

SINGLE-ENDED ANALOG-INPUT 16-BIT STEREO ANALOG-TO-DIGITAL CONVERTER

FEATURES

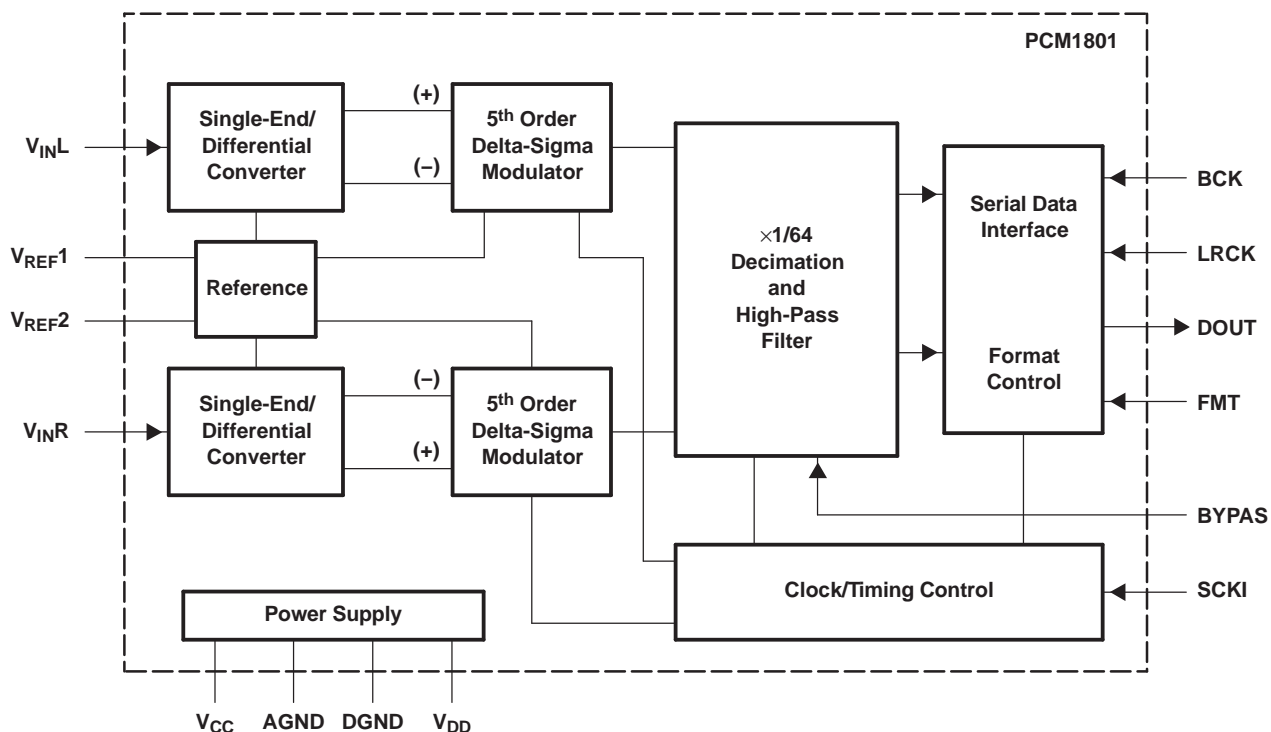
- Dual 16-Bit Monolithic $\Delta\Sigma$ ADC
- Single-Ended Voltage Input
- Antialiasing Filter Included
- **64 \times Oversampling Decimation Filter:**
Pass-Band Ripple: ± 0.05 dB
Stop-Band Attenuation: -65 dB
- **Analog Performance:**
THD+N: -88 dB (typical)
SNR: 93 dB (typical)
Dynamic Range: 93 dB (typical)
Internal High-Pass Filter
- **PCM Audio Interface:** Left-Justified, 1^2S
- **Sampling Rate:** 4 kHz to 48 kHz
- **System Clock:** 256 f_s , 384 f_s , or 512 f_s
- **Single 5-V Power Supply**
- **Small SO-14 Package**

APPLICATIONS

- DVD Recorders
- DVD Receivers
- AV Amplifier Receivers
- Electric Musical Instruments

DESCRIPTION

The PCM1801 is a low-cost, single-chip stereo analog-to-digital converter (ADC) with single-ended analog voltage inputs. The PCM1801 uses a delta-sigma modulator with 64 times oversampling, a digital decimation filter, and a serial interface that supports slave mode operation and two data formats. The PCM1801 is suitable for a wide variety of cost-sensitive consumer applications where good performance is required.



B0004-02



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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

| PRODUCT | PACKAGE TYPE | PACKAGE CODE | PACKAGE MARKING | ORDERING NUMBER | TRANSPORT MEDIA | QUANTITY |
|----------|--------------|--------------|-----------------|-----------------|-----------------|----------|
| PCM1801U | 14-pin SOIC | D | PCM1801U | PCM1801U | Rails | 56 |
| | | | | PCM1801U/2K | Tape and reel | 2000 |

ABSOLUTE MAXIMUM RATINGS

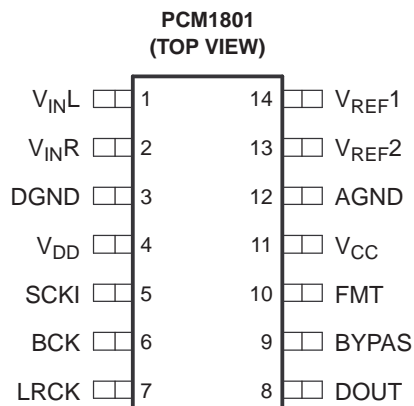
| | |
|---|--|
| Supply voltage: V_{DD} , V_{CC} | –0.3 V to 6.5 V |
| Supply voltage differences: V_{DD} , V_{CC} | ±0.1 V |
| GND voltage differences: AGND, DGND | ±0.1 V |
| Digital input voltage | –0.3 V to ($V_{DD} + 0.3$ V), < 6.5 V |
| Analog input voltage | –0.3 V to ($V_{CC} + 0.3$ V), < 6.5 V |
| Input current (any pin except supplies) | ±10 mA |
| Power dissipation | 300 mW |
| Operating temperature range | –25°C to 85°C |
| Storage temperature | –55°C to 125°C |
| Lead temperature, soldering | 260°C, 5 s |
| Package temperature (IR reflow, peak) | 235°C |

RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range

| | | MIN | NOM | MAX | UNIT |
|--|----------------|-------|--------|-----|------|
| Analog supply voltage, V_{CC} | | 4.5 | 5 | 5.5 | V |
| Digital supply voltage, V_{DD} | | 4.5 | 5 | 5.5 | V |
| Analog input voltage, full-scale (–0 dB) | | 2.828 | | | Vp-p |
| Digital input logic family | | TTL | | | |
| Digital input clock frequency | System clock | 8.192 | 24.576 | | MHz |
| | Sampling clock | 32 | 48 | | kHz |
| Digital output load capacitance | | 10 | | | pF |
| Operating free-air temperature, T_A | | –25 | 85 | | °C |

PIN CONFIGURATION



P0005-01

Table 1. PIN ASSIGNMENTS

| NAME | PIN | I/O | DESCRIPTION |
|------------|-----|-----|---|
| AGND | 12 | – | Analog ground |
| BCK | 6 | I | Bit clock input |
| BYPAS | 9 | I | HPF bypass control ⁽¹⁾ L: HPF enabled H: HPF disabled |
| DGND | 3 | – | Digital ground |
| DOUT | 8 | O | Audio data output |
| FMT | 10 | I | Audio data format ⁽¹⁾ L: MSB-first, left-justified H: MSB-first, I ² S |
| LRCK | 7 | I | Sampling clock input |
| SCKI | 5 | I | System clock input; 256 f _S , 384 f _S , or 512 f _S |
| V_{CC} | 11 | – | Analog power supply |
| V_{DD} | 4 | – | Digital power supply |
| V_{INL} | 1 | I | Analog input, Lch |
| V_{INR} | 2 | I | Analog input, Rch |
| V_{REF1} | 14 | – | Reference 1 decoupling capacitor |
| V_{REF2} | 13 | – | Reference 2 decoupling capacitor |

(1) With 100-k Ω typical pulldown resistor

ELECTRICAL CHARACTERISTICS

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, 16-bit data, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted.

