

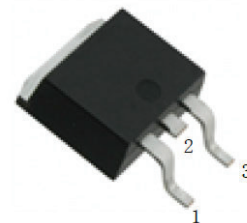
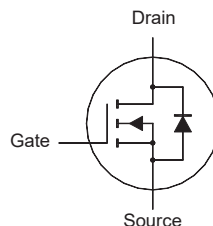
N-Channel Enhancement Mode MOSFET

Features

- Surface-mounted package
- Halogen and Antimony Free(HAF), RoHS compliant

Application

- DC-DC converters and Off-line UPS
- Motor / Body Load Control



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

Key Parameters

Parameter	Value	Unit
BV_{DSS}	40	V
$R_{DS(ON)}$ Max	32 @ $V_{GS} = 10\text{ V}$	$m\Omega$
	42 @ $V_{GS} = 4.5\text{ V}$	
$V_{GS(th)}$ typ	1.6	V
Q_g typ	9.5 @ $V_{GS} = 10\text{ V}$	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	16	A
		10	
Peak Drain Current, Pulsed ¹⁾	I_{DM}	35	A
Avalanche Current	I_{AS}	9.1	A
Single Pulse Avalanche Energy ²⁾	E_{AS}	4.1	mJ
Power Dissipation	P_{tot}	14.7	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	$R_{\theta JC}$	8.4	$^\circ\text{C/W}$
Thermal Resistance from Junction to Ambient ³⁾	$R_{\theta JA}$	41	$^\circ\text{C/W}$

¹⁾ Pulse Test: Pulse Width $\leq 100\text{ }\mu\text{s}$, 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 $T_J = 25^\circ\text{C}$, $L = 0.1\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 9.1\text{ A}$, $V_{GS} = 10\text{ V}$.

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 $I_D = 250\ \mu\text{A}$	BV_{DSS}	40	-	-	V
Drain-Source Leakage Current at $V_{DS} = 32\ \text{V}$	I_{DSS}	-	-	1	μA
Gate Leakage Current at $V_{GS} = \pm 20\ \text{V}$	I_{GSS}	-	-	± 100	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	1.2	-	2.5	V
Drain-Source On-State Resistance at $V_{GS} = 10\ \text{V}$, $I_D = 5\ \text{A}$ at $V_{GS} = 4.5\ \text{V}$, $I_D = 3\ \text{A}$	$R_{DS(on)}$	- -	27 -	32 42	m Ω
DYNAMIC PARAMETERS					
Forward Transconductance at $V_{DS} = 5\ \text{V}$, $I_D = 5\ \text{A}$	g_{fs}	-	7.5	-	S
Gate Resistance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	1.3	-	Ω
Input Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	423	-	pF
Output Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	36	-	pF
Reverse Transfer Capacitance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 20\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	31	-	pF
Gate charge total at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$ at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 4.5\ \text{V}$	Q_g	- -	9.5 4.4	- -	nC
Gate to Source Charge at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$	Q_{gs}	-	1.8	-	nC
Gate to Drain Charge at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$	Q_{gd}	-	1.6	-	nC
Turn-On Delay Time at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$, $R_g = 1\ \Omega$	$t_{d(on)}$	-	8	-	ns
Turn-On Rise Time at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$, $R_g = 1\ \Omega$	t_r	-	8	-	ns
Turn-Off Delay Time at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$, $R_g = 1\ \Omega$	$t_{d(off)}$	-	7	-	ns
Turn-Off Fall Time at $V_{DS} = 20\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 10\ \text{V}$, $R_g = 1\ \Omega$	t_f	-	1.6	-	ns
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at $I_S = 5\ \text{A}$, $V_{GS} = 0\ \text{V}$	V_{SD}	-	-	1.2	V
Body-Diode Continuous Current	I_S	-	-	16	A
Body-Diode Continuous Current, Pulsed	I_{SM}	-	-	35	A
Body Diode Reverse Recovery Time at $I_S = 5\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	5.9	-	ns
Body Diode Reverse Recovery Charge at $I_S = 5\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	2.4	-	nC

Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

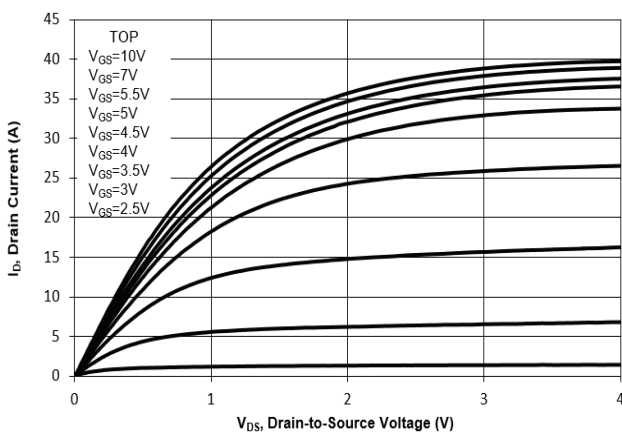


Fig. 2 Typical Transfer Characteristics

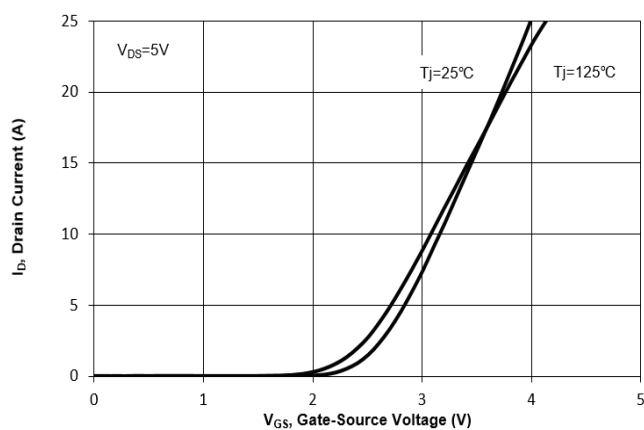


Fig. 3 On-Resistance vs. Drain Current

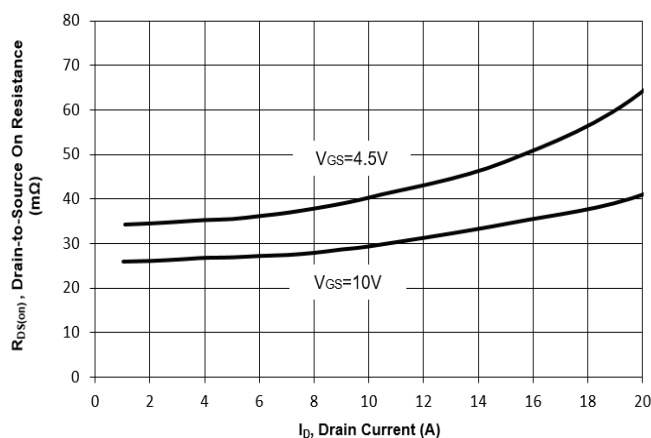


Fig. 4 On-Resistance vs. Gate to Source Voltage

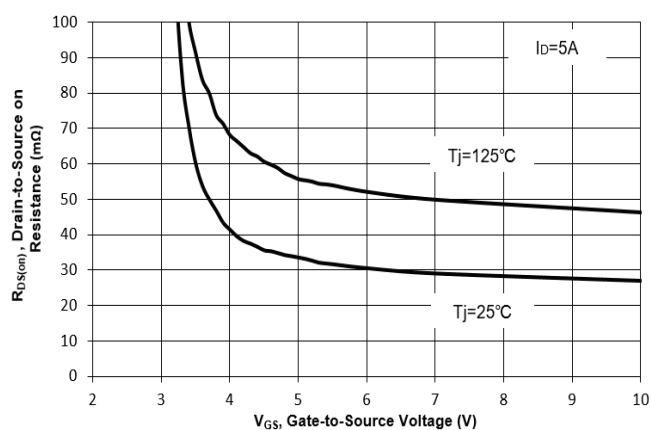


Fig. 5 On-Resistance vs. T_J

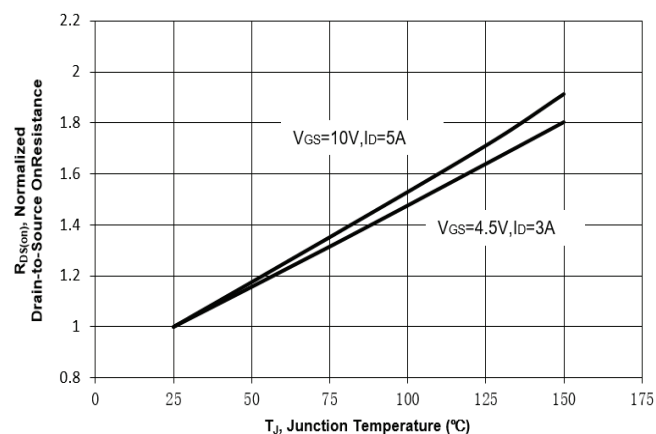
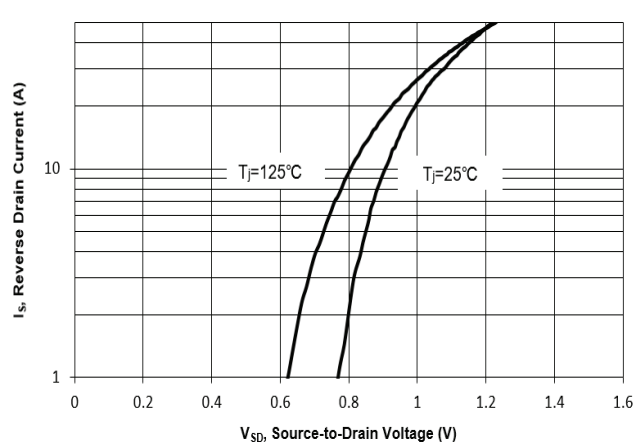


