EVM User's Guide: LMK6BEVM

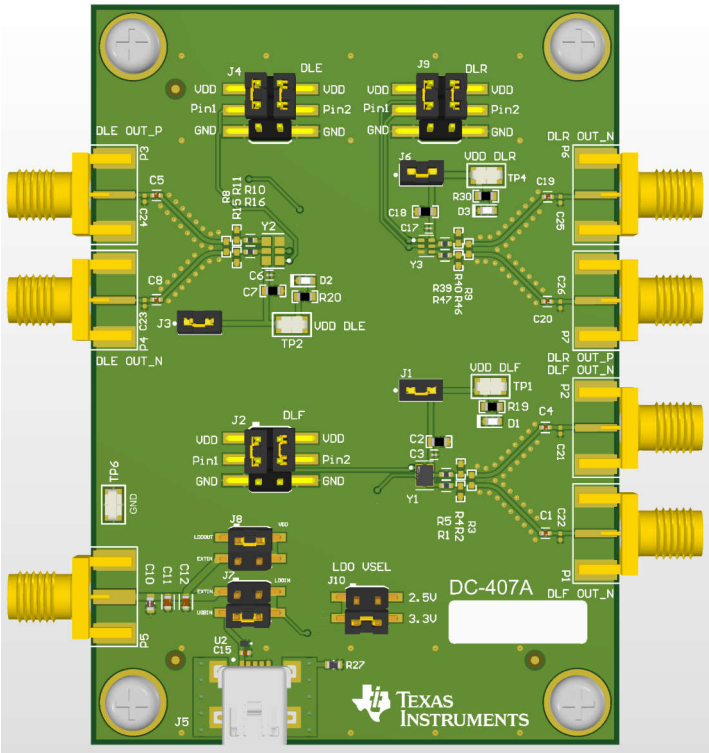
LMK6B 评估模块

1 说明

LMK6BEVM 提供了完整的评估平台，用于评估德州仪器 (TI) LMK6B 超低抖动高性能 BAW 振荡器系列的时钟性能和灵活性。该 EVM 可用作合规性测试、性能评估和初始系统原型设计的灵活时钟源。板载边缘安装 SMA 端口用于访问 LMK6B 的可配置时钟输出，使器件可以使用市售同轴电缆、适配器或平衡-非平衡变压器（不包含）与测试设备和参考板相连接。

2 特性

- 包含三种标准 6 引脚振荡器封装的尺寸：DLE (3.2mm × 2.5mm)、DLF (2.5mm × 2.0mm) 和 DLR (2.0mm × 1.6mm)
- 板载稳压器，可生成标准电源电压（2.5V、3.3V）
- 可仅通过 USB 供电，可选择外部电源



LMK6BEVM 评估板

3 评估模块概述

3.1 简介

LMK6B 是一款采用 TI BAW 技术的超高性能时钟振荡器。LMK6B 提供三种封装尺寸：DLE (3.2mm × 2.5mm)、DLF (2.5mm × 2.0mm) 和 DLR (2.0mm × 1.6mm)。所有三种封装都包含在 EVM 上，具有独立的端接网络。默认情况下，LMK6BEVM 组装 LMK6B 的 625MHz AC-LVPECL 型号，采用 DLF 封装尺寸 (Y1)。DLE 和 DLR 封装未组装，因此用户可以焊接所需的频率型号进行评估。

LMK6B 完全通过 USB 和板载稳压器供电。也可以使用外部电源进行评估。

要开始评估 LMK6B BAW 振荡器，请使用匹配的 SMA 同轴电缆对将时钟输出连接到示波器或相位噪声分析仪等测试设备，或将输出直接用作另一块参考板的时钟源。

3.2 套件内容

包装箱内包含：

- 一个 LMK6BEVM 板 (DC407A)

3.3 规格

- 支持 50MHz 至 2.5GHz 的标准频率
- ±20ppm 总频率稳定性，包含所有因素（包括 10 年老化影响）
- 超低抖动：Fout = 625MHz 时，最大 RMS 抖动为 35fs
- 工作温度范围为 –40°C 至 +85°C

4 实现结果

4.1 评估设置要求

评估需要以下硬件：

- 直流电源或 USB 电源
- 示波器
- 信号分析器（可选）

4.2 设置

4.2.1 连接图

图 4-1 显示了 LMK6BEVM 连接图。电路板的顶部区域包含适用于每种封装尺寸的三个区域。每个区域都包含一个用于组装 LMK6B 振荡器（Y1、Y2、Y3）的空间，一个用于将振荡器引脚 1 和 2 拉高或拉低的跳线（J2、J4、J9）以及一个带有 SMA 连接器（P1-P4、P6、P7）的输出端接网络。

