STM32G0

World’s 1st USB-C™ & Power Delivery 3.0 MCU
Why to use USB-C and Power Delivery Technology?

**USB Type-C connector enhances user experience**
- It’s a 24-pin miniature and reversible connector. USB-C cable has same plug as both ends.
- Some pins can be repurposed to support proprietary protocols (Alternate Modes).
- 15W of power can transit natively without USB PD protocol.

**To exchange more data faster with various protocols**
- 2 separate USB data paths available simultaneously: USB 2.0 + USB 3.1 (up to 10Gbit/s).
- Display Port, HDMI, MHL, Thunderbolt are supported to carry video/audio signals.
- Conventional I²C/SPI/UART/Ethernet interfaces can be "bridge" to USB-C.

**To get more power with a comprehensive and robust protocol**
- **USB Power Delivery** protocol enables power negotiation (up to 100W).
- It allows to discover power capabilities and needs between two USB-C connected devices.
- It enables advanced voltage and current negotiation to support fast charging.
- USB PD is used to activate Alternate Modes or to carry Authentication messages.

**To protect your application and extend its functionalities**
- Identification of genuine chargers or accessories using USB PD authentication messages.
- USB PD Alternate Modes and Vendor Defined Messages enable product differentiation.
- Secure firmware upgrade capability.
USB Power Delivery is a Protocol!

To get more power in a robust and safe way!
- Enables advanced and higher voltage and current negotiation (up to 100W)
- Source and Sink establish power contracts that match with their power capabilities and needs (ex: technology of battery used, power budget allocation, number of ports etc)
- Supply voltage ($V_{bus}$) is fixed (5V,9V,15V,20V) or configurable (Programming Power Supply)
- Dual Role Power devices can swapped power direction (ex: tablet charging a Notebook !)

To extend devices functionalities and create an unique differentiation!
- Use of USB PD Structured Vendor Defined Messages (VDMs) to extend the functionality a device exposes

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>Nominal voltage</th>
<th>Maximum current</th>
<th>Maximum power</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB PD</td>
<td>Configurable</td>
<td>5 A</td>
<td>100 W</td>
</tr>
<tr>
<td>USB Type-C Current @ 3.0 A</td>
<td>5 V</td>
<td>3.0 A</td>
<td>15 W</td>
</tr>
<tr>
<td>USB Type-C Current @ 1.5 A</td>
<td>5 V</td>
<td>1.5 A</td>
<td>7.5 W</td>
</tr>
<tr>
<td>USB BC 1.2</td>
<td>5 V</td>
<td>Up to 1.5 A</td>
<td>7.5 W</td>
</tr>
<tr>
<td>Default USB Power</td>
<td>USB 3.2</td>
<td>900 mA (x1)</td>
<td>4.5 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,500 mA (x2)</td>
<td>7.5 W</td>
</tr>
<tr>
<td></td>
<td>USB 2.0</td>
<td>500mA</td>
<td>2.5 W</td>
</tr>
</tbody>
</table>
**Terminology**

**Power roles**
- Source/Provider: Provide Power
- Sink/Consumer: Consume power
- DRP: **Dual Role Power** (can be either Sink or Source)

**Data roles**
- DFP: Downstream Facing Port (usually a Host / HUB ports)
- UFP: Upstream Facing Port (usually a device)
- DRD: **Dual-Role Data** - typical of "on-the-go" ports

**Power role and Data role can swap!**
Roles can be dynamically swapped using USB PD

**Alternate Mode capabilities enabled via USB PD**

**Authentication**

**Fast charging using PPS**
Be Connected with STM32G0

World’s First conventional MCU with built-in USB-C and PD interfaces

- Harness to the innovative features of USB-C technology with a standard microcontroller.
- Get more “power” and support new use-cases with USB Power Delivery
- Create differentiation features (authentication, fast charge, FW upgrade)

* UCPD stands for USB Type-C and Power Delivery Interface
Smart Integration

- **UCPD** is a new interface that supports:
  - USB Type-C connector management
  - USB Power Delivery r3.0 communication protocol

