



**DESCRIPTION**

The A2013H is a Low EMI, Filterless, 5W Mono Class D Audio Amplifier. The A2013H original Enhanced Emission Elimination which reduces EMI-radiated emissions. Filter less Amplifier Passes FCC Radiated Emissions Standards with 100mm of Cable.

The A2013H has the power-down function which can minimize the power consumption in the standby state. As for protection function, overcurrent protection function for speaker output terminal, over temperature protection function for inside of the device, and low supply voltage malfunction preventing function are prepared. while offering efficiencies above 90%. A patented, low-EMI modulation scheme renders the traditional classD output filter unnecessary, conserving board space.

The A2013H is available in MSOP-8, PSOP8 and DFN8 (2x2) packages.

**ORDERING INFORMATION**

Package Type	Part Number	
PSOP8 SPQ:4,000pcs/Reel	MP8	A2013HMP8R
		A2013HMP8VR
MSOP8 SPQ:3,000pcs/Reel	MS8	A2013HMS8R
		A2013HMS8VR
DFN8 (2x2) SPQ:3,000pcs/Reel	J8	A2013HJ8R
		A2013HJ8VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

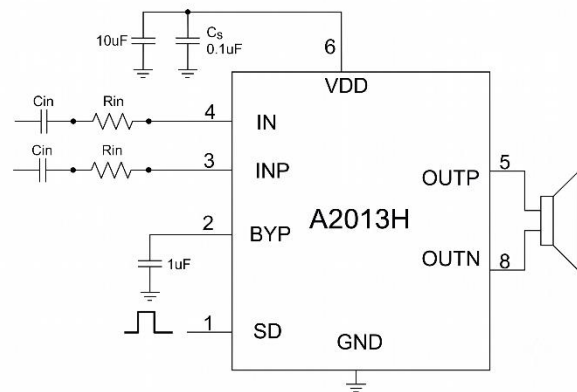
**FEATURES**

- High PSRR (80dB at 1kHz)
- Power Output:  
5.0W @5.0V, 10%THD+N, 2Ω  
3.5W @5.0V, 10%THD+N, 3Ω  
3.0W @5.0V, 10%THD+N, 4Ω
- 0.2%THD (0.5W、5V)
- Filter less ClassD
- 90% Efficiency
- 3.0-mA Quiescent Current (VDD=5V, No load)
- 2.0- 5.5V operation
- Over-current, Thermal and Low voltage Malfunction Protection function
- Improved pop & click circuitry eliminates noise during turn-on and turn-off transitions

**Application**

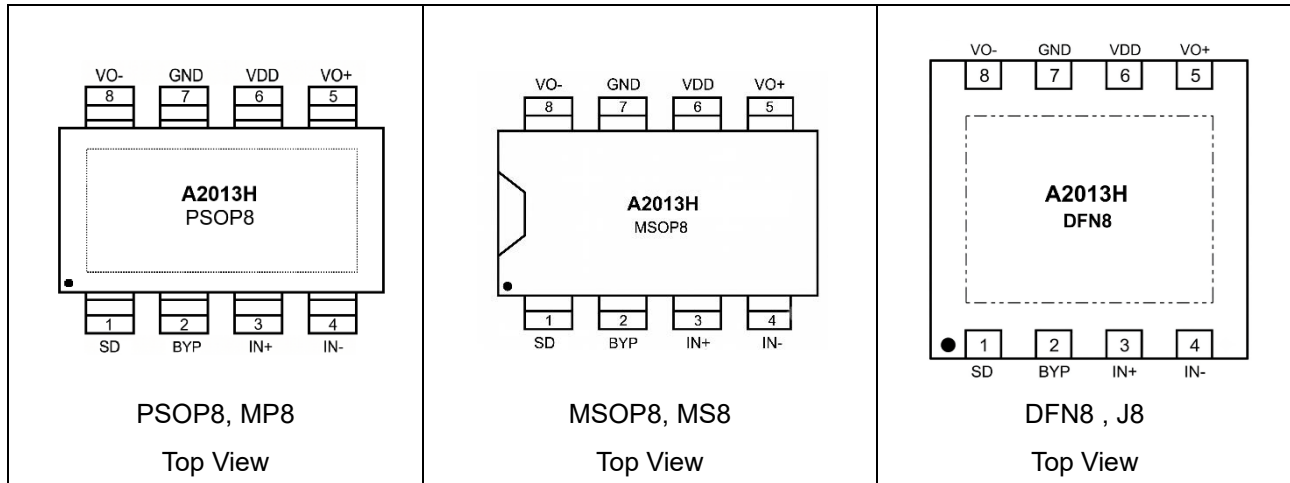
- Cellular Handsets
- Digital Camera
- PDAs
- Portable Information Appliances ( MP3 / MP4 / DFP / Portable DVD)

