# 16-Channel, Constant-Current LED Driver with 4-Channel Grouped Delay

**Check for Samples: TLC59282**

## FEATURES

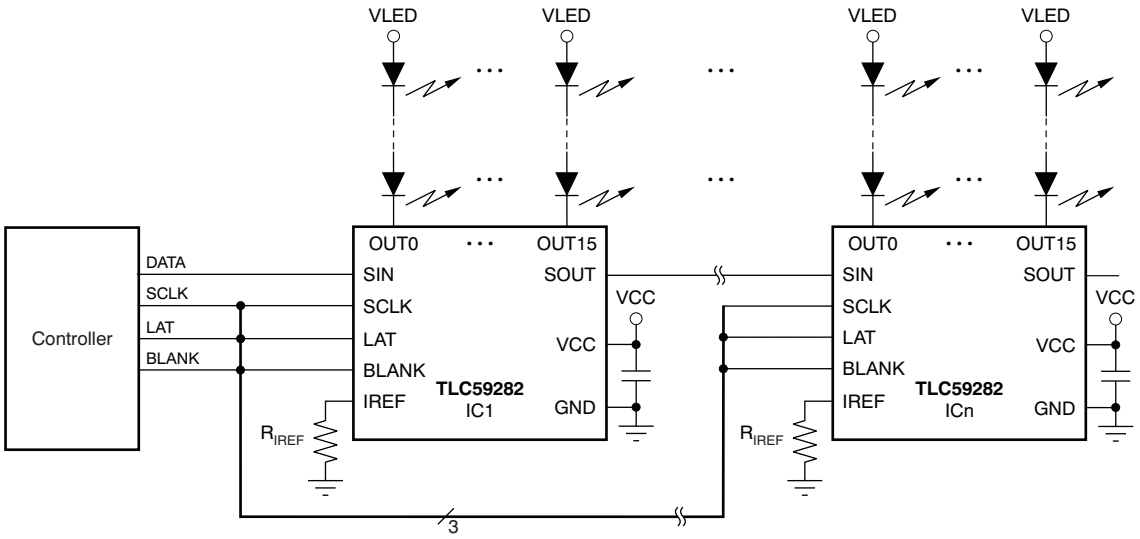
- **16 Channels, Constant-Current Sink Output with On/Off Control**
- **Capability (Constant-Current Sink): 35 mA ($V_{CC}$ ≤ 3.6 V), 45 mA ($V_{CC}$ > 3.6 V)**
- **LED Power-Supply Voltage up to 17 V**
- **$V_{CC}$ = 3 V to 5.5 V**
- **Constant-Current Accuracy:**
  - **Channel-to-Channel = ±0.6% (typ), ±2% (max)**
  - **Device-to-Device = ±1% (typ), ±3% (max)**
- **Low Saturation Voltage: 0.31 V at 20 mA (typ)**
  - **$T_A$ = +25°C, One Channel On**
- **CMOS Logic Level I/O**
- **Data Transfer Rate: 35 MHz**
- **BLANK Pulse Width: 30 ns**
- **Four-Channel Grouped Delay for Noise Reduction**
- **Operating Temperature: –40°C to +85°C**

## APPLICATIONS

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

## DESCRIPTION

The TLC59282 is a 16-channel, constant-current sink driver. Each channel can be individually controlled via a simple serial communications protocol that is compatible with 3.3 V or 5 V CMOS logic levels, depending on the operating VCC. Once the serial data buffer is loaded, a rising edge on LATCH transfers the data to the LEDx outputs. The BLANK pin can be used to turn off all OUTn outputs during power-on and output data latching to prevent unwanted image displays during these times. The constant-current value of all 16 channels is set by a single external resistor. Multiple TLC59282s can be cascaded together to control additional LEDs from the same processor.




**Typical Application Circuit (Multiple Daisy-Chained TLC59282s)**

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 |
|---|---|---|---|
| TLC59282 | SSOP-24/QSOP-24 | TLC59282DBQR | Tape and Reel, 2500 |
| | | TLC59282DBQ | Tube, 50 |
| TLC59282 | QFN-24 | TLC59282RGER | Tape and Reel, 3000 |
| | | TLC59282RGE | 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 | | | TLC59282 | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | –0.3 to +6 | V |
| $I_{OUT}$ | Output current (dc) | OUT0 to OUT15 | 50 | 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) | 4000 | V |
| | | Charged device model (CDM) | 1000 | 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.

## THERMAL INFORMATION

| THERMAL METRIC(1) | | TLC59282 | | UNITS |
|---|---|---|---|---|
| | | DBQ | RGE | |
| | | 24 PINS | 24 PINS | |
| $\theta_{JA}$ | Junction-to-ambient thermal resistance | 73.2 | 46.8 | °C/W |
| $\theta_{JCtop}$ | Junction-to-case (top) thermal resistance | 44.6 | 48.6 | |
| $\theta_{JB}$ | Junction-to-board thermal resistance | 38.9 | 23.0 | |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 12.3 | 1.2 | |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 39.7 | 22.9 | |
| $\theta_{JCbot}$ | Junction-to-case (bottom) thermal resistance | n/a | 6.3 | |

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

## RECOMMENDED OPERATING CONDITIONS

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

| PARAMETER | | TEST CONDITIONS | TLC59282 MIN | TLC59282 NOM | TLC59282 MAX | UNIT |
|---|---|---|---|---|---|---|
| **DC Characteristics: $V_{CC}$ = 3 V to 5.5 V** | | | | | | |
| $V_{CC}$ | Supply voltage | | 3 | | 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, 3 V ≤ $V_{CC}$ < 3.6 V | 2 | | 35 | mA |
| | | OUT0 to OUT15, 3.6 V ≤ $V_{CC}$ < 5.5 V | 2 | | 45 | 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 | 60 | | | ns |
| $T_{WL2}$ | | BLANK | 30 | | | ns |
| $T_{SU0}$ | Setup time | SIN–SCLK↑ | 4 | | | ns |
| $T_{SU1}$ | | LAT↓–SCLK↑ | 10 | | | ns |
| $T_{H0}$ | Hold time | SIN–SCLK↑ | 4 | | | ns |
| $T_{H1}$ | | LAT↓–SCLK↑ | 10 | | | ns |

## ELECTRICAL CHARACTERISTICS

At $V_{CC}$ = 3 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 | TLC59282 | | | 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 | | | 0.4 | V |
| $I_{IN}$ | Input current | $V_{IN}$ = $V_{CC}$ or GND at SIN and SCLK | –1 | | 1 | µA |
| $I_{CC0}$ | Supply current ($V_{CC}$) | SIN/SCLK/LAT = low, BLANK = high, $V_{OUTn}$ = 1 V, $R_{IREF}$ = open | | 0.1 | 1 | mA |
| $I_{CC1}$ | | SIN/SCLK/LAT = low, BLANK = high, $V_{OUTn}$ = 1 V, $R_{IREF}$ = 3 kΩ ($I_{OUT}$ = 16.8 mA target) | | 4.5 | 6 | mA |
| $I_{CC2}$ | | All OUTn = ON, SIN/SCLK/LAT/BLANK = low, $V_{OUTn}$ = 1 V, $R_{IREF}$ = 3 kΩ | | 7 | 15 | mA |
| $I_{CC3}$ | | All OUTn = ON, SIN/SCLK/LAT/BLANK = low, $V_{OUTn}$ = 1 V, $R_{IREF}$ = 1.5 kΩ ($I_{OUT}$ = 33.6mA target) | | 16 | 34 | mA |
| $I_{OLC}$ | Constant output current | All OUTn = ON, $V_{OUTn}$ = $V_{OUTfix}$ = 1 V, $R_{IREF}$ = 1.5 kΩ at OUT0 to OUT15 (see Figure 6), $T_A$ = +25°C | 32.1 | 33.7 | 35.3 | mA |
| $I_{OLKG}$ | Output leakage current | OUTn = OFF, $V_{OUTn}$ = $V_{OUTfix}$ = 17 V, BLANK = high, $R_{IREF}$ = 1.5 kΩ at OUT0 to OUT15 (see Figure 6) | | | 0.1 | µA |
| $\Delta I_{OLC0}$ | 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 | | ±0.6 | ±2 | % |
| $\Delta I_{OLC1}$ | 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, $T_A$ = +25°C | | ±1 | ±3 | % |
| $\Delta I_{OLC2}$ | Line regulation(3) | All OUTn = ON, $V_{OUTn}$ = $V_{OUTfix}$ = 1 V, $R_{IREF}$ = 1.5 kΩ at OUT0 to OUT15, $V_{CC}$ = 3 V to 5.5 V | | ±0.5 | ±1 | %/V |
| $\Delta I_{OLC3}$ | Load regulation(4) | All OUTn = ON, $V_{OUTn}$ = 1 V to 3V, $V_{OUTfix}$ = 1 V, $R_{IREF}$ = 1.5 kΩ | | ±1 | ±3 | %/V |
| $V_{IREF}$ | Reference voltage output | $R_{IREF}$ = 1.5 kΩ, $T_A$ = +25°C | 1.18 | 1.205 | 1.23 | V |
| $R_{PUP}$ | Pull-up resistor | BLANK | 250 | 500 | 750 | kΩ |
| $R_{PDWN}$ | Pull-down resistor | LAT | 250 | 500 | 750 | kΩ |

