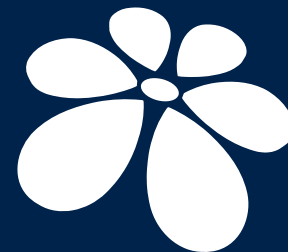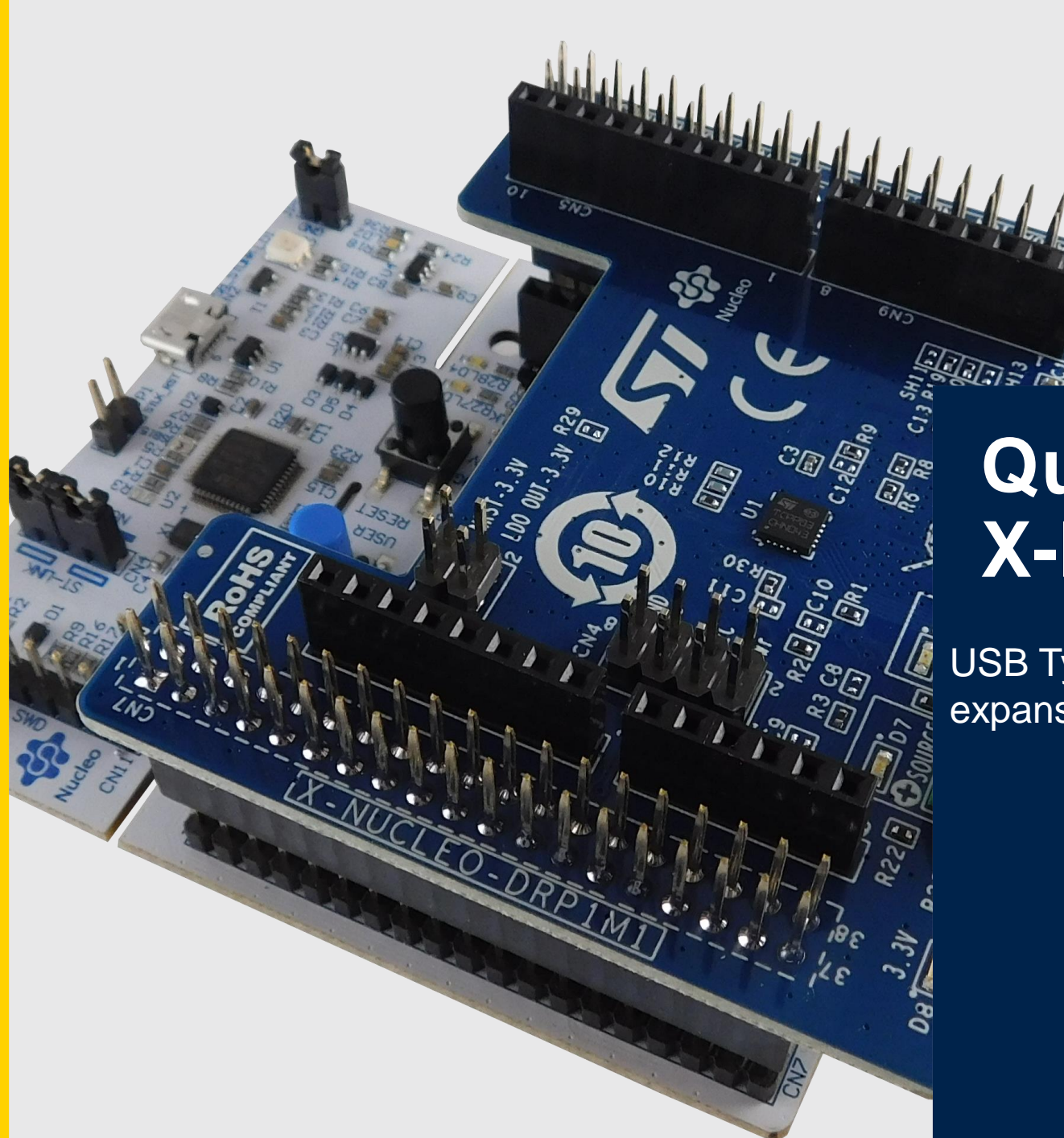# Quick Start Guide
X-NUCLEO-DRP1M1

USB Type-C Power Delivery DRP (Dual Role Power) expansion board based on TCPP03-M20 for STM32 Nucleo

STM32 Open **D**evelopment **E**nvironment

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STM32 Open Development Environment: Overview

USB Type-C Power Delivery DRP expansion board

Hardware overview 1/2

Hardware Description

The X-NUCLEO-DRP1M1 is an STM32 Nucleo expansion board to develop USB Type-C & Power Delivery Dual Role Power (DRP) applications with STM32 MCUs and companion Type-C Port Protection TCPP03-M20. This expansion board works with STM32 Nucleo development boards that embed the UCPD peripheral.

