

EVM User's Guide: THVD1454EVM

THVD1454EVM User's Guide



ABSTRACT

This document is the EVM User's guide for the THVD1454EVM which provides a quick way to evaluate the TI THVD1454, a half duplex RS-485 transceiver with selectable data rate and switchable integrated termination resistors, in the VSON (DRC) package.

Table of Contents

1 Introduction.....2

2 Board Description.....4

3 Board Component Overview.....4

4 Powering the Board.....6

5 Operation of THVD1454EVM.....7

 5.1 Default Operation.....7

 5.2 Potential Modifications.....7

6 Design Documents.....9

 6.1 Schematics.....9

 6.2 Layout.....11

 6.3 Bill of Materials.....13

7 References.....13

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1 Introduction

About This Manual

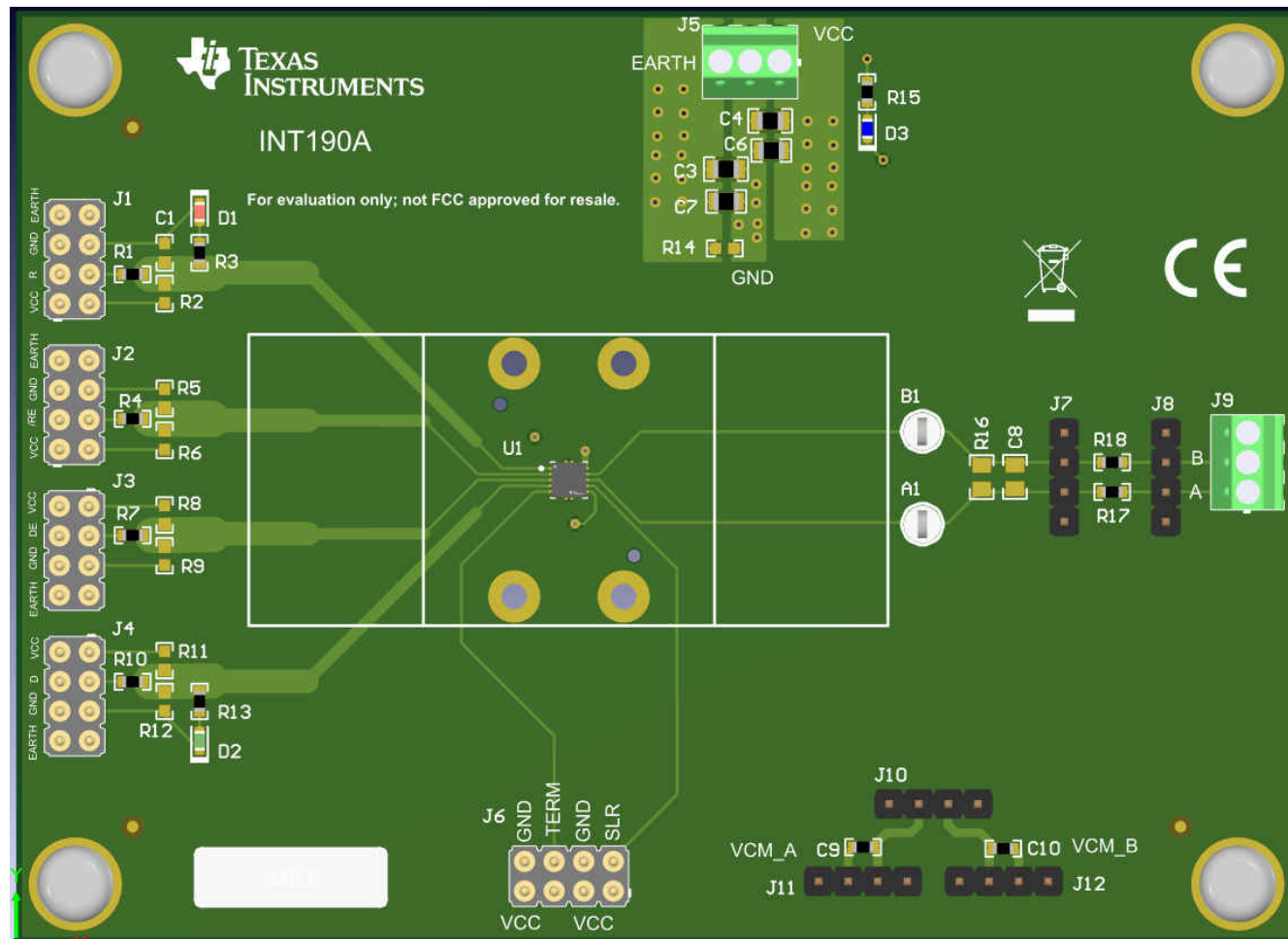


Figure 1-1. Top View of THVD1454EVM

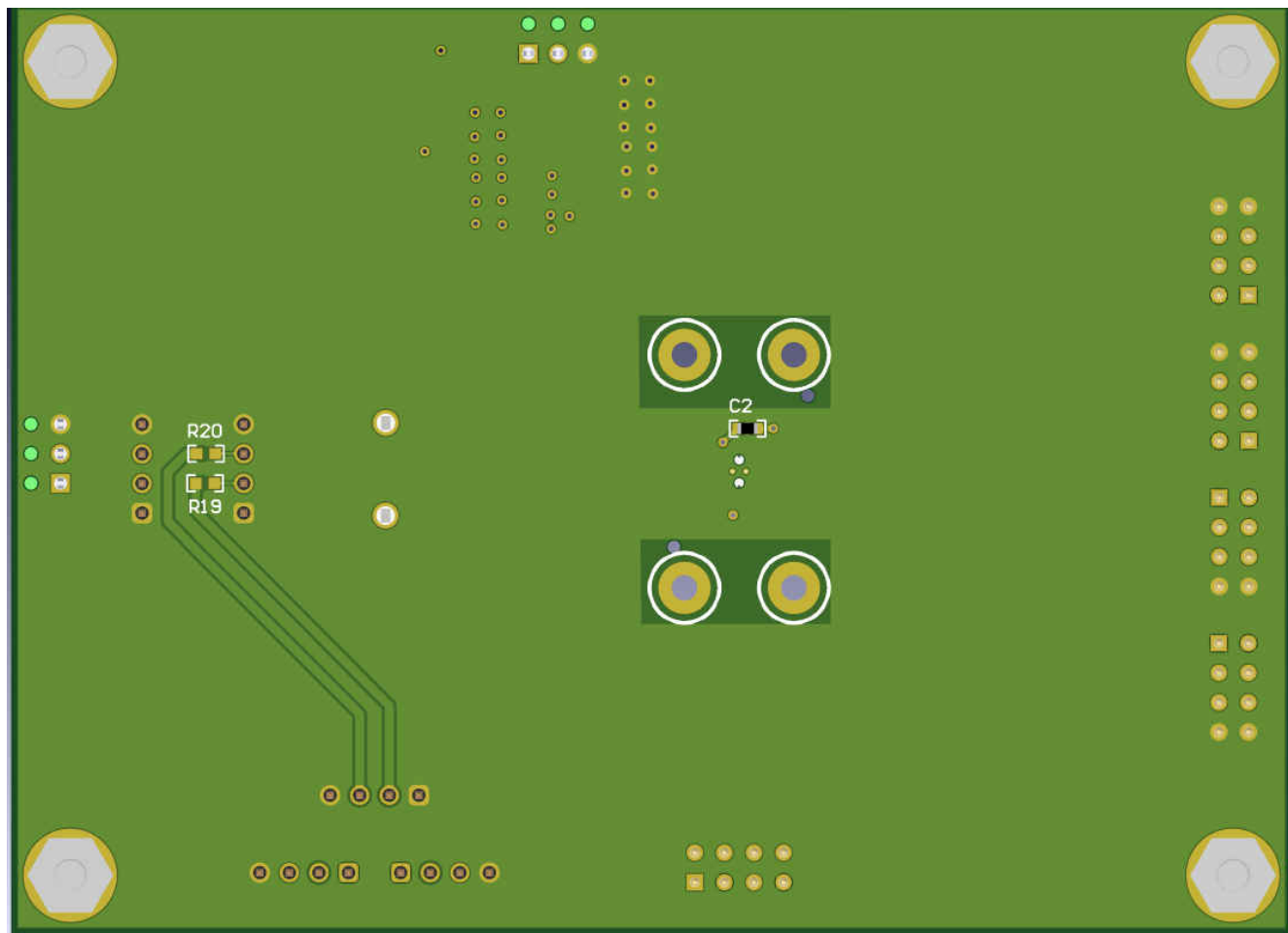


Figure 1-2. Bottom View of THVD1454EVM

Information About Cautions and Warnings

The information in the warning statement is provided for personal protection and the information in the caution statement is provided to protect the equipment from damage. Read each caution and warning statement carefully.



This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, see Electrostatic Discharge (ESD).

2 Board Description

Features

- Ready to Use out of Box with THVD1454 Pre-Installed
- Two 10 uF and Two 47 uF Decoupling Caps Pre-Installed on VCC to GND and GND to EARTH Connections
- Two Resistor Pads to create resistive link between GND and EARTH
- One 4x2 Header Connection for Feature Control Signals
- External Termination Resistor and Capacitor Pads on shared bus
- Common Mode Voltage Connection Points Located at J11 and J12

3 Board Component Overview

The THVD1454EVM is ready to operate directly out of box with a THVD1454 installed at U1. All the Signal and Power Jumpers/Inputs (J1 – J12) come pre-installed on board. See [Table 3-1](#) for component overview for Jumpers.

