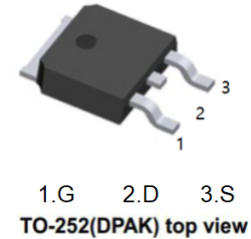


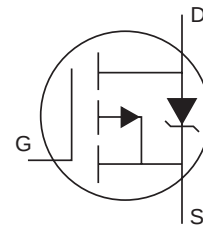
Description

- Advanced Process Technology
- Key Parameters Optimized for Class-D Audio Amplifier Applications
- Low $R_{DS(ON)}$ for Improved Efficiency
- Low Q_g and Q_{sw} for Better THD and Improved Efficiency
- Low Q_{rr} for Better THD and Lower EMI
- 175°C Operating Junction Temperature for Ruggedness
- Repetitive Avalanche Capability for Robustness and Reliability
- Multiple Package Options



Features

- $V_{DS}(V) = -60V$
- $R_{DS(ON)} < 97m\Omega (V_{GS} = -10V)$
- $R_{DS(ON)} < 130m\Omega (V_{GS} = -4.5V)$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	-60	V
V_{GS}	Gate-to-Source Voltage	± 20	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-20	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	-14	
I_{DM}	Pulsed Drain Current ①	-60	
$P_D @ T_C = 25^\circ C$	Power Dissipation	79	W
$P_D @ T_C = 100^\circ C$	Power Dissipation	39	
	Linear Derating Factor	0.53	W/°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to + 175	°C
	Clamping Pressure ⑥		N

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤		1.9	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted) ⑤⑧		50	
$R_{\theta JA}$	Junction-to-Ambient (free air) ⑤		110	

-60V P-Channel MOSFET
Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

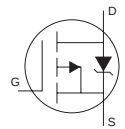
	Parameter	Min.	Typ.	Max.	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-55			V	$V_{GS} = 0V, I_D = -250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient		-52		mV/ $^\circ\text{C}$	Reference to 25°C , $I_D = -1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance		93	97	m Ω	$V_{GS} = -10V, I_D = -3.4A$ ③
			100	130		$V_{GS} = -4.5V, I_D = -2.7A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	-1.1	-2	-3.0	V	$V_{DS} = V_{GS}, I_D = -250\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient		-3.7		mV/ $^\circ\text{C}$	
I_{DSS}	Drain-to-Source Leakage Current			-2.0	μA	$V_{DS} = -55V, V_{GS} = 0V$
				-25		$V_{DS} = -55V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage			-100	nA	$V_{GS} = -20V$
	Gate-to-Source Reverse Leakage			100		$V_{GS} = 20V$
g_{fs}	Forward Transconductance	5.3			S	$V_{DS} = -25V, I_D = -14A$
Q_g	Total Gate Charge		31	47		$V_{DS} = -44V$
Q_{gs}	Gate-to-Source Charge		7.1			$V_{GS} = -10V$
Q_{gd}	Gate-to-Drain Charge		8.5			$I_D = -14A$
Q_{godr}	Gate Charge Overdrive		15			See Fig. 6 and 19
$t_{d(on)}$	Turn-On Delay Time		9.5		ns	$V_{DD} = -28V, V_{GS} = -10V$ ③
t_r	Rise Time		24			$I_D = -14A$
$t_{d(off)}$	Turn-Off Delay Time		21			$R_G = 2.5\Omega$
t_f	Fall Time		9.5			
C_{iss}	Input Capacitance		660		pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance		160			$V_{DS} = -50V$
C_{rss}	Reverse Transfer Capacitance		72			$f = 1.0MHz$, See Fig.5
C_{oss}	Effective Output Capacitance		280			$V_{GS} = 0V, V_{DS} = 0V$ to $-44V$
L_D	Internal Drain Inductance		4.5		nH	Between lead, 6mm (0.25in.) from package and center of die contact ④
L_S	Internal Source Inductance		7.5			

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②		120	mJ
I_{AR}	Avalanche Current ⑦	See Fig. 14, 15, 17a, 17b		A
E_{AR}	Repetitive Avalanche Energy ⑦			mJ

