

# CEM2SLIMSAS-EVM Evaluation Module (EVM)



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## ABSTRACT

The CEM2SLIMSAS-EVM together with the DS160PR410EVM-RSC, or other Texas Instrument's riser-card style PCI-Express 4.0 redriver or retimer evaluation module, provide a complete high-bandwidth platform for evaluating the signal conditioning features of the Texas Instruments PCI-Express 4.0 linear redrivers and retimers. These evaluation boards can be used for standard compliance testing, performance evaluation, and initial system prototyping.

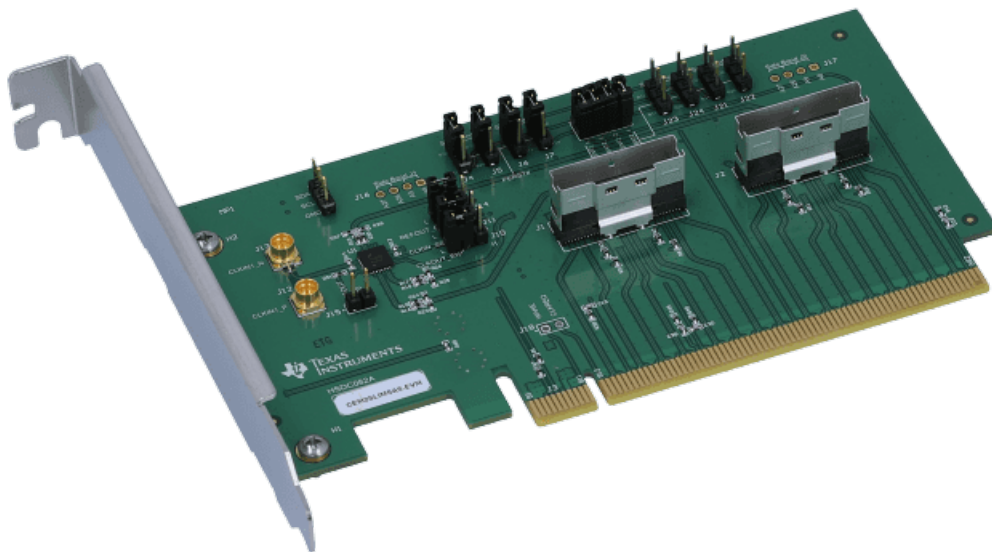


Figure 1-1. CEM2SLIMSAS-EVM - Top Side Photo

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## 1 Introduction

CEM2SLIMSAS-EVM is a PCI-Express 4.0 x16 to two x8 SlimSAS (SFF-8654) adapter. It enables DS160PR410EVM-RSC and other Texas Instruments PCI-Express 4.0 redriver or retimer riser card evaluation modules to interface to 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).

CEM2SLIMSAS-EVM features Texas instruments LMK00334 PCI-Express 4.0 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 4.0 compliant Goldfinger connector
- Two x8 SlimSAS (SFF-8654) connectors
- LMK00334 PCI-Express 4.0 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, and 4
- Enterprise storage

### 1.3 Description

#### 1.3.1 Connectors and Access Points

Table 1-1 shows CEM2SLIMSAS-EVM main connectors and access points.

**Table 1-1. Main Connectors and Access Points**

| COMPONENT | NAME                                  | FUNCTION / DESCRIPTION   |
|-----------|---------------------------------------|--|
| J1        | PCIe 4.0 x8 SlimSAS Connector 1       | Access points to PCIe lanes 0 - 7.<br>Use a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) to interface to SSDs with U.2 form factor.  |
| J2        | PCIe 4.0 x8 SlimSAS Connector 1       | Access points to PCIe lanes 8 - 15.<br>Use a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) to interface to SSDs with U.2 form factor. |
| J3        | PCIe CEM 4.0 x16 Goldfinger Connector | Access points to PCIe lanes 0 - 15.<br>Plug into a PCIe x16 CEM slot.  |
| J8        | 3x1 Header                            | I2C bus access point.  |
| J18       | 2x1 Header                            | Access point to WAKE and CLKREQ pins on the CEM connector.   |

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

**Table 1-2. PCIe Side Band Signal Controls**

| COMPONENT | NAME       | FUNCTION / DESCRIPTION   |
|-----------|------------|--|
| J4        | 3x1 Header | Provision for connecting PERST# signal from the CEM connector to B11 or B12 pin of SlimSAS connector J1.<br>Shunt installed across pins 1-2: PERST# signal routed to B11 pin of SlimSAS connector J1.<br>Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector J1 (default). |
| J5        | 3x1 Header | Provision for connecting PERST# signal from the CEM connector to B29 or B30 pin of SlimSAS connector J1.<br>Shunt installed across pins 1-2: PERST# signal routed to B29 pin of SlimSAS connector J1.<br>Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector J1 (default). |

**Table 1-2. PCIe Side Band Signal Controls (continued)**

| COMPONENT | NAME       | FUNCTION / DESCRIPTION   |
|-----------|------------|--|
| J6        | 3x1 Header | Provision for connecting PERST# signal from the CEM connector to B11 or B12 pin of SlimSAS connector J2.<br>Shunt installed across pins 1-2: PERST# signal routed to B11 pin of SlimSAS connector J2.<br>Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector J2 (default).   |
| J7        | 3x1 Header | Provision for connecting PERST# signal from the CEM connector to B29 or B30 pin of SlimSAS connector J2.<br>Shunt installed across pins 1-2: PERST# signal routed to B29 pin of SlimSAS connector J2.<br>Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector J2 (default).   |
| J9        | 4x2 Header | Provision for connecting PRSNT1 signal to PRSNT2_1, PRSNT2_2, PRSNT2_3 and PRSNT2_4 pins on the CEM connector.<br>Shunt installed across pins 1-2: PRSNT1 signal routed to PRSNT2_1 pin on the CEM connector (default).<br>Shunt installed across pins 3-4: PRSNT1 signal routed to PRSNT2_2 pin on the CEM connector (default).<br>Shunt installed across pins 5-6: PRSNT1 signal routed to PRSNT2_3 pin on the CEM connector (default).<br>Shunt installed across pins 7-8: PRSNT1 signal routed to PRSNT2_4 pin on the CEM connector (default). |
| J16       | 4x1 Header | Access point to the pins A8, A9, A26, and A27 of SlimSAS connector J1.   |
| J17       | 4x1 Header | Access point to the pins A8, A9, A26, and A27 of SlimSAS connector J2.   |
| J21       | 3x1 Header | Provision for connecting PRSNT2_2 pin on the CEM connector to B11 or B12 pin of SlimSAS connector J1.  |
| J22       | 3x1 Header | Provision for connecting PRSNT2_1 pin on the CEM connector to B29 or B30 pin of SlimSAS connector J1.  |
| J23       | 3x1 Header | Provision for connecting PRSNT2_4 pin on the CEM connector to B11 or B12 pin of SlimSAS connector J2.  |
| J24       | 3x1 Header | Provision for connecting PRSNT2_3 pin on the CEM connector to B29 or B30 pin of SlimSAS connector J2.  |

