



**HESTORE.HU**

elektronikai alkatrész áruház

**EN:** This Datasheet is presented by the manufacturer.

Please visit our website for pricing and availability at [www.hestore.hu](http://www.hestore.hu).

## TPIC6B595 Power Logic 8-Bit Shift Register

### 1 Features

- Low  $\bar{b}_{S(on)}$ , 5  $\Omega$  (Typical)
- Avalanche Energy, 30 mJ
- Eight Power DMOS Transistor Outputs of 150-mA Continuous Current
- Output Clamp Voltage, 50 V
- Devices are Cascadable
- Low-Power Consumption

### 2 Applications

- Instrumentation Clusters
- Tell-Tale Lamps
- LED Illumination and Controls
- Automotive Relay or Solenoids Drivers

### 3 Description

The TPIC6B595 device is a monolithic, high-voltage, medium-current power 8-bit shift register designed for use in systems that require relatively high load power. The device contains a built-in voltage clamp on the outputs for inductive transient protection. Power driver applications include relays, solenoids, and other medium current or high-voltage loads.

This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Data transfers through the shift and storage registers on the rising edge of the shift-register clock (SRCK) and the register clock (RCK), respectively.

The storage register transfers data to the output buffer when shift-register clear (SRCLR) is high. When SRCLR is low, the input shift register is cleared. When output enable ( $\bar{G}$ ) is held high, all data in the output buffers is held low and all drain outputs are off. When  $\bar{G}$  is held low, data from the storage register is transparent to the output buffers. When data in the output buffers is low, the DMOS-transistor outputs are off. When data is high, the DMOS transistor outputs have sink-current capability. The serial output (SER OUT) allows for cascading of the data from the shift register to additional devices.

Outputs are low-side, open-drain DMOS transistors with output ratings of 50 V and 150-mA continuous sink-current capability. Each output provides a 500-mA typical current limit at  $T_C = 25^\circ\text{C}$ . The current limit decreases as the junction temperature increases for additional device protection.

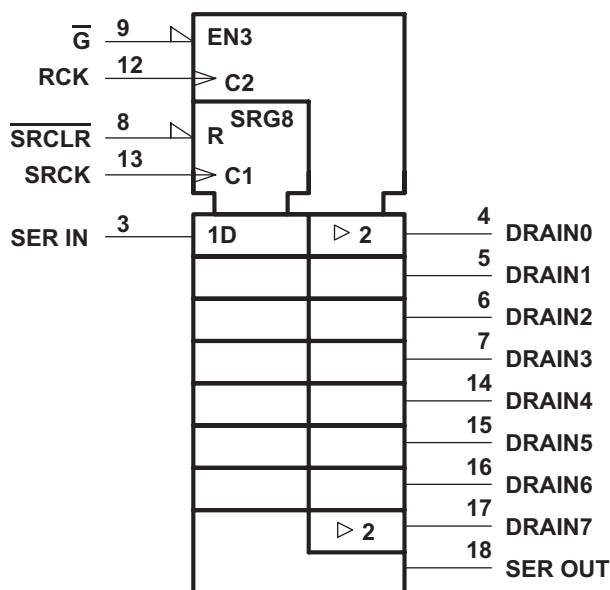
The TPIC6B595 is characterized for operation over the operating case temperature range of  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ .

#### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPIC6B595	SOIC (20)	12.80 mm × 7.50 mm
	PDIP (20)	24.33 mm × 6.35 mm

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

#### Logic Symbol



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



## Table of Contents

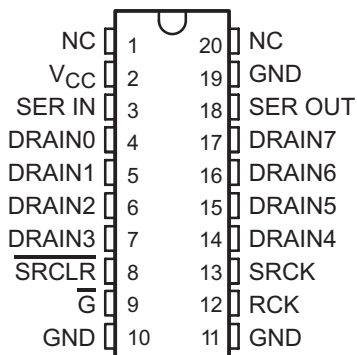
<p><b>1 Features</b> ..... 1</p> <p><b>2 Applications</b> ..... 1</p> <p><b>3 Description</b> ..... 1</p> <p><b>4 Revision History</b>..... 2</p> <p><b>5 Pin Configuration and Functions</b> ..... 3</p> <p><b>6 Specifications</b>..... 4</p> <p style="padding-left: 20px;">6.1 Absolute Maximum Ratings ..... 4</p> <p style="padding-left: 20px;">6.2 ESD Ratings ..... 4</p> <p style="padding-left: 20px;">6.3 Recommended Operating Conditions ..... 4</p> <p style="padding-left: 20px;">6.4 Thermal Information ..... 5</p> <p style="padding-left: 20px;">6.5 Electrical Characteristics ..... 5</p> <p style="padding-left: 20px;">6.6 Switching Characteristics ..... 6</p> <p style="padding-left: 20px;">6.7 Typical Characteristics ..... 7</p> <p><b>7 Parameter Measurement Information</b> ..... 9</p> <p><b>8 Detailed Description</b> ..... 11</p> <p style="padding-left: 20px;">8.1 Overview ..... 11</p>	<p style="padding-left: 20px;">8.2 Functional Block Diagram ..... 11</p> <p style="padding-left: 20px;">8.3 Feature Description ..... 12</p> <p style="padding-left: 20px;">8.4 Device Functional Modes ..... 13</p> <p><b>9 Application and Implementation</b> ..... 14</p> <p style="padding-left: 20px;">9.1 Application Information ..... 14</p> <p style="padding-left: 20px;">9.2 Typical Application ..... 14</p> <p><b>10 Power Supply Recommendations</b> ..... 16</p> <p><b>11 Layout</b>..... 16</p> <p style="padding-left: 20px;">11.1 Layout Guidelines ..... 16</p> <p style="padding-left: 20px;">11.2 Layout Example ..... 17</p> <p><b>12 Device and Documentation Support</b> ..... 18</p> <p style="padding-left: 20px;">12.1 Community Resources ..... 18</p> <p style="padding-left: 20px;">12.2 Trademarks ..... 18</p> <p style="padding-left: 20px;">12.3 Electrostatic Discharge Caution ..... 18</p> <p style="padding-left: 20px;">12.4 Glossary ..... 18</p> <p><b>13 Mechanical, Packaging, and Orderable Information</b> ..... 18</p>
--	--

## 4 Revision History

Changes from Revision A (May 2005) to Revision B	Page
<ul style="list-style-type: none"> <li>• Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i>, <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... 4</li> </ul>	4
Changes from Original (July 1995) to Revision A	Page
<ul style="list-style-type: none"> <li>• Changed SRCLR timing diagram ..... 9</li> </ul>	9

## 5 Pin Configuration and Functions

DW or N Package  
20-Pin SOIC or PDIP  
Top View



NC – No internal connection

### Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
DRAIN0	4	O	Open-drain output
DRAIN1	5		
DRAIN2	6		
DRAIN3	7		
DRAIN4	14		
DRAIN5	15		
DRAIN6	16		
DRAIN7	17		
$\overline{G}$	9	I	Output enable, active-low
GND	10, 11, 19	—	Power ground
NC	1, 20	—	No internal connection
RCK	12	I	Register clock
SERIN	3	I	Serial data input
SEROUT	18	O	Serial data output
SRCK	15	I	Shift register clock
$\overline{SRCLR}$	8	I	Shift register clear, active-low
VCC	2	I	Power supply

