

TPIC6273 POWER LOGIC OCTAL D-TYPE LATCH

SLIS011A – APRIL 1992 – REVISED OCTOBER 1995

- Low $r_{DS(on)}$. . . 1.3 Ω Typ
- Avalanche Energy . . . 75 mJ
- Eight Power DMOS Transistor Outputs of 250-mA Continuous Current
- 1.5-A Pulsed Current Per Output
- Output Clamp Voltage up to 45 V
- Low Power Consumption

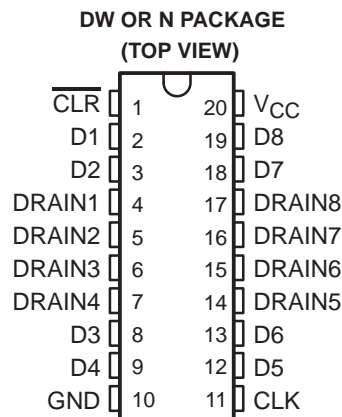
description

The TPIC6273 is a monolithic high-voltage high-current power logic octal D-type latch with DMOS transistor outputs 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.

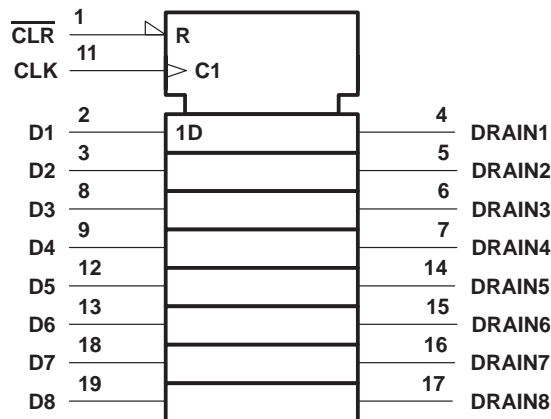
The TPIC6273 contains eight positive-edge-triggered D-type flip-flops with a direct clear input. Each flip-flop features an open-drain power DMOS transistor output.

When clear (\overline{CLR}) is high, information at the D inputs meeting the setup time requirements is transferred to the DRAIN outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When the clock input (CLK) is at either the high or low level, the D input signal has no effect at the output. An asynchronous \overline{CLR} is provided to turn all eight DMOS-transistor outputs off.

The TPIC6273 is characterized for operation over the operating case temperature range of -40°C to 125°C .



