TPS22965NEVM User's Guide

The TPS22965NEVM evaluation module allows the user to connect power to and control a single channel, 5.7 V, 16-mΩ ON-resistance, 6-A load switch with an adjustable rise time.

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1 Description

The TPS22965N device is a 5.7 V, 16-mΩ ON-resistance (R_{ON}), single-channel load switch with an adjustable rise time. The device contains an N-channel MOSFET that can operate over an input voltage range of 0.8 V to 5.7 V and can support a maximum continuous current of up to 6 A. The switch is controlled by an active high on and off input (ON), which is capable of interfacing directly with low-voltage GPIO control signals. The rise time of the device is internally controlled in order to avoid inrush current and can be adjusted using an external ceramic capacitor on the CT pin.

The TPS22965N device is available in a small, space-saving 2-mm × 2-mm 8-pin SON package with integrated thermal pad allowing for high-power dissipation.

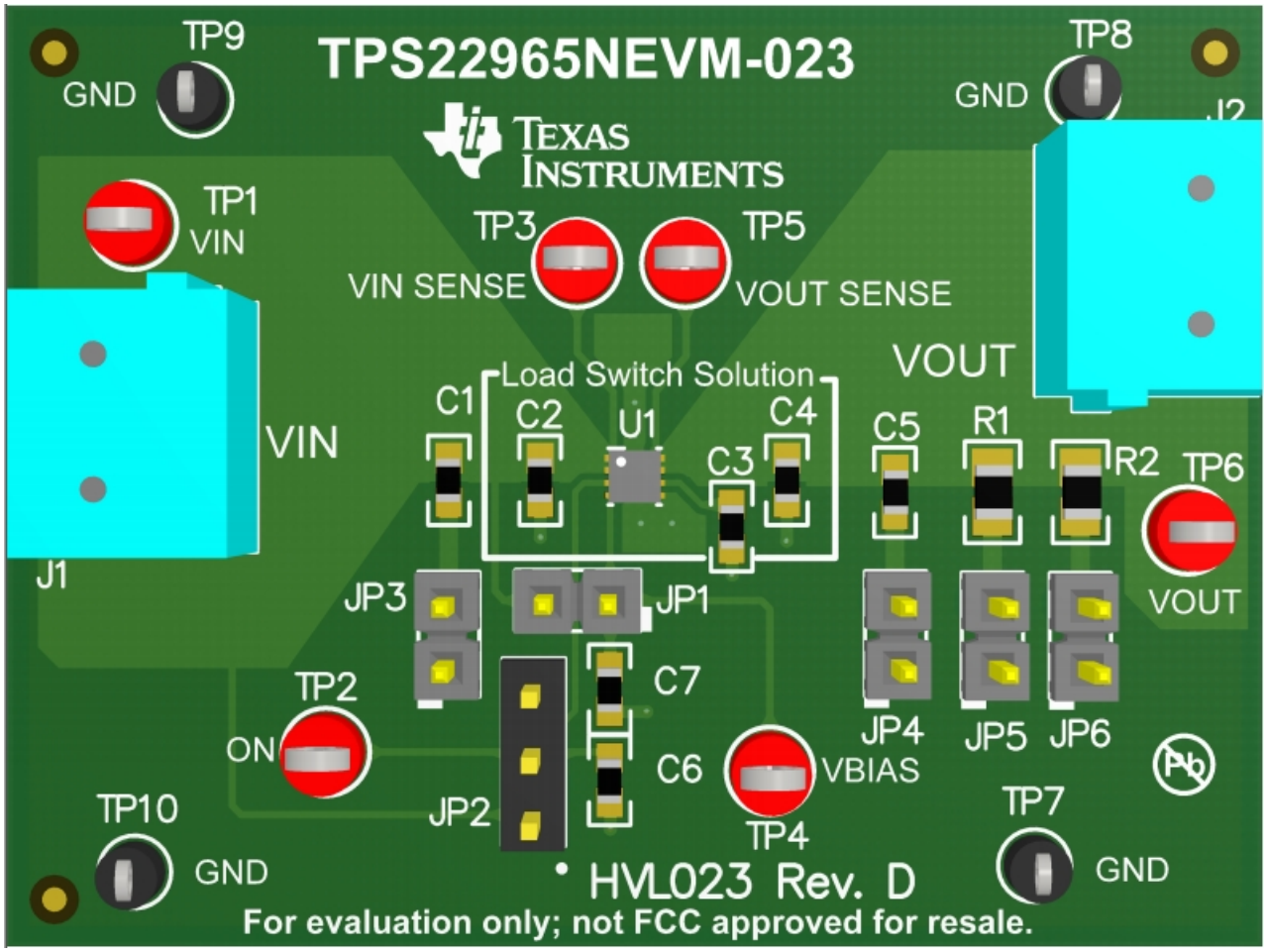

Figure 1. 3D Rendering of the TPS22965NEVM

1.1 Typical Applications

- Ultrabook™
- Notebooks and Netbooks
- Tablet PC
- Consumer Electronics
