ABSTRACT

This import guide describes how to extract a user’s application configurations from an existing TPS6598x device. The extracted application configurations can be reused with later versions of firmware using the TPS6598x Application Customization Tool which enables users to get more features and bug fixes while still retaining their application configuration.

Contents

1 Getting Started .................................................................................................................................. 2
  1.1 Purpose and Scope .......................................................................................................................... 2
  1.2 Hardware ........................................................................................................................................ 2
  1.3 Software .......................................................................................................................................... 2
2 Hardware Preparation and Flashing TPS6598x Firmware Image ................................................... 3
  2.1 Hardware Preparation .................................................................................................................... 3
  2.2 Flashing Old TPS6598x Firmware Image .................................................................................... 4
3 Using the TPS6598x Application Customization Tool ...................................................................... 6
  3.1 Starting a New Project .................................................................................................................... 7
  3.2 Device Settings .............................................................................................................................. 8
  3.3 Importing Configuration Settings from a TPS6598x .................................................................. 10
4 Sanity Check ....................................................................................................................................... 12
  4.1 System Setup ................................................................................................................................ 12
  4.2 Power-Delivery Contract Analysis ............................................................................................. 13

List of Figures

1 Aardvark Wired to SPI Pins of TPS65982-EVM (Top view of J2 and J3) ........................................ 3
2 Successful Configuration for FTDI ................................................................................................. 5
3 Successful SPI Flash Update ............................................................................................................ 6
4 Project Files ....................................................................................................................................... 7
5 TPS6598x Application Customization Tool With Intel Legacy Thunderbolt Project .................... 8
6 TPS6598x Default Device Settings ............................................................................................... 9
7 Saving GPIO Event Map and Miscellaneous Configuration Values ............................................. 10
8 Import Device Settings Window ...................................................................................................... 11
9 Successful Device Settings Import .................................................................................................. 11
10 Imported TPS6598x Custom Device Settings ............................................................................... 12
11 Setup for Basic Sanity Check .......................................................................................................... 13
12 PD-Contract Establishment Messages .......................................................................................... 14

List of Tables

1 I²C and SPI Pins on TPS65982-EVM ................................................................................................. 4
1 Getting Started

1.1 Purpose and Scope

This document describes how to port old TPS6598x firmware images to a newer firmware image, while retaining the user's custom configurations. Many of the old TPS6598x firmware images built using the TPS6598x Configuration Tool are older firmware versions which are depreciating. These older firmware images are not compatible with the newer TPS6598x Configuration Tool versions and therefore users cannot update them to make use of the latest firmware images.

To enable users to retain their configurations and use the latest versions of the firmware available, a new tool is being introduced by Texas Instruments known as TPS6598x Application Customization Tool. This tool can be used to customize and generate firmware images that can be loaded onto a TPS6598x device. This application report describes the procedure to update and configure a user's TPS6598x firmware images by importing application configuration settings from the user's TPS6598x device.

Details regarding each configuration setting are not within the scope of this guide. For information on which settings to choose for the user's application, refer to TPS65982 and TPS65986 Firmware User’s Guide (SLVUAH7).

1.2 Hardware

The following is a list of the required hardware. Different hardware is required depending on the selected adapter. See Section 4 for figures of each hardware setup.

- Windows-based PC with at least one USB2.0 (or later) port
- TPS6598x-EVM or user's custom board with TPS6598x
- Barrel-jack laptop-charger power-supply AC adapter (DC 20-V Output)
- TotalPhase Aardvark I²C/SPI Host Adapter (referred to simply as Aardvark) + USB Standard-A to Standard-B cable
- FTDI-based adapter board + USB micro-B to A cable

This application report describes how to write and read the firmware image using the TPS65982-EVM and Aardvark. For more information on acquiring the Aardvark HW or installing Aardvark drivers, refer to the TotalPhase website. To use these steps with a custom board, make the required hardware changes to bring out the SPI and I²C pins from the board to the Aardvark or FTDI-based adapter board. For information on using jumper wires to connect the TPS65982-EVM to the Aardvark or using the stand-alone TotalPhase SPI Flash update software, refer to the TPS65982-EVM User’s Guide.

