

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.

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1 Introduction

About This Manual

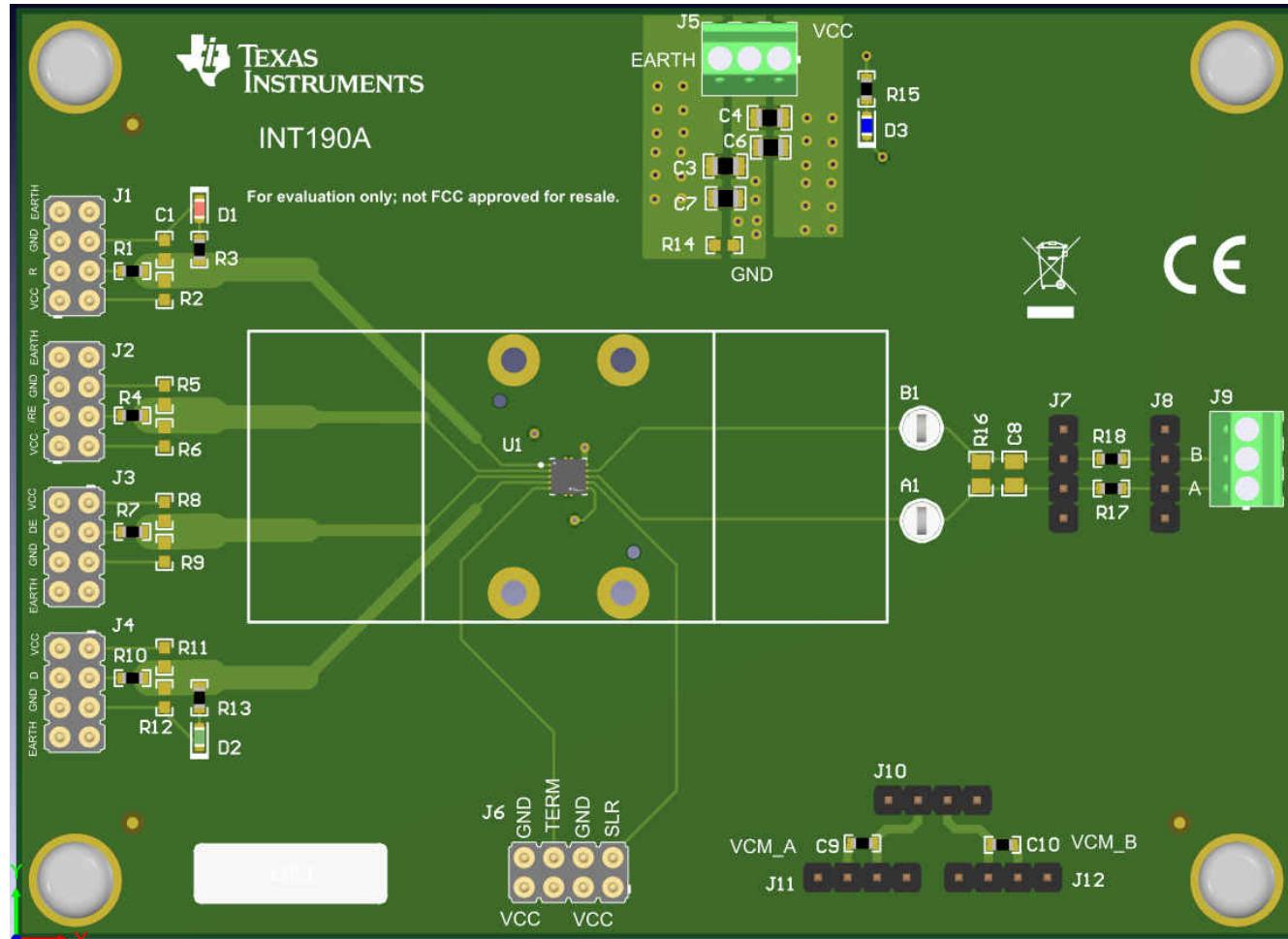


