EVM User's Guide: TSG06D00EVM

6GHz 双通道射频信号发生器评估模块的用户指南

说明

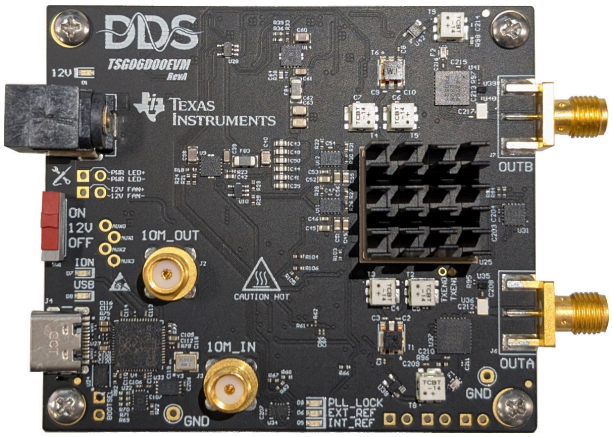
TSG06D00EVM 是德州仪器 (TI) 推出的一款双通道 6GHz 射频信号发生器评估模块，专为需要紧凑型、USB 控制射频源的工程师设计，适用于实验室工作台测试、系统评估及自动化测试应用。该器件提供两个半独立的相干射频输出通道，具有校准的功率输出和一个可通过 USB-TMC 访问的完整 SCPI 命令集。

开始使用

1. 从 TI.com 订购 TSG06D00EVM。
2. 从 TSG06D00EVM-GUI 下载最新软件。
3. 从 TSG06D00EVM 工具页面下载综合参考文件。
   a. 硬件设计文件（原理图、布局、物料清单）
   b. 性能数据和测试报告
   c. 技术参考手册（SCPI 命令、调试说明）

特性

- 两个半独立的 10MHz 至 6GHz 输出
  - 频率分辨率小于 1nHz
- 具有可选 10MHz 基准的板载时钟
- 基于 12V 输入的优化电源树
- 集成射频输出功率检测
- 具有用于 SCPI 的 NI-VISA 驱动程序的 USB-C 控制



TSG06D00EVM 硬件板

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1 评估模块概述

1.1 简介

以下 EVM 用户指南深入概述了 TSG06D00EVM 评估板硬件及软件 GUI 的使用方法，并提供了示例命令和脚本，以便在各种模式和功能下对信号发生器进行更改、配置和评估。

1.2 套件内容

- TSG06D00EVM
- USB Type-C® 电缆
- 12V 直流电源线 (外径 5.5mm / 内径 2.1mm 内径，正极中心)

有关正确使用所需的其他设备，请参阅节 2.2。

1.3 器件信息

TSG06D00EVM 使用德州仪器 (TI) 的以下器件。

表 1-1. 器件信息

器件	说明
DDS39RF12	16 位、双通道、24GSPS、12GHz 射频直接数字合成器 (DDS)
LMX2820	具有相位同步功能、JESD 和频率校准 <5µs 的 22.6GHz 宽带射频合成器
LMK04828	具有集成式 2370MHz 至 2630MHz VCO 且符合 JESD204B 标准的超低噪声时钟抖动消除器
LMH2110	具有 45dB 动态范围的 8GHz 对数 RMS 功率检测器
TPS259261	4.5V 至 13.8V、30mΩ、2A 至 5A 电子保险丝
TPSM82916	具有集成式铁氧体磁珠滤波器补偿的 17V 输入电压、6A 低噪声和低纹波降压转换器
TPSM82822	具有集成电感器、采用 2mm × 2.5mm × 1.1mm µSIP 封装的 5.5V 输入、2A 降压模块
LM27762	带有集成 LDO 的低噪声正负输出电荷泵
TPS7A9601	2A 超低噪声、超高 PSRR 射频稳压器

