Application Report
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TPS6598x OCP Mechanism and Programming Guide

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ABSTRACT

This document describes the functionality of the overcurrent protection (OCP) mechanism of the TPS6598x device, and how to program it using the *Application Customization Tool*. This guide defines THE peak current and provides steps on how to set the threshold of OCP on the TPS6598x device.

NOTE: This tool replaces the TPS6598x Application-Customization Tool; therefore, TI recommends using this tool to receive the latest firmware and features.

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Trademarks

1 Introduction

The TPS6598x family of devices can be configured to set the OCP threshold of the device. Upon an OCP trip, the device sends out a command to discharge the voltage on VBUS.

1.1 Related Documents

- TPS65988 Dual Port USB Type-C & USB PD Controller, data sheet
- TPS65981, TPS65982, and TPS65986 Host Interface Technical Reference Manual

1.2 Hardware

The required hardware follows:

- Windows®-based PC with at least one USB 2.0 (or later) port
- TPS6598x-EVM
- Barrel jack, laptop charger, power-supply AC adapter (20 V)
- USB Micro-B to USB Standard-A cable (for the USB2.0 low-speed endpoint [USB EP] option)
- TotalPhase Aardvark USB-to-SPI/I2C Host adapter + USB standard-B to -A cable + jumper wires or LaunchPad™ EVM to Aardvark adapter (for the Aardvark option)

NOTE: Only one of the two adapter options is required: TotalPhase Aardvark or USB Micro-B to USB Standard-A cable. The hardware and setup are different depending on the adapter selected.

1.3 OCP Mechanism

The OCP mechanism is primarily set by application firmware. The ILIMPPHV register is configured so that currents which exceed the ILIMPPHV set point over an extended time result in an OCP fault in the system.

NOTE: The TPS6598X Application Customization Tool GUI sets the OCP limit as a hard-set value and does not follow the USB PD peak current specifications for variable overload capabilities in the USB PD document, Section 6.4.1.2.3.6. This means that the maximum current and peak current percentage together create the overall OCP threshold.

1.4 Recommended Default Settings

When using the TPS65988EVM, the base firmware in the Application Customization Tool automatically sets Peak Current to 100% and the Overcurrent Timeout to 1.28 ms.

2 Using the TPS6598x Application Configuration Tool Startup

See the Application Customization Tool User's Guide for the basics on start-up using the Application Configuration Tool.

3 Setting OCP Threshold on the TPS6598x

3.1 Setting OCP Peak Current Threshold

After the desired firmware is selected, use the following instructions to set the desired OCP threshold.