| PARAMETER | | TEST CONDITIONS | PCM1801U | | | UNITS |
|--|-----------------------------------|-------------------------------|-------------|-------------|-------------|------------------------------|
| | | | MIN | TYP | MAX | |
| RESOLUTION | | | 16 | | | Bits |
| DIGITAL INPUT/OUTPUT | | | | | | |
| $V_{IH}^{(1)}$ | Input logic level | | 2 | | | VDC |
| $V_{IL}^{(1)}$ | | | | | 0.8 | |
| $I_{IN}^{(2)}$ | Input logic current | | | | ± 10 | μA |
| $I_{IN}^{(3)}$ | | | | | 100 | |
| $V_{OH}^{(4)}$ | Output logic level | $I_{OH} = -1.6\text{ mA}$ | 4.5 | | | VDC |
| $V_{OL}^{(4)}$ | | $I_{OL} = 3.2\text{ mA}$ | | | 0.5 | |
| f_S | Sampling frequency | | 4 | 44.1 | 48 | kHz |
| | System clock frequency | $256 f_S$ | 1.024 | 11.2896 | 12.288 | MHz |
| | | $384 f_S$ | 1.536 | 16.9344 | 18.432 | |
| | | $512 f_S$ | 2.048 | 22.5792 | 24.576 | |
| DC ACCURACY | | | | | | |
| | Gain mismatch, channel-to-channel | | | ± 1 | ± 2.5 | % of FSR |
| | Gain error | | | ± 2 | ± 5 | % of FSR |
| | Gain drift | | | ± 20 | | ppm of FSR/ $^\circ\text{C}$ |
| | Bipolar zero error | High-pass filter bypassed | | ± 2 | | % of FSR |
| | Bipolar zero drift | High-pass filter bypassed | | ± 20 | | ppm of FSR/ $^\circ\text{C}$ |
| DYNAMIC PERFORMANCE⁽⁵⁾ | | | | | | |
| THD+N | | FS (-0.5 dB) | | -88 | -80 | dB |
| | | -60 dB | | -90 | | |
| Dynamic range | | A-weighted | 90 | 93 | | dB |
| Signal-to-noise ratio | | A-weighted | 90 | 93 | | dB |
| Channel separation | | | 87 | 90 | | dB |
| ANALOG INPUT | | | | | | |
| Input range | | FS ($V_{IN} = 0\text{ dB}$) | | 2.828 | | Vp-p |
| Center voltage | | | | 2.1 | | V |
| Input impedance | | | | 30 | | k Ω |
| Antialiasing filter frequency response | | -3 dB | | 150 | | kHz |
| DIGITAL FILTER PERFORMANCE | | | | | | |
| Pass band | | | | | $0.454 f_S$ | Hz |
| Stop band | | | $0.583 f_S$ | | | Hz |
| Pass-band ripple | | | | | ± 0.05 | dB |
| Stop-band attenuation | | | -65 | | | dB |
| Delay time (latency) | | | | $17.4/f_S$ | | s |
| High-pass frequency response | | -3 dB | | $0.019 f_S$ | | mHz |

(1) Pins 5, 6, 7, 9, and 10 (SCKI, BCK, LRCK, BYPAS, and FMT)

(2) Pins 5, 6, 7 (SCKI, BCK, LRCK) Schmitt-trigger input

(3) Pins 9, 10 (BYPAS, FMT) Schmitt-trigger input with 100-k Ω typical pulldown resistor

(4) Pin 8 (DOUT)

(5) $f_{IN} = 1\text{ kHz}$, using the System Two™ audio measurement system by Audio Precision™ in rms mode with 20-kHz LPF and 400-Hz HPF in the performance calculation.

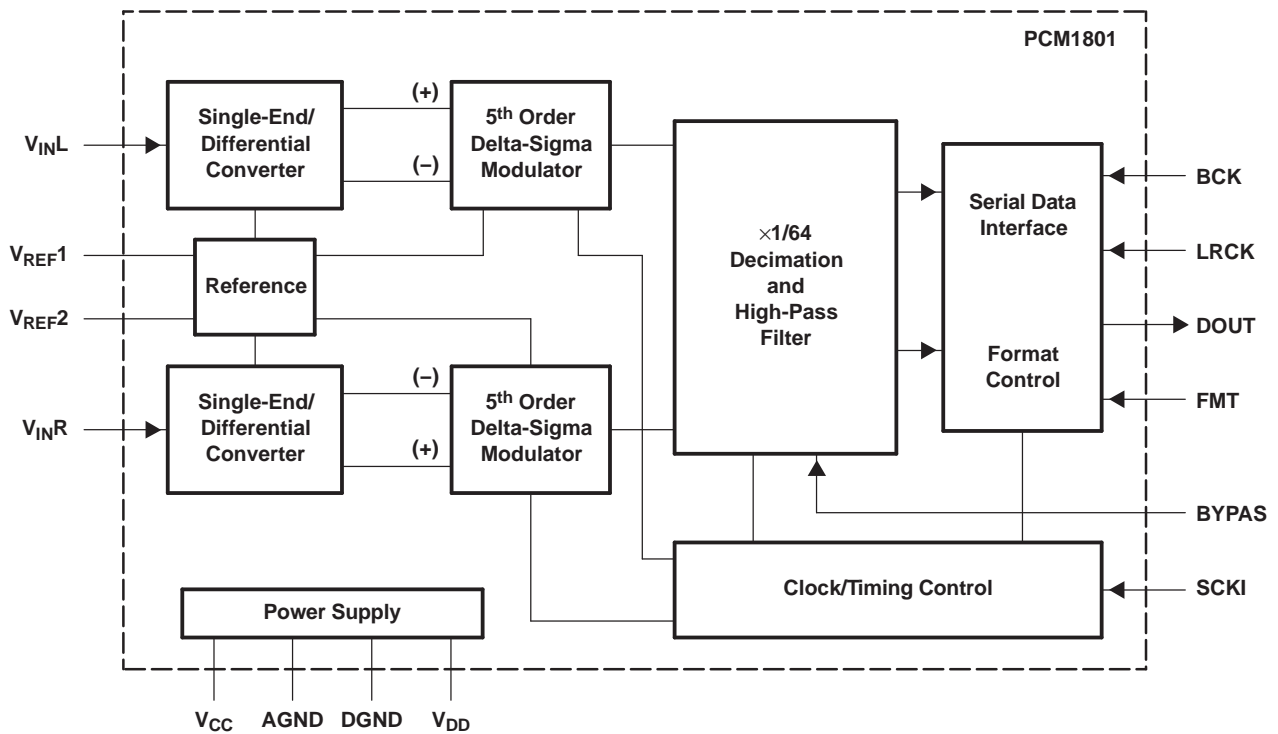
ELECTRICAL CHARACTERISTICS (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, 16-bit data, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted.

| PARAMETER | | TEST CONDITIONS | PCM1801U | | | UNITS |
|----------------------------------|-------------------------------|--------------------------------|----------|-----|-----|--------------------|
| | | | MIN | TYP | MAX | |
| POWER SUPPLY REQUIREMENTS | | | | | | |
| V_{CC} | Voltage range | | 4.5 | 5 | 5.5 | VDC |
| V_{DD} | | | 4.5 | 5 | 5.5 | |
| | Supply current ⁽⁶⁾ | $V_{CC} = V_{DD} = 5\text{ V}$ | | 18 | 24 | mA |
| | Power dissipation | $V_{CC} = V_{DD} = 5\text{ V}$ | | 90 | 120 | mW |
| TEMPERATURE RANGE | | | | | | |
| T_A | Operation | | -25 | | 85 | $^\circ\text{C}$ |
| T_{stg} | Storage | | -55 | | 125 | $^\circ\text{C}$ |
| θ_{JA} | Thermal resistance | | | 100 | | $^\circ\text{C/W}$ |

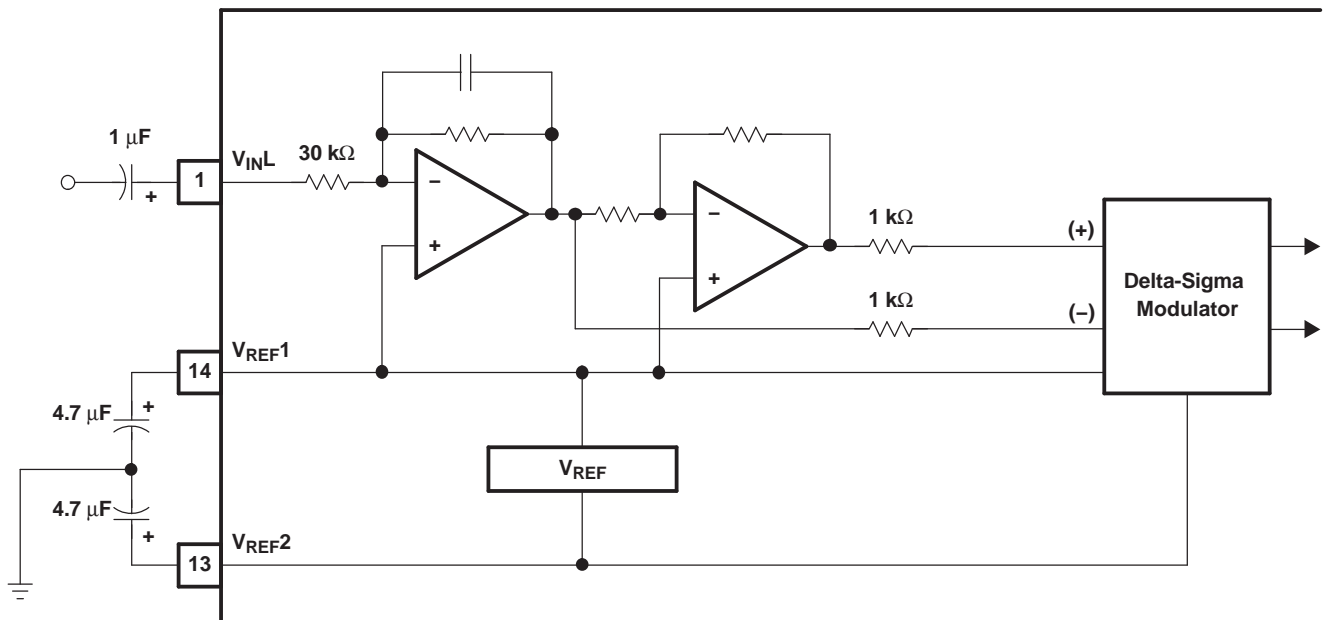
(6) No load on DOUT (pin 8)

