

DEM-DAI1753/54/55 EVM

PCM1753/PCM1754/PCM1755 Evaluation Module

User's Guide



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Read This First

About This Manual

The DEM-DAI1753/54/55 EVM is a complete evaluation platform for the PCM1753/PCM1754/PCM1755 series of 24-bit, 192-kHz stereo audio digital-to-analog converters (DACs). This user's guide provides the information needed to set up and operate the DEM-DAI1753/54/55 EVM, a test platform for the eight-channel, 24-bit [PCM1753](#), [PCM1754](#), and [PCM1755](#) audio DACs. For a more detailed description of the PCM1753/54/55 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-DAI1753/54/55 EVM.

[Chapter 1](#) discusses the block diagram and primary features of the DEM-DAI1753/54/55 EVM. 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-DAI1753/54/55 EVM.

[Chapter 3](#) 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.

Related Documentation From Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the DEM-DA11753/54/55 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
PCM1753/PCM1754/PCM1755 Product data sheet	SLES092

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-DAI1753/54/55 EVM is an evaluation board for the [PCM1753/PCM1754/PCM1755](#), a 24-bit, 192-kHz, enhanced multi-level, Delta-Sigma ($\Delta\Sigma$) audio DAC. This EVM provides all necessary connectors and circuitry for interfacing to audio test systems and commercial audio equipment.

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1.1 Functional Block Diagram

Figure 1-1 illustrates the functional block diagram of the DEM-DAI1753/54/55 EVM.

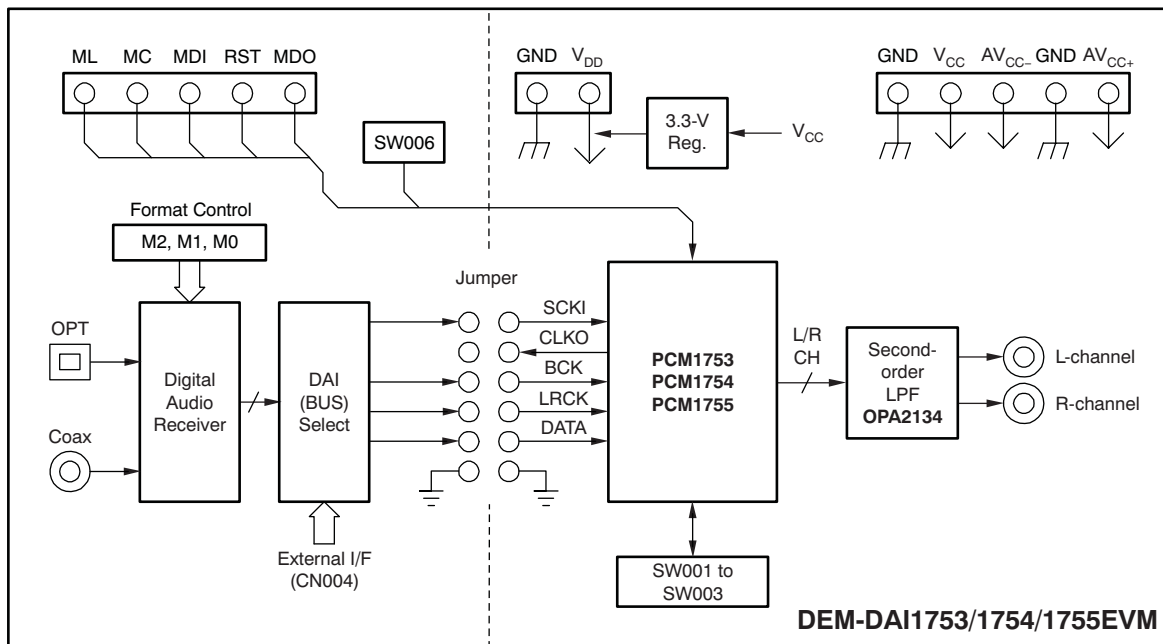


Figure 1-1. DEM-DAI1753/54/55 EVM Functional Block Diagram

1.2 EVM Features

The DEM-DAI1753/54/55 EVM offers the following features:

- Complete evaluation platform for the PCM1753/54/55 stereo audio DAC
- Onboard low-pass filters for the left and right channels
- Easy configuration using onboard switches and jumpers
- 96-kHz digital audio receiver accepts S/PDIF and optical inputs
- Centronics connector for interfacing to a PC parallel port (required for the demonstration software)
- Power-supply requirements: 5 V, 15 V, and –15 V
- CD-ROM containing demonstration software for programming the PCM1753/1755 internal registers (requires a PC running Microsoft® Windows®), a copy of this user's guide, and a [PCM1753/54/55 product data sheet](#)

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

1.3 Hardware Description

1.3.1 Power Supplies

The DEM-DAI1753/54/55 evaluation fixture requires three power supplies for operating the PCM1753/54/55, the digital support circuitry, and the low-pass filter operational amplifier (op amp). Standard banana jacks are provided for all power-supply connections.

Connector CN054 provides the 5-V supply required for V_{CC} . It is used to power the PCM1753/54/55 as well as the digital audio receiver (U002) and associated logic (U003 and U004).

Connectors CN051 (AV_{CC+}) and CN (AV_{CC-}) are used to power the [OPA2134](#) dual op amp (U101) that performs the DAC output low-pass filter function. AV_{CC+} can be set from 5 V to 18 V, while AV_{CC-} can be set from -5 V to -18 V.

Ground connections are made at connectors CN052 and CN055. Both are connected to the ground plane of the DEM-DAI1753/54/55 board.

1.3.2 Analog Output

The left and right audio outputs are available at RCA jacks CN104 and CN105, respectively. The outputs are taken from the low-pass filter, which has a gain of 2. The low-pass filter can be configured for one of two cutoff frequencies: 54 kHz or 108 kHz. Typically, the 54-kHz cutoff frequency is used for all measurements.

- For $f_{-3\text{ dB}} = 54\text{ kHz}$, jumpers JP101 through JP106 must all be installed.
- For $f_{-3\text{ dB}} = 108\text{ kHz}$, jumpers JP101 through JP106 must all be removed.

1.3.3 Digital Audio Interface

A digital audio receiver (U002) is provided for easy connection to S/PDIF and optical signal sources, including audio test systems (Audio Precision and Rhode and Schwarz) and commercial audio equipment (CD and DVD players). The receiver can operate at rates up to 96 kHz with 24-bit audio data.

Switches SW001 through SW003 are used to set the receiver output data format, as shown in [Table 1-1](#). [Table 1-2](#) shows the jumper configuration for JP001 for normal operation.

Table 1-1. Digital Audio Receiver Configuration

SW001	SW002	SW003	Receiver Output Data Format
L	L	L	16-bit to 24-bit, Left-Justified Format
L	H	L	16-bit to 24-bit, I ² S™ Format
H	L	H	16-bit, Right-Justified (or standard)
L	H	H	18-bit, Right-Justified (or standard)

Table 1-2. JP001 Jumper Configuration⁽¹⁾

JP001 Jumper	16-bit, Right-Justified Format	16-bit to 24-bit, I ² S Format	16-bit to 24-bit, Left-Justified Format
CLKO	X	X	X
SCLK	O	O	O
GND	O	O	O
BCK	O	O	N/C
BCK (left-justified)	N/C	N/C	N/C
LRCK	O	O	O
DATA	O	O	O

⁽¹⁾ O = Install jumper, N/C = Remove jumper, X = Do not care

Switch SW004 is a momentary-contact pushbutton switch that is normally open. It is used to reset the digital audio receiver when necessary.

