

# TLV1571, TLV1578

## 2.7 V TO 5.5 V, 1-/8-CHANNEL, 10-BIT, PARALLEL ANALOG-TO-DIGITAL CONVERTERS

SLAS170C – MARCH 1999 – REVISED FEBRUARY 2000

### features

- Fast Throughput Rate: 1.25 MSPS at 5 V, 625 KSPS at 3 V
- Wide Analog Input: 0 V to  $AV_{DD}$
- Differential Nonlinearity Error:  $< \pm 1$  LSB
- Integral Nonlinearity Error:  $< \pm 1$  LSB
- 8-to-1 Analog MUX – TLV1578
- Internal OSC
- Single 2.7-V to 5.5-V Supply Operation
- Low Power: 12 mW at 3 V and 35 mW at 5 V
- Auto Power Down of 1 mA Max
- Software Power Down: 10  $\mu$ A Max
- Hardware Configurable
- DSP and Microcontroller Compatible Parallel Interface
- Binary/Twos Complement Output
- Hardware Controlled Extended Sampling
- Channel Sweep Mode Operation and Channel Select
- Hardware or Software Start of Conversion

### applications

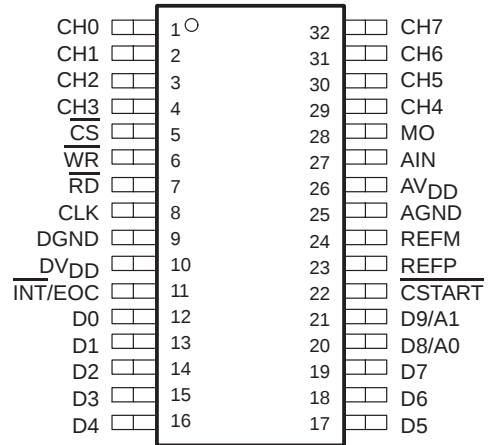
- Mass Storage and HDD
- Automotive
- Digital Servos
- Process Control
- General-Purpose DSP
- Image Sensor Processing

### description

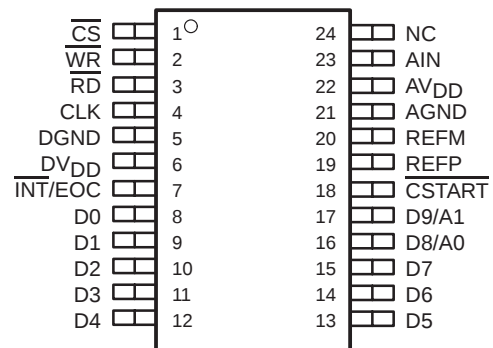
The TLV1571/1578 is a 10-bit data acquisition system that combines an 8-channel input multiplexer (MUX), a high-speed 10-bit ADC, and a parallel interface. The device contains two on-chip control registers allowing control of channel selection, software conversion start, and power down via the bidirectional parallel port. The control registers can be set to a default mode by applying a dummy RD signal when WR is tied low. This allows the TLV1571/1578 to be configured by hardware. The MUX is independently accessible. This allows the user to insert a signal conditioning circuit such as an antialiasing filter or an amplifier, if required, between the MUX and the ADC. Therefore, one signal conditioning circuit can be used for all eight channels. The TLV1571 is a single channel analog input device with all the same functions as the TLV1578.

The TLV1571/TLV1578 operates from a single 2.7-V to 5.5-V power supply. It accepts an analog input range from 0 V to  $AV_{DD}$  and digitizes the input at a maximum 1.25 MSPS throughput rate at 5 V. The power dissipations are only 12 mW with a 3-V supply or 35 mW with a 5-V supply. The device features an auto power-down mode that automatically powers down to 1 mA 50 ns after conversion is performed. In software power-down mode, the ADC is further powered down to only 10  $\mu$ A.

TLV1578  
DA PACKAGE  
(TOP VIEW)



TLV1571  
DW OR PW PACKAGE  
(TOP VIEW)



NC – No internal connection



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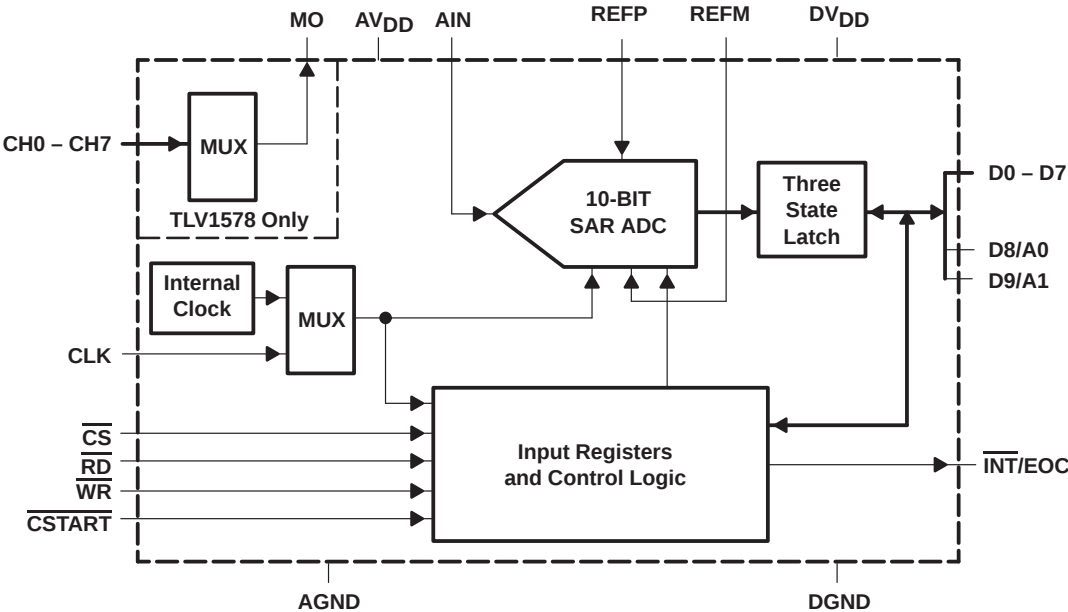
## description (continued)

Very high throughput rate, simple parallel interface, and low power consumption make the TLV1571/TLV1578 an ideal choice for high-speed digital signal processing requiring multiple analog inputs.

AVAILABLE OPTIONS

| T <sub>A</sub> | PACKAGE       |             |               |
|----------------|---------------|-------------|---------------|
|                | 32 TSSOP (DA) | 24 SOP (DW) | 24 TSSOP (PW) |
| 0°C to 70°C    | TLV1578CDA    | TLV1571CDW  | TLV1571CPW    |
| –40°C to 85°C  | TLV1578IDA    | TLV1571IDW  | TLV1571IPW    |

## functional block diagram – TLV1571/78



### Terminal Functions

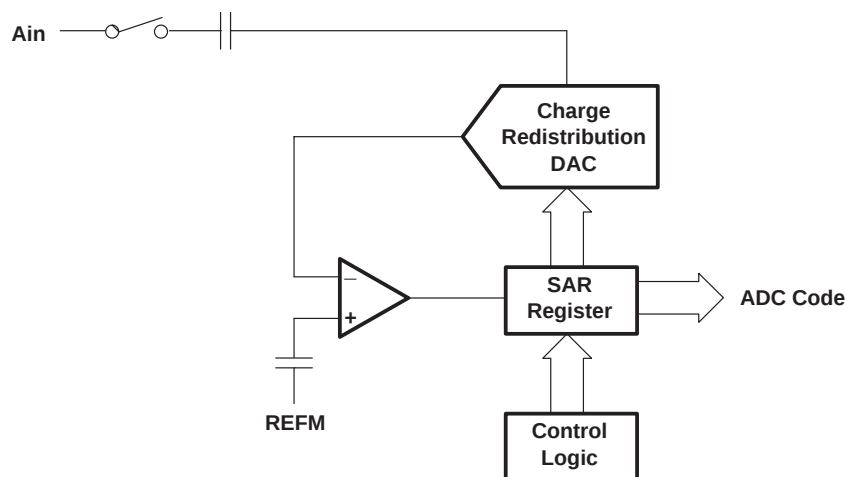
| TERMINAL                    |                |                 | I/O | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------|----------------|-----------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME                        | NO.            |                 |     |                                                                                                                                                                                                                                                                                                                                                                   |
|                             | TLV1571        | TLV1578         |     |                                                                                                                                                                                                                                                                                                                                                                   |
| AGND                        | 21             | 25              |     | Analog ground                                                                                                                                                                                                                                                                                                                                                     |
| AIN                         | 23             | 27              | I   | ADC analog input (used as single analog input channel for TLV1571)                                                                                                                                                                                                                                                                                                |
| AV <sub>DD</sub>            | 22             | 26              |     | Analog supply voltage, 2.7 V to 5.5 V                                                                                                                                                                                                                                                                                                                             |
| CH0 – CH7                   | –              | 1–4,<br>29–32   | I   | Analog input channels                                                                                                                                                                                                                                                                                                                                             |
| CLK                         | 4              | 8               | I   | External clock input                                                                                                                                                                                                                                                                                                                                              |
| $\overline{\text{CS}}$      | 1              | 5               | I   | Chip select. A logic low on $\overline{\text{CS}}$ enables the TLV1571/TLV1578.                                                                                                                                                                                                                                                                                   |
| $\overline{\text{CSTART}}$  | 18             | 22              | I   | Hardware sample and conversion start input. The falling edge of $\overline{\text{CSTART}}$ starts sampling and the rising edge of $\overline{\text{CSTART}}$ starts conversion.                                                                                                                                                                                   |
| DGND                        | 5              | 9               |     | Digital ground                                                                                                                                                                                                                                                                                                                                                    |
| DV <sub>DD</sub>            | 6              | 10              |     | Digital supply voltage, 2.7 V to 5.5 V                                                                                                                                                                                                                                                                                                                            |
| D0 – D7                     | 8–12,<br>13–15 | 12–16,<br>17–19 | I/O | Bidirectional 3-state data bus                                                                                                                                                                                                                                                                                                                                    |
| D8/A0                       | 16             | 20              | I/O | Bidirectional 3-state data bus. D8/A0 along with D9/A1 is used as address lines to access CR0 and CR1 for initialization.                                                                                                                                                                                                                                         |
| D9/A1                       | 17             | 21              | I/O | Bidirectional 3-state data bus. D9/A1 along with D8/A0 is used as address lines to access CR0 and CR1 for initialization.                                                                                                                                                                                                                                         |
| $\overline{\text{INT/EOC}}$ | 7              | 11              | O   | End-of-conversion/interrupt                                                                                                                                                                                                                                                                                                                                       |
| MO                          |                | 28              | O   | On-chip mux analog output                                                                                                                                                                                                                                                                                                                                         |
| NC                          | 24             |                 |     | Not connected                                                                                                                                                                                                                                                                                                                                                     |
| $\overline{\text{RD}}$      | 3              | 7               | I   | Read data. A falling edge on $\overline{\text{RD}}$ enables a read operation on the data bus when $\overline{\text{CS}}$ is low.                                                                                                                                                                                                                                  |
| REFM                        | 20             | 24              | I   | Lower reference voltage (nominally ground). REFM must be supplied or REFM pin must be grounded.                                                                                                                                                                                                                                                                   |
| REFP                        | 19             | 23              | I   | Upper reference voltage (nominally AV <sub>DD</sub> ). The maximum input voltage range is determined by the difference between the voltage applied to REFP and REFM.                                                                                                                                                                                              |
| $\overline{\text{WR}}$      | 2              | 6               | I   | Write data. A rising edge on the $\overline{\text{WR}}$ latches in configuration data when $\overline{\text{CS}}$ is low. When using software conversion start, a rising edge on $\overline{\text{WR}}$ also initiates an internal sampling start pulse. When $\overline{\text{WR}}$ is tied to ground, the ADC in nonprogrammable (hardware configuration mode). |

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### detailed description



**Figure 1. Analog-to-Digital SAR Converter**

The TLV1571/78 is a successive-approximation ADC 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.

