

DS560MB410 具有交叉点的低功耗 56Gbps PAM4 4 通道线性转接驱动器

1 特性

- 四通道多协议线性均衡器，支持高达 28GBd (PAM4) 和 32GBd (NRZ) 的接口
- 适用于高达 CEI-56G、以太网 (400 GbE)、光纤通道 (64GFC)、InfiniBand™ (HDR) 和 CPRI/eCPRI PCB 和铜缆应用
- 可选择的 CTLE 升压曲线，用于补偿 PCB 或电缆损耗
- 具有引脚或寄存器控制的集成 2x2 交叉点，适用于多路复用器、扇出和信号交叉
- 低功耗：160mW/通道 (典型值)
- 无需散热器
- 无缝支持 CR/KR 链路训练、自动协商和 FEC 直通功能的 CTLE 线性均衡
- 在 13.28GHz 下，将远距离链路扩展至比正常的 ASIC 至 ASIC 性能高 18dB+
- 用于 PAM-4 眼图对称性增强的眼图扩展器
- 低输入至输出延迟：80ps (典型值)
- 低附加随机抖动
- 小型 6.00mm x 6.00mm 小型球状引脚栅格阵列 (BGA) 封装，可轻松实现直通布线
- 无需参考时钟
- 单个 2.5V ±5% 电源
- -40°C 至 +85°C 的环境温度范围

2 应用

- 背板 (KR) 和中板 C2C 连接单元接口 (AUI) 范围扩展
- 有源铜缆 (ACC) (SFP56、QSFP56、QSFP-DD 或 OSFP)
- 实现故障转移冗余的多路复用器/多路信号分离器

3 说明

DS560MB410 是一款低功耗、高性能四通道线性均衡器，支持多速率、多协议接口，使用四级脉冲振幅调制 (PAM4) 时最高可达 28GBD，使用非归零码 (NRZ) 调制时最高可达 32GBD。它用于扩展背板、中板和有源铜缆 (ACC) 应用中高速串行链路的覆盖范围并提升稳定性。DS560MB410 可将两个 ASIC 之间的覆盖范围增加至比正常的 ASIC 到 ASIC 范围高 18dB 以上。

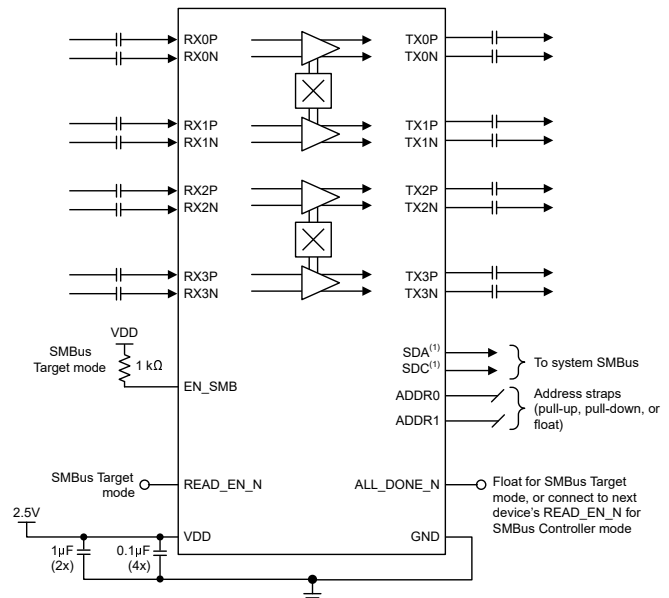
每个通道独立运行，用户可选择的 CTLE 升压曲线经过优化，可均衡 PCB 或铜缆损耗曲线。DS560MB410 均衡的线性特性保留了流经转接驱动器的输入信号特性。这种透明性使链路伙伴 ASIC 能够在链路训练期间自由协商 Tx 均衡器系数，并支持任务模式下的单个通道正向纠错 (FEC) 直通，同时更大幅度地降低对延迟的影响。

封装信息

器件型号	封装 ⁽¹⁾	封装尺寸 ⁽²⁾
DS560MB410	ZAS (nFBGA, 101)	6mm × 6mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

(2) 封装尺寸 (长 × 宽) 为标称值，并包括引脚 (如适用)。



简化版原理图



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4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (December 2022) to Revision A (October 2023)	Page
• 更新了封装信息表以包含封装引线.....	1
• 添加了澄清文字：信号交叉配置仅支持 NRZ (高达 32GBd)	3

5 说明 (续)

DS560MB410 在每对相邻通道之间包含一个完整的 2×2 交叉点，可支持 2 到 1 多路复用和 1 到 2 多路分解以实现故障转移冗余，还支持 1 对 2 扇出以实现诊断监控，以及支持信号交叉 (仅 NRZ，高达 32GBd) 以实现灵活的 PCB 布线。交叉点可通过引脚或 SMBus 寄存器接口进行控制。

