

TLC5602C, TLC5602M

VIDEO 8-BIT DIGITAL-TO-ANALOG CONVERTERS

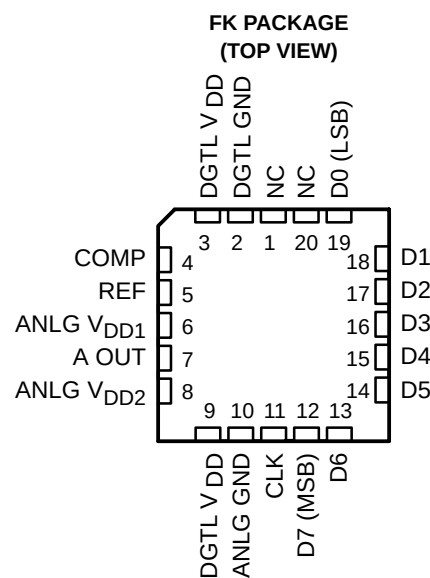
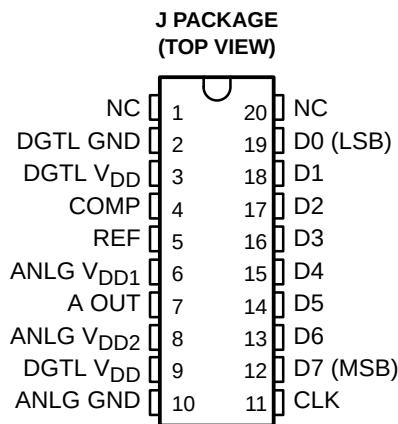
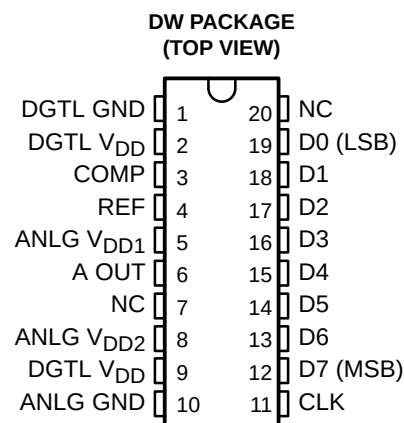
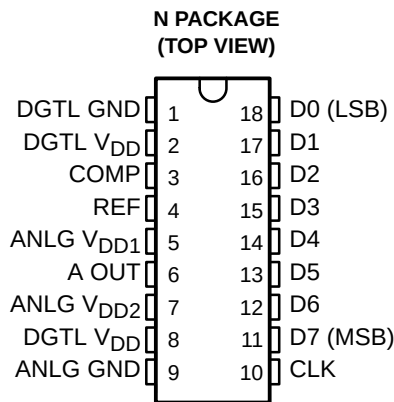
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- **8-Bit Resolution**
- **$\pm 0.2\%$ Linearity**
- **Maximum Conversion Rate**
30 MHz Typ
20 MHz Min
- **Analog Output Voltage Range**
 V_{DD} to $V_{DD} - 1\text{ V}$
- **TTL Digital Input Voltage**
- **5-V Single Power-Supply Operation**
- **Low Power Consumption . . . 80 mW Typ**
- **Interchangeable With Fujitsu MB40778**

description

The TLC5602x devices are low-power, ultra-high-speed video, digital-to-analog converters that use the LinEPIC™ 1- μm CMOS process. The TLC5602x converts digital signals to analog signals at a sampling rate of dc to 20 MHz. Because of high-speed operation, the TLC5602x devices are suitable for digital video applications such as digital television, video processing with a computer, and radar-signal processing.

The TLC5602C is characterized for operation from 0°C to 70°C. The TLC5602M is characterized over the full military temperature range of –55°C to 125°C.



