

EVM User's Guide: AUDIO-AM275-EVM AUDIO-AM62D-EVM DP83867 评估模块



说明

DP83867-EVM-AM 是一款工业以太网 PHY 附加电路板，可与基于 Arm® 的高性能微控制器评估模块配合使用。此附加电路板非常适合使用 EVM 进行初始以太网评估和原型设计。DP83867-EVM-AM 配备了 TI DP83867IR 低延迟 10/100/1000Mbps PHY，带有 RGMII 接口和标准 RJ45 以太网连接器。具有以太网扩展连接器的 EVM 支持 DP83867-EVM-AM，比如 [AUDIO-AM275-EVM](#)。

特性

- [DP83867IR](#) 低延迟 10/100/1000Mbps 工业以太网 PHY，带 RGMII 接口
- 标准 RJ45 以太网网络连接器
- DF40GB 48 屏蔽引脚连接器，用来连接基于 Arm 的处理器系列评估模块



1 评估模块概述

前言：使用前必读

有关正确的安装说明，请参阅 [安装](#)。

备注

TI 不建议在未安装硬件的情况下安装以太网附加电路板。对于在未安装适当硬件的情况下使用附加电路板造成的任何损坏，TI 概不负责。

1.1 如果您需要协助

如果您有任何反馈或问题，请访问 TI 产品信息中心 (PIC) 和 [TI E2E™ 论坛](#)，获取 EVM 工业以太网 PHY 附加电路板开发套件支持。有关 PIC 的联系信息，请访问 [TI 网站](#)。有关其他器件特定信息，请访问 [节 5.1](#)。

1.1 简介

基于 Arm 的处理器 EVM 工业以太网 PHY 附加电路板旨在为各种 EVM 提供额外的以太网外设支持，并允许为工业以太网应用的核心 SoC 进行快速原型设计。本用户指南详细介绍了该附加电路板的设计以及如何正确使用该接口。本用户指南还详细介绍了电路板的许多重要方面，包括但不限于引脚接头说明、测试点和信号路由。

1.2 套件内容

EVM 工业以太网 PHY 附加电路板套件包含以下项目：

- DP83867-EVM-AM 工业以太网 PHY 附加电路板
- 电路板安装硬件

不包括：

- EVM

备注

DP83867-EVM-AM 可与特定的 EVM 一起作为虚拟捆绑包提供。有关更多信息，请访问 EVM 产品页面 ([DP83867-EVM-AM](#))。

1.3 器件信息

DP83867 是一款功能齐全的物理层收发器，集成了 PMD 子层，支持 10BASE-T_e、100BASE-TX 和 1000BASE-T 以太网协议。

DP83867 旨在轻松实现 10/100/1000Mbps 以太网 LAN。该器件通过外部变压器直接连接双绞线介质。该设备通过 IEEE 802.3u 标准媒体独立接口 (MII)、IEEE 802.3z 千兆位媒体独立接口 (GMII) 或简化 GMII (RGMII) 直接连接到 MAC 层。

