

Restrictions:

IDT's ZSPM8025-KIT Evaluation Kit hardware and the Pink Power Designer™ software are designed only for evaluation of the ZSPM1025A PWM Controller IC and the Murata OKLP-X/25-W12-C Power Block; laboratory setup; and module development. The kit hardware and software must not be used for module production and production test setups.

IDT shall not be liable for any damages arising out of defects resulting from (i) delivered hardware and software, (ii) non-observance of instructions contained in this manual, or (iii) misuse, abuse, use under abnormal conditions, or alteration by anyone other than IDT. To the extent permitted by law, IDT hereby expressly disclaims and User expressly waives any and all warranties, whether express, implied, or statutory, including, without limitation, implied warranties of merchantability and of fitness for a particular purpose, statutory warranty of non-infringement, and any other warranty that may arise by reason of usage of trade, custom, or course of dealing.



Important Safety Warning: These procedures can result in high currents, which can cause severe injury or death. Only trained professional staff should connect external equipment. Ensure that all staff have read and understood this document and the high voltage safety disclaimer that is included with the kit.

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1 Introduction

This document describes the use of IDT's ZSPM8025-KIT for evaluating DC/DC point-of-load (POL) applications and provides additional kit information, including the circuit diagram and board layout. The kit incorporates IDT's ZSPM1025A digital PWM controller IC and the Murata OKLP-X/25-W12-C Power Block to form a "smart" buck converter (a.k.a. step-down DC-to-DC converter).

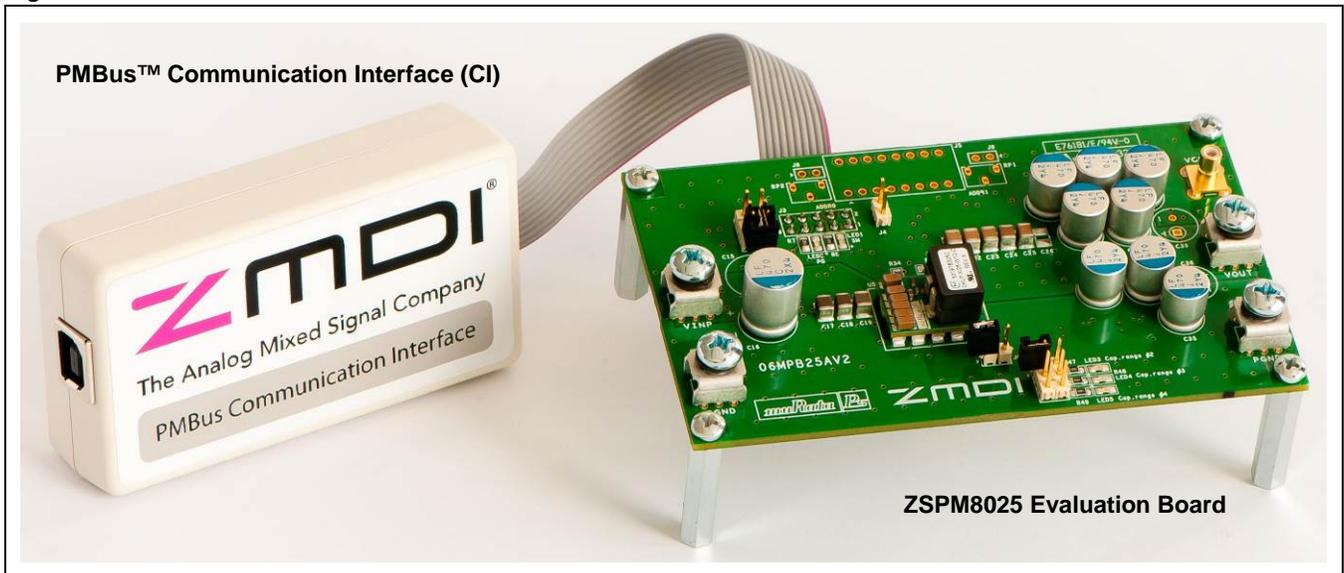
The ZSPM8025-KIT Evaluation Kit hardware functions with the ZSPM1025A Pink Power Designer™ graphical user interface (GUI), which is used to configure the ZSPM1025A features and for monitoring the internal measurements and fault conditions of the ZSPM1025A. The GUI software must be downloaded to the user's PC from the IDT website to ensure receiving the latest release as described in section 3. See section 2.2.2 for the requirements for the user's PC.

The PMBus™ Communication Interface (CI) provides the interface between the ZSPM8025-KIT Evaluation Kit and the user's PC.

1.1. Kit Contents

- ZSPM8025 Evaluation Board
- PMBus™ Communication Interface (CI)
- USB Cable
- *Startup Information* document
- *Safety Disclaimer* document

Figure 1.1 ZSPM8025-KIT Evaluation Kit Contents



2 ZSPM8025 Evaluation Board

2.1. Evaluation Board Overview

The ZSPM8025 Evaluation Kit provides all the necessary components for a first evaluation of IDT's ZSPM1025A digital PWM controller. The ZSPM1025A can be configured in the Pink Power Designer™ Graphical User Interface (GUI).

In addition to the ZSPM1025A controller, the Evaluation Board features the Murata OKLP-X/25-W12-C Power Block. The number of output capacitors can be selected with a jumper on the Evaluation Board. The electrical specifications can be found in Table 2.1, and the schematic is provided in Appendix B.

Table 2.1 Key Design Parameters for the Evaluation Kit Power Stage

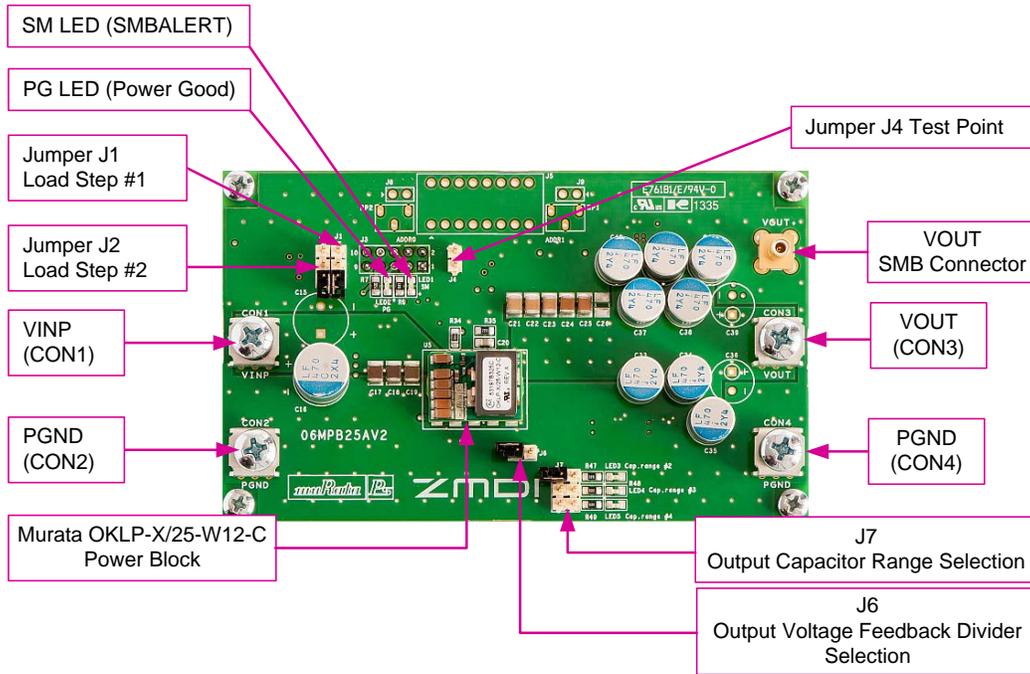
Parameter	Value
Input voltage	7 – 13.2V
Output voltage	0.6 to 1.2V or 1.2 to 3.6V
Maximum output current	25A*
Switching frequency	500kHz
* The Murata OKLP-X/25-W12-C Power Block has an output power limitation of 49.5W. The maximum output current is therefore a function of the output voltage.	

