STEVAL-2STPD01
Quick Start Guide

USB Type-C™ Power Delivery Dual Port adapter
based on the STPD01 Programmable Buck Converter

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STEVAL-2STPD01 Kit Overview

STEVAL-2STPD01 HW Overview

- Solution to demonstrate the performance and the features of the STPD01 Programmable Buck Converter, integrated in a dual port adapter architecture for USB Type-C™ Power Delivery application.

- **Features**:
  - PD Output: four fixed PDOs (5V@3A, 9V@3A, 15V@3A, 20V@3A)
  - Output Power: 120 W-rated (60W for each port)
  - Compliant with the latest USB Type-C and Power delivery specification
  - Two on-board STPD01 Programmable synchronous Buck Converters for USB Power Delivery, each one able to provide up to 60 W output power (20 V, 3 A).
  - Two on-board TCPP02-M18 protection for USB Type-C and PD Source applications.
  - Power sharing algorithm IP supporting dual-port application.
  - OVP, UVP, OC, SC protections.
  - RoHS compliant
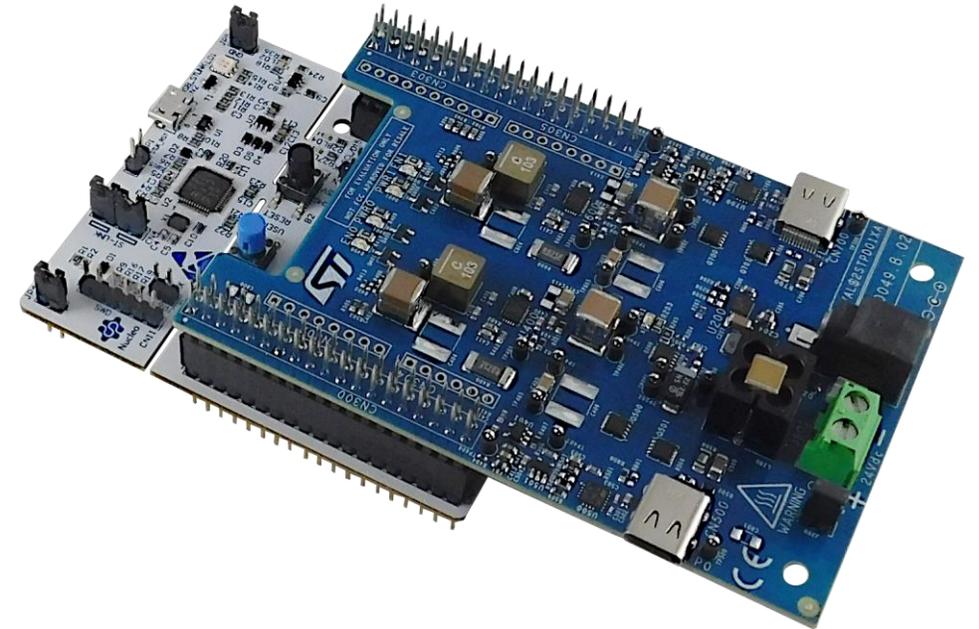
STEVAL-2STPD01 HW Architecture

Dual Port solution architecture may be divided in two sub-systems:

