User's Guide
SLVUAL0–October 2015

TPS22968NEVM Dual Channel, 5.5 V, 4 A Load Switch Evaluation Module

The TPS22968NEVM evaluation module contains a dual channel, 5.5-V, 4-A load switch with controlled turn on and adjustable rise time.

Contents

1 Description

The TPS22968N device contains two N-channel MOSFETs that can operate over an input voltage range of 0.8 V to 5.5 V and can support a maximum continuous current of up to 4 A per channel. Each switch is independently controlled by an on/off input (ON1, ON2), 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 a ceramic capacitor on the CTx pins. The TPS22968N is available in a small, space-saving 2 mm × 3 mm 10-pin SON package with integrated thermal pad allowing for high power dissipation.

The TPS22968N device can be evaluated using the TPS22968NEVM module. The TPS22968N Dual Load Switch device can be configured in either a dual switch configuration or a parallel switch configuration using the TPS22968NEVM.

1.1 Typical Applications

- Ultrabook™
- Notebooks/Netbooks
- Tablets
- Consumer Electronics

1.2 Features

- External capacitors for configurable rise time
- EVM configurable for single or parallel switch configurations
- Connection points to VIN, VOUT, VBIAS, ON pins as well as SENSE connections for accurate measurement of VIN and VOUT voltages
- High current connection terminals available for 4 A maximum continuous switch current operation
- VIN input voltage range: 0.8 V to 5.5 V
- VBIAS voltage range: 2.5 V to 5.5 V

2 Electrical Performance Specifications

Refer to the TPS22968N datasheet (SLVSCG3).