Main Features:

- USB Type-C reversible connector

- Adjustable overvoltage protection (OVP) on V_{BUS} & adjustable overcurrent protection (OCP) on V_{BUS}

- Surge protection and system-level ESD protection on V_{BUS}

- Overvoltage protection (OVP) on CC lines against short-to-V_{BUS}

- System-level ESD protection on CC lines

- Discharge on V_{BUS}, current sense on V_{BUS}

- Several power modes for battery-operated, allowing zero current consumption when no cable is attached on SINK mode and 3µA consumption when no cable attached on DRP mode

- Integrated "dead battery" management for fully depleted battery devices

- Over temperature protection (OTP)

- Compliant with the latest USB Type-C and USB power delivery standards

- Compliant with Programmable Power Supply (PPS)

Key Products on the Nucleo expansion board:

TCPP03-M30:
Protection for USB-C or Power Delivery

ESDA25P35-1U1M:
High-power transient voltage suppressor (TVS)
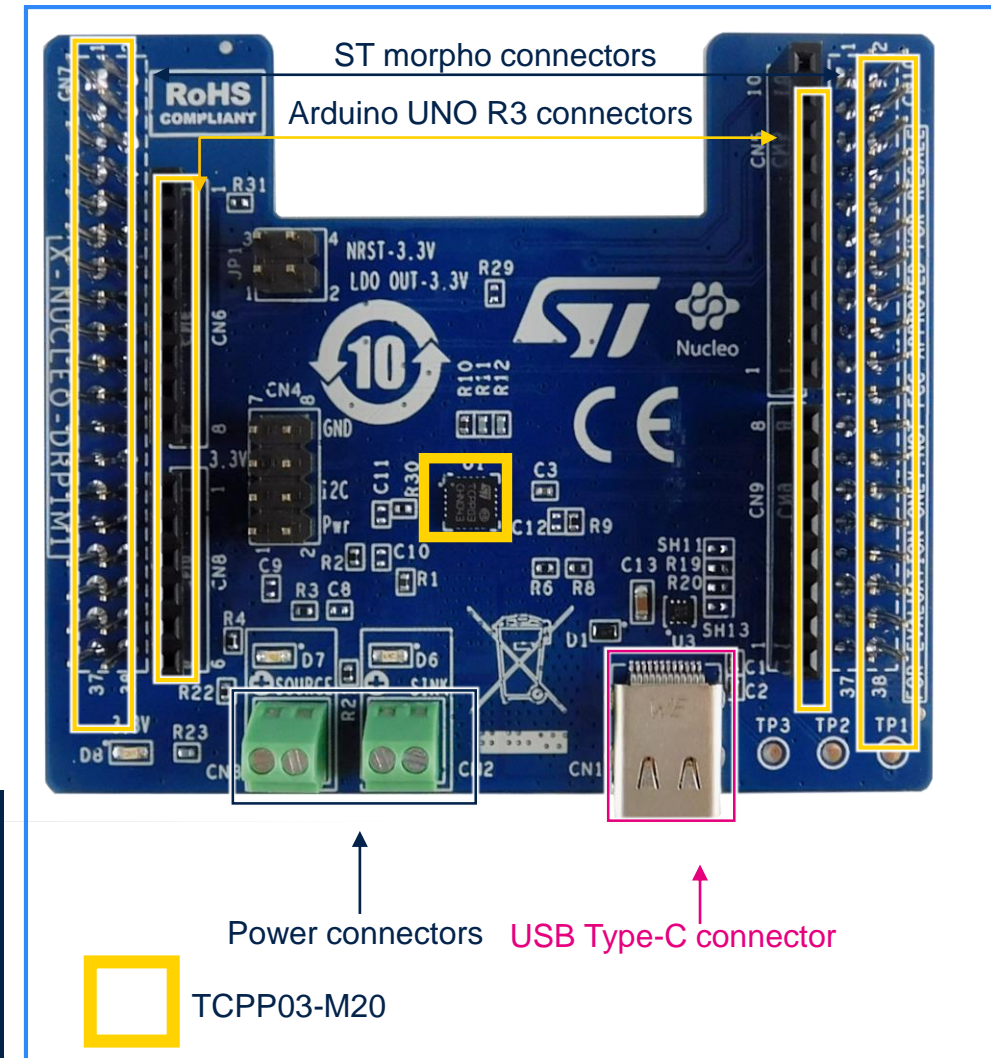
ECMF02-2AMX6:
Common-mode filter and ESD protection for USB 2.0

