Texas Instruments

TAS3308EVM

Evaluation Module for the TAS3308 Digital Audio Signal Processor

User's Guide

March 2008 — Digital Audio & Video Products

SLEU093

TAS3308EVM

Evaluation Module for the TAS3308 Digital Audio Signal Processor

User's Guide

Literature Number: SLEU093
March 2008

TEXAS INSTRUMENTS

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About This Manual

This manual describes the operation of the TAS3308EVM evaluation module from Texas Instruments.

How to Use This Manual

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Chapter 3 – System Interfaces

Chapter 4 – MSP430

Information About Cautions and Warnings

This manual may contain cautions and warnings.

CAUTION

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

WARNING

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

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 table contains a list of data manuals that have detailed descriptions of the integrated circuits used in the design of the TAS3308EVM. The data manuals can be obtained at the URL http://www.ti.com.

Related Documentation from Texas Instruments

Part Number	Literature Number
TAS3308	TAS3308 Data Manual
TLV1117-33	SLVS561
TPS3825-33	SLVS165

Additional Documentation

1. Graphical Development tool (GDE) for TAS3308 (GDE ver. 1.7 or later)
2. General Application Notes

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Overview

The TAS3308EVM PurePath Digital™ customer evaluation module demonstrates the Digital Audio Processor TAS3308 from Texas Instruments (TI).

TAS3308 is a fully programmable high-performance audio processor. It uses an efficient, custom, multi-instruction programming environment optimized for digital audio processing algorithms. The TAS3308 architecture provides high-quality audio processing by using a 48-bit data path, 28-bit filter coefficients, and a single-cycle 28 × 48-bit multiplier with a 76-bit accumulator. An embedded 8051 microprocessor provides algorithm and data control for the TAS3308. The TAS3308 is the commercial version intended for home audio and other commercial applications.

This is a single board EVM. EVM can be configured with a TAS5601 or similar power stage. This combination will provide complete signal processing and power amplification system solution which includes digital input/output (S/PDIF), analog inputs/outputs, interface to PC and DAP features like digital volume control, input and output mixers, auto mute, equalization, tone controls, loudness, dynamic range compression, surround effects.

The TAS3308 is well suited for inclusion in Digital Televisions, Home Theater Systems, Mini-Component Audio Systems and Pro-Audio systems.

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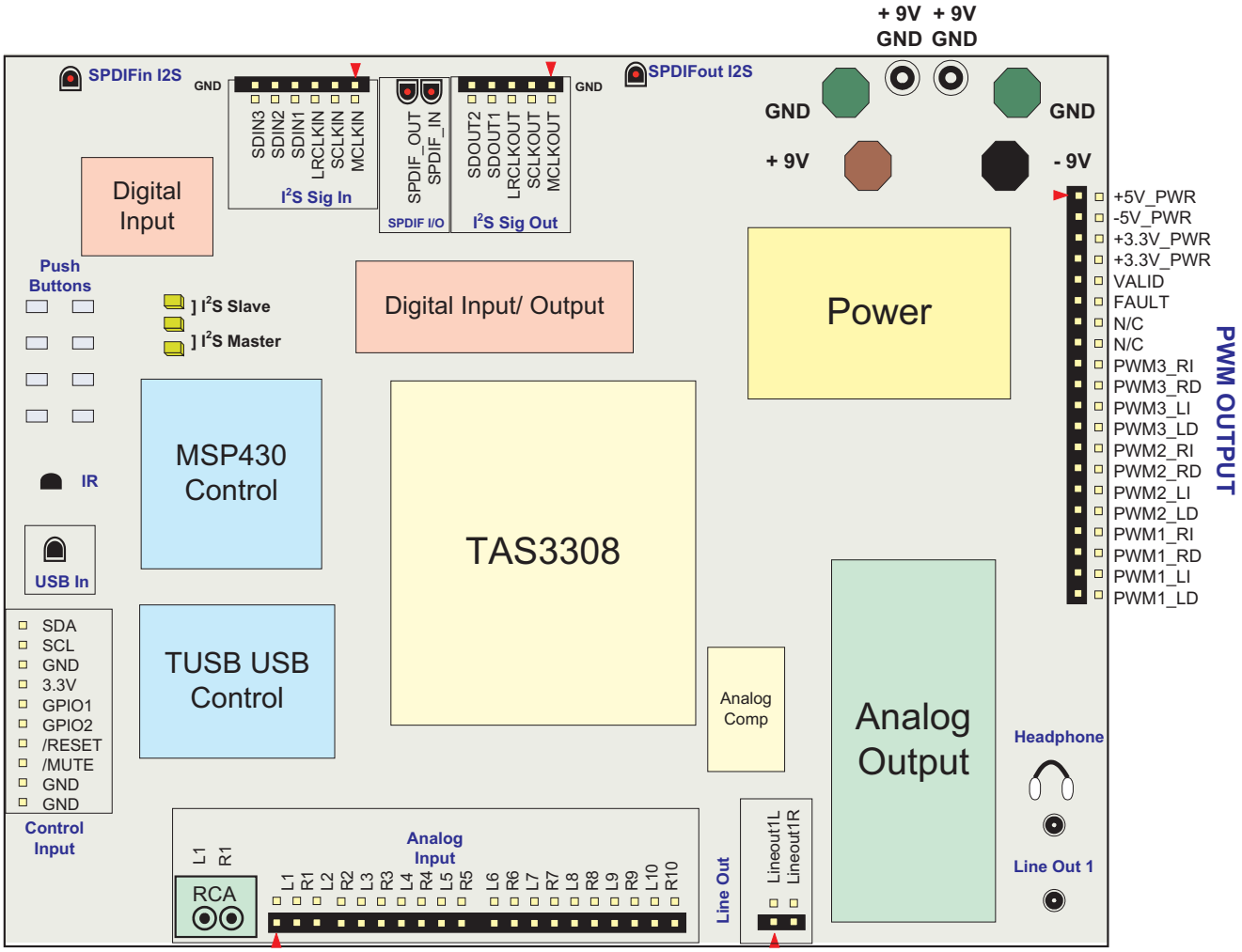
1.1 TAS3308EVM Features

- Socketed EEPROM for download of program and coefficients
- 6-channel discrete I^2S input/4-channel I^2S outputs
- 2-channel SPDIF receiver, optical input, into TAS3308 SDIN1
- 2-channel SPDIF transmitter, optical output from TAS3308 SDOUT1
- 2-channel SPDIF, optical input to TAS3308 SPDIFin
- 2-channel SPDIF, optical output from TAS3308 SDOUT2/SPDIFout
- A 10-input multiplexed ADC input
- PWM DAC stereo line output
- One PWM DAC Headphone output
- One Line output
- USB to PC connection for software control
- MSP430 for Standalone operation
- Double-sided plated-through PCB layout

The primary usage mode of the EVM is to provide a software development platform that receives the control and signal processing flow descriptions from a PC running the PurePath Studio Graphical Environment (GDE) or Integrated Development Environment (IDE) through the USB interface. In this mode of operation, the user will develop a signal processing flow (applications) and components using the PurePath Studio. The resulting programs can be loaded into the EVM EEPROM. The TAS3308 will then load the EEPROM contents and execute the signal processing flows. During execution, many of the TAS3308 signal processing flow parameters can be dynamically changed using the PurePath Studio Graphical development environment. Additional information on using the EVM with the PurePath Studio development environment is included in subsequent sections of this document and in the PurePath Studio online documentation.

