

DS125BR800AEVM

User's Guide



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DS125BR800AEVM Evaluation Kit

The DS125BR800AEVM – SMA evaluation kit provides a complete high band-width platform to evaluate the signal integrity and signal conditioning features of the Texas Instruments signal conditioning products – with Equalization and De-emphasis. SMA edge launch connectors are used as the input and the output connections for this evaluation board. Commercially available adaptor boards can be purchased to facilitate connection to cables or backplane interconnects.

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1 Features

- 8 Channel Repeater up to 12.5 Gbps
- Low 65 mW/channel power consumption, with option to power down unused channels
- Transparent management of link training protocol for PCIe, SAS, and 10G-KR
- Receive Equalization up to 30 dB at 12.5 Gbps
- Settable transmit de-emphasis driver to -12 dB
- Transmit output voltage control: 700 – 1300 mV
- Programmable via pin selection, EEPROM, or SMBus interface
- Single supply operation: $V_{IN} = 3.3V \pm 10\%$ or $V_{DD} = 2.5V \pm 5\%$
- -40°C to +85°C Operation
- 5 kV HBM ESD rating
- High speed signal flow-thru pin-out package: 54-pin WQFN (10 mm x 5.5 mm, 0.5 mm pitch)

Applications

FR-4 Backplane Traces and High Speed Cable

Ordering Information

EVM ID	DEVICE ID	DEVICE PACKAGE
DS125BR800AEVM	DS125BR800ANJYT	WQFN-54

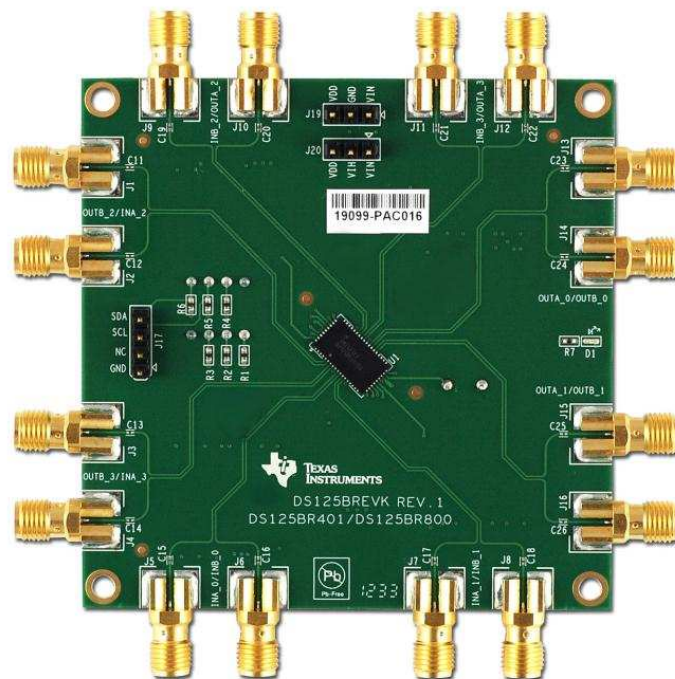


Figure 1. Top Assembly

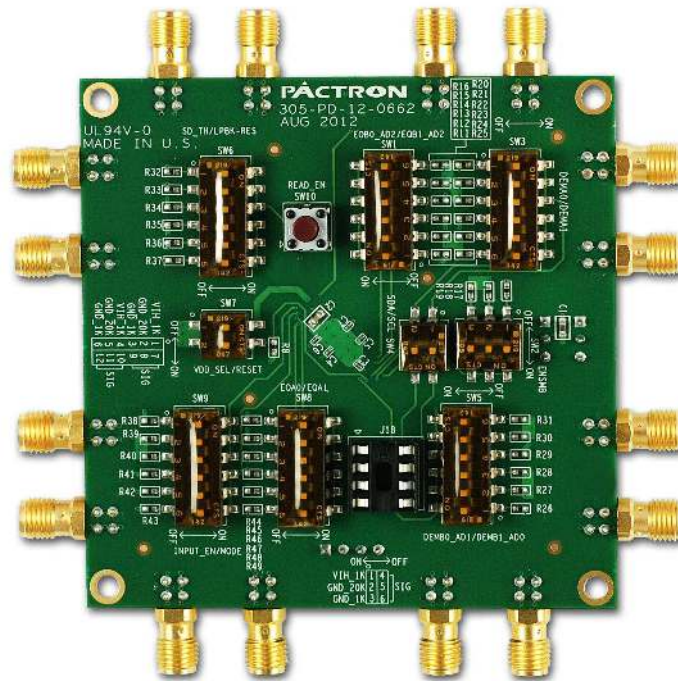


Figure 2. Bottom Assembly

2 4-Level IO Control

Many of the control pins on the DS125BR800A have more than two valid levels. [Table 1](#) below shows how to access each of these levels with the switch banks on the back side of the EVM.

