



## 1 评估模块概述

### 1.1 简介

德州仪器 (TI) LMR61440QEVm 评估模块可帮助设计人员评估 LMR604x0-Q1 宽输入降压转换器的运行情况和性能。LMR61440-Q1 是一款易于使用的同步降压直流/直流转换器，能够通过 3V 至最高 36V 的输入电压驱动高达 4A 的负载电流。LMR61440QEVm 具有 3.3V 的输出电压和 2.2MHz 的开关频率，支持高达 4A 的负载电流。LMR61440QEVm 可以支持优于 1% 的输出电压调节精度，并可以使用外部电阻分压器调节输出电压设定点。

LMR61440-Q1 采用 9 引脚 RAK WQFN 封装，具有预编程设置，可减少元件数量并实现高密度设计。

LMR61440QEVm 配备了 LMR614403SRAKRQ1 型号，后者允许以固定的 2.2MHz 开关频率提供可调节输出电压、外部同步和展频选项。有关该器件所有四个型号的详细信息，请参阅 LMR614x0-Q1 数据表。该 EVm 使用 LMR61440-Q1 并具有以下特性：

- 宽输入电压范围
- 宽占空比范围
- 集成了高侧和低侧功率 MOSFET
- 逐周期过流保护
- 内部环路补偿
- 专为满足低电磁干扰 (EMI) 要求而设计

### 1.2 套件内容

包装中包含：

1. LMR61440-Q1 评估模块 (LMR61440QEVm) ( 包含 LMR614403SRAKRQ1 )
2. EVm 免责声明自述文件

### 1.3 规格

下表提供了 LMR61440QEVm 性能表现的汇总。由于测试设置存在差异，因此实际测量值预计会与所列数值存在偏差。

| 规格        |        | 测试条件                             | 最小值 | 典型值   | 最大值  | 单位  |
|-----------|--------|----------------------------------|-----|-------|------|-----|
| $V_{IN}$  | 输入电压   |                                  | 8   | 12    | 36   | V   |
| $V_{OUT}$ | 输出电压   | $V_{IN} = 13.5V$                 |     | 3.3   | 3.32 | V   |
| $F_{SW}$  | 开关频率   |                                  |     | 2.2   |      | MHz |
| $I_{OUT}$ | 输出电流范围 |                                  | 0   |       | 4    | A   |
| 峰值效率      |        | $I_{OUT} = 2.2A, V_{IN} = 13.5V$ |     | 89.4% |      |     |

### 1.4 器件信息

LMR61440-Q1 是一款采用同步整流实现小尺寸、高转换效率的 36V、4A 直流/直流降压转换器。

表 1-1. 器件和封装配置

| EVM          | U1               | 频率     | 展频 | 电流 | 引脚 1 修整     |
|--------------|------------------|--------|----|----|-------------|
| LMR61440QEVm | LMR614403SRAKRQ1 | 2.2MHz | 启用 | 4A | 可调输出电压和模式选择 |

## 2 硬件

### 2.1 EVM 设置

本节对 EVM 上的测试点和连接器进行了说明，并说明了如何正确地连接、设置和使用 LMR61440QEVM。

该 EVM 使用包括 MODE/SYNC 功能的 LMR61440-Q1 转换器。此功能意味着，当此引脚连接到 GND 时，器件可以在脉冲频率调制 (PFM) 轻负载模式下运行。TI 观察到，当器件在 PFM 轻负载模式下运行时，如果输入电压接近输出电压，会出现额外的输出电压纹波。为了获得更高的性能，TI 建议将 EVM 配置为在强制脉宽调制 (FPWM) 模式下运行。