### sampling frequency, $f_s$

The TLV1571/TLV1578 requires 16 CLKs for each conversion, therefore the equivalent maximum sampling frequency achievable with a given CLK frequency is:

$$f_{s(max)} = (1/16) f_{CLK}$$

The TLV1571 and TLV1578 are software configurable. The first two MSB bits, D(9,8) are used to address which register to set. The rest of the eight bits are used as control data bits. There are two control registers, CR0 and CR1, that are user configurable. All of the register bits are written to the control register during write cycles. A description of the control registers is shown in Figure 2.

## detailed description (continued)

### control registers

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| A1 | A0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|----|----|----|----|----|----|----|----|----|

| Control Register Zero (CR0)                         |                      |                                            |                               |                                    |         |                         |              |                |
|-----------------------------------------------------|----------------------|--------------------------------------------|-------------------------------|------------------------------------|---------|-------------------------|--------------|----------------|
| A(1:0)=00                                           | D7                   | D6                                         | D5                            | D4                                 | D3      | D2                      | D1           | D0             |
|                                                     | STARTSEL             | PROGEOC                                    | CLKSEL                        | SWPWDN                             | MODESEL | CHSEL(2-0) <sup>†</sup> |              |                |
|                                                     |                      |                                            |                               |                                    |         |                         |              |                |
| 0: HARDWARE START (CSTART)<br><br>1: SOFTWARE START | 0: INT<br><br>1: EOC | 0: Internal Clock<br><br>1: External Clock | 0: NORMAL<br><br>1: Powerdown | 0: Single Channel<br>1: Sweep Mode | D(2-0)  |                         | Single Input | Channels Swept |
|                                                     |                      |                                            |                               |                                    | 0h      |                         | 0            | 0,1            |
|                                                     | 1h                   |                                            | 1                             | 0,1,2,3                            |         |                         |              |                |
|                                                     | 2h                   |                                            | 2                             | 0,1,2,3,4,5,                       |         |                         |              |                |
|                                                     | 3h                   |                                            | 3                             | 0,1,2,3,4,5,6,7                    |         |                         |              |                |
|                                                     | 4h                   |                                            | 4                             | N/A                                |         |                         |              |                |
|                                                     | 5h                   |                                            | 5                             | N/A                                |         |                         |              |                |
|                                                     | 6h                   |                                            | 6                             | N/A                                |         |                         |              |                |
|                                                     | 7h                   |                                            | 7                             | N/A                                |         |                         |              |                |

| Control Register One (CR1)                 |                                              |                                         |                                          |                                      |                                                              |           |                                             |                          |
|--------------------------------------------|----------------------------------------------|-----------------------------------------|------------------------------------------|--------------------------------------|--------------------------------------------------------------|-----------|---------------------------------------------|--------------------------|
| A(1:0)=01                                  | D7‡                                          | D6                                      | D5‡                                      | D4‡                                  | D3                                                           | D2        | D1                                          | D0                       |
|                                            | RESERVED                                     | OSCS PD                                 | 0 Reserved                               | 0 Reserved                           | OUTCODE                                                      | READREG   | STEST1                                      | STEST0                   |
|                                            |                                              |                                         |                                          |                                      |                                                              |           |                                             |                          |
| 0:<br>Reserved<br>Bit<br>Always<br>Write 0 | 0: INT. OSC.<br>SLOW<br>1: INT. OSC.<br>FAST | 0: Reserved<br>Bit<br>Always<br>Write 0 | 0: Reserved<br>Bit,<br>Always<br>Write 0 | 0: Binary<br><br>1: 2s<br>Complement | 0: Enable Self<br>Test<br>1: Enable<br>Register<br>Read back | CR1.(1–0) |                                             | IF READREG = 0<br>ACTION |
|                                            |                                              |                                         |                                          |                                      |                                                              | 0h        | Output =<br>CONVERSION result               |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 1h        | Output =<br>SELF TEST 1 result              |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 2h        | Output =<br>SELF TEST 2 result              |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 3h        | Output =<br>SELF TEST 3 result              |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 0h        | IF READREG = 1<br>Output Contents of<br>CR0 |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 1h        | Output Contents of<br>CR1                   |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 2h        | RESERVED                                    |                          |
|                                            |                                              |                                         |                                          |                                      |                                                              | 3h        | RESERVED                                    |                          |

<sup>†</sup> Don't care for TLV1571

<sup>‡</sup> When in read back mode, the values read from the control register reserved bits are don't care.

Figure 2. Input Data Format

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### detailed description (continued)

#### hardware configuration option

The TLV1571/TLV1578 can configure itself. This option is enabled when the  $\overline{WR}$  pin is tied to ground and a dummy  $\overline{RD}$  signal is applied. The ADC is now fully configured. Zeros or default values are applied to both control registers. The ADC is configured ideally for 3-V operation, which means the internal OSC is set at 10 MHz, single channel input mode, and hardware start of conversion using  $\overline{CSTART}$ .

#### ADC conversion modes

The TLV1571/TLV1578 provides two conversion modes and two start of conversion modes. In single channel input mode, a single channel is continuously sampled and converted. In sweep mode (only available for the TLV1578), a predetermined set of channels is continuously sampled and converted. Table 1 explains these modes in more detail.

**Table 1. Conversion Modes**

| MODES                                                         | START OF CONVERSION                   | OPERATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | COMMENT—SET BITS CR0.D(2–0) FOR INPUT                                                                                        |
|---------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Single Channel Input <sup>†</sup><br>CR0.D3 = 0<br>CR1.D7 = 0 | Hardware Start (CSTART)<br>CR0.D7 = 0 | <ul style="list-style-type: none"> <li>Repeated conversions from a selected channel</li> <li><math>\overline{CSTART}</math> falling edge to start sampling</li> <li><math>\overline{CSTART}</math> rising edge to start conversion</li> <li>If in INT mode, one INT pulse generated after each conversion</li> <li>If in EOC mode, EOC will go high to low at start of conversion, and return high at end of conversion.</li> </ul>                                                                                      | $\overline{CSTART}$ rising edge must be applied a minimum of 5 ns before or after CLK rising edge.                           |
|                                                               | Software Start<br>CR0.D7 = 1          | <ul style="list-style-type: none"> <li>Repeated conversions from a selected channel</li> <li><math>\overline{WR}</math> rising edge to start sampling initially. Thereafter, sampling occurs at the rising edge of <math>\overline{RD}</math>.</li> <li>Conversion begins after 6 clocks after sampling has begun. Thereafter, if in INT mode, one INT pulse is generated after each conversion</li> <li>If in EOC mode, EOC will go high to low at start of conversion and return high at end of conversion.</li> </ul> | With external clock, $\overline{WR}$ and $\overline{RD}$ rising edge must be a minimum 5 ns before or after CLK rising edge. |
| Channel Sweep<br>CR0.D3 = 1<br>CR1.D7 = 0                     | Hardware Start (CSTART)<br>CR0.D7 = 0 | <ul style="list-style-type: none"> <li>One conversion per channel from a predetermined sequence of channels</li> <li><math>\overline{CSTART}</math> falling edge to start sampling</li> <li><math>\overline{CSTART}</math> rising edge to start conversion</li> <li>If in INT mode, one INT pulse generated after each conversion</li> <li>If in EOC mode, EOC will go high to low at start of conversion, and return high at end of conversion.</li> </ul>                                                              | $\overline{CSTART}$ rising edge must be applied a minimum of 5 ns before or after CLK rising edge.                           |
|                                                               | Software Start<br>CR0.D7 = 1          | <ul style="list-style-type: none"> <li>One conversion per channel from a sequence of channels</li> <li><math>\overline{WR}</math> rising edge to start sampling</li> <li>ADC proceeds to sample next channel at rising edge of <math>\overline{RD}</math>. Conversion begins after 6 clocks and lasts 10 clocks</li> <li>If in INT mode, one INT pulse generated after each conversion</li> <li>If in EOC mode, EOC will go high to low at start of conversion and return high at end of conversion.</li> </ul>          | With external clock, $\overline{WR}$ and $\overline{RD}$ rising edge must be a minimum 5 ns before or after CLK rising edge. |

<sup>†</sup> Single channel input mode repeatedly samples and converts from the channel until  $\overline{WR}$  is applied.

## detailed description (continued)

### configure the device

The device can be configured by writing to control registers CR0 and CR1.

**Table 2. TLV1571/TLV1578 Programming Examples**

| REGISTER        | INDEX |    | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | COMMENT               |
|-----------------|-------|----|----|----|----|----|----|----|----|----|-----------------------|
|                 | D9    | D8 |    |    |    |    |    |    |    |    |                       |
| <b>EXAMPLE1</b> |       |    |    |    |    |    |    |    |    |    |                       |
| CR0             | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | Single channel        |
| CR1             | 0     | 1  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | Single Input          |
| <b>EXAMPLE2</b> |       |    |    |    |    |    |    |    |    |    |                       |
| CR0             | 0     | 0  | 0  | 1  | 1  | 0  | 1  | 0  | 1  | 1  | Sweep mode            |
| CR1             | 0     | 1  | 0  | 0  | 0  | 0  | 1  | 1  | 0  | 0  | 2's complement output |

### register read back

Control data written to the TLV1571/78 can be read back from the control registers CR0 and CR1. See Figure 2.

**NOTE:**

Data read out of CR1 reserved bits is don't care.

### power down

The TLV1571/TLV1578 offers two power-down modes, auto power down and software power down. This device will automatically proceed to auto power-down mode if  $\overline{RD}$  is not present one clock after conversion. Software power down is controlled directly by the user by pulling  $\overline{CS}$  to  $DV_{DD}$ .

**Table 3. Power Down Modes**

| PARAMETERS/MODES                       | AUTO POWER DOWN | SOFTWARE POWER DOWN<br>( $\overline{CS} = DV_{DD}$ ) |
|----------------------------------------|-----------------|------------------------------------------------------|
| Maximum power down dissipation current | 1 mA            | 10 $\mu$ A                                           |
| Comparator                             | Power down      | Power down                                           |
| Clock buffer                           | Power down      | Power down                                           |
| Reference                              | Active          | Power down                                           |
| Control registers                      | Saved           | Saved                                                |
| Minimum power down time                | 1 CLK           | 2 CLK                                                |
| Minimum resume time                    | 1 CLK           | 2 CLK                                                |

### self-test modes

The TLV1571/TLV1578 provides three self test modes. These modes can be used to check whether the ADC itself is working properly without having to supply an external signal. There are three tests that are controlled by writing to CR1(D1,D0) (see Table 4).

**Table 4. Self Tests**

| CR1(D1,D0) | SELF TEST VOLTAGE APPLIED                       | DIGITAL OUTPUT |
|------------|-------------------------------------------------|----------------|
| 0h         | Normal, no self test applied                    | N/A            |
| 1h         | VREFM applied to ADC input internally           | 000h           |
| 2h         | (VREFP-VREFM)/2 applied to ADC input internally | 200h           |
| 3h         | VIN = VREFP applied to ADC input internally     | 3FFh           |

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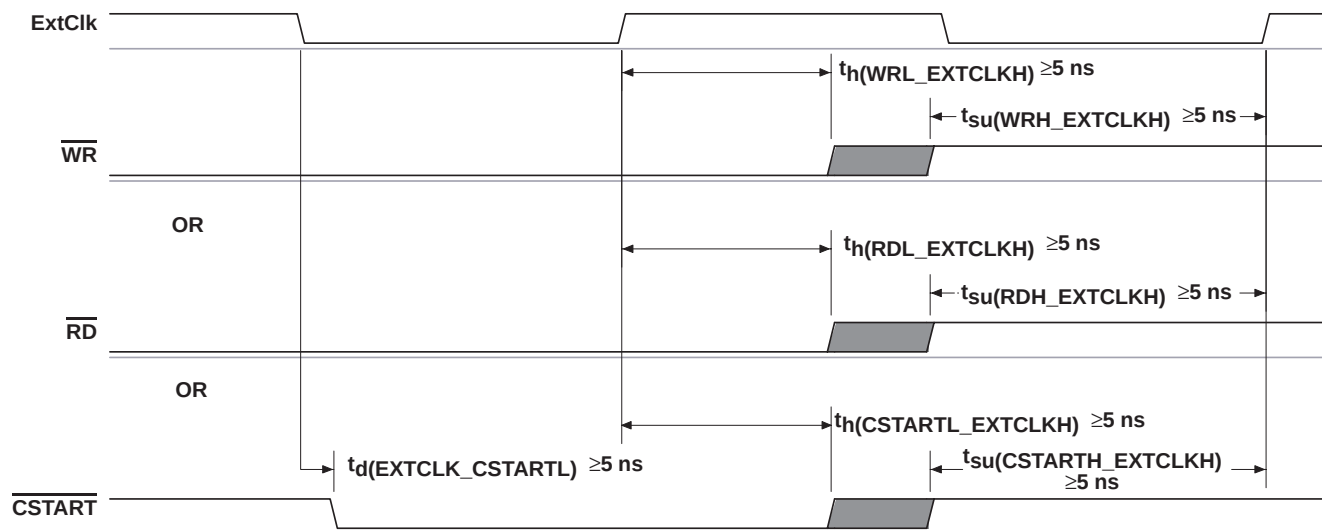
### detailed description (continued)

#### reference voltage input

The TLV1571/TLV1578 has two reference input pins: REFP and REFM. The voltage levels applied to these pins establish the upper and lower limits of the analog inputs to produce a full-scale and zero-scale reading respectively. The values of REFP, REFM, and the analog input should 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 REFP and is at zero when the input signal is equal to or lower than REFM.