The EVM has a Reset Button which resets all of the board logic. A red RESET LED is lit when Reset is active. The EVM also has a Mute button to mute the TAS3308 outputs. The Mute function is automatically activated following a reset. A yellow mute LED is lit when Mute is active.

The EVM also contains a MSP430F2252 controller that can be programmed to provide stand alone operation using the EVM push buttons or an IR remote input. The microcontroller interfaces to the TAS3308 through the I^2C, GPIO, and the Reset control lines. The microcontroller has and IR receiver, eight (8) circuit board pushbuttons and eight (8) LEDs to support user inputs.



TAS3308EVM

Figure 1-1. TAS3308EVM System

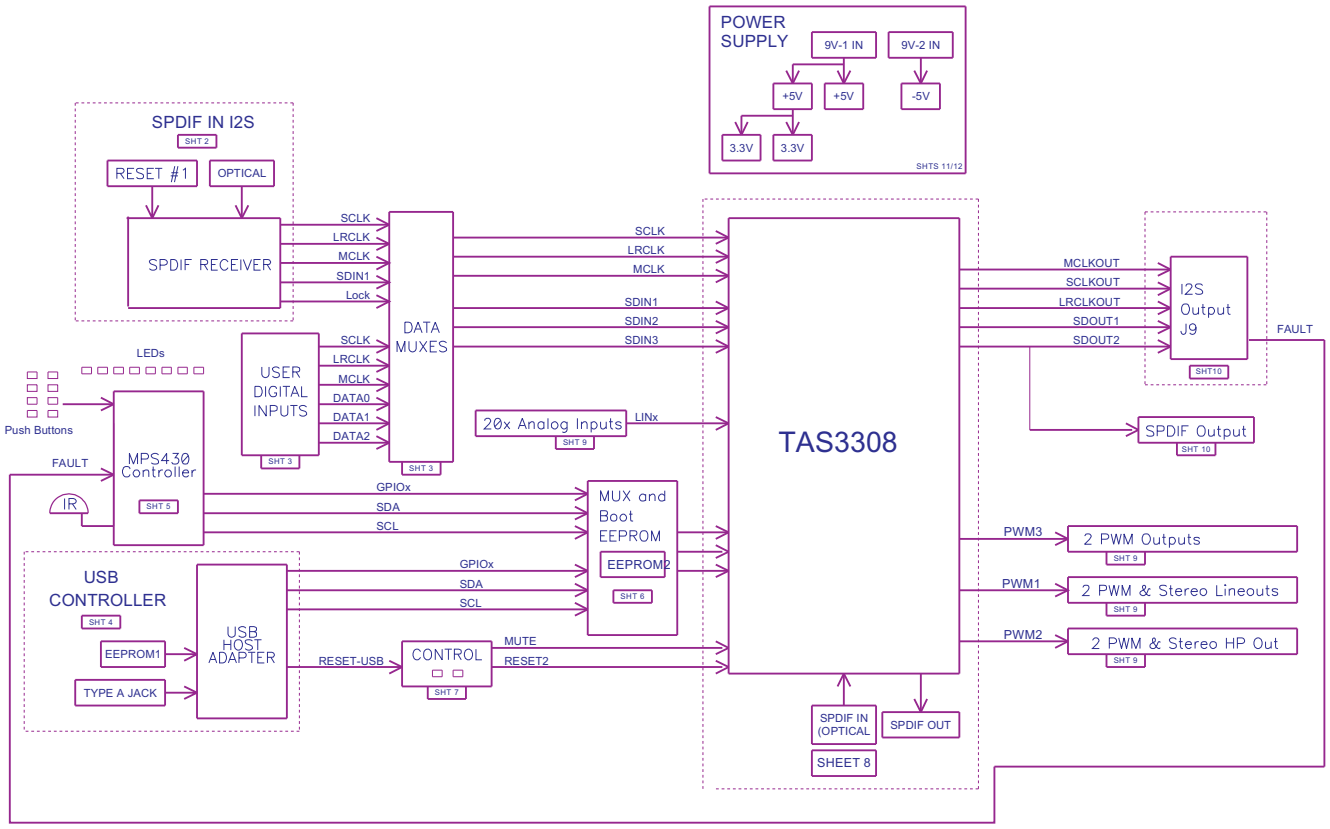


Figure 1-2. TAS3308EVM System

1.2 PCB Component Map

TAS3308EVM physical structure is shown in Figure 1-3.

