

## DAE - 89™

Floating Point DSP module with software for AVR and surround audio applications

Momentum Data Systems DAE-8 series modules provide a high performance off-the-shelf audio processing solution for OEMs and system integrators needing a low cost, quick time to market solution.

The DAE-89 module offers up to 20 I<sup>2</sup>S ports, allowing the mixed signal portions to be selected to meet the exact system requirements. The DAE-89 is based on Texas Instruments (TI) DA810, which is functionally similar to TI's C674x floating point DSP devices.

The DAE-89 can also be used with MDS HDMI switcher/repeater products, which range from a 1:1 repeater with OSD through a 8:2 switch.

By using MDS' audio and HDMI modules system designers can quickly implement the common functions needed of all AV Receivers and focus on the unique aspects of their products.

A key aspect of any complex system is the software. All of MDS' HDMI and DAE audio modules use a simple messaging interface to control their operation. The DAE-89 module include a host-side API that simplifies the setup of common AVR operations.

For customers of MDS DAE-82 module the DAE-89 offers a direct pin compatible upgrade path to the latest Dolby and DTS decoders, though in a larger form factor package due to the need to use two DSPs. For MDS DAE-7x customers the DAE-89 is a functional equivalent offering 1.5 to 3 times the DSP MIPs.

Also available is the APM-89L, which adds an ARM running Linux to the module design to create a more semi-autonomous audio subsystem.

For OEMs and integrators needing assistance with analog, system or software design, MDS' Audio Services Group can provide design services ranging from consulting through complete product design.

### AVR decoder firmware

Combined with that hardware platform is firmware that enables certain specific processing features that are common to AV Receivers (AVRs, which for these products also includes Pre-Processor or Pre-Pro applications).

In the nomenclature of the TI DSP devices used on the DAE-8, the overall software environment is called the Performance Audio Framework (PA/F). This environment creates a framework for using functional modules (decoders, filters, etc.) in a flow graph style connection, with support for the control and exception processing needed in AVR applications.

Texas Instruments  
Dual DA810 DSP  
based OEM  
Audio Module  
for ATMOS &  
UHD decoder  
systems



The individual functions - audio signal processor (ASP) blocks - are configured together into standard inter-connections. MDS offers specific configurations of ASPs, both standard ones like Dolby or DTS decoders or custom ones like the Clip/Level Indicator.



A common set of core functionality is built up from a unique topology of available decoders and ASPs. Not all functions are available in all configurations and the topology may have different features.

There are a number of optional ASPs that offer functionality from 3rd parties, for example THX or Dolby Volume.

When an DAE-89 is ordered, it is assigned a 4 digit order code that both defines the hardware and the firmware configuration (i.e. the decoder, ASPs and their topology) that go with it. Unless noted otherwise, the descriptions in this datasheet refers to the firmware in a generic sense and not a specific combination of features.

### Decoder and post processing firmware

The following standard TI audio signal processing (ASP) functions are provided in the DAE-8's firmware. Note that patent holder license agreements are required for access and/or use of many of these ASPs.

The next two figures illustrate a common configuration of the ASPs on DAE-89 systems using Dolby ATMOS or DTS UHD decoders. Not shown in these diagrams are the control paths from the host and the automatic actions that can occur.

There are 15 channels available for the primary output. The number of subwoofer channels normally ranges from 1 to 3. The Dolby or DTS renderers provide output channels matched with actual speaker usage. They can also be used with PCM data to upmix to higher channel counts in the same manner that legacy systems with PLII and Neo did.

Other output configurations, such as the front L/C/R be biamped, can be supported, the only restriction being that the total output channel count be 16 or less.

Note that the GEQ, and LOU use the same ASP block, it is instantiated with different parameters. Typically only one of GEQ or PEQ would typically be used.

The Subwoofer Management (SM) ASP creates 3 channels of subs; typically a L/C/R configuration for 3 channels, but mono subs can also be used.

The tone control (TC) has selectable frequencies for low and high and wide range of cut or boost levels.

# DAE-89 Digital Audio module for ATMOS and UHD systems

## Standard TI provided decoders and matrixing

- Dolby® ATMOS
- AAC decode (ISO/IEC 13818-7:1997 5.1.0.0)

## Standard TI ASPs

- BM & SM- Bass Management II and Sub Management (per speaker bass management, 0, 1, 2, or 3 subs).
- GEQ - TI Filter Library (configured for 8 bands/chan, common coefficient)
- TI processor loading
- Audio stream split
- SRC - Sample rate conversion
- DEL - Speaker delay
- SNG - Signal/Noise generator
- DM - Downmix

## TI ASPs from 3rd parties

Subject to availability; may require additional fees including algorithm porting charges.

