

# DSK\_AUDIO16\_BASE

Baseboard for DSK\_AUDIO4 Daughtercards  
for the  
Texas Instruments TMS320C6X11/6713/6416T/5510  
Digital Signal Processing (DSP) Starter Kits

Board Revision A.1  
FPGA Configuration 1.0.0

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# 1 Hardware

The DSK\_AUDIO16\_BASE is an intermediate-level daughtercard designed to allow the operation of up to four (4) DSK\_AUDIO4 daughtercards on the Texas Instruments TMS320C6211, TMS320C6711, TMS320C6713, TMS320C6416T, and TMS320C5510 DSP Starter Kits (DSK). It operates the DSK\_AUDIO4 boards with synchronized sampling at a 48kHz sample rate. A single interrupt is generated for all daughtercards. Individual DSK\_AUDIO4 daughtercards can be programmed by the DSP application to set amplifier gains, select the input source, and control various codec capabilities. The DSK\_AUDIO16\_BASE maps all audio data and control functions into the EMIF memory space of the DSK, and does not use the McBSPs on the DSK's Peripheral Interface connector.

## ***1.1 General Precautions***

Proper electrostatic discharge (ESD) precautions should be observed at all times when handling the DSK\_AUDIO16\_BASE daughtercard. Failure to do so may result in damage to the circuitry on the daughtercard or the DSK. Do not install or remove the DSK\_AUDIO16\_BASE daughtercard while power is supplied to the DSK. Do not install or remove DSK\_AUDIO4 daughtercards while power is supplied to the DSK\_AUDIO16\_BASE.

## ***1.2 Installation***

Installation should only be accomplished in an ESD-safe area. Pay careful attention to the pin 1 keying on the connectors. The DSK\_AUDIO4 daughtercard installed on the "DAUGHTERCARD A" connector (J5) on the DSK\_AUDIO16\_BASE must be configured to use its onboard oscillator (factory configuration). This is required because it supplies the codec master clock for the other DSK\_AUDIO4 boards and the codec interface logic on the DSK\_AUDIO16\_BASE. The other DSK\_AUDIO4 daughtercards mounted at positions B, C, or D (J6, J7, J8) must be configured to use their external (Timer 1) clock input. (See the DSK\_AUDIO4 documentation for information on configuring the codec master clock selection.) Install the DSK\_AUDIO4 daughtercards onto the DSK\_AUDIO16\_BASE connectors. Use 12mm stand-offs and hardware to securely fasten them to the DSK\_AUDIO16\_BASE.

Disconnect all power to the DSK. Install the DSK\_AUDIO16\_BASE daughtercard onto the DSK's Peripheral Interface and Memory Interface connectors (J3 and J4 on the 6211/6711/6713/6416T DSKs). Pay careful attention to the pin 1 keying on the connectors. Fasten the daughtercard to the DSK with 12mm stand-offs and hardware.

### 1.3 DSK\_AUDIO16\_BASE Memory Mapped Registers

The DSK\_AUDIO16\_BASE is mapped into the DSK's external EMIF memory space. Note that due to partial address decoding, it occupies the entire /CE3 memory space. (The board is hardwired at J4 to use the /CE3 space, but can be modified to use the /CE2 space if desired.) Descriptions of the registers are shown below.

Offset <sup>1</sup>	Name	Description
0	AUDIO16_CONFIGCOMM_REG	Used to transmit configuration commands to DSK_AUDIO4 daughtercards. This register should not be accessed except by using the codec configuration software API.
1	AUDIO16_VERSION_REG	Returns the 32-bit revision code for the DSK_AUDIO16 daughtercard hardware and logic configuration. Writes have no effect.
2	AUDIO16_IRQ_CONFIG_REG	Controls the interrupt configuration. See detailed description below.
3	AUDIO16_SERIAL_CONFIG_REG	Reserved register location. For upward compatibility, do not access this register.
4	AUDIO16_DATA_A_REG	Audio data register for DSK_AUDIO4 daughtercard in position A. See detailed description below.
5	AUDIO16_DATA_B_REG	Audio data register for DSK_AUDIO4 daughtercard in position B. See detailed description below.
6	AUDIO16_DATA_C_REG	Audio data register for DSK_AUDIO4 daughtercard in position B. See detailed description below.
7	AUDIO16_DATA_D_REG	Audio data register for DSK_AUDIO4 daughtercard in position B. See detailed description below.

Notes:

<sup>1</sup> Offset is shown in words. The actual offset is determined by the specific DSK and its memory interface configuration. See *dsk\_audio16.h* in the sample software for definitions specific to a DSK.

