

## 8-BIT DMOS SINK DRIVER WITH LATCH

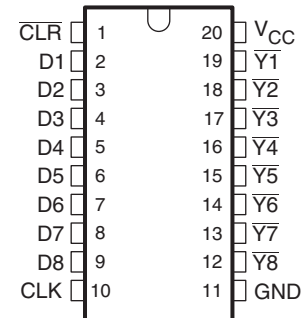
### FEATURES

- DMOS Process
- High Voltage Output ( $V_{ds} = 30\text{ V}$ )
- Output Current on Each Channel ( $I_{ds}\text{ Max} = 200\text{ mA}$ )
- Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17
- ESD Protection Exceeds JESD 22
  - 2000-V Human Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged Device Model (C101)
- LED Driver Application
- Output Clamp Diodes (Parasitic)
- Control Pins of  $\overline{\text{CLR}}$  and CLK Inputs
- Clock Input up to 1 MHz

### APPLICATIONS

- Lamp and Display (LED)
- Hammer
- Relay

N OR PW PACKAGE  
(TOP VIEW)



### DESCRIPTION

The TLC59210 is an 8-bit flip-flop driver for LED and solenoid with Schmitt-trigger buffers designed for 5-V  $V_{CC}$  operation.

These circuits are positive-edge-triggered D-type flip-flops with a direct clear ( $\overline{\text{CLR}}$ ) input. Information at the data (D) input meeting the setup time requirements is transferred to the  $\overline{Y}$  output on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When CLK is at either the high or low level, the D input has no effect at the output.

The TLC59210 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

### ORDERING INFORMATION<sup>(1)</sup>

$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
$-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$	PDIP – N	Reel of 1000	TLC59210IN	Y59210
	TSSOP – PW	Reel of 2000	TLC59210IPWR	Y59210

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).



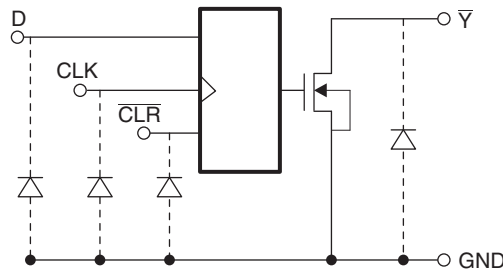
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**FUNCTION TABLE  
(EACH LATCH)<sup>(1)</sup>**

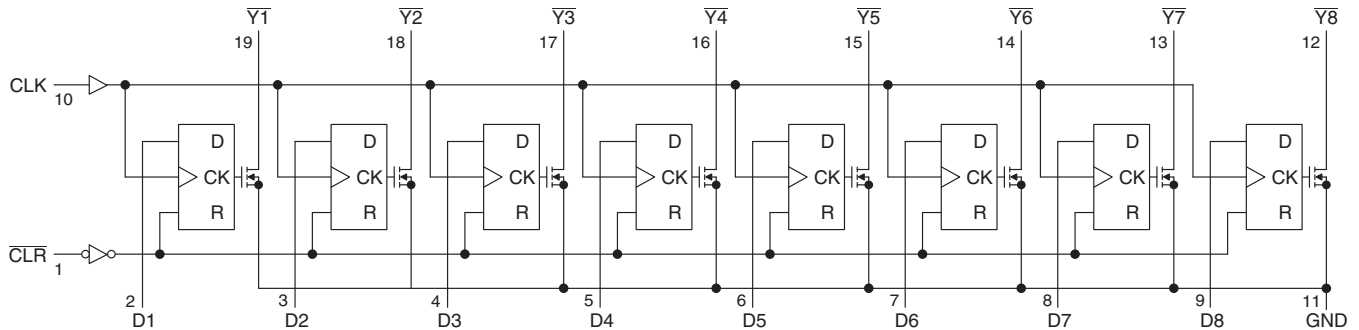
INPUTS			OUTPUT Y
CLR	CLK	D	
L	X	X	H*
H	↑	L	H*
H	↑	H	L
H	L	X	Y <sub>0</sub>
H	↓	X	Y <sub>0</sub>