电路板的左下区域包含用于配置电源网络的跳线。使用随附的 USB 电缆或连接到 EXTIN SMA 连接器 (P5) 的外部电源提供输入电源。

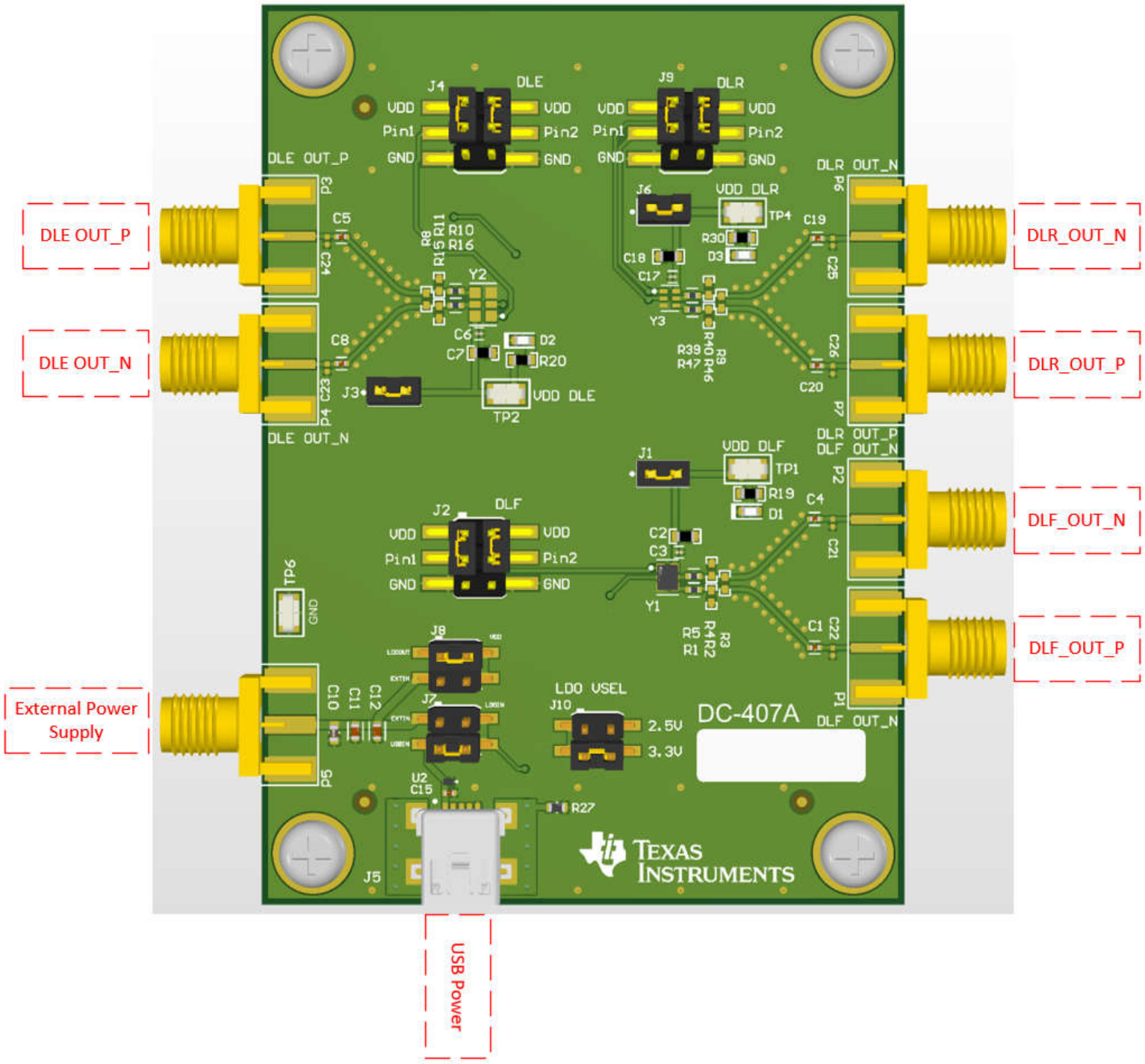


图 4-1. 连接图

4.2.2 电源

根据下表设置跳线。

表 4-1. 电源跳线配置

输入源	电压稳压器	J7 上要短接的引脚	J8 上要短接的引脚
5V USB	LDO	3-4	1-2
EXTIN	LDO	1-2	1-2
	旁路	开路	3-4

要使用板载稳压器，请向 EXTIN SMA 连接器 (P5) 施加介于 3.6V 到 5V 之间的电压，或使用微型 USB 连接器提供 5V 电压。稳压器根据 J10 的跳线选择为 LMK6B 器件提供 2.5V 或 3.3V 电压。

