EVM User's Guide: LOG300DEVM, LOG300RGTEVM
LOG300D and LOG300RGT Evaluation Modules

TEXAS INSTRUMENTS

Description

The LOG300DEVM and LOG300RGTEVM are evaluation modules for the LOG300 logarithmic detector with integrated low noise amplifier in the 16pin SOIC and 16pin VQFR package respectively. This evaluation module is designed to quickly and easily demonstrate the functionality and versatility of the device. The EVM is ready to connect to power (3V to 5.25V), signal sources, and test instruments through the use of onboard connectors. The EVM comes configured for easy connection with common 50Ω laboratory equipment on the inputs. The outputs are connected to a SMA connectors. The board also includes jumpers to easily disable or enable the LNA and frequency detect block of the IC if in case not in use.

Features

- Single supply operating range 3V to 5.25V
- Configurable to use and evaluate LNA and LOG detector block separately
- Easy-to-use SMA connectors for all input and output signal
- Provide flexibility to use either onboard or external bandpass filter (BPF)
- Layout configured to minimize parasitic and noise

Applications

- Arc fault detection
- Ultrasonic double paper feed detection
- Ultrasonic material detection
- Bubble counter and detection in fluid
- Ultrasonic distance detection
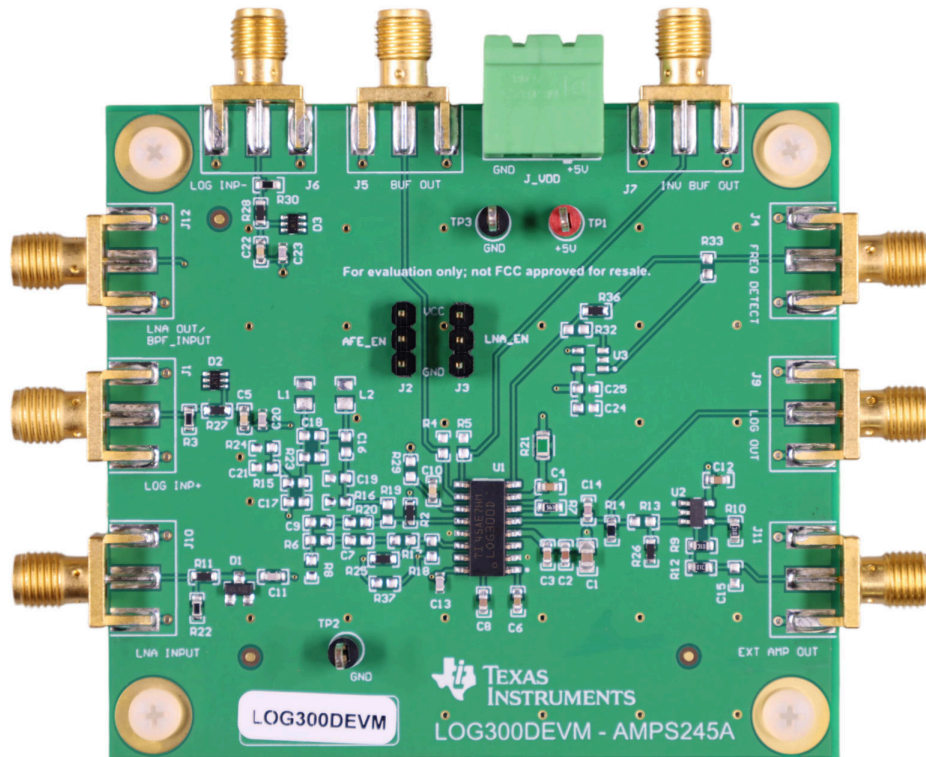
LOG300DEVM Board (Top View)

1 Evaluation Module Overview

1.1 Introduction

The LOG300DEVM and LOG300RGTEVM evaluation module is designed to evaluate the performance of an integrated logarithmic detector, low noise amplifier (LNA) and input frequency detector all in one single device LOG300. The EVM can operate over the single supply range of 3V to 5.2V. The LOG detector block can take the input from 25uV to 1.6Vp while the full analog front end (LNA + log detector combined) support input range from 6uVp to 200mVp. A back to back diode is also provided at the LNA input to protect from high voltage spikes. The EVM includes SMA connector for all inputs and output pins and a power connector for supply.

This user's guide provides device and connectors descriptions, schematic, bill of materials, and board layout of the EVM.

