TLV320DAC3203EVM-K

This user's guide describes the characteristics, operation, and use of the TLV320DAC3203EVM-K. This evaluation module (EVM) features a complete stereo audio codec with several inputs and outputs, extensive audio routing, mixing, and effects capabilities. A complete circuit description, schematic diagram, and bill of materials are also included.

The following related documents are available through the TI Web site at www.ti.com.

EVM-Compatible Device Data Sheets

Device	Literature Number
TLV320DAC3203	SLOS756
TAS1020B	SLAU434

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1 EVM Overview

1.1 Features

- Full-featured evaluation board for the TLV320DAC3203 stereo audio codec.
- USB connection to PC provides power, control, and streaming audio data for easy evaluation.
- Digital microphone connections
- Connection points for external control and digital audio signals for quick connection to other circuits or input devices.

The TLV320DAC3203EVM-K is a complete evaluation kit, including a universal serial bus (USB)-based motherboard and evaluation software for use with a personal computer (PC) running the Microsoft Windows™ operating systems XP, Vista or 7…

1.2 Introduction

The TLV320DAC3203EVM is in the TI modular EVM form factor, allowing direct evaluation of the device performance and operating characteristics and simplifying software development and system prototyping.

The TLV320DAC3203EVM-K is a complete evaluation and demonstration kit, including a USB-based motherboard called the USB-MODEVM Interface board and evaluation software compatible with a PC running the Microsoft Windows operating systems.

The TLV320DAC3203EVM-K is operational with one USB cable connection to a PC. The USB connection provides power, control, and streaming audio data to the EVM for reduced setup and configuration. The EVM also allows external control signals, audio data, and power for advanced operation. This allows prototyping and connection to the rest of the development, and system evaluation.

2 EVM Description and Basics

This section provides information on the analog input and output, digital control, power, and general connection of the TLV320DAC3203EVM-K.

2.1 TLV320DAC3203EVM-K Block Diagram

The TLV320DAC3203EVM-K consists of two separate circuit boards, the USB-MODEVM and the TLV320DAC3203EVM. The USB-MODEVM is built around the TAS1020B streaming audio USB controller with an 8051-based core. The motherboard features two positions for modular EVMs, or install one double-wide serial modular EVM. The TLV320DAC3203EVM is one of the double-wide modular EVMs designed to work with the USB-MODEVM.

The simple diagram of Figure 1 shows how the TLV320DAC3203EVM is connected to the USB-MODEVM. The USB-MODEVM Interface board is intended for use in USB mode, where control of the installed EVM is accomplished using the onboard USB controller device. Provision is made, however, for driving all the data buses (I^2C™, SPI™, I^2S, etc.) externally. The source of these signals is controlled by SW2 on the USB-MODEVM. See Table 1 for details on the switch settings.

The USB-MODEVM has two EVM positions that allow for the connection of two small evaluation module or one larger evaluation module. The TLV320DAC3203EVM is designed to fit over both of the smaller evaluation module slots as shown in Figure 1

2.1.1 USB-MODEVM Interface Board

The simple diagram of Figure 1 shows only the basic features of the USB-MODEVM Interface board.

Because the TLV320DAC3203EVM is a double-wide modular EVM, it is installed with connections to both EVM positions, connecting the TLV320DAC3203 digital control interface to the I^2C port realized using the TAS1020B, as well as the TAS1020B digital-audio interface.

In the factory configuration, the board is ready for use with the USB-MODEVM. See the USB-MODEVM Interface board schematic in Appendix G to view all the functions and configuration options available on the USB-MODEVM board.

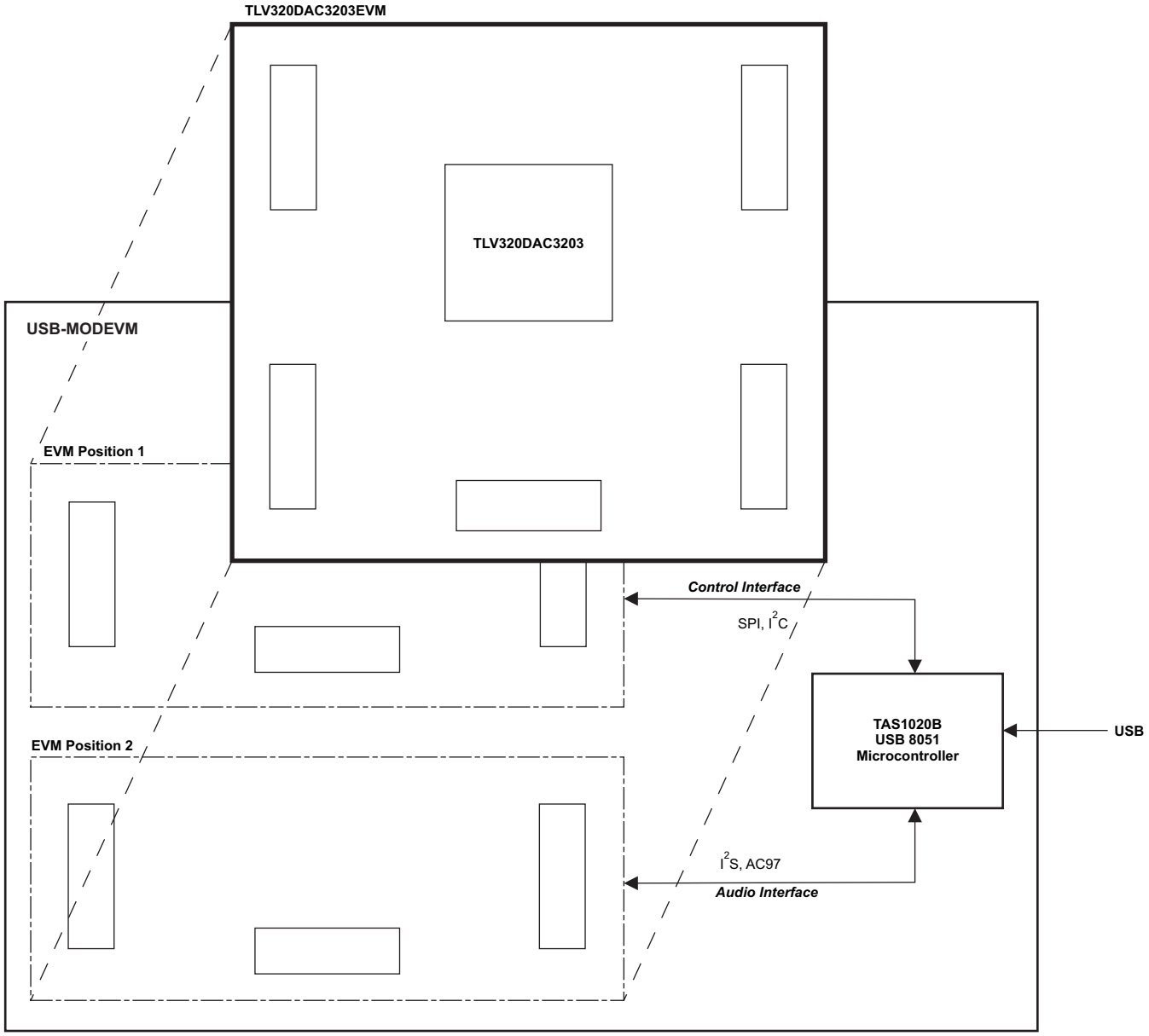


Figure 1. TLV320DAC3203EVM-K Block Diagram

2.2 Default Configuration and Connections

2.2.1 USB-MODEVM

Table 1 provides a list of the SW2 settings on the USB-MODEVM. For use with the TLV320DAC3203EVM, SW-2 positions 1, 3, 4, 5, 6, and 7 must be set to ON, whereas SW-2.2 and SW-2.8 must be set to OFF. If the TLV320DAC3203EVM is used with an external audio interface, SW2.4 and SW2.5 also must be set to OFF and such interface must be connected as explained in Section 2.4

Table 1. USB-MODEVM SW2 Settings

SW-2 Switch Number	Label	Switch Description
1	A0	USB-MODEVM EEPROM I^2C Address A0 ON: A0 = 0 OFF: A0 = 1
2	A1	USB-MODEVM EEPROM I^2C Address A1 ON: A1 = 0 OFF: A1 = 1
3	A2	USB-MODEVM EEPROM I^2C Address A2 ON: A2 = 0 OFF: A2 = 1
4	USB I^2S	I^2S Bus Source Selection ON: I^2S Bus connects to TAS1020 OFF: I^2S Bus connects to USB-MODEVM J14
5	USB MCK	I^2S Bus MCLK Source Selection ON: MCLK connects to TAS1020 OFF: MCLK connects to USB-MODEVM J14
6	USB SPI	SPI Bus Source Selection ON: SPI Bus connects to TAS1020 OFF: SPI Bus connects to USB-MODEVM J15
7	USB RST	RST Source Selection ON: EVM Reset Signal comes from TAS1020 OFF: EVM Reset Signal comes from USB-MODEVM J15
8	EXT MCK	External MCLK Selection ON: MCLK Signal is provided from USB-MODEVM J10 OFF: MCLK Signal comes from either selection of SW2-5

2.2.2 TLV320DAC3203 Jumper Locations

Table 2 provides a list of jumpers found on the EVM and their factory default conditions.

Table 2. List of Jumpers and Switches

Jumper	Default Position	Jumper Description
W1	1-2	Sets IOVDD to 3.3 V (default) or 1.8 V.
W2	2-3	Sets DIGMIC_PWR to 3.3 V (default) or 1.8 V.
W3	Removed	Connects GPIO2 to $\overline{\text{RESET}}$ line.
W4	Installed	Provides a means to measure LDOin/HPVDD current.
W5	Installed	Provides a means to measure AVDD current. *When using the internal LDO, this jumper should be removed.*
W6	Installed	Provides a means to measure DVDD current.
W7	Installed	Provides a means to measure IOVDD current.
W8	Removed	Connects 16-Ω load to HPL outputs.
W9	Removed	Connects 16-Ω load to HPR outputs.
W10	Removed	When installed, shorts across the output capacitor on HPL; remove this jumper if using AC-coupled output drive.
W11	Removed	When installed, shorts across the output capacitor on HPR; remove this jumper if using AC-coupled output drive.
W12	Removed	When inserted, connects MICBIAS to J2.4 for headset detection use.
W13	Installed	When installed, it selects onboard EEPROM as firmware source.
W14	2-3	When SW1 is configured for I^2C, selects SCLK source for digital microphone or headset detection use.
W15	Installed	Connects MISO to USB-MODEVM. Remove this jumper for digital microphone use.
SW1	Toward I^2C	When set to I^2C, the I^2C signals from P12/J12 are connected to the codec and SPI_SELECT is set low. When set to SPI, the SPI signals from P12/J12 are connected to the codec and SPI_SELECT is pulled to IOVDD.

2.3 Analog Signal Connections

2.3.1 Analog Inputs

Apply the analog input sources directly to terminal block J5 or input jack J4. The connection details are found in Appendix A.

2.3.2 Analog Output

The analog outputs are available from terminal block J1 or output jacks J2 and J3. Note that J3 is provided for signal-to-noise ratio (SNR) measurements only. The connection details are found in Appendix A.

2.4 Digital Signal Connections

The digital inputs and outputs of the EVM are monitored through P12 and P22. If external signals are connected to the EVM, digital inputs must be connected through J14 and J15 on the USB-MODEVM and the SW2 switch must be changed accordingly (see Section 2.2.1). The connector details are available in Section A.2.

