

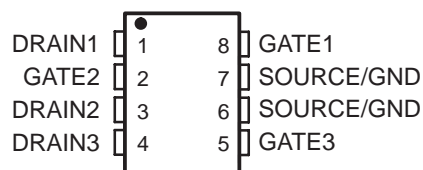
TPIC2302

3-CHANNEL COMMON-SOURCE POWER DMOS ARRAY

SLIS028B – APRIL 1994 – REVISED SEPTEMBER 1995

- Low $r_{DS(on)}$. . . 0.4 Ω Typ
- High-Voltage Outputs . . . 60 V
- Pulsed Current . . . 5 A Per Channel
- Fast Commutation Speed

**D PACKAGE
(TOP VIEW)**

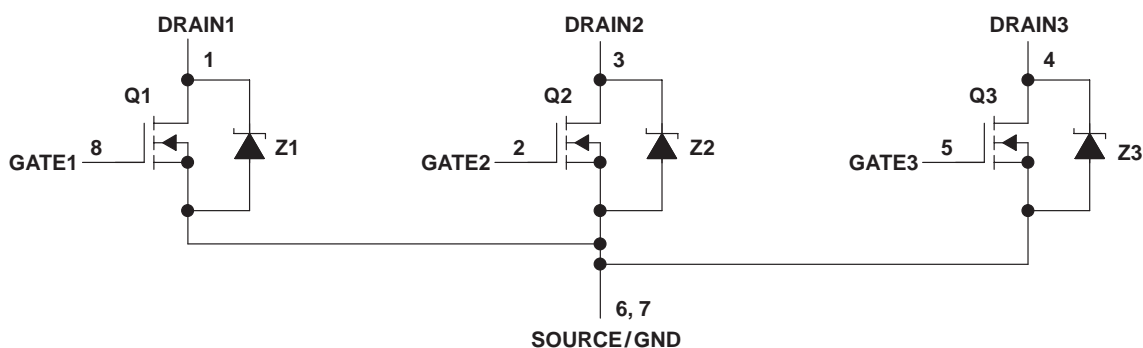


description

The TPIC2302 is a monolithic power DMOS array that consists of three electrically isolated N-channel enhancement-mode DMOS transistors configured with a common source and open drains. The TPIC2302 is offered in a standard 8-pin small-outline surface-mount (D) package.

The TPIC2302 is characterized for operation over the case temperature range of -40°C to 125°C .

schematic



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

Drain-to-source voltage, V_{DS}	60 V
Gate-to-source voltage, V_{GS}	± 20 V
Continuous drain current, each output, all outputs on, $T_C = 25^{\circ}\text{C}$	1 A
Pulsed drain current, each output, $T_C = 25^{\circ}\text{C}$ (see Note 1 and Figure 6)	5 A
Single-pulse avalanche energy, $T_C = 25^{\circ}\text{C}$, E_{AS} (see Figures 4 and 16)	9 mJ
Continuous total power dissipation at (or below) $T_C = 25^{\circ}\text{C}$	0.95 W
Operating virtual junction temperature range, T_J	-40°C to 150°C
Operating case temperature range, T_C	-40°C to 125°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.

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

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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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	$I_D = 1 \text{ mA}$,	$V_{DS} = V_{GS}$	1.5	1.85	2.2	V
$V_{DS(on)}$	Drain-to-source on-state voltage	$I_D = 1 \text{ A}$, See Notes 2 and 3	$V_{GS} = 10 \text{ V}$,		0.4	0.475	V
$V_{F(SD)}$	Forward on-state voltage, source-to-drain	$I_S = 1 \text{ A}$, $V_{GS} = 0$ (Z1, Z2, Z3), See Notes 2 and 3			0.9	1.1	V
I_{DSS}	Zero-gate-voltage drain current	$V_{DS} = 48 \text{ V}$, $V_{GS} = 0$	$T_C = 25^\circ\text{C}$		0.05	1	μA
			$T_C = 125^\circ\text{C}$		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	$V_R = 48 \text{ V}$	$T_C = 25^\circ\text{C}$		0.05	1	μA
			$T_C = 125^\circ\text{C}$		0.5	10	
$r_{DS(on)}$	Static drain-to-source on-state resistance	$V_{GS} = 10 \text{ V}$, $I_D = 1 \text{ A}$, See Notes 2 and 3 and Figures 6 and 7	$T_C = 25^\circ\text{C}$		0.4	0.475	Ω
			$T_C = 125^\circ\text{C}$		0.63	0.7	
g_{fs}	Forward transconductance	$V_{DS} = 10 \text{ V}$, See Notes 2 and 3	$I_D = 0.5 \text{ A}$,	0.85	1.02		S
C_{iss}	Short-circuit input capacitance, common source				115	145	pF
C_{oss}	Short-circuit output capacitance, common source	$V_{DS} = 25 \text{ V}$,	$V_{GS} = 0$,		60	75	
C_{rss}	Short-circuit reverse-transfer capacitance, common source	$f = 1 \text{ MHz}$			30	40	

