2.7W Mono Filter-less Class-D Audio Amplifier with Default Gain +18dB

Features

- Supply voltage range: 2.5 V to 5.5 V
- Support single-ended or differential analog input
- Low static operation current
- Low shut-down current
- Short power-on transient time
- Internal pull-low resistor on shut-down pins
- Short-circuit protection
- Over-temperature protection
- Default gain +18dB
- Loudspeaker power within 10% THD+N
  - 1.66W/ch into 8Ω loudspeaker
  - 2.70W/ch into 4Ω loudspeaker
- Loudspeaker efficiency
  - 90% @ 8Ω, THD+N=10%
  - 85% @ 4Ω, THD+N=10%
- TDFN-8 packages
- Integrated de-pop circuitry
- Internal generated 450kHz switching frequency

Applications

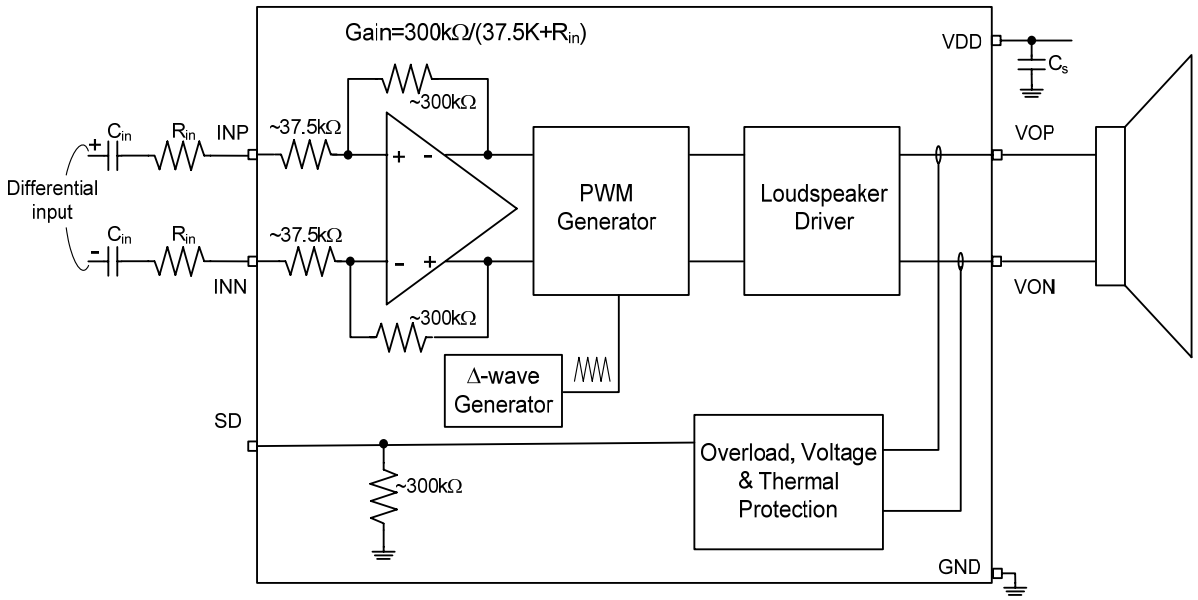
- Monitor audio
- PDA
- Portable multimedia devices
- Notebook computer
- Mobile phone

Description

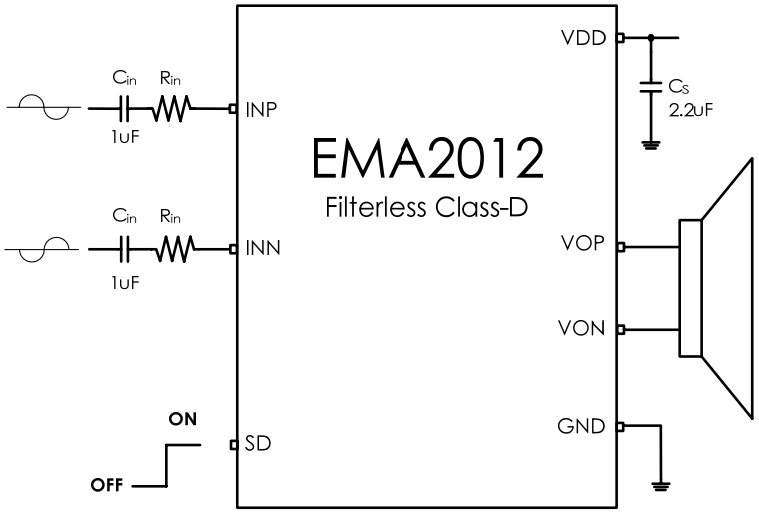
The EMA2012 is a mono, filter-less class-D audio amplifier. Operating with 5.0V loudspeaker driver supply, it can deliver 2.7W output power into 4 Ω loudspeaker within 10% THD+N or 2.2W at 1% THD+N. The gain can be reduced by external input resistors.

The EMA2012 is a mono audio amplifier with high efficiency and suitable for the notebook computer, and portable multimedia device.

Functional Block Diagram

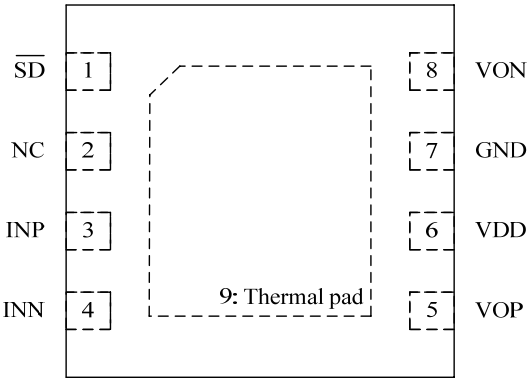


Typical Application Circuit



Pin Assignments

TDFN-8

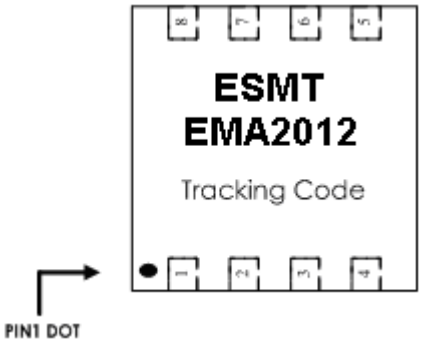


Order information

EMA2012-50FF08NRR

50	5.0V Operation
FF08	TDFN-8 Package
NRR	RoHS & Halogen free
	Rating: -40 to 85°C
	Package in Tape & Reel