Table 1. Switches to set the 4-Level input control pins

4-Level Input Settings	Setting for 3-pin switches (3-2-1)
0 - Tie 1 k Ω to GND	ON - OFF - OFF
R - Tie 20 k Ω to GND	OFF - ON - OFF
F - FLOAT (open)	OFF - OFF - OFF
1 - Tie 1 k Ω to VIH	OFF - OFF - ON

The following switches are used to set the input condition for the 4-level inputs:

- **SW1, SW2, SW3, SW5, SW6, SW8, SW9**

There are 3 switches connected to an input signal pin. Each switch when set to the ON position sets the pin to one of the 4-level setting. The 6-pin switches are assigned similar to the 3-pin switches. The only difference is 2 signal pins are connected and thus 6-5-4 is for the one signal pin and 3-2-1 is for another signal pin.

NOTE: Only 1 switch at the ON position is allowed. Activating more than one switch concurrently results in an indeterminate voltage level.

3 Switch Connection Overview

Table 2. Connection and Control Description

Component	Name	Function
J1 to J8	IN_B2+, IN_B2-, IN_B3+, IN_B3-, IN_A0+, IN_A0-, IN_A1+, IN_A1-	High-speed differential inputs
J9 to J16	OUT_B2+, OUT_B2-, OUT_B3+, OUT_B3-, OUT_A0+, OUT_A0-, OUT_A1+, OUT_A1-	High-speed differential outputs
J19	VIN or VDD	DC Power - VIN or VDD to DS125BR800A
J20	VIN or VDD	Jumper – VIN or VDD to VIH power
J17	SDA, SCL	Optional SMBUS access pins. See the datasheet for additional information on SMBUS.
J18	EEPROM	Optional socket for EEPROM
SW1	EQB[1:0] or AD[3:2]	PIN MODE – EQ control for channel B inputs SMBUS MODE – AD[3:2] device address bits
SW2	ENSMB	ENSMB = LOW – PIN MODE ENSMB = HIGH – SMBUS (slave mode) ENSMB = FLOAT – SMBUS (master mode – load configuration from EEPROM)
SW3	DEMA[1:0]	PIN MODE – DE control for channel A outputs
SW4	SDA/SCL	“ON” position connects SDA and SCL lines to the device pin.
SW5	DEMB[1:0] or AD[1:0]	PIN MODE – DE control for channel B outputs SMBUS MODE – AD[1:0] device address bits
SW6	SD_TH and LPBK - RES	SD_TH – Signal detect threshold level (FLOAT = Default level) LPBK function for BR401 only (FLOAT = Normal operation)
SW7	VDD_SEL and RESET	VDD_SEL – Enable or disable the internal 3.3V to 2.5V regulator. RESET – Enable or disable the device (LOW – enable)
SW8	EQA[1:0]	PIN MODE – EQ control for channel A inputs
SW9	INPUT_EN and MODE	INPUT_EN – Enable or disable the internal 50 ohm to VDD terminations MODE – Tie 1 kΩ to GND = GEN 1,2 and SAS 1,2 Float = Auto Mode Select (for PCIe and SAS-3) Tie 20 kΩ to GND = SAS-3 and GEN-3 without De-emphasis Tie 1 kΩ to VDD = SAS-3 and GEN-3 with De-emphasis
SW10	READ_EN	ENSMB = FLOAT – SMBUS (master mode – load configuration from EEPROM) SW6: SD_TH becomes the READ_EN pin. To start the loading at power up, set SW6 pin 3 to “ON” position (pull to GND). To manually control the start, set SW6 pin 1 to “ON” position (pull to VDD) and push the SW10 button for the high to low transition to start the loading. When the loading is complete the LED – D1 light should turn OFF.