- DTS-UHD™
- THX® Ultra2, THX® Select2, Neural-THX® Surround

## MDS ASPs

The following are the currently available ASPs from MDS. As with the other ASPs, not all are included in the standard configurations and additions/changes may require additional fees including algorithm porting charges.

- Advanced NIC - provides additional status and control capability
- INF - Infrasonic filter (non-standard)
- SM - Support for 3 subwoofer channels (standard on dual DSP)
- TC - Tone controls

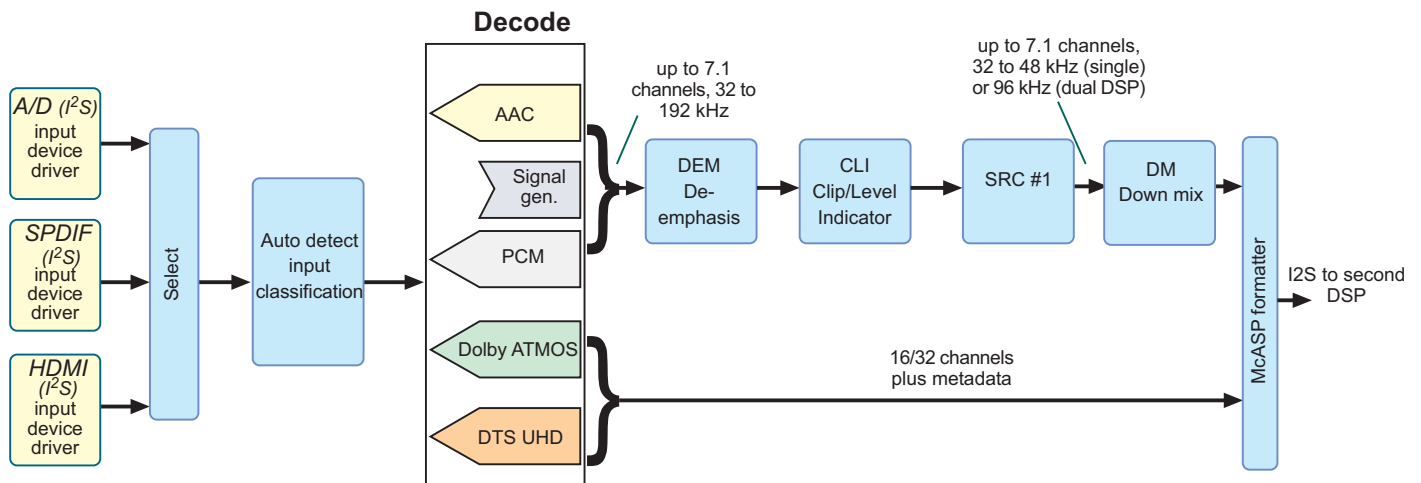
- CLI - Clip/level indicator
- ASC - Active Crossover (non-standard)
- MST - Multi-channel stereo
- PEQ - Parametric Eq allows up to 32 different bands of eq per channel (actual number of bands depends on system configuration)
- AAS/AAT - Audio Analysis Source/Tool (used for HDMI testing)

The DAE-89 modules use Texas Instruments' DA810 (part of TI's TMS320C674x+™ processor line) VLIW processor. Executing up to 8 instructions per clock cycle, these parts provide the computational power to perform I/O and decoder operations with enough CPU bandwidth left over for sophisticated sound field processing.

