

EVM User's Guide: PCM1841-Q1EVM

PCM1841-Q1 Evaluation Module



Description

The PCM1841Q1EVM-PDK evaluation module (EVM) allows the user to test the capabilities of Texas Instruments' PCM1841-Q1 device. The PCM1841-Q1 is a high-performance, Burr-Brown™ audio analog-to-digital converter (ADC) that supports simultaneous sampling of up to four analog channels. The device supports differential line and microphone inputs with 2-V_{RMS} full-scale signal. The device integrates microphone bias voltage, a phase-locked loop (PLL), a DC removal high-pass filter (HPF), and supports sample rates up to 192kHz. The device supports time-division multiplexing (TDM), I 2S, or left-justified (LJ) audio formats, selectable with the hardware pin level.

Get Started

1. Order the EVM from the [PCM1841Q1EVM-PDK](#) product page on ti.com.
2. Download the latest PCM1841-Q1 data sheet ([SBASAU2](#)).

3. Download the latest version of this user's guide.

Features

- Complete evaluation kit for the PCM1841-Q1: a stereo high performance ADC with hardware pin controls
- Powered from single 5V supply
- Jumper selection to control hardware pins
- Easy interfacing available for audio measurement tools
- On-board microphone provided for voice recording testing

Applications

- [Smart speakers](#)
- [DVD recorders and players](#)
- [AV receivers](#)
- [Video conference systems](#)
- [IP network cameras](#)



1 Evaluation Module Overview

1.1 Introduction

The PCM1841-Q1EVM is an evaluation module (EVM) designed to demonstrate the performance and functionality of the PCM1841-Q1 device. The PCM1841-Q1 is a high-performance audio analog-to-digital converter (ADC) that is configured through logic-level mode selection pins and does not require a digital interface such as I2C or SPI to configure registers. As such, no software is necessary to interface with the EVM. The EVM is powered with a single 5V supply. Access to the converter output is provided on the audio serial interface in I2S, LJ, or TDM format.

This user's guide describes the function and use of the PCM1841Q1EVM. This document includes the hardware configuration instructions, a quick-start guide, jumper and connector descriptions, schematics, and printed-circuit board (PCB) layout that demonstrate TI's recommended practices for these devices.

1.2 Kit Contents

- PCM1841-Q1 device
- PCM1841Q1EVM board

1.3 Specification

The PCM1841Q1EVM-PDK is an evaluation board to allow the user to measure the performance of the PCM1841-Q1 device. The EVM is powered off a single supply, features input terminals, test friendly output and clock terminals, and easy control over the control pins by using jumpers. Power supply options are made flexible, and a reset button is available to allow the user to replicate the end application as close as possible.

1.4 Device Information

- PCM1841-Q1, a quad-channel, 32-bit, up to 192kHz sampling, Burr-Brown Audio ADC

2 Hardware

2.1 EVM Overview

Figure 2-1 shows an overview of the system.