- NOTES: 2. Technique should limit $T_J - T_C$ to 10°C maximum, pulse duration $\leq 5 \text{ ms}$.
3. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

source-to-drain diode characteristics, $T_C = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{rr(SD)}$	Reverse-recovery time	$I_S = 0.5 \text{ A}$,	$V_{GS} = 0$, $V_{DS} = 48 \text{ V}$,		65		ns
Q_{RR}	Total diode charge	$di/dt = 100 \text{ A}/\mu\text{s}$,	See Figure 1		0.03		μC

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

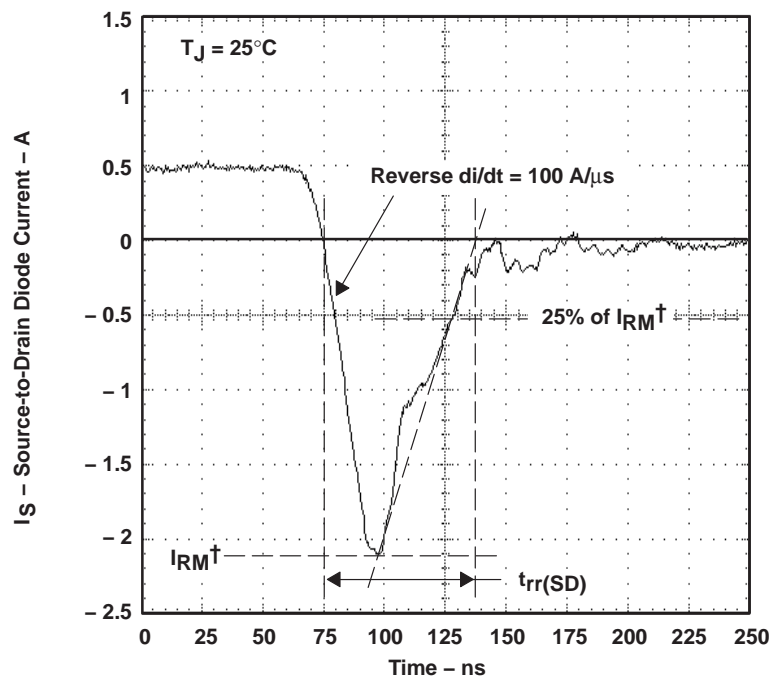
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(on)}$ Turn-on delay time	$V_{DD} = 25\text{ V},$ $R_L = 50\ \Omega,$ $t_{r1} = 10\text{ ns},$ See Figure 2		21	42	ns
$t_{d(off)}$ Turn-off delay time			20	40	
t_{r2} Rise time			5	10	
t_{f2} Fall time			13	26	
Q_g Total gate charge	$V_{DS} = 48\text{ V},$ See Figure 3 $I_D = 0.5\text{ A},$ $V_{GS} = 10\text{ V},$		3.1	3.8	nC
$Q_{gs(th)}$ Threshold gate-to-source charge			0.4	0.5	
Q_{gd} Gate-to-drain charge			1.3	1.6	
L_D Internal drain inductance			5		nH
L_S Internal source inductance			5		
R_g Internal gate resistance			0.25		Ω

thermal resistance

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

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

PARAMETER MEASUREMENT INFORMATION



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

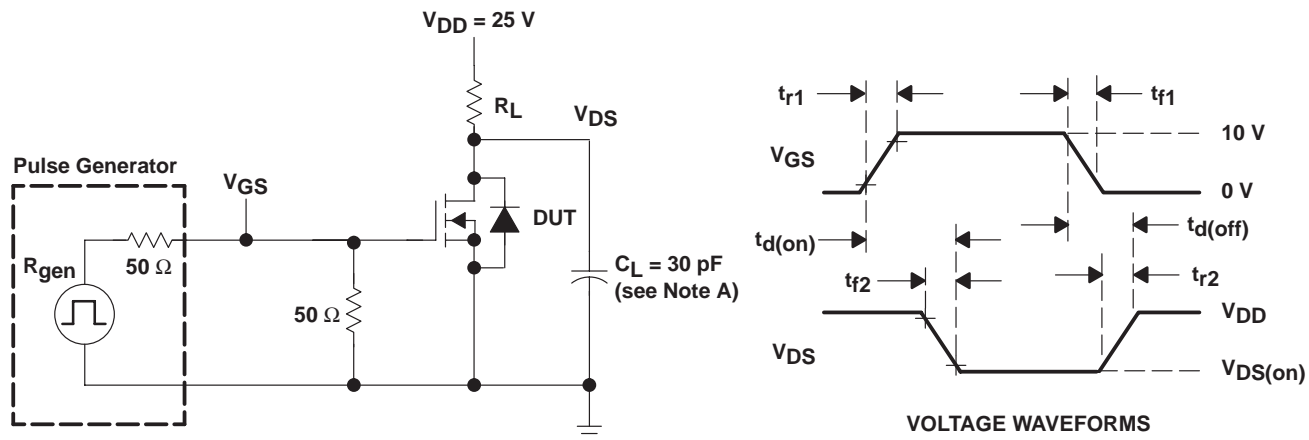
Figure 1. Reverse-Recovery-Current Waveform of Source-to-Drain Diode



