

TPS22810 Load Switch Evaluation Module

The TPS22810EVM evaluation module (EVM) allows the user to connect power to and control the 6-pin TPS22810 load switch device. Parameters such as the on-resistance, rise time, and quick output discharge can easily and accurately be evaluated. [Table 1](#) lists a short description of the TPS22810 load switch performance specifications.

Table 1. TPS22810 Rise Time, Output Current Rating, Enable, Undervoltage Lockout, and Output Discharge Characteristics

EVM	Device	Rise Time Typical (μ s)	V_{IN} (V)	Maximum Continuous Current (A)	Enable (EN/UVLO)	Quick Output Discharge
TPS22810EVM	TPS22810DBV (CH1)	Adjustable	2.7 to 18	2	Active High	Adjustable
TPS22810EVM	TPS22810DRV (CH2)	Adjustable	2.7 to 18	3	Active High	Adjustable

NOTE: The TPS22810-Q1 can also be evaluated on this EVM by replacing the TPS22810DBV (U1) with the TPS22810TDBVRQ1.

Trademarks

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1 Introduction

1.1 Description

The TPS22810EVM is a two-layer PCB containing the TPS22810 load switch device. The TPS22810EVM supports two packages for TPS22810 device, SOT-23 package (DBV) on CH1 and SON package (DRV) on CH2. The V_{IN} and V_{OUT} connections to the device and the PCB layout routing are capable of handling high continuous currents and provide a low-resistance pathway into and out of the device under test. Test point connections allow the EVM user to control the device with user-defined test conditions and make accurate RON measurements.

1.2 Features

This EVM has the following features:

- V_{IN} input voltage range: 2.7 to 18 V
- Access to the V_{IN} , V_{OUT} , CT, QOD, GND, and EN pins of the TPS22810 load switch device
- Onboard C_{IN} , C_{OUT} , and CT capacitors
- 2-A maximum continuous current operation for TPS22810DBV
- 3-A maximum continuous current operation for TPS22810DRV
- Ability to adjust the QOD resistance using jumpers
- Ability to change C_{OUT} capacitor using jumpers

2 Schematic

Figure 1 illustrates the EVM schematic.

