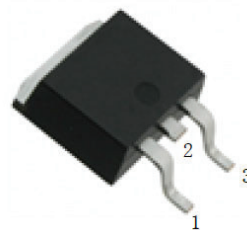
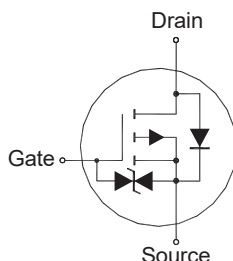


P-Channel Enhancement Mode MOSFET

Features

- AEC-Q101 Qualified
- Surface-mounted package
- Built-in G-S Protection Diode
- Halogen and Antimony Free(HAF), RoHS compliant
- Typical ESD Protection HBM Class 2

Classification	Voltage Range(V)
0A	< 125
0B	125 to < 250
1A	250 to < 500
1B	500 to < 1000
1C	1000 to < 2000
2	2000 to < 4000
3A	4000 to < 8000
3B	≥ 8000



1.Gate 2.Drain 3.Source
TO-252 Plastic Package

Key Parameters

Parameter	Value	Unit
$-BV_{DS}$	40	V
$R_{DS(ON)}$ Max	22 @ $-V_{GS} = 10$ V	mΩ
	32 @ $-V_{GS} = 6$ V	
$-V_{GS(th)}$ typ	2.2	V
Q_g typ	54.5 @ $-V_{GS} = 10$ V	nC

Absolute Maximum Ratings(at $T_a = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$-V_{DS}$	40	V
Gate-Source Voltage	V_{GS}	- 20 / + 10	V
Drain Current	$-I_D$	45	A
		31.5	
Peak Drain Current, Pulsed ¹⁾	$-I_{DM}$	180	A
Avalanche Current	$-I_{AS}$	35.7	A
Single Pulse Avalanche Energy ²⁾	E_{AS}	63.7	mJ
Total Power Dissipation	P_{tot}	50	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 175	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	3	$^\circ\text{C/W}$
Thermal Resistance from Junction to Ambient ³⁾	$R_{\theta JA}$	45	$^\circ\text{C/W}$

¹⁾ Pulse Test: Pulse Width ≤ 100 μs, Duty Cycle ≤ 2%, Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)} = 175^\circ\text{C}$.

²⁾ Limited by $T_{J(MAX)}$, starting $T_J = 25^\circ\text{C}$, $L = 0.1$ mH, $R_g = 25$ Ω, $-I_{AS} = 35.7$ A, $V_{GS} = 10$ V.

³⁾ Device Surface Mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate, in a still air.

Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $-I_D = 10\text{ mA}$	$-BV_{DS}$	40	-	-	V
Drain-Source Leakage Current at $-V_{DS} = 32\text{ V}$	$-I_{DSS}$	-	-	10	μA
Gate Leakage Current at $V_{GS} = -16 / +10\text{ V}$	I_{GSS}	-	-	± 10	μA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $-I_D = 1\text{ mA}$	$-V_{GS(th)}$	2	-	3	V
Drain-Source On-State Resistance at $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$ at $-V_{GS} = 6\text{ V}$, $-I_D = 10\text{ A}$	$R_{DS(on)}$	-	13 -	22 32	$\text{m}\Omega$
DYNAMIC PARAMETERS					
Forward Transconductance at $-V_{DS} = 5\text{ V}$, $-I_D = 10\text{ A}$	g_{fs}	-	22	-	S
Gate Resistance at $V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ V}$, $f = 1\text{ MHz}$	R_g	-	4.5	-	Ω
Input Capacitance at $V_{GS} = 0\text{ V}$, $-V_{DS} = 20\text{ V}$, $f = 1\text{ MHz}$	C_{iss}	-	3437	-	pF
Output Capacitance at $V_{GS} = 0\text{ V}$, $-V_{DS} = 20\text{ V}$, $f = 1\text{ MHz}$	C_{oss}	-	212	-	pF
Reverse Transfer Capacitance at $V_{GS} = 0\text{ V}$, $-V_{DS} = 20\text{ V}$, $f = 1\text{ MHz}$	C_{rss}	-	138	-	pF
Gate charge total at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$ at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 6\text{ V}$, $-I_D = 10\text{ A}$	Q_g	- -	54.5 33.3	- -	nC
Gate to Source Charge at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$	Q_{gs}	-	15.3	-	nC
Gate to Drain Charge at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$	Q_{gd}	-	8.9	-	nC
Turn-On Delay Time at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$, $R_g = 3.3\text{ }\Omega$	$t_{d(on)}$	-	18	-	ns
Turn-On Rise Time at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$, $R_g = 3.3\text{ }\Omega$	t_r	-	28	-	ns
Turn-Off Delay Time at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$, $R_g = 3.3\text{ }\Omega$	$t_{d(off)}$	-	32	-	ns
Turn-Off Fall Time at $-V_{DS} = 20\text{ V}$, $-V_{GS} = 10\text{ V}$, $-I_D = 10\text{ A}$, $R_g = 3.3\text{ }\Omega$	t_f	-	6.5	-	ns
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at $-I_S = 1\text{ A}$, $V_{GS} = 0\text{ V}$	$-V_{SD}$	-	-	1.3	V
Body-Diode Continuous Current	$-I_S$	-	-	45	A
Body-Diode Continuous Current, Pulsed	$-I_{SM}$	-	-	180	A
Body Diode Reverse Recovery Time at $-I_S = 10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	t_{rr}	-	18	-	ns
Body Diode Reverse Recovery Charge at $-I_S = 10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	Q_{rr}	-	14.8	-	nC