Figure 1-1. Top View of THVD1454EVM

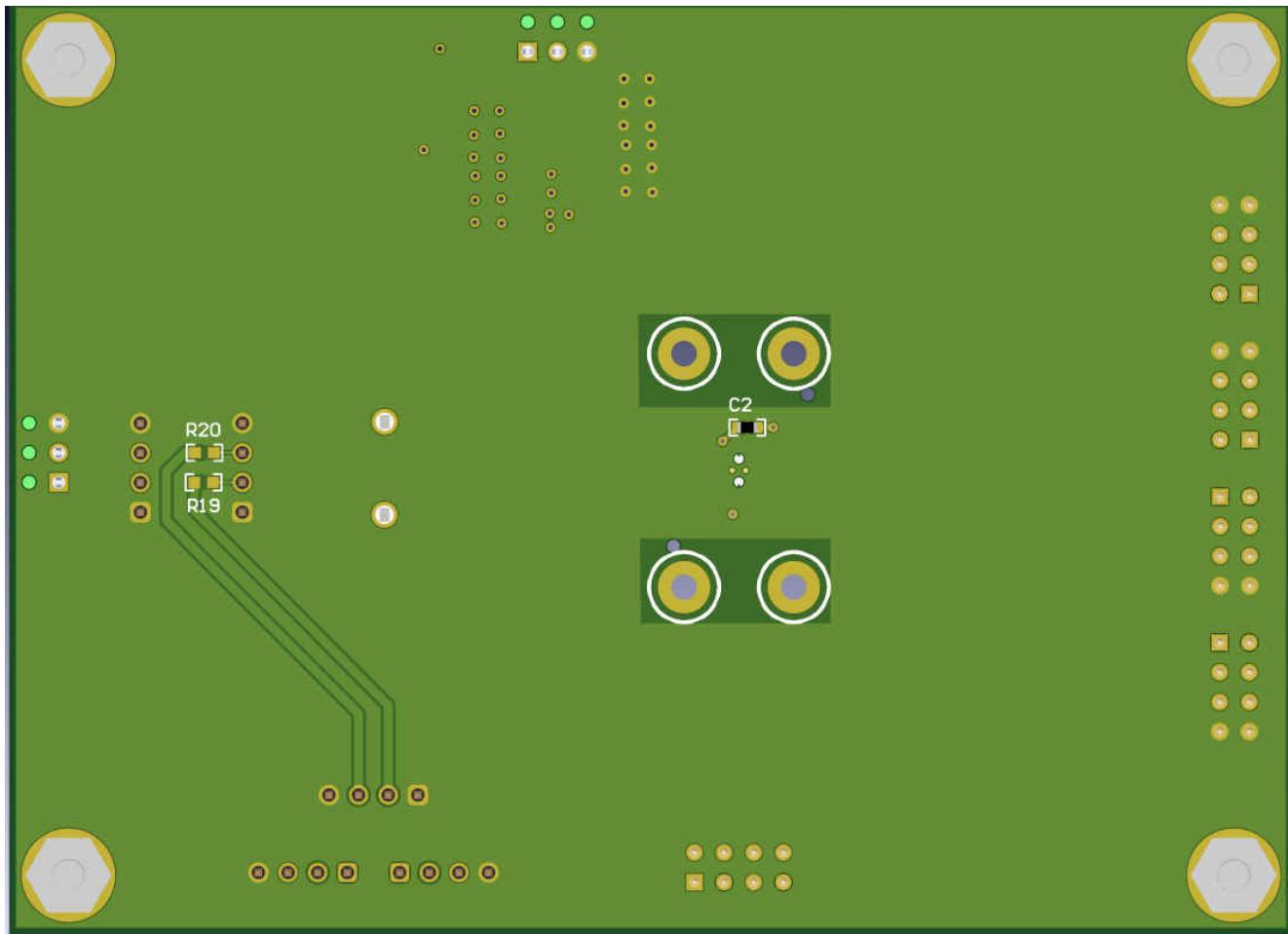


Figure 1-2. Bottom View of THVD1454EVM

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](#).