- Set-Top Boxes and Residential Gateways
- Telecom Systems
- Solid State Drives (SSD)

1.2 Features

- VIN input voltage range: 0.8 V to 5.7 V
- VBIAS input voltage range: 2.5 V to 5.7 V
- High current connection terminals available for 6 A maximum continuous switch current operation
- External capacitor for adjustable rise time control
- Test point connections to VIN, VOUT, VBIAS, and ON pins
- SENSE connections for accurate measurement of VIN and VOUT voltages used for voltage drop and ON-resistance calculations
- SON 8-pin package with thermal pad

2 Electrical Performance Specifications

Refer to the datasheet SLVSBJ0 for detailed electrical characteristics of the TPS22965N.

3 Schematic

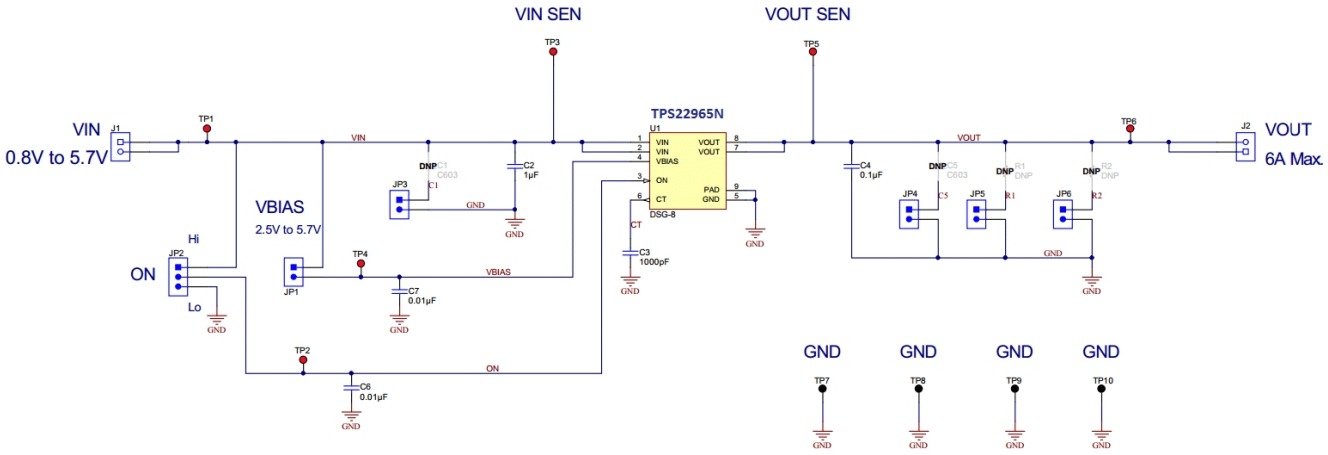

Figure 2. TPS22965NEVM Schematic

4 EVM Connections

This section describes the connectors, jumpers, and test points on the EVM.

4.1 J1 – VIN Power Connections

This is the high current input connection from the power supply. Connect the positive lead of the power supply to either terminal.

4.2 J2 – VOUT Power Connection

This is the high current output connection for loading the EVM. Connect the positive lead of the load to either terminal.