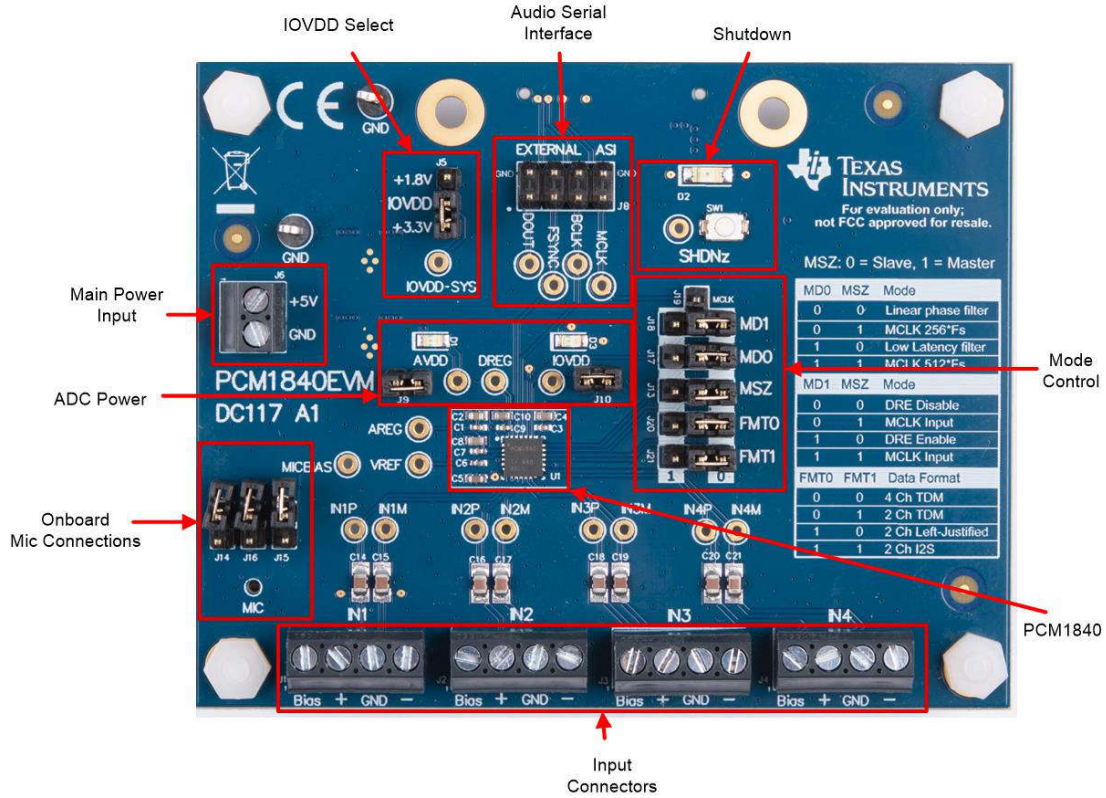


Figure 2-1. EVM Front Overview

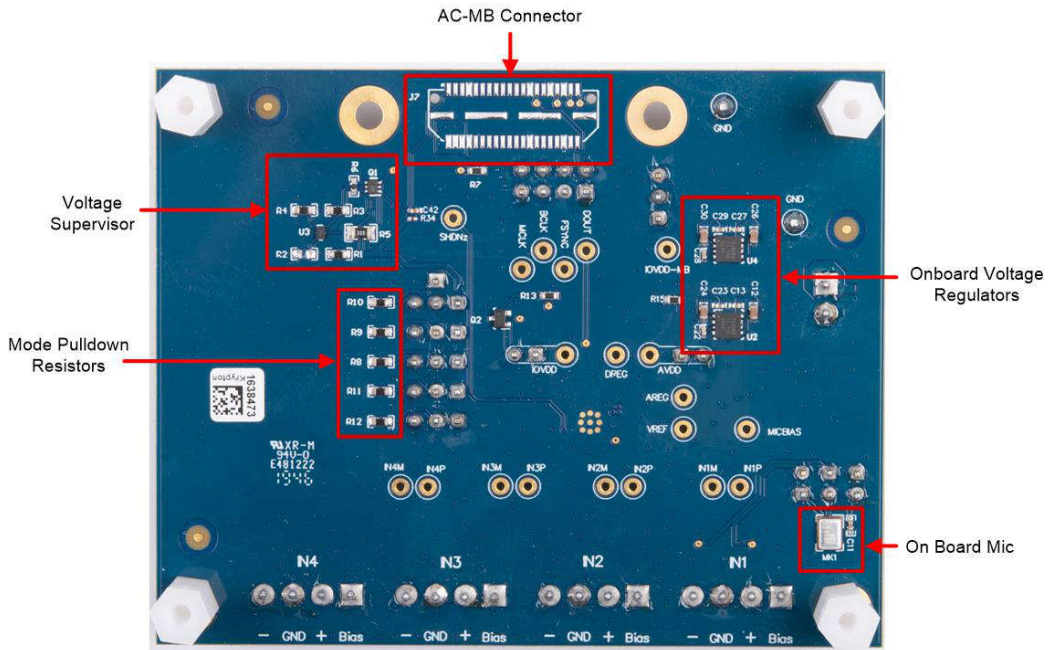


Figure 2-2. EVM Back Overview

2.2 Hardware Configuration

The format of the audio data and the operating mode of the ADC are controlled by the following pins: MD0, MD1, MSZ, FMT0, and FMT1. These signals are referenced to IOVDD and can be set to high (1) or low (0). If no shunt is installed, then a 10kΩ pulldown resistor sets the pin low so that the ADC remains in a defined state. [Table 2-1](#) shows the header numbers and the pin functions and [Table 2-2](#) shows the possible modes and output formats. The MSZ pin selects whether the device is a controller or a target on the audio bus. When MSZ is pulled high, the device is in target mode and MD1 becomes an input for MCLK. A shunt connecting J19 to the center pin of J18 routes the MCLK signal provided on J8 to the MD1 pin on the ADC to allow for easy interfacing with audio measurement equipment while in controller mode.

