2.7-W MONO FILTER-FREE CLASS-D AUDIO POWER AMPLIFIER

GENERAL DESCRIPTION

The TMPA2055DM is a mono class-D filter–free audio power amplifier IC. It delivers up to 2.7W power into a 3 ohms load or 2.3W power into a 4 ohm load or 1.5W power into an 8 ohm load. Two patents are pending.

With common mode input structure, TMPA2055DM requires no input or output coupling capacitors. It also features high Common Mode Rejection Ratio and Power Supply Rejection Ratio.

For multiple-input applications, independent gain control and corner frequency can be implemented by summing the input sources through resistor ratio and input capacitor values.

Analog input signal is converted into digital output which drives directly to the speaker. High power efficiency is achieved due to digital output at the load. The audio information is embedded in PWM（Pulse Width Modulation）.

APPLICATIONS

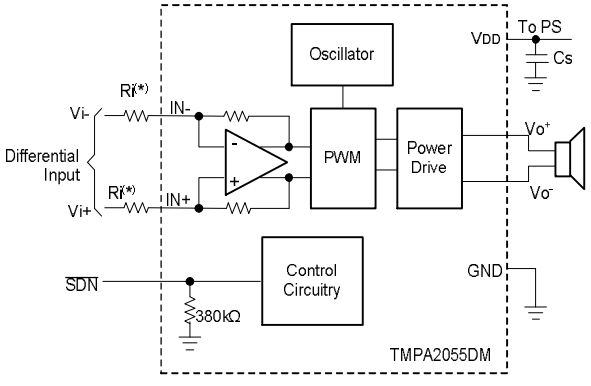
Multimedia application includes Cellular Phones, PDAs, DVD/CD players, TFT LCD TVs/Monitors, 2.1 channel/5.1 channel audio systems, USB audio. It is also ideal for other portable devices like Wireless Radios.

FEATURES

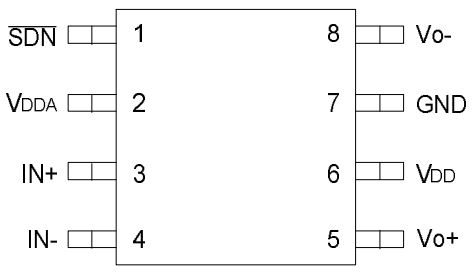
- **4.5V to 5.5V Single Supply**
- **Up to 2.7W at 5V, 3 ohms**
- **Up to 85% Power Efficiency**
- **2.2mA Quiescent Current at 5V**
- **Less Than 0.2uA Shutdown Current**
- **Popless Power-Up, Shutdown and Recovery**
- **Differential 230 KHz PWM Allows Bridge-Tied Load to Doubles Output Power and Eliminates LC Output Filter**
- **Common Mode Structure Requires No Input Capacitors**
- **BTL Output Requires No Output Capacitors**
- **Thermal Shutoff and Automatic Recovery**
- **Short-Circuit Protection**
- **Differential Signal Processing Improves CMRR**
- **Package：TSSOP8, SOP8, MSOP8 Available**

For best performance, please refer to http://www.taimec.com.tw/data/Tmpa2055EVM/tmpa2055dmEVM.pdf for PCB layout.

REFERENCE CIRCUIT



(*) Ris are optional.



（Please email david@taimec.com.tw for complete datasheet.）

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Note that the external components or PCB layout should be designed not to generate abnormal voltages to the chip to prevent from latch up which may cause damage to the device.

ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range unless otherwise noted(1)

Supply voltage, V_{DD}	In normal mode	-0.3V to 6V	V
	In shutdown mode	-0.3V to 7V	V
Input voltage, V_I		-0.3V to V_{DD}+0.3V	V
Continuous total power dissipation		See package dissipation ratings	
Operating free-air temperature, T_A		-20 to 85	°C
Operating junction temperature, T_J		-20 to 150	°C
Storage temperature, T_{stg}		-40 to 150	°C
Lead temperature 1,6mm(1/16 inch)from case for 10 seconds		260	°C

(1) Stresses beyond those listed under"absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions "is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITONS

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		4.5		5.5	V
High-level input voltage, V_{IH}	$\overline{SDN}$	2		V_{DD}	V
Low-level input voltage, V_{IL}	$\overline{SDN}$	0		0.8	V
Input resistor, R_i	Gain ≤ 20 V/V (26dB)	0			kΩ
Common Mode Input Voltage Range	V_{DD}=V_{DDA}=4.5V～5.5V, CMRR ≦ -55dB	0		V_{DD}	V
Operating free-air temperature, T_A		-20		85	°C

PACKAGE DISSIPATION RATINGS

PACKGE	DERATING FACTOR	T_A ≤ 25 °C POWER RATING	T_A = 70 °C POWER RATING	T_A = 85 °C POWER RATING
SOP8	6.39mW/ °C	0.799W	0.511W	0.415W

ELECTRICAL CHARACTERISTICS

T_A=25 °C (unless otherwise noted)

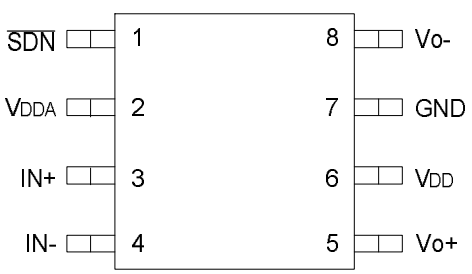
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$\lvert V_{OS} \rvert$	Output offset voltage (measured differentially)	V_I=0V,A_V=2, V_{DD}=V_{DDA}=4.5V to 5.5V		25		mV
PSRR	Power supply rejection ratio	V_{DD}=V_{DDA}=4.5V to 5.5V		-75	-55	dB
CMRR	Common mode rejection ratio	V_{DD}=V_{DDA}=4.5V to 5.5V, V_{IC}=1Vpp, RL=8Ω		-55	-50	dB
$\lvert I_{IH} \rvert$	High-level input current	V_{DD}=V_{DDA}=5.5V, V_I=5.8V ($\overline{SDN}$)			20	μA
$\lvert I_{IL} \rvert$	Low-level input current	V_{DD}=V_{DDA}=5.5V, V_I=-0.3V ($\overline{SDN}$)			1	μA
I_Q	Quiescent current	V_{DD}=V_{DDA}=5V, no load		2	3	mA
I_Q (SD)	Shutdown current	V($\overline{SDN}$)=0.8V, V_{DD}=V_{DDA}=4.5V to 5.5V		0.2	0.5	μA
$r_{DS(on)}$	Static drain-source on-state resistance	V_{DD}=V_{DDA}=4.5V		790		mΩ
f(sw)	Switching frequency	V_{DD}=V_{DDA}=4.5V to 5.5V	200	230	260	kHz
Av	BTL Gain	V_{DD}=V_{DDA}=4.5V to 5.5V	135kΩ / R_I+15kΩ	150kΩ / R_I+15kΩ	165kΩ / R_I+15kΩ	V/V
	Resistance from shutdown to GND			380		kΩ

OPERATING CHARACTERISTICS

T_A=25 °C, Av=2, R_L=8Ω speaker (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
P_O	Output power	THD+N=10%,f=1kHz, R_L=8Ω	V_{DD}=V_{DDA}=5V		1.5		W
P_O	Output power	THD+N=10%,f=1kHz, R_L=4Ω	V_{DD}=V_{DDA}=5V		2.3		W
P_O	Output power	THD+N=10%,f=1kHz, R_L=3Ω	V_{DD}=V_{DDA}=5V		2.7		W
THD+N	Total harmonic distortion plus noise	V_{DD}=V_{DDA}=5V, P_O=0.85W, R_L=8Ω, f=1kHz			0.55		%
		V_{DD}=V_{DDA}=5V, P_O=1.3W, R_L=4Ω, f=1kHz			0.55		
		V_{DD}=V_{DDA}=5V, P_O=1.5W, R_L=3Ω, f=1kHz			0.64		
SNR	Signal-to-noise ratio	V_{DD}=V_{DDA}=5V, P_O=1W, R_L=8Ω			84		dB
Z_I	Input impedance			13.5	15	16.5	kΩ