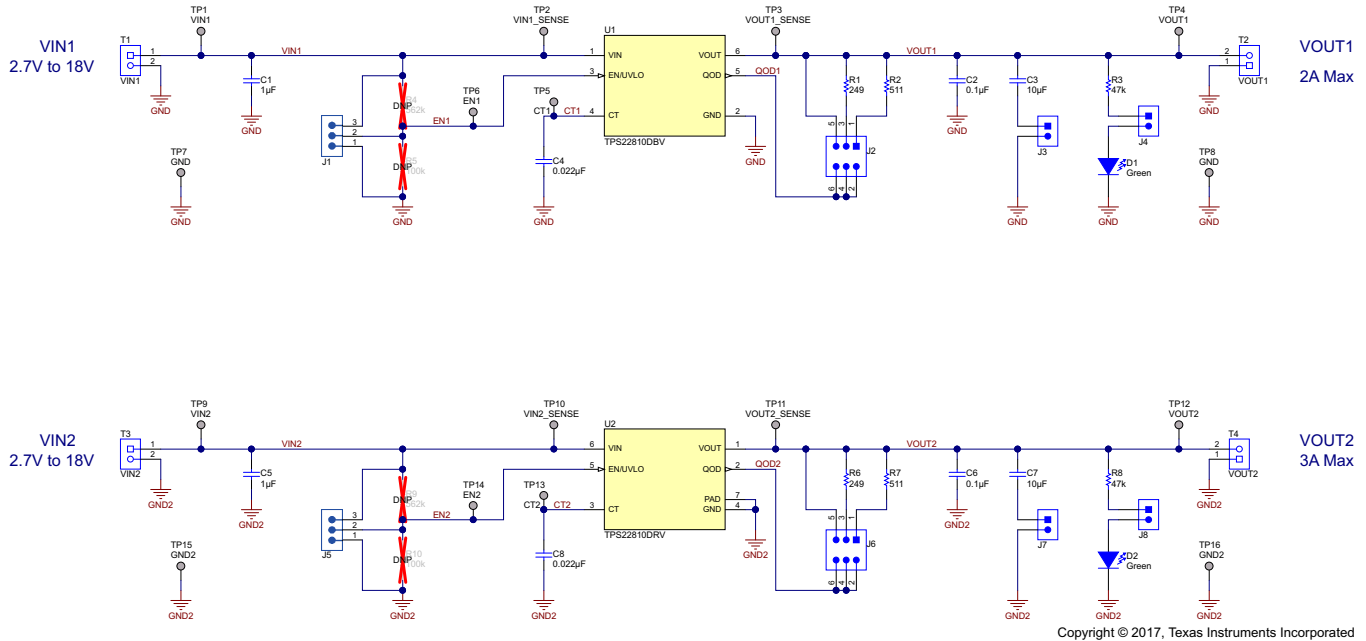


Figure 1. TPS22810EVM Schematic

3 General Configurations

3.1 Physical Access

Table 2 lists the TPS22810EVM input and output connector functionality, Table 3 describes the test point availability, and Table 4 describes the jumper functionality.

Table 2. Input and Output Connector Functionality

Connector	Label	Description
T1	CH1	VIN1(+), GND(-)
T2		VOUT1(+), GND(-)
T3	CH2	VIN2(+), GND2(-)
T4		VOUT2(+), GND2(-)

Table 3. Test Points Description

Channel	Test Points	Label	Description
CH1	TP1	VIN1	CH1 power supply input
	TP2	VIN1_SENSE	CH1 input voltage sense
	TP3	VOUT1_SENSE	CH1 output voltage sense
	TP4	VOUT1	CH1 output voltage
	TP5	CT1	CH1 slew rate control voltage
	TP6	EN1	CH1 enable input
	TP7, TP8	GND	GND

Table 3. Test Points Description (continued)

Channel	Test Points	Label	Description
CH2	TP9	VIN2	CH2 power supply input
	TP10	VIN2_SENSE	CH2 input voltage sense
	TP11	VOUT2_SENSE	CH2 output voltage sense
	TP12	VOUT2	CH2 output voltage
	TP13	CT	CH2 slew rate control voltage
	TP14	EN2	CH2 enable input
	TP15, TP16	GND2	GND

Table 4. Jumper and LED Descriptions

Jumper	Label	Description
J1	UVLO	CH1 UVLO selection 1-2 position disables the device 2-3 position sets default UVLO and enables the device Open position sets UVLO according to R4 and R5 ratio
J2	QOD	CH1 Quick Output Discharge (QOD) resistance selection 1-2 position sets 511-Ω external resistance in series with the QOD pin 3-4 position sets 249-Ω external resistance in series with the QOD pin 5-6 position sets default internal value Open position disables QOD function
J3	J3	CH1 10-μF capacitor connects to VOUT1, if installed
J4	J4	CH1 output power indicator LED pulled to VOUT1, if installed
J5	UVLO	CH2 UVLO selection 1-2 position disables the device 2-3 position sets default UVLO and enables the device Open position sets UVLO according to R9 and R10 ratio
J6	QOD	CH2 Quick Output Discharge (QOD) resistance selection 1-2 position sets 511-Ω external resistance in series with the QOD pin 3-4 position sets 249-Ω external resistance in series with the QOD pin 5-6 position sets default internal value Open position disables QOD function
J7	J7	CH2 10-μF capacitor connects to VOUT2, if installed
J8	J8	CH2 output power indicator LED pulled to VOUT2, if installed
D1, D2 (GREEN-LED)	Output power indicator	CH1, CH2 output power indicators, respectively. LED turns on whenever the output voltage is available.

3.2 Test Equipment

This section lists the following equipment required for test setup.

3.2.1 Power Supplies

One adjustable power supply: 0- to 20-V output, 0- to 3-A output current limit.

3.2.2 Meters

One DMM minimum needed and may require more if simultaneous measurements are required.

3.2.3 Oscilloscope

A DPO2024, or equivalent. Three 10× voltage probes and one DC current probe.

NOTE: A resistive load is recommended for testing. If an electronic load is used, ensure that the output load is set in the constant resistance (CR) mode, not in the constant current (CC) mode.

3.3 Test Configurations

Make sure the evaluation board has default jumper settings as shown in Table 5.