3 Schematic

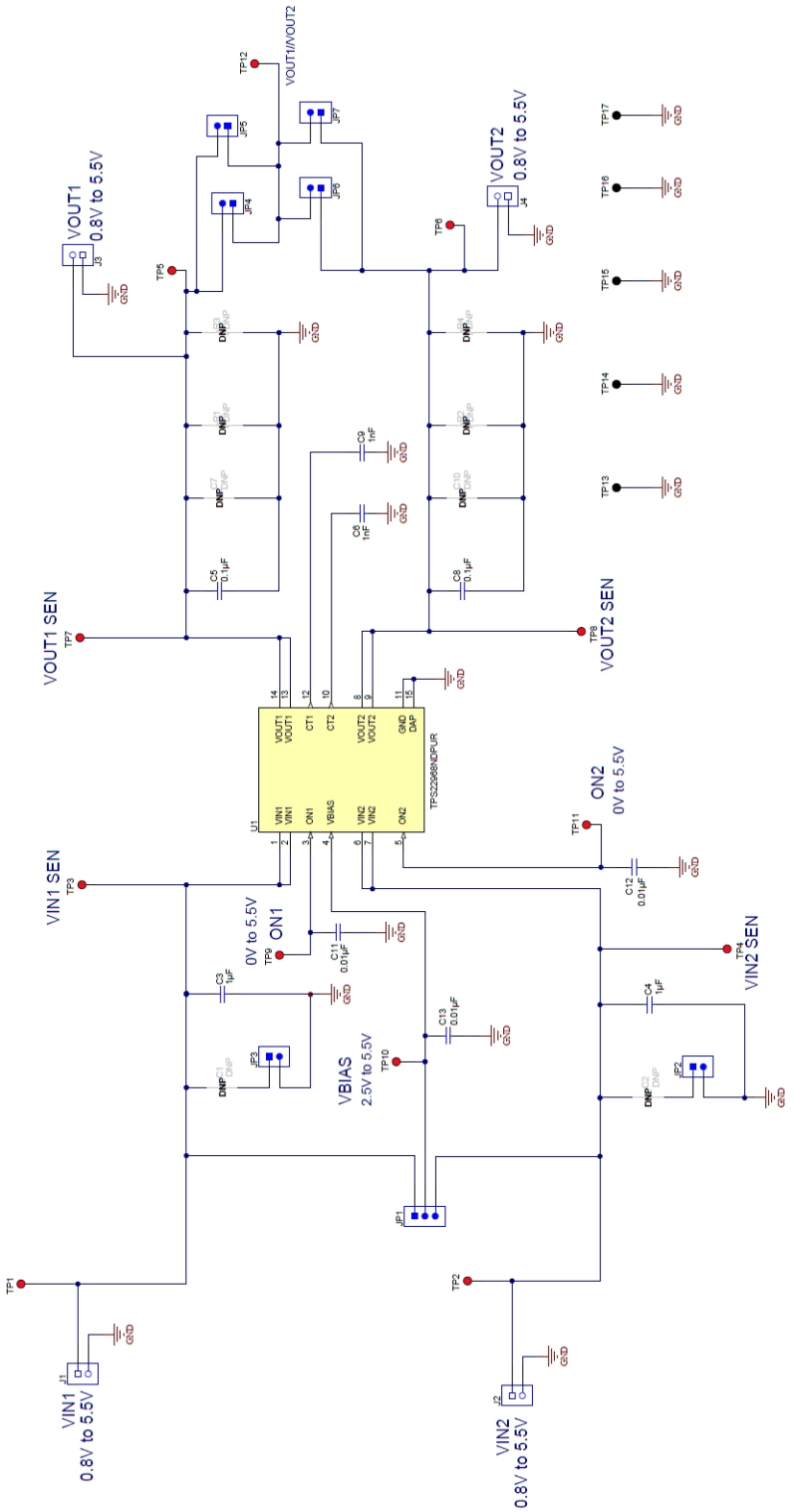

Figure 1. TPS22968NEVM Schematic

4 Layout

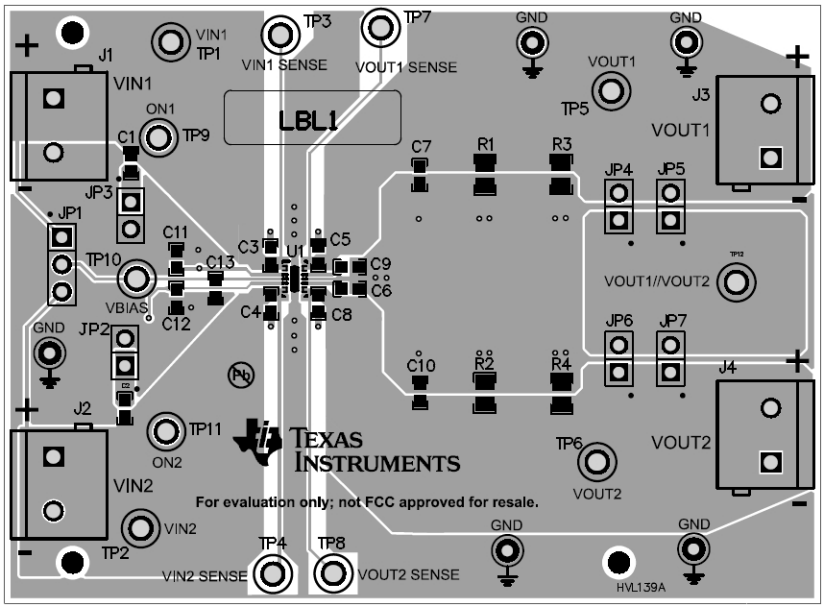

Figure 2. TPS22968NEVM Top

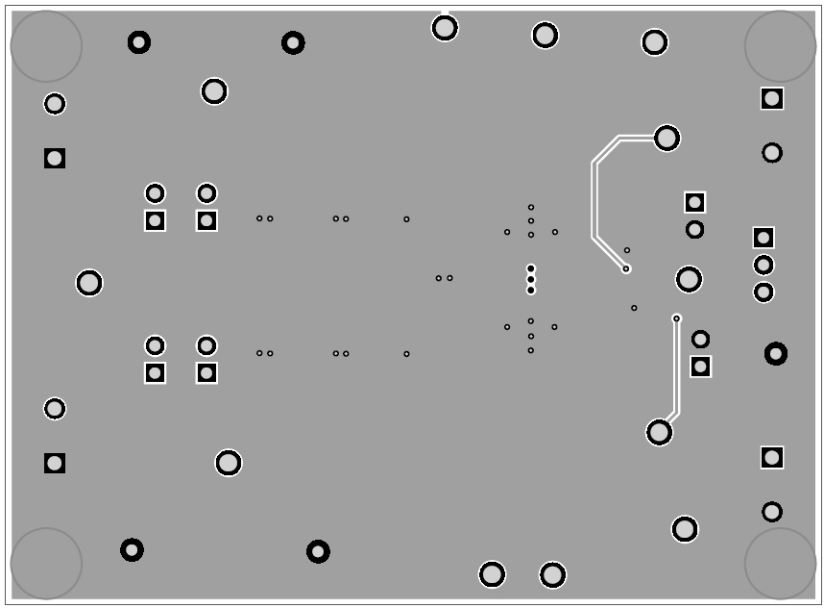

Figure 3. TPS22968NEVM Bottom

5 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the EVM.

