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SERIES L: CONSTRUCTION, INSTALLATION AND
PROTECTION OF CABLES AND OTHER ELEMENTS OF
OUTSIDE PLANT

**Universal power adapter and charger solution
for mobile terminals and other ICT devices**

Recommendation ITU-T L.1000



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Universal power adapter and charger solution for mobile terminals and other ICT devices

Summary

Recommendation ITU-T L.1000 provides high level requirements for a universal power adapter and charger solution that will reduce the number of power adapters and chargers produced and recycled by widening their application to more devices and increasing their lifetime.

The solution also aims to reduce energy consumption. The longer life cycle and possibility of avoiding device duplication reduces the demand on raw materials and waste.

The universal power adapter and charger solution is designed to serve the great majority of mobile terminals and other ICT devices.

History

Edition	Recommendation	Approval	Study Group
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Charger, common power adapter, ecodesign, energy-efficiency, power adapter, universal charger solution.

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Introduction

This Recommendation addresses the issue of a universal charger solution for mobile terminals. Further study is required to extend the solution to other ICT devices.

This Recommendation also takes into consideration energy efficiency, emissions reduction and the use of scarce and raw materials. It has been estimated (see Appendix VII) that the widespread adoption of a universal charger solution for mobile phones will result in a 50 per cent reduction in standby energy consumption and approximately 14 million tons of greenhouse gas emissions each year. The universal power adapter and charger solution will be more convenient and simpler to use for consumers who will be able to charge their mobile phones anywhere from any available universal mobile charger or common power adapter and use the same power adapter for many future handsets, thus eliminating up to 50'000 tons of duplicate power adapters and chargers.

It is noted that the environmental impact of any universal charger solution should be considered over the entire life cycle and that the transition towards a universal charger solution does not aim to replace existing chargers immediately; this is because there is an estimated 2 billion of them currently in use.

This Recommendation was drafted with support from and in consideration of activity in other SDOs and other types of organizations.

This Recommendation is designed to ensure the universal charger solution operates within recognized current and voltage safety parameters by adopting existing mobile terminal technologies such as computer USB output or recharging solutions in cars. Battery safety and lifetime issues have been considered in the drafting of this Recommendation.

Recommendation ITU-T L.1000

Universal power adapter and charger solution for mobile terminals and other ICT devices

1 Scope

This Recommendation describes the general requirements for a universal power adapter and charger solution for mobile terminals (e.g., mobile phones) and other ICT devices.

This Recommendation includes basic configurations and general requirements for the power adapter and charger interface, energy efficiency, safety, electromagnetic compatibility, resistibility, and eco-environmental specifications.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T K.21] Recommendation ITU-T K.21 (2008), *Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents.*
- [ITU-T K.66] Recommendation ITU-T K.66 (2004), *Protection of customer premises from overvoltages.*
- [ITU-T K.74] Recommendation ITU-T K.74 (2008), *EMC, resistibility and safety requirements for home network devices.*
- [CISPR 22] IEC, CISPR Publication 22 (2008), *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.*
- [CISPR 24] IEC, CISPR Publication 24 (1997), *Information technology equipment – Immunity characteristics – Limits and methods of measurement.*
- [IEC 60950-1] IEC 60950-1 (2005), *Information technology equipment – Safety – Part 1: General requirements.*
- [IEC 62430] IEC 62430 (2009), *Environmentally conscious design for electrical and electronic products.*
- [ISO 14040] ISO 14040 (2006), *Environmental management – Life cycle assessment – Principles and framework.*
- [ISO 14044] ISO 14044 (2006), *Environmental management – Life cycle assessment – Requirements and guidelines.*
- [IEEE 1680] IEEE 1680 (2009), *IEEE Standard for Environmental Assessment of Electronic Products.*
- [IEEE 1725] IEEE 1725 (2006), *Standard for Rechargeable Batteries for Cellular Telephones.*

3 Definitions

3.1 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.1.1 charger: A common term used to describe the power adapter for the mobile terminal or other ICT device used to apply power to the battery.

3.1.2 common power adapter: Power adapter that is fitted with a USB-IF Std-A receptacle for use with a detachable cable.

3.1.3 detachable cable: A detachable cable connects the power adapter to the mobile terminal or other ICT device for powering through two connectors, one on the charger side and one on the mobile terminal or ICT device side.

3.1.4 power adapter: The equipment that converts mains AC power voltage at the input to low DC power voltage at the output, or the equipment which transfers DC power supply, e.g., car voltage to another low voltage of DC power output.

3.1.5 universal charger solution: Overall initiative that defines the charger solution for different mobile terminals and ICT devices.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

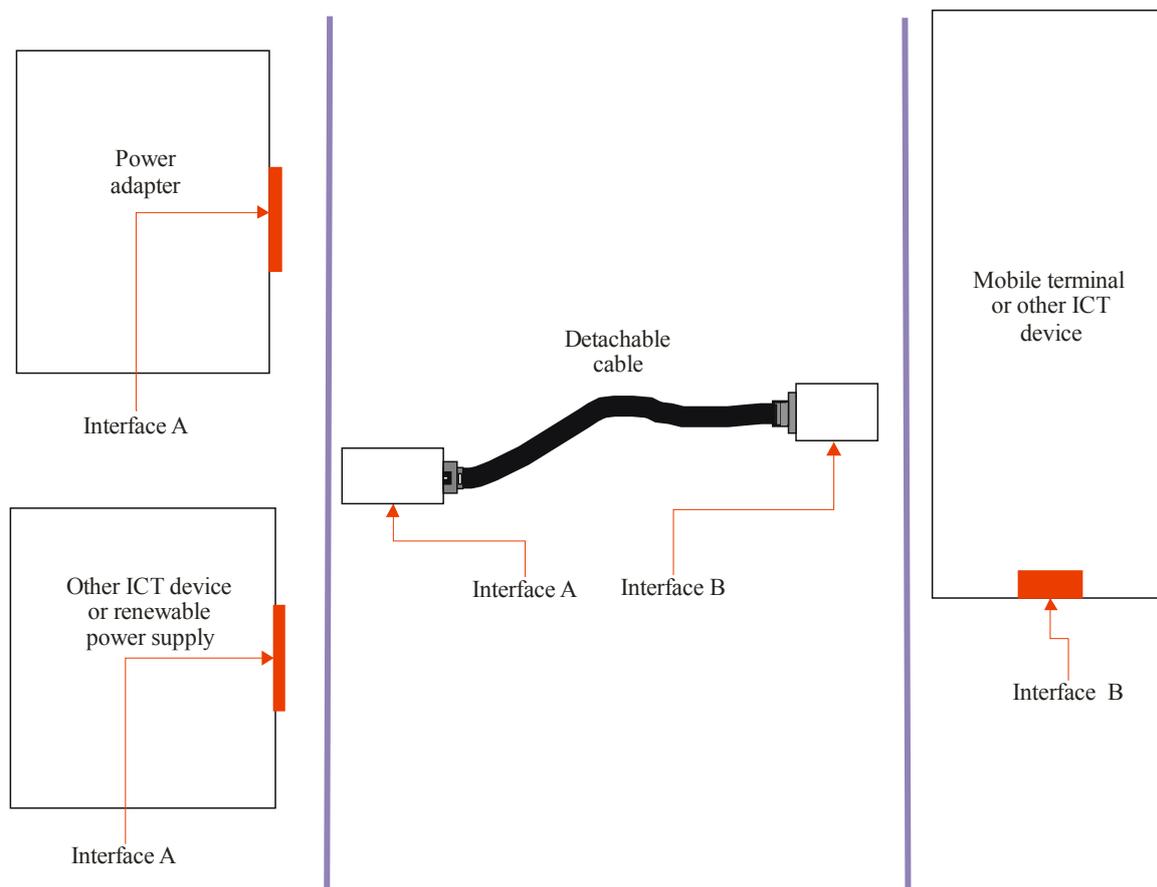
DC	Direct Current
GHG	Green House Gas emission
ICT	Information and Communication Technology
LVDC	Low Voltage Direct Current
OMTP	Open Mobile Terminal Platform
PDA	Personal Digital Assistant
SCCP	Short Chain Chlorinated Paraffins
USB	Universal Serial Bus