STL40DN3LLH5:
Dual N-channel MOSFET 30 V, 0.016 Ω typ., 40 A

ST morpho connectors

Arduino UNO R3 connectors

Power connectors   USB Type-C connector

☐ TCPP03-M20

USB Type-C Power Delivery DRP expansion board
Hardware overview 2/2

Interface configuration
(JP1)

Top view

SOURCE interface
(JP2)

Bottom view

V_{BUS} OVP voltage
selection table
(22V default)

P Max	Vbus Max
100W	22V
45W	17V
36W	13V
27W	10V
13W	6V
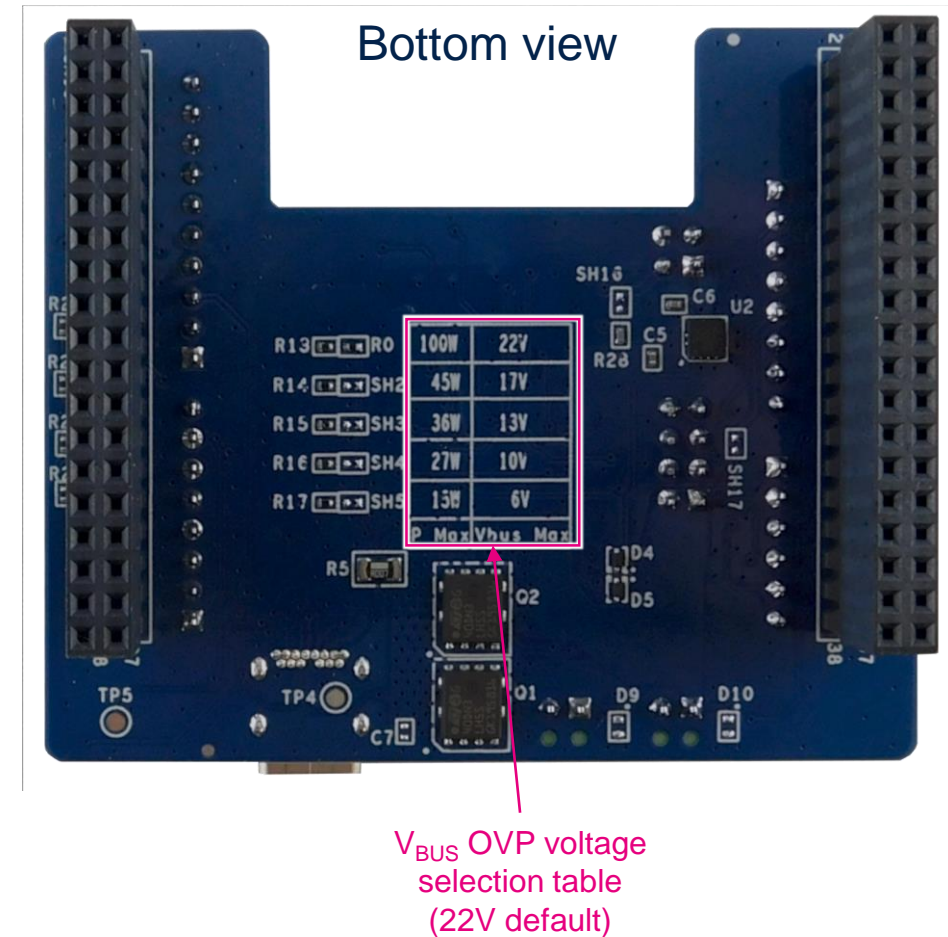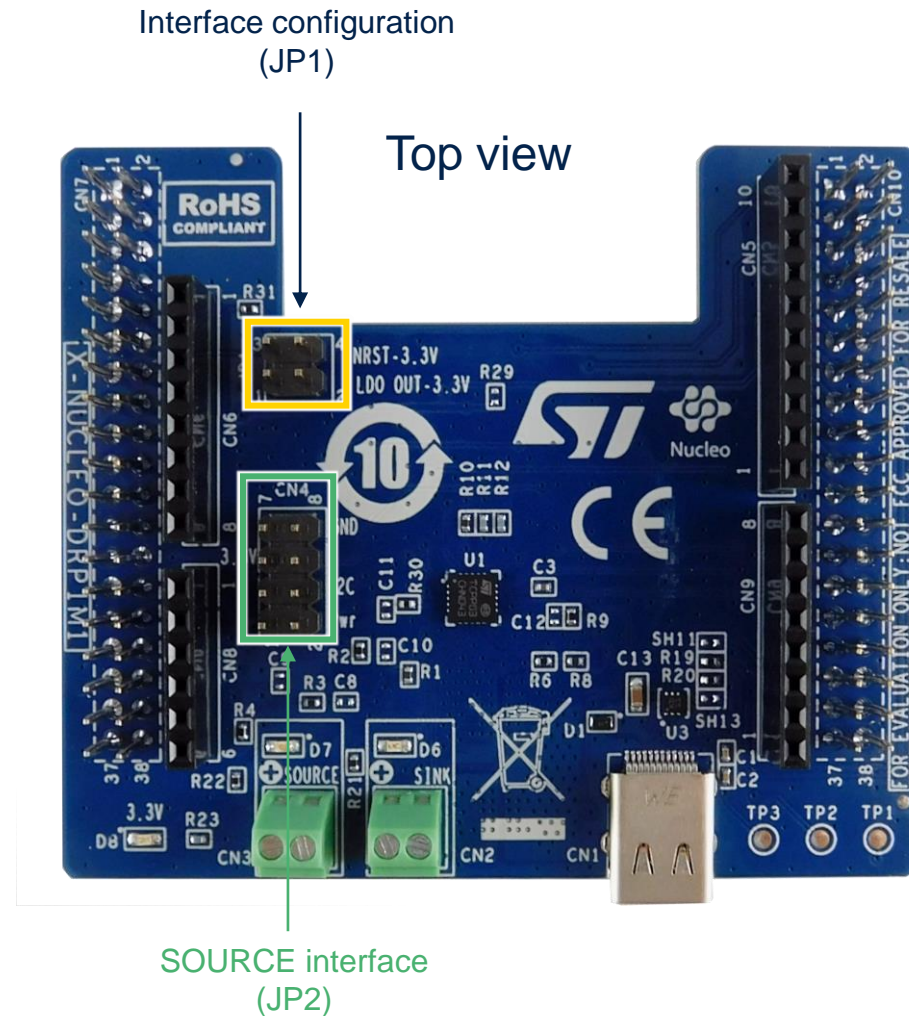
Click here to check pin
configuration tables