**TYPICAL APPLICATION**





**PIN DESCRIPTION**



Pin Number			Pin Name	Function
PSOP8	MSOP8	DFN8 (2x2)		
1	1	1	SD	Chip Enable (High Effective)
2	2	2	BYP	Bypass Capacitance Input Pin
3	3	3	INP	Positive Input Terminal
4	4	4	IN	Negative Input Terminal
5	5	5	OUTP	Positive Output Terminal
6	6	6	VDD	Power Supply
7	7	7	GND	Ground Pin
8	8	8	OUTN	Negative Output Terminal
9	-	9	Exposed pad	Connect to GND



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage	-0.3V~6.0V
Input Voltage	-0.3V~V <sub>DD</sub> +0.3V
Power dissipation	1W
Lead Temperature	+260°C
Junction Temperature	- 40 ~ +85°C
Storage Temperature	-65 ~ +125°C
ESD HBM Model	4000V

Stress beyond above listed "Absolute Maximum Ratings" may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



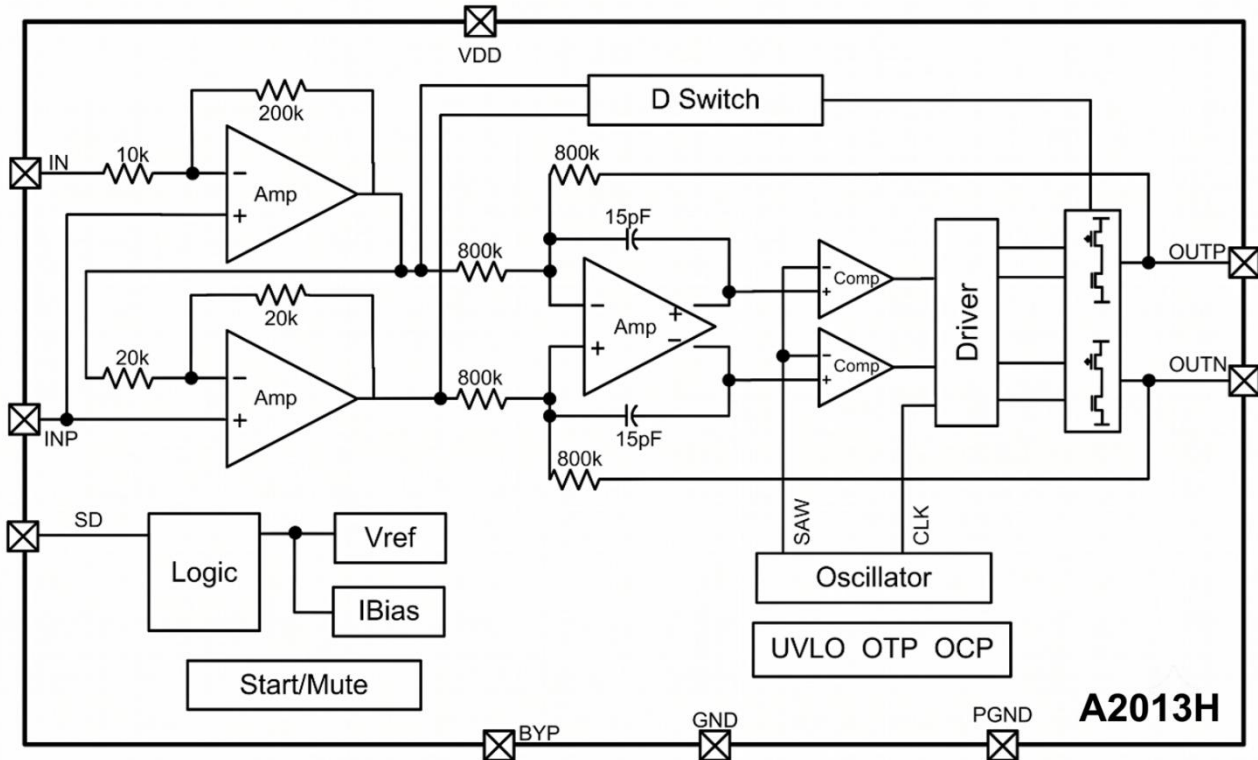
**ELECTRICAL CHARACTERISTICS**

V<sub>DD</sub> =5V, R<sub>L</sub>=4Ω unless otherwise specified. Typical values are at T<sub>A</sub> = 25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V <sub>DD</sub>	-	2.0	-	5.5	V
Quiescent Current	I <sub>Q,D</sub>	VSD=3.6V, No load	-	3	-	mA
Shutdown Current	I <sub>SHDN</sub>	VEN=0V	-1	-	1	uA
Shutdown Voltage Input High	V <sub>SDIH</sub>	-	1.5	-	-	V
Shutdown Voltage Input Low	V <sub>SDIL</sub>	-	-	-	0.4	
Output Offset Voltage	V <sub>OS</sub>	-	-	±10	-	mV
Output Power	P <sub>O</sub>	RL=2Ω, THD+N=10%, f=1kHz	-	5	-	W
		RL=3Ω, THD+N=10%, f=1kHz	-	3.5	-	
		RL=4Ω, THD+N=10%, f=1kHz	-	3	-	
		RL=8Ω, THD+N=10%, f=1kHz	-	2	-	
Total Harmonic Distortion + Noise	THD+N	2V/2V, R <sub>L</sub> =4Ω, P <sub>O</sub> =500mW	-	0.2	-	%
