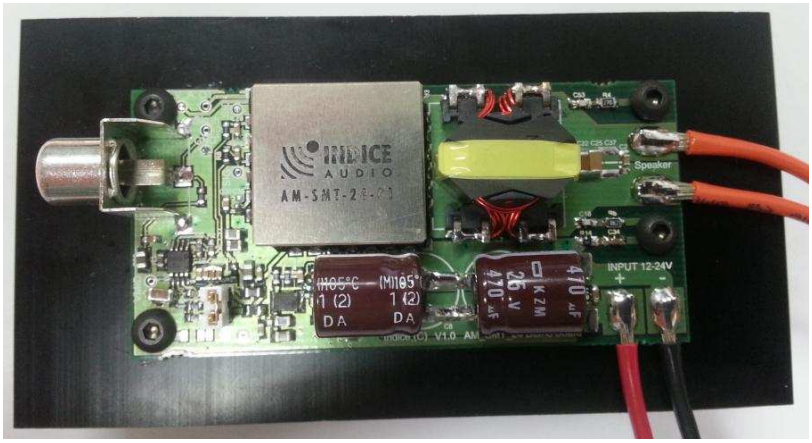
Datasheet – AM-SMT-24-01 Demo board

Indice Semiconductor Pty Ltd

Demo board for the Blade Power Amplifier Module



Features

- THD (min): <0.003%
- SNR: 114dB @ 24V
- Capable of 364W continuous into 1 Ω @ 27V
- Line level audio input for plug and play evaluation.
- Module dimensions: 24mm x 22mm
- SMT Mounting

Applications

- AV home audio, iPod docks, linear speakers, active speakers
- Automotive, marine
- Standalone power amps

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1 Introduction

1.1 Overview

Indice's Power Amplifier '*Blade*' provides class leading acoustic fidelity and control in a highly efficient, small package. Delivering uncompromising control of speakers with excellent attack, fade and phase response, the *Blade* has an impressive 114dB SNR and THD < 0.003. This is only possible with Indice's proprietary Continuous Sigma encoding with direct drive technology.

This demo board is recommended for use in evaluating the blade module with an external regulated power supply, loudspeaker and consumer audio source such as a PC sound card or mobile audio device.

1.2 Module Benefits

The Indice *Blade* enables audio equipment manufacturers to reduce power consumption, size, weight, and cost of their audio products. The demo board can be used either in free-air or with an additional heat sink by simply attaching the thermally enhanced board to a metal surface.

- **Ultra Small Package:** Combined with ultra high efficiency reduces the size and space required for thermal heat sink and controls.
- **Incredible power density:** Each *Blade* module is capable of continuous 180WRMS into a 2Ω load without heat sinking, with heat sinking, the amplifier can deliver 360 WRMS into 1Ω at 1% distortion.
- **High efficiency:** >96% efficient allows truly high density design with minimal heat sinking
- **Thermal cutoff:** In the event the module gets too hot, it features intelligent shutdown to prevent damage to the module and surrounding system.
- **Continuous sigma encoding:** Enables excellent attack, fade and phase alignment and with an asynchronous carrier, the EMI profile is dramatically reduced.
- **Excellent PSRR:** Our control scheme actively cancels out rail fluctuations resulting in a high Power Supply Rejection Ratio.
- **EMC:** Designed to meet the requirements of CISPR 25 and FCC providing the reference design recommendations are followed and correct system layout and other precautions are taken.

1.3 Indice Semiconductor Pty Ltd Support Contacts

The following key contacts should be used for any additional correspondence and queries in response to this document.

Email	support@indicesemi.com
Phone	+61 3 9831 7400 (9am – 5pm, Mon – Fri, UTC+10:00)

1.4 Demo board connectivity

Below in Figure 1 and Table 1 are details on the pin out and pin functions for the Blade audio module demo board.

