

# DSK\_AUDIO4

Four-Channel Audio Daughtercard  
for the  
Texas Instruments TMS320C6X11/6713/6416T/5510  
Digital Signal Processing (DSP) Starter Kits

(Board Revision A)

Educational DSP, LLC  
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# 1 Hardware

The DSK\_AUDIO4 is a four-channel audio input/output daughtercard designed to operate on the Texas Instruments TMS320C6211, TMS320C6711, TMS320C6713, TMS320C6416T, and TMS320C5510 DSP Starter Kits (DSK). It has two stereo line outputs, and 4 input channels that be selected from line level or microphone sources. The daughtercard is designed so that on power-up it is compatible with software written for the previous DUAL3006 audio daughtercard. In this mode it operates at a 48kHz sample rate using stereo line-level inputs and outputs with 0db gain. The daughtercard can then be programmed by the DSP application to set amplifier gains, select the input source, and control various codec capabilities. The programming interface uses the CNTL0/1 and STAT0/1 on the DSK's Peripheral Interface connector.

Four-channel operation is not possible on TMS320C6211 DSKs. When using the daughtercard on TMS320C6211/6711 DSKs, jumper JP1 must be installed on the DSK in order to make the McBSP's available on the Peripheral Interface connector.

## 1.1 General Precautions

Proper electrostatic discharge (ESD) precautions should be observed at all times when handling the DSK\_AUDIO4 daughtercard. Failure to do so may result in damage to the circuitry on the daughtercard or the DSK. Do not install or remove the daughtercard while power is supplied to the DSK.

## 1.2 Installation

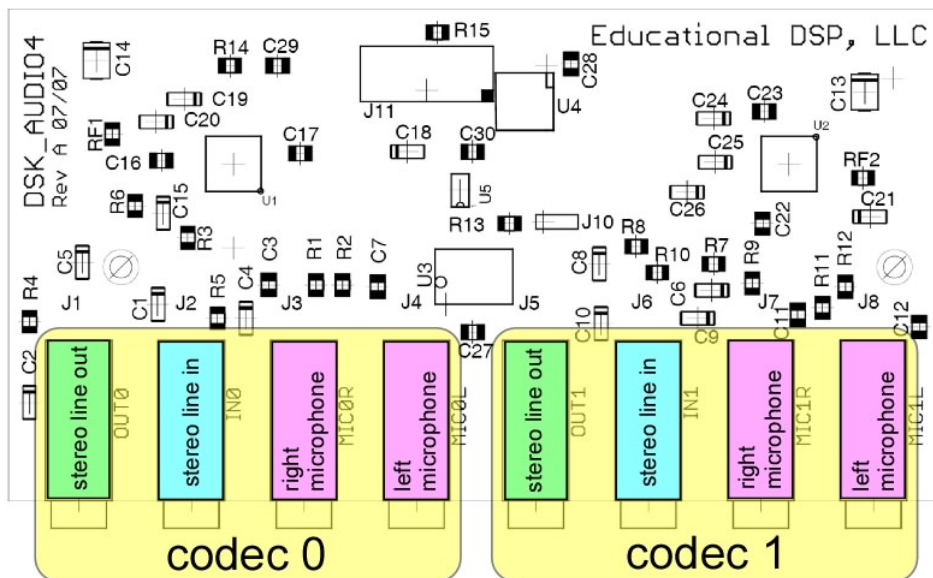
Installation should only be accomplished in an ESD-safe area. Disconnect all power to the DSK. Install the DSK\_AUDIO4 daughtercard on the DSK's Peripheral Interface connector (J3 on the 6211/6711/6713/6416T DSKs). Pay careful attention to the pin 1 keying on the connectors. Fasten the daughtercard to the DSK using the supplied 12mm stand-off and hardware.

Even with the 12mm stand-off installed, the numerous audio cables attached to the daughtercard can place stresses on the daughtercard/DSK connection, possibly damaging the daughtercard and/or DSK. It is recommended that the daughtercard be securely attached to the DSK using an enclosure panel (available from Educational DSP) or similar arrangement to prevent stress on the daughtercard to DSK connection.