- the "digital" stage, identified as the STM32 Nucleo-64 development board NUCLEO-G071RB that embeds the STM32G071RB;
- the "power" stage, identified as the expansion board, that physically manages, redirects, and converts the input supply to the main functional blocks of the solution, contributing also to output the expected voltages.
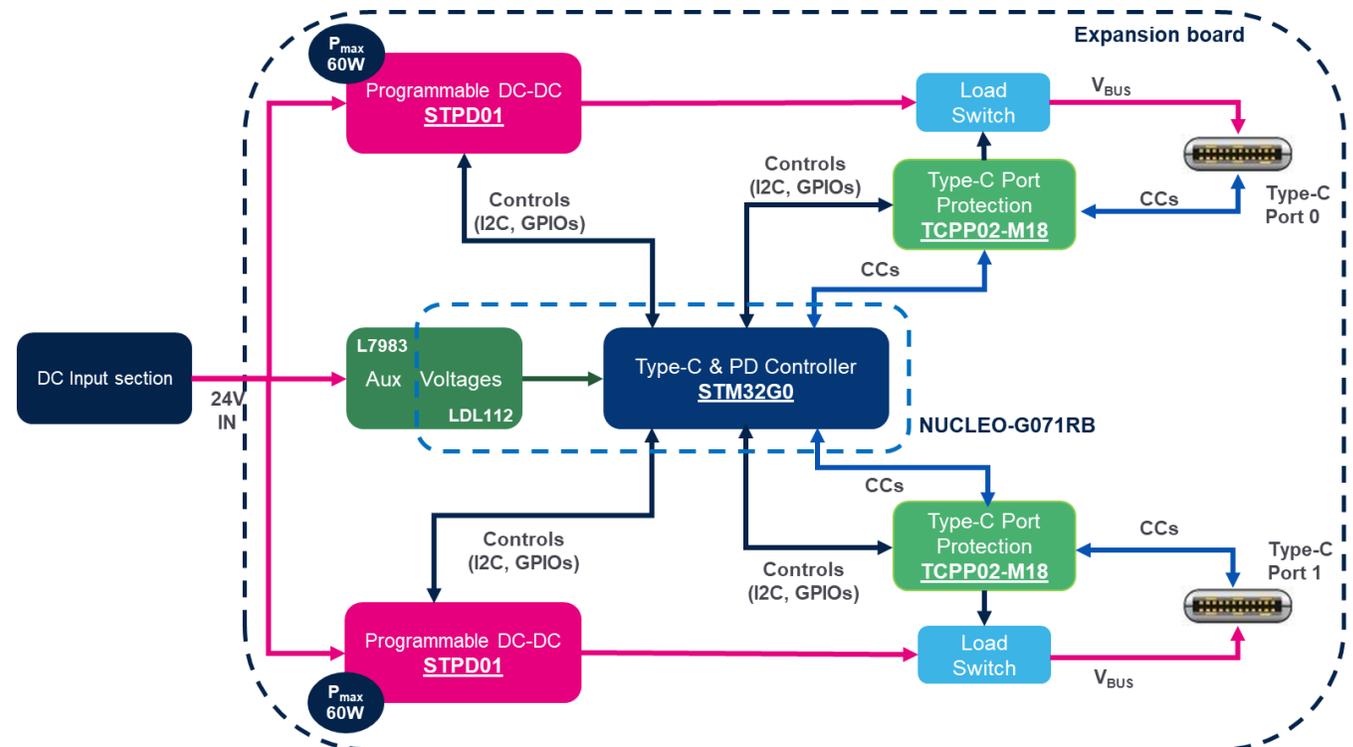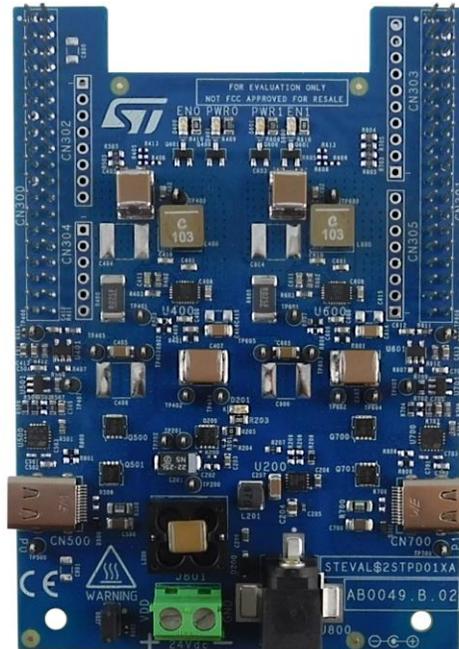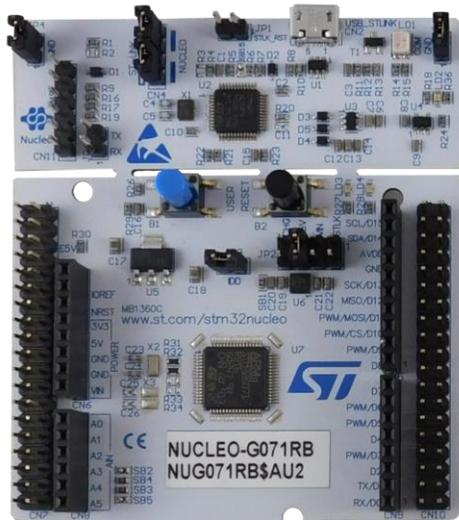
Relevant components in BOM