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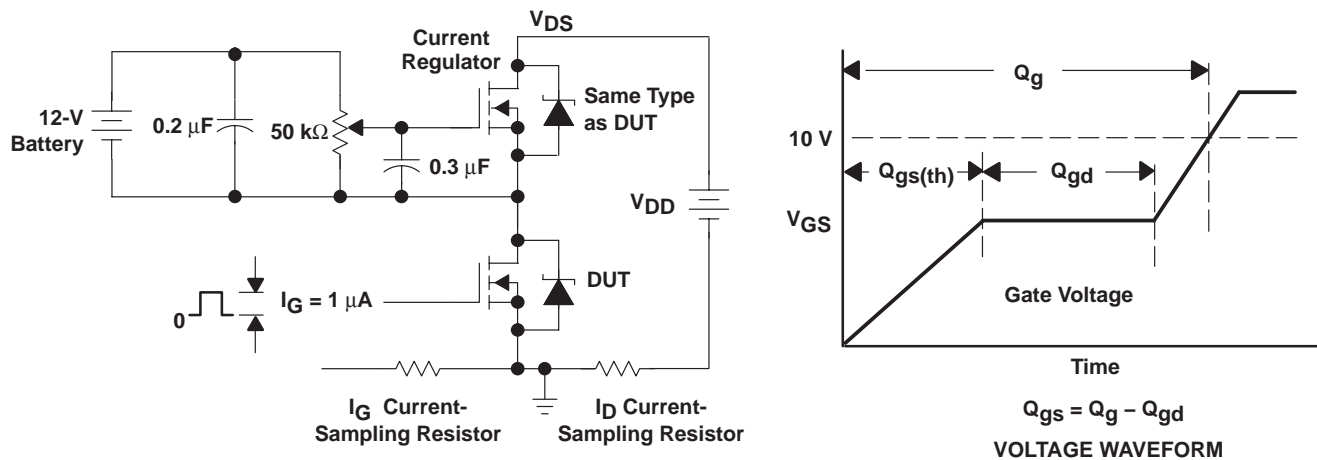
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

NOTE A: C_L includes probe and jig capacitance.

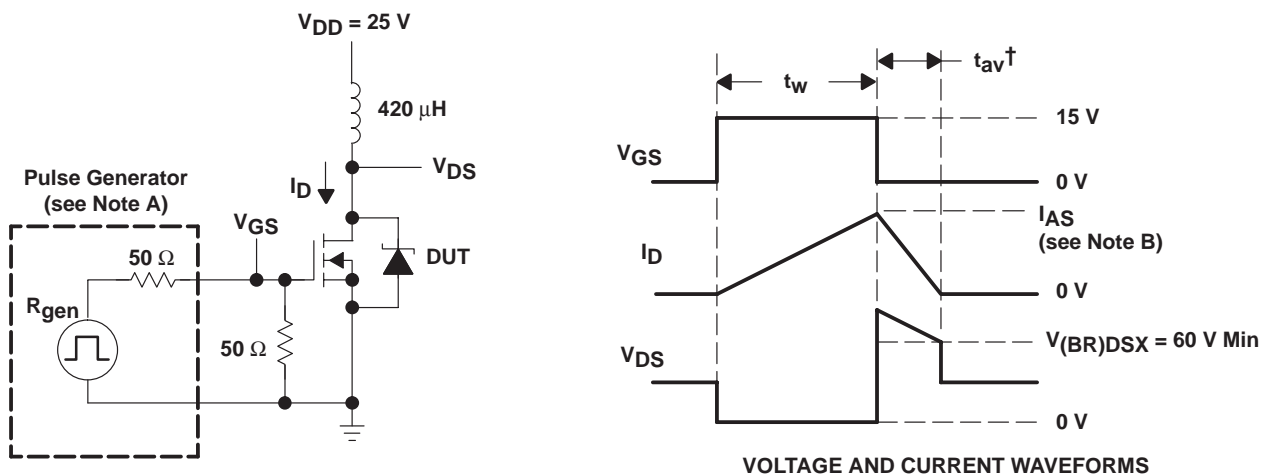
Figure 2. Resistive-Switching Test Circuit and Voltage Waveforms



TEST CIRCUIT

Figure 3. Gate-Charge Test Circuit and Voltage Waveform

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

† Non-JEDEC symbol for avalanche time

NOTES: A. The pulse generator has the following characteristics: $t_r \leq 10$ ns, $t_f \leq 10$ ns, $Z_O = 50 \Omega$.

B. Input pulse duration (t_w) is increased until peak current $I_{AS} = 5$ A.

Energy test level is defined as $E_{AS} = \frac{I_{AS} \times V_{(BR)DSX} \times t_{av}}{2} = 9$ mJ, where t_{av} = avalanche time.