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2 硬件

2.1 电路板概述

2.1.1 RF 信号链

TSG06D00EVM 具有两个半独立的射频输出通道，每个通道都具有相同的射频信号链，能够在 10MHz 至 6GHz 范围内输出信号，频率分辨率 <1nHz。

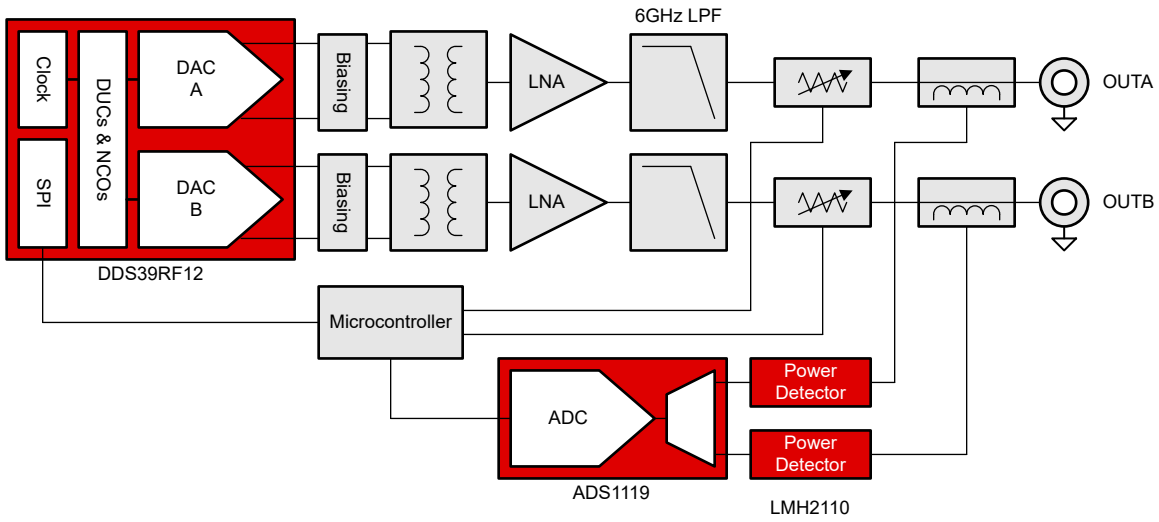


图 2-1. 射频输出方框图

DDS39RF12 以两种采样率模式运行。两个通道共享来自 LMX2820 的相同采样时钟，因此所使用的模式会影响两个通道。

表 2-1. 频率范围

频率范围	两个通道独立？	注释
10MHz 至 4.8GHz	有	当两个通道都在相同的频率范围内使用时，两个通道可以完全独立运行。
4.8GHz 至 6GHz	有	
混合（每个范围内一个通道）	附有注意事项	该仪器会切换 DAC 采样率以适应新的通道频率。另一个通道继续运行，但由于混叠，可能存在图像频率。用户负责在此配置中验证输出光谱纯度。

2.1.1.1 输出功率

TSG06D00EVM 能够在低频 (10MHz) 下提供高达 14dBm 的输出功率，在高频 (6GHz) 下提供高达 0dBm 的输出功率，并在整个频率范围内具有大致的线性压降。

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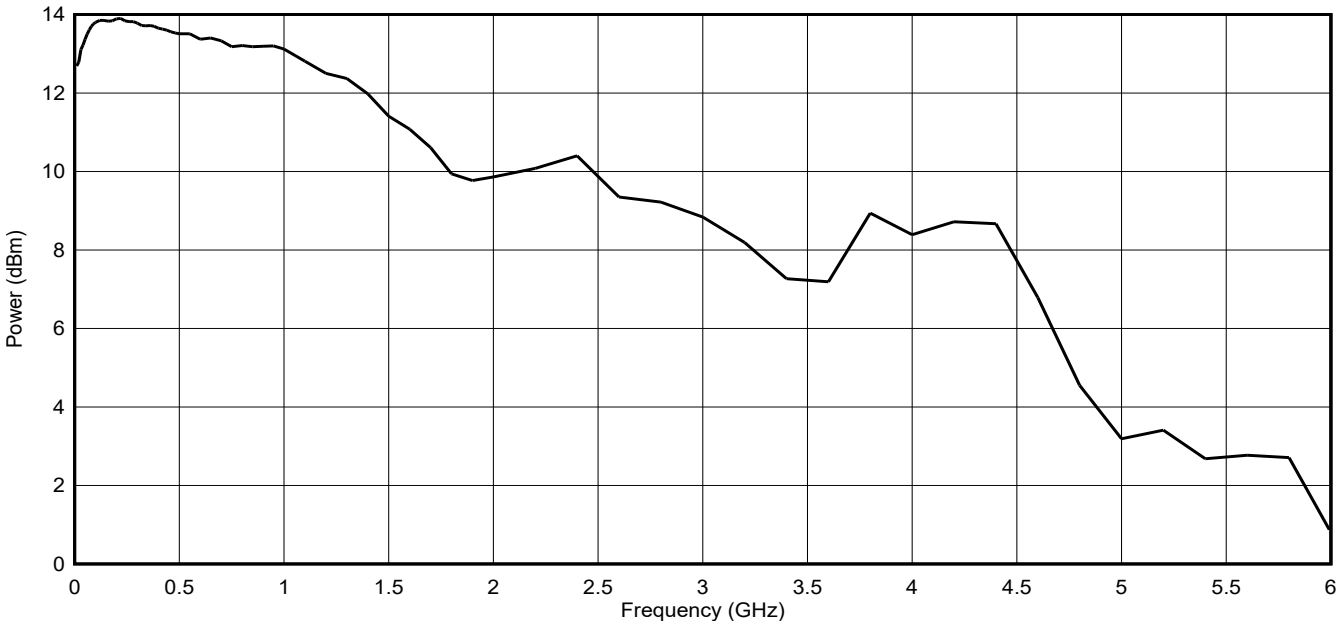