2.5 Power Connections

The TLV320DAC3203EVM is powered independently when being used in stand-alone operation or by the USB-MODEVM when it is plugged onto the motherboard.

2.5.1 Stand-Alone Operation

When used as a stand-alone EVM, power is applied to P23/J23 directly, making sure to reference the supplies to the appropriate grounds on that connector.

CAUTION

Verify that all power supplies are within the safe operating limits shown on the TLV320DAC3203 data sheet before applying power to the EVM.

P23/J23 provides a connection to the common power bus for the TLV320DAC3203EVM. Power is supplied on the pins listed in Table 6.

The TLV320DAC3203EVM-K motherboard (the USB-MODEVM Interface board) supplies power to P23/J23 of the TLV320DAC3203EVM. Power for the motherboard is supplied either through its USB connection or through terminal blocks on that board.

2.5.2 USB-MODEVM Operation

The USB-MODEVM Interface board is powered from several different sources:

- USB
- 6-V_{DC} to 10-V_{DC} AC/DC external wall supply (not included)
- Laboratory power supply

When powered from the USB connection, JMP6 must have a shunt from pins 1–2 (this is the default factory configuration). When powered from 6-V_{DC} to 10-V_{DC} power supply, either through the J8 terminal block or J9 barrel jack, JMP6 must have a shunt installed on pins 2–3. If power is applied in any of these ways, onboard regulators generate the required supply voltages, and no further power supplies are necessary.

If laboratory supplies are used to provide the individual voltages required by the USB-MODEVM Interface, JMP6 must have no shunt installed. Voltages are applied to J2 (+5 VA), J3 (+5 VD), J4 (+1.8 VD), and J5 (+3.3 VD). The onboard regulators from the +5-VD supply can generate +1.8 VD and +3.3 VD on the board by setting the switches on SW1 in the ON position (lower position, looking at the board with text reading right-side up). If +1.8 VD and +3.3 VD are supplied externally, disable the onboard regulators by placing the SW1 switches in the OFF position.

Each power supply voltage has an LED (D1-D7) that illuminates when the power supplies are active.

3 TLV320DAC3203EVM-K Setup and Installation

The following section provides information on using the TLV320DAC3203EVM-K, including setup, program installation, and program usage.

3.1 Software Installation

1. Download the latest version of the DAC3203 Control Software (CS) located in the TLV320DAC3203EVM-K Product Folder.
2. Open the self-extracting installation file.
3. Extract the software to a known folder.
4. Install the EVM software by double-clicking the **Setup** executable, and follow the directions. Restart the computer, if required.

This installs all the TLV320DAC3203EVM-K software and required drivers onto the PC.

3.2 EVM Connections

1. Ensure that the TLV320DAC3203EVM is installed on the USB-MODEVM Interface board, aligning J11, J12, J21, J22, and J23 with the corresponding connectors on the USB-MODEVM.
2. Verify that the jumpers and switches are in their default conditions.
3. Attach a USB cable from the PC to the USB-MODEVM Interface board. The default configuration provides power, control signals, and streaming audio through the USB interface from the PC. On the USB-MODEVM, LEDs D3, D4, D5, and D7 illuminate, indicating that the USB is supplying power.
4. For the first connection, the PC recognizes new hardware and begins an initialization process. Identify the location of the drivers or allow the PC to automatically search for them, if prompted. Allow the automatic detection option.
5. Once the PC confirms that the hardware is operational, D2 on the USB-MODEVM illuminates, indicating that the firmware has been loaded and the EVM is ready for use. **If D2 does not illuminate, verify that the EEPROM jumper and switch settings conform to Table 1 and Table 2.**

After the TLV320DAC3203EVM-K software installation (described in Section 3.2) is complete, begin evaluation and development with the TLV320DAC3203.

If running the software in Windows Vista or 7, right click the DAC3203EVM-K CS shortcut and select 'Properties'. Configure the Compatibility tab as shown below.

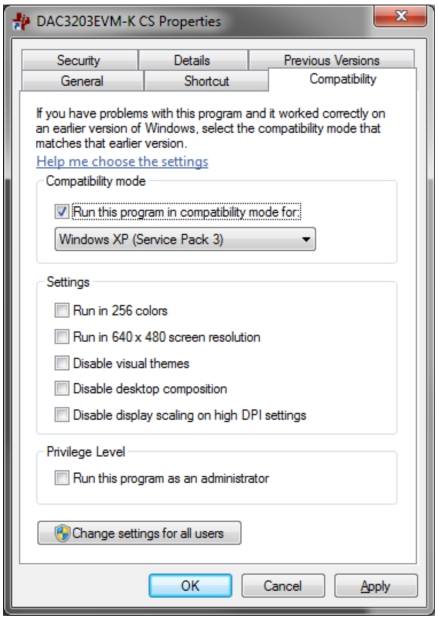


Figure 2. Compatibility Tab

The TLV320DAC3203EVM-K software can now be launched. An initial screen similar to Figure 3 is displayed.

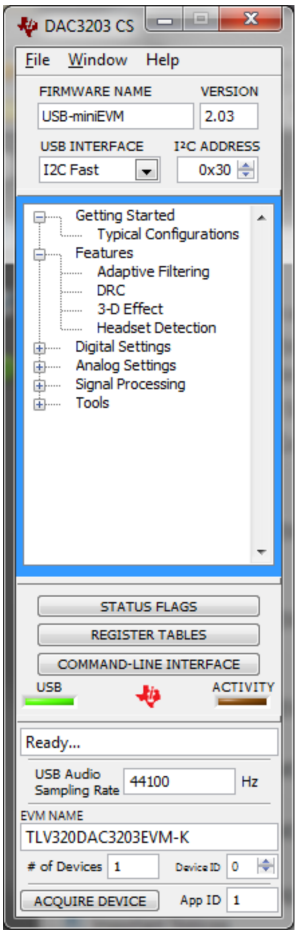


Figure 3. Initial Screen of TLV320DAC3203EVM-K Software

4 DAC3203 Control Software

The DAC3203 Control Software (CS) is an intuitive, easy-to-use, powerful tool for learning, evaluating, and controlling the TLV320DAC3203. The following sections describe the operation of this software.

NOTE: For configuration of the codec, the TLV320DAC3203 block diagram located in the TLV320DAC3203 data sheet is a good reference for determining the signal routing.

4.1 Main Panel Window

The Main Panel window, shown in Figure 3, provides easy access to all the features of the DAC3203 CS. The Firmware Name and Version boxes provide information about the firmware loaded into the EVM's EEPROM.

The USB-MODEVM Interface drop-down menu allows communication protocol selection which the TAS1020B USB Controller uses for communication with the TLV320DAC3203 or for toggling the TAS1020B GPIO pins. The TLV320DAC3203 supports I^2C Standard, I^2C Fast, and 8-bit register SPI. The USB-MODEVM Interface selection is global to all panels, including the command-line interface. Communicate with the TLV320DAC3203 using SPI by switching SW1 towards SPI and W15 must be inserted on the TLV320DAC3203EVM.

The Panel Selection Tree provides access to typical configurations, features, and other panels giving control over the TLV320DAC3203. The tree is divided into several categories containing items that pop up panels. A panel is opened by double-clicking any item inside a category in the Panel Selection Tree.

Below the Panel Selection Tree are three buttons that pop up the following:

- Status Flags - for monitoring the TLV320DAC3203 status flags
- Register Tables - for monitoring register pages
- Command-Line Interface - a tool to execute and generate scripts and monitor register activity

The USB LED indicates if the EVM kit is recognized by the software and the ACTIVITY LED illuminates every time a command request is sent.

The dialog box at the bottom of the Main Panel provides feedback of the current status of the software.

4.1.1 Typical Configurations

The Typical Configurations panel quickly increases familiarity with the TLV320DAC3203. This panel has controls relevant to the selected configuration and shows the script for that configuration loaded in a tab. Each script includes a brief description of the selected configuration, as shown in Figure 4.

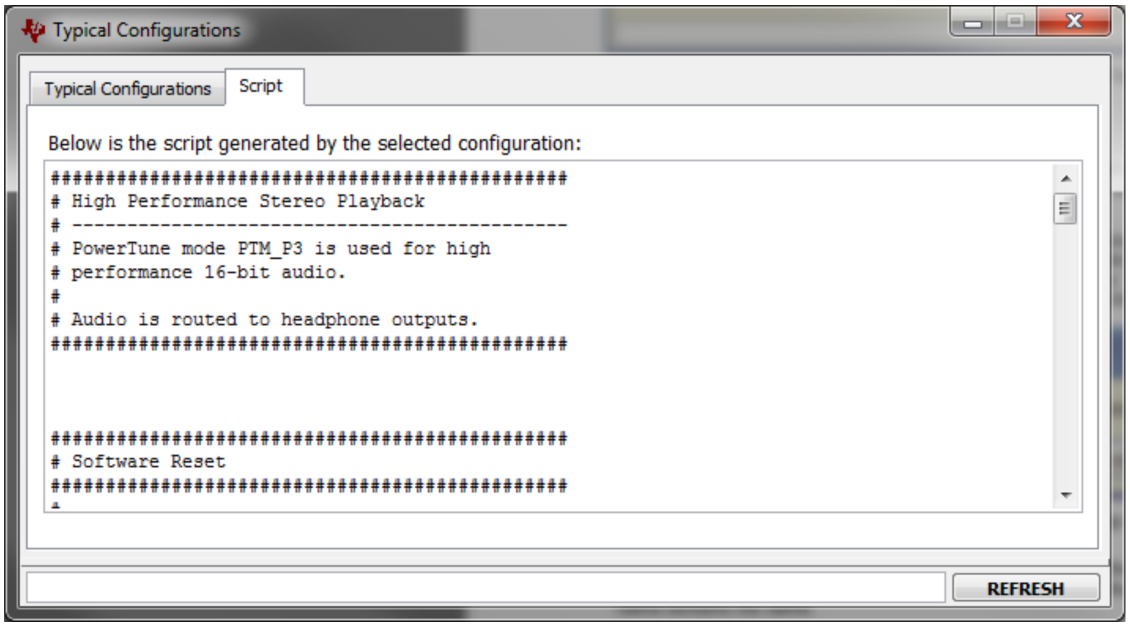


Figure 4. Playback Script Tab

4.1.2 Features

The **Features** category allows evaluation of various features of the TLV320DAC3203. Each of the **Features** panels include an **Information** tab that explains the feature and provides hardware setup information for easy evaluation.

Any item in the **Features** category is accessed with a double-click. As soon as a **Features** panel opens, a pop-up message appears asking if it can program the codec for that feature (see Figure 5). A command script is sent to the codec if the **OK** button is clicked. This script programs all registers necessary for evaluation of the feature. Bypass by clicking the **Cancel** button.

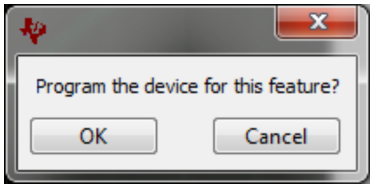


Figure 5. Program Device Pop-Up Window

The script corresponding to each feature is accessed at the Installation Directory\DATA\EVM folder. Also, each script is manually customized and loaded as the feature's start-up script as long as the file name remains the same.

