



# THE DATASHEET OF TAS5719PHPR

# 10-W/15-W Digital Audio Power Amplifier with Integrated Cap-Free HP Amplifier

Check for Samples: [TAS5717](#), [TAS5719](#)

## FEATURES

- **Audio Input/Output**
  - TAS5717 Supports 2×10 W and TAS5719 Supports 2×15 W Output
  - Wide PVDD Range, From 4.5 V to 26 V
  - Efficient Class-D Operation Eliminates Need for Heatsinks
  - Requires Only 3.3 V and PVDD
  - One Serial Audio Input (Two Audio Channels)
  - I<sup>2</sup>C Address Selection via PIN (Chip Select)
  - Supports 8-kHz to 48-kHz Sample Rate (LJ/RJ/I<sup>2</sup>S)
  - External Headphone-Amplifier Shutdown Signal
  - Integrated CAP-Free Headphone Amplifier
  - Stereo Headphone (Stereo 2-V RMS Line Driver) Outputs
- **Audio/PWM Processing**
  - Independent Channel Volume Controls With 24-dB to Mute
  - Programmable Two-Band Dynamic Range Control
  - 14 Programmable Biquads for Speaker EQ
  - Programmable Coefficients for DRC Filters
  - DC Blocking Filters
  - 0.125-dB Fine Volume Support
- **General Features**
  - Serial Control Interface Operational Without MCLK
  - Factory-Trimmed Internal Oscillator for Automatic Rate Detection
  - Surface Mount, 48-Pin, 7-mm × 7-mm HTQFP Package
  - AD, BD, and Ternary PWM-Mode Support
  - Thermal and Short-Circuit Protection

## Benefits

- **EQ: Speaker Equalization Improves Audio Performance**
- **DRC: Dynamic Range Compression. Can Be Used As Power Limiter. Enables Speaker Protection, Easy Listening, Night-Mode Listening**
- **DirectPath Technology: Eliminates Bulky DC Blocking Capacitors**
- **Stereo Headphone/Stereo Line Drivers: Adjust Gain via External Resistors, Dedicated Active Headpone Mute Pin, High Signal-to-Noise Ratio**
- **Two-Band DRC: Set Two Different Thresholds for Low- and High-Frequency Content**

## DESCRIPTION

The TAS5717/TAS5719 is a 10-W/15-W, efficient, digital audio-power amplifier for driving stereo bridge-tied speakers. One serial data input allows processing of up to two discrete audio channels and seamless integration to most digital audio processors and MPEG decoders. The device accepts a wide range of input data and data rates. A fully programmable data path routes these channels to the internal speaker drivers.

The TAS5717/9 is a slave-only device receiving all clocks from external sources. The TAS5717/TAS5719 operates with a PWM carrier between a 384-kHz switching rate and a 352-KHz switching rate, depending on the input sample rate. Oversampling combined with a fourth-order noise shaper provides a flat noise floor and excellent dynamic range from 20 Hz to 20 kHz.



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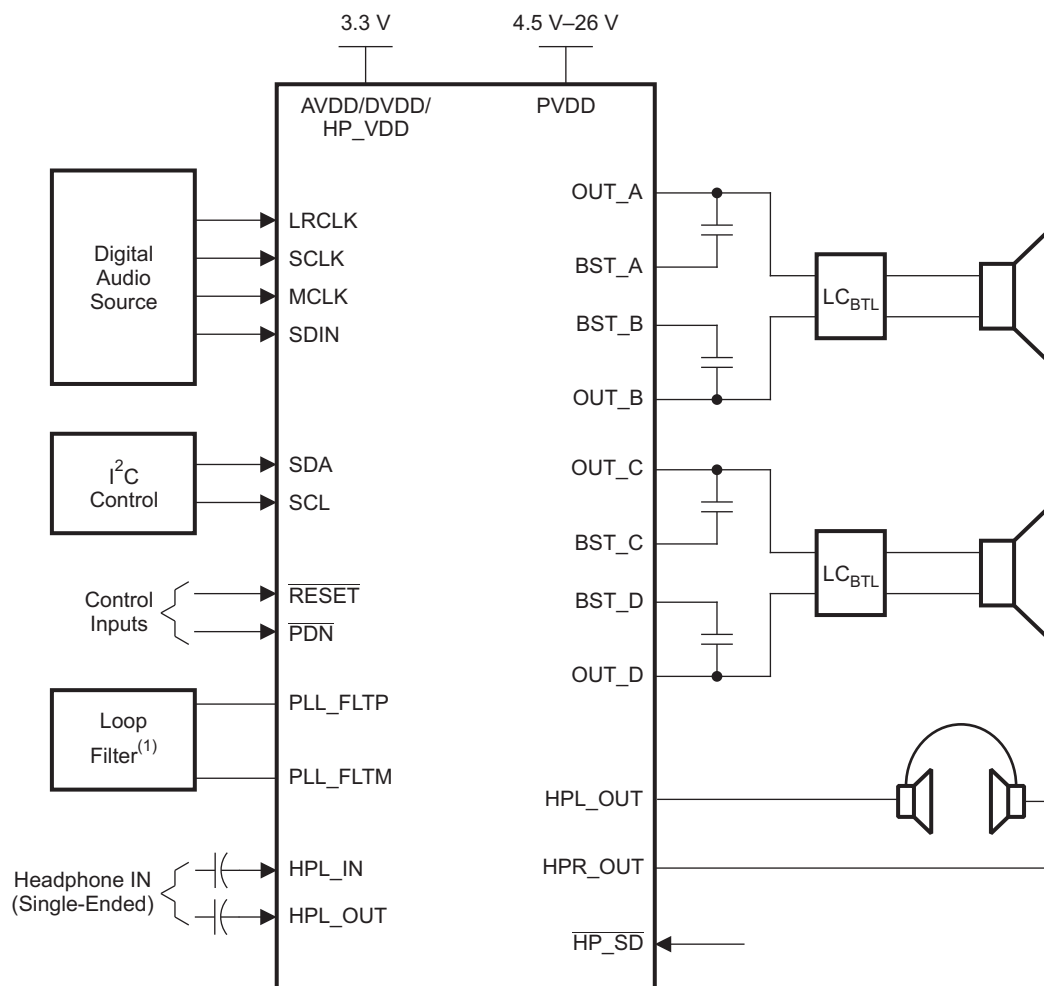
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

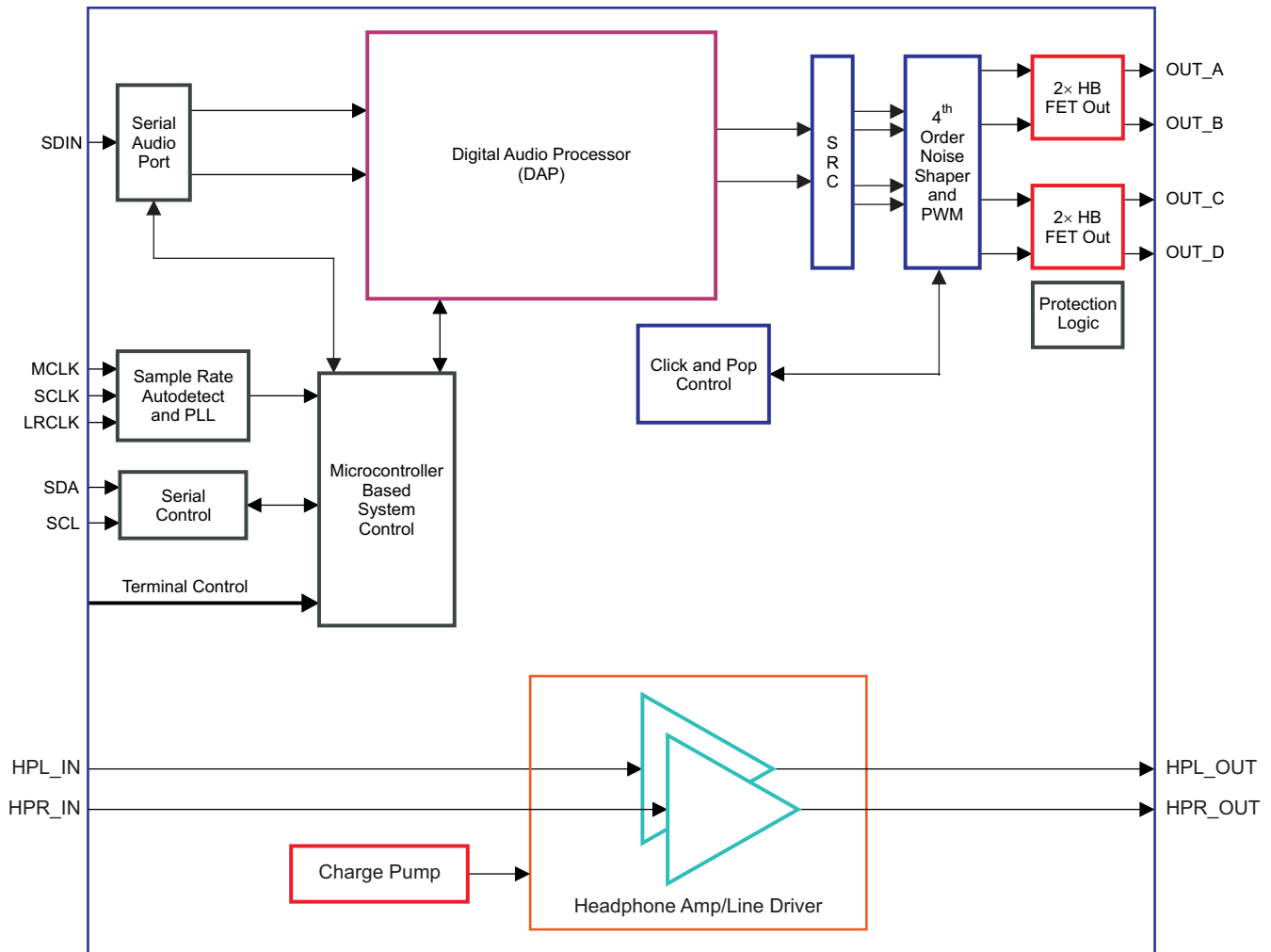
## SIMPLIFIED APPLICATION DIAGRAM



B0264-13

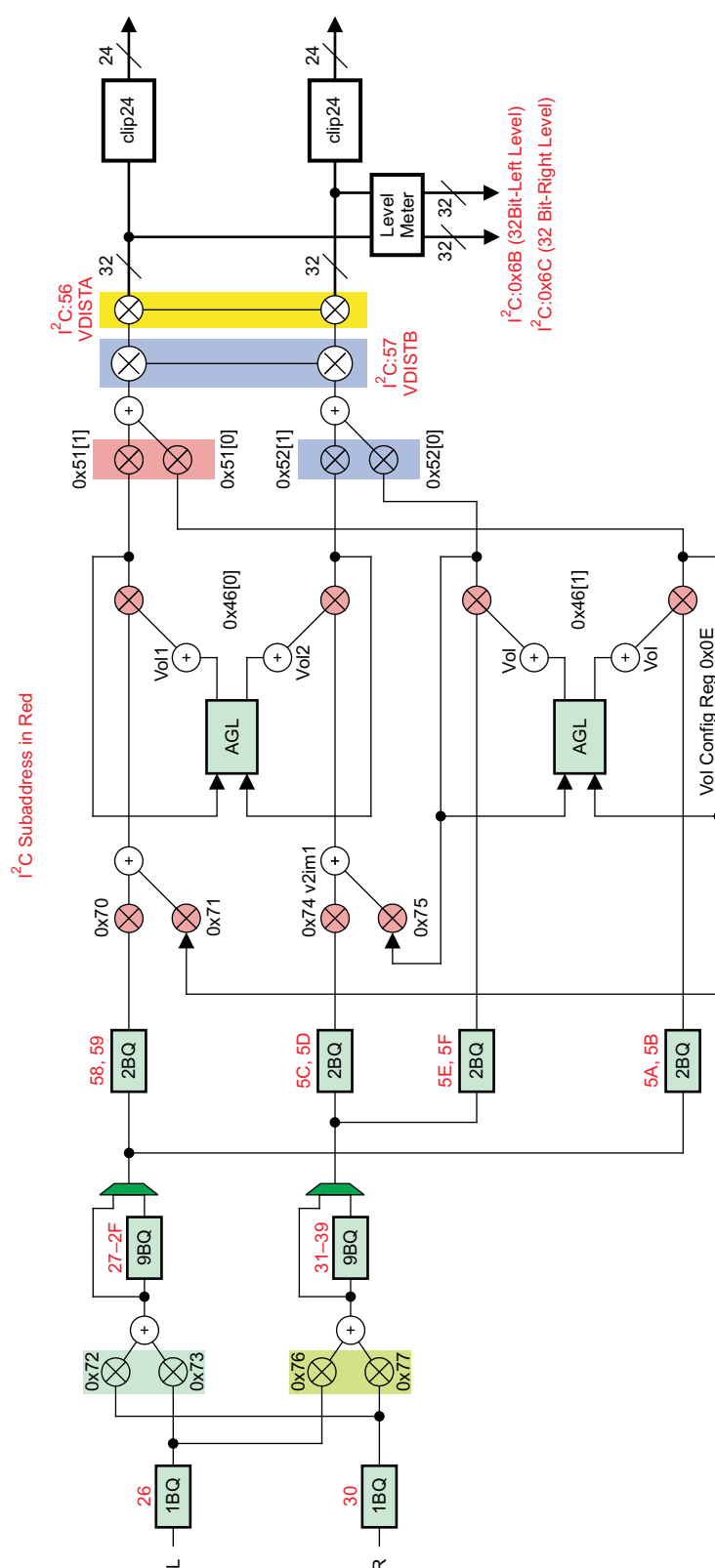
<sup>(1)</sup>See the TAS5717/9 User's Guide for loop-filter values.

## FUNCTIONAL VIEW



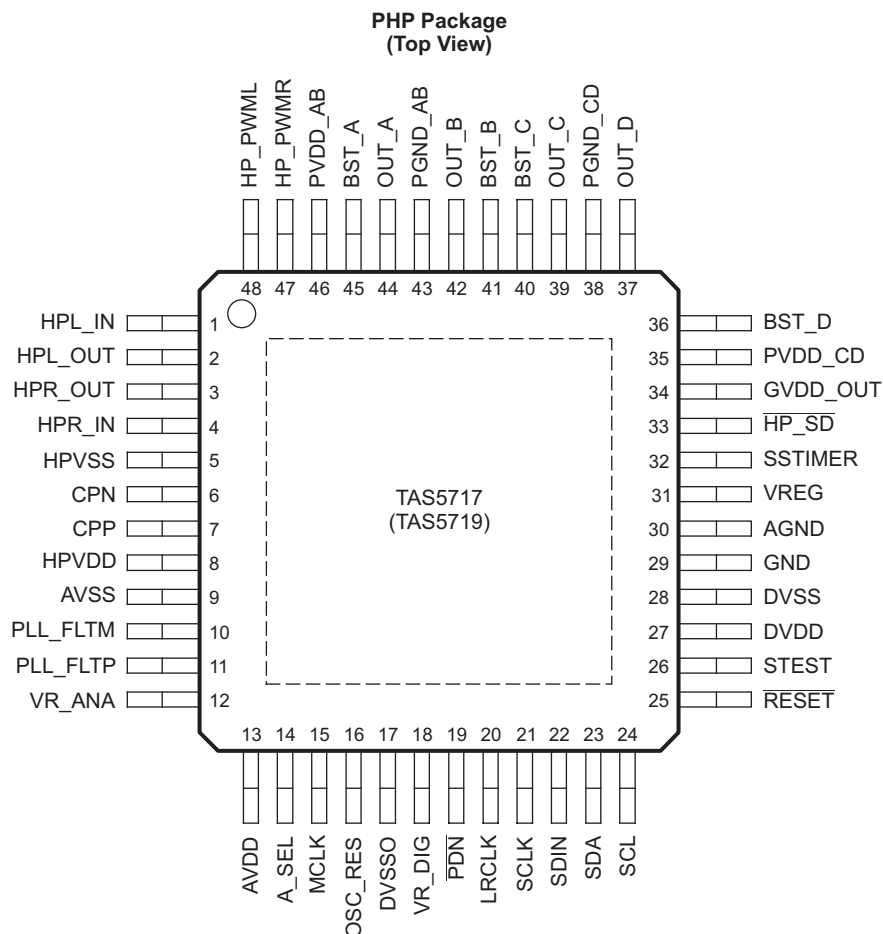
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## DAP PROCESS STRUCTURE



B0321-11

## PIN ASSIGNMENT AND DESCRIPTIONS



P0075-11

## PIN FUNCTIONS

| PIN   |     | TYPE <sup>(1)</sup> | 5-V TOLERANT | TERMINATION <sup>(2)</sup> | DESCRIPTION                                                                                                                                                       |
|-------|-----|---------------------|--------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME  | NO. |                     |              |                            |                                                                                                                                                                   |
| AGND  | 30  | P                   |              |                            | Analog ground for power stage                                                                                                                                     |
| A_SEL | 14  | DIO                 |              |                            | This pin is monitored on the rising edge of $\overline{\text{RESET}}$ . A value of 0 makes the I <sup>2</sup> C dev address 0x54, and a value of 1 makes it 0x56. |
| AVDD  | 13  | P                   |              |                            | 3.3-V analog power supply                                                                                                                                         |
| AVSS  | 9   | P                   |              |                            | Analog 3.3-V supply ground                                                                                                                                        |
| BST_A | 45  | P                   |              |                            | High-side bootstrap supply for half-bridge A                                                                                                                      |
| BST_B | 41  | P                   |              |                            | High-side bootstrap supply for half-bridge B                                                                                                                      |
| BST_C | 40  | P                   |              |                            | High-side bootstrap supply for half-bridge C                                                                                                                      |
| BST_D | 36  | P                   |              |                            | High-side bootstrap supply for half-bridge D                                                                                                                      |
| CPN   | 6   | IO                  |              |                            | Charge-pump flying-capacitor negative connection                                                                                                                  |
| CPP   | 7   | IO                  |              |                            | Charge-pump flying-capacitor positive connection                                                                                                                  |
| DVDD  | 27  | P                   |              |                            | 3.3-V digital power supply                                                                                                                                        |
| DVSS  | 28  | P                   |              |                            | Digital ground                                                                                                                                                    |
| DVSSO | 17  | P                   |              |                            | Oscillator ground                                                                                                                                                 |
| GND   | 29  | P                   |              |                            | Analog ground for power stage                                                                                                                                     |

(1) TYPE: A = analog; D = 3.3-V digital; P = power/ground/decoupling; I = input; O = output

(2) All pullups are weak pullups and all pulldowns are weak pulldowns. The pullups and pulldowns are included to assure proper input logic levels if the pins are left unconnected (pullups → logic 1 input; pulldowns → logic 0 input).

**PIN FUNCTIONS (continued)**

| PIN                       |     | TYPE <sup>(1)</sup> | 5-V<br>TOLERANT | TERMINATION <sup>(2)</sup> | DESCRIPTION                                                                                                                                                                                                                                                  |
|---------------------------|-----|---------------------|-----------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME                      | NO. |                     |                 |                            |                                                                                                                                                                                                                                                              |
| GVDD_OUT                  | 34  | P                   |                 |                            | Gate drive internal regulator output                                                                                                                                                                                                                         |
| HPL_IN                    | 1   | AI                  |                 |                            | Headphone left IN (single-ended, analog IN)                                                                                                                                                                                                                  |
| HPL_OUT                   | 2   | AO                  |                 |                            | Headphone left OUT (single-ended, analog OUT)                                                                                                                                                                                                                |
| HP_PWML                   | 48  | DO                  |                 |                            | PWM left-channel headphone out                                                                                                                                                                                                                               |
| HP_PWMR                   | 47  | DO                  |                 |                            | PWM right-channel headphone out                                                                                                                                                                                                                              |
| HPR_IN                    | 4   | AI                  |                 |                            | Headphone right IN (single-ended, analog IN)                                                                                                                                                                                                                 |
| HPR_OUT                   | 3   | AO                  |                 |                            | Headphone right OUT (single-ended, analog OUT)                                                                                                                                                                                                               |
| HP_SD                     | 33  | AI                  |                 |                            | Headphone shutdown (active-low)                                                                                                                                                                                                                              |
| HPVDD                     | 8   | P                   |                 |                            | Headphone supply                                                                                                                                                                                                                                             |
| HPVSS                     | 5   | P                   |                 |                            | Headphone ground                                                                                                                                                                                                                                             |
| LRCLK                     | 20  | DI                  | 5-V             | Pulldown                   | Input serial audio data left/right clock (sample rate clock)                                                                                                                                                                                                 |
| MCLK                      | 15  | DI                  | 5-V             | Pulldown                   | Master clock input                                                                                                                                                                                                                                           |
| OSC_RES                   | 16  | AO                  |                 |                            | Oscillator trim resistor. Connect an 18-k $\Omega$ 1% resistor to DVSSO.                                                                                                                                                                                     |
| OUT_A                     | 44  | O                   |                 |                            | Output, half-bridge A                                                                                                                                                                                                                                        |
| OUT_B                     | 42  | O                   |                 |                            | Output, half-bridge B                                                                                                                                                                                                                                        |
| OUT_C                     | 39  | O                   |                 |                            | Output, half-bridge C                                                                                                                                                                                                                                        |
| OUT_D                     | 37  | O                   |                 |                            | Output, half-bridge D                                                                                                                                                                                                                                        |
| $\overline{\text{PDN}}$   | 19  | DI                  | 5-V             | Pullup                     | Power down, active-low. $\overline{\text{PDN}}$ prepares the device for loss of power supplies by shutting down the noise shaper and initiating the PWM stop sequence.                                                                                       |
| PGND_AB                   | 43  | P                   |                 |                            | Power ground for half-bridges A and B                                                                                                                                                                                                                        |
| PGND_CD                   | 38  | P                   |                 |                            | Power ground for half-bridges C and D                                                                                                                                                                                                                        |
| PLL_FLTM                  | 10  | AO                  |                 |                            | PLL negative loop-filter terminal                                                                                                                                                                                                                            |
| PLL_FLTP                  | 11  | AO                  |                 |                            | PLL positive loop-filter terminal                                                                                                                                                                                                                            |
| PVDD_AB                   | 46  | P                   |                 |                            | Power-supply input for half-bridge output A                                                                                                                                                                                                                  |
| PVDD_CD                   | 35  | P                   |                 |                            | Power-supply input for half-bridge output C                                                                                                                                                                                                                  |
| $\overline{\text{RESET}}$ | 25  | DI                  | 5-V             | Pullup                     | Reset, active-low. A system reset is generated by applying a logic low to this pin. $\overline{\text{RESET}}$ is an asynchronous control signal that restores the DAP to its default conditions, and places the PWM in the hard-mute (high-impedance) state. |
| SCL                       | 24  | DI                  | 5-V             |                            | I <sup>2</sup> C serial control clock input                                                                                                                                                                                                                  |
| SCLK                      | 21  | DI                  | 5-V             | Pulldown                   | Serial audio data clock (shift clock). SCLK is the serial audio port input data bit clock.                                                                                                                                                                   |
| SDA                       | 23  | DIO                 | 5-V             |                            | I <sup>2</sup> C serial control data interface input/output                                                                                                                                                                                                  |
| SDIN                      | 22  | DI                  | 5-V             | Pulldown                   | Serial audio data input. SDIN supports three discrete (stereo) data formats.                                                                                                                                                                                 |
| SSTIMER                   | 32  | AI                  |                 |                            | Controls ramp time of OUT_X to minimize pop. Leave this pin floating for BD mode. Requires capacitor of 2.2 nF to GND in AD mode. The capacitor determines the ramp time.                                                                                    |
| STEST                     | 26  | DI                  |                 |                            | Factory test pin. Connect directly to DVSS.                                                                                                                                                                                                                  |
| VR_ANA                    | 12  | P                   |                 |                            | Internally regulated 1.8-V analog supply voltage. This pin must not be used to power external devices.                                                                                                                                                       |
| VR_DIG                    | 18  | P                   |                 |                            | Internally regulated 1.8-V digital supply voltage. This pin must not be used to power external devices.                                                                                                                                                      |
| VREG                      | 31  | P                   |                 |                            | Digital regulator output. Not to be used for powering external circuitry.                                                                                                                                                                                    |

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                             |                                                         | VALUE                             | UNIT |
|---------------------------------------------|---------------------------------------------------------|-----------------------------------|------|
| Supply voltage                              | DVDD, AVDD, HPVDD                                       | −0.3 to 3.6                       | V    |
|                                             | PVDD_X                                                  | −0.3 to 30                        | V    |
| Input voltage                               | HPL_IN, HPR_IN                                          | −0.3 to 4.2                       | V    |
|                                             | 3.3-V digital input                                     | −0.5 to DVDD + 0.5                | V    |
|                                             | 5-V tolerant <sup>(2)</sup> digital input (except MCLK) | −0.5 to DVDD + 2.5 <sup>(3)</sup> | V    |
|                                             | 5-V tolerant MCLK input                                 | −0.5 to AVDD + 2.5 <sup>(3)</sup> | V    |
| OUT_x to PGND_x                             |                                                         | 22 <sup>(4)</sup>                 | V    |
| BST_x to PGND_x                             |                                                         | 32 <sup>(4)</sup>                 | V    |
| Input clamp current, I <sub>IK</sub>        |                                                         | ±20                               | mA   |
| Output clamp current, I <sub>OK</sub>       |                                                         | ±20                               | mA   |
| Operating free-air temperature              |                                                         | 0 to 85                           | °C   |
| Operating junction temperature range        |                                                         | 0 to 150                          | °C   |
| Storage temperature range, T <sub>stg</sub> |                                                         | −40 to 125                        | °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* are not implied. Exposure to absolute-maximum conditions for extended periods may affect device reliability.
- (2) 5-V tolerant inputs are PDN, RESET, SCLK, LRCLK, MCLK, SDIN, SDA, and SCL.
- (3) Maximum pin voltage should not exceed 6 V.
- (4) DC voltage + peak ac waveform measured at the pin should be below the allowed limit for all conditions.

## THERMAL INFORMATION

| THERMAL METRIC <sup>(1)</sup> |                                                             | TAS5717 | UNIT |
|-------------------------------|-------------------------------------------------------------|---------|------|
|                               |                                                             | PHP     |      |
|                               |                                                             | 48 PINS |      |
| $\theta_{JA}$                 | Junction-to-ambient thermal resistance <sup>(2)</sup>       | 35.2    | °C/W |
| $\theta_{JB}$                 | Junction-to-board thermal resistance <sup>(3)</sup>         | 10.9    | °C/W |
| $\theta_{JC(bottom)}$         | Junction-to-case (bottom) thermal resistance <sup>(4)</sup> | 1.6     | °C/W |
| $\theta_{JC(top)}$            | Junction-to-case (top) thermal resistance <sup>(5)</sup>    | 19.7    | °C/W |
| $\psi_{JT}$                   | Junction-to-top characterization parameter <sup>(6)</sup>   | 3.4     | °C/W |
| $\psi_{JB}$                   | Junction-to-board characterization parameter <sup>(7)</sup> | 10.1    | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).
- (2) The junction-to-ambient thermal resistance under natural convection is obtained in a simulation on a JEDEC-standard, high-K board, as specified in JESD51-7, in an environment described in JESD51-2a.
- (3) The junction-to-board thermal resistance is obtained by simulating in an environment with a ring cold plate fixture to control the PCB temperature, as described in JESD51-8.
- (4) The junction-to-case (bottom) thermal resistance is obtained by simulating a cold plate test on the exposed (power) pad. No specific JEDEC standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.
- (5) The junction-to-case (top) thermal resistance is obtained by simulating a cold plate test on the package top. No specific JEDEC-standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.
- (6) The junction-to-top characterization parameter,  $\psi_{JT}$ , estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining  $\theta_{JA}$ , using a procedure described in JESD51-2a (sections 6 and 7).
- (7) The junction-to-board characterization parameter,  $\psi_{JB}$ , estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining  $\theta_{JA}$ , using a procedure described in JESD51-2a (sections 6 and 7).

**RECOMMENDED OPERATING CONDITIONS**

|                               |                                      |                                                         | MIN | NOM | MAX | UNIT |
|-------------------------------|--------------------------------------|---------------------------------------------------------|-----|-----|-----|------|
|                               | Digital/analog supply voltage        | DVDD, AVDD                                              | 3   | 3.3 | 3.6 | V    |
|                               | Half-bridge supply voltage           | PVDD_X                                                  | 4.5 |     |     | V    |
| V <sub>IH</sub>               | High-level input voltage             | 5-V tolerant                                            | 2   |     |     | V    |
| V <sub>IL</sub>               | Low-level input voltage              | 5-V tolerant                                            |     |     | 0.8 | V    |
| T <sub>A</sub>                | Operating ambient temperature range  |                                                         | 0   |     | 85  | °C   |
| T <sub>J</sub> <sup>(1)</sup> | Operating junction temperature range |                                                         | 0   |     | 125 | °C   |
| R <sub>L</sub> (BTL)          | Load impedance                       | Output filter: L = 15 µH, C = 680 nF                    | 4   | 8   |     | Ω    |
| L <sub>O</sub> (BTL)          | Output-filter inductance             | Minimum output inductance under short-circuit condition | 4.7 |     |     | µH   |

(1) Continuous operation above the recommended junction temperature may result in reduced reliability and/or lifetime of the device.

