

DEM-DAI1691 EVM

PCM1691 Evaluation Module

User's Guide



Literature Number: SBAU152
April 2009

Preface	7
1 Description and Hardware	9
1.1 Block Diagram	10
1.1.1 Electrostatic Discharge Warning	10
1.2 Basic Connections and Operation	11
1.3 EVM Configuration Controls	11
1.3.1 HDR001	11
1.3.2 HDR101	11
1.3.3 JP101	11
1.3.4 JP102	11
1.3.5 CN102	12
1.3.6 SW101	12
1.3.7 SW102	12
1.3.8 CN205	12
1.3.9 SW201	12
1.3.10 SW202	13
1.3.11 SW203	13
1.3.12 SW204	13
1.3.13 HDR301	13
1.3.14 SW301	13
1.3.15 SW302	13
1.3.16 JP401/05/09/13/17/21/25/29	13
1.3.17 JP402/06/10/14/18/22/26/30	13
1.3.18 JP403,04/07,08/11,12/15,16/19,20/23,24/27,28/31,32	13
2 Application Software	15
2.1 Description and Installation	16
2.2 Software Start-up Procedure	16
2.3 Using the Application Software	17
2.3.1 Audio Interface and Sampling Mode Control (SPI Mode)	18
2.3.2 Audio Interface and Sampling Mode Control (I ² C Mode)	19
2.3.3 USB Connection and EVM Not Recognized	20
2.3.4 Operation Mode Control	21
2.3.5 Digital Attenuation and Soft Mute Control	22
2.3.6 Zero Flag Control and Monitor	23
2.3.7 Analog Mute Function Control	24
2.3.8 Register Setting History, Register Direct Access	25
2.3.9 Register Contents View	26
3 Typical Performance and Example Data	27
3.1 Typical Performance Data	28
3.1.1 Typical Performance vs Sampling Rate and System Clock	28

3.2	Example Measurement Data	29
3.2.1	FFT: 0-dB Output.....	29
3.2.2	FFT: -60-dB Output.....	29
3.2.3	FFT: -120-dB Output	30
3.2.4	FFT: Bipolar Zero Output.....	30
4	Schematics and Printed Circuit Board Layouts	31
4.1	DEM-DAI/MDAC_USB Schematics	32
4.1.1	DEM-DAI/MDAC_USB Power Supply	32
4.1.2	DEM-DAI/MDAC_USB USB and MCU	33
4.1.3	DEM-DAI/MDAC_USB DIR	34
4.1.4	DEM-DAI/MDAC_USB Interface to DUT Board	35
4.1.5	DEM-DAI/MDAC_USB LPF and Buffer.....	36
4.2	DEM-PCM1691 Schematic (DUT Daughtercard)	37
4.3	Printed Circuit Board Layouts.....	38
4.3.1	DEM-DAI/MDAC_USB Silkscreen (Top)	38
4.3.2	DEM-DAI/MDAC_USB Top Layer.....	39
4.3.3	DEM-DAI/MDAC_USB Bottom Layer.....	40
4.3.4	DEM-PCM1691 (DUT Daughterboard) Silkscreen.....	41
4.3.5	DEM-PCM1691 (DUT Daughterboard) Top View.....	42
4.3.6	DEM-PCM1691 (DUT Daughterboard) Bottom View	43
4.4	Bills of Material (BOMs)	44
	Important Notices	48

List of Figures

1-1	DEM-DAI1691 Block Diagram	10
2-1	Error Message at Software Start-up	16
2-2	Audio Interface and Sampling Mode Control Tab—SPI Mode Recognized	18
2-3	Audio Interface and Sampling Mode Control Tab—I ² C Mode Recognized.....	19
2-4	Audio Interface and Sampling Mode Control Tab—USB Connection and EVM Not Recognized	20
2-5	Operation Mode Control Tab	21
2-6	Digital Attenuation and Soft Mute Control Tab	22
2-7	Zero Flag Control and Monitor Tab	23
2-8	Analog Mute Function Control Tab	24
2-9	Register Setting History, Register Direct Access Area	25
2-10	Register Contents View	26
3-1	Typical Performance vs f_s and f_{SCK}	28
3-2	FFT (0 dB).....	29
3-3	FFT (–60 dB).....	29
3-4	FFT (–120 dB)	30
3-5	FFT of BPZ Output	30
4-1	Power-Supply Section	32
4-2	USB and MCU Sections	33
4-3	DIR Section	34
4-4	Interface to DUT Board Section	35
4-5	LPF and Buffer Section.....	36
4-6	DEM-PCM1691	37
4-7	Silkscreen	38
4-8	Top Layer.....	39
4-9	Bottom Layer.....	40
4-10	Silkscreen	41
4-11	Top Layer.....	42
4-12	Bottom Layer.....	43

List of Tables

1-1	SW201: System Clock Rate Selection for DIR9001	12
1-2	SW201: Data Format Selection for DIR9001	12
4-1	Bill of Materials: DEM-DAI/MDAC_USB.....	44
4-2	Bill of Materials: DEM-PCM1691	47

Read This First

About This Manual

This document provides the information needed to set up and operate the DEM-DAI1691 EVM evaluation module, a test platform for the 24-bit, 192-kHz, differential output, eight-channel [PCM1691](#) audio digital-to-analog converter (DAC). For a more detailed description of the PCM1691, refer to the product data sheet available from the Texas Instruments web site at <http://www.ti.com>. Support documents are listed in the section of this guide entitled [Related Documentation from Texas Instruments](#).

How to Use This Manual

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the DEM-DAI1691 EVM. The abbreviation *DUT* refers to the PCM1691 device. Unless specifically noted, the information presented in this manual applies to the PCM1691.

[Chapter 1](#) describes the hardware setup guide for the EVM, including the necessary information required to configure the EVM switches and jumpers for product evaluation.

[Chapter 2](#) explains how to use the software provided with the DEM-DAI1691 EVM for controlling the PCM1691.

[Chapter 3](#) includes the EVM electrical schematics, printed circuit board (PCB) layouts, and the bills of material for both the DEM-PCM1691 and the DEM-DAI/MDAC_USB evaluation platform motherboard.

Information About Cautions and Warnings

This document contains caution statements.

CAUTION

This is an example of a caution statement. A caution statement describes a situation that could potentially damage your software or equipment.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation From Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the DEM-DAI1691 EVM. These documents are available from the [TI web site](#). The last character of 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 web site at <http://www.ti.com/> or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document(s) by both title and literature number.

Data Sheet	Literature Number
PCM1691 Product data sheet	SBAS450A
DIR9001 Product data sheet	SLES198
TUSB3410 Product data sheet	SLLS519G
MSP430F169 Product data sheet	SLAS368E
OPA2134 Product data sheet	SBOS058
SN74LVC2G14 Product data sheet	SCES200L
TPS76933 Product data sheet	SLVS203E
REG1117 Product data sheet	SBVS001D
SN74LVC2GU04 Product data sheet	SCES197M
SN74LVC1T45 Product data sheet	SCES515H
SN74LV541 Product data sheet	SCES573A

If You Need Assistance

If you have questions regarding either the use of this evaluation module or the information contained in the accompanying documentation, please contact the Texas Instruments Product Information Center at (972) 644-5580 or visit the TI web site at www.ti.com.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense is required to take whatever measures may be required to correct this interference.

Trademarks

All trademarks are the property of their respective owners.

Description and Hardware

The DEM-DAI1691 is an evaluation board for the [PCM1691](#), a 24-bit, 192-kHz, differential output, eight-channel audio DAC with a digital audio receiver, eight-channel second-order post filter, mode control interface to PC, and various switches and jumpers for configuration controls.

The DEM-DAI1691 operates from 5-V and ± 15 -V analog power supplies with an S/PDIF input signal.

Topic	Page
1.1 Block Diagram	10
1.2 Basic Connections and Operation.....	11
1.3 EVM Configuration Controls.....	11

1.1 Block Diagram

Figure 1-1 shows a block diagram of the DEM-DAI1691, which consists of the DEM-DAI/MDAC_USB and the DEM-PCM1691 (the DUT daughtercard).

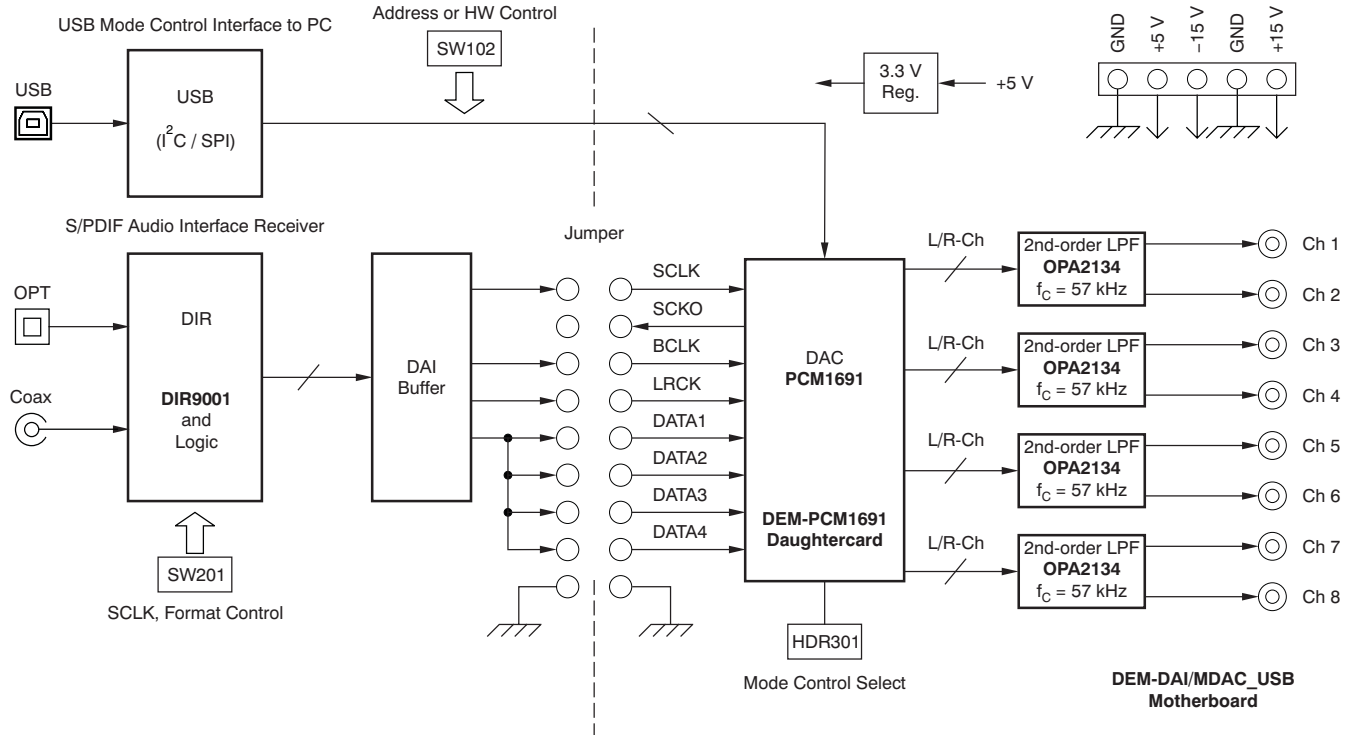


Figure 1-1. DEM-DAI1691 Block Diagram

1.1.1 Electrostatic Discharge Warning

Many of the components on the DEM-DAI1691 EVM 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.

CAUTION

Failure to observe ESD handling procedures may result in damage to EVM components.

1.2 Basic Connections and Operation

Follow these procedures to configure the DEM-DAI1691 for use.

