User's Guide

RS485HFDPLXDRCEVM User Guide

ABSTRACT

This document is the EVM User's guide for the RS485HFDPLXDRCEVM which provides a quick way to evaluate TI's Half Duplex RS-485 Transceivers in 10-Pin VSON (DRC) Packages such as the THVD2450DRC

	**Caution**	**Read the user's guide before use**

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).

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Trademarks

All trademarks are the property of their respective owners.

1 Board Description

1.1 Features

- Footprints for Both 10-Pin VSON (DRC) and 8-Pin SOIC (D) Half Duplex RS-485 Transceivers Indicated as U1 and U2 Respectively.
- THVD2450VDRC Installed as U1 by Default
- 2 Power Supply Terminals (J5 and J6) to Supply a Power Signal to VL (DRC packages only) and VCC Respectively.
- Can Short Power Supplies Together Via J15 if Single Supply for Logic and Device Are Wanted
- Power Supply Terminals allow for Power, Board-Ground, and Earth Connections.
- Power Supply Capacitors (2, 47 µF and 2, 10 µF – 1 of each Between Power and Board Ground and the Other Between Board-Ground and Earth) Installed by J6 and Pads Available for J5.
- Ground Current Limiting Resistor Pads (R14 and R15) Available Between Board Ground and Earth on Both J5 and J6
- Common Mode Voltage Connections (J12, J13, and J14) Available to Add a Common Mode Voltage to the RS-485 Differential Bus (Pins A and B); Check Specific IC Datasheet for Details on Common Mode Ranges
- 120 Ω Termination Resistor (R17) Installed by Default on Board
- Capacitor Pad Between A and B Pins (C12) Available to Test Termination Capacitance Effects.
- Single Ended Inputs DE, /RE, and D All Have Pads to Support Pull-Up or Pull-Down Resistors.
- Single Ended Output R has Pads for a Pull-Up Resistor and a Capacitive Load
- Devices with SLR Pins Can be Controlled Via the J11 Jumper
- LED's on R, D, and VCC Indicate Whether the Device is Receiving Data, Transmitting Data, and/or if the Device has an Active Supply.
- Test Points on A and B Lines Near Termination Resistor.

1.2 Applications

- Motor drives
- Factory automation and control
- HVAC systems
- Building automation
- Grid infrastructureElectricity meters
- Process analytics
- Video surveillance

1.3 Board Description

The RS485HFDPLXDRCEVM is ready to operate directly out of box with a THVD2450DRC installed at U1. All the signal and power jumpers/Inputs (J1 – J15) come pre-installed on board. Please see Table 1-1 through Table 1-5 for description for pads on the board, and to determine if it is pre-installed by default.

Table 1-1. Jumpers, Headers, Terminals Descriptions

Jumper ID	Function	Package	Comment	Installed?
J1	R Pin Output	8 Pin Header	N/A	Yes
J2	Enable 1 Input	8 Pin Header	DE on DRC Packages	Yes
J3	Enable 2 Input	8 Pin Header	/RE on DRC Packages	Yes
J4	D Pin Output	8 Pin Header	N/A	Yes
J5	VL Power Input	3 Pin Terminal Block	N/A	Yes
J6	VCC Power Input	3 Pin Terminal Block	N/A	Yes
J7	Termination Resistor Connect	2 Pin Header	Shunt J7 to Terminate A/B with 120 Ωs	Yes
J8	Differential Bus Jumper	4 Pin Header	N/A	Yes
J9	Differential Bus Jumper	4 Pin Header	N/A	Yes
J10	RS-485 Bus Output	3 Pin Terminal Block	N/A	Yes

Table 1-1. Jumpers, Headers, Terminals Descriptions (continued)

Jumper ID	Function	Package	Comment	Installed?
J11	SLR (Selectable Data Rate) Pin Control	8 Pin Header	SLR Pin not On Every IC That is Approved for this Board.	Yes
J12	Common Mode Connection	4 Pin Header	N/A	Yes
J13	Common Mode A Input	4 Pin Header	N/A	Yes
J14	Common Mode B Input	4 Pin Header	N/A	Yes
J15	VL to VCC Shunt	2 Pin Header	Shunt VCC to VL for Single Supply Use Cases	Yes

Table 1-2. Resistor Pad Descriptions

Resistor ID	Function	Package	Comment	Installed?
R1	0 Ω Connection Series Resistor	0603	For R Pin	Yes
R2	Pull Up Resistor	0603	For R Pin	No
R3	Current Limiting Resistor for Diode	0603	For R LED D1 (R pin)	Yes
R4	0 Ω Connection Series Resistor	0603	For Enable 1 (DE on DRC Pkg and /RE on D Pkg)	Yes
R5	Pull Up Resistor	0603	For Enable 1 (DE on DRC Pkg and /RE on D Pkg)	No
R6	Pull Down Resistor	0603	For Enable 1 (DE on DRC Pkg and /RE on D Pkg)	No
R7	0 Ω Connection Series Resistor	0603	For Enable 2 (/RE on DRC Pkg and DE on D Pkg)	Yes
R8	Pull Up Resistor	0603	For Enable 2 (/RE on DRC Pkg and DE on D Pkg)	No
R9	Pull Down Resistor	0603	For Enable 2 (/RE on DRC Pkg and DE on D Pkg)	No
R10	0 Ω Connection Series Resistor	0603	For D Pin	Yes
R11	Pull Up Resistor	0603	For D Pin	No
R12	Pull Down Resistor	0603	For D Pin	No
R13	Current Limiting Resistor for Diode	0603	For D LED D2 (D Pin)	Yes
R14	GND to EARTH Pull Down for VL supply	0603	N/A	No
R15	GND to EARTH Pull Down For VCC Supply	0603	N/A	No
R16	Current Limiting Resistor for Diode	0603	for VCC LED (D3)	Yes
R17	120ΩTermination Resistor	0805	Needed for RS-485 applications	Yes
R18	0 Ω Series connection Resistor “B” Line	0603	N/A	Yes