NC—No internal connection

LinEPIC is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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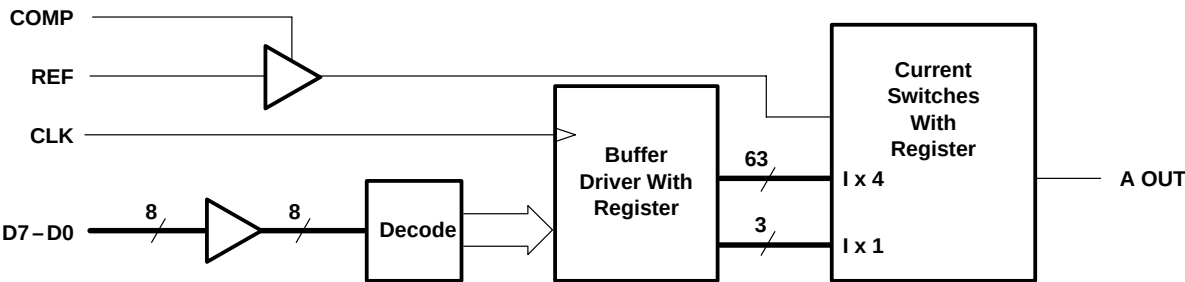
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AVAILABLE OPTIONS

PACKAGE				
T _A	WIDE-BODY SMALL OUTLINE (DW)	CERAMIC CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)
0°C to 70°C	TLC5602CDW			TLC5602CN
–55°C to 125°C		TLC5602MFK	TLC5602MJ	

functional block diagram



FUNCTION TABLE

STEP	DIGITAL INPUTS								OUTPUT VOLTAGE†
	D7	D6	D5	D4	D3	D2	D1	D0	
0	L	L	L	L	L	L	L	L	3.980 V
1	L	L	L	L	L	L	L	H	3.984 V
127	L	H	H	H	H	H	H	H	4.488 V
128	H	L	L	L	L	L	L	L	4.492 V
129	H	L	L	L	L	L	L	H	4.496 V
254	H	H	H	H	H	H	H	L	4.996 V
255	H	H	H	H	H	H	H	H	5.000 V

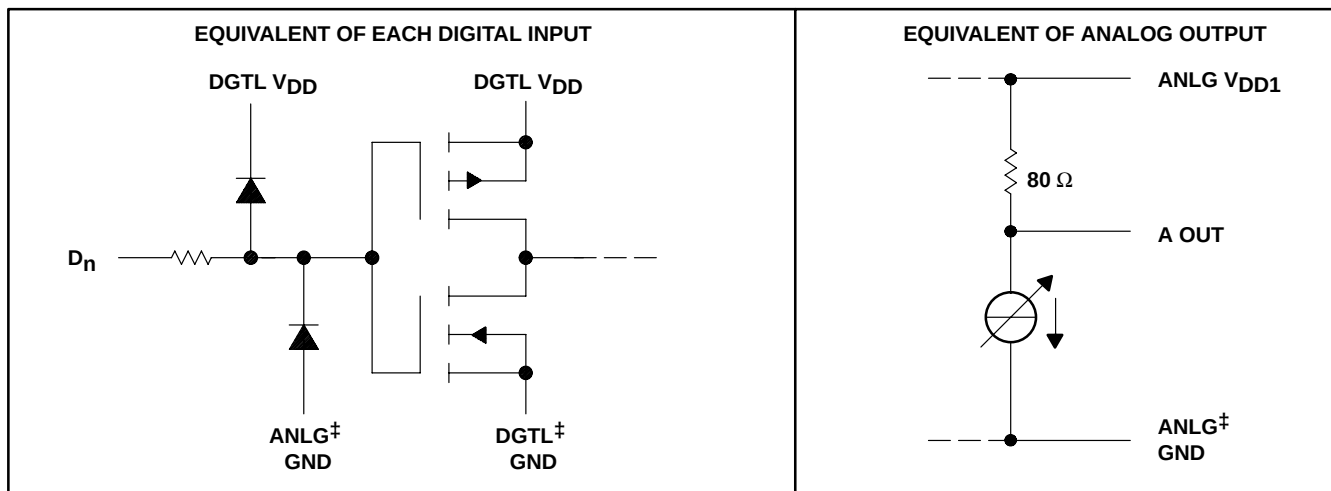
† V_{DD} = 5 V and V_{ref} = 4.02 V

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schematics of equivalent input and output



