

INTERNATIONAL STANDARD



Interoperability specifications of common external power **supply** supplies (EPS)
for use with data-enabled mobile telephones

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INTEROPERABILITY SPECIFICATIONS OF COMMON
EXTERNAL POWER ~~SUPPLY~~ SUPPLIES (EPS) FOR USE WITH
DATA-ENABLED MOBILE TELEPHONES****FOREWORD**

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International Standard IEC 62684 has been prepared by technical area 14: Interfaces and methods of measurement for personal computing equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Clause 1 is modified to include updated references to IEC Universal Serial Bus interface standards;
- b) Clause 2 is expanded to include references to IEC Universal Serial Bus interface standards;
- c) Subclause 4.1 is expanded to include requirements for non USB Micro-B plug DC plug connectors;
- d) Subclause 4.4 is modified to remove obsolete requirements for common mode noise and reference requirements of IEC Universal Serial Bus interface standards;
- e) Subclause 4.5 is modified to reference appropriate safety standards.

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1 Scope

This document specifies the interoperability of common external power supplies for use with data-enabled mobile telephones. It defines the common charging capability and specifies interface requirements for the external power supply.

Safety and EMC aspects are not covered by this document. Safety is covered by IEC 60950-1 or IEC 62368-1 and EMC is covered by ~~EN 301 489-34~~ regional /national standards.

This document defines interoperability based on legacy USB technologies and does not cover charging interfaces that implement IEC 62680-1-3 (USB Type-C™¹), IEC 62680-1-2 (USB PD) and IEC 63002.

NOTE: The content of this document is based on Annex II dated 12 January 2010 to the MoU regarding Harmonisation of a Charging Capability for Mobile Phone.

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

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

IEC 62680-2-1:2015, *Universal Serial Bus interfaces for data and power – Part 2-1: Universal Serial Bus specification, Revision 2.0*

IEC 62680-2-2, *Universal Serial Bus interfaces for data and power – Part 2-2: USB Micro-USB Cables and Connectors Specification, Revision 1.01*

~~EN 301 489-34 Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services – Part 34: Specific conditions for External Power Supply (EPS) for mobile phones~~

~~Universal Serial Bus Specification, Cables and Connectors Class Document, Revision 2.0, August 2007~~

~~(<http://www.usb.org/developers/docs>)~~

¹ USB Type-C™ is a trademark of the USB Implementers Forum (USB-IF). This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of this product.

~~USB Battery Charging Specification, Revision 1.1~~

~~USB Micro-USB Cables and Connectors Specification, Revision 1.01~~

~~USB-IF Cable Assembly Test Requirements for Compliant Usage of Connectors and Cables in Micro-USB 1.01~~

~~USB-IF Connector Test Requirements~~

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

adapter adapter

device for connecting from a USB Micro-B receptacle/plug defined in IEC 62680-2-2 to a specific non Micro-USB connector

Note 1 to entry: An adapter can also be a cable.

3.2 Abbreviated terms

~~For the purposes of this document, the following abbreviations apply:~~

AC	alternating current
DC	direct current
EPS	external power supply
ESR	equivalent series resistance
EUT	equipment under test
GND	ground
USB	Universal Serial Bus

~~Vbus Virtual Bus~~

4 EPS specification

4.1 DC plug connector specification

The cable assembly supplied with the EPS shall terminate in a USB Micro-B plug, defined in IEC 62680-2-2. The cable assembly may be permanently connected to the EPS or may be a detachable cable. In either case, the terminating USB Micro-B plug shall be compliant with the USB Micro-B cables and connectors specification, IEC 62680-2-2.

~~— shall meet the USB-IF connector test requirements,~~

~~— shall be compliant to the USB Micro-B cables and connectors specification, Rev 1.01 (Micro-USB 1.01) and~~

~~— shall be rated to meet all electrical specifications.~~

The cable assembly supplied with the EPS may also terminate in a non USB Micro-B plug if a manufacturer makes available an adaptor from the Micro-USB connector of a common EPS to a specific non-Micro-USB socket in the mobile phone.²

An EPS provided with a detachable cable shall be equipped with a USB Standard-A receptacle to connect to the EPS. The detachable cable assembly, supplied for use with the EPS, shall have USB Standard-A and USB Micro-B plugs and meet the USB-IF cable assembly test requirements for compliant usage of connectors and cables in Micro-USB 1.01 in IEC 62680-2-2.

