TEXAS INSTRUMENTS
DS560MB410
SNLS733 – DECEMBER 2022

DS560MB410 Low-Power 56-Gbps PAM4 4-Channel Linear Redriver with Crosspoint

1 Features

- Quad-channel multi-protocol linear equalizer supporting up to 28-GBd (PAM4) and 32-GBd (NRZ) interfaces
- Suitable for up to CEI-56G, Ethernet (400 GbE), Fibre Channel (64GFC), InfiniBand™ (HDR), and CPRI/eCPRI PCB and copper cable applications
- Selectable CTLE boost profiles to compensate either PCB or cable loss
- Integrated 2×2 crosspoint with pin or register control for mux, fanout, and signal crossing
- Low power consumption: 160 mW / channel (typical)
- No heat sink required
- Linear equalization with CTLE for seamless support of CR/KR link training, auto-negotiation, and FEC pass-through
- Extends long-reach links by 18-dB+ beyond normal ASIC-to-ASIC capability at 13.28 GHz
- Eye expander for PAM-4 eye symmetry enhancement
- Low input-to-output latency: 80 ps (typical)
- Low additive random jitter
- Small 6.00 mm × 6.00 mm BGA package for easy flow-through routing
- No reference clock required
- Single 2.5-V ± 5% power supply
- –40°C to +85°C ambient temperature range

2 Applications

- Backplane (KR) and midplane C2C attachment unit interface (AUI) reach extension
- Active copper cables (ACC) (SFP56, QSFP56, QSFP-DD, or OSFP)
- Mux and de-mux for failover redundancy

3 Description

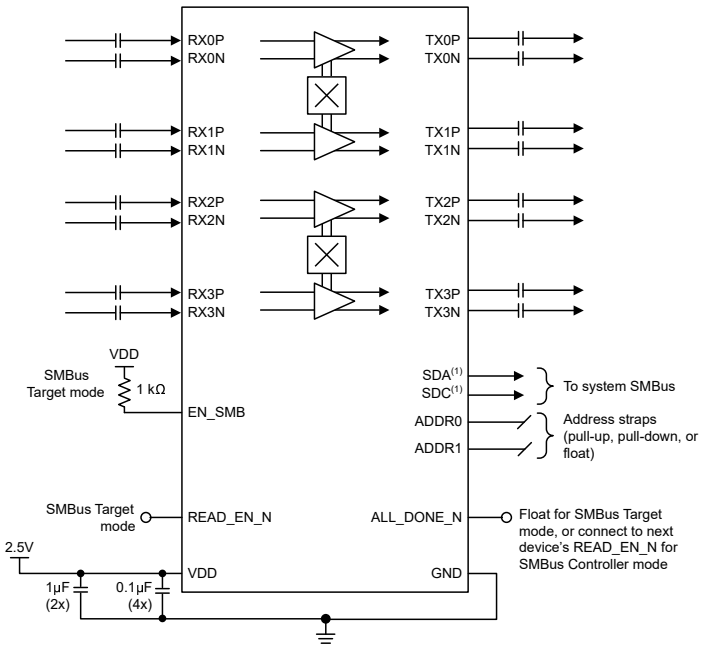
The DS560MB410 is a low-power, high-performance four-channel linear equalizer supporting multi-rate, multi-protocol interfaces up to 28 GBd using four-level pulse amplitude modulation (PAM4), or up to 32 GBd using non-return-to-zero (NRZ) modulation. It is used to extend the reach and robustness of high-speed serial links for backplane, midplane, and active copper cable (ACC) applications. The DS560MB410 can increase the reach between two ASICs by 18+ dB beyond the normal ASIC-to-ASIC reach.

Each channel operates independently with a user-selectable CTLE boost profile optimized for equalizing either PCB or copper cable loss profiles. The linear nature of the DS560MB410's equalization preserves input signal characteristics traveling through the redriver. This transparency allows link partner ASICs to negotiate Tx equalizer coefficients freely during link training and to support individual lane Forward Error Correction (FEC) pass-through in mission mode with minimal effect on latency.

Package Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
DS560MB410	ZAS (nFBGA, 101)	6.00 mm × 6.00 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



(1) SMBus signals need to be pulled up elsewhere in the system.