5 Basic configuration of universal power adapter and charger solution

The solution may consist of three elements:

- 1) common power adapter (e.g., charger for mobile terminal) or other ICT device or renewable energy power supply (e.g., solar, wind);
- 2) detachable cable;
- 3) mobile terminal or other ICT device.

NOTE – Further study is needed to specify more details (e.g., logical, functional or physical).



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NOTE 1 – A dedicated figure for mobile terminals is shown in Annex B.

NOTE 2 – Considered examples for the mobile terminal are shown in Appendices II, III, IV.

NOTE 3 – Further study of other ICT devices is required.

Figure 1 – One possible basic configuration of three elements for universal power adapter and charger solution

6 General requirements

6.1 Power adapter interface

The power adapter is required to provide an output DC voltage and DC current.

NOTE – A dedicated specification for mobile terminals is shown in Annex B.

6.2 Energy efficiency requirements

6.2.1 No-load power consumption

The no-load power consumption of the power adapter should be as low as practicable. It is expected that the industry will aim for a figure as close to zero as possible. If practicable, the power adapter should indicate to the customer its no load condition.

It is expected that the industry will aim for the power adapters and chargers to enter a shut-down mode to minimize power consumption either when the unit is removed from the supply or when the battery is fully charged, thereby ensuring significant energy savings.

NOTE – A dedicated specification for mobile terminals is shown in Annex B.

6.2.2 Power efficiency with load

It is expected that the industry will aim to minimize the power dissipated in the power adapter whilst powering the load device. An example of an evaluation of battery charging efficiency is given in Annex B.

NOTE – A dedicated specification for mobile terminals is shown in Annex B.

6.2.3 Solar power for chargers and mobile phones and related ICT devices

Solar-powered mobile terminals could reach about two billion people across the globe that do not have access to electricity. Solar power has the advantage of being more sustainable and better for the environment than the electricity grid which currently uses fossil fuel in its mix of energy sources.

It is therefore recommended that power adapters and chargers, mobile terminals and other ICT devices be designed to make maximum use of available renewable energy.

NOTE 1 – This can be of considerable interest for the requirements of some developing countries, e.g., solar, wind power.

As an example, power adapter and charger interfaces would need to be designed so that they do not stress the batteries inside the mobile terminal or other ICT device by providing too much current when solar input is also taking place. High temperature stresses on the ICT device caused by sun exposure should also be avoided.

NOTE 2 – In the future, this Recommendation may be updated to use additional renewable energy sources such as wind or other forms of energy harvesting as a source of power.

6.3 Safety requirements

The power adapter must be a limited power source in accordance with clause 2.5 of [IEC 60950-1], and comply with the safety requirements of [IEC 60950-1], [ITU-T K.74] and of the country where it is sold and used.

The power adapter is required to have a safety circuit in order to prevent any heat generation, leakage of electricity, fire ignition, etc., in fault condition.

The power adapter and detachable cable are required not to harm the human body by heat generation, leakage of electricity, fire ignition, etc., during normal/abnormal usage.

The power adapter and detachable cable are required to have sufficient endurance so as not to be easily damaged during normal use. The detachable cable is required to comply with the electrical current specification of the power adapter.

Safety aspects of different possible combinations of adapters, detachable cables and charged units should be addressed.

6.4 EMC requirements

Common power adapters, in accordance with the definition of this Recommendation, should comply with emission requirements described in [CISPR 22]. They should also comply with the immunity requirements described in [CISPR 24] and [ITU-T K.74].

6.5 Resistibility requirements

The resistibility requirements in [ITU-T K.21] and [ITU-T K.66] should be applied.

6.6 Eco-environmental specification

Environmental criteria are gaining importance in all aspects of electronic design.

A life cycle assessment (LCA) should be established in compliance with [ISO 14040] and [ISO 14044].

The universal charger or common power adapter should be compliant with [IEC 62430].

6.6.1 Ecodesign

Ecodesign has increased in importance due to full life cycle environmental impact considerations (GHG emissions and waste material). Eco certification is currently under development but there is currently no specific ecodesign for adapters or chargers, therefore some basic principles are contained in Appendix VI and in [IEEE 1680].

6.6.1.1 Ecodesign criteria for electronics

Environmental criterion for electronic goods key domain areas cover eco materials, reuse, recycling and design considerations.

It is recommended that due consideration be given to the environmental performance categories listed below:

- a) Environmentally sensitive materials:
 - comply with regulations, which restrict cadmium, mercury, lead, hexavalent chromium, and selected brominated flame retardants;
 - eliminate short chain chlorinated paraffins (SCCP) used as flame retardants and plasticizers;
 - eliminate paints and coatings that are incompatible with recycling or reuse;
 - for recycling purposes, identify environmentally sensitive components and hazardous materials.
- b) Packaging:

The ICT sector as a whole will be reviewing various improvements concerning packaging to decrease waste and landfill.

 - recyclable packaging materials;
 - separable packing materials;
 - packaging 90 per cent recyclable and plastics labelled;
 - design for end of life;
 - declaration of recycled content.