- Set/confirm HDR001, HDR101, JP101/2, and SW102 to set the proper EVM power configuration and mode control interface for the PCM1691.
- Set/confirm CN204/5 and SW203 to provide the proper system clock and other signals from the digital audio receiver to the PCM1691.
- Set/confirm jumper JP401-432 to select the interface type (differential or single-ended, ac- or dc-coupling) between the DAC outputs and the second-order low-pass filter (LPF) buffer.
- Set/confirm HDR301 to select the PCM1691 mode control type. No change from the default setting is required for general evaluation purposes.
- Connect the +5-V and ± 15 -V power supplies to V_{CC} , AV_{CC} , $-AV_{CC}$, and GND on connectors CN001 to CN005.
- Connect the S/PDIF signal into CN201 (COAX) or U201 (OPT), and connect the PC USB port to CN101 for mode control if required.
- Set/confirm the input data clock and format using SW201 and SW102 (hardware control) or the EVM control software (software SPI™ or I²C™ control).

1.3 EVM Configuration Controls

This section presents the standard parameters for the EVM. For normal operation, configure the EVM as discussed here.

1.3.1 HDR001

This header selects the power-supply source for the control and DIR blocks of the EVM.

- 1–2: Use the power supply provided on CN004/5 (default)
- 2–3: Use a separate power supply provided on 2-3 of HDR001

No change from the default setting is required for general evaluation purposes.

1.3.2 HDR101

HDR101 selects the power-supply configuration of the USB Interface block.

- SELF: Use the EVM power supply for the USB Interface block (default)
- BUS: Use the PC power supply provided via a connected USB cable

No change from the default setting is required for general evaluation purposes.

1.3.3 JP101

This jumper enables the pull-up resistors for the I²C control mode.

- ON: Enables two 1-k Ω pull-up resistors (one each for SCL and SDA) (default)
- OFF: Disables pull-up resistors (for hardware control mode)

No change from the default setting is required except when using hardware control mode.

1.3.4 JP102

JP102 enables a software control signal to be sent via USB to the DUT (PCM1691) according to the mode control selection of HDR301.

- ON: Enables signal to be sent to DUT in either SPI or I²C control mode (default)
- OFF: Disables the signal to be sent to DUT in hardware control mode

No change from the default setting is required except when using hardware control mode.

1.3.5 CN102

CN102 enables the test and write interface for U104; it is not used in any customer application. Always keep this connector open.

1.3.6 SW101

This switch resets the USB Interface (U102) and Mode Control Interface (U104) operation.

1.3.7 SW102

SW102 enables the user to set (or reset) the control signal for hardware control mode and the slave address for I²C mode, if required. These functions are defined for the PCM1691; the default setting is OFF.

- 1–8: RSV (Reserved, PCM1691 pin 23)
- 2–7: DEMP (De-emphasis, PCM1691 pin 20)
- 3–6: FMT (Format, PCM1691 pin 21)
- 4–5: RSV (Reserved, PCM1691 pin 22)

No change from the default setting is required except when using hardware control mode.

1.3.8 CN205

The DEM-DAI1691 supports a flexible PCM audio interface through a DAI bridge, so that the PCM1691 can interface with external devices or equipment in place of the DIR9001 digital receiver through an internal buffer. Interfacing with external components or devices can be done by changing the CN205 connections of SCKI, BCK, LRCK, DATA1/2/3/4, and GND from the left side to the right side, as shown in [Figure 4-3](#) (see [Section 4.1.3](#)). There is no change required from the default setting for general evaluation.

1.3.9 SW201

SW201 selects the system clock rate and format for U203, the DIR9001 digital receiver. [Table 1-1](#) and [Table 1-2](#) list the system clock rate selection and data format selection options, respectively, for the DIR9001 (U203).

Table 1-1. SW201: System Clock Rate Selection for DIR9001

PSCK1	PSCK0	System Clock Selection
On (H)	On (H)	512 f _S (Default)
On (H)	Off (L)	384 f _S
Off (L)	On (H)	256 f _S
Off (L)	Off (L)	128 f _S

Table 1-2. SW201: Data Format Selection for DIR9001

FMT1	FMT0	Data Format Selection
On (H)	On (H)	16-bit to 24-bit, MSB-first, I ² S™ format (default)
On (H)	Off (L)	16-bit to 24-bit, MSB-first, left-justified format
Off (L)	On (H)	24-bit, MSB-first, right-justified format
Off (L)	Off (L)	16-bit, MSB-first, right-justified format

1.3.10 SW202

This switch selects the S/PDIF input signal for U203.

- OPT: Selects the optical input (default)
- COAX: Selects the coaxial input

1.3.11 SW203

This switch selects the operating mode for U203.

- X'tal: Always output the XTI clock source
- PLL: Always output the recovered clock by PLL
- AUTO: Automatic clock selection by ERROR status (default)

1.3.12 SW204

SW204 resets the DIR (DIR9001) operation.

1.3.13 HDR301

This header selects the PCM1691 control mode.

- 1–2: Software (I²C) control mode
- 7–8: software (SPI) control mode (default)
- Open: Hardware control mode

1.3.14 SW301

SW301 resets the DUT (PCM1691) operation.

1.3.15 SW302

This switch controls the AMUTE (Analog Mute) function.

1.3.16 JP401/05/09/13/17/21/25/29

These jumpers control the signal flow from the DUT to the post low-pass filter/buffer.

- Open: Differential interface
- Short: Single-ended interface (default)

No change from the default setting is required for general evaluation purposes.

1.3.17 JP402/06/10/14/18/22/26/30

These jumpers control the signal flow from the DUT to the post low-pass filter/buffer.

- Open: AC coupling (default)
- Short: DC coupling

No change from the default setting is required for general evaluation purposes.

1.3.18 JP403,04/07,08/11,12/15,16/19,20/23,24/27,28/31,32

These jumpers select the interface type for the DUT to the post low-pass filter/buffer.

- Open: Differential interface
- Short: Single-ended interface (default)

No change from the default setting is required for general evaluation purposes.

Application Software

This chapter describes the functions and use of the DEM-DAI1691 EVM application software. The software provided with the DEM-DAI1691 allows programming of the PCM1691 internal registers. The software operates on computers that are equipped with Microsoft® Windows® 2000 and XP operating systems, and requires connection of the USB port to CN101 of the DEM-DAI1691 using a standard USB cable.

Topic	Page
2.1 Description and Installation.....	16
2.2 Software Start-up Procedure	16
2.3 Using the Application Software.....	17

2.1 Description and Installation

Download the following software tools and documentation from the [PCM1691 product folder](#) on the TI web site.

- Virtual COM port driver software (that is, the USB driver software) for the TUSB3410.
- Application software for the DEM-DAI1691

1. Installation Procedure for Virtual COM Port Driver Software

Refer to the documentation in the downloaded file (*Virtual COM Port Driver Installation Instructions.pdf*, also available at <http://focus.ti.com/docs/toolsw/folders/print/tusbwinvcp.html>)

2. Installation Procedure for Application Software

There is no installer software required. Copy the downloaded application software folder to the desired local folder. To uninstall the software, delete the local folder.

2.2 Software Start-up Procedure

Note: This procedure is very important in order for the DEM-DAI1691 to be properly detected by the PC.

- Step 1. Set HDR301 on the DEM-DAI1691 to SPI mode. (If you prefer to use I²C mode, set HDR301 to I²C mode.)
- Step 2. Turn on the power supply for the DEM-DAI1691.
- Step 3. Connect the USB connector on DEM-DAI1691 to the PC.
- Step 4. Launch the application software (that is, *EVM169x.exe*). The default control mode for the application software is SPI; if you prefer to use I²C mode, change the control mode setting to I²C, and then push the **Reconnect** button on the application software interface. After that, the preferred setting (SPI or I²C mode) is stored on the PC for both the DEM-DAI1691 and the software.

Error Message at Software Start-up

If the DEM-DAI1691 is not correctly detected by the application software, the error message shown in [Figure 2-1](#) appears on the PC. After pushing **OK**, the application software will launch with an indication of *No EVM* in red, and controlling the DEM-DAI1691 is impossible. In this case, check the USB connection between the DEM-DAI1691 and the PC, and the power-supply connection and voltage; unplug and reconnect these cables as needed, then try launching the software again by pushing the **Reconnect** button.

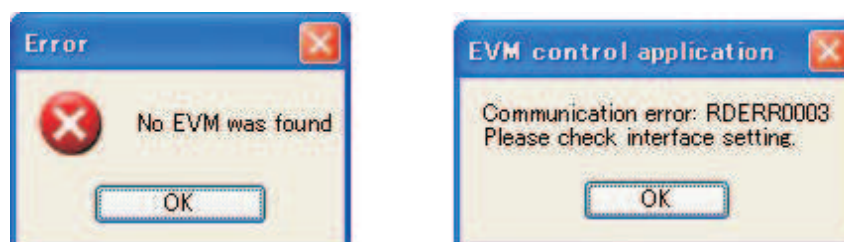


Figure 2-1. Error Message at Software Start-up

2.3 Using the Application Software

This section discusses the various controls available in the application software using screenshots and describing the possible control functions for each tab.

For evaluation of PCM1691 audio performance with EVM default conditions settings, no application software operation and no switch, jumper, or header setting changing on the EVM are required. This application software is used to control the register contents of the PCM1691 to various values necessary for a given application.

The PCM1691 operating mode, including the audio interface format and sampling mode, can be set through the serial control port by this PCM1691 control application software in either I²C or SPI control mode.

The application software is not required for PCM1691 hardware control mode. Switch SW102 on the EVM is used for limited functions in hardware control mode.

2.3.1 Audio Interface and Sampling Mode Control (SPI Mode)

Figure 2-2 shows the audio interface and sampling mode control tab for SPI mode.



Figure 2-2. Audio Interface and Sampling Mode Control Tab—SPI Mode Recognized

This screen has the following features:

- This tab is the initial window that appears, and indicates that the USB connection with the PC and the EVM is properly recognized; it also shows that SPI serial control is the interface mode.
- PCM1691 audio interface mode and oversampling mode can be set in this window.

Additionally, four important controls are visible in Figure 2-2.

Reconnect

This button performs a reconnect operation between the PC and the EVM. When the interface mode (either I²C or SPI) or the I²C slave address changes, pushing this button is required. For system recovery after releasing the USB cable or turning off the EVM power supply, pushing this button is also required.

Exit

This button closes and exits the application software.

MRST (Mode Register Reset)

The MRST button resets all PCM1691 register settings and the application software.

SRST (System Reset)

The SRST button resynchronizes the PCM1691. The register setting is not cleared.

2.3.2 Audio Interface and Sampling Mode Control (I²C Mode)

Figure 2-3 illustrates the audio interface and sampling mode control tab for I²C mode.



Figure 2-3. Audio Interface and Sampling Mode Control Tab—I²C Mode Recognized

As with SPI mode (see Section 2.3.1), this initial display screen confirms proper a USB connection with the PC and the EVM, as well as indicates that I²C serial control mode is properly recognized.

Note that when I²C mode is selected, there is an additional control that becomes active:

Address Setting

This field sets the I²C slave address for the software. This address must concur with the address registered on the EVM. In other words, the I²C address of the EVM and the software must be the same.

2.3.3 USB Connection and EVM Not Recognized

Figure 2-4 displays the audio interface and sampling mode control tab as it appears when the USB connection with the PC and the EVM and/or serial control mode is not properly recognized. Note the red **No EVM** button.