1.3 Software

The required software packages are the TPS6598x Host Interface Tool and the TPS6598x Application Customization Tool (SLVUAR8).

Follow the installation instructions from the respective user guides to install each tool. Ensure that the drivers are installed by the Windows system automatically on connection of Aardvark or FTDI-based adapter board for the first time. The TPS6598x Host Interface Tool may not function correctly if the Aardvark or FTDI drivers are installed properly in the Windows system.
Hardware Preparation and Flashing TPS6598x Firmware Image

2.1 Hardware Preparation

Figure 1 shows the hardware setup that should be used. Connect the Aardvark pins to the correct pins of the two 20-pin connectors J2 and J3 connectors on the backside of TPS6598x-EVM. If a BoosterPack or other FTDI-based adapter board is used with two 20-pin connectors that match the TPS65982-EVM, ensure proper orientation of the two boards based on the barrel-jack connector of the TPS6598x-EVM being positioned near pin 1 of both J2 and J3.

![Aardvark (SPI Pins) Diagram]

Figure 1. Aardvark Wired to SPI Pins of TPS65982-EVM (Top view of J2 and J3)

Now connect a USB cable to the Aardvark and Windows PC with the appropriate plug ends. Also connect the powered barrel-jack laptop charger to TPS6598x-EVM.

2.1.1 Custom Board Setup

This section describes the steps to use a custom TPS65982 board to import the configuration settings using an Aardvark or FTDI-based adapter board. The Aardvark or an FTDI-based adapter uses I\(^2\)C and SPI lines to read and write registers in the TPS6598x device, and to burn the firmware and configuration image to the SPI flash.

If the custom board is used instead of TPS65982-EVM (shown in this document), the user must re-map the I\(^2\)C and SPI pins on the custom board to a header or custom connector. Table 1 lists the I\(^2\)C and SPI pins on the TPS65982-EVM.
Table 1. I²C and SPI Pins on TPS65982-EVM

<table>
<thead>
<tr>
<th>Net Name</th>
<th>Header Pin Number</th>
<th>Header Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>I²C Pins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I²C_SDA1</td>
<td>Pin 20</td>
<td>J2</td>
</tr>
<tr>
<td>I²C_SCL1</td>
<td>Pin 18</td>
<td>J2</td>
</tr>
<tr>
<td>I²C_IRQ1Z</td>
<td>Pin 16</td>
<td>J2</td>
</tr>
<tr>
<td>SPI Pins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI_MOSI</td>
<td>Pin 11</td>
<td>J3</td>
</tr>
<tr>
<td>SPI_MISO</td>
<td>Pin 13</td>
<td>J3</td>
</tr>
<tr>
<td>SPI_CSZ</td>
<td>Pin 17</td>
<td>J3</td>
</tr>
<tr>
<td>SPI_CLK</td>
<td>Pin 14</td>
<td>J2</td>
</tr>
<tr>
<td>GND Pins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>Pin 3</td>
<td>J2</td>
</tr>
<tr>
<td></td>
<td>Pin 1</td>
<td>J3</td>
</tr>
</tbody>
</table>

2.2 Flashing Old TPS6598x Firmware Image

The user can skip this step if the old firmware images are already flashed to the TPS6598x-EVM or the custom board. To flash an old firmware image to TPS6598x-EVM or the custom board, use the steps in this section.

2.2.1 Configuration for FTDI or Aardvark Interface to the TPS65982

To configure the tool for FTDI or Aardvark, use the following steps:

Step 1. Open the TPS6598x Host Interface Tool GUI (also known as TPS6598x Utilities GUI).
Step 2. Follow the instructions provided in TPS6598x Utilities User Guide (SLVA701) to configure the tool to work with the FTDI-based adapter or Aardvark.
Step 3. Upon successful configuration, a confirmation appears as shown in Figure 2.
Step 4. The register mode return value can be either APP or BOOT depending upon whether a valid firmware existed on the TPS6598x-EVM.
The PC should automatically detect an Aardvark when adding the adapter; however, if the PC does recognize the Aardvark, download the Aardvark drivers from Total Phase and follow the installation prompts.

