

# **TAS5076-5182C6EVM**

***Evaluation Module for the TAS5076 Six-Channel  
Digital Audio PWM Processor and the TAS5182  
Digital Power MOSFET Driver***

## *User's Guide*

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products & application solutions:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
		Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265

## EVM IMPORTANT NOTICE

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

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the 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.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

**EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments  
Post Office Box 655303  
Dallas, Texas 75265

## **EVM WARNINGS AND RESTRICTIONS**

It is important to operate this EVM within the input voltage range of 0 V to 40 V for the output stage and 15 V  $\pm$ 10% for the control gate drive.

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 75°C. The EVM is designed to operate properly with certain components above 75°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.

### Mailing Address:

Texas Instruments  
Post Office Box 655303  
Dallas, Texas 75265

# Read This First

---

---

---

---

### ***About This Manual***

This manual describes the operation of the TAS5076–5182C6EVM evaluation module from Texas Instruments.

### ***How to Use This Manual***

This document contains the following chapters:

Chapter 1 – Overview

Chapter 2 – System Interface

Chapter 3 – Protection

### ***Information About Cautions and Warnings***

This book may contain cautions and warnings.

**This is an example of a caution statement.**

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

**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 is a list of technical documentation that may be useful to a user of the TAS5026–5182C6EVM. It includes data sheets having detailed descriptions of the integrated circuits used in the design of the TAS5026–5182C6EVM, as well as other potentially useful documents. These items can be obtained at <http://www.ti.com>.

<b>Data Sheets</b>	<b>Literature Number</b>
True Digital Audio Amplifier TAS5076 Digital Audio PWM Processor	SLES090
TAS5182 100W Stereo Digital Amplifier Power Stage Controller	SLES045
TPS79133, Ultra Low Noise, High PSRR, Fast RF, Low-Enable, 100 mA Low Dropout Regulator	SLVS325
TPS3801K33, Ultra-Small Supply Voltage Supervisors	SLVS219
LM317M, 3-Terminal, 500 mA, Adjustable Positive Voltage Regulator	SCVS297I
SN74AHC1G08 Single 2-Input Positive AND Gate	SCLS314
SN74LV123A Dual Retriggerable Monostable Multivibrators With Schmitt-Trigger Inputs	SCLS393
<b>Application Report</b>	
TAS5076-5182C6EVM Application Report	SLEA026
Digital Audio Measurements	SLAA114
System Design Considerations for True Digital Audio Power Amplifiers (Rev. A)	SLAA117

## FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

## Trademarks

Audio Precision is a trademark of Audio Precision, Inc.

Equibit is a trademark of Texas Instruments

Other trademarks are the property of their respective owners.

# Contents

---

---

---

<b>1</b>	<b>Overview</b>	<b>1-1</b>
1.1	TAS5076–5182C6EVM Features	1-2
1.2	PCB Outline	1-3
<b>2</b>	<b>System Interface</b>	<b>2-1</b>
2.1	PSU Interface (J109 and J110)	2-2
2.2	PSU Control Interface (J100)	2-3
2.3	Loudspeaker Connectors (J101, J102, J103, J104, J105, and J106)	2-3
2.4	Control Interface (J130)	2-4
2.5	PWM timing, ABD, and TC Register Setting	2-5
2.6	Digital Audio Interface (J140)	2-5
<b>3</b>	<b>Protection</b>	<b>3-1</b>
3.1	Device Fault Reporting	3-2
3.2	Autorecovery System	3-2

# Figures

---

---

---

1-1	Integrated True Digital Audio Amplifier System	1-2
1-2	Physical Structure for the TAS5076–5182C6EVM (Rough Outline)	1-3
2-1	Recommended Power-Up Sequence	2-2
2-2	J109 and J110 Pin Numbers (PCB Connector Top View)	2-2
2-3	Pin Numbers at PSU Control Interface	2-3
2-4	Pin Numbers at Loudspeaker Connectors	2-4
3-1	Autorecovery Loop	3-3