**AUDIO16\_DATA\_A\_REG: Audio Data (read-write)**  
**AUDIO16\_DATA\_B\_REG: Audio Data (read-write)**  
**AUDIO16\_DATA\_C\_REG: Audio Data (read-write)**  
**AUDIO16\_DATA\_D\_REG: Audio Data (read-write)**

Each DSK\_AUDIO4 daughtercard's audio data is sent and received through a single 32-bit register. Both the left and right samples for a given codec are contained in each 32-bit word read or written. When receive data is available, a receive interrupt is generated. To retrieve the data, the audio data register is read twice. The first read will return the codec 0 data and clear the receive interrupt. The second read will return the codec 1 data. To send audio data to the DSK\_AUDIO4, the codec 0 data is written first followed by the codec 1 data.

D31-D16	D15-D0
Left channel data	Right channel data

**AUDIO16\_IRQ\_CONFIG\_REG: Interrupt routing (write-only)**

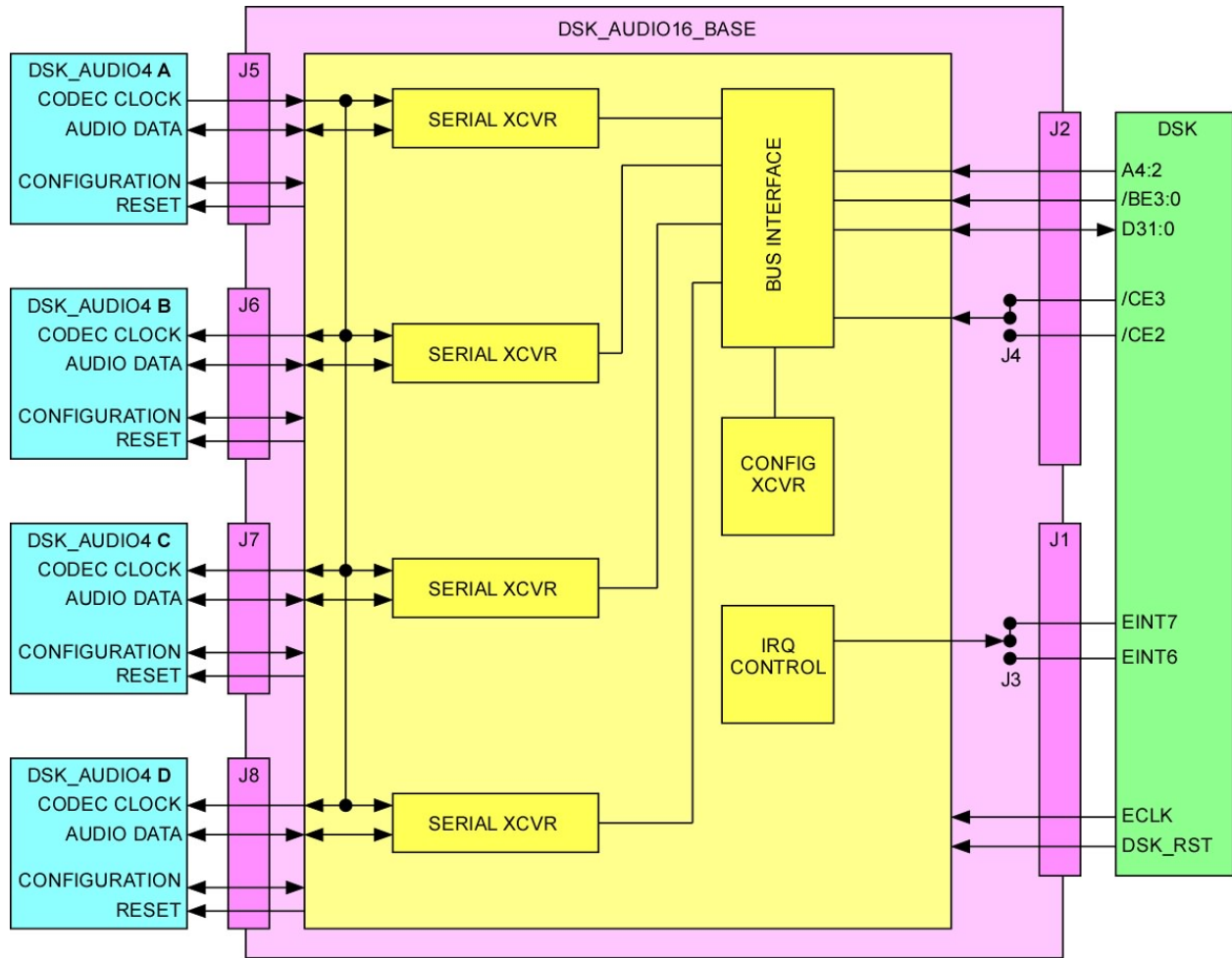
The AUDIO16\_CONFIG\_REG register is used to determine which events will cause the DSK\_AUDIO16\_BASE to generate an interrupt. Setting an Enable bit to 1 will cause that event to generate an interrupt. In general, only one interrupt event should be ever used since all DSK\_AUDIO4 sampling is all synchronized. The DSK\_AUDIO16\_BASE is hardwired to generate an interrupt on EINT7, but can be modified at J3 to use EINT6 instead.