要旁路板载稳压器并直接使用外部电源，请移除 J7 的跳线，并短接 J8 上的引脚 3-4。

4.2.3 时钟输出

要测试 Y1 的时钟输出，请将 P1 和 P2 SMA 连接器连接到示波器或相位噪声分析仪。同样，要测试 Y2 或 Y3 的时钟输出，请将 P3-P4 或 P6-P7 分别连接到示波器或相位噪声分析仪。

4.2.4 EVM 接头配置

表 4-2 总结了 EVM 接头配置，用于连接并为各个器件的 VDD 域供电；此外，还根据所组装的器件，连接到各个输出使能 (OE)、待机 (ST) 或频率选择 (FSEL) 引脚。

表 4-2. EVM 接头配置

元件	名称	说明
J7、J8	VDD	**VDD 电源电压源** J7：连接引脚 3-4（默认） J8：连接引脚 1-2（默认） 默认情况下，VDD 由 USB 电源和板载 LDO 供电。 有关更多详细信息，请参阅表 4-1。
J10	VDD_Reg	**VDD_Reg 电压电平** 连接引脚 3-4（默认）：选择 VDD = 3.3V 连接引脚 1-2：选择 VDD = 2.5V
J2、J4、J9	振荡器引脚 1 和 2（OE 和 FSEL）	**振荡器引脚 1 (OE)** 连接引脚 1-3（默认）：将 LMK6B OE 拉至 VDD，时钟输出使能 连接引脚 3-5：将 LMK6B OE 拉至 GND，时钟输出禁用 **振荡器引脚 2 (FSEL)** 连接引脚 2-4（默认）：将 LMK6B FSEL 拉至 VDD，输出频率 = 312.5MHz 连接引脚 4-6：将 LMK6B FSEL 拉至 GND，输出频率 = 156.25MHz 跳线已移除：LMK6B FSEL 内部偏置为中间电平，输出频率 = 625MHz

4.2.5 配置输出时钟终端

LMK6BEVM 预装了一个交流耦合终端，专为 LP-HCSL、LVDS、AC-LVPECL 和自定义摆幅输出格式而设计。对于 LVDS、AC-LVPECL 和自定义摆幅输出类型，使用 100Ω 差分终端来端接输出。如果输出为交流耦合，则使用连接到偏置电压的 50Ω 电阻端接 P 和 N 沟道，以设置所需的共模电压。