Table 1-2. Resistor Pad Descriptions (continued)

Resistor ID	Function	Package	Comment	Installed?
R19	0 Ω Series connection Resistor “A” Line	0603	N/A	Yes
R20	Common Mode Voltage to Bus Resistor for “B” Line	0603	Common Mode Test Resistor = 375Ω; Found on Backside of Board	No
R21	Common Mode Voltage to Bus Resistor for “A” Line	0603	Common Mode Test Resistor = 375Ω; Found on Backside of Board	No

Table 1-3. Capacitor Pad Descriptions

Capacitor ID	Function	Package	Comment	Installed?
C1	Load Capacitance for “R”	0603	N/A	No
C2	47 uF | 10 V Decoupling Capacitor	0805	From GND to EARTH on VL Supply	No
C3	47 uF | 10 V Decoupling Capacitor	0805	From VL to GND on VL supply	No
C4	10uF | 6.3V Decoupling Capacitor	0805	From GND to EARTH on VL Supply	No
C5	10uF | 6.3V Decoupling Capacitor	0805	FROM VL to GND on VL Supply	No
C6	47 uF | 10 V Decoupling Capacitor	0805	From GND to EARTH on VCC Supply	Yes
C7	47 uF | 10 V Decoupling Capacitor	0805	From VCC to GND on VCC Supply	Yes
C8	10 uF | 6.3 V Decoupling Capacitor	0805	From GND to EARTH on VCC Supply	Yes
C9	10uF | 6.3V Decoupling Capacitor	0805	From VCC to GND on VCC Supply	Yes
C10	100 nF | 6.3 V Decoupling Capacitor	0603	From VL pin on U1 to GND	Yes
C11	100 nF | 6.3 V Decoupling Capacitor	0603	From VCC pin on U1 and U2 to GND	Yes
C12	Termination Capacitance Pad	0805	A to B Capacitor pad to test different capacitive loading conditions	No
C13	100 nF | 25 V Decoupling Capacitor	0603	“A” Line Common Mode Decoupling Capacitor	Yes
C14	100 nF | 25 V Decoupling Capacitor	0603	“B” Line Common Mode Decoupling Capacitor	Yes

Table 1-4. LED Pad Descriptions

LED ID	Function	Package	Comment	Installed?
D1	“R” Line LED – Red	Non-Standard	N/A	Yes
D2	“D” Line LED – Green	Non-Standard	N/A	Yes
D3	“VCC” LED – Blue	Non-Standard	N/A	Yes

Table 1-5. IC Pad Descriptions

IC ID	Function	Package	Comment	Installed?
U1	Half Duplex RS-485 IC in DRC (10 Pin VSSON) Package	DRC	Comes Pre-installed with THVD2450VDRC	Yes
U2	Half Duplex RS-485 IC in D (8 Pin SOIC) Package	D	N/A	No

The default setup is optimized to work with the THVD2450VDRC operating in a single supply mode without a common mode voltage. By shorting headers J7 (device termination) and J15 (VL = VCC) the board is ready to operate in the default state. Please see section "Powering The EVM" for information on power supplies and operational modes of the board respectively.

2 Powering the EVM

Single Supply Operation (Logic Supply Equals Voltage Supply or DUT does not have VL pin)

Half Duplex RS-485 Transceivers in the DRC (VSSON) package from TI can have an additional logic supply pin, *VL*. This is used to power the internal digital logic circuits inside of the device. In single supply operation mode for devices, such as the THVD2450VDRC, the VL pin should be shorted to VCC by shorting J15 header pins, so that the digital circuits are properly powered. If using an 8-pin D (SOIC) device in place of the DRC package, there is only one supply pin and J15 can be left open. Please see Table 2-1 for single supply configuration based on package.

Table 2-1. Single Supply Operation Configuration

Component ID	IC Package	Comment
J15	VSSON	Shorted For Single Supply Operation
J15	SOIC	Can be Left Open or Shorted – no VL pin to connect to.
J5	Either	VL Supply – Leave Open
J6	Either	VCC Power Terminal
C2	Either	Leave DNI for Single Supply
C3	Either	Leave DNI for Single Supply
C4	Either	Leave DNI for Single Supply
C5	Either	Leave DNI for Single Supply
R14	Either	Leave DNI for Single Supply

To apply power onto the board, VCC is applied through the J6 terminal. With the board oriented with J6 on the top left, as shown in Figure 3-1, the signals are, from right to left, EARTH, GND, and VCC. The EARTH and GND distinction are used to help the end user determine operational qualities w.r.t. ground potential differences. If testing methods on reducing ground loop current, install a resistor on pad R15. Check the datasheet for proper powering considerations as this either recommend 3.3 V, 5 V or 3.3 V to 5 V.

2.1 Dual Supply Operation (Separate Digital Logic and Driver Supplies)

Half Duplex RS-485 Transceivers in the DRC (VSSON) package from TI can have an additional logic supply pin, *VL*. In Dual Supply operation the digital circuit supply, the supply which supplies the R, D, $\overline{RE}$, and DE pins, can be held at a low level – typically from 1.65 V to 5 V to be able to interface a RS-485 transceiver to digital systems using 1.8V logic. J15 should be left open. This option is only available for DRC (VSSON) packages. Please see Table 2-2 for information on power supply components.