#### sampling/conversion

All sampling, conversion, and data output in the device are started by a trigger. This could be the  $\overline{\text{RD}}$ ,  $\overline{\text{WR}}$ , or  $\overline{\text{CSTART}}$  signal depending on the mode of conversion and configuration. The rising edge of  $\overline{\text{RD}}$ ,  $\overline{\text{WR}}$ , and  $\overline{\text{CSTART}}$  signal are extremely important, since they are used to start the conversion. These edges need to stay close to the rising edge of the external clock (if they are used as CLK). The minimum setup and hold time with respect to the rising edge of the external clock should be 5 ns minimum. When the internal clock is used, this is not an issue since these two edges will start the internal clock automatically. Therefore, the setup time is always met. Software controlled sampling lasts 6 clock cycles. This is done via the CLK input or the internal oscillator if enabled. The input clock frequency can be 1 MHz to 20 MHz, translating into a sampling time from 0.6  $\mu\text{s}$  to 0.3  $\mu\text{s}$ . The internal oscillator frequency is 9 MHz minimum (oscillator frequency is between 9 MHz to 22 MHz), translating into a sampling time from 0.6  $\mu\text{s}$  to 0.3  $\mu\text{s}$ . Conversion begins immediately after sampling and lasts 10 clock cycles. This is again done using the external clock input (1 MHz–20 MHz) or the internal oscillator (9 MHz minimum) if enabled. Hardware controlled sampling, via  $\overline{\text{CSTART}}$ , begins on falling  $\overline{\text{CSTART}}$  lasts the length of the active  $\overline{\text{CSTART}}$  signal. This allows more control over the sampling time, which is useful when sampling sources with large output impedances. On rising  $\overline{\text{CSTART}}$ , conversion begins. Conversion in hardware controlled mode also lasts 10 clock cycles. This is done using the external clock input (1 MHz–20 MHz) or the internal oscillator (9 MHz minimum) as is the case in software controlled mode.



NOTE:  $t_{\text{su}}$  = setup time,  $t_{\text{h}}$  = hold time

Figure 3. Trigger Timing – Software Start Mode Using External Clock

### start of conversion mechanism

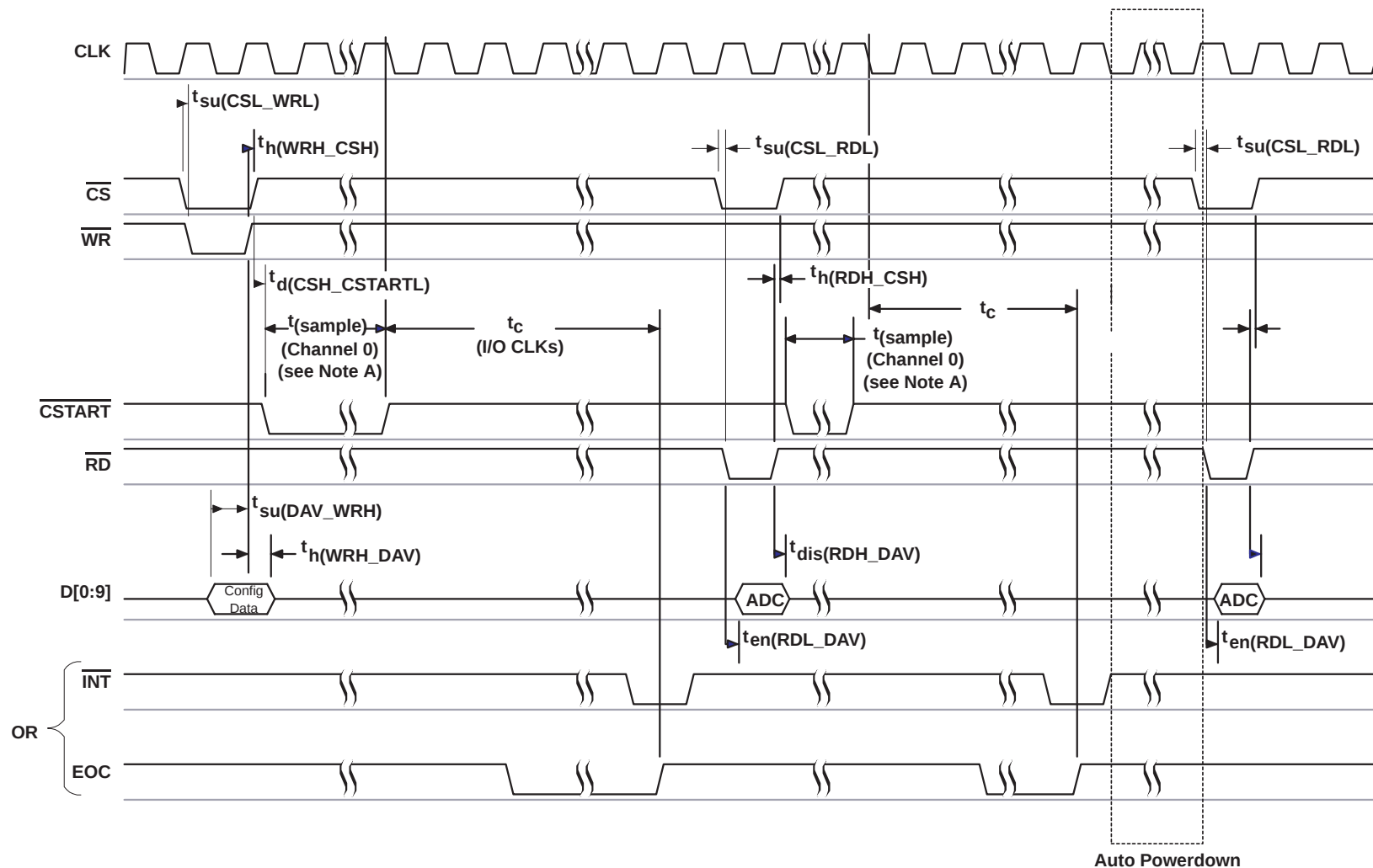
There are two ways to convert data: hardware and software. In the hardware conversion mode the ADC begins sampling at the falling edge of  $\overline{\text{CSTART}}$  and begins conversion at the rising edge of  $\overline{\text{CSTART}}$ . Software start mode ADC samples for 6 clocks, then conversion occurs for ten clocks. The total sampling and conversion process lasts only 16 clocks in this case. If  $\overline{\text{RD}}$  is not detected during the next clock cycle, the ADC automatically proceeds to a power down state. Data is valid on the rising edge of  $\overline{\text{INT}}$  in both conversion modes.

### hardware CSTART conversion

#### *external clock*

With  $\overline{\text{CS}}$  low and  $\overline{\text{WR}}$  low, data is written into the ADC. The sampling begins at the falling edge of  $\overline{\text{CSTART}}$  and conversion begins at the rising edge of  $\overline{\text{CSTART}}$ . At the end of conversion, EOC goes from low to high, telling the host that conversion is ready to be read out. The external clock is active and is used as the reference at all times. With this mode, it is required that  $\overline{\text{CSTART}}$  is not applied at the rising edge of the clock (see Figure 4).

start of conversion mechanism (continued)



NOTE A: AIN for TLV1571; channels sweep according to register settings.

Figure 4. Multichannel Input Mode Conversion – Hardware  $\overline{\text{CSTART}}$ , External Clock

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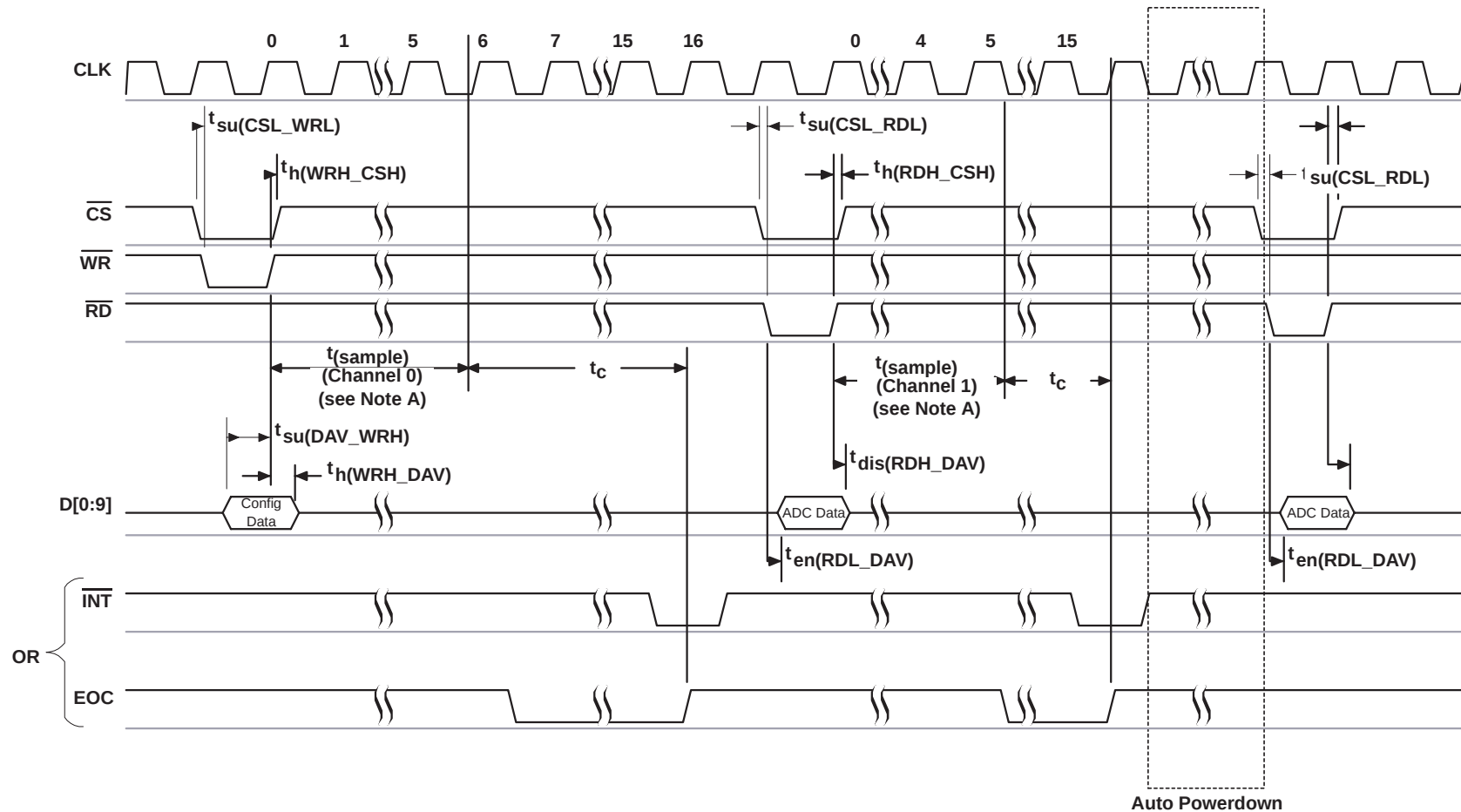


**Figure 5. Multichannel Input Mode Conversion – Hardware  $\overline{\text{CSTART}}$ , Internal Clock**

## software START conversion

### external clock

With  $\overline{\text{CS}}$  low and  $\overline{\text{WR}}$  low, data is written into the ADC. Sampling begins at the rising edge of  $\overline{\text{WR}}$ . The conversion process begins 6 clocks after sampling begins. At the end of conversion, INT goes low telling the host that conversion is ready to be read out. EOC is low during the conversion and makes a high-to-low transition at the end of the conversion. The external clock is active and used as the reference at all times. With this mode,  $\overline{\text{WR}}$  and  $\overline{\text{RD}}$  should not be applied at the rising edge of the clock (see Figure 3).