**RECOMMENDED OPERATING CONDITIONS FOR HEADPHONE/LINE DRIVER**

|                   |                                           |       | MIN | NOM | MAX | UNIT |
|-------------------|-------------------------------------------|-------|-----|-----|-----|------|
|                   | Digital/analog supply voltage             | HPVDD | 3   | 3.3 | 3.6 | V    |
| R <sub>hp_L</sub> | Headphone-mode load impedance (HPL/HPR)   |       | 16  | 32  |     | Ω    |
| R <sub>ln_L</sub> | Line-driver-mode load impedance (HPL/HPR) |       | 0.6 | 10  |     | kΩ   |

**PWM OPERATION AT RECOMMENDED OPERATING CONDITIONS**

| PARAMETER          | TEST CONDITIONS                     | VALUE | UNIT |
|--------------------|-------------------------------------|-------|------|
| Output sample rate | 11.025/22.05/44.1-kHz data rate ±2% | 352.8 | kHz  |
|                    | 48/24/12/8/16/32-kHz data rate ±2%  | 384   |      |

**PLL INPUT PARAMETERS AND EXTERNAL FILTER COMPONENTS**

| PARAMETER                                                     | TEST CONDITIONS      | MIN    | TYP | MAX    | UNIT  |
|---------------------------------------------------------------|----------------------|--------|-----|--------|-------|
| f <sub>MCLKI</sub> MCLK Frequency                             |                      | 2.8224 |     | 24.576 | MHz   |
| MCLK duty cycle                                               |                      | 40%    | 50% | 60%    |       |
| t <sub>r</sub> / t <sub>f(MCLK)</sub> Rise/fall time for MCLK |                      |        |     | 5      | ns    |
| LRCLK allowable drift before LRCLK reset                      |                      |        |     | 4      | MCLKs |
| External PLL filter capacitor C1                              | SMD 0603 Y5V         |        | 47  |        | nF    |
| External PLL filter capacitor C2                              | SMD 0603 Y5V         |        | 4.7 |        | nF    |
| External PLL filter resistor R                                | SMD 0603, metal film |        | 470 |        | Ω     |
| F <sub>cp</sub> Charge Pump Switching Frequency               |                      | 500    |     | 700    | KHz   |

## ELECTRICAL CHARACTERISTICS

### DC Characteristics

TA = 25°, PVCC\_X = 13 V, DVDD = AVDD = 3.3 V, RL = 8 Ω, BTL AD Mode, fS = 48 KHz (unless otherwise noted)

| PARAMETER                          |                                                              |                                                                             | TEST CONDITIONS                                       | MIN | TYP | MAX | UNIT |
|------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------|-----|-----|-----|------|
| V <sub>OH</sub>                    | High-level output voltage                                    | $\overline{\text{FAULTZ}}$ and SDA                                          | I <sub>OH</sub> = −4 mA<br>DVDD = 3 V                 | 2.4 |     |     | V    |
| V <sub>OL</sub>                    | Low-level output voltage                                     | $\overline{\text{FAULTZ}}$ and SDA                                          | I <sub>OL</sub> = 4 mA<br>DVDD = 3 V                  |     |     | 0.5 | V    |
| I <sub>IL</sub>                    | Low-level input current                                      |                                                                             | V <sub>I</sub> < V <sub>IL</sub> ; DVDD = AVDD = 3.6V |     |     | 75  | μA   |
| I <sub>IH</sub>                    | High-level input current                                     |                                                                             | V <sub>I</sub> > V <sub>IH</sub> ; DVDD = AVDD = 3.6V |     |     | 75  | μA   |
| I <sub>DD</sub>                    | 3.3 V supply current                                         | 3.3 V supply voltage (DVDD, AVDD)                                           | Normal mode                                           |     | 48  | 70  | mA   |
|                                    |                                                              |                                                                             | Reset ( $\overline{\text{RESET}}$ = low, PDN = high)  |     | 21  | 32  |      |
| I <sub>PVDD</sub>                  | Half-bridge supply current                                   | No load (PVDD_X)                                                            | Normal mode                                           |     | 20  | 34  | mA   |
|                                    |                                                              |                                                                             | Reset ( $\overline{\text{RESET}}$ = low, PDN = high)  |     | 5   | 13  |      |
| r <sub>DS(on)</sub> <sup>(1)</sup> | Drain-to-source resistance, LS                               | T <sub>J</sub> = 25°C, includes metallization resistance                    |                                                       |     | 200 |     | mΩ   |
|                                    | Drain-to-source resistance, HS                               | T <sub>J</sub> = 25°C, includes metallization resistance                    |                                                       |     | 200 |     |      |
| I/O Protection                     |                                                              |                                                                             |                                                       |     |     |     |      |
| V <sub>uvp</sub>                   | Undervoltage protection limit                                | PVDD falling                                                                |                                                       |     | 3.5 |     | V    |
| V <sub>uvp,hyst</sub>              | Undervoltage protection limit                                | PVDD rising                                                                 |                                                       |     | 4.5 |     | V    |
| OTE <sup>(2)</sup>                 | Overtemperature error                                        |                                                                             |                                                       |     | 150 |     | °C   |
| OTE <sub>HYST</sub> <sup>(2)</sup> | Extra temperature drop required to recover from error        |                                                                             |                                                       |     | 30  |     | °C   |
| I <sub>OC</sub>                    | Overcurrent limit protection                                 |                                                                             |                                                       |     | 4.5 |     | A    |
| I <sub>OCT</sub>                   | Overcurrent response time                                    |                                                                             |                                                       |     | 150 |     | ns   |
| R <sub>PD</sub>                    | Internal pulldown resistor at the output of each half-bridge | Connected when drivers are tristated to provide bootstrap capacitor charge. |                                                       |     | 3   |     | kΩ   |

(1) This does not include bond-wire or pin resistance.

(2) Specified by design

## AC Characteristics (BTL)

PVDD\_X = 12 V, BTL AD mode,  $f_s = 48$  KHz,  $R_L = 8\ \Omega$ , audio frequency = 1 kHz, (unless otherwise noted). All performance is in accordance with recommended operating conditions, unless otherwise specified.

| PARAMETER      |                                      | TEST CONDITIONS                                  | MIN | TYP               | MAX | UNIT    |
|----------------|--------------------------------------|--------------------------------------------------|-----|-------------------|-----|---------|
| P <sub>O</sub> | Power output per channel             | PVDD = 13 V, 10% THD, 1-kHz input signal         |     | 10                |     | W       |
|                |                                      | PVDD = 8 V, 10% THD, 1-kHz input signal          |     | 4.1               |     |         |
|                |                                      | PVDD = 18 V, 10% THD, 1-kHz input signal         |     | 15 <sup>(1)</sup> |     |         |
| THD+N          | Total harmonic distortion + noise    | PVDD = 13 V; P <sub>O</sub> = 1 W                |     | 0.13%             |     |         |
|                |                                      | PVDD = 8 V; P <sub>O</sub> = 1 W                 |     | 0.2%              |     |         |
| V <sub>n</sub> | Output integrated noise (rms)        | A-weighted                                       |     | 56                |     | $\mu$ V |
|                | Crosstalk                            | P <sub>O</sub> = 0.25 W, f = 1 kHz (BD mode)     |     | –82               |     | dB      |
|                |                                      | P <sub>O</sub> = 0.25 W, f = 1 kHz (AD mode)     |     | –69               |     |         |
| SNR            | Signal-to-noise ratio <sup>(2)</sup> | A-weighted, f = 1 kHz, maximum power at THD < 1% |     | –105              |     | dB      |

(1) 15 W is supported only in the TAS5719.

(2) SNR is calculated relative to 0-dBFS input level.

## AC Characteristics (Headphone/Line Driver)

PVDD\_X = 12 V, BTL AD mode,  $f_s = 48$  KHz,  $R_L = 8\ \Omega$ , audio frequency = 1 kHz, (unless otherwise noted). All performance is in accordance with recommended operating conditions, unless otherwise specified.

| PARAMETER |                                          | TEST CONDITIONS                                         | MIN | TYP | MAX | UNIT |
|-----------|------------------------------------------|---------------------------------------------------------|-----|-----|-----|------|
| Po(hp)    | Headphone power output per channel       | HP_VDD = 3.3 V (R <sub>hp</sub> = 32 $\Omega$ ; THD 1%) |     | 25  |     | mW   |
| HP_gain   | Headphone gain                           | Adjustable via Rin and Rfb                              |     |     |     |      |
| SNR_hp    | Signal-to-noise ratio (headphone mode)   | R <sub>hp</sub> = 32 $\Omega$                           |     | 101 |     | dB   |
| SNR_ln    | Signal-to-noise ratio (line driver mode) | 2-V rms output                                          |     | 105 |     | dB   |

## SERIAL AUDIO PORTS SLAVE MODE

over recommended operating conditions (unless otherwise noted)

| PARAMETER                      |                                                                     | TEST CONDITIONS       | MIN   | TYP | MAX    | UNIT        |
|--------------------------------|---------------------------------------------------------------------|-----------------------|-------|-----|--------|-------------|
| $f_{\text{SCLKIN}}$            | Frequency, SCLK $32 \times f_s$ , $48 \times f_s$ , $64 \times f_s$ | $C_L = 30 \text{ pF}$ | 1.024 |     | 12.288 | MHz         |
| $t_{\text{su1}}$               | Setup time, LRCLK to SCLK rising edge                               |                       | 10    |     |        | ns          |
| $t_{\text{h1}}$                | Hold time, LRCLK from SCLK rising edge                              |                       | 10    |     |        | ns          |
| $t_{\text{su2}}$               | Setup time, SDIN to SCLK rising edge                                |                       | 10    |     |        | ns          |
| $t_{\text{h2}}$                | Hold time, SDIN from SCLK rising edge                               |                       | 10    |     |        | ns          |
|                                | LRCLK frequency                                                     |                       | 8     | 48  | 48     | kHz         |
|                                | SCLK duty cycle                                                     |                       | 40%   | 50% | 60%    |             |
|                                | LRCLK duty cycle                                                    |                       | 40%   | 50% | 60%    |             |
|                                | SCLK rising edges between LRCLK rising edges                        |                       | 32    |     | 64     | SCLK edges  |
| $t_{\text{(edge)}}$            | LRCLK clock edge with respect to the falling edge of SCLK           |                       | -1/4  |     | 1/4    | SCLK period |
| $t_r / t_f(\text{SCLK/LRCLK})$ | Rise/fall time for SCLK/LRCLK                                       |                       |       |     | 8      | ns          |

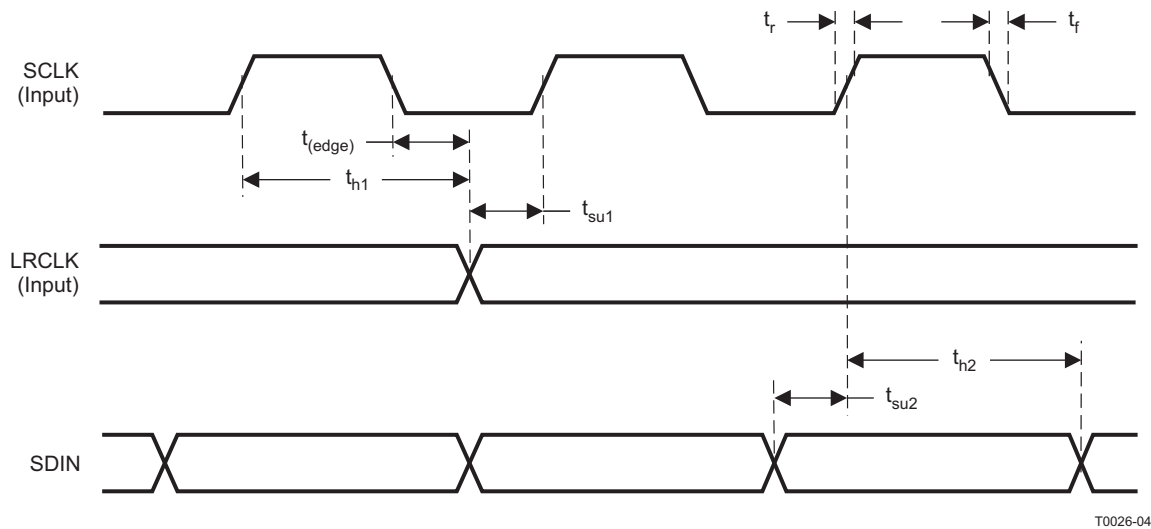


**Figure 1. Slave Mode Serial Data Interface Timing**

## I<sup>2</sup>C SERIAL CONTROL PORT OPERATION

Timing characteristics for I<sup>2</sup>C Interface signals over recommended operating conditions (unless otherwise noted)

| PARAMETER   |                                                | TEST CONDITIONS | MIN | MAX | UNIT    |
|-------------|------------------------------------------------|-----------------|-----|-----|---------|
| $f_{SCL}$   | Frequency, SCL                                 | No wait states  |     | 400 | kHz     |
| $t_{w(H)}$  | Pulse duration, SCL high                       |                 | 0.6 |     | $\mu$ s |
| $t_{w(L)}$  | Pulse duration, SCL low                        |                 | 1.3 |     | $\mu$ s |
| $t_r$       | Rise time, SCL and SDA                         |                 |     | 300 | ns      |
| $t_f$       | Fall time, SCL and SDA                         |                 |     | 300 | ns      |
| $t_{su1}$   | Setup time, SDA to SCL                         |                 | 100 |     | ns      |
| $t_{h1}$    | Hold time, SCL to SDA                          |                 | 0   |     | ns      |
| $t_{(buf)}$ | Bus free time between stop and start condition |                 | 1.3 |     | $\mu$ s |
| $t_{su2}$   | Setup time, SCL to start condition             |                 | 0.6 |     | $\mu$ s |
| $t_{h2}$    | Hold time, start condition to SCL              |                 | 0.6 |     | $\mu$ s |
| $t_{su3}$   | Setup time, SCL to stop condition              |                 | 0.6 |     | $\mu$ s |
| $C_L$       | Load capacitance for each bus line             |                 |     | 400 | pF      |

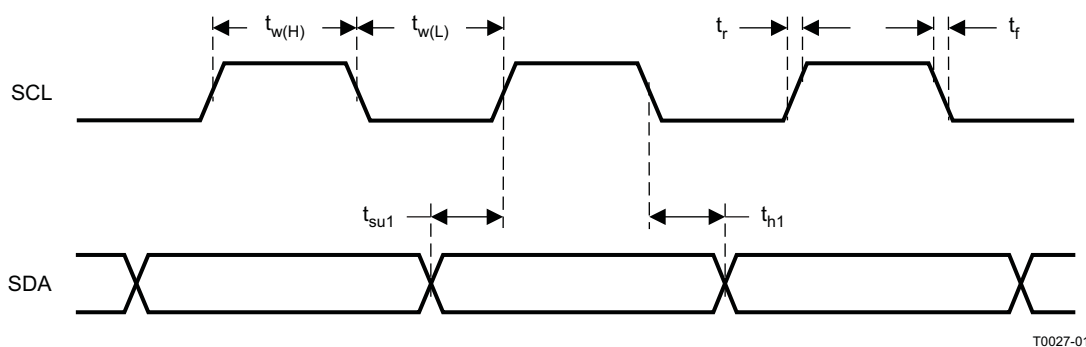


Figure 2. SCL and SDA Timing

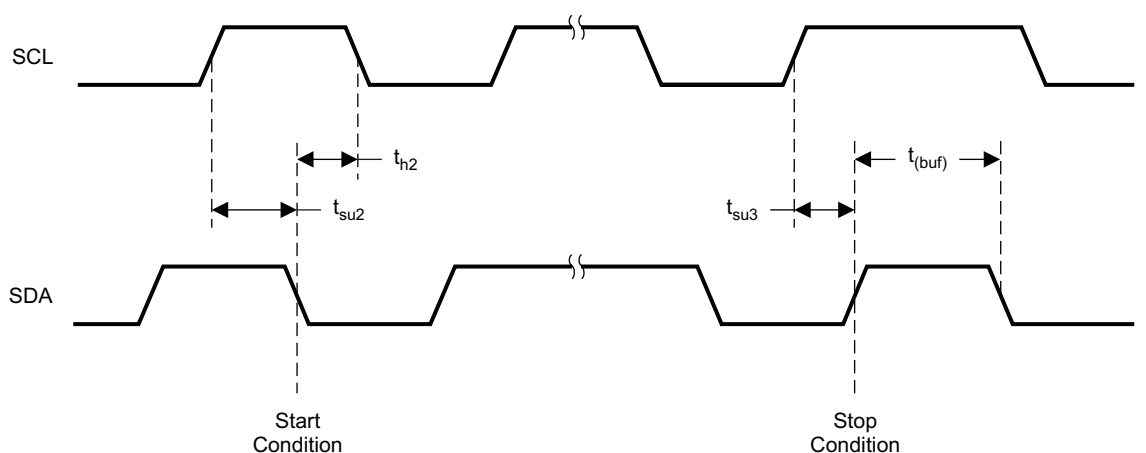
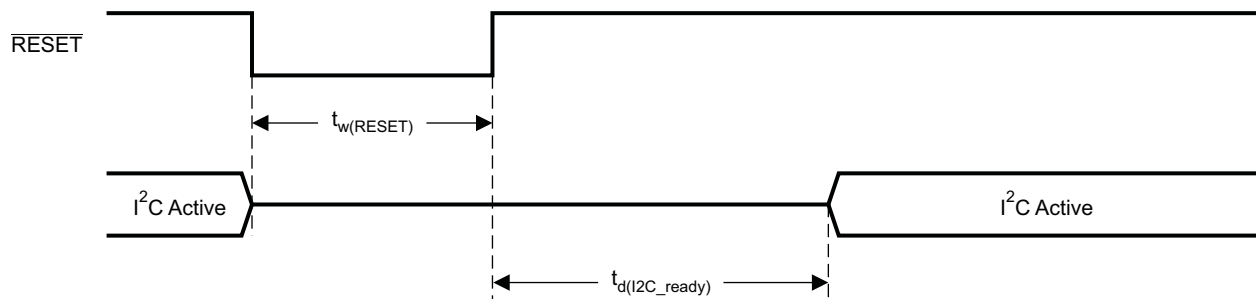


Figure 3. Start and Stop Conditions Timing

## RESET TIMING ( $\overline{\text{RESET}}$ )

Control signal parameters over recommended operating conditions (unless otherwise noted). Please refer to Recommended Use Model section on usage of all terminals.

| PARAMETER                          |                                                  | MIN | TYP | MAX | UNIT          |
|------------------------------------|--------------------------------------------------|-----|-----|-----|---------------|
| $t_{w(\text{RESET})}$              | Pulse duration, $\overline{\text{RESET}}$ active | 100 |     |     | $\mu\text{s}$ |
| $t_{d(\text{I}^2\text{C\_ready})}$ | Time to enable $\text{I}^2\text{C}$              |     |     | 12  | ms            |



System Initialization.  
Enable via  $\text{I}^2\text{C}$ .

T0421-01

- NOTES: 1. On power up, it is recommended that the TAS5717/9  $\overline{\text{RESET}}$  be held LOW for at least 100  $\mu\text{s}$  after DVDD has reached 3 V.
2. If  $\overline{\text{RESET}}$  is asserted LOW while  $\overline{\text{PDN}}$  is LOW, then the  $\overline{\text{RESET}}$  must continue to be held LOW for at least 100  $\mu\text{s}$  after  $\overline{\text{PDN}}$  is deasserted (HIGH).

**Figure 4. Reset Timing**

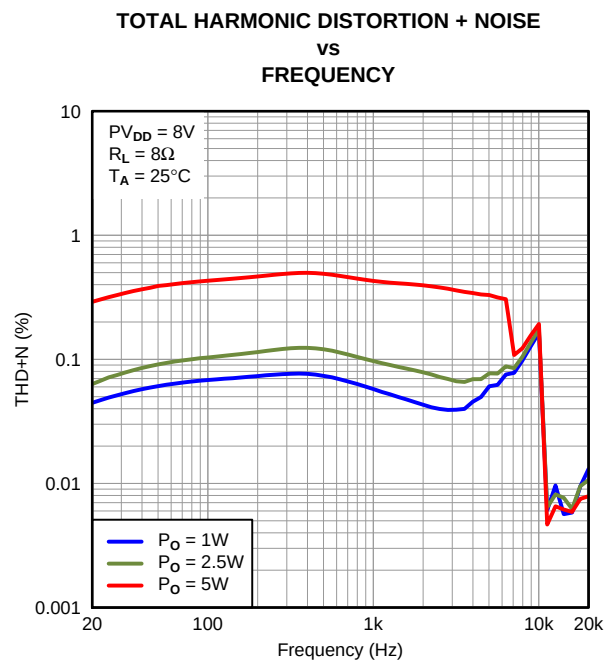
TYPICAL CHARACTERISTICS, BTL CONFIGURATION, 8 $\Omega$ 

Figure 5.

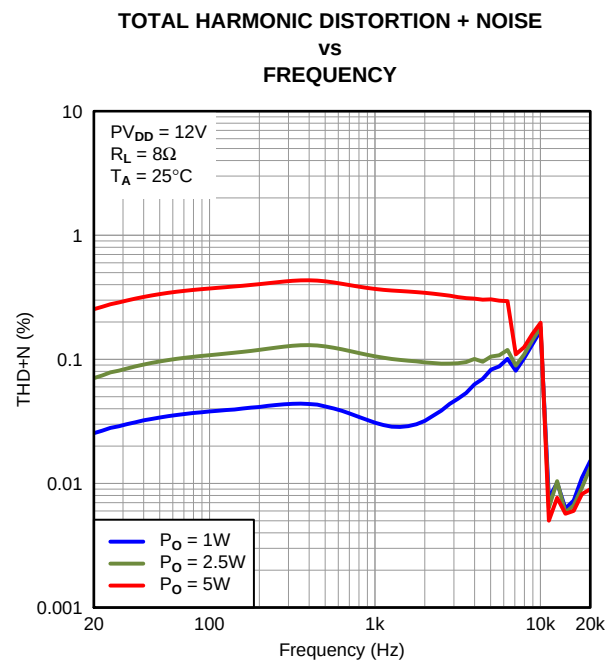


Figure 6.

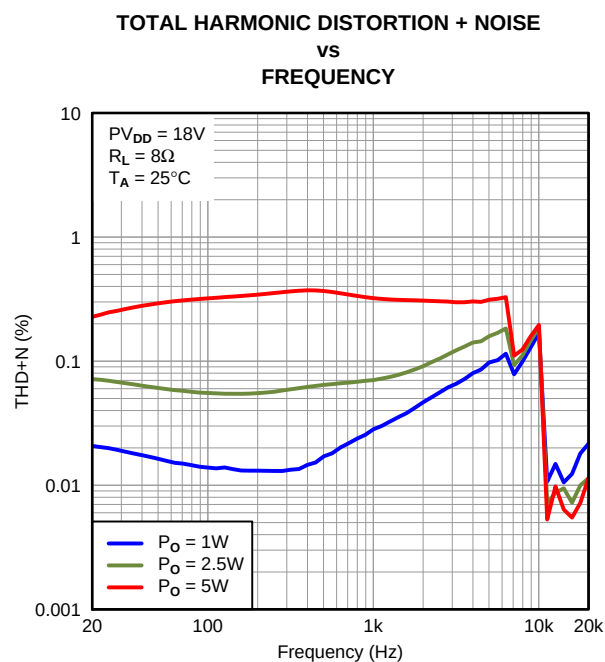


Figure 7.

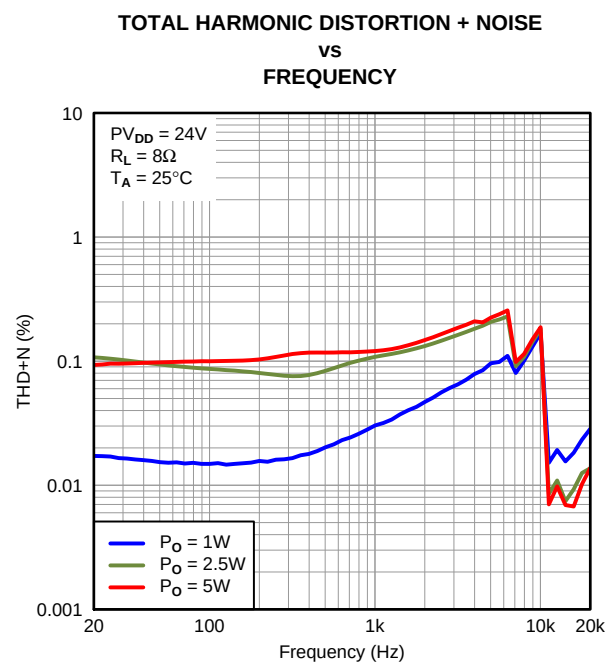


Figure 8.

## TYPICAL CHARACTERISTICS, BTL CONFIGURATION, 8Ω (continued)

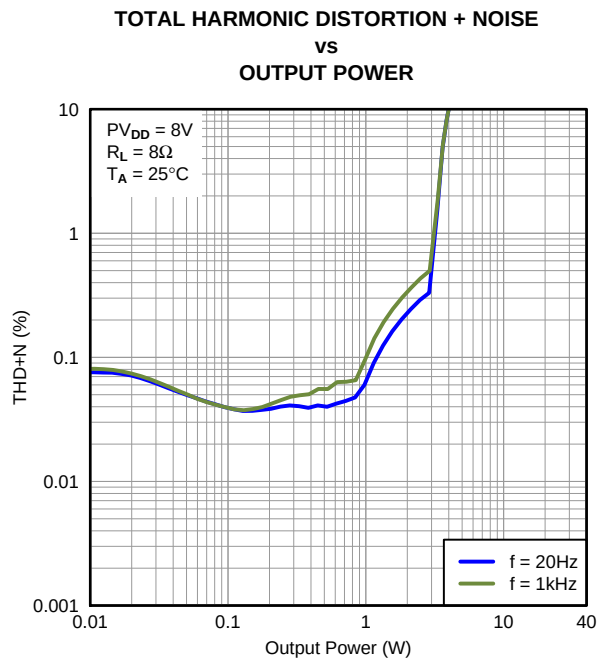


Figure 9.

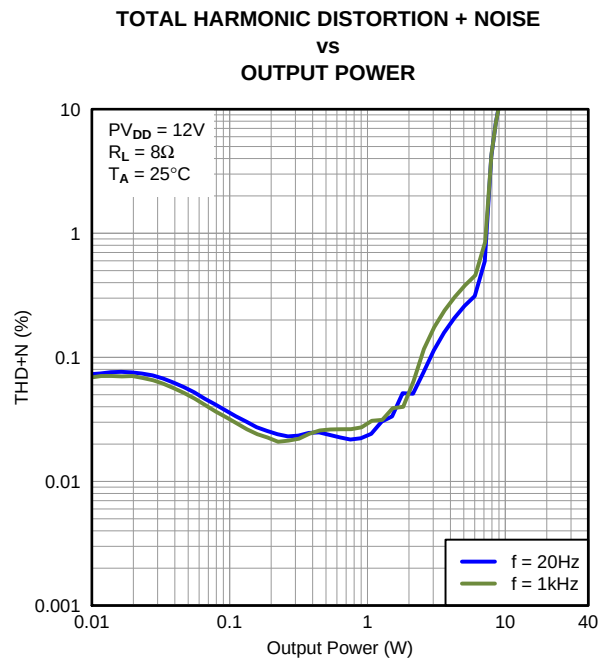


Figure 10.

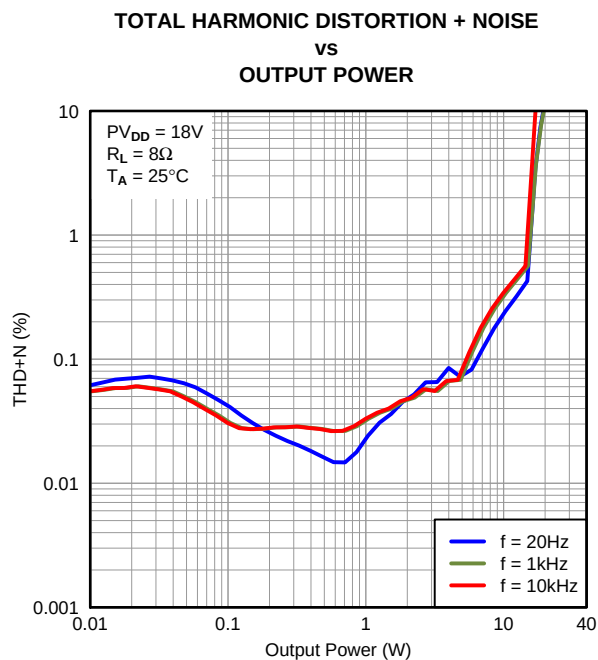


Figure 11.

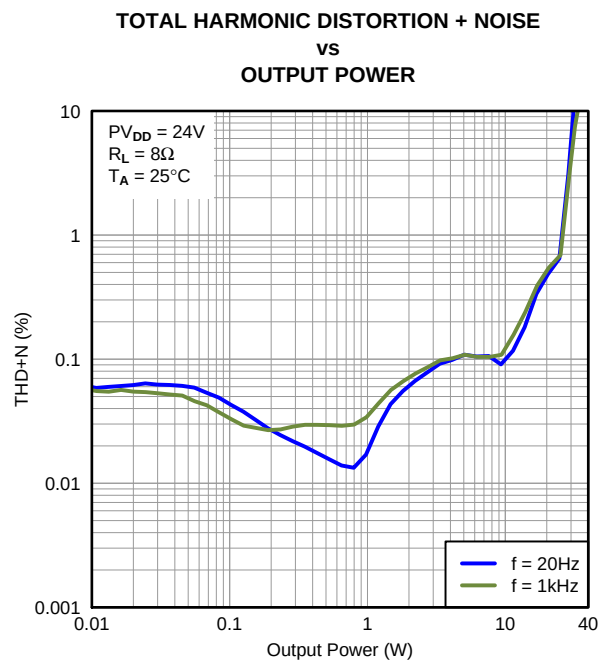
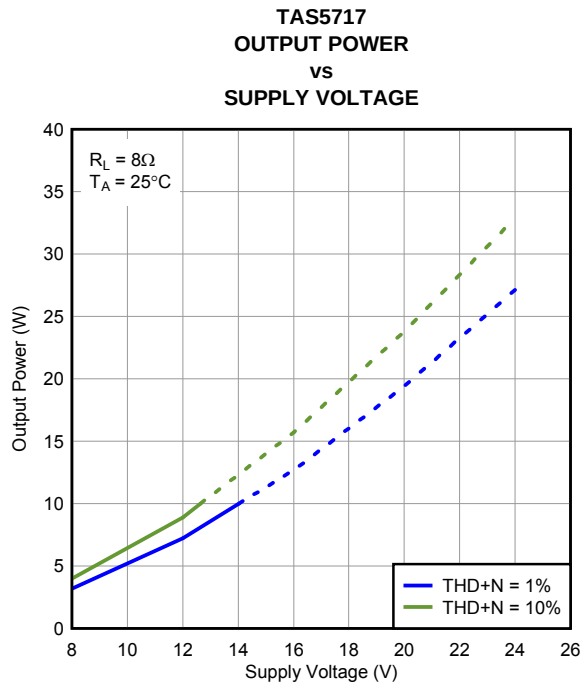


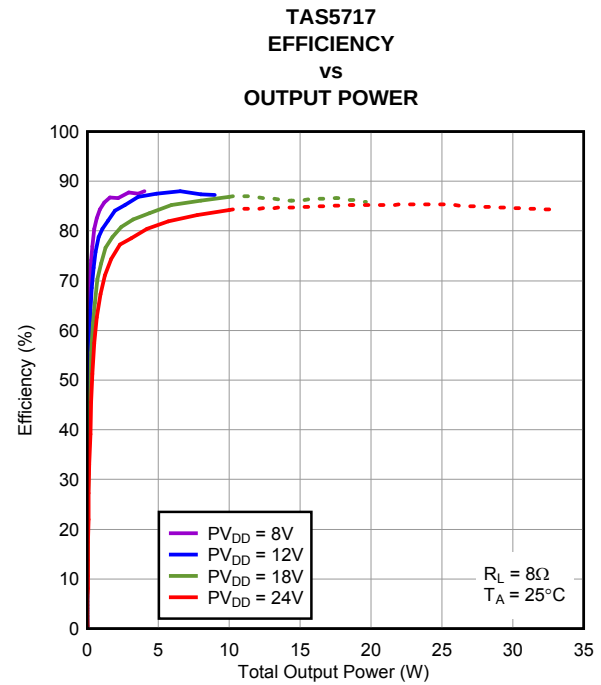
Figure 12.

## TYPICAL CHARACTERISTICS, BTL CONFIGURATION, 8Ω (continued)



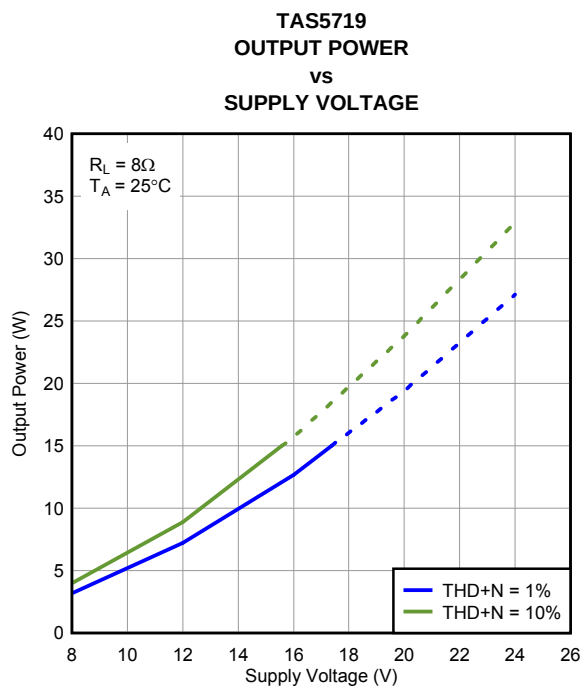
NOTE: Dashed lines represent thermally limited region.