- (1) L: Low-level  
 H: High-level  
 H\*: with pullup resistor  
 X: Irrelevant  
 ↑: Rising edge  
 ↓: Falling edge  
 Z: High-impedance (OFF)

**OUTPUT SCHEMATIC**



**LOGIC SYMBOL<sup>(1)</sup>**



(1) This symbol is in accordance with ANSI/IEEE Standard 91-1984 and IEC Publication 617-12.

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
$V_{CC}$	Supply voltage range		-0.5	7	V
D	Input voltage range		-0.5	7	V
$V_{ds}$	Output voltage range	H output	-0.5	32	V
$I_{ds}$	Output current range	1 bit for output low,	$V_{CC} = 3\text{ V to }3.6\text{ V}$	100	mA
			$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	200	
$I_{IK}$	Input clamp current	$V_I < 0\text{ V}$		-20	mA
$\theta_{JA}$	Package thermal impedance <sup>(2)</sup>	N package		69	°C/W
		PW package		83	
	Operating free-air temperature range		-40	85	°C
$T_{stg}$	Storage temperature range		-65	150	°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.
- (2) The package thermal impedance is calculated in accordance with JESD 51-7.

## RECOMMENDED OPERATING CONDITIONS

		CONDITIONS	MIN	MAX	UNIT
$V_{CC}$	Supply voltage		3	5.5	V
$V_{IH}$	High-level input voltage		$V_{CC} \times 0.7$	$V_{CC}$	V
$V_{IL}$	Low-level input voltage		0	$V_{CC} \times 0.3$	V
$V_{ds}$	Output voltage			30	V
$I_{ds}$	Output current	N package, $V_{CC} = 4.5\text{ V to }5.5\text{ V}$	Duty cycle < 42%	200	mA
			Duty cycle < 100%	130	
		PW package, $V_{CC} = 4.5\text{ V to }5.5\text{ V}$	Duty cycle < 24%	200	
			Duty cycle < 100%	95	
$T_A$	Operating free-air temperature		-40	85	°C

## ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$V_{T+}$	Positive-going input threshold	D, $\overline{\text{CLR}}$ , CLK			3.5	V	
$V_{T-}$	Negative-going input threshold	D, $\overline{\text{CLR}}$ , CLK	1.5			V	
$V_{HYS}$	Hysteresis	D, $\overline{\text{CLR}}$ , CLK	0.5		2	V	
$I_{IH}$	High-level input current	$V_{CC} = 5.5\text{ V}$ , $V_I = 5.5\text{ V}$		0	1	$\mu\text{A}$	
$I_{IL}$	Low-level input current	$V_{CC} = 5.5\text{ V}$ , $V_I = 0\text{ V}$		0	-1	$\mu\text{A}$	
$I_{OZ}$	Leakage current	$V_{ds} = 30\text{ V}$			5	$\mu\text{A}$	
$I_{off}$	Leakage current	$V_I = 0\text{ to }5\text{ V}$ , $V_O = 0\text{ to }30\text{ V}$ , $V_{CC} = 0$		0	5	$\mu\text{A}$	
$I_{CC}$	Supply current	$V_I = 0\text{ to }5\text{ V}$ , $V_O = 0\text{ to }30\text{ V}$ , $V_{CC} = 0$	Output = all OFF		0	5	$\mu\text{A}$
			Output = all ON		0	5	
$V_{OL}$	Low-level output voltage	$V_{CC} = 4.5\text{ V}$ , $I_O = 100\text{ mA}$		0.2	0.35	V	
		$V_{CC} = 4.5\text{ V}$ , $I_O = 200\text{ mA}$		0.5	0.7	V	
$r_{ON}$	ON-state resistance	$V_{CC} = 4.5\text{ V}$ , $I_O = 100\text{ mA}$		2	3.5	$\Omega$	
$C_i$	Input capacitance	$V_I = V_{CC}$ or GND		5		pF	