USB Type-C Power Delivery DRP expansion board
SW architecture overview

Software Description:

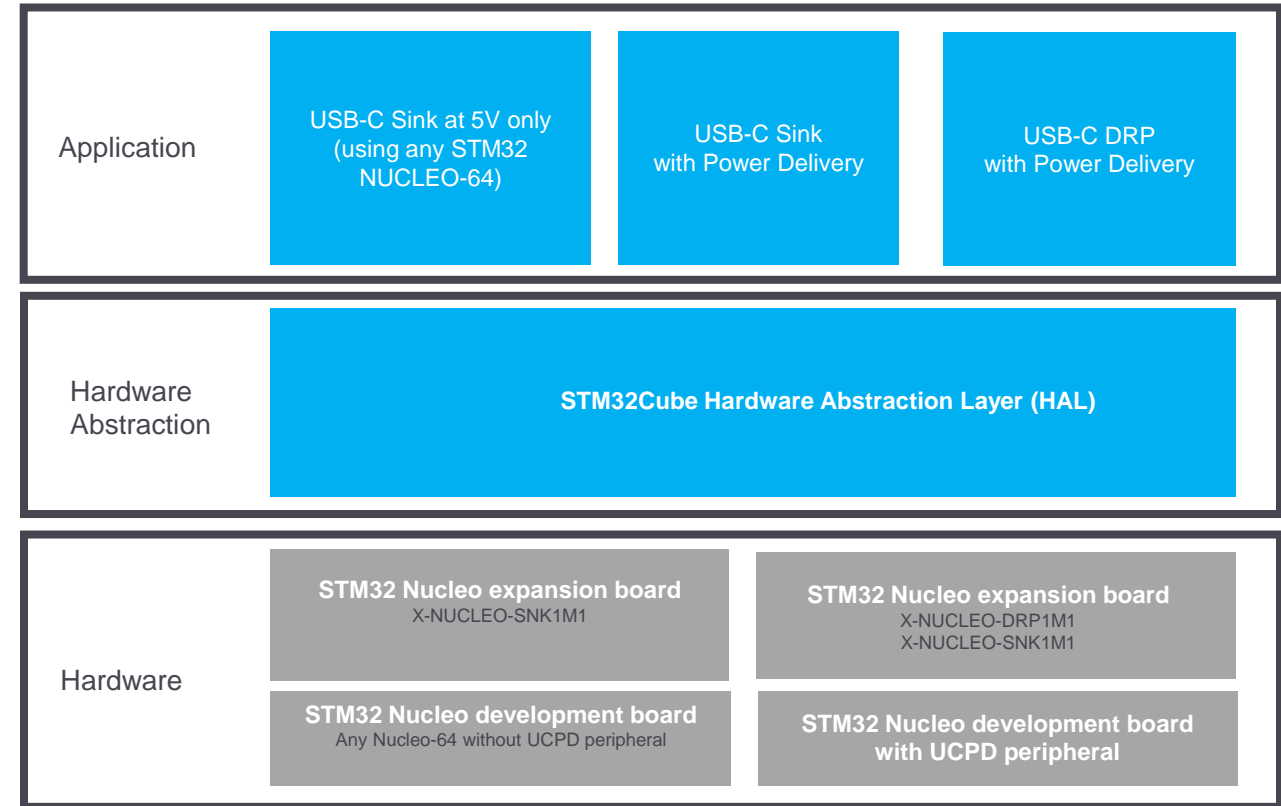The X-CUBE-TCPP software package contains the demo application examples for the USB Type-C DRP expansion boards for STM32 Nucleo (X-NUCLEO-DRP1M1) featuring the TCPP03-M20 USB Type-C port protection device.

