

## features

- Four 8-Bit D/A Converters
- Microprocessor Compatible
- TTL/CMOS Compatible
- Single Supply Operation Possible
- CMOS Technology

## applications

- Process Control
- Automatic Test Equipment
- Automatic Calibration of Large System Parameters, e.g. Gain/Offset

## description

The TLC7226C, TLC7226I, and TLC7226M consist of four 8-bit voltage-output digital-to-analog converters (DACs) with output buffer amplifiers and interface logic on a single monolithic chip.

Separate on-chip latches are provided for each of the four DACs. Data is transferred into one of these data latches through a common 8-bit TTL/CMOS-compatible 5-V input port. Control inputs A0 and A1 determine which DAC is loaded when  $\overline{WR}$  goes low. The control logic is speed compatible with most 8-bit microprocessors.

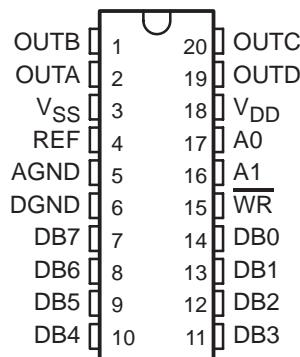
Each DAC includes an output buffer amplifier capable of sourcing up to 5 mA of output current.

The TLC7226 performance is specified for input reference voltages from 2 V to  $V_{DD} - 4$  V with dual supplies. The voltage mode configuration of the DACs allows the TLC7226 to be operated from a single power supply rail at a reference of 10 V.

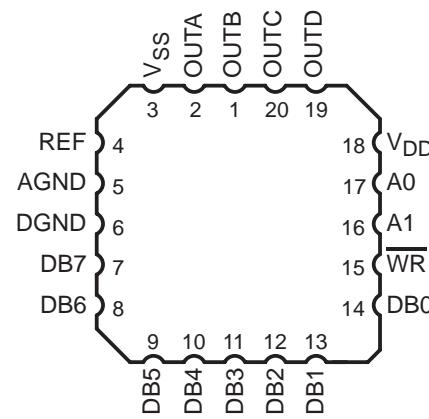
The TLC7226 is fabricated in a LinBiCMOS™ process that has been specifically developed to allow high-speed digital logic circuits and precision analog circuits to be integrated on the same chip. The TLC7226 has a common 8-bit data bus with individual DAC latches. This provides a versatile control architecture for simple interface to microprocessors. All latch-enable signals are level triggered.

Combining four DACs, four operational amplifiers, and interface logic into either a 0.3-inch wide, 20-terminal dual-in-line IC (DIP) or a small 20-terminal small-outline IC (SOIC) allows a dramatic reduction in board space requirements and offers increased reliability in systems using multiple converters. The Leadless Ceramic Chip Carrier (LCCC) package provides for operation at military temperature range. The pinout is aimed at optimizing board layout with all of the analog inputs and outputs at one end of the package and all of the digital inputs at the other.

DW OR N PACKAGE  
(TOP VIEW)



FK PACKAGE  
(TOP VIEW)



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# TLC7226C, TLC7226I, TLC7226M QUADRUPLE 8-BIT DIGITAL-TO-ANALOG CONVERTERS

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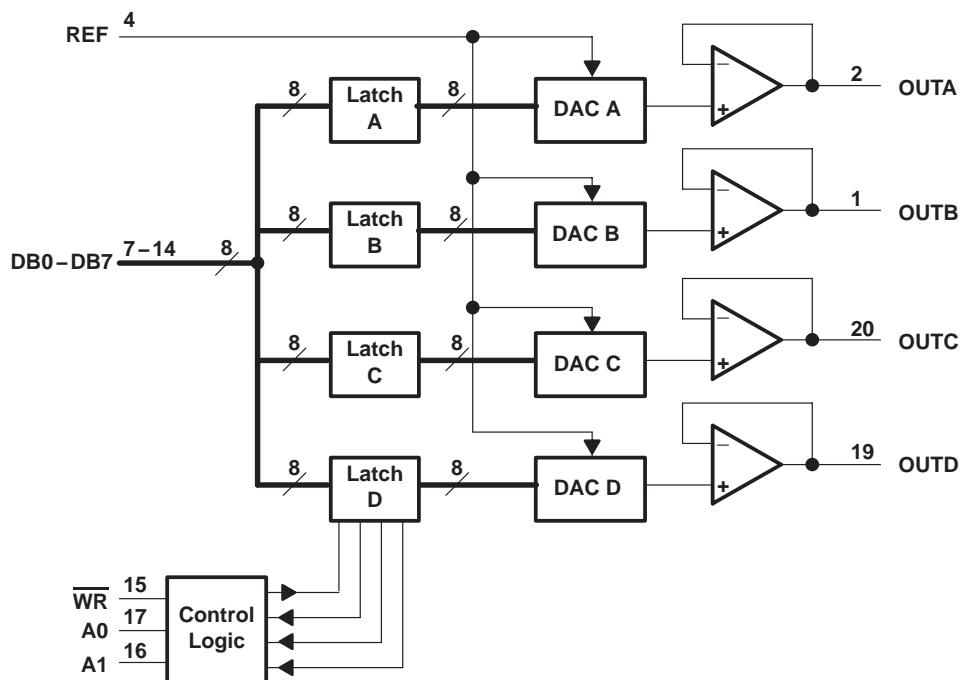
## description (continued)

The TLC7226C is characterized for operation from 0°C to 70°C. The TLC7226I is characterized for operation from -30°C to 85°C. The TLC7226M is characterized for operation from -55°C to 125°C.

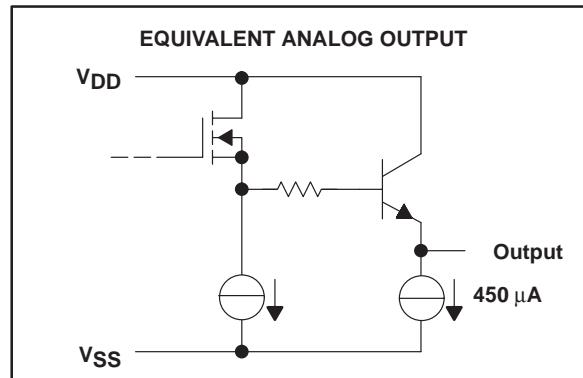
### AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGE		
	SMALL OUTLINE (DW)	PLASTIC DIP (N)	LCCC (FK)
0°C to 70°C	TLC7226CDW	TLC7226CN	—
-30°C to 85°C	TLC7226IDW	TLC7226IN	—
-55°C to 125°C	—	—	TLC7226MFKB

## functional block diagram



## schematic of outputs



# TLC7226C, TLC7226I, TLC7226M QUADRUPLE 8-BIT DIGITAL-TO-ANALOG CONVERTERS

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## Terminal Functions

TERMINAL NAME	NO. <sup>†</sup>	I/O	DESCRIPTION
AGND	5		Analog ground. AGND is the reference and return terminal for the analog signals and supply.
A0, A1	17, 16	I	DAC select inputs. The combination of high or low levels select either DACA, DACB, DACC, or DACD.
DGND	6		Digital ground. DGND is the reference and return terminal for the digital signals and supply.
DB0–DB7	14–7	I	Digital DAC data inputs. DB0–DB7 are the input digital data used for conversion.
OUTA	2	O	DACA output. OUTA is the analog output of DACA.
OUTB	1	O	DACB output. OUTB is the analog output of DACB.
OUTC	20	O	DACC output. OUTC is the analog output of DACC.
OUTD	19	O	DACD output. OUTD is the analog output of DACD.
REF	4	I	Voltage reference input. The voltage level on REF determines the full scale analog output.
V <sub>DD</sub>	18		Positive supply voltage input terminal
V <sub>SS</sub>	3		Negative supply voltage input terminal
WR	15	I	Write input. WR selects DAC transparency or latch mode. The selected input latch is transparent when WR is low.