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Logic supply voltage <sup>(2)</sup>	-0.3	7	V
V <sub>I</sub>	Logic input voltage	-0.3	7	V
V <sub>DS</sub>	Power DMOS drain-to-source voltage <sup>(3)</sup>	-0.3	50	V
	Continuous source-to-drain diode anode current	0	500	mA
	Pulsed source-to-drain diode anode current <sup>(4)</sup>	0	1	A
I <sub>D</sub>	Pulsed drain current, each output, all outputs ON, T <sub>C</sub> = 25°C <sup>(4)</sup>	0	500	mA
I <sub>D</sub>	Continuous drain current, each output, all outputs ON, T <sub>C</sub> = 25°C <sup>(4)</sup>	0	150	mA
I <sub>DM</sub>	Peak drain current single output, T <sub>C</sub> = 25°C <sup>(4)</sup>	0	500	mA
E <sub>AS</sub>	Single-pulse avalanche energy (see <a href="#">Figure 11</a> )	0	30	mJ
I <sub>AS</sub>	Avalanche current <sup>(5)</sup>	0	500	mA
	Continuous total dissipation	See <a href="#">Thermal Information</a>		
T <sub>J</sub>	Operating virtual junction temperature	-40	150	°C
T <sub>C</sub>	Operating case temperature	-40	125	°C
T <sub>stg</sub>	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, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to GND.
- (3) Each power DMOS source is internally connected to GND.
- (4) Pulse duration ≤ 100 μs and duty cycle ≤ 2%.
- (5) DRAIN supply voltage = 15 V, starting junction temperature (T<sub>JS</sub>) = 25°C, L = 1.5 H, I<sub>AS</sub> = 200 mA (see [Figure 11](#)).

### 6.2 ESD Ratings

		VALUE	UNIT	
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002 <sup>(1)</sup>	±2000	
		Charged-device model (CDM), per AEC Q100-011	All pins	±500
			Corner pins (1, 10, 20, 11)	±750

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 6.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Logic supply voltage		4.5	5.5	V
V <sub>IH</sub>	High-level input voltage	0.85 V <sub>CC</sub>			V
V <sub>IL</sub>	Low-level input voltage			0.15 V <sub>CC</sub>	V
	Pulsed drain output current, T <sub>C</sub> = 25°C, V <sub>CC</sub> = 5 V, all outputs on <sup>(1)(2)</sup> (see <a href="#">Figure 7</a> )	-500		500	mA
t <sub>su</sub>	Setup time, SER IN high before SRCKM ↑ (see <a href="#">Figure 9</a> )	20			ns
t <sub>h</sub>	Hold time, SER IN high after SRCKM ↑, (see <a href="#">Figure 9</a> )	20			ns
t <sub>w</sub>	Pulse duration (see <a href="#">Figure 9</a> )	40			ns
T <sub>C</sub>	Operating case temperature	-40		125	°C

- (1) Pulse duration ≤ 100 μs and duty cycle ≤ 2%.
- (2) Technique should limit T<sub>J</sub> - T<sub>C</sub> to 10°C maximum.

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TPIC6B595		UNIT
		DW (SOIC)	N (PDIP)	
		20 PINS	20 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	75.3	57	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	39.8	58.5	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	43.1	38	°C/W
ψ <sub>JT</sub>	Junction-to-top characterization parameter	15.4	25.2	°C/W
ψ <sub>JB</sub>	Junction-to-board characterization parameter	42.6	37.9	°C/W

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

## 6.5 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
V <sub>(BR)DSX</sub>	Drain-to-source breakdown voltage	I <sub>D</sub> = 1 mA	50			V	
V <sub>SD</sub>	Source-to-drain diode forward voltage	I <sub>F</sub> = 100 mA		0.85	1	V	
V <sub>OH</sub>	High-level output voltage, SER OUT	I <sub>OH</sub> = -20 μA, V <sub>CC</sub> = 4.5 V	4.4	4.49		V	
		I <sub>OH</sub> = -4 mA, V <sub>CC</sub> = 4.5 V	4	4.2			
V <sub>OL</sub>	Low-level output voltage, SER OUT	I <sub>OL</sub> = 20 μA, V <sub>CC</sub> = 4.5 V		0.005	0.1	V	
		I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = 4.5 V		0.3	0.5		
I <sub>IH</sub>	High-level input current	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub>			1	μA	
I <sub>IL</sub>	Low-level input current	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0			-1	μA	
I <sub>CC</sub>	Logic supply current	V <sub>CC</sub> = 5.5 V	All outputs OFF		20	100	μA
			All outputs ON		150	300	
I <sub>CC(FRQ)</sub>	Logic supply current at frequency	f <sub>SRCK</sub> = 5 MHz, All outputs off, C <sub>L</sub> = 30 pF, See <a href="#">Figure 9</a> and <a href="#">Figure 2</a>		0.4	5	mA	
I <sub>N</sub>	Nominal current	V <sub>DS(on)</sub> = 0.5 V, I <sub>N</sub> = I <sub>D</sub> , T <sub>C</sub> = 85°C		90		mA	
I <sub>DSX</sub>	OFF-state drain current	V <sub>DS</sub> = 40 V, V <sub>CC</sub> = 5.5 V		0.1	5	μA	
		V <sub>DS</sub> = 40 V, T <sub>C</sub> = 125°C, V <sub>CC</sub> = 5.5 V		0.15	8		
r <sub>DS(on)</sub>	Static drain-source ON-state resistance	I <sub>D</sub> = 100 mA, V <sub>CC</sub> = 4.5 V	See <sup>(1)</sup> and <sup>(2)</sup> and <a href="#">Figure 3</a> and <a href="#">Figure 4</a>	4.2	5.7	Ω	
		I <sub>D</sub> = 100 mA, T <sub>C</sub> = 125°C, V <sub>CC</sub> = 4.5 V		6.8	9.5		
		I <sub>D</sub> = 350 mA, V <sub>CC</sub> = 4.5 V		5.5	8		

(1) Technique should limit T<sub>J</sub> - T<sub>C</sub> to 10°C maximum.

(2) These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

(3) Nominal current is defined for a consistent comparison between devices from different sources. It is the current that produces a voltage drop of 0.5 V at T<sub>C</sub> = 85°C.

**TPIC6B595**

SLIS032B – JULY 1995 – REVISED JUNE 2015

[www.ti.com](http://www.ti.com)
**6.6 Switching Characteristics**
 $V_{CC} = 5\text{ V}$ ,  $T_C = 25^\circ\text{C}$ 

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$	Propagation delay time, low-to-high-level output from $\overline{G}$	$C_L = 30\text{ pF}$ , $I_D = 100\text{ mA}$ , See <a href="#">Figure 5</a> , <a href="#">Figure 8</a> and <a href="#">Figure 9</a>		150		ns
$t_{PHL}$	Propagation delay time, high-to-low-level output from $\overline{G}$			90		ns
$t_r$	Rise time, drain output			200		ns
$t_f$	Fall time, drain output			200		ns
$t_a$	Reverse-recovery-current rise time	$I_F = 100\text{ mA}$ , $di/dt = 10\text{ A}/\mu\text{s}$ <sup>(1) (2)</sup> , See <a href="#">Figure 10</a>		100		ns
$t_{rr}$	Reverse-recovery time			300		

 (1) Technique should limit  $T_J - T_C$  to  $10^\circ\text{C}$  maximum.