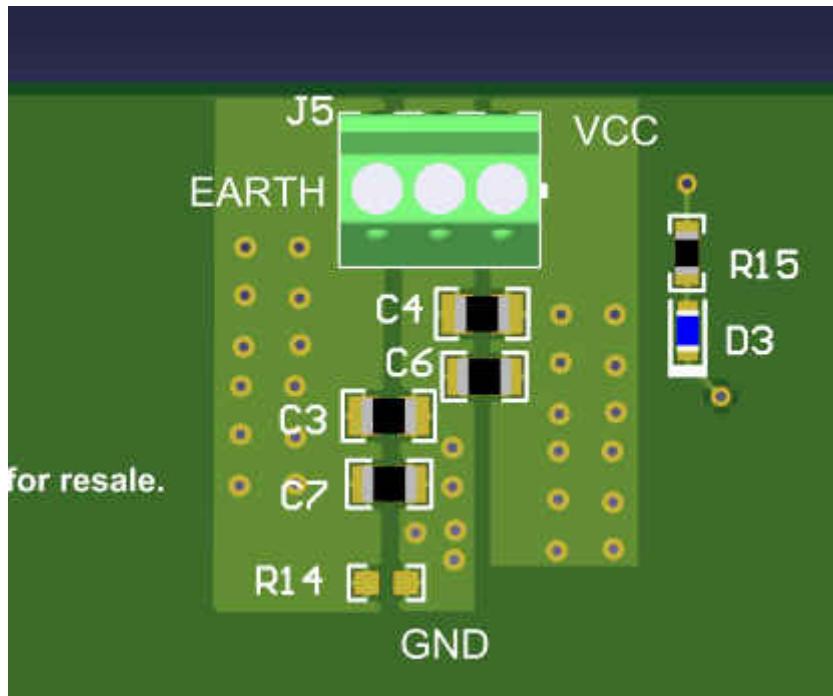


Figure 4-1. Power Connection Block View: J5

5 Operation of THVD1454EVM

5.1 Default Operation

After powering up the EVM with instructions listed [Powering The Board](#), the EVM is ready to 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.

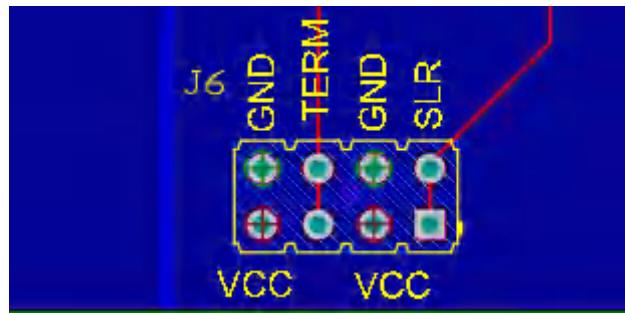


Figure 5-1. Control Block View: J6

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

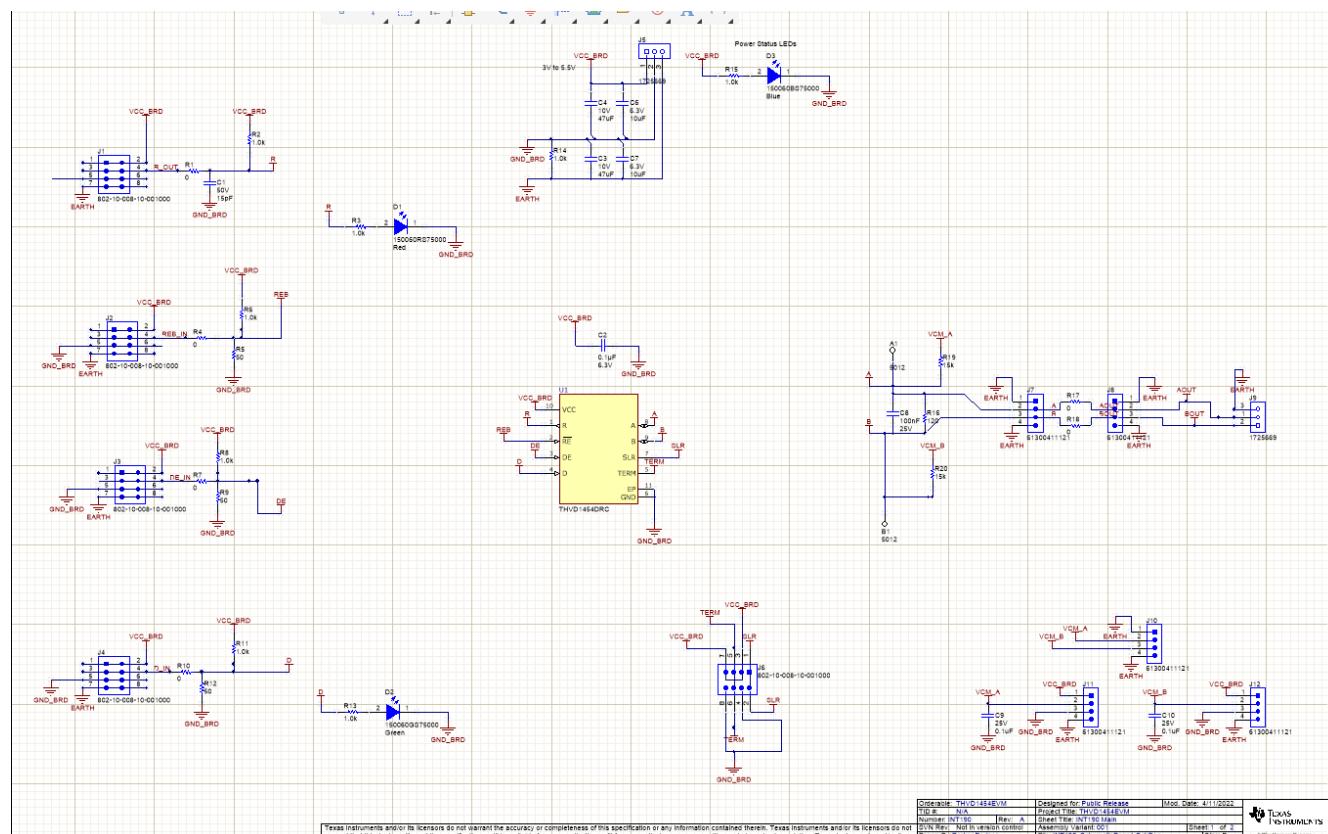
| Pin Jumper Pin | State | Function | Comment |
|-------------------|-------|---------------------------------|---------------------------------------|
| TERM J6-5, J6-6 | Low | Integrated Termination Disabled | For non-terminated nodes |
| TERM J6-5, J6-6 | High | Integrated Termination Enabled | Terminated 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