Efficiency	η	-	-	89	-	%
Power Supply Rejection Ratio	PSRR	No input, f=1kHz, V <sub>PP</sub> =200mV	-	80	-	dB
Carrier clock frequency	f <sub>OSC</sub>	-	-	400	-	kHz
VDD Under Voltage Protection Voltage	V <sub>UVLO</sub>	-	-	2	-	V
SD_ON Time	T <sub>SD_ON</sub>	-	-	300	-	ms
SD_OFF Time	T <sub>SD_OFF</sub>	-	-	50	-	ms
Thermal Protection	T <sub>SD</sub>	Thermal Shutdown	-	160	-	°C
		Thermal Shutdown Delay	-	25	-	°C



**BLOCK DIAGRAM**





## DETAILED INFORMATION

- **External device selection :**

### Input resistance Rin

The gain of the amplifier can be configured by choosing the parameter value of the input resistance:

$$\text{Gain} = \frac{400k\Omega}{R_{in} + 10K}$$

Low gain and large signal input can achieve the best performance, and the input resistance should be as close as possible to the input pin of the chip to obtain a better signal-to-noise ratio.

### Input capacitance Cin

In a typical application circuit, the input capacitor Cin should make the amplifier input signal best at DC level. The corner frequency of the high-pass filter is determined by the input capacitor Cin and the lowest input impedance Rin, and it is recommended to use 0.1uF~0.47uF.

$$f_c = \frac{1}{2\pi \times R_{in} \times C_{in}}$$

The leakage path of the capacitor is the input source through the input network (Rin, RF, Cin) to the load, this leakage current creates a DC bias voltage at the input of the amplifier, reducing the input voltage. For this reason, low leakage tantalum or ceramic capacitors are recommended.