The demonstration board also supports direct interfacing to audio decoders and signal processors via connector CN004 (unpopulated). SCLK, BCK, LRCK, and DATA are available and buffered by U005. In addition, 5 V (VCC) and ground are available at CN004. Switch SW005 is used to select between the digital audio receiver and connector CN004 as the source of the audio interface. [Table 1-3](#) shows the available switch settings.

Table 1-3. Digital Audio Source Selection

SW005 Setting	Source Selection
INT	Digital audio receiver (U002)
EXT	Connector CN004 via buffer U005

1.3.4 DIP-Switch Configuration

Switch SW006 is not used for the PCM1753/54/55. It is included for future products that may be compatible with this demonstration board. All switch elements must be set to the OFF position for the PCM1753/54/55.

1.3.5 Connector to PC Parallel Port / Host

The evaluation fixture includes a Centronics connector, CN003, that is used to connect to a PC parallel port or an alternative host controller. This connector is used to access the serial control port of the PCM1753/1755. The serial control port is used to program the PCM1753/1755 internal registers. A standard printer cable is used to connect CN003 of the evaluation fixture to a PC parallel port. The port signals are buffered using U006.

1.3.6 Operation Controls for PCM1754

SW001 to SW003 on the daughtercard are the operating controls for the PCM1754. These switches must be in position 2 (NC) for the PCM1753/1755.

- **SW001:** De-emphasis control ($f_s = 44.1$ kHz)
 - 1 (High) = De-emphasis ON
 - 3 (Low) = De-emphasis OFF
- **SW002:** Mute control
 - 1 (High) = Mute ON
 - 3 (Low) = Mute OFF
- **SW003:** Data format select
 - 1 (High) = 16-bit, Right-justified format
 - 3 (Low) = 16- to 24-bit, I²S format

1.4 Electrostatic Discharge Warning

Many of the components on the DEM-DAI1753/54/55 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.

Demonstration Software

Software is provided with the DEM-DAI1753/55 to allow programming of the PCM1753/55 internal registers. The software operates on computers equipped running Microsoft Windows. The demo software requires that the PC printer port be connected to CN003 of the DEM-DAI/DAC using a standard printer cable.

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2.1 Installation

The demo software is available for download at the TI web site ([slac237.zip](#)) as a compressed file. There is a single folder in the file, named *Dem1741-42-48*. This folder contains the application and all support files.

To install the software on your computer, first create a new folder on your hard drive with an appropriate name (for example, DEM1753_55, PCM1753_55, etc.). Then open the *Dem1741-42-48* folder in the installation download file, and copy all of the files in it to the new folder that you created on your hard disk.

Open the configuration setting file named *DEM1748.ini* with a text editor, such as Notepad or WordPad. When the file is opened, find the following line:

```
PCMIFADR = &h378
```

The **&h378** indicates the printer port address that the demo software will use to communicate with the DEM-DA1753/55. 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 match your computer port address.

2.2 Using the Demo Software

Double-click on the application file named *dem1741-42-48_rev10.exe*. A startup window will appear on your screen, as shown in [Figure 2-1](#). There are two menus near the top of the window, named **Execute** and **Window**.

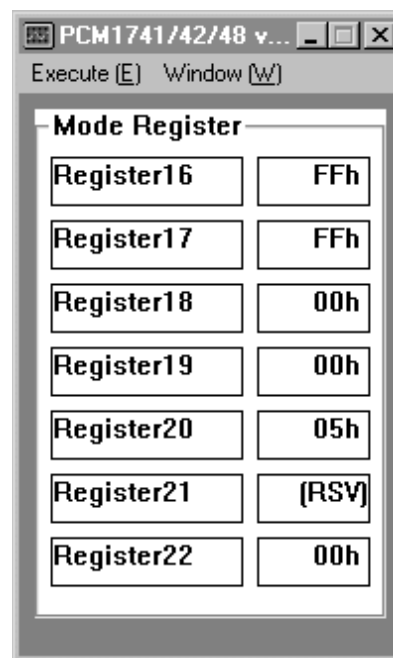


Figure 2-1. Startup Window

The Execute menu includes three selections: Initialize, Reset, and Exit. Selecting *Initialize* instructs the program to write all of the PCM1753/55 internal registers with the default values. Selecting *Reset* instructs the program to rewrite the PCM1753/55 internal registers with the data currently selected in the application windows. Selecting *Exit* closes the application.

The Window menu includes three selections: *Attenuation*, *Operational Control*, and *Function Control*. The following sections provide an explanation of each window.

2.3 Hold and Pass

Each window has a button near the top, labeled either HOLD or PASS. Toggle the setting by clicking on this button. When set to HOLD, the user can change the settings in a window, but the changes will not be written to the register(s) until the OK button (which appears at the bottom left corner of the window) is pressed. When set to PASS, changes made within a window are immediately written to the corresponding register(s).

2.3.1 Attenuation Window

The Attenuation window (shown in [Figure 2-2](#)) sets the digital attenuation registers internal to the PCM1753/55. There is an attenuator for both the left and right output channels; each attenuator has its own independent register to control its level. In the Attenuation window, there is a slider for each attenuator register. Use the slider handle or the arrows at each end of the slider to adjust the attenuation level. The left and right arrow keys on the keyboard can also be used to adjust the level. Immediately below each slider is a status display showing the current register setting (in decimals) and the corresponding attenuation level in decibels (dB).

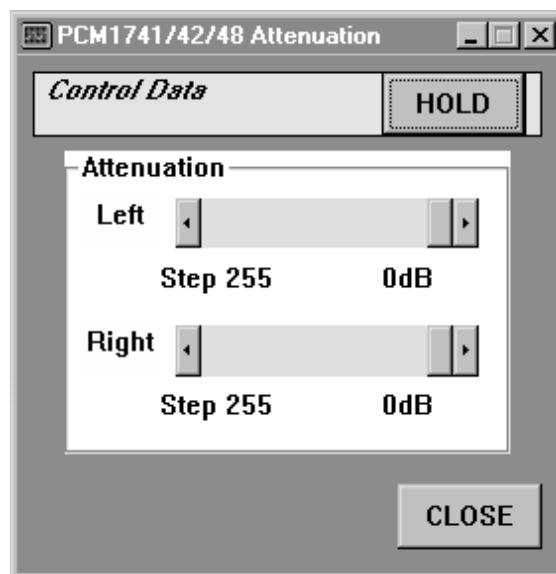


Figure 2-2. Attenuation Window

2.3.2 Operational Control Window

The Operational Control window is shown in [Figure 2-3](#). This window is used to set parameters for the following functions:

- Soft Mute (Mute Lch, Mute Rch): On or off
- DAC operation (DAC Lch, DAC Rch): On or off
- Digital De-Emphasis (DEM): Off, 32 kHz, 44.1 kHz, or 48 kHz

For more information regarding these functions, refer to the [PCM1753/55](#) data sheet.