logic symbol†



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

**FUNCTION TABLE
(each channel)**

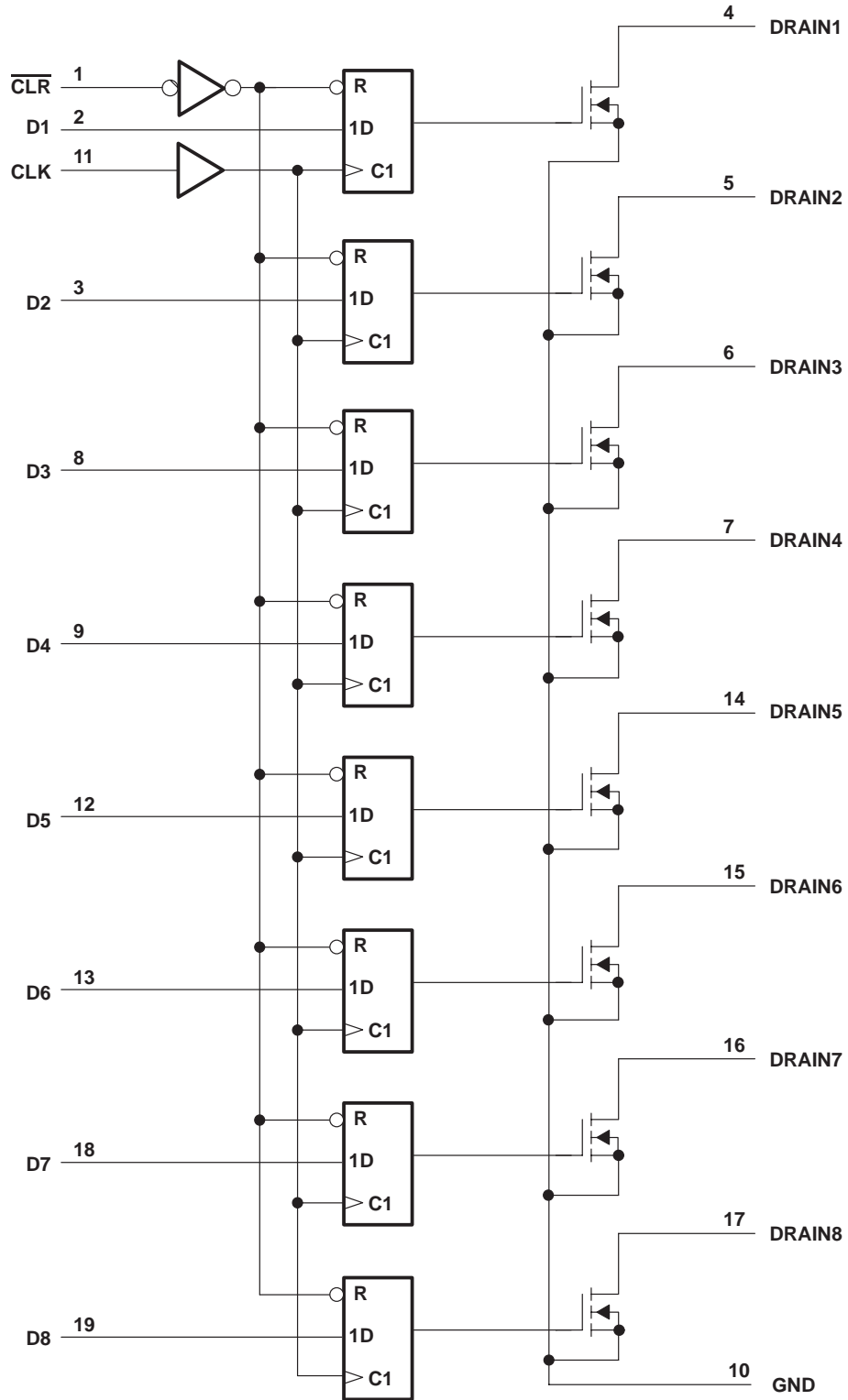
INPUTS			OUTPUT
\overline{CLR}	CLK	D	DRAIN
L	X	X	H
H	\uparrow	H	L
H	\uparrow	L	H
H	L	X	Latched

