TLC59210 8-BIT DMOS Sink Driver With Latch

1 Features

- DMOS Process
- High Voltage Output (V_{ds} = 30 V)
- Output Current on Each Channel (I_{ds} Max = 200 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

2 Applications

- Lamp and Display (LED)
- Hammer
- Relay

3 Description

The TLC59210 is an 8-bit flip-flop driver for LED and solenoid with Schmitt-trigger buffers. Each channel can sink up to 200mA and support an output voltage up to 30V. The TLC59210 is designed for V_{CC} and operation from 3.3V to 5.5V.

Each output channel is controlled by a positive-edge-triggered D-type flip-flops with a direct clear (CLR) input. Information at the data (D) input meeting the setup time requirements is transferred to the 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.

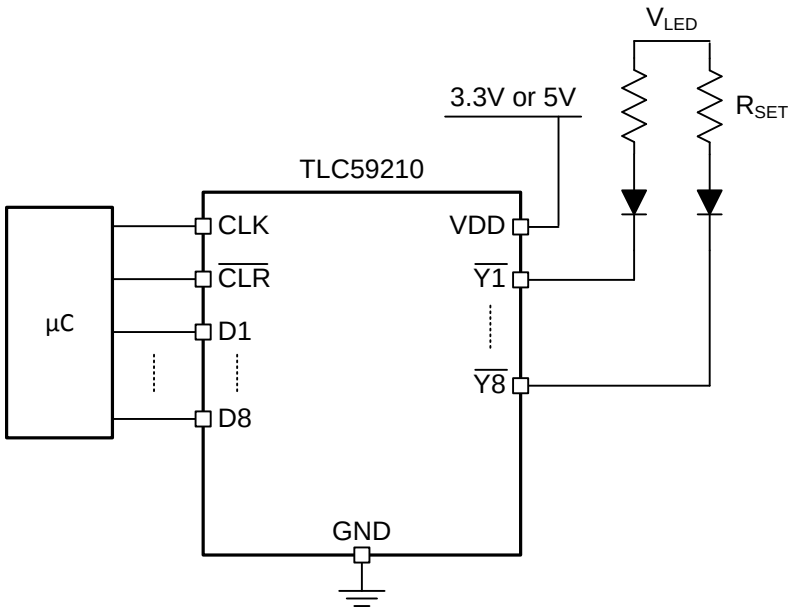
The TLC59210 is characterized for operation from –40°C to 85°C.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TLC59210	PDIP (20)	24.33 mm × 6.35 mm
	TSSOP (20)	6.50 mm × 4.40 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application Schematic



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Revision History

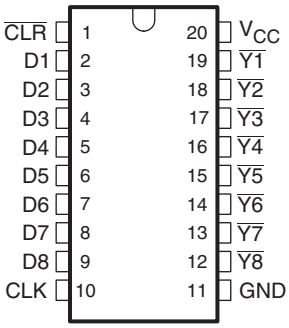
Changes from Original (March 2009) to Revision A **Page**

- Added *Pin Configuration and Functions* section, *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

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5 Pin Configuration and Functions

N or PW Package
20 Pin PDIP or TSSOP
(Top View)



Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	CLR	I	Direct Clear. When Low, all outputs are off
2	D1	I	Data Input 1
3	D2	I	Data Input 2
4	D3	I	Data Input 3
5	D4	I	Data Input 4
6	D5	I	Data Input 5
7	D6	I	Data Input 6
8	D7	I	Data Input 7
9	D8	I	Data Input 8
10	CLK	I	Clock input. A Rising Edge transfers information at the data input (D) to the output (Y).
11	GND	GND	Ground
12	Y8	Output	Data Output 8
13	Y7	Output	Data Output 7
14	Y6	Output	Data Output 6
15	Y5	Output	Data Output 5
16	Y4	Output	Data Output 4
17	Y3	Output	Data Output 3
18	Y2	Output	Data Output 2
19	Y1	Output	Data Output 1
20	V_{CC}	Power	Supply for Device

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6 Specifications

6.1 Absolute Maximum Ratings

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

				MIN	MAX	UNIT
V_{CC}	Supply voltage			–0.5	7	V
D	Input voltage			–0.5	7	V
V_{ds}	Output voltage	H output		–0.5	32	V
I_{ds}	Output current	1 bit for output low,	V_{CC} = 3 V to 3.6 V		100	mA
			V_{CC} = 4.5 V to 5.5 V		200	
I_{IK}	Input clamp current	V_I < 0 V			–20	mA
	Operating free-air temperature			–40	85	°C
T_{stg}	Storage temperature			–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.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 (2)	±1000	
		Machine Model (A115-A), per ANSI/ESDA/JEDEC Standard JESD-17 (3)	±200	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.
(3) JEDEC document JEP157 states that 200-V MM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

6.4 Thermal Information

THERMAL METRIC (1)		TLC59210		UNIT
		N (PDIP)	PW (TSSOP)	
		20 PINS	20 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	53.6	94.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	41.2	28.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	34.6	45.7	°C/W
ψ_{JT}	Junction-to-top characterization parameter	22.3	1.6	°C/W
ψ_{JB}	Junction-to-board characterization parameter	34.4	45.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