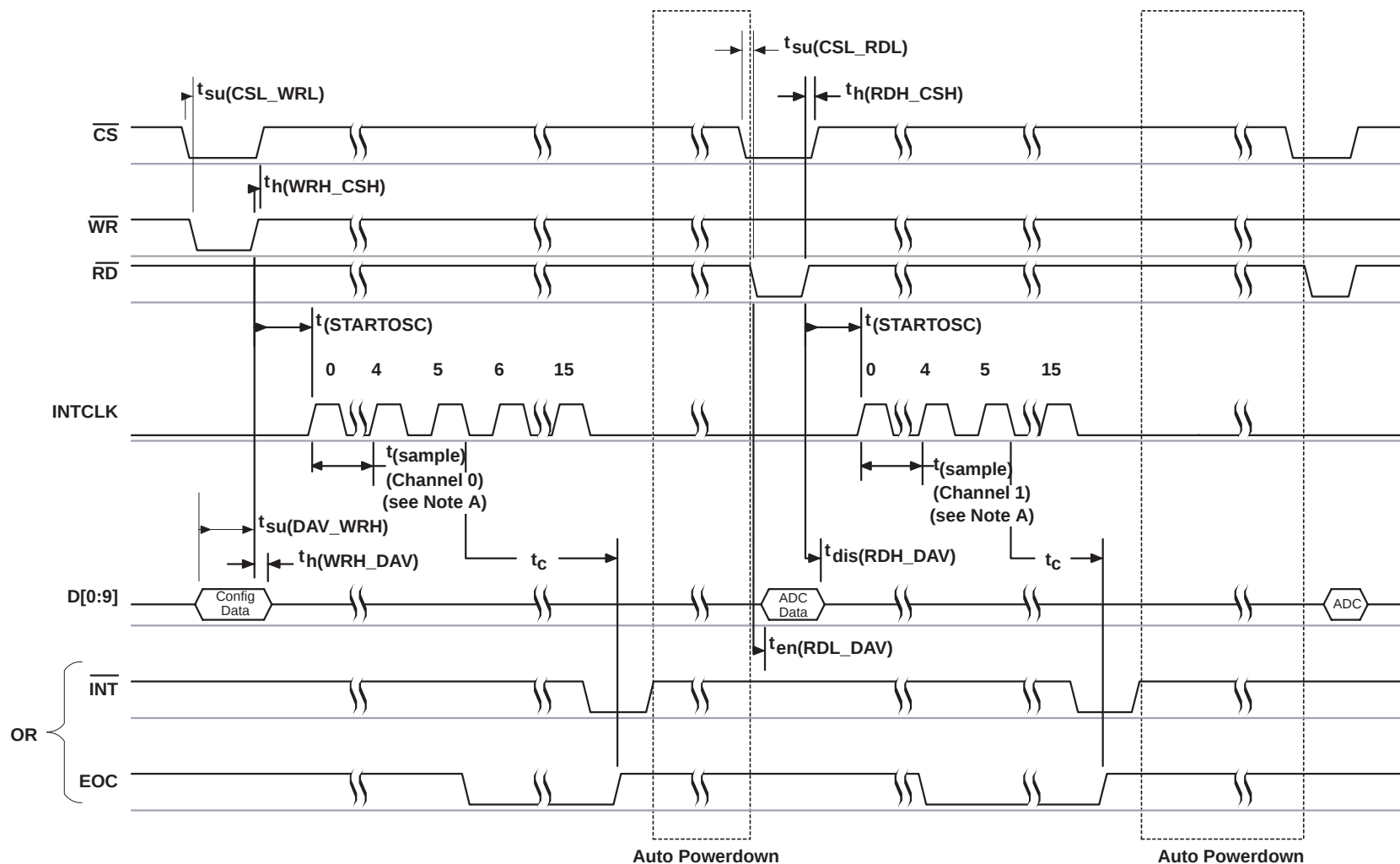
NOTE A: AIN for TLV1571; channels sweep according to register settings.

Figure 6. Multichannel Input Mode Conversion – Software Start, External Clock

## software START conversion (continued)

### internal clock

With  $\overline{CS}$  low and  $\overline{WR}$  low, data is written into the ADC. Sampling begins at the rising edge of  $\overline{WR}$ . Conversion begins 6 clocks after sampling begins. The internal clock begins at the rising edge of  $\overline{WR}$ . The internal clock is disabled after each conversion. Subsequent sampling begins at the rising edge of  $\overline{RD}$ .



NOTE A: AIN for TLV1571; channels sweep according to register settings.

Figure 7. Multichannel Input Mode Conversion – Software Start, Internal Clock

# TLV1571, TLV1578

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### software START conversion (continued)

#### system clock source

The TLV1571/TLV1578 internally derives multiple clocks from the SYSCLK for different tasks. SYSCLK is used for most conversion subtasks. The source of SYSCLK is programmable via control register zero bit 5. The source of SYSCLK is changed at the rising edge of  $\overline{WR}$  of the cycle when CR0.D5 is programmed.

#### internal clock (CR0.D5 = 0, SYSCLK = internal OSC)

The TLV1571/TLV1578 has a built-in 10 MHz OSC. When the internal OSC is selected as the source of SYSCLK, the internal clock starts with a delay (one half of the OSC period max) after the falling edge of the conversion trigger (either  $\overline{WR}$ ,  $\overline{RD}$ , or  $\overline{CSTART}$ ). The OSC speed can be set to  $10 \pm 1$  MHz or  $20 \pm 2$  MHz by setting register bit CR1.6.

#### external clock (CR0.D5 = 1, SYSCLK = external clock)

The TLV1571/TLV1578 is designed to accept an external clock input (CMOS/TTL logic) with frequencies from 1 MHz to 20 MHz.

#### host processor interface

The TLV1571/TLV1578 provides a generic high-speed parallel interface that is compatible with high-performance DSPs and general-purpose microprocessors. The interface includes D(0–9),  $\overline{INT}/\overline{EOC}$ ,  $\overline{RD}$ , and  $\overline{WR}$ .

#### output format

The data output format is unipolar (code 0 to 1023) when the device is operated in single-ended input mode. The output code format can be either binary or twos complement by setting register bit CR1.D3.

#### power up and initialization

After power up,  $\overline{CS}$  must be low to begin an I/O cycle.  $\overline{INT}/\overline{EOC}$  is initially high. The TLV1571/TLV1578 requires two write cycles to configure the two control registers. The first conversion after the device has returned from the power down state may be invalid and should be disregarded.

### definitions of specifications and terminology

#### integral nonlinearity

Integral nonlinearity refers to the deviation of each individual code from a line drawn from zero through full scale. The point used as zero occurs 1/2 LSB before the first code transition. The full-scale point is defined as level 1/2 LSB beyond the last code transition. The deviation is measured from the center of each particular code to the true straight line between these two points.

#### differential nonlinearity

An ideal ADC exhibits code transitions that are exactly 1 LSB apart. DNL is the deviation from this ideal value. A differential nonlinearity error of less than  $\pm 1$  LSB ensures no missing codes.

#### zero offset

The major carry transition should occur when the analog input is at zero volts. Zero error is defined as the deviation of the actual transition from that point.

#### gain error

The first code transition should occur at an analog value 1/2 LSB above negative full scale. The last transition should occur at an analog value 1 1/2 LSB below the nominal full scale. Gain error is the deviation of the actual difference between first and last code transitions and the ideal difference between first and last code transitions.



#### software START conversion (continued)

#### signal-to-noise ratio + distortion (SINAD)

Signal-to-noise ratio + distortion is the ratio of the rms value of the measured input signal to the rms sum of all other spectral components below the Nyquist frequency, including harmonics but excluding dc. The value for SINAD is expressed in decibels.

#### effective number of bits (ENOB)

For a sine wave, SINAD can be expressed in terms of the number of bits. Using the following formula,

$$N = (\text{SINAD} - 1.76)/6.02$$

it is possible to get a measure of performance expressed as N, the effective number of bits. Thus, the effective number of bits for a device for sine wave inputs at a given input frequency can be calculated directly from its measured SINAD.

#### total harmonic distortion (THD)

Total harmonic distortion is the ratio of the rms sum of the first six harmonic components to the rms value of the measured input signal and is expressed as a percentage or in decibels.

#### spurious free dynamic range (SFDR)

Spurious free dynamic range is the difference in dB between the rms amplitude of the input signal and the peak spurious signal.

#### DSP interface

The TLV1571/TLV1578 is a 10-bit 1-/8-analog input channel analog-to-digital converter with throughput up to 1.25 MSPS at 5 V and up to 625 KSPS at 3 V. To achieve 1.25 MSPS throughput, the ADC must be clocked at 20 MHz. Likewise to achieve 625 KSPS throughput, the ADC must be clocked at 10 MHz. The TLV1571/TLV1578 can be easily interfaced to microcontrollers, ASICs, and DSPs. Figure 8 shows the pin connections to interface the TLV1571/TLV1578 to the TMS320C6x DSP.

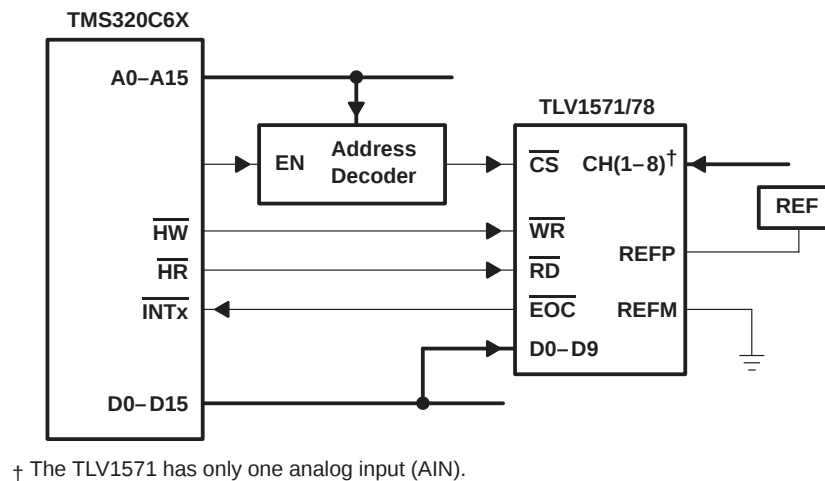


Figure 8. TMS320C6x DSP Interface

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### grounding and decoupling considerations

General practices should apply to the PCB design to limit high frequency transients and noise that are fed back into the supply and reference lines. This requires that the supply and reference pins be sufficiently bypassed. In most cases 0.1- $\mu$ F ceramic chip capacitors are adequate to keep the impedance low over a wide frequency range. Since their effectiveness depends largely on the proximity to the individual supply pin, they should be placed as close to the supply pins as possible.

To reduce high frequency and noise coupling, it is highly recommended that digital and analog grounds be shorted immediately outside the package. This can be accomplished by running a low impedance line between DGND and AGND under the package.

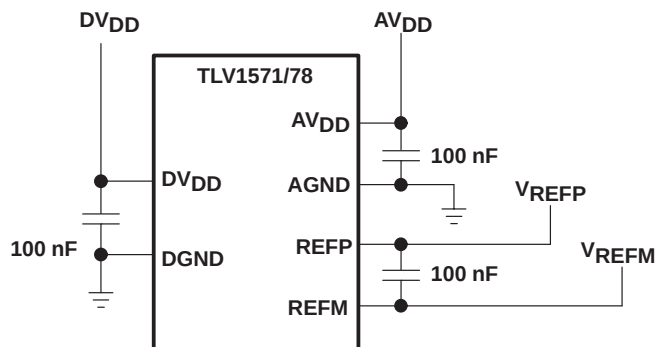


Figure 9. Placement for Decoupling Capacitors

### power supply ground layout

Printed-circuit boards that use separate analog and digital ground planes offer the best system performance. Wire-wrap boards do not perform well and should not be used. The two ground planes should be connected together at the low-impedance power-supply source. The best ground connection may be achieved by connecting the ADC AGND terminal to the system analog ground plane making sure that analog ground currents are well managed.

