EVM User's Guide: HS-COMPARATOR-EVM

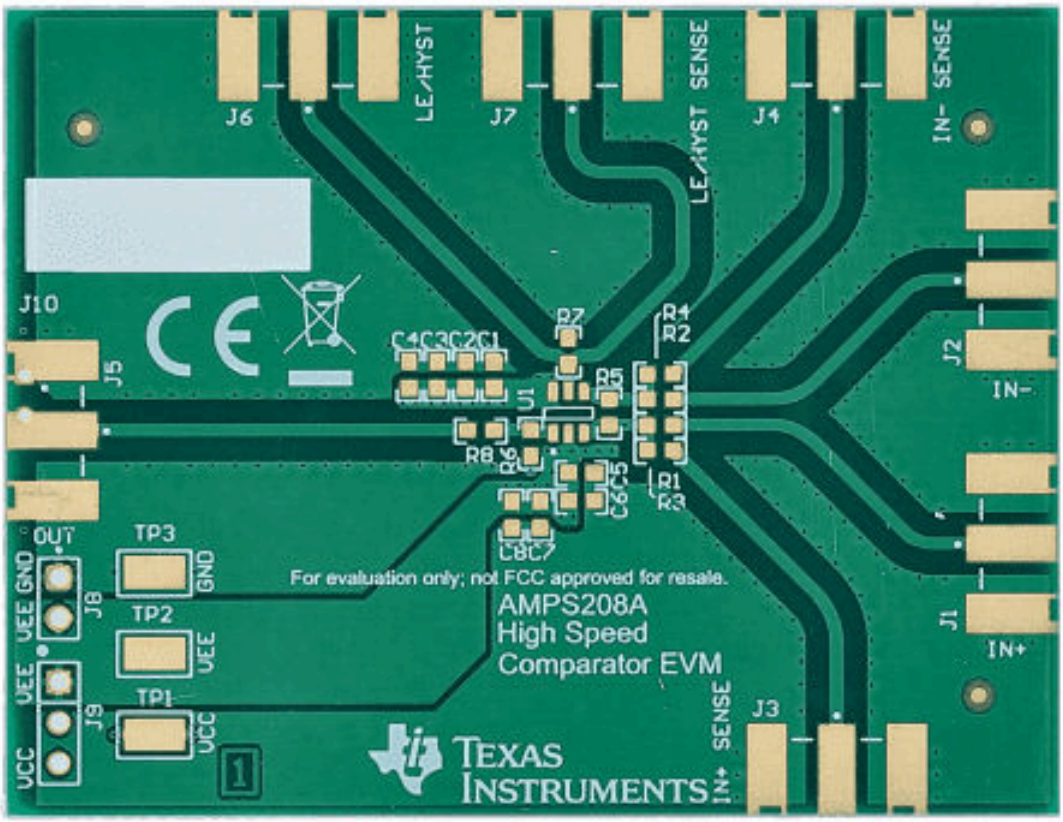
High Speed Comparator Evaluation Module

Description

The HS-COMPARATOR-EVM is an evaluation board designed to evaluate high speed single comparators in the 5-pin and 6-pin SOT-23 (DBV) packages, such as the TLV3601 and TLV1H103. The board has layout options intended to simply evaluate timing performance with different measurement tools. The output allows for direct connection to a 50Ω terminated oscilloscope.

Features

- Low propagation delay
- Low overdrive dispersion
- High toggle frequency
- Single ended push pull output
- 5-pin and 6-pin SOT-23 packages



HS-COMPARATOR-EVM Board (Top View)

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the functionality and set up procedure of HS-COMPARATOR-EVM, which is designed to evaluate the performance of any high-speed comparators in the 5-pin and 6-pin SOT-23 packages. Information such as the contents of the kit, specifications of the device, and recommended equipment for the set up is also included.

