- Low $r_{DS(on)} \dots 1.3 \Omega$ Typical
- Avalanche Energy . . . 75 mJ
- **Eight Power DMOS Transistor Outputs of** 250-mA Continuous Current
- 1.5-A Pulsed Current Per Output
- **Output Clamp Voltage at 45 V**
- **Devices Are Cascadable**
- **Low Power Consumption**

description

The TPIC6595 is a monolithic, high-voltage, highcurrent 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 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 shiftregister clear (SRCLR) is high. When SRCLR is low, the input shift register is cleared. When output enable (\overline{G}) is held high, all data in the output buffers is held low and all drain outputs are off. When \overline{G} is held low, data from the storage register is transparent to the output buffers. The serial output (SER OUT) allows for cascading of the data from the shift register to additional devices.

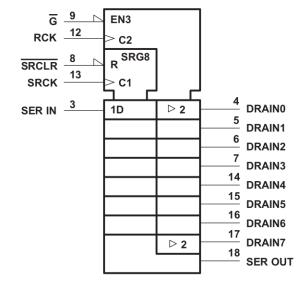
Outputs are low-side, open-drain transistors with output ratings of 45 V and 250-mA

20 | PGND PGND **∏** 19 | LGND V_{CC} [] 2 SER IN [] 3 18 SER OUT DRAINO 1 4 17 DRAIN7 DRAIN1 [5 16 DRAIN6 DRAIN2 \(\begin{array}{c} 6 \\ \exists \exists \) 15 DRAIN5 DRAIN3 7 14 DRAIN4 SRCLR 8 13 SRCK GΠ9 12 **∏** RCK 11 PGND PGND 10

DW OR N PACKAGE

(TOP VIEW)

logic symbol†



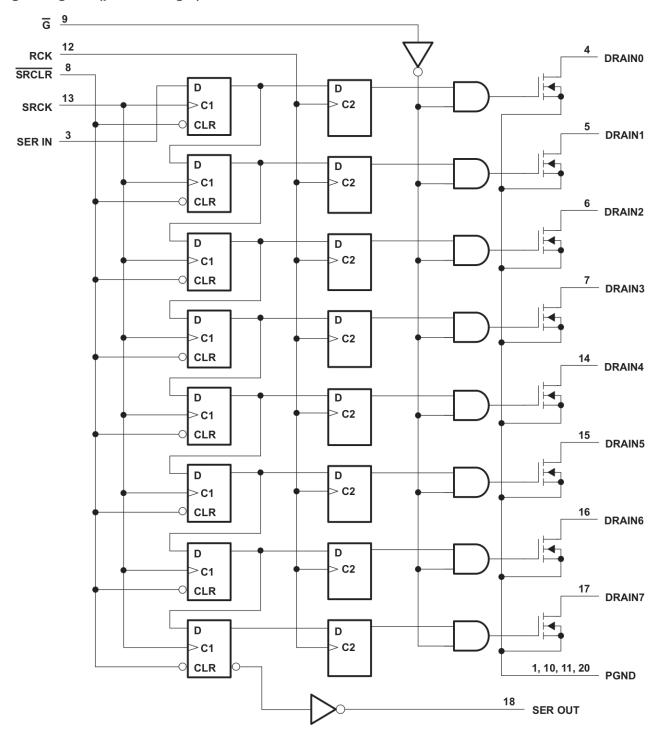
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

continuous sink current capability. 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.

Separate power and logic level ground pins are provided to facilitate maximum system flexibility. Pins 1, 10, 11, and 20 are internally connected, and each pin must be externally connected to the power system ground in order to minimize parasitic inductance. A single-point connection between pin 19, logic ground (LGND), and pins 1, 10, 11, and 20, power grounds (PGND), must be externally made in a manner that reduces crosstalk between the logic and load circuits.