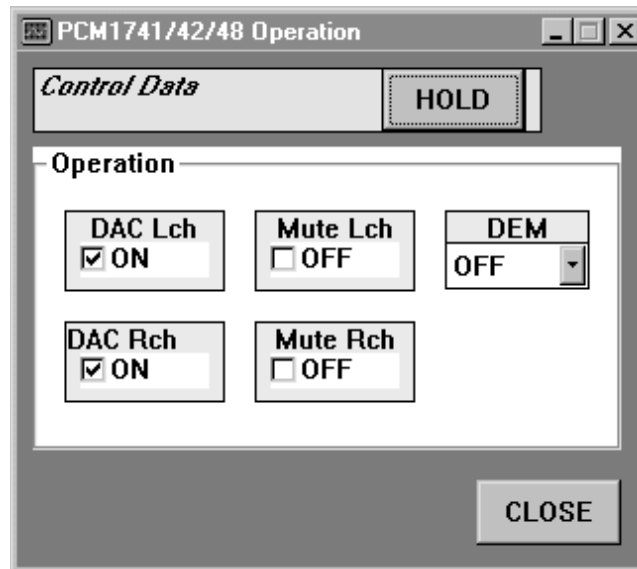


Figure 2-3. Operational Control Window

2.3.3 Function Control Window

The Function Control window is shown in [Figure 2-4](#). This window is used to set parameters for the following functions:

- Audio Data Format (Format)
- Digital Filter Low-Pass Response (Roll-Off): Sharp or Slow
- Zero Flag Output: Active high or active low
- Output Phase: Normal or Inverted
- L/R Zero Flag: Independent or Common
- Oversampling Rate: $64/32 f_s$ or $128/64 f_s$

For more information regarding these functions, refer to the [PCM1753/55](#) data sheet.

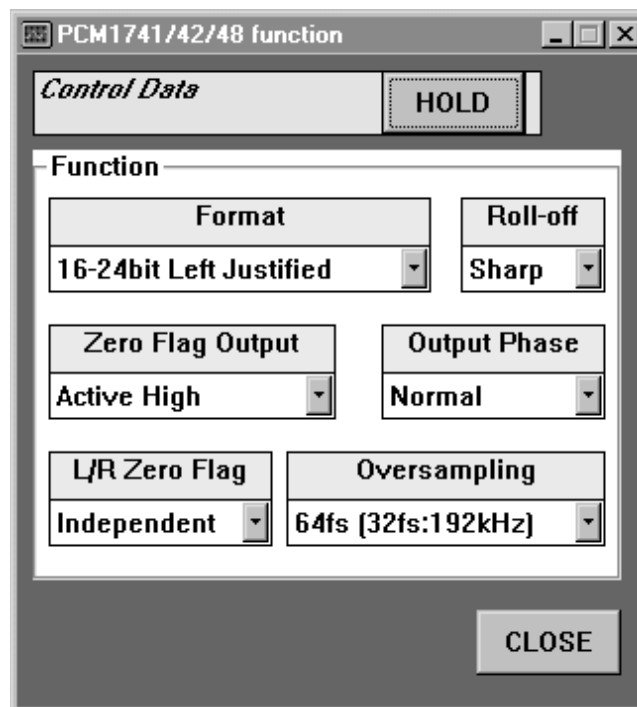


Figure 2-4. Function Control Window

Schematic, PCB Layout, and Bill of Materials

This chapter provides the electrical and physical layout information for the DEM-DAI/DAC and the DEM-DAI1753/54/55. 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-DAI1753/54/55 EVM PCBs.

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3.1 DEM-DAI/DAC Schematics

The schematic for the sections of the DEM-DAI/DAC is shown in Figure 3-1 through Figure 3-3.