Electrical characteristic curves

Fig. 1 Typical Output Characteristics

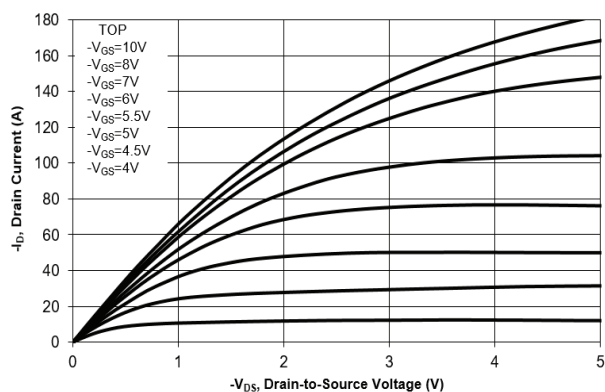


Fig. 2 Typical Transfer Characteristics

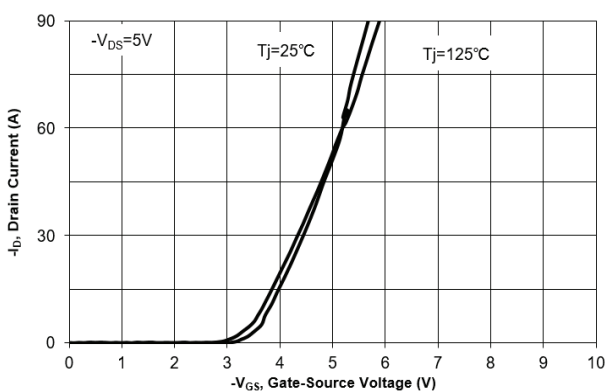


Fig. 3 on-Resistance vs. Drain Current

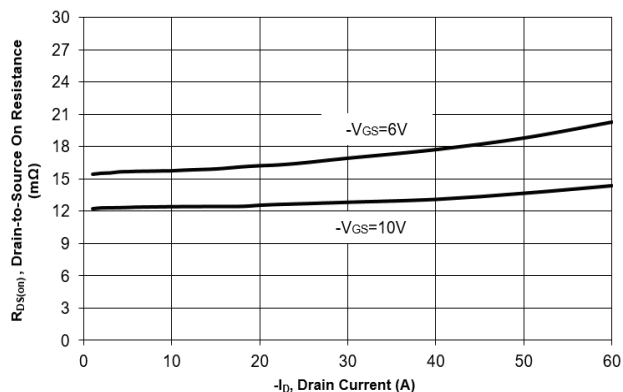


Fig. 4 on-Resistance vs. Gate to Source Voltage

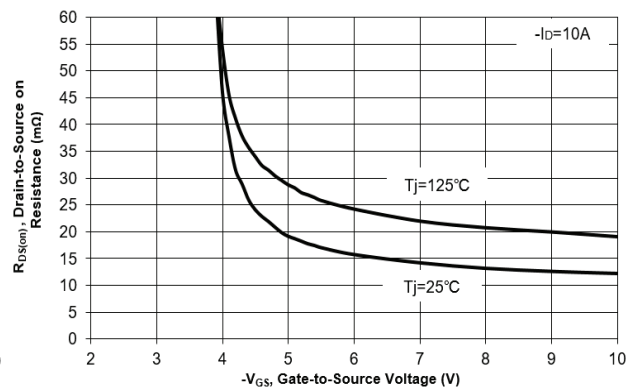


Fig. 5 on-Resistance vs. T_J

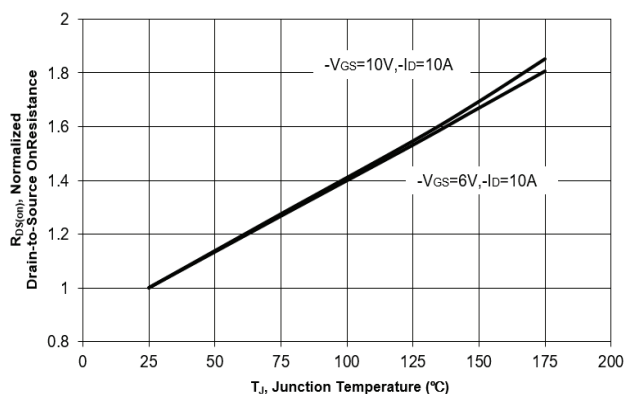
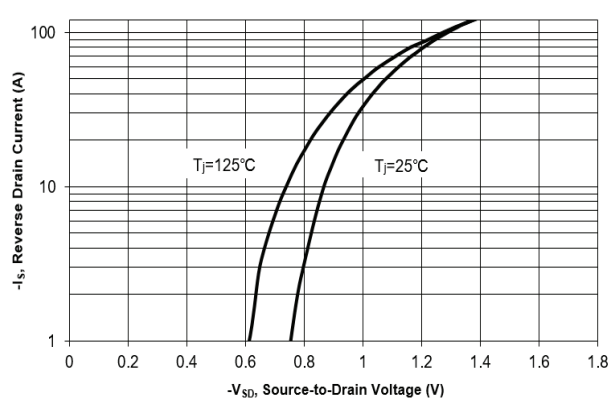


