EVM User's Guide: TMUX2821DSGDDF-EVM

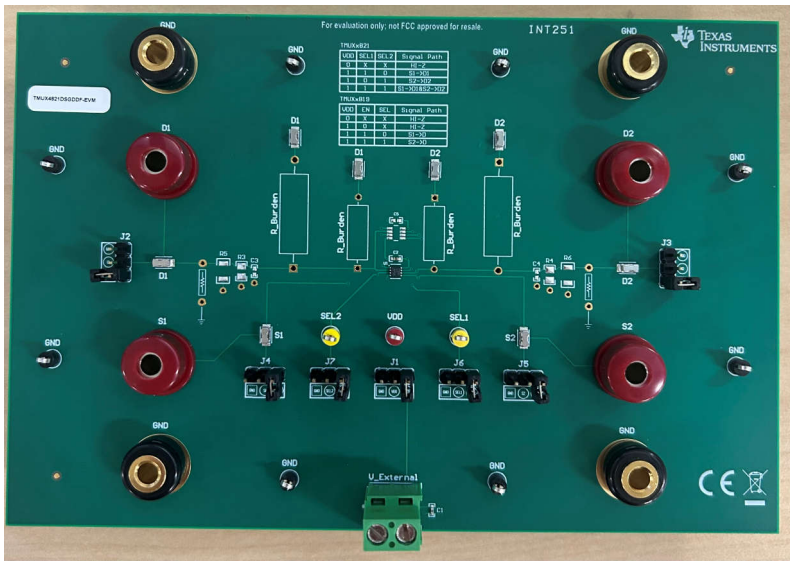
TMUX28XX Evaluation Module

Description

The TMUX28XX-DSG-DDF-EVM is used to evaluate the performance of the TMUX2821 and TMUX2819. The evaluation module (EVM) comes with a soldered TMUX2821. The EVM allows for an easy way for engineers to evaluate the TMUX2821 and TMUX2819 low Ron and ΔRon capabilities. The EVM has multiple resistor footprints that can be populated to test how the device affects the total resistance on the signal lane. Additionally, the EVM includes multiple test points and banana jack plug-ins to allow high current signals to be applied on the mux.

Features

- External power supply with decoupling capacitor from V_External to ground (1µF 0402)
- One power supply decoupling capacitor from VDD to ground (0.1µF 0402)
- Eight test points on I/Os supporting TMUX2821 and TMUX2819 full current and voltage capabilities
- Eight additional GND test points for ease of probing
- Four banana jack plug-ins on I/Os supporting TMUX2821 and TMUX2819 full current and voltage capabilities
- Four additional GND banana jack plug-ins



TMUX28XX-DSG-DDF-EVM (Top View)

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the TMUX28XX-DSG-DDF-EVM evaluation module (EVM) and the intended use. This board allows for the quick prototyping and characterization of TI's TMUX2821 and TMUX2819 multiplexers in DSG and DDF packages. This EVM allows for evaluation of the device impact on the total resistance on the signal path.

The following is continuation of the features list:

- One 3-pin header for connecting or disconnecting device from external power
- Two 3-pin headers for controlling the logic of the device
- Four 3-pin headers to change signal path state of device
- Multiple unpopulated footprints for potential additional RC loads
- Multiple through holes for mounting resistors

CAUTION

The EVM comes with jumpers populating the headers shorting the pins to ground. Make sure before first usage you are aware about the state of the pins and change them according to your application. Failing to do so risks the reliability of the device and EVM.

1.2 Kit Contents

The EVM kit includes the following :

- (1) TMUX28XX-DSG-DDF-EVM

1.3 Specification

The TMUX28XX-DSG-DDF-EVM is used for evaluating TMUX2821 and TMUX2819. The EVM has seven 3-pin headers; four headers for tying the I/Os to the voltage supply level, or to connect them to ground. Two headers for toggling the SEL pins to switch control the signal path routing of the device. The last 3-pin header allows for the VDD supply to be connected to an external source, to the board ground or left floating.

The EVM has test points on each I/O for a total of eight test points that are rated up to 2A to support testing the TMUX2821 and TMUX2819 at the fullest current carrying capabilities. Four of these test points are directly routed to the I/Os. The other four are routed to the unpopulated burden resistance that can be implemented for resistance testing. These are located above the burden resistor and routed to the upper lead. Make sure you connect these test point to ground to test the voltage across the burden resistors. Eight extra ground test points are provided to allow for more connection flexibility on the board.

