

DEM-DAI1681

PCM1681 Evaluation Module

User's Guide



Literature Number: SBAU137

April 2008

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Read This First

About This Manual

This document provides the information needed to set up and operate the DEM-DAI1681, a test platform for the eight-channel, 24-bit [PCM1681](#) audio digital-to-analog converter (DAC). The PCM1681 provides a subset of user-programmable functions through a parallel control port, in addition to a full set of user-programmable functions through a serial control port, SPI™, or I²C™. It also contains instructions to connect and set up the DEM-DAI1681 for operation, and for the installation and use of the software that controls the demonstration board. For a more detailed description of the PCM1681 product line, 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-DAI1681 evaluation module.

[Chapter 1](#) discusses the block diagram and primary features of the DEM-DAI1681. This chapter also provides general information regarding the default switch and jumper configurations.

[Chapter 2](#) explains how to use the software provided with the DEM-DAI1681.

[Chapter 3](#) presents measured typical performance and characteristic data for the PCM1681 when used with the DEM-DAI1681.

[Chapter 4](#) includes the EVM electrical schematics, printed circuit board (PCB) layout, and the bills of materials.

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.

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I²C is a trademark of NXP Semiconductors.
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Related Documentation From Texas Instruments

The following documents provide information regarding Texas Instruments integrated circuits used in the assembly of the DEM-DAI1681. 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 User's Guide. 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
PCM1681 Product data sheet	SLES211

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

The DEM-DAI1681 is an evaluation board for the [PCM1681](#), a 24-bit, 192-kHz, 8-channel audio DAC with digital audio receiver, 8-channel second-order post filter, mode control interface to a personal computer (PC), and various switches and jumpers for configuration controls.

The DEM-DAI1681 operates from 5-V and ± 15 -V analog power supplies with an S/PDIF input signal.

Project collateral discussed in this user's guide can be downloaded from the following URL: <http://www.ti.com/lit/zip/SBAU137>.

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1.1 Functional Block Diagram

Figure 1-1 illustrates the functional block diagram of the DEM-DAI1681.

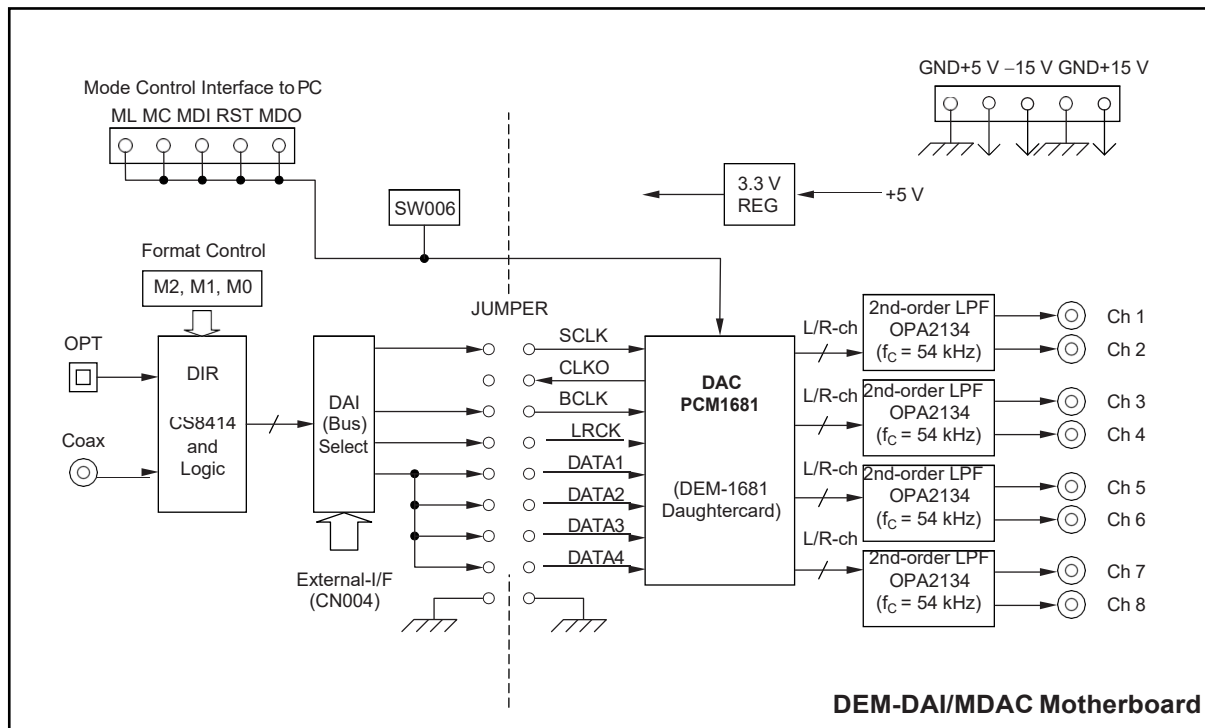


Figure 1-1. DEM-DAI1681 Functional Block Diagram

1.2 EVM Description

The DEM-DAI1681 EVM is shipped with the following items:

- EVM Motherboard: DEM-DAI/MDAC
- EVM Daughtercard: DEM-PCM1681
- CD-ROM containing application software, a copy of this user's guide, and a [PCM1681 product data sheet](#)

If any of these items are missing or damaged, please contact your local Texas Instruments representative.

This EVM consists of two PCBs. The DEM-DAI/MDAC motherboard is a common PCB for similar devices such as the [DEM-DAI1608](#) and the [DEM-DAI1680](#). The DEM-PCM1681 daughtercard contains the PCM1681 DAC device, as shown in [Figure 1-1](#).

1.3 Basic Connection and Operation

- Set/confirm jumper JP001 to provide the system clock and other digital signals from the digital audio receiver to the PCM1681.
- Set/confirm jumper JP201–JP224 to select the cutoff frequency of the second-order post low-pass filter (LPF) for DAC outputs.
- Set/confirm jumper HDR002 and HDR001 of the PCM1681 daughtercard to select mode control and corresponding primary pin function.
- Connect the +5-V and ±15-V power supplies to V_{CC} , AV_{CC} , $-AV_{CC}$, and GND on connectors CN051–CN055.
- Connect the S/PDIF signal into CN001 (COAX) or U001 (OPT).
- Connect the PC printer port to CN003 for mode control, if required.
- Set/confirm the input data format using SW001–SW003 and SW006 (H/W control mode) or the demonstration software (S/W SPI control).

1.4 EVM Configuration Controls

1.4.1 Jumper Controls

The following jumpers are provided onboard for configuration controls:

- **JP001:** Set Interface of Digital Signal from DIR to DAC (the device under test [DUT])
The digital signal generated by the digital interface receiver (DIR) is input to this jumper. For each shorted pin, the corresponding digital signal is applied to the PCM1681. All signals except for BCK and BCK [L/J] must be shorted for normal operation using the DIR; for BCK and BCK [L/J], one or the other must be shorted according to the data format selection of the DIR. [Figure 1-2](#) shows jumper JP001.

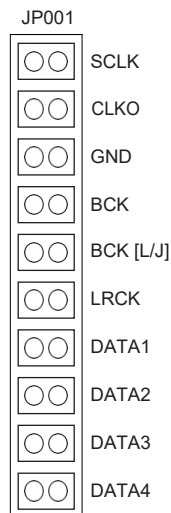


Figure 1-2. Jumper JP001

- **JP201–JP224 (24 Pieces):** Set f_c (Corner Frequency) Selection of Second-Order Post LPF
These jumpers determine the corner frequency (f_c) of the second-order post low-pass filter.
 - JP201–JP224 shorted: $f_c = 54$ kHz for $BW = 20$ kHz
 - JP201–JP224 open: $f_c = 108$ kHz for $BW = 40$ kHz

1.4.2 Switch Controls

The following switches, summarized in [Table 1-1](#) to [Table 1-3](#), are provided onboard for EVM control.

Table 1-1. SW006: Data Format Selection in Hardware Control Mode for PCM1681

FMT1 (as S4/ML)	FMT0 (as S1/RST)	Data Format Selection
On (L)	On (L)	24-bit, Right-Justified Format
On (L)	Off (H)	16-bit to 24-bit, I ² S Format
Off (H)	On (L)	16-bit to 24-bit, Left-Justified Format
Off (H)	Off (H)	24-bit, I ² S Mode TDM Format

Table 1-2. SW006: De-Emphasis and Mute Selection in Hardware Control Mode for PCM1681

MUTE (as S2/MDI)	DEMP (as S3/MC)	De-Emphasis and Mute Selection
On (L)	On (L)	Mute Off, De-Emphasis Off
On (L)	Off (H)	Mute Off, De-Emphasis 44.1 kHz On
Off (H)	On (L)	Mute On, De-Emphasis Off
Off (H)	Off (H)	Mute On, De-Emphasis 44.1 kHz On

Table 1-3. SW001/002/003: Format Selection for CS8414 (Digital Audio I/F Receiver)

SW003 (M2)	SW002 (M1)	SW001 (M0)	Data Format Selection
L	L	L	16-bit to 24-bit, Left-Justified ⁽¹⁾
L	H	L	16-bit to 24-bit, I ² S
H	L	H	16-bit, Right-Justified

⁽¹⁾ BCK of JP001 selection. When Left-Justified data format is used, move the jumper from BCK to BCK [L/J] for the JP001 setting.

