

Evaluation Board For CS8421

Features

- □ Asynchronous Sample Rate Conversion
- □ CS8416 S/PDIF Digital Audio Receiver
- □ CS8406 S/PDIF Digital Audio Transmitter
- Header for External Serial Audio I/O
- □ 3.3 V or 5.0 V Logic Interface
- No software required to operate.
- Demonstrates recommended layout and grounding arrangements.

Description

The CDB8421 demonstration board is an excellent means for evaluating the CS8421 sample rate converter. Evaluation requires a digital signal source, digital analyzer, and power supplies.

System timing can be provided by the CS8421, by the CS8416 phase-locked to its S/PDIF input, by an I/O stake header, or by an on-board oscillator. Digital I/O is available via coaxial (RCA) or optical connectors to the CS8416 and CS8406. All configuration control is handled from onboard switches.

ORDERING INFORMATION CDB8421

Evaluation Board

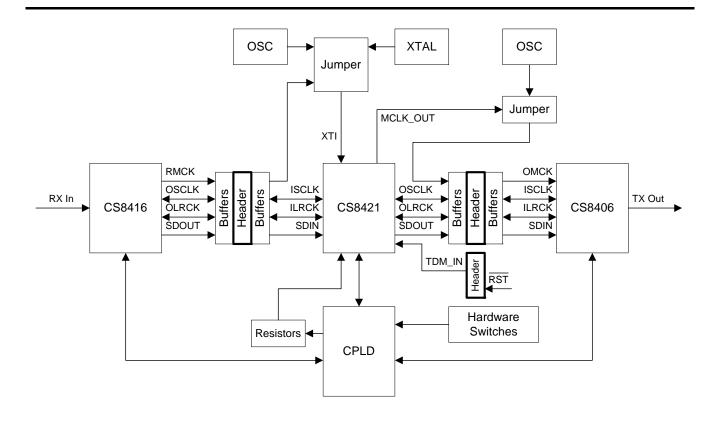




TABLE OF CONTENTS

	1. SYSTEM OVERVIEW	3
	1.1 CS8421 Sample Rate Converter	
	1.2 CS8406 Digital Audio Transmitter	
	1.3 CS8416 Digital Audio Receiver	
	1.4 Clocking	
	1.5 Clock and Data Headers	
	1.6 CPLD Board Setup	
	1.7 Power	
	1.8 Grounding and Power Supply Decoupling	
	2. BLOCK DIAGRAM	
	3. SCHEMATICS	9
	4. LAYOUT	17
	5. APPENDIX A: CS8406 TCBL CONNECTION FOR THE CDB8421 REV. A	20
	6. REFERENCES	21
	7. REVISION HISTORY	22
LIST	Γ OF FIGURES	
	Figure 1. Block Diagram	8
	Figure 2. Power	
	Figure 3. CS8416	
	Figure 4. CS8416 to CS8421	
	Figure 5. CS8421	
	Figure 6. CS8421 to CS8406	
	Figure 7. CS8406	
	Figure 8. Mode Switches	
	Figure 9. CPLD	
	Figure 10. Silk Screen	
	Figure 11. Topside Layer	
	Figure 12. Bottomside Layer	
LIST	Γ OF TABLES	
	Table 1. Clock Sources	Λ
	Table 1. Clock Sources Table 2. Switch S1, Serial Input and Output Master/Slave and Speed Mode Settings	
	Table 3. Switch S1, Serial Output Formats	
	Table 3. Switch S2, Serial Output Formats	
	Table 5. Switch S4, Board Setup	
	Table 6. System Connections	
	Table 0. System Connections	
	Table 8 Revision History	



1. SYSTEM OVERVIEW

The CDB8421 demonstration board is an excellent means for evaluating the CS8421 stereo sample rate converter. Digital audio signal interfaces are provided in the form of S/PDIF receiver and transmitter and PCM clock/data headers.

The CDB8421 schematic set is shown in Figures 1 through 9 and the board layout is shown in Figures 10 through 12, and the bill of materials is shown in Table 3.