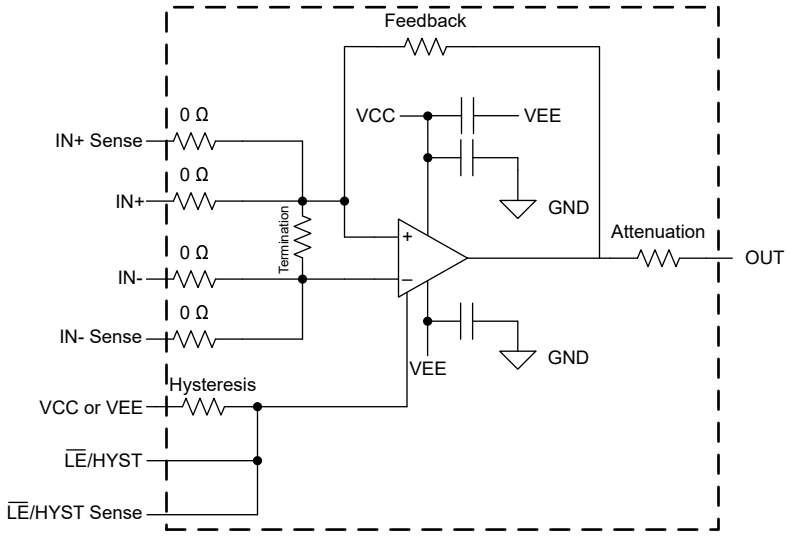


Figure 1-1. HS-COMPARATOR-EVM Block Diagram

1.2 Kit Contents

The kit comes with the following:

- 1 x HS-COMPARATOR-EVM

1.3 Specification

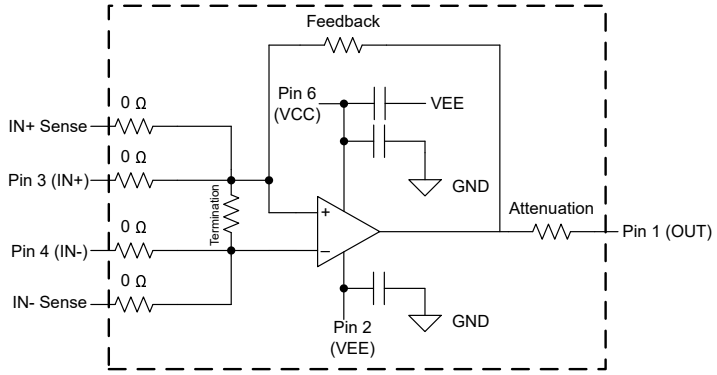


Figure 1-2. EVM Pin Assignments for Evaluating 5-pin Devices

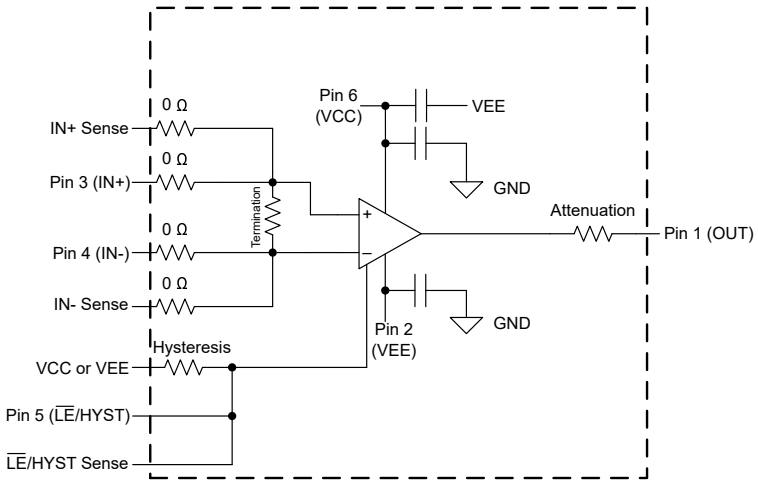


Figure 1-3. EVM Pin Assignments for Evaluating 6-pin Devices

1.4 Device Information

The following device is used in this evaluation module:

- TLV1H103

2 Hardware

2.1 Recommended Equipment Setup

- Power supply
- High speed functional generator with fast rise and fall time recommended (≤500 ps)
- High speed oscilloscope with 50Ω terminations
- SMA cables and adapters
  - Make sure to have matched cable lengths for IN+ SENSE, IN- SENSE, OUT

2.2 Board Setup

2.2.1 Power Supplies

Connect VCC to TP1 and connect VEE to TP2. If using single supply configuration, short both pins of J8 together to connect GND and VEE. If dual supply configuration is used, leave J8 pins unconnected and make the VCC and VEE connections previously mentioned, in addition to a GND connection to TP3.

