

4x4 Crosspoint Switch EVM

User's Guide

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address:
Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Copyright © 2003 - 2004, Texas Instruments Incorporated

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user is **not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Copyright © 2003 - 2004, Texas Instruments Incorporated



EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -0.7 V to 4 V and the output voltage range of -0.5 V to 4 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Copyright © 2003 - 2004, Texas Instruments Incorporated

Read This First

About This Manual

This evaluation module (EVM) user's guide describes the hardware, theory of operation, and use of the EVM for evaluating the high-speed performance and functionality of either the SN65LVDS125A or SN65LVDS250 4x4 crosspoint switches.

How to Use This Manual

Chapter 1 provides an overview of the functional configurations and signal paths. Typical hardware setup and results are discussed in Chapter 2. Chapter 3 provides schematics, the board layout, the board layers, fabrication notes, and bill of materials

Related Documentation from Texas Instruments

SN65LVDS125A, 4x4 1.5 Gbps LVDS Crosspoint Switch Data Sheet (SLLS595).

SN65LVDS250, 4x4 2.5 Gbps LVDS Crosspoint Switch Data Sheet (SLLS594).

If You Need Assistance

www.ti.com

E-mail technical support http://www-k.ext.ti.com/sc/technical_support/email_tech_support.asp

Product Information Centers:

Americas (972) 644-5580

Australia 1-800-999-084

Belgium (English) +32 (0) 27 45 55 32

China 108-00-886-0015

Finland (English) +358 (0) 9 25173948

France +33 (0) 1 30 70 11 64

Germany +49 (0) 8161 80 33 11

Hong Kong 800-96-5941

Indonesia 001-803-8861-1006

Israel (English) 1800 949 0107 (free phone)

Italy 800 79 11 37 (free phone)

Japan 0120-81-0036

Korea 080-551-2804
Malaysia 1-800-80-3973
Netherlands (English) +31 (0) 546 87 95 45
New Zealand 0800-446-934
Phillippines 1-800-765-7404
Singapore 800-886-1028
Spain +34 902 35 40 28
Sweden (English) +46 (0) 8587 555 22
Taiwan 0800-006800
Thailand 001-800-886-0010
United Kingdom +44 (0) 1604 66 33 99

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his expense will be required to take whatever measures may be required to correct this interference.

If your book does not discuss a product that creates radio frequency interference, delete this section from your preface. If your book does discuss a product that creates radio frequency interference, you must include this warning as it appears above.

Contents

Read This First	iii
About This Manual.....	iii
How to Use This Manual	iii
Related Documentation from Texas Instruments	iii
If You Need Assistance	iii
FCC Warning.....	iv
Contents	v
Figures	v
Tables	vi
1 Overview	1-1
1.1 Sample Functional Configurations	1-2
1.2 Signal Paths	1-4
2 Setup and Required Equipment	2-1
2.1 Applying an Input.....	2-1
2.2 Observing an Output.....	2-4
2.3 Typical Test Results	2-4
3 EVM Construction	3-1
3.1 Schematic.....	3-2
3.2 Board Layout Patterns	3-3
3.3 PCB Fabrication Requirements and Stack Up	3-8
3.4 Bill of Materials	3-9

Figures

Figure 1-1. Sample Functional Configurations of the 4x4 Crosspoint Switch	1-2
Figure 1-2. 4x4 Crosspoint Switch EVM	1-3
Figure 1-3. 4x4 Crosspoint Switch Signal Paths	1-4
Figure 2-1. EVM Power Connections for Either SN65LVDS125A or SN65LVDS250 Evaluation.	2-2
Figure 2-2. Termination for Interfacing LVDS, CML, or LVPECL Drivers	2-3
Figure 2-3. Typical Test Results	2-5
Figure 3-1. 4x4 Crosspoint Switch EVM Schematic	3-2
Figure 3-2. 4x4 Crosspoint Switch EVM Board Layout	3-3
Figure 3-3. Layer 1–Signal Plane	3-4
Figure 3-4. GND Plane	3-5
Figure 3-5. Layer 3–Vcc	3-5

Figure 3-6. Layer 4–Vcc01 Plane3-6
Figure 3-7. Layer 5–GND Plane3-6
Figure 3-8. Layer 6–GND/Signal Plane.....3-7

Tables

Table 2-1 Crosspoint Function Table.....2-3
Table 3-2. Bill of Materials for the SN65LVDS125A / SN65LVDS2503-9

1 Overview

This chapter provides a high-level description of the 4x4 crosspoint switch EVM mounted with either a SN65LVDS125A, 4x4 1.5-Gbps or a SN65LVDS250, 4x4 2.5-Gbps crosspoint switch.

Topic	Page
1.1 Sample Functional Configurations	1-2
1.2 Signal Paths	1-4

1.1 Sample Functional Configurations

The 4x4 crosspoint switch is a fully non-blocking switch that provides flexibility in switch configuration for the desired application.

A sample of various functions for which the EVMs can be configured is shown in Figure 1-1.