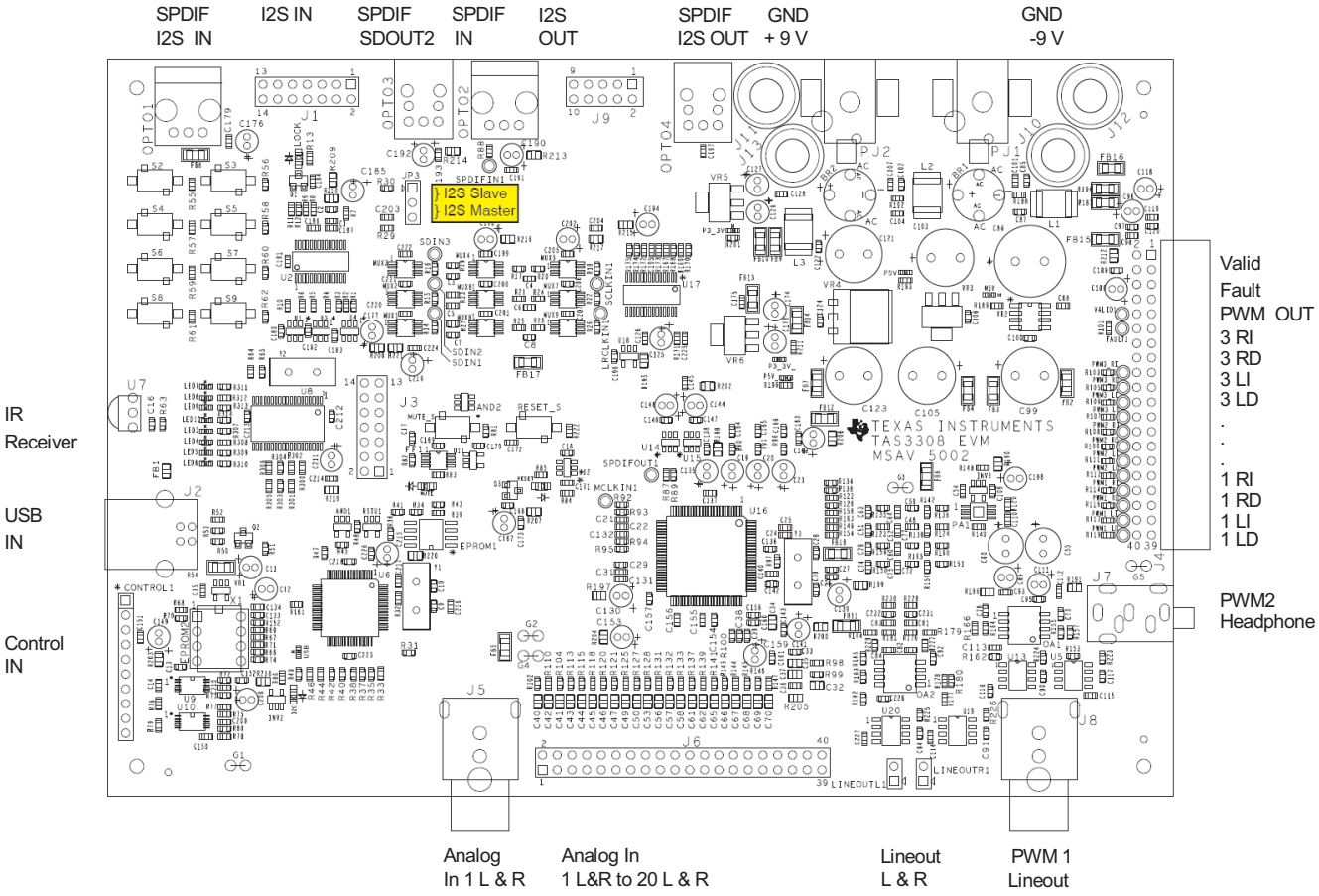


Figure 1-3. TAS3308EVM Component View

Quick Setup Guide

This chapter describes the overall TAS3308EVM board setup, power supply requirements and system interfaces. The chapter provides information regarding handling and unpacking, absolute operating conditions, and a description of the factory default jumper configuration.

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2.1 Electrostatic Discharge Warning

Many of the components on the TAS3308EVM 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.

2.2 Unpacking the EVM

Upon opening the TAS3308EVM package, please check to make sure that the following items are included:

- TAS3308EVM board using one TAS3308DCP (1 pc.)
- PurePath CD-ROM containing data sheets, application reports, user guides, Gerber files, and PC software tools (1 pc.)

If any of these items are missing, please contact the Texas Instruments Product Information Center nearest you to inquire about a replacement.

2.3 Power Supply Setup

The TAS3308EVM is powered via the ±9 V terminals or the 9 V (center hot) power connectors, PJ1 and PJ2. The TAS3308 EVM generates a 5-V, –5-V, and 3.3-V internal supplies that are fed to the TAS3308EVM components.

Set the power supplies to ±9 V. Then turn off the supplies and them to the EVM.

Once the cables are connected, switch on the power supply. Current consumption should be less than shown in Table 2-1, if higher switch off and double check the cabling.

Table 2-1. Recommended Supply Voltages for EVM Board

Description	Voltage Limitations	Current Requirement
9 V	8.5 V – 9.5 V	0.3 A
–9 V	–8.5 V – 9.4 V	0.1 A

CAUTION

Applying voltages above the limitations given in Table 2-1 may cause permanent damage to your hardware.

2.4 Digital Audio Inputs/Outputs

The digital audio inputs can be connected to the board in two ways, either in the SPDIF format optical TOSLINK input, OPTO1, or in I^2S format on connector J1. The pin out this and the other connectors is shown in Chapter 3.

The SPDIF I^2S IN input supplies signal to the TAS3308 SDIN1. When a valid lock is detected by the DIR9001 SPDIF receiver a blue SPDIF lock LED is lit.

The digital audio outputs can be to I^{2}S or SPDIF format optical TOSLINK. The I^{2}S output is provided on connector J9. There are two SPDIF output options. One SPDIF output can be produced by the TAS3308 on SDOUT2. This is set by a TAS3308 I^{2}C register configuration option. This output is available on OPTO3. The other SPDIF output is the SDOUT1 output that is converted into SPDIF format by an external encoder. This is output on OPTO4.

The TAS3308 has an optical SPDIF input from OPTO2. This is a pass though only connection to the TAS3308 SDOUT2/SPDIF output on, OPTO3.

2.5 Master/Slave Mode Operation

The TAS3308EVM is delivered configured to operate in clock master mode. However, the TAS3308 can be configured as a clock slave or master using JP3.

Table 2-2. JP2 Clock Master/Slave Setting

Jumper JP3 Pins	I^{2}S Clock Mode
1, 2	Slave
2, 3	Master

2.5.1 Master Mode

In master mode, the master clock, MCLK SCLK and LRCLK for the system are provided on J9. Data can be input on the analog input and as I^{2}S data on J1.

SPDIF I^{2}S input from OPTO1 is not supported in master mode.

Data can be output from the I^{2}S outputs on J9, SPDIF I^{2}S output, OPTO4, and from SPDIF SDOUT2 when the SDOUT2 is configured for SPDIF output.

2.5.2 Slave Mode

In slave mode, data and clocks can be input in the SPDIF I^{2}S IN, OPTO1, or the I^{2}S input, J1. The SPDIF input is selected automatically when EVM detects a valid SPDIF signal on OPTO1. If the EVM does not detect a valid SPDIF signal on OPTO1, then the I^{2}S inputs are used.

In slave mode, the TAS3308 ADC requires an external clock input from the I^{2}S IN or the SPDIF I^{2}S IN for correct operation. The performance of the ADC is affected by the clock source jitter.

Data can be output from the I^{2}S outputs on J9, SPDIF I^{2}S output, OPTO4, and from SPDIF SDOUT2 when the SDOUT2 is configured for SPDIF output.

2.6 EVM Default Configuration

The TAS3308 is placed into the default configuration by receiving a reset. The TAS3308 receives a reset from the power up circuitry, by pressing the Reset button, or by receiving a reset signal through the USB interface. Following the receipt of reset, the TAS3308 EVM will load the contents of EEPROM2 and come up with Mute enabled, clock master mode enabled, and the PWM outputs configured for Comb AD modulation.