### 1.3 Audio Connections

The audio connectors on the DSK\_AUDIO4 daughtercard are design to accept standard 3.5mm (1/8") stereo mini-plugs. When inserting plugs into the audio connectors, it is advisable to use your finger to maintain pressure on the rear of the connector housing to prevent stressing the connectors. Each codec has a stereo line output jack, a stereo line input jack, and two microphone input jacks. The microphone inputs are biased to be compatible with most electret microphones, and can also be used as line-level inputs as desired. The PCM3794 codec used on the DSK\_AUDIO4 daughtercard has a maximum input range of 1VRMS (+/-1.41V).

The audio connector locations as seen from the top of the daughtercard are as shown below.



### 1.4 Clock Operation

Both PCM3794 codecs operate as slave devices, with the DSP serial port McBSP1 providing all required serial communications signals to both codecs and McBSP0. The DSP serial port McBSP1 does this by using its Sample Rate Generator (SRG) hardware with a master clock input from the daughtercard. As shipped, the DSK\_AUDIO4 daughtercard is configured to operate using the 12.288MHz onboard oscillator, resulting in a 48KHz sample rate as the default configuration. To obtain variable sample rates by changing the master clock frequency, the DSP's TIMER1 output can be used to supply the master clock to the daughtercard. To use TIMER1, a jumper block (not supplied) must be installed at J10 as follows;

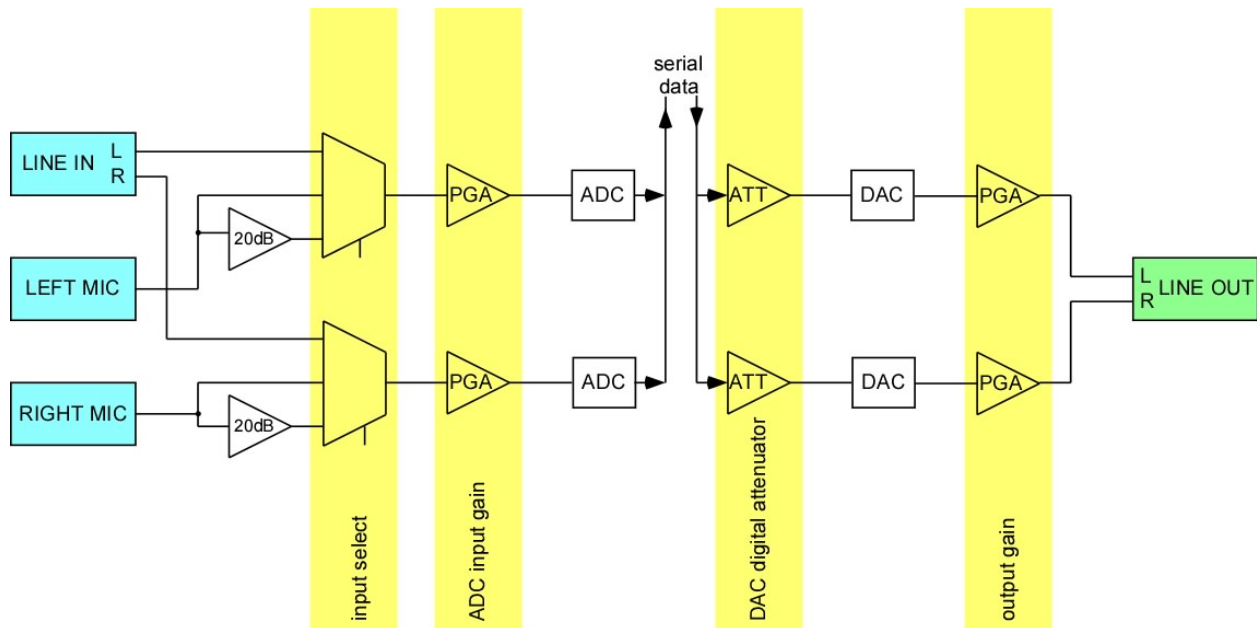
- Cut the trace on the board between J10-2 and J10-3.
- Solder a standard 0.050" spacing 3-position header strip at J10.
- Install a shunt between J10-1 and J10-2. This will connect the DSK's TIMER1 output as the PCM3794 master clock.