4.3 JP1 – VBIAS Power

This jumper connects VBIAS to the VIN voltage source. VBIAS must be maintained between 2.5 V – 5.7 V for proper operation on the TPS22965N device. If testing conditions involve taking the VIN voltage below 2.5 V, remove the shunt across JP1 and connect VBIAS voltage at TP4.

4.4 JP2 – ON Control

This three pin jumper connects the ON pin to either VIN or GND, which allows for quickly enabling/disabling the device after power is present.

4.5 TP2 – ON

This test point is used to monitor the EN pin voltage. This test point can also be used to drive the ON pin independently when JP2 is removed.

4.6 TP3 – VIN Sense

This test point provides a low current path to the input pins of the device for accurate voltage measurements. This sense connection should be used when measuring the voltage drop from VIN to VOUT which is used to calculate the ON-resistance. In cases where there is a large load current, it is recommended configure the power supply to use sense connections. Connect the positive sense lead to the VIN sense point to overcome voltage drop in cabling.

4.7 TP5 – VOUT Sense

This test point provides a low current path to the output pins of the device for accurate voltage measurements. This sense connection should be used when measuring the voltage drop from VIN to VOUT which is used to calculate the ON resistance.

4.8 TP7/TP8/TP9/TP10 – GND

These are the GND connection points to the EVM.

4.9 List of Test Points

Table 1. Test Point Functions

Test Points	Name	Description
J1	VIN	DC Input to VIN
J2	VOUT	VOUT connection
JP1	VBIAS	Connects VBIAS to VIN
JP2	ON	Connects ON to VIN or AGND
JP3	C1	Connects C1 to VIN
JP4	C5	Connects C5 to VOUT
JP5	R1	Connects R1 to VOUT
JP6	R2	Connects R2 to VOUT
TP1	VIN	VIN of TPS22965N
TP2	ON	ON of TPS22965N
TP3	VIN Sense	Sense connect to VIN of TPS22965N
TP4	VBIAS	VBIAS of TPS22965N
TP5	VOUT Sense	Sense connect to VOUT of TPS22965N
TP6	VOUT	VOUT of TPS22965N
TP7	GND	Ground connection
TP8	GND	Ground connection
TP9	GND	Ground connection
TP10	GND	Ground connection

5 Test Setup

This section will describe how to take key parameter measurements on the EVM.

5.1 R_{ON} Test Procedure

1. Setup the EVM as shown inFigure 3.
2. Set SOURCE1 level to 5.0V.
3. Place a shunt on JP2 shorting pins 1 to 2. This connects ON to VIN voltage. ON voltage must be between 1.1 V and 5.5 V for a valid ON state.
   (When testing R_{ON}, keep the switch operating in the always ON condition.)
4. Place a load on VOUT.
5. Turn on SOURCE1.
6. Record the voltage reading from METER1. Record the input current reading from SOURCE1. Calculate R_{ON} by dividing METER1 voltage level by the current reading from SOURCE1. The result will be the R_{ON} value for the switch.
7. Turn off SOURCE1.

