

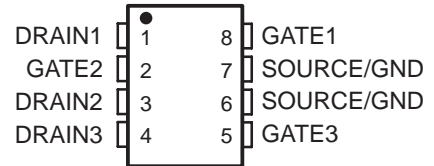
# TPIC2322L

## 3-CHANNEL COMMON-SOURCE LOGIC-LEVEL POWER DMOS ARRAY

SLIS036A – JUNE 1994 – REVISED OCTOBER 1994

- Low  $r_{DS(on)}$  . . . 0.6  $\Omega$  Typ
- High-Voltage Outputs . . . 60 V
- Pulsed Current . . . 2.25 A Per Channel
- Fast Commutation Speed
- Direct Logic-Level Interface

**D PACKAGE  
(TOP VIEW)**

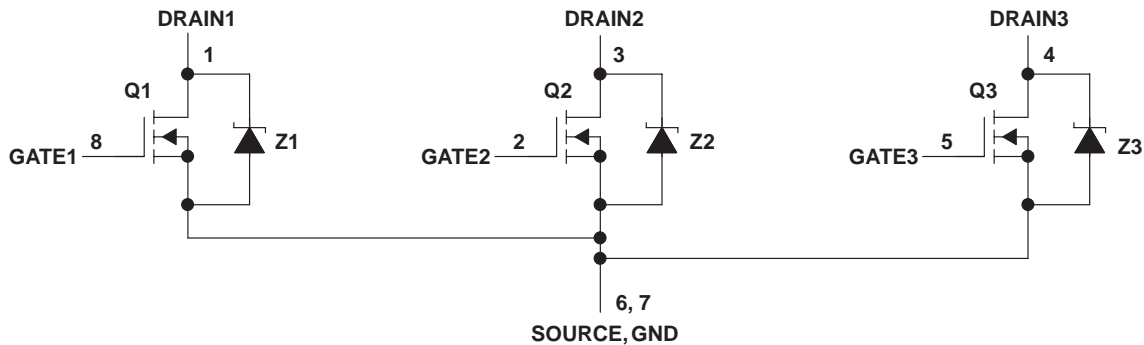


### description

The TPIC2322L is a monolithic logic-level power DMOS array that consists of three electrically isolated N-channel enhancement-mode DMOS transistors configured with a common source and open drains.

The TPIC2322L is offered in a standard eight-pin small-outline surface-mount (D) package and is characterized for operation over the case temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

### schematic



### absolute maximum ratings over operating case temperature range (unless otherwise noted)<sup>†</sup>

Drain-to-source voltage, $V_{DS}$	60 V
Gate-to-GND voltage	100 V
Drain-to-GND voltage	100 V
Gate-to-source voltage, $V_{GS}$	$\pm 20$ V
Continuous drain current, each output, all outputs on, $T_C = 25^{\circ}\text{C}$	0.75 A
Continuous source-to-drain diode current, $T_C = 25^{\circ}\text{C}$	0.75 A
Pulsed drain current, each output, $I_{max}$ , $T_C = 25^{\circ}\text{C}$ (see Note 1 and Figure 15)	2.25 A
Single-pulse avalanche energy, $E_{AS}$ , $T_C = 25^{\circ}\text{C}$ (see Figure 4)	30.4 mJ
Continuous total power dissipation at (or below) $T_C = 25^{\circ}\text{C}$ (see Figure 15)	0.95 W
Operating virtual junction temperature range, $T_J$	$-40^{\circ}\text{C}$ to $150^{\circ}\text{C}$
Operating case temperature range, $T_C$	$-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$
Storage temperature range	$-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	$260^{\circ}\text{C}$

<sup>†</sup> 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.

NOTE 1: Pulse duration = 10 ms and duty cycle = 2%.

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### electrical characteristics, $T_C = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{(BR)DSX}$	Drain-to-source breakdown voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	60			V
$V_{GS(th)}$	Gate-to-source threshold voltage	$I_D = 1\ \text{mA}$ , See Figure 5 $V_{DS} = V_{GS}$	1.5	1.85	2.2	V
$V_{(BR)}$	Reverse drain to GND breakdown voltage	Drain to GND current = $250\ \mu\text{A}$	100			V
$V_{DS(on)}$	Drain-to-source on-state voltage	$I_D = 0.75\ \text{A}$ , See Notes 2 and 3 $V_{GS} = 5\ \text{V}$		0.45	0.53	V
$V_{F(SD)}$	Forward on-state voltage, source-to-drain	$I_S = 0.75\ \text{A}$ , See Notes 2 and 3 and Figure 12 $V_{GS} = 0$		0.85	1	V
$I_{DSS}$	Zero-gate-voltage drain current	$V_{DS} = 48\ \text{V}$ , $V_{GS} = 0$		0.05	1	$\mu\text{A}$
		$T_C = 125^\circ\text{C}$		0.5	10	
$I_{GSSF}$	Forward gate current, drain short circuited to source	$V_{GS} = 16\ \text{V}$ , $V_{DS} = 0$		10	100	nA
$I_{GSSR}$	Reverse gate current, drain short circuited to source	$V_{SG} = 16\ \text{V}$ , $V_{DS} = 0$		10	100	nA
$I_{lkg}$	Leakage current, drain-to-GND	$V_{DGND} = 48\ \text{V}$		0.05	1	$\mu\text{A}$
				0.5	10	
$r_{DS(on)}$	Static drain-to-source on-state resistance	$V_{GS} = 5\ \text{V}$ , $I_D = 0.75\ \text{A}$ , See Notes 2 and 3 and Figures 6 and 7 $T_C = 25^\circ\text{C}$		0.6	0.7	$\Omega$
		$T_C = 125^\circ\text{C}$		0.94	1	
$g_{fs}$	Forward transconductance	$V_{DS} = 15\ \text{V}$ , $I_D = 0.5\ \text{A}$ , See Notes 2 and 3 and Figure 9	0.75	0.9		S
$C_{iss}$	Short-circuit input capacitance, common source	$V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$ , $V_{GS} = 0$ , See Figure 11		115	145	pF
$C_{oss}$	Short-circuit output capacitance, common source			60	75	
$C_{rss}$	Short-circuit reverse transfer capacitance, common source			30	40	