1.2 Kit Contents

- LOG300DEVM/LOG300RGTEVM
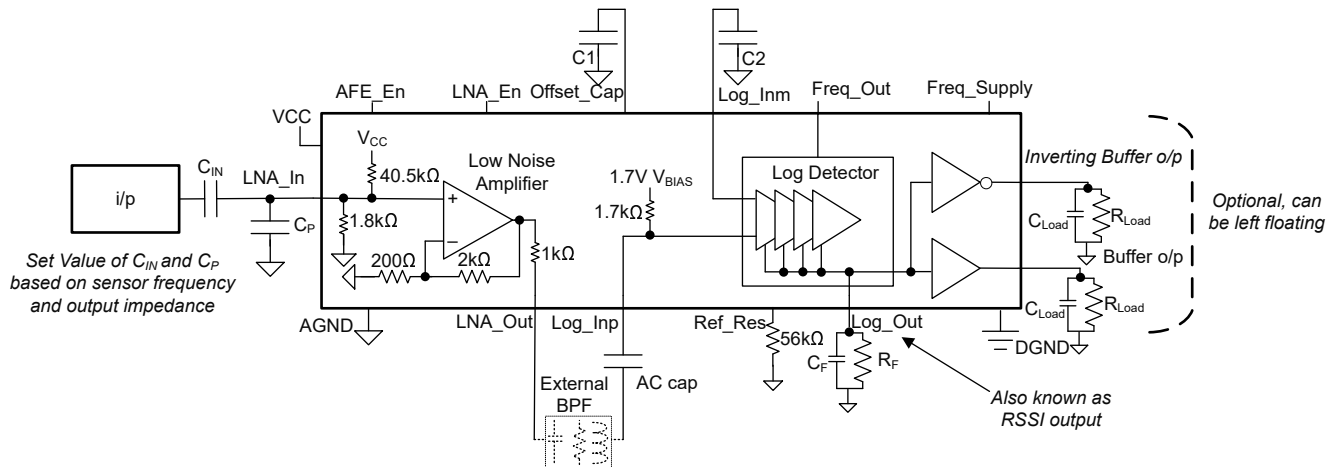- EVM Disclaimer Read Me

1.3 Specification

Figure 1-1. LOG300 Simplified Schematic

1.4 Device Information

The LOG300 is an integrated low-noise amplifier (LNA) + log detector analog front end (AFE). This device supports an input frequency range of 100Hz to 80MHz and a typical dynamic range of 97dB. The is intended for use in applications that require a wide dynamic range of voltage and signal measurement. The low input noise and high sensitivity of the integrated LNA, allows voltage measurement of signals as low as 4 µVrms up to 1.4 Vrms. The transient output response can be adjusted by tuning of the capacitor and the resistor connected at the log o/p pin. The LOG300 is available in a 16-pin SOIC and 16-pin VQFN package. The LOG300 is operational from a 3V to 5V supply and over the full ambient temperature range of –40°C to +125°C.
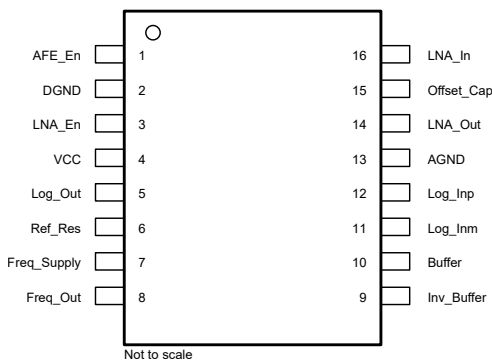
2 Hardware

2.1 Pin Specifications

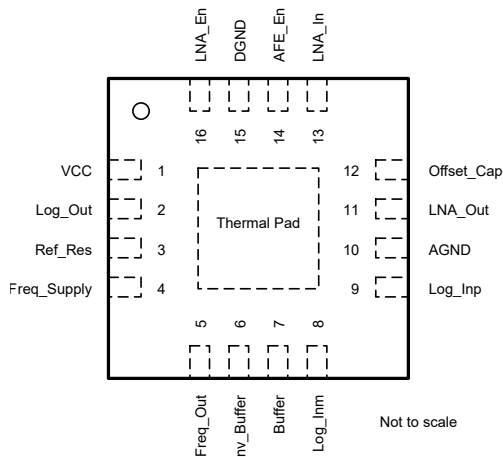**Figure 2-1. D Package, 16-Pin SOIC (Top View)**

Figure 2-2. RGT Package, 16-Pin VQFN (Top View)

2.2 Power Requirements

The EVMs are equipped with a DC socket (J_VDD) for easy connection of power. The positive supply input is labeled +5V, the ground supply input is labeled GND. The +5V is also connected to a test point TP1, which can be used for connecting power supply using clip connector. The EVM can safely operates from 3V to 5.25V supply but please note this device and hence the EVM does not support split-supply operation. Buy default three supply decaps C1, C2, C3 are connected at the Vcc pins. This along with R1 forms a low pass filter at supply. A ferrite bead FB1 is also connected to filter out high freq noise at the supply. This supply filter is important to get good PSRR performance from the device.

2.3 Input Connectors

There are six output connectors (SMA) on the EVM.

- LNA INPUT (J10): Connects to LNA input of the device. This has 50 ohm termination and is AC coupled to the device LNA input and also has a back to back diode for device input protection from overvoltage.
- LOG INP+ (J1): Connects to the non inverting input (Log i/p +) of the log detector block through a capacitor (AC coupled). This also is 50 ohm terminated and has a double stacked back to back diode to protect the device input pin from overvoltage.
- LOG INP- (J6) : Connects to inverting input of the LOG detector (Log i/p -). This can be used when feeding differential signal to LOG detector. The input structure is same as that of LOG INP+. To enable this connection R29 need to be connected.

2.4 Output Connectors

There are six output connectors (SMA) on the EVM.