BLOCK DIAGRAM



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ANALOG FRONT-END (Single Channel)

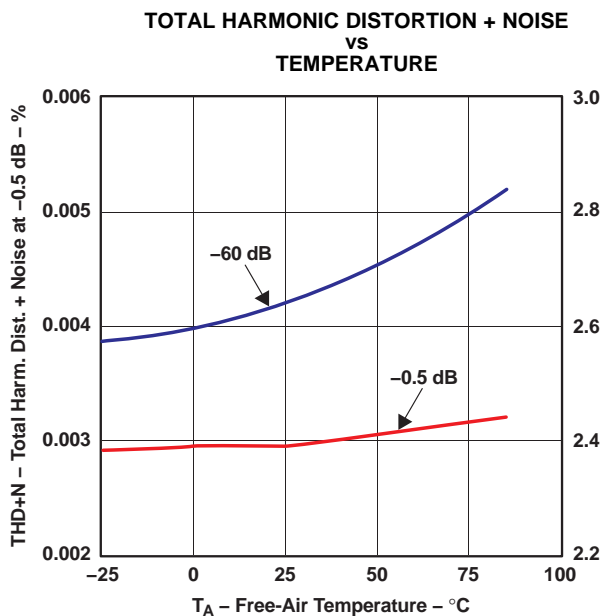


S0011-02

TYPICAL PERFORMANCE CURVES

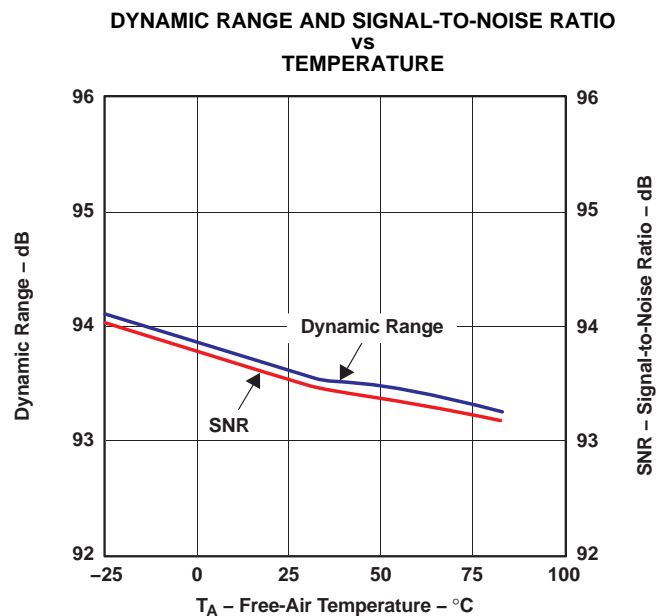
All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted

ANALOG DYNAMIC PERFORMANCE



G001

Figure 1.



G002

Figure 2.

TYPICAL PERFORMANCE CURVES (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted

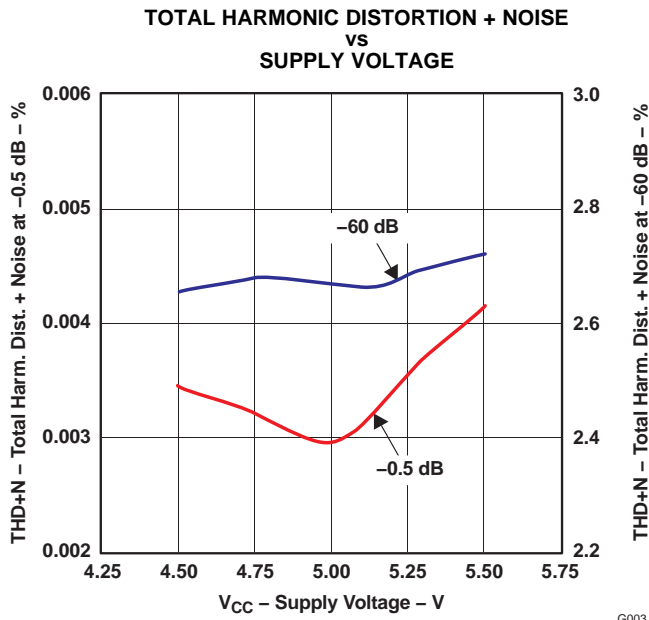


Figure 3.

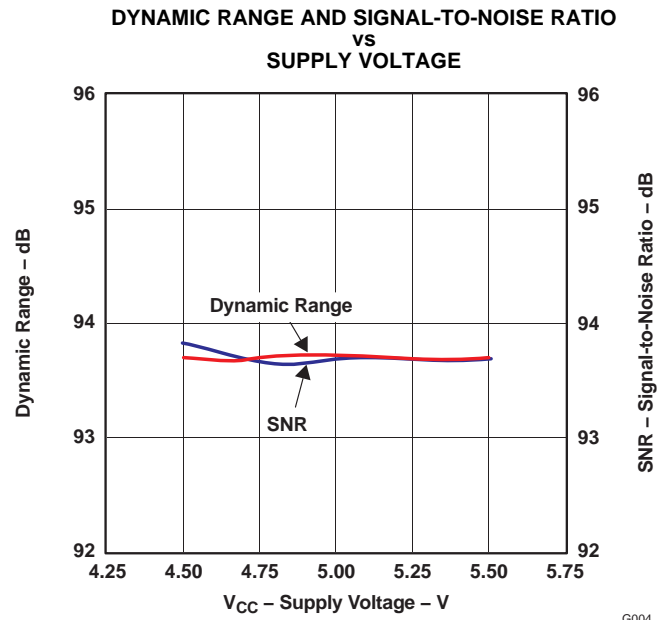


Figure 4.

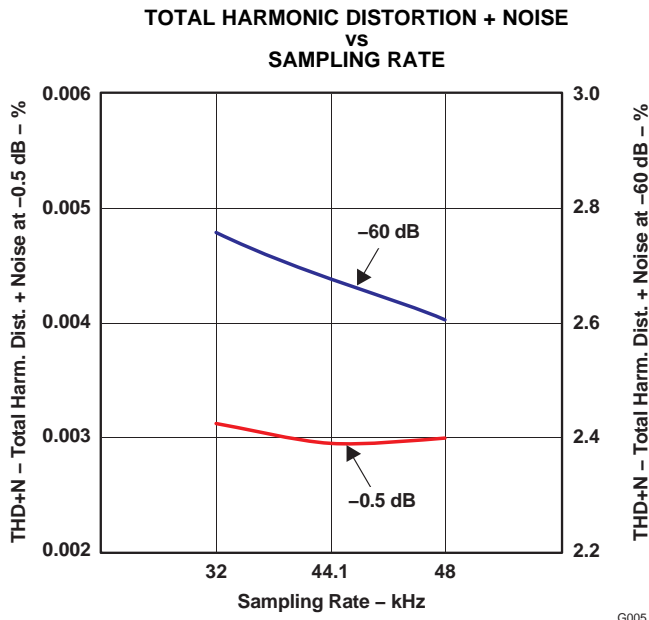


Figure 5.

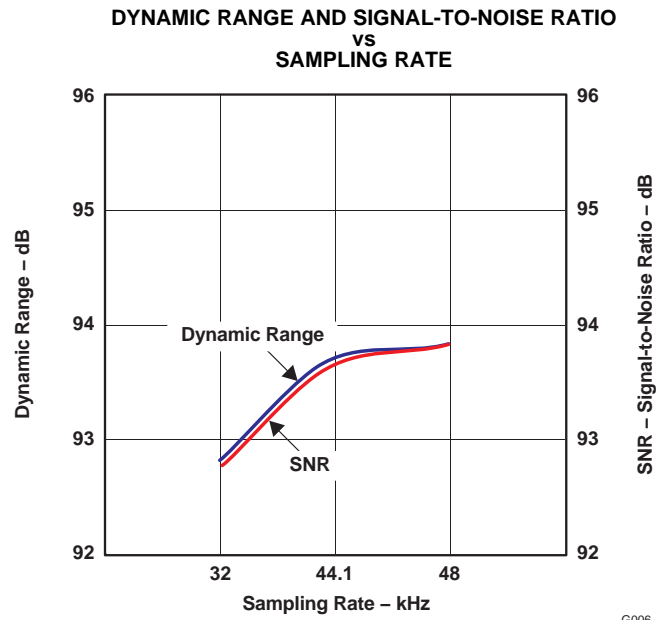


Figure 6.