5.1 J1 VIN1/J2 VIN2 – Input Connections

These are the high current input connections from the input source. Connect the positive lead to J1 and J2 terminal and the negative lead to a GND connection point.

5.2 J3 VOUT1/J4 VOUT2 – Output Connections

These are the high current connections for the outputs of the EVM. Connect the positive lead to J3 and J4 terminal and the negative lead to GND connection point.

5.3 JP1 – VBIAS

These jumpers connect VBIAS to either VIN1 or VIN2 voltage source. VBIAS must be maintained between 2.5 V – 5.5 V for proper operation of the TPS22968N device. If testing conditions involve taking the VIN voltage levels below 2.5V, remove the shunt across JP1 and connect VBIAS voltage at TP10.

5.4 JP2/JP3 - Input Capacitors

During normal operation the shorting jumper is removed on JP3 and JP4. These jumpers connect C1 and C2 capacitors (unpopulated) from the input of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the input capacitor.

5.5 JP4/JP5/JP6/JP7 – Output Parallel Connections

JP4-JP7 connects VOUT1 and VOUT2 together and is used when testing both device switches in parallel configuration.

5.6 TP1/TP2 – VIN1-VIN2

These are input connections to the device.

5.7 TP3/TP4 - VIN Sense, TP7/TP8 - VOUT Sense

These two connections are used when very accurate measurements of the input or output are required. R_{ON} measurements should be made using these sense connections when measuring the voltage drop from VIN to VOUT and then calculating the resistance.

5.8 TP5/TP6 – VOUT1-VOUT2

These are output connections to the device.

5.9 TP10 – VBIAS

This is the VBIAS connection point. VBIAS must be applied to the TPS22968N device at a voltage level of 2.5 V to 5.5 V level for proper operation. VBIAS may be applied direct at this connection point or applied using JP1.

5.10 TP9/TP11 – ON1-ON2

These are the enable inputs for the device. Apply an external enable/disable source to TP9 and TP11. The TPS22968N is active high. ON1 and ON2 must not be left floating. Refer to the datasheet for proper ON and OFF voltage level settings. A switching signal may also be used and connected at these points.

5.11 TP12 – VOUT1 // VOUT2

This is the common connection point for VOUT when the switch output are connected in parallel configuration.

5.12 TP13 – TP17 GND

These are the GND connection points to the EVM.

5.13 List of Test Points

Table 1. The Functions of Each Test Points

Test Points	Name	Description
J1	VIN1	DC Input to VIN1
J2	VIN2	DC Input to VIN2
J3	VOUT1	DC Output from VOUT1
J4	VOUT2	DC Output from VOUT2
JP1	VBIAS	Connects VBIAS to VIN1 or VIN2
JP2	C2	Connects C2 from VIN2 to GND
JP3	C1	Connects C1 from VIN1 to GND
JP4, JP5, JP6, JP7	VOUT1 // VOUT2	Shorts VOUT1 and VOUT2 together used in parallel switch configuration
TP1	VIN1	VIN1 Connection
TP2	VIN2	VIN2 Connection
TP3	VIN1 SEN	Sense connection to VIN1
TP4	VIN2 SEN	Sense connection to VIN2
TP5	VOUT1	VOUT1 Connection
TP6	VOUT2	VOUT2 Connection
TP7	VOUT1 SEN	Sense connection to VOUT1
TP8	VOUT2 SEN	Sense connection to VOUT2
TP9	ON1	ON1 Connection
TP10	VBIAS	VBIAS Connection
TP11	ON2	ON2 Connection
TP12	VOUT1 // VOUT2	VOUT1 and VOUT2 connected in parallel configuration
TP13	GND	Ground Connection
TP14	GND	Ground Connection
TP15	GND	Ground Connection
TP16	GND	Ground Connection
TP17	GND	Ground Connection

5.14 Test Procedure

Figure 4 shows a typical setup for the R_{ON} test of the EVM. VBIAS voltage must be present for the device to function, keep this voltage level constant between 2.5 V – 5.25 V. Adding a shunt across JP1 will connect the VBIAS pin to VIN1 (pin 1 to pin 2) or VIN2 (pin 2 to pin 3). When testing with input voltages below 2.5 V, JP2 shunt must be removed and VBIAS tied to another voltage source.