As described in this section, an example PurePath Studio GDE processing flow is supplied that configures the TAS3308 to support a I^{2}S digital PCM input, analog input, digital output, line output , headphone output and TAS5601 Power Stage for both master and slave mode.

2.7 TAS3308 Software Installation

The TAS3308 is programmed and configured using PurePath Studio. This PurePath Studio is composed of a graphical development environment (GDE), the integrated development environment (IDE) and the component publisher. The GDE permits the user to program TAS3308 using predefined signal processing components that are placed and connected graphically on the GDE pallet. PurePath Studio runs on a Windows® XP computer.

The IDE is software development environment that permits the user to construct and test the code for a new GDE component.

The component publisher is used to create the component, define the component's control interface and the ways in which the component can be used.

PurePath Studio software is supplied on the TAS3308 Software CD-ROM. The latest version of PurePath Studio is also available on the TI Extranet to registered users.

To access the TI PurePath Studio Extranet site

- To get access to the TI Extranet for the PurePath Studio tool suite – open a web browser and go to the following site and fill in the requested information.
  http://iag.itg.ti.com/msa/

There are two types of licenses

- For those who are interested only in evaluating the tools, there is an evaluation license.
- For those who are interested in product development using PurePath Studio tools there is a production license. This is the software license that is needed to support the EVM.

Access to the Extranet is available by using a browser to access my.ti.com and selecting Extranets. The PurePath Studio software is contained under the link TAS3108-PurePath Studio.

To load PurePath Studio Software suite

- **From CD-ROM** – Insert the TAS3308 Software CD-ROM. Open the TAS3308GDE directory and run setup_PurePath_Studio_vx.xx.exe. Follow the instructions to complete the installation.
- **From Download** – Save the installation file to temporary directory. Go to the temporary directory and run setup_PurePath_Studio_vx.xx.exe. Follow the instructions to compete the installation.
- The CD-ROM also contains initialization files for master and slave EVM initialization and a simple process flow that can be used to verify the TAS3308 EVM operation.
- After the PurePath Studio installation is complete, copy the contents of the CD-ROM TAS3308_Config directory to C:\ Program Files\Texas Instruments Inc\PurePath Studio\MyProcessFlows.

Using the TAS3308 EVM

After completing the software installation, turn on power supplies and connect USB cable to Input-USB board.

To start the GDE – Go to the Start menu and select All Programs/Texas Instruments/PurePath Studio/PurePath Studio GDE.

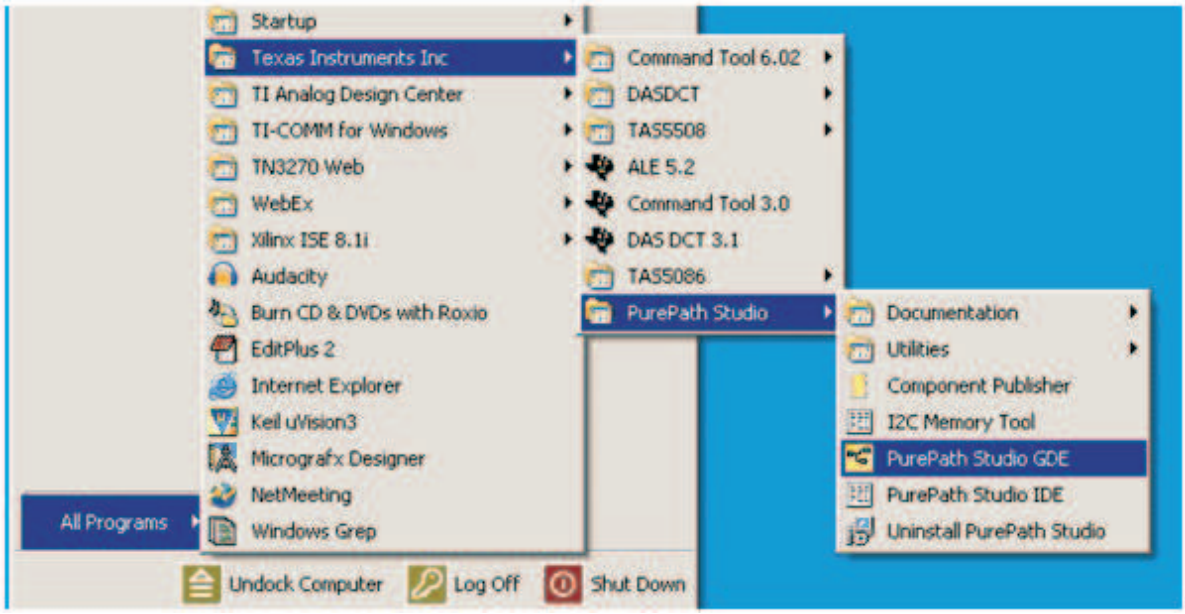

Figure 2-1. GDE Startup

The startup of GDE takes few seconds.

The TAS3308 requires an initialization configuration file to be loaded after a reset. This file configures the TAS3308 for the EVM configuration, enables the analog outputs, and sets the clock master/slave mode. Before loading or building a process flow verify that an initialization file is specified in the Execute I^2C command file window. This window is found under Tools/I^2C Command Tool.

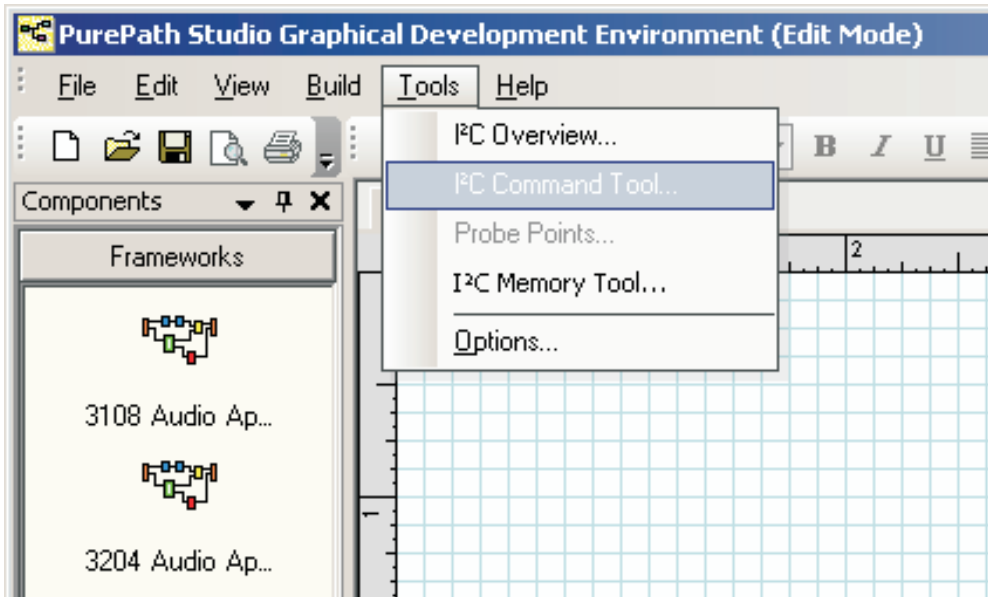

Figure 2-2. Setting the I^2C Initialization Sequence

If the EVM is to be operated in Master mode, select 3308EVM_init_master.cfg.

