ADS8028EVM-PDK

Figure 1. ADS8028EVM-PDK

This user's guide describes the characteristics, operation, and use of the ADS8028EVM-PDK. This evaluation module and performance development kit (EVM-PDK) is an evaluation system for the ADS8028, a 12-bit, 1-MSPS, 8-channel, successive approximation register (SAR) analog-to-digital converter (ADC). The EVM-PDK allows evaluation of all aspects of the ADS8028 device.

This document includes an EVM QuickStart section, hardware and software details, bill of materials, and schematic.

The following related documents are available through the Texas Instruments web site at http://www.ti.com.

Table 1. EVM-Compatible Device Data Sheets

Device	Literature Number
ADS8028	SBAS549
OPA836	SLOS712
REF5025	SBOS410

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1 EVM Overview

The ADS8028EVM-PDK is designed to evaluate the ADS8028. The ADS8028 is a 12-bit, 8-channel, multiplexed, SAR ADC, with a maximum throughput rate of 1 MSPS. The ADS8028 also offers an internal 2.5-V voltage reference and internal temperature sensor with 0.25°C resolution. The ADS8028EVM allows access to every pin of the converter and makes it easy to connect the ADS8028 SPI™-compatible serial interface to any host microprocessor or TI DSP based system with 1.8-V, 3.3-V, or 5-V logic capability. The ADS8028EVM-PDK combines the ADS8028EVM daughtercard with the digital sensor processor (DSP)-based MMB0 motherboard and ADCPro™ evaluation software for complete evaluation of the ADS8028.

1.1 Features

ADS8028EVM Features

- Easy-to-use ADCPro evaluation software for Microsoft® Windows® operating systems
- Built-in analysis tools for ADCPro, including scope, FFT, and histogram displays
- Simple device operation with full control of single 16-bit control register
- Data collection to text files
- 1.8-V, 3.3-V, or 5-V logic compatible with 16-bit, 20-MHz SPI Interface
- Contains all support circuitry needed for the ADS8028:
  - Voltage reference options: ADS8028 (2.5 V) internal reference, on-board REF5025 (2.5 V) reference, or external reference
  - Two on-board OPA836 (205-MHz unity-gain bandwidth / 1-mA quiescent current) ADC input drivers
  - Power supplied by MMB0 motherboard
- Compatible with the TI modular EVM system

ADS8028EVM-PDK Features

The ADS8028EVM-PDK includes the ADS8028EVM board with the DSP-based MMB0 motherboard, that can be used with ADCPro to quickly evaluate the device.

This manual covers the operation of the ADS8028EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS8028EVM.

Related Documentation from Texas Instruments

The related documents listed in Table 2 are available for download through the Texas Instruments web site at www.ti.com.

Table 2. Related Documents

Device	Literature Number
ADS8028	SBAS549

2   EVM Setup

This section is a quick guide to begin evaluating the ADS8028EVM with ADCPro.

2.1   *Default Jumper Configuration*

Figure 2 shows the location of jumpers on the EVM and their respective factory default settings.
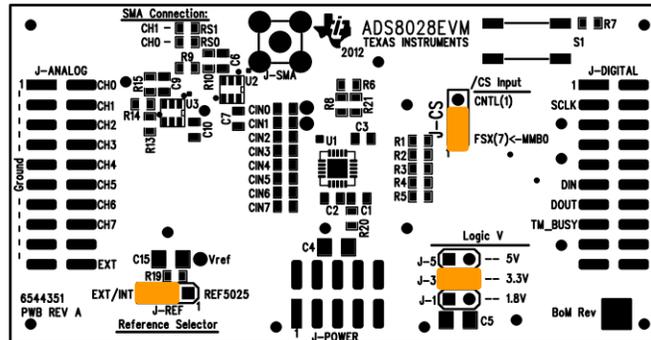
Figure 2. Jumper Locations and Default Settings

Table 3 lists the jumpers on the ADS8028EVM and their factory default settings.

Table 3. Default Jumper Configurations

Jumper	Default Position	Description
J-1	Open	1.8-V logic not selected
J-3	Short	3.3-V logic selected (BVDD = 3.3 V)
J-5	Open	5-V logic not selected
J-CS	Pins 1-2 (Down)	MMB0 FSX pin connected to $\overline{CS}$
J-REF	Pins 2-3 (Right)	Allows for external voltage reference input or internal voltage reference output

<div style="border:1px solid">

CAUTION

Only one of the digital interface jumpers (J-1, J-3, or J-5) should be shorted at a time to prevent large reverse currents that could potentially damage voltage regulators on the MMB0 motherboard.