Table 5. Default Jumper Setting for the TPS22810EVM

CH1				CH2			
J1	J2	J3	J4	J5	J6	J7	J8
2-3	1-2	Install	Install	2-3	1-2	Install	Install

Connect the VIN power supply to the T1/T3 terminal (VIN1/VIN2). The input voltage range of the TPS22810EVM is 2.7 to 18 V. External output loads can be applied to the load switch by using the T2/T4 terminal (VOUT1/VOUT2). The TPS22810 is active high device, and EN/UVLO pin must not be left floating. A shorting jumper must be installed on J1 (CH1)/J5 (CH2) in the 2-3 position.

3.3.1 On-Resistance (R_{ON}) Test Setup

Figure 2 shows the typical setup for measuring on-resistance for CH1. The voltage drop across the switch is measured using the sense connections (VIN1_SENSE, VOUT1_SENSE), and this can be divided by the load current to calculate the R_{ON} resistance.

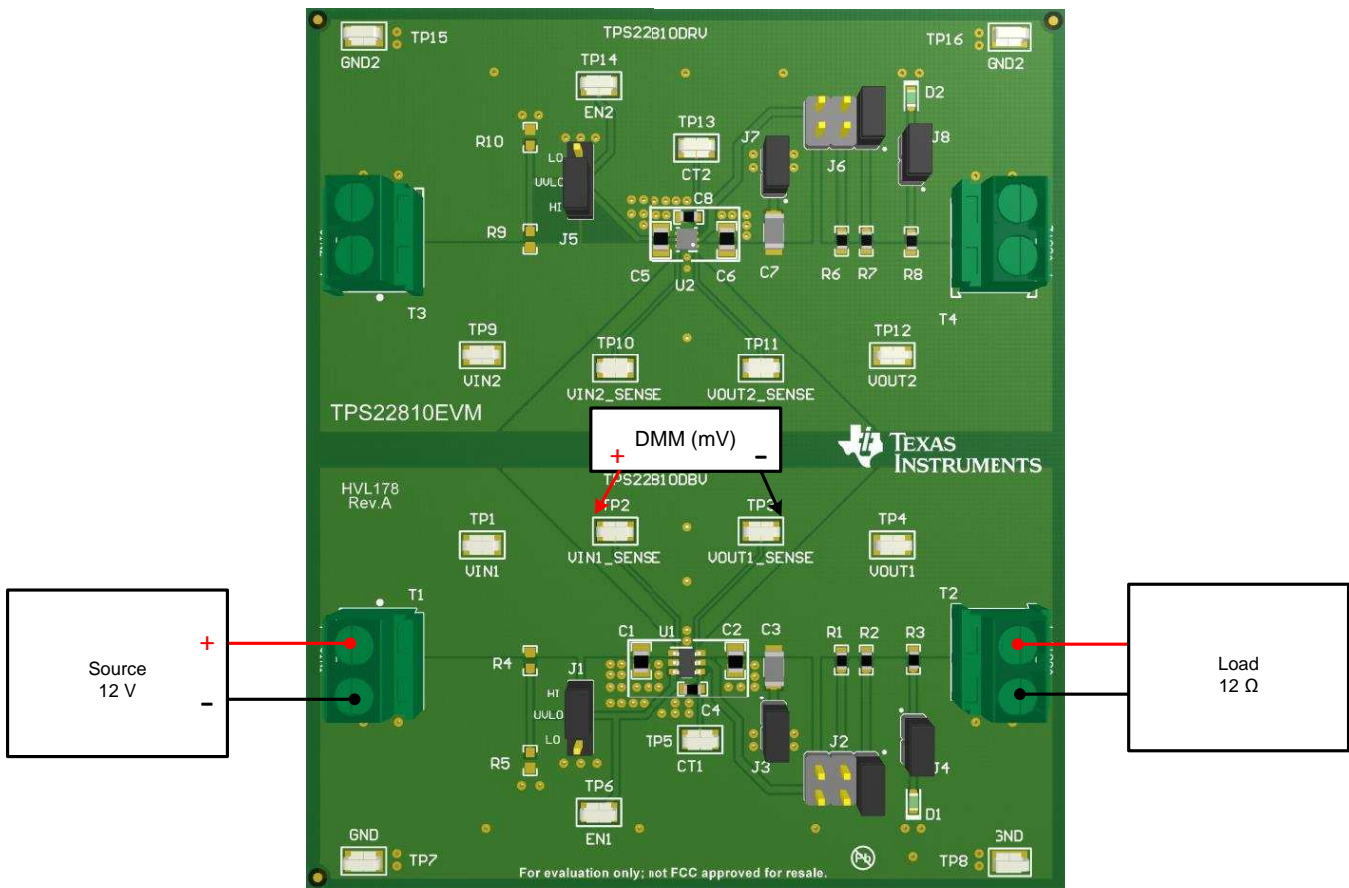


Figure 2. R_{ON} Measurement Test Setup

3.3.2 Rise Time Test Setup

Use the following instructions to measure the rise time of the TPS22810 for CH1 (CH2):

1. Uninstall jumper J1 (J5).
2. Set the load resistance to 12 Ω at terminal T2 (T4) and input supply voltage to 12 V at terminal T1 (T3). Enable the power supply and the load.
3. Apply a square wave (10-Hz frequency with 50% duty cycle) to the EN/UVLO pin at TP6 (TP14) of the load switch using a function generator.