DP83867 提供精确时钟同步，包括同步以太网时钟输出。器件具有低抖动、低延迟特性，可为时间敏感协议提供 IEEE 1588 帧开始检测。

DP83867 提供了出色的诊断功能，包括正常运行期间进行故障预测的动态链路质量监控。该器件支持长达 130m 的电缆。

有关更多信息，请参阅 [DP83867IR 数据表](#)。

2 硬件

2.1 元件标识

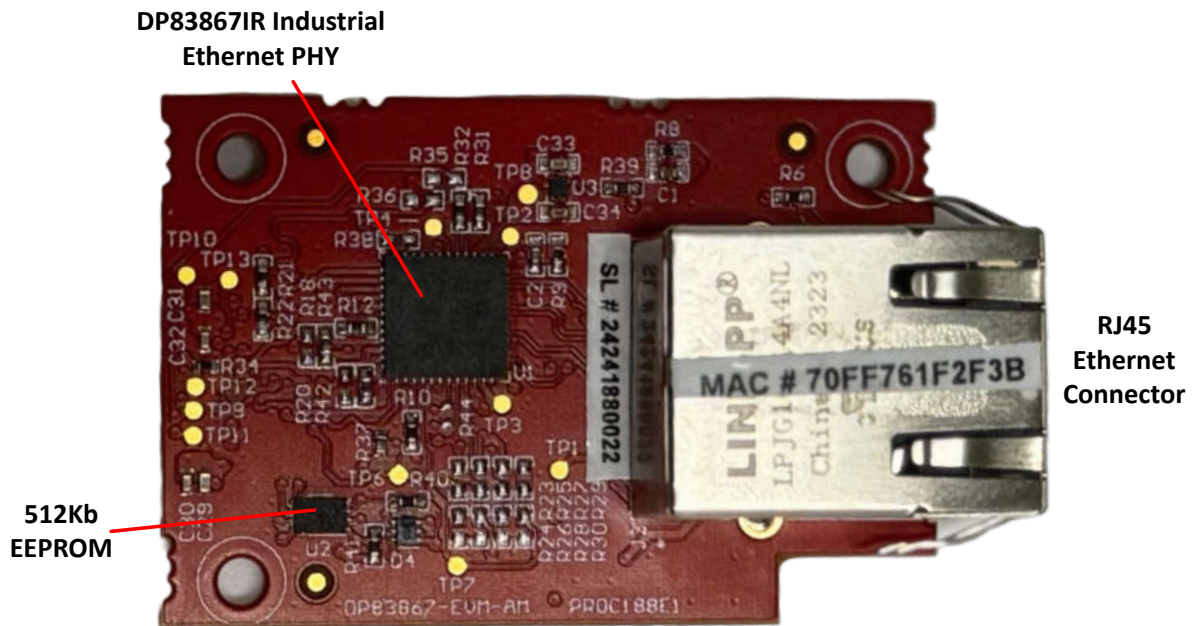


图 2-1. DP83867-EVM-AM 顶面

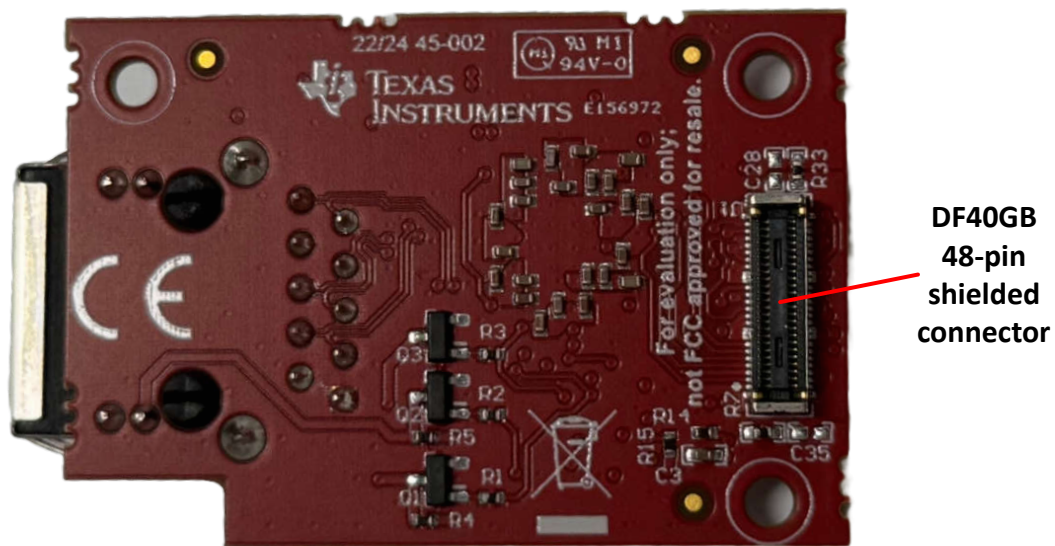


图 2-2. DP83867-EVM-AM 底部

2.2 电源要求

EVM 工业以太网 PHY 附加电路板由 DF40GB 48 引脚连接器的 3.3V 输入供电，该连接器将 DP83867-EVM-AM 与主 EVM 相连。以下各节介绍了为 EVM 工业以太网 PHY 附加电路板、支持元件和基准电压供电的配电网络拓扑。

2.2.1 电源树

DP83867-EVM-AM 电源由主 EVM 通过 DF40GB 连接器供电。

3.3V (VCC_3V3_SYS) 连接到 DF40GB 连接器上的引脚 44 和 46，传递到 DP83867IR 工业以太网 PHY 上的源输入 VDDIO。