Table 2-1. PCM1841-Q1 EVM Headers and Jumpers

Designator	Function
J1	Differential line, microphone input 1
J2	Differential line, microphone input 2
J3	Differential line, microphone input 3
J4	Differential line, microphone input 4
J5	IOVDD-SYS voltage selection (1.8V or 3.3V)
J6	+5-V supply input
J7	Connector to AC-MB
J8	Digital audio serial interface
J9	Connect AVDD to onboard 3.3V regulator
J10	Connect IOVDD to IOVDD-SYS
J13	MSZ select
J14	Connect MICBIAS to onboard microphone
J15	Microphone OUT+ to ADC IN1P
J16	Microphone OUT- to ADC IN1M
J17	MDO select
J18	MD1 select
J19	Connect MCLK to MD1
J20	FMT0 select
J21	FMT1 select

Table 2-2. PCM1841-Q1 Hardware Controllable Settings

MD0 Modes		
MD0	MSZ (0 = target, 1 = controller)	MD0 Functional Mode
0	0	Linear phase filter
0	1	MCLK = 256 × Fs
1	0	Low latency filter
1	1	MCLK = 512 × Fs
MD1 Modes		
MD1	MSZ (0 = target, 1 = controller)	MD1 Functional Mode
0	0	DRE disabled
0	1	MCLK input
1	0	DRE enabled
1	1	MCLK input
Audio Output Data Format		
FMT0	FMT1	Data Format
0	0	4 channel TDM
0	1	2 channel TDM
1	0	2 channel left-justified
1	1	2 channel I2S

All hardware pins are tied low by default, placing the device in target mode with a linear phase filter, DRE disabled, and 4-channel TDM audio output.

For more information on the operating modes of the PCM1841-Q1 device, see the [PCM1840 Quad Channel, 32-Bit, 192kHz, Burr-Brown Audio ADC Data Sheet](#).

2.2.1 PCM1841Q1EVM Inputs

The PCM1841-Q1 device is intended to be driven with differential line inputs or microphone inputs. Each of the inputs has a 1 μ F AC coupling film capacitor. Coupled with the 2.5k Ω input impedance, this sets the high pass filter cutoff frequency at approximately 63Hz. This can be adjusted by replacing the input AC coupling capacitors on the EVM if necessary. [Figure 2-3](#) shows the architecture of the inputs to the evaluation module. The EVM supports a differential full scale input range of 2V_{RMS} with an AVDD of 3.3V.

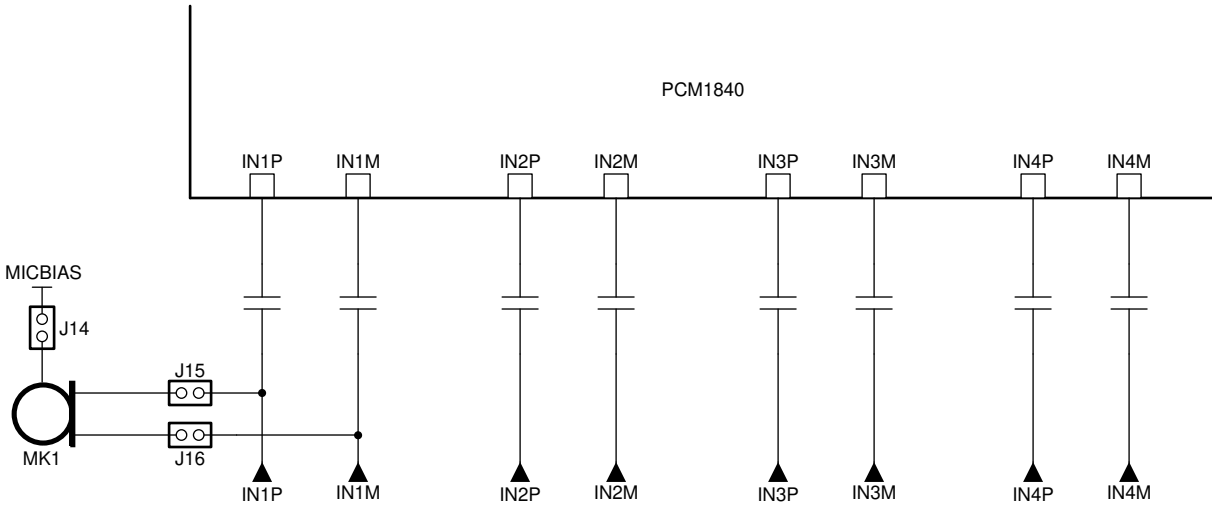


Figure 2-3. PCM1841Q1EVM Input Architecture

2.2.1.1 Line Inputs

For the line input configuration, shown in [Figure 2-4](#), the PCM1841-Q1 captures the audio signal provided through terminals J1 (IN1), J2 (IN2), J3 (IN3), and J4 (IN4). The input accepted in this mode is a differential, 2V_{RMS}, full-scale audio signal. Single-ended inputs are not supported by the PCM1841-Q1 device and the inputs must be AC coupled.

