

# TPS629211-Q1 Buck Converter Evaluation Module User's Guide



## ABSTRACT

The TPS629211-Q1EVM is designed to help user easily evaluate the performance of TPS629211-Q1. The user's guide includes the following:

- Performance characteristics
- EVM configuration
- Test setup
- Test result
- PCB layout
- Schematic diagram
- Bill of materials

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## Trademarks

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## 1 Introduction

The TPS629211-Q1 is high efficiency and highly flexible synchronous step-down buck converter in a small 1.6-mm × 2.1-mm SOT583 package. The TPS629211-Q1 can be configured to run 2.5 MHz or 1 MHz in either forced PWM mode or auto PFM/PWM mode. In 2.5-MHz auto PFM/PWM mode, TI AEE mode automatically adjusts the switching frequency based on both input and output voltage to hold a high efficiency through the whole operation range without the need of using different inductors. The device includes a MODE/S-CONF input to select different combinations of the following:

- External, internal feedback
- Maximum switching frequencies
- Output discharge enable, disable
- Auto PFM/PWM and forced PWM operations

The TPS629211-Q1EVM(BSR131-004) uses a 1-A TPS629211-Q1 to produce 3.3-V output from 6-V input.

## 2 Performance Specification

Table 2-1 provides a summary of TPS629211-Q1EVM performance specifications. All the specifications are given at an ambient temperature of 25°C.

**Table 2-1. TPS629211-Q1EVM Performance Specification Summary**

| Specification       | Test Conditions  | MIN | TYP          | MAX | UNIT               |
|---------------------|--|-----|--------------|-----|--------------------|
| Input voltage       |  | 5   | 6            | 10  | V                  |
| Output voltage      |  |     | 3.3          |     | V                  |
| Output current      |  | 0   |              | 1   | A                  |
| Input current       | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 0\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor   |     | 5.02         |     | mA                 |
|                     | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor   |     | 0.595        |     | A                  |
| Switching frequency | Set by Mode/S-CONF pin   |     | 2.5          |     | MHz                |
| Line regulation     | $V_{IN} = 5\text{ V} - 10\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                           |     | $\pm 0.1\%$  |     |                    |
| Load regulation     | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 0\text{ A} - 1\text{ A}$ , Forced PWM and Auto PFM/PWM with AEE, 2.5 MHz, 2.2- $\mu\text{H}$ inductor  |     | $\pm 0.15\%$ |     |                    |
| Output ripple       | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor   |     | 10.2         |     | mV                 |
| Peak efficiency     | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 0\text{ A} - 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                            |     | 91.5%        |     |                    |
|                     | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 0\text{ A} - 1\text{ A}$ , Auto PFM/PWM with AEE, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                 |     | 91.09%       |     |                    |
|                     | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 10\text{ mA}$ , Auto PFM/PWM with AEE, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                            |     | 83.9%        |     |                    |
| Output rise time    | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor   |     | 500          |     | $\mu\text{s}$      |
| Load transient      | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 0.5\text{ A} - 1\text{ A}$ , Slew rate: 1 A/us, Forced PWM, VSET, 2.5 MHz, 2.2- $\mu\text{H}$ inductor |     | $\pm 43.5$   |     | mV                 |
| Loop bandwidth      | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, VSET, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                                   |     | 163          |     | kHz                |
| Phase margin        | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, VSET, 2.5 MHz, 2.2- $\mu\text{H}$ inductor                                   |     | 83.2         |     | deg                |
| IC case temperature | $V_{IN} = 6\text{ V}$ , $V_{OUT} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ A}$ , Forced PWM, 2.5 MHz, 2.2- $\mu\text{H}$ inductor, 10 minutes soaking                     |     | 36.4         |     | $^{\circ}\text{C}$ |

### 3 EVM Configuration and Modification

The EVM is designed to provide access to features of the TPS629211-Q1. The EVM also provides jumpers for different configurations. Jumper selections must be made prior to enabling the TPS629211-Q1. Additional input and output capacitors can be added. The input voltage at which the IC turns on can be programmed with a voltage divider. The TPS629211-Q1EVM allows multiple MODE/S-CONF pin configurations for switching frequency, auto PFM/PWM with AEE, forced PWM, and output discharge setting as well as internal and external feedback options. The loop response can also be measured.

#### 3.1 Input and Output Capacitors

C2 is provided for additional input capacitance. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple. C6, C7, C8, and C9 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple. The total output capacitance must remain within the recommended range for the TPS629211-Q1.

#### 3.2 Configurable Enable Threshold Voltage

JP1 is provided as option for Enable pin with precise threshold voltage. R4 and R5 can be adjusted to set a user-selectable input voltage at which the IC turns on. The EVM pre-configured R4 and R5 to have 6.5-V rising and 5.85-V falling threshold voltage.

#### 3.3 MODE/S-CONF Setting

JP2 is used to set different MODE/S-CONF configurations. MODE/S-CONF can be connected to VIN and GND as a traditional HIGH or LOW level. R6 and R7 select the other device configurations including internal/external feedback, switching frequency, output discharge, and auto PFM/PWM or forced PWM options. The values of R6 and R7 can be changed per the user's requirement.

- While using the internal feedback (VSET) configuration for the output voltage setting, either float the FB pin by cutting the net tie (NT1) included on the back of the board or remove both R1 and R2 for 3.3-V output voltage. Other output voltage can be programmed by removing R1 and changing the value of R2. Ensure the JP2 jumper is placed correctly for proper operation with internal feedback.

#### **WARNING**

Ensure not to set the MODE/S-CONF pin for external feedback if either the net tie (NT1) is cut or R1 and R2 are removed. This could cause damage to the device due to lack of external feedback control.

- Dynamic mode option is an advance feature that allows the MODE/S-CONF pin to actively switch between forced PWM and auto PFM/PWM during operation, but this is only possible by driving the MODE/S-CONF pin between VIN and GND. This feature provides the user with the option of controlling when or if the device enters power save mode (DCM).

#### 3.4 Power Good

JP3 is provided as an option for power-good test point. If power good is not used, it is recommended to tie to GND or leave open.

#### 3.5 Power Good Pullup Voltage

JP4 is provided as an option for power-good pullup voltage of either  $V_{IN}$  or  $V_{OUT}$  with a 100-k $\Omega$  pullup resistor.

