EVM User's Guide: CDC6CEVM

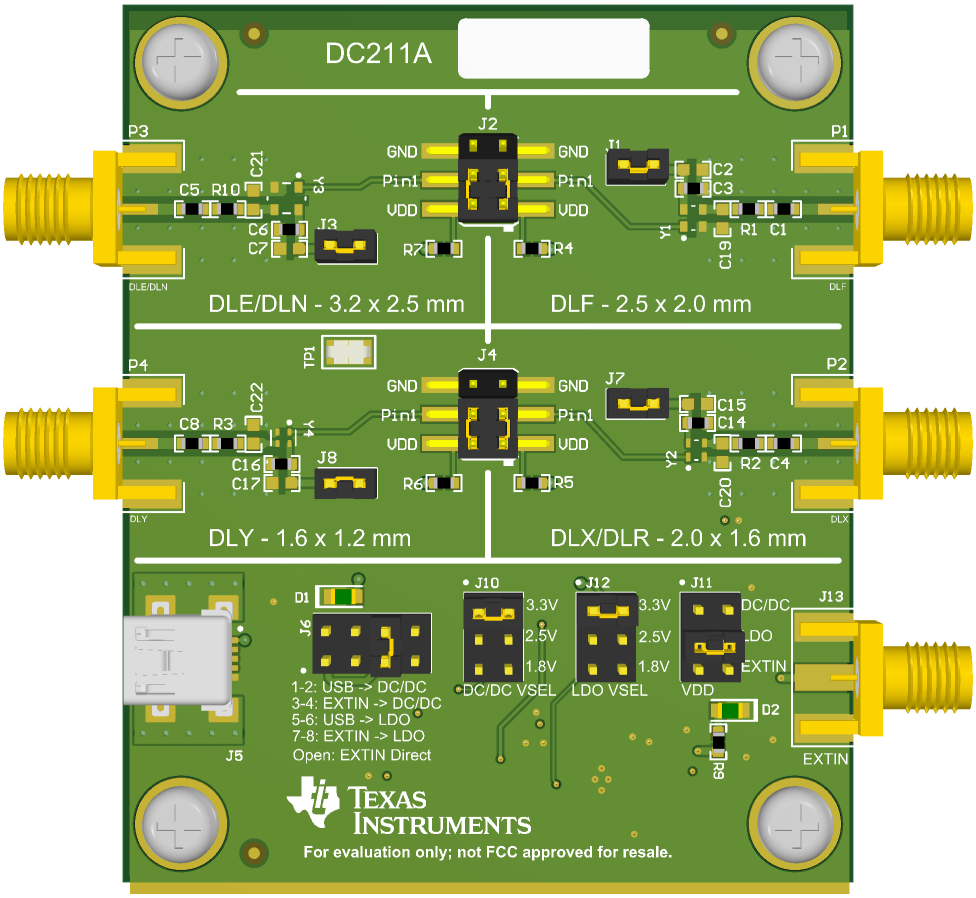
CDC6CEVM User's Guide

1 Description

The CDC6EVM provides a complete evaluation platform to evaluate the clock performance and flexibility of the Texas Instruments CDC6C low power, LVCMOS BAW Oscillator family. This EVM can be used as a flexible clock source for compliance testing, performance evaluation, and initial system prototyping. The onboard edge-launch SMA ports provide access to the configurable clock output of the CDC6C, which allows the device to interface with test equipment and reference boards using commercially available coaxial cables, adapters, or baluns (not included).

2 Features

- Contains footprints for four standard LVCMOS oscillator packages: DLE/DLN (3.2mm × 2.5mm), DLF (2.5mm × 2.0mm), DLX/DLR (2.0mm × 1.6mm), and DLY (1.6mm × 1.2mm)
- Onboard voltage regulators to generate standard supply voltages (1.8V, 2.5V, 3.3V)
- Can be powered using USB only, option for external power supply



CDC6CEVM Evaluation Board

3 Evaluation Module Overview

3.1 Introduction

The CDC6C is an LVCMOS high-performance clock oscillator using TI's BAW technology. The CDC6C is available in four package sizes: DLE/DLN (3.2mm × 2.5mm), DLF (2.5mm × 2.0mm), DLX/DLR (2.0mm × 1.6mm), and DLY (1.6mm × 1.2mm). All four footprints are included on the EVM with independent termination networks. By default the CDC6CEVM is populated with a 25MHz variant of CDC6C with a DLE package size. The DLF, DLX, and DLY footprints are left unpopulated by default so the user can solder the desired frequency variant for evaluation.

The CDC6CEVM can be powered entirely using USB and the onboard voltage regulators. An external power supply can also be used for evaluation.

To begin evaluating the CDC6C BAW oscillator, use an SMA coaxial cable to connect one of the clock outputs to test equipment such an oscilloscope or phase noise analyzer, or use the output directly as a clock source for another reference board.