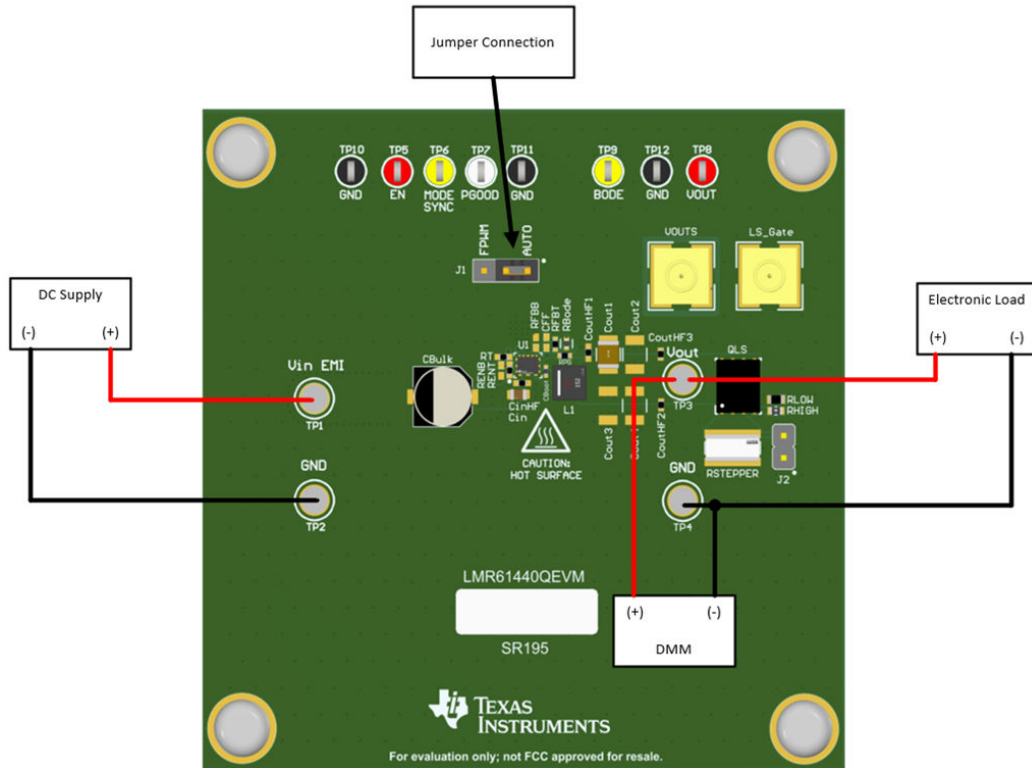


图 2-1. EVM 板连接

除 EVM 板之外，测试设置还包括以下仪器：

- **电源：**输入直流电压源必须能够提供 36V 电压和 4A 电流。
- **负载：**负载必须是电子恒流 (CC) 或恒阻 (CR) 模式负载，能够在 3.3V 电压下支持 4A 的负载电流。执行空载输入电流测试时，请断开电子负载。
- **万用表：**
  - **电压表 1：**在 VIN (TP1) 和 GND (TP2) 处测量输入电压。
  - **电压表 2：**在 VOUT ( TP3 或 VOUTS ) 和 GND (TP4) 处测量输出电压
  - **电流表 1：**测量输入电流。
  - **电流表 2：**测量输出电流。
- **示波器：**将示波器带宽设置为 20MHz 并采用交流耦合模式，使用短接地引线直接测量输出电容器两端的输出电压纹波。将示波器探头尖端放置在输出电容器的正极端子上，接地引线放置在输出电容器的负极端子上。TI 不建议使用长引线接地，因为该连接会因接地回路很大而引起额外的噪声。若要测量其他波形，请在必要时调整示波器。
- **负载电流瞬态：**

EVM 上提供了负载瞬态发生器。将合适的脉冲发生器连接到 "LS\_gate" SMB 连接器，并根据需要调整负载电流脉冲振幅和持续时间，同时检测 J2 处的电压。使用了 10mΩ 检测电阻，可提供 10mV/A 的比例因子脉冲占

空比必须保持在较低水平，以免损坏 MOSFET。可使用 VOUTS SMB 或直接跨接于输出电容器两端来监测输出电压。TI 建议使用高速差分探头。另请参阅图 2-2。