图 2-2. 输出功率与输出频率间的关系

2.1.2 时钟

该电路板具有板载时钟，使用 100MHz VCXO 作为 LMK04828 抖动清除器的频率基准，以在馈送到 LMX2820 射频合成器之前调节时钟信号，从而为 DDS39RF12 直接数字合成器生成高达 12GHz 的时钟。

板载 10MHz TCXO 提供用于同步的低频时钟，或者提供外部 10MHz 选项。内部和外部基准都被缓冲并路由到 10MHz 输出，从而为另一电路板或仪表提供基准。

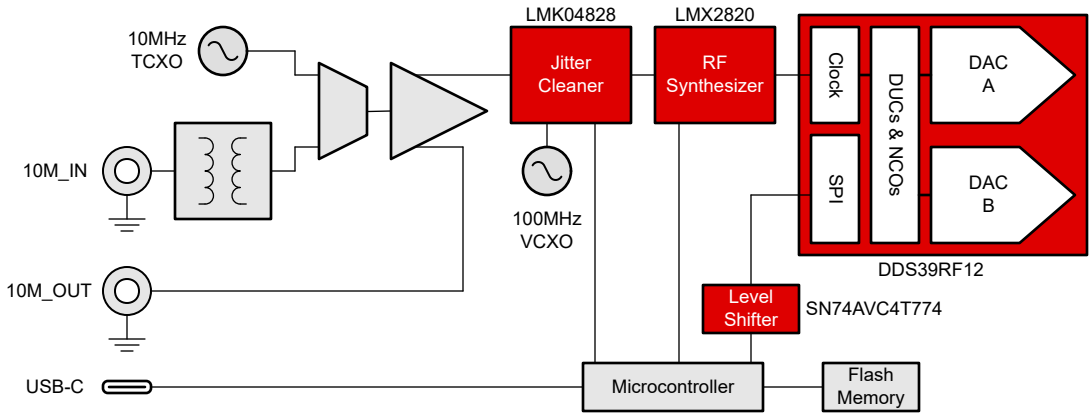


图 2-3. 时钟方框图

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2.1.3 电源

该电路板由 12V 电源供电，并使用精选的 TI 电源元件为所有元件提供所需的电压，同时更大限度地减少向敏感射频信号路径引入额外的噪声和失真。

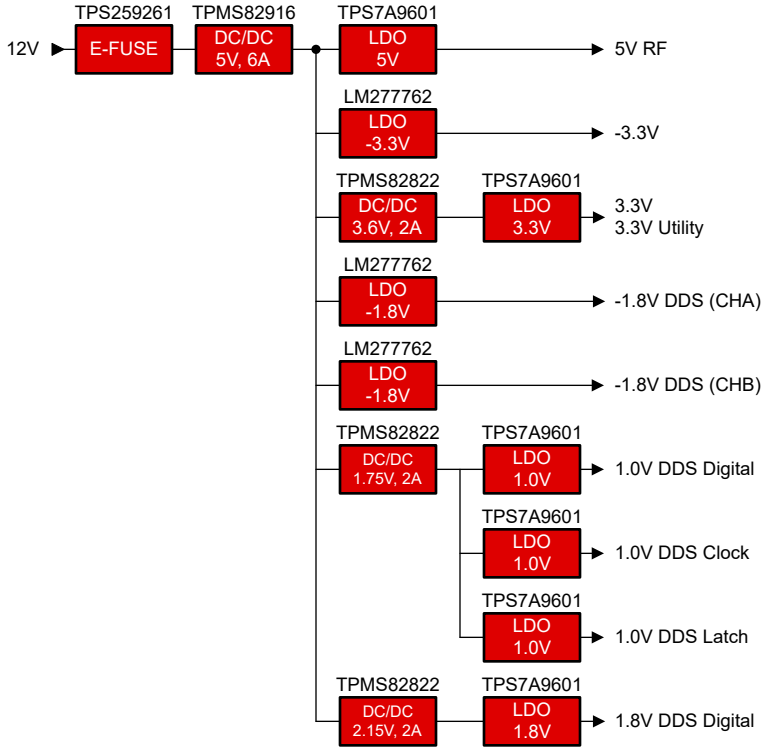


图 2-4. 电源方框图

2.2 所需设备

EVM 套件不包含以下设备，但需要该设备才能正确使用。

- 能够提供 1.5A 电流的 12V 电源。该 EVM 包含一个直流桶形插头适配器（外径 5.5mm / 内径 2.1mm，中心正极）。
- 用于射频输出的带通滤波器。TI 建议使用具有窄通带（在所需带宽的 5% 至 15% 范围内）和超小插入损耗的滤波器。
- 用于射频输出和 10MHz 基准输入/输出的 SMA 电缆（如果用于同步）。
- 用于冷却 EVM 的桌面风扇。此 EVM 的运行温度非常高，需要外部冷却系统才能正常使用。如果 EVM 未正确冷却而器件出现过热，EVM 会自行关断，直到其冷却。