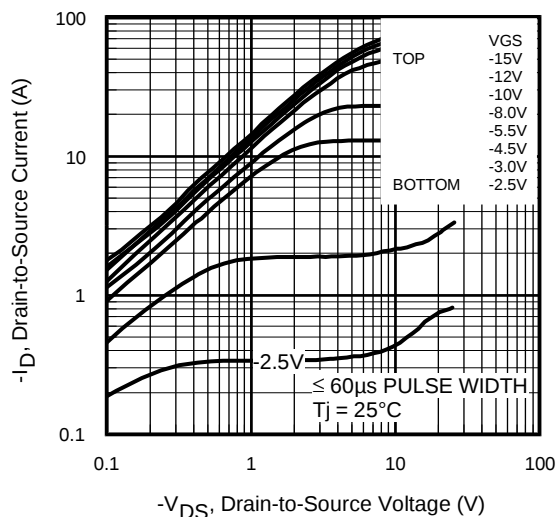
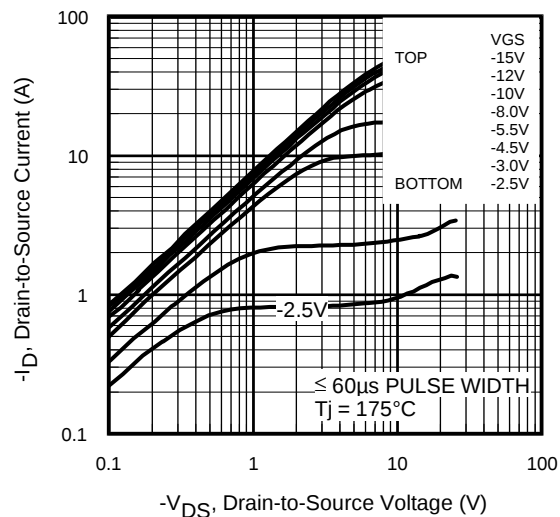
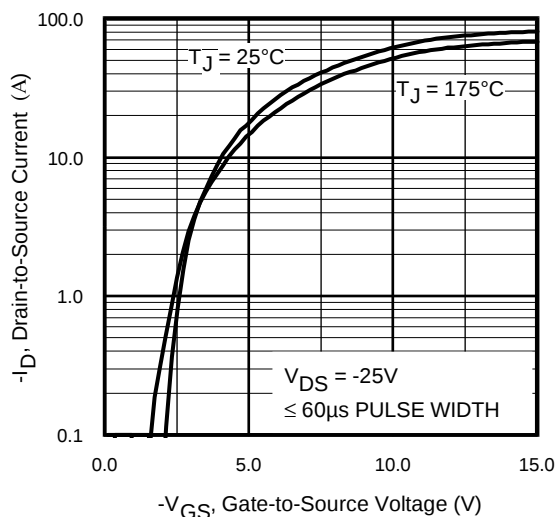
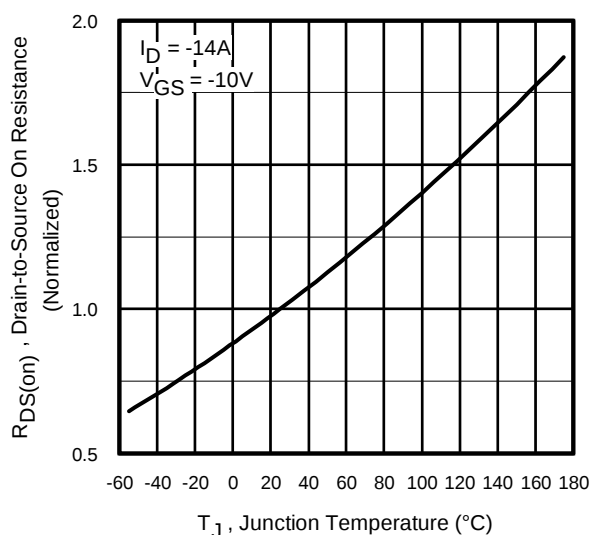
Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S @ T_C = 25^\circ\text{C}$	Continuous Source Current (Body Diode)			-20	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①			-60		
V_{SD}	Diode Forward Voltage			-1.2	V	$T_J = 25^\circ\text{C}, I_S = -14A, V_{GS} = 0V$ ③
t_{rr}	Reverse Recovery Time		57	86	ns	$T_J = 25^\circ\text{C}, I_F = -14A$
Q_{rr}	Reverse Recovery Charge		120	180	nC	$di/dt = 100A/\mu s$ ③



-60V P-Channel MOSFET
Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 1.24\text{mH}$, $R_G = 25\Omega$, $I_{AS} = -14\text{A}$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ This only applies for I-Pak, L_S of D-Pak is measured between lead and center of die contact
- ⑤ R_{θ} is measured at T_J of approximately 90°C .
- ⑥ Contact factory for mounting information
- ⑦ Limited by T_{jmax} . See Figs. 14, 15, 17a, 17b for repetitive avalanche information
- ⑧ When D-Pak mounted on 1" square PCB (FR-4 or G-10 Material) .
For recommended footprint and soldering techniques refer to application note #AN-994
- ⑨ Refer to D-Pak package for Part Marking, Tape and Reel information.