NOTES: 2. Technique should limit  $T_J - T_C$  to  $10^\circ\text{C}$  maximum.  
3. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

### source-to-drain diode characteristics, $T_C = 25^\circ\text{C}$ (see schematic diagram)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{rr}$	Reverse-recovery time	$I_F = 0.375\ \text{A}$ , $dI/dt = 100\ \text{A}/\mu\text{s}$ , See Figures 1 and 14 $V_{DS} = 48\ \text{V}$		85		ns
$Q_{RR}$	Total diode charge			0.19		$\mu\text{C}$

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## 3-CHANNEL COMMON-SOURCE LOGIC-LEVEL POWER DMOS ARRAY

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### resistive-load switching characteristics, $T_C = 25^\circ\text{C}$

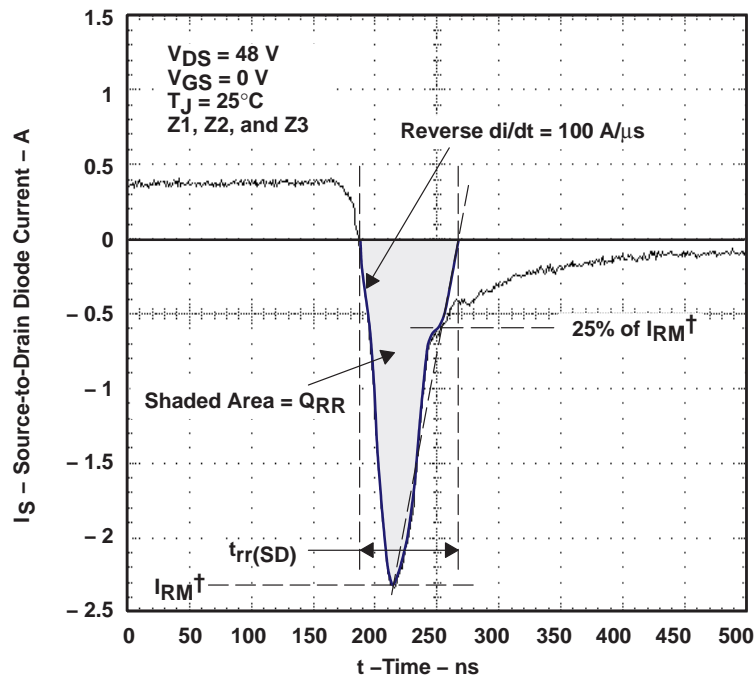
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(on)}$ Turn-on delay time	$V_{DD} = 25\text{ V},$ $R_L = 67\ \Omega,$ $t_{dis} = 10\text{ ns},$ See Figure 2		21	42	ns
$t_{d(off)}$ Turn-off delay time			26	52	
$t_r$ Rise time			14	28	
$t_f$ Fall time			13	26	
$Q_g$ Total gate charge	$V_{DS} = 48\text{ V},$ See Figure 3 $I_D = 0.375\text{ A},$ $V_{GS} = 5\text{ V},$		1.8	2.3	nC
$Q_{gs(th)}$ Threshold gate-to-source charge			0.4	0.5	
$Q_{gd}$ Gate-to-drain charge			1.1	1.4	
$L_D$ Internal drain inductance			5		nH
$L_S$ Internal source inductance			5		
$R_g$ Internal gate resistance			0.25		$\Omega$

### thermal resistance

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{\theta JA}$ Junction-to-ambient thermal resistance, See Note 4	All outputs with equal power		130		$^\circ\text{C/W}$
$R_{\theta JP}$ Junction-to-pin thermal resistance			44		$^\circ\text{C/W}$

NOTE 4: Package mounted on an FR4 printed-circuit board with no heat sink.

