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Operational energy Efficiency for Users (OEU); Adaptive and multiple output power supplies based on USB Type C with USB PD support

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Operational energy Efficiency for Users (OEU).

Modal verbs terminology

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Executive summary

- From 28 December 2024, a wide range of portable devices sold in the EU should have a USB-C® charging port. This will also apply to laptops from 28 April 2026.
- The attractiveness of Type-C stems from three factors:
  - Compact rotation-symmetric, versatile with a range of V / A / W supported, wide adoption.
- Type-C represents some culture-shock versus the familiar USB-A: not only more compact and delicate, but 40 times (with USB PD 3.1 96 times) more powerful.
- The Directive has a noticeable market effect with ample equipment using Type-C interfaces. However, there is so far poor indications on product compliance and to which version, and there is a significant amount of such products already in use preceding the Directive coming into force.
- Furthermore, users may find it difficult to select suitable sources, chargers, for their equipment.

Introduction

With the introduction of the USB-C interface an easy to handle and rotation-symmetric plug became available that is suitable being the standard for Smartphone and Tablet charging and connection. In the meantime, fast charging of Smartphones and Tablets has become a habit and a need, and this is available on the USB-C interface with the USB Power Delivery (PD) function.

The USB PD options are wide ranging and leading to difficulties in understanding the requirements to achieve full compatibility between in particular chargers and Smartphones and Tablets, and are leading to safety issues, given the maximum voltage, current and power, the latter up to 240 W, that also require suitable cables; USB-C is not anymore the innocent 5 V, initially 2,5 W later 7,5 W: up to 240 W is enough to result in burns and fire.

NOTE: USB-C® and USB Type-C® are registered trademarks of the USB-IF.

1 Scope

The present document provides background information on the USB-C interface and associated USB Power Delivery functions, with a focus on User aspects.

USB-C is not anymore, the innocent 5 V, initially 2,5 W later 7,5 W interface: up to 240 W is enough to result in burns and fire.

The deliverable intends to help users understand the implications of USB PD on USB-C, help in easily and successfully procure and employ USB PD supporting systems, and avoid safety issues.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] Directive (EU) 2022/2380 of the European Parliament and of the Council of 23 November 2022 amending Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment (Text with EEA relevance).

[i.2] EN IEC 62680-1-3:2021: "Universal serial bus interfaces for data and power - Part 1-3: Common components – USB Type-C® Cable and Connector Specification".

[i.3] USB-IF specification USB Type-C® with USB PD 3.0 support.

[i.4] USB-IF specification USB Type-C® with USB PD 3.1 support.

3 Definition of terms, symbols and abbreviations.

3.1 Terms

For the purposes of the present document, the following terms apply:

multisource: source with multiple ports, e.g. multiport charger

sink: device consuming power across a USB-C® interface, where applicable with USB PD support

socket: USB Type-C® receptacle

source: device delivering power across a USB-C® interface, where applicable with USB PD support

type-C: USB Type-C® with USB PD 3.0 support (≤ 60 / 100 W)

type-C(3.1): USB Type-C® with USB PD 3.1 support (≤ 144 / 240 W)

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

PD	Power Delivery according to the USB-C® PD set of specifications
PPS	Programmable Power Supply

NOTE: As included in the USB PD 3.1 specification [i.4].

USB BC 1.2	USB Battery Charging 1.2
USB 3.x	USB-IF specifications regarding the signal transfer rate across USB interfaces
USB-IF	USB Implementers Forum

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4.1 EU Regulation, and defining standards and specifications

Directive (EU) 2022/2380 [i.1]**:**

From 28 December 2024, a wide range of portable devices (mobile phones, tablets and e-readers, digital cameras and video game consoles, headphones, earbuds and portable loudspeakers, wireless mice and keyboards, portable navigation systems) sold in the EU should have a USB-C® charging port. This will also apply to laptops from 28 April 2026.

The Directive (EU) 2022/2380 [i.1] **requires compliance with:**

- EN IEC 62680-1-3:2021 [i.2], which is based on.
- USB-IF specification USB Type-C® with USB PD 3.0 support [i.3].