SW004: Manual reset for CS8414

SW005: Digital Audio Interface Selection

- Internal—CS8414
- External—(CN004)

1.4.3 DEM-PCM1681 Daughtercard Configuration Controls

This section discusses the headers that are provided as configuration controls for the PCM1681 daughtercard.

1.4.3.1 HDR001: Select Signal Path for Pin 1 of PCM1681

Either 1-2 or 3-2 must be shorted according to the function of pin 1 of the PCM1681, which is determined by the HDR002 setting. [Table 1-4](#) summarizes the select signal path configuration for HDR002.

Table 1-4. HDR001: Signal Path Selection for Pin 1 of PCM1681

HDR001		Signal Path for Pin 1 of PCM1681
1-2	3-2	
Short	Open	Path for ZR1 output for S/W (SPI and I ² C) Control Mode
Open	Short	Path for FMT0 input for H/W Control Mode

1.4.3.2 HDR002: Select Mode Control of PCM1681

Either 1-2, 3-4, 5-6, or 7-8 must be shorted in order to select mode control type and oversampling condition of the PCM1681. [Table 1-5](#) summarizes the mode control selection configuration for HDR002.

Table 1-5. HDR002: Mode Control Selection of PCM1681

HDR002				Mode Control of PCM1681
1-2	3-4	5-6	7-8	
Short	Open	Open	Open	S/W (I ² C) Control Mode
Open	Short	Open	Open	H/W Control Mode with Narrow Band Operation
Open	Open	Short	Open	H/W Control Mode with Wide Band Operation
Open	Open	Open	Short	S/W (SPI) Control Mode

1.5 Electrostatic Discharge Warning

Many of the components on the DEM-DAI1681 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.

1.6 Absolute Maximum Ratings

Table 1-6 summarizes the absolute maximum ratings for the DEM-DAI1681 EVM.

Table 1-6. EVM Absolute Maximum Ratings

Parameter	DEM-DAI1681 EVM			UNIT
	MIN	TYP	MAX	
Power Supplies				
5-V Power supply CN054			+6	V
±15-V Power supply CN051/3			±18	V
Signal Inputs				
S/PDIF input CN001			±2	V
PC interface input CN003	0		4	V
Signal Outputs				
Line outputs CN201 to CN208			±4	V

Demonstration Software

This chapter provides information regarding the software that is provided with the DEM-DAI1681. The software allows programming of the PCM1681 internal registers.

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2.1 Overview

Use the demonstration software on a personal computer (PC) or lab PC that meets the following requirements:

- Equipped with Microsoft® Windows® operating system (Windows XP or earlier)
- Available printer port
- CD-ROM drive

2.2 Installation

First, connect the PC printer port to CN003 on the DEM-DAI1681 using a standard printer cable.

Next, install the demonstration software. The software is distributed on a CD-ROM that is shipped with the DEM-DAI1681. The software is also available for download from the [DEM-DAI1681 product folder](#) at www.ti.com.

To install the software on the PC, first create a new folder on your hard disk drive with an appropriate name (such as *DEM1681*). Next, load the CD-ROM into the PC, and navigate to the DEM1681 folder on the CD-ROM. Copy all the files in the DEM1681 directory to the new folder on the PC.

Open the configuration setting file named *dem1608.ini* using a text editor, such as Notepad or WordPad. When the file is open, search for the following command line:

```
PCMI FADR = &h378
```

The address *&h378* indicates the printer port address that the demonstration software uses to communicate with the DEM-DAI1681. This address must be set to *&h378*, *&h278*, or *&h3BC*. Most PCs use *&h378* as the default printer port address. If your printer port is not located at *&h378*, edit the address to correspond with the PC printer port address.

2.3 Using the Demonstration Software

Open the working directory you created on the PC (see the [Installation](#) section). Double-click on the application file named *dem1608.exe*. A window appears on your desktop screen, as shown in [Figure 2-1](#). There are two menu selections (Execute and Window) in the menu bar near the top of the window.

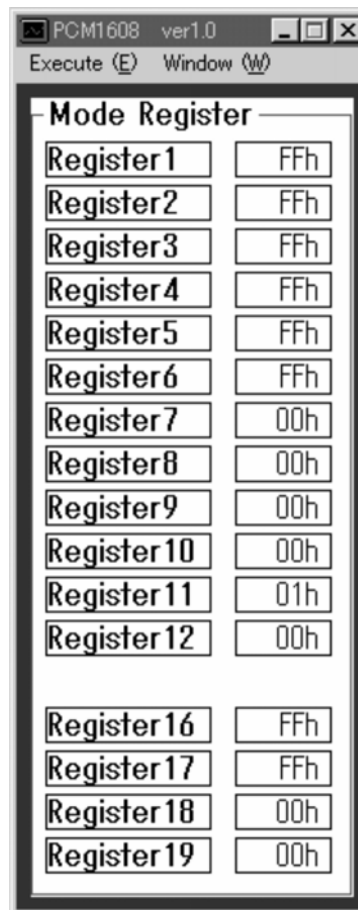


Figure 2-1. Demonstration Software Window

The **Execute** menu includes three selections:

- *Initialize* instructs the program to write almost of the PCM1681 internal registers with the default values
 - *Reset* instructs the program to rewrite the PCM1681 internal registers with the data currently selected in the application window
- This window and function is not applicable on the PCM1681:
- *Exit* closes the application

The **Window** menu includes five options:

- Attenuation control (see [Figure 2-2](#)): enables users to control PCM1681 digital attenuation level by changing the slider position for each channel.
- Operation control (see [Figure 2-3](#)): allows users to control mute on/off and DAC operation enable/disable by channel.
- Function control (see [Figure 2-4](#)): controls various programmable functions, such as Interface formats, oversampling mode, DAC output phase, de-emphasis function/frequency, and so forth. Some functions are not available for the PCM1681; see [Table 2-1](#) for details.

These windows and functions are not applicable on the PCM1681:

- GPO control
- Register read

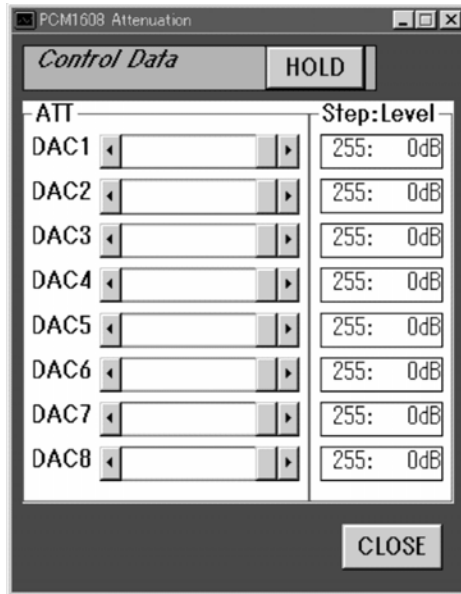


Figure 2-2. Attenuation Control

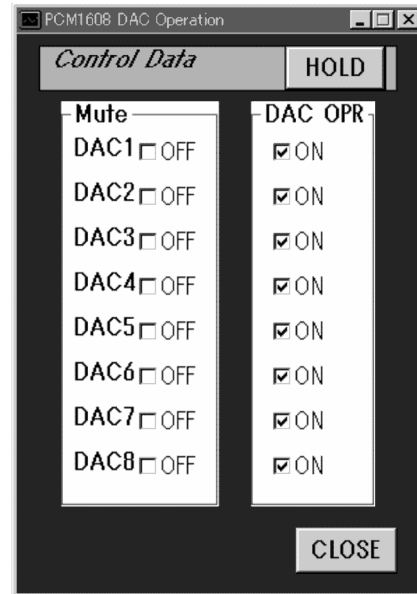


Figure 2-3. Operation Control

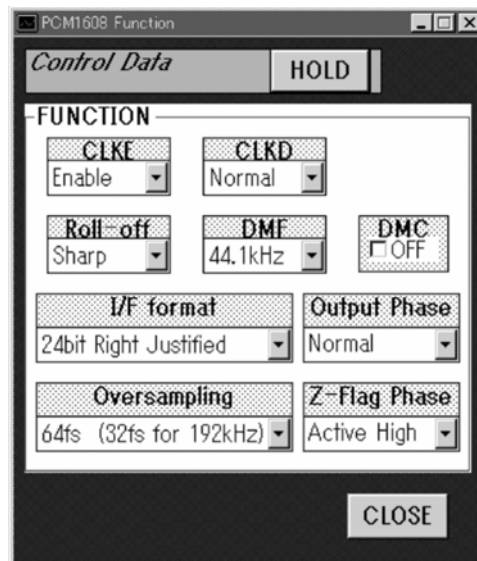


Figure 2-4. Function Control

2.3.1 HOLD and PASS

Near the top of each window, there is a small button. This button is labeled either *HOLD* or *PASS*. You can toggle the current setting by clicking on this button. When set to *HOLD*, the settings in an active window can be changed, but are not written to the register(s) until you press the OK button that appears at the bottom of the screen.

