



Understanding USB Type C: Cable Types, Pitfalls and More.

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Overview

“USB” or [Universal Serial Bus](https://adafru.it/Hbg) (<https://adafru.it/Hbg>) is a standard that was created as a means to make connectors more universal and transparent. USB C is a **specific shape of USB connector** and was designed to take that universality a step further by being the one connector for almost anything including data, power/charging, video and audio. The connector is also reversible, it has no up or down orientation!

While USB C does make some things a lot easier, there is also lots of confusion and uncertainty surrounding it. Are all USB C cables the same? (No). What can USB C do that older USB cable types can't? (A lot more but it also depends on the cable). Can a USB C cable damage hardware? (Potentially). USB C can be tricky but much of the confusion is hopefully cleared up in the following pages.

Confused and in a dash?

If you need USB C info in a jiff, we got you covered. **When in USB C doubt, check this graphic out! (Click to embiggen)**


EVERYTHING YOU NEED TO KNOW ABOUT USB C, A GRAPHIC

USB C Version Speeds and Specs

USB VERSION/ CABLE TYPE	3.0	3.1 GEN 1	3.1 GEN 2 (FULL-FEATURED)	THUNDERBOLT 3 PASSIVE	THUNDERBOLT 3 ACTIVE
SPEED	480 Mbps	5 Gbps	10 Gbps	40 Gbps	40 Gbps
MAX LENGTH	4 Meters	2 Meters	1 Meters	0.5 Meters	2 Meters
ASSOCIATED SYMBOL(S)					
DISPLAY/4K SUPPORT	No	No	No	Yes	Yes
PROTOCOL SUPPORT	-	-	-	DisplayPort (DP)	DisplayPort (DP)
CURRENT RATING	3A/5A*	3A/5A*	3A/5A*	3A/5A*	3A/5A*

*Always double check a cable's capabilities before using to power laptops or monitors. Only 5A cables should be used. Never use a 3A USB C cable to power these devices.

USB C is a **specific shape of USB connector**. It was designed to take the universality of USB a step further by being the one connector for almost anything including data, power/charging, video and audio.



USB C cables and hubs for purchase

These three items will fill most USB C related cable needs. Additionally, all of the following parts have the required USB C specifications and certifications including implemented safeguards for protecting cables and ports.

"Full-featured" USB C to USB C cable

This cable is best for charging USB C devices as well as data transfer. It is **NOT** meant to be used as a DisplayPort or to connect any other type of display receptacle. The cable includes an **EMARK chip**, required by the **USB C specification (but sometimes left out)**. That means you can use this for high current (**5A**) charging.



USB C to USB C Cable - USB 3.1 Gen 4 with E-Mark - 1 meter long

\$9.95
IN STOCK

Add To Cart

Thunderbolt 3 USB C cable

This cable can be used for DisplayPort. Which means it can be used with other monitors as display receptacles. Additionally it contains all the same features the above "Full-featured" USB C cable has.

1 x [Belkin Thunderbolt 3 Cable \(USB C to USB C\)](#)

DisplayPort support, 4K support, monitor powering, 40 Gbps

BUY NOW

USB C Adapter Hub

The current downside of USB C is that, quite often, newer computers have only USB C ports. This means with older cables and devices you'll often need an apter to connect to the usb ports. This adapter hub is great for those situations.

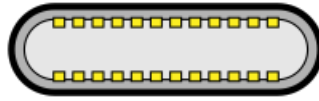
1 x [HooToo USB C Hub](#)

6-in-1 USB C to 4K HDMI Adapter

BUY NOW

What is USB C?

USB C refers solely the shape of a 24 pin connector (<https://adafru.it/Hbh>) which can be either a plug (<https://adafru.it/Hbi>) or receptacle (<https://adafru.it/Hbi>). The connector has more pins than past USB shapes (like A and micro B) so it can charge devices and transfer your data incredibly quickly. The main purpose that USB C was created for was to do away with all the various cables and adapters to make a more universal solution for both charging and data transfer.



What is it not?

As mentioned earlier, USB C refers to the shape of a 24 pin connector. Just because a cable is USB C doesn't mean it supports a specific power, transfer speed or protocol. For example, if a cable is USB C it could be USB 3.1 (fast data transfer), 2.0 (slower data transfer) or a different specification.

How is it different from other USB cables?

- Backwards compatibility. Most older cables had a host side (USB B) and a device side (Micro B). USB C has dual role and is reversible. This means it can transfer power and data both ways.
- Some cables can transfer large amounts of wattage to power monitors or laptops.
- USB C can operate in alternate modes such as DisplayPort, Thunderbolt, HDMI or USB 3.1.
- The cable has a great [interoperability](https://adafru.it/Hbj) (<https://adafru.it/Hbj>) meaning it is highly supported by many well trusted organizations and is becoming a common feature for many devices.