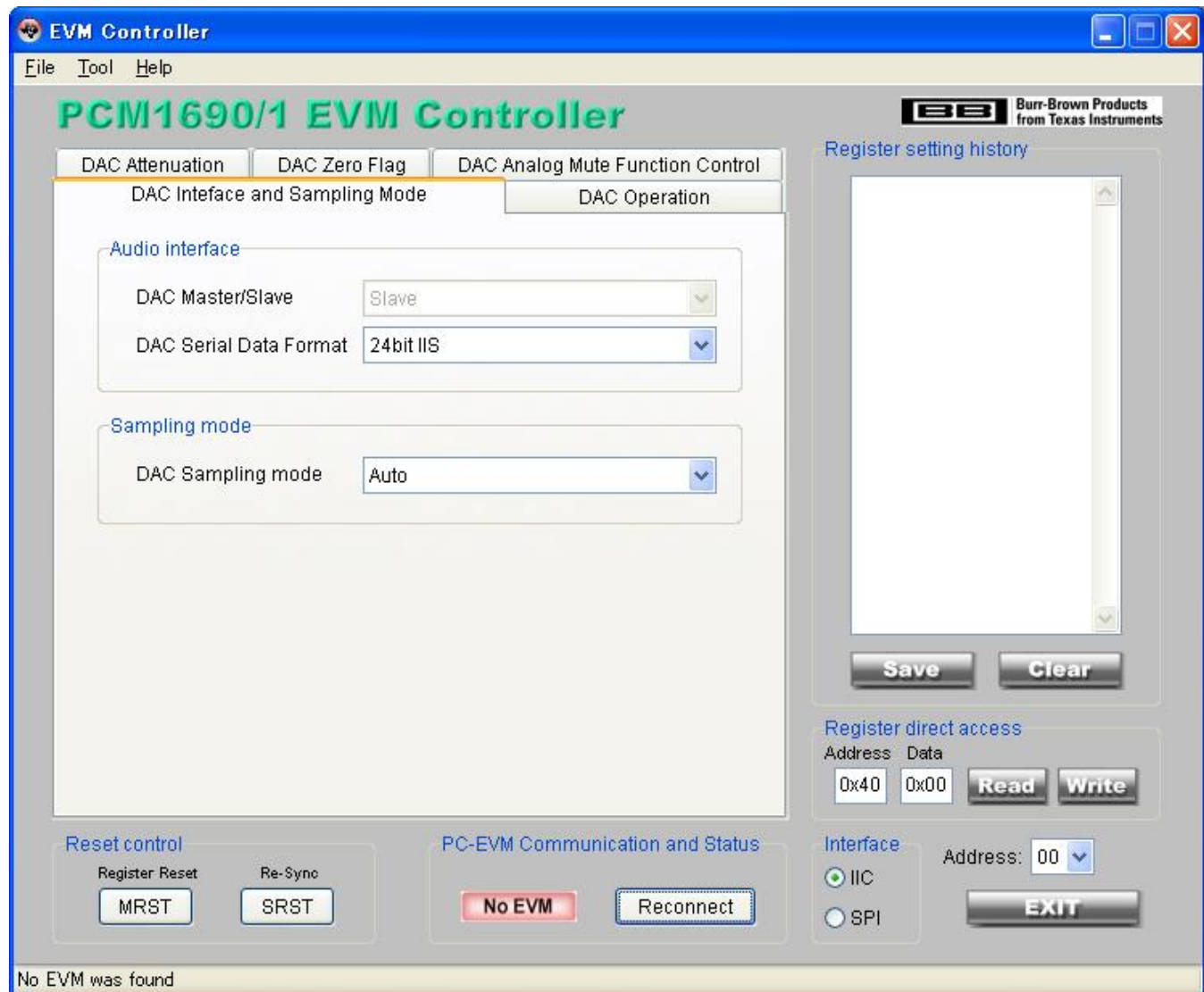


Figure 2-4. Audio Interface and Sampling Mode Control Tab—USB Connection and EVM Not Recognized

Troubleshooting

If there is no change after pushing *Reconnect* button, the following items should be checked:

- q Are the power supplies correctly distributed for the EVM?
- q Is the EVM properly connected to the PC?
- q Is the USB port on the PC activated?
- q Is the Virtual COM port driver software (that is, the USB driver software) correctly installed on the PC?
- q Is the selection of SPI/I²C control mode coincident between the application software and the EVM setting for the PCM1691?
- q If I²C mode is selected, is the I²C slave address the same for the application software and the EVM setting on the PCM1691?

If you have thoroughly reviewed these procedures and there continues to be no change with the **No EVM** indication, contact the Texas Instruments product support center nearest you for assistance.

2.3.4 Operation Mode Control

The operation mode control tab is shown in [Figure 2-5](#).



Figure 2-5. Operation Mode Control Tab

This tab has the following features:

- Power-Save Mode
- De-emphasis
- Digital filter roll-off
- Polarity (phase) between input and output

As illustrated in [Figure 2-5](#), these features can be controlled by channel pairs or by all channels.

2.3.5 Digital Attenuation and Soft Mute Control

Figure 2-6 shows the digital attenuation and soft mute control tab.

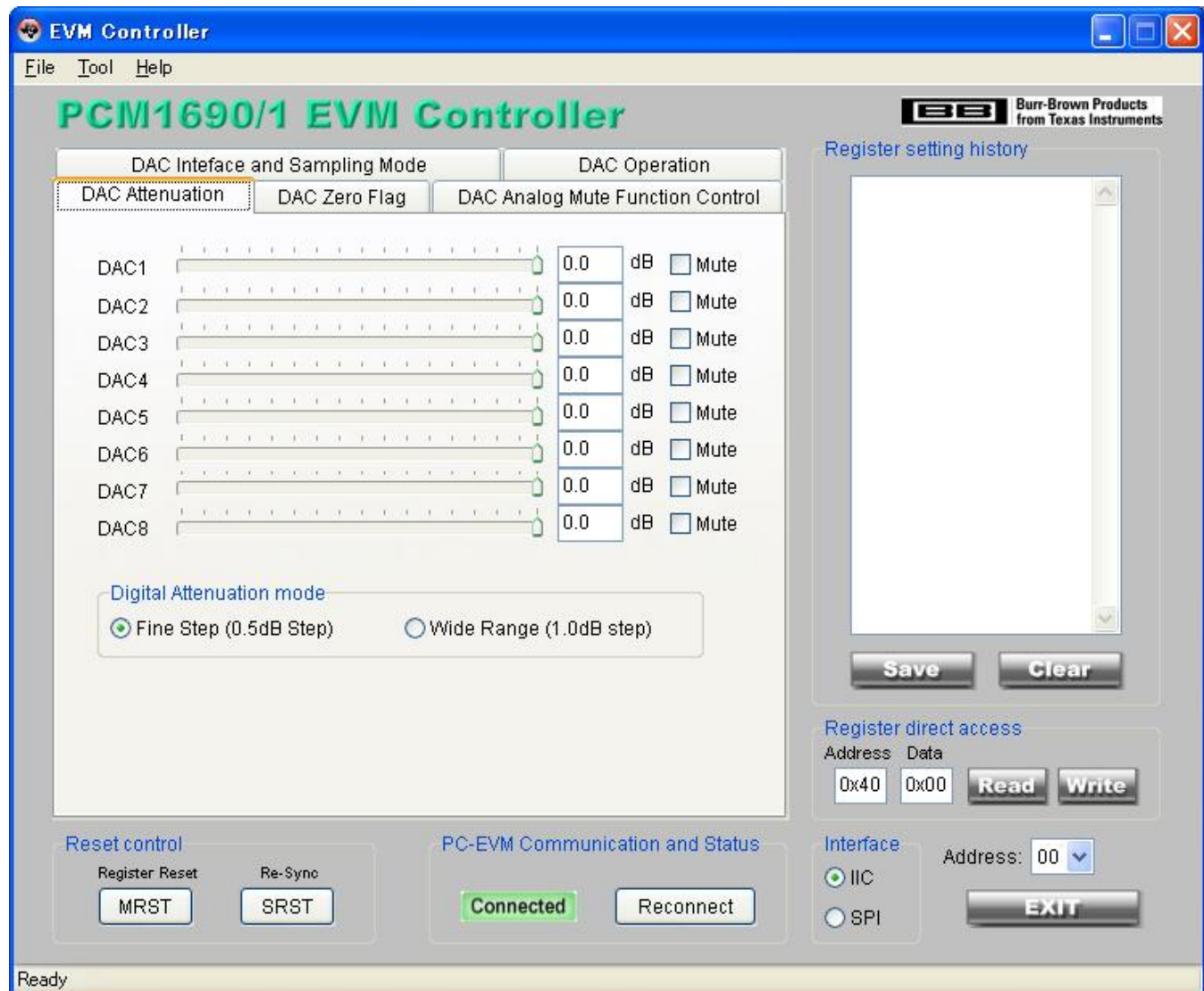


Figure 2-6. Digital Attenuation and Soft Mute Control Tab

Digital attenuation can be controlled for each channel by either changing the slider location or directly entering a target number in 0.5- or 1-dB increments.

- Soft mute on or off using digital attenuation can be also controlled for each channel; operation of digital attenuation control is ignored while the mute is on.
- Choose between *Fine* or *Wide* digital attenuation mode (fine control extends to 63 dB with 0.5-dB steps; wide control covers a 100-dB range with 1.0-dB steps),

2.3.6 Zero Flag Control and Monitor

Figure 2-7 shows the zero flag control and monitor tab.

