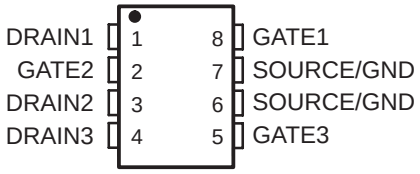
- **Low $r_{DS(on)}$ . . . 0.4 Ω Typ**
- **High-Voltage Outputs . . . 60 V**
- **Pulsed Current . . . 5 A Per Channel**
- **Fast Commutation Speed**

D PACKAGE
(TOP VIEW)

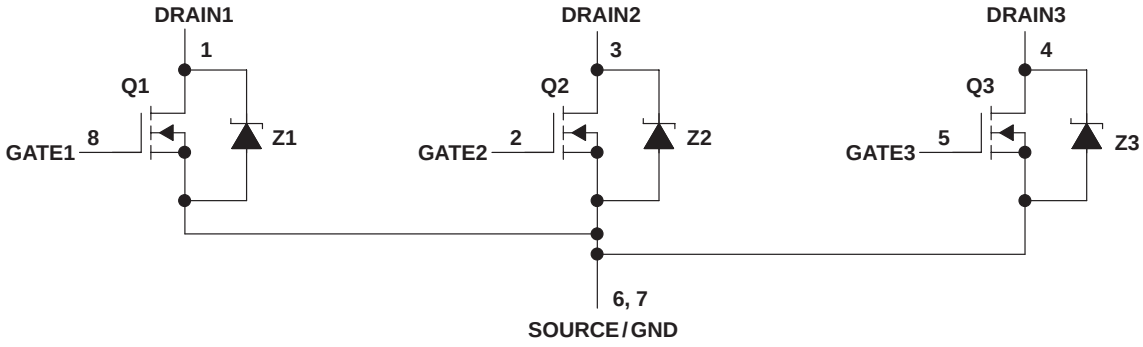


description

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°C	1 A
Pulsed drain current, each output, T_C = 25°C (see Note 1 and Figure 6)	5 A
Single-pulse avalanche energy, T_C = 25°C, E_{AS} (see Figures 4 and 16)	9 mJ
Continuous total power dissipation at (or below) T_C = 25°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%

electrical characteristics, T_C = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{(BR)DSX}$	Drain-to-source breakdown voltage	I_D = 250 µA, V_{GS} = 0		60			V
$V_{GS(th)}$	Gate-to-source threshold voltage	I_D = 1 mA, V_{DS} = V_{GS}		1.5	1.85	2.2	V
$V_{DS(on)}$	Drain-to-source on-state voltage	I_D = 1 A, V_{GS} = 10 V, See Notes 2 and 3			0.4	0.475	V
$V_{F(SD)}$	Forward on-state voltage, source-to-drain	I_S = 1 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 V, V_{GS} = 0	T_C = 25°C		0.05	1	µA
			T_C = 125°C		0.5	10	
I_{GSSF}	Forward gate current, drain short circuited to source	V_{GS} = 16 V, V_{DS} = 0			10	100	nA
I_{GSSR}	Reverse gate current, drain short circuited to source	V_{SG} = 16 V, V_{DS} = 0			10	100	nA
I_{lkg}	Leakage current, drain-to-GND	V_R = 48 V	T_C = 25°C		0.05	1	µA
			T_C = 125°C		0.5	10	
$r_{DS(on)}$	Static drain-to-source on-state resistance	V_{GS} = 10 V, I_D = 1 A, See Notes 2 and 3 and Figures 6 and 7	T_C = 25°C		0.4	0.475	Ω
			T_C = 125°C		0.63	0.7	
g_{fs}	Forward transconductance	V_{DS} = 10 V, I_D = 0.5 A, See Notes 2 and 3		0.85	1.02		S
C_{iss}	Short-circuit input capacitance, common source	V_{DS} = 25 V, V_{GS} = 0, f = 1 MHz			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°C maximum, pulse duration ≤5 ms.
3. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