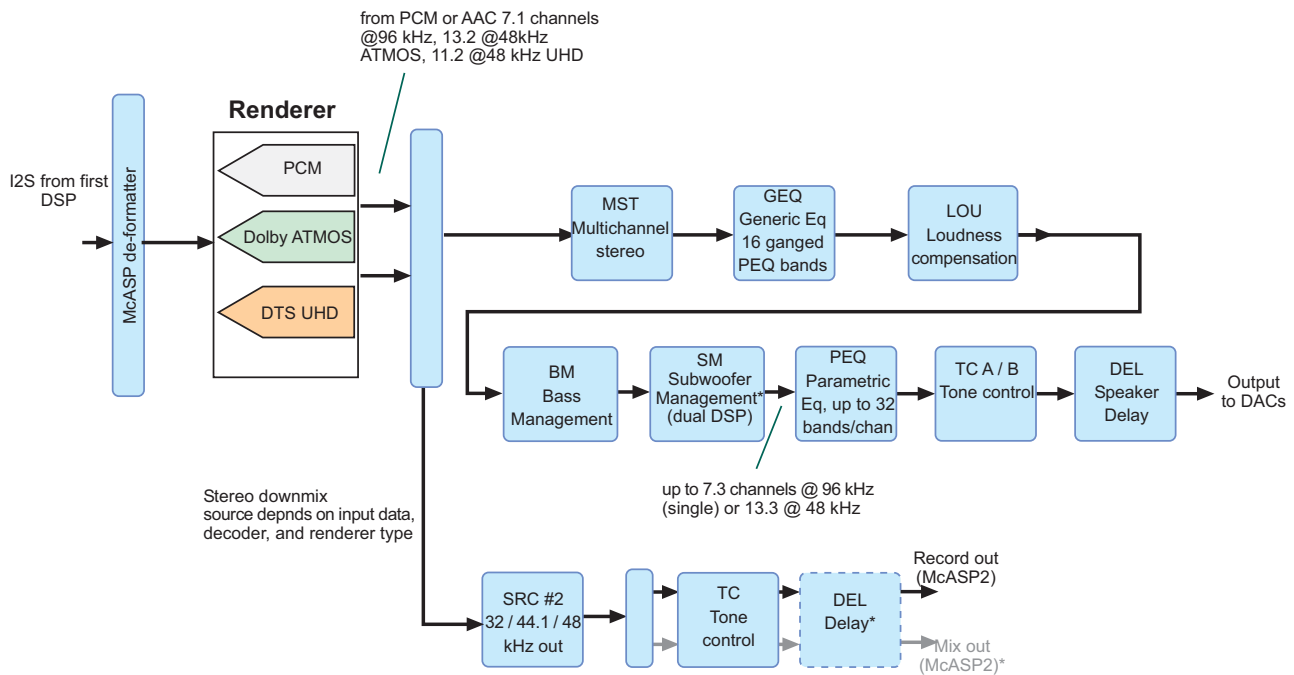
The use of floating point arithmetic throughout overcomes the inherent dynamic range limitations of fixed point (integer) processors. The DA810 has 4 floating point ALUs and 2 floating point multipliers, so there is no performance penalty associated with preferred floating point operations, particularly in filtering sections, which greatly benefit from floating point calculations to maintain wide dynamic range with low distortion.

## Creating the audio system

In addition to the typical power supply and front and rear panel hardware and associated control processor(s), signal switching/muxing, and (optional) balanced I/O, some additional hardware is needed to create a complete system with the DAE-89 modules. A single zone system is assumed, as well as the use of MDS' HDMI solutions.



**Input, decode, and ASP configuration for the front end of the signal chain.**



## Standard post decode ASP configuration.

Also required are external volume controls that have a artifact free MUTE (for example the CS3308) as well as circuitry to prevent power on/off transients on analog outputs.

An external ADC for analog input capability is supported. Up to 8 ADC channels (7.1) are supported, though from a practical aspect 6 channels (5.1) is generally all that is needed to support legacy multi-channel analog sources.

MDS offers development systems for purchase to provide a design as a starting point for your own system. Alternately MDS engineering services can be used to create custom versions specific to your requirements.

### DAE-89 module details

As described on the prior pages, what is ordered is a specific hardware plus firmware product and the price and capabilities vary depending on the feature set included.

The remainder of this section provides details on the hardware.

#### Common Features - DSP

While most features of the DSP are brought out to the digital connector, some features are not used/supported (for example, USB and UARTs). Some signal lines may only be used on certain firmware versions.

#### Common Features - connector

All DAE-8 series modules use the same 140 pin connector for digital signals and power, a Hirose FX8C-140S-SV5

receptacle. This allows mating heights of 10 to 16mm to allow circuitry to be placed under the board if desired; do not place any analog circuitry under the DAE module.

The DAE-89 uses 3.3 and 5V power from the digital connector. On the DAE-89 board the peak 3.3V power is 3A. About 100 mA is used on the 5V supply.

#### Common Features - booting

All modules are intended to boot from a local SPI serial flash. The host can write to this flash directly for field updates.

JTAG is available for use with CCS compatible emulators, but a Tag-Connect adapter is needed. Please contact MDS for more information

#### Common Features - control

The board is controlled through an I2C port on the DSP. A messaging protocol developed by TI (Alpha Messaging) is used to interact with the board. (Higher level libraries are provided for common AVR functions to isolate the complexity of the low level messaging.)

#### Common Features - I2S ports

With the exception of a few I2S data lines, the three McASP ports on the DA8xx device are brought out to the connector. From the raw hardware perspective this provides up to 20 I2S data lines in three clock domains.

