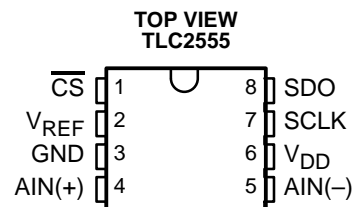
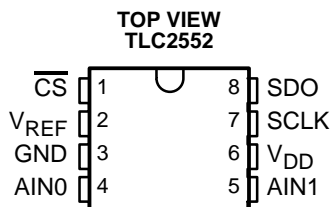
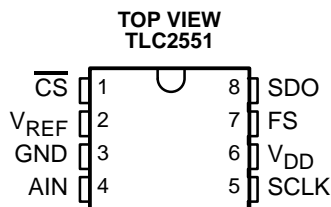


TLC2551, TLC2552, TLC2555

5-V, LOW-POWER, 12-BIT, 175/360 KSPS, SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

- Maximum Throughput . . . 175/360 KSPS
- INL/DNL: ± 1 LSB Max, SINAD: 72 dB, SFDR: 85 dB, $f_i = 20$ kHz
- SPI/DSP-Compatible Serial Interface
- Single 5-V Supply
- Rail-to-Rail Analog Input With 500 kHz BW
- Three Options Available:
 - TLC2551: Single Channel Input
 - TLC2552: Dual Channels With Autosweep
 - TLC2555: Single Channel With Pseudo-Differential Input
- Low Power With Autopower Down
 - Operating Current: 3.5 mA
 - Autopower Down: 8 μ A
- Small 8-Pin MSOP and SOIC Packages



description

The TLC2551, TLC2552, and TLC2555 are a family of high performance, 12-bit, low-power, miniature, CMOS analog-to-digital converters (ADC). The TLC255x family uses a 5-V supply. Devices are available with single, dual, or single pseudo-differential inputs. Each device has a chip select (\overline{CS}), serial clock (SCLK), and serial data output (SDO) that provides a direct 3-wire interface to the serial port of most popular host microprocessors (SPI interface). When interfaced with a TMS320™ DSP, a frame sync signal (FS) can be used to indicate the start of a serial data frame on \overline{CS} for all devices or on FS for the TLC2551.

The TLC2551, TLC2552, and TLC2555 are designed to operate with very low power consumption. The power saving feature is further enhanced with an autopower-down mode. This product family features a high-speed serial link to modern host processors with SCLK up to 20 MHz. The maximum SCLK frequency is dependent upon the mode of operation (see Table 1). The TLC255x family uses SCLK as the conversion clock, which provides synchronous operation and a minimum conversion time of 1.5 μ s using a 20-MHz SCLK.

AVAILABLE OPTIONS

| T _A | PACKAGED DEVICES | |
|----------------|-------------------|------------|
| | 8-MSOP (DGK) | 8-SOIC (D) |
| 0°C to 70°C | TLC2551CDGK (AHF) | |
| | TLC2552CDGK (AHH) | |
| | TLC2555CDGK (AHJ) | |
| –40°C to 85°C | TLC2551IDGK (AHG) | TLC2551ID |
| | TLC2552IDGK (AHI) | TLC2552ID |
| | TLC2555IDGK (AHK) | TLC2555ID |



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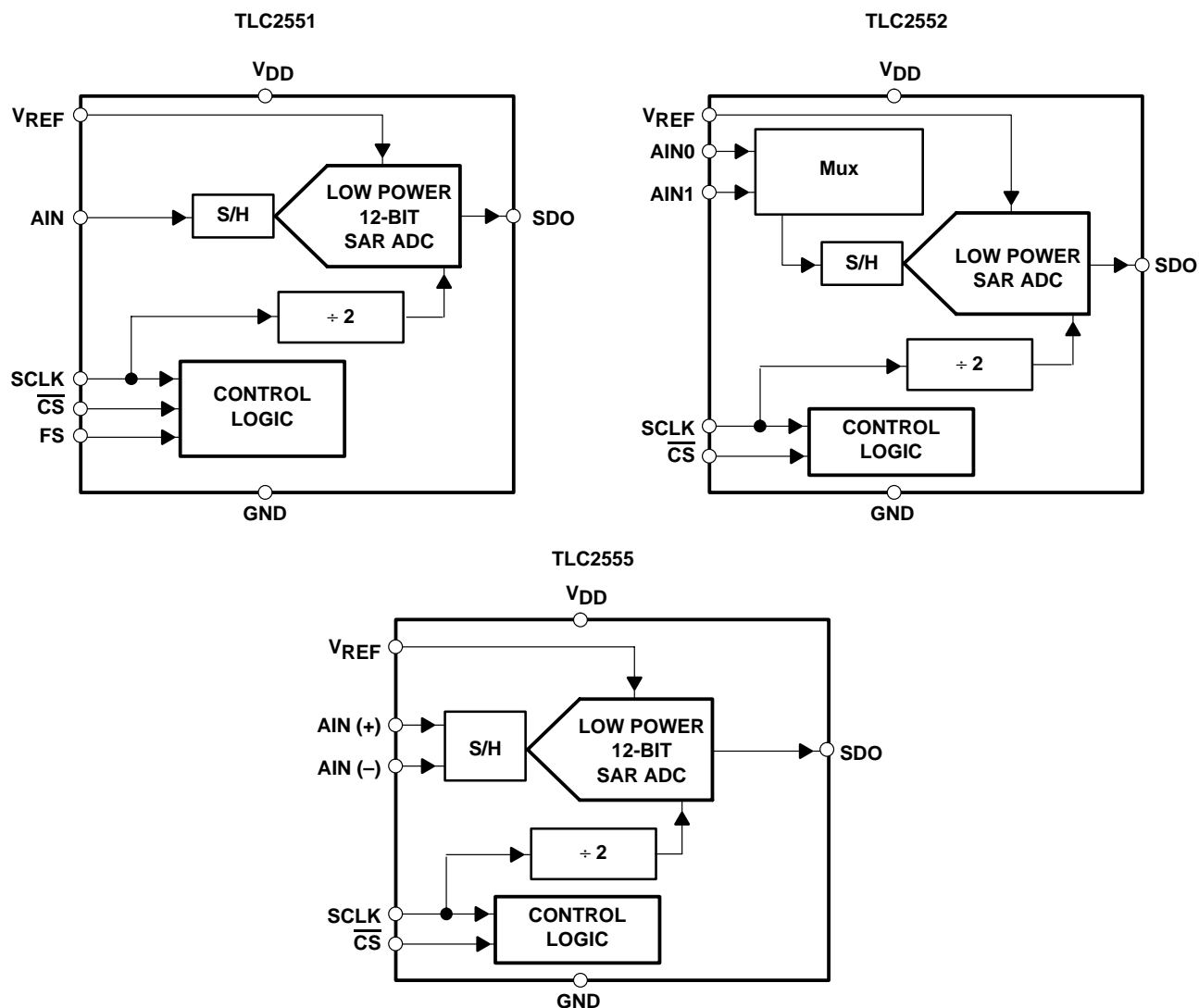
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TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

functional block diagram



Terminal Functions

TLC2551

| TERMINAL | | I/O | DESCRIPTION |
|------------------------|-----|-----|---|
| NAME | NO. | | |
| AIN | 4 | I | Analog input channel |
| $\overline{\text{CS}}$ | 1 | I | Chip select. A high-to-low transition on the $\overline{\text{CS}}$ input removes SDO from 3-state within a maximum setup time. $\overline{\text{CS}}$ can be used as the FS pin when a dedicated DSP serial port is used. |
| FS | 7 | I | DSP frame sync input. Indication of the start of a serial data frame. Tie this terminal to V_{DD} if not used. |
| GND | 3 | I | Ground return for the internal circuitry. Unless otherwise noted, all voltage measurements are with respect to GND. |
| SCLK | 5 | I | Output serial clock. This terminal receives the serial SCLK from the host processor. |
| SDO | 8 | O | The 3-state serial output for the A/D conversion result. SDO is kept in the high-impedance state until $\overline{\text{CS}}$ falling edge or FS rising edge, whichever occurs first. The output format is MSB first. When FS is not used ($\text{FS} = 1$ at the falling edge of $\overline{\text{CS}}$), the MSB is presented to the SDO pin after $\overline{\text{CS}}$ falling edge and output data is valid on the first falling edge of SCLK. When $\overline{\text{CS}}$ and FS are both used ($\text{FS} = 0$ at the falling edge of $\overline{\text{CS}}$), the MSB is presented to the SDO pin after the falling edge of $\overline{\text{CS}}$. When $\overline{\text{CS}}$ is tied/held low, the MSB is presented on SDO after rising FS. Output data is valid on the first falling edge of SCLK. (This is typically used with an active FS from a DSP.) |
| V_{DD} | 6 | I | Positive supply voltage |
| V_{REF} | 2 | I | External reference input |

TLC2552/55

| TERMINAL | | I/O | DESCRIPTION |
|------------------------|-----|-----|---|
| NAME | NO. | | |
| AIN0 /AIN(+) | 4 | I | Analog input channel 0 for TLC2552—Positive input for TLC2555 |
| AIN1/AIN(–) | 5 | I | Analog input channel 1 for TLC2552—Inverted input for TLC2555 |
| $\overline{\text{CS}}$ | 1 | I | Chip select. A high-to-low transition on $\overline{\text{CS}}$ removes SDO from 3-state within a maximum delay time. This pin can be connected to the FS output from a DSP on a dedicated serial port. |
| GND | 3 | I | Ground return for the internal circuitry. Unless otherwise noted, all voltage measurements are with respect to GND. |
| SCLK | 7 | I | Output serial clock. This terminal receives the serial SCLK from the host processor. |
| SDO | 8 | O | The 3-state serial output for the A/D conversion result. SDO is kept in the high-impedance state when $\overline{\text{CS}}$ is high and presents output data after the $\overline{\text{CS}}$ falling edge until the LSB is presented. The output format is MSB first. SDO returns to the Hi-Z state after the 16th SCLK. Output data is valid on the falling SCLK edge. |
| V_{DD} | 6 | I | Positive supply voltage |
| V_{REF} | 2 | I | External reference input |

detailed description

The TLC2551, TLC2552, and TLC2555 are successive approximation (SAR) ADCs utilizing a charge redistribution DAC. Figure 1 shows a simplified version of the ADC.

The sampling capacitor acquires the signal on AIN during the sampling period. When the conversion process starts, the SAR control logic and charge redistribution DAC are used to add and subtract fixed amounts of charge from the sampling capacitor to bring the comparator into a balanced condition. When the comparator is balanced, the conversion is complete and the ADC output code is generated.