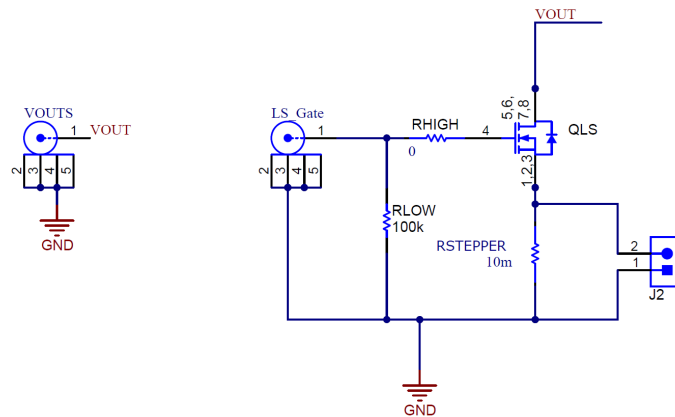


图 2-2. 负载瞬态发生器

### 2.1.1 快速入门

1. 在 VIN+ 和 VIN- 测试点之间连接电压电源。
2. 在 VOUT 和 GND 测试点之间连接负载。
3. 将电源电压设置在 8V 至 36V 之间的适当电平。将电源的电流限制设置为适当的电平。
4. 打开电源。在默认配置下，EVM 启动并提供  $V_{OUT} = 3.3V$ 。
5. 监控输出电压。使用 LMR61440-Q1 器件时，负载电流必须为 4A 或更低。

### 2.1.2 测试点

电路板顶部上的测试点用于连接 EVM 的输入和输出。有关测试点的详细说明，请参阅表 2-1。

表 2-1. EVM 测试点

| 测试点          | 信号            | 说明                                                                                    |
|--------------|---------------|---------------------------------------------------------------------------------------|
| TP1          | VIN           | EVM 的输入电源，包括一个 EMI 滤波器。连接至合适的输入电源。在此点连接以进行传导 EMI 测试。                                  |
| TP2          | GND           | 输入电源的接地连接                                                                             |
| TP5          | EN            | 此测试点从 IC 连接到 EN 引脚。                                                                   |
| TP7          | PGOOD         | 此测试点从 IC 连接到 PGOOD 引脚。该测试点是 PGOOD 引脚的开漏输出。通过使用电阻器 R3，PGOOD 引脚可以通过上拉电阻器连接到 VOUT 或保持开路。 |
| TP6          | MODE/SYNC     | 此测试点从 IC 连接到 MODE/SYNC 引脚。此测试点通过 R8 连接到 GND。                                          |
| TP10、TP11    | GND           | 此测试点连接到 GND。                                                                          |
| TP3          | VOUT          | 到 EVM 的输出电压                                                                           |
| TP4          | GND           | 负载的接地连接                                                                               |
| TP8、TP9、TP12 | VOUT/BODE/GND | 用于连接 FRA 来测量波德图                                                                       |
| J2           | Isense        | 用于在使用瞬态电流发生器时检测负载电流瞬态                                                                 |
| LS_gate      | 负载瞬态输入        | 用于为负载瞬态电流发生器提供栅极驱动                                                                    |
| VOUTS        | 输出电压检测点       | 用于向示波器或其他敏感仪器提供高质量输出电压检测                                                              |

## 3 实现结果

### 3.1 性能数据和结果

实际性能数据可能会受到测量技术和环境变量的影响。这些曲线仅供参考，并可能与实际现场测量结果有所不同。除非另有说明，否则  $V_{in} = 13.5V$ 、 $V_{out} = 3.3V$  且  $F_{sw} = 2.2MHz$ 。

