



THE DATASHEET OF ADS801U





12-Bit, 25MHz Sampling ANALOG-TO-DIGITAL CONVERTER

FEATURES

- NO MISSING CODES
- LOW POWER: 270mW
- INTERNAL REFERENCE
- WIDEBAND TRACK-AND-HOLD: 65MHz
- SINGLE +5V SUPPLY

APPLICATIONS

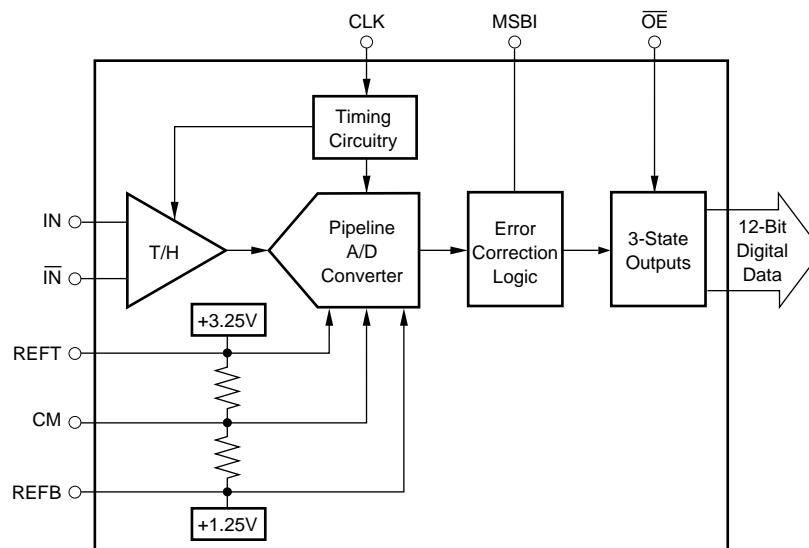
- IF AND BASEBAND DIGITIZATION
- DIGITAL COMMUNICATIONS
- TEST INSTRUMENTATION
- CCD IMAGING
 - Copiers
 - Scanners
 - Cameras
- VIDEO DIGITIZING
- GAMMA CAMERAS

DESCRIPTION

The ADS801 is a low-power, monolithic 12-bit, 25MHz Analog-to-Digital (A/D) converter utilizing a small geometry CMOS process. This complete converter includes a 12-bit quantizer, wideband track-and-hold, reference, and three-state outputs. It operates from a single +5V power supply and can be configured to accept either single-ended or differential input signals.

The ADS801 employs digital error correction to provide excellent Nyquist differential linearity performance for demanding imaging applications. Its low distortion, high SNR, and high oversampling capability give it the extra margin needed for telecommunications, instrumentation, and video applications.

This high-performance A/D converter is specified over temperature for AC and DC performance at a 25MHz sampling rate. The ADS820 is available in an SO-28 package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| | |
|--|---------------------------------|
| +V _S | +6V |
| Analog Input | 0V to (+V _S + 300mV) |
| Logic Input | 0V to (+V _S + 300mV) |
| Case Temperature | +100°C |
| Junction Temperature | +150°C |
| Storage Temperature | +125°C |
| External Top Reference Voltage (REFT) | +3.4V Max |
| External Bottom Reference Voltage (REFB) | +1.1V Min |

NOTE: (1) Stresses above these ratings may permanently damage the device.



ELECTROSTATIC DISCHARGE SENSITIVITY

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⁽¹⁾

| PRODUCT | PACKAGE-LEAD | PACKAGE DESIGNATOR | SPECIFIED TEMPERATURE RANGE | PACKAGE MARKING | ORDERING NUMBER | TRANSPORT MEDIA, QUANTITY |
|---------|--------------|--------------------|-----------------------------|-----------------|-----------------|---------------------------|
| ADS801U | SO-28 | DW | -40°C to +85°C | ADS801U | ADS801U | Rails, 28 |
| ADS801U | " | " | " | " | ADS801U/1K | Tape and Reel, 1000 |

NOTE: (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

ELECTRICAL CHARACTERISTICS

At T_A = +25°C, V_S = +5V, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.

| PARAMETER | CONDITIONS | TEMP | ADS800U | | | UNITS |
|--|-----------------------------------|--|-------------------------|---------------------|--------------|---------------|
| | | | MIN | TYP | MAX | |
| Resolution | | | | 12 | | Bits |
| Specified Temperature Range | T _{AMBIENT} | | -40 | | +85 | °C |
| ANALOG INPUT | | | | | | |
| Differential Full-Scale Input Range | Both Inputs, 180° Out-of-Phase | | +1.25 | | +3.25 | V |
| Common-Mode Voltage | | | | +2.25 | | V |
| Analog Input Bandwidth (-3dB) | | | | 400 | | MHz |
| Small-Signal | -20dBFS ⁽¹⁾ Input | +25°C | | 65 | | MHz |
| Full-Power | 0dBFS Input | +25°C | | 1.25 4 | | MΩ pF |
| Input Impedance | | | | | | |
| DIGITAL INPUT | | | | | | |
| Logic Family | | | TTL/HCT Compatible CMOS | | | |
| Convert Command | Start Conversion | | | Falling Edge | | |
| ACCURACY⁽²⁾ | | | | | | |
| Gain Error | | f _S = 2.5MHz +25°C Full | | ±0.6 ±1.0 ±85 | ±1.5 ±2.5 | % % |
| Gain Tempco | | | | | | ppm/°C |
| Power-Supply Rejection of Gain | Δ +V _S = ±5% | +25°C | | 0.03 | 0.15 | %FSR/% |
| Input Offset Error | | Full | | ±2.1 | ±3.0 | % |
| Power-Supply Rejection of Offset | Δ +V _S = ±5% | +25°C | | 0.05 | 0.15 | %FSR/% |
| CONVERSION CHARACTERISTICS | | | | | | |
| Sample Rate | | | 10k | | 25M | Sample/s |
| Data Latency | | | | 6.5 | | Convert Cycle |
| DYNAMIC CHARACTERISTICS | | | | | | |
| Differential Linearity Error | | | | | | |
| f = 500kHz | | +25°C 0°C to +85°C | | ±0.3 ±0.4 | ±1.0 ±1.0 | LSB LSB |
| f = 10MHz | | +25°C 0°C to +85°C | | ±0.3 ±0.4 | ±1.0 ±1.0 | LSB LSB |
| No Missing Codes | | 0°C to +85°C | | Tested | | LSB |
| Integral Linearity Error at f = 500kHz | | Full | | ±1.7 | | LSB |
| Spurious-Free Dynamic Range (SFDR) | | | | | | |
| f = 500kHz (-1dBFS input) | | +25°C | 63 | 77 | | dBFS |
| f = 10MHz (-1dBFS input) | | Full | 62 | 73 | | dBFS |
| | | +25°C | 57 | 61 | | dBFS |
| | | Full | 55 | 61 | | dBFS |

NOTES: (1) dBFS refers to dB below Full-Scale. (2) Percentage accuracies are referred to the internal A/D converter Full-Scale Range of 4V_{p-p}. (3) IMD is referred to the larger of the two input signals. If referred to the peak envelope signal (=0dB), the intermodulation products will be 7dB lower. (4) No "rollover" of bits.

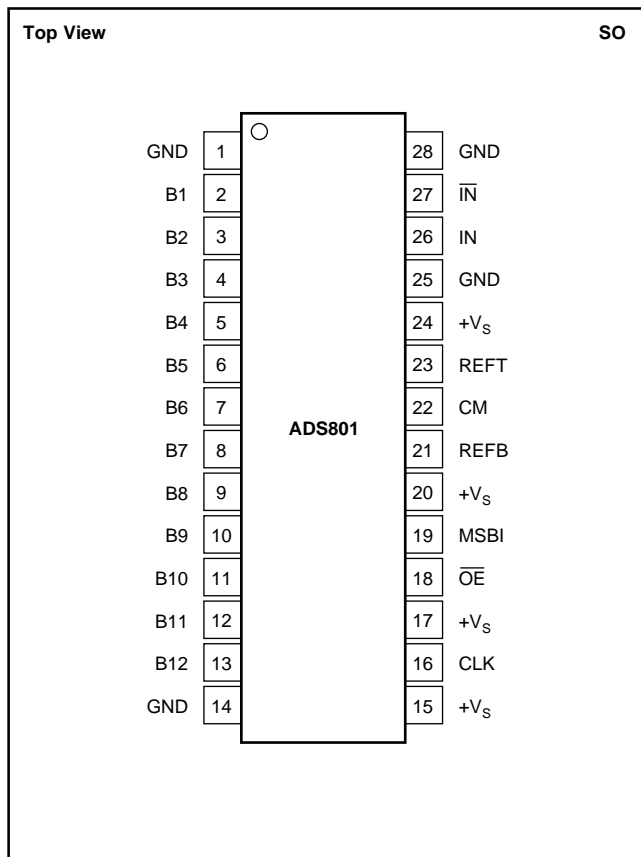
ELECTRICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.

