EVM User's Guide for TCA9511A

This document discusses how to set up and use the TCA9511A EVM.

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Trademarks

1 Introduction

This EVM allows designers to evaluate the TCA9511A at different loading conditions (pull up resistors and bus capacitance), V_{CC} voltages, and series resistances if needed.

1.1 Features

This EVM supports:

- Adjustable pull up resistors on both sides of the TCA9511A with jumper shunts.
- Adjustable load capacitance on both sides of the TCA9511A with DIP switches.
- Onboard I^2C slave (TMP1075D) on 'OUT' side of the TCA9511A.
- Open top socket (if user supplies) testing on bottom on board.
- Hot insertion testing (if user acquires female connector).

1.2 Applications

- Rack Servers
- Telecommunications Equipment

1.3 Description

This EVM allows designers to evaluate the TCA9511A at different loading conditions (pull up resistors and bus capacitance), V_{CC} voltages, and series resistances if needed.

2 EVM Setup

Equipment needed to evaluate the TCA9511A:

- Power supply capable of supplying the desired voltage to the TCA9511A and I^2C bus.
- 4 channel oscilloscope if users wish to observe I^2C transactions on both sides of the TCA9511A.
- Microcontroller, processor, or digital analyzer which can send and receive I^2C.

2.1 Power in selector

This EVM allows the user the option of powering the board using the external power input test point denoted as TP8 or by using a female mating connector which on this EVM is called the V_{CC} backplane power.

Figure 1. Power In Selector

Most users power the device by using the V_{CC} external test point location. To use this procedure to power the board, the user should shunt J7 positions 1 and 2. When done correctly and power is supplied, LED D1 turns on. The V_{CC} external voltage should not be used below 2.3 V or above 5.5 V; otherwise, the TCA9511A is outside of its recommended operating conditions.

Figure 2. V_{CC} External Select

The alternative way to power this EVM is to use the Samtec mating connector (model: MEC1-105-02-F-DEM2). This connector allows users to test and evaluate the TCA9511A hot insertion function. Powering the EVM in this way requires the user to shunt J7 positions 2 and 3 then supply power through the Samtec mating connector pin 1. The exposed traces on the male mating connector have staggered connection points to the female mating connector and allow for the GND to connect to the female mating connector first, then V_{CC}, then SDAIN and SCLIN. This allows the board to see GND first before connecting to power. Afterwards, the device will power up and turn on the 1-V precharge that the TCA9511A features before finally connecting to the SDAIN and SCLIN points on the female connector. Note that the 1-V precharge feature only works if the pull up resistor is not present on the TCA9511A EVM "IN" inside, but on the female side of the mating connector. This is why R2 and R4 are not populated on the TCA9511A EVM and the pull up resistor selectors are not shunted in box.

