

## 8-CHANNEL, 12-/10-/8-BIT, 2.7-V TO 5.5-V LOW POWER DIGITAL-TO-ANALOG CONVERTERS WITH POWER DOWN AND INTERNAL REFERENCE

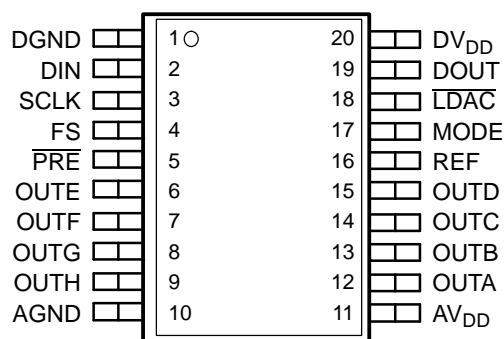
### FEATURES

- Eight Voltage Output DACs in One Package
  - TLV5630 . . . 12-Bit
  - TLV5631 . . . 10-Bit
  - TLV5632 . . . 8-Bit
  - 1  $\mu$ s in Fast Mode
  - 3  $\mu$ s in Slow Mode
- Programmable Settling Time vs Power Consumption
  - 1  $\mu$ s in Fast Mode
  - 3  $\mu$ s in Slow Mode
  - 18 mW in Slow Mode at 3 V
  - 48 mW in Fast Mode at 3 V
- Compatible With TMS320 and SPI Serial Ports
- Monotonic Over Temperature
- Low Power Consumption:
  - 18 mW in Slow Mode at 3 V
  - 48 mW in Fast Mode at 3 V
- Power-Down Mode
- Internal Reference
- Data Output for Daisy-Chaining

### APPLICATIONS

- Digital Servo Control Loops
- Digital Offset and Gain Adjustment
- Industrial Process Control
- Machine and Motion Control Devices
- Mass Storage Devices

DW OR PW PACKAGE  
(TOP VIEW)



### DESCRIPTION

The TLV5630, TLV5631, and TLV5632 are pin-compatible, eight-channel, 12-/10-/8-bit voltage output DACs each with a flexible serial interface. The serial interface allows glueless interface to TMS320 and SPI, QSPI, and Microwire serial ports. It is programmed with a 16-bit serial string containing 4 control and 12 data bits.

Additional features are a power-down mode, an  $\overline{\text{LDAC}}$  input for simultaneous update of all eight DAC outputs, and a data output which can be used to cascade multiple devices, and an internal programmable band-gap reference.

The resistor string output voltage is buffered by a rail-to-rail output amplifier with a programmable settling time to allow the designer to optimize speed vs power dissipation. The buffered, high-impedance reference input can be connected to the supply voltage.

Implemented with a CMOS process, the DACs are designed for single-supply operation from 2.7 V to 5.5 V, and can operate on two separate analog and digital power supplies. The devices are available in 20-pin SOIC and TSSOP packages.



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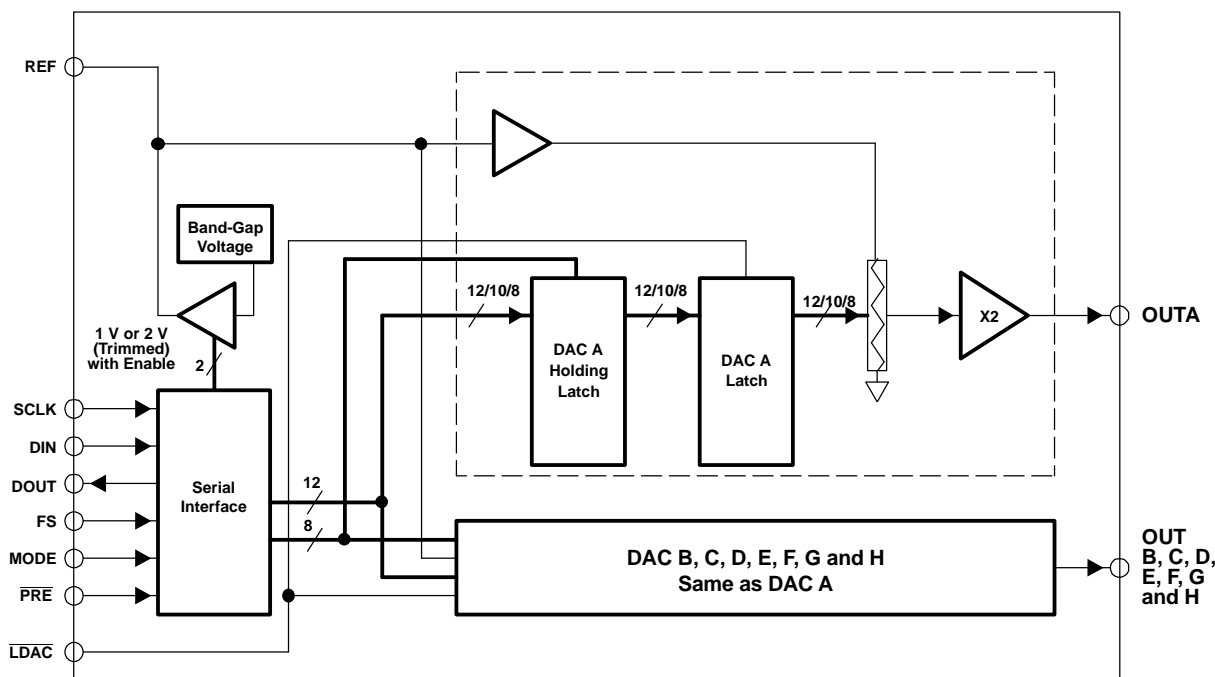


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGE		
	SOIC (DW)	TSSOP (PW)	RESOLUTION
40°C to 85°C	TLV5630IDW	TLV5630IPW	12
	TLV5631IDW	TLV5631IPW	10
	TLV5632IDW	TLV5632IPW	8

## FUNCTIONAL BLOCK DIAGRAM



## Terminal Functions

TERMINAL NAME NO.		I/O	DESCRIPTION
AGND	10	P	Analog ground
AV <sub>DD</sub>	11	P	Analog power supply
DGND	1	P	Digital ground
DIN	2	I	Digital serial data input
DOUT	19	O	Digital serial data output
DV <sub>DD</sub>	20	P	Digital power supply
FS	4	I	Frame sync input
LDAC	18	I	Load DAC. The DAC outputs are only updated, if this signal is low. It is an asynchronous input.
MODE	17	I	DSP/μC mode pin. High = μC mode, NC = DSP mode.
PRE	5	I	Preset input
REF	16	I/O	Voltage reference input/output
SCLK	3	I	Serial clock input
OUTA-OUTH	12-15, 6-9	O	DAC outputs A, B, C, D, E, F, G and H

