16-Channel, Constant-Current LED Driver

Check for Samples: TLC59281

FEATURES

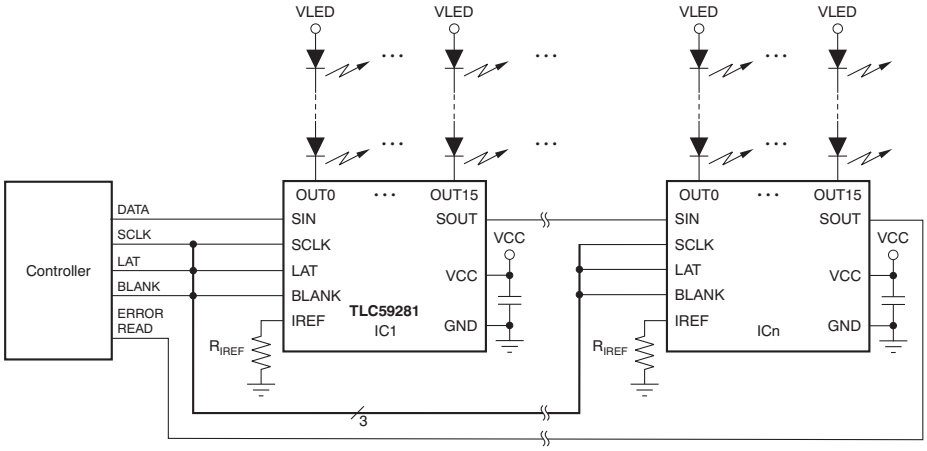
- **16 Channels, Constant-Current Sink Output with On/Off Control**
- **35-mA Capability (Constant-Current Sink)**
- **10-ns High-Speed Constant-Current Switching Transient Time**
- **Low On-Time Error**
- **LED Power-Supply Voltage up to 17 V**
- **V_{CC} = 3.0 V to 5.5 V**
- **Constant-Current Accuracy:**
  - **Channel-to-Channel = ±1%**
  - **Device-to-Device = ±1%**
- **CMOS Logic Level I/O**
- **35-MHz Data Transfer Rate**
- **20-ns BLANK Pulse Width**
- **Operating Temperature: –40°C to +85°C**

APPLICATIONS

- **LED Video Displays**
- **Message Boards**
- **Illumination**

DESCRIPTION

The TLC59281 is a 16-channel, constant-current sink LED driver. Each channel can be turned on/off by writing serial data to an internal register. The constant-current value of all 16 channels is set by a single external resistor.



Typical Application Circuit (Multiple Daisy-Chained TLC59281s)

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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION(1)

PRODUCT	PACKAGE-LEAD	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
TLC59281	SSOP-24/QSOP-24	TLC59281DBQR	Tape and Reel, 2500
		TLC59281DBQ	Tube, 50
TLC59281	QFN-24	TLC59281RGER	Tape and Reel, 3000
		TLC59281RGE	Tape and Reel, 250

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or visit the device product folder at www.ti.com.

ABSOLUTE MAXIMUM RATINGS(1)(2)

Over operating free-air temperature range, unless otherwise noted.

PARAMETER			TLC59281	UNIT
V_{CC}	Supply voltage: V_{CC}		–0.3 to +6.0	V
I_{OUT}	Output current (dc)	OUT0 to OUT15	40	mA
V_{IN}	Input voltage range	SIN, SCLK, LAT, BLANK, IREF	–0.3 to V_{CC} + 0.3	V
V_{OUT}	Output voltage range	SOUT	–0.3 to V_{CC} + 0.3	V
		OUT0 to OUT15	–0.3 to +18	V
$T_{J(MAX)}$	Operating junction temperature		+150	°C
T_{STG}	Storage temperature range		–55 to +150	°C
	ESD rating	Human body model (HBM)	2	kV
		Charged device model (CDM)	500	V

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not supported.
(2) All voltage values are with respect to network ground terminal.

DISSIPATION RATINGS

PACKAGE	OPERATING FACTOR ABOVE T_A = +25°C	T_A < +25°C POWER RATING	T_A = +70°C POWER RATING	T_A = +85°C POWER RATING
SSOP-24/QSOP-24	14.3 mW/°C	1782 mW	1140 mW	927 mW
QFN-24(1)	24.8 mW/°C	3106 mW	1988 mW	1615 mW

(1) The package thermal impedance is calculated in accordance with JESD51-5.

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RECOMMENDED OPERATING CONDITIONS

At T_A= –40°C to +85°C, unless otherwise noted.

PARAMETER		TEST CONDITIONS	TLC59281			UNIT
			MIN	NOM	MAX	
DC Characteristics: V_{CC} = 3 V to 5.5 V						
V_{CC}	Supply voltage		3.0		5.5	V
V_O	Voltage applied to output	OUT0 to OUT15			17	V
V_{IH}	High-level input voltage		0.7 × V_{CC}		V_{CC}	V
V_{IL}	Low-level input voltage		GND		0.3 × V_{CC}	V
I_{OH}	High-level output current	SOUT			–1	mA
I_{OL}	Low-level output current	SOUT			1	mA
I_{OLC}	Constant output sink current	OUT0 to OUT15	2		35	mA
T_A	Operating free-air temperature range		–40		+85	°C
T_J	Operating junction temperature range		–40		+125	°C
AC Characteristics: V_{CC} = 3 V to 5.5 V						
$f_{CLK\ (SCLK)}$	Data shift clock frequency	SCLK			35	MHz
T_{WH0}	Pulse duration	SCLK	10			ns
T_{WL0}		SCLK	10			ns
T_{WH1}		LAT	20			ns
T_{WH2}		BLANK	20			ns
T_{WL2}		BLANK	20			ns
T_{SU0}	Setup time	SIN–SCLK↑	4			ns
T_{SU1}		LAT↑–SCLK↑	100			ns
T_{H0}	Hold time	SIN–SCLK↑	3			ns
T_{H1}		LAT↑–SCLK↑	10			ns

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ELECTRICAL CHARACTERISTICS

At V_{CC} = 3.0 V to 5.5 V and T_A = –40°C to +85°C. Typical values at V_{CC} = 3.3 V and T_A = +25°C, unless otherwise noted.

PARAMETER		TEST CONDITIONS	TLC59281			UNIT
			MIN	TYP	MAX	
V_{OH}	High-level output voltage	I_{OH} = –1 mA at SOUT	V_{CC} – 0.4		V_{CC}	V
V_{OL}	Low-level output voltage	I_{OL} = 1 mA at SOUT	0		0.4	V
I_{IN}	Input current	V_{IN} = V_{CC} or GND at SIN, SCLK, LAT, and BLANK	–1		1	µA
I_{CC1}	Supply current (V_{CC})	SIN/SCLK/LAT = low, BLANK = high, V_{OUTn} = 1 V, R_{IREF} = 27 kΩ		1	2	mA
I_{CC2}		SIN/SCLK/LAT = low, BLANK = high, V_{OUTn} = 1 V, R_{IREF} = 3 kΩ		4.5	8	mA
I_{CC3}		SIN/SCLK/LAT/BLANK = low, V_{OUTn} = 1 V, R_{IREF} = 3 kΩ		7	18	mA
I_{CC4}		SIN/SCLK/LAT/BLANK = low, V_{OUTn} = 1 V, R_{IREF} = 1.5 kΩ		16	40	mA
I_{OLC}	Constant output current	All OUTn = ON, V_{OUTn} = V_{OUTfix} = 1 V, R_{IREF} = 1.5 kΩ (see Figure 6), at OUT0 to OUT15	31	34	37	mA
I_{OLKG}	Output leakage current	All OUTn for constant-current driver, all outputs off BLANK = high, V_{OUTn} = V_{OUTfix} = 17 V, R_{IREF} = 1.5 kΩ (see Figure 6), at OUT0 to OUT15			0.1	µA
ΔI_{OLC}	Constant-current error (channel-to-channel)(1)	All OUTn = ON, V_{OUTn} = V_{OUTfix} = 1 V, R_{IREF} = 1.5 kΩ at OUT0 to OUT15		±1	±3	%
ΔI_{OLC1}	Constant-current error (device-to-device)(2)	All OUTn = ON, V_{OUTn} = V_{OUTfix} = 1 V, R_{IREF} = 1.5 kΩ at OUT0 to OUT15		±1	±6	%
ΔI_{OLC2}	Line regulation(3)	All OUTn = ON, V_{OUTn} = V_{OUTfix} = 1 V, R_{IREF} = 1.5 kΩ at OUT0 to OUT15		±0.5	±1	%/V
ΔI_{OLC3}	Load regulation(4)	All OUTn = ON, V_{OUTn} = 1 V to 3V, V_{OUTfix} = 1 V, R_{IREF} = 1.5 kΩ, at OUT0 to OUT15		±1	±3	%/V
V_{IREF}	Reference voltage output	R_{IREF} = 1.5 kΩ	1.16	1.20	1.24	V

