

## Evaluation Board for CS4812

### Features

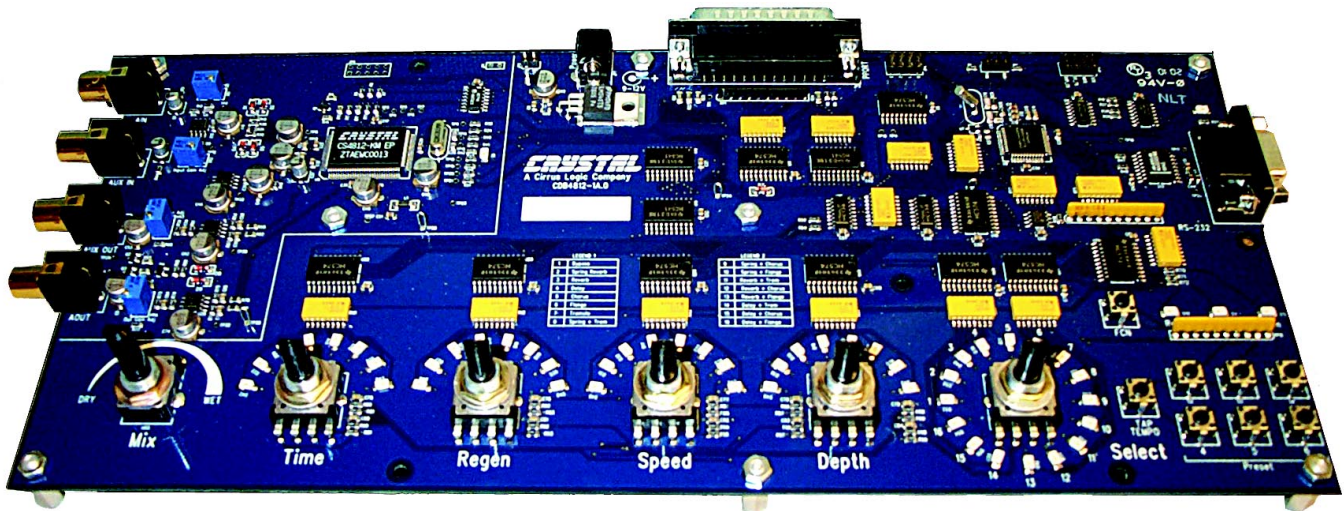
- Evaluation Platform for the CS4812 Single Chip Multi-Effects Processor
- DSP Boots from on-board microcontroller or from PC
- Selection of up to 6 User Presets
- Selection of 16 different Factory Presets
- Real-time adjustable parameter control
- On-Board Hardware Wet/Dry Mix Control
- User Adjustable Input and Output Gain

### Description

The CDB4812 is a stand-alone demonstration platform for the CS4812 multi-effects processor system-on-a-chip. The board is designed to showcase musical effects processing applications including spring reverb, digital reverb, delay, chorus, flange, and tremolo effects. The on-board microcontroller allows the user to change parameters on the DSP in real-time. Also, a PC GUI, connected from a PC parallel port, can be used for more thorough control of the DSP's parameters. Parameter levels are shown with LED rings around the rotary encoders which are used for parameter and preset control. The user can select from 16 factory presets, and store up to 6 user presets. All presets are stored by the microcontroller in an external serial EEPROM.

### ORDERING INFORMATION

CDB4812



### Preliminary Product Information

This document contains information for a new product. Cirrus Logic reserves the right to modify this product without notice.

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## 1. CDB4812 SYSTEM OVERVIEW

The CDB4812 is a complete, stand-alone digital signal processing (DSP) system based on the CS4812 fixed function, multi-effects audio processor. The CS4812 contains an on-chip analog-to-digital converter (ADC), digital-to-analog converter (DAC), and fixed function DSP core with a large amount of on-chip RAM. The DSP functionality (changing effects) is controlled during runtime by an on-board microcontroller. An analog audio mixer adds the processed signal to the input so that the user can vary the amount of the effect applied at the output. The user can also set the gain of the analog input and output to optimize the interface with line-level audio equipment.

## 2. DIGITAL SIGNAL PROCESSOR

The DSP program is loaded from the microcontroller at reset (or from the PC GUI). In this application, the micro control port uses SPI control format to communicate with the DSP. All of the various parameters that can be controlled during run-time are messaged into the DSP from the host microcontroller (or PC).

The *CS4812 Data Sheet* and its associated application note, AN195, have details on the DSP and the guitar effects application code. Other codes may become available, please check the Cirrus Logic web site (<http://www.cirrus.com>) for availability.