# Tables

---

---

---

2-1	Recommended Supply Voltages .....	2-2
2-2	J109 Pin Description .....	2-3
2-3	J110 Pin Description (For decrease of impedance to reach performance) .....	2-3
2-4	J100 Pin Description .....	2-3
2-5	Pin Description of Loudspeaker Connectors .....	2-4
2-6	J130 Pin Description .....	2-4
2-7	ABD and Inter Channel Delay Register Setting .....	2-5
2-8	J140 Pin Description .....	2-6
2-9	Clock Rates .....	2-6
3-1	TAS5182 Warning/Error Signal Decoding .....	3-2



## Overview

---

---

---

---

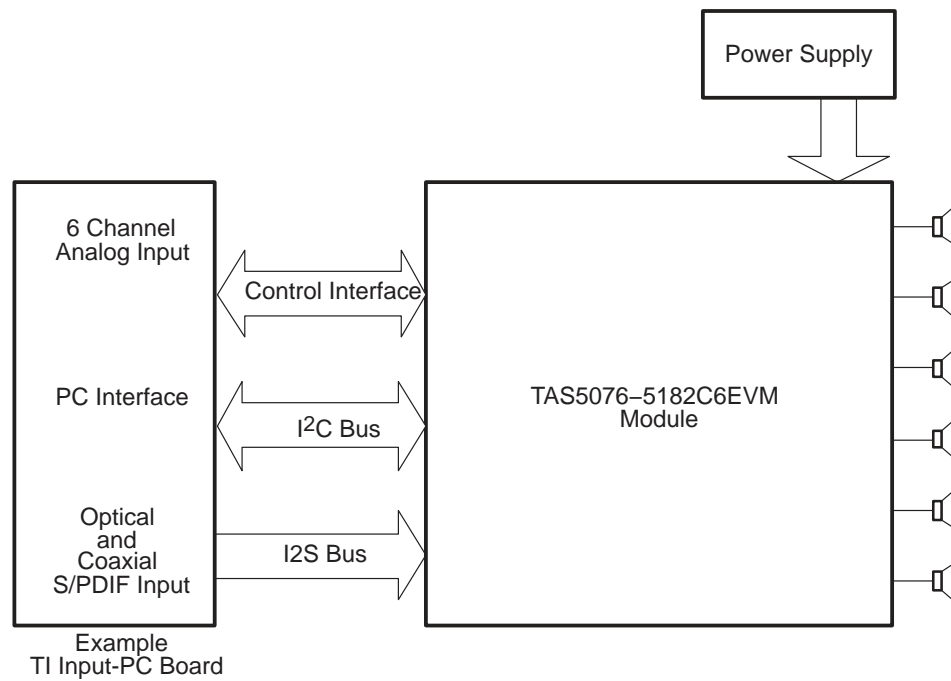
The TAS5076–5182C6EVM board is a six channel Pure Path Digital™ evaluation module for the integrated circuits TAS5076PFC and TAS5182DCA from Texas Instruments (TI). The TAS5076PFC is a 24-bit multi channel Pure Path Digital pulse-width modulator based on Equibit™ technology. The TAS5182DCA is a high-performance MOSFET gate driver with built-in overcurrent and over temperature protection for the MOSFETs.

The TAS5076 and TAS5182 together with 24 IRFIZ24N MOSFETs provide the complete conversion of a 3.3-V digital audio input stream to six times 100 W into 6-Ω impedance. The chipset is ideal for applications requiring absolute highest audio quality, minimum size and weight, and high power efficiency. The chipset can be used in a range of products such as high-end slim-line AV receivers, high-end DVD receivers, and multi-way active speakers.

The TAS5076–5182C6EVM module is an integrated true digital audio amplifier system, which includes digital volume control interface and failure protection reporting.