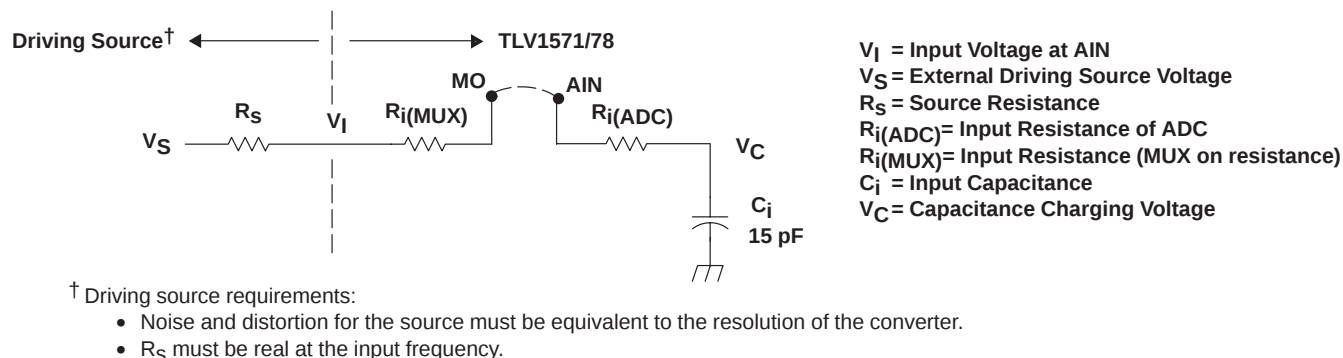


Figure 10. Equivalent Input Circuit Including the Driving Source

## simplified analog input analysis

Using the equivalent circuit in Figure 9, the time required to charge the analog input capacitance from 0 to  $V_S$  within 1/2 LSB,  $t_{ch}(1/2 \text{ LSB})$ , can be derived as follows.

The capacitance charging voltage is given by:

$$V_{C(t)} = V_S \left( 1 - e^{-t_{ch}/R_t C_i} \right)$$

Where:

$$R_t = R_S + R_i \quad (1)$$

$$R_i = R_{i(ADC)} + R_{i(MUX)}$$

$$t_{ch} = \text{Charge time}$$

The input impedance  $R_i$  is 718  $\Omega$  at 5 V, and is higher ( $\sim 1.25 \text{ k}\Omega$ ) at 2.7 V. The final voltage to 1/2 LSB is given by:

$$V_C(1/2 \text{ LSB}) = V_S - (V_S/2048) \quad (2)$$

Equating equation 1 to equation 2 and solving for cycle time  $t_c$  gives:

$$V_S - (V_S/2048) = V_S \left( 1 - e^{-t_{ch}/R_t C_i} \right) \quad (3)$$

and time to change to 1/2 LSB (minimum sampling time) is:

$$t_{ch}(1/2 \text{ LSB}) = R_t \times C_i \times \ln(2048)$$

Where:

$$\ln(2048) = 7.625$$

Therefore, with the values given, the time for the analog input signal to settle is:

$$t_{ch}(1/2 \text{ LSB}) = (R_S + 718 \Omega) \times 15 \text{ pF} \times \ln(2048) \quad (4)$$

This time must be less than the converter sample time shown in the timing diagrams, which is 6x SCLK.

$$t_{ch}(1/2 \text{ LSB}) \leq 6 \times 1/f_{(SCLK)} \quad (5)$$

Therefore the maximum SCLK frequency is:

$$\text{Max}(f_{(SCLK)}) = 6/t_{ch}(1/2 \text{ LSB}) = 6/(\ln(2048) \times R_t \times C_i) \quad (6)$$

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### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                  |                             |
|------------------------------------------------------------------|-----------------------------|
| Supply voltage, GND to $V_{CC}$                                  | –0.3 V to 6.5 V             |
| Analog input voltage range                                       | –0.3 V to $AV_{DD} + 0.3$ V |
| Reference input voltage range                                    | $AV_{DD} + 0.3$ V           |
| Digital input voltage range                                      | –0.3 V to $DV_{DD} + 0.3$ V |
| Operating virtual junction temperature range, $T_J$              | –40°C to 150°C              |
| Operating free-air temperature range, $T_A$ : TLV1571C, TLV1578C | 0°C to 70°C                 |
| TLV1571I, TLV1578I                                               | –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                       |

<sup>†</sup> 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.

### recommended operating conditions

#### power supplies

|                                   | MIN | MAX | UNIT |
|-----------------------------------|-----|-----|------|
| Analog supply voltage, $AV_{DD}$  | 2.7 | 5.5 | V    |
| Digital supply voltage, $DV_{DD}$ | 2.7 | 5.5 | V    |

NOTE 1:  $Abs(AV_{DD} - DV_{DD}) < 0.5$  V

#### analog inputs

|                                | MIN  | MAX   | UNIT |
|--------------------------------|------|-------|------|
| Analog input voltage, $A_{IN}$ | AGND | VREFP | V    |

#### digital inputs

|                                                  |                                                | MIN | NOM | MAX | UNIT |
|--------------------------------------------------|------------------------------------------------|-----|-----|-----|------|
| High-level input voltage, $V_{IH}$               | $DV_{DD} = 2.7$ V to 5.5 V                     | 2.1 | 2.4 |     | V    |
| Low level input voltage, $V_{IL}$                | $DV_{DD} = 2.7$ V to 5.5 V                     |     |     | 0.8 | V    |
| Input CLK frequency                              | $DV_{DD} = 4.5$ V to 5.5 V                     |     |     | 20  | MHz  |
|                                                  | $DV_{DD} = 2.7$ V to 3.3 V                     |     |     | 10  | MHz  |
| Pulse duration, CLK high, $t_{w(CLKH)}$          | $DV_{DD} = 4.5$ V to 5.5 V, $f_{CLK} = 20$ MHz | 23  |     |     | ns   |
|                                                  | $DV_{DD} = 2.7$ V to 3.3 V, $f_{CLK} = 10$ MHz | 46  |     |     | ns   |
| Pulse duration, CLK low, $t_{w(CLKL)}$           | $DV_{DD} = 4.5$ V to 5.5 V, $f_{CLK} = 20$ MHz | 23  |     |     | ns   |
|                                                  | $DV_{DD} = 2.7$ V to 3.3 V, $f_{CLK} = 10$ MHz | 46  |     |     | ns   |
| Rise time, I/O and control, CLK, $\overline{CS}$ | 50 pF output load                              | 4   |     |     | ns   |
| Fall time, I/O and control, CLK, $\overline{CS}$ | 50 pF output load                              | 4   |     |     |      |

### reference specifications

|                            |               |                 | MIN  | NOM | MAX              | UNIT |
|----------------------------|---------------|-----------------|------|-----|------------------|------|
| External reference voltage | VREFP         | $AV_{DD} = 3$ V | 2    |     | $AV_{DD}$        | V    |
|                            |               | $AV_{DD} = 5$ V | 2.5  |     | $AV_{DD}$        | V    |
|                            | VREFM         | $AV_{DD} = 3$ V | AGND |     | 1                | V    |
|                            |               | $AV_{DD} = 5$ V | AGND |     | 2                | V    |
|                            | VREFP – VREFM |                 | 2    |     | $AV_{DD} - AGND$ | V    |



electrical characteristics over recommended operating free-air temperature range, supply voltages, and reference voltages (unless otherwise noted)

#### digital specifications

| PARAMETER                                    | TEST CONDITIONS                                                     | MIN           | TYP | MAX | UNIT          |
|----------------------------------------------|---------------------------------------------------------------------|---------------|-----|-----|---------------|
| <b>Logic inputs</b>                          |                                                                     |               |     |     |               |
| $I_{IH}$ High-level input current            | $DV_{DD} = 5\text{ V}$ , $DV_{DD} = 3\text{ V}$ , Input = $DV_{DD}$ | -1            |     | 1   | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current             | $DV_{DD} = 5\text{ V}$ , $DV_{DD} = 3\text{ V}$ , Input = 0 V       | -1            |     | 1   | $\mu\text{A}$ |
| $C_i$ Input capacitance                      |                                                                     |               | 10  | 15  | pF            |
| <b>Logic outputs</b>                         |                                                                     |               |     |     |               |
| $V_{OH}$ High-level output voltage           | $I_{OH} = 50\text{ }\mu\text{A}$ to 0.5 mA                          | $DV_{DD}-0.4$ |     |     | V             |
| $V_{OL}$ Low-level output voltage            | $I_{OL} = 50\text{ }\mu\text{A}$ to 0.5 mA                          |               |     | 0.4 | V             |
| $I_{OZ}$ High-impedance-state output current | $DV_{DD} = 5\text{ V}$ , $DV_{DD} = 3\text{ V}$ , Input = $DV_{DD}$ |               |     | 1   | $\mu\text{A}$ |
| $I_{OL}$ Low-impedance-state output current  | $DV_{DD} = 5\text{ V}$ , $DV_{DD} = 3\text{ V}$ , Input = 0 V       |               |     | -1  | $\mu\text{A}$ |
| $C_o$ Output capacitance                     |                                                                     |               | 5   |     | pF            |
| Internal clock                               | 3 V, $AV_{DD} = DV_{DD}$                                            | 9             | 10  | 11  | MHz           |
|                                              | 5 V, $AV_{DD} = DV_{DD}$                                            | 18            | 20  | 22  |               |

#### dc specifications

| PARAMETER                                                    |                                   | TEST CONDITIONS                                                      | MIN                                | TYP                    | MAX    | UNIT |    |
|--------------------------------------------------------------|-----------------------------------|----------------------------------------------------------------------|------------------------------------|------------------------|--------|------|----|
| Resolution                                                   |                                   |                                                                      | 10                                 |                        |        | Bits |    |
| Accuracy                                                     |                                   |                                                                      |                                    |                        |        |      |    |
| Integral nonlinearity, INL                                   |                                   | Best fit                                                             | ±0.5                               |                        | ±1     | LSB  |    |
| Differential nonlinearity, DNL                               |                                   |                                                                      | ±0.5                               |                        | ±1     | LSB  |    |
| Missing codes                                                |                                   |                                                                      | 0                                  |                        |        |      |    |
| E <sub>O</sub>                                               | Offset error                      |                                                                      | ±0.1%                              |                        | ±0.15% | FSR  |    |
| E <sub>G</sub>                                               | Gain error                        |                                                                      | ±0.1%                              |                        | ±0.2%  | FSR  |    |
| Analog input                                                 |                                   |                                                                      |                                    |                        |        |      |    |
| C <sub>i</sub>                                               | Input capacitance                 | A <sub>IN</sub> , AV <sub>DD</sub> = 3 V, AV <sub>DD</sub> = 5 V     | 15                                 |                        |        | pF   |    |
|                                                              |                                   | MUX input, AV <sub>DD</sub> = 3 V, AV <sub>DD</sub> = 5 V            | 25                                 |                        |        | pF   |    |
| I <sub>lkg</sub>                                             | Input leakage current             | V <sub>A<sub>IN</sub></sub> = 0 to AV <sub>DD</sub>                  |                                    |                        | ±1     | μA   |    |
| r <sub>i</sub>                                               | Input MUX ON resistance           | AV <sub>DD</sub> = DV <sub>DD</sub> = 3 V                            | 240                                |                        | 680    | Ω    |    |
|                                                              |                                   | AV <sub>DD</sub> = DV <sub>DD</sub> = 5 V                            | 215                                |                        | 340    |      |    |
| Voltage reference input                                      |                                   |                                                                      |                                    |                        |        |      |    |
| r <sub>i</sub>                                               | Input resistance                  |                                                                      | 2                                  |                        |        | kΩ   |    |
| C <sub>i</sub>                                               | Input capacitance                 |                                                                      | 300                                |                        |        | pF   |    |
| Power supply                                                 |                                   |                                                                      |                                    |                        |        |      |    |
| Operating supply current, I <sub>DD</sub> + I <sub>REF</sub> |                                   | AV <sub>DD</sub> = DV <sub>DD</sub> = 3 V, f <sub>CLK</sub> = 10 MHz | 4                                  |                        | 5.5    | mA   |    |
|                                                              |                                   | AV <sub>DD</sub> = DV <sub>DD</sub> = 5 V, f <sub>CLK</sub> = 20 MHz | 7                                  |                        | 8.5    | mA   |    |
| PD                                                           | Power dissipation                 | AV <sub>DD</sub> +DV <sub>DD</sub> = 3 V                             | 12                                 |                        | 17     | mW   |    |
|                                                              |                                   | AV <sub>DD</sub> +DV <sub>DD</sub> = 5 V                             | 35                                 |                        | 43     | mW   |    |
| I <sub>PD</sub>                                              | Supply current in power-down mode | Software                                                             | I <sub>DD</sub> + I <sub>REF</sub> | AV <sub>DD</sub> = 3 V | 1      | 8    | μA |
|                                                              |                                   |                                                                      |                                    | AV <sub>DD</sub> = 5 V | 2      | 10   | μA |
|                                                              |                                   | Auto                                                                 | I <sub>DD</sub> + I <sub>REF</sub> | AV <sub>DD</sub> = 3 V | 0.5    | 1    | mA |
|                                                              |                                   |                                                                      |                                    | AV <sub>DD</sub> = 5 V | 0.5    | 1    | mA |

