

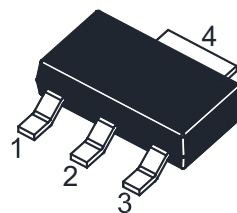
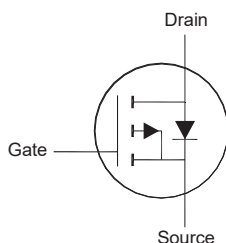
P-Channel Enhancement Mode MOSFET

Features

- Advanced trench cell design
- Halogen and Antimony Free(HAF),
RoHS compliant

Applications

- Portable appliances
- Battery management



1.Gate 2.Drain 3.Source 4.Drain
SOT-223 Plastic Package

Key Parameters

Parameter	Value	Unit
$-BV_{DS}$	40	V
$R_{DS(ON)}$ Max	60 @ $-V_{GS} = 10$ V	m Ω
	85 @ $-V_{GS} = 4.5$ V	
$-V_{GS(th)}$ typ	1.4	V
Q_g typ	14.2 @ $-V_{GS} = 10$ 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	V
Drain Current	$-I_D$	10	A
		6.3	
Peak Drain Current ¹⁾	$-I_{DM}$	40	A
Avalanche Current	$-I_{AS}$	16.1	A
Avalanche Energy ²⁾	E_{AS}	12.9	mJ
Total Power Dissipation	P_{tot}	10.4	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 150	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	12	$^\circ\text{C/W}$
Thermal Resistance from Junction to Ambient ³⁾	$R_{\theta JA}$	80	$^\circ\text{C/W}$

¹⁾ Pulse Test: Pulse Width ≤ 100 μs , Duty Cycle $\leq 2\%$, Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)} = 150^\circ\text{C}$.

²⁾ Limited by $T_{J(MAX)}$, starting $T_J = 25^\circ\text{C}$, $L = 0.1$ mH, $R_g = 25$ Ω , $-I_{AS} = 16.1$ A, $V_{GS} = 10$ V.

³⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in 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 $-I_D = 250\ \mu\text{A}$	$-BV_{DS}$	40	-	-	V
Drain-Source On-State Current at $-V_{DS} = 32\ \text{V}$	$-I_{DSS}$	-	-	1	μA
Gate-Source Leakage Current at $V_{GS} = \pm 16\ \text{V}$	I_{GSS}	-	-	± 100	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $-I_D = 250\ \mu\text{A}$	$-V_{GS(th)}$	1	-	2	V
Drain-Source On-State Resistance at $-V_{GS} = 10\ \text{V}$, $-I_D = 4\ \text{A}$ at $-V_{GS} = 4.5\ \text{V}$, $-I_D = 3\ \text{A}$	$R_{DS(ON)}$	- -	48.5 -	60 85	m Ω
DYNAMIC PARAMETERS					
Forward Transconductance at $-V_{DS} = 5\ \text{V}$, $-I_D = 3\ \text{A}$	g_{fs}	-	7	-	S
Gate resistance at $V_{DS} = 0\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	42.6	-	Ω
Input Capacitance at $V_{GS} = 0\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	806	-	pF
Output Capacitance at $V_{GS} = 0\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	61	-	pF
Reverse Transfer Capacitance at $V_{GS} = 0\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	46	-	pF
Total Gate Charge at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$ at $-V_{GS} = 4.5\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$	Q_g	- -	14.2 6.6	- -	nC
Gate-Source Charge at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$	Q_{gs}	-	2.8	-	nC
Gate-Drain Charge at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$	Q_{gd}	-	1.9	-	nC
Turn-On Delay Time at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$, $R_G = 3.3\ \Omega$	$t_{d(on)}$	-	5	-	ns
Turn-On Rise Time at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$, $R_G = 3.3\ \Omega$	t_r	-	15	-	ns
Turn-Off Delay Time at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$, $R_G = 3.3\ \Omega$	$t_{d(off)}$	-	43	-	ns
Turn-Off Fall Time at $-V_{GS} = 10\ \text{V}$, $-V_{DS} = 20\ \text{V}$, $-I_D = 4\ \text{A}$, $R_G = 3.3\ \Omega$	t_f	-	10	-	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	$-I_S$	-	-	10	A
Body-Diode Continuous Current, Pulsed	$-I_{SM}$	-	-	40	A
Body Diode Reverse Recovery Time at $-I_S = 4\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	9	-	ns
Body Diode Reverse Recovery Charge at $-I_S = 4\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	5	-	nC

Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

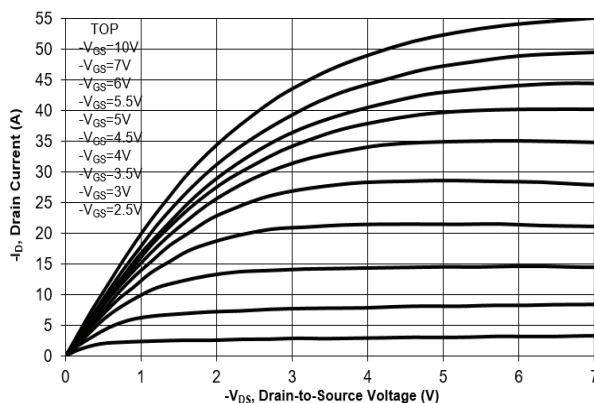


Fig. 2 Typical Transfer Characteristics

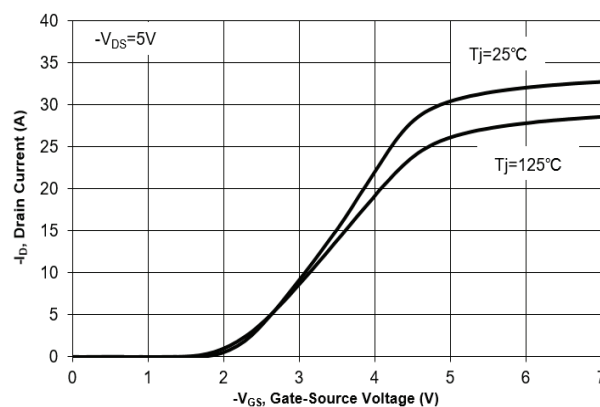


Fig. 3 on-Resistance vs. Drain Current

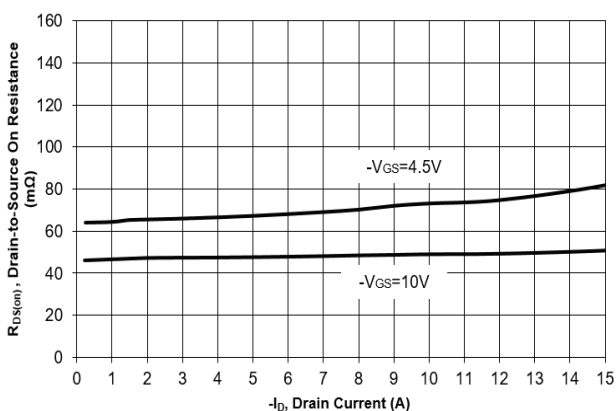


Fig. 4 on-Resistance vs. Gate to Source Voltage

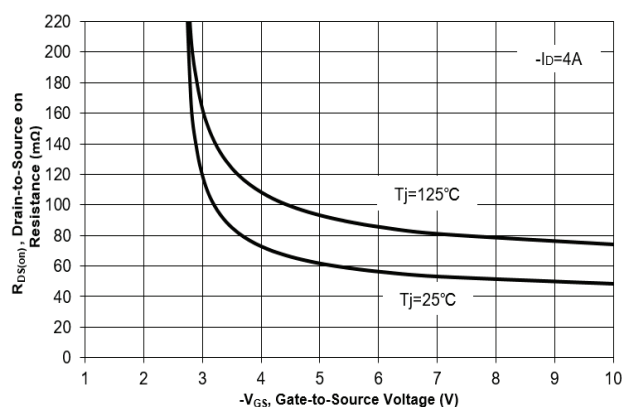


Fig. 5 on-Resistance vs. T_J

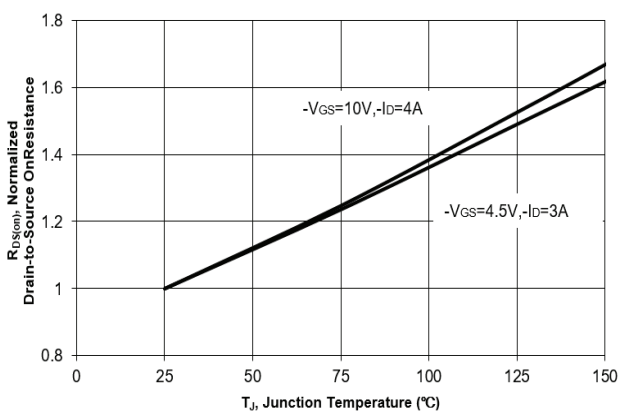
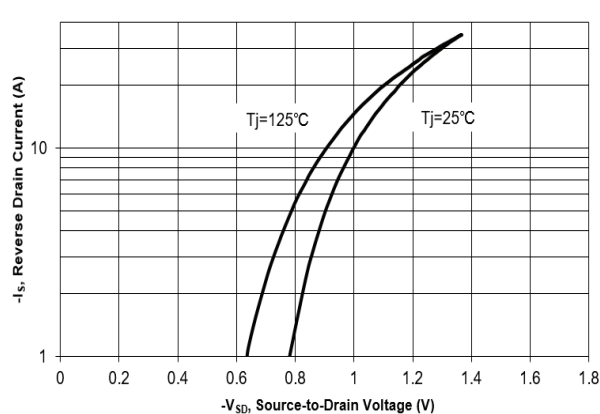