## 3. ANALOG INPUT

The analog input to the on-chip ADC (J1/AIN) is single-ended, with an adjustable voltage gain of -60 to +26 dB. Adjusting the 12-turn Input Gain Adj potentiometer VR1 clockwise will increase the input gain. For best signal-to-noise performance the input gain should be increased until just before audible clipping is encountered with a maximum level input signal. The full scale input of the ADC (driven single-ended) is 1.77V RMS (5 V p-p). The ADC input signal is anti-aliased with a passive filter,  $F_c = 480$  kHz, as shown in the schematic dia-

gram of [Figure 1 on page 5](#). The ADC input is protected against overvoltage by diodes D1 and D2.

## 4. ANALOG OUTPUT

The processed output signal is mixed with the amplified input signal with potentiometer VR5 (Mix). Turning Mix clockwise increases the amount of the processed (wet) signal that appears at the output. The mixed output is then buffered with an output stage that has a variable gain of -60 to +6 dB adjusted via 12-turn potentiometer VR4 (Out Gain Adj). Turning the Out Gain Adj clockwise increases the output gain. The best signal-to-noise ratio is obtained when the full scale output of the CDB4812 matches the full scale (non-clipped) amplitude capabilities of the downstream circuitry (ideally 5 V p-p or 1.77 V RMS). The noise floor will increase when the gain of the output buffer is greater than one.

The differential analog output from the CS4812 DAC is buffered with a 2-pole active butterworth filter U2A,  $F_c = 16$  kHz,  $A_v = 0.83$  V/V. The purpose of the filter is to convert the output to single ended prior to mixing, attenuate out-of-band noise generated by the DAC, and limit the signal swing to 5 V p-p.

Q3 acts as a shunt to attenuate any voltage transients that may occur during power up/down. Q3 is controlled by a digital output pin (PIO3) on the CS4812 that is asserted at power-up and de-asserted after the DSP has booted.

## 5. CONTROL

When using the CDB4812 without PC control, the microcontroller on the board will be monitoring the rotary encoders and switches for any input from the user. If the select knob is rotated or a user preset switch is selected, this preset is retrieved from EEPROM and then sent to the DSP. If the user has turned a parameter encoder (the Time, Regen, Speed, Depth, and Select knobs), the microcontrol-

ler will examine which parameter on the DSP needs to be changed, and send the updated value to the DSP. [“APPENDIX B: FACTORY PRESET DEFAULT SETTINGS” ON PAGE 13](#) details in tabular form how the various encoders map to the factory presets default values. The microcontroller then updates the LED ring around the appropriate encoder to update the user of a change in value.

The user preset buttons can be used to store presets into the EEPROM on the CDB4812. After the desired preset and dial values are selected, holding down a user preset button for 5 seconds will save the current effects setup. This setup can be recalled by pressing the same user preset button. The board will indicate when the preset is saved by briefly flashing the LED ring around the Select Dial.

The DSP on this board can also be controlled with a PC parallel port. A Graphical User Interface (GUI) program for the PC is used to change parameters in the DSP. The GUI can access all of the parameters available on the DSP, whereas the onboard controls can only access 4 parameters at a time. Details on how to configure the board for PC parallel port control are contained in [“APPENDIX C: CONFIGURING THE CDB4812 FOR PC GUI CONTROL” ON PAGE 14](#).

## 6. POWER SUPPLY

Power is attached to the board through a 2.5 mm power connector JP7, positive is the center contact. An unregulated 9 VDC, 0.5 A wall transformer is supplied with the board.

An on-board voltage regulator supplies 200 mA@5 V to the system from an 8 to 12 VDC input. An external power resistor can be used to limit the input voltage to the board in applications where a 12 V supply is not available.

## 7. LAYOUT NOTES

The reference filter capacitors C32 and C37 must be kept as close as practical to the device, the CM-FILT+ signal trace (pin 93) and CMFILT- ground return trace (pin 94) should be on the top side of the board and as short as possible. Keep other traces away from this node, as any noise coupled into the CMFILT+ pin will appear at the DAC outputs with little or no attenuation.

Mount the 0.047 uf surface mount power supply decoupling capacitors as close to the device as possible. Again, keep the traces to these capacitors and the device supply pins and ground pins on the top side of the board and as short as practical.

The anti-aliasing filter capacitors for the ADC should be mounted as close to the device as practical. The AC shorting capacitors on the ADC input should also be close to the device. All digital traces should be kept away from the analog input and output sections of the board.

A ground fill is used on both top and bottom layers to minimize noise coupling and ground trace impedance. Separate analog and digital grounds are not needed and should not be used.