Figure 13.



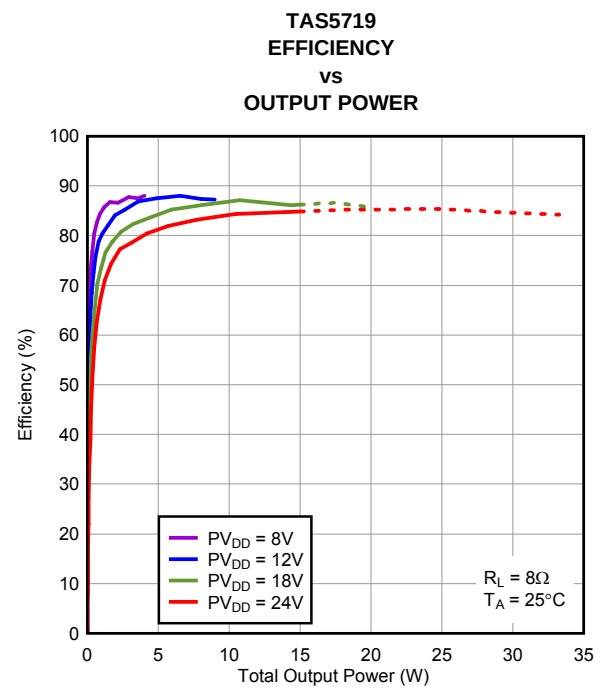
NOTE: Dashed lines represent thermally limited region.

Figure 14.



NOTE: Dashed lines represent thermally limited region.

Figure 15.



NOTE: Dashed lines represent thermally limited region.

Figure 16.

# **TYPICAL CHARACTERISTICS, BTL CONFIGURATION, 8Ω (continued)**

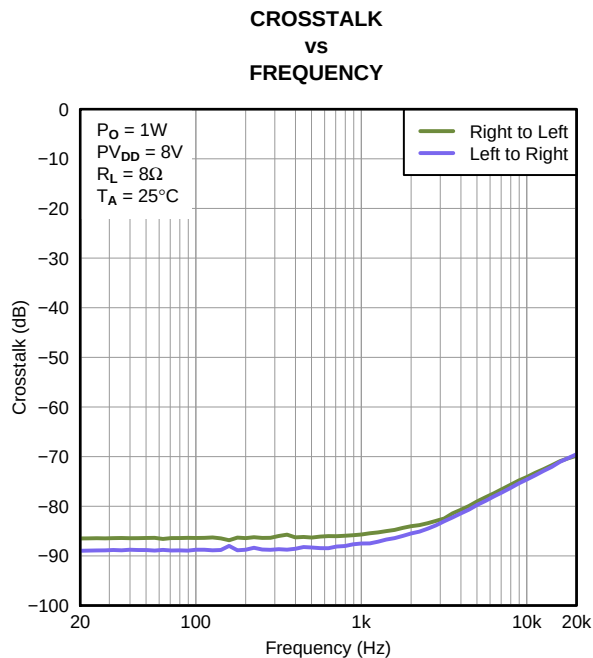


**Figure 17.**

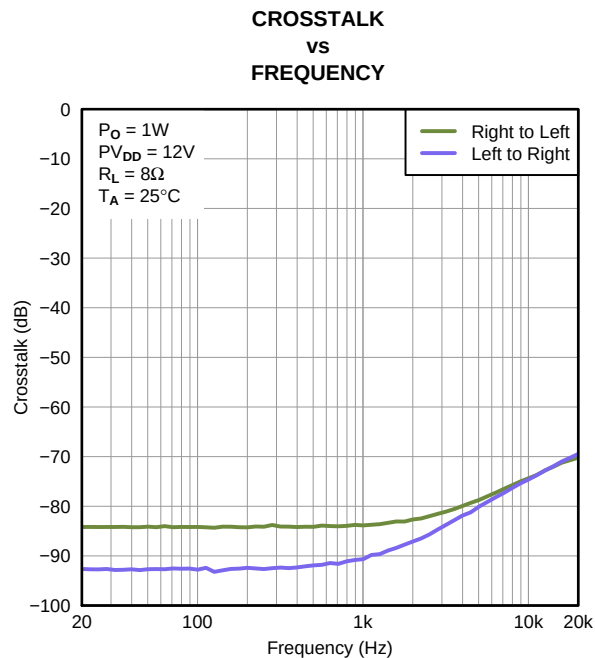


**Figure 18.**

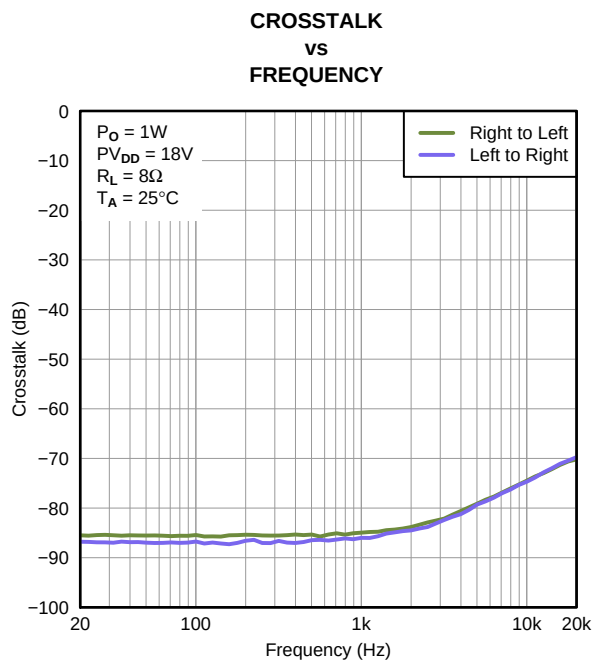


**Figure 19.**

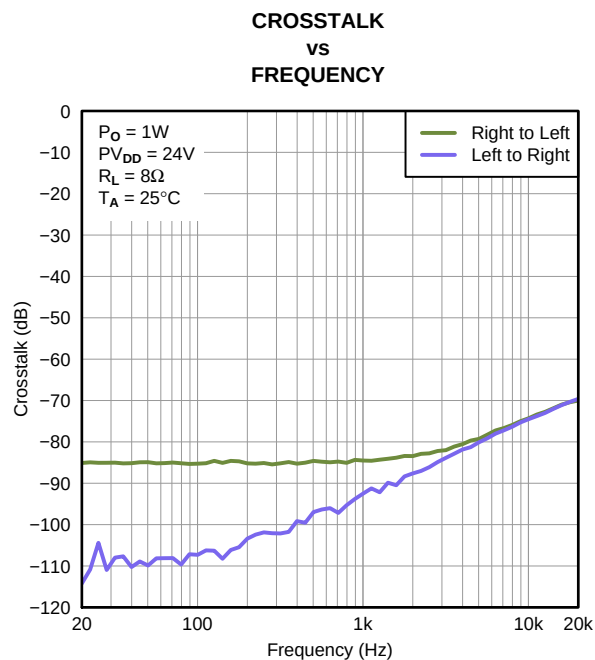


**Figure 20.**

## TYPICAL CHARACTERISTICS, HEADPHONE TESTS, SE CONFIGURATION, 32Ω

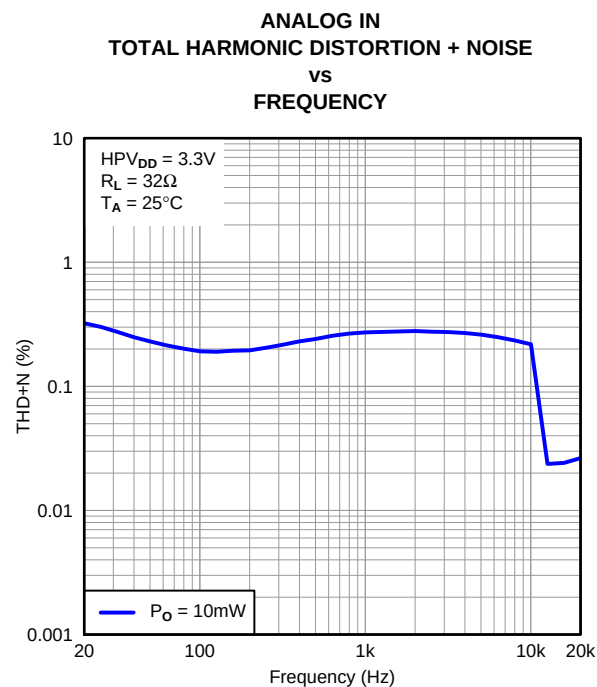


Figure 21.

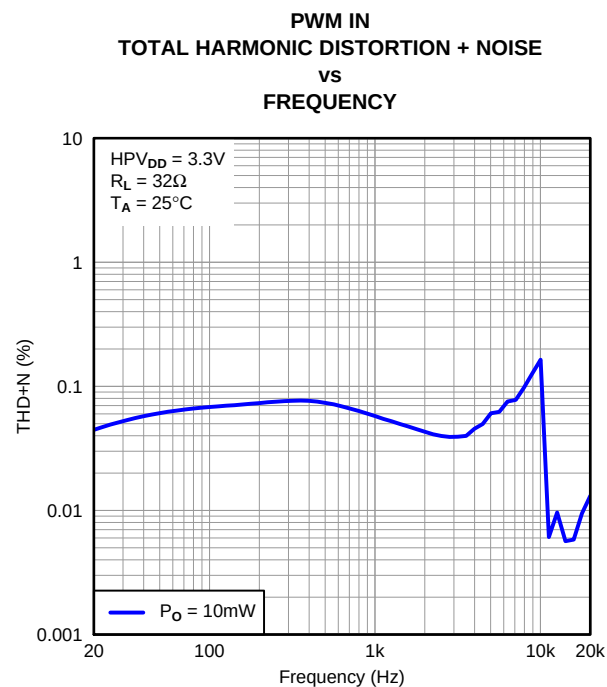


Figure 22.

# **TYPICAL CHARACTERISTICS, LINE DRIVER TESTS, SE CONFIGURATION, 5k $\Omega$**

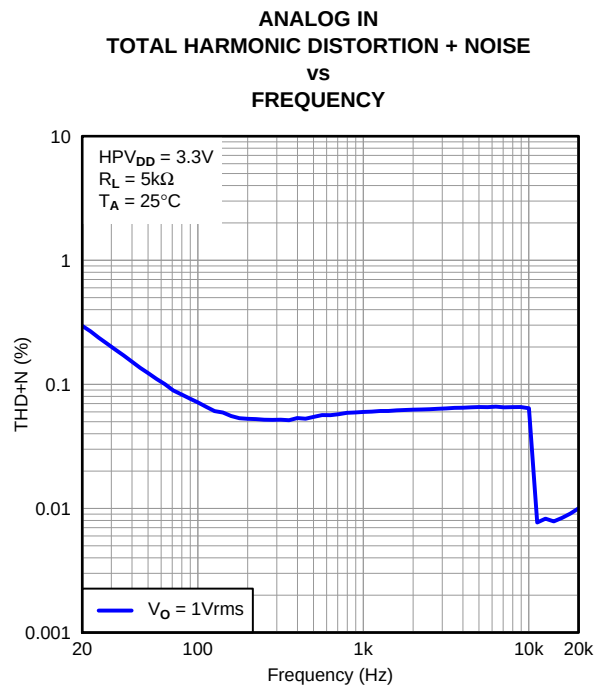


**Figure 23.**

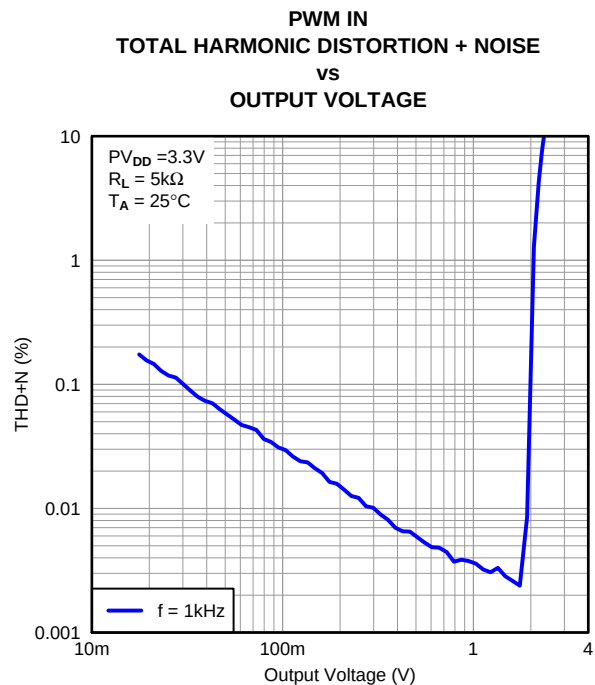


**Figure 24.**

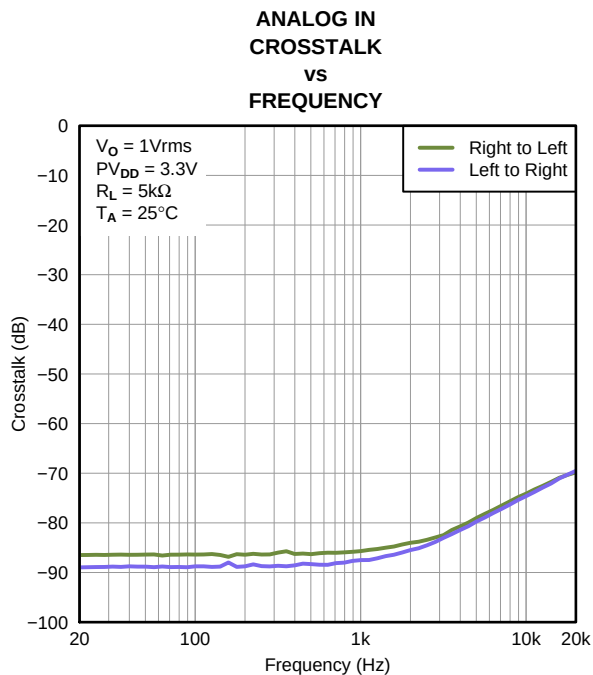


**Figure 25.**

## DETAILED DESCRIPTION

### POWER SUPPLY

To facilitate system design, the TAS5717/9 needs only a 3.3-V supply in addition to the (typical) 13-V power-stage supply. An internal voltage regulator provides suitable voltage levels for the gate drive circuitry. Additionally, all circuitry requiring a floating voltage supply, e.g., the high-side gate drive, is accommodated by built-in bootstrap circuitry requiring only a few external capacitors.

In order to provide good electrical and acoustical characteristics, the PWM signal path for the output stage is designed as identical, independent half-bridges. For this reason, each half-bridge has separate bootstrap pins (BST\_X) and power-stage supply pins (PVDD\_X). The gate drive voltages (GVDD\_AB and GVDD\_CD) are derived from the PVDD voltage. Special attention should be paid to placing all decoupling capacitors as close to their associated pins as possible. In general, inductance between the power-supply pins and decoupling capacitors must be avoided.

For a properly functioning bootstrap circuit, a small ceramic capacitor must be connected from each bootstrap pin (BST\_X) to the power-stage output pin (OUT\_X). When the power-stage output is low, the bootstrap capacitor is charged through an internal diode connected between the gate-drive regulator output pin (GVDD\_X) and the bootstrap pin. When the power-stage output is high, the bootstrap capacitor potential is shifted above the output potential and thus provides a suitable voltage supply for the high-side gate driver. In an application with PWM switching frequencies in the range from 352 kHz to 384 kHz, it is recommended to use 33-nF ceramic capacitors, size 0603 or 0805, for the bootstrap supply. These 33-nF capacitors ensure sufficient energy storage, even during minimal PWM duty cycles, to keep the high-side power stage FET (LDMOS) fully turned on during the remaining part of the PWM cycle.

Special attention should be paid to the power-stage power supply; this includes component selection, PCB placement, and routing. As indicated, each half-bridge has independent power-stage supply pins (PVDD\_X). For optimal electrical performance, EMI compliance, and system reliability, it is important that each PVDD\_X pin is decoupled with a 100-nF ceramic capacitor placed as close as possible to each supply pin.

The TAS5717/9 is fully protected against erroneous power-stage turnon due to parasitic gate charging.

### I<sup>2</sup>C CHIP SELECT/HP\_SHUTDOWN

A\_SEL/HP\_SD is an input pin during power up. It can be pulled high or low. HIGH indicates an I<sup>2</sup>C subaddress of 0x56, and LOW a subaddress of 0x54.

### DEVICE PROTECTION SYSTEM

#### Overcurrent (OC) Protection With Current Limiting

The device has independent, fast-reacting current detectors on all high-side and low-side power-stage FETs. The detector outputs are closely monitored a protection system. If the high-current condition situation persists, i.e., the power stage is being overloaded, a protection system triggers a latching shutdown, resulting in the power stage being set in the high-impedance (Hi-Z) state. The device returns to normal operation once the fault condition (i.e., a short circuit on the output) is removed. Current limiting and overcurrent protection are not independent for half-bridges. That is, if the bridge-tied load between half-bridges A and B causes an overcurrent fault, half-bridges A, B, C, and D are shut down.

#### Overtemperature Protection

The TAS5717/9 has an overtemperature-protection system. If the device junction temperature exceeds 150°C (nominal), the device is put into thermal shutdown, resulting in all half-bridge outputs being set in the high-impedance (Hi-Z) state and FAULT being asserted low. The TAS5717/9 recovers automatically once the temperature drops approximately 30°.

## Undervoltage Protection (UVP) and Power-On Reset (POR)

The UVP and POR circuits of the TAS5717/9 fully protect the device in any power-up/down and brownout situation. While powering up, the POR circuit resets the overload circuit (OLP) and ensures that all circuits are fully operational when the PVDD and AVDD supply voltages reach 4.5 V and 2.7 V, respectively. Although PVDD and AVDD are independently monitored, a supply voltage drop below the UVP threshold on AVDD or on either PVDD pin results in all half-bridge outputs immediately being set in the high-impedance (Hi-Z) state and **FAULT** being asserted low.

## CLOCK, AUTO DETECTION, AND PLL

The TAS5717/9 is a slave device. It accepts MCLK, SCLK, and LRCLK. The digital audio processor (DAP) supports all the sample rates and MCLK rates that are defined in the [clock control register](#).

The TAS5717/9 checks to verify that SCLK is a specific value of  $32 f_s$ ,  $48 f_s$ , or  $64 f_s$ . The DAP only supports a  $1 \times f_s$  LRCLK. The timing relationship of these clocks to SDIN is shown in subsequent sections. The clock section uses MCLK or the internal oscillator clock (when MCLK is unstable, out of range, or absent) to produce the internal clock (DCLK) running at 512 times the PWM switching frequency.

The DAP can autodetect and set the internal clock-control logic to the appropriate settings for all supported clock rates as defined in the clock control register.

TAS5717/9 has robust clock error handling that uses the built-in trimmed oscillator clock to quickly detect changes/errors. Once the system detects a clock change/error, it mutes the audio (through a single-step mute) and then forces PLL to limp using the internal oscillator as a reference clock. Once the clocks are stable, the system autodetects the new rate and reverts to normal operation. During this process, the default volume is restored in a single step (also called hard unmute). The ramp process can be programmed to ramp back slowly (also called soft unmute) as defined in volume register (0x0E).

## SERIAL DATA INTERFACE

Serial data is input on SDIN. The PWM outputs are derived from SDIN. The TAS5717/9 DAP accepts serial data in 16-, 20-, or 24-bit left-justified, right-justified, or I<sup>2</sup>S serial data format.

## PWM Section

The TAS5717/9 DAP device uses noise-shaping and sophisticated nonlinear correction algorithms to achieve high power efficiency and high-performance digital audio reproduction. The DAP uses a fourth-order noise shaper to increase dynamic range and SNR in the audio band. The PWM section accepts 24-bit PCM data from the DAP and outputs two BTL PWM audio output channels.

The PWM section has individual-channel dc-blocking filters that can be enabled and disabled. The filter cutoff frequency is less than 1 Hz. Individual-channel de-emphasis filters for 44.1- and 48-kHz are included and can be enabled and disabled.

Finally, the PWM section has an adjustable maximum modulation limit of 93.8% to 99.2%.

For detailed description of using audio processing features like DRC and EQ, see the User's Guide and TAS570X GDE software development tool documentation. Also see the GDE software development tool for the device data path.

## I<sup>2</sup>C COMPATIBLE SERIAL CONTROL INTERFACE

The TAS5717/9 DAP has an I<sup>2</sup>C serial control slave interface to receive commands from a system controller. The serial control interface supports both normal-speed (100-kHz) and high-speed (400-kHz) operations without wait states. As an added feature, this interface operates even if MCLK is absent.

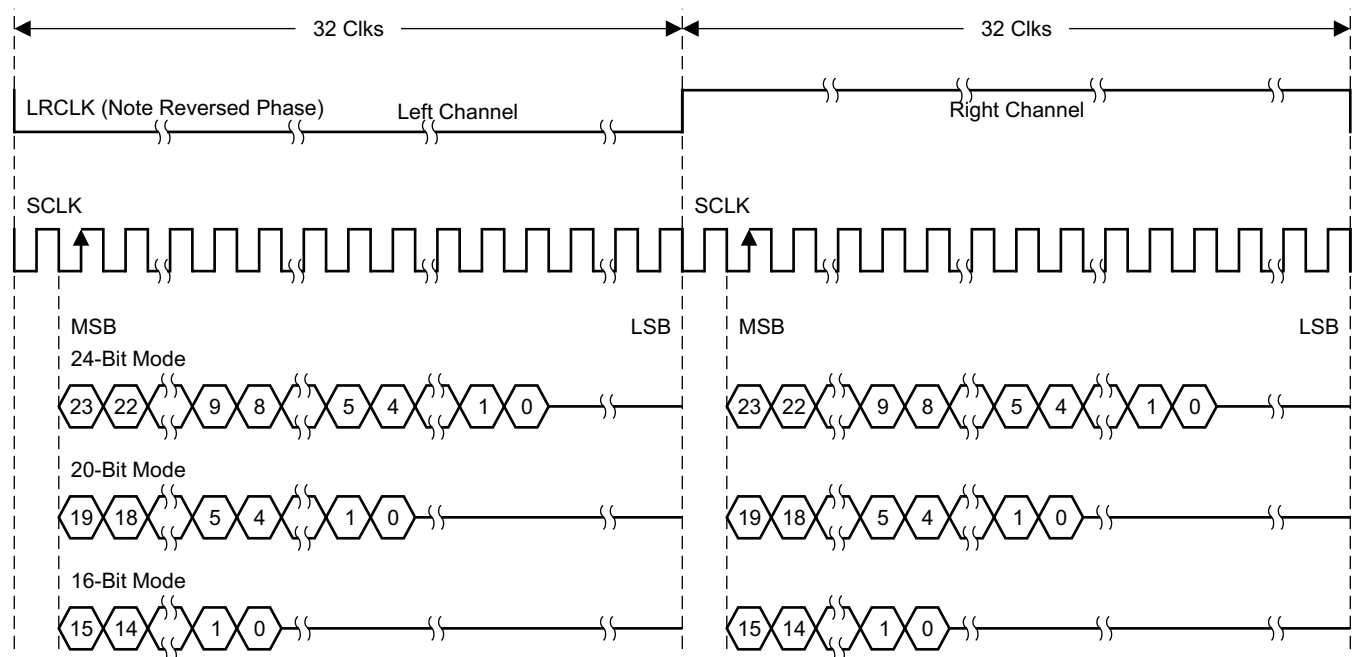
The serial control interface supports both single-byte and multiple-byte read and write operations for status registers and the general control registers associated with the PWM.

## SERIAL INTERFACE CONTROL AND TIMING

### I<sup>2</sup>S Timing

I<sup>2</sup>S timing uses LRCLK to define when the data being transmitted is for the left channel and when it is for the right channel. LRCLK is low for the left channel and high for the right channel. A bit clock running at  $32, 48, \text{ or } 64 \times f_s$  is used to clock in the data. There is a delay of one bit clock from the time the LRCLK signal changes state to the first bit of data on the data lines. The data is written MSB-first and is valid on the rising edge of bit clock. The DAP masks unused trailing data-bit positions.

2-Channel I<sup>2</sup>S (Philips Format) Stereo Input

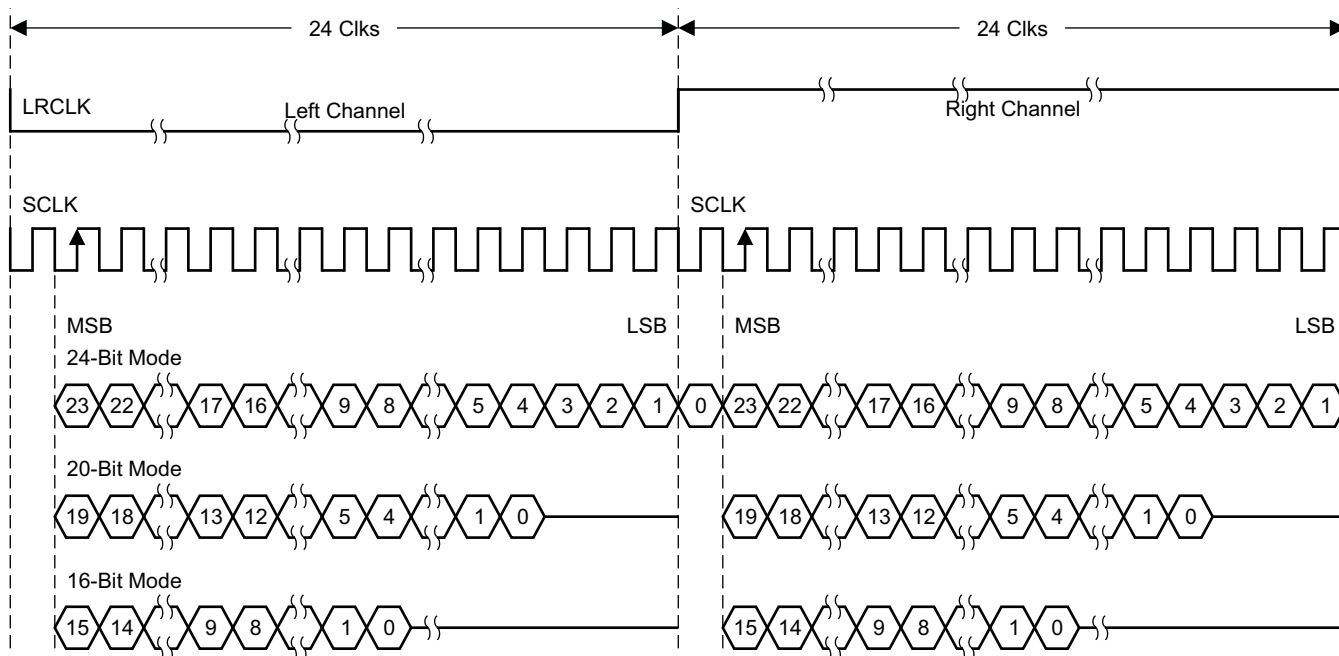


T0034-01

NOTE: All data presented in 2s-complement form with MSB first.

**Figure 26. I<sup>2</sup>S 64- $f_s$  Format**

## 2-Channel I<sup>2</sup>S (Philips Format) Stereo Input/Output (24-Bit Transfer Word Size)

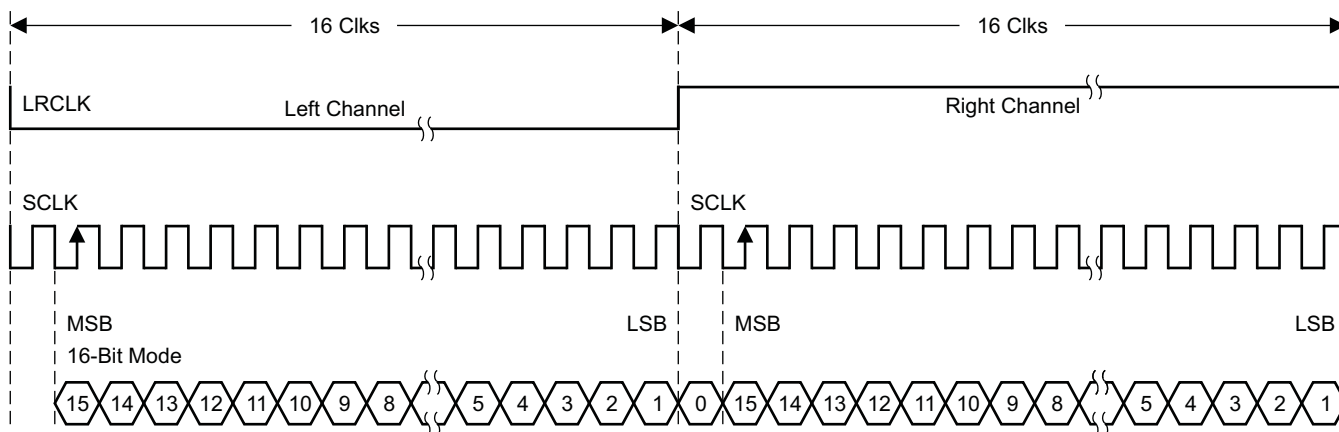


T0092-01

NOTE: All data presented in 2s-complement form with MSB first.

**Figure 27. I<sup>2</sup>S 48-f<sub>s</sub> Format**

## 2-Channel I<sup>2</sup>S (Philips Format) Stereo Input



T0266-01

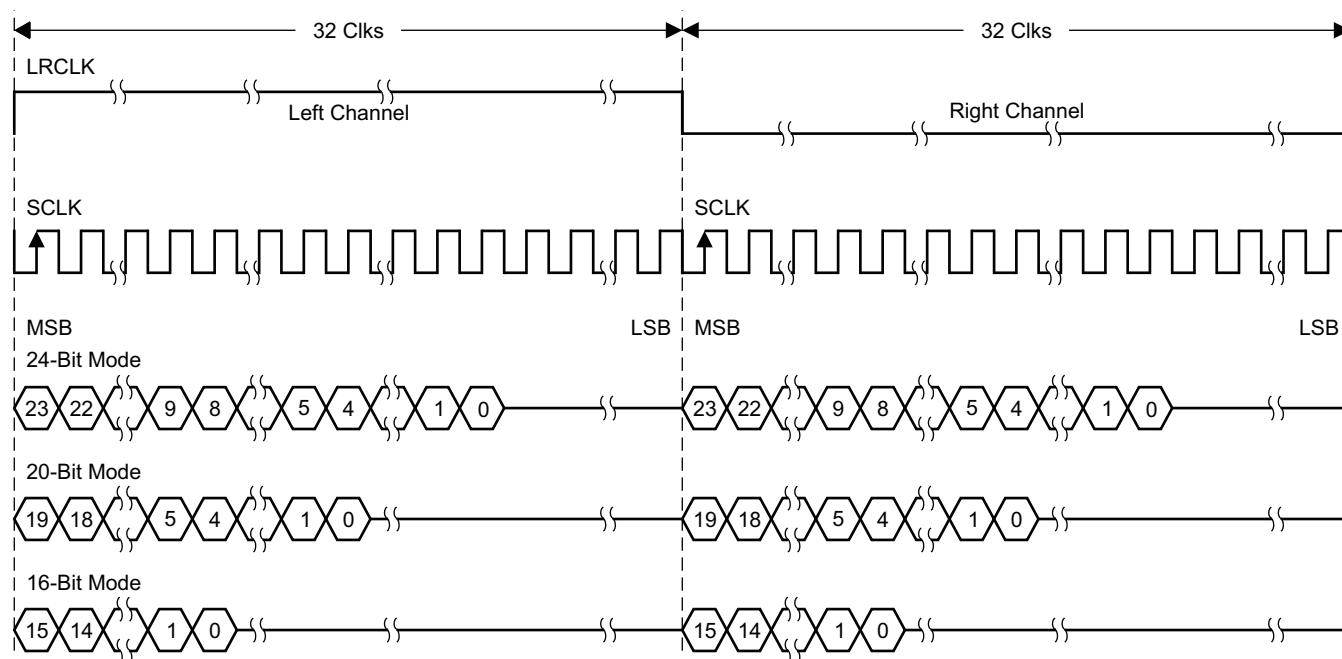
NOTE: All data presented in 2s-complement form with MSB first.