- The expansion board is plugged onto an STM32 Nucleo development board (any STM32 development board, NUCLEO-G071RB or NUCLEO-G474RE) with an STM32 Nucleo-64 with UCPD peripheral microcontroller that executes the code.

- X-NUCLEO-SNK1M1 or X-NUCLEO-DRP1M1 USB Type-C receptacle can be connected to any Type-C source. The X-CUBE-TCPP selects the highest and closest power profile to the value indicated by the binary file from the power profiles available on the source.

- Product summary The X-CUBE-TCPP can be downloaded from www.st.com or GitHub.

Key Features:

- Binary and source code application example files for the X-NUCLEO-DRP1M1 USB Type-C Power Delivery DRP expansion board

- USB-C&PD capabilities and USB2.0 data operation with NUCLEO-G474RE development board

- Package compatible with STM32CubeMX

- Free user-friendly license terms

Application	USB-C Sink at 5V only (using any STM32 NUCLEO-64)	USB-C Sink with Power Delivery	USB-C DRP with Power Delivery

Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)

Hardware	STM32 Nucleo expansion board X-NUCLEO-SNK1M1	STM32 Nucleo expansion board X-NUCLEO-DRP1M1 X-NUCLEO-SNK1M1
	STM32 Nucleo development board Any Nucleo-64 without UCPD peripheral	STM32 Nucleo development board with UCPD peripheral

Latest info available at www.st.com
X-CUBE-TCPP

life.augmented

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Demo Example: battery powered DRP application with STM32G474RE

- 1x USB-C Power Delivery DRP expansion board (**X-NUCLEO-DRP1M1**)

- 1x STM32 Nucleo development board (**NUCLEO-G474RE or NUCLEO-G071RB or NUCLEO-G0B1RE)**

- 1x USB type A to micro-B cable

- 1x Laptop/PC with Windows 7, 8 or above

- 1x USB Type-C cable

- 1x any USB Type-C wall charger

- 1x any 5V – 1.5A (or higher current) voltage power supply

X-NUCLEO-DRP1M1

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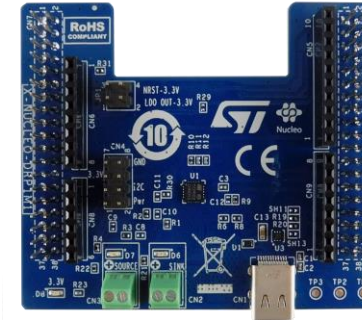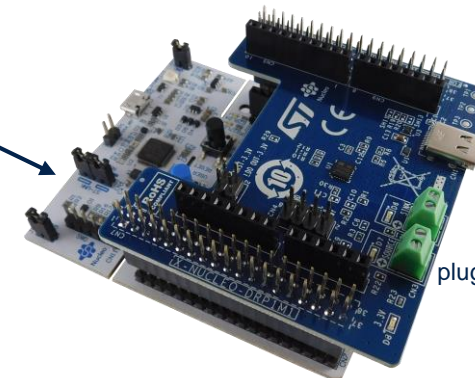NUCLEO-G071RB or
NUCLEO-G474RE or
NUCLEO-G0B1RE