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted), see [Figure 1](#)

PARAMETER	TEST CONDITIONS	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C to }85^\circ\text{C}$		UNIT
			MIN	TYP	MAX	MIN	MAX	
$t_{TLH}$	Output = low to high	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		180	230		260	ns
$t_{THL}$	Output = high to low	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		300	450		500	ns
$t_{PLH}$	Output = low to high	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		320	480		550	ns
$t_{PHL}$	Output = high to low	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		320	480		550	ns
$t_{PHLR}$	$\overline{\text{CLR}}-\bar{Y}$	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		320	480		550	ns

## TIMING REQUIREMENTS

over recommended operating free-air temperature range,  $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , O/C to Y (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$T_A = -40^\circ\text{C to }85^\circ\text{C}$		UNIT
			MIN	MAX	
$t_{su}$	Setup time	CLK $\uparrow$	$V_{DD} = 4.5\text{ V}$	10	ns
$t_h$	Hold time	CLK $\uparrow$	$V_{DD} = 4.5\text{ V}$	10	ns
$t_w$	Pulse width	CLK, $\overline{\text{CLR}}$	$V_{DD} = 4.5\text{ V}$	30	ns

## ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$V_{T+}$	Positive-going input threshold	D, $\overline{\text{CLR}}$ , CLK			2.52	V	
$V_{T-}$	Negative-going input threshold	D, $\overline{\text{CLR}}$ , CLK	0.9			V	
$V_{HYS}$	Hysteresis	D, $\overline{\text{CLR}}$ , CLK	0.33		1.32	V	
$I_{IH}$	High-level input current	$V_{CC} = 3.6\text{ V}$ , $V_I = 3.6\text{ V}$		0	1	$\mu\text{A}$	
$I_{IL}$	Low-level input current	$V_{CC} = 3.6\text{ V}$ , $V_I = 0\text{ V}$		0	-1	$\mu\text{A}$	
$I_{OZ}$	Leakage current	$V_O = 30\text{ V}$			5	$\mu\text{A}$	
$I_{off}$	Leakage current	$V_{CC} = 0\text{ V}$ , $V_I = 0\text{ to }3.6\text{ V}$ , $V_O = 0\text{ to }30\text{ V}$		0	5	$\mu\text{A}$	
$I_{CC}$	Supply current	$V_{CC} = 3.6\text{ V}$ , $V_I = 0\text{ to }3.6\text{ V}$ , $V_O = 0\text{ to }30\text{ V}$	Output = all OFF		0	5	$\mu\text{A}$
			Output = all ON		0	5	
$V_{OL}$	Low-level output voltage	$V_{CC} = 3\text{ V}$ , $I_O = 100\text{ mA}$		0.35	0.7	V	
$r_{ON}$	ON-state resistance	$V_{CC} = 4.5\text{ V}$ , $I_O = 100\text{ mA}$		3.5	7	$\Omega$	
$C_i$	Input capacitance	$V_I = V_{CC}\text{ or GND}$		5		pF	

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 3\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted), see [Figure 1](#)

