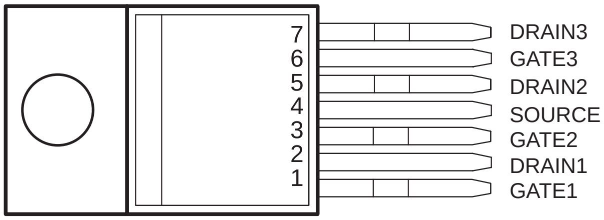
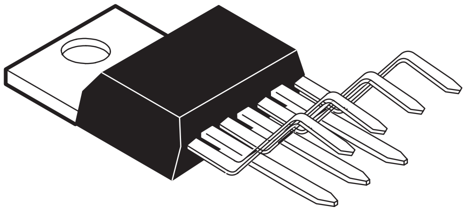
TPIC2301
3-CHANNEL COMMON-SOURCE POWER DMOS ARRAY

SLIS018 – SEPTMEBER 1992

- **Three 7.5-A Independent Output Channels, Continuous Current Per Channel**
- **Low $r_{DS(on)}$ . . . 0.09 Ω Typical**
- **Output Voltage . . . 60 V**
- **Pulsed Current . . . 15 A Per Channel**
- **Avalanche Energy . . . 120 mJ**

KV PACKAGE
(TOP VIEW)



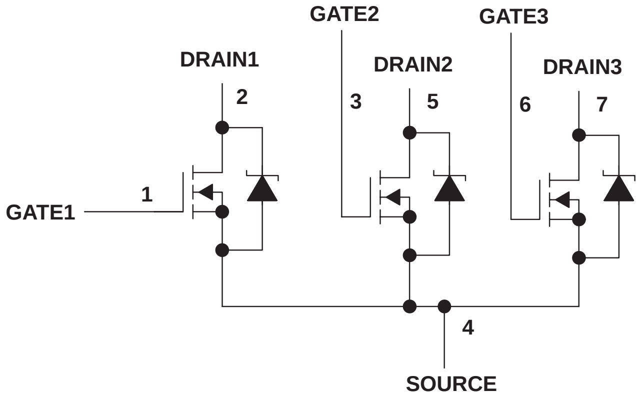


The tab is electrically connected to SOURCE.

description

The TPIC2301 is a monolithic power DMOS array that consists of three independent N-channel enhancement-mode DMOS transistors connected in a common-source configuration with open drains.

schematic



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

Drain-source voltage, V_{DS}	60 V
Gate-source voltage, V_{GS}	±20 V
Continuous source-drain diode current	7.5 A
Pulsed drain current, each output, all outputs on, I_D (see Note 1)	15 A
Continuous drain current, each output, all outputs on	7.5 A
Single-pulse avalanche energy, E_{AS} (see Figure 4)	120 mJ
Continuous power dissipation at (or below) T_A = 25°C (see Note 2)	2 W
Continuous power dissipation at (or below) T_C = 75°C, all outputs on (see Note 2)	50 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}	–40°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTES: 1. Pulse duration = 10 ms, duty cycle = 6%

2. For operation above 25°C free-air temperature, derate linearly at the rate of 16 mW/°C. For operation above 75°C case temperature, and with all outputs conducting, derate linearly at the rate of 0.66 W/°C. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded.

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

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{(BR)DS}$	Drain-source breakdown voltage	$I_D = 1\ \mu A$, $V_{GS} = 0$		60			V
V_{TGS}	Gate-source threshold voltage	$I_D = 1\ mA$, $V_{DS} = V_{GS}$		1.2	1.75	2.4	V
$V_{DS(on)}$	Drain-source on-state voltage	$I_D = 7.5\ A$, $V_{GS} = 15\ V$, See Notes 3 and 4			0.68	0.94	V
I_{DSS}	Zero-gate-voltage drain current	$V_{DS} = 48\ V$, $V_{GS} = 0$	$T_C = 25°C$		0.07	1	µA
			$T_C = 125°C$		1.3	10	
I_{GSSF}	Forward gate current, drain short circuited to source	$V_{GS} = 20\ V$, $V_{DS} = 0$			10	100	nA
I_{GSSR}	Reverse gate current, drain short circuited to source	$V_{GS} = –20\ V$, $V_{DS} = 0$			10	100	nA
$r_{DS(on)}$	Static drain-source on-state resistance	$V_{GS} = 15\ V$, $I_D = 7.5\ A$, See Notes 3 and 4 and Figures 5 and 6	$T_C = 25°C$		0.09	0.125	Ω
			$T_C = 125°C$		0.15	0.21	
g_{fs}	Forward transconductance	$V_{DS} = 15\ V$, $I_D = 5\ A$, See Notes 3 and 4		3.3	4.7		S
C_{iss}	Short-circuit input capacitance, common source	$V_{DS} = 25\ V$, $V_{GS} = 0$, $f = 300\ kHz$			490		pF
C_{oss}	Short-circuit output capacitance, common source				285		
C_{rss}	Short-circuit reverse transfer capacitance, common source				90		