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

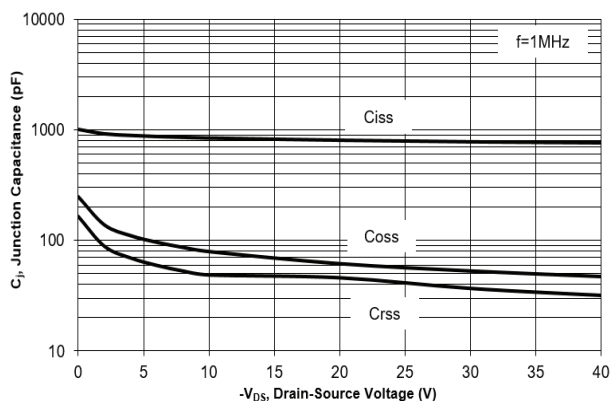


Fig. 8 Drain-Source Leakage Current vs. T_j

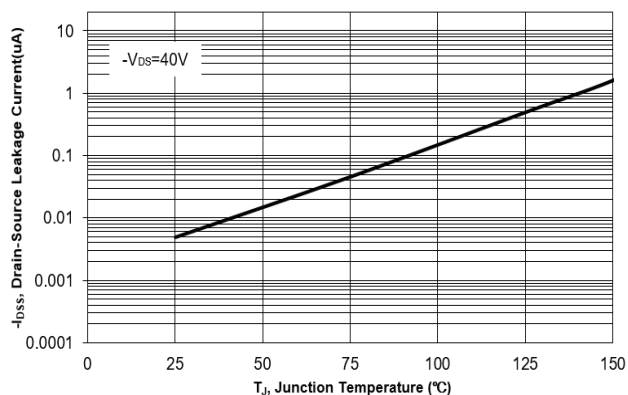


Fig. 9 V_{(BR)DSS} vs. Junction Temperature

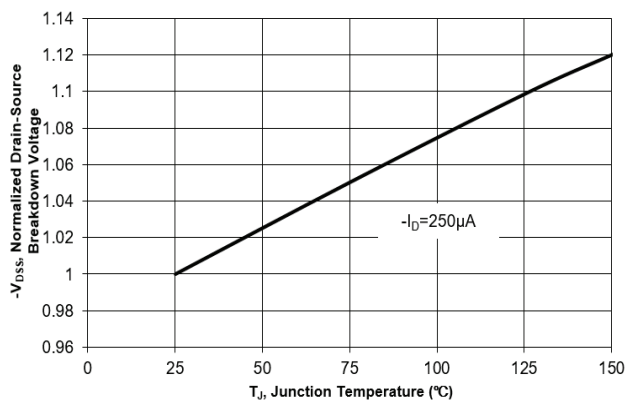


Fig. 10 Gate Threshold Variation vs. T_j