4.2 Type-C characterisation

The attractiveness of Type-C stems from three factors:

- Compact socket and compact and rotation-symmetric **connector**.
- Versatile due to range of voltages, currents and power ratings supported.
- Wide adoption by industry for powering, charging and wired connections.

a) The Type-C socket and connector:

- The Type-C socket and connector are compact, rotation symmetry:
  - with 2 x 10 contacts delicate with respect to the familiar basic USB-A equivalent;
  - less delicate than asymmetric USB-A micro, and open symmetric equivalents.

b) Type-C used for powering and charging equipment:

- Type-C meets 'fast charging' for smartphones and tablets, also allowing many other types of devices to be powered and/or charged; it also allows over a single Type-C to simultaneously charge and e.g. connect a USB-A memory key.

- However, Type-C use for powering and charging is complex, and its high-power ability requires precautions to avoid overload, overheating, damage and burns.

c) Other use of Type-C

- inherits legacy USB applications, in an interim period requiring USB-A to Type-C converters and converter cables. Type-C's compact design and connector symmetry, and its enhanced capabilities according to USB 3.x, make it attractive as a de-facto external connection for applications including video and LAN signals.

4.3 Type-C challenges and issues for powering and/or charging

Type-C represents some culture-shock versus the familiar USB-A: not only more compact and delicate, but 40 times (with PD 3.1 96 times) more powerful, as illustrated in Table 4-1.

Table 4-1: USB, evolution of voltages, currents and power levels

Specification	Maximum voltage	Maximum current	Maximum power
USB 2.0	5 V	500 mA	2,5 W
USB 3.0 / 3.1	5 V	900 mA	4,5 W
USB BC 1.2	5 V	1.5 A	7,5 W
USB Type-C 1.2	5 V	3 A	15 W
USB PD 3.0	20 V	3 / 5 A	60 / 100 W (see note 1)
USB PD 3.1	48 V	3 / 5 A	144 / 240 W (see note 2)
NOTE 1: 100 W is possible with 5 A current, requiring special and coded cables. NOTE 2: 240 W is possible with 5 A current, requiring special and coded cables.			

While it is understandable that the USB-IF, in view of backward compatibility, kept USB in the name of Type-C, the naming USB-C® and USB Type-C® may not sufficiently warn the users that Type-C is a different, more powerful and far more complex type of USB.

4.4 Issues with the Type-C specifications

- Type-C moves USB from 'uncomplicated, safe and rugged' to 'complex, high-power and delicate', requiring precautions to avoid overload, overheating, damage and burns.
- While there is industry wide adherence to the principles of Type-C, there is so far poor formal indications and proof of compliance to these specifications; USB-IF terminology, symbols and labelling requirements are often not followed; for sources compliance may have to be verified from the (small print) detailed specifications.
- There is a lack of information on power requirements, requested and provided, for power consuming devices, sinks; while it is understood that indicating minimum and maximum power requirements may be not straightforward, or even arbitrary, the absence of such information is nevertheless a problematic omission.
- Matching source capabilities to (single or multiple) sink requirements appear to be difficult for users, certainly in absence of information on requirements of the sinks.
- Multisources, e.g. multiport chargers, may have an aggregate maximum power of the ports above the total power rating, and require a complex power management:
  - There should be a minimal 15 W (3 A at 5 V) reserved for each port (less is not negotiable), including 15 W (3 A at 5 V) for USB-A ports if provided.
  - Adding sinks changes the operating conditions, which may require re-negotiation (as far as possible) for already connected ports, and that may lead to:
    - unexpected behaviour, including an interruption in power delivery;
    - lower performance when ports' power levels are (re-)negotiated down;

- some risk for overloading of the multisource.

4.5 A qualitative view of the current market of devices implementing Type-C

There is already ample equipment on the market implementing Type-C interfaces. Furthermore, the Directive has already a noticeable positive effect on the market.