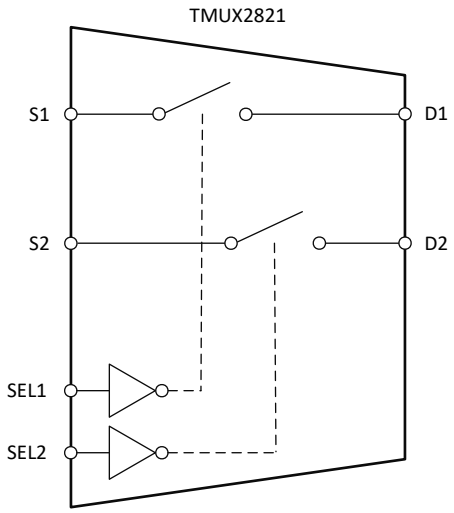


Figure 1-1. TMUX2821 Simplified Circuit

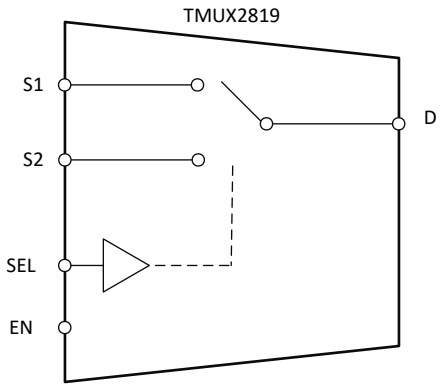


Figure 1-2. TMUX2819 Simplified Circuit

1.4 Device Information

The TMUX2821 and TMUX2819 are complementary metal-oxide semiconductor (CMOS) multiplexers. The TMUX2821 has two independently selectable, single-pole, single-throw (SPST) switch channels. The TMUX2819 has one single-pole, double-throw (SPDT) channel. The devices work with a single supply (1.8V to 5.5V), but can pass bidirectional analog and digital signals beyond the supply from -5V to 5V.

The devices also features powered off protection up to ±5V, which isolates the Dx from a voltage on the Sx even when there is no supply voltage present (VDD = 0V). Without this protection feature, any voltage on the switch can back-power the supply rail through an internal ESD diode and cause potential damage to the rest of the system.

With 1mΩ RON-flatness, the TMUX2821 and TMUX2819 are excellent choices for passing signals without adding distortion.

2 Hardware

2.1 Power Requirements

TMUX28XX-DSG-DDF-EVM requires a 1.8V to 5.5V supply provided either through the J1 terminal from the V-External, or directly hooked to the red VDD test point to provide a passive signal pathway between the Sx and Dx pins in according to the logic selected. Note, facing up and straight the V-External connections are GND is the left terminal VDD is the right one.

2.2 Header and Jumper Information

The TMUX28XX-DSG-DDF-EVM has seven 3-pin headers to control the power supply connection, the control inputs, the sources and drains. The following is a description of each header.

1. **Supply Header J1**

   Header J1 connects the VDD pin to either the external power or to ground via a jumper. If Header J1 is not connected, then the devices supply is left floating. Figure 2-1 shows header J1.

   a. To connect to the external supply, short the J1-2 location on the header to J1-3. The V_EXT terminal is now supplying the device power.
   b. To connect to ground, short the J1-2 location on the header to J1-1. The device supply pin is now grounded.
   c. To leave the device supply pin floating, leave J1-2 unconnected and floating.

2. **Control Header J6**

   Header J6 connects the SEL1 pin to either VDD or ground by a jumper. If Header J6 is not connected, then the devices SEL1 pin is left floating.

   a. To connect to VDD, short the J6-2 location on the header to J6-3. VDD is now connected to the devices SEL1 pin.
   b. To connect to ground, GND, short the J6-2 location on the header to J6-1. The device SEL1 pin is now grounded.
   c. Leaving J6-2 unconnected leaves the SEL1 pin floating. Doing this is not recommended as the device is in an unknown state.

3. **Control Header J7**

   Header J7 connects the SEL2 pin to either VDD or ground via a jumper. If Header J7 is not connected, then the devices SEL2 pin is left floating.

   a. To connect to VDD, short the J7-2 location on the header to J7-3. VDD is now connected to the devices SEL2 pin.
   b. To connect to ground, GND, short the J7-2 location on the header to J7-1. The device SEL2 pin is now grounded.
   c. Leaving J7-2 unconnected leaves the SEL2 pin floating. Doing this is not recommended as the device is in an unknown state.