‡ ANLG GND and DGTL GND do not connect internally and should be tied together as close to the device terminals as possible.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, ANLG V_{DD} , DGTL V_{DD}	–0.5 V to 7 V
Digital input voltage range, V_I	–0.5 V to 7 V
Analog reference voltage range, V_{ref}	$V_{DD} - 1.7$ V to $V_{DD} + 0.5$ V
Operating free-air temperature range, T_A : TLC5602C	0°C to 70°C
TLC5602M	–55°C to 125°C
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

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

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V _{DD}		4.75	5	5.25	V
Analog reference voltage, V _{ref}		3.8	4	4.2	V
High-level input voltage, V _{IH}		2			V
Low-level input voltage, V _{IL}				0.8	V
Pulse duration, CLK high or low, t _W		25			ns
Setup time, data before CLK↑, t _{SU}		16.5			ns
Hold time, data after CLK↑, t _H		12.5			ns
Phase compensation capacitance, C _{comp} (see Note 1)		1			μF
Load resistance, R _L		75			Ω
Operating free-air temperature, T _A	TLC5602C	0		70	°C
	TLC5602M	−55		125	

NOTE 1: The phase compensation capacitor should be connected between COMP and ANLG GND.



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electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP [‡]	MAX	UNIT	
I _{IH}	High-level input current	Digital inputs	V _I = 5 V		±1			μA	
I _{IL}	Low-level input current		V _I = 0 V		±1			μA	
I _{ref}	Input reference current		V _{ref} = 4 V		10			μA	
V _{FS}	Full-scale analog output voltage		V _{DD} = 5 V,	V _{ref} = 4.02 V	V _{DD} −15	V _{DD}	V _{DD} +15	mV	
V _{ZS}	Zero-scale analog output voltage		V _{DD} = 5 V, T _A = full range [§]	V _{ref} = 4.02 V,	TLC5602C	3.919	3.98	4.042	V
					TLC5602M	3.919	3.98	4.042	
					TLC5602M	3.919	3.98	4.062	
r _o	Output resistance		T _A = 25°C		TLC5602C	60	80	120	Ω
			T _A = full range [§]		TLC5602M				
C _i	Input capacitance		f _{clock} = 1 MHz, T _A = 25°C		15			pF	
I _{DD}	Supply current		f _{clock} = 20 MHz, V _{ref} = V _{DD} −0.95 V		16			25	mA

[‡] All typical values are at V_{DD} = 5 V and T_A = 25°C.

[§] Full range for the TLC5602C is 0°C to 70°C, and full range for the TLC5602M is -55°C to 125°C.

operating characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP [†]	MAX	UNIT
E _{L(adj)}	Linearity error, best-straight-line		T _A = full range [‡]	TLC5602C			±0.2%	
			T _A = 25°C	TLC5602M			±0.2%	
			T _A = full range [‡]				±0.4%	
E _L	Linearity error, end point					±0.15%		
E _D	Linearity error, differential					±0.2%		
G _{diff}	Differential gain		NTSC 40-IRE modulated ramp, f _{clock} = 14.3 MHz, Z _L ≥ 75 kΩ			0.7%		
f _{diff}	Differential phase					0.4°		
t _{pd}	Propagation delay time, CLK to analog output		C _L = 10 pF			25		ns
t _s	Settling time to within 1/2 LSB		C _L = 10 pF			30		ns

[†] All typical values are at V_{DD} = 5 V and T_A = 25°C.

[‡] Full range for the TLC5602C is 0°C to 70°C, and full range for the TLC5602M is -55°C to 125°C.



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PARAMETER MEASUREMENT INFORMATION