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

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

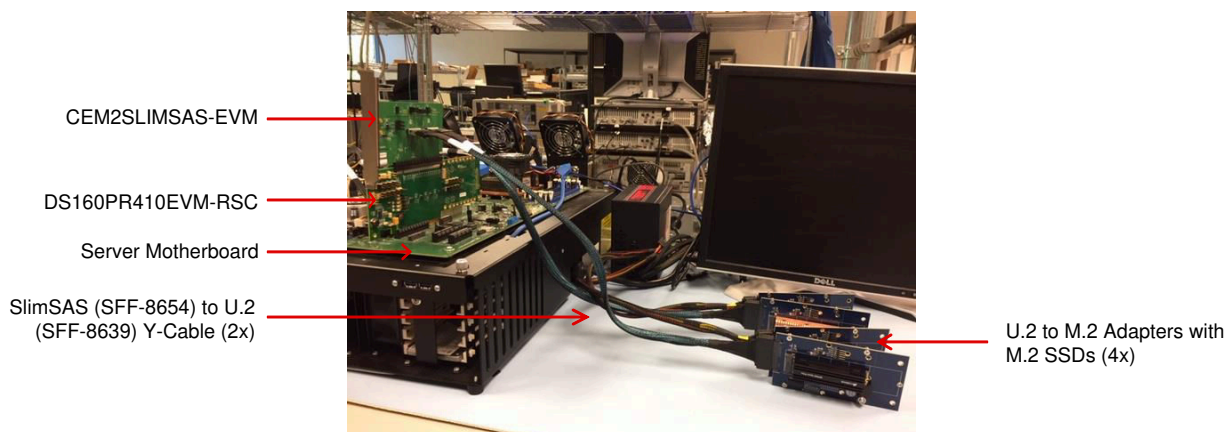
| COMPONENT | NAME           | FUNCTION / DESCRIPTION  |
|-----------|----------------|---|
| J10       | 3x1 Header     | Clock distributor (LMK00334) output enable<br>Shunt installed across pins 1-2: outputs disabled.<br>Shunt installed across pins 2-3: outputs enabled (default).   |
| J11       | 3x1 Header     | Clock distributor (LMK00334) input select<br>Shunt installed across pins 1-2: CLKIN1 (An external clock source coming from the SMP connectors) selected.<br>Shunt installed across pins 2-3: CLKIN0 (PCIe system clock coming from the CEM connector) selected (default). |
| J12 - J13 | SMP Connectors | Provision for connecting an external clock source to the LMK00334 CLK1 input<br>Plug into a PCIe x16 CEM slot.  |
| J14       | 3x1 Header     | Clock distributor (LMK00334) LVCMOS reference output enable<br>Shunt installed across pins 1-2: reference output enabled.<br>Shunt installed across pins 2-3: reference output disabled (default).  |
| J15       | 2x1 Header     | Access point to the LMK00334 reference output.  |

## 1.4 Quick-Start Guide

- Check that the shunts are at the following default positions as shown in [Figure 1-1](#).
  - J4: Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector J1.
  - J5: Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector J1.
  - J6: Shunt installed across pins 2-3: PERST# signal routed to B12 pin of SlimSAS connector J2.
  - J7: Shunt installed across pins 2-3: PERST# signal routed to B30 pin of SlimSAS connector J2.
  - J9: 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.
  - J10: Shunt installed across pins 2-3: LMK00334 outputs enabled.
  - J11: Shunt installed across pins 2-3: PCIe system clock selected as an input to the LMK00334.
  - J14: Shunt installed across pins 2-3: LMK00334 reference output disabled.
- Plug DS160PR410EVM-RSC, 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.
- Install CEM2SLIMSAS-EVM into the straddle connector on the riser card selected in the prior step.
- Connect a SlimSAS (SFF-8654) to U.2 (SFF-8639) cable assembly (not included) into the SlimSAS connector J1 of the CEM2SLIMSAS-EVM. Alternatively, connect the second cable assembly into the SlimSAS connector J2 of the CEM2SLIMSAS-EVM.
- Attached an endpoint or endpoints on the other side of the cable. Ensure that the power is also provided to the endpoint(s) prior to powering up the motherboard.
- Power-up the motherboard.
- Observe a successful linkup of the endpoint(s) using system BIOS or other available system utility.

## 2 Typical Test Setup

[Figure 2-1](#) shows a typical system test setup with the DS160PR410EVM-RSC and CEM2SLIMSAS-EVM placed between a CPU on a server motherboard and PCIe 4.0 endpoints. The endpoints are SSDs with M.2 form factor mounted on U.2 to M.2 adapters.