- **Power supply decoupling capacitor CS**

The A2013H requires sufficient power supply decoupling capacitors to keep THD and PSRR as low as possible. Using different types of capacitors for different types of noise on the power supply is the best decoupling method. For higher frequency transients, it is recommended to use a 0.1uF low ESR ceramic capacitor as close as possible to the device VDD terminal. To filter low-frequency noise signals, it is recommended to use a capacitor of 10uF or above, and the location should be close to the audio power amplifier.

- **Digital Amplifier Function**

The A2013H has digital amplifiers with analog input PWM pulse output and maximum output 5W (RofL=2Ω) ×1ch. Distortion of PWM pulse output signal and noise of the signal is reduced by adopting “Pure Pulse Direct Speaker Drive Circuit”.

In addition, A2013H has been designed so that high-efficiency can be maintained within an average power range (100mW or so) that is used for mobile terminal.



• **Pop noise reduction function**

The Pop Noise Reduction Function works in the cases of Power-on, Power-off, Power-down on, and Power-down off and, the pop-noise can be suppressed according to control the power down by the following procedure.

- Power down mode is cancelled after power-on and the power supply is stabilized enough.
- Power down mode is set before Power-off.

• **SD terminal function**

Only a switching control between open mode and Power-down mode is available when a single control terminal is used.

SD	Mode
H	Open
L	Shutdown

• **Efficiency**

The theoretical best efficiency of a linear amplifier is 78%; however, that efficiency is only exhibited at peak output powers. Under normal operating levels (typical music reproduction levels), efficiency falls below 30%, whereas the A2013H still exhibits >90% efficiencies under the same conditions.

**Bypass terminal output:**

The voltage of VDD/2 is output from the bypass terminal. Capacitor (1 $\mu$ F) is connected between the bypass terminal and GND for stabilization.

• **Protection Function**

A2013H has the following protection functions for the digital amplifier: Over-current Protection function, Thermal function condition Under voltage Lockout.

• **Over-current Protection function**

This is the function to establish the over-current protection mode when detecting a short circuit between A2013H differential output terminal and VDD, or another differential output. In the over current protection mode, the differential output terminal becomes a high impedance state. The over current protection mode can be cancelled by power down or turning on the power again.

• **Thermal Protection function**

This is the function to establish the thermal protection mode when detecting excessive high temperature of A2013H itself. In the thermal protection mode, the differential output terminal becomes Weak Low state (a state grounded through high resistivity). And, when A2013H gets out of such condition, the protection mode is cancelled.



- **Undervoltage Lockout**

The A2013H has an automatic shutdown function at low voltage. When the power supply voltage drops below 2.1 V, the A2013H enters the shutdown state; when the device is in the shutdown state, turning on the power supply, or resetting the SD pin level can make the device work again.

- **When to Use an Output Filter**

Design the A2013H without an output filter if the traces from amplifier to speaker are short. The A2013H passed FCCCE radiated emissions with no shielding with speaker trace wires 100 mm long or less wireless handsets and PDAs are great applications for class-D without a filter.