source-to-drain diode characteristics, T_C = 25°C

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

resistive-load switching characteristics, T_C = 25°C

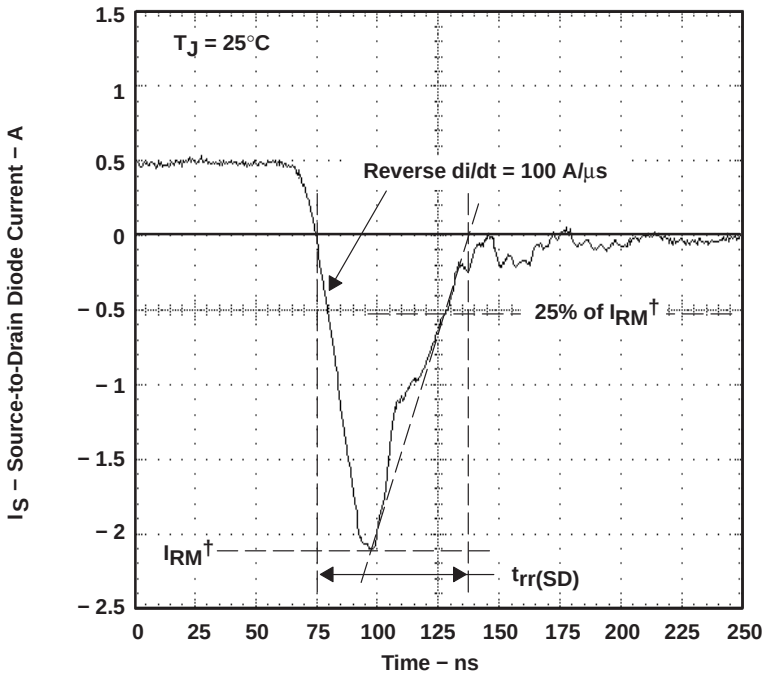
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(on)}$	Turn-on delay time	V_{DD} = 25 V, R_L = 50 Ω, t_{r1} = 10 ns, t_{f1} = 10 ns, See Figure 2		21	42	ns
$t_{d(off)}$	Turn-off delay time			20	40	
t_{r2}	Rise time			5	10	
t_{f2}	Fall time			13	26	
Q_g	Total gate charge	V_{DS} = 48 V, I_D = 0.5 A, V_{GS} = 10 V, See Figure 3		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		°C/W
$R_{\theta JP}$	Junction-to-pin thermal resistance			44		

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

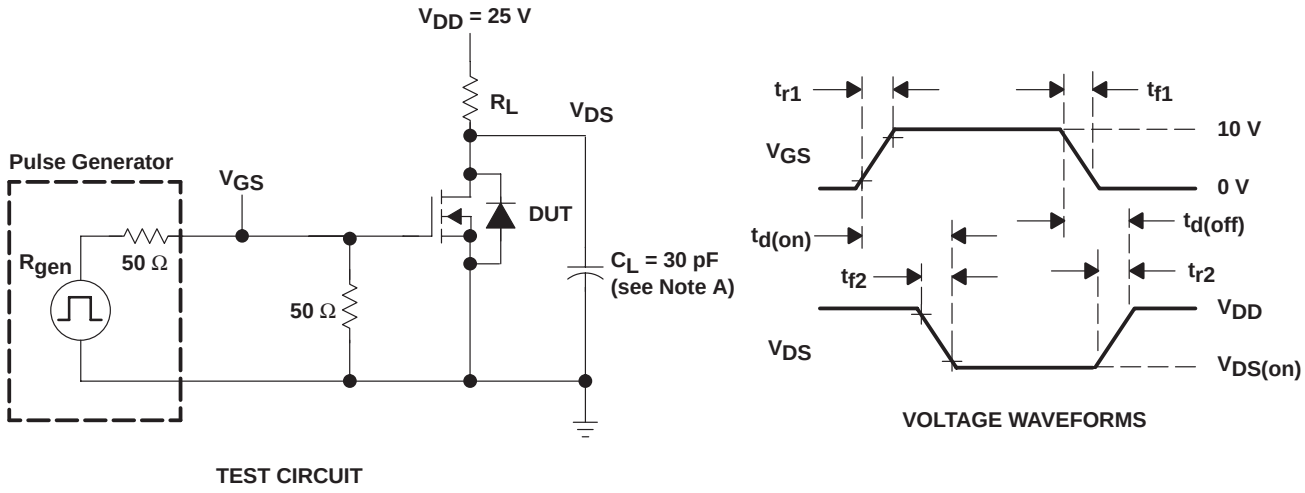
PARAMETER MEASUREMENT INFORMATION



† I_{RM} = maximum recovery current

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

PARAMETER MEASUREMENT INFORMATION



NOTE A: C_L includes probe and jig capacitance.