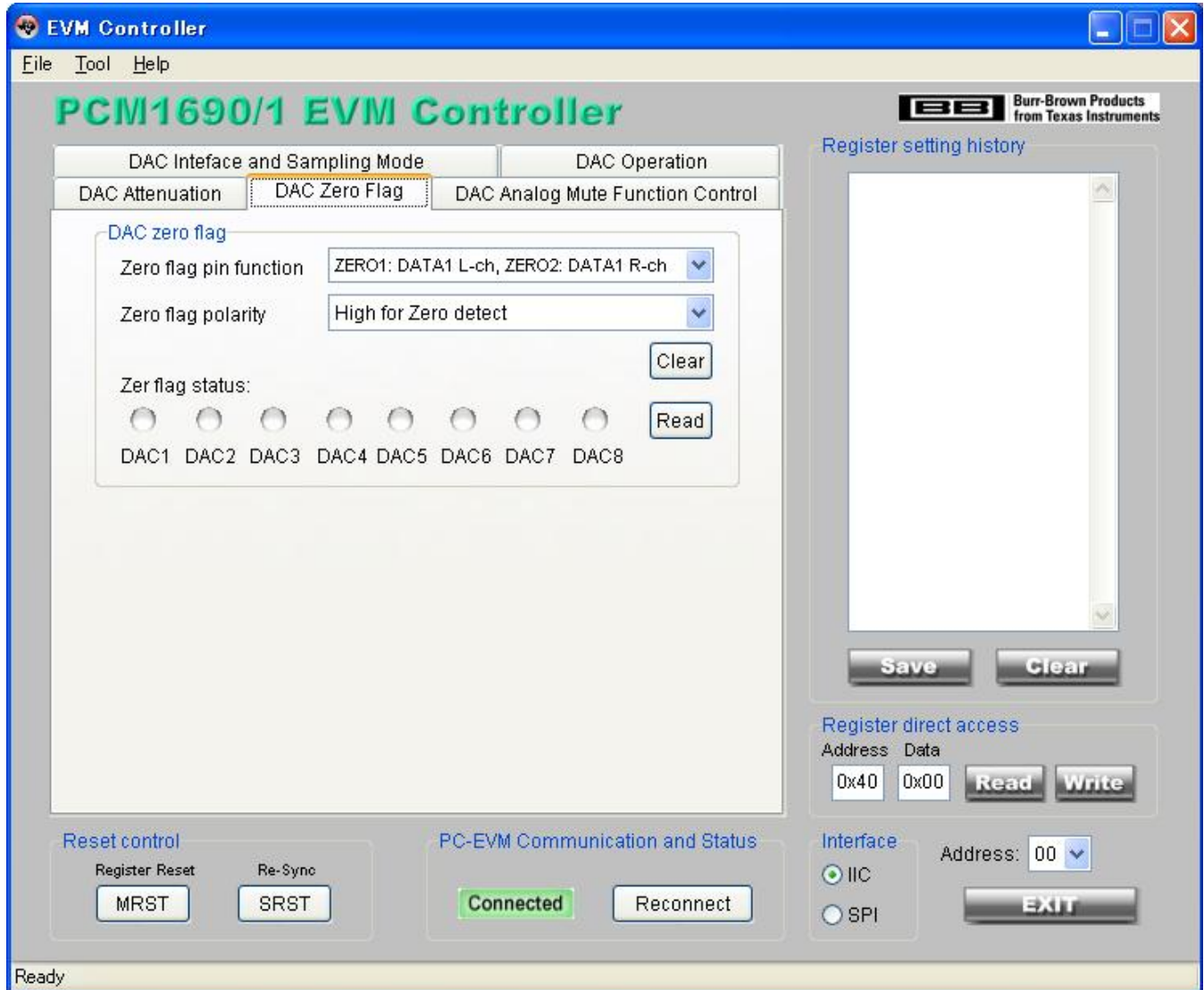


Figure 2-7. Zero Flag Control and Monitor Tab

Both the function and the signal polarity of the zero flag pins (PCM1691 pins 1 and 2) can be controlled. The status of zero input detection is updated by channel when a Read command is performed; a zero flag indication is cleared by pushing the *Clear* button.

2.3.7 Analog Mute Function Control

Figure 2-8 illustrates the analog mute function control tab.



Figure 2-8. Analog Mute Function Control Tab

This window enables the user to select a source event for the analog mute control function of the PCM1691. Four source events can be selected independent of each other:

- SCKI lost
- Asynchronous clocks
- ZERO1 or ZERO2 detection
- DAC disable command

2.3.8 Register Setting History, Register Direct Access

The Register Setting History and Register Direct Access area of the software interface is shown in [Figure 2-9](#).

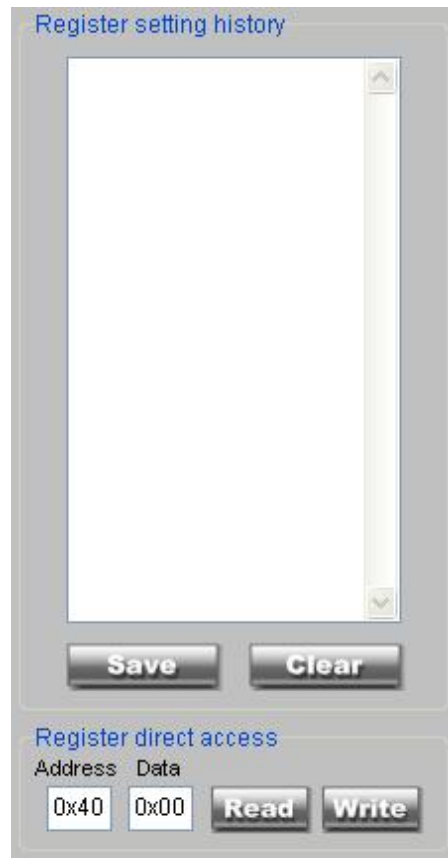


Figure 2-9. Register Setting History, Register Direct Access Area

Register Setting History

The register setting history is shown as *Register Address*, *Register Data* in hexadecimal. This history can be downloaded as a comma-separated value (.csv) file by pressing the **Save** button. An upload function is also available from the File menu. The **Clear** button clears this history.

Register Direct Access

Both read and write functions (read and write any data to or from any address) are available.

Open Script from File Menu

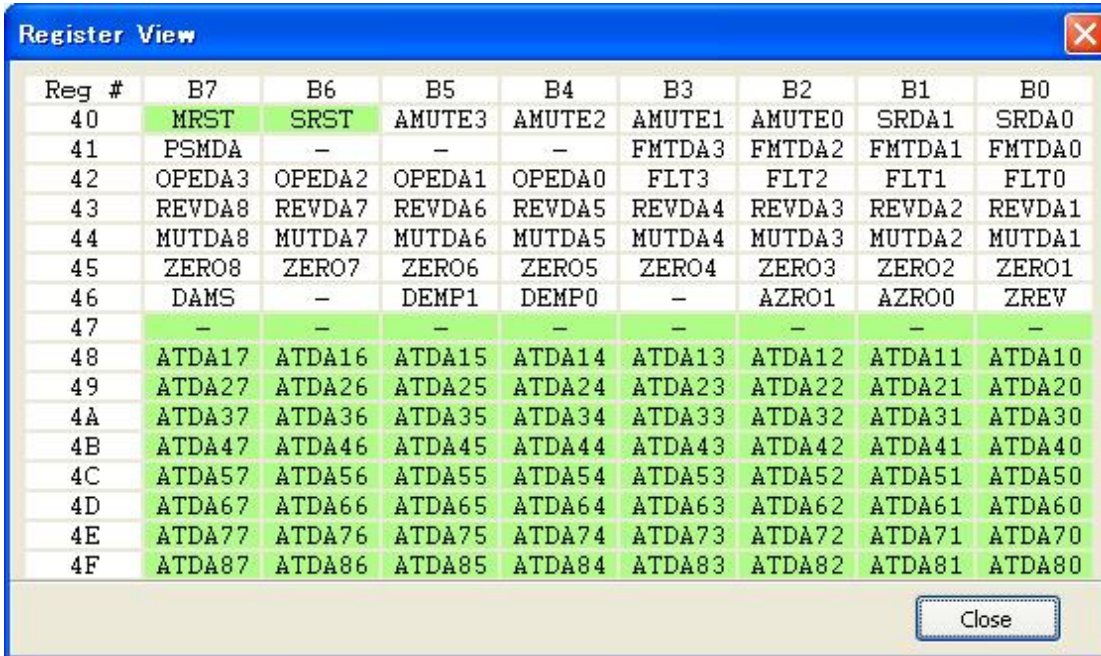
This menu uploads a previously saved register setting snapshot from a stored .csv file.

Save Register Snapshot from File Menu

This menu downloads a register setting snapshot in .csv file format. The saved register setting snapshot can then be uploaded by the File/Open Script command.

2.3.9 Register Contents View

Figure 2-10 illustrates a view of the register contents. This option shows all registers of the PCM1691 in a register map format.



Reg #	B7	B6	B5	B4	B3	B2	B1	B0
40	MRST	SRST	AMUTE3	AMUTE2	AMUTE1	AMUTE0	SRDA1	SRDA0
41	PSMDA	-	-	-	FMTDA3	FMTDA2	FMTDA1	FMTDA0
42	OPEDA3	OPEDA2	OPEDA1	OPEDA0	FLT3	FLT2	FLT1	FLT0
43	REVDA8	REVDA7	REVDA6	REVDA5	REVDA4	REVDA3	REVDA2	REVDA1
44	MUTDA8	MUTDA7	MUTDA6	MUTDA5	MUTDA4	MUTDA3	MUTDA2	MUTDA1
45	ZERO8	ZERO7	ZERO6	ZERO5	ZERO4	ZERO3	ZERO2	ZERO1
46	DAMS	-	DEMP1	DEMP0	-	AZRO1	AZRO0	ZREV
47	-	-	-	-	-	-	-	-
48	ATDA17	ATDA16	ATDA15	ATDA14	ATDA13	ATDA12	ATDA11	ATDA10
49	ATDA27	ATDA26	ATDA25	ATDA24	ATDA23	ATDA22	ATDA21	ATDA20
4A	ATDA37	ATDA36	ATDA35	ATDA34	ATDA33	ATDA32	ATDA31	ATDA30
4B	ATDA47	ATDA46	ATDA45	ATDA44	ATDA43	ATDA42	ATDA41	ATDA40
4C	ATDA57	ATDA56	ATDA55	ATDA54	ATDA53	ATDA52	ATDA51	ATDA50
4D	ATDA67	ATDA66	ATDA65	ATDA64	ATDA63	ATDA62	ATDA61	ATDA60
4E	ATDA77	ATDA76	ATDA75	ATDA74	ATDA73	ATDA72	ATDA71	ATDA70
4F	ATDA87	ATDA86	ATDA85	ATDA84	ATDA83	ATDA82	ATDA81	ATDA80

Figure 2-10. Register Contents View

The Register View window has three options (available in the application software):

Open Register View Window

Select *Tools* → *Register Map*. This window indicates latest entire register settings of PCM1691.

Register View Window Color Indicators

Green shaded cells (as shown in Figure 2-10) indicate a register value of '1'. White shaded cells indicate a register value of '0'.

Register View Window Operation

After updating a register setting for the PCM1691 through the application software, the update is reflected in this register view.

Typical Performance and Example Data

This chapter presents typical PCM1691 performance and example measurement data when measured with the DEM-DAI1691.

Topic	Page
3.1 Typical Performance Data	28
3.2 Example Measurement Data	29

3.1 Typical Performance Data

This section illustrates baseline PCM1691 performance on the DEM-DAI1691 with the default configuration. These data include typical performance versus sampling rate and system clock, and FFT results for full-scale, -60 dB, -120 dB, and bipolar zero at 48 kHz/ $512 f_s$. As a result of a performance limitation of the second-order active LPF and buffer for $2 \cdot V_{RMS}$ out followed by the PCM1691 output, the reading performance is shown with 0.5 -dB to 1.0 -dB degradation in dynamic range, signal-to-noise ratio (SNR), and channel separation.

3.1.1 Typical Performance vs Sampling Rate and System Clock

Figure 3-1 shows typical PCM1691 performance versus the sampling rate and system clock.

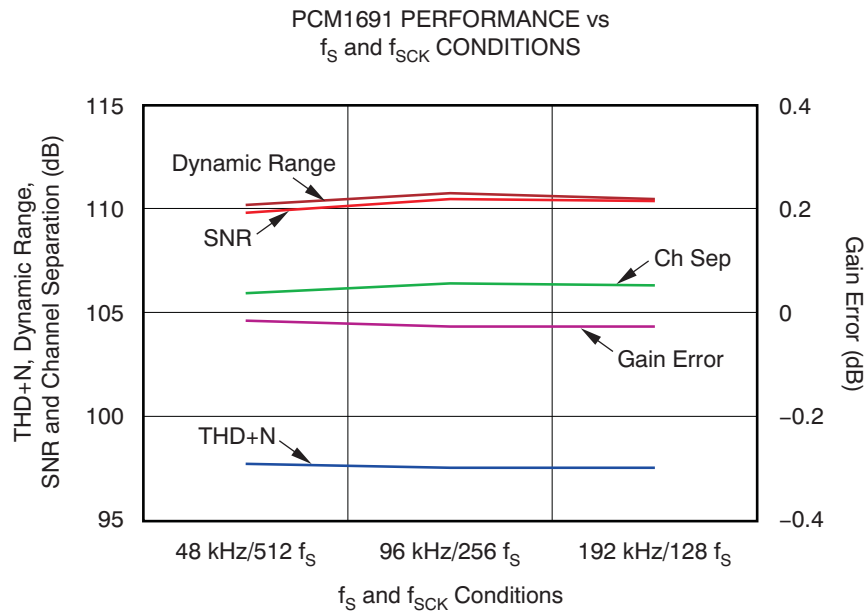


Figure 3-1. Typical Performance vs f_s and f_{SCK}

3.2 Example Measurement Data

Figure 3-2 through Figure 3-5 show the dynamic performance of the PCM1691 in a variety of FFT graphs.