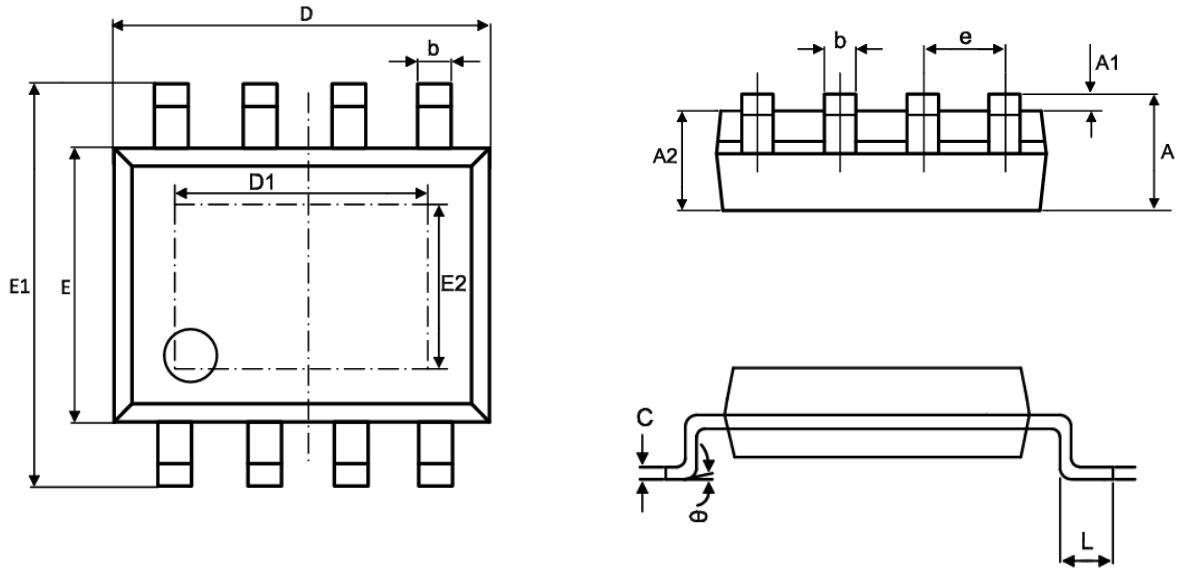
A ferrite bead filter can often be used if the design is failing radiated emissions without an LC filter, and the frequency sensitive circuit is greater than 1 MHz. This is good for circuits that just have to pass FCC and CE because FCC and CE only test radiated emissions greater than 30 MHz. If choosing a ferrite bead, choose one with high impedance at high frequencies, but very low impedance at low frequencies.

Use an LC output filter if there are low frequency (< 1 MHz) EMI sensitive circuits and/or there are long leads from amplifier to speaker.



**PACKAGE INFORMATION**

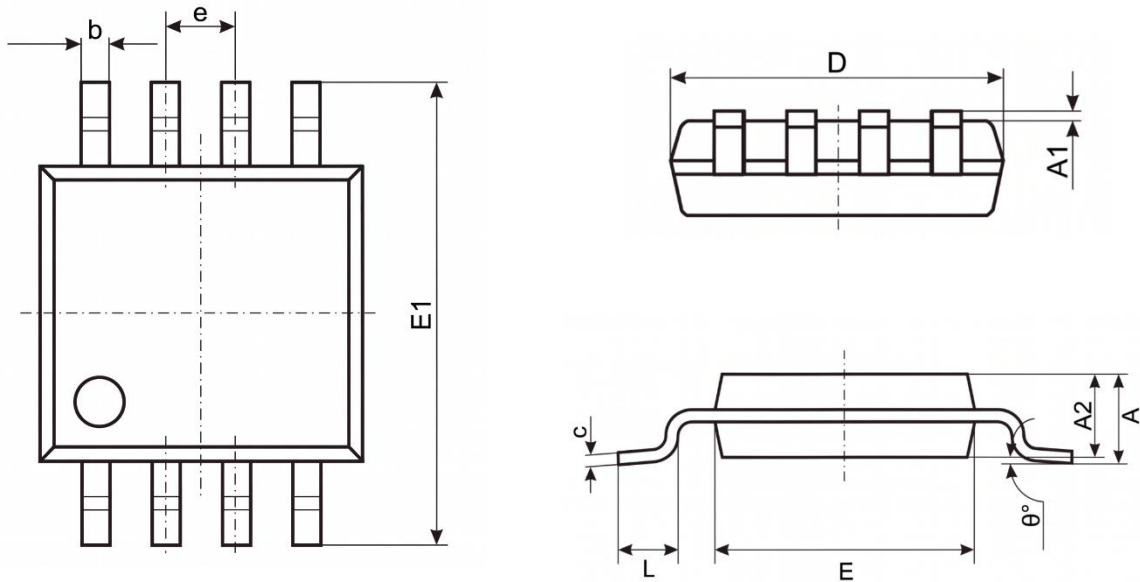
Dimension in PSOP8 (Unit: mm):