1.1 CS8421 Sample Rate Converter

A complete description of the CS8421 is included in the CS8421 product data sheet [1], available online at http://www.cirrus.com

D9 (SRC_UNLOCK) indicates when the SRC is not locked and output from the CS8421 SD-OUT pin is not valid.

1.2 CS8406 Digital Audio Transmitter

The operation of the CS8406 transmitter and a discussion of the digital audio interface are included in the CS8406 data sheet [2].

The CS8406 converts the PCM data generated by the CS8421 to the standard S/PDIF data format. The CS8406 can operate in master or slave mode and accepts 128*Fs, 256*Fs, or 512*Fs master clock on the OMCK input pin. The serial audio input data for the CS8406 is received from the serial audio output of the CS8421. Digital Interface format selection of I²S (up to 24-bit), Left Justified (up to 24-bit), or Right Justified (16 or 24-bit) can be made.

S/PDIF output is through J6 or J15.

1.3 CS8416 Digital Audio Receiver

The operation of the CS8416 receiver (see Figure 3) and a discussion of the digital audio interface are included in the CS8416 data sheet [3].

The CS8416 converts the input S/PDIF data stream into PCM data for the CS8421. The CS8416 operates in master or slave mode and can output either 128*Fs or 256*Fs from its RMCK pin. Digital Interface format selection of I²S (24-bit), Left Justified (24-bit), or Right Justified (16 or 24-bit) can be made.

The CS8416 contains an internal input multiplexer which must be set to receive data from either the optical input connector (J12) or coaxial input connector (J5). This is done by setting the appropriate switch on switch-bank S4 to the COAXIAL or OPTICAL position.

D10 (RERR) indicates a receiver error, such as loss of lock.

S/PDIF input is through J5 or J12.



1.4 Clocking

Table 1 shows the available I/O configurations and their respective clock sources. When the CS8416 is selected to master SCLK and LRCK (CS8421 input port set to slave), J7 should be set to 8416. When the CS8421 input port is selected to master SCLK and LRCK (CS8416 set to slave), J7 may be set to 8416, OSC, or XTAL. When the CS8406 is selected to master SCLK and LRCK (CS8421 output port set to slave), J13 should be set to OSC. When the CS8421 output port is selected to master SCLK and LRCK (CS8406 set to slave), J13 should be set to 8421. The board is shipped with a 24.576 MHz crystal/oscillator stuffed at Y1, Y2, and Y3.

CS8421 Input Port	CS8421 Output Port	CS8421 XTI/XTO Clock Source	CS8406 OMCK Clock Source
Master	Slave	CS8416 RMCK	Y3
Slave	Master	CS8416 RMCK, Y1, or Y2	CS8421 MCLK_OUT
Slave	Slave	CS8416 RMCK, Y1, or Y2	Y3

Table 1. Clock Sources

1.5 Clock and Data Headers

The CDB8421 includes headers for input (J8) and output (J11) port clocks and data. These headers can enabled/disabled using S4. When not using these headers, SDIN should be jumpered to SDOUT on both J8 and J11. The pin functions for headers J8 and J11 are shown in Table 7.

The CDB8421 also includes a header for TDM operation (J16). Refer to the CS8421 data sheet for possible TDM configurations [1]. This header can enabled/disabled using J14.

All headers operate at the VL supply, therefore any external circuit connected to these headers should also operate at VL.

1.6 CPLD Board Setup

The CPLD (U2) controls all of the configuration for the CS8421, CS8416, and CS8406. The CPLD decodes switches S1, S2, S3, and S4 and sets the appropriate mode of operation.

Switch S1 controls the master/slave and MCLK/LRCK ratio settings for the CS8421, CS8416, and CS8406. The functions for S1[3:0] are detailed in Table 2.