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

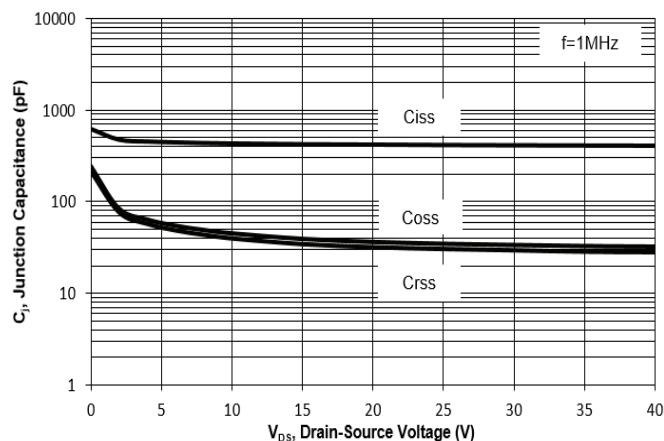


Fig. 8 Drain-Source Leakage Current vs. T_j

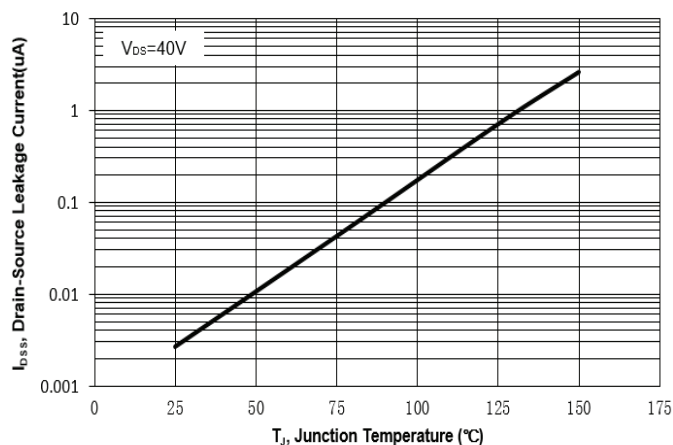


Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