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2.3 硬件设置

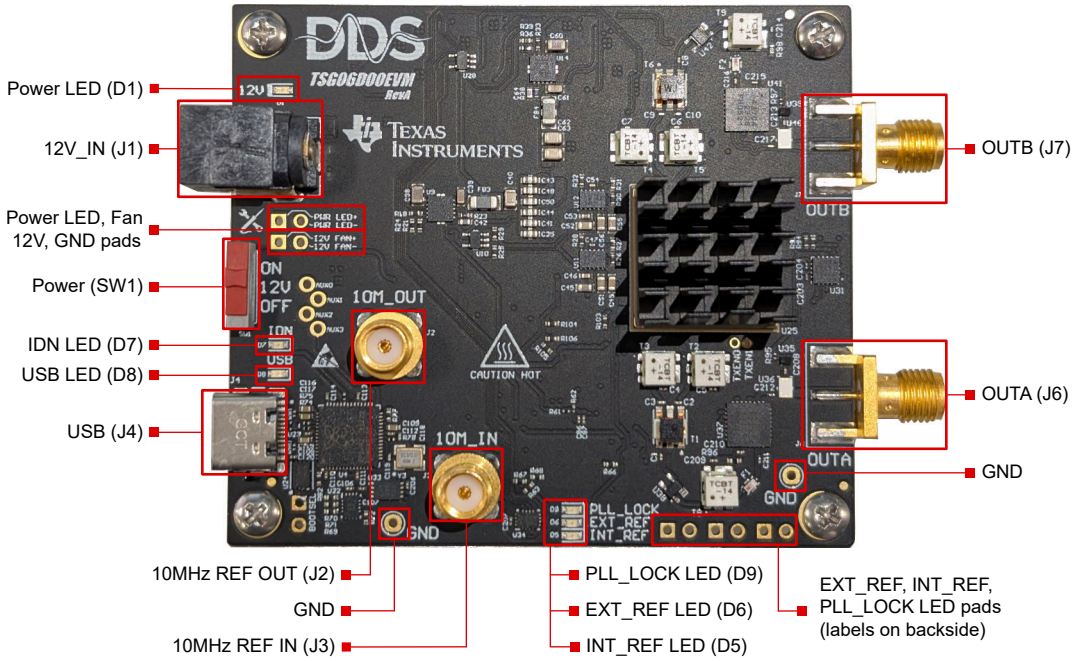


图 2-5. 电路板连接、指示器和控制

1. 连接 12V 直流电源 (J1)
   a. 请将 12V 直流电源（最小电流 1.5A）连接至 J1 接口（桶形插口，外径 5.5mm / 内径 2.1mm，中心正极）。
   b. 在连接所有电缆之前，将 SW1 保持在 OFF 位置。
2. 连接射频输出 (OUT A, OUT B)
   a. 将 50Ω SMA 电缆从 OUTA (J6) 或 OUTB (J7) 连接到仪器或受测器件 (DUT)。
   b. 在任何未使用的端口上安装 50Ω SMA 终端器。
3. 基准时钟（可选）
   a. 默认选择内部基准；无需电缆。
   b. 对于外部 10MHz：将干净源连接到 10M_IN (J3)，然后在上电后发送 ROSC:SOUR EXT。板载 TCXO 在外部模式下自动断电。
4. 为 SCPI (J4) 连接 USB
   a. 请使用 USB 2.0 线缆将 J4（USB-C）连接至主机电脑。
   b. 这只能执行 SCPI 命令。该电路板不由 USB 供电。
5. 启用板电源 (SW1)
   a. 将 SW1 切换至 ON 位置。确认 12V 电源指示灯 LED 亮起。

2.4 LED 指示灯

下表中的 LED 可用于快速检查电路板的状态。PCB 上设计了额外焊盘，用于焊接外部 LED，以便在已安装的应用或外壳中使用。

表 2-2. LED 指示灯

名称	指示符	功能	说明
12V	D1	12V 电源指示灯	当存在 12V 电源且 SW1 接通时亮起。如果此 LED 熄灭，则该电路板未通电。

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表 2-2. LED 指示灯（续）

名称	指示符	功能	说明
PWR LED+ PWR LED-	焊盘	电源 LED （外部）	用于焊接外部 LED 以指示 12V 电源（如果安装在外壳中）的焊盘。
