AMC7832EVM User's Guide

This user's guide describes the characteristics, operation, and use of the AMC7832 evaluation module (EVM). This user's guide also discusses the proper setup and configuration of software and hardware and reviews various aspects of program operation. A complete circuit description, schematic diagram, and bill of materials are also included.

Contents

1 Overview ... 3
1.1 AMC7832EVM Kit Contents ... 3
1.2 Related Documentation from TI ... 3
2 AMC7832EVM Hardware Setup ... 4
2.1 Theory of Operation for AMC7832 Hardware ... 4
2.2 Signal Definitions of J6 (10-Pin Male Connector Socket) ... 5
2.3 Theory of Operation for SDM-USB-DIG Platform ... 6
3 AMC7832EVM Software Setup ... 7
3.1 Operating Systems for AMC7832EVM Software ... 7
3.2 AMC7832EVM Software Installation ... 7
4 AMC7832EVM Hardware Overview ... 9
4.1 Electrostatic Discharge Warning ... 9
4.2 Connecting the Hardware ... 9
4.3 Connecting the USB Cable to the SDM-USB-DIG ... 10
4.4 AMC7832EVM Power Configurations ... 10
4.5 ADC Signal Pins ... 11
4.6 DAC Signal Pins ... 11
4.7 GPIO Signal Pins ... 12
5 AMC7832EVM Software Overview ... 13
5.1 Starting the AMC7832EVM Software ... 13
5.2 AMC7832EVM Software Features ... 14
6 AMC7832EVM Documentation ... 22
6.1 AMC7832EVM Board Schematic ... 22
6.2 AMC7832EVM PCB Components Layout ... 24
6.3 AMC7832 Test Board Bill of Materials ... 25

List of Figures

1 AMC7832EVM Hardware Setup ... 4
2 AMC7832 Test Board Block Diagram ... 4
3 SDM-USB-DIG Platform Block Diagram ... 6
4 AMC7832EVM Installer Directory ... 7
5 AMC7832EVM Install Path ... 8
6 Typical Hardware Connections on the AMC7832EVM ... 10
7 Confirmation of SDM-USB-DIG Platform Driver Installation ... 10
8 AMC7832EVM GUI Location ... 13
9 AMC7832EVM GUI – Power On ... 13
10 Software Reset Button ... 14
11 Low Level Configuration Page ... 14

Microsoft, Windows are registered trademarks of Microsoft Corporation.

Copyright © 2014–2016, Texas Instruments Incorporated

12 ADC Page 15
13 ADC Block Activation Sequence 15
14 ADC Channel MUX 16
15 DAC Page 17
16 Program DAC Registers 17
17 DAC Read 18
18 ALARMS Page 18
19 Enable Low Limit and High Limit Fields 19
20 CH-FALR-CT Menu 19
21 Clear DAC Options 19
22 GPIO Page 20
23 GPIO Write or Read 21
24 Board Schematic 23
25 AMC7832EVM PCB Components Layout 24

List of Tables

1 Contents of AMC7832EVM Kit 3
2 Related Documentation 3
3 J6 Signal Definition 5
4 Default Jumper Settings 9
5 AMC7832EVM Jumper and Shunt Resistor Settings 11
6 AMC7832EVM ADC Signal Connections 11
7 AMC7832EVM DAC Signal Connections 12
8 AMC7832EVM DAC Range Connections 12
9 AMC7832EVM GPIO Signal Definition 12
10 Conversion Rates 16
11 Bill of Materials 25

Copyright © 2014–2016, Texas Instruments Incorporated

1 Overview

This EVM features the AMC7832 device, a highly integrated, low-power, complete analog monitoring and control solution that includes a 17-channel (12-bit) ADC, 12-channel (12-bit) DAC, eight GPIOs, and a local temperature sensor. The DACs include a flexible output range that allows the device to be fully compatible with a large array of biasing technologies, such as LDMOS, GaAs, and GaN. The devices also feature programmable out-of-range alarms, an internal reference, and a low-power, SPI-compatible serial interface.

1.1 AMC7832EVM Kit Contents

Table 1 details the contents of the EVM kit. Contact the TI Product Information Center nearest you if any component is missing. TI highly recommends to verify that the user has the latest versions of the related software at the TI website, www.ti.com.

Table 1. Contents of AMC7832EVM Kit(1)

ITEM	QUANTITY
AMC7832EVM PCB evaluation board	1
SDM-USB-DIG platform PCB	1
USB extender cable	1

(1) The 24-V wall adapter is not included with the evaluation module (EVM). Optionally, a 24-V (750-mA) center-positive wall adapter can be separately purchased to interface to the onboard 2.1 x 5.5-mm DC jack. In the case that a wall adapter is not available, external terminal blocks are included, which can interface with external supplies.

1.2 Related Documentation from TI

The following document provides information regarding TI integrated circuits used in the assembly of the AMC7832EVM. This user's guide is available from the TI website under literature number SLAU544. A letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI website at www.ti.com, or call the TI Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 2. Related Documentation

DOCUMENT	LITERATURE NUMBER
AMC7832 Product Data Sheet	SLAS836
SDM-USB-DIG Platform User's Guide	SBOU136

Copyright © 2014–2016, Texas Instruments Incorporated

2 AMC7832EVM Hardware Setup

This section provides the overall system setup for the EVM. A PC runs software that communicates with the SDM-USB-DIG platform, which generates the power and digital signals used to communicate with the EVM board. An optional +24-V wall supply can provide power through the J5 connector to provide power to on-board power regulators (LDOs) that regulate the analog and digital supplies. By default, on-board connectors are included on the EVM board for external supplies. Figure 1 displays the system setup for the AMC7832EVM.

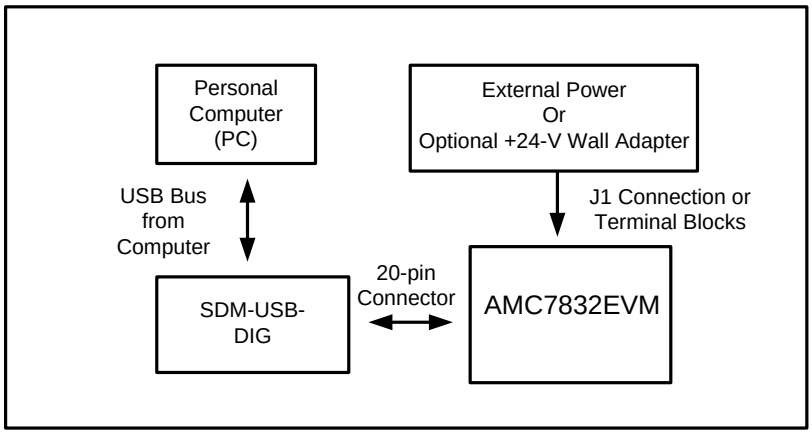


Figure 1. AMC7832EVM Hardware Setup

2.1 Theory of Operation for AMC7832 Hardware

A block diagram of the AMC7832EVM test board is displayed in Figure 2. The EVM board provides testpoints for the supplies, internal reference, ground connections, SPI inputs, ADC inputs, and DAC outputs.

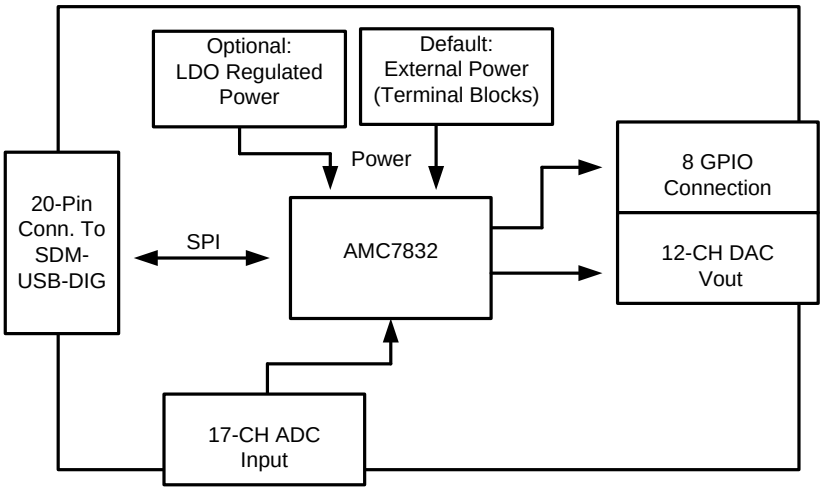


Figure 2. AMC7832 Test Board Block Diagram

Copyright © 2014–2016, Texas Instruments Incorporated

2.2 Signal Definitions of J6 (10-Pin Male Connector Socket)

The AMC7832EVM includes a 20-pin connector socket used to communicate between the EVM and the SDM-USB-DIG platform. Although the I^2C pins are brought out to the J12 header, the I^2C communication lines (I2C_SCL and I2C_SDA) are not used. The pin out of the J6 connector is shown in Table 3.

Table 3. J6 Signal Definition

PIN ON J3	SIGNAL	DESCRIPTION
1	SCL	I^2C clock signal (SCL)
2	DIG_GPIO2	GPIO – control output or measure input
3	DIG_GPIO0	GPIO – control output or measure input
4	DIG_GPIO3	GPIO – control output or measure input
5	SDA	I^2C data signal (SDA)
6	DIG_GPIO4	GPIO – control output or measure input
7	DIG_GPIO1	GPIO – control output or measure input
8	DIG_GPIO5	GPIO – control output or measure input
9	MOSI	SPI data output (MOSI)
10	DIG_GPIO6	GPIO – control output or measure input
11	VDUT	Switchable DUT power supply: +3.3 V, +5 V, Hi-Z (disconnected). Note: when VDUT is Hi-Z all digital I/O are Hi-Z as well.
12	DIG_GPIO7	GPIO – control output or measure input
13	SCLK	SPI Clock Signal (SCLK)
14	DIG_GPIO8	GPIO – control output or measure input
15	GND	Power Return (GND)
16	DIG_GPIO9	GPIO – control output or measure input
17	CS	SPI chip select signal ($\overline{CS}$)
18	DIG_GPIO10	GPIO – control output or measure input
19	MISO	SPI data input (MISO)
20	DIG_GPIO11	GPIO – control output or measure input

Copyright © 2014–2016, Texas Instruments Incorporated

2.3 Theory of Operation for SDM-USB-DIG Platform

The SDM-USB-DIG platform is a general-purpose data acquisition system that is used on select TI EVMs.

The core component of the platform is the MSP430F5528, an ultra-low power 16-bit MCU. The microcontroller receives information from the host PC and translates it into I^2C, SPI, or other digital I/O patterns. The connected device (in this case, the AMC7832 device) connects to the I/O interface of the platform. During digital I/O transactions, the platform obtains information from the AMC7832 device and sends to the host PC for interpretation. A block diagram of the platform is shown in Figure 3.