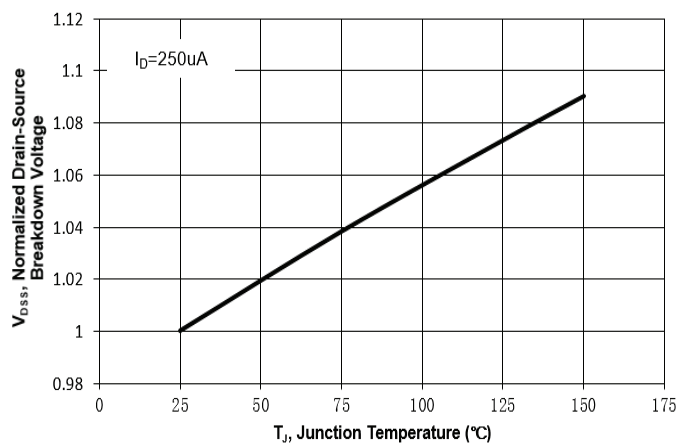


Fig. 10 Gate Threshold Variation vs. T_j

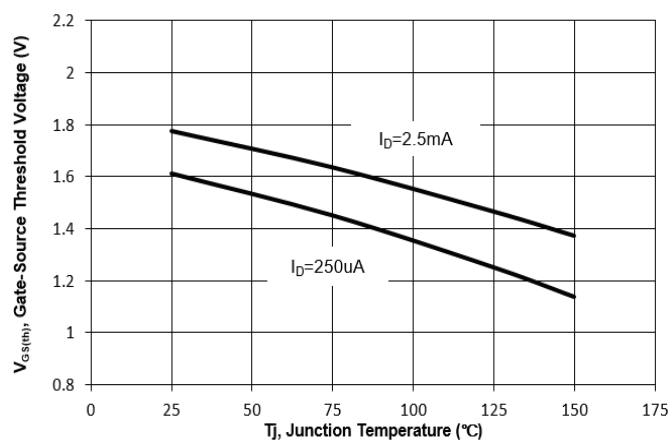


Fig. 11 Gate Charge

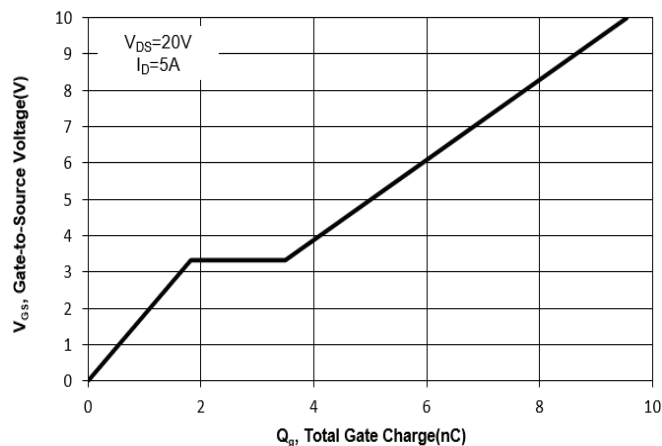
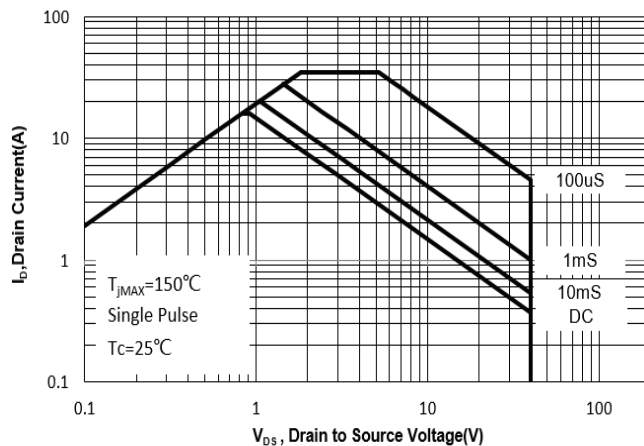