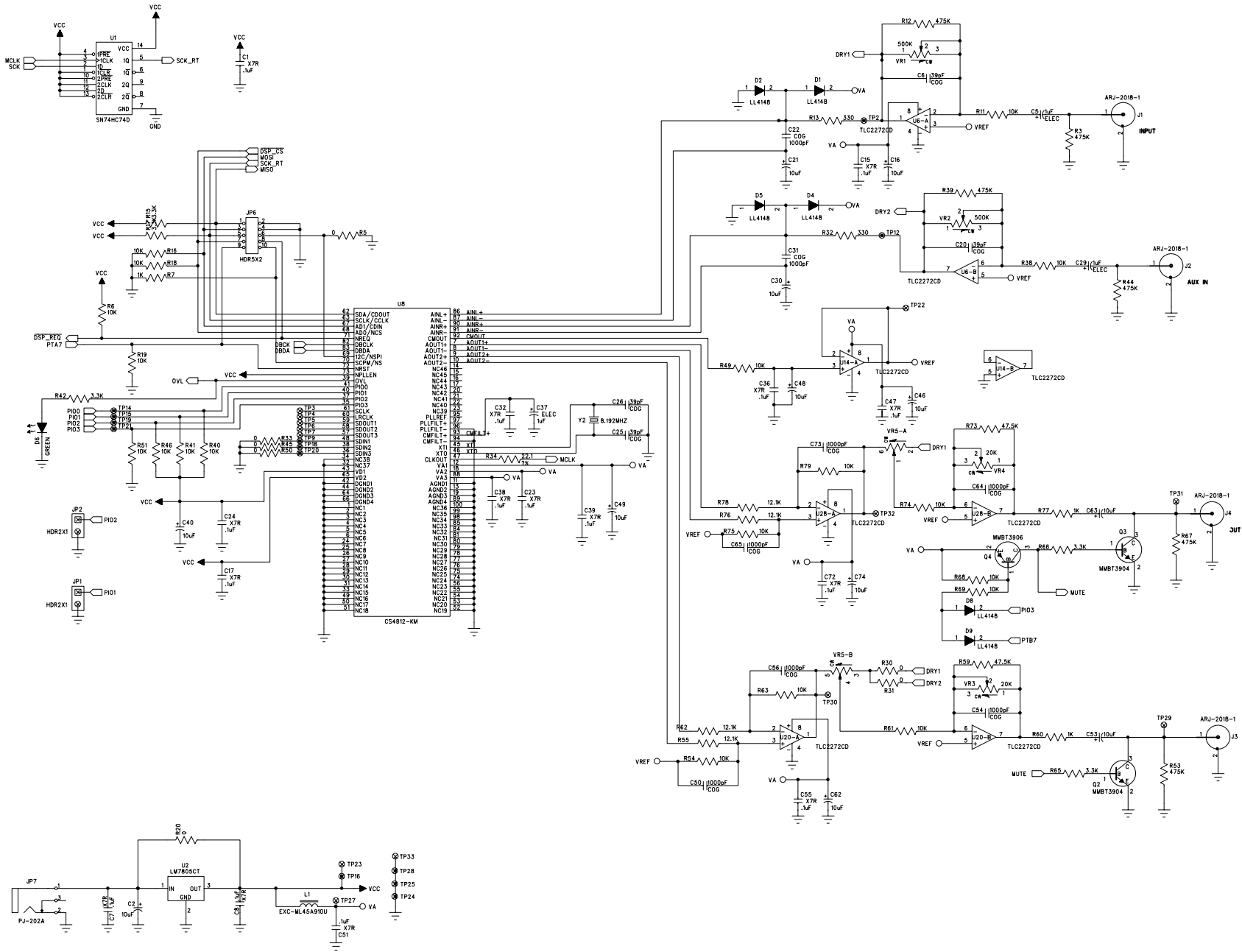


Figure 1. DSP Schematic



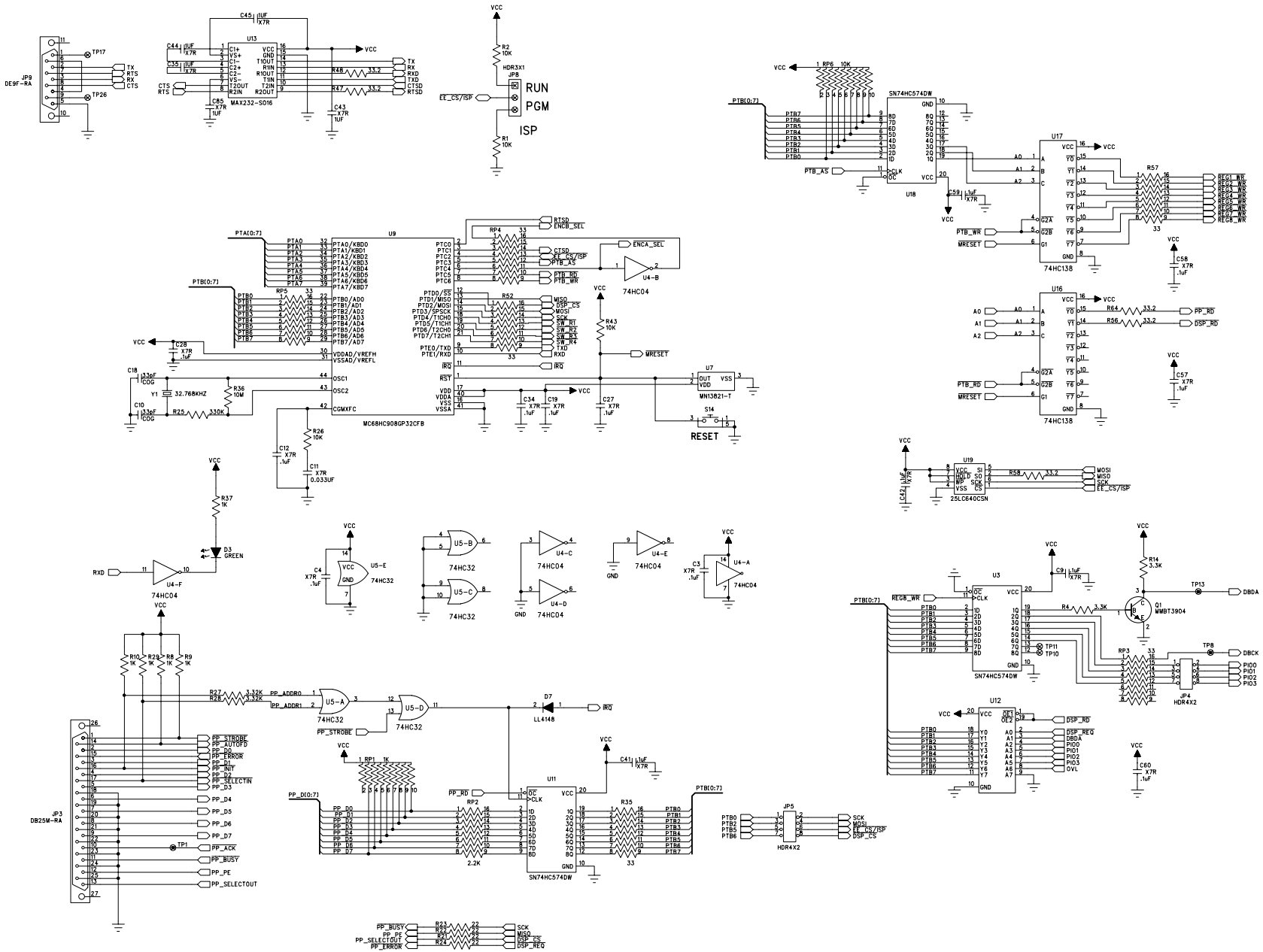


Figure 2. Microcontroller

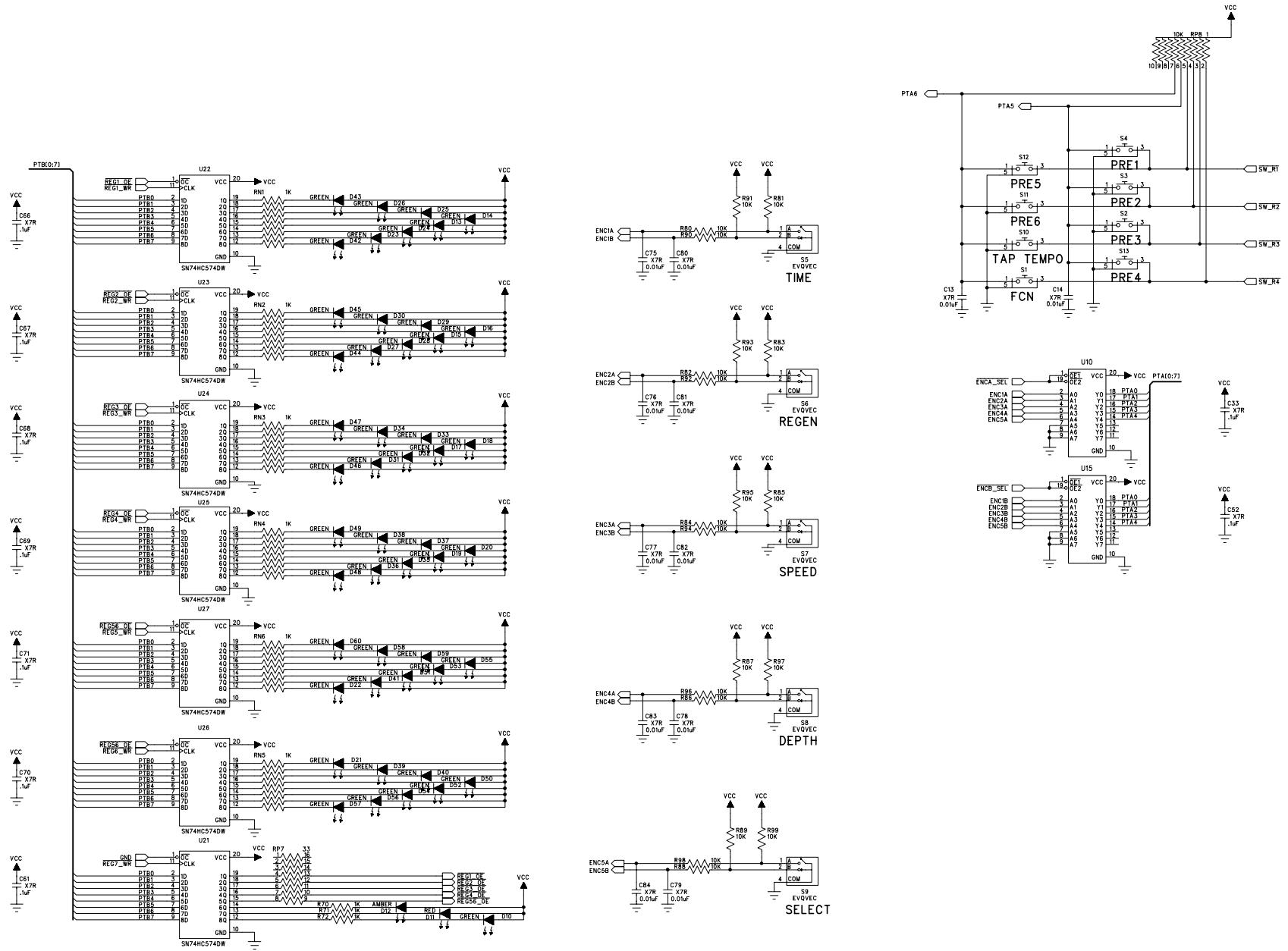


Figure 3. Rotary Encoder/LED Ring Schematic



## 8. CDB4812 BILL OF MATERIALS

Item	Qty	Reference	Value	Manufacturer	Part Number	Description	PCB Decal
1	4	J1-4	ARJ-2018-1	A/D Electronics	ARJ-2018-1	RCA Jack - Right Angle, Gold Plated	ARJ-2018-1
2	1	JP7	PJ-202A	Cui Stack	PJ-202A	Connector, DC Power Jack	CON_PJ-202A
3	1	C22	1000pF	Kemet	C0805C102J5GAC	CAP, 1000pF, COG, 0805, 50V, 5%	CSN_0805
4	7	C31 C50 C54 C56 C64-65 C73	1000pF	Kemet	C0805C102K5GAC	CAP, 1000pF, COG, 0805, 50V, 10%	CSN_0805