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature (unless otherwise noted) <sup>(1)</sup>

	UNIT
Supply voltage, (AV <sub>DD</sub> , DV <sub>DD</sub> to GND)	7 V
Reference input voltage range	- 0.3 V to AV <sub>DD</sub> + 0.3
Digital input voltage range	- 0.3 V to DV <sub>DD</sub> + 0.3
Operating free-air temperature range, T <sub>A</sub>	-40°C to 85°C
Storage temperature range, T <sub>stg</sub>	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

- (1) 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	TYP	MAX	UNIT
Supply voltage, AV <sub>DD</sub> , DV <sub>DD</sub>	5-V operation	4.5	5	5.5	V
	3-V operation	2.7	3	3.3	V
High-level digital input, V <sub>IH</sub>	DV <sub>DD</sub> = 2.7 V	2			V
	DV <sub>DD</sub> = 5.5 V	2.4			
Low-level digital input, V <sub>IL</sub>	DV <sub>DD</sub> = 2.7 V			0.6	V
	DV <sub>DD</sub> = 5.5 V			1.0	
Reference voltage, V <sub>ref</sub>	AV <sub>DD</sub> = 5 V, See <sup>(1)</sup>	GND	2.048	AV <sub>DD</sub>	V
	AV <sub>DD</sub> = 3 V, See <sup>(1)</sup>	GND	1.024	AV <sub>DD</sub>	
Analog output load resistance, R <sub>L</sub>		2			kΩ
Analog output load capacitance, C <sub>L</sub>				100	pF
Clock frequency, f <sub>CLK</sub>				30	MHz
Operating free-air temperature, T <sub>A</sub>		-40		85	°C

- (1) Reference input voltages greater than AV<sub>DD</sub>/2 causes saturation for large DAC codes.

## ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>POWER SUPPLY</b>					
I <sub>DD</sub> Power supply current	No load, All inputs = DV <sub>DD</sub> or GND, V <sub>ref</sub> = 2.048 V, See <sup>(1)</sup>	Fast	16	21	mA
		Slow	6	8	
Power-down supply current			0.1		μA
POR Power on threshold			2		V
PSRR Power supply rejection ratio	Full scale, See <sup>(2)</sup>		-50		dB

- (1) I<sub>DD</sub> is measured while continuously writing code 2048 to the DAC. For V<sub>IH</sub> < DV<sub>DD</sub> - 0.7 V and V<sub>IL</sub> > 0.7 V, supply current increases.  
(2) Power supply rejection ratio at full scale is measured by varying AV<sub>DD</sub> and is given by: PSRR = 20 log [(E<sub>G</sub>(AV<sub>DD</sub>max) - E<sub>G</sub>(AV<sub>DD</sub>min))/V<sub>DD</sub>max]

## ELECTRICAL CHARACTERISTICS (continued)

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
STATIC DAC SPECIFICATIONS							
Resolution		TLV5630		12			Bits
		TLV5631		10			Bits
		TLV5632		8			Bits
INL	Integral nonlinearity	TLV5630	V <sub>ref</sub> = 1 V, 2 V	Code 40 to 4095	±2	±6	LSB
		TLV5631		Code 20 to 1023	±0.5	±2	LSB
		TLV5632		Code 6 to 255	±0.3	±1	LSB
DNL	Differential nonlinearity	TLV5630	V <sub>ref</sub> = 1 V, 2 V	Code 40 to 4095	±0.5	±1	LSB
		TLV5631		Code 20 to 1023	±0.1	±1	LSB
		TLV5632		Code 6 to 255	±0.1	±1	LSB
E <sub>ZS</sub>	Zero scale error (offset error at zero scale)					±30	mV
E <sub>ZS</sub> TC	Zero scale error temperature coefficient			30			μV/°C
E <sub>G</sub>	Gain error					±0.6	%Full Scale V
EGTC	Gain error temperature coefficient			10			ppm/°C
OUTPUT SPECIFICATIONS							
V <sub>O</sub>	Voltage output range	R <sub>L</sub> = 10 kΩ		0	AV <sub>DD</sub> -0.4		V
	Output load regulation accuracy	R <sub>L</sub> = 2 kΩ vs 10 kΩ				±0.3	%Full Scale V
REFERENCE OUTPUT							
V <sub>REFOUTL</sub>	Low reference voltage	V <sub>DD</sub> > 4.75 V		1.010	1.024	1.040	V
V <sub>REFOUTH</sub>	High reference voltage			2.020	2.048	2.096	V
I <sub>ref</sub> (Source)	Output source current					1	mA
I <sub>ref</sub> (Sink)	Output sink current			-1			mA
	Load capacitance	See <sup>(3)</sup>		1	10		μF
PSRR	Power supply rejection ratio			60			dB
REFERENCE INPUT							
V <sub>I</sub>	Input voltage range			0	AV <sub>DD</sub>		V
R <sub>I</sub>	Input resistance			50			kΩ
C <sub>I</sub>	Input capacitance			10			pF
	Reference input bandwidth	V <sub>ref</sub> = 0.4 V <sub>pp</sub> + 2.048 Vdc, Input code = 0x800	Fast	2.2			MHz
			Slow	1.9			MHz
	Reference feedthrough	V <sub>ref</sub> = 2 V <sub>pp</sub> at 1 kHz + 2.048 Vdc, See <sup>(4)</sup>		84			dB
DIGITAL INPUTS							
I <sub>IH</sub>	High-level digital input current	V <sub>I</sub> = DV <sub>DD</sub>				1	μA
I <sub>IL</sub>	Low-level digital input current	V <sub>I</sub> = 0 V		1			μA
C <sub>I</sub>	Input capacitance			8			pF

(3) In parallel with a 100-nF capacitor

(4) Reference feedthrough is measured at the DAC output with an input code = 0x000.

## ELECTRICAL CHARACTERISTICS (continued)

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>DIGITAL OUTPUT</b>						
V <sub>OH</sub>	High-level digital output voltage	R <sub>L</sub> = 10 kΩ	2.6			V
V <sub>OL</sub>	Low-level digital output voltage	R <sub>L</sub> = 10 kΩ			0.4	V
	Output voltage rise time	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 20 pF, Includes propagation delay		5	10	ns
<b>ANALOG OUTPUT DYNAMIC PERFORMANCE</b>						
t <sub>s(FS)</sub>	Output settling time, full scale	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 100 pF, See <sup>(5)</sup>	Fast	1	3	μs
			Slow	3	7	
t <sub>s(CC)</sub>	Output settling time, code to code	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 100 pF, See <sup>(6)</sup>	Fast	0.5	1	μs
			Slow	1	2	
SR	Slew rate	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 100 pF, See <sup>(7)</sup>	Fast	4	10	V/μs
			Slow	1	3	
	Glitch energy	See <sup>(8)</sup>		4		nV-s
	Channel crosstalk	10 kHz sine, 4 V <sub>PP</sub>		90		dB

- (5) Settling time is the time for the output signal to remain within ±0.5 LSB of the final measured value for a digital input code change of 0x080 to 0xFFFF and 0xFFFF to 0x080, respectively. Assured by design; not tested.
- (6) Settling time is the time for the output signal to remain within ±0.5 LSB of the final measured value for a digital input code change of one count. The max time applies to code changes near zero scale or full scale. Assured by design; not tested.
- (7) Slew rate determines the time it takes for a change of the DAC output from 10% to 90% full-scale voltage.
- (8) Code transition: TLV5630 - 0x7FF to 0x800, TLV5631 - 0x7FC to 0x800, TLV5632 - 0x7F0 to 0x800.