Configuration Examples

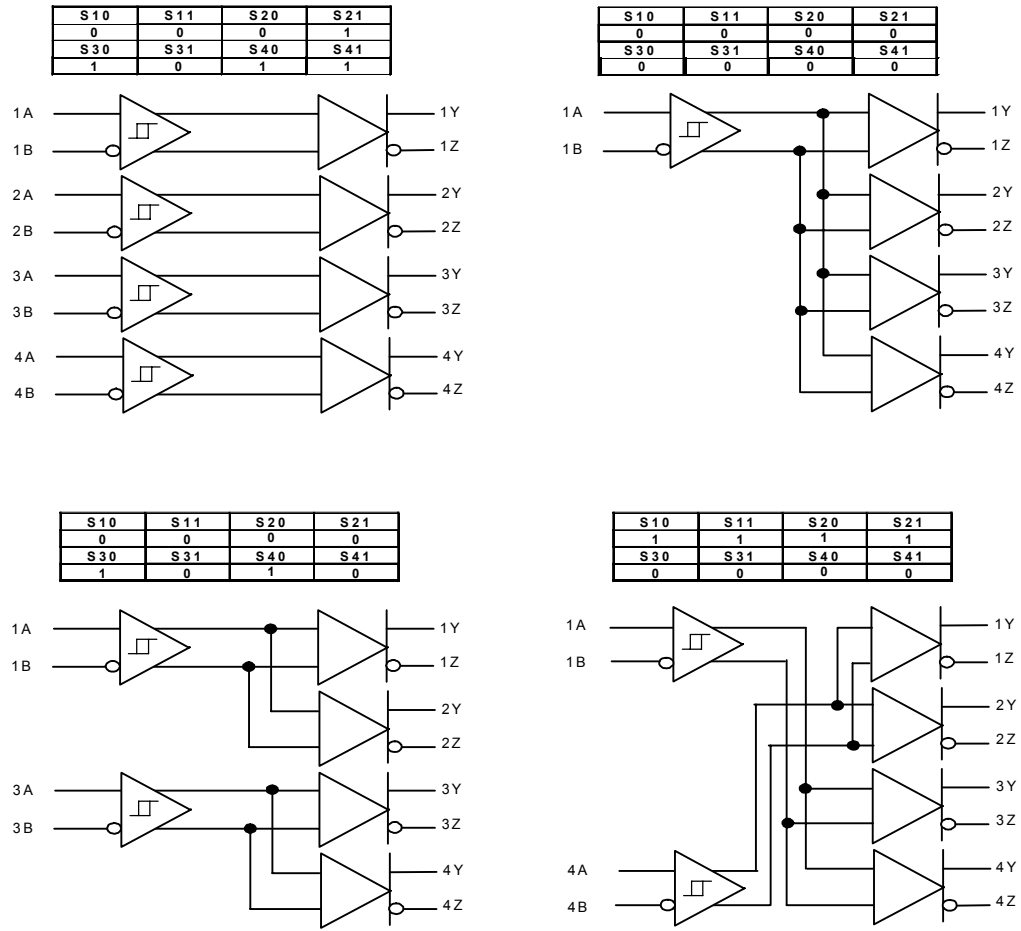


Figure 1-1. Sample Functional Configurations of the 4x4 Crosspoint Switch

Figure 1-2 shows the 4x4 crosspoint switch EVM (part number SN65LVDS125A or SN65LVDS250). The EVM comes with either the SN65LVDS125A or SN65LVDS250 installed and a copy of the data sheet. The latest version of the data sheet is also available from www.ti.com.

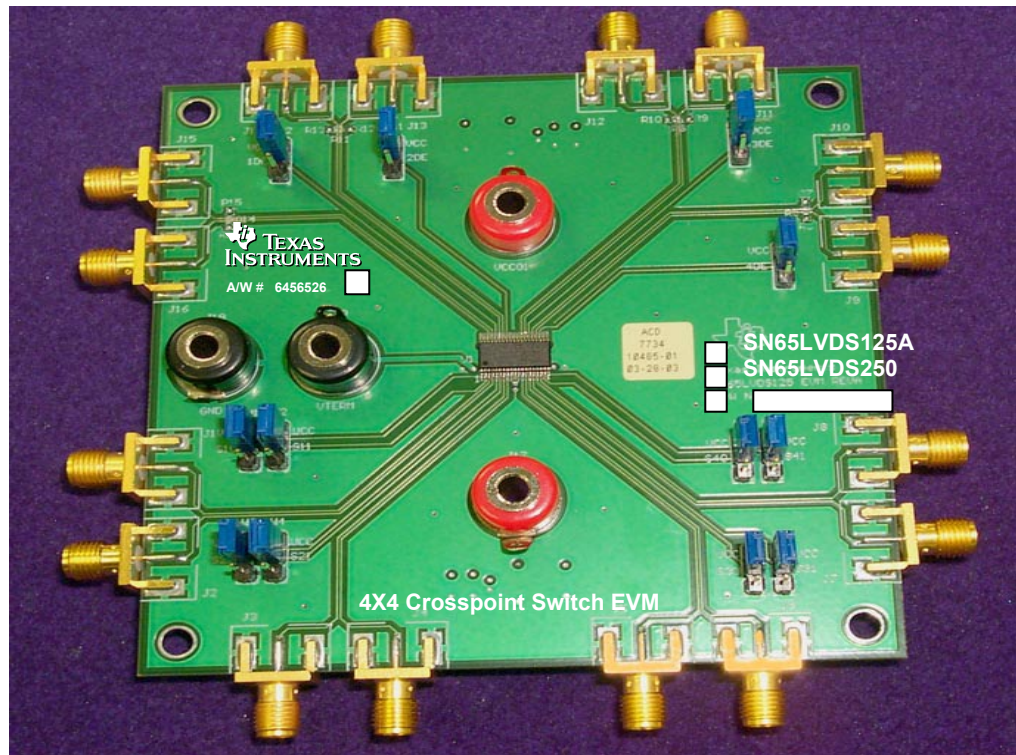


Figure 1-2. 4x4 Crosspoint Switch EVM

1.2 Signal Paths

The signal paths on this EVM (see Figure 1-3) include:

- ❑ Sixteen edge-launch SMA connectors (J1–J16) for high-speed data transmission
- ❑ Eight jumpers (W1–W8) for active switch logic control
- ❑ Four jumpers (W9–W12) for enabling and disabling the outputs
- ❑ Three banana jacks (J17, J18, J19) for power and ground connections. Banana jack J20 is used for non-LVDS type configurations.