INT_REF	D5	内部基准锁定	当仪器处于内部基准模式时，指示 LMX2820 PLL 锁定状态。 Steady = 已锁定且正常运行。
EXT_REF	D6	外部基准锁定	当仪器处于外部基准模式时，指示 LMX2820 PLL 锁定状态。 Steady = 已锁定到外部 10MHz 源。
IDN	D7	标识	接收到 *IDN? 查询时亮起。用于确定工作台上哪个电路板正在响应 USB 命令。
USB	D8	USB	USB 5V 电源指示灯
PLL_LOCK	D9	PLL 锁定指示器	指示 LMX2820 PLL 锁定状态。Steady = 已锁定且正常运行。
PLL_LOCK LED+ PLL_LOCK LED-	焊盘	PLL 锁定指示器（外部）	用于焊接 PLL_LOCK 的外部 LED（如果安装在外壳中）的焊盘。
INT_REF LED+ INT_REF LED-	焊盘	内部基准锁定（外部）	用于焊接 INT_REF 的外部 LED（如果安装在外壳中）的焊盘。
EXT_REF LED+ EXT_REF LED-	焊盘	外部基准锁定 （外部）	用于焊接 EXT_REF 的外部 LED（如果安装在外壳中）的焊盘。

2.5 输入、输出和控制

表 2-3 中的输入、输出和控制在电路板上可用。

表 2-3. 输入、输出和控制

名称	指示符	连接器	方向	说明
12V_IN	J1	桶形插孔	输入	12V 直流电路板电源。正中心，最小 1.5A。连接电源后，电路板的电源由 SW1 进行开关。
风扇 （外部）	12V FAN+ 12V FAN-	焊盘	输出	12V 直流和 GND 连接器，用于焊接外部风扇（如果安装在外壳中）。
USB	J4	USB 2.0 Type-C	控制	仅限 SCPI 命令界面。枚举为 USB-TMC (VID 0x2E8A, PID 0x1107)。请勿向电路板提供电源。
10M_OUT	J2	SMA 母头	输出	10MHz 基准输出。可用于菊花链或外部仪器的缓冲基准信号。
10M_IN	J3	SMA 母头	输入	外部 10MHz 基准输入。
OUTA	J6	SMA 母头	输出	通道 A 主射频输出。 如果未使用，则终止。
OUTB	J7	SMA 母头	输出	通道 B 主射频输出。通道 A 的信号链相同。如果未使用，则端接。