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6.5 Electrical Characteristics: V_{CC} = 4.5 V to 5.5 V

over recommended operating free-air temperature range, T_A = –40°C to 85°C (unless otherwise noted)

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

6.6 Electrical Characteristics: V_{CC} = 3 V to 3.6 V

over recommended operating free-air temperature range, T_A = –40°C to 85°C (unless otherwise noted)

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

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6.7 Timing Requirements: V_{CC} = 4.5 V to 5.5 V

over recommended operating free-air temperature range, O/C to Y (unless otherwise noted)

			MIN	NOM	MAX	UNIT
t_{su}	Setup time, CLK↑	V_{DD} = 4.5 V	10			ns
t_h	Hold time, CLK↑	V_{DD} = 4.5 V	10			ns
t_w	Pulse width, CLK, $\overline{CLR}$	V_{DD} = 4.5 V	30			ns

6.8 Timing Requirements: V_{CC} = 3 V to 3.6 V

over recommended operating free-air temperature range, O/C to Y (unless otherwise noted)

			MIN	NOM	MAX	UNIT
t_{su}	Setup time, CLK↑	V_{DD} = 3 V	10			ns
t_h	Hold time, CLK↑	V_{DD} = 3 V	10			ns
t_w	Pulse width, CLK, $\overline{CLR}$	V_{DD} = 3 V	30			ns

6.9 Switching Characteristics: V_{CC} = 4.5 V to 5.5 V

over recommended operating free-air temperature range, T_A = –40°C to 85°C (unless otherwise noted), see Figure 5

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

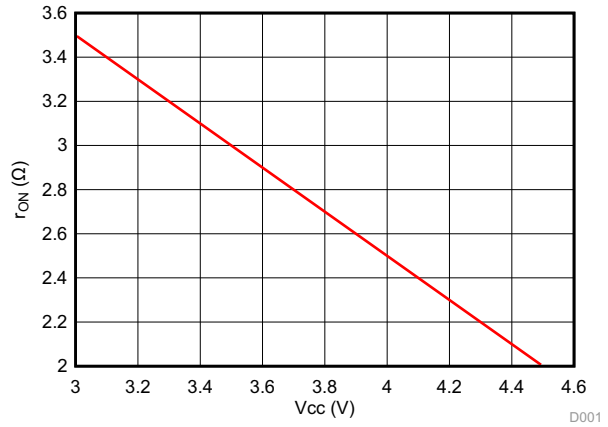
6.10 Switching Characteristics: V_{CC} = 3 V to 3.6 V

over recommended operating free-air temperature range, T_A = –40°C to 85°C (unless otherwise noted), see Figure 5

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

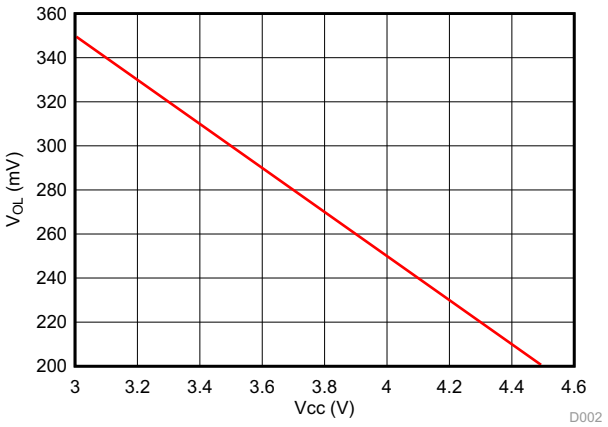
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6.11 Typical Characteristics



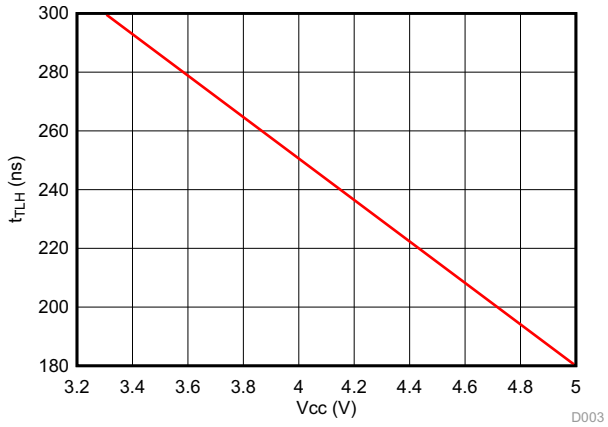
I_O = 100mA

Figure 1. r_{ON} vs V_{CC} Conditions I_O= 100mA



I_O = 100mA

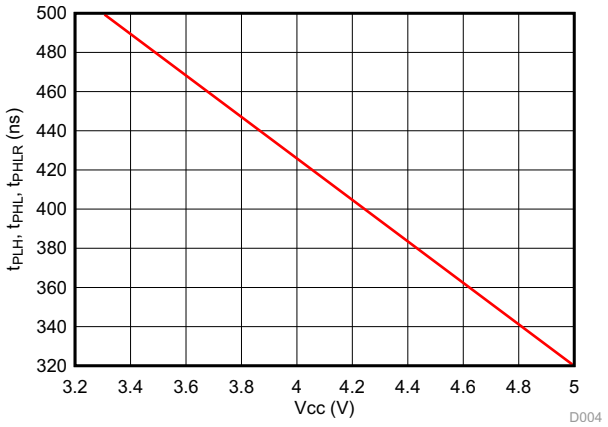
Figure 2. V_{OL} vs V_{CC} Conditions I_O = 100mA



