EVM User's Guide: TMCS1170EVM

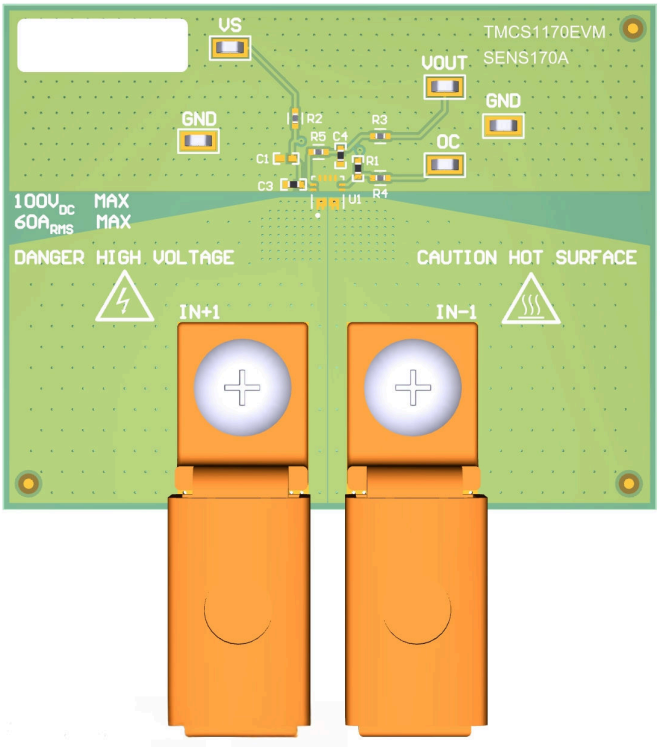
TMCS1170 评估模块

说明

TMCS1170EVM 评估模块 (EVM) 旨在方便使用隔离霍尔效应精密电流传感器 TMCS1170。该 EVM 允许用户在测量隔离输出的同时，通过霍尔输入侧推动最大工作电流。

特性

- TMCS1170 评估
- 测试点支持轻松访问器件引脚
- 采用较大铜平面来帮助散热
- 采用较大接线片连接器以将 EVM 连接到较大载流导线



1 评估模块概述

1.1 简介

本用户指南介绍了 TMCS1170 评估模块 (EVM) 的特性、运行和使用。本 EVM 旨在评估 TMCS1170 电压输出隔离式霍尔效应电流检测放大器在各种配置下的性能。此电路板布局并非是目标电路的模型，也并非专门用于电磁 (EMI) 测试。但是，这些封装支持为嘈杂环境实施滤波器。TMCS1170 的这款 EVM 没有填充 TMCS1170，可用于任何 TMCS1170 型号。因此，用户可以测试单个静态点的所有灵敏度变化（A = 2.5V、B = 1.65V 或 C = 0.5V）。本文档中的评估板、评估模块和 EVM 等术语指的是 TMCS1170EVM。本文档包括原理图、参考印刷电路板 (PCB) 布局和完整的物料清单 (BOM)。

TMCS1170 霍尔效应电流检测放大器（也称为隔离式电流检测放大器），可在独立于电源电压的 $0V_{DC}$ 至 $\pm100V_{DC}$ 共模电压下检测通过引线框的电流产生的磁通量，并具有功能型隔离功能。该器件有 A=2.5V、B=1.65V 或 C=0.5V 的零输入参考点配置，有五个固定灵敏度可供选择：44mV/A、66mV/A、80mV/A、132mV/A 和 200mV/A。这些器件由 3V 至 5.5V 单电源供电，随温度变化的最大电源电流为 8mA。

1.2 套件内容

表 1-1 列出了 TMCS1170EVM 套件的内含物。如果缺少任何元件，请与离您最近的德州仪器 (TI) 客户支持中心联系。TI 强烈建议查看 TI 网站 www.ti.com 上的 TMCS1170 系列产品文件夹，了解有关该产品的更多信息。