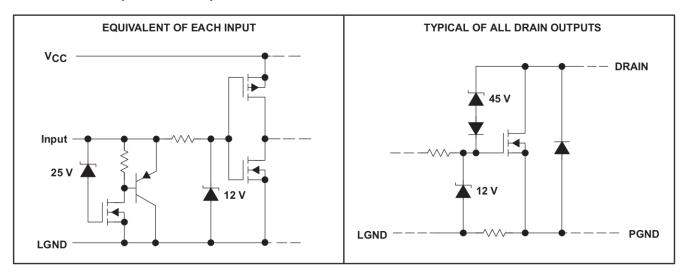
The TPIC6595 is characterized for operation over the operating case temperature range of -40° C to 125°C.

logic diagram (positive logic)





schematic of inputs and outputs



absolute maximum ratings over recommended operating case temperature range (unless otherwise noted)†

Logic supply voltage, V _{CC} (see Note 1)	7 V
Logic input voltage range, V _I	0.3 V to 7 V
Power DMOS drain-to-source voltage, V _{DS} (see Note 2)	
Continuous source-drain diode anode current	
Pulsed source-drain diode anode current	2 A
Pulsed drain current, each output, all outputs on, I _{Dn.} T _A = 25°C (see Note 3)	750 mA
Continuous drain current, each output, all outputs on, I _{Dn} , T _A = 25°C	250 mA
Peak drain current single output, I _{DM} ,T _A = 25°C (see Note 3)	
Single-pulse avalanche energy, E _{AS} (see Note 4)	75 mJ
Avalanche current, I _{AS} (see Note 4)	1 A
Continuous total power dissipation	See Dissipation Rating Table
Operating virtual junction temperature range, T _J	40°C to 150°C
Storage temperature range, T _{stq}	−65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltage values are with respect to LGND and PGND.
 - 2. Each power DMOS source is internally connected to PGND.
 - 3. Pulse duration \leq 100 μ s, duty cycle \leq 2 %
 - 4. DRAIN supply voltage = 15 V, starting junction temperature (T_{JS}) = 25°C, L = 100 mH, I_{AS} = 1 A (see Figure 4).

DISSIPATION RATING TABLE

PACKAGE	$T_{\mbox{\scriptsize A}} \le 25^{\circ}\mbox{\scriptsize C}$ POWER RATING	DERATING FACTOR ABOVE T _A = 25°C	T _A = 125°C POWER RATING
DW	1125 mW	9.0 mW/°C	225 mW
N	1150 mW	9.2 mW/°C	230 mW



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recommended operating conditions over recommended operating temperature range (unless otherwise noted)

	MIN	MAX	UNIT
Logic supply voltage, V _{CC}	4.5	5.5	V
High-level input voltage, V _{IH}	0.85 V _{CC}		V
Low-level input voltage, V _{IL}		0.15 V _{CC}	V
Pulsed drain output current, T _C = 25°C, V _{CC} = 5 V (see Notes 3 and 5)	-1.8	1.5	Α
Setup time, SER IN high before SRCK↑, t _{SU} (see Figure 2)	10		ns
Hold time, SER IN high after SRCK↑, t _h (see Figure 2)	10		ns
Pulse duration, t _W (see Figure 2)	20	·	ns
Operating case temperature, T _C	-40	125	°C

electrical characteristics, V_{CC} = 5 V, T_C = 25°C (unless otherwise noted)