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2.2 ADS8028EVM-PDK Kit Operation

To prepare to evaluate the ADS8028 with the ADS8028EVM-PDK, complete the following steps:

1. Verify the ADS8028EVM jumper settings from the factory as shown in Figure 2 and also listed in Table 3.
2. Install ADCPro and the ADS8028EVM plug-in software. Complete hardware connections and driver installation as per the ADCPro HW/SW Installation Manual. Use the following jumper settings on the MMB0 to configure power with the external supply.
    *   MMB0 J12 → Short (power supplied to the MMB0 through MMB0 J2 jack)
    *   MMB0 J13A → Open (+VA supply is not used on the ADS8028EVM)
    *   MMB0 J13B → Short (power supplied to the ADS8028EVM through the MMB0 J5 header)
    *   No additional power connections are required
3. Plug the ADS8028EVM onto the MMB0 motherboard. The female portion of J-ANALOG, J-DIGITAL, and J-POWER on the bottom of the EVM align with male connectors J7, J4, and J5 (respectively) on the MMB0.
4. Connect the included USB cable to J1 on the MMB0 and to an unused USB port on the computer with ADCPro installed.
5. Connect an external supply (using the included CA-2186 cable) to the MMB0.

3 ADS8028EVM Hardware Details

Figure 3 shows the location of headers J-ANALOG, J-DIGITAL, and J-POWER and their assigned pin numbers. The notation *J-NAME.<#>* is used in this user's guide for identifying header pins. For example, J-ANALOG.1 refers to pin 1 on the J-ANALOG header.
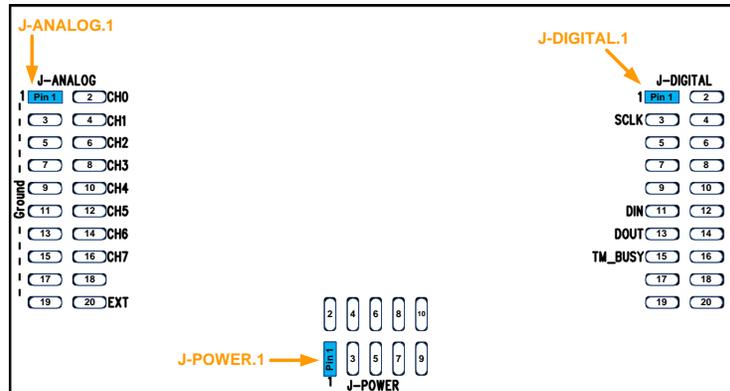
Figure 3. Headers and Pin Numbers

Table 4 provides a quick summary of the connections required for operation of the ADS8028. The purpose of the MMB0 motherboard is to provide power and SPI communication to the ADS8028EVM. Analog inputs of interest must be applied to the ADS8028EVM by the user. For a complete list of connections and pins, refer to the ADS8028EVM schematic in Section 5.2.

Table 4. Critical Connections

Function		Header and Pin	Pin Name	Description
SPI	$\overline{CS}$	J-DIGITAL.7	FSX	Chip select; active low logic input
	SCLK	J-DIGITAL.3	CLKX	SCLK
	DIN	J-DIGITAL.11	DX	Data In
	DOUT	J-DIGITAL.13	DR	Data Out
	TM_BUSY	J-DIGITAL.15	INT	Busy output; high during temperature conversion
Power	1.8V	J-POWER.7	+1.8VD	Digital interface supply (BVDD)[1]
	3.3V	J-POWER.9	+3.3VD	Digital interface supply (BVDD)[1]
	5.0V	J-POWER.10	+5VD	Digital interface supply (BVDD)[1]
	5.0V (AVDD)	J-POWER.3	+5VA	Analog operation supply (AVDD)
	GND	J-POWER.5 and J-POWER.6	DGND and AGND	Digital and Analog supply grounds[2]
Analog inputs	Channels 0 and 1	J-ANALOG.1-4	—	Analog Inputs (Buffered)[3]
	Channels 2 to 7	J-ANALOG.5-16	—	Analog Inputs[3]

[1] Only one digital supply connection (BVDD) is required when evaluating the ADS8028EVM as a stand-alone board. Check that the corresponding jumper (J-1, J-3, or J-5) is correctly selected to power the ADS8028 digital interface.

[2] AGND and DGND are shorted on the ADS8028EVM.

[3] All ADS8028 analog inputs are single-ended and connect between the even and odd pins on the J-ANALOG header. All odd pins on J-ANALOG are connected to AGND.

3.1 Analog Inputs

The ADS8028 provides eight single-ended input channels plus an internal temperature sensor. The eight analog input channels to the ADS8028 (AIN0 to AIN7) are connected to J-ANALOG on the ADS8028EVM. Channels 0 and 1 are buffered converter inputs. The OPA836 is configured as a unity-gain buffer on these channels. Channels 2 to 7 connect directly to the converter with an option to add an RC filter before the converter input. Figure 4 shows the EVM schematic portion of the analog inputs. All discrete resistors and capacitors shown in Figure 4 are size 0603 and can be modified to adjust circuit gain and filtering. Note that not all components shown in Figure 4 are installed and have values "NI" (not installed).