DS560MB410 具有小型封装尺寸和经优化的高速信号退出，非常适合小型应用。简化的均衡控制、低功耗和超低附加抖动使其适用于背板和中板上的芯片至芯片范围扩展和信号分配。6.00mm × 6.00mm 小尺寸可轻松适应有源铜缆 (ACC) 装配应用，无需散热器。

DS560MB410 采用单个电源，可尽可能减少对外部组件的需求。这些特性降低了 PCB 布局布线复杂度以及物料清单 (BOM) 成本。DS560MB410 可通过 SMBus 或外部 EEPROM 进行配置。单个 EEPROM 最多可由 16 个器件共享。

6 Device and Documentation Support

6.1 Documentation Support

6.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [DS560MB410 Programmer's Guide](#)
- Texas Instruments, [50 GbE PAM4 Equalization Optimization with TI DS560MB410 Redrivers](#)

6.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

6.3 Support Resources

6.4 Trademarks

InfiniBand™ is a trademark of InfiniBand Trade Association.

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6.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

6.6 术语表

TI 术语表

本术语表列出并解释了术语、首字母缩略词和定义。

7 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DS560MB410ZASR	Active	Production	NFBGA (ZAS) 101	2500 LARGE T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410
DS560MB410ZASR.A	Active	Production	NFBGA (ZAS) 101	2500 LARGE T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410
DS560MB410ZASR.B	Active	Production	NFBGA (ZAS) 101	2500 LARGE T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410
DS560MB410ZAST	Active	Production	NFBGA (ZAS) 101	250 SMALL T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410
DS560MB410ZAST.A	Active	Production	NFBGA (ZAS) 101	250 SMALL T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410
DS560MB410ZAST.B	Active	Production	NFBGA (ZAS) 101	250 SMALL T&R	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS560MB410ZASR	NFBGA	ZAS	101	2500	330.0	16.4	6.3	6.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS560MB410ZASR	NFBGA	ZAS	101	2500	336.6	336.6	31.8

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

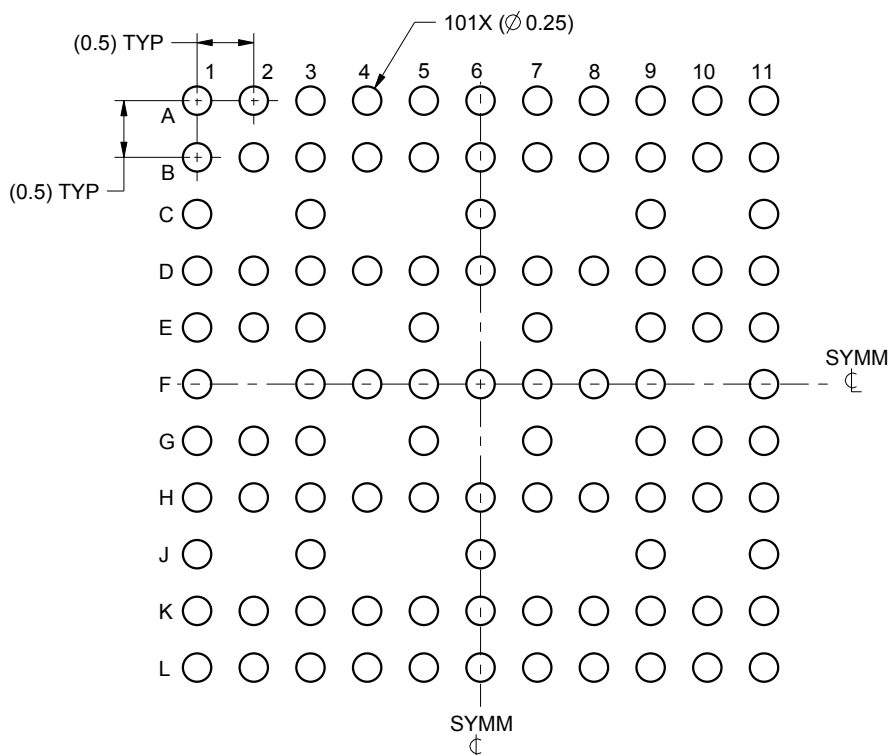
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