<sup>†</sup> Terminal numbers shown are for the DW, N, and FK packages.

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

Supply voltage range, V <sub>DD</sub> : AGND or DGND	.....	–0.3 V to 17 V
V <sub>SS</sub> <sup>‡</sup>	.....	–0.3 V to 24 V
Supply voltage range, V <sub>SS</sub> : AGND or DGND	.....	–7 V to 0.3 V
Voltage range between AGND and DGND	.....	–17 V to 17 V
Input voltage range, V <sub>I</sub> (to DGND)	.....	–0.3 V to V <sub>DD</sub> + 0.3 V
Reference voltage range: V <sub>ref</sub> (to AGND)	.....	–0.3 V to V <sub>DD</sub>
V <sub>ref</sub> (to V <sub>SS</sub> )	.....	–0.3 V to 20 V
Output voltage range, V <sub>O</sub> (to AGND) (see Note 1)	.....	V <sub>SS</sub> to V <sub>DD</sub>
Continuous total power dissipation at (or below) T <sub>A</sub> = 25°C (see Note 2)	.....	500 mW
Operating free-air temperature range, T <sub>A</sub> : C suffix	.....	0°C to 70°C
E suffix	.....	–30°C to 85°C
M suffix	.....	–55°C to 125°C
Storage temperature range, T <sub>stg</sub>	.....	–65°C to 150°C
Case temperature for 10 seconds: FK package	.....	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.

<sup>‡</sup> The V<sub>SS</sub> terminal is connected to the substrate and must be tied to the most negative supply voltage applied to the device.

NOTES: 1. Output voltages may be shorted to AGND provided that the power dissipation of the package is not exceeded. Typically short circuit current to AGND is 60 mA.  
2. For operation above T<sub>A</sub> = 75°C, derate linearly at the rate of 2 mW/°C.

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## recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, $V_{DD}$		11.4	16.5	V
Supply voltage, $V_{SS}$		-5.5	0	V
High-level input voltage, $V_{IH}$		2		V
Low-level input voltage, $V_{IL}$		0.8		V
Reference voltage, $V_{ref}$		0	$V_{DD} - 4$	V
Load resistance, $R_L$		2		kΩ
Setup time, address valid before $\overline{WR} \downarrow$ , $t_{su}(AW)$ (see Figure 1)	$V_{DD} = 11.4 \text{ V to } 16.5 \text{ V}$	*0		ns
Setup time, data valid before $\overline{WR} \uparrow$ , $t_{su}(DW)$ (see Figure 1)	$V_{DD} = 11.4 \text{ V to } 16.5 \text{ V}$	*45		ns
Hold time, address valid after $\overline{WR} \uparrow$ , $t_h(AW)$ (see Figure 1)	$V_{DD} = 11.4 \text{ V to } 16.5 \text{ V}$	*0		ns
Hold time, data valid after $\overline{WR} \uparrow$ , $t_h(DW)$ (see Figure 1)	$V_{DD} = 11.4 \text{ V to } 16.5 \text{ V}$	*10		ns
Pulse duration, $\overline{WR}$ low, $t_w$ (see Figure 1)	$V_{DD} = 11.4 \text{ V to } 16.5 \text{ V}$	*50		ns
Operating free-air temperature, $T_A$	C suffix	0	70	°C
	I suffix	-25	85	
	M suffix	-55	125	

\* This parameter is not tested for M suffix devices.

## electrical characteristics over recommended operating free-air temperature range

**dual power supply over recommended power supply and reference voltage ranges,  $AGND = DGND = 0 \text{ V}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$I_I$	Input current, digital	$V_I = 0 \text{ V or } V_{DD}$				$\pm 1$	μA
$I_{(DD)}$	Supply current	$V_I = 0.8 \text{ V or } 2.4 \text{ V, } V_{DD} = 16.5 \text{ V, } V_{SS} = -5 \text{ V, }$ No load		6	16		mA
$I_{(SS)}$	Supply current	$V_I = 0.8 \text{ V or } 2.4 \text{ V, }$ No load		4	10		mA
$r_{i(\text{ref})}$	Reference input resistance			2	4		kΩ
Power supply sensitivity		$\Delta V_{DD} = \pm 5\%$				0.01	%/%
$C_i$	REF input	All 0s loaded	C and I suffix	65			pF
			M suffix	*30			
	Digital inputs	All 1s loaded				*300	
			C and I suffix			8	
			M suffix			*12	

\* This parameter is not tested for M suffix devices.

**TLC7226C, TLC7226I, TLC7226M**  
**QUADRUPLE 8-BIT DIGITAL-TO-ANALOG CONVERTERS**

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**operating characteristics over recommended operating free-air temperature range**

**dual power supply over recommended power supply and reference voltage ranges, AGND = DGND = 0 V (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Slew rate			*2.5			V•μs	
Settling time to 1/2 LSB	Positive full scale	V <sub>ref</sub> = 10 V	*5			μs	
	Negative full scale		*7				
Resolution			8			bits	
Total unadjusted error		V <sub>DD</sub> = 15 V ±5%, V <sub>ref</sub> = 10 V	±2			LSB	
Linearity error	Differential/integral		±1			LSB	
Full-scale error			±2			LSB	
Gain error			±0.25			LSB	
Temperature coefficient of gain	Full scale	V <sub>DD</sub> = 14 V to 16.5 V, V <sub>ref</sub> = 10 V	±20			ppm/°C	
	Zero-code error		±50			μV/°C	
Zero-code error			±20		±80	mV	
Digital crosstalk glitch impulse area		V <sub>ref</sub> = 0	50			nV•s	

\* This parameter is not tested for M suffix devices.