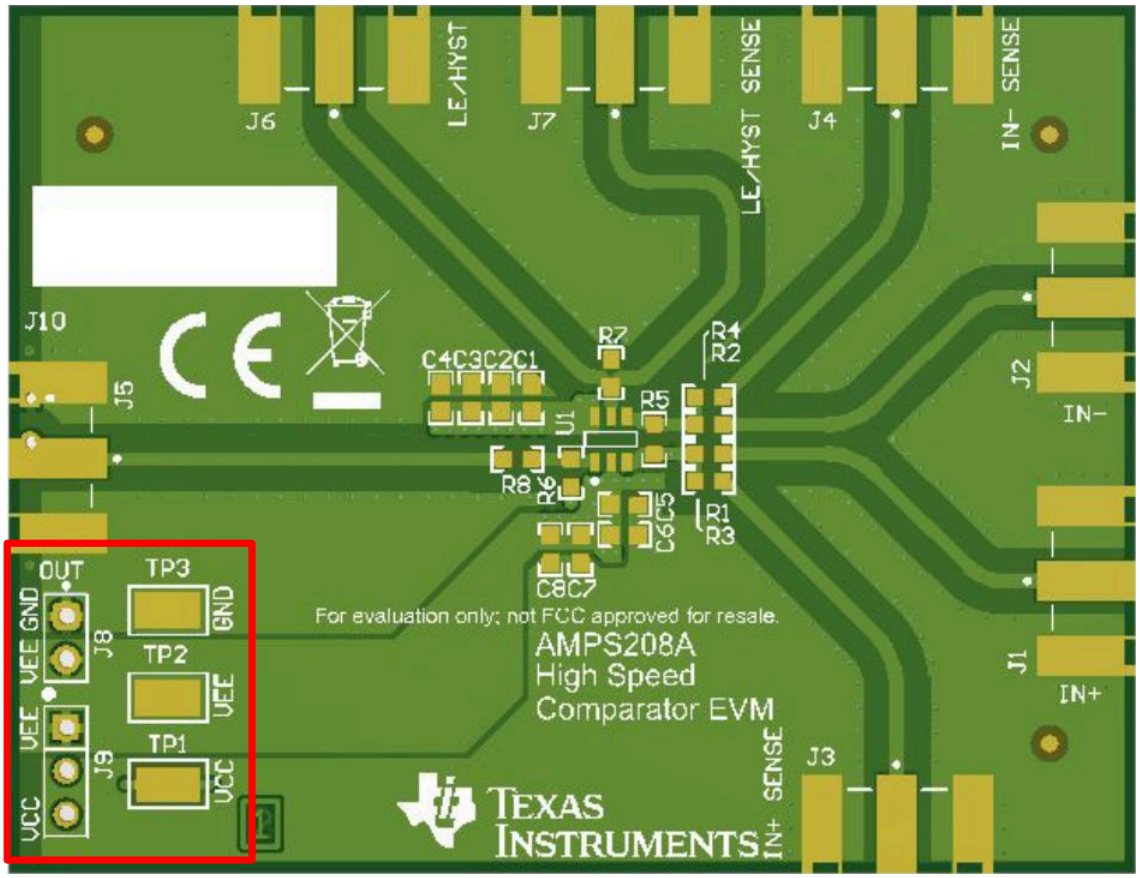


Figure 2-1. Power Supplies Connection

2.2.2 Inputs

Resistors R1, R2, R3, and R4 are all 0Ω resistor components. The input terminals (IN+ and IN-) have corresponding sense lines so that the inputs to the device can be terminated on the lines with 50Ω to an oscilloscope. This allows the input signals to be observed with minimal loading and distortion. All input connections are through SMA connectors. If the input signal to the device does not need to be evaluated on an oscilloscope, then R3 and R4 can be left uninstalled. However, the input signal can need to be terminated if the 50Ω setting of the oscilloscope is not connected.

There is an optional resistor pad on the input (R5) side of the device meant for termination of the input signal. R5 can be populated with a 100Ω resistor if applying an unterminated LVDS signal to the board. Alternatively, R5 can be populated with a 50Ω resistor if applying a function generator output that needs a 50Ω termination. One of the inputs can be GND and the board is operating in split supply in this situation. Otherwise the pad can be left unpopulated.