TYPICAL PERFORMANCE CURVES (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_s = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384\text{ f}_s$, unless otherwise noted

SUPPLY CURRENT

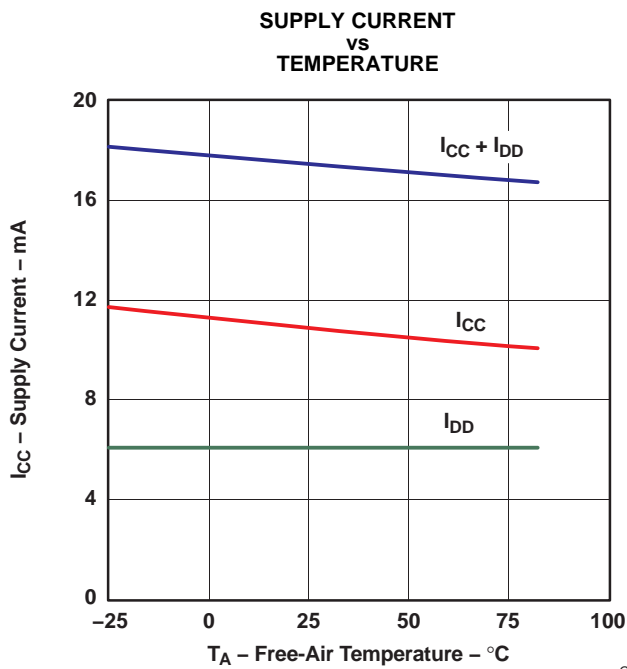


Figure 7.

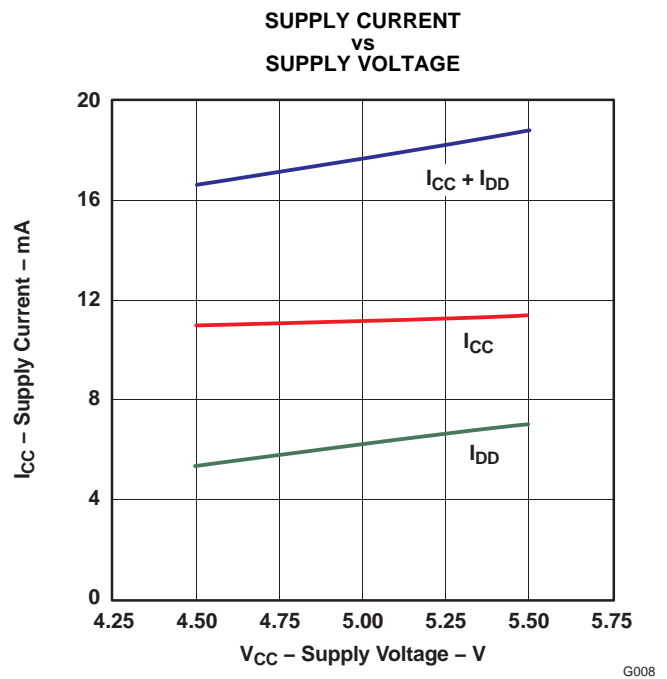


Figure 8.

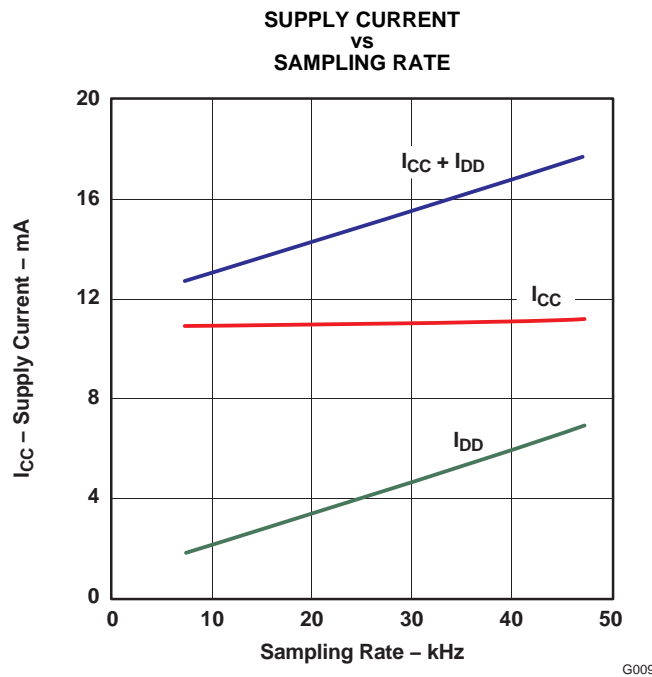


Figure 9.

TYPICAL PERFORMANCE CURVES (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted

OUTPUT SPECTRUM

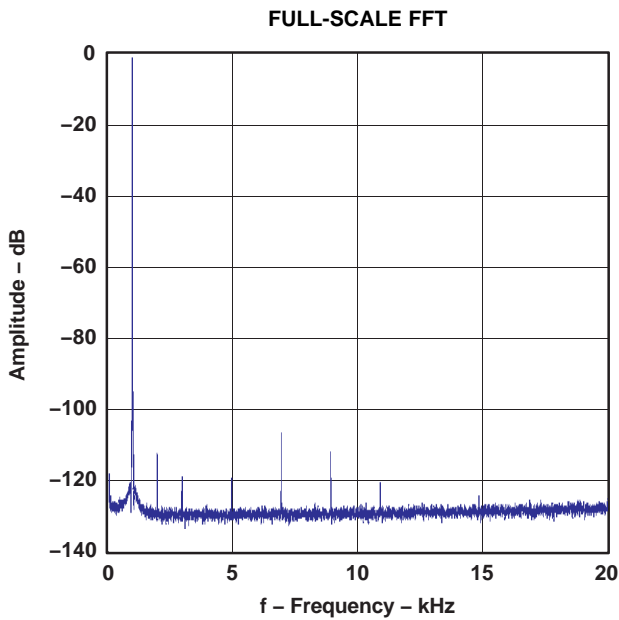


Figure 10.

G010

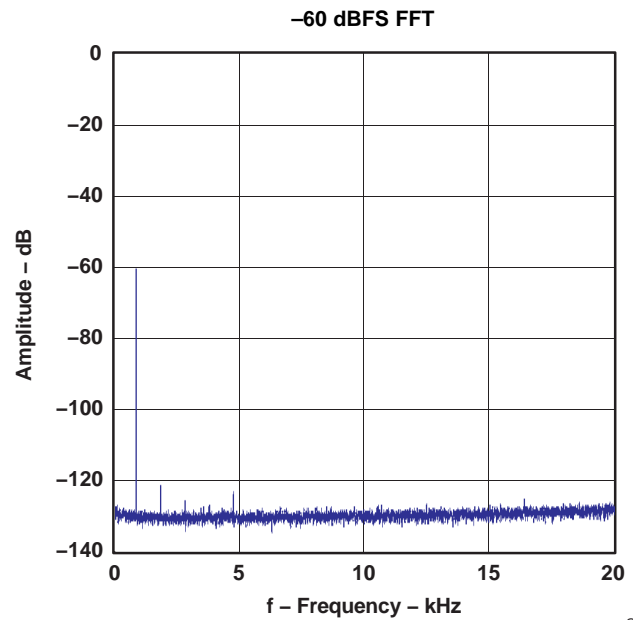


Figure 11.

G011

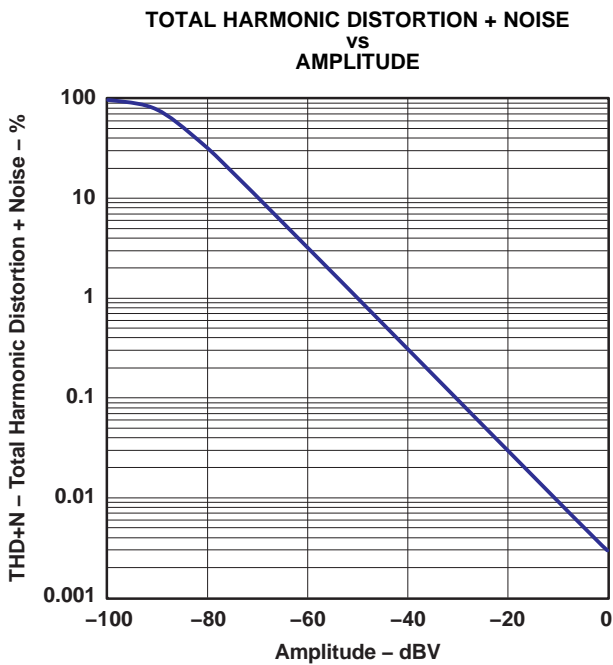


Figure 12.