#### 3.6 Feedforward Capacitor Option

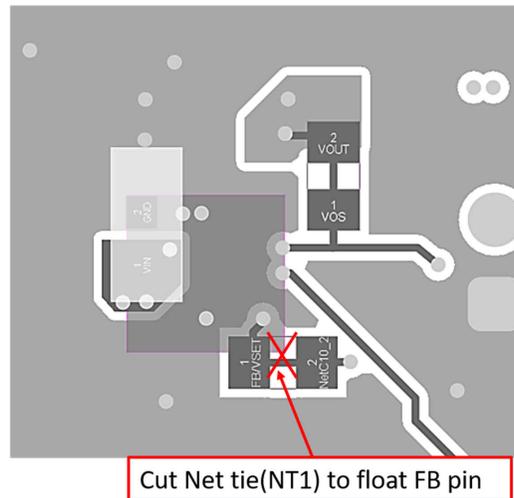
C10 is provided as an optional of feedforward capacitor ( $C_{FF}$ ), which helps to improve the loop stability if needed. More detailed discussion on the optimization for stability versus transient response can be found in [Optimizing Transient Response of Internally Compensated dc-dc Converter With Feedforward Capacitor](#) and [Feedforward Capacitor to Improve Stability and Bandwidth With the TPS621-Family and TPS821-Family](#) application reports.

### 3.7 Output Voltage Setting

The TPS629211-Q1EVM is configured for external feedback as default with an output voltage of 3.3 V set by R1 and R2. Additionally, if the internal feedback (VSET) configuration is used, the user can cut net tie NT1 located on the back of the board. This modification is shown in [Figure 3-1](#). This will float the FB pin resulting in a 3.3-V output voltage using the internal VSET. Resistors R1 and R2 can also be changed to set the output voltage between 0.6 V and 5.5 V. See TPS629211-Q1 data sheet for recommended values. R2 was populated with 34 k such that if the internal (VSET) is chosen while R1 is removed, the device will regulate to 1.8-V output voltage.

#### WARNING

If the output voltage is increased, make sure the voltage rating of output capacitor C5 is sized appropriately.

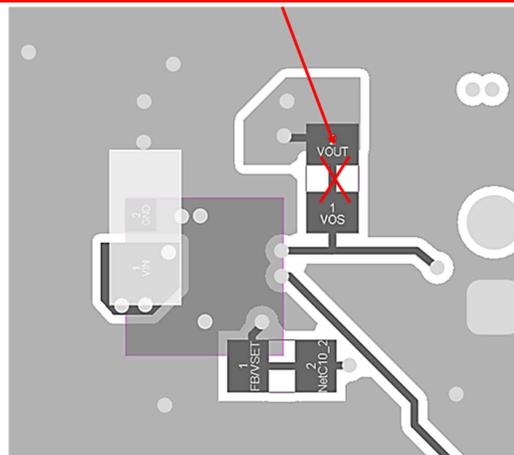


**Figure 3-1. Internal Feedback (VSET) Configuration Board Modification**

### 3.8 Loop Response Measurement

The loop response can be measured after simply changing to the board. First, cut net tie (NT2) and install a 10-Ω 0603 resistor on the bottom of board. [Figure 3-2](#) shows this change. An AC signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added 10-Ω resistor.

Cut Net tie(NT2) to install 10ohm resistor for bode plot measurement



**Figure 3-2. Bode Plot Measurement Board Modification**

## 4 EVM Test Setup

This section describes how to properly test the EVM.

### 4.1 Input and Output Connectors

**Table 4-1. Input and Output Connector**

| Connector | Pin s           | Description   |
|-----------|-----------------|---|
| J1        | Pin 1 and Pin 2 | $V_{IN}$ positive input for input supply                      |
|           | Pin 3 and Pin 4 | S+ and S– input voltage sense. Input voltage measure points   |
|           | Pin 5 and Pin 6 | GND return for input supply                                   |
| J2        | Pin 1 and Pin 2 | $V_{OUT}$ output voltage connection                           |
|           | Pin 3 and Pin 4 | S+ and S– output voltage sense. Output voltage measure points |
|           | Pin 5 and Pin 6 | GND output return connection                                  |

### 4.2 Jumper Configuration

#### 4.2.1 JP1 Enable

**Table 4-2. Enable Pin Configuration**

| Jumper Short Location            | Description  |
|----------------------------------|--|
| Pin 2 and Pin 3                  | Turn on the device as default.   |
| Pin 3 and Pin 4                  | Turn off the device.   |
| Pin 1 and Pin 2, Pin 3 and Pin 4 | Set programmable Enable threshold voltage with R4 and R5.                      |
| Pin 3 and Pin 4                  | Pin 1 can be used for external supply voltage with R4 and R5 resistor divider. |

#### 4.2.2 JP2 MODE/S-CONF

**Table 4-3. MODE/S-CONF Pin Configuration**

| Jumper Short Location | Description   |
|-----------------------|---|
| Pin 1 and Pin 3       | Forced PWM, 2.5 MHz, external FB, output discharge enabled                        |
| Pin 3 and Pin 5       | Auto PFM/PWM with AEE, 2.5 MHz, external FB, output discharge enabled             |
| Pin 2 and Pin 4       | 52.3 k to GND, Forced PWM, 2.5MHz, internal FB(VSET), output discharge disabled   |
| Pin 4 and Pin 6       | 42.2 k to GND, Auto PFM/PWM, 2.5MHz, internal FB(VSET), output discharge disabled |

#### 4.2.3 JP3 Power Good

The PGOOD output is on pin 1 of this header with a convenient ground on pin 2. If PG is not used, short pin 1 and pin 2 by a jumper.

#### 4.2.4 JP4 PG Pullup Voltage

**Table 4-4. PG Pullup Voltage Option**

| Jumper Short Location | Description  |
|-----------------------|--|
| Pin 1 and Pin 2       | PG pulls up to the output voltage.   |
| Pin 2 and Pin 3       | PG pulls up to the input voltage.  |
| No jumper             | JP4 pin 2 can pull up to different external voltage. This external voltage must remain below 18 V. |

## 5 Test Results

This section provides the test results of TPS629211-Q1EVM.