4.1.3 Control Categories

The **Digital Settings**, **Analog Settings**, and **Signal Processing** categories provide control of many registers and other features of the TLV320DAC3203 . These categories are intended for the advanced user. Hovering the mouse cursor on top of a control displays a tip strip containing page, register, and bit information. As an example, hovering on top of the *J* control of the Clocks / Interface panel, as shown in Figure 6, displays p0_r6_b5-0, meaning that this control writes to Page 0/Register 6, Bits D5 to D0.

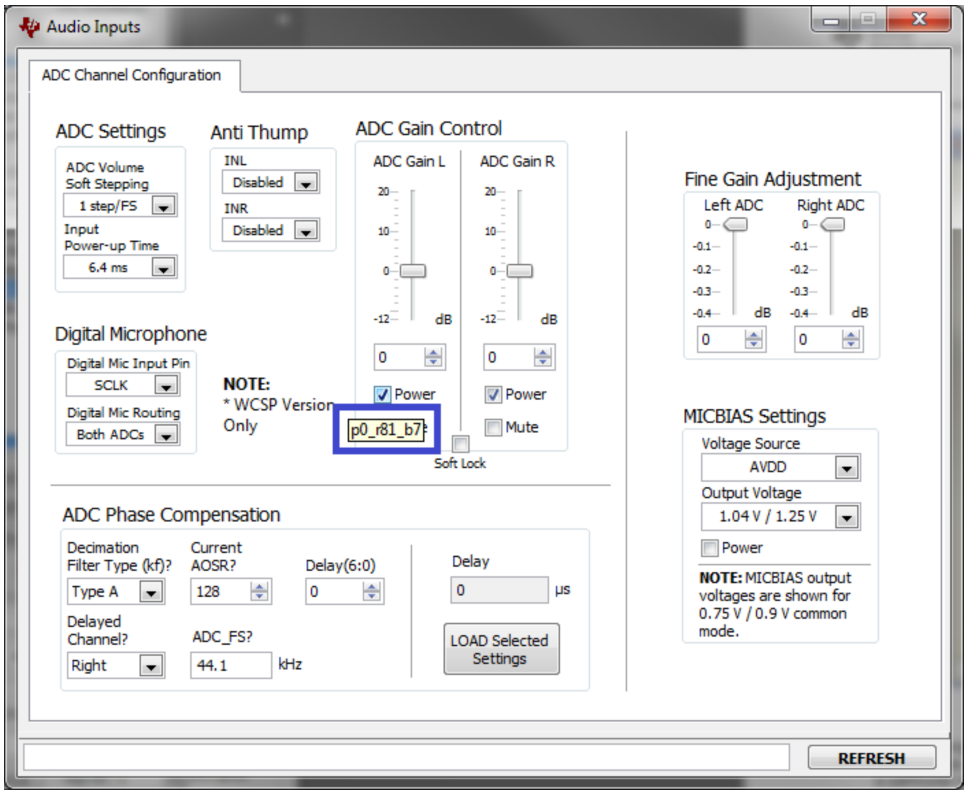


Figure 6. Audio Inputs Panel

Ensure that a control is compatible with the current state of the codec by comparing it with the data sheet. As an example, some controls in the **Analog Setup** panel must be modified in a particular order as described in the data sheet. Other controls must only be modified with a specific hardware setup, such as powering up the AVDD LDO.

All controls update their status with respect to the register contents in the following conditions:

- A panel is opened.
- The **Execute Command Buffer** button in the **Command-Line Interface** is pressed, if enabled to do so.
- The **Refresh** button at the bottom right of a panel is pressed.

4.2 Status Flags Panel

The TLV320DAC3203 status flags are monitored in the **Status Flags** panel (Figure 7), located below the **Panel Selection Tree** . Pressing the **POLL** button continuously reads all the registers relevant to each flag and updates those flags accordingly. The rate at which the registers are read is modified by changing the value in the **Polling Interval** numeric control. Note that a smaller interval reduces responsiveness of other controls, especially volume sliders, due to bandwidth limitations. By default, the polling interval is 200 ms with a minimum setting 20 ms.

The **Sticky Flags** tab contains indicators whose corresponding register contents clear every time a read is performed to that register. Read all the sticky flags by clicking the **Read Sticky Flags** button.

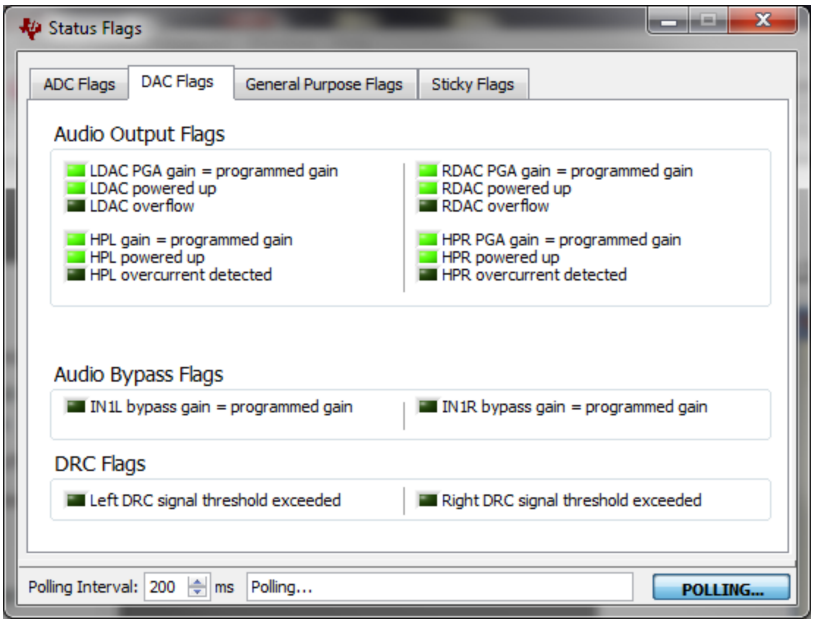
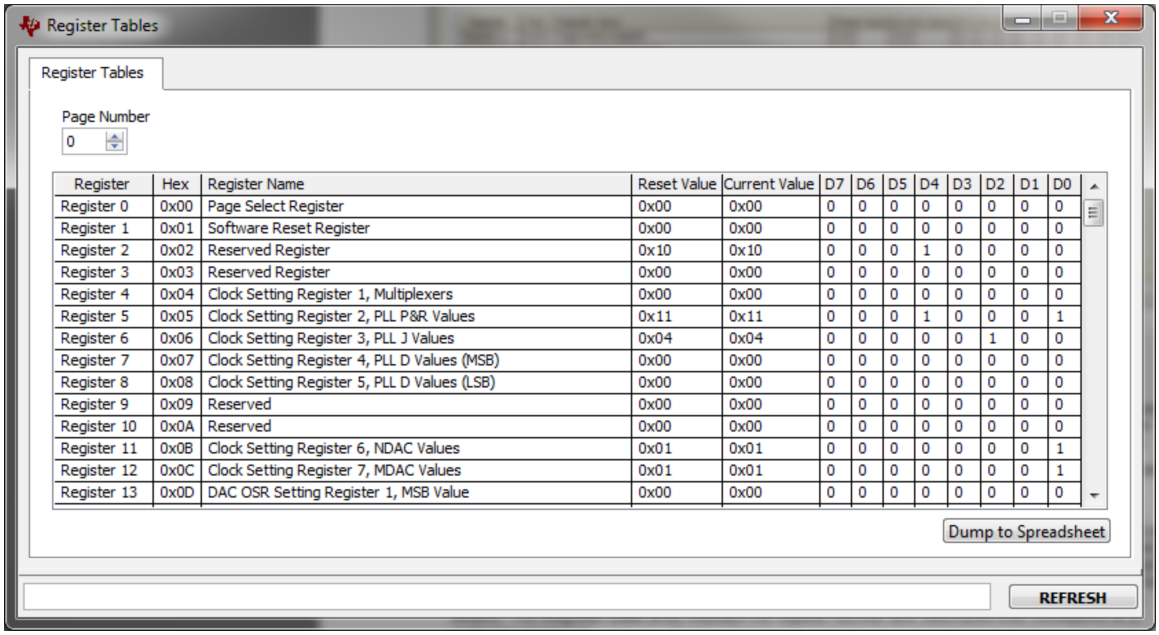


Figure 7. Status Flags Panel

4.3 Register Tables Panel

The contents of configuration and coefficient pages of the TLV320DAC3203 are accessed through the **Register Tables** panel (Figure 8).

The **Page Number** control changes to the page displayed in the register table. The register table contains page information such as the register name, reset value, current value, and a bitmap of the current value. Export the contents of the selected page into a spreadsheet by clicking the **Dump to Spreadsheet** button.



Register	Hex	Register Name	Reset Value	Current Value	D7	D6	D5	D4	D3	D2	D1	D0
Register 0	0x00	Page Select Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 1	0x01	Software Reset Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 2	0x02	Reserved Register	0x10	0x10	0	0	0	1	0	0	0	0
Register 3	0x03	Reserved Register	0x00	0x00	0	0	0	0	0	0	0	0
Register 4	0x04	Clock Setting Register 1, Multiplexers	0x00	0x00	0	0	0	0	0	0	0	0
Register 5	0x05	Clock Setting Register 2, PLL P&R Values	0x11	0x11	0	0	0	1	0	0	0	1
Register 6	0x06	Clock Setting Register 3, PLL J Values	0x04	0x04	0	0	0	0	0	1	0	0
Register 7	0x07	Clock Setting Register 4, PLL D Values (MSB)	0x00	0x00	0	0	0	0	0	0	0	0
Register 8	0x08	Clock Setting Register 5, PLL D Values (LSB)	0x00	0x00	0	0	0	0	0	0	0	0
Register 9	0x09	Reserved	0x00	0x00	0	0	0	0	0	0	0	0
Register 10	0x0A	Reserved	0x00	0x00	0	0	0	0	0	0	0	0
Register 11	0x0B	Clock Setting Register 6, NDAC Values	0x01	0x01	0	0	0	0	0	0	0	1
Register 12	0x0C	Clock Setting Register 7, MDAC Values	0x01	0x01	0	0	0	0	0	0	0	1
Register 13	0x0D	DAC OSR Setting Register 1, MSB Value	0x00	0x00	0	0	0	0	0	0	0	0

Figure 8. Register Tables Panel

4.4 Command-Line Interface Panel

The **Command-Line Interface** panel provides a means for communication with the TLV320DAC3203 using a simple scripting language (described in Section G.1). The TAS1020B USB Controller (located on the USB-MODEVM motherboard) handles all communication between the PC and the TLV320DAC3203.

A script is loaded into the command buffer, either by loading a script file using the **File** menu or by pasting text from the clipboard using the Ctrl-V key combination (Figure 9).

When the command buffer is executed, the resulting return data packets from each individual command are displayed in the **Command History** control. This control is an array (with a maximum size of 100 elements) that contains information about each command as well as status. The **Interface** box displays the interface used for a particular command in the **Command History** array. The Command box displays the type of command executed (i.e., write, read) for a particular interface. The Flag Retries box displays the number of read iterations performed by a **Wait for Flag** command (see Section G.1 for details). The **Register Data** array displays the register number and data bytes that correspond to a particular command.

The **Information** tab provides additional information related to the **Command History** as well as additional settings. The **Syntax** and **Examples** tabs provide useful information related to the scripting language.

The **File** menu provides some options for working with scripts. The first option, *Open Script File...*, loads a command file script into the command buffer. This script can then be executed by pressing the **Execute Command Buffer** button. The contents of the **Command Buffer** are saved using the *Save Script File...* option.