3.2 Kit Contents

The box contains:

- One CDC6CEVM board (DC211A)

3.3 Specifications

- Supports standard frequencies from 1MHz to 200MHz
- ±50ppm total frequency stability inclusive of all factors, including 10 years aging
- Low power consumption: 5.7mA typical at 25MHz
- Low jitter: < 1ps RMS jitter for Fout ≥ 10 MHz
- Operating temperature range of -40°C to +105°C

4 Implementation Results

4.1 Evaluation Setup Requirement

The evaluation requires the following hardware:

- DC power supply or USB power supply
- Oscilloscope
- Signal analyzer (optional)

4.2 Setup

4.2.1 Connection Diagram

Figure 4-1 shows the CDC6CEVM (DCC211A) connection diagram. The top region of the board contains 4 quadrants, one for each package size. Each quadrant contains a footprint to populate a CDC6C oscillator (Y1, Y2, Y3, Y4), a jumper to pull the OE pin high or low (J2, J4), and an output termination network with an SMA connector (P1, P2, P3, P4).

The bottom region of the board contains jumpers for configuring the power supply network. Input power can be provided with the included USB cable, or with an external supply connected to the EXTIN SMA connector.

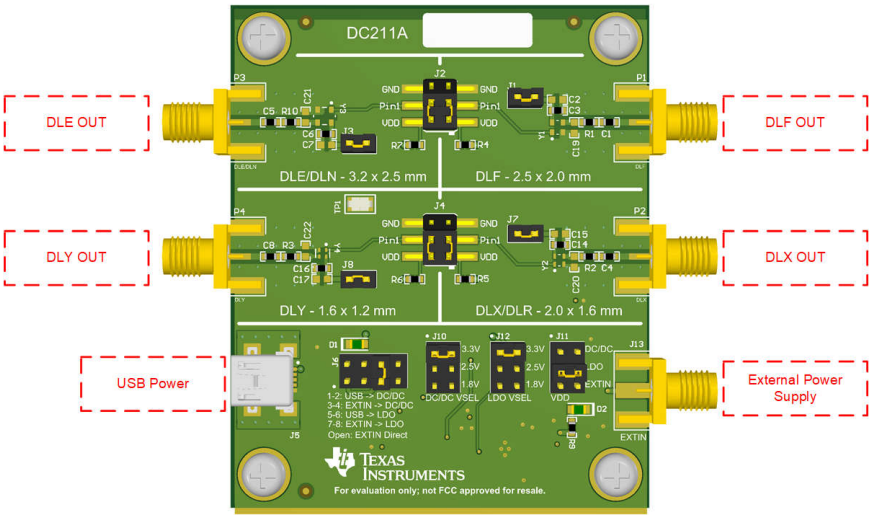


Figure 4-1. Connection Diagram

4.2.2 Power Supply

Set the jumpers according to the table below.

Table 4-1. Power Supply Jumper Configuration

Input Source	Voltage Regulator	Pins to Short on J6	Pins to Short on J11
5V USB	DC/DC Buck Converter	1-2	1-2
	LDO	5-6	3-4
EXTIN	DC/DC Buck Converter	3-4	1-2
	LDO	7-8	3-4
	Bypass	open	5-6

To use one of the onboard voltage regulators, apply between 3.6V and 5V to the EXTIN SMA connector (J13), or supply 5V using the mini USB connector. The voltage regulator provides 1.8V, 2.5V, or 3.3V to the CDC6C devices based on the jumper selection on J10 or J12.

To bypass the onboard voltage regulators and use an external supply directly, remove the jumper from J6 and short pins 5-6 on J11.

4.2.3 Clock Output

To test the clock output of Y1, connect the P1 SMA connector to an oscilloscope or phase noise analyzer. Similarly, to test the clock output of Y2, Y3, or Y4, connect P2, P3, or P4, respectively, to an oscilloscope or phase noise analyzer.

4.2.4 EVM Header Configuration

Table 4-2 summarizes the EVM header configurations to connect and route power to the VDD domains of the individual devices, in addition to the individual output enable (OE) or standby pins depending on the device populated.

Table 4-2. EVM Header Configurations

Component	Name	Description
J6, J11	VDD	**VDD Supply Voltage Source** J6: Tie pins 5-6 (default) J11: Tie pins 3-4 (default) By default, VDD is sourced from USB power supply and onboard LDO See Table 4-1 for more details
J10, J12	VDD_Reg	**VDD_Reg Voltage Level** Tie pins 1-2 (default): Selects VDD = 3.3V Tie pins 3-4: Selects VDD = 2.5V Tie pins 5-6: Selects VDD = 1.8V
J2	DLE/DLN and DLF OE	**CDC6C DLF (Y1) OE** Tie pins 1-3 (default): Pull CDC6CDLF OE to VDD Tie pins 3-5: Pull CDC6C DLF (Y1) OE to GND **CDC6C DLE/DLN (Y3) OE** Tie pins 2-4 (default): Pull CDC6C DLE/DLN (Y3) OE to VDD Tie pins 4-6: Pull CDC6C DLE/DLN (Y3) OE to GND
J4	DLX and DLY OE	**CDC6C DLX (Y2) OE** Tie pins 1-3 (default): Pull CDC6C DLX (Y2) OE to VDD Tie pins 3-5: Pull CDC6C DLX (Y2) OE to GND **CDC6C DLY (Y4) OE** Tie pins 2-4 (default): Pull CDC6C DLY (Y4) OE to VDD Tie pins 4-6: Pull CDC6C DLY (Y4) OE to GND
J1	VDD_DLF	**DLF VDD Supply** Tie pins 1-2 (default): Connect VDD to CDC6C DLF (Y1) Leave open: Disconnect VDD from CDC6C DLF (Y1)