4 Quick Start Guide

1. Connect J19: VIN = 3.3V or VDD = 2.5V and GND.

- **For VIN = 3.3V:**
Set SW7 pin1 (VDD_SEL) to the ON position (enable internal LDO regulator) and float VDD at J19.
- **For VIN = 2.5V:**
Set SW7 pin1 (VDD_SEL) to the OFF positions (disable internal LDO regulator) and float VIN at J19.

2. Set jumper – J20 for VIH connection to VIN or VDD.

3. Connect 50 Ohm SMA cables to the board.

- The input signals J1 to J8 can be connected from a pattern generator. Set SW7 pin1 (VDD_SEL) to the ON position (enable internal LDO regulator) and float VDD at J19.
- The output signals J9 to J16 can be connected to a scope.

Table 3. SMA Channel Connections

A/B Channels	Input Channel	Output Channel
B-Channels	J1 – IN_B2+, J2 – IN_B2-	J9 – OUT_B2+, J10 – OUT_B2-
	J3 – IN_B3+, J4 – IN_B3-	J11 – OUT_B3+, J12 – OUT_B3-
A-Channels	J5 – IN_A0+, J6 – IN_A0-	J13 – OUT_A0+, J14 – OUT_A0-
	J7 – IN_A1+, J8 – IN_A1-	J15 – OUT_A1+, J16 – OUT_A1-

4. Set the control pins for normal operation

- SW7 – RESET = 0 (enables the device): set switch pin2 to the ON position.
- SW9 – INPUT_EN = 1 (50 ohm input termination): set switches (3-2-1) = (OFF-OFF-**ON**).
- SW9 – MODE = VDD (enables SAS-3 / PCIe GEN3 mode): set switches (6-5-4) = (OFF-OFF-**ON**).
- SW6 – SD_TH = F (default signal detect threshold level): set switches (3-2-1) = (OFF-OFF-OFF).
- SW6 – LPBK - RES = F (normal operation): set switches (6-5-4) = (OFF-OFF-OFF).

5. Set the input equalization level.

- **For external pin mode control of the equalization level:**
- Set ENSMB = 0 (1 kΩ to GND) by using the SW2 (3-2-1) = (**ON**-OFF-OFF).
- SW4 pin1,2 must be set to the OFF positions, so the SMBUS signals are disconnected.
- Refer to [Table 1](#) for information on the 3 switch settings for the 4 level input.

Example:

- Set EQB[1:0] with SW1 for the B bank of inputs (top 4 inputs of DS125BR800A).
- SW1 (6-5-4), (3-2-1) = (OFF-**ON**-OFF), (OFF-**ON**-OFF) = EQB[1:0] = R,R (Level 6).
- Set EQA[1:0] with SW8 for the A bank of inputs (bottom 4 inputs of DS125BR800A).
- SW8 (6-5-4), (3-2-1) = (OFF-**ON**-OFF), (OFF-**ON**-OFF) = EQA[1:0] = R,R (Level 6).

Table 4. EQ Settings available with PIN MODE

Level	EQA/B[1:0]	SW1 - EQB[1:0] or SW8 - EQA[1:0]						EQ (dB) @ 6 GHz
		6	5	4	3	2	1	
1	0, 0	ON	OFF	OFF	ON	OFF	OFF	3.1
2	0, R	ON	OFF	OFF	OFF	ON	OFF	6.7
3	0, F	ON	OFF	OFF	OFF	OFF	OFF	8.4
4	0, 1	ON	OFF	OFF	OFF	OFF	ON	9.1
5	R, 0	OFF	ON	OFF	ON	OFF	OFF	13.7
6	R, R	OFF	ON	OFF	OFF	ON	OFF	16.2
7	R, F	OFF	ON	OFF	OFF	OFF	OFF	15.9
8	R, 1	OFF	ON	OFF	OFF	OFF	ON	17.0
9	F, 0	OFF	OFF	OFF	ON	OFF	OFF	20.7
10	F, R	OFF	OFF	OFF	OFF	ON	OFF	21.8
11	F, F	OFF	OFF	OFF	OFF	OFF	OFF	23.6
12	F, 1	OFF	OFF	OFF	OFF	OFF	ON	24.7
13	1, 0	OFF	OFF	ON	ON	OFF	OFF	28.0
14	1, R	OFF	OFF	ON	OFF	ON	OFF	29.2
15	1, F	OFF	OFF	ON	OFF	OFF	OFF	30.9
16	1, 1	OFF	OFF	ON	OFF	OFF	ON	31.9

6. Set the output VOD and De-emphasis level.

- **For external pin mode control for the VOD and De-emphasis level:**

- Set ENSMB = 0 (1 kΩ to GND) by using the SW2 (3-2-1) = (**ON**-OFF-OFF).
- SW4 pin1,2 must be set to the OFF positions, so the SMBUS signals are disconnected.
- Refer to [Table 1](#) for information on the 3 switch settings for the 4 level input.