Both the **Command Buffer** and **Command History** are cleared by clicking their corresponding **Clear** buttons.

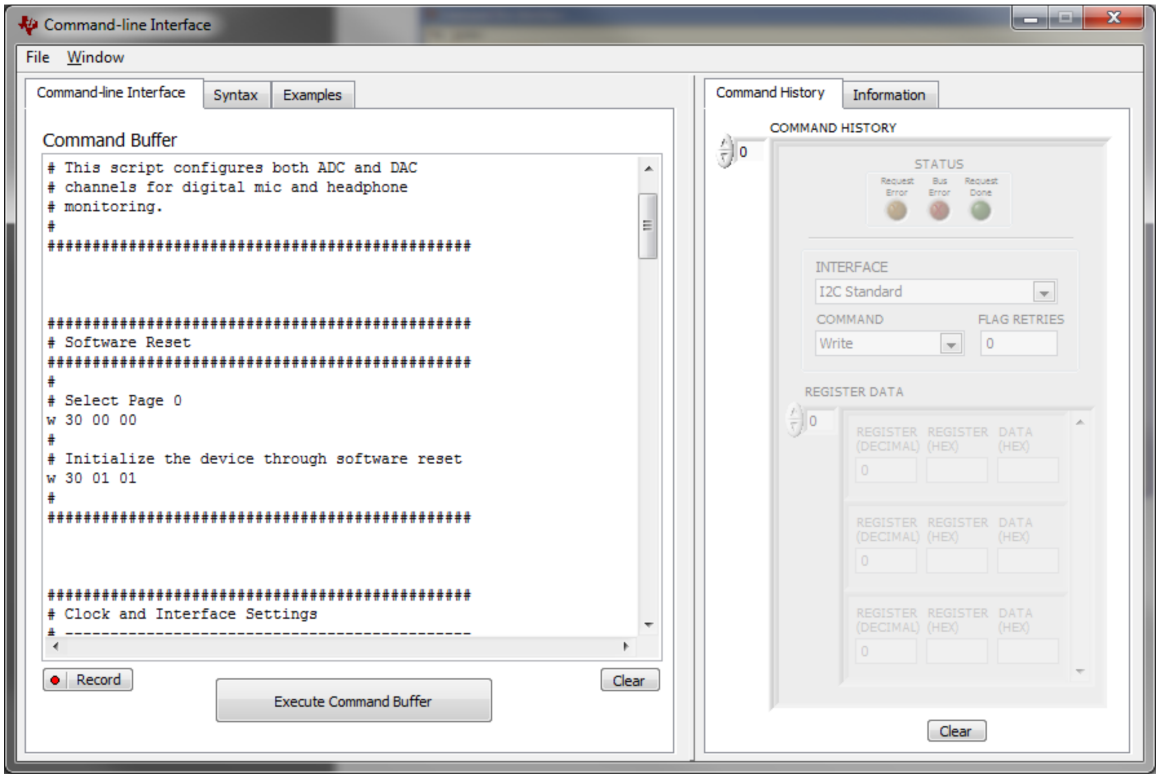


Figure 9. Command-line Interface Panel

Appendix A EVM Connector Descriptions

This appendix contains the connection details for each of the main connectors on the EVM.

A.1 Analog Interface Connectors

A.1.1 Analog Dual-Row Socket Details, J11 and J21

The TLV320DAC3203EVM has two analog dual-row sockets located at the bottom of the board. These sockets provide support to the EVM and connect the analog ground plane of the EVM to the USB-MODEVM analog ground. Consult Samtec at www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 3 summarizes the analog interface pinout for the TLV320DAC3203EVM.

Table 3. Analog Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
J11.1	NC	Not connected
J11.2	NC	Not connected
J11.3	NC	Not connected
J11.4	NC	Not connected
J11.5	NC	Not connected
J11.6	NC	Not connected
J11.7	NC	Not connected
J11.8	NC	Not connected
J11.9	AGND	Analog Ground
J11.10	NC	Not connected
J11.11	AGND	Analog Ground
J11.12	NC	Not connected
J11.13	AGND	Analog Ground
J11.14	NC	Not connected
J11.15	NC	Not connected
J11.16	NC	Not connected
J11.17	AGND	Analog Ground
J11.18	NC	Not connected
J11.19	AGND	Analog Ground
J11.20	NC	Not connected
J21.1	NC	Not connected
J21.2	NC	Not connected
J21.3	NC	Not connected
J21.4	NC	Not connected
J21.5	NC	Not connected
J21.6	NC	Not connected
J21.7	NC	Not connected
J21.8	NC	Not connected
J21.9	AGND	Analog Ground
J21.10	NC	Not connected
J21.11	AGND	Analog Ground
J21.12	NC	Not connected
J21.13	AGND	Analog Ground
J21.14	NC	Not connected
J21.15	NC	Not connected
J21.16	NC	Not connected

Table 3. Analog Interface Pinout (continued)

PIN NUMBER	SIGNAL	DESCRIPTION
J21.17	AGND	Analog Ground
J21.18	NC	Not connected
J21.19	AGND	Analog Ground
J21.20	NC	Not connected

A.1.2 Analog Screw Terminal and Audio Jack Details, J1 to J10

Access the analog inputs and outputs through screw terminals or audio jacks.

Table 4 summarizes the screw terminals and audio jacks available on the TLV320DAC3203EVM.

Table 4. Alternate Analog Connectors

DESIGNATOR	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6
J1 (HEADPHONE)	HPL	GND	HPR			
J2 (HEADSET OUTPUT)	GND	HPL	HPR	SCLK	NC	NC
J3 (HEADPHONE TEST ONLY)	GND	HPL	HPR	NC	NC	
J4 (LINE IN)	GND	INL	INR	NC	NC	
J5 (LINE IN)	INL	GND	INR			
J6 (DIG_MIC 1)	DIG_MIC_PWR	DIG_MIC_CLK	DIG_MIC_DATA	DIG_MIC_GND		
J7 (DIG_MIC 2)	DIG_MIC_PWR	DIG_MIC_CLK	DIG_MIC_DATA	DIG_MIC_GND		

A.2 Digital Interface Connectors, P12/J12 and P22/J22

The TLV320DAC3203EVM easily interfaces with multiple control platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row header/socket combination at P12/J12 and P22/J22. These headers/sockets provide access to the digital control and serial data pins of the device. Consult Samtec at www.samtec.com or call 1-800- SAMTEC-9 for a variety of mating connector options. Table 5 summarizes the digital interface pinout for the TLV320DAC3203EVM.

Table 5. Digital Interface Pinout

PIN NUMBER	SIGNAL	DESCRIPTION
P12.1/J12.1	NC	Not connected
P12.2/J12.2	NC	Not connected
P12.3/J12.3	SCLK	SPI serial clock
P12.4/J12.4	DGND	Digital ground
P12.5/J12.5	NC	Not connected
P12.6/J12.6	NC	Not connected
P12.7/J12.7	/SS	SPI chip select
P12.8/J12.8	$\overline{\text{RESET}}$	TAS1020B reset
P12.9/J12.9	NC	Not connected
P12.10/J12.10	DGND	Digital ground
P12.11/J12.11	MOSI	SPI MOSI Slave Serial Data Input
P12.12/J12.12	NC	Not connected
P12.13/J12.13	MISO	SPI MISO Slave Serial Data Output
P12.14/J12.14	$\overline{\text{RESET}}$	TAS1020B reset
P12.15/J12.15	NC	Not connected
P12.16/J12.16	SCL	I^2C serial clock
P12.17/J12.17	NC	Not connected
P12.18/J12.18	DGND	Not connected
P12.19/J12.19	NC	Not connected
P12.20/J12.20	SDA	I^2C Serial Data Input/Output
P22.1/J22.1	NC	Not connected
P22.2/J22.2	NC	Not connected
P22.3/J22.3	BCLK	Audio serial data bus bit clock (Input/Output)
P22.4/J22.4	DGND	Not connected
P22.5/J22.5	NC	Not connected
P22.6/J22.6	NC	Not connected
P22.7/J22.7	WCLK	Audio Serial Data Bus Word Clock (Input/Output)
P22.8/J22.8	NC	Not connected
P22.9/J22.9	NC	Not connected
P22.10/J22.10	DGND	Not connected
P22.11/J22.11	DIN	Audio Serial Data Bus Data Input (Input)

Table 5. Digital Interface Pinout (continued)

PIN NUMBER	SIGNAL	DESCRIPTION
P22.12/J22.12	NC	Not connected
P22.13/J22.13	DOUT	Audio Serial Data Bus Data Output (Output)
P22.14/J22.14	NC	Not connected
P22.15/J22.15	NC	Not connected
P22.16/J22.16	NC	Not connected
P22.17/J22.17	MCLK	Master Clock Input
P22.18/J22.18	DGND	Not connected
P22.19/J22.19	NC	Not connected
P22.20/J22.20	NC	Not connected

Note that P22/J22 comprises the signals needed for an I^{2}S™ serial digital-audio interface; the control interface (I^{2}C™ and $\overline{\text{RESET}}$) signals are routed to P12/J12.

A.3 Power Supply Connector Pin Header, P23/J23

P23/J23 provides a connection to the common power bus for the TLV320DAC3203EVM. Power is supplied on the pins listed in Table 6.

Table 6. Power Supply Pin Out

SIGNAL	PIN NUMBER		SIGNAL
NC	P23.1/J23.1	P23.2/J23.2	NC
+5 VA	P23.3/J23.3	P23.4/J23.4	NC
DGND	P23.5/J23.5	P23.6/J23.6	AGND
+1.8 VD	P23.7/J23.7	P23.8/J23.8	NC
+3.3 VD	P23.9/J23.9	P23.10/J23.10	NC

The TLV320DAC3203EVM-K motherboard (the USB-MODEVM Interface board) supplies power to P23/J23 of the TLV320DAC3203EVM. Power for the motherboard is supplied either through its USB connection or through terminal blocks on that board.

Appendix B TLV320DAC3203EVM Schematic

The schematic diagram for the TLV320DAC3203EVM is provided as a reference.