The USB C advantage



The comparison of these two laptops show a large advantage for devices with just a couple USB C ports vs older models with many different ports and connectors. Not only is space saved with USB C ports, the amount of cables to keep track of for different purposes (HDMI, VGA etc...) is drastically reduced. On the flip side, until USB C becomes more standard, many hubs and adapters will be needed to connect older devices to USB C ports.

left image source: <https://pixabay.com/photos/usb-hdmi-vga-1394-lan-laptop-1884/> (<https://adafru.it/Hbk>)

right image source:

<https://pixabay.com/photos/macbook-pro-2016-adapter-usb-c-2381729/> (<https://adafru.it/Hbl>)



What can USB C do?

A USB C cable **has the potential** to hold some or more of these features:

- Device charging
- Monitor and laptop power
- Fast data transfer - up to 40 Gbps (Thunderbolt 3)
- Audio support
- HDMI - see [this hdmi.org page \(https://adafru.it/Hbm\)](https://adafru.it/Hbm)
- DisplayPort - see [this displayport.org page \(https://adafru.it/Hbn\)](https://adafru.it/Hbn)
- MHL (Mobile High-Definition) - see a good explanation on [Wikipedia \(https://adafru.it/Hbo\)](https://adafru.it/Hbo)
- Thunderbolt 3 - see [this Digital Trends article \(https://adafru.it/Hbp\)](https://adafru.it/Hbp)

Again, these features are **cable specific**, meaning any given USB C cable may not have some of these features. On the

other hand, the **vast majority** of cables **can transfer data and charge devices**.

The next section will cover the many different USB C cable types and how to select a cable to use for specific features.

Cable Types and Differences

USB C cables can have variations in speed, power, and protocol capabilities. Additionally there are different length requirements to watch out for. When in doubt, buy cables from the device manufacturer. You can also buy USB C cables from Adafruit as we have [specific cables for specific needs \(https://adafru.it/Hbq\)](https://adafru.it/Hbq) that are all tested and researched.

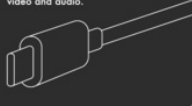
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*Always double check a cable's capabilities before using to power laptops or monitors. Only 5A cables should be used. Never use a 3A USB C cable to power these devices.

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Speed

A USB C cable with 3.1 Gen 2 capabilities vs one with 2.0 can mean a vast difference in data transfer. [For example, two cable types transferring the same HD movie can take vastly different times \(https://adafru.it/Hbr\)](https://adafru.it/Hbr):

- 3.1 Gen 2 takes **5 seconds** at 10 Gbps
- 2.0 takes **1.7 min** at 480 MBps

USB C cables run at different speeds measured in [bits per second \(https://adafru.it/Hbs\)](https://adafru.it/Hbs). These include:

- USB 2.0
 - 480 Mbps (megabits per second)
- USB 3.0
 - 5 Gbps (gigabits per second)
- [USB 3.1 Gen 1 \(https://adafru.it/Hbt\)](https://adafru.it/Hbt)
 - 5 Gbps
- USB 3.1 Gen 2
 - 10 Gbps
 - ***Note USB 3.1 gen 4 in store?** (<https://adafru.it/Hbu>)
- USB 3.2 and 4.0

- These cables will not be covered in this guide at this time, as they are not yet widely adopted.

USB 2.0 2001	USB 2.0 Revised	USB 3.0 2011	USB 3.1 2014
1.5 Mbit/s <i>(Low Speed)</i>			
12 Mbit/s <i>(Full Speed)</i>		5 Gbit/s <i>(SuperSpeed)</i>	10 Gbit/s <i>(SuperSpeed+)</i>
480 Mbit/s <i>(High Speed)</i>			

If you run across the term “Full-featured” this a reference to speed and typically means USB 3.1 Gen 2.

Power

All USB-C cables must be able to carry a minimum of 20V 3A, but can also carry high-power 20V 5A current (<https://adafru.it/Hbh>).

For cables with up to 3A and 5A delivery, they can be used for

- Charging USB type C enabled devices such as cell phones and tablets.
- Transferring photos and music between devices.

