ABSTRACT
The DS320-SLIMSAS-EVM together with the DS320PR810-RSC-EVM, or other Texas Instrument's riser-card style PCI-Express™ 5.0 redriver evaluation module, provides a complete high-bandwidth platform for evaluating the signal conditioning features of the Texas Instruments PCI-Express 5.0 linear redrivers. These evaluation boards can be used for performance evaluation and initial system prototyping.

Figure 1-1. DS320-SLIMSAS-EVM – Top Side View

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Trademarks
PCI-Express™ is a trademark of PCI SIG.
All trademarks are the property of their respective owners.
1 Introduction

DS320-SLIMSAS-EVM is a PCI-Express 5.0 x16 to two x8 SlimSAS (SFF-8654) adapter, which enables DS320PR810-RSC-EVM and other Texas Instruments PCI-Express 5.0 redriver riser card evaluation modules to interface with up to four U.2 solid state drives (SSDs) using commercially available SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assemblies (not included). Interface to M.2 SSDs is also possible using commercially available U.2 to M.2 adapter cards (not included).

DS320-SLIMSAS-EVM features Texas instruments LMK00334 PCI-Express clock buffer for distributing the PCI-Express 100 MHz reference clock to downstream SSDs. It also allows flexible assignment of the PCI-Express side band signals using jumpers.

1.1 Features

- PCIe-Express CEM 5.0 compliant Goldfinger connector
- Two x8 SlimSAS (SFF-8654) connectors
- LMK00334 PCI-Express clock buffer
- Flexible assignment of PCI-Express side band signals
- Supports PCI-Express 1 x4, 2 x4, and 4 x4 bifurcation

1.2 Applications

- PCI Express Gen-1, 2, 3, 4 and 5
- Enterprise storage

1.3 Description

1.3.1 Connectors and Access Points

Table 1-1 shows DS320-SLIMSAS-EVM main connectors and access points.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>NAME</th>
<th>FUNCTION / DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>P2</td>
<td>PCIe 4.0 x8 SlimSAS Connector 1</td>
<td>Access points to PCIe lanes 0 - 7. Use a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) to interface to SSDs with U.2 form factor.</td>
</tr>
<tr>
<td>P3</td>
<td>PCIe 4.0 x8 SlimSAS Connector 1</td>
<td>Access points to PCIe lanes 8 - 15. Use a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) to interface to SSDs with U.2 form factor.</td>
</tr>
<tr>
<td>P1</td>
<td>PCIe CEM 5.0 x16 Goldfinger Connector</td>
<td>Access points to PCIe lanes 0 - 15. Plug into a PCIe x16 CEM slot.</td>
</tr>
<tr>
<td>J7</td>
<td>3x1 Header</td>
<td>I2C bus access point.</td>
</tr>
<tr>
<td>J1</td>
<td>2x1 Header</td>
<td>Access point to WAKE and CLKREQ pins on the CEM connector.</td>
</tr>
</tbody>
</table>

Table 1-2 shows PCIe side band signal controls and access points.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>NAME</th>
<th>FUNCTION / DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>J8</td>
<td>3x1 Header</td>
<td>Provision for connecting PERST# signal from the CEM connector to B11 or B12 pin of SlimSAS connector P2. Shunt installed across pins 1-2: PERST# signal routed to B11 pin of SlimSAS connector P2. Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector P2 (default).</td>
</tr>
<tr>
<td>J10</td>
<td>3x1 Header</td>
<td>Provision for connecting PERST# signal from the CEM connector to B29 or B30 pin of SlimSAS connector P2. Shunt installed across pins 1-2: PERST# signal routed to B29 pin of SlimSAS connector P2. Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector P2 (default).</td>
</tr>
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### Table 1-2. PCIe Side Band Signal Controls (continued)

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<tr>
<th>COMPONENT</th>
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<th>FUNCTION / DESCRIPTION</th>
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<tr>
<td>J16</td>
<td>4x2 Header</td>
<td>Provision for connecting PRSNT1 signal to PRSNT2_1, PRSNT2_2, PRSNT2_3 and PRSNT2_4 pins on the CEM connector. Shunt installed across pins 1-2: PRSNT1 signal routed to PRSNT2_1 pin on the CEM connector (default). Shunt installed across pins 3-4: PRSNT1 signal routed to PRSNT2_2 pin on the CEM connector (default). Shunt installed across pins 5-6: PRSNT1 signal routed to PRSNT2_3 pin on the CEM connector (default). Shunt installed across pins 7-8: PRSNT1 signal routed to PRSNT2_4 pin on the CEM connector (default).</td>
</tr>
<tr>
<td>J5</td>
<td>4x1 Header</td>
<td>Access point to the pins A8, A9, A26, and A27 of SlimSAS connector P2.</td>
</tr>
<tr>
<td>J6</td>
<td>4x1 Header</td>
<td>Access point to the pins A8, A9, A26, and A27 of SlimSAS connector P3.</td>
</tr>
<tr>
<td>J12</td>
<td>3x1 Header</td>
<td>Provision for connecting PRSNT2_2 pin on the CEM connector to B11 or B12 pin of SlimSAS connector P2.</td>
</tr>
<tr>
<td>J14</td>
<td>3x1 Header</td>
<td>Provision for connecting PRSNT2_1 pin on the CEM connector to B29 or B30 pin of SlimSAS connector P2.</td>
</tr>
<tr>
<td>J13</td>
<td>3x1 Header</td>
<td>Provision for connecting PRSNT2_4 pin on the CEM connector to B11 or B12 pin of SlimSAS connector P3.</td>
</tr>
<tr>
<td>J15</td>
<td>3x1 Header</td>
<td>Provision for connecting PRSNT2_3 pin on the CEM connector to B29 or B30 pin of SlimSAS connector P3.</td>
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</table>

Table 1-2 shows PCIe reference clock controls and access points.

### Table 1-3. PCIe Reference Clock Controls and Access Points

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>NAME</th>
<th>FUNCTION / DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>JMP2</td>
<td>3x1 Header</td>
<td>Clock distributor (LMK00334) output enable Shunt installed across pins 1-2: outputs disabled. Shunt installed across pins 2-3: outputs enabled (default).</td>
</tr>
<tr>
<td>JMP1</td>
<td>3x1 Header</td>
<td>Clock distributor (LMK00334) input select Shunt installed across pins 1-2: CLKIN1 (An external clock source coming from the SMP connectors) selected. Shunt installed across pins 2-3: CLKIN0 (PCIe system clock coming from the CEM connector) selected (default).</td>
</tr>
<tr>
<td>J2 - J3</td>
<td>SMP Connectors</td>
<td>Provision for connecting an external clock source to the LMK00334 CLK1 input Plug into a PCIe x16 CEM slot.</td>
</tr>
<tr>
<td>JMP3</td>
<td>3x1 Header</td>
<td>Clock distributor (LMK00334) LVCMOS reference output enable Shunt installed across pins 1-2: reference output enabled. Shunt installed across pins 2-3: reference output disabled (default).</td>
</tr>
<tr>
<td>J4</td>
<td>SMP Connector</td>
<td>Access point to the LMK00334 reference output.</td>
</tr>
</tbody>
</table>
1.4 Quick-Start Guide

1. Check that the shunts are at the following default positions as shown in Figure 1-1.
   • J8: Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector P2.
   • J10: Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector P2.
   • J9: Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector P3.
   • J11: Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector P3.
   • J16: Shunts installed across pins 1-2, 3-4, 5-6, and 7-8: PRSNT1 signal routed to PRSNT2_1, PRSNT2_2, PRSNT2_3, and PRSNT2_4 pins on the CEM connector.
   • JMP2: Shunt installed across pins 2-3: LMK00334 outputs enabled.
   • JMP1: Shunt installed across pins 2-3: PCIe system clock selected as an input to the LMK00334.
   • JMP3: Shunt installed across pins 2-3: LMK00334 reference output disabled.

2. Plug DS320PR810-RSC-EVM, or other riser card style TI evaluation board into a PCIe x16 CEM slot on a motherboard. Ensure that the motherboard is powered down prior to installing the riser card.

3. Install DS320-SLIMSAS-EVM into the straddle connector on the riser card selected in the prior step.

4. Connect a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) into the SlimSAS connector P2 of the DS320-SLIMSAS-EVM. Alternatively, connect the second cable assembly into the SlimSAS connector P3 of the DS320-SLIMSAS-EVM.

5. Attached an endpoint or endpoints on the other side of the cable. Ensure that the power is also provided to one or more of the endpoints prior to powering up the motherboard.

6. Power-up the motherboard.

7. Observe a successful linkup of one or more of the endpoints using system BIOS or other available system utility.

2 Typical Test Setup

Figure 2-1 shows a typical system test setup with the DS320PR810-RSC-EVM and DS320-SLIMSAS-EVM placed between a CPU on a server motherboard and PCIe 5.0 endpoints. The endpoints are SSDs with M.2 form factor mounted on U.2 to M.2 adapters.

The test setup features the following items not included in the DS320-SLIMSAS-EVM:
• SlimSAS x8 (SFF-8654) to 2x PCIe Drive Receptacle (SFF-8639) Cable (for U.2, 1×4 only), Part #: SLSP-8X-39X2F4-0.5M. More information about this item is available here.
• PCIe 4.0 U.2 to M.2 Adapter, Part #: PCI-AD-U2M2-04-G4. More information about this item is available here.
3 Board Layout

Figure 3-1. Top Layer

Figure 3-2. Bottom Layer
4 Schematic

Figure 4-1. Controls Schematic Page
Figure 4-2. Clock Distribution Schematic Page
Figure 4-3. Goldfinger Connector Schematic Page
Figure 4-4. SlimSAS Connector 1 Schematic Page
Figure 4-5. SlimSAS Connector 2 Schematic Page
## 5 Bill of Materials

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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 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。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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.

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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/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。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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.
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 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:

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