6.6.2 Lifetime

The expected lifetime of the power adapter element of a universal power adapter and charger solution should be designed so that it is of sufficient duration to deliver waste reduction through extended normal use.

The initial value for the lifetime parameter should be set at 5 years to match the ecodesign objective of the universal charger solution for mobile devices including electronics, enclosure, cables and plugs. Further studies are required to analyse the effects of various parameters (e.g., temperature, use) on this value and to set values for other ICT products in the next step.

Product longevity/life cycle extension topics are covered below:

- availability of additional longer life warranty;
- spare or replacement parts should be made available for five years as well as information on how to obtain the parts.

Annex A

Extending the universal power adapter and charger solution to many more ICT devices than mobile terminals

(This annex forms an integral part of this Recommendation)

In the future, this Recommendation may be generalized to use the universal power adapter and charger solution with other ICT devices.

Some forum even considers the extension of this issue to electrical household devices not connected to any telecom network. The introduction of LVDC (low voltage direct current) mains or a very low voltage home network could be one of the solutions to avoid the need for many power adapters or chargers. This next step should address the issue of having a standard power connector and additionally an alternative standard device ICT connector. This issue could become more complex as the scope widens from mobile terminals to the other ICT devices.

It is seen as very useful to define in a first instance an immediate solution, even if it does not cover the entire spectrum of mobile terminals available today, and then progress to a solution that is more open to the evolution of parameters such as higher current, different charging voltages required by new battery technologies or higher energy; all of which introduce the issue of self recognition and configuration of the power adapter and charger in addition to the connecting issue, whether it is manual or automatic self configuration.

Annex B

Universal charger solution for mobile terminals

(This annex forms an integral part of this Recommendation)

B.1 Basic configuration

The basic configuration of a universal charger solution for mobile terminals consists of:

- 1) a power adapter (charger of the mobile terminal) or other ICT device;
- 2) a detachable cable;
- 3) a mobile terminal.

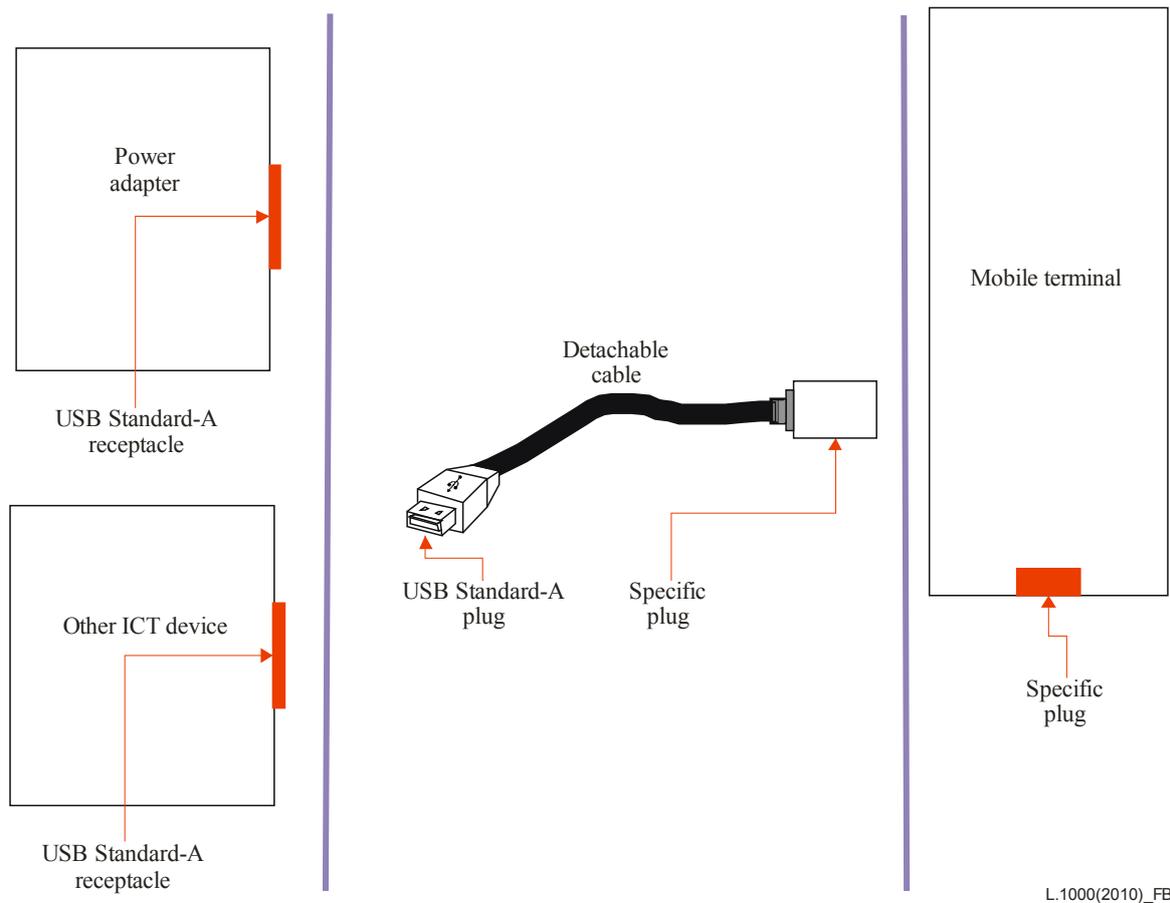


Figure B.1 – Basic elements of universal charger solution for mobile terminals

The use of a three element configuration can expand the application of a common power adapter and charger.

Firstly, it unifies the power adapter and charger output port into one type, which enables different types of mobile terminals to share one type of power adapter and charger.

Secondly, the application of the power adapter and charger can be expanded. For instance, it can act as the power supply for portable or household small electric equipment (MP3/MP4, PDA, camera, wireless earphone, and so on).

It also contributes to the reduction of e-waste, environmental protection, resource conservation and cost reduction.

B.2 Common power adapter/universal charger solution and cable

The AC input of the power adapter should accept a range of AC nominal voltage between 100 and 240 V and a nominal frequency of 50 and 60 Hz.

The common power adapter is required to provide an output DC voltage of 5.0 V \pm 5%.

The common power adapter is required to provide at minimum an output current of 500 mA. The maximum current of the USB Std-A receptacle is 1500 mA.

The USB Std-A receptacle of power adapter should be durable enough to match the lifetime to the power adapter, a good example of this is a ruggedized type.