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

TYPICAL CHARACTERISTICS

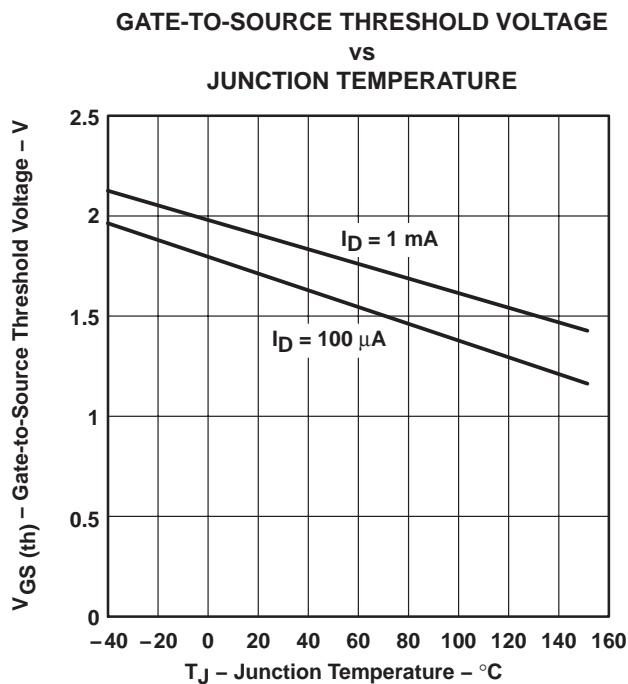


Figure 5

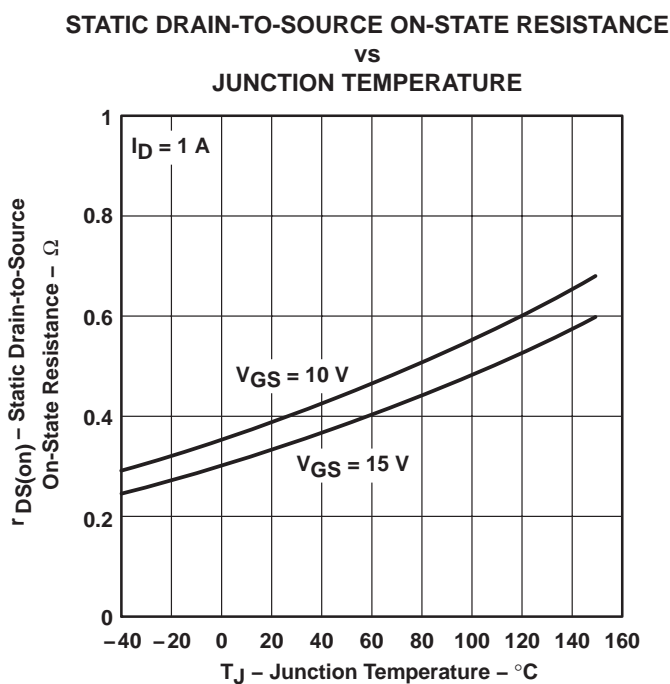


Figure 6

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TYPICAL CHARACTERISTICS

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