| PARAMETER | CONDITIONS | TEMP | ADS800U | | | UNITS |
|--|---|---------------|-------------------------|--------------|--------|------------|
| | | | MIN | TYP | MAX | |
| DYNAMIC CHARACTERISTICS (Cont.) | | | | | | |
| 2-Tone Intermodulation Distortion (IMD) ⁽³⁾ f = 4.4MHz and 4.5MHz (−7dBFS each tone) | | +25°C Full | | −64 −63 | | dBc dBc |
| Signal-to-Noise Ratio (SNR) f = 500kHz (−1dBFS input) | | +25°C Full | 64 61 | 66 64 | | dB dB |
| f = 10MHz (−1dBFS input) | | +25°C Full | 62 58 | 65 64 | | dB dB |
| Signal-to-(Noise + Distortion) (SINAD) f = 500kHz (−1dBFS input) | | +25°C Full | 63 60 | 66 63 | | dB dB |
| f = 10MHz (−1dBFS input) | | +25°C Full | 56 54 | 59 58 | | dB dB |
| Differential Gain Error | NTSC or PAL | +25°C | | 0.5 | | % |
| Differential Phase Error | NTSC or PAL | +25°C | | 0.1 | | degrees |
| Aperture Delay Time | | +25°C | | 2 | | ns |
| Aperture Jitter | | +25°C | | 7 | | ps rms |
| Over-Voltage Recovery Time ⁽⁴⁾ | 1.5x Full-Scale Input | +25°C | | 2 | | ns |
| OUTPUTS | | | | | | |
| Logic Family | Logic Selectable Logic LOW, $C_L = 15\text{pF max}$ Logic HIGH, $C_L = 15\text{pF max}$ | Full | TTL/HCT Compatible CMOS | | | V |
| Logic Coding | | | 0 | Falling Edge | 0.4 | |
| Logic Levels | | Full | +2.5 | | $+V_S$ | V |
| 3-State Enable Time | | | | 20 | 40 | ns |
| 3-State Disable Time | | Full | | 2 | 10 | ns |
| POWER-SUPPLY REQUIREMENTS | | | | | | |
| Supply Voltage: $+V_S$ | Operating | Full | +4.75 | +5.0 | +5.25 | V |
| Supply Current: $+I_S$ | Operating | +25°C | | 54 | 65 | mA |
| | Operating | Full | | 54 | 68 | mA |
| Power Consumption | Operating | +25°C | | 270 | 325 | mW |
| | Operating | Full | | 270 | 340 | mW |
| Thermal Resistance, θ_{JA} SO-28 | | | | 75 | | °C/W |

NOTES: (1) dBFS refers to dB below Full-Scale. (2) Percentage accuracies are referred to the internal A/D converter Full-Scale Range of 4Vp-p. (3) IMD is referred to the larger of the two input signals. If referred to the peak envelope signal (=0dB), the intermodulation products will be 7dB lower. (4) No "rollover" of bits.

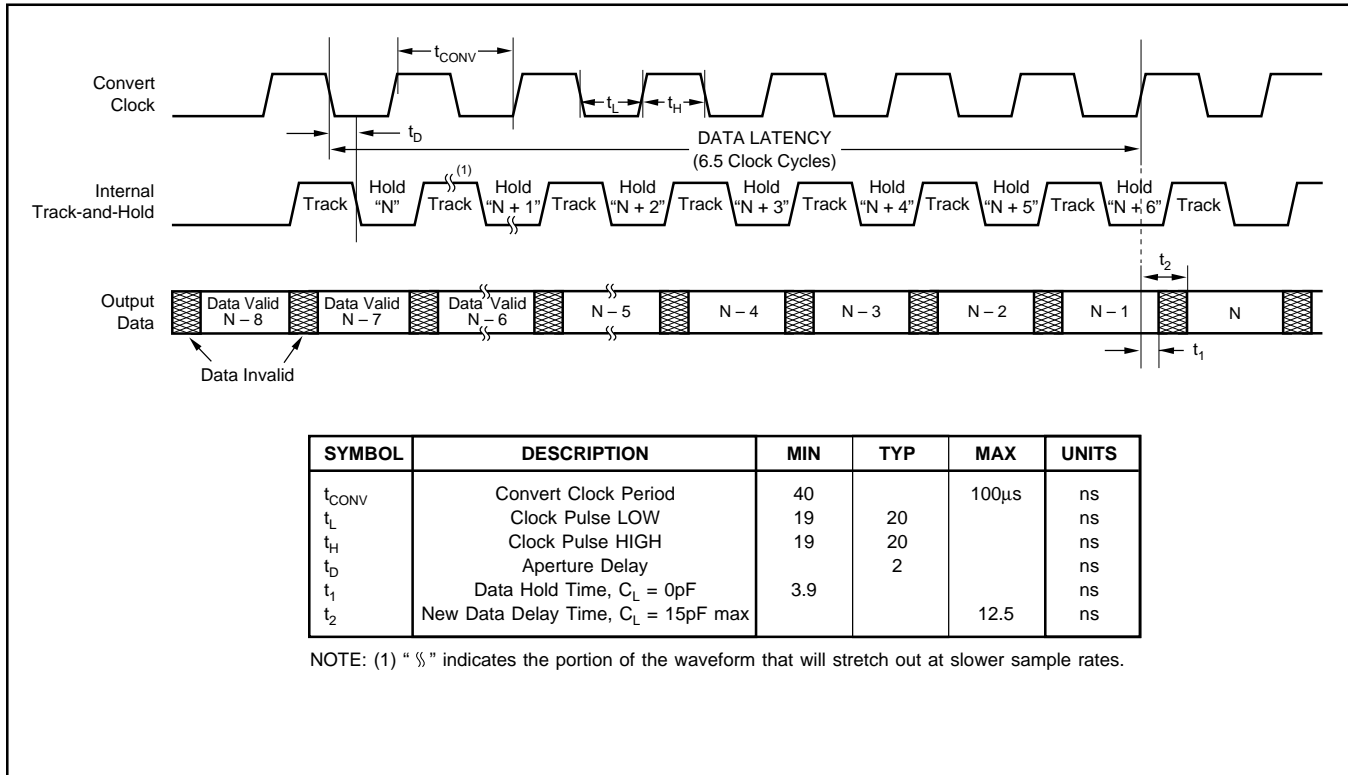
PIN CONFIGURATION



PIN DESCRIPTIONS

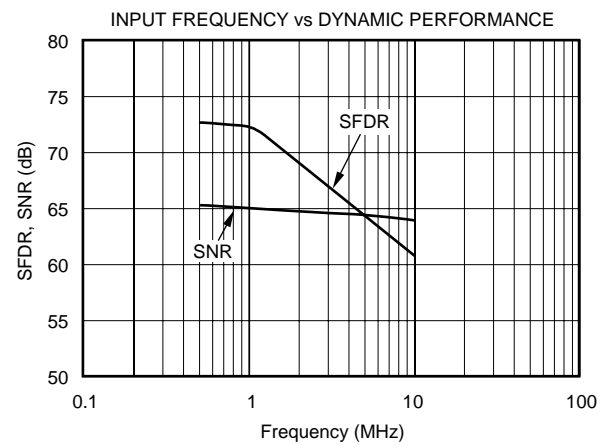
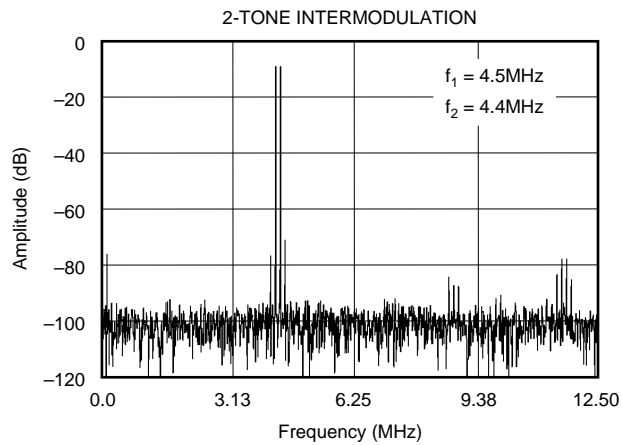
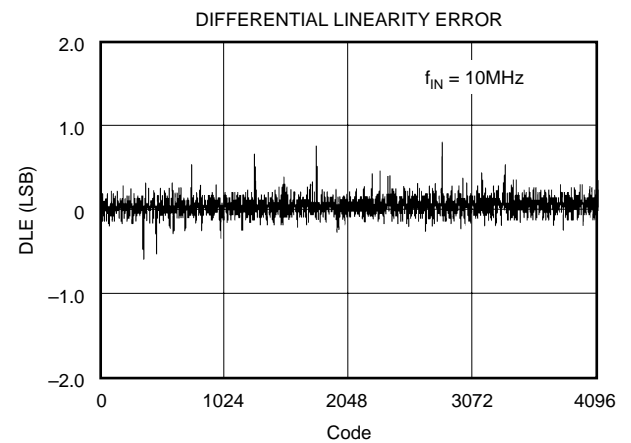
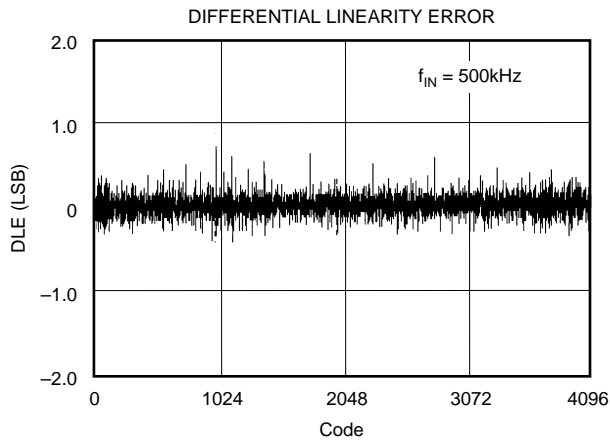
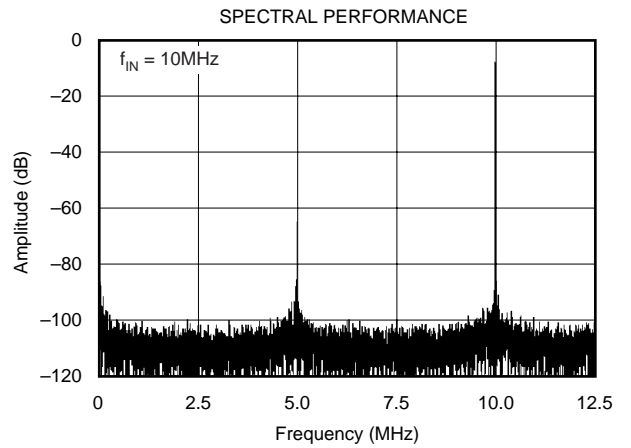
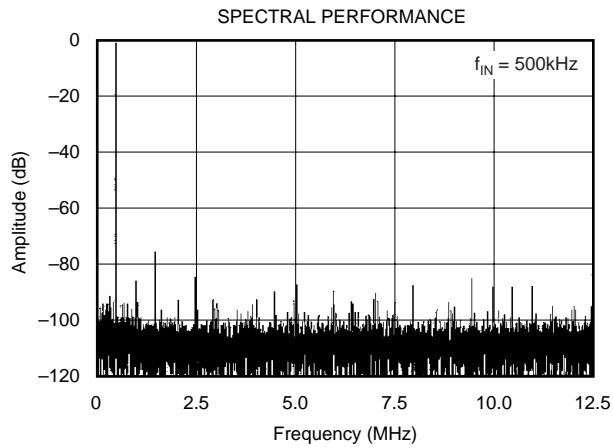
| PIN | DESIGNATOR | DESCRIPTION |
|-----|-----------------|--|
| 1 | GND | Ground |
| 2 | B1 | Bit 1, Most Significant Bit (MSB) |
| 3 | B2 | Bit 2 |
| 4 | B3 | Bit 3 |
| 5 | B4 | Bit 4 |
| 6 | B5 | Bit 5 |
| 7 | B6 | Bit 6 |
| 8 | B7 | Bit 7 |
| 9 | B8 | Bit 8 |
| 10 | B9 | Bit 9 |
| 11 | B10 | Bit 10 |
| 12 | B11 | Bit 11 |
| 13 | B12 | Bit 12, Least Significant Bit (LSB) |
| 14 | GND | Ground |
| 15 | +V _S | +5V Power Supply |
| 16 | CLK | Convert Clock Input, 50% Duty Cycle |
| 17 | +V _S | +5V Power Supply |
| 18 | OE | HIGH: High-Impedance State. LOW or Floating: Normal Operation. Internal pull-down resistors. |
| 19 | MSBI | Most Significant Bit Inversion, HIGH: MSB inverted for complementary output. LOW or Floating: Straight output. Internal pull-down resistors. |
| 20 | +V _S | +5V Power Supply |
| 21 | REFB | Bottom Reference Bypass. For external bypassing of internal +1.25V reference. |
| 22 | CM | Common-Mode Voltage. It is derived by (REFT + REFB)/2. |
| 23 | REFT | Top Reference Bypass. For external bypassing of internal +3.25V reference. |
| 24 | +V _S | +5V Power Supply |
| 25 | GND | Ground |
| 26 | IN | Input |
| 27 | IN | Complementary Input |
| 28 | GND | Ground |