1. Click on the desired port to be programmed (Device 1, port X), as shown in Figure 1.

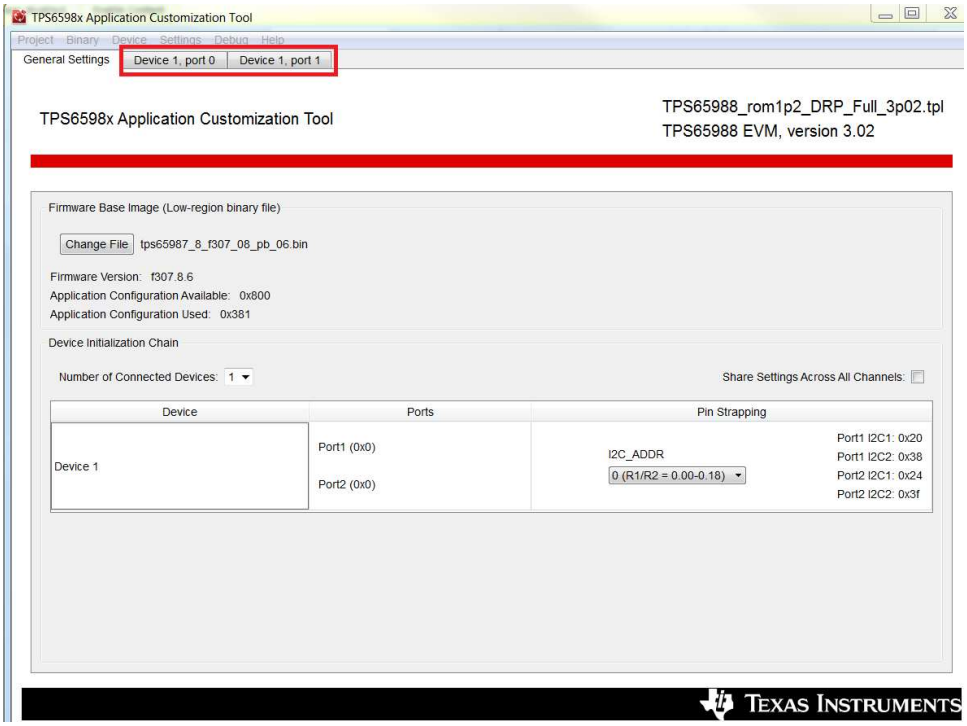

Figure 1. Main Window of TPS6598x Application Configuration Tool

2. Navigate to either Transmit Source Capabilities or Transmit Sink Capabilities, depending on the intended use case (see Figure 2).

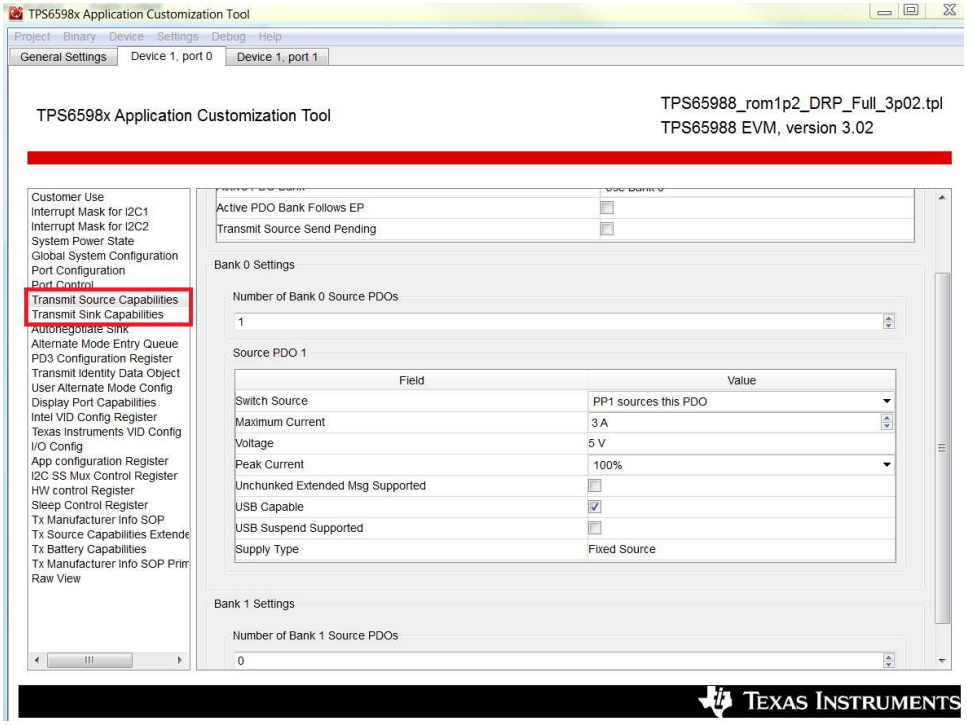

Figure 2. Transmit Source Capabilities Window

3. Click on the Peak Current drop-down box to configure the settings for the desired application (see Figure 3).

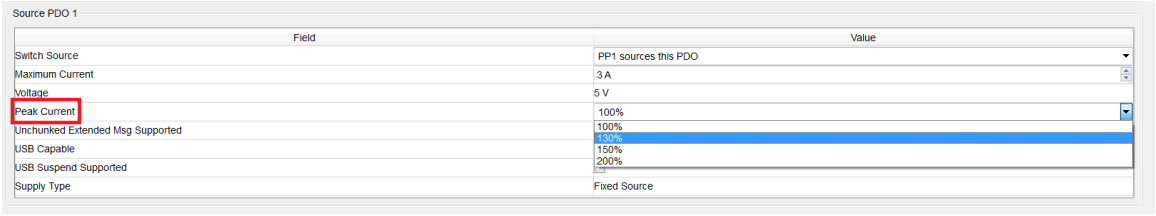

Figure 3. Peak Current Configuration Drop-down

3.2 Setting OCP Timeout Limit

The following instructions provide details on setting the desired OCP Timeout limit:

1. Navigate to Global System Configuration to configure the intended Overcurrent Timeout value. The drop-down box allows for multiple time-out configuration settings (see Figure 4).

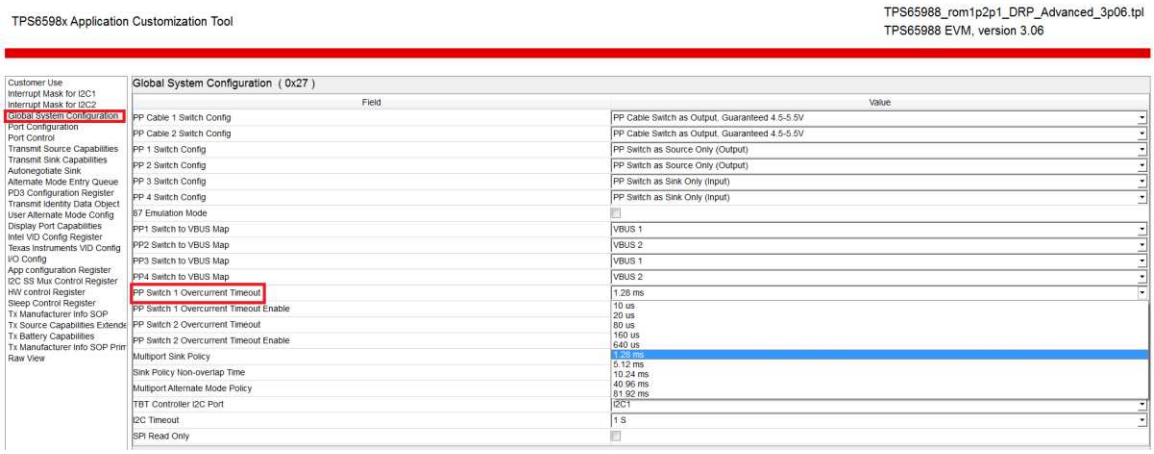

Figure 4. Global System Configuration Window

2. After setting the desired Overcurrent Timeout, click the Device menu and then select *Flash App Firmware to Device*.
3. Specify the appropriate adapter.

4. Click the Read Current Region Offsets button to automatically obtain correct offsets (optional), as shown in Figure 5.

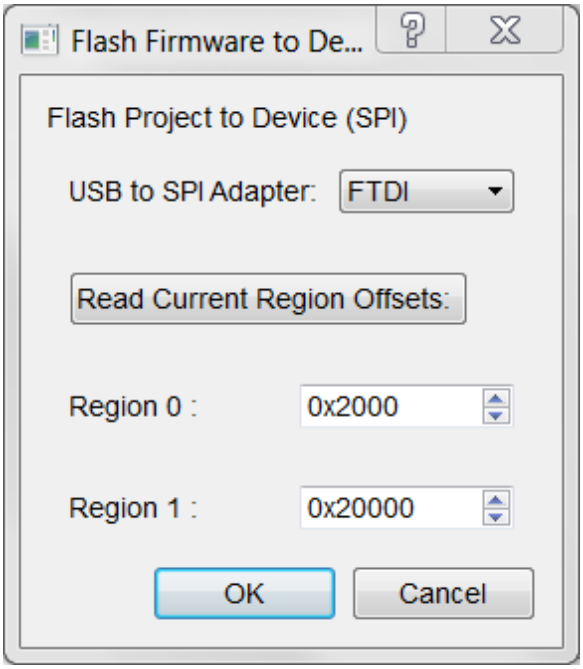

Figure 5. Load Application Firmware Window

5. Click OK. If successful, a window displays indicating a successful SPI Flash (see Figure 6).

Figure 6. Successful Flash Update

6. Reset the TPS6598x device to load the new firmware.

4 Results and Analysis

4.1 Test Procedure

To perform the OCP test, do the following:

1. Power the TPS65988EVM through the barrel jack or an external power supply.
2. Connect a UFP board to the TPS65988EVM through the USB Type-C cable. In the following test case, source PDO of TPS65988EVM was set to 5 V at 3 A.
3. Connect an oscilloscope probe onto the VBUS test point of the port that has a UFP board attached.
4. Set up an electronic load (e-load) between VBUS and GND on the UFP board.
5. Configure the oscilloscope to trigger off the negative edge of the VBUS probe line. This lets the user know when an OCP event has occurred.
6. When the test setup has been configured properly, press TRANS to set the current transition. This step controls the current level at which the e-load transitions. If the slew rate is too slow, go to SLEW and set an appropriate level to decrease the time each transition requires to reach the set high current.
7. Turn on the INPUT button to start using the e-load and loading the UFP board. At this point, an OCP event should be captured on the oscilloscope.

4.2 Test Results

Figure 7 shows the default OCP event waveform.

Figure 7. Default OCP Event Waveform

The waveform in Figure 7 has the following configuration flashed onto the TPS65988EVM:

- Voltage: 5 V
- Maximum current: 3 A
- Peak current: 100%
- PP switch Overcurrent Timeout: 1.28 ms

NOTE: The measurement cursors were set based on when the e-load went above the peak current programmed, to when the VBUS line responded by pulling the voltage to ground. In this example, the Overcurrent Timeout was measured to be 1.56 ms, which implies that some extra delay (approximately 300 µs) caused the time-out to be longer than expected. This falls within the expected time-out value, because the time it takes VBUS to pull low after an OCP event always includes some propagation and a synchronizer timing delay.

Figure 8 shows the default OCP event waveform scope.

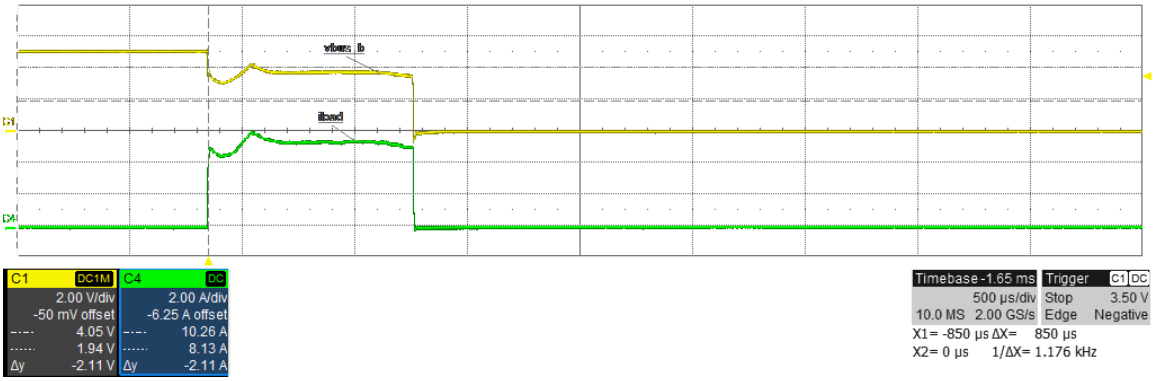

Figure 8. Default OCP Event Waveform (Scope)

The waveform in Figure 8 has the following configuration flashed onto the TPS65988EVM:

- Voltage: 5 V
- Maximum current: 3 A
- Peak current: 130%
- PP switch Overcurrent Timeout: 640 µs

NOTE: In this example, the Overcurrent Timeout was measured to be 850 µs, corresponding to the same delay issue of approximately 300 µs seen in the previous waveform (see Figure 7).

As previously shown, the OCP mechanism can be configured by accessing the Global System Register (0x27). The peak current and time delay can be adjusted to suit the application of the user.

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