Figure 2. Resistive-Switching Test Circuit and Voltage Waveforms

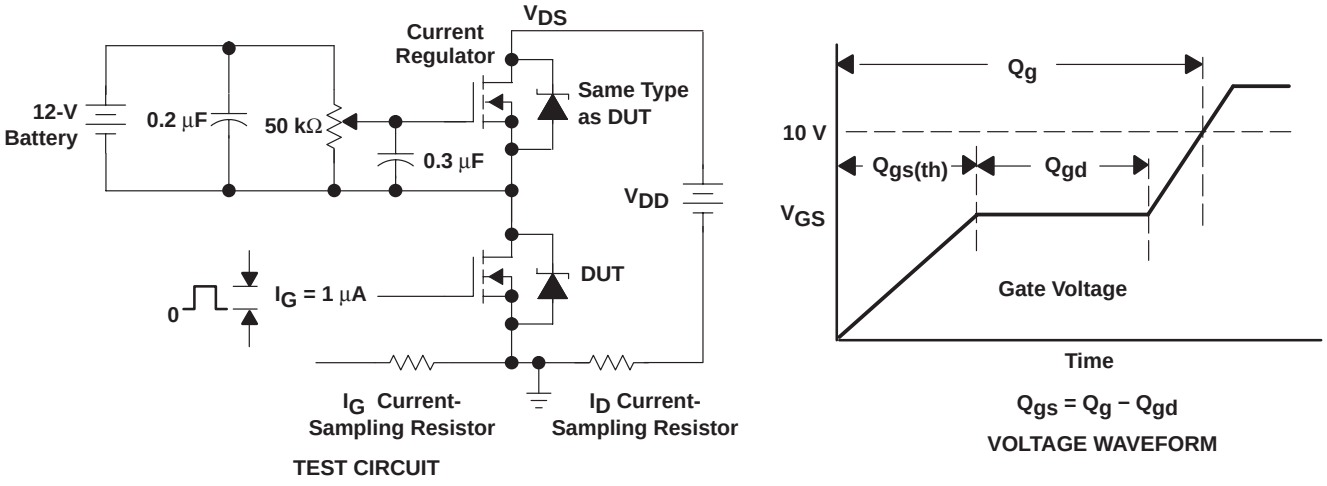
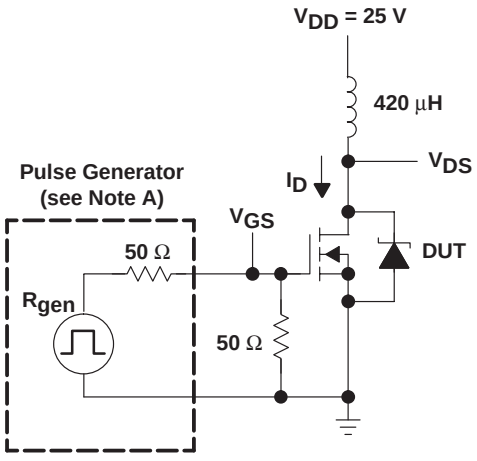


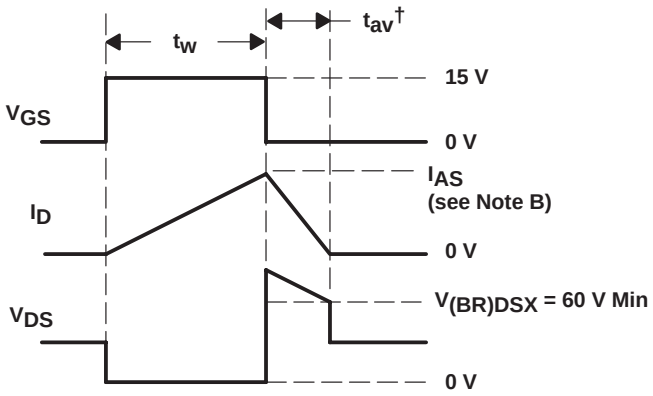
Figure 3. Gate-Charge Test Circuit and Voltage Waveform

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS
77251−1443

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

† Non-JEDEC symbol for avalanche time

NOTES: A. The pulse generator has the following characteristics: $t_r \le 10$ ns, $t_f \le 10$ 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 $E_{AS} = \dfrac{I_{AS} \times V_{(BR)DSX} \times t_{av}}{2} = 9$ mJ, where t_{av} = avalanche time.

