

**PROCESS CHANGE NOTICE**
 **PRODUCT CHANGE NOTICE**

**MAXIM INTEGRATED** HEREBY ISSUES NOTIFICATION OF CHANGE  
 THAT MAY AFFECT THE FOLLOWING CATEGORIES:

|                                 |                                    |                                   |                               |   |
|---------------------------------|------------------------------------|-----------------------------------|-------------------------------|---|
| <input type="checkbox"/> DESIGN | <input type="checkbox"/> WAFER FAB | <input type="checkbox"/> ASSEMBLY | <input type="checkbox"/> TEST | <input checked="" type="checkbox"/> ELEC/MECH SPECS |
|---------------------------------|------------------------------------|-----------------------------------|-------------------------------|---|

AFFECTED PRODUCT:

Ordering P/N: (See PN listing XLS in PCN ZIP file)

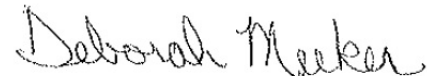
CHANGE FROM: THD+N max = 0.06 %

CHANGE TO: Removed: THD+N max spec

JUSTIFICATION: Max THD+N limit removed to accurately reflect the performance of the part

TRACEABILITY: Maxim Integrated maintains full traceability by device marking, packaging labels and shipment documents.

Maxim Integrated's Change Notification System is designed to keep our customer base apprised of major product, manufacturing, or facility improvements.



Deborah Meeker / PCN Coordinator

For further information, please contact either of the people listed below.

**Contact your local Maxim Integrated Company Representative**

or

Deborah Meeker, PCN Coordinator

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# MAX98357A/MAX98357B

## PCM Input Class D Audio Power Amplifiers

### General Description

The MAX98357A/MAX98357B are digital pulse-code modulation (PCM) input Class D power amplifiers that provide Class AB audio performance with Class D efficiency. These ICs offer five selectable gain settings (3dB, 6dB, 9dB, 12dB, and 15dB) in I<sup>2</sup>S/left-justified mode set by a single gain select input and a fixed 12dB gain in TDM mode.

The digital audio interface is highly flexible with the MAX98357A supporting I<sup>2</sup>S data and the MAX98357B supporting left-justified data. Both ICs support 8 channel time division multiplexed (TDM) data. The digital audio interface accepts specified sample rates between 8kHz and 96kHz for all supported data formats. The ICs can be configured to produce a left channel, right channel, or (left/2 + right/2) output from the stereo input data. The ICs operate using 16/24/32-bit data for I<sup>2</sup>S and left-justified modes as well as 16-bit or 32-bit data using TDM mode. The ICs eliminate the need for the external MCLK signal that is typically used for PCM communication. This reduces EMI and possible board coupling issues in addition to reducing the size and pin count of the ICs.

The ICs also feature a very high wideband jitter tolerance (12ns typ) on BCLK and LRCLK to provide robust operation.

Active emissions-limiting, edge-rate limiting, and overshoot control circuitry greatly reduce EMI. A filterless spread-spectrum modulation scheme eliminates the need for output filtering found in traditional Class D devices and reduces the component count of the solution.

The ICs are available in 9-pin WLP (1.345mm x 1.435mm x 0.64mm) and 16-pin TQFN (3mm x 3mm x 0.75mm) packages and are specified over the -40°C to +85°C temperature range.

### Applications

Notebook and Netbook Computers  
Cellular Phones  
Tablets

**Ordering Information** appears at end of data sheet.

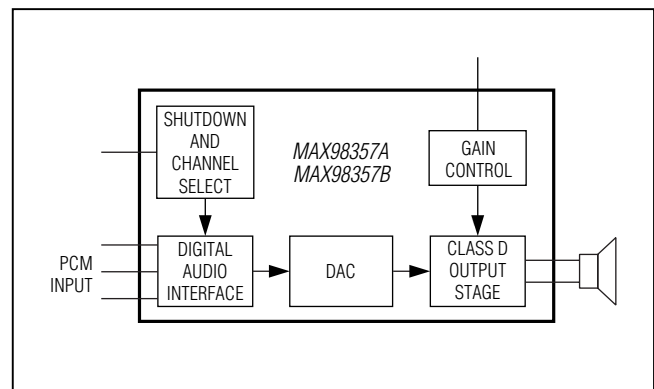
**Functional Diagram** appears at end of data sheet.

For related parts and recommended products to use with this part, refer to [www.maximintegrated.com/MAX98357A.related](http://www.maximintegrated.com/MAX98357A.related).

### Features

- ◆ Single-Supply Operation (2.5V to 5.5V)
- ◆ 3.2W Output Power into 4Ω at 5V
- ◆ 2.4mA Quiescent Current
- ◆ 92% Efficiency ( $R_L = 8\Omega$ ,  $P_{OUT} = 1W$ )
- ◆ 25μV<sub>RMS</sub> Output Noise ( $A_V = 15dB$ )
- ◆ Low 0.015% THD+N at 1kHz
- ◆ No MCLK Required
- ◆ Sample Rates of 8kHz to 96kHz
- ◆ Supports Left, Right, or (Left/2 + Right/2) Output
- ◆ Sophisticated Edge Rate Control Enables Filterless Class D Outputs
- ◆ 77dB PSRR at 1kHz
- ◆ Low RF Susceptibility Rejects TDMA Noise from GSM Radios
- ◆ Extensive Click-and-Pop Reduction Circuitry
- ◆ Robust Short-Circuit and Thermal Protection
- ◆ Available in Space-Saving Packages:  
1.345mm x 1.435mm WLP (0.4mm Pitch)  
and 3mm x 3mm TQFN

### Simplified Block Diagram



Please add a condition for TQFN that only spec's the typical THD+N with no max spec. Add WLP to the existing condition box that has the max spec as shown below.