S1[3:0]	CS8421 Input	CS8421 Output
0000	Slave	Slave
0001	Slave	Master (Master Clock = 128*Fs)
0010	Slave	Master (Master Clock = 256*Fs)
0011	Slave	Master (Master Clock = 384*Fs)
0100	Slave	Master (Master Clock = 512*Fs)
1000	Master (Master Clock = 128*Fs)	Slave
1001	Master (Master Clock = 256*Fs)	Slave
1010	Master (Master Clock = 384*Fs)	Slave
1011	Master (Master Clock = 512*Fs)	Slave

Table 2. Switch S1, Serial Input and Output Master/Slave and Speed Mode Settings



Switch S2 controls the interface format of the CS8406 and the CS8421 output port. The functions for switches S2[3:0] are detailed in Table 3.

S2[3:0]	CS8421 Output Configuration
0000	I2S 16-bit Data
0001	I2S 20-bit Data
0010	I2S 24-bit Data
0011	I2S 32-bit Data
0100	Left Justified 16-bit Data
0101	Left Justified 20-bit Data
0110	Left Justified 24-bit Data
0111	Left Justified 32-bit Data
1000	Right Justified 16-bit Data
1001	Right Justified 20-bit Data
1010	Right Justified 24-bit Data
1011	Right Justified 32-bit Data
1100	TDM Mode, 16-bit Data
1101	TDM Mode, 20-bit Data
1110	TDM Mode, 24-bit Data
1111	TDM Mode, 32-bit Data

Table 3. Switch S2, Serial Output Formats

Switch S3 controls the interface format of the CS8416 and the CS8421 input port. The functions for switches S3[2:0] are detailed in Table 4.

\$3[2:0]	CS8421 Output Configuration
000	I2S up to 32-bit Data
001	Left Justified up to 32-bit Data
010	Right Justified 16-bit Data
011	Right Justified 20-bit Data
100	Right Justified 24-bit Data
101	Right Justified 32-bit Data
110	Left Justified 24-bit Data

Table 4. Switch S3, Serial Input Formats



Switch S4 allows any of the PCM clocks/data to be turned off, selection between the OPTI-CAL and COAXIAL S/PDIF inputs, bypassing the CS8421 sample rate converter, and turning off the CS8421 MCLK_OUT signal. To input and output S/PDIF to and from the CS8421, the switches labeled 8416_PCM, 8421_INPUT_PCM, 8421_OUTPUT_PCM, and 8406_PCM should all be set in the CLOSED position. The functions for switches S4[6:0] are detailed in Table 5.

Switch Name	OPEN	CLOSED
8416_PCM	Inhibits Clock I/O and Data Output from CS8416 to Header J8	Allows Clock I/O and Data Output from CS8416 to Header J8
8421_INPUT_PCM	Inhibits Clock I/O and Data Input from Header J8 to CS8421	Allows Clock I/O and Data Input from Header J8 to CS8421
8421_OUPUT_PCM	Inhibits Clock I/O and Data Output from CS8421 to Header J11	Allows Clock I/O and Data Output from CS8421 to Header J11
8406_PCM	Inhibits Clock I/O and Data Output from Header J11 to CS8406	Allows Clock I/O and Data Output from Header J11 to CS8406
8416_RXSEL	Selects Coaxial Connector (J5) for S/PDIF Input	Selects Optical Receiver (J12) for S/PDIF Input
8421_BYPASS	Selects CS8421 SRC Bypass Mode (no sample rate conversion)	Selects CS8421 SRC Active Mode
8421_MCLK_OUT	CS8421 MCLK_OUT Pin Held Low	CS8421 MCLK_OUT Pin Active

Table 5. Switch S4, Board Setup

NOTE: The reset button must be pressed before a new mode of operation takes affect.

Some speed modes and switch combinations are not compatible with the CS8416, CS8421, or the CS8406. LED's D4, D5, and D7 indicate that a switch setting is not compatible with the corresponding part.

1.7 Power

Power must be supplied to the evaluation board through the +5.0 V binding post (J1). On-board regulators supply +3.3 V and +2.5 V to the rest of the board. Jumper J3 sets the VL supply of the CS8416, CS8421, and CS8406 to either +3.3 V or +5.0 V. All voltage inputs must be referenced to the single black banana-type ground connector (J2).