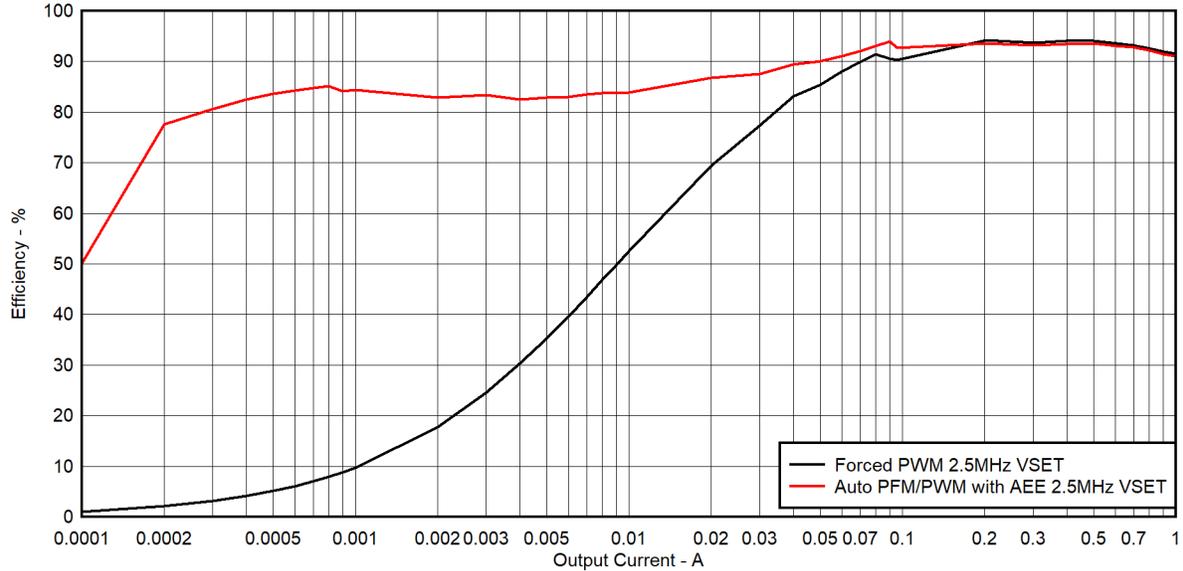


Figure 5-1. Efficiency,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $F_{SW} = 2.5\text{ MHz}$

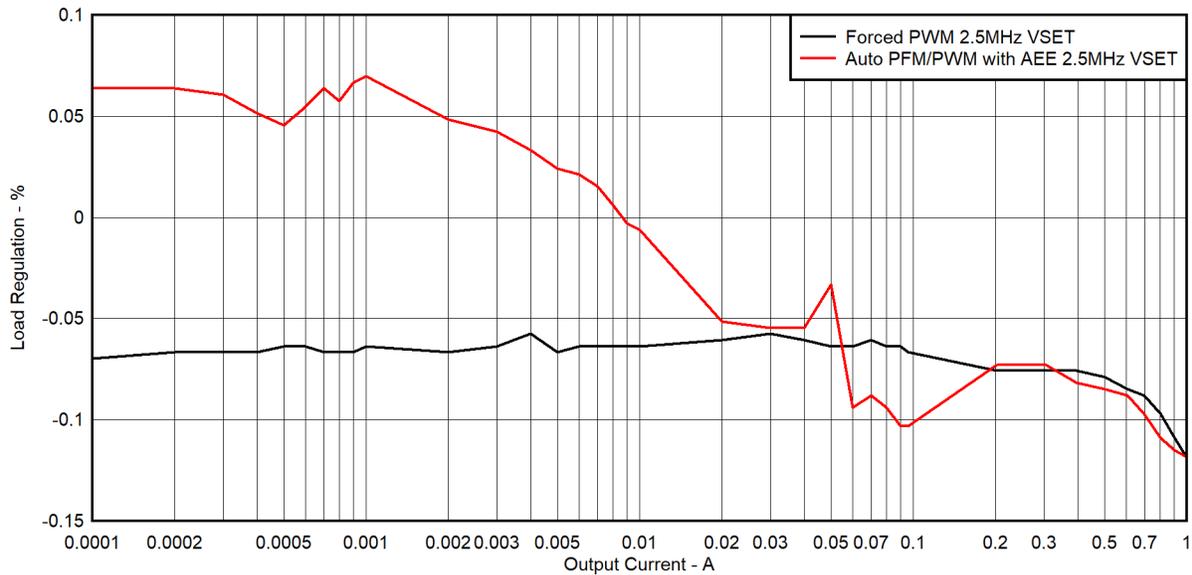
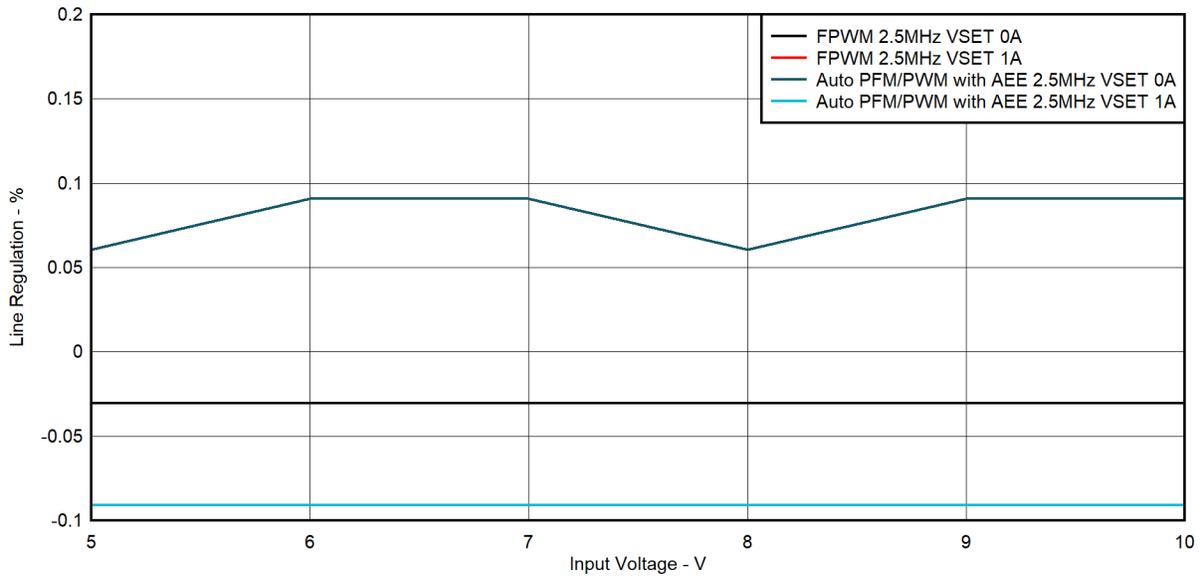
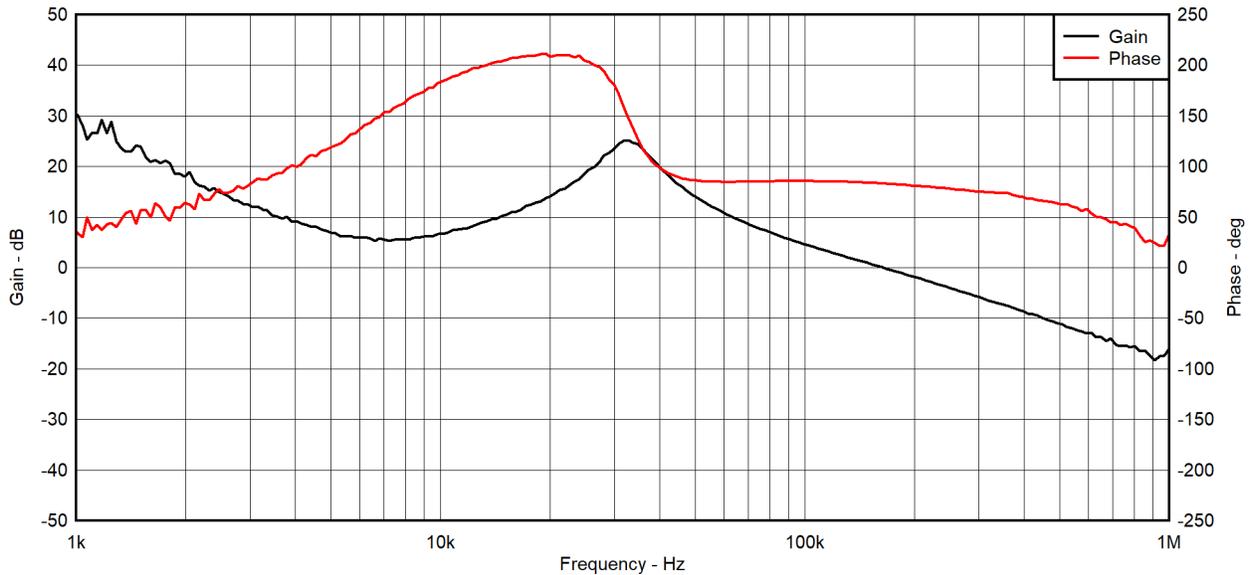