(2) These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

### 6.7 Typical Characteristics

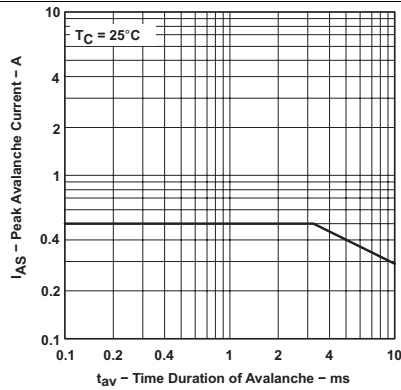


Figure 1. Peak Avalanche Current vs Time Duration of Avalanche

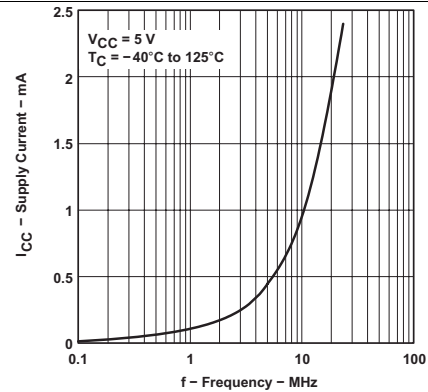
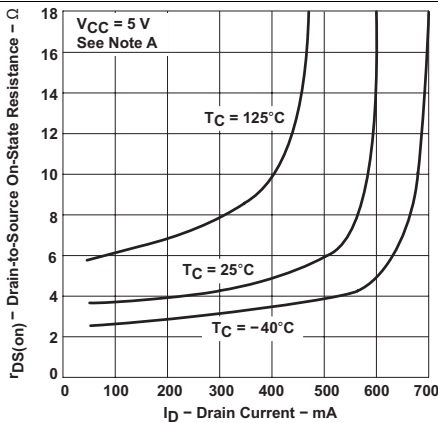
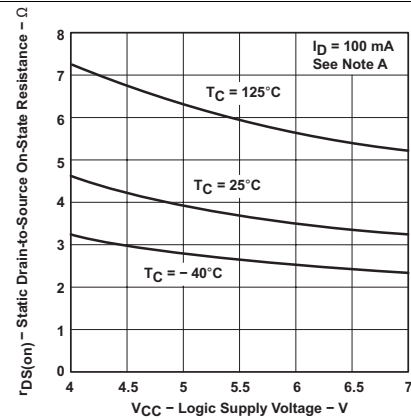


Figure 2. Supply Current vs Frequency



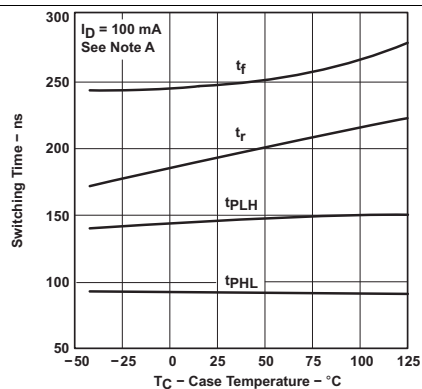
Technique should limit  $T_J - T_C$  to 10°C maximum.

Figure 3. Drain-to-Source On-State Resistance vs Drain Current



Technique should limit  $T_J - T_C$  to 10°C maximum.

Figure 4. Static Drain-to-Source On-State Resistance vs Logic Supply Voltage



Technique should limit  $T_J - T_C$  to 10°C maximum

Figure 5. Switching Time vs Case Temperature

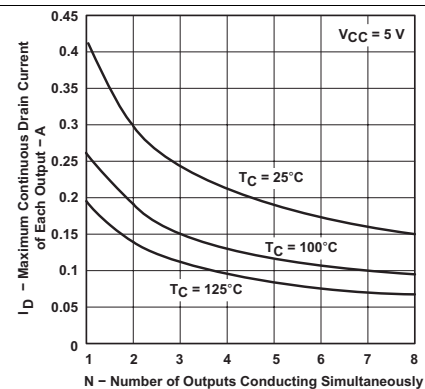
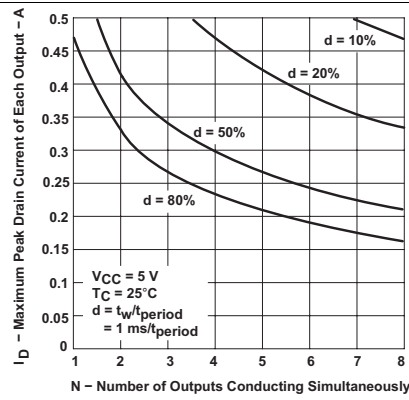


Figure 6. Maximum Continuous Drain Current of Each Output vs Number of Outputs Conducting Simultaneously