Fig 1. Typical Output Characteristics

Fig 2. Typical Output Characteristics

Fig 3. Typical Transfer Characteristics

Fig 4. Normalized On-Resistance vs. Temperature

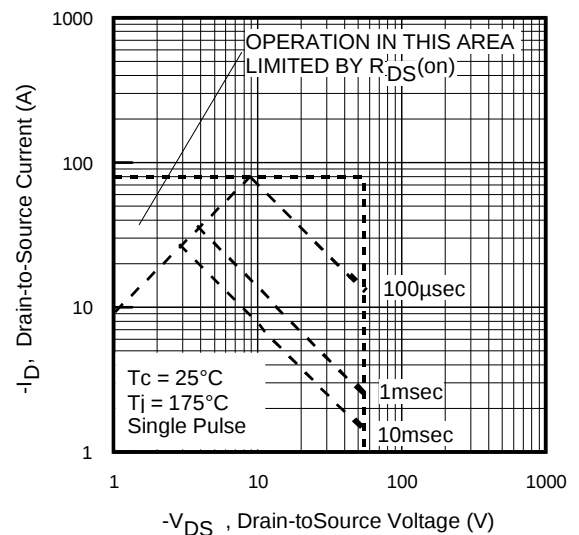
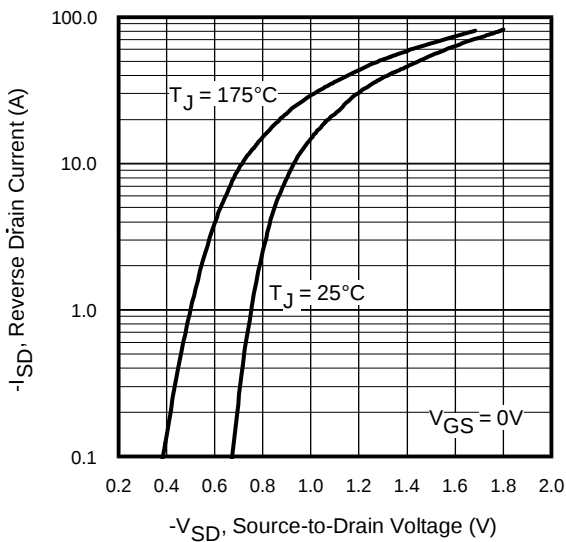
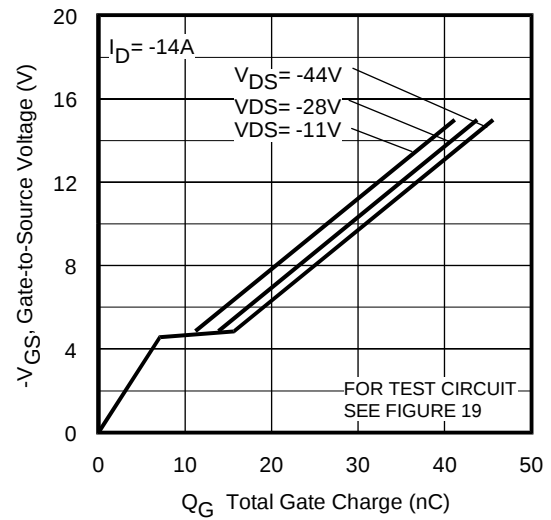
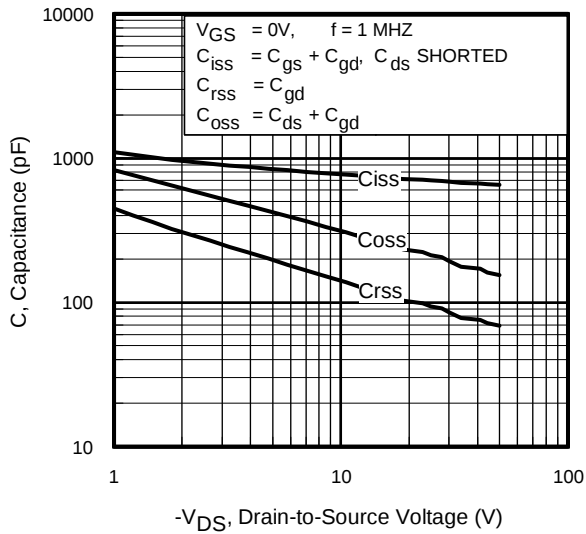