#### 3.1.1 效率、负载调整 and 噪声

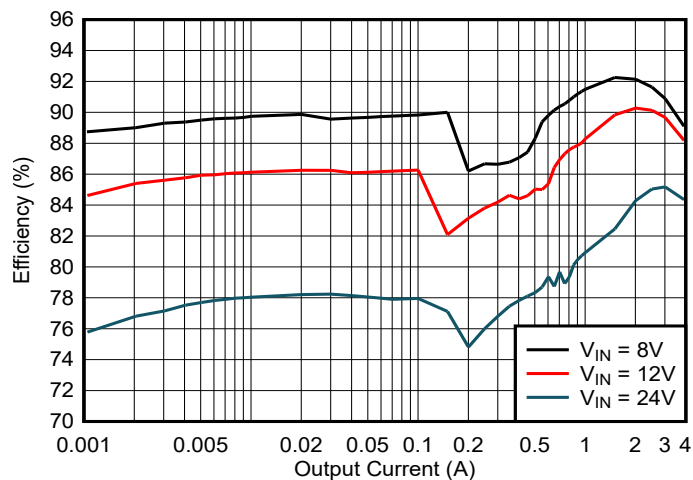


图 3-1. 转换效率 (2.1MHz)

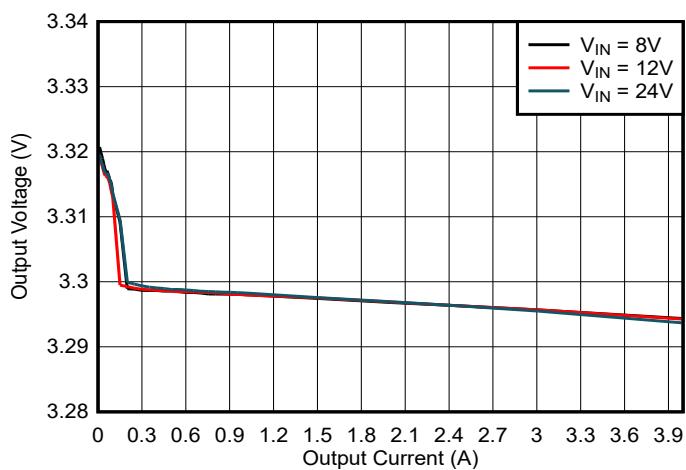