TLC2551, TLC2552, TLC2555

5-V, LOW-POWER, 12-BIT, 175/360 KSPS, SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

detailed description (continued)

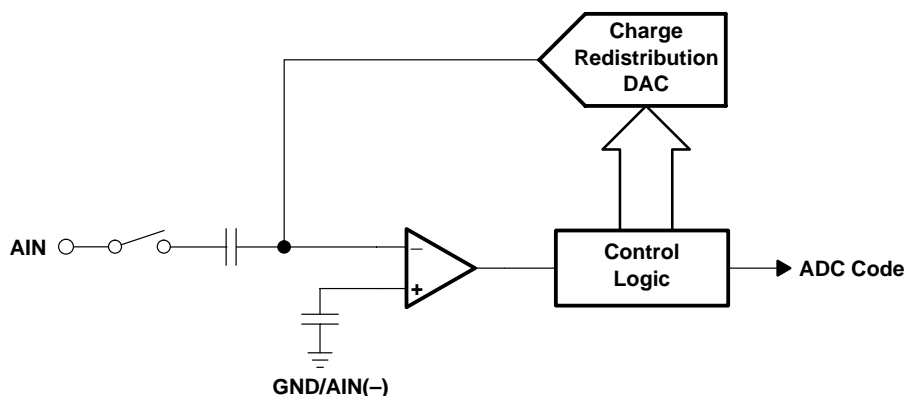


Figure 1. Simplified SAR Circuit

serial interface

| OUTPUT DATA FORMAT | |
|------------------------------|------------|
| MSB | LSB |
| D15–D4 | D3–D0 |
| Conversion result (OD11–OD0) | Don't care |

The output data format is binary (unipolar straight binary).

binary

Zero-scale code = 000h, Vcode = GND

Full-scale code = FFFh, Vcode = $V_{REF} - 1 \text{ LSB}$

pseudo-differential inputs

The TLC2555 operates in pseudo-differential mode. The inverted input is available on pin 5. It can have a maximum input ripple of $\pm 0.2 \text{ V}$. This is normally used for ground noise rejection.

control and timing

start of the cycle

Each cycle may be started by either \overline{CS} , FS, or a combination of both. The internal state machine requires one SCLK high-to-low transition to determine the state of these control signals so internal blocks can be powered up in an active cycle. Special care to SPI mode is necessary. Make sure there is at least one SCLK whenever \overline{CS} (pin 1) is high to assure proper operation.

TLC2551

- Control via \overline{CS} (FS = 1 at the falling edge of \overline{CS})—The falling edge of \overline{CS} is the start of the cycle. The MSB may be read on the first falling SCLK edge after \overline{CS} is low. Output data changes on the rising edge of SCLK. This is typically used for a microcontroller with an SPI interface, although it can also be used for a DSP. The microcontroller SPI interface may be programmed for CPOL = 0 (serial clock referenced to ground) and CPHA = 1 (data is valid on the falling edge of serial clock). At least one falling edge transition on SCLK is needed whenever \overline{CS} is brought high.
- Control via FS—The MSB is presented after the rising edge of FS. The falling edge of FS starts the cycle. The MSB may be read on the first falling edge of SCLK after FS is low. This is the typical configuration when the ADC is the only device on the DSP serial port.

control and timing (continued)

- Control via both \overline{CS} and FS—The MSB is presented after the falling edge of \overline{CS} . The falling edge of FS starts the sampling cycle. The MSB may be read on the first falling SCLK edge after FS is low. Output data changes on the rising edge of SCLK. This control via \overline{CS} and FS is typically used for multiple devices connected to a TMS320 DSP.

TLC2552 and TLC2555

All control is provided using \overline{CS} (pin 1) on the TLC2552 and TLC2555. The cycle starts on the falling edge transition provided by either a \overline{CS} signal from an SPI microcontroller or FS signal from a TMS320 DSP. Timing is similar to the TLC2551, with control via \overline{CS} only.

TLC2552 channel MUX reset cycle

The TLC2552 uses \overline{CS} to reset the analog input multiplexer (MUX). A short active \overline{CS} cycle (4 to 7 SCLKs) resets the MUX to AIN0. When the \overline{CS} cycle time is greater than 7 SCLKs in duration, as is the case for a complete conversion cycle, (\overline{CS} is low for 16 SCLKs plus maximum conversion time), the MUX toggles to the next channel (see Figure 4 for timing).

sampling

The converter sample time is 12 SCLKs in duration, beginning on the fifth SCLK received after the converter has received a high-to-low \overline{CS} transition (or a high-to-low FS transition for the TLC2551).

conversion

The TLC2551, TLC2552, and TLC2555 completes conversion in the following manner. The conversion starts after the 16th SCLK falling edge during the cycle and requires 28 SCLKs to complete. Enough time for conversion should be allowed before a rising \overline{CS} or FS edge so that no conversion is terminated prematurely.

TLC2552 input channel selection is toggled on each rising \overline{CS} edge. The MUX channel can be reset to AIN0 via \overline{CS} as described earlier and in Figure 4. The input is sampled for 12 SCLKs and converted. The result is presented on SDO during the next cycle. Care should also be taken to allow enough time between samples to avoid prematurely terminating the cycle, which occurs on a rising \overline{CS} transition if the conversion is not complete.

The SDO data presented during a cycle is the result of the conversion of the sample taken during the previous cycle.

TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

timing diagrams/conversion cycles

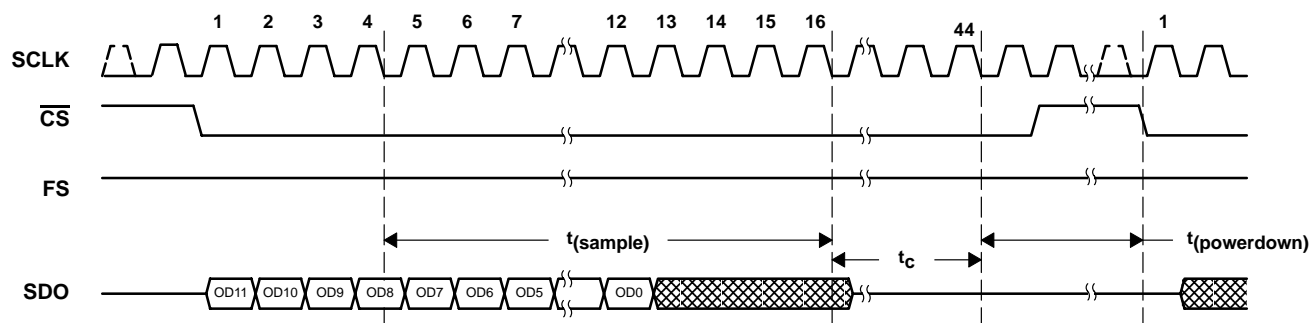


Figure 2. TLC2551 Timing: Control via $\overline{\text{CS}}$ (FS = 1)

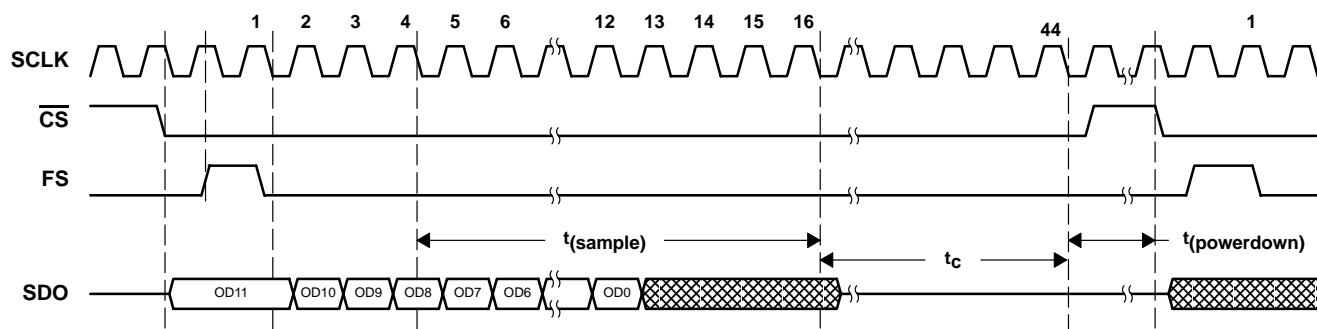


Figure 3. TLC2551 Timing: Control via $\overline{\text{CS}}$ and FS or FS Only

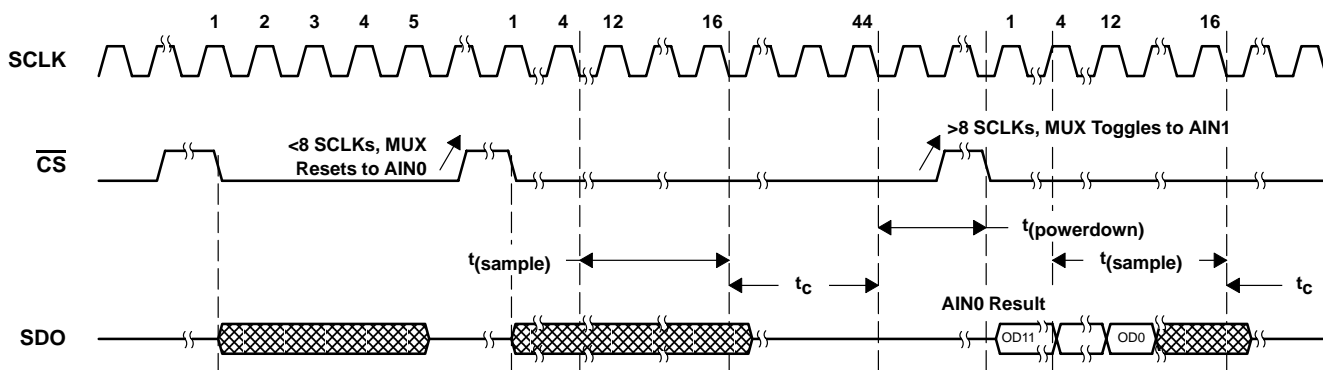


Figure 4. TLC2552 Reset Timing

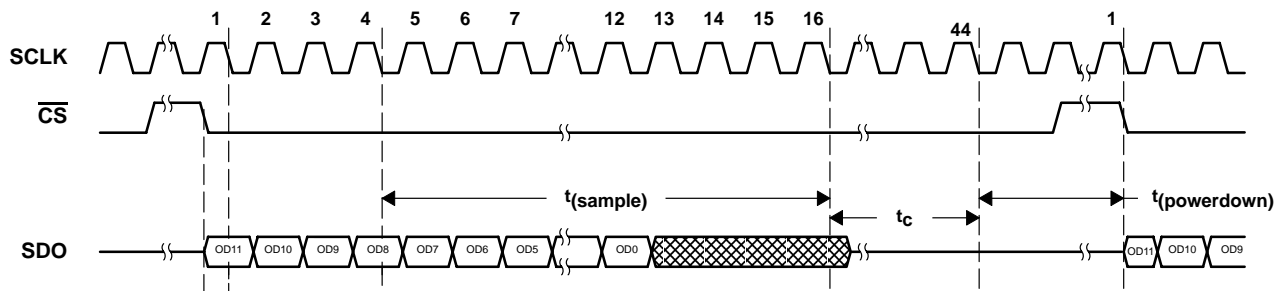


Figure 5. TLC2552 and TLC2555 Timing



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using $\overline{\text{CS}}$ as the FS input

When interfacing the TLC2551 with the TMS320 DSP, the FSR signal from the DSP may be connected to the $\overline{\text{CS}}$ input if this is the only device on the serial port. This connection saves one output terminal from the DSP. (Output data changes on the falling edge of SCLK. This is the default configuration for the TLC2552 and TLC2555).