- LNA OUT/ BPF_INPUT (J12): LNA output (LNA o/p) comes to this connector. There is also provision to disconnect the LNA output from this connector (by removing R25) and connect it to the on board Bandpass filter provision by shorting R37
- LOG output (J9): LOG detector output (LOG o/p) comes to this connector.
- BUF_OUT (J5): Non inverting Buffer output
- INV BUF OUT (J7): Inverted buffer output.
- FREQ DETECT (J4): frequency detect output. If there is a need to drive large capacitor from freq detect, it is advisable to remove R36 and populate R32, R33, C23, C25 and U3 to digitally buffer frequency detect output.
- EXT AMP OUT (J11): the output from the LOG detector can be amplified or buffered using an external amplifier U2. Output of which can be taken from this connector.

2.5 Onboard Bandpass Filter

To filter out the input noise outside the frequency of interest, a bandpass need to be added before LOG input. This can either be done by connected an external bandpass filter between LNA out (J12) and LOG input+ (J1) or using the onboard bandpass filter provided on the EVM. Note that the RLC components of BPF need to be populated by the user as per the filter center frequency and quality factor requirement. To use the onboard BPF, short R18 and R19 and open R25 and R2.

2.6 LNA and AFE Enable/Disable

If LNA or the entire AFE (LNA+LOG Detector) is not in use, then disable to save power. This can be done by pulling down the LNA_En and AFE_En pin to ground by shorting the jumper between PIN1 and PIN2 of J3 and J2, respectively. Keeping the pin floating or shorting PIN2 and PIN3 of these two jumpers keeps the two blocks enabled.

2.7 Offset Cancellation And Log In- Cap Capacitor Value Selection

The offset cancellation cap (C8) needs to be selected based on the input frequency to the system. To get the best performance, use the value as recommended in the table below.

Frequency (kHz)	Offset_cap (C8) Value (nF)
40	150
65	100
85	68
180	33
255	33
310	22
370	15
850	6.8

Note

Offset cap must never be less than 1nF.

Also, TI recommends to match the impedance of LOG IN+ and LOG IN- for the frequencies equal to or less than the supply filter cutoff frequency formed by R1 and decaps (C1||C2||C3).
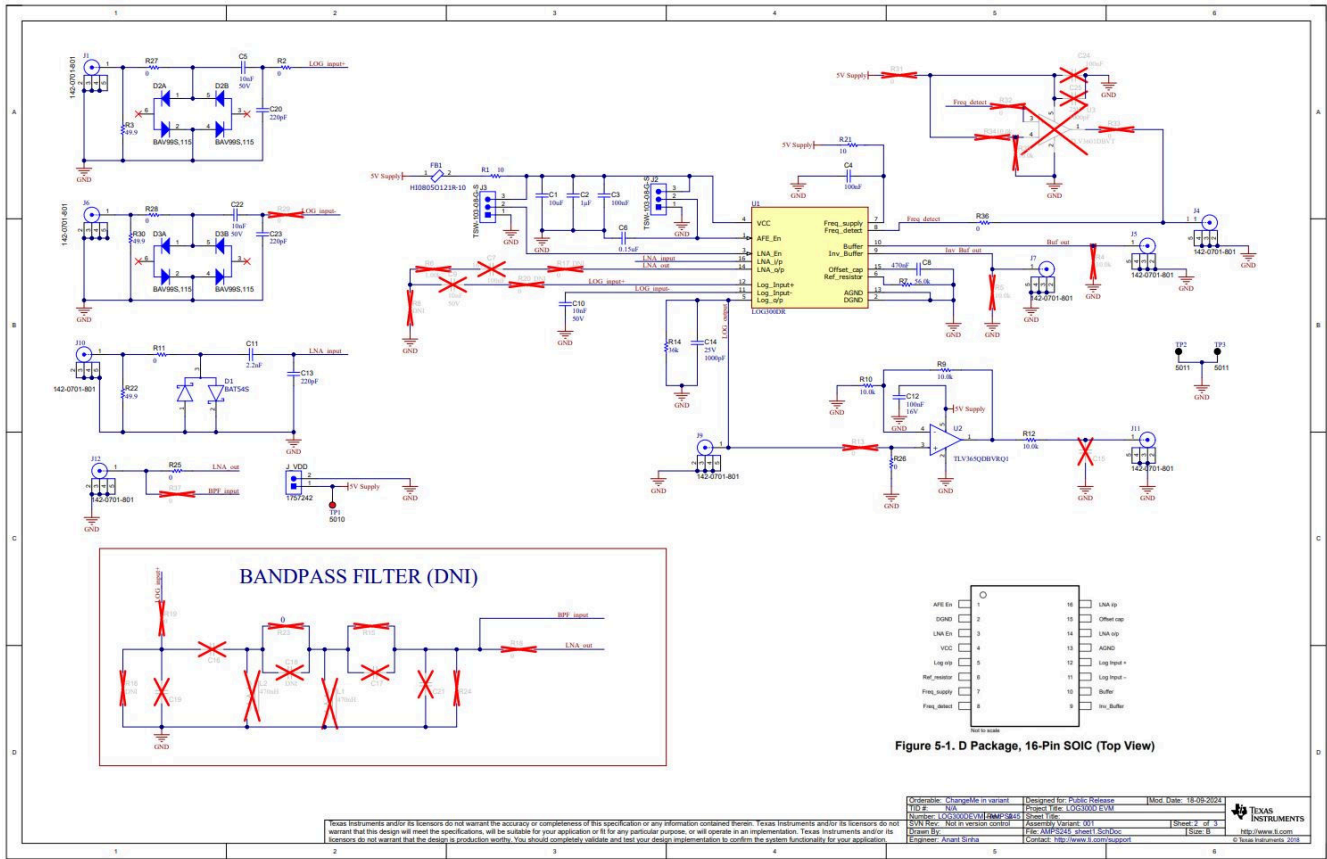
3 Hardware Design Files