Topic	Page
1.1 TAS5076–5182C6EVM Features .....	1-2
1.2 PCB Outline .....	1-3

Figure 1–1. Integrated True Digital Audio Amplifier System



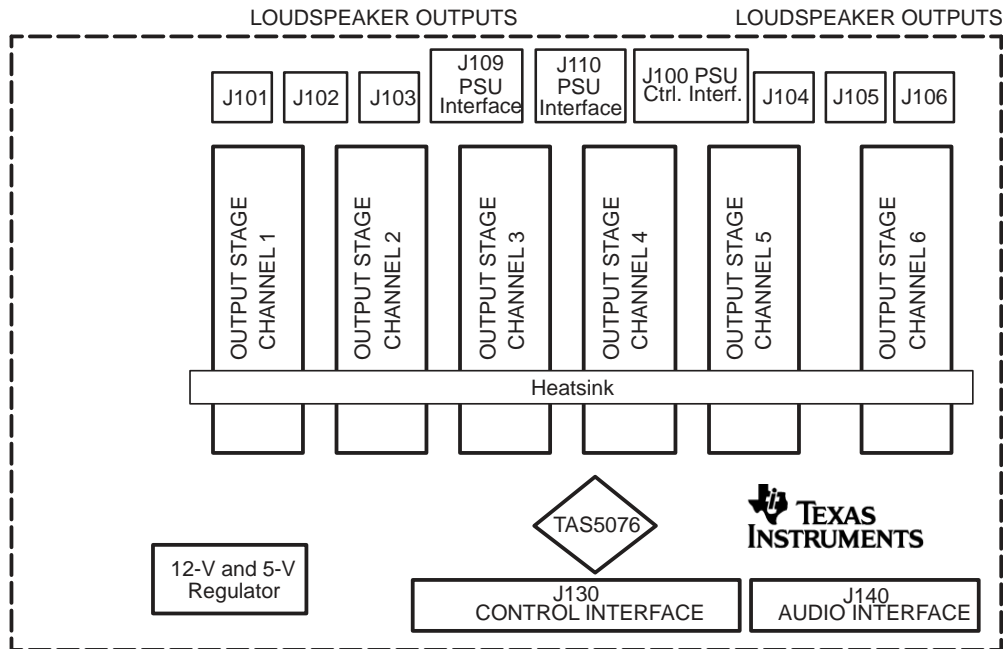
## 1.1 TAS5076–5182C6EVM Features

- Six channel TDAA reference design (double-sided plated-through PCB layout)
- Self-contained protection system (short circuit and thermal)
- Standard I<sup>2</sup>S and I<sup>2</sup>C / Control connector for TI input board

## 1.2 PCB Outline

The physical structure for the TAS5076–5182C6EVM is illustrated in Figure 1–2.

Figure 1–2. Physical Structure for the TAS5076–5182C6EVM (Rough Outline)





# System Interface

---

---

---

---

This chapter describes the TAS5076–5182C6EVM board in regards to power supplies and system interfaces.

<b>Topic</b>	<b>Page</b>
2.1 PSU Interface (J109 and J110) .....	2-2
2.2 PSU Control Interface (J100) .....	2-3
2.3 Loudspeaker Connectors (J101, J102, J103, J104, J105, and J106)	2-3
2.4 Control Interface (J130) .....	2-4
2.5 PWM timing, ABD, and TC Register Setting .....	2-5
2.6 Digital Audio Interface (J140) .....	2-5

## 2.1 PSU Interface (J109 and J110)

The TAS5076–5182C6EVM module must be powered from external power supplies. High-end audio performance requires a stabilized power supply with low ripple voltage and low output impedance throughout the audio band, see the application note *Power Supply Considerations TDAA AV-Receivers (SLEA028)*.

**Note:**

The length of power supply cable must be minimized. Increasing length of PSU cable is equal to increasing the distortion for the amplifier at high output levels and low frequencies.

The maximum output stage supply voltage depends on the speaker load resistance. Check the maximum supply voltage in the TAS5182 data sheet.