Bits D[15:8] indicate which interrupts are currently pending. This information is not normally used, since only a single interrupt is enabled.

D31-D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Not used	TX Interrupt Flag				RX Interrupt Flag				TX Interrupt Enable				RX Interrupt Enable			
	D	C	B	A	D	C	B	A	D	C	B	A	D	C	B	A
0x0000	—	—	—	—	—	—	—	—	0	0	0	0	0	0	0	0

## 2 Operation

The DSK\_AUDIO16\_BASE simplified functional block diagram is shown below. All interface logic between the DSK and the DSK\_AUDIO4 boards is contained in a single field-programmable gate array (FPGA) device.



## ***2.1 Hardware Operation and Limitations***

The DSK\_AUDIO16\_BASE has two LED indicators. Indicator D1 (green) indicates the presence of 3.3V power, and should be illuminated whenever the DSK has power supplied. Indicator D2 (red) indicates when the FPGA logic has not been configured. It should be off in normal operation, indicating that the FPGA logic has successfully been configured. It will illuminate briefly on power up while the FPGA is configuring itself, and then turn off.

The logic design in the DSK\_AUDIO16\_BASE is configured to operate at a 48kHz sample frequency with all codecs on the DSK\_AUDIO4 boards configured as slaves. (Note that this is the default configuration of the DSK\_AUDIO4.) Operation at other frequencies, or with codecs acting as masters, is not currently supported.

The DSK\_AUDIO4 board in position A supplies the codec master clock for all DSK\_AUDIO4 boards and the DSK\_AUDIO16\_BASE logic. The other DSK\_AUDIO4 boards in positions B, C, or D must be configured to use an external codec master clock. (This involves a hardware modification to the DSK\_AUDIO4 boards as described in the DSK\_AUDIO4 documentation.)