### PARAMETER MEASUREMENT INFORMATION



$\dagger I_{RM}$  = maximum recovery current

Figure 1. Reverse-Recovery-Current Waveform of Source-to-Drain Diode



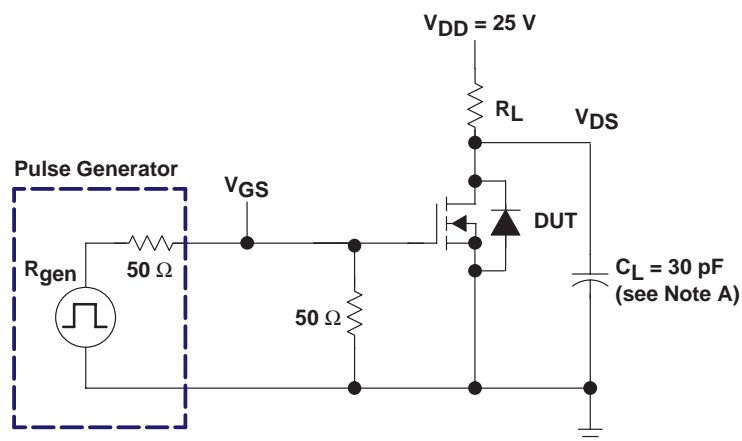
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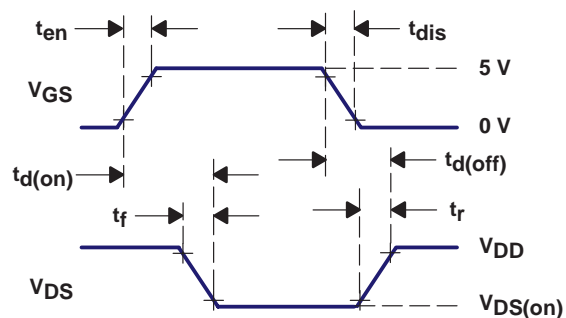
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### PARAMETER MEASUREMENT INFORMATION



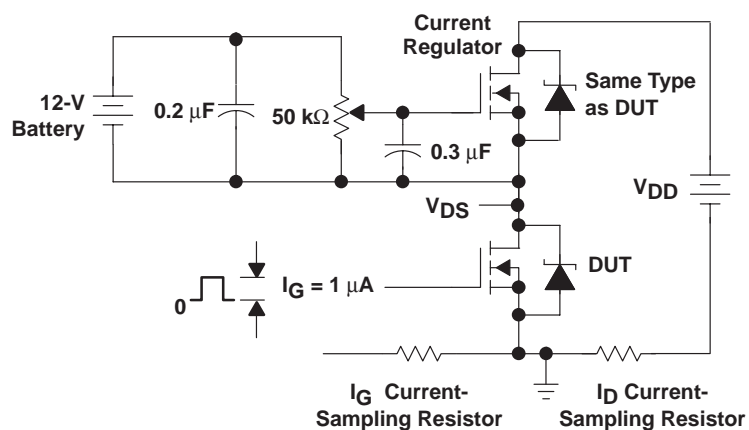
TEST CIRCUIT

NOTE A: C<sub>L</sub> includes probe and jig capacitance.

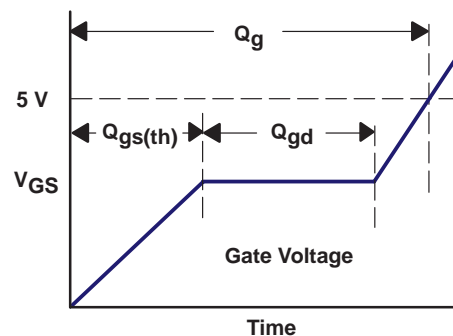


VOLTAGE WAVEFORMS

Figure 2. Resistive-Switching Test Circuit and Voltage Waveforms



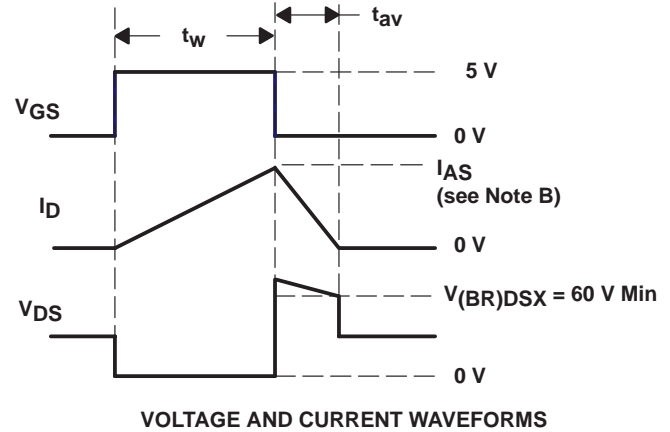
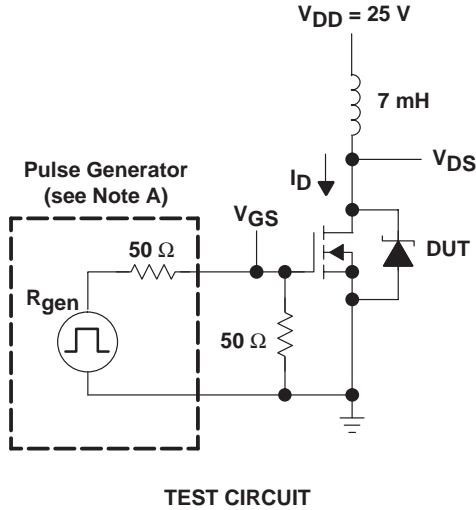
TEST CIRCUIT