C_L = 30 pF

R_L = 240 Ω, 24-V Pullup

Figure 3. t_{TLH} vs V_{CC}



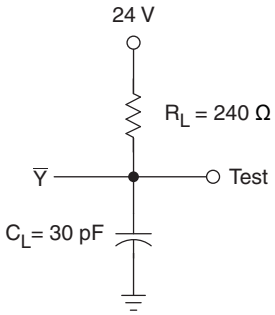
C_L = 30 pF

R_L = 240 Ω, 24-V Pullup

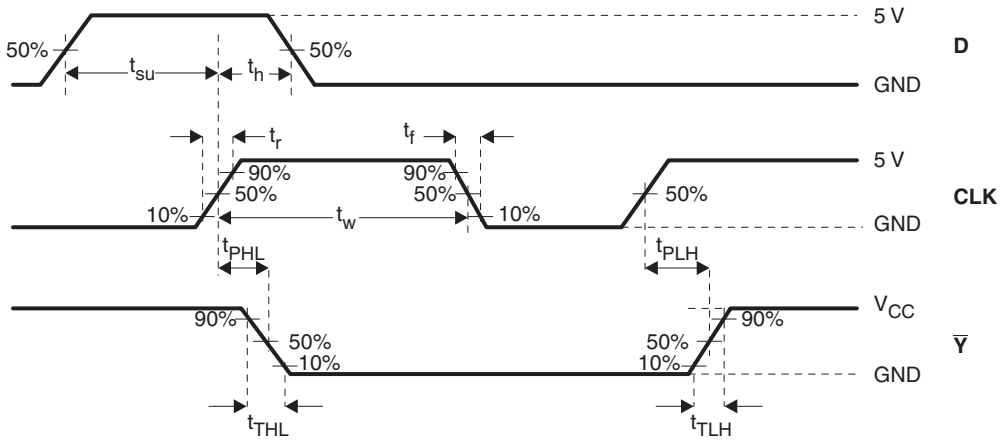
Figure 4. Propagation Delay vs V_{CC}

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7 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 ≤ 1 MHz, Z_O = 50 Ω, t_r ≤ 3 ns, and t_f ≤ 3 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 5. Test Circuit and Voltage Waveforms

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8 Detailed Description

8.1 Overview

The TLC59210 is an 8-bit flip-flop driver for LED and solenoid with Schmitt-trigger buffers. Each output channel is controlled by a positive-edge-triggered D-type flip-flops with a direct clear (CLR) input. Information at the data (D) input meeting the setup time requirements is transferred to the 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.

8.2 Functional Block Diagram

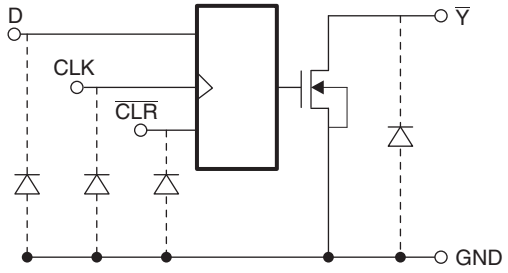
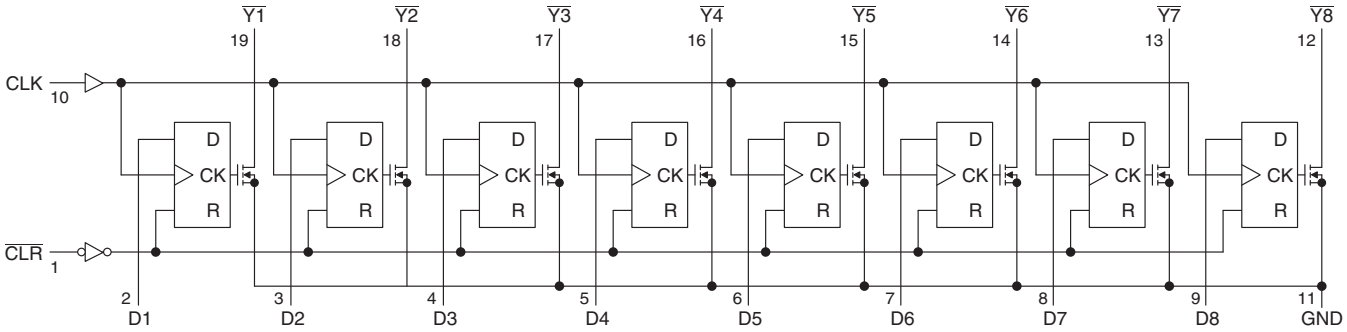


Figure 6. Output Schematic



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

Figure 7. Logic Symbol

8.3 Feature Description

The TLC59210 features the ability to independently control 8 Sinking Outputs (Y). At each CLK pulse the output can be latched high or low depending on the input state (D). The CLR function allows for all outputs to be set high.