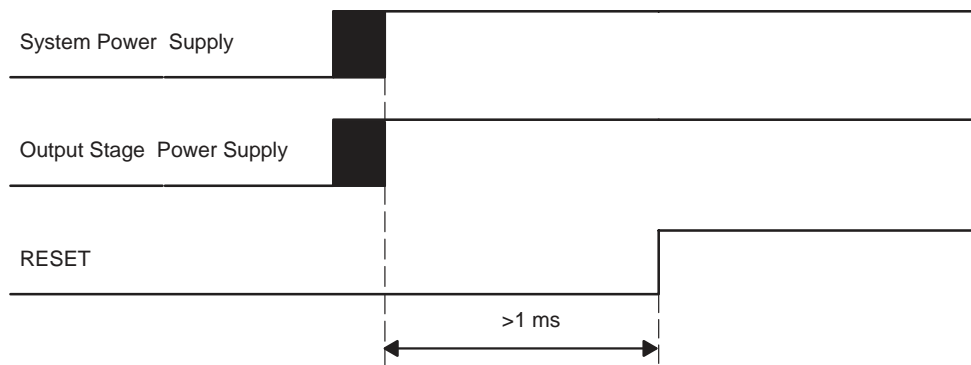
*Table 2–1. Recommended Supply Voltages*

Description	Voltage limitations	Current Recommendations
System power supply voltage	15 V (min. 14.5 V, max 29.5 V)	0.15 A
Output stage supply voltage	0 V–40.55 V	5.5 A <sup>†</sup>

<sup>†</sup> the rated current corresponds to two channel full scale (100 W each) at 1 kHz.

The recommended TAS5182 power-up sequence is shown in the Figure 2–1. For proper TAS5182 operation the RESET signal should be kept low during power up. RESET is pulled low during power up for 200 ms by the onboard reset generator (U681).

*Figure 2–1. Recommended Power-Up Sequence*



*Figure 2–2. J109 and J110 Pin Numbers (PCB Connector Top View)*



Table 2–2. J109 Pin Description

Pin #	Net-Name at Schematics	Description
1	V-HBRIDGE	Output stage supply voltage
2	–	System power supply
3	GND	Ground
4	GND	Ground

Table 2–3. J110 Pin Description (For decrease of impedance to reach performance)

Pin #	Net-Name at Schematics	Description
1	V-HBRIDGE	Extra output stage supply voltage
2	V-HBRIDGE	Extra output stage supply voltage
3	GND	Extra ground
4	GND	Extra ground

## 2.2 PSU Control Interface (J100)

This interface is used for onboard sensing of output supply voltage and for future use.

Figure 2–3. Pin Numbers at PSU Control Interface



Table 2–4. J100 Pin Description

Pin #	Net-Name at Schematics	Description
1	NOT USED	–
2	V-HBRIDGE	Sense of output supply voltage
3	GND	Ground
4	$\overline{\text{RESET}}$	System reset (bidirectional)
5	V-HBRIDGE-CTRL	Power supply output voltage control signal

## 2.3 Loudspeaker Connectors (J101, J102, J103, J104, J105, and J106)

### Caution

Both positive and negative speaker outputs are floating and may not be connected to ground (e.g., through an oscilloscope).

Figure 2–4. Pin Numbers at Loudspeaker Connectors



Table 2–5. Pin Description of Loudspeaker Connectors

Pin #	Net-Name at Schematics	Description
1	OUT-1	Speaker negative output
2	OUT-2	Speaker positive output

## 2.4 Control Interface (J130)

This interface connects the TAS5076–5182C6EVM board to the micro-controller section.