4. Observe the waveform at VOUT1, TP4 (TP12) with an oscilloscope to measure the slew rate and rise time of the load switch with a given input voltage of 12 V.
5. Change the default 22-nF CT capacitor C4 (C8) to vary the output voltage rise time.

Figure 3 shows an example of a rise time measurement taken on the TPS22810EVM.

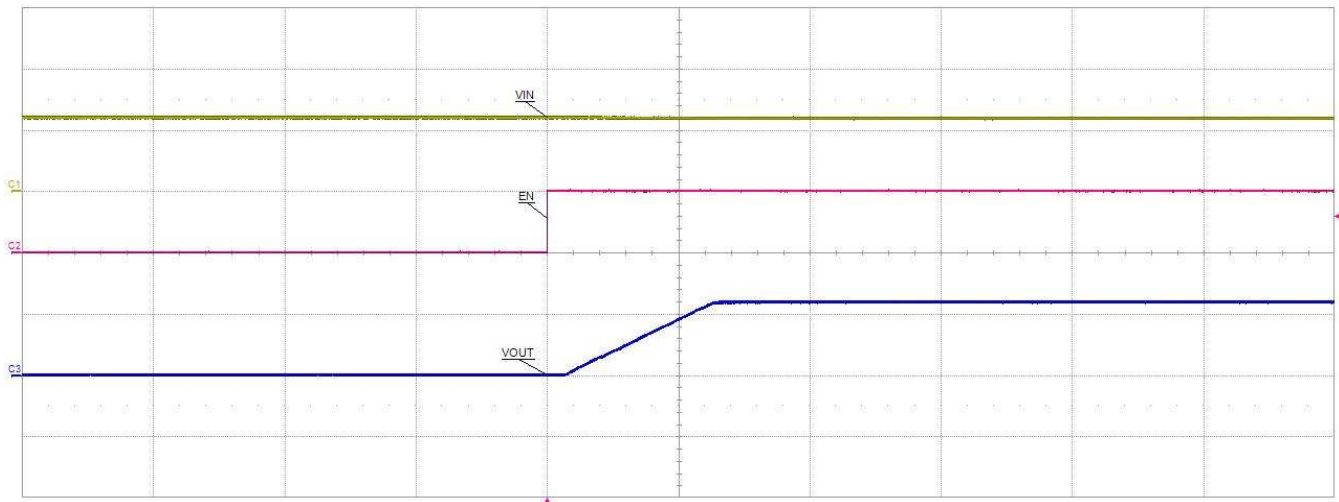


Figure 3. TPS22810 VOUT Rise Profile (VIN = 12 V, CT = 22 nF, COUT = 10 μ F, RL = 12 Ω)

3.3.3 Quick Output Discharge (QOD) Test Setup

Use the following instructions to measure the VOUT fall time of the TPS22810 for CH1 (CH2):

1. Uninstall jumper J2 (J6) to set QOD = OPEN
2. Set the load resistance to 1000 Ω at terminal T2 (T4) and input supply voltage to 12 V at terminal T1 (T3). Enable the power supply and the load.
3. Apply a square wave (5-Hz frequency with 50% duty cycle) to the EN/UVLO pin at TP6 (TP14) of the load switch using a function generator.
4. Observe the waveform at VOUT1, TP4 (TP12) with an oscilloscope to measure the fall time of the load switch.
5. Change the jumper J2 (J6) setting to 1-2 position, which sets 511- Ω external resistance in series with the QOD pin. Observe the waveform at VOUT1, TP4 (TP12).
6. Change the jumper J2 (J6) setting to 5-6 position to set QOD = VOUT. Observe the waveform at VOUT1, TP4 (TP12).