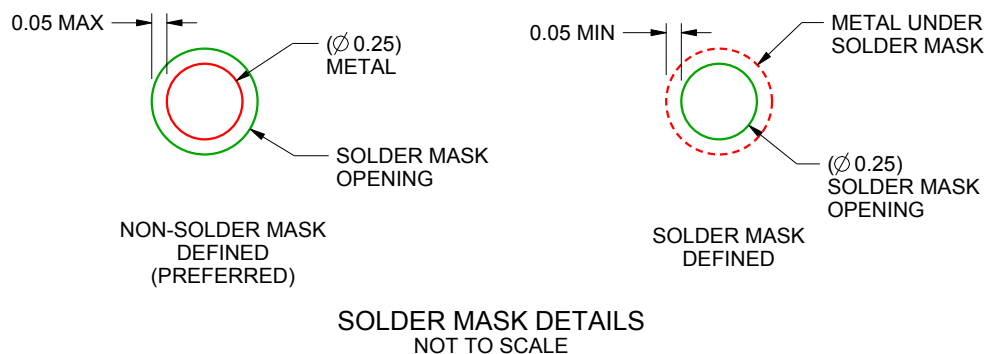
ZAS0101A

NFBGA - 1.2 mm max height

PLASTIC BALL GRID ARRAY



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

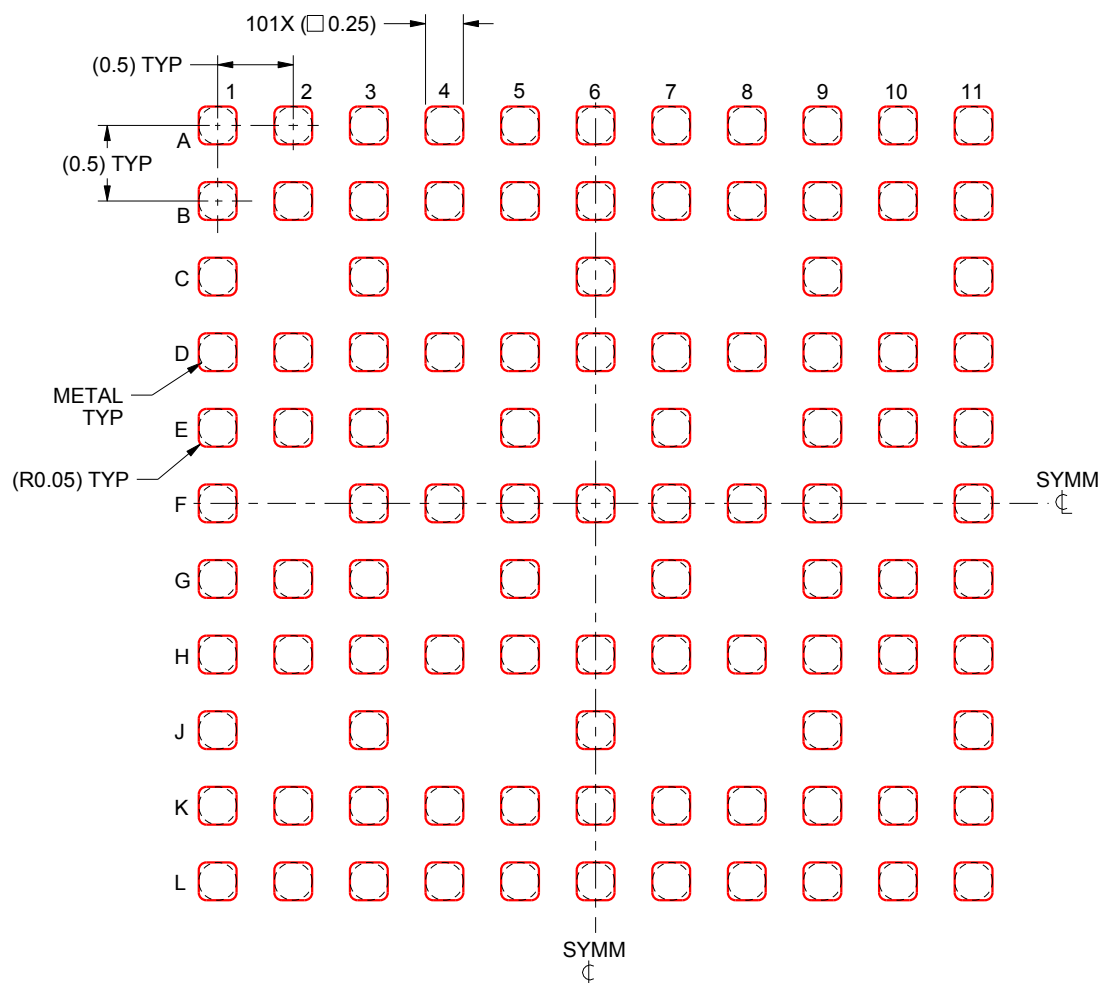
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For information, see Texas Instruments literature number SPRAA99 (www.ti.com/lit/spraa99).

EXAMPLE STENCIL DESIGN

ZAS0101A

NFBGA - 1.2 mm max height

PLASTIC BALL GRID ARRAY



SOLDER PASTE EXAMPLE
 BASED ON 0.1 mm THICK STENCIL
 SCALE:20X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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