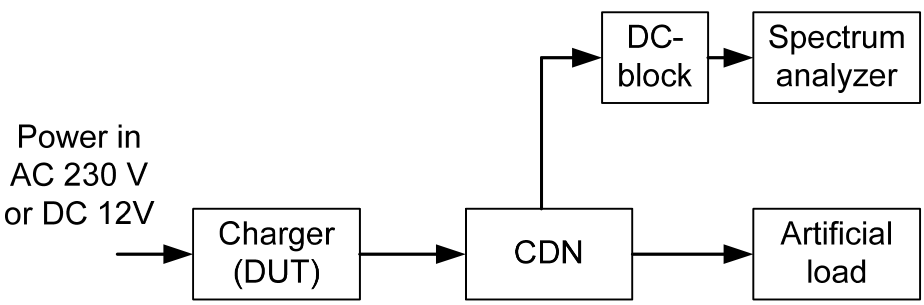

Figure 4 Test set up for high frequency voltage components

Proceed as follows:

a) Connect supply power for charger;

b) Connect the charger to artificial load via coupling and decoupling network (CDN) and connect spectrum analyzer via DC block to CDN;

c) Set output voltage to 5,0 V by artificial load control;

d) Measure high frequency components from 1 MHz - 150 MHz using the following spectrum analyzer settings:

- Input attenuator: 0 dB (ATT).
- Video resolution band filter: 100 kHz (VBW).
- Resolution band filter: 100 kHz (RBW).
- Sweep time: 30 ms (SWP).
- Detector: Max. peak
- Average measurement

5.4 Leakage current of AC chargers

5.4.1 Test purpose

The purpose of this test is to verify that the charger complies with the requirements of leakage current specified in IEC 6X XXX-1 section 6.1.6.

5.4.2 Requirements

Maximum leakage current from AC mains to the mobile device through the charger is 5 µA measured according to the IEC 60 950-1.

5.4.3 Equipment

For test equipment see IEC 60 950-1.

5.4.4 Method of test

Test should be made in accordance with IEC 60 950-1.

6 Electrical testing of 2 mm barrel type chargers

6.1 Charging voltage / current window

6.1.1 Test purpose

The purpose of this test is to verify that the charger complies with voltage / current window specified in IEC 6X XXX-1 section 6.2.1.

6.1.2 Requirements

The minimum recommended charging current for standard chargers is 300 mA between 2,0 V and 4,65 V. During charging, the current and voltage values shall not exceed the charging window shown in Figure 5.