3.2.1 FFT: 0-dB Output

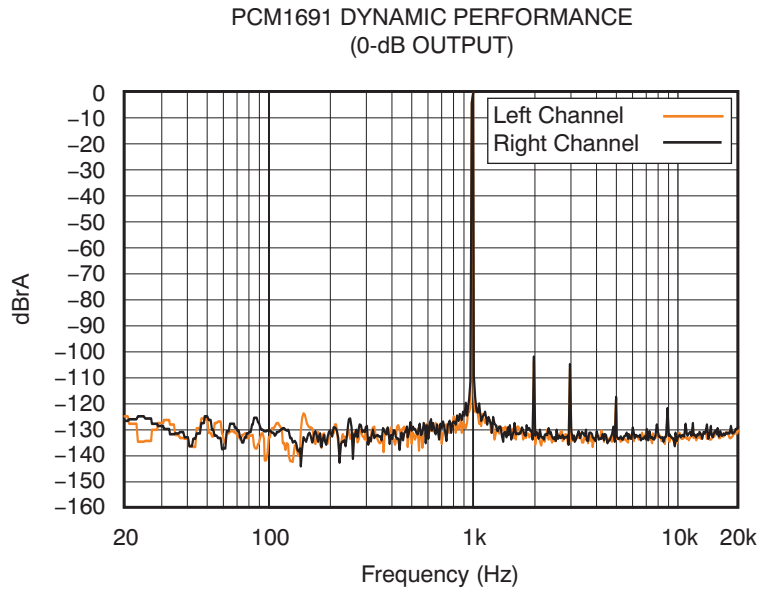


Figure 3-2. FFT (0 dB)

3.2.2 FFT: -60-dB Output

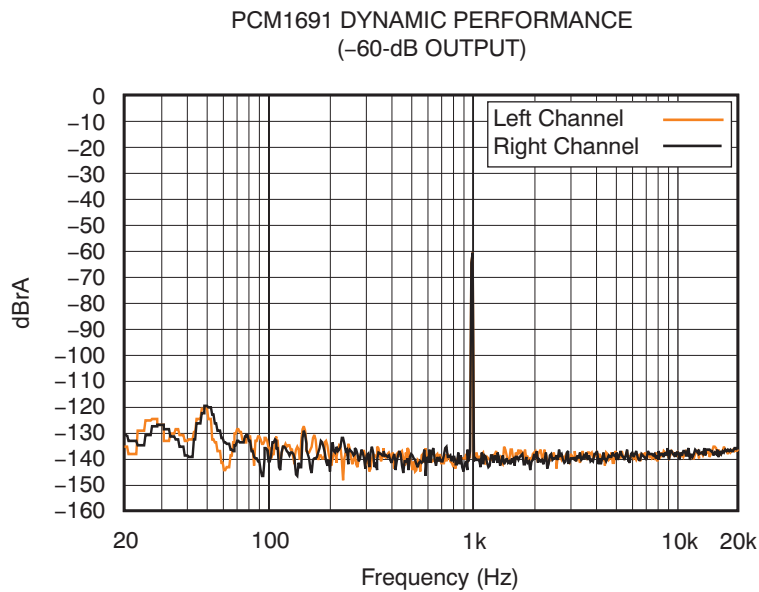


Figure 3-3. FFT (-60 dB)

3.2.3 FFT: -120-dB Output

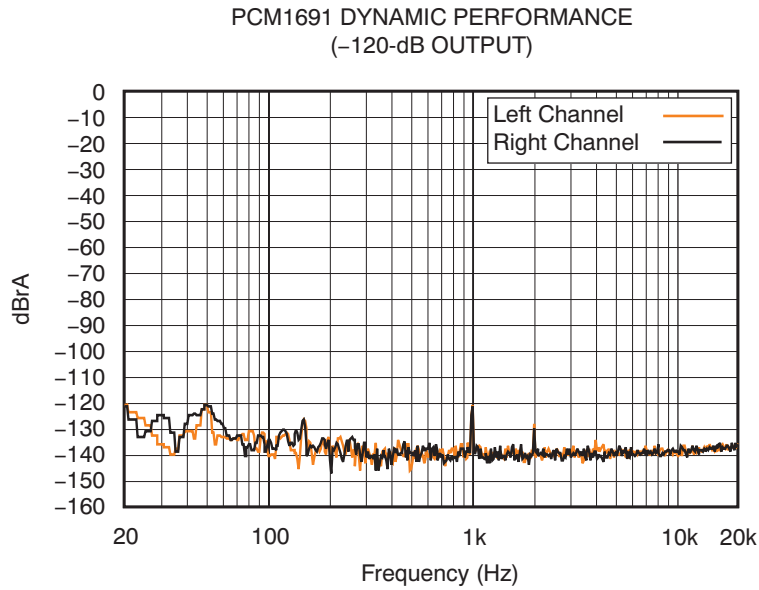


Figure 3-4. FFT (-120 dB)

3.2.4 FFT: Bipolar Zero Output

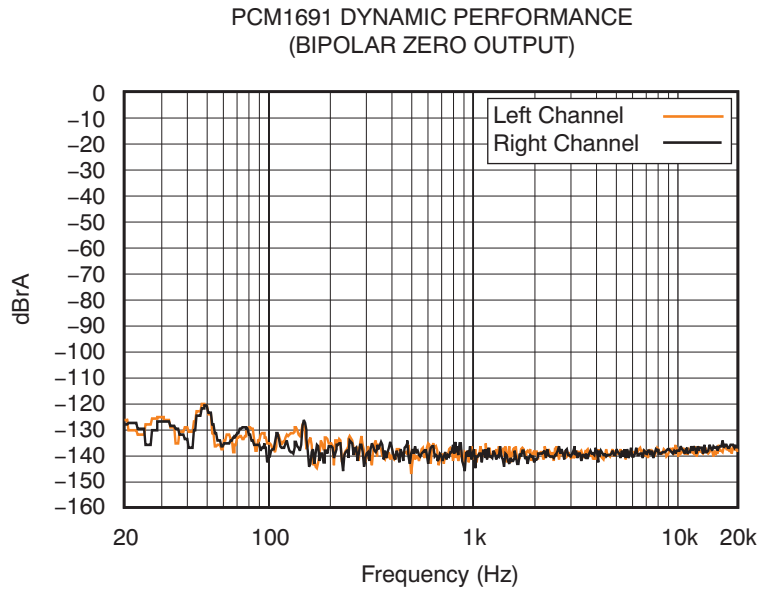


Figure 3-5. FFT of BPZ Output

Schematics and Printed Circuit Board Layouts

This chapter presents the schematics, printed circuit board (PCB) layouts, and bills of material (BOMs) of the DEM-DAI/MDAC_USB and the DEM-PCM1691.

Topic	Page
4.1 DEM-DAI/MDAC_USB Schematics	32
4.2 DEM-PCM1691 Schematic (DUT Daughtercard).....	37
4.3 Printed Circuit Board Layouts	38
4.4 Bills of Material (BOMs)	44

4.1 DEM-DAI/MDAC_USB Schematics

4.1.1 DEM-DAI/MDAC_USB Power Supply

The power-supply section is shown in [Figure 4-1](#).

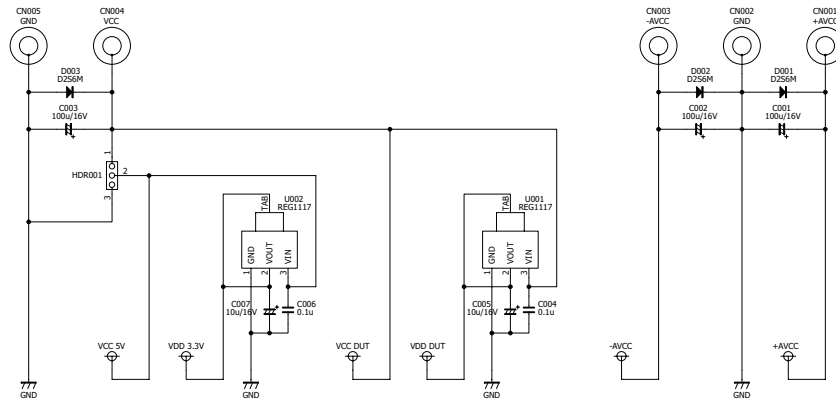


Figure 4-1. Power-Supply Section

4.1.2 DEM-DAI/MDAC_USB USB and MCU

The USB and MCU section is illustrated in Figure 4-2.

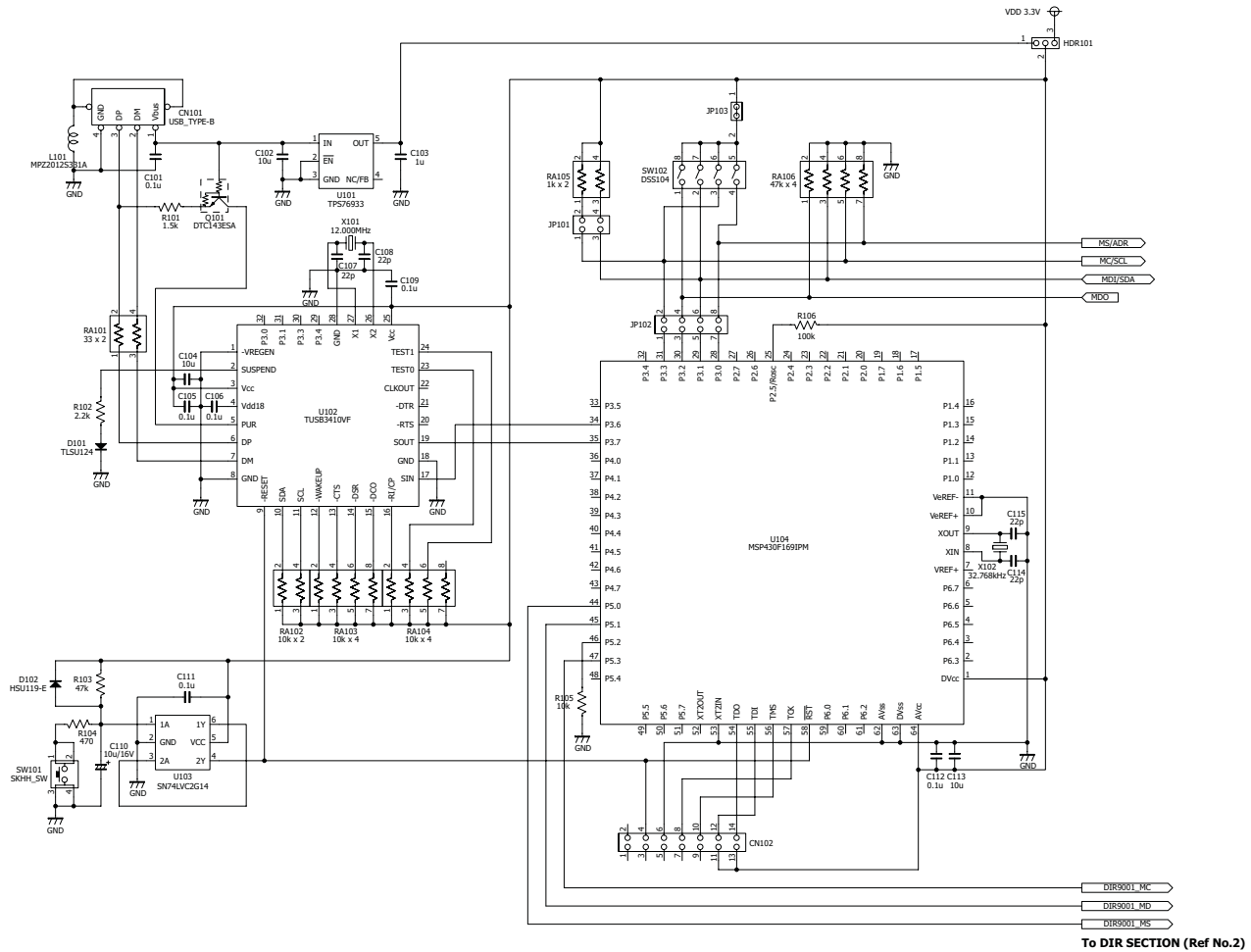


Figure 4-2. USB and MCU Sections

4.1.4 DEM-DAI/MDAC_USB Interface to DUT Board

Figure 4-4 illustrates the interface to DUT board section.

