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SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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

Recommendation ITU-T L.1000

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Recommendation ITU-T L.1000

Universal power adapter and charger solution for mobile terminals and other hand-held 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 vast majority of mobile terminals and other ICT devices.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Keywords

Charger, ecodesign, energy-efficiency, power adapter, universal charger solution.

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Introduction

This Recommendation defines the requirements of a universal charger solution for mobile terminals and other hand-held ICT devices. 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. In 2011, it has been estimated 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 from any available universal mobile charger 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, according to the 2018 ITU-D Measuring the Information Society Report – Volume 1 (https://www.itu.int/en/ITU-D/Statistics/Pages/publications/misr2018.aspx), there are around 8 billion mobile-cellular subscriptions in the world.

The GSMA report [b-GSMA] states that in 2017 only 66% of world population had a mobile phone. This data shows that there is a large margin for growth in the number of devices in the coming years and, therefore, in the number of chargers.

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 hand-held ICT devices

1 Scope

This Recommendation describes the general requirements for a universal power adapter and charger solution for mobile terminals (any terminal able to connect to a mobile network) and other hand-held ICT devices (e.g., camera, wireless earphone, smartwatch and wearables) compliant with the electrical current limits set out in Annex A.

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 (2019), *Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents*.

[ITU-T K.66] Recommendation ITU-T K.66 (2011), *Protection of customer premises from overvoltages*.

[ITU-T K.74] Recommendation ITU-T K.74 (2015), *EMC, resistibility and safety requirements for home network devices*.

ITU-T K.136] Recommendation ITU-T K.136 (2018), *Electromagnetic compatibility requirements for radio telecommunication equipment.*

[ITU-T K.137] Recommendation ITU-T K.137 (2018), *Electromagnetic compatibility requirements and measurement methods for wireline telecommunication network equipment.*

[ITU-T L.1010] Recommendation ITU-T L.1010 (2014), *Green battery solutions for mobile phones and other hand-held information and communication technology devices*.

[ITU-T L.1015] Recommendation ITU-T L.1015 (2019), *Criteria for evaluation of the environmental impact of mobile phones*.

[ITU-T L.1020] Recommendation ITU-T L.1020 (2018), *Circular economy: Guide for operators and suppliers on approaches to migrate towards circular ICT goods and networks*.

[CISPR 32] IEC, CISPR Publication 32: 2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements.*

[CISPR 35] IEC, CISPR Publication 35: 2016, *Electromagnetic compatibility of multimedia equipment – Immunity requirements.*

[IEC 60950-1] IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements.*

[IEC 62368-1] IEC 62368-1:2018, *Audio/video, information and communication technology equipment – Part 1: Safety requirements.*

[IEC 62430] IEC 62430:2009, *Environmentally conscious design for electrical and electronic products*.

[IEC 62680-1-1] IEC 62680-1-1:2015, *Universal Serial Bus interfaces for data and power – Part 1-1: Common components – USB Battery Charging Specification, Revision 1.2*.

[IEC 62680-1-2] IEC 62680-1-2:2018, *Universal serial bus interfaces for data and power – Part 1-2: Common components – USB Power Delivery specification*.

[IEC 62680-1-3] IEC 62680-1-3:2018, *Universal serial bus interfaces for data and power – Part 1-3: Universal Serial Bus interfaces – Common components – USB Type-C™ Cable and Connector Specification.*

[IEC 62680-2-1] IEC 62680-2-1:2015, *Universal serial bus interfaces for data and power – Part 2-1: Universal Serial Bus Specification, Revision 2.0.*

[IEC 62684] IEC 62684:2018, *Interoperability specifications of common external power supply (EPS) for use with data-enabled mobile phones.*

[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*.

[EN 301 489-34] ETSI EN 301 489-34 (2010), *Electromagnetic compatibility and Radio spectrum matters (ERM); Electromagnetic compatibility (EMC) standard for audio equipment and services; Part 34: specific conditions for External Power Supply (EPS) for mobile phones.*

[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.*

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 hand-held ICT devices used to apply power to the battery.

3.1.2 detachable cable: A detachable cable connects the power adapter to the mobile terminal or other hand-held ICT devices for powering through two connectors, one on the charger side and one on the mobile terminal or other hand-held ICT devices side.

3.1.3 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.