表 1-1. TMCS1170EVM 套件内容

条目	数量
TMCS1170EVM 测试板	1

1.3 规格

以下是用以设置和使用 TMCS1170EVM 的说明。图 1-1 所示为 A4F (66mV/A) 灵敏度型号上的简单低侧设置示例。此器件可提供隔离，外部电源按*高电压* (HV)（对于负载）和*低电压* (LV)（对于 DUT 电源）加以区分。HV 电源可以隔离，并具有与 LV 电源不同的电位。

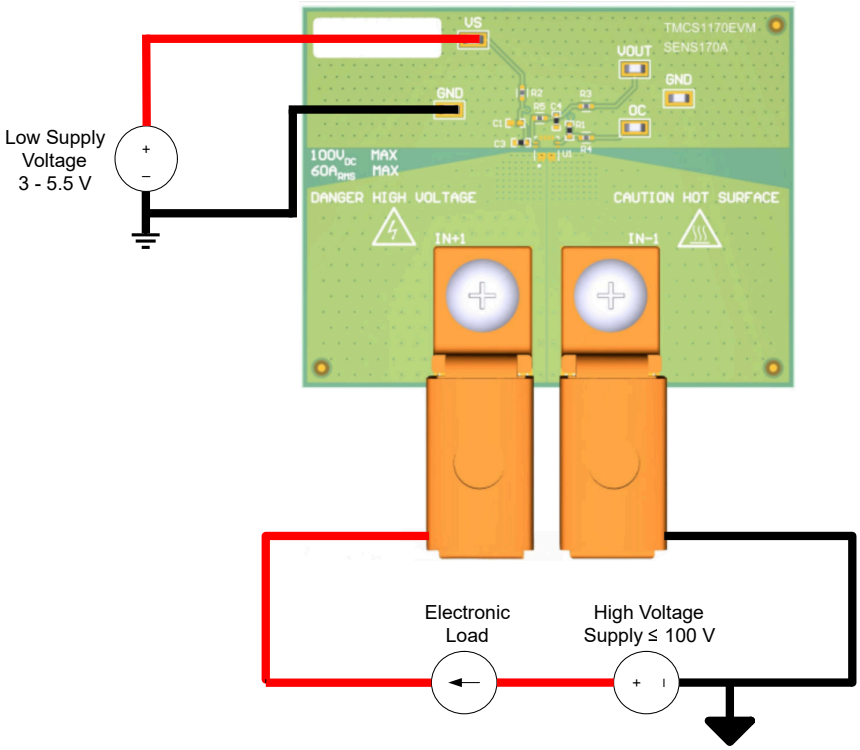


图 1-1. 用于功能隔离的低侧正向电流设置

1. 将大电流接线片连接器连接到要测试的灵敏度版本的 IN+ 和 IN-。

2. 将外部 LV 电源的端子连接到所选 EVM 灵敏度型号上的 GND 和 VCC 测试点。务必先连接 GND，并确保外部 LV 电源在 3V 和 5.5V 之间。
3. 按节 2.2 连接输入端。

警告

测量电流时，首先确保设备（导线、连接器等）可以承受相应的电流和功率耗散。其次，确保流经器件输入端的电流保持在 TMCS1170 数据表的器件安全工作区限制范围内。否则可能会导致 EVM 损坏或人身伤害。

请勿触摸 HV 端子

表面高温。接触会导致烫伤。请勿触摸！

1.4 器件信息

TMCS1170 是一款基于霍尔效应且易于使用的高性能隔离式电流检测放大器。TMCS1170EVM 是一系列 EVM，用于对所有 TMCS1170 灵敏度型号提供基本的功能评估。TMCS1170EVM 并非针对电磁兼容性 (EMC) 测试进行布局。TMCS1170EVM 系列包含 6 个单独可订购的 PCB，每个部分都采用了单独的灵敏度。

TMCS1170 目前可提供 12 引脚、3mm × 3mm VQFN 熔合引线表面贴装式封装。表 1-2 列出了可用的灵敏度选项。在所有 EVM 型号中，可以用 EVM 检查的部件包括 TMCS1170 器件概要 中列出的以下器件。