Table 4-2. EVM Header Configurations (continued)

Component	Name	Description
J3	VDD_DLE	**DLE/DLN VDD Supply** Tie pins 1-2 (default): Connect VDD to CDC6C DLE/DLN (Y3) Leave open: Disconnect VDD from CDC6C DLE/DLN (Y3)
J7	VDD_DLX	**DLX VDD Supply** Tie pins 1-2 (default): Connect VDD to CDC6C DLX (Y2) Leave open: Disconnect VDD from CDC6C DLX (Y2)
J8	VDD_DLY	**DLY VDD Supply** Tie pins 1-2 (default): Connect VDD to CDC6C DLY (Y4) Leave open: Disconnect VDD from CDC6C DLY (Y4)

4.2.5 Configuring the Output Clock Termination

The CDC6CEVM comes pre-populated with an AC-coupled LVCMOS termination. The termination can be modified to support either an AC-coupled or a DC-coupled LVCMOS output format. To switch the Y1, Y2, Y3, or Y4 formats to DC-coupled, replace C1, C5, C4, and C8, respectively, with 0-ohm resistors.

4.3 Performance Data and Results

4.3.1 Typical Measurement

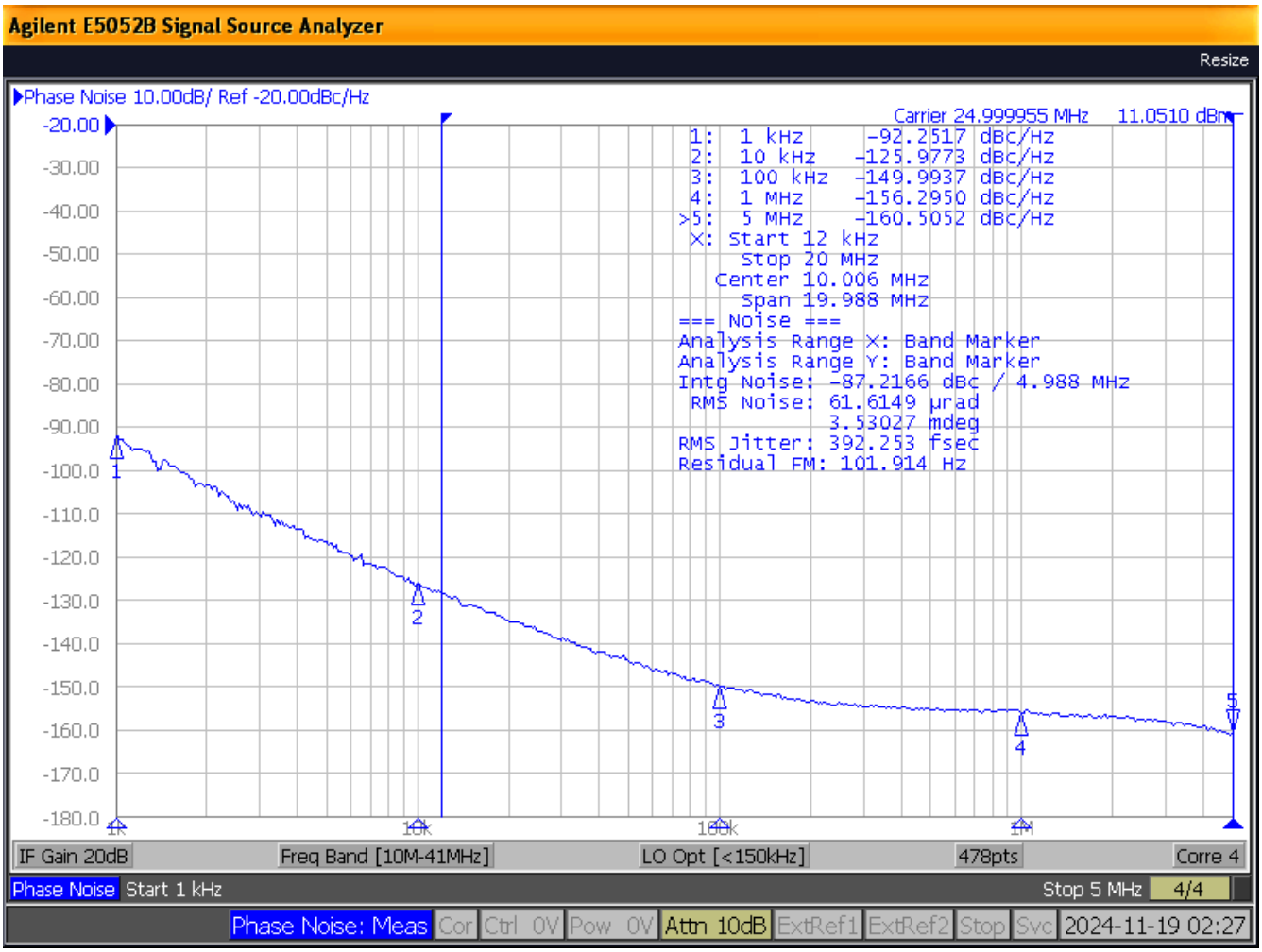


Figure 4-2. Phase Noise Plot of 25MHz CDC6C Variant

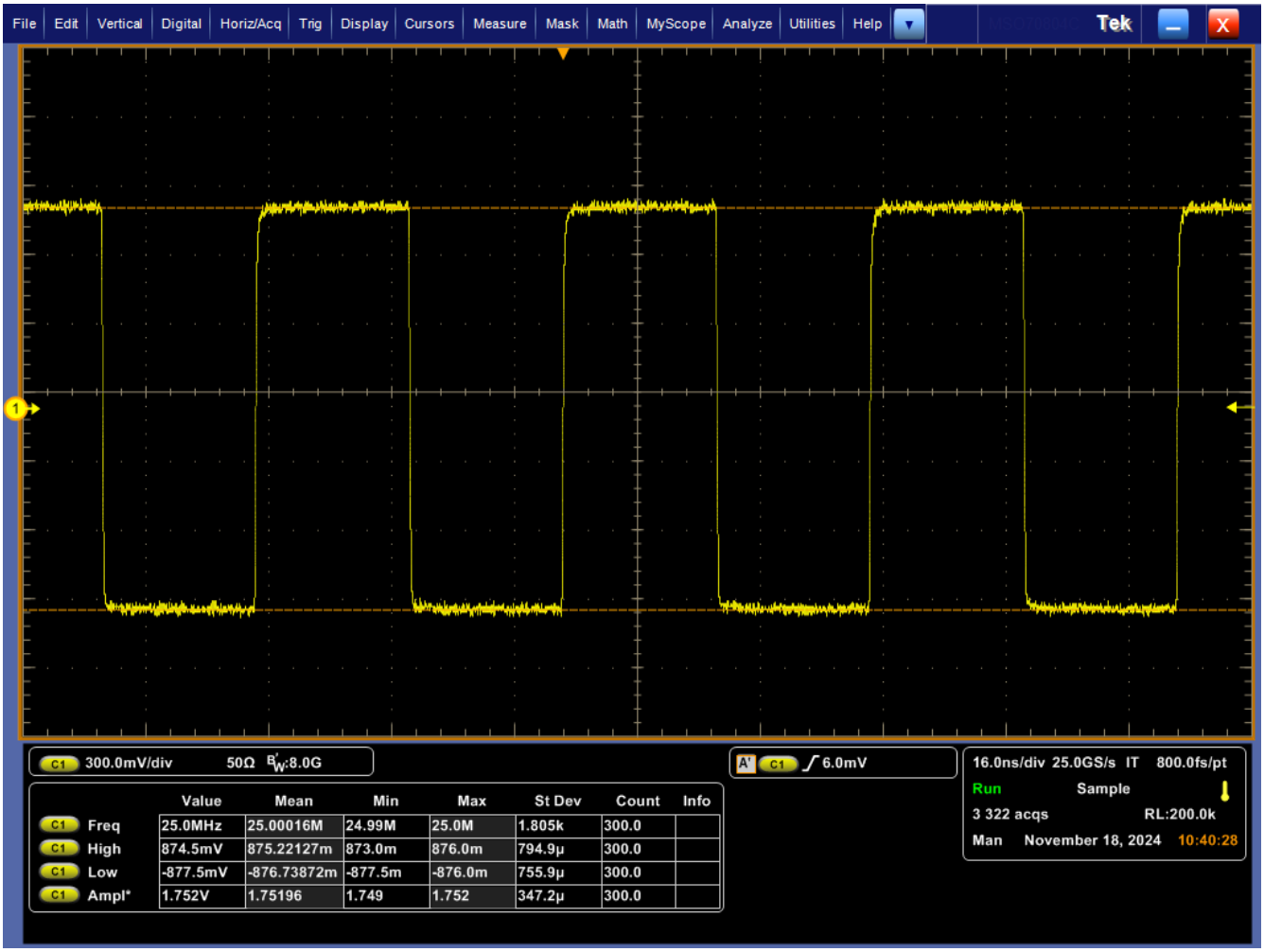


Figure 4-3. Oscilloscope Waveform of 25MHz CDC6C Variant

The output amplitude is reduced from 3.3V to around 1.75V due to the internal 50Ω termination of the oscilloscope