(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:

$$I_{OUT(IDEAL)} = 41.9 \times \left( \frac{1.205}{R_{IREF}} \right)$$

(3) Line regulation is calculated by this equation:

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

(4) Load regulation is calculated by the equation:

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

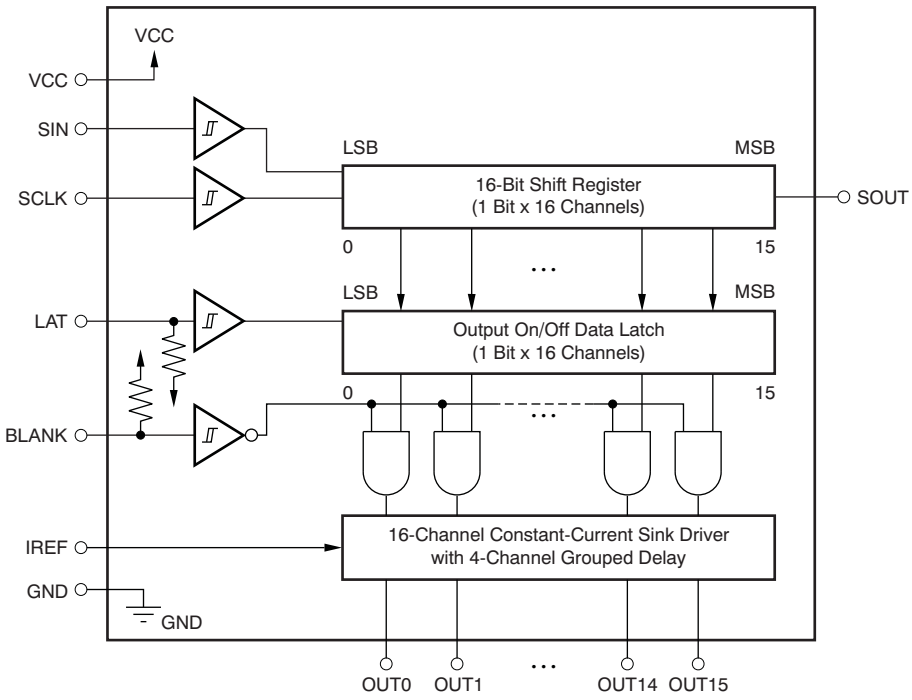
## SWITCHING CHARACTERISTICS

At $V_{CC}$ = 3 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 | TLC59282 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| $t_{R0}$ | Rise time | SOUT (see Figure 5) | | 5 | 12 | ns |
| $t_{R1}$ | | OUTn (see Figure 4) | | 10 | 30 | ns |
| $t_{F0}$ | Fall time | SOUT (see Figure 5) | | 5 | 12 | 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 OUT0/OUT7/OUT8/OUT15 on/off | | 18 | 36 | ns |
| $t_{D2}$ | | LAT↑ or BLANK↑↓ to OUT1/OUT6/OUT9/OUT14 on/off | | 38 | 69 | ns |
| $t_{D3}$ | | LAT↑ or BLANK↑↓ to OUT2/OUT5/OUT10/OUT13 on/off | | 58 | 102 | ns |
| $t_{D4}$ | | LAT↑ or BLANK↑↓ to OUT3/OUT4/OUT11/OUT12 on/off | | 78 | 135 | ns |
| $t_{ON\_ERR}$ | Output on-time error(1) | On/off latch data = all '1', 30 ns BLANK low level one-shot pulse input | –15 | | 15 | ns |

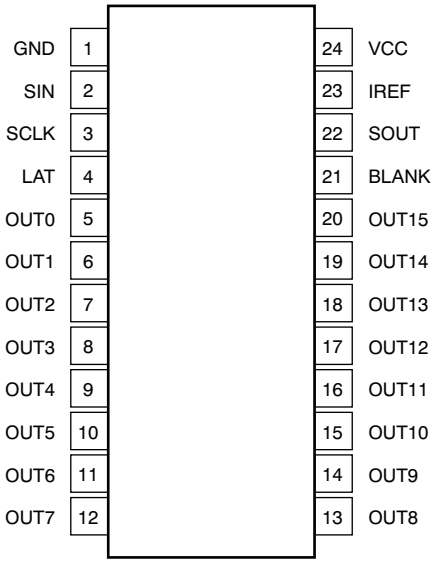
(1) Output on-time error ($t_{ON\_ERR}$) is calculated by the formula: $t_{ON\_ERR}$ (ns) = $t_{OUT\_ON}$ – BLANK low level one-shot pulse width ($T_{WL2}$). $t_{OUT\_ON}$ indicates the actual on-time of the constant-current output.

## FUNCTIONAL BLOCK DIAGRAM

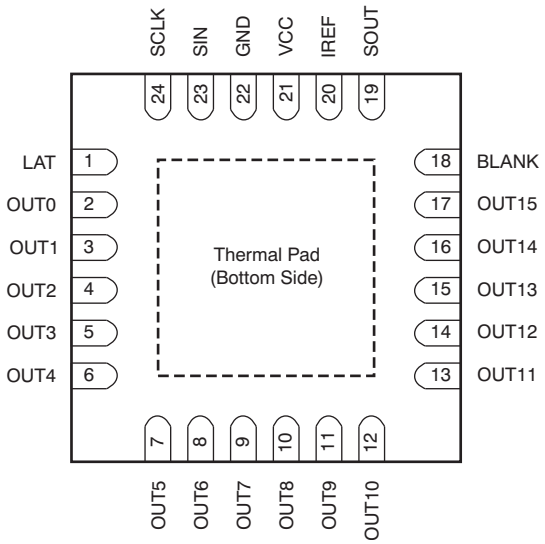


## DEVICE INFORMATION

**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.

## TERMINAL FUNCTIONS

| TERMINAL | | | I/O | DESCRIPTION |
|---|---|---|---|---|
| NAME | DBQ | RGE | | |
| SIN | 2 | 23 | I | Serial data input for driver on/off control; Schmitt buffer input. When SIN is high, data '1' are written into the LSB of the 16-bit shift register at the SCLK rising edge. |
| SCLK | 3 | 24 | I | Serial data shift clock; Schmitt buffer input. All data in the 16-bit shift register are shifted toward the MSB by 1-bit synchronization of SCLK. |
| LAT | 4 | 1 | I | Level triggered latch; Schmitt buffer input. The data in the 16-bit shift register continue to transfer to the output on/off data latch while LAT is high. Therefore, if the data in the 16-bit shift register are changed when LAT is high, the data in the data latch are also changed. The data in the data latch are held when LAT is low. This pin is internally pulled down to GND with a 500 kΩ (typ) resistor. |
| BLANK | 21 | 18 | I | Blank, all outputs; Schmitt buffer input. When BLANK is high, all constant-current outputs (OUT0–OUT15) are forced off. When BLANK is low, all constant-current outputs are controlled by the data in the output on/off data latch. This pin is internally pulled up to $V_{CC}$ with a 500 kΩ (typ) resistor. |
| 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 16-bit 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 |