NOTES: 3. Technique should limit $T_J – T_C$ to 10°C maximum.
4. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{SD}	Forward on voltage	$I_S = 7.5\ A$, $V_{GS} = 0$, $di/dt = 100\ A/\mu s$, $V_{DS} = 48\ V$, See Figure 1		0.8	1.3	V
t_{rr}	Reverse recovery time			200		ns
Q_{RR}	Total source-drain diode charge			1.5		µC

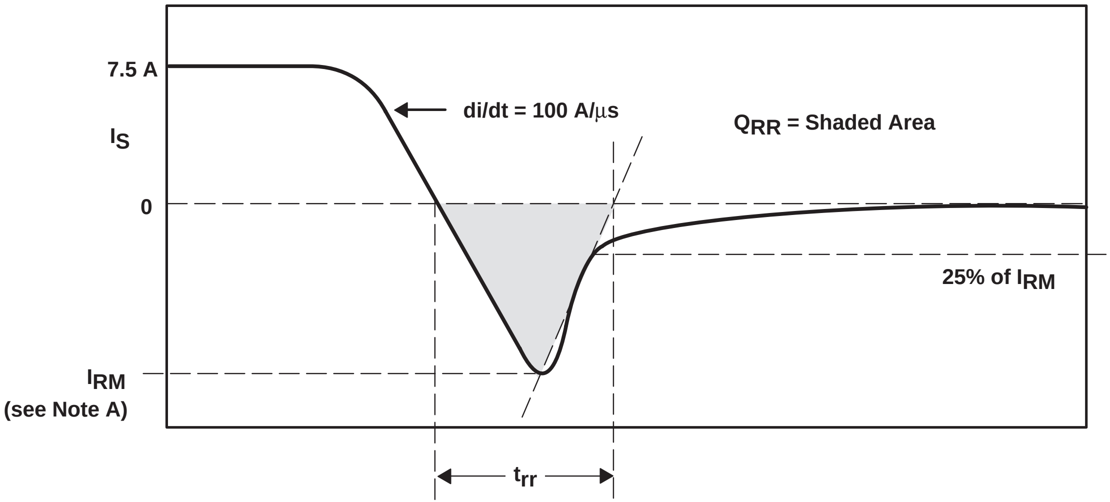
resistive-load switching characteristics, $T_C = 25°C$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 25\ V$, $R_L = 6.7\ \Omega$, $t_{en} = 10\ ns$, $t_{dis} = 10\ ns$, See Figure 2		12		ns
$t_{d(off)}$	Turn-off delay time			100		
t_r	Rise time			43		
t_f	Fall time			5		
Q_g	Total gate charge	$V_{DS} = 48\ V$, $I_D = 2.5\ A$, $V_{GS} = 10\ V$, See Figure 3		13.6	18	nC
Q_{gs}	Gate-source charge			8.3	11	
Q_{gd}	Gate-drain charge			5.3	7	
L_D	Internal drain inductance			7		nH
L_S	Internal source inductance			7		