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical characteristic curve

Fig. 7 Typical Junction Capacitance

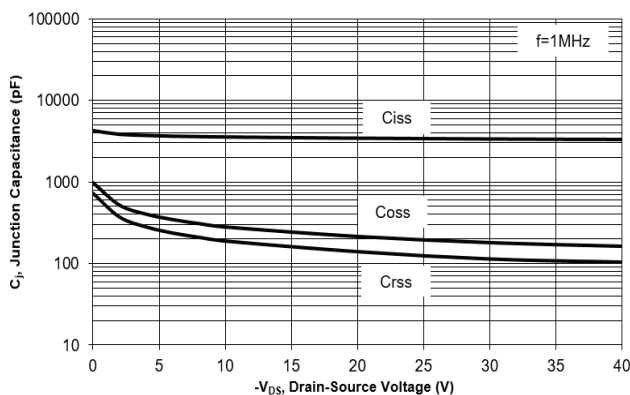


Fig. 8 Drain-Source Leakage Current vs. T_j

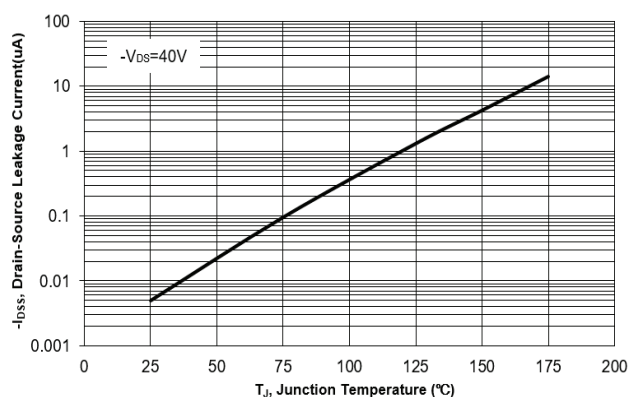


Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

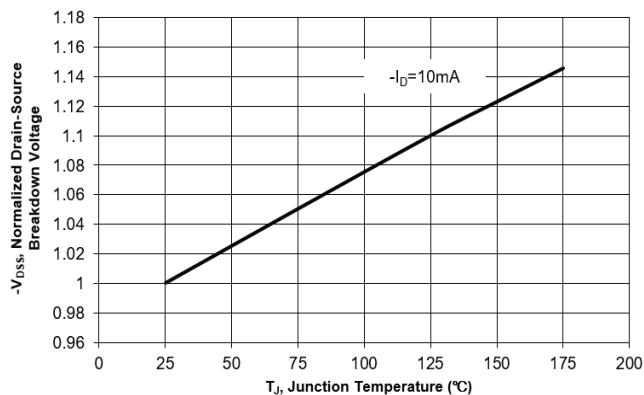


Fig. 10 Gate Threshold Variation vs. T_j

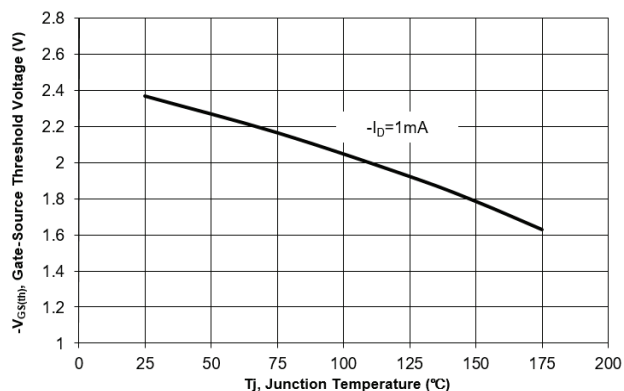


Fig. 11 Gate Charge

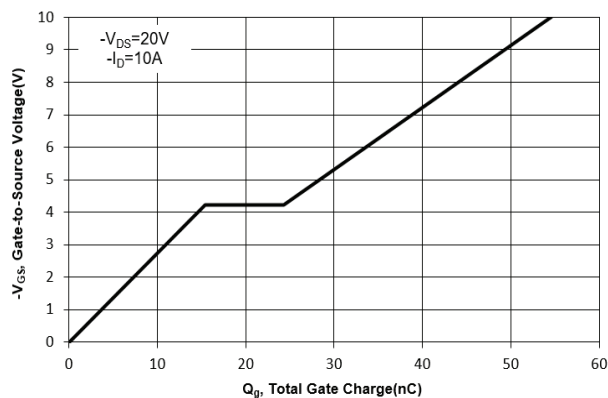
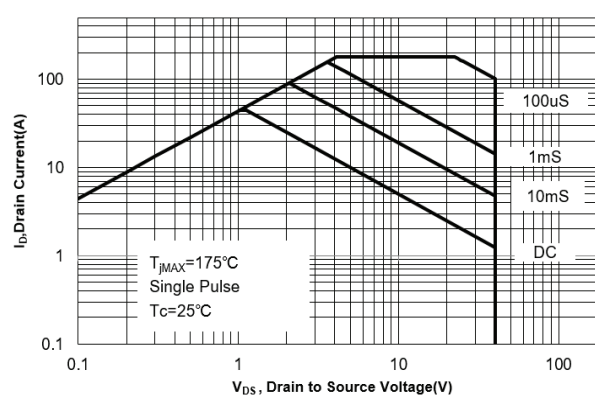