5 Hardware Design Files

5.1 Schematics

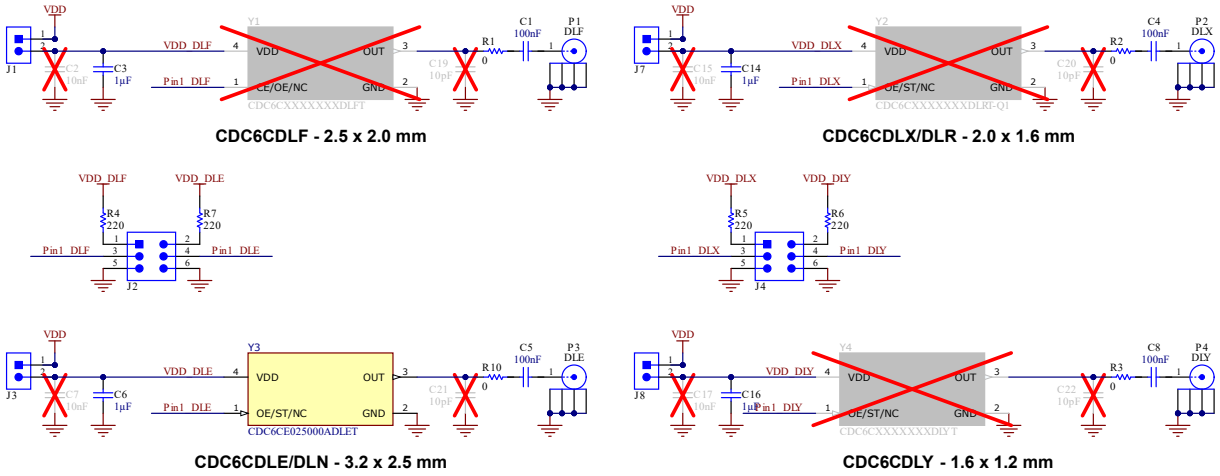


Figure 5-1. Schematic - CDC6C Oscillators

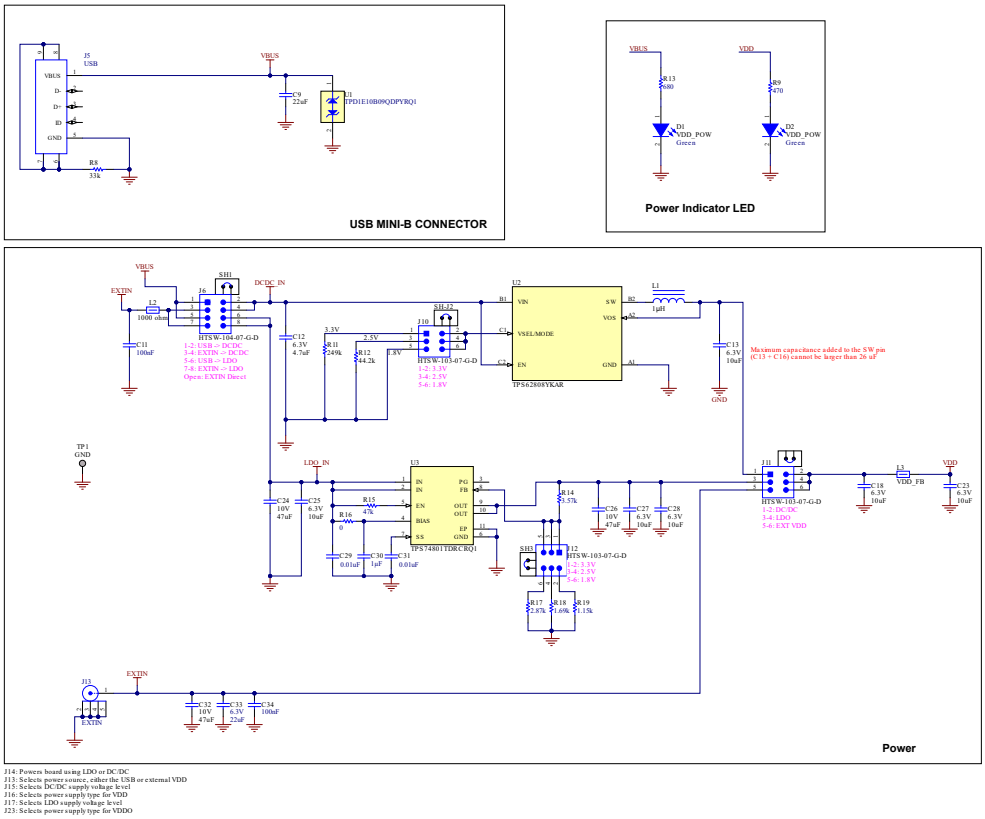


Figure 5-2. Schematic - Power Supply

5.2 PCB Layout and Layer Stack-Up

5.2.1 PCB Layer Stack-Up

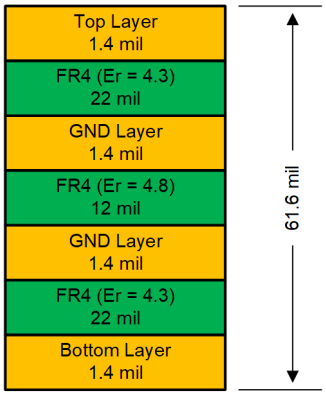


Figure 5-3. PCB Layer Stack-Up

5.2.2 PCB Layout

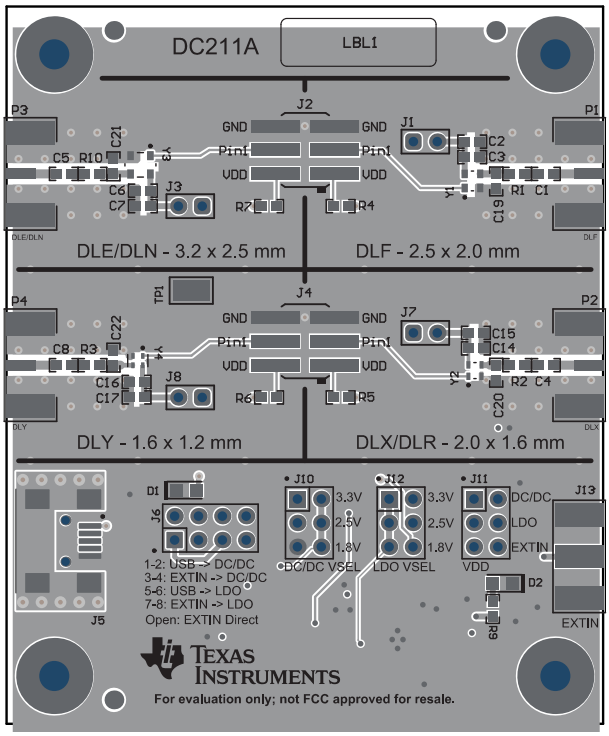


Figure 5-4. Top View Composite

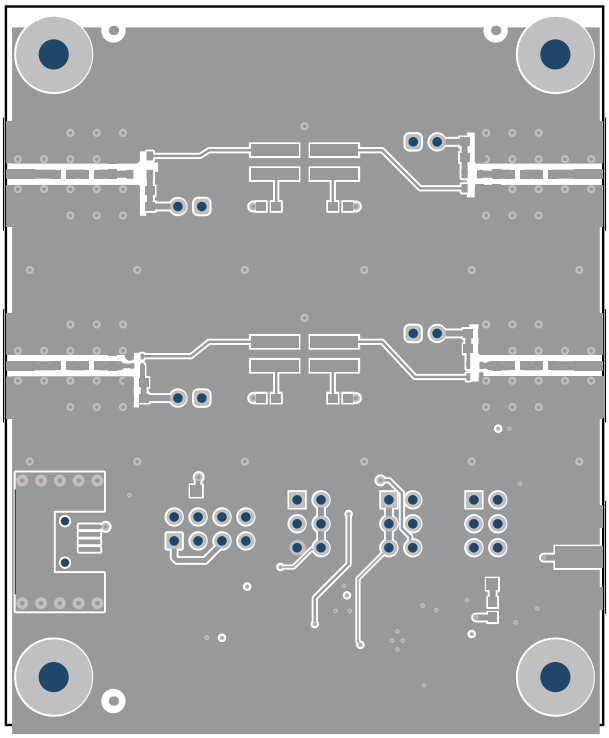


Figure 5-5. Top Layer

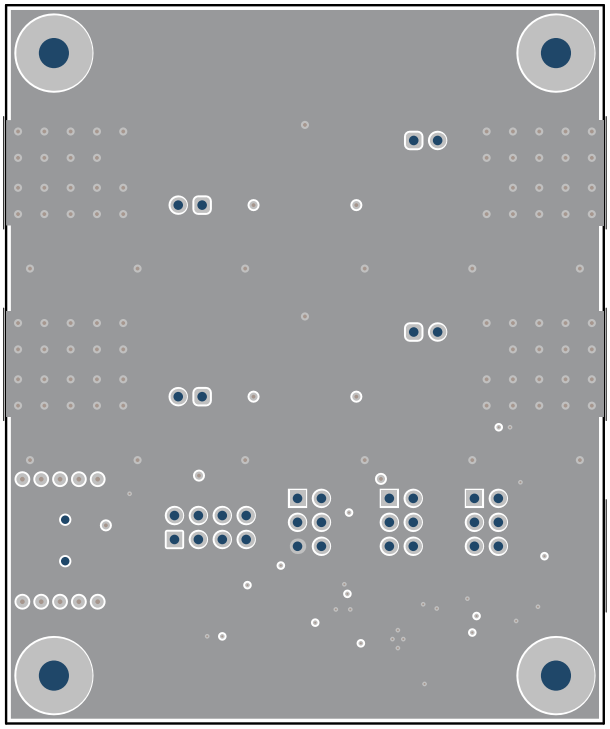


Figure 5-6. GND Layer

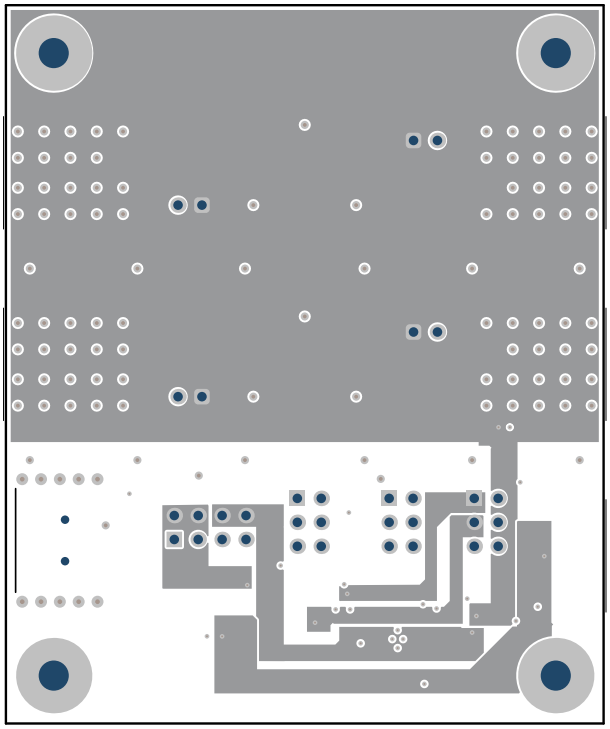


Figure 5-7. PWR Layer

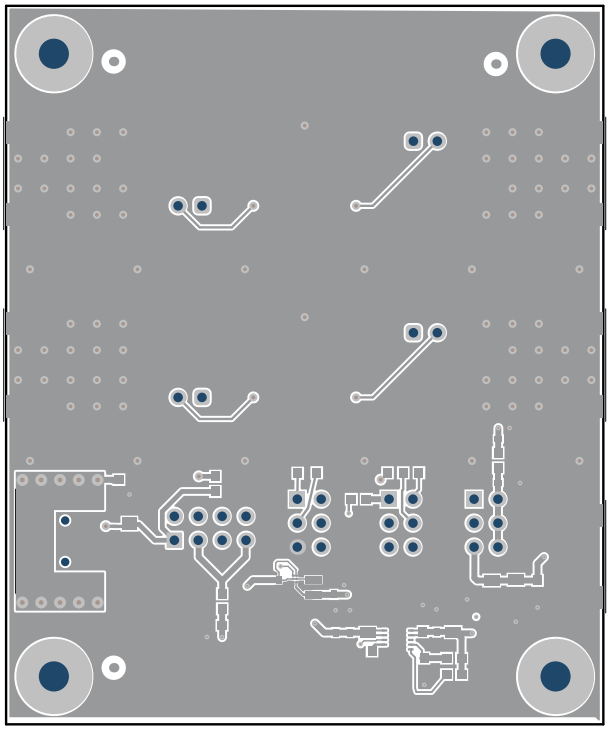


Figure 5-8. Bottom Layer

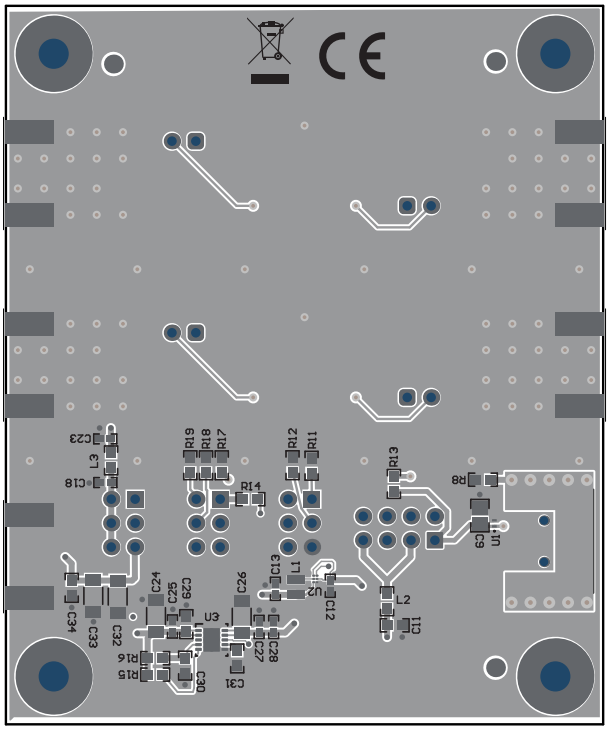


Figure 5-9. Bottom View Composite

5.3 Bill of Materials

Designator	Quantity	Value	Description	PartNumber	Manufacturer
C1, C4, C5, C8, C11, C34	6	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R71C104KA37J	MuRata
C3, C6, C14, C16, C30	5	1uF	CAP, CERM, 1 µF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	C0603C105K4RACAUTO	Kemet
C9	1	22uF	CAP, CERM, 22 uF, 10 V, +/- 20%, X5R, 0805	LMK212BJ226MG-T	Taiyo Yuden
C12	1	4.7uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0402	GRM155R60J475ME47D	MuRata
C13, C18, C23, C25, C27, C28	6	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0402	GRM155R60J106ME15D	MuRata