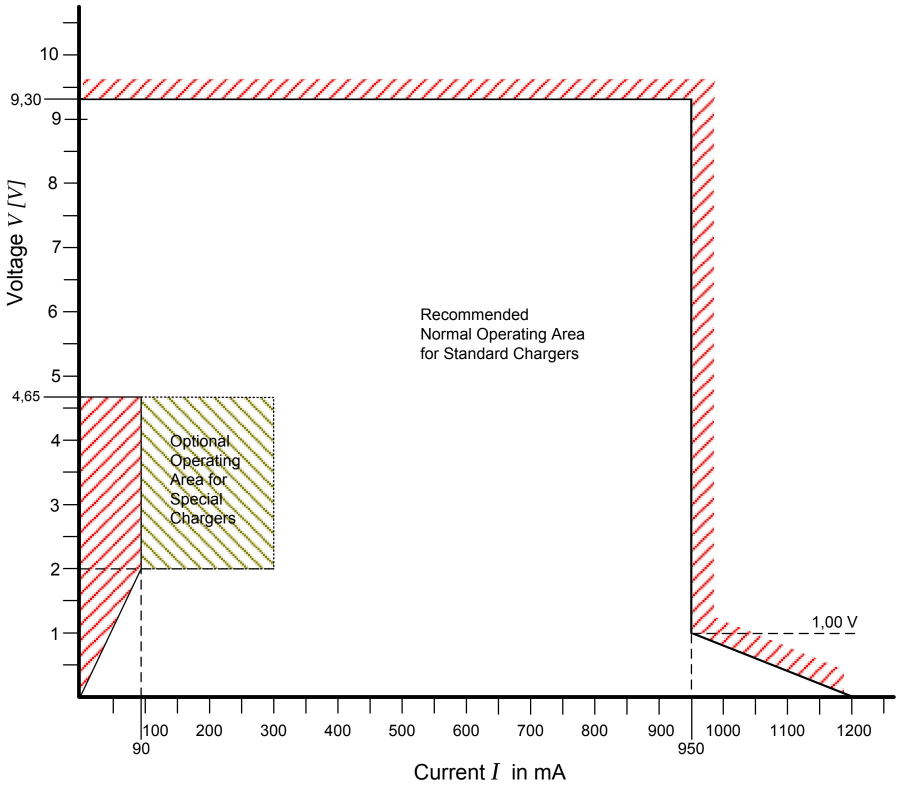

Figure 5 Charging current/voltage window for 2 mm barrel chargers

6.1.3 Equipment

The following equipment is required to perform the test:

- Variable resistive load 0 kΩ - 6 kΩ;
- Voltage meter or oscilloscope;
- Current meter;
- AC power source (if charger is AC powered);
- DC power source (if charger is designed for car environment);

6.1.4 Method of test

Proceed as follows:

a) Connect charger to variable load and set variable load to maximum resistance (6 kΩ).

b) Set power source output to nominal value and connect charger to power source.

c) Measure output voltage from charging interface.

d) Increase the load step by step to a short circuit. Measure the voltage and the current at each step. Use at least 30 steps covering entire resistance area from 6 kΩ to short circuit.

Repeat the test using minimum and maximum supply voltages specified to the charger (recommendation for AC-powered chargers is nominal voltage ± 20 percent). Repeat test in minimum and maximum temperatures specified to charger.

6.2 Current linearity for standard chargers

6.2.1 Test purpose

The purpose of this test is to verify that the charger complies with the current linearity requirements of IEC 6X XXX-1 section 6.2.2.

6.2.2 Requirements

Maximum current fluctuation is 30 percent when the charger output voltage varies from 3,5 V to 4,6 V (for example 500 mA - 0,3 x 500 mA = 350 mA) when input voltage and ambient temperature stay constant. The current linearity specification is shown in Figure 6.

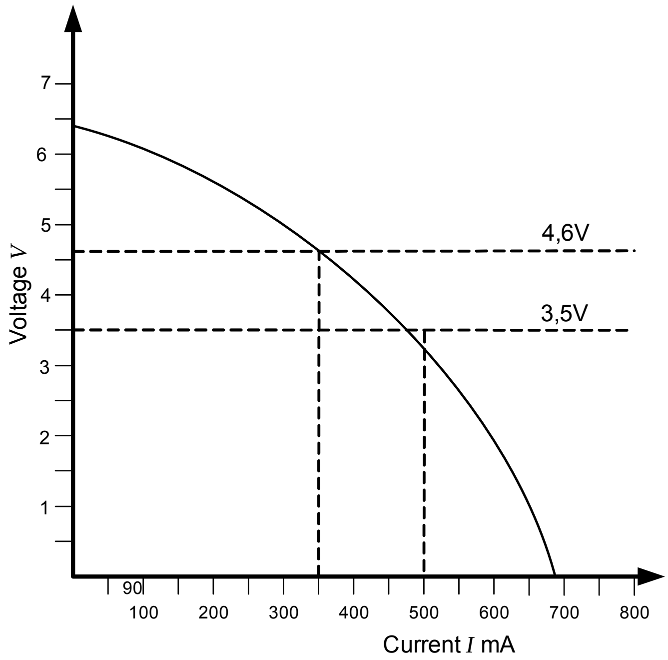

Figure 6 Current linearity specification

6.2.3 Equipment

The following equipment is required to perform the test:

- Variable resistive load 0 Ω - 5 kΩ;
- Voltage meter or oscilloscope;
- Current meter;
- AC power source (if charger is AC powered);
- DC power source (if charger is designed for car environment);

6.2.4 Method of test

Proceed as follows:

a) Connect charger output to variable load via current meter.
b) Set power source output to nominal value and connect charger to power source.
c) Set voltage meter to measure output voltage and adjust the variable load so that the output voltage is 3,5 V. Measure the current.
d) Adjust variable load so that the output voltage is 5,0 V and measure the current again.

6.3 Current linearity recommendation for special chargers

6.3.1 Test purpose

The purpose of this test is to verify that the charger complies with the current linearity recommendation specified in IEC 6X XXX-1 section 6.2.4.