When the button is set to *PASS*, any setting changes made in an active window are immediately written to the corresponding register(s).

2.3.2 Applicable Function Control

Table 2-1 summarizes the various functions of the DEM-DAI1681 and the default settings for each function. Note that the software is also designed to control the DEM-DAI1608 as well as the DEM-DAI1681; therefore, there are several inconsistencies between the demonstration software and the PCM1681 register definitions. Table 2-1 also describes these differences between the software of DEM-DAI1681 and PCM1681 in detail.

Table 2-1. Applicable Function Control Summary

Function	PCM1681 Default Setting	Availability on DEM-DAI1681
Digital Attenuation Control, 0 dB to –63 dB in 0.5-dB Steps	0 dB, No Attenuation	Applicable
Soft Mute Control	Mute Disabled	Applicable
DAC1–8 Operation Control	DAC1–8 Enabled	Applicable
Audio Data Format Control	16-Bit to 24-Bit Left-Justified	Partly Applicable ⁽¹⁾
Digital Filter Roll-Off Control	Sharp Roll-Off	Applicable
De-Emphasis All Channel Function Control	De-Emphasis All Channel Disabled	Applicable
De-Emphasis All Channel Sample Rate Selection	44.1 kHz	Applicable
Output Phase Select	Normal Phase	Applicable
Zero Flag Polarity Select	High	Applicable
Software Reset Control	Reset Disabled	Not Applicable
Output Phase Select per Channel	Reverse Phase	Not Applicable
Oversampling Rate Control	Narrow (x64, x32, x16) mode	Applicable
Digital Filter Roll-Off Control per DATA Group	Slow Roll-Off	Not Applicable
Zero Flag Combination Select	ZR1: DATA1 Lch ZR2: DATA1 Rch	Not Applicable
Digital Attenuation Mode Select	0 to –63 dB, 0.5-dB step	Not Applicable
Zero Detect Status (Read-only, I ² C Interface Only)	Not Applicable	Not Applicable
Function	DEM-DAI1681 Default Setting	Availability on PCM1681
SCKO Frequency Selection and Output Enable Control	Enabled as SCKO = SCKI	Not Applicable
GPO Output Set and Control	Enabled as Zero Flags, not GPOs	Not Applicable
Register Read and Address Control	Enabled without Auto-Increment	Not Applicable

⁽¹⁾ There is a difference between applicable formats and default setting.

Typical Performance and Measurement Examples

This chapter presents typical performance and a measured data example of the PCM1681 on the DEM-PCM1681. The process of measuring dynamic characteristics is also discussed, along with example characteristic data. Performance evaluations used the Audio Precision SYS-2722® audio analyzer.

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3.1 Typical Device Performance

Figure 3-1 illustrates a measurement example of PCM1681 performance on a DEM-DAI1681 with default settings.

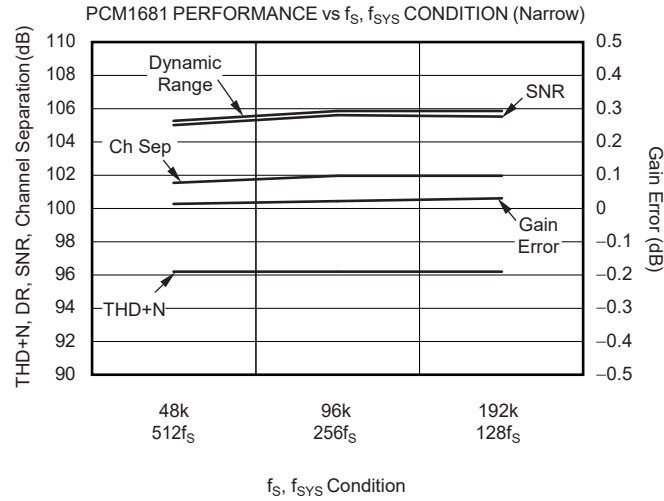


Figure 3-1. PCM1681 Performance vs f_s (Sampling Rate) and f_{SYS} (System Clock)

3.2 Measurement Examples

Figure 3-2 illustrates THD+N performance according to a 1-kHz signal sweep of the digital input level.

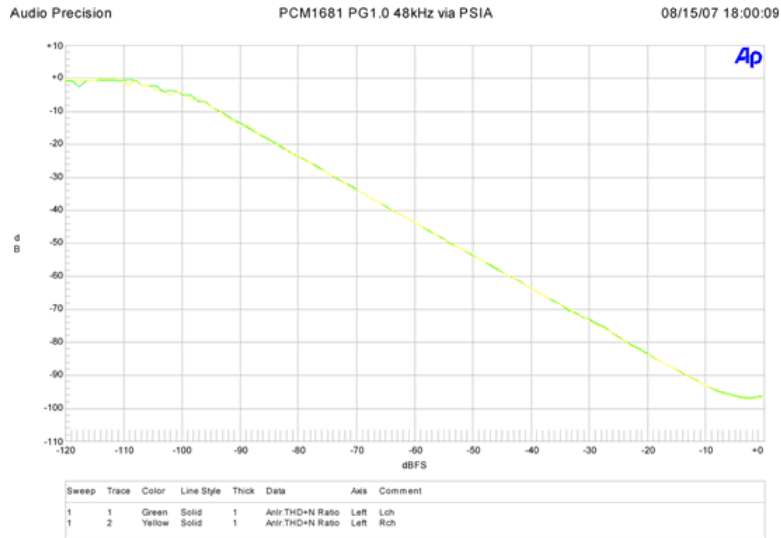


Figure 3-2. THD+N vs Input Level

Figure 3-3 through Figure 3-6 show FFT results for full-scale performance and characteristic performance under a range of conditions. FFT data numbers are 32-k points for all four FFT graphs.

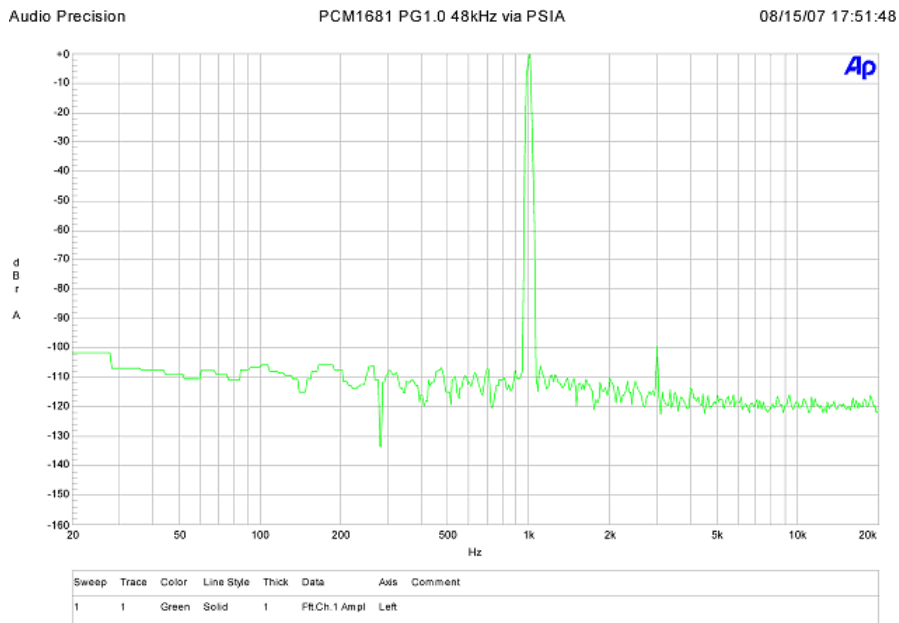


Figure 3-3. FFT (0 dB)