2.5V (VDD_2V5) 连接到 DF40GB 连接器上的引脚 4 和 6，并作为输入传递到 LDO (TLV75510PDQNR)，后者输出 1.0V (VDD_1V0)。VDD_2V5 连接到 VDDA_2P5 输入，VDD_1V0 连接到以太网 PHY 的 VDD1P0 输入。

图 2-3 展示了 DP83867-EVM-AM 的电源连接。

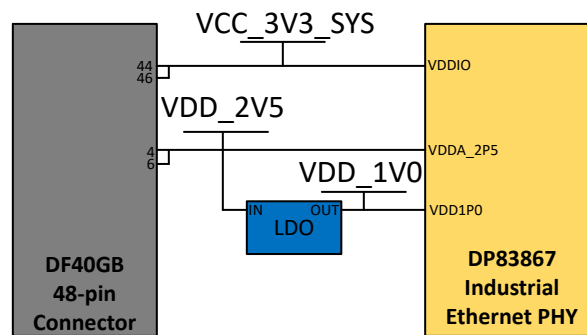


图 2-3. 电源树

2.3 功能方框图

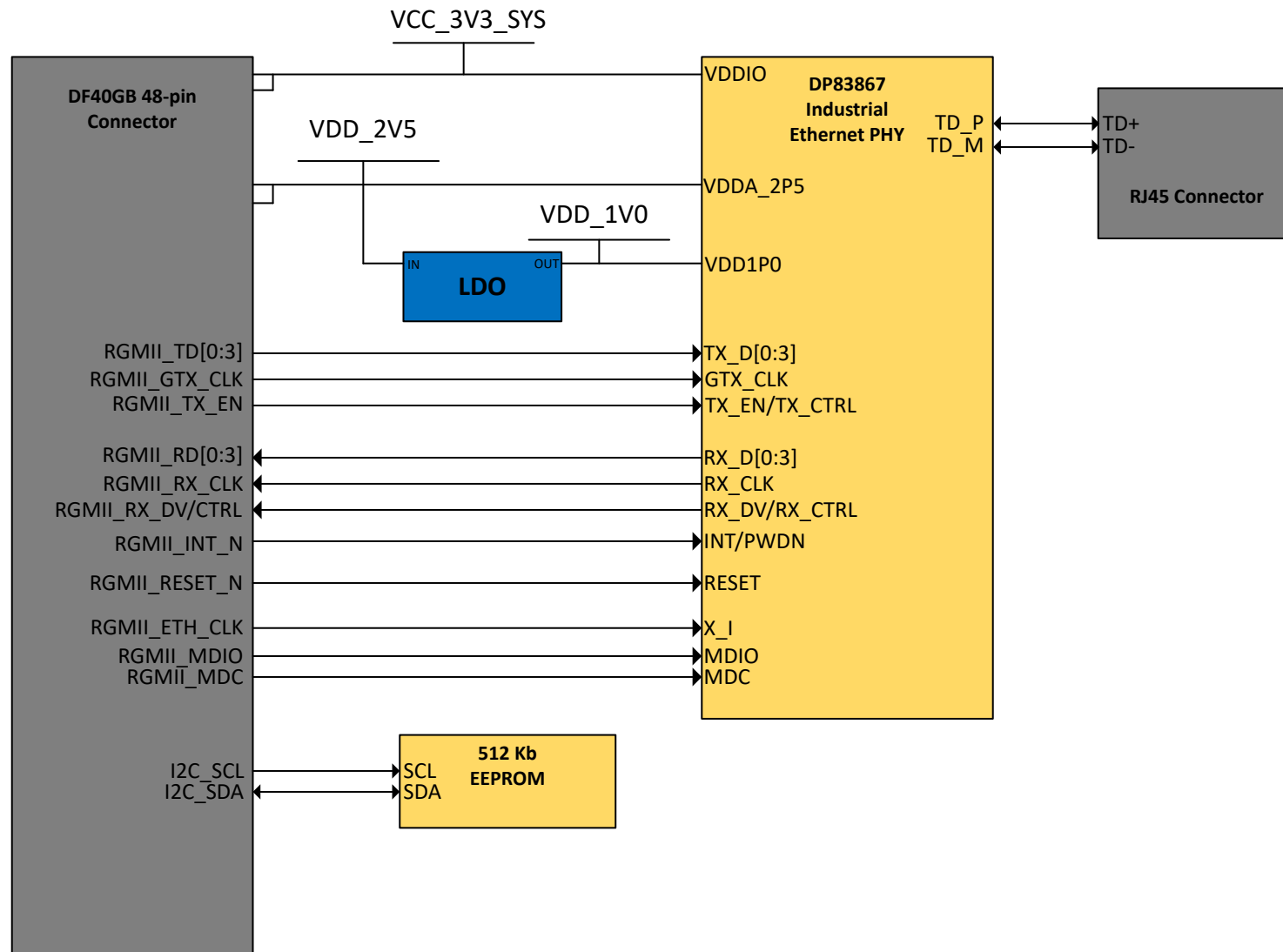


图 2-4. AMx 工业以太网 PHY 附加电路板方框图

2.4 接头信息

DP83867-EVM-AM 配备了 [Hirose DF40GB 2x24](#) 引脚连接器 (J1)，用于连接到 AMx EVM。下面列出了此连接器与此 EVM 相关的特性：

- 2x24 引脚
- 屏蔽连接器，可支持高速信号并防止噪声
- 高密度安装

有关接头引脚及其说明的完整列表，请参阅[表 2-1](#)。

表 2-1. DF40GB 接头引脚分配

引脚编号	信号	说明	说明	信号	引脚编号
1	GND	接地	外部电压监测器	EXT_VMON	2
3	TX_CLK	发送时钟	2.5V 电源	VDD_2V5	4
5	GND	接地	2.5V 电源	VDD_2V5	6
7	TX_D0	发送数据 0	接地	GND	8
9	TX_D1	发送数据 1	以太网 PHY 中断	PWDN/INTn	10
11	TX_D2	发送数据 2	以太网 PHY 的复位输入	RESETn	12
13	TX_D3	发送数据 3	碰撞检测	COL	14
15	GND	接地	接地	GND	16
17	GND	接地	接地	GND	18
19	RX_CLK	接收时钟	MDIO 时钟	MDIO_MDC	20
