

Restrictions:

IDT's ZSPM8835-KIT Evaluation Kit hardware and the Pink Power Designer™ software are designed only for evaluation of the ZSPM1035D PWM Controller IC and the Murata OKLP-X/35-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 ZSPM8835-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 ZSPM1035D digital PWM controller IC and the Murata OKLP-X/35-W12-C Power Block to form a "smart" buck converter (a.k.a. step-down DC-to-DC converter).

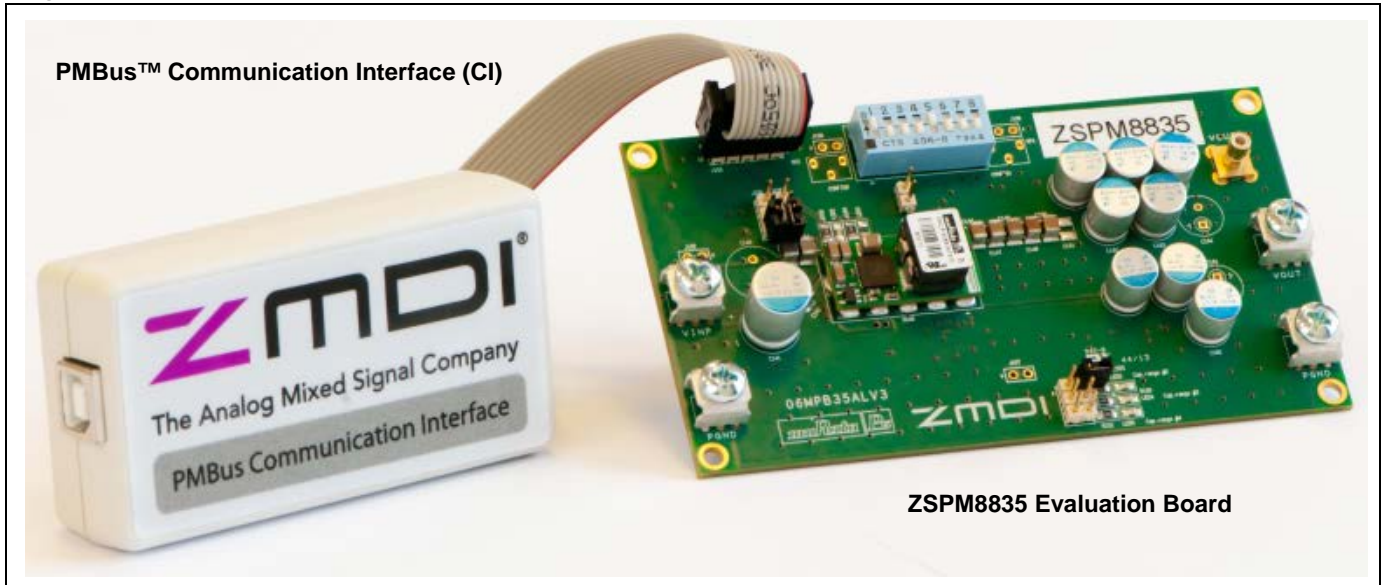
The ZSPM8835-KIT Evaluation Kit hardware functions with the ZSPM1035D Pink Power Designer™ graphical user interface (GUI), which is used for monitoring the internal measurements and fault conditions of the ZSPM1035D. The GUI software must be downloaded to the user's PC from the IDT website to ensure 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 ZSPM8835-KIT Evaluation Kit and the user's PC.

1.1. Kit Contents

- ZSPM8835 Evaluation Board
- PMBus™ Communication Interface (CI)
- USB Cable
- *Startup Information* document
- *Safety Disclaimer* document

Figure 1.1 ZSPM8835-KIT Evaluation Kit Contents



2 ZSPM8835 Evaluation Board

2.1. Evaluation Board Overview

The ZSPM8835 Evaluation Kit provides all the necessary components for a first evaluation of IDT's ZSPM1035D digital PWM controller. The ZSPM1035D can be configured using the two pin-strap resistors to select the output voltage and the control loop performance. See the *ZSPM1035D Data Sheet* for more details.

In addition to the ZSPM1035D controller, the Evaluation Board features the Murata OKLP-X/35-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 | 1.25 to 3.4V |
| Maximum output current | 35A* |
| Switching frequency | 500kHz |