## DIGITAL INPUT TIMING REQUIREMENTS

PARAMETER		MIN	TYP	MAX	UNIT
t <sub>su(FS-CK)</sub>	Setup time, FS low before next negative SCLK edge	8			ns
t <sub>su(C16-FS)</sub>	Setup time, 16 <sup>th</sup> negative edge after FS low on which bit D0 is sampled before rising edge of FS. μC mode only	10			ns
t <sub>su(FS-C17)</sub>	μC mode, setup time, FS high before 17 <sup>th</sup> positive SCLK.	10			ns
t <sub>su(CK-FS)</sub>	DSP mode, setup time, SCLK low before FS low.	5			ns
t <sub>WL(LDAC)</sub>	LDAC duration low	10			ns
t <sub>WH</sub>	SCLK pulse duration high	16			ns
t <sub>WL</sub>	SCLK pulse duration low	16			ns
t <sub>su(FS-CK)</sub>	Setup time, FS low before first negative SCLK edge	8			ns
t <sub>su(D)</sub>	Setup time, data ready before SCLK falling edge	8			ns
t <sub>h(D)</sub>	Hold time, data held valid after SCLK falling edge	5			ns
t <sub>WH(FS)</sub>	FS duration high	10			ns
t <sub>WL(FS)</sub>	FS duration low	10			ns
t <sub>s</sub>	Settling time	See AC specs			

## TYPICAL CHARACTERISTICS

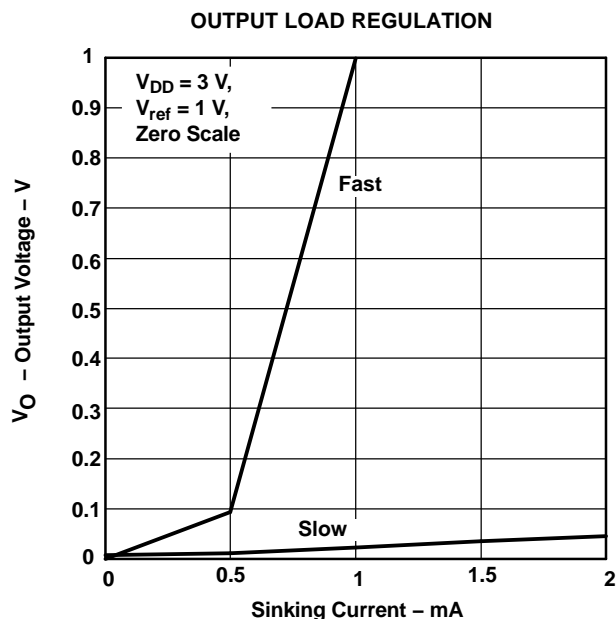


Figure 1.

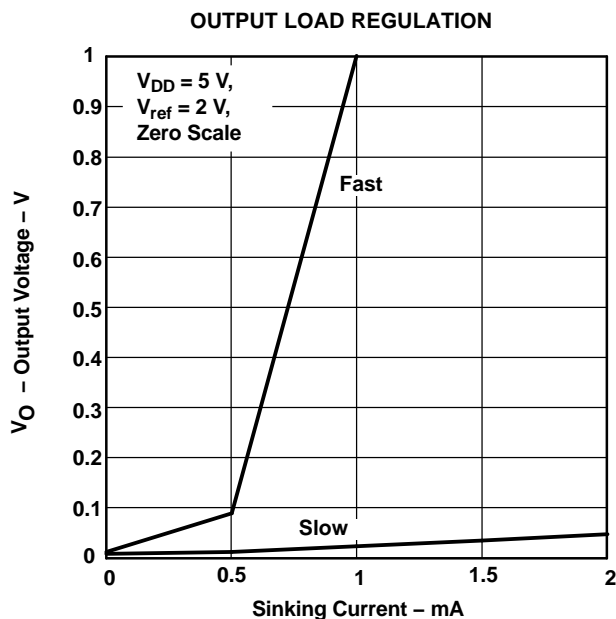


Figure 2.

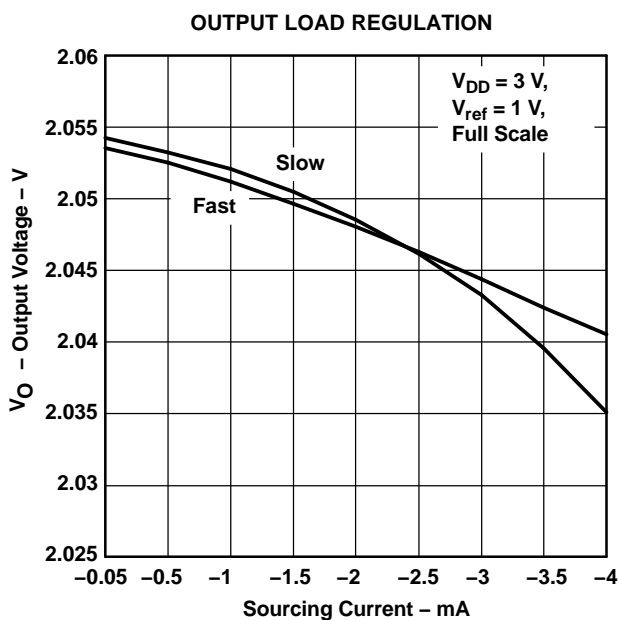


Figure 3.