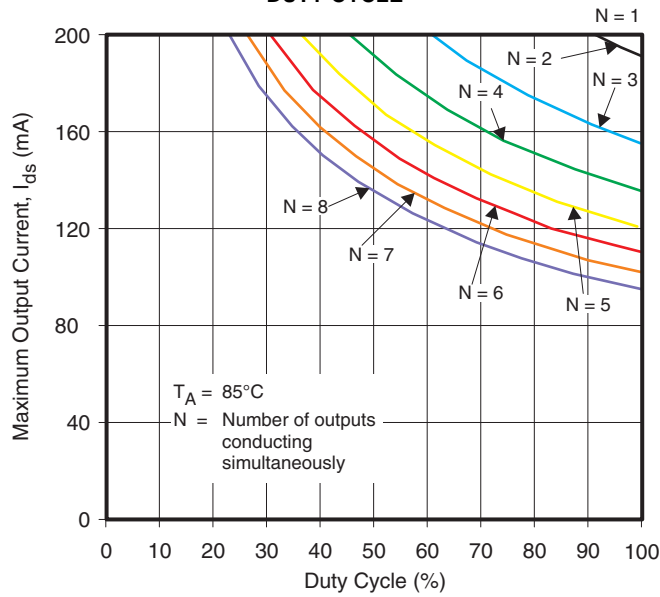
PARAMETER	TEST CONDITIONS	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C to }85^\circ\text{C}$		UNIT
			MIN	TYP	MAX	MIN	MAX	
$t_{TLH}$	Output = low to high	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		300	450		500	ns
$t_{THL}$	Output = high to low	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		300	450		500	ns
$t_{PLH}$	Output = low to high	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		500	700		850	ns
$t_{PHL}$	Output = high to low	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		500	700		850	ns
$t_{PHLR}$	$\overline{\text{CLR}}-\bar{Y}$	$C_L = 30\text{ pF}$ , $R_L = 240\ \Omega$ , 24-V pullup		500	700		850	ns

## TIMING REQUIREMENTS

over recommended operating free-air temperature range,  $V_{CC} = 3\text{ V to }3.6\text{ V}$ , O/C to Y (unless otherwise noted)

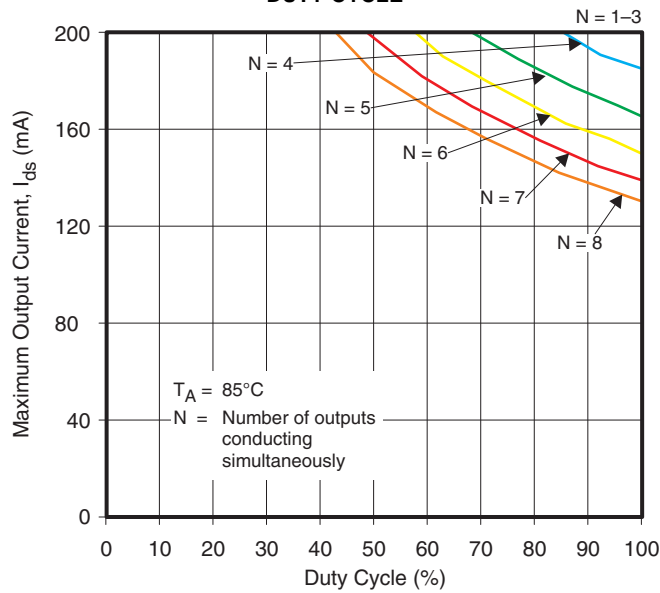
PARAMETER		TEST CONDITIONS	$T_A = -40^\circ\text{C to }85^\circ\text{C}$		UNIT
			MIN	MAX	
$t_{su}$	Setup time	CLK $\uparrow$	$V_{DD} = 3\text{ V}$	10	ns
$t_h$	Hold time	CLK $\uparrow$	$V_{DD} = 3\text{ V}$	10	ns
$t_w$	Pulse width	CLK, $\overline{\text{CLR}}$	$V_{DD} = 3\text{ V}$	30	ns