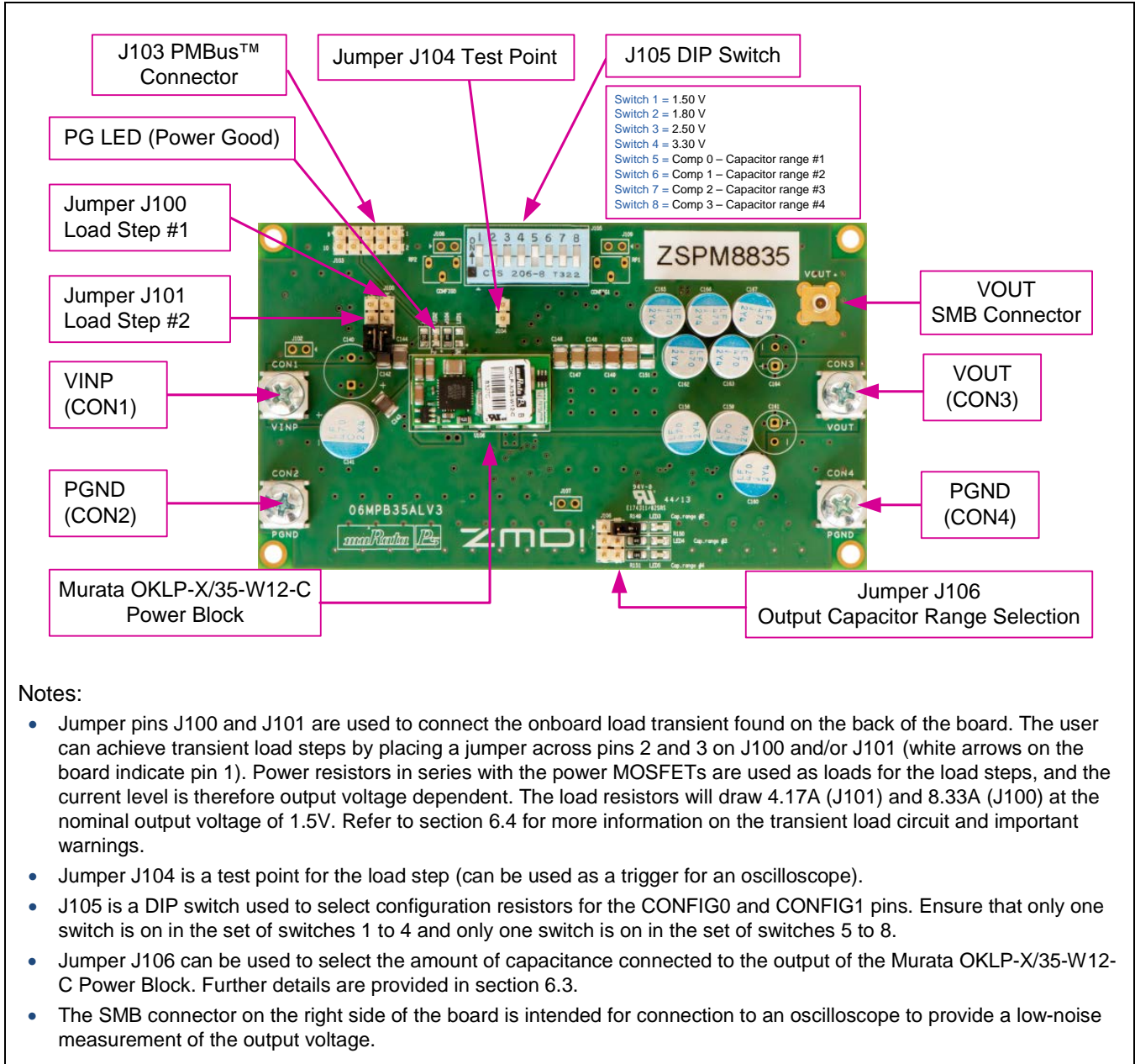
* **Important:** The Murata OKLP-X/35-W12-C Power Block has an output power limit of 82.5W. The maximum output current is therefore a function of the output voltage.

The board also provides the connections needed for digital communication between the ZSPM1035D 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 ZSPM8835 Evaluation Board and the board connections that will be completed in the subsequent setup steps. Do not make the connections at this point. Note that some settings for the DIP switches are not allowed; therefore, before using the kit, ensure that switches 1 and 5 are in the “ON” position and the rest of the switches are in the “OFF” position as shown in Figure 2.1.

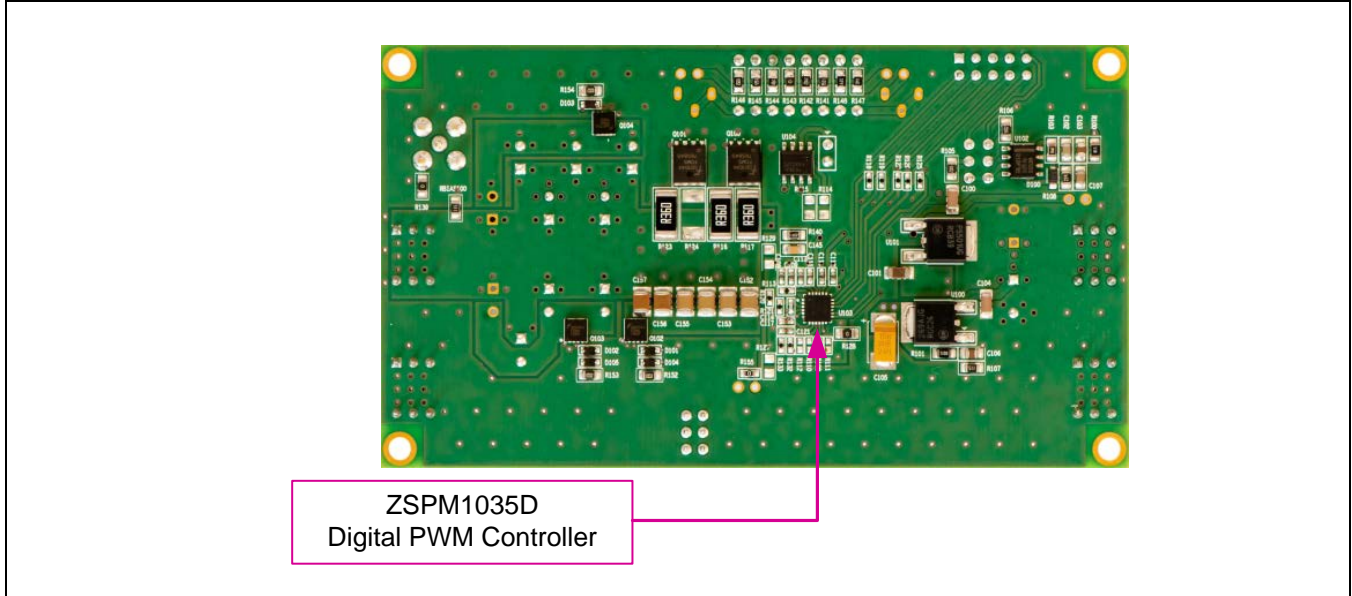
Figure 2.1 ZSPM8835-KIT Evaluation Board (Top Side)



Notes:

- Jumper pins J100 and J101 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 J100 and/or J101 (white arrows on the board indicate pin 1). 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. The load resistors will draw 4.17A (J101) and 8.33A (J100) at the nominal output voltage of 1.5V. Refer to section 6.4 for more information on the transient load circuit and important warnings.
- Jumper J104 is a test point for the load step (can be used as a trigger for an oscilloscope).
- J105 is a DIP switch used to select configuration resistors for the CONFIG0 and CONFIG1 pins. Ensure that only one switch is on in the set of switches 1 to 4 and only one switch is on in the set of switches 5 to 8.
- Jumper J106 can be used to select the amount of capacitance connected to the output of the Murata OKLP-X/35-W12-C Power Block. Further details are 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.