## PARAMETER MEASUREMENT INFORMATION

## PIN EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

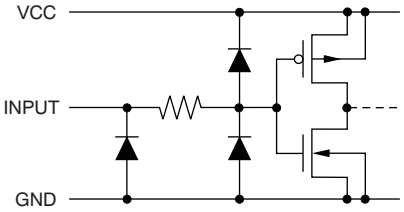



**Figure 1. SIN, SCLK, LAT, BLANK**

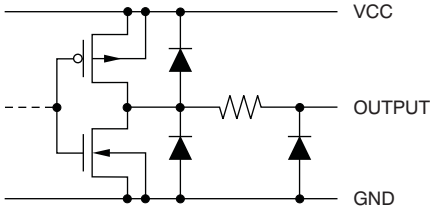



**Figure 2. SOUT**

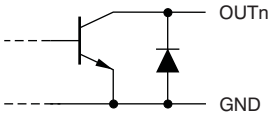
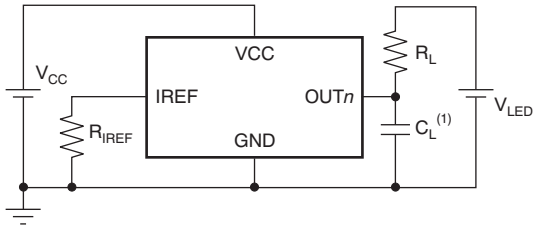


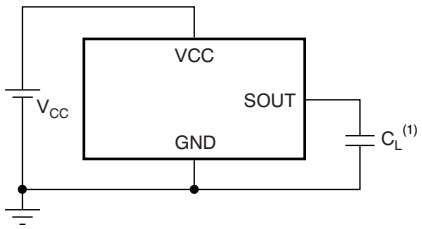

**Figure 3. OUT0 Through OUT15**

## 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**

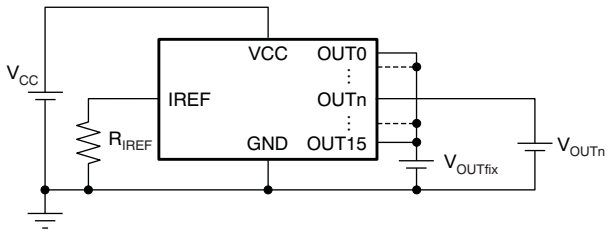
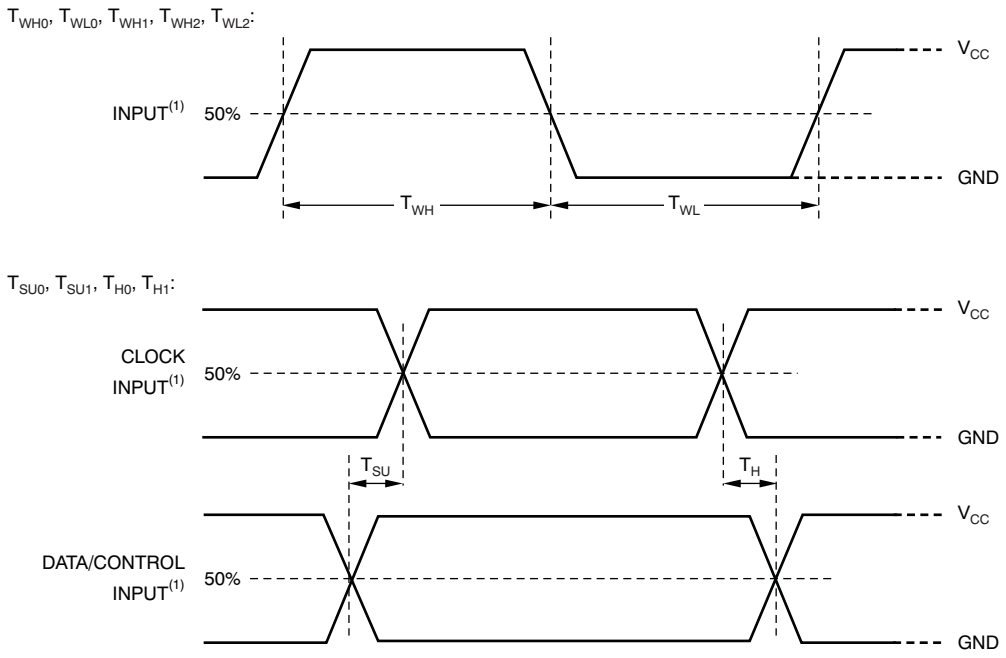