- To return to the 12.288MHz master clock, place the shunt between J10-2 and J10-3.

The range of sample rates over which the PCM3794 will operate is discussed in the PCM3794 datasheet available from Texas Instruments. Note that the sample rate can also be varied by changing the McBSP configuration and/or the PCM3794 configuration. (See the *Advanced Codec Configuration* section for more information.)

## 2 Programming the Codecs

The daughtercard programming interface provides control over a number of codec functions. Simple C-language function calls provide access to these functions. Source code and sample projects are available on the Educational DSP website. A simplified block diagram of the PCM3794 codec signal flow is shown below. The programming interface permits control of the functions that are highlighted in yellow.



### 2.1 Hardware Requirements

The programming interface uses the CNTL0/1 and STAT0/1 signals on the DSK's Peripheral Interface connector. In general, you should not write to the DSK CPLD register (DC\_REG) that controls these signals when using the daughtercard. The daughtercard also uses the daughtercard reset signal. If the daughtercard reset signal is asserted and released, the daughtercard codecs will be reprogrammed to their default configuration.

## 2.2 Application Programming Interface (API)

The functions that make up the codec configuration API are listed below.

- void DskAudio4\_Init(void);
  - This function must be called before any other API function.
- Int16 DskAudio4\_ResetDaughterCardToDefaults(void);
  - Resets the daughtercard to the default power-up configuration.
- Int32 DskAudio4\_GetDaughterCardInfo(void);
  - Returns information on the daughtercard type and version.
- Int16 DskAudio4\_SelectInputSource(UINT8 codec, UINT8 lsrc, UINT8 rsrc);
  - Selects whether to use line or microphone input sources.
- Int16 DskAudio4\_SetAdcAnalogGain(UINT8 codec, UINT8 channel, float gain);
  - Sets the gain of the input amplifiers.
- Int16 DskAudio4\_SetDacInputAttenuation(UINT8 codec, UINT8 channel, float gain);
  - Sets the gain of the DAC digital attenuator.
- Int16 DskAudio4\_SetLineOutAnalogGain(unsigned char codec, unsigned char channel, float gain);
  - Sets the gain of the output amplifiers.
- Int16 DskAudio4\_WriteCodecSetting(UINT8 codec, UINT8 address, UINT8 data);
  - Writes arbitrary data to any codec register. Misuse of this function can cause damage to the daughtercard and/or DSK. See the *Advanced Codec Configuration* section for more information.

Individual API functions are described in detail below. Note that the data types used are established by the *tistdtypes.h* include file for portability across platforms.

## DskAudio4\_Init

```
void DskAudio4_Init(void);
```

### Return Value

None.

### Parameters

None.

### Remarks

Does a hardware reset of the daughtercard and initializes the API variables. Always call this function before calling any other API function.

## DskAudio4\_ResetDaughtercardToDefaults

```
Int16 DskAudio4_ResetDaughtercardToDefaults();
```

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

None.

### Remarks

Causes the daughtercard to restore both codecs to the power-up default configuration (DUAL3006-compatible operation).

## DskAudio4\_GetDaughtercardInfo

```
Int32 DskAudio4_GetDaughtercardInfo();
```

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard. Otherwise, returns information about the daughtercard compressed into the 32-bit integer.

- Byte 3 (MSB) - daughtercard type (0x30 for DSK\_AUDIO4)
- Byte 2 - daughtercard hardware revision (0x10 for PCB rev A)
- Byte 1 - daughtercard firmware revision (high byte)
- Byte 0 (LSB) - daughtercard firmware revision (low byte)

### Parameters

None.

### Remarks

Can be used to test for daughtercard compatibility within a DSP application.

## DskAudio4\_SelectInputSource

```
Int16 DskAudio4_SelectInputSource(UINT8 codec, UINT8 lsrc, UINT8 rsrc);
```

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

*codec*

Selects the desired codec. Set to 0 for codec 0 or 1 for codec 1.

*lsrc*

Selects the input source for the codec's left channel. The following symbols are defined;

- DSK\_AUDIO4\_INPUT\_LINE - use line input
- DSK\_AUDIO4\_INPUT\_MIC\_0DB - use microphone, no preamp
- DSK\_AUDIO4\_INPUT\_MIC\_20DB - use microphone with 20db preamp

*rsrc*

Selects the input source for the codec's right channel. See *lsrc*.

