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## 2.5W STEREO CLASS-D AUDIO POWER AMPLIFIER WITH VOLUME CONTROL

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### GENERAL DESCRIPTION

The TMPA208DS is a stereo class-D audio power amplifier with volume control. It delivers up to 2.5W/ch(5W in all) into a 3 ohm load or 2W/ch(4W in all) into a 4 ohm load or 1.25W/ch(2.5W in all) into an 8 ohm load.

With differential input structure, TMPA208DS features high Common Mode Rejection Ratio and Power Supply Rejection Ratio.

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) .

DC volume control is convenient for LCD projectors, LCD monitors, powered speakers, and other consumer products especially when using remote control.

### APPLICATIONS

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

### FEATURES

- ◆ 2.5V to 6V Single Supply
- ◆ Up to 5Wrms Max. Power or 2.5Wrms/ch.
- ◆ Up to 86% Power Efficiency
- ◆ 3mA /Ch Quiescent Current
- ◆ Less Than 0.2uA /Ch Shutdown Current
- ◆ Pop-less Power-Up, Shutdown and Recovery
- ◆ Differential 230 KHz PWM Allows Bridge-Tied Load to Increase Output Power
- ◆ DC Volume Control
- ◆ BTL Output Requires No Output Capacitors
- ◆ Thermal Shutoff and Automatic Recovery
- ◆ Output Pin Short-Circuit Protection (Short to Other Outputs, Short to VCC, Short to Ground)
- ◆ Compatible with earphone application
- ◆ Differential Signal Processing Improves CMRR & Eliminates Power Regulation
- ◆ Package : TSSOP20 Available

For best performance, please refer to

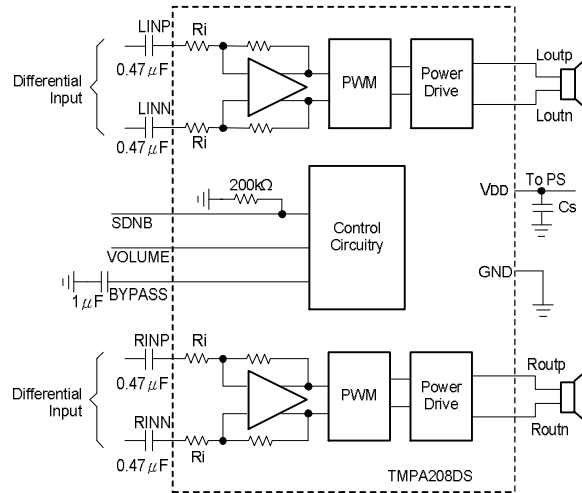
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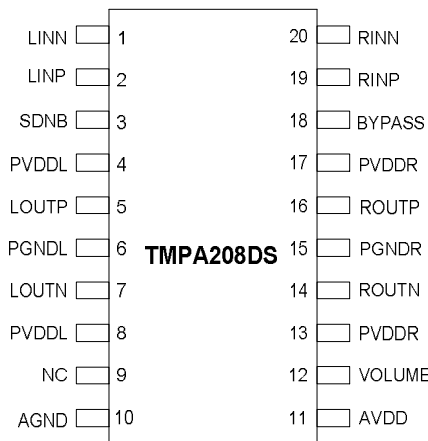
for PCB layout.

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**REFERENCE CIRCUIT ( Please refer to TMPA002.APP for application )**