Table 3-1. Power Jumpers/Inputs (J1 – J12)

Jumper ID	Function	Package	Comment	Installed?
J1	"R" Pin output	4x2 Header	N/A	Y
J2	"/RE" Pin Input	4x2 Header	N/A	Y
J3	"DE" Pin Input	4x2 Header	N/A	Y
J4	"D" Pin Input	4x2 Header	N/A	Y
J5	VCC Terminal	3-Pin Terminal Block	N/A	Y
J6	Control Signal Header	4x2 Header	N/A	Y
J7	Bus Header #1	4x1 Header	Between Series Resistor and IC	Y
J8	Bus Header #2	4x1 Header	Between Series Resistor and Terminal	Y
J9	Differential Bus Connection Terminal	3-Pin Terminal Block	N/A	Y
J10	"A" Line Common Mode Input	4x1 Header	N/A	Y
J11	"B" Line Common Mode Input	4x1 Header	N/A	Y
J12	Differential Bus Common Mode Input	4x1 Header	N/A	Y

Resistor Pad IDs (R1-R20), function, package, comment, and default installation status are shown in [Table 3-2](#).

Table 3-2. Resistor Pad IDs (R1-R20)

Resistor ID	Function	Package	Comment	Installed?
R1	0 Ohm Series Resistor	0603	"R" Pin	Y
R2	Pull-Up Resistor	0603	"R" Pin	N
R3	LED Current Limiting Resistor	0603	"R" Pin LED	Y
R4	0 Ohm Series Resistor	0603	"/RE" Pin	Y
R5	Pull-Down Resistor	0603	"/RE Pin"	N
R6	Pull-Up Resistor	0603	"/RE Pin"	N
R7	0 Ohm Series Resistor	0603	"DE Pin"	Y
R8	Pull-Up Resistor	0603	"DE Pin"	N
R9	Pull-Down Resistor	0603	"DE Pin"	N
R10	0 Ohm Series Resistor	0603	"D Pin"	Y
R11	Pull-Up Resistor	0603	"D Pin"	N
R12	Pull-Down Resistor	0603	"D Pin"	N

Table 3-2. Resistor Pad IDs (R1-R20) (continued)

Resistor ID	Function	Package	Comment	Installed?
R13	LED Current Limiting Resistor	0603	"D Pin LED"	Y
R14	GND to EARTH Resistor	0603	N/A	N
R15	LED Current Limiting Resistor	0603	"VCC LED"	N
R16	Termination Resistor Pad	0805	N/A	N
R17	0 Ohm Series Resistor	0603	"A Pin"	Y
R18	0 Ohm Series Resistor	0603	"B Pin"	Y
R19	Common Mode Resistor "A Pin"	0603	N/A	N
R20	Common Mode Resistor "B Pin"	0603	N/A	N

Capacitor Pad IDs (C1 - C10), function, package, comment, and default installation status are shown in [Table 3-3](#).

Table 3-3. Capacitor Pad IDs (C1 - C10)

Capacitor ID	Function	Package	Comment	Installed?
C1	Capacitive Load on "R" Pin	0603	N/A	N
C2	IC HF Decoupling Capacitor	0603	N/A	Y
C3	GND to Earth 47uF Decoupling Capacitor	0805	N/A	Y
C4	VCC to GND 47uF Decoupling Capacitor	0805	N/A	Y
C6	VCC to GND 10uF Decoupling Capacitor	0805	N/A	Y
C7	Earth to GND 10uF Decoupling Capacitor	0805	N/A	Y
C8	Termination Capacitor Pad	0805	N/A	N
C9	"A" Pin Common Mode Decoupling Capacitor	0603	N/A	Y
C10	"B" Pin Common Mode Decoupling Capacitor	0603	N/A	Y

Other component IDs, function, package, comment, and default installation status are shown in [Table 3-4](#).

Table 3-4. Other component IDs

Other Component ID	Function	Package	Comment	Installed?
D1	LED indicator for Data Reception at "R" pin	Custom	"Red"	Y
D2	LED Indicator For Data Transmission at "D" pin	Custom	"Green"	N
D3	LED Indicator for Board Power	Comment	"Blue"	Y
U1	Main EVM IC	DRC	N/A	Y

4 Powering the Board

Powering the THVD1454EVM is a quick process. To power on the board have top side of board facing upwards with J5 at the top of the EVM. From left to right the power terminal pins of J5 are connected to Earth, GND, and VCC respectively - this is also noted on the EVM.