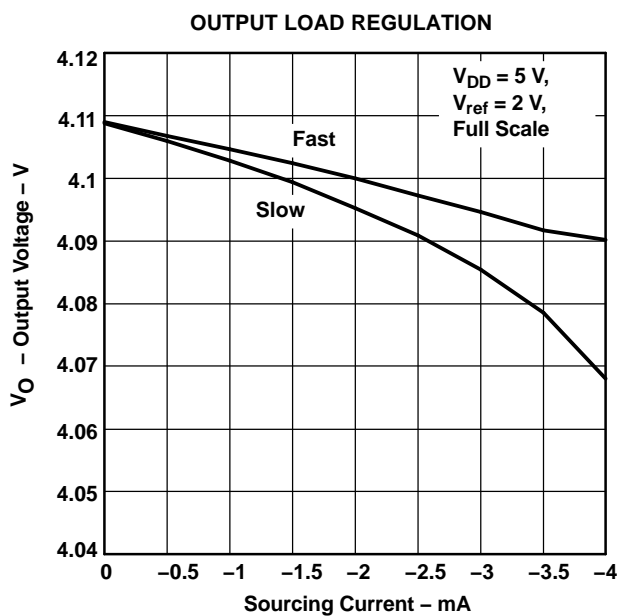
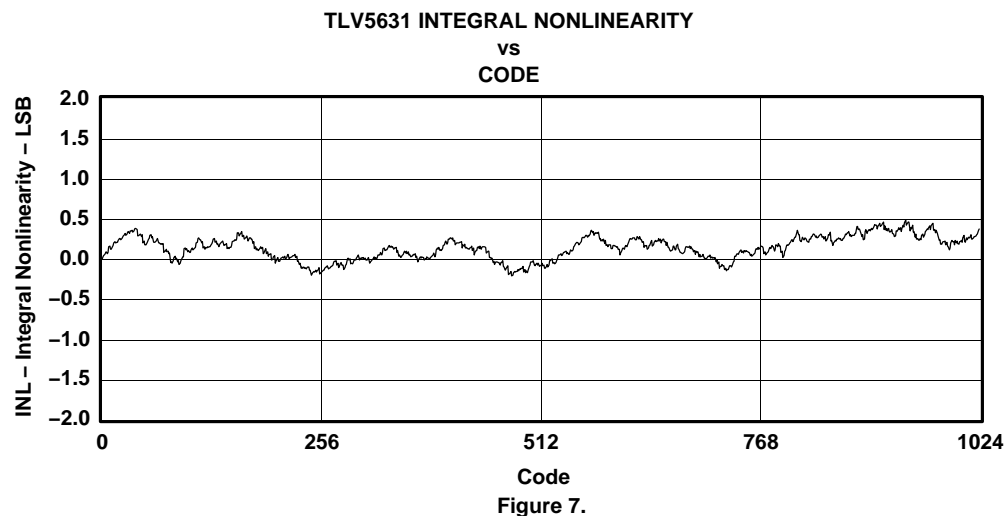
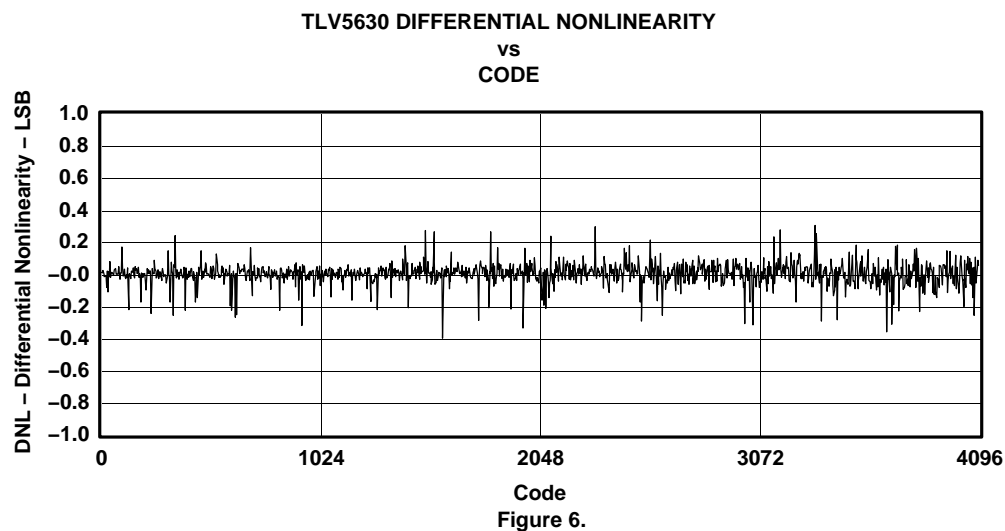
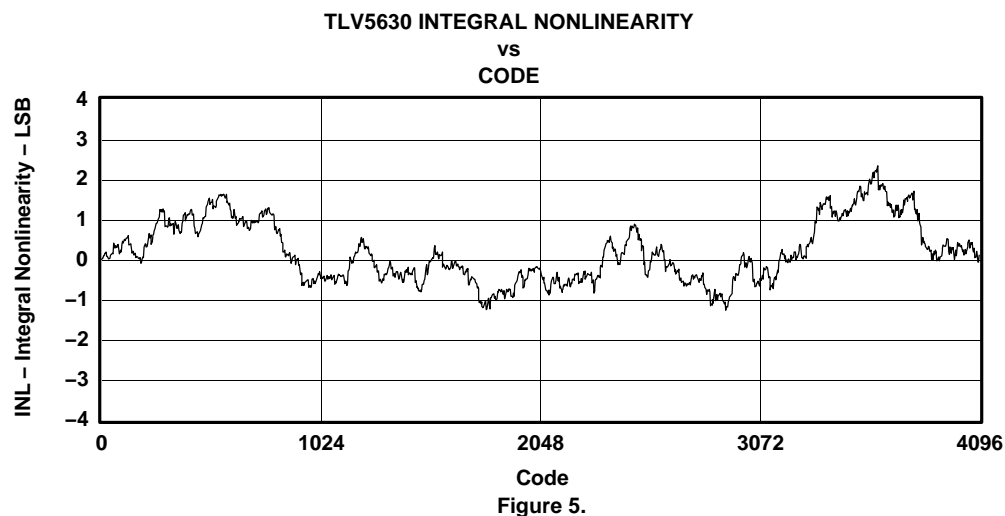


Figure 4.

## TYPICAL CHARACTERISTICS (continued)



## TYPICAL CHARACTERISTICS (continued)

TLV5631 DIFFERENTIAL NONLINEARITY  
vs  
CODE

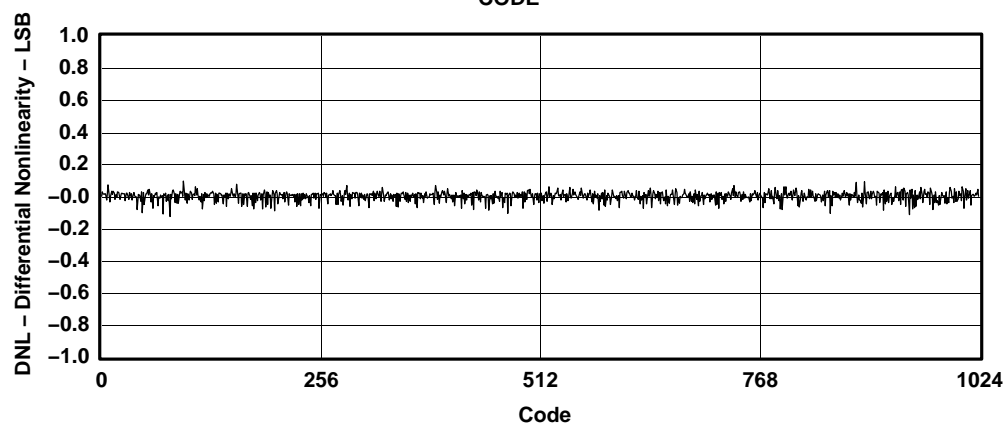


Figure 8.