TIMING DIAGRAM



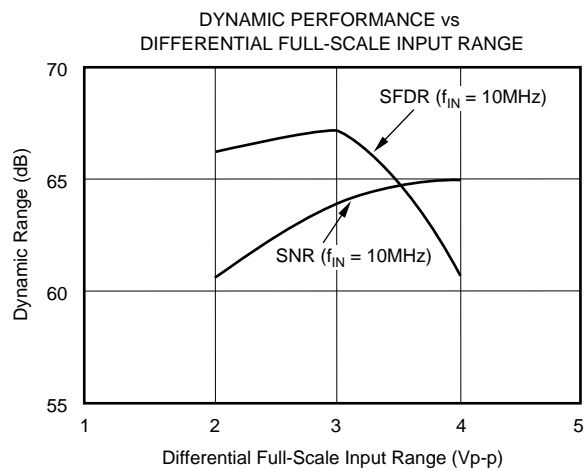
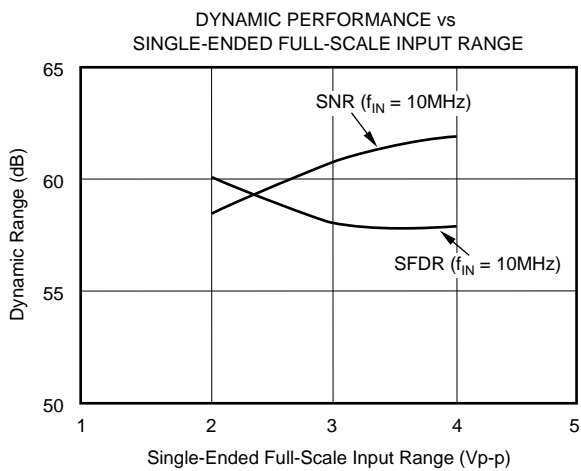
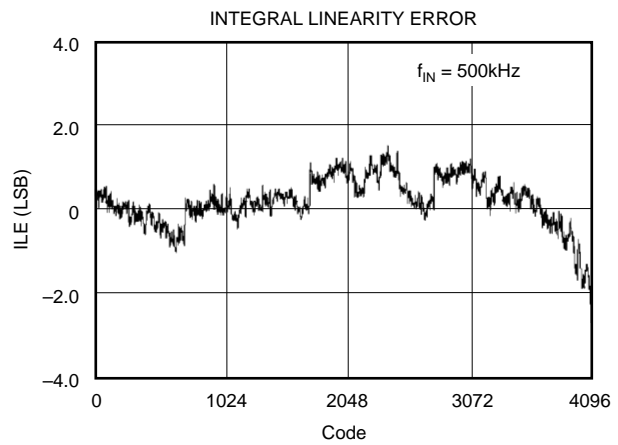
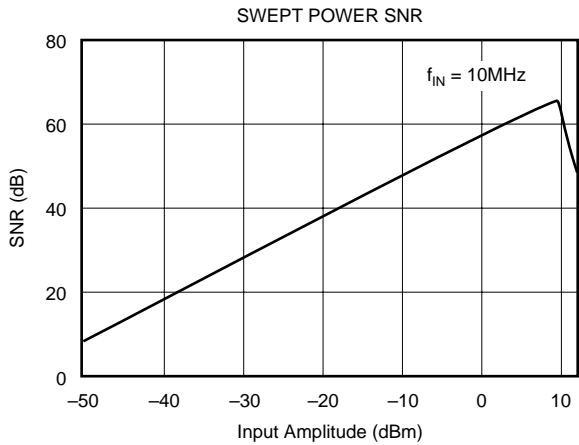
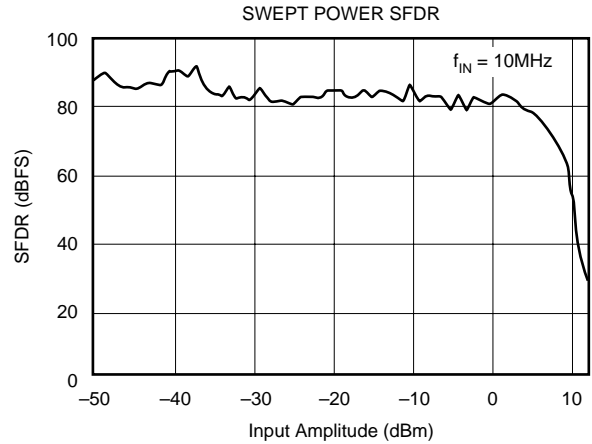
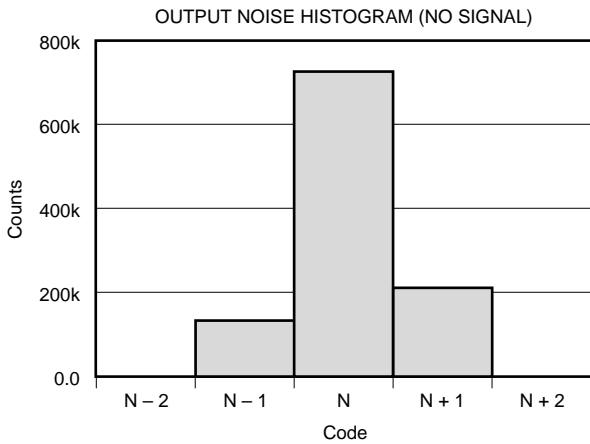
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.