5	4	C6 C20 C25-26	39pF	Kemet	C0805C390J5GAC	CAP, 39PF, COG, 0805, 50V, 5%	CSN_0805
6	12	C13-14 C75-84	0.01uF	Kemet	C0805C103K5RAC	CAP, 0.01UF, X7R, 0805, 50V, 10%	CSN_0805
7	38	C1 C3-4 C7-9 C12 C15 C17 C19 C23-24 C27-28 C32-34 C36 C38-39 C41-42 C47 C51-52 C55 C57-61 C66-72	.1uF	Kemet	C0805C104K5RAC	CAP, 0.1UF, X7R, 0805, 50V, 10%	CSN_0805
8	4	C35 C43-45	1uf	Kemet	C0805C105K8RAC	CAP, 1UF, X7R, 0805, 10V, 10%	CSN_0805
9	1	C11	0.033UF	Kemet	C0805C333J5RAC	CAP, 0.033UF, X7R, 0805, 50V, 5%	CSN_0805
10	2	C10 C18	33pF	Kemet	C1206C330J5GAC	CAP, 33PF, COG, 1206, 50V, 5%	CSN_1206
11	3	C5 C29 C37	1uF	Panasonic	ECE-V1HA010R	CAP, 1uF, ELEC, VA Series, SMT Case-B, 50V, 20%	CSP_ELEC_170SQ