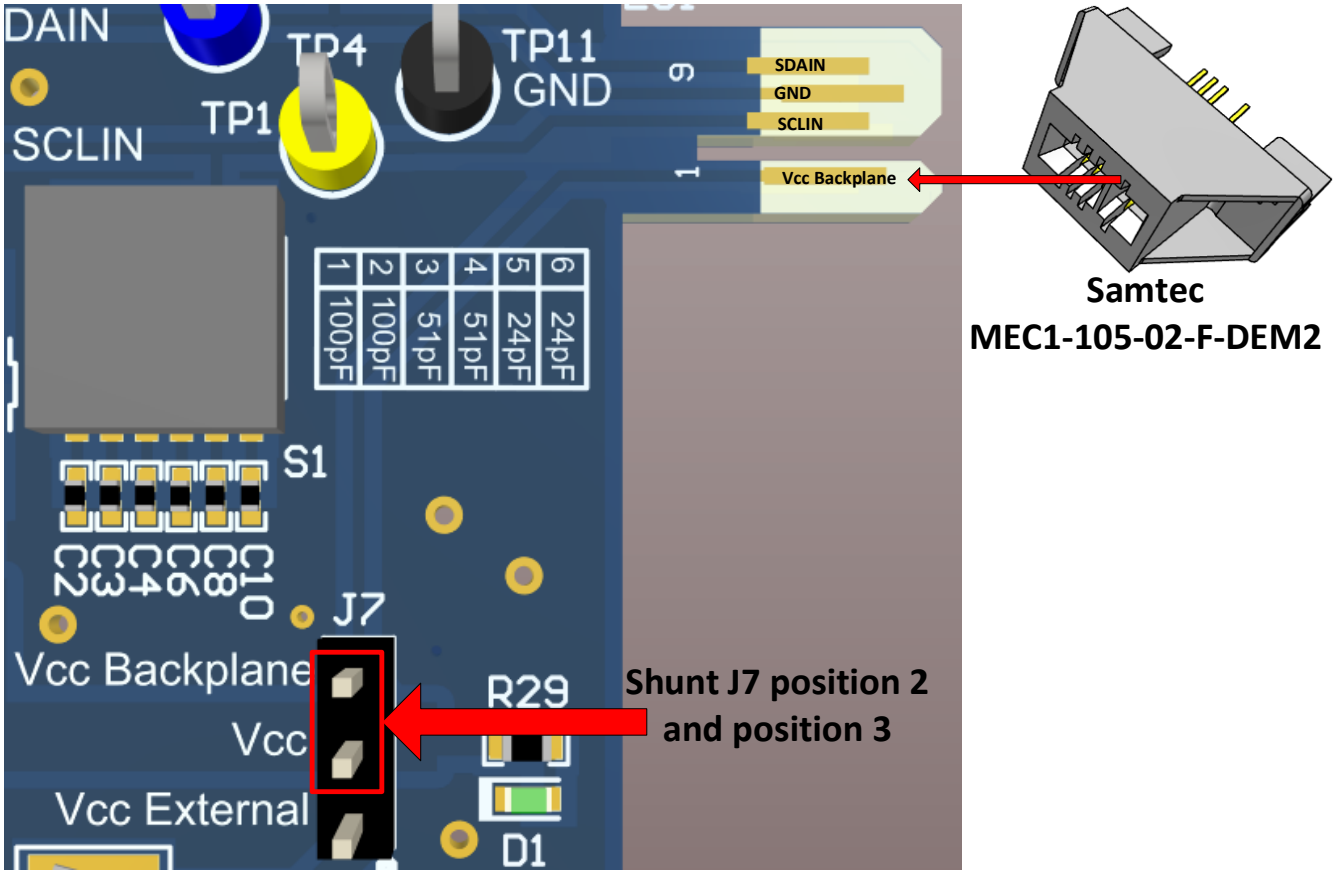


Figure 3. V_{CC} Backplane Select

2.2 Pull up resistor Selector

The TCA9511A EVM provides optional pull up resistor selectors on SDAIN, SDAOUT, SCLIN, and SCLOUT. Note that SDAIN/SCLIN do not have a pull up resistor populated on the board in order to showcase the pre-charge feature of the TCA9511A. In an end equipment, it is assumed the pull up resistor would be populated on the backplane while the TCA9511A sits on a card without pull up resistors on SDAIN/SCLIN. For the purposes of evaluation, the pull up resistors can be selected on the EVM.

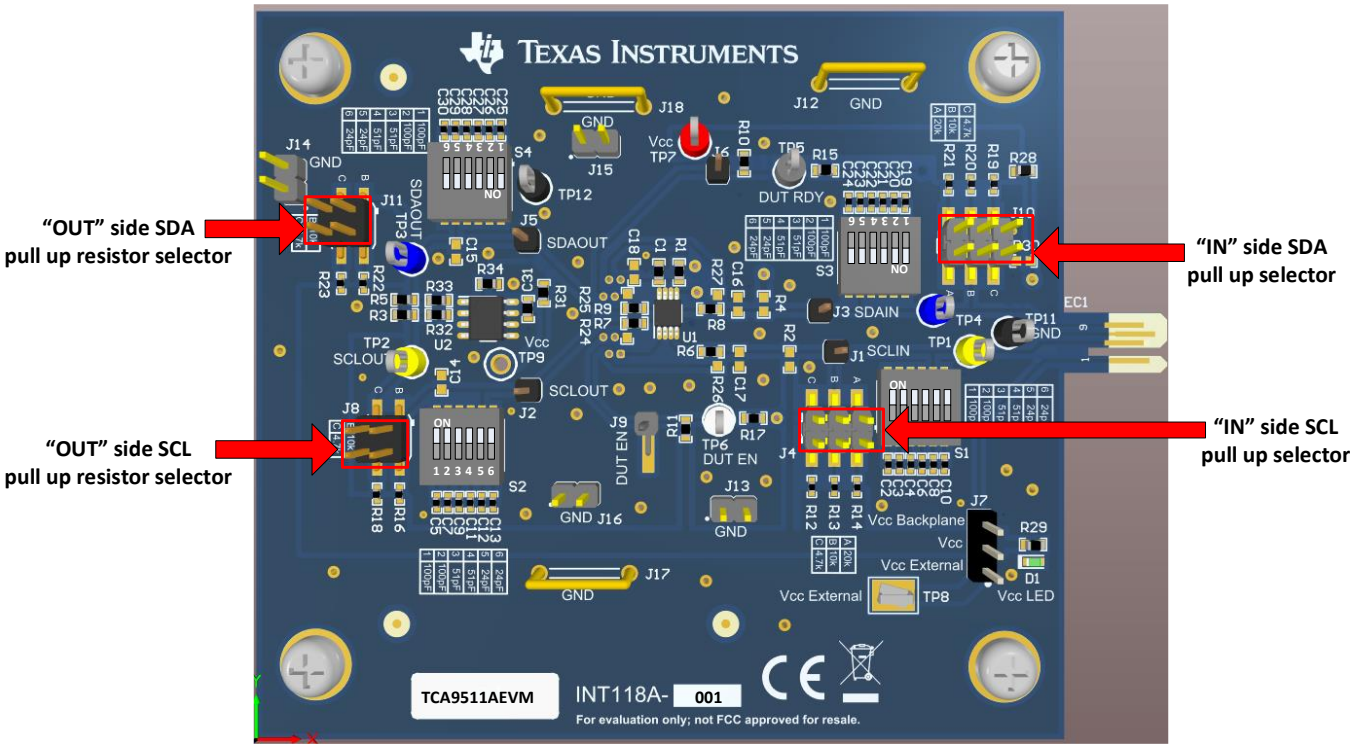


Figure 4. Pull Up Resistor Select

J4 and J10 are used to select the pull up resistors on SDAIN/SCLIN. Both jumpers have the letters 'A', 'B', and 'C' to denote the value of the pull up resistors. Multiple pull up resistors can be selected on J4 and J10 which would put the pull up resistors in parallel. The possible equivalent pull up resistances are displayed in Table 1.