If the test setup includes an Earth or Chassis connection, connect this to the left pin of J5. If no Earth or Chassis connection exist in the test setup connect this pin to GND. Next connect the GND connection to the center pin of J5 as this is what the THVD1454 references as its GND connection. Finally connect the positive terminal of a 3.3V to 5V supply voltage to the right most pin on J5. The board is now ready to be powered on; this is done correctly when the blue LED "D3" lights up.

The Proper orientation of the J5 Terminal Block is shown in [Figure 4-1](#).

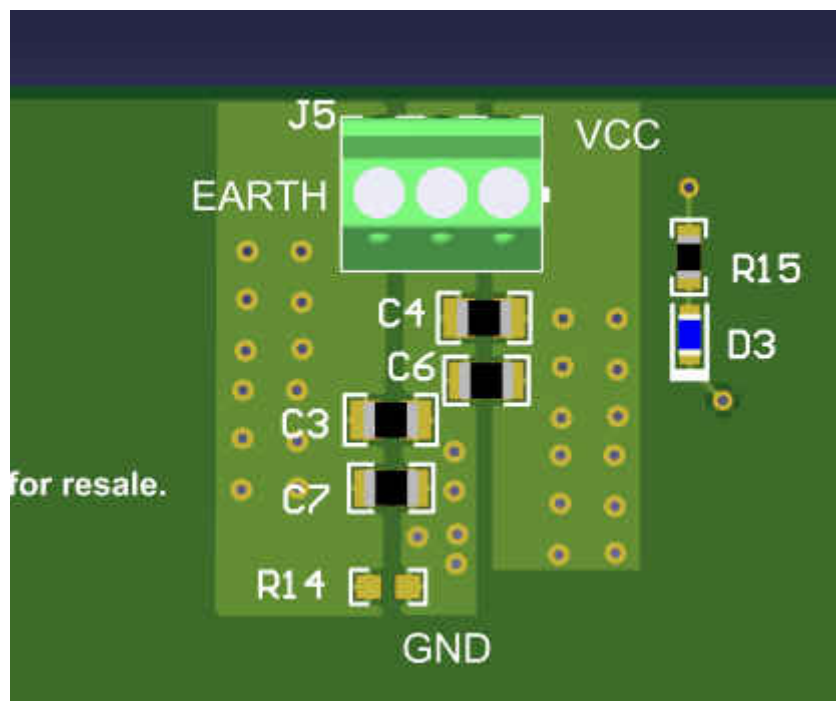


Figure 4-1. Power Connection Block View: J5

5 Operation of THVD1454EVM

5.1 Default Operation

After powering up the EVM with instructions listed [Powering The Board](#), the EVM is ready to ready to operate without modification. If all pins, besides VCC and GND, are left floating after power up the following each pin is in the states listed in [Table 5-1](#).

Table 5-1. Default Pin States THVD1454

Pin on THVD1454	Associated Jumper	Default State	Comment
R	J1	Hi-Z	/RE is pulled high by default leaving RX disabled
/RE	J2	Logic High	Internal pull-up leaves /RE ~ VCC by default. RX disabled
DE	J3	Logic Low	Internal pull-down leaves DE ~GND by default. TX disabled
D	J4	Logic High	Internal pull-up leaves "D" high - preventing floating input on data input pin
TERM	J6	Logic Low	Internal pull-down disables integrated termination resistor by default
B	J7, J8, and J9	Hi-Z	Driver disabled by default.
A	J7, J8, and J9	Hi-Z	Driver Disabled by default
SLR	J6	Logic Low	Slew Rate Control is disabled by default allowing for maximum speeds of 20Mbps

To transmit data under the default setup see [Table 5-2](#).

Table 5-2. TX Function Table

DE (J3)	D (J4)	A (Output)	B (Output)
Low	X	Hi-Z	Hi-Z
High	Low	Low	High
High	High	High	Low

Under the default conditions the A and B pins are unterminated and can handle data up to a speed of 20Mbps.

To receive data under the default setup see receiver function table below. For best results on reception DE should be held low to disable the driver.

Table 5-3. RX Function Table

/RE (J2)	V _A - V _B (J7, J8, and J9)	R (J1)
High	X	Hi-Z
Low	≥ -45 mV	High
Low	≤ -200 mV	Low
Low	-45 mV ≤ V _A - V _B ≤ -200 mV	Indeterminate

For potential modifications and deviations away from default setup, please see [Potential Modifications](#).

5.2 Potential Modifications

With a understanding of the board in its default state there are a few modifications that can be made either via the header blocks or by adding addition components.

[Figure 5-1](#) shows the control header J6, which with the addition of two shunts can control the Slew Rate Control (SLR) feature and Integrated Termination (TERM) features.