**single power supply, V<sub>DD</sub> = 14.25 V to 15.75 V, V<sub>SS</sub> = AGND = DGND = 0 V, V<sub>ref</sub> = 10 V (unless otherwise noted)**

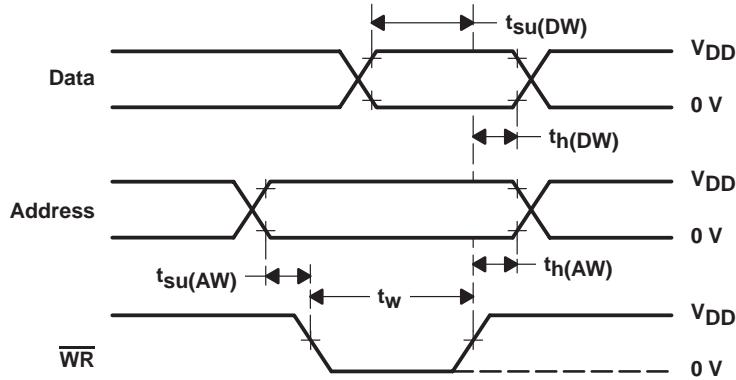
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current, I <sub>DD</sub>		V <sub>I</sub> = 0.8 V or 2.4 V, No load	5		13	mA
Slew rate			*2			V•μs
Settling time to 1/2 LSB	Positive full scale		*5			μs
	Negative full scale		*20			
Resolution			8			bits
Total unadjusted error			±2			LSB
Full-scale error			±2			LSB
Temperature coefficient of gain	Full scale	V <sub>DD</sub> = 14 V to 16.5 V, V <sub>ref</sub> = 10 V	±20			ppm/°C
	Zero-code error		±50			μV/°C
Linearity error	Differential		±1			LSB
Digital crosstalk-glitch impulse area			50			nV•s

\* This parameter is not tested for M suffix devices.

# TLC7226C, TLC7226I, TLC7226M QUADRUPLE 8-BIT DIGITAL-TO-ANALOG CONVERTERS

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## PARAMETER MEASUREMENT INFORMATION



NOTES: A.  $t_r = t_f = 20$  ns over  $V_{DD}$  range.  
B. The timing measurement reference level is equal to  $V_{IH} + V_{IL}$  divided by 2.  
C. The selected input latch is transparent while  $\overline{WR}$  is low. Invalid data during this time can cause erroneous outputs.

Figure 1. Write-Cycle Voltage Waveforms

## TYPICAL CHARACTERISTICS

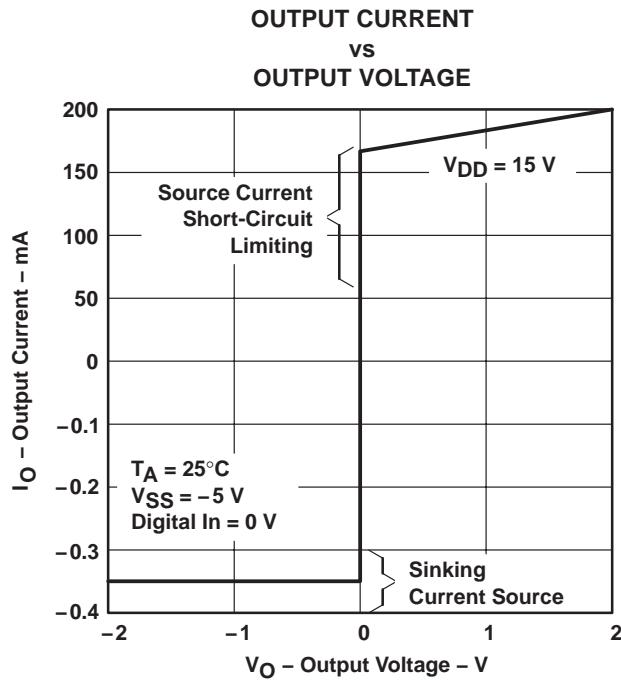


Figure 2

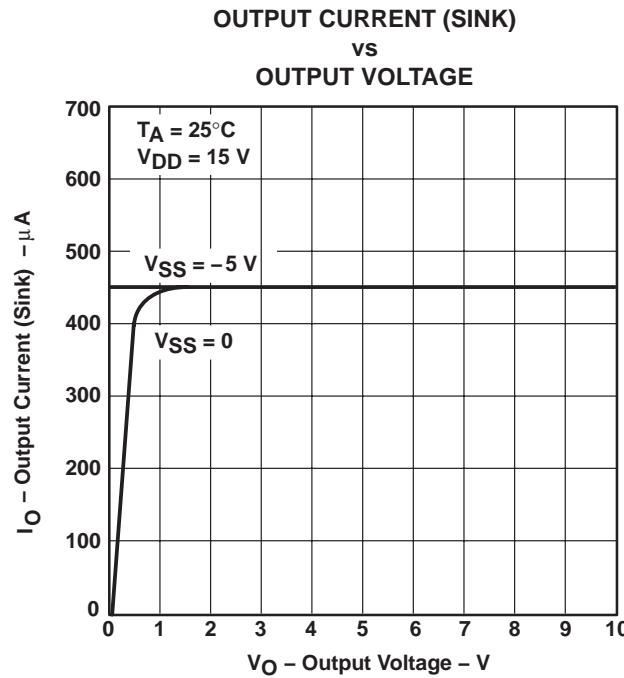
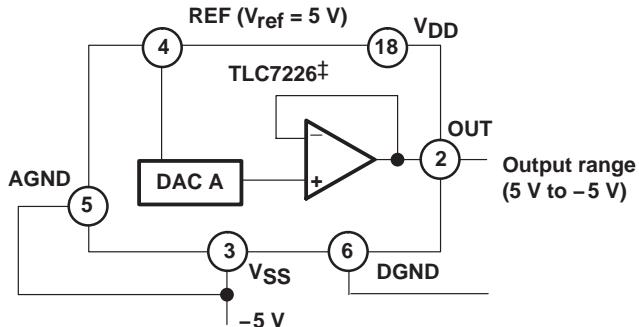


Figure 3

## PRINCIPLES OF OPERATION

### AGND bias for direct bipolar output operation

The TLC7226 can be used in bipolar operation without adding more external operational amplifiers as shown in Figure 4 by biasing AGND to  $V_{SS}$ . This configuration provides an excellent method for providing a direct bipolar output with no additional components. The transfer values are shown in Table 1.



‡ Digital inputs omitted for clarity.

**Figure 4. AGND Bias for Direct Bipolar Operation**

**Table 1. Bipolar (Offset Binary) Code**

DAC LATCH CONTENTS		ANALOG OUTPUT
MSB	LSB	
1111	1111	$+ V_{ref} \left( \frac{127}{128} \right)$
1000	0001	$+ V_{ref} \left( \frac{1}{128} \right)$
1000	0000	0 V
0111	1111	$- V_{ref} \left( \frac{1}{128} \right)$
0000	0001	$- V_{ref} \left( \frac{127}{128} \right)$
0000	0000	$- V_{ref} \left( \frac{128}{128} \right) = - V_{ref}$

### AGND bias for positive output offset

The TLC7226 AGND terminal can be biased above or below the system ground terminal, DGND, to provide an offset analog output voltage level. Figure 5 shows a circuit configuration to achieve this for channel A of the TLC7226. The output voltage,  $V_O$ , at OUTA can be expressed as:

$$V_O = V_{BIAS} + D_A (V_I) \quad (1)$$

where  $D_A$  is a fractional representation of the digital input word ( $0 \leq D \leq 255/256$ ).

