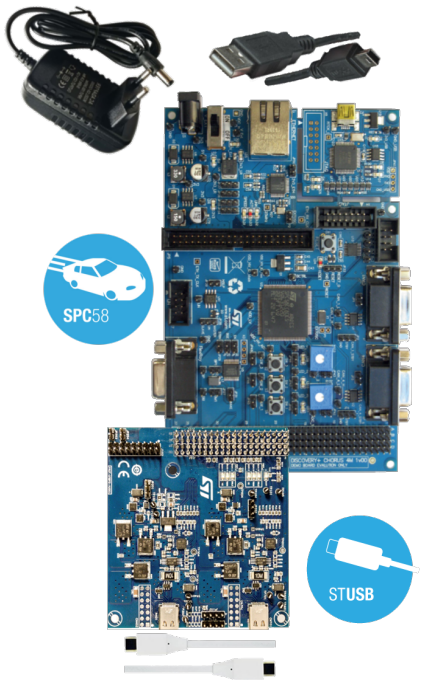
AEKD-USBTYPEC1

Data brief

USB Type-C™ and USB Power Delivery evaluation kit based on the automotive grade SPC58 MCU and AutoDevKit development initiative



Features

- Kit consisting of two boards:
  - Dual-port USB Type-C function board (AEK-USB-2TYPEC1)
  - SPC58 Chorus discovery board (SPC58EC-DISP)
- USB Power Delivery software stack pre-loaded on SPC58 discovery board
- Power board connector on USB function board
- Power Data Objects (PDO)
  - 5 V 500 mA available without external power board
  - other PDOs possible if a compatible power board (not included) is connected
- Downloadable (STSW-USB2TYPEC1) compiled flash image firmware
- Portion of connector on SPC58 Chorus discovery board available for extensions as part of the AutoDevKit development initiative
- All key ST components are qualified automotive grade
- RoHS compliant

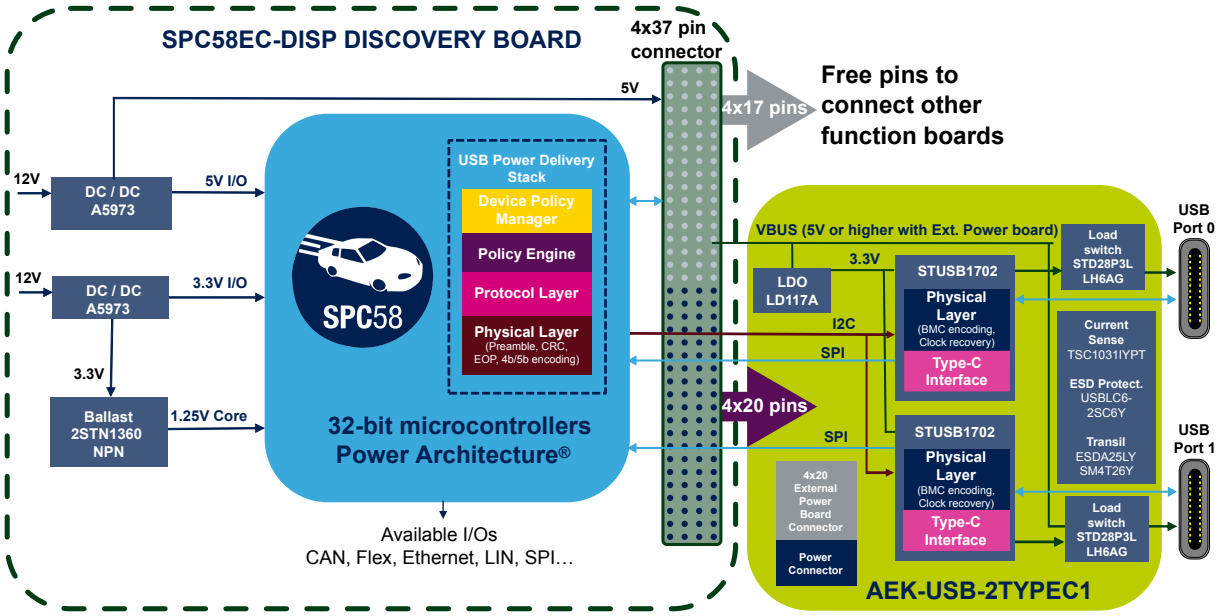
Description

The AEKD-USBTYPEC1 evaluation kit is designed to let you test the USB Power Delivery protocol stack implemented on the ASIL-B automotive grade 32-bit Power Architecture® microcontroller SPC58 C (Chorus) line (from 1 to 10 MB flash, single or multi-core, including ISO CAN FD and Ethernet peripherals).