The board also provides the connections needed for digital communication between the ZSPM1025A and the GUI software via the PMBus™ Communications Interface (CI).

An on-board transient load is also provided for generating load transients with high current slew rates.

Figure 2.1 shows the ZSPM8025 Evaluation Board and the board connections that will be completed in the subsequent setup steps. Do not make the connections at this point.

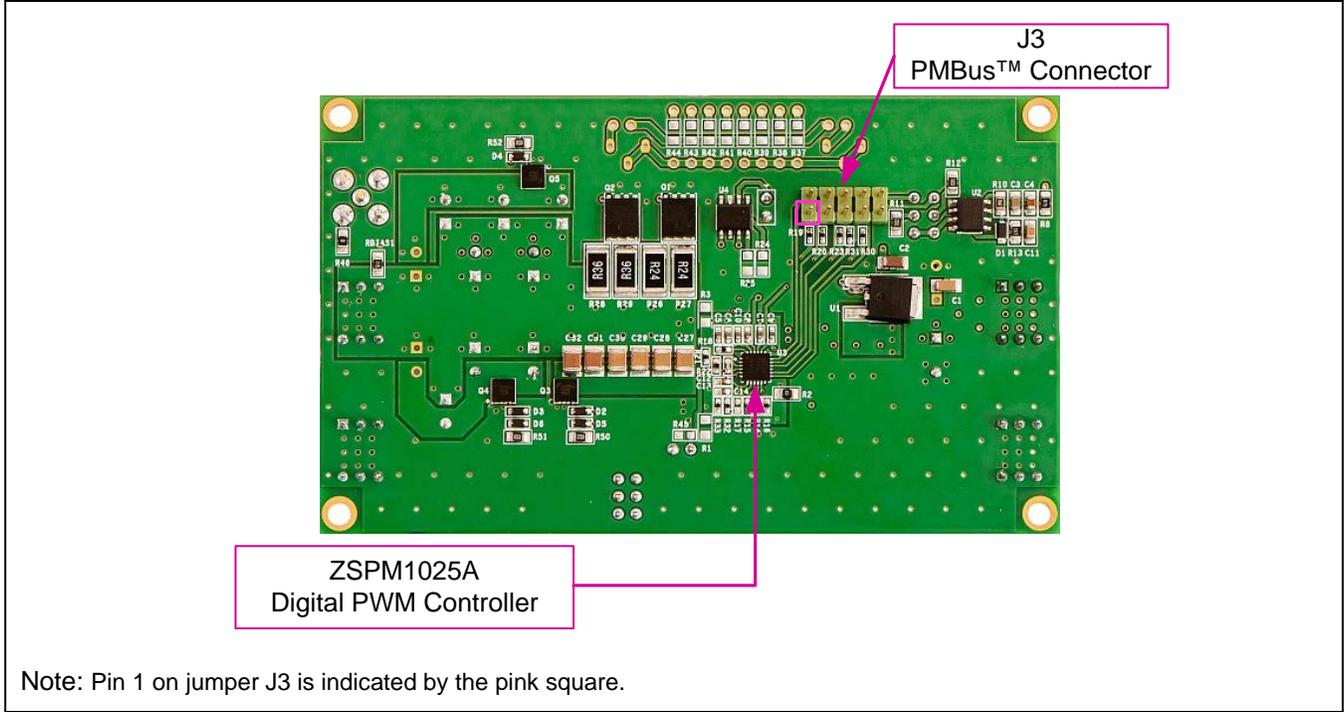
Figure 2.1 ZSPM8025-KIT Evaluation Board (Top Side)



Notes:

- Jumper pins J1 and J2 are used to connect the onboard load transient found on the back of the board. The user can achieve transient load steps by placing a jumper across pins 2 and 3 on J1 and/or J2 (white arrows on the board indicate pin 1; see important warning in section 6.4). Power resistors in series with the power MOSFETs are used as loads for the load steps, and the current level is therefore output voltage dependent. At the nominal output voltage of 1.2V, the load resistors will draw 6.7A if using only J2 and 10A if using only J1. Refer to section 6.4 for more information on the transient load circuit.
- Jumper J4 is a test point for the load step (can be used as a trigger for an oscilloscope).
- Jumper J6 can be used to select the output voltage feedback divider. Further details provided in section 6.2.
- Jumper J7 can be used to select the amount of capacitance connected to the output of the Murata OKLP-X/25-W12-C Power Block. Further details provided in section 6.3.
- The SMB connector on the right side of the board is intended for connection to an oscilloscope to provide a low noise measurement of the output voltage.

Figure 2.2 ZSPM8025-KIT Evaluation Board (Bottom Side)

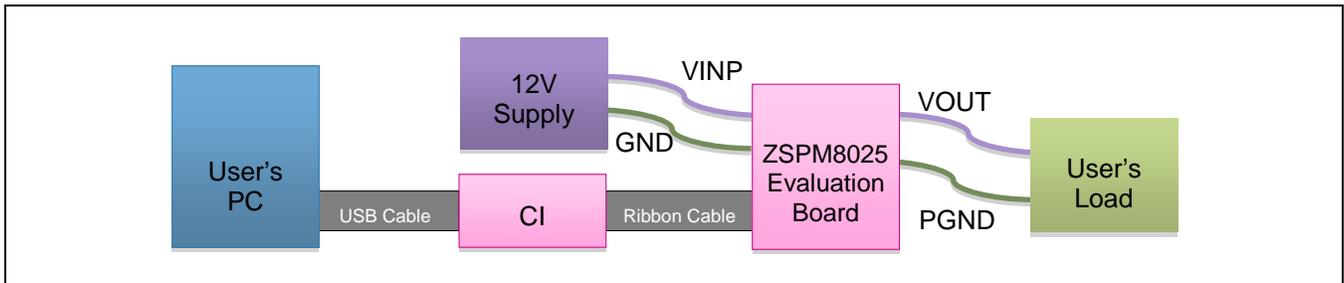


Note: Pin 1 on jumper J3 is indicated by the pink square.