4. **Drain Header J2**

   Header J2 connects the D1 pin to either VDD or ground by a jumper. If Header J2 is not connected, then the devices D1 pin is left floating.

   a. To connect to VDD, short the J2-2 location on the header to J2-1. VDD is now connected to the devices D1 pin.
   b. To connect to ground, GND, short the J2-2 location on the header to J2-3. The device D1 pin is now grounded.
   c. Leaving J2-2 unconnected leaves the D1 pin floating.

5. **Drain Header J3**

   Header J3 connects the D2 pin to either VDD or ground via a jumper. If Header J3 is not connected, then the devices D2 pin is left floating.

   a. To connect to VDD, short the J3-2 location on the header to J3-1. VDD is now connected to the devices D2 pin.
   b. To connect to ground, GND, short the J3-2 location on the header to J3-3. The device D2 pin is now grounded.
   c. Leaving J3-2 unconnected leaves the D2 pin floating.

6. **Source Header J4**

   Header J4 connects the S1 pin to either VDD or ground by a jumper. If Header J4 is not connected, then the devices S1 pin is left floating.

   a. To connect to VDD, short the J4-2 location on the header to J4-3. VDD is now connected to the devices S1 pin.
   b. To connect to ground, GND, short the J4-2 location on the header to J4-1. The device S1 pin is now grounded.
   c. Leaving J4-2 unconnected leaves the S1 pin floating.

7. **Source Header J5**

   Header J5 connects the S2 pin to either VDD or ground by a jumper. If Header J5 is not connected, then the devices S2 pin is left floating.

   a. To connect to VDD, short the J5-2 location on the header to J5-3. VDD is now connected to the devices S2 pin.
   b. To connect to ground, GND, short the J5-2 location on the header to J5-1. The device S2 pin is now grounded.
   c. Leaving J5-2 unconnected leaves the S2 pin floating.

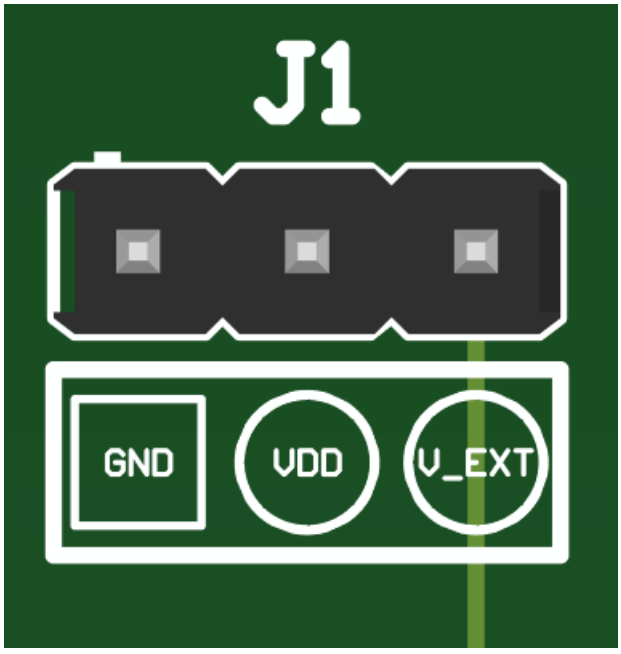


Figure 2-1. Header J1 : J1-1(GND), J1-2(Connection to device VDD), J1-3 (V_EXT)