Table 1. J4 and J10 pull up resistor selector

Pull up resistor combinations	Equivalent pull up resistance (Ω)
None Selected	OPEN
A	20 k
B	10 k
C	4.7 k
A // B	6.6 k
B // C	3.2 k
A // C	3.8 k
A // B // C	2.7 k

The SDAOUT and SCLOUT lines also include selected pull up resistors through J8 and J11 and has 20-k Ω pull up resistors populated on the bus. All possible equivalent pull up resistances are provided in Table 2.

Table 2. J8 and J11 pull up resistor selector

Pull up resistor combinations	Equivalent pull up resistance (Ω)
None Selected	20 k
B	6.6 k
C	3.8 k
B // C	2.7 k

Alternatively R2 and R4 can be populated to allow for the user to choose the pull up resistor not offered on the SCLIN and SDAIN line. If necessary, resistors R3 and R5 can be depopulated and replaced with the user's preferred pull up value for the SCLOUT and SDAOUT line.

2.3 Load capacitance selector

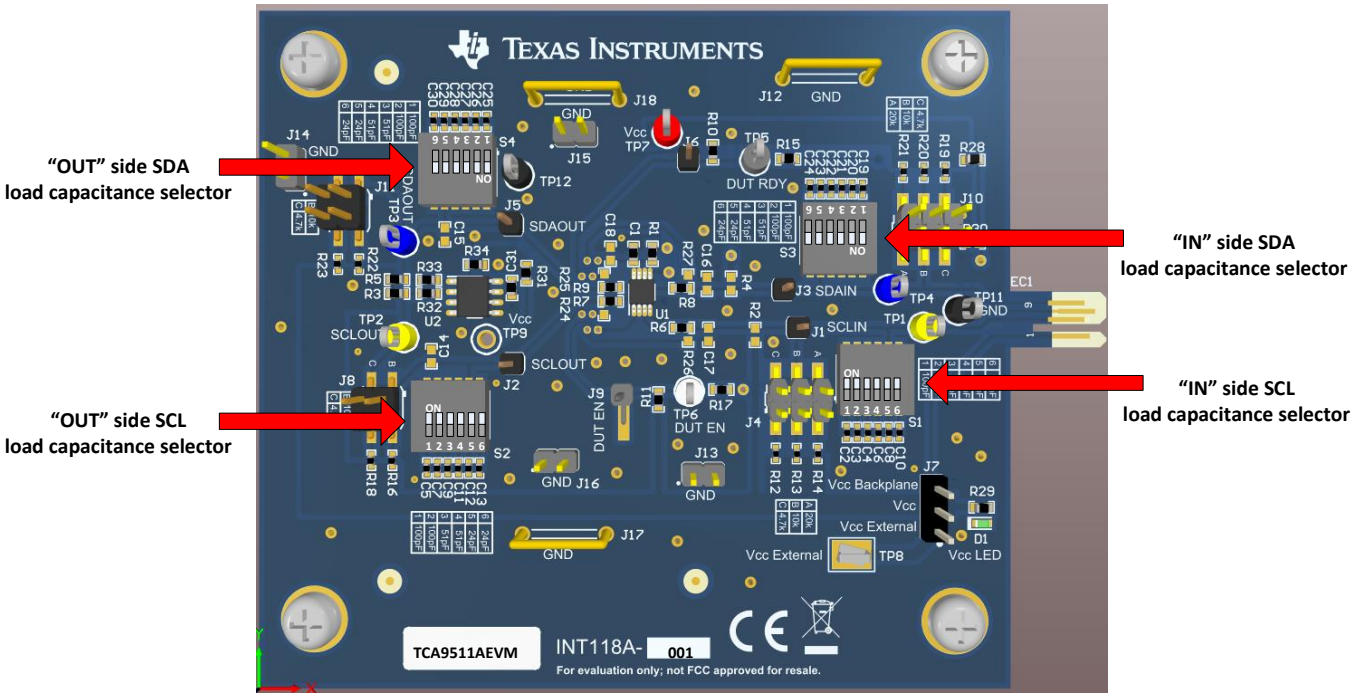


Figure 5. Load Capacitor Select

The TCA9511A EVM provides a way for the designer to test the device under capacitive loading which is one of the main constraints in an I²C system. Switches denoted as S1, S2, S3, and S4 provide the user with the ability to change the I²C bus capacitance with up to about 350 pF of capacitance. The switched capacitor can be selected in increments of about 25 pF, about 50 pF, and 100 pF. Each of the switched capacitors have two of each value so any capacitive loading between 0 pF to 350 pF in any factor of 25 pF can be chosen. For example: if the user wants a total capacitance of 275 pF, the user chooses to switch in 2 x 100 pF, 1 x 50 pF, and 1 x 25 pF for a combined capacitance of about 275 pF.

Note there is additional capacitance due to parasitics from the PCB line traces and ICs on the board. For SDA/SCL pins of a device, assume 10 pF max per device on the I²C line. The "OUT" side of TCA9511A of this EVM for example has TCA9511A SDA/SCL and TMP1075D SDA/SCL so the maximum capacitance on the "OUT" side of the TCA9511A is 20 pF total from the ICs.

2.3.1 TMP1075D

An I²C temperature sensor is included in this EVM denoted as U2 (located on the 'outside' of the TCA9511A). This allows users to test I²C communication from either the "IN" side of the TCA9511A or the "OUT" side of the TCA9511A with an onboard I²C slave if the TCA9511A is enabled. The slave address to this device on this EVM is 0x48h.