Optionally, the user can add an SMA connector at J-SMA and use an SMA input for channels 0 and 1 if an SMA connection is more convenient. RS0 and RS1 resistors select the SMA input channel. If the SMA input has a 50-Ω source impedance, R10 and other input resistors can be modified for impedance matching, otherwise they can provide signal attenuation and input current limiting.
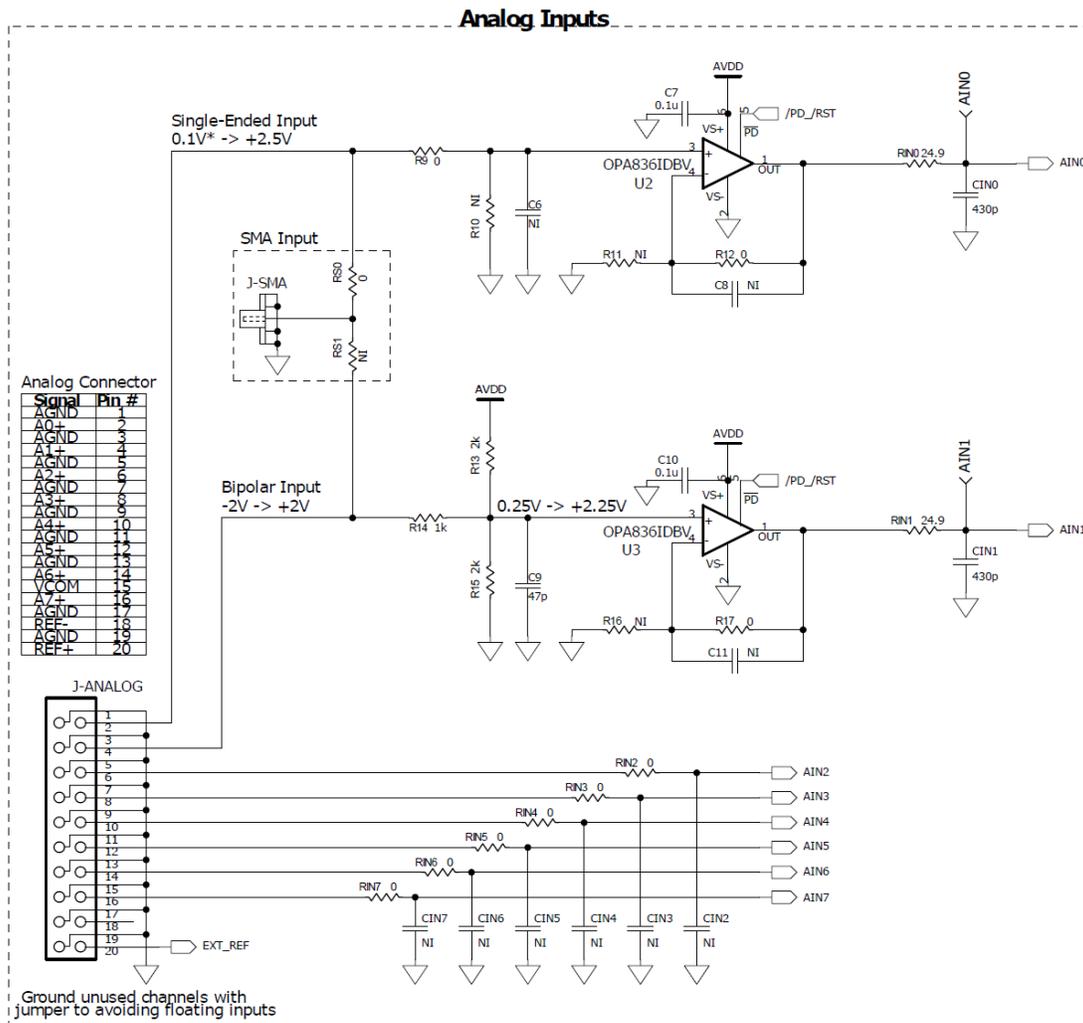
Figure 4. Analog Input Header Schematic

NOTE: All odd pins on J-ANALOG connect to GND. Therefore, all analog input connections can be easily made across even and odd pin numbers (The channel 0 input connects to J-ANALOG.1-2, channel 1 input connects to J-ANALOG.3-4, etc.).

3.2 Digital Control

The SPI digital control signals are applied directly to the J-DIGITAL header on the ADS8028EVM. When using the ADS8028EVM-PDK (the combination of the ADS8028EVM, MMB0 motherboard, and ADCPro software), these signals are supplied by the MMB0 motherboard through J4. If the ADS8028EVM is instead evaluated as a stand-alone board, these signals must be supplied by another microcontroller or processor according to the timing characteristics in the ADS8028 data sheet.