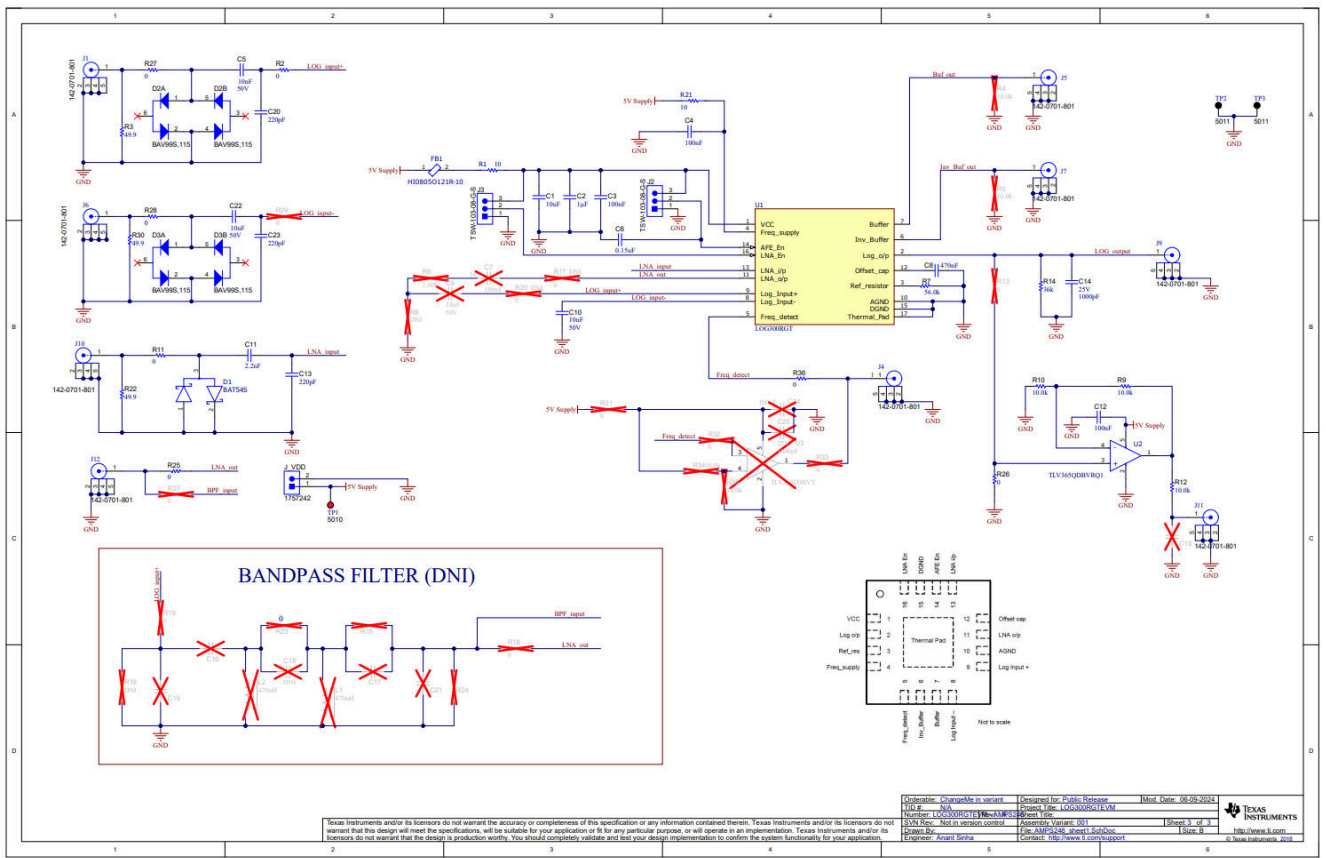## 3.1 Schematics

Figure 3-1. Schematic for LOG300DEVM

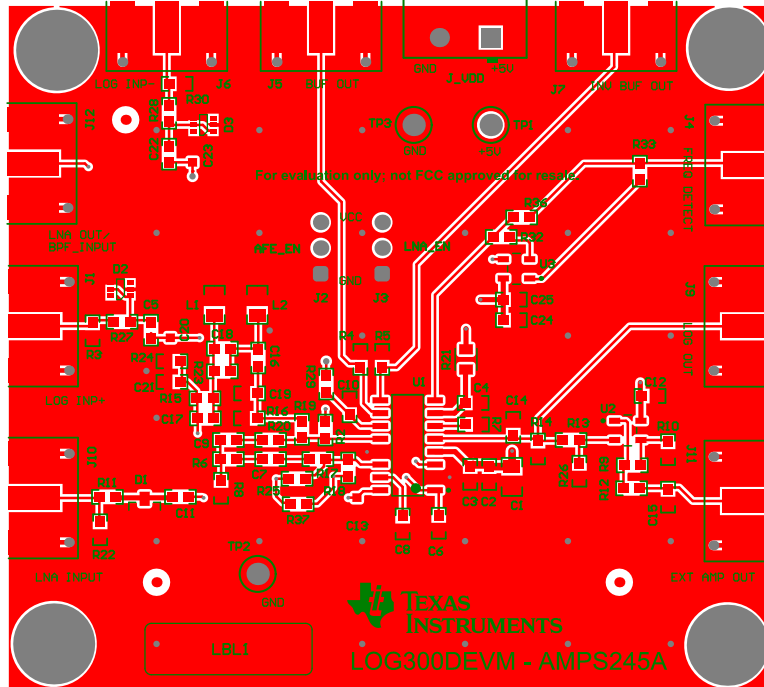**Figure 3-2. Schematic for LOG300RGTEVM**

3.2 PCB Layouts