**Figure 28. I<sup>2</sup>S 32-f<sub>s</sub> Format**

### Left-Justified

Left-justified (LJ) timing uses LRCLK to define when the data being transmitted is for the left channel and when it is for the right channel. LRCLK is high for the left channel and low for the right channel. A bit clock running at  $32, 48, \text{ or } 64 \times f_s$  is used to clock in the data. The first bit of data appears on the data lines at the same time LRCLK toggles. The data is written MSB-first and is valid on the rising edge of the bit clock. The DAP masks unused trailing data-bit positions.

2-Channel Left-Justified Stereo Input

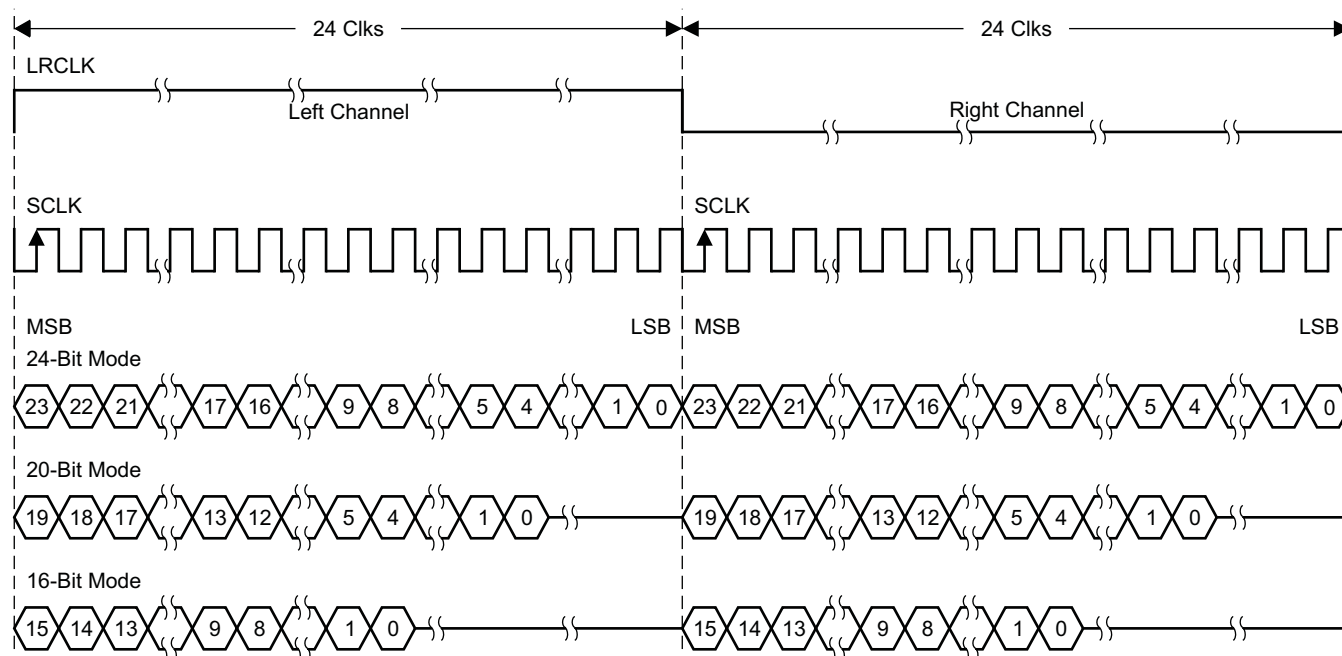


T0034-02

NOTE: All data presented in 2s-complement form with MSB first.

**Figure 29. Left-Justified 64-f<sub>s</sub> Format**

2-Channel Left-Justified Stereo Input (24-Bit Transfer Word Size)

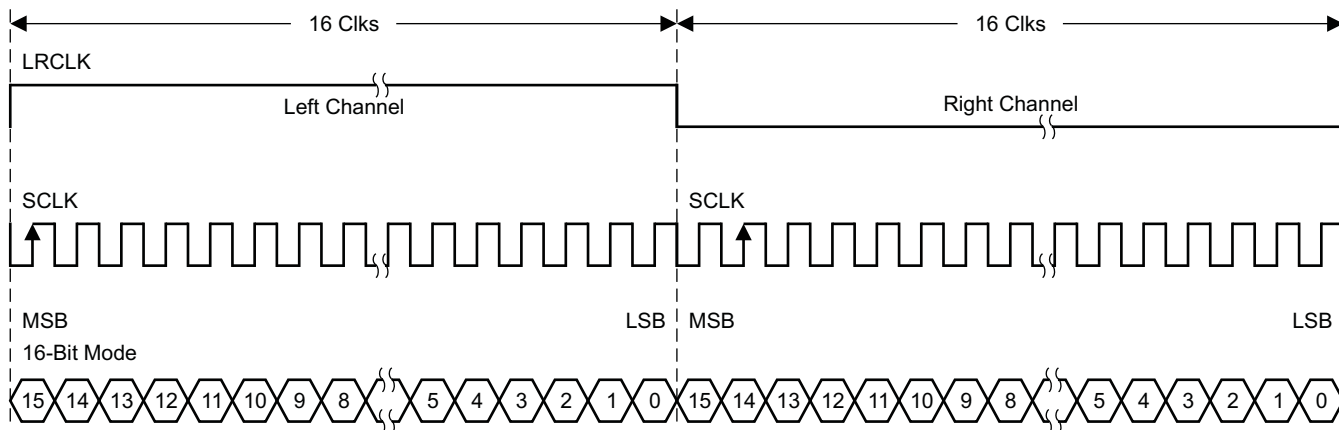


T0092-02

NOTE: All data presented in 2s-complement form with MSB first.

**Figure 30. Left-Justified 48-f<sub>s</sub> Format**

## 2-Channel Left-Justified Stereo Input



T0266-02

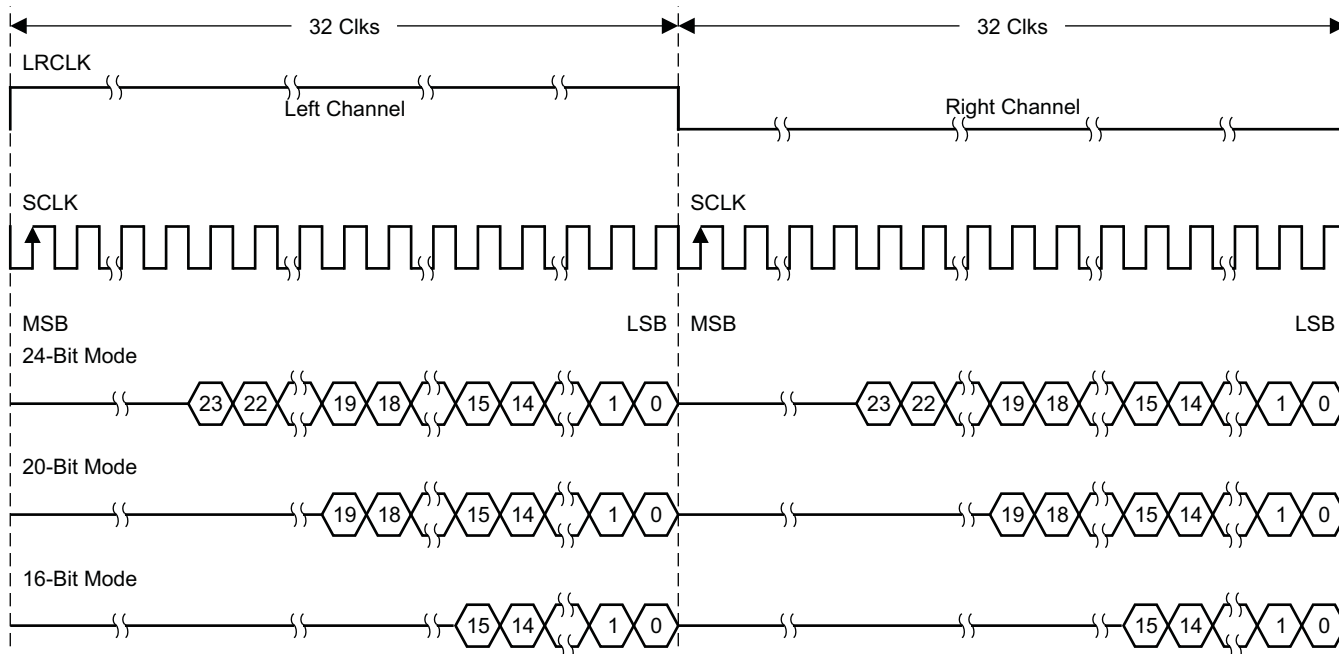
NOTE: All data presented in 2s-complement form with MSB first.

**Figure 31. Left-Justified 32- $f_s$  Format**

## Right-Justified

Right-justified (RJ) timing uses LRCLK to define when the data being transmitted is for the left channel and when it is for the right channel. LRCLK is high for the left channel and low for the right channel. A bit clock running at  $32, 48, \text{ or } 64 \times f_s$  is used to clock in the data. The first bit of data appears on the data 8 bit-clock periods (for 24-bit data) after LRCLK toggles. In RJ mode the LSB of data is always clocked by the last bit clock before LRCLK transitions. The data is written MSB-first and is valid on the rising edge of bit clock. The DAP masks unused leading data-bit positions.

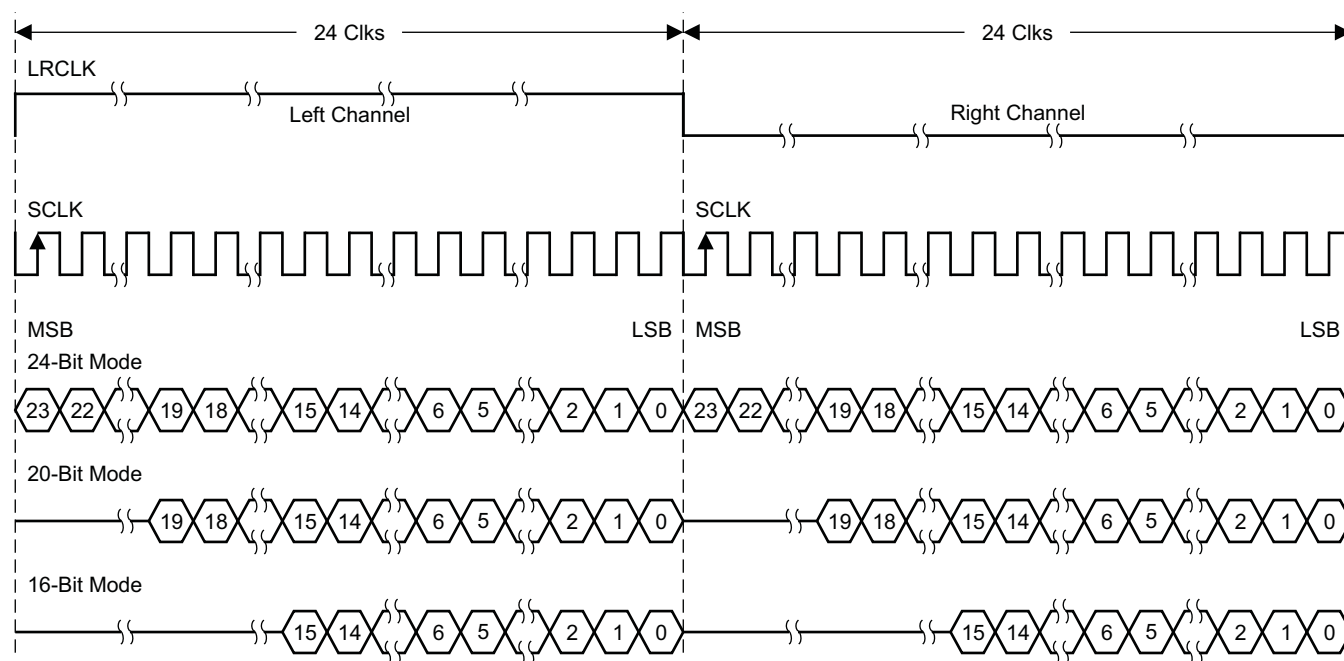
## 2-Channel Right-Justified (Sony Format) Stereo Input



T0034-03

**Figure 32. Right-Justified 64- $f_s$  Format**

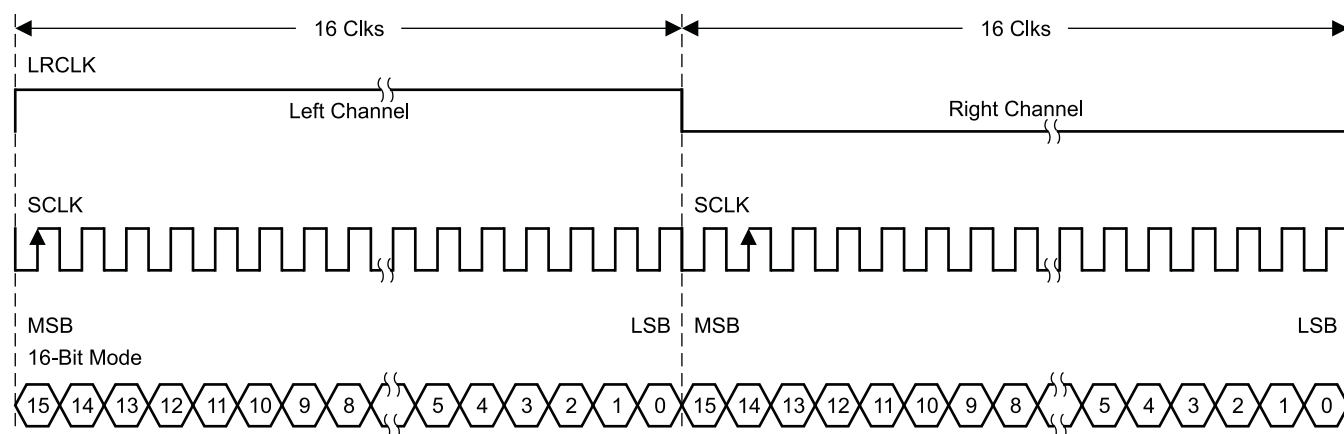
# 2-Channel Right-Justified Stereo Input (24-Bit Transfer Word Size)



T0092-03

**Figure 33. Right-Justified 48-f<sub>s</sub> Format**

# 2-Channel Right-Justified (Sony Format) Stereo Input



T0266-03

**Figure 34. Right-Justified 32-f<sub>s</sub> Format**

## I<sup>2</sup>C SERIAL CONTROL INTERFACE

The TAS5717/9 DAP has a bidirectional I<sup>2</sup>C interface that is compatible with the Inter IC (I<sup>2</sup>C) bus protocol and supports both 100-kHz and 400-kHz data transfer rates for single- and multiple-byte write and read operations. This is a slave-only device that does not support a multimaster bus environment or wait-state insertion. The control interface is used to program the registers of the device and to read device status.

The DAP supports the standard-mode I<sup>2</sup>C bus operation (100 kHz maximum) and the fast I<sup>2</sup>C bus operation (400 kHz maximum). The DAP performs all I<sup>2</sup>C operations without I<sup>2</sup>C wait cycles.

### General I<sup>2</sup>C Operation

The I<sup>2</sup>C bus employs two signals; SDA (data) and SCL (clock), to communicate between integrated circuits in a system. Data is transferred on the bus serially, one bit at a time. The address and data can be transferred in byte (8-bit) format, with the most significant bit (MSB) transferred first. In addition, each byte transferred on the bus is acknowledged by the receiving device with an acknowledge bit. Each transfer operation begins with the master device driving a start condition on the bus and ends with the master device driving a stop condition on the bus. The bus uses transitions on the data pin (SDA) while the clock is high to indicate start and stop conditions. A high-to-low transition on SDA indicates a start and a low-to-high transition indicates a stop. Normal data-bit transitions must occur within the low time of the clock period. These conditions are shown in Figure 35. The master generates the 7-bit slave address and the read/write (R/W) bit to open communication with another device and then waits for an acknowledge condition. The TAS5717/9 holds SDA low during the acknowledge clock period to indicate an acknowledgment. When this occurs, the master transmits the next byte of the sequence. Each device is addressed by a unique 7-bit slave address plus R/W bit (1 byte). All compatible devices share the same signals via a bidirectional bus using a wired-AND connection. An external pullup resistor must be used for the SDA and SCL signals to set the high level for the bus.

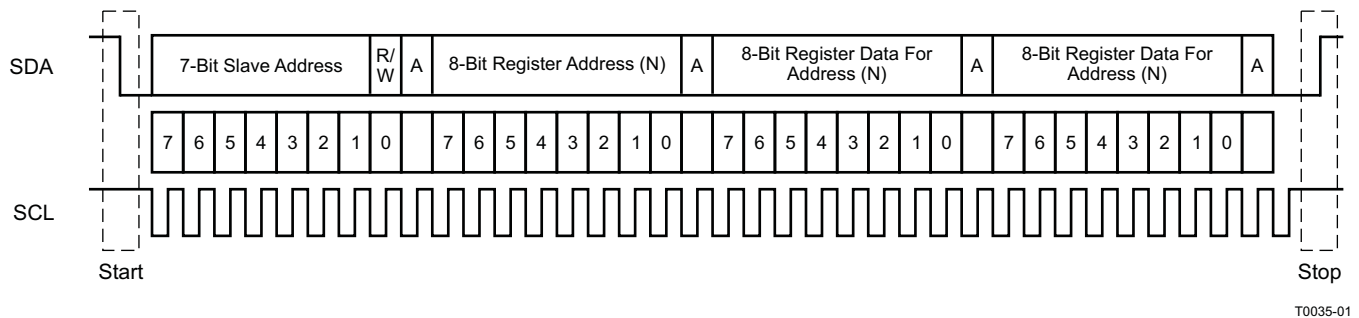


Figure 35. Typical I<sup>2</sup>C Sequence

There is no limit on the number of bytes that can be transmitted between start and stop conditions. When the last word transfers, the master generates a stop condition to release the bus. A generic data transfer sequence is shown in Figure 35.

The 7-bit address for TAS5717/9 is 0101 010 (0x54) or 0101 011 (0x56) defined by A\_SEL (external pulldown for 0x54 and pullup for 0x56). Stereo device with Headphone should use 0x54 as its device address.

### Single- and Multiple-Byte Transfers

The serial control interface supports both single-byte and multiple-byte read/write operations for subaddresses 0x00 to 0x1F. However, for the subaddresses 0x20 to 0xFF, the serial control interface supports only multiple-byte read/write operations (in multiples of 4 bytes).

During multiple-byte read operations, the DAP responds with data, a byte at a time, starting at the subaddress assigned, as long as the master device continues to respond with acknowledges. If a particular subaddress does not contain 32 bits, the unused bits are read as logic 0.

During multiple-byte write operations, the DAP compares the number of bytes transmitted to the number of bytes that are required for each specific subaddress. For example, if a write command is received for a biquad subaddress, the DAP expects to receive five 32-bit words. If fewer than five 32-bit data words have been received when a stop command (or another start command) is received, the data received is discarded.

Supplying a subaddress for each subaddress transaction is referred to as random I<sup>2</sup>C addressing. The TAS5717/9 also supports sequential I<sup>2</sup>C addressing. For write transactions, if a subaddress is issued followed by data for that subaddress and the 15 subaddresses that follow, a sequential I<sup>2</sup>C write transaction has taken place, and the data for all 16 subaddresses is successfully received by the TAS5717/9. For I<sup>2</sup>C sequential write transactions, the subaddress then serves as the start address, and the amount of data subsequently transmitted, before a stop or start is transmitted, determines how many subaddresses are written. As was true for random addressing, sequential addressing requires that a complete set of data be transmitted. If only a partial set of data is written to the last subaddress, the data for the last subaddress is discarded. However, all other data written is accepted; only the incomplete data is discarded.

### Single-Byte Write

As shown in Figure 36, a single-byte data-write transfer begins with the master device transmitting a start condition followed by the I<sup>2</sup>C device address and the read/write bit. The read/write bit determines the direction of the data transfer. For a data-write transfer, the read/write bit is 0. After receiving the correct I<sup>2</sup>C device address and the read/write bit, the DAP responds with an acknowledge bit. Next, the master transmits the address byte or bytes corresponding to the TAS5717/9 internal memory address being accessed. After receiving the address byte, the TAS5717/9 again responds with an acknowledge bit. Next, the master device transmits the data byte to be written to the memory address being accessed. After receiving the data byte, the TAS5717/9 again responds with an acknowledge bit. Finally, the master device transmits a stop condition to complete the single-byte data-write transfer.

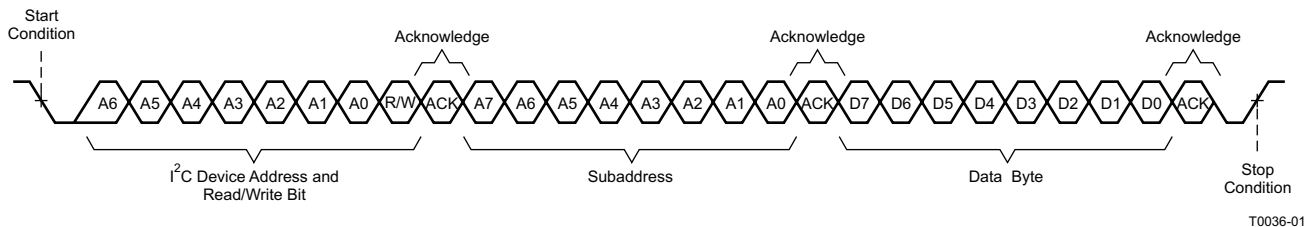


Figure 36. Single-Byte Write Transfer

### Multiple-Byte Write

A multiple-byte data-write transfer is identical to a single-byte data write transfer except that multiple data bytes are transmitted by the master device to the DAP as shown in Figure 37. After receiving each data byte, the TAS5717/9 responds with an acknowledge bit.

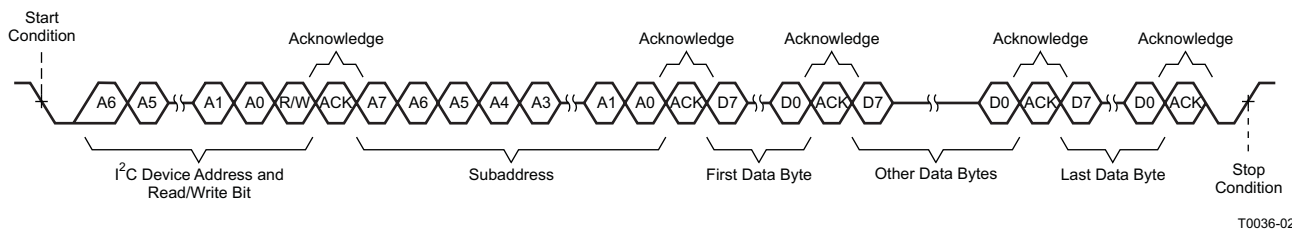


Figure 37. Multiple-Byte Write Transfer

## Single-Byte Read

As shown in Figure 38, a single-byte data-read transfer begins with the master device transmitting a start condition followed by the I<sup>2</sup>C device address and the read/write bit. For the data-read transfer, both a write followed by a read are actually done. Initially, a write is done to transfer the address byte or bytes of the internal memory address to be read. As a result, the read/write bit becomes a 0. After receiving the TAS5717/9 address and the read/write bit, TAS5717/9 responds with an acknowledge bit. In addition, after sending the internal memory address byte or bytes, the master device transmits another start condition followed by the TAS5717/9 address and the read/write bit again. This time the read/write bit becomes a 1, indicating a read transfer. After receiving the address and the read/write bit, the TAS5717/9 again responds with an acknowledge bit. Next, the TAS5717/9 transmits the data byte from the memory address being read. After receiving the data byte, the master device transmits a not-acknowledge followed by a stop condition to complete the single-byte data-read transfer.

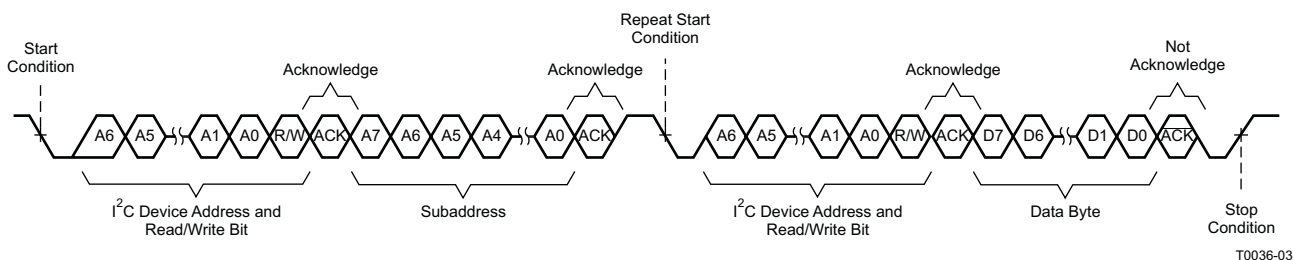


**Figure 38. Single-Byte Read Transfer**

## Multiple-Byte Read

A multiple-byte data-read transfer is identical to a single-byte data-read transfer except that multiple data bytes are transmitted by the TAS5717/9 to the master device as shown in Figure 39. Except for the last data byte, the master device responds with an acknowledge bit after receiving each data byte.

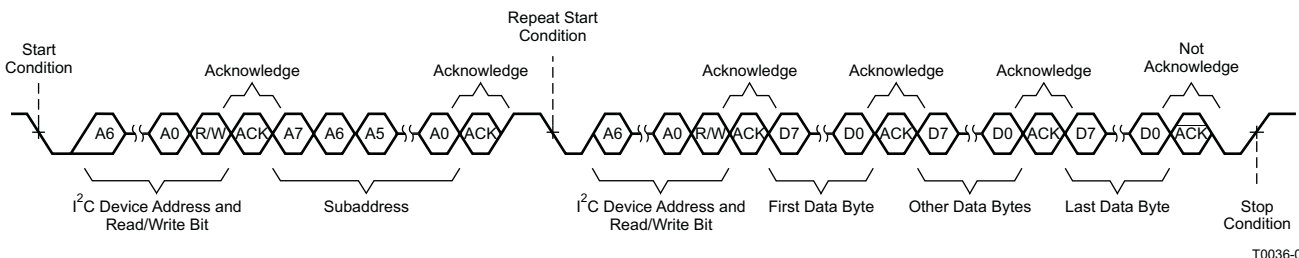


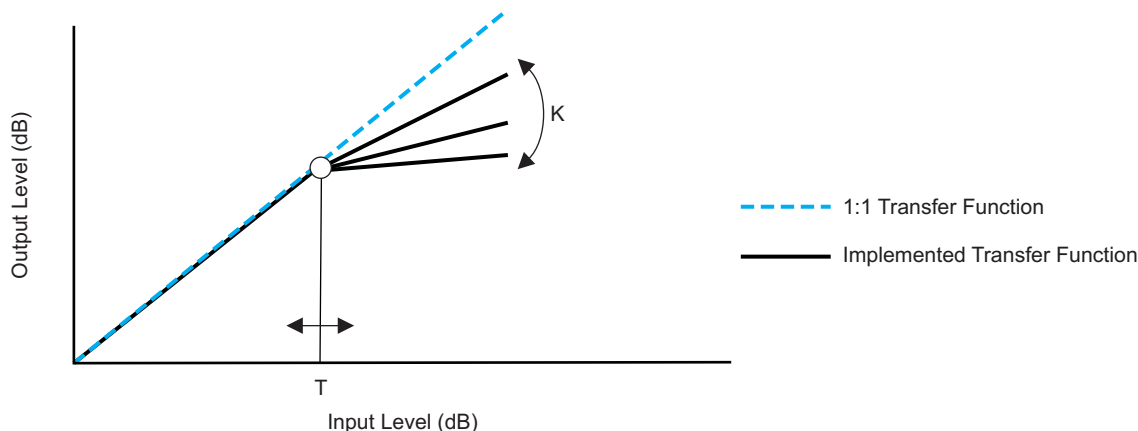
**Figure 39. Multiple-Byte Read Transfer**

## Dynamic Range Control (DRC)

The DRC scheme has a single threshold, offset, and slope (all programmable). There is one ganged DRC for the high-band left/right channels and one DRC for the low-band left/right channels.

The DRC input/output diagram is shown in Figure 40.

See the GDE software tool for more description on the T, K, and O parameters.

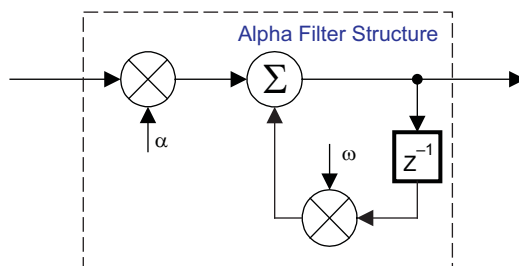
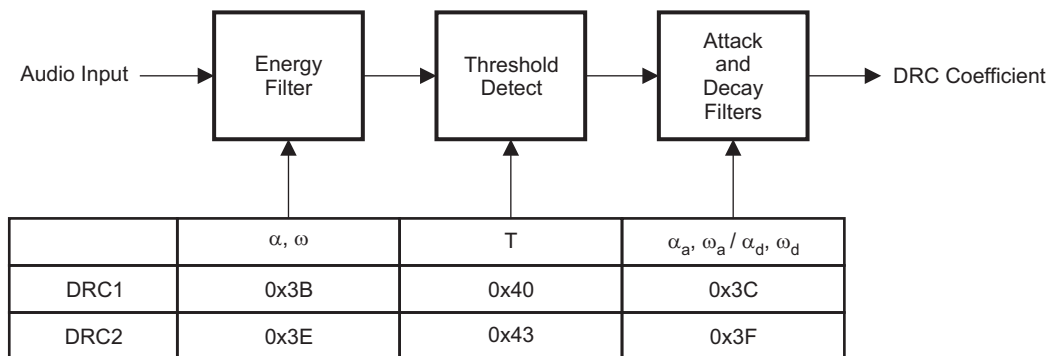


M0091-03

Professional-quality dynamic range compression automatically adjusts volume to flatten volume level.

- Each DRC has adjustable threshold levels.
- Programmable energy, attack, and decay time constants
- *Transparent compression*: compressors can attack fast enough to avoid apparent clipping before engaging, and decay times can be set slow enough to avoid pumping.

**Figure 40. Dynamic Range Control**



B0265-04

T = 9.23 format, all other DRC coefficients are 3.23 format

**Figure 41. DRC Structure**

## PWM LEVEL METER

The structure in Figure 42 shows the PWM level meter that can be used to study the power profile.