- First implementation in STM32G0 series
High Flexibility

Sink, Source and Dual Role Power roles supported

Dual Port - Certified* Solution

- Cortex®-M0+ STM32 platform
- Up to 2 built-in USB-C & PD3.0 interfaces
- 128 Kbytes of Flash – 36 Kbytes of SRAM
- Versatile analog and digital peripherals
- 28,32,48,64-pin packages available

(*) : USB-IF TID 227
STM32G0 UCPD manages the Configuration & Communication channels (CC lines) allowing:

1. Type-C Control
2. USB PD communication

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Optimized Partitioning

Source (charger)
- Device Policy Manager
  - Policy Engine
  - Protocol
  - Physical Layer
  - USB-C Control
  - Source Port
  - Power Source(s)
  - BMC

Sink (device)
- Device Policy Manager
  - Policy Engine
  - Protocol
  - Physical Layer
  - USB-C Control
  - Sink Port
  - Power Source(s)

Connections:
- VBUS
- CC
- BMC
Built-in Features

USB-C control
+ Built-in Rp/Rd resistors
+ CC logic control (CC PHY)
+ CC lines voltage monitoring
+ Dead battery resistors
+ Fast Role Swap signaling

✓ Attach/detach and role management (SNK, SRC, DRP)
✓ Resolve cable orientation and twist connections to establish USB 2.0 /USB 3.x data bus routing
✓ Discover and configure VBUS or VCONN

Integration value represents $0.15

USB PD
+ PD transceiver PHY
+ Digital BMC
+ CRC encoding/decoding

✓ Power contract negotiation (up to 100W)
✓ Power or USB data Role swap
✓ Alternate mode through Vendor Define Messages
✓ PPS, Firmware upgrade, Authentication messages
Typical Block Diagram

Ex: Multi-Port Docking Station

- Port 1 negotiates power contracts with external USB-C power adapter.
- Port 2 supplies plugged accessory and handle HDMI signals request when TV detected, or USB devices inserted into legacy USB connectors.
STM32G0 is PD3.0 compliant device and it supports all PD3.0 features:

- Collision avoidance
- Fast role swap (FRS)
- Programming Power Supply (PPS)
- FW upgrade via CC lines
- Authentication via USB PD
More Security

Integrated security features, ready for tomorrow’s needs

Firmware IP protection

Mutual distrustful

Secret key storage

Secure firmware upgrade

Authentication

User flash

Securable Memory Area

- Execute-only Protection
- Read-out Protection
- Write Protection
- Memory Protection Unit (MPU)
- AES-256 / SHA-256 Encryption
- True Random Number Generator
- Unique ID

Standard user flash by default

Can be secured once exiting
No more access nor debug

Configurable size

Good fit to store critical data
- Critical routines
- Keys
USB-C Authentication Ready

Verify that the device is genuine & embeds the expected profile

- Security messages carry via USB PD3.0
- Compliant solution with timing constraints

- Flexible authentication library.
- Initiator and Responder mode supported
- Secret keys storage in securable memory area or external secure-micro (ST-SAFE)
Smart Ecosystem for Short Time-to-market

Discover and learn

STM32G071B-DISCO

Develop

NUCLEO-G071RB

STM32G081B-EVAL

Configure and Debug
Evaluation board with USB-C daughter board
- USB-C N°1 : DRP / 45W,
- USB-C N°2 : USB-C adapter to type-A and Display Port
Discovering USB-C

STM32G071B-DISCO

- Discover and display USB-C power and feature capabilities of any host.
- Analyze and sniff USB PD data packets and display Vbus voltage, Ibus current
- Debug, configure and inject USB PD3.0 packet using STM32CubeMonitor UCPD.
Easy Configuration

Device selection and peripherals configuration (port 1 or 2 and role of each port: SNK, SRC, DRP)

USB-PD middleware parameters settings

Code generation
PC Software GUI to display and configure parameters of USB PD Middleware
Note: Our STM32G0/UCPD solution has successfully passed the USB-IF Test Procedure for PD 3.0 Controller Silicon || PD 3.0 Power Brick || PD 3.0 Power Bank, and it's posted on the USB-IF Integrator's List. During the certification workshop our STM32G0 evaluation board (Port 1 / DRP role) has been used.