Simplified Schematic

Table of Contents

4 Revision History

DATE	REVISION	NOTES
December 2022	*	Initial Release

5 Description (Continued)

The DS560MB410 includes a full 2×2 crosspoint between each pair of adjacent channels to enable 2-to-1 multiplexing and 1-to-2 de-multiplexing for failover redundancy, 1-to-2 fanout for diagnostic monitoring, and signal crossover for PCB routing flexibility. The crosspoint is controllable through pins or the SMBus register interface.

The DS560MB410's small package dimensions and optimized high-speed signal escape are ideal for small form-factor applications. Simplified equalization control, low power consumption, and ultra-low additive jitter make it suitable for chip-to-chip reach extension and signal distribution over backplanes and midplanes. The small 6.00 mm × 6.00 mm footprint easily fits in active copper cable (ACC) assembly applications without the need for a heat sink.

The DS560MB410 has a single power supply and minimal need for external components. These features reduce PCB routing complexity and bill of materials (BOM) cost. The DS560MB410 can be configured through SMBus or through an external EEPROM. Up to 16 devices can share a single EEPROM.

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.
All trademarks are the property of their respective owners.

6.5 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

6.6 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS560MB410ZASR	ACTIVE	NFBGA	ZAS	101	2500	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410	Samples
DS560MB410ZAST	ACTIVE	NFBGA	ZAS	101	250	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 85	DS56MB410	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

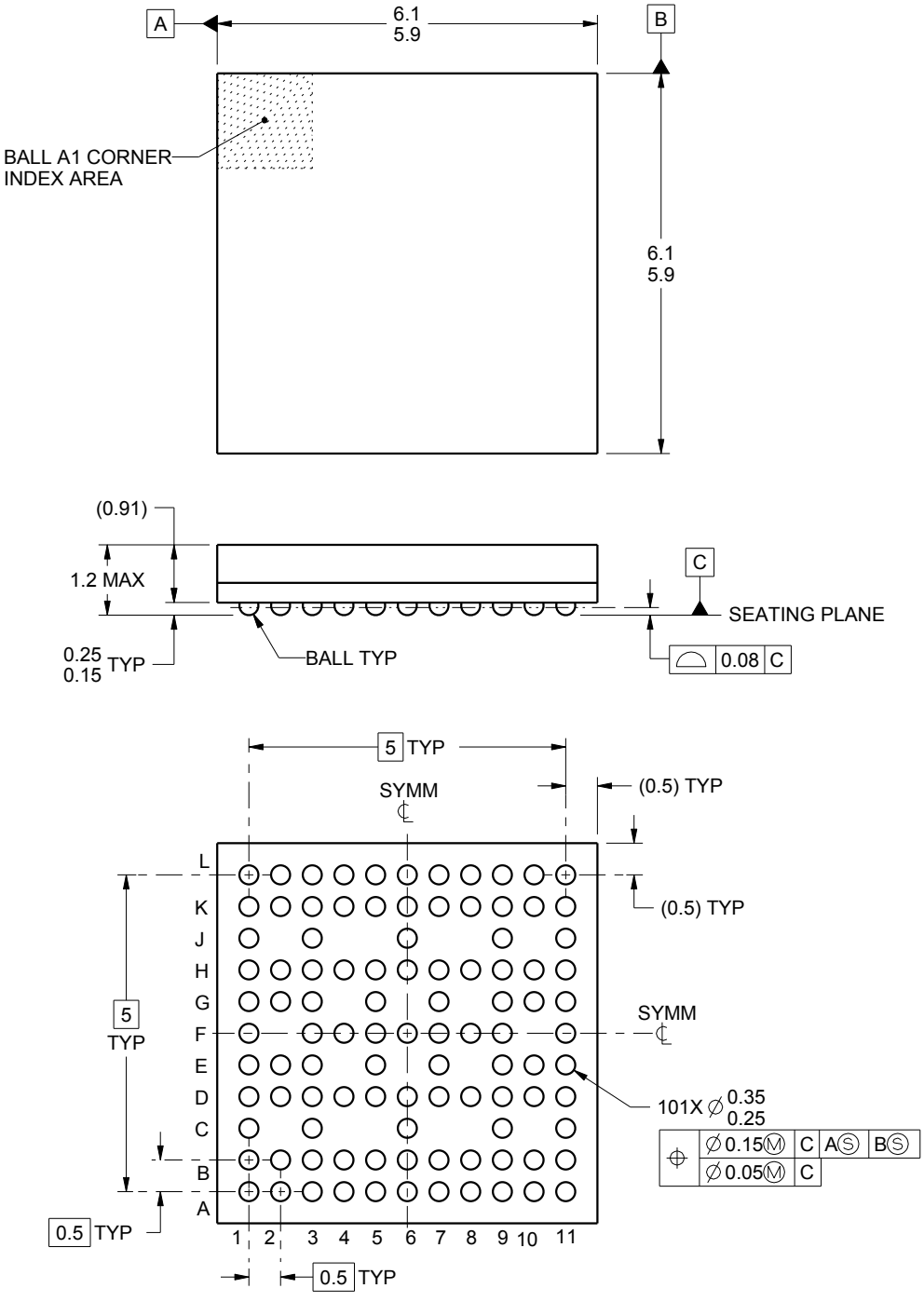
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