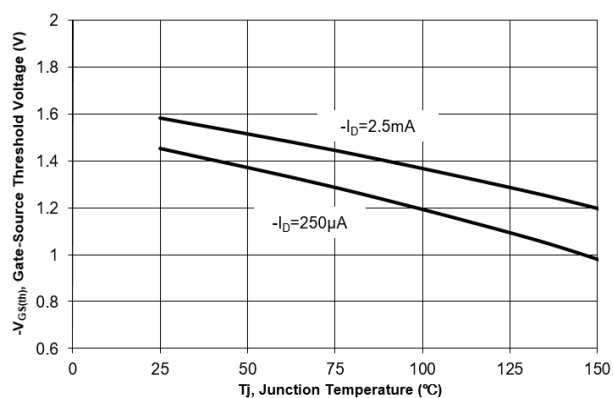


Fig. 11 Gate Charge

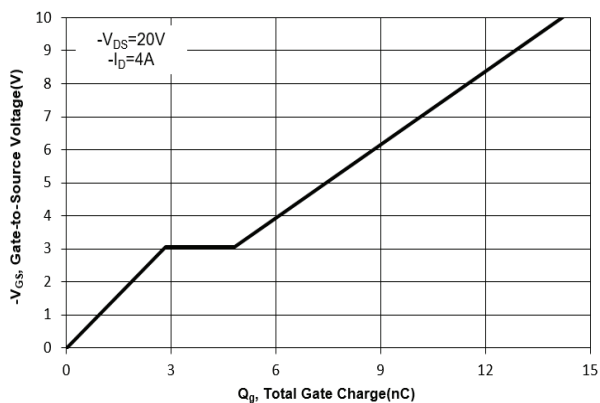
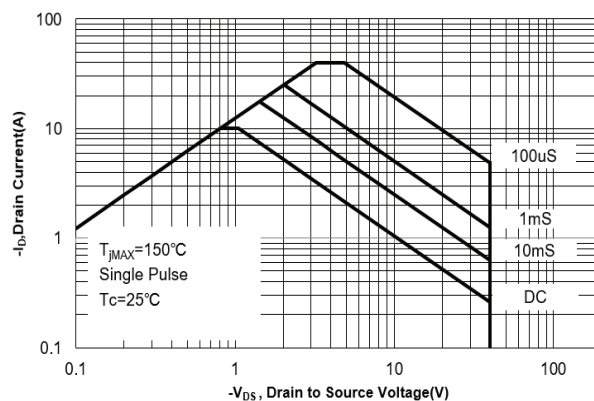


Fig. 12 Safe Operation Area



Electrical Characteristics Curves

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

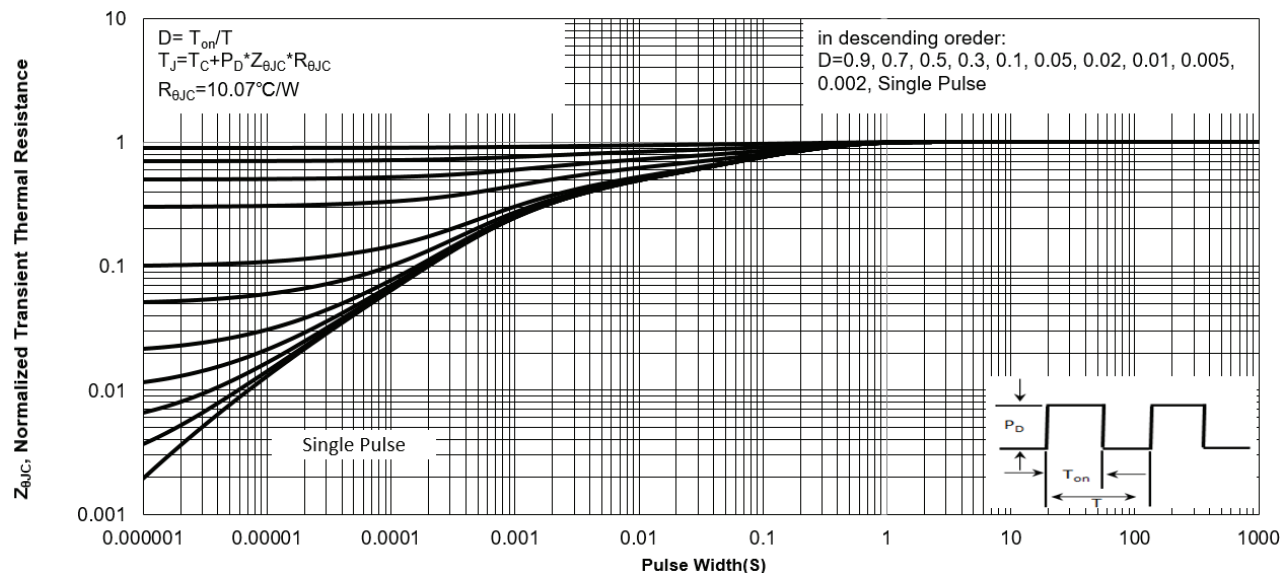
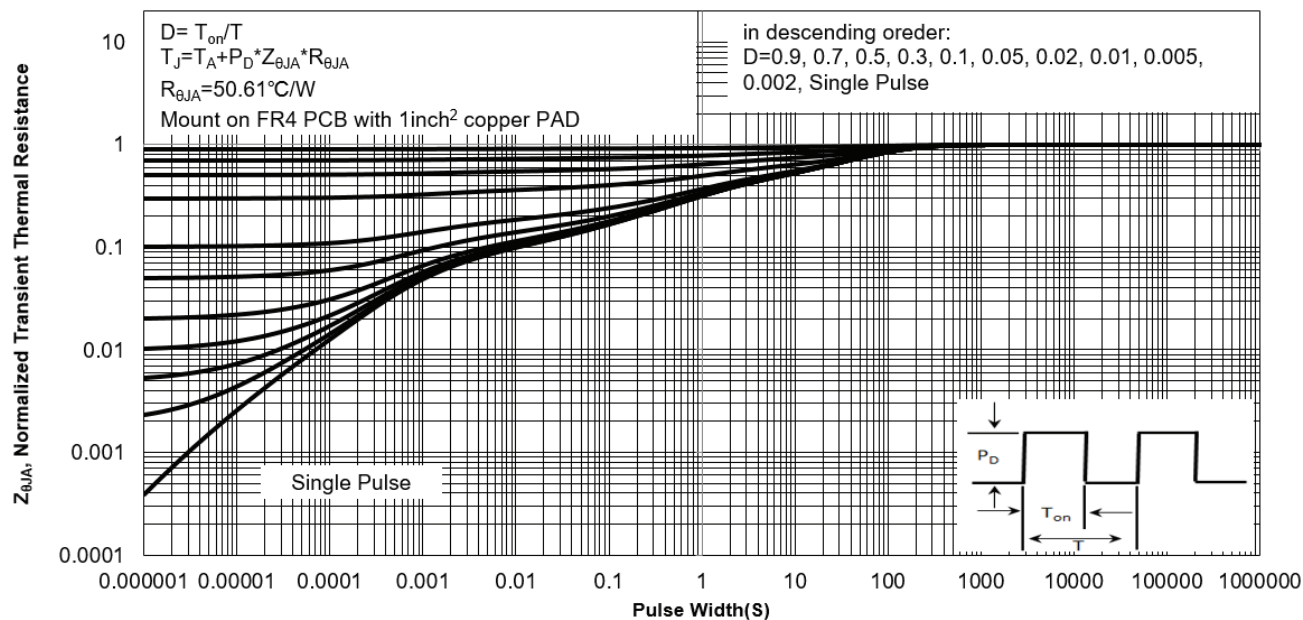


Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



Test Circuits

Fig.1-1 Switching times test circuit

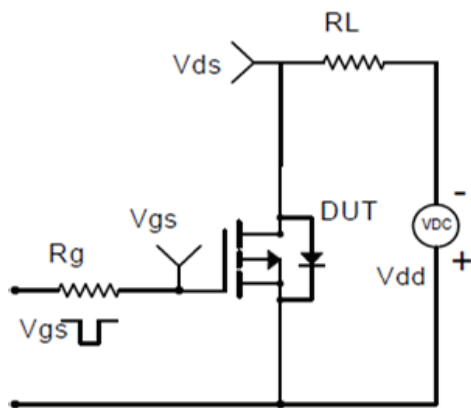


Fig.1-2 Switching Waveform

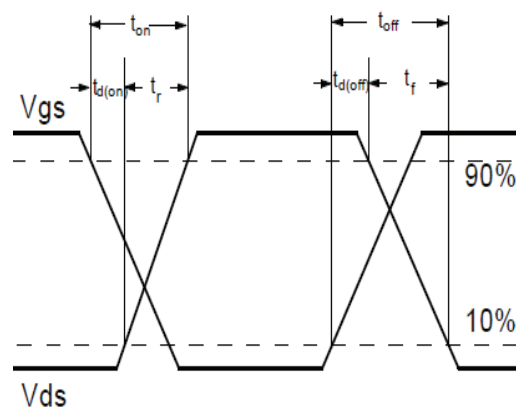


Fig.2-1 Gate charge test circuit

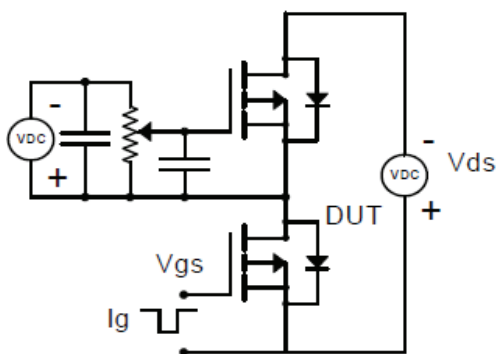


Fig.2-2 Gate charge waveform

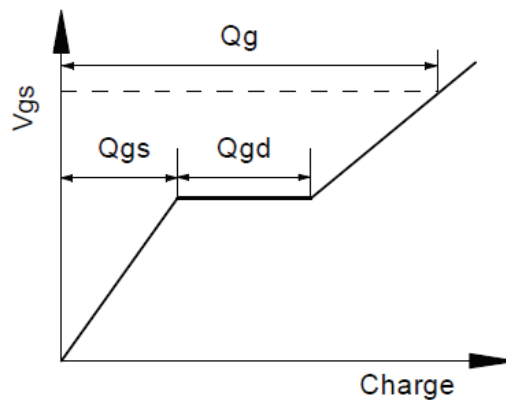


Fig.3-1 Avalanche test circuit

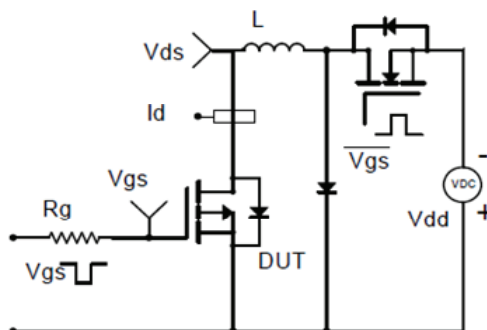
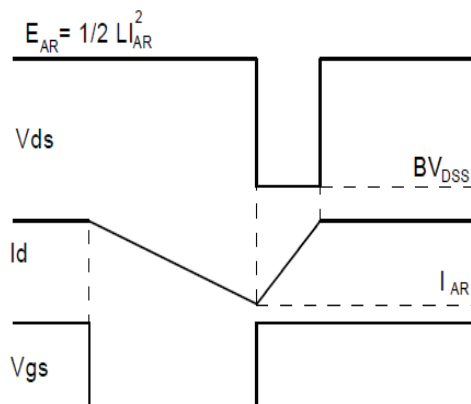
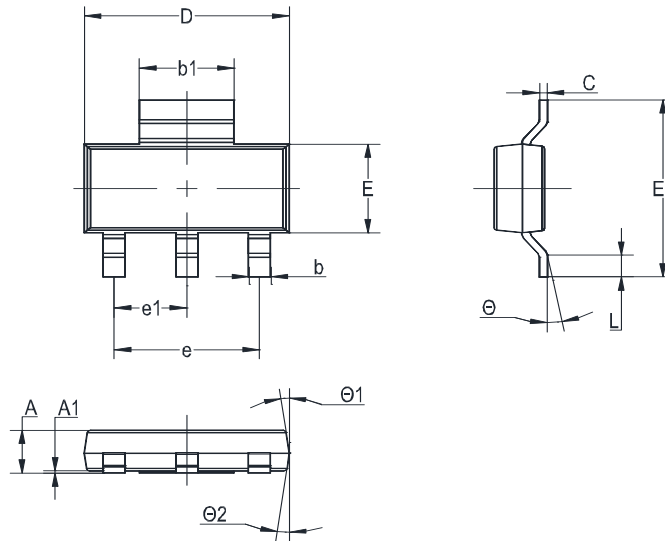


Fig.3-2 Avalanche waveform



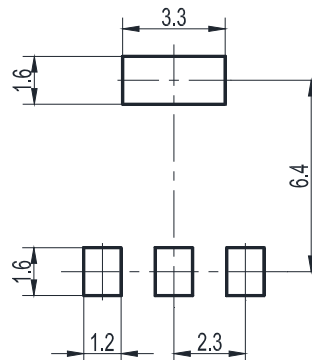
Package Outline (Dimensions in mm)

SOT-223



Unit	A	A1	b	b1	C	D	E	E1	e	e1	L	Θ	Θ1	Θ2
mm	1.8 1.5	0.1 MAX	0.8 0.6	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	7.3 6.7	4.6 TYP	2.3 TYP	1.1 0.7	10° 0°	7° 0°	7° 0°

Recommended Soldering Footprint



Packing information

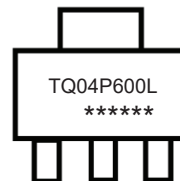
Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
SOT-223	12	8 ± 0.1	0.315 ± 0.004	330	13	3,000

Marking information

" TQ04P600L " = Part No.

" ***** " = Date Code Marking

Font type: Arial



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