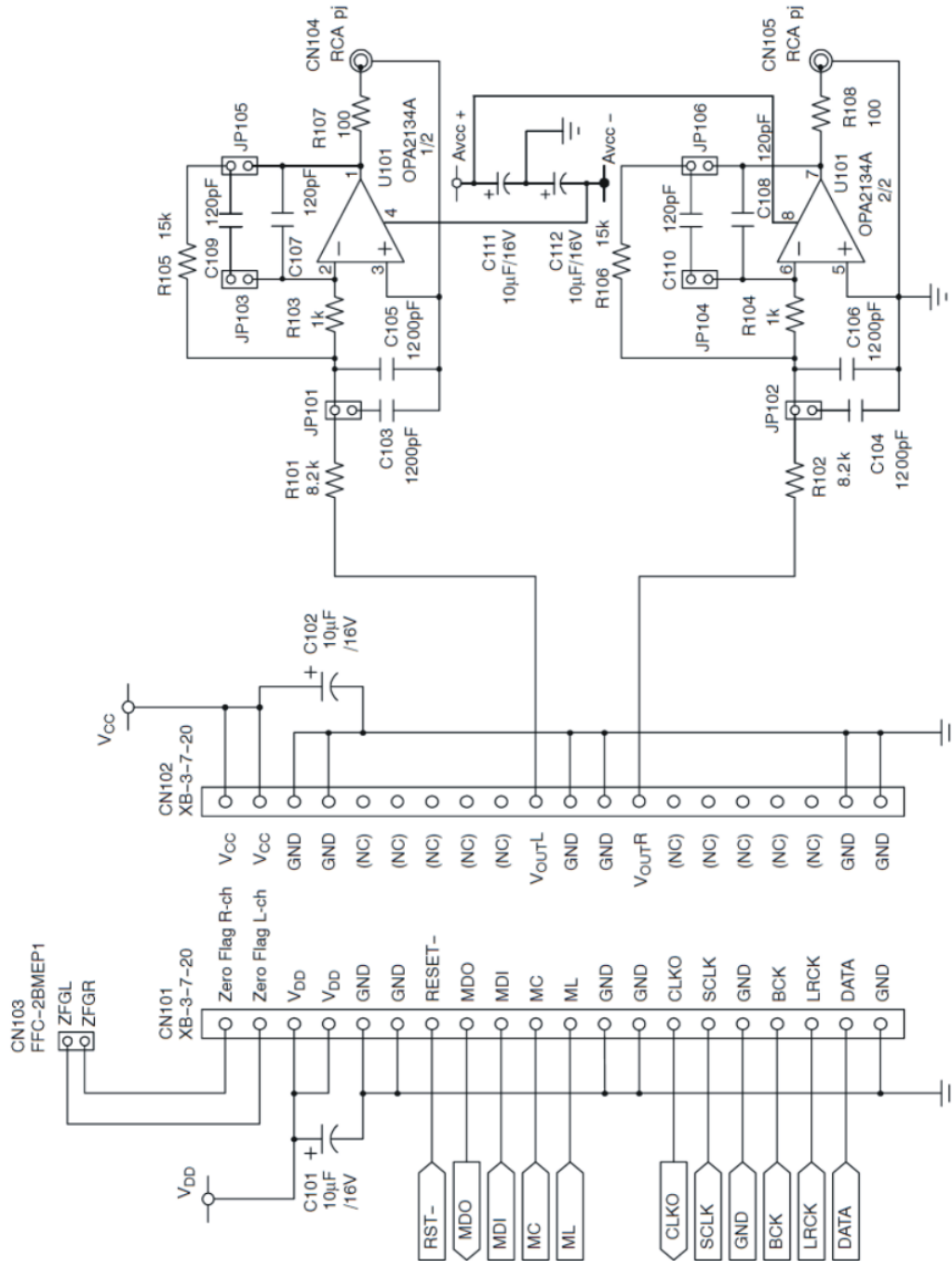


Figure 3-1. Low-Pass Filter Schematic

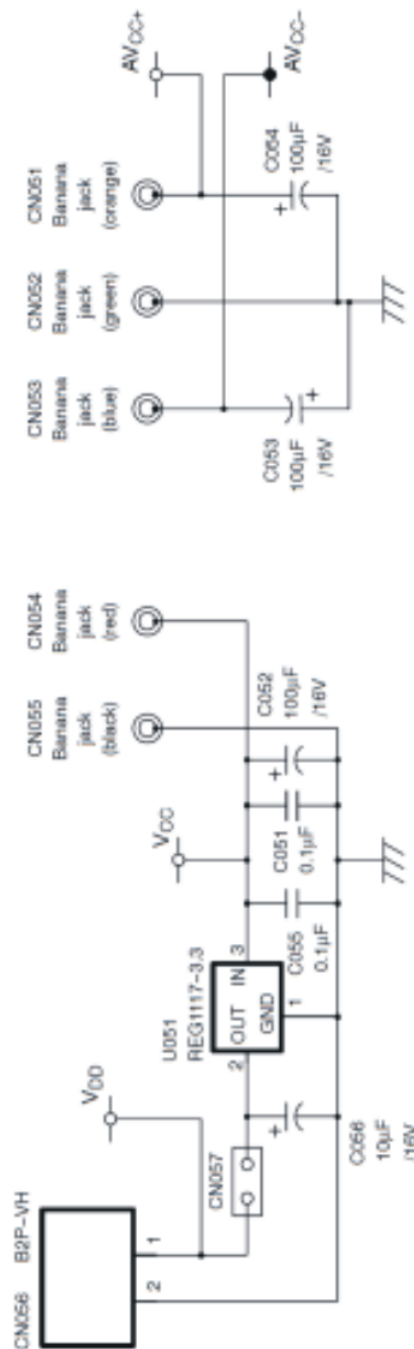


Figure 3-2. Daughtercard Sockets, Connector, and Regulator Schematic

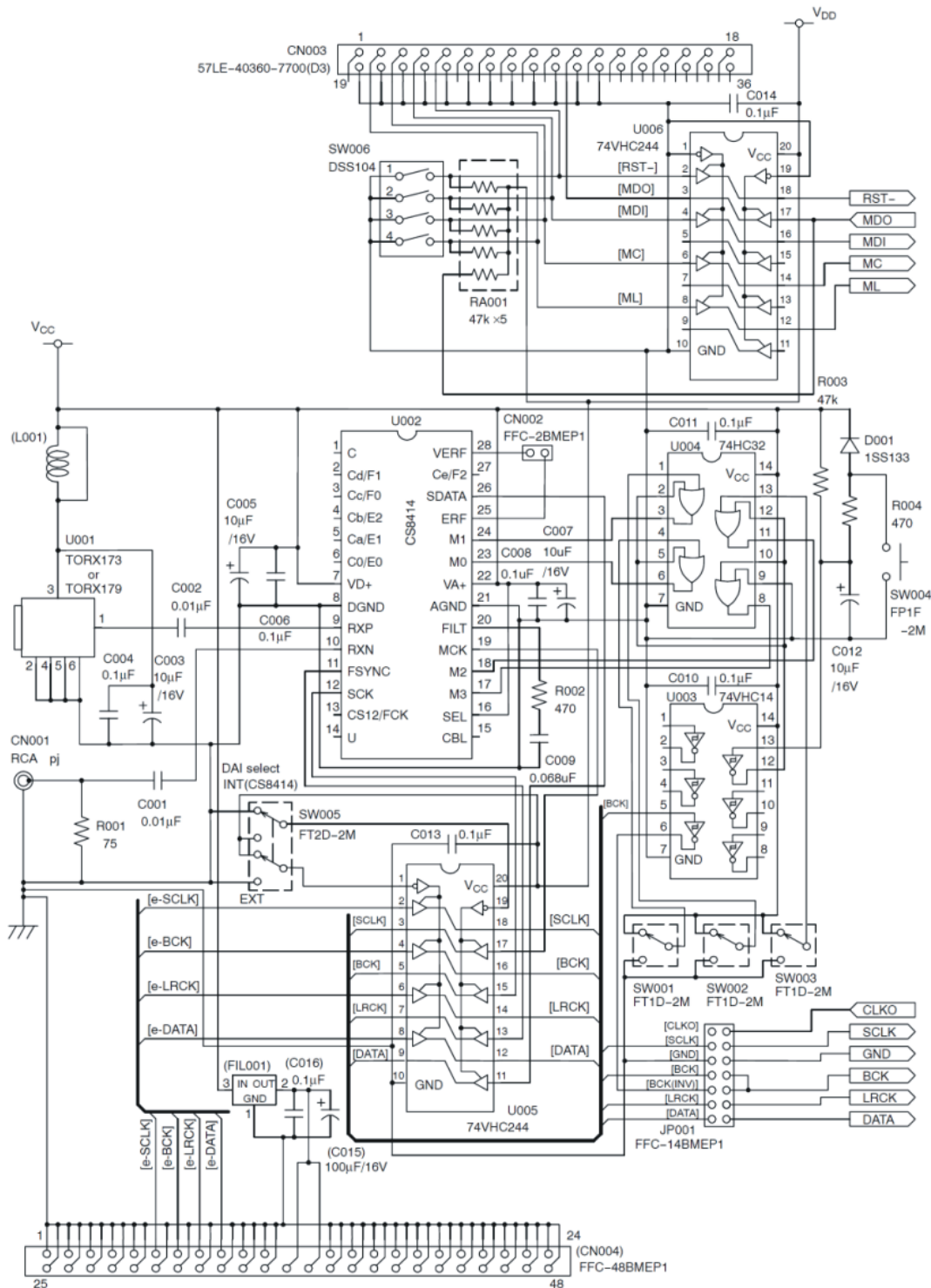


Figure 3-3. Digital Audio Interface Schematic

3.2 DEM-PCM1753/54/55 Schematic

Figure 3-4 illustrates the schematic for the DEM-PCM1753/54/55.