Order, Mark and Packing Information

Package	Product ID	Marking	Packing
TDFN-8	EMA2012-50FF08NRR		5K units Tape & Reel

Pin Description

NAME	PIN	IO TYPE	DESCRIPTION
	TDFN-8		
$\overline{SD}$	1	I	Shutdown EMA2012 (Low active logic)
NC	2	NC	No internal connect
INP	3	I	Positive differential input
INN	4	I	Negative differential input
VOP	5	O	Positive output
VDD	6	P	Power supply
GND	7	G	Power ground
VON	8	O	Negative output
Thermal pad	9	G	Must be connected the package thermal pad to PCB thermal land.

Available Package

Package Type	Device no.	θ_{JA} (^{o}C/W)	Exposed Thermal Pad
TDFN-8 (3x3mm)	EMA2012	45.8	Yes

Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNIT
VDD	Supply for analog cells & loudspeaker driver	2.5	6.0	V
	Input voltage	-0.3	5.5	V
T_{stg}	Storage temperature	-65	150	^{o}C
T_a	Ambient operating temperature	-40	85	^{o}C

Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
VDD	Supply for analog cells & loudspeaker driver	2.5	5.5	V
V_{IH}	High-Level Input Voltage	70% X VDD	VDD	V
V_{IL}	Low-Level Input Voltage	0	35% X VDD	V

General Electrical Characteristics (T_A=25°C)

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNIT
Iq	Operating current	VDD=SD=5V		5.7		mA
I_{PD}	Supply current during power-down mode	VDD=5.0V; SD#=0		2	50	μA
V_{offset}	Output offset voltage	Input ac grounded, VDD=2.5V ~ 5.0V		5	25	mV
Tsd	Junction temperature for driver shutdown		145	150	155	°C
Thys	Temperature hysteresis for recovery from shutdown		115	120	125	°C
f_{sw}	Switching rate of loudspeakers driver		300	450	600	kHz
Ton	Turn-on time	VDD = 3.6 V		1	4	msec
R_{SC}	Loudspeaker short-circuit detect resistance	VDD = 5.0 V		2.8	3.2	ohm

Electrical Characteristics and Specifications for Loudspeaker

- Gain= 8V/V, Load=8Ω, f_{in}=1 kHz (unless otherwise noted)

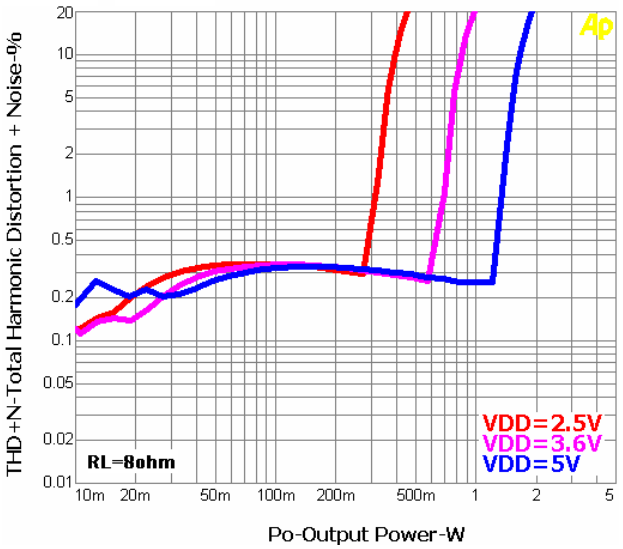
SYMBOL	PARAMETER	CONDITION		MIN	TYP	MAX	UNIT
P_O	RMS Output Power	VDD=5.0V	THD+N = 10 %		1.66		W
			THD+N = 1 %		1.35		W
		VDD=3.6V	THD+N = 10 %		0.85		W
			THD+N = 1 %		0.68		W
		VDD=2.5V	THD+N = 10 %		0.39		W
			THD+N = 1 %		0.31		W
THD+N	Total Harmonic Distortion plus Noise	VDD=5.0V, Po=1.0W			0.24		%
		VDD=3.6V, Po=0.5W			0.34		%
		VDD=2.5V, Po=0.2W			0.4		%
SNR	Signal to Noise Ratio	VDD=5.0V, Po=1.0W			90		dB
PSRR	Power Supply Rejection Ratio	VDD=3.6V, V_{ripple}=200mVpp Inputs ac grounded with Ci=2μF f=217 Hz			-60		dB
CMRR	Common-Mode Rejection Ratio	VDD=3.6V, V_{IC}=1Vpp, f=217Hz			-50		dB
V_n	Output integrated noise (A-weighted)	VDD=3.6V f_{in}=20Hz ~ 20kHz			148		μV
η	Efficiency	VDD=5V, THD+N=10%			88.5		%

- Gain= 8 V/V, Load=4Ω, f_{in}=1 kHz (unless otherwise noted)