The biggest difference between 3A and 5A cables is **5A cables can generally power laptops and monitors while 3A cables cannot.**



Always double check a cable's capabilities before using to power laptops or monitors



NEVER USE A CHEAP CABLE TO CHARGE YOUR COMPUTER
NEVER USE A 3A USB C CABLE TO POWER A LAPTOP OR MONITOR

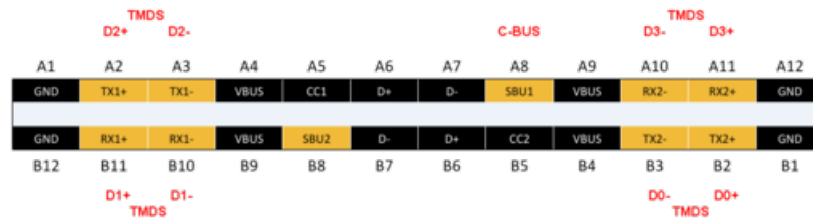


Protocols / Alternate Modes:

Different USB C cables may support different protocols, or ways of transferring data, such as MHL, HDMI, Thunderbolt 3 and DisplayPort. In relation to USB C, these protocols are called **alternate modes**. Having support for one protocol type may give support for another but this is not generally the case.

MHL (Mobile High-Definition) (<https://adafruit.it/Hbo>)

- Connects smart phones to TVs.
- Allows MHL-enabled source and display devices to be connected through a USB Type C port.
- Look for MHL support on product page where you are ordering from to ensure MHL is supported.



HDMI (<https://adafruit.it/Hbv>)

- Allows HDMI-enabled sources with a USB C connector to directly connect to standard HDMI display devices without requiring an adapter.
- Look for HDMI support..

Thunderbolt 3 (<https://adafruit.it/Hbw>)

- Typically used for monitors and 4K support. This gives a large speed boost when transferring data at 40 Gbps.
- Can require [active](https://adafruit.it/Hbx) cables for higher performance, if over 0.5 meters.
- Thunderbolt 3 cables also **support the DisplayPort protocol**.

DisplayPort (<https://adafruit.it/Hby>)

- Another type of digital display interface, backwards compatible with HDMI/DVI/VGA.
- Look for DisplayPort support.

Length

In general, the faster the speed of a USB cable, the shorter it should be due to the electrical characteristics inherent to high speed data transfer.

Here are the different cable speeds and corresponding suggested lengths:

USB 2.0

- Up to 4 meters.

USB 3.1 Gen 1

- Up to 2 meters.

USB 3.1 Gen 2

- Up to 1 meter.

Table 3-1 USB Type-C Standard Cable Assemblies

Cable Ref	Plug 1	Plug 2	USB Version	Cable Length	Current Rating	USB Power Delivery (BMC)	USB Type-C Electronically Marked
CC2-3	C	C	USB 2.0	≤ 4 m	3 A	Supported	Optional
CC2-5					5 A		Required
CC3G1-3	C	C	USB 3.1 Gen1	≤ 2 m	3 A	Supported	Required
CC3G1-5					5 A		
CC3G2-3	C	C	USB 3.1 Gen2	≤ 1 m	3 A	Supported	Required
CC3G2-5					5 A		

Thunderbolt 3 cables

- If the cable is over half a meter, it needs to be a special [active cable \(https://adafru.it/Hbx\)](https://adafru.it/Hbx), meaning there are a bit of electronics inside to help things out.
- If 0.5 m or under, can be passive. The only thing under the rubber sheathing is copper wire.
- For more details, check the product pages of the cables you are considering.

Adapters and Hubs

Many new laptops, such as the Macbook Pro, have only USB C ports. If you're trying to connect any non-USB C device like USB 3.1, HDMI or Thunderbolt, you'll need an adapter.



Legacy Adapters: (<https://adafru.it/Hbh>)

Connecting an older device to a host with a USB C receptacle requires a cable or adapter with a USB A or USB B plug or receptacle at one end and a USB C plug at the other. Legacy adapters (i.e. adapters with a USB A or USB B plug) with a USB C receptacle are "not defined or allowed" by the specification since they can create "many invalid and potentially unsafe" cable combinations.

Audio Adapter Accessory Mode (<https://adafru.it/Hbh>)

A device with a USB C port may support analog headsets through an audio adapter with a 3.5 mm jack, providing four standard analog audio connections (Left, Right, Microphone, and Ground). The audio adapter may optionally include a USB C charge-through port to allow 500 mA device charging.

Alternate Modes (<https://adafru.it/Hbh>)

Alternate Mode hosts and sinks can be connected with either regular full-featured USB C cables, or converter cables/adapters:

USB 3.1 Type C to Type C full-featured cable

- DisplayPort, MHL, HDMI and Thunderbolt Alternate Mode USB C ports can be interconnected with standard passive full-featured USB Type C cables. These cables are only marked with standard "trident" SuperSpeed USB logo (for Gen 1 cables) or the SuperSpeed+ USB 10 Gbit/s logo (for Gen 2 cables) on both ends. Cable length should be 2.0 m or less for Gen 1 and 1.0 m or less for Gen 2



Thunderbolt Type C to Type C active cable (<https://adafruit.it/Hbx>)

- Thunderbolt 3 Alternate Mode with cables longer than 0.5 m requires active USB C cables that are certified and electronically marked for high-speed Thunderbolt 3 transmission, similarly to high-power 5 A cables. These cables are marked with a Thunderbolt logo on both ends. They do not support USB 3 backwards compatibility, only USB 2 or Thunderbolt. Cables can be marked for both Thunderbolt and 5 A power delivery at the same time.