Table 2-2. Dual Supply Operation Configuration

Component ID	IC Package	Comment
J15	VSSON	Left Open for Dual Supply Operation
J15	SOIC	Dual Supply Not an Supported for SOIC
J5	VSSON	VL Power Input
J6	VSSON	VCC Power Input
C2	VSSON	47uF | 10V Decoupling Capacitor
C3	VSSON	47uF | 10V Decoupling Capacitor
C4	VSSON	10 uF | 6.3 V Decoupling Capacitor
C5	VSSON	10 uF | 6.3 V Decoupling Capacitor
R14	VSSON	Can be added – however will be in parallel with R15 so make any resistance calculations based on what's on R15 and R14

Powering the board is like single supply option. J5 and J6 have the same pin orientation – from left to right it is the EARTH pin, GND pin, and voltage supply pin. Attach VL power source to J5 and VCC power source to J6.

3 Operating The EVM

3.1 Default Operation

With an understanding of how the board is setup and how to power the board for both supply situations the next topic is how to operate the board. Out of the box the board, when powered, can operate the THVD2450V as a half duplex RS-485 transceiver. The devices pins can be broken down into 4 distinct groups: single ended communication pins, differential communication pins, power pins, and control pins. Power pins are discussed in Powering the EVM and Dual Supply Operation (Separate Digital Logic and Driver Supplies). The following details are for the other 3 categories.

The single ended communication pins are to be connected directly, through their respective jumpers, to a single ended bus – these pins are the “R” and “D” pins and represent RX and TX single ended data respectively. For both package types R is referenced to J1 and D is reference to J4 – these are the signal connection points for the EVM.

Control signals can vary between devices. A a minimum this board supports an Active High Driver Enable (DE) and an Active Low Receiver Enable ($\overline{RE}$) these are accessed through Jumpers J2 and J3; however, the order of these pins is dependent on package. Devices such as the THVD2450VDRC also contains a slew rate limiting pin which turns on / off slew rate limiting for the device. In DRC packages without this feature, this pin should be grounded. This pin is accessed through jumper J11.

Also, the last group of signals are the differential bus pins A and B. This connects to the differential bus through terminal block J10. All differential data should be output/input through J10 to model the bus performance for a specific application. For terminated bus operation J7 should be shunted.

A jumper configuration map is shown in Figure 3-1, where pin 1 is the top left corner of the shown jumpers with every subsequent pin increasing by one in a clockwise direction. A summary table of component configuration in Table 3-1 is shown below Figure 3-1.

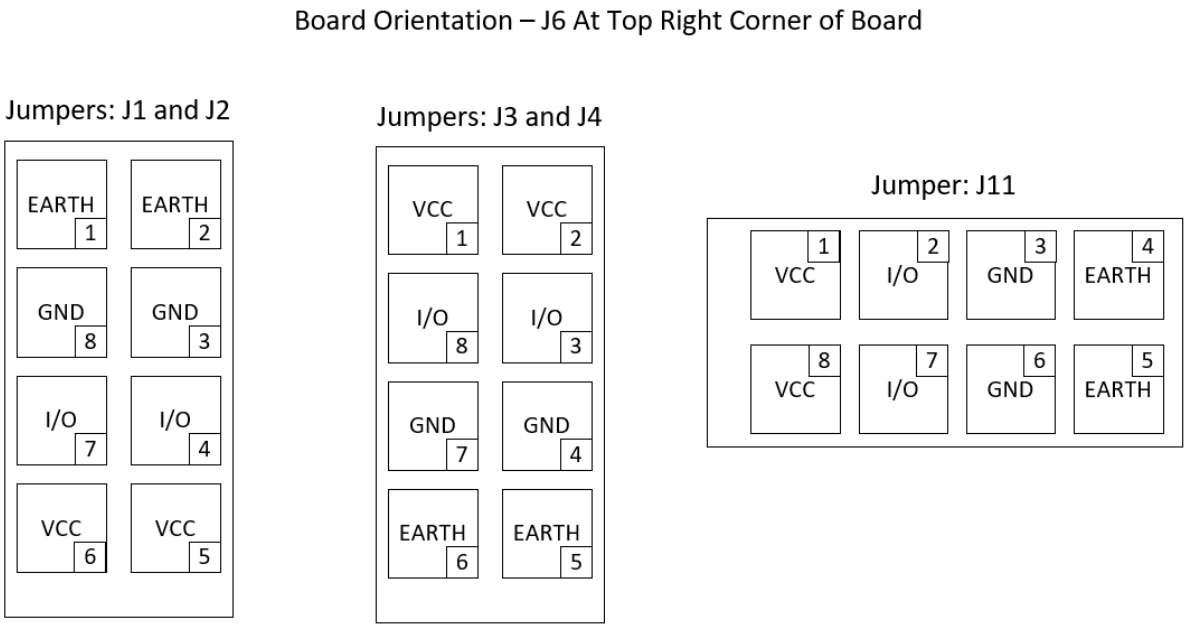

Figure 3-1. Jumper, Header Configuration Map

Table 3-1. Jumper Configuration for Default Operation

Jumper ID	Signal – Jumper Pin	Comment
J1	RX –Pin 4 or 7	Receive Data – to keep always high or low shunt J1 I/O pins to VCC or GND.
J2	Enable – Pin 4 or 7	DE for VSSON and /RE for SOIC – shunt J2 I/O pins to VCC or GND if only 1 mode is to be used.
J3	Enable – Pin 3 or 8	/RE for VSSON and DE for SOIC – shunt J3 I/O pins to VCC or GND if only 1 is to be used
J4	TX – Pin 3 or 8	Transmit Data – to keep always high or low shunt J4 I/O pins to VCC or GND
J11	SLR – Pin 2 and 7	Shunt I/O pin on J11 to either High or Low on VSSON packages with SLR – if not included Ground This Pin.
J7	N/A	Shunt for Terminated Bus Open for Unterminated Bus
J10	N/A	Differential Bus Output Terminal.
J5	N/A	Leave Floating for single supply applications, attach digital supply if dual operation is used.
J6	N/A	Attach VCC to J6
J15	N/A	Shunt for Single Supply Open for Dual Supply