### Remarks

Selects the left and right input sources for the specified codec.

## DskAudio4\_ SetAdcAnalogGain

Int16 DskAudio4\_SetAdcAnalogGain(UINT8 codec, UINT8 channel, float gain);

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

*codec*

Selects the desired codec. Set to 0 for codec 0 or 1 for codec 1.

*channel*

Selects codec channel. Set to 0 for left channel, 1 for right channel.

*gain*

Sets the analog input PGA gain from +30db to -12db in 1db steps.

### Remarks

Sets the gain of the ADC analog input programmable-gain amplifier (PGA) from +30db to -12db in 1db steps. The gain parameter is truncated to the nearest valid value.

## DskAudio4\_ SetDacInputAttenuation

Int16 DskAudio4\_SetDacInputAttenuation(UINT8 codec, UINT8 channel, float gain);

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

*codec*

Selects the desired codec. Set to 0 for codec 0 or 1 for codec 1.

*channel*

Selects codec channel. Set to 0 for left channel, 1 for right channel.

*gain*

Sets the DAC digital input attenuation from 0db to -62db in 1db steps.

### Remarks

Sets the DAC digital input attenuation from 0db to -62db in 1db steps. The gain parameter is truncated to the nearest valid value. Setting the gain to less than -62 mutes the DAC input.

## DskAudio4\_ SetLineOutAnalogGain

Int16 DskAudio4\_SetLineOutAnalogGain(UINT8 codec, UINT8 channel, float gain);

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

*codec*

Selects the desired codec. Set to 0 for codec 0 or 1 for codec 1.

*channel*

Selects codec channel. Set to 0 for left channel, 1 for right channel.

*gain*

Sets the line output PGA gain from +6db to -70db.

### Remarks

Sets the gain of the line output programmable-gain amplifier (PGA) from +6db to -70db. The gain step size is 0.5db from +6db to -11db, 1.0db from -12db to -24db, 2.0db from -26db to -42db, and 4.0db from -46db to -70db. The gain parameter is truncated to the nearest valid value.

## DskAudio4\_ WriteCodecSetting

Int16 DskAudio4\_WriteCodecSetting(UINT8 codec, UINT8 address, UINT8 data);

### Return Value

Returns -1 on error, indicating a problem communicating with the daughtercard.

### Parameters

*codec*

Selects the desired codec. Set to 0 for codec 0 or 1 for codec 1.

*address*

The address of the codec register to write to.

*data*

The data to write to the selected codec register.

### Remarks

For advanced users, this function supports the programming of any register in the PCM3794 codec. It should not be used without a thorough understanding of McBSP configuration, the PCM3794 codec, and the DSK\_AUDIO4 schematic diagram. See the *Advanced Codec Configuration* section for more information.