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

TYPICAL CHARACTERISTICS

GATE-TO-SOURCE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

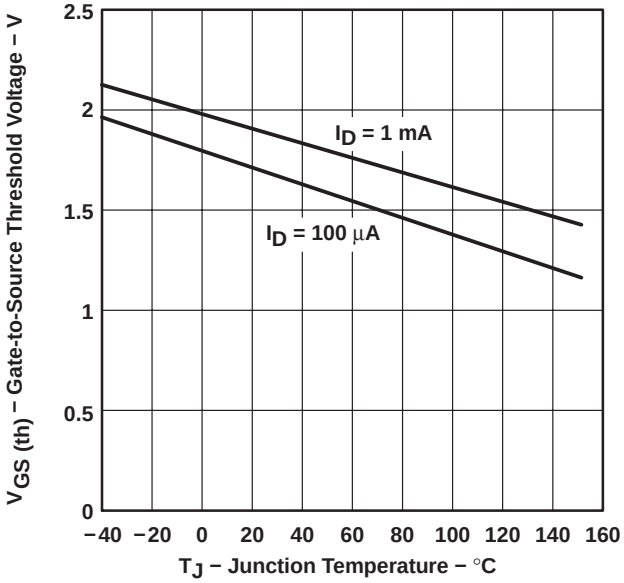


Figure 5

STATIC DRAIN-TO-SOURCE ON-STATE RESISTANCE vs JUNCTION TEMPERATURE

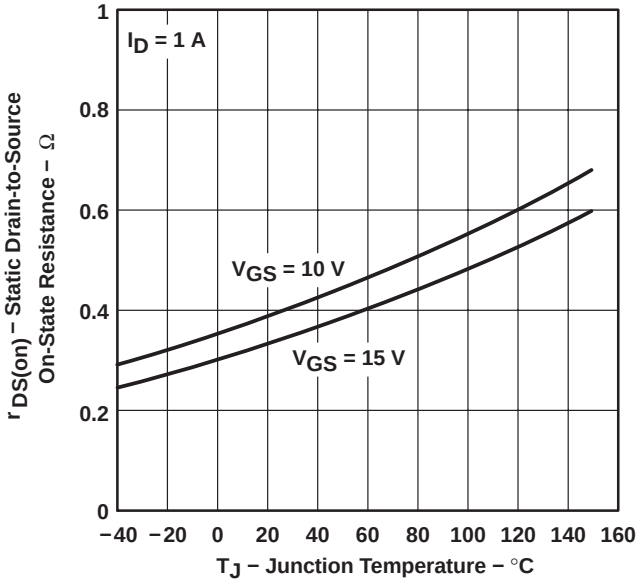


Figure 6

TYPICAL CHARACTERISTICS

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