Table 2–6. J130 Pin Description

Pin #	Net-Name at Schematics	Description
1	GND	Ground
2	V-HBRIDGE-CTRL	Power supply output voltage control
3	GND	Ground
4	$\overline{\text{RESET}}$	System reset (bidirectional). TAS5076 enters a 4-ms initiation sequence before PWM signals are present at output. Activate $\overline{\text{MUTE}}$ before $\overline{\text{RESET}}$ for quiet reset.
5	$\overline{\text{ERR-RCVY}}$	Error recovery (or soft reset) provides reduced click and pop reset, without resetting I <sup>2</sup> C volume register settings.
6	$\overline{\text{MUTE}}$	Ramp volume from any setting to noiseless soft mute. Mute can also be activated by I <sup>2</sup> C.
7	RESERVED	–
8	RESERVED	–
9	RESERVED	–
10	SDA	I <sup>2</sup> C data clock
11	GND	Ground
12	SCL	I <sup>2</sup> C bit clock
13	RESERVED	–
14	RESERVED	–
15	RESERVED	–
16	RESERVED	–
17	GND	Ground
18	RESERVED	–
19	RESERVED	–
20	$\overline{\text{SHUTDOWN}}$	Shutdown error reporting. Activated if one or more TAS5182 has overcurrent or over temperature.



Table 2–6. J130 Pin Description (Continued)

Pin #	Net-Name at Schematics	Description
21	RESERVED	–
22	TEMP-WARNING	Temperature warning. Activated if one or more TAS5182 has reached warning temperature level.
23	RESERVED	–
24	RESERVED	–
25	GND	Ground
26	GND	Ground
27	RESERVED	–
28	RESERVED	–
29	RESERVED	–
30	RESERVED	–
31	GND	Ground
32	GND	Ground
33	+5V	+5-V supply (out)
34	+5V	+5-V supply (out)

## 2.5 PWM Tming, ABD and Inter Channel Delay Register Setting

For maximum performance, the PWM timing shall be optimized for the configuration and layout. These so called ABD and inter-channel delays shall be programmed by I<sup>2</sup>C to the TAS5076 at startup and at every reset. See the TAS5076 data manual for these register programming details.

Table 2–7. ABD and Inter Channel Delay Register Setting

Register Description	Register	Setting
Inter channel delay channel 1	0Ch	01h
Inter channel delay channel 2	0Dh	49h
Inter channel delay channel 3	0Eh	91h
Inter channel delay channel 4	0Fh	39h
Inter channel delay channel 5	10h	21h
Inter channel delay channel 6	11h	69h
ABD delay	12h	1Dh

## 2.6 Digital Audio Interface (J140)

The digital audio interface contains digital audio signal data (I2S), clocks, etc. See the TAS5076 data manual for signal timing and details not explained in this document.

Table 2–8. J140 Pin Description

Pin #	Net-Name at Schematics	Description
1	GND	Ground
2	MCLK	Master clock input. Low jitter system clock for PWM generation and reclocking.  Ground connection from source to the TAS5076 must be a low impedance connection.
3	GND	Ground
4	SDIN1	I2S Data 1, Channel 1 and 2
5	SDIN2	I2S Data 2, Channel 3 and 4
6	SDIN3	I2S Data 3, Channel 5 and 6
7	RESERVED	–
8	GND	Ground
9	GND	Ground
10	GND	Ground
11	SCLK	I2S bit clock
12	GND	Ground
13	LRCLK	I2S left/right clock
14	GND	Ground
15	RESERVED	–
16	GND	Ground

Table 2–9. Clock Rates

Speed	TAS5076 System Control Register 0 (x02h)	Sample Frequency Fs	LRCLK	SCLK (64xFs)	MCLK
Normal Speed MCLK = 256xFs	D7 = 0 D6 = 0	32 kHz	32 kHz	2.048 MHz	8.192 MHz
		44.1 kHz	44.1 kHz	2.8224 MHz	11.2896 MHz
		48 kHz	48 kHz	3.072 MHz	12.288 MHz
Double Speed MCLK = 256xFS	D7 = 0 D6 = 1	64 kHz	64 kHz	4.096 MHz	16.384 MHz
		88 kHz	88.2 kHz	5.6448 MHz	22.5792 MHz
		96 kHz	96 kHz	6.144 MHz	24.576 MHz
Quad Speed MCLK = 128xFS	D7 = 1 D6 = 0	176 kHz	176.4 kHz	11.2896 MHz	22.579 MHz
		192 kHz	192 kHz	12.288 MHz	24.576 MHz

# Protection

---

---

---

---

The TAS5182 protects the output MOSFET devices and provides fault reporting (including over-temperature protect and short circuit protection). The TAS5182 is on the evaluation module configured in latching mode after all errors. In this mode error recovery is handled by TAS5076.