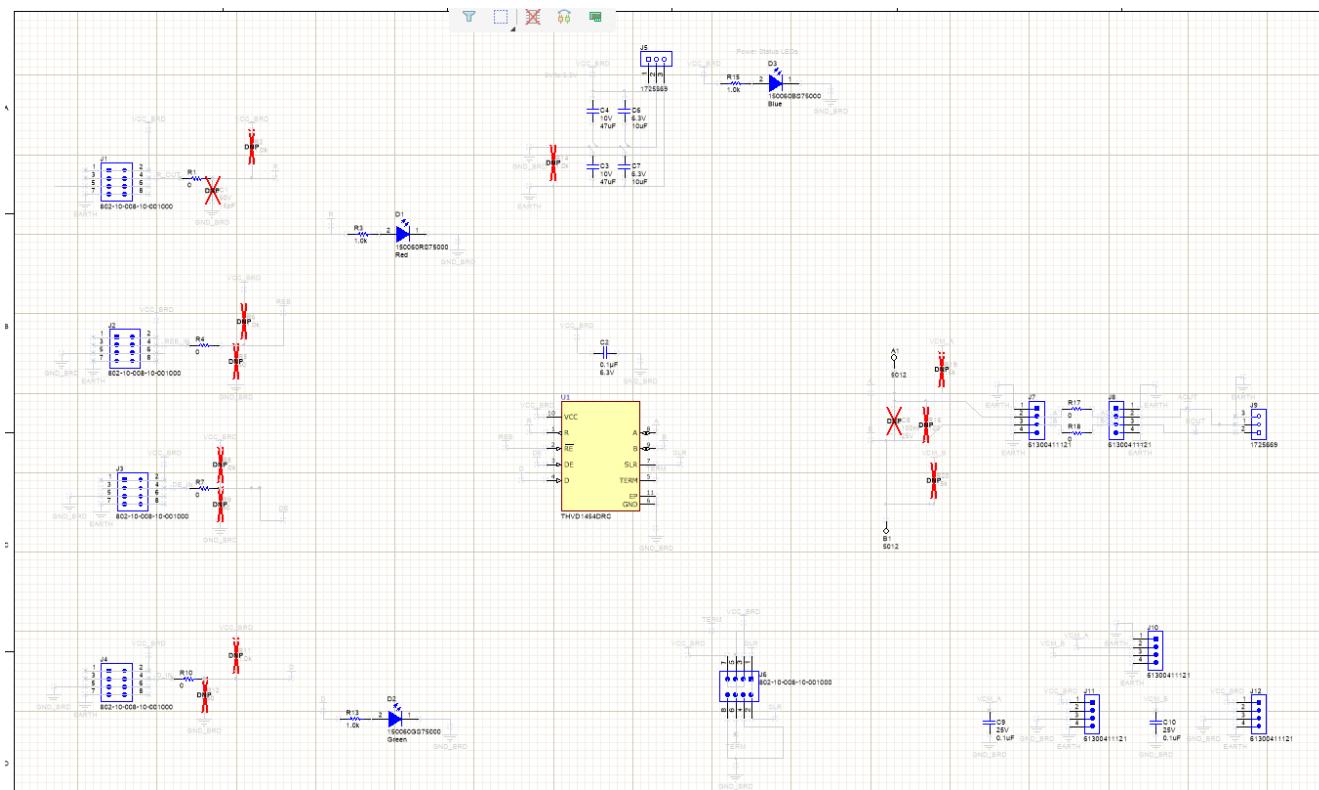
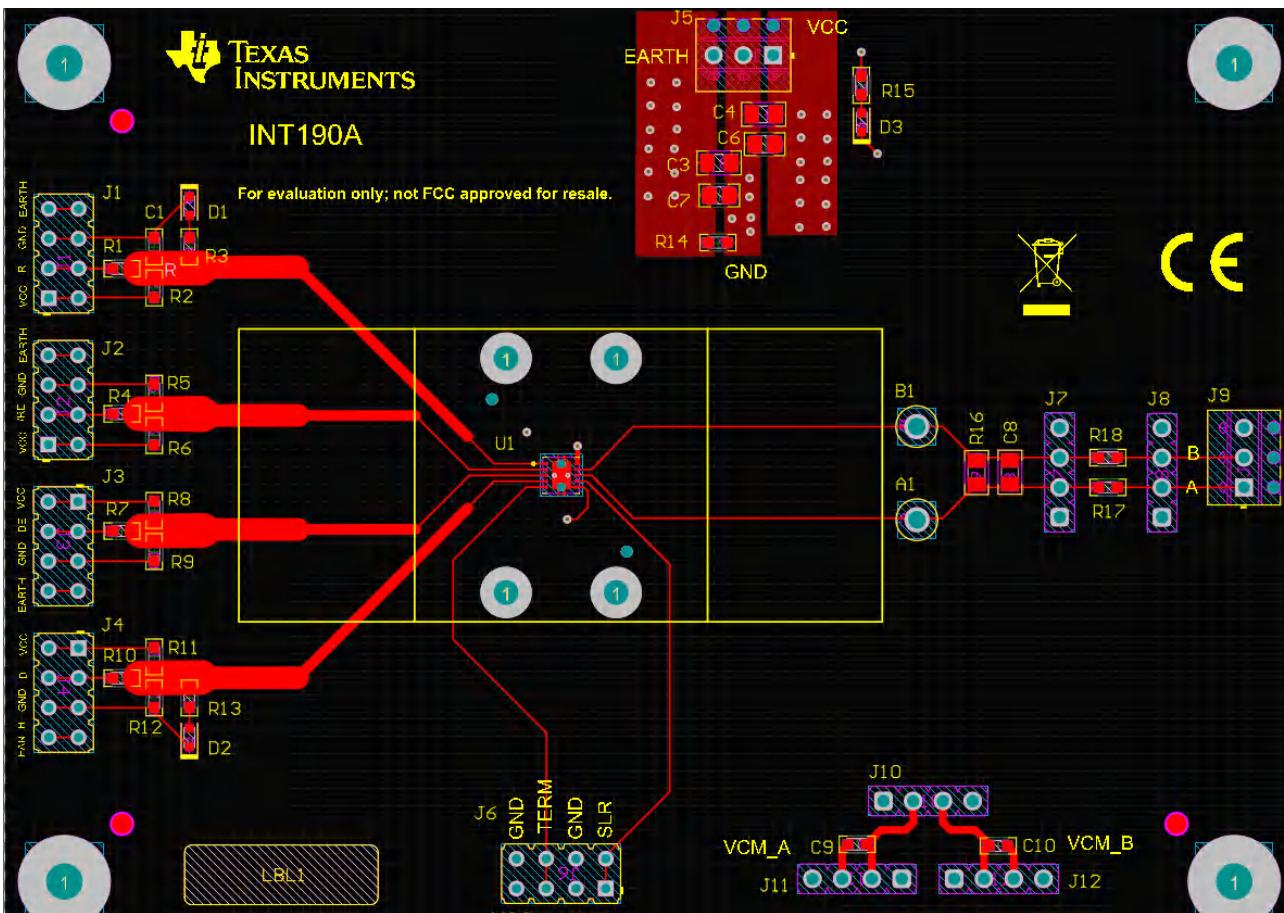
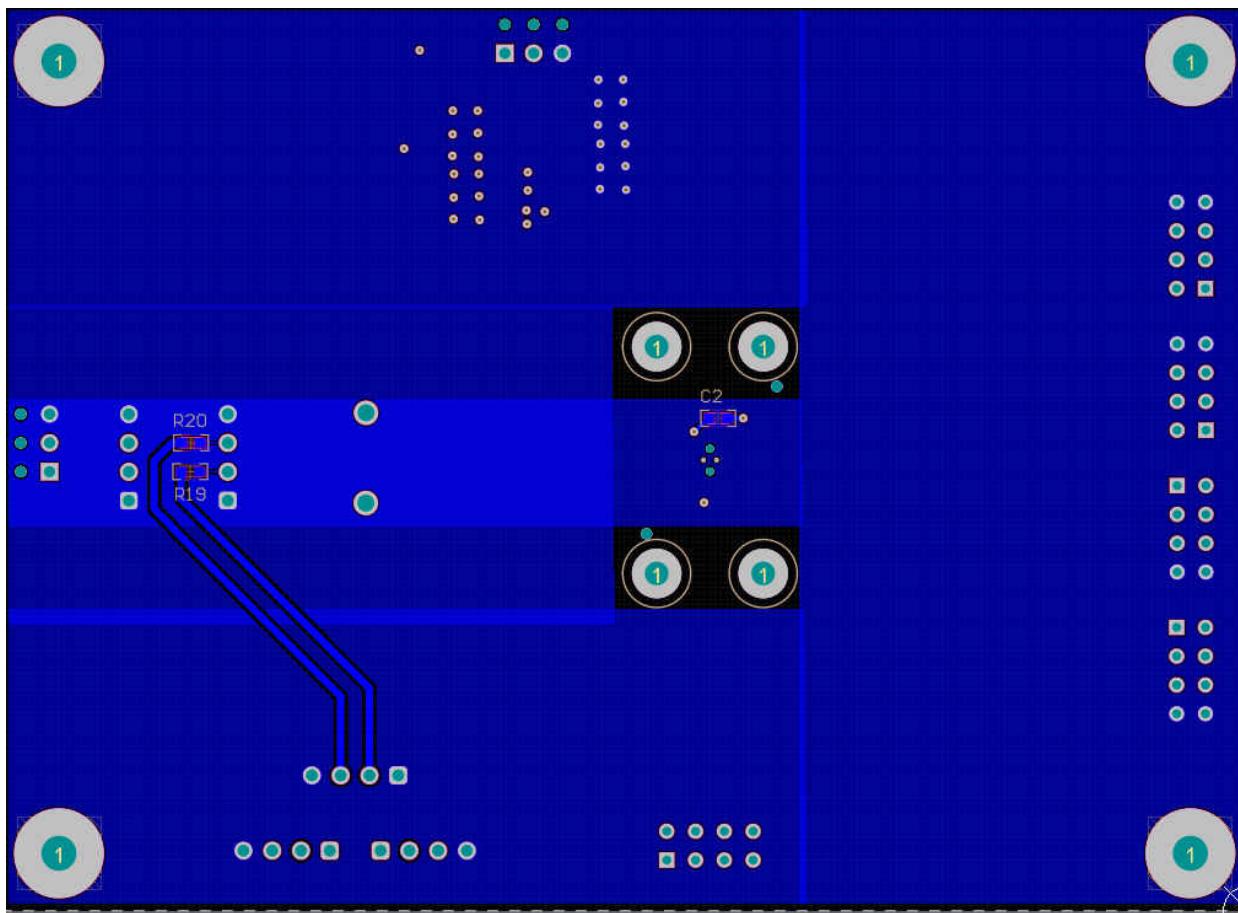


Figure 6-2. Schematic - DNI Markings Shown

6.2 Layout





6.3 Bill of Materials

| Manufacturer | PartNumber | Designator | Quantity |
|---------------------|----------------------|---------------------------|----------|
| Keystone | 5012 | A1, B1 | 2 |
| Kemet | C0603C104K9PACT7867 | C2 | 1 |
| Samsung | CL21A106KQFNNNG | C6, C7 | 2 |
| TDK | C1608X7R1E104K080AA | C9, C10 | 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, J6 | 5 |
| Phoenix Contact | 1725669 | J5, J9 | 2 |
| Wurth 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

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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 isotope 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

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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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