**TOP VIEW**

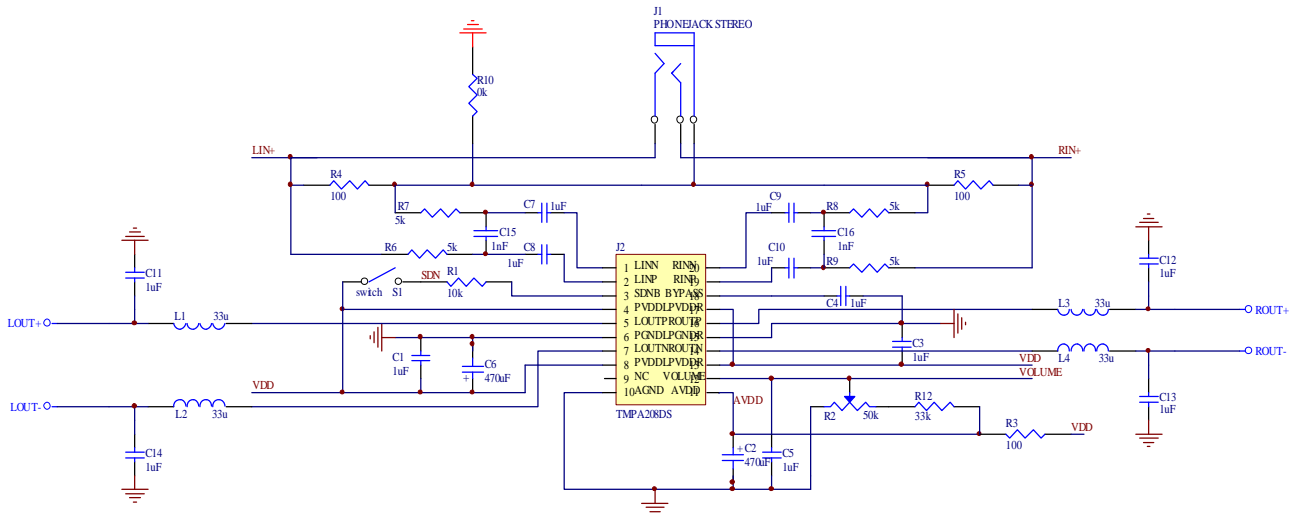


**( Please email [david@taimec.com.tw](mailto:david@taimec.com.tw) for complete datasheet. )**

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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.**

Typical Application



TERMINAL FUNCTIONS

| TERMINAL |        | I/O | DESCRIPTION  |
|----------|--------|-----|--|
| NAME     | PIN NO |     |  |
| AGND     | 10     | —   | Analog ground  |
| BYPASS   | 18     | O   | Bypass   |
| LINN     | 1      | I   | Negative differential input for left channel   |
| LINP     | 2      | I   | Positive differential input for left channel   |
| LOUTN    | 7      | O   | Negative output for left channel   |
| LOUTP    | 5      | O   | Positive output for left channel   |
| NC       | 9      | —   | No connection  |
| PGNDL    | 6      | —   | Ground for left channel H-bridge   |
| PGNDR    | 15     | —   | Ground for right channel H-bridge  |
| PVDDL    | 4,8    | —   | Power supply for left channel H-bridge   |
| PVDDR    | 13,17  | —   | Power supply for right channel H-bridge  |
| RINN     | 20     | I   | Negative differential input for right channel  |
| RINP     | 19     | I   | Positive differential input for right channel  |
| ROUTN    | 14     | O   | Negative output for right channel  |
| ROUTP    | 16     | O   | Positive output for right channel  |
| SDNB     | 3      | I   | Places the amplifier in shutdown mode if a TTL logic low is placed on this terminal; normal operation if a TTL logic high is placed on this terminal |
| AVDD     | 11     | —   | Analog power supply  |
| VOLUME   | 12     | I   | DC Volume control  |

**ABSOLUTE MAXIMUM RATINGS**Over operating free-air temperature range unless otherwise noted <sup>(1)</sup>

|  |                              |
|--|------------------------------|
| Supply voltage range, V <sub>DD</sub> , PV <sub>DD</sub> | 0.3V to 6V                   |
| Input voltage range, V <sub>I</sub>                      | 0V to 5.5V                   |
| Continuous total power dissipation                       | See Dissipation Rating Table |
| Operating free-air temperature, T <sub>A</sub>           | -20 °C to 85 °C              |
| Operating junction temperature range, T <sub>J</sub>     | -20 °C to 150 °C             |
| Storage temperature range, T <sub>stg</sub>              | -65 °C to 150 °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.

**DISSIPATION RATINGS TABLE**

| PACKAGE     | T <sub>A</sub> ≤ 25 °C | DERATING FACTOR | T <sub>A</sub> = 70 °C | T <sub>A</sub> = 85 °C |
|-------------|------------------------|-----------------|------------------------|------------------------|
| TSSOP20(FD) | 2.18W                  | 21.8mW/°C       | 1.2W                   | 872mW                  |

**RECOMMENDED OPERATING CONDITIONS**

|  | MIN  | TYP | MAX | UNIT |
|--|------|-----|-----|------|
| Supply voltage, V <sub>DD</sub>                | 2.5  |     | 6   | V    |
| High-level input voltage, V <sub>IH</sub>      | SDNB | 2   |     | V    |
| Low-level input voltage, V <sub>IL</sub>       | SDNB |     | 0.8 | V    |
| PWM frequency                                  | 200  |     | 300 | KHz  |
| Operating free-air temperature, T <sub>A</sub> | -20  |     | 85  | °C   |
| Operating junction temperature, T <sub>J</sub> | -20  |     | 125 | °C   |