However:

- There are on the market sources, chargers, which do not meet Type-C minimal requirements fully, which is 3 A at 5 V (15 W) for each port (including for USB-A ports).
- USB-IF continuously bringing out newer versions of the specifications: for sale is a mix of products following different versions, which version may not be indicated.
- A lack of formal indications and proof of whether products comply to the specifications and to which version (pre-Type-C, Type-C or Type-C(3.1)), even by respected brands; from detailed specifications the adherence may not be clear either. There is also a significant amount of such products already in use that will be carried over past 2024.
- So far, in particular for smart phones and tablets, power requirements are often not stated explicitly; PCs usually state a maximum power. Since users may find it difficult to select suitable sources, chargers, for their equipment, some manufacturers provide lists of compatible equipment; this is only partially helpful, as such lists typically are restricted to equipment from major brands only, and typically exclude laptops.
- Sinks, power consuming equipment, may contain support for non-declared Type-C options, due to the use of common subsystems, e.g. (slow) charging on 5 V 3 A.

4.6 EU Directive 2022/2380 taking effect

The Directive is not only enforcing Type-C as the preferred and mandatory common interface for powering and charging a broad range of devices, and decoupling the sales of devices and chargers (sinks and sources), with its effect already noticeable on the market, but in the process also has these 'side'-effects:

- Enforcing formal compliance to the Type-C specification EN IEC 62680-1-3:2021 [i.2], USB Type-C® with PD 3.0 support [i.3], something the USB-IF has so far not been able to achieve.
- Imposing indication of minimum and maximum power requirements for power consuming devices (sinks), an important complement to the Type-C specification.
- Requiring warnings for risks and potential dangers associated with use of high-power Type-C and beyond Type-C, a necessary complement the Type-C specifications use.

5 Conclusions

- Directive 2022/2380 applies since 28 December 2024 for a wide range of portable devices sold in the EU, adding laptops from 28 April 2026; however, it already has a noticeable effect on the market.

  It imposes:

  - use of USB-C® charging port;
  - in compliance to EN IEC 62680-1-3:2021 [i.2]/ USB-IF specification USB Type-C® with PD 3.0 support [i.3]; and
  - decoupling of device and charger sales.
- Type-C capabilities allow its use for a wide range of device and applications.

- Type-C is different from USB-A: complex, powerful, delicate and with potential dangers.
- Users may find it difficult to select optimised matching chargers.
- Users may find it difficult to avoid non-compliant devices, lacking accessible specifications and labelling.
- Users may find it difficult to understand the behaviour of multisources, e.g. multiport chargers: adding sinks changes the operating conditions, which may require re-negotiation (as far as possible) for already connected ports, and that may lead to unexpected behaviour, including an interruption in power delivery.

6 Recommendations

- More attention should be given by manufacturers and sales channels to the differences between the legacy USB-A and Type-C: the complexity and high-power ability require technical advice and precautions to avoid overload, overheating, damage and burns.
- It would be helpful if equipment implementing Type-C would explicitly state, on the equipment and/or on the packaging, its full compliance to the Directive [i.1] and/or EN IEC 62680-1-3:2021 [i.2]and/or USB Type-C® with USB PD 3.0 support [i.3]; the EC marking without a date of issue may not be sufficient.
- It would be helpful if power consuming equipment would specify, in addition to technically supported minimum and maximum power levels, as required by the Directive [i.1], also:
  - the supported recommended minimum power level; and
  - the typical average power consumption level;

  for a fictional laptop, these values could be like 15 W, 100 W, 30 W and 60 W, respectively.
- It would be helpful if multisources would document their behaviour when additional sinks are added (see Annex D)
- It is recommended to use with devices without batteries, such as LAN and USB hubs, either a dedicated source, or, in case of powered by a multisource, a semi-static configuration of the latter.

7 Potential issue when using USB-A sources (chargers) with Type-C sinks

There is a potential issue for using USB-A chargers, sources, with adapters or cables to Type-C sinks: a Type-C sink may expect, often not specified, up to 3 A at 5 V (15 W), while USB-A chargers may provide for example only 1, or 2,1 A (5 or 10,5 W), or even less. This may result in overheating and/or failure of at least the charger.

Annex A:
How to select a Type-C source (charger)

1) Check on the sink(s) to be charged or powered for the required combination(s) of V / A / W.

2) Choose by preference a charger from a reliable source, with CE marking, with clear references to PD, PPS, etc., even better with Type-C certification and labelling.