Figure 5 shows the schematic connections to the J-DIGITAL header. The $\overline{CS}$ signal can be routed to J-DIGITAL.1 or J-DIGITAL.7 (default) through the J-CS jumper. Ensure that the J-CS jumper is positioned to route $\overline{CS}$ to J-DIGITAL.7 (short pins J-CS.1-2) for proper SPI communication when using the ADS8028EVM-PDK. Additionally, the S1 push-button switch allows the user to manually reset and power-down the ADS8028 and OPA836 op amps on the ADS8028EVM while the button is held. When the button is released, the ADS8028 powers up with default conditions.
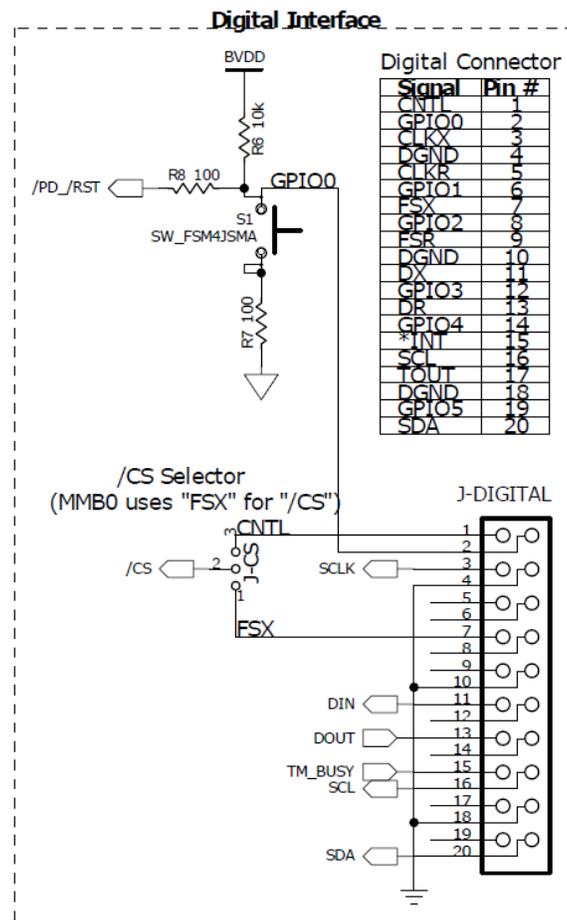
Figure 5. Digital Interface Header Schematic

> **NOTE:** By default, the J-CS jumper on the ADS8028EVM is shorted between pins J-CS.1-2. This setting is required for proper SPI communication between the MMB0 motherboard and the ADS8028.

3.3 Power Supply

The ADS8028EVM requires two power-supply rails: one 5-V analog supply (AVDD) and a configurable digital interface (BVDD). Three selectable voltages are available for the digital interface to make the EVM compatible with different logic levels. Jumpers J-1, J-3, and J-5 on the ADS8028EVM select 1.8-V, 3.3-V, or 5-V BVDD digital interface voltages, respectively. Refer to Table 3 for the ADS8028EVM jumper functions and default settings. The default jumper settings of J-1 (open), J-3 (short), and J-5 (open) are recommended when using the ADS8028EVM with the MMB0 3.3-V logic.

Power rails are supplied to the ADS8028EVM through the J-POWER header. If the ADS8028EVM is being evaluated as a stand-alone board, the user must supply power to the J-POWER header by direct connections to a power supply. Otherwise, the MMB0 motherboard supplies the ADS8028EVM with power through J-5 when the ADS8028EVM daughtercard is mounted on the MMB0. Check the MMB0 jumper settings listed in the *ADS8028EVM-PDK Kit Operation* section if the ADS8028EVM is not receiving power when connected to the MMB0 motherboard. Figure 6 shows a schematic of J-POWER header connections on the ADS8028EVM.
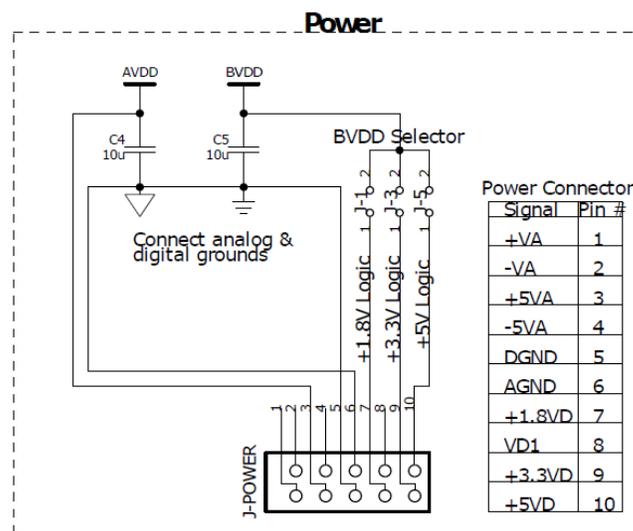
Figure 6. Power Header Schematic

CAUTION

Do not apply voltages that the exceed the absolute maximum ratings of the installed components. The absolute maximum supply voltage of the OPA836 limits the maximum analog supply voltage of the ADS8028EVM to 5.5 V. The digital supply voltage should not exceed the analog supply voltage.