VOLTAGE WAVEFORM

Figure 3. Gate-Charge Test Circuit and Voltage Waveform

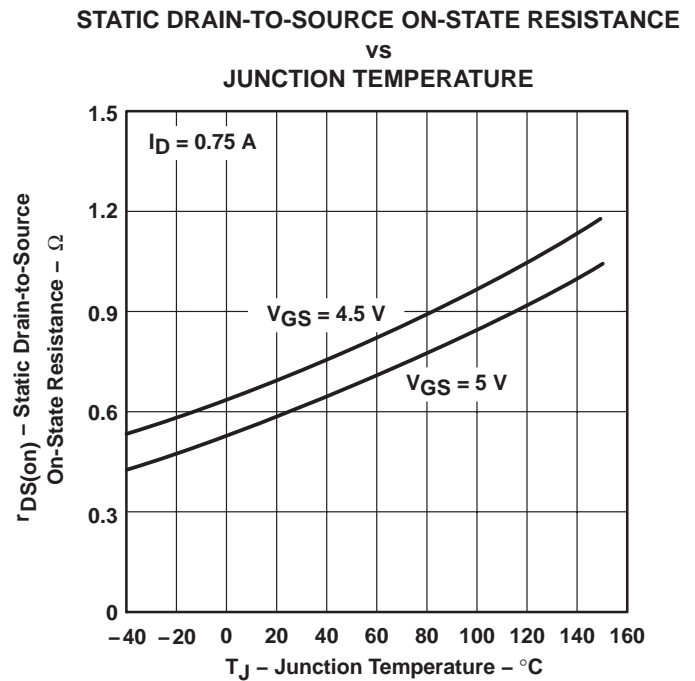
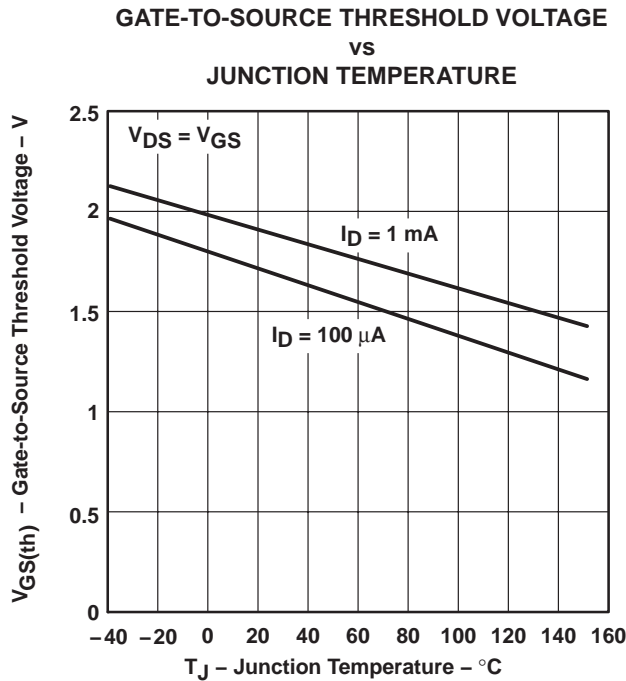
### PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The pulse generator has the following characteristics:  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_0 = 50 \Omega$ .  
 B. Input pulse duration ( $t_w$ ) is increased until peak current  $I_{AS} = 2.25$  A.  
 Energy test level is defined as  $E_{AS} = \frac{I_{AS} \times V_{(BR)DSX} \times t_{av}}{2} = 30.4$  mJ.