TLV5632 INTEGRAL NONLINEARITY  
vs  
CODE

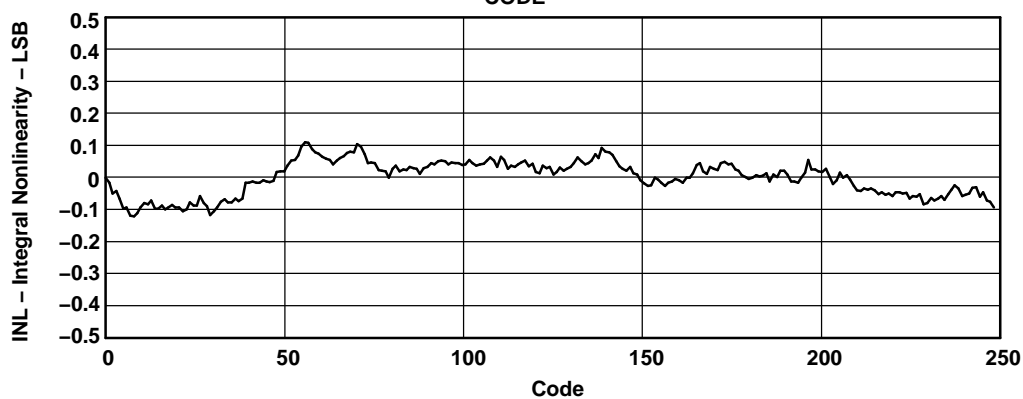


Figure 9.

TLV5632 DIFFERENTIAL NONLINEARITY  
vs  
CODE

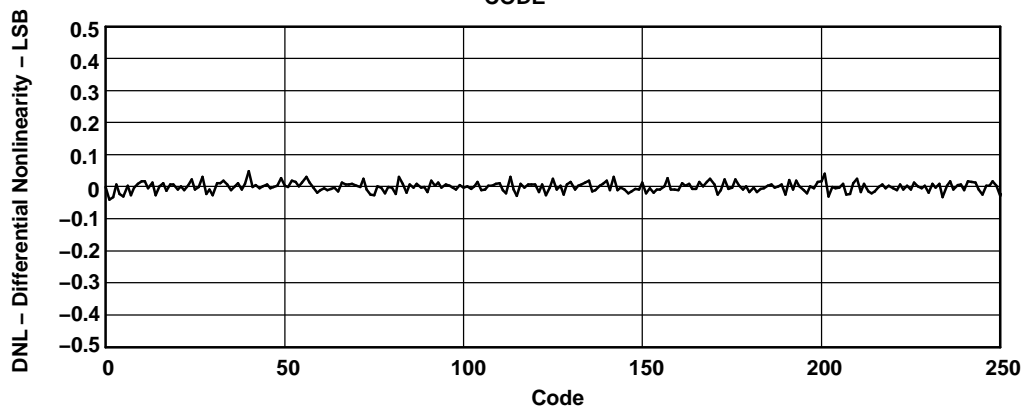
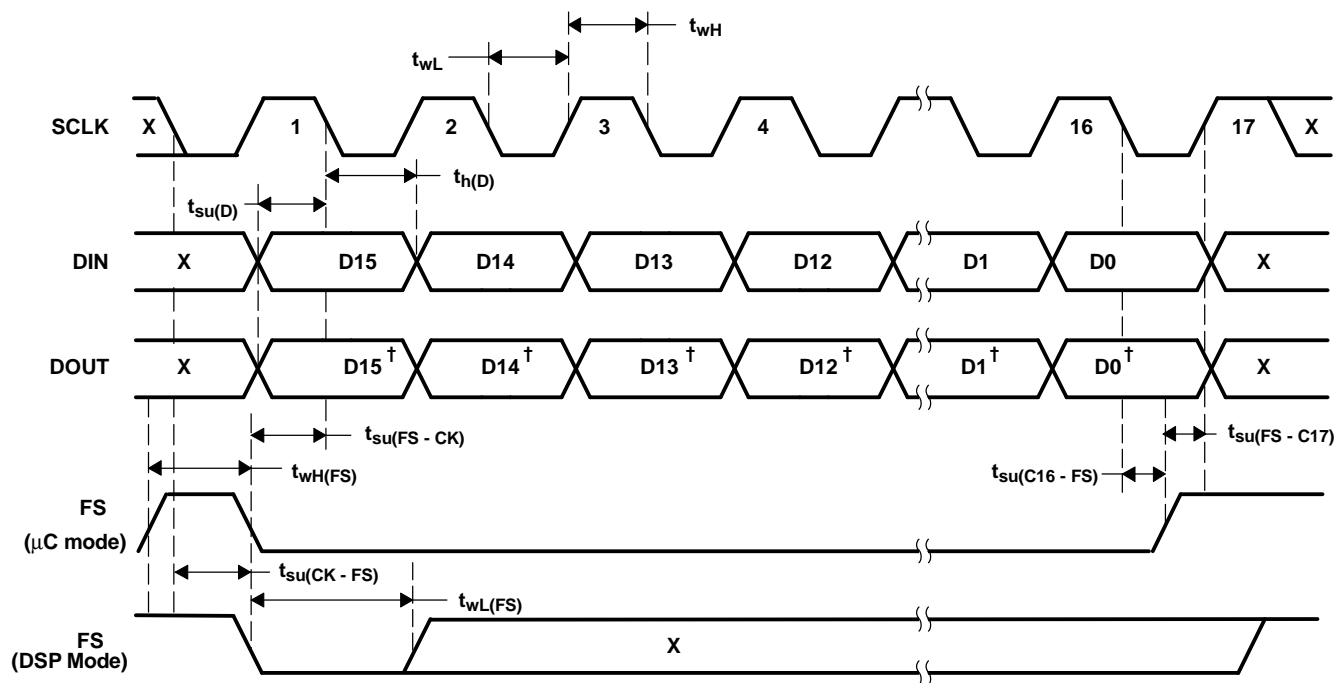


Figure 10.