**ELECTRICAL CHARACTERISTICS**T<sub>A</sub> = 25 °C, V<sub>DD</sub> = PV<sub>DD</sub> = 5V (unless otherwise noted)

| PARAMETER            |   | TEST CONDITIONS   | MIN | TYP        | MAX  | UNIT |
|----------------------|---|---|-----|------------|------|------|
| V <sub>OS</sub>      | Output offset voltage ( measured differentially ) | V <sub>I</sub> = 0V, A <sub>V</sub> = 20dB, R <sub>L</sub> = 8Ω             |     | 25         | 50   | mV   |
| PSSR                 | Power supply rejection ratio                      | V <sub>DD</sub> = PV <sub>DD</sub> = 3.5V to 5.5V                           |     | -70        |      | dB   |
| I <sub>IH</sub>      | High-level input current                          | V <sub>DD</sub> = AV <sub>DD</sub> = 5.5V,<br>V <sub>I</sub> = 5.8V (SDNB)  |     | 30         |      | μA   |
| I <sub>IL</sub>      | Low-level input current                           | V <sub>DD</sub> = AV <sub>DD</sub> = 5.5V,<br>V <sub>I</sub> = -0.3V (SDNB) |     |            | 1    | μA   |
| I <sub>DD</sub>      | Supply current                                    | No load   |     | 6          | 10   | mA   |
| I <sub>DD</sub> (SD) | Supply current in shutdown mode                   | SDNB = 0V   |     | 50         | 1000 | nA   |
| r <sub>ds(on)</sub>  | Drain-source on-state resistance                  | V <sub>DD</sub> = 5V, I <sub>O</sub> = 500mA,<br>T <sub>J</sub> = 25 °C     |     | 450        | 600  | mΩ   |
|                      |   | High side<br>Low side   |     | 450<br>600 |      |      |
| A <sub>V</sub>       | Voltage gain                                      | R <sub>L</sub> = 8Ω, VOLUME = 2.8V  |     | 18         |      | dB   |
| R <sub>i</sub>       | Input resistance                                  | VOLUME = 2.8V ~ 0V  | 24  |            | 200  | kΩ   |

**OPERATING CHARACTERISTICS** $T_A=25\text{ }^\circ\text{C}$ ,  $V_{DD}=PV_{DD}=5\text{V}$ ,  $R_L=8\Omega$  speaker, Gain=18dB (unless otherwise noted)

| PARAMETER   | TEST CONDITIONS   | MIN | TYP  | MAX | UNIT  |
|---|---|-----|------|-----|-------|
| P <sub>O</sub> Output power per channel<br>(Limited by thermal condition) | f=1kHz, R <sub>L</sub> =3Ω, stereo operation                                  |     | 2.5  |     | W     |
|   | f=1kHz, R <sub>L</sub> =4Ω, stereo operation                                  |     | 2    |     | W     |
|   | f=1kHz, R <sub>L</sub> =8Ω, stereo operation                                  |     | 1.25 |     | W     |
| THD+N Total harmonic distortion plus noise                                | R <sub>L</sub> =8Ω, P <sub>O</sub> =1.2W, f=1kHz                              |     | 0.4% |     |       |
| Thermal trip point  |   |     | 150  |     | °C    |
| Thermal hysteresis  |   |     | 20   |     | °C    |
| V <sub>n</sub> Integrated noise floor                                     | 20 Hz to 20 kHz, inputs ac grounded   |     | 85   |     | μVrms |
| SNR Signal-to-noise ratio   | V <sub>DD</sub> =AV <sub>DD</sub> =5V, P <sub>O</sub> =1W, R <sub>L</sub> =8Ω |     | 95   |     | dB    |
| Crosstalk Crosstalk between outputs                                       | V <sub>DD</sub> =AV <sub>DD</sub> =5V, P <sub>O</sub> =1W R <sub>L</sub> =8Ω  |     | -68  |     | dB    |

**VOLTAGE RANGE OF "VOLUME" AT DIFFERENT VDD**

| VDD  | MAX  | MIN |
|------|------|-----|
| 5V   | 2.8V | 0V  |
| 3.6V | 1.9V | 0V  |
| 3V   | 1.3V | 0V  |

**VOLTAGE GAIN AT  $T_A=25\text{ }^\circ\text{C}$ ,  $R_L=8\Omega$** 

| V <sub>DD</sub> =PV <sub>DD</sub> =5V | VOLTAGE GAIN | VOLTAGE of VOLUME |
|---------------------------------------|--------------|-------------------|
| 5V                                    | 18dB/-27dB   | 2.8V/0V           |
| 3.6V                                  | 18dB/-27dB   | 1.9V/0V           |
| 3V                                    | 16dB/-27dB   | 1.4V/0V           |