5.15 R_{ON} Test Procedure

1. Setup the EVM per Figure 4.
2. Set SOURCE1 level to 5.0 V.
3. Place a shunt across JP1 from pin 1 to pin 2.
4. Connect ON1 and ON2 to a DC source between 1.2 V and 5.5 V. SOURCE1 supply can be used for this. (When testing R_{ON} it is desired to have the switch operating in the always ON condition.)
5. Place a load on VOUT1 and VOUT2.
6. Turn on SOURCE1.
7. Record the voltage reading from METER1 and METER2 as well as the input current reading from SOURCE1.
8. Turn SOURCE1 off.
9. Calculate the R_{ON} value for switch 1 by dividing the METER1 voltage level by half of the current reading from SOURCE1.
10. Calculate the R_{ON} value for switch 2 by dividing the METER2 voltage level by half of the current reading from SOURCE1.

5.16 t_R, t_{ON} Test Procedure

1. 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.
2. Set up the EVM per Figure 5
3. Set SOURCE1 level to 5.0 V.
4. Place a shunt across JP1 from pin 1 to pin 2.
5. Place a load on VOUT1 and VOUT2 (a 10 Ω, 3.25 W resistor is recommended for this test).
6. Set Signal Generator output to 0–2 Vpp, 10–100 Hz, and 25% duty cycle.
7. Turn SOURCE1 on.
8. Enable the Signal Generator output.
9. Rise time (t_R) and turn-on time (t_{ON}) can be observed with an Oscilloscope by syncing the scope trigger on the rising edge of the on signal. A detailed description of t_R and t_{ON} are listed in the TPS22968N Datasheet under the Switching Characteristics Section.
10. Turn SOURCE1 off and disable the signal generator output.