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**electrical characteristics over recommended operating free-air temperature range, supply voltages, and reference voltages (unless otherwise noted) (continued)**

**ac specifications,  $AV_{DD} = DV_{DD} = 5\text{ V}$  (unless otherwise noted)**

| PARAMETER                                 |       | TEST CONDITIONS                        |                                                    | MIN    | TYP | MAX   | UNIT |
|-------------------------------------------|-------|----------------------------------------|----------------------------------------------------|--------|-----|-------|------|
| Signal-to-noise ratio, SNR                |       | f <sub>I</sub> = 100 kHz,<br>80% of FS | f <sub>S</sub> = 1.25 MSPS, AV <sub>DD</sub> = 5 V | 56     | 60  |       | dB   |
|                                           |       |                                        | f <sub>S</sub> = 625 KSPS, AV <sub>DD</sub> = 3 V  | 58     | 60  |       | dB   |
| Signal-to-noise ratio + distortion, SINAD |       | f <sub>I</sub> = 100 kHz,<br>80% of FS | f <sub>S</sub> = 1.25 MSPS, AV <sub>DD</sub> = 5 V | 55     | 60  |       | dB   |
|                                           |       |                                        | f <sub>S</sub> = 625 KSPS, AV <sub>DD</sub> = 3 V  | 55     | 60  |       | dB   |
| Total harmonic distortion, THD            |       | f <sub>I</sub> = 100 kHz,<br>80% of FS | f <sub>S</sub> = 1.25 MSPS, AV <sub>DD</sub> = 5 V |        | –60 | –56   | dB   |
|                                           |       |                                        | f <sub>S</sub> = 625 KSPS, AV <sub>DD</sub> = 3 V  |        | –60 | –56   | dB   |
| Effective number of bits, ENOB            |       | f <sub>I</sub> = 100 kHz,<br>80% of FS | f <sub>S</sub> = 1.25 MSPS, AV <sub>DD</sub> = 5 V | 9      | 9.3 |       | Bits |
|                                           |       |                                        | f <sub>S</sub> = 625 KSPS, AV <sub>DD</sub> = 3 V  | 9      | 9.3 |       | Bits |
| Spurious free dynamic range, SFDR         |       | f <sub>I</sub> = 100 kHz,<br>80% of FS | f <sub>S</sub> = 1.25 MSPS, AV <sub>DD</sub> = 5 V |        | –63 | –56   | dB   |
|                                           |       |                                        | f <sub>S</sub> = 625 KSPS, AV <sub>DD</sub> = 3 V  |        | –63 | –56   | dB   |
| Analog input                              |       |                                        |                                                    |        |     |       |      |
| Channel-to-channel cross talk             |       |                                        |                                                    | –75    |     |       | dB   |
| Full-power bandwidth                      | –1 dB | Full-scale 0 dB input sine wave        |                                                    | 12     | 18  |       | MHz  |
|                                           | –3 dB | Full-scale 0 dB input sine wave        |                                                    | 30     |     |       | MHz  |
| Small-signal bandwidth                    | –1 dB | –20 dB input sine wave                 |                                                    | 15     | 20  |       | MHz  |
|                                           | –3 dB | –20 dB input sine wave                 |                                                    | 35     |     |       | MHz  |
| Sampling rate, f <sub>S</sub>             |       | AV <sub>DD</sub> = 4.5 V to 5.5 V      |                                                    | 0.0625 |     | 1.25  | MSPS |
|                                           |       | AV <sub>DD</sub> = 2.7 V to 3.3 V      |                                                    | 0.0625 |     | 0.625 | MSPS |

timing requirements,  $AV_{DD} = DV_{DD} = 5\text{ V}$  (unless otherwise noted)

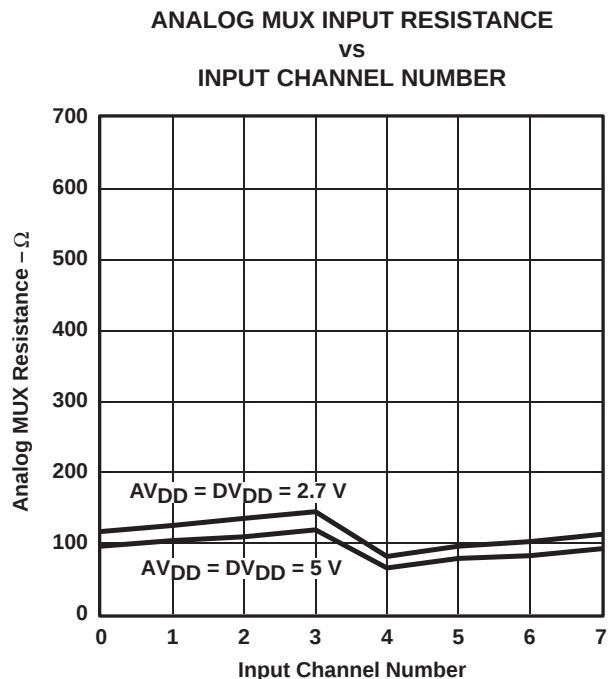
| PARAMETER                         |                                                                           | TEST CONDITIONS                          | MIN | TYP | MAX | UNIT          |
|-----------------------------------|---------------------------------------------------------------------------|------------------------------------------|-----|-----|-----|---------------|
| $t_{c(\text{CLK})}$               | Cycle time, CLK                                                           | $DV_{DD} = 4.5\text{ V to }5.5\text{ V}$ | 50  |     |     | ns            |
|                                   |                                                                           | $DV_{DD} = 2.7\text{ V to }3.3\text{ V}$ | 100 |     |     | ns            |
| $t_{(\text{sample})}$             | Reset and sampling time                                                   |                                          |     | 6   |     | SYSCLK Cycles |
| $t_c$                             | Total conversion time                                                     |                                          |     | 10  |     | SYSCLK Cycles |
| $t_{wL(\text{EOC})}$              | Pulse width, end of conversion, EOC                                       |                                          |     | 10  |     | SYSCLK Cycles |
| $t_{wL(\text{INT})}$              | Pulse width, interrupt                                                    |                                          |     | 1   |     | SYSCLK Cycles |
| $t_{(\text{STARTOSC})}$           | Start-up time, internal oscillator                                        |                                          | 100 |     |     | ns            |
| $t_d(\text{CSH\_CSTARTL})$        | Delay time, $\overline{\text{CS}}$ high to $\overline{\text{CSTART}}$ low |                                          |     | 10  |     | ns            |
| $t_{en(\text{RDL\_DAV})}$         | Enable time, data out                                                     | $DV_{DD} = 5\text{ V at }50\text{ pF}$   |     | 20  |     | ns            |
|                                   |                                                                           | $DV_{DD} = 3\text{ V at }50\text{ pF}$   |     | 40  |     | ns            |
| $t_{dis(\text{RDH\_DAV})}$        | Disable time, data out                                                    | $DV_{DD} = 5\text{ V at }50\text{ pF}$   |     | 5   |     | ns            |
|                                   |                                                                           | $DV_{DD} = 3\text{ V at }50\text{ pF}$   |     | 10  |     | ns            |
| $t_{su(\text{CSL\_WRL})}$         | Setup time, $\overline{\text{CS}}$ to $\overline{\text{WR}}$              |                                          | 5   |     |     | ns            |
| $t_h(\text{WRH\_CSH})$            | Hold time, $\overline{\text{CS}}$ to $\overline{\text{WR}}$               |                                          | 5   |     |     | ns            |
| $t_w(\text{WR})$                  | Pulse width, write                                                        |                                          | 1   |     |     | Clock Period  |
| $t_w(\text{RD})$                  | Pulse width, read                                                         |                                          | 1   |     |     | Clock Period  |
| $t_{su(\text{DAV\_WRH})}$         | Setup time, data valid to $\overline{\text{WR}}$                          |                                          | 10  |     |     | ns            |
| $t_h(\text{WRH\_DAV})$            | Hold time, data valid to $\overline{\text{WR}}$                           |                                          | 5   |     |     | ns            |
| $t_{su(\text{CSL\_RDL})}$         | Setup time, $\overline{\text{CS}}$ to $\overline{\text{RD}}$              |                                          |     | 5   |     | ns            |
| $t_h(\text{RDH\_CSH})$            | Hold time, $\overline{\text{CS}}$ to $\overline{\text{RD}}$               |                                          |     | 5   |     | ns            |
| $t_h(\text{WRL\_EXTCLKH})$        | Hold time $\overline{\text{WR}}$ to clock high                            |                                          | 5   |     |     | ns            |
| $t_h(\text{RDL\_EXTCLKH})$        | Hold time $\overline{\text{RD}}$ to clock high                            |                                          | 5   |     |     | ns            |
| $t_h(\text{CSTARTL\_EXTCLKH})$    | Hold time $\overline{\text{CSTART}}$ to clock high                        |                                          | 5   |     |     | ns            |
| $t_{su(\text{WRH\_EXTCLKH})}$     | Setup time $\overline{\text{WR}}$ high to clock high                      |                                          | 5   |     |     | ns            |
| $t_{su(\text{RDH\_EXTCLKH})}$     | Setup time $\overline{\text{RD}}$ high to clock high                      |                                          | 5   |     |     | ns            |
| $t_{su(\text{CSTARTH\_EXTCLKH})}$ | Setup time $\overline{\text{CSTART}}$ high to clock high                  |                                          | 5   |     |     | ns            |
| $t_d(\text{EXTCLK\_CSTARTL})$     | Delay time clock low to $\overline{\text{CSTART}}$ low                    |                                          | 5   |     |     | ns            |

NOTE: Specifications subject to change without notice.  
Data valid is denoted as DAV.