## 3 Advanced Codec Configuration

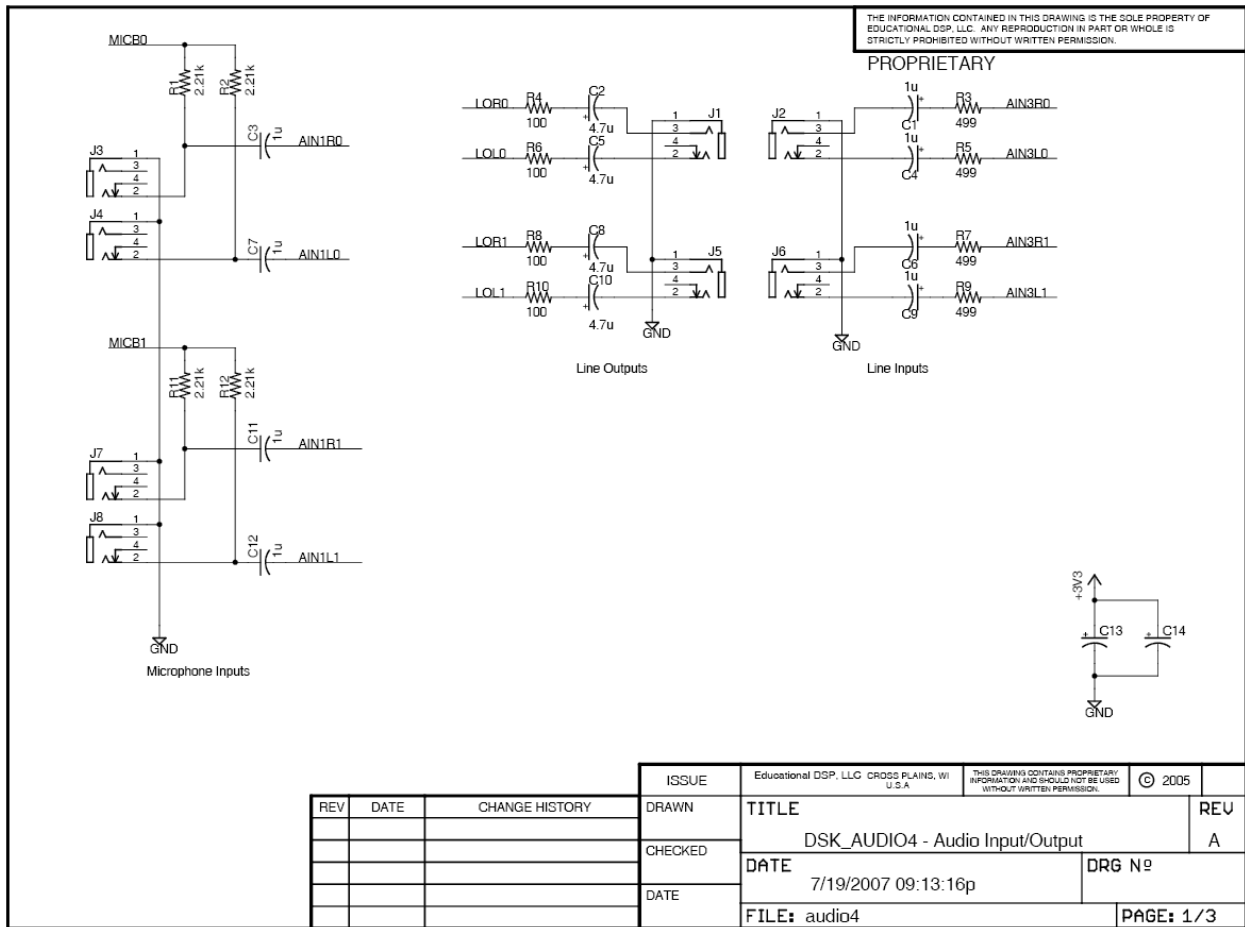
### 3.1 Cautions

The DSK\_AUDIO4 daughtercard is designed to synchronize the sampling of the two codecs by operating McBSP1 in master mode and having it supply the CLKX/CLKR and FSX/FSR signals to both codecs and McBSP0. A 74LVC2G34 dual buffer (U5) is used to drive the CLKX1/FSX1 signals from McBSP1 onto the CLKX0/FSX0 signals for McBSP0 and the attached PCM3794 codec 0 (U1). To prevent signal contention, **do NOT configure codec U1 or McBSP0 as master devices**. If you wish to operate U1 or McBSP0 as a master, then U5 must be removed from the board in order to isolate the McBSP CLKX and FSX signals.