If the EVM is to be operated in Slave mode, select 3308EVM_init_slave.cfg.

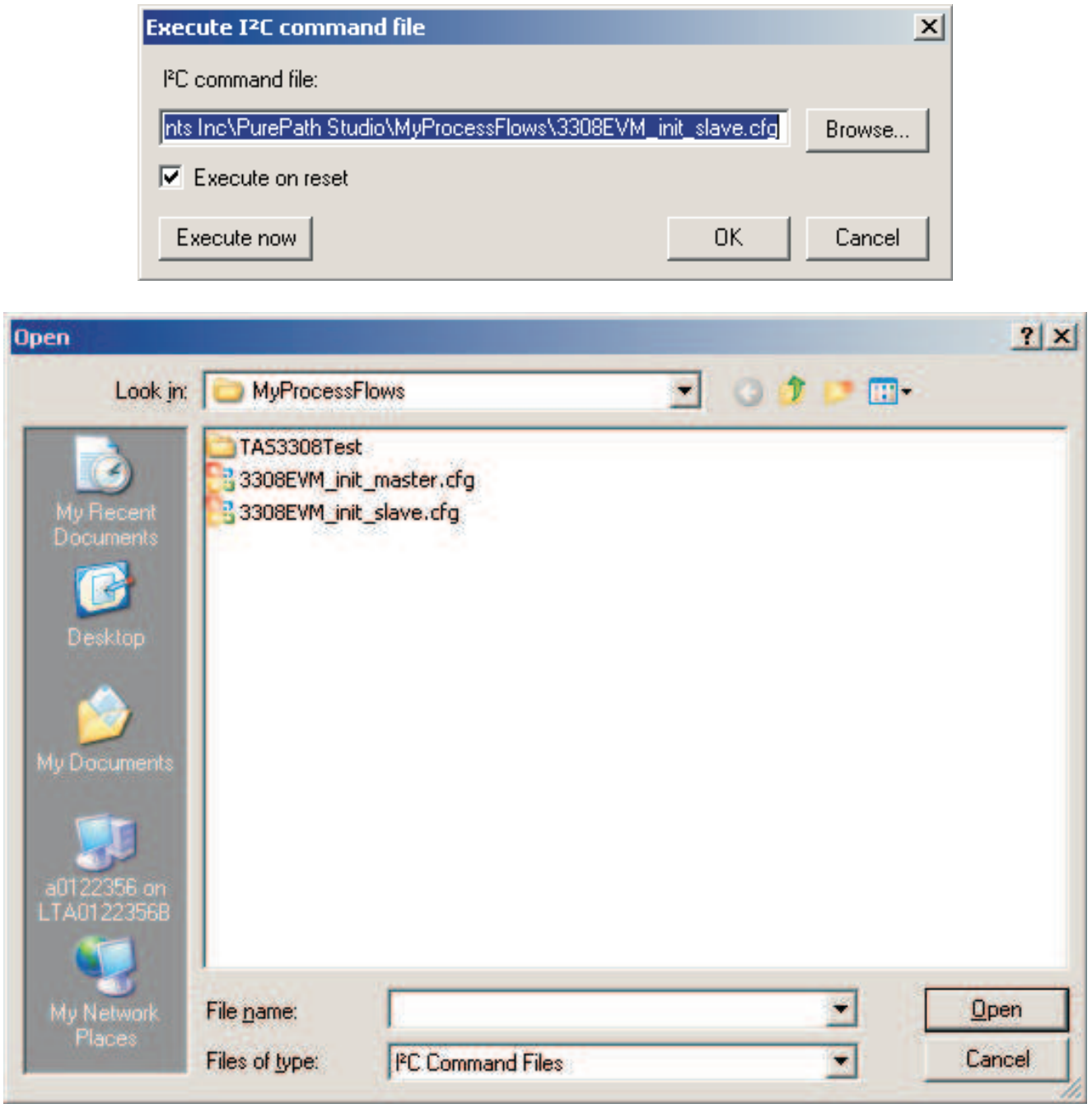

Figure 2-3. Specifying the I²C Initialization Sequence

Then verify that the “Execute on reset” box is checked.

At this point a process flow can be built using the TAS3308 application framework, the TAS3308 I/O components and the audio processing components.

Building and running a process flow

A good starting point is to load the predefined TAS3308 Test process flow.

This flow is loaded by selecting File/Open.