3.1.4 universal charger solution: Overall initiative that defines a unified charger solution for different mobile terminals and other hand-held 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 basic target configuration of a universal charger solution consists of:

1) a power adapter (charger of the mobile terminal), other ICT device for charging (which can also be used for data transfer), or renewable energy power supply (e.g. solar, wind);
2) a detachable cable (used for charging or data transfer) or optionally a captive cable (used for charging only) depending on market demand;
3) a mobile terminal, or other hand-held ICT device.

NOTE – Wireless charger to be considered for future work.

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 A.

6.2 Energy efficiency requirements

Documents such as [b-DOE], [b-IEA], [b-CUI] provide information on energy efficiency and no load latest requirements and industry feasibility.

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 industry will aim for power adapters and chargers to enter a shut-down mode to minimize power consumption when the unit is either 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 A.

6.2.2 Power efficiency with load

It is expected that 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 A.

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

6.2.3 Renewable energy sources for chargers and mobile phones and related ICT devices

Mobile terminals powered by renewable energy sources could provide mobile connectivity to about one billion people across the globe that do not have access to electricity [b-IEA Energy]. Solar and wind power have 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 sources.

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 and wind power 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.

This is, and will be, of particular importance in order to have the possibility of fast recharge from anywhere, as autonomy may not be sufficient with more intensive use and with the imminent 5G broadband.

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] and [ITU-T K.74]. National regulations override the content of this Recommendation.

The power adapter requires a safety circuit in order to prevent excessive heating and leakage current or a fire ignition in fault conditions.

The power adapter and detachable cable require 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 and detachable cables should be addressed in compliance with the charger unit. 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.

6.4 EMC requirements

Universal chargers, in accordance with the definition of this Recommendation, should comply with emission requirements described in [CISPR 32]. They should also comply with the immunity requirements described in [CISPR 35], [ITU-T K.74], [ITU-T K.136] and [ITU-T K.137]. National regulations override the content of this Recommendation.

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.

Circular economy aspect needs to be considered during the design of universal adapter, based on the guidance on circular economy for ICT contained in [ITU-T L.1020].

A life cycle assessment (LCA) should be established in compliance with [ISO 14040] and [ISO 14044], noting the requirements of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992) [b-Basel Conv].

The universal charger 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 [IEEE 1680] and in [b-BC MPPI].

Some criteria on eco-specification can be found in [ITU-T L.1015].

6.6.1.1 Ecodesign criteria for electronics

Environmental design criteria for electronic goods should cover the key areas of more environmentally sound materials, provisions for reuse and ease of recycling.

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

a) Environmentally sensitive materials:
   - comply with regulations, which restrict the usage of sensitive materials, e.g., cadmium, mercury, lead, hexavalent chromium, and selected brominated flame retardants, hB;
   - 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) Environmental impact:
   - minimize size (less materials and components);
   - user guidance – e.g., unplug charger reminder.

c) 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

Universal charger solution for mobile terminals

(This annex forms an integral part of this Recommendation.)

A.1 Basic target configuration

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

1) a power adapter (charger of the mobile terminal), other ICT device for charging (which can also be used for data transfer), or renewable energy power supply (e.g., solar, wind);
2) a highly recommended solution of detachable cable (used for charging or data transfer) which enables the friendly use on different powering output ports, (reuse) or a non-recommended alternative solution of captive cable (used for charging only), depending on market demand;
3) a mobile terminal.