The universal charger solution is initially prepared to cover mobile terminals as widely as possible. ITU Members and Member States may:

- apply this solution to data-enabled mobile terminals initially;
- have a higher output current value of more than 500 mA, with a goal of 850 mA minimum charging current to obtain a shorter charging time, which should result in a better user experience since many such devices have much larger battery capacities;
NOTE – A data-enabled mobile terminal is one that provides local USB data connectivity functionality.
- use a captive cable to replace interface A for non data-enabled mobile terminals for a limited time period in some regions.

The diameter/length of the detachable cable should be decided carefully in accordance with the maximum output current.

The cable assembly voltage drop at 5 V nominal at 500 mA is lower than 125 mV (maximum drop across the power pair, from pin to pin).

The no-load power consumption of the power adapter should be below 0.15 W.

The average charging efficiency of the power adapter in active mode should be higher than the value that is calculated as follows:

When the output current is below 550 mA, average efficiency $\cong 0.0626 \cdot \ln(P_{no}) + 0.622$.

When the output current is equal to or higher than 550 mA, average efficiency $\cong 0.0750 \cdot \ln(P_{no}) + 0.561$.

P_{no} is the output power of the power adapter in active mode.

B.3 Compatibility aspects

The compatibility aspects of the different possible combinations of adapters, detachable cables and the mobile terminals to be charged should be considered.

In Figure B.1, in the case where a detachable cable has a Standard-A USB and a specific connector which is not a USB connector, the detachable cable should conform to the requirements of each relevant interface.

Appendix V gives information on what is required to obtain compliancy with legacy mobile terminals.

B.4 Charger solution safety

Charging system safety as well as battery safety is handled in existing standards. [IEEE 1725] establishes criteria for design analysis for quality and reliability of rechargeable Li-Ion and Li-Ion polymer batteries for mobile terminal applications. Also included in the standard are battery pack electrical and mechanical construction, packaging technologies, pack and cell level charge and discharge controls, and overall system considerations.

Appendix I

Use cases

(This appendix does not form an integral part of this Recommendation)

This appendix introduces use cases from an OMTP recommendation [b-OMTP], which provides a useful set of charging and data use cases. In addition, it also provides additional use cases which are not covered by OMTP use cases.

The use cases listed below are provided as examples of common usage and do not constitute a complete or exhaustive list of possible use cases.

I.1 OMTP use cases

(From OMTP recommendation, Common Charging and Local Data Connectivity Ver1.0)

I.1.1 OMTP charging use cases

Charging use case 1:

A user wishes to recharge a terminal but does not have her/his own charger so she/he uses an alternative common charger.

Charging use case 2:

A user has two terminals from different manufacturers. She/he wants to bring with her/him only one charger to be used to charge both.

Charging use case 3:

A user wants to buy a new phone. She/he wants to keep the old charger to be used on the new phone avoiding having to buy an additional charger.

Charging use case 4:

A user wants to charge his phone through her/his laptop.

Charging use case 5:

A user should be able to use a single cable to charge her/his terminal from any USB Standard-A port. This would include Standard-A ports on PCs, cars, airport charging hubs and different nation's chargers.

Charging use case 6:

A user should be able to charge a terminal using a common charger supplied with a different manufacturer's device.

Charging use case 7:

A user should be able to charge a terminal whilst using the same connector for data transfer to/from a PC.

Charging use case 8:

A user should be able to use the common phone functionalities during charging.

I.1.2 OMTP data use cases

Data use case 1:

A user should be able to use a standard data cable to connect to any compliant mobile terminal to a PC or entertainment system.

Data use case 2:

A user should be able to use a digital headset with a standard data connector to connect with any compliant mobile terminal. The connector is easy to use in mobile situations and durable enough for daily use.

Data use case 3:

An operator can use a standard data connector to access and modify the terminal data of any compliant terminal, including re-flashing the terminal.

Data use case 4:

The terminal can be charged using the data connector.

Data use case 5:

A user has a data-enabled terminal that can be connected to a computer for use as a modem. The user may use the high speed xlink packet access (HSxPA) capabilities in her/his terminal.

Data use case 6:

The user has a terminal with a high speed UICC interface and she/he is able to access UICC services and data using a computer.

Data use case 7:

A user can stream the following kinds of digital media over the data connector:

Standard definition (SDTV) video

High definition (HDTV) video

Digital audio

Digital still pictures

Data use case 8:

The user has a terminal and wishes to connect with a car-kit. See [b-OMTP].

Data use case 9:

A user has a terminal and wishes to automatically synchronize audio, video and other data with portable electronic devices and in-home and in-vehicle audio/video systems.

1.2 Additional ITU-T use cases

Use case 1:

A user has a mobile phone or other ICT device with a single interface (to be defined) providing multiple functions for charging, digital data communications, audio remote control, analogue audio I/O (ear-jack, microphone), and analogue video I/O.

Use case 2:

The user wants to be informed when the device is fully charged.

Use case 3:

A user may have a disability or age-related requirements to be able to easily connect the detachable cable. She/he needs to be presented with a simple alignment of connectors and an easy means of distinction between connector A and B.

Appendix II

Common charging and local data connectivity (OMTP)

(This appendix does not form an integral part of this Recommendation)

This appendix provides the example for common charging and local data solution for mobile terminals as defined by OMTP in association with GSMA.

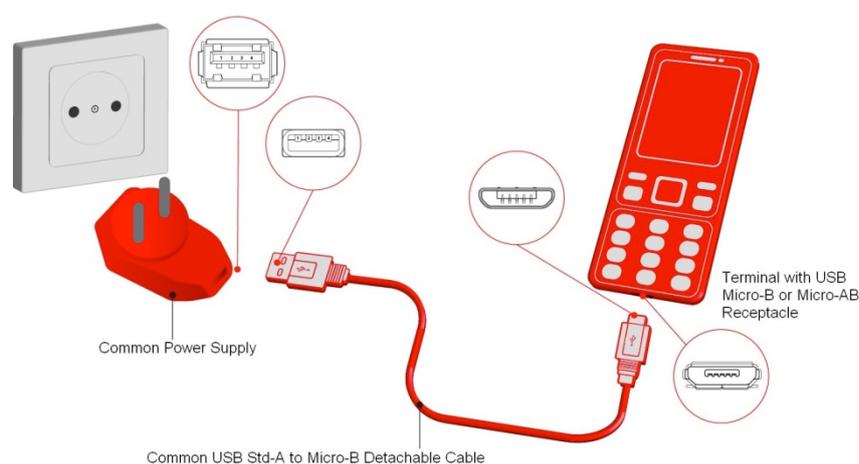


Figure II.1 – Common charging and local data connectivity

(Source GSMA UCS <http://www.gsmworld.com/ucs>)

Common power supply:

Standard-A receptacle.