X-NUCLEO-DRPM1
plugged on to a compatible STM32 Nucleo board

USB type A to
micro-B cable

USB type-C cable

USB type-C wall charger

Any 5V source

Demo Example: battery powered DRP application with STM32G474RE
SW pre-requisites
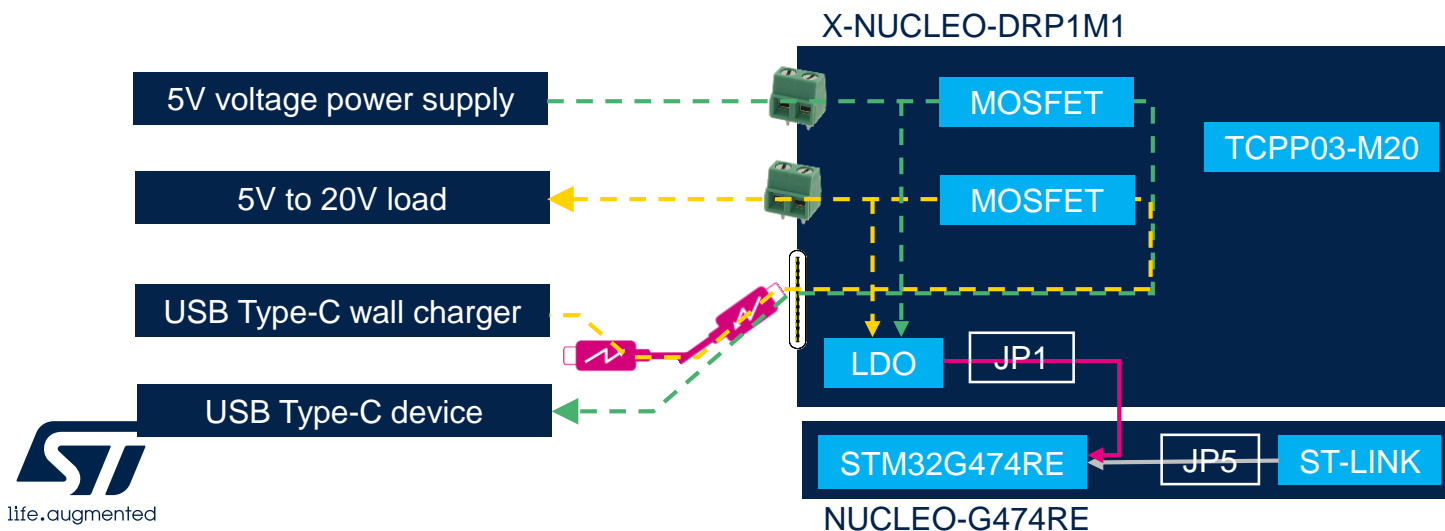
- STM32CubeIDE: All-in-one multi-OS software tool for programming STM32 products or STSW-LINK009: ST-LINK/V2-1 USB driver

- STM32CubeMonUCPD: Monitoring and configuration software tool for STM32 USB-C and Power Delivery 3.0 applications

- X-CUBE-TCPP: software package including the application examples for NUCLEO-G071RB, NUCLEO-G474RE or NUCLEO-G0B1RE to be associated to X-NUCLEO-DRP1M1

Demo Example: battery powered DRP application with STM32G474RE

- Programming mode:
  - STM32G474RE is powered by ST-LINK
  - STM32G474RE power supply is always present because ST-LINK power is connected

- System validation (realistic case):
  - STM32G474RE is powered by system:
    - The battery (5V voltage power supply) or
    - Type-C™ connector (USB Type-C™ wall charger)
  - When battery is empty and no source on Type-C™ connector, STM32G474RE is unpowered
  - STM32G474RE cannot be programmed because ST-LINK does not supply the system (STM32CubeMonUCPD still functional)

X-NUCLEO-DRP1M1

| 5V voltage power supply |
| 5V to 20V load |
| USB Type-C wall charger |
| USB Type-C device |