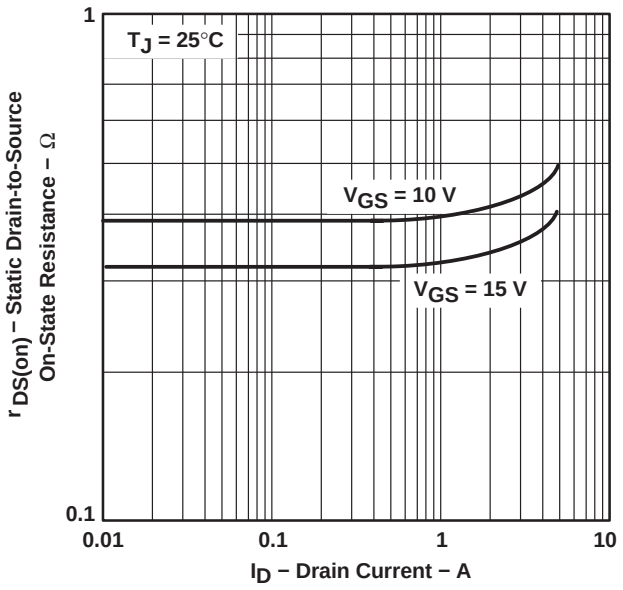


Figure 7

DRAIN CURRENT vs DRAIN-TO-SOURCE VOLTAGE

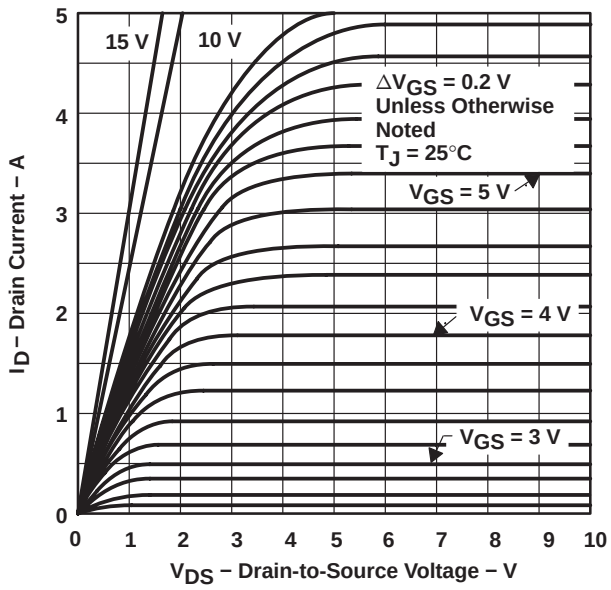


Figure 8

DISTRIBUTION OF FORWARD TRANSCONDUCTANCE

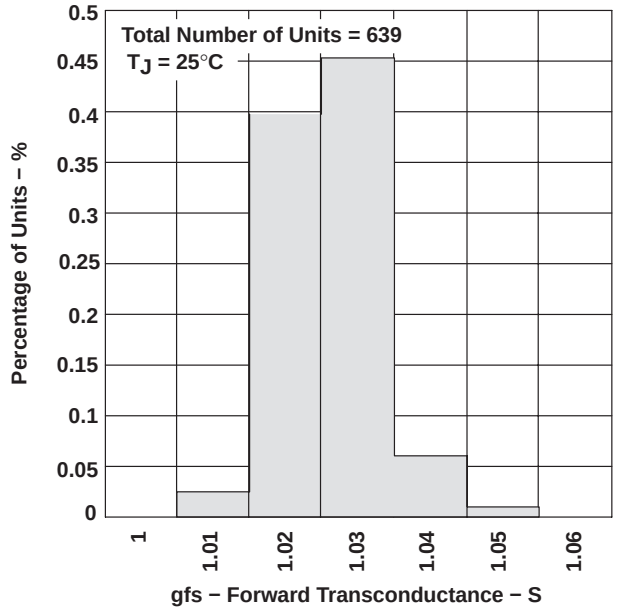


Figure 9

DRAIN CURRENT vs GATE-TO-SOURCE VOLTAGE

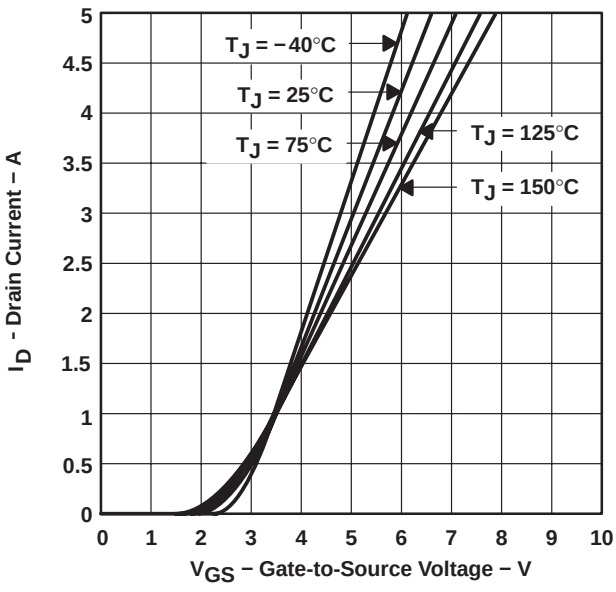


Figure 10

TYPICAL CHARACTERISTICS

CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