图 3-2. 输出电压调节

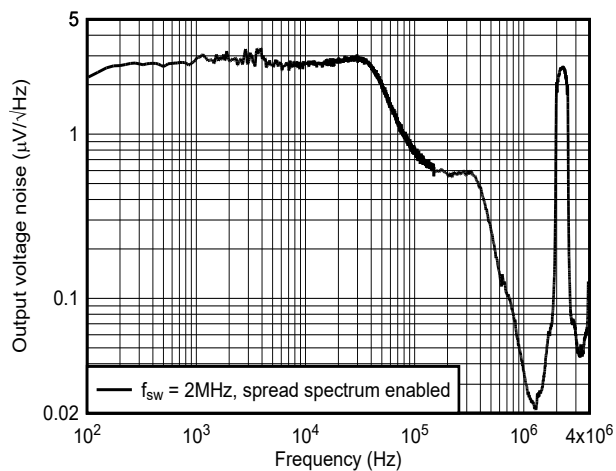
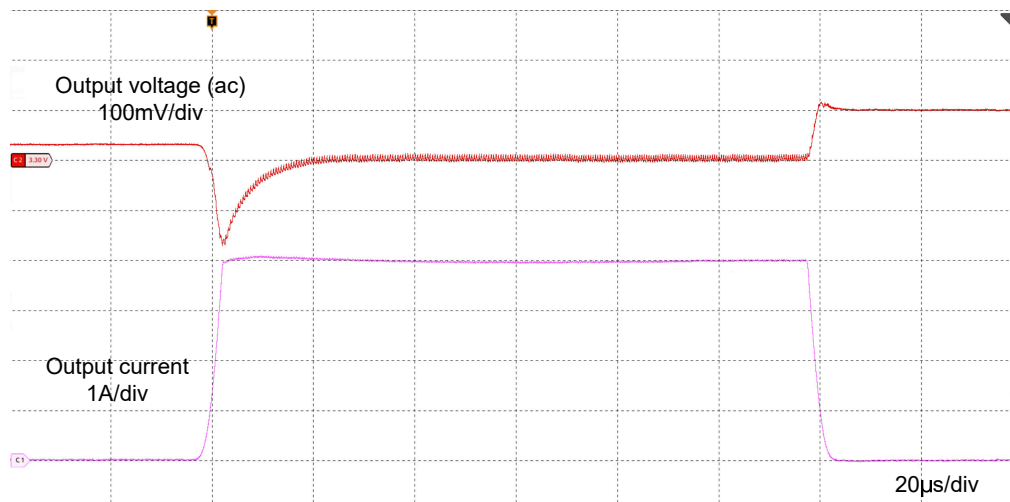
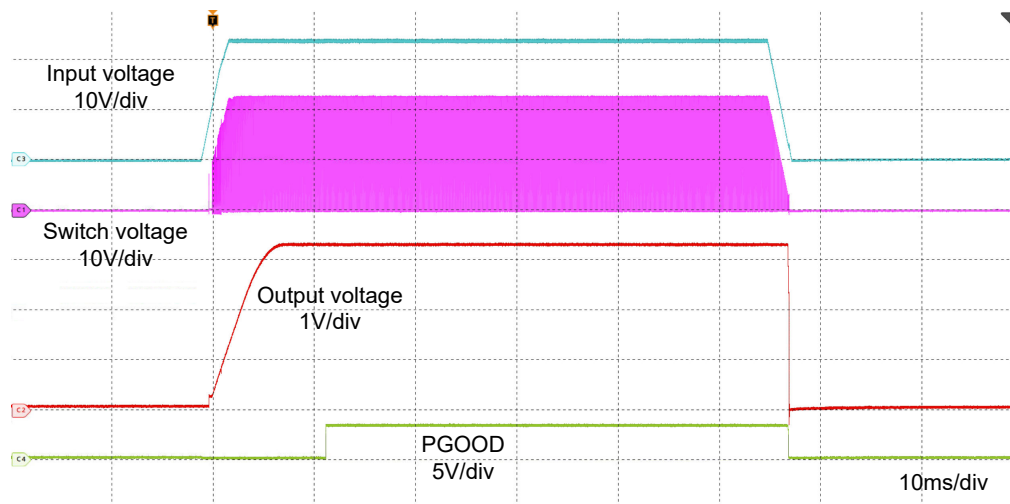