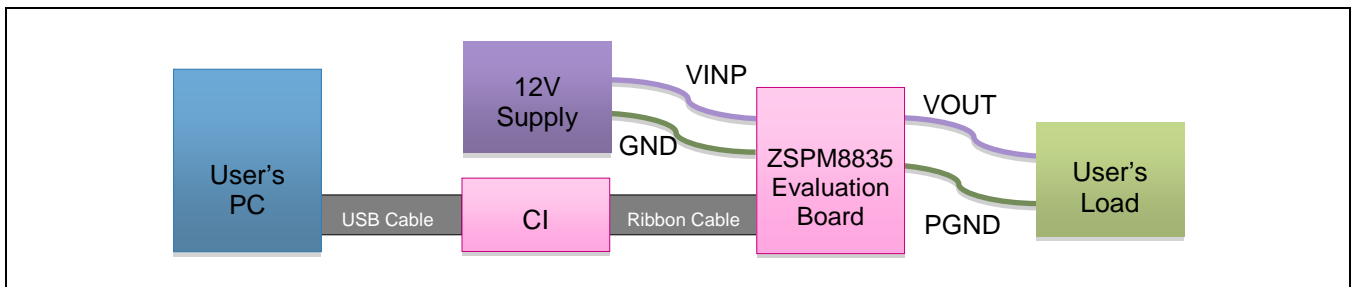
Figure 2.2 ZSPM8835-KIT Evaluation Board (Bottom Side)



2.2. General Setup for the Evaluation System

The basic setup for using the ZSPM8835 Evaluation Kit is illustrated in Figure 2.3. The pink-shaded blocks and the cables 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 ZSPM1035D controller and the Murata OKLP-X/35-W12-C with the Evaluation Kit:

- **DC power supply:** An external power supply is required for the ZSPM8835 Evaluation Board. Its output voltage must be at least 12V with a rated output current of approximately 1A to 8A 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 in 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 ZSPM8835 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 ZSPM8835 KIT is the ZSPM1035D Pink Power Designer™ graphical user interface (GUI), which is required to monitor the internal measurement and fault conditions of the ZSPM1035D. The Pink Power Designer™ must be downloaded from the ZSPM1035D product page on IDT's website located at www.IDT.com/ZSPM1035D.

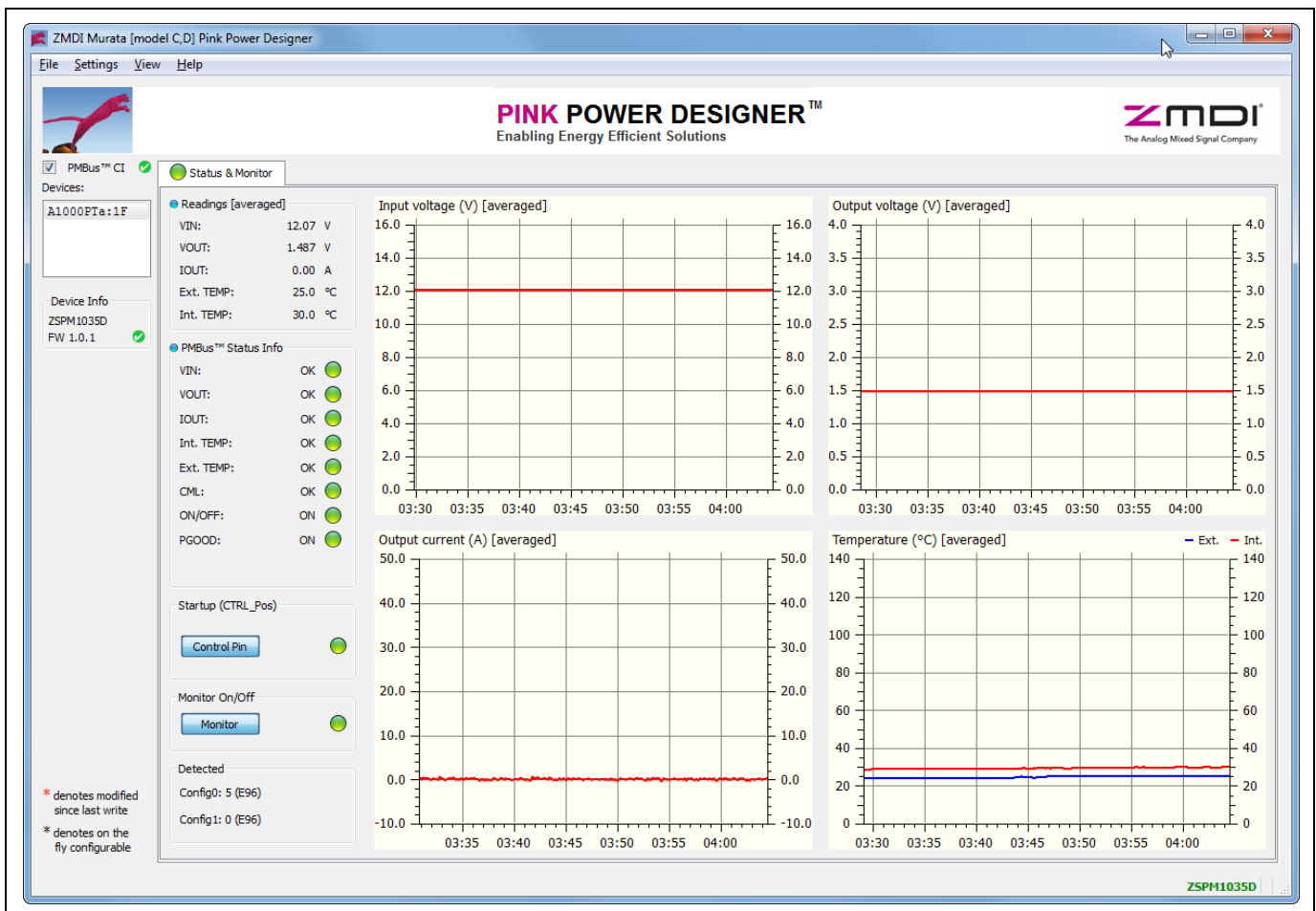
1. Click on this link on the ZSPM1035D product page to download the zip file for the GUI: **Pink Power Designer(TM) GUI for ZSPM1035C/D Rev. X.x.y** (X.x.y refers to the latest version of the file.)
2. Extract the executable file *IDT_ZSPM1035CD_PPDGui_X.x.y_win32-setup.exe* from the zip file.
3. Install the Pink Power Designer™ GUI software by clicking on the extracted file *IDT_ZSPM1035CD_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 ZSPM1035C/D*, which is included in the software and can also be downloaded from the ZSPM1035D product page on IDT's web site (www.IDT.com/ZSPM1035D). To open it from within the GUI, 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 graphic user interface (GUI) designed by IDT to enable the user to 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 controller under test. 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 ZSPM1035D controller.