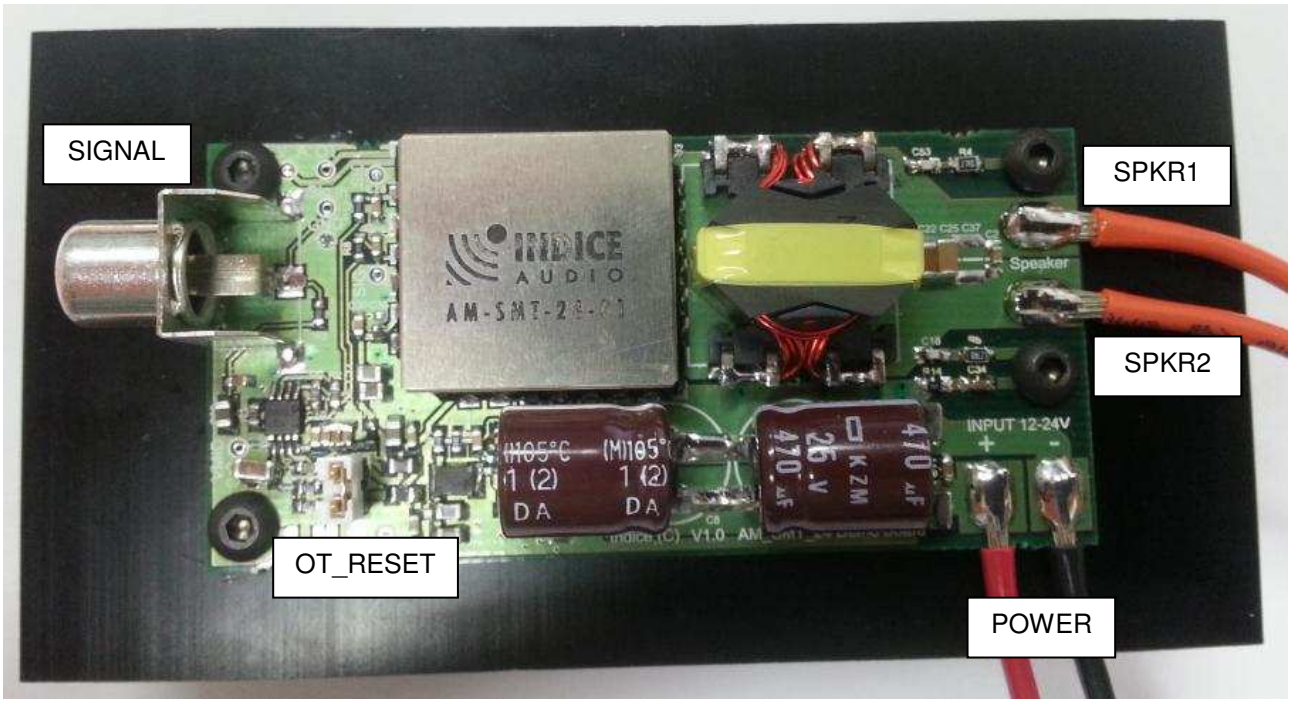

Figure 1: Top view of AM-SMT-24-01 demo board with pins labelled

Name	I/O	A/D	Description
SIGNAL	I	A	1VRMS audio input
SPKR1	O	A	Positive speaker output
SPKR2	O	A	Negative speaker output
Vin +	I	A	Positive power supply input. 12 – 27VDC.
Vin -	I	A	Negative power supply input.
OT_RESET	I	D	Header/switch allowing reset of the module after an over temperature condition. This switch also provides mute/low power standby functionality.

Table 1: Pin functions of AM-SMT-24-01 demo board– Input or O – Output. A/D column indicates either A – Analogue or D – Digital.

1.5 Demo board specifications

Parameter	Minimum	Nominal	Maximum	Conditions
Supply operating voltage	12V	24V	27V	
Supply voltage – Damage threshold			29V	
Output load resistance	1Ω		∞	
THD at minimum point		0.003%		4Ω load
Noise floor, SNR				4Ω load
12V		23µV, 112dB		
24V		34µV, 115dB		
27V		40µV, 114dB		
Output offset voltage		3mV		Vin=27V
Efficiency, at rated power		97%		4Ω load, Vin=27V
Idle losses				No load
12V		420mW		
24V		960mW		
27V		1.35W		
Standby power		72mW		Vin=24V, 5V_D=0V
5V_D current		25mA		Vin=24V, 5V_D=5.2V
Input signal for full output swing		1V RMS		Vin=27V
Voltage gain, end to end		60dB		

Table 2: Table of specifications, these values are subject to change without notification

	12V	27V
Output power, Rload 4ohm	18W	96W
2ohm	36W	189W
1ohm	72W	351W

Table 3: Expected continuous output power into resistive loads at 1% distortion due to rail clipping. 1KHz sinusoid – use as rough guide for speaker and PSU rating

2 Demo board Functionality

2.1 Basic System Diagram

Figure 2 is a basic system diagram depicting the AM-SMT-24 Demo Board.