C24, C26, C32	3	47uF	CAP, CERM, 47 uF, 10 V, +/- 10%, X5R, AEC-Q200 Grade 1, 1206	GRT31CR61A476KE13L	MuRata
C29, C31	2	0.01uF	CAP, CERM, 0.01 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E2X7R2A103K080AA	TDK
C33	1	22uF	CAP, CERM, 22 uF, 6.3 V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	CGA5L1X7R0J226M160AC	TDK
D1, D2	2	Green	LED, Green, SMD	LTST-C171GKT	Lite-On
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
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone
J1, J3, J7, J8	4		Header, 100mil, 2x1, Gold, TH	HTSW-102-07-G-S	Samtec
J2, J4	2		Header, 2.54mm, 3x2, Gold, Black, SMT	GBC03DABN-M30	Sullins Connector Solutions
J5	1		Connector, Receptacle, Mini-USB Type B, R/A, Top Mount SMT	1734035-2	TE Connectivity

Designator	Quantity	Value	Description	PartNumber	Manufacturer
J6	1		Connector Header Through Hole 8 position 0.100" (2.54mm)	HTSW-104-07-G-D	Samtec
J10, J11, J12	3		Header, 2.54mm, 3x2, Gold, TH	HTSW-103-07-G-D	Samtec
J13, P1, P2, P3, P4	5		Connector, End launch SMA, 50 ohm, SMT	142-0701-851	Cinch Connectivity
L1	1	1uH	Inductor, Shielded, Metal Composite, 1 µH, 2.7 A, 0.057 ohm, SMD	DFE201610E-1R0M=P2	MuRata
L2	1	1000 ohm	Ferrite Bead, 1000 ohm @ 100 MHz, 0.6 A, 0603	BLM18HE102SN1D	MuRata
L3	1	750 ohm	Ferrite Bead, 750 ohm @ 100 MHz, 0.4 A, 0603	742792656	Wurth Elektronik
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R3, R10	4	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06030000Z0EA	Vishay-Dale