对于 LP-HCSL，输出可以与高阻抗负载连接，以提供全信号摆幅。与传统的 HCSL 驱动器不同，它无需外部端接电阻器。

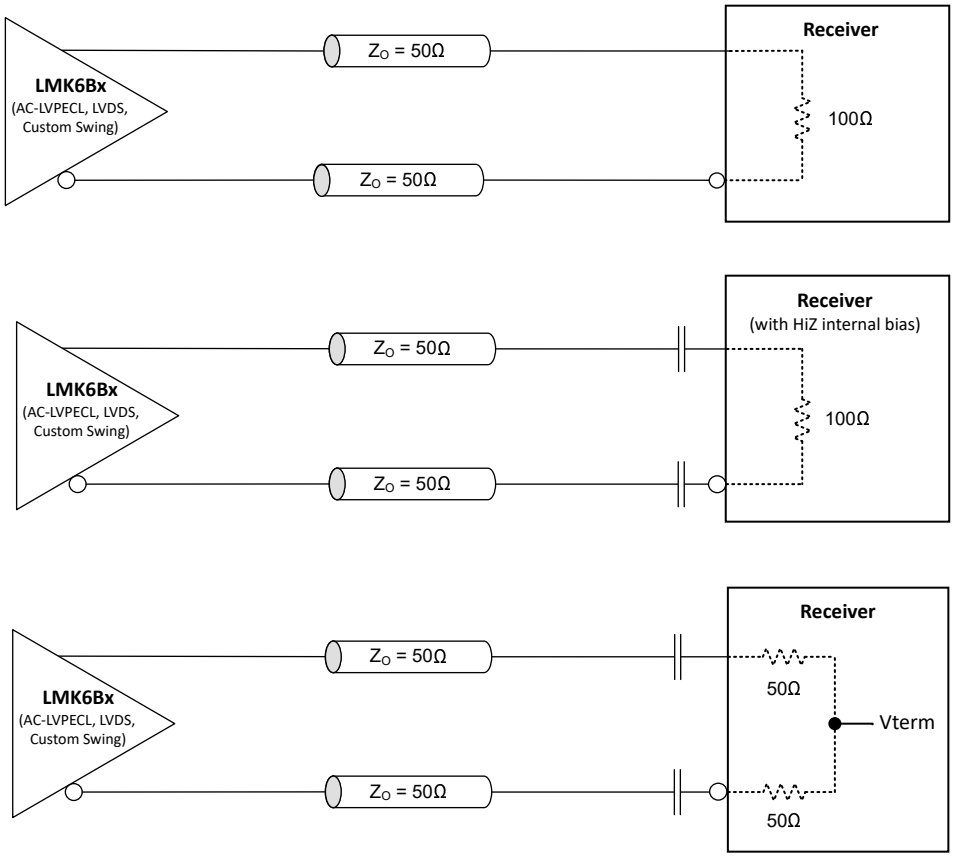


图 4-2. AC-LVPECL、LVDS 和自定义摆幅输出终端

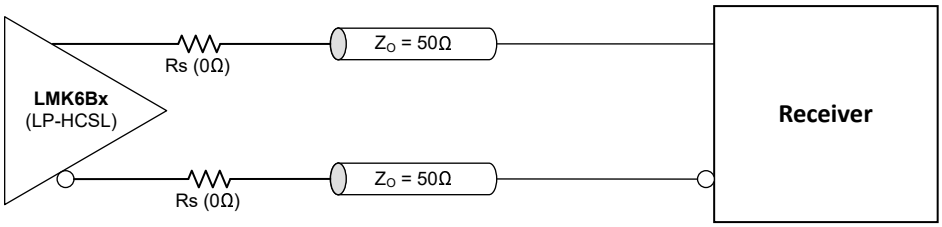


图 4-3. LP-HCSL 输出端接

4.3 性能数据和结果

4.3.1 典型测量

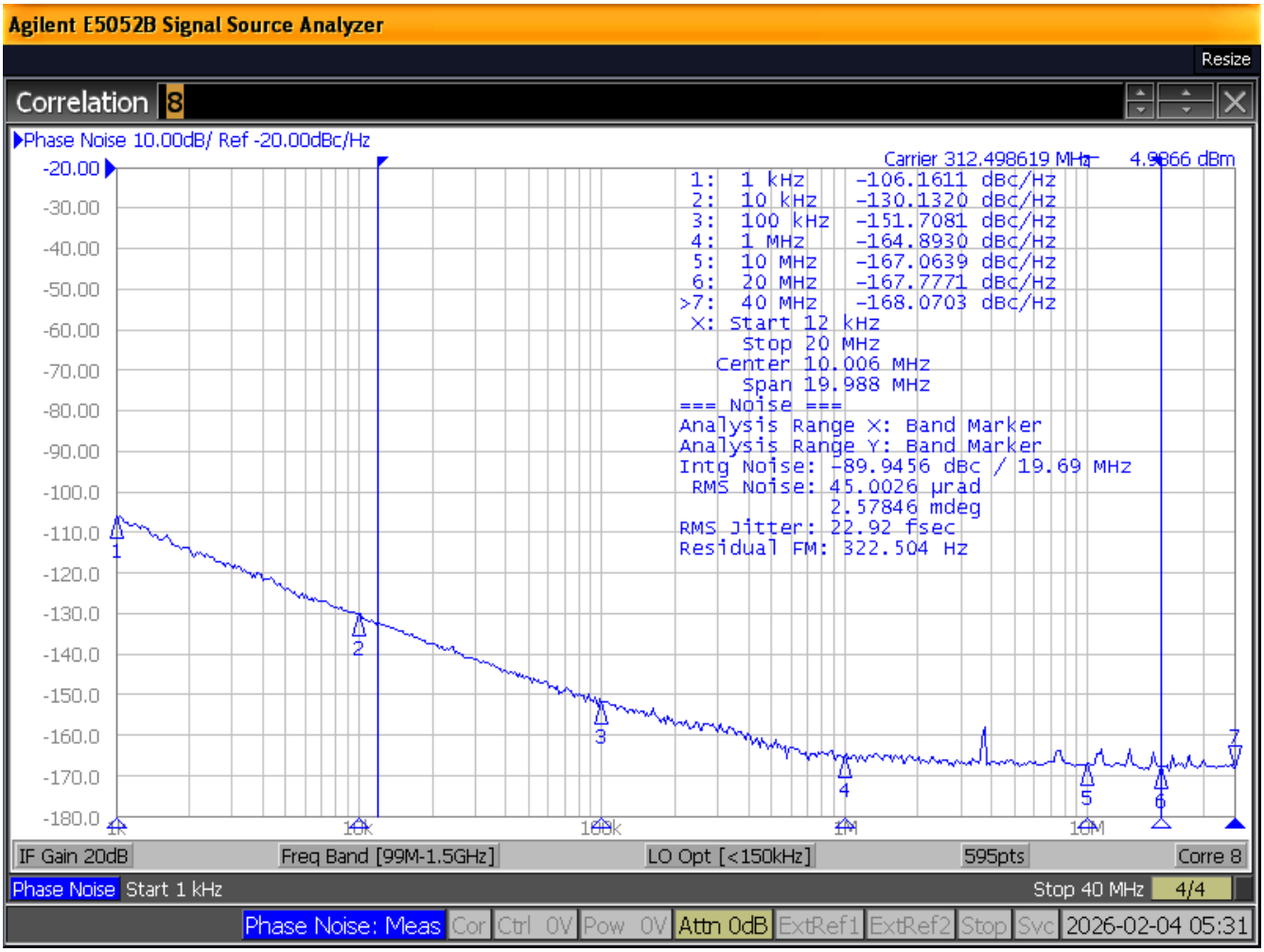


图 4-4. 312.5MHz LMK6B 型号的相位噪声图