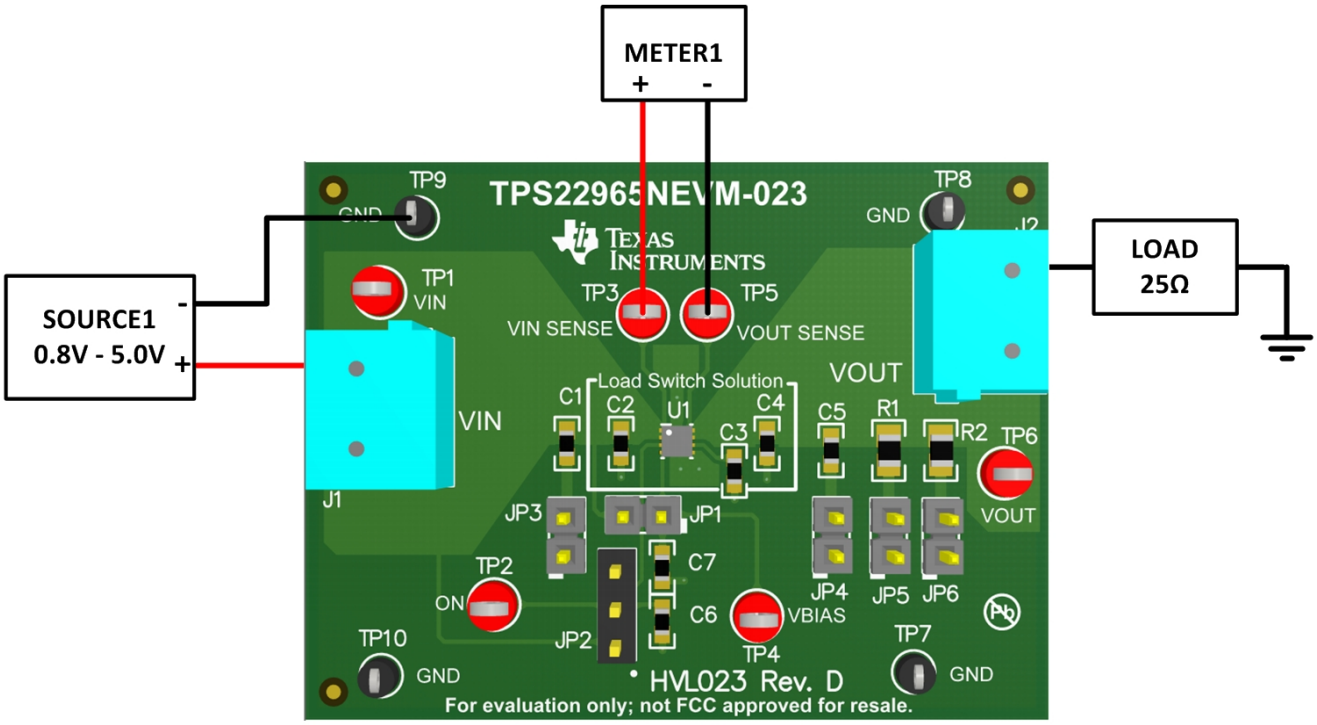

Figure 3. TPS22965EVM-023 Recommended R_{ON} Test Setup

5.2 AC Parameter Test Procedure (t_R, t_{ON}, t_F, t_{OFF}, t_D)

1. A detailed description of t_R, t_{ON}, t_F, t_{OFF}, and t_D are listed in the TPS22965N Datasheet (SLVSBJ0) under the Switching Characteristics Section
2. The rise time (t_R) is selected by the CT capacitor value on each switch channel. The EVM is shipped with a default CT value of 1 nF.
3. Set up the EVM as shown in Figure 4.
4. Set SOURCE1 level to 5.0 V.
5. Remove the shunt from JP2.
6. Place a load on VOUT. (A 10-Ω, 3.25-W resistor is recommended for this test).
7. Set the signal generator output to 0 to 2 Vpp levels, 10 to 100 Hz, and 25% duty cycle. Connect signal generator output to TP2.
8. Turn on SOURCE1.
9. Turn ON the signal generator output.
10. Rise time (t_R), turn-on time (t_{ON}), and delay time (t_D) can be observed with a Oscilloscope sync the scope trigger on the rising edge of the ON signal.
11. Fall time (t_F) and turn-off time (t_{OFF}) can be observed from the oscilloscope by charging the scope triggering to sync with the falling edge of the ON signal.
12. Turn off SOURCE1 and disable the signal generator output.