3.4   Voltage Reference

The ADS8028EVM allows the user flexibility to select different voltage reference sources for the ADS8028. Options include the:

*   ADS8028 internal 2.5-V voltage reference,
*   Onboard REF5025 2.5-V reference, or
*   External reference source

When the ADS8028 powers up, the internal 2.5-V reference is selected as the reference source by default. To use an external reference source, the internal voltage reference must be disabled by performing a serial interface write to the ADS8028 control register to update bit 2. When using an external source, shorting pins J-REF.1-2 uses the REF5025 external 2.5-V reference. If a reference voltage other than 2.5 V is needed, the REF5025 can be replaced with any other reference in the REF50xx family.

Shorting pins J-REF.2-3 connects J-ANALOG.20 to the ADS8028 reference input. This short allows the user to output the internal ADS8028 voltage reference to another circuit or allows a external reference voltage to be applied to the ADS8028 reference input when the internal reference is disabled. The allowable voltage range for an external voltage reference is 1 V to AVDD (5 V when the ADS8028EVM is used with the MMB0).
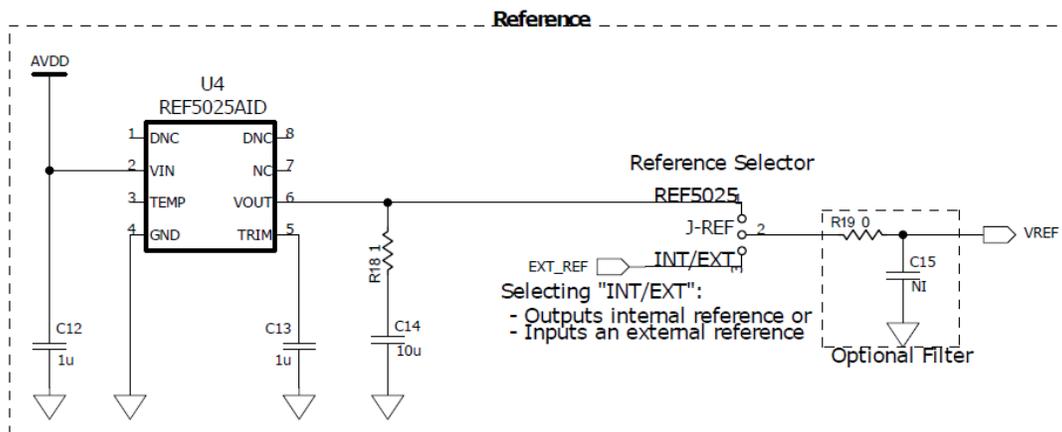
Figure 7. EVM Voltage Reference Schematic

CAUTION

The user should avoid connecting any external voltage reference to the ADS8028 before a serial write to the ADS8028 control register disables the internal reference source. Providing an external source prior to this communication draws additional current from the external source. The ADS8028 internal protection circuitry limits this current to 20 mA.

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4 Using the ADS8028EVM-PDK with ADCPro

This section covers the use of the ADS8028EVM-PDK plug-in for ADCPro. For general ADCPro software use and instructions, refer to the ADCPro User's Guide.

The ADS8028EVM-PDK plug-in for ADCPro provides complete control over all ADS8028 settings. It consists of a tabbed interface (see Figure 8), with different functions available on each tab. The tabs are:

• Channel Selection
• Controls
• About

The ADS8028EVM settings can be adjusted when not acquiring data. During acquisition, all controls are disabled and settings may not be changed. When a setting is changed on the ADS8028EVM plug-in, it takes effect immediately. The effect of some settings, such as the Channel Selection, are not detected until the user starts acquiring data from the ADS8028. The option to acquire data is disabled until both an EVM plug-in and Test plug-in have been loaded from the respective drop-down file menus.

ADS8028EVM settings correspond to settings described in the ADS8028 data sheet.