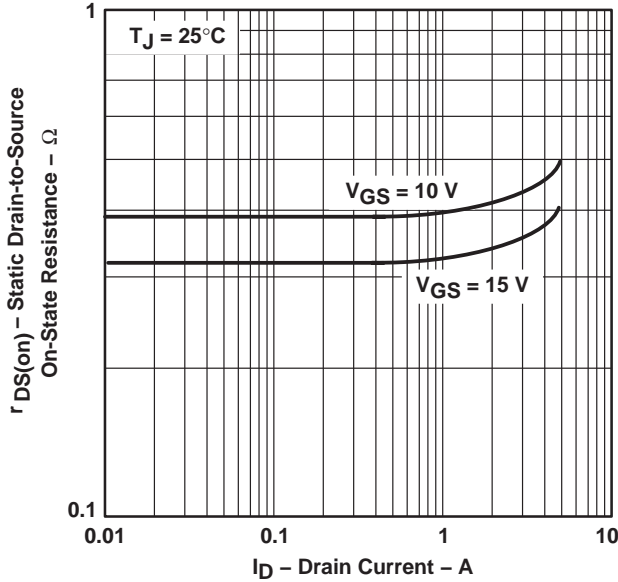


Figure 7

DRAIN CURRENT
vs
DRAIN-TO-SOURCE VOLTAGE

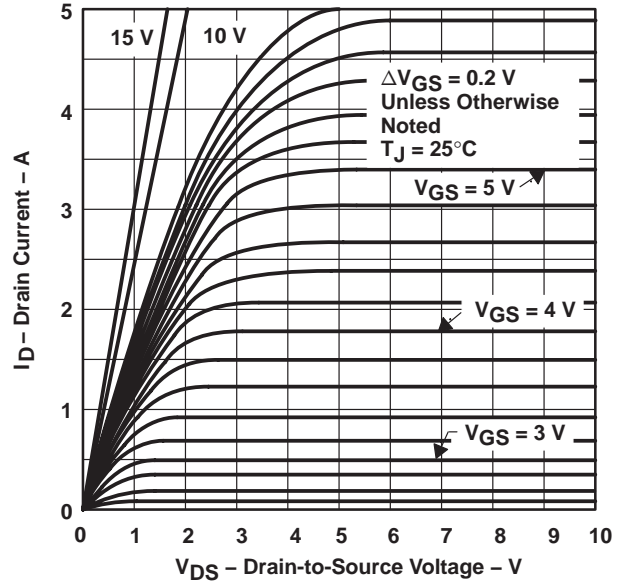


Figure 8

DISTRIBUTION OF
FORWARD TRANSCONDUCTANCE

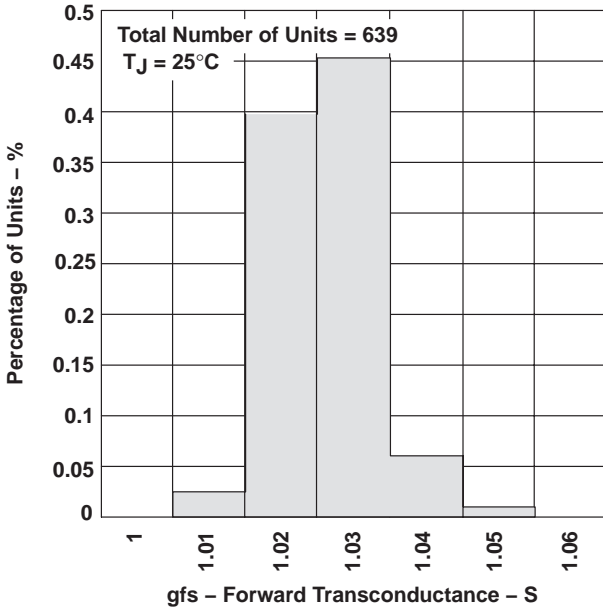


Figure 9

DRAIN CURRENT
vs
GATE-TO-SOURCE VOLTAGE