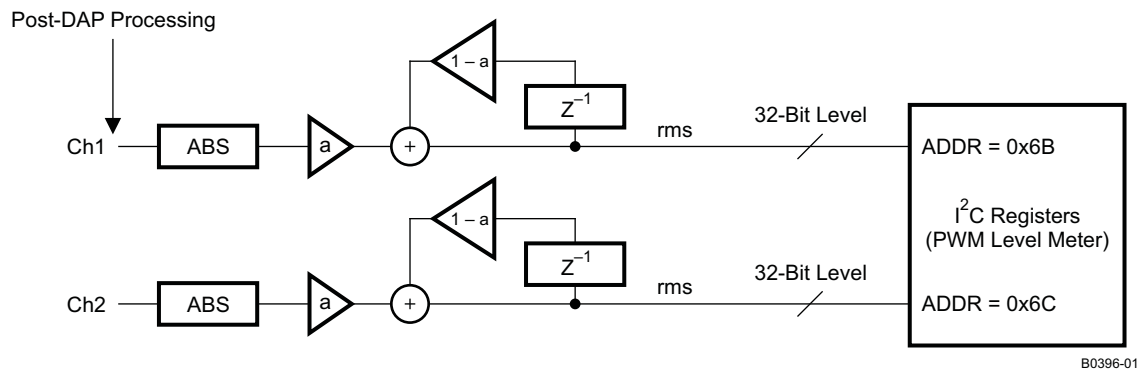


Figure 42. PWM Level Meter Structure

## 26-Bit 3.23 Number Format

All mixer gain coefficients are 26-bit coefficients using a 3.23 number format. Numbers formatted as 3.23 numbers means that there are 3 bits to the left of the binary point and 23 bits to the right of the binary point. This is shown in Figure 43.

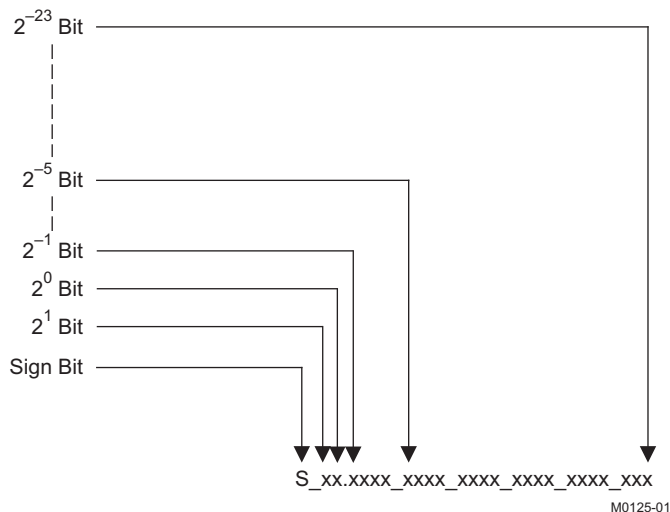


Figure 43. 3.23 Format

The decimal value of a 3.23 format number can be found by following the weighting shown in Figure 43. If the most significant bit is logic 0, the number is a positive number, and the weighting shown yields the correct number. If the most significant bit is a logic 1, then the number is a negative number. In this case every bit must be inverted, a 1 added to the result, and then the weighting shown in Figure 44 applied to obtain the magnitude of the negative number.

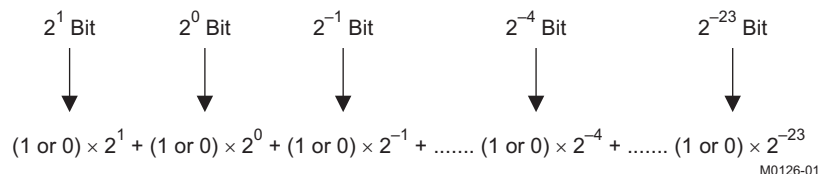
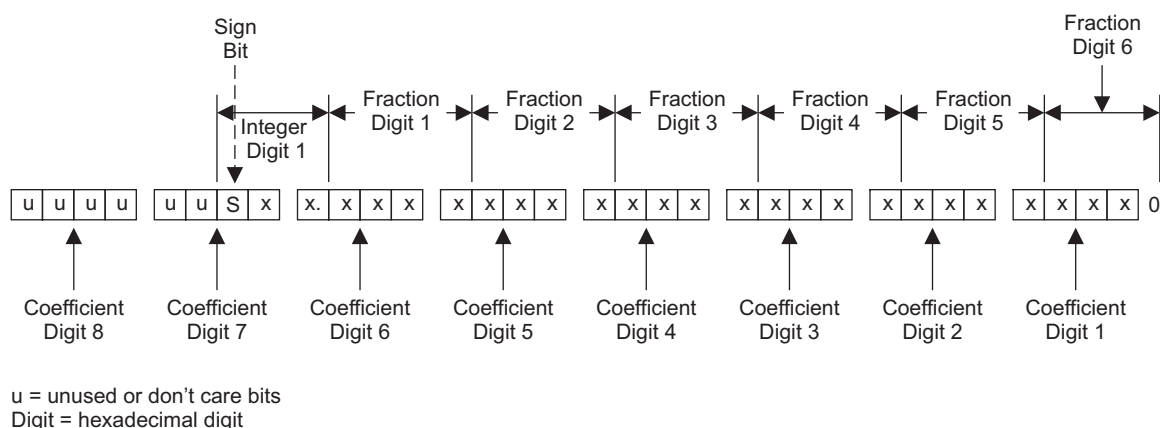


Figure 44. Conversion Weighting Factors—3.23 Format to Floating Point

Gain coefficients, entered via the I<sup>2</sup>C bus, must be entered as 32-bit binary numbers. The format of the 32-bit number (4-byte or 8-digit hexadecimal number) is shown in Figure 45



M0127-01

**Figure 45. Alignment of 3.23 Coefficient in 32-Bit I<sup>2</sup>C Word**

**Table 1. Sample Calculation for 3.23 Format**

| db | Linear            | Decimal                | Hex (3.23 Format)          |
|----|-------------------|------------------------|----------------------------|
| 0  | 1                 | 8,388,608              | 80 0000                    |
| 5  | 1.77              | 14,917,288             | 00E3 9EA8                  |
| -5 | 0.56              | 4,717,260              | 0047 FACC                  |
| X  | $L = 10^{(X/20)}$ | $D = 8388608 \times L$ | $H = \text{dec2hex}(D, 8)$ |

**Table 2. Sample Calculation for 9.17 Format**

| db | Linear            | Decimal                | Hex (9.17 Format)          |
|----|-------------------|------------------------|----------------------------|
| 0  | 1                 | 131,072                | 20 000                     |
| 5  | 1.77              | 231,997                | 38 A3D                     |
| -5 | 0.56              | 73,400                 | 11 EB8                     |
| X  | $L = 10^{(X/20)}$ | $D = 131,072 \times L$ | $H = \text{dec2hex}(D, 8)$ |

**Table 3. Serial Control Interface Register Summary**

| SUBADDRESS | REGISTER NAME                  | NO. OF BYTES | CONTENTS                                | INITIALIZATION VALUE |
|------------|--------------------------------|--------------|-----------------------------------------|----------------------|
|            |                                |              | A u indicates unused bits.              |                      |
| 0x00       | Clock control register         | 1            | Description shown in subsequent section | 0x6C                 |
| 0x01       | Device ID register             | 1            | Description shown in subsequent section | 0xC1                 |
| 0x02       | Error status register          | 1            | Description shown in subsequent section | 0x00                 |
| 0x03       | System control register 1      | 1            | Description shown in subsequent section | 0xA0                 |
| 0x04       | Serial data interface register | 1            | Description shown in subsequent section | 0x05                 |
| 0x05       | System control register 2      | 1            | Description shown in subsequent section | 0x40                 |
| 0x06       | Soft mute register             | 1            | Description shown in subsequent section | 0x00                 |
| 0x07       | Master volume                  | 2            | Description shown in subsequent section | 0x03FF (mute)        |
| 0x08       | Channel 1 vol                  | 2            | Description shown in subsequent section | 0x00C0 (0 dB)        |
| 0x09       | Channel 2 vol                  | 2            | Description shown in subsequent section | 0x00C0 (0 dB)        |
| 0x0A       | Channel 3 vol                  | 2            | Description shown in subsequent section | 0x00C0 (0 dB)        |
| 0x0B–0x0D  |                                | 1            | Reserved <sup>(1)</sup>                 |                      |
| 0x0E       | Volume configuration register  | 1            | Description shown in subsequent section | 0xF0                 |
| 0x0F       |                                | 1            | Reserved <sup>(1)</sup>                 |                      |
| 0x10       | Modulation limit register      | 1            | Description shown in subsequent section | 0x01                 |
| 0x11       | IC delay channel 1             | 1            | Description shown in subsequent section | 0xAC                 |
| 0x12       | IC delay channel 2             | 1            | Description shown in subsequent section | 0x54                 |
| 0x13       | IC delay channel 3             | 1            | Description shown in subsequent section | 0xAC                 |
| 0x14       | IC delay channel 4             | 1            | Description shown in subsequent section | 0x54                 |
| 0x15–0x19  |                                | 1            | Reserved <sup>(1)</sup>                 |                      |
| 0x1A       | Start/stop period register     | 1            |                                         | 0x68                 |
| 0x1B       | Oscillator trim register       | 1            |                                         | 0x82                 |
| 0x1C       | BKND_ERR register              | 1            |                                         | 0x57                 |
| 0x1D–0x1F  |                                | 1            | Reserved <sup>(1)</sup>                 |                      |
| 0x20       | Input MUX register             | 4            | Description shown in subsequent section | 0x0001 7772          |
| 0x21       | Ch 4 source select register    | 4            | Description shown in subsequent section | 0x0000 4303          |
| 0x22–0x24  |                                | 4            | Reserved <sup>(1)</sup>                 |                      |
| 0x25       | PWM MUX register               | 4            | Description shown in subsequent section | 0x0102 1345          |
| 0x26       | ch1_bq[0]                      | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                                |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a2[25:0]                      | 0x0000 0000          |
| 0x27       | ch1_bq[1]                      | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                                |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a2[25:0]                      | 0x0000 0000          |
| 0x28       | ch1_bq[2]                      | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                                |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                                |              | u[31:26], a2[25:0]                      | 0x0000 0000          |

(1) Reserved registers should not be accessed.

**Table 3. Serial Control Interface Register Summary (continued)**

| SUBADDRESS | REGISTER NAME | NO. OF BYTES | CONTENTS           | INITIALIZATION VALUE |
|------------|---------------|--------------|--------------------|----------------------|
| 0x29       | ch1_bq[3]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2A       | ch1_bq[4]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2B       | ch1_bq[5]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2C       | ch1_bq[6]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2D       | ch1_bq[7]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2E       | ch1_bq[8]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x2F       | ch1_bq[9]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x30       | ch2_bq[0]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |
| 0x31       | ch2_bq[1]     | 20           | u[31:26], b0[25:0] | 0x0080 0000          |
|            |               |              | u[31:26], b1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], b2[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a1[25:0] | 0x0000 0000          |
|            |               |              | u[31:26], a2[25:0] | 0x0000 0000          |

**Table 3. Serial Control Interface Register Summary (continued)**

| SUBADDRESS | REGISTER NAME               | NO. OF BYTES | CONTENTS                | INITIALIZATION VALUE |
|------------|-----------------------------|--------------|-------------------------|----------------------|
| 0x32       | ch2_bq[2]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x33       | ch2_bq[3]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x34       | ch2_bq[4]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x35       | ch2_bq[5]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x36       | ch2_bq[6]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x37       | ch2_bq[7]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x38       | ch2_bq[8]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x39       | ch2_bq[9]                   | 20           | u[31:26], b0[25:0]      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]      | 0x0000 0000          |
| 0x3A       |                             | 4            | Reserved <sup>(2)</sup> |                      |
| 0x3B       | DRC1 softening filter alpha | 8            | u[31:26], ae[25:0]      | 0x0008 0000          |
|            | DRC1 softening filter omega |              | u[31:26], oe[25:0]      | 0x0078 0000          |
| 0x3C       | DRC1 attack rate            | 8            |                         | 0x0000 0100          |
|            | DRC1 release rate           |              |                         | 0xFFFF FF00          |

(2) Reserved registers should not be accessed.

**Table 3. Serial Control Interface Register Summary (continued)**

| SUBADDRESS | REGISTER NAME               | NO. OF BYTES | CONTENTS                                | INITIALIZATION VALUE |
|------------|-----------------------------|--------------|-----------------------------------------|----------------------|
| 0x3D       |                             | 8            | Reserved <sup>(3)</sup>                 |                      |
| 0x3E       | DRC2 softening filter alpha | 8            | u[31:26], ae[25:0]                      | 0x0008 0000          |
|            | DRC2 softening filter omega |              | u[31:26], oe[25:0]                      | 0xFFFF 0000          |
| 0x3F       | DRC2 attack rate            | 8            | u[31:26], at[25:0]                      | 0x0008 0000          |
|            | DRC2 release rate           |              | u[31:26], rt[25:0]                      | 0xFFFF 0000          |
| 0x40       | DRC1 attack threshold       | 4            | T1[31:0] (9.23 format)                  | 0x0800 0000          |
| 0x41–0x42  |                             | 4            | Reserved <sup>(3)</sup>                 |                      |
| 0x43       | DRC2 attack threshold       | 4            | T2[31:0] (9.23 format)                  | 0x0074 0000          |
| 0x44–0x45  |                             | 4            | Reserved <sup>(3)</sup>                 |                      |
| 0x46       | DRC control                 | 4            | Description shown in subsequent section | 0x0002 0000          |
| 0x47–0x4E  |                             | 4            | Reserved <sup>(3)</sup>                 |                      |
| 0x4F       | PWM switching rate control  | 4            | u[31:4], src[3:0]                       | 0x0000 0008          |
| 0x50       | EQ control                  | 4            | Description shown in subsequent section | 0x0F70 8000          |
| 0x51       | Ch 1 output mixer           | 8            | Ch 1 output mix1[1]                     | 0x0080 0000          |
|            |                             |              | Ch 1 output mix1[0]                     | 0x0000 0000          |
| 0x52       | Ch 2 output mixer           | 8            | Ch 2 output mix2[1]                     | 0x0080 0000          |
|            |                             |              | Ch 2 output mix2[0]                     | 0x0000 0000          |
| 0x53       |                             | 16           | Reserved <sup>(3)</sup>                 |                      |
| 0x54       |                             | 16           | Reserved <sup>(3)</sup>                 |                      |
| 0x56       | Output post-scale           | 4            | u[31:26], post[25:0]                    | 0x0080 0000          |
| 0x57       | Output pre-scale            | 4            | u[31:26], pre[25:0] (9.17 format)       | 0x0002 0000          |
| 0x58       | ch1_bq[10]                  | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]                      | 0x0000 0000          |
| 0x59       | ch1_bq[11]                  | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]                      | 0x0000 0000          |
| 0x5A       | ch4_bq[0]                   | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]                      | 0x0000 0000          |
| 0x5B       | ch4_bq[1]                   | 20           | u[31:26], b0[25:0]                      | 0x0080 0000          |
|            |                             |              | u[31:26], b1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], b2[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a1[25:0]                      | 0x0000 0000          |
|            |                             |              | u[31:26], a2[25:0]                      | 0x0000 0000          |

(3) Reserved registers should not be accessed.

**Table 3. Serial Control Interface Register Summary (continued)**

| SUBADDRESS | REGISTER NAME                 | NO. OF BYTES | CONTENTS                                                   | INITIALIZATION VALUE |
|------------|-------------------------------|--------------|------------------------------------------------------------|----------------------|
| 0x5C       | ch2_bq[10]                    | 20           | u[31:26], b0[25:0]                                         | 0x0080 0000          |
|            |                               |              | u[31:26], b1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], b2[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a2[25:0]                                         | 0x0000 0000          |
| 0x5D       | ch2_bq[11]                    | 20           | u[31:26], b0[25:0]                                         | 0x0080 0000          |
|            |                               |              | u[31:26], b1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], b2[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a2[25:0]                                         | 0x0000 0000          |
| 0x5E       | ch3_bq[0]                     | 20           | u[31:26], b0[25:0]                                         | 0x0080 0000          |
|            |                               |              | u[31:26], b1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], b2[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a2[25:0]                                         | 0x0000 0000          |
| 0x5F       | ch3_bq[1]                     | 20           | u[31:26], b0[25:0]                                         | 0x0080 0000          |
|            |                               |              | u[31:26], b1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], b2[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a1[25:0]                                         | 0x0000 0000          |
|            |                               |              | u[31:26], a2[25:0]                                         | 0x0000 0000          |
| 0x60–0x61  |                               | 4            | Reserved <sup>(4)</sup>                                    |                      |
| 0x62       | IDF post scale                | 4            |                                                            | 0x0000 0080          |
| 0x63–0x6A  |                               |              | Reserved <sup>(4)</sup>                                    |                      |
| 0x6B       | Left channel PWM level meter  | 4            | Data[31:0]                                                 | 0x0000 0000          |
| 0x6C       | Right channel PWM level meter | 4            | Data[31:0]                                                 | 0x0000 0000          |
| 0x6D–0x6F  |                               |              | Reserved <sup>(4)</sup>                                    |                      |
| 0x70       | ch1 inline mixer              | 4            | u[31:26], in_mix1[25:0]                                    | 0x0080 0000          |
| 0x71       | inline_DRC_en_mixer_ch1       | 4            | u[31:26], in_mixdrc_1[25:0]                                | 0x0000 0000          |
| 0x72       | ch1 right_channel mixer       | 4            | u[31:26], right_mix1[25:0]                                 | 0x0000 0000          |
| 0x73       | ch1 left_channel_mixer        | 4            | u[31:26], left_mix_1[25:0]                                 | 0x0080 0000          |
| 0x74       | ch2 inline mixer              | 4            | u[31:26], in_mix2[25:0]                                    | 0x0080 0000          |
| 0x75       | inline_DRC_en_mixer_ch2       | 4            | u[31:26], in_mixdrc_2[25:0]                                | 0x0000 0000          |
| 0x76       | ch2 left_chanel mixer         | 4            | u[31:26], left_mix1[25:0]                                  | 0x0000 0000          |
| 0x77       | ch2 right_channel_mixer       | 4            | u[31:26], right_mix_1[25:0]                                | 0x0080 0000          |
| 0x78–0xF7  |                               |              | Reserved <sup>(4)</sup>                                    |                      |
| 0xF8       | Update dev address key        | 4            | Dev Id Update Key[31:0] (Key = 0xF9A5A5A5)                 | 0x0000 0000          |
| 0xF9       | Update dev address reg        | 4            | u[31:8], New Dev Id[7:0] (New Dev Id = 0x38 for TAS5717/9) | 0x0000 0054          |
| 0xFA–0xFF  |                               | 4            | Reserved <sup>(4)</sup>                                    |                      |

(4) Reserved registers should not be accessed.

All DAP coefficients are 3.23 format unless specified otherwise.

Registers 0x3B through 0x46 should be altered only during the initialization phase.

**CLOCK CONTROL REGISTER (0x00)**

The clocks and data rates are automatically determined by the TAS5717/9. The clock control register contains the autodetected clock status. Bits D7–D5 reflect the sample rate. Bits D4–D2 reflect the MCLK frequency.

**Table 4. Clock Control Register (0x00)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                               |
|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------------------------------------|
| 0        | 0        | 0        | –        | –        | –        | –        | –        | $f_S = 32\text{-kHz}$ sample rate                                      |
| 0        | 0        | 1        | –        | –        | –        | –        | –        | Reserved                                                               |
| 0        | 1        | 0        | –        | –        | –        | –        | –        | Reserved                                                               |
| <b>0</b> | <b>1</b> | <b>1</b> | –        | –        | –        | –        | –        | <b><math>f_S = 44.1/48\text{-kHz}</math> sample rate<sup>(1)</sup></b> |
| 1        | 0        | 0        | –        | –        | –        | –        | –        | $f_S = 16\text{-kHz}$ sample rate                                      |
| 1        | 0        | 1        | –        | –        | –        | –        | –        | $f_S = 22.05/24\text{-kHz}$ sample rate                                |
| 1        | 1        | 0        | –        | –        | –        | –        | –        | $f_S = 8\text{-kHz}$ sample rate                                       |
| 1        | 1        | 1        | –        | –        | –        | –        | –        | $f_S = 11.025/12\text{-kHz}$ sample rate                               |
| –        | –        | –        | 0        | 0        | 0        | –        | –        | MCLK frequency = $64 \times f_S$ <sup>(2)</sup>                        |
| –        | –        | –        | 0        | 0        | 1        | –        | –        | MCLK frequency = $128 \times f_S$ <sup>(2)</sup>                       |
| –        | –        | –        | 0        | 1        | 0        | –        | –        | MCLK frequency = $192 \times f_S$ <sup>(3)</sup>                       |
| –        | –        | –        | <b>0</b> | <b>1</b> | <b>1</b> | –        | –        | <b>MCLK frequency = <math>256 \times f_S</math><sup>(1)(4)</sup></b>   |
| –        | –        | –        | 1        | 0        | 0        | –        | –        | MCLK frequency = $384 \times f_S$                                      |
| –        | –        | –        | 1        | 0        | 1        | –        | –        | MCLK frequency = $512 \times f_S$                                      |
| –        | –        | –        | 1        | 1        | 0        | –        | –        | Reserved                                                               |
| –        | –        | –        | 1        | 1        | 1        | –        | –        | Reserved                                                               |
| –        | –        | –        | –        | –        | –        | <b>0</b> | –        | <b>Reserved<sup>(1)</sup></b>                                          |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | <b>Reserved<sup>(1)</sup></b>                                          |

(1) Default values are in **bold**.

(2) Only available for 44.1-kHz and 48-kHz rates

(3) Rate only available for 32/44.1/48-KHz sample rates

(4) Not available at 8 kHz

**DEVICE ID REGISTER (0x01)**

The device ID register contains the ID code for the firmware revision.

**Table 5. General Status Register (0x01)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                 |
|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>Identification code<sup>(1)</sup></b> |

(1) Default values are in **bold**.

## ERROR STATUS REGISTER (0x02)

The error bits are sticky and are not cleared by the hardware. This means that the software must clear the register (write zeroes) and then read them to determine if they are persistent errors.

Error definitions:

- MCLK error: MCLK frequency is changing. The number of MCLKs per LRCLK is changing.
- SCLK error: The number of SCLKs per LRCLK is changing.
- LRCLK error: LRCLK frequency is changing.
- Frame slip: LRCLK phase is drifting with respect to internal frame sync.

**Table 6. Error Status Register (0x02)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                         |
|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------------------------------|
| 1        | -        | -        | -        | -        | -        | -        | -        | MCLK error                                                       |
| -        | 1        | -        | -        | -        | -        | -        | -        | PLL autolock error                                               |
| -        | -        | 1        | -        | -        | -        | -        | -        | SCLK error                                                       |
| -        | -        | -        | 1        | -        | -        | -        | -        | LRCLK error                                                      |
| -        | -        | -        | -        | 1        | -        | -        | -        | Frame slip                                                       |
| -        | -        | -        | -        | -        | 1        | -        | -        | Clip indicator                                                   |
| -        | -        | -        | -        | -        | -        | 1        | -        | Overcurrent, overtemperature, overvoltage, or undervoltage error |
| 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        | Reserved                                                         |
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>No errors</b> <sup>(1)</sup>                                  |

(1) Default values are in **bold**.

## SYSTEM CONTROL REGISTER 1 (0x03)

System control register 1 has several functions:

- Bit D7: If 0, the dc-blocking filter for each channel is disabled.  
If 1, the dc-blocking filter (-3 dB cutoff <1 Hz) for each channel is enabled.
- Bit D5: If 0, use soft unmute on recovery from a clock error. This is a slow recovery. Unmute takes the same time as the volume ramp defined in register 0x0E.  
If 1, use hard unmute on recovery from clock error. This is a fast recovery, a single-step volume ramp.
- Bits D1–D0: Select de-emphasis

**Table 7. System Control Register 1 (0x03)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                       |
|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------------------------------|
| 0        | -        | -        | -        | -        | -        | -        | -        | PWM high-pass (dc blocking) disabled                           |
| <b>1</b> | -        | -        | -        | -        | -        | -        | -        | <b>PWM high-pass (dc blocking) enabled</b> <sup>(1)</sup>      |
| -        | <b>0</b> | -        | -        | -        | -        | -        | -        | <b>Reserved</b> <sup>(1)</sup>                                 |
| -        | -        | <b>0</b> | -        | -        | -        | -        | -        | <b>Soft unmute on recovery from clock error</b> <sup>(1)</sup> |
| -        | -        | 1        | -        | -        | -        | -        | -        | Hard unmute on recovery from clock error                       |
| -        | -        | -        | <b>1</b> | -        | -        | -        | -        | <b>Reserved</b> <sup>(1)</sup>                                 |
| -        | -        | -        | -        | <b>0</b> | -        | -        | -        | <b>Reserved</b> <sup>(1)</sup>                                 |
| -        | -        | -        | -        | -        | <b>0</b> | -        | -        | <b>Reserved</b> <sup>(1)</sup>                                 |
| -        | -        | -        | -        | -        | -        | <b>0</b> | <b>0</b> | <b>No de-emphasis</b> <sup>(1)</sup>                           |
| -        | -        | -        | -        | -        | -        | 0        | 1        | De-emphasis for $f_s = 32$ kHz                                 |
| -        | -        | -        | -        | -        | -        | 1        | 0        | De-emphasis for $f_s = 44.1$ kHz                               |
| -        | -        | -        | -        | -        | -        | 1        | 1        | De-emphasis for $f_s = 48$ kHz                                 |

(1) Default values are in **bold**.

**SERIAL DATA INTERFACE REGISTER (0x04)**

As shown in [Table 8](#), the TAS5717/9 supports nine serial data modes. The default is 24-bit, I<sup>2</sup>S mode.

**Table 8. Serial Data Interface Control Register (0x04) Format**

| RECEIVE SERIAL DATA<br>INTERFACE FORMAT | WORD<br>LENGTH | D7–D4       | D3       | D2       | D1       | D0       |
|-----------------------------------------|----------------|-------------|----------|----------|----------|----------|
| Right-justified                         | 16             | 0000        | 0        | 0        | 0        | 0        |
| Right-justified                         | 20             | 0000        | 0        | 0        | 0        | 1        |
| Right-justified                         | 24             | 0000        | 0        | 0        | 1        | 0        |
| I <sup>2</sup> S                        | 16             | 000         | 0        | 0        | 1        | 1        |
| I <sup>2</sup> S                        | 20             | 0000        | 0        | 1        | 0        | 0        |
| <b>I<sup>2</sup>S<sup>(1)</sup></b>     | <b>24</b>      | <b>0000</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> |
| Left-justified                          | 16             | 0000        | 0        | 1        | 1        | 0        |
| Left-justified                          | 20             | 0000        | 0        | 1        | 1        | 1        |
| Left-justified                          | 24             | 0000        | 1        | 0        | 0        | 0        |
| Reserved                                |                | 0000        | 1        | 0        | 0        | 1        |
| Reserved                                |                | 0000        | 1        | 0        | 1        | 0        |
| Reserved                                |                | 0000        | 1        | 0        | 1        | 1        |
| Reserved                                |                | 0000        | 1        | 1        | 0        | 0        |
| Reserved                                |                | 0000        | 1        | 1        | 0        | 1        |
| Reserved                                |                | 0000        | 1        | 1        | 1        | 0        |
| Reserved                                |                | 0000        | 1        | 1        | 1        | 1        |

(1) Default values are in **bold**.

## SYSTEM CONTROL REGISTER 2 (0x05)

When bit D6 is set low, the system exits all-channel shutdown and starts playing audio; otherwise, the outputs are shut down (hard mute).

**Table 9. System Control Register 2 (0x05)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                                                                                                                                                                                                   |
|----------|----------|----------|----------|----------|----------|----------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>0</b> | –        | –        | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                                                                                                                                                                                             |
| –        | <b>0</b> | –        | –        | –        | –        | –        | –        | Exit all-channel shutdown (normal operation) <sup>(2)</sup>                                                                                                                                                                                |
| –        | <b>1</b> | –        | –        | –        | –        | –        | –        | <b>Enter all-channel shutdown (hard mute)</b> <sup>(1)</sup>                                                                                                                                                                               |
| –        | –        | <b>0</b> | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                                                                                                                                                                                             |
| –        | –        | –        | <b>1</b> | –        | –        | –        | –        | Headphone Mode                                                                                                                                                                                                                             |
| –        | –        | –        | <b>0</b> | –        | –        | –        | –        | <b>Speaker Mode</b>                                                                                                                                                                                                                        |
| –        | –        | –        | –        | <b>1</b> | –        | –        | –        | 1. In speaker mode, a value of 1 means device is in ternary modulation.<br>2. In headphone mode, a value of 1 means channel volume in headphone mode = 0x08/0x09 (same as speaker channel volume).                                         |
| –        | –        | –        | –        | <b>0</b> | –        | –        | –        | 1. In speaker mode, a value of 0 means device is in not in ternary modulation (AD or BD as defined in register 0x25).<br>2. In headphone mode, 0 means channel volume in headphone mode = 0x0C (headphone volume register). <sup>(1)</sup> |
| –        | –        | –        | –        | –        | <b>0</b> | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                                                                                                                                                                                             |
| –        | –        | –        | –        | –        | –        | <b>0</b> | –        | A_SEL/HP_SD configured as input                                                                                                                                                                                                            |
| –        | –        | –        | –        | –        | –        | <b>1</b> | –        | A_SEL/HP_SD configured configured as output to use as external HP amplifier shutdown signal                                                                                                                                                |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | Internal power stage $\overline{\text{FAULT}}$ signal is the source of A_SEL/HP_SD pin                                                                                                                                                     |
| –        | –        | –        | –        | –        | –        | –        | <b>1</b> | HPSDZ is the source of A_SEL/HP_SD pin (set this before switching to headphone mode)                                                                                                                                                       |

(1) Default values are in **bold**.

(2) When exiting all-channel shutdown, soft unmute is might not occur unless register 0x03, bit 5 is set to 1.

## SOFT MUTE REGISTER (0x06)

Writing a 1 to any of the following bits sets the output of the respective channel to 50% duty cycle (soft mute).

**Table 10. Soft Mute Register (0x06)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                    |
|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------------------------|
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>              |
| –        | –        | –        | –        | –        | <b>1</b> | –        | –        | Soft mute channel 3                         |
| –        | –        | –        | –        | –        | <b>0</b> | –        | –        | <b>Soft unmute channel 3</b> <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | <b>1</b> | –        | Soft mute channel 2                         |
| –        | –        | –        | –        | –        | –        | <b>0</b> | –        | <b>Soft unmute channel 2</b> <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | –        | <b>1</b> | Soft mute channel 1                         |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | <b>Soft unmute channel 1</b> <sup>(1)</sup> |

(1) Default values are in **bold**.

**VOLUME REGISTERS (0x07, 0x08, 0x09)**

Step size is 0.125 dB and volume registers are 2 bytes.