Fig 7. Typical Source-Drain Diode Forward Voltage

Fig 8. Maximum Safe Operating Area

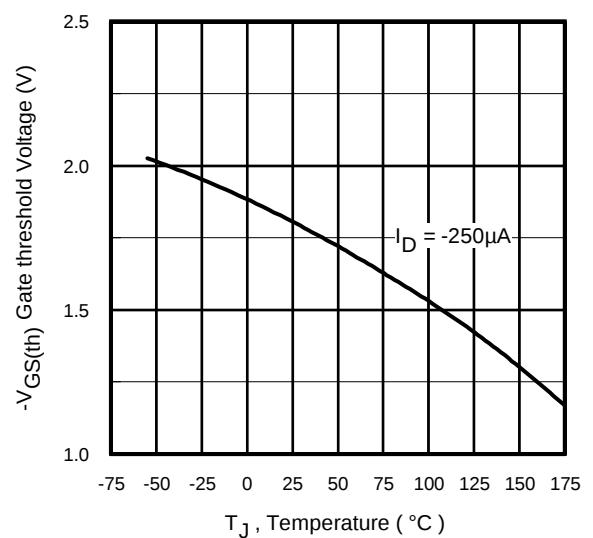
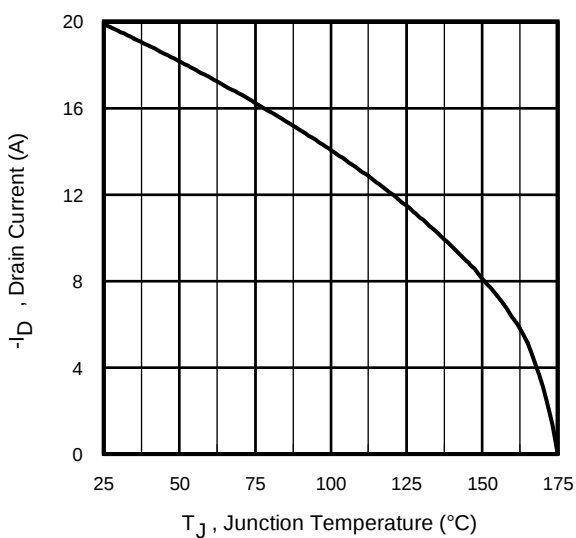


Fig 9. Maximum Drain Current vs. Case Temperature

Fig 10. Threshold Voltage vs. Temperature

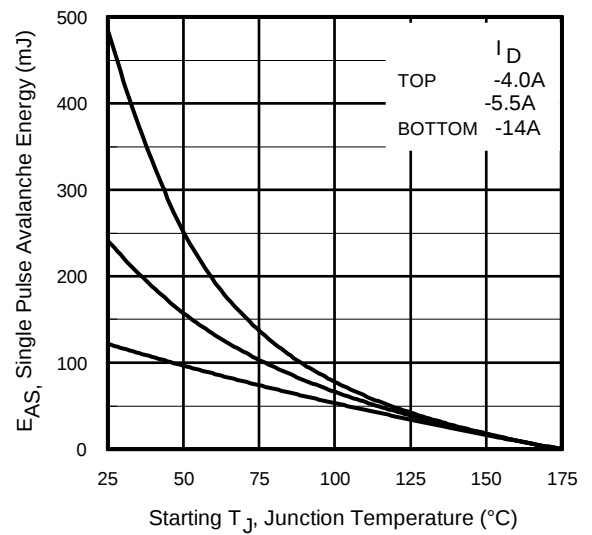
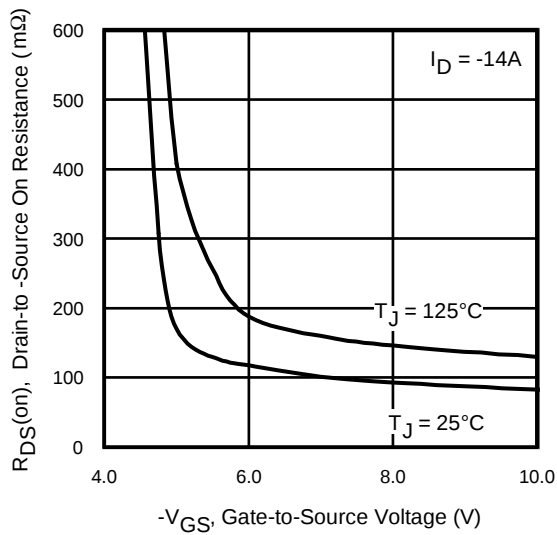
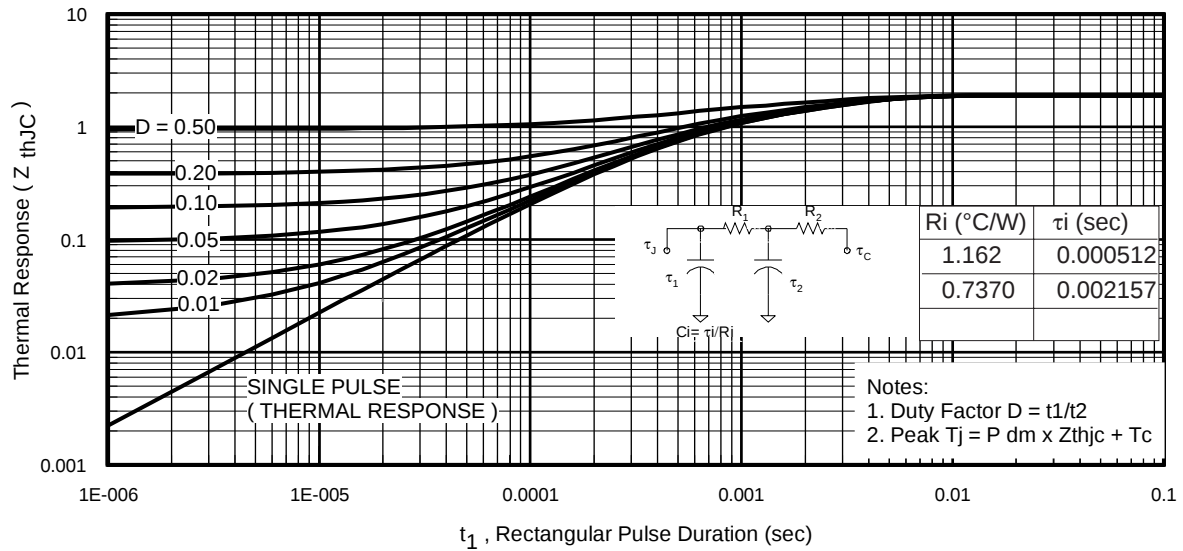