6.3.2 Requirements

Requirements for part A, measuring peak currents at *f* > ½ Hz

Test is passed if crest factor < 1,14.

$$\text{Crest factor} = I_{max} / I_{rms},$$

for negative peaks (current minimum value) the limit is I_{min} / I_{rms} >0,86.

Maximum peak current for different charging currents are shown in Figure 7 and limits for 91 mA, 300 mA, 500 mA, 700 mA and 900 mA are presented in Table 3.

Table 3 Minimum and maximum peak current values for different RMS currents

Charging current (RMS)	Minimum peak current	Maximum peak current
91 mA	78 mA*) / 90 mA	104 mA
300 mA	258 mA	342 mA
500 mA	430 mA	570 mA
700 mA	602 mA	798 mA
900 mA	774 mA	950 mA
*) Current may go under 90 mA only if voltage is below 2,0 V (see 6.1.2)		

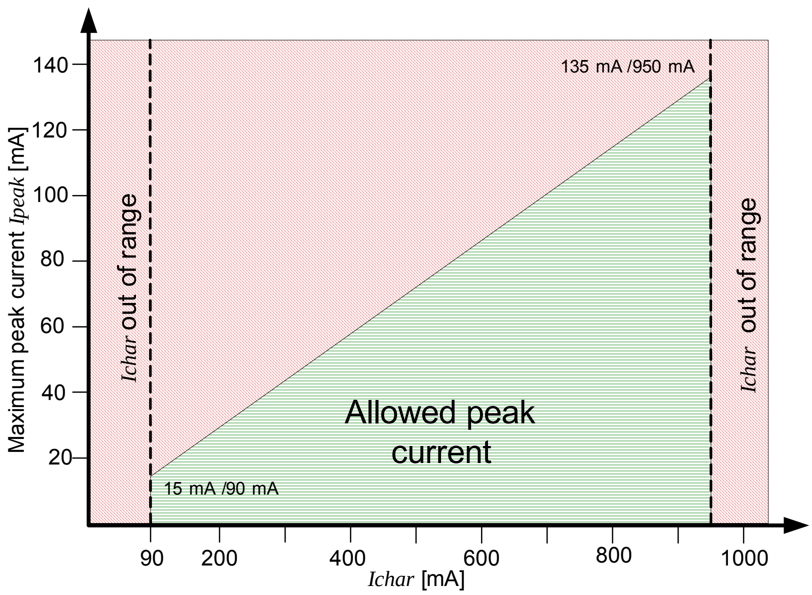

Figure 7 Maximum allowed charging current peaks (crest factor) f_{Ichar} > ½ Hz

Requirements for part B, measuring current slew rate at *f* < ½ Hz

Test is passed if current slew rate is 0,28xI_{char} A/sec.

Maximum slew rate for different charging currents can found in Figure 8 and limits for 300 mA, 500 mA, and 700 mA are presented in Table 4.

If the charger maximum output current is below 300 mA, only a small slew rate is allowed. In that case, the main focus of the testing should be to ensure that the current stays above 90 mA.