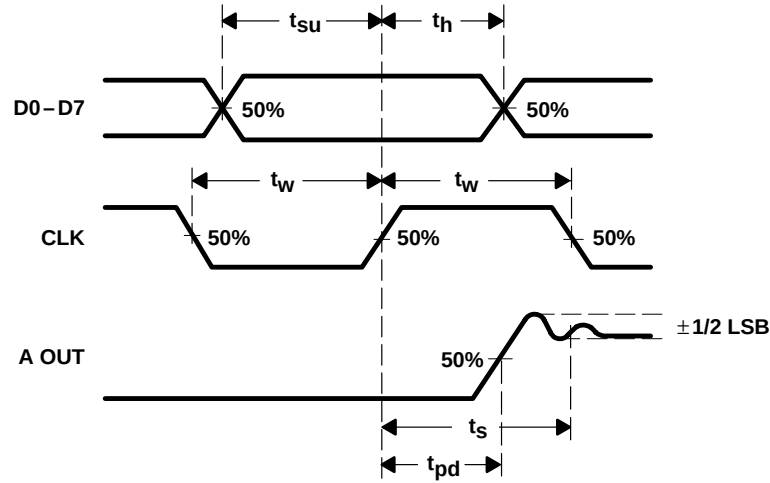


Figure 1. Voltage Waveforms

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TYPICAL CHARACTERISTICS

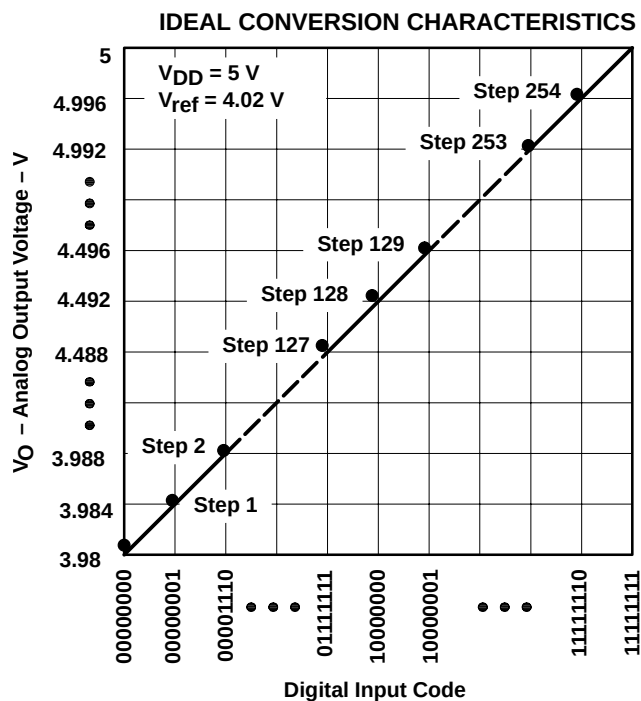


Figure 2

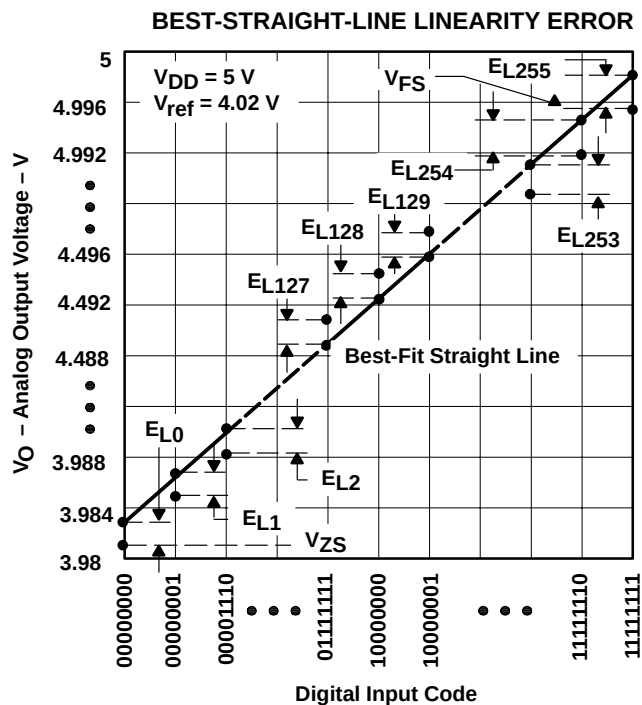


Figure 3

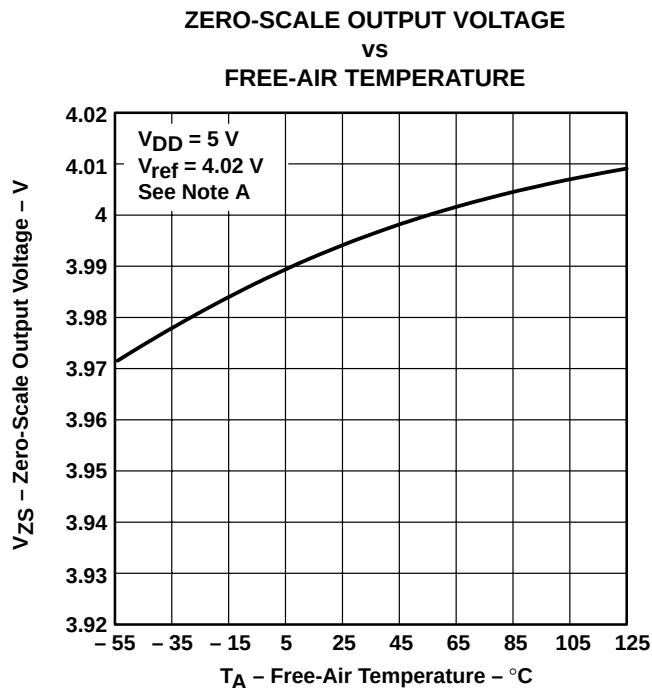


Figure 4