(1) The deviation of each output from the average of OUT0–OUT15 constant-current. Deviation is calculated by the formula:

$$\Delta\,(\%) = \left(\frac{I_{OUTn}}{\frac{(I_{OUT0} + I_{OUT1} + \ldots + I_{OUT14} + I_{OUT15})}{16}} - 1 \right) \times 100$$

(2) The deviation of the OUT0–OUT15 constant-current average from the ideal constant-current value. Deviation is calculated by the following formula:

$$\Delta\,(\%) = \left(\frac{\frac{(I_{OUT0} + I_{OUT1} + \ldots I_{OUT14} + I_{OUT15})}{16} - (\text{Ideal Output Current})}{\text{Ideal Output Current}} \right) \times 100$$

Ideal current is calculated by the formula:

$$I_{OUT(IDEAL)} = 42 \times \left(\frac{1.20}{R_{IREF}} \right)$$

(3) Line regulation is calculated by this equation:

$$\Delta\,(\%/V) = \left(\frac{(I_{OUTn} \text{ at } V_{CC} = 5.5 \text{ V}) - (I_{OUTn} \text{ at } V_{CC} = 3.0 \text{ V})}{(I_{OUTn} \text{ at } V_{CC} = 3.0 \text{ V})} \right) \times \frac{100}{5.5 \text{ V} - 3 \text{ V}}$$

(4) Load regulation is calculated by the equation:

$$\Delta\,(\%/V) = \left(\frac{(I_{OUTn} \text{ at } V_{OUTn} = 3 \text{ V}) - (I_{OUTn} \text{ at } V_{OUTn} = 1 \text{ V})}{(I_{OUTn} \text{ at } V_{OUTn} = 1 \text{ V})} \right) \times \frac{100}{3 \text{ V} - 1 \text{ V}}$$

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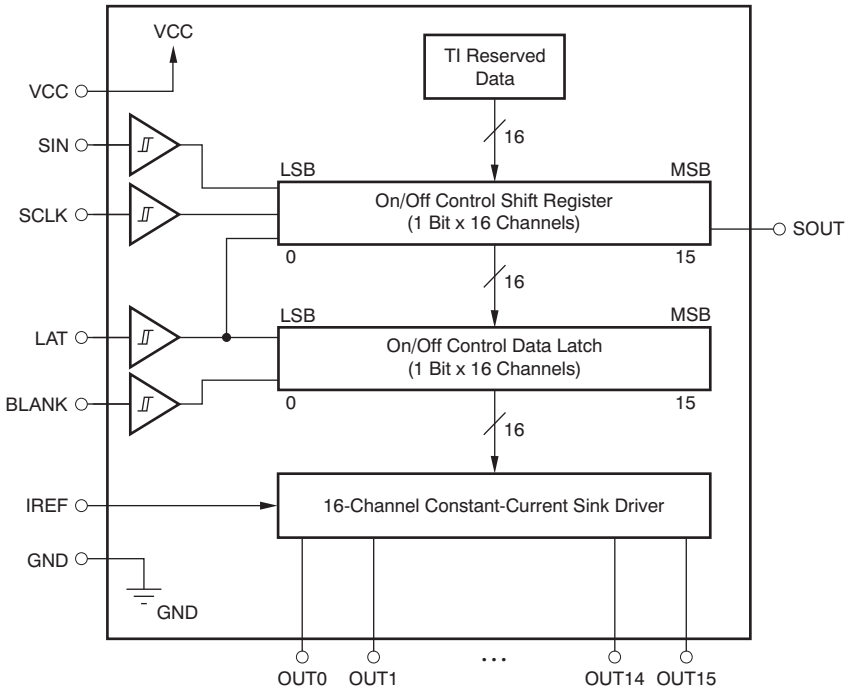
SWITCHING CHARACTERISTICS

At V_{CC} = 3.0 V to 5.5 V, T_A = –40°C to +85°C, C_L = 15 pF, R_L = 130 Ω, R_{IREF} = 1.5 kΩ, and V_{LED} = 5.5 V. Typical values at V_{CC} = 3.3 V and T_A = +25°C, unless otherwise noted.

PARAMETER		TEST CONDITIONS	TLC59281			UNIT
			MIN	TYP	MAX	
t_{R0}	Rise time	SOUT (see Figure 5)		5	15	ns
t_{R1}		OUTn (see Figure 4)		10	30	ns
t_{F0}	Fall time	SOUT (see Figure 5)		5	15	ns
t_{F1}		OUTn (see Figure 4)		10	30	ns
t_{D0}	Propagation delay time	SCLK↑ to SOUT		8	20	ns
t_{D1}		LAT↑ or BLANK↓ to OUTn sink current on (see Figure 10)		12	30	ns
t_{D2}		LAT↑ or BLANK↑ to OUTn sink current off (see Figure 10)		12	30	ns
t_{ON_ERR}	Output on-time error(1)	On/off latch data = all '1', 20 ns BLANK low level one-shot pulse input (see Figure 4)	–8		+8	ns

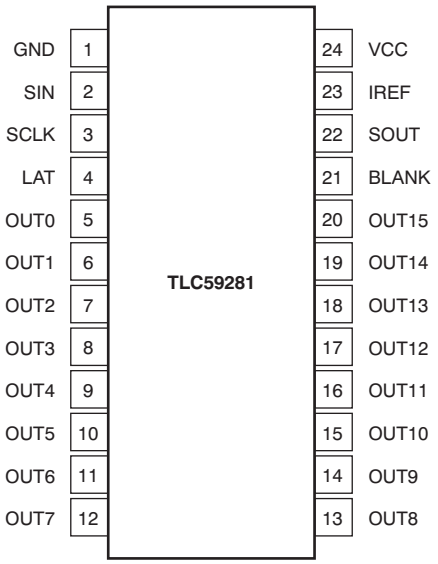
(1) Output on-time error (t_{ON_ERR}) is calculated by the formula: t_{ON_ERR} (ns) = t_{OUT_ON} – BLANK low level one-shot pulse width (T_{WL2}). t_{OUT_ON} indicates the actual on-time of the constant-current driver.

FUNCTIONAL BLOCK DIAGRAM

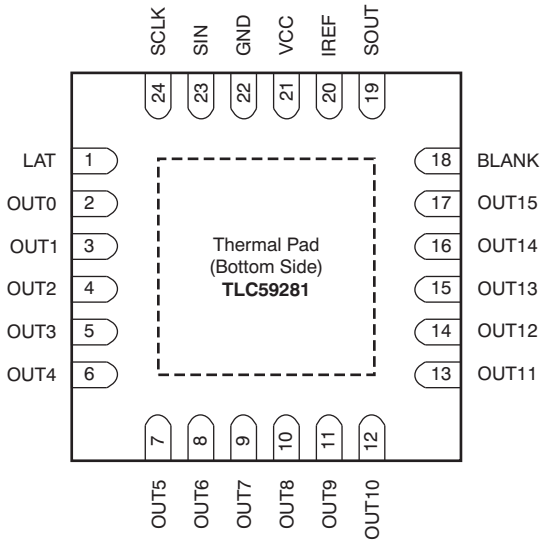


DEVICE INFORMATION

SSOP-24/QSOP-24
DBQ PACKAGE
(TOP VIEW)



QFN-24
RGE PACKAGE
(TOP VIEW)



NOTE: Thermal pad is not connected to GND internally. The thermal pad must be connected to GND via the PCB pattern.