5 硬件设计文件

5.1 原理图

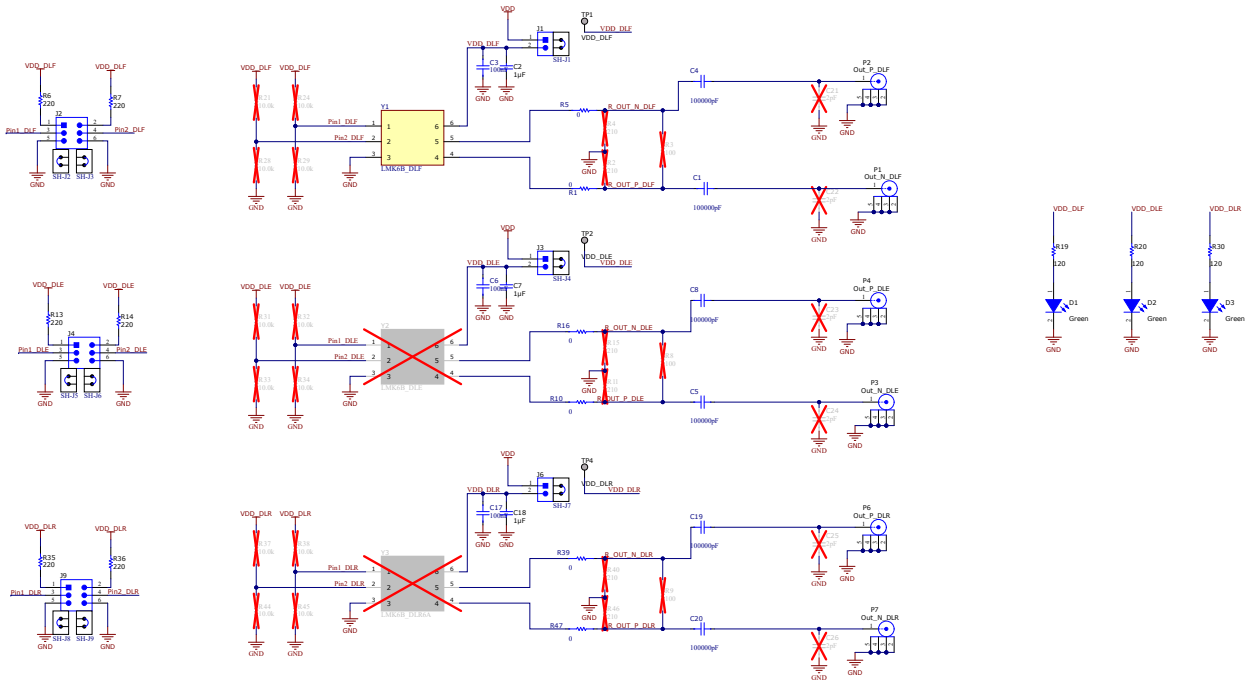


图 5-1. 原理图 - LMK6B 振荡器

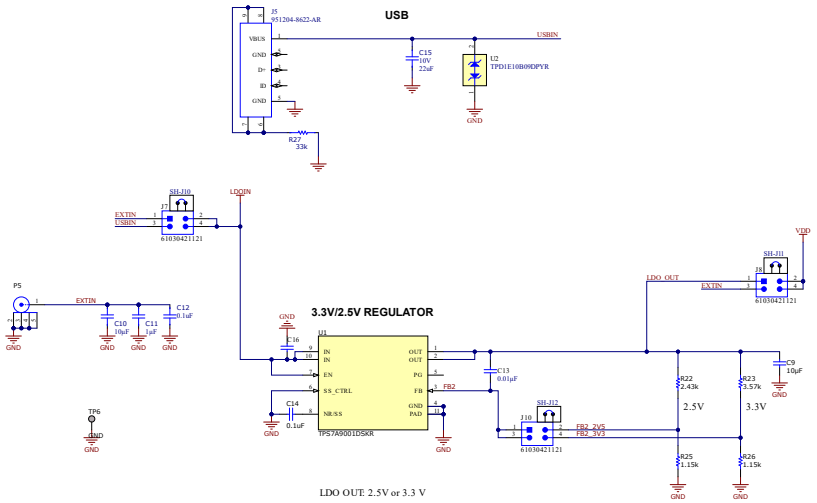


图 5-2. 原理图 - 电源

5.2 PCB 布局和层堆叠

5.2.1 PCB 层堆叠

#	Name	Material	Type	Weight	Thickness	Dk
	Top Overlay		Overlay			
	Top Solder	Solder Resist	Solder Mask		0.4mil	4
1	Top Layer		Signal	1oz	1.4mil	
	Dielectric 1	MT40	Prepreg		10mil	3.45
2	Int1 (GND)		Signal	1oz	1.4mil	
	Dielectric 2	FR4	Core		32.87mil	4.8
3	Int2 (PWR)		Signal	1oz	1.4mil	
	Dielectric 3	MT40	Prepreg		10mil	3.45
4	Bottom Layer		Signal	1oz	1.4mil	
	Bottom Solder	Solder Resist	Solder Mask		0.4mil	4
	Bottom Overlay		Overlay			