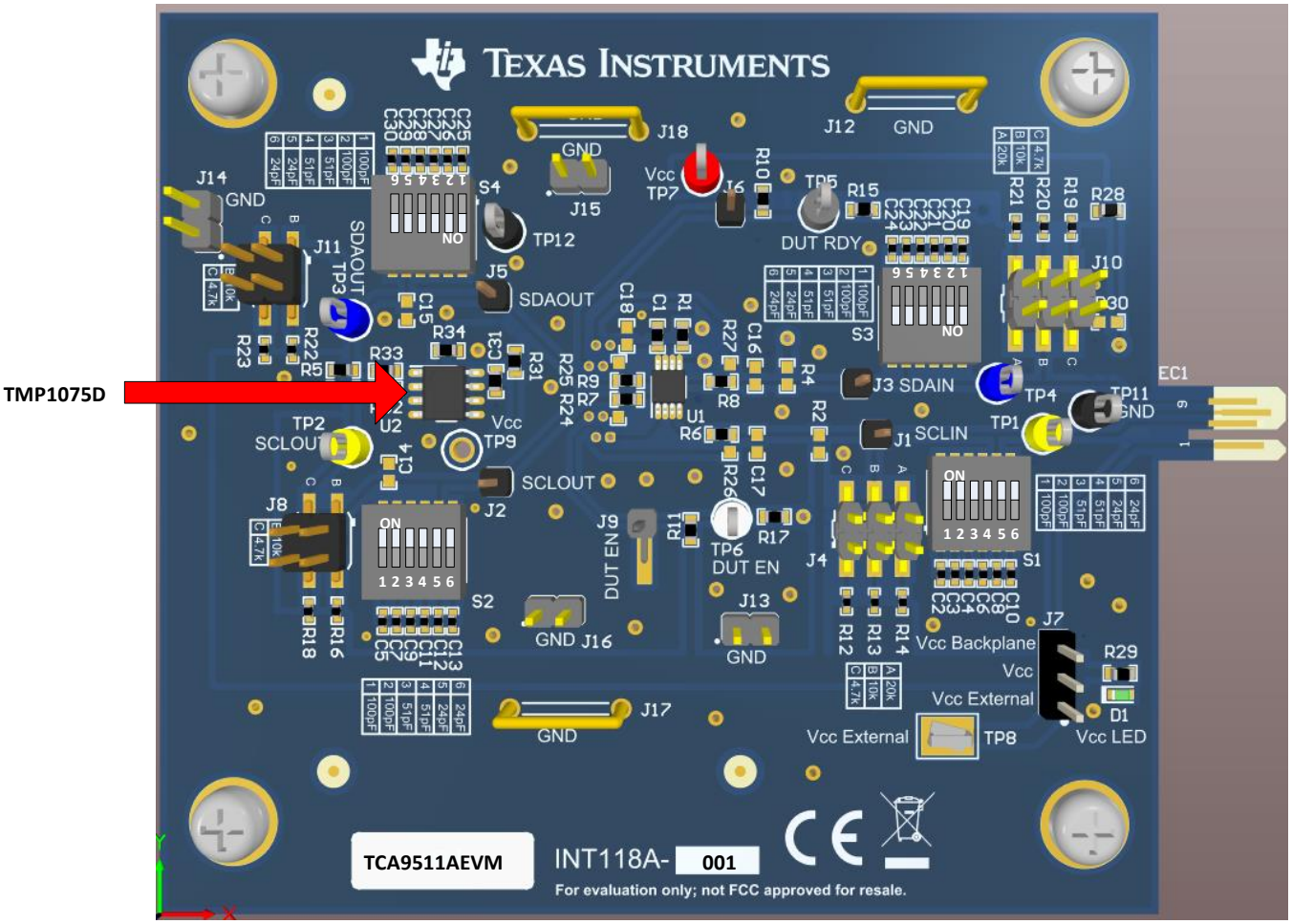


Figure 6. TMP1075

2.3.2 Open top socket (DNP)

The EVM does have the ability to test devices through a open top clamshell type socket (Loranger 04335 081 6218B) though the user would need to acquire the socket as this EVM does not include the socket. This functionality can be useful for doing temperature testing across multiple units without the need to desolder and resolder units.