1. ST Morpho connectors (CN300, CN301)
2. **STPD01PUR** Programmable Buck Converter for USB Power Delivery (U400, U600)
3. **TSV991AILT** rail to rail Op-Amp (U401, U501, U601, U701)
4. **TCPP02-M18** Type-C port protection for Source (U500, U700)
5. **STL11N3LLH6** N-channel 30V, 11 A STripFET H6 Power MOSFET (Q500, Q501, Q700, Q701)
6. **STL9P3LLH6** P-channel -30 V, -9 A STripFET H6 Power MOSFET (Q200)
7. **L7983PU50R** 60V, 300mA synchronous step-down switching regulator (U200)
8. Type-C connector (CN500, CN700)
9. **ESDA25P35-1U1M** High-power Transient Voltage Suppressor (D500, D700)
10. **SMM4F28A-TR** 400W, 28 V TVS (D200)
11. DC Power Connector (J801)
12. DC Power Jack (J800)
13. Indication LEDs (D400, D401, D600, D601)
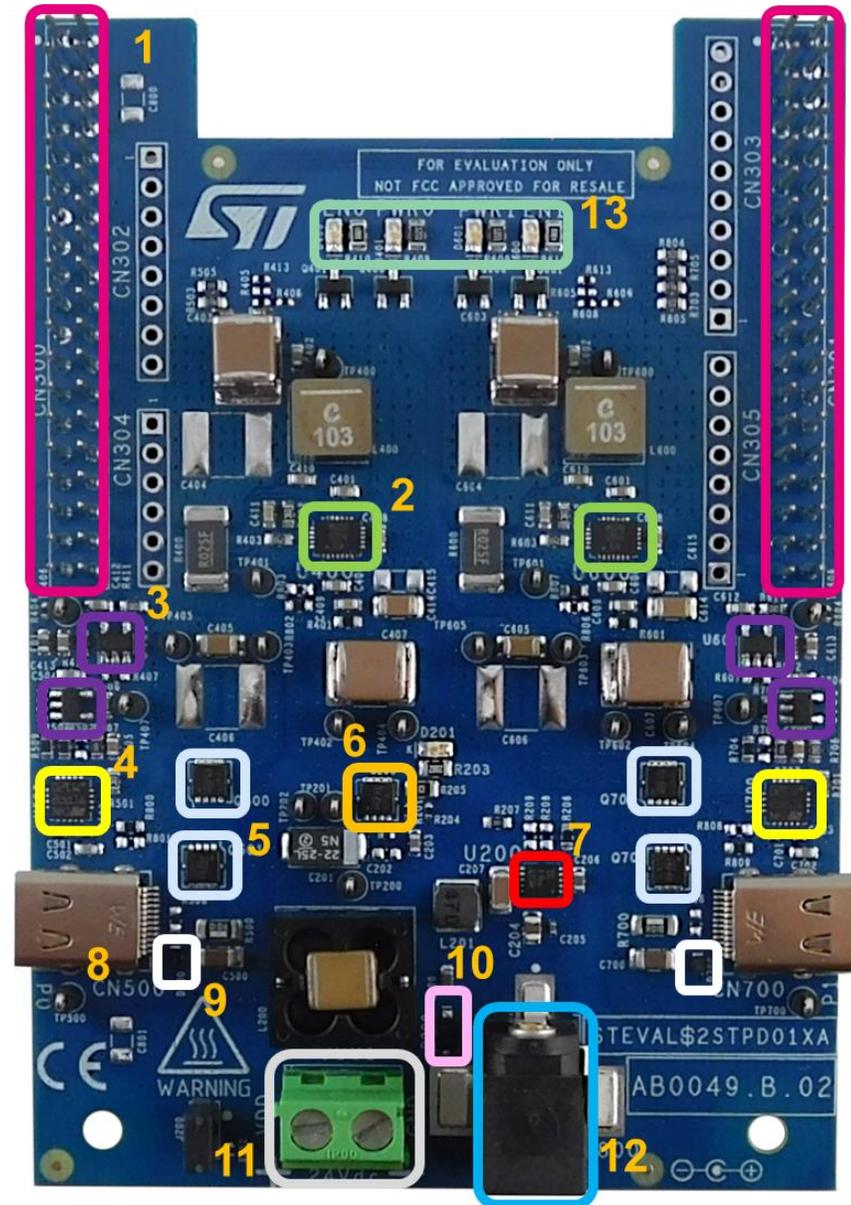
STEVAL-2STPD01 SW Architecture