图 5-3. PCB 层堆叠

5.2.2 PCB 布局

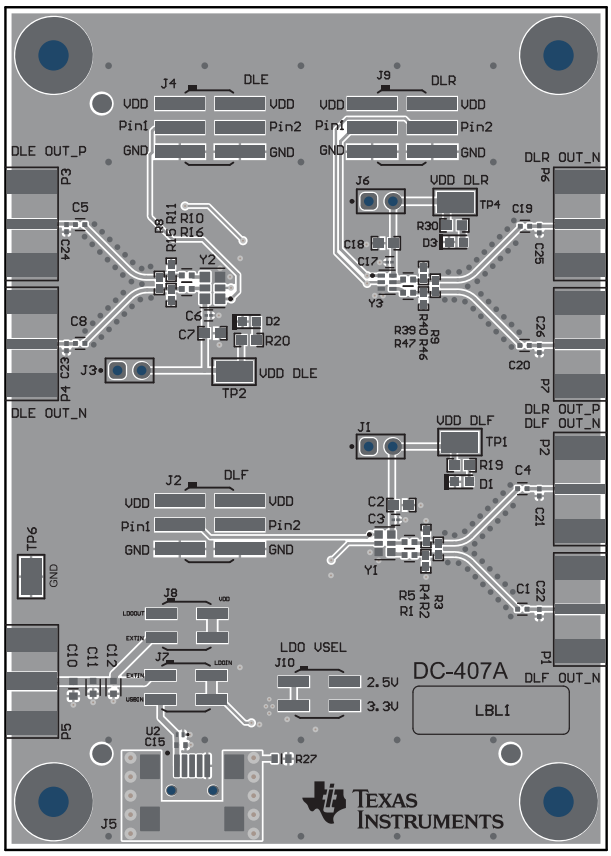


图 5-4. 顶视图组合

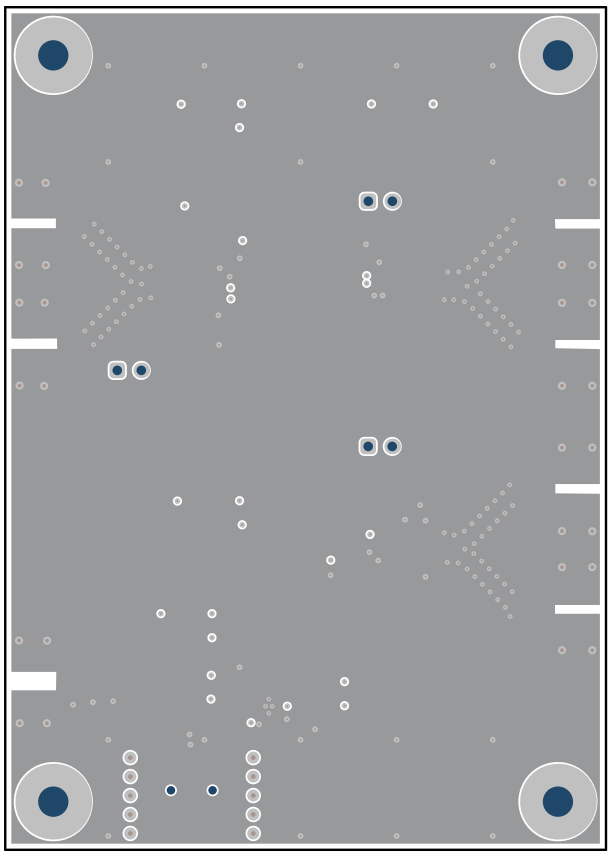


图 5-5. GND 层

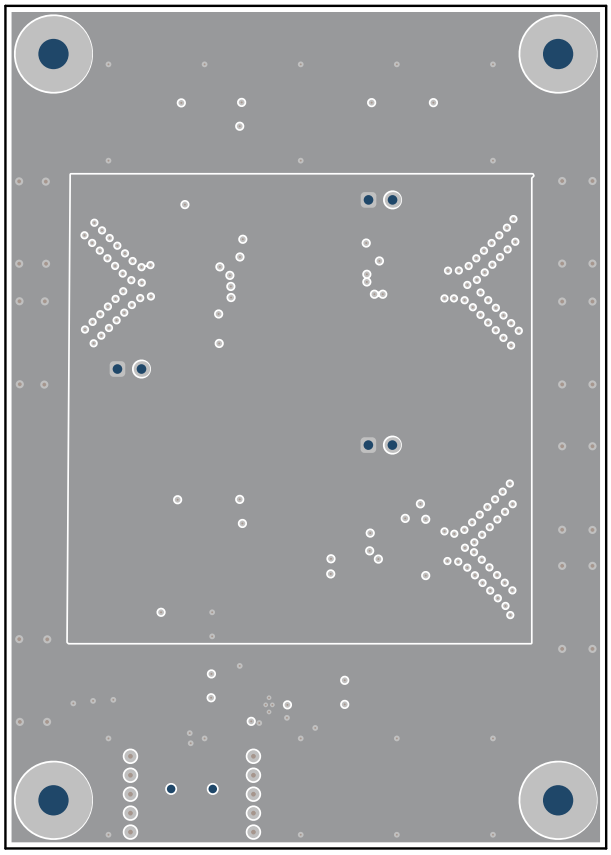


图 5-6. PWR 层

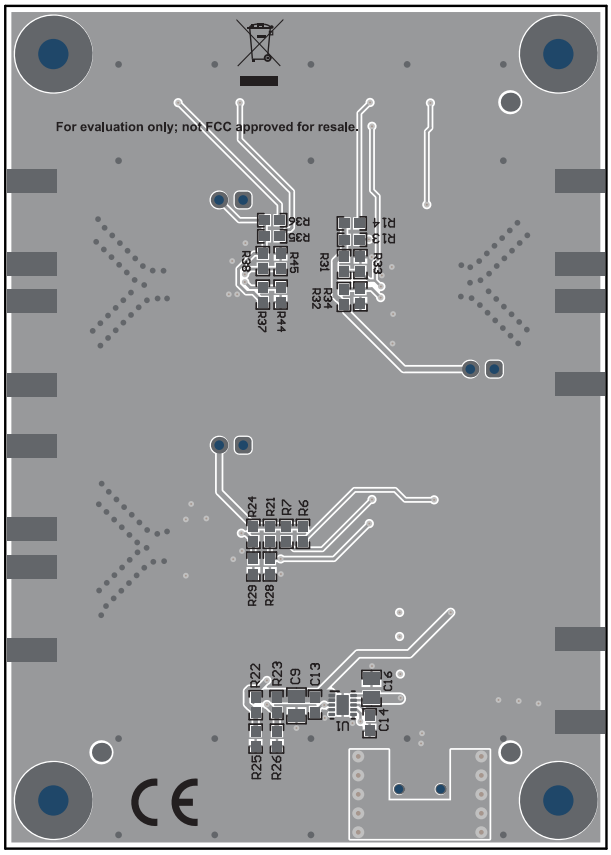


图 5-7. 底视图 (复合)

5.3 物料清单 (BOM)