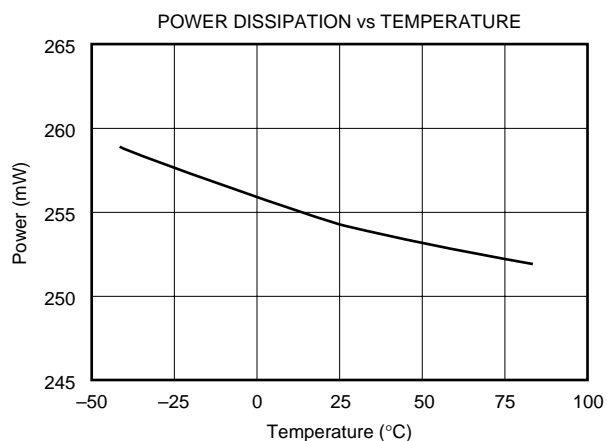
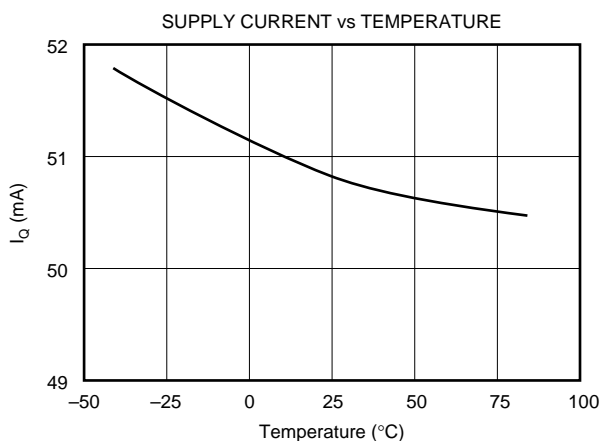
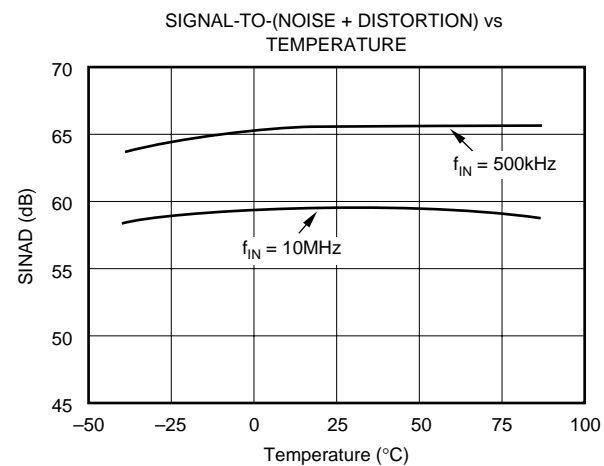
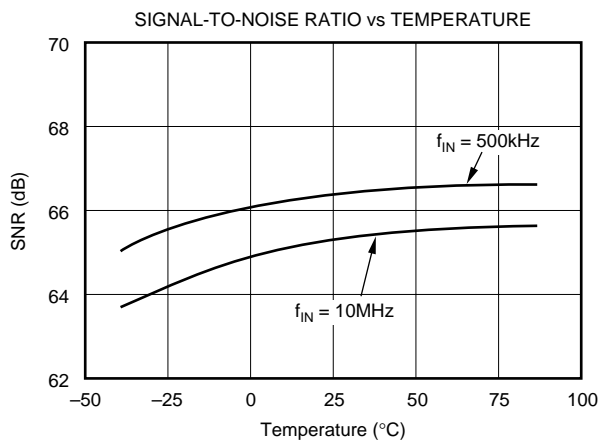
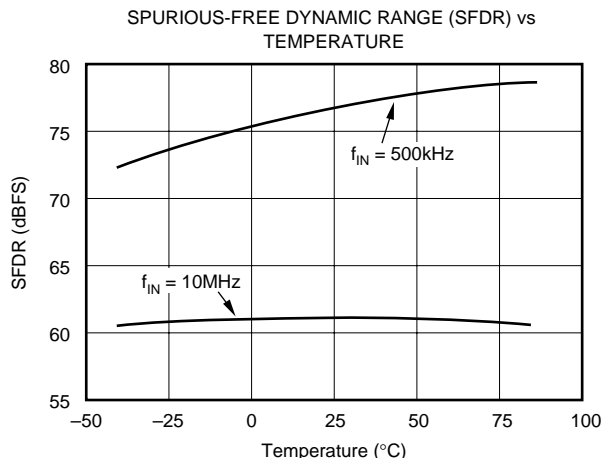
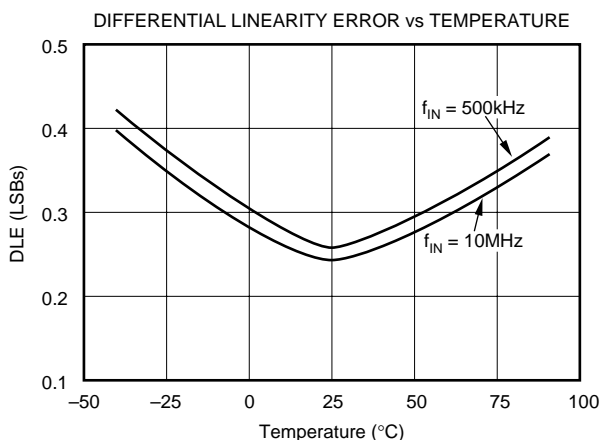
TYPICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.



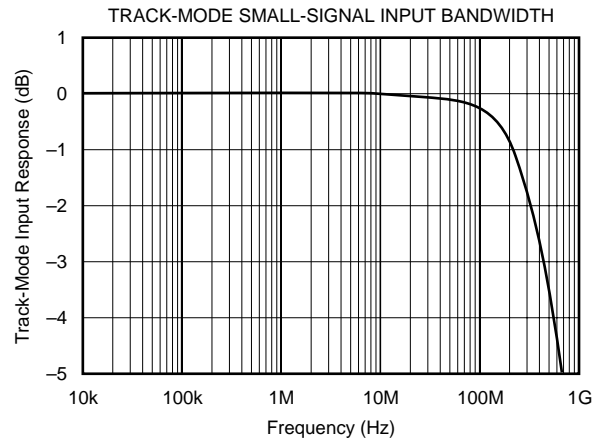
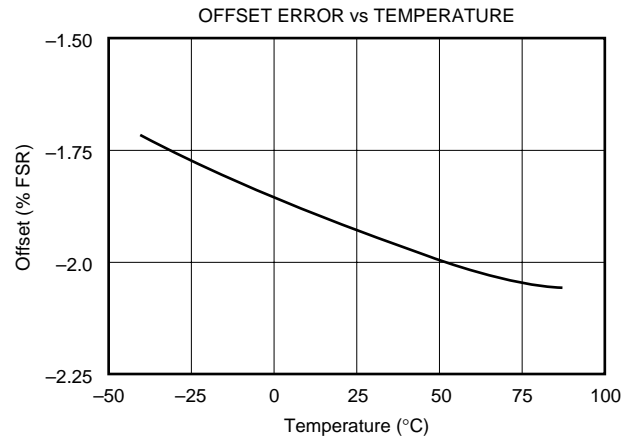
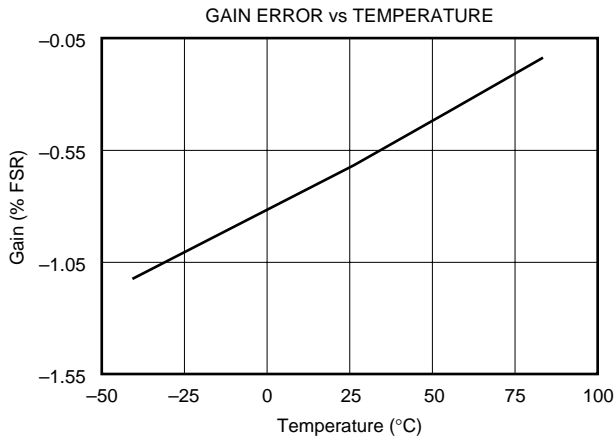
TYPICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.



TYPICAL CHARACTERISTICS (Cont.)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, Sampling Rate = 25MHz, and with a 50% duty cycle clock having a 2ns rise-and-fall time, unless otherwise noted.



THEORY OF OPERATION

The ADS801 is a high-speed, sampling A/D converter with pipelining. It uses a fully differential architecture and digital error correction to ensure 12-bit resolution. The differential track-and-hold circuit is shown in Figure 1. The switches are controlled by an internal clock that is a non-overlapping 2-phase signal, ϕ_1 and ϕ_2 . At the sampling time, the input signal is sampled on the bottom plates of the input capacitors. In the next clock phase, ϕ_2 , the bottom plates of the input capacitors are connected together and the feedback capacitors are switched to the op amp output. At this time, the charge redistributes between C_1 and C_H , completing one track-and-hold cycle. The differential output is a held DC representation of the analog input at the sample time. The track-and-hold circuit can also convert a single-ended input signal into a fully differential signal for the quantizer.

The pipelined quantizer architecture has 11 stages with each stage containing a 2-bit quantizer and a 2-bit Digital-to-Analog Converter (DAC), as shown in Figure 2. Each 2-bit quantizer stage converts on the edge of the sub-clock, which is twice the frequency of the externally applied clock. The output of each quantizer is fed into its own delay line to time-

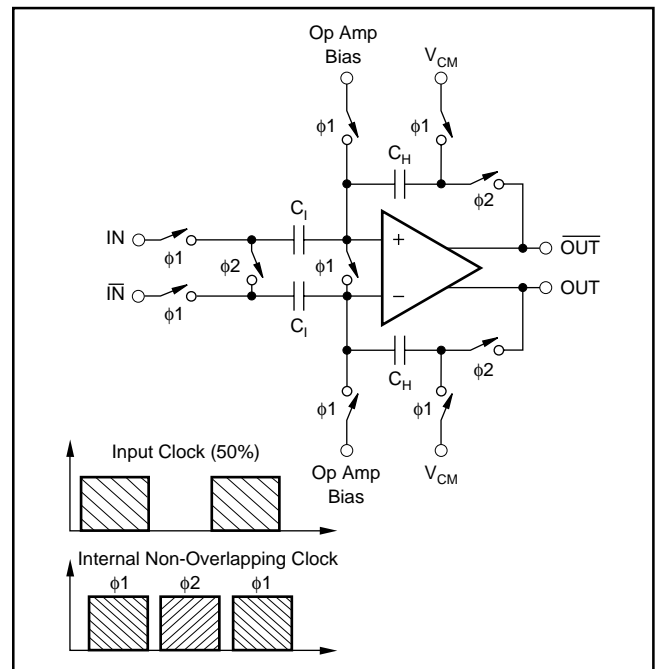


FIGURE 1. Input Track-and-Hold Configuration with Timing Signals.