R4, R5, R6, R7	4	220	RES, 220, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603220RJNEA	Vishay-Dale
R8	1	33k	RES, 33 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060333K0JNEA	Vishay-Dale
R9	1	470	RES, 470, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603470RJNEA	Vishay-Dale
R11	1	249k	RES, 249 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603249KFKEA	Vishay-Dale
R12	1	44.2k	RES, 44.2 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060344K2FKEA	Vishay-Dale
R13	1	680	RES, 680, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603680RJNEA	Vishay-Dale
R14	1	3.57k	RES, 3.57 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06033K57FKEA	Vishay-Dale
R15	1	47k	RES, 47 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060347K0JNEA	Vishay-Dale
R16	1	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	ERJ-3GEY0R00V	Panasonic
R17	1	2.87k	RES, 2.87 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06032K87FKEA	Vishay-Dale
R18	1	1.69k	RES, 1.69 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06031K69FKEA	Vishay-Dale
R19	1	1.15k	RES, 1.15 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06031K15FKEA	Vishay-Dale
SH1, SH2, SH3, SH-J1, SH-J2, SH-J2A, SH-J2B, SH-J3, SH-J4A, SH-J4B, SH-J5, SH-J6	12	1x2	Shunt, 100mil, Gold plated, Black	SNT-100-BK-G	Samtec
TP1	1		Test Point, Miniature, SMT	5019	Keystone
U1	1		Automotive 1-Channel ESD in 0402 Package With 10pF Capacitance and 9V Breakdown, DPY0002A (X1SON-2)	TPD1E10B09QDPYRQ1	Texas Instruments