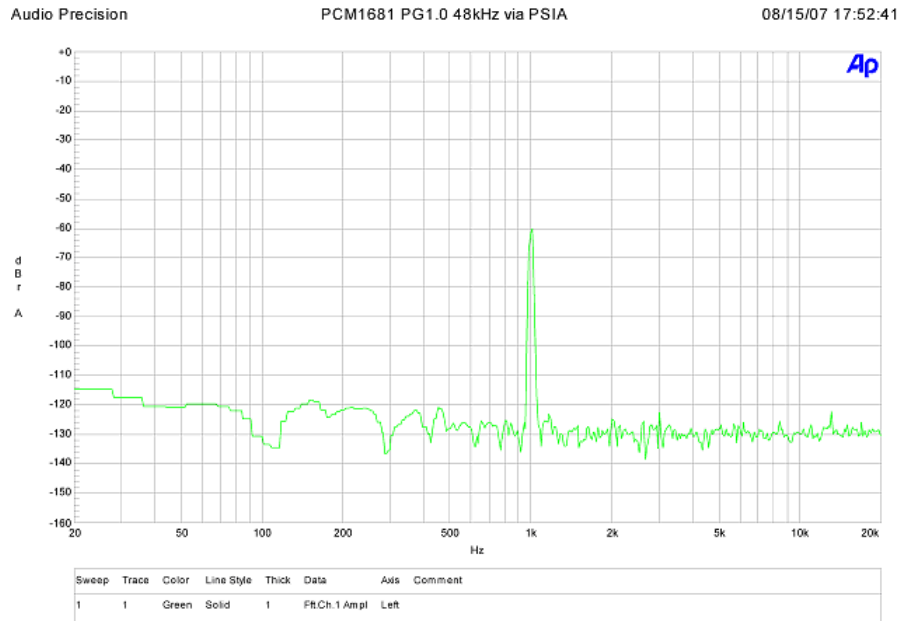


Figure 3-4. FFT (-60 dB)

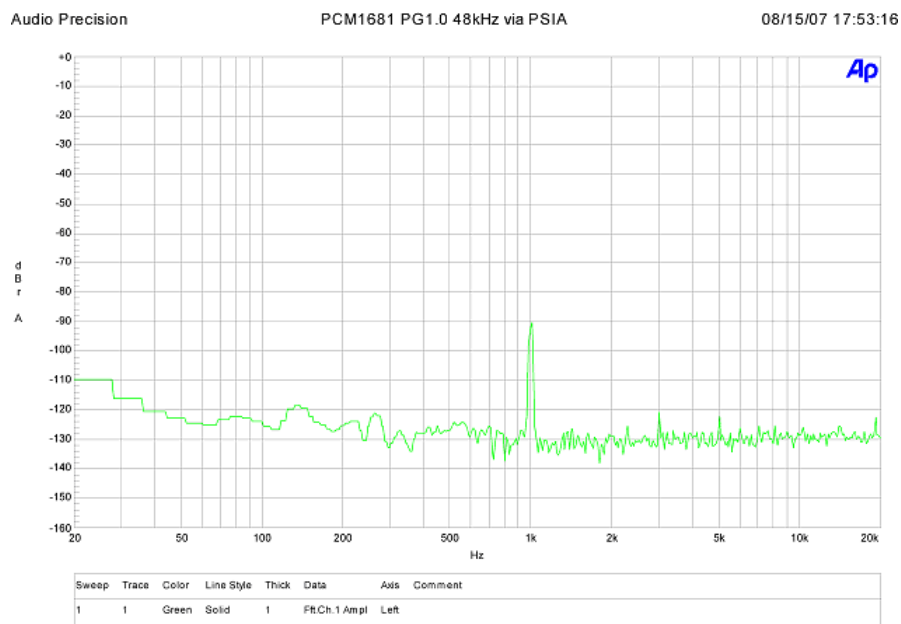


Figure 3-5. FFT (-90 dB)

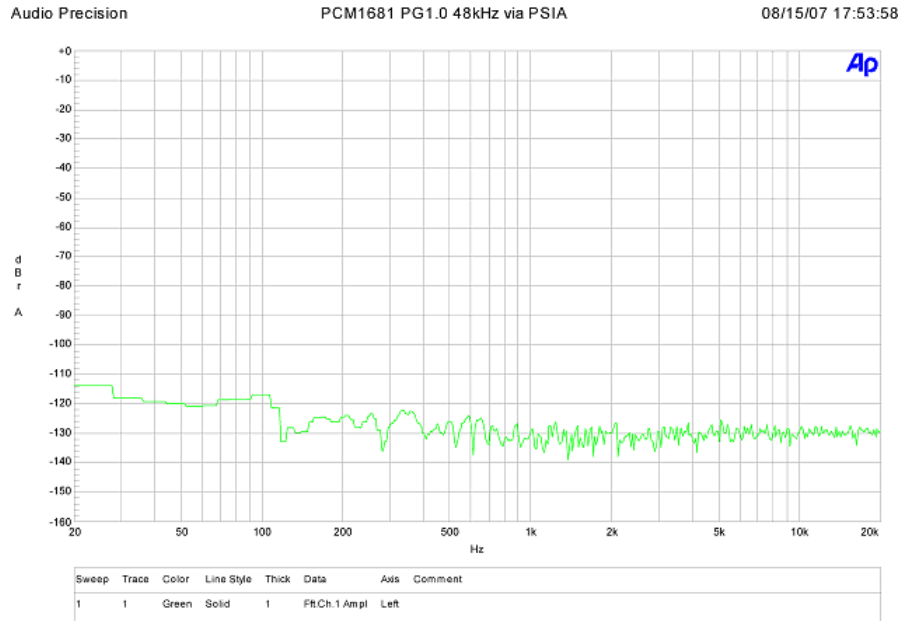


Figure 3-6. FFT (BPZ)

Figure 3-7 shows the out-of-band noise characteristic according to the system clock ratio and oversampling mode (narrow/wide) setting. A relatively high ratio and wide mode is recommended for lower out-of-band noise.

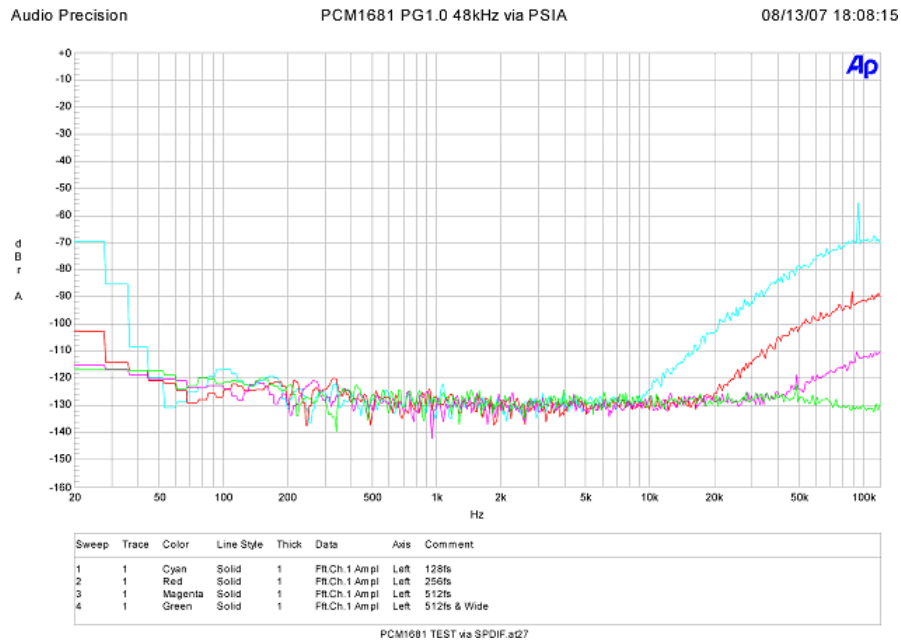


Figure 3-7. Out-of-Band Noise vs System Clock and Oversampling Condition

Schematic, PCB Layout, and Bill of Materials

This chapter provides the electrical and physical layout information for the DEM-DAI/MDAC and the DEM-PCM1681. The bill of materials (BOM) is included for component and manufacturer reference.

Note: Board layouts are not to scale. These are intended to show how the board is laid out; they are not intended to be used for manufacturing DEM-DAI1681 PCBs.

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4.1 DEM-DAI/MDAC Schematics

The schematic for the sections of the DEM-DAI/MDAC is shown in [Figure 4-1](#) through [Figure 4-3](#).