图 3-3. 输出电压噪声

### 3.1.2 负载瞬态

图 3-4. 负载瞬态,  $I_{OUT} = 0\text{mA}$  至  $4\text{A}$ 

### 3.1.3 启动和关断

图 3-5.  $V_{IN}$  启动和停止,  $I_{OUT} = 4\text{A}$



## 4.2 电路板布局

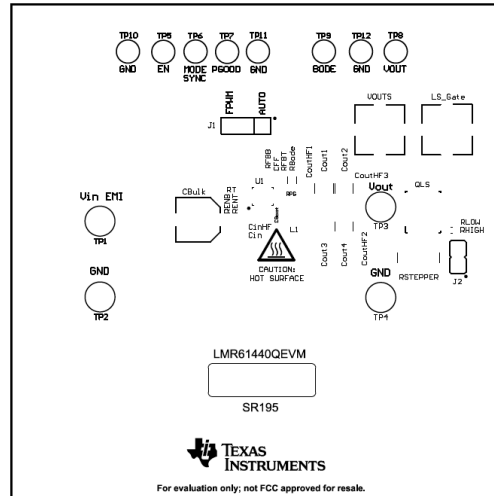


图 4-2. EVM 顶部覆盖层

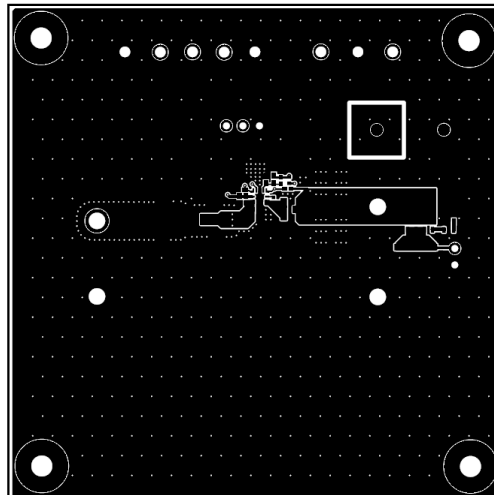


图 4-3. EVM 顶部铜层

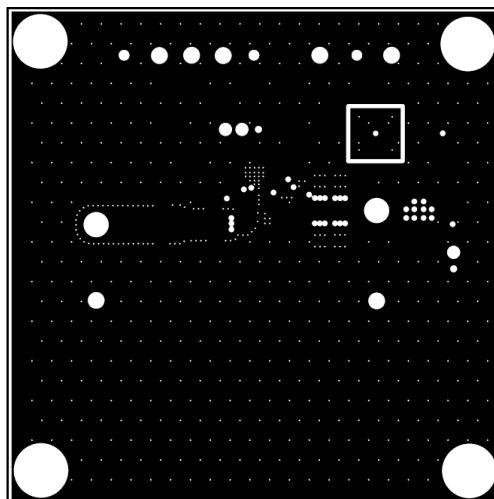


图 4-4. EVM 中层一

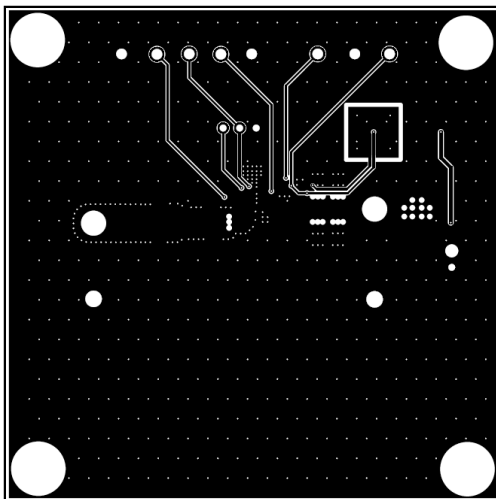


图 4-5. EVM 中层二

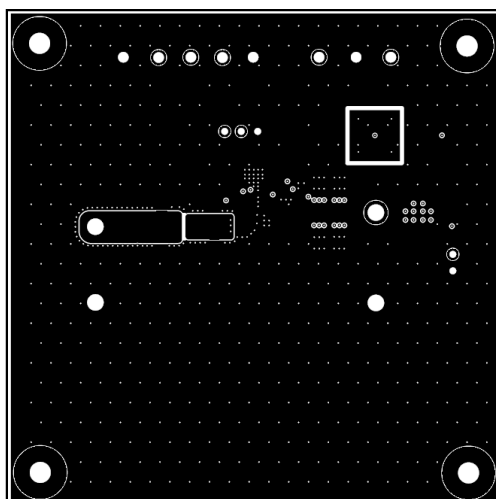


图 4-6. EVM 底部铜层

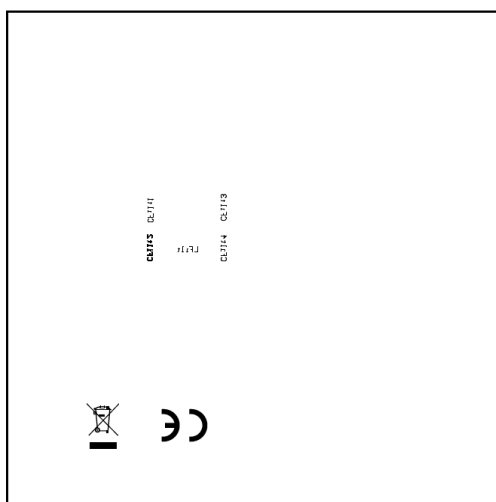


图 4-7. EVM 底部覆盖层

### 4.3 物料清单

表 4-1. 物料清单

| 指示符             | 数量 | 说明                                                                    | 器件型号                 | 封装                               | 制造商                         |
|-----------------|----|-----------------------------------------------------------------------|----------------------|----------------------------------|-----------------------------|
| !PCB1           | 1  | 印刷电路板                                                                 | SR195                |                                  | 不限                          |
| CBoot           | 1  | 0.1 $\mu$ F $\pm$ 10% 25V 陶瓷电容器 X7R 0402 ( 公制 1005 )                  | CS0402KRX7R8BB104    | FP-CS0402KRX7R8BB104_0402-MFG    | Yageo                       |
| CBulk           | 1  | 电容, 铝制, 47 $\mu$ F, 50V, $\pm$ 20%, 0.68 $\Omega$ , AEC-Q200 2 级, SMD | EEE-FT1H470AP        | Panasonic_D                      | Panasonic                   |
| CFilt1、CFilt2   | 2  | 电容, 陶瓷, 2.2 $\mu$ F, 50V, $\pm$ 10%, X7R, AEC-Q200 1 级, 0805          | CGA4J3X7R1H225K125AB | 0805_HV                          | TDK                         |
| CFilt3、CFilt4   | 2  | 电容, 陶瓷, 2.2 $\mu$ F, 50V, $\pm$ 10%, X7R, AEC-Q200 1 级, 0805          | CGA4J3X7R1H225K125AB | 0805L                            | TDK                         |
| Cin             | 1  | 4.7 $\mu$ F $\pm$ 10% 50V 陶瓷电容器 X7R 0805 ( 公制 2012 )                  | C2012X7R1H475K125AC  | FP-C2012X7R1H475K125AC_0805-MFG  | TDK                         |
| CinHF、CoutHF1   | 2  | 电容, 陶瓷, 0.1 $\mu$ F, 50V, $\pm$ 10%, X7R, AEC-Q200 1 级, 0402          | GCM155R71H104KE02D   | 0402                             | MuRata                      |