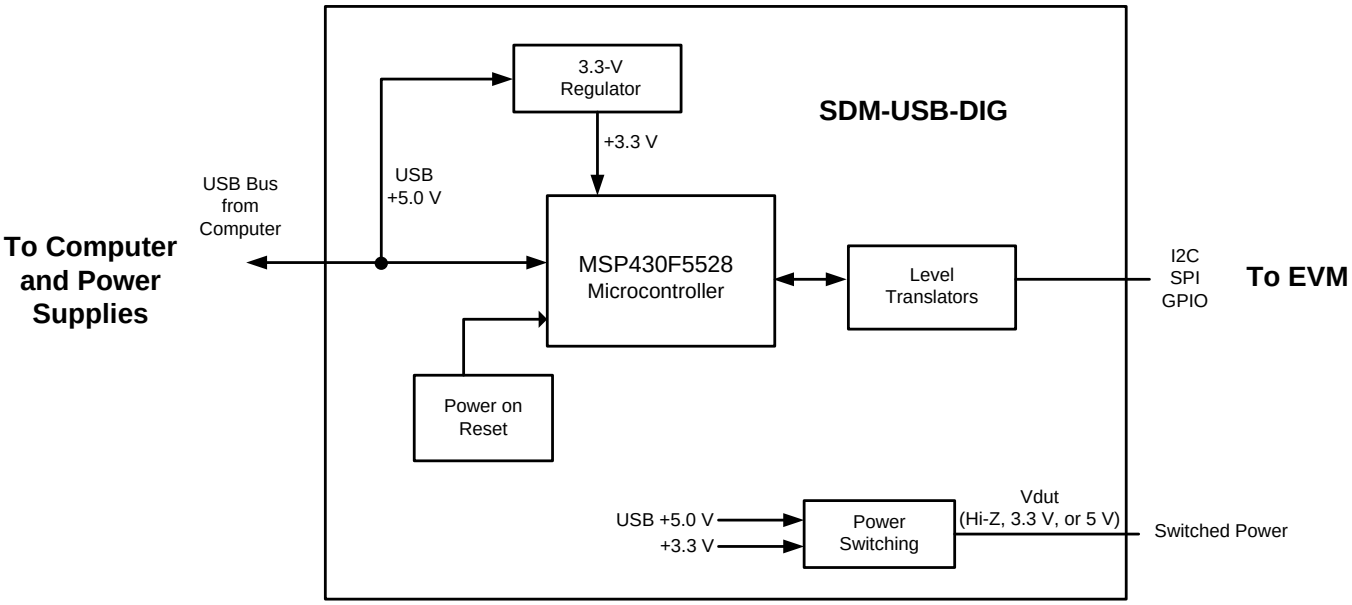


Figure 3. SDM-USB-DIG Platform Block Diagram

Copyright © 2014–2016, Texas Instruments Incorporated

3 AMC7832EVM Software Setup

This section provides the procedure for EVM software installation.

3.1 Operating Systems for AMC7832EVM Software

The EVM software was tested on the Microsoft® Windows® XP and Windows 7 operating systems with the United States and European regional settings. The software should also be compatible with other Windows operating systems.

3.2 AMC7832EVM Software Installation

The software is available through the EVM product folder on the TI website. After the software is downloaded on the PC, navigate to the AMC7832EVM_Installer folder, and run the setup.exe file, as shown in Figure 4. When the software is launched, an installation dialog opens and prompts the user to select an installation directory. If left unchanged, the software location defaults to C:\Program Files (x86)\AMC7832EVM on Windows 7 machines, as shown in Figure 5. For Windows XP machines, the path location can be found at C:\Program Files\AMC7832EVM. The software installation automatically copies the required drivers for the SDM-USB-DIG and AMC7832EVM to the PC. After the software is installed, connecting the SDM-USB-DIG to a USB port may launch a driver installation dialog. Choose the 'Install this driver software anyway' option to continue with installation. (Note: On XP machines, choose to have the system automatically find the driver or software.)

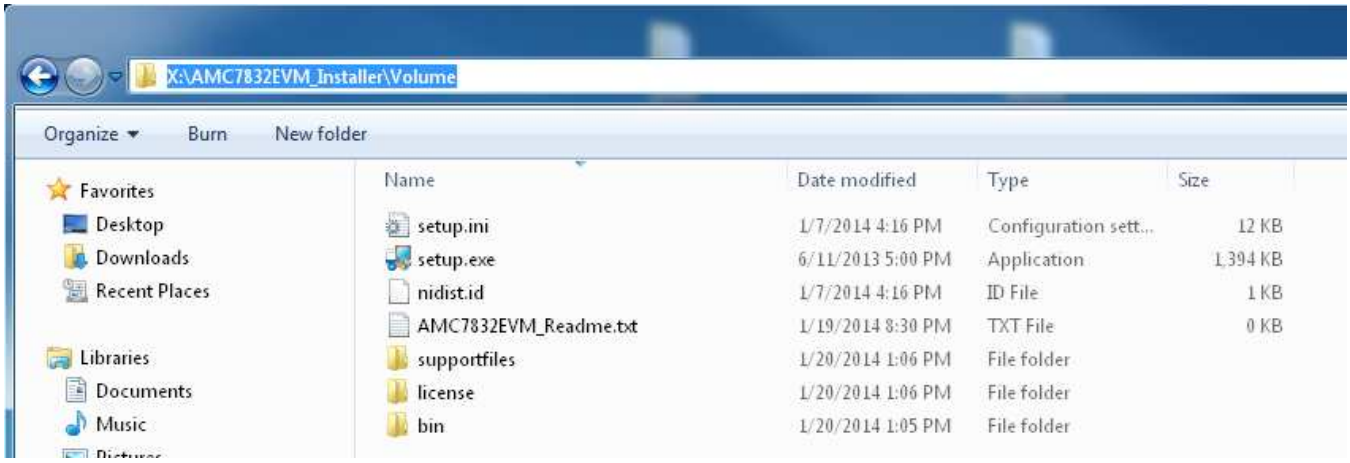


Figure 4. AMC7832EVM Installer Directory

Copyright © 2014–2016, Texas Instruments Incorporated

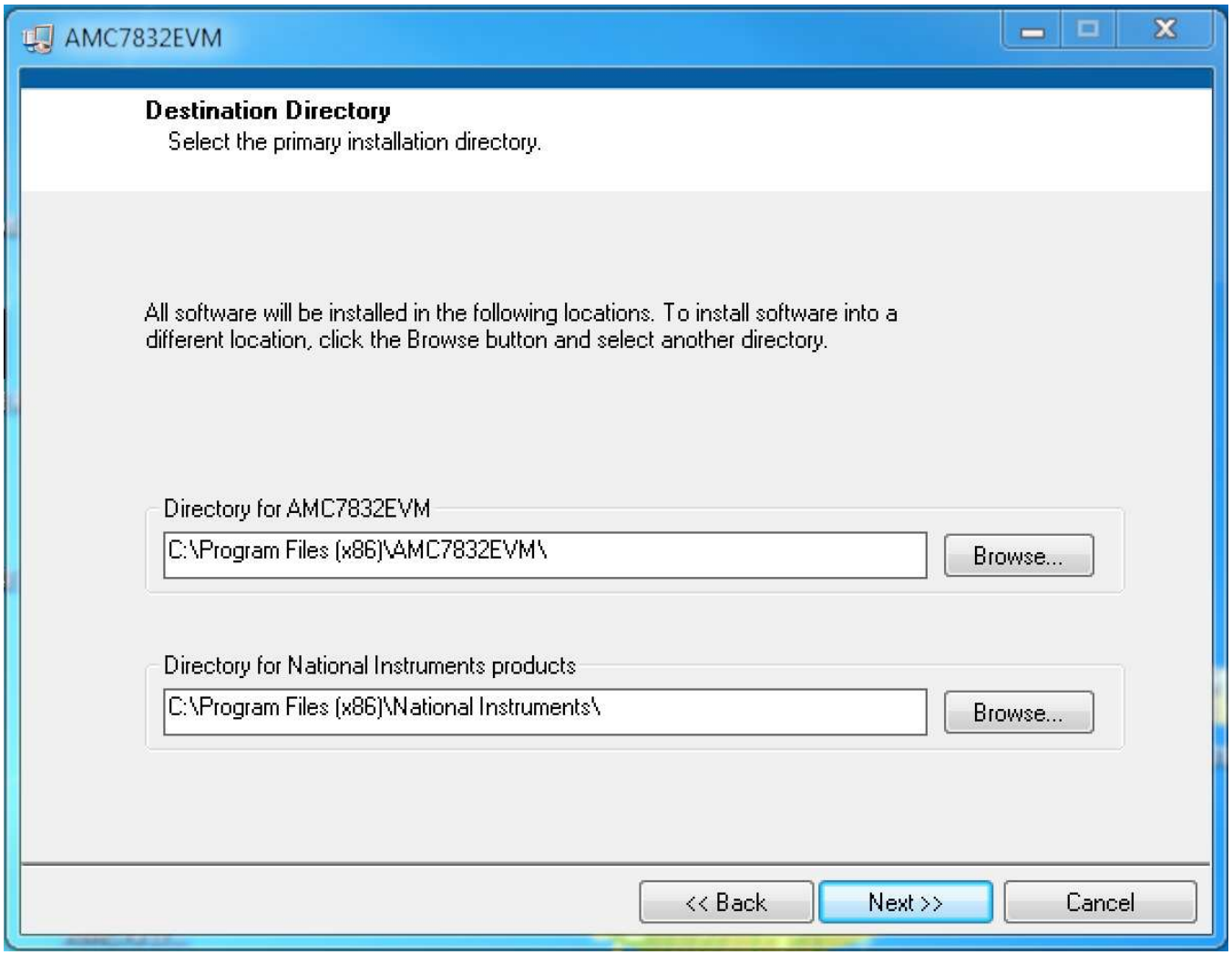


Figure 5. AMC7832EVM Install Path

Copyright © 2014–2016, Texas Instruments Incorporated

4 AMC7832EVM Hardware Overview

The subsequent sections provide detailed information on the EVM hardware, and jumper configuration settings. To use the onboard supplies set the AV_{DD} and IOV_{DD} jumper connections to the default configuration listed in Table 4. The table also displays the default configurations of all jumper connections on the AMC7832EVM. Connect the USB extender cable from the SDM-USB-DIG to the PC, and the +24-V wall adapter to the J1 terminal.

Table 4. Default Jumper Settings(1)

JUMPER	DEFAULT POSITION	FUNCTION
JP1	Shunt on 1-2	Selecting DAC Range • 1-2: (DAC range 0 to 5 V or 0 to 10 V) • 2-3: (DAC range –10 to 0 V)
JP2	Shunt on 1-2	Selecting DAC Range • 1-2: (DAC range 0 to 5 V or 0 to 10 V) • 2-3: (DAC range –10 to 0 V)
JP3	Shunt on 1-2	Selecting Internal or External AV_{DD} • 1-2: Internal 5-V Supply • 2-3: External Supply
JP4	Shunt on 2-3	Selecting DAC Range • 1-2: (DAC range –10 to 0 V) • 2-3: (DAC range 0 to 5 V or 0 V to 10 V)
JP5	Shunt on 2-3	Selecting DAC Range • 1-2: (DAC range –10 to 0 V) • 2-3: (DAC range 0 to 5 V or 0 to 10 V)
JP6	Shunt on 1-2	Selecting Internal or External IOV_{DD} • 1-2: Internal 3.3-V supply • 2-3: External supply

(1) Table 4 lists the default connections for the 24-V supply. Refer to Table 5 for24-V wall adapter connections.