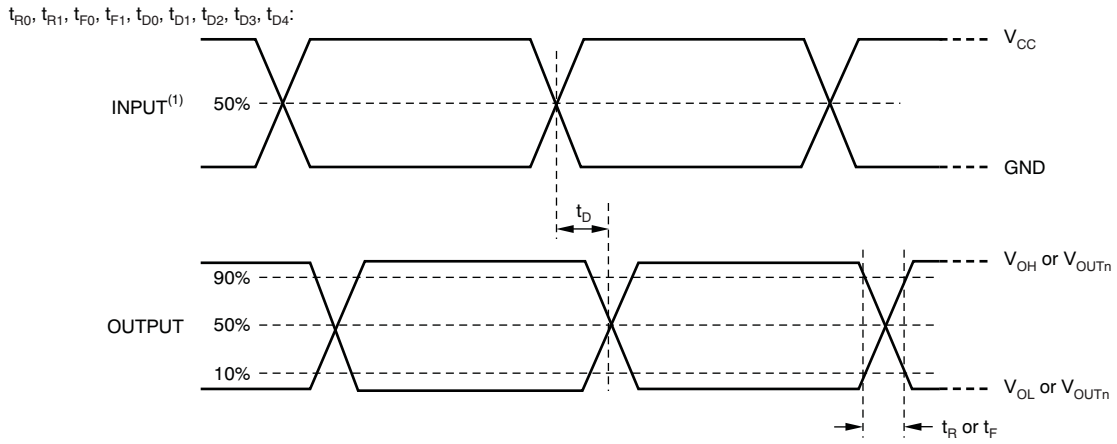

**Figure 6. Constant-Current Test Circuit for OUTn**

## TIMING DIAGRAMS



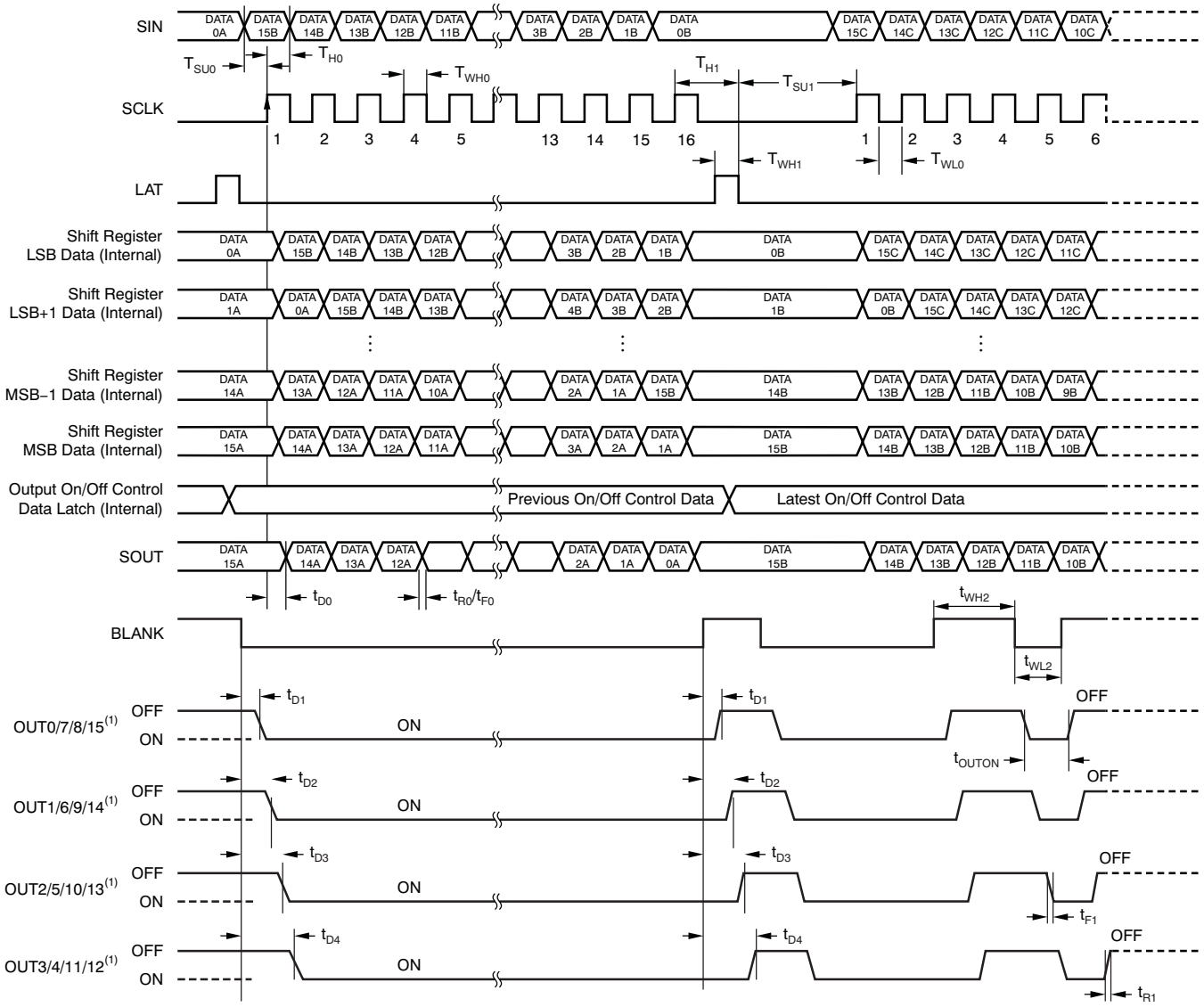

(1) Input pulse rise and fall time is 1 ns to 3 ns.

**Figure 7. Input Timing**




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

**Figure 8. Output Timing**




(1) Output on/off data = FFFFh.

(2) $t_{ON\_ERR} = t_{OUTON} - T_{WL2}$.

**Figure 9. Timing Diagram**

## TYPICAL CHARACTERISTICS

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

**REFERENCE RESISTOR vs OUTPUT CURRENT**

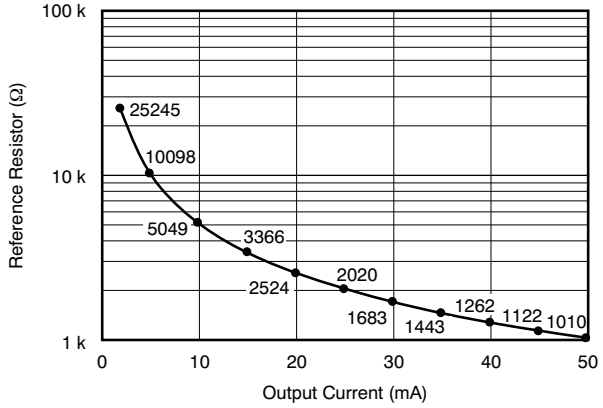



**Figure 10.**

**OUTPUT CURRENT vs OUTPUT VOLTAGE**

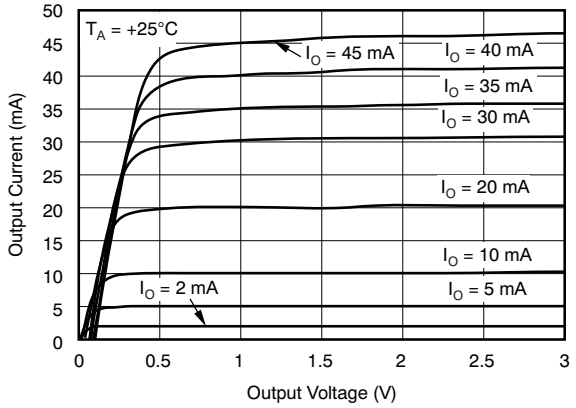



**Figure 11.**

**OUTPUT CURRENT vs OUTPUT VOLTAGE**

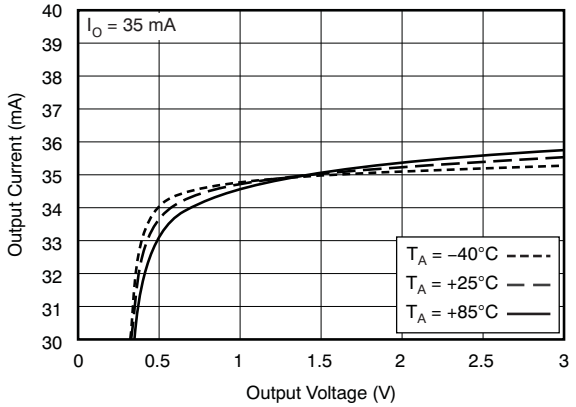



**Figure 12.**

**$\Delta I_{OLC}$ vs AMBIENT TEMPERATURE**

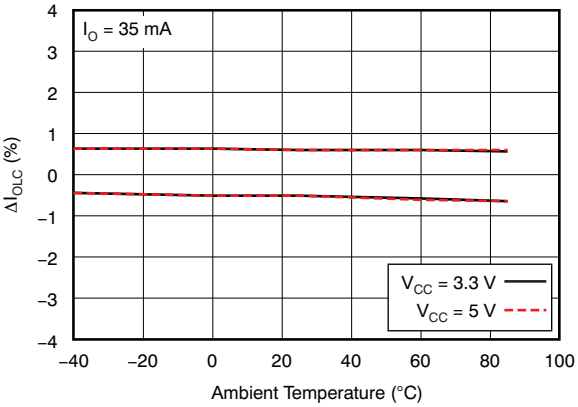



**Figure 13.**

**$\Delta I_{OLC}$ vs OUTPUT CURRENT**

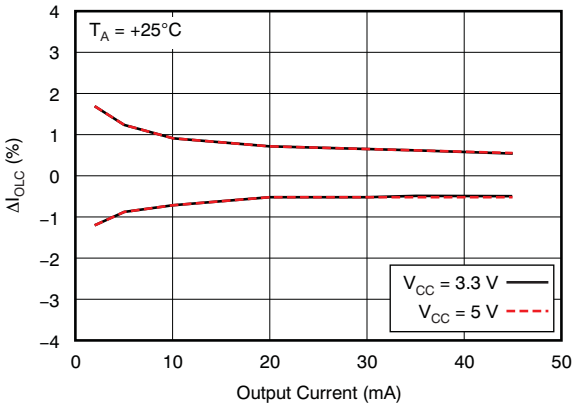



**Figure 14.**

**CONSTANT-CURRENT OUTPUT VOLTAGE WAVEFORM**

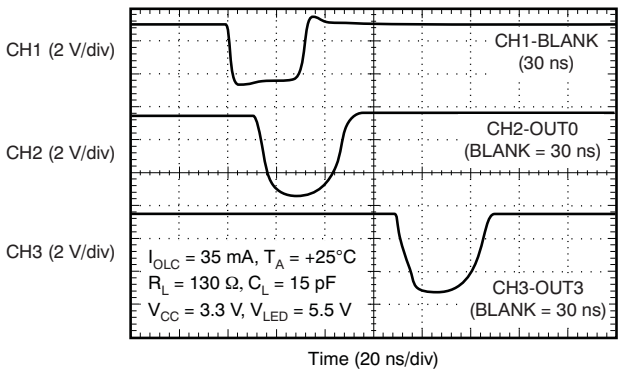



**Figure 15.**

# 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.

$$R_{IREF}\ (k\Omega) = \frac{V_{IREF}\ (V)}{I_{OLC}\ (mA)} \times 41.9$$

Where:

$V_{IREF}$ = the internal reference voltage on the IREF pin (typically 1.205 V) (1)

$I_{OLC}$ must be set in the range of 2 mA to 35 mA when $V_{CC}$ is less than 3.6 V. Also, when $V_{CC}$ is equal to 3.6 V or greater, $I_{OLC}$ must be set in the range of 2 mA to 45 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**

| $I_{OLC}$ (mA, Typical) | $R_{IREF}$ (kΩ) |
|---|---|
| 45 ($V_{CC}$ > 3.6 V only) | 1.12 |
| 40 ($V_{CC}$ > 3.6 V only) | 1.26 |
| 35 | 1.44 |
| 30 | 1.68 |
| 25 | 2.02 |
| 20 | 2.52 |
| 15 | 3.37 |
| 10 | 5.05 |
| 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**

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

When the IC is initially powered on, the data in the 16-bit shift register and output on/off data latch are not set to the respective default value. Therefore, the output on/off 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 output on/off data latch.