Product summary	
dual-port USB Type-C function board	AEK-USB-2TYPEC1
SPC58 Chorus discovery board	SPC58EC-DISP
automotive grade USB Type-C controller (with Tx/Rx line driver and BMC)	STUSB1702
firmware package for the AEKD-USBTYPEC1 kit	STSW-USB2TYPEC1

1 Hardware architecture

Figure 1. **AEKD-USBTYPEC1 block diagram**



The AEKD-USBTYPEC1 kit includes the following components:

- SPC58EC-DISP discovery board
- AEK-USB-2TYPEC1 USB function board
- STSW-USB2TYPEC1 firmware
- USB Type-C to USB Type-C cable (not electrically marked)
- 12V 2A AC/DC power supply to power the SPC58EC-DISP board
- Type-A to Mini USB cable for Test mode screen output to the PC and board programming

The following optional components can be added separately:

- P-NUCLEO-USB001 or P-NUCLEO-USB002 system to simulate the Consumer role instead of a USB Type-C compatible mobile phone or a tablet.
- External power board to allow other PDOs.

1.1 USB function board - AEK-USB-2TYPEC1

The functional interface board hosts two STUSB1702 automotive grade USB Type-C controller with TX/RX line driver and BMC for the USB Type-C ports.

For each port, the status is signaled with a set of LEDs. Once the power profile is successfully negotiated between the Provider (AEKD-USBTYPEC1) and Consumer (USB Type-C and PD compatible device connected to one of the ports), a green LED signals that the Explicit state has been achieved.

For ESD protection, the board includes an ESDALY dual Transil™ array and very low capacitance USBLC6-2SC6Y. There are numerous test points on the board for debugging.

1.2 SPC58EC-DISP discovery board with SPC58 microcontroller

The SPC58EC-DISP discovery board hosts an SPC58 microcontroller and CAN, Flex and Ethernet ports, as well as a 4 x 37 pin connector which maps to most of the microcontroller I/O pins. You can assign different functions to one microcontroller pin (e.g., GPIO or Clock for SPI interface or Timer) with the SPC5 Studio GUI, which also supports the generation of .h configuration files from the pin setups established in the GUI.

2 ST's AutoDevKit development initiative

AutoDevKit governs the hardware and software connection between micro discovery boards and specific function boards for applications like stepper motor control, led control, etc.

Each function board has a dedicated driver with abstractions for the specific microcontroller peripherals to ensure portability between platforms. The drivers are SPC5 Studio plugins that are instantiated dynamically by the tool according to the microcontroller used for the development. The instantiation process generates the appropriate source code and indicates how a function board should be connected to the chosen discovery board.

2.1 AutoDevKit for AEKD-USBTYPEC1

The AEKD-USBTYPEC1 evaluation kit consists of a discovery board (SPC58EC-DISP) and a USB Type-C dual port interface function board (AEK-USB-2TYPEC1).

The 20x4 function board female connector on the function board is connected to the 4x37 male connector on the discovery board from the 18th pin to 37th pin. These pins cover the following purposes:

1. The connection between the USB function board and the discovery board.
2. The connection of a power board (not included in the demo kit) and the discovery board to be plugged on top of the function board 4x20 male connector.

Lines 1 to 17 on the discovery board 4x37 connector can be used to connect additional function boards according to the AutoDevKit development initiative.

3 USB Power Delivery overview

The USB Type-C and USB Power Delivery specifications allow smarter connectivity with fewer cables, less connectors and universal chargers. The Type-C connector supports all the features of previous standards, and ports can be configured to only supply power in a Provider role, only sink power in a Consumer role, or be able to switch between both in a Dual role.

Both data and power roles can be independently and dynamically swapped using the USB Power Delivery protocol.

Most automotive applications require support for the Provider role only. When a USB device is connected, the Provider and the device (Consumer) negotiate a contract for the power objects through configuration channels.

The message exchange between Provider and Consumer are listed below:

1. The Provider sends a `Source Capabilities` message to the Consumer, advertising its power capabilities.
2. The device then sends a `Request` for one of the advertised power profiles.
3. The provider accepts or rejects this request according to its power balance
4. If confirmed, provider sends as an `Accept` message to the device
5. The provider then switches to the requested power profile and sends a `PS_Ready` confirmation message

Each received message is acknowledged with a `GoodCRC` to confirm correct reception. Incorrect receptions are ignored and persistent communication errors should trigger a soft reset to re-establish communication. If the error persists, a hard reset is performed.