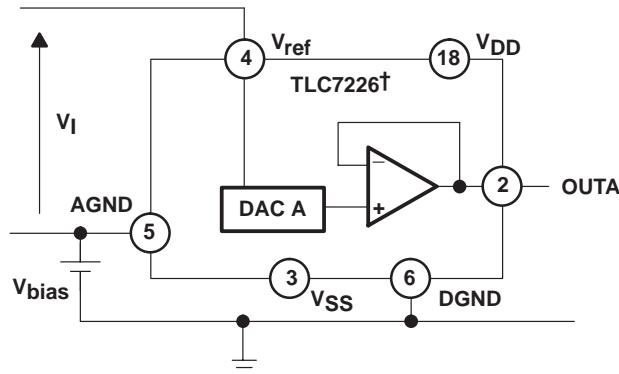
Increasing AGND above system GND reduces the output range.  $V_{DD} - V_{ref}$  must be at least 4 V to ensure specified operation. Since the AGND terminal is common to all four DACs, this method biases up the output voltages of all the DACs in the TLC7226. Supply voltages  $V_{DD}$  and  $V_{SS}$  for the TLC7226 should be referenced to DGND.

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## PRINCIPLES OF OPERATION

### AGND bias for positive output offset (continued)



† Digital inputs omitted for clarity.

Figure 5. AGND Bias Circuit

### interface logic information

Address lines A0 and A1 select which DAC accepts data from the input port. Table 2 shows the operations of the four DACs. Figure 6 shows the input control logic. When the  $\overline{WR}$  signal is low, the input latches of the selected DAC are transparent and the output responds to activity on the data bus. The data is latched into the addressed DAC latch on the rising edge of  $\overline{WR}$ . While  $\overline{WR}$  is high, the analog outputs remain at the value corresponding to the data held in their respective latches.

Table 2. Function Table

CONTROL INPUTS			OPERATION
$\overline{WR}$	A1	A0	
H	X	X	No operation Device not selected
L	L	L	DAC A transparent
↑	L	L	DAC A latched
L	L	H	DAC B transparent
↑	L	H	DAC B latched
L	H	L	DAC C transparent
↑	H	L	DAC C latched
L	H	H	DAC D transparent
↑	H	H	DAC D latched

L = low, H = high, X = irrelevant

## PRINCIPLES OF OPERATION

### interface logic information (continued)

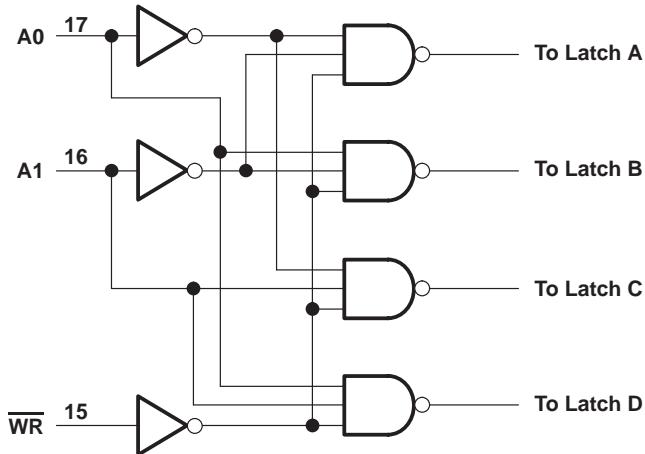


Figure 6. Input Control Logic

### unipolar output operation

The unipolar output operation is the basic mode of operation for each channel of the TLC7226, with the output voltages having the same positive polarity as  $V_{ref}$ . The TLC7226 can be operated with a single power supply ( $V_{SS} = AGND$ ) or with positive/negative power supplies. The voltage at  $V_{ref}$  must never be negative with respect to AGND to prevent parasitic transistor turnon. Connections for the unipolar output operation are shown in Figure 7. Transfer values are shown in Table 3.

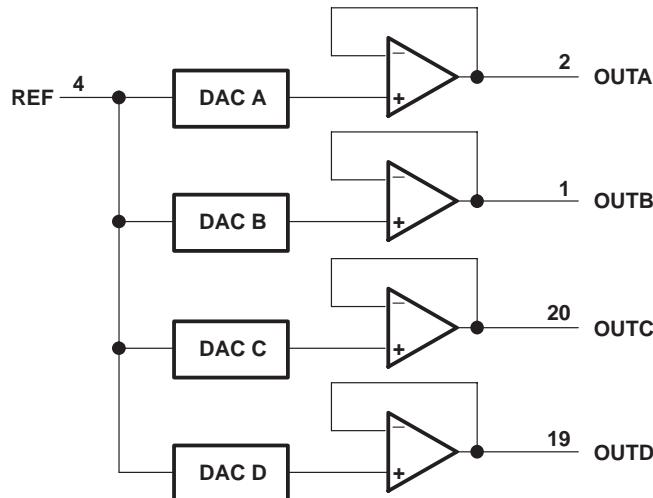


Figure 7. Unipolar Output Circuit

Table 3. Unipolar Code

DAC LATCH CONTENTS		ANALOG OUTPUT
MSB	LSB	
1111	1111	$+ V_{ref} \left( \frac{255}{256} \right)$
1000	0001	$+ V_{ref} \left( \frac{129}{256} \right)$
1000	0000	$+ V_{ref} \left( \frac{128}{256} \right) = + \frac{V_{ref}}{2}$
0111	1111	$+ V_{ref} \left( \frac{127}{256} \right)$
0000	0001	$+ V_{ref} \left( \frac{1}{256} \right)$
0000	0000	0 V

NOTE A. 1 LSB =  $\left( V_{ref} 2^{-8} \right) = V_{ref} \left( \frac{1}{256} \right)$

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## PRINCIPLES OF OPERATION

### linearity, offset, and gain error using single-ended power supplies

When an amplifier is operated from a single power supply, the voltage offset can still be either positive or negative. With a positive offset, the output voltage changes on the first code change. With a negative offset the output voltage may not change with the first code depending on the magnitude of the offset voltage.

The output amplifier, with a negative voltage offset, attempts to drive the output to a negative voltage. However, because the most negative supply rail is ground, the output cannot be driven to a negative voltage.

So when the output offset voltage is negative, the output voltage remains at zero volts until the input code value produces a sufficient output voltage to overcome the inherent negative offset voltage, resulting in a transfer function shown in Figure 8.

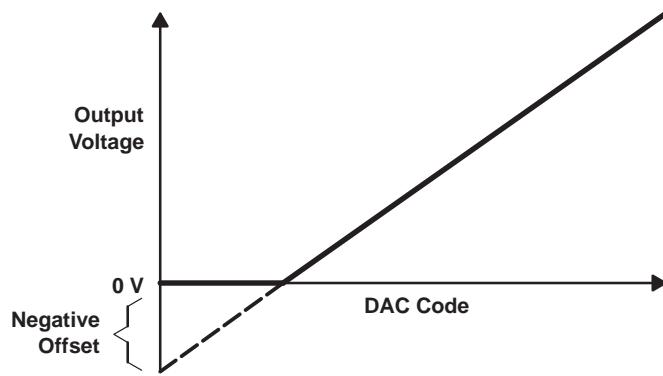


Figure 8. Effect of Negative Offset (Single Power Supply)

This negative offset error, not the linearity error, produces the breakpoint. The transfer function would have followed the dotted line if the output buffer could be driven to a negative voltage.