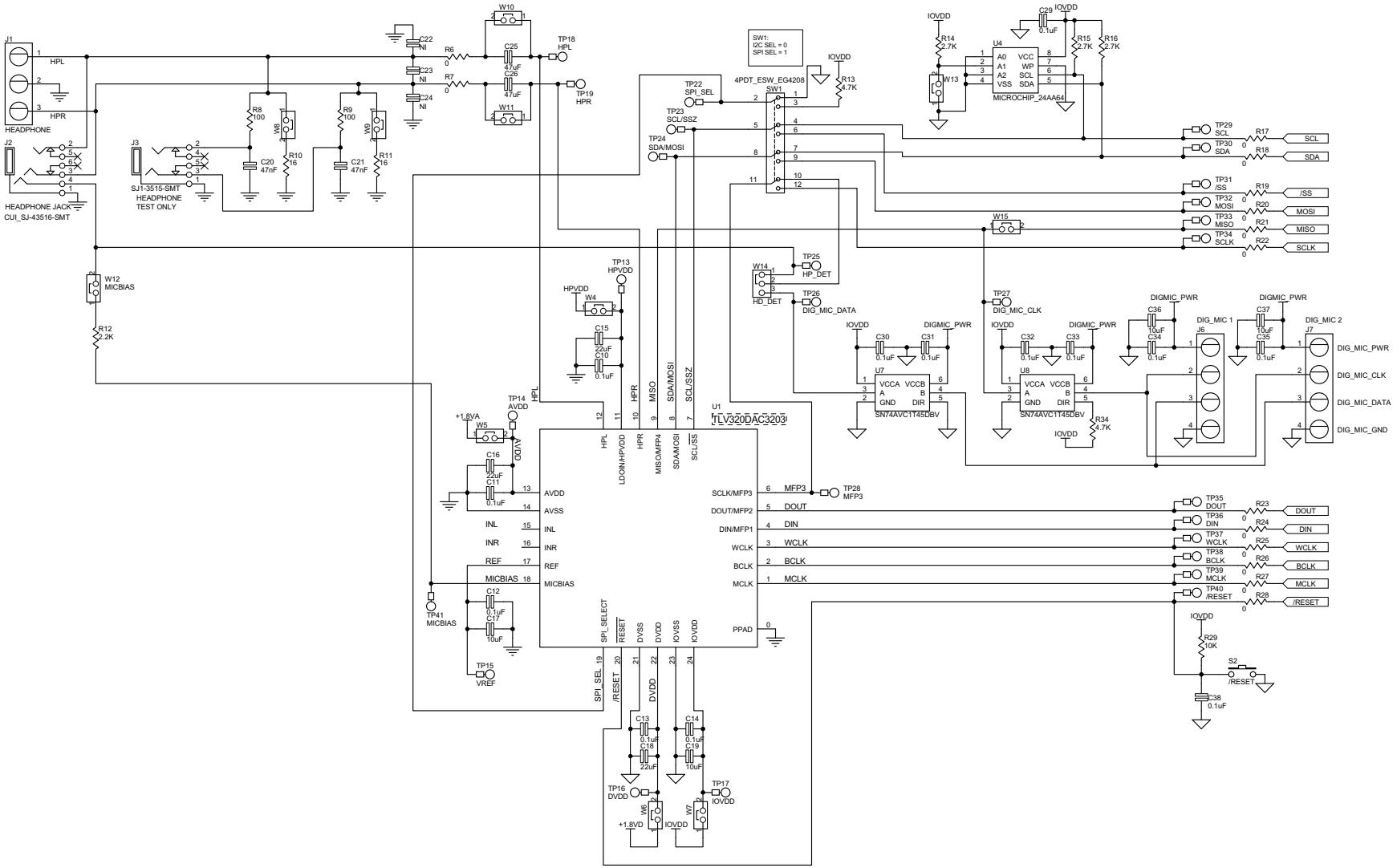


Figure 10. TLV320AIC3253EVM Schematic (Sheet 1 of 2)

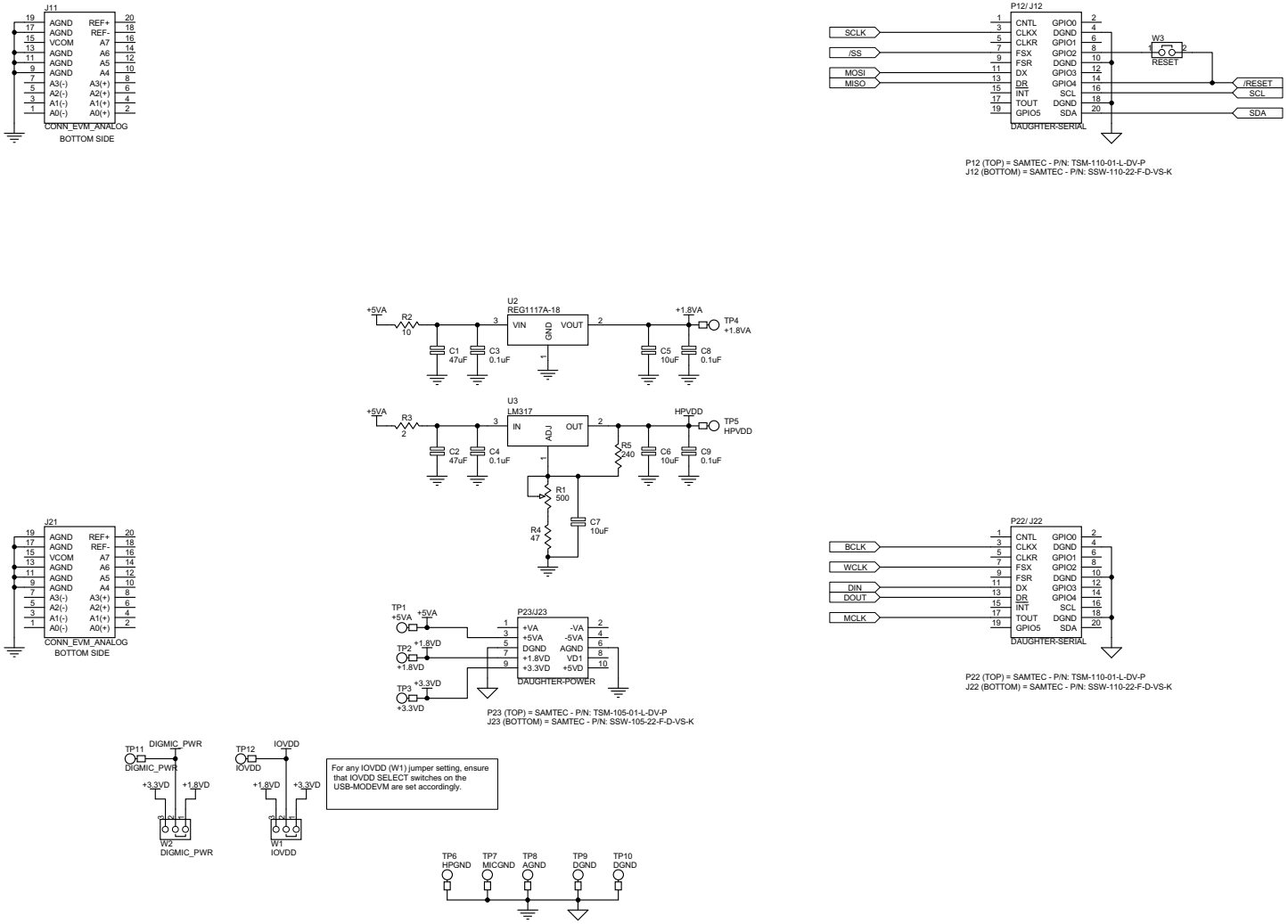


Figure 11. TLV320AIC3253EVM Schematic (Sheet 2 of 2)