Minimum 850 mA at DC 5.0 V $\pm 5\%$.

No-load consumption ≤ 0.15 W.

Meets or exceeds EU directive 278/2009 energy efficiency targets.

Complies with all [b-USB Battery] USB-IF battery charger 1.0 specifications.

Common USB Std-A to Micro-B detachable cable:

Standard-A plug on CPS end.

Micro-B USB on terminal end.

Meet all characteristics defined in [b-USB SPEC].

Micro-USB for charging and local data connectors:

Micro-B or AB connector capable of charging the terminal battery.

Meet all characteristics defined in [b-USB Cables].

Appendix III

Technical requirements and test method for the power adapter and the charging/data port of mobile telecommunication terminal equipment (YD/T 1591)

(This appendix does not form an integral part of this Recommendation)

This appendix provides the example for universal power adapter and charger solution for mobile terminals.

III.1 Basic connectivity architecture

The charging connectivity consists of three segments, refer to Figure III.1:

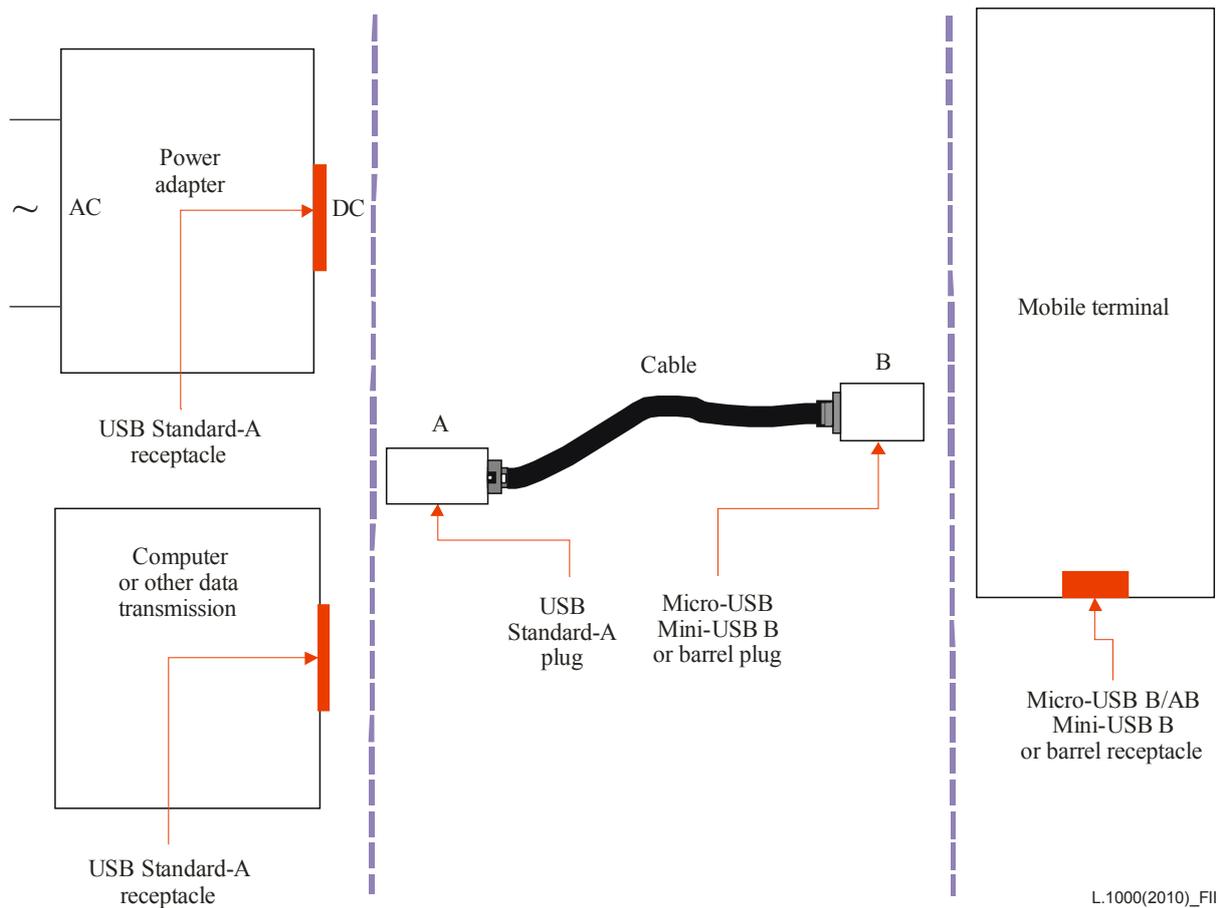
- 1) AC power adapter;
- 2) detachable cable;
- 3) mobile terminal (power consumer).

The first segment is an AC power adapter, which transforms AC power supply to DC power output. The DC output port shall be a USB Standard-A receptacle.

The second segment is a detachable cable with USB standard-A plug at end "A" and a Micro-USB B plug, Mini-USB B plug or barrel plug at end "B".

The third segment is a mobile terminal. The charging port of the mobile terminal shall be a Micro-USB B/AB, a Mini-USB B or a barrel receptacle. The mobile terminal with OTG function shall use a Micro-USB AB receptacle.

Besides, the micro-USB B/AB, a Mini-USB B receptacle can also be used for data transmission.



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Figure III.1 – Basic architecture

III.2 Power adapter – DC output port

The physical characteristics of the DC output port of the power adapter is the USB Standard-A receptacle. The USB-A receptacle meets the requirements defined in Figure III.2 when it is used as an output port of the power adapter.

VBUS is defined as anode of DC output and GND is defined as cathode of DC output. D+ is connected to D– inside the adapter and separate from other circuits. As a special joint, it is used to identify whether the device connected to the terminal equipment is an adapter defined in this Recommendation or not.