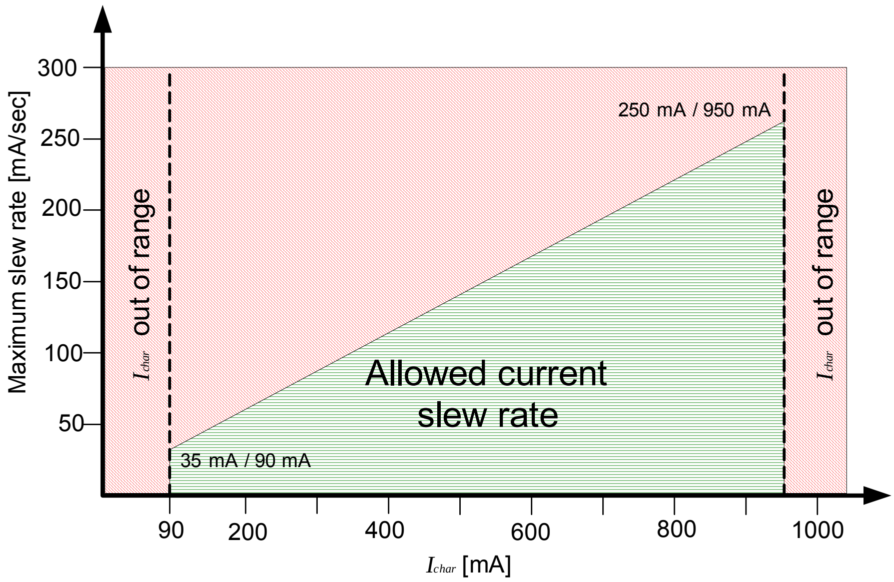

Figure 8 Maximum allowed charging current slew rate f_{Ichar} ≤ ½ Hz

Table 4 Maximum current difference from average charging current

	Maximum difference between two sequential results		
Charging current	**1s measuring interval**	**2s measuring interval**	**3s measuring interval**
300 mA	84 mA	168 mA	252 mA
500 mA	140 mA	280 mA	420 mA
700 mA	196 mA	392 mA	588 mA

6.3.3 Equipment

The following equipment is required to perform the test:

- Variable resistive load 0- 6 kΩ;
- Current meter;
- AC power source (if charger is AC powered);
- DC power source (if charger is designed for car environment).

6.3.4 Method of test

<u>Part A, measuring peak currents at *f* > ½ Hz</u>

Proceed as follows:

a) If the charger is powered by AC or DC voltage (for example a primary battery), set the power source output to nominal value and connect the charger to the power source. If charger is powered by some other way, use it in average charging environment.

b) Connect the charger to a variable load. Set the load so that the average charging current is 91 mA.

c) Set the oscilloscope to measure current changes that have a frequency of at least ½ Hz. This can be done by setting the oscilloscope sweep time so that there is a 2 s time axis visible on screen (200 ms/div if the screen is divided to ten parts).

d) Measure the highest and lowest current peak values. Also measure the highest and lowest current peak values using faster sweep time in oscilloscope to find maximum peak values.

Repeat the measurements using 300 mA, 500 mA and 700 mA currents if the charger can provide such currents.

Repeat the test using maximum current.

If the charger is powered by AC or DC voltage, repeat the test using minimum and maximum supply voltages specified to the charger (recommendation for AC-powered chargers is nominal voltage ± 20 percent).

If charger is powered in some other way, test it under the most extreme conditions where it is designed to operate.

Part B, measuring current slew rate at f < ½ Hz

Proceed as follows:

a) Connect the charger to a variable load. Use nominal voltage and average environment as described in Part A. Start charging.
b) Set the load so that the average charging current is 300 mA (if charger can supply that current).
c) Set oscilloscope to measure current and measure current value once per second. Collect ten results during ten seconds. Fast current spikes are ignored. Measurement can be done, for example, setting oscilloscope sweep time to 10 ms/div and measuring average current.

Repeat the test with a 2-second interval between measurements and also a 3-second interval between measurements.

Repeat measurements using 500 mA and 700 mA average currents if the charger can provide such currents. Always repeat the test with the maximum current.

If charger is powered by AC or DC voltage, repeat the test using minimum and maximum supply voltages specified to the charger (recommendation for AC-powered chargers is nominal voltage ± 20 percent).

If charger is powered in some other way, test it in the most extreme conditions where it is designed to operate.

7 Electrical testing of 2 mm barrel interface accessories

These tests are designed to be used for accessories that are connected between a charger and a device both using the 2 mm barrel charging interface.

7.1 Charging voltage / current window

7.1.1 Test purpose

The purpose of this test is to verify that accessory’s charging interface complies with the requirements of specified in IEC 6X XXX-1 section 6.3.1.

7.1.2 Requirements

During charging, the current and voltage values shall not exceed the charging window shown inFigure 5. For operation with standard chargers it is allowed that the recommended minimum current of 300 mA is reduced to 200 mA.

If tested accessory is designed to be a special charger, the correct current /voltage window is presented in Figure 5, but the charging voltage and current can be in the optional area of special chargers.

7.1.3 Equipment

The following equipment is required to perform the test.