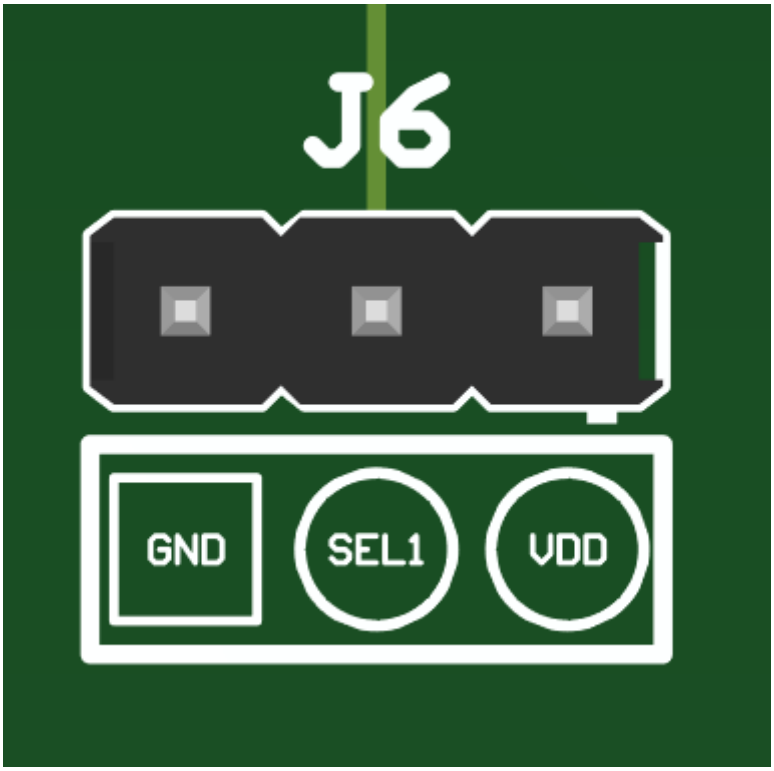


Figure 2-2. Header J6 : J6-1(GND), J6-2(Connection to device SEL1), J6-3 (VDD)

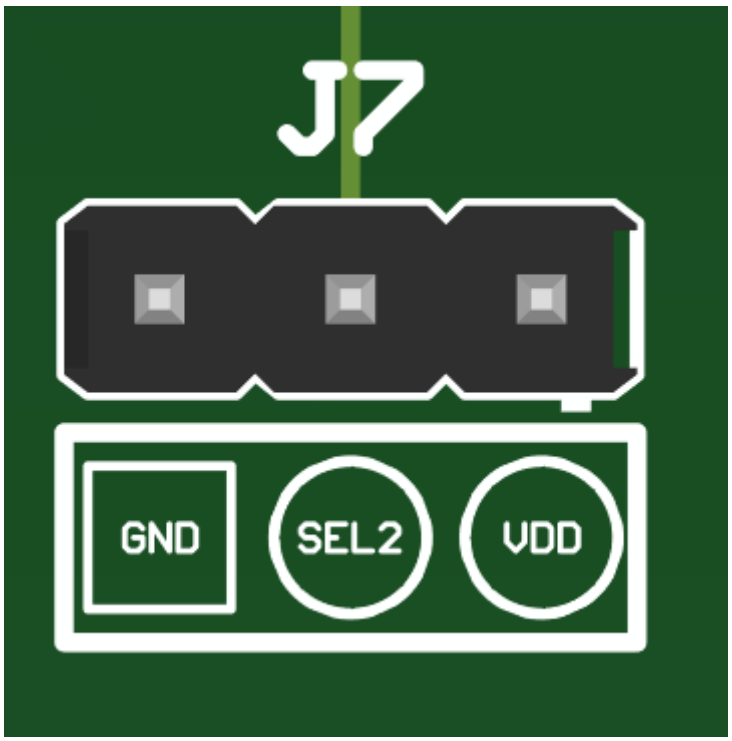


Figure 2-3. Header J7 : J7-1(GND), J7-2(Connection to device SEL2), J7-3 (VDD)

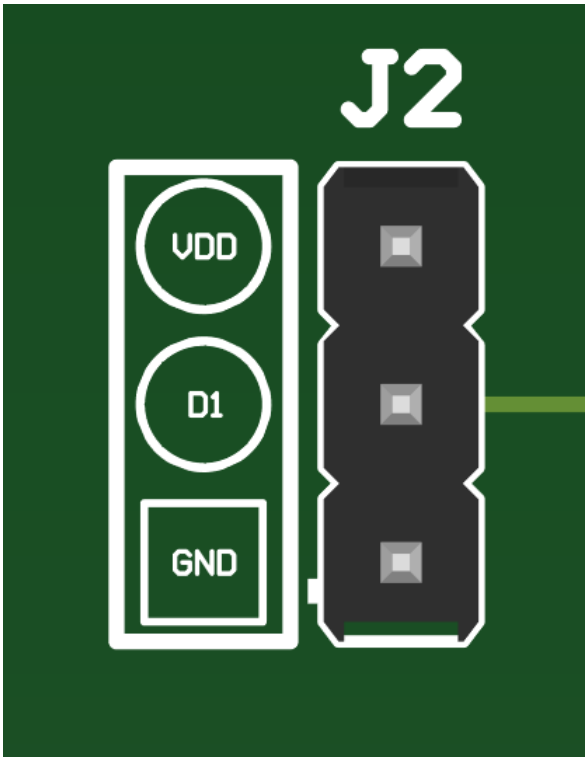


Figure 2-4. Header J2 : J2-1(VDD), J2-2(Connection to device D1), J2-3 (GND)