Main SW functional layers are:

1. **Hardware abstraction**
   - **STM32CubeG0 HAL** Hardware Abstraction Layer for the STM32G0 microcontroller.
   - **Board Support Package (BSP)** library layer containing the drivers of the STPD01 and TCPP02-M18 devices.
2. **Middleware**
   - **USB PD Library** containing the ST USB-PD middleware stack main blocks (**Policy Engine**, **Protocol Layer**, **Physical Layer**, **USB-C port Control**)

3. **Application**
   - **Device Policy Manager** to manage USB power delivery resources in the platform
   - **Power Monitor** to monitor, at higher level, the bus status acquiring the voltage-current pair and reaching events
   - **Power Sharing**, a specific IP to distribute the power between the two ports, starting from the Power input budget and considering the operative status of each port

Application	Device Policy Manager	Power Monitor	Power Sharing
Middleware	USB PD Library		FreeRTOS
Hardware Abstraction	Hardware Abstraction Layer API		Board Support Package
Hardware	STM32G071RB	STPD01	TCPP02-M18
	STEVAL-2STPD01		
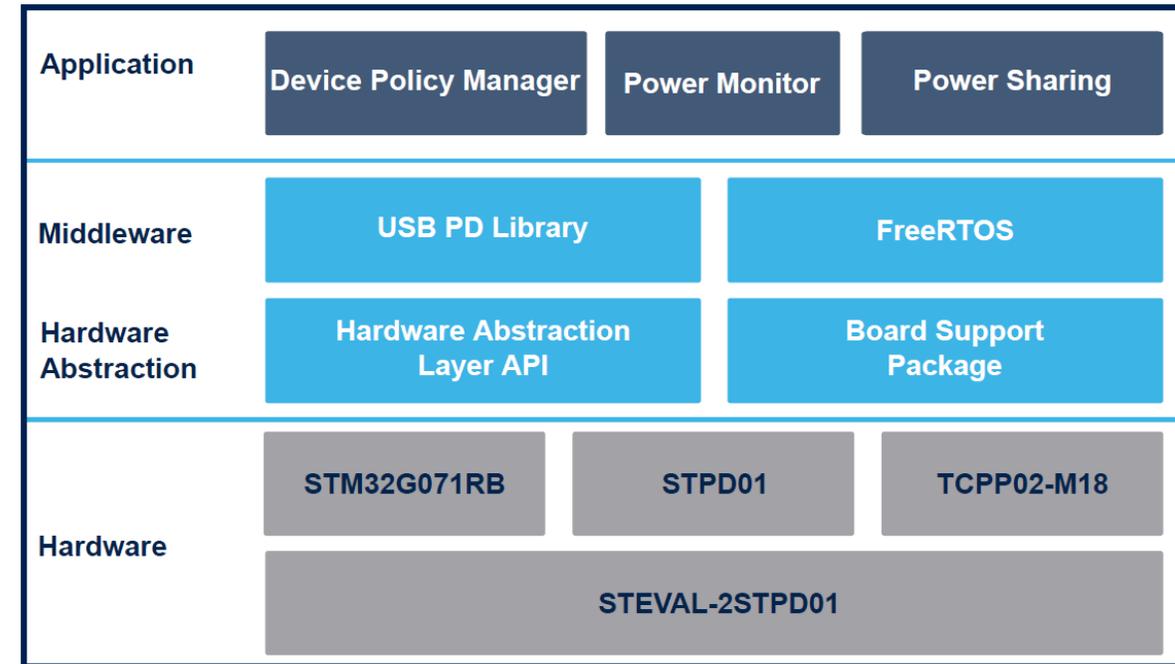
Setup & programming the STEVAL-2STPD01

STEVAL-2STPD01 Input Power

- **Available Input Power**:

  – The board has been designed to offer 60W for each port, with the largest list of available PDOs: 20V, 15V, 9V and 5V @ 3A.

  – To permit the board to provide the max rated power (120W), the minimum available input power must be >144W, with a minimum voltage of 21V.

  – The board can be supplied through two different connectors:

    – The DC Power Jack J800 that can absorb 5A maximum.