SCLK and conversion speed

The SCLK input can range in frequency from 100 kHz to 20 MHz. The required number of conversion clocks is 14. The conversion clock for the ADC is SCLK/2 which translates to 28 SCLK cycles to perform a conversion. For a 15-MHz SCLK, the minimum total cycle time is given by: $16 \times (1/15 \text{ M}) + 14 \times (1/7.5 \text{ M}) + 1 \text{ SCLK} = 3.0 \mu\text{s}$. An additional SCLK is added to account for the required $\overline{\text{CS}}$ or FS high time. These times specify the minimum cycle time for an active $\overline{\text{CS}}$ or FS signal. If violated, the conversion terminates, invalidating the next data output cycle. Table 1 gives the maximum SCLK frequency for a given operational mode.

control via pin 1 ($\overline{\text{CS}}$, SPI interface)

All devices are compatible with this mode of operation. A falling $\overline{\text{CS}}$ initiates the cycle. (For TLC2551, the FS input is tied to V_{DD} .) $\overline{\text{CS}}$ remains low for the entire cycle time (sample + convert + 1 SCLK) and can then be released.

NOTE:

IMPORTANT: A single SCLK is required whenever $\overline{\text{CS}}$ is high.

control via pin 1 ($\overline{\text{CS}}$, DSP interface)

All devices are compatible with this mode of operation. The FS signal from a DSP is connected directly to the $\overline{\text{CS}}$ input of the ADC. A falling edge on the $\overline{\text{CS}}$ input initiates the cycle. (For TLC2551, the FS input can be tied to V_{DD} , although better performance can be achieved by using the FS input for control. Refer to the *control via pin 1 and pin 7 ($\overline{\text{CS}}$ and FS or FS only, DSP interface)* section. The $\overline{\text{CS}}$ input should remain low for the entire cycle time (sample + convert + 1 SCLK) and can then be released.

NOTE:

IMPORTANT: A single SCLK is required whenever $\overline{\text{CS}}$ is high. This requirement is usually of little consequence since SCLK is normally always present when interfacing with a DSP.

control via pin 1 and pin 7 ($\overline{\text{CS}}$ and FS or FS only, DSP interface)

Only the TLC2551 is compatible with this mode of operation. The $\overline{\text{CS}}$ input to the ADC can be controlled via a general-purpose I/O pin from the DSP. The FS signal from the DSP is connected directly to the FS input of the ADC. A falling edge on $\overline{\text{CS}}$, if used, releases the MSB on the SDO output. When $\overline{\text{CS}}$ is not used, the rising FS edge releases the MSB. The falling edge on the FS input while SCLK is high initiates the cycle. The $\overline{\text{CS}}$ and FS inputs should remain low for the entire cycle time (sample + convert + 1 SCLK) and can then be released.

reference voltage

An external reference is applied via V_{REF} . The voltage level applied to this pin establishes the upper limit of the analog inputs to produce a full-scale reading. The value of V_{REF} and the analog input must not exceed the positive supply or be less than GND, consistent with the specified absolute maximum ratings. The digital output is at full scale when the input signal is equal to or higher than V_{REF} and at zero when the input signal is equal to or lower than GND.

powerdown and powerup

Autopower down is built into these devices in order to reduce power consumption. The actual power savings depends on the inactive time between cycles and the power supply (loading) decoupling/storage capacitors. *Power-down takes effect immediately after the conversion is complete.* This is fast enough to provide some power savings between cycles with longer than 1 SCLK inactive time. *The device power goes down to 8 μA within 0.5 μs .* To achieve the lowest power-down current (*deep powerdown*) of 1 μA requires 2-ms inactive time between cycles. The power-down state is initiated at the end of conversion. These devices wake up *immediately* at the next falling edge of $\overline{\text{CS}}$ or the rising edge of FS.

TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

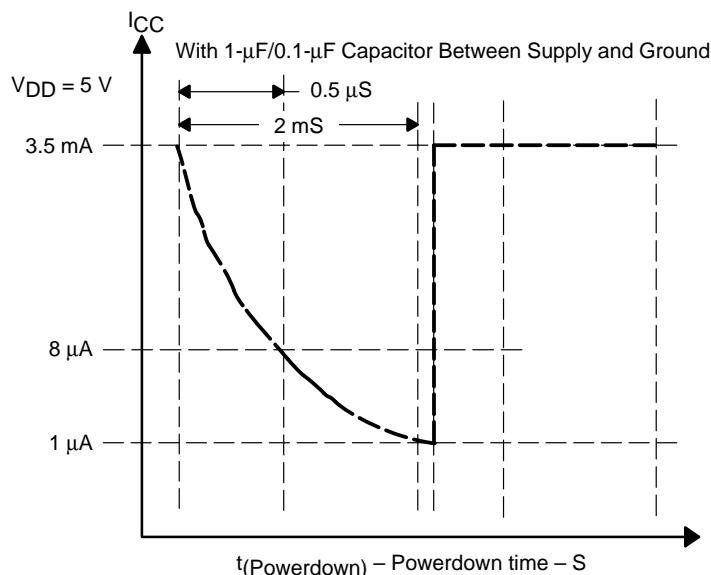


Table 1. Modes of Operation and Data Throughput

| CONTROL PIN(s)/DEVICE | MAX SCLK (MHz) (50/50 duty cycle) $V_{DD} = 4.5\text{ V}$ | APPROXIMATE CONVERSION THROUGHPUT (ksp/s) $V_{DD} = 4.5\text{ V}$ |
|---|---|---|
| $\overline{\text{CS}}$ control only (TLC2551 only) | | |
| For SPI† | 15 | 333 |
| DSP interface‡ | 8 | 175 |
| $\overline{\text{CS}}$ and FS control (TLC2551 only)§ | | |
| DSP interface | 20 | 400 |

† See Figure 21(a).

‡ See Figure 21(b).

§ See Figure 21(c).

absolute maximum ratings over operating free-air temperature (unless otherwise noted)¶

| | |
|--|-----------------------------------|
| Supply voltage range, GND to V_{DD} | –0.3 V to 6.5 V |
| Analog input voltage range | –0.3 V to $V_{DD} + 0.3\text{ V}$ |
| Reference input voltage | $V_{DD} + 0.3\text{ V}$ |
| Digital input voltage range | –0.3 V to $V_{DD} + 0.3\text{ V}$ |
| Operating virtual junction temperature range, T_J | –40°C to 150°C |
| Operating free-air temperature range, T_A : C | 0°C to 70°C |
| I | –40°C to 85°C |
| Storage temperature range, T_{stg} | –65°C to 150°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C |

¶ Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|--|--|------|------|----------|-------------|
| Supply voltage, V_{DD} | | 4.5 | 5 | 5.5 | V |
| Positive external reference voltage input, V_{REFP} (see Note 1) | | 2 | | V_{DD} | V |
| Analog input voltage (see Note 1) | | 0 | | V_{DD} | V |
| High level control input voltage, V_{IH} | | 2.1 | | | V |
| Low-level control input voltage, V_{IL} | | | | 0.6 | V |
| Setup time, \overline{CS} falling edge before first SCLK falling edge, $t_{su}(CSL-SCLKL)$ | $V_{DD} = REF = 4.5\text{ V}$ | 40 | | | ns |
| Hold time, \overline{CS} falling edge after SCLK falling edge, $t_h(SCLKL-CSL)$ | | 5 | | | ns |
| Delay time, delay from \overline{CS} falling edge to FS rising edge $t_d(CSL-FSH)$ (TLC2551 only) | | 0.5 | | 7 | SCLKs |
| Setup time, FS rising edge before SCLK falling edge, $t_{su}(FSH-SCLKL)$ (TLC2551 only) | | 0.35 | | | SCLKs |
| Hold time, FS hold high after SCLK falling edge, $t_h(SCLKL-FSL)$ (TLC2551 only) | | | | 0.65 | SCLKs |
| Pulse width \overline{CS} high time, $t_w(H_CS)$ | | 100 | | | ns |
| Pulse width FS high time, $t_w(H_FS)$ (TLC2551 only) | | 0.75 | | | SCLKs |
| SCLK cycle time, $V_{DD} = 5.5\text{ V}$ to 4.5 V , $t_c(SCLK)$ (maximum tolerance of 40/60 duty cycle) | | 50 | | 10000 | ns |
| Pulse width low time, $t_w(L_SCLK)$ | | 0.4 | | 0.6 | SCLKs |
| Pulse width high time, $t_w(H_SCLK)$ | | 0.4 | | 0.6 | SCLKs |
| Hold time, hold from end of conversion to \overline{CS} high, $t_h(EOC-CSH)$ (EOC is internal, indicates end of conversion time, t_c) | | | 0.05 | | μs |
| Active \overline{CS} cycle time to reset internal MUX to AIN0, $t_{(Reset\ cycle)}$ (TLC2552 only) | | 4 | | 7 | SCLKs |
| Delay time, delay from \overline{CS} falling edge to SDO valid, $t_d(CSL-SDOV)$ | $V_{DD} = REF = 4.5\text{ V}$, 25-pF load | | | 40 | ns |
| Delay time, delay from FS falling edge to SDO valid, $t_d(FSL-SDOV)$ (TLC2551 only) | $V_{DD} = REF = 4.5\text{ V}$, 25-pF load | | | 1 | ns |
| Delay time, delay from SCLK rising edge to SDO valid, $t_d(SCLKH-SDOV)$ | $V_{DD} = REF = 4.5\text{ V}$, 25-pF load | | | 11 | ns |
| Delay time, delay from 17th SCLK rising edge to SDO 3-state, $t_d(SCLK17H-SDOZ)$ | $V_{DD} = REF = 4.5\text{ V}$, 25-pF load | | | 30 | ns |
| Conversion time, t_c | | | 28 | | SCLKs |
| Sampling time, $t_{(sample)}$ | See Note 2 | 300 | | | ns |
| Operating free-air temperature, T_A | TLC2551/2/5C | 0 | | 70 | $^{\circ}C$ |
| | TLC2551/2/5I | -40 | | 85 | |

- NOTES: 1. Analog input voltages greater than that applied to V_{REF} convert as all ones (111111111111), while input voltages less than that applied to GND convert as all zeros(000000000000).
2. Minimal $t_{(sample)}$ is given by $0.9 \times 50\text{ pF} \times (R_S + 0.5\text{ k}\Omega)$, where R_S is the source output impedance.



TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN

SLAS276D – MARCH 2000 – REVISED MAY 2003

electrical characteristics over recommended operating free-air temperature range,
 $V_{DD} = V_{REF} = 4.5\text{ V to }5.5\text{ V}$, (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|---|--|---|--|--------|------|-----|------|
| V _{OH} | High-level output voltage | V _{DD} = 5.5 V, I _{OH} = −0.2 mA at 30-pF load | | 2.4 | | | V |
| V _{OL} | Low-level output voltage | V _{DD} = 5.5 V, I _{OL} = 0.8 mA at 30-pF load | | | | 0.4 | V |
| I _{OZ} | Off-state output current (high-impedance-state) | V _O = V _{DD} | $\overline{\text{CS}}$ = V _{DD} | 1 | 2.5 | | μA |
| | | V _O = 0 | | −1 | −2.5 | | |
| I _{IH} | High-level input current | V _I = V _{DD} | | 0.005 | 2.5 | | μA |
| I _{IL} | Low-level input current | V _I = 0 V | | −0.005 | 2.5 | | μA |
| I _{CC} | Operating supply current | $\overline{\text{CS}}$ at 0 V, V _{DD} = 4.5 V to 5.5 V | | 3 | 3.5 | | mA |
| I _{CC} (AUTOPWDN) | Autopower-down current t _(powerdown) ≥ 0.5 μs | For all digital inputs, 0 ≤ V _I ≤ 0.3 V or V _I ≥ V _{DD} − 0.3 V, SCLK = 0, V _{DD} = 4.5 V to 5.5 V, Ext ref | | 8 | | | μA |
| | Deep autopower-down current t _(powerdown) ≥ 2 ms | | | 1 | | | |
| Selected analog input channel leakage current | | Selected channel at V _{DD} | | 1 | | | μA |
| | | Selected channel at 0 V | | −1 | | | |
| C _i | Input capacitance | Analog inputs | | 20 | 45 | 50 | pF |
| | | Control Inputs | | 5 | | 25 | |
| Input on resistance | | V _{DD} = 5.5 V | | 500 | | | Ω |

† All typical values are at $V_{DD} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

TLC2551, TLC2552, TLC2555
5-V, LOW-POWER, 12-BIT, 175/360 KSPS,
SERIAL ANALOG-TO-DIGITAL CONVERTERS WITH AUTOPOWER DOWN
 SLAS276D – MARCH 2000 – REVISED MAY 2003

ac specifications ($f_i = 20$ kHz)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|------------------------------------|-----|------|-----|------|
| SINAD Signal-to-noise ratio + distortion | 400 KSPS, $V_{DD} = V_{REF} = 5$ V | 70 | 72 | | dB |
| THD Total harmonic distortion | 400 KSPS, $V_{DD} = V_{REF} = 5$ V | | –84 | –80 | dB |
| ENOB Effective number of bits | 400 KSPS, $V_{DD} = V_{REF} = 5$ V | | 11.8 | | bits |
| SFDR Spurious free dynamic range | 400 KSPS, $V_{DD} = V_{REF} = 5$ V | | –84 | –80 | dB |
| Analog Input | | | | | |
| Full-power bandwidth, –3 dB | | | 1 | | MHz |
| Full-power bandwidth, –1 dB | | | 500 | | kHz |

external reference specifications

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------------------|-----------------------------|-------------------------------------|-----|----------|------------|
| Reference input voltage | $V_{DD} = 4.5$ V to 5.5 V | 2 | | V_{DD} | V |
| Reference input impedance | $V_{DD} = 5.5$ V | $\overline{CS} = 1$, SCLK = 0 | | 100 | M Ω |
| | | $\overline{CS} = 0$, SCLK = 20 MHz | | 20 25 | k Ω |
| Reference current | $V_{DD} = V_{REF} = 5.5$ V | | 100 | 400 | μ A |
| Reference input capacitance | $V_{DD} = V_{REF} = 5.5$ V | $\overline{CS} = 1$, SCLK = 0 | | 5 | 15 |
| | | $\overline{CS} = 0$, SCLK = 20 MHz | | 20 45 | 50 |
| V_{REF} Reference voltage | $V_{DD} = 4.5$ V to 5.5 V | | | V_{DD} | V |

dc specification, $V_{DD} = V_{REF} = 4.5$ V to 5.5 V, SCLK frequency = 20 MHz (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------|------------|-----------|-----------|------|
| INL Integral linearity error (see Note 4) | | | ± 0.6 | ± 1 | LSB |
| DNL Differential linearity error | See Note 3 | | ± 0.5 | ± 1 | LSB |
| E_O Offset error (see Note 5) | See Note 3 | TLC2551/52 | | ± 1.5 | LSB |
| | | TLC2555 | | ± 2.5 | |
| E_G Gain error (see Note 5) | See Note 3 | TLC2551/52 | | ± 2 | LSB |
| | | TLC2555 | | ± 5 | |
| E_t Total unadjusted error (see Note 6) | See Note 3 | TLC2551/52 | | ± 2 | LSB |
| | | TLC2555 | | ± 5 | |

- NOTES: 3. Analog input voltages greater than that applied to V_{REF} convert as all ones (111111111111).
 4. Linear error is the maximum deviation from the best straight line through the A/D transfer characteristics.
 5. Zero error is the difference between 000000000000 and the converted output for zero input voltage; full-scale error is the difference between 111111111111 and the converted output for full-scale input voltage.
 6. Total unadjusted error comprises linearity, zero, and full-scale errors.

PARAMETER MEASUREMENT INFORMATION

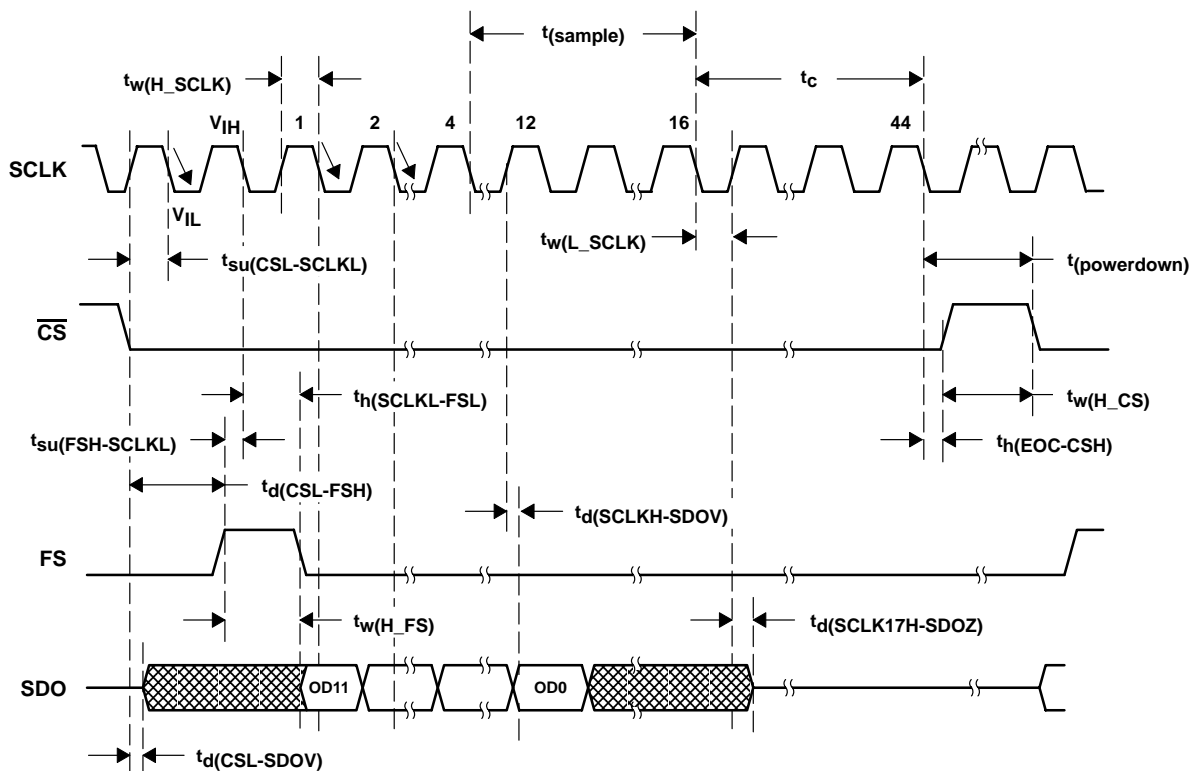


Figure 6. TLC2551 Critical Timing (Control via \overline{CS} and FS or FS only)

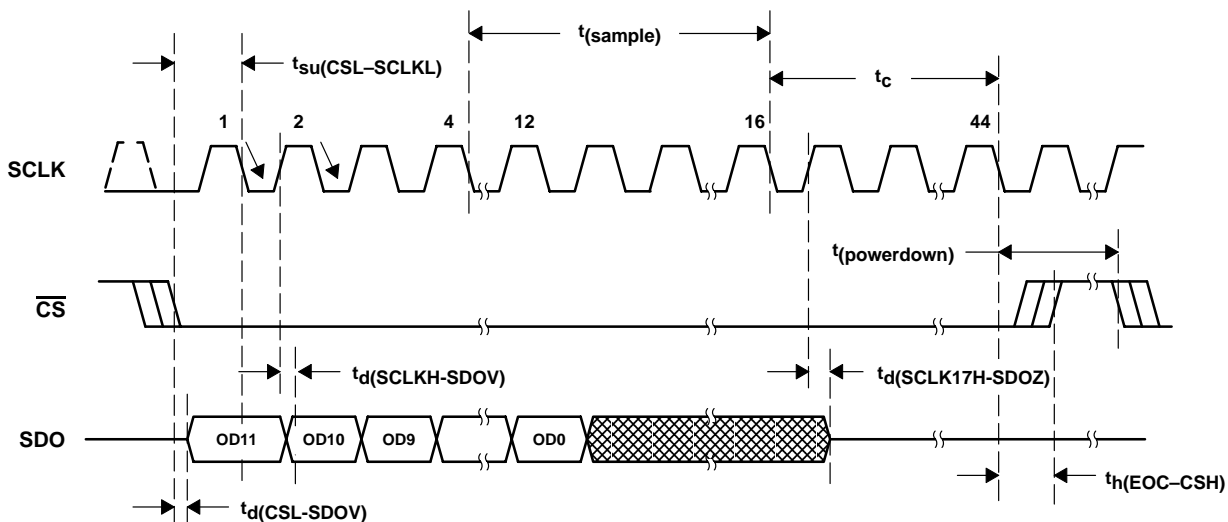


Figure 7. TLC2551 Critical Timing (Control via \overline{CS} only, FS = 1)