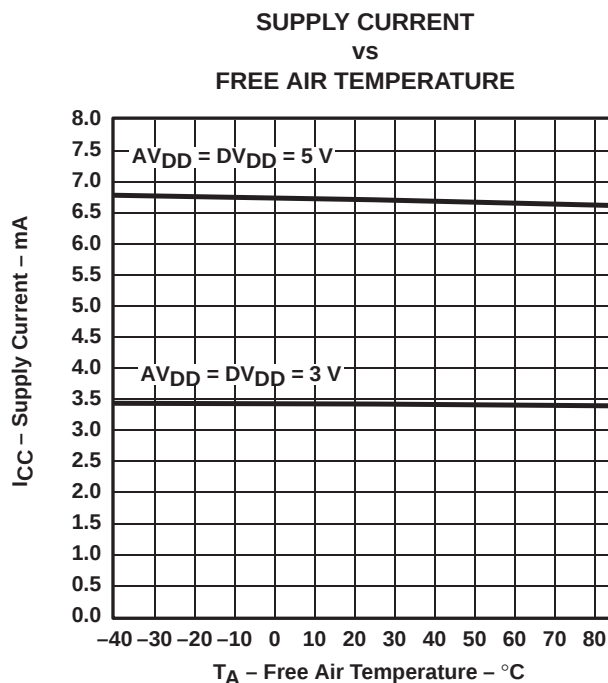
**TLV1571, TLV1578**  
**2.7 V TO 5.5 V, 1-/8-CHANNEL, 10-BIT,**  
**PARALLEL ANALOG-TO-DIGITAL CONVERTERS**

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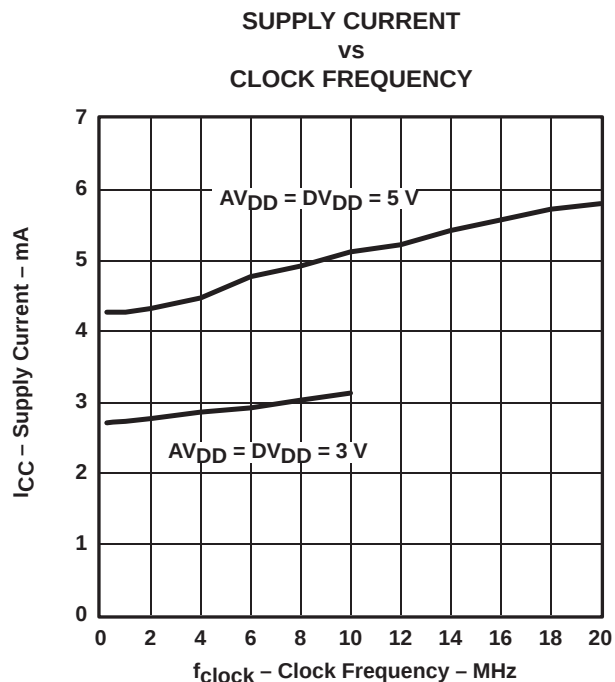
**TYPICAL CHARACTERISTICS**



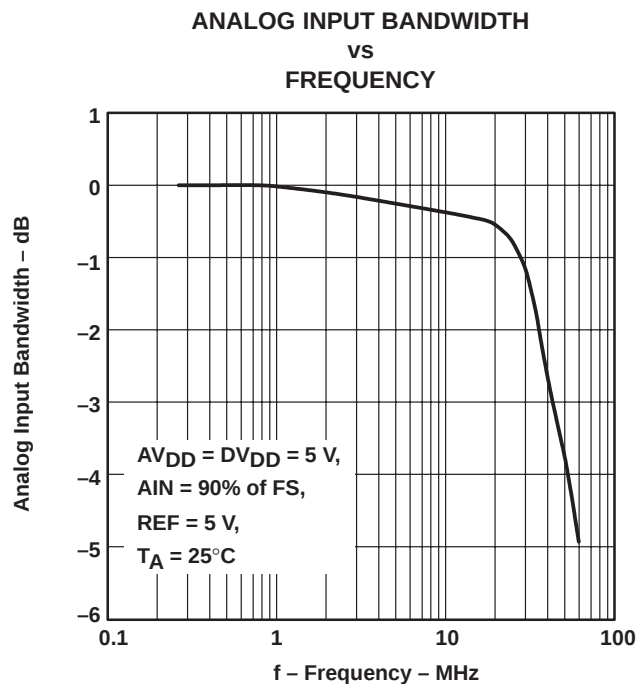
**Figure 11**



**Figure 12**



**Figure 13**



**Figure 14**

## TYPICAL CHARACTERISTICS

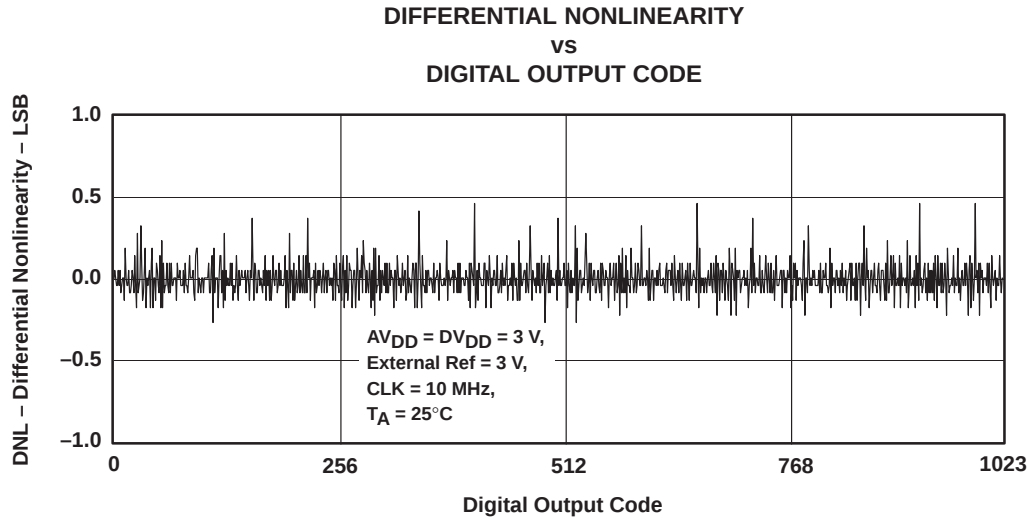


Figure 15

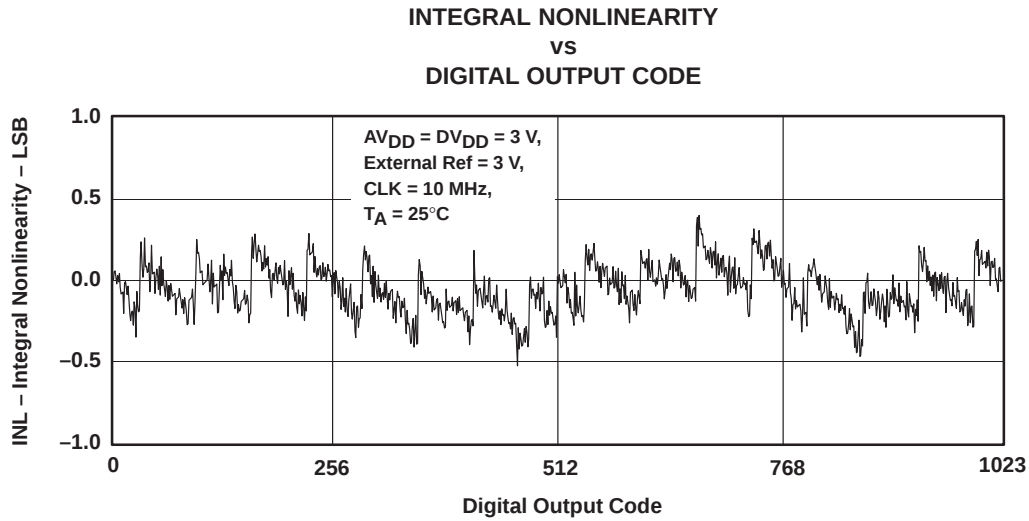
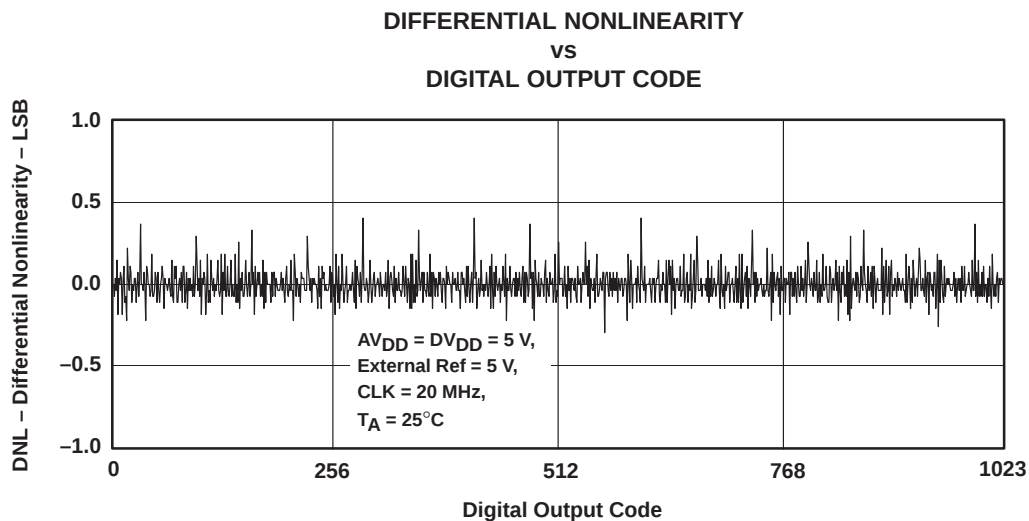


Figure 16

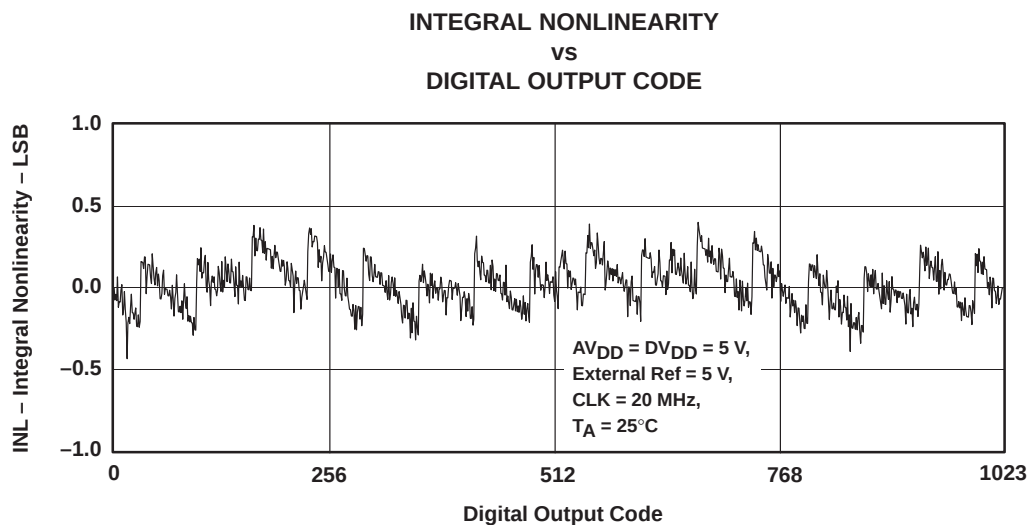
**TLV1571, TLV1578**  
**2.7 V TO 5.5 V, 1-/8-CHANNEL, 10-BIT,**  
**PARALLEL ANALOG-TO-DIGITAL CONVERTERS**