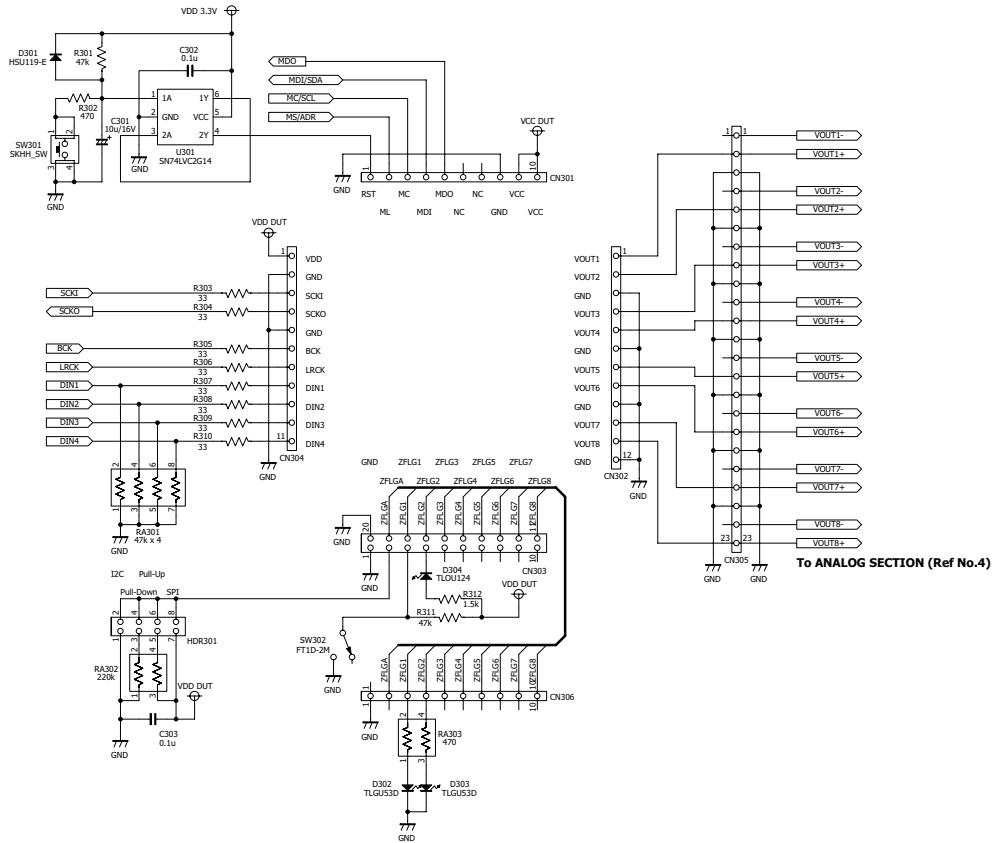


Figure 4-4. Interface to DUT Board Section

4.1.5 DEM-DAI/MDAC_USB LPF and Buffer

The LPF and buffer section is shown in Figure 4-5.

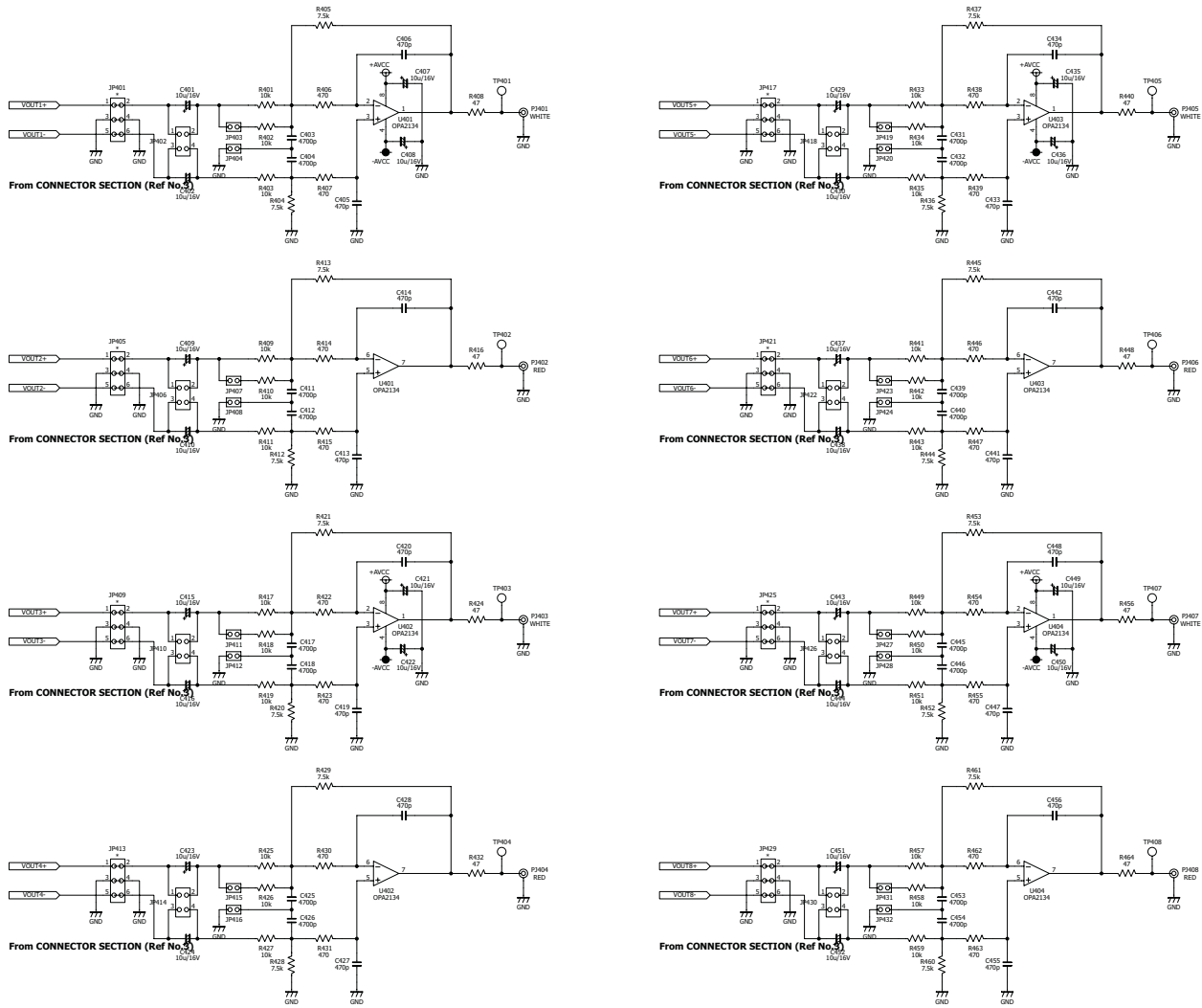


Figure 4-5. LPF and Buffer Section

4.2 DEM-PCM1691 Schematic (DUT Daughtercard)

Figure 4-6 shows the DEM-DAI1691 schematic.

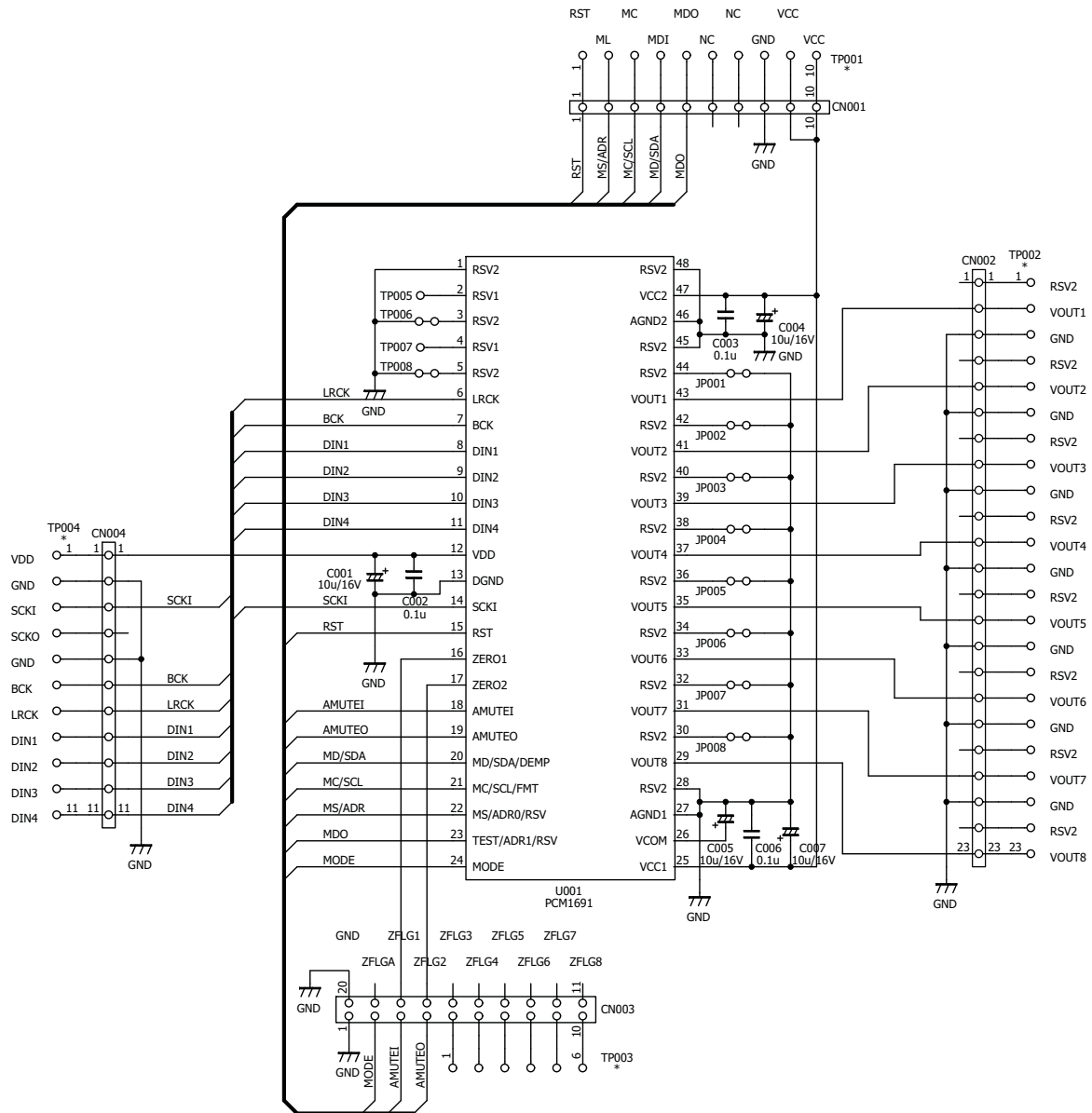


Figure 4-6. DEM-PCM1691

4.3.2 DEM-DAI/MDAC_USB Top Layer

Figure 4-8 shows the top layer image of the board.