8.4 Device Functional Modes

Table 1. Function Table (Each Latch)(1)

INPUTS			OUTPUT $\overline{Y}$
$\overline{CLR}$	CLK	D	
L	X	X	H*
H	↑	L	H*
H	↑	H	L
H	L	X	Y_0
H	↓	X	Y_0

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

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9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

In an LED display application, TLC59210 is used to drive the current sink for 8 LEDs in parallel. LED display patterns can be created by providing different bit patterns. Each LED can be duty cycled by either duty cycling the LED supply or the control bit.

9.1.1 Setting LED Current

The LED current is primarily dependent on the supply voltage, the forward voltage of the LED, and the series resistor (RSET). In many applications the supply voltage and LED forward voltage cannot be adjusted. Hence, RSET is utilized to adjust the LED current.

9.1.2 PWM Brightness Dimming

The perceived brightness of the LEDs can be adjusted by use of PWM dimming. For example, an LED driven at 50% duty cycle will appear less bright than it would at 100% duty cycle.

9.2 Typical Application

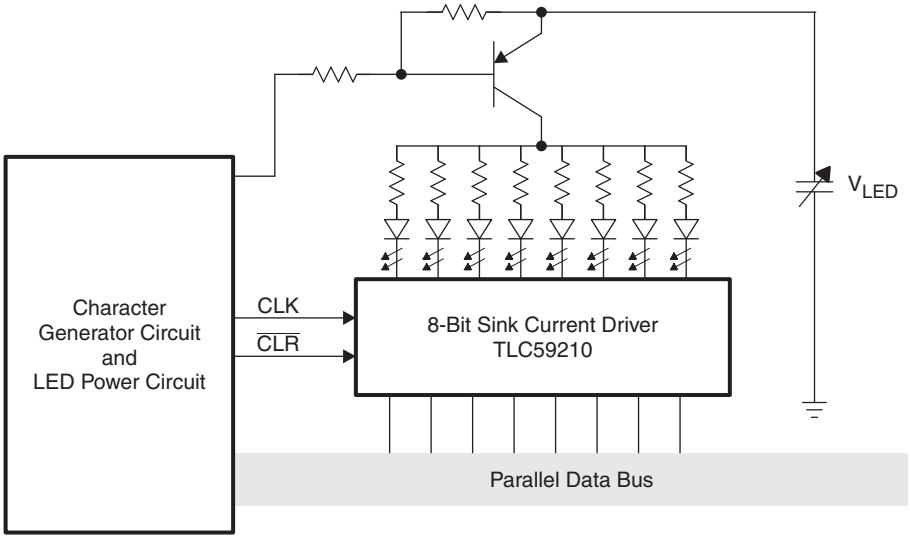


Figure 8. Typical Application Schematic

9.2.1 Design Requirements

For an LED display application, a parallel data bus used to provide the input control for TLS59210. A character generator circuit and LED power circuit are used to generate the bit pattern written into the TLC59210 to provide the power control for the entire LED array. The LED power circuit controls the total current into the array and can also power cycle the LED array. For simple implementation, LED power circuit could be eliminated. The V_{LED} can be connected directly to the resistor and LED string.

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Typical Application (continued)

9.2.2 Detailed Design Procedure

The combination of LED Supply voltage (V_{LED}), the LED forward voltage (V_F), and external resistor sets the maximum LED current (I_{DS}) that would appear with a 100% duty cycle.

$$I_{DS} = (VLED - VF)/R_{SET} \quad (1)$$

The maximum total power dissipation and maximum current through each channel of TLC59210 is determined by the number of the LEDs that are on at one time, the LED duty cycle, and the ambient temperature. The following graphs show how the maximum channel current may be limited by the total power dissipation.

9.2.3 Application Curves

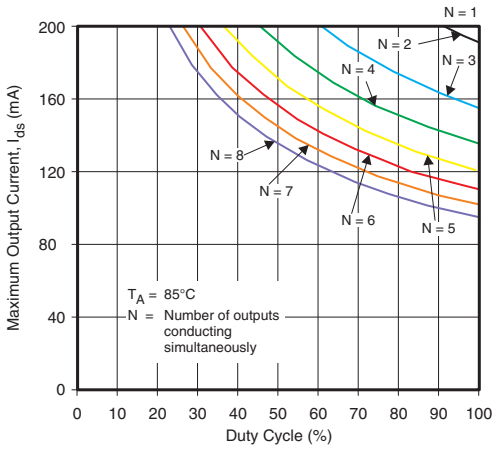


Figure 9. Maximum Output Current vs Duty Cycle (TSSOP (PW) Package)

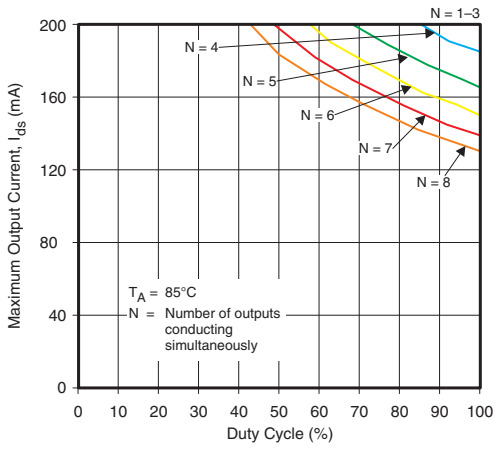


Figure 10. Maximum Output Current vs Duty Cycle (DIP (N) Package)

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10 Power Supply Recommendations

TLC59210 operates from a VCC range of 3 V to 5.5 V. The system will also require a power supply for the LEDs. The supply voltage of the LEDs must be greater than the forward voltage of the LED plus the VOL of the channel, but not greater than 30V.