	PARAMETER		TEST CONDI	TIONS	MIN	TYP	MAX	UNIT
V(BR)DSX	Drain-source breakdown voltage	I _D = 1 mA			45			V
V _{SD}	Source-drain diode forward voltage	I _F = 250 mA,	See Note 3			0.85	1	V
	High-level output voltage,	I _{OH} = -20 mA	, V _{CC} = 4.5 V		4.4	4.49		V
Vон	SER OUT	$I_{OH} = -4 \text{ mA},$	V _{CC} = 4.5 V		4.1	4.3		V
Mari	Low-level output voltage, SER	I _{OH} = 20 mA,	V _{CC} = 4.5 V			0.002	0.1	V
VOL	OUT	$I_{OH} = 4 \text{ mA},$	V _{CC} = 4.5 V			0.2	0.4	V
V _(hys)	Input hysteresis	V _{DS} = 15 V				1.3		V
lіН	High-level input current	$V_{CC} = 5.5 V$,	$V_I = V_{CC}$				1	μΑ
I _I L	Low-level input current	V _{CC} = 5.5 V,	V _I = 0				-1	μΑ
ICCL	Logic supply current	I _O = 0,	All inputs low			15	100	μΑ
ICC(FRQ)	Logic supply current frequency	f _{SRCK} = 5 MH See Figures 1,	lz, I _O = 0, 2, and 6	C _L = 30 pF,		0.6	5	mA
IN	Nominal current	$V_{DS(on)} = 0.5$ $I_{N} = I_{D}$	V, T _C = 85°C	See Notes 5, 6, and 7		250		mA
	Off state desire surrent	V _{DS} = 40 V				0.05	1	
IDSX	Off-state drain current	V _{DS} = 40 V,	T _C = 125°C			0.15	5	μА
		I _D = 250 mA,	V _{CC} = 4.5 V			1.3	2	
r _{DS(on)}	Static drain-source on-state resistance	I _D = 250 mA, V _{CC} = 4.5 V	T _C = 125°C,	See Notes 5 and 6 and Figures 9 and 10		2	3.2	Ω
		I _D = 500 mA,	V _{CC} = 4.5 V			1.3	2	

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_{C} = 25^{\circ}\text{C}$

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
tPLH	Propagation delay time, low-to-high-level output from \overline{G}			650		ns	
tPHL	Propagation delay time, high-to-low-level output from \overline{G}	C _L = 30 pF, I _D = 250 mA,		150		ns	
t _r	Rise time, drain output	See Figures 1 and 2		750		ns	
t _f	Fall time, drain output			425		ns	
ta	Reverse-recovery-current rise time	I _F = 250 mA, di/dt = 20 A/μs,		100			
t _{rr}	Reverse-recovery time	See Notes 5 and 6 and Figure 3		300		ns	

NOTES: 3. Pulse duration \leq 100 μ s, duty cycle \leq 2%

- 5. Technique should limit $T_J T_C$ to 10°C maximum.
- 6. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.
- 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_C = 85°C.



thermal resistance

	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	
	R _{θJA} Thermal resistance, junction-to-ambient	DW package			111	0000
K _θ JA		N package	All 8 outputs with equal power		108	°C/W

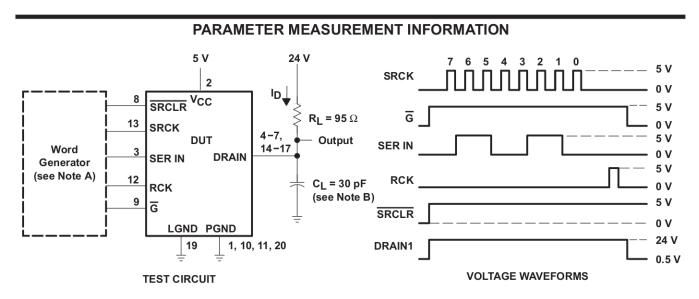


Figure 1. Resistive Load Operation

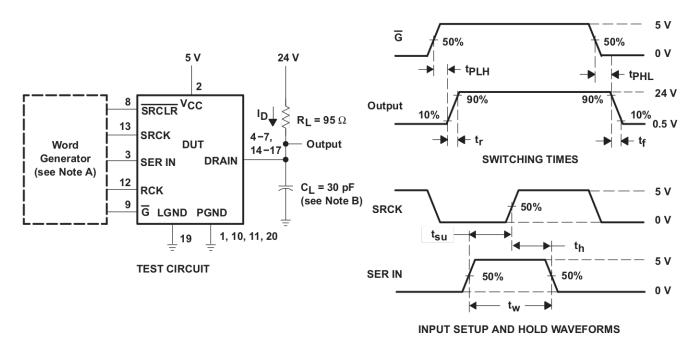


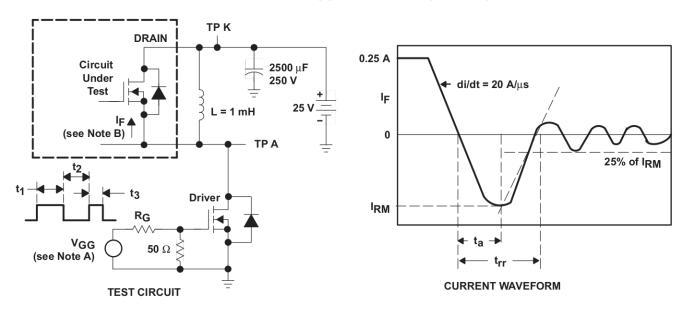
Figure 2. Test Circuit, Switching Times, and Voltage Waveforms

NOTES: A. Outputs DRAIN 1, 2, 5, and 6 low (PGND), all other DRAIN outputs are at 24 V. The word generator has the following characteristics: $t_{\Gamma} \le 10$ ns, $t_{W} = 300$ ns, pulsed repetition rate (PRR) = 5 kHz, $Z_{O} = 50 \Omega$.

B. C_I includes probe and jig capacitance.

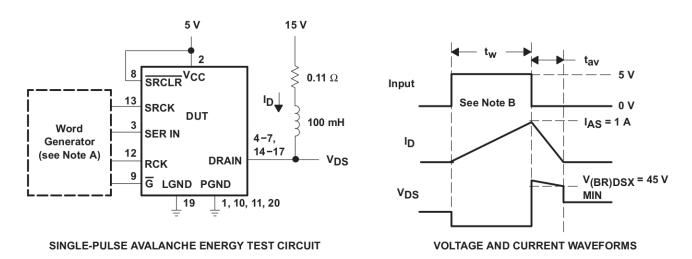


PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The VGG amplitude and RG are adjusted for di/dt = 20 A/ μ s. A VGG double-pulse train is used to set IF = 0.25 A, where t_1 = 10 μ s, t_2 = 7 μ s, and t_3 = 3 μ 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.

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

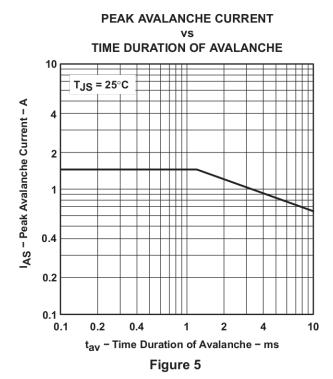


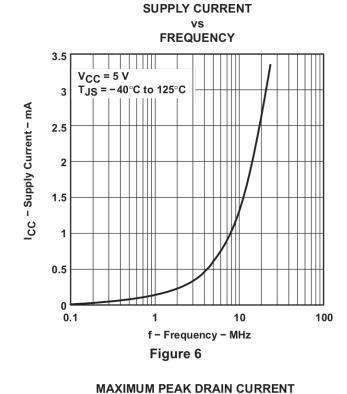
- NOTES: A. The word generator has the following characteristics: $t_{\Gamma} \le 10$ ns, $t_{f} \le 10$ ns, $Z_{O} = 50$ Ω .
 - B. Input pulse duration, t_W , is increased until peak current $I_{AS} = 1$ A. Energy test level is defined as $E_{AS} = I_{AS} \times V_{(BR)DSX} \times t_{aV}/2 = 75$ mJ, where t_{aV} = avalanche time.

Figure 4. Single-Pulse Avalanche Energy Test Circuit and Waveforms

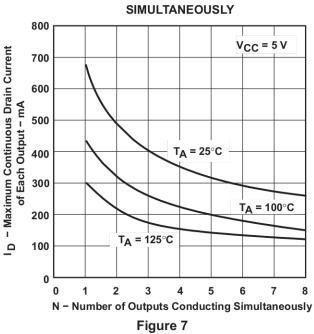


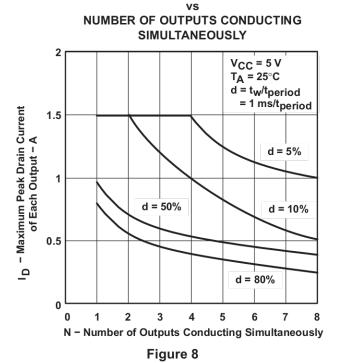
TYPICAL CHARACTERISTICS





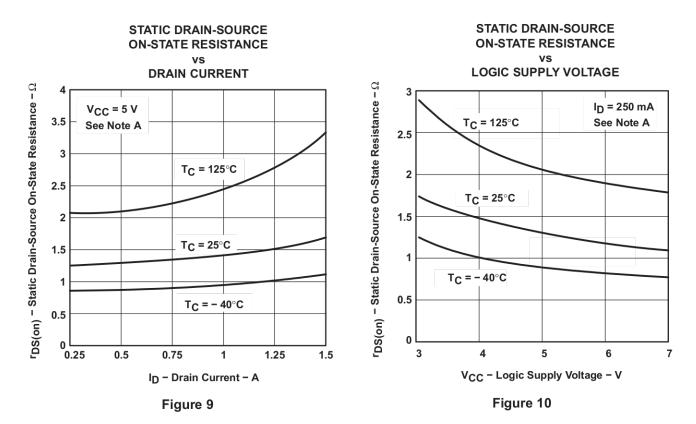
MAXIMUM CONTINUOUS DRAIN CURRENT OF EACH OUTPUT vs NUMBER OF OUTPUTS CONDUCTING SIMULTANEOUSLY

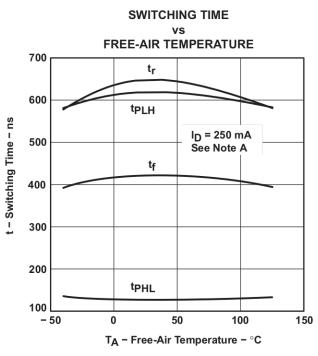




OF EACH OUTPUT

TYPICAL CHARACTERISTICS





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



Figure 11

SLIS010B - APRIL 1992 - REVISED MAY 2005

Revision History

DATE	REV	PAGE	SECTION	DESCRIPTION
5/18/05	В	5	Figure 1	Changed SRCLR timing diagram
10/1/96	Α		_	_
4/1992	*			Original reversion

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



PACKAGE OPTION ADDENDUM

11-Jan-2021

PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead finish/ Ball material	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
							(6)				
TPIC6595DW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6595	Samples
TPIC6595DWG4	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		TPIC6595	Samples
TPIC6595DWR	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6595	Samples
TPIC6595DWRG4	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		TPIC6595	Samples
TPIC6595N	ACTIVE	PDIP	N	20	20	RoHS & Green	NIPDAU	N / A for Pkg Type	-40 to 125	TPIC6595N	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 (CI) 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.



PACKAGE OPTION ADDENDUM

11-Jan-2021

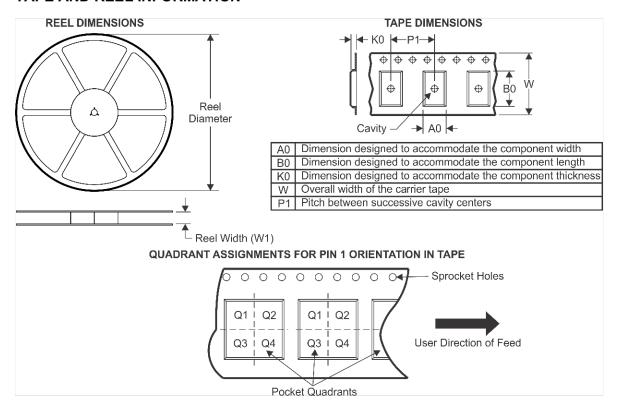
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PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION

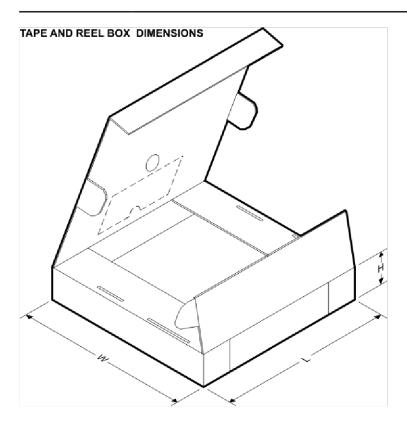


*All dimensions are nominal

	Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
Г	TPIC6595DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
Г	TPIC6595DWRG4	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1

PACKAGE MATERIALS INFORMATION

www.ti.com 5-Jul-2019



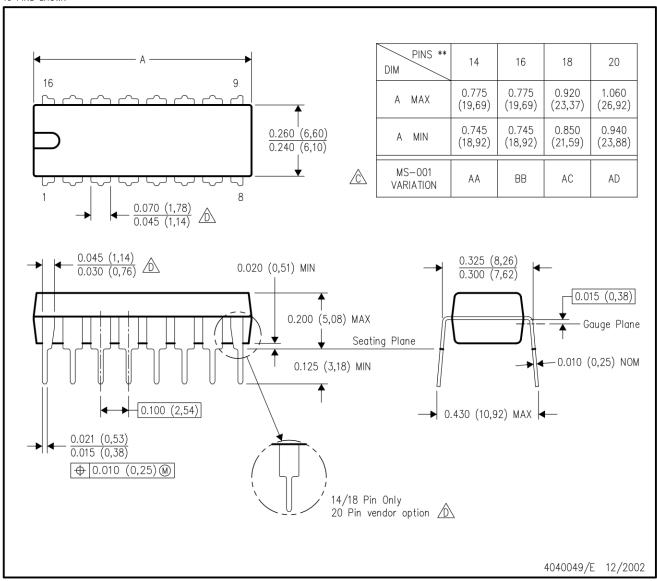
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPIC6595DWR	SOIC	DW	20	2000	350.0	350.0	43.0
TPIC6595DWRG4	SOIC	DW	20	2000	350.0	350.0	43.0

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



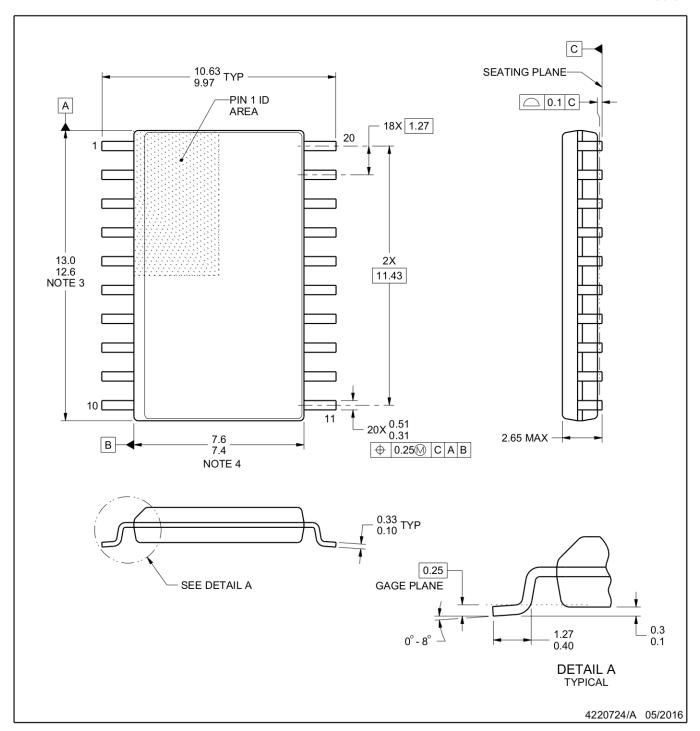
NOTES:

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





SOIC



NOTES:

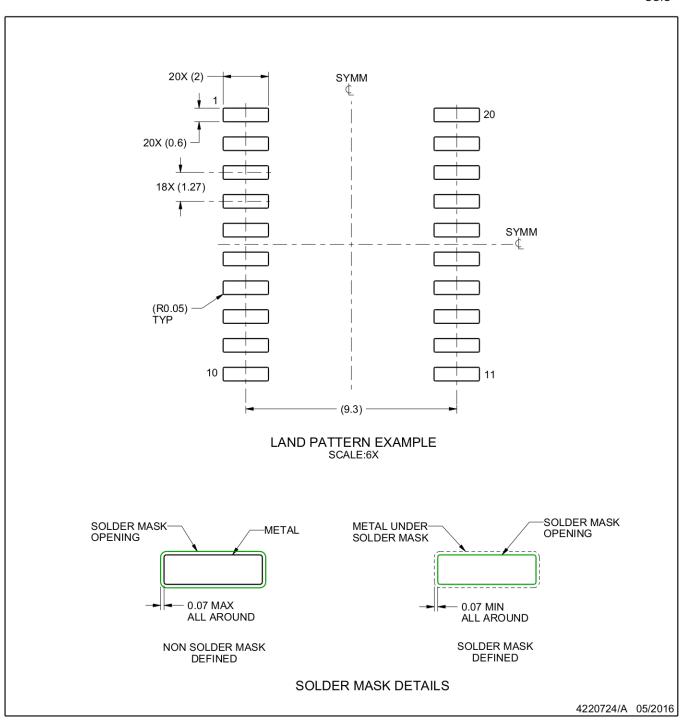
- 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

 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.



SOIC



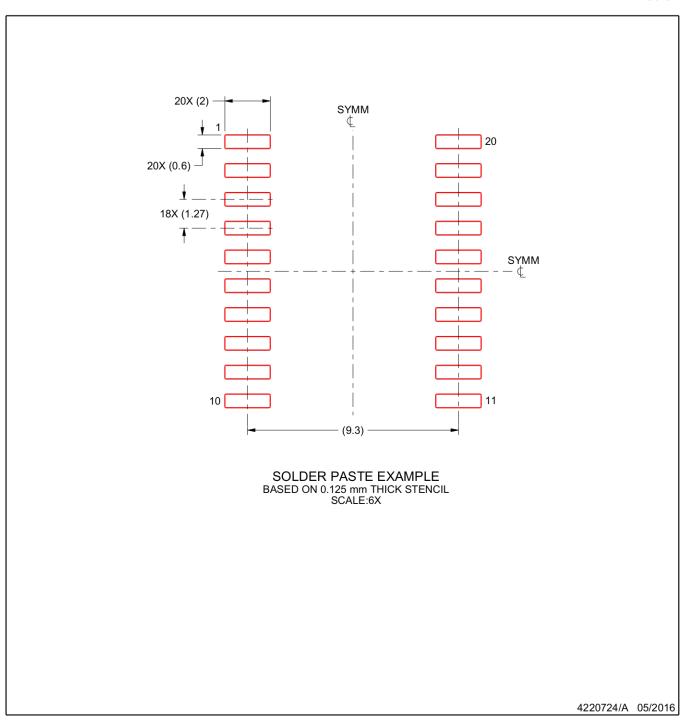
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOIC



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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