4.1 Electrostatic Discharge Warning

Many of the components on the AMC7832EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

4.2 Connecting the Hardware

To connect the SDM-USB-DIG to the EVM board, align and firmly connect the female and male ends of the 20-pin connectors (see Figure 6). Verify the connection is snug, as loose connections may cause intermittent operation.

Copyright © 2014–2016, Texas Instruments Incorporated

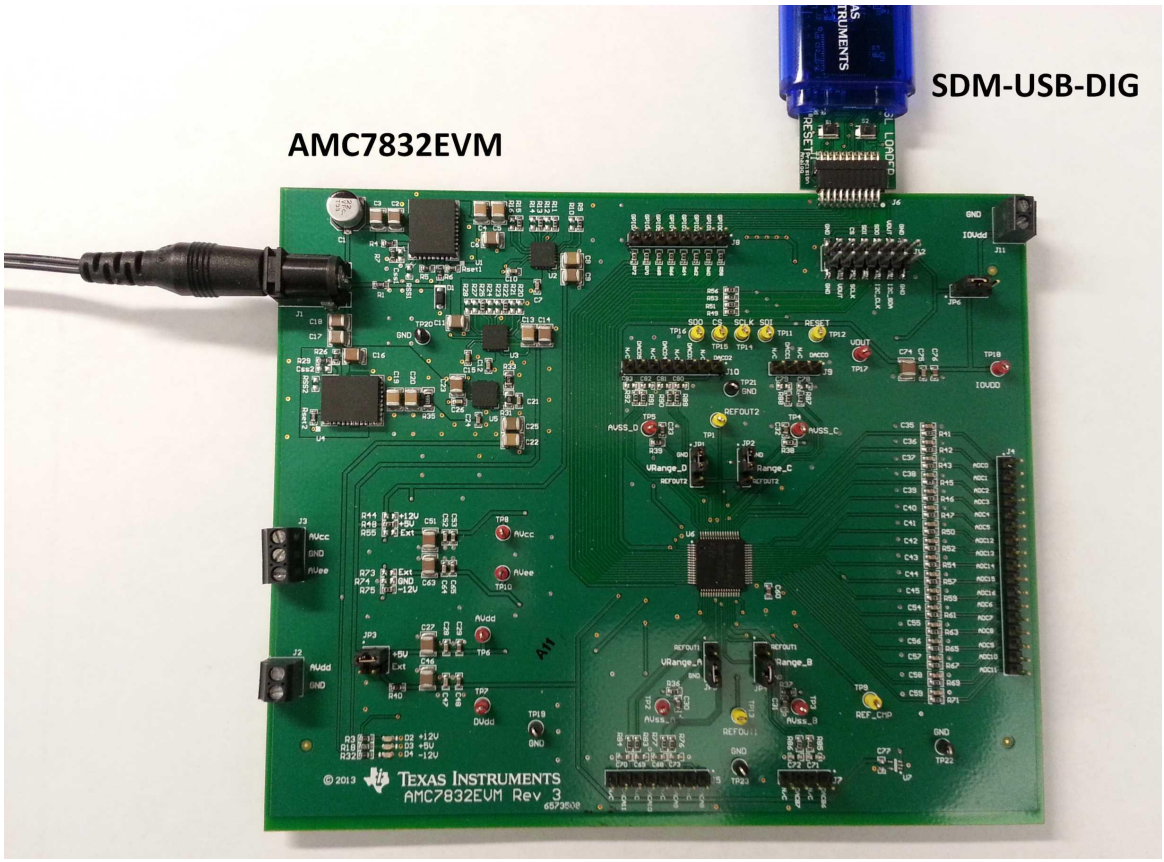


Figure 6. Typical Hardware Connections on the AMC7832EVM

4.3 Connecting the USB Cable to the SDM-USB-DIG

Figure 7 shows the typical response when connecting the SDM-USB-DIG platform to a USB port of a PC for the first time. The PC usually responds with a popup dialog window that states Found New Hardware, USB Device. The popup window then changes to Found New Hardware, Virtual COM Port (CDC). This popup indicates that the device is ready for use. The CDC driver is used for communication between the SDM-USB-DIG and PC.

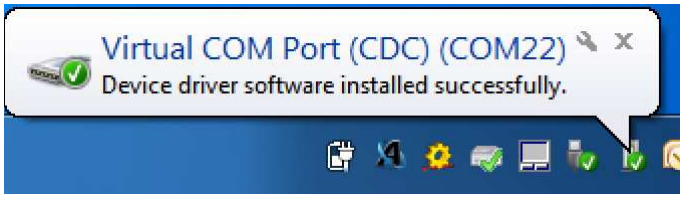


Figure 7. Confirmation of SDM-USB-DIG Platform Driver Installation

4.4 AMC7832EVM Power Configurations

This section describes the various power configurations that can be used by the EVM.

The AMC7832EVM provides terminal blocks for external supplies as well as (optional) onboard power conditioning to convert a 24-V supply into a +12-V, -12-V, and 5-V supply. Jumpers JP3 and JP6 can be configured to use external supplies through the J2 and J11 terminal blocks or the jumpers can be configured for the onboard regulated supplies. Additionally, the AV_{CC} and AV_{EE} inputs are, by default, connected to external terminal blocks, but can be configured to use the onboard regulated supplies by populating the shunt resistors as shown in Table 5.

Copyright © 2014–2016, Texas Instruments Incorporated

Additionally, IOV_{DD} is supplied by the SDM-USB-DIG, but can be externally sourced by setting the JP6 jumper, and connecting an external source to the J11 terminal block.

Table 5. AMC7832EVM Jumper and Shunt Resistor Settings

SIGNAL	JUMPER	DEFAULT POSITION	FUNCTION
AV_{DD}	JP3	Shunt on 1-2	Selecting Internal or External AV_{DD} • 1-2: Internal 5-V supply • 2-3: External supply
IOV_{DD}	JP6	Shunt on 1-2	Selecting Internal or External IOV_{DD} • 1-2: Internal 3.3-V supply • 2-3: External supply
AV_{CC}	R44, R48, R55	R44 – Not populated	+12-V LDO supply
		R48 – Not populated	+5-V LDO supply (default)
		R55 – 0-Ω shunt	External supply
AV_{EE}	R73, R74, R75	R73 – 0-Ω shunt	External supply
		R74 – Not populated	GND
		R75 – Not populated	–12-V LDO supply (default)

4.5 ADC Signal Pins

The AMC7832 device contains 17 ADC single-ended channels, 12 of which have bipolar inputs (ADC0 through ADC11) and have an input range of –12.5 to 12.5 V. The unipolar inputs, (ADC12 through ADC16), have a range of 0 to 5 V. These signal pins are connected to the J4 connector, which is described in Table 6.

Table 6. AMC7832EVM ADC Signal Connections

NAME	CONNECTOR	DESCRIPTION
ADC0	J4-1	ADC Channel 0 Input
ADC1	J4-2	ADC Channel 1 Input
ADC2	J4-3	ADC Channel 2 Input
ADC3	J4-4	ADC Channel 3 Input
ADC4	J4-5	ADC Channel 4 Input
ADC5	J4-6	ADC Channel 5 Input
ADC6	J4-12	ADC Channel 6 Input
ADC7	J4-13	ADC Channel 7 Input
ADC8	J4-14	ADC Channel 8 Input
ADC9	J4-15	ADC Channel 9 Input
ADC10	J4-16	ADC Channel 10 Input
ADC11	J4-17	ADC Channel 11 Input
LV_ADC12	J4-7	ADC Channel 12 Input
LV_ADC13	J4-8	ADC Channel 13 Input
LV_ADC14	J4-9	ADC Channel 14 Input
LV_ADC15	J4-10	ADC Channel 15 Input
LV_ADC16	J4-11	ADC Channel 16 Input

4.6 DAC Signal Pins

The 12 DAC voltage outputs of the AMC7832 device are accessible through the J5, J7, J9, and J10 connectors, as shown in Table 7. The DAC voltage ranges are configurable through software and hardware. Table 4 describes the selectable voltage ranges and jumper configurations for JP1, JP2, JP4, and JP5.

Copyright © 2014–2016, Texas Instruments Incorporated

Table 7. AMC7832EVM DAC Signal Connections

NAME	CONNECTOR	DESCRIPTION
DACC0	J9-1	DAC-C0 output
DACC1	J9-3	DAC-C1 output
DACD2	J10-1	DAC-D2 output
DACD3	J10-3	DAC-D3 output
DACD4	J10-5	DAC-D4 output
DACD5	J10-7	DAC-D5 output
DACB6	J7-1	DAC-B6 output
DACB7	J7-3	DAC-B7 output
DACA8	J5-1	DAC-A8 output
DACA9	J5-3	DAC-A9 output
DACA10	J5-5	DAC-A10 output
DACA11	J5-7	DAC-A11 output

Table 8. AMC7832EVM DAC Range Connections

JUMPER	DEFAULT POSITION	CONNECTION	FUNCTION
JP1	Shunt on 1-2	GND	1-2: (DAC Range 0 to 5 V or 0 to 10 V)
		REFOUT2	2-3: (DAC Range –10 to 0 V)
JP2	Shunt on 1-2	GND	1-2: (DAC Range 0 to 5 V or 0 to 10 V)
		REFOUT2	2-3: (DAC Range –10 to 0 V)
JP4	Shunt on 2-3	REFOUT1	1-2: (DAC Range –10 to 0 V)
		GND	2-3: (DAC Range 0 to 5 V or 0 to 10 V)
JP5	Shunt on 2-3	REFOUT1	1-2: (DAC Range –10 to 0 V)
		GND	2-3: (DAC Range 0 to 5 V or 0 to 10 V)

4.7 GPIO Signal Pins

The 8 GPIO signals on the EVM can be measured on the J8 header. A signal description of the J8 header is provided in Table 9.

Table 9. AMC7832EVM GPIO Signal Definition

NAME	CONNECTOR	DESCRIPTION
GPIO0	J8-1	General Purpose I/O (GPIO0)
GPIO1	J8-2	General Purpose I/O (GPIO1)
GPIO2	J8-3	General Purpose I/O (GPIO2)
GPIO3	J8-4	General Purpose I/O (GPIO3)
GPIO4	J8-5	General Purpose I/O (GPIO4)
GPIO5	J8-6	General Purpose I/O (GPIO5)
GPIO6	J8-7	General Purpose I/O (GPIO6)
GPIO7	J8-8	General Purpose I/O (GPIO7)

NOTE: External 10-kΩ pullup resistors are required for GPIO4 to GPIO7 operation.

Copyright © 2014–2016, Texas Instruments Incorporated

5 AMC7832EVM Software Overview

This section discusses how to use the AMC7832EVM software.

5.1 Starting the AMC7832EVM Software

After the hardware connections are established and jumper settings configured, launch the software located in the AMC7832EVM folder of the Start All Programs menu, and select the AMC7832EVM icon.