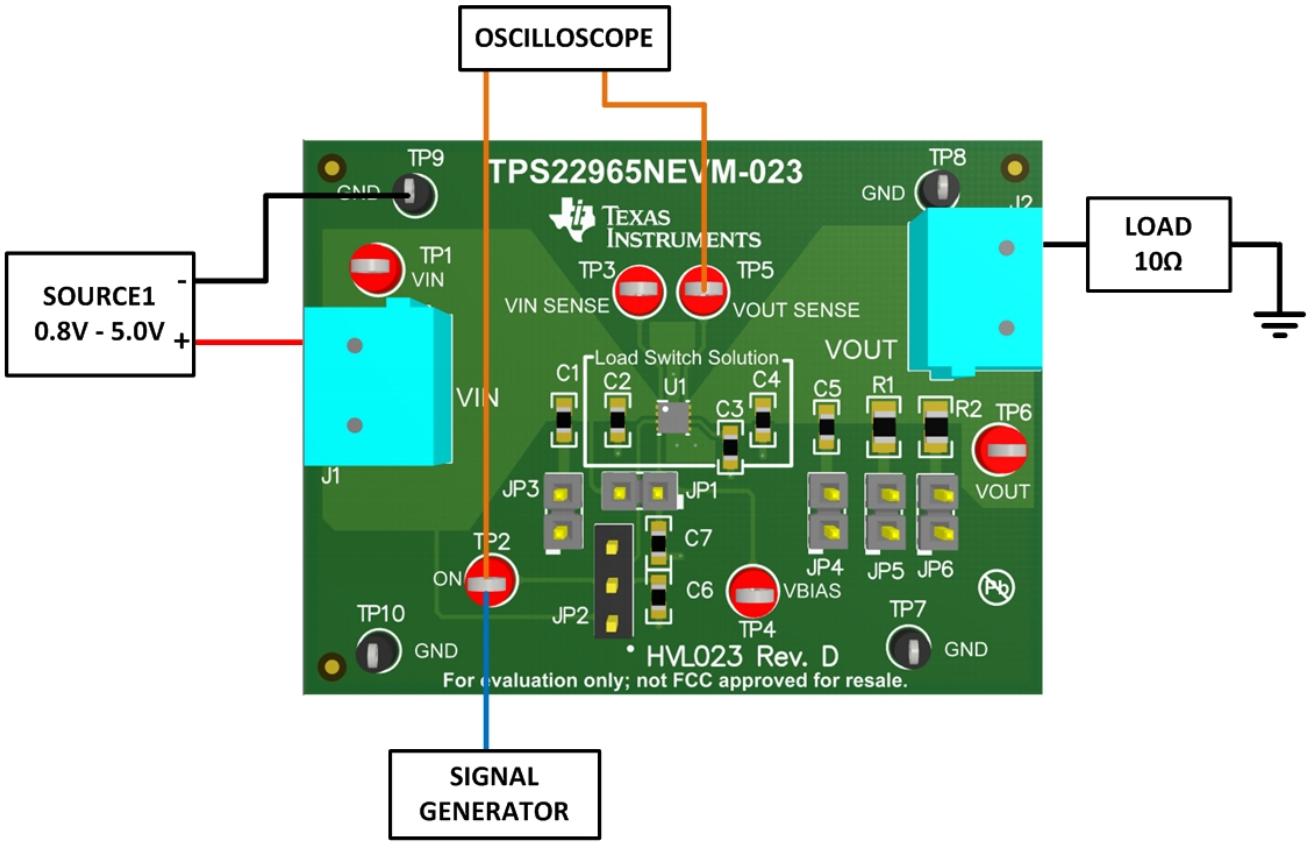

Figure 4. TPS22965NEVM Recommended AC Parameter Test Setup

6 Board Assembly and Layout