表 1-2. TMCS1170 器件概要

产品	参考点	灵敏度	线性范围	故障跳变电平
TMCS1170B9F	1.65V	90mV/A	±14.7A	±14.7A
TMCS1170B7F	1.65V	132mV/A	±10A	±10A
TMCS1170B3F	1.65V	44mV/A	±30A	±30A
TMCS1170B1F	1.65V	26.4mV/A	±50A	±50A
TMCS1170A8F	2.5V	200mV/A	±10A	±10A
TMCS1170A6F	2.5V	100mV/A	±20A	±20A
TMCS1170A4F	2.5V	66mV/A	±30A	±30A
TMCS1170A2F	2.5V	40mV/A	±50A	±50A
TMCS1170C5F	0.5V	80mV/A	50A	50A

1.5 通用德州仪器 (TI) 高压评估 (TI HV EVM) 用户安全指南

务必遵循 TI 的安装和应用说明，包括在建议的电气额定电压和功率限制范围内使用所有接口元件。务必采取电气安全防护措施，这样有助于确保自身和周围人员的人身安全。如需更多信息，请联系 TI 的产品信息中心，网址为 http://support/ti./com。

保存所有警告和说明以供将来参考。

警告

务必遵循警告和说明，否则可能引发电击和灼伤危险，进而造成财产损失或人员伤亡。

TI HV EVM 一词是指通常以开放式框架、敞开式印刷电路板装配形式提供的电子器件。该器件严格*用于开发实验室环境，仅供了解开发和应用高压电路相关电气安全风险且接受过专门培训、具有专业知识背景的合格专业用户使用。德州仪器 (TI) 严禁任何其他不合规的使用和/或应用。*如果不满足合格要求，应立即停止进一步使用 HV EVM。

1. 工作区安全
   a. 保持工作区整洁有序。
   b. 每次电路通电时，都必须由具有资质的观察员在场监督。
   c. TI HV EVM 及接口电子元件通电区域必须设有有效的防护栏和标识；指示可能存在高压操作，以避免意外接触。
   d. 开发环境中使用的所有接口电路、电源、评估模块、仪器、仪表、示波器和其他相关装置如果超过 50Vrms/75VDC，则必须置于紧急断电 (EPO) 保护电源板内。
   e. 使用稳定且不导电的工作台。
   f. 使用充分绝缘的夹钳和导线来连接测量探针和仪器。尽量不要徒手进行测试。
2. 电气安全
   作为一项预防措施，工程实践中通常需假定整个 EVM 可能存在用户完全可接触到的高电压。
   a. 执行任何电气测量或其他诊断测量之前，需切断 TI HV EVM 及其全部输入、输出和电气负载的电源。再次确认 TI HV EVM 已安全断电。
   b. 确认 EVM 断电后，根据所需的电路配置、接线、测量设备连接和其他应用需求执行进一步操作，同时仍假定 EVM 电路和测量仪器均带电。
   c. EVM 准备就绪后，根据需要将 EVM 通电。

警告

EVM 通电后，请勿触摸 EVM 或电路，因为 EVM 或电路可能存在高压，会造成电击危险。

3. 人身安全
   a. 穿戴人员防护装备（例如乳胶手套或具有侧护板的安全眼镜）或将 EVM 放置于带有联锁装置的透明塑料箱中，避免意外接触。

安全使用限制条件：

勿将 EVM 作为整体或部分生产单元使用。

2 硬件

2.1 电路

本节总结了 TMCS1170EVM 元件。

2.1.1 旁路电容器

C1 和 C3 分别是 TMCS1170 的 10 µ F 和 0.1 µ F 电源旁路电容器。这些器件有助于实现 TMCS1170 的平滑电源电压。默认情况下，未组装 10 µ F 电容，但在为了评估潜在的超高噪声电源时，也可以组装。