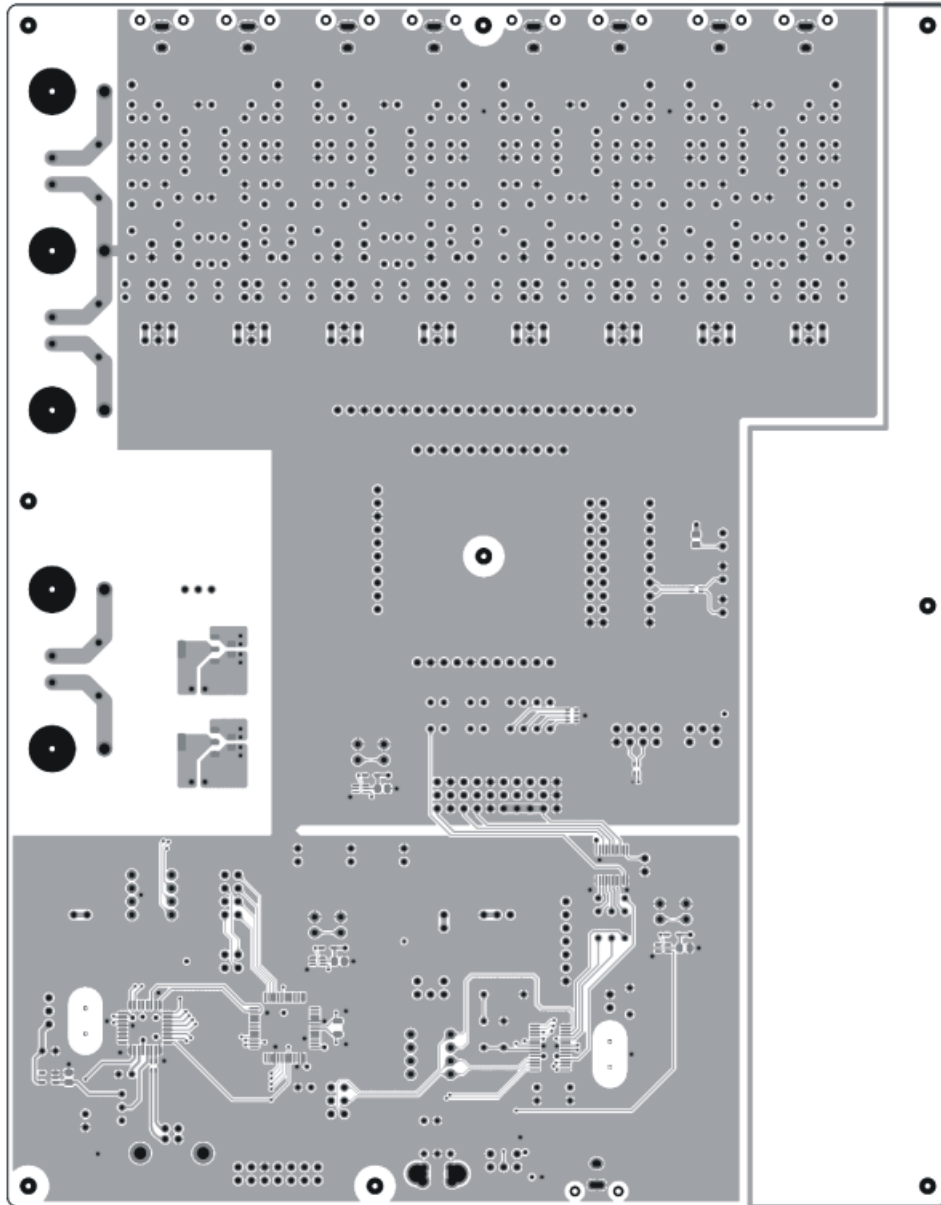


Figure 4-8. Top Layer

4.3.3 DEM-DAI/MDAC_USB Bottom Layer

Figure 4-9 shows the bottom layer image of the board.

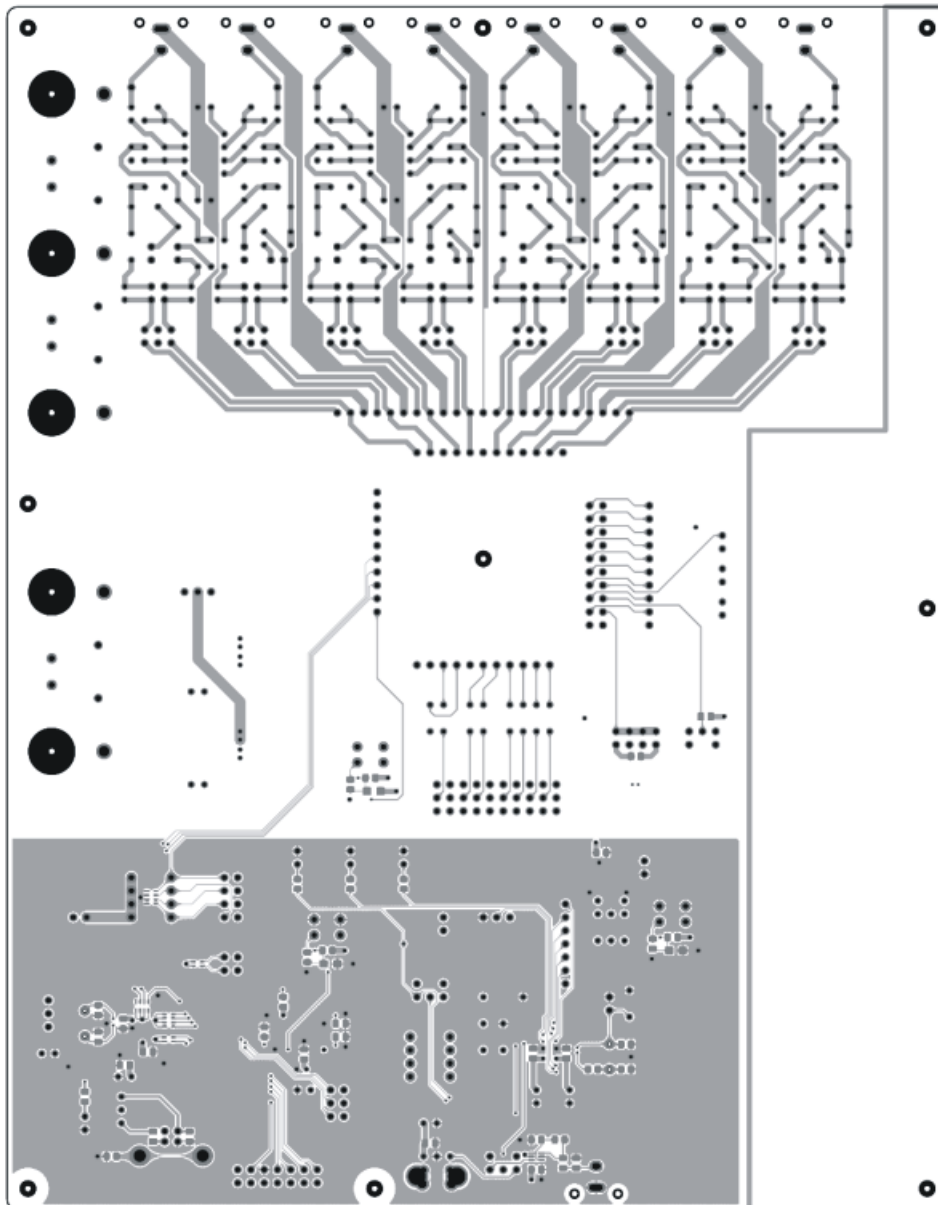


Figure 4-9. Bottom Layer

4.3.4 DEM-PCM1691 (DUT Daughterboard) Silkscreen

Figure 4-10 shows the silkscreen plane, top layer image for the DUT daughterboard.

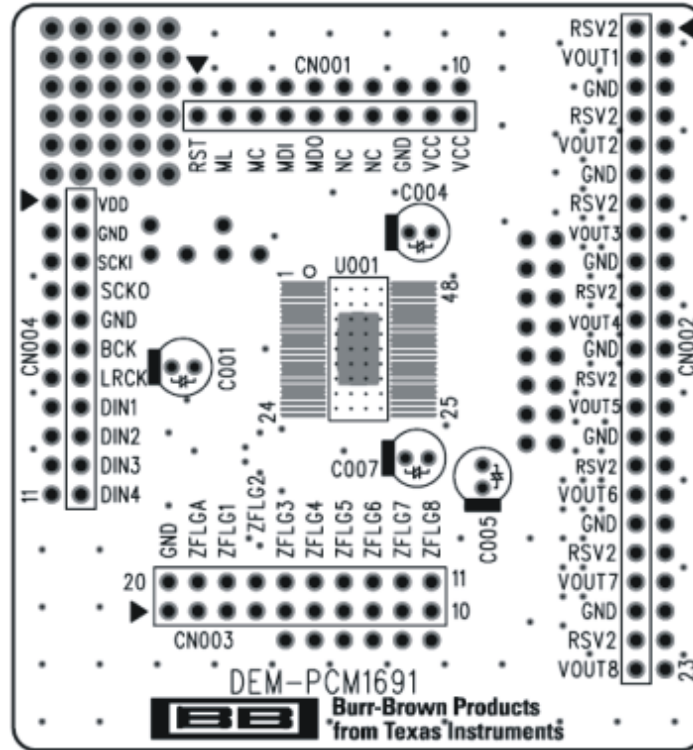


Figure 4-10. Silkscreen

4.3.5 DEM-PCM1691 (DUT Daughterboard) Top View

Figure 4-11 shows the top layer image for the DUT daughterboard.

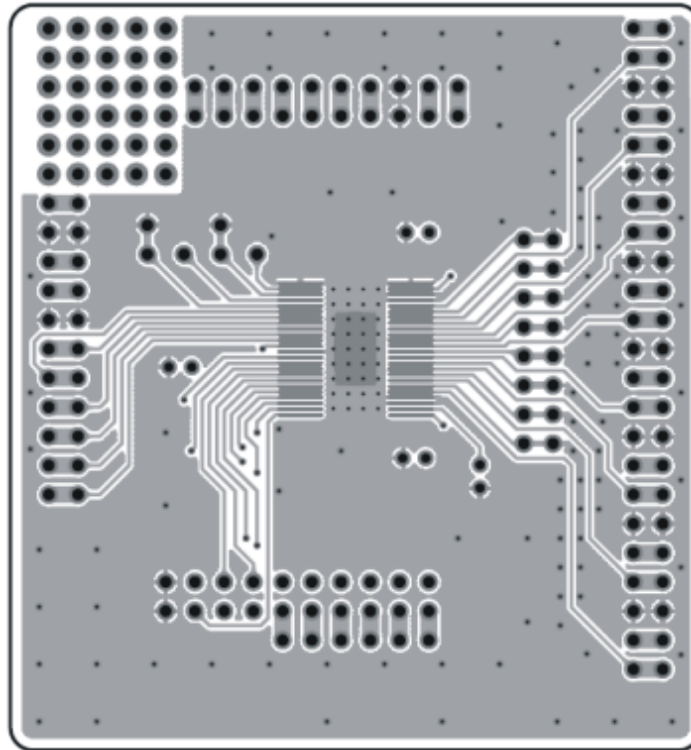


Figure 4-11. Top Layer

4.3.6 DEM-PCM1691 (DUT Daughterboard) Bottom View

Figure 4-12 shows the bottom layer image for the DUT daughterboard.