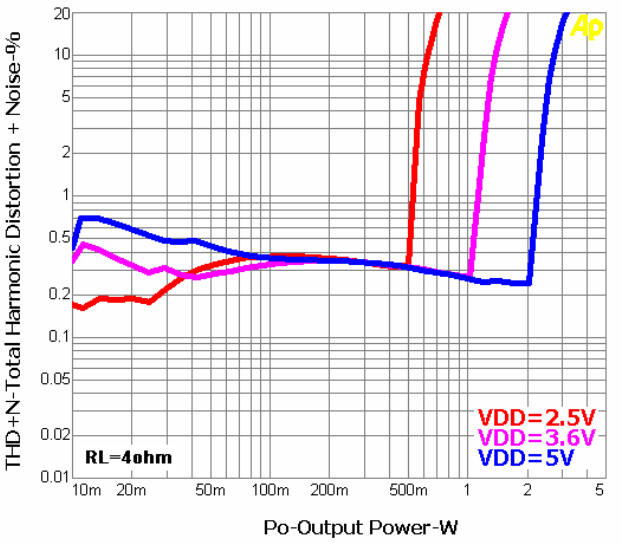
SYMBOL	PARAMETER	CONDITION		MIN	TYP	MAX	UNIT
P_O	RMS Output Power	VDD=5.0V	THD+N = 10 %		2.7		W
			THD+N = 1 %		2.2		W
		VDD=3.6V	THD+N = 10 %		1.3		W
			THD+N = 1 %		1.1		W
		VDD=2.5V	THD+N = 10 %		0.6		W
			THD+N = 1 %		0.5		W
THD+N	Total Harmonic Distortion plus Noise	VDD=5.0V, Po=2.0W			0.24		%
		VDD=3.6V, Po=1.0W			0.34		%
		VDD=2.5V, Po=0.5W			0.4		%
SNR	Signal to Noise Ratio	VDD=5.0V, Po=1.8W			90		dB
PSRR	Power Supply Rejection Ratio	VDD=3.6V, V_{ripple}=200mVpp Inputs ac grounded with Ci=2μF f=217 Hz			-60		dB
CMRR	Common-Mode Rejection Ratio	VDD=3.6V, V_{IC}=1Vpp, f=217Hz			-55		dB
V_n	Output integrated noise (A-weighted)	VDD=3.6V f_{in}=20Hz ~ 20kHz			148		μV
η	Efficiency	VDD=5.0V, THD+N=10%			80		%

Typical Characteristics (Gain= 8 V/V, unless otherwise noted)

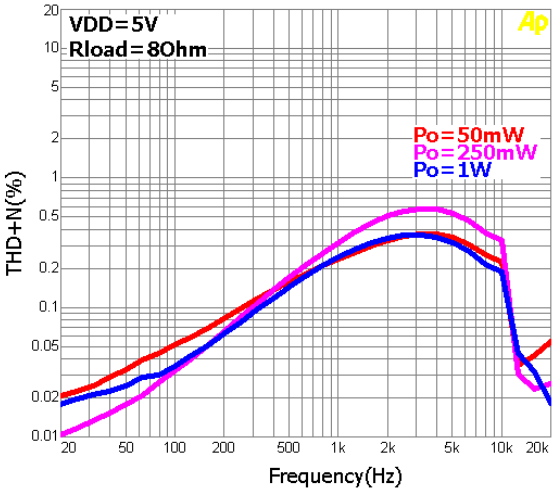
TOTAL HARMONIC DISTORTION+NOISE
vs
OUTPUT POWER



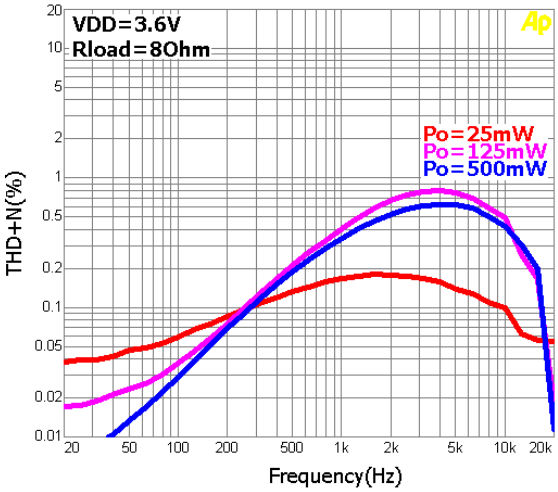
TOTAL HARMONIC DISTORTION+NOISE
vs
OUTPUT POWER



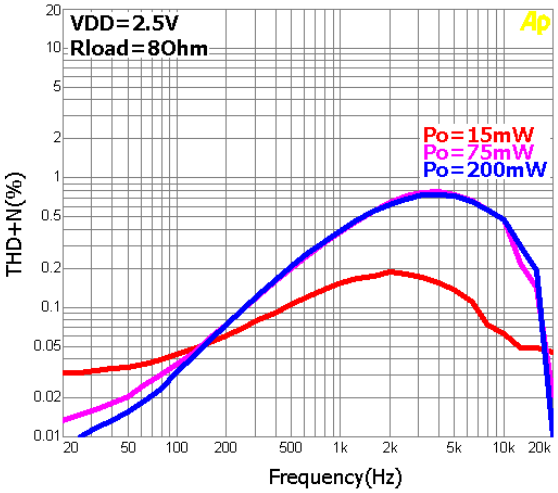
Total Harmonic distortion +Noise(THD+N) vs Signal Frequency



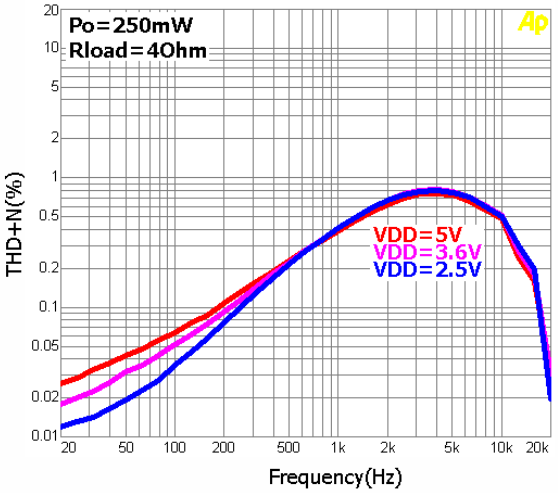
Total Harmonic distortion +Noise(THD+N) vs Signal Frequency