WARNING: Please refer to the CS8421 data sheet for allowable voltage levels.

1.8 Grounding and Power Supply Decoupling

The CS8421 requires careful attention to power supply and grounding arrangements to optimize performance. Figure 1 provides an overview of the connections to the CS8421, Figure 10 shows the component placement, Figure 11 shows the top layout, and Figure 12 shows the bottom layout. The decoupling capacitors are located as close to the CS8421 as possible. Extensive use of ground plane fill in the evaluation board yields large reductions in radiated noise.



CONNECTOR	Reference Designator	INPUT/OUTPUT	SIGNAL PRESENT
+5V	J1	Input	+5.0 V Power Supply
GND	J2	Input	Ground Reference
VL	J3	Input	+3.3 V to +5.0 V Variable Power Supply for VD
COAX IN	J5	Input	CS8416 digital audio input via coaxial cable
OPTICAL IN	J12	Input	CS8416 digital audio input via optical cable
COAX OUT	J6	Output	CS8406 digital audio output via coaxial cable
OPTICAL OUT	J15	Output	CS8406 digital audio output via optical cable
PCM Headers	J8	Input/Output	I/O for PCM Clocks & Data
TDM Header	J11 J16	Input/Output	I/O for TDM Clocks & Data

Table 6. System Connections

PIN	SIGNAL
1	Master Clock
2	Serial Bit Clock
3	Left-Right (Word) Clock
4	Serial Data (In for J8, Out for J11)
5	Serial Data (Out for J8, In for J11)
6-10	Ground

Table 7. Header Connections (J8 and J11)

2. BLOCK DIAGRAM

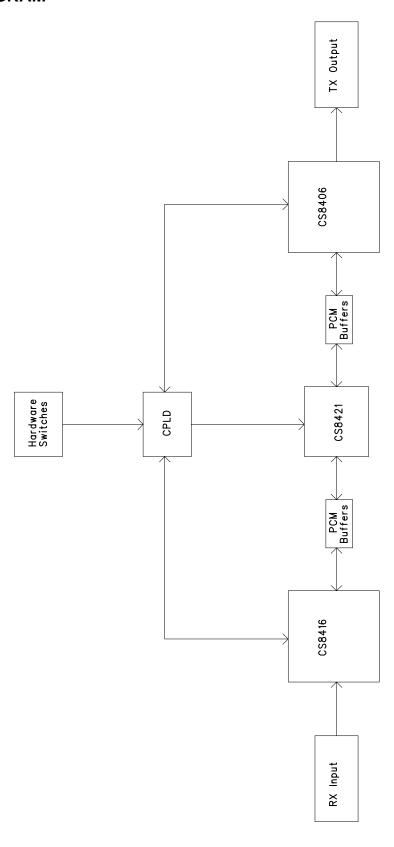
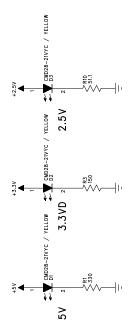


Figure 1. Block Diagram

3. SCHEMATICS



STANDOFFS

\(\times\) WHI \(\times\) WH4

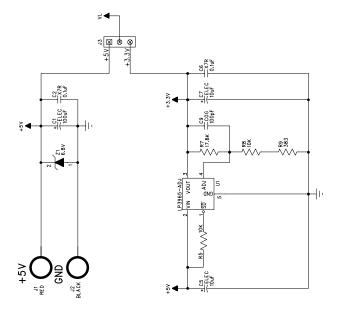
\(\times\) WH2 \(\times\) WH5

\(\times\) WH5 \(\times\) WH6

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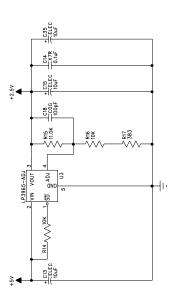