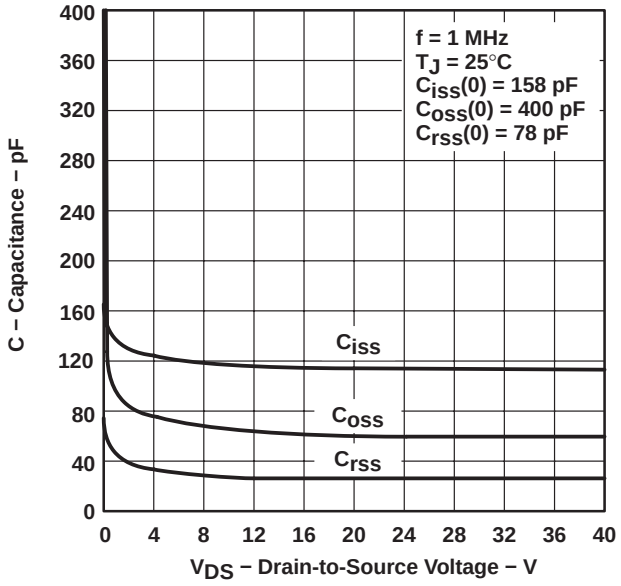


Figure 11

SOURCE-TO-DRAIN DIODE CURRENT vs SOURCE-TO-DRAIN VOLTAGE

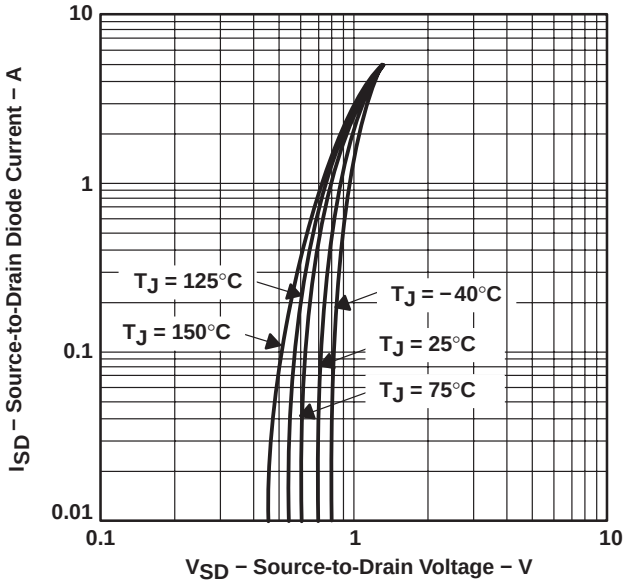


Figure 12

DRAIN-TO-SOURCE VOLTAGE AND GATE-TO-SOURCE VOLTAGE vs GATE CHARGE

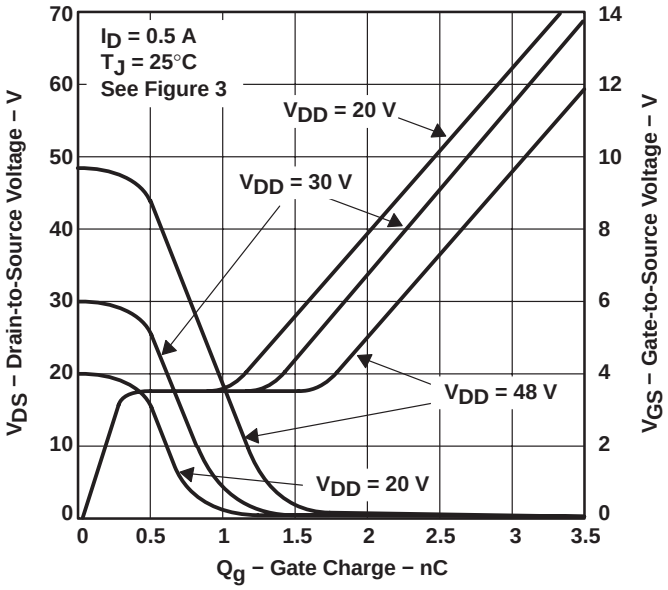


Figure 13

REVERSE-RECOVERY TIME vs REVERSE di/dt

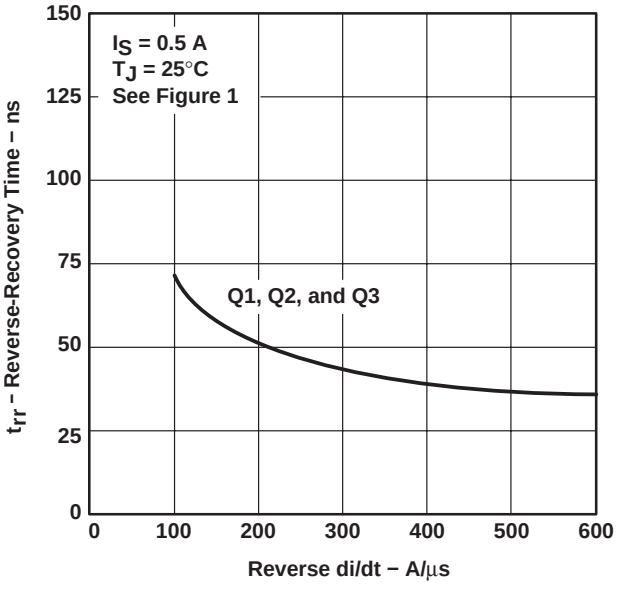
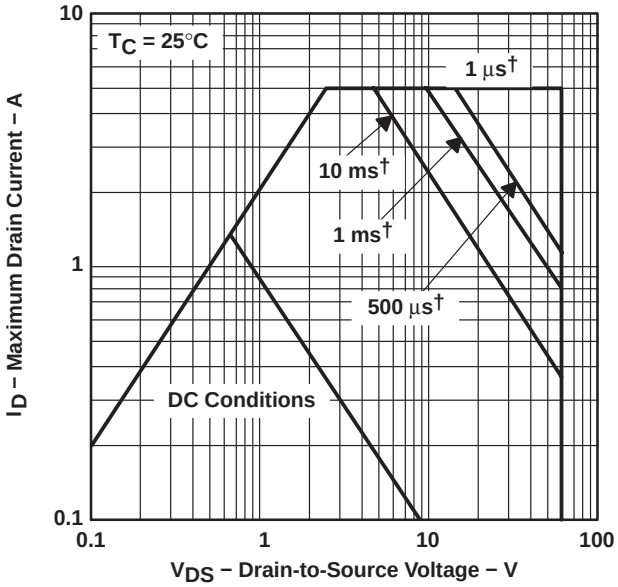