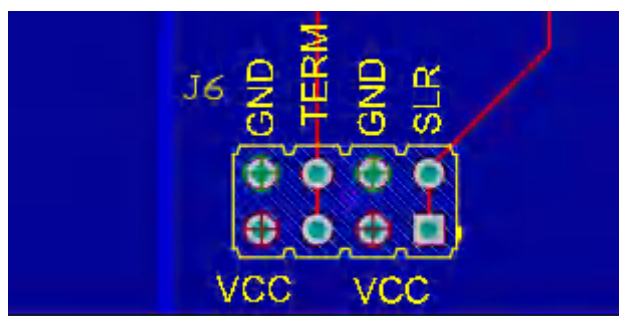


Figure 5-1. Control Block View: J6

The J6 header has pin one on the bottom right hand corner and pin two on the top right hand corner. The pins increment up from right to left with the top row even pin numbers and the bottom row odd numbers. A signal map is shown in [Table 5-4](#).

Table 5-4. J6 Pin Mapping

J6 Pin #	SIGNAL
1	SLR
2	SLR
3	VCC
4	GND
5	TERM
6	TERM
7	VCC
8	GND

A function table of SLR and TERM is shown in [Table 5-5](#).

Table 5-5. J6 Function Table

Pin Jumper Pin	State	Function	Comment
TERM J6-5, J6-6	Low	Integrated Termination Disabled	For non-terminated nodes
TERM J6-5, J6-6	High	Integrated Terminatino Enabled	Terminated with 120Ω between A and B.
SLR J6-1, J6-2	Low	Slew Rate Control Disabled	Max Speed is 20Mbps
SLR J6-1, J6-2	High	Slew Rate Control Enabled	Max Speed is 500Kbps

Beyond the controllable features accessed through J6 there are also pads for external pull-up, pull-down, and capacitive loads available on J1, J2, J3, and J4. For typical applications capacitive loads are placed on "R" pin and the other pins may or may not have external pull-up or pull-down resistors. All the pads are in 0603 packages and can be varied based on customers testing needs.

The final modifications are around the differential bus pins - A and B. To help simulate capacitive loading of a cable a 0805 termination capacitor pad, ID = C8, is available between A and B pins. The option to add an external termination resistance is also possible with a 0805 pad, ID = R16. This external termination when paired with the integrated termination resistor can allow for quick measurements of power measurements on a terminated bus. The power testing can be expanded with the addition of common mode loading resistances R19 and R20.