Figure 2. Power

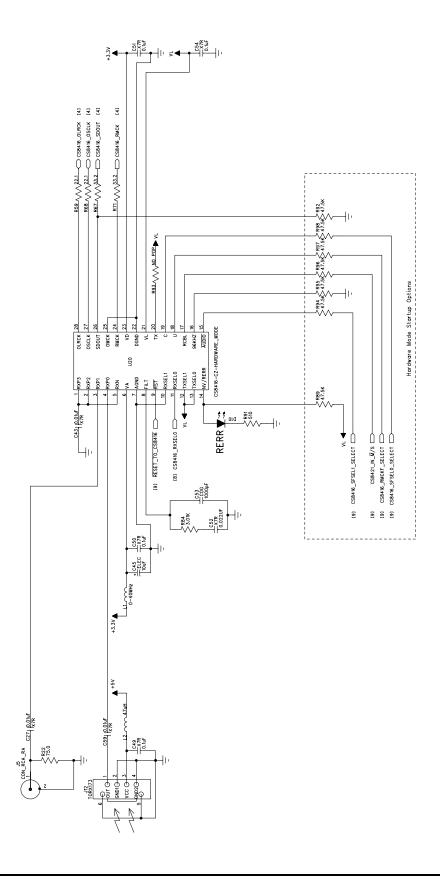


Figure 3. CS8416



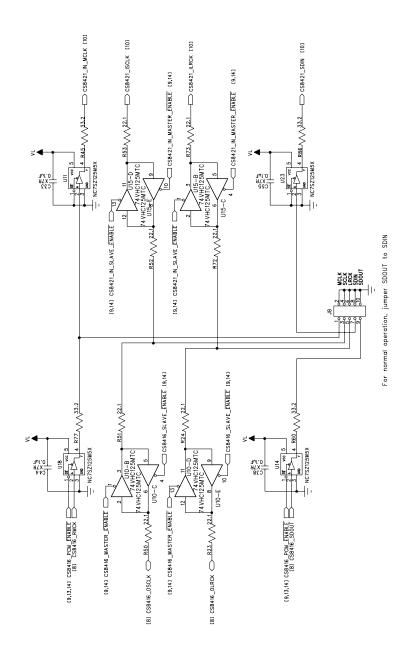
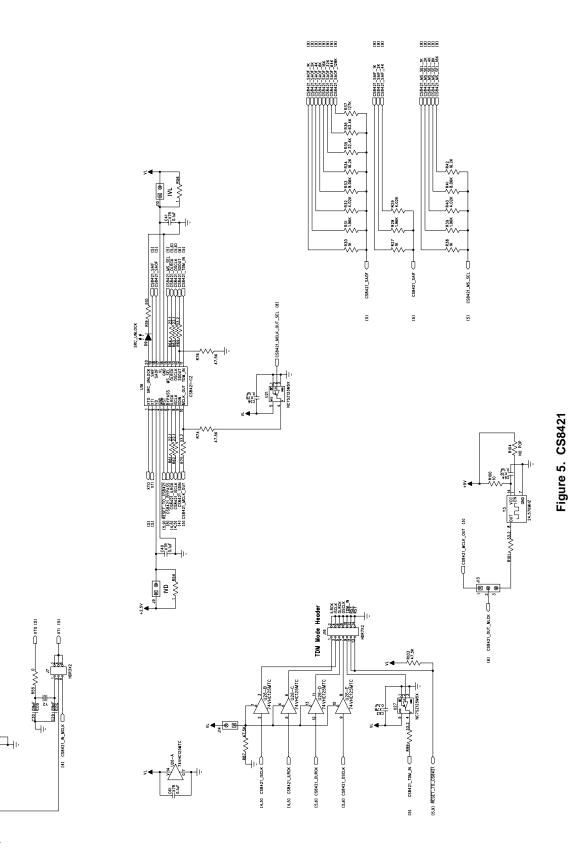