Fig. 12 Safe Operation Area



Electrical Characteristics Curves

Fig. 13 Normalized Maximum Transient Thermal Impedance($Z_{\theta JC}$)

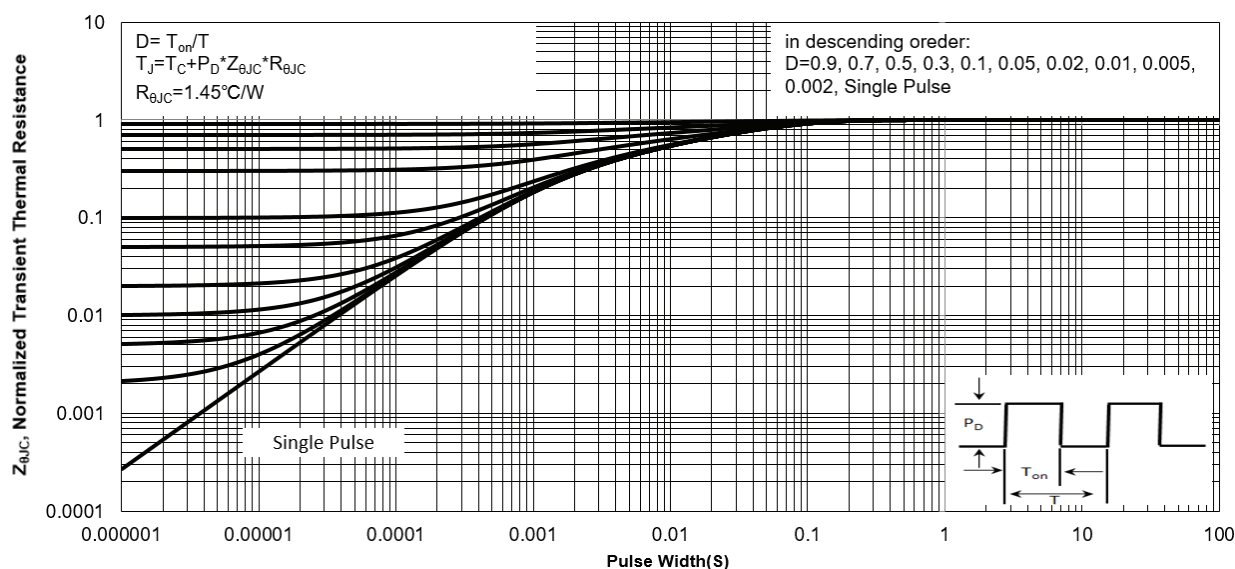
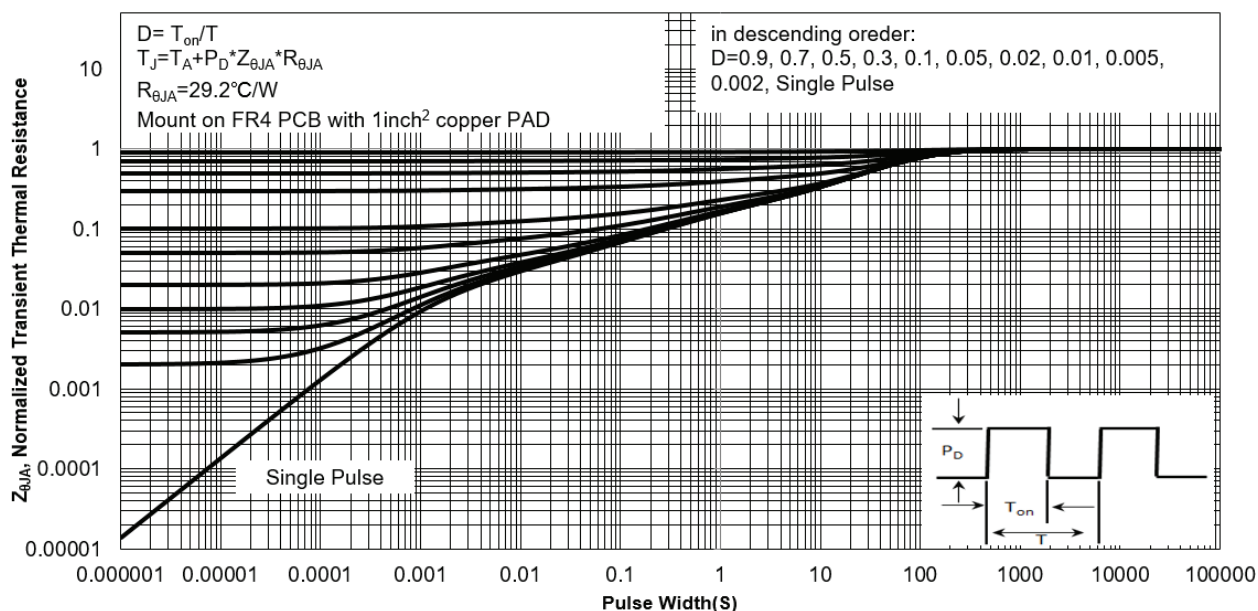


Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



Test Circuits

Fig.1-1 Switching times test circuit

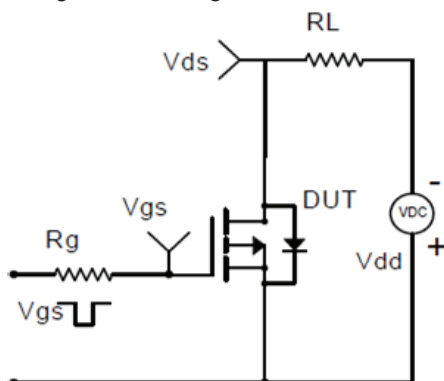


Fig.1-2 Switching Waveform

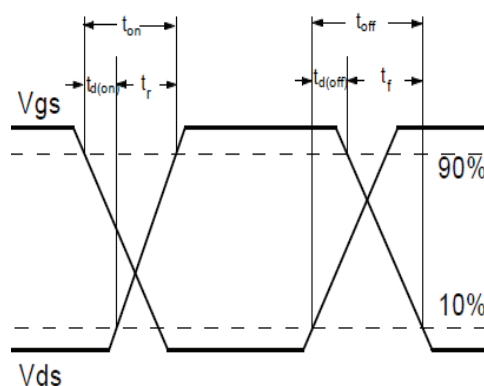


Fig.2-1 Gate charge test circuit

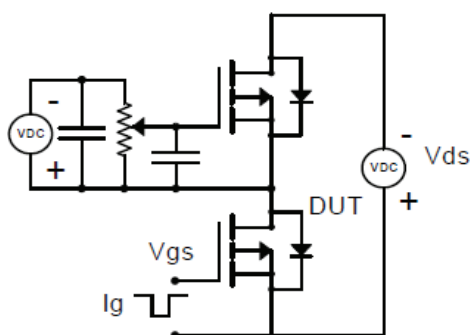


Fig.2-2 Gate charge waveform

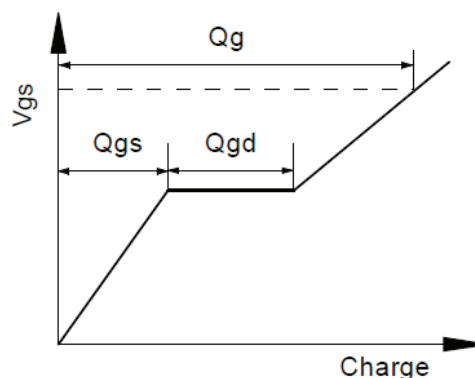


Fig.3-1 Avalanche test circuit

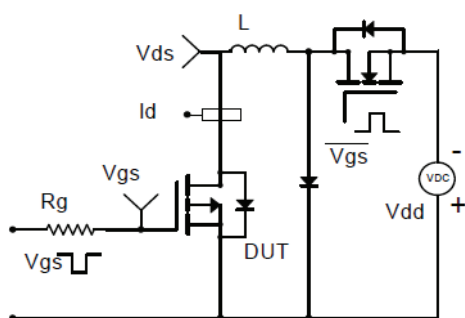
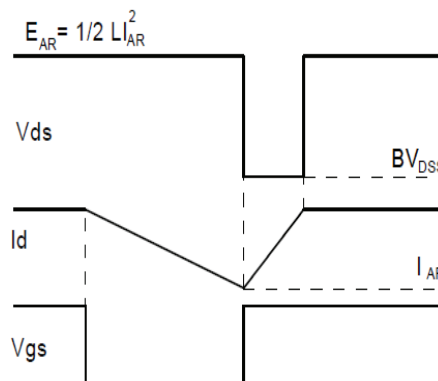
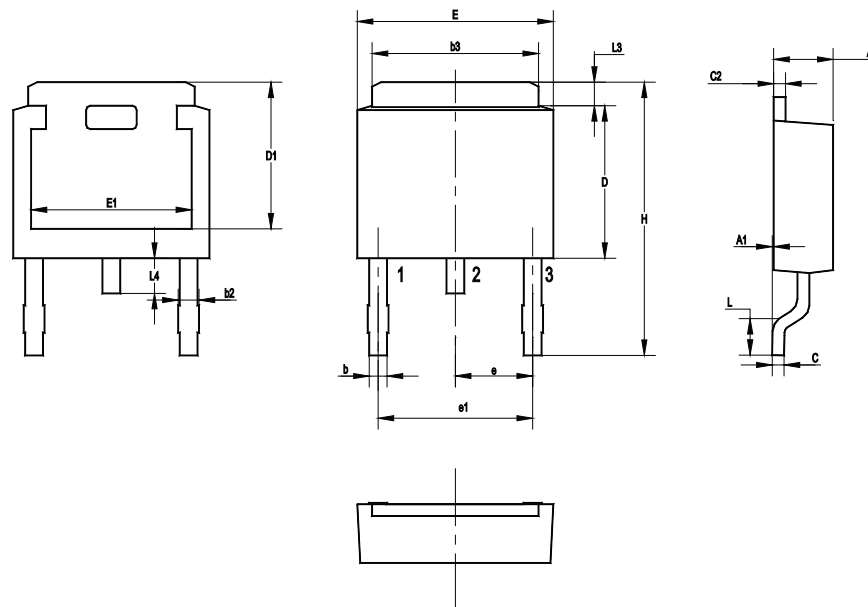
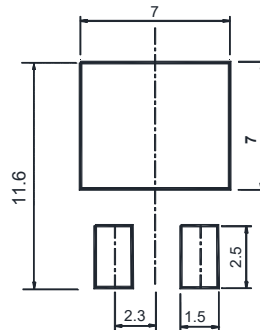


Fig.3-2 Avalanche waveform



Package Outline (Dimensions in mm)
TO-252


UNIT	A	A1	b	b2	b3	C	C2	D	D1	E	E1	e	e1	H	L	L3	L4
mm	2.5	0.15	1.0	1.15	5.5	0.65	0.65	6.2	5.4	6.7	5.0	2.30	4.60	10.7	1.78	1.20	1.10
	2.1	0	0.5	0.65	4.9	0.4	0.4	5.6	5.0	6.1	4.6	TYP.	TYP.	9	1.40	0.85	0.51

Recommended Soldering Footprint

Packing information

Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
TO-252	16	8 ± 0.1	0.315 ± 0.004	330	13	2,500

Marking information

" TR04P220SKS " = Part No.

" ***** " = Date Code Marking

Font type: Arial



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