4.1 Top-Level Controls

The ADCPro top-level controls for the ADS8028EVM-PDK plug-in include the sample rate and standby controls. The *Sample Rate* indicator, in the upper right corner of the plug-in interface, is always visible and can be modified by the user by typing in a different value. The *Standby* control, in the lower left corner, places the ADS8028 in standby mode when pressed. The user must exit standby mode to make the data acquisition option available again. The top-level controls are highlighted in Figure 8.
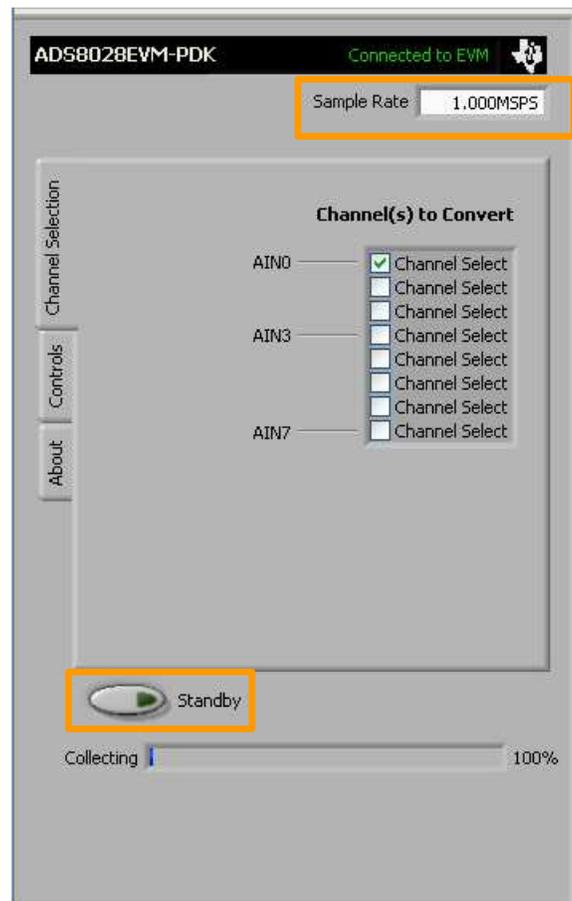
Figure 8. ADCPro: ADS8028EVM Panel

4.2 Channel Selection Tab

The ADS8028 can acquire data from one to eight channels, sequentially. The *Channel Select* tab provides the control to select which channels are sampled. A channel is selected to be sampled if a check mark is seen in the box corresponding to the channel number. Channels are listed sequentially, starting with channel 0 (AIN0) at the top of the list and channel 7 (AIN7) at the bottom. Figure 9 shows where to select channels in the *Channel Select* tab.
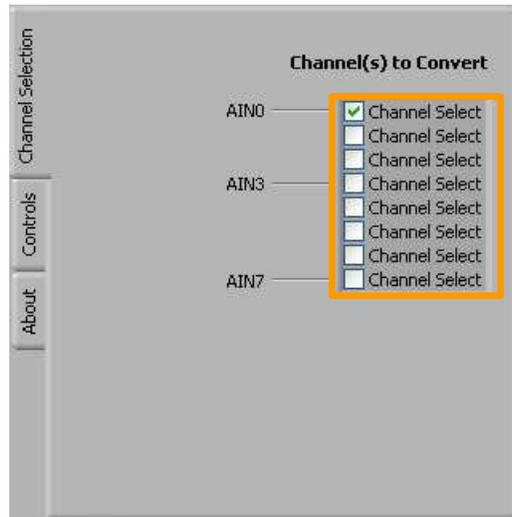
Figure 9. ADCPro: Channel Selection Tab

NOTE: If multiple channels are selected for acquisition, then each channel is sampled at a slower rate, given by the sampling rate divided by the number of channels selected for acquisition.

4.3 Controls Tab

The *Controls* tab allows for reference source selection and operation of the ADS8028 internal temperature sensor. Figure 10 highlights the controls the user can modify on the *Controls* tab.
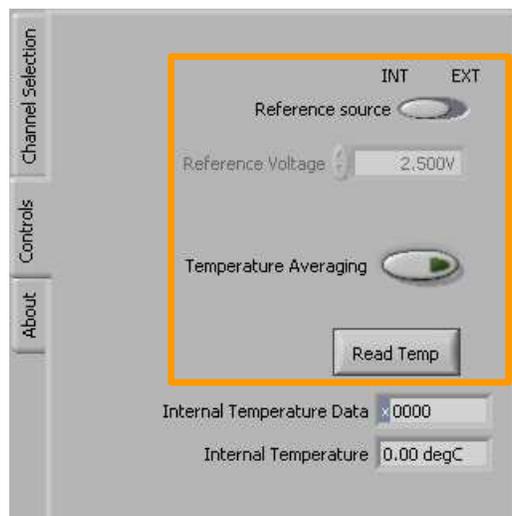
Figure 10. ADCPro: Controls Tab

The *Reference Source* control selects between the ADS8028 internal voltage reference (INT) and an external voltage reference source (EXT). Selecting EXT disables the internal voltage reference and allows the user to specify the applied reference voltage in the *Reference Voltage* indicator to display the correct voltage output values.