2.2.2 SPI Firmware Update

The user should flash the old firmware that has the custom configurations using the SPI firmware update procedure. Refer to the TPS6598x Utilities User Guide to successfully update the firmware on the TPS6598x-EVM. Upon a successful update, a confirmation message is displayed as shown in Figure 3.
After successfully flashing the TPS6598x device, disconnect/re-connect the barrel-jack adapter or press the Reset button on the TPS65982-EVM (S3) to load the newly installed firmware image on the SPI flash IC. When using an FTDI-based adapter, disconnect the barrel-jack and micro-USB cable for a few seconds before reconnecting back as the FTDI pins may latch on to the states of the adapter unless power is completely removed.

3 Using the TPS6598x Application Customization Tool

Now the TPS6598x board is running the application which contains the user’s custom configurations and a firmware for controlling the TPS6598x device. The objective is to update this application which contains the latest firmware available but still containing the user’s custom configuration. For this purpose, use the new TPS6598x Application Customization tool. This tool is used to customize and generate firmware images that can be loaded onto TPS6598x devices. The Application Customization Tool is capable of loading firmware settings from a TPS6598x at run time over a USB to I2C adapter (an Aardvark or FTDI-based adapter).

The user guide of the TPS6598x Application Customization tool (SLVUAR8) describes the installation procedure and the complete process of using TI-provided firmware projects to create usable firmware. To install the tool, use the steps listed in the user's guide.

This tool includes TI-provided projects, which are firmware templates that contain configuration settings that are specific to various applications. These projects are to be used as a starting point in generating or adopting custom firmware.

NOTE: Projects have a varying level of configurability depending on the application and therefore TI recommends selecting a project that matches with the user's intended device and application.
3.1 Starting a New Project

When starting a new project, users typically open default templates (.tpl), which are provided by Texas Instruments. The default images cover the primary use cases for TPS6598x applications.

To load and use one of the TI projects, use the following steps:

1. Click the File menu and then select New Project. The next window displayed allows the user to browse, select, and open a default project (see Figure 4).
2. Select the appropriate .tpl project file for the application then click the OK button.

![Figure 4. Project Files](image)

The user now sees additional functionality, depending on the project that is loaded. In Figure 5, for example, the user now the following is displayed:

- The TPS65982 – Intel Apex Creek, version 2.4 project has been loaded to the tool.
- The low-region firmware image has been loaded as shown in the Firmware Base Image section of the General Settings tab.
- The available configurable settings within the Global and Device Settings tab, which are described in the respective firmware user’s guide for the selected TPS6598x device.
- Billboarding information is now configurable in the String Table section of the General Settings tab.
3.2 Device Settings

After creating a new project from the default templates for the intended application and device, all default device configurations values are available in the Device Settings tab as shown in Figure 6.

Each of the configuration values can be viewed by selecting the appropriate vertical tabs (on the left-hand side of the GUI) in the Device Settings tab. The Raw view tab provides the raw values embedded in the configuration registers.
Older firmware versions included configurations for the Miscellaneous Configuration and GPIO Event Map within the firmware code and not in the configuration structure area. But newer firmware, which uses the TPS6598x Application Customization Tool, does not include the Miscellaneous Configuration and GPIO Event Map within the firmware code. The user must save these values before importing device settings from a running board.

To save GPIO Event Map, save the value of register 0x5c to a notepad program (see Figure 7).

To save Miscellaneous Configuration, copy the value of register 0x5e to a notepad program (see Figure 7).
3.3 Importing Configuration Settings from a TPS6598x

Now that the base device settings are loaded in the TPS6598x Application Customization tool, import the device and firmware settings from a TPS6598x-EVM at run-time.

NOTE: This function is extracting the contents of each register directly and placing in the device settings on the tool. Therefore, only import device settings to a project that is for the associated device. For example, if the contents of a TPS65982 device are imported into a TPS65983 project, the contents will not be placed appropriately.