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

### TYPICAL CHARACTERISTICS



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## 3-CHANNEL COMMON-SOURCE LOGIC-LEVEL POWER DMOS ARRAY

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### TYPICAL CHARACTERISTICS

STATIC DRAIN-TO-SOURCE ON-STATE RESISTANCE  
vs  
DRAIN CURRENT

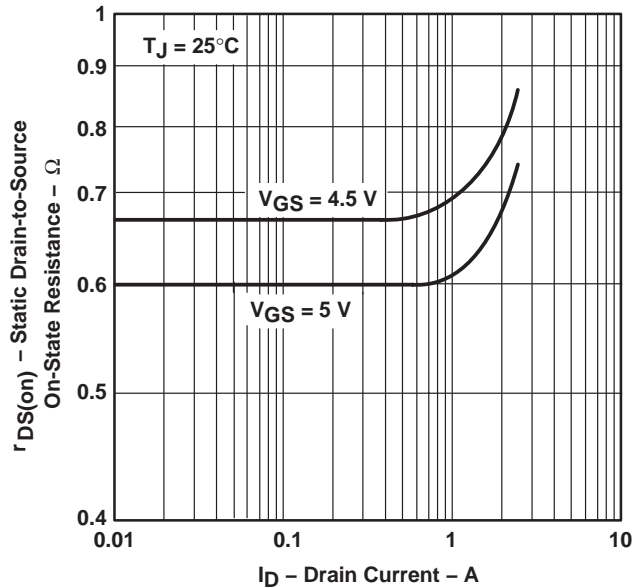


Figure 7

DRAIN CURRENT  
vs  