The above requirement also applies to a cables used as an adaptor, i.e. when the USB Micro-B is connected to the mobile telephone by an adaptor where the mobile telephone does not have a Micro-USB interface.

4.2 AC input characteristic

The EPS shall meet Class II the requirements of IEC 60950-1 or IEC 62368-1 with a maximum touch current not exceeding 90 µA.

The EPS AC input shall operate over the following range:

- voltage range: the rated input voltage range should be at least covers the range 100 V to 230 V;
- frequency: 50 Hz to 60 Hz.

4.3 Environmental specification

The EPS operational environmental range, over which the DC output characteristics defined in 4.4 shall be maintained, shall be

- temperature range: 0 °C to +45 35 °C,
- relative humidity: up to 90 %.

4.4 DC output characteristics

~~For EPS with permanently connected cables, the voltage at the USB Micro-B plug of the EPS shall be $5\text{ V} \pm 0,25\text{ V}$ with no load current to rated output current.~~

~~For EPS with detachable cables the voltage at the USB standard A receptacle shall be $(5 \pm 0,25)\text{ V}$ with no load current to rated output current. The maximum voltage drop caused by the detachable cable shall be 125 mV when measured across the power pair pins of the USB Micro-B plug, while drawing 500 mA from a nominal 5 V source.~~

~~The minimum rated output current shall be 500 mA.~~

~~The maximum rated output current shall be 1 500 mA.~~

~~The maximum output current at any voltage shall not be greater than 1 500 mA.~~

The DC output voltage of the EPS shall be as specified in IEC 62680-2-1. The cable voltage drop shall be as specified in IEC 62680-2-1.

The ripple voltage on the output with a no-load current to maximum rated output current shall be no more than 80 mV peak-to-peak measured at 20 MHz bandwidth using the test method as defined in Clause 6 when measured in accordance with the test method defined in 5.2.

² Memorandum of Understanding regarding Harmonisation of a Charging Capability for Mobile Phones. 5 June 2009, clause 4.2.1.

~~The common mode noise at the DC output when measured in accordance with Clause 6 shall be~~

~~— AC voltage frequency component: 95 V peak-to-peak maximum;~~

~~— EPS switching frequency component:~~

- ~~a) the peak-to-peak voltage measured in the frequency range of 1 kHz to 100 kHz shall not exceed 1 V peak-to-peak;~~
- ~~b) the peak-to-peak voltage measured in the frequency range of 100 kHz to 400 kHz shall not exceed 200 mV peak-to-peak;~~
- ~~c) the peak-to-peak voltage measured in the frequency range of 400 kHz to 1 MHz shall not exceed 39 mV peak-to-peak;~~
- ~~d) the peak-to-peak voltage measured in the frequency range of 1 MHz to 100 MHz shall not exceed 20 mV peak-to-peak;~~
- ~~e) the occupied bandwidth of the fundamental measured with peak hold shall not exceed $\pm 10\%$ of the EPS switching frequency;~~
- ~~f) the maximum amount of slew within any 100 ns window is 1,25 V peak-to-peak.~~

~~NOTE— Noise in the FM and TV bands from the EPS should be minimized as it may cause interference to any FM radio and/or TV function of the mobile telephone to which the EPS is connected. At the time of writing, no suitable method of measurement has been defined and is the subject of ongoing work.~~

Proprietary methods for faster charging at higher voltages and/or currents are permitted, provided that interoperability according to IEC 62680-1-1 is guaranteed when the peer connected device (EPS or the mobile telephone) supports only IEC 62680-1-1.

4.5 Protection

~~The maximum output voltage under Single Fault Condition shall not exceed 9 V.~~

~~The maximum output current under Single Fault Condition shall not exceed 3 A.~~

~~The EPS shall not be damaged as a result of either any over temperature condition of the EPS circuitry components which is not due to a fault of the EPS, or any output short circuit condition. If shut down occurs, the unit shall not resume operation until AC power is cycled or the failure condition causing the shut down has been removed.~~

The EPS shall comply with all appropriate safety standards, for example as specified by IEC 60950-1 or IEC 62368-1.

4.6 EPS detection

To enable the mobile telephone to detect that it is connected to an EPS, the EPS shall meet the USB-IF charging port ~~test~~ requirements for a Dedicated Charging Port as defined in ~~USB Battery Charging Specification, Revision 1.1 (BC 1.1), Section 4.1 'Charging Port'~~ IEC 62680-1-1.