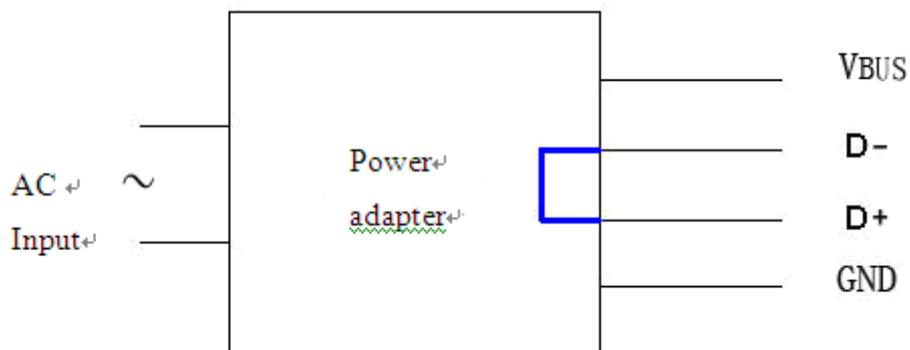


Figure III.2 – The D+ and D– signal line in the power adapter

III.3 Electrical characteristics

III.3.1 Voltage accommodation

The power adapter shall be capable of being supplied at the input AC voltage of 100-240 V \pm 10%. The rated frequency shall be 50/60 Hz or 50-60 Hz. The steady state input current of the equipment shall not exceed the rated current by more than 10% under normal load.

III.3.2 Output voltage

The rated output voltage of power adapter shall be 5.0 V, the tolerance shall be within the range of \pm 5%.

III.3.3 Output current

The rated output current of the power adapter shall be between 500 mA and 1500 mA, and the output current of the power adapter is declared by the manufacturer.

1) Rated output current

The power adapter output voltage shall be between 4.75 V and 5.25 V under rated output current.

2) Maximum output current

The maximum output current of the power adapter shall not exceed the rated current by more than 50% under normal load, and the maximum output current shall not exceed 1500 mA. The power adapter may reduce the output current when the output voltage is below 2 V.

For the compliant range of output voltage and output current, see Figure III.3:

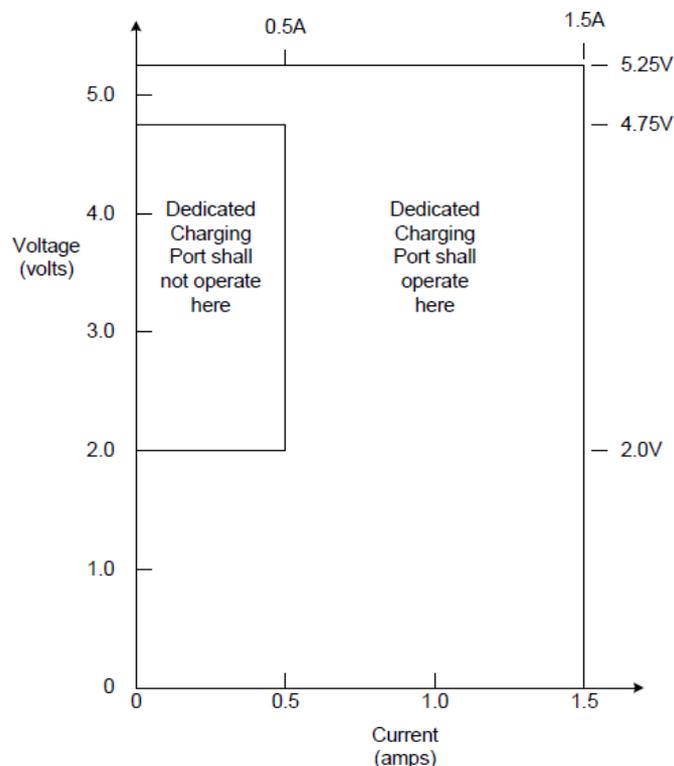


Figure III.3 – Sketch map for output voltage and output current range (USB-IF)

III.3.4 Output ripple

Table III.1 – Requirement for output ripple

Input voltage	Load-simulator for test	Output ripple limited value
100-240 Vac/50-60 Hz	0-rated output current	$V_{p-p} \leq 200 \text{ mV}$

III.3.5 Short current

Table III.2 – Requirement for short current

Input voltage	Load-simulator for test	Short current limited value
100-240 Vac/50-60 Hz	Short circuit	<rated current by more than 50%, and shall not exceed 1500 mA

III.3.6 Current sink

In any case, the current from the mobile terminal to the power adapter shall be less than 5 mA, whether the power adapter connects to a power supply socket or not.

III.3.7 Energy consumption without load

Table III.3 – Requirement for energy consumption without load

Input voltage	Load-simulator for test	Energy consumption limited value
220 V/50 Hz	Open circuit	<150 mW

III.3.8 Average efficiency

The actual average efficiency of the power adapter shall not exceed the following formula:

For a rated output current less than 550 mA,

$$\text{average efficiency} \geq 0.0626 \cdot \ln(P_{no}) + 0.622$$

For a rated output current not less than 550 mA,

$$\text{average efficiency} \geq 0.0750 \cdot \ln(P_{no}) + 0.561$$

where

P_{no} is the rated output power of the power adapter, namely the rated output voltage times the rated output current.

III.3.9 Touch current

The touch current shall not exceed 20 μA from AC input port to DC output port for the AC power adapter.

III.4 Identification mark proposal

The power adapter may be marked with the logo showed in Figure III.4.