小心

在高射频功率等级下，启用电源的未端接 SMA 输出是不良做法，它可能会给输出级带来压力并意外辐射。在任何未使用的输出上安装 50Ω SMA 终端，或在该通道上发送 OUTP 0 命令。

2.6 USB 接口

TSG06D00EVM 作为 USB 测试和测量类 (USBTMC) 器件进行枚举。任何与 VISA 兼容的软件都可以自动检测 USBTMC。

以下 Python 示例通过 USB 读回供应商 ID 和产品 ID。

```
# pip install pyvisa pyvisa-py
import pyvisa
import time
```


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```
rm = pyvisa.ResourceManager()
# Filter by TI USB VID 0x2E8A, PID 0x1107
matches = [r for r in rm.list_resources() if '2E8A'in r]
if not matches:
    raise RuntimeError('TSG06D00EVM not found - check 12V power and USB cable')
sg = rm.open_resource(matches[0])
sg.timeout = 5000

print(sg.query('*IDN?'))
    Texas\sInstruments,TSG06D00EVM,3XVhZkw5942P4x73,v0.9.2
```

表 2-4. USB 参数

参数	值	说明
USB VID	0x2E8A	供应商 ID - 德州仪器 (TI)
USB PID	0x1107	产品 ID - 德州仪器 (TI)USB-TMC SCPI 接口