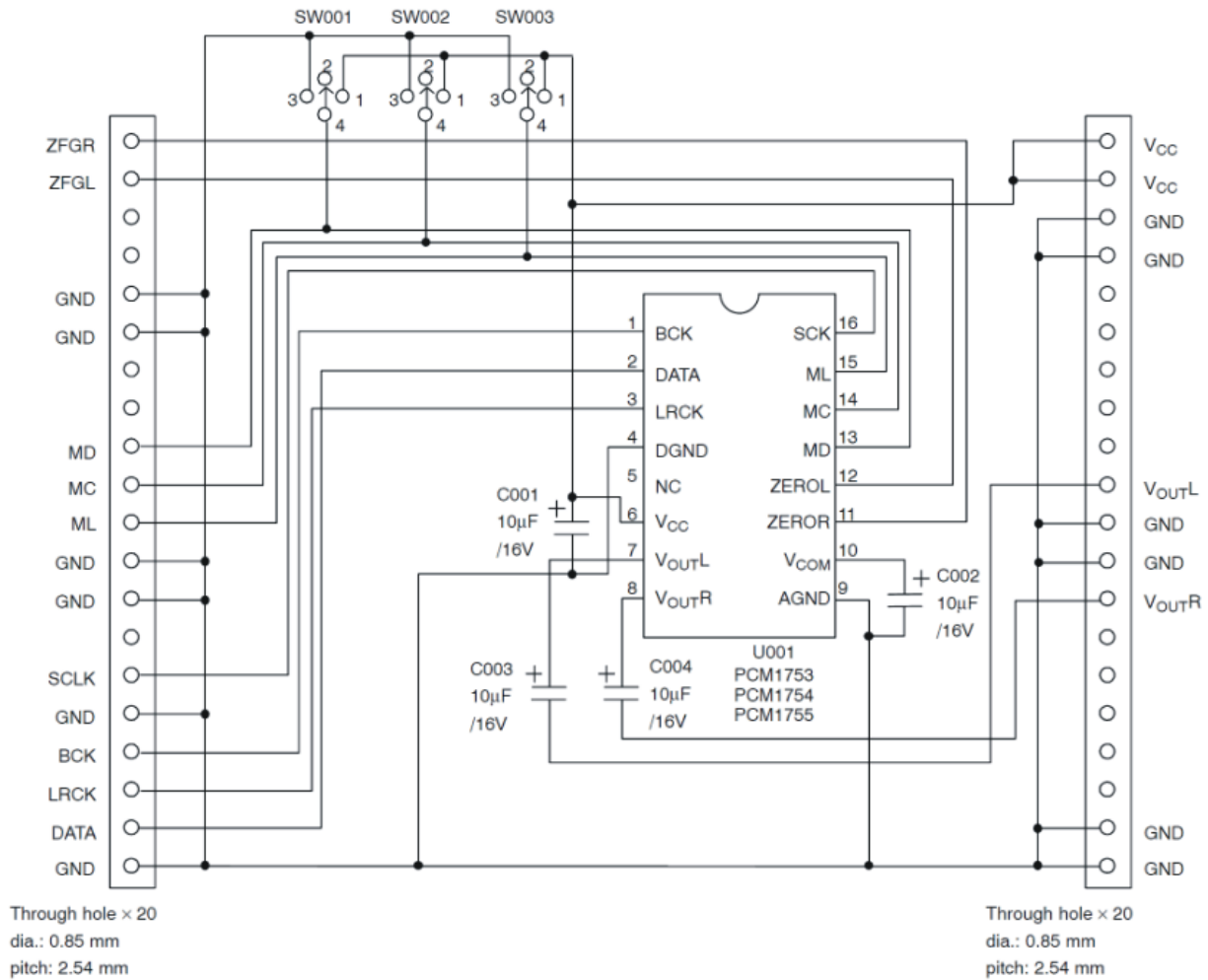


Figure 3-4. DEM-PCM1753/54/55 Daughtercard Schematic

3.3 Printed Circuit Board Layout—DEM-DAI/DAC

Figure 3-5 through Figure 3-7 illustrate the printed circuit board (PCB) layout for the DEM-DAI/DAC.