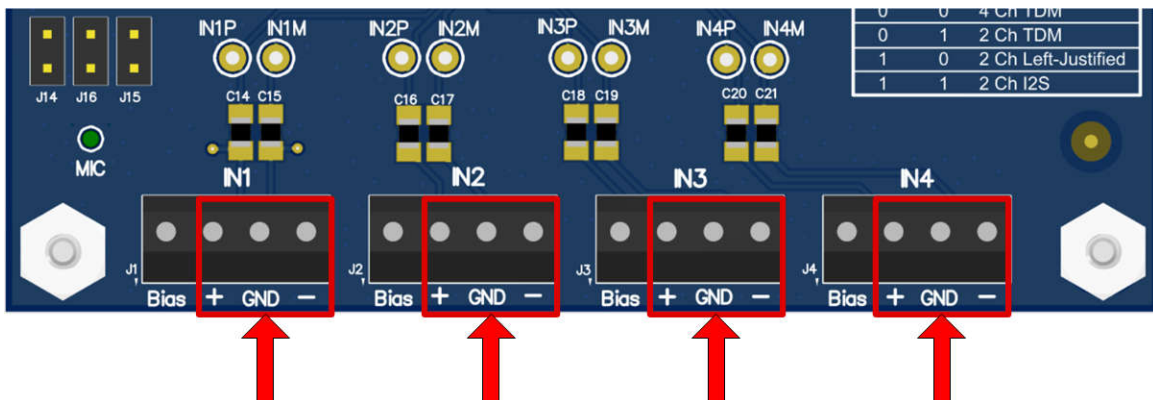


Figure 2-4. PCM1841Q1EVM Connection for Line Input Application

2.2.1.2 Onboard Microphone Input

For the onboard microphone input configuration (shown in Figure 2-5), the PCM1841Q1EVM records the audio captured from the microphone located on the bottom-left edge of the board. MICBIAS is used to power the onboard microphone through J14. J15, and J16 must be installed to connect the microphone output to the ADC inputs. There must not be any connections to J1 during onboard microphone use to preserve the performance of the microphone.

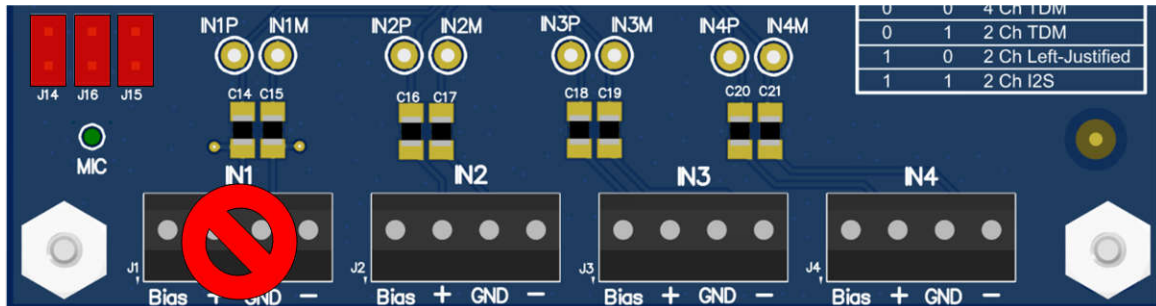


Figure 2-5. PCM1841Q1EVM Connection for the Onboard Microphone Test

2.3 Power Supply

The PCM1841Q1EVM can be powered with a single 5V power supply connected to J6. Onboard low dropout regulators convert the 5V supply to the 3.3V and 1.8V rails used by the ADC. The analog supply, AVDD, is fixed at 3.3V. The digital supply, IOVDD, can be set to either 1.8V or 3.3V with J5. A possibility is to power the ADC directly by removing J9 and J5 and applying a voltage directly to the AVDD and IOVDD test points. Note that if this is done, then this is important to keep J10 populated (or make sure there is a path between the pins if the supply current is being monitored) as this jumper connects the applied IOVDD to the mode selection pins and other circuitry that relies on IOVDD. If external supplies are used, then there is an onboard voltage supervisor, U3, that holds the ADC in shutdown until both AVDD and IOVDD have reached the respective threshold voltages. The shutdown thresholds for the supply voltages can be adjusted as shown in Equation 1 and Equation 2. The supervisor can also be removed from the shutdown logic by depopulating R5. For more information on the reset supervisor, see the *TPS37xx Dual-Channel, Low-Power, High-Accuracy Voltage Detectors* data sheet.

$$V_{MON(AVDD)} = \left(1 + \frac{R_3}{R_4}\right) \times 1.188 \quad (1)$$

$$V_{MON(IOVDD)} = \left(1 + \frac{R_1}{R_2}\right) \times 1.188 \quad (2)$$

3 Hardware Design Files

3.1 PCM1841Q1EVM Schematic

Figure 3-1 and Figure 3-2 show the schematics for the PCM1841Q1EVM.