6 Test Setup

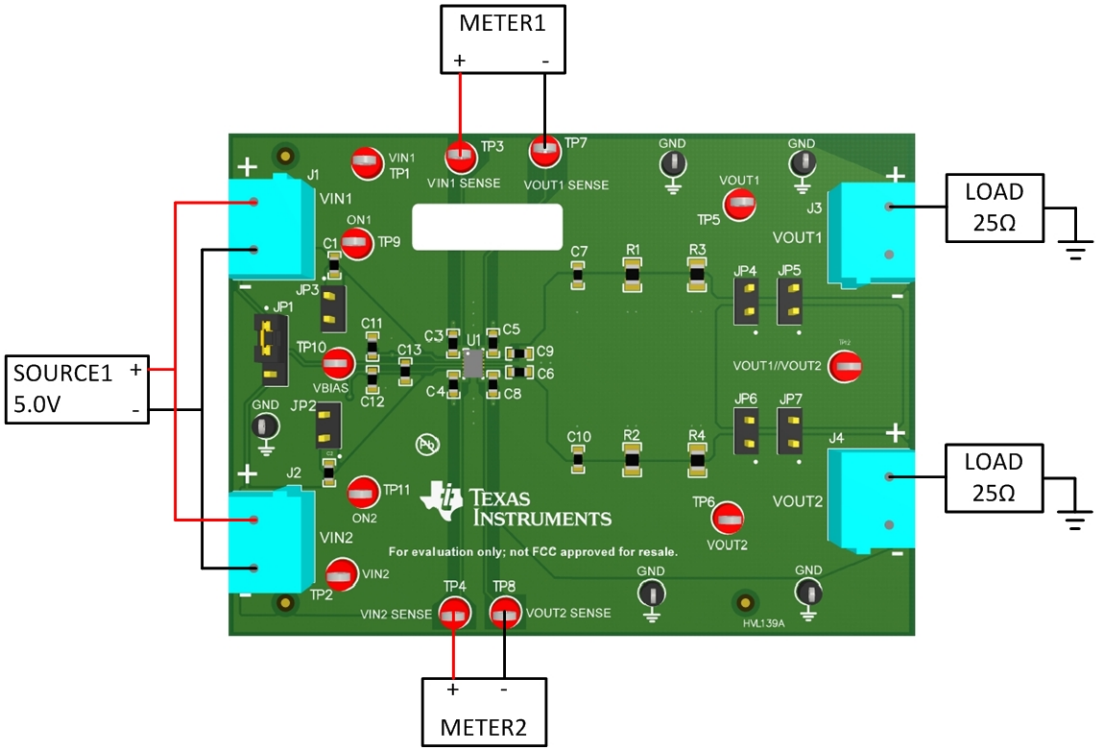

Figure 4. TPS22968NEVM Recommended R_{ON} Test Set Up

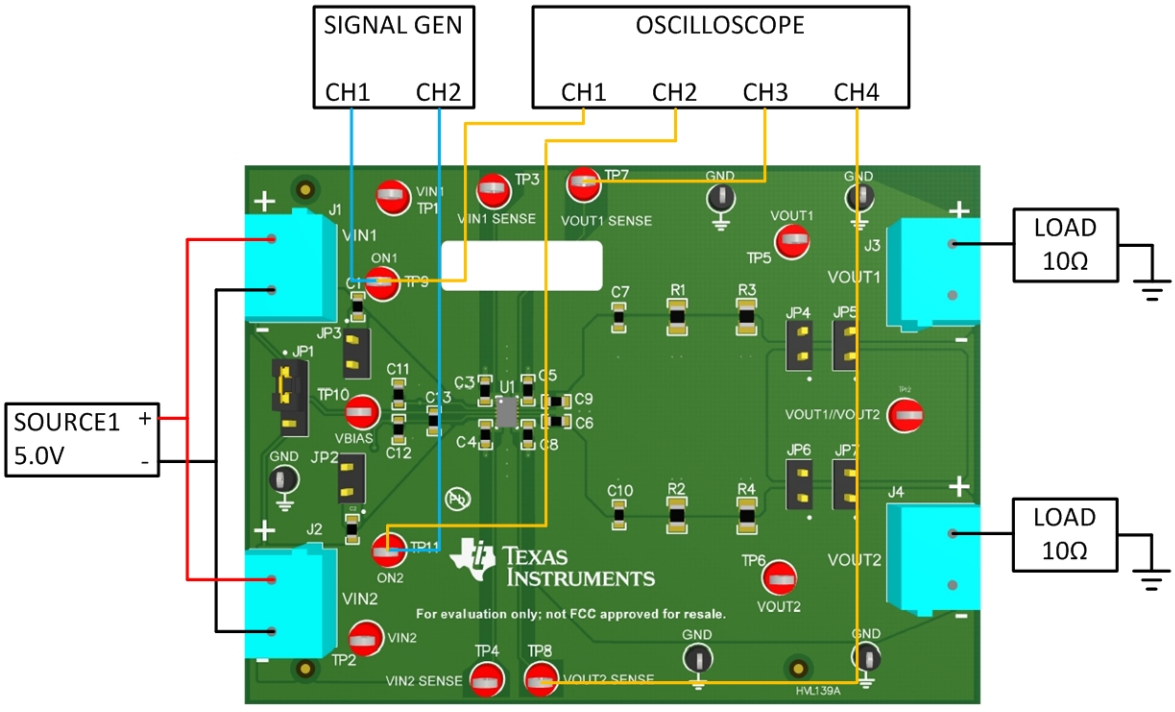

Figure 5. TPS22968NEVM Recommended t_R Test Set Up

7 Performance Data and Typical Characteristic Curves

Figure 6 shows the typical performance curve for the TPS22968NEVM.