Example:

- Set DEMB[1:0] with SW5 for the B bank of outputs (top 4 outputs of DS125BR800A).
- SW5 (6-5-4), (3-2-1) = (**ON**-OFF-OFF), (OFF-OFF-**ON**) = DEMB[1:0] = 0,1 (VOD=1.0V, DE=0 dB).
- Set DEMA[1:0] with SW3 for the A bank of outputs (bottom 4 outputs of DS125BR800A).
- SW3 (6-5-4), (3-2-1) = (**ON**-OFF-OFF), (OFF-OFF-**ON**) = DEMA[1:0] = 0,1 (VOD=1.0V, DE=0 dB).

Table 5. DE and VOD Settings available in PIN MODE

Level	EQA/B[1:0]	SW1 - EQB[1:0] or SW8 - EQA[1:0]						GEN1 and GEN2	
		6	5	4	3	2	1	Inner Amplitude (V _{PP})	DE (dB)
1	0, 0	ON	OFF	OFF	ON	OFF	OFF	0.8	0
2	0, R	ON	OFF	OFF	OFF	ON	OFF	0.9	0
3	0, F	ON	OFF	OFF	OFF	OFF	OFF	0.6	-3.5
4	0, 1	ON	OFF	OFF	OFF	OFF	ON	1.0	0
5	R, 0	OFF	ON	OFF	ON	OFF	OFF	0.7	-3.5
6	R, R	OFF	ON	OFF	OFF	ON	OFF	0.5	-6
7	R, F	OFF	ON	OFF	OFF	OFF	OFF	1.1	0
8	R, 1	OFF	ON	OFF	OFF	OFF	ON	0.7	-3.5
9	F, 0	OFF	OFF	OFF	ON	OFF	OFF	0.6	-6
10	F, R	OFF	OFF	OFF	OFF	ON	OFF	1.2	0
11	F, F	OFF	OFF	OFF	OFF	OFF	OFF	0.8	-3.5
12	F, 1	OFF	OFF	OFF	OFF	OFF	ON	0.6	-6
13	1, 0	OFF	OFF	ON	ON	OFF	OFF	1.3	0
14	1, R	OFF	OFF	ON	OFF	ON	OFF	0.9	-3.5
15	1, F	OFF	OFF	ON	OFF	OFF	OFF	0.7	-6
16	1, 1	OFF	OFF	ON	OFF	OFF	ON	0.5	-9

NOTE: The De-Emphasis levels are also available in SAS-3 / GEN-3 mode when MODE = 1

5 SMBus Slave Mode of the EQ, VOD, and De-Emphasis level:

- Set ENSMB = 1 (1 k Ω to VIH) by using the SW2 (3-2-1) = (OFF-OFF-**ON**).
- Set SW4 pin1,2 to the ON position so the SMBUS signals are connected.
- Set SW3 pin1 thru pin6 switches to the OFF position so they do not connect to the SDA and SCL line.
- Set the SW1 and SW5 for the AD[3:0] pins. AD[3:0]=0000 sets device slave address = B0'hex.
- Connect SDA, SCL and GND to J17. Please refer to datasheet for register map for EQ, VOD and DEM.