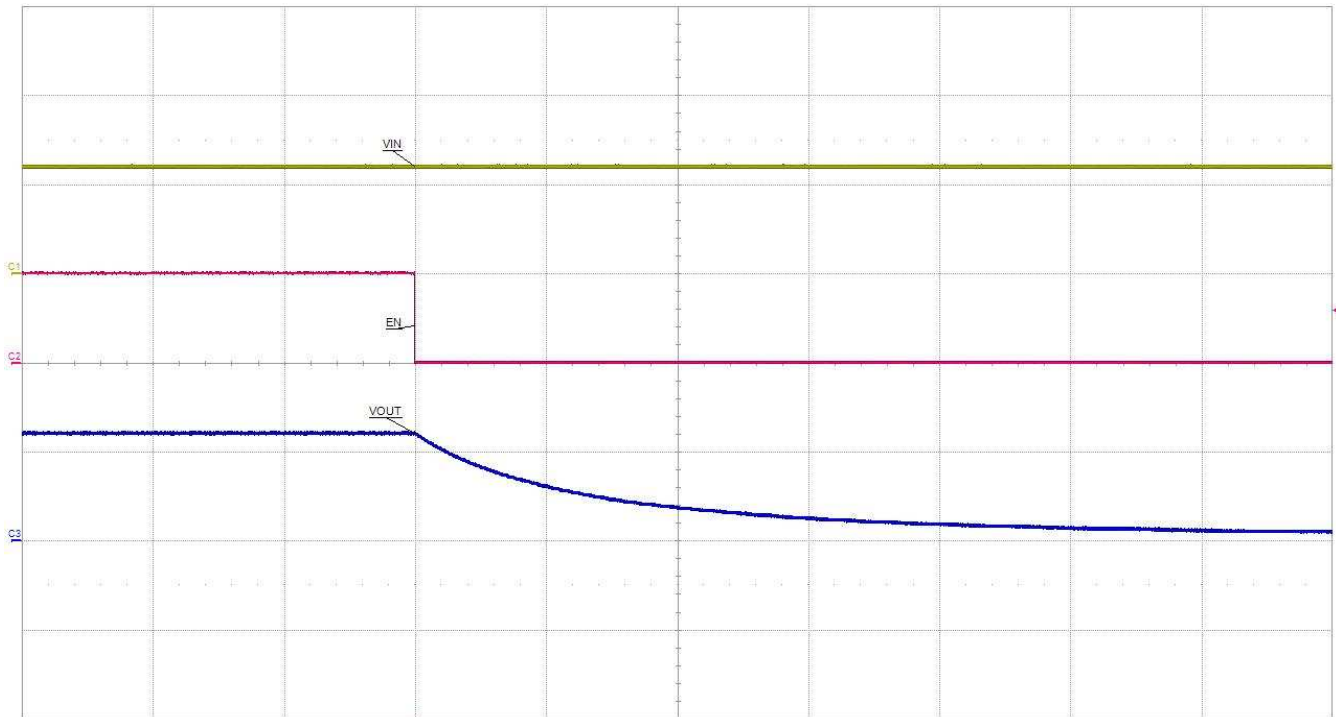


Figure 4. TPS22810 VOUT Fall Profile With QOD = OPEN (VIN = 12 V, CT = 22 nF, COUT = 10 μ F, RL = 1000 Ω)