## 2.2 Codec Configuration Application Programming Interface (API)

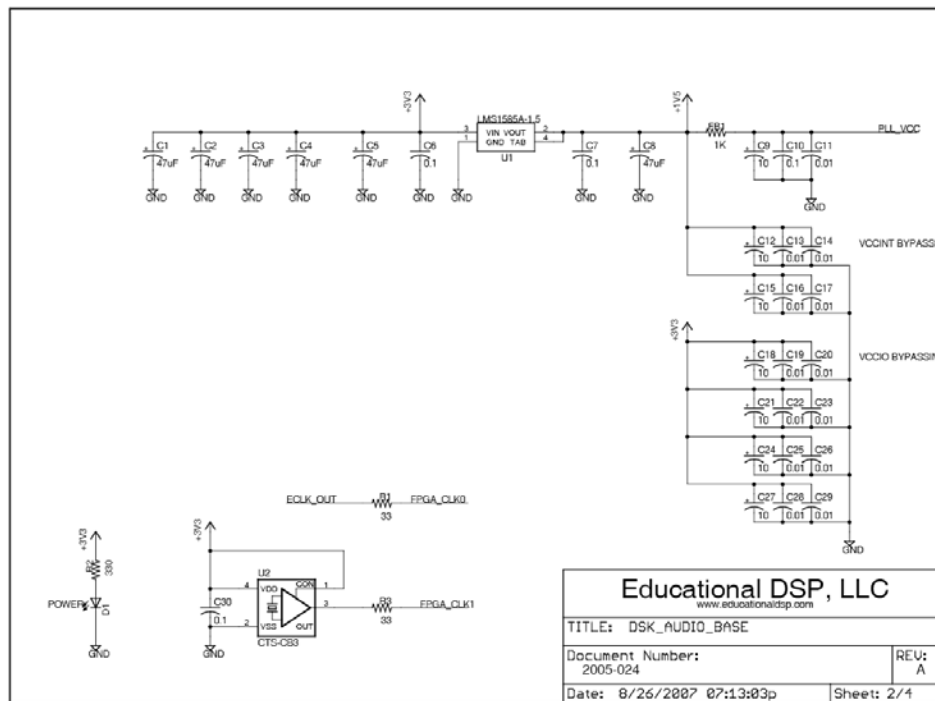
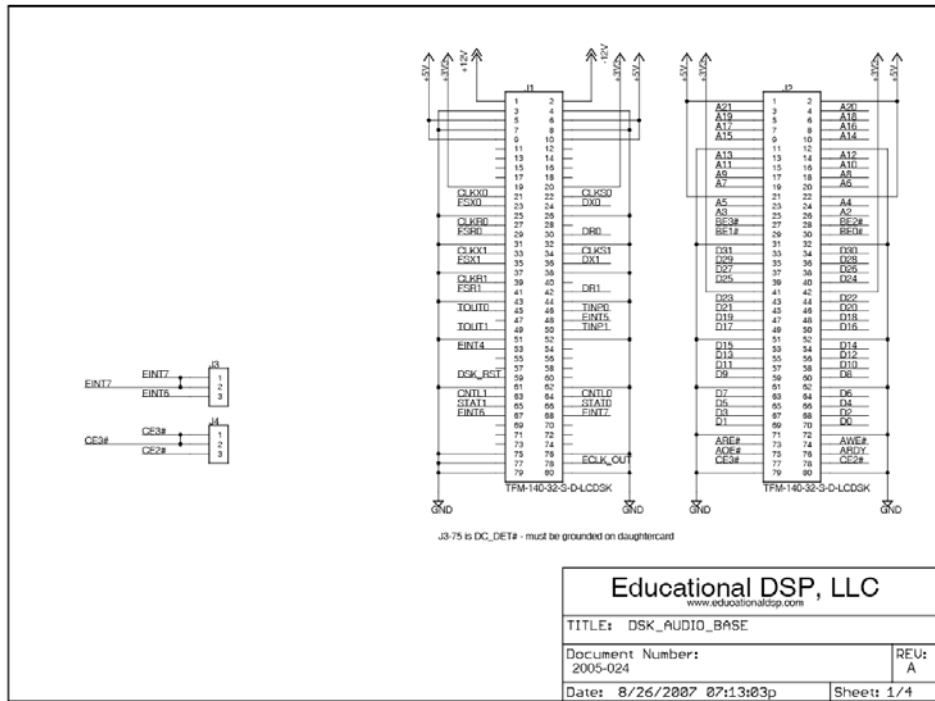
The codec configuration API for the DSK\_AUDIO16\_BASE is similar to the DSK\_AUDIO4 codec configuration API, with the addition of the parameter *dcard* to identify the intended DSK\_AUDIO4 board. (For daughtercard A, set *dcard* = 0) Due to the memory-mapped interface, an initialization function is not needed for the DSK\_AUDIO16\_BASE. The functions that make up the codec configuration API are listed below. The sample software for the DSK\_AUDIO16\_BASE demonstrates the use of some API functions.

- Int16 DskAudio16\_ResetDaughtercardToDefaults(UINT8 dcard);
  - Resets the specified daughtercard to the default power-up configuration.
- Int32 DskAudio16\_GetDaughtercardInfo(UINT8 dcard);
  - Returns information on the specified daughtercard's type and version.
- Int16 DskAudio16\_SelectInputSource(UINT8 dcard, UINT8 codec, UINT8 lsrc, UINT8 rsrc);
  - Selects whether to use line or microphone input sources.
- Int16 DskAudio16\_SetAdcAnalogGain(UINT8 dcard, UINT8 codec, UINT8 channel, float gain);
  - Sets the gain of the input amplifiers.
- Int16 DskAudio16\_SetDacInputAttenuation(UINT8 dcard, UINT8 codec, UINT8 channel, float gain);
  - Sets the gain of the DAC digital attenuator.
- Int16 DskAudio16\_SetLineOutAnalogGain(UINT8 dcard, unsigned char codec, unsigned char channel, float gain);
  - Sets the gain of the output amplifiers.
- Int16 DskAudio16\_WriteCodecSetting(UINT8 dcard, UINT8 codec, UINT8 address, UINT8 data);
  - Writes arbitrary data to any codec register. Misuse of this function can cause damage to the daughtercard(s) and/or DSK.