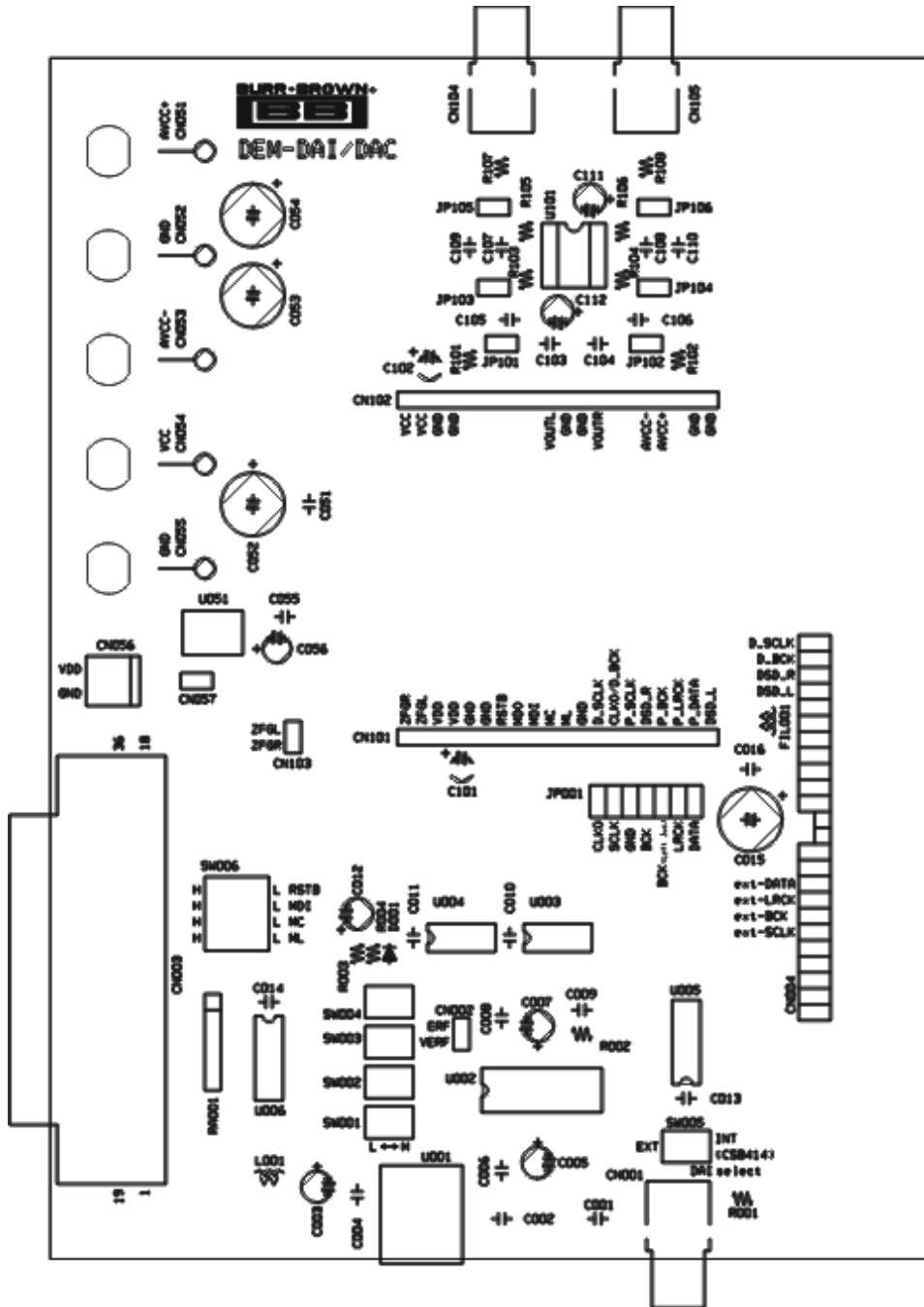


Figure 3-5. DEM-DAI/DAC Board Layout—Silkscreen

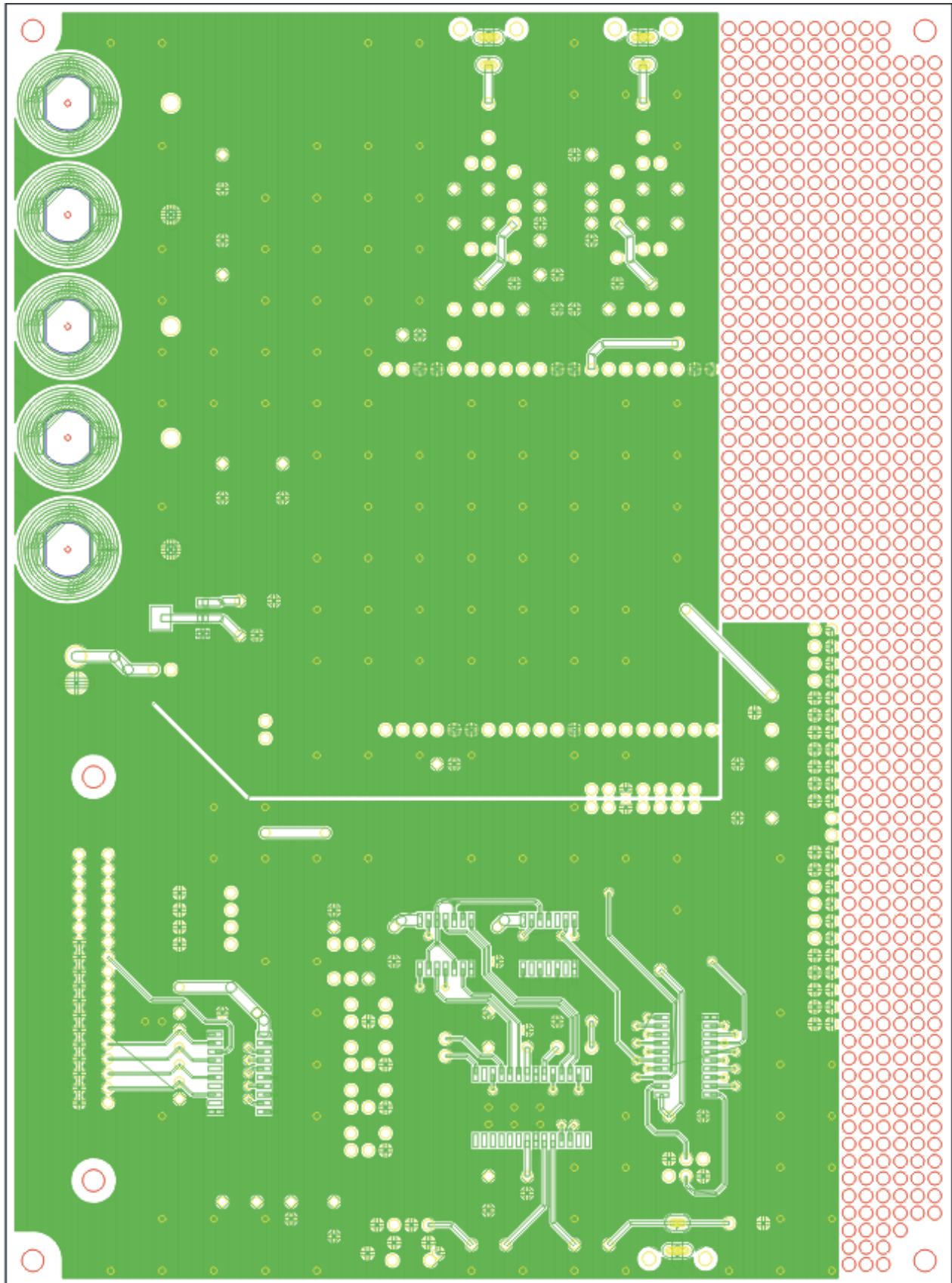


Figure 3-6. DEM-DAI/DAC Board Layout—Top (Component) Side

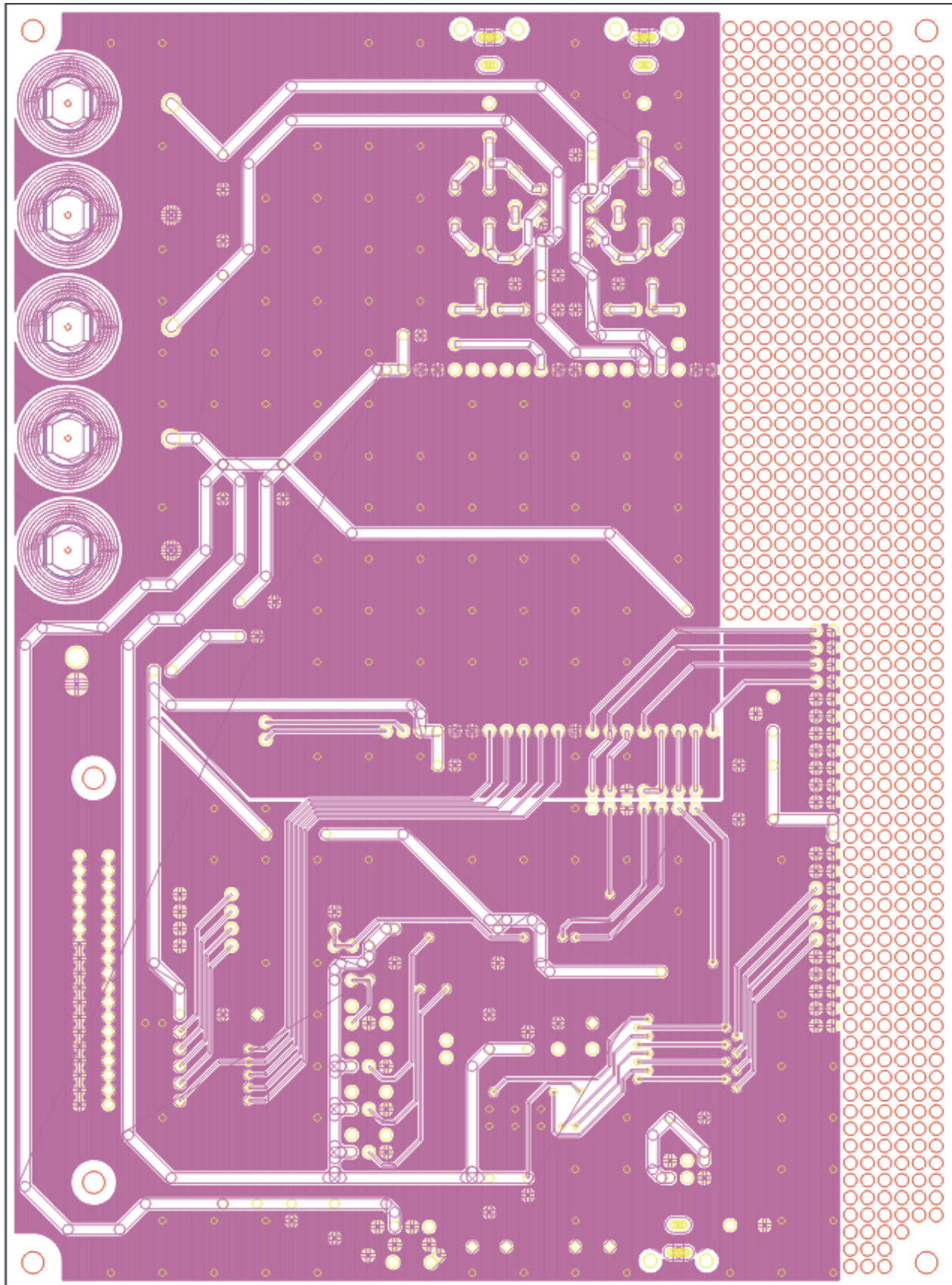


Figure 3-7. DEM-DAI/DAC Board Layout—Bottom View

3.4 Printed Circuit Board Layout—DEM-PCM1753/54/55 Daughtercard

Figure 3-8 through Figure 3-10 illustrate the PCB layout for the DEM-PCM1753/54/55.