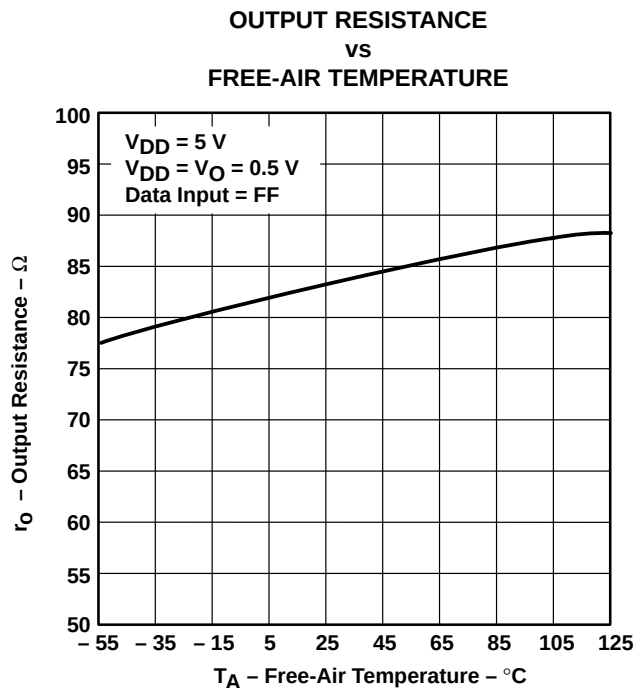


Figure 5

NOTE A: V_{ref} is relative to ANLG GND. V_{DD} is the voltage between ANLG V_{DD} and DGTL V_{DD} tied together and ANLG GND and DGTL GND tied together.

TYPICAL CHARACTERISTICS

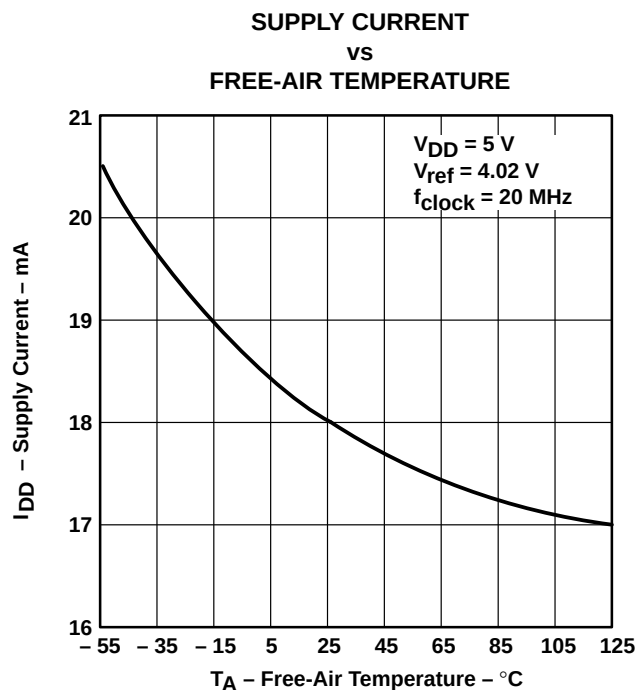
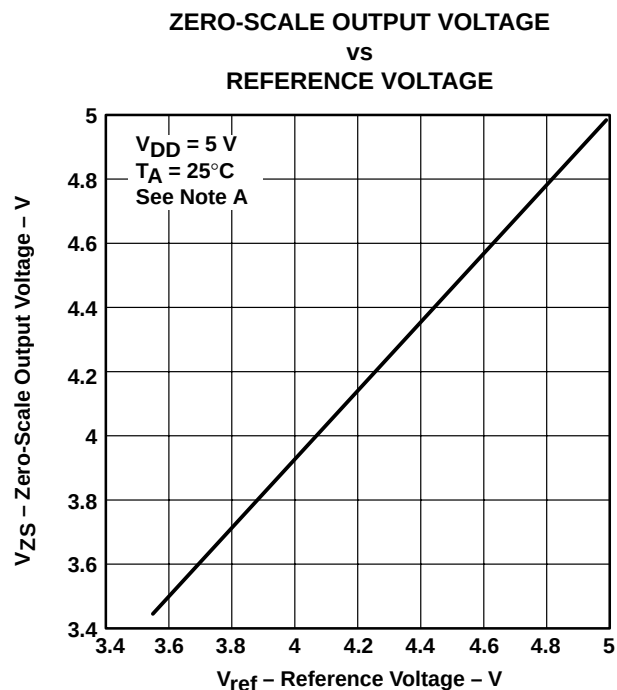