6 Bill of Materials**Table 6. Bill of Materials**

Item	Qty	Reference	Digikey PN	Manufacturer PN	Description
1	1	C1	445-3448-1-ND	C1608Y5V0J106Z	CAP CER 10UF 6.3V Y5V 0603
2	1	C2	445-1322-1-ND	C1608X5R0J105K	CAP CER 1.0UF 6.3V X5R 0603
3	5	C3, C4, C5, C6, C7	445-4711-1-ND	C0603X5R0J104M	CAP CER .10UF 6.3V X5R 0201
4	16	C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26	587-2483-1-ND	LMK063BJ224MP-F	CAP CER .22UF 10V X5R 0201
5	1	D1	511-1592-1-ND	SML-P12PTT86	LED GRN 0.2MM 13MCD 0402 SMD
6	16	J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16	J801-ND	142-0761-881	CONN JACK SMA 50 OHMS PC MOUNT
7	1	J17	WM6504-ND	22-28-4043	CONN HEADER 4POS .100 VERT GOLD
8	2	J19, J20	WM6503-ND	22-28-4033	CONN HEADER 3POS .100 VERT GOLD
9	1	J18	3M5473-ND	4808-3004-CP	SOCKET IC 8-POS .3"
10	31	R1, R2, R3, R4, R8, R11, R13, R14, R16, R17, R19, R20, R22, R23, R25, R26, R28, R29, R31, R32, R34, R35, R37, R38, R40, R41, R43, R44, R46, R47, R49	P1.00KLCT-ND	ERJ-2RKF1001X	RES 1.00K 1/10W 1% 0402
11	1	R7	P220LCT-ND	ERJ-2RKF2200X	RES 220 1/10W 1% 0402
12	13	R12, R15, R18, R21, R24, R27, R30, R33, R36, R39, R42, R45, R48	P20.0KLCT-ND	ERJ-2RKF2002X	RES 20.0K 1/10W 1% 0402
13	2	R5, R6	P4.70KLCT-ND	ERJ-2RKF4701X	RES 4.70K OHM 1/10W 1% 0402 SMD
14	6	SW1, SW3, SW5, SW6, SW8, SW9	CT2196MST-ND	219-6MST	SWITCH TAPE SEAL 6 POS SMD
15	1	SW2	CT2193MST-ND	219-3MST	SWITCH TAPE SEAL 3 POS SMD
16	2	SW4, SW7	CT2192MST-ND	219-2MST	SWITCH TAPE SEAL 2 POS SMD
17	1	SW10	P12225SCT-ND	EVQ-21505R	SWITCH LT 6MM 160GF 5MM HEIGHT
18	1	U1	NA	DS125BR800ANJYT	BUFFER - REPEATER