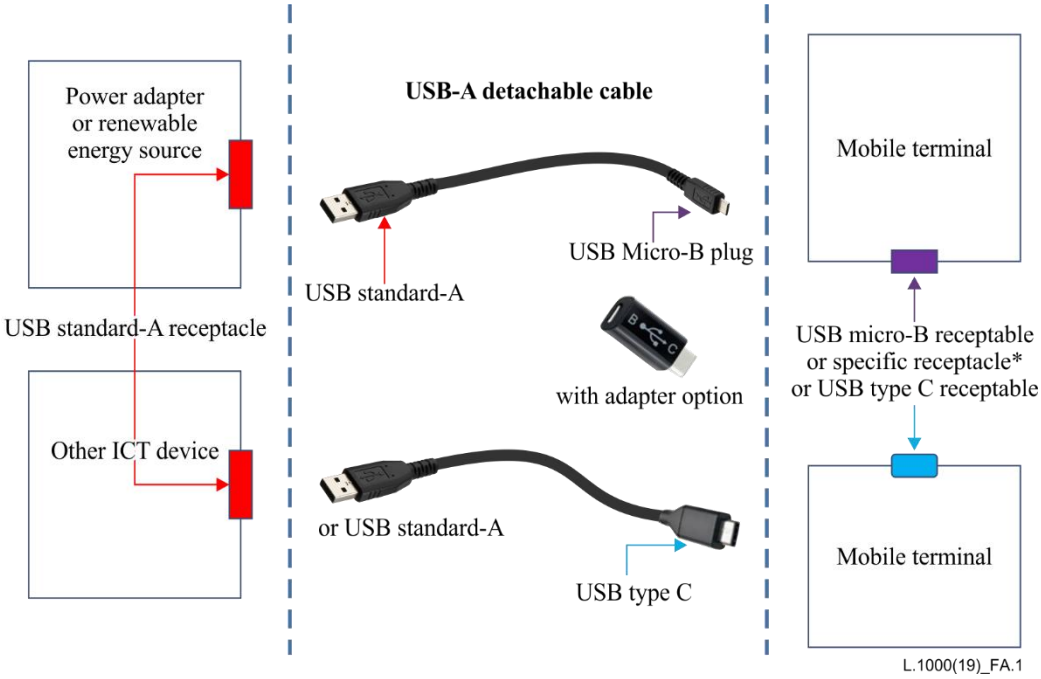
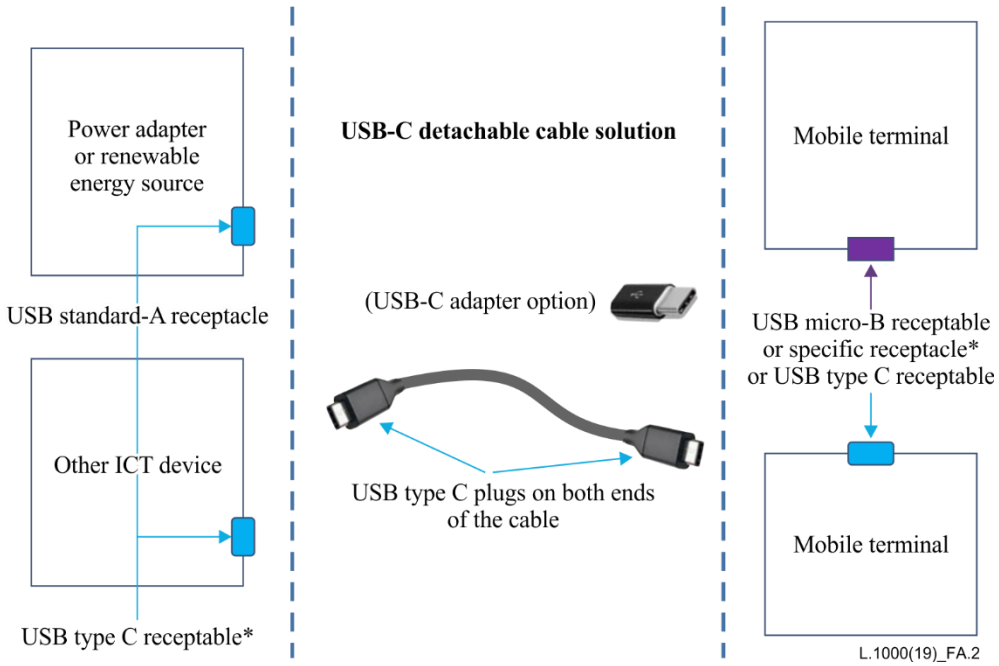


Figure A.1 – Basic elements of more general charging solutions



* In the case of a specific connector on the mobile terminal, the adapter between micro USB plug and the device receptacles is not represented on the figure

Figure A.2 – Basic elements of charging solutions using USB-C detechable cable

The use of a three-element configuration can expand the application of a universal charger.

Firstly, it unifies the power adapter and charger output port into one type USB Standard-A [IEC 62680-2-1] or USB Type C [IEC 62680-1-3], which enables different types of mobile terminals to share unified types of power adapter and charger.

The USB Standard-A [IEC 62680-2-1] and USB Type C [IEC 62680-1-3] or Micro-B [b-USB Cables] can be used for both powering and data transfer purposes. This means the mobile terminal can be supplied with a single cable to both charge the mobile terminal and transfer data (e.g., data transfer for software update, or images and videos with terminals having this capability) which reduces e-waste and improves user experience.

Secondly, the application of the power adapter and charger can be expanded to other hand-held ICT devices. For instance, it can act as the power supply for portable or household small electric equipment.

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

A.2 Universal charger solution and cable

The maximum environmental benefit will only be achieved by making a transition towards a single universal charging solution which is flexible and easy to use for the widest possible range of mobile phones and other hand-held ICT devices: the target solution.