G012

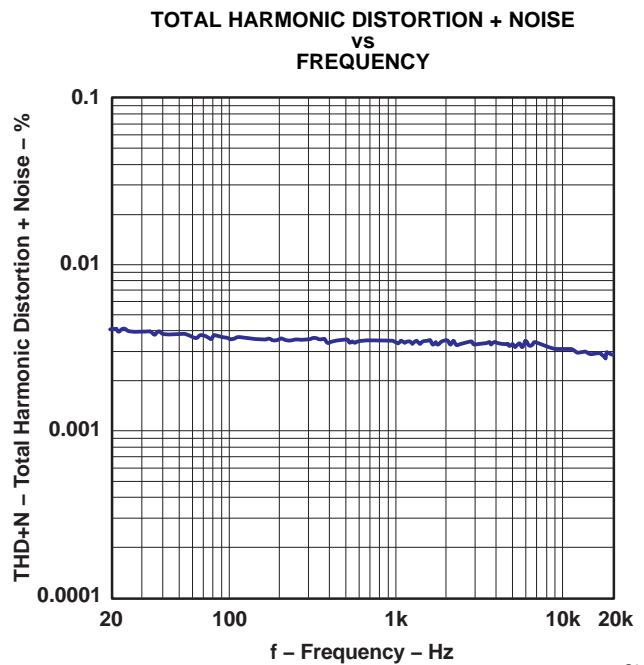


Figure 13.

G013

TYPICAL PERFORMANCE CURVES (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted

DECIMATION FILTER

OVERALL CHARACTERISTICS

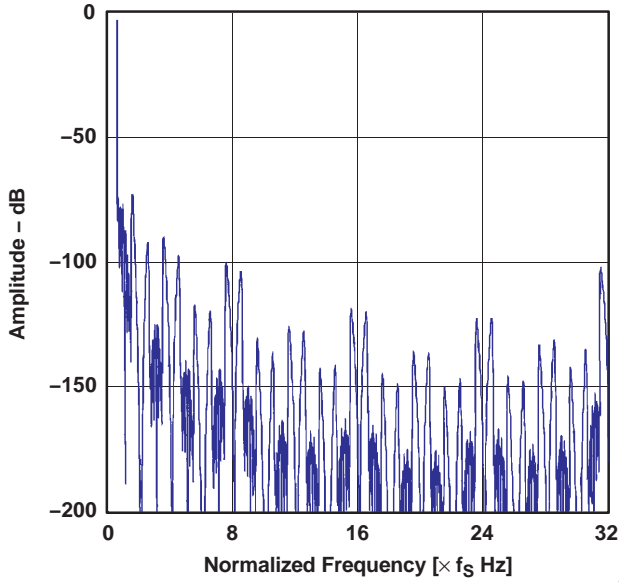


Figure 14.

STOP-BAND ATTENUATION CHARACTERISTICS

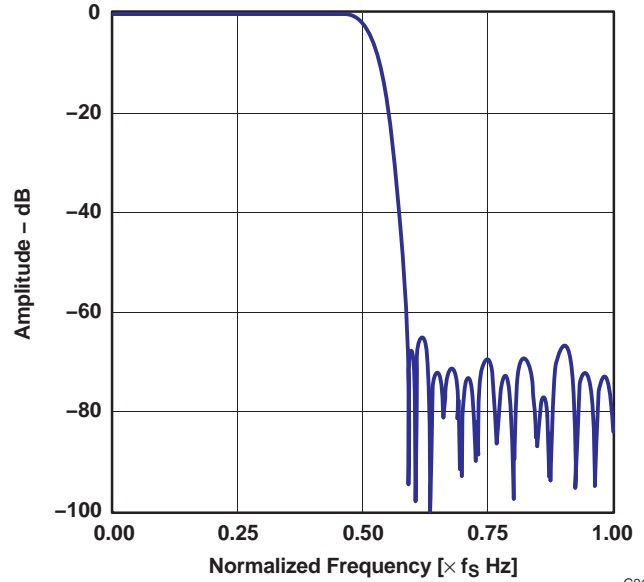


Figure 15.

PASS-BAND RIPPLE CHARACTERISTICS

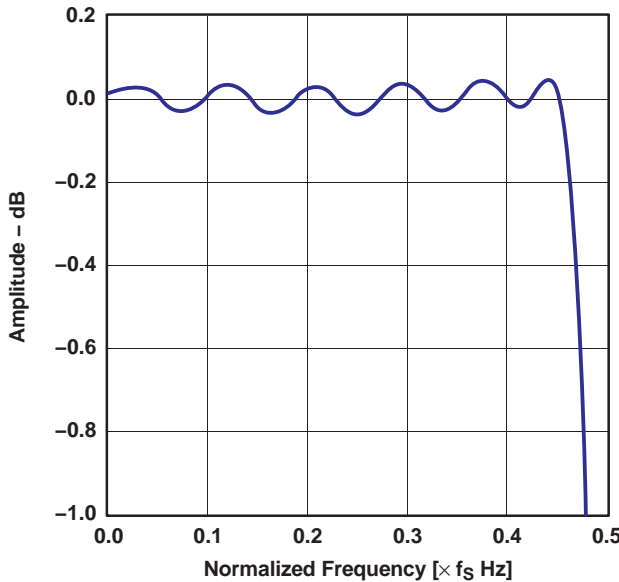


Figure 16.

TRANSITION BAND CHARACTERISTICS

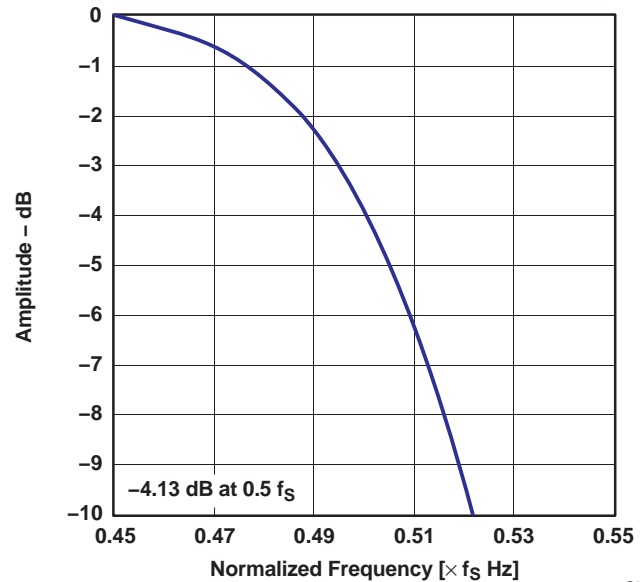


Figure 17.

TYPICAL PERFORMANCE CURVES (continued)

All specifications at $T_A = 25^\circ\text{C}$, $V_{DD} = V_{CC} = 5\text{ V}$, $f_S = 44.1\text{ kHz}$, and $\text{SYSCLK} = 384 f_S$, unless otherwise noted

HIGH-PASS FILTER

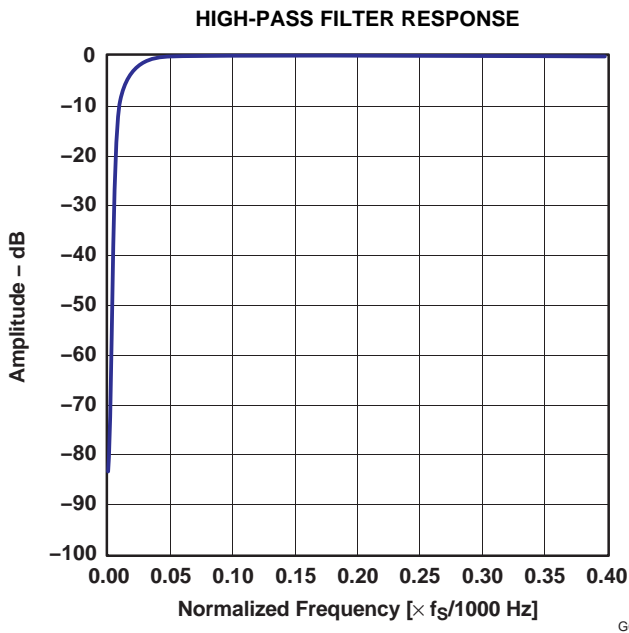


Figure 18.

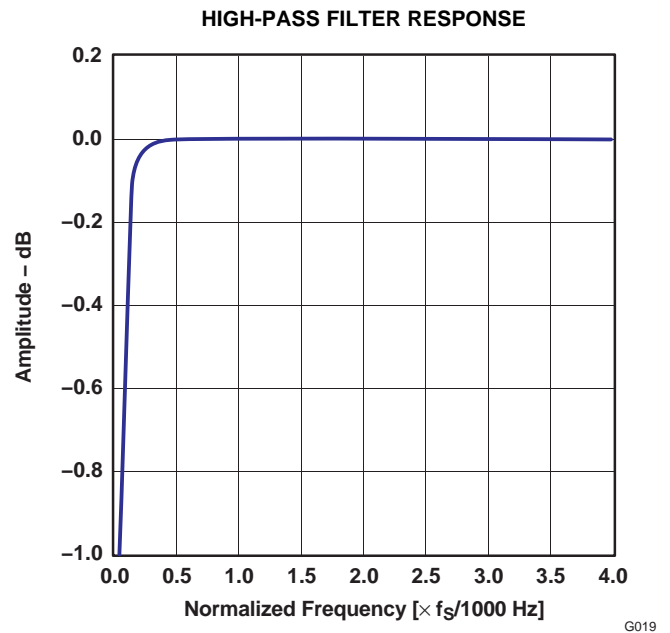


Figure 19.