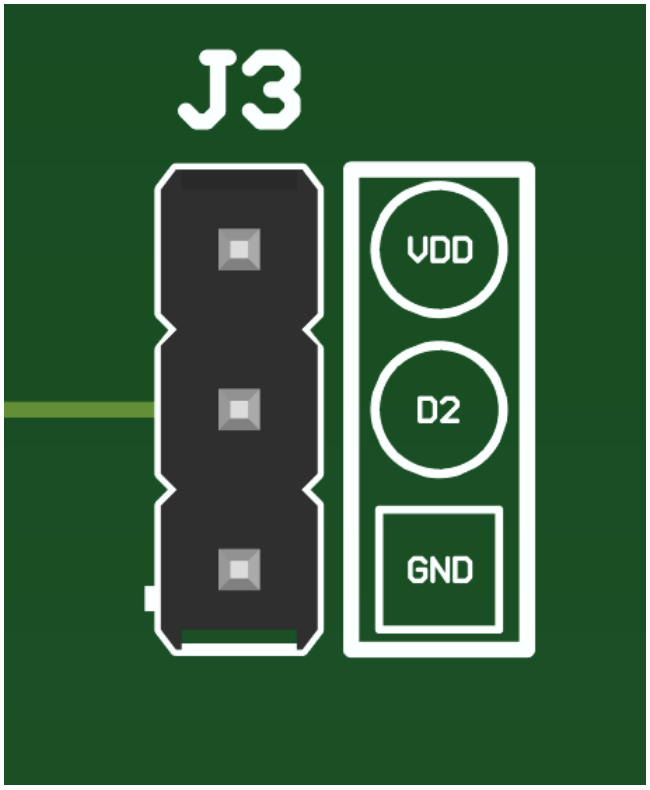


Figure 2-5. Header J3 : J3-1(VDD), J3-2(Connection to device D2), J3-3 (GND)

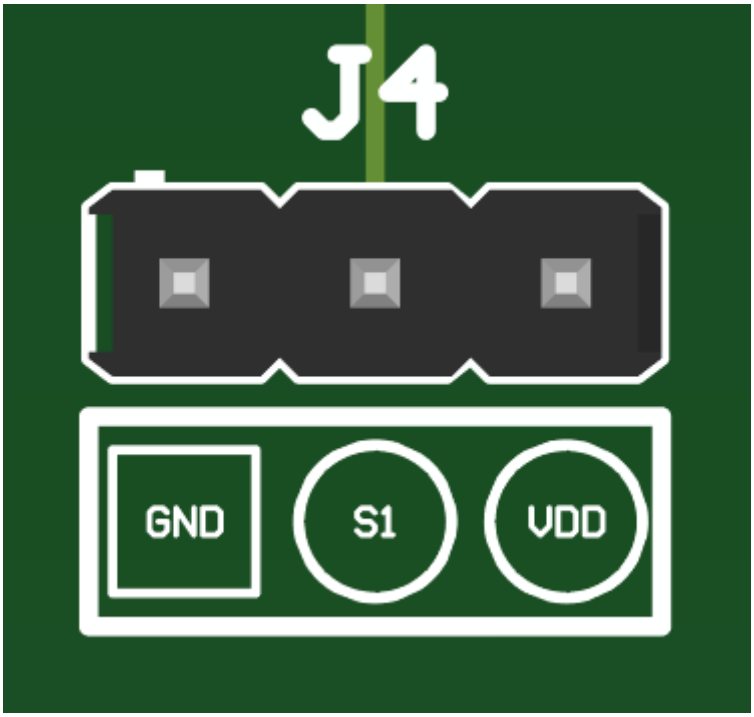


Figure 2-6. Header J4 : J4-1(GND), J4-2(Connection to device S1), J4-3 (VDD)