The target date for the full implementation of the target solution is 3 years from the date of publication of this Recommendation.

A.2.1 Target solution

This solution is introduced with the following characteristics:

– A highly recommended option of detachable cable with a USB Std-A connector [IEC 62680-2-1] on the charger side to a USB Micro-B or a USB type-C plug connector

[b-USB Cables] or a detachable cable with USB type C connectors [IEC 62680-1-3] at both end.

– A non-recommended option, depending on market demand, of captive cable terminating in a USB connector (Micro-B type or type C).
– A plug adapter may be used as option for connecting from a USB type C receptacle/plug to any specific connector. Examples of specific connectors are listed in Figure A.2. A plug adapter can also be the cable itself. In that case the USB-C voltage and current management protocol may not be used.
– A rated charging current in the range 750 mA (preferably 1000 mA) to 3000 mA.
– No-load power consumption of the power adapter below 0.03 W.
– These requirements are designed to maximise the re-use of the most impactful aspect of a charging solution, namely, the external power supply and enable a market where it is no longer necessary to sell a new power supply with every new ICT device.

A.2.2 Transitional solution for compatibility with an existing device

Trying to address this large range of requirements in the near term with one universal charger solution is not immediately achievable, therefore this Recommendation also defines the specific requirements for the transition to the target solution where appropriate to specific market or customer needs.

This solution has the following characteristics:

– Detachable cable with USB standard A connector to any specific connector or optional captive cable terminating in a specific connector.
– A plug adapter to support USB type C connector can be supplied if customers want to use a USB type C connector embedded mobile terminal with the existing charger from the transitional solution. This is covering the most common case based on the Recommendation ITU-T L.1000 initial version that has resulted in UPA with USB standard A charger output and standard detachable cable with USB Micro-B output that will need a plug adapter to be used with a mobile having a USB type C receptacle.
– A rated charging current in the range 750 mA to 2000 mA.

No-load power consumption of the power adapter shall be below 0.03 W.

A.2.3 Common features

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

The universal charger is required to provide by default an output DC voltage of 5.0 V ±5%.

For universal charger with USB type C [IEC 62680-1-3], other output voltage shall be controlled through USB type C applicable control protocol defined in [IEC 62680-1-2] in order to deliver defined voltage and current values with defined accuracies.

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

The diameter/length/material of the detachable cable should be designed to be compatible with the maximum output current.

The cable assembly voltage drop at 5 V nominal voltage input and at 750 mA current should be lower than 125 mV (maximum drop across the power pair, from pin to pin).

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

– When the rated output current is below 550 mA, average efficiency ≧ 0.0626*ln(Pno)+0.622.

– When the rated output current is equal to or higher than 550 mA, average efficiency ≧ 0.0750*ln(Pno)+0.561.

Pno is the output power of the power adapter in active mode.

A.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 A.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.

The universal charger defined in this Recommendation is required to be compliant with [IEC 62680-2-1] and [IEC 62680-1-1] (minimum output current of 500 mA and maximum output current of 3000 mA).

[b-IEC 63002] is an international standard for common charging interoperability of mobile devices. [b-IEC 63002] builds on the global adoption of USB technologies for smartphone and small-device charging and data interoperability and leverage the latest USB Type-C™ and USB-PD technologies ([IEC 62680-1-3] and [IEC 62680-1-2]) to enable charging interoperability across a broader range of mobile product categories. [b-IEC 63002] provides specifications and guidelines for charging interoperability to improve re-usability and longevity of adapters and devices, safety, power savings and other aspects important for end-user satisfaction. Additionally, charging use cases without power adapters can also be supported). [b-IEC 63002] does not take the approach of specifying "universal" or common product adapters because of open issues associated with arbitrary combinations and limitations. Instead, the standard focuses on interoperability specifications in order to support global industry in developing interoperable charging solutions that meet regulatory compliance.

Mobile terminals shall adapt to a rated charging current range from 750 mA to 2000 mA, ensuring that chargers compliant with this Recommendation are used.

A.4 Charger solution safety

Charging system safety as well as battery safety is handled in existing standards. At minimum, [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. National regulations override the content of this Recommendation.

A.5 Additional EMC DC output characteristics

The values for common mode noise and ripple voltage are equivalent to those defined by IEC in the EMC chapter of [IEC 62684] with testing method as defined by regional standardisation bodies e.g., [EN 301 489-34] for Europe. National regulations override the content of this Recommendation.

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