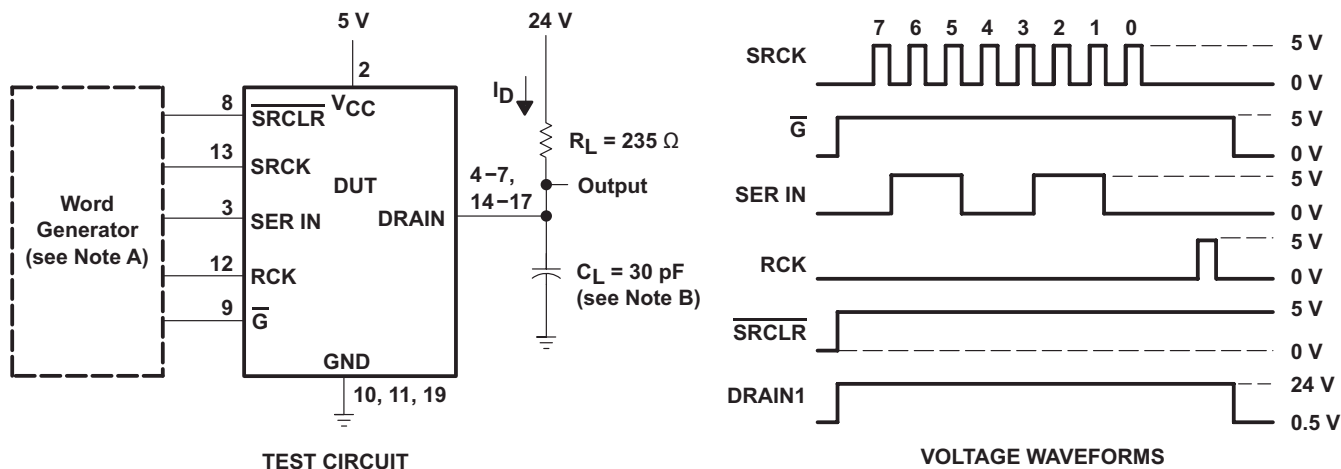


**Typical Characteristics (continued)**



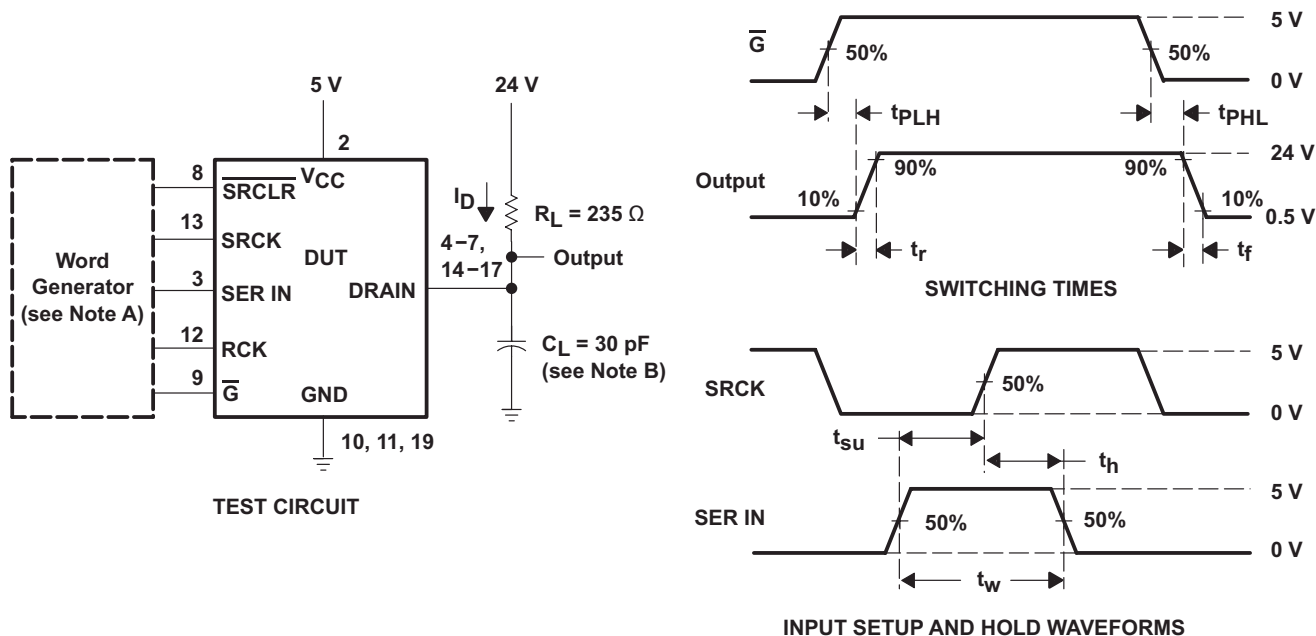
**Figure 7. Maximum Peak Drain Current of Each Output vs Number of Outputs Conducting Simultaneously**

## 7 Parameter Measurement Information



- A. The word generator has the following characteristics:  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $t_w = 300$  ns, pulsed repetition rate (PRR) = 5 kHz,  $Z_O = 50 \Omega$ .
- B.  $C_L$  includes probe and jig capacitance.

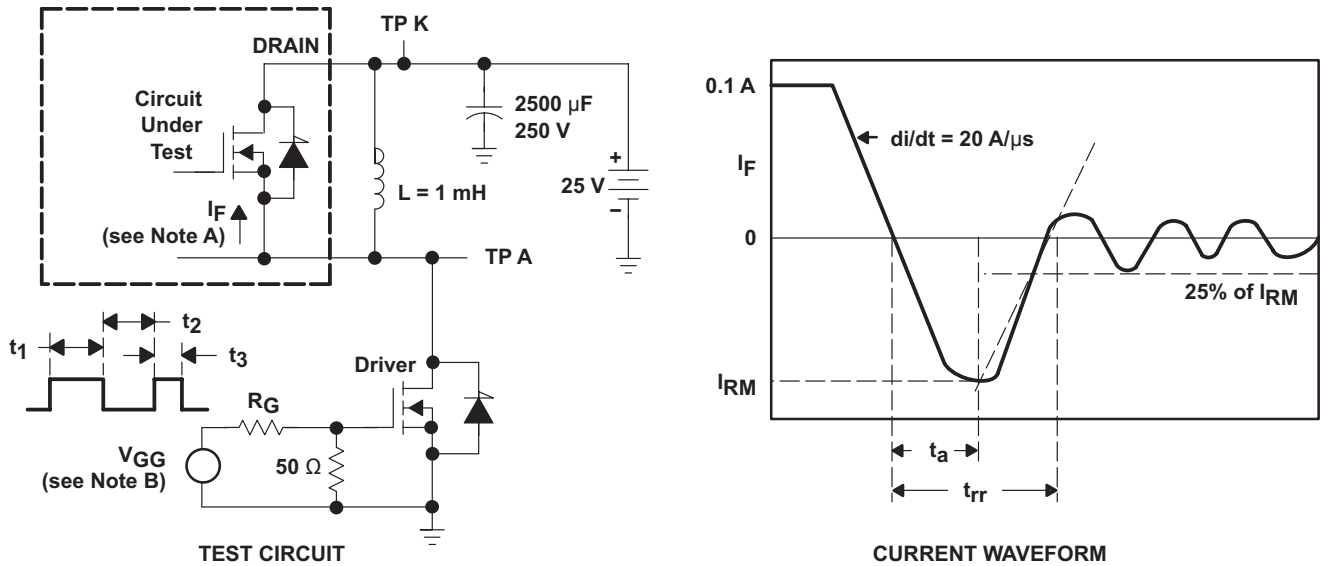
**Figure 8. Resistive-Load Test Circuit and Voltage Waveforms**



- A. The word generator has the following characteristics:  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $t_w = 300$  ns, pulsed repetition rate (PRR) = 5 kHz,  $Z_O = 50 \Omega$ .
- B.  $C_L$  includes probe and jig capacitance.

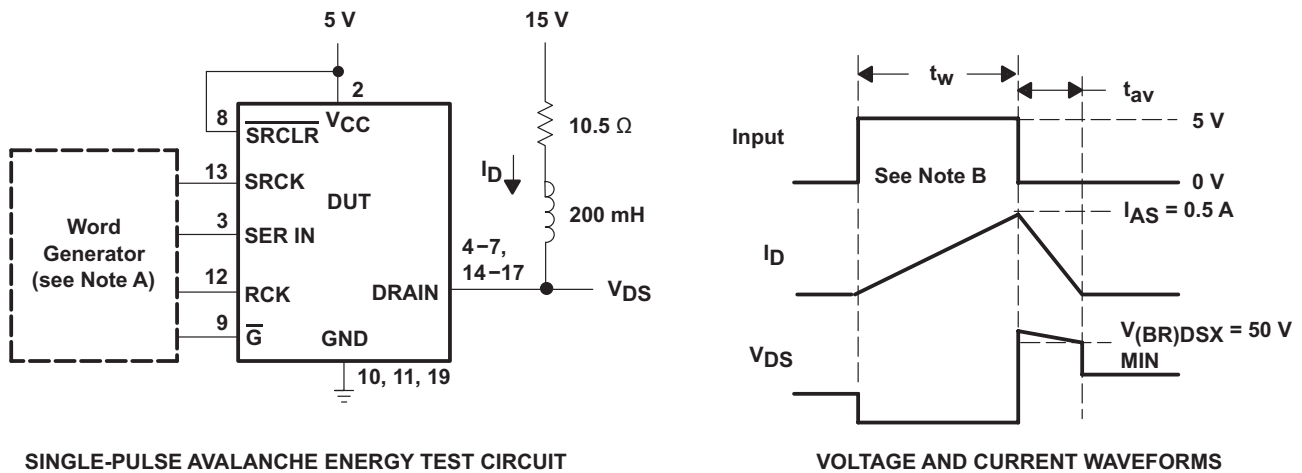
**Figure 9. Test Circuit, Switching Times, and Voltage Waveforms**

Parameter Measurement Information (continued)



- A. The DRAIN terminal under test is connected to the TP K test point. All other terminals are connected together and connected to the TP A test point.
- B. The  $V_{GG}$  amplitude and  $R_G$  are adjusted for  $di/dt = 20 \text{ A}/\mu\text{s}$ . A  $V_{GG}$  double-pulse train is used to set  $I_F = 0.1 \text{ A}$ , where  $t_1 = 10 \mu\text{s}$ ,  $t_2 = 7 \mu\text{s}$ , and  $t_3 = 3 \mu\text{s}$ .

Figure 10. Reverse-Recovery-Current Test Circuit and Waveforms of Source-to-Drain Diode



- A. The word generator has the following characteristics:  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ ,  $Z_O = 50 \Omega$ .
- B. Input pulse duration,  $t_w$ , is increased until peak current  $I_{AS} = 0.5 \text{ mA}$ . Energy test level is defined as  $E_{AS} = I_{AS} \times V_{(BR)DSX} \times t_{av}/2 = 30 \text{ mJ}$ .

Figure 11. Single-Pulse Avalanche Energy Test Circuit and Waveforms

## 8 Detailed Description

### 8.1 Overview

The TPIC6B595 device is a monolithic, high-voltage, medium-current power 8-bit shift register designed for use in systems that require relatively high load power. The device contains a built-in voltage clamp on the outputs for inductive transient protection, so it can also drive relays, solenoids, and other medium-current or high-voltage loads.

### 8.2 Functional Block Diagram

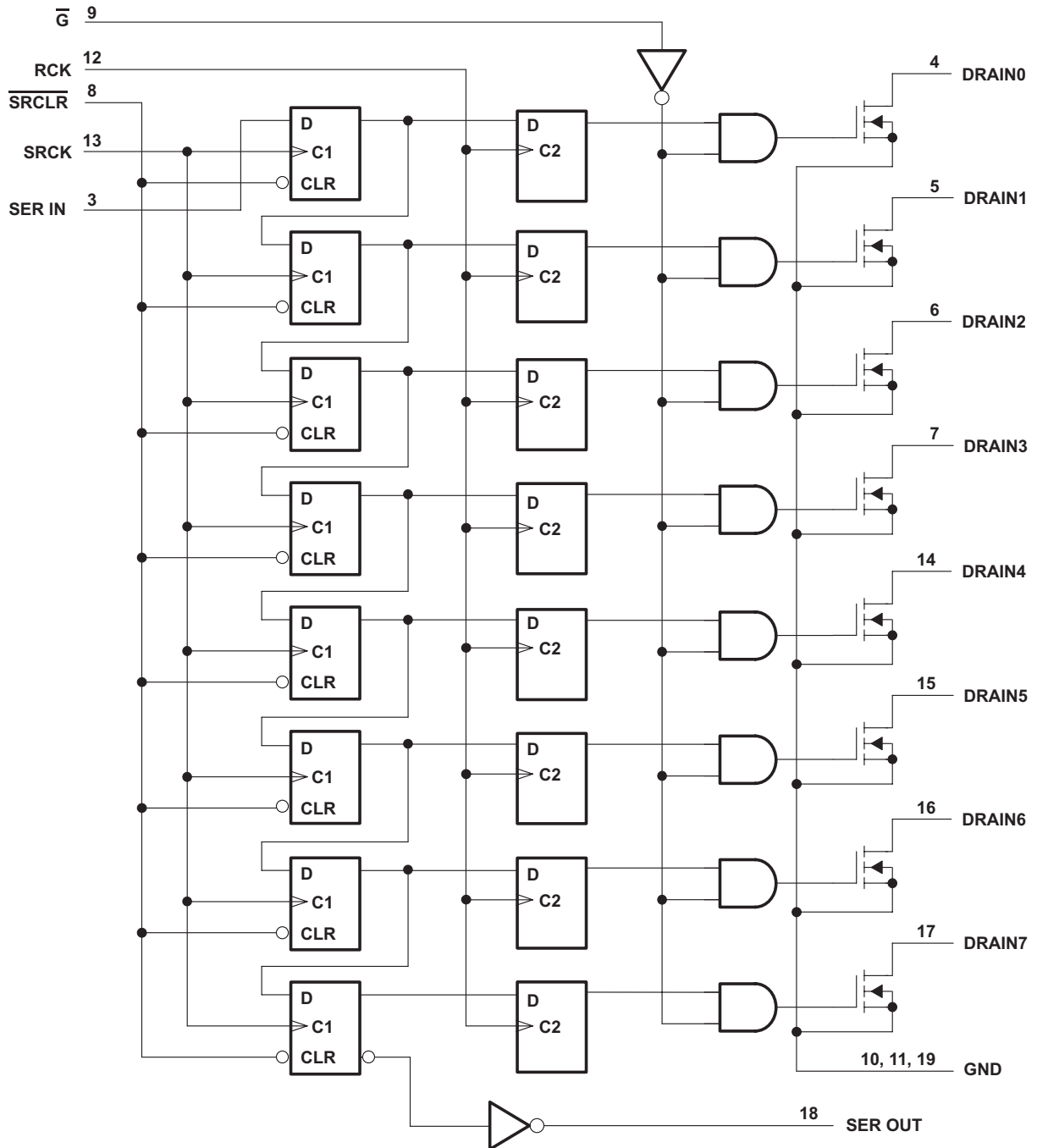
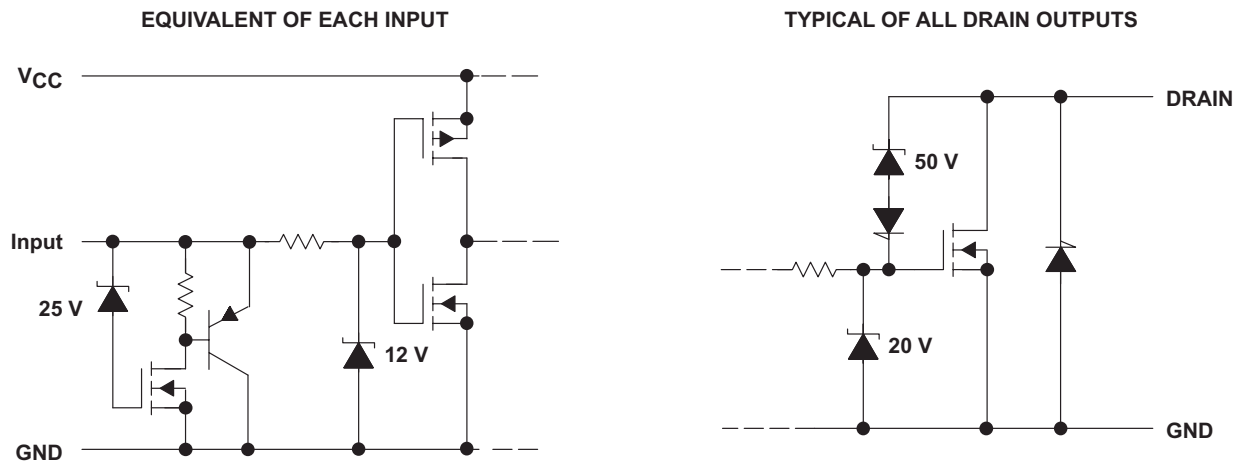


Figure 12. Logic Diagram (Positive Logic)

**Functional Block Diagram (continued)**



**Figure 13. Schematic of Inputs**

**8.3 Feature Description**

**8.3.1 Serial-In Interface**

This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Data transfers through both the shift and storage registers on the rising edge of the shift register clock (SRCK) and the register clock (RCK), respectively. The storage register transfers data to the output buffer when shift register clear (SRCLR) is high.

**8.3.2 Clear Register**

A logical low on ( $\overline{\text{SRCLR}}$ ) clears all registers in the device. TI suggests clearing the device during power up or initialization.

**8.3.3 Output Control**

Holding the output enable ( $\overline{\text{G}}$ ) high holds all data in the output buffers low, and all drain outputs are off. Holding ( $\overline{\text{G}}$ ) low makes data from the storage register transparent to the output buffers. When data in the output buffers is low, the DMOS transistor outputs are OFF. When data is high, the DMOS transistor outputs have sink-current capability. This pin can also be used for global PWM dimming.

**8.3.4 Cascaded Application**

The serial output (SER OUT) allows for cascading of the data from the shift register to additional devices. Connect the device (SEROUT) pin to the next device (SERIN) for daisy Chain. This provides improved performance for applications where clock signals may be skewed, devices are not located near one another, or the system must tolerate electromagnetic interference.

**8.3.5 Current Limit Function**

Outputs are low-side, open-drain DMOS transistors with output ratings of 50 V and 150-mA continuous sink current capability. Each output provides a 500-mA typical current limit at  $T_C = 25^\circ\text{C}$ . The current limit decreases as the junction temperature increases for additional device protection.

## 8.4 Device Functional Modes

### 8.4.1 Operation With $V(V_{CC}) < 4.5$ (Minimum $V(V_{CC})$ )

This device works normally during  $4.5\text{ V} \leq V(V_{CC}) \leq 5.5\text{ V}$ , when operation voltage is lower than 4.5 V. TI can't ensure the behavior of device, including communication interface and current capability.

### 8.4.2 Operating With $5.5\text{ V} < V(V_{CC}) < 6\text{ V}$

This device works normally during this voltage range, but reliability issues may occur while the device works for a long time in this voltage range.

## 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

The TPIC6B595 device is a serial-in parallel-out, Power+LogicE 8-bit shift register with low-side switch DMOS outputs rating of a 150 mA per channel. The device is designed for use in systems that require relatively high load power. The device contains a built-in voltage clamp on the outputs for inductive transient protection. Power driver applications include relays, solenoids, and other medium current or high-voltage loads. The following focuses on automotive cluster applications for the TPIC6B595 device.

### 9.2 Typical Application

The typical application of the TPIC6B595 device is the automotive cluster driver. In this example, two TPIC6B595 power shift registers are cascaded and used to turn on LEDs in the cluster panel. In this case, the LED must be updated after all 16 bits of data have been loaded into the serial shift registers. MCU outputs the data to the serial input (SER IN) while clocking the shift register clock (SRCK). After the 16th clock, a pulse to the register clock (RCK) transfers the data to the storage registers. If output enable (G) is low, then the LEDs are turned ON corresponding to the status word with ones being ON and zeros OFF. With this simple scheme, MCU use SPI interface can turn on 16 LEDs using only two ICs as illustrated in Figure 14.

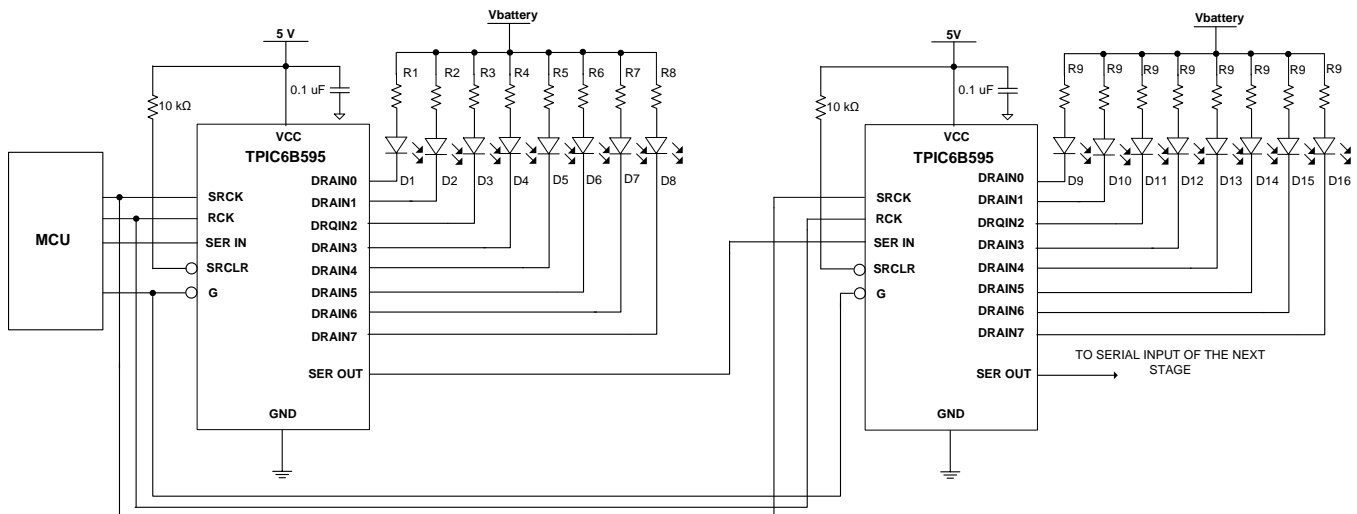


Figure 14. Typical Application Schematic

#### 9.2.1 Design Requirements

Use the design parameters in Table 1 for this design example.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V <sub>SUPPLY</sub>	9-16 V
V(D1), V(D2), V(D3), V(D4), V(D5), V(D6), V(D7), V(D8)	2 V
V(D9), V(D10), V(D11), V(D12), V(D13), V(D14), V(D15), V(D16)	3.3 V
I(D1), I(D2), I(D3), I(D4), I(D5), I(D6), I(D7), I(D8)	20mA When V <sub>battery</sub> is 12 V
I(D9), I(D10), I(D11), I(D12), I(D13), I(D14), I(D15), I(D16)	30mA When V <sub>battery</sub> is 12 V

### 9.2.2 Detailed Design Procedure

To begin the design process, one must decide on a few parameters. The designer must know the following:

- Vsupply - LED supply is connect battery directly or fix voltage, this application connect the battery directly.
- V(Dx) – LED forward voltage
- I(Dx) – LED setting current when battery is 12 V.  
R1,R2,R3,R4,R5,R6,R7,R8

$$R1 = R2 = R3 = R4 = R5 = R6 = R7 = R8 = \frac{(V_{supply} - V(Dx))}{I(Dx)} = \frac{(12V - 2V)}{0.02A} = 500\Omega \quad (1)$$

When Vsupply is 9 V,

$$I(D1) = I(D2) = I(D3) = I(D4) = I(D5) = I(D6) = I(D7) = I(D8) = \frac{(V_{supply} - V(Dx))}{R_x} = 14mA \quad (2)$$

When Vsupply is 16 V,

$$I(D1) = I(D2) = I(D3) = I(D4) = I(D5) = I(D6) = I(D7) = I(D8) = \frac{(V_{supply} - V(Dx))}{R_x} = 28mA \quad (3)$$

R9,R10,R11,R12,R13,R14,R15,R16

$$R9 = R10 = R11 = R12 = R13 = R14 = R15 = R16 = \frac{(V_{supply} - V(Dx))}{I(Dx)} = \frac{(12V - 3.3V)}{0.03A} = 290\Omega \quad (4)$$

When Vsupply is 9 V,

$$I(D9) = I(D10) = I(D11) = I(D12) = I(D13) = I(D14) = I(D15) = I(D16) = \frac{(V_{supply} - V(Dx))}{R_x} = 19.7mA \quad (5)$$

When Vsupply is 16 V,

$$I(D9) = I(D10) = I(D11) = I(D12) = I(D13) = I(D14) = I(D15) = I(D16) = \frac{(V_{supply} - V(Dx))}{R_x} = 43.8mA \quad (6)$$

#### NOTE

If customers can accept the current variation when battery voltage is changing, they can connect to the battery directly. If customers need the less variation of current, they must use the voltage regulator as supply voltage of LED, or change to constant current LED driver directly.

### 9.2.3 Application Curve

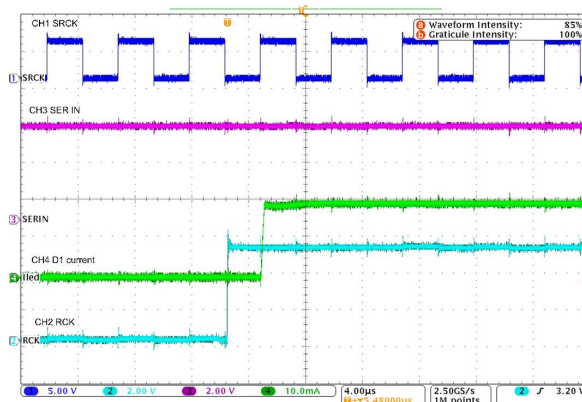


Figure 15. CH1 is SRCK, CH2 is RCK, CH3 is SER IN, CH4 is D1 current



## 10 Power Supply Recommendations

The TPIC6B595 device is designed to operate from an input voltage supply range from 4.5 V and 5.5 V. This input supply should be well regulated. TI recommends placing the ceramic bypass capacitors near the VCC pin.

## 11 Layout

### 11.1 Layout Guidelines

There is no special layout requirement for the digital signal pin; the only requirement is placing the ceramic bypass capacitors near the corresponding pin. Because the TPIC6B595 device does not have a thermal shutdown protection function, to prevent thermal damage,  $T_J$  must be less than 150°C. If the total sink current is high, the power dissipation might be large. The devices are currently not available in the thermal pad package, so good PCB design can optimize heat transfer, which is absolutely essential for the long-term reliability of the device. Maximize the copper coverage on the PCB to increase the thermal conductivity of the board, because the major heat-flow path from the package to the ambient is through the copper on the PCB. Maximum copper is extremely important when the design does not include heat sinks attached to the PCB on the other side of the package.

- Add as many thermal vias as possible directly under the package ground pad to optimize the thermal conductivity of the board.
- All thermal vias should be either plated shut or plugged and capped on both sides of the board to prevent solder voids. To ensure reliability and performance, the solder coverage should be at least 85%.

## 11.2 Layout Example

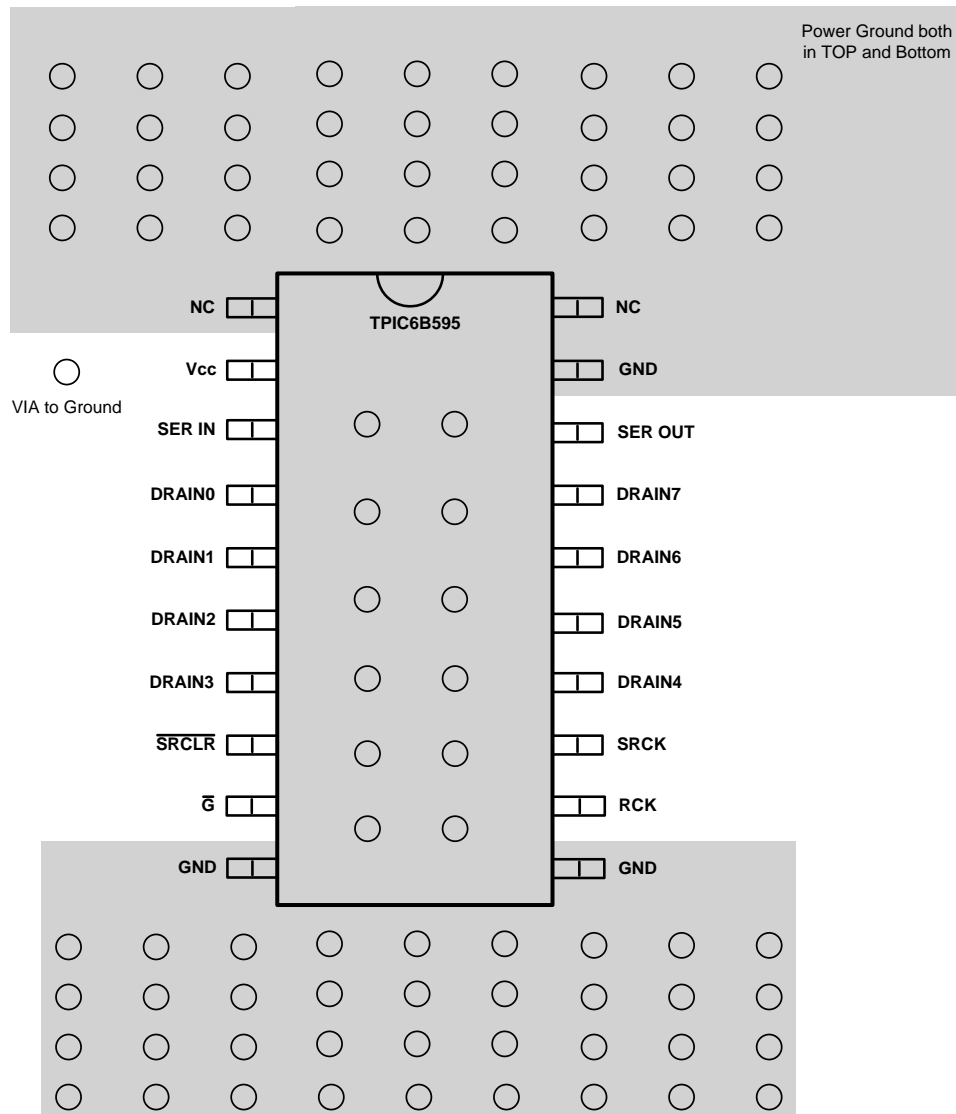


Figure 16. TPIC6B595 Layout Example

## 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](http://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.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPIC6B595DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6B595	<a href="#">Samples</a>
TPIC6B595DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TPIC6B595	<a href="#">Samples</a>
TPIC6B595DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6B595	<a href="#">Samples</a>
TPIC6B595DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TPIC6B595	<a href="#">Samples</a>
TPIC6B595N	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 125	TPIC6B595N	<a href="#">Samples</a>

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

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

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

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

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

(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.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**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



### 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
TPIC6B595DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