ANTI_ALIASING FILTER

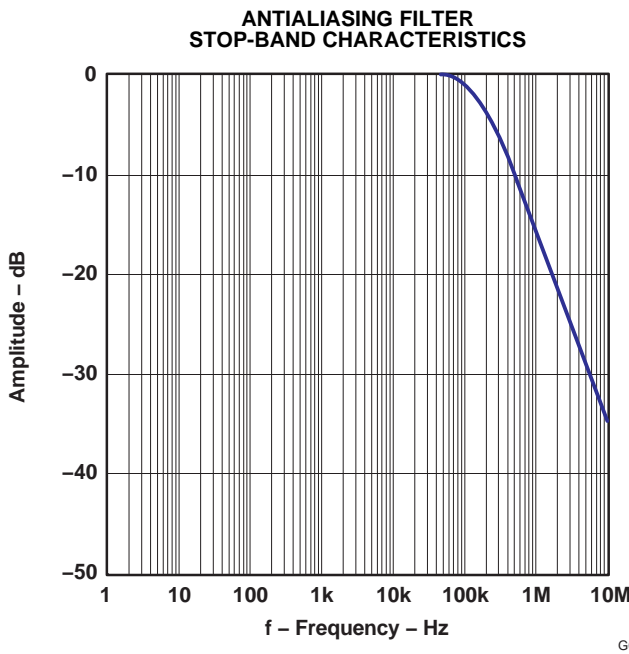


Figure 20.

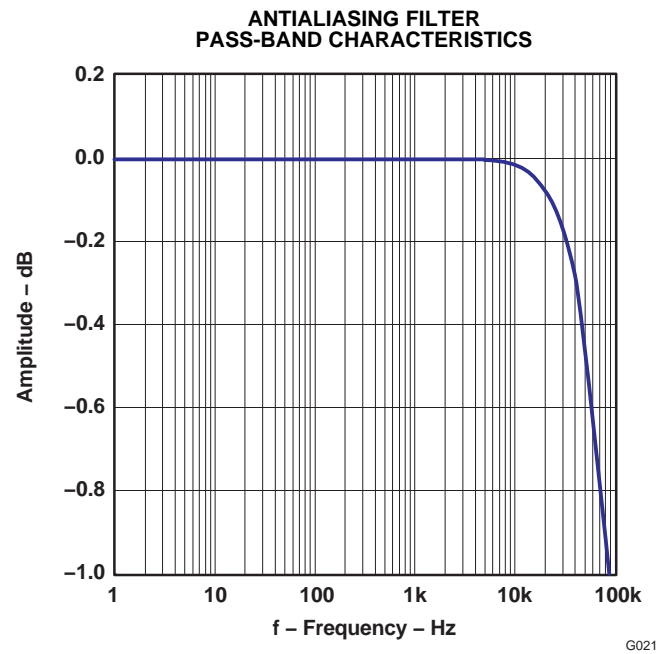


Figure 21.

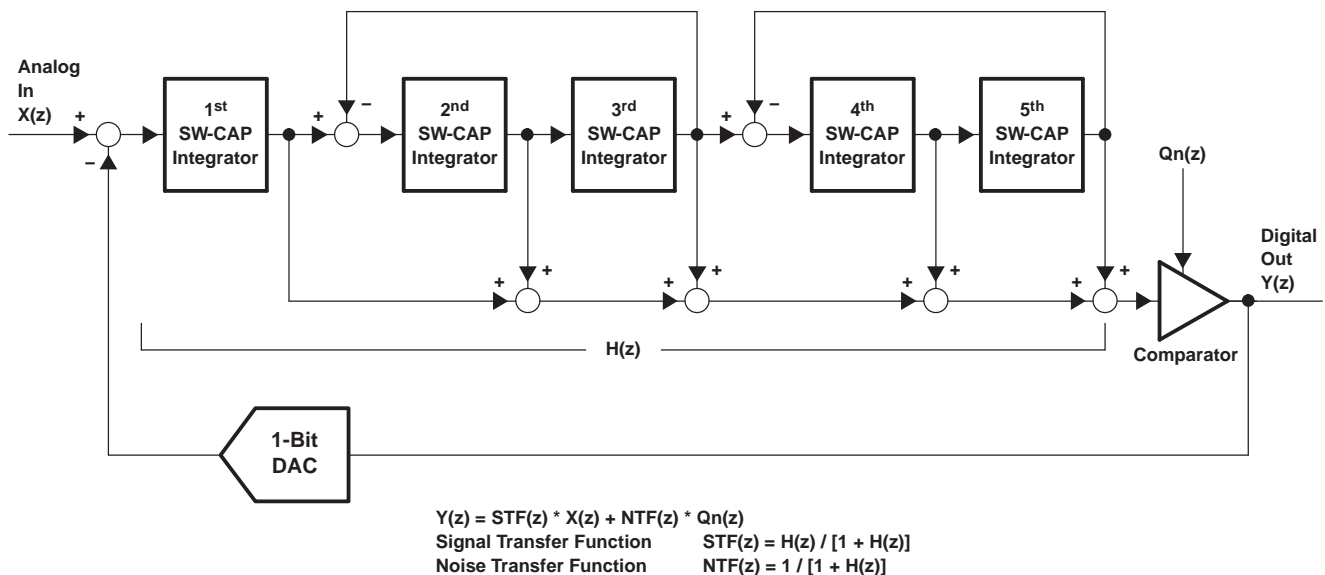
THEORY OF OPERATION

The PCM1801 consists of a band-gap reference, two channels of a single-to-differential converter, a fully differential 5th-order delta-sigma modulator, a decimation filter (including digital high-pass), and a serial interface circuit. The block diagram illustrates the total architecture of the PCM1801, and the analog front-end diagram illustrates the architecture of the single-to-differential converter and the antialiasing filter. Figure 22 illustrates the architecture of the 5th-order delta-sigma modulator and transfer functions.

An internal high-precision reference with two external capacitors provides all reference voltages which are required by the converter, and defines the full-scale voltage range of both channels. The internal single-ended to differential voltage converter saves the design, space, and extra parts needed for external circuitry required by many delta-sigma converters. The internal full-differential architecture provides a wide dynamic range and excellent power-supply rejection performance.

The input signal is sampled at a $64\times$ oversampling rate, eliminating the need for a sample-and-hold circuit and simplifying antialias filtering requirements. The 5th-order delta-sigma noise shaper consists of five integrators which use a switched-capacitor topology, a comparator, and a feedback loop consisting of a 1-bit digital-to-analog converter (DAC). The delta-sigma modulator shapes the quantization noise, shifting it out of the audio band in the frequency domain. The high order of the modulator enables it to randomize the modulator outputs, reducing idle tone levels.

The $64-f_s$, 1-bit stream from the modulator is converted to $1-f_s$, 16-bit digital data by the decimation filter, which also acts as a low-pass filter to remove the shaped quantization noise. The dc components are removed by a digital high-pass filter, and the filtered output is converted to time-multiplexed serial signals through a serial interface which provides flexible serial formats.



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Figure 22. Simplified Diagram of the PCM1801 5th-Order Delta-Sigma Modulator

SYSTEM CLOCK

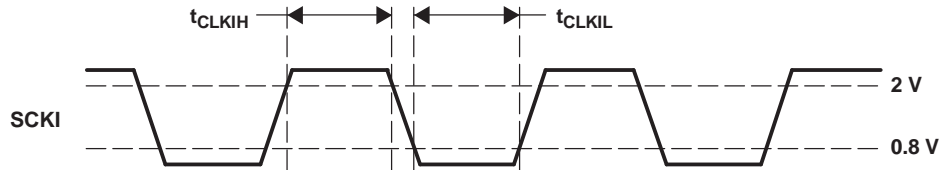
The system clock for the PCM1801 must be either $256 f_s$, $384 f_s$, or $512 f_s$, where f_s is the audio sampling frequency. The system clock must be supplied on SCK1 (pin 5).

The PCM1801 also has a system clock detection circuit that automatically senses if the system clock is operating at $256 f_s$, $384 f_s$, or $512 f_s$.

When a $384-f_s$ or $512-f_s$ system clock is used, the PCM1801 automatically divides the clock down to $256 f_s$ internally. This $256-f_s$ clock is used to operate the digital filter and the modulator. Table 2 lists the relationship of typical sampling frequencies and system clock frequencies. Figure 23 illustrates the system clock timing.