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TERMINAL FUNCTIONS

TERMINAL			I/O	DESCRIPTION
NAME	DBQ	RGE		
SIN	2	23	I	Serial data input for driver on/off control. When SIN = high level, data '1' are written into LSB of the on/off control shift register at the rising edge of SCLK.
SCLK	3	24	I	Serial data shift clock. Schmitt buffer input. All data in the on/off control shift register are shifted toward the MSB by 1-bit synchronization of SCLK. A rising edge on SCLK is allowed 100 ns after a rising edge of LAT.
LAT	4	1	I	Edge triggered latch. The data in the on/off control data shift register are transferred to the on/off control data latch at this rising edge. At the same time, the data in the on/off control shift register are replaced with TI reserved data for production test. LAT must be toggled only once after the shift data are updated to avoid the on/off control latch data being replaced with TI reserved data in the shift register. The reserved data is not a fixed number.
BLANK	21	18	I	Blank, all outputs. When BLANK = high level, all constant-current outputs (OUT0–OUT15) are forced off. When BLANK = low level, all constant-current outputs are controlled by the on/off control data in the data latch.
IREF	23	20	I/O	Constant-current value setting, OUT0–OUT15 sink constant-current is set to desired value by connection to an external resistor between IREF and GND.
SOUT	22	19	O	Serial data output. This output is connected to the MSB of the on/off data shift register. SOUT data changes at the rising edge of SCLK.
OUT0	5	2	O	Constant-current output. Each output can be tied together with others to increase the constant-current. Different voltages can be applied to each output.
OUT1	6	3	O	Constant-current output
OUT2	7	4	O	Constant-current output
OUT3	8	5	O	Constant-current output
OUT4	9	6	O	Constant-current output
OUT5	10	7	O	Constant-current output
OUT6	11	8	O	Constant-current output
OUT7	12	9	O	Constant-current output
OUT8	13	10	O	Constant-current output
OUT9	14	11	O	Constant-current output
OUT10	15	12	O	Constant-current output
OUT11	16	13	O	Constant-current output
OUT12	17	14	O	Constant-current output
OUT13	18	15	O	Constant-current output
OUT14	19	16	O	Constant-current output
OUT15	20	17	O	Constant-current output
VCC	24	21	—	Power-supply voltage
GND	1	22	—	Power ground

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PARAMETER MEASUREMENT INFORMATION

PIN EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

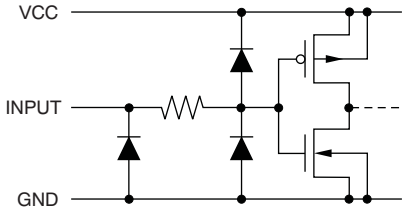


Figure 1. SIN, SCLK, LAT, BLANK

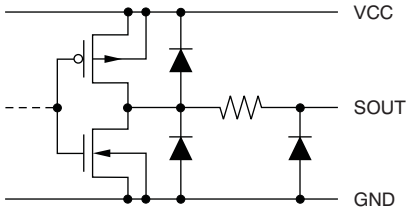


Figure 2. SOUT

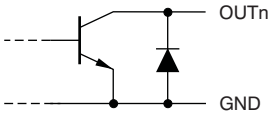
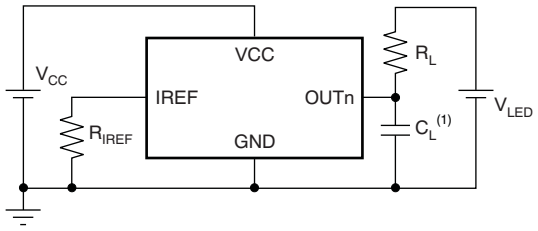


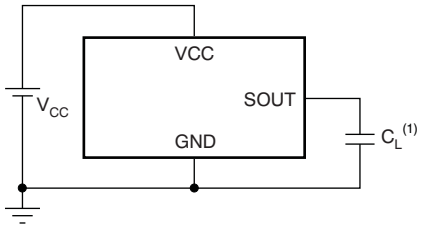
Figure 3. OUT0 Through OUT15

TEST CIRCUITS



(1) C_L includes measurement probe and jig capacitance.

Figure 4. Rise Time and Fall Time Test Circuit for OUTn



(1) C_L includes measurement probe and jig capacitance.

Figure 5. Rise Time and Fall Time Test Circuit for SOUT

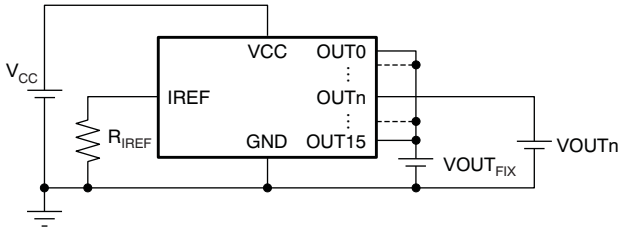


Figure 6. Constant-Current Test Circuit for OUTn

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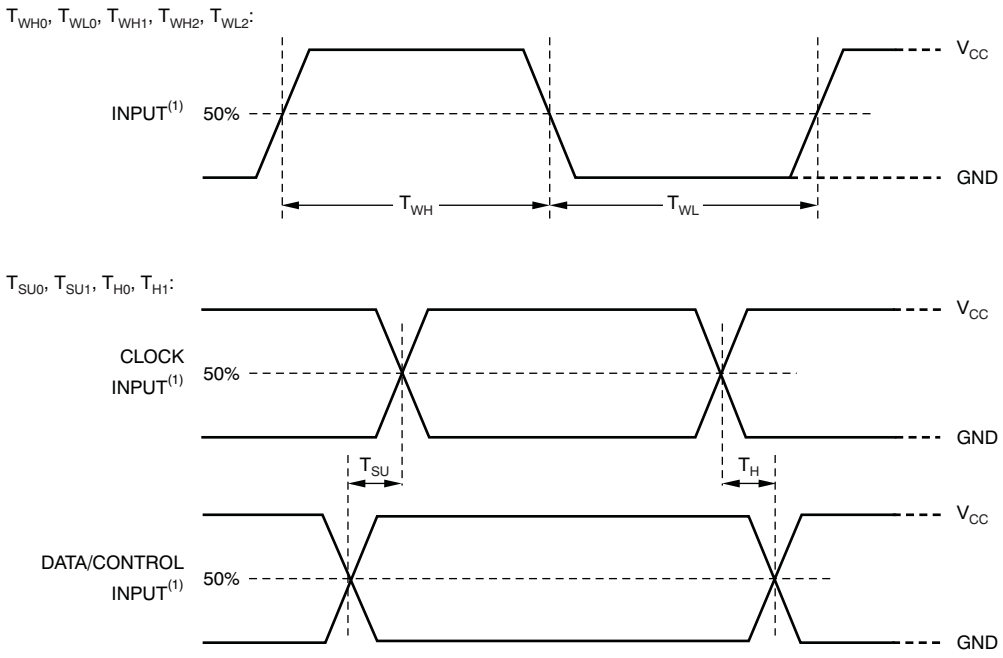
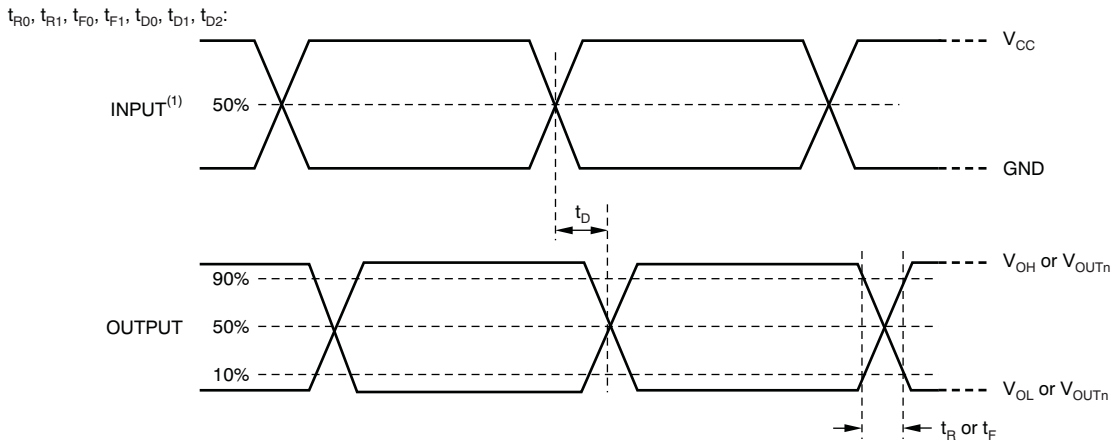
TIMING DIAGRAMS