Figure 4. CS8416 to CS8421





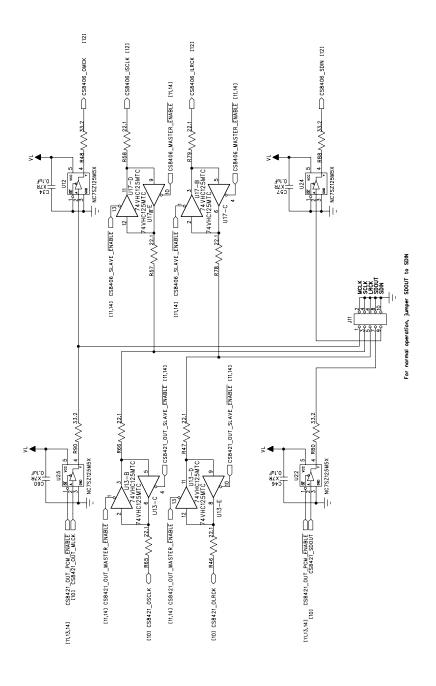
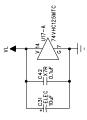


Figure 6. CS8421 to CS8406





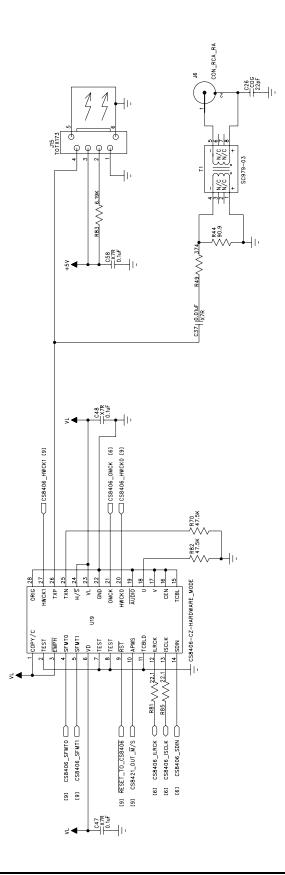


Figure 7. CS8406



Right Justified 20-bit Data Right Justified 16-bit Data

Left Justified 24-bit Data

Left Justified 32-bit Data

000

5 5 5 101 을 둳 皇 Ē

switch settings are reserved

All other

Left Justified 16-bit Data Left Justified 20-bit Data

010

910 010

90

I2S 24-bit Data I2S 32-bit Data

12S 20-bit Data 12S 16-bit Data

000 000 90 Right Justified 24-bit Data Right Justified 32-bit Data

TDM Mode 20-bit Data TDM Mode 24-bit Data TDM Mode 32-bit Data

TDM Mode 16-bit Data

CS8421 SAL Innut

CS8421 SAI Output Port Options (S2) SAOF13:01 CSB421 Output Port Configuration

CS8421 SAI Input Port Options (S	SAIF[2:0] CS8421 input Port Configuration	000 12S up to 32-bit Data	001 Left Justified up to 32-bit Da	010 Right Justified 16-bit Data	100 Right Justified 20-bit Data	101 Right Justified 24-bit Data	110 Right Justified 32-bit Data	All other switch settings are reserved	
(S1)									
Select	tput		128*Fs)	56*Fs)	34*Fs)	2*Fs)			
	8			.73	8	<u>5</u>			
Ratio	CS8421 Ou	Slave	Master (128*Fs)	Master (256*Fs)	Master (384*Fs)	Master (512*Fs)	Slave	Slave	
t M/S & Ratio	21 Input CSB421 Output						sr (128*Fs) Slave	ar (256*Fs) Slave	
CS8421 SAI Port M/S & Ratio Select (S1)	MS_SEL[3:0] CS8421 Input CS8421 Ou	Slave	Slave Master (1	Slave Master (2	Slave Master (35	Slave Master (51	Master (128*Fs) Slave	Master (256*Fs) Slave	

Master (128*Fs) Slave Master (256*Fs) Slave Master (384*Fs) Slave Master (512*Fs) Slave

000 5 101

_									
S8421 SAI Input Port Options (S3)	CS8421 Input Port Configuration	I2S up to 32-bit Data	Left Justified up to 32-bit Data	Right Justified 16—bit Data	Right Justified 20—bit Data	Right Justified 24-bit Data	Right Justified 32—bit Data	All other switch settings are reserved	
58421	SAIFT2:03	000	100	010	100	101	110	All other s	