Figure 6



NOTE A: V_{ref} is relative to ANLG GND. V_{DD} is the voltage between ANLG V_{DD} and DGTL V_{DD} tied together and ANLG GND and DGTL GND tied together.

Figure 7

TLC5602C, TLC5602M

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APPLICATION INFORMATION

The following design recommendations benefit the TLC5602 user:

- Physically separate and shield external analog and digital circuitry as much as possible to reduce system noise.
- Use RF breadboarding or RF printed-circuit-board (PCB) techniques throughout the evaluation and production process.
- Since ANLG GND and DGTL GND are not connected internally, these terminals need to be connected externally. With breadboards, these ground lines should connect to the power-supply ground through separate leads with proper supply bypassing. A good method is to use a separate twisted pair for the analog and digital supply lines to minimize noise pickup.

Use wide ground leads or a ground plane on the PCB layouts to minimize parasitic inductance and resistance. The ground plane is the better choice for noise reduction.

- ANLG V_{DD} and DGTL V_{DD} are also separated internally, so they must connect externally. These external PCB leads should also be made as wide as possible. Place a ferrite bead or equivalent inductance in series with ANLG V_{DD} and the decoupling capacitor as close to the device terminals as possible before the ANLG V_{DD} and DGTL V_{DD} leads are connected together on the board.
- Decouple ANLG V_{DD} to ANLG GND and DGTL V_{DD} to DGTL GND with a 1- μ F and 0.01- μ F capacitor, respectively, as close as possible to the appropriate device terminals. A ceramic chip capacitor is recommended for the 0.01- μ F capacitor.
- Connect the phase compensation capacitor between COMP and ANLG GND with as short a lead-in as possible.
- The no-connection (NC) terminals on the small-outline package should be connected to ANLG GND.
- Shield ANLG V_{DD} , ANLG GND, and A OUT from the high-frequency terminals CLK and D7–D0. Place ANLG GND traces on both sides of the A OUT trace on the PCB.



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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)
TLC5602CDW	Active	Production	SOIC (DW) 20	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC5602C
TLC5602CDW.A	Active	Production	SOIC (DW) 20	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC5602C
TLC5602CDWR	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC5602C
TLC5602CDWR.A	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC5602C

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

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

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

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

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

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

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

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLC5602CDWR	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)
TLC5602CDWR	SOIC	DW	20	2000	535.4	167.6	48.3