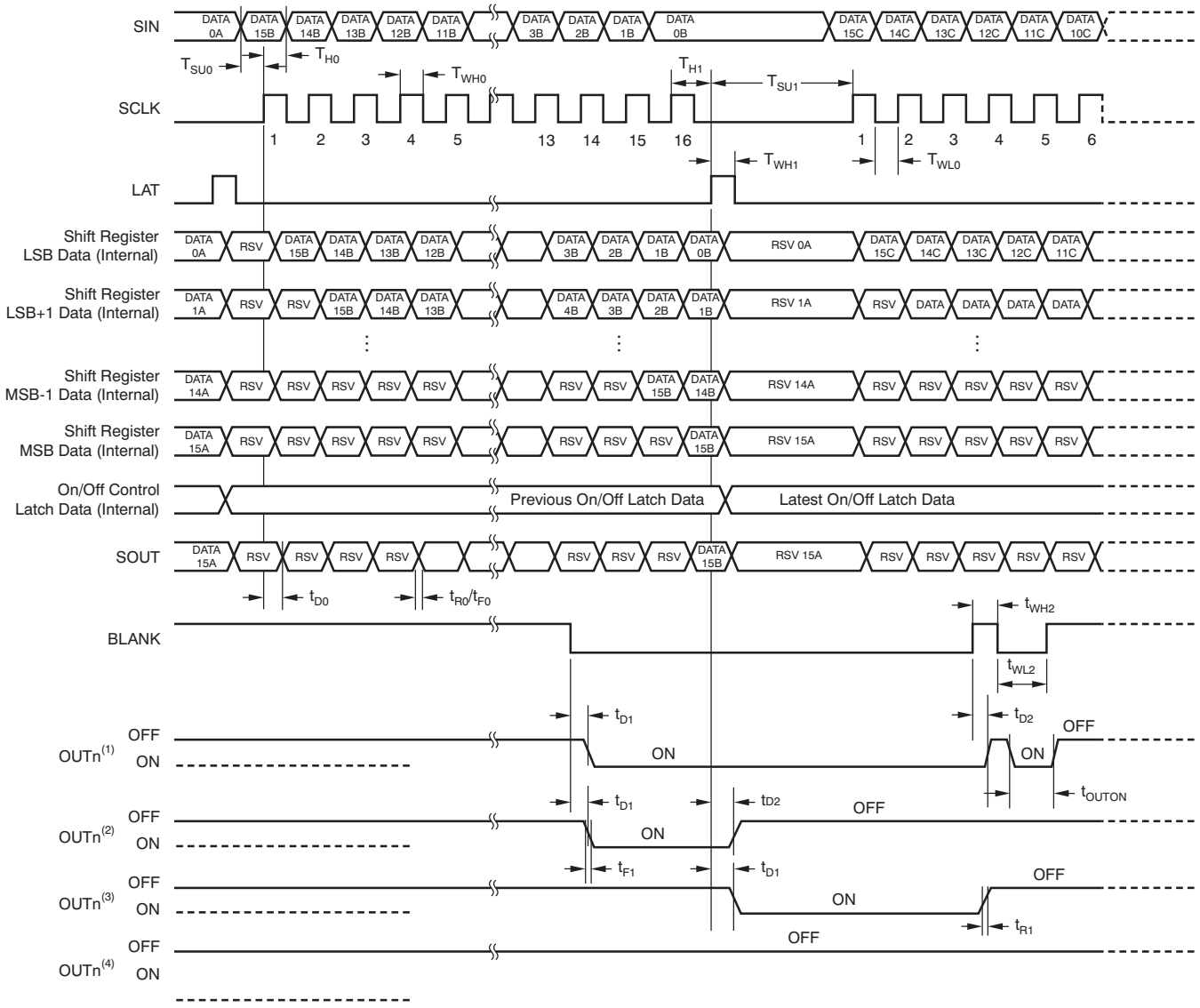
(1) Input pulse rise and fall time is 1 ns to 3 ns.

Figure 7. Input Timing



(1) Input pulse rise and fall time is 1 ns to 3 ns.

Figure 8. Output Timing



(1) On/off latched data are '1'.

(2) On/off latched data are changed from '1' to '0' at the second LAT signal.

(3) On/off latched data are changed from '0' to '1' at the second LAT signal.

(4) On/off latched data are '0'.

Figure 9. Timing Diagram

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TYPICAL CHARACTERISTICS

At V_{CC} = 3.3 V and T_A = +25°C, unless otherwise noted.

REFERENCE RESISTOR vs OUTPUT CURRENT

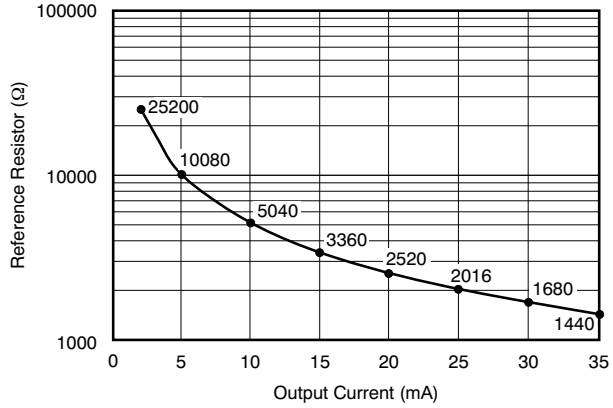

Figure 10.

POWER DISSIPATION RATE vs FREE-AIR TEMPERATURE

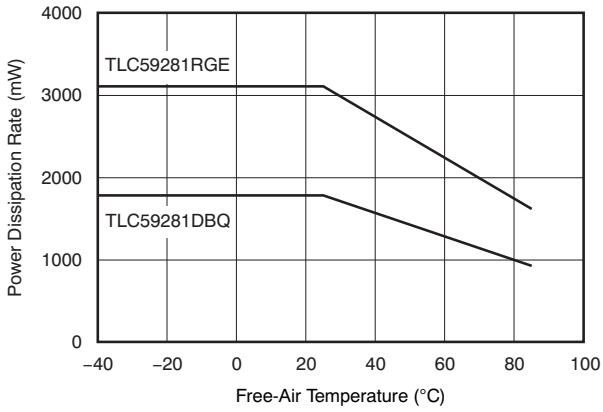

Figure 11.

OUTPUT CURRENT vs OUTPUT VOLTAGE

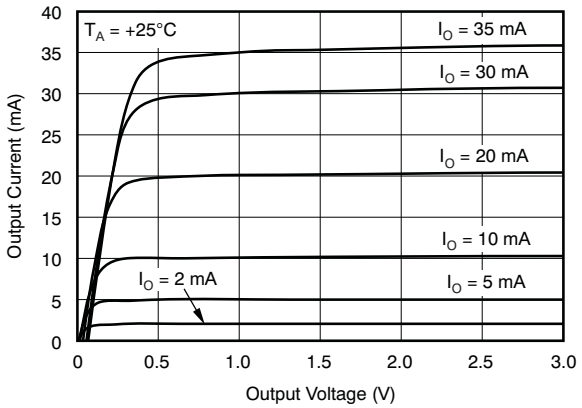

Figure 12.

OUTPUT CURRENT vs OUTPUT VOLTAGE

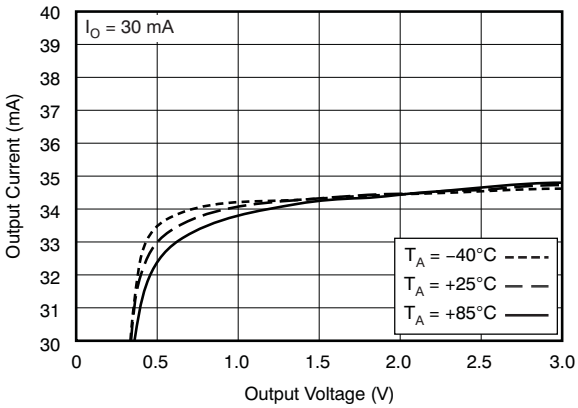

Figure 13.

ΔI_{OLC} vs AMBIENT TEMPERATURE

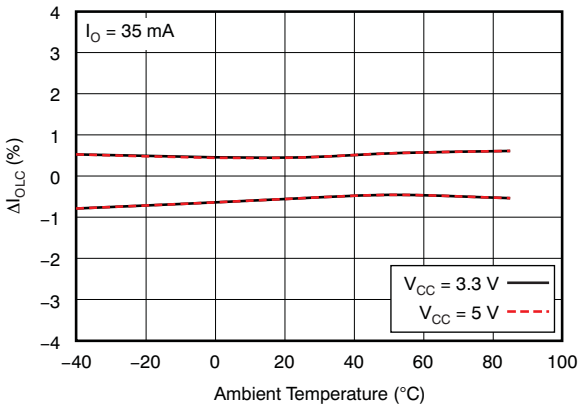

Figure 14.

ΔI_{OLC} vs OUTPUT CURRENT

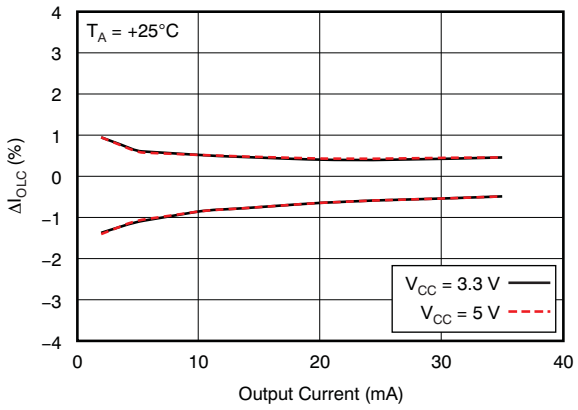

Figure 15.