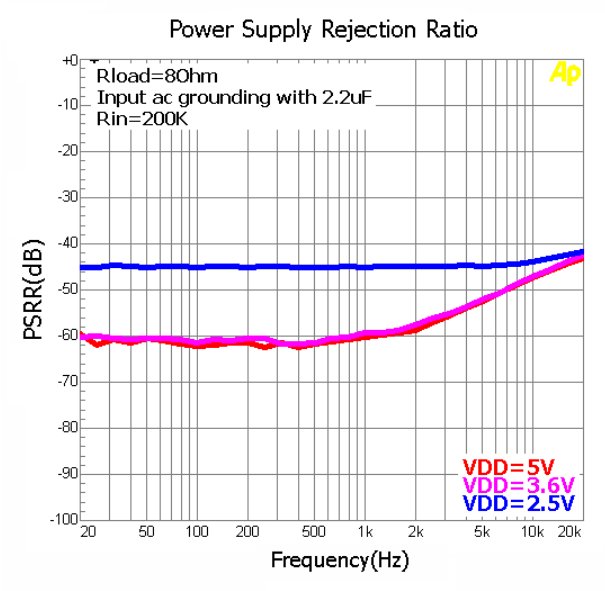


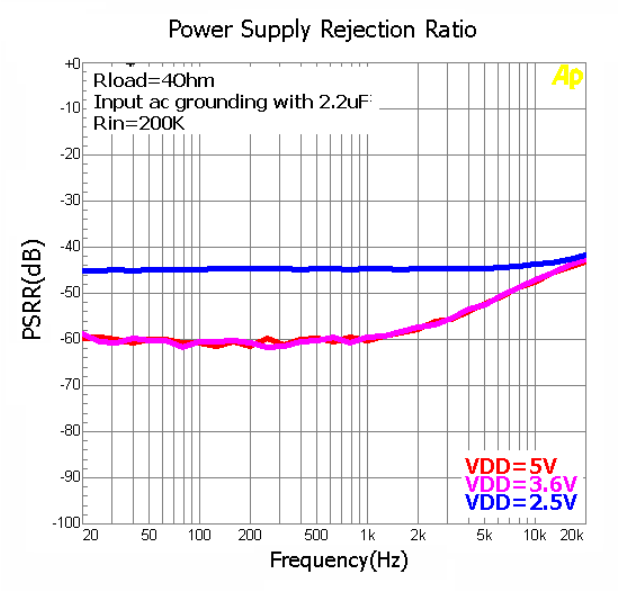
Total Harmonic distortion +Noise(THD+N) vs Signal Frequency

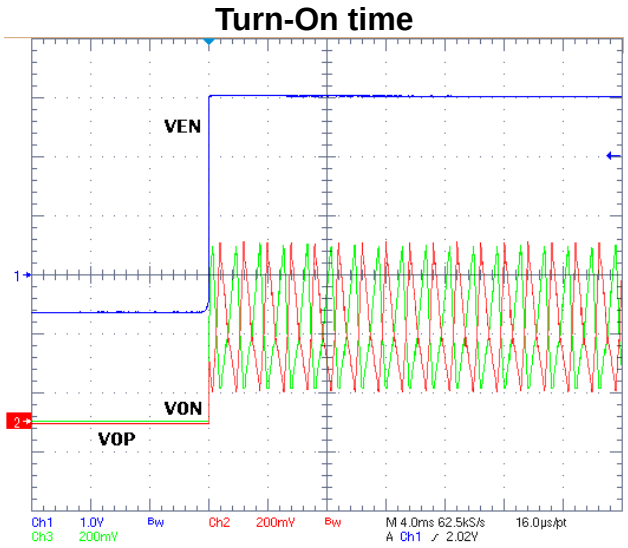


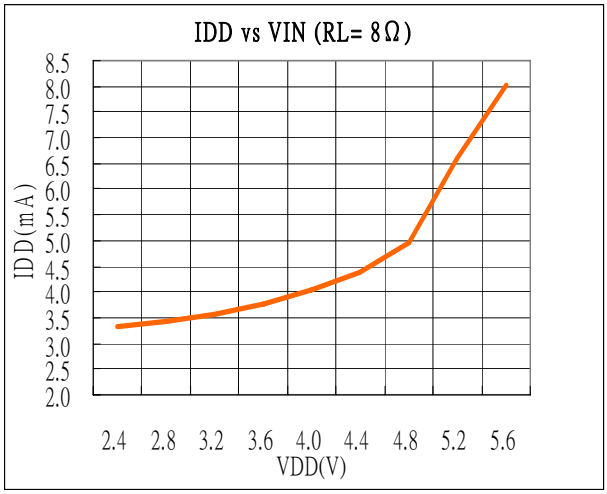
Total Harmonic distortion +Noise(THD+N) vs Signal Frequency