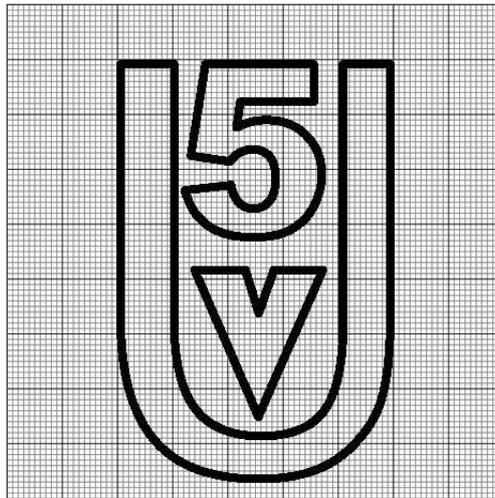


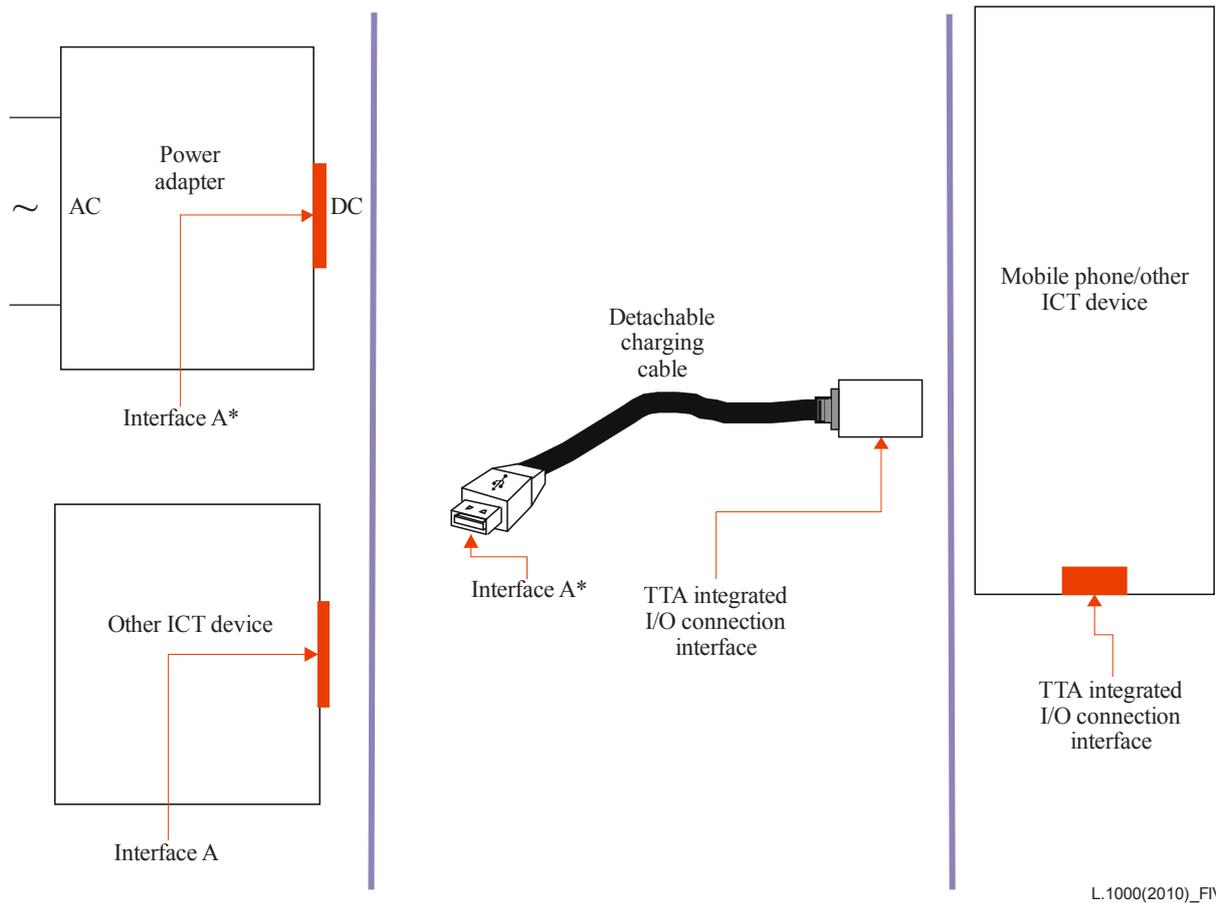
Figure III.4 – Identification mark

Appendix IV

Integrated I/O connection for universal power adapter/charging solution for mobile terminals (TTAS.KO-06.0028/R4)

(This appendix does not form an integral part of this Recommendation)

Figure IV.1 shows the basic configuration of a TTA integrated I/O connection interface with a mobile phone and other ICT devices.



NOTE – Interface A* is not always necessarily physically separated.

Figure IV.1 – Basic architecture

The purpose of "Integrated I/O connection interface for mobile phone" standardization is to provide:

- 1) universal specifications on battery charging and peripherals (data communications, remote control, ear-jack, microphone, TV I/O) via terminal profile and terminal manufacturer; and
- 2) physical specifications on integrated interfaces as shown in Figure IV.2.

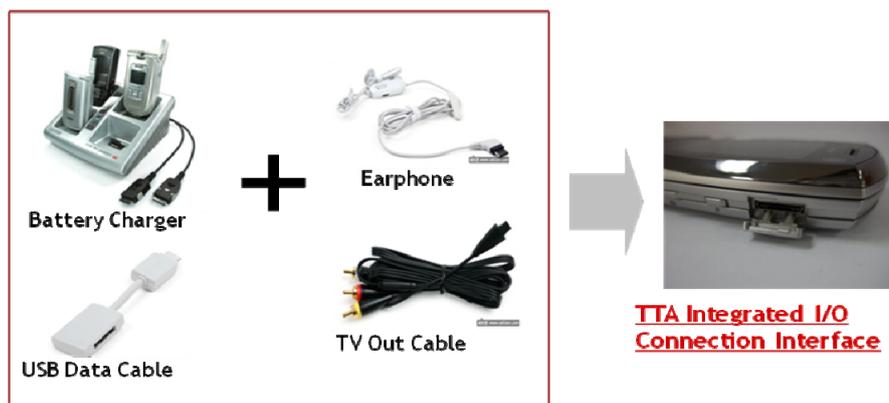


Figure IV.2 – Integrated I/O connection interface

The TTA integrated I/O connection interface consists of two rows of 10 pins. The socket is completely surrounded by a metallic substance with a thickness of 0.25 mm. The inside of the shell is 10.6 (+0.05, -0.02) mm wide and 2.1 (+0.06) mm thick. The dimension is small enough to fit into slim mobile devices which are currently being produced.

The charging characteristics for external terminals are as shown in Table IV.1.

Table IV.1 – External terminal signals for charging

Pin No.	Signal	Description
13	Battery ID	<ul style="list-style-type: none"> • 27 KΩ: 450 mA and 4.7 KΩ: 750 mA (1.5 KΩ: 900 mA is optional) • Allowable ID resistance error: $\pm 10\%$ • Allowable charging current deviation: ± 50 mA • ID port of the charger must recognize all 3 resistance values (27 KΩ, 4.7 KΩ and 1.5 KΩ) • The charger must recognize 1.5 KΩ ID resistor and output 750 mA even though the charger does not support a 900 mA output
9,10	Power (+4.2V)	Charger output voltage must be in the range of 4.2 ± 0.05 V
1,20	Power ground	Power grounding

The details of signal per pin for 20-pin in the TTA integrated I/O connection interface is shown in Table IV.2.