For a DAC, linearity is measured between zero input code (all inputs 0) and full scale code (all inputs 1) after offset and full scale are adjusted out or accounted for in some way. However, single power supply operation does not allow for adjustment when the offset is negative due to the breakpoint in the transfer function. So the linearity in the unipolar mode is measured between full scale code and the lowest code which produces a positive output voltage.

The code is calculated from the maximum specification for the negative offset.

## APPLICATION INFORMATION

### bipolar output operation using external amplifier

Each of the DACs of the TLC7226 can also be individually configured to provide bipolar output operation, using an external amplifier and two resistors per channel. Figure 9 shows a circuit used to implement offset binary coding (bipolar operation) with DAC A of the TLC7226. In this case:

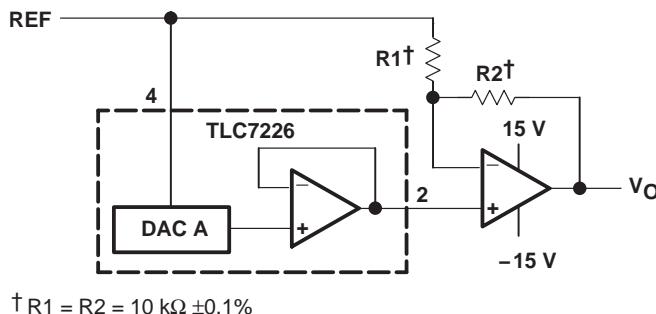
$$V_O = 1 + \frac{R2}{R1} \times (D_A \times V_{ref}) - \frac{R2}{R1} \times (V_{ref}) \quad (2)$$

with  $R1 = R2$

$$V_O = (2D_A - 1) \times V_{ref}$$

where  $D_A$  is a fractional representation of the digital word in latch A.

Mismatch between R1 and R2 causes gain and offset errors. Therefore, these resistors must match and track over temperature. The TLC7226 can be operated with a single power supply or from positive and negative power supplies.



**Figure 9. Bipolar Output Circuit**

### staircase window comparator

In many test systems, it is important to be able to determine whether some parameter lies within defined limits. The staircase window comparator shown in Figure 10 is a circuit that can be used to measure the  $V_{OH}$  and  $V_{OL}$  thresholds of a TTL device under test. Upper and lower limits on both  $V_{OH}$  and  $V_{OL}$  can be programmed using the TLC7226. Each adjacent pair of comparators forms a window of programmable size (see Figure 11). When the test voltage ( $V_{test}$ ) is within a window, then the output for that window is higher. With a reference of 2.56 V applied to the REF input, the minimum window size is 10 mV.

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## APPLICATION INFORMATION

### staircase window comparator (continued)

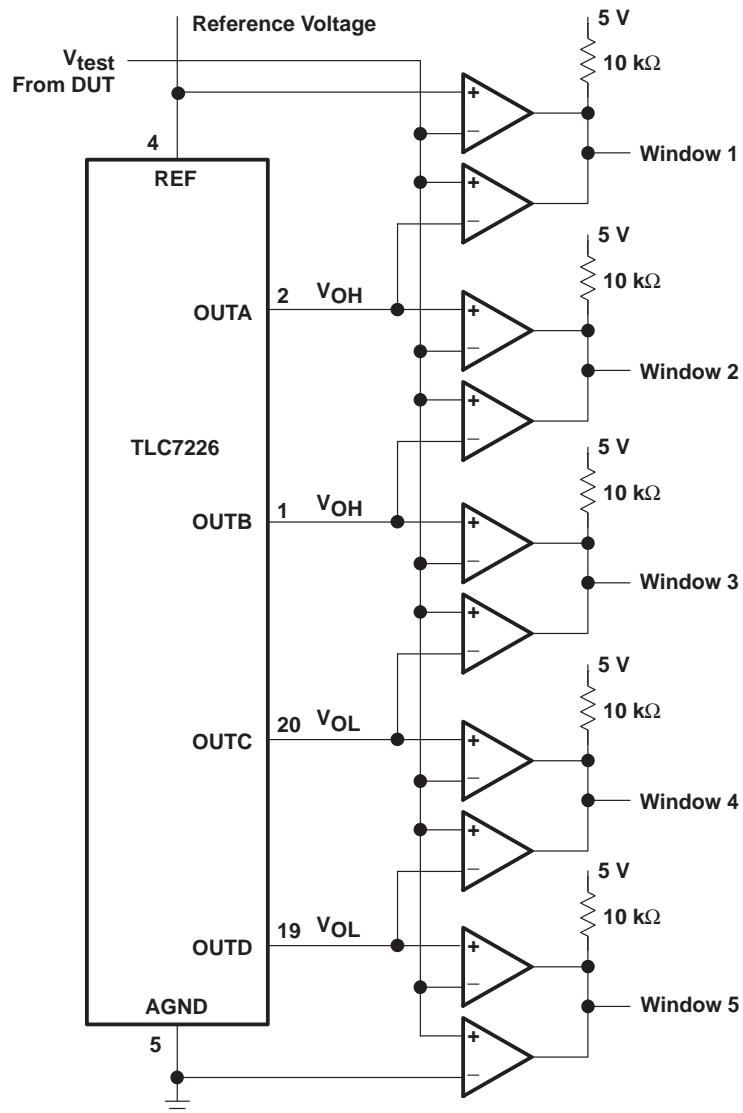
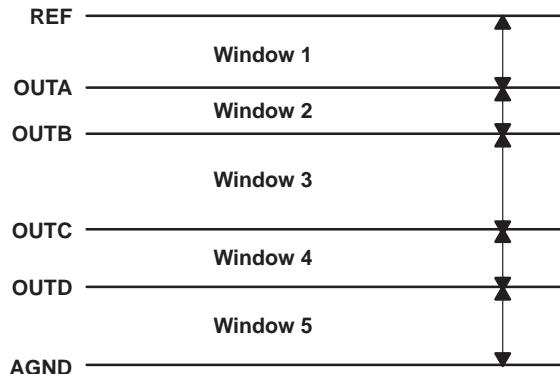