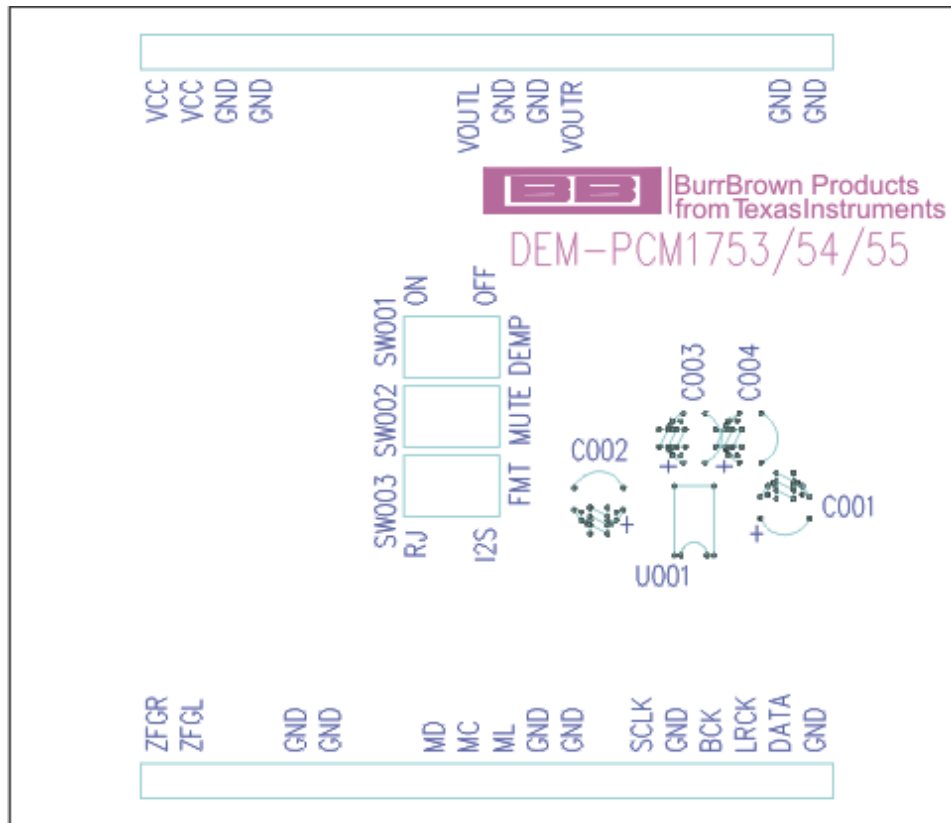


Figure 3-8. DEM-PCM1753/54/55 Board Layout—Silkscreen

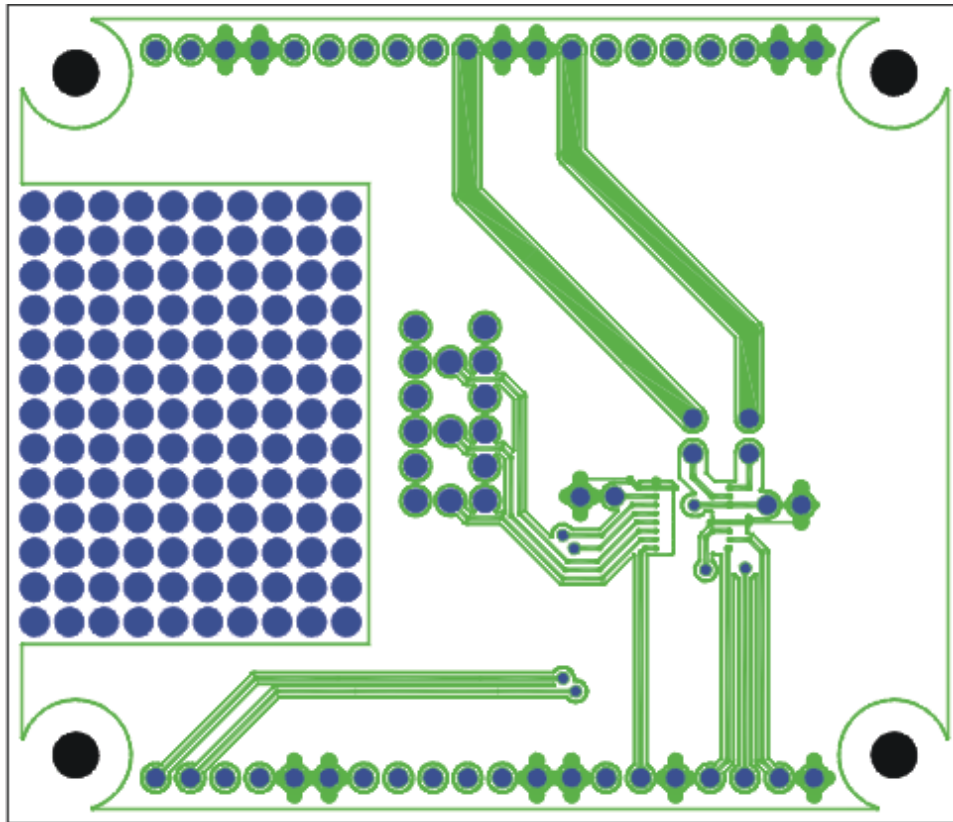


Figure 3-9. DEM-PCM1753/54/55 Board Layout—Top (Component) Side

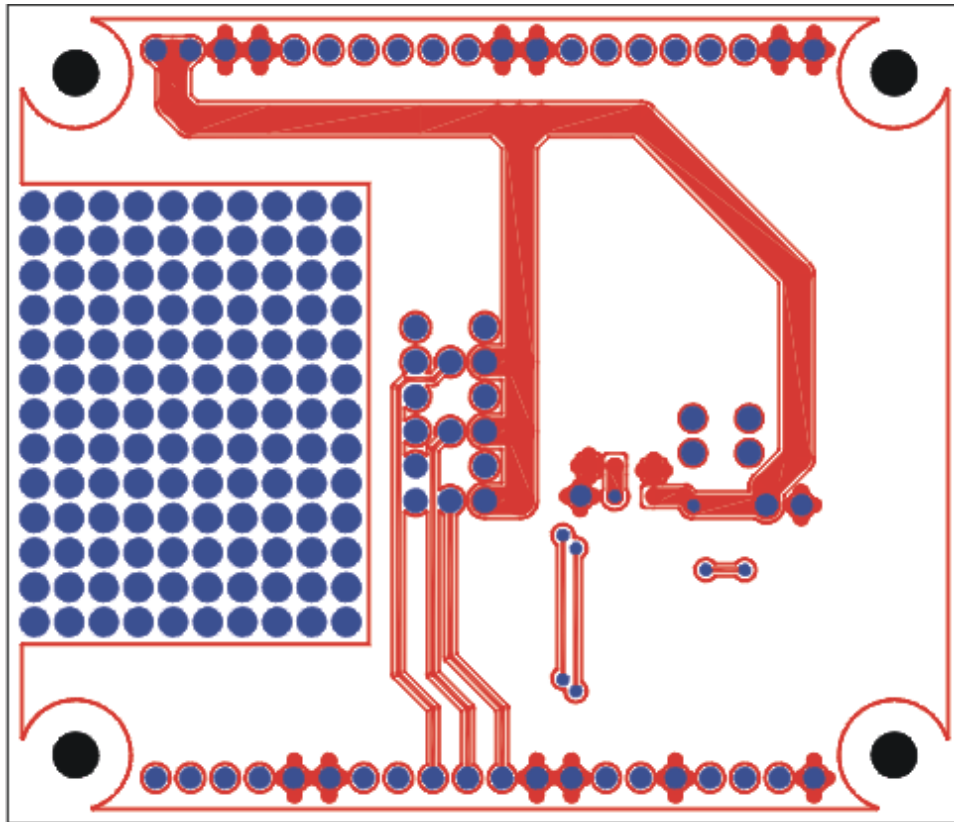


Figure 3-10. DEM-PCM1753/54/55 Board Layout—Bottom View

3.5 Component Lists

3.5.1 Bill of Materials for DEM-DAI/DAC

Table 3-1 lists the bill of materials for the DEM-DAI/DAC.

Table 3-1. Bill of Materials—DEM-DAI/DAC

Qty	Ref Des	Item	Value	Mfr Part No.	Manufacturer
2	C001,C002	Poly film capacitors	0.01 μ F	AMFF0050J103	NISSEI
4	C004, C006, C008, (C016), C051	Poly film capacitors	0.1 μ F	AMFF0050J104	NISSEI
1	C009	Poly film capacitors	0.068 μ F	AMFF0050J683	NISSEI
5	C010, C011, C013, C014, C055	Chip monolithic ceramic capacitor	0.1 μ F	RPE132F104Z50	Mmurata
5	C003, C005, C007, C111, C112	Aluminum electrolytic capacitor	10 μ F/16V	ROA-16V100M	ELNA
3	(C015), C052, C053, C054	Aluminum electrolytic capacitor	100 μ F/16V	ROA-16V101M	ELNA
2	C101, C102	Aluminum electrolytic capacitor	10 μ F/16V	R3A-16V100M	ELNA
4	C103, C104, C105, C106	Polypropylene capacitor	1200 pF	APSF0100J122	NISSEI
4	C107, C108, C109, C110	Polypropylene capacitor	120 pF	APSF0100J121	NISSEI
1	C012	Aluminum electrolytic capacitor	10 μ F/16V	SME16VB10M	Nichicemi
1	C056	Tantalum capacitor	10 μ F/16V	DN1C100M1S	NEC
1	CN003	L- type ribbon connector		57LE40360-7700(D3)	DDK
3	CN002, CN057, CN103	2-pin connector	1 pin \times 2 row	FFC-2BMEP1	HONDA TSUSHIN KOGYO CO LTD
1	CN105	RCA connector (red)	Red	LPR6520-0802	SMK
1	CN104	RCA connector (white)	White	LPR6520-0803	SMK
1	CN001	RCA connector (yellow)	Yellow	LPR6520-0804	SMK
1	CN051	RCA connector (orange)	Yellow	T-45 (Yellow)	SATO PARTS
1	CN052	RCA connector (green)	Green	T-45 (Green)	SATO PARTS
1	CN053	Banana jack (blue)	Blue	T-45 (Blue)	SATO PARTS
1	CN054	Banana jack (red)	Red	T-45 (Red)	SATO PARTS
1	CN055	Banana jack (black)	Black	T-45 (Black)	SATO PARTS
1	CN056	VH connector 2-pin		B2P-VH	JST
2	CN101, CN102	Connector, 20-pin		XB-3-7-20	MAC8
1	D001	Diode		1SS133	ROHM
1	JP001	14-pin connector	7 pin \times 2 row	FFC-14BMEP1	HONDA TSUSHIN KOGYO CO LTD
6	JP101–JP106	2-pin connector	1 pin \times 2 row	FFC-2BMEP1	HONDA TSUSHIN KOGYO CO LTD
1	R001	Metal Film Resistors, 1/4W	75 Ω	SN14C2C-75 Ω F	KOA