The Side Panel

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

The Status & Monitor Tab

The “Status & Monitor” provides monitoring of voltage, current, and temperatures. The status of the internal fault monitoring is shown.

The CONTROL pin of the ZSPM1035D can be toggled to enable or disable the output of the ZSPM8835 Evaluation Board. The pin-strap configuration indexes for the CONFIG0 and CONFIG1 pins are displayed in the bottom left corner. Refer to the *ZSPM1035D Data Sheet* for definitions of the configuration indexes.

5 Evaluation Kit Setup for a 1.5V Output Voltage

This section covers the steps for powering up the ZSPM8835 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 these step-by-step instructions to power up the ZSPM8835 Evaluation Board:

- Step 1:** Set switches 1 and 5 on DIP switch J105 to ON and ensure that no jumper is placed on header J106. The remainder of the switches must be in the OFF position. This selects the standard configuration for the ZSPM8835 Evaluation Board. The standard configuration has an output voltage of 1.50V and operates with the lowest output capacitor range.
- 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 J103 with the orientation shown in Figure 5.1 (pin 1 is labeled on the board) and use the USB cable to connect the CI to a USB port on the user’s PC.
- Step 3:** Start the Pink Power Designer™ and follow the instructions given in the *Pink Power Designer™ Graphic User Interface (GUI) Guide for the ZSPM1035C/D* to select the Murata OKLP-X/35-W12-C Power Block and the ZSPM1035D controller via the Murata Power Block Wizard. Then click “Finish” to proceed to the main window of the GUI.

- 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 ZSPM8835 Evaluation Board. The Pink Power Designer™ GUI will now recognize the ZSPM1035D and show the device in the status panel on the left side of the screen.
 Note: Because the ZSPM1035D has not yet been enabled by the GUI, there should be no voltage present on the output connectors of the ZSPM8835 Evaluation Board at this time.
- Step 5:** Ensure that monitoring of the input voltage, output voltage, output current, and the readings of internal and external temperature is active. The virtual LED next to the “Monitor” button will be green when monitoring is enabled (see Figure 5.2). Click on the “Monitor” button to enable monitoring if the virtual LED is not green.
- Step 6:** Click on the “Control Pin” button located in the “Startup” subsection to enable the output of the ZSPM8835 Evaluation Board. The power-good (PG) LED on the board should be on now (shown in Figure 2.1), and a voltage of 1.5V should be present on the output terminals.

Figure 5.1 ZSPM8835-KIT – PMBus™CI Connection (Top Side of the PCB)

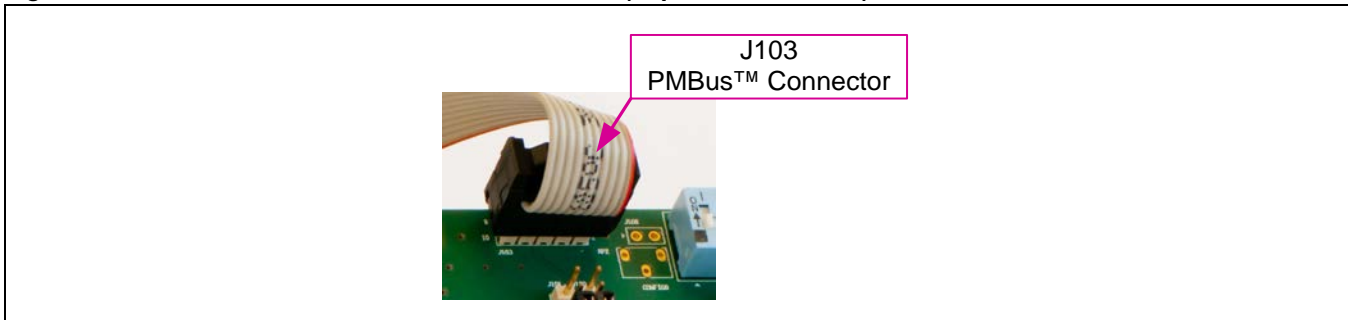
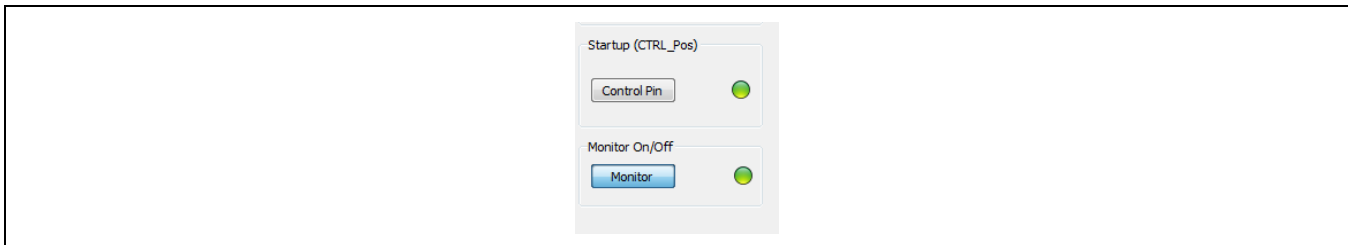


Figure 5.2 Control Pin Button



6 Evaluation Board Hardware Setup

6.1. Introduction

The ZSPM1035D PWM controller has two configuration pins that support pin-strapping of the following parameters:

- Output Voltage, VOUT
- Compensation Loop Parameters
- Output Voltage Slew Rate (this parameter is permanently preconfigured to be 10 V/ms on the Evaluation Board)

The output voltage is set with a pin-strap resistor between the CONFIG0 pin and the AGND pin of the ZSPM1035D that is selected with the J105 DIP switch. Refer to section 6.2 for more information on the output voltage selection on the ZSPM8835 Evaluation Board. The *ZSPM1035D Data Sheet* provides detailed information about the output voltage selection of the ZSPM1035D.