TYPICAL CHARACTERISTICS (continued)

At V_{CC} = 3.3 V and T_A = +25°C, unless otherwise noted.

CONSTANT-CURRENT OUTPUT VOLTAGE WAVEFORM

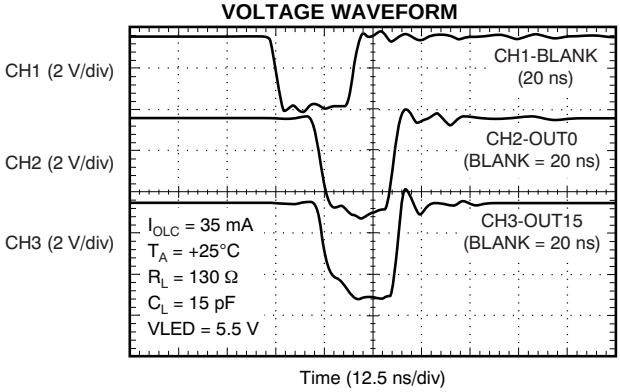

Figure 16.

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DETAILED DESCRIPTION

SETTING FOR THE CONSTANT SINK CURRENT VALUE

The constant-current values are determined by an external resistor (R_{IREF}) placed between IREF and GND. The resistor (R_{IREF}) value is calculated by Equation 1.

$$R_{IREF}\ (k\Omega) = \frac{V_{IREF}\ (V)}{I_{OLC}\ (mA)} \times 42$$

Where:

V_{IREF} = the internal reference voltage on the IREF pin (typically 1.20 V) (1)

I_{OLC} must be set in the range of 2 mA to 35 mA. The constant sink current characteristic for the external resistor value is shown in Figure 10. Table 1 describes the constant-current output versus external resistor value.

Table 1. Constant-Current Output versus External Resistor Value

I_{OLCMax} (mA, Typical)	R_{IREF} (kΩ)
35	1.44
30	1.68
25	2.02
20	2.52
15	3.36
10	5.04
5	10.1
2	25.2

CONSTANT-CURRENT DRIVER ON/OFF CONTROL

When BLANK is low, the corresponding output is turned on if the data in the on/off control data latch are '1' and remains off if the data are '0'. When BLANK is high, all outputs are forced off. This control is shown in Table 2.

Table 2. On/Off Control Data Truth Table

ON/OFF CONTROL LATCH DATA	CONSTANT-CURRENT OUTPUT STATUS
0	Off
1	On

When the IC is initially powered on, the data in the on/off control shift register and data latch are not set to the respective default value. Therefore, the on/off control data must be written to the data latch before turning the constant-current output on. BLANK should be at a high level when powered on because the constant-current may be turned on as a result of random data in the on/off control latch.

The on/off data corresponding to any unconnected OUTn outputs should be set to ‘0’ before turning on the remaining outputs. Otherwise, the supply current (I_{CC}) increases while the LEDs are on.

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REGISTER CONFIGURATION

The TLC59281 has an on/off control data shift register and data latch. Both the on/off control shift register and latch are 16 bits long and are used to turn the constant-current drivers on and off. Figure 17 shows the shift register and latch configuration. The data at the SIN pin are shifted in to the LSB of the shift register at the rising edge of the SCLK pin; SOUT data change at the rising edge of SCLK. The timing diagram for data writing is shown in Figure 18. The driver on/off is controlled by the data in the on/off control data latch.

The on/off data are latched into the data latch by a rising edge of LAT after the data are written into the on/off control shift register by SIN and SCLK. At the same time, the data in the on/off control shift register are replaced with TI reserved data for production test. Therefore, LAT must be input only once after the on/off data update to avoid the on/off control data latch being replaced with TI reserved data in the shift register. When the IC initially powers on, the data in the on/off control shift register and latch are not set to the default values; on/off control data must be written to the on/off control data latch before turning the constant-current output on. BLANK should be high when the IC is powered on because the constant-current may be turned on at that time as a result of random values in the on/off data latch. All constant-current outputs are forced off when BLANK is high.

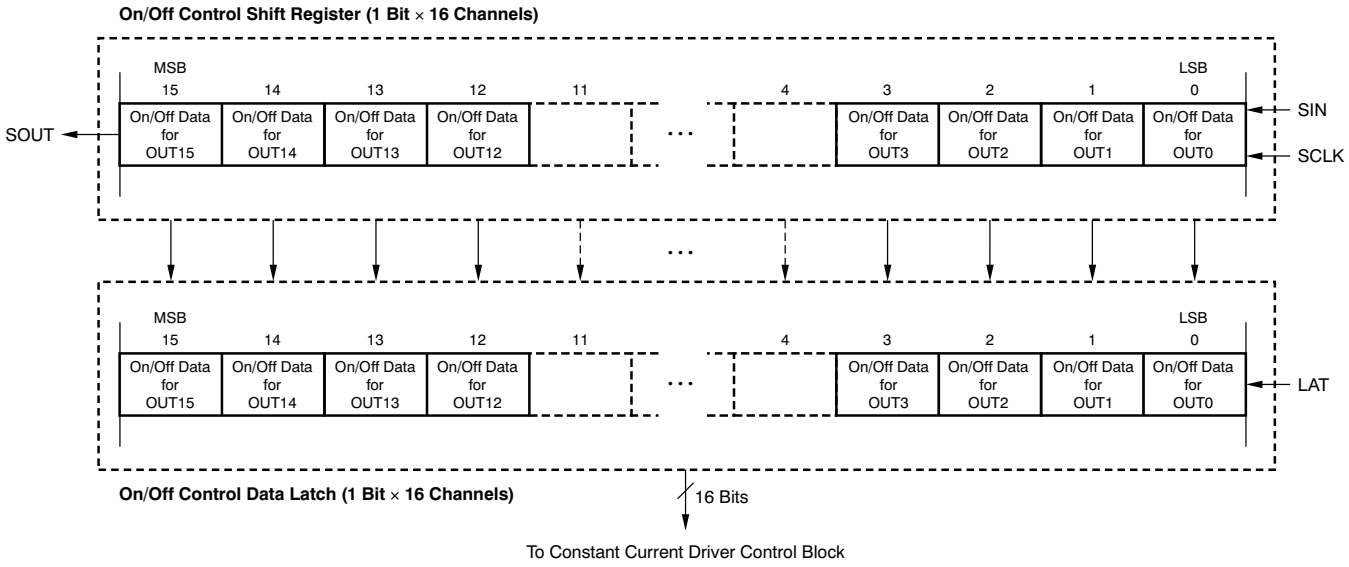

Figure 17. On/Off Control Shift Register and Latch Configuration

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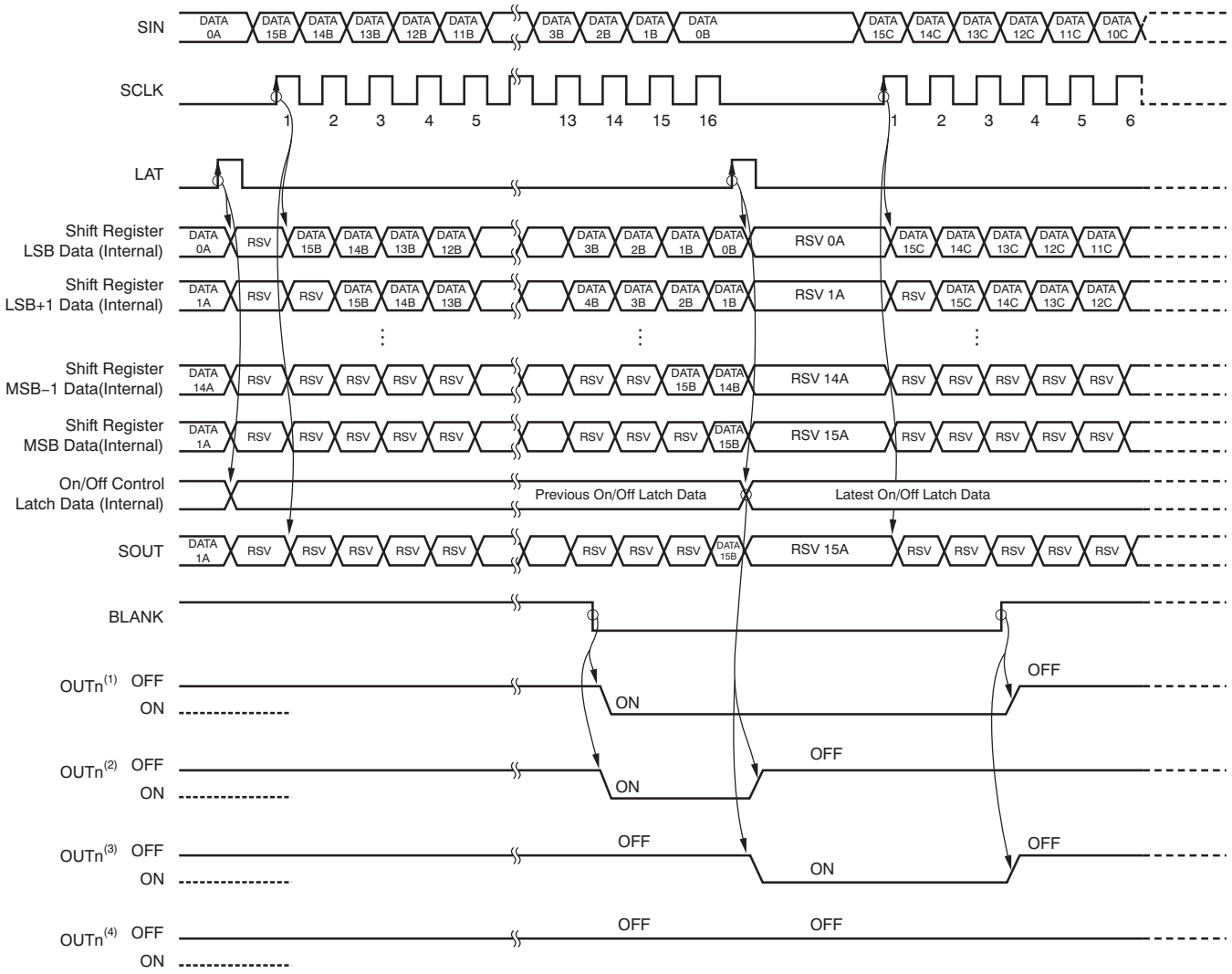