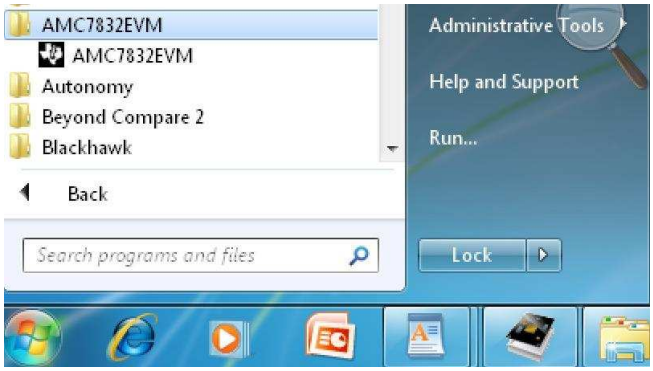


Figure 8. AMC7832EVM GUI Location

If the SDM-USB-DIG is properly connected to the AMC7832EVM, the GUI should automatically power on the system and display *CONNECTED: Power On* in the upper right area of the GUI (see Figure 9).

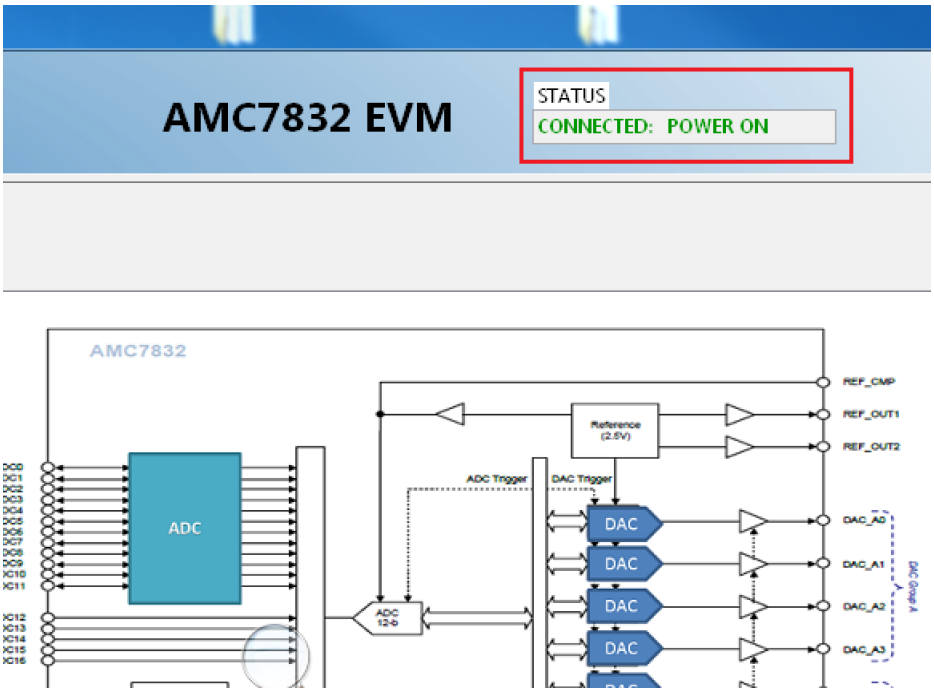


Figure 9. AMC7832EVM GUI – Power On

If the SDM-USB-DIG has a faulty connection, or is not connected at all, the GUI launches in simulation mode. In simulation mode, *NOT CONNECTED: Simulating* is displayed in the top right area of the GUI. If this text appears while the SDM-USB-DIG device is connected, then unplug the SDM-USB-DIG and close the GUI. Reconnect the SDM-USB-DIG, and ensure that the connectors are correctly aligned. After doing those steps, verify the USB extender cable is properly connected to both the SDM-USB-DIG and PC, and relaunch the GUI. This issue can also occur if the CDC driver is installed incorrectly. The AMC7832EVM software may need to be reinstalled.

Copyright © 2014–2016, Texas Instruments Incorporated

5.2 AMC7832EVM Software Features

The following subsections describe the functionality of each page of the AMC7832EVM GUI.

5.2.1 Software Reset

The AMC7832 *Software Reset* button, shown in Figure 10, resets the AMC7832 device and resets all registers to their default setting.

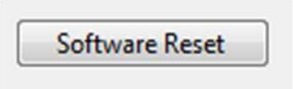


Figure 10. Software Reset Button

5.2.2 AMC7832EVM Low Level Configuration Page

The AMC7832EVM features a register map page that allows access to low-level communication by directly writing to and reading from the AMC7832 device's registers. Selecting a register on the Register Map list presents a description of the values in that register and also displays information such as the register's address, default value, size, and current value. The register values can be modified through the Hex Write Register field, or set through Boolean checkboxes in the Register Data column, as displayed in Figure 11.

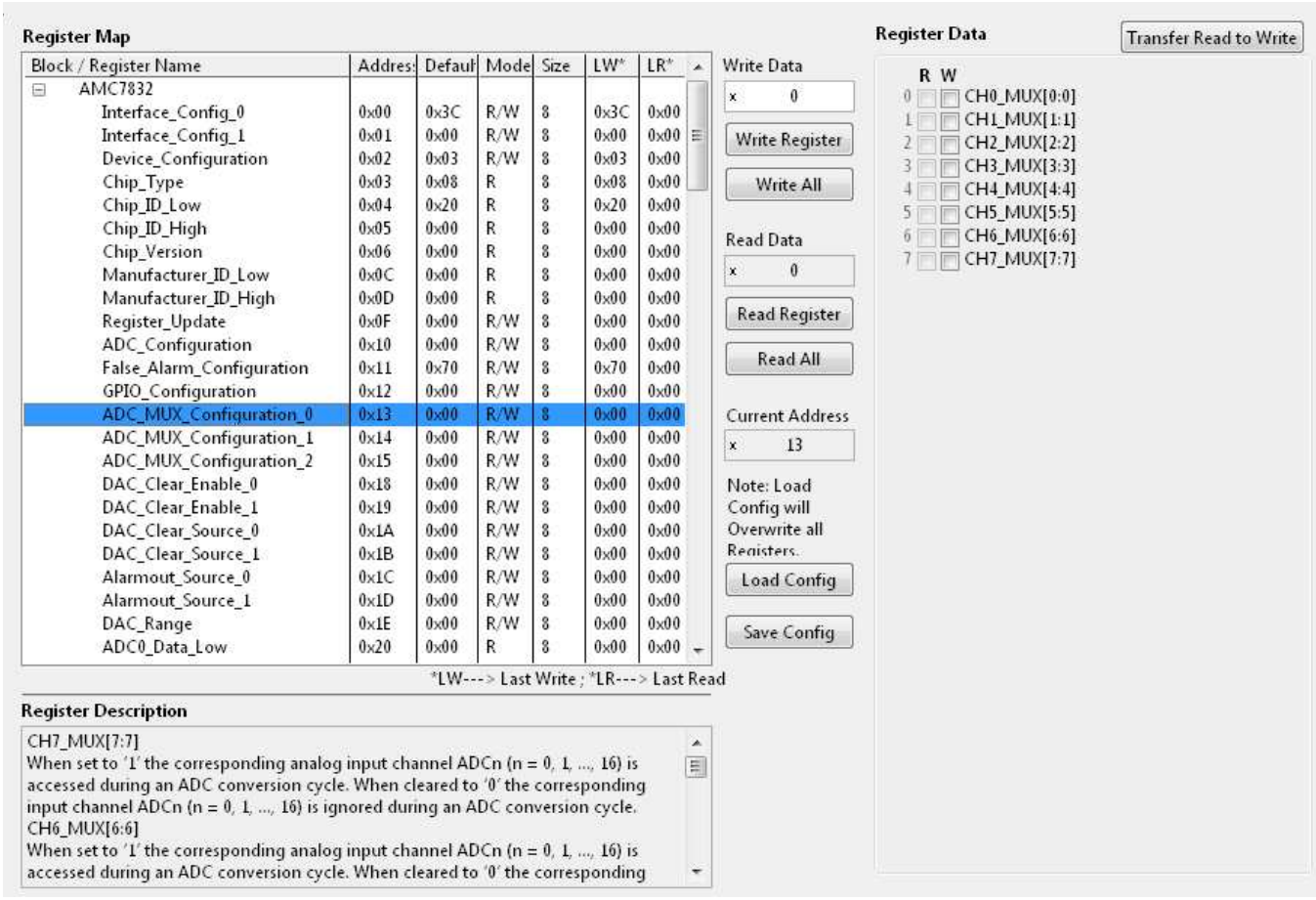


Figure 11. Low Level Configuration Page

Copyright © 2014–2016, Texas Instruments Incorporated

This low-level configuration page also provides the option to save the register map settings as a configuration file, which is done by pressing the *Save Config* button. Additionally, the configuration files can be accessed through the *Load Config* button.

5.2.3 AMC7832EVM ADC Page

This page provides insight into the functionality of the AMC7832 device's (17) channel 12-bit ADC. The ADC block includes 12 high-voltage bipolar ADC channels featuring a –12.5-V to 12.5-V input range, and 5 low-voltage unipolar analog channels that accept a range of 0-V to 5-V. The high-voltage channels are labeled as (ADC0 through ADC11), while the low-voltage channels are printed as (LV_ADC12 through LV_ADC16). Figure 12 displays the ADC Page.