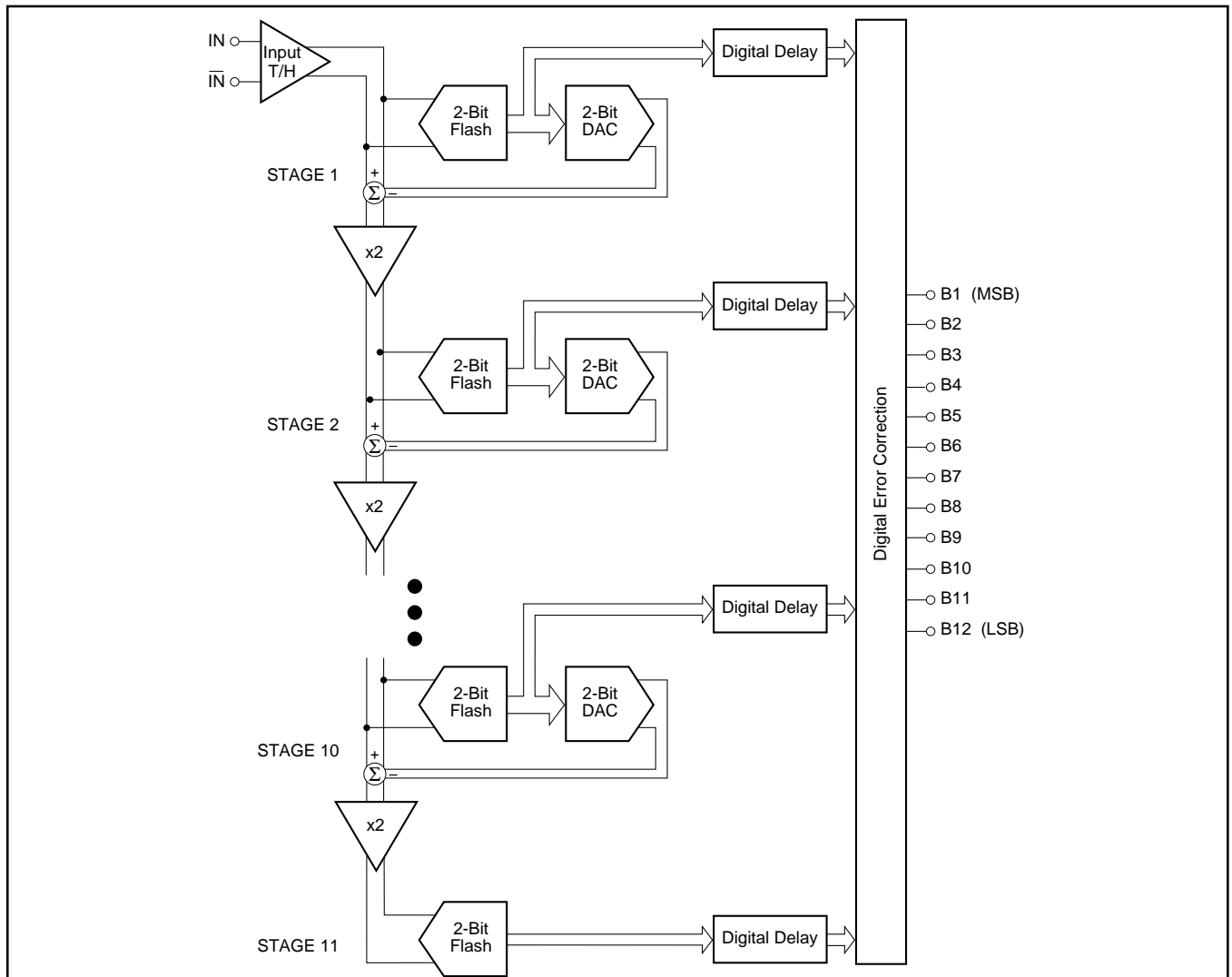


FIGURE 2. Pipeline A/D Converter Architecture.

align it with the data created from the following quantizer stages. This aligned data is fed into a digital error correction circuit that can adjust the output data based on the information found on the redundant bits. This technique gives the ADS801 excellent differential linearity and ensures no missing codes at the 12-bit level.

Since there are two pipeline stages per external clock cycle, there is a 6.5 clock cycle data latency from the start convert signal to the valid output data. The output data is available in Straight Offset Binary (SOB) or Binary Two's Complement (BTC) format.

THE ANALOG INPUT AND INTERNAL REFERENCE

The analog input of the ADS801 can be configured in various ways and driven with different circuits, depending on the nature of the signal and the level of performance desired. The ADS801 has an internal reference that sets the full-scale input range of the A/D converter. The differential input range has each input centered around the common-mode of +2.25V, with each of the two inputs having a full-scale range of +1.25V to +3.25V. Since each input is 2Vp-p and 180° out-of-phase with the other, a 4V differential input signal to the quantizer results. As shown in Figure 3, the positive full-scale reference (REFT) and the negative full-scale (REFB) are brought out for external bypassing. In addition, the common-mode voltage (CM) may be used as a reference to provide the appropriate offset for the driving circuitry. However, care must be taken not to appreciably load this reference node. For more information regarding external references, single-ended input, and ADS801 drive circuits, refer to the applications section.

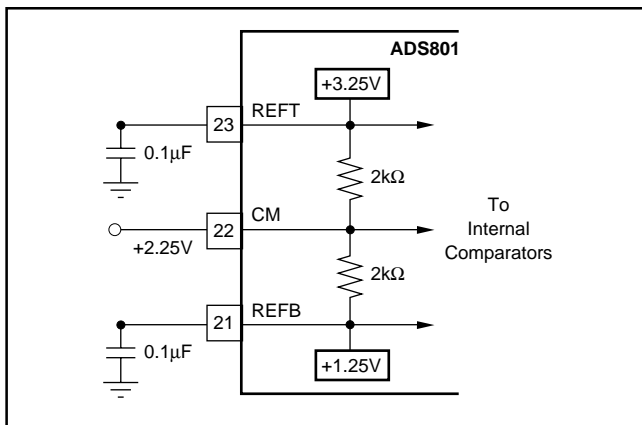


FIGURE 3. Internal Reference Structure.

CLOCK REQUIREMENTS

The CLK pin accepts a CMOS level clock input. The rising and falling edges of the externally applied convert command clock controls the various interstage conversions in the pipeline. Therefore, the duty cycle of the clock should be held at 50% with low jitter and fast rise-and-fall times of 2ns or less. This is particularly important when digitizing a high-frequency input and operating at the maximum sample rate. Deviation from a 50% duty cycle will effectively shorten some of the interstage settling times, thus degrading the SNR and DNL performance.

DIGITAL OUTPUT DATA

The 12-bit output data is provided at CMOS logic levels. The standard output coding is Straight Offset Binary (SOB) where a full-scale input signal corresponds to all “1s” at the output, as shown in Table I. This condition is met with pin 19 “LO” or Floating, due to an internal pull-down resistor. By applying a logic “HI” voltage to this pin, a Binary Two's Complement (BTC) output will be provided where the most significant bit is inverted. The digital outputs of the ADS801 can be set to a high-impedance state by driving \overline{OE} (pin 18) with a logic HIGH. Normal operation is achieved with pin 18 LOW or Floating, due to internal pull-down resistors. This function is provided for testability purposes and is not meant to drive digital buses directly or be dynamically changed during the conversion process.

| DIFFERENTIAL INPUT ⁽¹⁾ | OUTPUT CODE | |
|--|----------------------------------|-----------------------|
| | SOB PIN 19 FLOATING or LOW | BTC PIN 19 HIGH |
| +FS (IN = +3.25V, \overline{IN} = +1.25V) | 111111111111 | 011111111111 |
| +FS - 1LSB | 111111111111 | 011111111111 |
| +FS - 2LSB | 111111111110 | 011111111110 |
| +3/4 Full-Scale | 111000000000 | 011000000000 |
| +1/2 Full-Scale | 110000000000 | 010000000000 |
| +1/4 Full-Scale | 101000000000 | 001000000000 |
| +1LSB | 100000000001 | 000000000001 |
| Bipolar Zero (IN = \overline{IN} = +2.25V) | 100000000000 | 000000000000 |
| -1LSB | 011111111111 | 111111111111 |
| -1/4 Full-Scale | 011000000000 | 111000000000 |
| -1/2 Full-Scale | 010000000000 | 110000000000 |
| -3/4 Full-Scale | 001000000000 | 101000000000 |
| -FS + 1LSB | 000000000001 | 100000000001 |
| -FS (IN = +1.25V, \overline{IN} = +3.25V) | 000000000000 | 100000000000 |

NOTE: (1) In the single-ended input mode, +FS = +4.25V and -FS = +0.25V.

TABLE I. Coding Table for the ADS801.

APPLICATIONS

DRIVING THE ADS801

The ADS801 has a differential input with a common-mode of +2.25V. For AC-coupled applications, the simplest way to create this differential input is to drive the primary winding of a transformer with a single-ended input. A differential output is created on the secondary if the center tap is tied to the common-mode voltage of +2.25V, as per Figure 4. This transformer-coupled input arrangement provides good high-

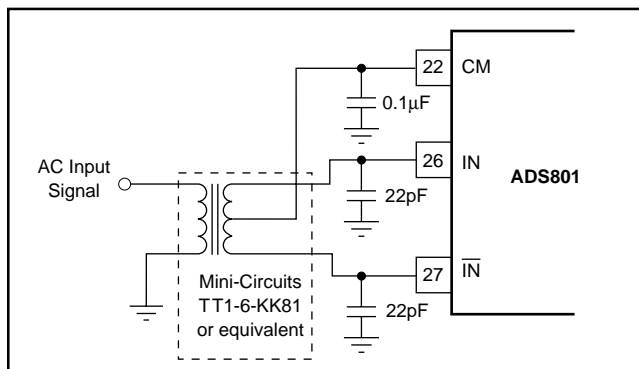


FIGURE 4. AC-Coupled Single-Ended to Differential Drive Circuit Using a Transformer.

frequency AC performance. It is important to select a transformer that gives low distortion and does not exhibit core saturation at full-scale voltage levels. Since the transformer does not appreciably load the ladder, there is no need to buffer the Common-Mode (CM) output in this instance. In general, it is advisable to keep the current draw from the CM output pin below $0.5\mu\text{A}$ to avoid nonlinearity in the internal reference ladder. A FET input operational amplifier, such as the OPA130, can provide a buffered reference for driving external circuitry. The analog IN and $\bar{\text{IN}}$ inputs should be bypassed with 22pF capacitors to minimize track-and-hold glitches and to improve high input frequency performance.