TOP VIEW



TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION
NAME	PIN NO		
IN-	4	I	Negative differential input
IN+	3	I	Positive differential input
V_{DD}	6	I	Digital Power supply
V_O+	5	O	Positive BTL output
GND	7	I	Digital ground
V_O-	8	O	Negative BTL output
SDN	1	I	Shutdown terminal (active low logic)
V_{DDA}	2	I	Analog Power supply

TYPICAL CHARACTERISTICS

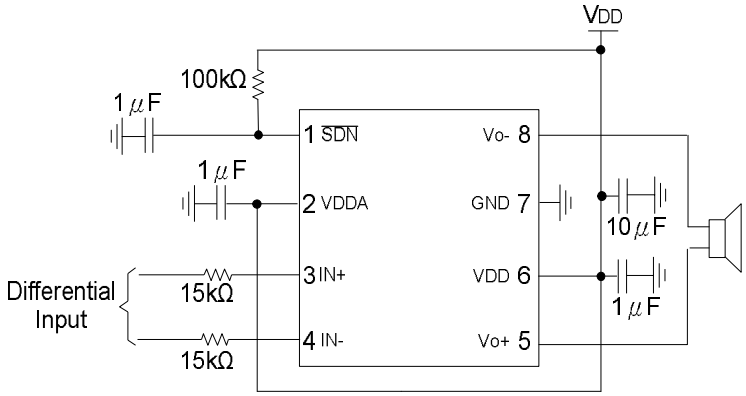
Note 1. Input coupling 1μF capacitors are used for all measurements.

2. Differential inputs are applied and BTL outputs are measured.

3. Balanced LC filter is used for THD+N measurement and power efficiency measurement.

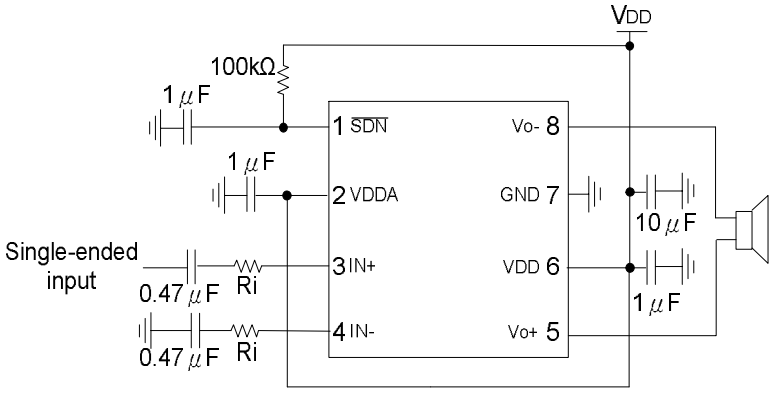
4. Characteristic frequency of the LC filter is set 41KHz unless otherwise specified.

APPLICATION INFORMATION



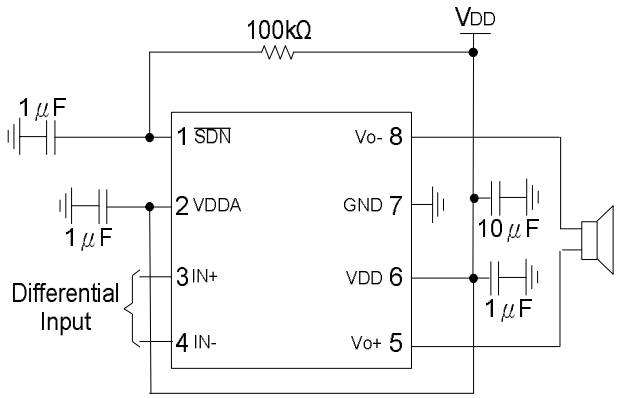
Suppose source impedance of the input is relatively smaller than 15k ohms.