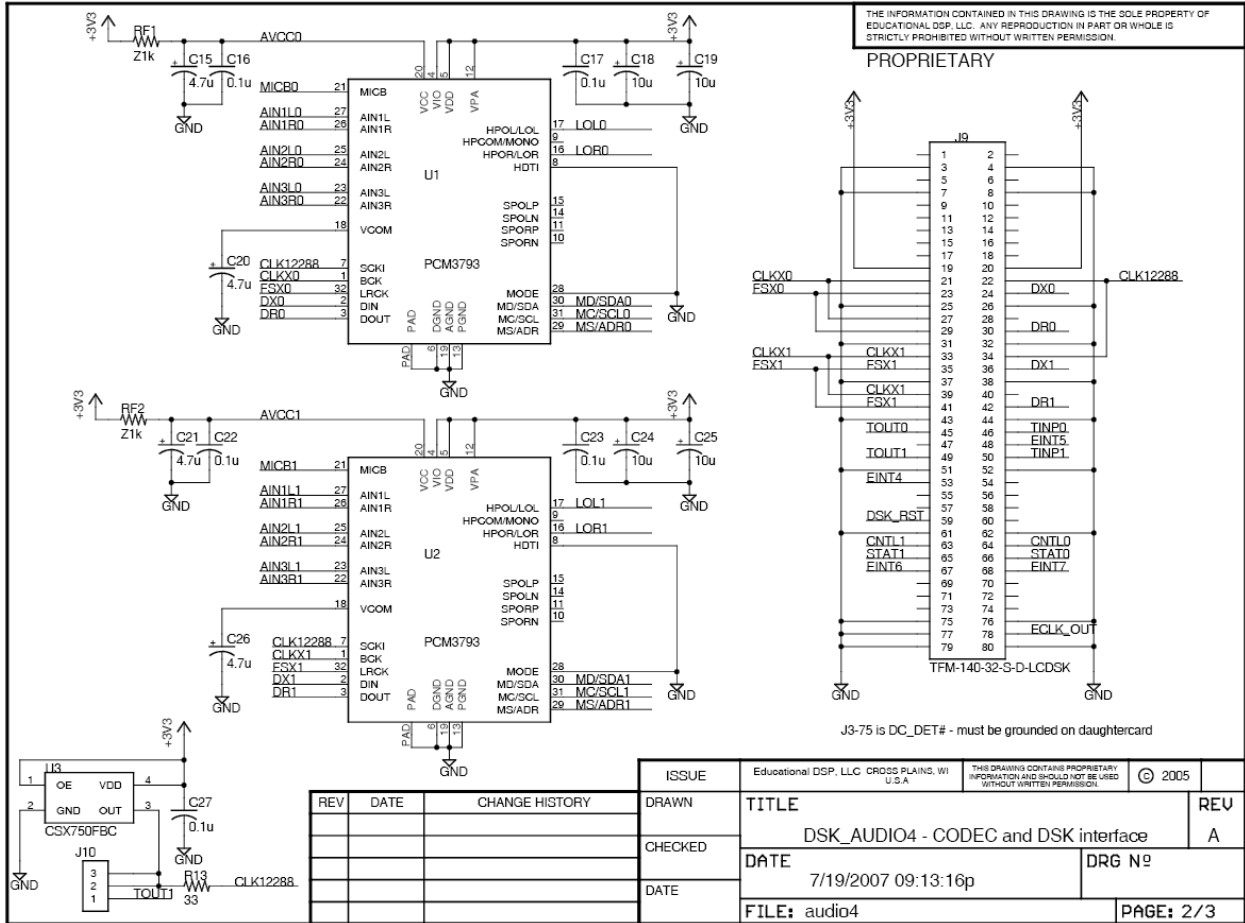
### 3.2 Application Programming Interface (API)

The DskAudio4\_WriteCodecSetting function can be used to write any value to any codec register. No checking is performed on the address or data passed to the function. As discussed in *Cautions* above, operating codec 0 (U1) as a master will cause contention and possible damage unless U5 is removed from the board. Also, McBSP1 must be operated as a slave whenever you operate codec 1 (U2) as a master.

# 4 Schematic Diagram



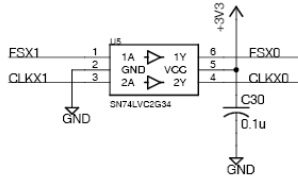
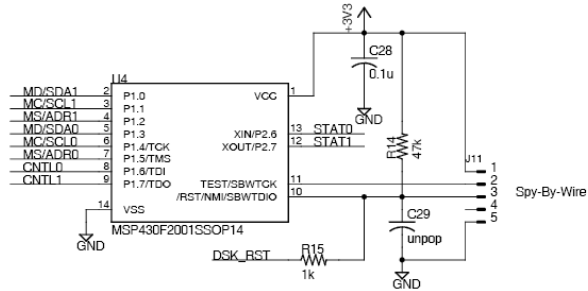
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# 5 Board Layout