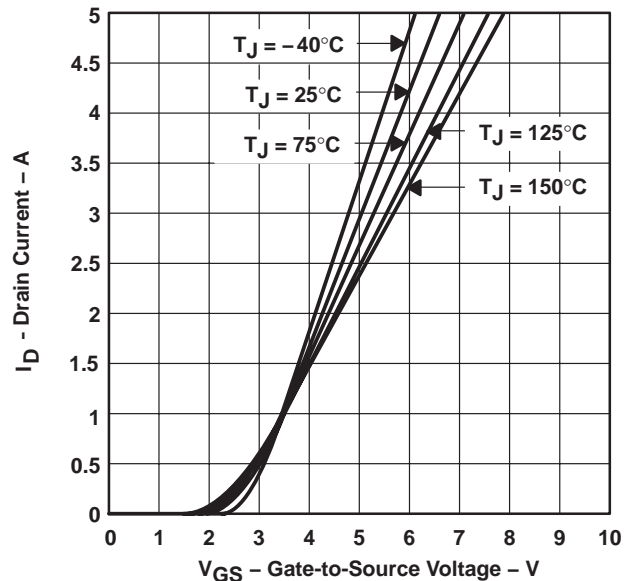


Figure 10

TYPICAL CHARACTERISTICS

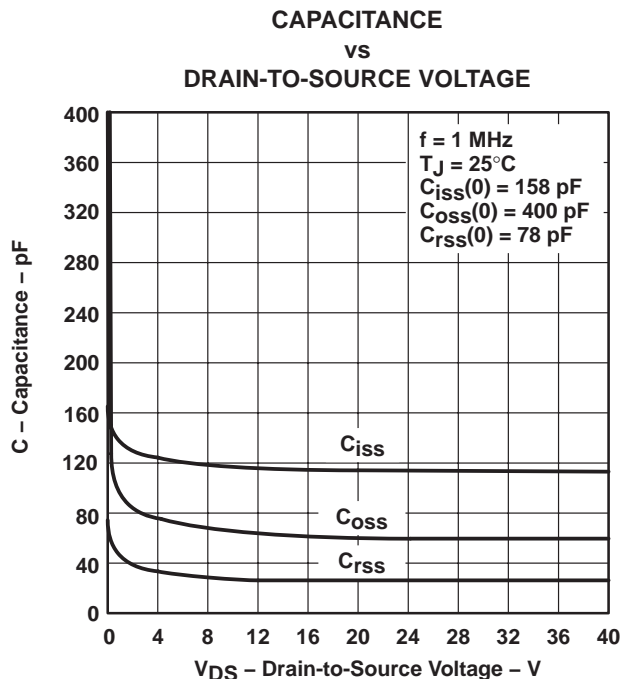


Figure 11

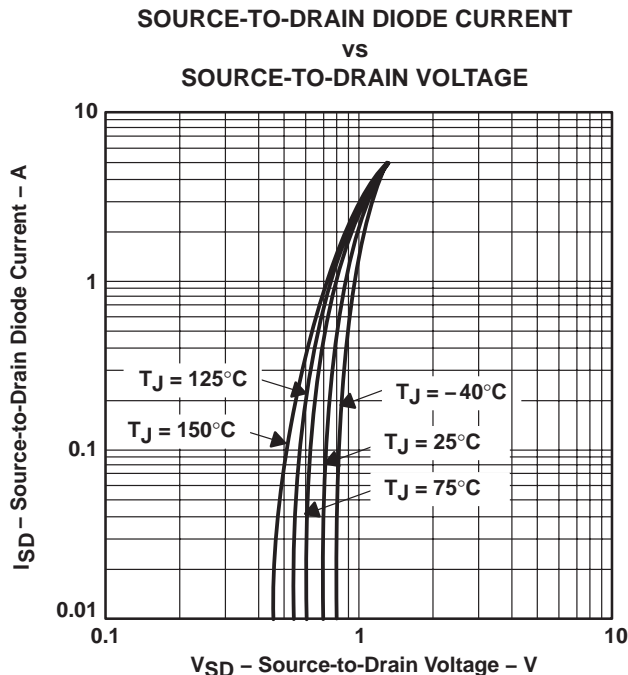


Figure 12

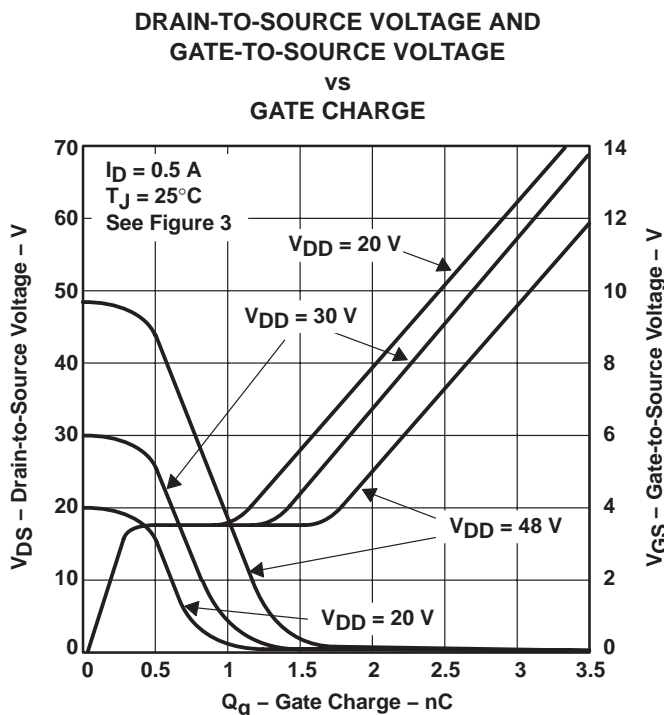


Figure 13

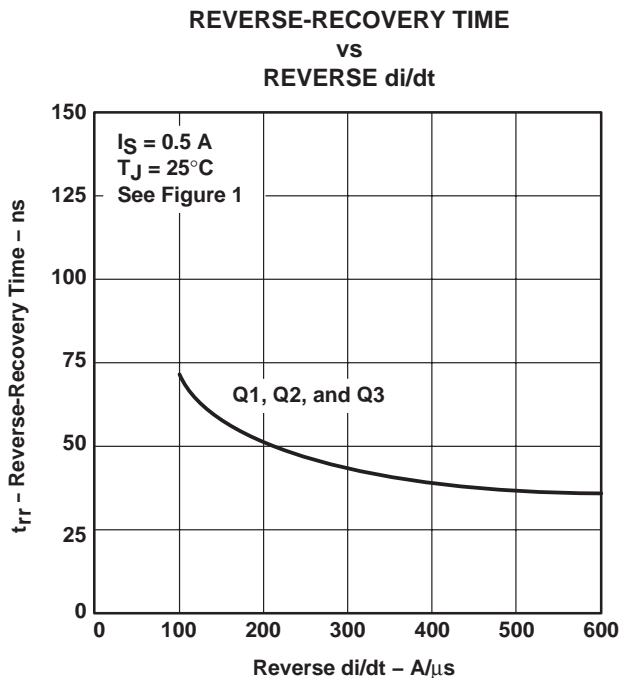
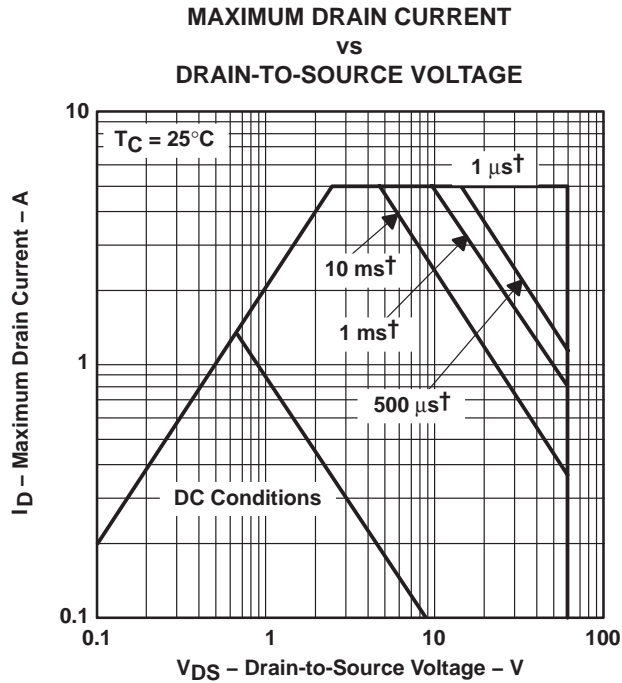