2.2. General Setup for the Evaluation System

The basic setup for using the ZSPM8025 Evaluation Kit is illustrated in Figure 2.3. The pink shaded blocks and the USB cable are the kit.

Figure 2.3 Pink Power Evaluation Kit Setup



2.2.1. User Instrumentation

The following user equipment is required or recommended for demonstrating the features of the ZSPM1025A controller and the Murata OKLP-X/25-W12-C with the Evaluation Kit:

- **DC power supply:** An external power supply is required for the ZSPM8025 Evaluation Board. Its output voltage should be at least 12V with a rated output current of approximately 1A to 5A depending on the test conditions.
- **Electronic load:** An external DC load is highly recommended as the Evaluation Board features only transient loads due to constraints on power dissipation. While an electronic load can be very advantageous, load resistors could also be sufficient for testing. Ensure that the electronic load has an adequate power rating.
- **Oscilloscope:** Connecting an oscilloscope to the Evaluation Kit is strongly recommended for measuring the performance of the Evaluation Board in the time domain. The Evaluation Board features an SMB connector connected to the output of the power stage for easy connection to an oscilloscope.

2.2.2. User Computer

A Windows®-based computer (PC) is required for interfacing with the ZSPM8025 Evaluation Board through the PMBus™ Communication Interface. The user will need administrative rights on the PC to download and install the Pink Power Designer™ GUI for the kit. The PC must meet the following requirements:

- Windows® XP or Windows® 7
- Internet access

3 Software Installation and Setup

The software for the ZSPM8025 KIT is the ZSPM1025A Pink Power Designer™ graphical user interface (GUI), which is required to monitor the internal measurement and fault conditions of the ZSPM1025C. The Pink Power Designer™ must be downloaded from the ZSPM1025A product page on IDT's website located at www.IDT.com/ZSPM1025A.

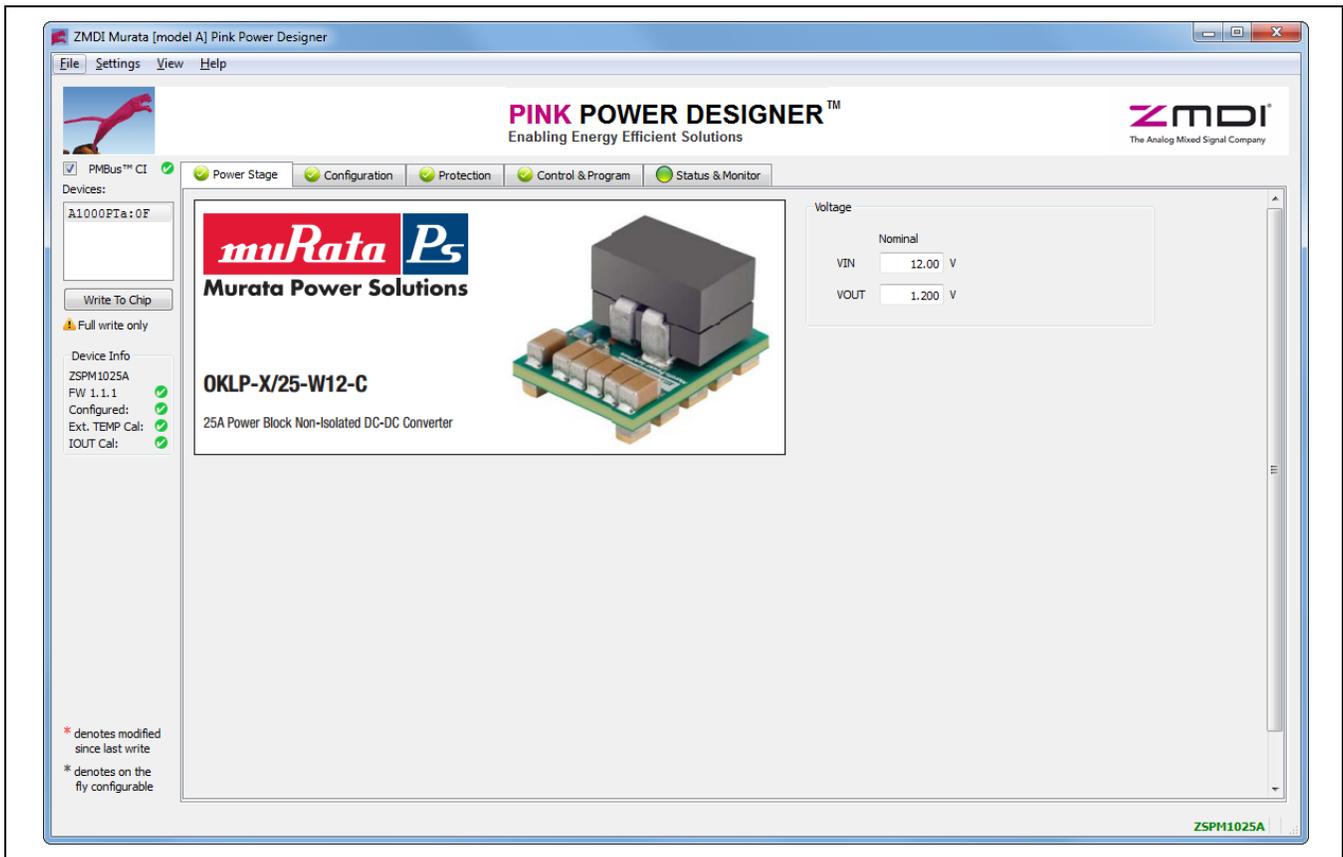
1. Go to the ZSPM1025A product page and download the zip file for the GUI: **Pink Power Designer(TM) GUI for ZSPM1025A Rev. X.x.y**. (X.x.y refers to the latest version of the file.)
2. Extract the executable file *ZMDI_ZSPM1025A_PPDGui_X.x.y_win32-setup.exe* from the zip file. (Note: X.x.y refers to the current version.)
3. Install the Pink Power Designer™ GUI software by clicking on *ZMDI_ZSPM1025A_PPDGui_X.x.y_win32-setup.exe*.

4 Pink Power Designer™ Software Overview

This section gives a brief introduction to the Pink Power Designer™ software. For full instructions for using the software, refer to the *Pink Power Designer™ Graphic User Interface (GUI) for the ZSPM1025A*, which is included in the software and can also be downloaded from the ZSPM1025A product page on IDT's web site (www.IDT.com/ZSPM1025A). To open it, click “Help” on the top menu of the Pink Power Designer™ GUI and then click “User Guide” (see Figure 4.1).

The Pink Power Designer™ is a graphical user interface (GUI) designed by IDT to enable the user to configure the device and monitor the internal measurements and fault conditions on the evaluation or application board. The Pink Power Designer™ GUI includes a wizard which will guide the user through a simple selection process to select the output voltage and output capacitance. The display is structured with a main window and a side panel on the left side for status information.