Figure.1 Differential Input With Gain= $\frac{150k}{15k+15k}$ = 5



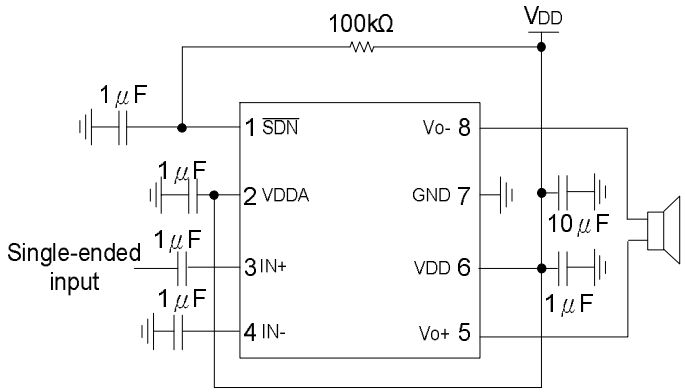
Ri=15k ohms if source impedance of the input is relatively smaller than 15k ohms.

Figure.2 Single-ended Input With Gain= $\frac{150k}{15k+Ri}$



Suppose source impedance of the input is much smaller than 15k.

Figure.3 Differential Input With Gain= $\frac{150k}{15k}$ = 10



Suppose source impedance of the input is much smaller than 15k.

Figure.4 Single-ended Input With Gain= $\frac{150k}{15k}$ = 10

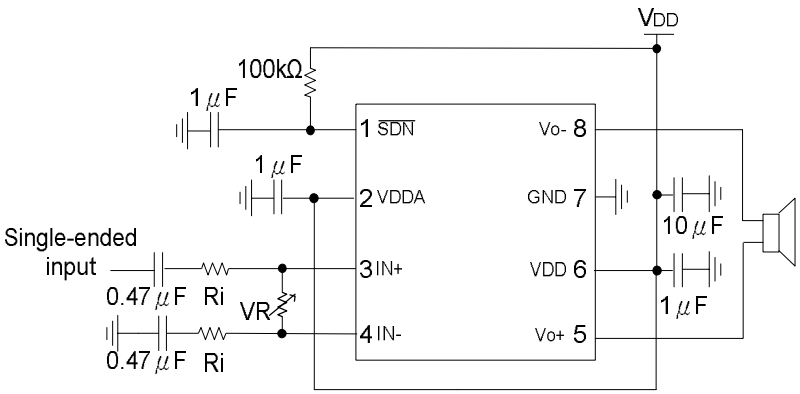


Figure.5 Single-ended Input With Gain Control

Note：Please refer to document 010 APP for more application examples.

Figure 5 ~7 show typical ferrite bead and LC output filters.

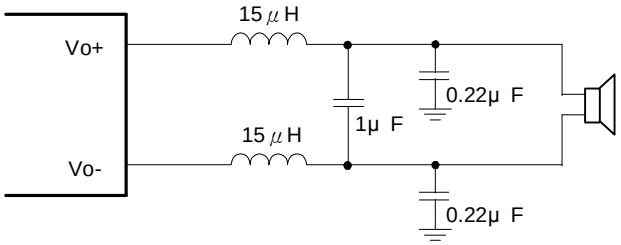


Figure 5. Typical LC Output Filter, Cutoff Frequency of 41 kHz,
Speaker Impedance=4Ω