**Figure 2-1. Example Test Setup**

The test setup features the following items not included in the CEM2SLIMSAS-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

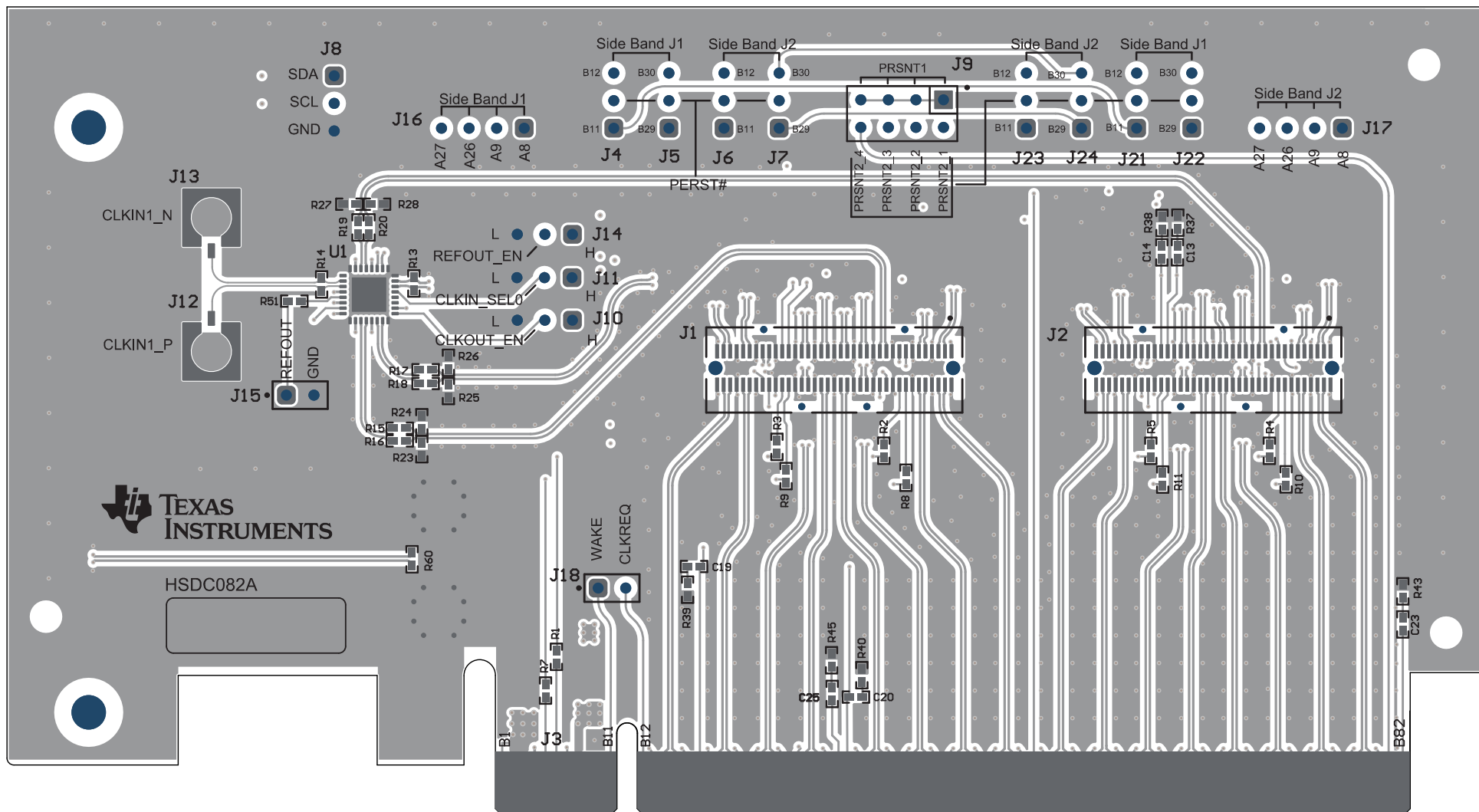


Figure 3-1. Top Layer

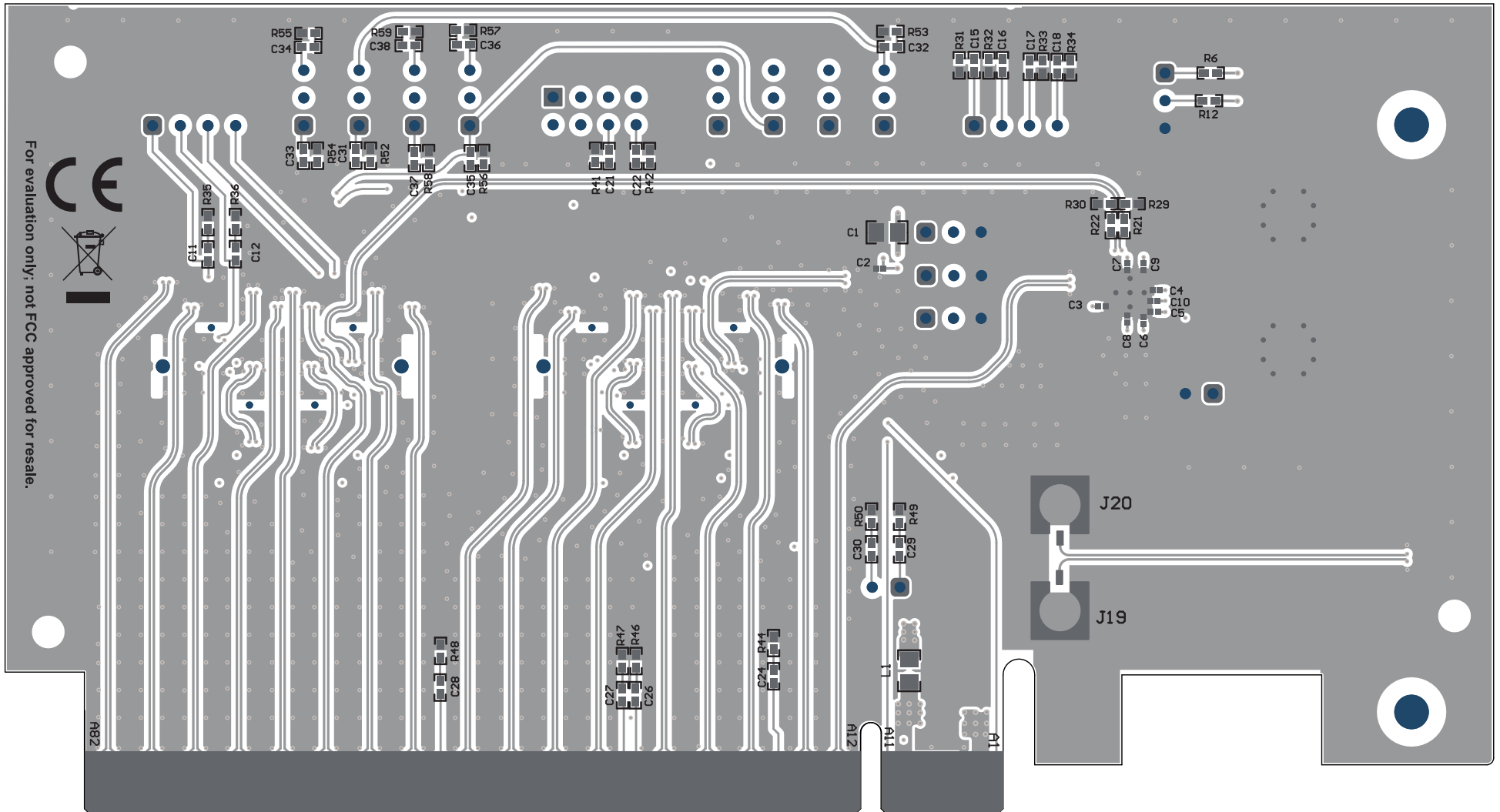
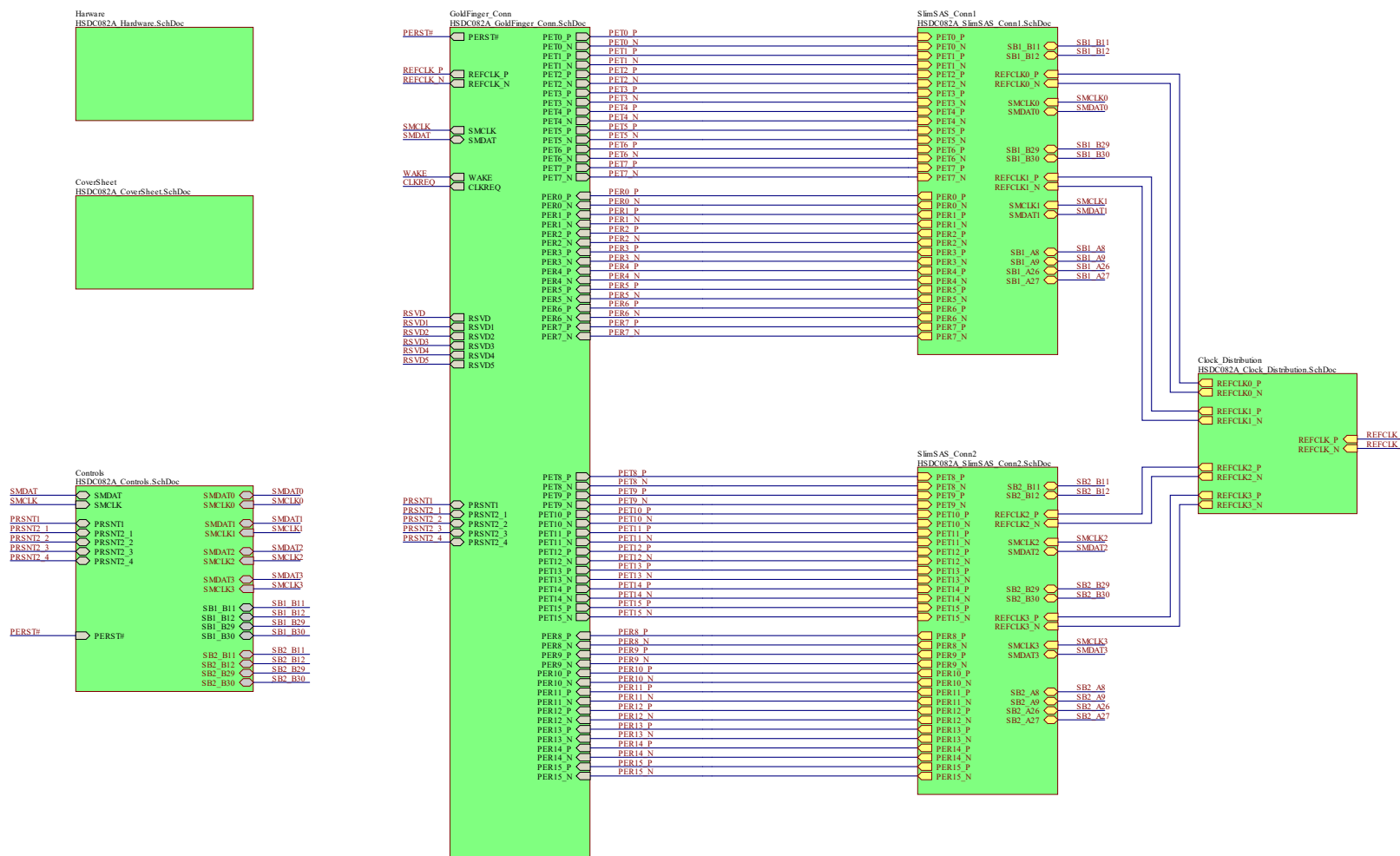


Figure 3-2. Bottom Layer

## 4 Schematic and Bill of Materials

### 4.1 Schematic

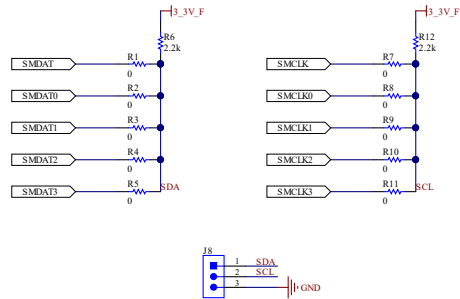


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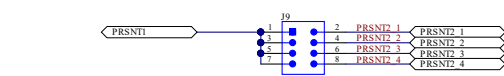
Figure 4-1. Top Level Schematic Page



DC Signals



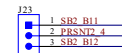
PRESENT Signals



J9 is a provision for connecting PRSNT1 signal to PRSNT2\_1, PRSNT2\_2, PRSNT2\_3 and PRSNT2\_4 pins on CEM connector.



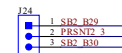
J21 is a provision for connecting PRSNT2\_2 signal from CEM connector to B11 or B12 pin of SlnSAS connector J1.



J23 is a provision for connecting PRSNT2\_4 signal from CEM connector to B11 or B12 pin of SlnSAS connector J2.



J22 is a provision for connecting PRSNT2\_1 signal from CEM connector to B29 or B30 pin of SlnSAS connector J1.



J24 is a provision for connecting PRSNT2\_3 signal from CEM connector to B29 or B30 pin of SlnSAS connector J2.

PCB Global RESET Signals



J4 is a provision for connecting PERSTP signal from CEM connector to B11 or B12 pin of SlnSAS connector J1.



J6 is a provision for connecting PERSTP signal from CEM connector to B11 or B12 pin of SlnSAS connector J2.

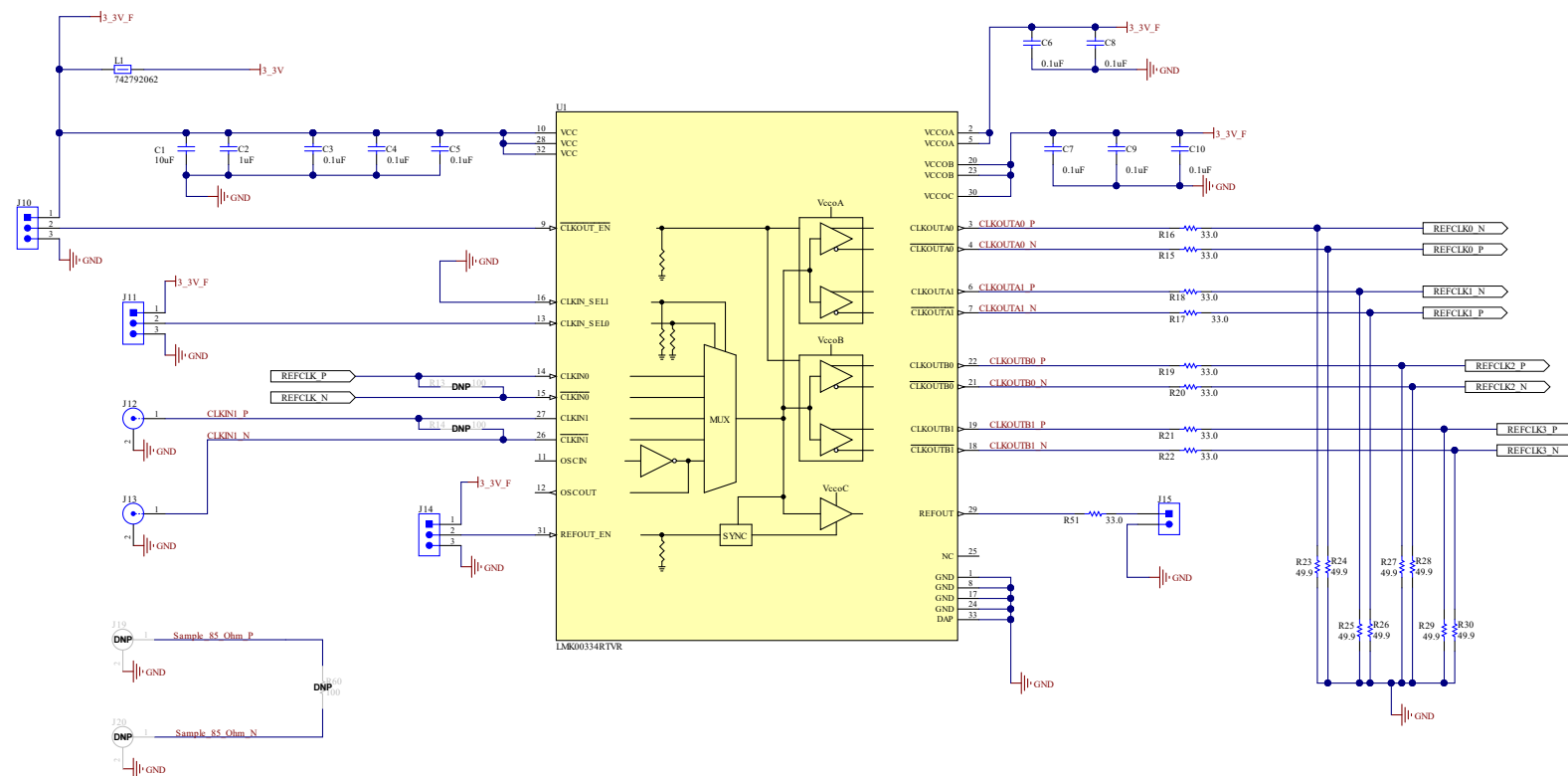


J5 is a provision for connecting PERSTP signal from CEM connector to B29 or B30 pin of SlnSAS connector J1.



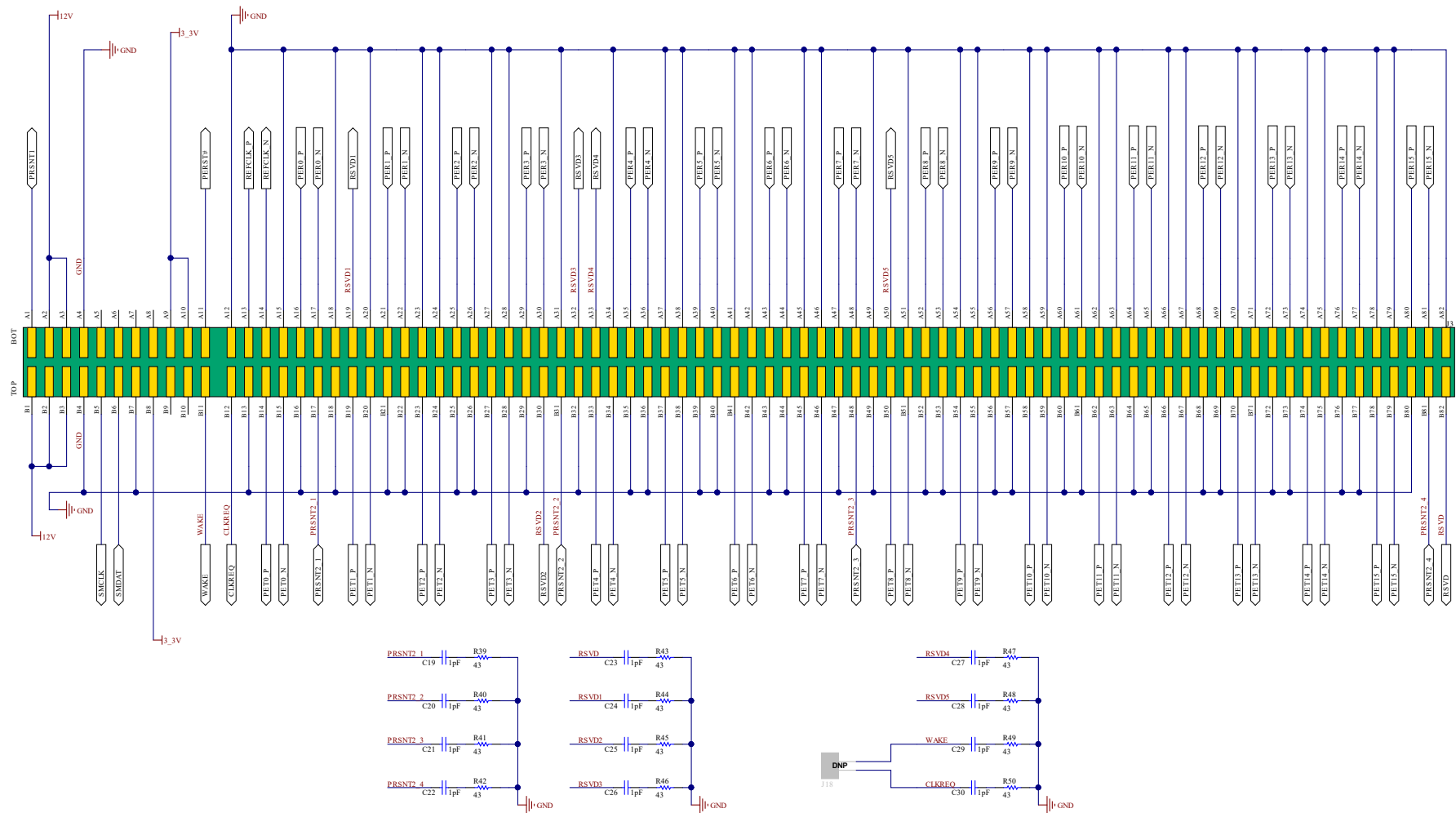
J7 is a provision for connecting PERSTP signal from CEM connector to B29 or B30 pin of SlnSAS connector J2.

Figure 4-2. Controls Schematic Page



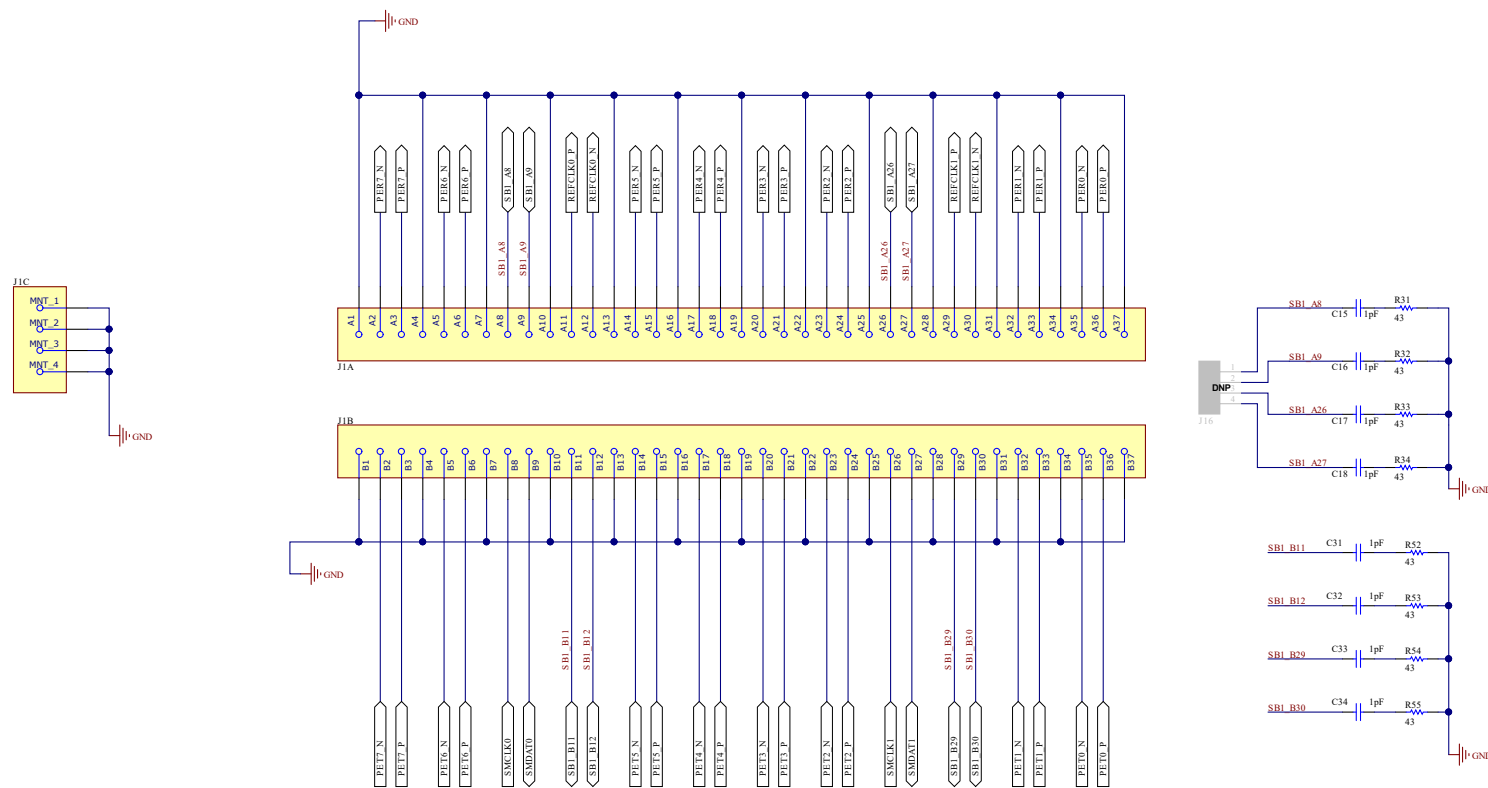
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Figure 4-3. Clock Distribution Schematic Page



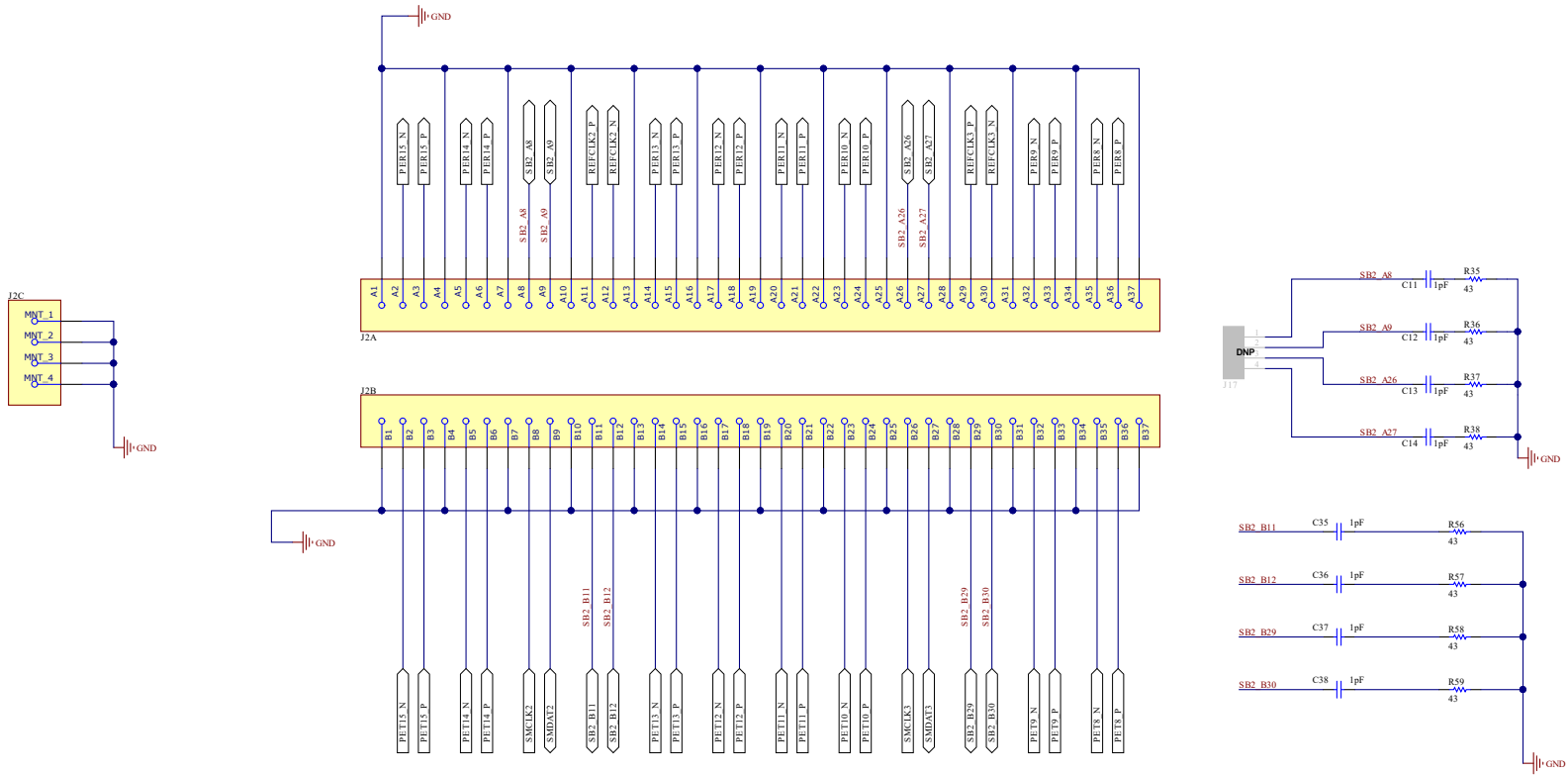
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Figure 4-4. Goldfinger Connector Schematic Page



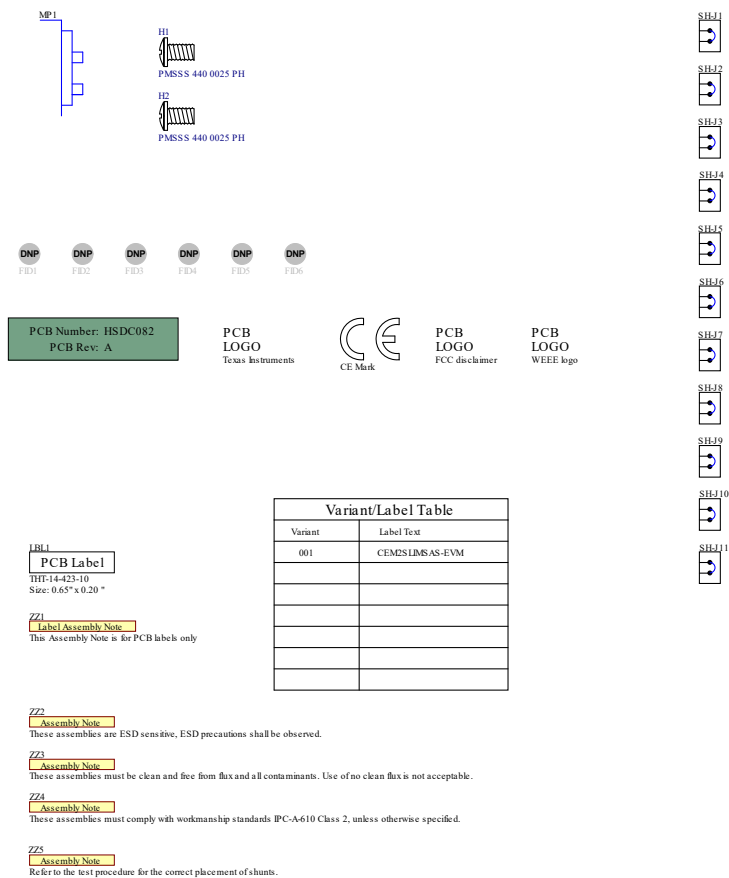
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**Figure 4-5. SlimSAS Connector 1 Schematic Page**



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Figure 4-6. SlimSAS Connector 2 Schematic Page