The *Temperature Averaging* control configures the ADS8028 to average eight temperature measurements.

The *Read Temp* button returns the output of the internal ADS8028 temperature sensor reading. The output code is displayed in the *Internal Temperature Data* indicator and the corresponding temperature value in degrees Celsius is displayed in the *Internal Temperature* indicator.

4.4   About Tab

The *About* tab provides information on the EVM hardware and software versions.

The plug-in version is the software version of the ADCPro plug-in. The firmware version is the firmware version loaded and running on the processor.

5   Schematics and Bill of Materials

A complete schematic for the ADS8028EVM is included in this user's guide. Refer to Table 5 for a bill of materials. Gerber files are available on request. Please e-mail support@ti.com or E2E Community Forums and ask for details on how to receive the files.

5.1   Bill of Materials

> **NOTE:**   All components should be compliant with the European Union Restriction on Use of Hazardous Substances (RoHS) Directive. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS-compliant. (For more information about TI's position on RoHS compliance, see the Design Support section at http://www.ti.com.)

Table 5. ADS8028EVM Bill of Materials

Item No.	Qty	Value	Ref Des	Description	Manufacturer	Part Number
1	1	—		Printed Circuit Board, 3.2 In x 1.7 In x 0.062 In	Any	6544351
2	2	430 pF	CIN0, CIN1	Capacitor, C0G Ceramic, 50V, 5%, 0603	Murata	GRM1885C1H431JA01D
3	5	1 µF	C1-C3, C12, C13	Capacitor, X7R Ceramic, 25V, 10%, 0603	Murata	GRM188R71E105KA12D
4	3	10 µF	C4, C5, C14	Capacitor, X7R Ceramic, 25V, 10%, 1206	Taiyo Yuden	TMK316B7106KL-TD
5	0	—	C6, C8, C11, CIN2-CIN7	Not Installed	—	—
6	2	0.1 µF	C7, C10	Capacitor, X7R Ceramic, 25V, 10%, 0603	Murata	GRM188R71E104KA01D
7	1	47 pF	C9	Capacitor, C0G Ceramic, 50V, 5%, 0603	Murata	GRM1885C1H470JA01D
8	0	—	C15	Not Installed	—	—
9	3	—	J-1, J-3, J-5	CONN HEADER 2POS .100" SGL GOLD	Samtec	TSW-102-07-L-S
10	2	—	J-ANALOG(A), J-DIGITAL(A)	CONN HEADER 20POS .100" SMD TIN	Samtec	TSM-110-01-T-DV-P
11	2	—	J-ANALOG(B), J-DIGITAL(B)	CONN RECPT 20POS .100" SMT GOLD	Samtec	SSW-110-22-F-D-VS-K
12	1	—	J-POWER(A)	CONN HEADER 10POS .100" DBL SMD	Samtec	TSM-105-01-T-DV-P
13	1	—	J-POWER(B)	CONN RECPT 10POS .100" SMT GOLD	Samtec	SSW-105-22-F-D-VS-K
14	2	—	J-CS, J-REF	CONN HEADER 3POS .100" SGL GOLD	Samtec	TSW-103-07-L-S
15	0	—	J-SMA	Not Installed	—	—
16	2	24.9 Ω	RIN0, RIN1	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-0724R9L
17	2	2.7 kΩ	RE3, RE4	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-072K7L
18	5	47 Ω	R1-R5	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-0747RL
19	1	10 kΩ	R6	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-0710KL
20	2	100 Ω	R7, R8	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-07100RL
21	14	0 Ω	R9, R12, R17, R19-R21, RIN2-RIN7, RS0, RE1	Resistor, Chip, 1/10W, < 0.05Ω, 0603	Yageo	RC0603JR-070RL
22	0	—	R10, R11, R16, RE2, RS1	Not Installed	—	—
23	1	1 Ω	R18	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-071RL
24	2	2 kΩ	R13, R15	Resistor, Chip, 1/10W, 1%, 0603	Panasonic	ERJ-3EKF2001V
25	1	1 kΩ	R14	Resistor, Chip, 1/10W, 1%, 0603	Yageo	RC0603FR-071KL
26	1	—	S1	Tactile Switch, 6x6 mm, Surface Mount	TE Connectivity	FSM4JSMATR
27	1	—	U1	IC, ADC, SAR, 12-Bit, 1 MSPS, 8-Channel, RTJ-20	Texas Instruments	ADS8028IRTJT
28	2	—	U2, U3	IC, OPAMP, VFB, RRO, 205MHZ, SOT23-6	Texas Instruments	OPA836IDBVT
29	1	—	U4	IC, Precision Voltage Reference, 2.5V, SO-8	Texas Instruments	REF5025AID
30	1	—	U5	IC, EEPROM, 256KBIT, 400KHZ, TSSOP-8	Microchip Technology	24AA256-I/ST
31	11	—	—	Shunt, 100-mil, Black	3M	969102-0000-DA