(1) On/off latched data are '1'.

(2) On/off latched data are changed from '1' to '0' at the second LAT signal.

(3) On/off latched data are changed from '0' to '1' at the second LAT signal.

(4) On/off latched data are '0'.

Figure 18. On/Off Control Operation

LAYOUT CONSIDERATIONS

The output current transient time in the TLC59281 is very fast. In addition, all outputs turn on or off at the same time to minimize the output on-time error. This high current demand can cause GND to shift in the entire system, and lead to false triggering of signals. To overcome this issue, design all GND lines to be as wide and short as possible in order to reduce parasitic inductance and resistance.

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (September 2010) to Revision B **Page**

- Added *Layout Considerations* section 15

Changes from Original (January 2010) to Revision A **Page**

- Changed SO-24 to SSOP-24/QSOP-24 in Package/Ordering Information table 2
- Changed SO-24 to SSOP-24/QSOP-24 in Dissipation Ratings table 2
- Changed SO-24 to SSOP-24/QSOP-24 in DBQ pinout 6

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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)
TLC59281DBQ	Active	Production	SSOP (DBQ) | 24	50 | TUBE	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	TLC59281
TLC59281DBQR	Active	Production	SSOP (DBQ) | 24	2500 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	TLC59281
TLC59281RGER	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	TLC 59281
TLC59281RGET	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-	TLC 59281

(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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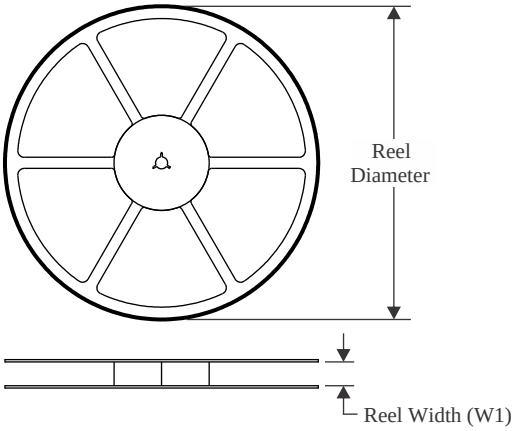
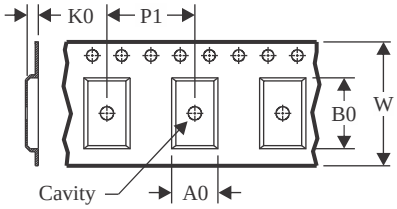
TAPE AND REEL INFORMATION

REEL DIMENSIONS

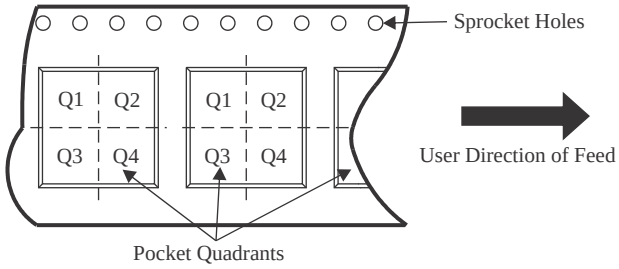


TAPE DIMENSIONS



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

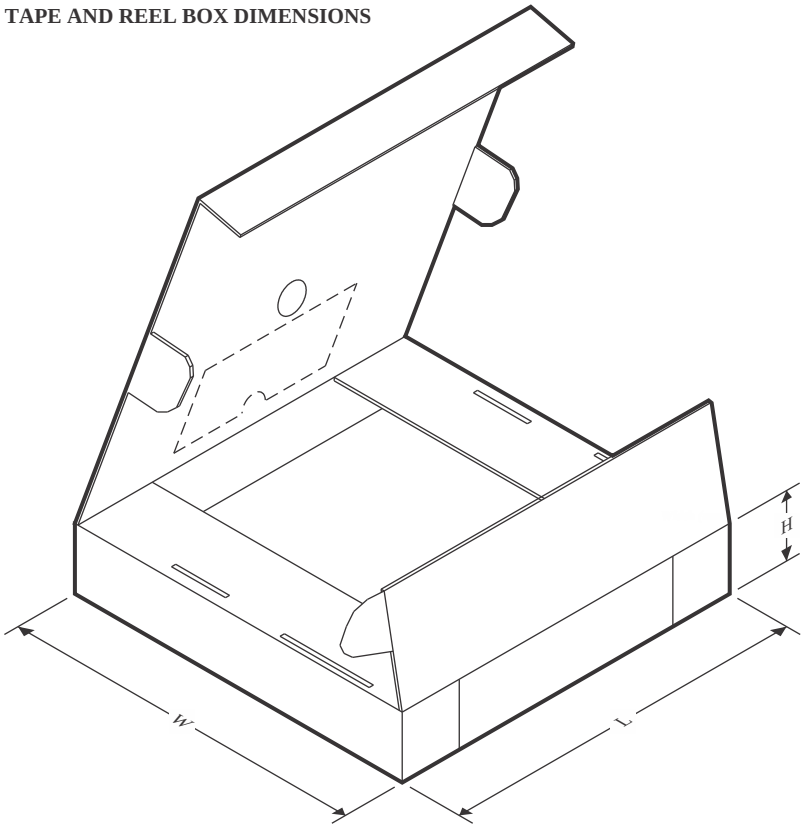
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLC59281DBQR	SSOP	DBQ	24	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLC59281RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
TLC59281RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

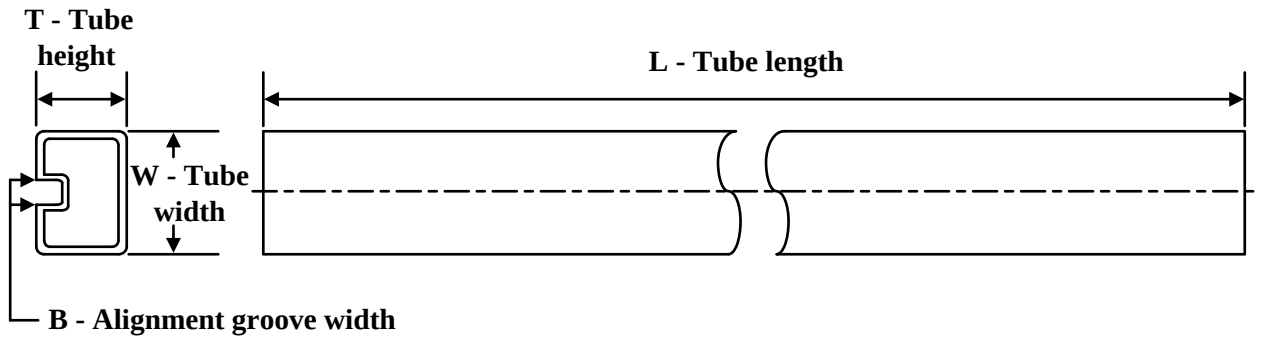
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC59281DBQR	SSOP	DBQ	24	2500	356.0	356.0	35.0
TLC59281RGER	VQFN	RGE	24	3000	356.0	356.0	35.0
TLC59281RGET	VQFN	RGE	24	250	210.0	185.0	35.0