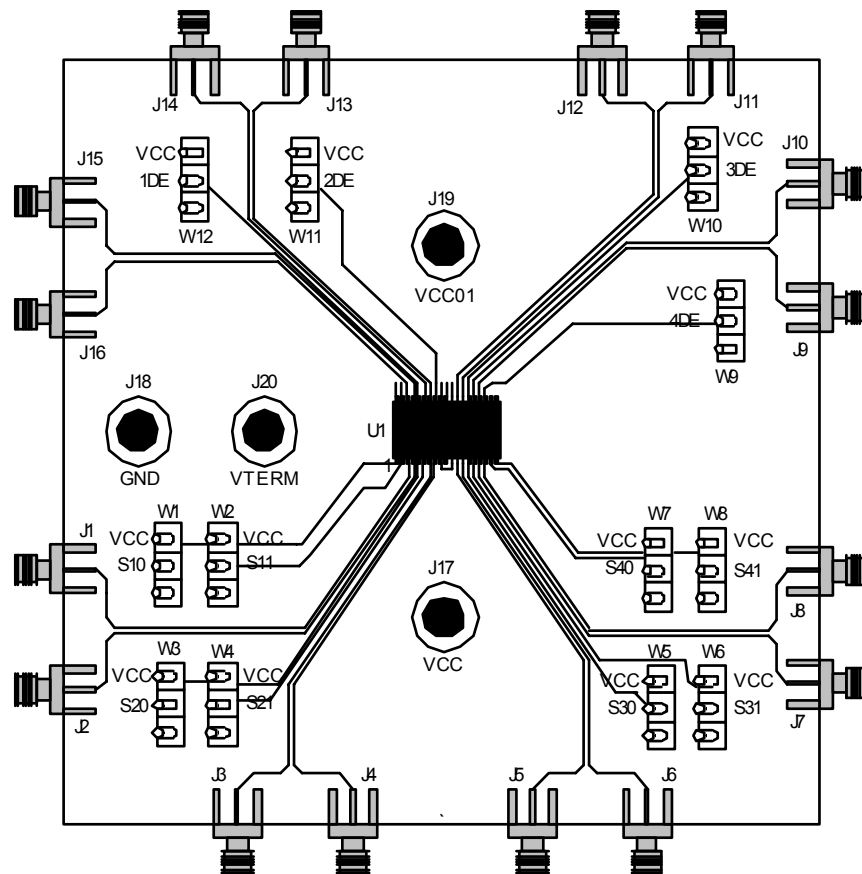


Figure 1-3. 4x4 Crosspoint Switch Signal Paths

2 Setup and Required Equipment

Both the SN65LVDS125A and the SN65LVDS250 LVDS driver output characteristics are compliant with the requirements of the TIA/EIA-644 standard. LVDS drivers nominally provide a 350-mV differential signal, with a 1.2-V offset from ground. These levels are attained when driving a 100- Ω differential line-termination test load. This requirement includes the effects of up to 32 standard receivers with their ground references offset up to ± 1 V from that of the driver. This common-mode loading limitation of LVDS drivers affects how the driver's characteristics are observed with this EVM, and the test setup that follows in this manual.

By using three power jacks (J17, J18, and J19) and by optionally installing termination resistors, different methods of probing can be used to evaluate the device output characteristics. The typical setup for the 4x4 crosspoint switch EVM is shown in Figure 2-1.

2.1 Applying an Input

While the use of a split power plane allows the EVM to be terminated within the oscilloscope, offsetting the EVM ground requires the inputs to the device to also be offset. Figure 2-1 shows how to offset the EVM and the inputs to the device. Setting power supply 1 to 3.3 V and power supply 2 to 1.2 V causes the voltage swing of the LVDS outputs to be within the limits of -200 mV to 200 mV instead of the typical 1 V to 1.4 V. This requires the inputs of the 4x4 crosspoint switch EVM to also be offset by 1.2 V, resulting in a voltage swing of -200 mV to 200 mV. VTERM, banana jack J20, is provided for non-LVDS input terminations such as LVPECL, which requires a termination voltage. When applying an LVDS input, VTERM can be left open or connected to GND, which is the common-mode voltage when using the aforementioned -200-mV to 200-mV input swing.