3.2 Potential Modifications for Single Ended Pins

There are a few options with respect to the single ended data and control signals for modification on this EVM. Jumpers J1 through J4 all contain pads that are blank by default. For D, DE, and $\overline{RE}$ signals there are 0603 sized pads for either pull-up or pull-down resistors to have a default logic on these pins with the added benefit of still being able to external signals to this pin. The R pin also contains a pull-up resistor 0603 sized, as is common in UART based applications, as well as a 0603 sized pad to ground for a capacitive load if testing requires capacitive loading on the R pin. A summary of possible single ended signal pathway modifications on the EVM are in Table 3-2.

Table 3-2. Modifications For Single Ended Pins

Associated Jumper / Signal	`Pad ID	Comment
J1 / R	R2	Pull Up Resistor Pad
J1 / R	C1	Capacitive Load Pad
J2 / EN1	R5	Pull Up Resistor Pad
J2 / EN1	R6	Pull Down Resistor Pad
J3 / EN2	R8	Pull Up Resistor Pad
J3 / EN2	R9	Pull Down Resistor Pad
J4 / D	R11	Pull Up Resistor Pad
J4 / D	R12	Pull Down Resistor Pad

3.3 Potential Modifications for Differntial Pins

The Differential side of the RS-485 transceiver also has a few minor modifications that can be made. There is the option for a termination capacitor, C12, along with the termination resistor. This capacitor can be used to help estimate effects of capacitive cabling on the signal pathway. The other modification is by applying a common mode voltage through the common mode jumpers J12 – J14 that is routed to the A and B lines through common mode resistors, R20 and R21, which by default are not installed. For full common mode testing R20 and R21 should be selected to be 375 Ω as this is the standard for RS-485 devices. A summary of modifications can be shown in Table 3-3.

Table 3-3. Modifications for Differential Pins

Associated Jumper / Signal	Pad ID	Comment
J12 and J13 / Common Mode on “A”	R21	Common Mode Resistor to “A”
J12 and J14 / Common Mode on “B”	R20	Common Mode Resistor to “B”
N/A / A and B	C12	Termination Capacitor Pad

4 Schematic

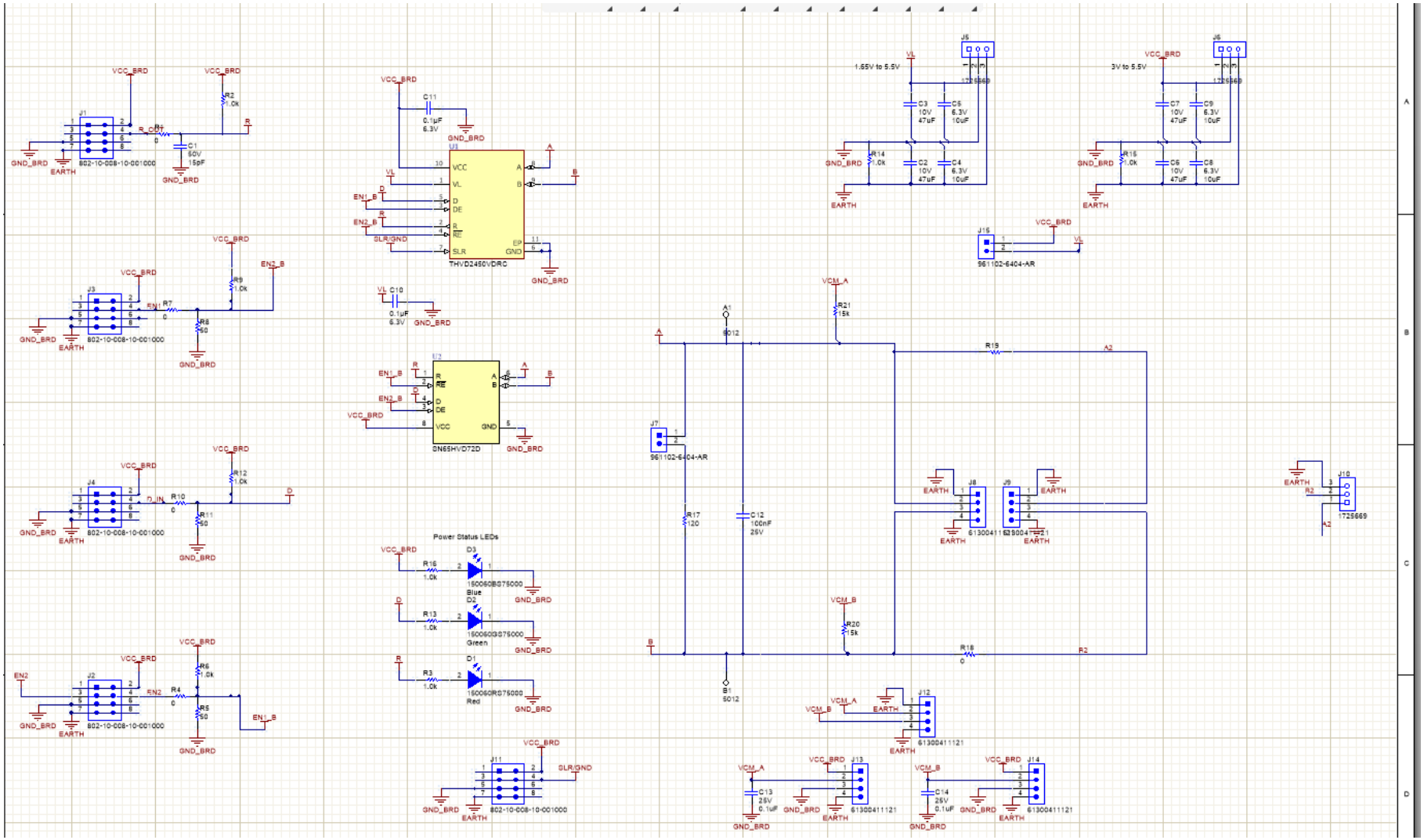

Figure 4-1. Schematic - DNI Components Shown

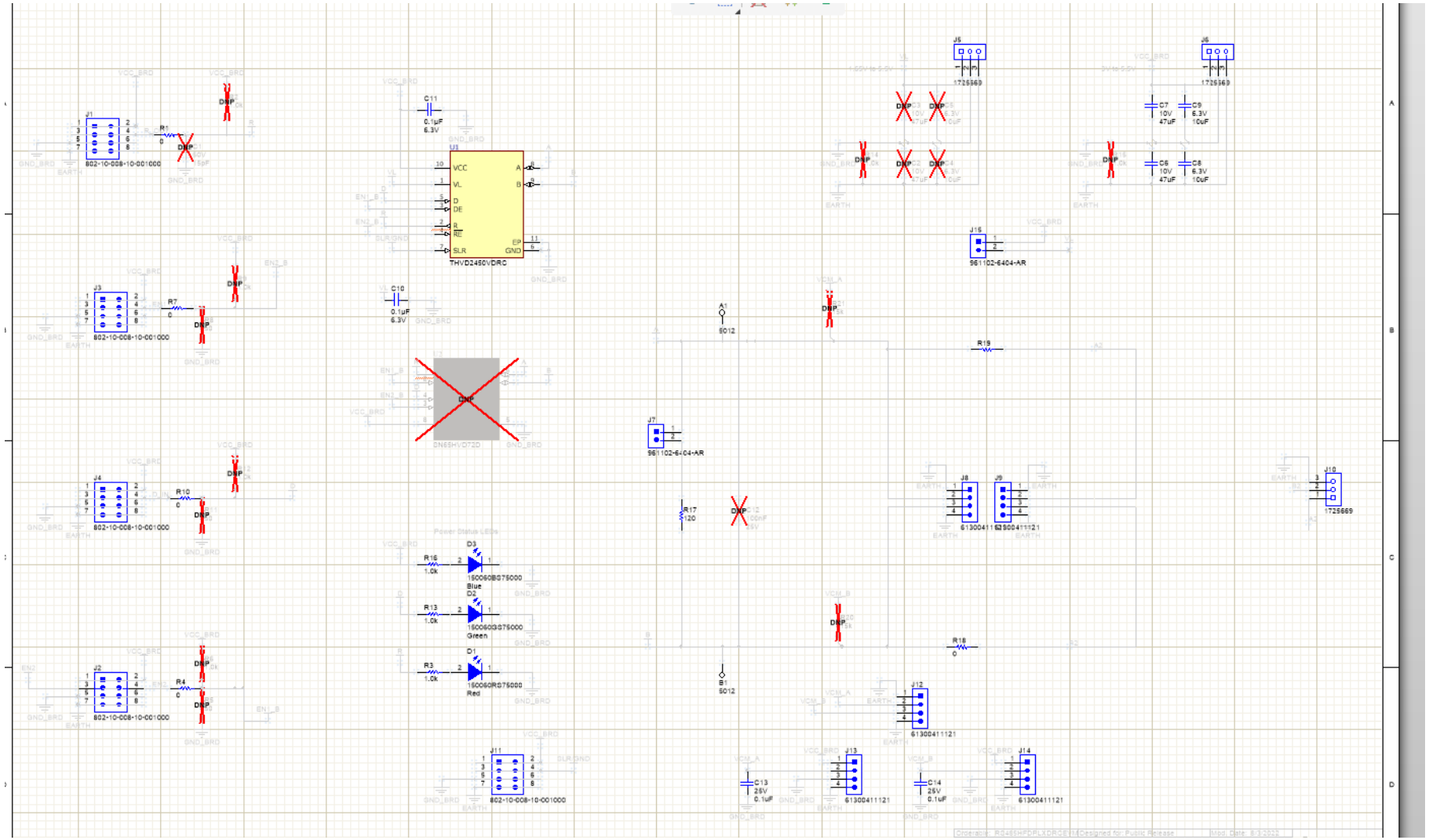

Figure 4-2. Schematic with DNI Components Marked

5 Layout

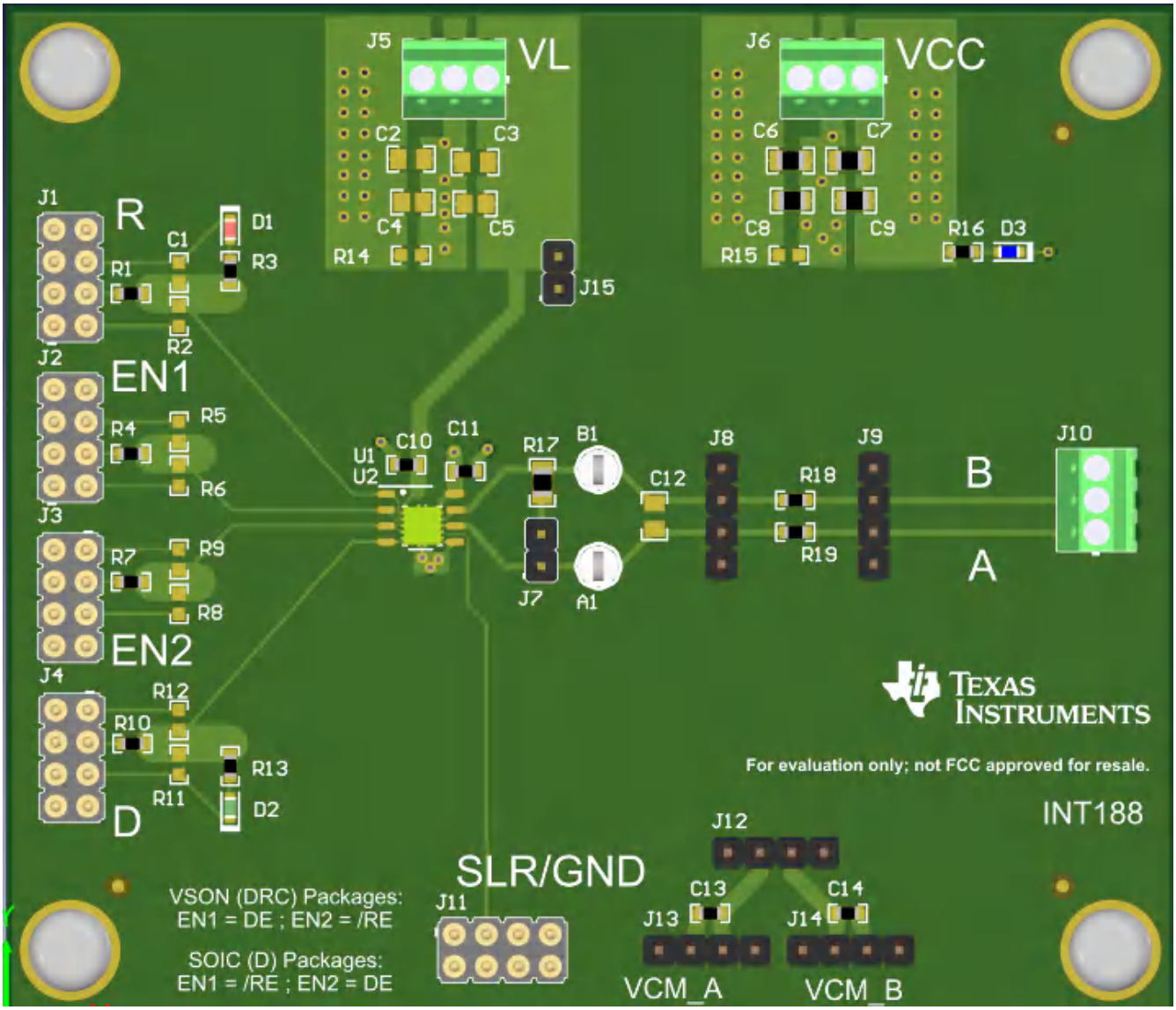

Figure 5-1. 3D View - Top

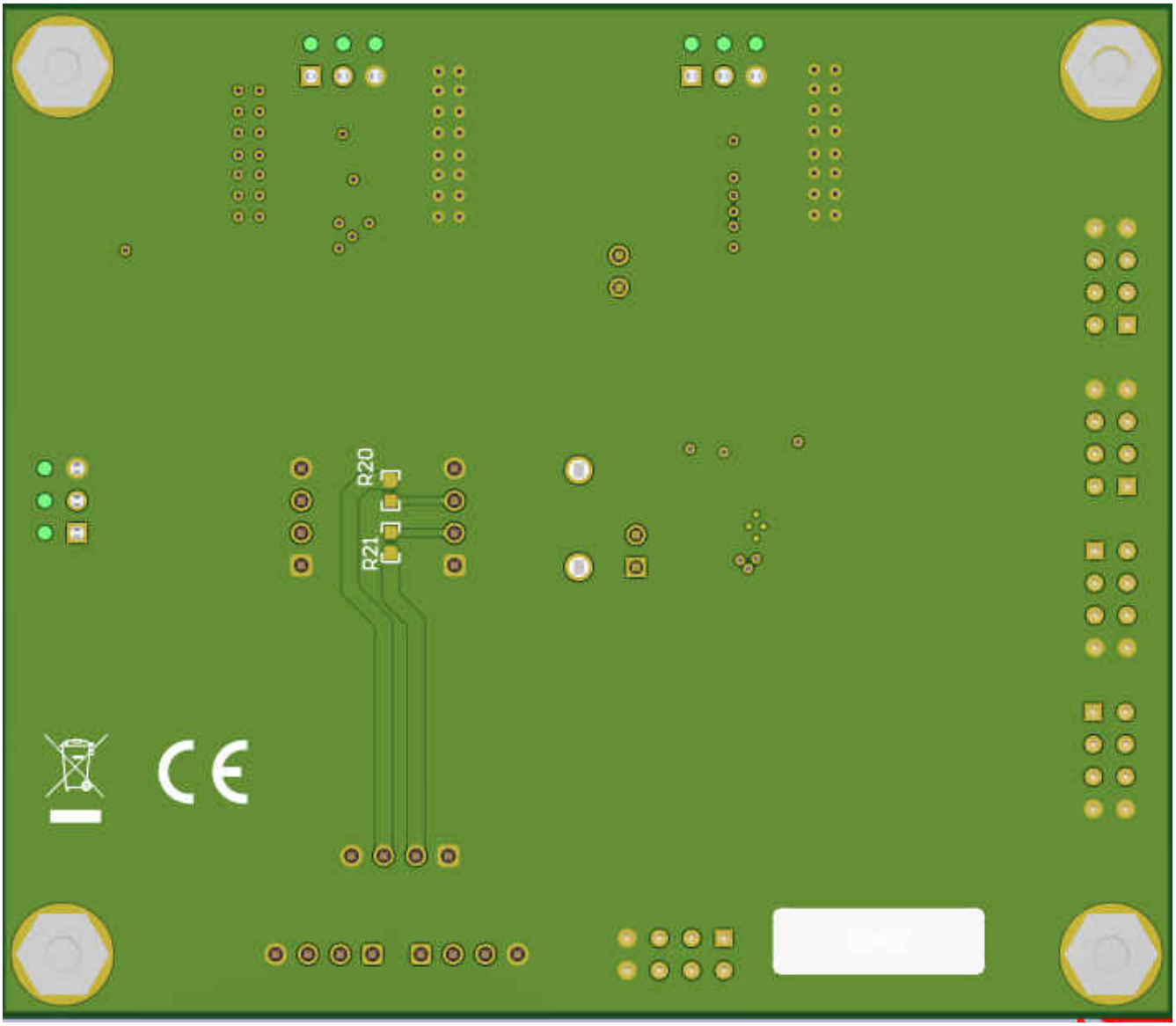

Figure 5-2. 3D View - Bottom

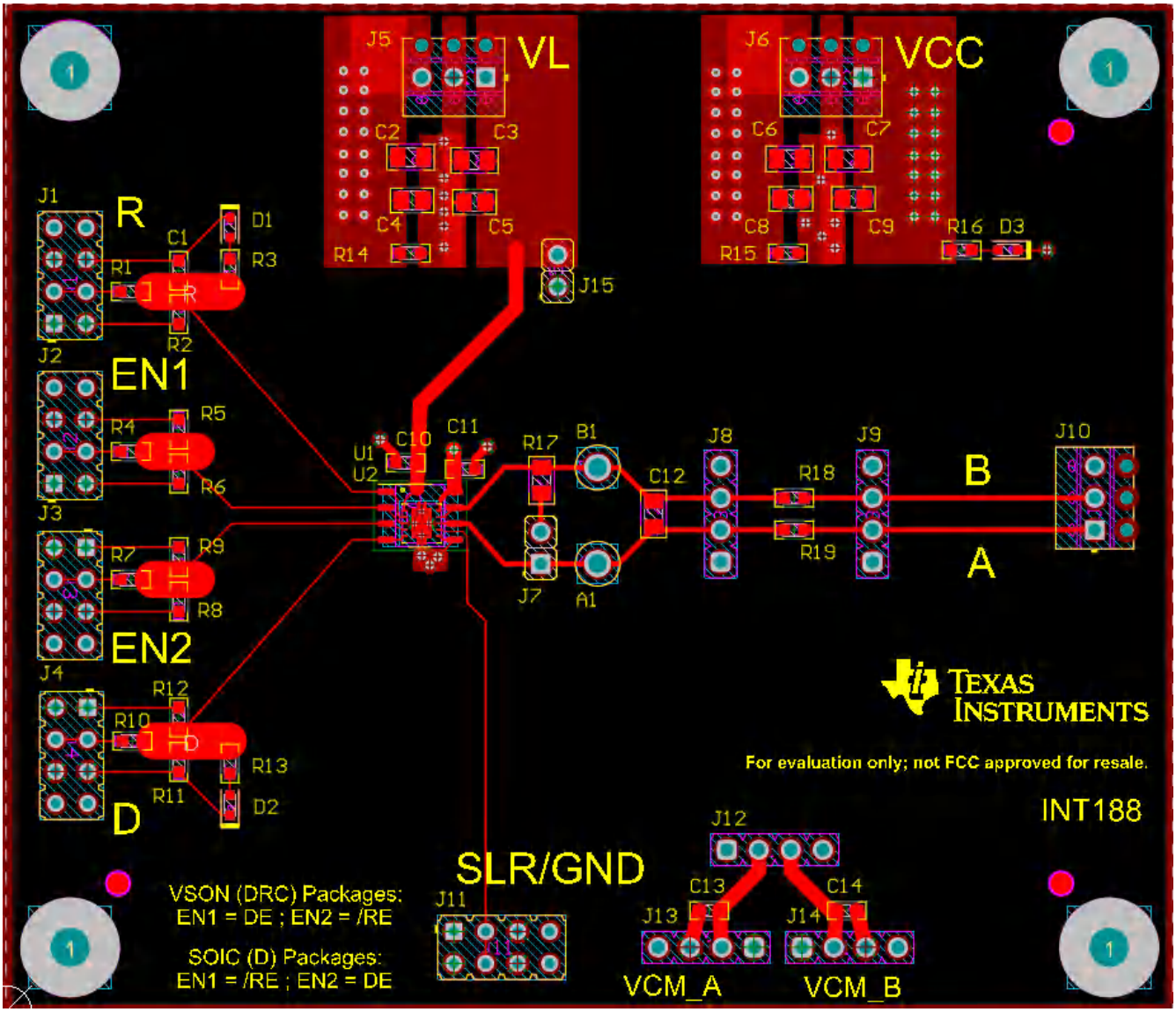

Figure 5-3. PCB Top Layer

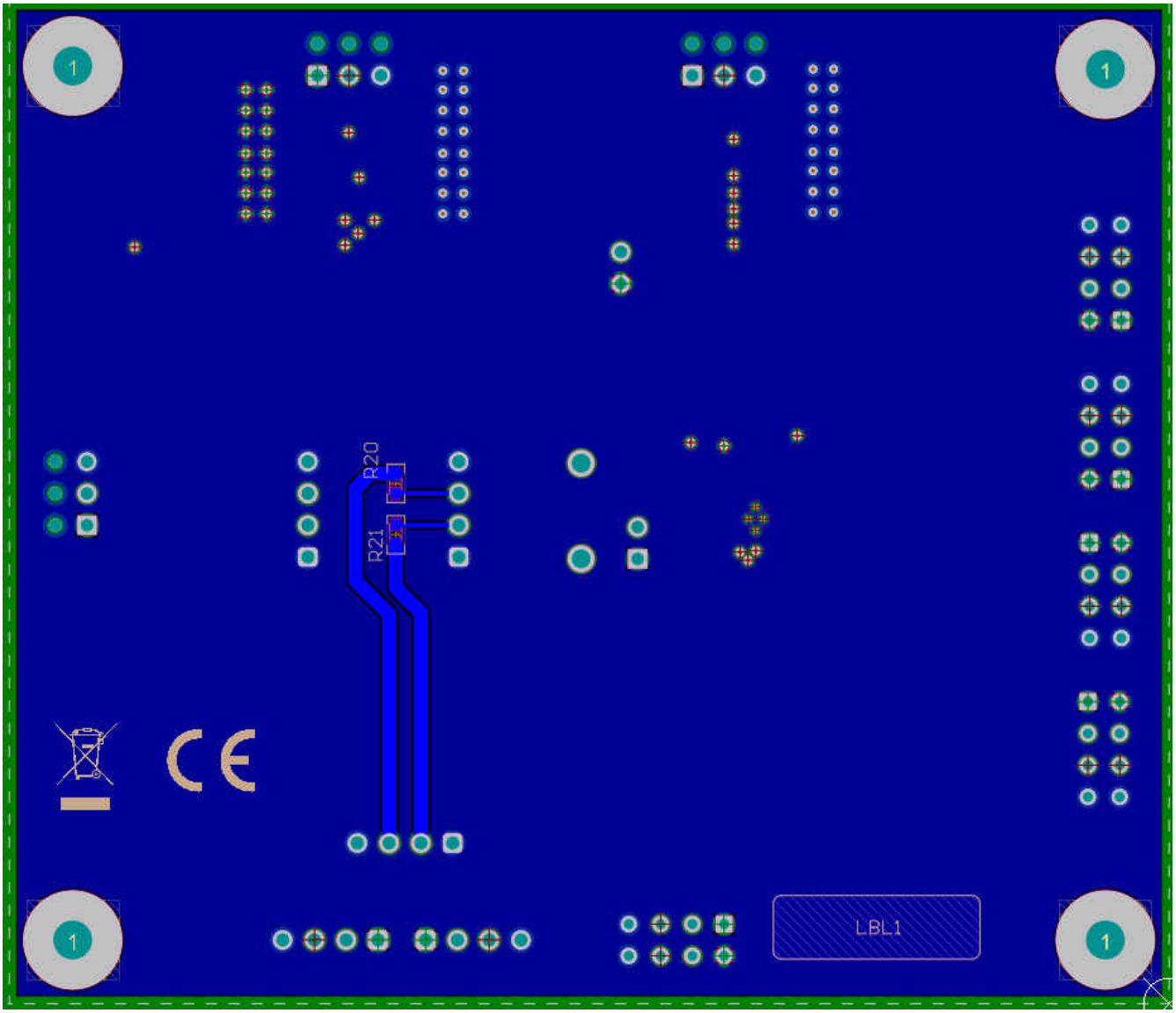

Figure 5-4. PCB Bottom Layer

6 Bill of Materials

Table 6-1. Bill of Materials

Manufacturer	PartNumber	Designator	Quantity
Keystone	5012	A1, B1	2
TDK	C2012X5R1A476M125AC	C6, C7	2
Samsung	CL21A106KQFNNNG	C8, C9	2
Kemet	C0603C104K9PAC7867	C10, C11	2
TDK	C1608X7R1E104K080AA	C13, C14	2
Wurth Elektronik	150060RS75000	D1	1
Wurth Elektronik	150060GS75000	D2	1
Wurth 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, J11	5
Phoenix Contact	1725669	J5, J6, J10	3
3M	961102-6404-AR	J7, J15	2
Wurth Elektronik	61300411121	J8, J9, J12, J13, J14	5
Brady	THT-14-423-10	LBL1	1
Vishay-Dale	RCS06030000Z0EA	R1, R4, R7, R10, R18, R19	6
Vishay-Dale	CRCW06031K00JNEA	R3, R13, R16	3
Panasonic	ERJ-P06J121V	R17	1
Texas Instruments	THVD2450VDRC	U1	1

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

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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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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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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3.4 *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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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