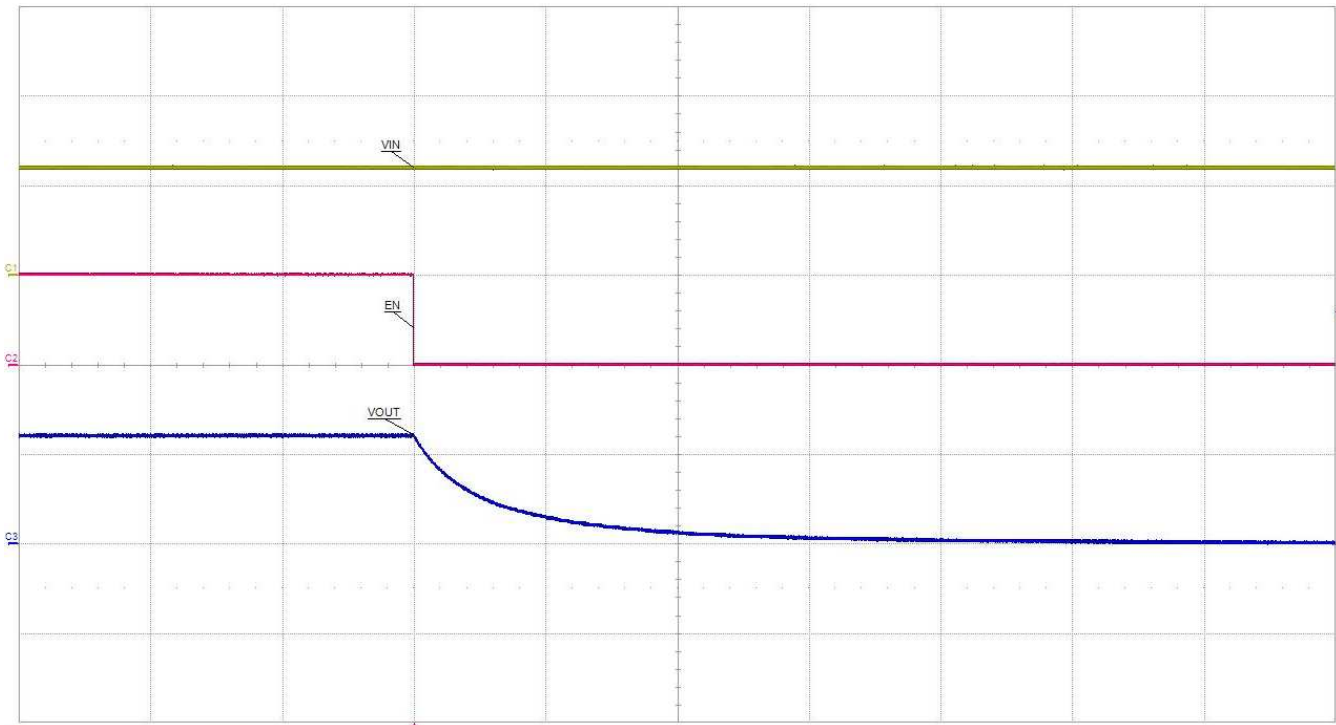


Figure 5. TPS22810 VOUT Fall Profile With External Discharge Resistor of 511 Ω (VIN = 12V, CT = 22 nF, COUT = 10 μ F, RL = 1000 Ω)



Figure 6. TPS22810 VOUT Fall Profile With QOD = VOUT (VIN = 12 V, CT = 22 nF, COUT = 10 μ F, RL = 1000 Ω)

4 EVM Board Assembly Drawings and Layout Guidelines

4.1 PCB Drawings

Figure 7 shows component placement of the EVM and Figure 8 and Figure 9 show PCB layout images.