Master volume – 0x07 (default is mute)  
 Channel-1 volume – 0x08 (default is 0 dB)  
 Channel-2 volume – 0x09 (default is 0 dB)  
 Headphone volume – 0x0B (default is 0 dB)

**Table 11. Master Volume Table**

| Value  | Level  | Value  | Level  | Value  | Level  | Value  | Level | Value  | Level  | Value  | Level  |
|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|--------|
| 0x0000 | 24.000 | 0x0027 | 19.250 | 0x004E | 14.250 | 0x0075 | 9.375 | 0x009C | 4.500  | 0x00C3 | -0.375 |
| 0x0001 | 23.875 | 0x0028 | 19.000 | 0x004F | 14.125 | 0x0076 | 9.250 | 0x009D | 4.375  | 0x00C4 | -0.500 |
| 0x0002 | 23.750 | 0x0029 | 18.875 | 0x0050 | 14.000 | 0x0077 | 9.125 | 0x009E | 4.250  | 0x00C5 | -0.625 |
| 0x0003 | 23.625 | 0x002A | 18.750 | 0x0051 | 13.875 | 0x0078 | 9.000 | 0x009F | 4.125  | 0x00C6 | -0.750 |
| 0x0004 | 23.500 | 0x002B | 18.625 | 0x0052 | 13.750 | 0x0079 | 8.875 | 0x00A0 | 4.000  | 0x00C7 | -0.875 |
| 0x0005 | 23.375 | 0x002C | 18.500 | 0x0053 | 13.625 | 0x007A | 8.750 | 0x00A1 | 3.875  | 0x00C8 | -1.000 |
| 0x0006 | 23.250 | 0x002D | 18.375 | 0x0054 | 13.500 | 0x007B | 8.625 | 0x00A2 | 3.750  | 0x00C9 | -1.125 |
| 0x0007 | 23.125 | 0x002E | 18.250 | 0x0055 | 13.375 | 0x007C | 8.500 | 0x00A3 | 3.625  | 0x00CA | -1.250 |
| 0x0008 | 23.000 | 0x002F | 18.125 | 0x0056 | 13.250 | 0x007D | 8.375 | 0x00A4 | 3.500  | 0x00CB | -1.375 |
| 0x0009 | 22.875 | 0x0030 | 18.000 | 0x0057 | 13.125 | 0x007E | 8.250 | 0x00A5 | 3.375  | 0x00CC | -1.500 |
| 0x000A | 22.750 | 0x0031 | 17.875 | 0x0058 | 13.000 | 0x007F | 8.125 | 0x00A6 | 3.250  | 0x00CD | -1.625 |
| 0x000B | 22.625 | 0x0032 | 17.750 | 0x0059 | 12.875 | 0x0080 | 8.000 | 0x00A7 | 3.125  | 0x00CE | -1.750 |
| 0x000C | 22.500 | 0x0033 | 17.625 | 0x005A | 12.750 | 0x0081 | 7.875 | 0x00A8 | 3.000  | 0x00CF | -1.875 |
| 0x000D | 22.375 | 0x0034 | 17.500 | 0x005B | 12.625 | 0x0082 | 7.750 | 0x00A9 | 2.875  | 0x00D0 | -2.000 |
| 0x000E | 22.250 | 0x0035 | 17.375 | 0x005C | 12.500 | 0x0083 | 7.625 | 0x00AA | 2.750  | 0x00D1 | -2.125 |
| 0x000F | 22.125 | 0x0036 | 17.250 | 0x005D | 12.375 | 0x0084 | 7.500 | 0x00AB | 2.625  | 0x00D2 | -2.250 |
| 0x0010 | 22.000 | 0x0037 | 17.125 | 0x005E | 12.250 | 0x0085 | 7.375 | 0x00AC | 2.500  | 0x00D3 | -2.375 |
| 0x0011 | 21.875 | 0x0038 | 17.000 | 0x005F | 12.125 | 0x0086 | 7.250 | 0x00AD | 2.375  | 0x00D4 | -2.500 |
| 0x0012 | 21.750 | 0x0039 | 16.875 | 0x0060 | 12.000 | 0x0087 | 7.125 | 0x00AE | 2.250  | 0x00D5 | -2.625 |
| 0x0013 | 21.625 | 0x003A | 16.750 | 0x0061 | 11.875 | 0x0088 | 7.000 | 0x00AF | 2.125  | 0x00D6 | -2.750 |
| 0x0014 | 21.500 | 0x003B | 16.625 | 0x0062 | 11.750 | 0x0089 | 6.875 | 0x00B0 | 2.000  | 0x00D7 | -2.875 |
| 0x0015 | 21.375 | 0x003C | 16.500 | 0x0063 | 11.625 | 0x008A | 6.750 | 0x00B1 | 1.875  | 0x00D8 | -3.000 |
| 0x0016 | 21.250 | 0x003D | 16.375 | 0x0064 | 11.500 | 0x008B | 6.625 | 0x00B2 | 1.750  | 0x00D9 | -3.125 |
| 0x0017 | 21.125 | 0x003E | 16.250 | 0x0065 | 11.375 | 0x008C | 6.500 | 0x00B3 | 1.625  | 0x00DA | -3.250 |
| 0x0018 | 21.000 | 0x003F | 16.125 | 0x0066 | 11.250 | 0x008D | 6.375 | 0x00B4 | 1.500  | 0x00DB | -3.375 |
| 0x0019 | 20.875 | 0x0040 | 16.000 | 0x0067 | 11.125 | 0x008E | 6.250 | 0x00B5 | 1.375  | 0x00DC | -3.500 |
| 0x001A | 20.750 | 0x0041 | 15.875 | 0x0068 | 11.000 | 0x008F | 6.125 | 0x00B6 | 1.250  | 0x00DD | -3.625 |
| 0x001B | 20.625 | 0x0042 | 15.750 | 0x0069 | 10.875 | 0x0090 | 6.000 | 0x00B7 | 1.125  | 0x00DE | -3.750 |
| 0x001C | 20.500 | 0x0043 | 15.625 | 0x006A | 10.750 | 0x0091 | 5.875 | 0x00B8 | 1.000  | 0x00DF | -3.875 |
| 0x001D | 20.375 | 0x0044 | 15.500 | 0x006B | 10.625 | 0x0092 | 5.750 | 0x00B9 | 0.875  | 0x00E0 | -4.000 |
| 0x001E | 20.250 | 0x0045 | 15.375 | 0x006C | 10.500 | 0x0093 | 5.625 | 0x00BA | 0.750  | 0x00E1 | -4.125 |
| 0x001F | 20.125 | 0x0046 | 15.250 | 0x006D | 10.375 | 0x0094 | 5.500 | 0x00BB | 0.625  | 0x00E2 | -4.250 |
| 0x0020 | 20.000 | 0x0047 | 15.125 | 0x006E | 10.250 | 0x0095 | 5.375 | 0x00BC | 0.500  | 0x00E3 | -4.375 |
| 0x0021 | 19.875 | 0x0048 | 15.000 | 0x006F | 10.125 | 0x0096 | 5.250 | 0x00BD | 0.375  | 0x00E4 | -4.500 |
| 0x0022 | 19.750 | 0x0049 | 14.875 | 0x0070 | 10.000 | 0x0097 | 5.125 | 0x00BE | 0.250  | 0x00E5 | -4.625 |
| 0x0023 | 19.625 | 0x004A | 14.750 | 0x0071 | 9.875  | 0x0098 | 5.000 | 0x00BF | 0.125  | 0x00E6 | -4.750 |
| 0x0024 | 19.500 | 0x004B | 14.625 | 0x0072 | 9.750  | 0x0099 | 4.875 | 0x00C0 | 0.000  | 0x00E7 | -4.875 |
| 0x0025 | 19.375 | 0x004C | 14.500 | 0x0073 | 9.625  | 0x009A | 4.750 | 0x00C1 | -0.125 | 0x00E8 | -5.000 |

**Table 11. Master Volume Table (continued)**

| Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   |
|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|
| 0x0026 | 19.125  | 0x004D | 14.375  | 0x0074 | 9.500   | 0x009B | 4.625   | 0x00C2 | –0.250  | 0x00E9 | –5.125  |
| 0x00EA | –5.250  | 0x0119 | –11.125 | 0x0148 | –17.000 | 0x0177 | –22.875 | 0x01A6 | –28.750 | 0x01D5 | –34.625 |
| 0x00EB | –5.375  | 0x011A | –11.250 | 0x0149 | –17.125 | 0x0178 | –23.000 | 0x01A7 | –28.875 | 0x01D6 | –34.750 |
| 0x00EC | –5.500  | 0x011B | –11.375 | 0x014A | –17.250 | 0x0179 | –23.125 | 0x01A8 | –29.000 | 0x01D7 | –34.875 |
| 0x00ED | –5.625  | 0x011C | –11.500 | 0x014B | –17.375 | 0x017A | –23.250 | 0x01A9 | –29.125 | 0x01D8 | –35.000 |
| 0x00EE | –5.750  | 0x011D | –11.625 | 0x014C | –17.500 | 0x017B | –23.375 | 0x01AA | –29.250 | 0x01D9 | –35.125 |
| 0x00EF | –5.875  | 0x011E | –11.750 | 0x014D | –17.625 | 0x017C | –23.500 | 0x01AB | –29.375 | 0x01DA | –35.250 |
| 0x00F0 | –6.000  | 0x011F | –11.875 | 0x014E | –17.750 | 0x017D | –23.625 | 0x01AC | –29.500 | 0x01DB | –35.375 |
| 0x00F1 | –6.125  | 0x0120 | –12.000 | 0x014F | –17.875 | 0x017E | –23.750 | 0x01AD | –29.625 | 0x01DC | –35.500 |
| 0x00F2 | –6.250  | 0x0121 | –12.125 | 0x0150 | –18.000 | 0x017F | –23.875 | 0x01AE | –29.750 | 0x01DD | –35.625 |
| 0x00F3 | –6.375  | 0x0122 | –12.250 | 0x0151 | –18.125 | 0x0180 | –24.000 | 0x01AF | –29.875 | 0x01DE | –35.750 |
| 0x00F4 | –6.500  | 0x0123 | –12.375 | 0x0152 | –18.250 | 0x0181 | –24.125 | 0x01B0 | –30.000 | 0x01DF | –35.875 |
| 0x00F5 | –6.625  | 0x0124 | –12.500 | 0x0153 | –18.375 | 0x0182 | –24.250 | 0x01B1 | –30.125 | 0x01E0 | –36.000 |
| 0x00F6 | –6.750  | 0x0125 | –12.625 | 0x0154 | –18.500 | 0x0183 | –24.375 | 0x01B2 | –30.250 | 0x01E1 | –36.125 |
| 0x00F7 | –6.875  | 0x0126 | –12.750 | 0x0155 | –18.625 | 0x0184 | –24.500 | 0x01B3 | –30.375 | 0x01E2 | –36.250 |
| 0x00F8 | –7.000  | 0x0127 | –12.875 | 0x0156 | –18.750 | 0x0185 | –24.625 | 0x01B4 | –30.500 | 0x01E3 | –36.375 |
| 0x00F9 | –7.125  | 0x0128 | –13.000 | 0x0157 | –18.875 | 0x0186 | –24.750 | 0x01B5 | –30.625 | 0x01E4 | –36.500 |
| 0x00FA | –7.250  | 0x0129 | –13.125 | 0x0158 | –19.000 | 0x0187 | –24.875 | 0x01B6 | –30.750 | 0x01E5 | –36.625 |
| 0x00FB | –7.375  | 0x012A | –13.250 | 0x0159 | –19.125 | 0x0188 | –25.000 | 0x01B7 | –30.875 | 0x01E6 | –36.750 |
| 0x00FC | –7.500  | 0x012B | –13.375 | 0x015A | –19.250 | 0x0189 | –25.125 | 0x01B8 | –31.000 | 0x01E7 | –36.875 |
| 0x00FD | –7.625  | 0x012C | –13.500 | 0x015B | –19.375 | 0x018A | –25.250 | 0x01B9 | –31.125 | 0x01E8 | –37.000 |
| 0x00FE | –7.750  | 0x012D | –13.625 | 0x015C | –19.500 | 0x018B | –25.375 | 0x01BA | –31.250 | 0x01E9 | –37.125 |
| 0x00FF | –7.875  | 0x012E | –13.750 | 0x015D | –19.625 | 0x018C | –25.500 | 0x01BB | –31.375 | 0x01EA | –37.250 |
| 0x0100 | –8.000  | 0x012F | –13.875 | 0x015E | –19.750 | 0x018D | –25.625 | 0x01BC | –31.500 | 0x01EB | –37.375 |
| 0x0101 | –8.125  | 0x0130 | –14.000 | 0x015F | –20.875 | 0x018E | –25.750 | 0x01BD | –31.625 | 0x01EC | –37.500 |
| 0x0102 | –8.250  | 0x0131 | –14.125 | 0x0160 | –20.000 | 0x018F | –25.875 | 0x01BE | –31.750 | 0x01ED | –37.625 |
| 0x0103 | –8.375  | 0x0132 | –14.250 | 0x0161 | –20.125 | 0x0190 | –26.000 | 0x01BF | –31.875 | 0x01EE | –37.750 |
| 0x0104 | –8.500  | 0x0133 | –14.375 | 0x0162 | –20.250 | 0x0191 | –26.125 | 0x01C0 | –32.000 | 0x01EF | –37.875 |
| 0x0105 | –8.625  | 0x0134 | –14.500 | 0x0163 | –20.375 | 0x0192 | –26.250 | 0x01C1 | –32.125 | 0x01F0 | –38.000 |
| 0x0106 | –8.750  | 0x0135 | –14.625 | 0x0164 | –20.500 | 0x0193 | –26.375 | 0x01C2 | –32.250 | 0x01F1 | –38.125 |
| 0x0107 | –8.875  | 0x0136 | –14.750 | 0x0165 | –20.625 | 0x0194 | –26.500 | 0x01C3 | –32.375 | 0x01F2 | –38.250 |
| 0x0108 | –9.000  | 0x0137 | –14.875 | 0x0166 | –20.750 | 0x0195 | –26.625 | 0x01C4 | –32.500 | 0x01F3 | –38.375 |
| 0x0109 | –9.125  | 0x0138 | –15.000 | 0x0167 | –20.875 | 0x0196 | –26.750 | 0x01C5 | –32.625 | 0x01F4 | –38.500 |
| 0x010A | –9.250  | 0x0139 | –15.125 | 0x0168 | –21.000 | 0x0197 | –26.875 | 0x01C6 | –32.750 | 0x01F5 | –38.625 |
| 0x010B | –9.375  | 0x013A | –15.250 | 0x0169 | –21.125 | 0x0198 | –27.000 | 0x01C7 | –32.875 | 0x01F6 | –38.750 |
| 0x010C | –9.500  | 0x013B | –15.375 | 0x016A | –21.250 | 0x0199 | –27.125 | 0x01C8 | –33.000 | 0x01F7 | –38.875 |
| 0x010D | –9.625  | 0x013C | –15.500 | 0x016B | –21.375 | 0x019A | –27.250 | 0x01C9 | –33.125 | 0x01F8 | –39.000 |
| 0x010E | –9.750  | 0x013D | –15.625 | 0x016C | –21.500 | 0x019B | –27.375 | 0x01CA | –33.250 | 0x01F9 | –39.125 |
| 0x010F | –9.875  | 0x013E | –15.750 | 0x016D | –21.625 | 0x019C | –27.500 | 0x01CB | –33.375 | 0x01FA | –39.250 |
| 0x0110 | –10.000 | 0x013F | –15.875 | 0x016E | –21.750 | 0x019D | –27.625 | 0x01CC | –33.500 | 0x01FB | –39.375 |
| 0x0111 | –10.125 | 0x0140 | –16.000 | 0x016F | –21.875 | 0x019E | –27.750 | 0x01CD | –33.625 | 0x01FC | –39.500 |
| 0x0112 | –10.250 | 0x0141 | –16.125 | 0x0170 | –22.000 | 0x019F | –27.875 | 0x01CE | –33.750 | 0x01FD | –39.625 |
| 0x0113 | –10.375 | 0x0142 | –16.250 | 0x0171 | –22.125 | 0x01A0 | –28.000 | 0x01CF | –33.875 | 0x01FE | –39.750 |
| 0x0114 | –10.500 | 0x0143 | –16.375 | 0x0172 | –22.250 | 0x01A1 | –28.125 | 0x01D0 | –34.000 | 0x01FF | –39.875 |
| 0x0115 | –10.625 | 0x0144 | –16.500 | 0x0173 | –22.375 | 0x01A2 | –28.250 | 0x01D1 | –34.125 | 0x0200 | –40.000 |
| 0x0116 | –10.750 | 0x0145 | –16.625 | 0x0174 | –22.500 | 0x01A3 | –28.375 | 0x01D2 | –34.250 | 0x0201 | –40.125 |
| 0x0117 | –10.875 | 0x0146 | –16.750 | 0x0175 | –22.625 | 0x01A4 | –28.500 | 0x01D3 | –34.375 | 0x0202 | –40.250 |

**Table 11. Master Volume Table (continued)**

| Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   |
|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|
| 0x0118 | –11.000 | 0x0147 | –16.875 | 0x0176 | –22.750 | 0x01A5 | –28.625 | 0x01D4 | –34.500 | 0x0203 | –40.375 |
| 0x0204 | –40.500 | 0x0233 | –46.375 | 0x0262 | –52.250 | 0x0291 | –58.250 | 0x02C0 | –64.000 | 0x02EF | –69.875 |
| 0x0205 | –40.625 | 0x0234 | –46.500 | 0x0263 | –52.375 | 0x0292 | –58.125 | 0x02C1 | –64.125 | 0x02F0 | –70.000 |
| 0x0206 | –40.750 | 0x0235 | –46.625 | 0x0264 | –52.500 | 0x0293 | –58.375 | 0x02C2 | –64.250 | 0x02F1 | –70.125 |
| 0x0207 | –40.875 | 0x0236 | –46.750 | 0x0265 | –52.625 | 0x0294 | –58.500 | 0x02C3 | –64.375 | 0x02F2 | –70.250 |
| 0x0208 | –41.000 | 0x0237 | –46.875 | 0x0266 | –52.750 | 0x0295 | –58.625 | 0x02C4 | –64.500 | 0x02F3 | –70.375 |
| 0x0209 | –41.125 | 0x0238 | –47.000 | 0x0267 | –52.875 | 0x0296 | –58.750 | 0x02C5 | –64.625 | 0x02F4 | –70.500 |
| 0x020A | –41.250 | 0x0239 | –47.125 | 0x0268 | –53.000 | 0x0297 | –58.875 | 0x02C6 | –64.750 | 0x02F5 | –70.625 |
| 0x020B | –41.375 | 0x023A | –47.250 | 0x0269 | –53.125 | 0x0298 | –59.000 | 0x02C7 | –64.875 | 0x02F6 | –70.750 |
| 0x020C | –41.500 | 0x023B | –47.375 | 0x026A | –53.250 | 0x0299 | –59.125 | 0x02C8 | –65.000 | 0x02F7 | –70.875 |
| 0x020D | –41.625 | 0x023C | –47.500 | 0x026B | –53.375 | 0x029A | –59.250 | 0x02C9 | –65.125 | 0x02F8 | –71.000 |
| 0x020E | –41.750 | 0x023D | –47.625 | 0x026C | –53.500 | 0x029B | –59.375 | 0x02CA | –65.250 | 0x02F9 | –71.125 |
| 0x020F | –41.875 | 0x023E | –47.750 | 0x026D | –53.625 | 0x029C | –59.500 | 0x02CB | –65.375 | 0x02FA | –71.250 |
| 0x0210 | –42.000 | 0x023F | –47.875 | 0x026E | –53.750 | 0x029D | –59.625 | 0x02CC | –65.500 | 0x02FB | –71.375 |
| 0x0211 | –42.125 | 0x0240 | –48.000 | 0x026F | –53.875 | 0x029E | –59.750 | 0x02CD | –65.625 | 0x02FC | –71.500 |
| 0x0212 | –42.250 | 0x0241 | –48.125 | 0x0270 | –54.000 | 0x029F | –59.875 | 0x02CE | –65.750 | 0x02FD | –71.625 |
| 0x0213 | –42.375 | 0x0242 | –48.250 | 0x0271 | –54.125 | 0x02A0 | –60.000 | 0x02CF | –65.875 | 0x02FE | –71.750 |
| 0x0214 | –42.500 | 0x0243 | –48.375 | 0x0272 | –54.250 | 0x02A1 | –60.125 | 0x02D0 | –66.000 | 0x02FF | –71.875 |
| 0x0215 | –42.625 | 0x0244 | –48.500 | 0x0273 | –54.375 | 0x02A2 | –60.250 | 0x02D1 | –66.125 | 0x0300 | –72.000 |
| 0x0216 | –42.750 | 0x0245 | –48.625 | 0x0274 | –54.500 | 0x02A3 | –60.375 | 0x02D2 | –66.250 | 0x0301 | –72.125 |
| 0x0217 | –42.875 | 0x0246 | –48.750 | 0x0275 | –54.625 | 0x02A4 | –60.500 | 0x02D3 | –66.375 | 0x0302 | –72.250 |
| 0x0218 | –43.000 | 0x0247 | –48.875 | 0x0276 | –54.750 | 0x02A5 | –60.625 | 0x02D4 | –66.500 | 0x0303 | –72.375 |
| 0x0219 | –43.125 | 0x0248 | –49.000 | 0x0277 | –54.875 | 0x02A6 | –60.750 | 0x02D5 | –66.625 | 0x0304 | –72.500 |
| 0x021A | –43.250 | 0x0249 | –49.125 | 0x0278 | –55.000 | 0x02A7 | –60.875 | 0x02D6 | –66.750 | 0x0305 | –72.625 |
| 0x021B | –43.375 | 0x024A | –49.250 | 0x0279 | –55.125 | 0x02A8 | –61.000 | 0x02D7 | –66.875 | 0x0306 | –72.750 |
| 0x021C | –43.500 | 0x024B | –49.375 | 0x027A | –55.250 | 0x02A9 | –61.125 | 0x02D8 | –67.000 | 0x0307 | –72.875 |
| 0x021D | –43.625 | 0x024C | –49.500 | 0x027B | –55.375 | 0x02AA | –61.250 | 0x02D9 | –67.125 | 0x0308 | –73.000 |
| 0x021E | –43.750 | 0x024D | –49.625 | 0x027C | –55.500 | 0x02AB | –61.375 | 0x02DA | –67.250 | 0x0309 | –73.125 |
| 0x021F | –43.875 | 0x024E | –49.750 | 0x027D | –55.625 | 0x02AC | –61.500 | 0x02DB | –67.375 | 0x030A | –73.250 |
| 0x0220 | –44.000 | 0x024F | –49.875 | 0x027E | –55.750 | 0x02AD | –61.625 | 0x02DC | –67.500 | 0x030B | –73.375 |
| 0x0221 | –44.125 | 0x0250 | –50.000 | 0x027F | –55.875 | 0x02AE | –61.750 | 0x02DD | –67.625 | 0x030C | –73.500 |
| 0x0222 | –44.250 | 0x0251 | –50.125 | 0x0280 | –56.000 | 0x02AF | –61.875 | 0x02DE | –67.750 | 0x030D | –73.625 |
| 0x0223 | –44.375 | 0x0252 | –50.250 | 0x0281 | –56.250 | 0x02B0 | –62.000 | 0x02DF | –67.875 | 0x030E | –73.750 |
| 0x0224 | –44.500 | 0x0253 | –50.375 | 0x0282 | –56.125 | 0x02B1 | –62.125 | 0x02E0 | –68.000 | 0x030F | –73.875 |
| 0x0225 | –44.625 | 0x0254 | –50.500 | 0x0283 | –56.375 | 0x02B2 | –62.250 | 0x02E1 | –68.125 | 0x0310 | –74.000 |
| 0x0226 | –44.750 | 0x0255 | –50.625 | 0x0284 | –56.500 | 0x02B3 | –62.375 | 0x02E2 | –68.250 | 0x0311 | –74.250 |
| 0x0227 | –44.875 | 0x0256 | –50.750 | 0x0285 | –56.625 | 0x02B4 | –62.500 | 0x02E3 | –68.375 | 0x0312 | –74.125 |
| 0x0228 | –45.000 | 0x0257 | –50.875 | 0x0286 | –56.750 | 0x02B5 | –62.625 | 0x02E4 | –68.500 | 0x0313 | –74.375 |
| 0x0229 | –45.125 | 0x0258 | –51.000 | 0x0287 | –56.875 | 0x02B6 | –62.750 | 0x02E5 | –68.625 | 0x0314 | –74.500 |
| 0x022A | –45.250 | 0x0259 | –51.125 | 0x0288 | –57.000 | 0x02B7 | –62.875 | 0x02E6 | –68.750 | 0x0315 | –74.625 |
| 0x022B | –45.375 | 0x025A | –51.250 | 0x0289 | –57.125 | 0x02B8 | –63.000 | 0x02E7 | –68.875 | 0x0316 | –74.750 |
| 0x022C | –45.500 | 0x025B | –51.375 | 0x028A | –57.250 | 0x02B9 | –63.125 | 0x02E8 | –69.000 | 0x0317 | –74.875 |
| 0x022D | –45.625 | 0x025C | –51.500 | 0x028B | –57.375 | 0x02BA | –63.250 | 0x02E9 | –69.125 | 0x0318 | –75.000 |
| 0x022E | –45.750 | 0x025D | –51.625 | 0x028C | –57.500 | 0x02BB | –63.375 | 0x02EA | –69.250 | 0x0319 | –75.125 |
| 0x022F | –45.875 | 0x025E | –51.750 | 0x028D | –57.625 | 0x02BC | –63.500 | 0x02EB | –69.375 | 0x031A | –75.250 |
| 0x0230 | –46.000 | 0x025F | –51.875 | 0x028E | –57.750 | 0x02BD | –63.625 | 0x02EC | –69.500 | 0x031B | –75.375 |
| 0x0231 | –46.125 | 0x0260 | –52.000 | 0x028F | –57.875 | 0x02BE | –63.750 | 0x02ED | –69.625 | 0x031C | –75.500 |

**Table 11. Master Volume Table (continued)**

| Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level   | Value  | Level    |
|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|----------|
| 0x0232 | –46.250 | 0x0261 | –52.125 | 0x0290 | –58.000 | 0x02BF | –63.875 | 0x02EE | –69.750 | 0x031D | –75.625  |
| 0x031E | –75.750 | 0x0344 | –80.500 | 0x036A | –85.250 | 0x0390 | –90.000 | 0x03B6 | –94.750 | 0x03DC | –99.500  |
| 0x031F | –75.875 | 0x0345 | –80.625 | 0x036B | –85.375 | 0x0391 | –90.125 | 0x03B7 | –94.875 | 0x03DD | –99.625  |
| 0x0320 | –76.000 | 0x0346 | –80.750 | 0x036C | –85.500 | 0x0392 | –90.250 | 0x03B8 | –95.000 | 0x03DE | –99.750  |
| 0x0321 | –76.125 | 0x0347 | –80.875 | 0x036D | –85.625 | 0x0393 | –90.375 | 0x03B9 | –95.125 | 0x03DF | –99.875  |
| 0x0322 | –76.250 | 0x0348 | –81.000 | 0x036E | –85.750 | 0x0394 | –90.500 | 0x03BA | –95.250 | 0x03E0 | –100.000 |
| 0x0323 | –76.375 | 0x0349 | –81.125 | 0x036F | –85.875 | 0x0395 | –90.625 | 0x03BB | –95.375 | 0x03E1 | –100.125 |
| 0x0324 | –76.500 | 0x034A | –81.250 | 0x0370 | –86.000 | 0x0396 | –90.750 | 0x03BC | –95.500 | 0x03E2 | –100.250 |
| 0x0325 | –76.625 | 0x034B | –81.375 | 0x0371 | –86.125 | 0x0397 | –90.875 | 0x03BD | –95.625 | 0x03E3 | –100.375 |
| 0x0326 | –76.750 | 0x034C | –81.500 | 0x0372 | –86.250 | 0x0398 | –91.000 | 0x03BE | –95.750 | 0x03E4 | –100.500 |
| 0x0327 | –76.875 | 0x034D | –81.625 | 0x0373 | –86.375 | 0x0399 | –91.125 | 0x03BF | –95.875 | 0x03E5 | –100.625 |
| 0x0328 | –77.000 | 0x034E | –81.750 | 0x0374 | –86.500 | 0x039A | –91.250 | 0x03C0 | –96.000 | 0x03E6 | –100.750 |
| 0x0329 | –77.125 | 0x034F | –81.875 | 0x0375 | –86.625 | 0x039B | –91.375 | 0x03C1 | –96.125 | 0x03E7 | –100.875 |
| 0x032A | –77.250 | 0x0350 | –82.000 | 0x0376 | –86.750 | 0x039C | –91.500 | 0x03C2 | –96.250 | 0x03E8 | –101.000 |
| 0x032B | –77.375 | 0x0351 | –82.125 | 0x0377 | –86.875 | 0x039D | –91.625 | 0x03C3 | –96.375 | 0x03E9 | –101.125 |
| 0x032C | –77.500 | 0x0352 | –82.250 | 0x0378 | –87.000 | 0x039E | –91.750 | 0x03C4 | –96.500 | 0x03EA | –101.250 |
| 0x032D | –77.625 | 0x0353 | –82.375 | 0x0379 | –87.125 | 0x039F | –91.875 | 0x03C5 | –96.625 | 0x03EB | –101.375 |
| 0x032E | –77.750 | 0x0354 | –82.500 | 0x037A | –87.250 | 0x03A0 | –92.000 | 0x03C6 | –96.750 | 0x03EC | –101.500 |
| 0x032F | –77.875 | 0x0355 | –82.625 | 0x037B | –87.375 | 0x03A1 | –92.125 | 0x03C7 | –96.875 | 0x03ED | –101.625 |
| 0x0330 | –78.000 | 0x0356 | –82.750 | 0x037C | –87.500 | 0x03A2 | –92.250 | 0x03C8 | –97.000 | 0x03EE | –101.750 |
| 0x0331 | –78.125 | 0x0357 | –82.875 | 0x037D | –87.625 | 0x03A3 | –92.375 | 0x03C9 | –97.125 | 0x03EF | –101.875 |
| 0x0332 | –78.250 | 0x0358 | –83.000 | 0x037E | –87.750 | 0x03A4 | –92.500 | 0x03CA | –97.250 | 0x03F0 | –102.000 |
| 0x0333 | –78.375 | 0x0359 | –83.125 | 0x037F | –87.875 | 0x03A5 | –92.625 | 0x03CB | –97.375 | 0x03F1 | –102.125 |
| 0x0334 | –78.500 | 0x035A | –83.250 | 0x0380 | –88.000 | 0x03A6 | –92.750 | 0x03CC | –97.500 | 0x03F2 | –102.250 |
| 0x0335 | –78.625 | 0x035B | –83.375 | 0x0381 | –88.125 | 0x03A7 | –92.875 | 0x03CD | –97.625 | 0x03F3 | –102.375 |
| 0x0336 | –78.750 | 0x035C | –83.500 | 0x0382 | –88.250 | 0x03A8 | –93.000 | 0x03CE | –97.750 | 0x03F4 | –102.500 |
| 0x0337 | –78.875 | 0x035D | –83.625 | 0x0383 | –88.375 | 0x03A9 | –93.125 | 0x03CF | –97.875 | 0x03F5 | –102.625 |
| 0x0338 | –79.000 | 0x035E | –83.750 | 0x0384 | –88.500 | 0x03AA | –93.250 | 0x03D0 | –98.000 | 0x03F6 | –102.750 |
| 0x0339 | –79.125 | 0x035F | –83.875 | 0x0385 | –88.625 | 0x03AB | –93.375 | 0x03D1 | –98.125 | 0x03F7 | –102.875 |
| 0x033A | –79.250 | 0x0360 | –84.000 | 0x0386 | –88.750 | 0x03AC | –93.500 | 0x03D2 | –98.250 | 0x03F8 | –103.000 |
| 0x033B | –79.375 | 0x0361 | –84.125 | 0x0387 | –88.875 | 0x03AD | –93.625 | 0x03D3 | –98.375 | 0x03F9 | –103.125 |
| 0x033C | –79.500 | 0x0362 | –84.250 | 0x0388 | –89.000 | 0x03AE | –93.750 | 0x03D4 | –98.500 | 0x03FA | –103.250 |
| 0x033D | –79.625 | 0x0363 | –84.375 | 0x0389 | –89.125 | 0x03AF | –93.875 | 0x03D5 | –98.625 | 0x03FB | –103.375 |
| 0x033E | –79.750 | 0x0364 | –84.500 | 0x038A | –89.250 | 0x03B0 | –94.000 | 0x03D6 | –98.750 | 0x03FC | –103.500 |
| 0x033F | –79.875 | 0x0365 | –84.625 | 0x038B | –89.375 | 0x03B1 | –94.125 | 0x03D7 | –98.875 | 0x03FD | –103.625 |
| 0x0340 | –80.000 | 0x0366 | –84.750 | 0x038C | –89.500 | 0x03B2 | –94.250 | 0x03D8 | –99.000 | 0x03FE | –103.750 |
| 0x0341 | –80.250 | 0x0367 | –84.875 | 0x038D | –89.625 | 0x03B3 | –94.375 | 0x03D9 | –99.125 | 0x03FF | Mute     |
| 0x0341 | –80.250 | 0x0368 | –85.000 | 0x038E | –89.750 | 0x03B4 | –94.500 | 0x03DA | –99.250 |        |          |
| 0x0343 | –80.375 | 0x0369 | –85.125 | 0x038F | –89.875 | 0x03B5 | –94.625 | 0x03DB | –99.375 |        |          |

**VOLUME CONFIGURATION REGISTER (0x0E)**

Bits Volume slew rate (used to control volume change and MUTE ramp rates). These bits control the number of steps in a volume ramp. Volume steps occur at a rate that depends on the sample rate of the I<sup>2</sup>S data as follows:

| Sample rate (kHz) | Approximate ramp rate |
|-------------------|-----------------------|
| 8/16/32           | 125 $\mu$ s/step      |
| 11.025/22.05/44.1 | 90.7 $\mu$ s/step     |
| 12/24/48          | 83.3 $\mu$ s/step     |

**Table 12. Volume Configuration Register (0x0E)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                                |
|----------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------------------------------------|
| <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> | <b>0</b> | –        | –        | –        | Reserved <sup>(1)</sup>                                                 |
| –        | –        | –        | –        | –        | <b>0</b> | <b>0</b> | <b>0</b> | Volume slew 512 steps (43 ms volume ramp time at 48 kHz) <sup>(1)</sup> |
| –        | –        | –        | –        | –        | 0        | 0        | 1        | Volume slew 1024 steps (85-ms volume ramp time at 48 kHz)               |
| –        | –        | –        | –        | –        | 0        | 1        | 0        | Volume slew 2048 steps (171-ms volume ramp time at 48 kHz)              |
| –        | –        | –        | –        | –        | 0        | 1        | 1        | Volume slew 256 steps (21-ms volume ramp time at 48 kHz)                |
| –        | –        | –        | –        | –        | 1        | X        | X        | Reserved                                                                |

(1) Default values are in **bold**.