6 Design Documents

6.1 Schematics

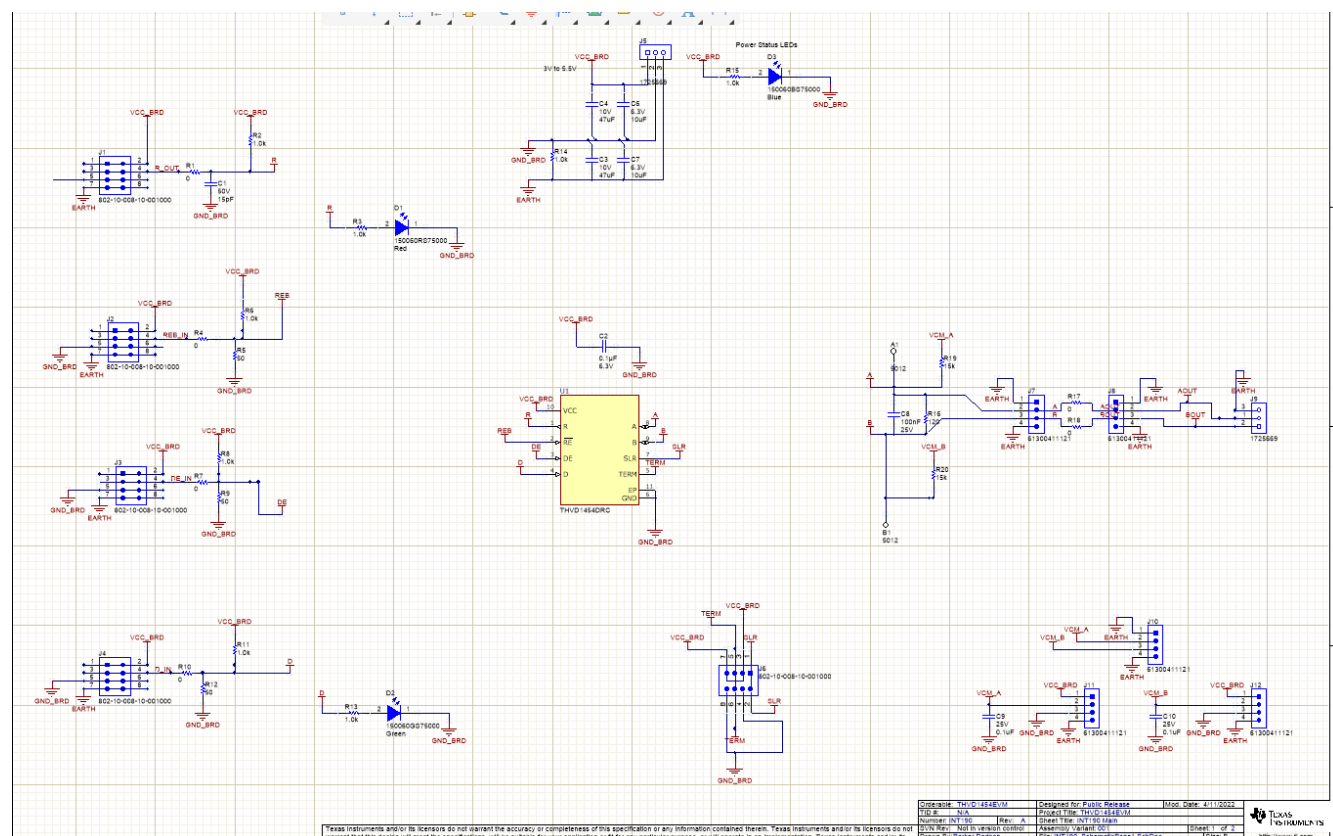