DRAIN-TO-SOURCE VOLTAGE

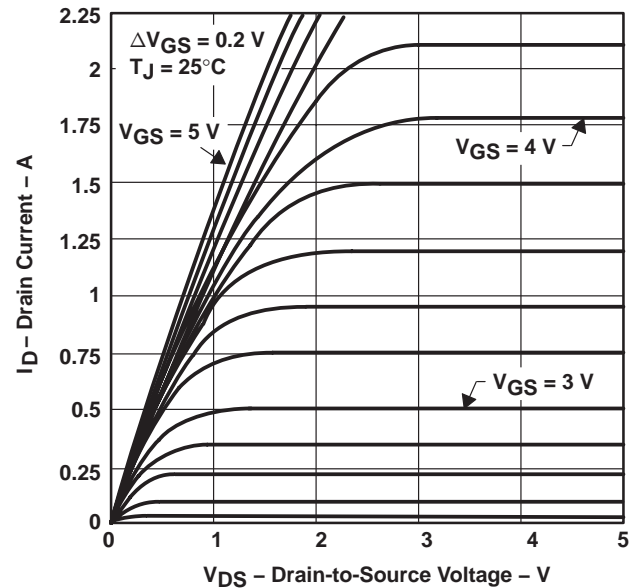


Figure 8

DISTRIBUTION OF  
FORWARD TRANSCONDUCTANCE

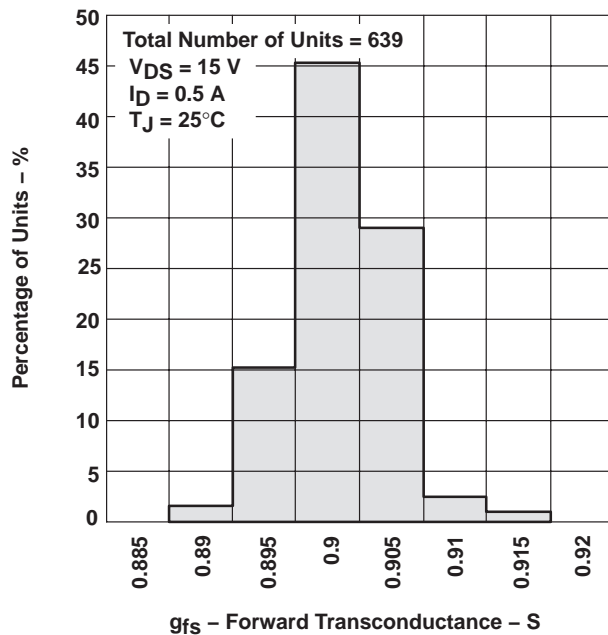


Figure 9

DRAIN CURRENT  
vs  
GATE-TO-SOURCE VOLTAGE

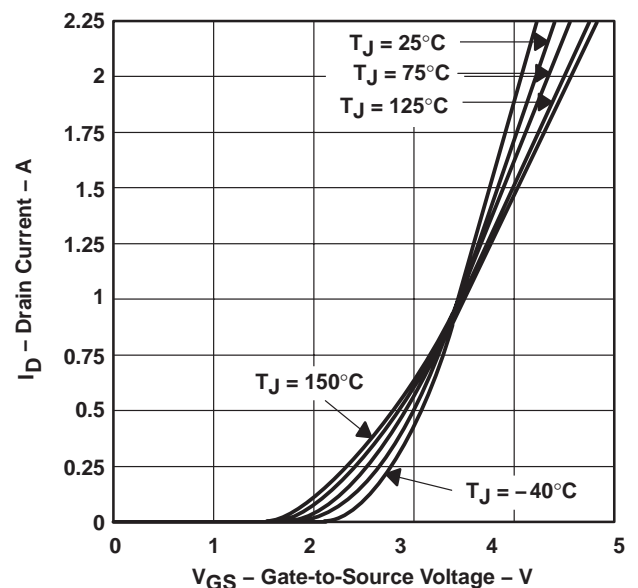


Figure 10

# TPIC2322L 3-CHANNEL COMMON-SOURCE LOGIC-LEVEL POWER DMOS ARRAY

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## TYPICAL CHARACTERISTICS

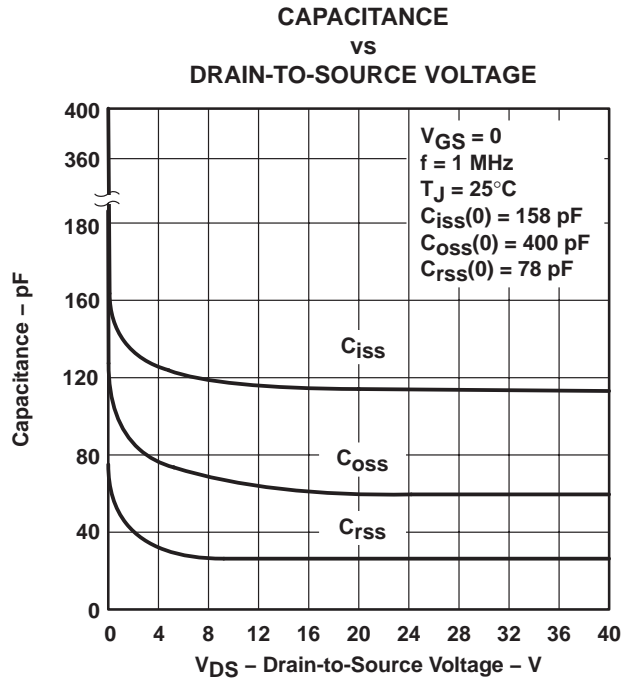


Figure 11

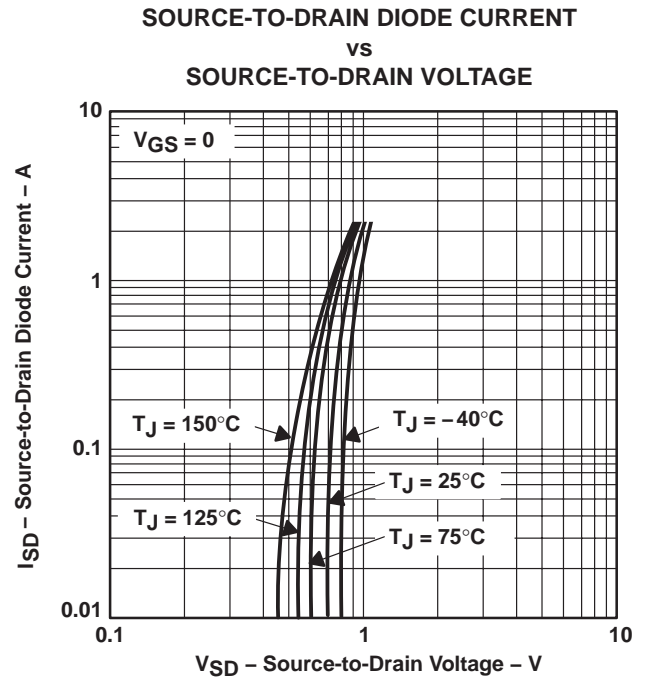


Figure 12

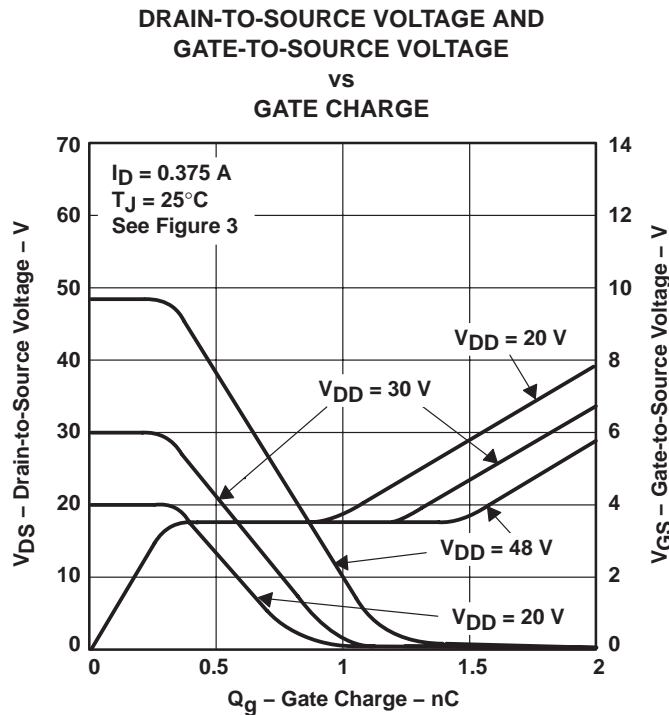


Figure 13

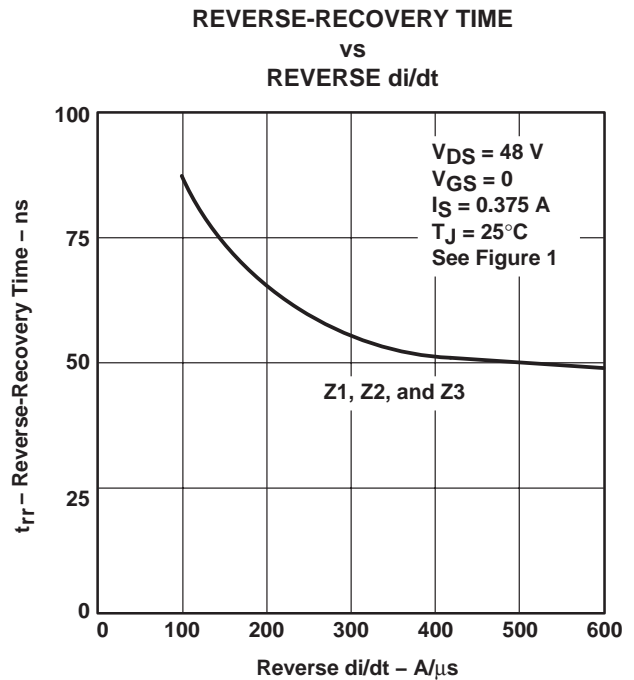


Figure 14



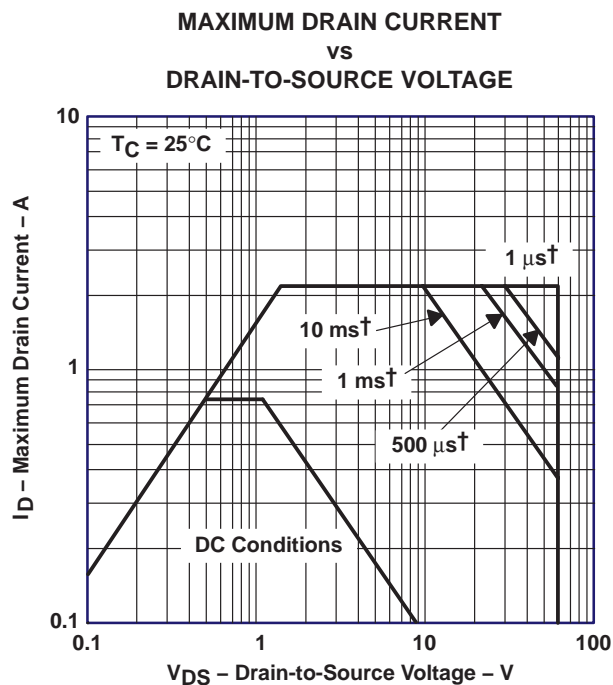
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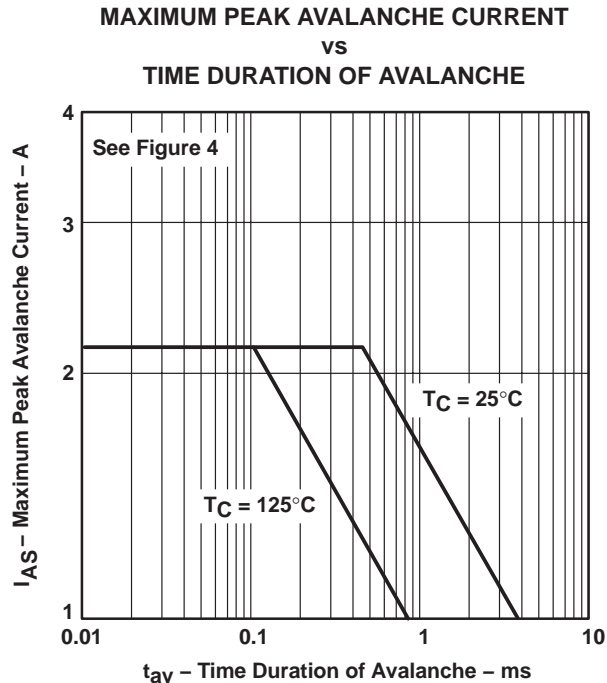
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### THERMAL INFORMATION