To perform the import function, use the following the steps:

1. Connect the barrel-jack connector to the TPS6598x-EVM and connect the Aardvark to Windows PC using a USB Micro-B to A cable.
2. Click the Device menu and then select Import Settings from Device.
3. Select the appropriate USB to I²C adapter (FTDI or Aardvark), I²C address, and device settings tab to place the settings.
4. (Optional) Click the Test Read (Mode Register 0x3): button to ensure proper device connection. If APP is displayed next to this button, the TPS6598x device has loaded the application firmware.
5. Select Device Settings tab and click the OK button to import the device settings. If successful, a window is displayed which indicates a successful import of device settings (see Figure 9).

![Figure 8. Import Device Settings Window](image)

Figure 8. Import Device Settings Window

The configuration settings from the device are now viewable in the Device Settings tab that was selected.

In the Device Settings tab, the registers 0x5c and 0x5e values are blank. Ensure that the Miscellaneous Configuration values and GPIO Event Map values are restored. To restore the GPIO Event Map values, copy the saved values to the 0x5c register in the Raw View section of the GUI. To restore the Miscellaneous Configuration values, copy the saved values to register 0x5e in the Raw View section of the GUI.

The user can now save the low-region binary file which can be flashed onto the TPS6598x device using the TPS6598x Utilities Tool. The user can also save the modified project (.pjt), which contains the updated configuration.
4 Sanity Check

This section describes how to perform a basic sanity check after the firmware on the custom board has been upgraded with the configuration. Performing this check is a good idea because any change in the configuration can alter the performance of the firmware.

Using a USB PD protocol analyzer, such as the Teledyne Lecroy, is best to perform this check.

4.1 System Setup

Figure 11 shows the system setup. The TPS65982-EVM mounted on a custom FTDI-based adapter board on the left-side of Figure 11 is referred to as the Docking Station system. The TPS65982-EVM along with an Aardvark or a custom FTDI-based adapter board on the right-side of Figure 11 is referred to as the Notebook system. The Docking Station is connected to a barrel-jack connector. The Docking Station system is the one which is intended to be upgraded to the latest firmware.
The *Docking Station* and *Notebook* systems are connected through the Teledyne Lecroy analyzer as shown in Figure 11. Connect the Teledyne Lecroy analyzer to a Windows PC using a Type-C to A cable.

### 4.2 Power-Delivery Contract Analysis

This section describes how to analyze the PD contract and PD messages using the Teledyne Lecroy analyzer. To use the Teledyne Lecroy analyzer, the user should have installed the Mercury T2/T2C USB protocol suite which is available on the Teledyne website (teledyne.com). The user can use any other Protocol analyzer as well.

To analyze whether all configuration settings were imported correctly from the old firmware, review the PD-contract establishment and alternate-mode negotiation using PD messages under two scenarios. The first scenario uses the old firmware code with the setup shown in Figure 11. The second scenario uses the new firmware code with the setup shown in Figure 11.

To start the PD-contract analysis, follow the following steps:

1. Disconnect the USB Type-C cable from the *Notebook* system and the barrel-jack adapter from the *Docking Station* system.
2. Start the USB protocol suite and check whether the power and status LEDs are glowing.
3. Connect the barrel-jack adapter.
4. Start recording of the PD contract using the USB protocol suite.
5. Connect the USB Type-C cable to the *Notebook* system.
Step 6. Wait for some time and then stop recording in the USB protocol suite.

The user should now able to see the PD-contract establishment messages being exchanged by the source and sink as shown in Figure 12. The user can now also see the device searching and entering alternate modes if enabled.

Figure 12. PD-Contract Establishment Messages

NOTE: The PD messages and contract negotiation depends upon the user-configuration settings in the firmware. The messages shown in Figure 12 should be considered as an example only. These messages will differ depending upon the configuration settings on the user’s board.

Save this exchange and repeat this exercise with the newer firmware and imported configuration settings on the Docking Station system. The user should be able to see the same PD contracts being established and similar messaging and negotiations occurring as in the earlier case.
# Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

## Changes from Original (June 2016) to A Revision

<table>
<thead>
<tr>
<th>Changes</th>
<th>Page</th>
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<tr>
<td>• Deleted references to the USB2MANY board and replaced them with Aardvark or FTDI-based adapter</td>
<td>2</td>
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