| Cout1           | 1  | 电容, 陶瓷, 22 $\mu$ F, 16V, X7R, 20%, 焊盘 SMD, 1210, $\pm$ 125°C, 汽车 T/R  | CGA6P1X7R1C226M250AC | FP-CGA6P1X7R1C226M250AC_1210-MFG | TDK                         |
| CoutHF2、CoutHF3 | 2  | 电容, 陶瓷, 0.1 $\mu$ F, 50V, $\pm$ 10%, X7R, AEC-Q200 1 级, 0402          | GCM155R71H104KE02D   | 0402S                            | MuRata                      |
| H1、H2、H3、H4     | 4  | 机械螺钉, 圆头, #4-40 x 1/4, 尼龙, 飞利浦盘形头                                     | NY PMS 440 0025PH    | NY PMS 440 0025PH                | B&F Fastener Supply         |
| H5、H6、H7、H8     | 4  | 六角螺柱, 0.5"L #4-40, 尼龙                                                 | 1902C                | Keystone_1902C                   | Keystone                    |
| J1              | 1  | 接头, 100mil, 3x1, 金, TH                                                | HTSW-103-07G-S       | Samtec_HTSW-103-07G-S            | Samtec                      |
| J2              | 1  | 接头, 100mil, 2x1, 金, TH                                                | PBC02SAAN            | Sullins_PBC02SAAN                | Sullins Connector Solutions |
| L1              | 1  | 电感, 屏蔽, 复合, 1.5 $\mu$ H, 3.2A, 0.014 $\Omega$ , AEC-Q200 1 级, SMD     | XGL4020-152MEC       | FP-XGL4020-152MEC_SMD2-MFG       | Coilcraft                   |
| LBL1            | 1  | 热转印打印标签, 0.650" ( 宽 ) x 0.200" ( 高 ) - 10,000/卷                       | THT-14-423-10        | Label_650x200                    | Brady                       |
| LFilt           | 1  | 电感, 屏蔽, 复合, 2.2 $\mu$ H, 5.5A, 0.04 $\Omega$ , AEC-Q200 1 级, SMD      | XAL4020-222MEC       | XAL4020                          | Coilcraft                   |
| LS_Gate、VOUTS   | 2  | 连接器, SMT, SMB 插孔组合件 50 $\Omega$                                       | 131-3711-201         | Johnson_131-3711-201             | Cinch Connectivity          |
| QLS             | 1  | MOSFET, N 沟道, 25V, 100A, DQH0008A (VSON-CLIP-8)                       | CSD16321Q5           | DQH0008A                         | 德州仪器 (TI)                   |