Figure 14

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THERMAL INFORMATION



† Less than 0.1 duty cycle

Figure 15

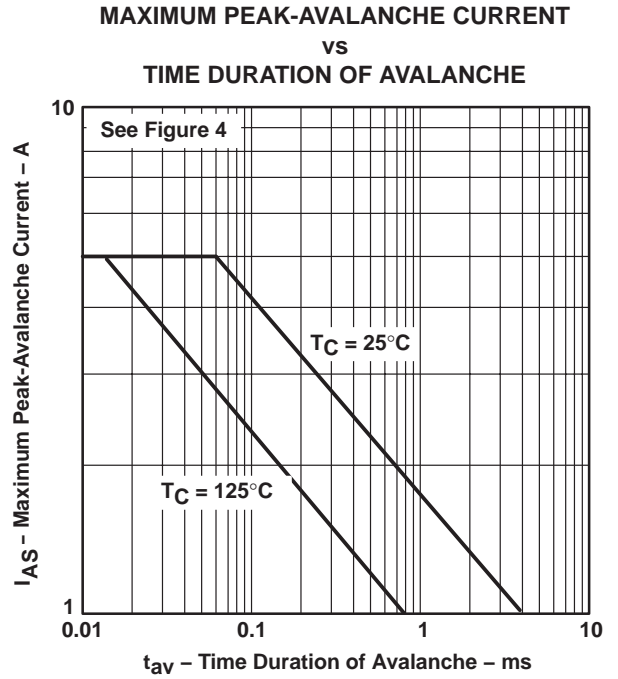
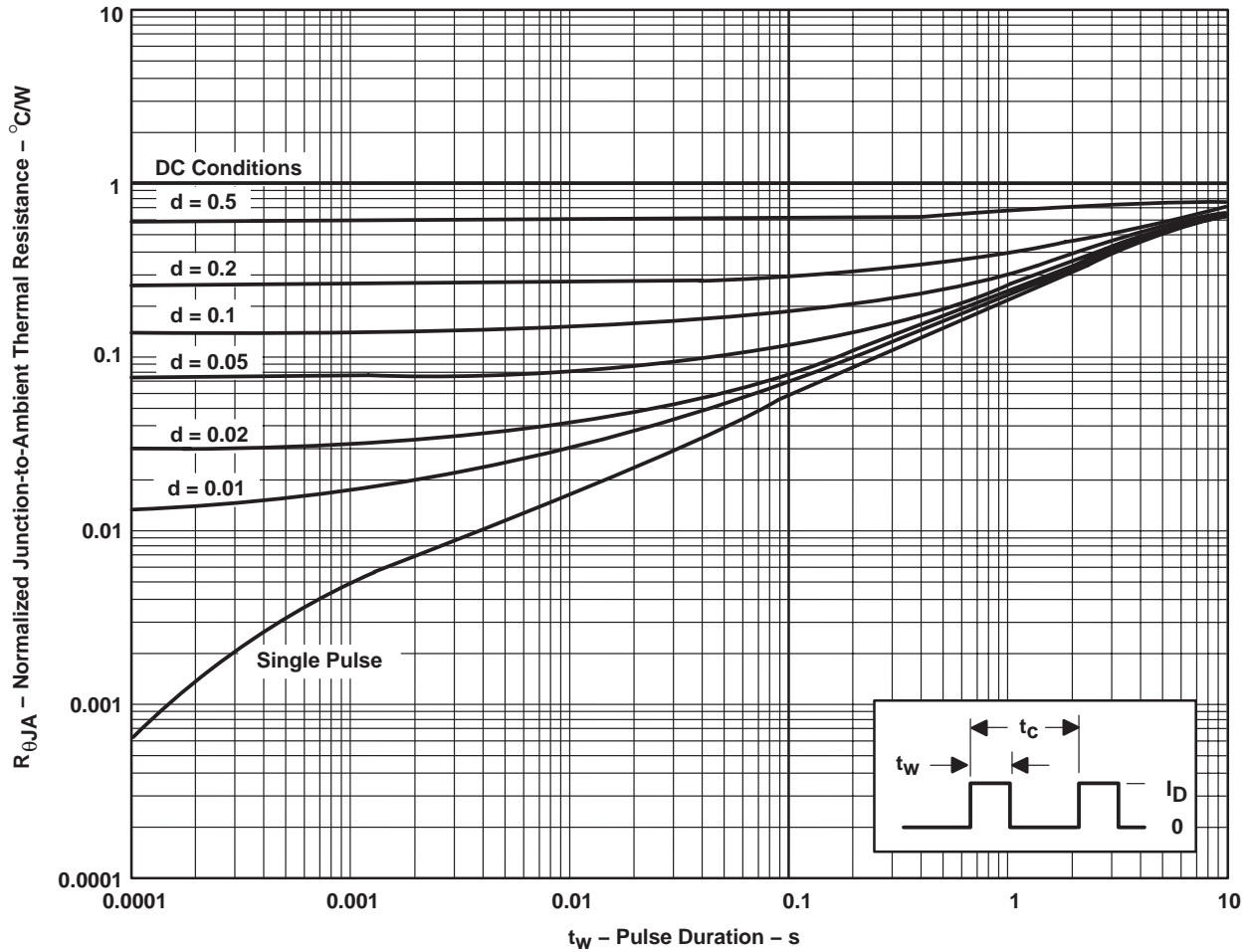