TUBE



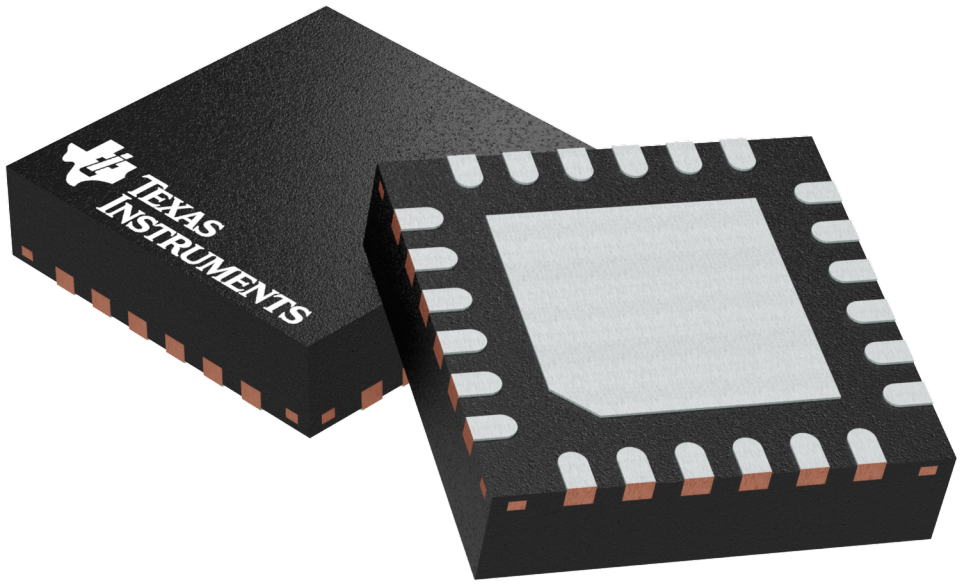
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
TLC59281DBQ	DBQ	SSOP	24	50	506.6	8	3940	4.32

GENERIC PACKAGE VIEW

RGE 24 VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

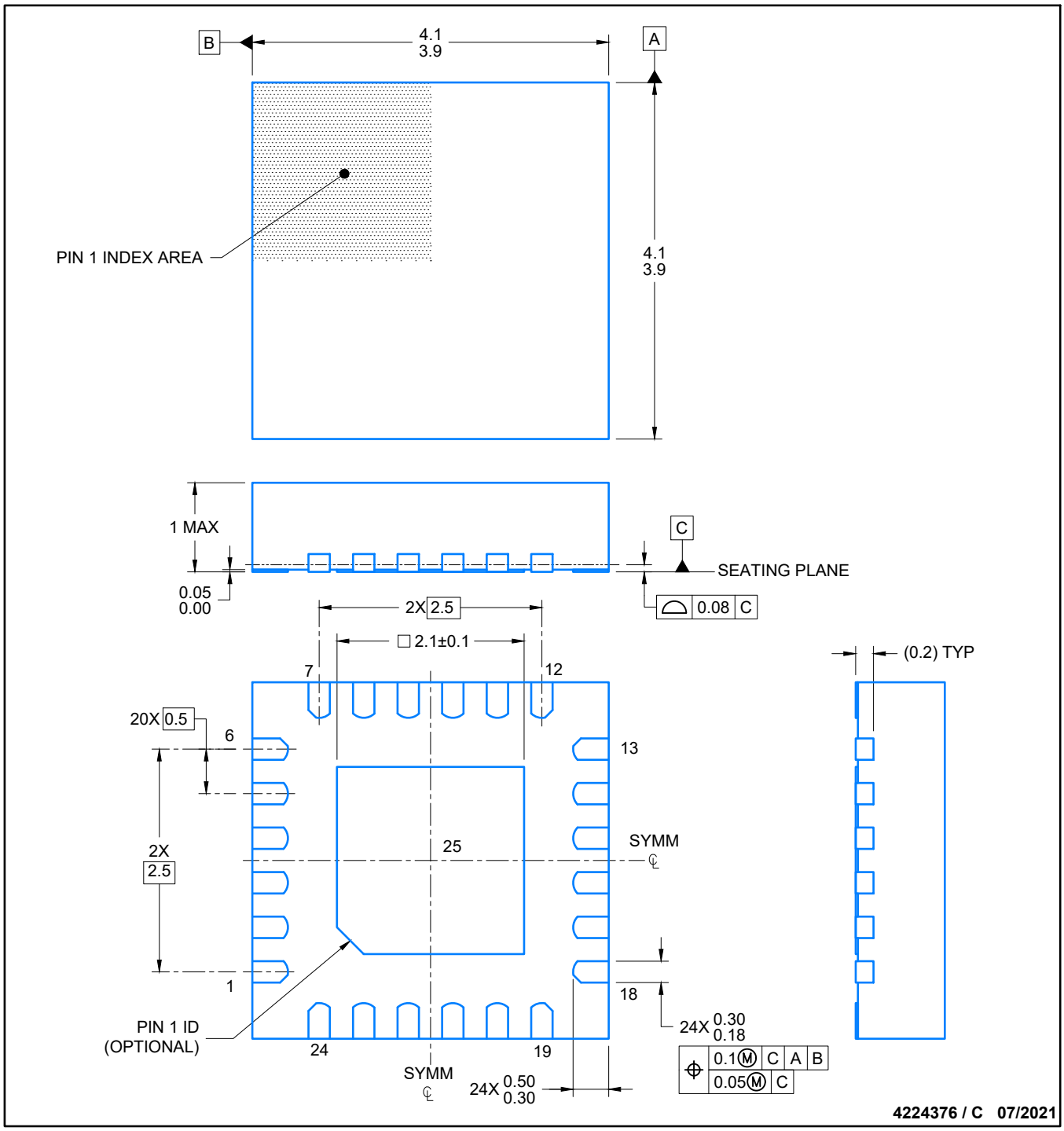
4204104/H

PACKAGE OUTLINE

RGE0024C

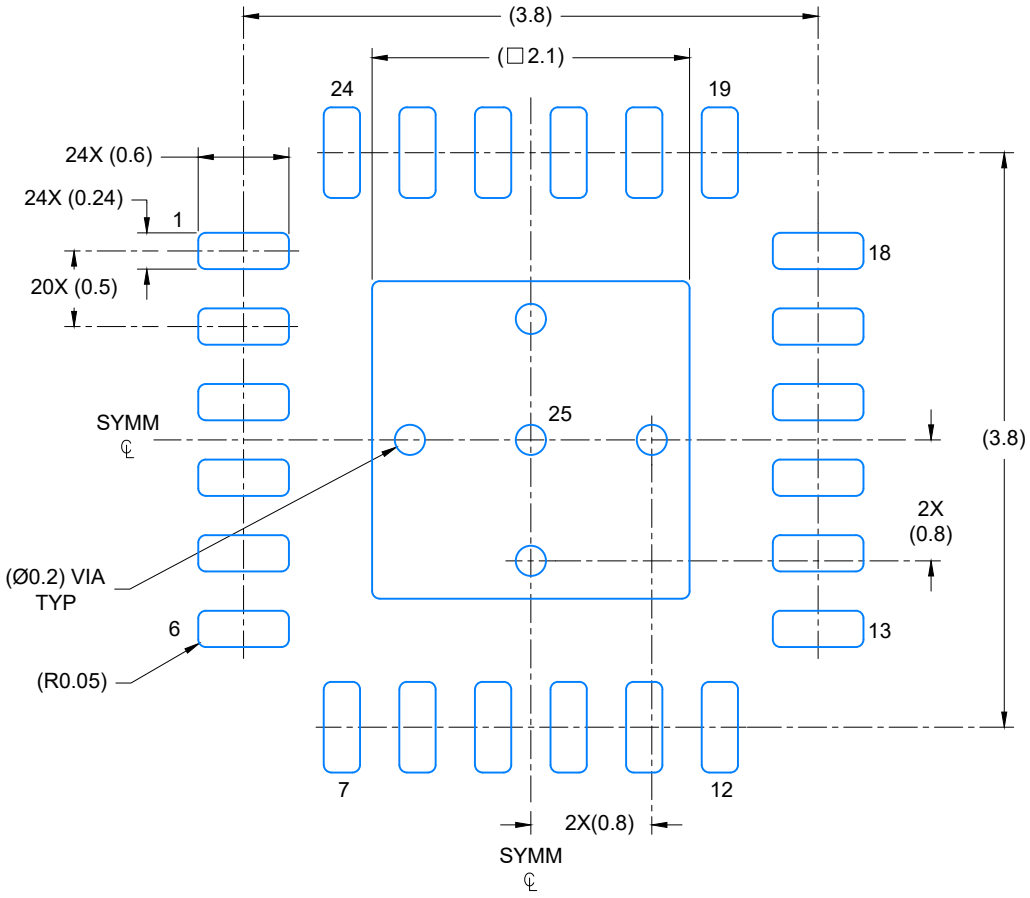
VQFN - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