- DC power source
- Variable resistive load 0 – 6 kΩ
- Voltage meter or oscilloscope
- Current meter

7.1.4 Method of test

Proceed as follows:

a) Set the DC power source output to 6,0 V, current limit to 500 mA, and connect it to the accessory's 2 mm barrel charging input connector;
b) Connect the accessory's charging interface (output) to a variable load. Set the variable load to maximum resistance value of 6 kΩ;
c) Measure the output voltage from accessory's charging interface. Increase the load value step by step to short circuit. Use at least 30 steps covering entire resistance area from 6 kΩ to short circuit.

Set DC power source output to 5,7 V, current limit to 300 mA, and repeat the test in minimum and maximum temperatures specified to the accessory.

Set DC power source output to 9.3 V, current limit to 950 mA, and repeat the test in minimum and maximum temperatures specified to the accessory.

7.2 Accessory power consumption during device booting

7.2.1 Test purpose

The purpose of this test is to verify that an enhancement does not disturb the booting up of the device. When a device is booting up with an empty battery, the accessory can only use a very small amount of power. See IEC 6X XXX-1 section 6.3.3.

This test does not apply for accessories designed for the car environment or for special chargers.

7.2.2 Requirements

The recommended maximum current difference (current consumption in accessory) is 10 mA when voltage in the accessory's charging interface is less or equal to 3,5 V.

The maximum current consumption in accessory during boot-up is shown in Figure 9

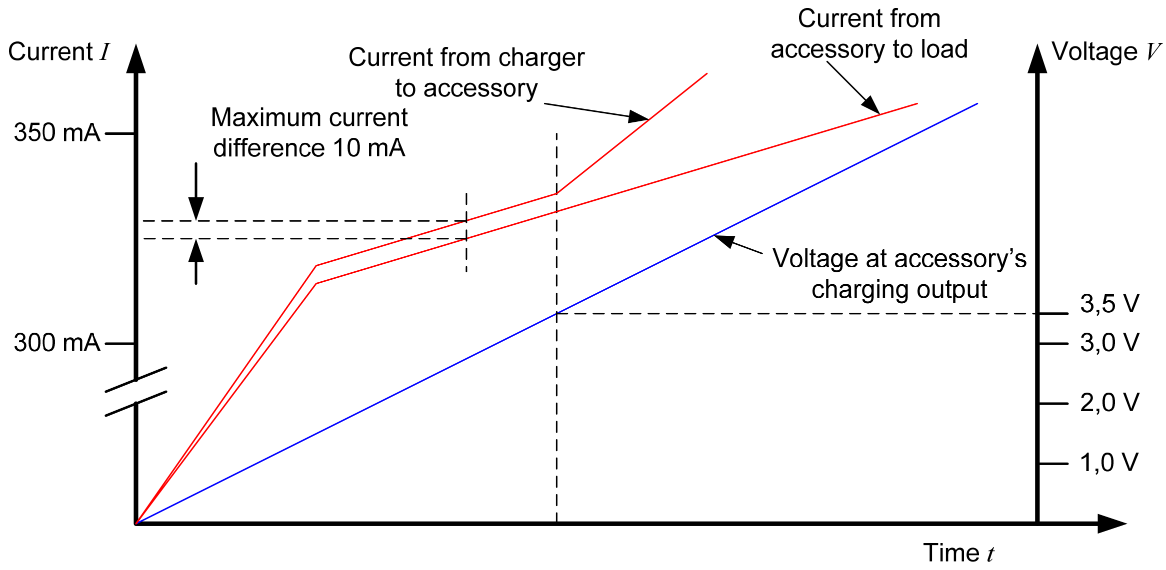

Figure 9 Maximum current consumption in accessory during boot-up

7.2.3 Equipment

The following equipment is required to perform the test:

- 2 current meters (oscilloscope can be used);
- Voltage meter (oscilloscope can be used);
- Variable load, maximum load 10 kΩ;
- DC power supply.

7.2.4 Method of test

Proceed as follows:

a) Set the output of a DC power supply to 5,7 V and current limit to 300 mA.

b) Connect the DC power supply to the accessory and accessory's charging interface (output) to a variable load.

c) Set one current meter to measure the current from the DC power supply to the accessory and another current meter to measure the current from the accessory to the load.

d) Set a voltage meter to measure the voltage from the accessory's charging interface (output).

e) Set load so that voltage is 2,0 V. Decrease load so that voltage rises, and measure both currents all the time. Test is done when the voltage has risen to 4,0 V.

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