12	12	C2 C16 C21 C30 C40 C46 C48-49 C53 C62-63 C74	10uF	Panasonic	ECE-V1EA100P	CAP, 10uF, Elec, VA Series, SMT Case-C, 25V, 20%	CSP_ELEC_208SQ
13	1	JP3	DB25-M	Adam Tech	DB25-PL-24	Conn, DB25, Male Pins, Rt. Angle	DB25M-RA
14	1	JP9		Adam Tech	DE09-SL-24	Conn, DE9, Female Sockets, Rt. Angle	DE9F-RA
15	2	JP1-2	HDR2X1	Samtec	TSW-102-07-G-S	Header, 2X1, .1"CTRS, .025"SQ Pins	HDR2X1
16	1	JP8		Samtec	TSW-103-07-G-S	Stake Header, 0.1" CTRS, 3X1	HDR3
17	2	JP4-5		Samtec	TSW-104-07-G-D	Stake Header, .1 CTRS, 4X2	HDR4X2
18	1	JP6		Samtec	TSW-105-07-G-D	Stake Header, 5X2, .1" Center, Gold	HDR5X2
19	1	L1	BEAD	Panasonic	EXC-ML45A910U	Ferrite Bead, 1806	IND_1806
20	1	D12	AMBER	Panasonic	LN1451C	LED, SMT 3216, Amber	LED_PANA 3216