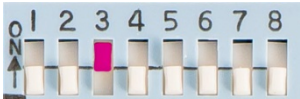


The ZSPM1035D has four pre-configured compensators that are selectable with a pin-strap resistor between the CONFIG1 pin and AGND that is selected with the J105 DIP switch. The four compensators have been designed to work for specific ranges of output capacitors. Section 6.3 describes how the Evaluation Board can be configured for any of the four capacitor ranges, thereby enabling simple comparisons of the dynamic performance of the complete solution. The *ZSPM1035D Data Sheet* provides further information about the compensation loop configurations of the ZSPM1035D controller and typical performance measurements.

6.2. Output Voltage Selection

The ZSPM1035D has been pre-configured for 30 different output voltages (see the *ZSPM1035D Data Sheet*) selectable by a pin-strap resistor between the CONFIG0 pin and AGND. Four common output voltages can be selected with DIP switch J105 on the ZSPM8835 Evaluation Board.

Important: Ensure that for the set of switches 1 through 4 on DIP switch J105, only one switch is in the ON position.

Table 6.1 ZSPM8835 Evaluation Board - Output Voltage Selection

| Output Voltage VOUT | DIP Switch J105 | Output Voltage VOUT | DIP Switch J105 |
|---------------------|---|---------------------|---|
| 1.50V |  | 2.50V |  |
| 1.80V |  | 3.30V |  |

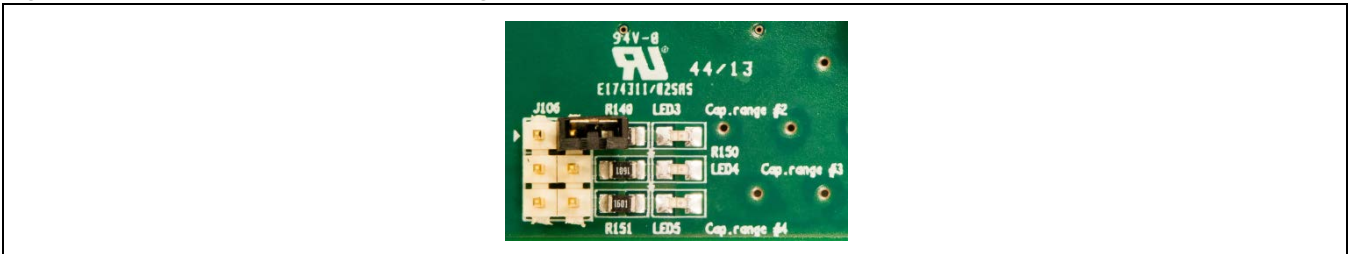
Follow these steps to change the output voltage:

1. Ensure that the input voltage for the ZSPM8835 Evaluation Board is OFF.
2. Select the nominal output voltage by setting the DIP switch corresponding to the required output voltage to the “ON” position. Make sure the three remaining DIP switches are in the “OFF” position.
3. Apply the input voltage to the ZSPM8835 Evaluation Board.
4. Enable the output voltage by clicking the “Control Pin” button in the Pink Power Designer GUI™.

6.3. Output Capacitor Range Selection

The ZSPM1035D controllers have been pre-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 *ZSPM1035D Data Sheet* for more information on the output capacitor ranges). The Evaluation Board enables the customer to test the performance of the controller for each of the four output capacitor ranges. A minimum set of ceramic capacitors are always present on the output of the Murata OKLP-X/35-W12-C Power Block (capacitor range #1, no jumper on J106) and further capacitor banks can be selected with a jumper on header J106 (see Table 6.2). The type and number of capacitors connected to the output for each range are listed in Table 6.2. On the Evaluation Board, one of the three LEDs adjacent to J106 will turn green to indicate if capacitor range #2, #3, or #4 has been selected (see Figure 6.1). If none of the LEDs is on, it means that capacitor range #1 has been selected.

Figure 6.1 J106 - Output Capacitor Range Hardware Selection

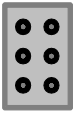

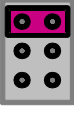

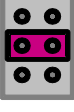

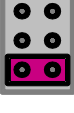



It is important to ensure that the output capacitor range selected on J106 matches the compensator selected for the ZSPM1035D. The compensator can be selected on the J105 DIP switch with switches 5 through 8 (see Table 6.2).

Important: Ensure that for the set of switches 5 through 8 on DIP switch J105, only one switch is in the ON position.

The output voltage slew rate is always set to 10 V/ms on the ZSPM8835 Evaluation Board.

Table 6.2 ZSPM8835 Evaluation Board – Output Capacitors

| Capacitor Range | Ceramic Capacitor | Bulk Electrolytic Capacitors | Header J106 | DIP Switch J105 |
|-----------------|--|------------------------------|--|---|
| #1 | 3 x 100µF 6.3V X5R 2 x 47µF 10V X7R | None |  |  Comp0 Setting |
| #2 | 7 x 100µF 6.3V X5R 4 x 47µF 10V X7R | None |  |  Comp1 Setting |
| #3 | 3 x 100µF 6.3V X5R 2 x 47µF 10V X7R | 3 x 470µF, 7mΩ ESR |  |  Comp2 Setting |
| #4 | 7 x 100µF 6.3V X5R 4 x 47µF 10V X7R | 8 x 470µF, 7mΩ ESR |  |  Comp3 Setting |

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 for the ZSPM8835 Evaluation Board is OFF.
2. Select the output capacitor range via header J106.
3. Select the compensator matching the output capacitor range using positions 5 through 8 on the J105 DIP switch.
4. Select the nominal output voltage on using positions 1 through 4 on the J105 DIP switch.
5. Apply the input voltage to the ZSPM8835 Evaluation Board.
6. Enable the output voltage by clicking the “Control Pin” in the Pink Power Designer GUI™.
7. Test the dynamic performance using either the on-board transient loads or an external electronic load.

6.4. On-Board Transient Loads

The ZSPM8835 Evaluation Board has on-board transient loads that can be used to test the dynamic performance of the ZSPM1035D controller. The transient loads consist of a simple timer circuit driving a power MOSFET. The power MOSFET is connected in series with resistors connected across the output of the Murata OKLP-X/35-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 on headers J100 and J101 (see Figure 6.2). The timing signal for the transient loads has an ON time of approximately 1 millisecond with a time period of approximately 80 milliseconds as demonstrated in Figure 6.3.