21	GND	接地	MDIO 数据	MDIO_MDIO	22
23	RX_D0	接收数据 0	接地	GND	24
25	RX_D1	接收数据 1	抑制	INH	26
27	RX_D2	接收数据 2	25MHz 基准时钟	REF_CLK	28
29	RX_D3	接收数据 3	载波侦听	CRS	30
31	GND	接地	接地	GND	32
33	GND	接地	接地	GND	34
35	TXEN	发送使能	电路板连接检测	BRD_CONN_DET	36
37	EEPROM_A2	EEPROM I2C 地址位 [2]	IEEE 1588 SFD	1588_SFD	38
39	RX_ER	接收数据错误	I2C 时钟	I2C_SCL	40
41	GND	接地	I2C 数据	I2C_SDA	42
43	ETH_GPIO0	ETH GPIO0	IO 电压电源	VDDIO	44
45	RXDV	接收数据有效	IO 电压电源	VDDIO	46
47	EEPROM_A0	EEPROM I2C 地址位 [0]	RGMII ETH CLKOUT	CLKOUT	48

2.5 测试点

DP83867-EVM-AM 配备了多个用于硬件调试和基准测试的测试点。表 2-2 展示了电路板上的测试点及每个测试点关联的信号网络。

表 2-2. DP83867-EVM-AM 测试点

测试点	信号	说明
TP1	VCC	RJ45 VCC
TP2	VDDA1P8	模拟 1.8V 输入
TP3	ETH_LED0	链路建立指示器
TP4	CLK_OUT	ETH PHY 基准时钟输出
TP5	EXT_VMON	外部电压监测器
TP6	ETH_GPIO0	PHY GPIO0
TP7	ETH_GPIO1	PHY GPIO1
TP8	VDD_1V0	1.0V LDO 输出
TP9	INH	抑制
TP10	1588_SFD	1588 帧开始
TP11	COL	碰撞检测
TP12	CRS	载波侦听
TP13	RX_ER	接收错误