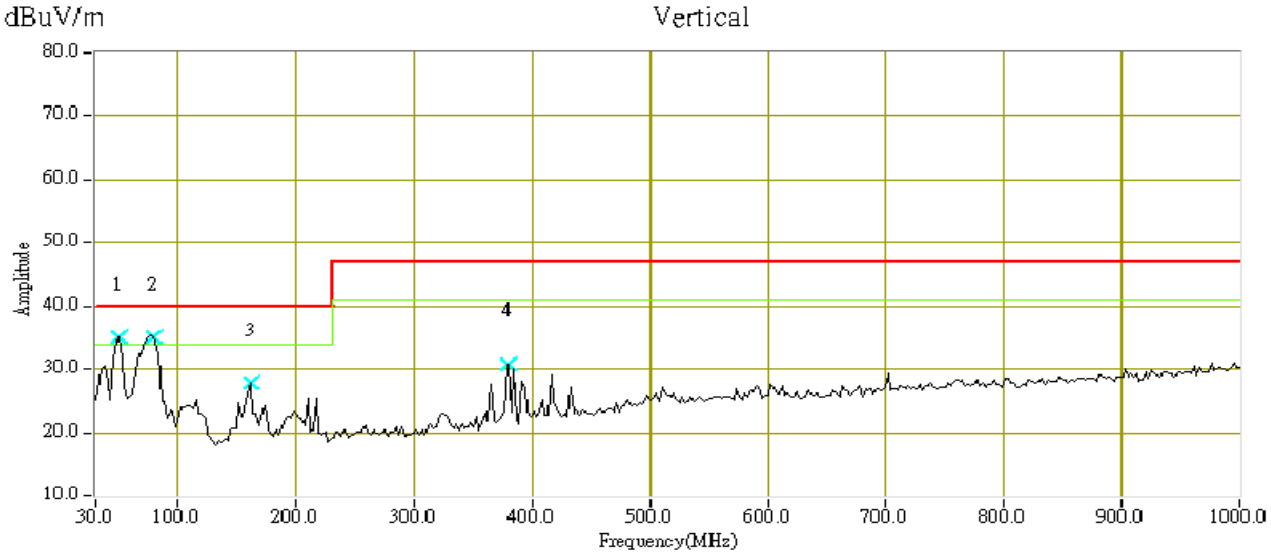




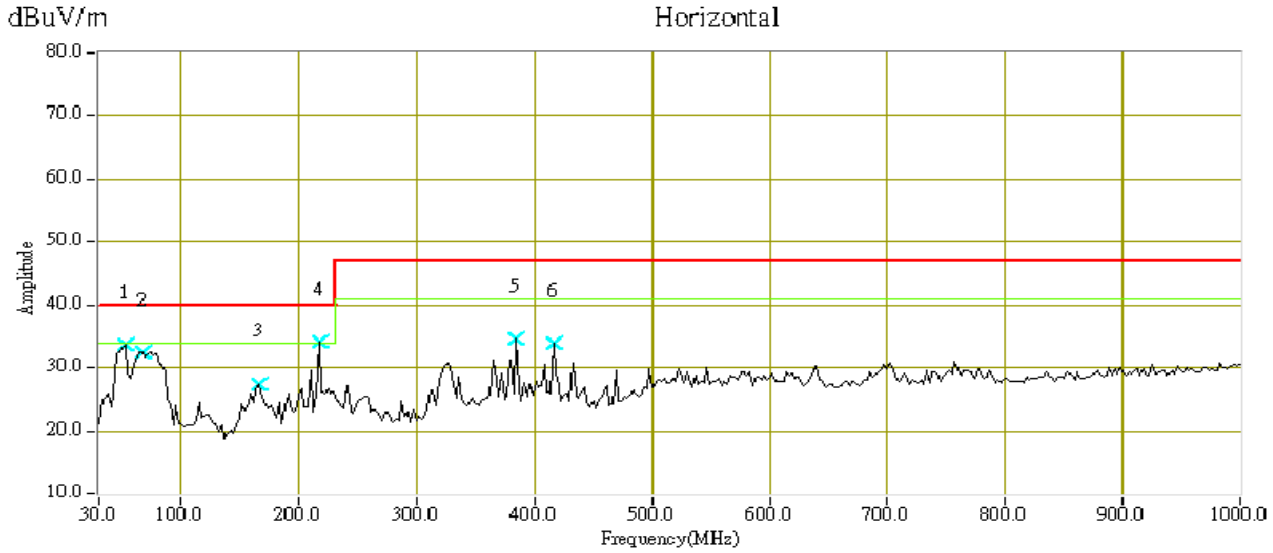




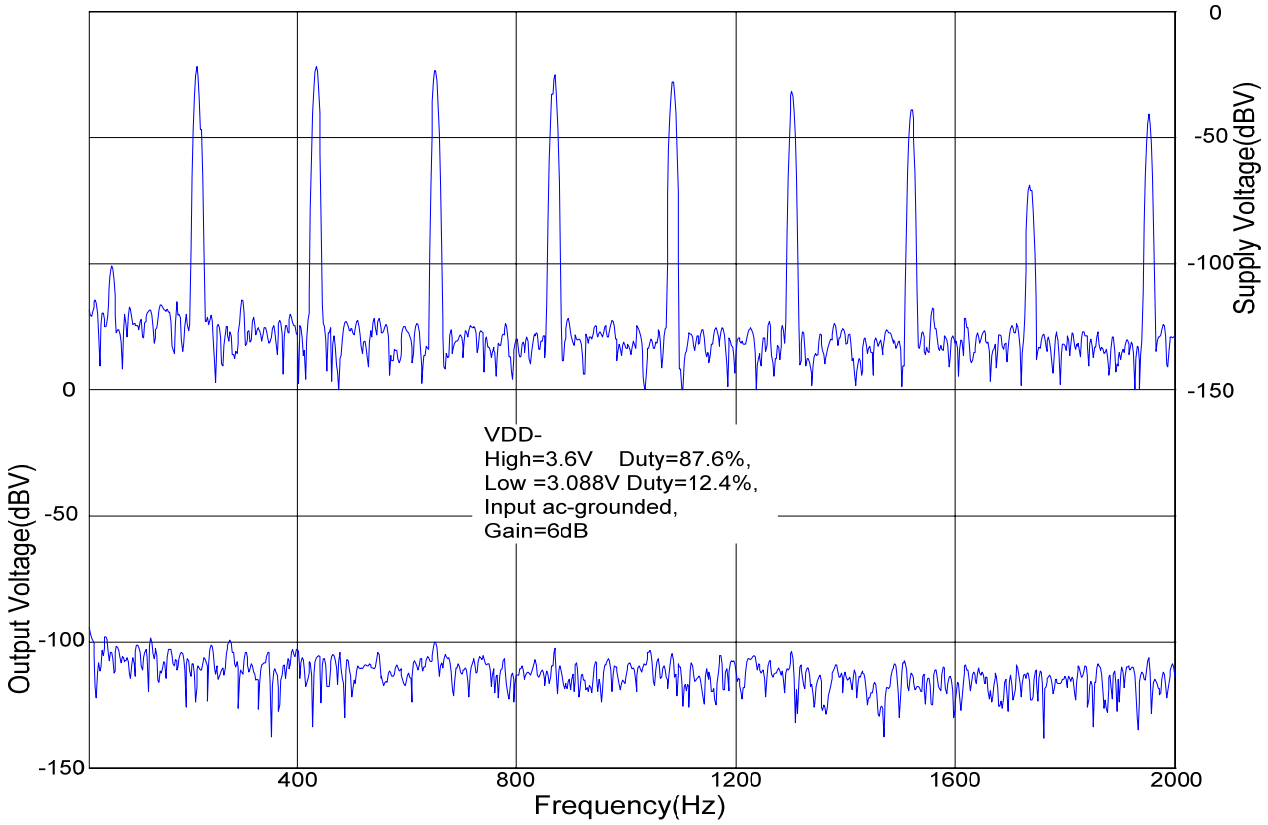
- EMI Test – CISPR22 Class B (Vertical)