2	R107, R108	Metal Film Resistors, 1/4W	100 Ω	SN14C2C-100 Ω F	KOA
2	R002, R004	Metal Film Resistors, 1/4W	470 Ω	SN14C2C-470F	KOA
2	R103, R104	Metal Film Resistors, 1/4W	1 k Ω	SN14C2C-1k Ω F	KOA
2	R101, R102	Metal Film Resistors, 1/4W	8.2 k Ω	SN14C2C-8.2k Ω F	KOA
2	R105, R106	Metal Film Resistors, 1/4W	15 k Ω	SN14C2C-15k Ω F	KOA
1	R003	Metal Film Resistors, 1/4W	47 k Ω	SN14C2C-47k Ω F	KOA
1	RA001	Resistor array	47 k Ω \times 5	M6-1-473J	BI
1	U001	TOSLINK® optical connector		TORX179P	Toshiba

Table 3-1. Bill of Materials—DEM-DAI/DAC (continued)

Qty	Ref Des	Item	Value	Mfr Part No.	Manufacturer
1	U002	Digital Audio I/F Receiver IC		CS8414-CS	Cirrus Logic
1	U003	General-purpose Logic IC		TC74VHC14F	Toshiba
1	U004	General-purpose Logic IC		TC74HCT32AF	Toshiba
2	U005, U006	General-purpose Logic IC		TC74VHC244F	Toshiba
1	U051	Regulator IC		REG1117-3.3	Texas Instruments
1	U101	IC socket DIP-8 pin		100-008-000	3M
3	SW001, SW002, SW003	Toggle Switch (1-pole DT)		FT1D-2M	Fujisoku
1	SW004	Puch Switch		FP1F-2M	Fujisoku
1	SW005	Toggle Switch (2-pole DT)		FT2D-2M	Fujisoku
1	SW006	DIP Switch, 4-element		A6D-4103	OMRON
4	—	spacer		AR-325B	HIROSUGI

3.5.2 Bill of Materials for DEM-PCM1753/54/55

Table 3-2 lists the bill of materials for the DEM-PCM1753/54/55.

Table 3-2. Bill of Materials—DEM-PCM1753/54/55

Qty	RefDes	Description	Size	Mfr Part Number	MFR
4	C001–C004	Aluminum capacitor	10 μ F/16 V	R3A-16V100M	ELNA
2	C005, C006	Ceramic capacitor	0.1 μ F (2125)	GRM40B104K50PT/ GRM21BB11H104KA0 1L	Murata
3	SW001–SW003	Toggle switch (2-pole DT)		G-12AP	NKK
1	U001	IC	SSOP, 16-pin	PCM1753DBQ	Honda
1	U001	IC	SSOP, 16-pin	PCM1754DBQ	Texas Instruments
1	(U001)	IC	SSOP, 16-pin	PCM1755DBQ	Texas Instruments

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -0.3 V to $+6.5\text{ V}$ and the output voltage range of -4.0 V to $+4.0\text{ V}$.

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.

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During normal operation, some circuit components may have case temperatures greater than $+60^{\circ}\text{C}$. The EVM is designed to operate properly with certain components above $+60^{\circ}\text{C}$ 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.

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