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**Figure 4-7. Hardware Page**

## 4.2 Bill of Materials

**Table 4-1. Bill of Materials**

| DESIGNATOR   | QTY | VALUE  | DESCRIPTION  | PACKAGE REFERENCE             | PART NUMBER        | MANUFACTURER            |
|--|-----|--------|--|-------------------------------|--------------------|-------------------------|
| !PCB1  | 1   |        | Printed Circuit Board  |                               | HSDC082            | Any                     |
| C1   | 1   | 10uF   | CAP, CERM, 10 uF, 10 V, +/- 10%, X5R, 0805                               | 0805                          | C0805C106K8PACTU   | Kemet                   |
| C2   | 1   | 1uF    | CAP, CERM, 1 uF, 6.3 V, +/- 20%, X5R, 0201                               | 0201                          | GRM033R60J105MEA2D | MuRata                  |
| C3, C4, C5, C6, C7, C8, C9, C10  | 8   | 0.1uF  | CAP, CERM, 0.1 uF, 6.3 V, +/- 10%, X5R, 0201                             | 0201                          | GRM033R60J104KE19D | MuRata                  |
| C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38 | 28  | 1pF    | CAP, CERM, 1 pF, 50 V, +/- 10%, C0G/NPO, 0402                            | 0402                          | GJM1555C1H1R0BB01D | MuRata                  |
| H1, H2   | 2   |        | MACHINE SCREW PAN PHILLIPS 4-40  | Machine Screw, 4-40, 1/4 inch | PMSSS 440 0025 PH  | B and F Fastener Supply |
| J1, J2   | 2   |        | CONN MINISAS RCTP SLDR SMD   | HDR74                         | U10-B074-200T      | Amphenol                |
| J4, J5, J6, J7, J8, J10, J11, J14, J21, J22, J23, J24  | 12  |        | Header, 100mil, 3x1, Gold, TH  | 3x1 Header                    | TSW-103-07-G-S     | Samtec                  |
| J9   | 1   |        | Header, 100mil, 4x2, Gold, TH  | 4x2 Header                    | TSW-104-07-G-D     | Samtec                  |
| J12, J13   | 2   |        | Plug, 50 Ohm, Straight, SMT  | SMA Plug, Straight, SMT       | 0853050232         | Molex                   |
| J15  | 1   |        | Header, 100mil, 2x1, Gold, TH  | 2x1 Header                    | TSW-102-07-G-S     | Samtec                  |
| L1   | 1   | 80 ohm | Ferrite Bead, 80 ohm @ 100 MHz, 0.5 A, 0805                              | 0805                          | 742792062          | Würth Elektronik        |
| LBL1   | 1   |        | Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll | PCB Label 0.650 x 0.200 inch  | THT-14-423-10      | Brady                   |
| MP1  | 1   |        | PCI bracket  | PCI_BRCKT_NPTH_2              | 9B90-0000A         | Gompf Brackets, Inc.    |
| R1, R2, R3, R4, R5, R7, R8, R9, R10, R11   | 10  | 0      | RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402                                | 0402                          | ERJ-2GE0R00X       | Panasonic               |
| R6, R12  | 2   | 2.2k   | RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402                          | 0402                          | CRCW04022K20JNED   | Vishay-Dale             |

Table 4-1. Bill of Materials (continued)

| DESIGNATOR   | QTY | VALUE | DESCRIPTION  | PACKAGE REFERENCE       | PART NUMBER      | MANUFACTURER                |
|--|-----|-------|--|-------------------------|------------------|-----------------------------|
| R15, R16, R17, R18, R19, R20, R21, R22, R51  | 9   | 33.0  | RES, 33.0, 1%, 0.062 W, 0402   | 0402                    | RC0402FR-0733RL  | Yageo America               |
| R23, R24, R25, R26, R27, R28, R29, R30   | 8   | 49.9  | RES, 49.9, 1%, 0.063 W, 0402   | 0402                    | RC0402FR-0749R9L | Yageo America               |
| R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R52, R53, R54, R55, R56, R57, R58, R59 | 28  | 43    | RES, 43, 5%, 0.063 W, AEC-Q200 Grade 0, 0402   | 0402                    | CRCW040243R0JNED | Vishay-Dale                 |
| SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11  | 11  | 1x2   | Shunt, 100mil, Flash Gold, Black   | Closed Top 100mil Shunt | SPC02SYAN        | Sullins Connector Solutions |
| U1   | 1   |       | LMK00334 4-Output PCIe Gen1/Gen2/Gen3/Gen4 Clock Buffer/Level Translator, RTV0032A (WQFN-32) | RTV0032A                | LMK00334RTVR     | Texas Instruments           |
| FID1, FID2, FID3, FID4, FID5, FID6   | 0   |       | Fiducial mark. There is nothing to buy or mount.   | N/A                     | N/A              | N/A                         |
| J16, J17   | 0   |       | Header, 100mil, 4x1, Gold, TH  | 4x1 Header              | TSW-104-07-G-S   | Samtec                      |
| J18  | 0   |       | Header, 100mil, 2x1, Gold, TH  | 2x1 Header              | TSW-102-07-G-S   | Samtec                      |
| J19, J20   | 0   |       | Plug, 50 Ohm, Straight, SMT  | SMP Plug, Straight, SMT | 0853050232       | Molex                       |
| R13, R14, R60  | 0   | 100   | RES, 100, 1%, 0.063 W, AEC-Q200 Grade 0, 0402  | 0402                    | CRCW0402100RFKED | Vishay-Dale                 |



## 5 References

For references, see the following:

1. Texas Instruments, [DS160PR410 Quad-Channel PCI-Express 4.0 Linear Redriver Datasheet](#) (SNLS645)
2. Texas Instruments, [LMK00334 Four-Output PCIe/Gen1/Gen2/Gen3/Gen4 Clock Buffer and Level Translator Datasheet](#) (SNAS635)
3. Texas Instruments, [DS160PR410EVM-RSC Evaluation Module User's Guide](#) (SNLU252)

## 6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from Revision * (April 2020) to Revision A (July 2021)</b>                                | <b>Page</b> |
|--|-------------|
| • Updated the numbering format for tables, figures and cross-references throughout the document..... | <b>3</b>    |

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