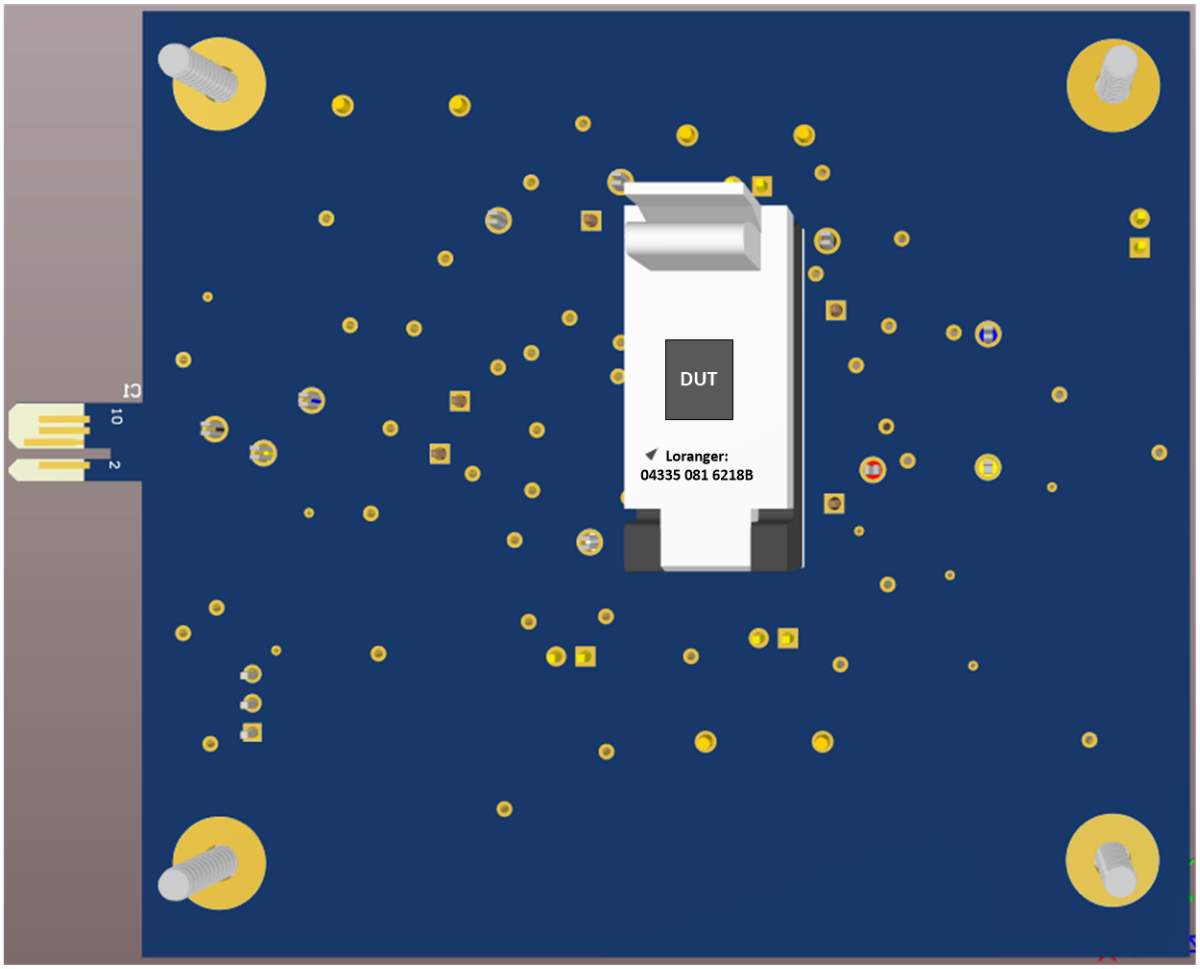


Figure 7. Open top socket

The PCB must be modified to support using the top socket. The user should depopulate: R6, R7, R8, R9, C1, and U1 and populate R24, R25, R26, R27, and C18.