PACKAGE OUTLINE

ZAS0101A

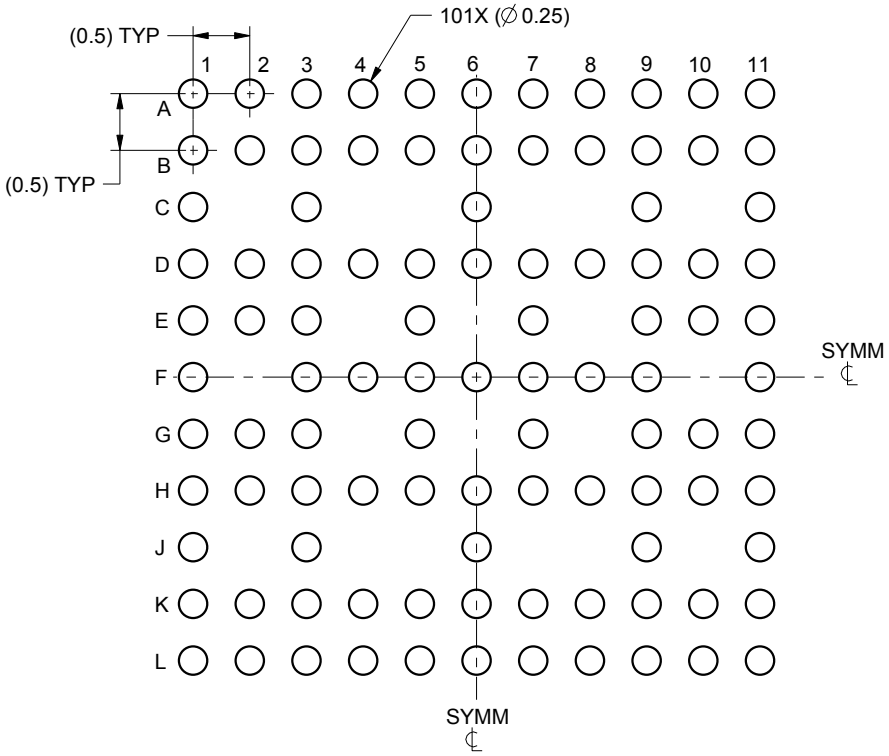
NFBGA - 1.2 mm max height

PLASTIC BALL GRID ARRAY

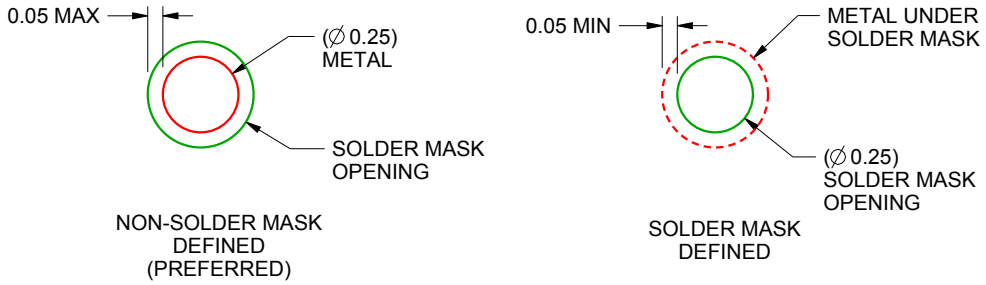


NOTES:

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.