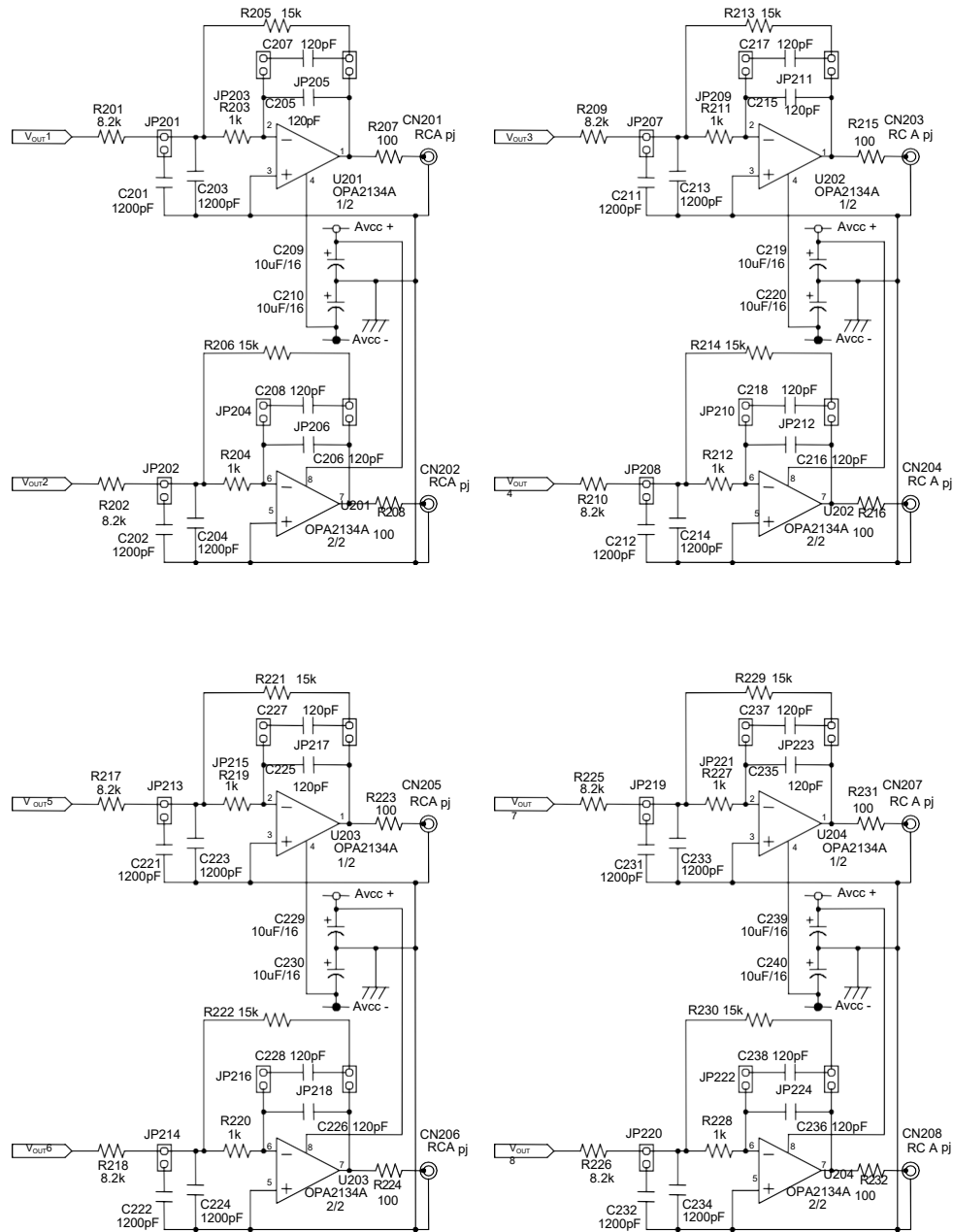


Figure 4-1. Low-Pass Filter Schematic

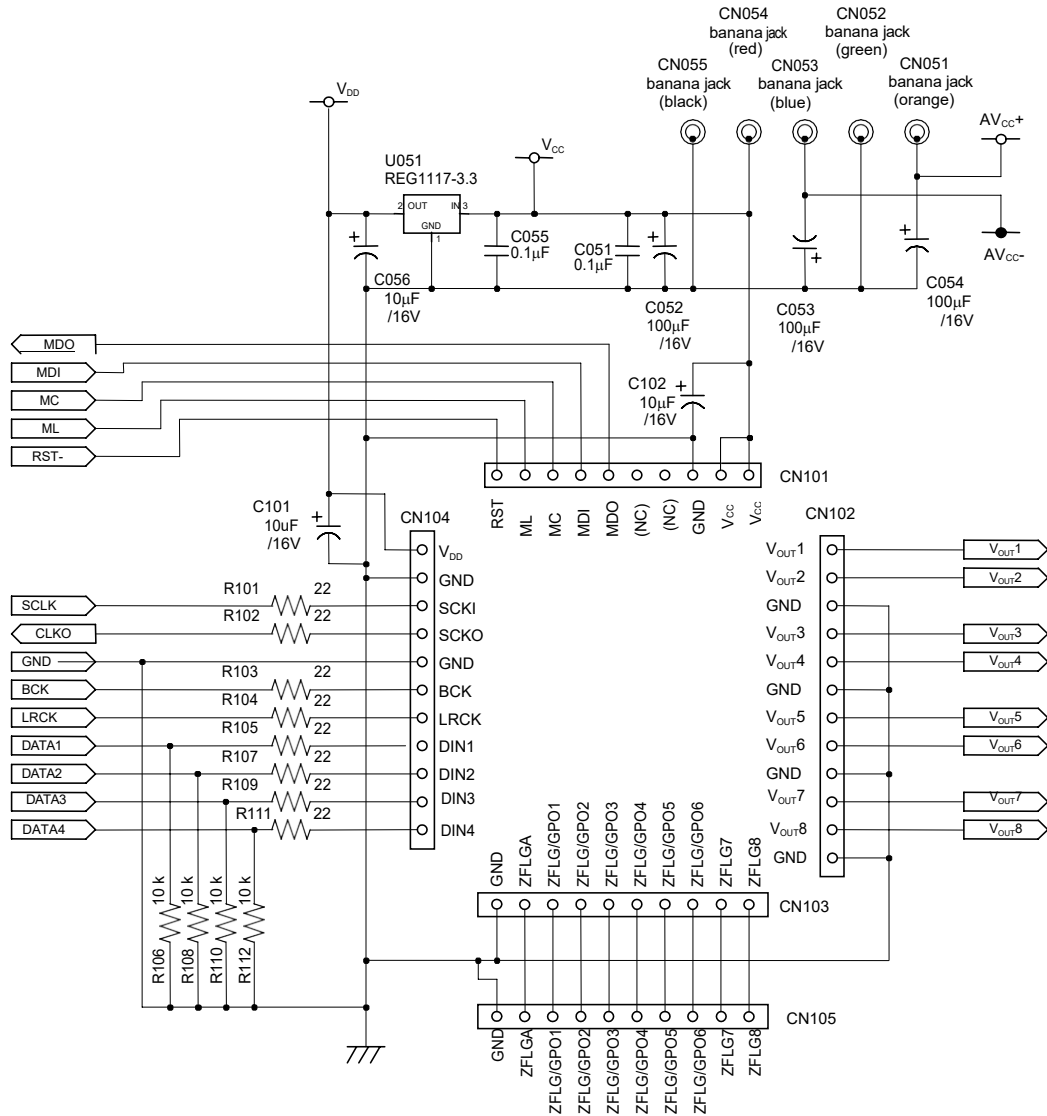


Figure 4-2. Daughtercard Sockets, Connector, and Regulator Schematic

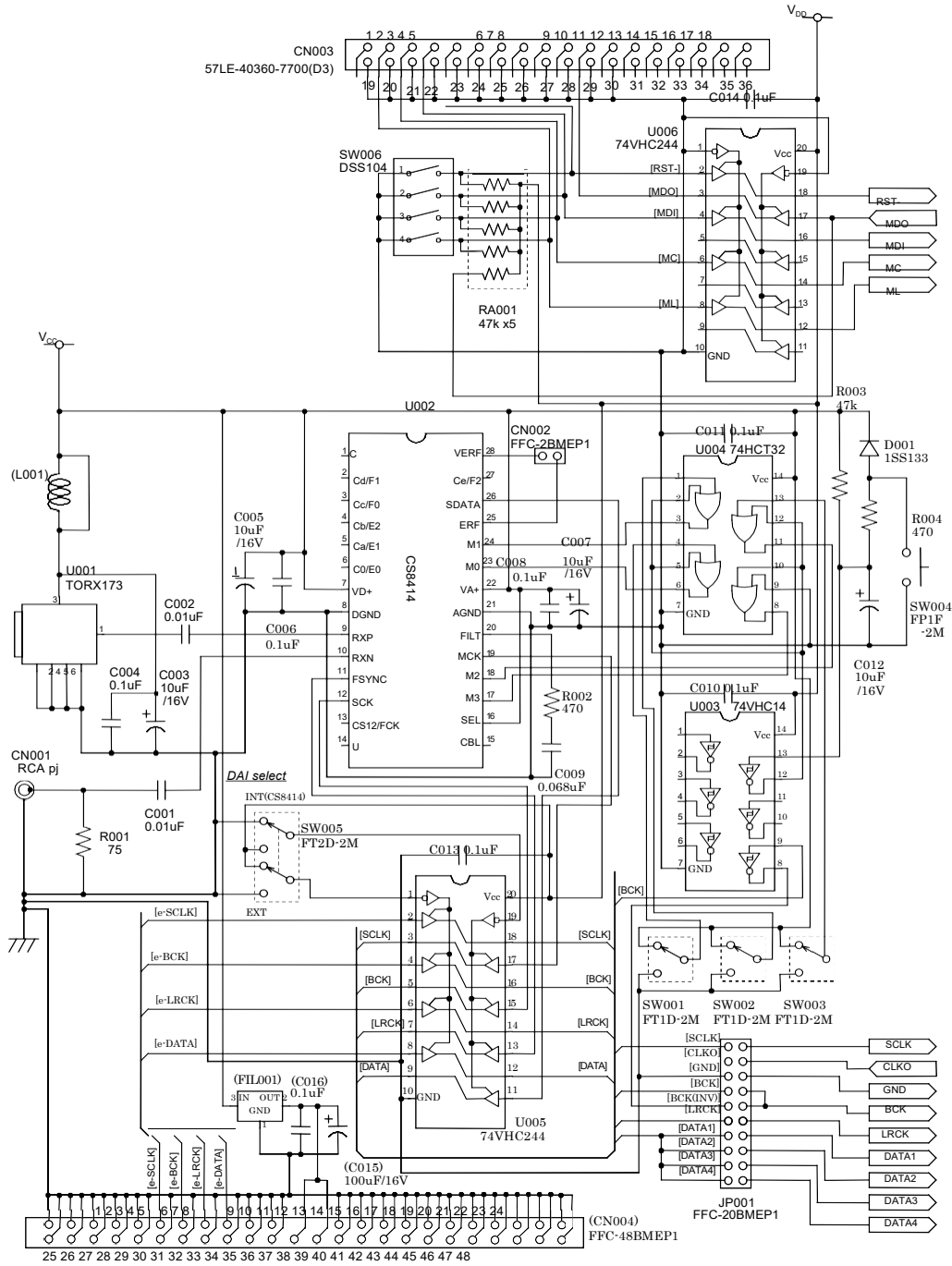


Figure 4-3. Digital Audio Interface Schematic

4.2 DEM-PCM1681 Schematic