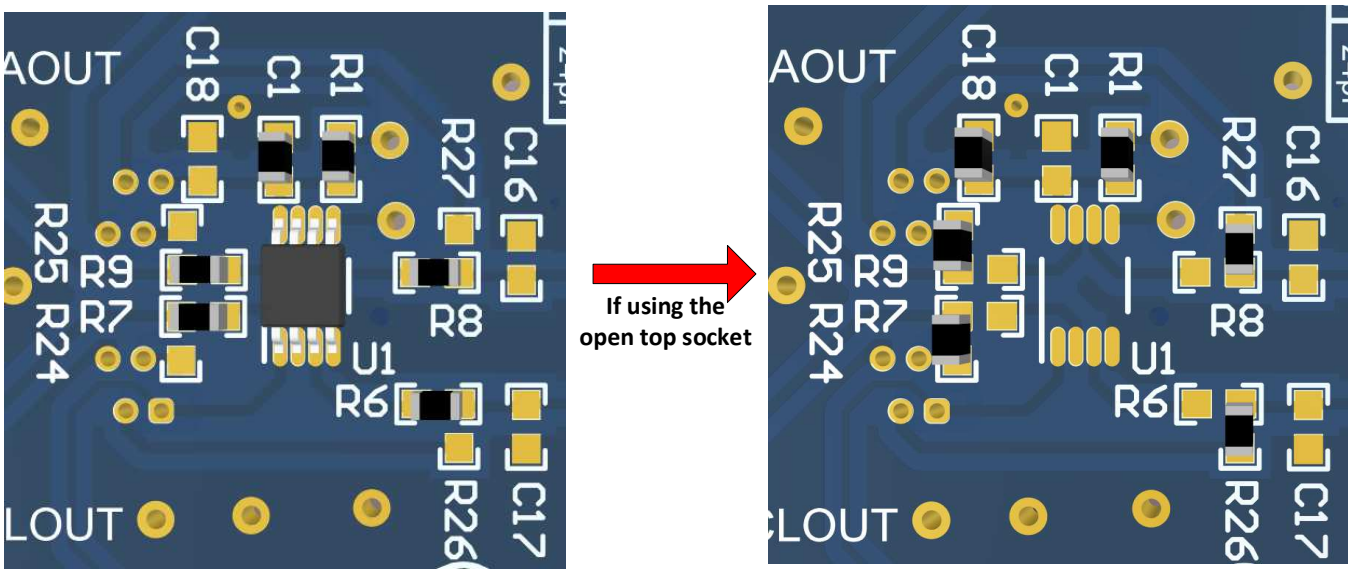


Figure 8. Socket Board set up

3 Board Layout

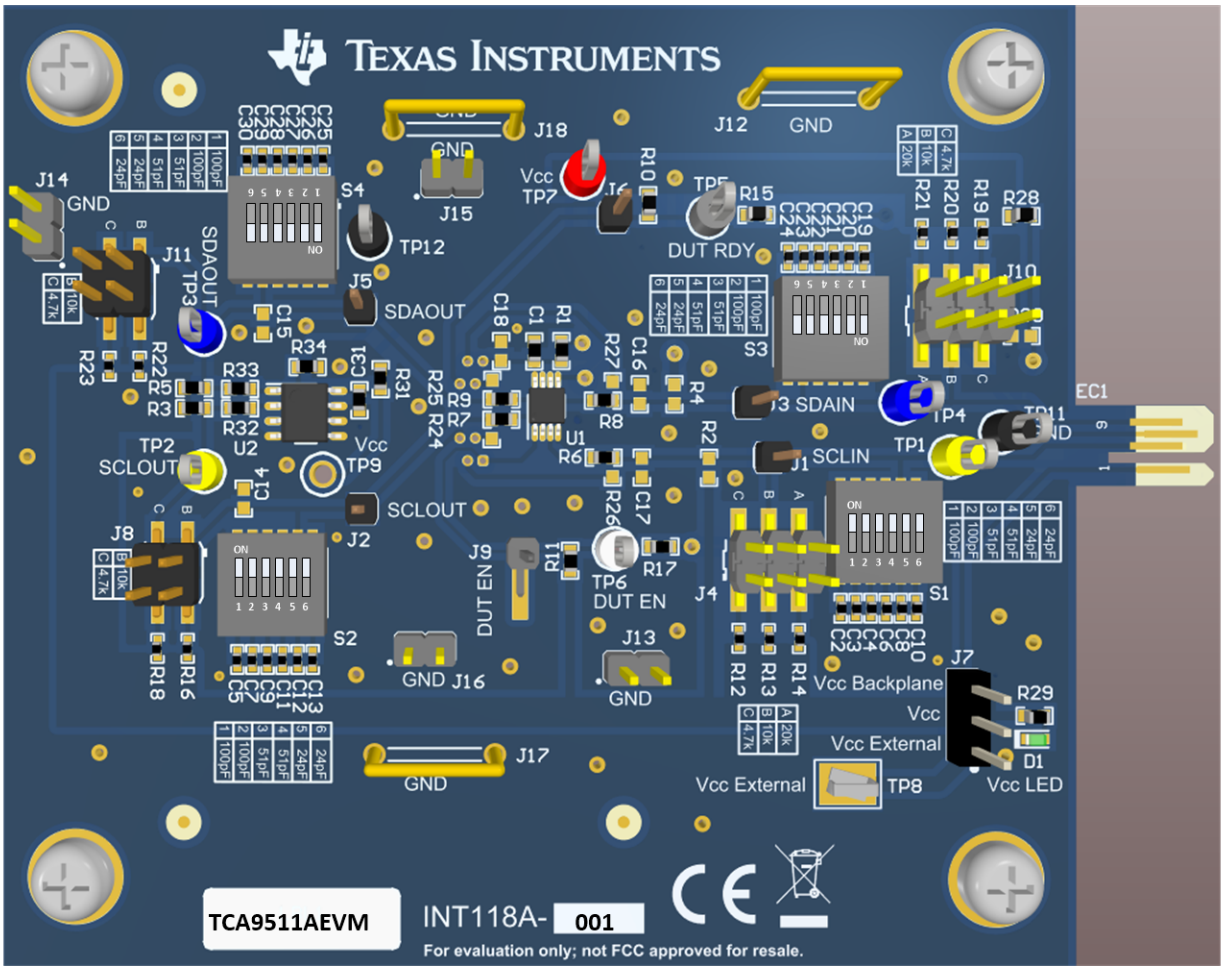