Fig 12. On-Resistance Vs. Gate Voltage

Fig 13. Maximum Avalanche Energy Vs. Drain Current

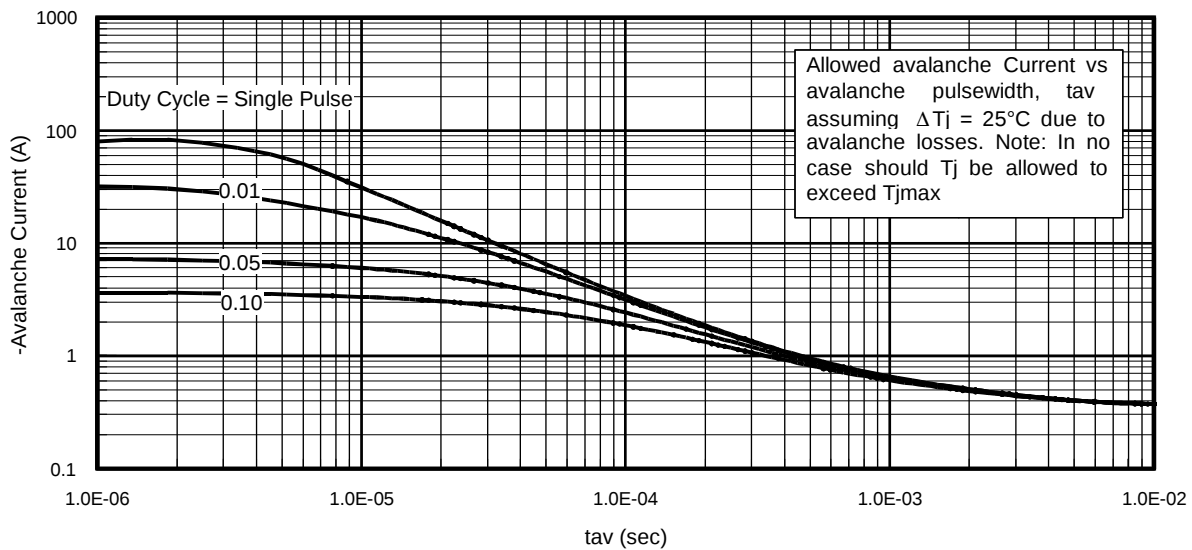


Fig 14. Typical Avalanche Current Vs. Pulsewidth

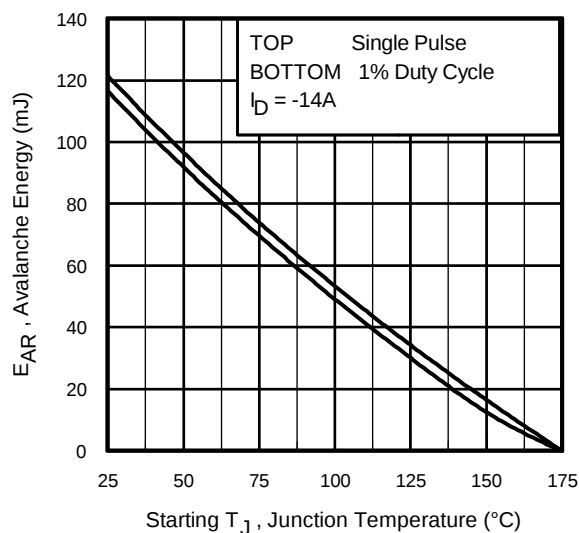


Fig 15. Maximum Avalanche Energy Vs. Temperature

Notes on Repetitive Avalanche Curves , Figures 14, 15:

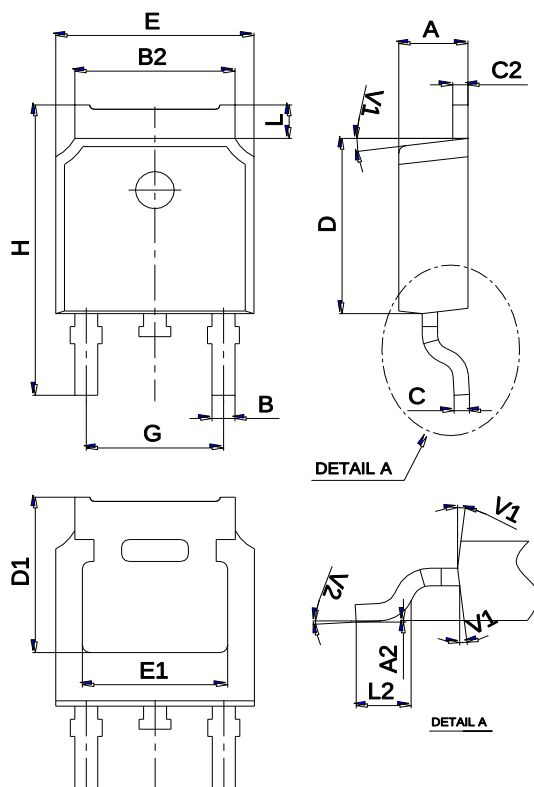
1. Avalanche failures assumption:
Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 17a, 17b.
4. $P_{D(ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. I_{av} = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed T_{jmax} (assumed as 25°C in Figure 14, 15).
 t_{av} = Average time in avalanche.
 D = Duty cycle in avalanche = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{thJC}]$$

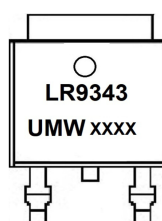
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

Package Mechanical Data TO-252



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10		2.50	0.083		0.098
A2	0		0.10	0		0.004
B	0.66		0.86	0.026		0.034
B2	5.18		5.48	0.202		0.216
C	0.40		0.60	0.016		0.024
C2	0.44		0.58	0.017		0.023
D	5.90		6.30	0.232		0.248
D1	5.30REF			0.209REF		
E	6.40		6.80	0.252		0.268
E1	4.63			0.182		
G	4.47		4.67	0.176		0.184
H	9.50		10.70	0.374		0.421
L	1.09		1.21	0.043		0.048
L2	1.35		1.65	0.053		0.065
V1		7°			7°	
V2	0°		6°	0°		6°

Marking



Ordering information

Order code	Package	Baseqty	Deliverymode
UMW IRLR9343TR	TO-252	2500	Tape and reel