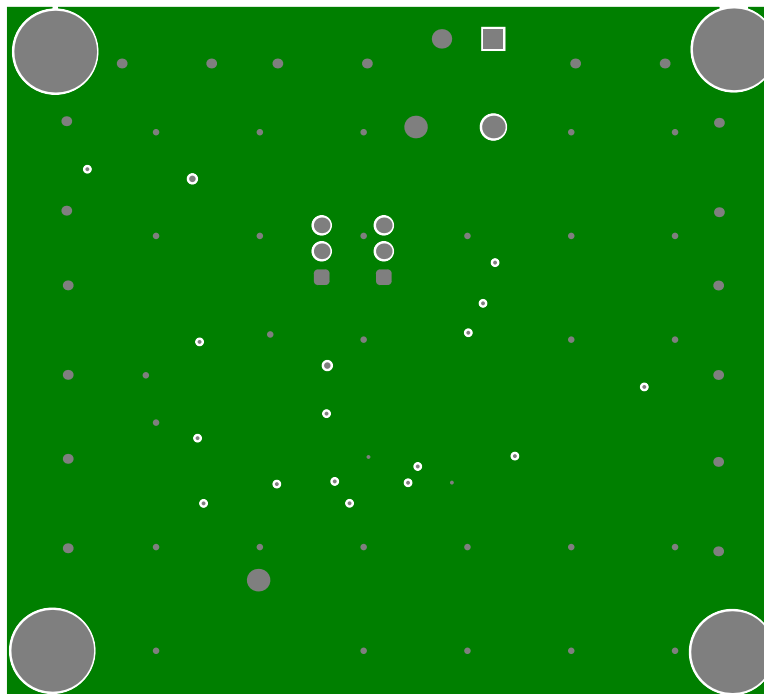**Figure 3-3. LOG300DEVM Top Layer**

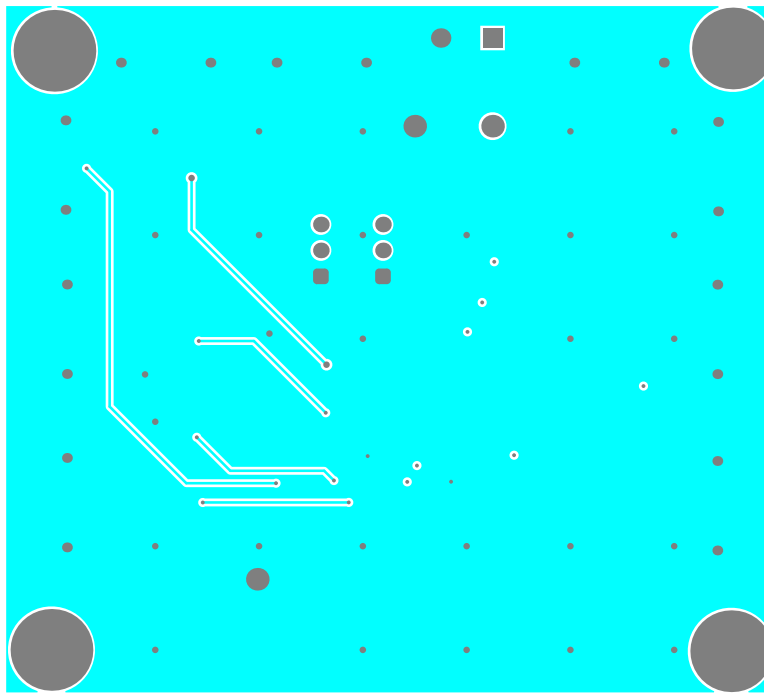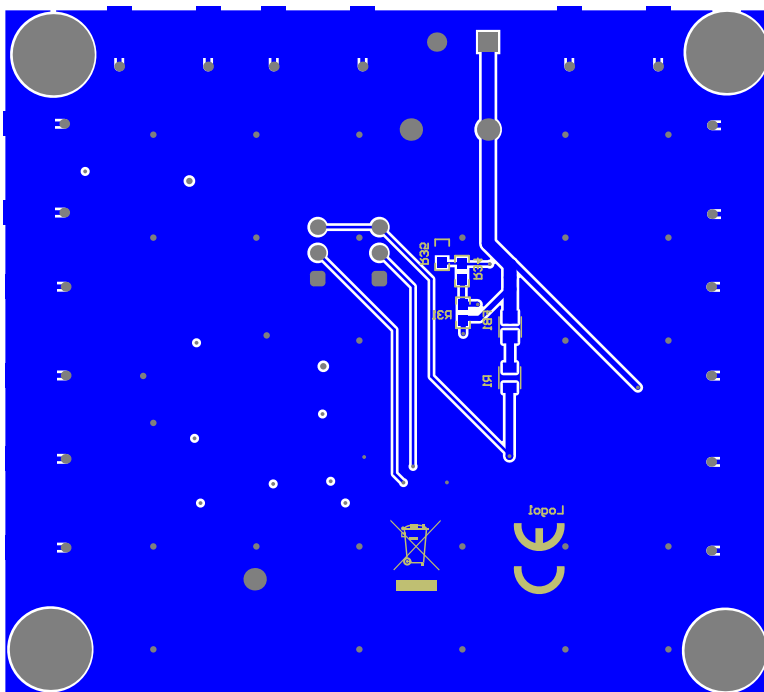**Figure 3-4. LOG300DEVM Layer 1**