PARAMETER MEASUREMENT INFORMATION

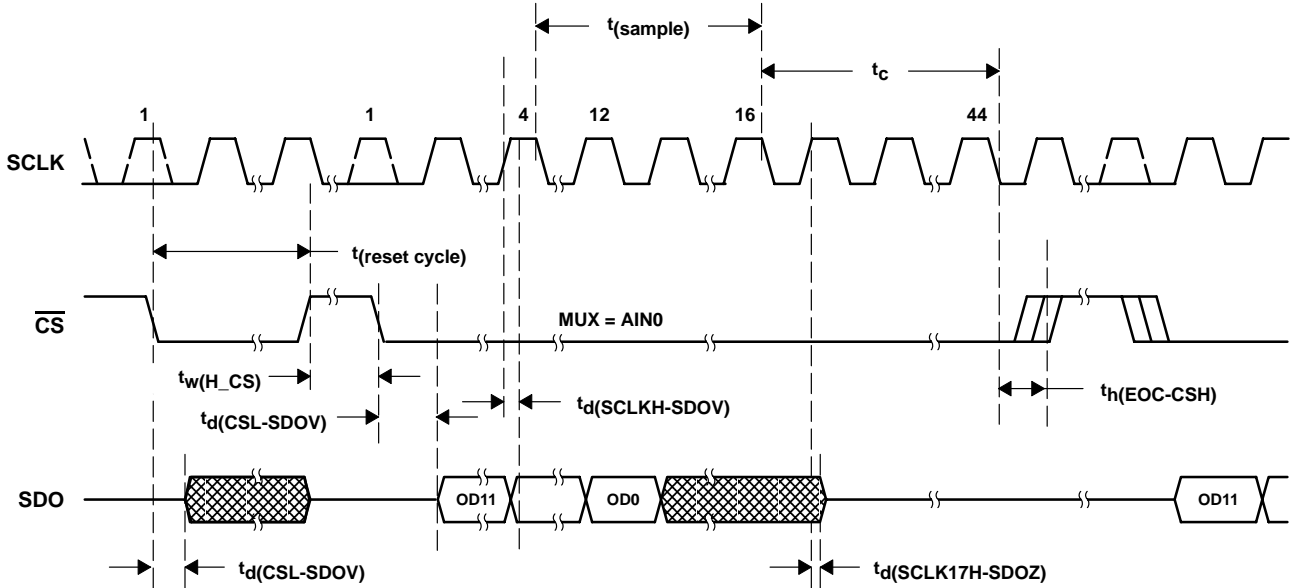


Figure 8. TLC2552 Reset Cycle Critical Timing

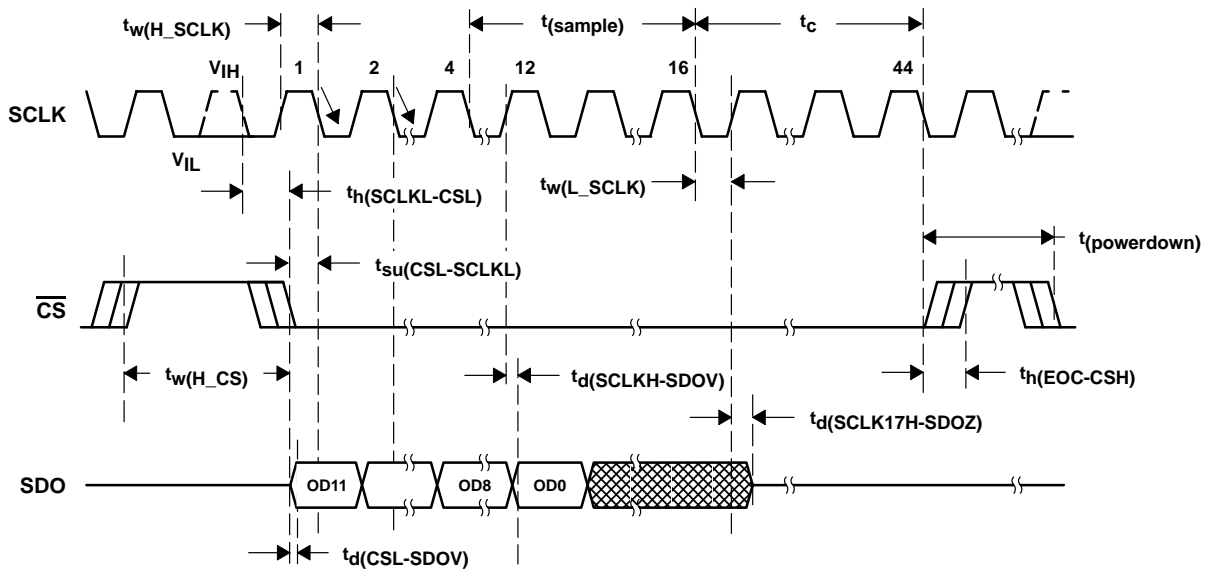


Figure 9. TLC2552 and TLC2555 Conversion Cycle Critical Timing

TYPICAL CHARACTERISTICS

INTEGRAL NONLINEARITY
vs
FREE-AIR TEMPERATURE

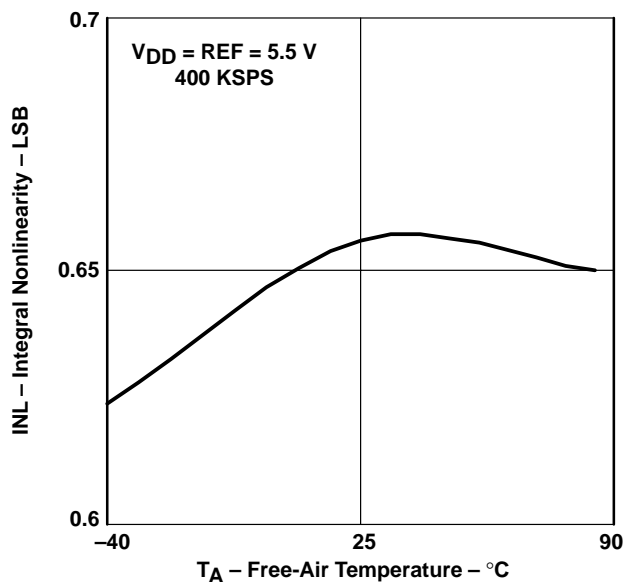


Figure 10

DIFFERENTIAL NONLINEARITY
vs
FREE-AIR TEMPERATURE

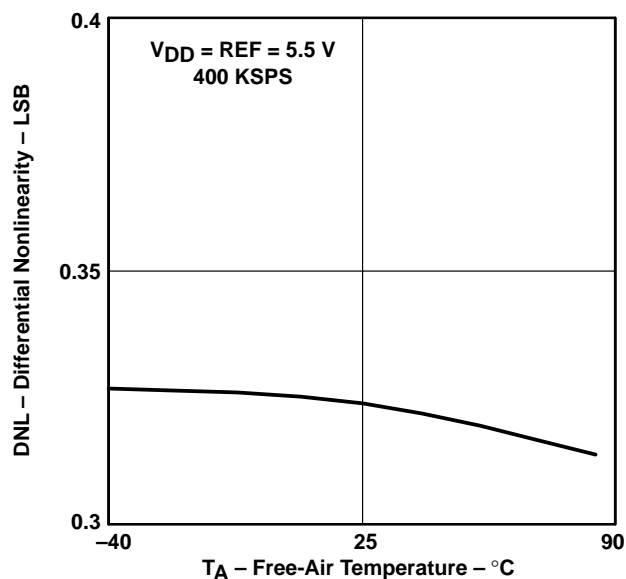


Figure 11

OFFSET ERROR
vs
FREE-AIR TEMPERATURE

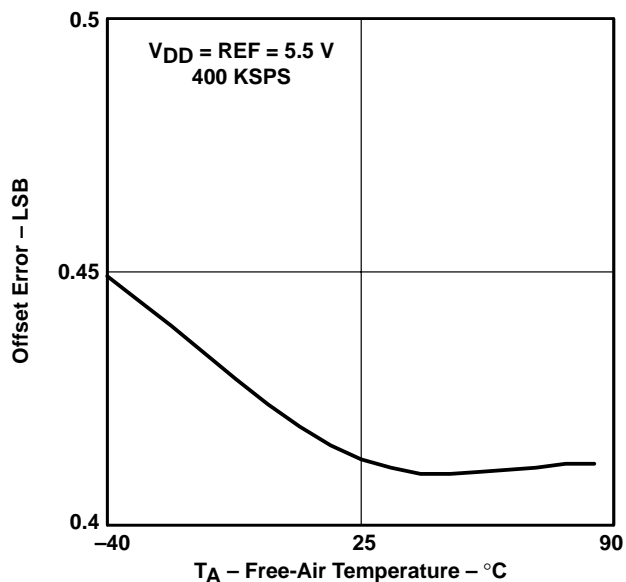


Figure 12

GAIN ERROR
vs
FREE-AIR TEMPERATURE

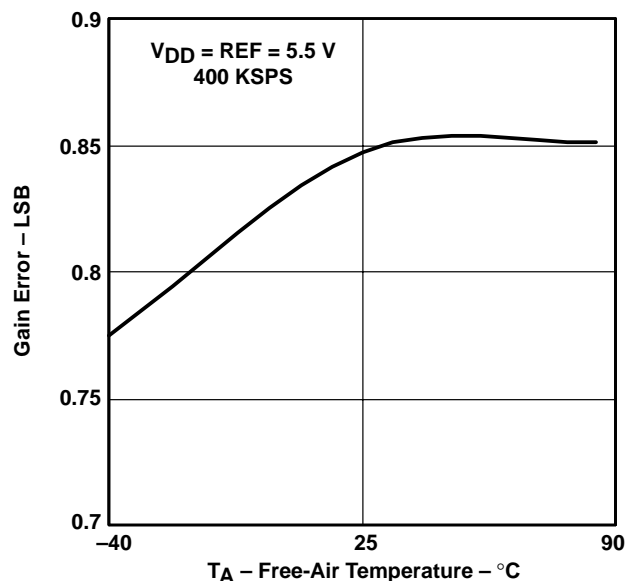


Figure 13

TYPICAL CHARACTERISTICS

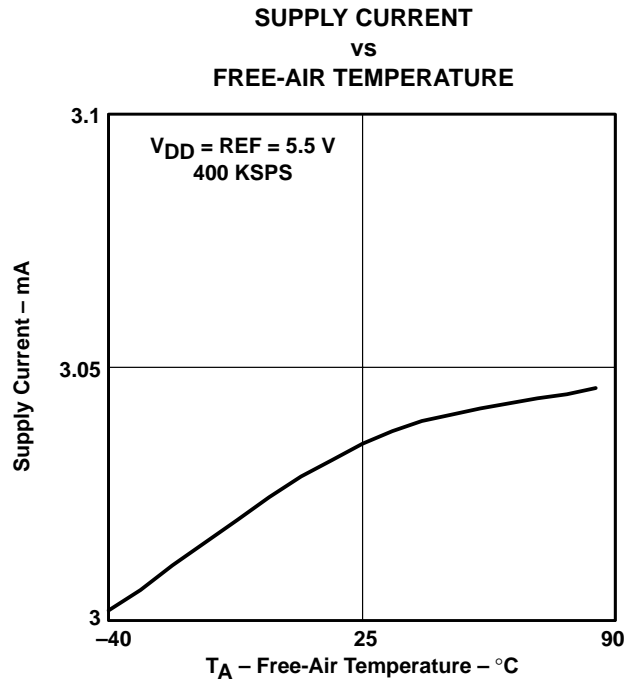


Figure 14

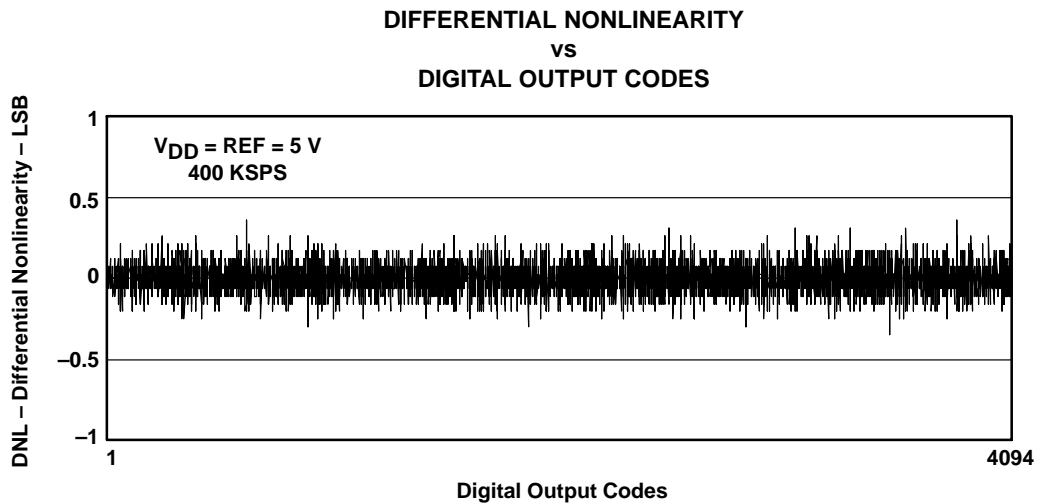


Figure 15

TYPICAL CHARACTERISTICS

INTEGRAL NONLINEARITY vs DIGITAL OUTPUT CODES

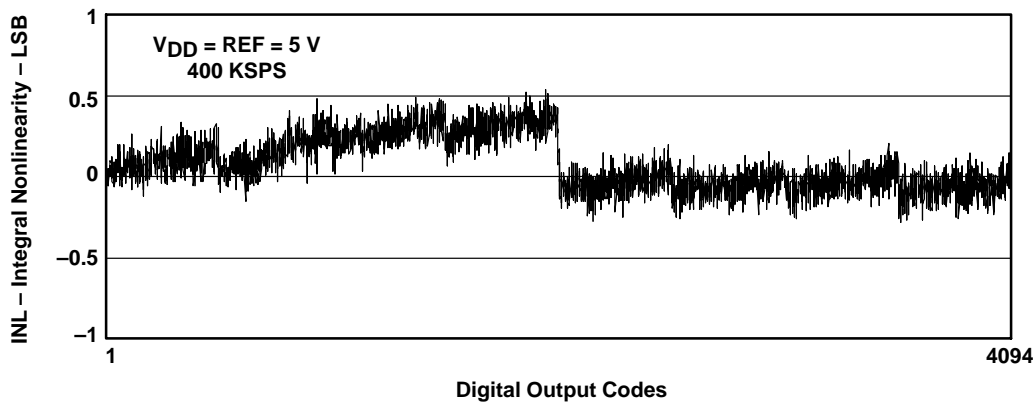


Figure 16

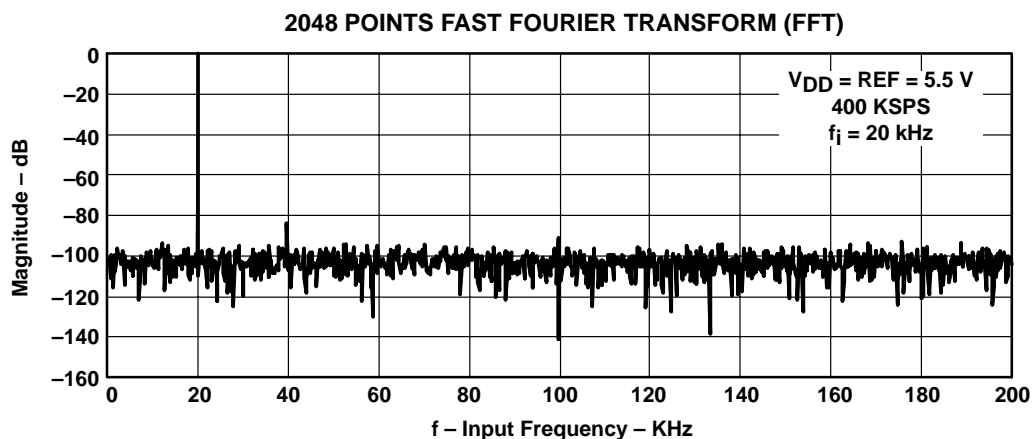


Figure 17

TYPICAL CHARACTERISTICS

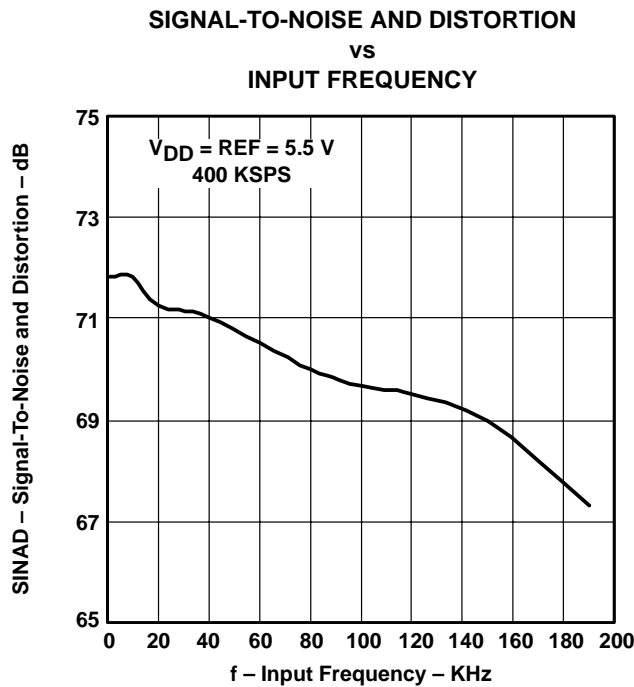


Figure 18

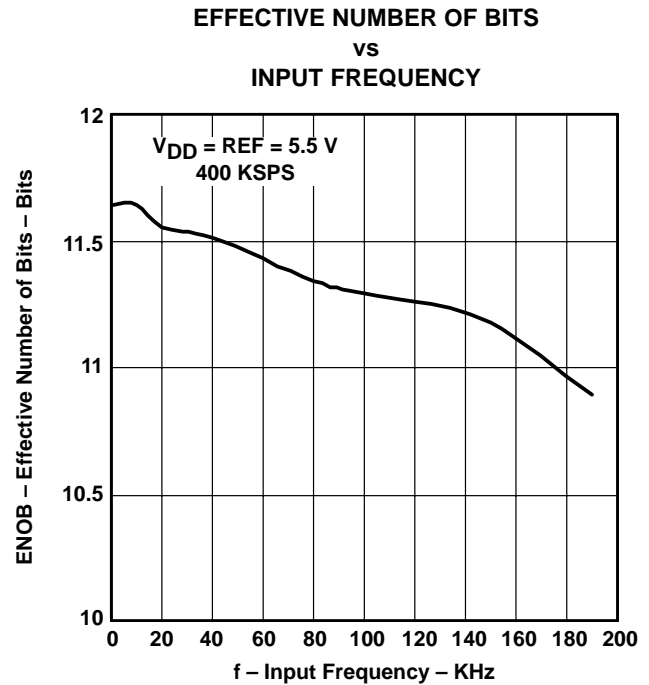


Figure 19

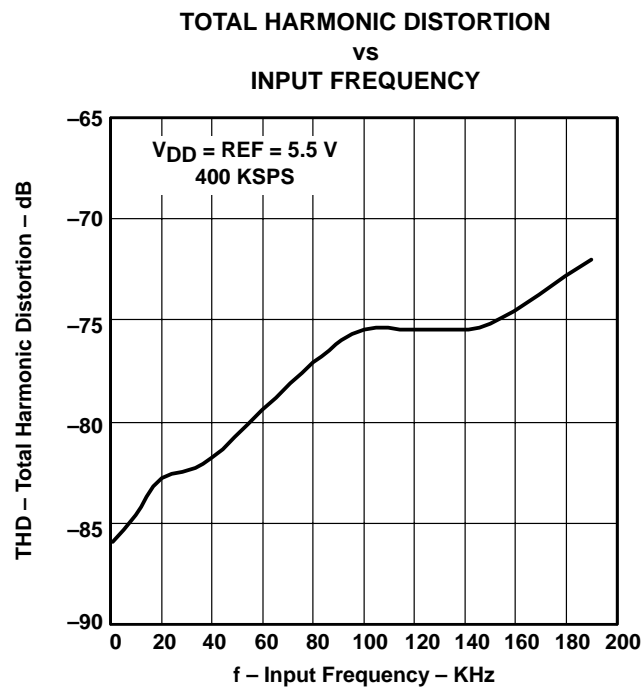


Figure 20

APPLICATION INFORMATION

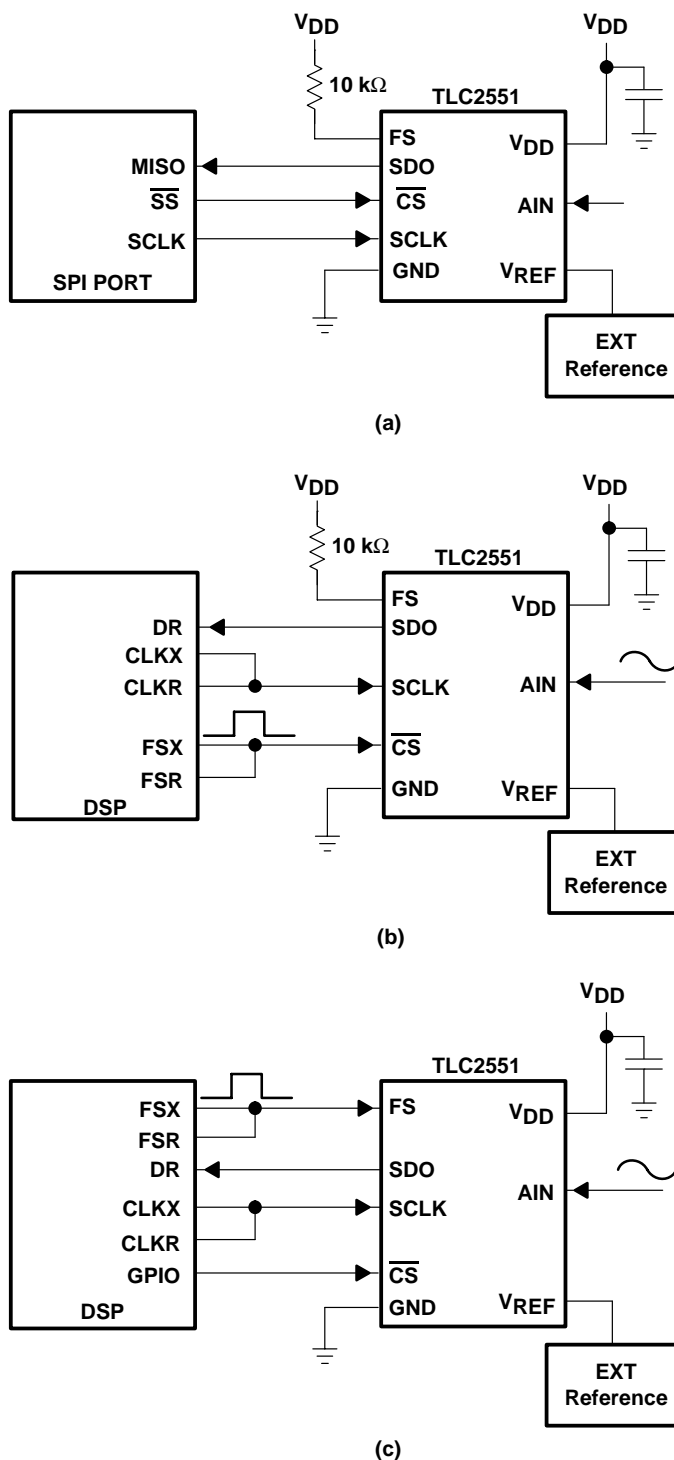


Figure 21. Typical TLC2551 Interface to a TMS320 DSP

APPLICATION INFORMATION

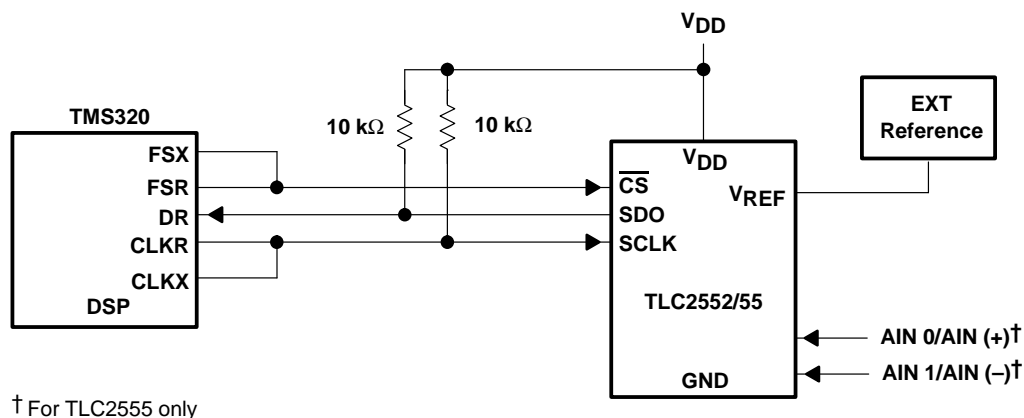


Figure 22. Typical TLC2552/55 Interface to a TMS320 DSP

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLC2551CDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | 0 to 70 | AHF |