The output 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.

## REGISTER CONFIGURATION

The TLC59282 has a 16-bit shift register and an output on/off data latch. Both the shift register and data latch are 16 bits long and are used to turn the constant-current outputs on and off. Figure 16 shows the shift register and data latch configuration. The data at the SIN pin are shifted in to the LSB of the 16-bit shift register at the rising edge of the SCLK pin; SOUT data change at the rising edge of SCLK.

The output on/off data in the 16-bit shift register continue to transfer to the output on/off data latch while LAT is high. Therefore, if the data in the 16-bit shift register are changed when LAT is high, the data in the data latch are also changed. The data in the data latch are held when LAT is low. When the IC initially powers on, the data in the output on/off 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. The OUTn on/off are controlled by the data in the output on/off data latch. The timing diagram and truth table for writing data are shown in Figure 17 and Table 3.

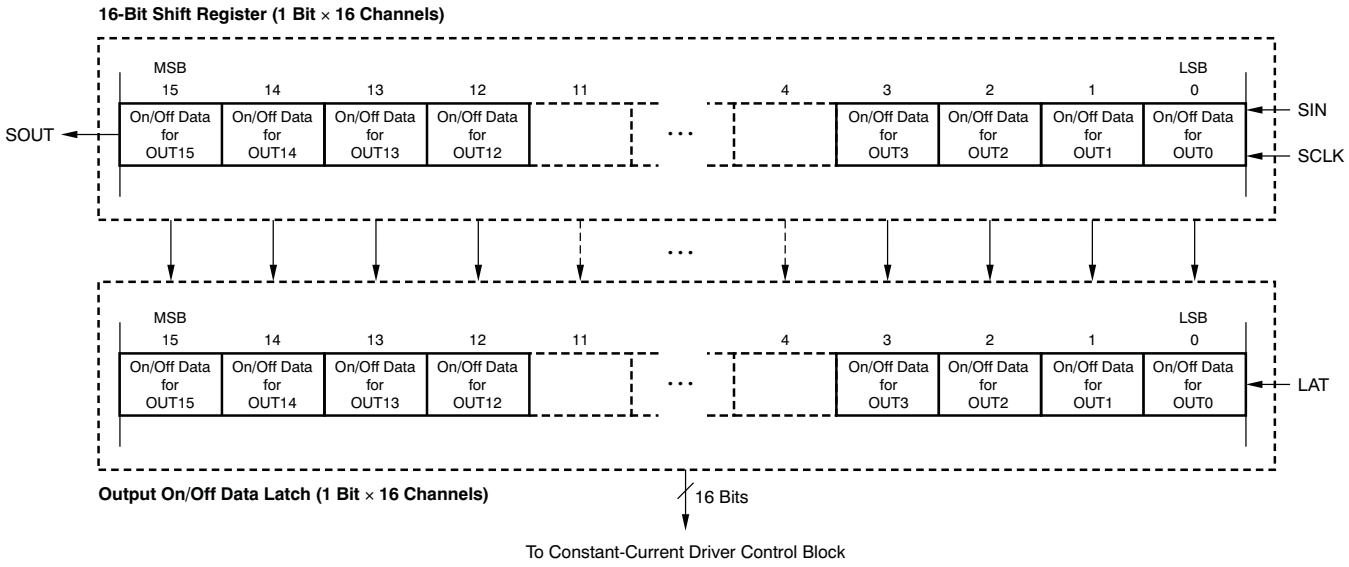



**Figure 16. 16-Bit Shift Register and Output On/Off Data Latch Configuration**

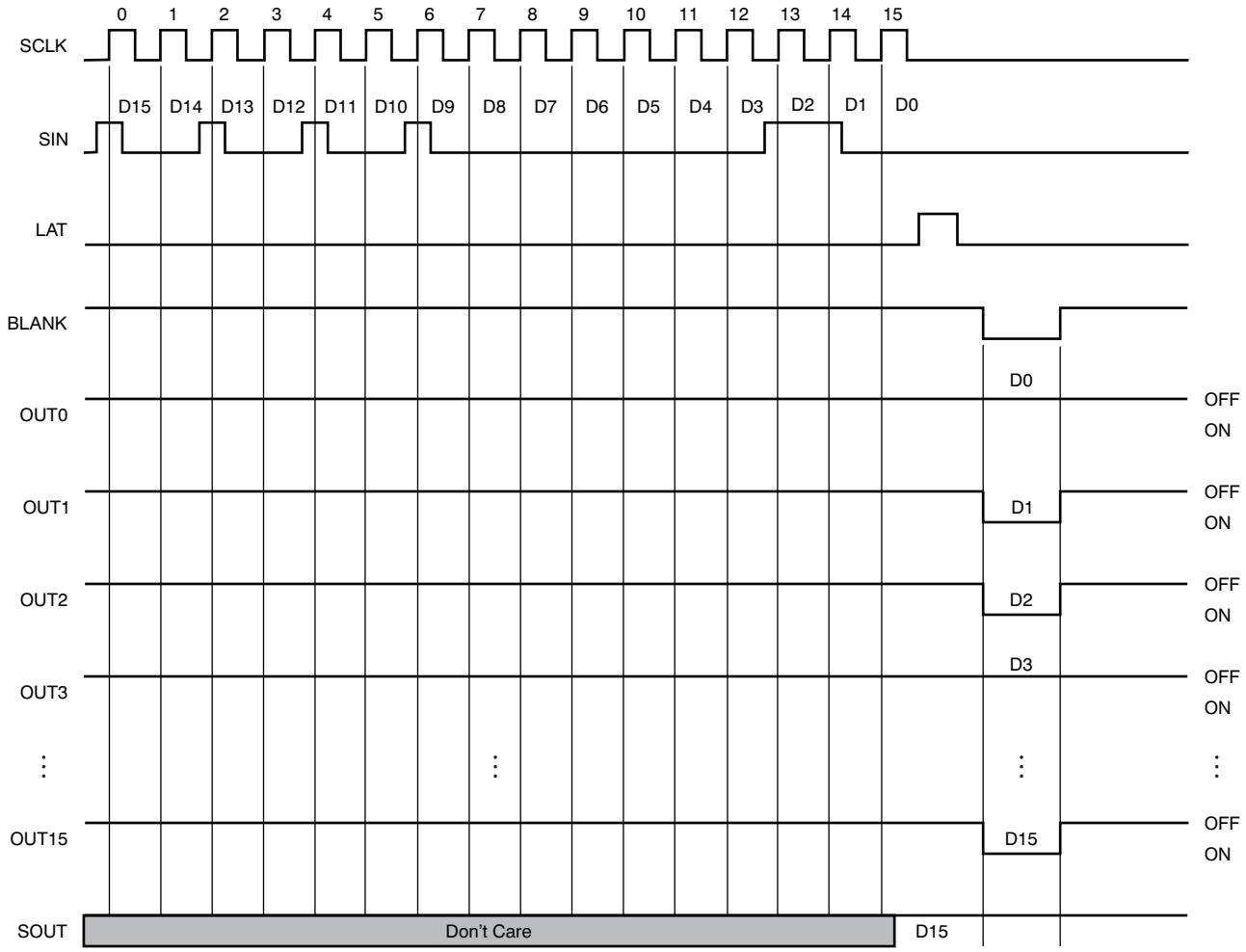



**Figure 17. Operation Timing Diagram**

**Table 3. Truth Table in Operation**

| SCLK | LAT | BLANK | SIN | OUT0…OUT7…OUT15 | SOUT |
|---|---|---|---|---|---|
| ↑ | High | Low | Dn | Dn…Dn – 7…Dn – 15 | Dn – 15 |
| ↑ | Low | Low | Dn + 1 | No change | Dn – 14 |
| ↑ | High | Low | Dn + 2 | Dn + 2…Dn – 5…Dn – 13 | Dn – 13 |
| ↓ | — | Low | Dn + 3 | Dn + 2…Dn – 5…Dn – 13 | Dn – 13 |
| ↓ | — | High | Dn + 3 | Off | Dn – 13 |

## NOISE REDUCTION

Large surge currents may flow through the IC and the board if all 16 outputs turn on or off simultaneously. These large current surges could induce detrimental noise and electromagnetic interference (EMI) into other circuits. The TLC59282 independently turns on or off the outputs for each color group with a 20 ns (typ) delay time; see Figure 9. The output current sinks are grouped into four groups. The first group that is turned on/off are OUT0/7/8/15; the second group that is turned on/off are OUT1/6/9/14; the third group that is turned on/off are OUT2/5/10/13; and the fourth group is OUT3/4/11/12. Both turn-on and turn-off are delayed. However, the state of each output is controlled by the data in the output on-off data latch and BLANK level.