MOSFET

TCPP03-M20

MOSFET

LDO   JP1

STM32G474RE   JP5   ST-LINK

NUCLEO-G474RE

Power path:
- Consumer
- Provider
- STM32G474RE powered by ST-LINK
- STM32G474RE powered by system

Demo Example: battery powered DRP application with STM32G474RE

HW configuration:
1. X-NUCLEO-DRP1M1: no jumper
2. NUCLEO-G474RE :
    - JP5: 5V_STLINK jumper to select 5V from ST-LINK USB as power source for STM32G747RE
    - JP8: 1-2 jumper to select 5V as reference voltage initiator
3. Connect USB type A to micro-USB cable to NUCLEO-G474RE board

SW programming / monitoring:
- Drag and drop: G4_DRP1M1_DRP.bin to NUCLEO-G474RE NODE (or use IDE for programming)
1. Monitor with STM32CubeMonUCPD

Applicative use cases:

1. Battery working (5V source connected on SOURCE connector) and SINK device connected to Type-C connector
    - SINK device can be a smartphone, USB key, Hard drive, accessory, …
    - SINK device is being supplied and STM32CubeMonUCPD indicates 5V and the associated current
    - 3.3V LED ON, SOURCE LED ON

2. Battery working (5V source connected on SOURCE connector) and SOURCE device connected to Type-C connector
    - SOURCE device (wall adapter as example) presents its highest voltage available on the SOURCE indicated by STM32CubeMonUSCPD
    - 3.3V LED ON, SOURCE LED ON, SINK LED ON

3. Battery empty (no source connected on SOURCE connector) and no SOURCE device connected to Type-C connector
    - Cannot be done. STLINK used for programming STM32G474RE powers STM32G474RE continuously
    - 3.3V LED ON while it should be OFF

4. Battery empty (no source connected on SOURCE connector) and SOURCE device connected to Type-C connector
    - SOURCE device (wall adapter as example) presents its highest voltage available on the SOURCE indicated by STM32CubeMonUSCPD
    - 3.3V LED ON, SOURCE LED OFF, SINK LED ON

Demo Example: battery powered DRP application with STM32G474RE

HW configuration:

1. X-NUCLEO-DRP1M1
   1. JP1: 2x jumpers LDO OUT - 3.3V and NRS - 3.3V to power STM32G474RE with 3.3V LDO output
2. NUCLEO-G474RE :
   - JP5: no jumper
   - JP8: 2-3 jumper to select 3.3V as reference voltage initiator
3. Connect USB type A to micro-USB cable to NUCLEO-G474RE board

SW monitoring:

1. Monitor with STM32CubeMonUCPD

Applicative use cases:

1. Battery working (5V source connected on SOURCE connector) and SINK device connected to Type-C connector
   - SINK device can be a smartphone, USB key, Hard drive, accessory, …
   - SINK device is being supplied and STM32CubeMonUCPD indicates 5V and the associated current
   - 3.3V LED ON, SOURCE LED ON

2. Battery working (5V source connected on SOURCE connector) and SOURCE device connected to Type-C connector
   - SOURCE device (wall adapter as example) present its highest voltage available on the SOURCE indicated by STM32CubeMonUSCPD
   - 3.3V LED ON, SOURCE LED ON, SINK LED ON

3. Battery empty (no source connected on SOURCE connector) and no SOURCE device connected to Type-C connector
   - All LEDs OFF

4. Battery empty (no source connected on SOURCE connector) and SOURCE device connected to Type-C connector
   - SOURCE device (wall adapter as example) present its highest voltage available on the SOURCE indicated by STM32CubeMonUSCPD
   - 3.3V LED ON, SINK LED ON

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Documents & related resources

All documents are available in the DOCUMENTATION tab of the related products webpage

<u>X-NUCLEO-DRP1M1</u>:

- **DB4515:** USB Type-C™ Power Delivery dual role power (DRP) and dual role data (DRD) expansion board based on TCPP03-M20 for STM32 Nucleo – **Data Brief**

- **UM2891**: Getting started with the X-NUCLEO-DRP1M1 USB Type-C™ Power Delivery dual role port expansion board based on TCPP03-M20 for STM32 Nucleo - **User Manual**

- Schematics, Gerber files, BOM

<u>X-CUBE-TCPP</u>:

- **DB4442:** USB Type-C software expansion for STM32Cube – **Data Brief**

- **AN5418:** How to build a simple USB-PD sink application with STM32CubeMX – **Application Note**

TCPP03-M20 Related Resources

- **AN5225**: USB Type-C Power Delivery using STM32 MCUs and MPUs - **Application note**

- **TA0357**: Overview of USB Type-C™ and Power Delivery technologies - **Technical Article**

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STM32 Open Development Environment: Overview

FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

The STM32 Open Development Environment (ODE) is an **open**, **flexible**, **easy** and **affordable** way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs.