    – The DC Power Connector J801 able to sustain more than 10A.
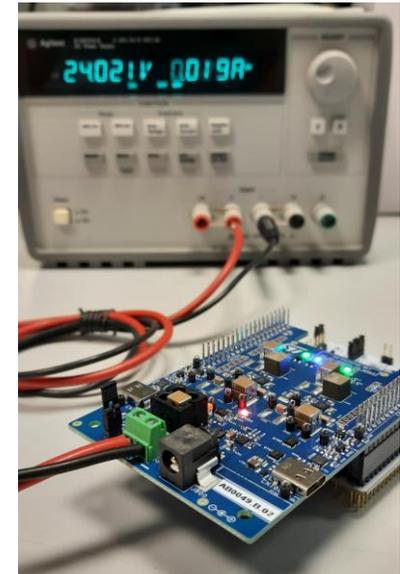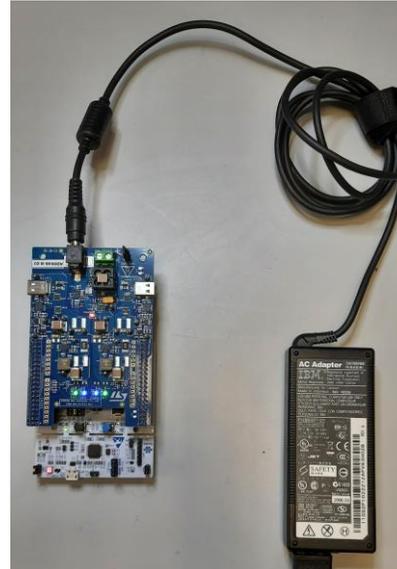
How to Setup the STEVAL-2STPD01

Instructions:

- Unpack and turn-on the STEVAL-2STPD01: the board has been already programmed for you!

- Connect the board to a DC source through the DC Power Jack (J800) or the DC Power Connector (J801)**(*)**.

- First the red LED D201 tuns ON and, the LED LD4 on the NUCLEO-G071RB board starts to blink fast.

- After few milliseconds, the application runs turning ON all the LEDs (D400, D401, D600 and D601) on the expansion board, and the LED LD4 on the NUCLEO-G071RB board starts to blink slowly.

- If the power supply isn't rated as 24V, 6A (i.e. Default value saved in the STM32G071RB Flash), the Input Power Setting (Voltage and Current) must be fixed in the application setting values (see next slide).

- Finally, the board is ready to be connected to one or two Sink platforms.

(*): *a 24V,6A DC power supply, universal input AC 110-240V (branded Arotelicht, model CJ-2460) has been used to generate up to 60W per port*

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How to Setup the Input Power in the STEVAL-2STPD01 (1/2)

Instructions

This procedure permits to set the Input Power data different from the Default value (24V, 6A), to be compliant with the user power supply specification:

- Download and install the STM32CubeMonitor-UCPD from the ST site.

- Connect the power supply to one of the two STEVAL-2STPD01 power connectors (J800 or J801)

- Connect the NUCLEO-G071RB USB_STLINK CN2 connector (of the STEVAL-2STPD01), to the PC through a micro-B USB cable.

- Open the STM32CubeMonitor-UCPD program

- Select the board STEVAL-2STPD01

- Select one Port (1 or 2)

How to Setup the Input Power in the STEVAL-2STPD01 (2/2)

Instructions:

- Select **Send free test**

- Set new Voltage and Current writing in the box

To set the new Voltage and Current is enough to write in the free text box:

V=XX[.X] C=YY[.Y]

example:

V=22.5 C=5.0

- Press **Send message to connected Port**

How to run the demo with the STEVAL-2STPD01

- Connect two USBPD Sink platforms (as USBPD smartphones) to the two ports by using two Type-C to Type-C cable,

- For each port, the STEVAL-2STPD01 provides the PDO requested by the attached Sink.

- At the maximum power input, the STEVAL-2STPD01 can provide up to 60W for each port.

How to re-program the STEVAL-2STPD01

- Verify the jumper JP2 on the NUCLEO-G071RB (of the STEVAL-2STPD01), fits 5-6 header pins, and J200 on the expansion board is fitted.

- Using a micro-B USB cable, connect the board thru the USB_STLINK CN2 connector to a laptop where has been pre-installed the STLINKV2 driver.

- Supply the board using an external power supply

- Program the board:
  - By dragging & dropping the new application binary from the project folder directory to the NUCLEO Mass Storage image on laptop OS application tree.
  - By using one of the available IDEs (STMicroelectronics STM32CubeIDE, IAR EWARM or Keil µVision / MDK-ARM).