## REVISION HISTORY

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

**Changes from Revision B (July 2011) to Revision C** **Page**

- Added *Low Saturation Voltage* Features bullet ..... 1

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

- Changed Constant-Current Accuracy Features bullet ..... 1
- Added RGE package information to *Package/Ordering Information* table ..... 2
- Added RGE package to *Thermal Information* table ..... 2
- Changed *Input current* parameter test conditions in Electrical Characteristics table ..... 4
- Added RGE pin out and footnote to *Device Information* section ..... 6
- Added RGE information to *Terminal Functions* table ..... 7
- Deleted Figure 11, *POWER DISSIPATION RATE vs FREE-AIR TEMPERATURE* ..... 11

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TLC59282DBQ | ACTIVE | SSOP | DBQ | 24 | 50 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TLC59282 | Samples |
| TLC59282DBQR | ACTIVE | SSOP | DBQ | 24 | 2500 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TLC59282 | Samples |
| TLC59282RGER | ACTIVE | VQFN | RGE | 24 | 3000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TLC 59282 | Samples |
| TLC59282RGET | ACTIVE | VQFN | RGE | 24 | 250 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | TLC 59282 | Samples |

(1) 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.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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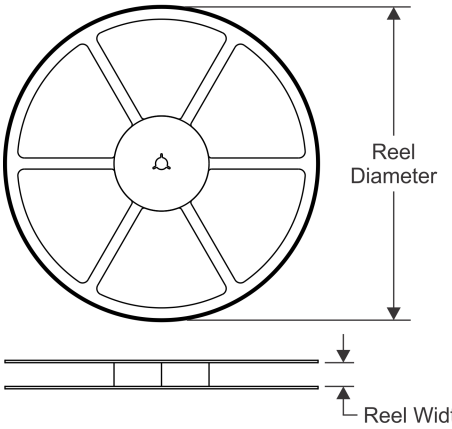
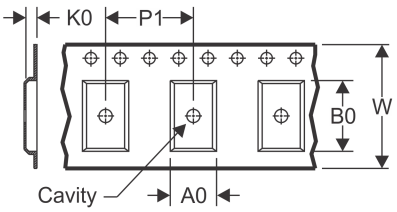
## TAPE AND REEL INFORMATION

REEL DIMENSIONS

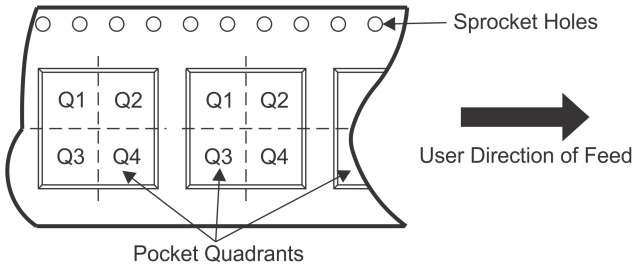



TAPE DIMENSIONS




| | |
|---|---|
| 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 |

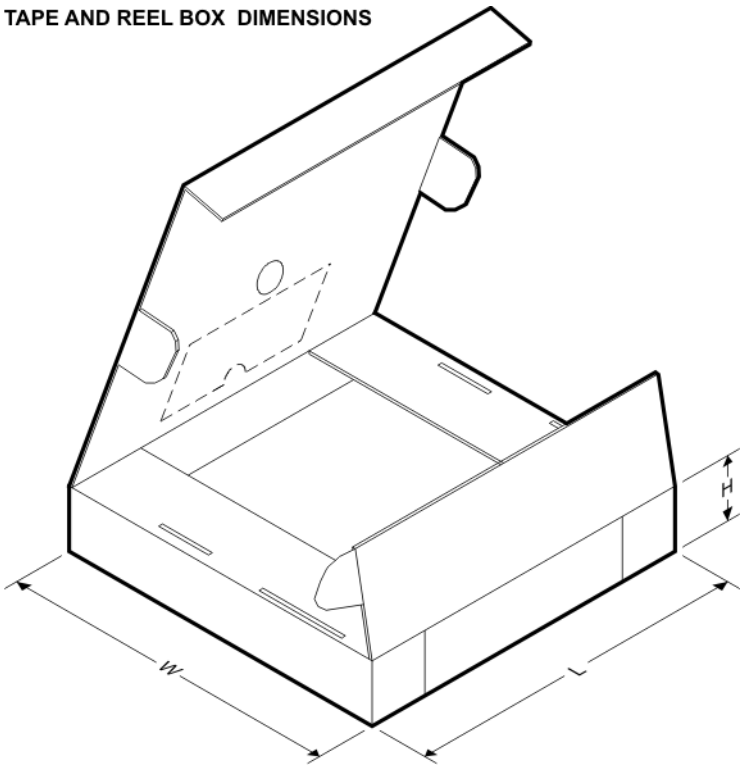
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TLC59282DBQR | SSOP | DBQ | 24 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| TLC59282RGER | VQFN | RGE | 24 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| TLC59282RGET | VQFN | RGE | 24 | 250 | 180.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS



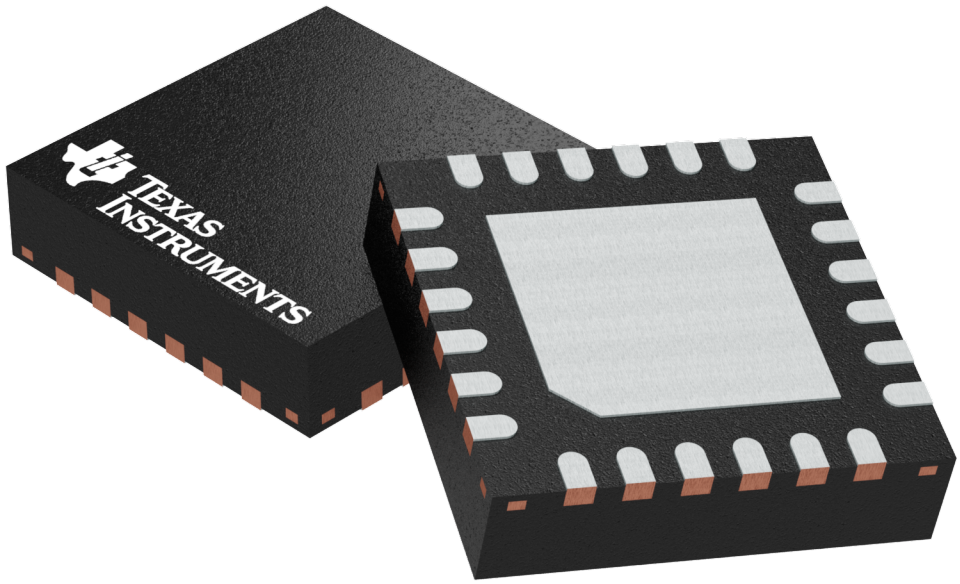

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TLC59282DBQR | SSOP | DBQ | 24 | 2500 | 367.0 | 367.0 | 38.0 |
| TLC59282RGER | VQFN | RGE | 24 | 3000 | 853.0 | 449.0 | 35.0 |
| TLC59282RGET | VQFN | RGE | 24 | 250 | 210.0 | 185.0 | 35.0 |