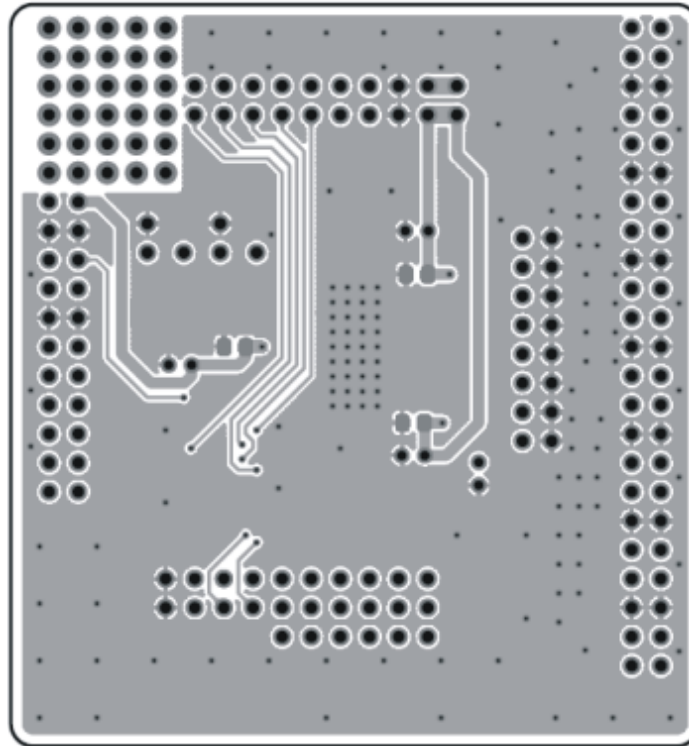


Figure 4-12. Bottom Layer

4.4 Bills of Material (BOMs)

Table 4-1 lists the BOM information for the DEM-DAI/MDAC_USB board. Table 4-2 includes the BOM information for the DEM-PCM1691 board.

Table 4-1. Bill of Materials: DEM-DAI/MDAC_USB

Qty	Reference Designators	Part Name, Type	Specification	Manufacturer Part No	Manufacturer
2	C207, C208	Chip Ceramic Capacitor	18 pF, J		Murata
4	C107, C108, C114, C115	Chip Ceramic Capacitor	22 pF, J		Murata
20	C004, C006, C101, C105, C106, C109, C111, C112, C201, C203, C204, C206, C209, C214-C218, C302, C303	Chip Ceramic Capacitor	0.1 μ F	GRM188B11E104KA01	Murata
1	C103	Chip Ceramic Capacitor	1 μ F	GRM188B11A105(K)	Murata
3	C102, C104, C113	Chip Ceramic Capacitor	10 μ F	GRM21BB31A106KA	Murata
16	C405, C406, C413, C414, C419, C420, C427, C428, C433, C434, C441, C442, C447, C448, C455, C456	Polypropylene Capacitor	470 pF	APSF0100J471	NISSEI
17	C211, C403, C404, C411, C412, C417, C418, C425, C426, C431, C432, C439, C440, C445, C446, C453, C454	Polypropylene Capacitor	4700 pF	APSF0100J472	NISSEI
1	C212	Polypropylene Capacitor	0.068 μ F	APSF0100J683	NISSEI
3	C110, C213, C301	Chip Tantalum Capacitor	10 μ F/16 V	ESVA1C106M	NEC TOKIN
5	C005, C007, C202, C205, C210	OS Capacitor	10 μ F/16 V	16SS10M	SANYO
24	C401, C402, C407-C410, C415, C416, C421-C424, C429, C430, C435-C438, C443, C444, C449, C450-C452	Electrolytic Capacitor	10 μ F/16 V	R0A-16V100M	ELNA
3	C001-C003	Electrolytic Capacitor	220 μ F/25 V	R0A-25V221M	ELNA
12	R303-R310, R212-R214, R215	Chip Resistor	33 Ω , D	RP0816	Susumu
8	R408, R416, R424, R432, R440, R448, R456, R464	Chip Resistor	47 Ω , D	RP0816	Susumu
1	R201	Chip Resistor	75 Ω , D	RR0816	Susumu
1	R205	Chip Resistor	330 Ω , D	RR0816	Susumu
20	R104, R204, R211, R302, R406, R407, R414, R415, R422, R423, R430, R431, R438, R439, R446, R447, R454, R455, R462, R463	Chip Resistor	470 Ω , D	RP0816	Susumu
2	R209, R208	Chip Resistor	680 Ω , D	RR0816	Susumu
2	R101, R312	Chip Resistor	1.5 k Ω , D	RP0816	Susumu
3	R102, R203, R207	Chip Resistor	2.2 k Ω , D	RP0816	Susumu
16	R404, R405, R412, R413, R420, R421, R428, R429, R436, R437, R444, R445, R452, R453, R460, R461	Chip Resistor	7.5 k Ω , D	RP0816	Susumu

Table 4-1. Bill of Materials: DEM-DAI/MDAC_USB (continued)

Qty	Reference Designators	Part Name, Type	Specification	Manufacturer Part No	Manufacturer
25	R105, R401-R403, R409-R411, R417-R419, R425-R427, R433-R435, R441-R443, R449-R451, R45-R459	Chip Resistor	10 k Ω , D	RP0816	Susumu
5	R103, R202, R210, R301, R311	Chip Resistor	47 k Ω , D	RP0816	Susumu
1	R106	Chip Resistor	100 k Ω , D	RP0816	Susumu
1	RA101	Resistor Networks	33 Ω x 2	CN1J2	KOA
1	RA303	Resistor Networks	470 Ω x 2	CN1J2	KOA
1	RA105	Resistor Networks	1 k Ω x 2	CN1J2	KOA
1	RA102	Resistor Networks	10 k Ω x 2	CN1J2	KOA
1	RA302	Resistor Networks	220 k Ω x 2	CN1J2	KOA
2	RA103, RA104	Resistor Networks	10 k Ω x 4	CN1J4	KOA
2	RA106, RA301	Resistor Networks	47 k Ω x 4	CN1J4	KOA
1	L101	Chip Ferrite Bead		MPZ2012S331A	TDK
3	D102, D204, D301	Chip Diode		HSU119-E	Renesas
3	D001-D003	Diode		CMS05	Toshiba
3	D201, D302, D303	LED	Green	TLPGU1002A	Toshiba
1	D304	LED	Orange	TLOU1002A	Toshiba
2	D101, D202	LED	Red	TLSU1002A	Toshiba
1	D203	LED	Yellow	TLYU1002A	Toshiba
1	Q101	Digital Transistor		DTC143E	ROHM
4	U401-U404	Op Amp		OPA2134PA	TI
3	U103, U204, U301	IC		SN74LVC2G14	TI
1	U202	Logic IC	Package: DCK	SN74LVC2GU04	TI
1	U206	Logic IC	Package: DCK	SN74LVC1T45	TI
1	U205	Logic IC		SN74LV541	TI
1	U203	IC	DIR	DIR9001	TI
1	U104	IC	MCU	MSP430F169IPM	TI
1	U102	IC	USB	TUSB3410VF	TI
1	U101	LDO Regulator IC	100 mA, 3.3 V	TPS76933	TI
2	U001, U002	Regulator IC	800 mA, 3.3 V	REG1117-3.3	TI
1	U201	TOSlink	Receiver	TORX141	Toshiba
1	X101	Crystal Resonator	12.000 MHz	CX5032GB	KSS
1	X201	Crystal Resonator	24.576 MHz	CX5032GB	KSS
1	X102	Crystal Resonator	32.768 kHz	FC-135, 12.5pF	EPSON
3	HDR001, HDR101, HDR203	TH-type Male Connector	3-pin	FFC-3AMEP1	HTK
1	HDR301	TH-type Male Connector	8-pin	FFC-8BMEP1	HTK
17	JP202, JP403, JP404, JP407, JP408, JP411, JP412, JP415, JP416, JP419, JP420, JP423, JP424, JP427, JP428, JP431, JP432	TH-type Male Connector	2-pin	FFC-2BMEP1	HTK
9	JP101, JP402, JP406, JP410, JP414, JP418, JP422, JP426, JP430	TH-type Male Connector	4-pin	FFC-4BMEP1	HTK

Table 4-1. Bill of Materials: DEM-DAI/MDAC_USB (continued)

Qty	Reference Designators	Part Name, Type	Specification	Manufacturer Part No	Manufacturer
1	JP201	TH-type Male Connector	6-pin	FFC-6BMEP1	HTK
1	JP102	TH-type Male Connector	8-pin	FFC-8BMEP1	HTK
1	CN203	TH-type Male Connector	6-pin	FFC-6AMEP1	HTK
3	CN202, CN204, CN205	TH-type Male Connector	2-pin	FFC-2BMEP1	HTK
1	CN102	TH-type Male Connector	14-pin	FFC-14BMEP1	HTK
2	CN301, CN306	TH-type Male Connector	10-pin	Z-220-10FD	HTK
1	CN304	TH-type Male Connector	11-pin	Z-220-11FD	HTK
1	CN302	TH-type Male Connector	12-pin	Z-220-12FD	HTK
1	CN305	TH-type Male Connector	23-pin	Z-220-23FD	HTK
1	CN303	TH-type Male Connector	20-pin	Z-279S-20FD	HTK
5	CN001-CN005	Banana Jack	Yellow, Green, Blue, Red, Black	T-45	Sato Parts
1	CN101	USB Connector type B	USB_TYPE-B	67068-8001	Molex
1	CN201	RCA Pin Jack	Yellow	LPR6520-0804	SMK
4	PJ402, PJ404, PJ406, PJ408	RCA Pin Jack	Red	LPR6520-0802	SMK
4	PJ401, PJ403, PJ405, PJ407	RCA Pin Jack	White	LPR6520-0803	SMK
2	SW102, SW201	DIP Switch		DSS104	Fujisoku
2	SW202, SW302	Toggle Switch		FT1D-2M	Fujisoku
1	SW203	Toggle Switch		FT1E-2M	Fujisoku
3	SW101, SW204, SW301	Tact Switch			Alps
4	TP402, TP404, TP406, TP408	Test Pin	RED	LC-2-G	Mac8
4	TP401, TP403, TP405, TP407	Test Pin	WHITE	LC-2-G	Mac8
1	TP201	Test Pin	RED	LC-4-G	Mac8

Table 4-2. Bill of Materials: DEM-PCM1691

Qty	Reference Designators	Part Name, Type	Specification	Manufacturer Part No	Manufacturer
3	C002, C003, C006	Chip Ceramic Capacitor	0.1 μ F	GRM188B11E104KA01	Murata
4	C001, C004, C005, C007	Electrolytic Capacitor	10 μ F/16 V	R3A-16V100M	ELNA
1	U001	IC	DAC	PCM1691	TI
1	CN001	TH-type Male Connector	10-pin	FFC-10AMEP1	HTK
1	CN004	TH-type Male Connector	11-pin	FFC-11AMEP1	HTK
1	CN002	TH-type Male Connector	23-pin	FFC-23AMEP1	HTK
1	CN003	TH-type Male Connector	20-pin	FFC-20BMEP1	HTK

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit 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. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

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 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.**

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. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

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.

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.**

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 contact the TI application engineer or visit www.ti.com/esh.

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.

FCC Warning

This evaluation board/kit 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 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments 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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -4 V to $+4\text{ V}$ and the output voltage range of -4 V to $+4\text{ V}$.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 $+55^{\circ}\text{C}$. The EVM is designed to operate properly with certain components above $+55^{\circ}\text{C}$ as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for 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, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated