

TPIC6595 电源逻辑 8 位移位寄存器

1 特性

- 低 $r_{DS(on)}$: 1.3Ω (典型值)
- 雪崩能量: 75mJ
- 250mA 连续电流的八个功率 DMOS 晶体管输出
- 每个输出 1.5A 脉冲电流
- 45V 时的输出钳位电压
- 器件可级联
- 低功耗

2 应用

- 仪表组
- 信号灯
- LED 照明和控制
- 汽车继电器或螺线管驱动器

3 说明

TPIC6595 是一款单片、高压、高电流功率 8 位移位寄存器，专为负载功率要求相对较高的系统而设计。该器件包含内置的输出钳位电压，用于提供电感瞬态保护。电源驱动器应用包括继电器、螺线管和其他中等电流或高电压负载。

该器件包含一个可对 8 位 D 类存储寄存器进行馈送的 8 位串行输入、并行输出移位寄存器。移位和存储寄存器之间的数据传输分别在移位寄存器时钟 (SRCK) 和寄存器时钟 (RCK) 的上升沿上发生。当移位寄存器清零 (SRCLR) 为高电平时，存储寄存器将数据传输到输出缓冲器。只有当 RCK 为低电平时，写入数据和读取数据才有效。当 SRCLR 为低电平时，输入移位寄存器将清零。当输出使能 (\bar{G}) 保持高电平时，输出缓冲器中的所有数据将保持低电平，并且所有漏极输出将关闭。当 \bar{G} 保持低电平时，来自存储寄存器中的数据对输出缓冲器透明。串行输出 (SER OUT) 允许将数据从移位寄存器级联到其他器件。

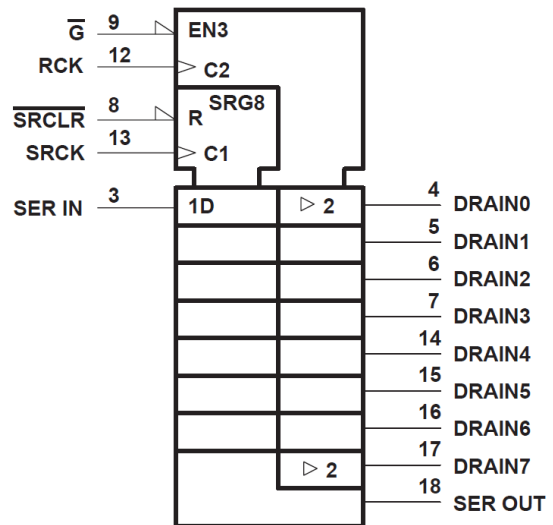
输出为低侧、漏极开路 DMOS 晶体管，额定输出功率为 45V，连续灌电流能力为 250mA。当输出缓冲器中的数据较低时，DMOS 晶体管的输出被关闭。当数据较高时，DMOS 晶体管输出具有灌电流能力。

提供单独的电源和逻辑电平接地引脚，有助于尽可能提高系统灵活性。引脚 1、10、11 和 20 在内部连接，每个引脚必须从外部连接到电源系统接地，以尽可能减小寄生电感。引脚 19 逻辑接地 (LGND) 以及引脚 1、10、11 和 20 电源接地 (PGND) 之间的单点连接必须在外部进行，以减少逻辑和负载电路之间的串扰。TPIC6595 具有 -40°C 至 125°C 的额定管壳工作温度范围。

器件信息 1

器件型号	封装	本体尺寸 (标称值)
TPIC6595	SOIC (20)	12.80mm × 7.50mm
	PDIP (20)	25.4mm × 6.35mm

logic symbol†



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

典型应用



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4 Pin Configuration and Functions

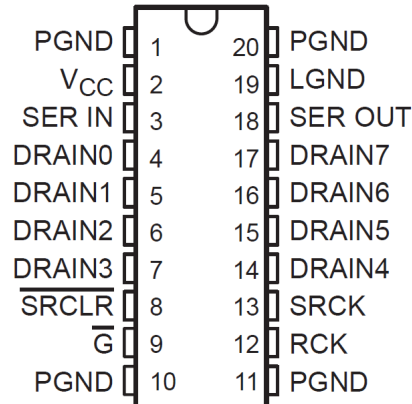


图 4-1. DW or N Package, 20-pin SOIC (Top- View)

表 4-1. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
DRAIN0	4	O	Open-drain output
DRAIN1	5		
DRAIN2	6		
DRAIN3	7		
DRAIN4	14		
DRAIN5	15		
DRAIN6	16		
DRAIN7	17		
\bar{G}	9	I	Output enable, active-low
LGND	19	-	Logic ground
PGND	1, 10, 11, 20	-	Power ground
RCK	12	I	Register clock
SER IN	3	I	Serial data input
SER OUT	18	O	Serial data output
SRCK	13	I	Shift register clock
SRCLR	8	I	Shift register clear, active-low
V _{CC}	2	I	Power supply

(1) O = Output; I = Input;

5 Specifications

over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

5.1 Absolute Maximum Ratings

		MIN	MAX	UNIT
V_{CC}	Logic supply voltage		7	V
V_I	Logic input voltage range	-0.3	7	V
V_{DS}	Power DMOS drain-to-source voltage		45	V
	Continuous source-drain diode anode current		1	A
	Pulsed source-drain diode anode current		2	A
	Pulsed drain current, each output, all outputs on, see also ⁽³⁾		750	mA
I_{Dn}	Continuous drain current, each output, all outputs on, $T_A = 25^\circ$		250	mA
I_{DM}	Peak drain current single output, $T_A = 25^\circ\text{C}$ (See ⁽³⁾)		2	A
E_{AS}	Single-pulse avalanche energy (See ⁽⁴⁾)		75	mJ
I_{AS}	Avalanche current (See ⁽⁴⁾)		1	A
	Continuous total power dissipation	see Dissipation Rating Table		⁽⁵⁾
T_J	Operating virtual junction temperature range	-40	150	$^\circ\text{C}$
T_{stg}	Storage temperature	-65	150	$^\circ\text{C}$
	Lead temperature 1, 6mm (1/16 inch) from case for 10 seconds		260	$^\circ\text{C}$

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All voltage values are with respect to network ground terminal GND.
- (3) Pulse duration $\leq 100\mu\text{s}$, duty cycle $\leq 2\%$
- (4) DRAIN supply voltage = 15V, starting junction temperature (T_{JS}) = 25°C , $L = 100\text{mH}$, $I_{AS} = 1\text{A}$ (see [图 6-4](#)).
- (5) See Dissipation Table

5.2 Dissipation Rating Table

PACKAGE	$T_C \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_C = 25^\circ\text{C}$	$T_C = 125^\circ\text{C}$ POWER RATING
DW	1125mW	9.0mW/ $^\circ\text{C}$	225mW
N	1150mW	9.2mW/ $^\circ\text{C}$	230mW

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

5.3 Recommended Operating Conditions

		MIN	MAX	UNIT
V_{CC}	Logic supply voltage	4.5	5.5	V
V_{IH}	High-level input voltage	$0.85V_{CC}$		V
V_{IL}	Low-level input voltage		$0.15V_{CC}$	V
	Pulsed drain output current, $T_C = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$ See ⁽¹⁾ , ⁽²⁾	-1.8	1.5	A
t_{su}	Setup time, SER IN high before SRCK \uparrow , see 图 6-2	10		ns
t_h	Hold time, SER IN high after SRCK \uparrow , see 图 6-2	10		ns
t_w	Pulse duration, see 图 6-2	20		ns

5.3 Recommended Operating Conditions (续)

		MIN	MAX	UNIT
T_C	Operating case temperature	-40	125	°C

- (1) Pulse duration $\leq 100\mu\text{s}$, duty cycle $\leq 2\%$.
- (2) Technique must limit $T_J - T_C$ to 10°C maximum.

over operating free-air temperature range ($V_{CC} = 5\text{V}$, $T_C = 25^\circ\text{C}$, unless otherwise noted)

5.4 Electrical Characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{(BR)DSX}$	Drain-source breakdown voltage	$I_D = 1\text{mA}$	45			V
V_{SD}	Source-drain diode forward voltage	$I_F = 250\text{mA}$, see (1)		0.85	1	V
V_{OH}	High-level output voltage, High-level output voltage, SER OUT	$I_{OH} = -20\text{mA}$, $V_{CC} = 4.5\text{V}$	4.4	4.49		V
		$I_{OH} = -4\text{mA}$, $V_{CC} = 4.5\text{V}$	4.1	4.3		
V_{OL}	Low-level output voltage, SER OUT	$I_{OH} = 20\text{mA}$, $V_{CC} = 4.5\text{V}$		0.002	0.1	V
		$I_{OH} = 4\text{mA}$, $V_{CC} = 4.5\text{V}$		0.2	0.4	
$V_{(hys)}$	Input hysteresis	$V_{DS} = 15\text{V}$		1.3		V
I_{IH}	High-level input current	$V_{CC} = 5.5\text{V}$, $V_I = V_{CC}$			1	μA
I_{IL}	Low-level input current	$V_{CC} = 5.5\text{V}$, $V_I = 0$			-1	μA
I_{CCL}	Logic supply current	$I_O = 0$, All inputs low		15	100	μA
$I_{CC(FRQ)}$	Logic supply current frequency	$f_{SRCK} = 5\text{MHz}$, $I_O = 0$, $CL = 30\text{pF}$	See 图 6-1, 图 6-2, and 图 5-1	0.6	5	mA
I_N	Nominal current	$V_{DS(on)} = 0.5\text{V}$, $I_N = I_D$, $T_C = 85^\circ\text{C}$.	See (2), (3), and (4)	250		mA
I_{DSX}	Off-state drain current	$V_{DS} = 40\text{V}$		0.05	1	μA
		$V_{DS} = 40\text{V}$; $T_C = 125^\circ\text{C}$		0.15	5	
$r_{DS(on)}$	Static drain-source on-state resistance	$I_D = 250\text{mA}$, $V_{CC} = 4.5\text{V}$	See (2), (3), 图 5-5 and 图 5-6	1.3	2	Ω
		$I_D = 250\text{mA}$, $V_{CC} = 4.5\text{V}$, $T_C = 125^\circ\text{C}$.		2	3.2	
		$I_D = 500\text{mA}$, $V_{CC} = 4.5\text{V}$		1.3	2	

- (1) Pulse duration $\leq 100\mu\text{s}$, duty cycle $\leq 2\%$.
- (2) Technique must limit $T_J - T_C$ to 10°C maximum.
- (3) These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.
- (4) Nominal current is defined for a consistent comparison between devices from different sources. The current produces a voltage drop of 0.5V at $T_C = 85^\circ\text{C}$.

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

5.5 Switching Characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output from G	$C_{LL} = 30\text{pF} = 30\text{pF}$, $I_{DD} = 250\text{mA}$, See 图 6-1 and 图 6-2		650		ns
t_{PHL}	Propagation delay time, high-to-low-level output from G			150		ns
t_r	Rise time, drain output			750		ns
t_f	Fall time, drain output			425		ns

5.5 Switching Characteristics (续)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_a	Reverse-recovery-current rise time	$I_{FF} = 250\text{mA}$, $di/dt = 20\text{A}/\mu\text{s}$. See (1), (2), and 图 6-3		100		ns
t_{rr}	Reverse-recovery time			300		

- (1) Technique must limit $T_J - T_C$ to 10°C maximum.
- (2) These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

5.6 Thermal Resistance Characteristics

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
$R_{\theta JA}$	Thermal resistance, junction-to-ambient	DW		111	°C/W
		N	All eight outputs with equal power	108	

5.7 Typical Characteristics

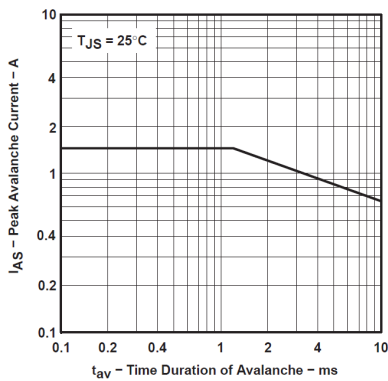


图 5-1. Peak Avalanche Current vs. Time Duration of Avalanche

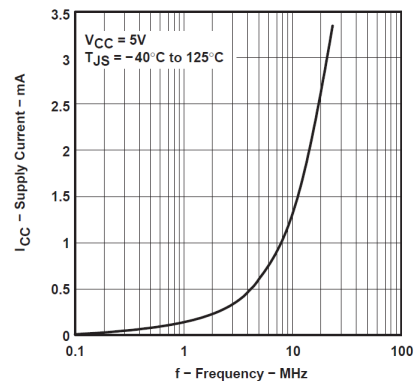


图 5-2. Supply Current vs. Frequency

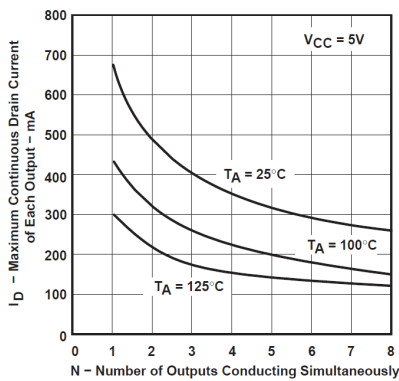


图 5-3. Maximum Continuous Drain Current of Each Output vs. Number Of Outputs Conducting Simultaneously

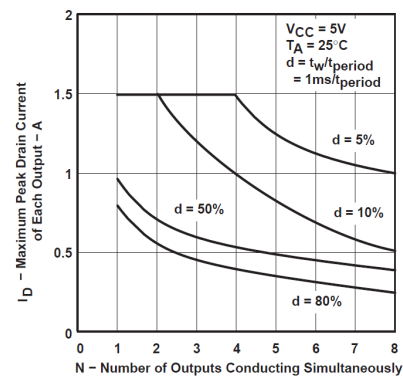


图 5-4. Maximum Peak Drain Current of Each Output vs. Number of Outputs Conducting Simultaneously

5.7 Typical Characteristics (continued)

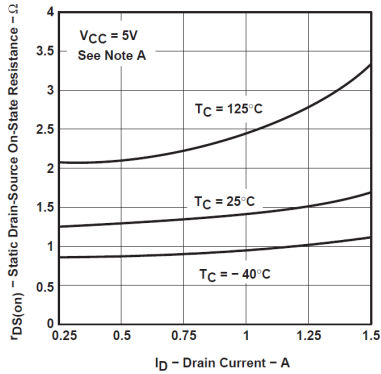


图 5-5. Static Drain-source On-state Resistance vs. Drain Current

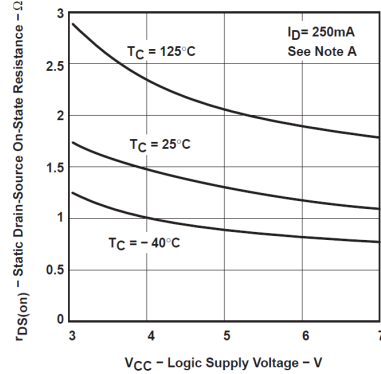


图 5-6. Static Drain-source On-state Resistance vs. Logic Supply Voltage

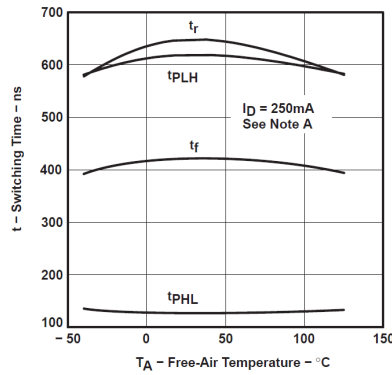
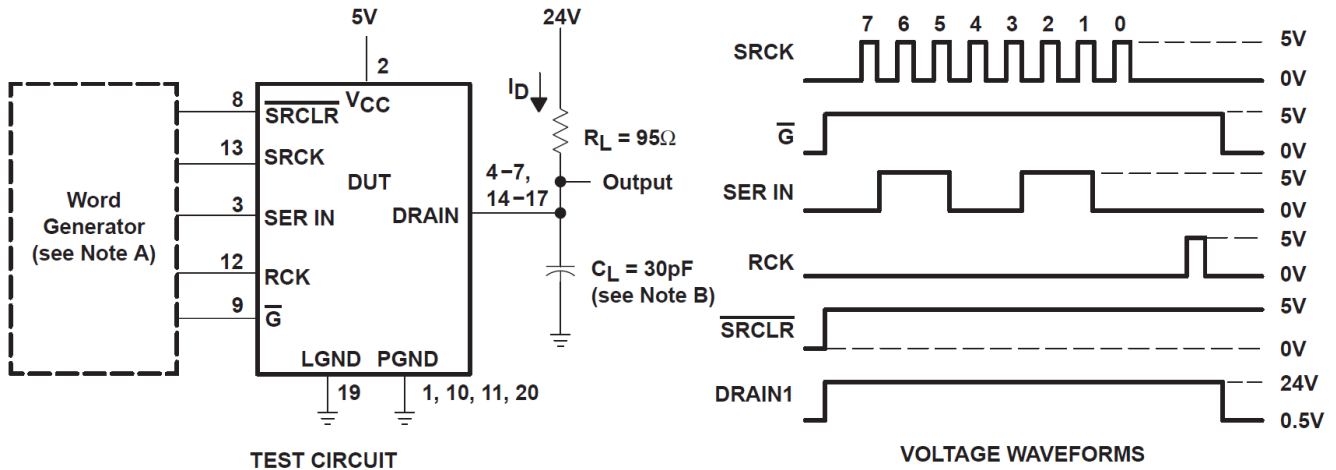


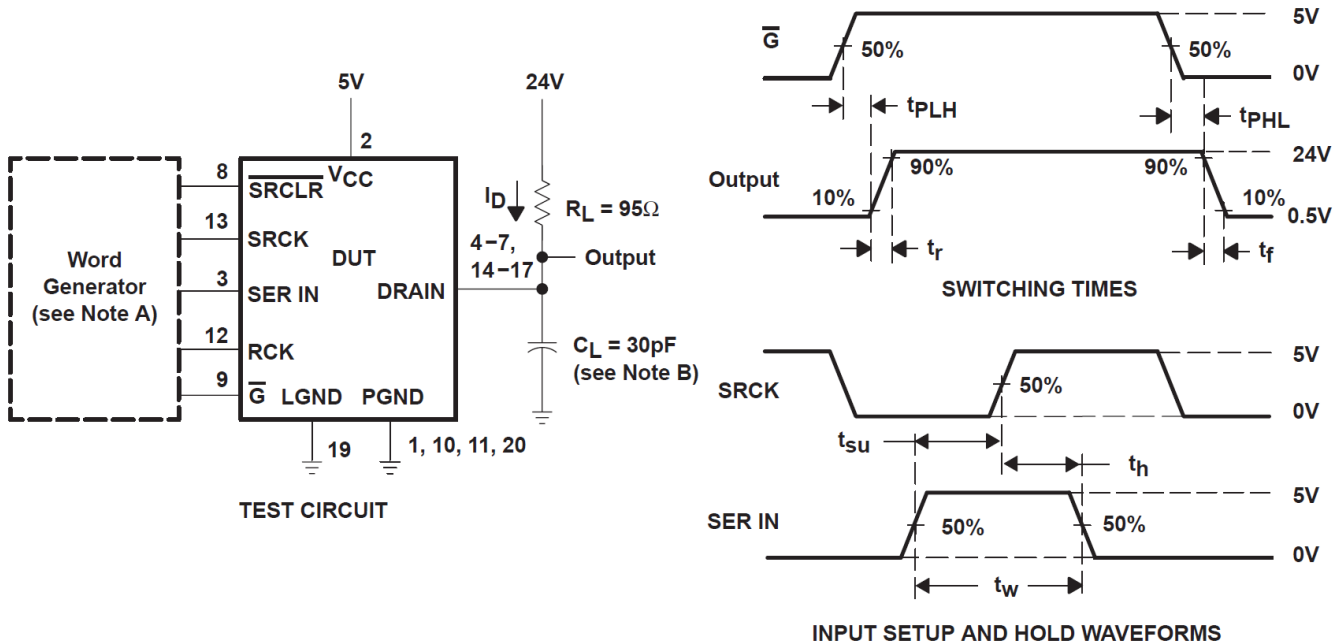
图 5-7. Switching Time vs. Free-air Temperature

6 Parameter Measurement Information



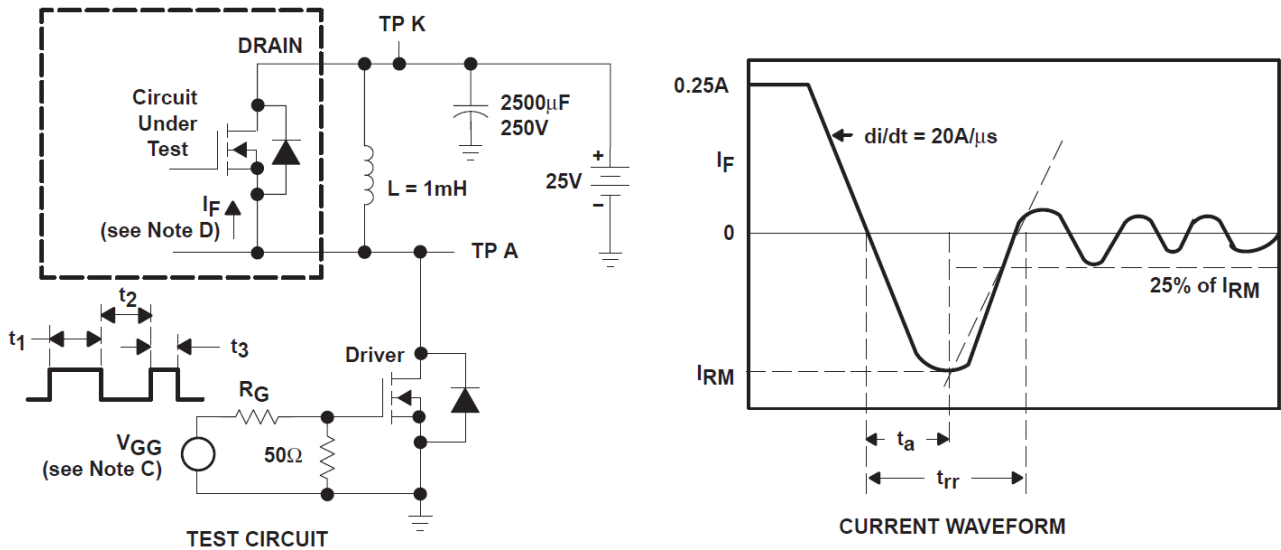
A. Write data and read data are valid only when RCK is low

图 6-1. Resistive Load Operation



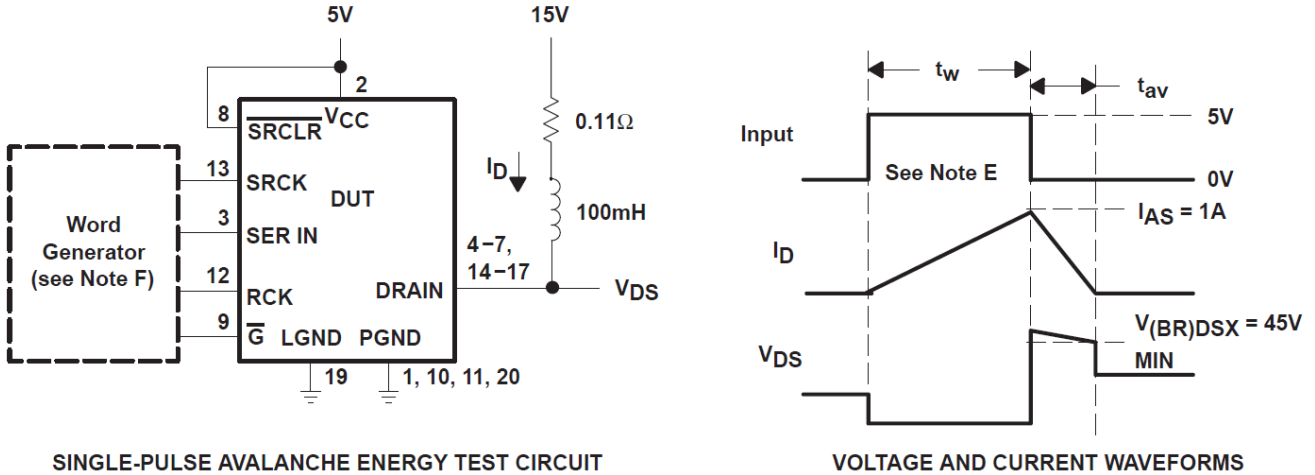
- A. Outputs DRAIN 1, 2, 5, and 6 low (PGND), all other DRAIN outputs are at 24V. The word generator has the following characteristics: $t_r \leq 10\text{ns}$, $t_f \leq 10\text{ns}$, $t_w = 300\text{ns}$, pulsed repetition rate (PRR) = 5kHz, $Z_0 = 50\Omega$.
- B. C_L includes probe and jig capacitance.

图 6-2. Test Circuit, Switching Times, and Voltage Waveforms



- A. The V_{GG} amplitude and R_G are adjusted for $di/dt = 20A/\mu s$. A V_{GG} double-pulse train is used to set $I_F = 0.25A$, where $t_1 = 10\mu s$, $t_2 = 7\mu s$, and $t_3 = 3\mu s$.
- B. 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.

图 6-3. Reverse-Recovery-Current Test Circuit and Waveforms of Source-Drain Diode



- A. The word generator has the following characteristics: $t_r \leq 10ns$, $t_f \leq 10ns$, $Z_O = 50\Omega$.
- B. Input pulse duration, t_w , is increased until peak current $I_{AS} = 1A$. Energy test level is defined as $E_{AS} = I_{AS} \times V_{(BR)DSX} \times t_{av}/2 = 75mJ$, where t_{av} = avalanche time.

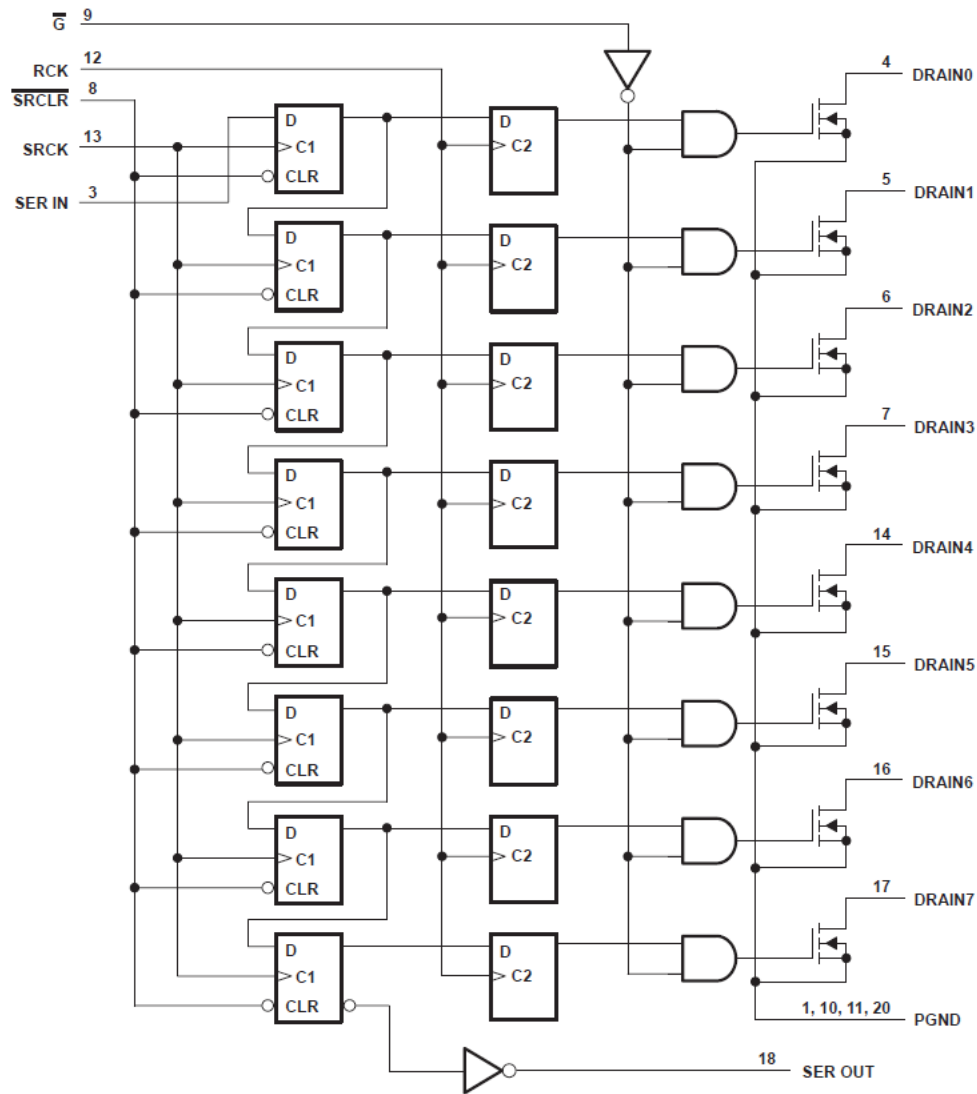
图 6-4. Single-Pulse Avalanche Energy Test Circuit and Waveforms

7 Detailed Description

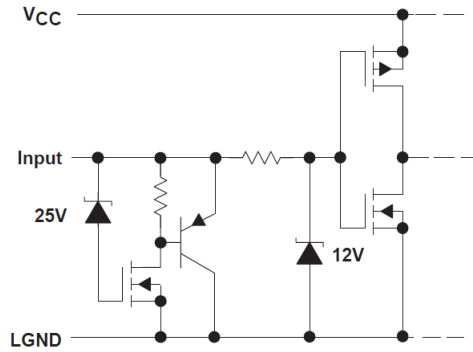
7.1 Overview

The TPIC6595 is a monolithic, high-voltage, high-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.

7.2 Functional Block Diagram

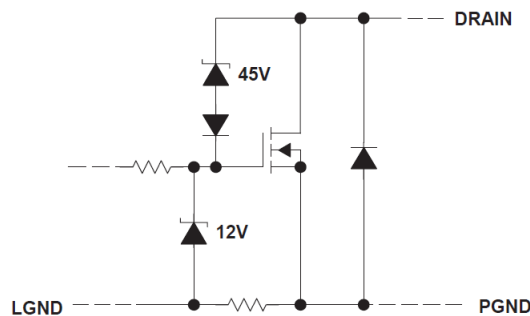


Functional Block Diagram



Equivalent of Each Input Schematic

TYPICAL OF ALL DRAIN OUTPUTS



Typical of All Drain Outputs Schematic

7.3 Feature Description

7.3.1 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. Write data and read data are valid only when RCK is low. The storage register transfers data to the output buffer when shift register clear ($\overline{\text{SRCLR}}$) is high.

7.3.2 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.

7.3.3 Output Control

When output enable ($\overline{\text{G}}$) is held high, all data in the output buffers is held 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.

7.3.4 Cascaded Application

The serial output (SER OUT) allows for cascading of the data from the shift register to additional devices. Connect the device (SER OUT) pin to the next device (SER IN) for daisy Chain.

7.3.5 Current Limit Function

Outputs are low-side, open-drain DMOS transistors with output ratings of 45V and 250mA continuous sink current capability.

7.4 Device Functional Modes

7.4.1 Operating with $V_{cc} < 4.5V$

This device works normally during $4.5V \leq V_{cc} \leq 5.5V$, when operation voltage is lower than 4.5V, correct behavior of the device, including communication interface and current capability, is not assured.

7.4.2 Operating with $5.5V < V_{cc} \leq 7V$

The device works normally in this voltage range, but reliability issues can occur if the device works for a long time in this voltage range.

8 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

8.1 Documentation Support

8.1.1 Related Documentation

8.2 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击 [通知](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

8.3 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [使用条款](#)。

8.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

8.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

8.6 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

9 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision B (May 2005) to Revision C (March 2025) Page

- 更新了整个文档中的表格、图和交叉参考的编号格式..... 1
- 将内容从传统格式更新为当前格式..... 1

Changes from Revision A (October 1996) to Revision B (May 2005) Page

- Changed SRCLR timing diagram..... 8

Changes from Revision * (April 1992) to Revision A (October 1996) Page

- 原始修订版本..... 1

10 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 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)
TPIC6595DW	Obsolete	Production	SOIC (DW) 20	-	-	Call TI	Call TI	-40 to 125	
TPIC6595DWG4	Obsolete	Production	SOIC (DW) 20	-	-	Call TI	Call TI	-	
TPIC6595DWR	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6595
TPIC6595DWR.A	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6595
TPIC6595DWRG4	Obsolete	Production	SOIC (DW) 20	-	-	Call TI	Call TI	-	
TPIC6595N	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TPIC6595N
TPIC6595N.A	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TPIC6595N

(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

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

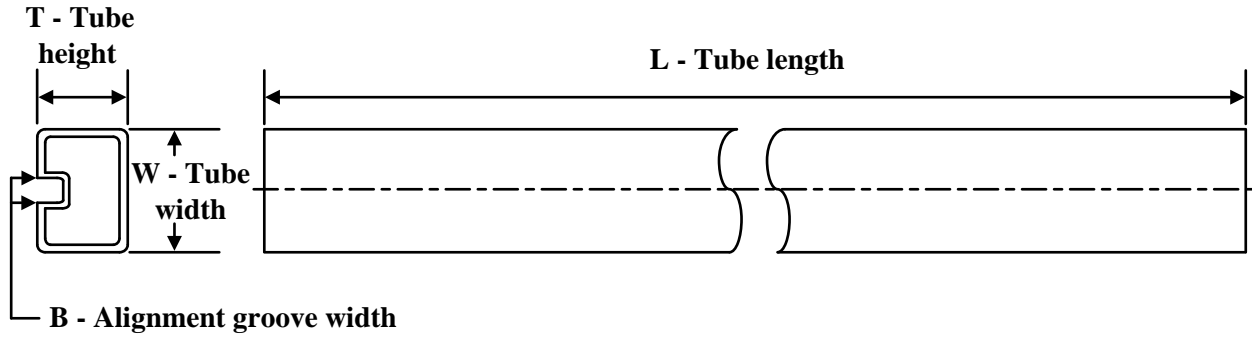

*All dimensions are nominal

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
TPIC6595DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
TPIC6595DWR	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)
TPIC6595DWR	SOIC	DW	20	2000	350.0	350.0	43.0
TPIC6595DWR	SOIC	DW	20	2000	350.0	350.0	43.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TPIC6595N	N	PDIP	20	20	506	13.97	11230	4.32
TPIC6595N.A	N	PDIP	20	20	506	13.97	11230	4.32

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

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

DW0020A



PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

EXAMPLE BOARD LAYOUT

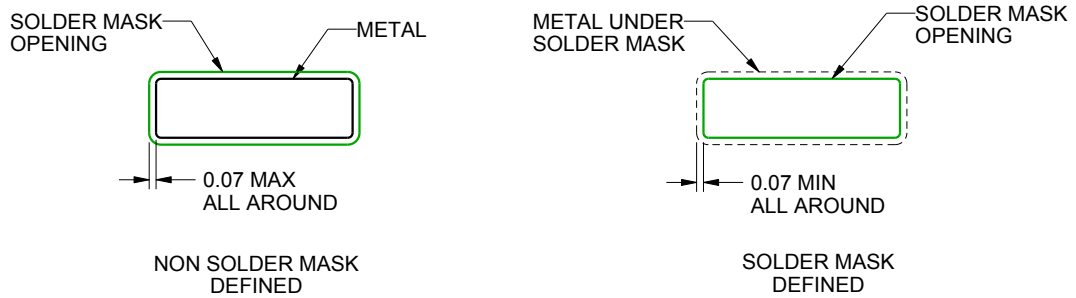
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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