# 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.

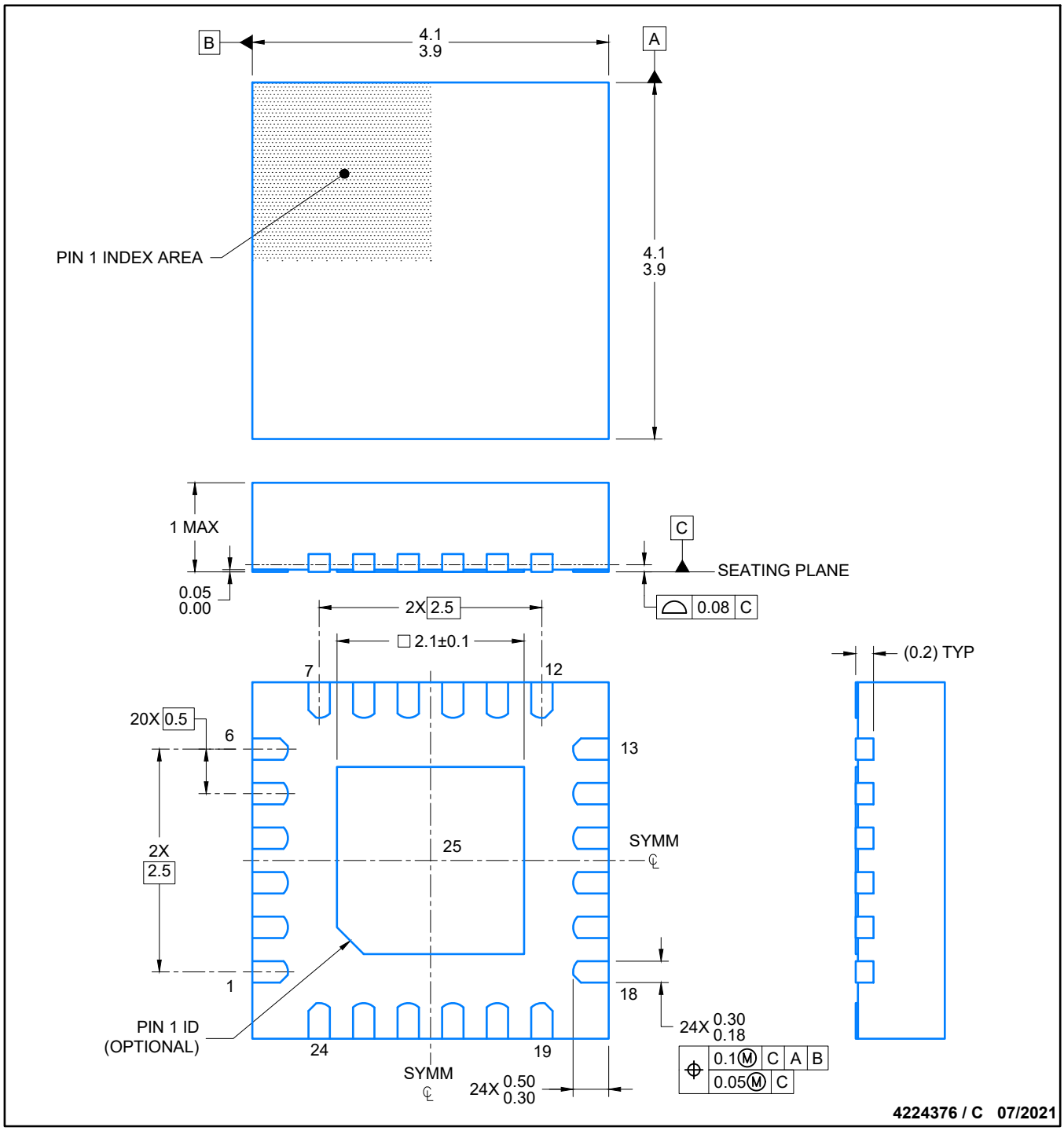
4204104/H

# PACKAGE OUTLINE

## RGE0024C

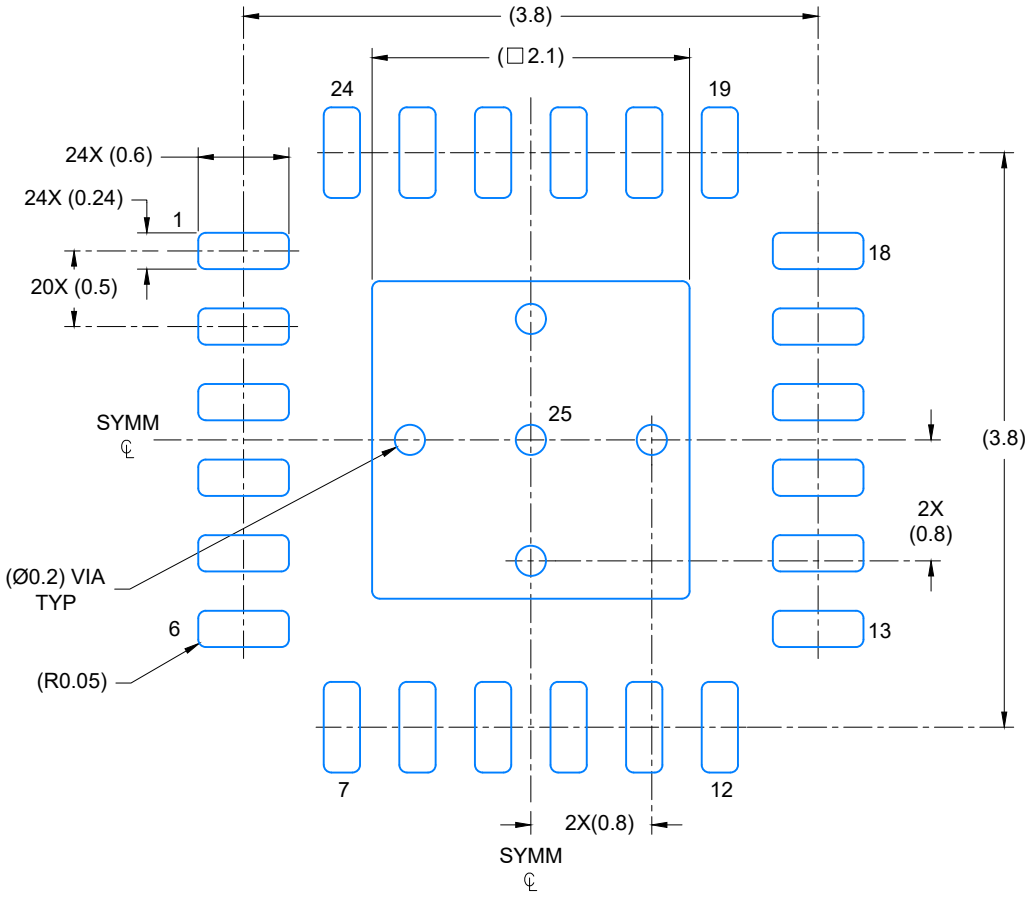
## VQFN - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