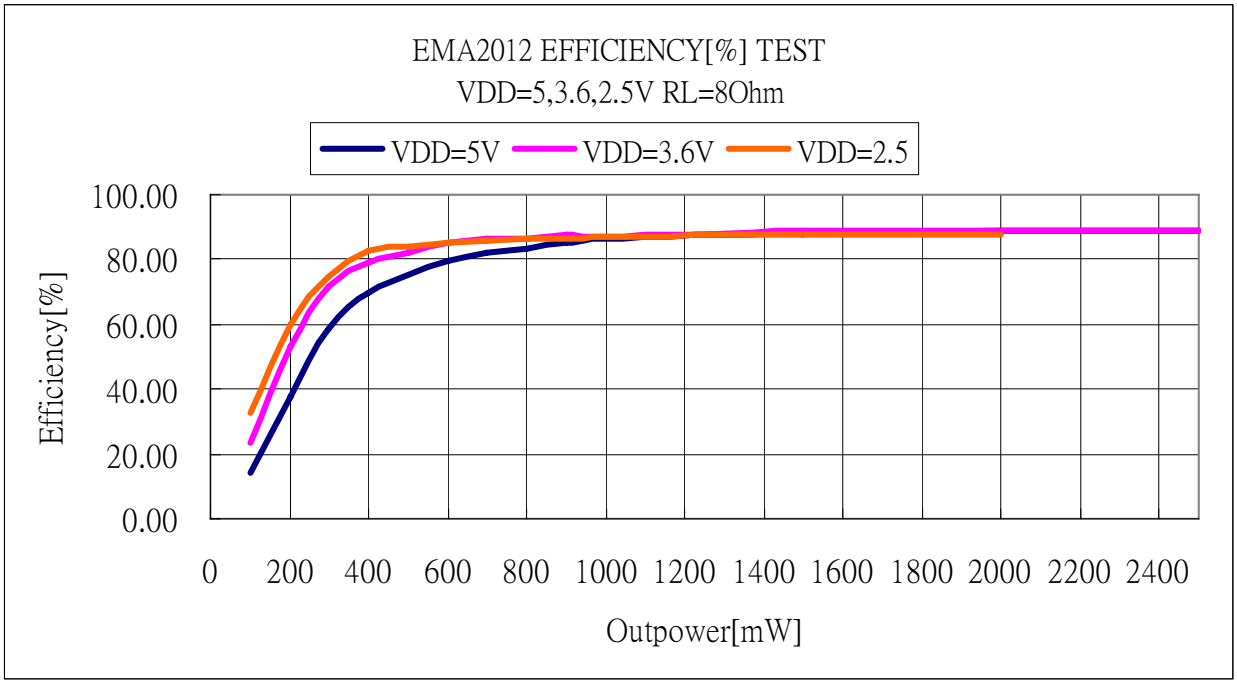
- EMI Test – CISPR22 Class B (Horizontal)

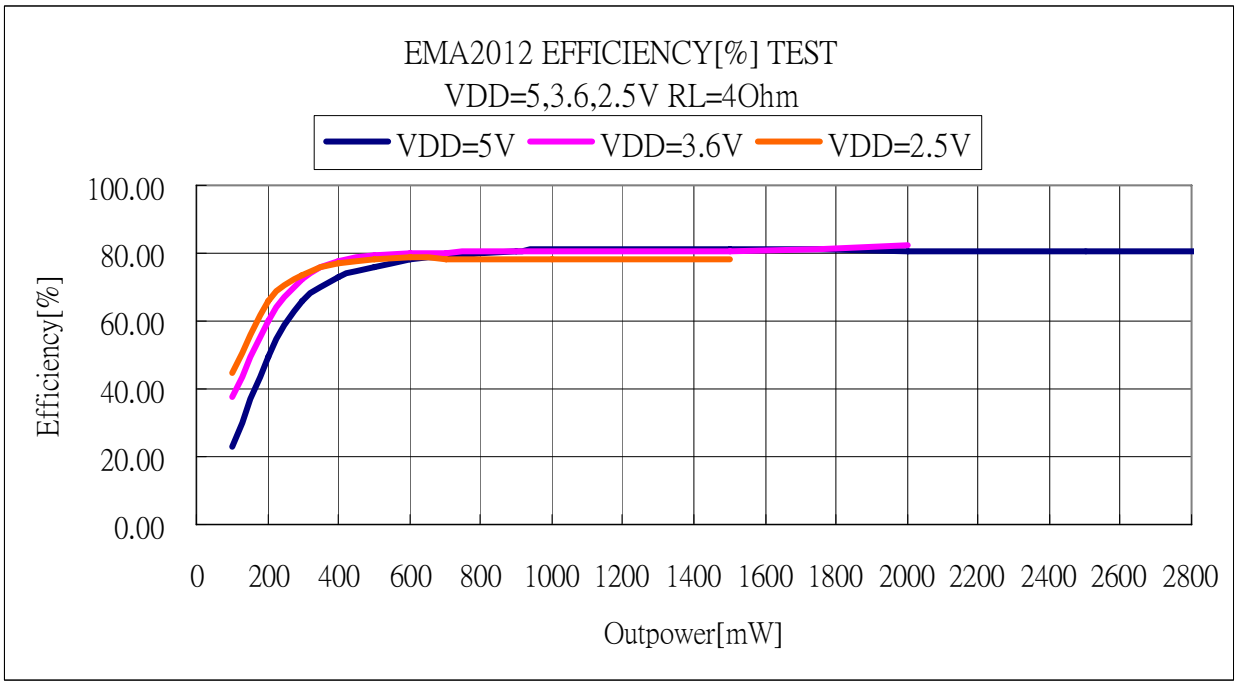


- GSM Power Supply Rejection vs Frequency



- Efficiency


EMA2012 EFFICIENCY[%] TEST
VDD=5,3.6,2.5V RL=8Ohm
VDD=5V
VDD=3.6V
VDD=2.5
100.00
80.00
60.00
40.00
20.00
0.00
Efficiency[%]
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Outpower[mW]


EMA2012 EFFICIENCY[%] TEST
VDD=5,3.6,2.5V RL=4Ohm
VDD=5V
VDD=3.6V
VDD=2.5V
100.00
80.00
60.00
40.00
20.00
0.00
Efficiency[%]
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
Outpower[mW]

Operation Descriptions

- Self-protection circuits (Typical values are used below.)