器件类别	USB-TMC	USBTMC 488.2
建议的超时	5000ms	校准扫描可能需要几秒钟时间
终端器	\n	以换行符结尾的响应

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3 软件

3.1 所需软件

可以使用提供的 GUI 来控制硬件，也可以通过 SCPI 命令直接控制硬件。Python 用作脚本控制的示例。请通过 TI.com 上的 TSG06D00EVM 工具页面下载并安装最新的 GUI 软件。

- TSG06D00EVM-GUI
- Python

3.2 GUI 安装

1. 下载并安装最新的 GUI 软件。

备注

始终建议在此器件中使用最新的固件。可在 ti.com.cn 上查找最新版本的 GUI。

要更新已安装的 GUI 的固件，请执行以下操作：

1. 选择*文件*。
2. 选择*固件更新*。



3. 选择*电路板和最新固件*。
4. 选择*更新*。

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4 实现结果

4.1 评估设置

1. 按节 2.3 中所述连接硬件。
2. 启动 GUI 软件，软件将自动检测所连接的硬件。
3. 使用 GUI 控制射频输出的输出状态、频率、相位和振幅，以及是否使用板载基准或外部基准。
   a. 命令行界面可用于使用技术参考手册中指定的 SCPI 命令来实现硬件的高级控制。

4.2 SCPI 控制示例

首次上电后使用与 SCPI 兼容的终端运行这些命令，以验证电路板是否正常运行，然后再继续操作。技术参考手册中提供了更多命令。

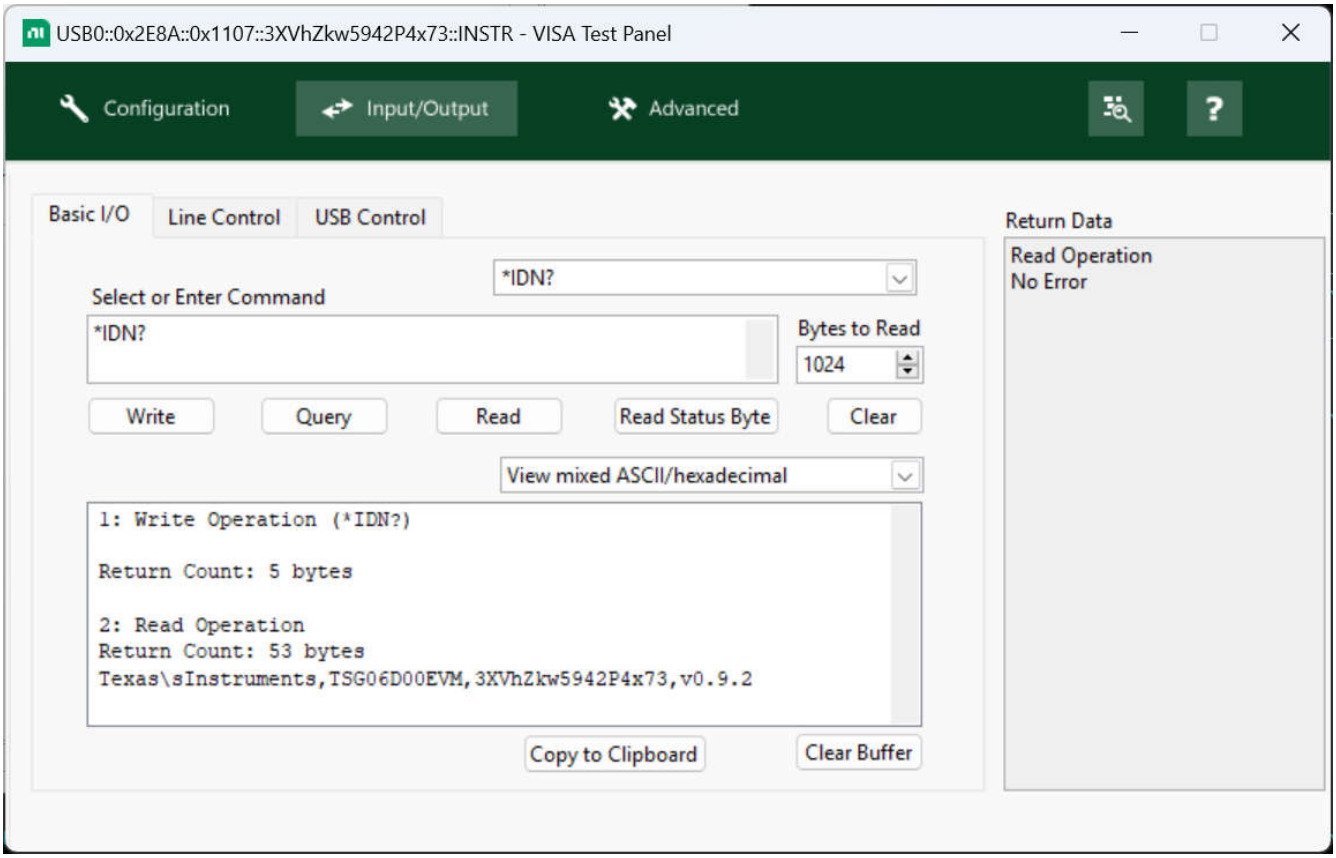


图 4-1. SCPI 兼容终端