Figure 5-2. Load Regulation,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $F_{SW} = 2.5\text{ MHz}$



**Figure 5-3. Line Regulation,  $V_{IN} = 5\text{ V}$ – $10\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 0\text{ A}$ , and  $1\text{ A}$   $F_{SW} = 2.5\text{ MHz}$**



**Figure 5-4. Loop Response Forced PWM VSET,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$**

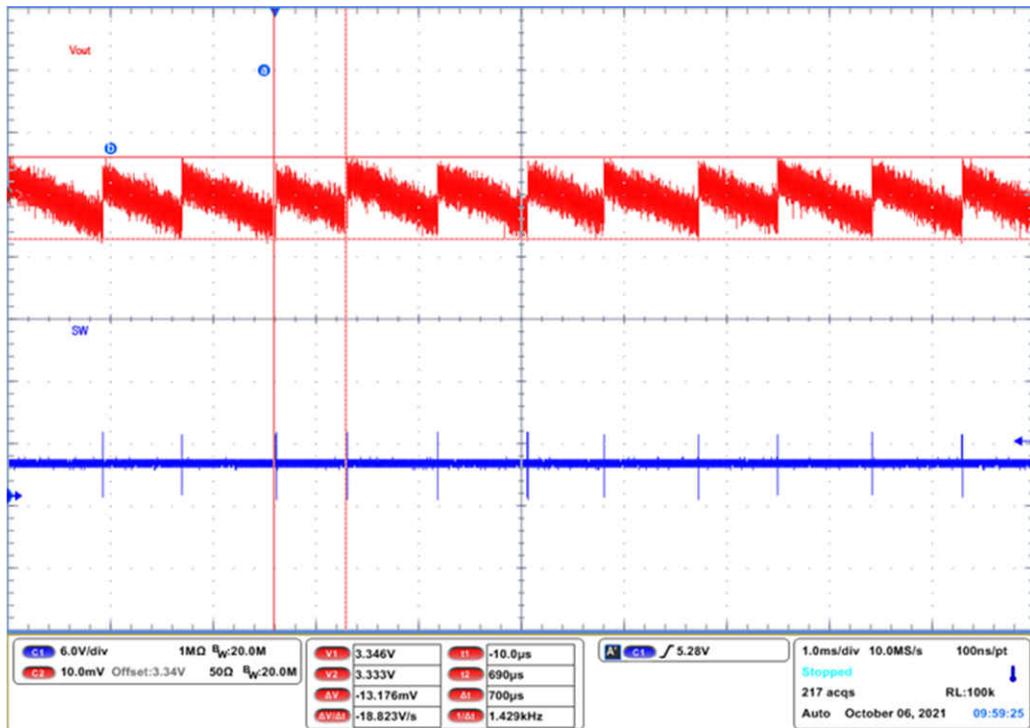


Figure 5-5. Output Voltage Ripple Auto PFM/PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 0\text{ A}$

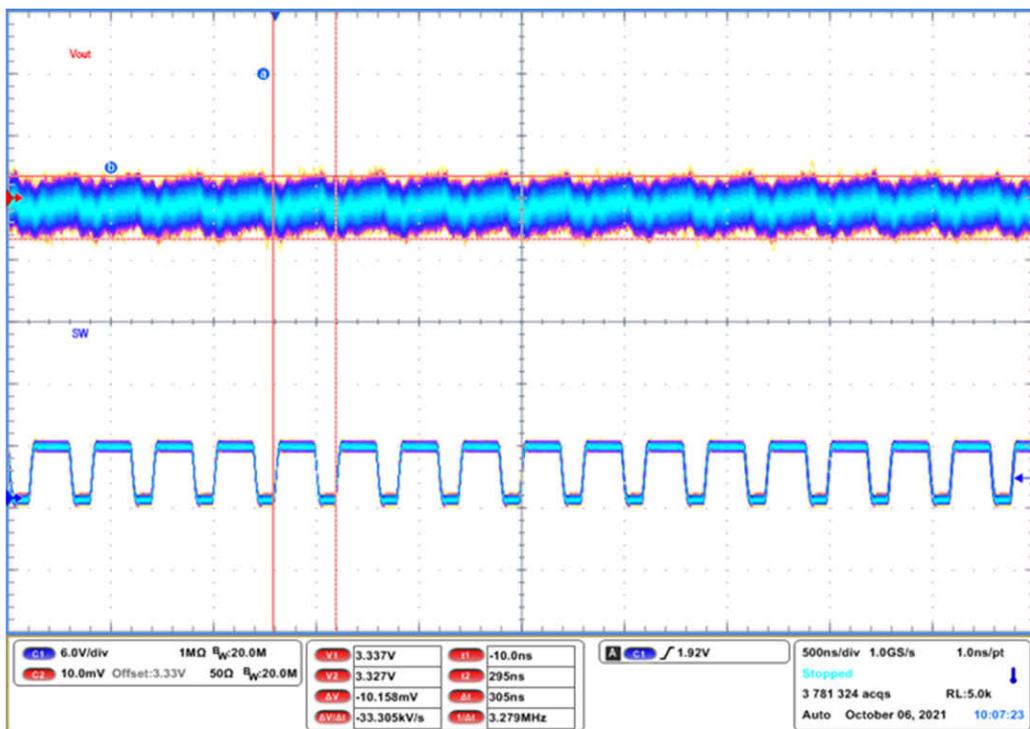


Figure 5-6. Output Voltage Ripple Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$