  EMA2012 has built-in over-temperature, overload and under-voltage detectors.

  (i) If the internal junction temperature is higher than 150°C, the outputs of loudspeaker drivers will be disabled and connected to ground and the temperature hysteresis for EMA2012 to return to normal operation is about 30°C. The variation of protected temperature is around 10%.

  (ii) To protect loudspeaker drivers from current damage when the wires connected to loudspeakers are shorted to one another or shorted to GND, circuits for the detection of output loading are built in the EMA2012. For normal operation, loudspeaker resistance is larger than 3.2Ω is required. Otherwise, overload detectors may activate. Once overload detector is active, loudspeaker drivers will be disabled and at low state. EMA2012 will be recovery from overload fault by pulling SD# down to low and back to high after removing the short. Once the lines connected to loudspeakers are shorted to VDD, EMA2012 will be burnt.

  (iii) When the VDD voltage is lower than 2.1V, EMA2012 will disable and loudspeaker drivers are at low state, cease EMA2012 beside voltage detector circuit. When VDD becomes larger than 2.2V, EMA2012 will return to normal operation.

- Anti-pop design

  EMA2012 is with anti-pop design. Annoying pop sounds during initial power on and power down/up are suppressed. When one of the operations mentioned above is applied, EMA2012 will internally generate appropriate control signals to suppress pop sounds.

Application Circuit Information

- Input resistors (R_{in}) and input capacitors (C_{in})

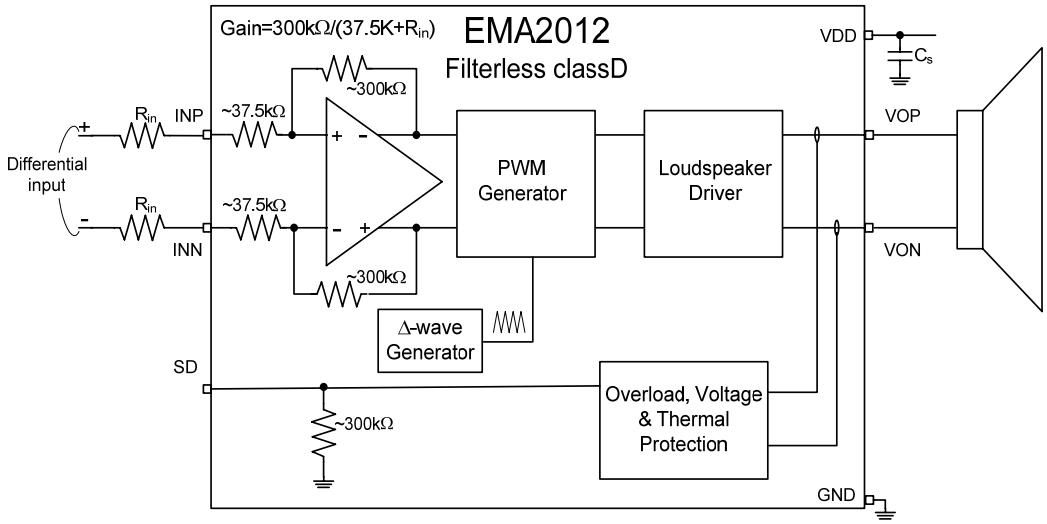
  The total gain of the audio amplifier (EMA2012) is set by input resistor (R_{in}) according to the following equation (a). The default gain is +18dB without input resistor, and the gain can be reduced by external input resistor. The performance at low frequency (bass) is affected by the corner frequency (f_c) of the high-pass filter composed of input resistors (R_{in}) and input capacitors (C_{in}), determined in equation (b).

$$Gain = \frac{300k\Omega}{37.5k + R_{in}} \left(V/V\right) \cdots\cdots\cdots (a)$$

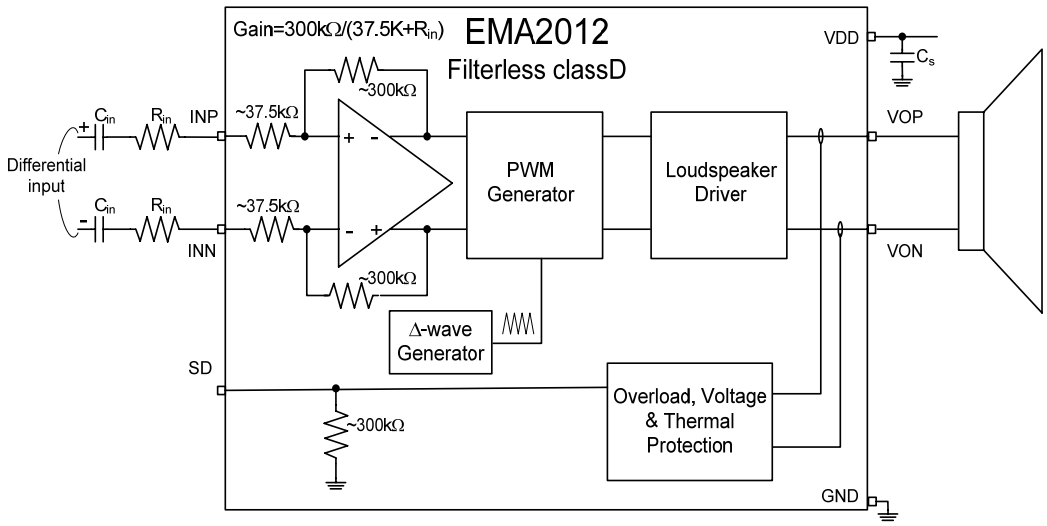
$$f_c = \frac{1}{2\pi(37.5k + R_{in})C_{in}} \left(Hz\right) \quad \cdots\cdots\cdots (b)$$

  For differential audio signal application, the input capacitors (C_{in}), for DC decoupling, are not required. When single-ended audio source is used, the input capacitors (C_{in}) are required.