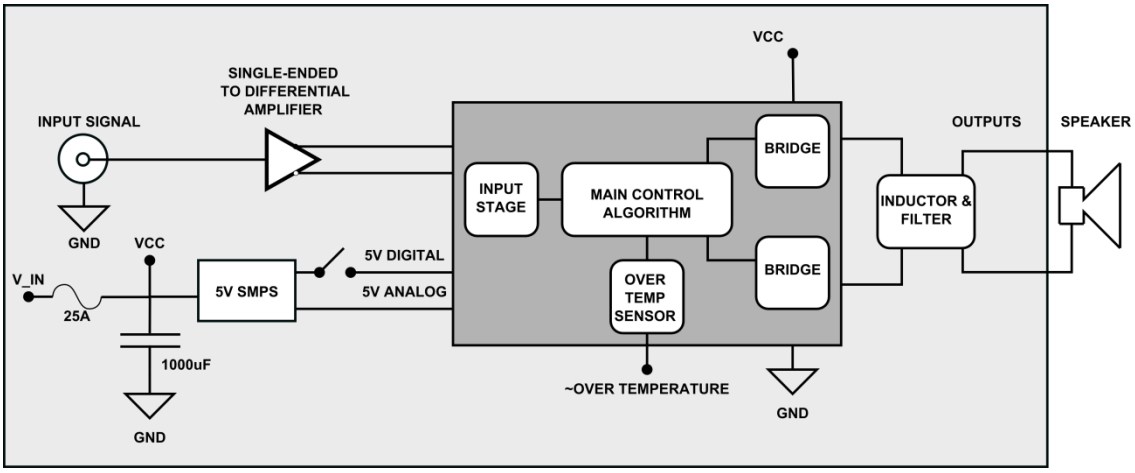

Figure 2: Basic system diagram

2.2 Power supply considerations

The power supply unit (PSU) must be capable of driving peak current into the desired load or reduced performance will result due to clipping as the rail voltage fluctuates. The requirement on the PSU can be minimised by using additional parallel capacitance which provides the transient currents while the PSU provides currents which are closer to the average. The demo board has 1000uF onboard.

The customer must measure the ripple of VCC into each amplifier channel to ensure the maximum voltage rating of the module is not exceeded. Generally, more power supply capacitance is better however there is a cost benefit that the customer will need to determine for their implementation.

A 25A fuse (F1) protects the entire circuit. However this fuse may blow when providing full power into <1ohm loads at >24V. If required, short out this fuse and use an appropriately rated external fuse in-line with the input rail.

Note: If a bidirectional supply such as our Indice car audio PSU is used, then excess energy is fed back into the external energy source (for example, a car battery) and rail capacitance can actually be kept very small, usually requiring no electrolytic capacitors if an external battery is available.

2.3 Output load and thermal considerations

A single loudspeaker with total impedance of >1ohm can be used. The module can be operated at continuous full power into >2ohm loads without heat-sinking.

For full power capability into <2ohm loads, heat-sinking is recommended: The board is fully surface mount and single sided, this allows direct thermal contact to a metal surface with the use of a thermal compound. M3 mounting holes are provided to hold the demo board on the heat-sink.

The module comes standard with over temperature protection circuitry that prevents damage to the internal electronics in the event that heat sinking is not sufficient for the power being driven into the load. When the over temperature shutdown activates, OT~ is driven LOW and the module output (audio) is muted. In order to restore normal operation, the module temperature must be under the cut-off temperature (this function has approximately 5°C of hysteresis) at which point OT~ will be driven high. Power must then be removed from 5V_D for a minimum of 25ms. Normal operation will resume when power is reapplied to 5V_D. The demo

board has a switch (or header on earlier boards) which allows manual resetting in this manner. Removing power from 5V_D can also be used to disable the output, placing the module into a low-power state.