Appendix C TLV320DAC3203EVM Layout Views

C.1 Layout Views

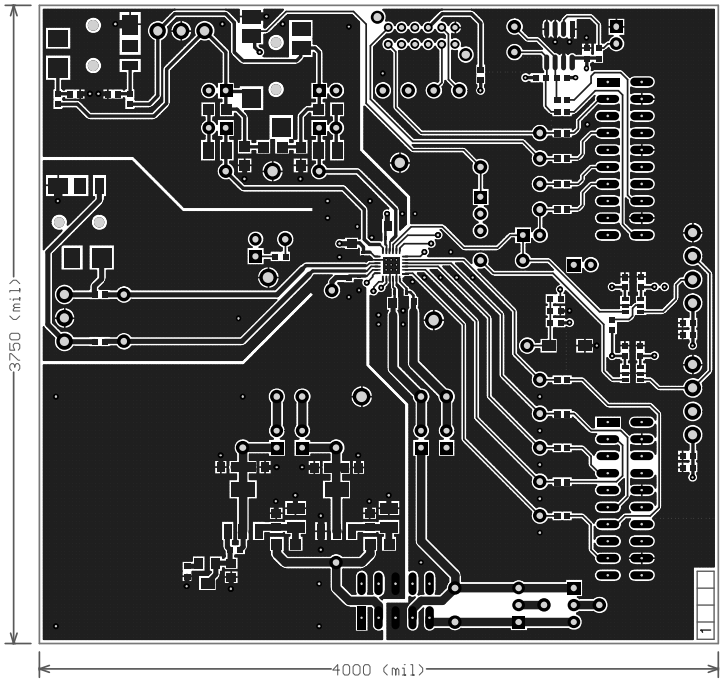


Figure 12. Top Layer

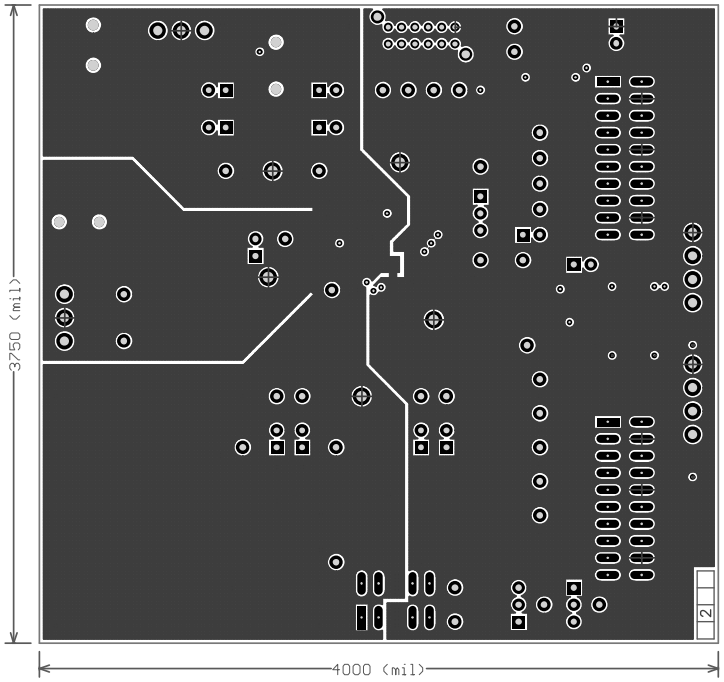


Figure 13. Mid-Layer 1

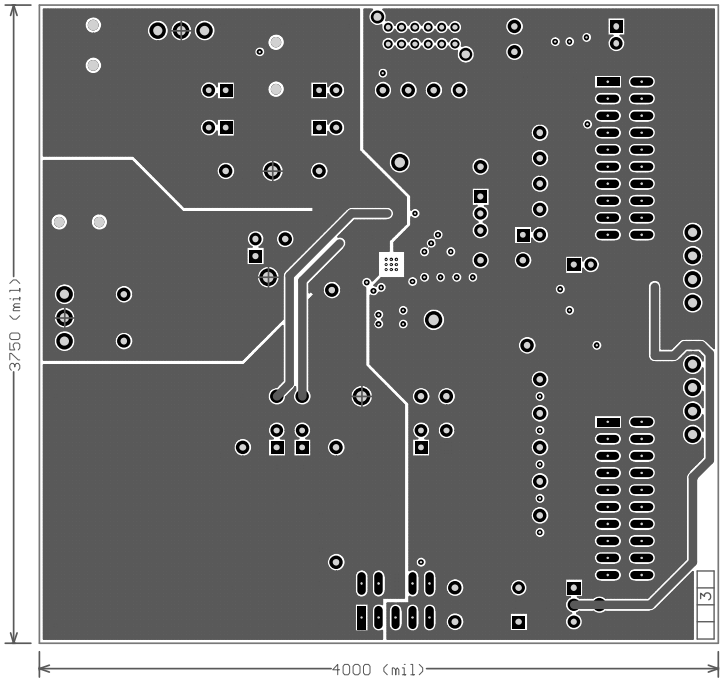


Figure 14. Mid-Layer 2

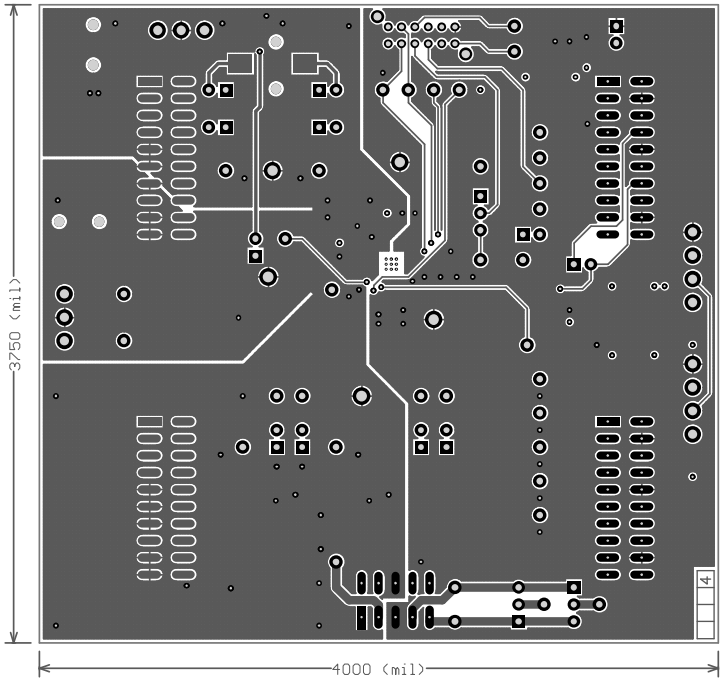


Figure 15. Bottom Layer

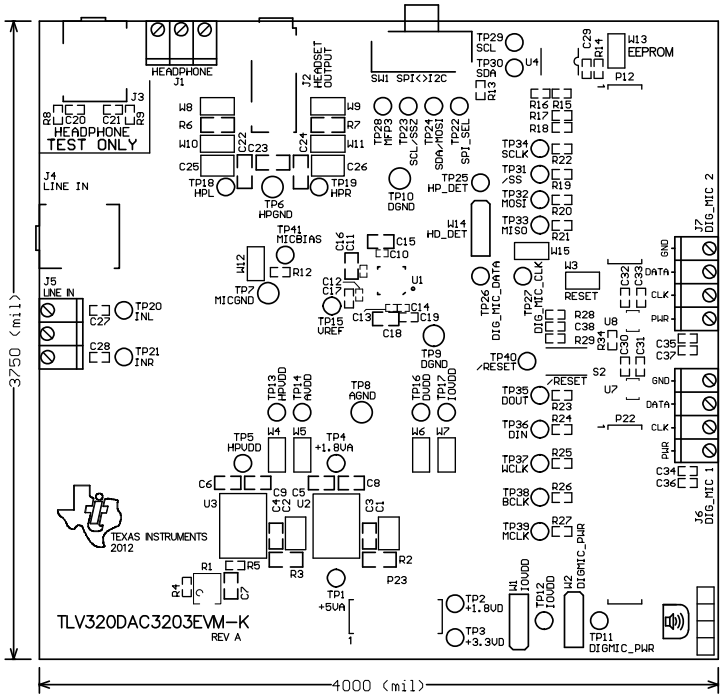


Figure 16. Top Overlay

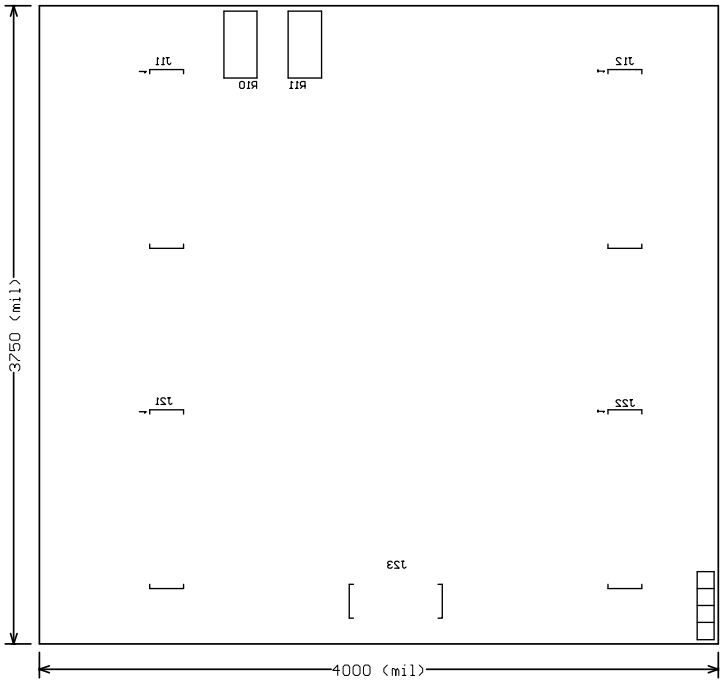


Figure 17. Bottom Overlay

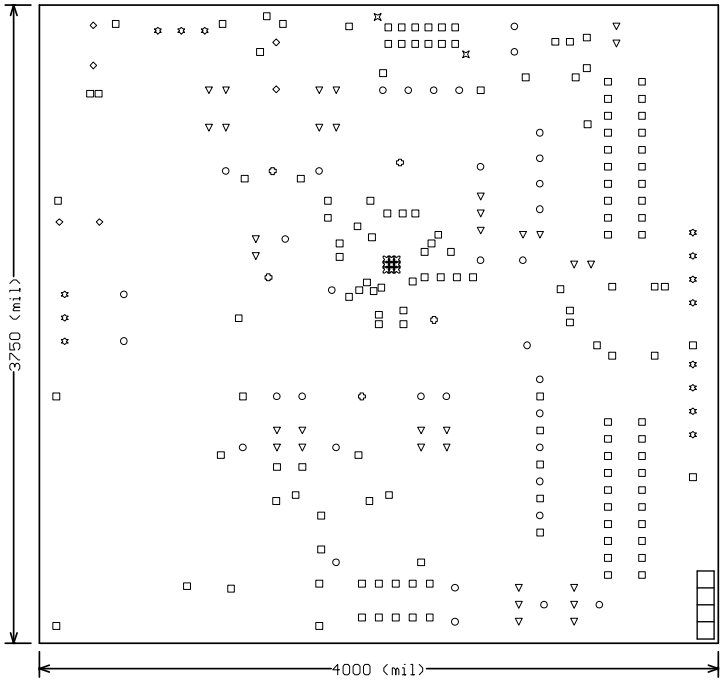


Figure 18. Drill Drawing

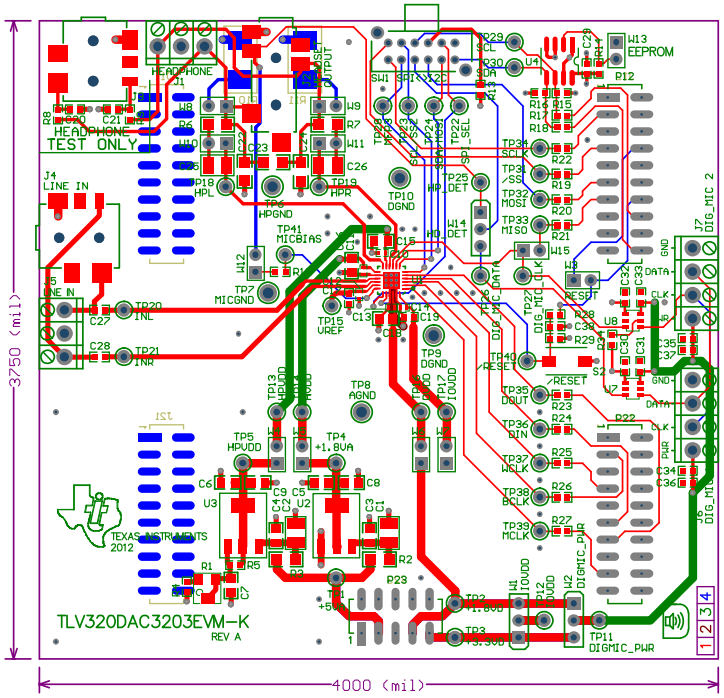


Figure 19. Composite

Appendix D TLV320DAC3203EVM Bill of Materials

The complete bill of materials for the TLV320DAC3203EVM is provided as a reference.

Table 7. TLV320DAC3203EVM Bill of Materials

PCB					
Qty	**Value**	**Ref Des**	**Description**	**Vendor**	**Part number**
1		N/A	TLV320DAC3203_RGE_EVM_REV01 (PWB)	Texas Instruments	
RESISTORS					
Qty	**Value**	**Ref Des**	**Description**	**Vendor**	**Part number**
12	0 Ω	R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28	Resistor, 0 Ω, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEY0R00V
2	0 Ω	R6, R7	Resistor, 0 Ω, 1/4W, 5%, 1206 SMD	Panasonic	ERJ-8GEY0R00V
1	2 Ω	R3	Resistor, 2.0 Ω, 1/4W, 5%, 1206	Panasonic	ERJ-8GEYJ2R0V
1	10 Ω	R2	Resistor, 10 Ω, 1/4W, 5%, 1206 SMD	Panasonic	ERJ-8GEYJ100V
2	16 Ω	R10, R11	Resistor, 16 Ω, 1W, 5%, 2512 SMD	Panasonic	ERJ-1TYJ160U
1	47 Ω	R4	Resistor, 47 Ω, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEYJ470V
2	100 Ω	R8, R9	Resistor, 100 Ω, 1/10W, 1%, 0603 SMD	Panasonic	ERJ-3EKF1000V
1	240 Ω	R5	Resistor, 240 Ω, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEYJ241V
1	500 Ω	R1	TRIMPOT 500 Ω, 4 mm, top adjust SMD	Bourns Inc.	3214W-1-501E
1	2.2 kΩ	R12	Resistor, 2.2 kΩ, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEYJ222V
3	2.7 kΩ	R14, R15, R16	Resistor, 2.7 kΩ, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEYJ272V
3	4.7 kΩ	R13, R29, R34	Resistor, 4.7 kΩ, 1/10W, 5%, 0603 SMD	Panasonic	ERJ-3GEYJ472V
CAPACITORS					
Qty	**Value**	**Ref Des**	**Description**	**Vendor**	**Part number**
2	47000 pF	C20, C21	Ceramic capacitor, 47000 pF, 50 V, X7R, 10%, 0603	TDK Corporation	C1608X7R1H473K
5	0.1 µF	C10, C11, C12, C13, C14	Ceramic capacitor, 10 µF, 6.3 V, X5R, 10%, 0402	TDK Corporation	C1005X5R0J104K
8	0.1 µF	C29, C30, C31, C32, C33, C34, C35, C38	Ceramic capacitor, 0.1 µF, 25 V, X7R, 0603	TDK Corporation	C1608X7R1E104K
4	0.1 µF	C3, C4, C8, C9	Ceramic capacitor, 0.1 µF, 25 V, X7R, 0805	Panasonic	ECJ-2VB1E104K
2	no value - not installed	C27, C28	Ceramic capacitor, 0.47 µF, 10 V, X5R, 10%, 0603		
4	10 µF	C17, C19, C36, C37	Ceramic capacitor, 10 µF, 6.3 V, X5R, 0603	Panasonic	ECJ-1VB0J106M
3	10 µF	C5, C6, C7	Ceramic capacitor, 10 µF, 10 V, X5R, 0805	Panasonic	ECJ-2FB1A106K
3	22 µF	C15, C16, C18	Ceramic capacitor, 22 µF, 6.3 V, X5R, 20%, 0805	TDK Corporation	C2012X5R0J226M
4	47 µF	C1, C2, C25, C26	Ceramic capacitor, 47 µF, 10 V, X5R, 1210	Murata	GRM32ER61A476KE20L
3	no value – not installed	C22, C23, C24	Capacitor 1206	N/A	N/A
INTEGRATED CIRCUITS					
Qty	**Value**	**Ref Des**	**Description**	**Vendor**	**Part number**
1		U1	Audio Codec	Texas Instruments	TLV320DAC3203IRGE
1		U2	Single output LDO, 1.0 A, fixed (1.8 V)	Texas Instruments	REG1117A-1.8 (SOT-223, DCY)
1		U3	3-Pin, 1.5-A adjustable voltage regulator	Texas Instruments	LM317DCY
1		U4	IC serial EEPROM, 64 k, 2.5 V, 8-SOIC	MicroChip	24LC64-I/SN
2		U7, U8	Single-bit dual-supply bus transceiver	Texas Instruments	SN74AVC1T45DBVR