LAND PATTERN EXAMPLE
SCALE:15X

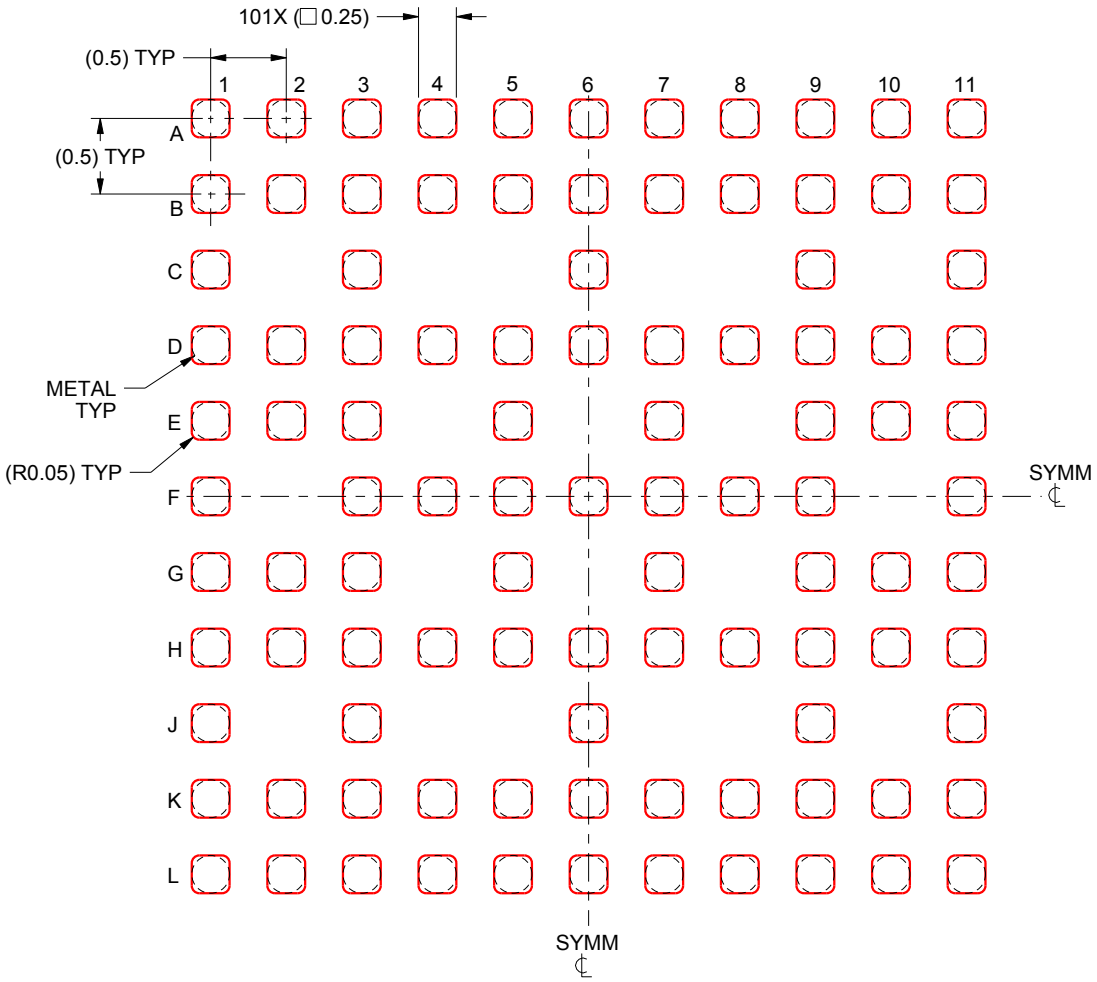


SOLDER MASK DETAILS
NOT TO SCALE

4222303/A 09/2015

NOTES: (continued)

3. 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).



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

4222303/A 09/2015

NOTES: (continued)

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

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