H = high level, L = low level, X = irrelevant

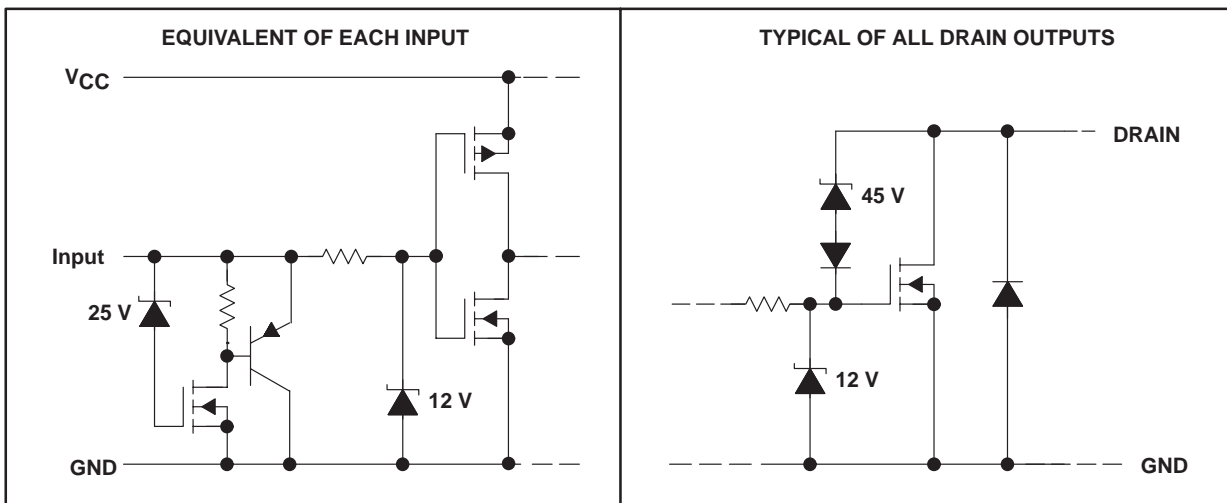
TPIC6273 POWER LOGIC OCTAL D-TYPE LATCH

SLIS011A – APRIL 1992 – REVISED OCTOBER 1995

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)	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, I_{Dn} , $T_A = 25^\circ\text{C}$ (see Note 3)	750 mA
Continuous drain current, each output, all outputs on, I_{Dn} , $T_A = 25^\circ\text{C}$	250 mA
Peak drain current single output, I_{DM} , $T_A = 25^\circ\text{C}$ (see Note 3)	2 A
Single-pulse avalanche energy, E_{AS} (see Figure 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_{stg}	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

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

DISSIPATION RATING TABLE

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

TPIC6273

POWER LOGIC OCTAL D-TYPE LATCH

SLIS011A – APRIL 1992 – REVISED OCTOBER 1995

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, $T_C = 25^\circ\text{C}$, $V_{CC} = 5\text{ V}$ (see Notes 3 and 5)	-1.8	1.5	A
Setup time, D high before $\text{CLK}\uparrow$, t_{SU} (see Figure 2)	10		ns
Hold time, D high after $\text{CLK}\uparrow$, t_H (see Figure 2)	15		ns
Pulse duration, t_W (see Figure 2)	25		ns
Operating case temperature, T_C	-40	125	$^\circ\text{C}$

electrical characteristics, $V_{CC} = 5\text{ V}$, $T_C = 25^\circ\text{C}$ (unless otherwise noted)

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 Note 3		0.85	1	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_{CC} Logic supply current	$I_O = 0$, All inputs low		15	100	μA
I_N Nominal current	$V_{DS(on)} = 0.5\text{ V}$, $I_N = I_D$, $T_C = 85^\circ\text{C}$ See Notes 5, 6, and 7		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	$I_D = 250\text{ mA}$, $V_{CC} = 4.5\text{ V}$		1.3	2	Ω
	$I_D = 250\text{ mA}$, $T_C = 125^\circ\text{C}$, $V_{CC} = 4.5\text{ V}$ See Notes 5 and 6 and Figures 8 and 9		2	3.2	
	$I_D = 500\text{ mA}$, $V_{CC} = 4.5\text{ V}$		1.3	2	

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 CLK	$C_L = 30\text{ pF}$, $I_D = 250\text{ mA}$, See Figures 1, 2, and 10		625		ns
t_{PHL} Propagation delay time, high-to-low-level output from CLK			150		ns
t_r Rise time, drain output			675		ns
t_f Fall time, drain output			400		ns
t_a Reverse-recovery-current rise time	$I_F = 250\text{ mA}$, $di/dt = 20\text{ A}/\mu\text{s}$, See Notes 5 and 6 and Figure 3		100		ns
t_{rr} Reverse-recovery time			300		

- NOTES: 3. Pulse duration $\leq 100\ \mu\text{s}$, 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.
7. 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 $T_C = 85^\circ\text{C}$.

thermal resistance

PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
$R_{\theta JA}$ Thermal resistance, junction-to-ambient	DW package		111	$^\circ\text{C}/\text{W}$
	N package	All 8 outputs with equal power	108	