Figure 5 illustrates another possible low-cost interface circuit that utilizes resistors and capacitors in place of a transformer. Depending on the signal bandwidth, the component values should be carefully selected in order to maintain the product performance outlined. The input capacitors, C_{IN} , and the input resistors, R_{IN} , create a high-pass filter with the lower corner frequency at $f_c = 1/(2\pi R_{\text{IN}} C_{\text{IN}})$. The corner frequency can be reduced by either increasing the value of R_{IN} or C_{IN} . If the circuit operates with a 50Ω or 75Ω impedance level, the resistors are fixed and only the value of the capacitor can be increased. Usually AC-coupling capacitors are electrolytic or tantalum capacitors with values of $1\mu\text{F}$ or higher. It should be noted that these large capacitors become inductive with increased input frequency, which could lead to signal amplitude errors or oscillation. To maintain a low AC-coupling impedance throughout the signal band, a small value (e.g. $1\mu\text{F}$) ceramic capacitor could be added in parallel with the polarized capacitor.

Capacitors C_{SH1} and C_{SH2} are used to minimize current glitches resulting from the switching in the input track-and-hold stage and to improve signal-to-noise performance. These capacitors can also be used to establish a low-pass filter and effectively reduce the noise bandwidth. In order to create a real pole, resistors R_{SER1} and R_{SER2} were added in series with each input. The cutoff frequency of the filter is determined by $f_c = 1/(2\pi R_{\text{SER}} \cdot (C_{\text{SH}} + C_{\text{ADC}}))$, where R_{SER} is the resistor in

series with the input, C_{SH} is the external capacitor from the input to ground, and C_{ADC} is the internal input capacitance of the A/D converter (typically 4pF).

Resistors R_1 and R_2 are used to derive the necessary common-mode voltage from the buffered top and bottom references. The total load of the resistor string should be selected so that the current does not exceed 1mA. Although the circuit in Figure 5 uses two resistors of equal value so that the common-mode voltage is centered between the top and bottom reference ($+2.25\text{V}$), it is not necessary to do so. In all cases the center point, V_{CM} , should be bypassed to ground in order to provide a low-impedance AC ground.

If the signal needs to be DC-coupled to the input of the ADS801, an operational amplifier input circuit is required. In the differential input mode, any single-ended signal must be modified to create a differential signal. This can be accomplished by using two operational amplifiers; one in the noninverting mode for the input and the other amplifier in the inverting mode for the complementary input. The low distortion circuit in Figure 6 will provide the necessary input shifting required for signals centered around ground. It also employs a diode for output level shifting to ensure a low distortion $+3.25\text{V}$ output swing. Other amplifiers can be used in place of the OPA842s if the lowest distortion is not necessary. If output level shifting circuits are not used, care must be taken to select operational amplifiers that give the necessary performance when swinging to $+3.25\text{V}$ with a $\pm 5\text{V}$ supply operational amplifier.

The ADS801 can also be configured with a single-ended input full-scale range of $+0.25\text{V}$ to $+4.25\text{V}$ by tying the complementary input to the common-mode reference voltage (see Figure 7). This configuration will result in increased even-order harmonics, especially at higher input frequencies. However, this tradeoff may be quite acceptable for time-domain applications. The driving amplifier must give adequate performance with a $+0.25\text{V}$ to $+4.25\text{V}$ output swing in this case.

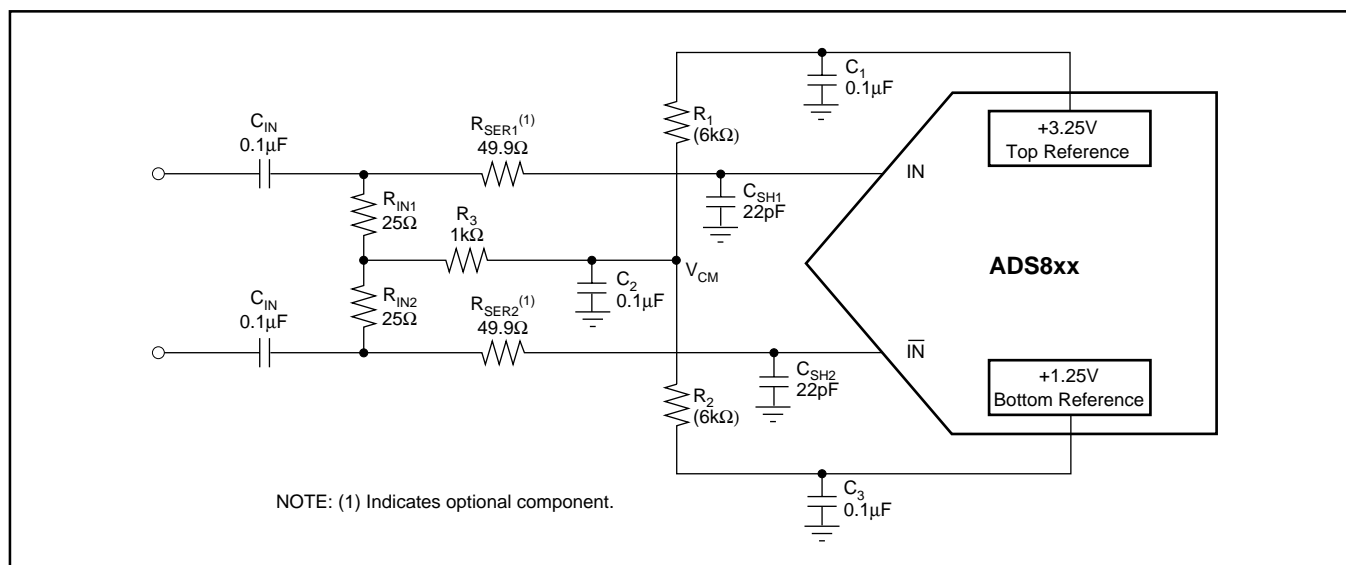


FIGURE 5. AC-Coupled Differential Input Circuit.

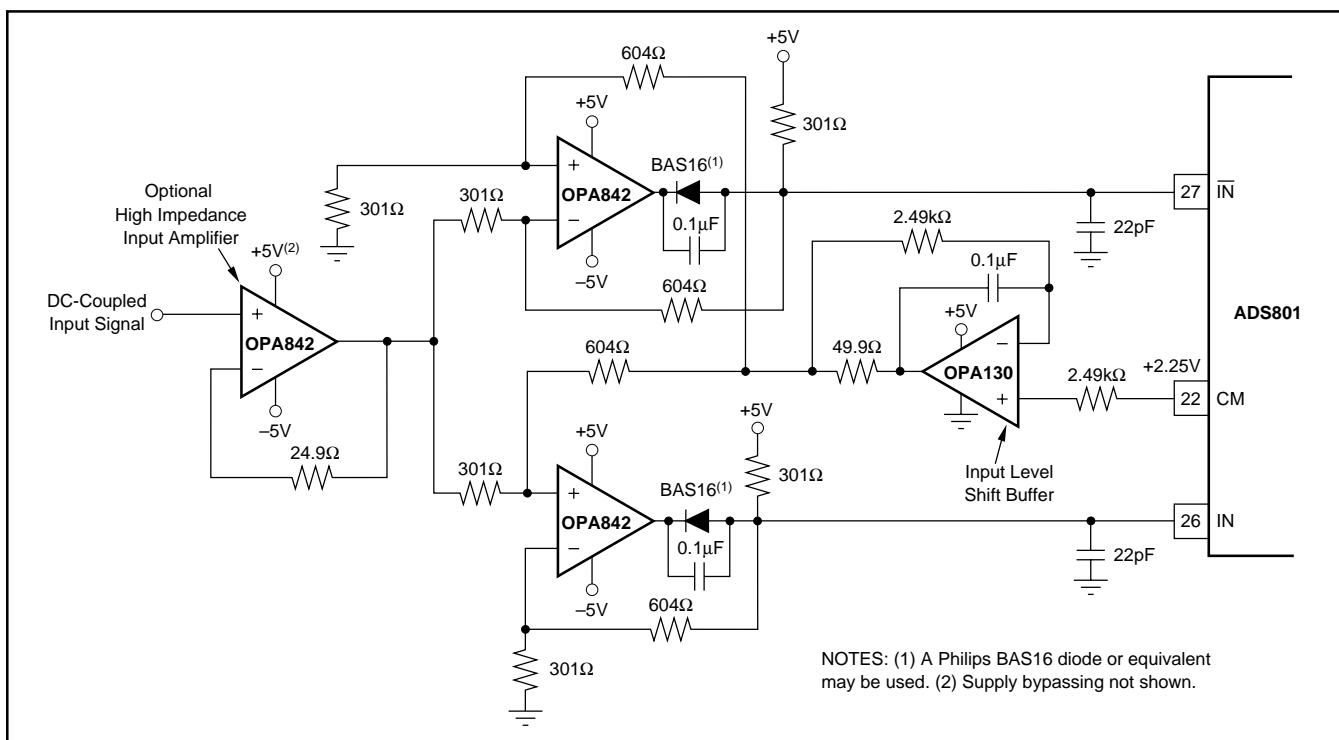


FIGURE 6. A Low-Distortion, DC-Coupled, Single-Ended to Differential Input Driver Circuit.

