User's Guide

Getting Started With TPS2674x-Q1

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ABSTRACT

This guide aims to aid in the initial development of systems leveraging the TPS2674x-Q1 family of automotive PD controllers. By the end of this document, the user should have access to the proper development tools and have a valid firmware image loaded to the device.

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Trademarks

1 Introduction

The TPS2674x-Q1 family of devices are a series of automotive grade USB Power Delivery (PD) controllers. The device integrates an Arm Cortex-M0+ core along with flash memory, a PD transceiver (physical layer), I2C interfaces, and GPIO pins in order to enable a working USB PD system. Texas Instruments provides a base firmware image that ensures the Power Delivery protocol is met. Settings specific to each system's requirements are configurable via a Graphical User Interface (GUI).

The PD system can be completed by adding a DC/DC converter to supply VBUS power. Additional peripheral circuits can be added to enable USB data and DisplayPort™ over USB-C®.

2 Accessing Development Resources

A handful of tools are available to aid in the PD development process. Access to these tools are available via the ti.com product page.

Tool	Description
Firmware Files	Firmware required for device operation. Device function is customized via the GUI according to the system requirements. Preconfigured examples are provided supporting compatible DCDC converters and different port power/voltage levels.
Graphical User Interface	Create a custom firmware configuration, generate the binary firmware image, and program the device.
TPS26742EQ1EVM	Evaluation module featuring TPS26742E-Q1 silicon and peripheral circuitry. May also be used to evaluate TPS26741-Q1, TPS26741E-Q1, and TPS26742-Q1 by swapping the IC.
TPS26744EQ1EVM	Evaluation module featuring TPS26744E-Q1 silicon and peripheral circuitry. May also be used to evaluate TPS26743E-Q1 by swapping the IC.
DCDC Daughtercard	DC/DC converter IC and circuitry required to generate VBUS for each port. Pairs with TPS26742EQ1EVM.
TI-PD-ANALYZER	PD traffic analysis tool for system debug.

Several documents are available providing greater depth on each of the topics discussed in this guide.

Document	Description
TPS26742EQ1 EVM User's Guide	Detailed walk-through of the design and function of the TPS26742E-Q1 evaluation module.
TPS26744EQ1 EVM User's Guide	Detailed walk-through of the design and function of the TPS26744E-Q1 evaluation module.
Application Customization Tool User's Guide	How-to guide describing use of the GUI to customize firmware configurations and programming of the PD controller device.

2.1 TPS2674x-Q1 Evaluation Modules

Multiple evaluation modules supporting the TPS2674x-Q1 device family are available. The variants aid in developing different types of PD systems. Refer to the ti.com product page for EVM availability.

EVM Variant	Target Use Case
TPS26742EQ1EVM	Dual port charge only, up to 240W output per port
TPS26744EQ1EVM	Dual port charge + DisplayPort Over Type-C, up to 140W output per port

To evaluate other devices in the TPS2674x-Q1 family, the primary IC can be swapped on the EVMs. To evaluate TPS26741-Q1, TPS26741E-Q1, or TPS26742-Q1, order the appropriate IC and populate to TPS26742EQ1EVM. To evaluate TPS26743E-Q1, order the IC and populate to TPS26744EQ1EVM.

2.2 DCDC Daughtercards

An external DC/DC converter is required to complete the PD system. Daughtercards featuring different TI converters are available to pair with TPS26742EQ1EVM. TPS26744EQ1EVM integrates two LM251772-Q1 converters, so no additional hardware is required. Consult the appropriate EVM User's Guide for details.

DCDC Daughtercard Variant	Target Use Case
LM251772EVM-PD	9V to 36V VIN, 5V to 48V VOUT up to 5A load current
LM72650QEVM	48V VIN, 5V to 36V VOUT up to 5A load current
BQ25858EVM / BQ25858BEVM	48V VIN, 5V to 48V VOUT up to 5A load current. One of each EVM is required for dual port systems.

2.3 TPS2674x-Q1 Firmware

TPS2674x-Q1 requires firmware to run the Arm Cortex-M0+ core. The firmware format is referred to as a TI Firmware Update (TFU) image. Texas Instruments provides the base firmware and configuration examples to aid initial system development.

The user may also create a custom configuration tailored to their system needs using the GUI. Consult the Application Customization Tool User's Guide for complete details. Once the base firmware and custom system configuration are combined into a TFU binary file, the final binary image can be flashed to the device.

2.4 Graphical User Interface

A GUI is used to configure the base firmware image according to the specific system requirements and flash the image to TPS2674x-Q1. This includes items such as external DCDC selection, port power capabilities, and temperature and voltage protection mechanism thresholds. This allows the user to apply TPS2674x according to their specific needs.

This Getting Started Guide provides instructions for flashing one of the preconfigured images. Refer to the Graphical User Interface User's Guide for detailed instructions regarding custom configurations.

To flash the device:

1. Power the EVM with a DC supply at the input screw terminal
2. Connect PC to EVM via USB cable
    a. Type-C, J16 for TPS26742EQ1EVM (with DCDC daughtercards connected)
    b. Type-B, J12 for TPS26744EQ1EVM
3. Open the TPS2674x-Q1 GUI

Once the GUI has loaded:

1. Ensure the EVM is recognized (bottom left).
2. If hardware is not recognized, reconfigure the COM port settings in the USB to I2C menu, Serial Port Settings.
3. Select "App Config." Choose the configuration binary file through the file explorer based on the EVM selected, connected DCDC converter(s) and power level. Click "Apply to GUI".
4. Select "Flash To Device," then "Flash to device from GUI generated TFU file." Click FLASH
5. If successful, the "Mode:," "Buildversion:," and "Version:," fields will all populate.
6. Cycle the input power.

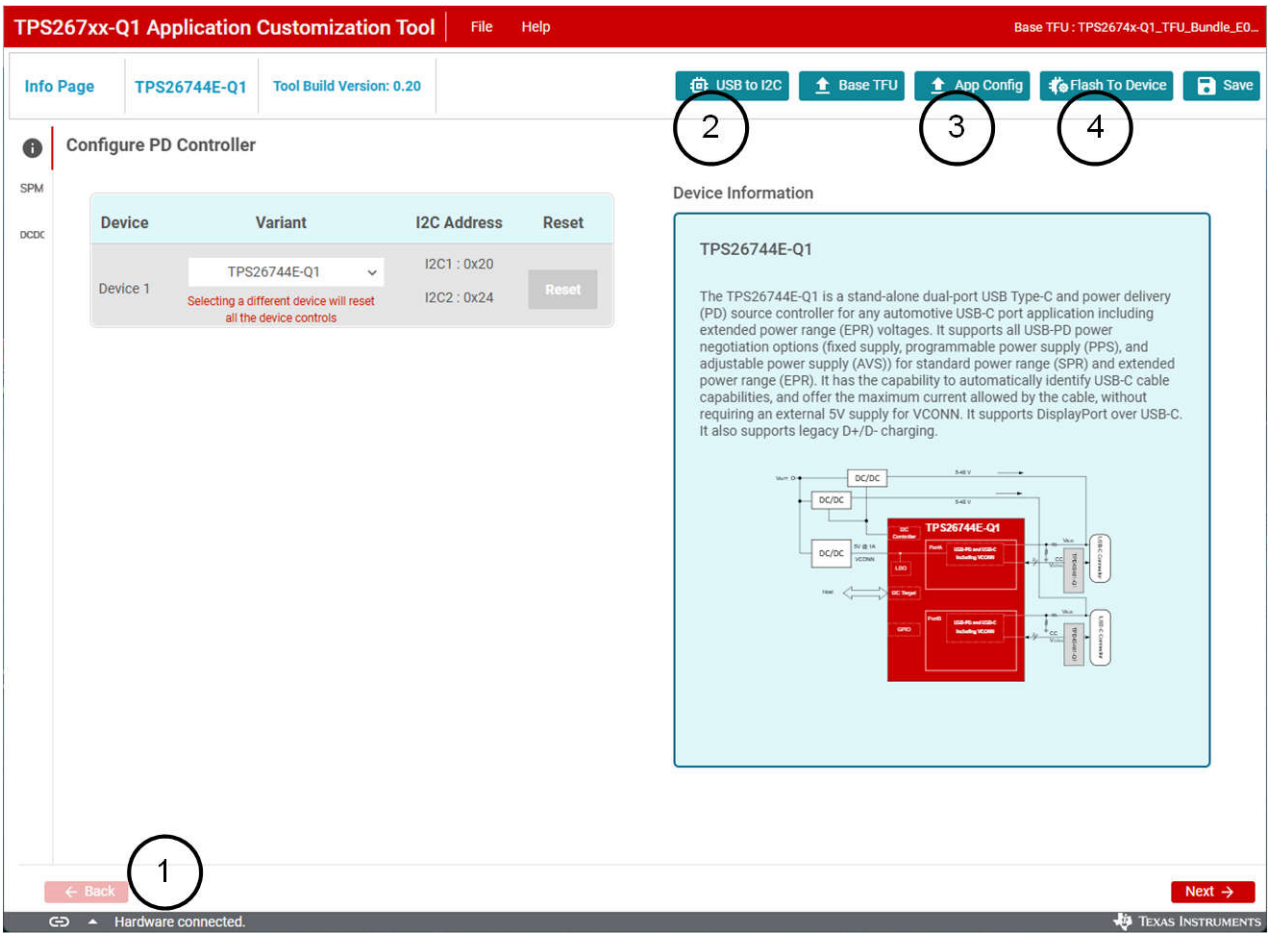

Figure 2-1. GUI Operations

3 Suggested Accessories

A few accessories are recommended to ease in the development and debug process of USB PD systems.

Using the EVM as a TI Firmware Update (TFU) Flash Programmer

TPS2674x-Q1 uses a secure command set for firmware flashing. Therefore, a USB to I2C bridge is required to take the binary firmware image from the PC to the target device.

This bridge is built into both TPS2674x-Q1 EVMs and can be used to flash custom hardware. Jumpers must be removed to disconnect the onboard IC from the I2C bus. Consult the appropriate EVM User's Guide for details.

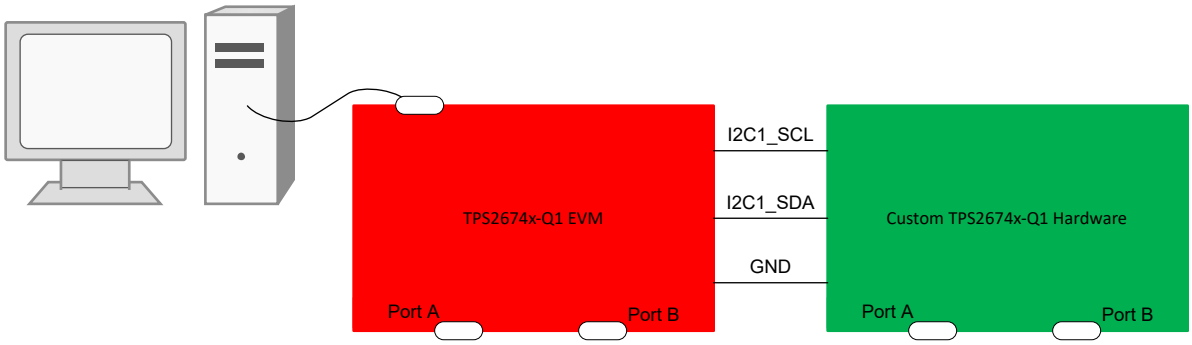

Figure 3-1. Firmware Update with TPS2674x-Q1 EVM

PD Trigger

A PD trigger is a device that is capable of connecting to the Type-C PD port and communicating with the source controller. This is primarily used to force a desired output voltage and current limit for testing purposes. Once the PD trigger is used to negotiate a PD contract, an electronic load can be used to validate the negotiated output capabilities. PassMark® PM125 or PM240 with firmware V4.7 or newer are also recommended and integrates a PD trigger and an electronic load. Older PD triggers may not be PD 3.2 compliant and thus may not function with TPS2674x-Q1.

4 Validation Tests

Port Advertisements test

Connect a PD trigger to the output Type-C port. The trigger will show the available PD contracts advertised by TPS2674x-Q1. These will match the GUI configuration as long as an over temperature or input voltage protection mechanism is not active.

Load test

Connect a PD trigger to the output Type-C port and an electronic load from VBUS to GND. Negotiate a desired contract using the PD trigger, then increase the load. The load will be supported indefinitely as long as a protection mechanism does not activate.

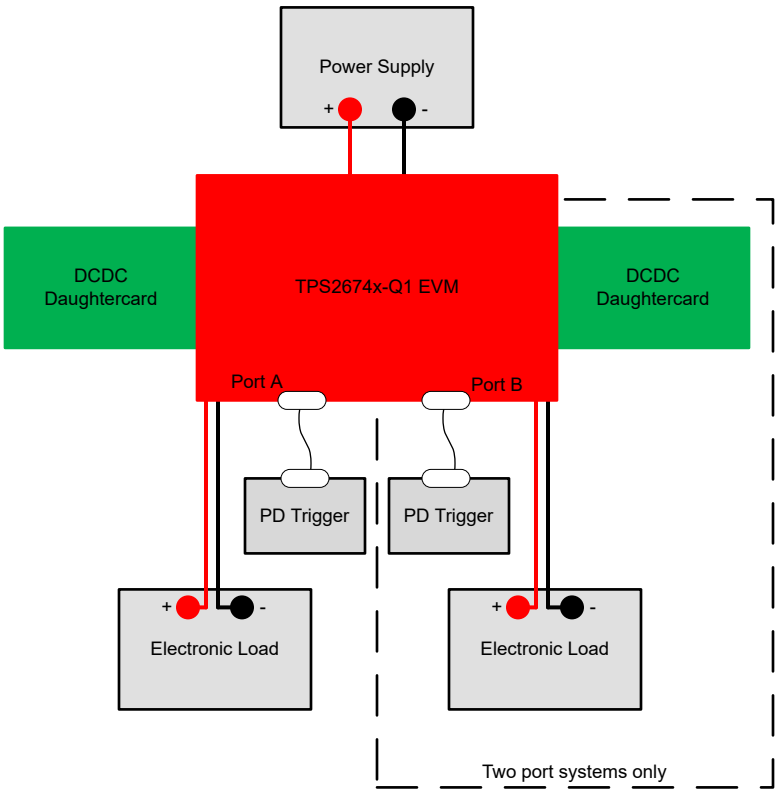

Figure 4-1. Validation Test Simplified Diagram

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