5.2 Schematic
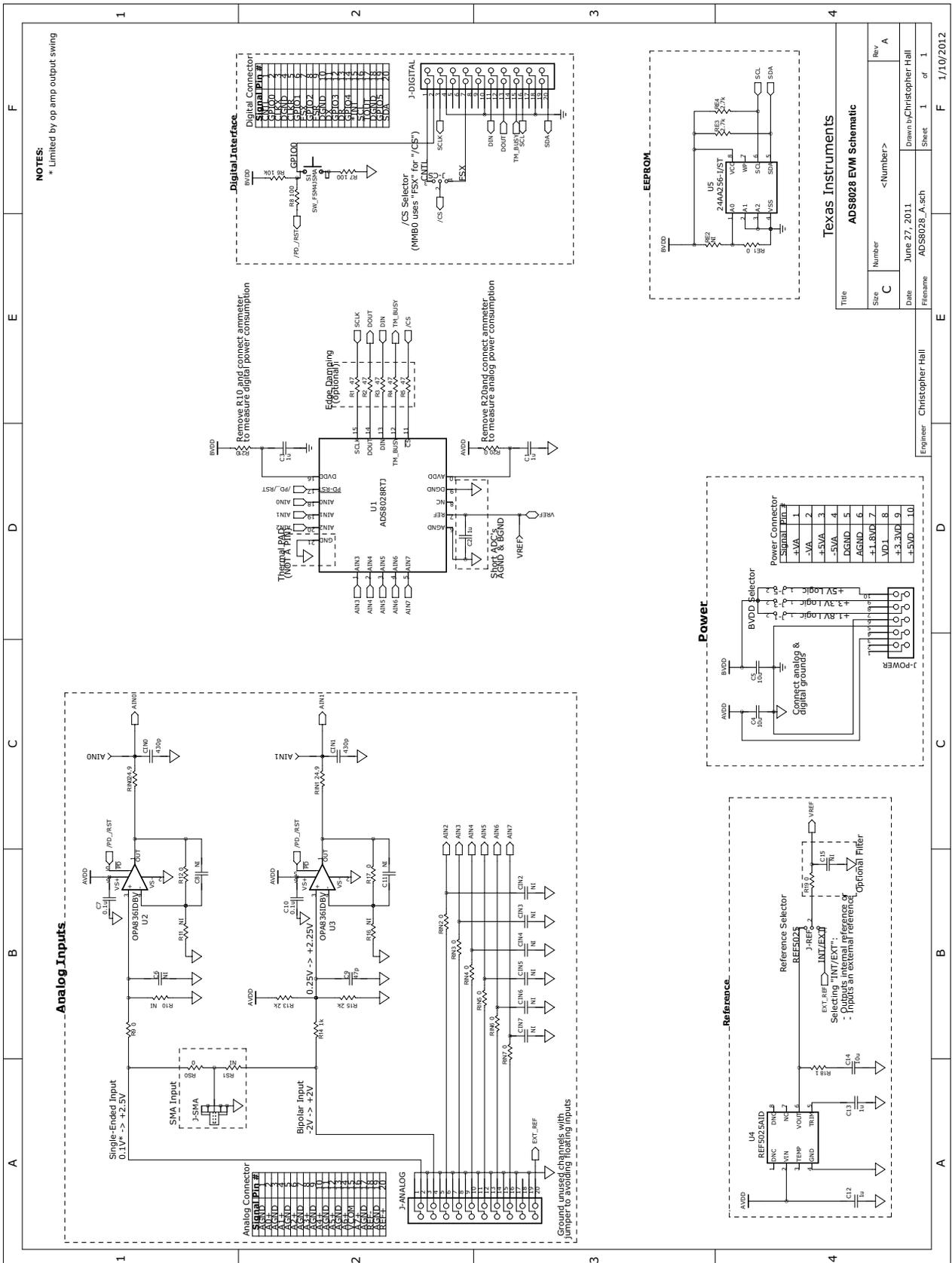
Revision History

Changes from Original (April 2012) to A Revision   **Page**

- Replaced reference of adapter to external supply in two places in the *ADS8028EVM-PDK Kit Operation* section. **………** 5

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

    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 and conditions 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 and conditions 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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

    2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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.

3. *Regulatory Notices:*

    3.1 *United States*

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

        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*

  Concerning EVMs Including Radio Transmitters:

  This device complies with Industry Canada license-exempt RSS standard(s). 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。
  http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

  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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

  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
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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。 http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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 WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (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 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 AND CONDITIONS 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 MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

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8. *Limitations on Damages and Liability:*

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

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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