thermal resistance

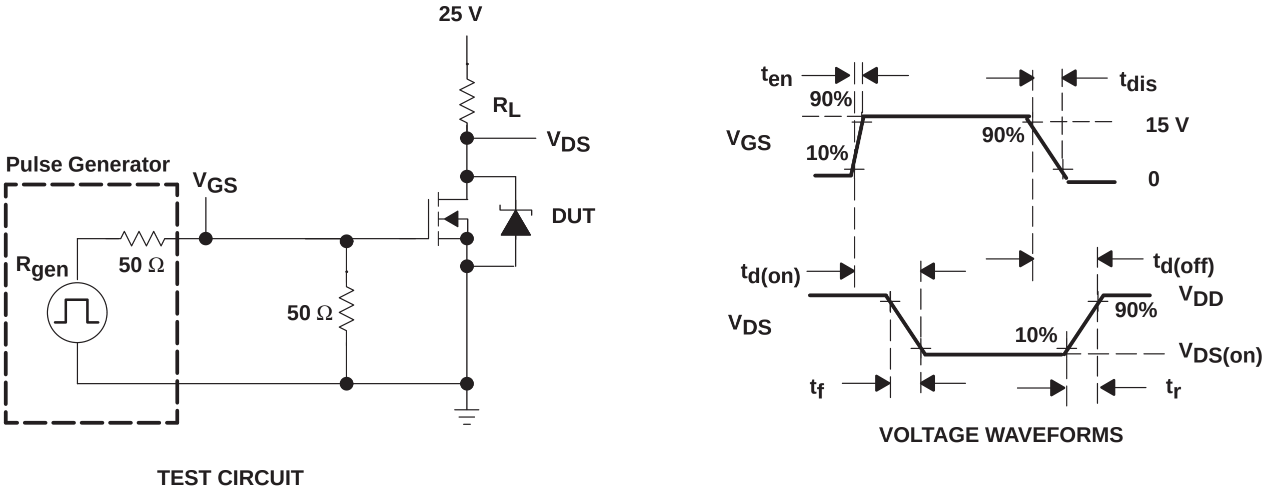
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	All outputs with equal power			62.5	°C/W
$R_{\theta JC}$	Junction-to-case thermal resistance	All outputs with equal power			1.5	°C/W
		One output dissipating power			3.3	°C/W