11 Layout

11.1 Layout Guidelines

The traces carrying power through the LEDs should be wide enough to handle the necessary current. All LED current passes through the device and into the ground node. There must be a strong connection between the device ground and the circuit board ground.

11.2 Layout Example

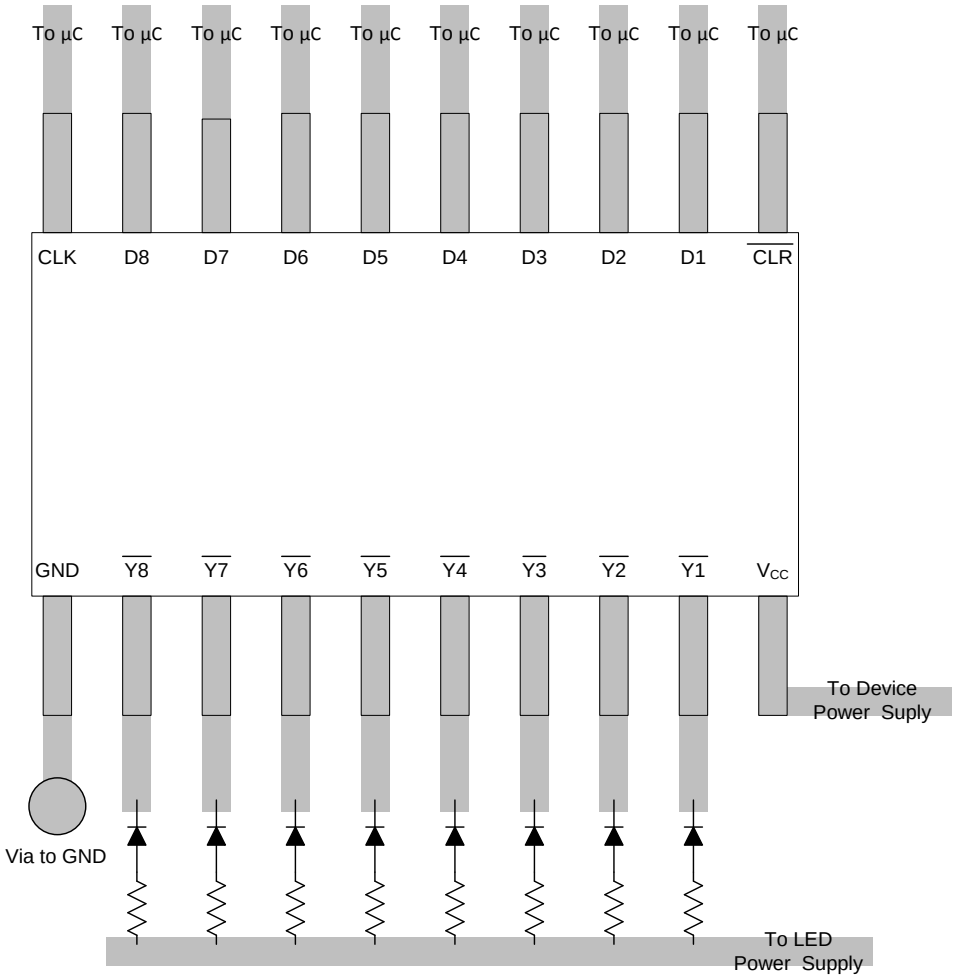


Figure 11. Layout Example

12 Device and Documentation Support

12.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.2 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.3 Electrostatic Discharge Caution



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.

12.4 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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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)
TLC59210IN	Active	Production	PDIP (N) | 20	20 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	TLC59210IN
TLC59210IN.A	Active	Production	PDIP (N) | 20	20 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	TLC59210IN
TLC59210IPWR	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	Y59210
TLC59210IPWR.A	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y59210
TLC59210IPWRG4	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y59210
TLC59210IPWRG4.A	Active	Production	TSSOP (PW) | 20	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	Y59210

(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.

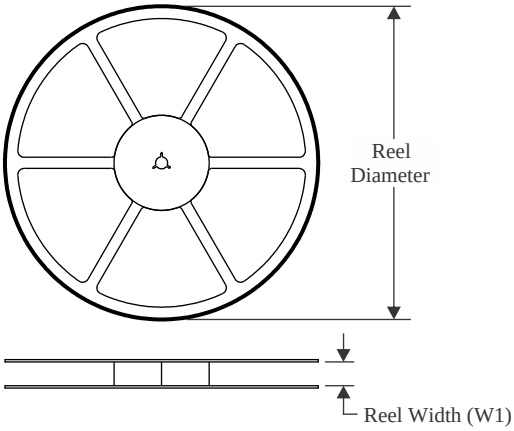
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

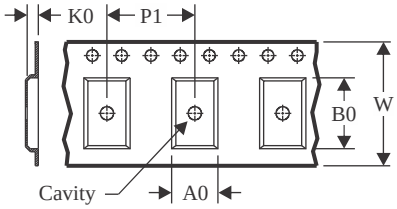
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