**MODULATION LIMIT REGISTER (0x10)****Table 13. Modulation Limit Register (0x10)**

| D7 | D6 | D5 | D4 | D3 | D2       | D1       | D0       | MODULATION LIMIT            |
|----|----|----|----|----|----------|----------|----------|-----------------------------|
| 0  | 0  | 0  | 0  | 0  | –        | –        | –        | Reserved                    |
| –  | –  | –  | –  | –  | 0        | 0        | 0        | 99.2%                       |
| –  | –  | –  | –  | –  | 0        | 0        | 1        | 98.4%                       |
| –  | –  | –  | –  | –  | <b>0</b> | <b>1</b> | <b>0</b> | <b>97.7%</b> <sup>(1)</sup> |
| –  | –  | –  | –  | –  | 0        | 1        | 1        | 96.9%                       |
| –  | –  | –  | –  | –  | 1        | 0        | 0        | 96.1%                       |
| –  | –  | –  | –  | –  | 1        | 0        | 1        | 95.3%                       |
| –  | –  | –  | –  | –  | 1        | 1        | 0        | 94.5%                       |
| –  | –  | –  | –  | –  | 1        | 1        | 1        | 93.8%                       |

(1) Default values are in **bold**.

## INTERCHANNEL DELAY REGISTERS (0x11, 0x12, 0x13, and 0x14)

Internal PWM channels 1, 2,  $\bar{1}$ , and  $\bar{2}$  are mapped into registers 0x11, 0x12, 0x13, and 0x14.

**Table 14. Channel Interchannel Delay Register Format**

| BITS DEFINITION | D7       | D6       | D5       | D4       | D3       | D2       | D1 | D0 | FUNCTION                                                            |
|-----------------|----------|----------|----------|----------|----------|----------|----|----|---------------------------------------------------------------------|
|                 | 0        | 0        | 0        | 0        | 0        | 0        | –  | –  | Minimum absolute delay, 0 DCLK cycles                               |
|                 | 0        | 1        | 1        | 1        | 1        | 1        | –  | –  | Maximum positive delay, $31 \times 4$ DCLK cycles                   |
|                 | 1        | 0        | 0        | 0        | 0        | 0        | –  | –  | Maximum negative delay, $-32 \times 4$ DCLK cycles                  |
|                 |          |          |          |          |          |          | 0  | 0  | Reserved                                                            |
| SUBADDRESS      | D7       | D6       | D5       | D4       | D3       | D2       | D1 | D0 | Delay = (value) $\times$ 4 DCLKs                                    |
| <b>0x11</b>     | <b>1</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | <b>1</b> | –  | –  | <b>Default value for channel 1<sup>(1)</sup></b>                    |
| <b>0x12</b>     | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | –  | –  | <b>Default value for channel 2<sup>(1)</sup></b>                    |
| <b>0x13</b>     | <b>1</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | <b>1</b> | –  | –  | <b>Default value for channel <math>\bar{1}</math><sup>(1)</sup></b> |
| <b>0x14</b>     | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | –  | –  | <b>Default value for channel <math>\bar{2}</math><sup>(1)</sup></b> |

(1) Default values are in **bold**.

ICD settings have high impact on audio performance (e.g., dynamic range, THD, crosstalk, etc.) Therefore, appropriate ICD settings must be used. By default, the device has ICD settings for the AD mode. If used in BD mode, then update these registers before coming out of all-channel shutdown.

| MODE | AD MODE | BD MODE |
|------|---------|---------|
| 0x11 | AC      | B8      |
| 0x12 | 54      | 60      |
| 0x13 | AC      | A0      |
| 0x14 | 54      | 48      |

**PWM SHUTDOWN GROUP REGISTER (0x19)**

Settings of this register determine which PWM channels are active. The value should be 0x30 for BTL mode and 0x3A for PBTTL mode. The default value of this register is 0x30. The functionality of this register is tied to the state of bit D5 in the system control register.

This register defines which channels belong to the shutdown group (SDG). If a 1 is set in the shutdown group register, that particular channel is **not** started following an *exit out of all-channel shutdown* command (if bit D5 is set to 0 in system control register 2, 0x05).

**Table 15. PWM Shutdown Group Register (0x19)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                               |
|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------------------------------------|
| <b>0</b> | –        | –        | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                         |
| –        | <b>0</b> | –        | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                         |
| –        | –        | <b>1</b> | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                         |
| –        | –        | –        | <b>1</b> | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                         |
| –        | –        | –        | –        | <b>0</b> | –        | –        | –        | <b>PWM channel 4 does not belong to shutdown group.</b> <sup>(1)</sup> |
| –        | –        | –        | –        | 1        | –        | –        | –        | PWM channel 4 belongs to shutdown group.                               |
| –        | –        | –        | –        | –        | <b>0</b> | –        | –        | <b>PWM channel 3 does not belong to shutdown group.</b> <sup>(1)</sup> |
| –        | –        | –        | –        | –        | 1        | –        | –        | PWM channel 3 belongs to shutdown group.                               |
| –        | –        | –        | –        | –        | –        | <b>0</b> | –        | <b>PWM channel 2 does not belong to shutdown group.</b> <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | 1        | –        | PWM channel 2 belongs to shutdown group.                               |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | <b>PWM channel 1 does not belong to shutdown group.</b> <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | –        | 1        | PWM channel 1 belongs to shutdown group.                               |

(1) Default values are in **bold**.

## START/STOP PERIOD REGISTER (0x1A)

This register is used to control the soft-start and soft-stop period following an enter/exit all-channel shutdown command or change in the PDN state. This helps reduce pops and clicks at start-up and shutdown. The times are only approximate and vary depending on device activity level and I<sup>2</sup>S clock stability.

**Table 16. Start/Stop Period Register (0x1A)**

| D7 | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                        |
|----|----------|----------|----------|----------|----------|----------|----------|-----------------------------------------------------------------|
| 0  | –        | –        | –        | –        | –        | –        | –        | <b>SSTIMER enabled</b> <sup>(1)</sup>                           |
| 1  | –        | –        | –        | –        | –        | –        | –        | SSTIMER disabled                                                |
| –  | <b>0</b> | <b>0</b> | –        | –        | –        | –        | –        | <b>Reserved</b> <sup>(1)</sup>                                  |
| –  | –        | –        | 0        | 0        | –        | –        | –        | No 50% duty cycle start/stop period                             |
| –  | –        | –        | 0        | 1        | 0        | 0        | 0        | 16.5-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 0        | 0        | 1        | 23.9-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 0        | 1        | 0        | 31.4-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 0        | 1        | 1        | 40.4-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 1        | 0        | 0        | 53.9-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 1        | 0        | 1        | 70.3-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | 0        | 1        | 1        | 1        | 0        | 94.2-ms 50% duty cycle start/stop period                        |
| –  | –        | –        | <b>0</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>125.7-ms 50% duty cycle start/stop period</b> <sup>(1)</sup> |
| –  | –        | –        | 1        | 0        | 0        | 0        | 0        | 164.6-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 0        | 0        | 1        | 239.4-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 0        | 1        | 0        | 314.2-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 0        | 1        | 1        | 403.9-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 1        | 0        | 0        | 538.6-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 1        | 0        | 1        | 703.1-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 1        | 1        | 0        | 942.5-ms 50% duty cycle start/stop period                       |
| –  | –        | –        | 1        | 0        | 1        | 1        | 1        | 1256.6-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 0        | 0        | 0        | 1728.1-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 0        | 0        | 1        | 2513.6-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 0        | 1        | 0        | 3299.1-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 0        | 1        | 1        | 4241.7-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 1        | 0        | 0        | 5655.6-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 1        | 0        | 1        | 7383.7-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 1        | 1        | 0        | 9897.3-ms 50% duty cycle start/stop period                      |
| –  | –        | –        | 1        | 1        | 1        | 1        | 1        | 13,196.4-ms 50% duty cycle start/stop period                    |

(1) Default values are in **bold**.

**OSCILLATOR TRIM REGISTER (0x1B)**

The TAS5717/9 PWM processor contains an internal oscillator to support autodetect of I<sup>2</sup>S clock rates. This reduces system cost because an external reference is not required. Currently, TI recommends a reference resistor value of 18.2 kΩ (1%). This should be connected between OSC\_RES and DVSSO.

Writing 0x00 to register 0x1B enables the trim that was programmed at the factory.

Note that trim must always be run following reset of the device.

**Table 17. Oscillator Trim Register (0x1B)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                                              |
|----------|----------|----------|----------|----------|----------|----------|----------|-----------------------------------------------------------------------|
| <b>1</b> | –        | –        | –        | –        | –        | –        | –        | Reserved <sup>(1)</sup>                                               |
| –        | <b>0</b> | –        | –        | –        | –        | –        | –        | Oscillator trim not done (read-only) <sup>(1)</sup>                   |
| –        | 1        | –        | –        | –        | –        | –        | –        | Oscillator trim done (read only)                                      |
| –        | –        | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | –        | –        | Reserved <sup>(1)</sup>                                               |
| –        | –        | –        | –        | –        | –        | 0        | –        | Select factory trim (Write a 0 to select factory trim; default is 1.) |
| –        | –        | –        | –        | –        | –        | <b>1</b> | –        | Factory trim disabled <sup>(1)</sup>                                  |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | Reserved <sup>(1)</sup>                                               |

(1) Default values are in **bold**.

**BKND\_ERR REGISTER (0x1C)**

When a back-end error signal is received from the internal power stage, the power stage is reset, stopping all PWM activity. Subsequently, the modulator waits approximately for the time listed in [Table 18](#) before attempting to re-start the power stage.

**Table 18. BKND\_ERR Register (0x1C)**

| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                           |
|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------------------|
| 0        | 0        | 0        | 0        | –        | –        | –        | –        | Headphone enable time = 0 ms                       |
| 0        | 0        | 0        | 1        | –        | –        | –        | –        | Headphone enable time = 2 ms                       |
| 0        | 0        | 1        | 0        | –        | –        | –        | –        | Headphone enable time = 4 ms                       |
| 0        | 0        | 1        | 1        | –        | –        | –        | –        | Headphone enable time = 6 ms                       |
| 0        | 1        | 0        | 0        | –        | –        | –        | –        | Headphone enable time = 8 ms                       |
| <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | –        | –        | –        | –        | Headphone enable time = 10 ms <sup>(1)</sup>       |
| 0        | 1        | 1        | 0        | –        | –        | –        | –        | Headphone enable time = 12 ms                      |
| 0        | 1        | 1        | 1        | –        | –        | –        | –        | Headphone enable time = 14 ms                      |
| 1        | 0        | 0        | 0        | –        | –        | –        | –        | Headphone enable time = 16 ms                      |
| 1        | 0        | 0        | 1        | –        | –        | –        | –        | Headphone enable time = 18 ms                      |
| 1        | 0        | 1        | 0        | –        | –        | –        | –        | Headphone enable time = 20 ms                      |
| 1        | 0        | 1        | 1        | –        | –        | –        | –        | Headphone enable time = 22 ms                      |
| 1        | 1        | 0        | 0        | –        | –        | –        | –        | Headphone enable time = 24 ms                      |
| 1        | 1        | 0        | 1        | –        | –        | –        | –        | Headphone enable time = 26 ms                      |
| 1        | 1        | 1        | 0        | –        | –        | –        | –        | Headphone enable time = 28 ms                      |
| 1        | 1        | 1        | 1        | –        | –        | –        | –        | Headphone enable time = 30 ms                      |
| –        | –        | –        | –        | <b>0</b> | <b>0</b> | <b>1</b> | <b>0</b> | Set back-end reset period to 299 ms <sup>(1)</sup> |
| –        | –        | –        | –        | 0        | 0        | 1        | 1        | Set back-end reset period to 449 ms                |
| –        | –        | –        | –        | 0        | 1        | 0        | 0        | Set back-end reset period to 598 ms                |
| –        | –        | –        | –        | 0        | 1        | 0        | 1        | Set back-end reset period to 748 ms                |
| –        | –        | –        | –        | 0        | 1        | 1        | 0        | Set back-end reset period to 898 ms                |
| –        | –        | –        | –        | 0        | 1        | 1        | 1        | Set back-end reset period to 1047 ms               |
| –        | –        | –        | –        | 1        | 0        | 0        | 0        | Set back-end reset period to 1197 ms               |

(1) Default values are in **bold**.

**Table 18. BKND\_ERR Register (0x1C) (continued)**

| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | FUNCTION                             |
|----|----|----|----|----|----|----|----|--------------------------------------|
| –  | –  | –  | –  | 1  | 0  | 0  | 1  | Set back-end reset period to 1346 ms |
| –  | –  | –  | –  | 1  | 0  | 1  | X  | Set back-end reset period to 1496 ms |
| –  | –  | –  | –  | 1  | 1  | X  | X  | Set back-end reset period to 1496 ms |

**INPUT MULTIPLEXER REGISTER (0x20)**

This register controls the modulation scheme (AD or BD mode) as well as the routing of I<sup>2</sup>S audio to the internal channels.

**Table 19. Input Multiplexer Register (0x20)**

| D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | FUNCTION                           |
|-----|-----|-----|-----|-----|-----|-----|-----|------------------------------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>            |
| D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | FUNCTION                           |
| 0   | –   | –   | –   | –   | –   | –   | –   | Channel-1 AD mode <sup>(1)</sup>   |
| 1   | –   | –   | –   | –   | –   | –   | –   | Channel-1 BD mode                  |
| –   | 0   | 0   | 0   | –   | –   | –   | –   | SDIN-L to channel 1 <sup>(1)</sup> |
| –   | 0   | 0   | 1   | –   | –   | –   | –   | SDIN-R to channel 1                |
| –   | 0   | 1   | 0   | –   | –   | –   | –   | Reserved                           |
| –   | 0   | 1   | 1   | –   | –   | –   | –   | Reserved                           |
| –   | 1   | 0   | 0   | –   | –   | –   | –   | Reserved                           |
| –   | 1   | 0   | 1   | –   | –   | –   | –   | Reserved                           |
| –   | 1   | 1   | 0   | –   | –   | –   | –   | Ground (0) to channel 1            |
| –   | 1   | 1   | 1   | –   | –   | –   | –   | Reserved                           |
| –   | –   | –   | –   | 0   | –   | –   | –   | Channel 2 AD mode <sup>(1)</sup>   |
| –   | –   | –   | –   | 1   | –   | –   | –   | Channel 2 BD mode                  |
| –   | –   | –   | –   | –   | 0   | 0   | 0   | SDIN-L to channel 2                |
| –   | –   | –   | –   | –   | 0   | 0   | 1   | SDIN-R to channel 2 <sup>(1)</sup> |
| –   | –   | –   | –   | –   | 0   | 1   | 0   | Reserved                           |
| –   | –   | –   | –   | –   | 0   | 1   | 1   | Reserved                           |
| –   | –   | –   | –   | –   | 1   | 0   | 0   | Reserved                           |
| –   | –   | –   | –   | –   | 1   | 0   | 1   | Reserved                           |
| –   | –   | –   | –   | –   | 1   | 1   | 0   | Ground (0) to channel 2            |
| –   | –   | –   | –   | –   | 1   | 1   | 1   | Reserved                           |
| D15 | D14 | D13 | D12 | D11 | D10 | D9  | D8  | FUNCTION                           |
| 0   | 1   | 1   | 1   | 0   | 1   | 1   | 1   | Reserved <sup>(1)</sup>            |
| D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | FUNCTION                           |
| 0   | 1   | 1   | 1   | 0   | 0   | 1   | 0   | Reserved <sup>(1)</sup>            |

(1) Default values are in **bold**.

## CHANNEL 4 SOURCE SELECT REGISTER (0x21)

This register selects the channel 4 source.

**Table 20. Subchannel Control Register (0x21)**

| D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | FUNCTION                            |
|-----|-----|-----|-----|-----|-----|-----|-----|-------------------------------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>             |
| D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | FUNCTION                            |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>             |
| D15 | D14 | D13 | D12 | D11 | D10 | D9  | D8  | FUNCTION                            |
| 0   | 1   | 0   | 0   | 0   | 0   | 1   | –   | Reserved <sup>(1)</sup>             |
| –   | –   | –   | –   | –   | –   | –   | 0   | (L + R)/2                           |
| –   | –   | –   | –   | –   | –   | –   | 1   | Left-channel post-BQ <sup>(1)</sup> |
| D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | FUNCTION                            |
| 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | Reserved <sup>(1)</sup>             |

(1) Default values are in **bold**.

## PWM OUTPUT MUX REGISTER (0x25)

This DAP output mux selects which internal PWM channel is output to the external pins. Any channel can be output to any external output pin.

Bits D21–D20: Selects which PWM channel is output to OUT\_A

Bits D17–D16: Selects which PWM channel is output to OUT\_B

Bits D13–D12: Selects which PWM channel is output to OUT\_C

Bits D09–D08: Selects which PWM channel is output to OUT\_D

Note that channels are encoded so that channel 1 = 0x00, channel 2 = 0x01, ..., channel 4 = 0x03.

**Table 21. PWM Output Mux Register (0x25)**

| D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | FUNCTION                                    |
|-----|-----|-----|-----|-----|-----|-----|-----|---------------------------------------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | Reserved <sup>(1)</sup>                     |
| D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | FUNCTION                                    |
| 0   | 0   | –   | –   | –   | –   | –   | –   | Reserved <sup>(1)</sup>                     |
| –   | –   | 0   | 0   | –   | –   | –   | –   | Multiplex channel 1 to OUT_A <sup>(1)</sup> |
| –   | –   | 0   | 1   | –   | –   | –   | –   | Multiplex channel 2 to OUT_A                |
| –   | –   | 1   | 0   | –   | –   | –   | –   | Multiplex channel 1 to OUT_A                |
| –   | –   | 1   | 1   | –   | –   | –   | –   | Multiplex channel 2 to OUT_A                |
| –   | –   | –   | –   | 0   | 0   | –   | –   | Reserved <sup>(1)</sup>                     |
| –   | –   | –   | –   | –   | –   | 0   | 0   | Multiplex channel 1 to OUT_B                |
| –   | –   | –   | –   | –   | –   | 0   | 1   | Multiplex channel 2 to OUT_B                |
| –   | –   | –   | –   | –   | –   | 1   | 0   | Multiplex channel 1 to OUT_B <sup>(1)</sup> |
| –   | –   | –   | –   | –   | –   | 1   | 1   | Multiplex channel 2 to OUT_B                |

(1) Default values are in **bold**.

**Table 21. PWM Output Mux Register (0x25) (continued)**

| D15      | D14      | D13      | D12      | D11      | D10      | D9       | D8       | FUNCTION                                    |
|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------------------------|
| <b>0</b> | <b>0</b> | –        | –        | –        | –        | –        | –        | Reserved <sup>(2)</sup>                     |
| –        | –        | 0        | 0        | –        | –        | –        | –        | Multiplex channel 1 to OUT_C                |
| –        | –        | <b>0</b> | <b>1</b> | –        | –        | –        | –        | Multiplex channel 2 to OUT_C <sup>(2)</sup> |
| –        | –        | 1        | 0        | –        | –        | –        | –        | Multiplex channel 1 to OUT_C                |
| –        | –        | 1        | 1        | –        | –        | –        | –        | Multiplex channel 2 to OUT_C                |
| –        | –        | –        | –        | <b>0</b> | <b>0</b> | –        | –        | Reserved <sup>(2)</sup>                     |
| –        | –        | –        | –        | –        | –        | 0        | 0        | Multiplex channel 1 to OUT_D                |
| –        | –        | –        | –        | –        | –        | 0        | 1        | Multiplex channel 2 to OUT_D                |
| –        | –        | –        | –        | –        | –        | 1        | 0        | Multiplex channel 1 to OUT_D                |
| –        | –        | –        | –        | –        | –        | <b>1</b> | <b>1</b> | Multiplex channel 2 to OUT_D <sup>(2)</sup> |
| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                                    |
| <b>0</b> | <b>1</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | Reserved <sup>(2)</sup>                     |

(2) Default values are in **bold**.**DRC CONTROL REGISTER (0x46)****Table 22. DRC Control Register (0x46)**

| D31      | D30      | D29      | D28      | D27      | D26      | D25      | D24      | FUNCTION                       |
|----------|----------|----------|----------|----------|----------|----------|----------|--------------------------------|
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | Reserved <sup>(1)</sup>        |
| D23      | D22      | D21      | D20      | D19      | D18      | D17      | D16      | FUNCTION                       |
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | Reserved <sup>(1)</sup>        |
| D15      | D14      | D13      | D12      | D11      | D10      | D9       | D8       | FUNCTION                       |
| <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | Reserved <sup>(1)</sup>        |
| D7       | D6       | D5       | D4       | D3       | D2       | D1       | D0       | FUNCTION                       |
| <b>0</b> | <b>0</b> | –        | –        | –        | –        | –        | –        | Reserved <sup>(1)</sup>        |
| –        | –        | 0        | –        | –        | –        | –        | –        | Reserved                       |
| –        | –        | 1        | –        | –        | –        | –        | –        | Reserved                       |
| –        | –        | –        | <b>0</b> | –        | –        | –        | –        | Reserved <sup>(1)</sup>        |
| –        | –        | –        | –        | <b>0</b> | –        | –        | –        | Reserved <sup>(1)</sup>        |
| –        | –        | –        | –        | –        | <b>0</b> | –        | –        | Reserved <sup>(1)</sup>        |
| –        | –        | –        | –        | –        | –        | <b>0</b> | –        | DRC2 turned OFF <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | 1        | –        | DRC2 turned ON                 |
| –        | –        | –        | –        | –        | –        | –        | <b>0</b> | DRC1 turned OFF <sup>(1)</sup> |
| –        | –        | –        | –        | –        | –        | –        | 1        | DRC1 turned ON                 |

(1) Default values are in **bold**.

## PWM SWITCHING RATE CONTROL REGISTER (0x4F)

PWM switching rate should be selected through the register 0x4F before coming out of all-channel shutdown.

**Table 23. PWM Switching Rate Control Register (0x4F)**

| D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | FUNCTION                |
|-----|-----|-----|-----|-----|-----|-----|-----|-------------------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup> |
| D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | FUNCTION                |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup> |
| D15 | D14 | D13 | D12 | D11 | D10 | D9  | D8  | FUNCTION                |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup> |
| D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | FUNCTION                |
| –   | –   | 0   | 0   | –   | –   | –   | –   | Reserved <sup>(1)</sup> |
| –   | –   | –   | –   | 0   | 1   | 1   | 0   | SRC = 6 <sup>(1)</sup>  |
| –   | –   | –   | –   | 0   | 1   | 1   | 1   | SRC = 7                 |
| –   | –   | –   | –   | 1   | 0   | 0   | 0   | SRC = 8                 |
| –   | –   | –   | –   | 1   | 0   | 0   | 1   | SRC = 9                 |
| –   | –   | –   | –   | 1   | 0   | 1   | 0   | Reserved                |
| –   | –   | –   | –   | 1   | 1   | –   | –   | Reserved                |

(1) Default values are in **bold**.

## EQ CONTROL (0x50)

**Table 24. EQ Command (0x50)**

| D31 | D30 | D29 | D28 | D27 | D26 | D25 | D24 | FUNCTION                                                                                                                                                                                      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| D23 | D22 | D21 | D20 | D19 | D18 | D17 | D16 | FUNCTION                                                                                                                                                                                      |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| D15 | D14 | D13 | D12 | D11 | D10 | D9  | D8  | FUNCTION                                                                                                                                                                                      |
| 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | FUNCTION                                                                                                                                                                                      |
| 0   |     |     |     |     |     |     |     | EQ ON <sup>(1)</sup>                                                                                                                                                                          |
| 1   | –   | –   | –   | –   | –   | –   | –   | EQ OFF (bypass BQ 0–7 of channels 1 and 2)                                                                                                                                                    |
| –   | 0   | –   | –   | –   | –   | –   | –   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| –   | –   | 0   | –   | –   | –   | –   | –   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
|     |     | 1   |     |     |     |     |     | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| –   | –   | –   | 0   | –   | –   | –   | –   | L and R can be written independently. <sup>(1)</sup>                                                                                                                                          |
| –   | –   | –   | 1   | –   | –   | –   | –   | L and R are ganged for EQ biquads; a write to the left-channel biquad is also written to the right-channel biquad. (0x29–0x2F is ganged to 0x30–0x36. Also, 0x58–0x5B is ganged to 0x5C–0x5F. |
| –   | –   | –   | –   | 0   | –   | –   | –   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| –   | –   | –   | –   | –   | 0   | 0   | 0   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| –   | –   | –   | –   | –   | 0   | 0   | 1   | Reserved <sup>(1)</sup>                                                                                                                                                                       |
| –   | –   | –   | –   | –   | 0   | 1   | X   | Reserved                                                                                                                                                                                      |
| –   | –   | –   | –   | –   | 1   | X   | X   | Reserved                                                                                                                                                                                      |

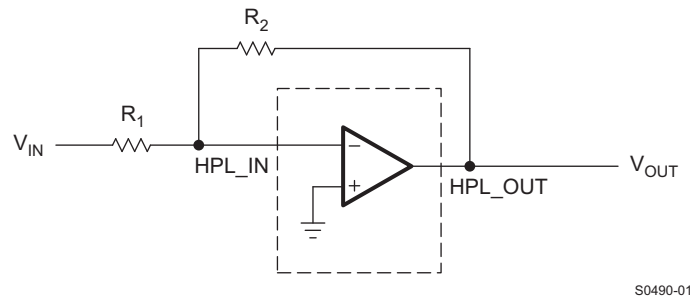
(1) Default values are in **bold**.

## USING HEADPHONE AMPLIFIER IN TAS5717

This device has a stereo output which can be used as a line driver or a headphone driver that can output 2-V<sub>rms</sub> stereo. An audio system can be set up for different applications using this device.

### Case 1 – Headphone (HP)/Line Drive With Analog Input:

The device can be represented as shown in [Figure 46](#): analog inputs (single-ended) as HPL\_IN (pin 1) and HPR\_IN (pin 4) with the outputs HPL\_OUT (pin 2) and HPR\_OUT (pin 3).



S0490-01

**Figure 46. Headphone/Line Driver with Analog Input**

HP\_SD pin can be used turn ON/OFF the headphone amplifier/line driver.

Speaker channels are independent of headphone/line driver in this mode.

### Case 2 – Headphone With I<sup>2</sup>S Input:

**Hardware setup:** The HP\_PWML and HP\_PWMR signals should be fed into a low-pass filter (LPF), and the output of the LPF is fed to analog inputs (HPL\_IN and HPR\_IN). The A\_SEL pin has a 15-kΩ pulldown to ground and should be routed to headphone amplifier enable (HP\_SDZ pin 33).

**Software setup:** Write to register 0x05 bits D4 = 1, D1 = 1, and D0 = 1 (13 hex). When D4 and D1 are set to 1, the A\_SEL pin goes high and thus enables the headphone output. When register 0x05 D4 = 1, the device is in headphone mode and the speaker outputs are in shutdown.

**NOTE:** The speaker and headphone cannot be used at the same time as they both share the same digital channel. DAP can be used for headphone volume.

## APPLICATION INFORMATION

### LINE DRIVER AMPLIFIERS

Single-supply headphone and line driver amplifiers typically require dc-blocking capacitors. The top drawing in Figure 47 illustrates the conventional line driver amplifier connection to the load and output signal.

DC blocking capacitors for headphone amps are often large in value, and a mute circuit is needed during power up to minimize click and pop for both headphone and line driver. The output capacitors and mute circuits consume PCB area and increase cost of assembly, and can reduce the fidelity of the audio output signal.