Figure 10. Logic Level Measurement

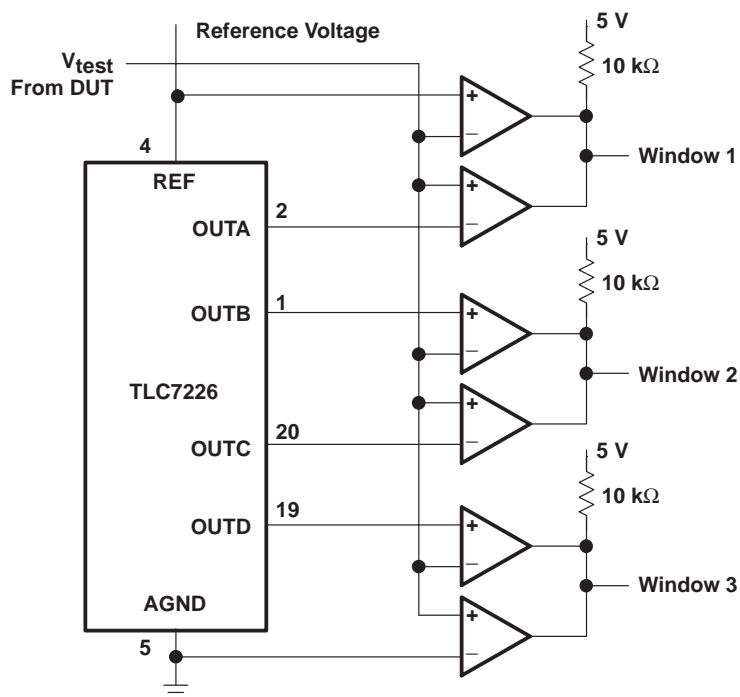
## APPLICATION INFORMATION

### staircase window comparator (continued)



**Figure 11. Adjacent Window Structure**

The circuit can easily be adapted as shown in Figure 12 to allow for overlapping of windows. When the three outputs from this circuit are decoded, five different nonoverlapping programmable window possibilities can again be defined (see Figure 13).



**Figure 12. Overlapping Window Circuit**

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## APPLICATION INFORMATION

### staircase window comparator (continued)

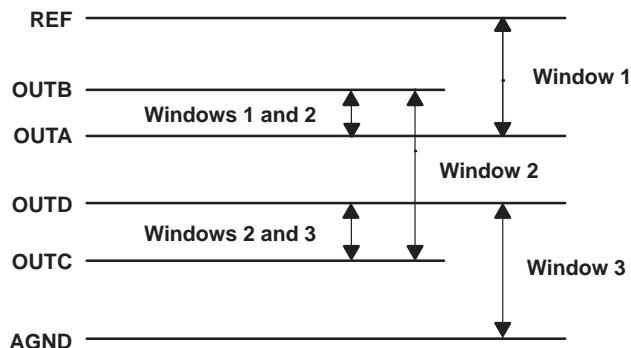


Figure 13. Overlapping Window Structure

### output buffer amplifier

The unity-gain output amplifier is capable of sourcing 5 mA into a 2-k $\Omega$  load and can drive a 3300-pF capacitor. The output can be shorted to AGND indefinitely or it can be shorted to any voltage between  $V_{SS}$  and  $V_{DD}$  consistent with the maximum device power dissipation.

### multiplying DAC

The TLC7226 can be used as a multiplying DAC when the reference signal is maintained between 2 V and  $V_{DD} - 4$  V. When this configuration is used,  $V_{DD}$  should be 14.25 V to 15.75 V. A low output-impedance buffer should be used so that the input signal is not loaded by the resistor ladder. Figure 14 shows the general schematic.

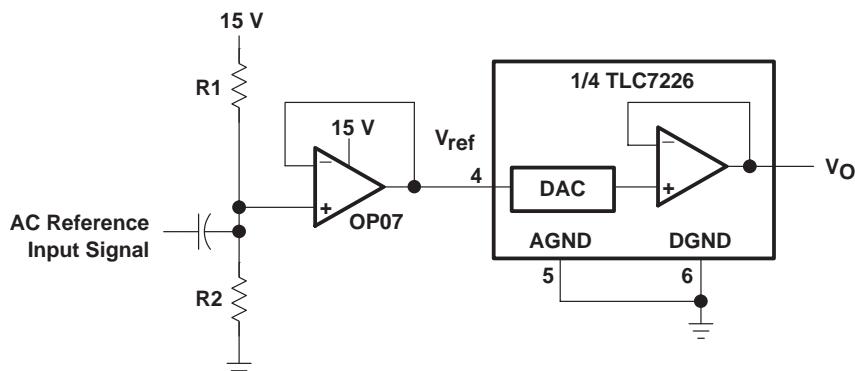


Figure 14. AC Signal Input Scheme

**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)
5962-87802012A	Active	Production	LCCC (FK)   20	55   TUBE	ROHS Exempt	SNPB	N/A for Pkg Type	-55 to 125	5962-87802012A TLC7226 MFKB
5962-87802012C	Active	Production	LCCC (FK)   20	55   TUBE	ROHS Exempt	Call TI	N/A for Pkg Type	-55 to 125	5962-87802012C
5962-87802012C.A	Active	Production	LCCC (FK)   20	55   TUBE	ROHS Exempt	Call TI	N/A for Pkg Type	-55 to 125	5962-87802012C
<a href="#">TLC7226CDW</a>	Active	Production	SOIC (DW)   20	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC7226C
TLC7226CDW.A	Active	Production	SOIC (DW)   20	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC7226C
TLC7226CDWG4	Active	Production	SOIC (DW)   20	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC7226C
<a href="#">TLC7226CDWR</a>	Active	Production	SOIC (DW)   20	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC7226C
TLC7226CDWR.A	Active	Production	SOIC (DW)   20	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC7226C
<a href="#">TLC7226CN</a>	Active	Production	PDIP (N)   20	20   TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC7226CN
TLC7226CN.A	Active	Production	PDIP (N)   20	20   TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC7226CN
<a href="#">TLC7226IDW</a>	Active	Production	SOIC (DW)   20	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLC7226I
TLC7226IDW.A	Active	Production	SOIC (DW)   20	25   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLC7226I
<a href="#">TLC7226IDWR</a>	Active	Production	SOIC (DW)   20	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLC7226I
TLC7226IDWR.A	Active	Production	SOIC (DW)   20	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLC7226I
<a href="#">TLC7226IN</a>	Active	Production	PDIP (N)   20	20   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	TLC7226IN
TLC7226IN.A	Active	Production	PDIP (N)   20	20   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	TLC7226IN
<a href="#">TLC7226MFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	ROHS Exempt	SNPB	N/A for Pkg Type	-55 to 125	5962-87802012A TLC7226 MFKB
TLC7226MFKB.A	Active	Production	LCCC (FK)   20	55   TUBE	ROHS Exempt	SNPB	N/A for Pkg Type	-55 to 125	5962-87802012A TLC7226 MFKB

<sup>(1)</sup> **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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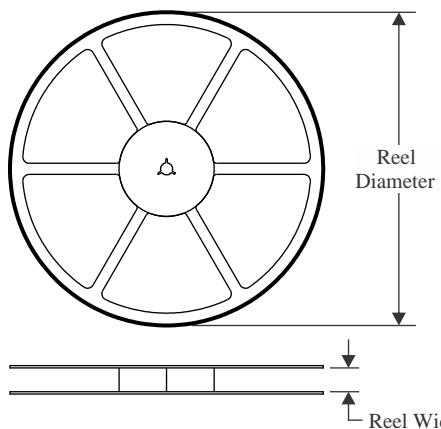
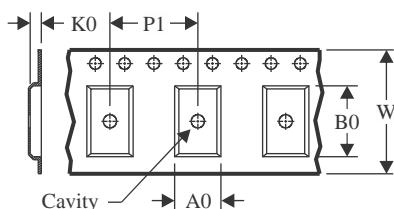
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TLC7226, TLC7226M :**