PARAMETER MEASUREMENT INFORMATION



NOTE A: I_{RM} = maximum recovery current

Figure 1. Reverse-Recovery-Current Waveforms of Source-Drain Diode

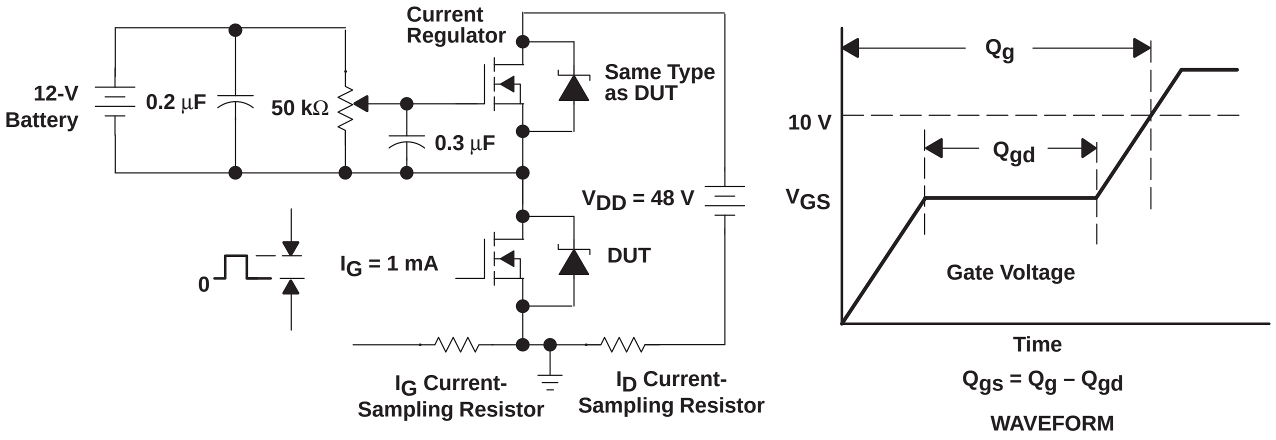


VOLTAGE WAVEFORMS

TEST CIRCUIT

Figure 2. Resistive Switching

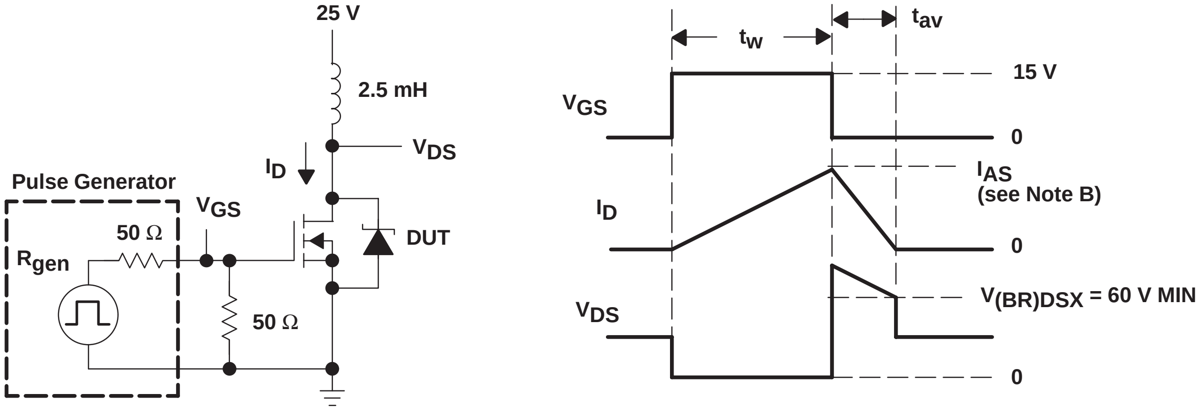
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

WAVEFORM

Figure 3. Gate-Charge Test Circuit and Waveform



TEST CIRCUIT

VOLTAGE AND CURRENT WAVEFORMS

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 $I_{AS} = 7.5$ A.

Energy test level is defined as $E_{AS} = \frac{I_{AS} \times V_{(BR)DSX} \times t_{av}}{2} = 120$ mJ min.