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**TYPICAL CHARACTERISTICS**



**Figure 17**



**Figure 18**

## TYPICAL CHARACTERISTICS

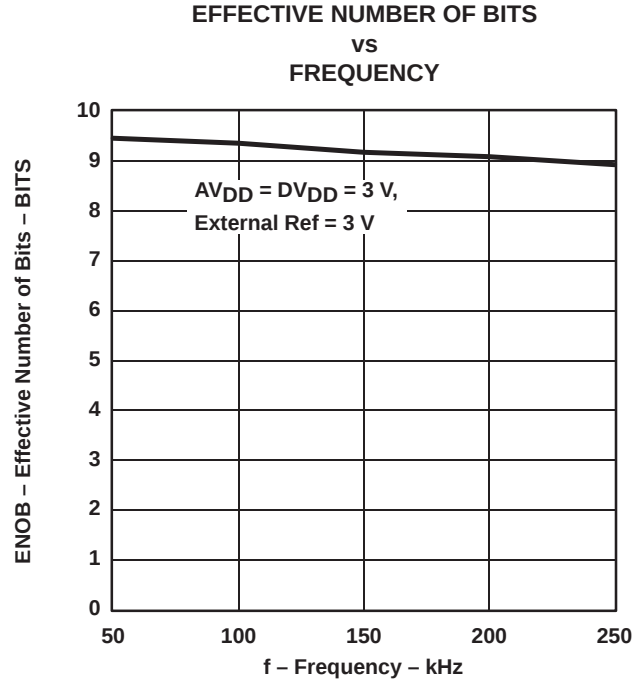


Figure 19

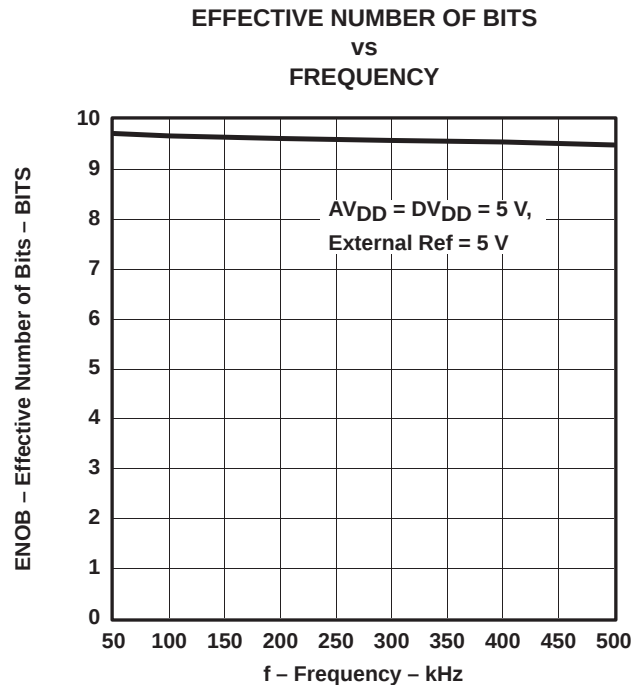


Figure 20

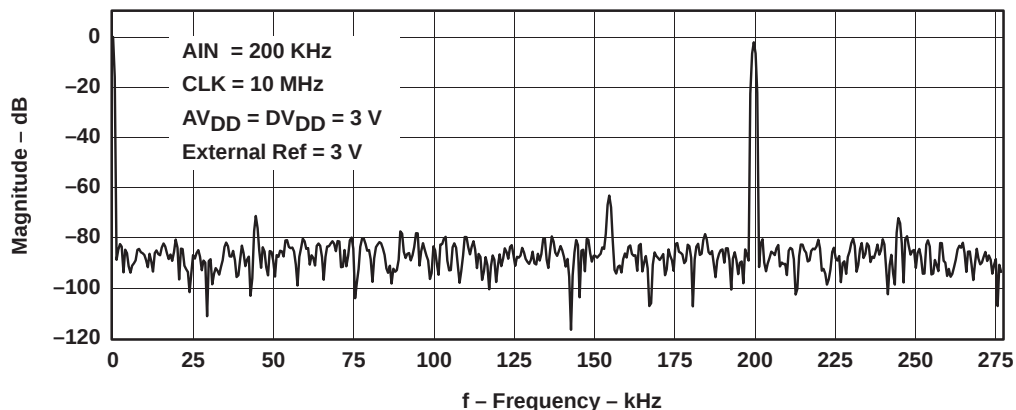
**TLV1571, TLV1578**  
**2.7 V TO 5.5 V, 1-/8-CHANNEL, 10-BIT,**  
**PARALLEL ANALOG-TO-DIGITAL CONVERTERS**

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**TYPICAL CHARACTERISTICS**

**FAST FOURIER TRANSFORM**

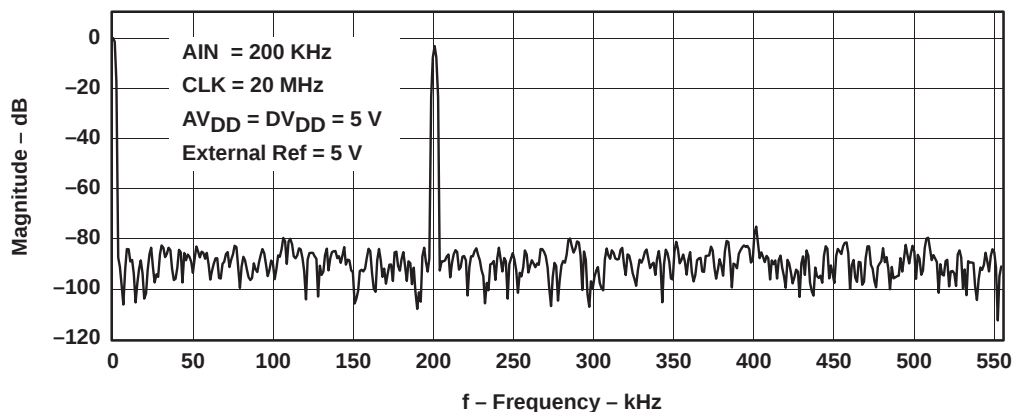
**vs**  
**FREQUENCY**



**Figure 21**

**FAST FOURIER TRANSFORM**

**vs**  
**FREQUENCY**



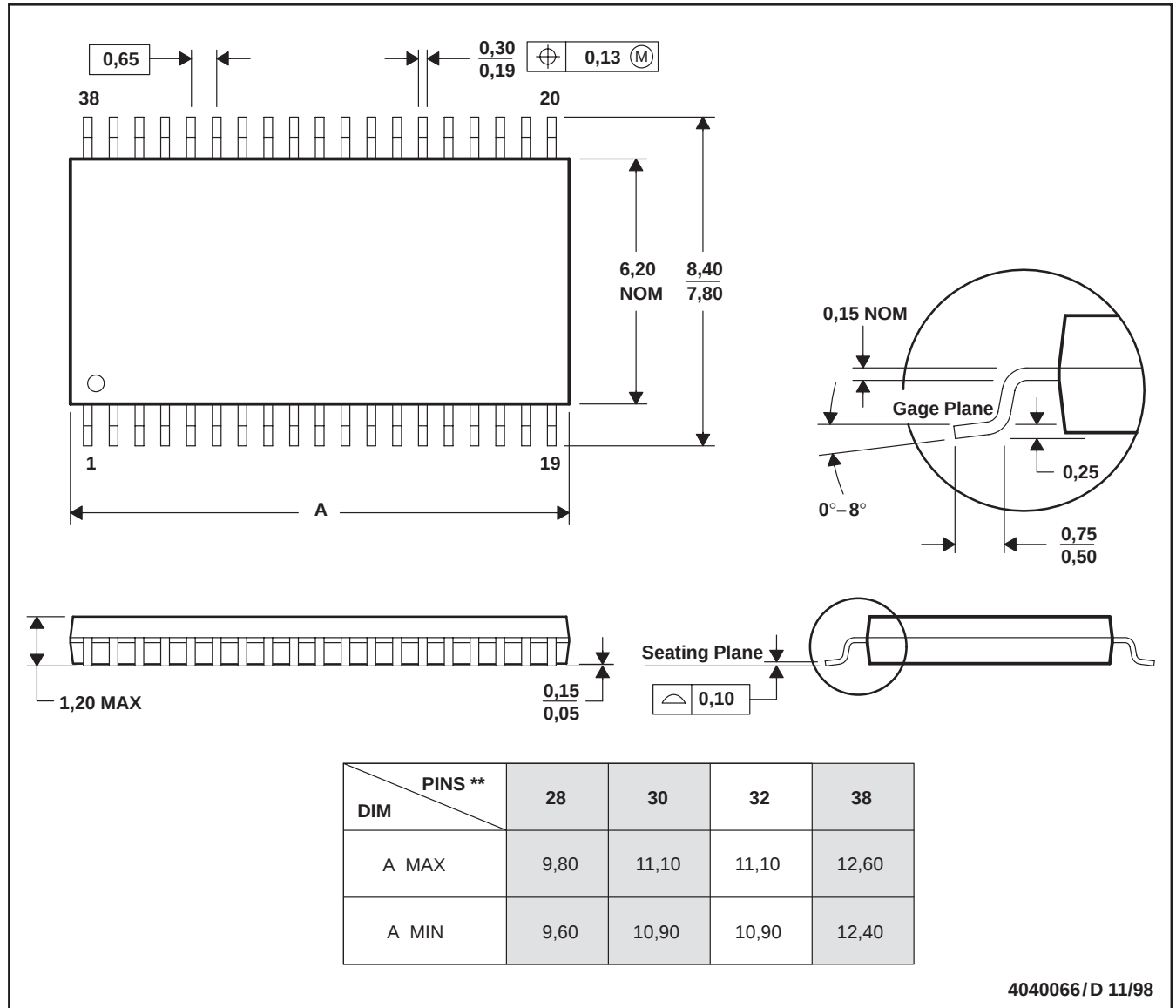
**Figure 22**

## MECHANICAL DATA

DA (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

38 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion.  
D. Falls within JEDEC MO-153

**TLV1571, TLV1578**  
**2.7 V TO 5.5 V, 1-/8-CHANNEL, 10-BIT,**  
**PARALLEL ANALOG-TO-DIGITAL CONVERTERS**

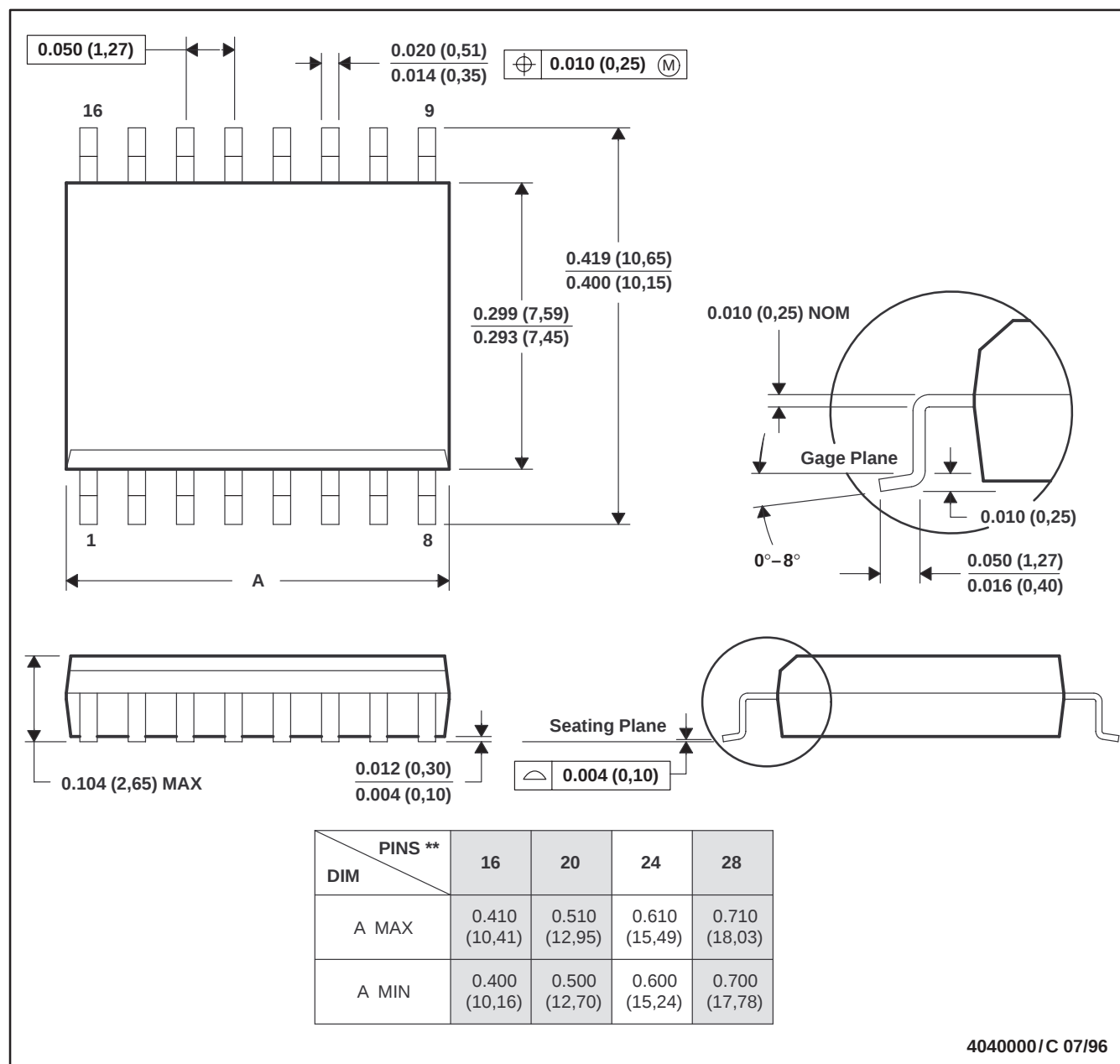
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**MECHANICAL DATA**

**DW (R-PDSO-G\*\*)**

**PLASTIC SMALL-OUTLINE PACKAGE**

16 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MS-013

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