Figure 4.1 The Pink Power Designer™ GUI



The “Murata Power Block” Wizard

Upon start-up of the GUI, a wizard will guide the user through a simple selection process. The wizard will select the correct configuration data for the ZSPM1025A controller. The wizard can also be invoked within the GUI by selecting “New” in the “File” menu.

The Side Panel

The side panel provides information about the status of the PMBus™ CI and the device connected to the PMBus™ CI.

The Main Window

The main window of the Pink Power Designer™ has a number of tabs allowing configuration and monitoring for the ZSPM1025A. The following tabs are implemented in the Pink Power Designer™ tool:

- “Power Stage” tab: definition of nominal input and output voltage for the Evaluation Kit.
- “Configuration” tab: configuration of parameters for sequencing and startup.
- “Protection” tab: settings for protection warning and fault levels.
- “Control & Program” tab: calibration procedures and options for downloading of the configuration into the non-volatile memory (NVM).
- “Status & Monitor” tab: status and monitoring functions to monitor

5 Evaluation Kit Setup for a 1.2V Output Voltage

This section covers the steps for powering up the ZSPM8025 Evaluation Kit for the first time.



Important Safety Warning: The following procedures can result in high currents, which can cause severe injury or death. Only trained professional staff should connect external equipment. Do not enable the power supply connected to the input terminals until indicated in the following steps.

Follow this step-by-step instruction to power up the ZSPM8025 Evaluation Board:

- Step 1:** Make sure no jumpers are connected on headers J6 and J7. This selects the low output voltage range up to 1.2V and the minimum output capacitor range for the Murata OKLP-X/25-W12-C Power Block.
- Step 2:** Connect the power supply to the connectors labeled CON1 (VINP in Figure 2.1) and CON2 (PGND). Connect the load to the CON3 (VOUT) and CON4 (PGND) connectors. The load can be either a resistor or an electronic load. Connect the PMBus™ CI to connector J3 (see Figure 5.1) and to a USB port on the user's PC.
- Step 3:** Start the Pink Power Designer™ and follow these steps to load a configuration file using the Murata Power Block Wizard.
- Click the “Murata Power Block Wizard” button (see Figure 5.2).
 - Select the Murata OKLP-X/25-W12-C Power Block by clicking on it and click “Next” to proceed (see Figure 5.3).
 - Select “Range 1: 0.35V to 1.20V (without voltage divider) by clicking on it and click “Next” to proceed (see Figure 5.4).
 - Select “Range 1: Ceramic Capacitors 200µF to 400µF” and click “Finish” to open the main window of the Pink Power Designer™ GUI (see Figure 5.5).

Figure 5.1 ZSPM8025-KIT – PMBus™ CI Connection (Bottom Side of the PCB)

