

# WDR04N042L-HAF

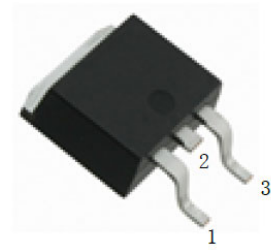
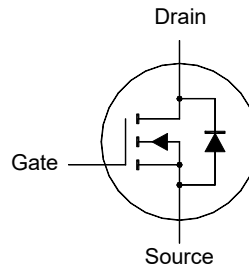
## N-Channel Enhancement Mode MOSFET

### Features

- Low  $R_{DS(on)}$  to minimize conduction losses
- Low capacitance to minimize driver losses
- Halogen and Antimony Free(HAF), RoHS compliant

### Application

- Synchronous buck converter



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

### Key Parameters

Parameter	Value	Unit
$BV_{DSS}$	40	V
$R_{DS(ON)}$ Max	4.2 @ $V_{GS} = 10$ V	m $\Omega$
	5.2 @ $V_{GS} = 4.5$ V	
$V_{GS(th)}$ typ	1.6	V
$Q_g$ typ	46.2 @ $V_{GS} = 10$ 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	$V_{GS}$	$\pm 20$	V
Continuous Drain Current	$I_D$	$T_c = 25^\circ\text{C}$	75
		$T_c = 100^\circ\text{C}$	47
Peak Drain Current <sup>1)</sup>	$I_{DM}$	400	A
Avalanche Current	$I_{AS}$	32.5	A
Single Pulse Avalanche Energy <sup>2)</sup>	$E_{AS}$	52.9	mJ
Power Dissipation	$P_D$	41.6	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$

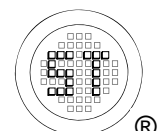
### Thermal Characteristics

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

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

<sup>2)</sup> Limited by  $T_{J(MAX)}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1$  mH,  $R_g = 25$   $\Omega$ ,  $I_D = 32.5$  A,  $V_{GS} = 10$  V.

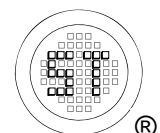
<sup>3)</sup> Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.



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

Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>STATIC PARAMETERS</b>					
Drain-Source Breakdown Voltage at $I_D = 250 \mu\text{A}$	$BV_{DSS}$	40	-	-	V
Drain-Source Leakage Current at $V_{DS} = 40 \text{ V}$	$I_{DSS}$	-	-	1	$\mu\text{A}$
Gate Leakage Current at $V_{GS} = \pm 20 \text{ V}$	$I_{GSS}$	-	-	$\pm 100$	nA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$	$V_{GS(th)}$	1.2	-	2.2	V
Drain-Source On-State Resistance at $V_{GS} = 10 \text{ V}$ , $I_D = 40 \text{ A}$ at $V_{GS} = 4.5 \text{ V}$ , $I_D = 40 \text{ A}$	$R_{DS(on)}$	- -	3.2 -	4.2 5.2	$\text{m}\Omega$
<b>DYNAMIC PARAMETERS</b>					
Forward Transconductance at $V_{DS} = 5 \text{ V}$ , $I_D = 20 \text{ A}$	$g_{fs}$	-	31.3	-	S
Gate resistance at $V_{GS} = 0 \text{ V}$ , $V_{DS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	$R_g$	-	2.3	-	$\Omega$
Input Capacitance at $V_{GS} = 0 \text{ V}$ , $V_{DS} = 25 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{iss}$	-	2244	-	pF
Output Capacitance at $V_{GS} = 0 \text{ V}$ , $V_{DS} = 25 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{oss}$	-	690	-	pF
Reverse Transfer Capacitance at $V_{GS} = 0 \text{ V}$ , $V_{DS} = 25 \text{ V}$ , $f = 1 \text{ MHz}$	$C_{rss}$	-	52	-	pF
Gate charge total at $V_{DS} = 20 \text{ V}$ , $I_D = 40 \text{ A}$ , $V_{GS} = 10 \text{ V}$ at $V_{DS} = 20 \text{ V}$ , $I_D = 40 \text{ A}$ , $V_{GS} = 4.5 \text{ V}$	$Q_g$	- -	46.2 23.8	- -	nC
Gate to Source Charge at $V_{DS} = 20 \text{ V}$ , $I_D = 40 \text{ A}$ , $V_{GS} = 4.5 \text{ V}$	$Q_{gs}$	-	7.9	-	nC
Gate to Drain Charge at $V_{DS} = 20 \text{ V}$ , $I_D = 40 \text{ A}$ , $V_{GS} = 4.5 \text{ V}$	$Q_{gd}$	-	12.7	-	nC
Turn-On Delay Time at $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 22 \text{ V}$ , $I_D = 40 \text{ A}$ , $R_g = 4.7 \Omega$	$t_{d(on)}$	-	29	-	nS
Turn-On Rise Time at $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 22 \text{ V}$ , $I_D = 40 \text{ A}$ , $R_g = 4.7 \Omega$	$t_r$	-	102	-	nS
Turn-Off Delay Time at $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 22 \text{ V}$ , $I_D = 40 \text{ A}$ , $R_g = 4.7 \Omega$	$t_{d(off)}$	-	20	-	nS
Turn-Off Fall Time at $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 22 \text{ V}$ , $I_D = 40 \text{ A}$ , $R_g = 4.7 \Omega$	$t_f$	-	16	-	nS
<b>Body-Diode PARAMETERS</b>					
Drain-Source Diode Forward Voltage at $I_S = 40 \text{ A}$ , $V_{GS} = 0 \text{ V}$	$V_{SD}$	-	-	1.2	V
Body-Diode Continuous Current	$I_S$	-	-	75	A
Body-Diode Continuous Current, Pulsed	$I_{SM}$	-	-	400	A
Body Diode Reverse Recovery Time at $I_S = 40 \text{ A}$ , $di/dt = 100 \text{ A} / \mu\text{s}$	$t_{rr}$	-	25.2	-	nS
Body Diode Reverse Recovery Charge at $I_S = 40 \text{ A}$ , $di/dt = 100 \text{ A} / \mu\text{s}$	$Q_{rr}$	-	9.3	-	nC