Table IV.2 – Details of functions for 20 pins

Pin No.	Signal	Input/Output classification (based on terminal)	Remarks
1	Power ground	Power	Charging, common GND
2	Reserved	–	Reserved
3	EAR_MIC+	Input	Differential MIC+ signal input
4	EAR_MIC-	Input	Differential MIC- signal input
5	EAR_L	Output	Headset left channel speaker output
6	EAR_R	Output	Headset right channel speaker output
7	Device-sense Device-detection	Input	External device identification External device ID recognition
8	Remote key	Input	External device key input
9	Power (+4.2V)/SWB+	Power	Charging/power supply from terminal
10	Power (+4.2V)/SWB+	Power	Charging/power supply from terminal
11	On switch	Input, output	Remote power-on pin of terminal
12	Reserved	–	Reserved
13	Battery ID	Input	Battery type detection Battery mounting status detection
14	TV out	Output	Composite analogue video output
15	UART_RXD	Input	UART signal input to terminal
16	UART_TXD	Output	UART signal output from terminal
17	VBUS	Power	USB +5.0 V power input
18	USB D–	Input, output	Minus (–) line of the differential, bidirectional USB signal
19	USB D+	Input, output	Plus (+) line of the differential, bidirectional USB signal
20	Power ground	Power	Power GND, common GND

Appendix V

Reliability and safety issue of high current charge

(This appendix does not form an integral part of this Recommendation)

Charging system safety as well as battery safety is handled in existing standards. [IEEE 1725] establishes criteria for design analysis for quality and establishes criteria for reliability of rechargeable Li-Ion and Li-Ion polymer batteries for mobile telephone applications. Also included in the standard are battery pack electrical and mechanical construction, packaging technologies, pack and cell level charge and discharge controls, and overall system considerations.

Mobile terminals that have been manufactured and sold in the market prior to the publication of this Recommendation may not be compatible or be able to support safe charging with the common power adapter or charger defined in this Recommendation. In this instance, the designer should select a different physical design to ensure the detachable cable cannot be used with any mobile terminals that meet the conditions described above. For instance, the identification functions and/or current limitation mechanism would need to be added to the specific cable to avoid any potential damage and/or danger when this specific cable is used on the mobile terminals described above.

As of today, the USB-IF 500 mA @ 5 V is generally accepted as being able to charge a mobile phone without electronic failure due to, for example, heat excess inside the charging circuitry of the phone, and without any safety issues involving the battery.

A simple calculation of the product of current and voltage is proposed assuming the maximum dissipation inside the phone is based on the established safe USB-IF 500 mA @ 5 V to ensure reliability and safety. If a switch mode power supply is recommended for resistive loads, the assumption is that the battery voltage at the beginning of charge is low, e.g., 3.9 V, while the power supply charge voltage at the input of the phone is 5 V.

NOTE 1 – The battery charge voltage value is for information only and is intended to show the principle of identification of the safe area.

So the maximum safe power, P_0 , is:

$$P_0 = (5 - 3.9) \times 500 = 550 \text{ mW}$$

To keep the heat loss inside the phone constant, no matter what the voltage (U) is at the input of the phone, the current (I) can be calculated by using:

$$I = P_0/U$$

U(V)	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
I=P/dU (mA)	1833	1375	1100	917	786	688	611	550	500

NOTE 2 – Considering 5 V + 5% and an overall cable resistance + connectors of 500 mohm (5.25 V – 0.25 V = 5 V at 500 mA at the input of the mobile phone). Further studies are necessary to get the final values for a proper design.

The result is shown in Figure V.1. This solution should ensure that the adapter always maintains the current inside the safe area.

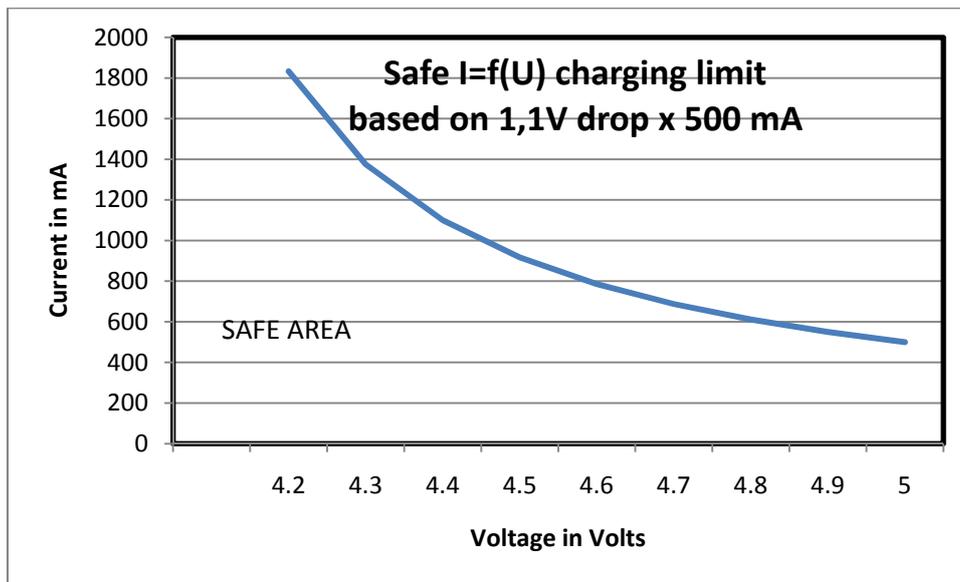


Figure V.1 – Power adapter safe output characteristic for compatibility with existing phones rechargeable by standard USB plug (5 V × 500 mA)

NOTE 3 – An additional safety measure may be added so that during the first minute the current is not higher than, e.g., 350 mA when the battery is fully discharged, e.g., a battery at a voltage of 2 V.

Appendix VI

Ecodesign criteria for electronics

(This appendix does not form an integral part of this Recommendation)

Environmental criteria are gaining importance in all aspects of electronic design. Attention is therefore drawn to EPEAT documentation [b-EPEAT IEEE 1680] which summarizes all aspect of ECO design and is linked to the IEEE 1680 family of standards. The green electronics council presentation of this standard shows that it is based on the following previous ones:

[IEC 62430] – Horizontal standard for environmentally conscious design of electrical and electronic products.

[b-IEC 62075] – Vertical standard for environmentally conscious design of ICT/CE products.

EPEAT carries 51 total environmental criteria, identified in a criteria table contained in [IEEE 1680] – 23 required criteria and 28 optional criteria.

It is planned that in the future IEEE 1680.4 will also address mobile terminals.

More details are located on the informational website.

Appendix VII

GSMA universal charging solution

(This appendix does not form an integral part of this Recommendation)

In partnership with many leading mobile operators and manufacturers, the GSMA has committed to implement a cross-industry standard for a universal charging solution (UCS) for new mobile phones.

The objective of the initiative is for the mobile industry worldwide to adopt a common format for mobile phone charger connections and energy-efficient chargers, which will:

- reduce standby energy consumption;
- eliminate thousands of tons of duplicate chargers;
- enhance the end-user experience for mobile customers.

The UCS product definition calls for a common power supply with a detachable cable based on USB-IF standards. The first models produced to meet the agreed specification are expected to be shipped in 2010.

Amongst the perceived benefits will be reductions in CO₂ emissions as published by GSMA in [b-GSMA CO₂].

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