Important: The load current is a function of the nominal output voltage set on DIP switch J105 and the resistance of the transient load. Be sure to calculate the expected load current before enabling the transient loads. Enabling both loads at the same time by placing jumpers across both J101 and J100 creates a load resistance of 0.12Ω, 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 2.5V. Using both jumpers is not recommended.

Figure 6.2 J100 and J101 – Transient Load Selection

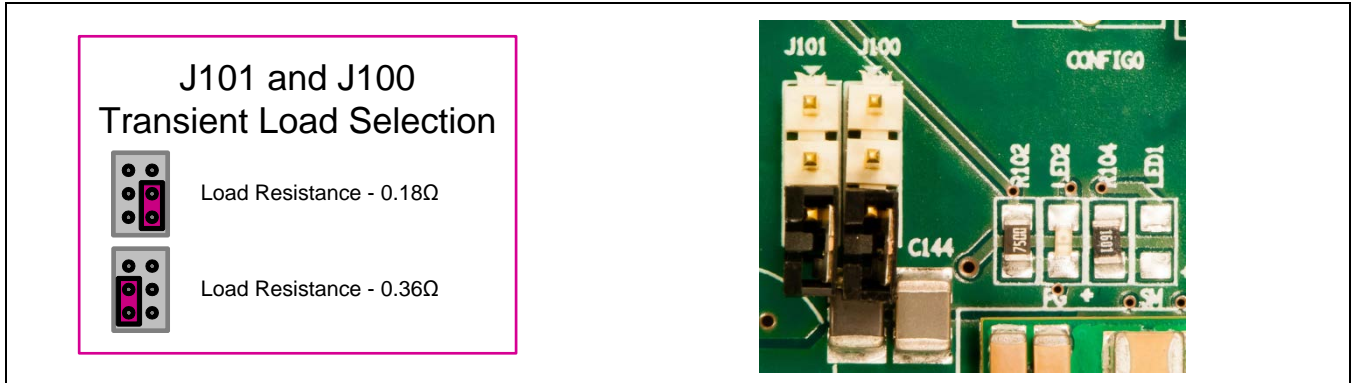
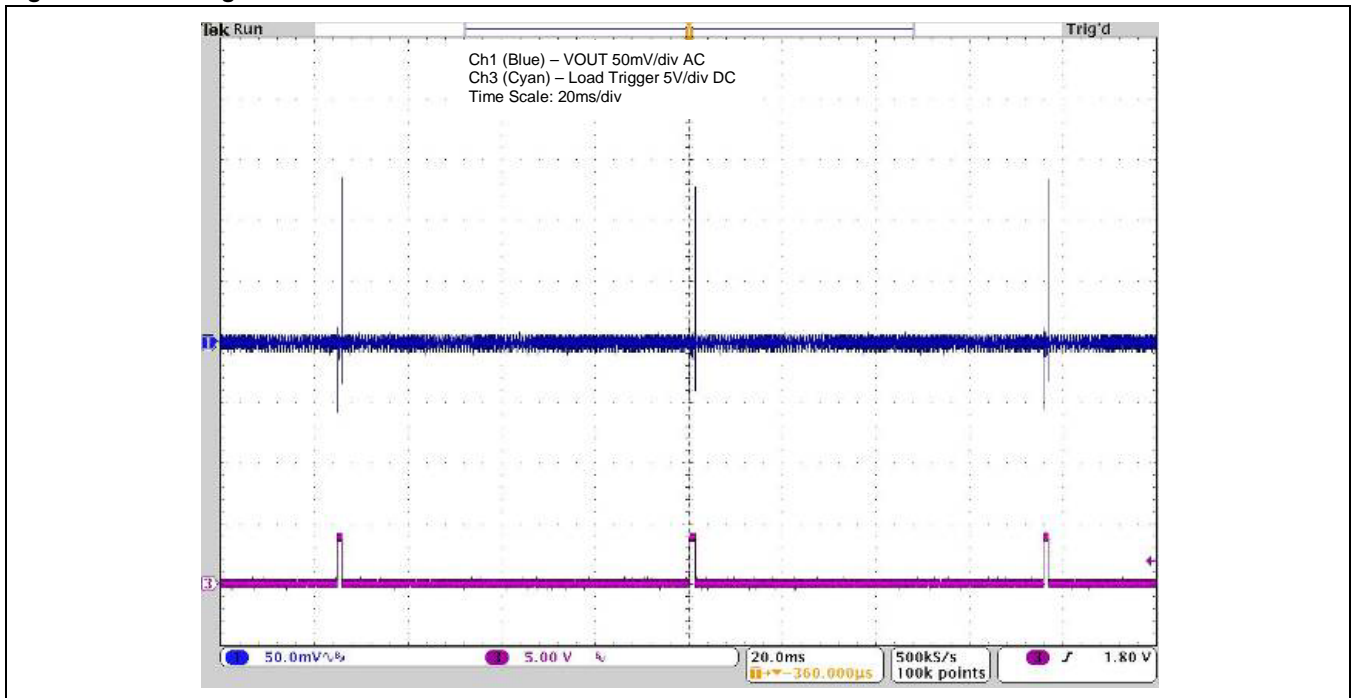


Figure 6.3 Timing for the On-Board Transient Loads



7 Support

IDT provides additional support tools for the ZSPM8835-KIT and the IDT Pink Power Designer™ on www.IDT.com. If further support is needed, contact IDT at www.IDT.com/go/support.

8 Related Documents

| Document |
|--|
| <i>ZSPM1035D Data Sheet</i> |
| <i>Pink Power Designer™ Graphic User Interface (GUI) Guide for the ZSPM1025C/D and ZSPM1035C/D</i> |

Visit www.IDT.com/ZSPM1035D or contact your nearest sales office for the latest version of these documents.