2.1.2 输出滤波器

C4、R3 和 R5 是可选输出滤波器的空间占用。默认值为 3.3nF 和 0 Ω ，但未安装电容器。

2.1.3 负载连接器

警告 - 外部连接：对于系统中连接的所有硬件/元件，与硬件的所有外部连接必须保持在建议的工作条件和预期用途范围内。

标记为 IN+ 和 IN- 的输入连接器对应于 EVM 随附的高电流等级负载连接器。默认情况下，EVM 由其中两个连接器填充。这些元件通过螺钉拧到电路板上以进行接触，并可轻松移动到所需的灵敏度选项以进行测试。熔合引线框输入（被测器件的引脚 1 和 2）接受一个负载，该负载被转换为可产生电压的霍尔元件感应的磁场。该电压被选定的器件灵敏度放大，并出现在 VOUT 测试点上。对于直流测量，所含连接器可接受的最大负载输入为 90A。然而，连续允许负载受 TMCS1170 数据表中描述的 60A 超温安全工作区 (SOA) 的限制。

2.1.4 TMCS1170 隔离式电流检测放大器

U1 是 TMCS1170 隔离式电流检测放大器。

- 磁场是基于连接在输入端 IN+ 和 IN – 上的负载电流产生的，并流经 TMCS1170 引线框。
- 输出电压摆幅限制和所需的负载电流检测范围是决定器件选择的关键因素。
- 在负载电流被相应的器件灵敏度转换和放大后，所选器件必须允许输出电压保持在可接受的范围内。最大输出电压必须保持在 GND + 10mV 至 Vs - 100mV 的范围内。
- 选择适当的灵敏度以创建相应的最大输出摆幅，并尽可能减少误差。

2.2 测量

以下过程用于配置涉及电子负载的测量评估。

2.2.1

1. 如图 1-1 所示，对于低侧测量，请将电子负载正极输入端子连接到能够提供所需最大负载电流的电源正极端子。对于高侧测量，请将电子负载正极输入端子连接到 EVM 的负载源端子（IN+ 或 IN – ）。对于正向电流的高侧测量，IN- 源到电子负载；对于反向电流，IN+ 源到负载。
2. 将电子负载负输出端子连接到外部电源 GND 端子进行高侧测量，或连接到 EVM 的负载吸收端子进行低侧测量。
3. 对于高侧测量，请将外部电源连接到 EVM 的负载吸收端子。而对于低侧测量，请将 EVM（IN+ 或 IN- ）的负载源端子连接到外部电源 GND。
4. 导通所有已连接的电源。
5. 使用电子负载或实际系统负载施加负载。
6. 测量 VOUT 测试点处的输出电压。

备注

输出电压等于器件灵敏度乘以通过 DUT 引线框的负载电流。

2.2.2 高级测量提示

若要评估预期负载是否与所测量负载匹配，请使用额定值能承受最大预期电流并与 DUT 串联的精密分流电阻器。精密分流器具有开尔文连接，生成的检测电压可通过精密万用表（例如 3458a 万用表）测量。优选检测外部分流电压，因为典型万用表的电流限值可能远低于所述的所需电流测量限值。此外，某些仪表的电压测量精度优于电流测量精度。

要评估 DUT 承受快速电流脉冲时的性能，请使用短的大规格导线或短汇流条来降低 HV 电源、负载和 EVM 之间的电感和电阻。尽量减小电感则有助于提升负载压摆率。如果需要评估大瞬态电流尖峰 (>20A) 的性能，请务必使用具有足够电压余量的电源，以适应电线/总线、电路板平面和 DUT 引线框电阻的串联电阻。在电源端子之间使用一个大电容器组，以确保有足够的电荷库可用，从而防止电源下降并帮助提供通过器件的大浪涌电流。

如果需要评估温度性能，请使用宽而薄的汇流条来降低系统的散热能力并尽量减小系统的电感。电路板温度不是 DUT 温度的准确指标。通过在 DUT 封装顶部放置一层导热油脂并将热传感器直接放置在导热油脂上，可以获得更精确的测量结果。要了解更多信息和有关热最佳实践的详细信息，请参阅封装内磁性电流传感器的热实施指南。有关减小输入多边形尺寸和铜重量的信息，另请参阅 TMCS1123 霍尔效应电流传感器的热分析应用手册，了解使用 TMCS1170 进行设计时所要权衡的近似值。