表 4-1. 物料清单 ( 续 )

| 指示符             | 数量 | 说明                                                                        | 器件型号                | 封装                              | 制造商                  |
|-----------------|----|---------------------------------------------------------------------------|---------------------|---------------------------------|----------------------|
| RBoDe           | 1  | 49.9Ω ±1% 0.063W, 1/16W 片上电阻 0402 ( 1005 公制 ) 抗硫化, 汽车 AEC-Q200 厚膜         | AF0402FR-0749R9L    | FP-AF0402FR-0749R9L_0402-MFG    | YAGEO                |
| RENT            | 1  | 电阻, 30.0k, 1%, 0.063W, AEC-Q200 0 级, 0402                                 | CRCW040230K0FKED    | 0402                            | Vishay-Dale          |
| RFBT            | 1  | 电阻, 0, 5%, 0.063W, 0402                                                   | RC0402JR-070RL      | 0402L                           | Yageo America        |
| RHIGH           | 1  | CRCW 系列 0603 0.1W 00hm 跳线表面贴装厚膜片上电阻                                       | CRCW06030000Z0EAC   | FP-CRCW06030000Z0EAC_0603-MFG   | Vishay               |
| RLOW            | 1  | 电阻, 100k, 1%, 0.1W, AEC-Q200 0 级, 0603                                    | CRCW0603100KFKEA    | 0603S                           | Vishay-Dale          |
| RPG             | 1  | 电阻, 100k, 5%, 0.063W, AEC-Q200 0 级, 0402                                  | CRCW0402100KJNED    | 0402L                           | Vishay-Dale          |
| RSTEPPER        | 1  | 10mΩ, ±1%, 3W, 片上电阻, 宽, 2512 ( 公制 6432 ), 1225, 汽车 AEC-Q200, 电流检测, 金属箔    | KRL6432E-M-R010F-T1 | FP-KRL6432E-M-R010F-T1_2512-MFG | Susumu               |
| RT              | 1  | 电阻, 15.0k, 1%, 0.063W, AEC-Q200 0 级, 0402                                 | CRCW040215K0FKED    | 0402                            | Vishay-Dale          |
| SH-J1           | 1  | 连接器跳线 S2 (1x 2) 位置并联连接器, 黑色, 顶部开口, 0.100" (2.54mm), GoldHORTING, 0.100" 金 | QPC02SXGN-RC        | FP-QPC02SXGN-RC_JUMPER-MFG      | Sullins              |
| TP1、TP2、TP3、TP4 | 4  | 引脚, 双转塔, TH                                                               | 1502-2              | Keystone1502-2                  | Keystone             |
| TP5、TP8         | 2  | 测试点, 多用途, 红色, TH                                                          | 5010                | Keystone5010                    | Keystone Electronics |
| TP6、TP9         | 2  | 测试点, 通用, 黄色, TH                                                           | 5014                | Keystone5014                    | Keystone Electronics |
| TP7             | 1  | 测试点, 通用, 白色, TH                                                           | 5012                | Keystone5012                    | Keystone Electronics |
| TP10、TP11、TP12  | 3  | 测试点, 多用途, 黑色, TH                                                          | 5011                | Keystone5011                    | Keystone Electronics |
| U1              | 1  | LMR614403SRAKRQ1                                                          | LMR614403SRAKRQ1    | VBC0009A-MFG                    | 德州仪器 (TI)            |

## 5 其他信息

### 5.1 商标

所有商标均为其各自所有者的财产。

## STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

**Evaluation Kits 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 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.

### 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 instructions, 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/sds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/sds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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。
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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/sds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/sds/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.

#### 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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