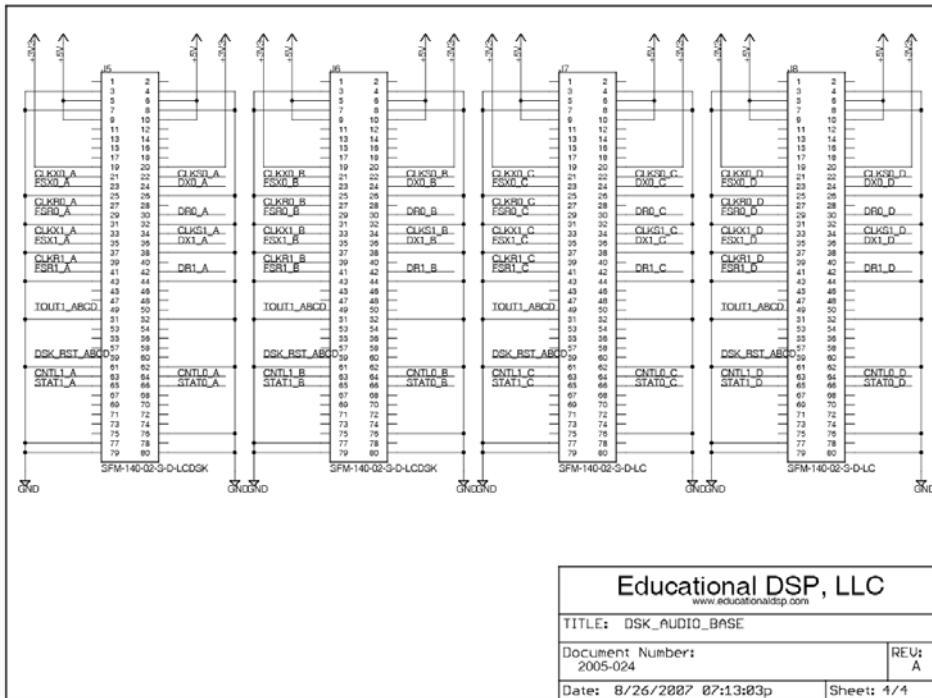
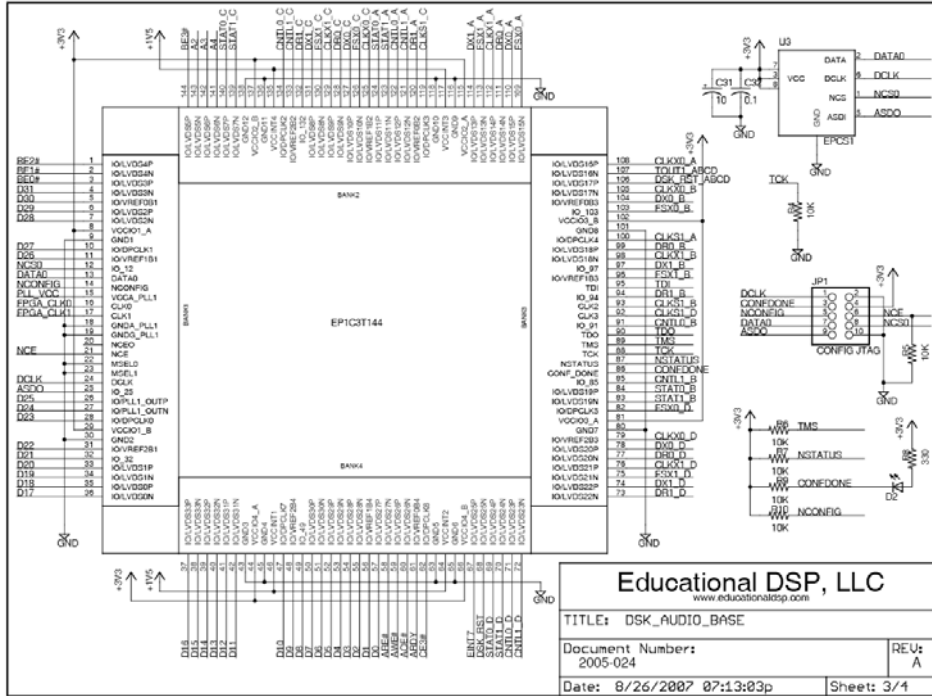
Individual API functions are described in more detail in the DSK\_AUDIO4 documentation. Note that the data types used are established by the *tistdtypes.h* include file for portability across DSP platforms.



### 3 Schematic Diagram



# DSK\_AUDIO16\_BASE Baseboard for DSK\_AUDIO4



## 4 Board Layout