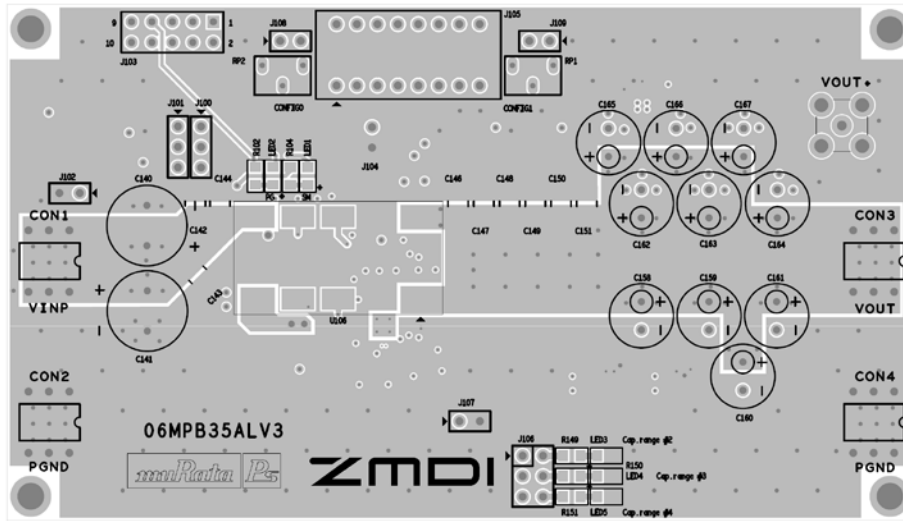
9 Definitions of Acronyms

| Term | Description |
|------|------------------------|
| DIP | Dual In-line Package |
| PWM | Pulse Width Modulation |

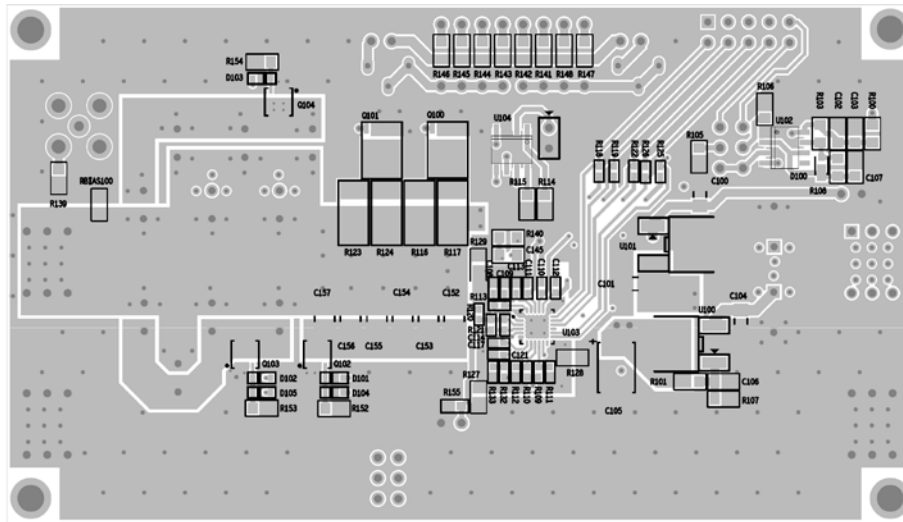
10 Document Revision History

| Revision | Date | Description |
|----------|------------------|--|
| 1.00 | January 23, 2014 | First release. |
| 1.01 | June 13, 2014 | Updated cover imagery and contact information. Updated images of software. |
| | April 14, 2016 | Changed to IDT branding. |