2.4 Input signal conditioning

The demo board is configured for interfacing with consumer audio sources of 1VRMS line-level. It contains a single-ended to differential amplification circuit shown in Figure 3 which amplifies the line-level signal and provides the 5V differential signals required for operation of the blade module. A 1VRMS sinusoidal signal will result in full power with a 27V rail. If a lower input rail voltage is being used, scale the input signal accordingly.

The amplification circuit used in the demo board is trading off performance for ease of evaluation – providing the ability to use consumer-grade audio sources. For full audio performance in an integrated solution it is recommended to use a differential audio source (such as a DAC's differential outputs) and keep the signals fully differential and as large as possible until they are buffered for the blade module's 0-5V inputs. This reduces the impact of common-mode noise sources and increases SNR. That said, the circuit in Figure 3 is not mandatory and the amplifier can be operated single ended with a reduction in its performance specs. Of particular note, full rail output can only be reached using the full swing of both differential inputs.

Refer to the AM-SMT-24-01 module datasheet for the recommended system implementation for the AM-SMT-24-01 module.

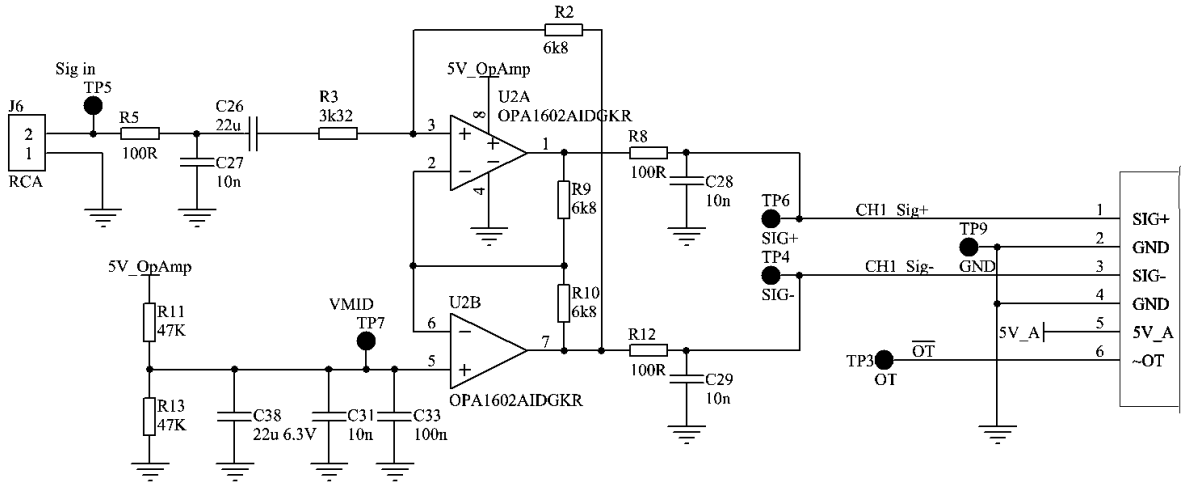

Figure 3 – Converting single ended input to differential

2.5 Output stage and EMI filtering

The circuit depicted in Figure 4 is implemented on-board to ensure correct operation when driving a load. L1 and C1 stop majority of switching noise from reaching the load while R1, R2, C2 and C3 act as snubbers to remove high frequency components so the amplifier is EMI compliant. The circuit includes a connection to the amplifier CHASSIS which is critical in the function of this filter.