Symbol	Millimeters	
	Min	Max
A	1.350	1.750
A1	0.050	0.150
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
D1	3.202	3.402
E	3.800	4.000
E1	5.800	6.200
E2	2.313	2.513
e	1.270 BSC	
L	0.400	1.270
θ	0°	8°



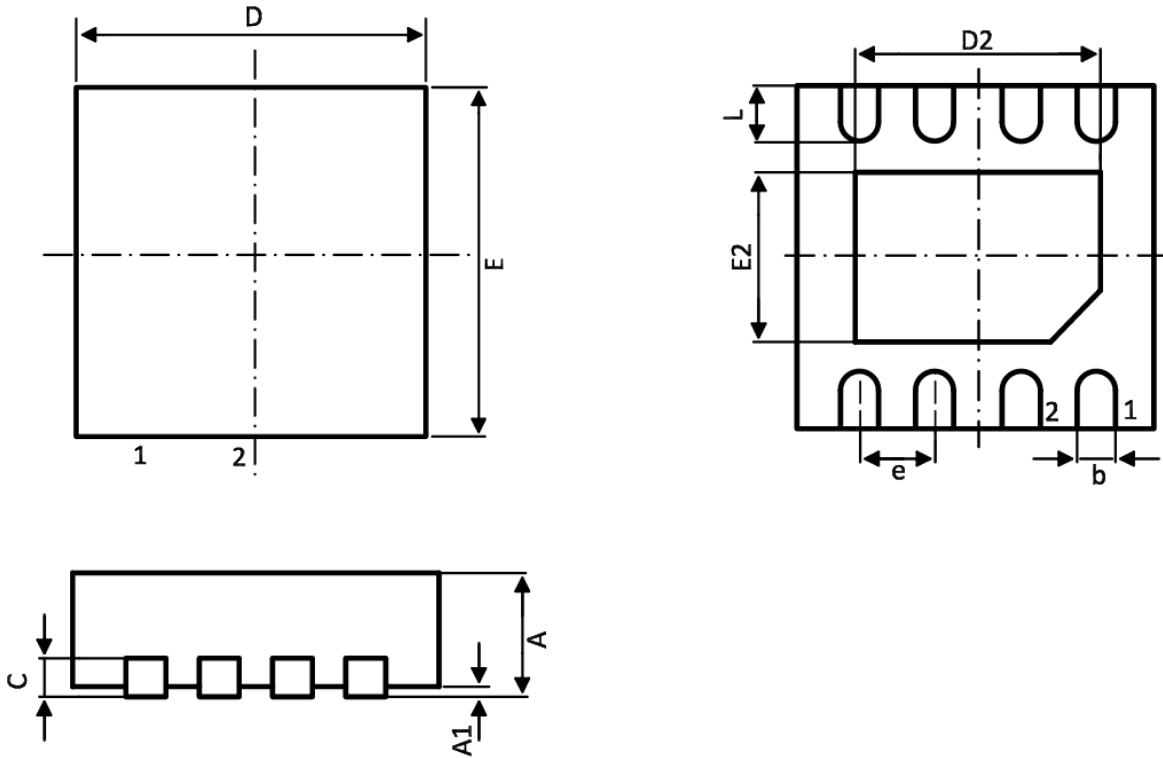
Dimension in MSOP8 (Unit: mm):



Symbol	Millimeters	
	Min	Max
A	0.820	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.250	0.380
c	0.090	0.230
D	2.900	3.100
E	2.900	3.100
E1	4.750	5.050
e	0.650 BSC	
L	0.400	0.800
$\theta$	0°	6°



Dimension in DFN8 (2x2) (Unit: mm):



Symbol	Millimeters	
	Min	Max
A	0.70	0.80
A1	-	0.05
b	0.25	0.35
c	0.18	0.25
D	2.90	3.10
D2	2.50 REF	
E	2.90	3.10
E2	1.55 REF	
e	0.65 BSC	
L	0.30	0.50



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