Appendix A: ZSPM8835 Evaluation Board

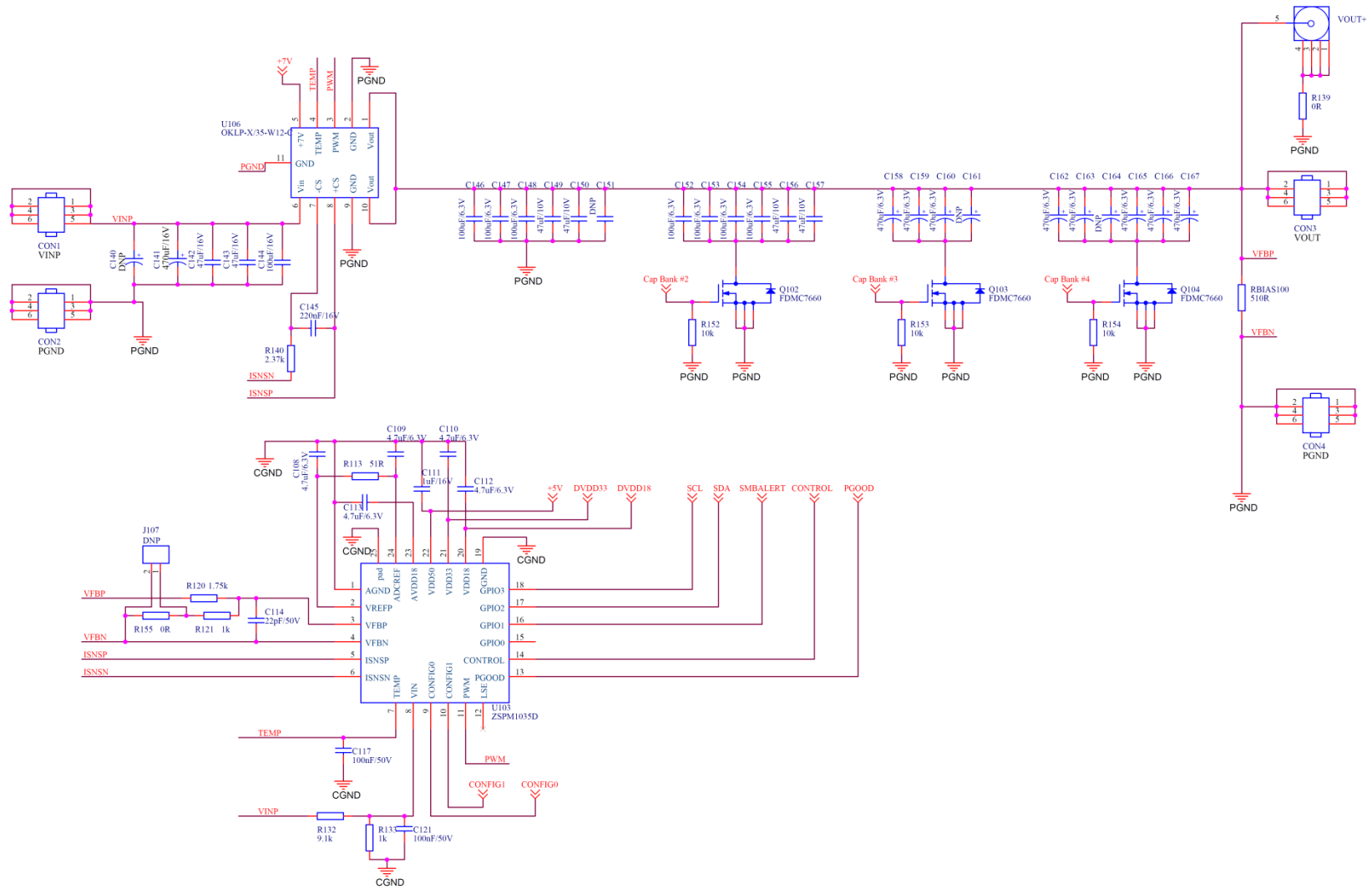


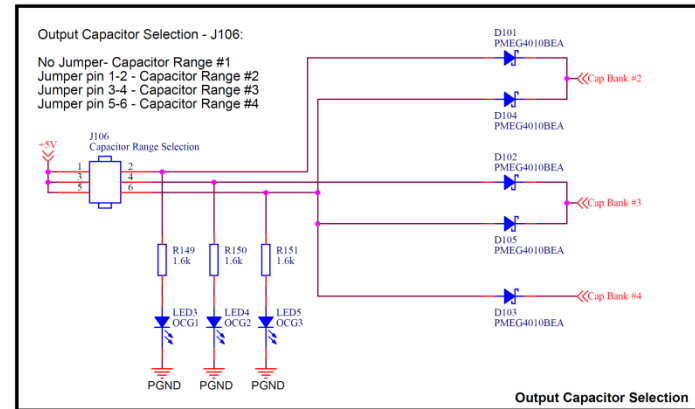
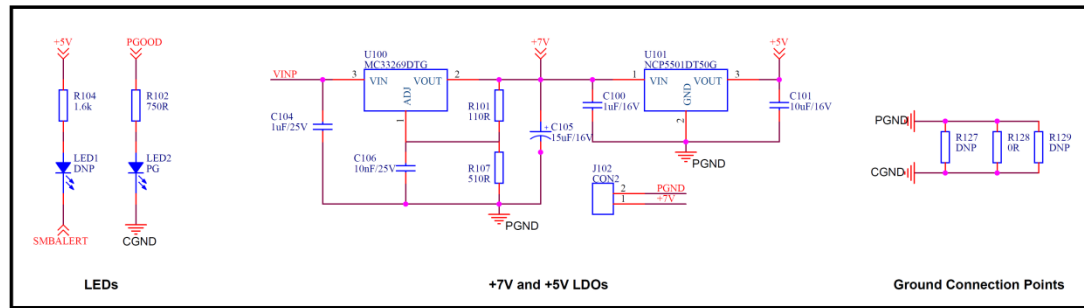
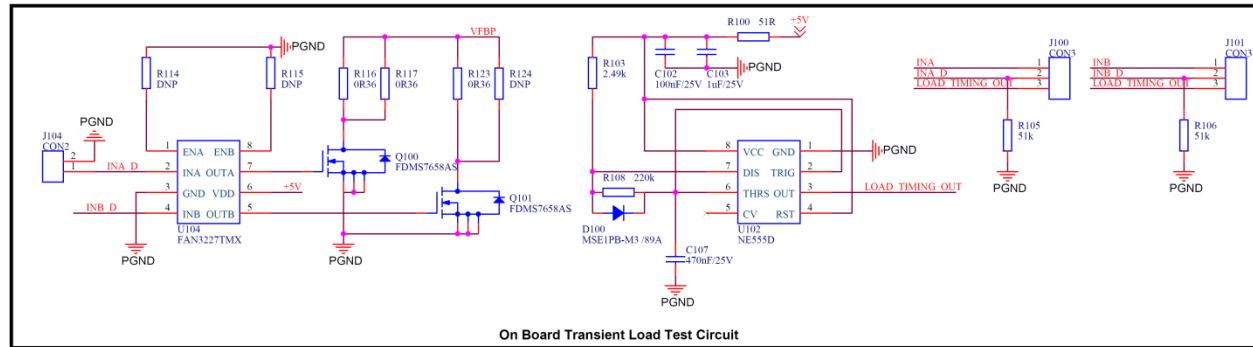
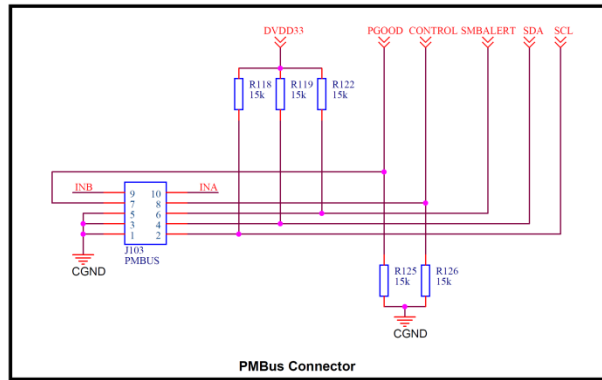
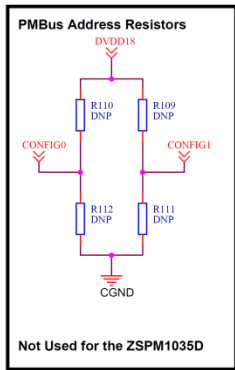
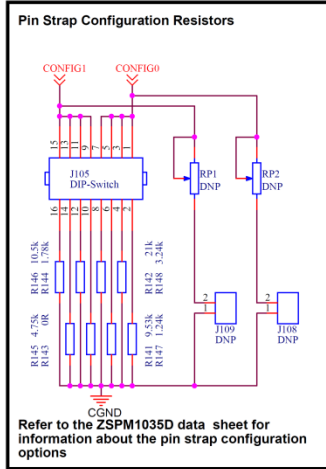
Top Side



Bottom Side

Appendix B: ZSPM8835 Evaluation Board Schematic





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