

## TLIN1028x EVM User's Guide

This user guide describes the TLIN1028x evaluation module (EVM). This EVM helps designers evaluate device performance, support fast development, and analyze automotive local interconnect network (LIN) systems using TLIN1028x LIN physical layer transceiver devices.



**Figure 1. TLIN1028x DRB Board Image**

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### Trademarks

All trademarks are the property of their respective owners.

## 1 Introduction

### 1.1 Features

The EVM supports the following features:

- *Master Mode* and *Slave Mode* configurations
- Terminal block and header pins are available on all power and LIN bus connections
- Access to the VCC output of the integrated LDO.
- Ability to test the local WAKE feature. (TLIN1238x only)

### 1.2 Description

The TLIN1028x EVM provides users with the ability to evaluate the TI TLINx028x-Q1, TLINx038x-Q1, and TLINx238x-Q1 family of single-channel, LIN transceivers. The EVM allows both master and slave mode applications to be evaluated through the use of a single jumper that connects or disconnects the external 1-k $\Omega$  pullup resistor and series diode required in master mode from the LIN bus.

The EVM has access to the integrated, low-voltage VCC rail that provides the pull-up for RXD, and the logic level for the enable (EN) control input pins through the use of a jumper. The TLIN1028x supports a  $V_{IH}$  from 2 V to 5.5 V, allowing operation with a variety of microcontrollers with common IO voltage levels such as 2.5 V, 3.3 V, and 5 V. Non-populated capacitor pads are available on the TXD, RXD, and LIN pins to accommodate a variety of different tests requiring various capacitive load conditions.

The TLIN SBC family supports both 12 V and 24 V automotive applications and is operated with a supply voltage from 5.5 V to 28 V, plus an extended bus fault protection of  $\pm 45$  V.

If additional ESD protection is desired, a diode pad is available on the LIN bus to accommodate any SOD323 diode. A header is provided on the power and LIN bus connections to allow the EVM to be evaluated in a larger system.

## 2 EVM Setup and Requirements

Use the following equipment to evaluate the performance of the TLIN1028x device:

- Power supply capable of supplying the desired supply voltage. Typical LIN applications use 12 V or 24 V, but the TLIN1028x operates with any supply voltage from 5.5 V to 28 V. Connect this voltage across the VBAT and GND pins of either the J1 and J9 banana jacks, or pins 1 and 3 of the J6 header.
- If the LIN bus interface is to be observed on an oscilloscope, use probes capable of tolerating voltages as large as VBAT.
- The logic interface pins (TXD, RXD, and EN) may interface to a microcontroller, pattern generator, or logic analyzer with logic levels matching the VCC voltage.
- Access to LDO output can be used for testing load and thermal capabilities.

### 2.1 Master Mode

To configure the board for master mode, place a shunt on J8 to connect the external 1-k $\Omega$  resistor and series diode to the LIN bus per the LIN specification.

### 2.2 Slave Mode

To configure the board for slave mode, remove the shunt on J8 to disconnect the external 1-k $\Omega$  resistor and series diode from the LIN bus per the LIN specification.

## 2.3 Local Wake-up

With the TLINx238x device, there is local wake-up capability on the WAKE pin. On the EVM, this function can be tested and used by populating the J7 jumper and using the S2 pushbutton. Populating the J7 jumper connects the WAKE pin to the pushbutton, which biases the WAKE pin to a divided down VSUP level (~90% of VSUP). When the S2 pushbutton is pressed, it pulls this level to GND, and thus shows a high to low transition on the pin. This will trigger a local wake-up request, and place the device in STANDBY mode. If the voltage level needs to be adjusted, R7 and R8 can be switched out to change the resistor divider.

## 2.4 TXD and RXD

Access to the TXD and RXD pins is available on the J3 2x2 header on the board. GND pins are also included on this header to allow for easy driving using a function generator or return path for an oscilloscope probe. Pads to add capacitance to the TXD and RXD traces are available by using the C7 and C8 pads, respectively.