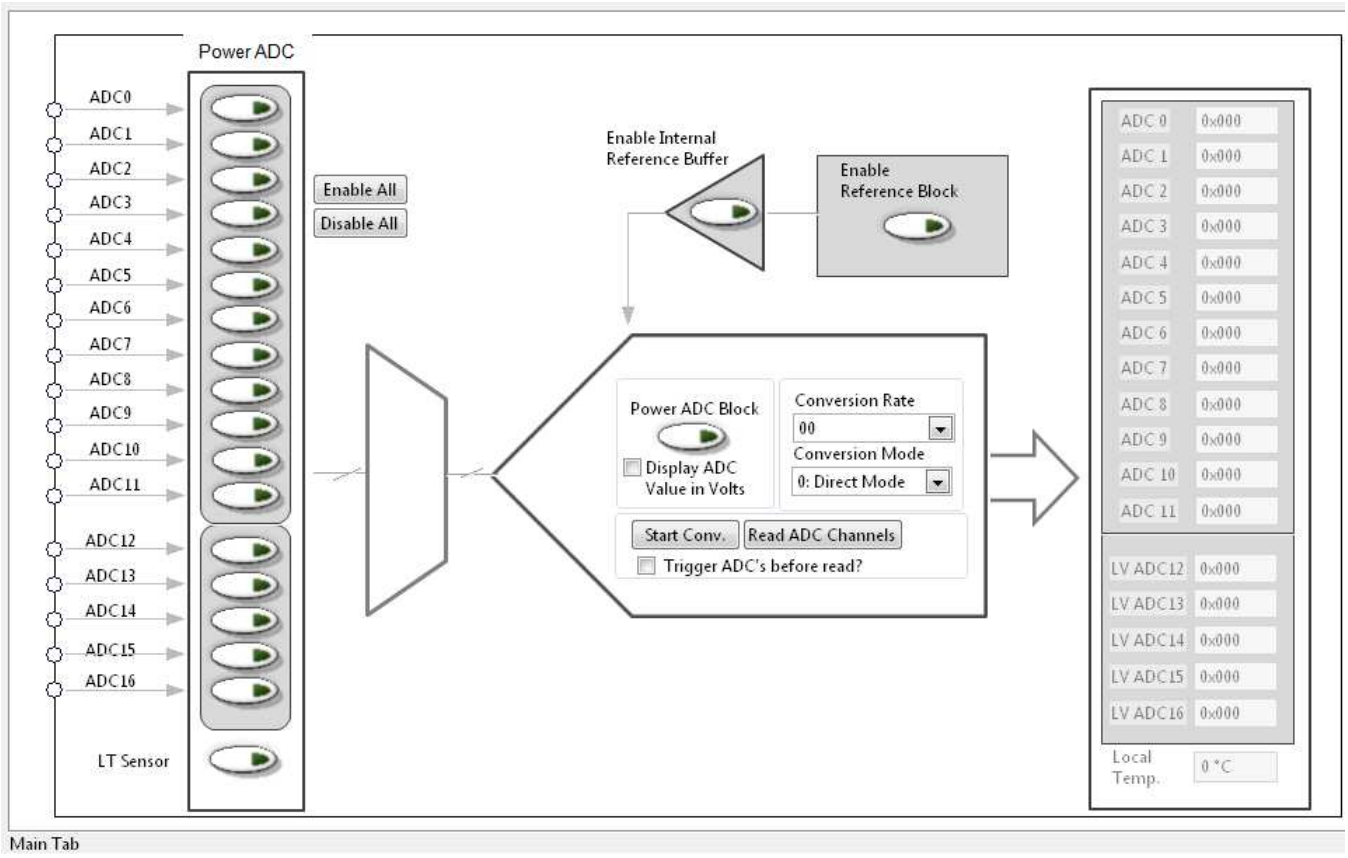


Figure 12. ADC Page

To completely activate the ADC block, the *Enable Reference Block* must be enabled, along with the *Enable Internal Reference Buffer* and *Power ADC Block*. This sequence is shown in Figure 13.

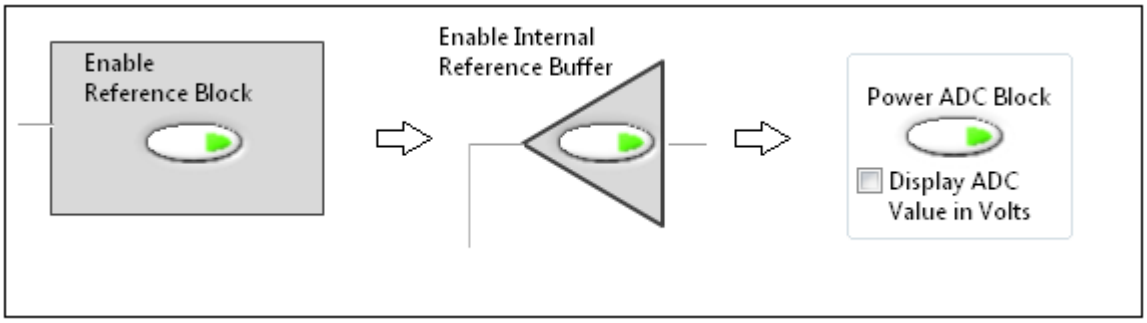


Figure 13. ADC Block Activation Sequence

Copyright © 2014–2016, Texas Instruments Incorporated

After the device is configured, individual channels can be enabled by selecting their respective *ADC MUX* button, as shown in Figure 14.



Figure 14. ADC Channel MUX

To trigger conversions, press the *Start Conv* button or automatically trigger conversions before every read by enabling the auto-trigger checkbox. The ADC data registers, displayed on the right side of the GUI, are updated with the converted results when the *Read ADC* button is pressed.

Most of the controls listed within the ADC image are used to setup the ADC configuration register. These include the conversion rate and conversion mode parameters, which are selectable through their respective drop-down list. The selectable conversion rates are listed in Table 10.

Table 10. Conversion Rates

CONVERSION RATE	THROUGHPUT (ADC0 THROUGH ADC11) (SINGLE-CHANNEL AUTO MODE)	THROUGHPUT (LVADC12 THROUGH LVADC16) (SINGLE-CHANNEL AUTO MODE)
00	29 kSPS	87 kSPS
01	29 kSPS	43.5 kSPS
10	29 kSPS	29 kSPS
11	14.5 kSPS	14.5 kSPS

The conversion mode can be either auto or direct mode. In direct mode, the analog inputs, specified in the ADC channel registers, are converted sequentially one time. In auto mode, the analog inputs are converted sequentially and repeatedly. After a conversion is completed, the ADC multiplexer returns to the first channel and repeats the process.

The internal local temperature sensor is accessible through the *LT Sensor* button and is updated after a conversion is triggered and the *Read ADC* button is pressed.

5.2.4 AMC7832EVM DAC Page

The DAC page gives the user an interface to observe and control the different data registers, modes, and configurations available for each individual DAC channel.

To fully activate the DAC block, set the *Enable Reference Block*. To set the DAC channels individually, select their respective checkbox in the Power DACs column (see Figure 15).

Copyright © 2014–2016, Texas Instruments Incorporated

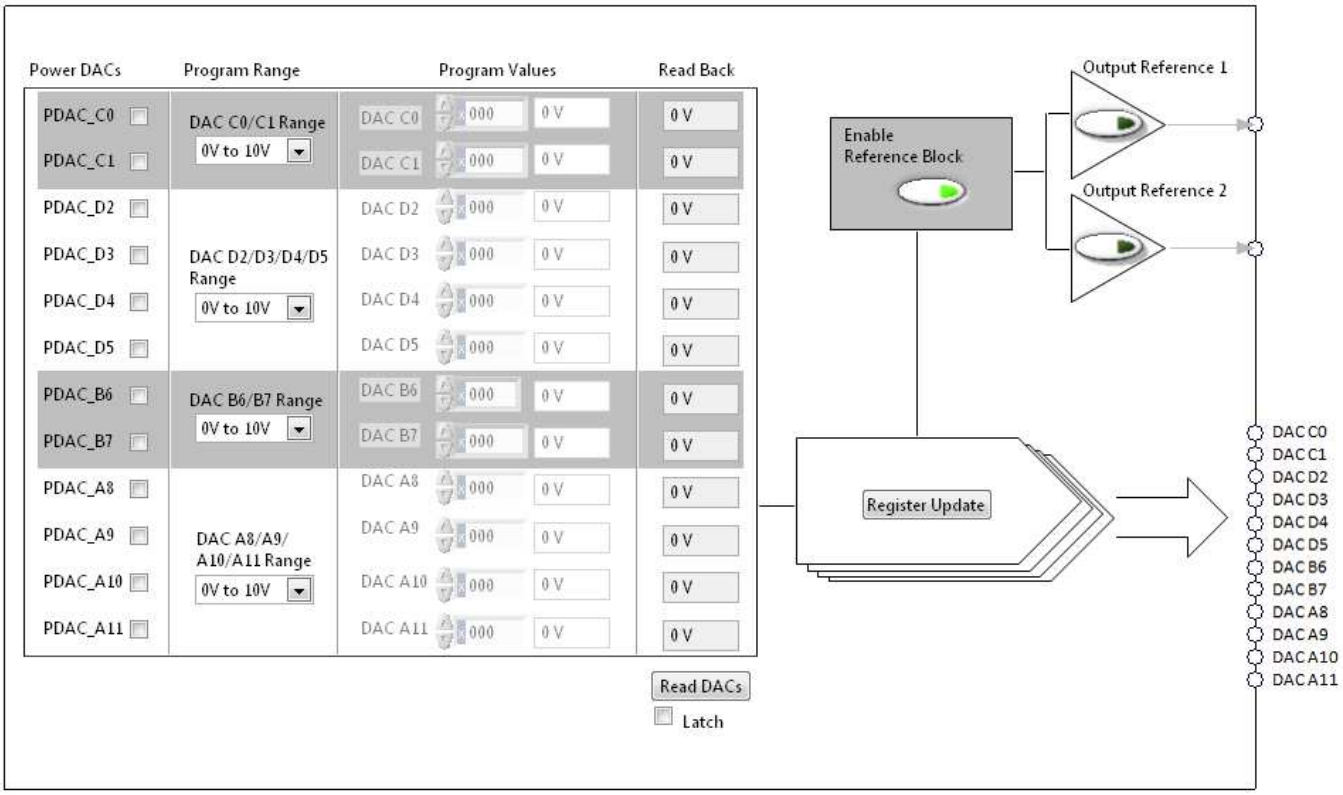


Figure 15. DAC Page

The 12 DAC channels are broken up into different DAC banks, where each channel within a bank shares a common programmable voltage range, which is selectable through the Program Range column. The default range upon startup is the 0-V to 10-V range, but it should be noted that this range is not fully realizable because AV_{CC} is connected to the +5-V LDO supply. For default operation, it is better to select the 0-V to 5-V range. If the 0-V to 10-V range is desired, populate the correct shunt resistor for AV_{CC}, shown in Table 5, to connect the AV_{CC} supply to +12-V.

NOTE: Special care must be taken when selecting the –10-V to 0-V range, as this requires an external jumper modification and also requires that the user select the appropriate *Output Reference* button. The *Output Reference 1* button sets the negative voltage range for DAC Banks A and B, while the *Output Reference 2* button sets the negative range for DAC Banks C and D. The DAC voltage range jumper settings are displayed in Table 8. Ensure that the AMC7832EVM board is powered off before selecting different jumper positions.

The DAC page also displays two input fields in the Program Values column (see Figure 16).

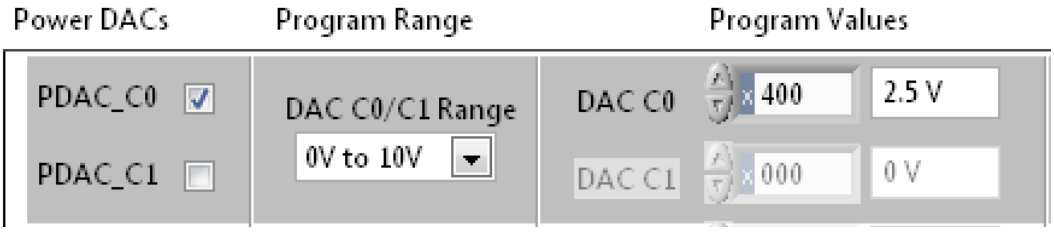


Figure 16. Program DAC Registers

Copyright © 2014–2016, Texas Instruments Incorporated

Either one of these windows can be programmed with the desired DAC output voltage or hexadecimal value. When these values are entered, they are instantly written to the internal DAC buffer register. Pressing the *Register Update* button shifts the contents of the DAC buffer stage to the DAC latch stage, which then updates the DAC output voltage.