Figure 3-5. LOG300DEVM Layer 2
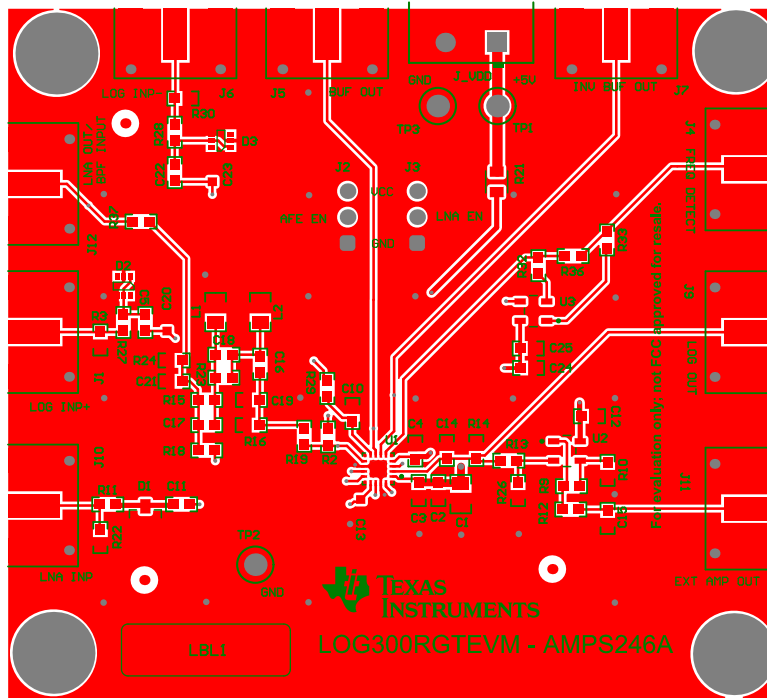

Figure 3-6. LOG300DEVM Bottom Layer

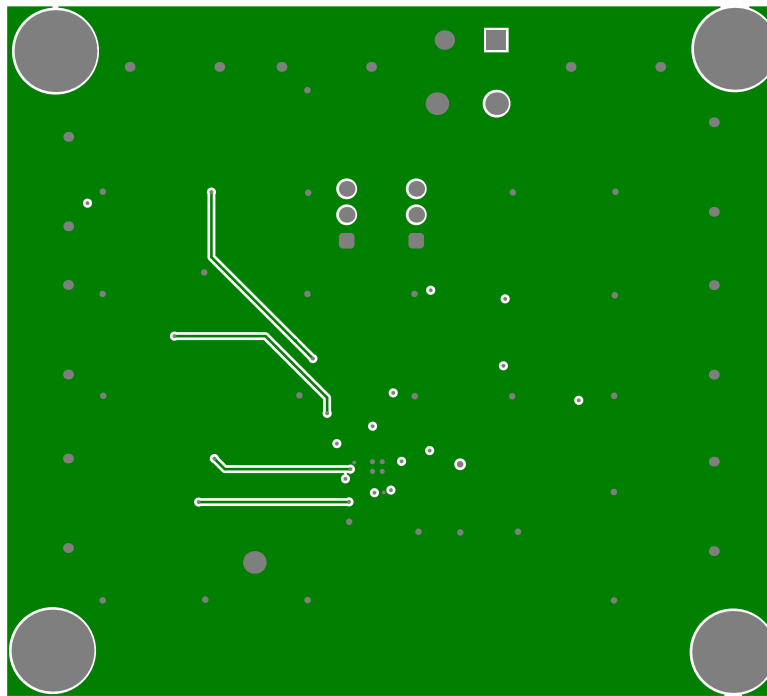