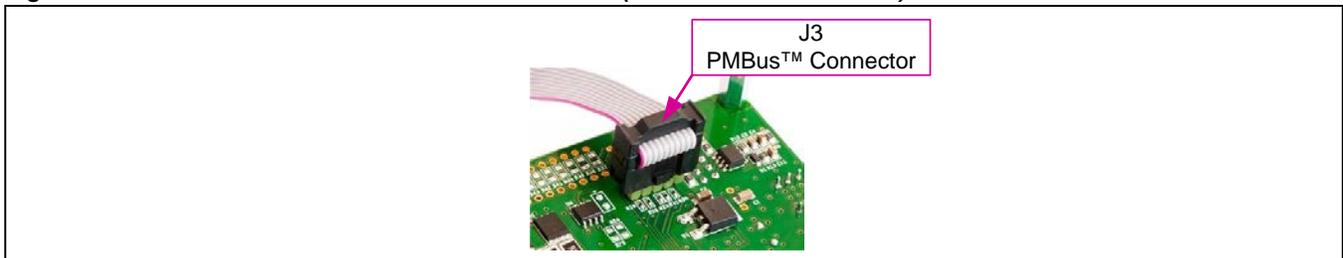


Figure 5.2 Pink Power Designer™ Wizard – Project Selection



Figure 5.3 Pink Power Designer™ Wizard – Power Block Selection

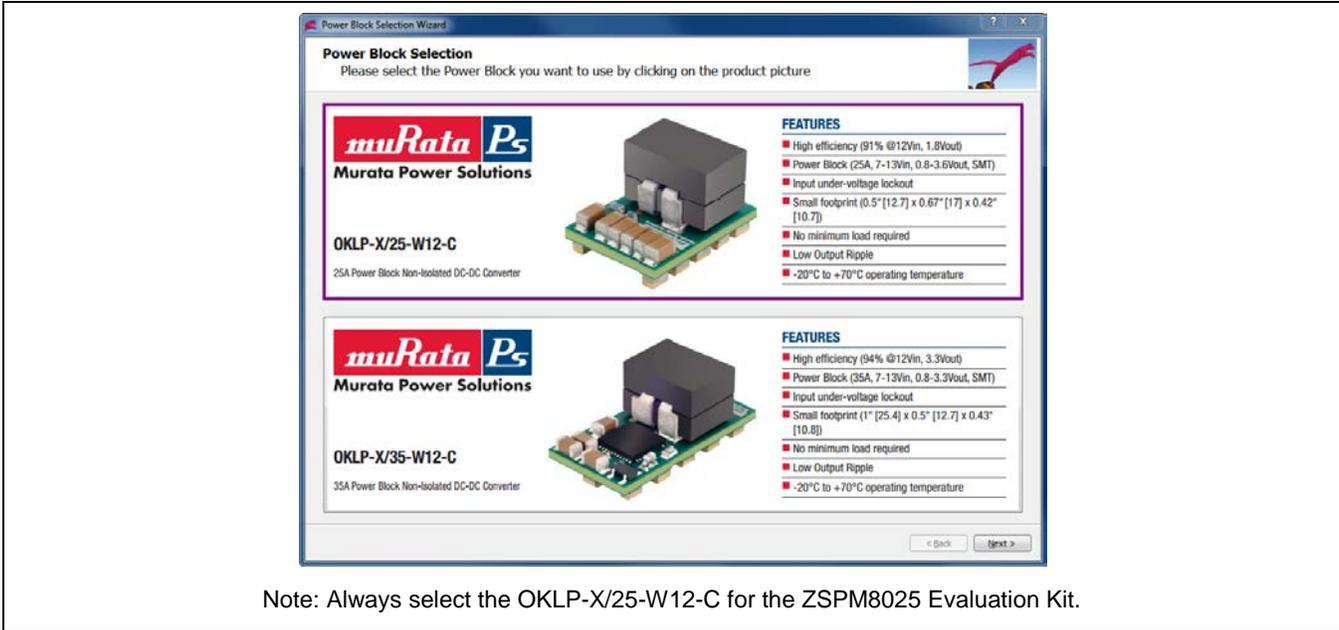


Figure 5.4 Pink Power Designer™ Wizard – Output Voltage Range Selection

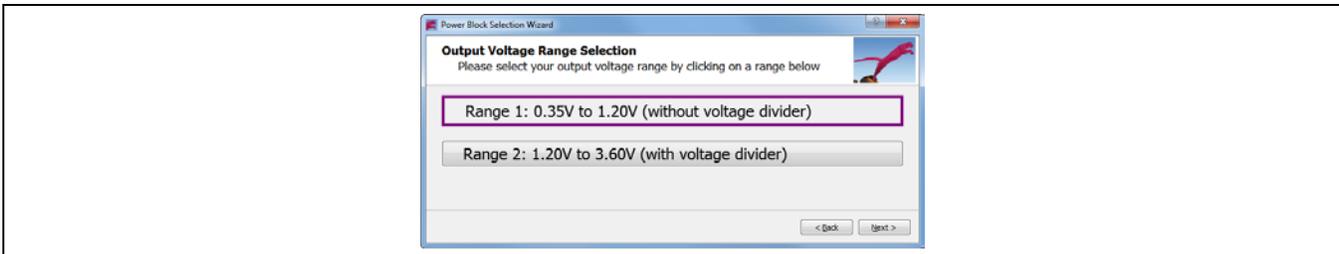
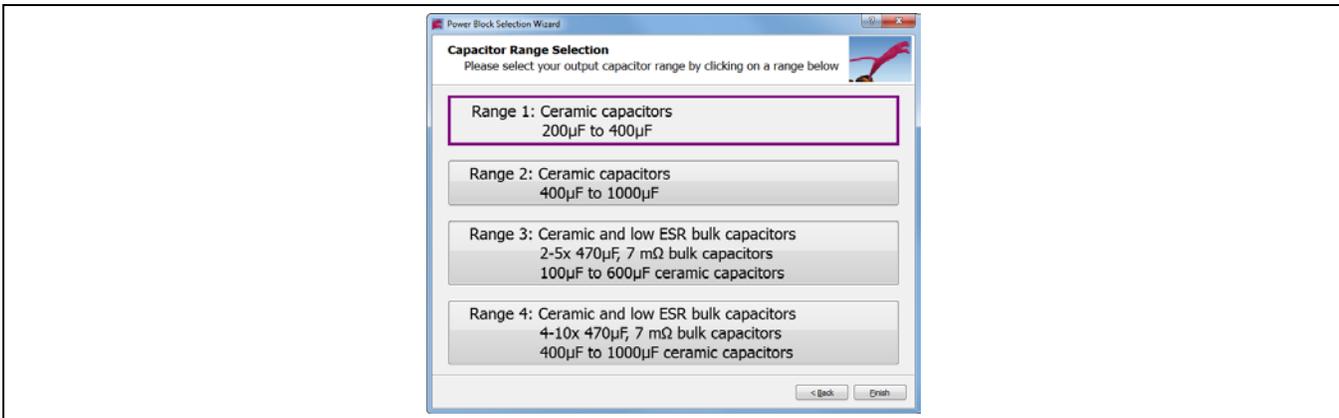


Figure 5.5 Pink Power Designer™ Wizard – Output Capacitor Range Selection



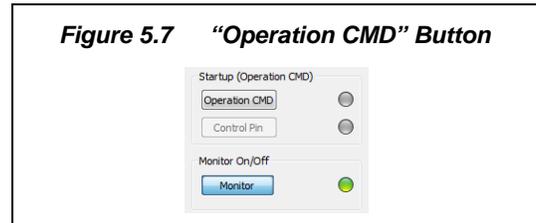
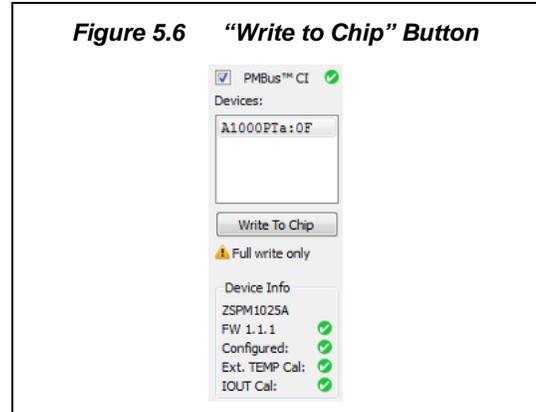
Step 4: Set the power supply voltage to 12V and enable the output of the power supply. If the power supply has no enable button, ensure that the output voltage is set to 12V before connecting it to the ZSPM8025 Evaluation Board. The Pink Power Designer™ GUI will now recognize the ZSPM1025A and show the device in the status panel on the left side of the screen (see Figure 5.6).

Note: Because the ZSPM1025A has not yet been configured by the GUI, there should be no voltage present on the output connectors of the ZSPM8025 Evaluation Board at this time.

Step 5: Click on the “Write to Chip” button (see Figure 5.6) in the side panel to program the configuration data into the volatile memory of the ZSPM1025A. It may be necessary to confirm the “Write to Chip” command depending on the state of the ZSPM1025A.

Step 6: Click on the “Status & Monitor” tab and ensure that monitoring is active for the input voltage, output voltage, output current, and the readings of internal and external temperature. The virtual LED next to the “Monitor” button will be green when monitoring is enabled (see Figure 5.7). Click on the “Monitor” button to enable monitoring if the virtual LED is not green.

Step 7: Click on the “Operation CMD” button located in the “Startup” subsection (see Figure 5.7) to enable the output of the ZSPM8025 Evaluation Board. The power-good (PG) LED on the board should be on now (see Figure 2.1) and a voltage of 1.2V should be present on the output terminals. Clicking the “Operation CMD” button again will toggle the output voltage off.



6 Evaluation Board Hardware and Software Setup

6.1. Introduction

The ZSPM1025A is a configurable controller that must be configured in the Pink Power Designer™ GUI. The GUI is also needed to test the features of the ZSPM8025 Evaluation Board. Eight configuration files for the ZSPM1025A are part of the GUI download package. The GUI wizard will help the user load a configuration file based on a simple selection process. The wizard can be opened within the GUI by selecting “File” -> “New” in the menu, or it can be selected when the Pink Power Designer™ GUI is started on the user’s PC.

The output voltage is set as part of the configuration data in the GUI. For output voltages up to 1.2V, the controller is configured to operate without a feedback divider. For output voltages above 1.2V the controller is configured to operate with a feedback divider in the feedback path. The feedback divider can be enabled by placing a jumper on header J6. Refer to section 6.2 for more information on the output voltage selection on the ZSPM8025 Evaluation Board. The *ZSPM1025A Data Sheet* provides detailed information about the output voltage feedback divider for the ZSPM1025A.