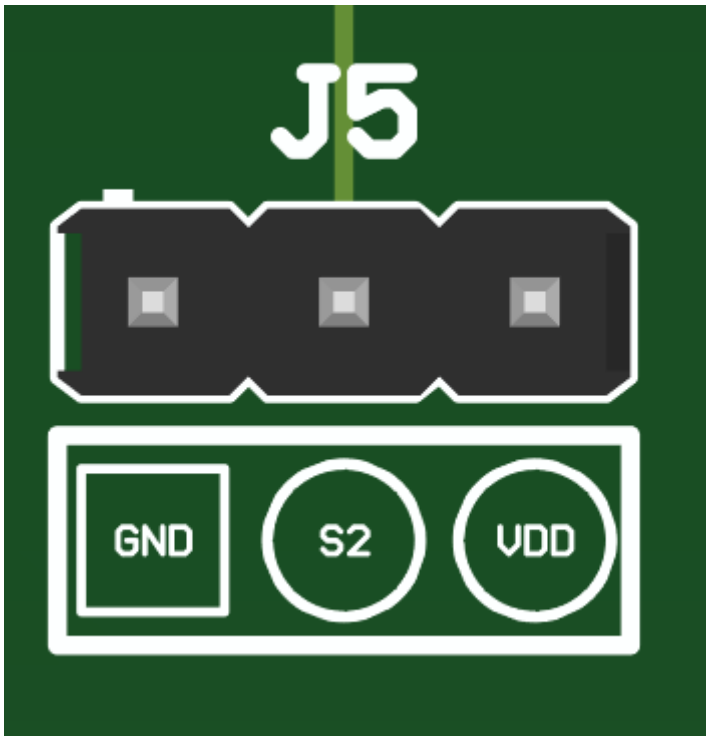


Figure 2-7. Header J5 : J5-1(GND), J5-2(Connection to device S2), J5-3 (VDD)

The logic headers J6(SEL1) and J7(SEL2) can be used to control both the TMUX2821 and TMUX2819. The TMUX2819 has an EN pin which can be controlled by SEL2 and the SEL pin to be controlled by SEL1.

TMUXx821

VDD	SEL1	SEL2	Signal Path
0	X	X	HI-Z
1	1	0	S1->D1
1	0	1	S2->D2
1	1	1	S1->D1&S2->D2

Figure 2-8. TMUX28XX-DSG-DDF-EVM TMUX2821 Truth Table

TMUXx819

VDD	EN	SEL	Signal Path
0	X	X	HI-Z
1	0	X	HI-Z
1	1	0	S1->D
1	1	1	S2->D

Figure 2-9. TMUX28XX-DSG-DDF-EVM TMUX2819 Truth Table

2.3 Test Points

The board has a total of 19 test points. 8 GND, 2 SEL, 1 VDD, and 8 I/O.

Test Point ID	Description	Signal
S1	Surface Mount	S1
S2	Surface Mount	S2
D1	Surface Mount	D1
D1	Surface Mount	D1
D1	Surface Mount	D1
D2	Surface Mount	D2
D2	Surface Mount	D2
D2	Surface Mount	D2
VDD	Red	VDD
SEL1	Yellow	SEL1/SEL
SEL2	Yellow	SEL2/EN
GND	Black	GND
GND	Black	GND
GND	Black	GND
GND	Black	GND
GND	Black	GND
GND	Black	GND
GND	Black	GND
GND	Black	GND

3 Hardware Design Files

The following section includes hardware design files for TMUX28XX-DSG-DDF-EVM . This section includes the board level schematic, PCB layout and Bill of materials (BOM).