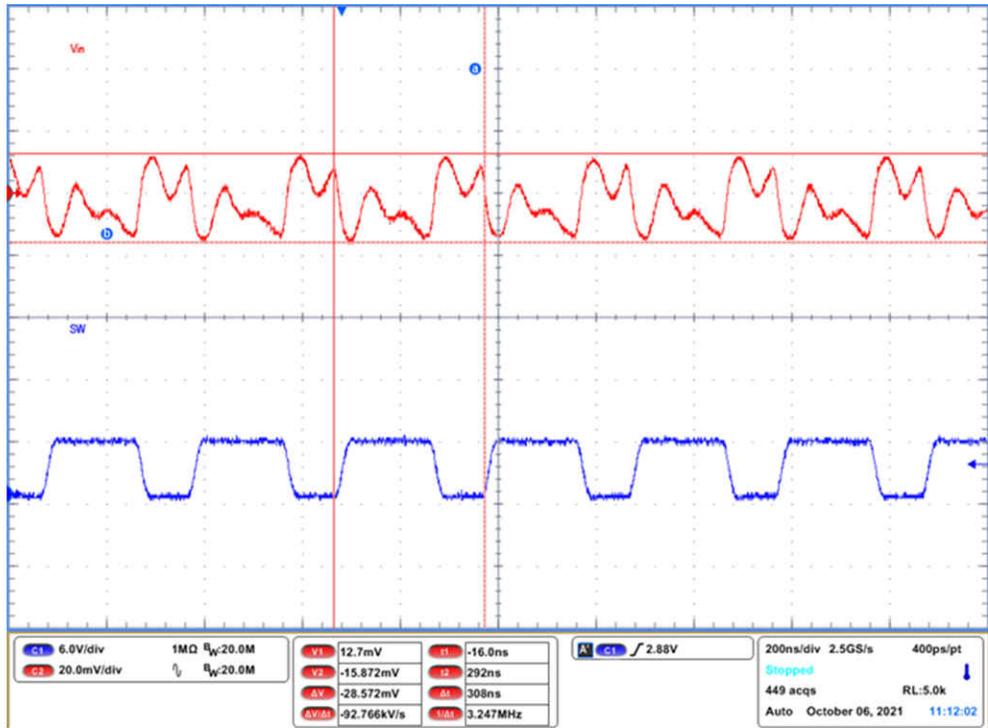


Figure 5-7. Input Voltage Ripple Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$

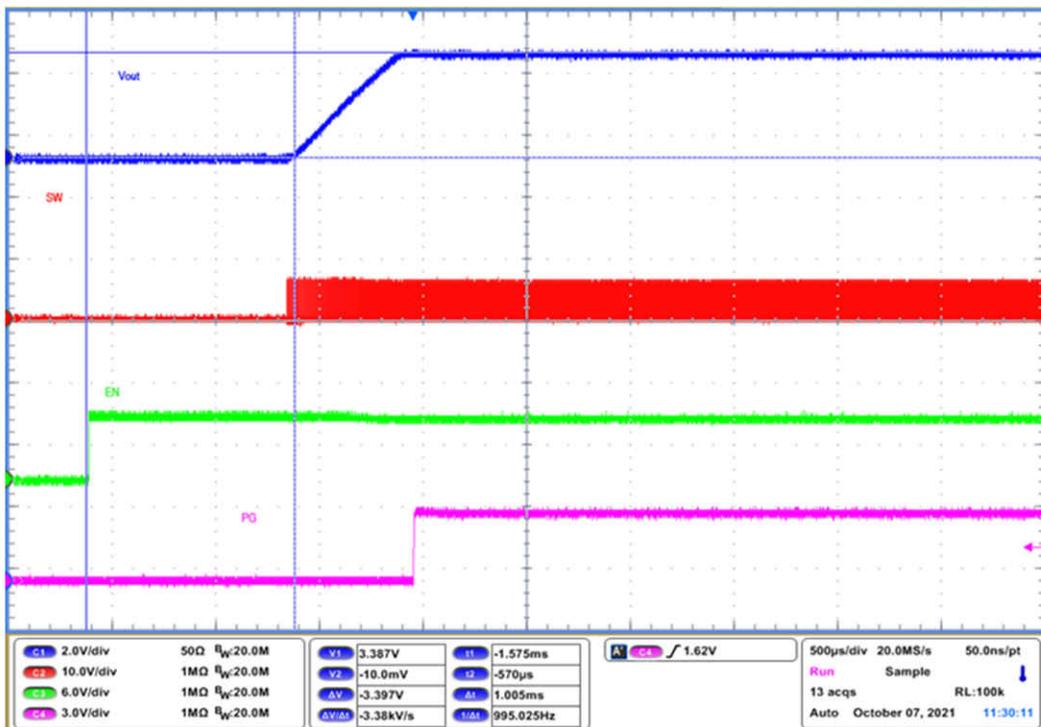


Figure 5-8. Enable Start Up Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$

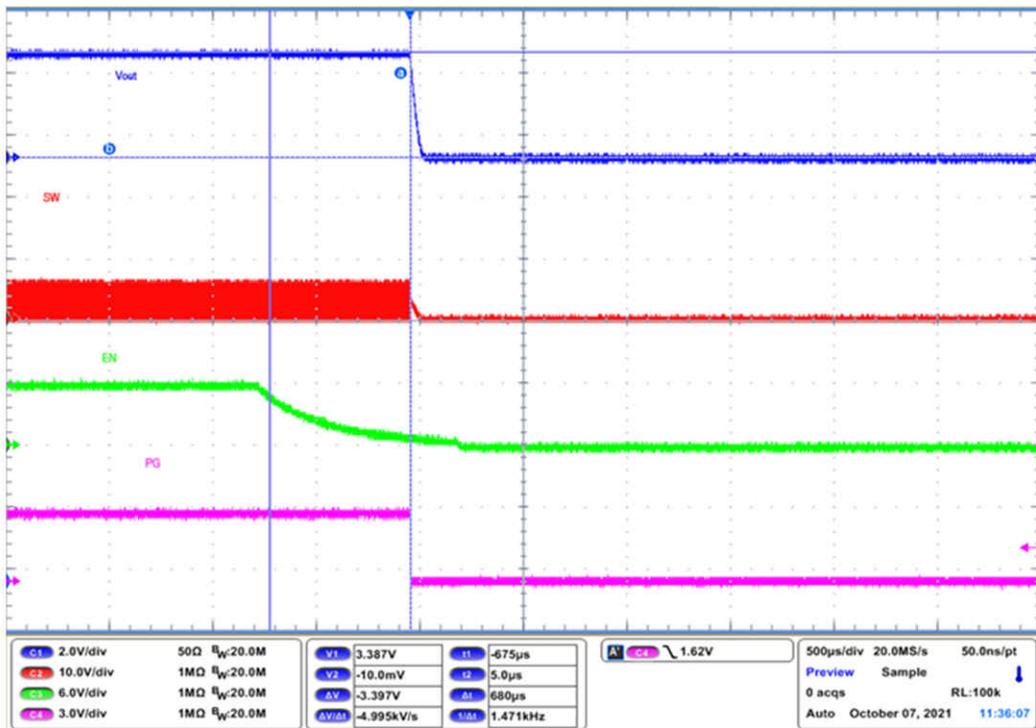


Figure 5-9. Enable Shutdown Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$