Item	Qty	Reference	Value	Manufacturer	Part Number	Description	PCB Decal
21	51	D3 D6 D10 D13-60	GREEN	Panasonic	LN1351C	LED, SMT 3216, Green	LED_PANA 3216
22	1	D11	RED	Panasonic	LN1251C	LED, SMT 3216, Red	LED_PANA 3216
23	5	S5-9	EVQVEC	Panasonic	EVQ-VECF0224B	Encoder, 24 Pulse, Vertical, No Bushing	PANA- EVQVEC
24	2	VR3-4	20K	Bourns	3266W-203	Pot, 20K, LIN, 10TURN, TOP-ADJ, TH	POT-BRNS- 3266W
25	2	VR1-2	500K	Bourns	3266W-504	Pot, 500K, LIN, 10TURN, TOP-ADJ, TH	POT-BRNS- 3266W
26	1	VR5	20K	Panasonic	EVJ-Y91F03B203	Pot, Dual, LIN, 1TURN, 20K	POT-PANA- EVJY9
27	1	U8	CS4812- KM	Crystal Semi	CS4812-KM	Stereo DSP / CODEC, QFP100-14X20	QFP100- 14X20
28	1	U9	MC68HC9 08GP32CF B	Motorola	MC68HC908GP32C FB	Microcontroller, QFP-44 10X10	QFP44- 10X10
29	7	R5 R20 R30-31 R33 R45 R50	0	Dale	CRCW0805000FT	Res, 0-OHM, 0805	RES_0805
30	11	R7-10 R29 R37 R60 R70-72 R77	1K	Dale	CRCW08051001F	Res, 1K, 0805, 1/10W, 1%. 100ppm	RES_0805
31	43	R1-2 R6 R11 R16 R18-19 R26 R38 R40-41 R43 R46 R49 R51 R54 R61 R63 R68-69 R74-75 R79- 99	10K	Dale	CRCW08051002F	Res, 10K, 0805, 1/10W, 1%. 100ppm	RES_0805
32	4	R55 R62 R76 R78	12.1K	Dale	CRCW08051212F	Res, 12.1K, 0805, 1/10W, 1%. 100ppm	RES_0805
33	1	R34	22.1	Dale	CRCW080522R1F	Res, 22.1 OHMS, 0805, 1/10W, 1%. 100ppm	RES_0805
34	2	R13 R32	330	Dale	CRCW12063300F	Res, 330, 0805, 1/10W, 1%, 100ppm	RES_0805
35	7	R4 R14-15 R17 R42 R65-66	3.3K	Dale	CRCW0805332J	Res, 3.3K, 0805, 1/8W, 5%, 200ppm	RES_0805
36	2	R27-28	3.32K	Dale	CRCW08053321F	Res, 3.32K, 0805, 1/10W, 1%. 100ppm	RES_0805