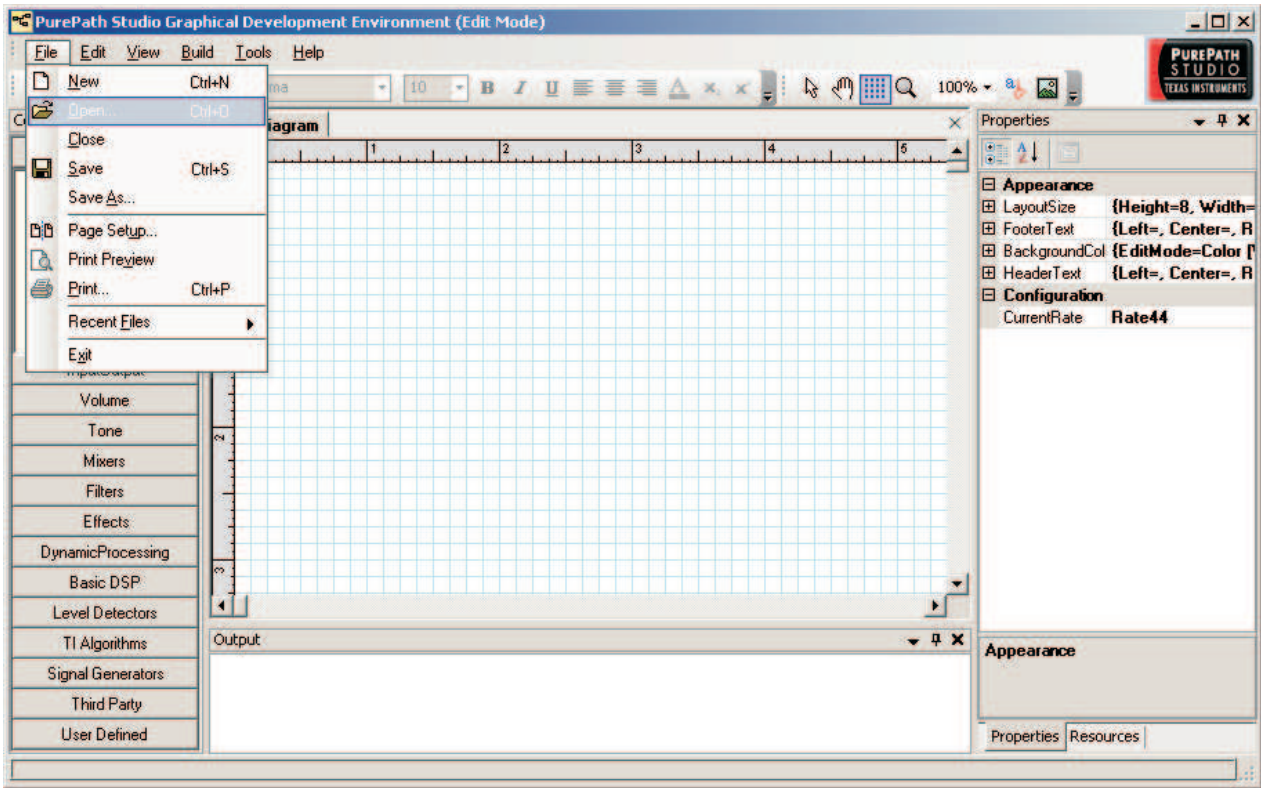

Figure 2-4. Loading a Process Flow

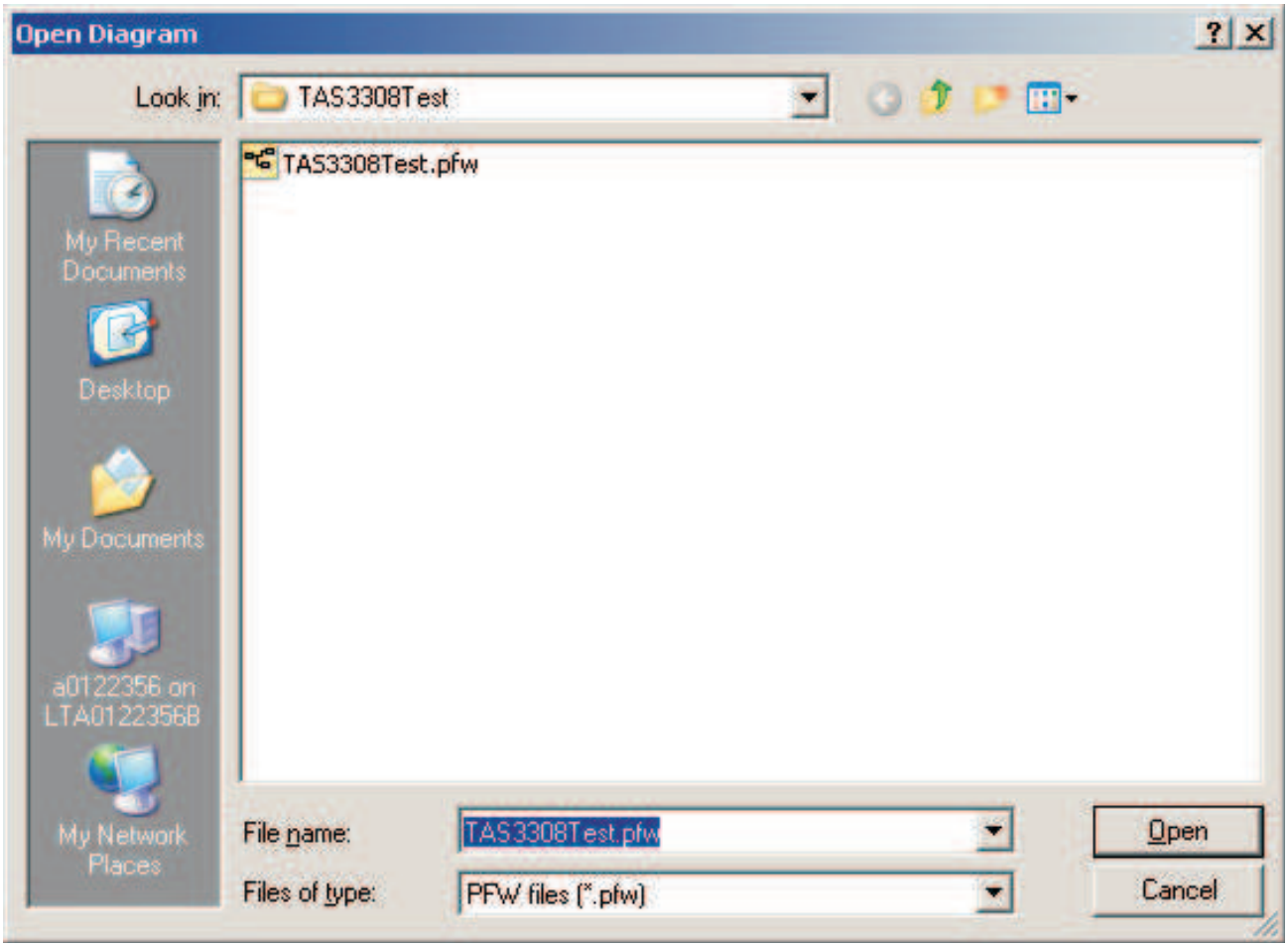

Figure 2-5. Loading a Process Flow (Part B)

This loads a process flow that streams a signal from either the ADC or SAP1 input to the PWM and SAP output.