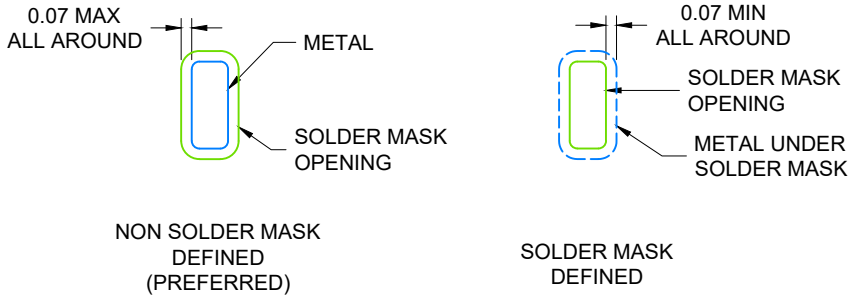

NOTES:

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

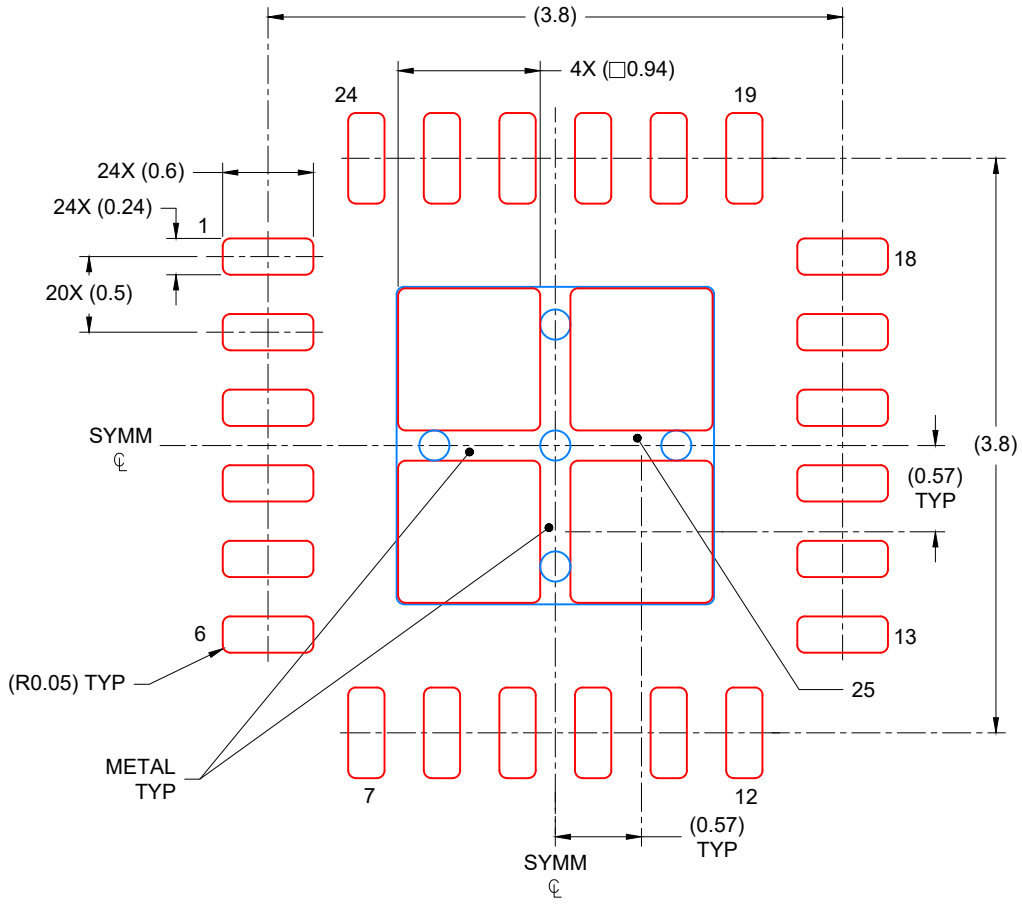



SOLDER MASK DETAILS

4224376 / C 06/2021

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

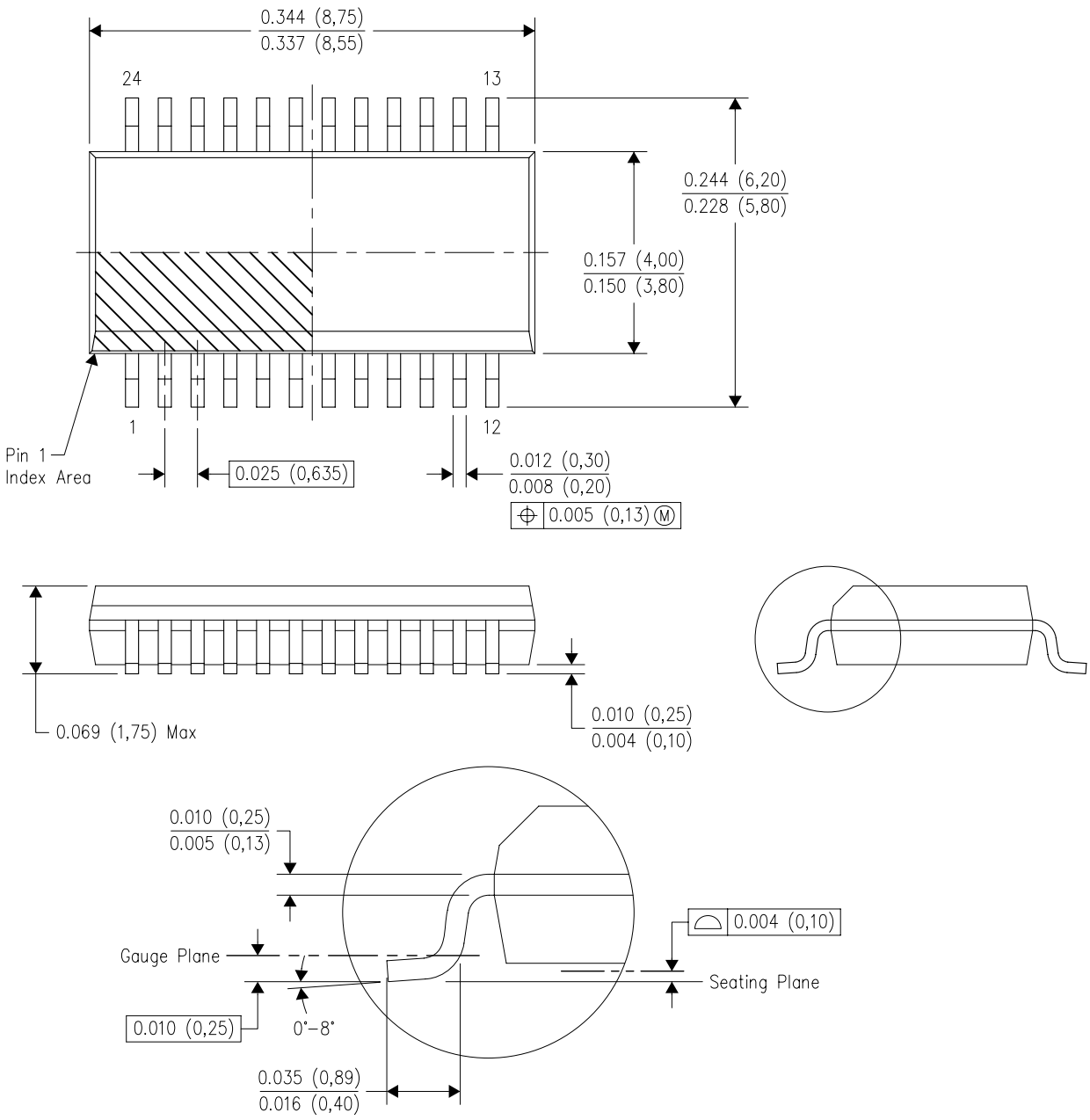
EXPOSED PAD
80% PRINTED COVERAGE BY AREA
SCALE: 20X

4224376 / C 06/2021

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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