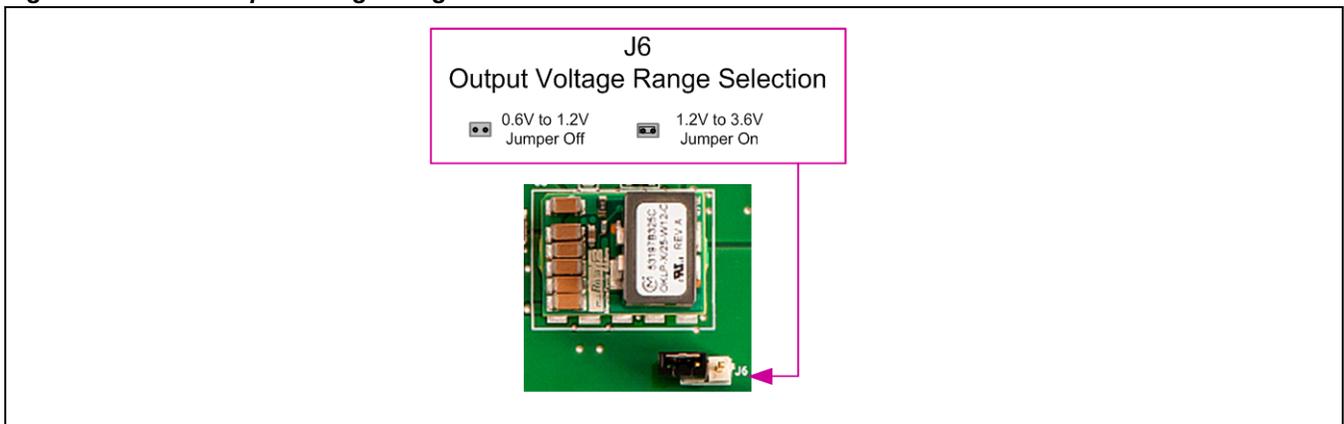
The ZSPM1025A has four pre-configured compensators that are part of the configuration files provided by IDT. The four compensators have been designed to work for specific ranges of output capacitors. Section 6.3 describes how the Evaluation Board can be configured for any of the four capacitor ranges, thereby enabling simple comparisons of the dynamic performance of the complete solution. The output capacitor range can be selected on header J7 (see section 6.3). The *ZSPM1025A Data Sheet* provides further information about the compensation loop configuration of the ZSPM1025A controller and typical performance measurements.

6.2. Setting the Output Voltage

The nominal output voltage can be set in the Pink Power Designer™ GUI. The output voltage range must be selected on jumper J6 before powering up the ZSPM8025 Evaluation Board and loading configuration data into the ZSPM1025A.

Important: Do not combine the higher voltage range of 1.2V to 3.6V (selected by installing the jumper on J6) with the lowest load resistance setting (selected by installing jumpers across pins 2 and 3 on both J2 and J1; see section 6.4).

Figure 6.1 J6 – Output Voltage Range Hardware Selection



Follow these steps to change the output voltage:

1. Ensure that the input voltage from the power supply for the ZSPM8025 Evaluation Board is OFF.
2. Select the ZSPM1025A output voltage range with jumper J6 (see Figure 6.1).
3. Apply the input voltage to the ZSPM8025 Evaluation Board.
4. Use the Pink Power Designer™ Power Block Selection wizard to load the correct configuration file for the selected output voltage range and output capacitor range. Please refer to the *Pink Power Designer™ Graphic User Interface (GUI) for the ZSPM1025A*, which is included in the software and can also be downloaded from the ZSPM1025A product page on IDT's web site (www.IDT.com/ZSPM1025A) for full instructions for the software.
5. Enter the nominal output voltage in the "Power Stage" tab of the Pink Power Designer™ GUI.
6. Click "Write to Chip" in the side panel of the Pink Power Designer™ GUI to write the configuration data to the volatile memory of the ZSPM1025A.
7. Enable the output voltage by clicking the "Operation CMD" button in the "Status & Monitor" tab of the Pink Power Designer™ GUI.

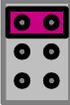
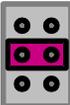
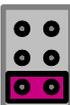
6.3. Output Capacitor Range Selection

The ZSPM1025A controller can be configured with four sets of compensation loop parameters. Each set of compensation parameters has been designed to match a range of output capacitors (see the *ZSPM1025A Data Sheet* for more information on the output capacitor ranges). The ZSPM8025 Evaluation Board allows the user to test the performance of the controller for each of the four output capacitor ranges.

A minimum number of ceramic capacitors are always connected to the output of the Murata OKLP-X/25-W12-C Power Block (capacitor range #1, no jumper on J7) and further capacitor banks can be selected with a jumper on header J7 (see Table 6.1). On the Evaluation Board, one of the three LEDs adjacent to J7 will turn green to indicate if capacitor range #2, #3, or #4 has been selected (see Figure 2.1). If none of the LEDs are on, it means that capacitor range #1 has been selected.

Note: It is important that the output capacitor range selected on J7 matches the compensator settings loaded in Pink Power Designer™ GUI.

Table 6.1 ZSPM8025 Evaluation Board – Output Capacitors

Capacitor Range	Ceramic Capacitor	Bulk Electrolytic Capacitors	Header J7
#1	3 x 100µF 6.3V X5R 2 x 47µF 10V X7R	None	
#2	7 x 100µF 6.3V X5R 4 x 47µF 10V X7R	None	
#3	3 x 100µF 6.3V X5R 2 x 47µF 10V X7R	3 x 470µF, 7mΩ ESR	
#4	7 x 100µF 6.3V X5R 4 x 47µF 10V X7R	8 x 470µF, 7mΩ ESR	

Note: Pin 1 on J7 is indicated by ►.

6.3.1. Output Capacitor Range Test Procedure

To test the performance of the four selectable compensators, follow these simple steps:

1. Make sure that the input voltage from the power supply for the ZSPM8025 Evaluation Board is OFF.
2. Select the ZSPM1025A output capacitor range via header J7.
3. Use the “Murata Power Block” wizard of the Pink Power Designer™ GUI to load a project file for a configuration matching the output capacitor range selected on J7. Select “New” in the “File” menu to open the “Murata Power Block” wizard and then click the “Project File” button to access the list of project files or click “Murata Power Block Wizard” to use the wizard to load a project file. (For more details on project files, refer to the *Pink Power Designer™ Graphic User Interface (GUI) Guide for the ZSPM1025A.*)
4. Select the output voltage range on jumper J6 (see section 6.2) and enter the nominal output voltage in the “Power Stage” tab of the Pink Power Designer™ GUI.
5. Apply the input voltage to the ZSPM8025 Evaluation Board.
6. Click the “Write to Chip” button in the Pink Power Designer™ GUI to write the configuration data from the project file into the non-volatile memory of the ZSPM1025A.
7. Enable the output voltage by clicking the “Operation CMD” button in the “Status & Monitor” tab of the Pink Power Designer GUI™.
8. Measure the dynamic performance with an oscilloscope using either the on-board transient loads or an external electronic load.

6.4. On Board Transient Loads

The ZSPM8025 Evaluation Board has on-board transient loads that can be used to test the dynamic performance of the ZSPM1025A controller. The transient loads consist of a simple timer circuit driving the power MOSFET. The power MOSFET is connected in series with resistors connected across the output of the Murata OKLP-X/25-W12-C Power Block. A schematic of the transient load circuitry is provided in Appendix B.