Figure 9. EVM TOP

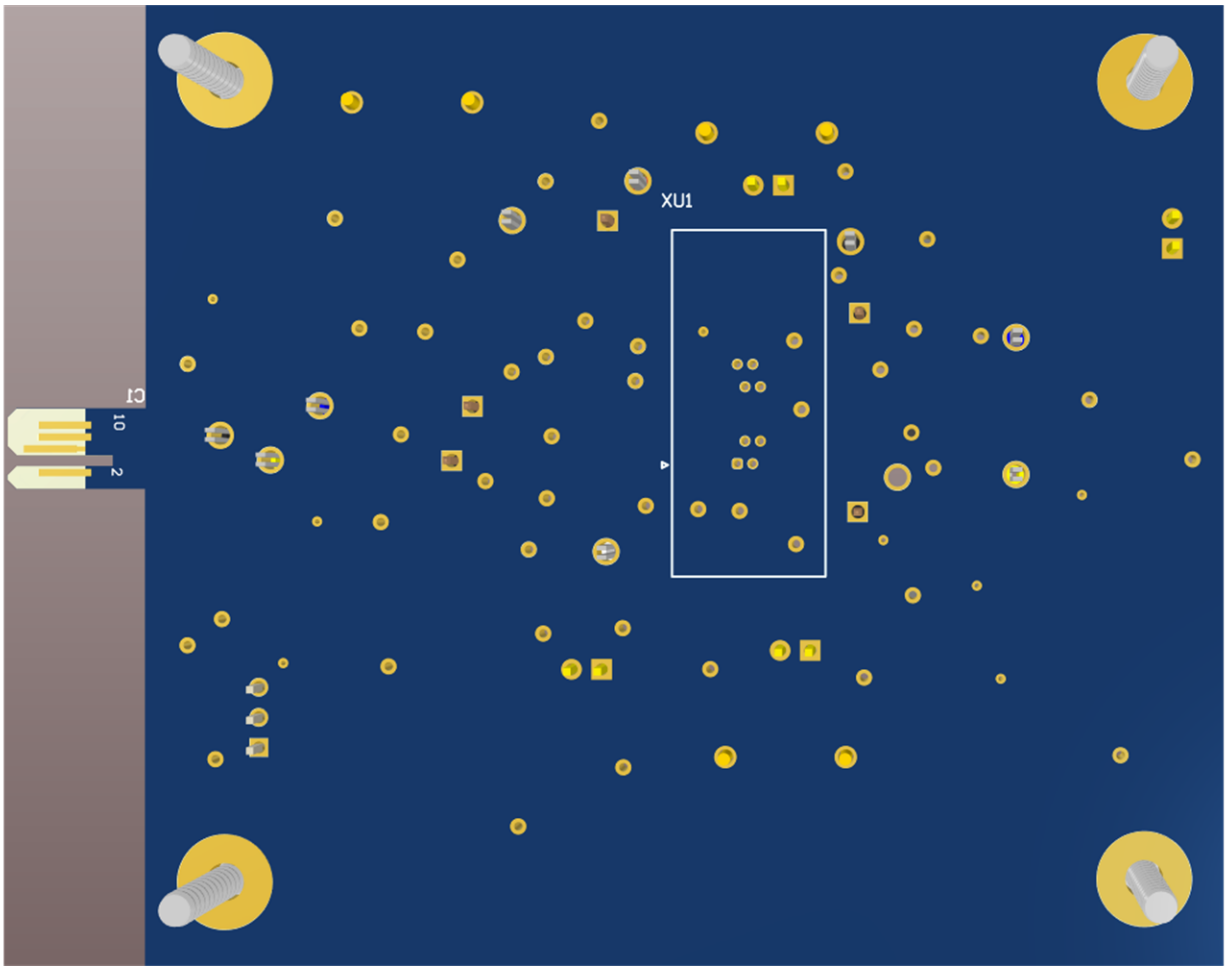
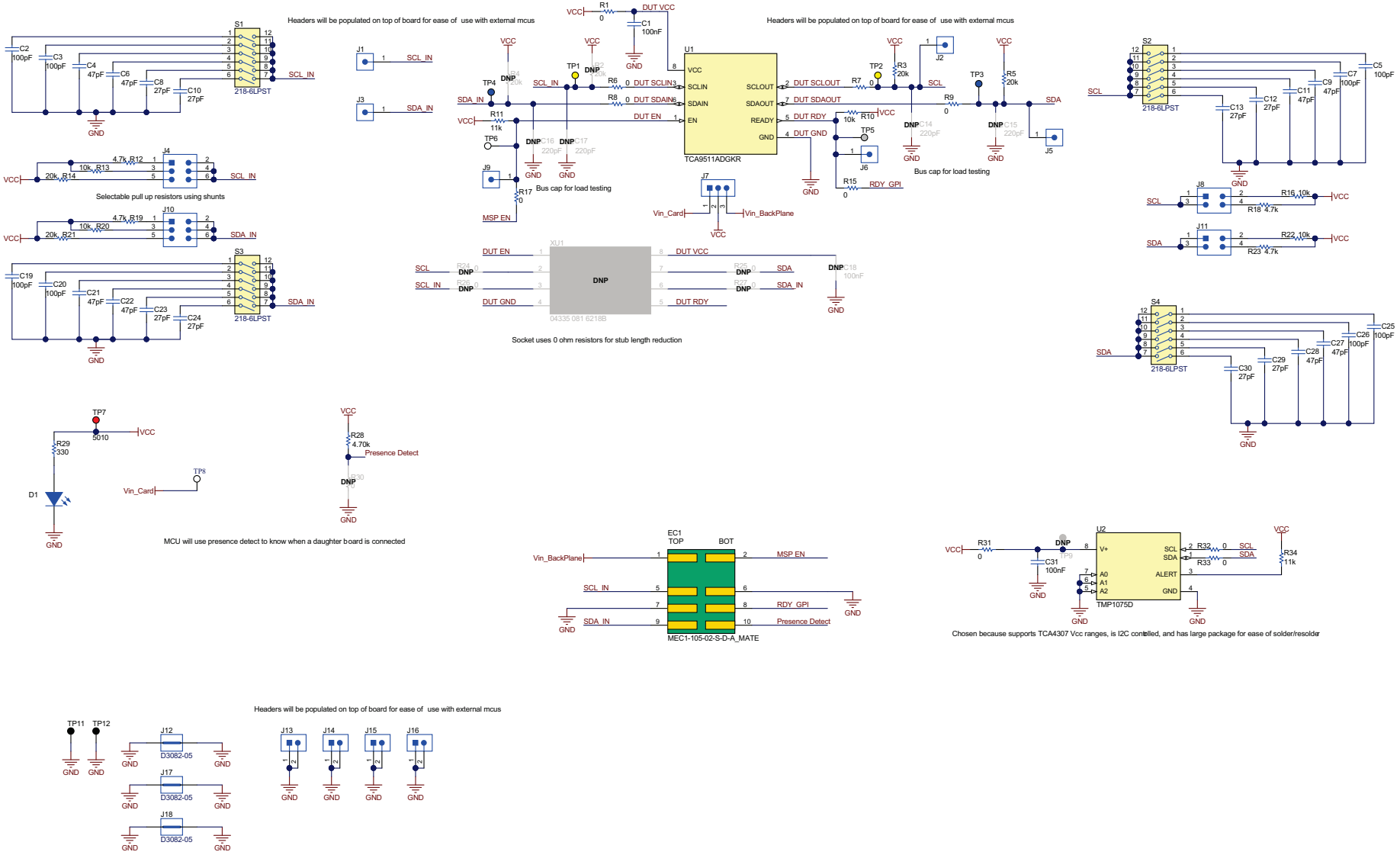