7.1 t_R and t_{ON} Scope Capture

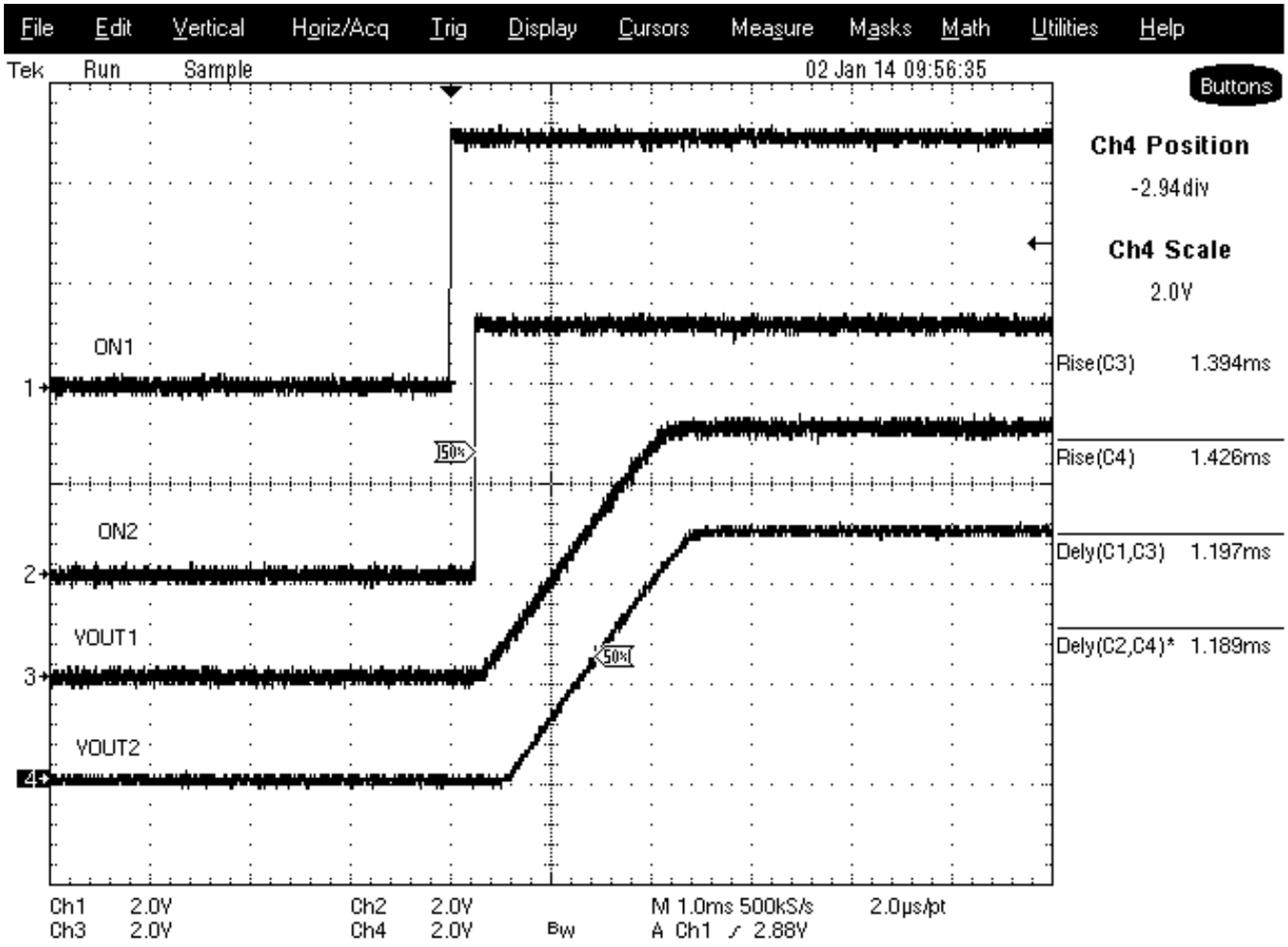

Figure 6. TPS22968NEVM t_R with VIN = 5 V, CT = 1 nF and Load = 10 Ω.

Parallel Switch Operation

The TPS22968N device switches can be connected in parallel configuration by adding shorting shunts across JP4, JP5, JP6, and JP7. Parallel switch configuration lowers R_{ON} and raises maximum continuous current capability. Refer to Applications Note SLVA585 for further details.

8 Bill of Materials

Table 2 shows the EVM components list according to the schematic shown in Figure 1.

Table 2. EVM Components List

Quantity	Designator	Description	Manufacturer	Part Number
1	!PCB1	Printed Circuit Board	Any	HVL139
2	C3, C4	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0603	MuRata	GRM188R61C105KA93D
2	C5, C8	CAP, CERM, 0.1 µF, 25 V, ±10%, X7R, 0603	MuRata	GRM188R71E104KA01D
2	C6, C9	CAP, CERM, 1000 pF, 50 V, ±10%, X7R, 0603	Kemet	C0603C102K5RACTU
3	C11, C12, C13	CAP, CERM, 0.01 µF, 16 V, ±10%, X7R, 0603	MuRata	GRM188R71C103KA01D
4	J1, J2, J3, J4	Terminal Block, 5.08 MM VERT 2POS, TH	On-Shore Technology	ED120/2DS
14	JP1, JP2, JP3, JP4, JP5, JP6, JP7,	Header, 100 mil, 2 × 1, Gold, TH	Samtec	TSW-102-07-G-S
1	SH-JP1	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	Test Point, Compact, Red, TH	Keystone	5005
5	TP13, TP14, TP15, TP16, TP17	Test Point, Miniature, Black, TH	Keystone	5001
1	U1	Dual Channel 4 A Load Switch	Texas Instruments	TPS22968NDMGR

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      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.

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- *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.*

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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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