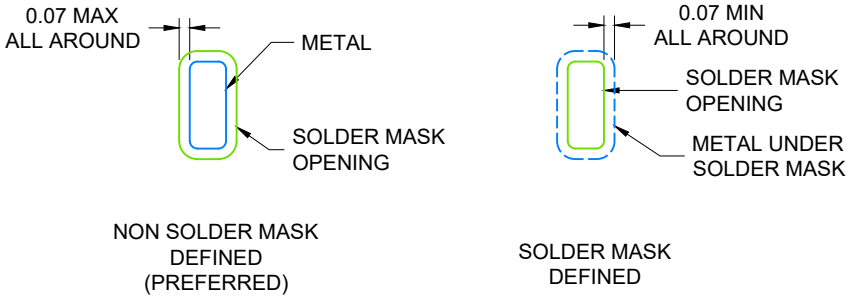
NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE

SCALE: 20X



SOLDER MASK DETAILS

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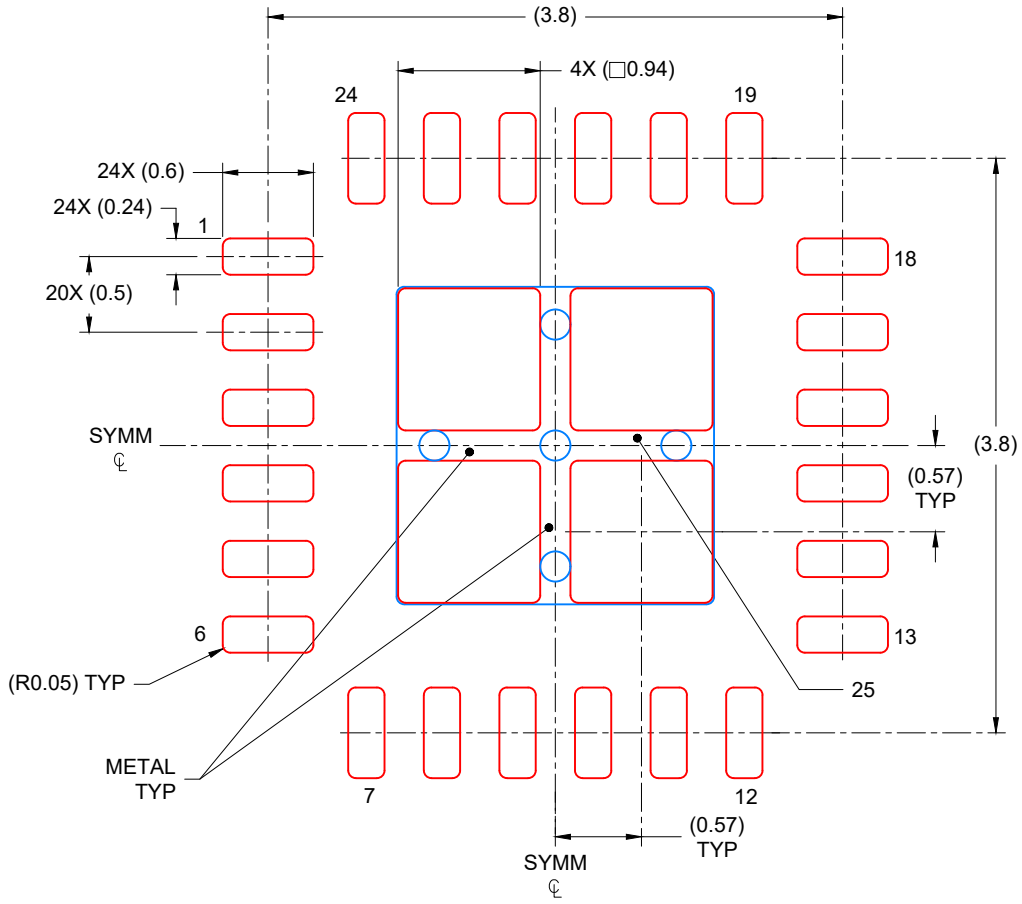
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. 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

EXPOSED PAD
80% PRINTED COVERAGE BY AREA
SCALE: 20X

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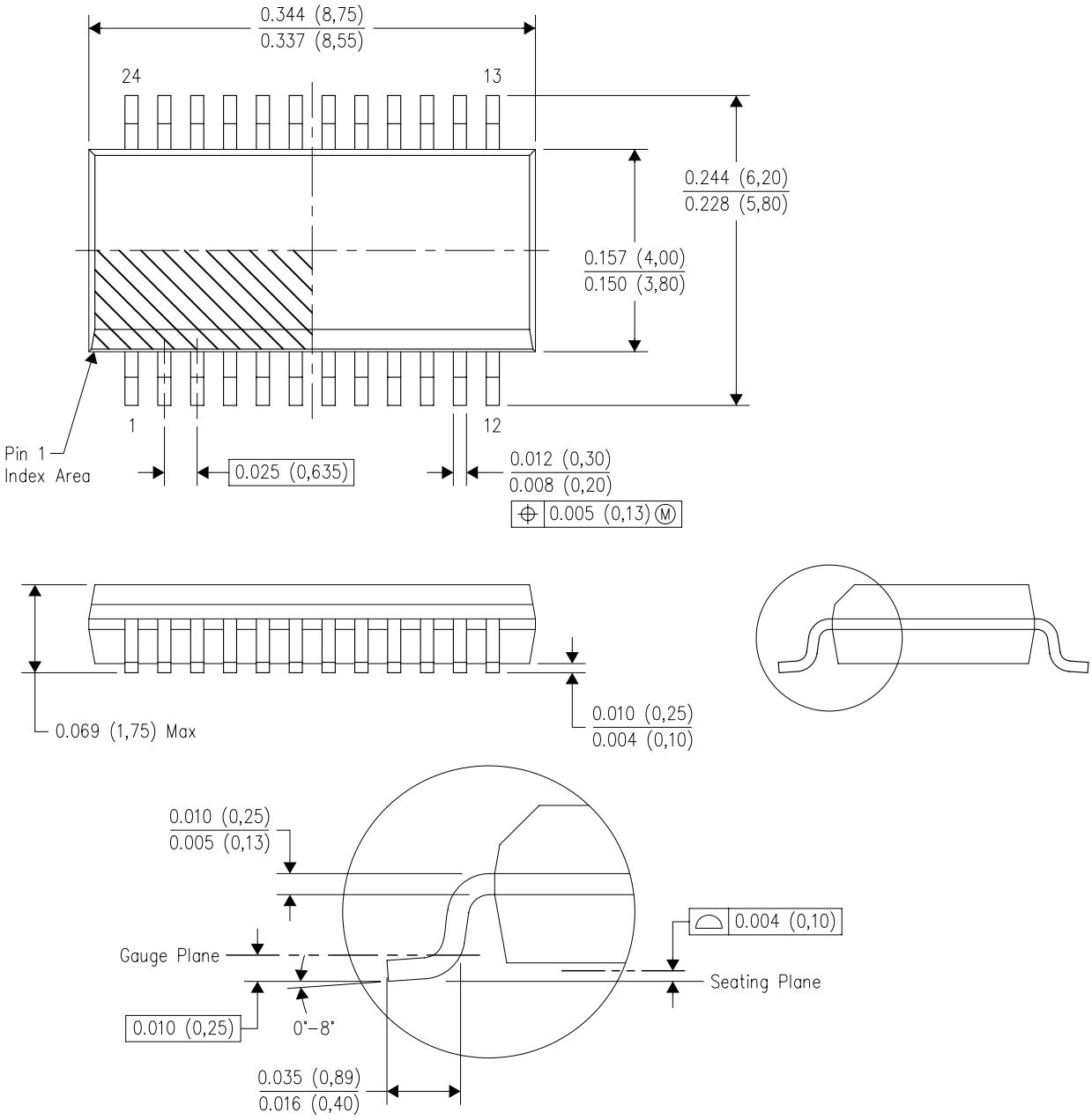
NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations..

DBQ (R–PDSO–G24) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15) per side.
D. Falls within JEDEC MO–137 variation AE.

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