3 硬件设计文件

3.1 原理图

图 3-1 展示了 TMCS1170EVM PCB 的原理图。

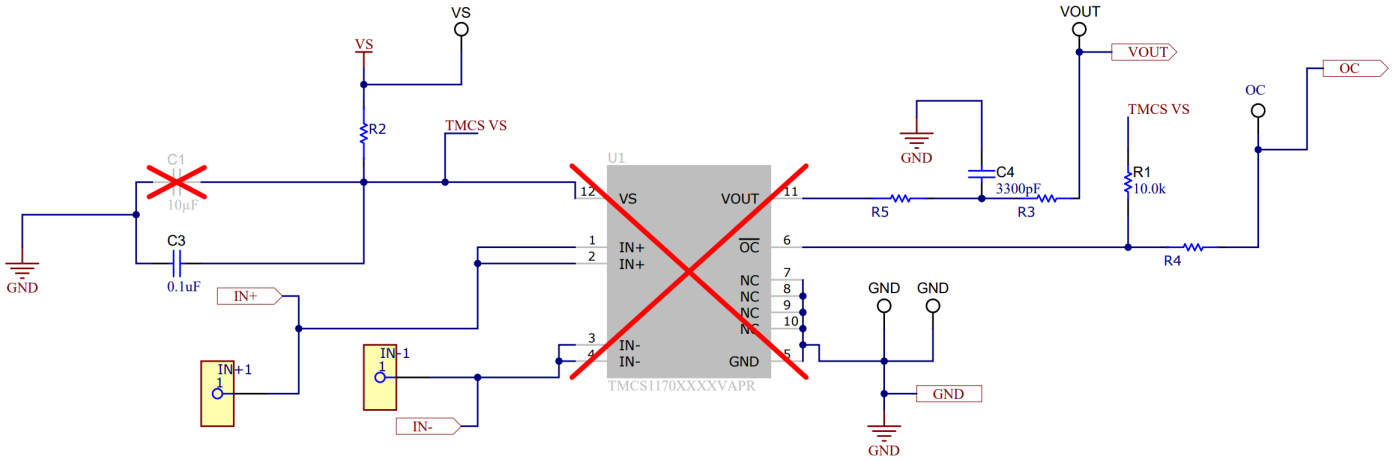


图 3-1. TMCS1170EVM 的原理图

3.2 PCB 布局

图 3-2 至图 3-5 描绘了 TMCS1170EVM 的 PCB 层。

备注

电路板布局未按比例显示。这些图旨在显示电路板的布局。而不用于制造 TMCS1170EVM PCB。

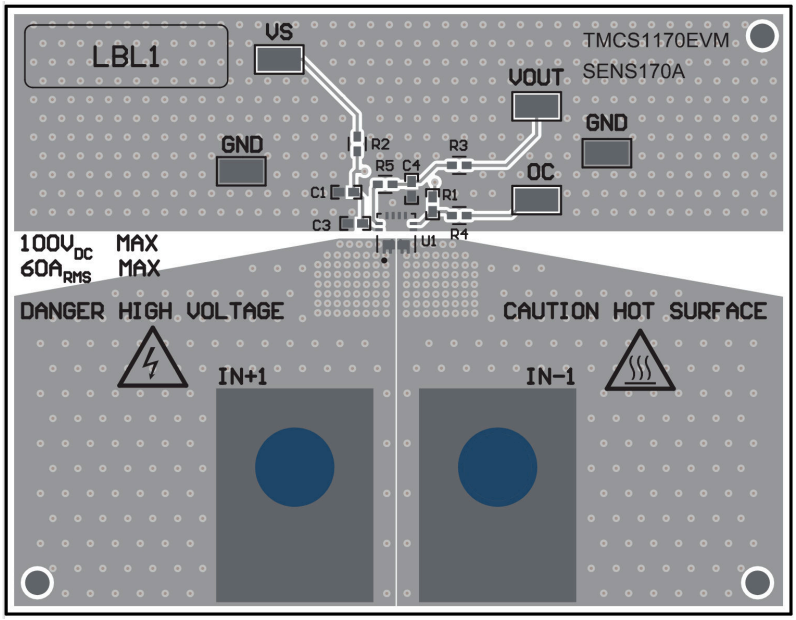


图 3-2. 顶层丝印层

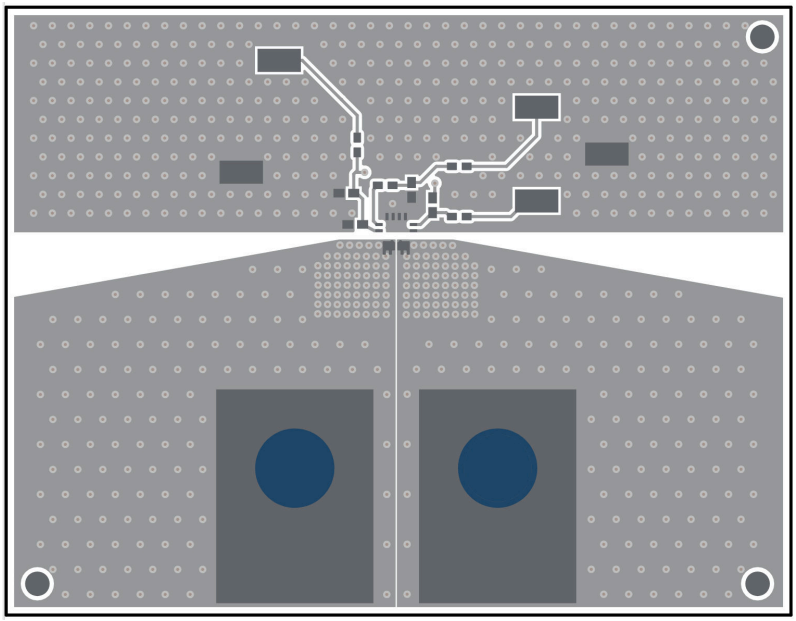


图 3-3. 顶层

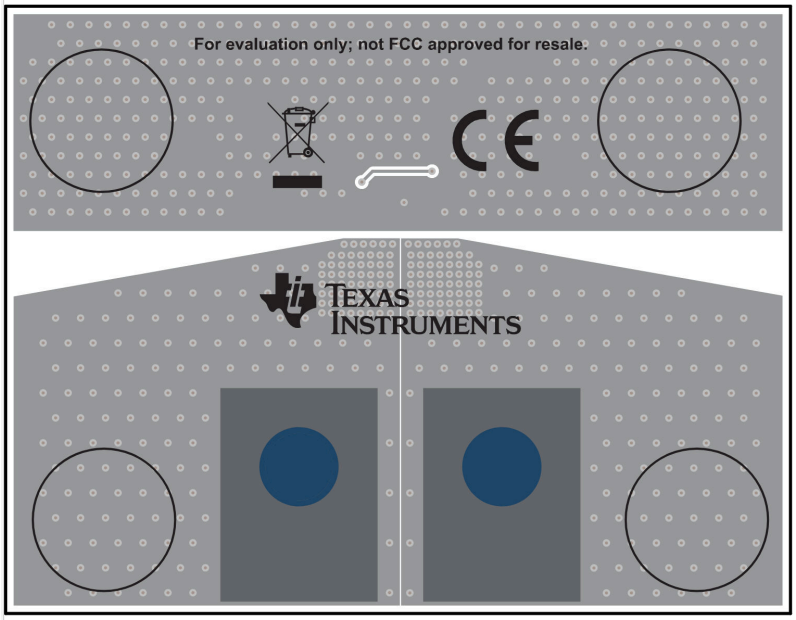


图 3-4. 底层丝印层

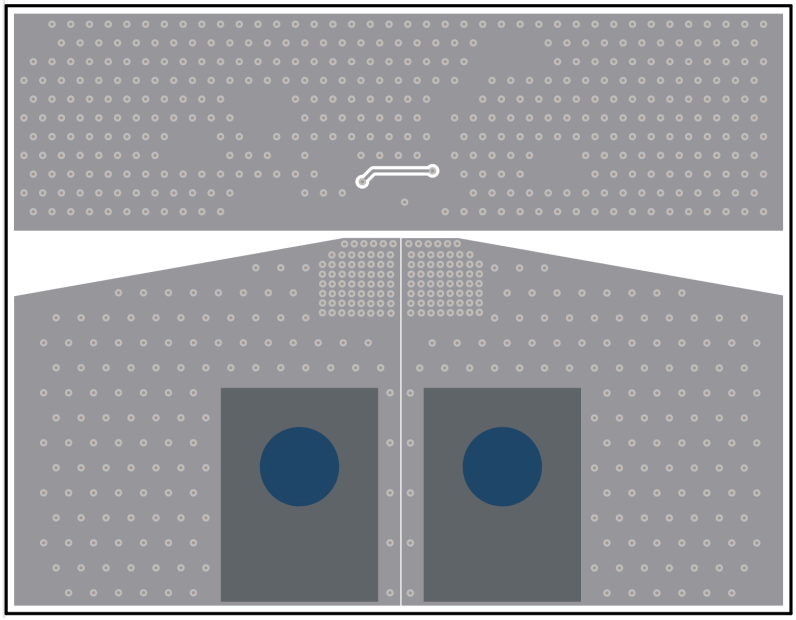


图 3-5. 底层

3.3 物料清单

表 3-1. TMCS1170EVM 物料清单

位号	数量	值	说明	封装参考	器件型号	制造商
C3	1	0.1uF	电容，陶瓷，0.1uF，6.3V，+/-10%，X7R，0402	0402	GRM155R70J104KA01D	MuRata
C4	1	3300pF	电容，陶瓷，3300pF，50V，+/-10%，X7R，AEC-Q200 1 级，0402	0402	GCM155R71H332KA37D	MuRata