PARAMETER MEASUREMENT INFORMATION

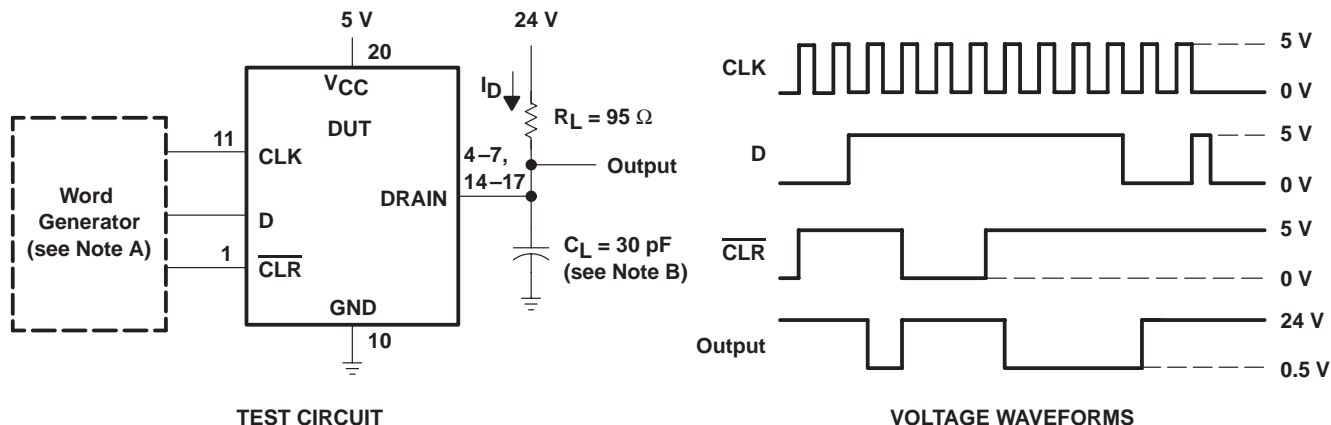


Figure 1. Resistive Load Normal Operation

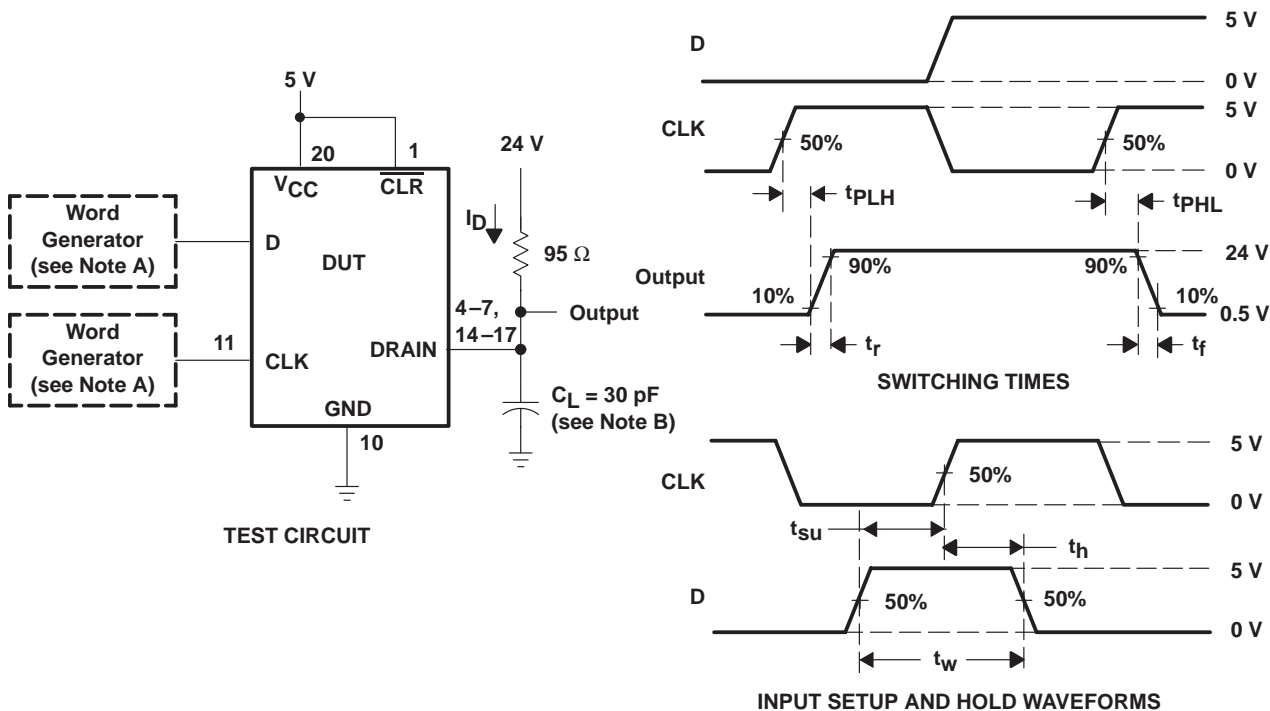


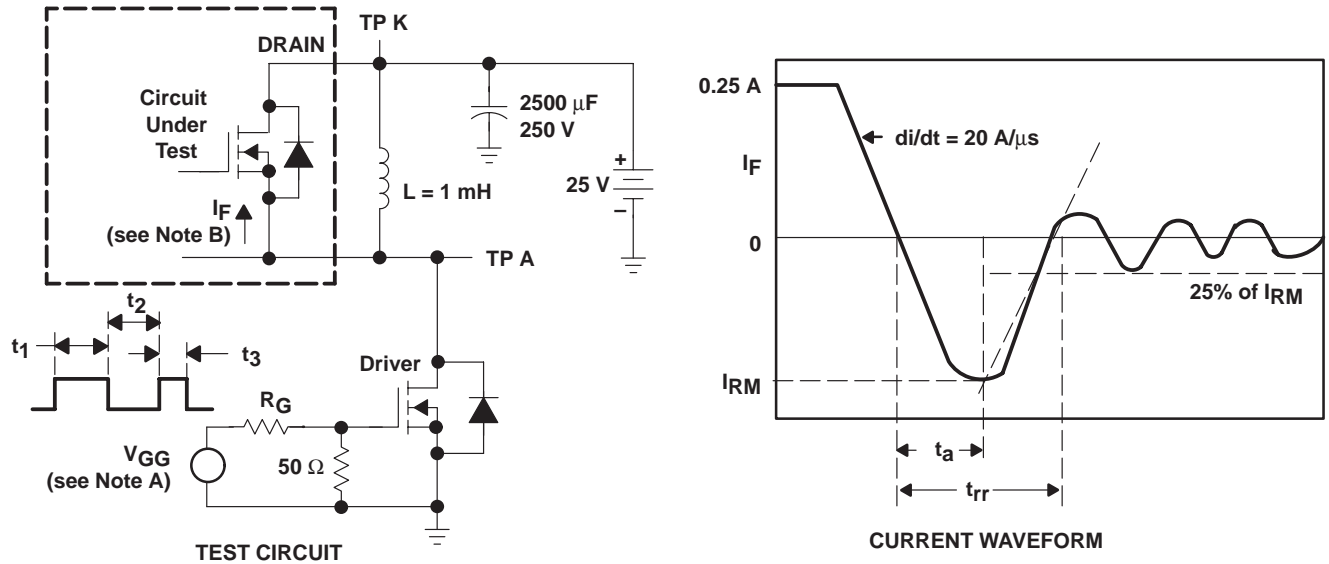
Figure 2. Test Circuit, Switching Times, and Voltage Waveforms

- NOTES: 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, $Z_0 = 50$ Ω .
B. C_L includes probe and jig capacitance.