Figure 16

THERMAL INFORMATION

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



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

NOTE A: $Z_{\theta A}(t) = r(t) R_{\theta JA}$
 t_w = pulse duration
 t_c = cycle time
 d = duty cycle = t_w/t_c

Figure 17

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TPIC2302D	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TPIC2302DR	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI

⁽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) 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.

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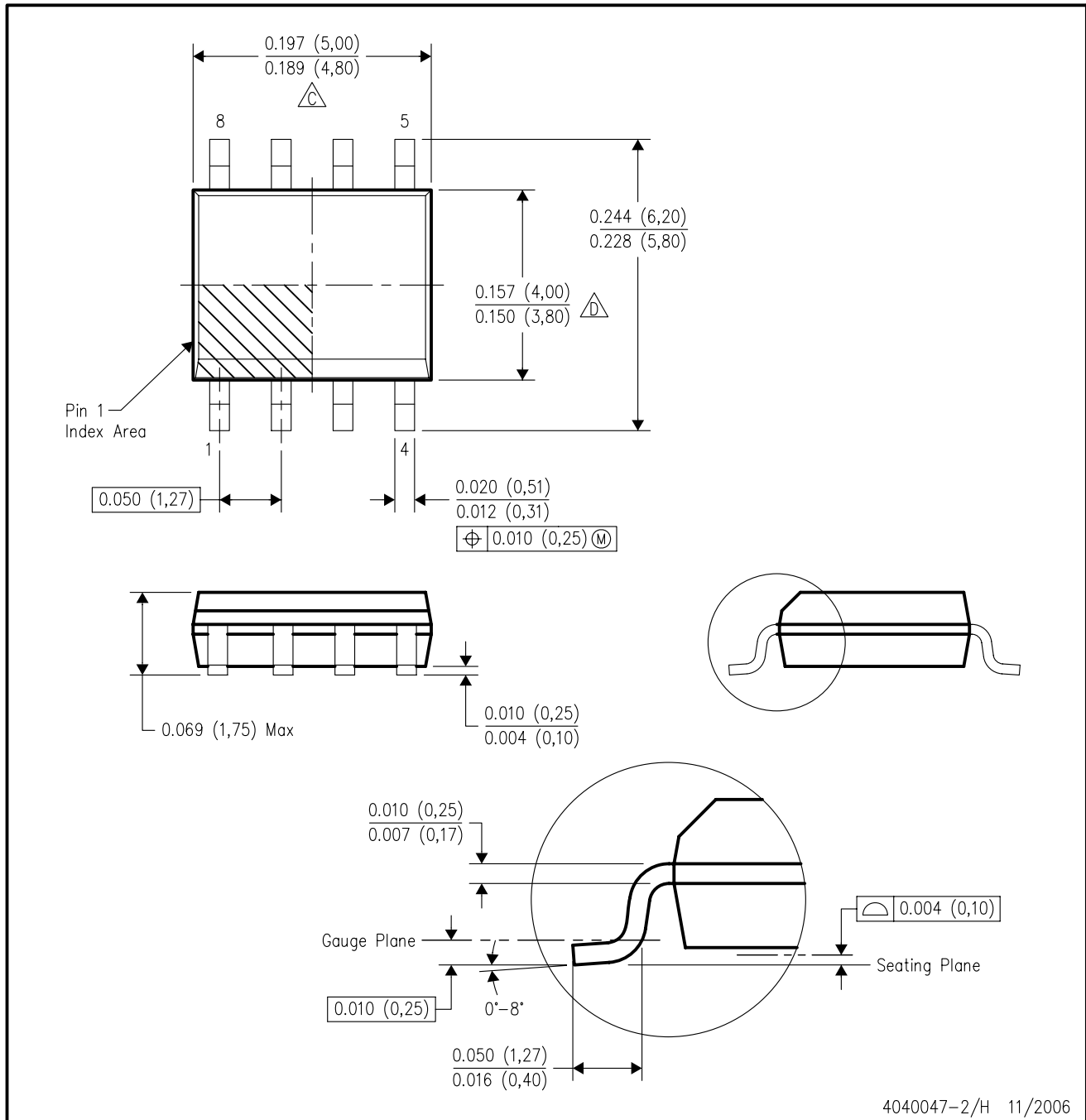
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Δ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - M Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AA.

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