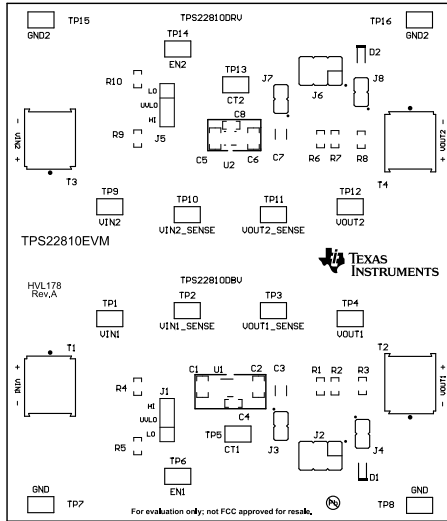


Figure 7. Top Side Placement

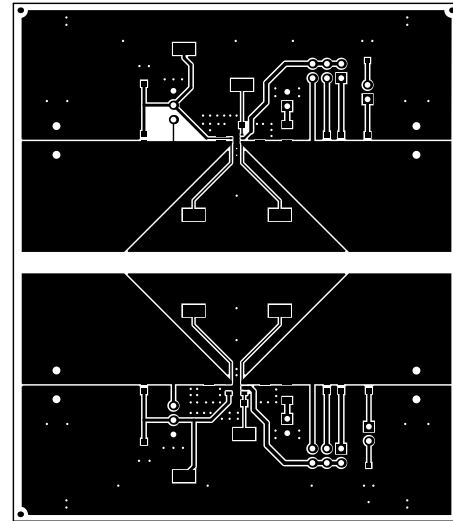


Figure 8. Top Layer

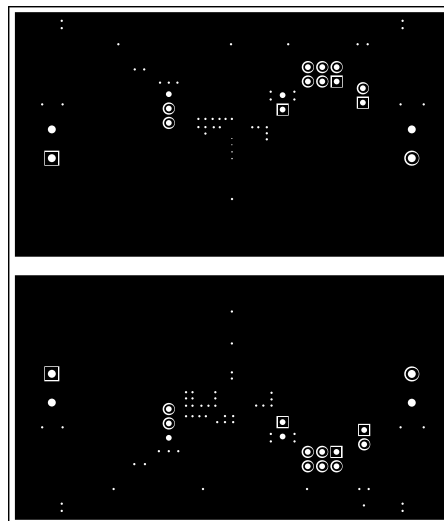


Figure 9. Bottom Layer

5 Bill Of Materials (BOM)

Table 6 lists the EVM BOM.

Table 6. TPS22810EVM Bill of Materials

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		HVL178	Any
C1, C5	2	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0805	0805	GRM21BR71E105KA99L	Murata
C2, C6	2	0.1uF	CAP, CERM, 0.1 µF, 25 V, +/- 10%, X7R, 0805	0805	GRM21BR71E104KA01L	Murata
C3, C7	2	10uF	CAP, CERM, 10 µF, 25 V, +/- 10%, X7R, 1206	1206	GRM31CR71E106KA12L	Murata
C4, C8	2	0.022uF	CAP, CERM, 0.022 µF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H223KA01D	Murata
D1, D2	2	Green	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J5	2		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J2, J6	2		Header, 100mil, 3x2, Gold, TH	Sullins 100mil, 2x3, 230 mil above insulator	PBC03DAAN	Sullins Connector Solutions
J3, J4, J7, J8	4		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
R1, R6	2	249	RES, 249, 1%, 0.1 W, 0603	0603	CRCW0603249RFKEA	Vishay-Dale
R2, R7	2	511	RES, 511, 1%, 0.1 W, 0603	0603	CRCW0603511RFKEA	Vishay-Dale
R3, R8	2	47k	RES, 47 k, 5%, 0.1 W, 0603	0603	CRCW060347K0JNEA	Vishay-Dale
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	8	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
T1, T2, T3, T4	4		Terminal Block, 2x1, 5.08mm, TH	10.16x15.2x9mm	282841-2	TE Connectivity
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16	16		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		18-V, 79-mohm, On-Resistance Load Switch, DBV0006A	DBV0006A	TPS22810DBV	Texas Instruments
U2	1		18-V, 79-mohm, On-Resistance Load Switch, DRV0006A	DRV0006A	TPS22810DRV	Texas Instruments
R4, R9	0	562k	RES, 562 k, 1%, 0.1 W, 0603	0603	RC0603FR-07562KL	Yageo America
R5, R10	0	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	RC0603FR-07100KL	Yageo America

Revision History

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

Changes from A Revision (April 2017) to B Revision Page

- Added note regarding TPS22810-Q1 evaluation after [Table 1](#)..... 1
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Changes from Original (November 2016) to A Revision Page

- Added TPS22810DRV to specifications in [Table 1](#) 1
 - Split out the continuous current bullets for the two devices in the *Features* section. 1
 - Changed VOUT2 from 2A to 3A on the TPS22810DRV schematic. 2
 - Changed output current limit from 0 to 2 A, to 0 to 3 A. 3
 - Deleted EVM rating sentence stating 2-A maximum continuous current in the *Test Configurations* section. 4
 - Deleted 2 A from the U1 and U2 *Description* column in the BOM. 9
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3. *Regulatory Notices:*
 - 3.1 *United States*
 - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: 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 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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.

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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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3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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