
Digital Audio Solution

Table of Contents

Features	1
Applications	1
Digital Audio Solution	1
Performance	2
FPGA Functional Description	3
About Spectrum Design Solutions	3
List of Changes	4

Features

Following are the features of digital audio solution:

- SPDIF or I2S digital audio
- DSP EQ functionality
- Volume control with fader
- Anti-clipping limiter
- Over-current detection
- Offset calibration
- H-Bridge output device

Applications

Following are the applications of digital audio solution:

- D-class audio
- Low power audio
- Embedded audio

Digital Audio Solution

The digital audio system provides an audio processing and amplification solution based on the Microsemi® field programmable gate array (FPGA). The solution accepts any standard digital audio format including I2S, optical SPDIF, coax SPDIF, or any of the widely used serial formats that represent variants of the standard I2S format. The audio interface converts the audio stream into logic-level signals appropriate for the digital inputs of the Fusion FPGA.

A microprocessor is used to configure the FPGA through a standard I2C interface. The microprocessor also provides the communication bridge between the FPGA and the user interface which may be implemented anything from push-button switches to a graphical Windows control interface.

The FPGA drives a standard H-Bridge which provides the power to the output speaker load. The level of the output is dependent on the PWM signals controlling the H-Bridge, which are modulated inside the FPGA. An output filter is necessary to remove the high-frequency switching elements of the output signal. The switching frequency must be set in such a way that the switching components can be adequately filtered without distorting the audio itself.

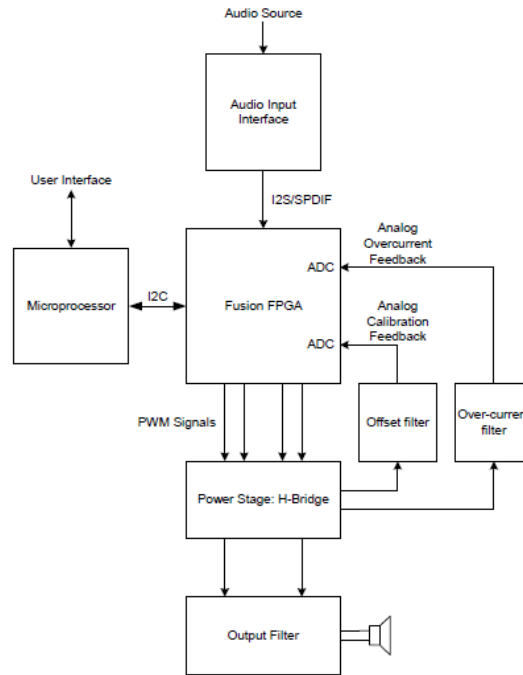


Figure 1 • Digital Audio Solution

The offset filter circuit measures the offset of the H-Bridge during the calibration sequence and adjusts the dynamic range as appropriate for the ADC of the Fusion FPGA. Similarly, the over-current filter measures the V_{ds} of the output FET devices to detect error conditions. The thresholds for error detection and offset compensation are set digitally inside the FPGA.

Performance

The digital audio solution can be implemented for audio sampling rates between 48 kHz to 192 kHz, and switching frequencies up to 100 kHz. The FPGA is synchronized to the audio stream and run at 256 x the audio sampling rate, or the system clock runs asynchronously up to 100 MHz.

FPGA Functional Description

The Fusion FPGA supports the standard audio formats including SPDIF, I2S, and other synchronous serial modes. The design provides volume control, fading, and limiting as well as a graphic equalizer for tuning poor speakers and amplifiers. The PWM output can drive an H-bridge directly, thus providing a single chip front end to an audio power stage.

The digital audio solution utilizes the ADC functionality on the Microsemi Fusion device for over-current detection and calibration. The over-current detection circuit triggers, when the analog feedback (filtered Vds of the output FET) crosses a pre-defined threshold indicating excessive source/sink current or a short to a power rail. The output is disabled in order to protect the power devices from a catastrophic failure. In a similar fashion, the analog input for the calibration circuit detects offsets in the output bridge and compensates for this in the PWM modulation.

The FPGA in the digital audio solution is highly configurable and can be dynamically configured through the I2C communication bus. Parameters such as the limiting attack and release thresholds, graphic equalizer coefficients, fading rates, over current threshold, and so on can be configured by a host microprocessor allowing for a very versatile FPGA implementation.

About Spectrum Design Solutions

Spectrum Design Solutions is highly specialized in FPGA design and has successfully completed designs for fortune 100 companies down to small start-ups. Our engineers have many years of experience making performance trade-offs for FPGA designs targeting high speed, area reduction, and low power

Spectrum Design Solutions is an engineering consulting and product development firm headquartered at 420 North 5th Street, Suite950, Minneapolis, MN 55401. Telephone: 612-435-0789.

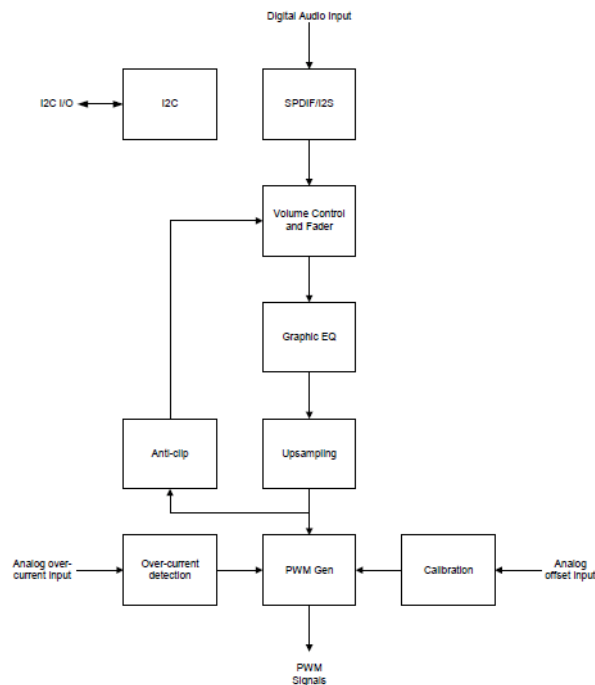


Figure 2 • Fusion FPGA Design

List of Changes

The following shows important changes made in this document for each revision.

Revision	Changes	Page
Revision 1 (July 2016)	Non-technical updates.	N/A
Revision 0 (December 2005)	Initial release.	N/A



Power Matters.™

Microsemi Corporate Headquarters

One Enterprise, Aliso Viejo,
CA 92656 USA

Within the USA: +1 (800) 713-4113

Outside the USA: +1 (949) 380-6100

Sales: +1 (949) 380-6136

Fax: +1 (949) 215-4996

E-mail: sales.support@microsemi.com

www.microsemi.com

© 2016 Microsemi Corporation. All rights reserved. Microsemi and the Microsemi logo are trademarks of Microsemi Corporation. All other trademarks and service marks are the property of their respective owners.

Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer's responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided "as is, where is" and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.

About Microsemi

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif., and has approximately 4,800 employees globally. Learn more at www.microsemi.com.