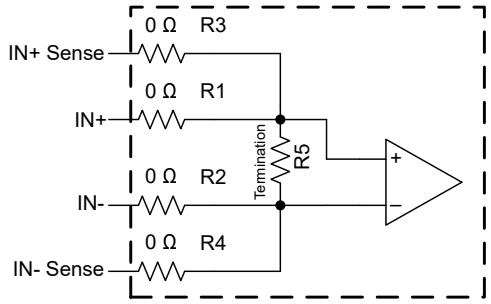


Figure 2-2. Input Side Block Diagram

2.2.3 Outputs

R8 is known as the attenuation resistor, and is used to attenuate the output by setting the top half of a voltage divider circuit, with the bottom half supplied by the load, such as an internal termination of the oscilloscope. TI does not recommend to populate with a low value resistor as the output of the comparator is not able to drive such a load as the amount of current sourced is significant. A 1kΩ resistor is recommended for this footprint which, coupled with an internal 50Ω termination of the scope creates an attenuation factor of 1:21 which can be rectified using oscilloscope settings. A high speed probe can be used for measurement of the output, but rise and fall times can be limited.

Two types of output connections are supplied depending on the needed configuration. J5, an SMA connector, can be populated or J10, a two-pin jumper, can be populated if using an active probe. If measuring the output and input (via input sense connections J3 and J4), TI recommends to use length matched cables on the output and sense lines to minimize distortion issues.

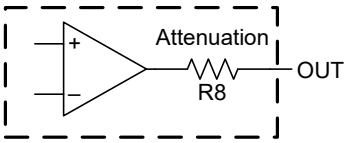


Figure 2-3. Output Side Block Diagram

2.2.4 Hysteresis

The HS-COMPARATOR-EVM is able to support both external hysteresis and devices with an integrated hysteresis pin.

External hysteresis can be applied through external component R6, a feedback resistor, and R1, a series resistor for IN+. Necessary calculations for the hysteresis window must be made to figure out the value of both resistors.

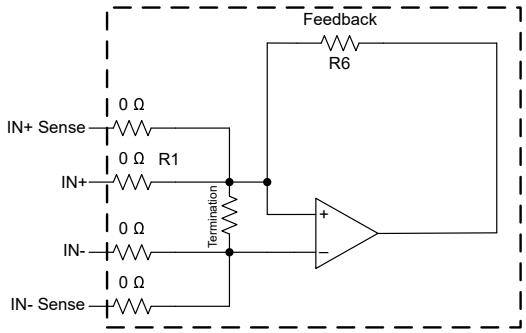


Figure 2-4. External Hysteresis Schematic

For devices such as the TLV1H103 that utilizes a hysteresis pin called $\overline{LE}$/HYST, the internal hysteresis can be adjusted through the attachment of an external resistor (R7) connecting to VEE.

Alternatively, the pin also functions as an inverting Latch Enable. If the pin is connected to VEE, then the device holds the output state for as long as the pin remains connected to that voltage. If the pin is connected to VCC, then the device functions normally with no hysteresis. Connections for VCC and VEE are supplied through J9 with R7 being populated with a 0Ω resistor. However, if necessary to control when the device latches, then a pulsing signal can be applied to SMA connector J6, with SMA connector J7 being the corresponding sense line for that input.

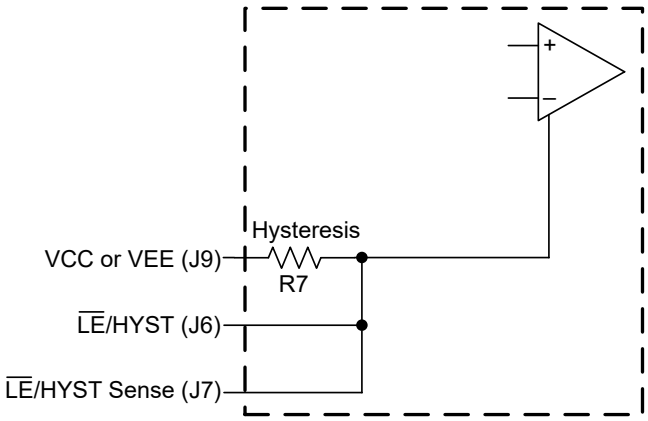


Figure 2-5. $\overline{LE}$/HYST Block Diagram

2.3 Quick-Start Procedure using TLV1H103

Note

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

The following connections are made using a split supply configuration. Split supply configuration is advantageous for measurement purposes. The reference voltage can be set to GND, while the other input can be set to an AC waveform that toggles between negative and positive voltage at a 0 DC offset. Thus, the output is toggling whenever the AC waveform toggles.

This configuration allows for two distinct advantages compared to a single supply input. The first advantage is that the reference voltage is at GND; a non-noisy voltage level. If the reference voltage level needs to be changed in relation to the supplies, then the supply voltages can be altered instead. The second advantage being able to zoom into the input as much as possible due to the 0 DC offset of the waveform.

1. Set power supply positive terminal to 2.5V and negative terminal to -2.5V. Disable power supply output
2. Connect positive terminal supply to TP1, negative terminal to TP2, and GND to TP3.
3. Populate R7 with 0Ω resistor and connect $\overline{LE}$/HYST to positive terminal through JP with jumper.
4. Make sure that the cables connecting to IN+SENSE and OUT are matched length and impedance. Perform any deskewing if necessary
5. Set the function generator to produce a square wave output with 100mVpp at 1MHz, with a DC offset of 0V. Disable the signal generator output. Connect the output to IN+.
6. Connect IN- to GND through an SMA 50Ω termination barrel.
7. Connect OUT to a 50Ω terminated scope channel.
8. Connect IN+SENSE to a 50Ω terminated scope channel.
9. Enable the power supply and the signal generator.
10. Verify the supply current is < 60mA.
11. Monitor and verify the input from IN+SENSE.
12. Monitor and verify OUT.

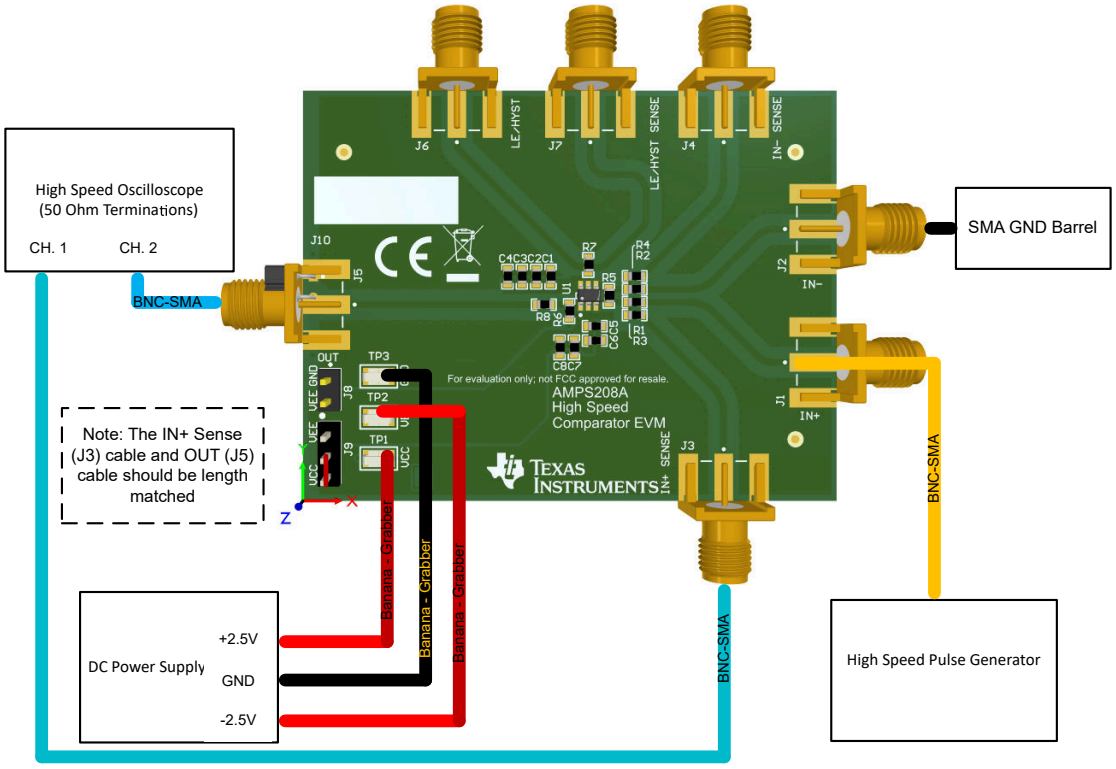


Figure 2-6. HS-COMPARATOR-EVM Quick Start Setup Using TLV1H103

Next, is a scope shot capture of the inputs and outputs described in the quick-start procedure. Here, the propagation delay between IN+ and OUT is measured by taking the time delta between when IN+ and OUT reach 50% of the respective transitions.