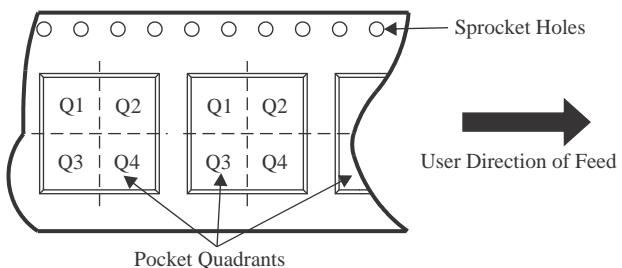
- Catalog : [TLC7226](#)
- Military : [TLC7226M](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


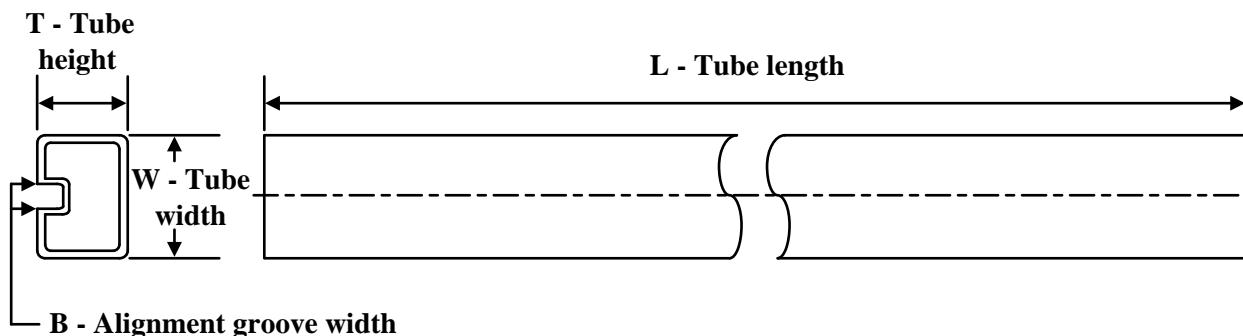
\*All dimensions are nominal

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
TLC7226CDWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
TLC7226IDWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC7226CDWR	SOIC	DW	20	2000	350.0	350.0	43.0
TLC7226IDWR	SOIC	DW	20	2000	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)
5962-87802012A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-87802012C	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-87802012C.A	FK	LCCC	20	55	506.98	12.06	2030	NA
TLC7226CDW	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC7226CDW.A	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC7226CDWG4	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC7226CN	N	PDIP	20	20	506	13.97	11230	4.32
TLC7226CN.A	N	PDIP	20	20	506	13.97	11230	4.32
TLC7226IDW	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC7226IDW.A	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC7226IN	N	PDIP	20	20	506	13.97	11230	4.32
TLC7226IN.A	N	PDIP	20	20	506	13.97	11230	4.32
TLC7226MFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLC7226MFKB.A	FK	LCCC	20	55	506.98	12.06	2030	NA

# GENERIC PACKAGE VIEW

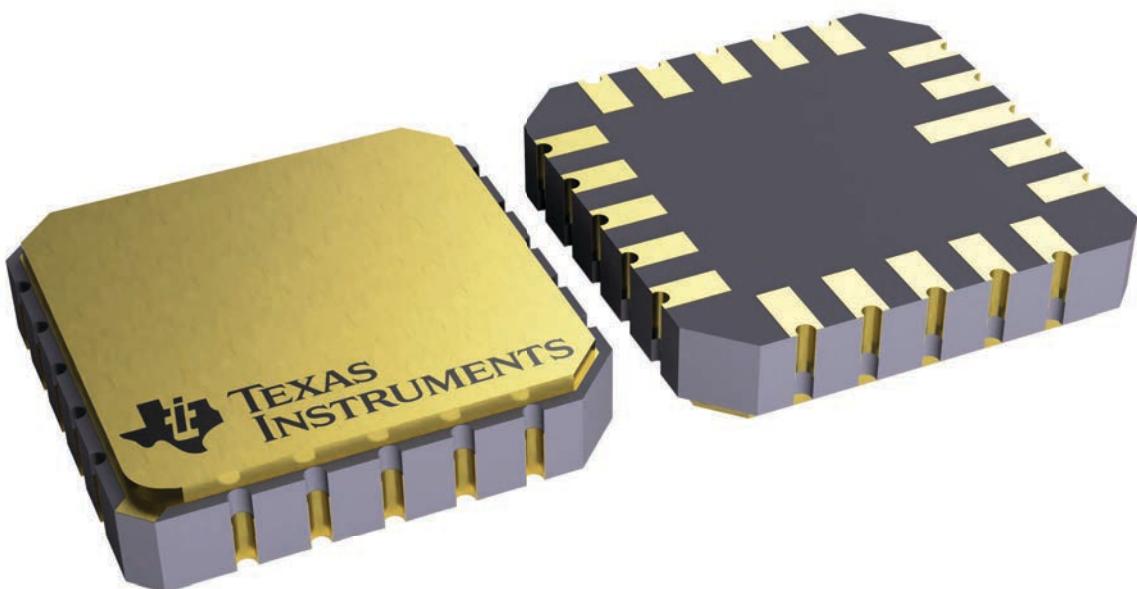
**FK 20**

**LCCC - 2.03 mm max height**

**8.89 x 8.89, 1.27 mm pitch**

**LEADLESS CERAMIC CHIP CARRIER**

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4229370VA\

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.

△ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

△ The 20 pin end lead shoulder width is a vendor option, either half or full width.