```
# 1. Identify the instrument
*IDN?
  Texas\sInstruments,TSG06D00EVM,3XVhZkw5942P4x73,v0.9.2
# 2. Run built-in self-test
*TST?
  PASS
# 3. Check error queue is empty
SYST:ERR:COUNT?
  0
# 4. Select Channel A and set to 1GHz, -5dBm, 0deg phase
INST:NSEL 1
FREQ 1e9
POW -5.0
PHAS 0.0
# 5. Enable output and measure
OUTP 1
POW?
```


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```
  -5.23
# 6. Disable output when done
OUTP 0
```

备注

*TST? 返回 PASS，而 POW? 返回一个可信的 dBm 读数。如果电源读数意外，请先运行输出校准。

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4.3 Python 脚本示例

使用下列 python 脚本示例直接控制电路板，而无需 GUI。技术参考手册中提供了更多命令。

```
# pip install pyvisa pyvisa-py
import pyvisa
import time

rm = pyvisa.ResourceManager()
matches = [r for r in rm.list_resources() if '2E8A' in r]
if not matches:
    raise RuntimeError('TSG06D00EVM not found - check 12V power and USB cable')
sg = rm.open_resource(matches[0])
sg.timeout = 5000
print(sg.query('*IDN?'))
assert sg.query('*TST?').strip() == 'PASS', 'Self-test failed'
sg.write('SYST:ERR:CLEAR')

# Set 10MHz Reference to Internal
sg.write('ROSC:SOUR INT')
print(f"Reference Mode: {sg.query('ROSC:SOUR?')}")

# Configure CH A - 1GHz, -5dBm, 0° Phase
sg.write('INST:NSEL 1')
sg.write('FREQ 1e9')
sg.write('POW -5')
sg.write('PHAS 0.0')
sg.write('OUTP 1')
time.sleep(0.1)

# Readback State of CH A
freq_a =float(sg.query('FREQ?'))
power_a =float(sg.query('POW?'))
phase_a =float(sg.query('PHAS?'))
output_a =float(sg.query('OUTP?'))
print(f"Channel A:")
print(f" Frequency: {freq_a/1e9:.4f} GHz")
print(f" Power: {power_a:.2f} dBm")
print(f" Phase: {phase_a} deg")
print(f" Output: {'ON'if output_a else'OFF'}")

# Configure CH B - 2.4GHz, -10dBm, +90° Phase
sg.write('INST:NSEL 2')
sg.write('FREQ 2.4e9')
sg.write('POW -10')
sg.write('PHAS 90.0')
sg.write('OUTP 1')
time.sleep(0.1)

# Readback State of CH B
freq_b =float(sg.query('FREQ?'))
power_b =float(sg.query('POW?'))
phase_b =float(sg.query('PHAS?'))
output_b =float(sg.query('OUTP?'))
print(f"Channel B:")
print(f" Frequency: {freq_b/1e9:.4f} GHz")
print(f" Power: {power_b:.2f} dBm")
print(f" Phase: {phase_b} deg")
print(f" Output: {'ON'if output_b else'OFF'}")

# Check for Errors
if int(sg.query('SYST:ERR:COUNT?')) >0:
    print('Error:', sg.query('SYST:ERR:NEXT?'))

# Uncomment lines below to disable both channels when done
# sg.write('INST:NSEL 1')
# sg.write('OUTP 0')
# sg.write('INST:NSEL 2')
# sg.write('OUTP 0')
# sg.close()
```


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4.4 功率组合

两个通道可进行相干合成，在一种频率下实现约 6dB 的输出功率提升。这要求两个通道都处于相同的工作范围内。

1. 将 OUT A 和 OUT B 连接到 Wilkinson 组合器、混合耦合器或等效 50Ω 组合器的两个输入端口。对两个端口使用匹配的电缆长度。将频谱分析仪或功率计连接到组合器输出。
2. 将两个通道转换为相同的频率并启用两个输出。
3. 将通道 A 相位设置为 0 度：INST:NSEL 1，然后是 PHAS 0。通道 A 是基准。
4. 选择通道 B (INST:NSEL 2) 并在监控组合器输出功率时扫描其相位。当两个信号同相到达组合器时，组合功率达到峰值。预计比任一通道高大约 6dB。如果扫描得太远，信号会开始抵消，功率会下降。

SCPI 命令：

```
# Channel A - reference, phase = 0
INST:NSEL 1
FREQ 1e9
POW 5.0
PHAS 0
OUTP 1
# Channel B - sweep phase until combined power peaks
INST:NSEL 2
FREQ 1e9
POW 5.0
OUTP 1
PHAS 0    # adjust until POW? peaks
```

在调节通道 B 的相位时，可使用通道 A 的 POW? 功能监测板载耦合检波器。为获得最佳精度，建议在合成器输出端使用外部功率计，因为板载检波器一次仅能检测一个通道的信号。

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5 硬件设计文件

硬件设计文件可从 TI.com 上的 TSG06D00EVM 工具页面下载。

5.1 原理图

原理图可从 TI.com 上的 TSG06D00EVM 工具页面下载。

5.2 PCB 布局

PCB 布局文件可从 TI.com 上的 TSG06D00EVM 工具页面下载。

5.3 物料清单 (BOM)

物料清单可从 TI.com 上的 TSG06D00EVM 工具页面下载。

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6 其他信息

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7 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (June 2026) to Revision A (September 2026)	Page
• 在*所需设备* 部分添加了桌面风扇冷却 EVM 的要点	5
• 在 *GUI 安装* 部分添加了内容和图示	9

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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 DEGREDATION 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 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/lsds/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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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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:*

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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.

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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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