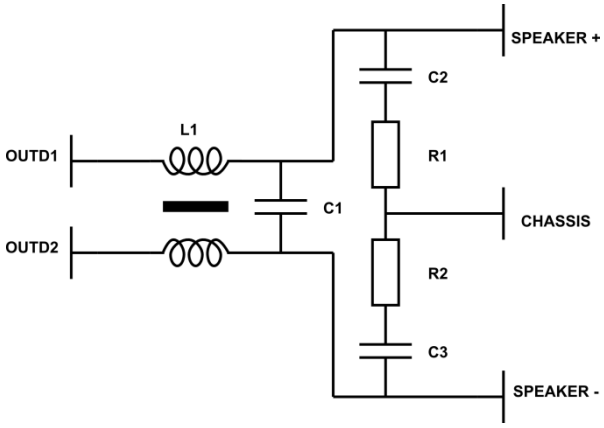

Figure 4 – Output stage filter and EMI filter. CHASSIS = Metal chassis of the amplifier housing

Filter component values:

- L1 is a shared-core differentially wound inductor with total inductance of 2.8uH – Refer to magnetic specification AM-SMT-IND-1.PDF for construction details
- C1= ~1uF consisting of 2 x 470nF, 1 x 100nF, 1 x 1nF + 100pF Ceramic Capacitors, X7R, >35V, 1206
- CHASSIS = Chassis connection to the case of the amplifier which is recommended to be metal.
- C2 / C3 = 100pF Ceramic Capacitor, X7R, >35V, 1206
- R1 / R2 = 0R 0805

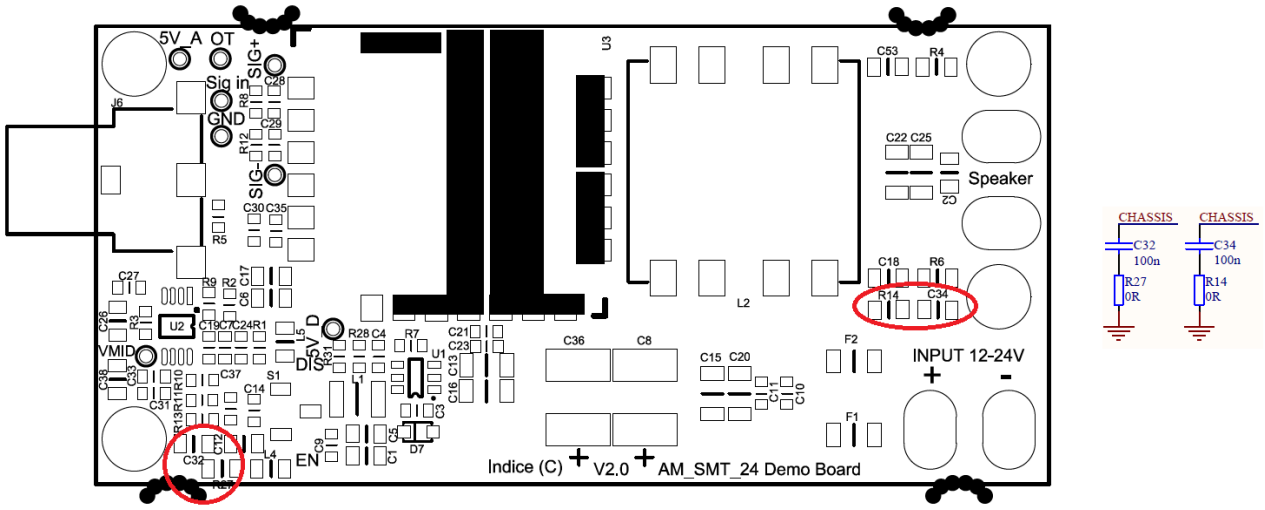

Figure 5 – Chassis to GND connection

Housing and installation:

It is recommended the Blade amplifier is installed inside a metal housing with the CHASSIS connection made between the demo board and the metal housing per Figure 4 and Figure 5.

3 Ordering Information

Ordering code	Interface	Description
AM-SMT-24-01	SMT	Power amplifier module (*Blade*)
EVM-1-SMT-01	EVB	Single channel evaluation board

4 Revision Control

Version	Date	Details
0.1	15/07/2014	Document creation
0.2	17/07/2014	First edit
0.3	22/07/2014	Power supply considerations and specifications added
0.4	28/7/2014	Formatting of tables changed for consistency and fixed broken reference links
0.5	04/08/2014	Updated specifications for module performance throughout the document
0.6	21/08/2014	Updated section 2.5
0.7	03/09/2014	Updated section 1.5, 2.2
0.8	16/09/2014	Updated section 1.5
0.9	02/10/2014	Updates to section 1.1, 1.5, 3