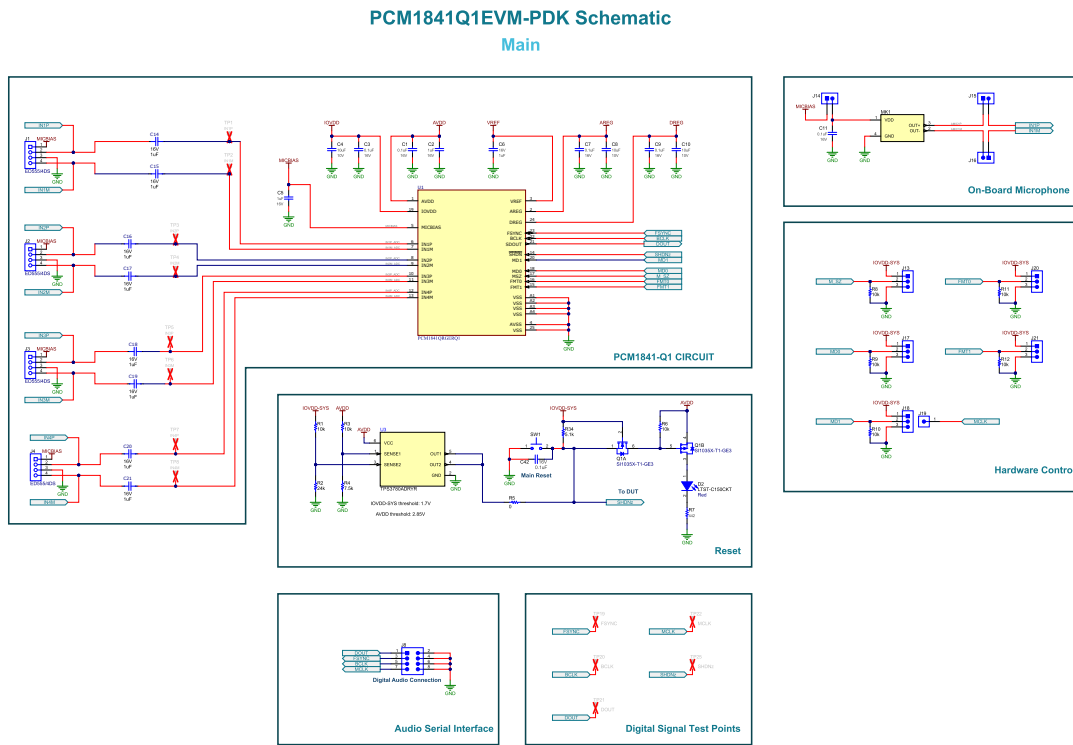


Figure 3-1. PCM1841Q1EVM Schematics - Main

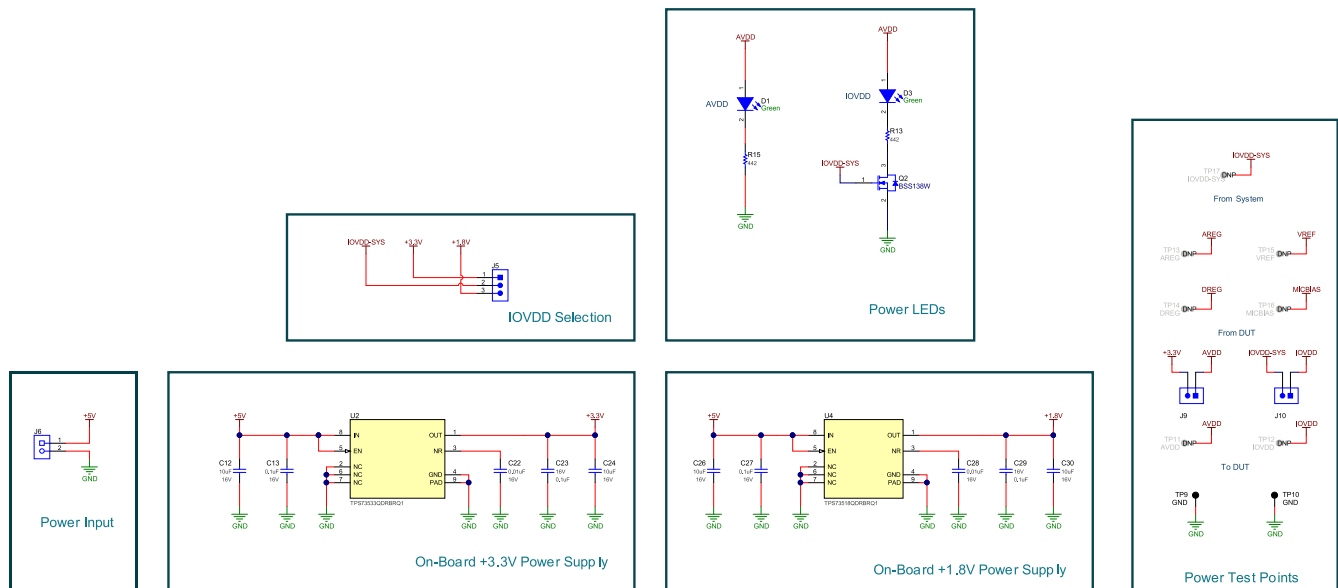


Figure 3-2. PCM1841Q1EVM Schematics - Power

3.2 PCB Layouts

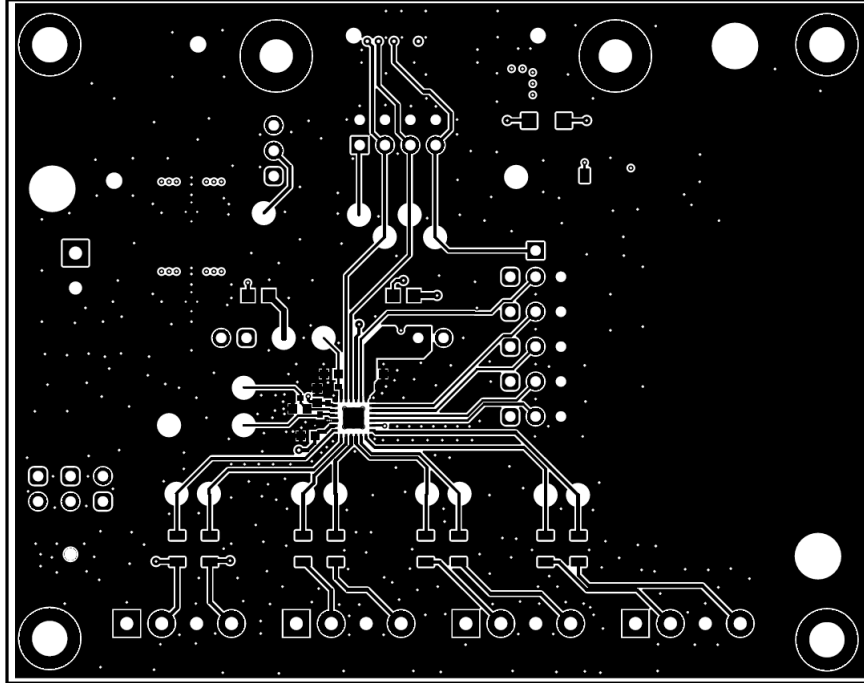


Figure 3-3. Top Layer

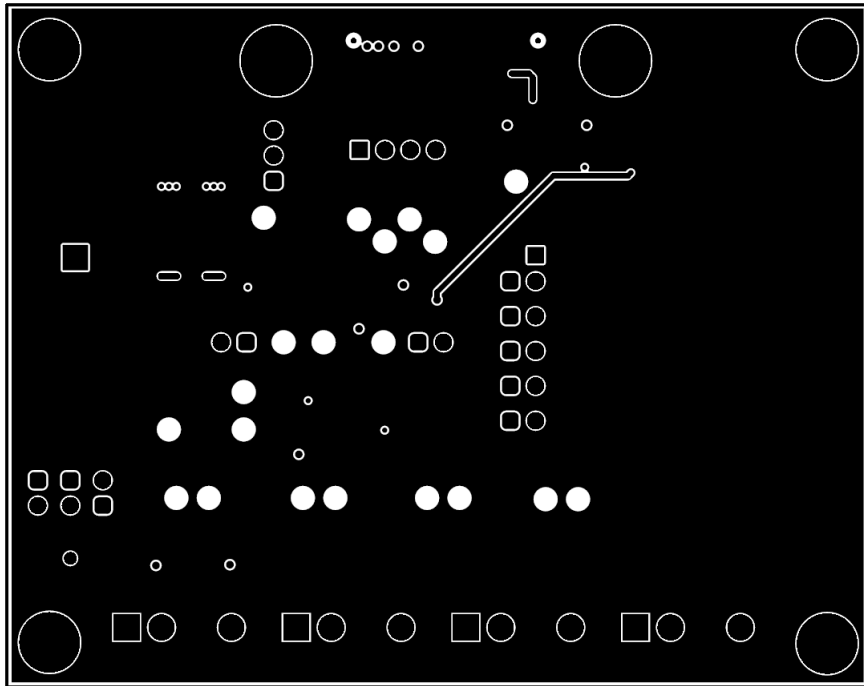


Figure 3-4. Power Plane 1

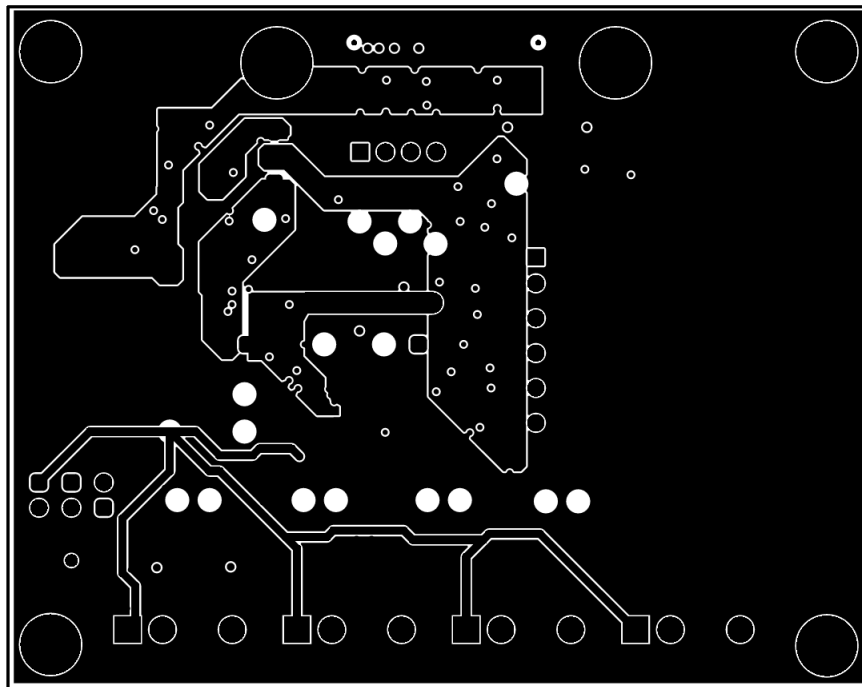


Figure 3-5. Power Plane 2

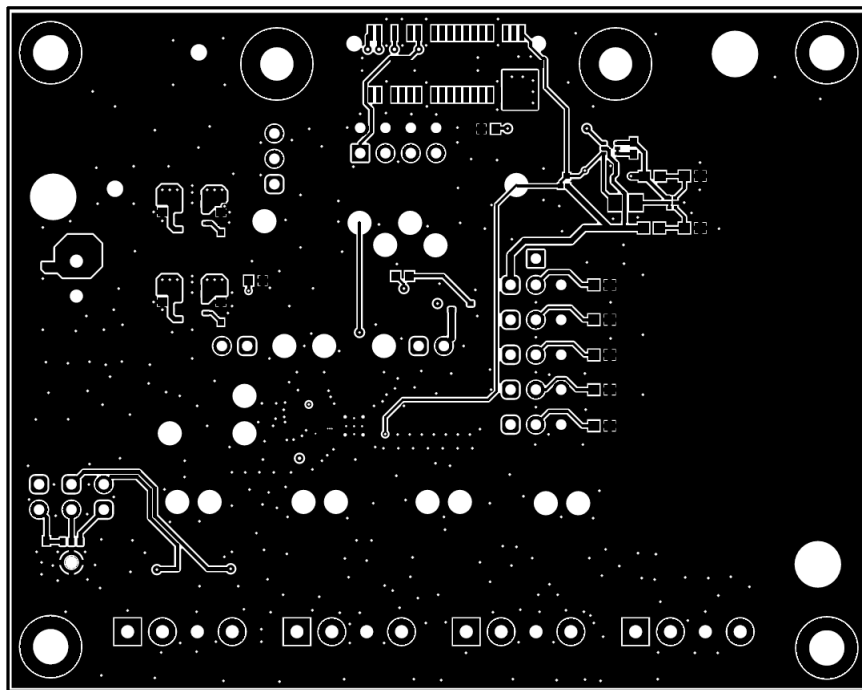


Figure 3-6. Bottom Layer

3.3 PCM1841Q1EVM Bill of Materials

Table 3-1. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		DC290	Any		
C1, C3, C7, C9, C11, C13, C23, C27, C29, C42	10	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	0402	8.85012E+11	Würth Elektronik		
C2	1	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	0603	8.85012E+11	Würth Elektronik		
C4, C8, C10	3	10uF	CAP, CERM, 10uF, 10V, +/- 20%, X5R, 0603	0603	C1608X5R1A106M080A C	TDK		
C5	1	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	0603	EMK107B7105KA-T	Taiyo Yuden		
C6	1	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X5R, 0402	0402	EMK105BJ105KVHF	Taiyo Yuden		
C12, C24, C26, C30	4	10uF	CAP, CERM, 10uF, 16V, +/- 20%, X5R, 0603	0603	EMK107BBJ106MA-T	Taiyo Yuden		
C14, C15, C16, C17, C18, C19, C20, C21	8		1µF Film Capacitor 12V 10V Acrylic, Metallized 1206 (3216 Metric)	1206	FCA1206A105M-H3	Cornell Dubilier Electronics		
C22, C28	2	0.01uF	CAP, CERM, 0.01uF, 16V, +/- 10%, X7R, 0402	0402	520L103KT16T	AT Ceramics		
D1, D3	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On		
D2	1	Red	LED, Red, SMD	1206	LTST-C150CKT	Lite-On		