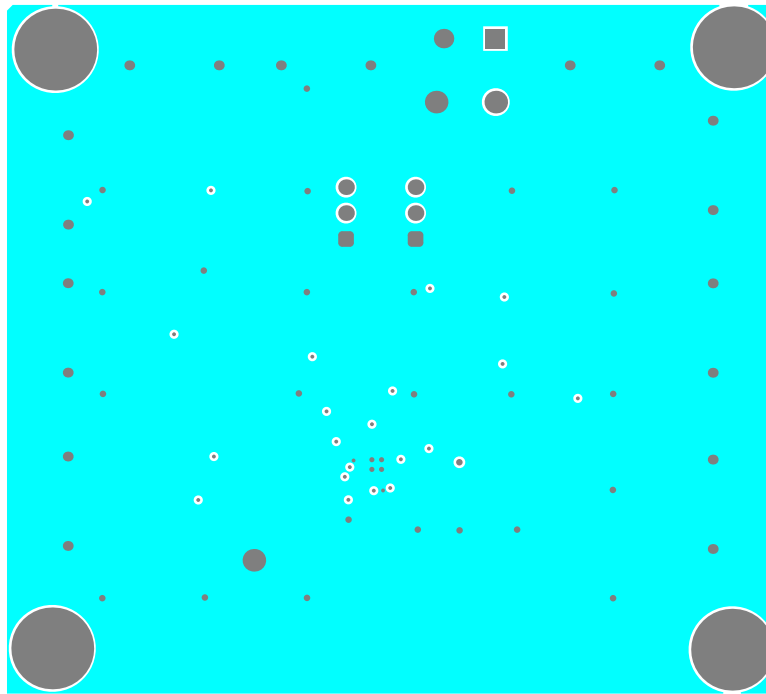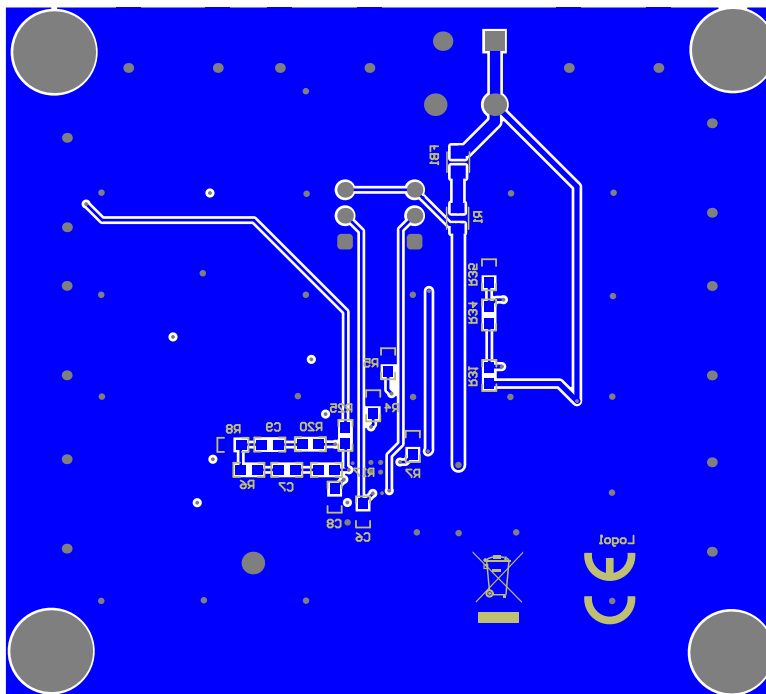**Figure 3-7. LOG300RGTEVM Top Layer**