† Less than 2% duty cycle

**Figure 15**



**Figure 16**

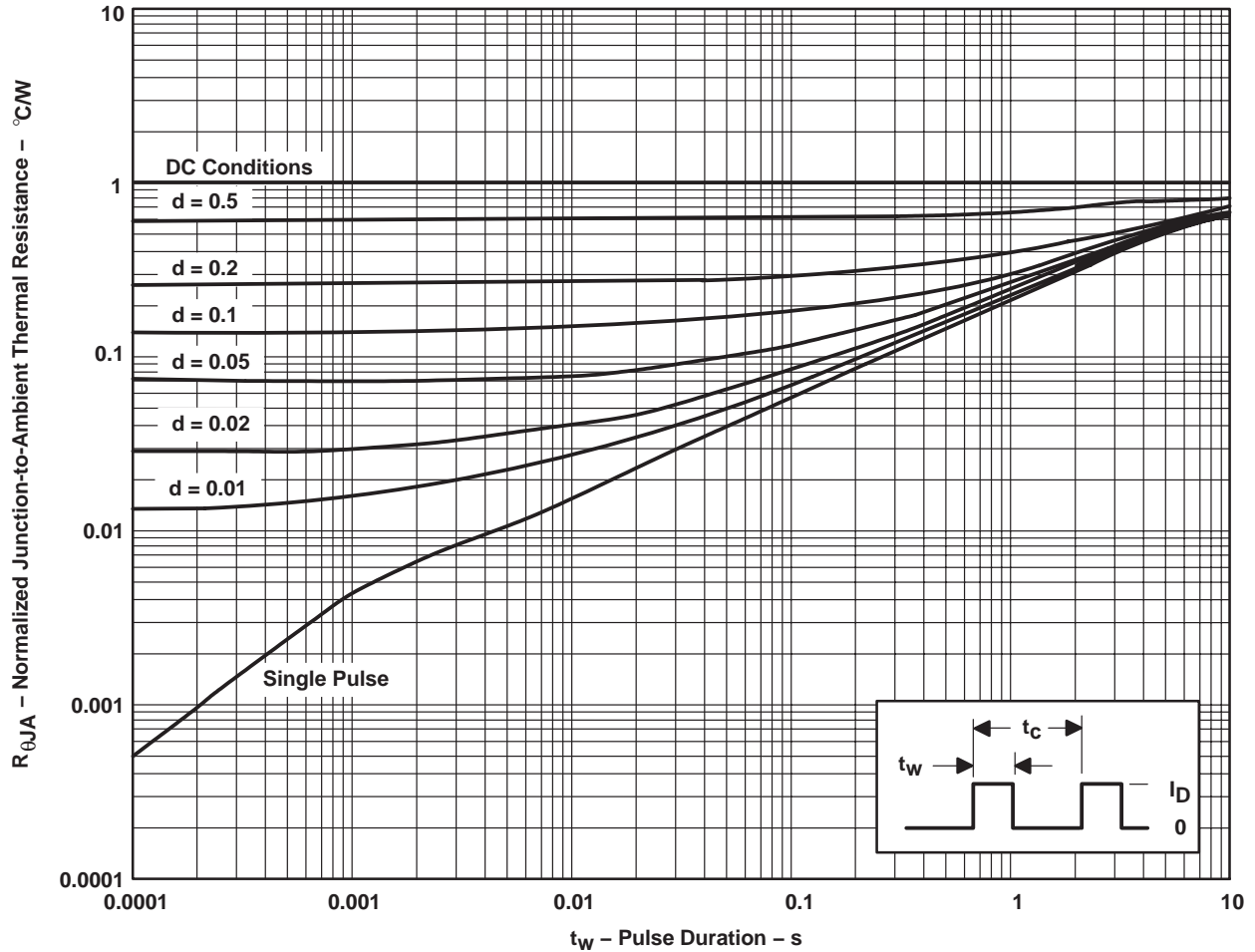


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## THERMAL INFORMATION

### D PACKAGE† NORMALIZED JUNCTION-TO-AMBIENT THERMAL RESISTANCE vs PULSE DURATION



† Device mounted on FR4 printed-circuit board with no heat sink.

NOTES:  $Z_{\theta A}(t) = r(t) R_{\theta JA}$   
 $t_W$  = pulse duration  
 $t_C$  = cycle time  
 $d$  = duty cycle =  $t_W/t_C$

Figure 17

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TPIC2322LD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

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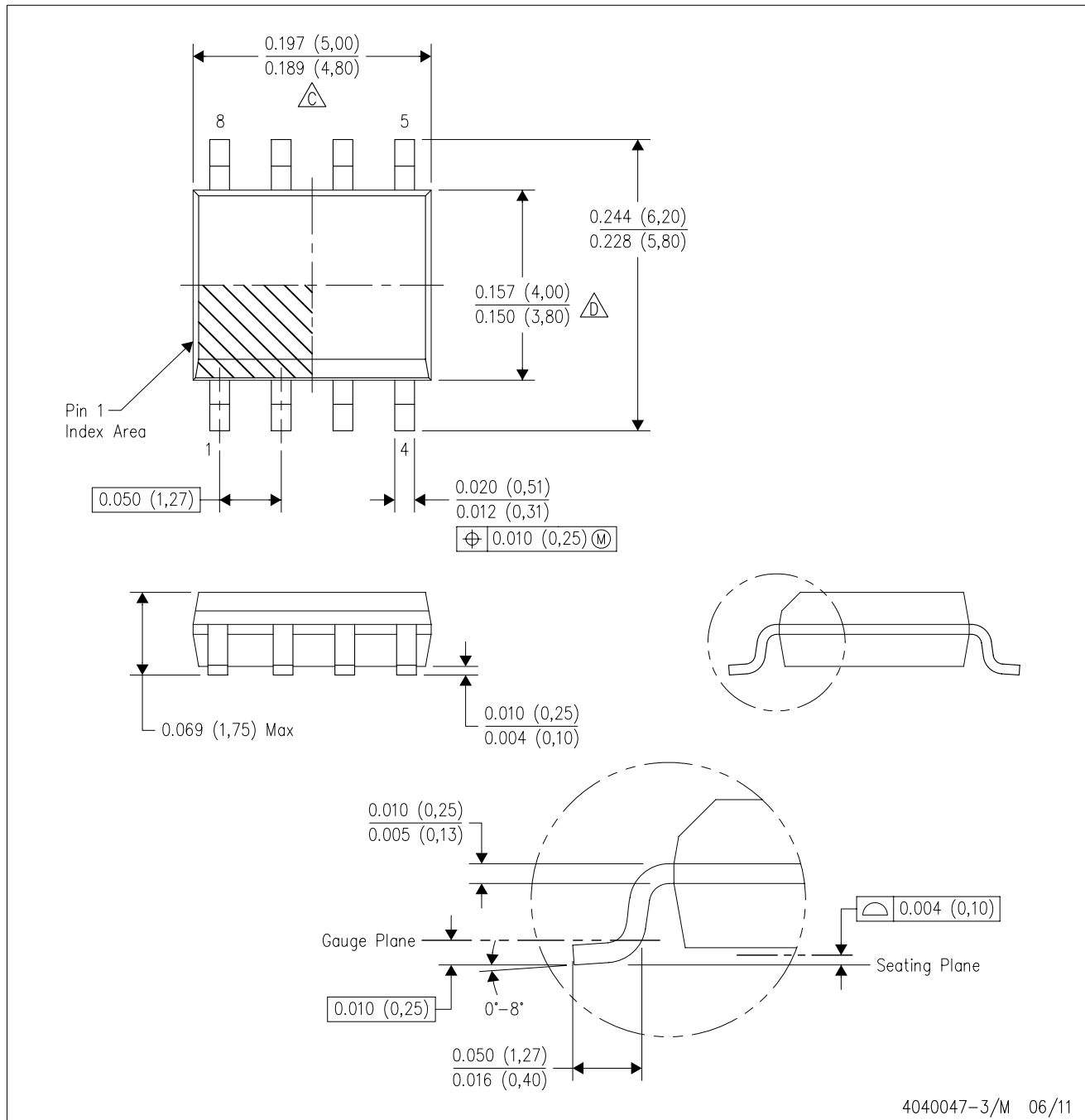
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

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