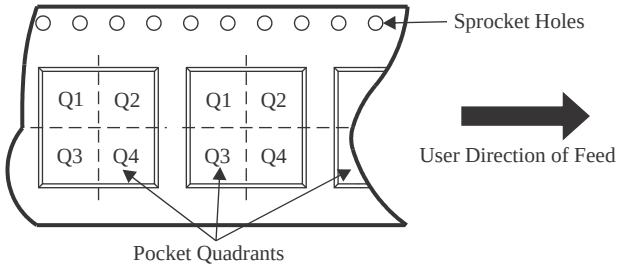


TAPE DIMENSIONS



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

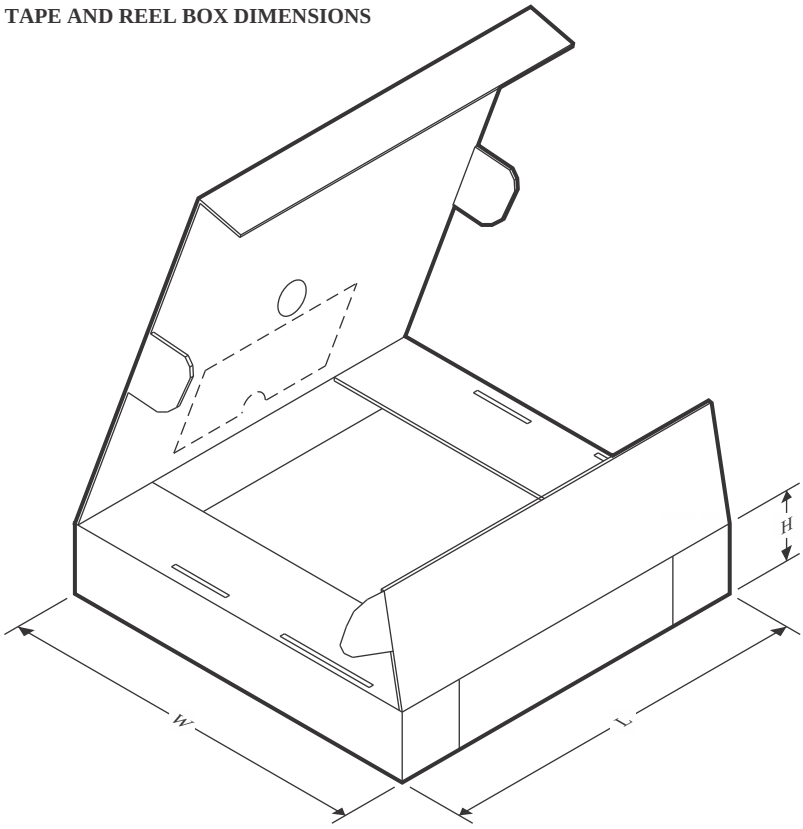
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLC59210IPWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1
TLC59210IPWRG4	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1

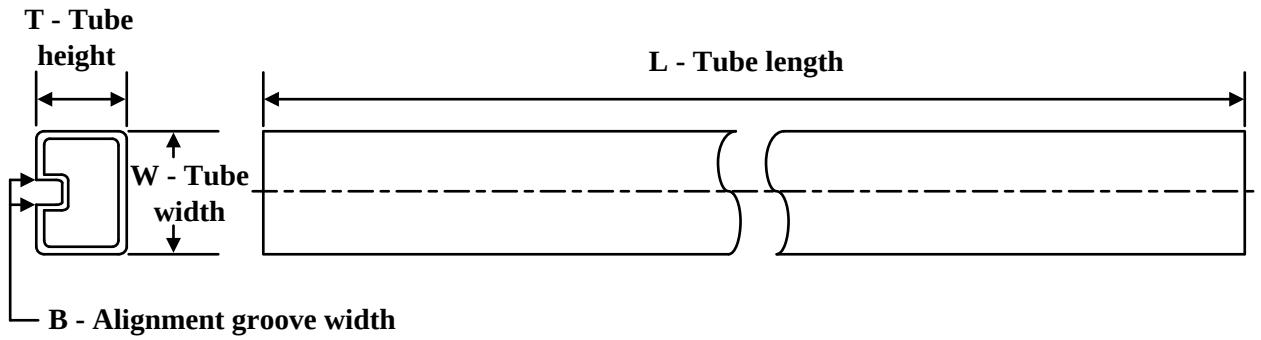
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC59210IPWR	TSSOP	PW	20	2000	353.0	353.0	32.0
TLC59210IPWRG4	TSSOP	PW	20	2000	353.0	353.0	32.0

TUBE



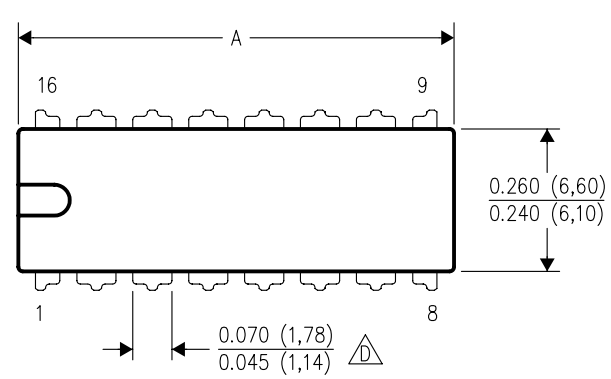
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
TLC59210IN	N	PDIP	20	20	506	13.97	11230	4.32
TLC59210IN.A	N	PDIP	20	20	506	13.97	11230	4.32