2.6 接口

2.6.1 以太网接口

2.6.1.1 工业以太网 PHY

AMx EVM 工业以太网 PHY 附加电路板使用一个 RGMII 信号端口连接到 32 引脚以太网 PHY (DP83867IR)。该 PHY 配置为广播 10/100/1000Mb 操作。该 PHY 的以太网数据信号端接至 RJ45 连接器。LED 用于指示链路状态和活动。

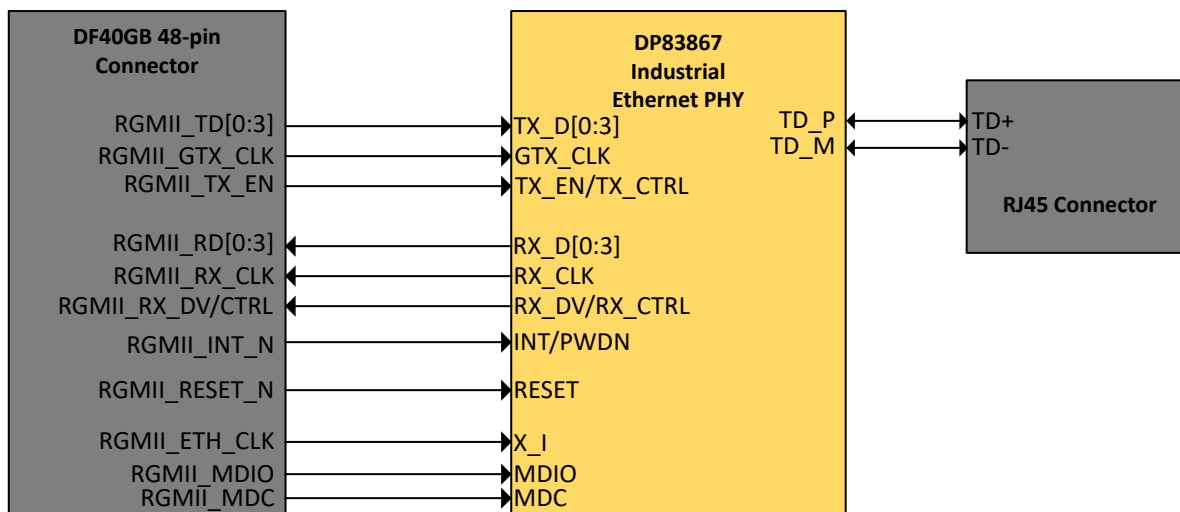


图 2-5. 工业以太网 PHY

该以太网 PHY 需要三个单电源：VDDIO (3.3V 或 1.8V)、VDDA2P5 (2.5V) 和 VDD1P0 (VDD_1V0)，这些电源通过 DF40GB 连接器 (J1) 供电。

在一些 EVM 上，CPSW 信号的 RGMII 端口在 PRU-ICSS 以太网信号使用的相同 MCU 焊球上进行内部多路复用。要使用 RGMII，必须将焊球设置为适合 RGMII 的多路复用模式。

从主 EVM SoC 到 PHY 的 MDIO 和中断信号需要通过 2.2k Ω 上拉电阻器连接到 I/O 电源电压，才能正常工作。默认情况下，DP83867-EVM-AM 上未组装这些电阻器，但如果主 EVM 没有上拉这些信号，则可以组装这些电阻器。中断信号由主 EVM SoC 映射的 GPIO 信号驱动。

以太网 PHY 的复位信号多数情况下由 2 路输入与门驱动。与门的输入是由主 SoC EVM 生成的 GPIO 信号和主 EVM 上的复位状态信号。

2.6.1.2 工业以太网 PHY Strap 配置电阻器

以太网 PHY 使用很多功能引脚用作 Strap 配置选项，以便将器件置于特定的运行模式。

备注

DP83867-EVM-AM 专为 3.3V 的 VDDIO 电压而设计。如果该电路板连接到 1.8V VDDIO 系统，则必须更新 Strap 配置电阻器。有关 Strap 配置电阻器模式的完整详细信息，请参阅 [DP83867IR 数据表](#) 中的 4 级 Strap 配置电阻器比率表。