~~The top level requirements are~~

- ~~— the EPS shall short the D+ and D– lines with a resistance not greater than 200 Ω ,~~
- ~~— the resistance between the D+ or D– lines of the EPS and either Vbus or GND shall be greater than 2 M Ω ,~~
- ~~— the capacitance between the D+ or D– lines of the EPS and either Vbus or GND shall be less than 1 nF.~~

4.7 Reliability

The durability of the plug and receptacles shall, as a minimum, meet the performance as given in ~~Table 3-1 of Universal Serial Bus, Cables and Connectors Class Document, Revision 2.0 August 2007~~ Table 6-7 of IEC 62680-2-1:2015.

- ~~— USB Micro-B plug: 10 000 cycles;~~
- ~~— Standard A receptacle and plug: 10 000 cycles (ruggedized Standard A).~~

5 Testing requirements

5.1 General

The requirements in Clause 5 have been developed to try to ensure that common EPSs perform correctly with any data-enabled mobile phone to which they may be connected. Most of the requirements can be verified using existing and well-understood measurement techniques, which do not need defining in this document.

The ~~common mode voltage and~~ ripple voltage at the DC output can be affected by the load on the output of the EPS. For these parameters, the test procedures outlined in 5.2 shall be used.

~~6.2 Common mode voltage of the DC output~~

- a) ~~The EPS shall be connected to an AC power source wherein one or the other of the AC mains is a neutral conductor, bonded to earth either at the upstream service transformer, or locally in the laboratory environment.~~

~~Rationale~~

- ~~1) In most installations, it is required that one or the other of the AC mains is bonded to earth at the upstream service transformer, and is termed the "neutral" or "return" conductor; and~~
- ~~2) common mode noise is manifested to the greatest extent when one or the other of AC mains is bonded as such.~~

~~NOTE Many synthesized AC power supplies produce isolated AC outputs with no connection to earth. Common-mode noise measurements are reduced in such situations, since the EPS common-mode noise source has no real ground reference. Therefore, isolated AC outputs should have one or the other of the output lines bonded to local ground or neutral. Similar considerations exist when using variable autotransformers to produce the required AC line voltage.~~

- b) ~~The EPS shall be powered by 253 V AC $\pm 1\%$ / $\pm 0\%$ at 50 Hz $\pm 1\%$.~~

~~Rationale~~

- ~~1) Common mode noise amplitude is greater at higher AC mains voltage, and~~
- ~~2) AC mains voltages that may be seen by the EPS and its associated mobile terminal are permitted to range up to 230 V AC $\pm 10\%$;~~

- c) ~~The EPS shall be loaded with a $(10 \pm 0,01) \Omega$ resistive load, between the Vbus and GND terminals of the USB Micro-B plug. For an EPS with a detachable cable, a 1 m cable length shall be used during testing. To provide the equivalent capacitive load of a generic mobile terminal, a conductive metal box measuring $(100 \pm 1) \text{ mm} \times (60 \pm 1) \text{ mm} \times (12 \pm 1) \text{ mm}$ shall be connected to the GND terminal of the USB Micro-B plug. The EPS cable, resistor, and simulated mobile terminal shall be kept at least 30 cm from nearby metal structures and shall be supported upon a low-dielectric material, such as Styrofoam or corrugated cardboard box.~~

~~Rationale~~

~~While the amplitude and frequency of common mode noise produced by a given EPS will dynamically change over the operational modes and battery charging cycle, it is necessary to create a common test load which will give repeatable measurements. The resistive portion of the load will cause a certain frequency and amplitude of common mode noise~~

~~from a given EPS, while the USB cable and simulated mobile terminal contribute a distributed shunt capacitance to earth, which in normal use, serves to attenuate the common mode noise, as in a capacitive AC voltage divider. Without this latter provision, any common mode noise test is generally too restrictive, and is not realistic.~~

- ~~d) The common mode noise waveform shall be measured at the GND terminal of the USB Micro-B plug. The sampling probe shall have an input impedance of 10 M Ω in parallel with 8 pF.~~

~~Rationale~~

~~Common mode noise is that electrical signal present at the output negative conductor with respect to earth. The probe impedance, as well as shunt capacitance to the test bench, does artificially load, and therefore attenuate, the measured common mode noise.~~

5.2 Ripple voltage at the DC output

- a) The USB Micro-B plug of the EPS shall be connected to a load representative of a mobile phone with the following characteristics:
- USB Micro-B receptacle connection;
 - a capacitance of $(1 \pm 0,1) \mu\text{F}$ between the Vbus and GND terminals of the USB Micro-B receptacle. This capacitance shall have a typical ESR of 0,01 Ω at 1 MHz and 0,6 Ω at 10 kHz;
 - a variable or switchable resistance between the Vbus and GND terminals of the USB Micro-B receptacle. It shall be possible to select a resistance of 10 k Ω to simulate a no-load condition and other resistances suitable to draw 25 %, 50 %, 75 % and 100 % of the rated current of the EPS.
- b) Place the EUT into an environmental chamber.
- c) Connect an oscilloscope to the Vbus and GND terminals. Set the oscilloscope to **vertical axis** of 20 mV per division, **horizontal axis** of 1 s per division and 20 MHz bandwidth.
- d) Allow the temperature of the EPS to stabilize for at least 10 min.
- e) Turn on the AC power to the EPS and allow it to operate for at least 10 min before making any measurements.
- f) Measure the peak-to-peak voltage of the signal on the oscilloscope under each possible combination of the following parameters:
- AC frequency: 47 Hz, 50 Hz, 60 Hz and 63 Hz;
 - AC voltage: 90 V, 120 V, 207 V and 253 V;
 - load: 0 %, 25 %, 50 %, 75 % and 100 % of the rated output current;
 - temperature: 0 °C, 25 °C and 45 °C.

Bibliography

IEC 62680-1-2, *Universal Serial Bus interfaces for data and power – Part 1-2: Common components – USB Power Delivery Specification*

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

IEC 63002, *Identification and communication interoperability method for external power supplies used with portable computing devices*

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(<http://ec.europa.eu/docsroom/documents/2417>)

Annex II to the MoU, 12 January 2010
(<http://ec.europa.eu/docsroom/documents/2418>)

European Commission, *Standardisation mandate to CEN, CENELEC and ETSI on a common Charging Capability for Mobile Telephones*
(<http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=437#>)

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

IEC 62680-2-1:2015, *Universal Serial Bus interfaces for data and power – Part 2-1: Universal Serial Bus specification, Revision 2.0*

IEC 62680-2-2, *Universal Serial Bus interfaces for data and power – Part 2-2: USB Micro-USB Cables and Connectors Specification, Revision 1.01*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

¹ USB Type-C™ is a trademark of the USB Implementers Forum (USB-IF). This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of this product.

- IEC Electropedia: available at <http://www.electropedia.org>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

adapter

device for connecting from a USB Micro-B receptacle/plug defined in IEC 62680-2-2 to a specific non Micro-USB connector

Note 1 to entry: An adapter can also be a cable.

3.2 Abbreviated terms

AC	alternating current
DC	direct current
EPS	external power supply
ESR	equivalent series resistance
EUT	equipment under test
GND	ground
USB	Universal Serial Bus

4 EPS specification

4.1 DC plug connector specification

The cable assembly supplied with the EPS shall terminate in a USB Micro-B plug, defined in IEC 62680-2-2. The cable assembly may be permanently connected to the EPS or may be a detachable cable. In either case, the terminating USB Micro-B plug shall be compliant with the USB Micro-B cables and connectors specification, IEC 62680-2-2.

The cable assembly supplied with the EPS may also terminate in a non USB Micro-B plug if a manufacturer makes available an adaptor from the Micro-USB connector of a common EPS to a specific non-Micro-USB socket in the mobile phone.²

An EPS provided with a detachable cable shall be equipped with a USB Standard-A receptacle to connect to the EPS. The detachable cable assembly, supplied for use with the EPS, shall have USB Standard-A and USB Micro-B plugs and meet the USB-IF cable assembly requirements in IEC 62680-2-2.

The above requirement also applies to a cable used as an adaptor, i.e. when the USB Micro-B is connected to the mobile telephone by an adaptor where the mobile telephone does not have a Micro-USB interface.

4.2 AC input characteristic

The EPS shall meet the requirements of IEC 60950-1 or IEC 62368-1 with a maximum touch current not exceeding 90 μ A.

The EPS AC input shall operate over the following range:

- voltage range: the rated input voltage range covers the range 100 V to 230 V;
- frequency: 50 Hz to 60 Hz.

² Memorandum of Understanding regarding Harmonisation of a Charging Capability for Mobile Phones. 5 June 2009, clause 4.2.1.