## 2.5 VCC Load Testing

J10 gives access to the integrated LDO output, with a GND connection on the other header pin for convenience. Loads (electric or no) can be applied here to test the stability and performance of the integrated LDO.

## 2.6 LED Indication

LEDs D2 and D3 indicate when EN is high (D2), and when VCC is high (D3). These LEDs are only connected to their respective signals if the sliders on S1 are in the "On" position, as indicated on the S1 component.

# 3 Schematic and Bill of Materials

## 3.1 Schematic

[Figure 2](#) illustrates the EVM schematic.

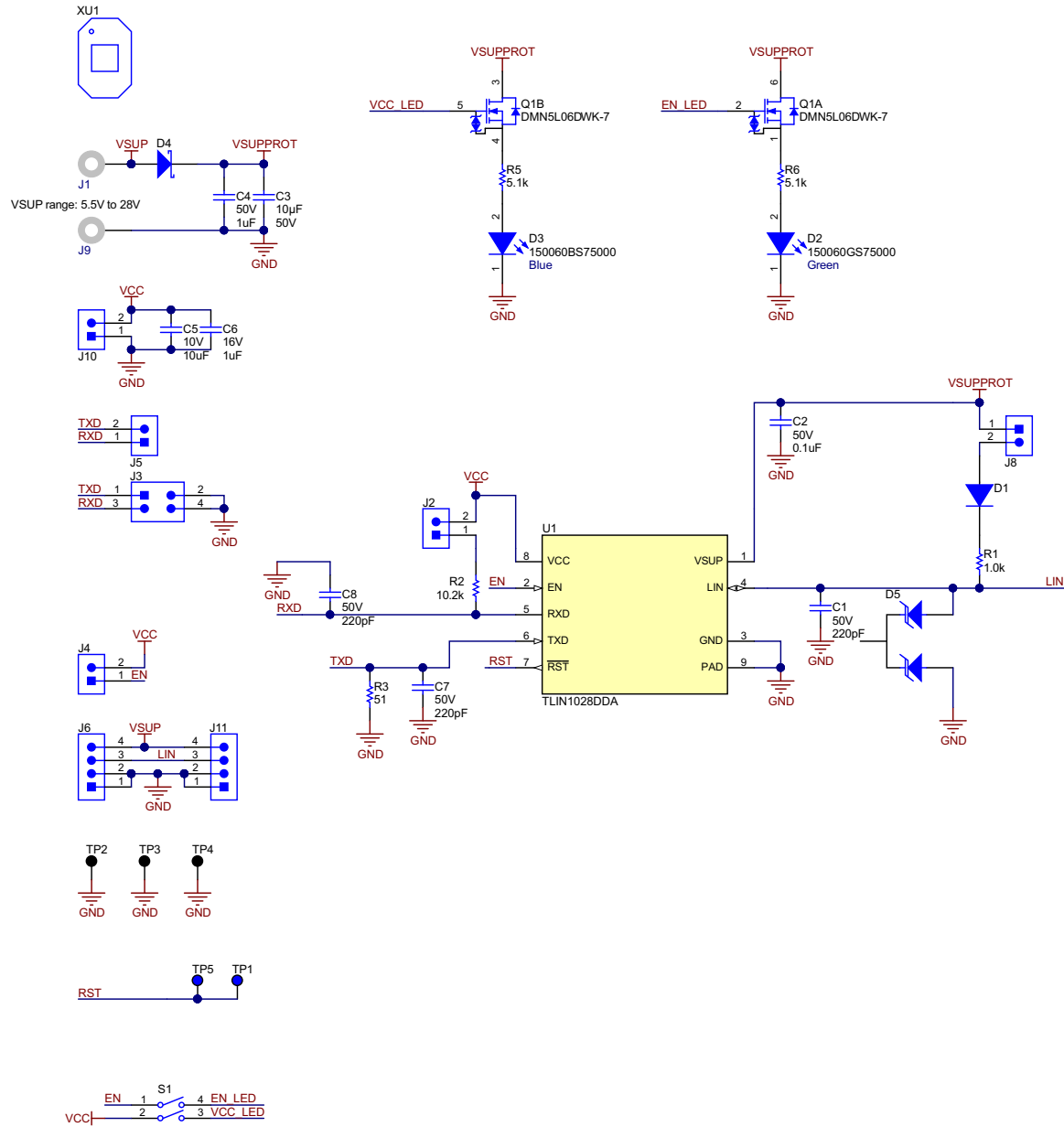


Figure 2. TLIN1028xDRB EVM Schematic

### 3.2 Bill of Materials

Table 1 lists the EVM BOM.