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

TYPICAL CHARACTERISTICS

STATIC DRAIN-SOURCE ON-STATE RESISTANCE vs CASE TEMPERATURE

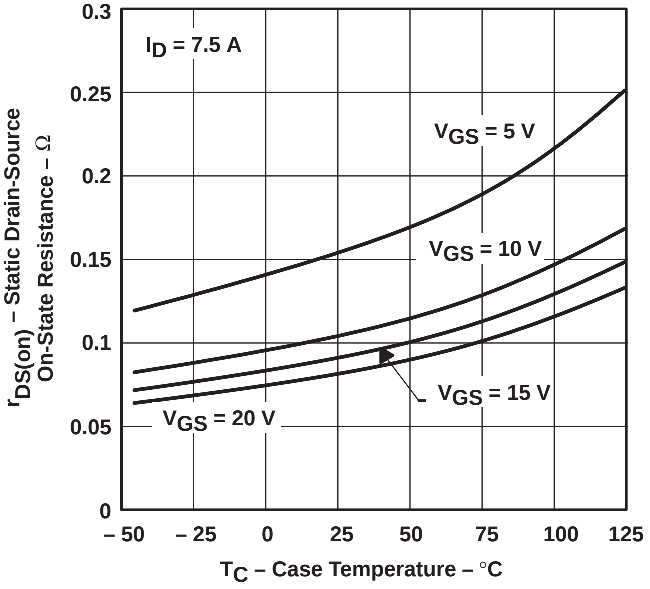


Figure 5

STATIC DRAIN-SOURCE ON-STATE RESISTANCE vs DRAIN CURRENT

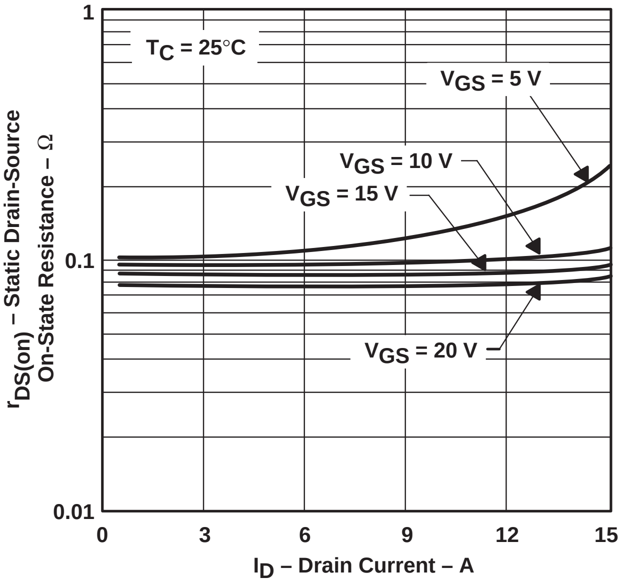


Figure 6

DISTRIBUTION OF FORWARD TRANSCONDUCTANCE

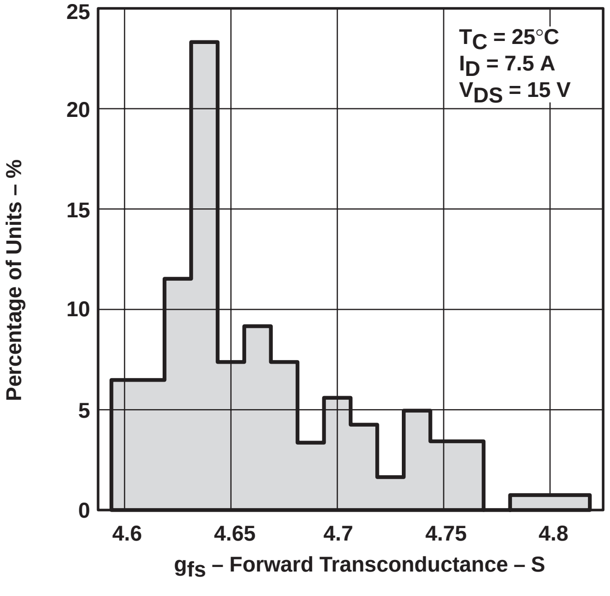