Figure 3-8. LOG300RGTEVM Layer 1

Figure 3-9. LOG300RGTEVM Layer 2

Figure 3-10. LOG300RGTEVM Bottom Layer

3.3 Bill of Materials (BOM)

Table 3-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	Manufacturer	Package Reference
!PCB1	1		Printed Circuit Board	LOG300DEVM - AMPS245 / LOG300RGTEVM - AMPS246	Any	
C1	1	10uF	CAP, CERM, 10uF, 25V, +/- 10%, X5R, 0805	TMK212BBJ106KG-T	Taiyo Yuden	0805
C2	1	1uF	CAP, CERM, 1µF, 16V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	EMK107B7105KAHT	Taiyo Yuden	0603
C3, C4, C12	3	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R71C104KA37J	MuRata	0603
C5, C10, C22	3	0.01uF	CAP, CERM, 0.01uF, 50V, +/- 10%, X7R, 0603	GRM188R71H103KA01D	MuRata	0603
C6	1	0.15uF	CAP, CERM, 0.15uF, 50V, +/- 10%, X5R, 0603	C1608X5R1H154K080AB	TDK	0603
C8	1	0.47uF	CAP, CERM, 0.47uF, 10V, +/- 10%, X7R, 0603	C0603C474K8RACTU	Kemet	0603
C11	1	2200pF	CAP, CERM, 2200pF, 25V, +/- 10%, X7R, 0603	GRM188R71E222KA01D	MuRata	0603
C13, C20, C23	3		CAP CER 220PF 50V X7R 0603 AUTO	C0603Y221K5RACAUTO	Kemet	0603
C14	1	1000pF	CAP, CERM, 1000pF, 25V,+/- 1%, C0G/NP0, 0603	C0603C102F3GACTU	Kemet	0603
D1	1		Diode Array 1 Pair Series Connection Schottky 30V 200mA Surface Mount TO-236-3, SC-59, SOT-23-3	BAT54S	ON Semi	SOT23
D2, D3	2	100V	Diode, Switching, 100V, 0.2A, SOT-363	BAV99S,115	Nexperia	SOT-363
FB1	1		120 Ohms at 100MHz 1 Power, Signal Line Ferrite Bead 0805 (2012 Metric) 4A 20mOhm	HI0805O121R-10	Laird	0805
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply	Screw
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone	Standoff
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	SJ-5303 (CLEAR)	3M	Transparent Bumpon
J1, J4, J5, J6, J7, J9, J10, J11, J12	9		Connector, End launch SMA, 50 ohm, SMT	142-0701-801	Cinch Connectivity	End Launch SMA
J2, J3	2		Header, 2.54mm, 3x1, Gold, TH	TSW-103-08-G-S	Samtec	Header, 2.54mm, 3x1, TH
J_VDD	1		Header (Shrouded), 5.08mm, 2x1, Tin, R/A, TH	1757242	Phoenix Contact	Header, 5.08mm, 2x1, R/A, TH
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady	PCB Label 0.650 x 0.200 inch
R1, R21	2	10	Res Thin Film 0805 10 Ohm 0.1% 0.25W(1/4W) ±25ppm/C Pad SMD Medical T/R	2-1625868-7	TE Connectivity	0805
R2, R11, R25, R26, R27, R28, R36	7	0	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	PMR03EZPJ000	Rohm	0603
R3, R22, R30	3	49.9	RES, 49.9, 0.1%, 0.1 W, 0603	RT0603BRD0749R9L	Yageo America	0603

Table 3-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	Manufacturer	Package Reference
R7	1	56.0k	RES, 56.0 k, 0.1%, 0.1 W, 0603	RG1608P-563-B-T5	Susumu Co Ltd	0603
R9, R10, R12	3	10.0k	RES, 10.0 k, 0.1%, 0.1 W, 0603	RG1608P-103-B-T5	Susumu Co Ltd	0603
R14	1	36k	RES, 36 k, 5%, 0.1 W, 0603	RC0603JR-0736KL	Yageo America	0603
TP1	1		Test Point, Multipurpose, Red, TH	5010	Keystone Electronics	Red Multipurpose Testpoint
TP2, TP3	2		Test Point, Multipurpose, Black, TH	5011	Keystone Electronics	Black Multipurpose Testpoint
U1	1		80MHz, Logarithmic Detector With Integrated Low-Noise Amplifier	LOG300DR / LOG300RGT	Texas Instruments	SOIC16 / VQFN16
U2	1		Automotive 50MHz single-supply operational amplifier with rail-to-rail input and output 5-SOT-23 -40 to 125	TLV365QDBVRQ1	Texas Instruments	SOT23-5
C7, C24	0	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R71C104KA37J	MuRata	0603
C9	0	0.01uF	CAP, CERM, 0.01uF, 50V, +/- 10%, X7R, 0603	GRM188R71H103KA01D	MuRata	0603
C15	0	2200pF	CAP, CERM, 2200pF, 25V, +/- 10%, X7R, 0603	GRM188R71E222KA01D	MuRata	0603
C16, C19	0	4700pF	CAP, CERM, 4700pF, 100V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R72A472KA37D	MuRata	0603
C17, C18, C21	0	3300pF	CAP, CERM, 3300pF, 50V,+/- 10%, X7R, 0603	8.85012E+11	Wurth Elektronik	0603
C25	0	1000pF	CAP, CERM, 1000pF, 25V,+/- 1%, C0G/NP0, 0603	C0603C102F3GACTU	Kemet	0603
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
L1, L2	0	470nH	Inductor, Multilayer, Ferrite, 470nH, 1.1A, 0.12 ohm, SMD	LQM21PNR47MC0D	MuRata	0805
R4, R5, R34, R35	0	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	ERJ-3EKF1002V	Panasonic	0603
R6	0	1.00k	RES, 1.00 k, 0.1%, 0.1 W, 0603	RT0603BRD071KL	Yageo America	0603
R8, R15, R16, R23, R24	0	1.00k	RES, 1.00 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	ERA3AEB102V	Panasonic	0603
R13, R17, R18, R19, R20, R29, R31, R32, R33, R37	0	0	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	PMR03EZPJ000	Rohm	0603
U3	0		2.5ns high-speed rail-to-rail comparator with push-pull outputs 5-SOT-23 -40 to 125	TLV3601DBVT	Texas Instruments	SOT23-5

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

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

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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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの

措置を取っていただく必要がありますのでご注意ください。

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。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ

ンスツルメンツ株式会社

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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.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

    8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

    8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

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.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE AND DISCLAIMER