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## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

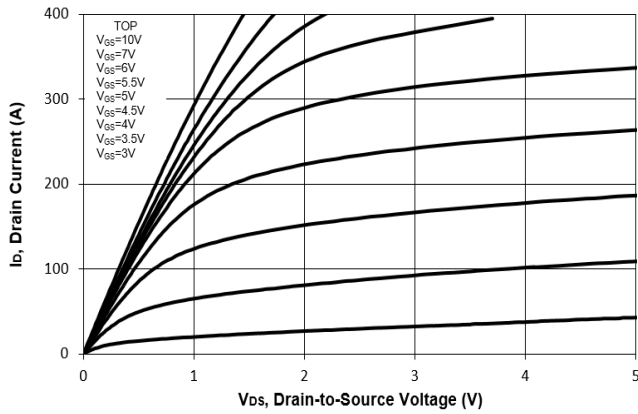


Fig. 2 Typical Transfer Characteristics

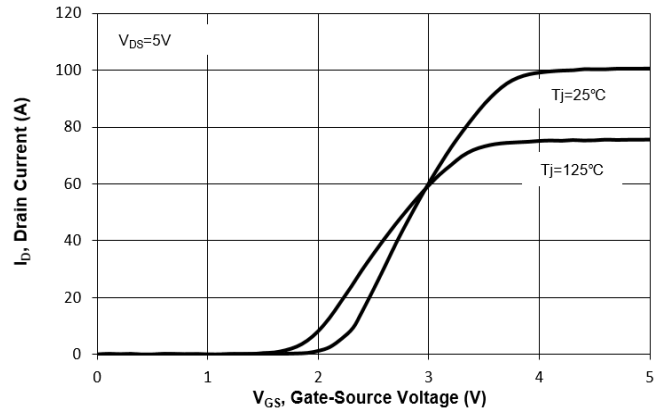


Fig. 3 On-Resistance vs. Drain Current

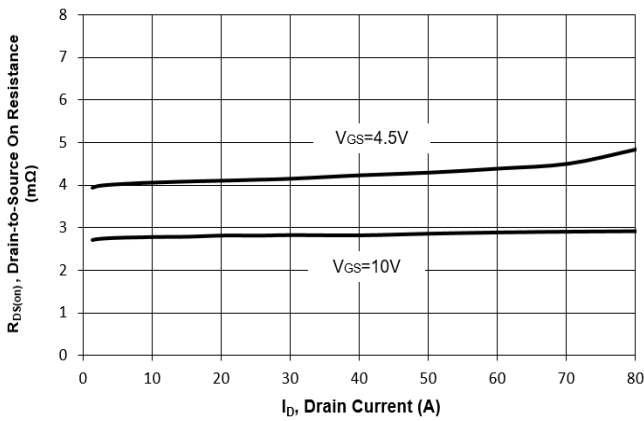


Fig. 4 On-Resistance vs. Gate Voltage

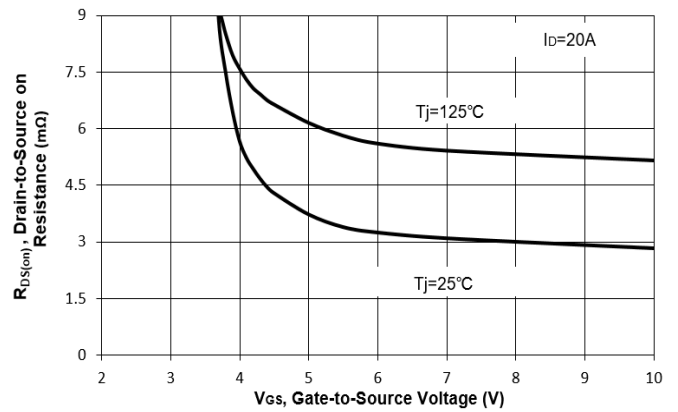


Fig. 5 On-Resistance vs.  $T_J$

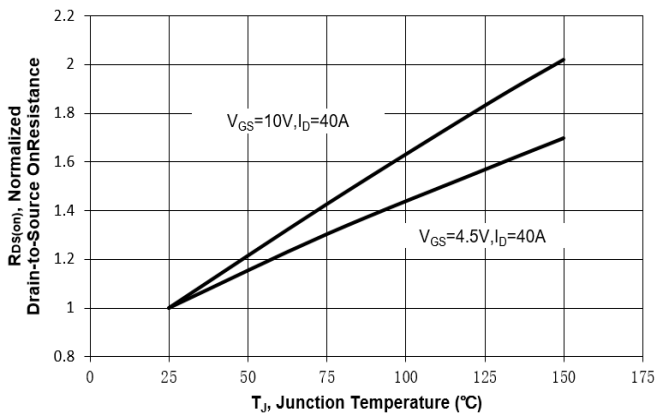