Figure 7

DRAIN CURRENT vs DRAIN-TO-SOURCE VOLTAGE

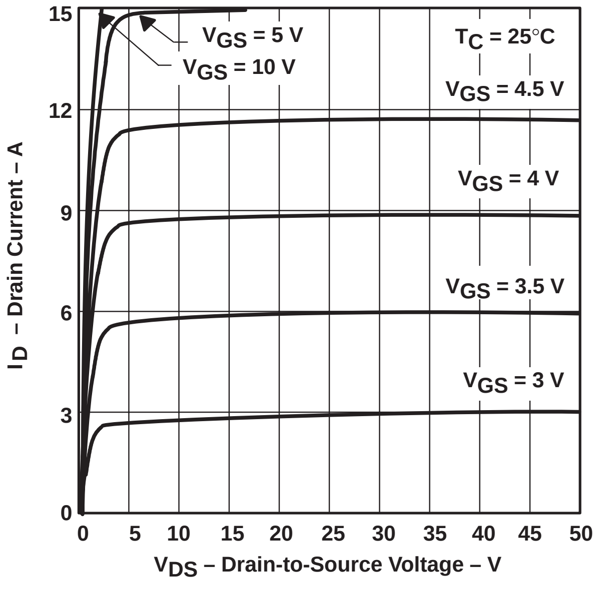


Figure 8

TYPICAL CHARACTERISTICS

GATE-SOURCE THRESHOLD VOLTAGE vs CASE TEMPERATURE

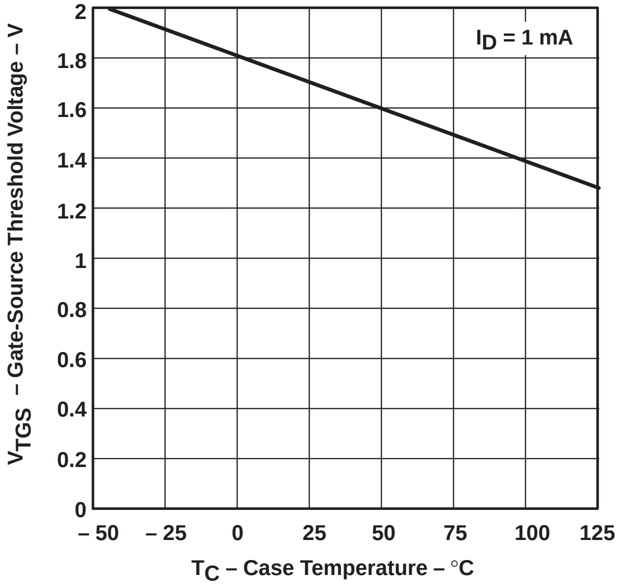


Figure 9

SOURCE-DRAIN DIODE CURRENT vs SOURCE-DRAIN VOLTAGE

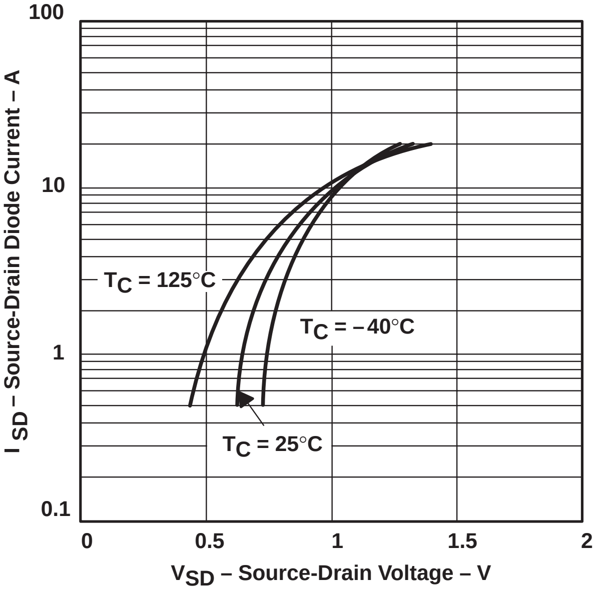


Figure 10

GATE-SOURCE VOLTAGE vs GATE CHARGE