98357B

1.0M Input Class D Audio Power Amplifiers

|   |      |
|---|------|
| f = 1kHz, P <sub>OUT</sub> = 1W, T <sub>A</sub> = +25°C,<br>Z <sub>SPK</sub> = 4Ω + 33μH, TGFN. | 0.02 |
|---|------|

**ELECTRICAL CHARACTERISTICS (continued)**

(V<sub>DD</sub> = 5V, V<sub>GND</sub> = 0V, GAIN\_SLOT = V<sub>DD</sub>. BCLK = 3.072MHz, LRCLK = 48kHz, speaker loads (Z<sub>SPK</sub>) connected between OUTP and OUTN, Z<sub>SPK</sub> = ∞, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                   | SYMBOL           | CONDITIONS  | MIN   | TYP   | MAX  | UNITS             |
|---|------------------|---|---|-------|------|-------------------|
| Output Power (Note 3)                       | P <sub>OUT</sub> | THD+N 10%,<br>gain = 12dB   | Z <sub>SPK</sub> = 4Ω + 33μH                            |       | 3.2  | W                 |
|   |                  |   | Z <sub>SPK</sub> = 8Ω + 68μH                            |       | 1.8  |                   |
|   |                  |   | Z <sub>SPK</sub> = 8Ω + 68μH,<br>V <sub>DD</sub> = 3.7V |       | 0.93 |                   |
|   |                  | THD+N = 1%,<br>gain = 12dB  | Z <sub>SPK</sub> = 4Ω + 33μH                            |       | 2.5  |                   |
|   |                  |   | Z <sub>SPK</sub> = 8Ω + 68μH                            |       | 1.4  |                   |
|   |                  |   | Z <sub>SPK</sub> = 8Ω + 68μH,<br>V <sub>DD</sub> = 3.7V |       | 0.77 |                   |
| Total Harmonic Distortion + Noise           | THD+N            | f = 1kHz, P <sub>OUT</sub> = 1W, T <sub>A</sub> = +25°C,<br>Z <sub>SPK</sub> = 4Ω + 33μH <b>WLP</b> |   | 0.02  | 0.06 | %                 |
|   |                  | f = 1kHz, P <sub>OUT</sub> = 0.5W, T <sub>A</sub> = +25°C,<br>Z <sub>SPK</sub> = 8Ω + 68μH          |   | 0.013 |      |                   |
| Dynamic Range                               | DR               | A-weighted,<br>V <sub>RMS</sub> = 2.54V, 24- or 32-bit data   |   | 105   |      | dB                |
| Output Noise                                | V <sub>N</sub>   | A-weighted, 24- or 32-bit data (Note 4)   |   | 25    |      | μV <sub>RMS</sub> |
| Gain (Relative to a 2.1dBV Reference Level) | A <sub>V</sub>   | GAIN_SLOT = GND through 100kΩ   | 14.4  | 15    | 15.6 | dB                |
|   |                  | GAIN_SLOT = GND   | 11.4  | 12    | 12.6 |                   |
|   |                  | GAIN_SLOT = unconnected   | 8.4   | 9     | 9.6  |                   |
|   |                  | GAIN_SLOT = V <sub>DD</sub>   | 5.4   | 6     | 6.6  |                   |
|   |                  | GAIN_SLOT = V <sub>DD</sub> through 100kΩ   | 2.4   | 3     | 3.6  |                   |
| Current Limit                               | I <sub>LIM</sub> |   |   | 2.8   |      | A                 |
| Efficiency                                  | ε                | Z <sub>SPK</sub> = 8Ω + 68μH, THD+N = 10%,<br>f = 1kHz, gain = 12dB                                 |   | 92    |      | %                 |
| DAC Gain Error                              |                  |   |   | 1     |      | %                 |
| Frequency Response                          |                  |   | -0.2  |       | +0.2 | dB                |
| Class D Switching Frequency                 | f <sub>OSC</sub> |   |   | 330   |      | kHz               |
| Spread-Spectrum Bandwidth                   |                  |   |   | ±12.5 |      | kHz               |

**DAC DIGITAL FILTERS**

**VOICE MODE IIR LOWPASS FILTER (LRCLK < 30kHz)**

|                      |                  |                      |                           |    |
|----------------------|------------------|----------------------|---------------------------|----|
| Passband Cutoff      | f <sub>PLP</sub> | Ripple limit cutoff  | 0.443<br>x f <sub>S</sub> | Hz |
|                      |                  | -3dB cutoff          | 0.446<br>x f <sub>S</sub> |    |
| Stopband Cutoff      | f <sub>SLP</sub> |                      | 0.464<br>x f <sub>S</sub> | Hz |
| Stopband Attenuation |                  | f > f <sub>SLP</sub> | 75                        | dB |