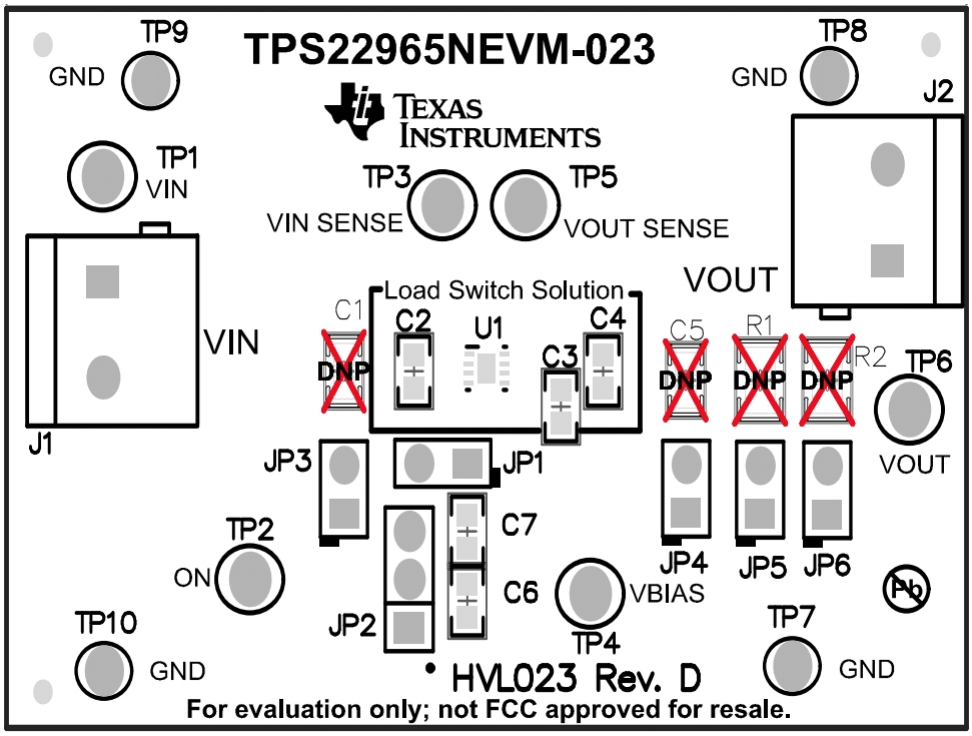

Figure 5. TPS22965NEVM Top Assembly

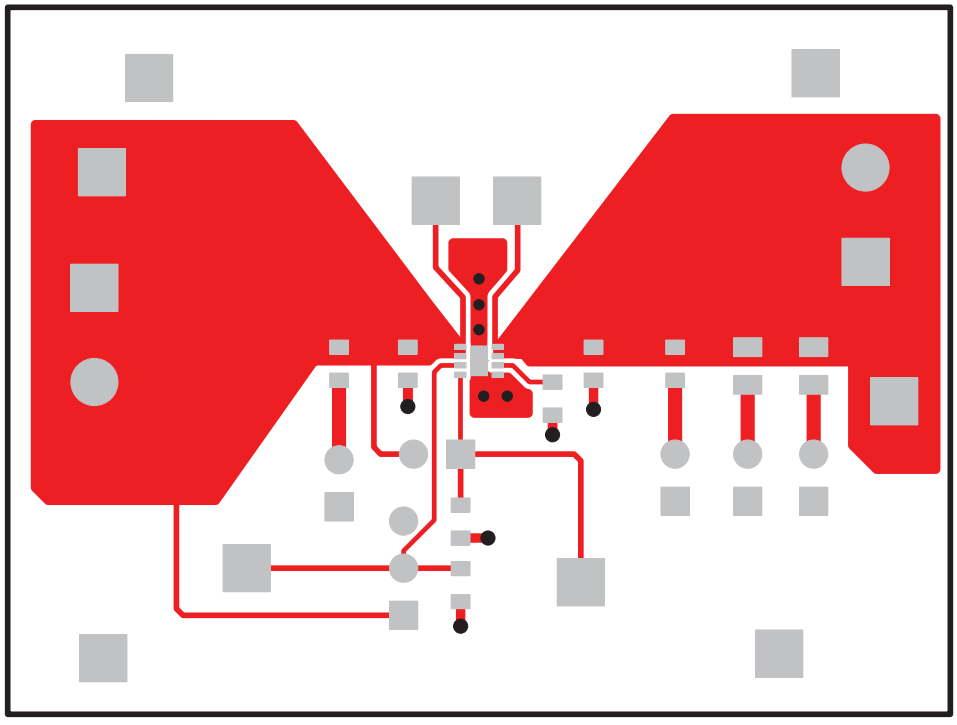

Figure 6. TPS22965NEVM PCB (Top)