**THERMAL INFORMATION**  
**MAXIMUM OUTPUT CURRENT**  
**vs**  
**DUTY CYCLE**



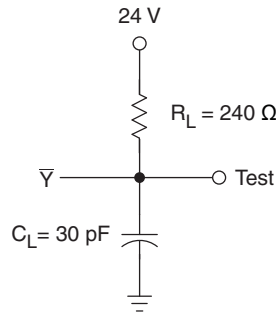
**TSSOP (PW) PACKAGE**

**MAXIMUM OUTPUT CURRENT**  
**vs**  
**DUTY CYCLE**

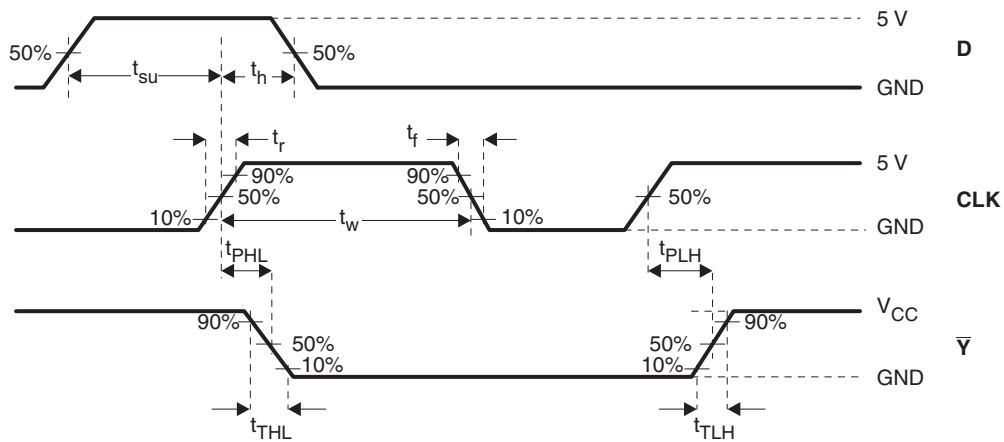


**DIP (N) PACKAGE**

PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT FOR O/D OUTPUT

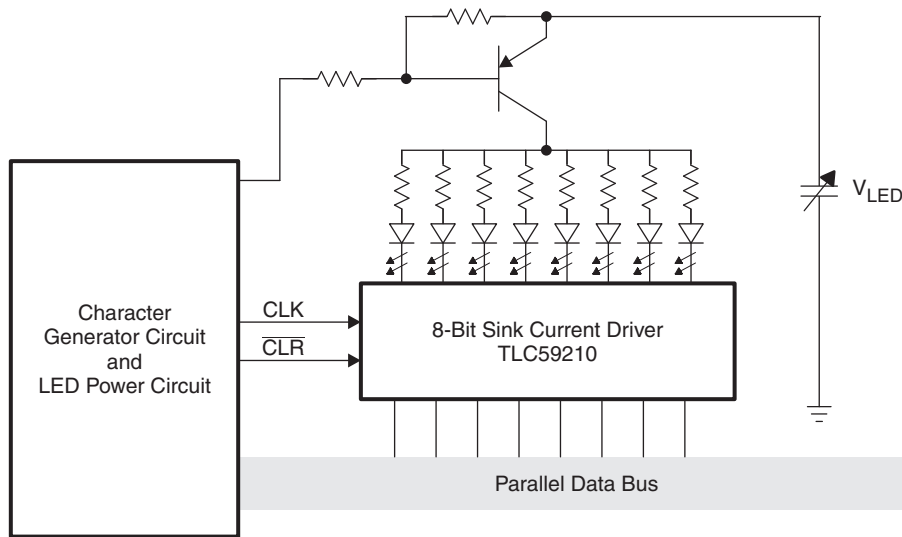


VOLTAGE WAVEFORMS

- A.  $C_L$  includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 3 \text{ ns}$ , and  $t_f \leq 3 \text{ ns}$ .
- D. The outputs are measured one at a time with one transition per measurement.
- E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Test Circuit and Voltage Waveforms

APPLICATION INFORMATION





**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>
TLC59210IN	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TLC59210IPWR	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 INFORMATION



### 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
TLC59210IPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC59210IPWR	TSSOP	PW	20	2000	346.0	346.0	33.0

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



4040064-5/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

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Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
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Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
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