Figure 10. EVM Bottom

4 Schematic and Bill of Materials

4.1 Schematic



4.2 Bill of Materials

Table 3. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		INT118	Any		
C1, C31	2	0.1uF	CAP, CERM, 0.1 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet		
C2, C3, C5, C7, C19, C20, C25, C26	8	100pF	CAP, CERM, 100 pF, 50 V, +/- 1%, C0G/NP0, 0402	0402	04025A101FAT2A	AVX		
C4, C6, C9, C11, C21, C22, C27, C28	8	47pF	CAP, CERM, 47 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	885012005044	Wurth Elektronik		
C8, C10, C12, C13, C23, C24, C29, C30	8	27pF	CAP, CERM, 27 pF, 50 V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402	GCM1555C1H270JA16D	MuRata		
D1	1	Green	LED, Green, SMD	LED_0603	LTST-C191KGKT	Lite-On		
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastner Supply		
H5, H6, H7, H8	4		Hex Standoff Threaded #4-40 Nylon 0.750" (19.05mm) 3/4" Natural	RFI SHIELD CLIP TIN SMD	1902D	Keystone		
J1, J2, J3, J5, J6	5		Header, 2.54 mm, 1x1, Gold, TH	Header, 2.54 mm, 1x1, TH	61300111121	Wurth Elektronik		
J4, J10	2		Header, 2.54mm, 3x2, Gold, SMT	Header, 2.54mm, 3x2, SMT	TSM-103-01-L-DV	Samtec		
J7	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J8, J11	2		Header, 2.54mm, 2x2, Gold, SMT	Header, 2.54mm, 2x2, Gold, TH	61030421121	Wurth Elektronik		
J9	1		Header, 1x1, Gold, SMT	Header, 1x1, SMT	GBC01SFBN-M30	Sullins Connector Solutions		
J12, J17, J18	3		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin		
J13, J14, J15, J16	4		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions		
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		
R1, R6, R7, R8, R9, R15, R17, R31, R32, R33	10	0	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	0603	PMR03EZPJ000	Rohm		
R3, R5	2	20k	RES, 20 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060320K0JNEA	Vishay-Dale		
R10	1	10k	RES, 10 k, 5%, 0.1 W, 0603	0603	RC1608J103CS	Samsung Electro-Mechanics		
R11, R34	2	11k	RES, 11 k, 5%, 0.1 W, 0603	0603	RC0603JR-0711KL	Yageo		
R12, R18, R19, R23	4	4.7k	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04024K70JNED	Vishay-Dale		
R13, R16, R20, R22	4	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0JNED	Vishay-Dale		
R14, R21	2	20k	RES, 20 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ203X	Panasonic		
R28	1	4.70k	RES, 4.70 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD074K7L	Yageo America		
R29	1	330	RES, 330, 5%, 0.1 W, 0603	0603	RC0603JR-07330RL	Yageo		
S1, S2, S3, S4	4		Switch, SPST, Slide, Off-On, 6 Pos, 0.025A, 24V, SMD	5.8x8.79mm	218-6LPST	CTS Electrocomponents		
TP1, TP2	2		Test Point, Multipurpose, Yellow, TH	Yellow Multipurpose Testpoint	5014	Keystone		

Table 3. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate PartNumber	Alternate Manufacturer
TP3, TP4	2		Test Point, Multipurpose, Blue, TH	Blue Multipurpose Testpoint	5127	Keystone		
TP5	1		Test Point, Multipurpose, Grey, TH	Grey Multipurpose Testpoint	5128	Keystone		
TP6	1		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone		
TP7	1		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone		
TP8	1		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
TP11, TP12	2		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		
U1	1		Hot Swappable 2-Wire Bus Buffers, DGK0008A (VSSOP-8)	DGK0008A	TCA9511ADGKR	Texas Instruments		Texas Instruments
U2	1		I2C Compatible Upgrade to Industry Standard LM75 / TMP75 Digital Temperature Sensors, D0008A (SOIC-8)	D0008A	TMP1075D	Texas Instruments	TMP1075DR	Texas Instruments
C14, C15, C16, C17	0	220pF	CAP, CERM, 220 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603C221K5RACTU	Kemet		
C18	0	0.1uF	CAP, CERM, 0.1 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet		
R2, R4	0	20k	RES, 20 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060320K0JNEA	Vishay-Dale		
R24, R25, R26, R27	0	0	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	0603	PMR03EZPJ000	Rohm		
R30	0	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo		
TP9	0		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone		
XU1	0		Socket, MSOP-8, 25.6mil Pitch	Socket, MSOP-8, 25.6mil Pitch	04335 081 6218B	Loranger		
Note: Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.								

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 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。
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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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.

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.

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 compliance in all respects with such laws and regulations. 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.

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