Figure 4-4 illustrates the schematic for the DEM-PCM1681.

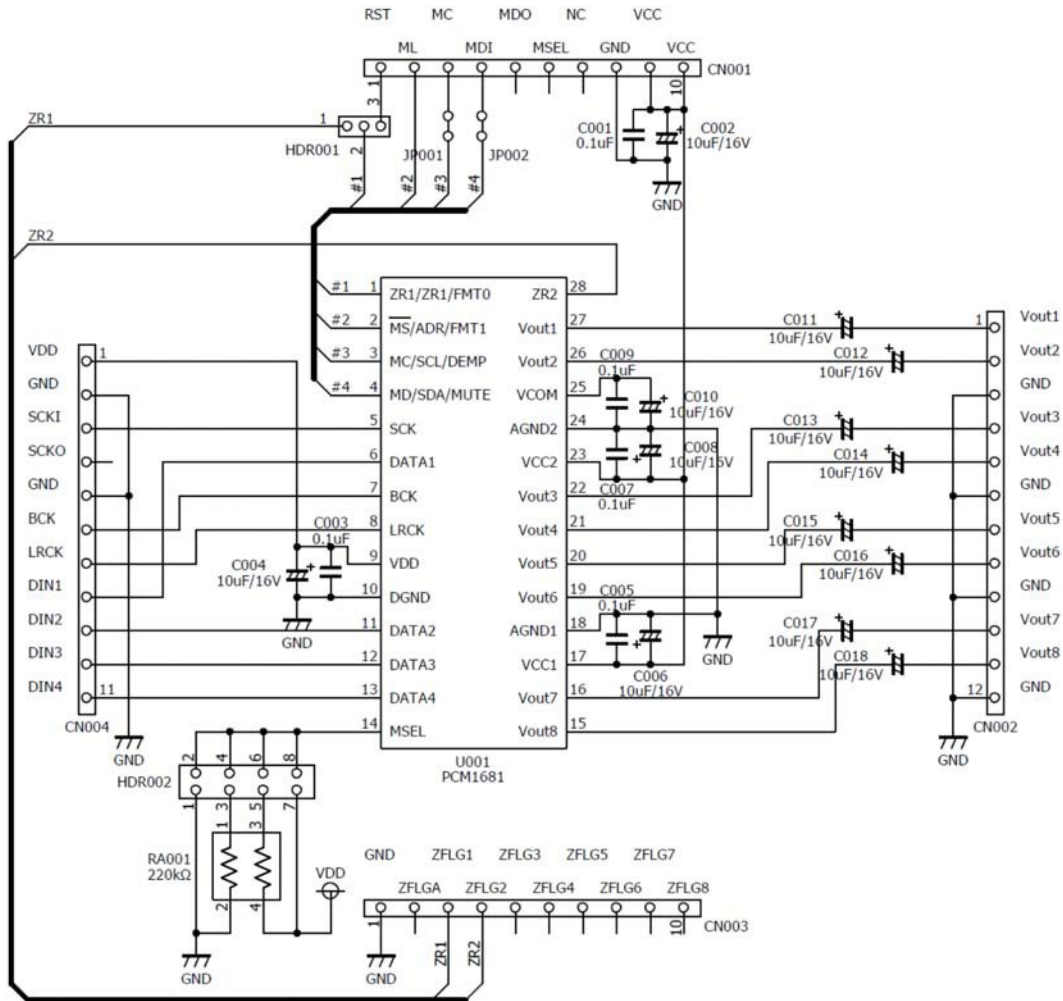


Figure 4-4. PCM1681 Daughtercard Schematic

4.3 Printed Circuit Board Layout—DEM-DAI/MDAC

Figure 4-5 through Figure 4-7 illustrate the printed circuit board (PCB) layout for the DEM-DAI/MDAC.