3) Choose a charger:

   a) Single port charger: at least of 15 W, by preference of 15, 27, 45 of 60 W, as these can deliver the maximum 3 A current at each voltage supported (see Table A-1).

   b) For multiport chargers: at least of 15 W for every port (including USB-A ports if provided), and preferably a total maximum power equal to the aggregate maximum power of all ports.

Table A-1: Preferred Type-C source (charger) power levels for single port charger

Power	5 V	9 V	15 V	20 V
15 W	3 A	–	-	-
27 W	3 A	3 A	-	-
45 W	3 A	3 A	3 A	-
60 W	3 A	3 A	3 A	3 A

Annex B:
Some recommendations for use of USB-C and USB-A

Awareness of the increased maximum power:

1) No longer with a maximum power of 7,5 W, now with a power of up to 100 or 240 W (the power of a 'slow cooker'), there is an increasing risk of burns, burning and fire.

Patience is a good thing, USB-A to USB-C use:

2) To charge a smartphone or tablet, a charger with USB-A with a maximum current of 3 A (or higher), with a cable USB-A to USB-C, is in fact a good and safe choice, also for the batterie.

3) But, for USB-A chargers with a maximum current of less than 3 A, ensure the maximum current requested by the device to be charged stays below that of the charger (see Annex C).

Undocumented but maybe welcome functions:

4) With USB-C and PD, there may be unexpected and often undocumented possibilities, such as:

   a) A smartphone or tablet charged with the dedicated charger of a PC with USB-C socket or connector; at e.g. 5 V this could be performed even with a standard USB-C cable.

   b) PCs that can be charged or 'topped-up', in the 'sleep mode' or 'off', or even 'on', with a USB-C charger with or without PD, e.g. with a charger for a smartphone (PCs may 'protest' with messages about the possible insufficiency of the available power for charging).

   c) Always check the specifications of source and sink, and do a test, with care, and on a suitable and quiet moment (best before the need arises).

Annex C:
Reminder on basic current and power management

1) Current and power limiting also over a USB-C® interface, with or without USB PD, should in normal operation be left to the sink, the power consuming device:

   a) When limiting current and power is taking place at the source (the device delivering power over a USB-C® and where applicable with USB PD support) it is a situation of overloading: the source's overloading protection should be available and should provide a sharp cut-off to avoid overheating and damage of both source and sink.

   b) When the source does not limit the current and power in a controlled way, then there is a risk of overheating and damage.

   c) To avoid situations of overloading it is therefore necessary that the source (the power adapter / charger) has sufficient aggregated current and power capacity in all possible situations.

Annex D:
The behaviour of multisources

1) For most multiport sources, e.g. a multiport charger, the behaviour when an additional sink is connected is not specified or documented, and may therefore be for users difficult to understand; the connection of an additional sink changes the operating conditions, resulting in:

   a) re-negotiation of the power provisioning parameters for at least some ports;

   b) a short interruption of power on all ports may be expected to start the re-negotiations; this may affect devices without batteries that are powered by a multisource; examples could be network devices such as LAN and USB hubs;

   c) the re-negotiations are device dependent and may have other unexpected consequences: adding an additional sink, even a sink with a low power requirement, may lead to previously connected sinks to be provided less or no power, and this may be dependent on the order of the ports;

   d) the precise behaviour of a multiport source is typically not documented in the specifications; however, it is possible to observe, learn and document the behaviour, including the ordering of the ports in re-negotiations, by 'trial and error'.

Annex C: Bibliography

- https://www.europarl.europa.eu/news/en/press-room/20220930IPR41928/long-awaited-common-charger-for-mobile-devices-will-be-a-reality-in-2024.
- Directive 2022/2380 - Amendment of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment.
- Common charger agreement – Challenges and perspectives for European Standardization.
- https://usb.org/developers.
- https://usb.org/compliance.

Annex D:
Change history

Date	Version	Information about changes
V0.0.1	22/09/2024	Early and stable draft
V0.0.2	21/10/2024	Stable draft; WI references updates, small additions and improvements

History

Document history		
V1.1.1	June 2025	Publication