H1, H2, H3, H4	4		Small nylon hex nut, 0.10 thick with a 0.250 outside diameter and a 4-40 threading	Hex Nut, 4-40 Thread, 250" Head Dia	9605	Keystone		
H5, H6, H7, H8	4		Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"	Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"	4802	Keystone		
J1, J2, J3, J4	4		Terminal Block, 3.5mm Pitch, 4x1, TH	14x8.2x6.5mm	ED555/4DS	On-Shore Technology		
J5, J13, J17, J18, J20, J21	6		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec		

Table 3-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
J6	1		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology		
J8	1		Header, 100mil, 4x2, Gold, TH	4x2 Header	TSW-104-07-G-D	Samtec		
J9, J10, J14, J15, J16	5		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec		
J19	1		Header, 100mil, 1pos, Gold, TH	Test point	TSW-101-07-G-S	Samtec		
MK1	1		Ultra-Low Noise Microphone with Differential Output, LGA-4	4x3mm, LGA	ICS-40720	InvenSense		
Q1	1	20V	MOSFET, 2-CH, N/P-CH, 20V, 0.18A, SOT-563	SOT-563	SI1035X-T1-GE3	Vishay-Siliconix		None
Q2	1	50V	MOSFET, N-CH, 50V, 0.21A, SOT-323	SOT-323	BSS138W	Fairchild Semiconductor		None
R1, R3, R8, R9, R10, R11, R12	7	10k	RES, 10 k, 5%, 0.1 W, 0603	0603	CRCW060310K0JNEA	Vishay-Dale		
R2	1	24k	RES, 24 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060324K0JNEA	Vishay-Dale		
R4	1	7.5k	RES, 7.5 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06037K50JNEA	Vishay-Dale		
R5	1	0	RES, 0, 5%, 0.125 W, 0805	0805	CRCW08050000Z0EA	Vishay-Dale		
R6	1	10k	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale		