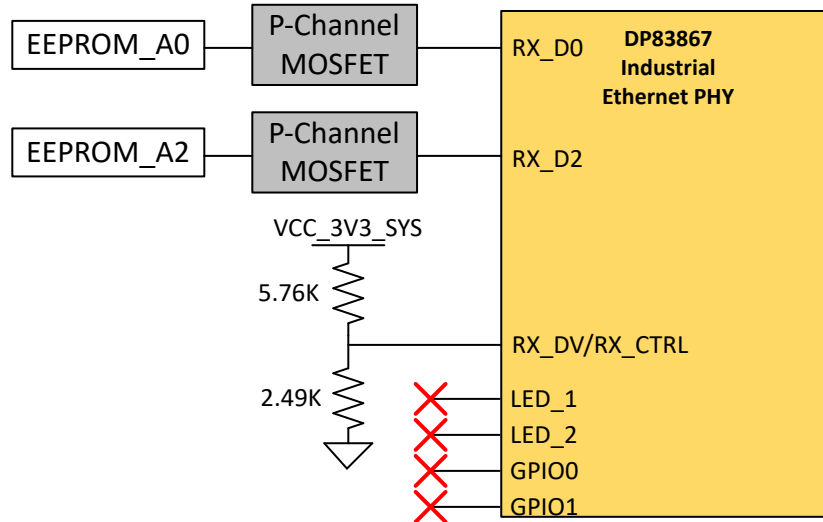


图 2-6. 工业以太网 PHY Strap 配置电阻器

表 2-3. 10/100/1000MB 工业以太网 PHY Strap 配置电阻器

功能引脚	DP83867-EVM-AM 上的模式	功能
RX_D0	EEPROM_A0	PHY 地址：0[EEPROM_A2][EEPROM_A0]。有关 PHY 寻址的更多信息，请参阅 节 2.6.1.4 。
RX_D2	EEPROM_A2	
RX_DV/RX_CTRL	3	启用自动协商
LED_1	1	时钟偏移 TX[2] = 2ns 广播能力 10/100/1000Mbps
LED_2	1	时钟偏移 TX[1] = 2ns 时钟偏移 TX[0] = 2ns
GPIO0	1	时钟偏移 RX[0] = 2ns
GPIO1	1	时钟偏移 RX[2] = 2ns 时钟偏移 RX[1] = 2ns

2.6.1.3 RJ45 连接器中的 LED 指示

EVM 工业以太网 PHY 附加电路板有一个 RJ45 网络端口，用于连接主 EVM SoC 的 RGMII 端口。该 RJ45 连接器包含两个双色 LED，用于指示链路和活动。

- RGMII 端口的 RJ45 连接器 LED 指示：

表 2-4. ICSSM PRU1 RJ45 连接器 LED 指示

LED	颜色	指示
右侧 LED	绿色	以太网 PHY 电源已建立
	黄色	速度为 10BT 的链路已接通
左侧 LED	绿色	以太网活动指示器
	黄色	GPIO0

2.6.1.4 多连接器寻址

对于具有多个以太网附加电路板连接器的 AMx EVM，每个 DP83867-EVM-AM 需要不同的 EEPROM I2C 地址和 PHY 地址。EEPROM A0 和 A2 网络由主 EVM 上的拉电阻器设置，通过在 DP83867-EVM-AM 上实现的 FET 网络驱动 PHY 地址网络。表 2-5 详细说明了在附加 PHY 电路板上实现的多连接器 I2C 和 PHY 寻址方案。

备注

- EEPROM I2C 地址位 A2 和 A0 由主 EVM 上的拉电阻驱动。下表列出了每个枚举连接器的拉电阻。
- EEPROM I2C 地址位 A1 始终拉高至附加电路板上的 VDDIO。
- EEPROM I2C 地址定义为以下 8 位：8b1010[A2][A1][A0][R/W]。
- 拉至 VDDIO/GND 是通过 10k Ω 电阻实现的。
- 所有具有单个连接器的 EVM 都配置为 CONNECTOR_0。

表 2-5. 多连接器 I2C/PHY 寻址方案

Connector_#	EEPROM_A2 (连接器引脚 37)		EEPROM_A1		EEPROM_A0 (连接器引脚 47)		I2C 地址	DP83867 PHY 地址
	拉动	A2	拉动	A1	拉动	A0		
CONNECTOR_0	GND	0	VDDIO	1	GND	0	0x52	5b00000
CONNECTOR_1	GND	0	VDDIO	1	VDDIO	1	0x53	5b00001
CONNECTOR_2	VDDIO	1	VDDIO	1	GND	0	0x56	5b00100
CONNECTOR_3	VDDIO	1	VDDIO	1	VDDIO	1	0x57	5b00101