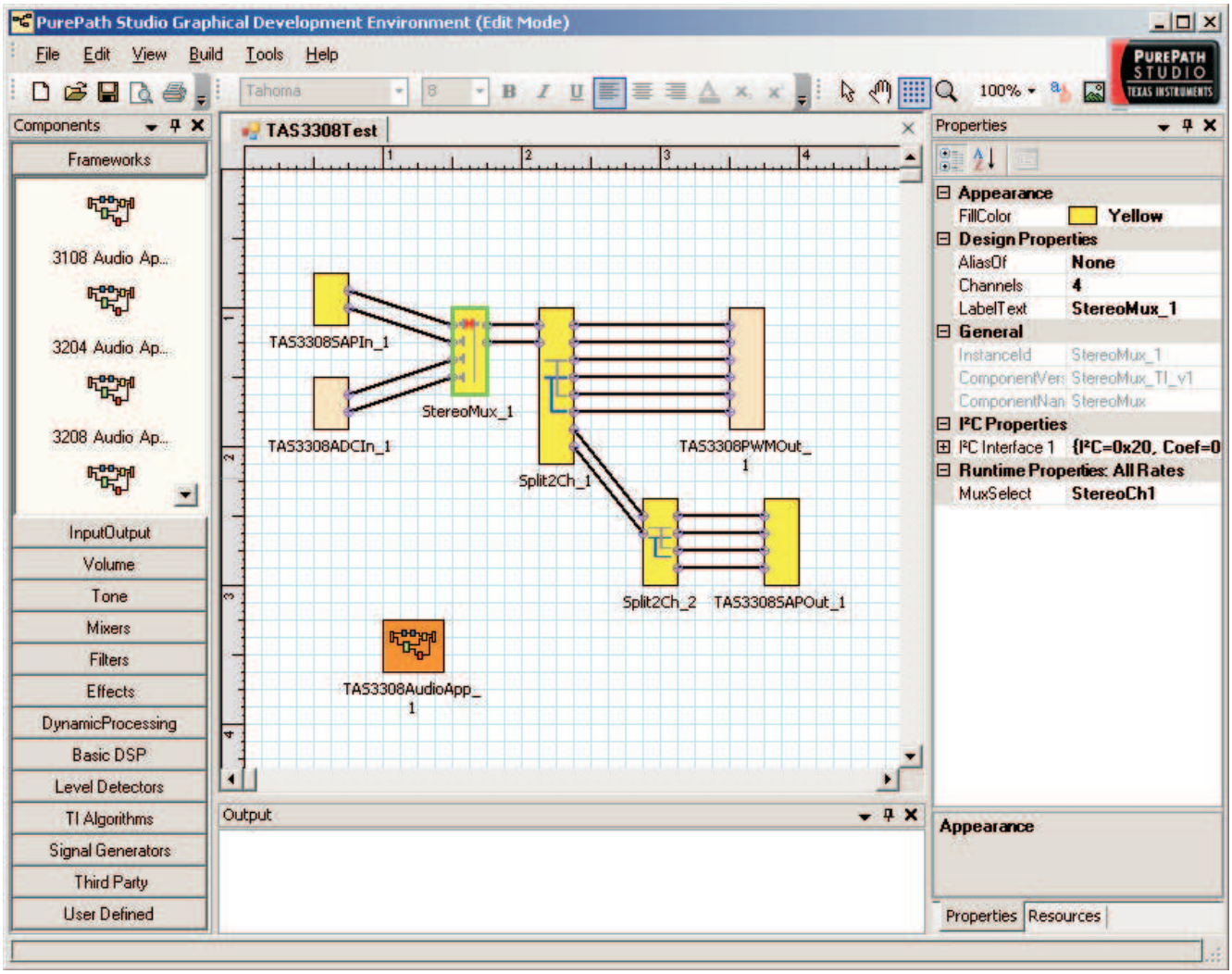

Figure 2-6. GDE Test Process Flow

The input selection is performed by selecting the Mux and changing the Mux Select Property to StereoCh1 or StereoCh2.

To build this process flow and execute it on the EVM, select Build/ Generate Code, then Build/Download code, and finally then Build/Run.

When the GDE transitions to run mode, the GDE resets the TAS3308EVM.

The reset restores the TAS3308 register to the default values.

The TAS3308 will then load the EEPROM image and the TAS3308_init_master/slave.cfg file.

At this point the TAS3308 EVM transitions to the run mode with the mute in the ON state.

For the TAS3308 to stream audio out of the DAC outputs, the mute must be returned to the inactive state. This is done by pressing the mute button. The mute LED is extinguished.

For more advanced use of the GDE please refer to GDE online help, GDE Release notes and *TAS3108 MCU Programmer's Reference Guide*.

System Interfaces

This chapter describes the TAS3308EVM board power supplies and system interfaces.

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3.1 Control Interface (Control1), Input

This interface connects the TAS3308EVM board to an internal controller. This is a general-purpose interface.

Table 3-1. Control1 Pin Description

PIN NO.	NET-NAME AT SCHEMATICs	DESCRIPTION
1	SDA	I^2C bidirectional data line
2	SCL	I^2C input clock line
3	GND	Ground
4	3.3 V	Power
5	GPIO1	General-purpose bidirectional I/O 1
6	GPIO2	General-purpose bidirectional I/O 2
7	RESETZ	System reset (bidirectional). Activate /MUTE before /RESET for quiet reset
8	MUTEZ	Ramp volume from any setting to noiseless soft mute. Mute can also be activated by I^2C
9	GPIO3	General-purpose bidirectional I/O 3
10	GPIO4	General-purpose bidirectional I/O 4

3.2 Digital Audio Interface, Input (J1)

The digital audio interface contains digital audio signal data (I^2S), clocks etc. See *TAS3308 Data Manual* for signal timing and details not explained in this document.

Table 3-2. J1 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	MCLKin	Master clock input
3	GND	Ground
4	SCLKin	I^2S bit clock
5	GND	Ground
6	LRCLKin	I^2S left-right clock
7	GND	Ground
8	SDIN1	I^2S data 1, channel 1 and 2
9	GND	Ground
10	SDIN2	I^2S data 2, channel 3 and 4
11	GND	Ground
12	SDIN3	I^2S data 3, channel 5 and 6
13	GND	Ground
14	GND	Ground

3.3 PWM Output (J4)

Table 3-3. J4 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	5V_PWR	5V_PWR
3	GND	Ground
4	–5V_PWR	–5V_PWR
5	GND	Ground
6	3.3V_PWR	3.3V_PWR
7	GND	Ground
8	3.3V_PWR	3.3V_PWR
9	GND	Ground
10	VALID	VALID
11	GND	Ground
12	FAULT	FAULT
13	GND	Ground
14	N/C	N/C
15	GND	Ground
16	N/C	N/C
17	GND	Ground
18	PWM3_RI	PWM3_RI
19	GND	Ground
20	PWM3_RD	PWM3_RD
23	GND	Ground
22	PWM3_LI	PWM3_LI
23	GND	Ground
24	PWM3_LD	PWM3_LD
25	GND	Ground
26	PWM2_RI	PWM2_RI
27	GND	Ground
28	PWM2_RD	PWM2_RD
29	GND	Ground
30	PWM2_LI	PWM2_LI
31	GND	Ground
32	PWM2_LD	PWM2_LD
33	GND	Ground
34	PWM1_RI	PWM2_RI
35	GND	Ground
36	PWM1_RD	PWM2_RD
37	GND	Ground
38	PWM1_LI	PWM2_LI
39	Ground	Ground
40	PWM1_LD	PWM2_LD