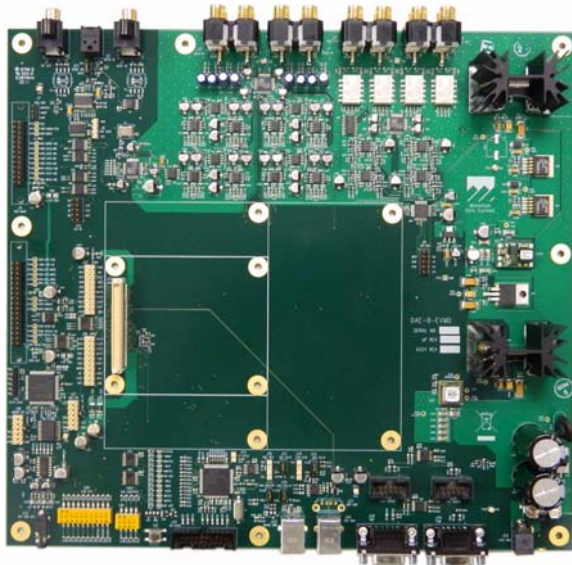
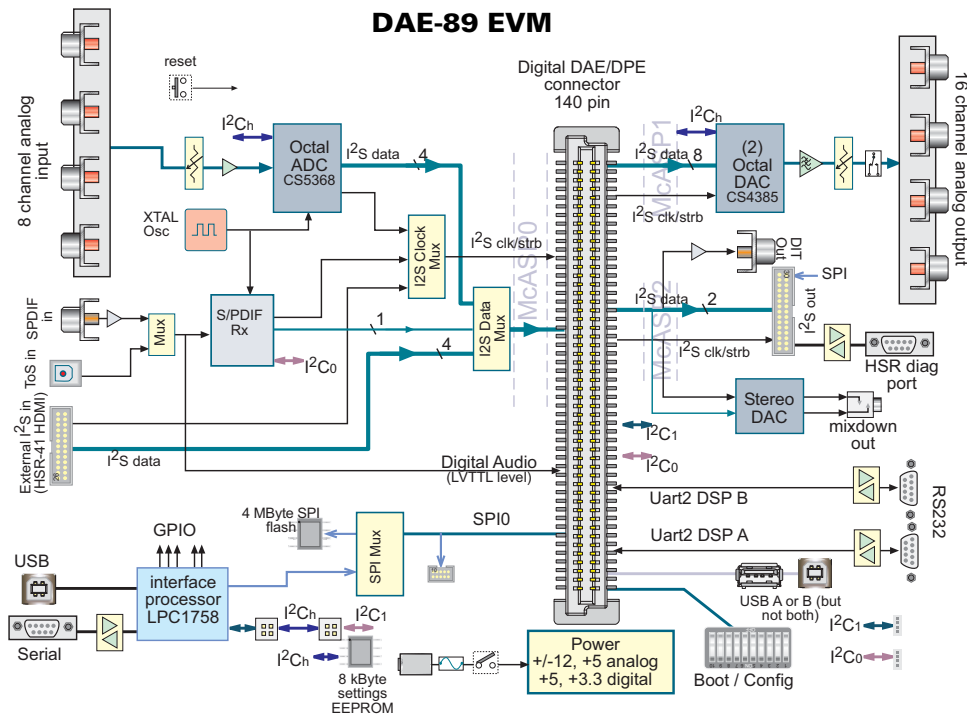
However the AVR firmware makes specific use of certain ports. 4 data lines of McASP0 are used for audio input.



# DAE-89 Digital Audio module

## HDMI input/output

MDS offers a number of different HDMI repeater/switching solutions to provide access to the audio carried by HDMI interconnects.



**DAE-89 EVM board.**

Typically the downstream HDMI device will be a TV or similar display device which does not decode audio. In that case the DAE-8 is configured to provide the stereo downmix as 2 channel PCM for the HDMI output of the AVR.

# DAE-89 Digital Audio modules

## Ordering information (order code is in *Italics*)

Shipment of DAE-8 products with decoder capability requires appropriate license information from Dolby Labs and Digital Theater Systems.

Modules orders are subject to minimum quantities, please contact MDS sales department for a quotation.

Ordering codes consist of the hardware model followed by 2 or more alpha-numeric code that indicates a specific combination of firmware modules (standard and optional).

Some features may incur additional charges for porting or per unit license fees.

*EVM-DAE-89xx*: DAE development system.

- DAE MotherBoard (includes 13.3 analog out) for DAE-89
- DAE-89xx module
- Power supply
- HSR-41 HDMI repeater module

## Supported ADC/DACs/Volume controls

Different parts have different control requirements. While in most cases the host processor can take responsibility, there are some direct hardware level interactions that the DAE board needs to be involved with (for example the MUTE signals).

Please contact MDS to discuss hardware choices and to determine if specific hardware might require modification to the DAE's drivers.

*Some options require MDS to create a customer specific firmware release and incur a porting charge. These charges do not include the license fee from the algorithm vendor. Adding additional processing options will reduce CPU availability for other features.*

Consulting services are also available from Momentum Data Systems.

## Related items

Please visit <http://www.mds.com> for more information on these and other products to speed your design to market.



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DAE-89 Data Sheet rev 1b Sep 2014 Specifications subject to change

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