物料清单

位号	说明	制造商	器件型号	数量
C1、C4、C5、C8、C19、C20	0.1µF ±10% 10V 陶瓷电容器 X7R 0402（公制 1005）	Wurth Electronics	8.85012E+11	6
C2、C7、C18	电容，陶瓷，1µF，16V，+/-10%，X7R，AEC-Q200 1 级，0603	TDK	CGA3E1X7R1C105K080AC	3
C3、C6、C17	0.1µF ±10% 16V 陶瓷电容 0201（公制 0603）	Passive Plus	0201BB104KW160	3
C9、C16	电容，陶瓷，10µF，16V，+/-20%，X7R，0805	Taiyo Yuden	EMK212BB7106MG-T	2
C10	10µF ±20% 25V 陶瓷电容器 X5R 0603（公制 1608）	Murata Electronics	ZRB18AR61E106ME01L	1
C11	1µF ±10% 16V 陶瓷电容器 X7S 0603（公制 1608）	Murata	GRM188C71C105KA12D	1
C12	0.1µF ±10% 16V 陶瓷电容器 X7R 0603（公制 1608）	Murata Electronics North America	GCJ188R71C104KA01D	1
C13	电容，陶瓷，0.01µF，25V，+/-1%，C0G/NP0，0603	Kemet	C0603C103F3GACTU	1
C14	电容，陶瓷，0.1µF，16V，+/-5%，X7R，0603	Kemet	C0603C104J4RACTU	1
C15	通用片状多层陶瓷电容器，0402，22uF，X5R，15%，20%，10V	Murata	GRM158R61A226ME15D	1
D1、D2、D3	LED，绿色，SMD	Lite-On	LTST-C190GKT	3
H1、H2、H3、H4	机械螺钉，圆头，#4-40 x 1/4，尼龙，飞利浦盘形头	B&F Fastener Supply	NY PMS 440 0025 PH	4
H5、H6、H7、H8	六角螺柱，0.5"L #4-40，尼龙	Keystone	1902C	4
J1、J3、J6	接头，100mil，2x1，金，TH	Samtec	TSW-102-07-G-S	3
J2、J4、J9	接头，2.54mm，3x2，金，黑色，SMT	Sullins Connector Solutions	GBC03DABN-M30	3
J5	连接器，插口，Mini-USB Type B，R/A，顶部安装 SMT	TE Connectivity	1734035-2	1
J7、J8、J10	接头，2.54mm，2x2，金，SMT	Wurth Elektronik	61030421121	3
P1、P2、P3、P4、P5、P6、P7	连接器，末端发射 SMA，50Ω，SMT	Cinch Connectivity	142-0701-851	7
R1、R5、R10、R16、R39、R47	电阻厚膜，0Ω，0.2W，0402	Vishay Dale	CRCW04020000Z0EDHP	6
R6、R7、R13、R14、R35、R36	电阻，220，5%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	CRCW0603220RJNEA	6
R19、R20、R30	电阻，120，5%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	CRCW0603120RJNEA	3
R22	电阻，2.43k，1%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	CRCW06032K43FKEA	1
R23	电阻，3.57k，1%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	CRCW06033K57FKEA	1
R25、R26	电阻，1.15k，1%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	CRCW06031K15FKEA	2
R27	33kΩ ±0.1% 0.1W，1/10W 片上电阻器 0603（1608 公制），汽车 AEC-Q200 薄膜	Panasonic	ERA-3AEB333V	1

位号	说明	制造商	器件型号	数量
SH-J1、SH-J2、SH-J3、SH-J4、SH-J5、SH-J6、SH-J7、SH-J8、SH-J9、SH-J10、SH-J11、SH-J12	分流器，100mil，镀金，黑色	Samtec	SNT-100-BK-G	12
TP1、TP2、TP4、TP6	测试点，微型，SMT	Keystone	5019	4
U1	500mA 高精度、低噪声、低压降 (LDO) 稳压器，DSK0010A (WSON-10)	德州仪器 (TI)	TPS7A9001DSKR	1
U2	具有 10pF 电容、击穿电压为 9V、采用 0402 封装的单通道 ESD，DPY0002A (X1SON-2)	德州仪器 (TI)	TPD1E10B09DPYR	1
Y1	LMK6B_DLF	德州仪器 (TI)	LMK6BPK625000FDLFR	1
C21、C22、C23、C24、C25、C26	陶瓷电容 2pF 50V C0G ±0.1pF SMD 0402 +125°C 纸质 T/R	Samsung	CL05C020BB5NNNC	0
FID1、FID2、FID3	基准标记。没有需要购买或安装的元件。	不适用	不适用	0
R2、R4、R11、R15、R40、R46	电阻，210，1%，0.063W，AEC-Q200 0 级，0402	Vishay-Dale	CRCW0402210RFKED	0
R3、R8、R9	电阻，100，1%，0.125W，AEC-Q200 1 级，0402	AT Ceramics	ATC504L1000FTNCFT	0
R21、R24、R28、R29、R31、R32、R33、R34、R37、R38、R44、R45	电阻，10.0k，1%，0.1W，0603	Yageo	RC0603FR-0710KL	0
Y2	LMK6B_DLE	德州仪器 (TI)	LMK6B_DLE	0
Y3	LMK6B_DLR6A	德州仪器 (TI)	LMK6B_DLR6A	0

6 其他信息

商标

所有商标均为其各自所有者的财产。

7 相关文档

有关 LMK6B 器件的更多信息，请参阅 LMK6Bx 超低抖动高性能 BAW 振荡器数据表。

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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

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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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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。
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。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

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:*

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, INDEMITY 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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最后更新日期：2025 年 10 月