## PARAMETER MEASUREMENT INFORMATION



† Previous input data

Figure 11. Serial Interface Timing

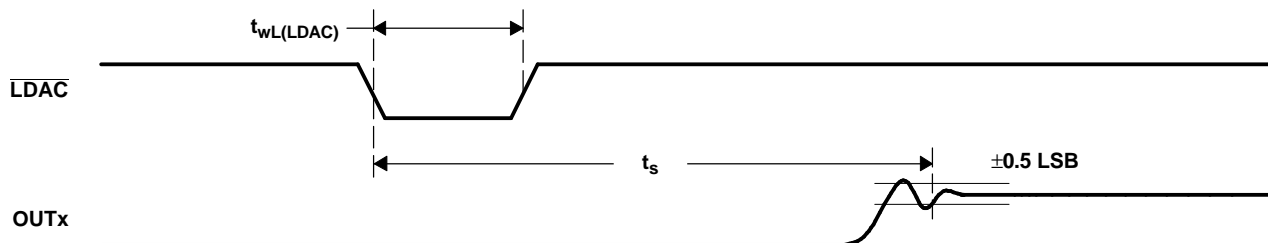


Figure 12. Output Timing

## APPLICATION INFORMATION

### GENERAL FUNCTION

The TLV5630/31/32 are 8-channel, single-supply DACs, based on a resistor string architecture. They consist of a serial interface, a speed and power-down control logic, an internal reference, a resistor string, and a rail-to-rail output buffer.

The output voltage (full scale determined by reference) for each channel is given by:

$$2\text{REF} \frac{\text{CODE}}{0\text{x}1000} [\text{V}]$$

where REF is the reference voltage and CODE is the digital input value. The input range is 0x000 to 0xFFFF for the TLV5630, 0x000 to 0xFFC for the TLV5631, and 0x000 to 0xFF0 for the TLV5632.

### POWER ON RESET (POR)

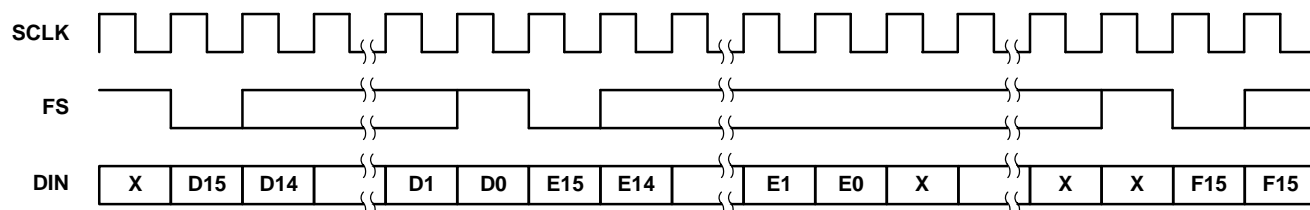
The built-in power-on-reset circuit controls the output voltage after power up. On power up, all latches including the preset register are set to zero, but the DAC outputs are only set to zero if the  $\overline{\text{LDAC}}$  is low. The DAC outputs may have a small offset error produced by the output buffer. The registers remains at zero until a valid write sequence is made to the DAC, changing the DAC register data. This is useful in applications where it is important to know the state of the outputs of the DAC after power up. All digital inputs must be logic low until the digital and analog supplies are applied. Any logic high voltages applied to the logic input pins when power is not applied to  $\text{AV}_{\text{DD}}$  and  $\text{DV}_{\text{DD}}$ , may power the device logic circuit through the overvoltage protection diode causing an undesired operation. When separate analog ( $\text{AV}_{\text{DD}}$ ) and digital ( $\text{DV}_{\text{DD}}$ ) supplies are used,  $\text{AV}_{\text{DD}}$  must come up first before  $\text{DV}_{\text{DD}}$ , to ensure that the power-on-reset circuit operates correctly.

### SERIAL INTERFACE

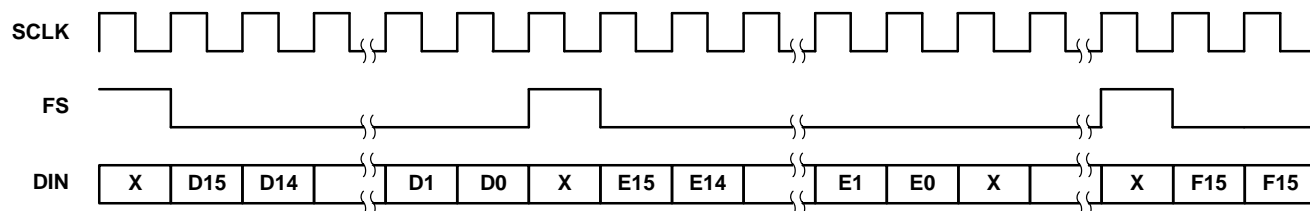
A falling edge of FS starts shifting the data on DIN starting with the MSB to the internal register on the falling edges of SCLK. After 16 bits have been transferred, the content of the shift register is moved to one of the DAC holding registers, depending on the address bits within the data word. A logic 0 on the  $\overline{\text{LDAC}}$  pin is required to transfer the content of the DAC holding register to the DAC latch and to update the DAC outputs.  $\overline{\text{LDAC}}$  is an asynchronous input. It can be held low if a simultaneous update of all eight channels is not needed.

For daisy-chaining, DOUT provides the data sampled on DIN with a delay of 16 clock cycles.

#### DSP Mode:



#### μC Mode:



## APPLICATION INFORMATION (continued)

Difference between DSP mode (MODE = N.C. or 0) and  $\mu$ C (MODE = 1) mode:

- In  $\mu$ C mode, FS needs to be held low until all 16 data bits have been transferred. If FS is driven high before the 16<sup>th</sup> falling clock edge, the data transfer is cancelled. The DAC is updated after a rising edge on FS.
- In DSP mode, FS needs to stay low for 20 ns and can go high before the 16<sup>th</sup> falling clock edge.
- In DSP mode there needs to be one falling SCLK edge before FS goes low to start the write (DIN) cycle. This extra falling SCLK edge has to happen at least 5 ns before FS goes low,  $t_{su(CK-FS)} \geq 5$  ns.
- In  $\mu$ C mode, the extra falling SCLK edge is not necessary. However, if it does happen, the extra negative SCLK edge is not allowed to occur within 10 ns after FS goes HIGH to finish the WRITE cycle ( $t_{su(FS-C17)}$ ).

## SERIAL CLOCK FREQUENCY AND UPDATE RATE

The maximum serial clock frequency is given by:

$$f_{sclmax} = \frac{1}{t_{whmin} + t_{wlmin}} = 30 \text{ MHz}$$

The maximum update rate is:

$$f_{updatemax} = \frac{1}{16(t_{whmin} + t_{wlmin})} = 1.95 \text{ MHz}$$

Note, that the maximum update rate is just a theoretical value for the serial interface, as the settling time of the DAC has to be considered also.