1 S2 0 SA0F3 1 53 0 WH 8449 6 SAF2 5 SAF1 4 SAF1 CS8421_SA0F3 CS8421_SA0F2 CS8421_SA0F2 CS8421_SA0F0 (4,9) CS6470 POU FINANCIO (6,9) SCRAFO POU F CSB421_SAIF2 CSB421_SAIF1 CSB421_SAIF0 CSB421_MS_SEL3 CSB421_MS_SEL2 CSB421_MS_SEL1 CSB421_MS_SEL0

5555

666

5555

PCM IN/OUT PCM IN/OUT PCM IN/OUT PCM IN/OUT SRC ACTIVE OPTICAL CLOSED 8 BYPASS SRC PCM OFF PCM OFF PCM OFF PCM OFF COAXIAL OPEN PFF BOARD SETUP (S4) 8421_OUTPUT_PCM 8421_INPUT_PCM 8421_MCLK_0UT 8421_BYPASS 8416_RXSEL 8406_PCM

Figure 8. Mode Switches

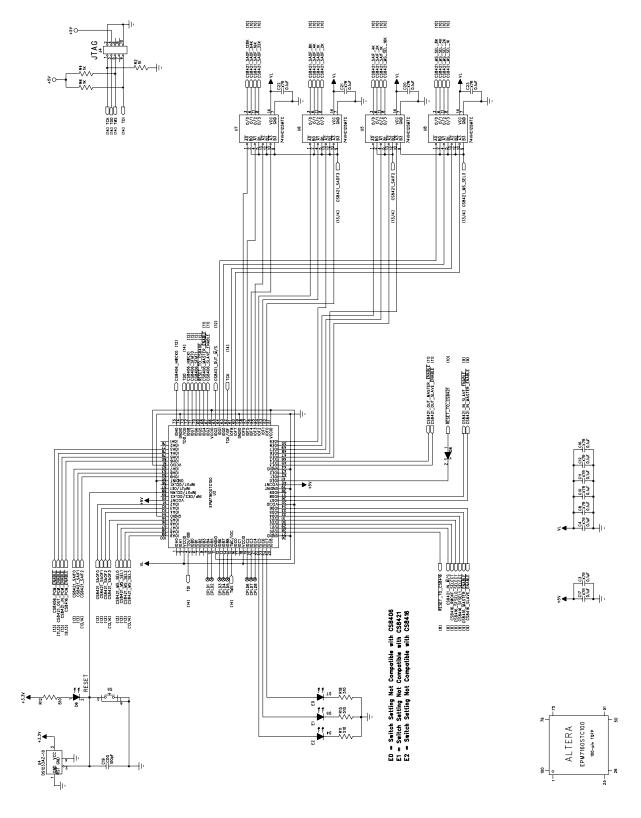
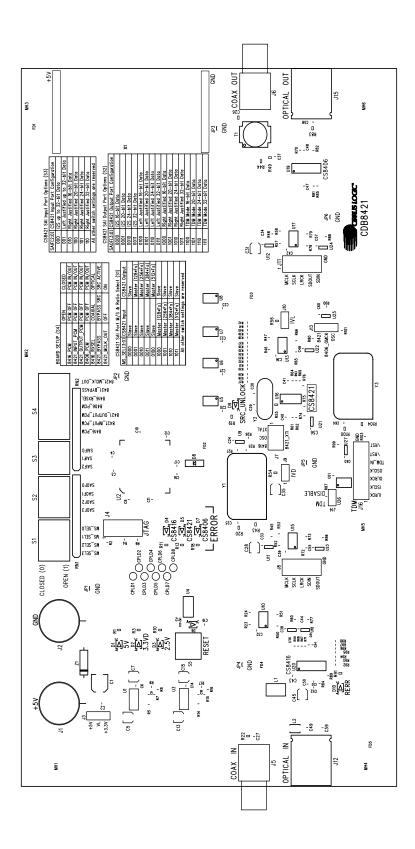