Figure 6-1. Schematic - No Schematic Markings

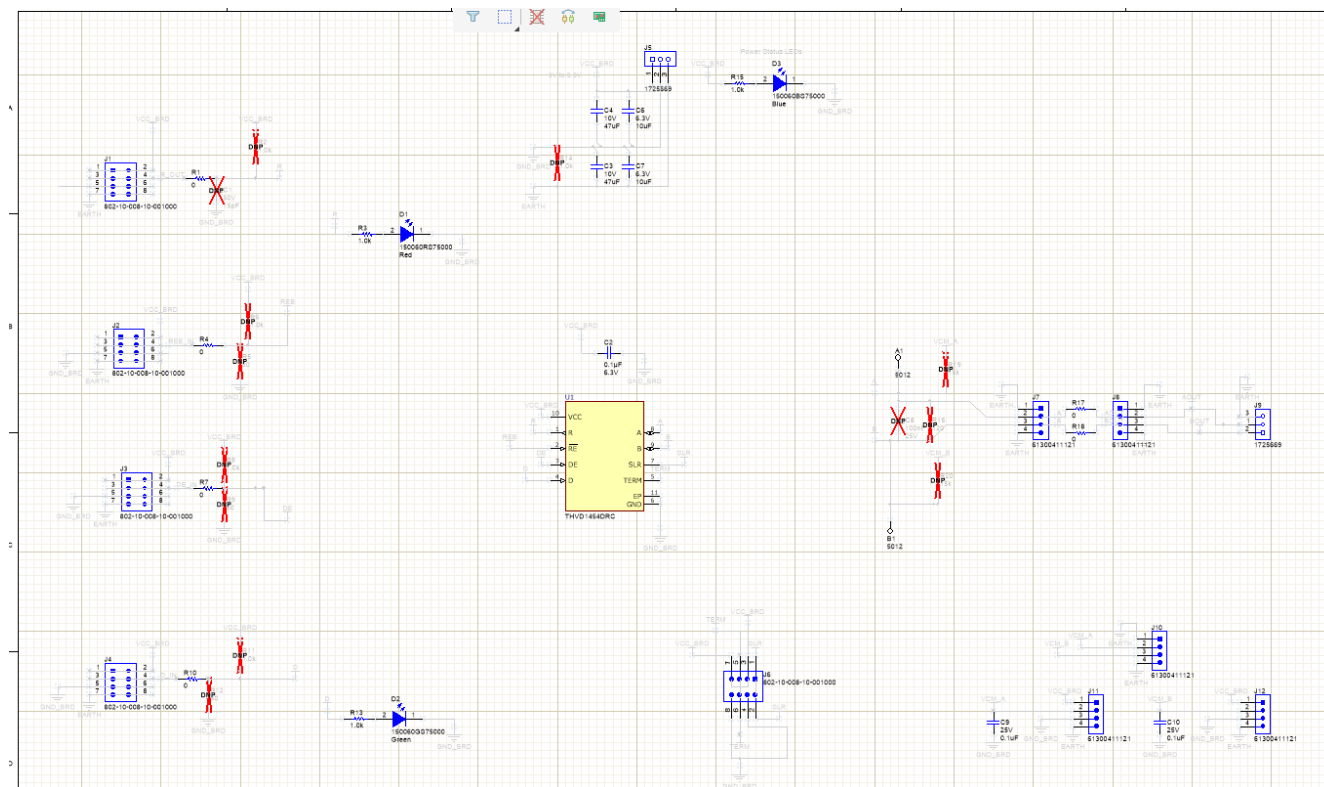