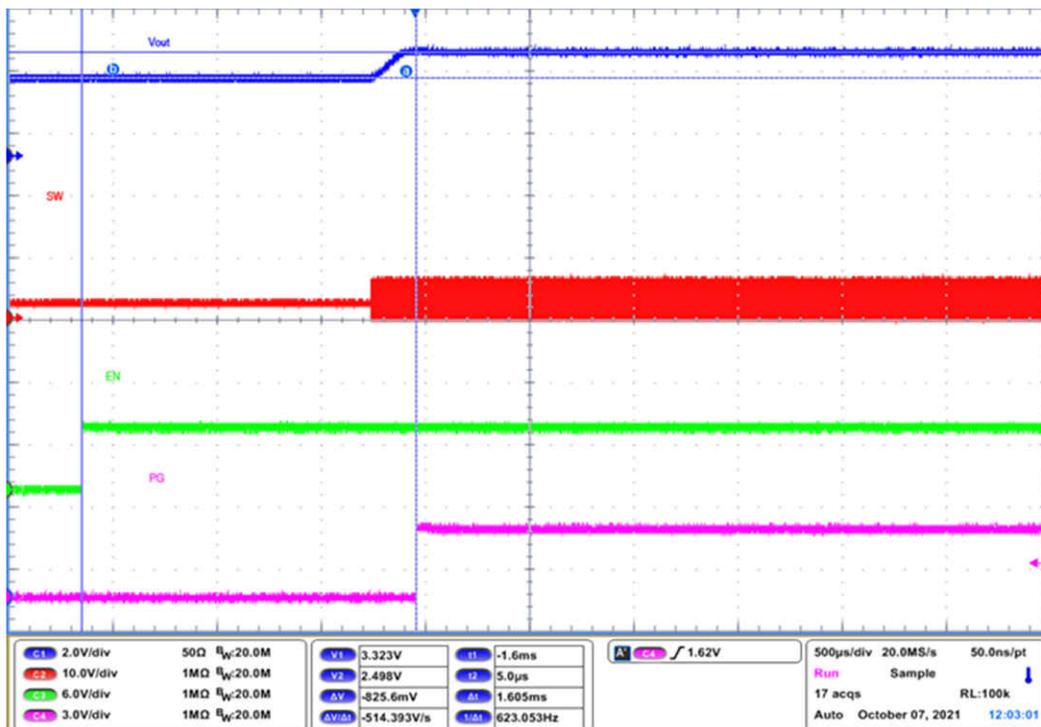


Figure 5-10. Enable Pre-Bias Start-Up Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 0\text{ A}$

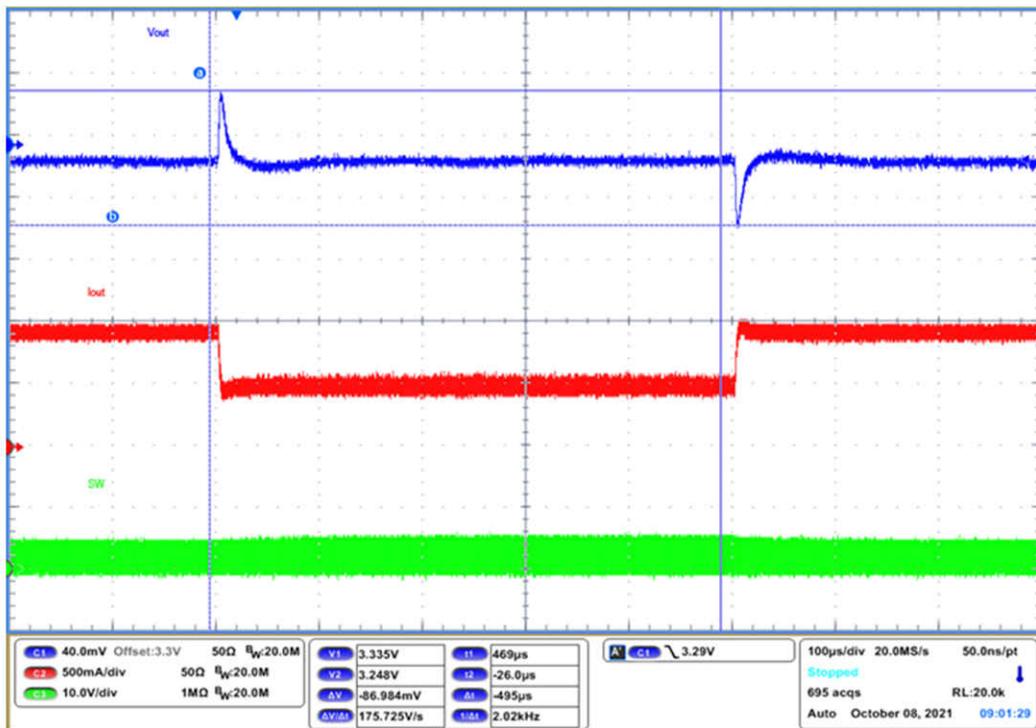


Figure 5-11. Load Transient Forced PWM VSET,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 0.5\text{ A} - 1\text{ A}$ , Slew Rate =  $1\text{ A}/\mu\text{s}$

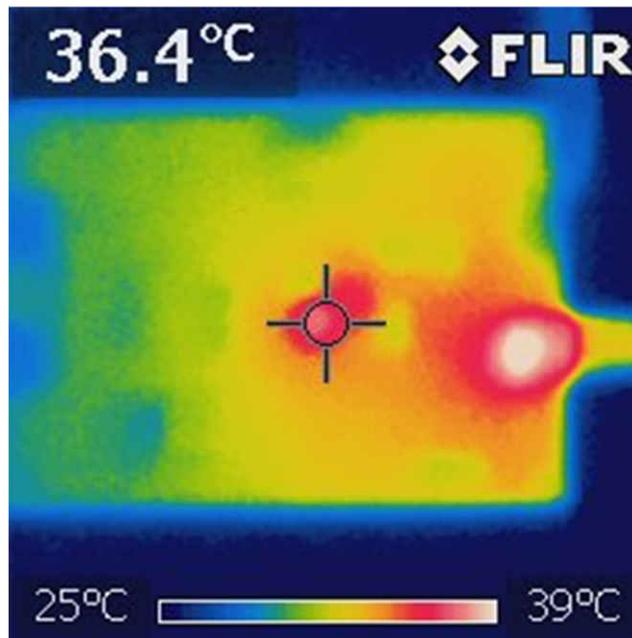


Figure 5-12. Thermal Performance Forced PWM,  $V_{IN} = 6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{OUT} = 1\text{ A}$ ,  $F_{SW} = 2.5\text{ MHz}$

## 6 Board Layout

This section provides the EVM board layout and illustrations.