<b>Topic</b>	<b>Page</b>
3-1 Device Fault Reporting .....	3-2
3-2 Autorecovery System .....	3-2

### 3.1 Device Fault Reporting

The  $\overline{\text{ERR0}}$  and  $\overline{\text{SHUTDOWN}}$  outputs from the TAS5182 indicate fault conditions. See the TAS5182 data sheet for a description of these pins.

The  $\overline{\text{ERR0}}$  signals at the TAS5076–5182C6EVM board are all joined (wire-or) to one single warning signal.

Shutdown signals are all jointed (wired-or) to one single shutdown signal.

The shutdown signal together with the  $\overline{\text{ERR0}}$  (temperature warning) at the PWM interface (J130) gives chip state information as described in Table 3–1. Device fault reporting outputs are open-drain outputs.

Table 3–1. TAS5182 Warning/Error Signal Decoding

ERR0	SHUTDOWN	DEVICE CONDITION
0	0	Over-temperature error and/or overcurrent error
0	1	Over-temperature warning
1	0	Undervoltage lockout due to GVDD or overcurrent error
1	1	Normal operation, no errors/warnings

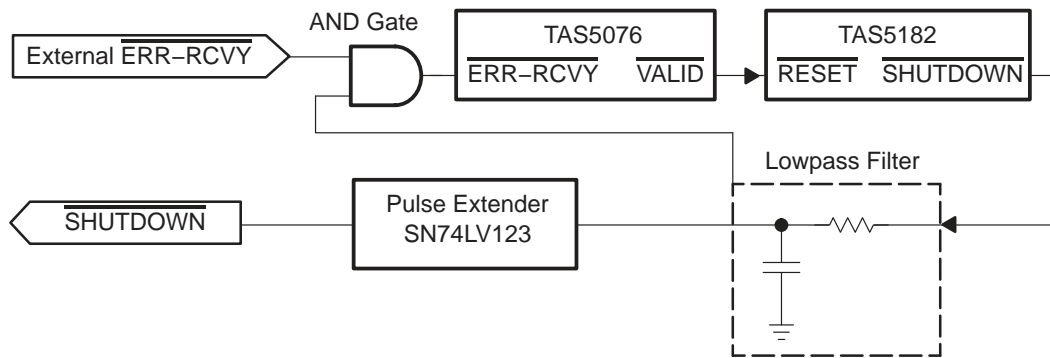
### 3.2 Autorecovery System

The TAS5076–5182C6EVM is configured in autorecovery mode, as closed loop between the TAS5076 and shutdown signal from the TAS5182. In autorecovery mode, the  $\overline{\text{SHUTDOWN}}$  signal from the TAS5182 is connected to the  $\overline{\text{ERR-RCVY}}$  input on the PWM processor.

The short circuit protection error condition results in the following autorecovery sequence:

- 1) H-bridge output is in high impedance state (Hi-Z state) just after short circuit.
- 2)  $\overline{\text{ERR-RCVY}}$  at the PWM processor is forced low by TAS5182  $\overline{\text{SHUTDOWN}}$  signal.
- 3)  $\overline{\text{RESET}}$  at the TAS5182 is forced low by the PWM processor  $\overline{\text{VALID}}$  signal.
- 4) The  $\overline{\text{RESET}}$  signal goes high after approx. 4 ms, which restarts switching of TAS5182.

Figure 3-1. Autorecovery Loop



The  $\overline{\text{EXTERNAL-ERR-RCVY}}$  (J130) pin 5 is used to provide click and pop reduced error recovery without resetting the TAS5076 registers. This can also be used as a soft reset.

The  $\overline{\text{SHUTDOWN}}$  (J130) pin 20 can be used for external microprocessor for registration of overcurrent events, which leads to deactivation of the amplifier (because of possible short circuit of output) when repeated constantly.