Fig. 12 Safe Operation Area



Electrical Characteristics Curves

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

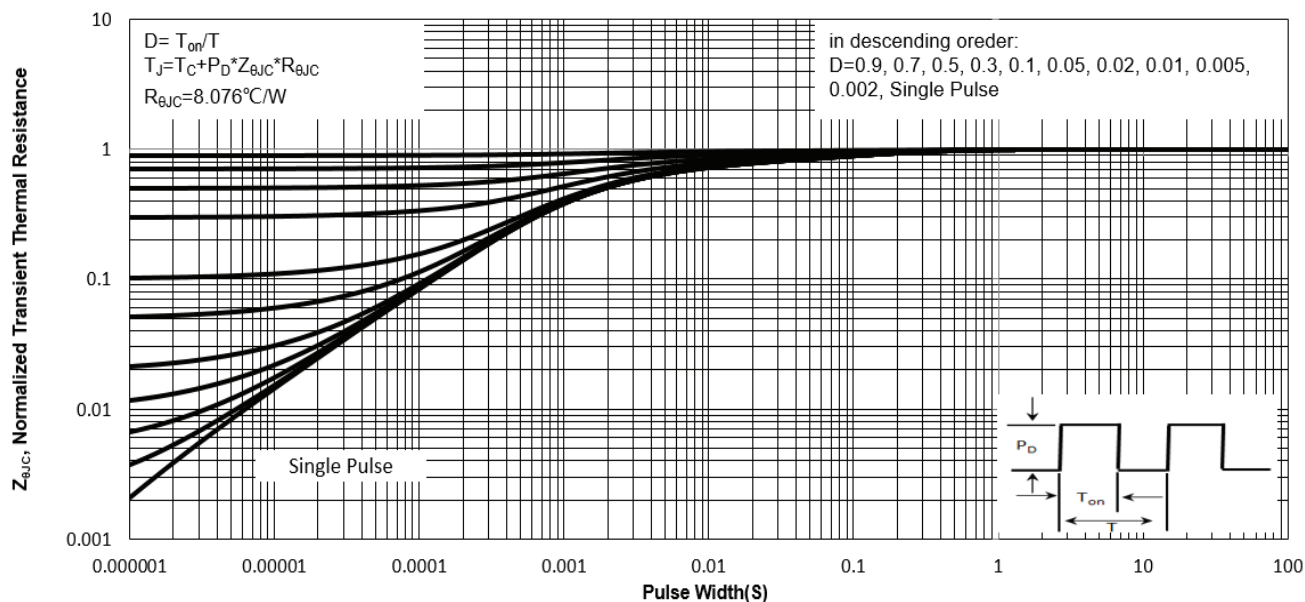
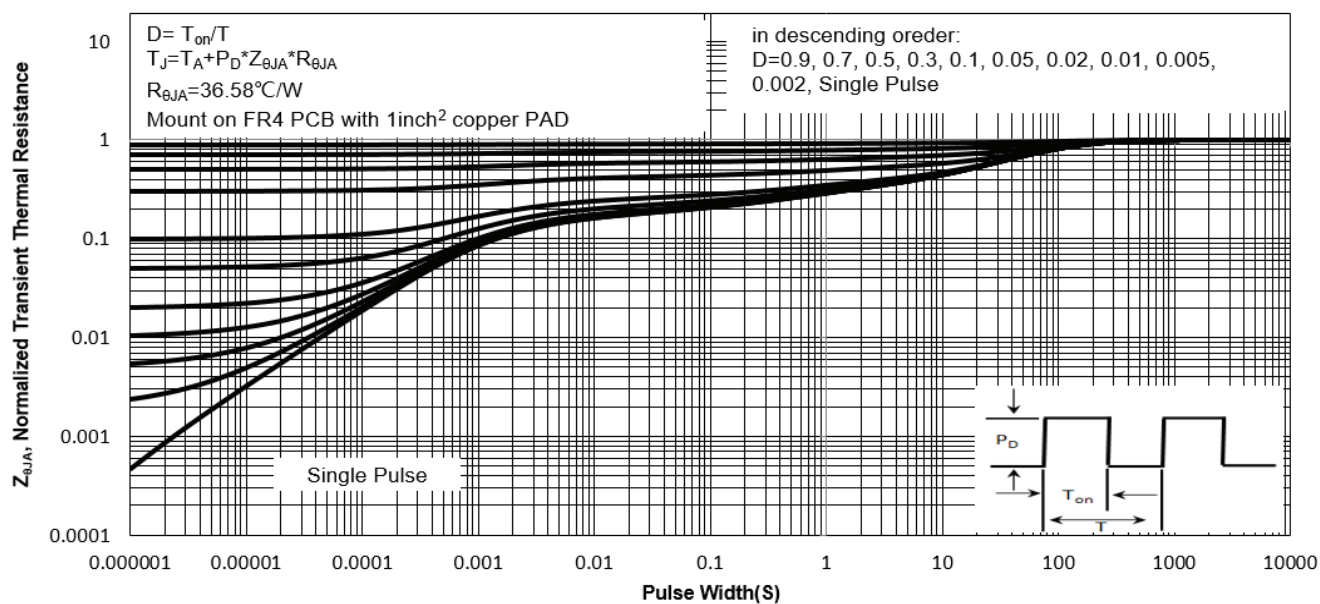
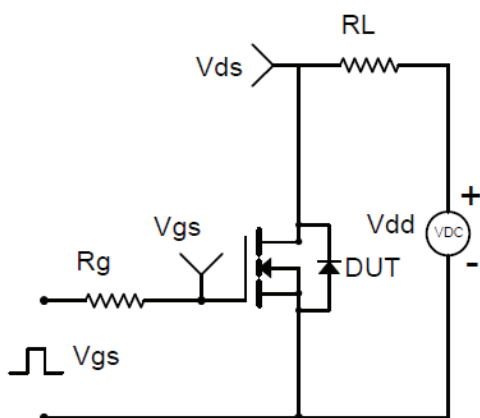