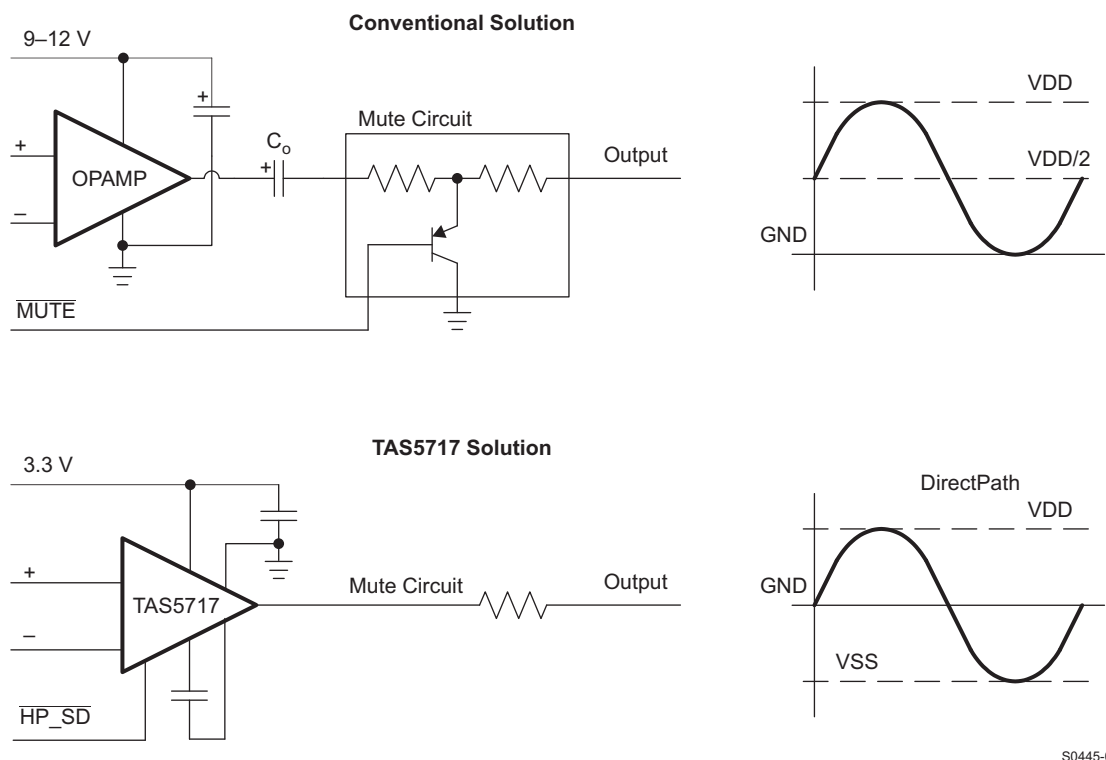


Figure 47. Conventional and DirectPath HP and Line Driver

The DirectPath™ amplifier architecture operates from a single supply but makes use of an internal charge pump to provide a negative voltage rail.

Combining the user provided positive rail and the negative rail generated by the IC, the device operates in what is effectively a split supply mode.

The output voltages are now centered at zero volts with the capability to swing to the positive rail or negative rail, combining this with the build in click and pop reduction circuit, the DirectPath™ amplifier requires no output dc blocking capacitors.

The bottom block diagram and waveform of Figure 47 illustrate the ground-referenced headphone and line driver architecture. This is the architecture of the TAS5717/9.

### COMPONENT SELECTION

#### Charge Pump

The charge pump flying capacitor serves to transfer charge during the generation of the negative supply voltage. The PVSS capacitor must be at least equal to the charge pump capacitor in order to allow maximum charge transfer. Low ESR capacitors are an ideal selection, and a value of 1μF is typical. Capacitor values that are smaller than 1μF can not be recommended for the HP section as it will limit the negative voltage swing in low impedance loads.

## Decoupling Capacitors

The TAS5717/9 is a DirectPath™ amplifier that requires adequate power supply decoupling to ensure that the noise and total harmonic distortion (THD) are low. A good low equivalent-series-resistance (ESR) ceramic capacitor, typically 1μF, placed as close as possible to the device PVDD leads works best. Placing this decoupling capacitor close to the TAS5717/9 is important for the performance of the amplifier. For filtering lower frequency noise signals, a 10μF or greater capacitor placed near the audio power amplifier would also help, but it is not required in most applications because of the high PSRR of this device.

## Gain Setting Resistors Ranges

The gain setting resistors,  $R_{in}$  and  $R_{fb}$ , must be chosen so that noise, stability and input capacitor size of the TAS5717/9 is kept within acceptable limits. Voltage gain is defined as  $R_{fb}$  divided by  $R_{in}$ . Selecting values that are too low demands a large input ac-coupling capacitor,  $C_{in}$ . Selecting values that are too high increases the noise of the amplifier. Table 25 lists the recommended resistor values for different gain settings.

**Table 25. Recommended Resistor Values**

| INPUT RESISTOR<br>VALUE, $R_{in}$ | FEEDBACK RESISTOR<br>VALUE, $R_{fb}$ | DIFFERENTIAL<br>INPUT GAIN | INVERTING INPUT<br>GAIN | NON INVERTING<br>INPUT GAIN |
|-----------------------------------|--------------------------------------|----------------------------|-------------------------|-----------------------------|
| 10 kΩ                             | 10 kΩ                                | 1.0 V/V                    | –1.0 V/V                | 2.0 V/V                     |
| 10 kΩ                             | 15 kΩ                                | 1.5 V/V                    | –1.5 V/V                | 2.5 V/V                     |
| 10 kΩ                             | 20 kΩ                                | 2.0 V/V                    | –2.0 V/V                | 3.0 V/V                     |
| 4.7 kΩ                            | 47 kΩ                                | 10.0 V/V                   | –10.0 V/V               | 11.0 V/V                    |

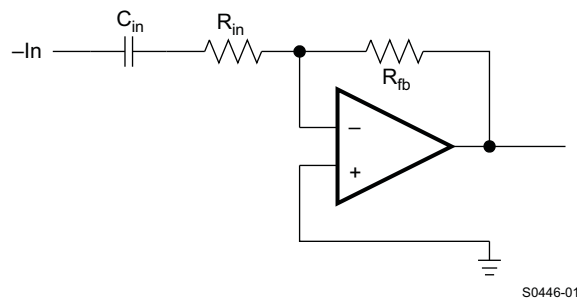


**Figure 48. Inverting Gain Configuration**

## Input-Blocking Capacitors

DC input-blocking capacitors are required to be added in series with the audio signal into the input pins of the TAS5717/9. These capacitors block the DC portion of the audio source and allow the TAS5717/9 inputs to be properly biased to provide maximum performance. The input blocking capacitors also limit the DC gain to 1, limiting the DC-offset voltage at the output.

These capacitors form a high-pass filter with the input resistor,  $R_{in}$ . The cutoff frequency is calculated using Equation 1. For this calculation, the capacitance used is the input-blocking capacitor and the resistance is the input resistor chosen from Table 25, then the frequency and/or capacitance can be determined when one of the two values is given.

$$f_{c_{in}} = \frac{1}{2\pi \times R_{in} \times C_{in}} \quad C_{in} = \frac{1}{2\pi \times f_{c_{in}} \times R_{in}} \quad (1)$$

## Using the TAS5717/9 as a 2nd order filter

Several audio DACs used today require an external low-pass filter to remove out of band noise. This is possible with the TAS5717/9 as it can be used like a standard OPAMP. Several filter topologies can be implemented both single ended and differential. In the figure below a Multi Feed Back (MFB), with differential input and single ended input is shown.

An AC-coupling capacitor to remove dc-content from the source is shown, it serves to block any dc content from the source and lowers the dc-gain to 1 helping reducing the output dc-offset to minimum.

The component values can be calculated with the help of the TI FilterPro™ program available on the TI website at:

<http://focus.ti.com/docs/toolsw/folders/print/filterpro.html>

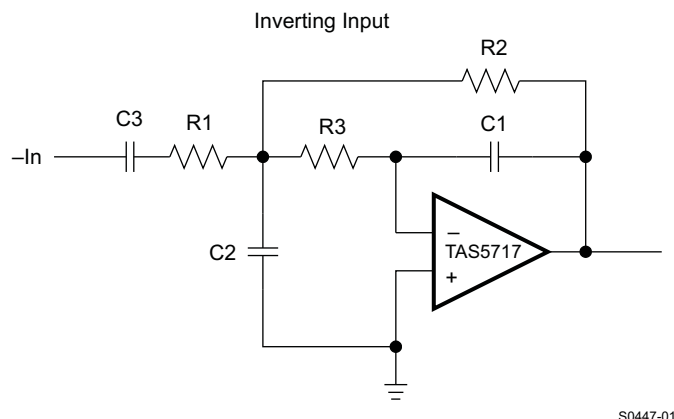


**Figure 49. Second-Order Active Low-Pass Filter**

The resistor values should have a low value for obtaining low noise, but should also have a high enough value to get a small size ac-coupling cap. C2 can be split in two with the midpoint connected to GND, this can increase the common-mode attenuation.

### Pop-Free Power Up

Pop-free power up is ensured by keeping the  $\overline{\text{HP\_SD}}$  low during power supply ramp up and down. The pin should be kept low until the input AC-coupling capacitors are fully charged before asserting the  $\overline{\text{HP\_SD}}$  pin high, this way proper pre-charge of the ac-coupling is performed and pop-less power-up is achieved. Figure 50 illustrates the preferred sequence.

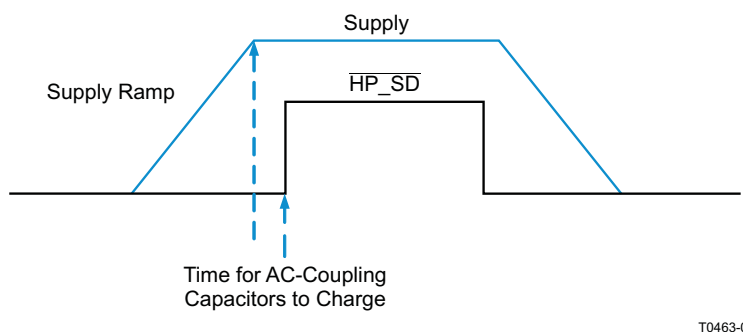


**Figure 50. Power-Up/Down Sequence**

## REVISION HISTORY

| Changes from Original (November 2010) to Revision A                                                           | Page |
|---------------------------------------------------------------------------------------------------------------|------|
| • Changed the SNR typ value from 70°C to 105°C .....                                                          | 10   |
| • Deleted sub section titled 11.12 BANK SWITCHING .....                                                       | 31   |
| • Changed <a href="#">Table 3</a> rows 0x01, 0x03, 0x0E, 0x10, 0x1A, and 0x1C Initialization Values .....     | 33   |
| • Changed <a href="#">Table 3</a> rows 0x07, 0x08, 0x09, and 0x1A No of Bytes and Initialization Values ..... | 33   |
| • Changed <a href="#">Table 3</a> row 0x46 and 0x4F Initialization Values .....                               | 36   |
| • Changed <a href="#">Table 3</a> row 0x50 register name From: Bank switch control To: EQ control .....       | 36   |
| • Changed <a href="#">Table 3</a> row 0xF9 Initialization Value .....                                         | 37   |
| • Changed Section 11.34 BANK SWITCH AND EQ CONTROL (0x50) to EQ CONTROL 90x50) .....                          | 55   |
| • Changed <a href="#">Table 24</a> . Bank Switching Command (0x50) to EQ Command (0x50) .....                 | 55   |
| • Changed the Function descriptions to: Reserved for D5, D2, D1, and D0 .....                                 | 55   |

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TAS5717PHP       | ACTIVE        | HTQFP        | PHP                | 48   | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-3-260C-168 HR  | 0 to 85      | TAS5717                 | <a href="#">Samples</a> |
| TAS5717PHPR      | ACTIVE        | HTQFP        | PHP                | 48   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-3-260C-168 HR  | 0 to 85      | TAS5717                 | <a href="#">Samples</a> |
| TAS5719PHP       | ACTIVE        | HTQFP        | PHP                | 48   | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-3-260C-168 HR  | 0 to 85      | TAS5719                 | <a href="#">Samples</a> |
| TAS5719PHPR      | ACTIVE        | HTQFP        | PHP                | 48   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-3-260C-168 HR  | 0 to 85      | TAS5719                 | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

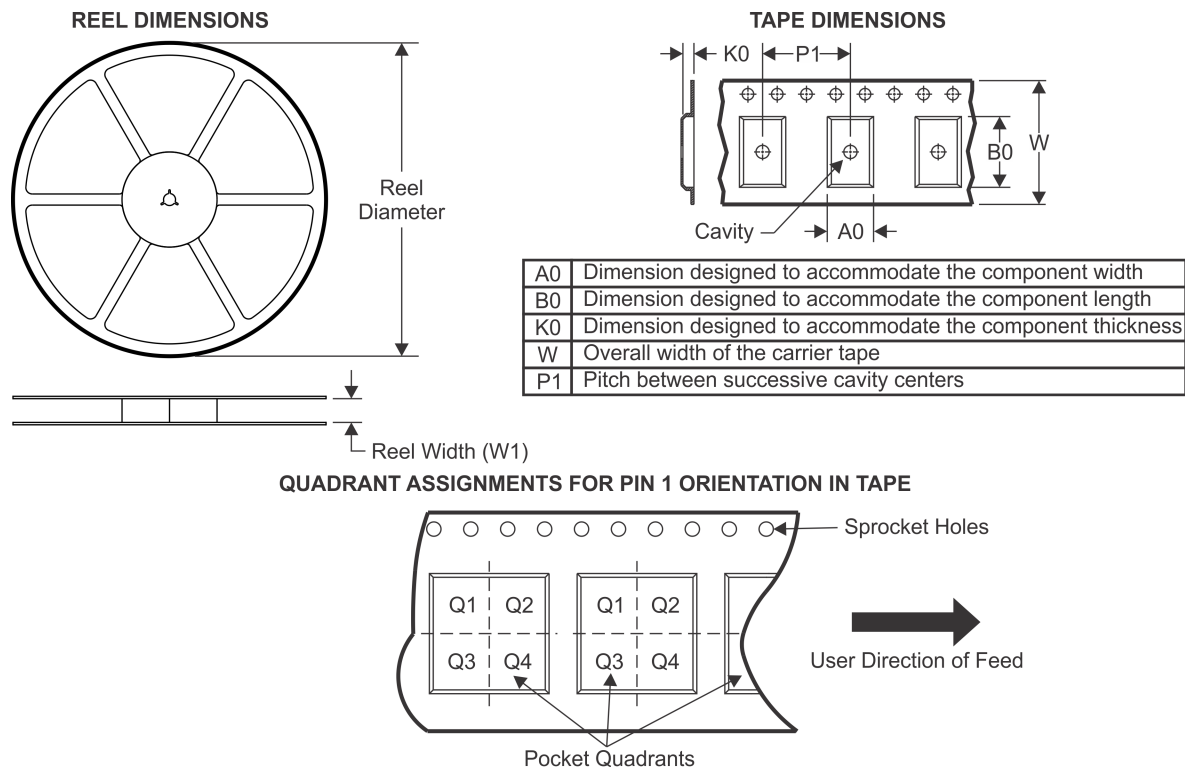
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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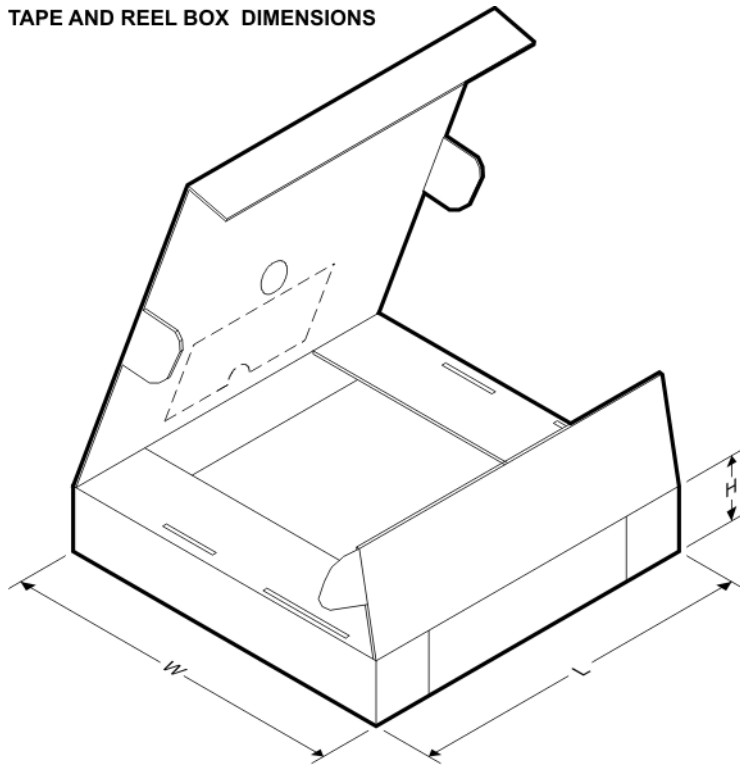
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**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TAS5717PHPR | HTQFP        | PHP             | 48   | 1000 | 330.0              | 16.4               | 9.6     | 9.6     | 1.5     | 12.0    | 16.0   | Q2            |
| TAS5719PHPR | HTQFP        | PHP             | 48   | 1000 | 330.0              | 16.4               | 9.6     | 9.6     | 1.5     | 12.0    | 16.0   | Q2            |

## TAPE AND REEL BOX DIMENSIONS

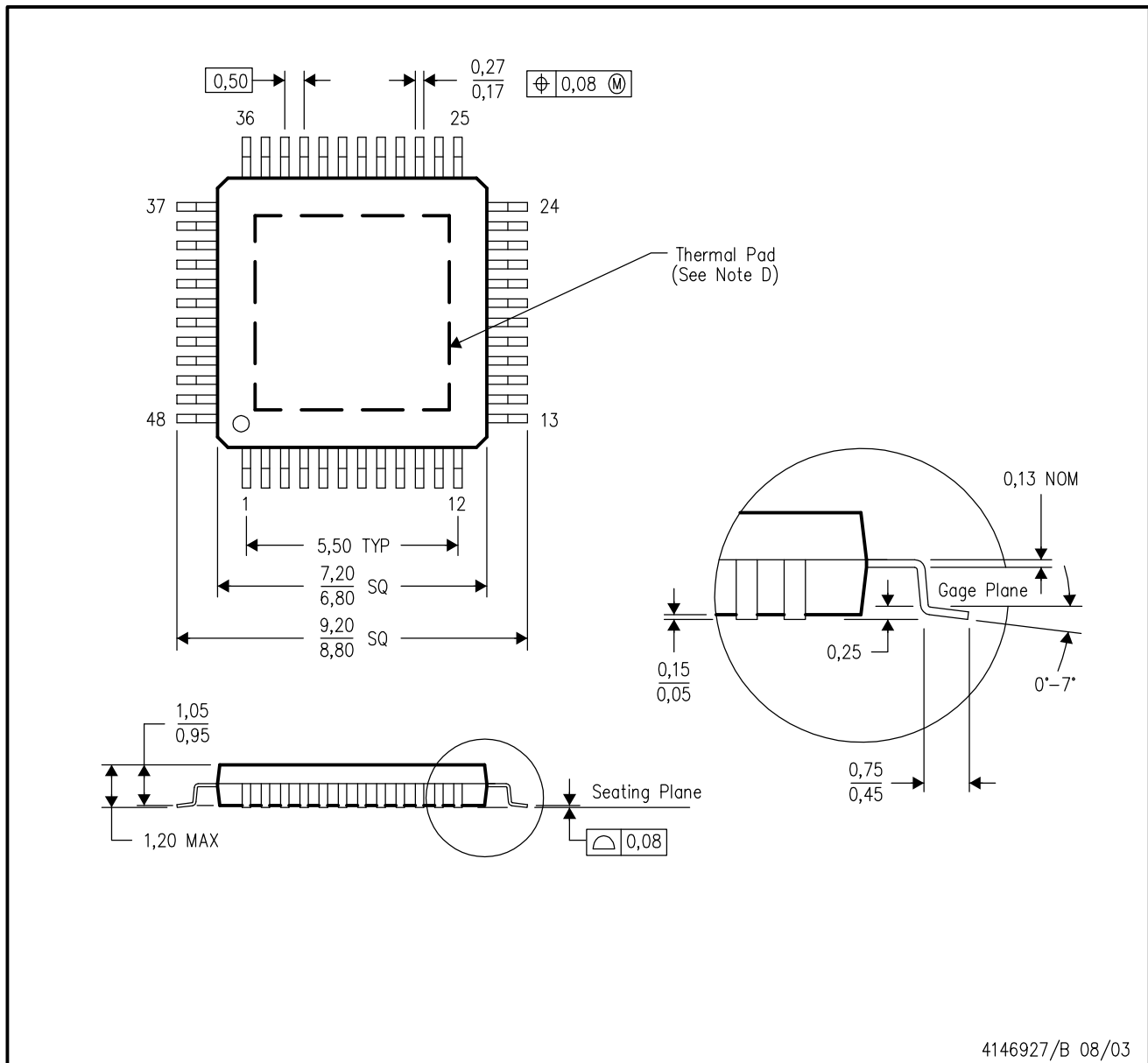


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TAS5717PHPR | HTQFP        | PHP             | 48   | 1000 | 350.0       | 350.0      | 43.0        |
| TAS5719PHPR | HTQFP        | PHP             | 48   | 1000 | 350.0       | 350.0      | 43.0        |

PHP (S-PQFP-G48)

PowerPAD™ PLASTIC QUAD FLATPACK



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion
  - D. This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 for information regarding recommended board layout. This document is available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - E. Falls within JEDEC MS-026

PowerPAD is a trademark of Texas Instruments.

PHP (S-PQFP-G48)

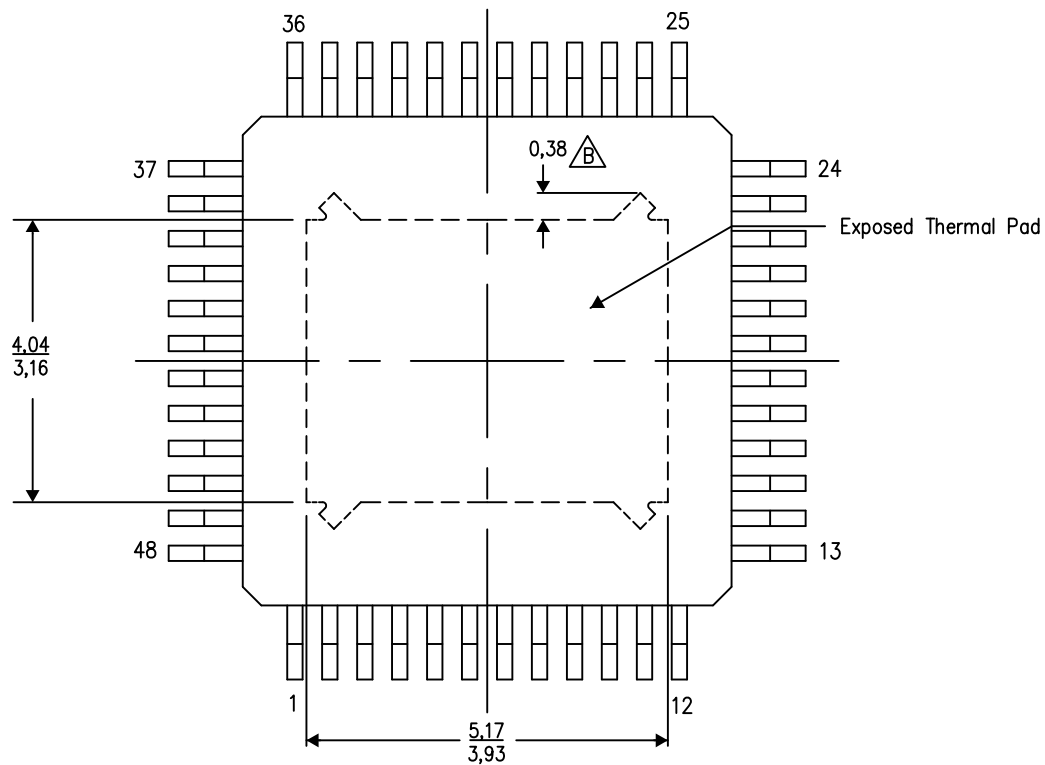
PowerPAD™ PLASTIC QUAD FLATPACK

## THERMAL INFORMATION

This PowerPAD™ package incorporates an exposed thermal pad that is designed to be attached to a printed circuit board (PCB). The thermal pad must be soldered directly to the PCB. After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For additional information on the PowerPAD package and how to take advantage of its heat dissipating abilities, refer to Technical Brief, PowerPAD Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 and Application Brief, PowerPAD Made Easy, Texas Instruments Literature No. SLMA004. Both documents are available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



4206329-9/P 03/15

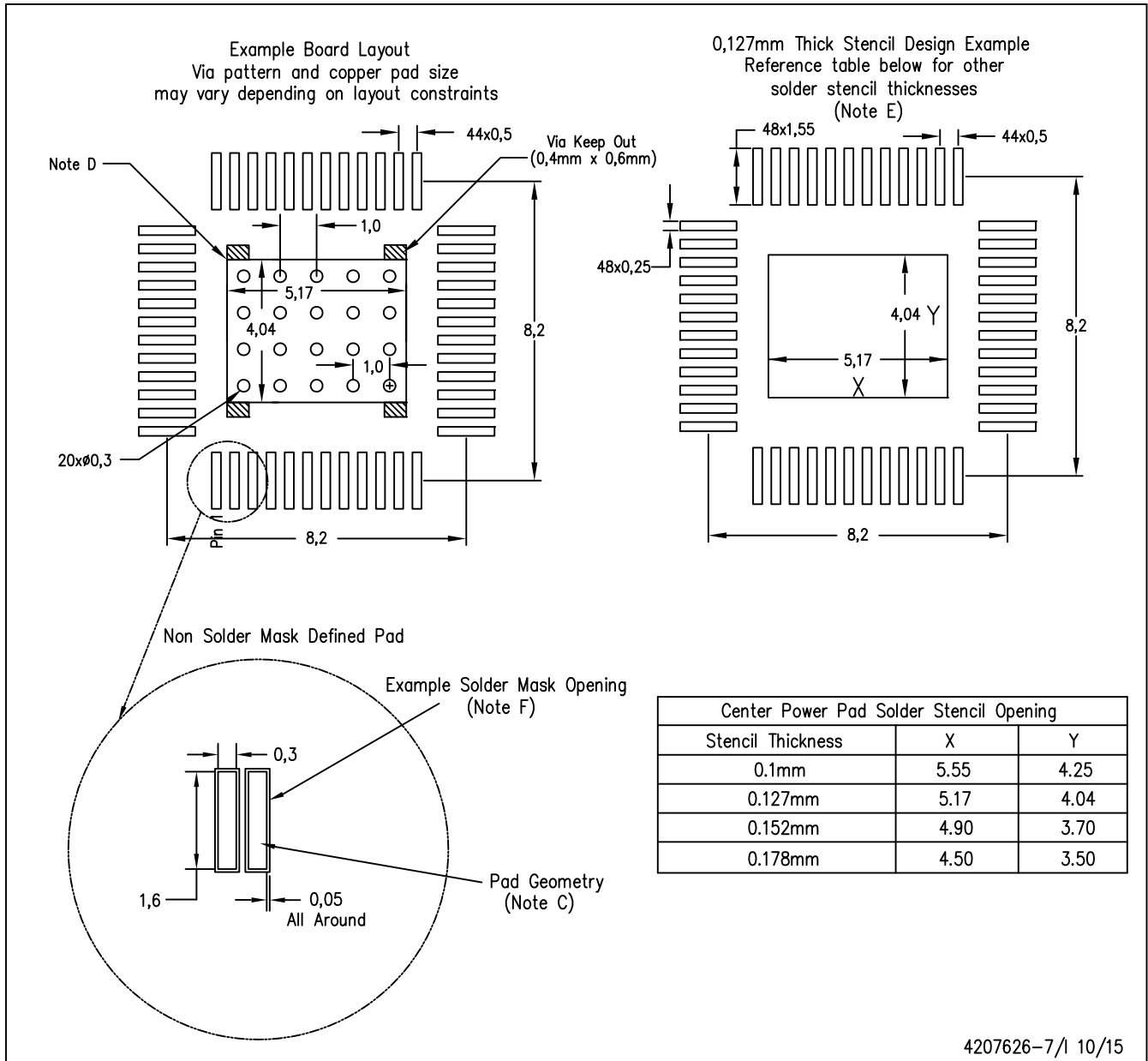
NOTE: A. All linear dimensions are in millimeters

 Tie strap features may not be present.

PowerPAD is a trademark of Texas Instruments

PHP (S-PQFP-G48)

PowerPAD™ PLASTIC QUAD FLATPACK



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad Thermally Enhanced Package, Texas Instruments Literature No. SLMA002, SLMA004, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting options for vias placed in the thermal pad.

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PHP (S-PQFP-G48)

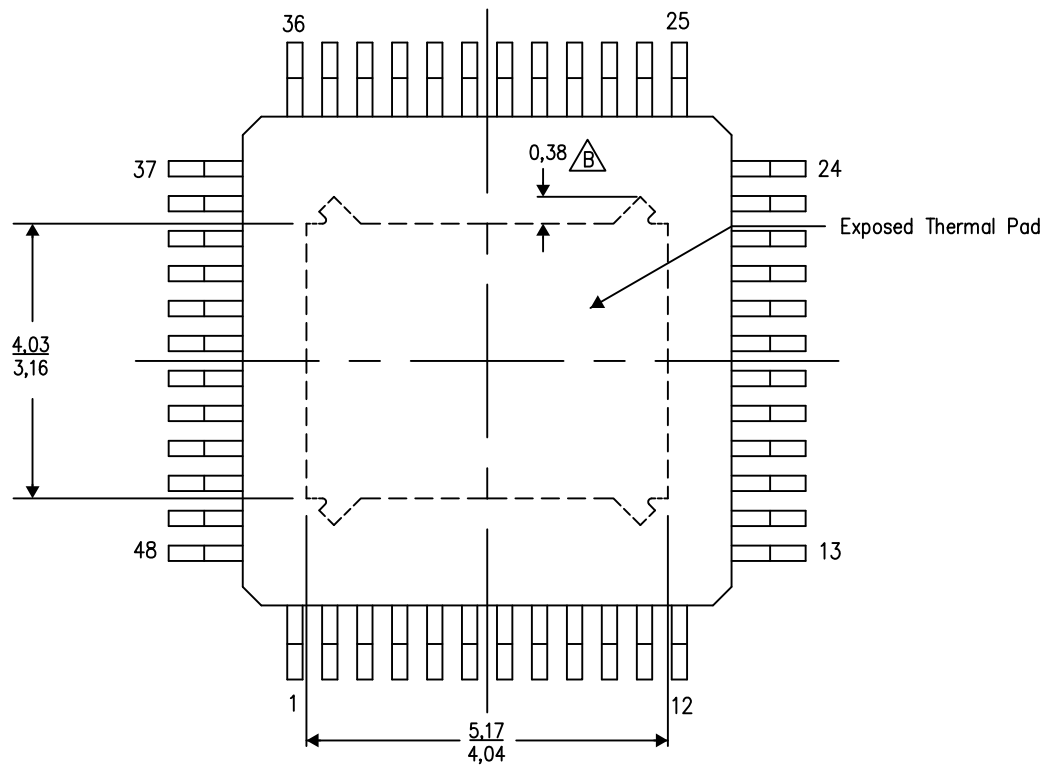
PowerPAD™ PLASTIC QUAD FLATPACK

## THERMAL INFORMATION

This PowerPAD™ package incorporates an exposed thermal pad that is designed to be attached to a printed circuit board (PCB). The thermal pad must be soldered directly to the PCB. After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

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The exposed thermal pad dimensions for this package are shown in the following illustration.



Top View

Exposed Thermal Pad Dimensions

4206329-18/P 03/15

NOTE: A. All linear dimensions are in millimeters

 Tie strap features may not be present.

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