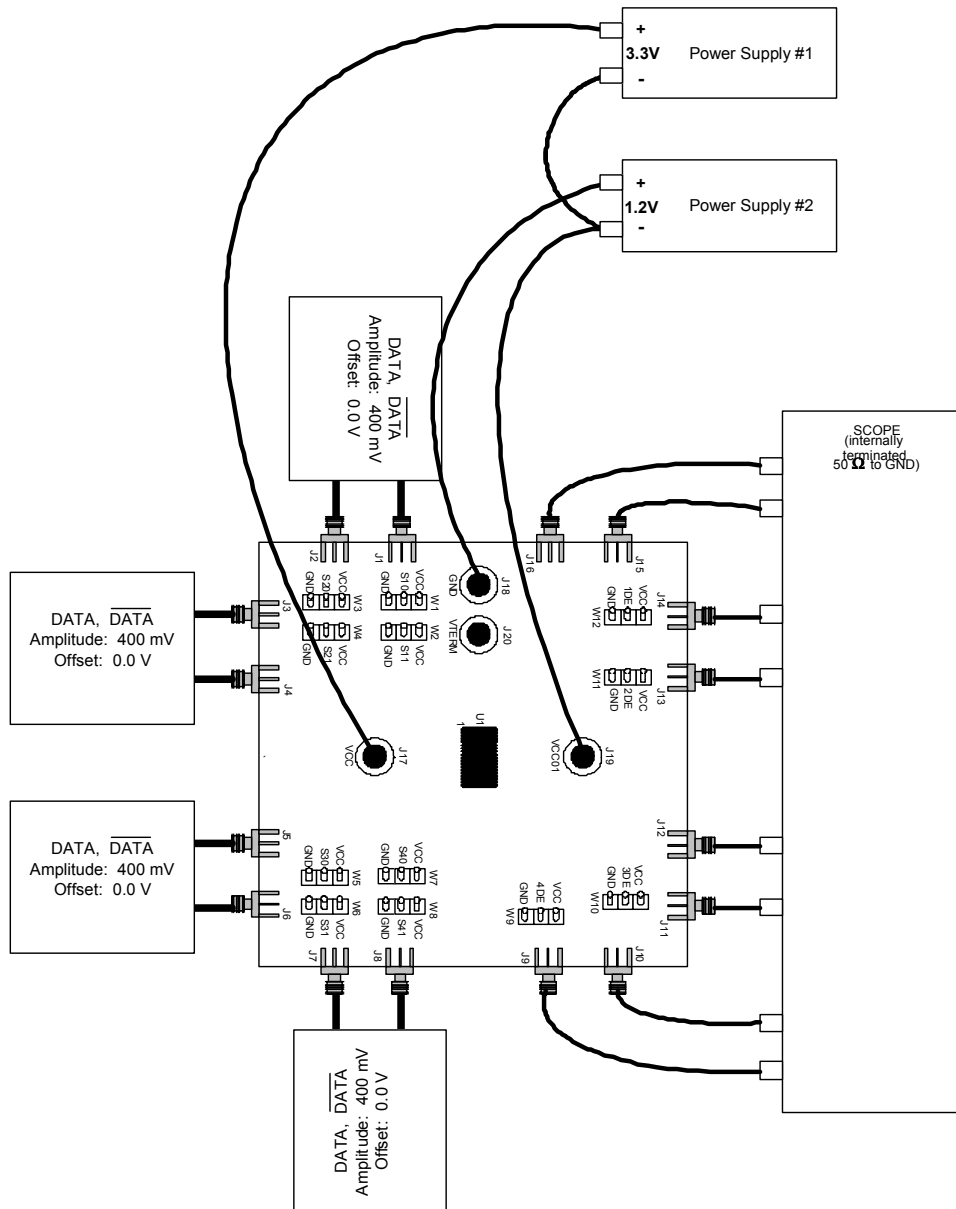


Figure 2-1. EVM Power Connections for Either SN65LVDS125A or SN65LVDS250 Evaluation.

Many possible configurations for the 4x4 crosspoint switches are made available. Table 2-1 provides a description of the different functions and the required selector settings.

Table 2-1 Crosspoint Function Table

Output Channel 1			Output Channel 2			Output Channel 3			Output Channel 4		
Control Pins		Input Selected	Control Pins		Input Selected	Control Pins		Input Selected	Control Pins		Input Selected
S10	S11	1Y/1Z	S20	S21	2Y/2Z	S30	S31	3Y/3Z	S40	S41	4Y/4Z
0	0	1A/1B	0	0	1A/1B	0	0	1A/1B	0	0	1A/1B
0	1	2A/2B	0	1	2A/2B	0	1	2A/2B	0	1	2A/2B
1	0	3A/3B	1	0	3A/3B	1	0	3A/3B	1	0	3A/3B
1	1	4A/4B	1	1	4A/4B	1	1	4A/4B	1	1	4A/4B

Apply inputs to the SMA connectors J1–J8. The EVM comes with 50- Ω resistors installed to VTERM, providing a termination scheme easily adjusted to accommodate LVDS, LVPECL, or CML output structures. (See Figure 2-2).

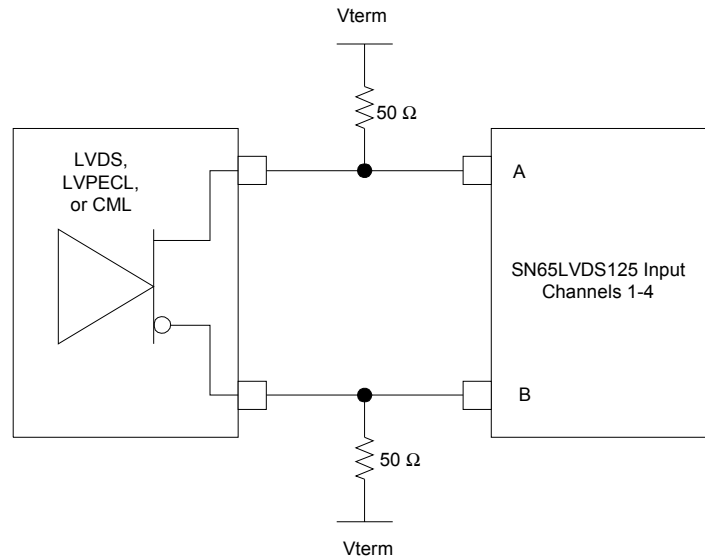


Figure 2-2. Termination for Interfacing LVDS, CML, or LVPECL Drivers

2.2 Observing an Output

In order to minimize the parasitic capacitance in high-speed measurements (probe capacitance), the 4x4 crosspoint switch EVM provides an offset power plane (layer 5). This power plane allows the user to offset the device so that the common-mode output is compatible with the 50 ohms to ground termination within the scope. Terminating the EVM within the scope eliminates any bandwidth limitations introduced by a probe.

Direct connection to an oscilloscope with 50-Ω internal terminations to ground is accomplished without requiring installation of resistors R5 – R16 on the EVM. The outputs are available at J9–J16 for direct connection to oscilloscope inputs. All cabling used to source and measure signals must be electrically matched in length to prevent any skew between conductors of the differential inputs.

Referring back to 2-1, power supply 1 is used to provide the required 3.3 V to the EVM. Power supply 2 is used to offset the EVM ground relative to the device under test (DUT) ground. With this power scheme, the common-mode voltage seen by either the SN65LVDS125A or the SN65LVDS250 is approximately equal to that of the oscilloscope, thus preventing significant common-mode current flow. Using dual supplies and offsetting the EVM ground relative to the DUT ground are simply steps required for the test and evaluation of devices. Actual designs include high-impedance receivers, which do not require the setup steps outlined above. If the EVM outputs are to be evaluated with a high-impedance probe, direct probing on the EVM is supported via installation of a 100-Ω resistor across the solder pads (R5, R8, R11, and R14).

Note: Power Supply 2

.Power supply 2 must be able to sink current.

2.3 Typical Test Results

Figure 2-3 is a typical result obtained with the EVM setup shown in Figure 2-1. The inputs (J1–J8) were stimulated with a $2^{23}-1$ PRBS signal at 1.5 Gbps. The input levels for both clock and data were a differential voltage of 400 mV, with a common-mode voltage of 0 V (referenced to the ground of the pattern generator).

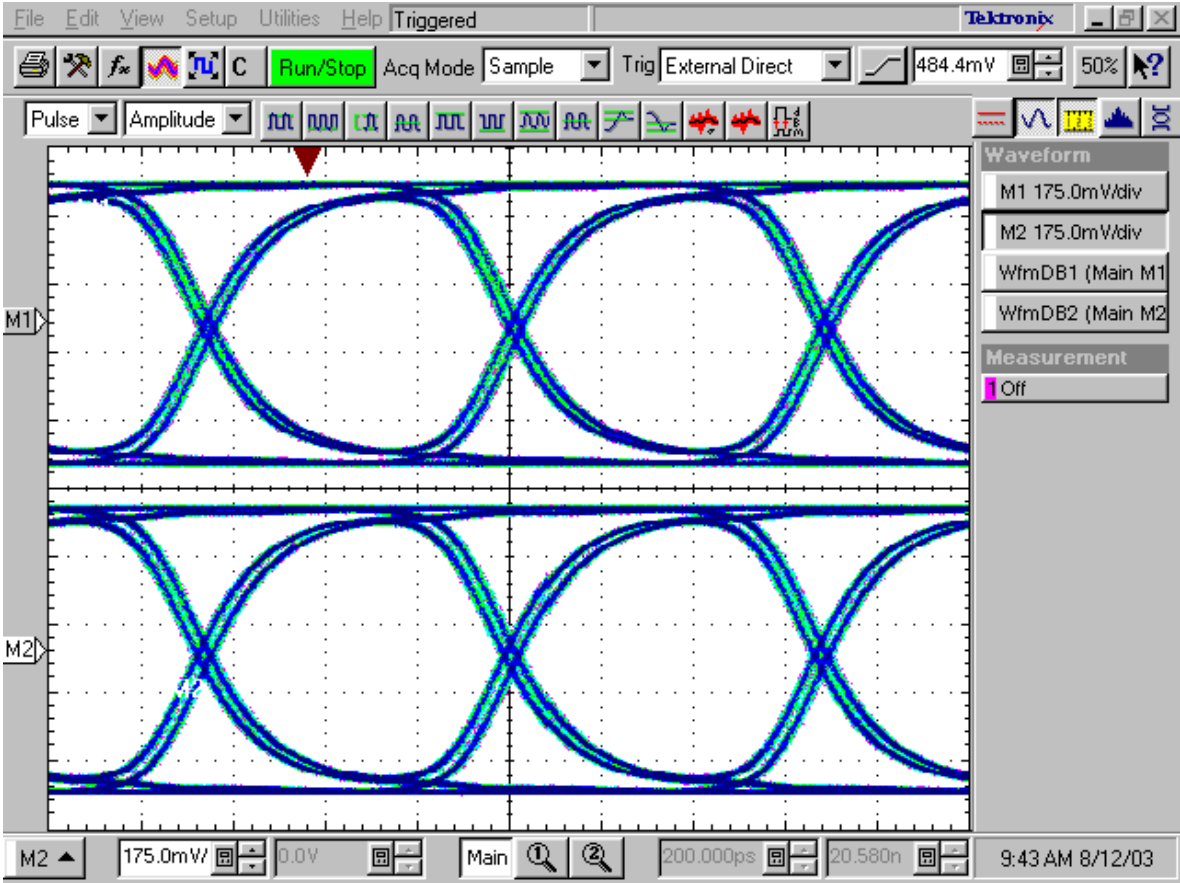


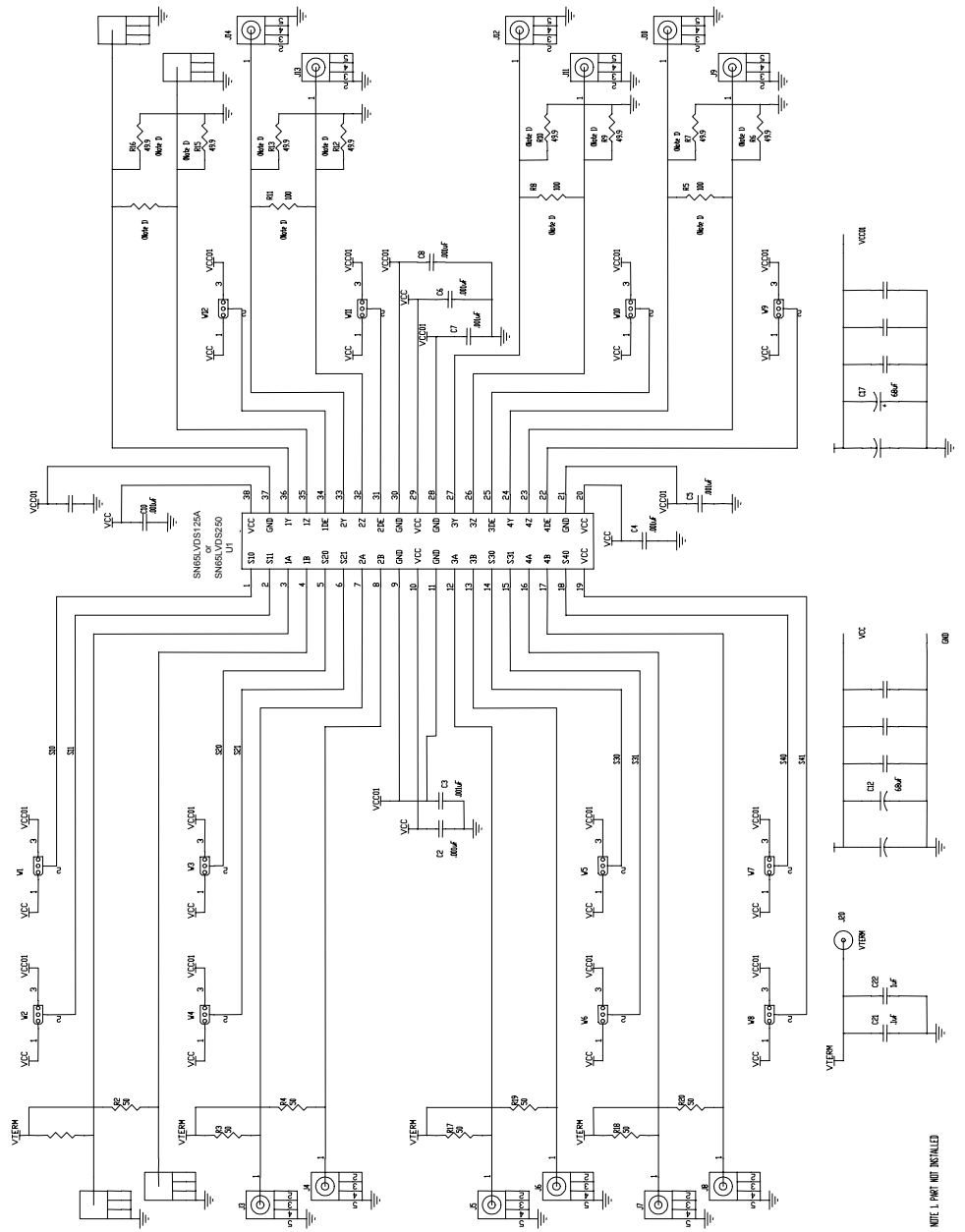
Figure 2-3. Typical Test Results.

3 EVM Construction

This chapter presents the schematics, board layouts, fabrication information, and the bill of materials.

Topic	Page
3.1 Schematic	3-2
3.2 Board Layout Patterns	3-3
3.3 PCB Fabrication Requirements and Stack Up	3-8
3.4 Bill of Materials	3-9

3.1 Schematic



3.2 Board Layout Patterns

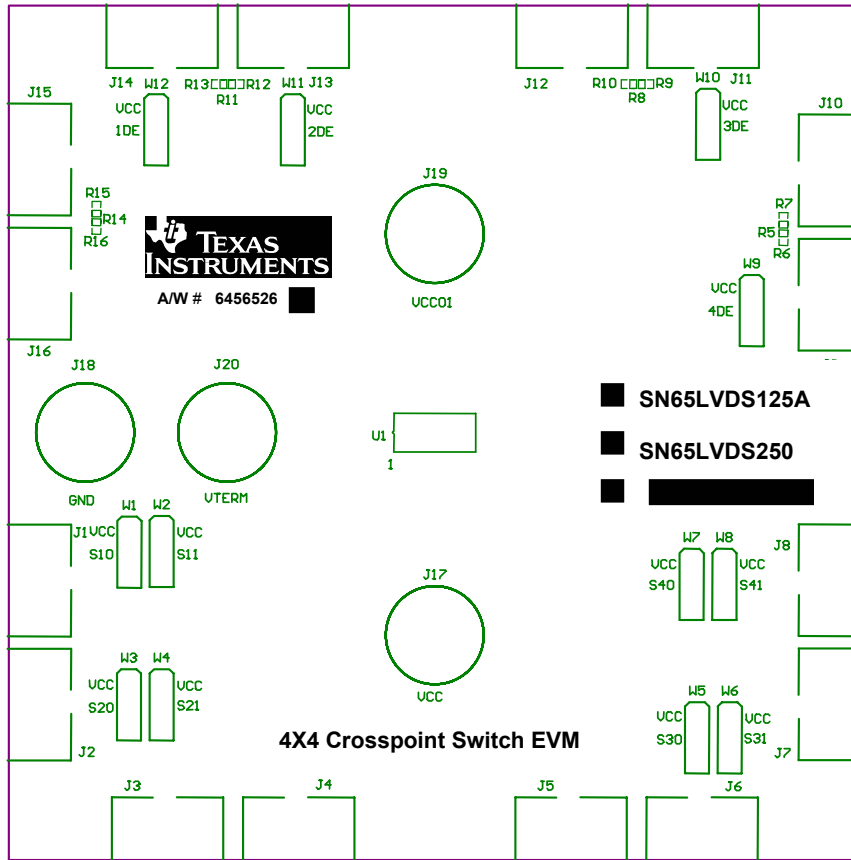


Figure 3-2. 4x4 Crosspoint Switch EVM Board Layout

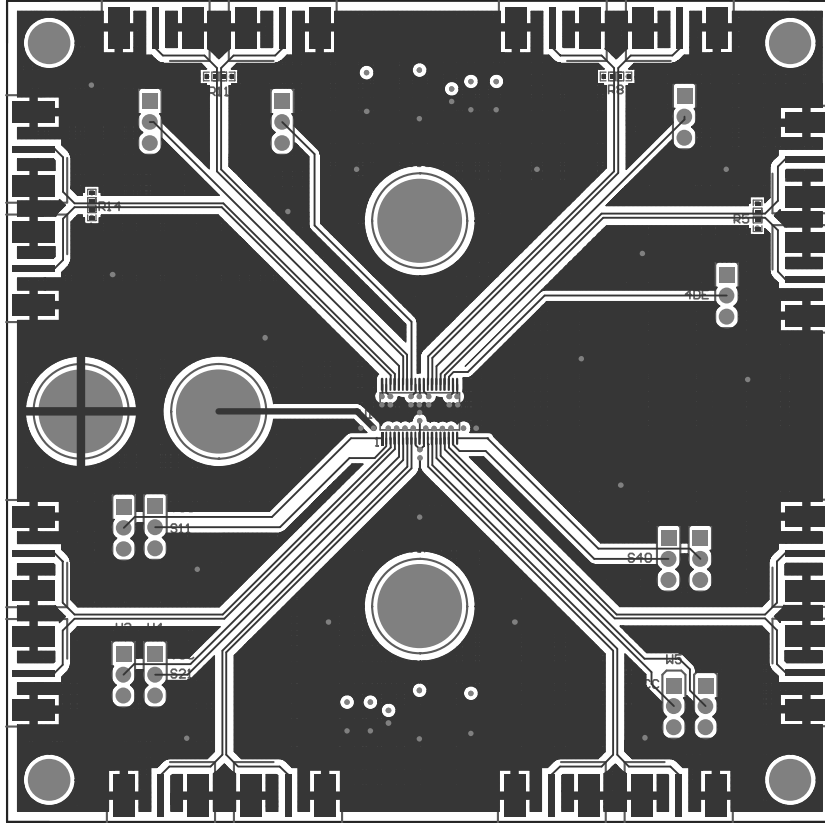


Figure 3-3. Layer 1–Signal Plane

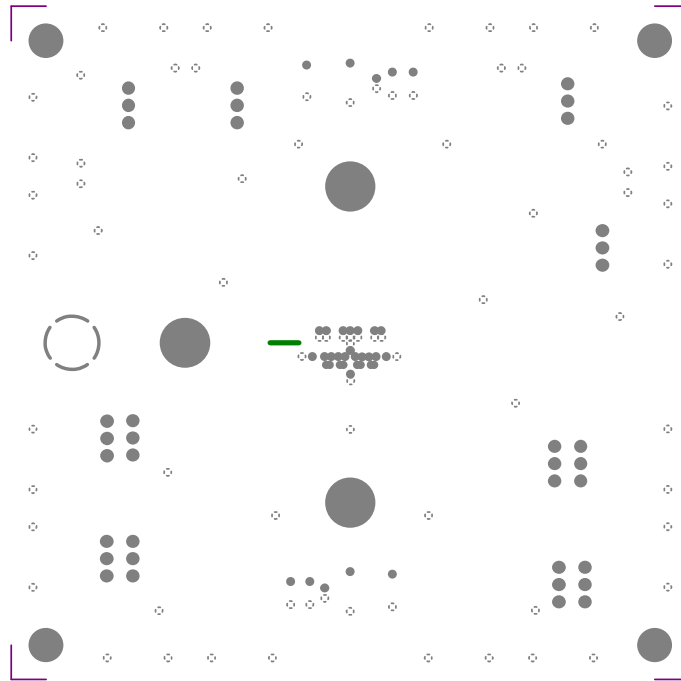


Figure 3-4. GND Plane

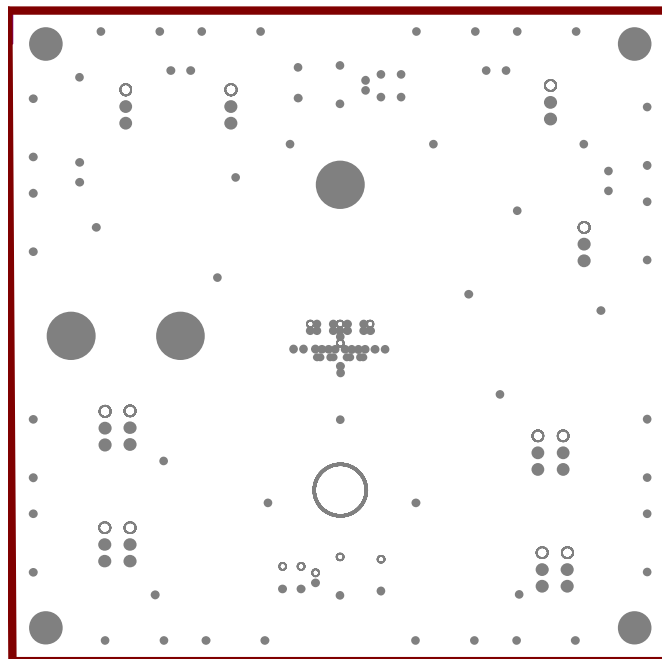


Figure 3-5. Layer 3-Vcc

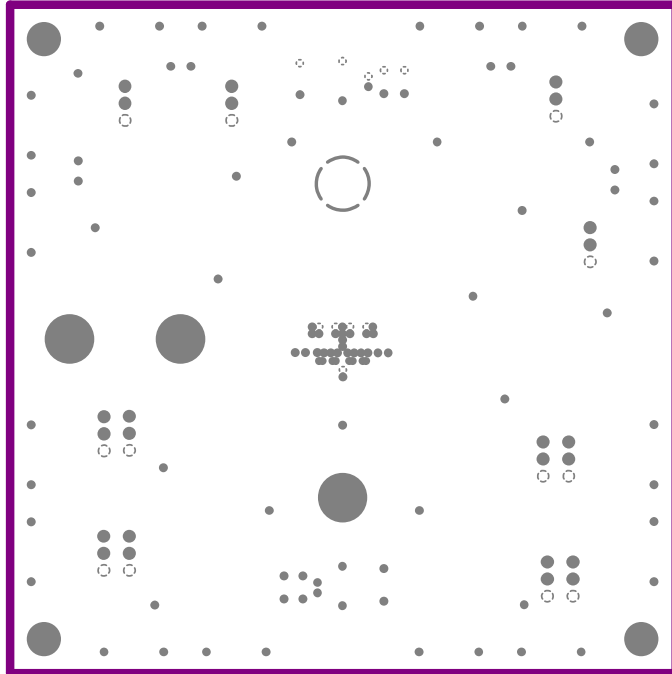


Figure 3-6. Layer 4–Vcc01 Plane

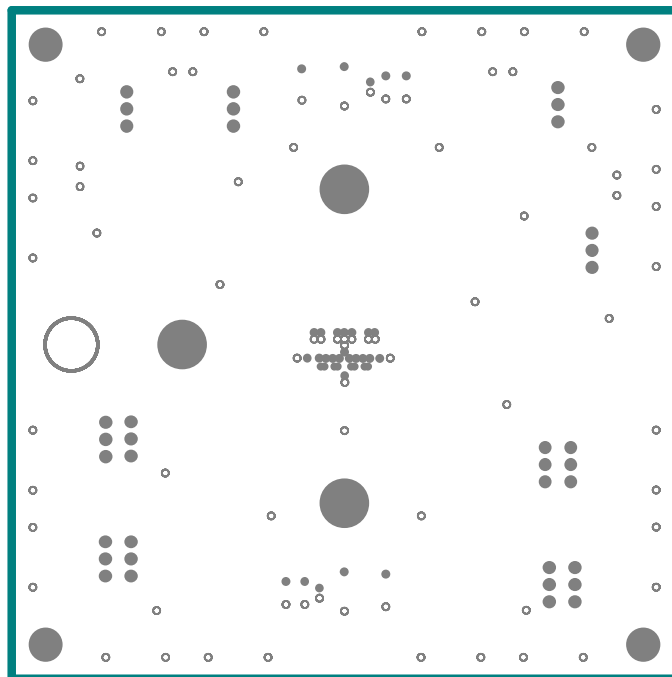


Figure 3-7. Layer 5–GND Plane

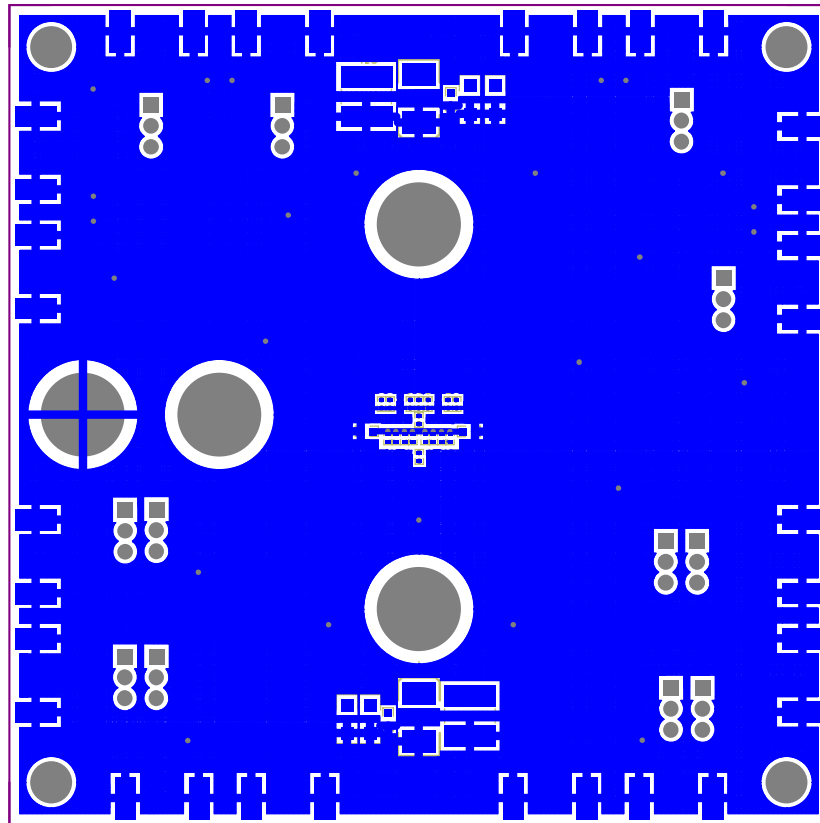
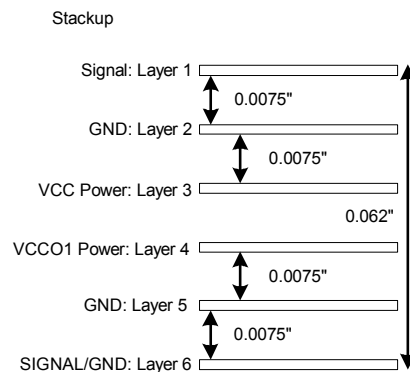


Figure 3-8. Layer 6–GND/Signal Plane

3.3 PCB Fabrication Requirements and Stack Up

Notes:

1. PWB TO BE FABRICATED TO MEET OR EXCEED IPC-6012, CLASS 3 STANDARDS AND WORKMANSHIP SHALL CONFORM TO IPC-A-600, CLASS 3 CURRENT REVISIONS
2. BOARD MATERIAL AND CONSTRUCTION TO BE UL APPROVED AND MARKED ON THE FINISHED BOARD.
3. LAMINATE MATERIAL: COPPER-CLAD NELCO N4000-13 (DO NOT USE -13SI)
4. COPPER WEIGHT: 1oz FINISHED
5. FINISHED THICKNESS: 0.062" +/- 0.010"
6. MIN PLATING THICKNESS IN THROUGH HOLES: .001"
7. SMOBC / HASL
8. LPI SOLDERMASK BOTH SIDES USING APPROPRIATE LAYER ARTWORK: COLOR = GREEN
9. LPI SILKSCREEN AS REQUIRED: COLOR = WHITE
10. VENDOR INFORMATION TO BE INCORPORATED ON BACK SIDE WHENEVER POSSIBLE
11. MINIMUM COPPER CONDUCTOR WIDTH IS: 0.009"
MINIMUM CONDUCTOR SPACING IS: 0.006"
12. NUMBER OF FINISHED LAYERS: 6
13. ALL 8 MIL HOLES TO BE PLUGGED AND COPLANAR TO SURFACE
14. SPACING BETWEEN LAYERS 1 AND 2 SHOULD BE 0.0075"
SPACING BETWEEN LAYERS 2 AND 3 SHOULD BE 0.0075"
SPACING BETWEEN LAYERS 4 AND 5 SHOULD BE 0.0075"
SPACING BETWEEN LAYERS 5 AND 6 SHOULD BE 0.0075"



3.4 Bill of Materials