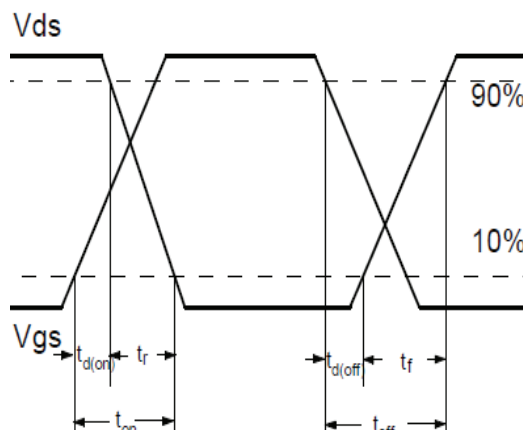
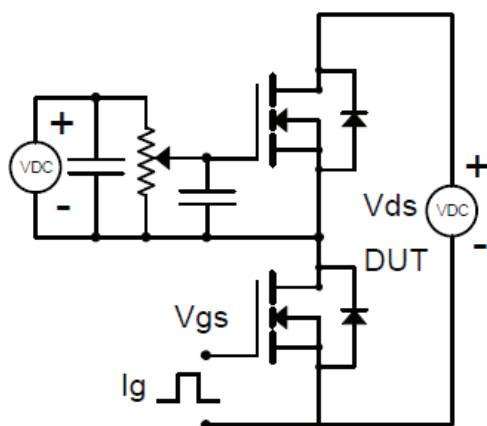
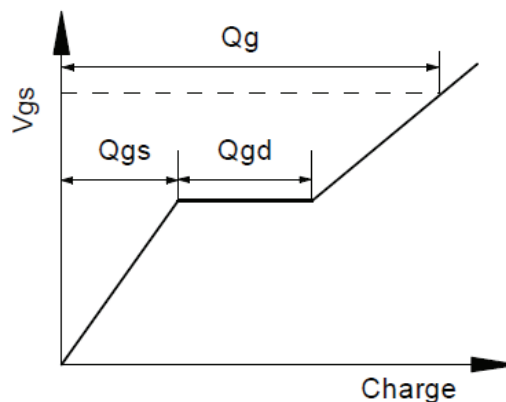
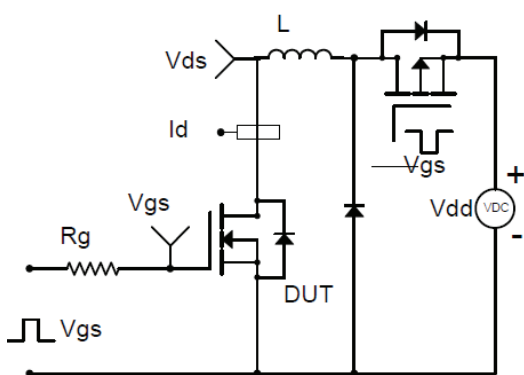
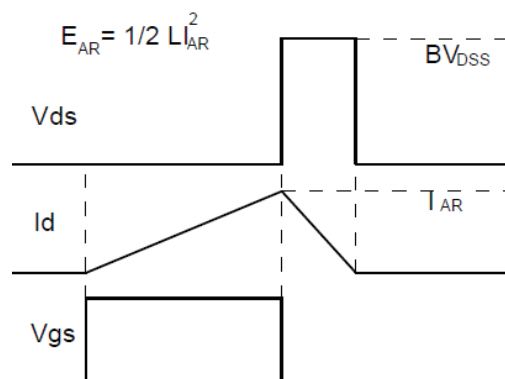