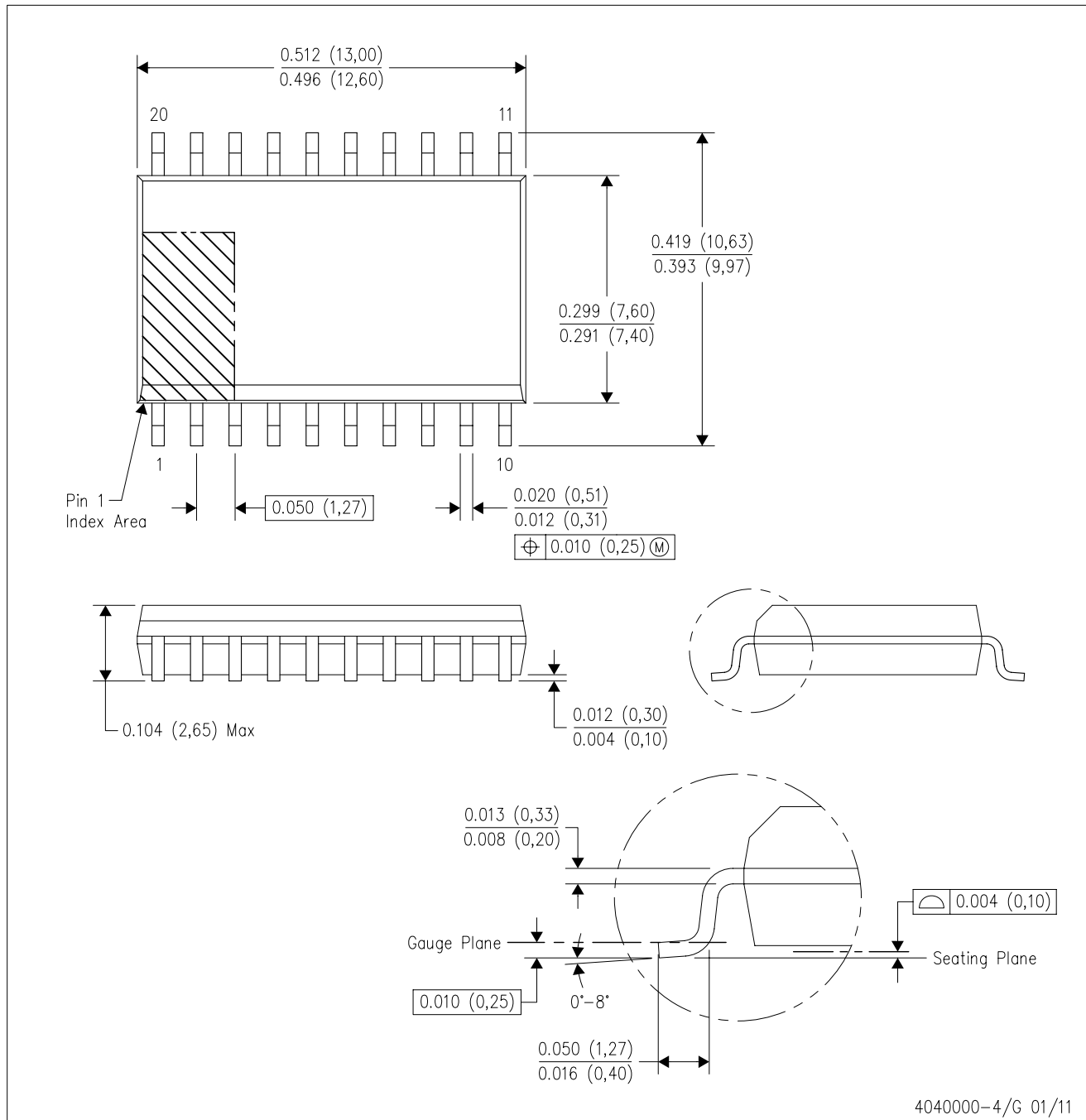


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPIC6B595DWR	SOIC	DW	20	2000	367.0	367.0	45.0

DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE

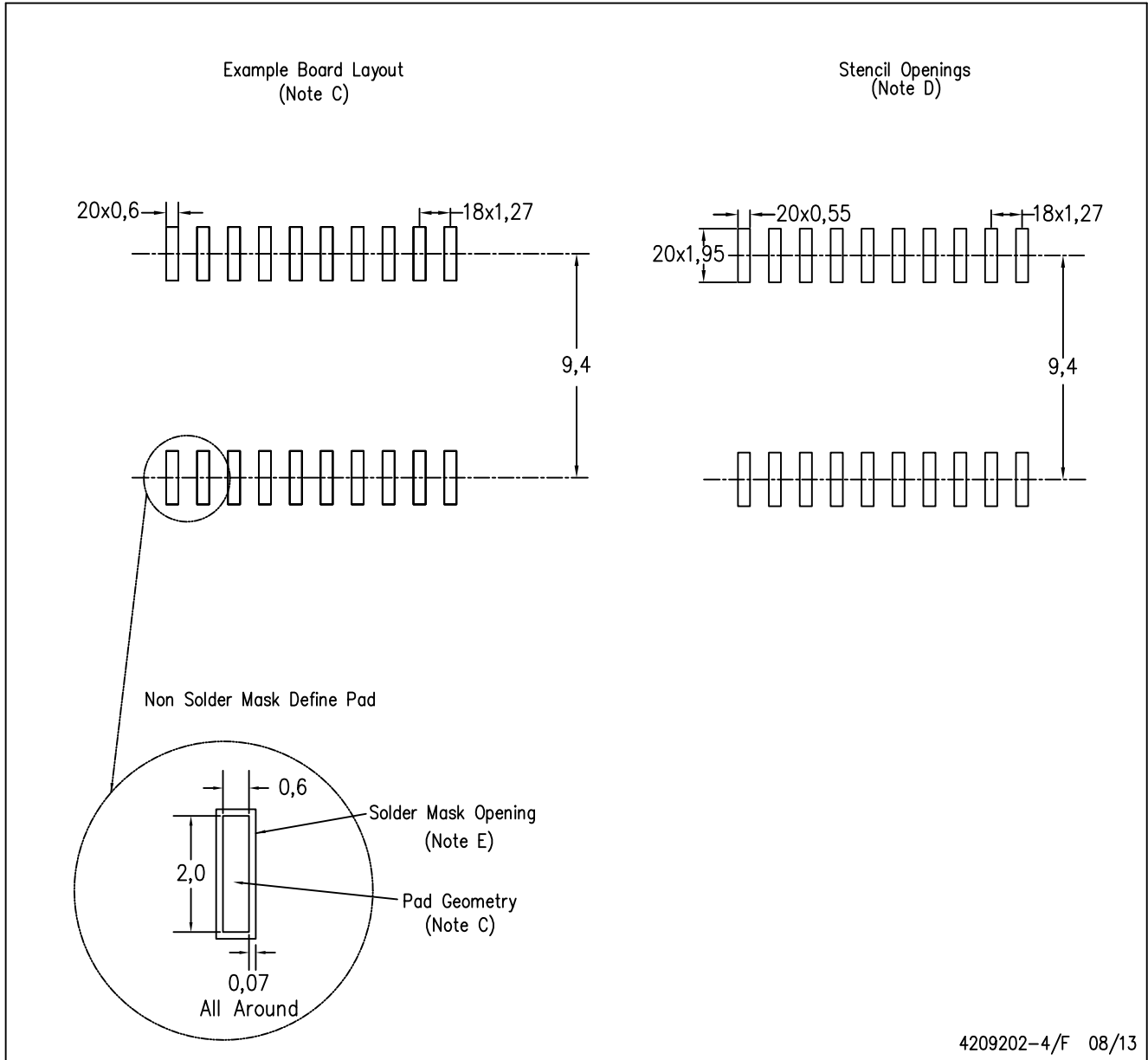


- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-013 variation AC.



DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



4209202-4/F 08/13

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)