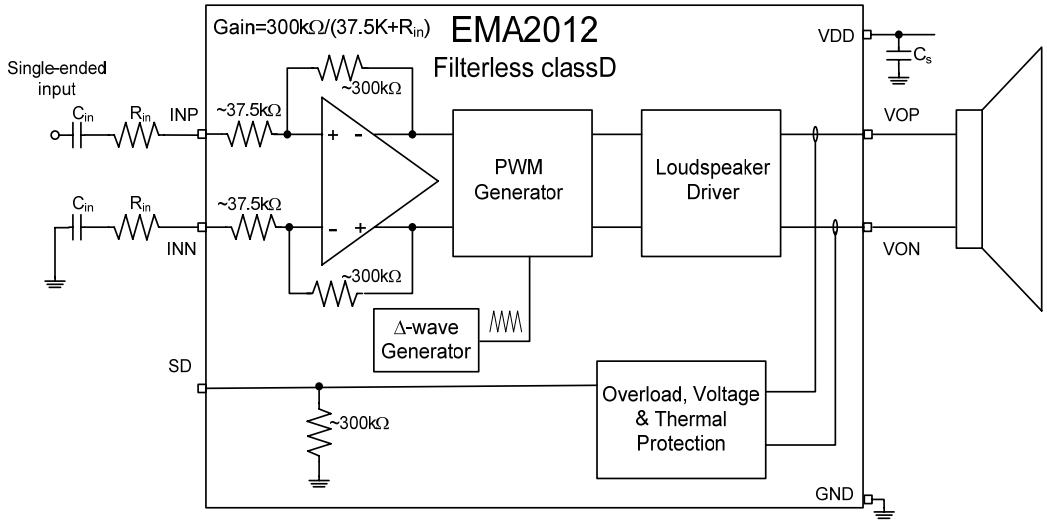
- Cost effective application circuit for fully differential input



- Suggested application circuit for fully differential input

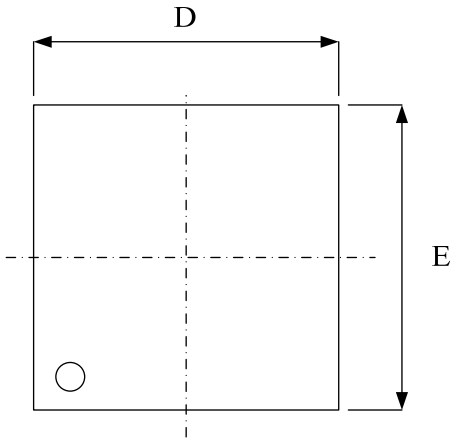


- Suggested application circuit for single-ended input

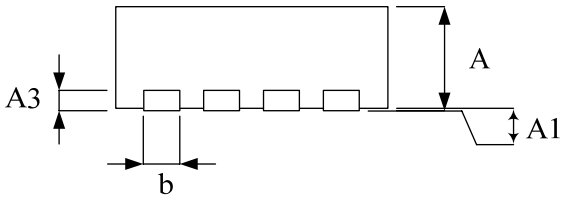


Package Outline Drawing

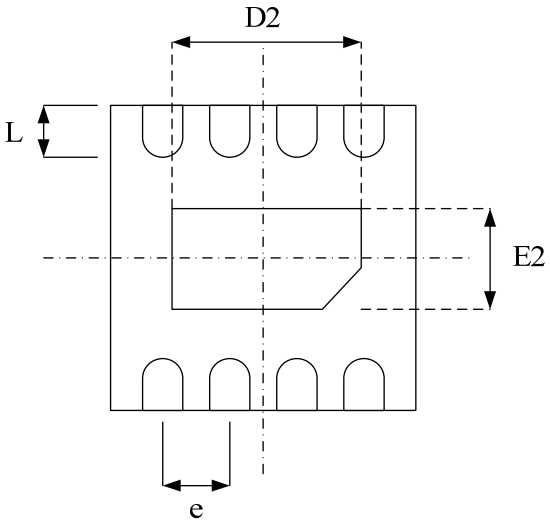
TDFN-8L (3x3 mm)



TOP VIEW



SIDE VIEW



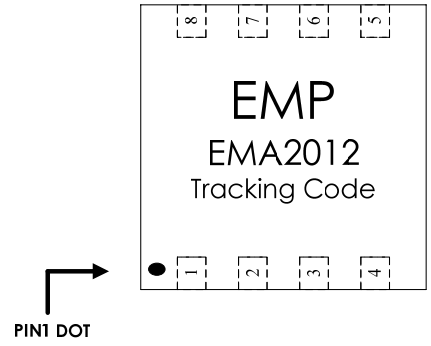
BOTTOM VIEW

Symbol	Dimension in mm	
	Min	Max
A	0.70	0.85
A1	0.00	0.05
A3	0.18	0.25
b	0.25	0.35
D	3.90	3.10
E	2.90	3.10
e	0.65 BSC	
L	0.30	0.50

Exposed pad

	Dimension in mm	
	Min	Max
D2	1.60	0.65
E2	1.35	1.75

Old order, Mark and Packing Information

Package	Product ID	Marking	Packing
TDFN-8	EMA2012-50FF08NRR		5K units Tape & Reel

Revision History

Revision	Date	Description
0.1	2011.09.02	Original
0.2	2012.06.05	Modify package outline drawing
1.0	2013.10.31	Remove Preliminary Marking logo change to ESMT POD format change

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