Table 7. TLV320DAC3203EVM Bill of Materials (continued)

MISCELLANEOUS ITEMS					
Used	**Value**	**Ref Des**	**Description**	**Vendor**	**Part number**
1		S2	Light touch switch, 6 mm × 3.5 mm, 240 gf, SMD	Panasonic	EVQ-5PN04K
1		SW1	Switch slide, 4PDT, 30 V, rt angle	E-Switch	EG4208
2		P12, P22	20 pin SMT plug header	Samtec	TSM-110-01-L-DV-P
4		J11, J12, J21, J22	20 pin SMT socket header	Samtec	SSW-110-22-F-D-VS-K
1		P23	10 Pin SMT plug header	Samtec	TSM-105-01-L-DV-P
1		J23	10 pin SMT socket header	Samtec	SSW-105-22-F-D-VS-K
1		J2	Jack audio mini (3.5 mm) 4-COND PCB-RA, RoHS	CUI Inc.	SJ-43516-SMT
2	do not install J4	J3, J4	3.5 mm audio jack, T-R-S, SMD	CUI Inc.	SJ1-3515-SMT
2	do not install J5	J1, J5	Screw terminal block, 3 position	On Shore Technology	ED555/3DS
2		J6, J7	Screw terminal block, 4 position	On Shore Technology	ED555/4DS
12	not installed	TP1, TP2, TP3, TP4, TP5, TP11, TP12, TP13, TP14, TP15, TP16, TP17	TEST POINT PC MINI 0.040"D RED	Keystone Electronics	5000
24	not installed	TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36, TP37, TP38, TP39, TP40, TP41	TEST POINT PC MINI 0.040"D WHITE	Keystone Electronics	5002
5		TP6, TP7, TP8, TP9, TP10	TEST POINT PC MULTI PURPOSE BLK	Keystone Electronics	5011
12		W3, W4, W5, W6, W7, W8, W9, W10, W11, W12, W13, W15	2-pin thru-hole plug header (Jumper), 0.1" spacing	Samtec	TSW-102-07-L-S
3		W1, W2, W4	3 position jumper, 0.1" spacing	Samtec	TSW-103-07-L-S
	Installed per test procedure	Installed per test procedure	Header shorting block	Samtec	SNT-100-BK-T

ATTENTION:

Alternate Resistor and Capacitor vendors may be used. In this case substitutions must have like descriptions.

All components should be RoHS compliant. Some part numbers may be either leaded or RoHS. Verify purchased components are RoHS compliant.

Appendix E USB-MODEVM Schematic

The schematic diagram for USB-MODEVM Interface Board is provided as a reference.

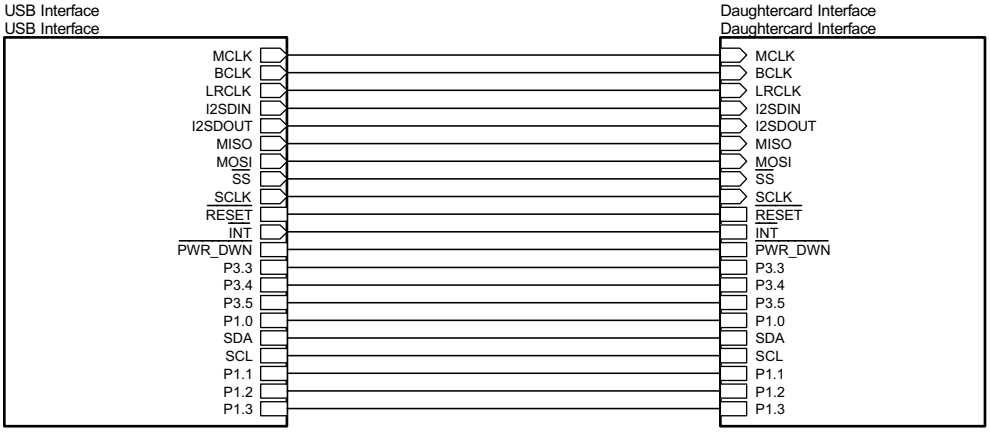


Figure 20. USB-MODEVM Schematic (Sheet 1 of 3)

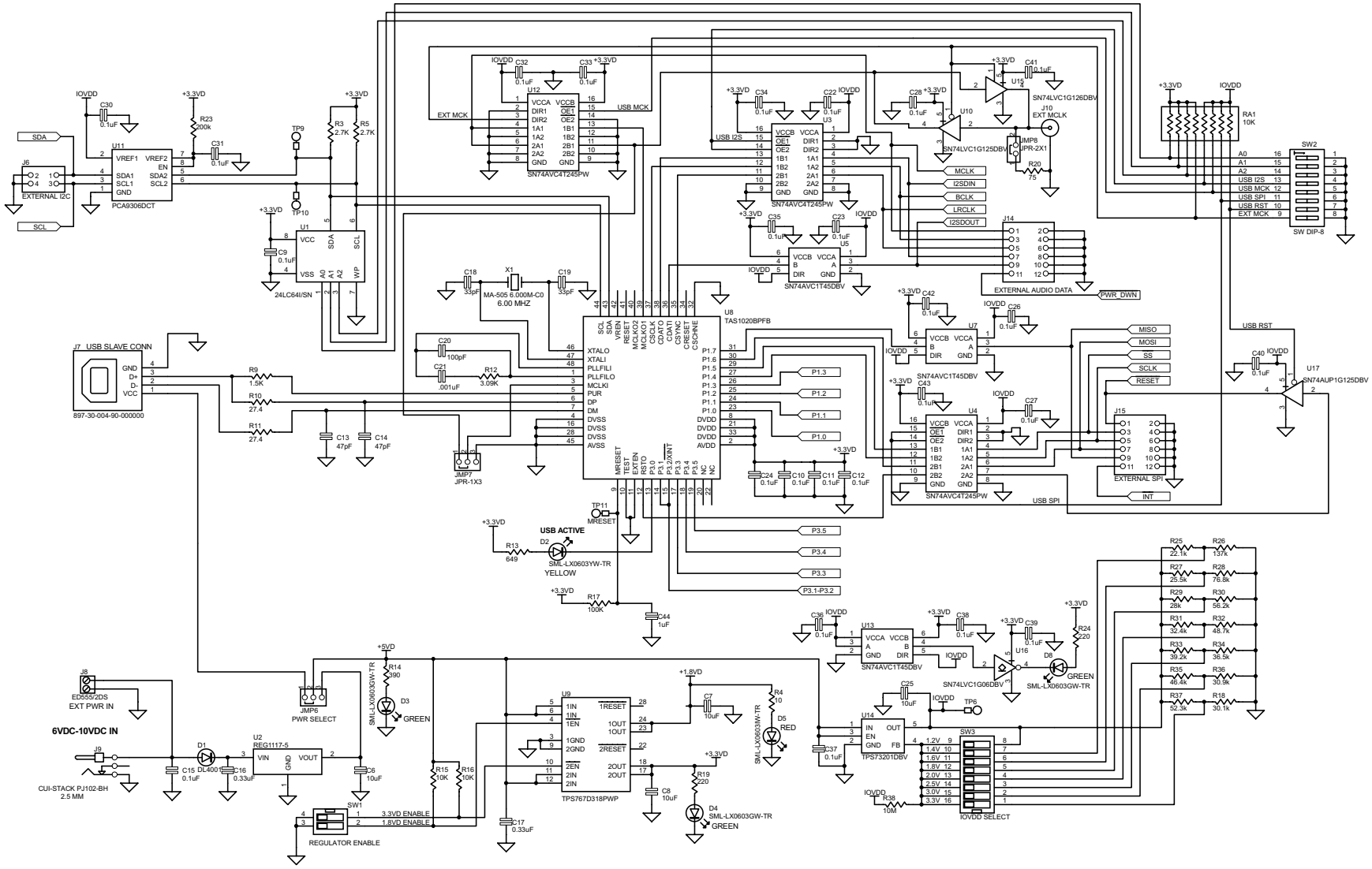


Figure 21. USB-MODEVM Schematic (Sheet 2 of 3)