**Table 1. Bill of Materials**

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
C1,C7, C8	3	220pF, 50V	CAP, CERM, 220 pF, 50 V, ±10%, X7R, 0603	0603	C0603C221K5RACTU	Kemet
C2	1	0.1uF, 50V	CAP, CERM, 0.1 µF, 50 V, ±10%, X7R, 0603	0603	885012206095	Würth Elektronik
C3	1	10uF, 50V	CAP, CERM, 10 µF, 50 V, ±10%, JB, 1206	1206	C3216JB1H106K160AB	TDK
C4	1	1uF	CAP, CERM, 15 pF, 50 V, +/-5%, X7R, 0805	0805	C0805C105K5RACTU	Kemet
C5	1	10uF	CAP, CERM, 220 pF, 50 V, ±1%, X7R, 0805	0805	885012207026	Würth Elektronik
C6	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R71C105KA64D	MuRata
C9	1	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0603	0603	C0603C103J5RACTU	Kemet
D1	1	75V	Diode, Switching, 75 V, 0.15 A, AEC-Q101, DO-213AC	DO-213AC	LL4448-GS08	Vishay-Semiconductor
D2	1	Green	LED, Green, SMD	LED_0603	150060GS75000	Würth Elektronik
D3	1	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D4	1	80V	Diode, Schottky, 80 V, 1 A, SMB	SMB	B180B-13-F	Diodes Inc.
D5	1	27V	Diode, TVS, Uni, 27 V, 38Vc, SOT-23	SOT-23	MMBZ27VCL-7-F	Diodes Inc.
FID1, FID2, FID3	3		Fiducial Mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303	3M
J1, J9	2		Standard Banana Jack, Uninsulated, 8.9mm	Keystone575-8	575-8	Keystone
J2, J4, J5, J8, J10	5		Header, 100mil, 2x1, Gold, TH	Header, 2x1, 100mil	5-146261-1	TE Connectivity
J3	1		Header, 2.54mm, 2x2, Gold, TH	Header, 2.54mm, 2x2, TH	PBC02DAAN	Sullins Connector Solutions
J6,J11	2		Header, 2.54 mm, 4x1 Gold, TH	Header, 2.54 mm, 4x1, TH	PBC04SAAN	Sullins Connector Solutions
Q1	1	50V	MOSFET, 2-CH, N-CH, 50V, 0.305 A, AEC-Q101, SOT-363	SOT-363	DMN5L06DWK-7	Diodes Inc.
R1	1	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R2	1	10.2k	RES, 10.2 k, 1%, 0.1 W, 0603	0603	CRCW060310K2FKEA	Vishay-Dale
R3	1	51	RES, 51, 5%, 0.1 W, 0603	0603	CRCW060351R0JNEA	Vishay-Dale
R5, R6	2	5.1k	RES, 5.1 k, 5%, 01 W, 0603	0603	RC0603JR-075K1L	Yageo
S1	1		Switch, SPST, 2Pos, SMD	6.55x6.68mm	SD02H0SB	C&K Components
TP1, TP5	2		Test Point, Multipurpose, Blue, TH	Blue Multipurpose Testpoint	5127	Keystone
TP2, TP3, TP4	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		Automotive Local Interconnect Network Transceiver, DRB0008F	DRB0008F	TLIN1028DRB	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:

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**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.

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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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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.

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- 4 *EVM Use Restrictions and Warnings:*
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      - 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.
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9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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