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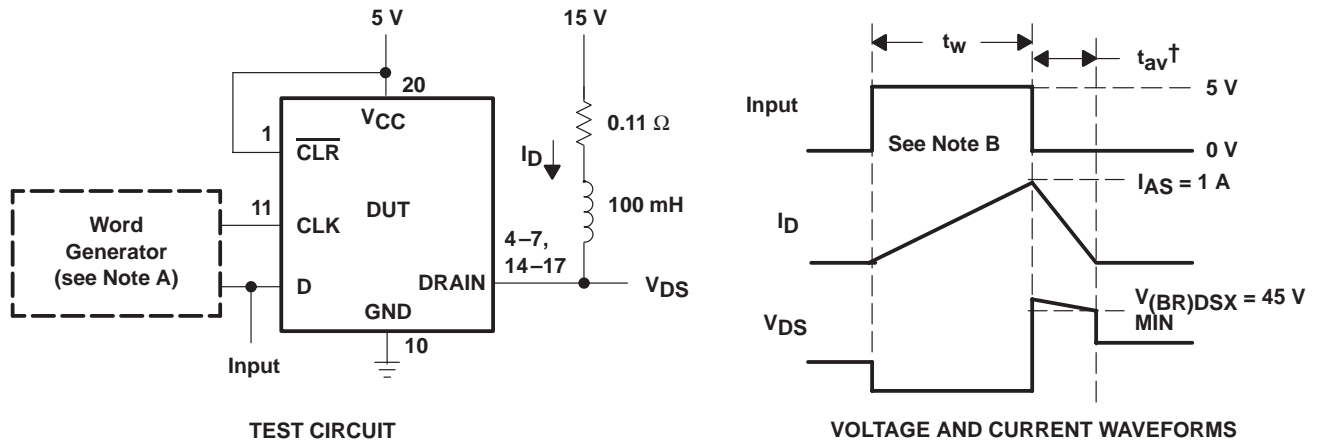
SLIS011A – APRIL 1992 – REVISED OCTOBER 1995

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. 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 $I_F = 0.25 \text{ A}$, where $t_1 = 10 \mu\text{s}$, $t_2 = 7 \mu\text{s}$, and $t_3 = 3 \mu\text{s}$.
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

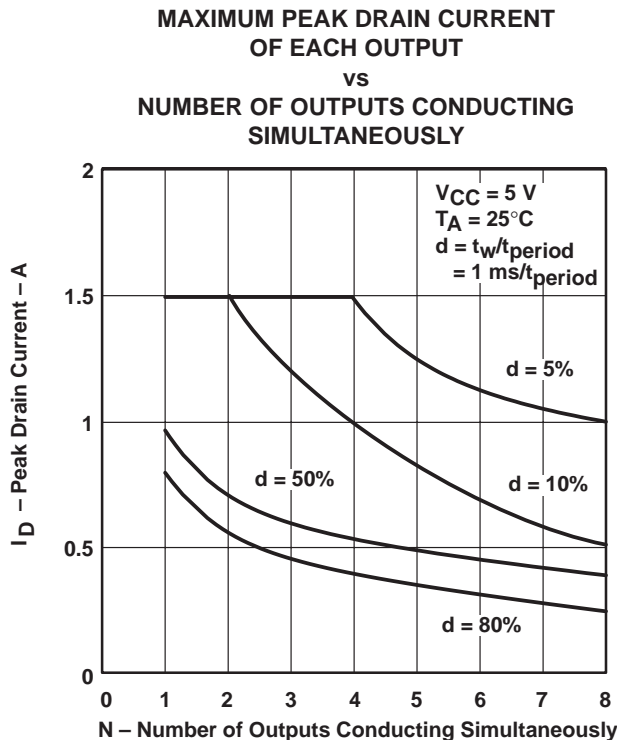
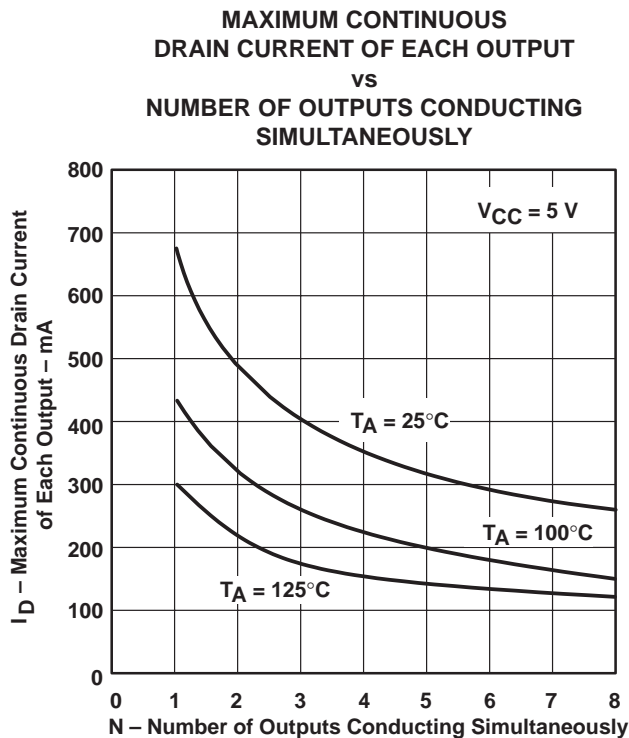
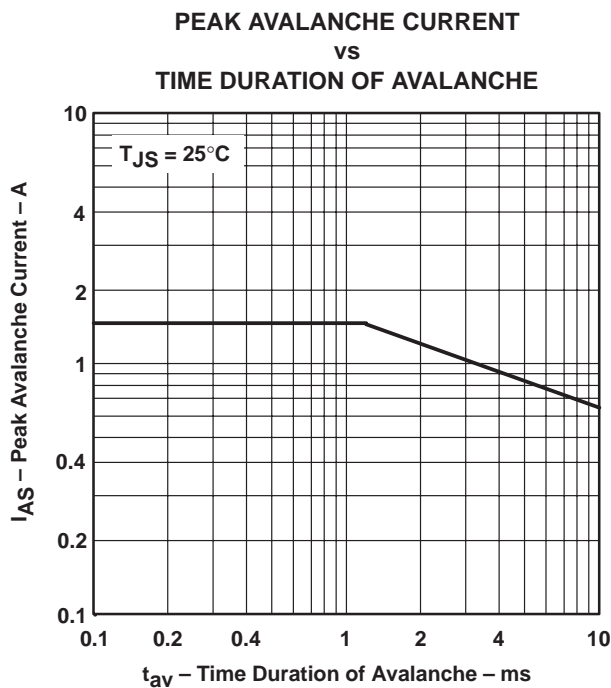