7 Schematic

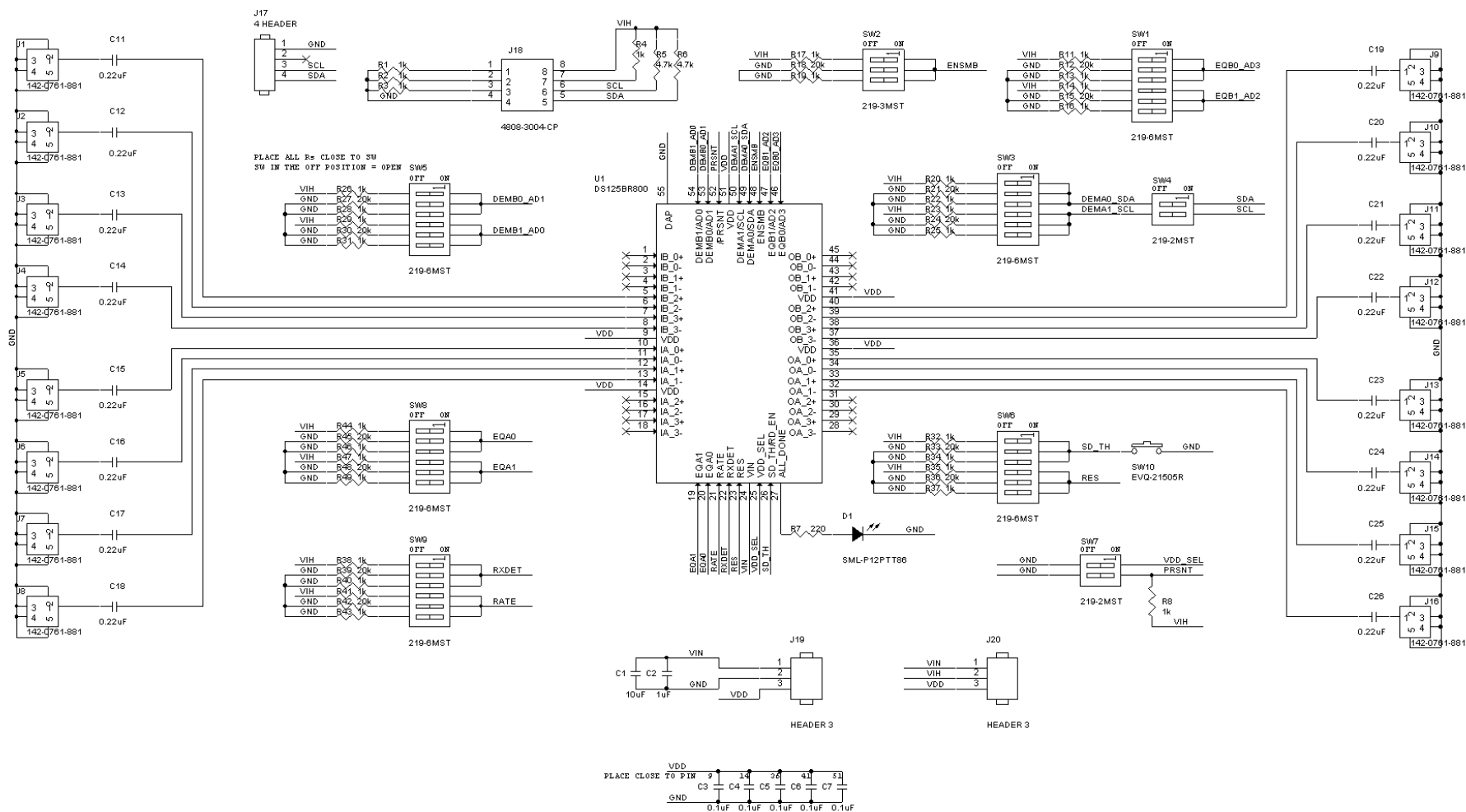


Figure 3. Schematic

8 EVM Layout

The following Figures show the DS125BR800AEVM board layout. The EVM controls signal integrity functions via a combination of switches and jumpers.

The DS125BR800A is very compact and low power. The QFN package offers an exposed thermal pad to enhance electrical and thermal performance. This must be soldered to the copper landing on the PWB.

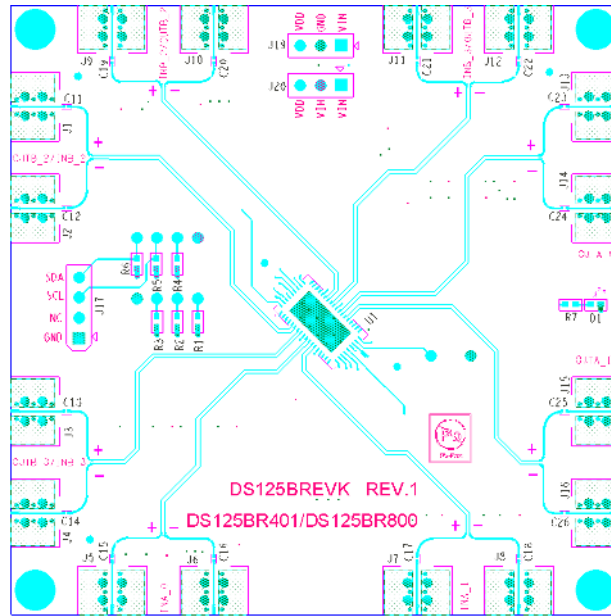


Figure 4. Top Assembly Layer

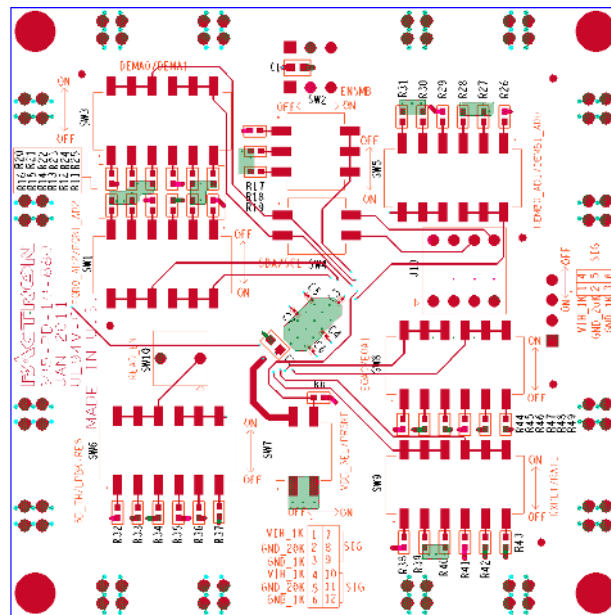


Figure 5. Bottom Assembly Layer

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3. *Regulatory Notices:*
 - 3.1 *United States*
 - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
 - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page
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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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