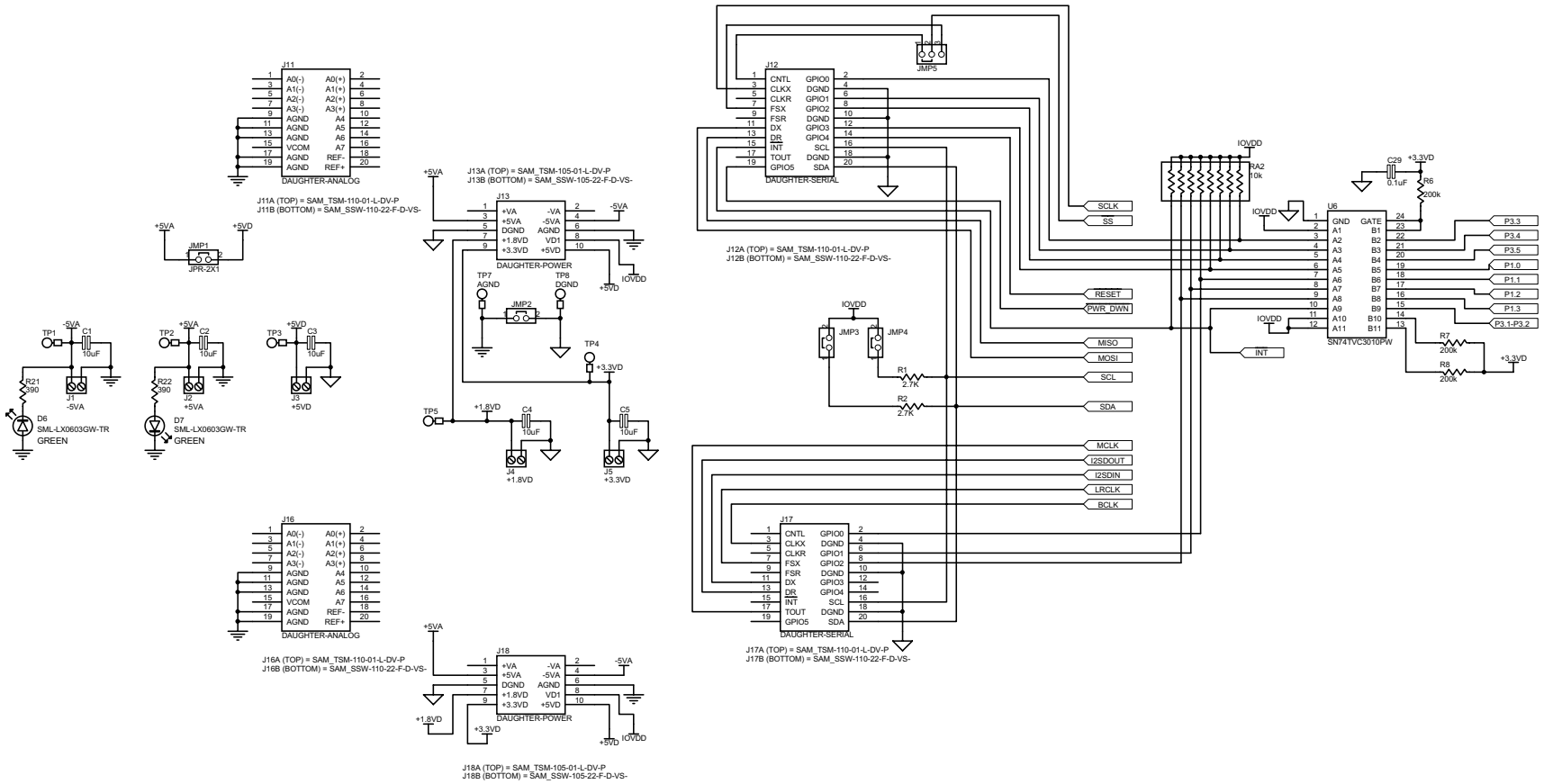


Figure 22. USB-MODEVM Schematic (Sheet 3 of 3)

Appendix F USB-MODEVM Bill of Materials

The complete bill of materials for USB-MODEVM Interface Board is provided as a reference.

Table 8. USB-MODEVM Bill of Materials

Designators	Description	Manufacturer	Mfg. Part Number
R4	10 Ω, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ1300V
R10, R11	27.4 Ω, 1/16W, 1%, chip resistor	Panasonic	ERJ-3EKF27R4V
R20	75 Ω, 1/4W, 1%, chip resistor	Panasonic	ERJ-14NF75R0U
R19	220 Ω, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ221V
R14, R21, R22	390 Ω, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ391V
R13	649 Ω, 1/16W, 1%, chip resistor	Panasonic	ERJ-3EKF6490V
R9	1.5 kΩ, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ1352V
R1–R3, R5–R8	2.7 kΩ, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ272V
R12	3.09 kΩ, 1/16W, 1%, chip resistor	Panasonic	ERJ-3EKF3091V
R15, R16	10 kΩ, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ1303V
R17, R18	100 kΩ, 1/10W, 5%, chip resistor	Panasonic	ERJ-3GEYJ1304V
RA1	10 kΩ, 1/8W, octal isolated resistor array	CTS Corporation	742C163103JTR
C18, C19	33 pF, 50-V ceramic chip capacitor, ±5%, NPO	TDK	C1608C0G1H330J
C13, C14	47 pF, 50-V ceramic chip capacitor, ±5%, NPO	TDK	C1608C0G1H470J
C20	100 pF, 50-V ceramic chip capacitor, ±5%, NPO	TDK	C1608C0G1H101J
C21	1000 pF, 50-V ceramic chip capacitor, ±5%, NPO	TDK	C1608C0G1H102J
C15	0.1 µF, 16-V ceramic chip capacitor, ±10%, X7R	TDK	C1608X7R1C104K
C16, C17	0.33 µF, 16-V ceramic chip capacitor, ±20%, Y5V	TDK	C1608X5R1C334K
C9–C12, C22–C28	1 µF, 6.3-V ceramic chip capacitor, ±10%, X5R	TDK	C1608X5R0J1305K
C1–C8	10 µF, 6.3-V ceramic chip capacitor, ±10%, X5R	TDK	C3216X5R0J1306K
D1	50-V, 1-A diode MELF SMD	Micro Commercial Components	DL4001
D2	Yellow LED	Lumex	SML-LX0603YW-TR
D3– D7	Green LED	Lumex	SML-LX0603GW-TR
D5	Red LED	Lumex	SML-LX0603IW-TR
Q1, Q2	N-Channel MOSFET	Zetex	ZXMN6A07F
X1	6-MHz crystal SMD	Epson	MA-505 6.000M-C0
U8	USB streaming controller	Texas Instruments	TAS1020BPFB
U2	5-V LDO regulator	Texas Instruments	REG1117-5
U9	3.3- or 1.8-V LDO regulator	Texas Instruments	TPS767D318PWP
U3, U4	Quad, 3-State buffers	Texas Instruments	SN74LVC125APW
U5–U7	Single IC buffer driver with open drain o/p	Texas Instruments	SN74LVC1G07DBVR
U10	Single 3-State buffer	Texas Instruments	SN74LVC1G125DBVR
U1	64 k, 2-wire serial EEPROM I^2C	Microchip	24LC64I/SN
	USB-MODEVM PCB	Texas Instruments	6463995
TP1–TP6, TP9–TP11	Miniature test point terminal	Keystone Electronics	5000
TP7, TP8	Multipurpose test point terminal	Keystone Electronics	5011
J7	USB type B slave connector thru-hole	Mill-Max	897-30-004-90-000000
J13, J2–J5, J8	2-position terminal block	On Shore Technology	ED555/2DS
J9	2.5 mm power connector	CUI Stack	PJ-102B
J130	BNC connector, female, PC mount	AMP/Tyco	414305-1
J131A, J132A, J21A, J22A	20-pin SMT plug	Samtec	TSM-110-01-L-DV-P
J131B, J132B, J21B, J22B	20-pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
J133A, J23A	10-pin SMT plug	Samtec	TSM-105-01-L-DV-P
J133B, J23B	10-pin SMT socket	Samtec	SSW-105-22-F-D-VS-K
J6	4-pin double row header (2x2) 0.1"	Samtec	TSW-102-07-L-D
J134, J135	12-pin double row header (2x6) 0.1"	Samtec	TSW-106-07-L-D
JMP1–JMP4	2-position jumper, 0.1" spacing	Samtec	TSW-102-07-L-S

Table 8. USB-MODEVM Bill of Materials (continued)

Designators	Description	Manufacturer	Mfg. Part Number
JMP8–JMP14	2-position jumper, 0.1" spacing	Samtec	TSW-102-07-L-S
JMP5, JMP6	3-position jumper, 0.1" spacing	Samtec	TSW-103-07-L-S
JMP7	3-position dual row jumper, 0.1" spacing	Samtec	TSW-103-07-L-D
SW1	SMT, half-pitch 2-position switch	C&K Division, ITT	TDA02H0SK1
SW2	SMT, half-pitch 8-position switch	C&K Division, ITT	TDA08H0SK1
	Jumper plug	Samtec	SNT-100-BK-T

Appendix G Writing Scripts

G.1 Writing Scripts

A script is a text file containing data sent to the serial control buses.

Each line in a script file is one command. No provision is made for extending lines beyond one line, except for the **>** command. A line is terminated by a carriage return.

The first character of a line is the command. Commands are:

l Set the interface bus
r Read from the serial control bus
w Write to the serial control bus
> Extend repeated write commands to lines below a **w**
Comment
b Break
d Delay

f Wait for Flag

The first command, **l**, sets the interface for the commands to follow. This command must be followed by one of the following parameters:

i2cstd	Standard mode I^2C bus
i2cfast	Fast mode I^2C bus
spi8	SPI bus with 8-bit register addressing
spi16	SPI bus with 16-bit register addressing

For example, if a fast mode I^2C bus is used, the script begins with:

l i2cfast

A double-quoted string of characters following the **b** command provides information about each breakpoint. When the script is executed, the software's command handler halts as soon as a breakpoint is detected and displays the string of characters within double quotes.

The Wait for Flag command, **f,** reads a specified register and verifies if the bitmap provided with the command matches the data being read. If the data does not match, the command handler retries up to 200 times. This feature is useful when switching buffers in parts that support the adaptive filtering mode. The command f syntax follows:

```
f [i2c address] [register] [D7][D6][D5][D4][D3][D2][D1][D0]
where 'i2c address' and 'register' are in hexadecimal format
and 'D7' through 'D0' are in binary format with values of 0,
1 or X for don't care.
```

Anything following a comment command **#** is ignored by the parser, provided that it is on the same line.

The delay command, **d**, allows specification of a time in milliseconds, that the script pauses before proceeding. **The delay time is entered in decimal format.**

A series of byte values follows either a read or write command. Each byte value is expressed in hexadecimal, and each byte must be separated by a space. Commands are interpreted and sent to the TAS1020B by the program.

The first byte following an **r** (read) or **w** (write) command is the I^2C slave address of the device (if I^2C is used) or the first data byte written (if SPI is used, note that SPI interfaces are not standardized on protocols, so the meaning of this byte varies with the device being addressed on the SPI bus). The second byte is the starting register address where data is written (again, with I^2C; SPI varies). Following these two bytes are data, if writing; if reading, the third byte value is the number of bytes read, (expressed in hexadecimal).

For example, writing the values 0xAA 0x55 to an I²C device with a slave address of 0x30, starting at a register address of 0x03, the input is:

```
#example script
I i2cfast
w 30 03 AA 55
r 30 03 02
```

This script begins with a comment, specifies that a fast I²C bus is used, then writes *0xAA 0x55* to the I²C slave device at address 0x30, writing the values into registers 0x03 and 0x04. The script then reads back two bytes from the same device starting at register address 0x03. Note that the slave device value does not change. Setting the R/$\overline{W}$ bit for I²C devices in the script is unnecessary; the read or write command does that.

If extensive repeated write commands are sent and commenting is desired for a group of bytes, the **>** command extends the bytes to the following lines. A usage example for the **>** command follows:

```
#example script for '>' command
I i2cfast
# Write AA and BB to registers 3 and 4, respectively
w 30 03 AA BB
# Write CC, DD, EE and FF to registers 5, 6, 7 and 8, respectively
> CC DD EE FF
# Place a commented breakpoint
b "AA BB CC DD EE FF was written, starting at register 3"
# Read back all six registers, starting at register 3
r 30 03 06
```

The following example demonstrates usage of the Wait for Flag command, **f**:

```
I i2cfast
# Switch to Page 44
w 30 00 2C
# Switch buffers
w 30 01 05
# Wait for bit D0 to clear. 'x' denotes a don't care.
f 30 01 xxxxxxx0
```

Write the scripts with a text editor; Jedit is a highly recommended, general-use editor. For more information, go to: http://www.jedit.org.

Once the script is written, use it in the command window by running the program and then selecting *Open Script File...* from the File menu. Locate the script and open it. The script is then displayed in the command buffer. Edit the script once it is in the buffer and save it by selecting *Save Script File...* from the File menu.

Once the script is in the command buffer, execute it by pressing the *Execute Command Buffer* button. If there are breakpoints in the script, the script executes to that point and a dialog box with a continuation button is presented, asking to continue execution of the script. When ready to proceed, push that button and the script continues.

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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

日本テキサス・インスツルメンツ株式会社
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西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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日本テキサス・インスツルメンツ株式会社
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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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 which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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