| TLC2551CDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | 0 to 70 | AHF |
| TLC2551CDGKR | Active | Production | VSSOP (DGK) 8 | 2500 LARGE T&R | Yes | Call TI Nipdauag | Level-1-260C-UNLIM | 0 to 70 | AHF |
| TLC2551CDGKR.A | Active | Production | VSSOP (DGK) 8 | 2500 LARGE T&R | Yes | Call TI | Level-1-260C-UNLIM | 0 to 70 | AHF |
| TLC2551ID | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2551I |
| TLC2551ID.A | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2551I |
| TLC2551IDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHG |
| TLC2551IDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHG |
| TLC2551IDR | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2551I |
| TLC2551IDR.A | Active | Production | SOIC (D) 8 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2551I |
| TLC2552CDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | 0 to 70 | AHH |
| TLC2552CDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | 0 to 70 | AHH |
| TLC2552ID | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2552I |
| TLC2552ID.A | Active | Production | SOIC (D) 8 | 75 TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 2552I |
| TLC2552IDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHI |
| TLC2552IDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHI |
| TLC2555IDGK | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHK |
| TLC2555IDGK.A | Active | Production | VSSOP (DGK) 8 | 80 TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | AHK |

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLC2551IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



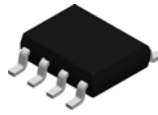
*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLC2551IDR | SOIC | D | 8 | 2500 | 350.0 | 350.0 | 43.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TLC2551CDGK | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2551CDGK.A | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2551ID | D | SOIC | 8 | 75 | 505.46 | 6.76 | 3810 | 4 |
| TLC2551ID.A | D | SOIC | 8 | 75 | 505.46 | 6.76 | 3810 | 4 |
| TLC2551IDGK | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2551IDGK.A | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2552CDGK | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2552CDGK.A | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2552ID | D | SOIC | 8 | 75 | 505.46 | 6.76 | 3810 | 4 |
| TLC2552ID.A | D | SOIC | 8 | 75 | 505.46 | 6.76 | 3810 | 4 |
| TLC2552IDGK | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2552IDGK.A | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2555IDGK | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |
| TLC2555IDGK.A | DGK | VSSOP | 8 | 80 | 331.47 | 6.55 | 3000 | 2.88 |

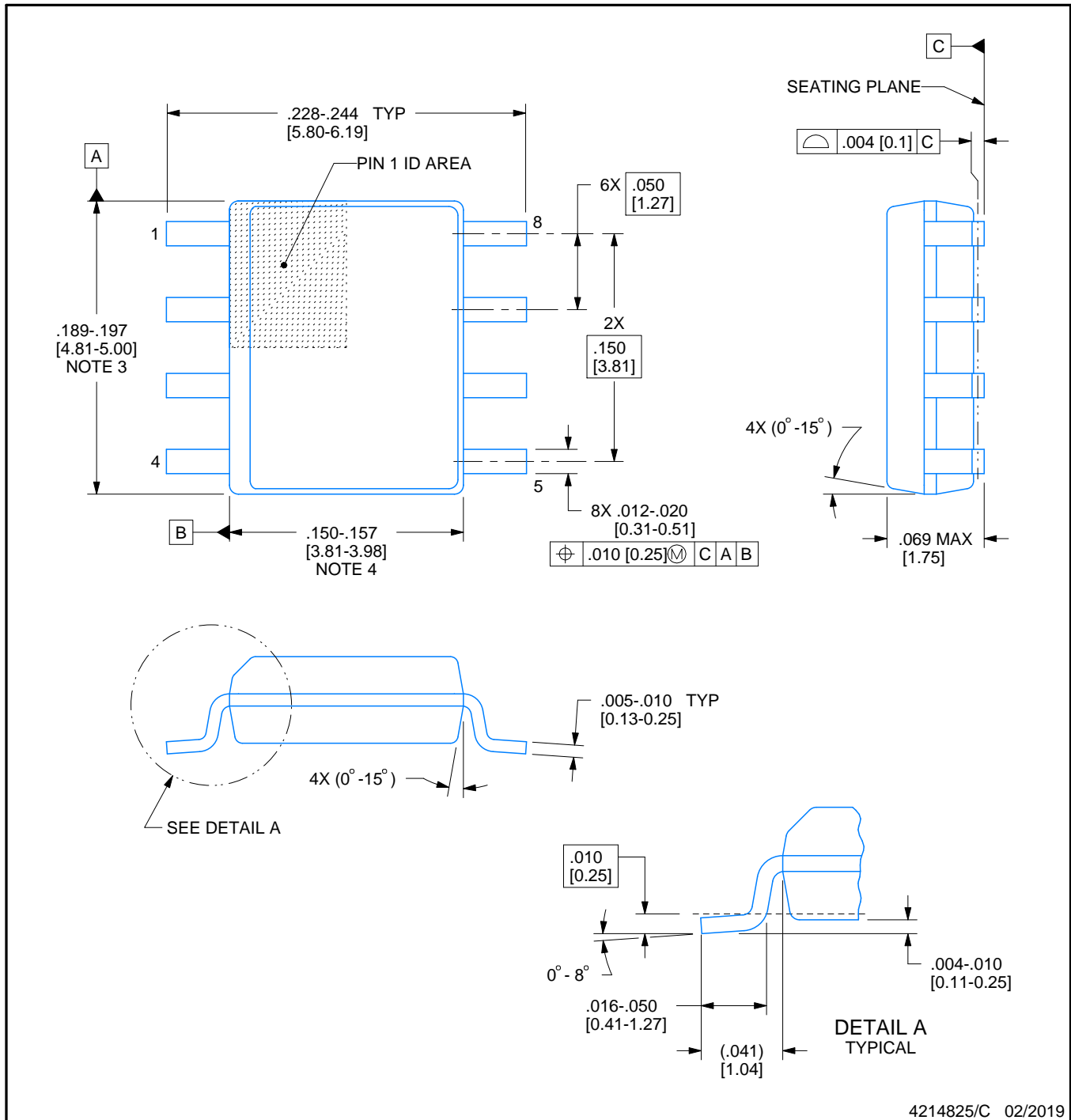


D0008A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

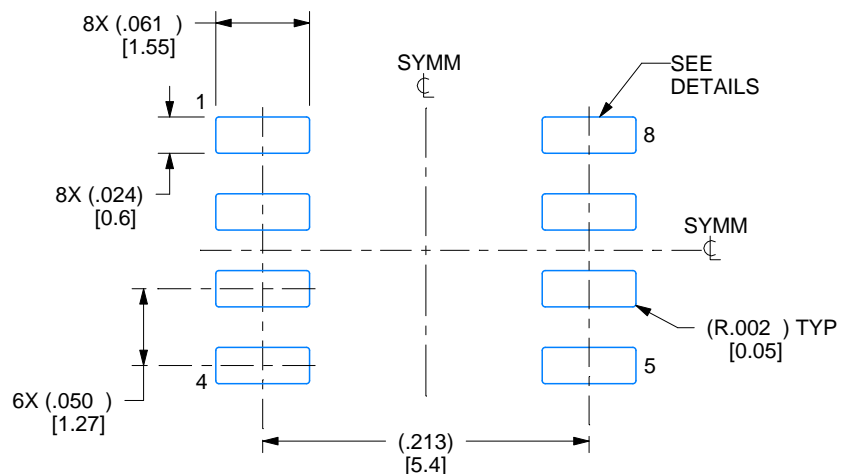
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