The Read Back column allows the user to read back the register contents of either the latch or buffer stage, which is selectable through the Boolean checkbox below the *Read DACs* button, as shown in Figure 17. The results are read back after the *Read DACs* button is pressed.

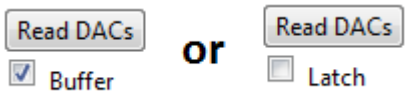


Figure 17. DAC Read

5.2.5 AMC7832EVM ALARMS Page

The AMC7832 ALARMS page gives the user access to the programmable out-of-range alarms for the internal temperature sensor and low-voltage ADC channels (ADC12 through ADC16). Figure 18 displays the ALARMS page of the AMC7832EVM. The page displays the name of each alarm, shown in the Alarm Name column, and provides information such as the value, high limit, low limit, and alarm status, along with other additional options.

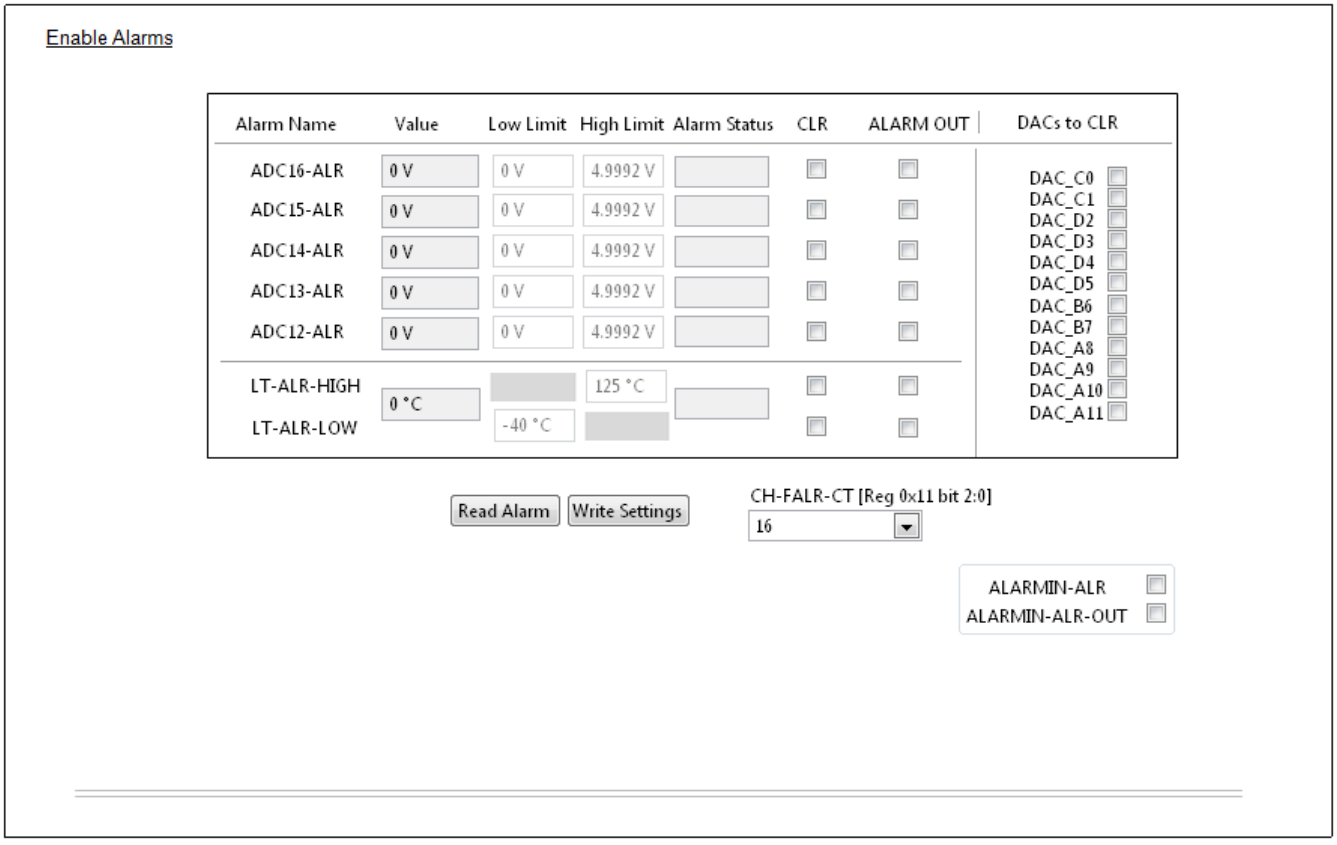


Figure 18. ALARMS Page

To use the ALARMS page, enable the ADC channel or temperature sensor in the ADCs page of the GUI. Achieve this by enabling the appropriate channel's mux. After the channels are active, the Low Limit and High Limit fields are available to edit (see Figure 19).

Copyright © 2014–2016, Texas Instruments Incorporated

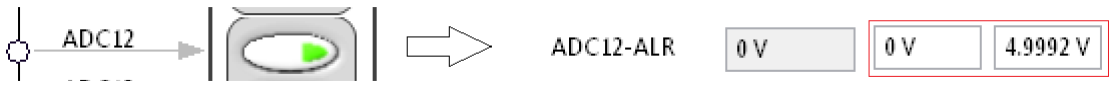


Figure 19. Enable Low Limit and High Limit Fields

The *Write Settings* button is used to write the values from the Low Limit and High Limit fields into the device. The *Read Alarm* button is used to read the state of the active channels. When an alarm is triggered, the Alarm Status will display the text 'Tripped' in red. If the channel values are within the range of the alarm thresholds the status will display 'No Alarm' in black text.

Figure 20 displays the False Alarm protection, CH-FALR-CT drop-down list, which contains integer values that are related to the consecutive number of samples required for the alarm to activate. The list defaults to 16 consecutive samples, and therefore requires 16 conversions with an over range value before the alarm is triggered.

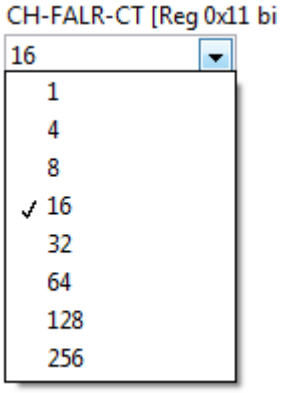


Figure 20. CH-FALR-CT Menu

The CLR, ALARM OUT, and DACs to CLR column, as shown in Figure 21, allow the user to tie DAC output behavior to alarm events. By selecting the CLR checkbox, the alarm events are able to force the DACs into a clear state, regardless of which DAC operation mode is active, auto or manual. The DAC channels to clear are selectable under the DACs to CLR column.

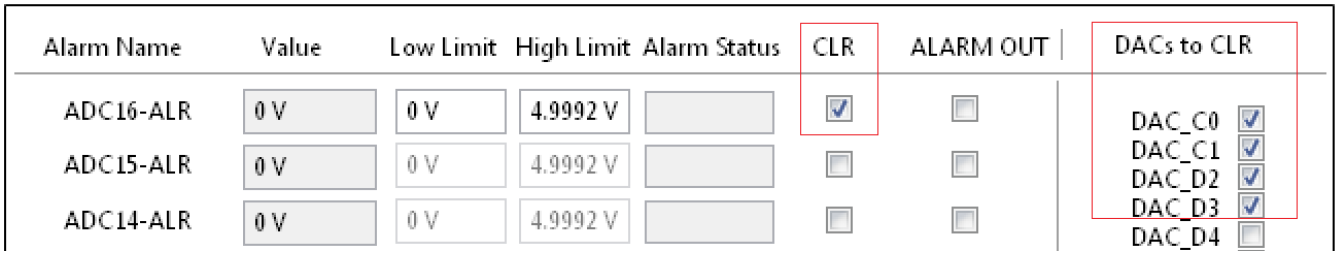


Figure 21. Clear DAC Options

The ALARM OUT checkbox allows the device to create an external signal on GPIO1 that goes low (active) when an alarm event is detected. The general-purpose I/O, more specifically GPIO1 must be configured for ALARMOUT for this function to take effect.

The ALARMIN-ALR checkbox gives the user the ability to clear the DACs with an active low input signal through GPIO0. Just as with GPIO1, GPIO0 must be configured for ALARMIN for this function to take effect.

Copyright © 2014–2016, Texas Instruments Incorporated

The ALARMIN-ALR-OUT checkbox enables the propagation of alarm signals by allowing the user to input an active-low signal to the ALARMIN pin, which then creates an active low signal on the ALARMOUT pin. These functions need to be set in the GPIO configuration register, which is available for configuration in the GPIO page of the AMC7832EVM GUI.

5.2.6 AMC7832EVM GPIO Page

The AMC7832 GPIO page features the first four (GPIO0 to GPIO3) general-purpose I/O of the AMC7832 device. These four GPIOs are also configurable for other specific functions, including the ability to externally trigger conversions, enable alarms, and provide an output indicating conversion completion. The GPIO page also provides a detailed description textbox that gives more information about the different GPIO pins as the user hovers over the pulldown list under the GPIO Block column (see Figure 22).