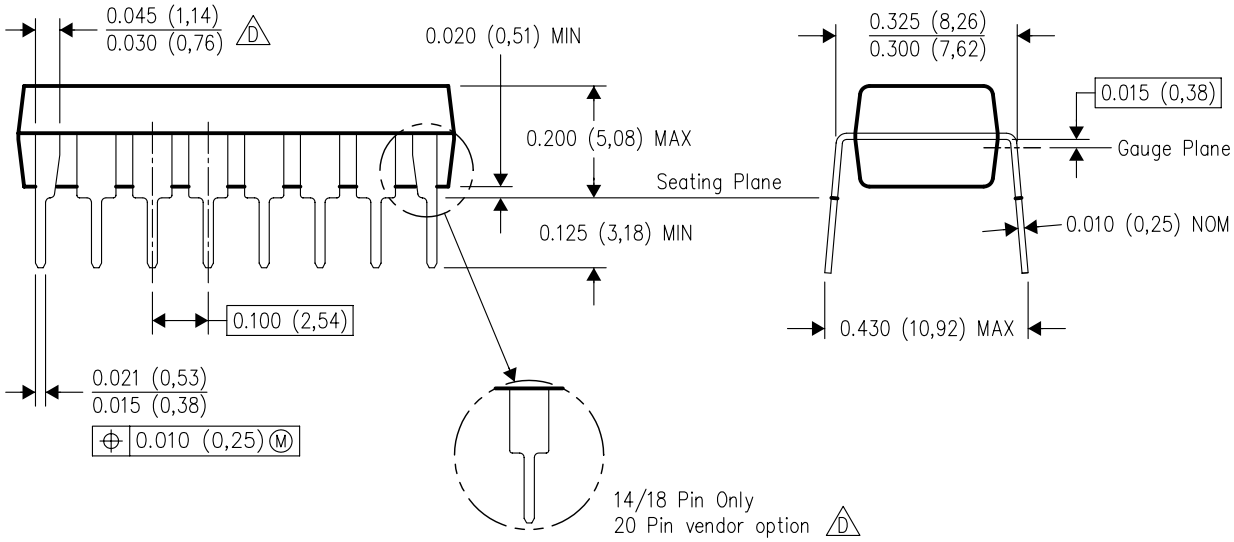
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

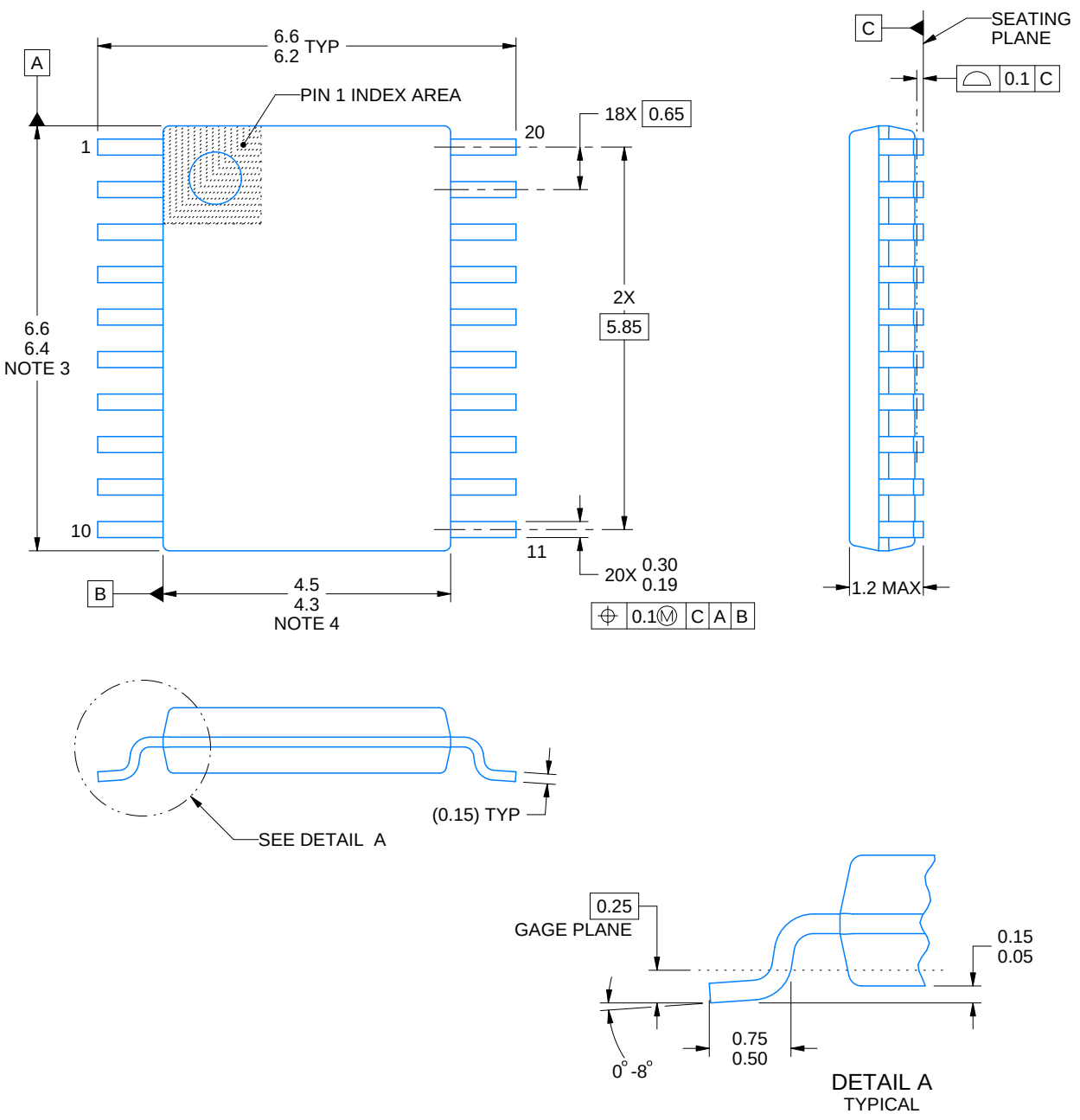
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