TUBE



*All dimensions are nominal

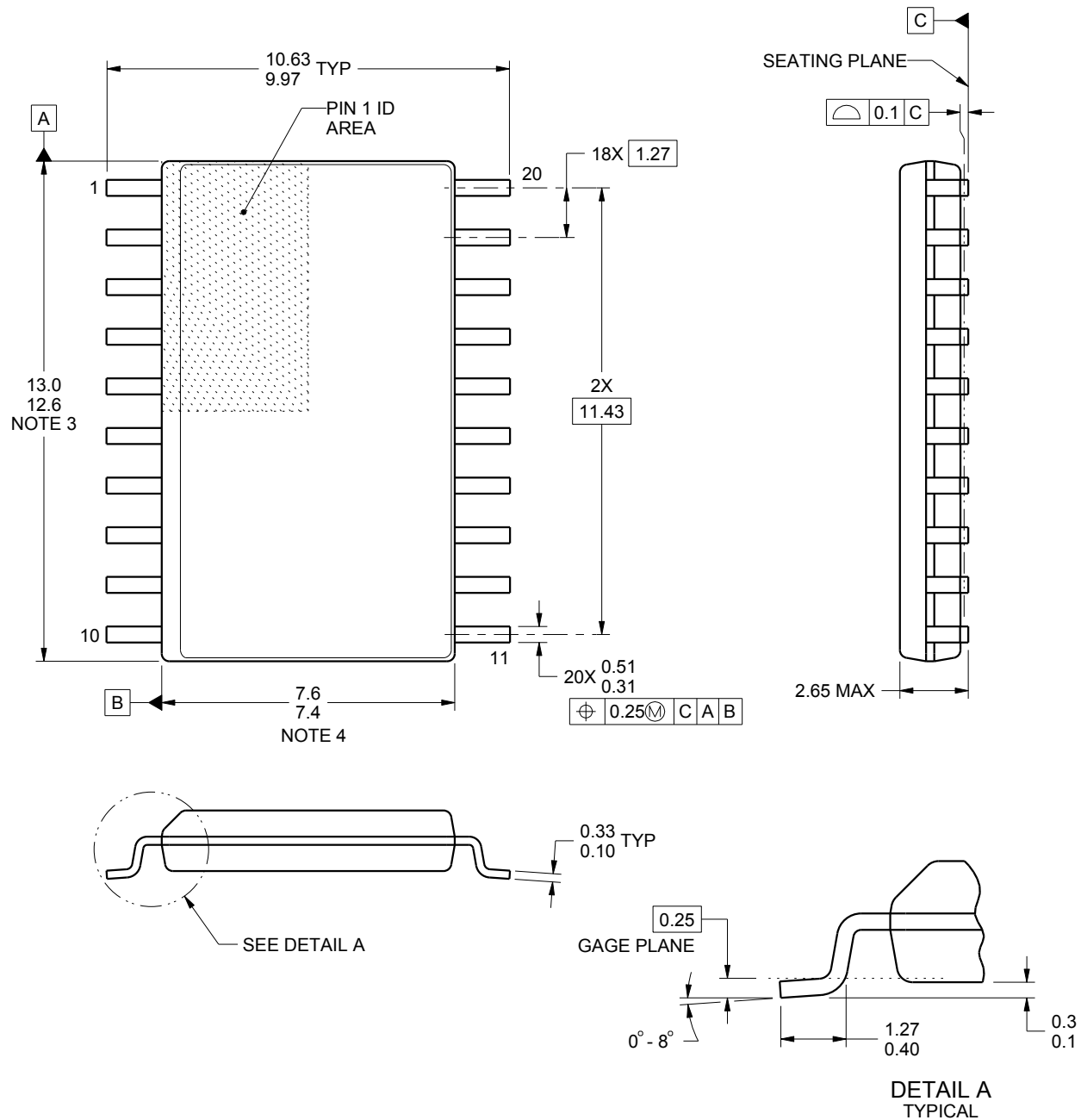
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TLC5602CDW	DW	SOIC	20	25	506.98	12.7	4826	6.6
TLC5602CDW.A	DW	SOIC	20	25	506.98	12.7	4826	6.6

DW0020A

PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



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NOTES:

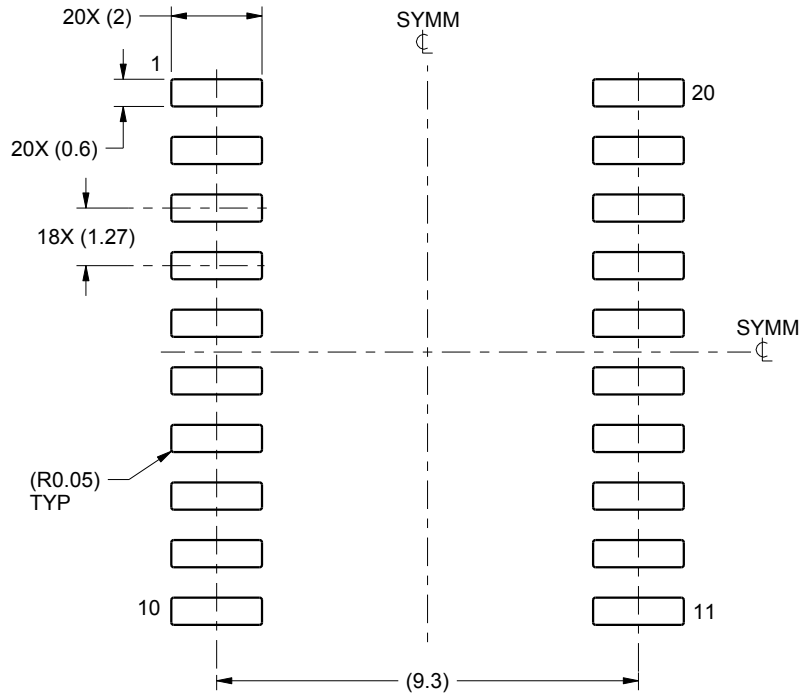
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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

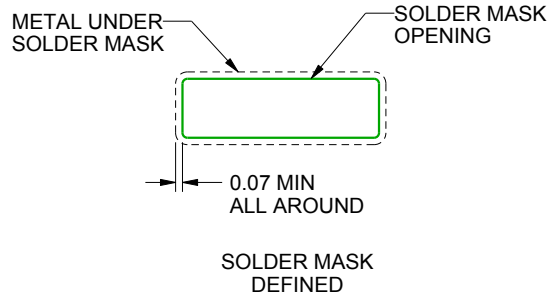
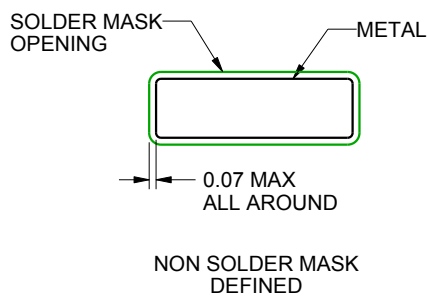
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

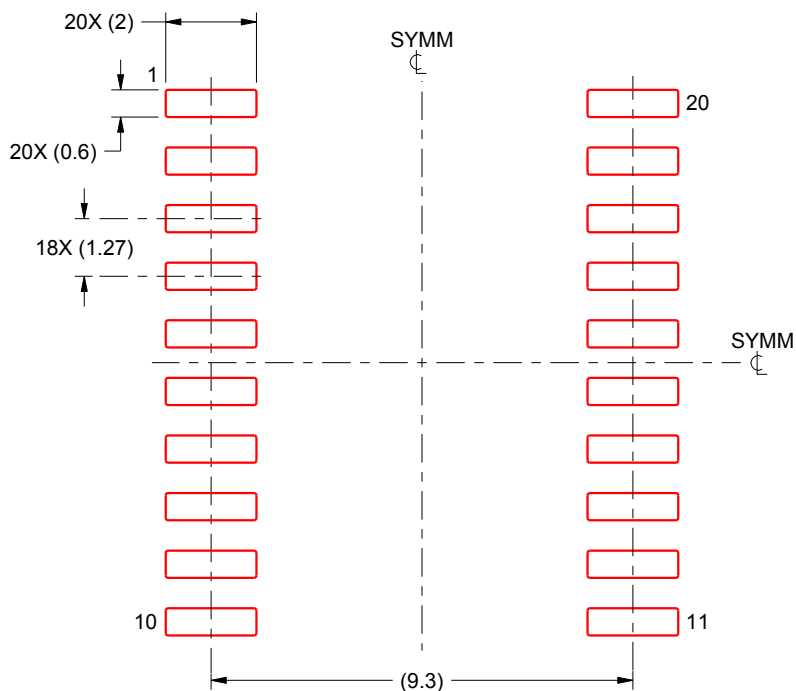
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



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

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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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