3.4 Analog Input (J6)

Table 3-4. J6 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	LineIn1L	Line in left channel 1 also on RCA J5
3	GND	Ground
4	LineIn1R	Line in right channel 1 also on RCA J5
5	GND	Ground
6	LineIn2L	Line in left channel 2
7	GND	Ground
8	LineIn2R	Line in right channel 2
9	GND	Ground
10	LineIn3L	Line in left channel 3
11	GND	Ground
12	LineIn3R	Line in right channel 3
13	GND	Ground
14	LineIn4L	Line in left channel 4
15	GND	Ground
16	LineIn4R	Line in right channel 4
17	GND	Ground
18	LineIn5L	Line in left channel 5
19	GND	Ground
20	LineIn5R	Line in right channel 5
23	GND	Ground
22	LineIn6L	Line in left channel 6
23	GND	Ground
24	LineIn6R	Line in right channel 6
25	GND	Ground
26	LineIn7L	Line in left channel 7
27	GND	Ground
28	LineIn7R	Line in right channel 7
29	GND	Ground
30	LineIn8L	Line in left channel 8
31	GND	Ground
32	LineIn8R	Line in right channel 8
33	GND	Ground
34	LineIn9L	Line in left channel 9
35	GND	Ground
36	LineIn9R	Line in right channel 9
37	GND	Ground
38	LineIn10L	Line in left channel 10
39	GND	Ground
40	LineIn10R	Line in right channel 10

3.5 Digital Audio Interface, Output (J9)

The digital audio interface contains digital audio signal data (I^2S), clocks, etc. See *TAS3308 Data Manual* for signal timing and details not explained in this document.

Table 3-5. J9 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	MCLKO	Master clock input
3	GND	Ground
4	SCLKout	I^2S bit clock
5	GND	Ground
6	LRCLKout	I^2S left-right clock
7	GND	Ground
8	SDOUT1	I^2S data 1, channel 1 and 2
9	GND	Ground
10	SDOUT2	I^2S data 2, channel 3 and 4

3.6 RCA Connectors

Table 3-6. RCA Connectors Pin Description

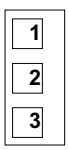
PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	Signal	Channel input/output – tip
2	AGND	Analog ground – sleeve

3.7 MSP430 Port Connector (J3)

Table 3-7. J3 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	TDO	TDO
2		
3	TCLK	TCLK
4	3.3 V	3.3 V
5	TMS	TMS
6		
7	TCK	TCK
8	TEST	TEST
9	GND	GND
10		
11	RESET	RESET
12		
13		
14		

3.8 I^2S Master Slave Jumper (JP3)



PCB Connector (Top View)

Table 3-8. JP3 Pin Description

PIN NO.	DESCRIPTION
1, 2	I^2S Slave
2, 3	I^2S Master

MSP430 Programming

This chapter describes the TAS3308EVM board power supplies and system interfaces.

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4.1 Example of MSP430 Programming

The MSP430 can be programmed to provide TAS3308 and power stage initialization and control. During Initialization the MSP430 should wait for the TAS3308 to complete booting from EEPROM. It would then send an initialization sequence to the TAS3308. At this point, the MSP430 would send I^{2}C commands to the TAS3308 when it receives an input from one of the onboard switches or the IR remote control.

The microcontroller has eight circuit board pushbuttons and LEDs to support user control functions.

These controls can be programmed to provide functions and indications, such as:

- Select analog/digital source
- Function 1 (surround effect) on/off
- Function 2 (EQ) on/off
- Function 3 (DRC) on/off
- Volume up/volume down

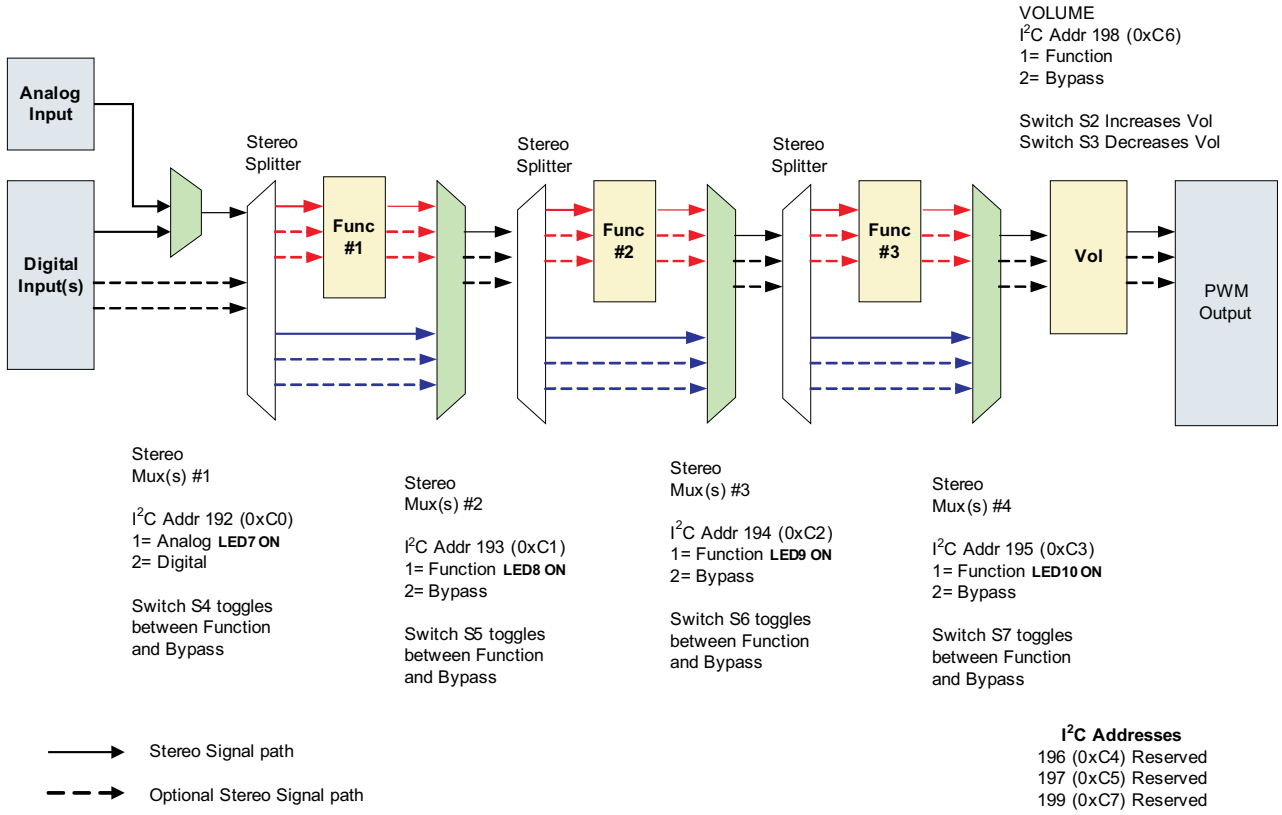

Figure 4-1. MSP430 Control Example

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of xxx V to xxx V and the output voltage range of xxx V to xxx 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.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than xxx C. The EVM is designed to operate properly with certain components above xxx 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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