3.1 Schematics

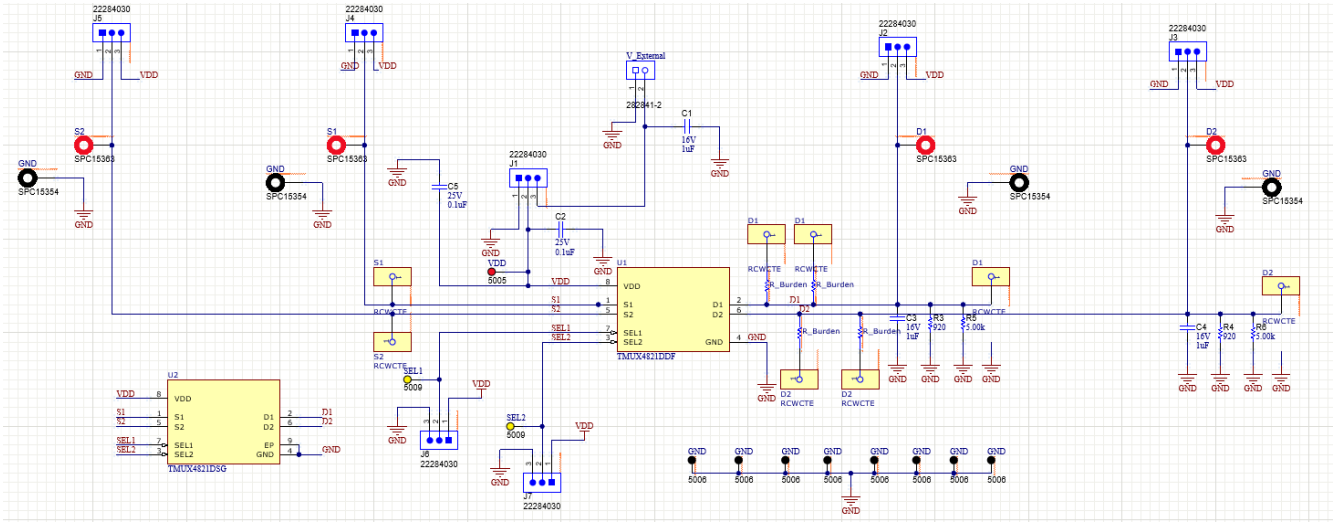


Figure 3-1. TMUX28XX-DSG-DDF-EVM Schematic

3.2 PCB Layouts

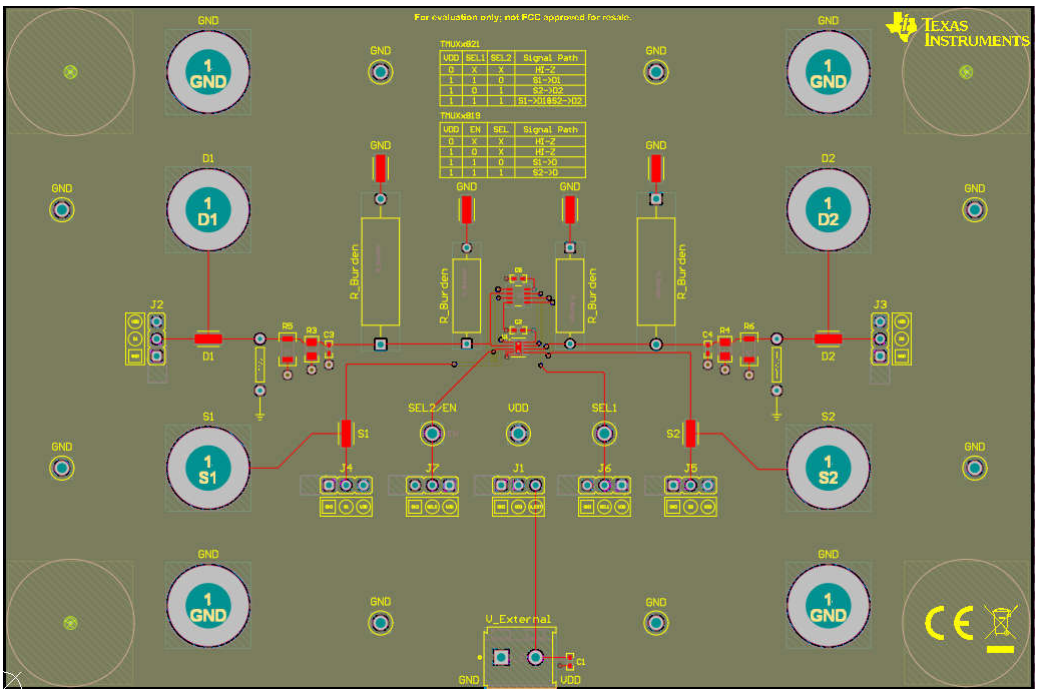


Figure 3-2. TMUX28XX-DSG-DDF-EVM Top Layer Layout

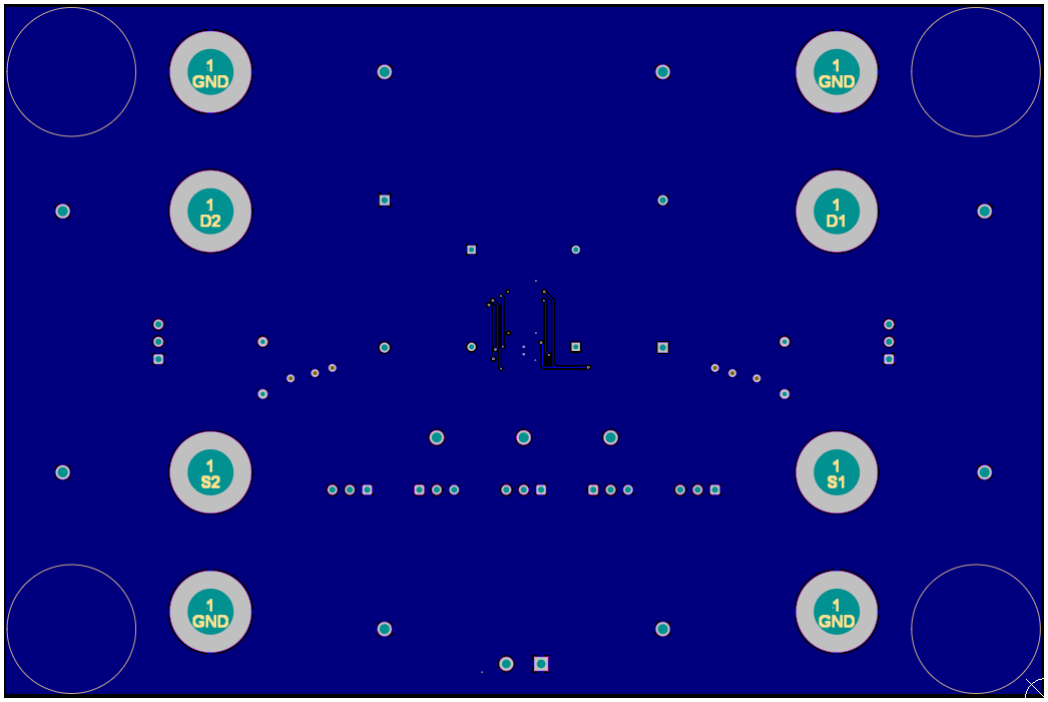


Figure 3-3. TMUX28XX-DSG-DDF-EVM Bottom Layer Layout

3.3 Bill of Materials (BOM)

Table 3-1. Bill of Materials

Designator	Qty	Value	Description	Manufacturer	Part Number
C1	1	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X5R, 0402	Taiyo Yuden	EMK105BJ105KVHF
C2	1	0.1uF	CAP, CERM, 0.1uF, 25V, +/- 10%, X5R, 0402	MuRata	GRM155R61E104KA87D
S1, S2, D1, D2	4		BANANA JACK, SOLDER LUG, RED, TH	Tenma	GSPC15363
S1, S2, D1, D2	8		PC Test Point Plating Surface Mount Mounting Type	KOA Speer	RCWCTE
GND	4		BANANA JACK, SOLDER LUG, BLACK, TH	Tenma	SPC15354
GND	8		Test Point, Compact, Black, TH	Keystone	5006
J1, J2, J3, J4, J5, J6, J7	7		CONN JUMPER S2 (1 x 2) Position Shunt Connector Black Open Top 0.100" (2.54mm) GoldHORTING .100" GOLD	Sullins	QPC02SXGN-RC
J1, J2, J3, J4, J5, J6, J7	7		Header, 2.54mm, 3x1, Tin, TH	Molex	22284030
P1, P2, P3, P4	4		Bumper Cylindrical, Dome 0.720" Dia (18.30mm) Polyurethane Black	Essentra Components	RBS-37BK