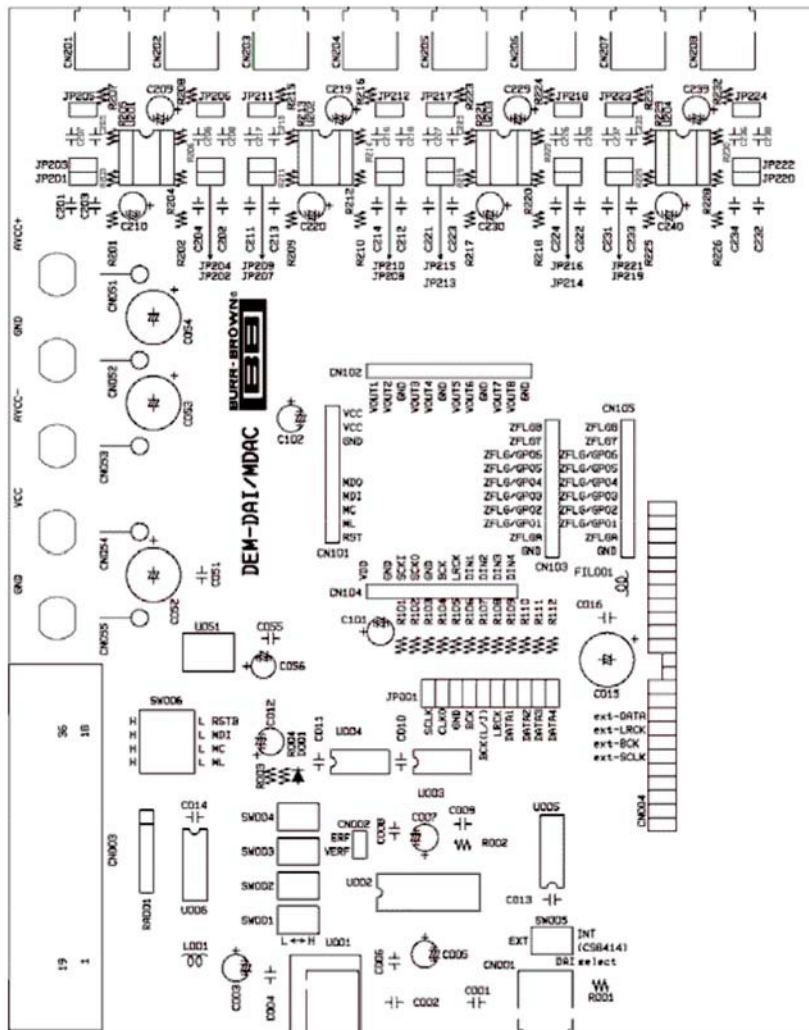


Figure 4-5. DEM-DAI/MDAC Board Layout—Silkscreen

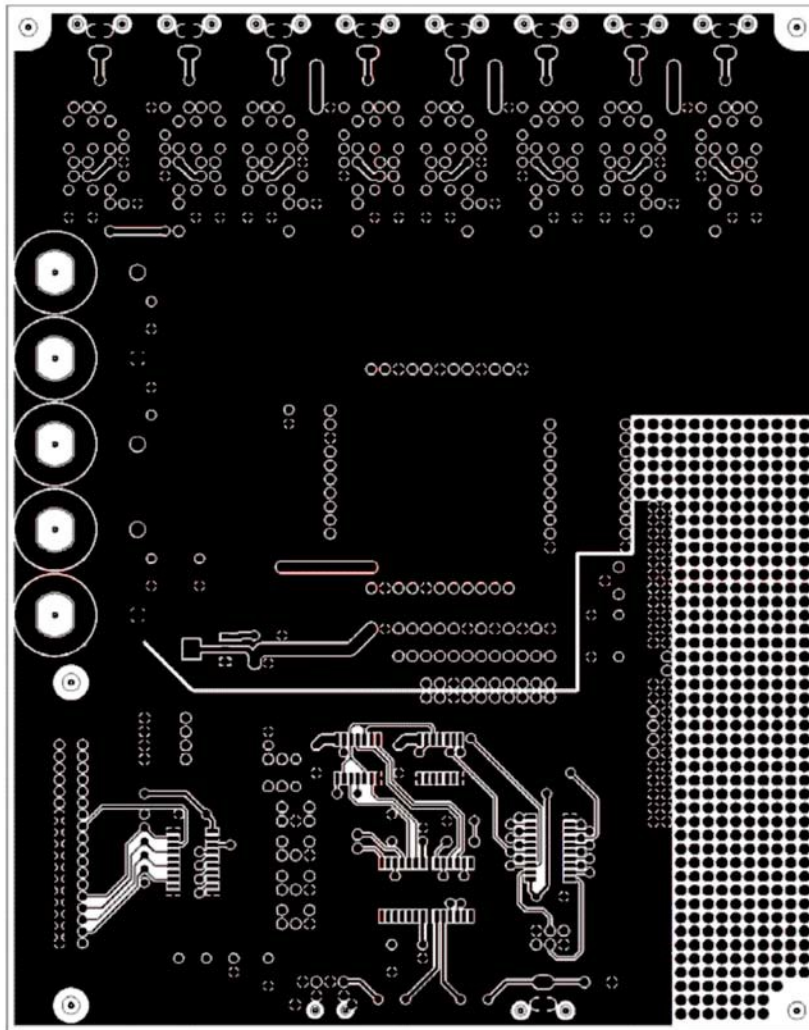


Figure 4-6. DEM-DAI/MDAC Board Layout—Top (Component) Side

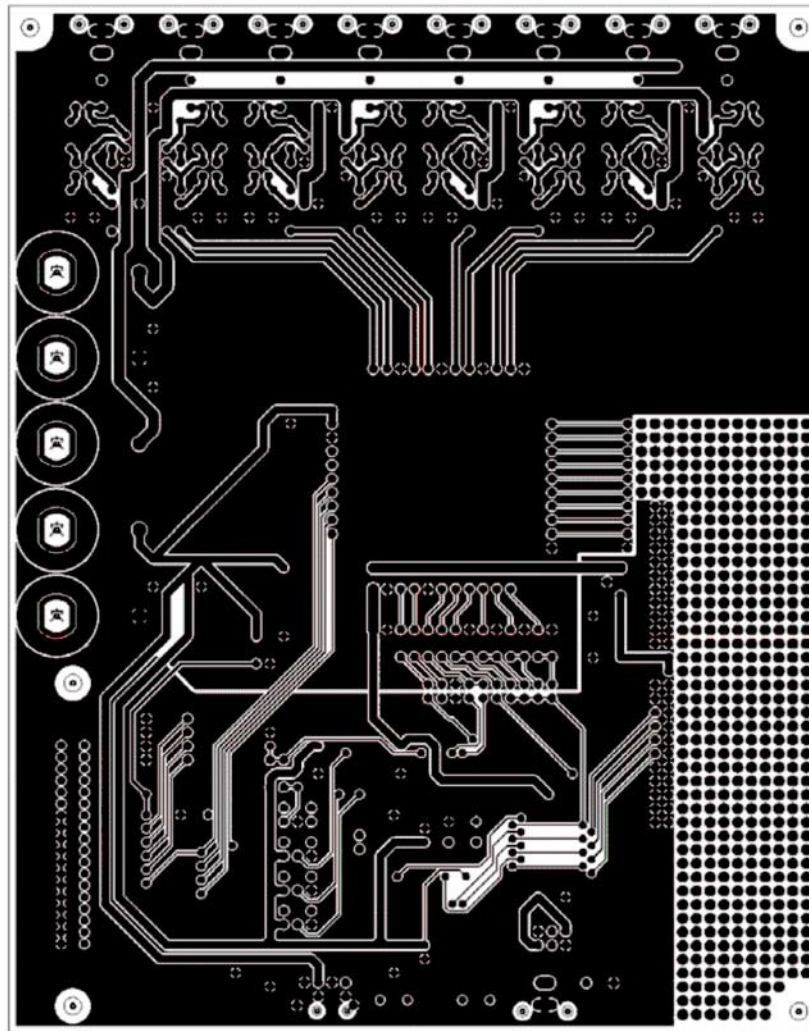


Figure 4-7. DEM-DAI/MDAC Board Layout—Bottom View

4.4 Printed Circuit Board Layout—DEM-PCM1681

Figure 4-8 through Figure 4-10 illustrate the PCB layout for the DEM-PCM1681.

