User's Guide

TLV3605EVM User's Guide

ABSTRACT

The TLV3605EVM is an evaluation board designed to evaluate the high-speed TLV3605 comparator. The TLV3605EVM has layout options intended to make it simple to evaluate timing performance with different measurement tools. The output of the TLV3605 is designed for low-voltage differential signals (LVDS), that provide high-speed signals to interconnect devices such as FPGAs with minimal power dissipation.

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Trademarks

1 Introduction

The TLV3605EVM is an evaluation board designed to evaluate the high-speed TLV3605 comparator. The TLV3605EVM has layout options intended to make it simple to evaluate timing performance with different measurement tools. The output of the TLV3605 is designed for low-voltage differential signals (LVDS), which provide high-speed signals to interconnect devices such as FPGAs with minimal power dissipation.

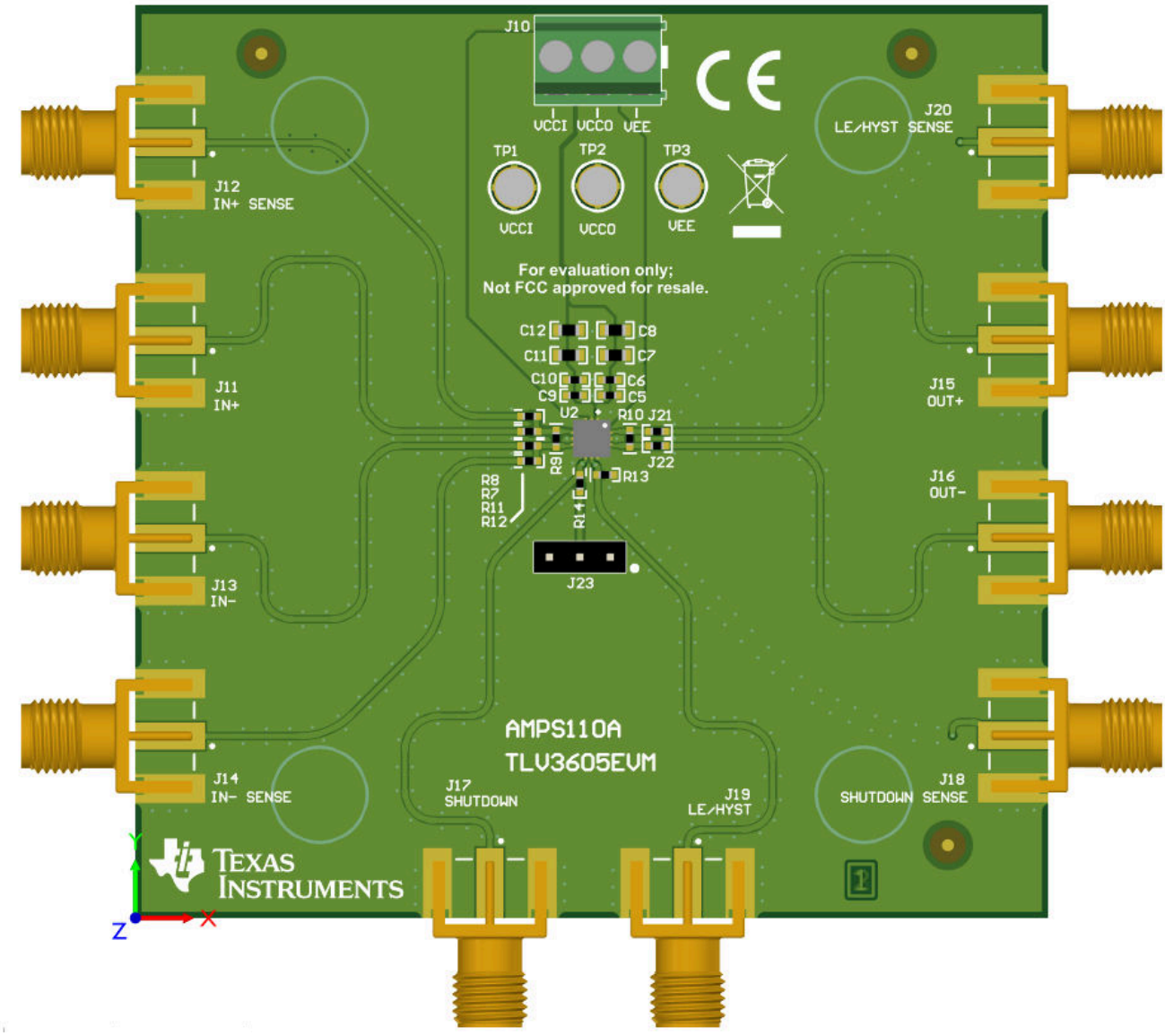

Figure 1-1. TLV3605EVM Board Top View

2 Features

- Low Propagation Delay: 800 ps
- Low Overdrive Dispersion: 450 ps
- High Toggle Frequency: 1.5 GHz/3.0 Gbps
- Narrow Pulse Width Detection Capability: 600ps
- LVDS Output
- Low Input Offset Voltage: +/-5mV
- RVK Package 12-Pin QFN

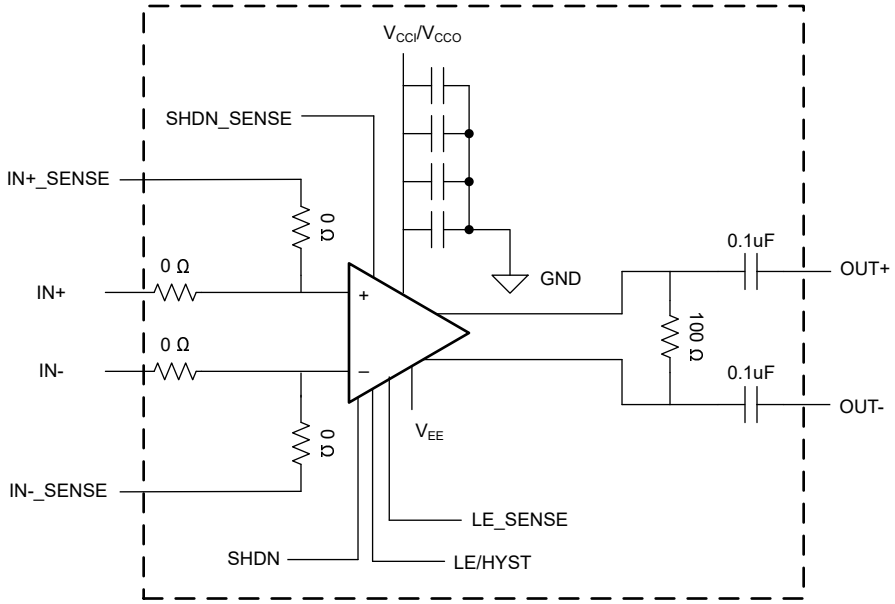

Figure 2-1. Block Diagram

3 EVM Specifications

- Supply Range: +2.4 V to +5.5 V (Single Supply Only)
- Input Common Mode Range: (Vee -200 mV) to (VCCI/VCCO + 200 mV)

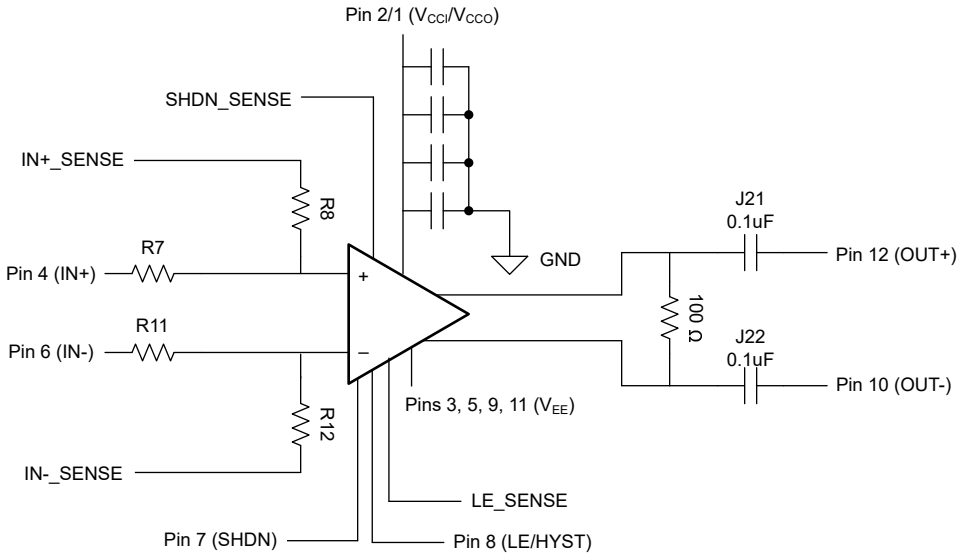

Figure 3-1. TLV3605EVM Pin Assignments

4 Recommended Equipment

- Power Supply
- High Speed Functional Generator with dual outputs
  - Fast rise/fall time recommended (≤ 500ps)
- High Speed Oscilloscope with 50Ω terminations
  - Differential probes with built in 100Ω terminations can be used to terminate the output properly
- SMA Cables/adapters
  - All forced input voltages and signals must have matched cable lengths.
    - IN+, IN-, SHUTDOWN, LE/HYST
  - All sensed voltages and signals
    - LE/HYST SENSE, IN+SENSE, IN-SENSE, SHUTDOWN SENSE, OUT+, and OUT-

5 How to Make a Propagation Delay Measurement With Latch

Note

Do not turn on power supply until all connections to the device are made to the board.

1. Set VCCI/VCCO Power Supply to 5.0 V and disable the power supply output
2. Since the same power supply is used for both VCCI and VCCO, connect positive terminal supply to TP1 and TP2, and negative terminal to TP3
3. Ensure that cables connecting to IN+, IN-, IN+SENSE, IN-SENSE, LE/HYST, LE/HYST SENSE, OUT+, and OUT- are matched length and impedance. Perform any deskewing if necessary. If IN- is a DC voltage reference, the cables used for IN- and IN- SENSE do not need to be matched.
   a. To make accurate measurements, match all forced input voltages (IN+, IN-, LE/HYST, SHDN) and match the cables for all sensed signals (IN+SENSE, IN-SENSE, LE/HYST SENSE, SHDN SENSE).
4. On one signal generator output, set the function generator to produce a square wave output with 100mVpp at 50MHz, with a DC offset of 0.300 V. On the other generator output, set the function generator to produce a square wave output with 5.0Vpp at 5MHz, with a DC offset of 0 V and 75% duty cycle. Disable the signal generator output. Connect the first output to IN+ and the second output to LE/HYST.
5. Set one of the outputs of the DC power supply to 300mV. Disable the power supply output. Connect the output to IN-.
6. Connect OUTP and OUTN to a 50Ω terminated scope. Alternatively, use a differential probe with a 100Ω termination and connect to the oscilloscope.
7. Connect IN+SENSE, IN-SENSE, and LE/HYST SENSE, to a 50Ω terminated scope channel.
8. Enable the VCCI/VCCO power supply.
9. Verify the supply current is < 17.5mA
10. Enable the IN- power supply.
11. Enable the signal generator.
12. Monitor and verify the inputs from IN+SENSE and IN-SENSE
13. Monitor and verify the outputs for OUT+ and OUT-

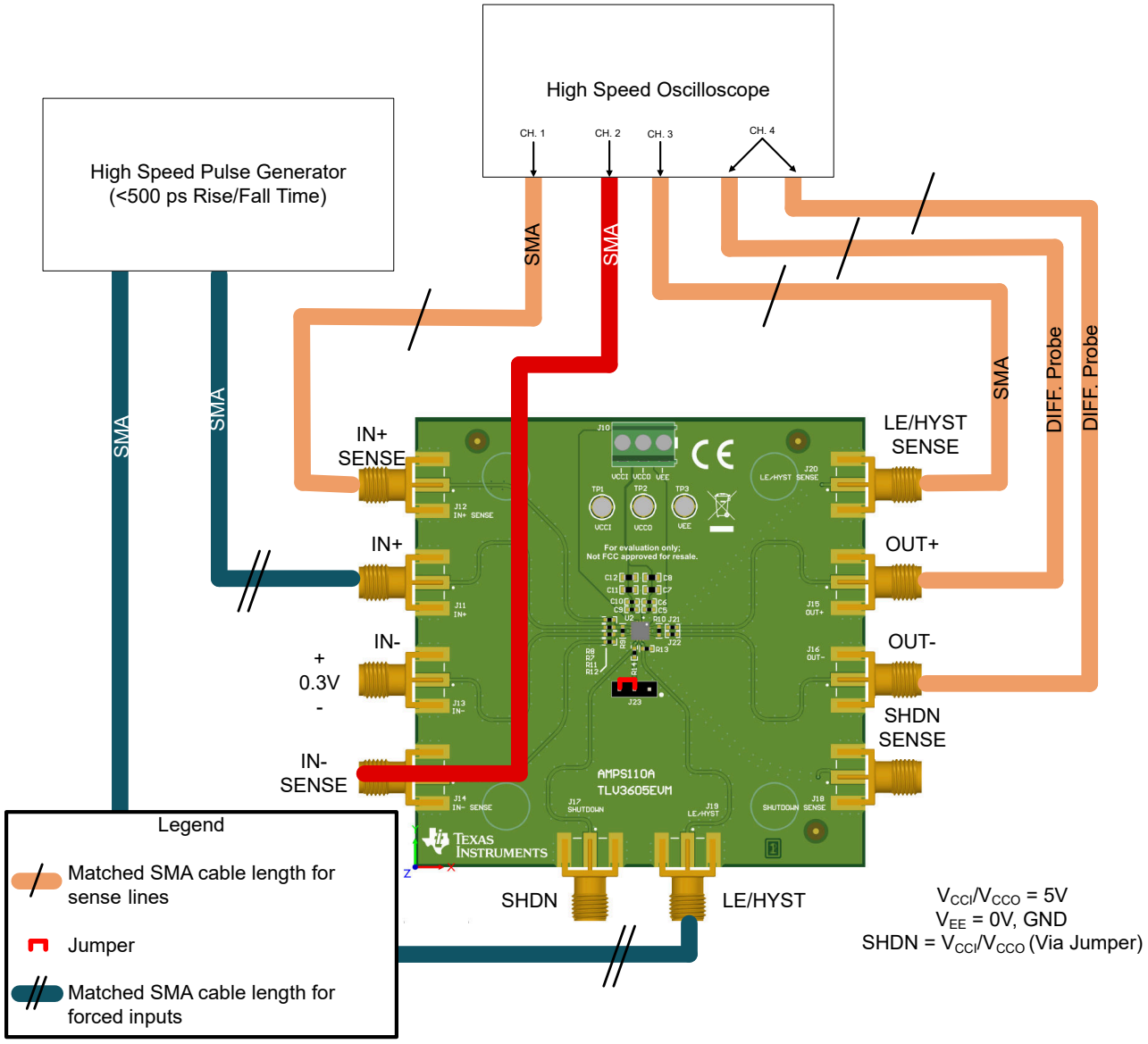

Figure 5-1. TLV3605 EVM Prop. Delay with Latch Setup

Next is a scope shot capture of the inputs and outputs described in the propagation delay procedure. This is defined as the time it takes for the output to respond when latch is disabled. Here, the propagation delay between LEB/HYST (LEB denotes active low) and the differential output is measured by taking the time delta between LEB/HYST 50% rising edge (disable latch), and when OUT (differential) reaches 50% of expected value (LOW). The propagation delay after latching was measured at 2.709ns with the setup described.

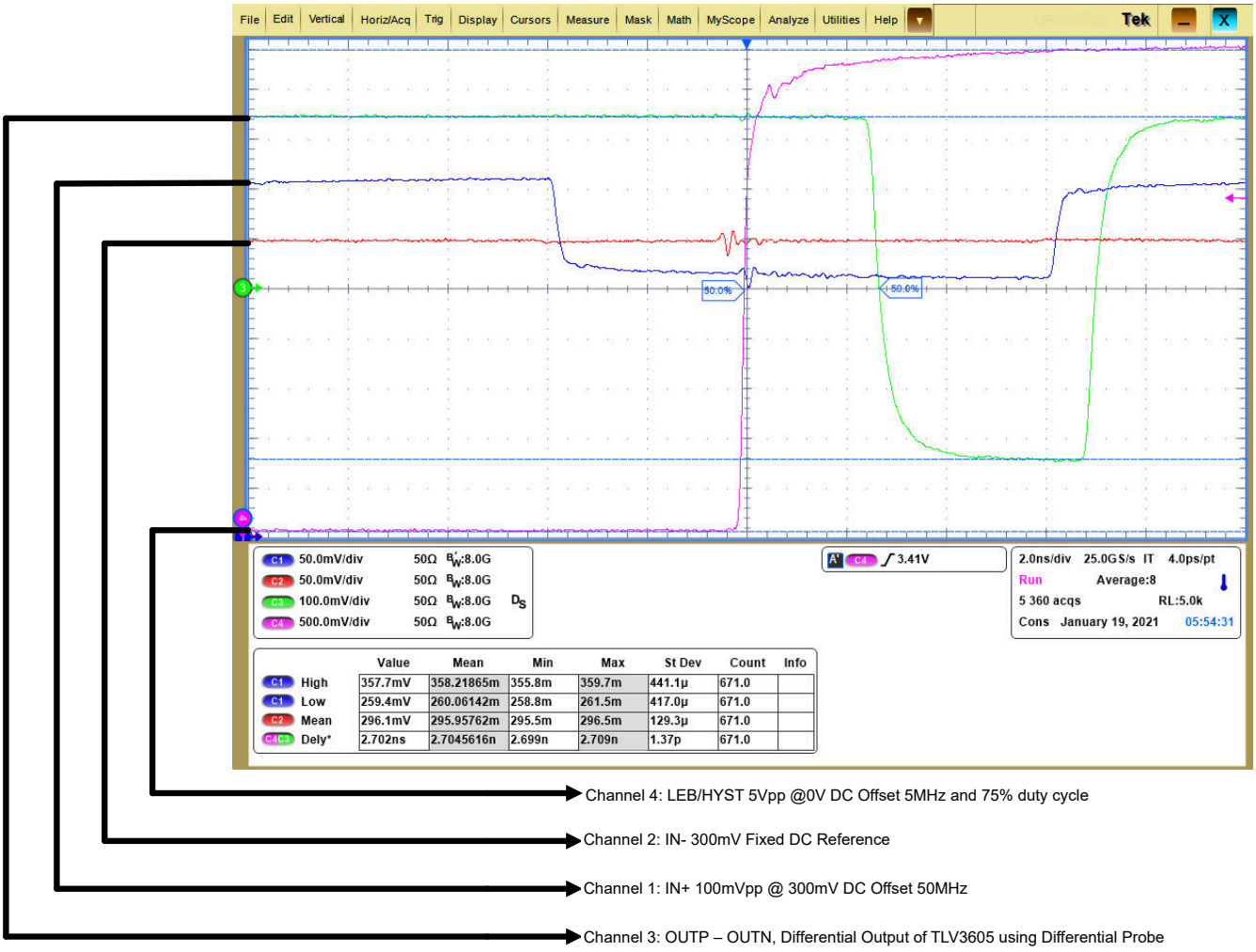

Figure 5-2. Quick Start Example

6 Board Setup

6.1 Supply Voltage

The TLV3605EVM operates from +2.4 V to +5.5 V. Connect VCCI and VEE using TP1 and TP3 respectively. Alternatively, J10 can also be used.

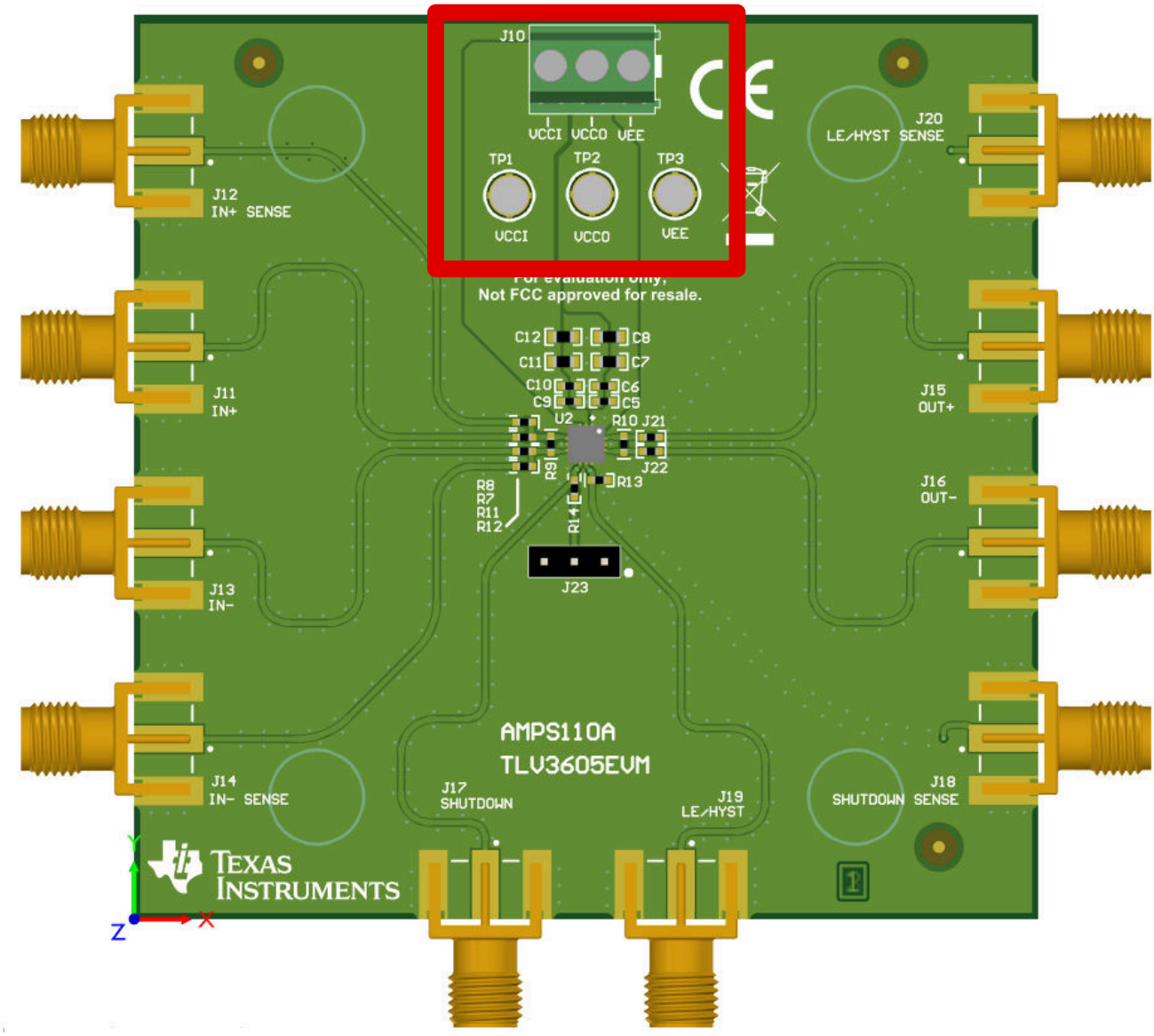

Figure 6-1. TLV3605EVM Supply Voltage Connection

6.2 Inputs

Resistors R8, R7, R11, and R12 are all 0 ohm resistors. The input terminals (IN+ and IN-) have corresponding sense lines so that the inputs to the device can be terminated on the lines with 50 ohms to an oscilloscope. This allows the input signals to be observed with minimal loading and distortion.

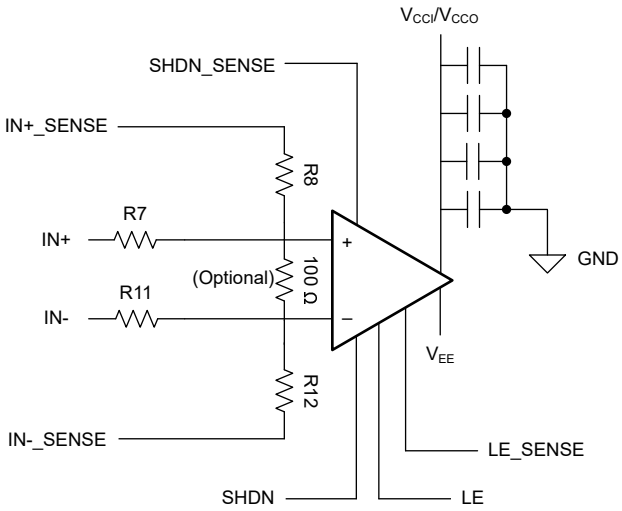

Figure 6-2. Input Side Schematic

The TLV3605EVM has an optional resistor pad between the device inputs meant for a 100 Ω resistor. This resistor is only needed if applying an unterminated LVDS signal to the board, otherwise it can be left uninstalled.

6.3 Outputs

R10 is only needed if it is preferred to measure the LVDS output directly across the component, or if the board is being used to feed directly to the inputs of another interconnect device such as an FPGA. Otherwise it can be left uninstalled.

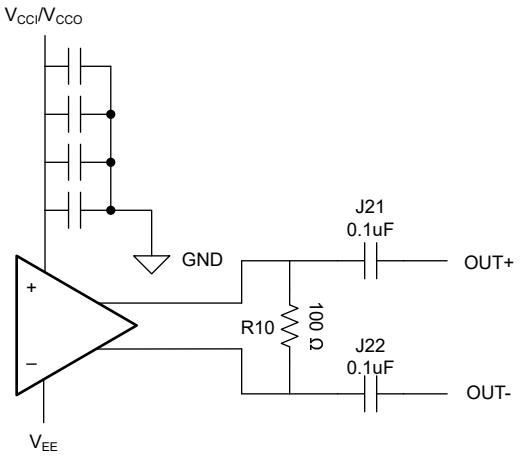

Figure 6-3. Output Side Schematic

J21 and J22 are installed with 0.1 uF capacitors. If probes are unavailable to measure the LVDS output across R10 or with a differential probe, these capacitors allow for the AC portion of the signal to be seen on a 50 Ω terminated scope. If equipment is available to measure the LVDS output with a respect to the 100 Ω resistor or with a differential probe, then J21 and J22 can be replaced with 0 Ω resistors to keep the DC integrity of the output signal.

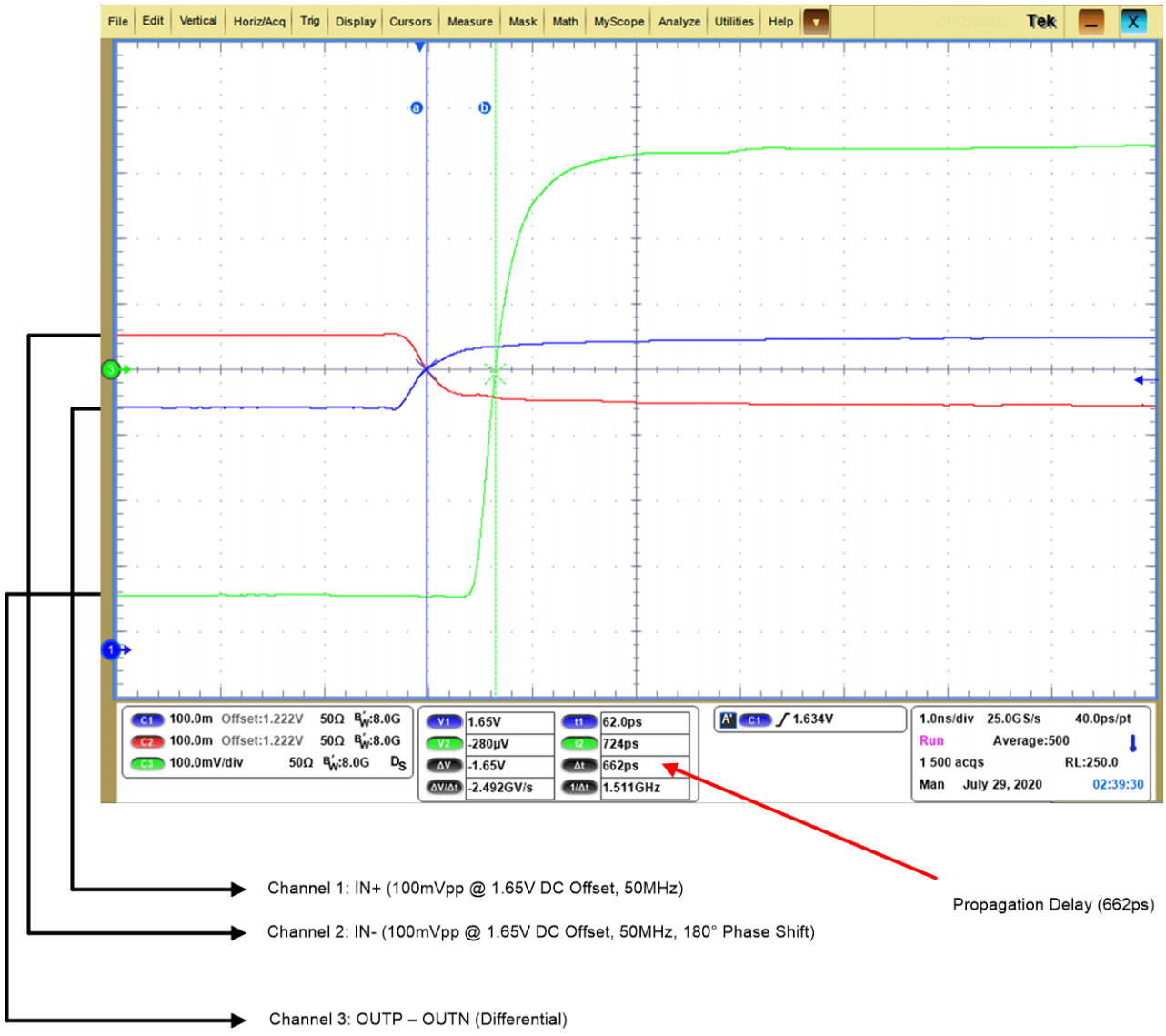

Figure 6-4. Differential Output of TLV3605EVM

7 Layout Guidelines

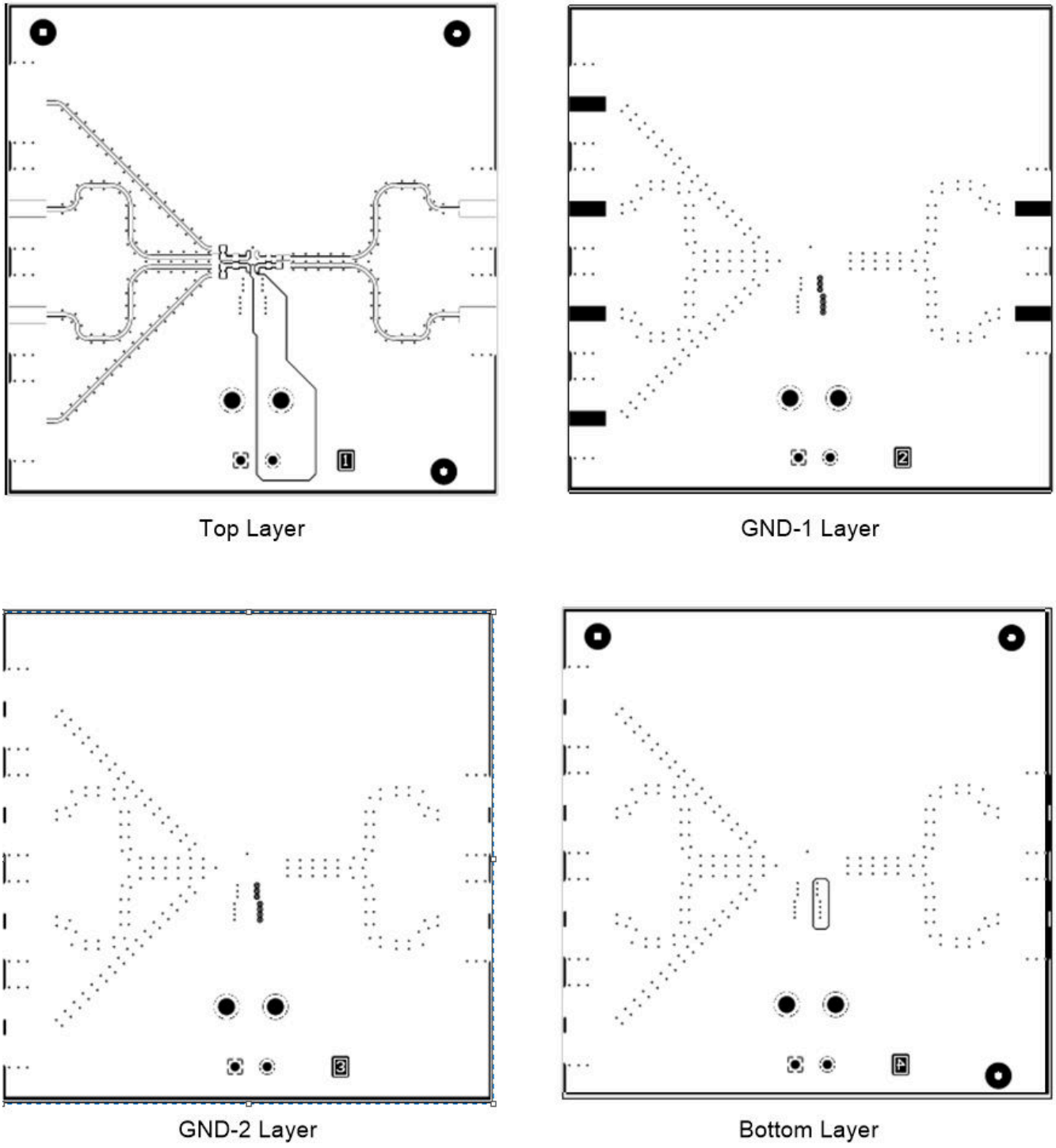

Figure 7-1. Layers

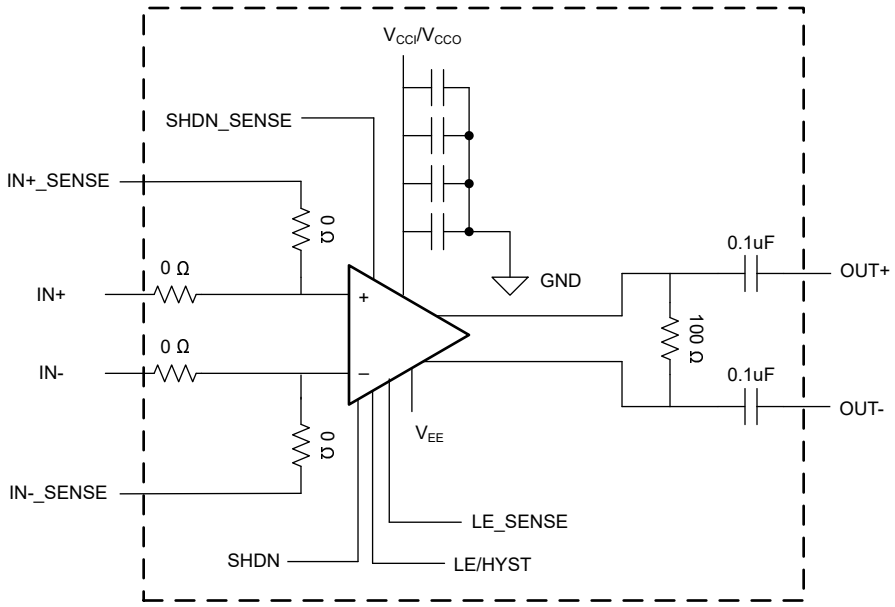

Figure 7-2. Block Diagram

8 Schematic

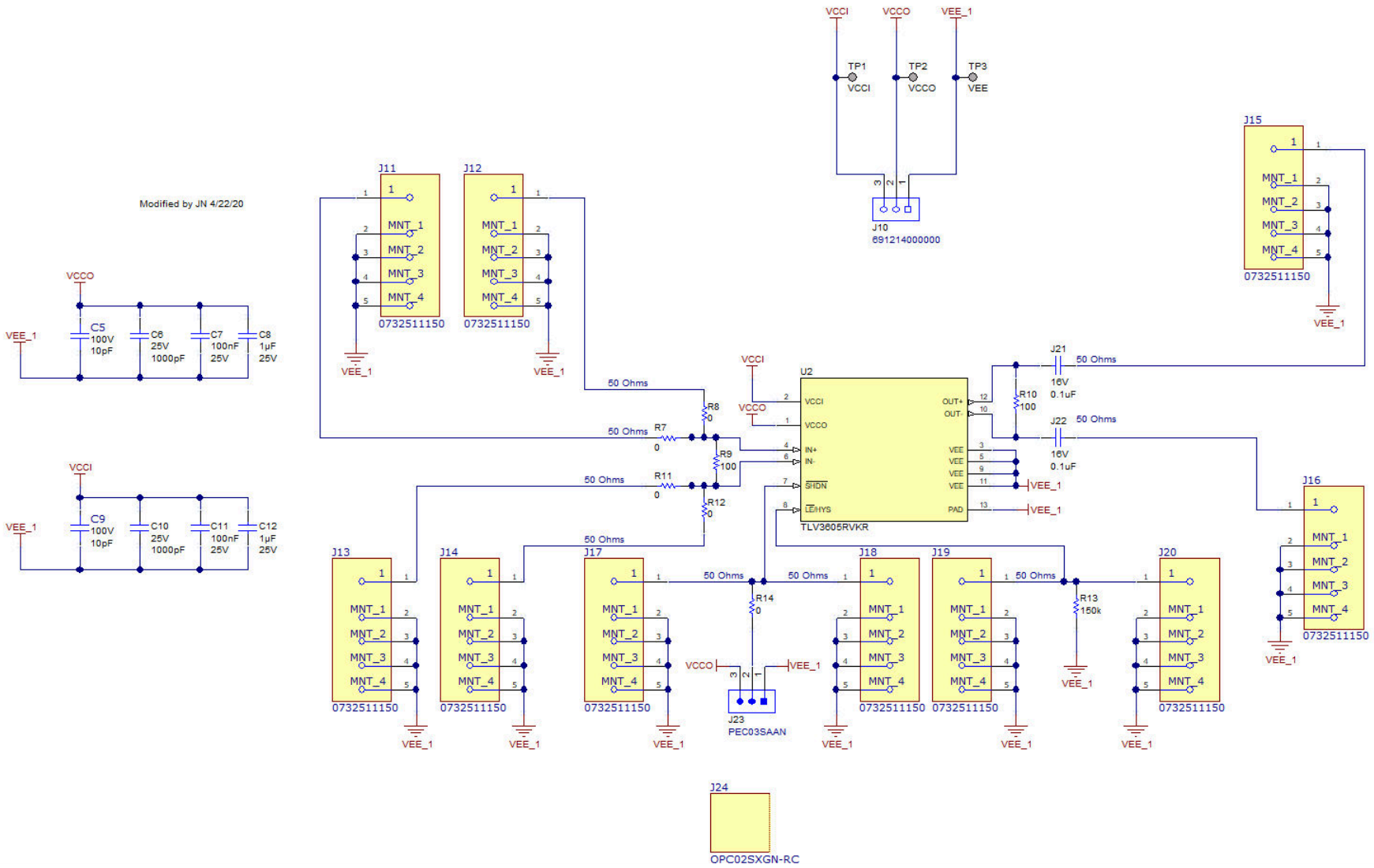

Figure 8-1. TLV3605 EVM Schematic

9 Bill of Materials

Table 9-1. BOM

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C5, C9	2		CAP 0402 10pF 5% C0G 100V 30ppm	0402 (1005M)	GRT1555C2A100JA02D	Murata		
C6, C10	2	1000pF	CAP, CERM, 1000 pF, 25 V,+/- 5%, C0G/NP0, 0402	0402	C0402C102J3GACTU	Kemet		
C7, C11	2	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	0603	C0603C104J3RACTU	Kemet		
C8, C12	2	1uF	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 0603	0603	C0603C105K3RACTU	Kemet		
FID1, FID2, FID3, FID4, FID5, FID6	6		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
H1, H2, H5, H6	4		Bumpon, Cylindrical, 0.312 X 0.200, Black	Black Bumpon	SJ61A1	3M		
J10	1		Terminal Block, 3.5mm, 3x1, Tin, TH	Terminal Block, 3.5mm, 3x1, Tin, TH	691214000000	Wurth Elektronik		
J11, J12, J13, J14, J15, J16, J17, J18, J19, J20	10		SMA Connector Receptacle, Female Socket 50Ohm Board Edge, End Launch Solder		0732511150	Molex Inc		
J21, J22	2	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	C0402C104K4RACAUTO	Kemet		
J23	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J24	1		CONN JUMPER S2 (1 x 2) Position Shunt Connector Black Open Top 0.100" (2.54mm) GoldHORTING .100 " GOLD	JUMPER	QPC02SXGN-RC	Sullins		
R7, R8, R11, R12, R14	5	0	RES, 0, 0%, 0.2 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0EDHP	Vishay-Dale		

Table 9-1. BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R13	1	150k	RES, 150 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF1503X	Panasonic		
TP1, TP2, TP3	3		Terminal, Turret, TH, Triple	Keystone1598-2	1598-2	Keystone		
U2	1		1ns High-Speed Comparator with LVDS Outputs, RVK0012A (QFN-12)	RVK0012A	TLV3605RVKR	Texas Instruments		Texas Instruments
R9, R10	0	100	RES, 100, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	MCS0402MD1000BE100	Vishay/Beyschlag		

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NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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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

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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

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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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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.

4 *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.

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