## DATA FORMAT

The 16-bit data word consists of two parts:

- Address bits (D15...D12)
- Data bits (D11...D0)

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
A3	A2	A1	A0	Data											

Ax: Address bits. See table.

## REGISTER MAP

A3	A2	A1	A0	FUNCTION
0	0	0	0	DAC A
0	0	0	1	DAC B
0	0	1	0	DAC C
0	0	1	1	DAC D
0	1	0	0	DAC E
0	1	0	1	DAC F
0	1	1	0	DAC G
0	1	1	1	DAC H
1	0	0	0	CTRL0
1	0	0	1	CTRL1
1	0	1	0	Preset
1	0	1	1	Reserved
1	1	0	0	DAC A and $\overline{B}$
1	1	0	1	DAC C and $\overline{D}$
1	1	1	0	DAC E and $\overline{F}$
1	1	1	1	DAC G and $\overline{H}$

## DAC A-H AND TWO-CHANNEL REGISTERS

Writing to DAC A-H sets the output voltage of channel A-H. It is possible to automatically generate the complement of one channel by writing to one of the four two-channel registers (DAC A and  $\bar{B}$  etc.).

The TLV5630 decodes all 12 data bits. The TLV5631 decodes D11 to D2 (D1 and D0 are ignored). The TLV5632 decodes D11 to D4 (D3 to D0 are ignored).

## PRESET

The outputs of the DAC channels can be driven simultaneously to a predefined value stored in the preset register by driving the  $\overline{PRE}$  input pin low and asserting the  $\overline{LDAC}$  input pin. The preset register is cleared (set to zero) by the POR circuit after power up. Therefore, it must be written with a predefined value before asserting the  $\overline{PRE}$  pin low, unless zero is the desired preset value. The  $\overline{PRE}$  input is asynchronous to the clock.

### CTRL0

BIT	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Function	X	X	X	X	X	X	X	PD	DO	R1	R0	IM
Default	X	X	X	X	X	X	X	0	0	0	0	0

PD : Full device power down      0 = normal      1 = power down  
DO : DOUT enable      0 = disabled      1 = enabled  
R1:0 : Reference select bits      0 = external      1 = external, 2 = internal 1 V, 3 = internal 2 V  
IM : Input mode      0 = straight binary      1 = twos complement  
X : Reserved

If DOUT is enabled, the data input on DIN is output on DOUT with a 16-cycle delay. That makes it possible to daisy-chain multiple DACs on one serial bus.

### CTRL1

BIT	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Function	X	X	X	X	P <sub>GH</sub>	P <sub>EF</sub>	P <sub>CD</sub>	P <sub>AB</sub>	S <sub>GH</sub>	S <sub>EF</sub>	S <sub>CD</sub>	S <sub>AB</sub>
Default	X	X	X	X	0	0	0	0	0	0	0	0

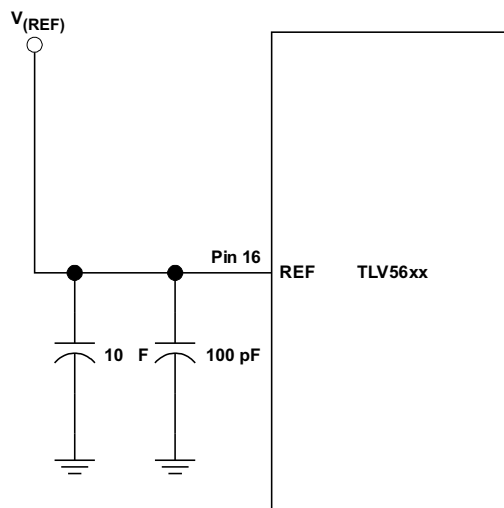
P<sub>XY</sub> : Power Down DAC<sub>XY</sub>      0 = normal      1 = power down  
S<sub>XY</sub> : Speed DAC<sub>XY</sub>      0 = slow      1 = fast  
XY : DAC pair AB, CD, EF or GH

In power-down mode, the amplifiers of the selected DAC pair are disabled and the total power consumption of the device is significantly reduced. Power-down mode of a specific DAC pair can be selected by setting the P<sub>XY</sub> bit within the data word to 1.

There are two settling time modes: fast and slow. Fast mode of a DAC pair is selected by setting S<sub>XY</sub> to 1 and slow mode is selected by setting S<sub>XY</sub> to 0.

## REFERENCE

The DAC reference can be sourced internally or externally by programming bits D2 (R1) and D1 (R0) of the CTRL0 register (address = 08h). If an external source of reference is applied to the REF pin, the device must be configured to accept the external reference source by setting R1 and R0 to 00 or 01. If R1 and R0 is set to select for internal reference, a voltage of 1.024 V (if R1 and R0 = 10) or 2.048 V (if R1 and R0 = 11) is available. The internal reference can source up to 1 mA, therefore, it can be used as an external system reference. A decoupling capacitor must be connected to the REF pin if internal reference is selected to ensure output stability. A 1  $\mu$ F to 10  $\mu$ F capacitor in parallel to a 100 pF capacitor should be sufficient, see [Figure 13](#).



**Figure 13. Reference Pin Decoupling Connection**

## BUFFERED AMPLIFIER

The DAC outputs are buffered by an amplifier with a gain of two, which are configurable as Class A (fast mode) or Class AB (slow or low-power mode). The output buffers have near rail-to-rail output with short-circuit protection, and can reliably drive a 2-k $\Omega$  load with a 100-pF load capacitance.

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TLV5630IDW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IDWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IDWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IPWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5630IPWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IDW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IDWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IDWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IPWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5631IPWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IDW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IDWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IDWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IPWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV5632IPWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

---

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBsolete:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

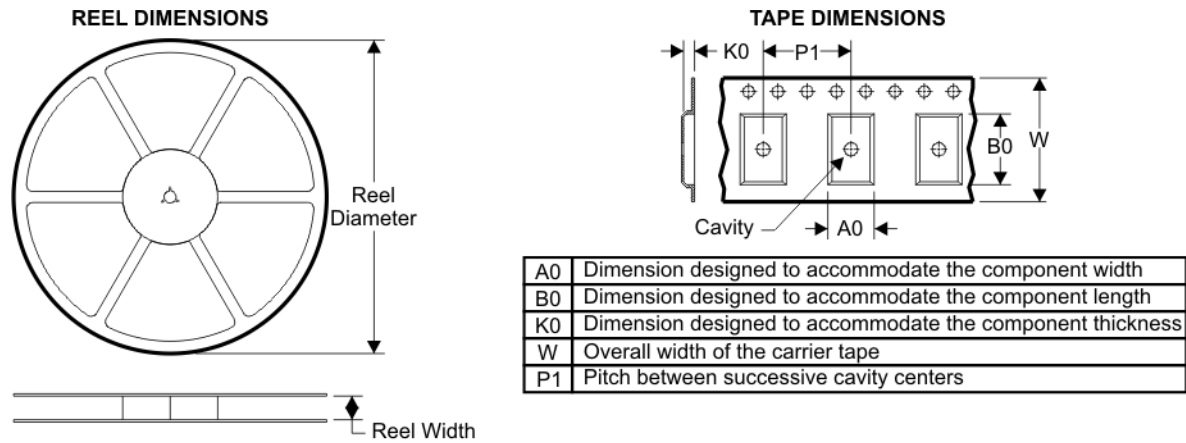
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