There are two transient loads that can be enabled via headers J1 and J2 respectively (see Figure 6.2). The two loads can be enabled at the same time to achieve a larger current step only if the output voltage range has been set to 0.6V to 1.2V (see important warnings below). The timing signal for the transient loads has an ON time of approximately 1 millisecond with a time period of approximately 80 milliseconds (see Figure 6.3).

Important: The load current is a function of the nominal output voltage set in the “Power Stage” tab and the resistance of the transient load. Be sure to calculate the expected load current before enabling the transient loads.

Important: Do not place jumpers on both J1 and J2 with the output voltage range setting for 1.2V to 3.6V (jumper on J6). Enabling both loads at the same time creates a load resistance of 0.072Ω, which results in an output current that will exceed the current limits of the Murata Power Block if the output voltage is set higher than 1.5V.

Figure 6.2 J1 and J2 – Transient Load Selection

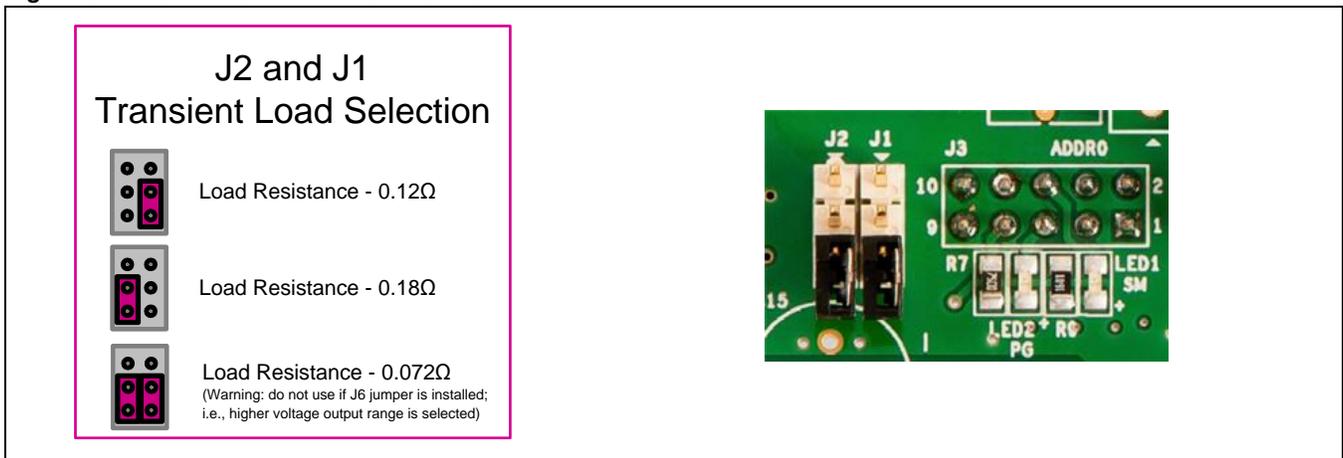
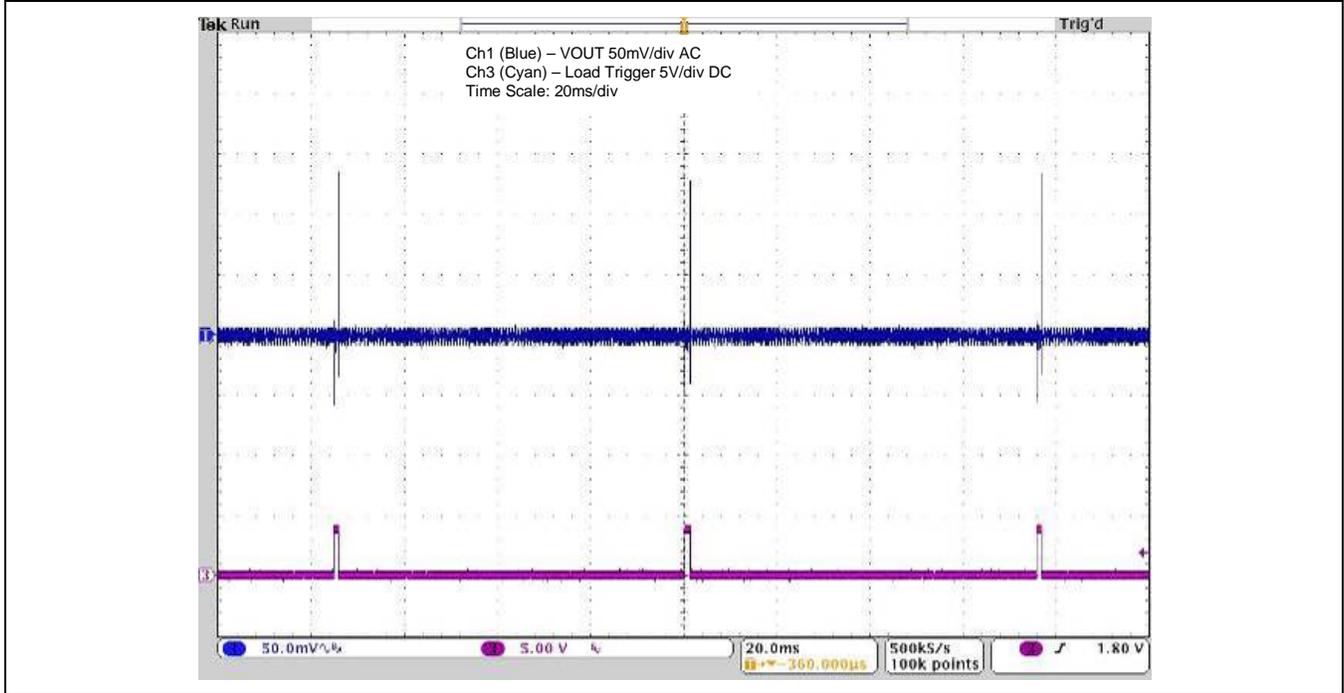


Figure 6.3 Timing for the On-Board Transient Loads



7 Support

IDT provides additional support tools for the ZSPM8025-KIT and the IDT Pink Power Designer™. If further support is needed, contact IDT at www.IDT.com/go/support.

8 Related Documents

Document
<i>ZSPM1025A Data Sheet</i>
<i>Pink Power Designer™ Graphic User Interface (GUI) Guide for the ZSPM1025A</i>
<i>ZSPM1025A Application Note – Programming and Calibration</i>

Visit the ZSPM1025A product page (www.IDT.com/ZSPM1025A) or contact your nearest sales office for the latest version of these documents.