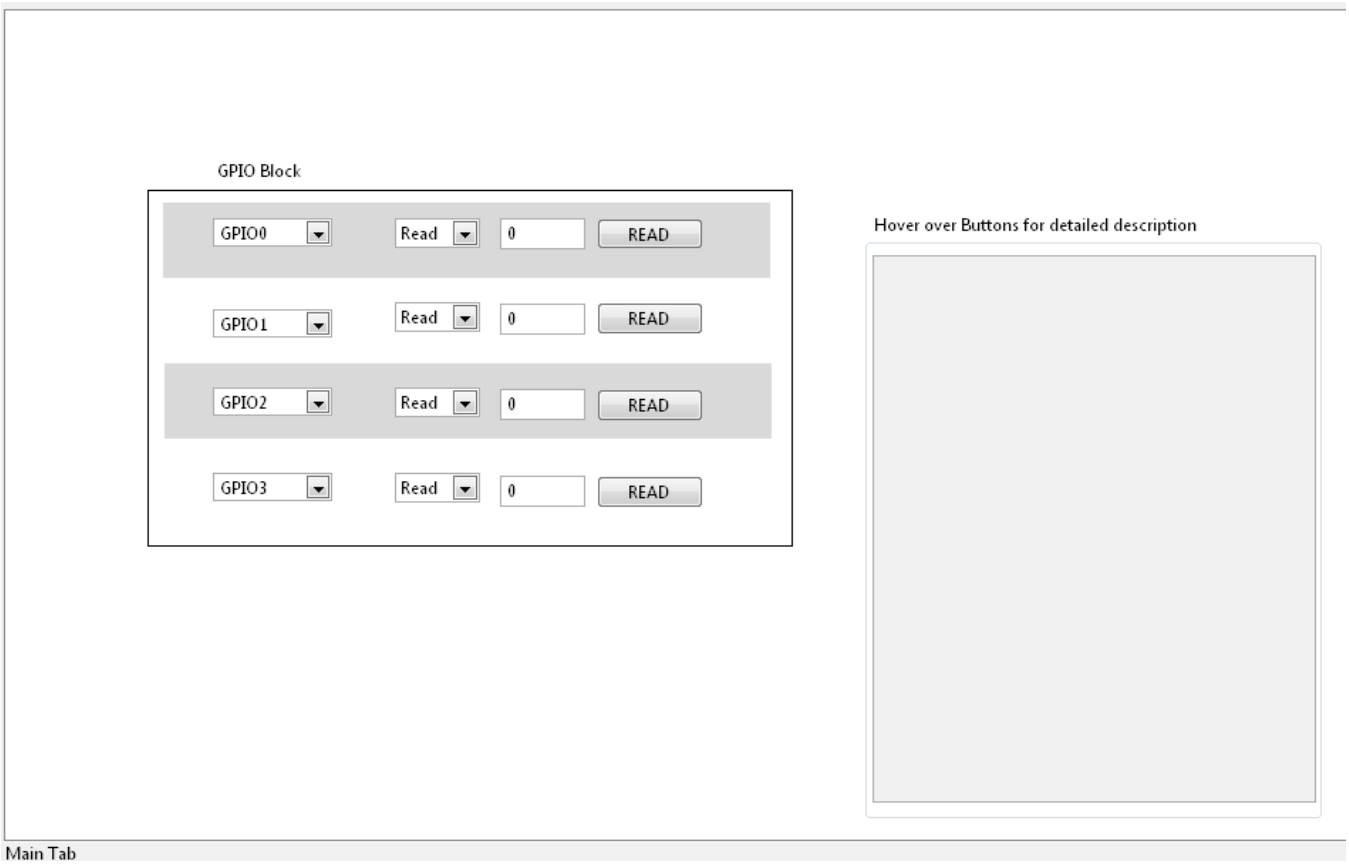


Figure 22. GPIO Page

Use the GPIO Block section of the GPIO tab, as shown in Figure 23, to set the various GPIO functions. The drop-down menu defaults to general-purpose I/O. To perform a write or read, set the W/R Function pulldown to either Write or Read. The W/R value enables the user to input or observe the Boolean value of the GPIO register. Press the *Generate Write/Read* button to write to or read from the GPIO pin.

Copyright © 2014–2016, Texas Instruments Incorporated

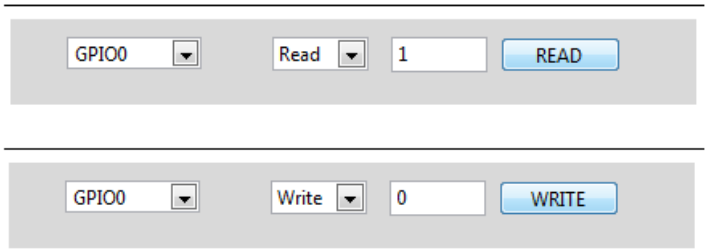


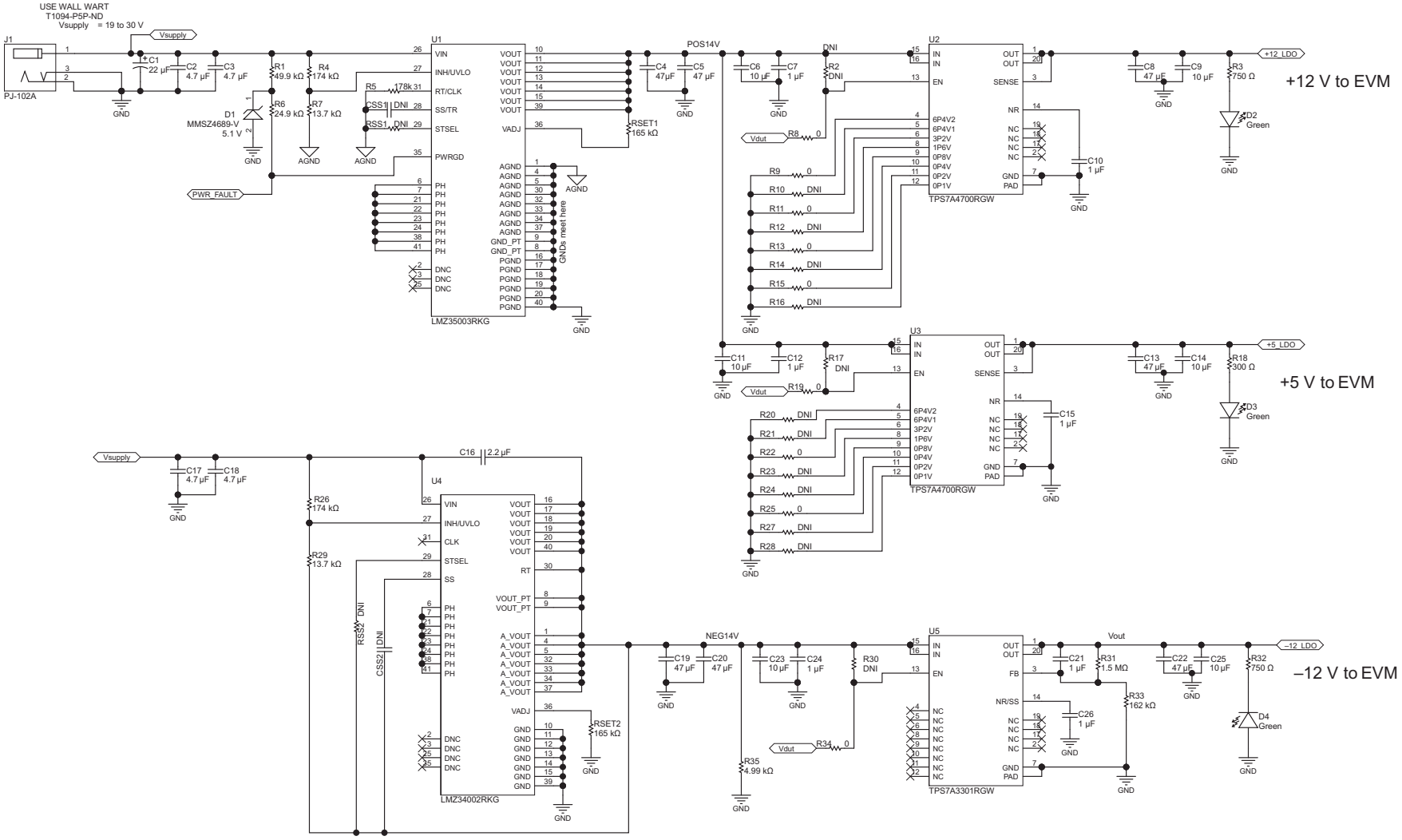
Figure 23. GPIO Write or Read

Copyright © 2014–2016, Texas Instruments Incorporated

6 AMC7832EVM Documentation

This section contains the schematic diagrams and complete bill of materials for the AMC7832EVM. Documentation information for the SDM-USB-DIG platform can be found in the *SDM-USB-DIG Platform User's Guide*, SBOU136, available at the TI website at www.ti.com.

6.1 AMC7832EVM Board Schematic



Copyright © 2014–2016, Texas Instruments Incorporated

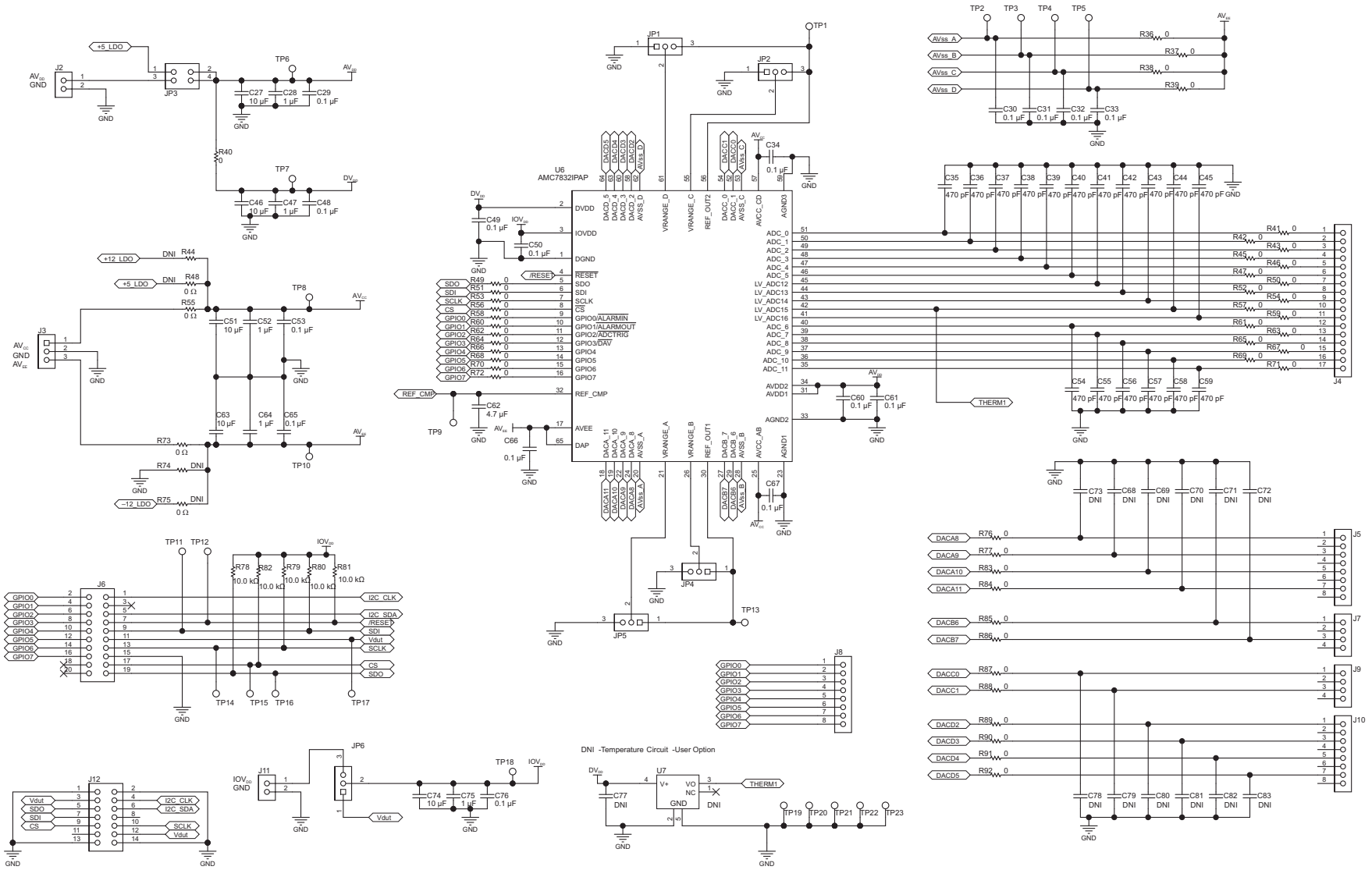


Figure 24. Board Schematic

Copyright © 2014–2016, Texas Instruments Incorporated

6.2 AMC7832EVM PCB Components Layout

Figure 25 shows the layout of the components for the AMC7832EVM board.