Table 3-2. Bill of Materials for SN65LVDS125A / SN65LVDS250 EVM

Item	6456526-1 Qty	6456526-2 Qty	6456526-3 Qty	Description	Pattern	Reference Designator
1	9	9	9	0.001 μ F	402	C2, C3, C4, C5, C6, C7, C8, C9, C10
2	2	2	2	0.01 μ F	603	C13, C18
3	1	1	1	0.1 μ F	603	C21
4	2	2	2	0.1 μ F	1206	C14, C19
5	4	4	4	100 Ω (uninstalled)	402	R5, R8, R11, R14
6	2	2	2	10 μ F	7343	C11, C16
7	1	1	1	1 μ F	603	C22
8	2	2	2	1 μ F	1206	C15, C20
9	12	12	12	3 pos jumper		W1, W2, W3, W4, W5, W6, W7, W8, W9, W10, W11, W12
10	8	8	8	49.9 Ω (uninstalled)	402	R6, R7, R9, R10, R12, R13, R15, R16
11	8	8	8	49.9 Ω	402	R1, R2, R3, R4, R17, R18, R19, R20
12	2	2	2	68 μ F	Cap 592D R	C12, C17
13	4	4	4	Banana jack		J17, J18, J19, J20
14	16	16	16	SMA PCB MT MOD	SMA END 50 Ω	J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16
15	1	0	0	SN65LVDS125A	38-TSSOP (DBT)	U1
16	0	1	0	SN65LVDS250	38-TSSOP (DBT)	U1
17	0	0	1	<i>Special</i>	38-TSSOP (DBT)	U1
18	4	4	4	Rubber feet	3/8"	
19	1	1	1	PWB	6456526	PWB