The STM32 ODE includes the following five elements:

○ STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer

○ STM32 Nucleo expansion boards. Boards with additional functionality to add sensing, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards

○ STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator

○ STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework

○ STM32Cube Function Packs. Set of function examples for some of the most common application cases built by leveraging the modularity and interoperability of STM32 Nucleo development boards and expansions, with STM32Cube software and expansions.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, mbed and GCC-based environments.

STM32 Nucleo development boards	STM32Cube development boards
STM32 Nucleo expansion boards (X-NUCLEO)	STM32Cube expansion software (X-CUBE)

Function Packs

STM32 Open Development Environment
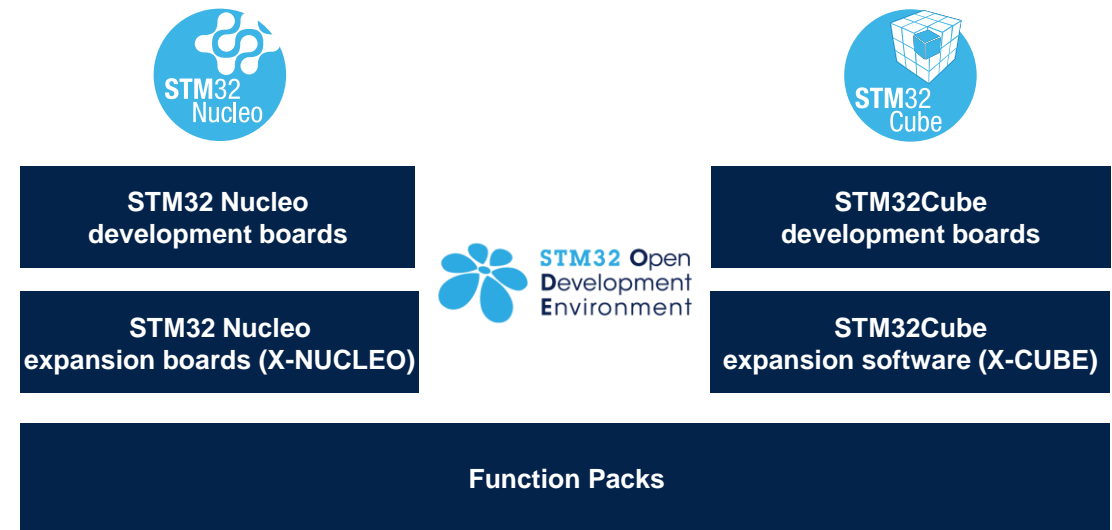
STM32 Open Development Environment: all that you need

The combination of a broad range of expandable boards based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

To start your design:

- Choose the appropriate STM32 Nucleo development board (MCU) and expansion (X-NUCLEO) boards (sensors, connectivity, audio, motor control etc.) for the functionality you need

- Select your development environment (IAR EWARM, Keil MDK, and GCC-based IDEs) and use the free STM32Cube tools and software.

- Download all the necessary software to run the functionality on the selected STM32 Nucleo expansion boards.

- Compile your design and upload it to the STM32 Nucleo development board.

- Then start developing and testing your application.

Software developed on the STM32 Open Development Environment prototyping hardware can be directly used in an advanced prototyping board or in and end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.

The building blocks	Your need	Our answer

Sense — Accelerometer, gyroscope, Inertial modules, magnetometer, Pressure, temperature, humidity, Proximity, microphone — COLLECT

Connect — Bluetooth LE, Sub-GHz radio, NFC, GNSS, IO-Link — TRANSMIT

HMI — Touch controller, LED drivers — ACCESS

Move — Stepper motor driver, DC & BLDC motor driver — ACTUATE

Power — Industrial input / output, Energy management & battery, USB — POWER

Process — General-purpose microcontrollers, Secure microcontrollers — PROCESS

Software

STM32 Open Development Environment

STM32 Cube

Power supply through USB or external source

STM32 microcontroller

Integrated debugging and programming ST-LINK probe

Complete product range from ultra-low power to high-performance

ST morpho extension header

Arduino™ UNO R3 extension headers

STM32 Nucleo