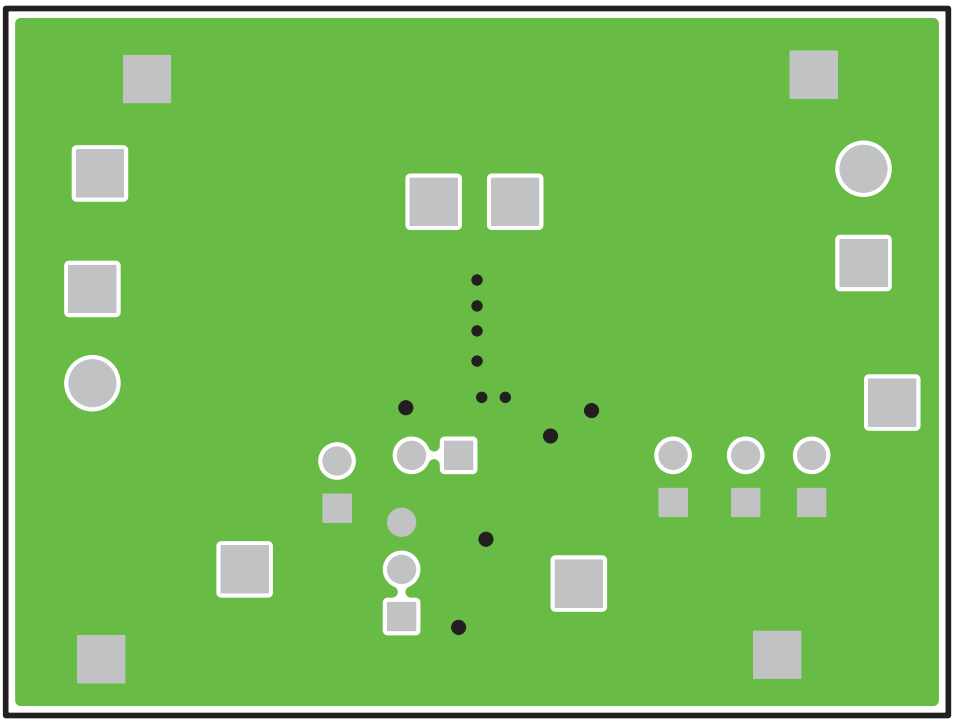

Figure 7. TPS22965NEVM PCB (Bottom)

7 Bill of Materials

Below is the EVM components list according to the schematic shown in Figure 2.

Table 2. EVM Component List

Count	RefDes	Value	Description	Size	Part Number	MFR
0	C1, C5	DNP	Capacitor, ceramic, 25 V, X7R, 20%	0603	C1608X5R1C105K	Std
1	C2	1 µF	Capacitor, ceramic, 16 V, X7R, 20%	0603	C1608X5R1C105K	Std
1	C3	1 µF	Capacitor, ceramic, 25 V, X7R, 20%	0603	C0603C102K5RACTU	Std
1	C4	0.1 µF	Capacitor, ceramic, 25 V, X7R, 20%	0603	C1608X7R1E104K	Std
2	C6, C7	0.01 µF	Capacitor, ceramic, 16 V, X7R, 20%	0603	C0603C103J5RACTU	Std
2	J1, J2	ED120 / 2DS	Terminal block, 2-pin, 15 A, 5.1 mm	0.40 x 0.35 in	ED120/2DS	OST
5	JP1, JP3, JP4, JP5, JP6	HMTSW-102-07-G-S-240	Header, male 2-pin, 100 mil spacing	0.100 in x 2	HMTSW-102-07-G-S-240	Sullins
1	JP2	TSW-103-07-G-S	Header, male 3-pin, 100 mil spacing	0.100 in x 3	TSW-103-07-G-S	Sullins
0	R1, R2	DNP	Resistor, chip, 1 / 16 W, x%	0805	Std	Std
6	TP1, TP2, TP3, TP4, TP5, TP6	5005	Test point, red, thru-hole compact style	0.125 x 0.125 in	5005	Keystone
4	TP10, TP11, TP12, TP13	5001	Test point, black, thru-hole compact style	0.125 x 0.125 in	5001	Keystone
1	U1	TPS22965NDSG	IC, 6-A load switch with controlled turn-on	SON-8	TPS22965NDSG	TI
2			Shunt, black	100 mil	929950-00	3M
1	—		PCB, 2 in x 1.5 in x 0.062 in		HVL023	Any

Notes: 1. These assemblies are ESD sensitive. Observe ESD precautions.

2. These assemblies must be clean and free from flux and all contaminants. Do not use no clean flux.

3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.

4. Ref designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFR components.

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      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.

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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.

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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.

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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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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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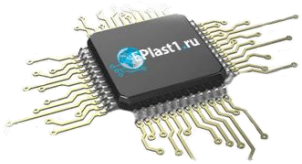
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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