Table 2. System Clock Frequencies

| SAMPLING RATE FREQUENCY (kHz) | SYSTEM CLOCK FREQUENCY | | |
|----------------------------------|------------------------|-----------|-----------|
| | 256 f_s | 384 f_s | 512 f_s |
| 32 | 8.1920 | 12.2880 | 16.3840 |
| 44.1 | 11.2896 | 16.9344 | 22.5792 |
| 48 | 12.2880 | 18.4320 | 24.5760 |



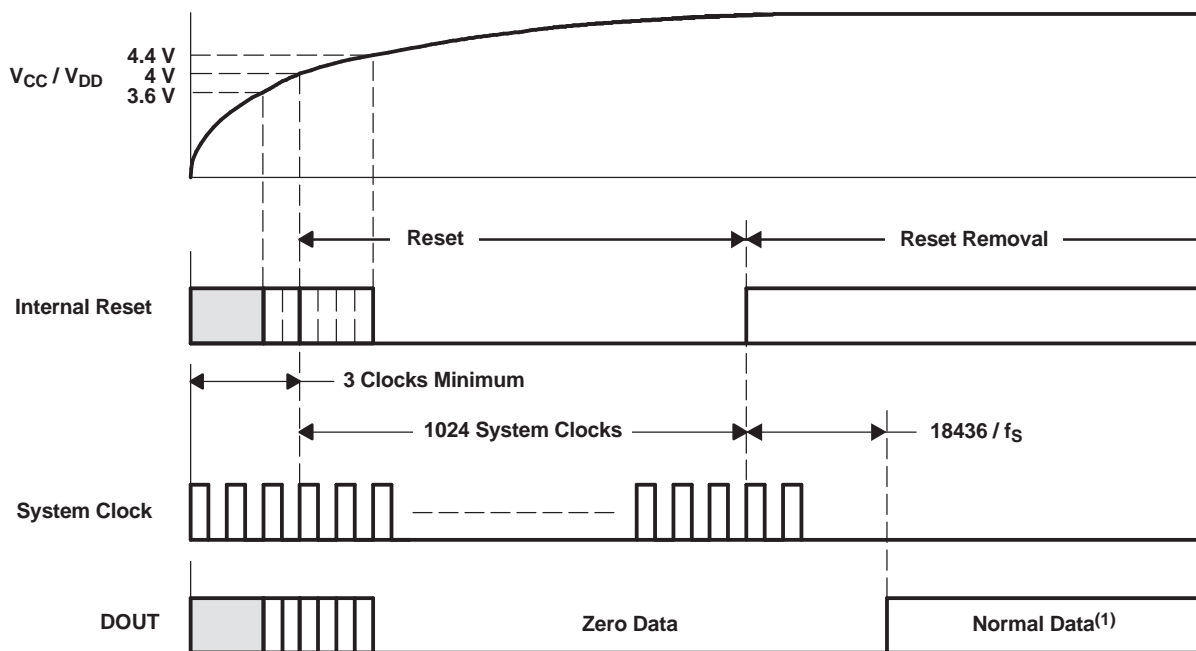
T0005-04

| | | |
|-----------------------------------|-------------|-------------|
| System clock pulse duration, HIGH | t_{CLKIH} | 12 ns (min) |
| System clock pulse duration, LOW | t_{CLKIL} | 12 ns (min) |

Figure 23. System Clock Timing

POWER-ON RESET

The PCM1801 has an internal power-on reset circuit, which initializes (resets) when the supply voltage (V_{CC}/V_{DD}) exceeds 4 V (typical). Because the system clock is used as the clock signal for the reset circuit, the system clock must be supplied as soon as power is applied; more specifically, the device must receive at least three system clock cycles before $V_{DD} > 4$ V. While $V_{CC}/V_{DD} < 4$ V (typical) and for 1024 system clock cycles after $V_{CC}/V_{DD} > 4$ V, the PCM1801 stays in the reset state and the digital output is forced to zero. The digital output is valid 18,436 f_s periods after release from the reset state. Figure 24 illustrates the internal power-on reset timing and the digital output for power-on reset.



T0014-02

- (1) The transient response (exponentially attenuated signal from $\pm 0.2\%$ dc of FSR with a 200-ms time constant) appears initially.

Figure 24. Internal Power-On Reset Timing

SERIAL AUDIO DATA INTERFACE

The PCM1801 interfaces the audio system through BCK (pin 6), LRCK (pin 7), and DOUT (pin 8).

The PCM1801 accepts 64-BCK/LRCK, 48-BCK/LRCK (only for a 384- f_s system clock) or 32-BCK/LRCK format for the left-justified format. And the PCM1801 accepts the 64-BCK/LRCK or 48-BCK/LRCK format (only for a 384- f_s system clock) for I²S format.

DATA FORMAT

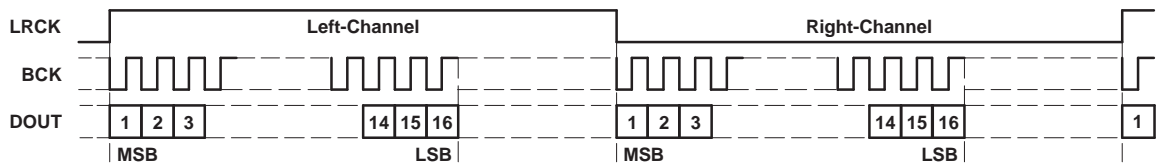
The PCM1801 supports two audio data formats in slave mode, which are selected by the FMT control input (pin 10) as shown in Table 3. Figure 25 illustrates the data format. If the application system cannot ensure an effective system clock prior to power up of the PCM1801, the FMT pin must be held LOW until the power-on reset sequence is completed. In this case, if the I²S format (FMT = HIGH) is required in the application, FMT can be set HIGH after the power-on reset sequence is completed.

Table 3. Data Format

| FMT | DATA FORMAT |
|-------|--------------------------|
| 0 (L) | 16-bit, left-justified |
| 1 (H) | 16-bit, I ² S |

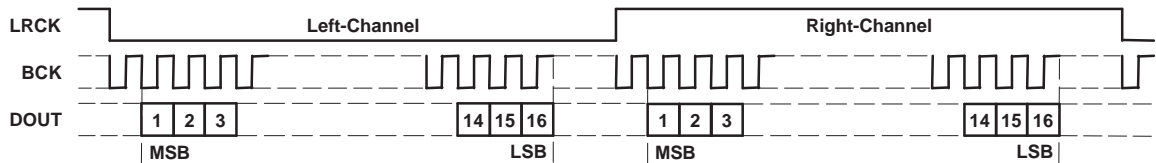
FMT = L

16-Bit, MSB-First, Left-Justified



FMT = H

16-Bit, MSB-First, I²S

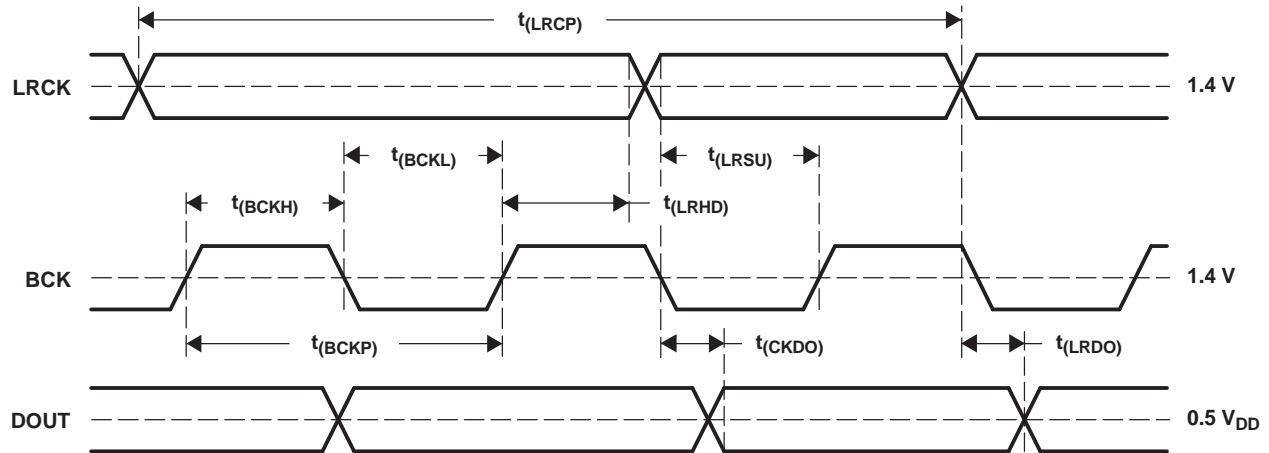


T0016-03

Figure 25. Audio Data Format

INTERFACE TIMING

Figure 26 illustrates the interface timing.