H1、H2、H3、H4	4		Bumpon，半球形，0.44 × 0.20，透明	透明 Bumpon	SJ-5303 (CLEAR)	3M
H5、H6、H7、H8、H9	5		跳线，带有测试点 1X2 引脚 2.54MM		60900213421	Würth Elektronik
IN-1、IN+1	2		端子连接器矩形接线片，接地 1/4 螺柱	CONN_TERM_RECT_LUG	CB70-14-190	Panduit
LBL1	1		热转印打印标签，0.650"（宽）x 0.200"（高）- 10,000/卷	PCB 标签 0.650x 0.200 英寸	THT-14-423-10	Brady
MP1、MP2	2		中等强度钢制六角螺母	NUT_1-4-20	95462A029	McMASTER-CARR
MP3、MP4	2		钝化 18-8 不锈钢盘头内六角螺钉 1/4"-20 螺纹尺寸、3/8" 长	NPTH_SCREW_M5x0.8mm	92196A535	McMaster-Carr
OC、TP1、TP2、TP4、TP5	5		测试点，微型，SMT	Testpoint_Keystone_Miniature	5015	KeyStone Electronics，Keystone
R1	1	10.0k	电阻，10.0k，1%，0.063W，AEC-Q200 0 级，0402	402	CRCW040210K0FKED	Vishay-Dale
R2、R3、R4、R5	4	0	0Ω 跳线 0.1W，1/10W 片式电阻器 0402（公制 1005）- 厚膜	0402	CR0402-10W-000T	Venkel

4 其他信息

商标

所有商标均为其各自所有者的财产。

4.1 德州仪器 (TI) 提供的相关文档

表 4-1 提供了用于 TMCS1170EVM 组装的 TI 集成电路的参考文献。本用户指南可从 TI 网站获得，文献编号为 SLVSKC4。附加到文献编号的任何字母对应于撰写本文档时已有的最新文档修订版。较新的修订版可从 www.ti.com 上获得，也可从德州仪器 (TI) 文献响应中心（电话为 (800) 477-8924）或产品信息中心（电话为 (972) 644-5580）获得。订购时，可通过文档标题或文献编号识别文档。

表 4-1. 相关文档

文档	文献编号
TMCS1170 产品数据表	SBOSAJ9

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.

【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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

重要通知和免责声明

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最后更新日期：2025 年 10 月