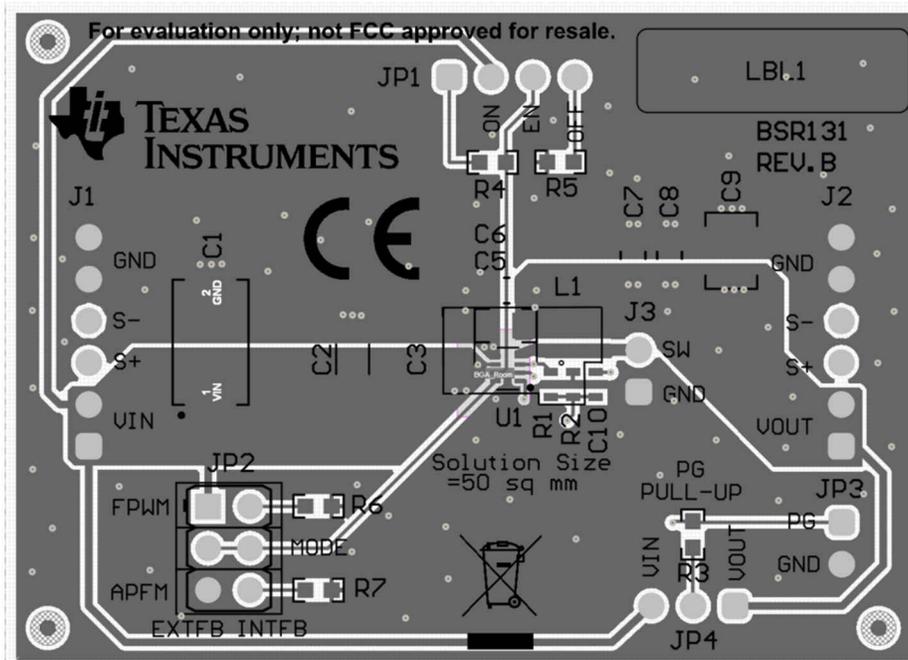


Figure 6-1. Top Assembly

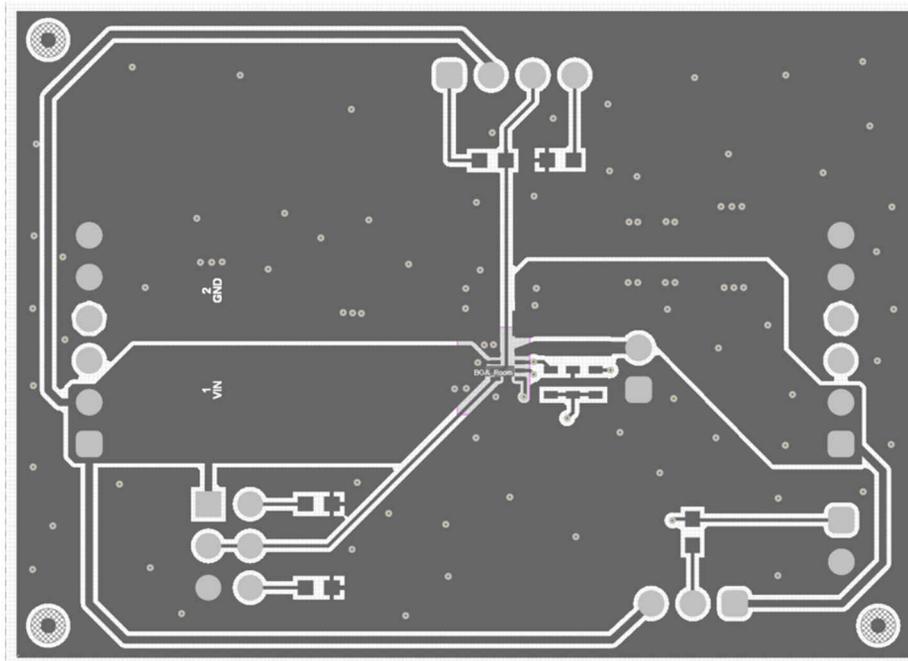
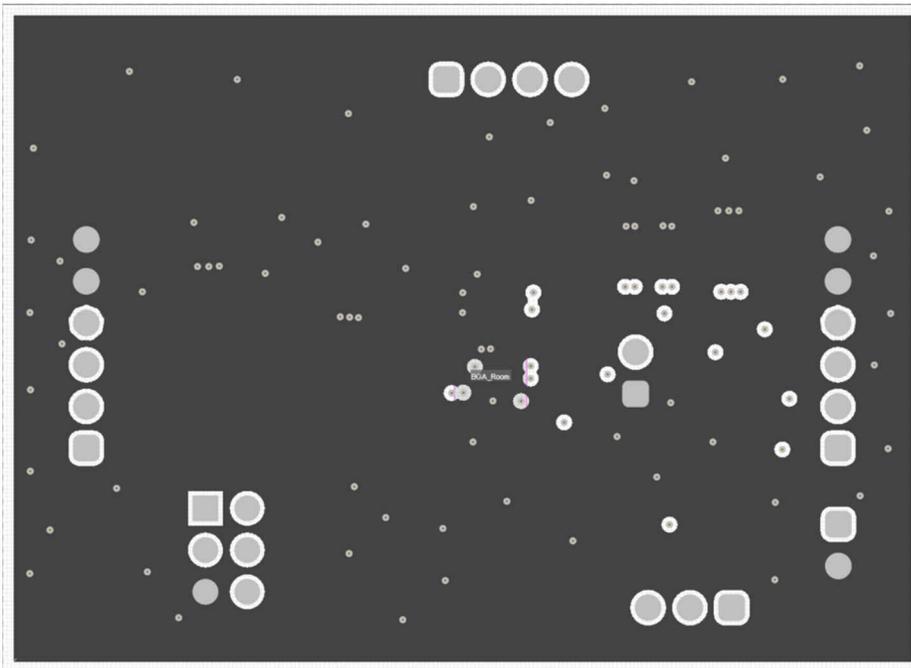
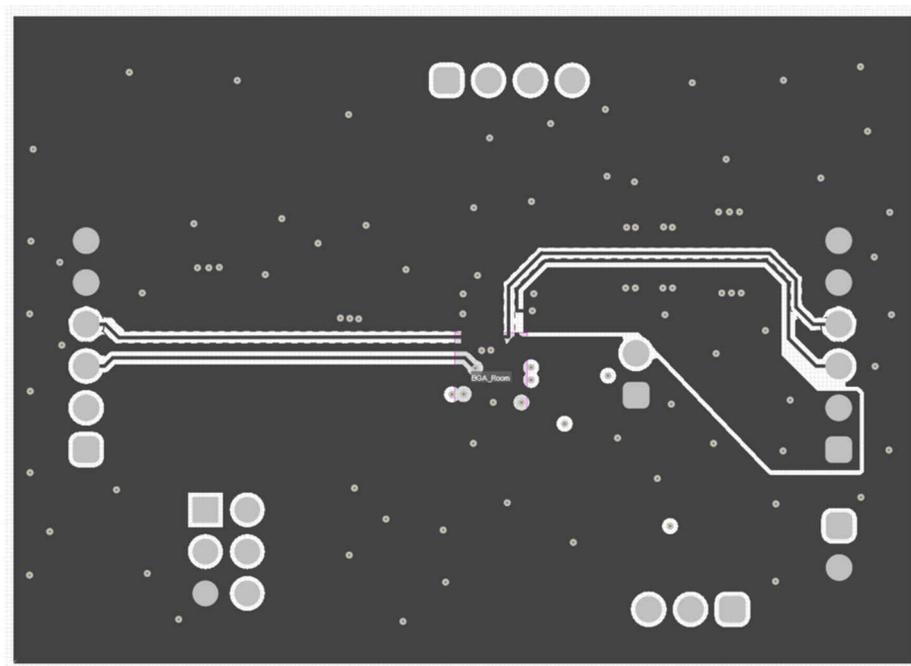