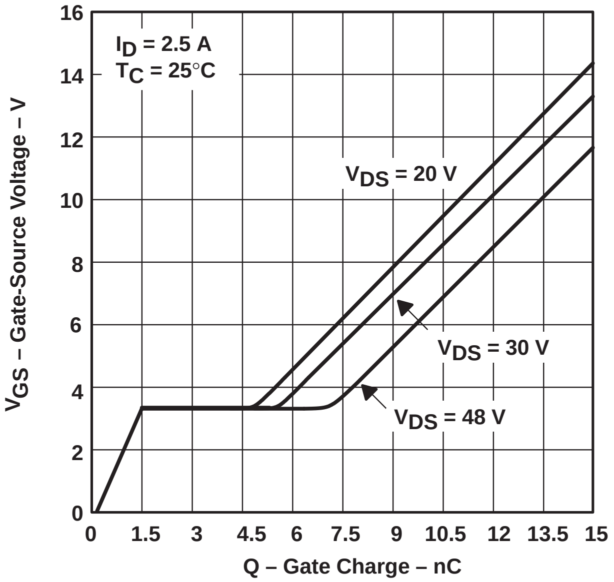


Figure 11

REVERSE RECOVERY TIME vs REVERSE di/dt

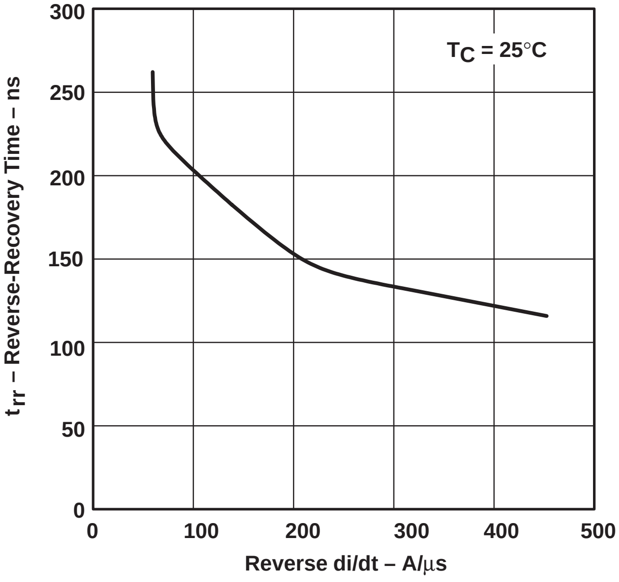


Figure 12

TYPICAL CHARACTERISTICS

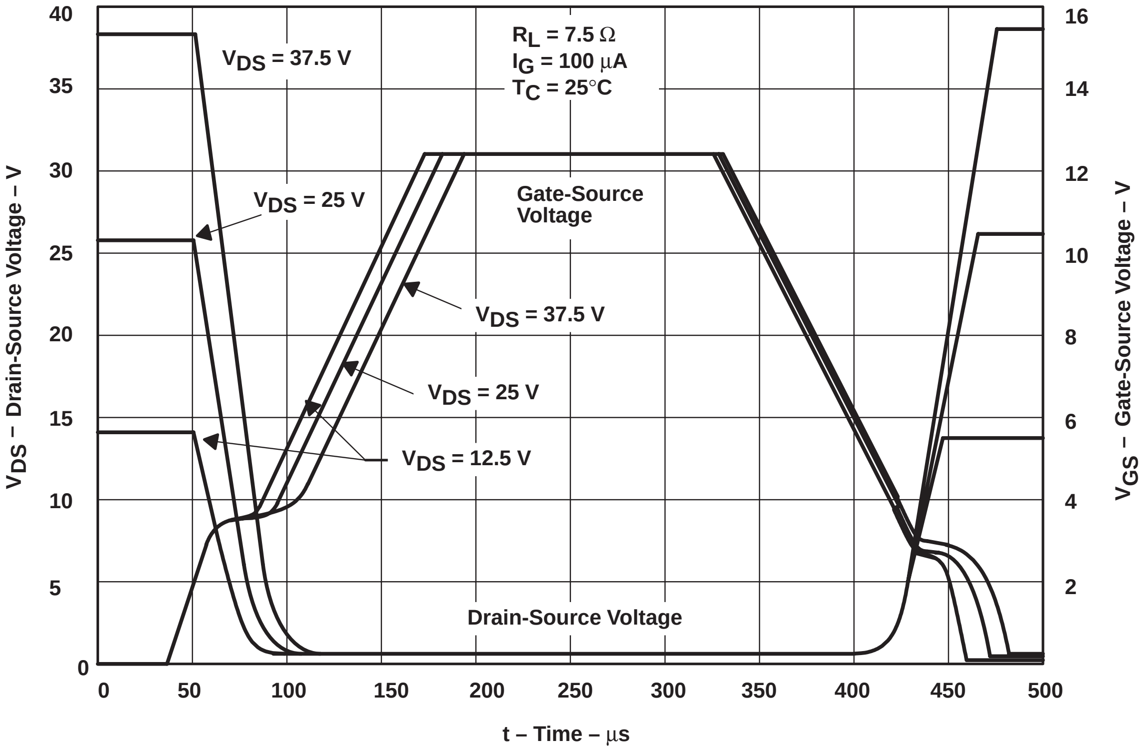


Figure 13. Resistive Switching Waveforms

THERMAL INFORMATION

MAXIMUM DRAIN CURRENT
vs
DRAIN-SOURCE VOLTAGE

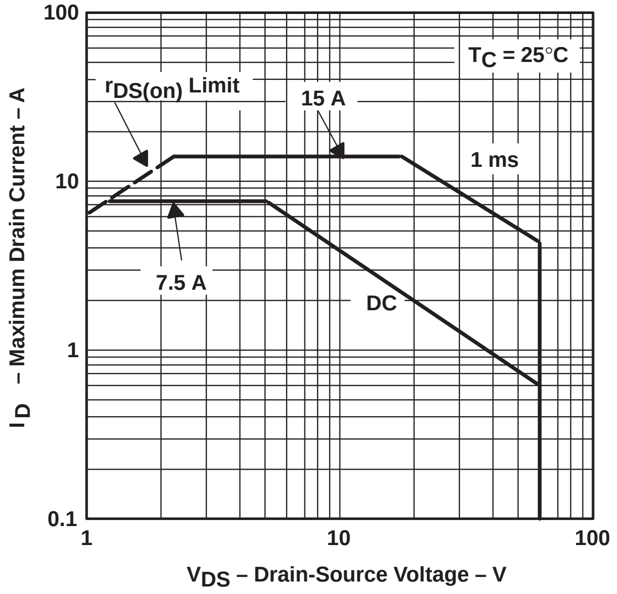


Figure 14