R7, R13, R15	3	442	RES, 442, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603442RFKEA	Vishay-Dale		
R34	1	5.1k	RES, 5.1 k, 5%, 0.05 W, 0201	0201	RC0201JR-075K1L	Yageo America		
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11	11	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M
SW1	1		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
TP9, TP10	2		Test Point, Multipurpose, Black, TH	Black Multipurpose Test point	5011	Keystone		

Table 3-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
U1	1		Quad Channel, 32Bit, 19kHz, Burr-Brown Audio ADC	VQFN24	PCM1841QRGERQ1	Texas Instruments		
U2	1		500mA, Low Quiescent Current, Low-Noise, High PSRR, Low-Dropout Linear Regulator for Automotive, DRB0008B (VSON-8)	DRB0008B	TPS73533QDRBRQ1	Texas Instruments		Texas Instruments
U3	1		Low Power, Dual Voltage Detector in Small uSON package, DRY0006A (USON-6)	DRY0006A	TPS3780ADRYR	Texas Instruments	TPS3780ADRYT	Texas Instruments
U4	1		500mA, Low Quiescent Current, Low-Noise, High PSRR, Low-Dropout Linear Regulator for Automotive, DRB0008B (VSON-8)	DRB0008B	TPS73518QDRBRQ1	Texas Instruments		Texas Instruments
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
J7	0		Connector, Header, High Speed, 20 pairs, SMT	QTE-020-01-X-D-A	QTE-020-01-L-D-A	Samtec		
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP11, TP12, TP13, TP14, TP15, TP16, TP17	0		Test Point, Miniature, Red, TH	Red Miniature Test point	5000	Keystone		
TP19, TP20, TP21, TP22, TP25	0		Test Point, Miniature, Green, TH	Green Miniature Test point	5116	Keystone		

4 Additional Information

4.1 Trademarks

Burr-Brown™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

5 Related Documentation

- Texas Instruments, [PCM1841-Q1 Quad Channel, 32-Bit, 192kHz, Burr-Brown Audio ADC](#) data sheet
- Texas Instruments, [TPS37xx Dual-Channel, Low-Power, High-Accuracy Voltage Detectors](#) data sheet

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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.
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 - 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 DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

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

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 Canada

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

Concerning EVMs Including Radio Transmitters:

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

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

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

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

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance 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/lstds/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

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/lstds/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.

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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.
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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, INDEMNITY 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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