PACKAGE OUTLINE

PW0020A

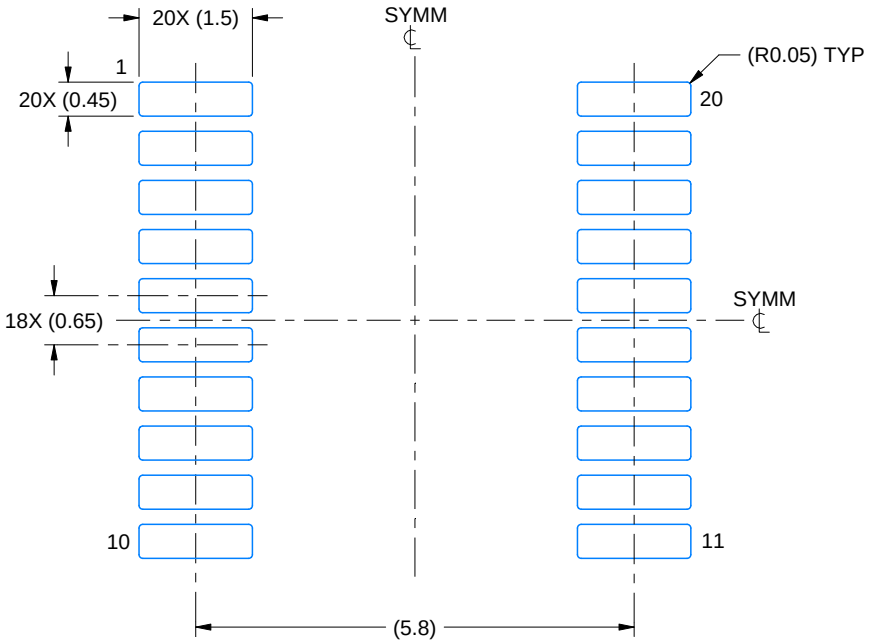
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

1. All linear dimensions are in millimeters. Any 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 0.25 mm per side.
5. Reference JEDEC registration MO-153.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

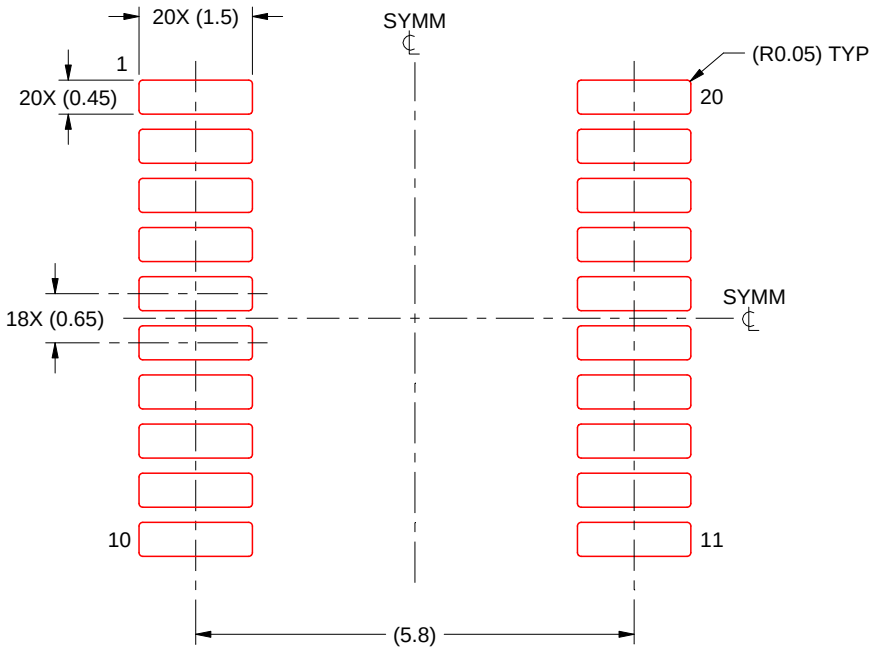


SOLDER MASK DETAILS

4220206/A 02/2017

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.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220206/A 02/2017

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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Last updated 10/2025