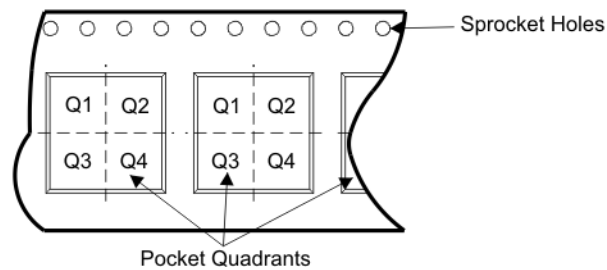
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**TAPE AND REEL BOX INFORMATION**



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



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV5630IDWR	DW	20	SITE 60	330	24	10.8	13.1	2.65	12	24	Q1
TLV5630IPWR	PW	20	SITE 60	330	16	6.95	7.1	1.6	8	16	Q1
TLV5631IDWR	DW	20	SITE 60	330	24	10.8	13.1	2.65	12	24	Q1
TLV5631IPWR	PW	20	SITE 60	330	16	6.95	7.1	1.6	8	16	Q1
TLV5632IDWR	DW	20	SITE 60	330	24	10.8	13.1	2.65	12	24	Q1
TLV5632IPWR	PW	20	SITE 60	330	16	6.95	7.1	1.6	8	16	Q1



## TAPE AND REEL BOX DIMENSIONS



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
TLV5630IDWR	DW	20	SITE 60	346.0	346.0	41.0
TLV5630IPWR	PW	20	SITE 60	346.0	346.0	33.0
TLV5631IDWR	DW	20	SITE 60	346.0	346.0	41.0
TLV5631IPWR	PW	20	SITE 60	346.0	346.0	33.0
TLV5632IDWR	DW	20	SITE 60	346.0	346.0	41.0
TLV5632IPWR	PW	20	SITE 60	346.0	346.0	33.0

## DW (R-PDSO-G20)

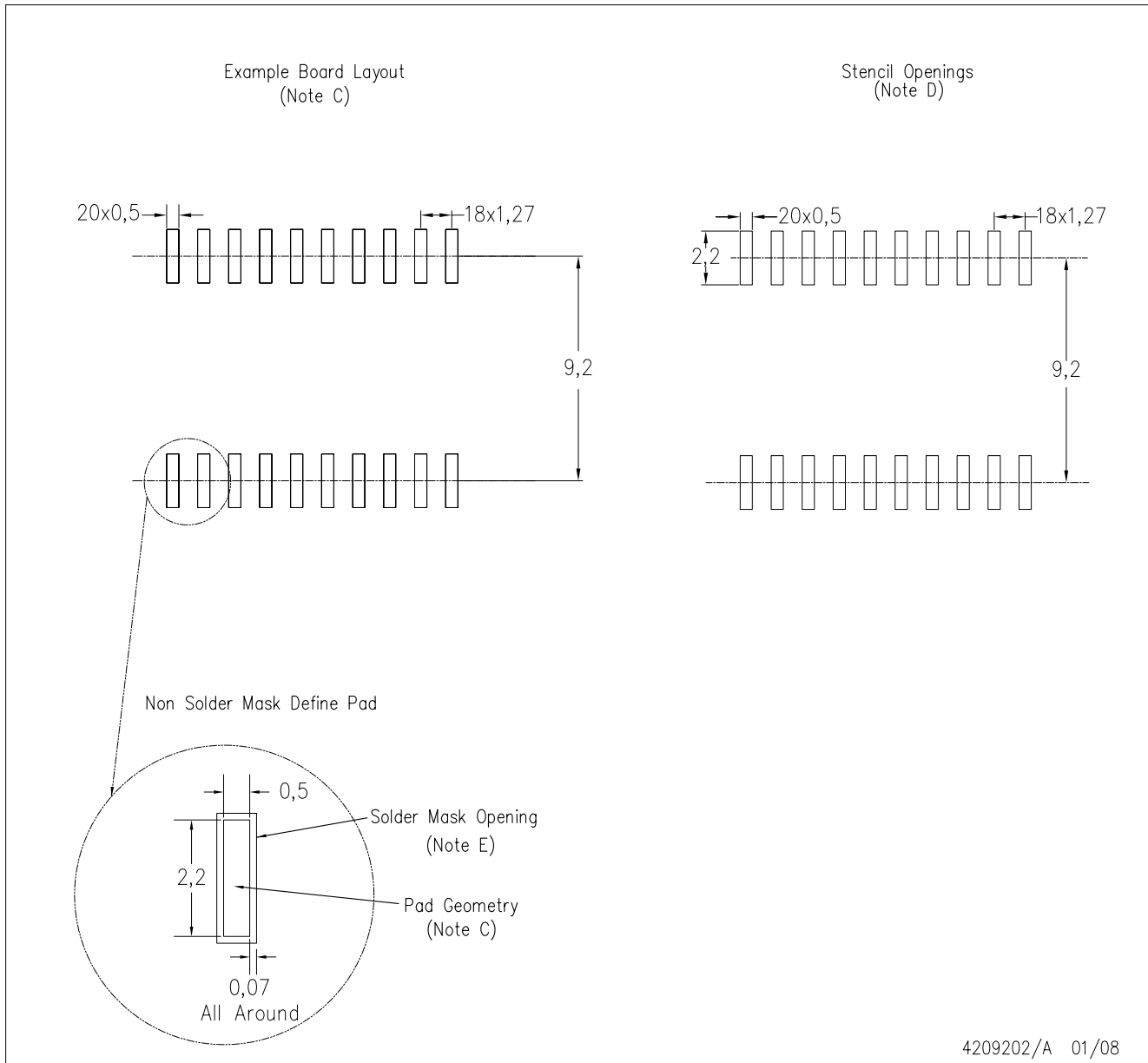
## PLASTIC SMALL-OUTLINE PACKAGE



4040000-4/F 06/2004

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

DW (R-PDSO-G20)



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## PW (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0,15.
  - Falls within JEDEC MO-153

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