Figure 14

THERMAL INFORMATION

**MAXIMUM DRAIN CURRENT
vs
DRAIN-TO-SOURCE VOLTAGE**



† Less than 0.1 duty cycle

Figure 15

**MAXIMUM PEAK-AVALANCHE CURRENT
vs
TIME DURATION OF AVALANCHE**

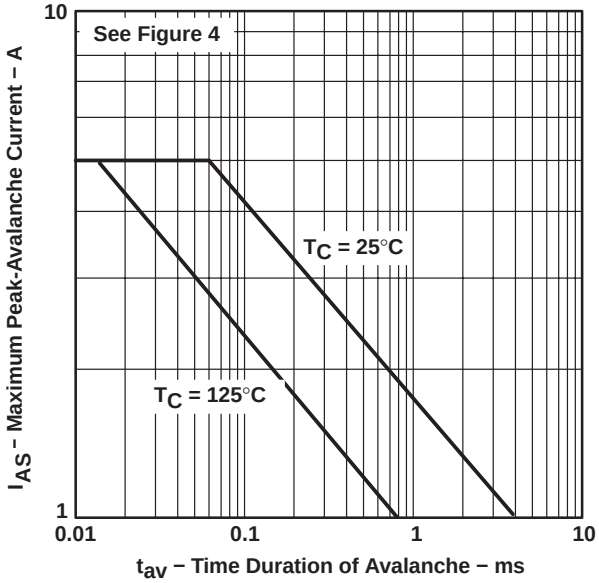
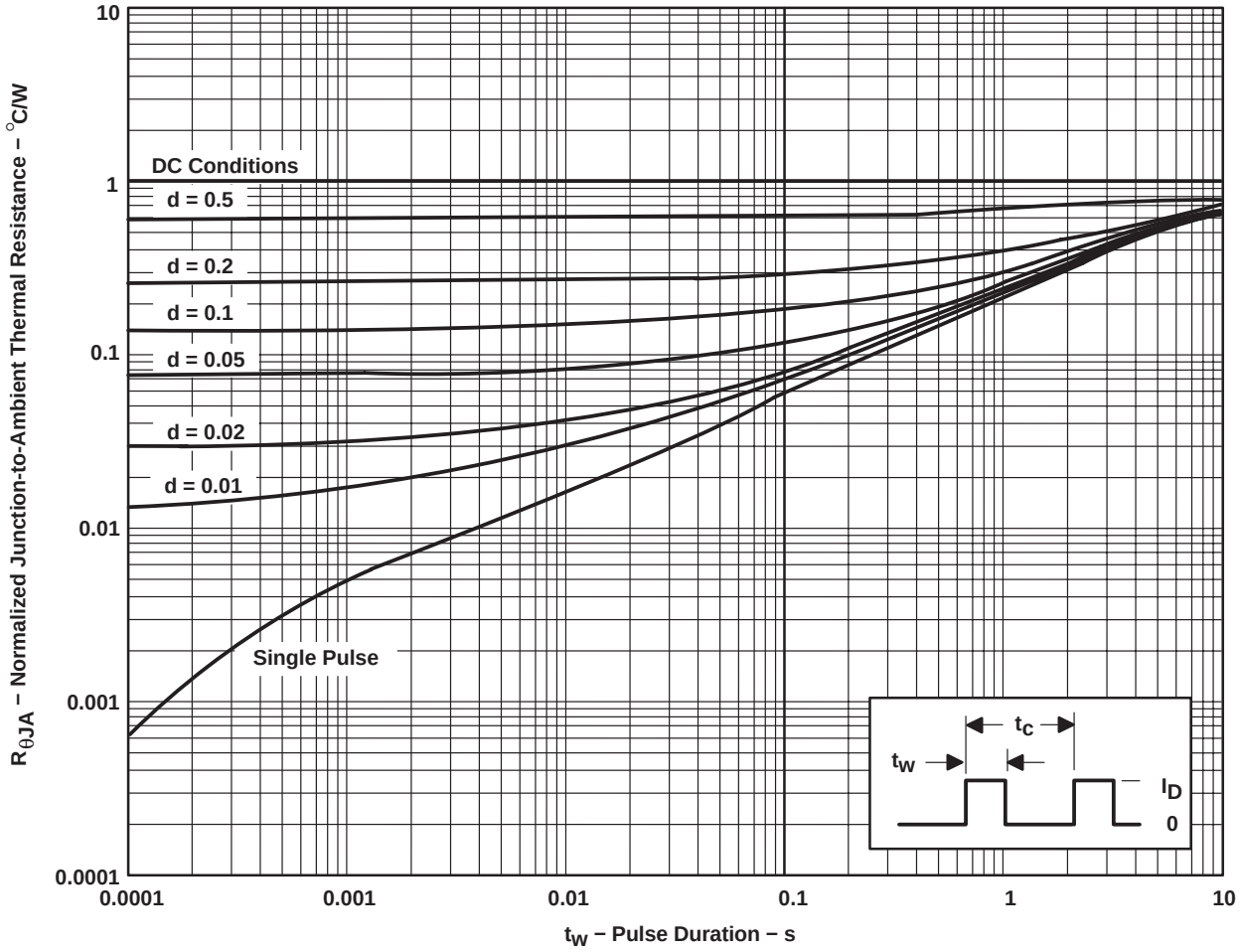