2.7 集成指南

AMx 以太网附加电路板生态系统不限于 DP83867 工业汽车以太网 PHY。可在附加电路板上设计各种具有基于 Arm 的处理器兼容信号的工业以太网 PHY，以便在不同的兼容 EVM 上使用。本节详细介绍了机械信息，并提供了设计工业以太网 PHY 附加电路板所需的尺寸。

备注

所有尺寸的测量单位均为英寸。

2.7.1 电路板尺寸

图 2-7 显示了与 AMx EVM 兼容的工业以太网 PHY 附加电路板的正确 PCB 尺寸。

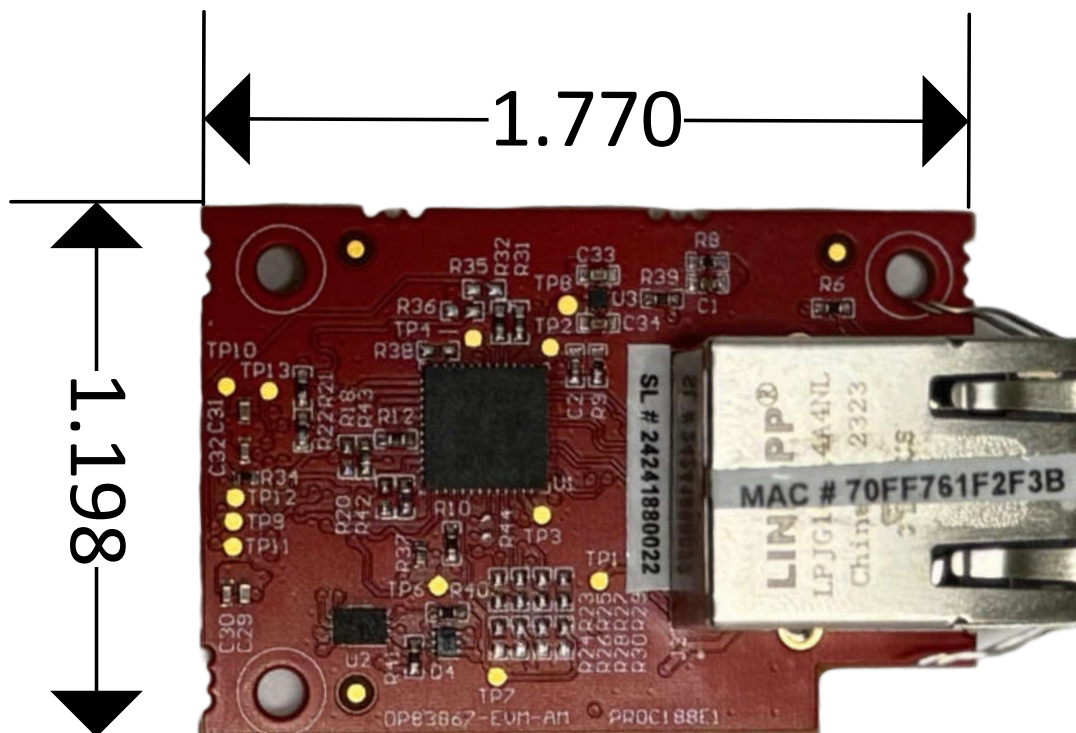


图 2-7. 工业以太网 PHY 附加电路板尺寸

2.7.2 安装

附加电路板套件包括安装硬件，可将电路板安装到任何基于 Arm 的兼容处理器 EVM 上。

安装硬件包括以下项目：

- 3 个 M3 螺钉
- 3 个塑料垫圈
- 3 个金属螺母
- 3 个塑料垫片

以下是安装附加电路板的推荐方法：

1. 将塑料垫圈放在所有螺钉上
2. 将带垫圈的螺钉放入附加电路板的安装孔中
3. 在主 EVM 上，将塑料垫片放在相应连接器的主 EVM 安装孔顶部
4. 将附加电路板的螺钉与塑料垫片和主 EVM 安装孔对齐
5. 向下按压附加电路板，直到听到咔嚓声，这表示连接器齐平
6. 将主 EVM 下侧的金属螺母拧到螺钉上，直到附加电路板和主 EVM 之间牢固连接