USB 3.1 Type C adapter cable (plug) or adapter (socket)

- These cables/adapters contain a valid DisplayPort, HDMI, or MHL plug/socket marked with the logo of the required Alternate Mode, and a USB-C plug with a "trident" SuperSpeed 10 Gbit/s logo on the other end. Cable length should be up to 0.15 meters.
- Active cables or adapters contain powered ICs to amplify/equalize the signal for extended length cables, or to perform active protocol conversion. The adapters for video Alt Modes may allow conversion from native video stream to other video interface standards (e.g., DisplayPort, HDMI, VGA or DVI).

Alternate Mode protocol support matrix for USB-C cables and adapters

Mode	USB 3.1 Type-C cable ^[a]					Adapter cable or adapter					Construction	
	DisplayPort		Thunderbolt		superMHL	HDMI	HDMI		DVI-D			Component video
	3.1	1.2 1.4	20 Gbit/s	40 Gbit/s		1.4b	1.4b	2.0b	single-link	dual-link		(YPbPr, VGA/DVI-A)
DisplayPort	Yes	Yes							No			Passive
		Optional							Yes	Yes	Yes	Active
Thunderbolt	Yes ^[c]	Yes ^[c]	Yes	Yes ^[d]					No			Passive
		Optional	Optional	Yes					Yes	Yes	Yes	Active
MHL	Yes				Yes		Yes	No	Yes	No	No	Passive
					Optional			Yes			Yes	Active
HDMI						Yes	Yes	No	Yes	No	No	Passive
						Optional					Yes	Active

Potential Dangers and Risks

Power caution (<https://adafru.it/Hbr>)

The amount of power that cables may deliver can differ for different devices. For example: If you use a cable that draws more power than a port can handle, you could harm the port.

Cables are supposed to contain safeguards. Sometimes manufacturers cut corners to reduce cost and don't follow standards, including the implementation of these safeguards.

☐ Cables which are not compliant can cause serious damage

Buying Cables Online

- Read reviews from wherever you are buying your cables. Make sure people are using for the same purposes as you (transferring data, streaming video to a TV/monitor, etc).

☐ If buying inexpensive cables, BE VERY CAREFUL AND LOOK FOR CERTIFICATIONS AND REVIEWS

Connecting to Monitors and laptops








- Use a specific cable for power and data transfer (usually marked with a DisplayPort or Thunderbolt symbol)
- **Always double check cable capabilities before using to power laptops or monitors**

☐ NEVER USE A CHEAP CABLE TO CHARGE YOUR COMPUTER
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Identifying your cable

If you are still unsure of what kind of USB C cable you have after looking for product specifications and checking comments on the product page, look for one of the below symbols on the cable to identify the cable type.

Even if you are correctly able to identify the cable, **never use a cable to power a laptop or monitor unless you are certain the cable supports 5A and you have double checked online resources about the specific cable you are using.**

Symbol		Max Speed	Power	Video
	USB 2.0	480Mbit/S	No	
	USB 3.0 (USB 3.1 Gen 1)	5 Gbit/S	No	
	USB 3.1 (USB 3.1 Gen 2)	10 Gbit/S	No	
	USB 3.0 (USB 3.1 Gen 1)	5 Gbit/S	Yes	
	USB 3.1 (USB 3.1 Gen 2)	10 Gbit/S	Yes	
	Thunderbolt 3	40 Gbit/S	Yes	Yes
	DP Alt mode	This symbol will be found next to the above symbols to identify that this port supports video		Yes

Takeaways

Label your cables!

- While cables do have individual markings, they should be more obvious and they are not.

Power

- If you plan on using an unknown cable for charging be careful, especially to when charging a computer.
- ***NEVER USE A 3A USB C CABLE TO POWER A LAPTOP OR MONITOR***
- Always double check a cable's capabilities before using to power laptops or monitors
- If you are just performing data transfer, you will typically be ok.

Display

- Some cables are meant for display receptacles only.
- These are generally Thunderbolt 3 cables and are marked with the Thunderbolt logo.

Buying cables

- Try to use the cable that came with the device when you purchased it. When in doubt, buy cables from the device manufacturer.
- Read reviews wherever you are buying cables from and make sure people are using for what you want to (read their comments)
- Cables from less-than-reputable sources may have cut corners. In doing that, they may have removed features which keep you safe.


When in USB C doubt, check this graphic out!

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By taking these precautions, you save yourself stress and avoid damaging your hardware and ports. Good luck with your connector adventures!