Figure 9. CPLD

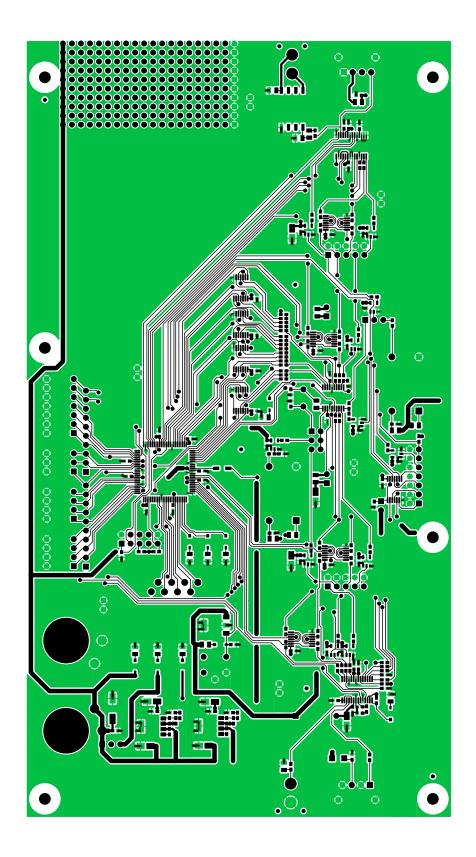


4. LAYOUT



DS641DB3 17







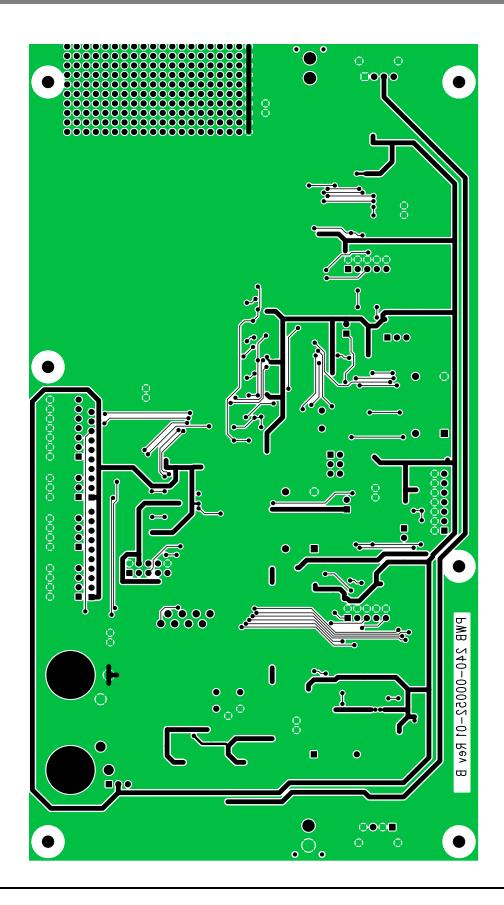


Figure 12



5. APPENDIX A: CS8406 TCBL CONNECTION FOR THE CDB8421 REV. A

Pin 15 of U19 on the CDB8421 Rev. A has been lifted. This eliminates the connection to the TCBL pin on the CS8406 part. The pin should remain lifted and no connection to the pin should be reestablished for the board to operate properly. Changes have been made to CDB8421 Rev. B boards so that the pin need not be lifted.



6. REFERENCES

- [1] CS8421 32-bit, 192 kHz, Asynchronous, Stereo Sample Rate Converter web page: http://www.cirrus.com/en/products/pro/detail/P1082.html
- [2] CS8406 192 kHz Digital Audio Transmitter web page: http://www.cirrus.com/en/products/pro/detail/P1009.html
- [3] **CS8416 192 kHz Digital Audio Receiver web page:** http://www.cirrus.com/en/products/pro/detail/P1005.html



7. REVISION HISTORY

Release	Date	Changes
DB1	October 2004	1st Release
DB2	November 2004	Corrected figure caption on page 10.
DB3	November 2004	2nd Release -Updated "Schematics" on page 9 and "Layout" on page 17Updated "References" on page 21.

Table 8. Revision History

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