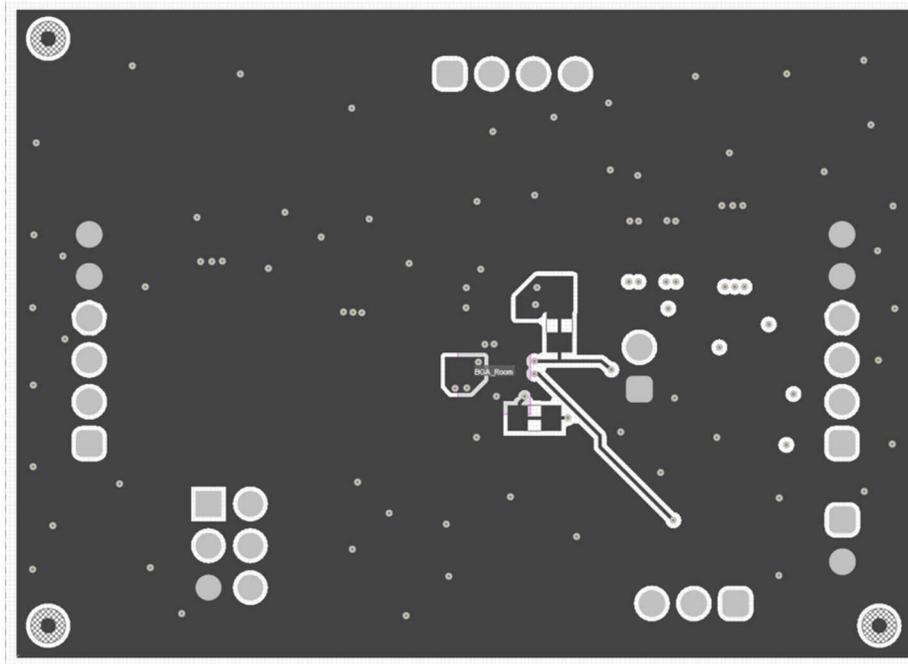
Figure 6-2. Top Layer



**Figure 6-3. Internal Layer 1**



**Figure 6-4. Internal Layer 2**



**Figure 6-5. Bottom Layer**



**Table 7-1. TPS629211-Q1EVM Bill of Materials (continued)**

| Designator | Qty | Value      | Description  | Package                  | Part Number         | Manufacturer     |
|------------|-----|------------|--|--------------------------|---------------------|------------------|
| C2         | 0   | 10 $\mu$ F | CAP, CERM, 10 $\mu$ F, 25 V, $\pm$ 20%, X7R, 1206_190                | 1206_190                 | C3216X7R1E106M160AE | TDK              |
| C6         | 0   | 22 $\mu$ F | CAP, CERM, 22 $\mu$ F, 6.3 V, $\pm$ 20%, X7T, AEC-Q200 Grade 1, 0805 | 0805                     | CGA4J1X7T0J226M     | TDK              |
| C7, C8     | 0   | 22 $\mu$ F | CAP, CERM, 22 $\mu$ F, 10 V, $\pm$ 20%, X7S, 0805                    | 0805                     | C2012X7S1A226M125AC | TDK              |
| C9         | 0   | 47 $\mu$ F | CAP, CERM, 47 $\mu$ F, 6.3 V, $\pm$ 20%, X7R, 1210                   | 1210                     | GRM32ER70J476ME20L  | MuRata           |
| C10        | 0   | 22 pF      | CAP, CERM, 22 pF, 50 V, $\pm$ 5%, COG/NPO, 0603                      | 0603                     | GRM1885C1H220JA01D  | MuRata           |
| J3         | 0   |            | Header, 2.54 mm, 2x1, Gold, TH                                       | Header, 2.54 mm, 2x1, TH | 61300211121         | Wurth Elektronik |

## 8 References

Texas Instruments, [TPS629211-Q1 3 V to 10 V, 1-A Low Iq Buck Converter in SOT583 Package](#) data sheet

## 9 Revision History

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

| Changes from Revision * (January 2022) to Revision A (September 2022)                             | Page |
|---|------|
| • Changed L1 value from 3.3 $\mu$ H to 2.2 $\mu$ H in the <a href="#">Bill of Materials</a> ..... | 15   |

## STANDARD TERMS FOR EVALUATION MODULES

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**User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

**EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.**

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#### 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.

#### 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](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](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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)  
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#### 3.4 European Union

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.

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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:*
      - 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.
      - 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.
  5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
  6. *Disclaimers:*
    - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
    - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
  7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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