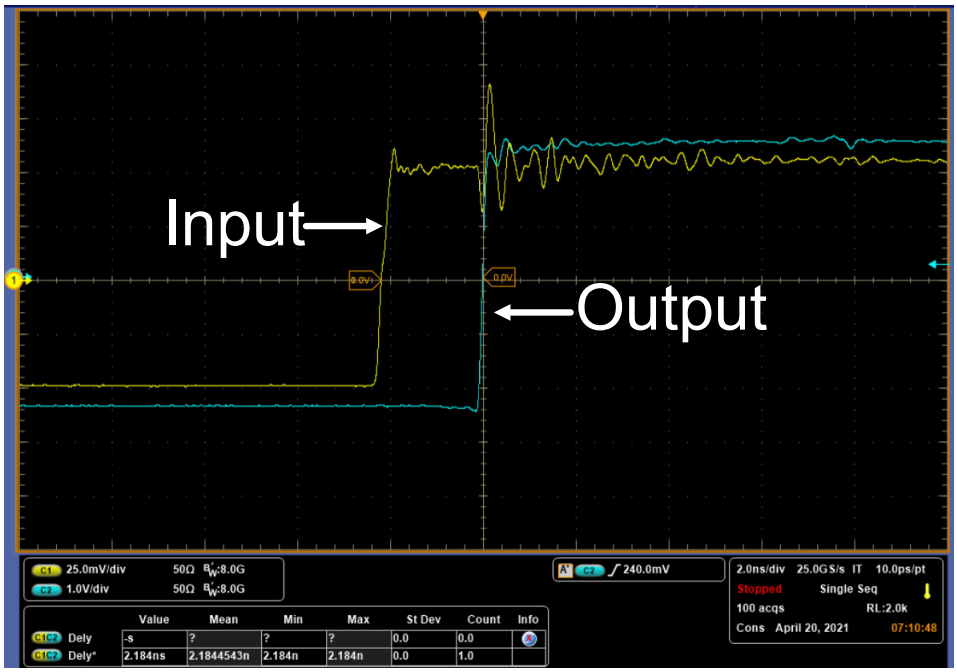


Figure 2-7. Propagation Delay Low to High

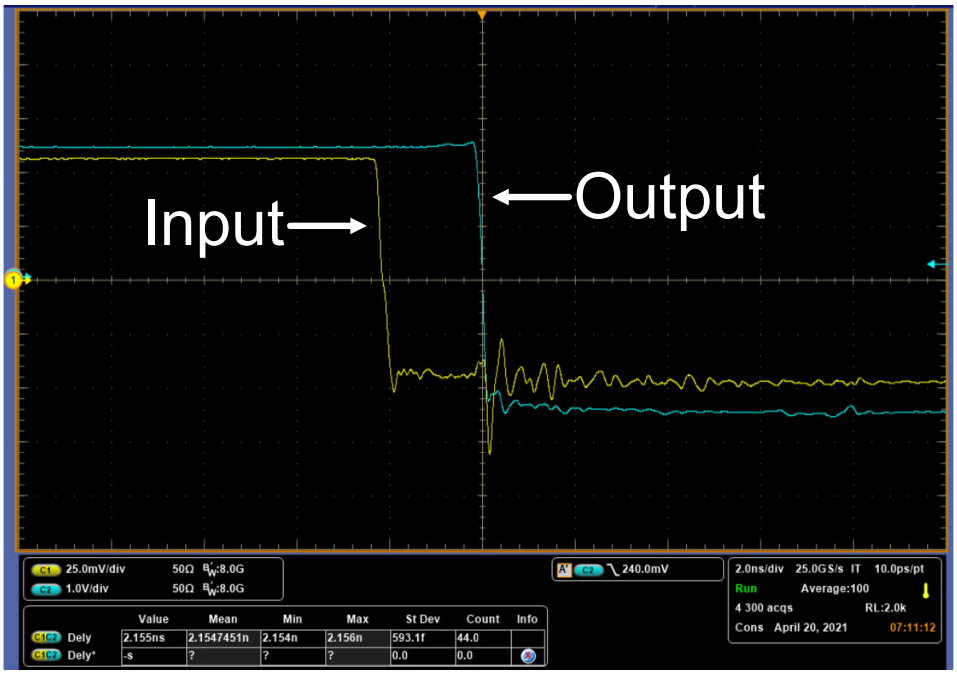


Figure 2-8. Propagation Delay High to Low

3 Hardware Design Files

3.1 Schematic

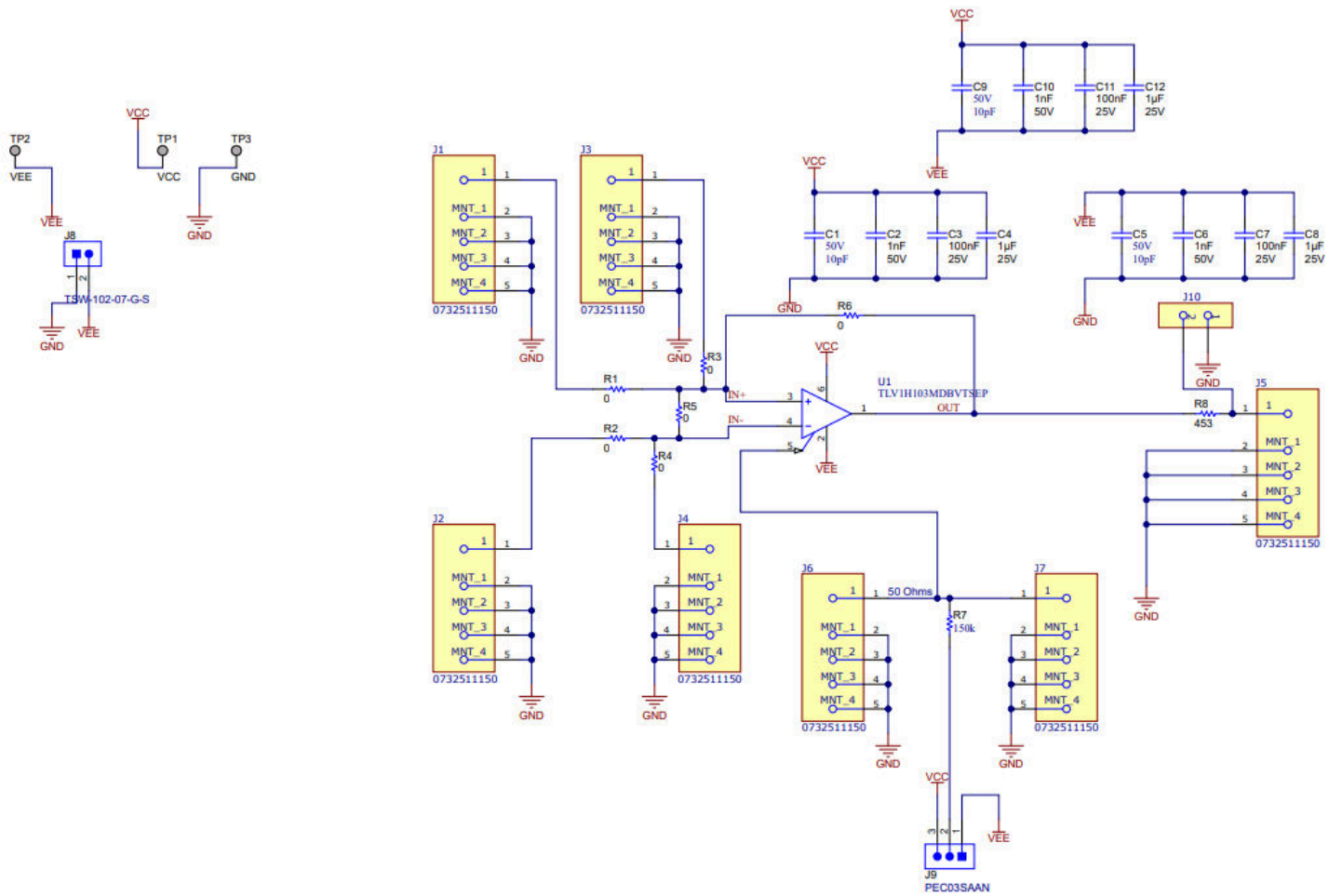


Figure 3-1. HS-COMPARATOR-EVM Schematic

3.2 PCB Layouts

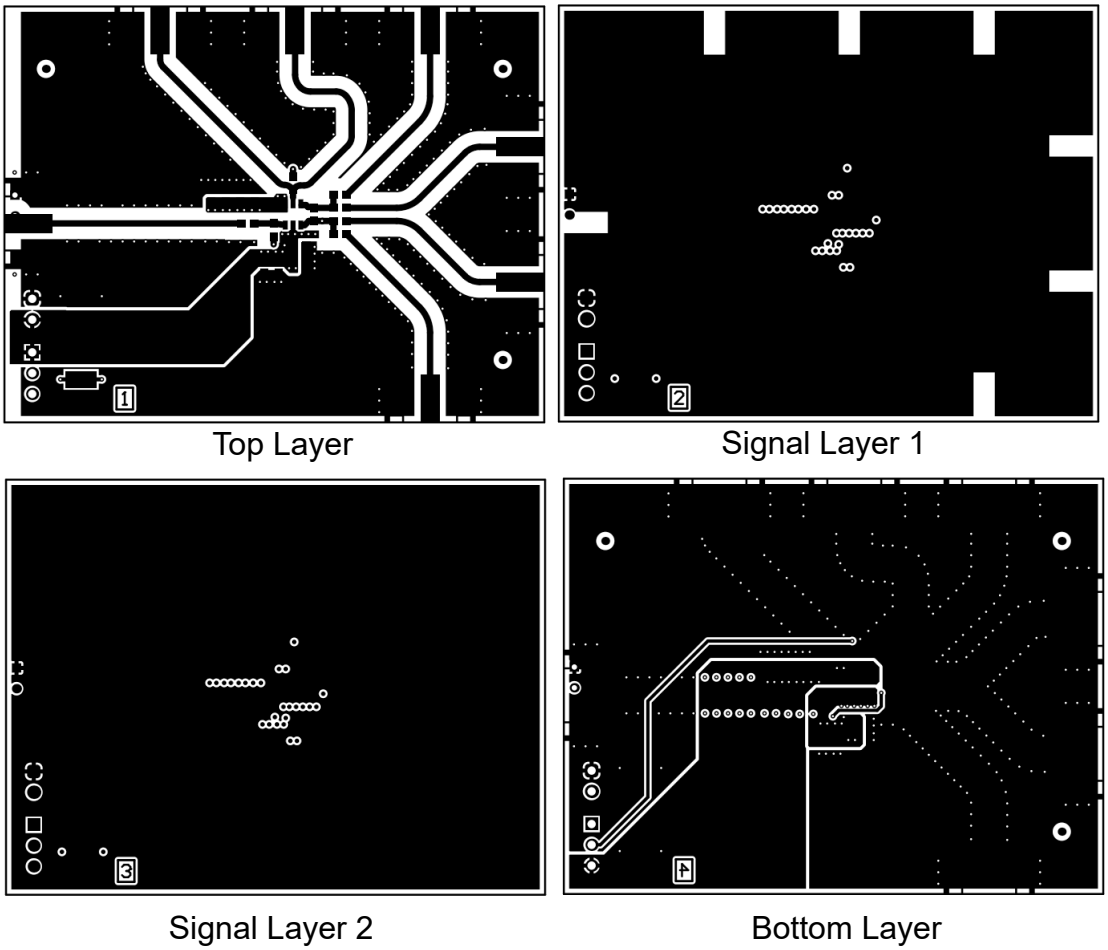


Figure 3-2. Layers

3.3 Bill of Materials

Table 3-1. HS-COMPARATOR-EVM Bill of Materials

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
C1, C5, C9	0	10pF	CAP, CERM, 10pF, 50V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0603	0603	CGA3E2C0G1H100D080AA	TDK
C2, C6, C10	0	1000pF	CAP, CERM, 1000pF, 50V, +/- 5%, X7R, 0603	0603	CL10C102JB8NNNC	Samsung Electro-Mechanics
C3, C7, C11	0	0.1uF	CAP, CERM, 0.1uF, 25V, +/- 5%, X7R, 0603	0603	C0603C104J3RACTU	Kemet
C4, C8, C12	0	1uF	CAP, CERM, 1uF, 25V, +/- 10%, X7R, 0603	0603	C0603C105K3RACTU	Kemet
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	0		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J2, J3, J4, J5, J6, J7	0		SMA Connector Receptacle, Female Socket 50Ohm Board Edge, End Launch Solder		0732511150	Molex Inc
J8	0		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J9	0		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J10	0		STANDRD SOLDER TAIL SIP SOCKET; 02 Pins; Tin (matte) over Nickel	HDR2	399-43-102-10-003000	Mill-Max
R1, R2, R3, R4, R5, R6	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R7	0	150k	RES, 150 k, 5%, 0.1 W, 0603	0603	CRCW0603150KJNEA	Vishay-Dale
R8	0	1k	RES, 1 k, 1%, 0.1 W, 0603	0603	RC0603FR-071KL	Yageo America
TP1, TP2, TP3	0		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	0		2.5ns High-Speed Comparator with Push Pull Output	SOT23-6	TLV1H103DBV	Texas Instruments

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

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   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 DEGREDATION 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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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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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

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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.

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:*

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