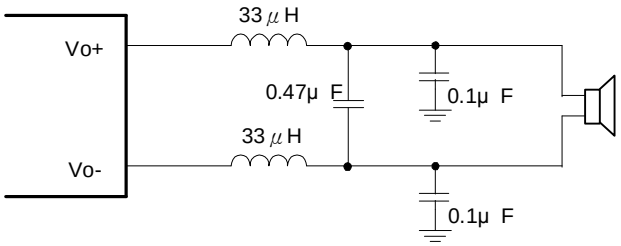


Figure 6. Typical LC Output Filter, Cutoff Frequency of 41 kHz,
Speaker Impedance=8Ω

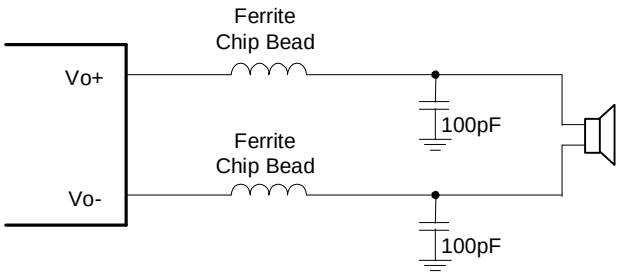


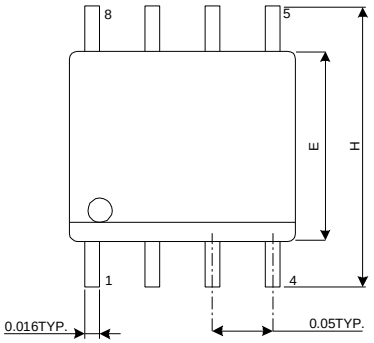
Figure 7. Typical Ferrite Chip Bead Filter
（Chip bead example：遠越科技 KML2012Q102N
1kohms@100MHz, DCR=0.2ohms, I=1A）

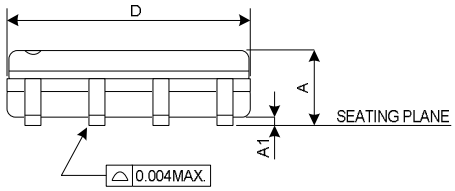
I Input Resistors and Gain

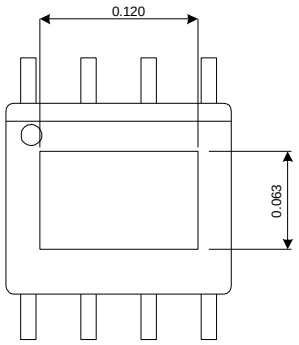
The BTL gain of the amplifier is determined by

$$\text{Gain}=\frac{150\text{kohms}}{\text{Ri}+15\text{kohms}}$$ where Ri is the source impedance of the input signal.

Physical Dimensions (IN MILLIMETERS)



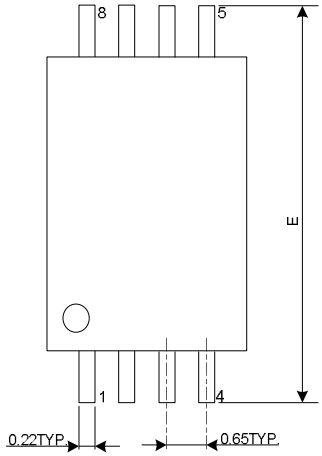


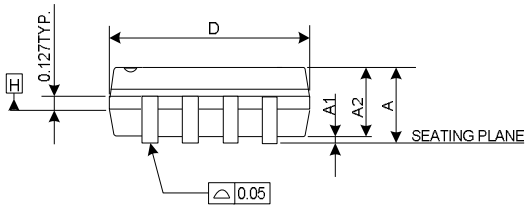


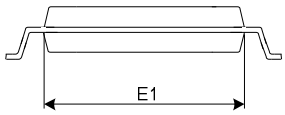
SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244

SOP8

Physical Dimensions (IN MILLIMETERS)







SYMBOLS	MIN.	NDM.	MAX.
A	-	-	1.20
A1	0.05	-	0.15
A2	0.96	1.01	1.06
D	2.90	3.00	3.10
E	6.40 BSC		
E1	4.30	4.40	4.50

TSSOP8

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