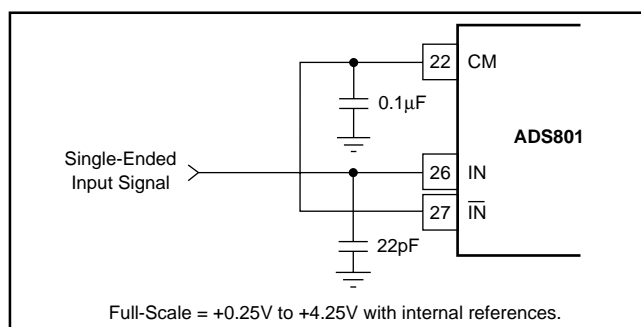


FIGURE 7. Single-Ended Input Connection.

EXTERNAL REFERENCES AND ADJUSTMENT OF FULL-SCALE RANGE

The internal reference buffers are limited to approximately 1mA of output current. As a result, these internal +1.25V and +3.25V references may be overridden by external references that have at least 18mA (at room temperature) of output drive capability. In this instance, the common-mode voltage will be set halfway between the two references. This feature can be used to adjust the gain error, improve gain drift, or to change the full-scale input range of the ADS801. Changing the full-scale range to a lower value has the benefit of easing the swing requirements of external input amplifiers. The external references can vary as long as the value of the external top reference (REF_{T_EXT}) is less than or equal to +3.4V, the value of the external bottom reference (REF_{B_EXT}) is greater than or equal to +1.1V, and the difference between the external references are greater than or equal to 1.5V.

For the differential configuration, the full-scale input range will be set to the external reference values that are selected. For the single-ended mode, the input range is

$2 \cdot (REF_{T_EXT} - REF_{B_EXT})$, with the common-mode being centered at $(REF_{T_EXT} + REF_{B_EXT})/2$. Refer to the typical characteristics for expected performance versus full-scale input range.

The circuit in Figure 8 works completely on a single +5V supply. As a reference element, it uses micro-power reference REF1004-2.5 that is set to a quiescent current of 0.1mA. Amplifier A_2 is configured as a follower to buffer the +1.25V generated from the resistor divider. To provide the necessary current drive, a pull-down resistor (R_p) is added.

Amplifier A_1 is configured as an adjustable-gain stage, with a range of approximately 1 to 1.32. The pull-up resistor again relieves the op amp from providing the full current drive. The value of the pull-up, pull-down resistors is not critical and can be varied to optimize power consumption. The need for pull-up, pull-down resistors depends only on the drive capability of the selected drive amplifier, and thus can be omitted.

PC-BOARD LAYOUT AND BYPASSING

A well-designed, clean pc-board layout will assure proper operation and clean spectral response. Proper grounding and bypassing, short lead lengths, and the use of ground planes are particularly important for high-frequency circuits. Multilayer pc-boards are recommended for best performance, but if carefully designed, a two-sided pc-board with large, heavy ground planes can give excellent results. It is recommended that the analog and digital ground pins of the ADS801 be connected directly to the analog ground plane. In our experience, this gives the most consistent results. The A/D converter power-supply commons should be tied together at the analog ground plane. Power supplies should be bypassed with 0.1μF ceramic capacitors as close to the pin as possible.

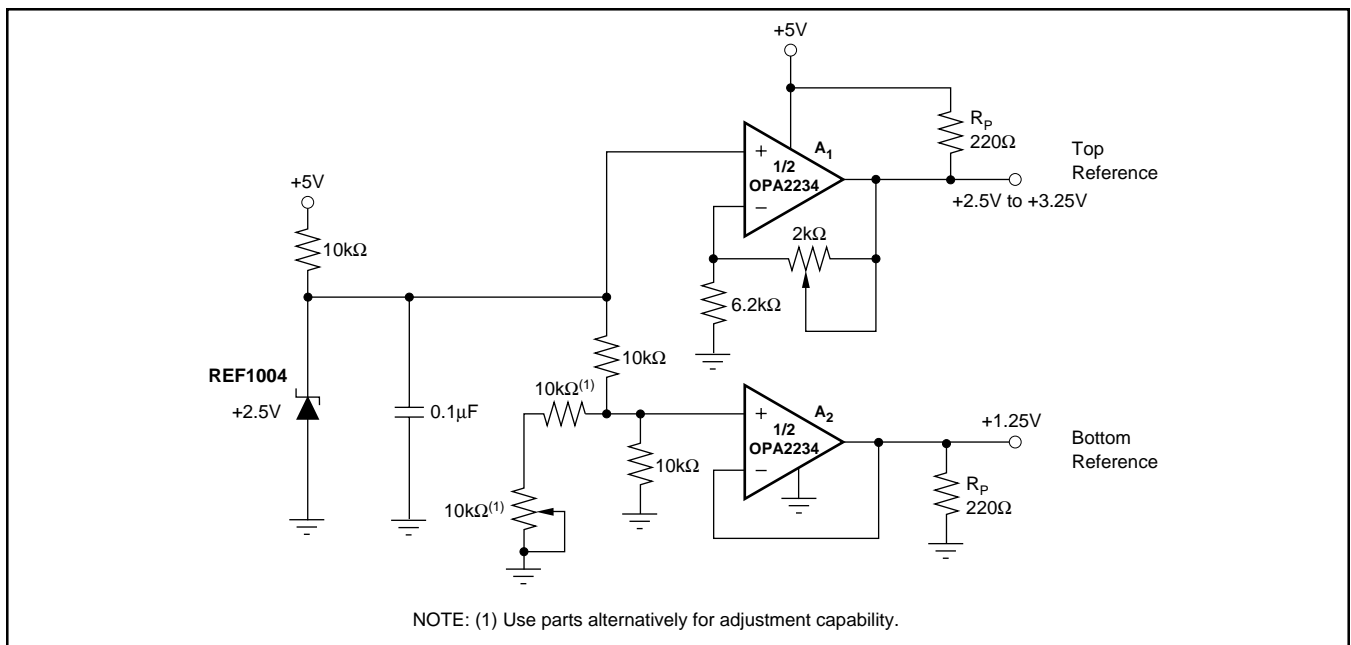


FIGURE 8. Optional External Reference to Set the Full-Scale Range Utilizing a Dual, Single-Supply Op Amp.

DYNAMIC PERFORMANCE TESTING

The ADS801 is a high-performance converter and careful attention to test techniques is necessary to achieve accurate results. Highly accurate phase-locked signal sources allow high-resolution FFT measurements to be made without using data windowing functions. A low-jitter signal generator, such as the HP8644A for the test signal, phase-locked with a low-jitter HP8022A pulse generator for the A/D converter clock, gives excellent results. Low-pass filtering (or bandpass filtering) of test signals is absolutely necessary to test the low distortion of the ADS801. Using a signal amplitude slightly lower than full-scale will allow a small amount of “headroom” so that noise or DC-offset voltage will not overrange the A/D converter and cause clipping on signal peaks.

DYNAMIC PERFORMANCE DEFINITIONS

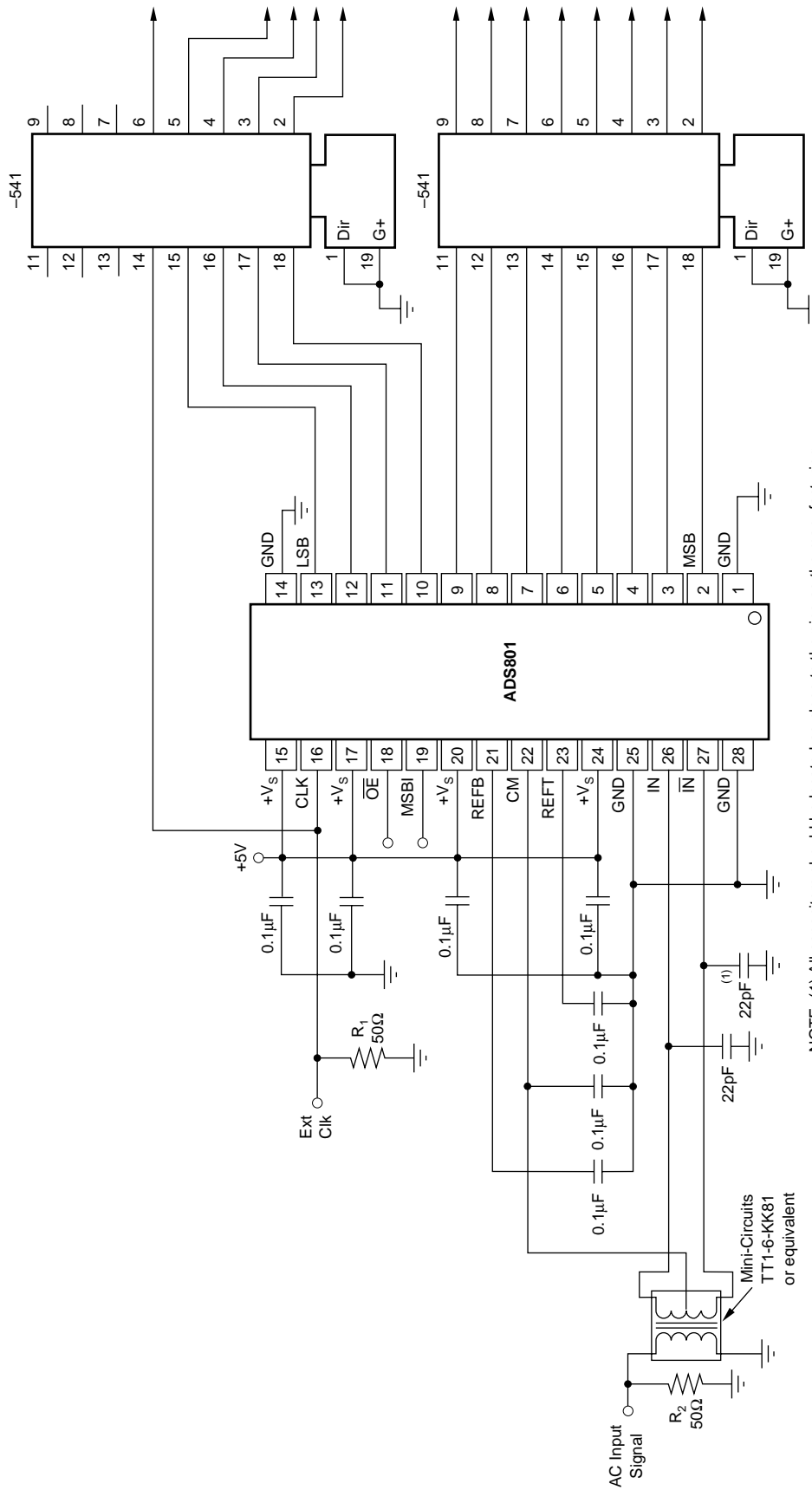
1. Signal-to-Noise-and-Distortion Ratio (SINAD):

$$10 \log \frac{\text{Sinewave Signal Power}}{\text{Noise} + \text{Harmonic Power (first 15 harmonics)}}$$
2. Signal-to-Noise Ratio (SNR):

$$10 \log \frac{\text{Sinewave Signal Power}}{\text{Noise Power}}$$
3. Intermodulation Distortion (IMD):

$$10 \log \frac{\text{Highest IMD Product Power (to 5th - order)}}{\text{Sinewave Signal Power}}$$