† Non-JEDEC symbol for avalanche ftime.

- NOTES: A. The word generator A 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 $I_{AS} = 1 \text{ A}$.
Energy test is defined as $E_{AS} = I_{AS} \times V_{(BR)DSX} \times t_{av}/2 = 75 \text{ mJ}$, where t_{av} = avalanche time.

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

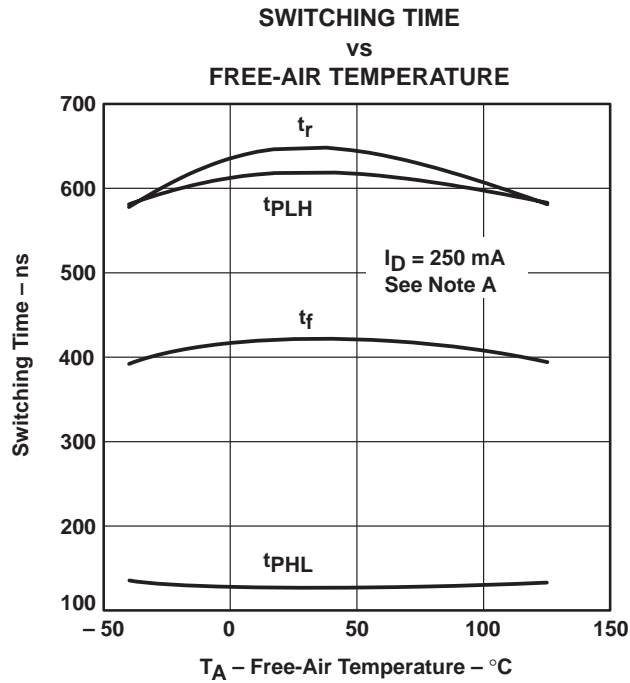
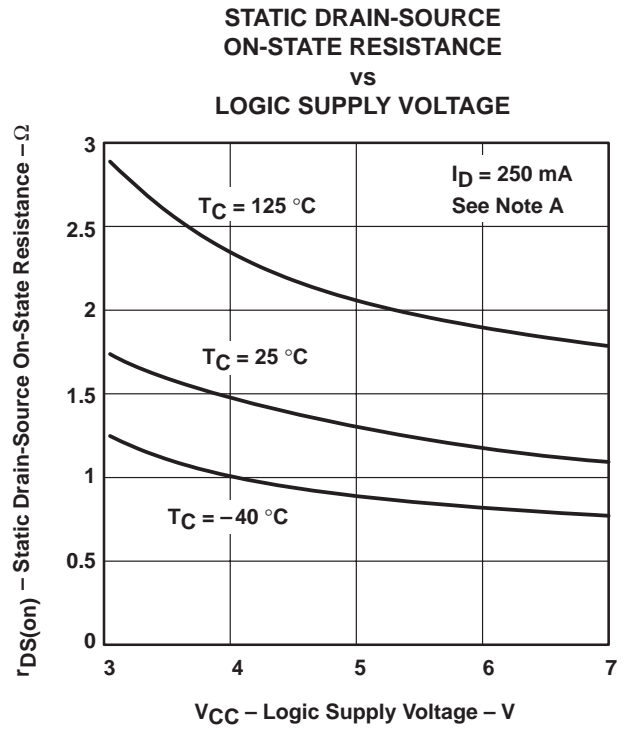
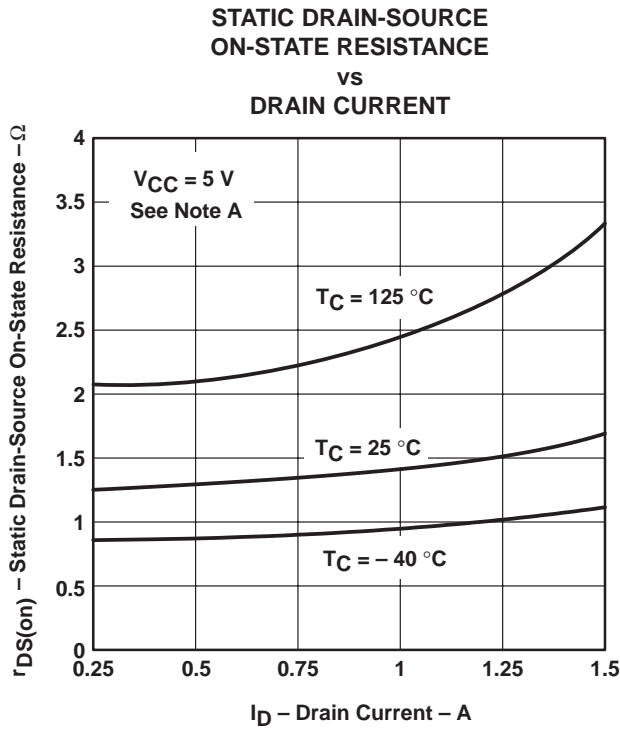
TYPICAL CHARACTERISTICS



TPIC6273 POWER LOGIC OCTAL D-TYPE LATCH

SLIS011A – APRIL 1992 – REVISED OCTOBER 1995

TYPICAL CHARACTERISTICS



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

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
TPIC6273DW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6273	Samples
TPIC6273DWG4	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		TPIC6273	Samples
TPIC6273DWR	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TPIC6273	Samples
TPIC6273DWRG4	ACTIVE	SOIC	DW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		TPIC6273	Samples
TPIC6273N	ACTIVE	PDIP	N	20	20	RoHS & Green	NIPDAU	N / A for Pkg Type	-40 to 125	TPIC6273N	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.

OBSELETE: 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

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
TPIC6273DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1
TPIC6273DWRG4	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)
TPIC6273DWR	SOIC	DW	20	2000	350.0	350.0	43.0
TPIC6273DWRG4	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)
TPIC6273DW	DW	SOIC	20	25	506.98	12.7	4826	6.6
TPIC6273DWG4	DW	SOIC	20	25	506.98	12.7	4826	6.6
TPIC6273N	N	PDIP	20	20	506	13.97	11230	4.32

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.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

DW0020A



PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

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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