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How to debug with STM32CubeIDE

The FW package allows the use of 3 IDE:
- STMicroelectronics STM32CubeIDE
- IAR EWARM
- Keil μVision / MDK-ARM

- STM32CubeIDE is an advanced C/C++ development platform from STMicroelectronics with many useful features

- Open the project, browse the STM32CubeIDE folder and open the available .project file. The path is:

  $/Firmware/Projects/STEVAL-2STPD01/STM32CubeIDE

- User can debug/modify the code using the IDE features
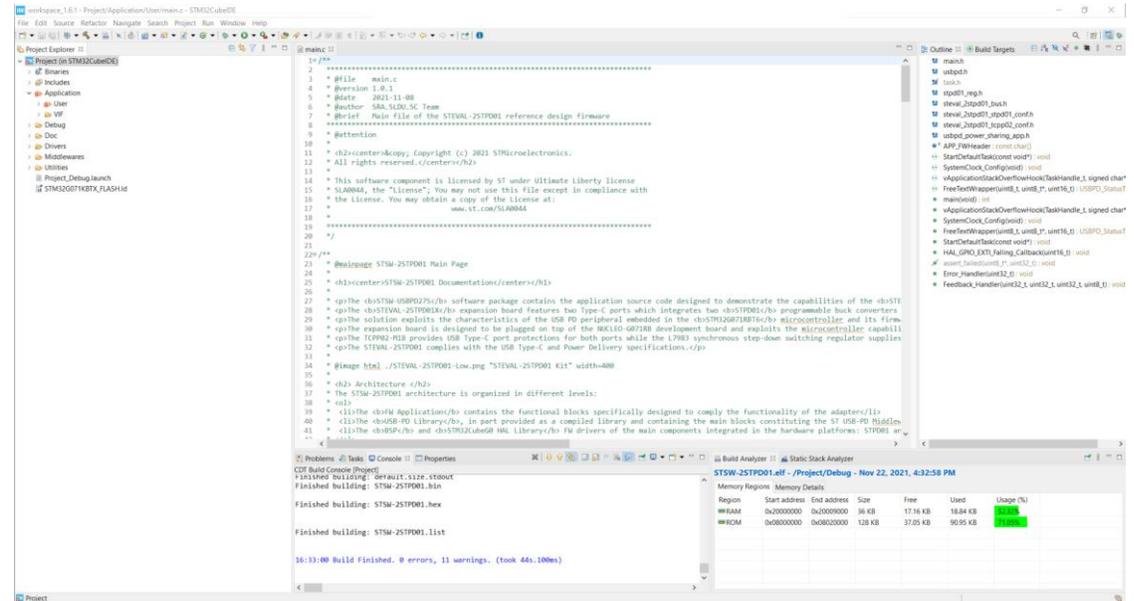
Monitoring and data logging with the STEVAL-2STPD01

How to quick test the STEVAL-2STPD01 (1/2)

- The STM32G071B-DISCO can easily interact with the STEVAL-2STPD01.

- Basic operations can be performed:

  - Profile requests

  - Control Messages

- The user can check bus the operation conditions in real-time, connecting it to one or both ports.

- STM32G071B-DISCO can also be used:

  - as a sniffer, to monitor a different Sink

  - with STM32CubeMonitor-UCPD to perform advanced testing
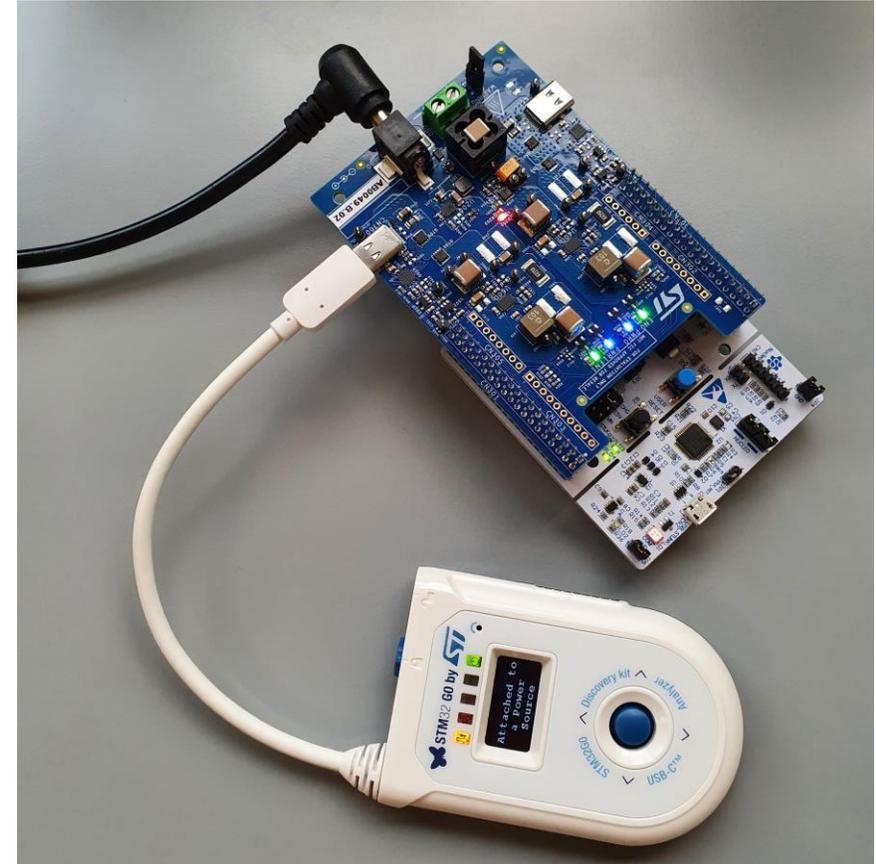
How to quick test the STEVAL-2STPD01 (2/2)

- After attaching the STM32G071B-DISCO to the STEVAL-2STPD01, the display shows the board's characteristics and features by clicking the blue joystick (on the right):
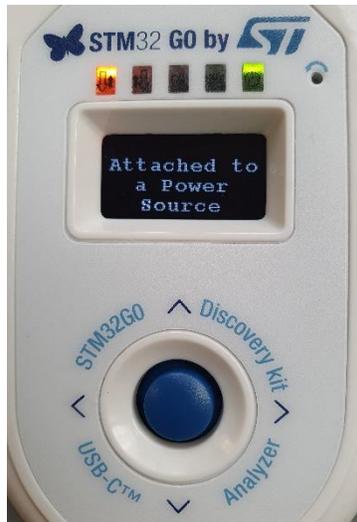
The display shows a USB-PD Source is "Attached"

The display shows the versioning of the adopted PD specification (PD3.0)

The display shows the number of PDO associated to the attached port, and the max available power

(Click 4 times for further information)
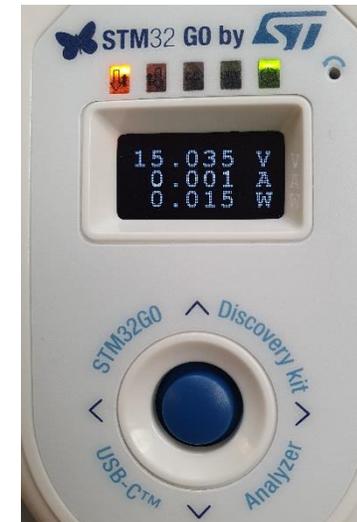
The display shows the selected PDO (provided by the Source) after the negotiation

The display shows the list of PDOs that the board can provide at the connected port.

Additional Information

Available Documents

- **STEVAL-2STPD01 Resources**

  - STEVAL-2STPD01 webpage

  - DB4525: STEVAL-2STPD01 Databrief

  - UM2880: STEVAL-2STPD01 Hardware User Manual

  - STSW-2STPD01 webpage

  - DB4512: STSW-2STPD01 Databrief

  - UM2882: STSW-2STPD01 Software User Manual

- **Main Products Resources**

  - STPD01 webpage

  - TCPP02-M18 webpage

- **USB-PD Resources**

  - UM2552: Managing USB power delivery systems with STM32 microcontrollers

  - AN5225: USB Type-C™ Power Delivery using STM32xx Series MCUs and STM32xxx Series MPUs

  - TA0357: Overview of USB Type-C and Power Delivery technologies

  - DB3747: STM32CubeMonitor-UCPDsoftware tool for USB Type-C™ Power Delivery port management

- **Programming tools Resources**

  - DB3871: STM32CubeIDEIntegrated Development Environment for STM32

  - DB3737: STLINK-V3MINImini debugger/programmer for STM32

- **STM32G071-Discovery**

  - DB3726: STM32G071B-DISCOSTM32G0 Discovery kit for USB Type-C™ and Power Delivery