Item	Qty	Reference	Value	Manufacturer	Part Number	Description	PCB Decal
37	5	R47-48 R56 R58 R64	33.2	Dale	CRCW080533R2F	Res, 33.2 OHMS, 0805, 1/10W, 1%. 100ppm	RES_0805
38	2	R59 R73	47.5K	Dale	CRCW08054752F	Res, 47.5K, 0805, 1/10W, 1%. 100ppm	RES_0805
39	6	R3 R12 R39 R44 R53 R67	475K	Dale	CRCW08054753F	Res, 475K, 0805, 1/10W, 1%. 100ppm	RES_0805
40	1	R36	10M	Dale	CRCW1206106J	Res, 10M, 1206, 1/8W, 5%, 200ppm	RES_1206
41	4	R21-24	22	Dale	CRCW1206220J	Res, 22 OHMS, 1206, 1/8W, 5%, 200ppm	RES_1206
42	1	R25	330K	Dale	CRCW1206334J	Res, 330K, 1206, 1/8W, 5%, 200ppm	RES_1206
43	1	U7	4.4V-4.7V	Panasonic	MN13821-T	IC, Volt Detect, 4.4V N-CH OD, SC59A	SC59A
44	2	RP6 RP8	10K	Bourns	4610X-101-103	Resistor Network, 9 Bussed, SIP10, 10K	SIP10
45	1	RP1	1K	Bourns	4610X-101-102	Resistor Network, 9 Bussed, SIP10, 100K	SIP10
46	1	U4	74HC04	Texas Instruments	SN74HC04D	Hex Inverter, SO14-150	SO14-150
47	1	U5	74HC32	Texas Instruments	SN74HC32D	Quad 2-input Pos-OR Gate, SO14-150	SO14-150
48	1	U1	SN74HC74D	Texas Instruments	SN74HC74D	Dual D-type Flip-flops, SO14-150	SO14-150
49	2	U16-17	74HC138	Texas Instruments	SN74HC138D	3-to-8 Line Decoder/Demux, SO16-150	SO16-150
50	1	RP2	2.2K	Bourns	4816P-001-222	Res Network, 2.2K, 8 Isolated, SO16-220	SO16-220
51	3	R35 R52 R57	33	Bourns	4816P-001-330	Res Network, 33-OHM, 8 Isolated, SO16-220	SO16-220
52	6	RN1-6	1K	Bourns	4816P-001-102	Res Network, 1K, 8 Isolated, SO16-220	SO16-220
53	4	RP3-5 RP7	33	Bourns	4816P-001-330	Res Network, 33 OHM, 8 Isolated, SO16-220	SO16-220
54	1	U13		Texas Instruments	MAX232DW	Dual RS-232 Driver / Receiver	SO16-300
55	3	U10 U12 U15		Texas Instruments	SN74HC541DW	Octal Buffers and Line Drivers, SO20-300	SO20-300
56	10	U3 U11 U18 U21-27	SN74HC574DW	Texas Instruments	SN74HC574DW	IC, Octal D-type Flip-flops, SO20W-300	SO20-300
57	1	U19		Microchip	25LC640CSN	SPI Serial EEPROM, 64K BIT, SO8-150	SO8-150
58	4	U6 U14 U20 U28	TLC2272CD	Texas Instruments	TLC2272CD	IC, Dual Op-amp, Low Noise, Single Supply, SO8	SO8-150

Item	Qty	Reference	Value	Manufacturer	Part Number	Description	PCB Decal
59	7	D1-2 D4-5 D7-9	LL4148	Diodes Inc	LL4148DI	General Purpose Signal Diode, SOD-80	SOD-80
60	1	Q4	MMBT3906	Motorola	MMBT3906LT1	Transistor, PNP, SOT23	SOT23
61	3	Q1-3	MMBT3904	Motorola	MMBT3904LT1	Transistor, NPN, SOT23	SOT23
62	8	S1-4 S10-13	MOM SW	C&K	PTS645TL50	Switch, Momentary, Pushbutton	SW-MOM-C&K
63	1	U2	LM7805CT	National Semiconductor	LM7805CT	Voltage Regulator, Positive, Fixed, 5V, TO-220	TO-220AB
64	33	TP1-33					TP60
65	1	Y1	32.768KHZ	Vishay	XT49S-20-32.768KZ	Crystal, Parallel Cut, 32.768KHZ, 20PF, HC49S	XTL-HC49S
66	1	Y2	8.192MHZ	Vishay	XT49S-20.8.192M	Crystal, Parallel Cut, 8.192MHZ, 20PF, HC49S	XTL-HC49S

## 9. APPENDIX A: MICROCONTROLLER FIRMWARE UPGRADES

The microcontroller for the CDB4812 is in-system programmable through the RS-232 port (DB9 serial connector). To obtain the firmware upgrades, please contact the Cirrus Logic DSP Applications Group. The firmware running on the CDB4812 microcontroller can be upgraded by using the procedure detailed below:

### 9.1 What's Needed for Microcontroller Programming

- PC with available COM port
- DB-9 Serial cable (common COM port cable)
- Terminal software (Microsoft™ Windows HyperTerminal will work)

### 9.2 Programming Procedure

1. With the CDB4812 board powered off, connect the Serial cable from the PC COM port to the Serial Port on the CDB4812
2. Run the Terminal program on the PC and configure as follows:
  - Baud Rate - 115200
  - Data Bits - 8
  - Parity - none
  - Stop Bits - 1
  - Flow Control - none
  - Line Delay - 3ms
3. On the CDB4812 header JP8 labeled MC, place the shunt in the PGM position for Program Mode
4. Connect power to the CDB4812 - on the terminal screen, the following text should appear:  
*HC08 Bootloader Version 1.0*  
  
*Boot>*
5. At the prompt, type w. The following message should appear:  
*Boot>w - Flash erase complete, erase successful*
6. At the next prompt, type p. The following message should appear:  
*Boot>p - waiting ...*
7. In the Terminal program, send the .s19 file as a Text file (using ASCII transfer mode). In HyperTerminal, go to **Transfer** at the top of the window, and choose **Send Text File**. In the file browser, choose the .s19 file to send.
8. Several characters should appear on the screen as the file is transmitted.
9. After sending the firmware file, a success message and a prompt should appear as below:  
*Flash programmed, verified*  
*Boot>*
10. Power off the CDB4812.
11. Place the shunt on the JP8 MC header in the RUN position.
12. Apply power to the CDB4812, the board should be running the new firmware.

**10. APPENDIX B: FACTORY PRESET DEFAULT SETTINGS**

This table describes the default relationship between each factory preset and the parameters that the Time, Regen, Speed, and Depth rotary encoders are assigned to. Also shown are default values of various parameters that the DSP uses for the factory presets (N/A indicates this encoder is not used in this mode).

<b>Preset #</b>	<b>Time Encoder Changes</b>	<b>Regen Encoder Changes</b>	<b>Speed Encoder Changes</b>	<b>Depth Encoder Changes</b>
1	N/A	N/A	N/A	N/A
2	Reverb Time	Reverb Room Size	N/A	N/A
3	Reverb Time	Reverb Room Size	N/A	N/A
4	Delay Time	Delay Regen	N/A	N/A
5	Chorus Delay	Chorus Regen	Chorus Rate	Chorus Depth
6	Chorus Delay	Chorus Regen	Chorus Rate	Chorus Depth
7	N/A	N/A	Tremelo Rate	Tremelo Depth
8	Reverb Time	Reverb Room Size	Tremelo Rate	Tremelo Depth
9	Reverb Time	Chorus Regen	Chorus Rate	Chorus Depth
10	Reverb Time	Chorus Regen	Chorus Rate	Chorus Depth
11	Reverb Time	Reverb Room Size	Tremelo Rate	Tremelo Depth
12	Reverb Time	Chorus Regen	Chorus Rate	Chorus Depth
13	Reverb Time	Chorus Regen	Chorus Rate	Chorus Depth
14	N/A	N/A	Tremelo Rate	Tremelo Depth
15	Delay Time	Delay Regen	Chorus Rate	Chorus Depth
16	Chorus Delay	Chorus Regen	Chorus Rate	Chorus Depth

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## **11. APPENDIX C: CONFIGURING THE CDB4812 FOR PC GUI CONTROL**

The following procedure will allow you to configure the CDB4812 for control via the CDB4816 PC GUI:

1. Use the procedure detailed in Appendix A to download the microcontroller image “pc-gui.s19” to the microcontroller.
2. Remove power from the CDB4812 board.
3. Install shunts across all 4 pairs of pins on J5.
4. Connect the PC parallel port to the CDB4812 with a 25 pin cable (supplied with the kit).
5. Reapply power to the CDB4812.
6. Start the CDB4812 GUI on the PC.

To reconfigure the board for stand-alone operation, use these steps:

1. Remove power from the board.
2. Disconnect the PC from the CDB4812.
3. Remove the shunts on all 4 pairs of pins on J5.
4. Reapply power to the CDB4812.
5. Using the procedure in Appendix A, download the microcontroller image “standalone.s19” to the microcontroller.

**CAUTION** The PC GUI CANNOT be used when the microcontroller is programmed with the stand-alone operation image. In this case, both the microcontroller and the PC will attempt to drive the communication lines to the DSP, and cause bus contention, which can result in damage to the microcontroller and/or the PC parallel port)

• **Notes** •

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SMART  
Analog™