SEL1, SEL2	2		Test Point, Compact, Yellow, TH	Keystone Electronics	5009
TMUX28XX-DSG-DDF-EVM	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10
U2	1		TMUX2821	Texas Instruments	TMUX2821DSG
V_External	1		Terminal Block, 2x1, 5.08mm, TH	TE Connectivity	282841-2
VDD	1		Test Point, Compact, Red, TH	Keystone Electronics	5005
C3, C4	0	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X5R, 0402	Taiyo Yuden	EMK105BJ105KVHF
C5	0	0.1uF	CAP, CERM, 0.1uF, 25V, +/- 10%, X5R, 0402	MuRata	GRM155R61E104KA87D
R3, R4	0	920Ω	RES, 920, 0.1%, 0.125 W, 0805	Yageo America	RT0805BRD07920RL
R5, R6	0	5kΩ	RES, 5.00 k, 0.1%, 0.25 W, 1206	State of the Art	D55342E07B05B0TTR
R_Burden	0	250Ω	250 Ohms ±0.1% 1W Through Hole Resistor Axial Flame Retardant Coating, Moisture Resistant, Safety Metal Film	Vishay	CMF60250R00BHEB
R_Burden	0	45Ω	Res Wirewound 45 Ohm 1% 3W ±20ppm/°C Ceramic Hi Temp Sil AXL Thru-Hole Bulk	Vishay	RS02B45R00FE12
U1	0		TMUX2821	Texas Instruments	TMUX2821DDF

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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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