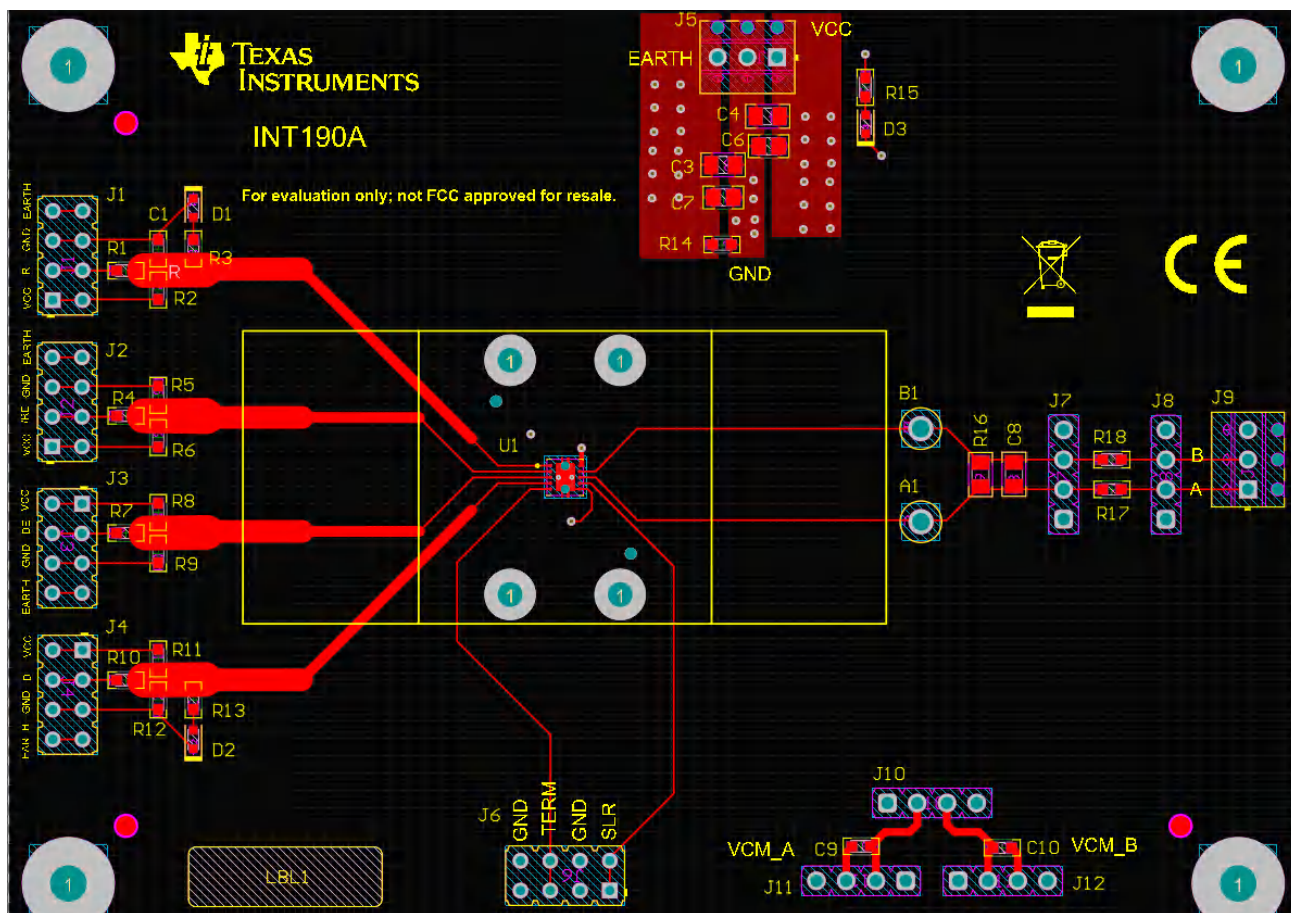
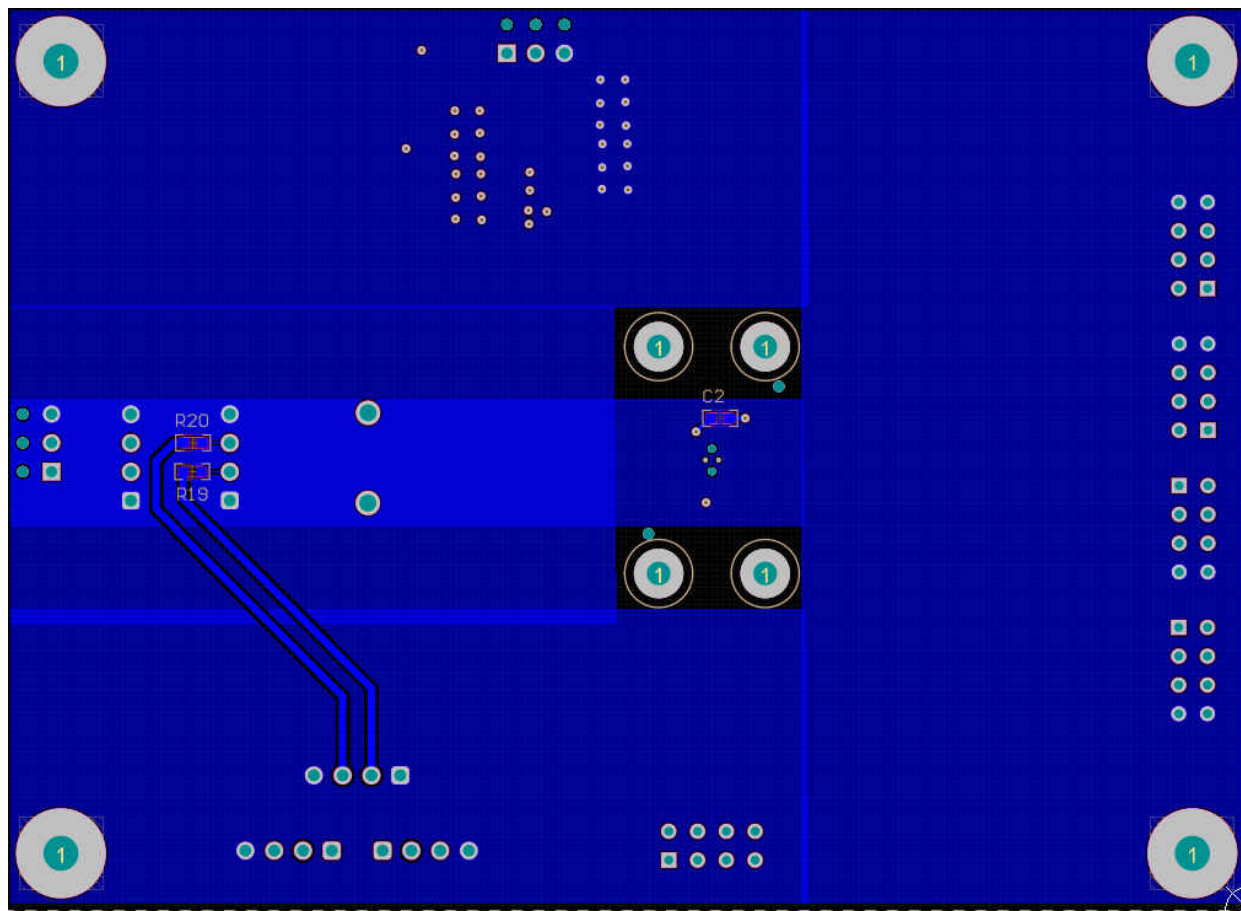


Figure 6-2. Schematic - DNI Markings Shown

6.2 Layout





6.3 Bill of Materials

Manufacturer	PartNumber	Designator	Quantity
Keystone	5012	A1, B1	2
Kemet	C0603C104K9PAC7867	C2	1
Samsung	CL21A106KQFNNNG	C6, C7	2
TDK	C1608X7R1E104K080AA	C9, C10	2
Würth Elektronik	150060RS75000	D1	1
Würth Elektronik	150060GS75000	D2	1
Würth Elektronik	150060BS75000	D3	1
B&F Fastener Supply	NY PMS 440 0025 PH	H1, H2, H3, H4	4
Keystone	1902C	H5, H6, H7, H8	4
Mill-Max	802-10-008-10-001000	J1, J2, J3, J4, J6	5
Phoenix Contact	1725669	J5, J9	2
Würth Elektronik	61300411121	J7, J8, J10, J11, J12	5
Brady	THT-14-423-10	LBL1	1
Vishay-Dale	RCS06030000Z0EA	R1, R4, R7, R10, R17, R18	6
Vishay-Dale	CRCW06031K00JNEA	R3, R13, R15	3
Texas Instruments	THVD1454DRC	U1	1

7 References

- THVD1454 3-V to 5.5-V Half Duplex RS-485 Transceiver With Integrated 120 Ω Switchable Termination and Slew Rate Control, Data Sheet, Texas Instruments

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.
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 - 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.
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 - 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 DEGRADATION 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/sds/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>

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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):*

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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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