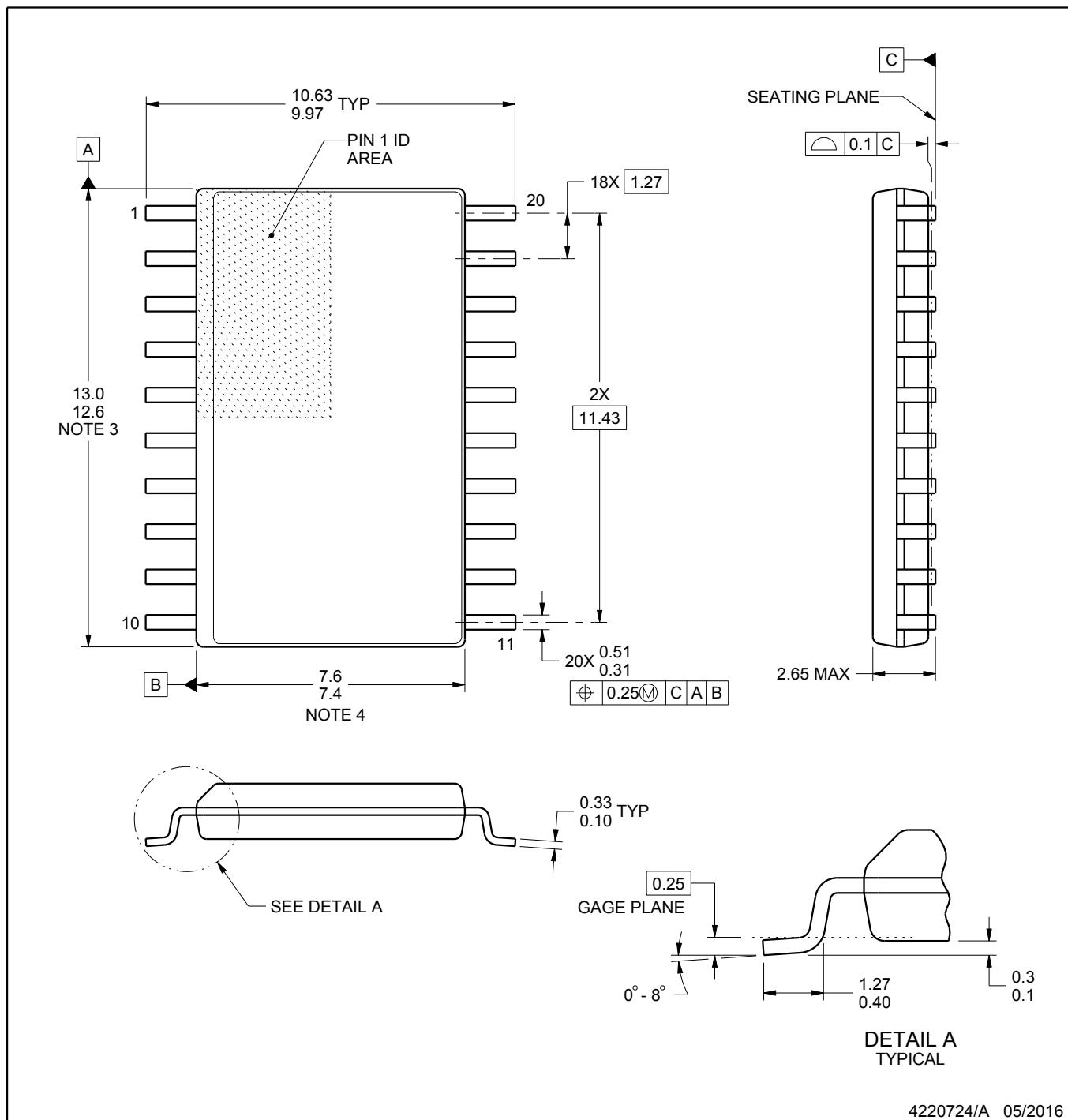


## PACKAGE OUTLINE

**DW0020A**

## **SOIC - 2.65 mm max height**

SOIC



## NOTES:

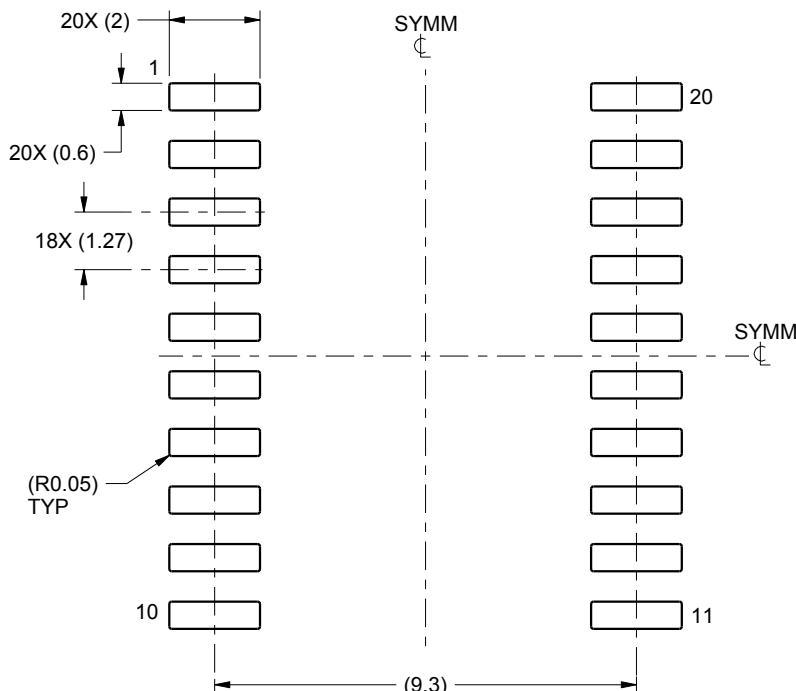
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

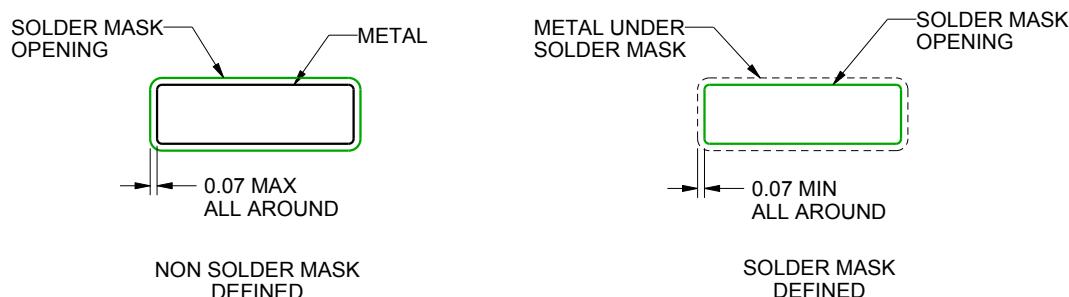
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

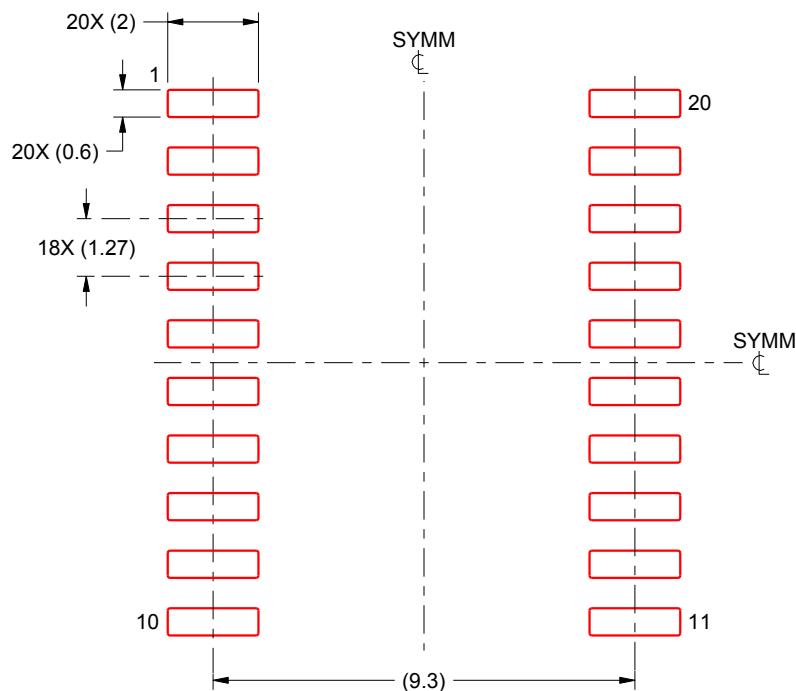
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.

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