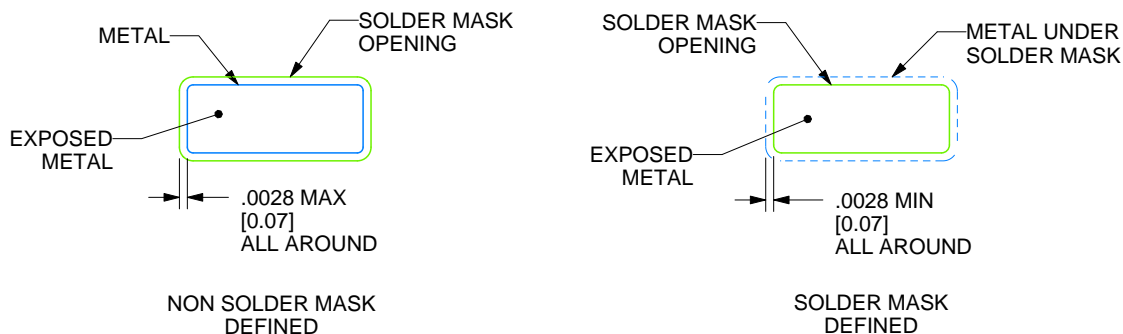
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

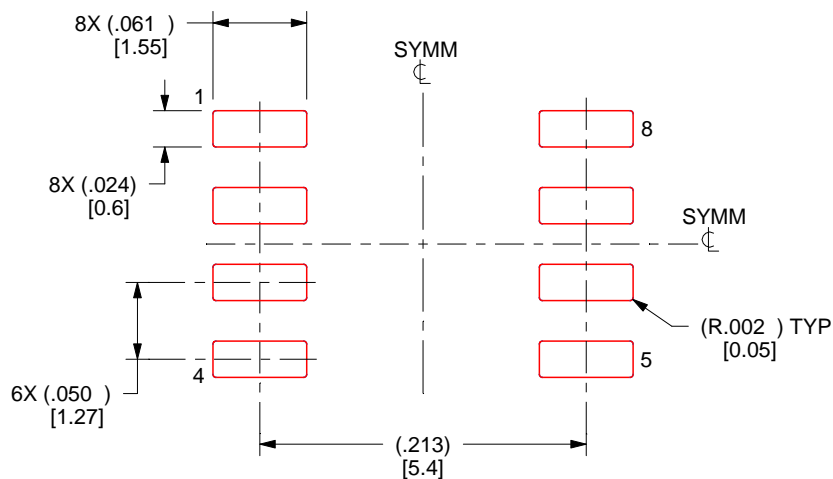
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



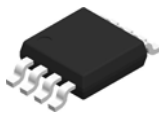
SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

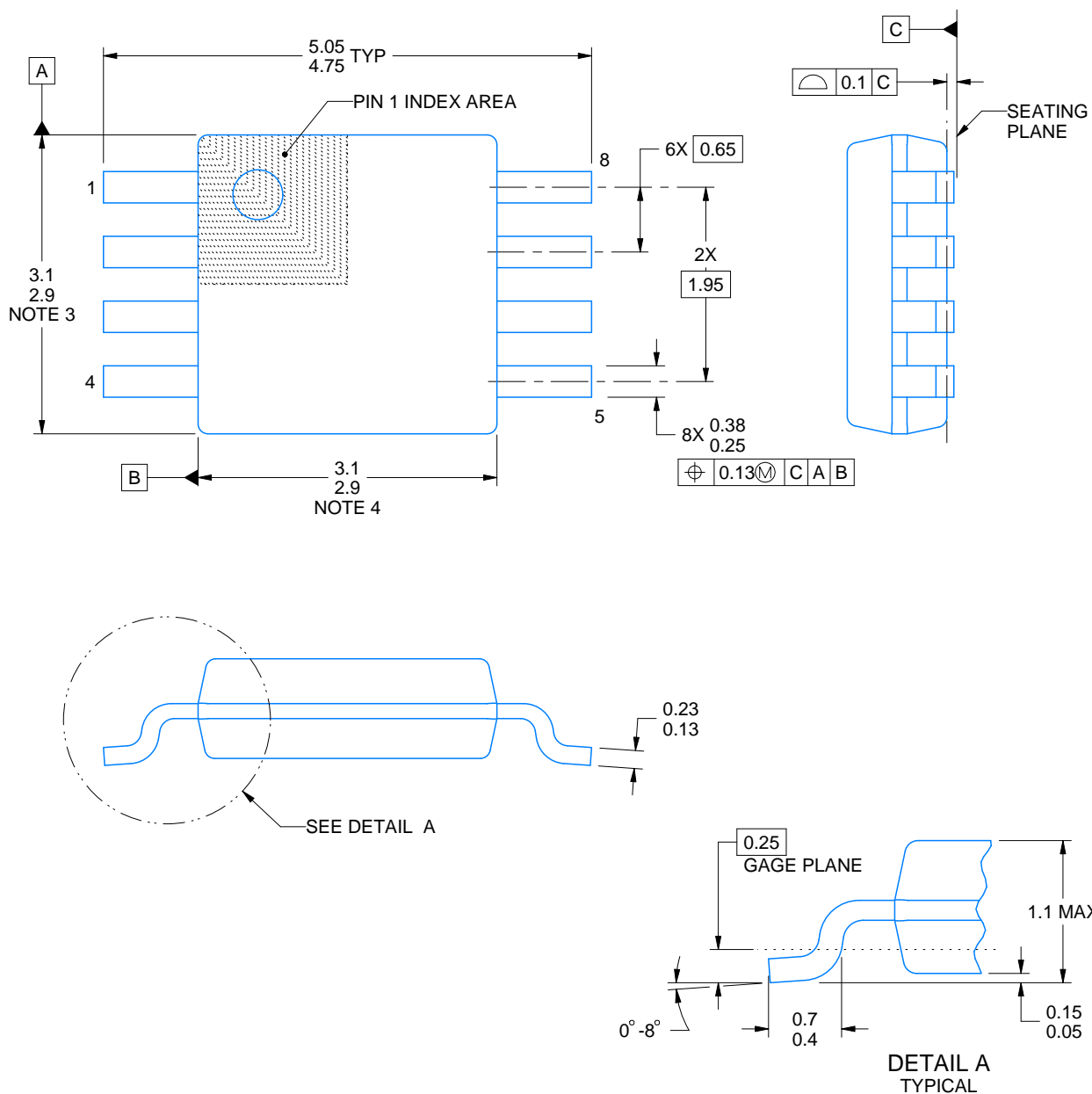
DGK0008A



PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4214862/A 04/2023

NOTES:

PowerPAD is a trademark of Texas Instruments.

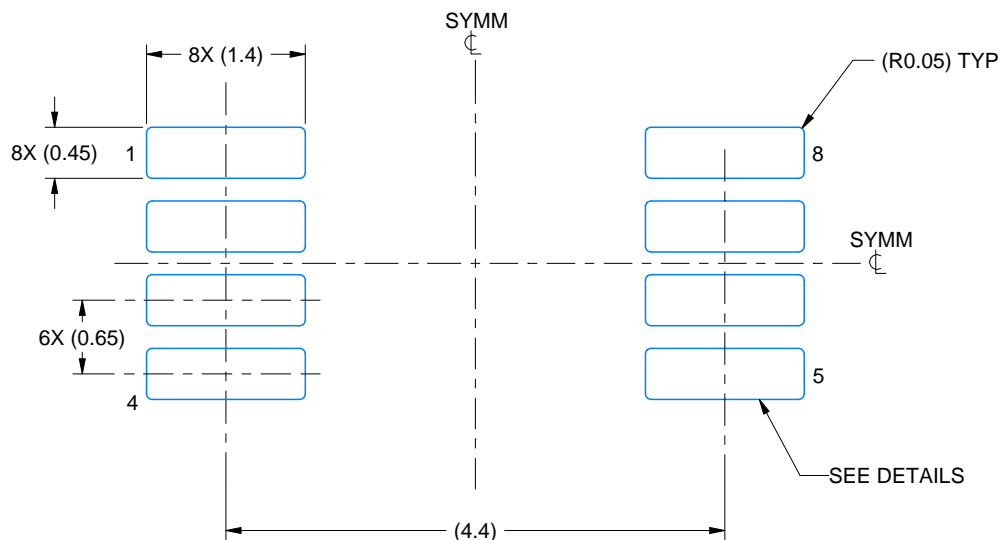
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

EXAMPLE BOARD LAYOUT

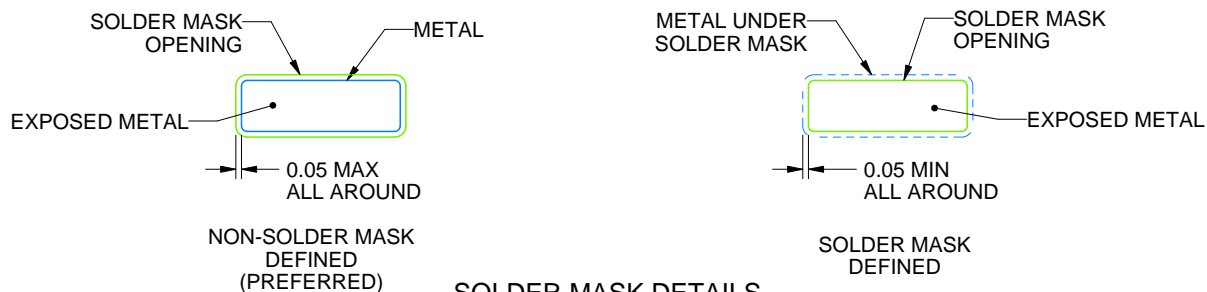
DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

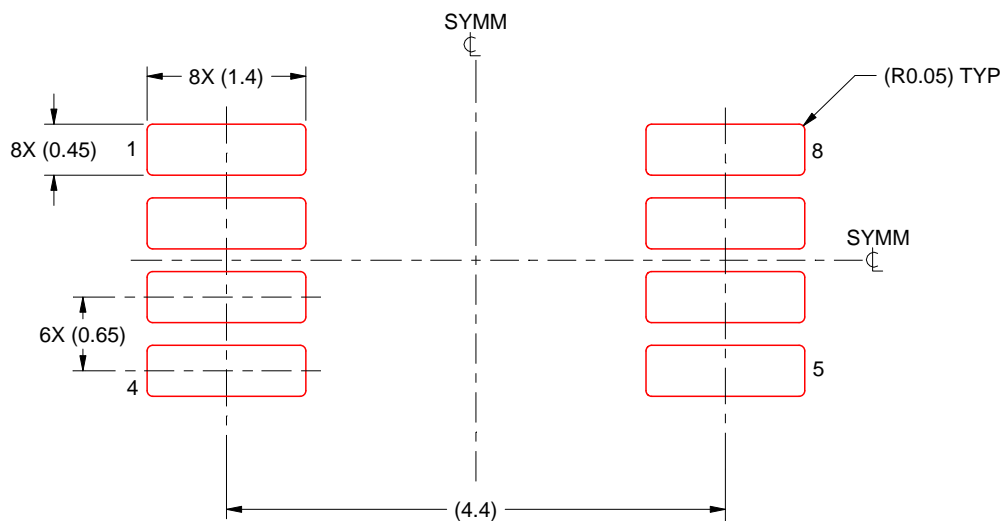
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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