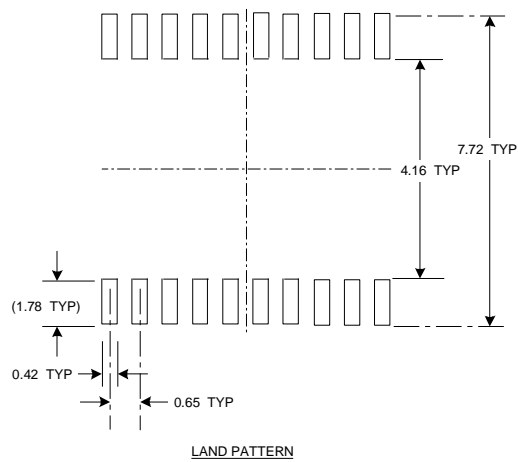
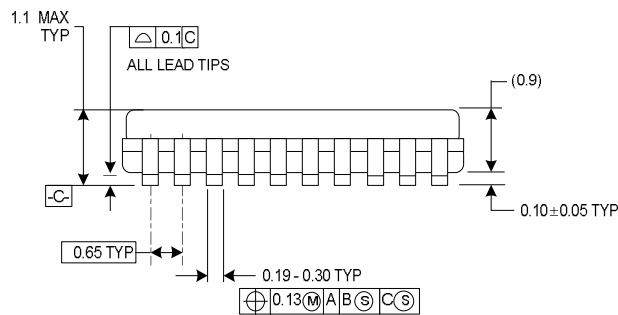
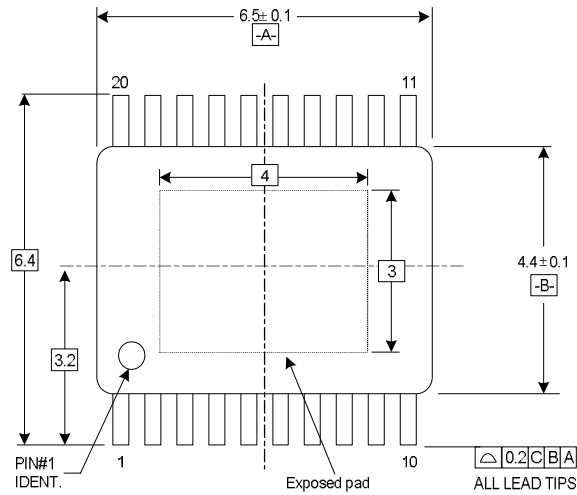
Table 1. TYPICAL DC VOLUME CONTROL

| VOLTAGE ON VOLUME PIN<br>(V) | TYPICAL GAIN OF AMPLIFIER<br>(dB) |
|------------------------------|-----------------------------------|
| 0-0.1                        | -38                               |
| 0.1-0.19                     | -36                               |
| 0.19-0.29                    | -34                               |
| 0.29-0.39                    | -32                               |
| 0.39-0.48                    | -30                               |
| 0.48-0.58                    | -28                               |
| 0.58-0.68                    | -26                               |
| 0.68-0.77                    | -24                               |
| 0.77-0.87                    | -22                               |
| 0.87-0.97                    | -20                               |
| 0.97-1.06                    | -18                               |
| 1.06-1.16                    | -16                               |
| 1.16-1.26                    | -14                               |
| 1.26-1.35                    | -12                               |
| 1.35-1.45                    | -10                               |
| 1.45-1.55                    | -8                                |
| 1.55-1.64                    | -6                                |
| 1.64-1.74                    | -4                                |
| 1.74-1.84                    | -2                                |
| 1.84-1.93                    | 0                                 |
| 1.93-2.03                    | 2                                 |
| 2.03-2.13                    | 4                                 |
| 2.13-2.22                    | 6                                 |
| 2.22-2.32                    | 8                                 |
| 2.32-2.42                    | 10                                |
| 2.42-2.51                    | 12                                |
| 2.51-2.61                    | 14                                |
| 2.61-2.71                    | 16                                |
| 2.71-2.8                     | 18                                |
| 2.8-2.9                      | 20                                |
| 2.9-VDD                      | —                                 |

\*Not fully tested but guaranteed by design.

\*\*This table is only for VDD=5V

**Physical Dimensions (IN MILLIMETERS)**



**TSSOP20**

## IMPORTANT NOTICE

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