IMD is referenced to the larger of the test signals f_1 or f_2 . Five “bins” either side of peak are used for calculation of fundamental and harmonic power. The “0” frequency bin (DC) is not included in these calculations, as it is of little importance in dynamic signal processing applications.



NOTE: (1) All capacitors should be located as close to the pins as the manufacturing process will allow. Ceramic X7R surface-mount capacitors or equivalent are recommended.

FIGURE 9. ADS801 Interface Schematic with AC-Coupling and External Buffers.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|---------|
| ADS801U | ACTIVE | SOIC | DW | 28 | 20 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | ADS801U | 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.

OBSELETE: 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.

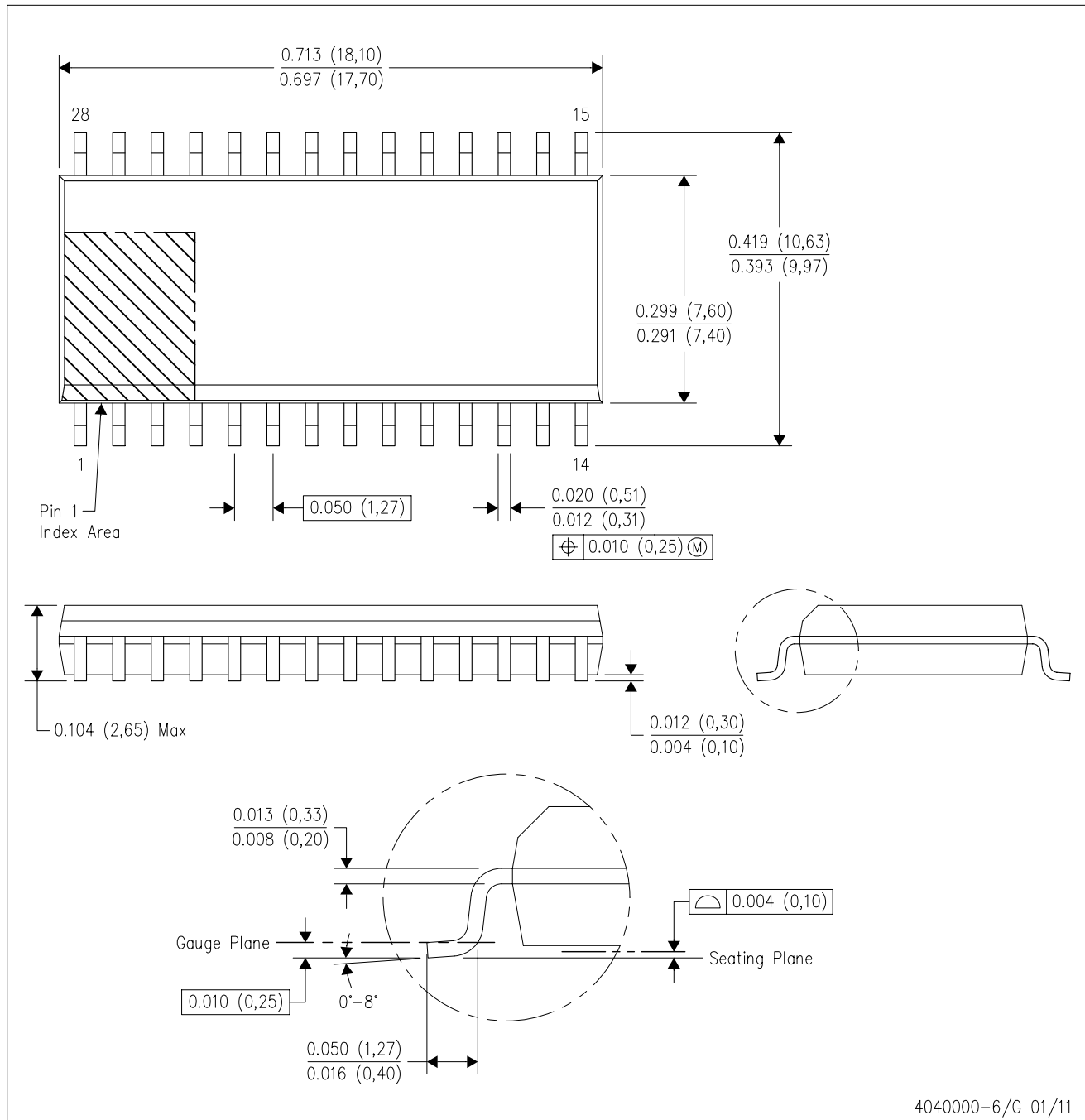
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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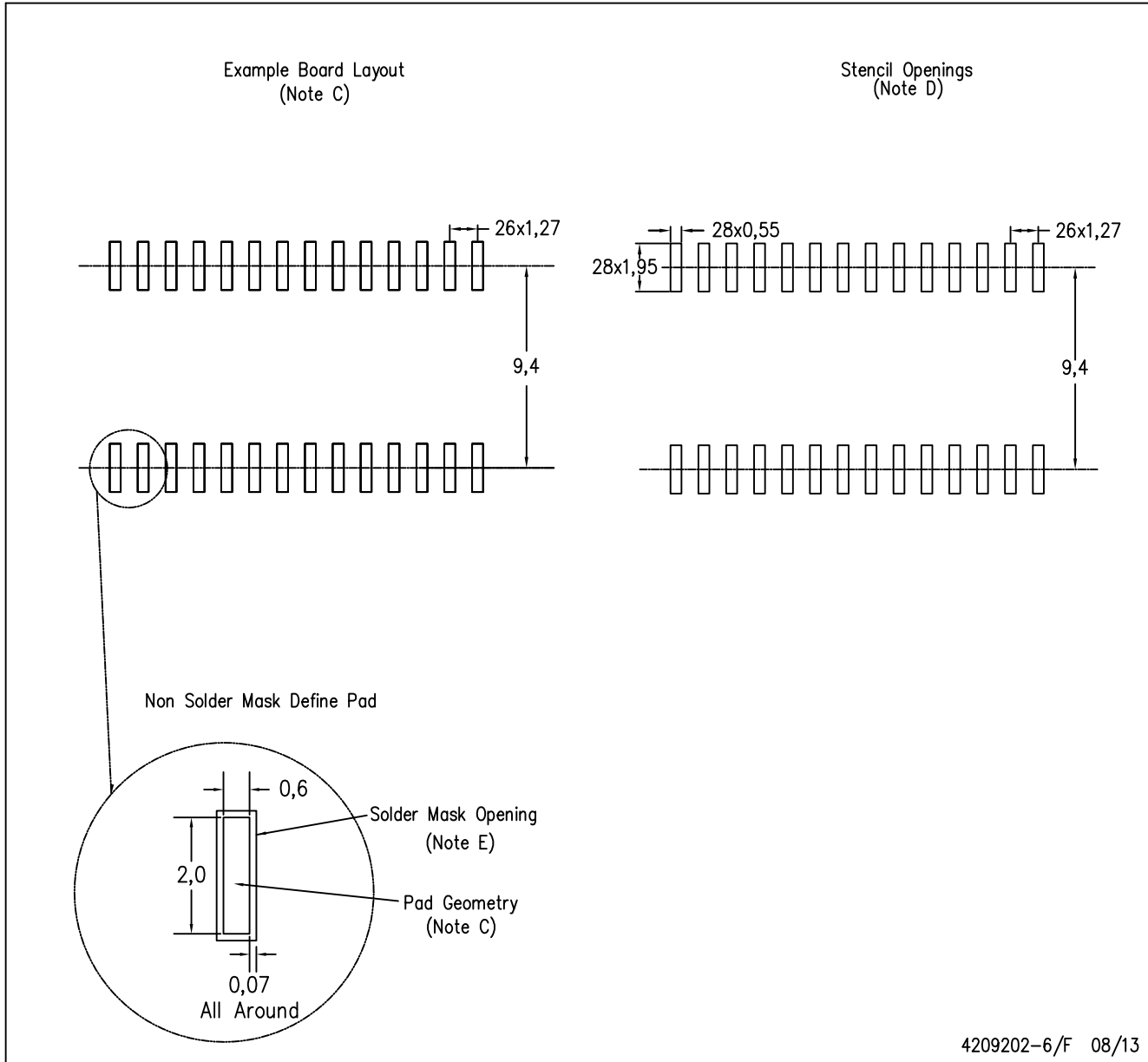


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- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-013 variation AE.

DW (R-PDSO-G28)

PLASTIC SMALL OUTLINE



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- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - D. 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
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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