3.1 USB Power Delivery negotiation

Power negotiation between the Consumer and Provider passes through the STUSB1702 controllers, which assume the master role during SPI communication with the microcontroller. The STUSB1702 controllers are configured by the microcontroller via the I2C protocol.

The device that assumes the USB Power Delivery Consumer role might be a compatible mobile phone or a tablet that can accept the 5 V, 500 mA PDO. If an external power board is connected, the USB Power Delivery stack can select an alternative PDO and the microcontroller will configure the desired output by acting on the power board and driving the general purpose I/O's on the male connector on the AEK-USB-2TYPEC1 interface board.

Note: You can also use the P-NUCLEO-USB001 or P-NUCLEO-USB002 evaluation kit as a compatible USB power Consumer.

If the voltage switch on the port does not occur within a specific time-out (established by the USB PD specification), the STUSB1702 signals that there is no voltage output from the port, which triggers a system reset to re-start power negotiation. The addition of an external power board may therefore require appropriate modifications to the stack.

Note: The USB Type-C cable in the AEKD-USBTYPEC1 kit is not electronically marked and is not suitable for currents above 3 A; the cable does not support USB 3.1 Gen1 or USB 3.1 Gen2 signaling.

4 Software package - STSW-USB2TYPEC1

The default firmware is already loaded on the SPC58EC-DISP discovery board of the kit, but you can download it from the STSW-USB2TYPEC1 page on the ST website.

You can use the Universal Debug Engine® (UDE) to flash new USB-PD firmware onto the SPC58 microcontroller memory. The application is available for download from the SPC5-UDESTK-SW page on www.st.com.

In addition to the firmware, the software package contains the following SPC5 Studio resources for USB Power Delivery:

- an abstract driver for the STUSB1702 device
- an SPC5 Studio plugin for the USB Power Delivery software stack
- a demo application for a 5 V 500 mA PDO

4.1 How to open the SPC5 Studio project

The SPC5 Studio project gives you access to the USBPD library plugin source code. Follow the procedure below to open the project:

Step 1. Obtain a valid username and password: send an email to credentials@spc5studio.com and specify the following information:
  - your company name
  - your project
  - project target run-rate
  - the date

Step 2. Open SPC5 Studio

Step 3. Go to [**Help**]>[**Install new Software**] and then click the [**Add**] button

Step 4. Enter the text “USBPD” in the name field

Step 5. Enter “usbpd.spc5studio.com” in the location field

Step 6. Confirm the form

Step 7. Enter the username and password

4.2 How to program SPC58 microcontroller present on SPC58EC-DISP

Step 1. Download and install SPC5-UDESTK-SW USB/JTAG debugger from www.st.com

Step 2. Connect the mini-B USB cable between your PC and the SPC58EC-DISP discovery board

Step 3. Turn-on the discovery board

Step 4. Run the UDE application on your PC

Step 5. In the UDE program, [**Open**] file st_usbpd.wsx

You will find the .wsx file in the zip in the UDE directory.

A window appears.

Step 6. In the new window, press [**Program All**]

A confirmation message appears in the same window when the operation in complete. At this point, the firmware is flashed to the microcontroller memory.

Step 7. Exit the window

Step 8. Reset the SPC58EC-DISP discovery board to run the updated firmware

4.3 Configuration of the USB-PD library through SPC5-Studio

After you download the package, you can open the project in SPC5-Studio and configure certain settings before you flash the firmware to the discovery board:

- Enable or disable Port 1 (enabled by default).

Note: Port 0 is always enabled.

- Enable or disable hardware CRC (enabled by default). If it is disabled, a software version is used.
- Enable or disable LED signals (enabled by default).
- Enable or disable hardware Test mode (disabled by default), to check the hardware.
- Enable or disable additional PDOs. The PDOs must be compliant with the external power board connected. You can define the current capability and the port for each PDO.
- Configure a logic table to determine the microcontroller pin combinations required to switch between different power board supply voltages.

Table 1. Default logic table for Port 0 and Port1

Vout_x [V]	Port_sig1	Port_sig2	Port_sig3
5V	L	L	L
9V	H	L	L
15V	H	H	L
20V	H	H	H

If Test mode is enabled, you must connect a USB cable between the SPC58EC-DISP discovery board and your PC to print debug messages to a terminal window on your PC. Configure the corresponding COM port with 38400 baud and N81.

Revision history

Table 2. **Document revision history**

Date	Version	Changes
14-Jun-2018	1	Initial release.
16-Jul-2018	2	Minor text edits

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