T0017-02

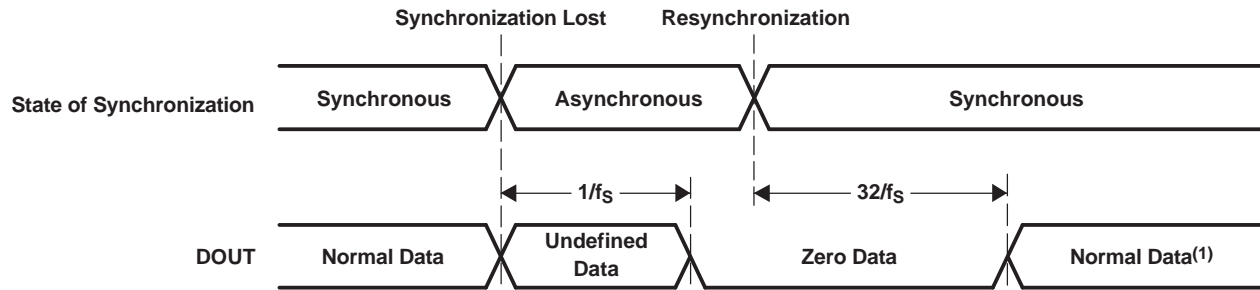
| DESCRIPTION | SYMBOL | MIN | TYP | MAX | UNITS |
|--|--------------|-----|-----|-----|---------|
| BCK period | $t_{(BCKP)}$ | 300 | | | ns |
| BCK pulse duration, HIGH | $t_{(BCKH)}$ | 120 | | | ns |
| BCK pulse duration, LOW | $t_{(BCKL)}$ | 120 | | | ns |
| LRCK setup time to BCK rising edge | $t_{(LRSU)}$ | 80 | | | ns |
| LRCK hold time to BCK rising edge | $t_{(LRHD)}$ | 40 | | | ns |
| LRCK period | $t_{(LRCP)}$ | 20 | | | μ s |
| Delay time, BCK falling edge to DOUT valid | $t_{(CKDO)}$ | -20 | | 40 | ns |
| Delay time, LRCK edge to DOUT valid | $t_{(LRDO)}$ | -20 | | 40 | ns |
| Rising time of all signals | $t_{(RISE)}$ | | | 20 | ns |
| Falling time of all signals | $t_{(FALL)}$ | | | 20 | ns |

NOTE: Timing measurement reference level is $(V_{IH} + V_{IL})/2$. Rising and falling time is measured from 10% to 90% of the I/O signal swing. Load capacitance of the DOUT signal is 20 pF.

Figure 26. Audio Data Interface Timing

SYNCHRONIZATION WITH DIGITAL AUDIO SYSTEM

The PCM1801 operates with LRCK synchronized to the system clock (SCKI). The PCM1801 does not require a specific phase relationship between LRCK and SCKI, but does require the synchronization of LRCK and SCKI. If the relationship between LRCK and SCKI changes more than 6 bit clocks (BCK) during one sample period due to LRCK or SCKI jitter, internal operation of the ADC halts within $1/f_s$ and the digital output is forced to BPZ until resynchronization between LRCK and SCKI is completed. In case of changes less than 5 bit clocks (BCK), resynchronization does not occur and the previously described digital output control and discontinuity do not occur. Figure 27 illustrates the ADC digital output for lost synchronization and resynchronization. During undefined data, some noise may be generated in the audio signal. Also, the transition of normal to undefined data and undefined or zero data to normal makes a discontinuity of data on the digital output and may generate some noise in the audio signal.



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- (1) The transient response (exponentially attenuated signal from $\pm 0.2\%$ dc of FSR with 200-ms time constant) appears initially.

Figure 27. ADC Digital Output for Loss of Synchronization and Re-Synchronization

HPF Bypass Control

The built-in function for dc component rejection can be bypassed by BYPAS (pin 9) control (see [Table 4](#)). In bypass mode, the dc component of the input analog signal, the internal dc offset, etc., are also converted and output in the digital output data.

Table 4. HPF Bypass Control

| BYPAS | HIGH-PASS FILTER (HPF) MODE |
|-------|-----------------------------|
| Low | Normal (dc cut) mode |
| High | Bypass (through) mode |

APPLICATION INFORMATION

BOARD DESIGN AND LAYOUT CONSIDERATIONS

V_{CC} , V_{DD} PINS

The digital and analog power supply lines to the PCM1801 should be bypassed to the corresponding ground pins with both 0.1- μF ceramic and 10- μF tantalum capacitors as close to the pins as possible to maximize the dynamic performance of the ADC. Although the PCM1801 has two power lines to maximize the potential of dynamic performance, using one common power supply is recommended to avoid unexpected power supply problems, such as latch-up due to power supply sequencing.

AGND, DGND PINS

To maximize the dynamic performance of the PCM1801, the analog and digital grounds are not internally connected. These points should have low impedance to avoid digital noise feedback into the analog ground. They should be connected directly to each other under the PCM1801 package to reduce potential noise problems.

V_{IN} PINS

A 1.0- μF tantalum capacitor is recommended as an ac-coupling capacitor, which establishes a 5.3-Hz cutoff frequency. If a higher full-scale input voltage is required, the input voltage range can be increased by adding a series resistor to the V_{IN} pins.

V_{REF} PINS

To ensure low source impedance, 4.7- μF tantalum capacitors are recommended from V_{REF1} to AGND and from V_{REF2} to AGND. These capacitors should be located as close as possible to the V_{REF1} and V_{REF2} pins to reduce dynamic errors on the ADC references.

APPLICATION INFORMATION (continued)

DOUT PIN

The DOUT pin has a large load-drive capability, but locating a buffer near the PCM1801 and minimizing load capacitance is recommended in order to minimize the digital-analog crosstalk and maximize the dynamic performance of the ADC.

FMT PIN

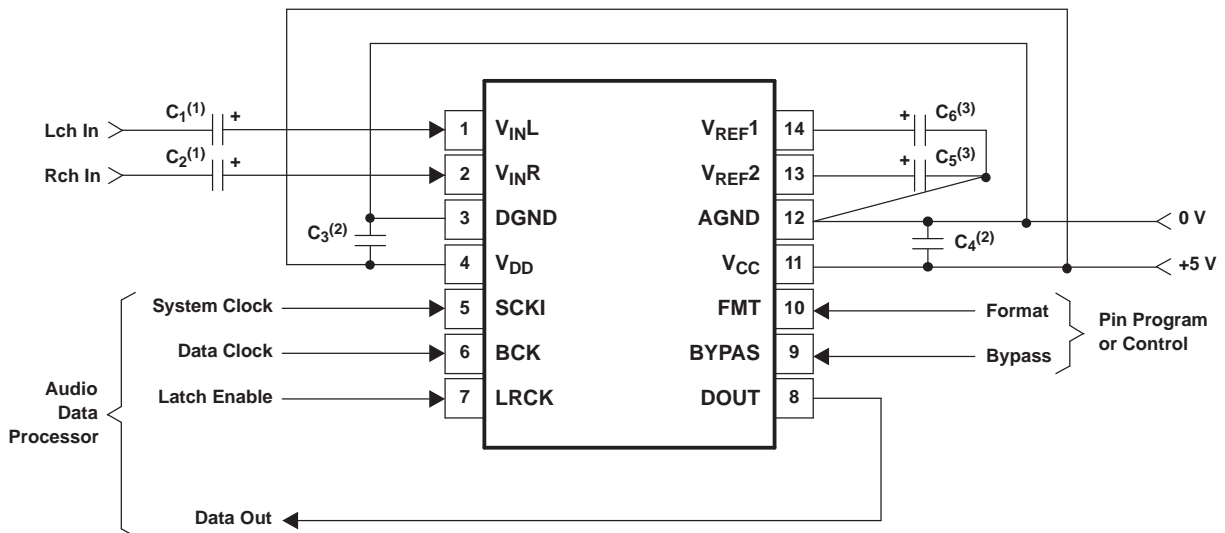
In general, the FMT pin is used for audio data format selection by tying up DGND or V_{DD} in accordance with interface requirements. If the application system cannot ensure an effective system clock prior to power up of the PCM1801 when I²S format is required, then the FMT pin must be set HIGH after the power-on reset sequence. This input control can be accomplished easily by connecting a C-R delay circuit with a delay time greater than 1 ms to the FMT pin.

SYSTEM CLOCK

The quality of the system clock can influence dynamic performance in the PCM1801. The duty cycle, jitter, and threshold voltage at the system clock input pin must be carefully managed. When power is supplied to the part, the system clock, bit clock (BCK), and word clock (LRCK) should also be supplied simultaneously. Failure to supply the audio clocks results in a power dissipation increase of up to three times normal dissipation and may degrade long-term reliability if the maximum power dissipation limit is exceeded.

TYPICAL CIRCUIT CONNECTION DIAGRAM

Figure 28 is a typical connection diagram illustrating a circuit for which the input HPF cutoff frequency is about 5 Hz.



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- (1) C1 and C2: A 1- μ F capacitor gives a 5.3-Hz ($\tau = 1 \mu\text{F} * 30 \text{ k}\Omega$) cutoff frequency for the input HPF in normal operation and requires a power-on setting time of 30 ms at power up.
- (2) C3 and C4: Bypass capacitors, 0.1- μ F ceramic and 10- μ F tantalum or aluminum electrolytic, depending on layout and power supply
- (3) C5 and C6: 4.7- μ F tantalum or aluminum electrolytic capacitors

Figure 28. Typical Circuit Connection

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| PCM1801U | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PCM1801U | Samples |
| PCM1801U/2K | ACTIVE | SOIC | D | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PCM1801U | Samples |
| PCM1801U/2KG4 | ACTIVE | SOIC | D | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PCM1801U | Samples |
| PCM1801UG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PCM1801U | Samples |

(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.

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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) Only one of markings shown within the brackets will appear on the physical device.

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D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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 other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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