U2	1		600-mA, Ultra-Low IQ Step-Down Converter, YKA0006ACAC (DSBGA-6)	TPS62808YKAR	Texas Instruments

Designator	Quantity	Value	Description	PartNumber	Manufacturer
U3	1		Single Output LDO, 1.5 A, Adjustable 0.8 to 3.6 V Output, 0.8 to 5.5 V Input, with Programmable Soft Start, 10-pin SON (DRC), -40 to 105 degC, Green (RoHS & no Sb/Br)	TPS74801TDRCRQ1	Texas Instruments
Y3	1		Low Power LVCMOS output BAW Oscillator	CDC6CE025000ADLET	Texas Instruments
C2, C7, C15, C17	0	0.01uF	CAP, CERM, 0.01 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E2X7R2A103K080AA	TDK
C19, C20, C21, C22	0	10pF	CAP, CERM, 10 pF, 100 V,+/- 5%, C0G/NP0, 0603	8.85012E+11	Wurth Elektronik
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
Y1	0		High-Performance BAW Oscillator	CDC6CXXXXXXXDLFT	Texas Instruments
Y2	0		Low Power LVCMOS output BAW Oscillator	CDC6CXXXXXXXDLRT-Q1	Texas Instruments
Y4	0		Low Power LVCMOS output BAW Oscillator	CDC6CXXXXXXXDLYT	Texas Instruments

6 Additional Information

Trademarks

All trademarks are the property of their respective owners.

7 Related Documentation

See the CDC6Cx Low Power LVCMOS output BAW Oscillator Data Sheet for more information about the CDC6C devices.

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.

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.

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