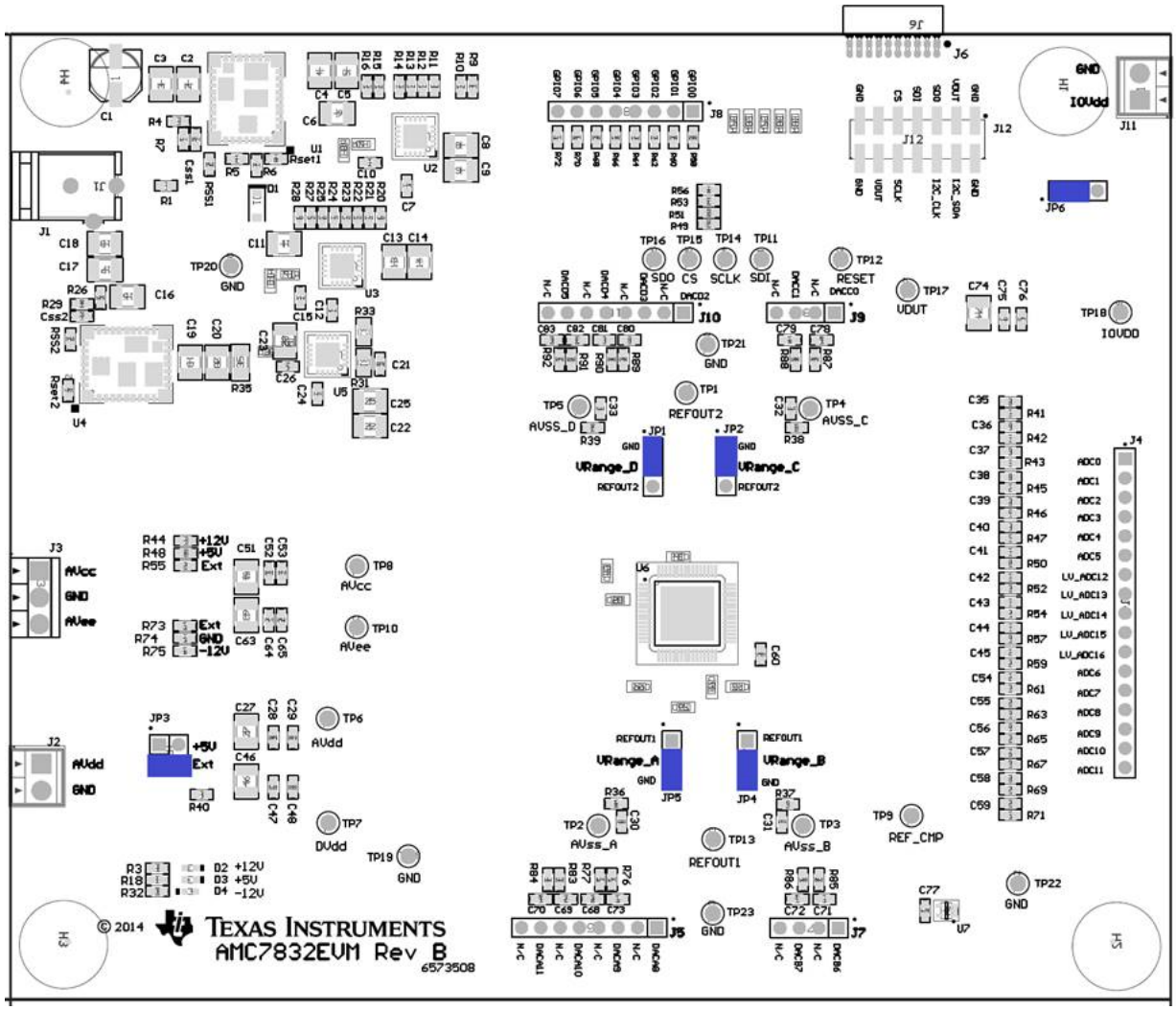


Figure 25. AMC7832EVM PCB Components Layout

Copyright © 2014–2016, Texas Instruments Incorporated

6.3 AMC7832 Test Board Bill of Materials

Table 11. Bill of Materials

ITEM	QTY	REF DES	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1		Printed Circuit Board	Any	6573508
2	1	C1	CAP, AL, 22uF, 35V, ±20%, 1 ohm, SMD	Panasonic	EEE-FC1V220P
3	4	C2, C3, C17, C18	CAP, CERM, 4.7uF, 50V, ±10%, X7R, 1210	MuRata	GRM32ER71H475KA88L
4	7	C4, C5, C8, C13, C19, C20, C22	CAP, CERM, 47uF, 16V, ±10%, X5R, 1210	MuRata	GRM32ER61C476KE15L
5	11	C6, C9, C11, C14, C23, C25, C27, C46, C51, C63, C74	CAP, CERM, 10uF, 25V, ±10%, X5R, 1210	MuRata	GRM32DR61E106KA12L
6	12	C7, C10, C12, C15, C21, C24, C26, C28, C47, C52, C64, C75	CAP, CERM, 1uF, 25V, ±10%, X5R, 0603	MuRata	GRM188R61E105KA12D
7	1	C16	CAP, CERM, 2.2uF, 100V, ±10%, X7R, 1210	MuRata	GRM32ER72A225KA35L
8	16	C29, C30, C31, C32, C33, C34, C48, C49, C50, C53, C60, C61, C65, C66, C67, C76	CAP, CERM, 0.1uF, 50V, ±10%, X7R, 0603	MuRata	GCM188R71H104KA57B
9	17	C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C54, C55, C56, C57, C58, C59	CAP, CERM, 470pF, 50V, ±10%, X7R, 0603	Kemet	C0603C471K5RACTU
10	1	C62	CAP, CERM, 4.7uF, 10V, ±10%, X5R, 0603	Kemet	C0603C475K8PACTU
11	0	C68, C69, C70, C71, C72, C73, C77, C78, C79, C80, C81, C82, C83, CSS1, CSS2	DNI		
12	1	D1	Diode, Zener, 5.1V, 500mW, SOD-123	Vishay-Semiconductor	MMSZ4689-V
13	3	D2, D3, D4	LED, Green, SMD	Lumex	SML-LX0603GW-TR
14	1	J1	Connector, DC Jack 2.1X5.5 mm, TH	CUI Inc.	PJ-102A
15	2	J2, J11	Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	On-Shore Technology	ED555/2DS
16	1	J3	Terminal Block, 6A, 3.5mm Pitch, 3-Pos, TH	On-Shore Technology	ED555/3DS
17	1	J4	Header, 100mil, 17x1, Vertical, Gold, TH	Samtec	TSW-117-08-G-S
18	3	J5, J8, J10	Header, TH, 100mil, 8x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-108-07-G-S
19	1	J6	Receptacle, 50mil 10x2, R/A, TH	Mill-Max	853-43-020-20-001000
20	2	J7, J9	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-104-07-G-S
21	1	J12	Header, 100mil, 7x2, Vertical, Gold, SMT	Samtec	TSM-107-02-L-DV-P
22	5	JP1, JP2, JP4, JP5, JP6	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec	TSW-103-07-G-S
23	1	JP3	Header, TH, 100mil, 2x2, Gold plated, 230 mil above insulator	Samtec	TSW-102-07-G-D
24	1	R1	RES, 49.9k ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-0749K9L
25	0	R2, R10, R12, R14, R16, R17, R20, R21, R23, R24, R27, R28, R30, R44, R55, R73, R74, RSS1, RSS2	DNI		
26	2	R3, R32	RES, 750 ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603750RFKEA
27	2	R4, R26	RES, 174k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603174KFKEA
28	1	R5	RES, 178k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603178KFKEA
29	1	R6	RES, 24.9k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060324K9FKEA

Copyright © 2014–2016, Texas Instruments Incorporated

Table 11. Bill of Materials (continued)

ITEM	QTY	REF DES	DESCRIPTION	MANUFACTURER	PART NUMBER
30	2	R7, R29	RES, 13.7k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060313K7FKEA
31	57	R8, R9, R11, R13, R15, R19, R22, R25, R34, R36 - R43, R45 - R54, R56 - R72, R75, R76, R77, R83 - R92	RES, 0 ohm, 5%, 0.1W, 0603	Panasonic	ERJ-3GEY0R00V
32	1	R18	RES, 300 ohm, 1%, 0.1W, 0603	Yageo America	RC0603FR-07300RL
33	1	R31	RES, 1.5Meg ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW08051M50JNEA
34	1	R33	RES, 162k ohm, 1%, 0.125W, 0805	Vishay-Dale	CRCW0805162KFKEA
35	1	R35	RES, 4.99k ohm, 1%, 0.25W, 1206	Vishay-Dale	CRCW12064K99FKEA
36	5	R78, R79, R80, R81, R82	RES, 10.0k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060310K0FKEA
37	2	RSET1, RSET2	RES, 165k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW0603165KFKEA
38	8	TP1, TP9, TP11, TP12, TP13, TP14, TP15, TP16	Test Point, TH, Miniature, Yellow	Keystone	5004
39	10	TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP10, TP17, TP18	Test Point, TH, Miniature, Red	Keystone	5000
40	5	TP19, TP20, TP21, TP22, TP23	Test Point, TH, Miniature, Black	Keystone	5001
41	1	U1	7-V to 50-V Input, 2.5-A Step-Down, Integrated Power Solution, RKG0041A	Texas Instruments	LMZ35003RKG
42	2	U2, U3	36-V, 1-A, 4.17-µVRMS, RF LDO Voltage Regulator, RGW0020A	Texas Instruments	TPS7A4700RGW
43	1	U4	4.5-V to 40-V Input, 15-W, Negative Output, Integrated Power Solution, RKG0041A	Texas Instruments	LMZ34002RKG
44	1	U5	–36-V, –1-A, Ultralow-Noise Negative Voltage Regulator, Adjustable, RGW0020A	Texas Instruments	TPS7A3301RGW
45	1	U6	12-Bit ANALOG MONITOR AND CONTROL (AMC) SOLUTION with Multichannel ADC, Bipolar DACs and Temperature Sensors, PAP0064G	Texas Instruments	AMC7832IPAP
46	0	U7	DNI		DNI
47	6	SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
48	4	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)

Copyright © 2014–2016, Texas Instruments Incorporated

Revision History

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

Changes from Original (February 2014) to A Revision **Page**

- Deleted row "+24-V wall supply" from Table 1, and added Note 1. 3
- Changed text "An optional +24-V wall supply..." in *Section 2* 4
- Changed "+24-V Wall Adapter" block in Figure 1 4
- Changed "Default" and "Optional" blocks in Figure 2 4
- Added Note 1 to Table 4 9
- Changed the second paragraph in Section 4.4 10
- Changed the DEFAULT POSITION of R48, R55, R73, and R75 in Table 5 11
- On the second page of the schematic; removed 'DNI' label and added '0 Ω' label to R55 and R73, added 'DNI' label to R48 and R75. 22
- Updated Figure 25. 24

Copyright © 2014–2016, Texas Instruments Incorporated

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・インスツルメンツ株式会社

東京都新宿区西新宿６丁目２４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。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.

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 AND CONDITIONS. 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 ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, 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 ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2015, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2016, Texas Instruments Incorporated