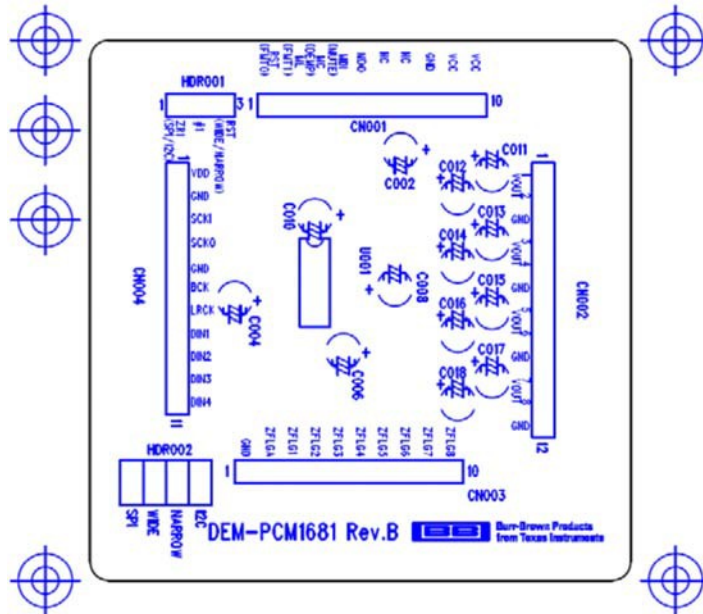


Figure 4-8. DEM-PCM1681 Board Layout—Silkscreen

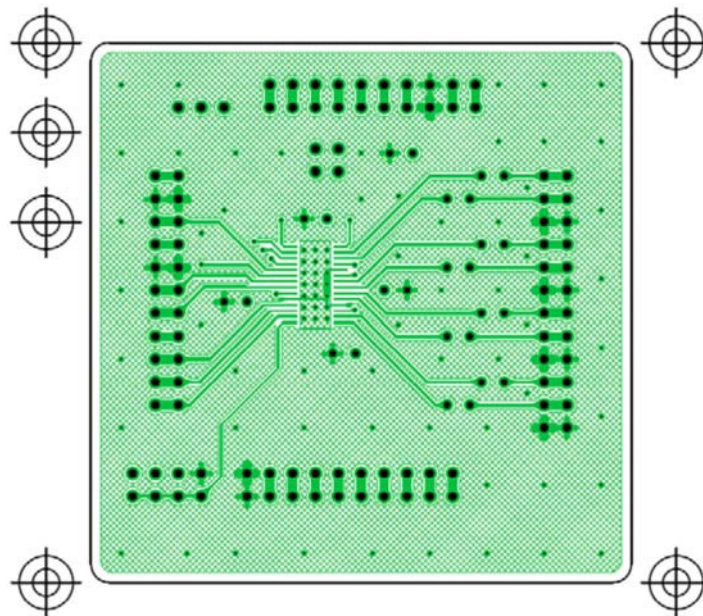


Figure 4-9. DEM-PCM1681 Board Layout—Top (Component) Side

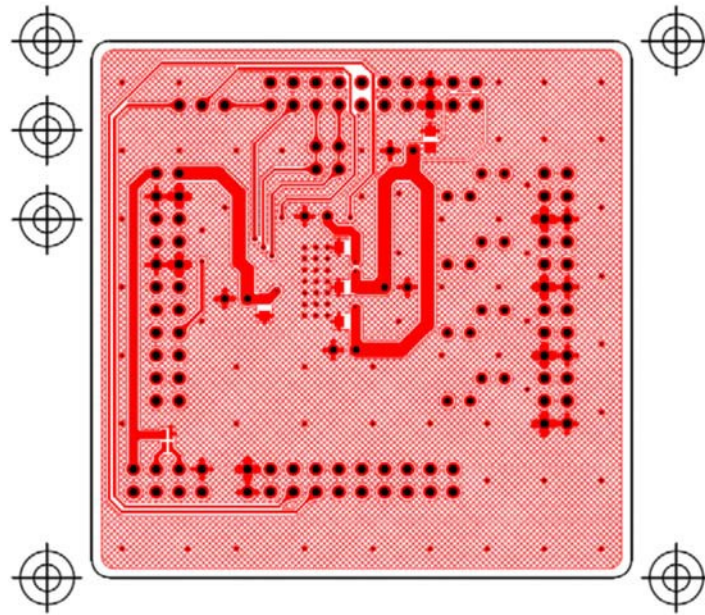


Figure 4-10. DEM-PCM1681 Board Layout—Bottom View

4.5 Component Lists

4.5.1 Bill of Materials for DEM-DAI/MDAC

Table 4-1 lists the bill of materials for the DEM-DAI/MDAC.

Table 4-1. Bill of Materials—DEM-DAI/MDAC

Qty	RefDes	Description	Size	Mfr Part Number	MFR
2	C001, C002	Film Capacitor	0.01 μ F	AMFF0050J103	Nissei Electric
13	C003, C005, C007, C101, C102, C209, C210, C219, C220, C229, C230, C239, C240	Aluminum Electrolytic Capacitor	10 μ F/16V	ROA-16V100M	ELNA
4	C004, C006, C008, C016, C051	Film Capacitor	0.1 μ F	AMFF0050J104	Nissei Electric
1	C009	Film Capacitor	0.068 μ F	AMFF0050J683	Nissei Electric
5	C010, C011, C013, C014, C055	Ceramic Capacitor	0.1 μ F	D55Y5V1H104Z51	NEC
1	C012	Aluminum Electrolytic Capacitor	10 μ F/16V	SME16VB10M	Nippon ChemiCon
3	C015, C052, C053, C054	Aluminum Electrolytic Capacitor	100 μ F/16V	ROA-16V101M	ELNA
1	C056	Tantalum Electrolytic Capacitor	10 μ F/16V	DN1C100M1S	NEC
16	C201, C202, C203, C204, C211, C212, C213, C214, C221, C222, C223, C224, C231, C232, C233, C234	Film Capacitor	1200pF	APSF0100J122	Nissei Electric
16	C205, C206, C207, C208, C215, C216, C217, C218, C225, C226, C227, C228, C235, C236, C237, C238	Film Capacitor	120pF	APSF0100J121	Nissei Electric
1	CN001	RCA Connector	Yellow	LPR6520-0804	SMK
1	CN002	Pin Header	2 Pins	FFC-2BMEP1	Honda
1	CN003	Ribbon Connector	36 Pins, Right Angle	57LE40360-7700(D3)	DDK
1	CN051	Banana Jack	Orange	T-45	Sato Parts
1	CN052	Banana Jack	Green	T-45	Sato Parts
1	CN053	Banana Jack	Blue	T-45	Sato Parts
1	CN054	Banana Jack	Red	T-45	Sato Parts
1	CN055	Banana Jack	Black	T-45	Sato Parts
2	CN101, CN103	Connector	10 Pins	Z-220-10FD	Honda
1	CN102	Connector	12 Pins	Z-220-12FD	Honda
1	CN104	Connector	11 Pins	Z-220-11FD	Honda
1	CN105	Pin Header	10 Pins	FFC-10AMEP1	Honda
4	CN201, CN203, CN205, CN207	RCA Connector	White	LPR6520-0803	SMK
4	CN202, CN204, CN206, CN208	RCA Connector	Red	LPR6520-0802	SMK
1	D001	Diode		1SS133	ROHM
1	JP001	Pin Header	20 pins	FFC-20BMEP1	Honda

Table 4-1. Bill of Materials—DEM-DAI/MDAC (continued)

Qty	RefDes	Description	Size	Mfr Part Number	MFR
24	JP201 to JP224	Pin Header	2 pins	FFC-2BMEP1	Honda
1	R001	Metal Film Resistor	75, 1/4W, F	SN14C2C	KOA
2	R002, R004	Metal Film Resistor	470, 1/4W, F	SN14C2C	KOA
1	R003	Metal Film Resistor	47k, 1/4W, F	SN14C2C	KOA
8	R101, R102, R103, R104, R105, R107, R109, R111	Metal Film Resistor	22, 1/4W, F	SN14C2C	KOA
4	R106, R108, R110, R112	Metal Film Resistor	10k, 1/4W, F	SN14C2C	KOA
8	R201, R202, R209, R210, R217, R218, R225, R226	Metal Film Resistor	8.2k, 1/4W, F	SN14C2C	KOA
8	R203, R204, R211, R212, R219, R220, R227, R228	Metal Film Resistor	1k, 1/4W, F	SN14C2C	KOA
8	R205, R206, R213, R214, R221, R222, R229, R230	Metal Film Resistor	15k, 1/4W, F	SN14C2C	KOA
8	R207, R208, R215, R216, R223, R224, R231, R232	Metal Film Resistor	100, 1/4W, F	SN14C2C	KOA
1	RA001	Resistor Array	47k x 5, J	M6-1-473J	Beckman
3	SW001, SW002, SW003	Toggle Switch	SPDT	FT1D-2M	Fujisoku
1	SW004	Push Switch		FP1F-2M	Fujisoku
1	SW005	Toggle Switch	DPDT	FT2D-2M	Fujisoku
1	SW006	DIP Switch	4 Poles	DSS104	Fujisoku
1	U001	Optical Transmitter	TOSLINK®	TORX179P	Toshiba
1	U002	Digital Audio I/F Receiver IC		CS8414-CS	Cirrus Logic
1	U003	Schmitt Trigger Inv		TC74VHC14F	Toshiba
1	U004	Quad 2-Input OR gate		TC74HCT32AF	Toshiba
2	U005, U006	Bus Buffer		TC74VHC244F	Toshiba
1	U051	3.3-V Regulator		REG1117-3.3	Texas Instruments
4	U201, U202, U203, U204	IC Socket	DIP 8 pins	ICC09-308-396C	KEL
4		Spacer		AR-325B	

4.5.2 Bill of Materials for DEM-PCM1681

Table 4-2 lists the bill of materials for the DEM-PCM1681.

Table 4-2. Bill of Materials—DEM-PCM1681

Qty	RefDes	Description	Size	Mfr Part Number	MFR
5	C001, C003, C005, C007, C009	Ceramic Capacitor	0.1 μ F (2125)	GRM21BB11H104KA01	Murata
13	C002, C004, C006, C008, C010, C011 to C018	Aluminum Electrolytic Capacitor	10 μ F/16V	R3A-16V100M	ELNA
2	CN001, CN003	Pin Header	10 Pins	FFC-10AMEP1	Honda
1	CN002	Pin Header	12 Pins	FFC-12AMEP1	Honda
1	CN004	Pin Header	11 Pins	FFC-11AMEP1	Honda
1	HDR001	Pin Header	3 Pins	FFC-3AMEP1	Honda
1	HDR002	Pin Header	8 Pins	FFC-8BMEP1	Honda
1	RA001	Network Resistor	220k x2 (1608), J	MNR12E0ABJ224	ROHM
1	U001	Audio DAC	24-bits, 192 kHz, 8-ch	PCM1681PWP	Texas Instruments

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