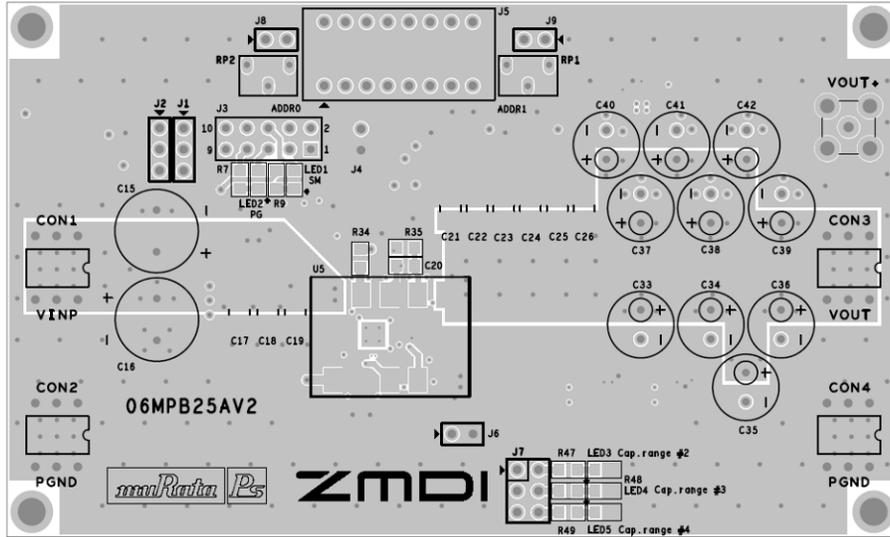
9 Definitions of Acronyms

Term	Description
PWM	Pulse Width Modulation
SMB	Sub-miniature Version B

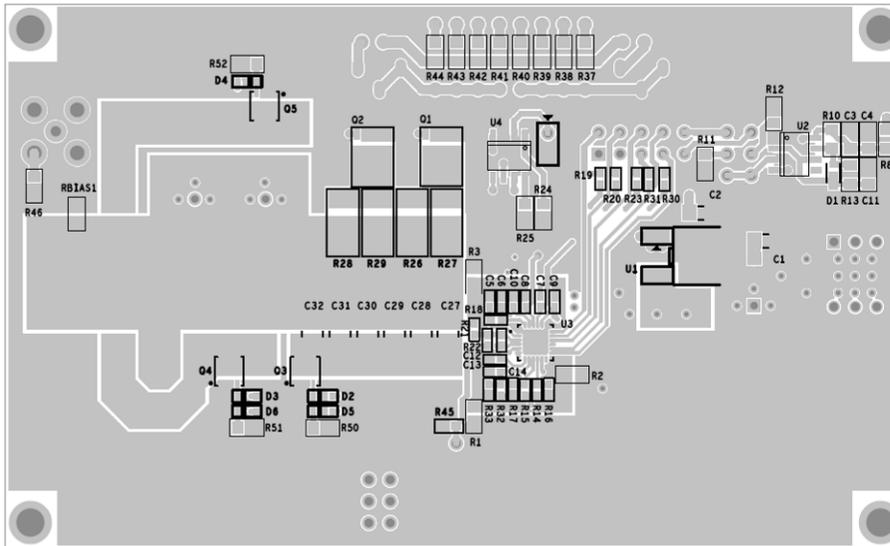
10 Document Revision History

Revision	Date	Description
1.00	January 23, 2014	First release.
1.01	June 24, 2014	Updated cover imagery and contact information. Updated images of software.
	April 13, 2016	Changed to IDT branding.

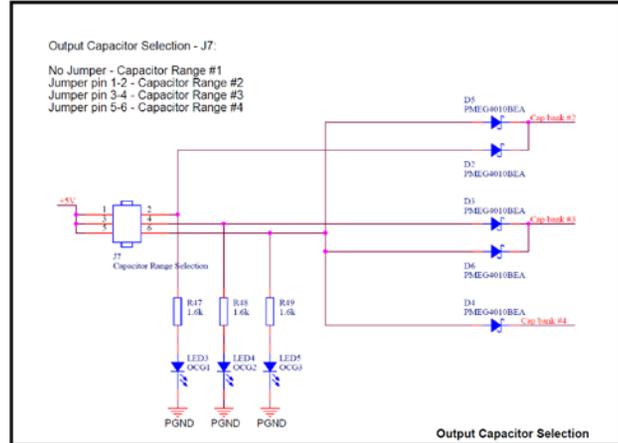
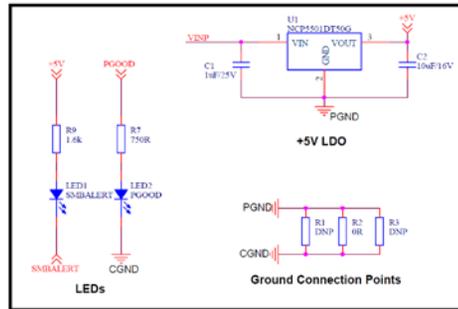
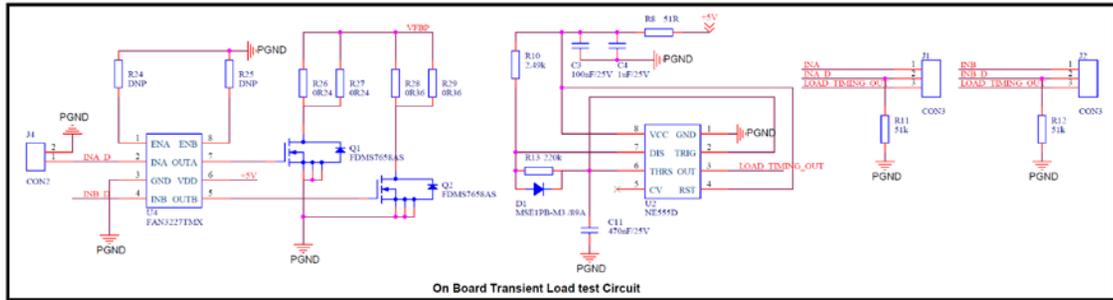
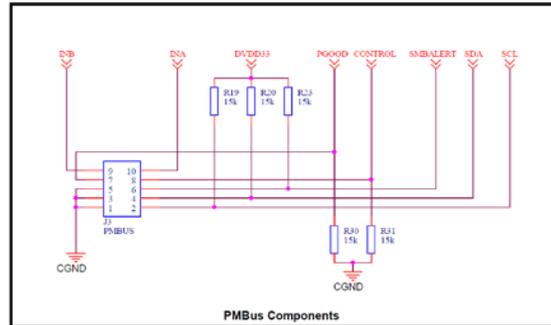
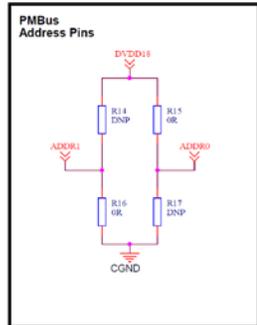
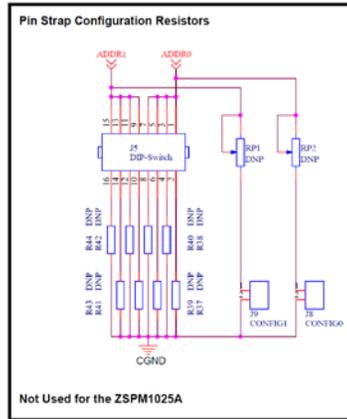
Appendix A: ZSPM8025 Evaluation Board



Top Side



Bottom Side



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