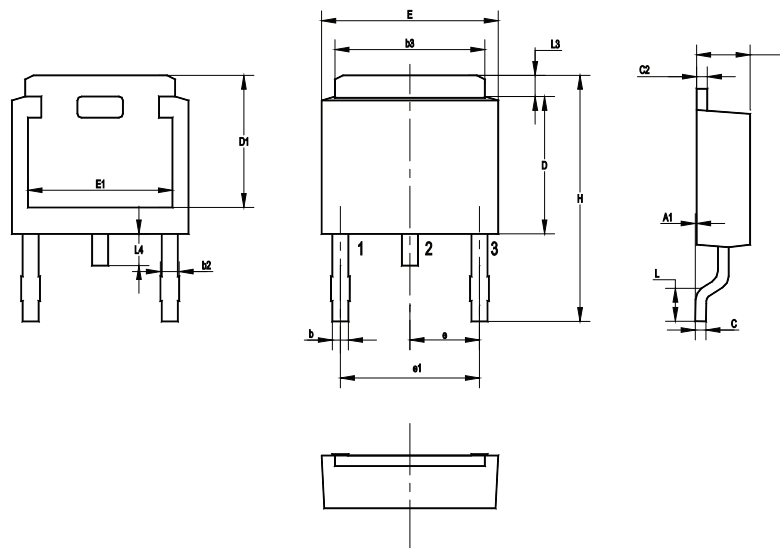
Fig. 14 Normalized Maximum Transient Thermal Impedance($Z_{\theta JA}$)



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


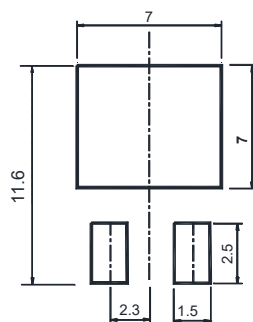
Package Outline (Dimensions in mm)

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

" TR04N320LS " = Part No.

" ***** " = Date Code Marking

Font type: Arial



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