Figure 16

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

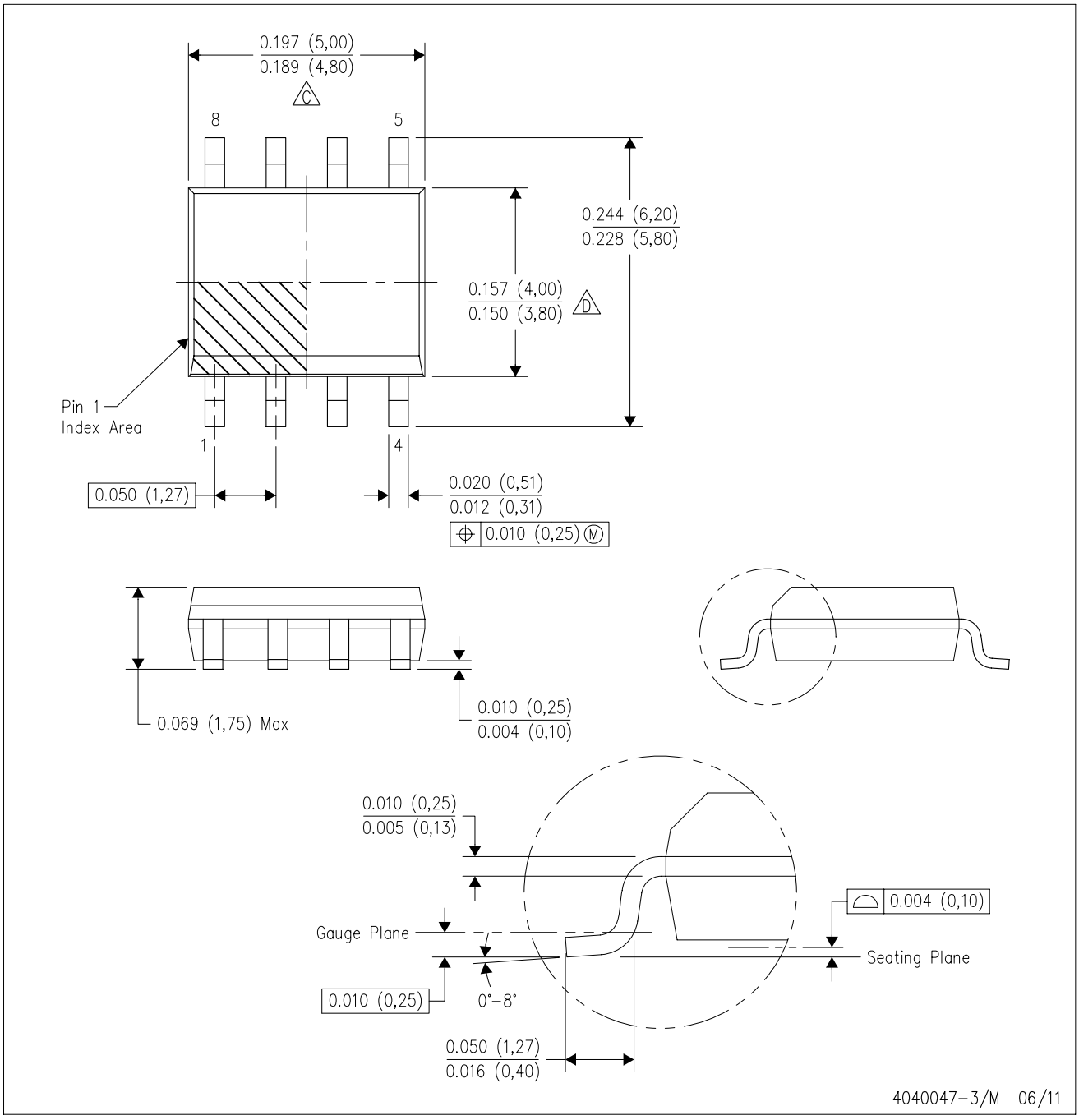
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TPIC2302D	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TPIC2302DR	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI

(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.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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.
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.
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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265