备注

TI 不建议在未安装硬件的情况下将以太网附加卡安装到 EVM。否则可能会损坏其中一个或两个电路板。

3 硬件设计文件

要下载包含 EVM 最新设计文件的 zip 文件，请前往 [ti.com](https://www.ti.com) 上的 EVM 产品页面 ([DP83867-EVM-AM](#))。

4 其他信息

4.1 已知硬件或软件问题

本节介绍了每个 EVM 版本目前已知的问题，以及相应的权变措施。EVM 组件上的修改标签中列出了已修复的问题。

表 4-1. DP83867-EVM-AM 已知问题和修改

问题编号	问题标题	问题描述	受影响的型号
问题 1	RGMII 引导失败	使用 DP83867-EVM-AM 工业 PHY 卡时 RGMII 引导失败。	A

4.1.1 问题 1 - RGMII 引导故障

适用的 EVM 版本：A

问题描述：当 DP83867-EVM-AM 工业 PHY 修订版 A 卡与 AUDIO-AM275-EVM/AUDIO-AM62D-EVM 电路板配合使用时，RGMII 引导失败。

备注

该问题仅在 RGMII 引导过程中出现。在应用程序执行期间，软件通过 MDIO 访问 PHY，并以编程方式配置正确的 TX 时钟偏移，从而避免双偏移问题。此外，此时序问题特定于 1000Mbps (千兆位) 链路速度运行。在较低的链路速度 (10Mbps 和 100Mbps) 下，RGMII TX 时钟时序裕度足以承受累积的双时钟偏移，并且引导会在不修改任何硬件的情况下成功。

根源：DP83867-EVM-AM 工业 PHY 修订版 A 卡通过硬件搭接进行配置，以在 PHY 侧施加 2ns 的 TX 时钟偏移。但是，默认情况下，AM62D/AM275 MAC 接口已经增加了 TX 时钟偏移。这会导致 RGMII TX 时钟线上累积的双时钟偏移，从而导致时序违规和引导故障。

权变措施：为了缓解此问题，PHY 卡 Strap 配置上的 TX 时钟偏移设置必须从 2ns 更改为 0ns，因为 MAC 侧已在内部补偿 TX 时钟偏移。请按照以下步骤操作：

1. 移除 DP83867-EVM-AM 工业 PHY 修订版 A 卡的 R23 上组装的所有现有电阻，并在工业 PHY 卡的 R23 上安装 10k Ω 电阻。
2. 移除 DP83867-EVM-AM 工业 PHY 修订版 A 卡的 R24 上组装的所有现有电阻，并在工业 PHY 卡的 R24 上安装 2.49k Ω 电阻。

下图展示了工业 PHY 卡上的电阻位置：

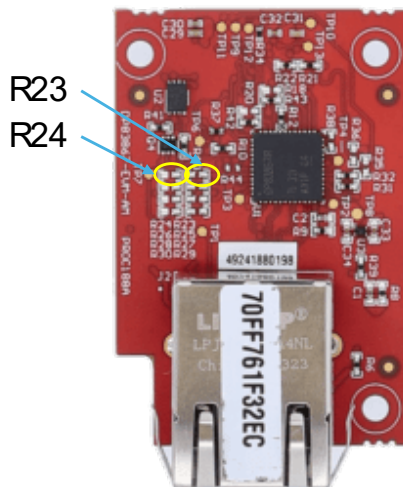


图 4-1. 工业 PHY 卡

4.2 商标

E2E™ is a trademark of Texas Instruments.

Arm® is a registered trademark of Arm Ltd.

所有商标均为其各自所有者的财产。

5 参考资料

5.1 参考文档

除了本文档外，还可以从 www.ti.com 下载以下参考资料。

- [AM275x 音频评估模块工具文件夹](#)
- [AM62Dx 音频评估模块工具文件夹](#)
- [DP83867IR 数据表](#)
- [DP83867IR 产品文件夹](#)
- [德州仪器 \(TI\) Code Composer Studio](#)

6 修订历史记录

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• 添加了 已知问题 部分.....	15
• 添加了 已知问题部分.....	15
• 添加了 问题 1 - RGMII 引导故障 部分及其解决方法.....	15

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 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。

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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

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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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