MAXIMUM PEAK AVALANCHE CURRENT
vs
TIME DURATION OF AVALANCHE

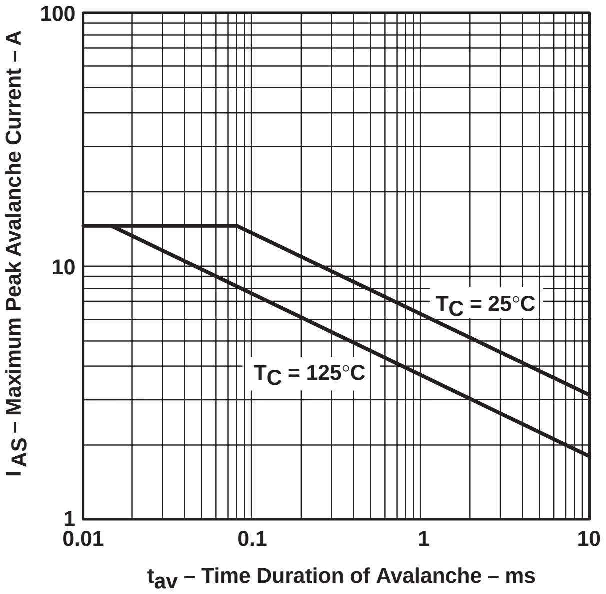
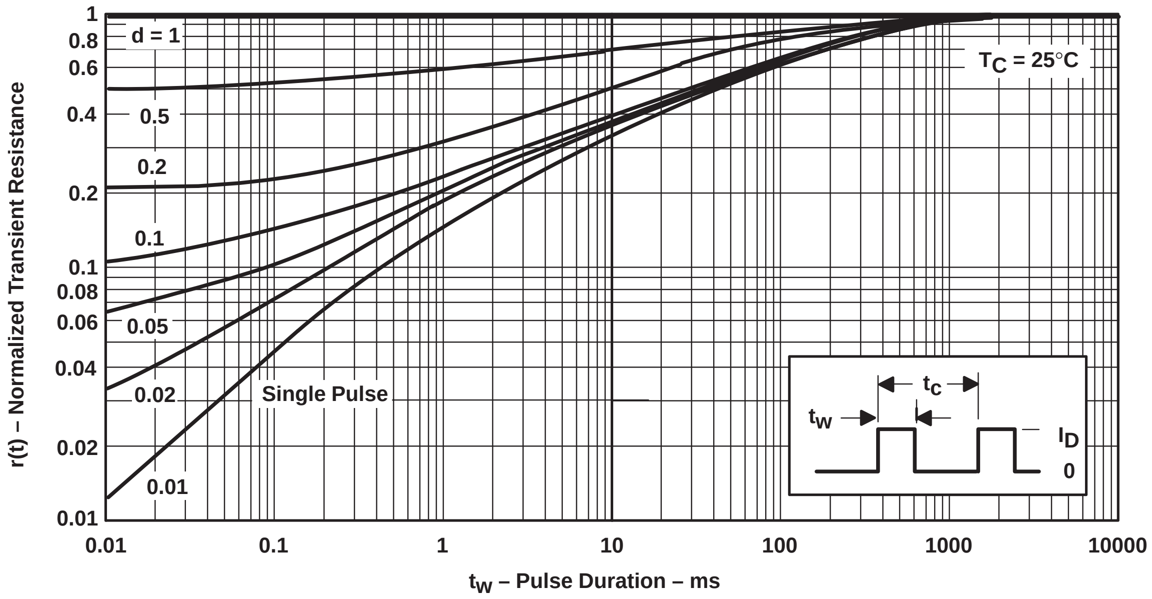


Figure 15

NORMALIZED TRANSIENT THERMAL IMPEDANCE
vs
SQUARE-WAVE PULSE DURATION



NOTES: $Z_{\theta JC}(t) = r(t)\ R_{\theta JC}$
t_w = pulse duration
t_c = period
d = duty cycle = t_w/t_c

Figure 16

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