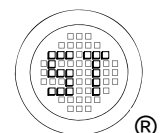
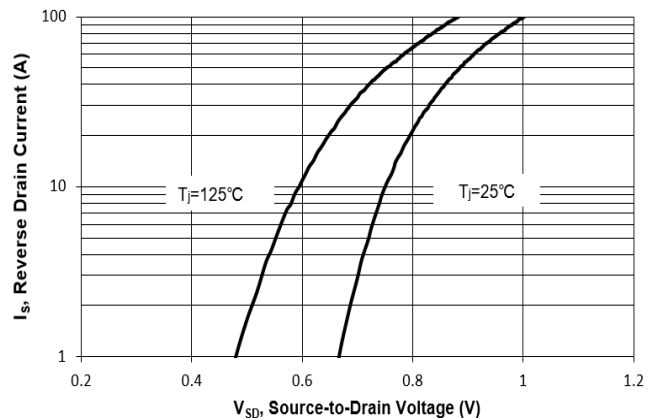


Fig. 6 Typical Body-Diode Forward Characteristics



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## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

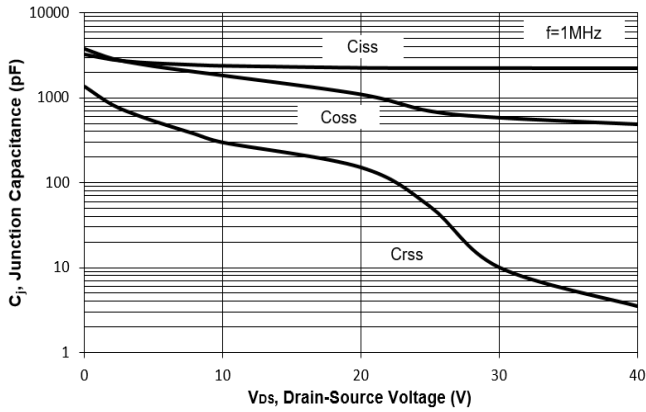


Fig. 8 Drain-Source Leakage Current vs. Tj

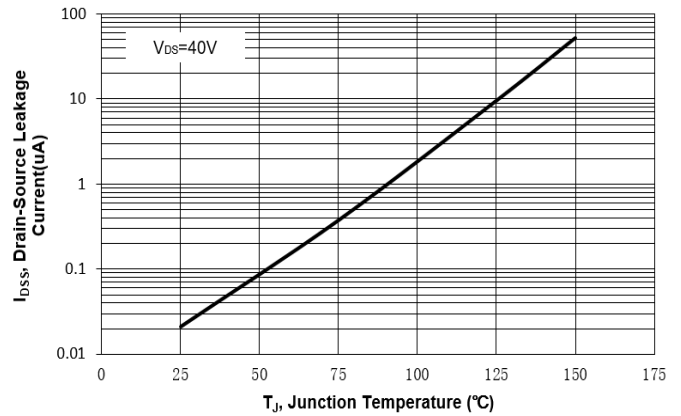


Fig. 9 V(BR)DSS vs. Junction Temperature

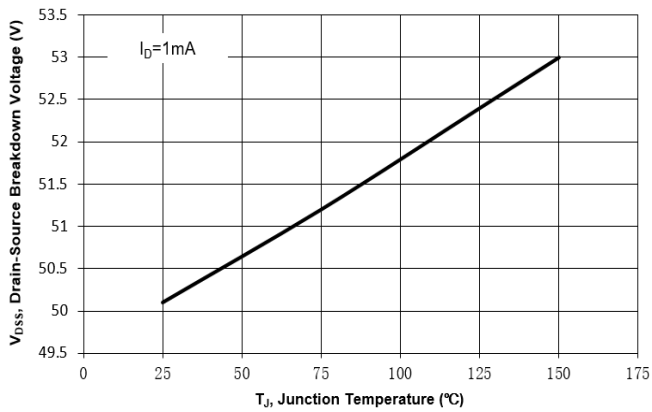


Fig. 10 Gate Threshold Variation vs. Tj

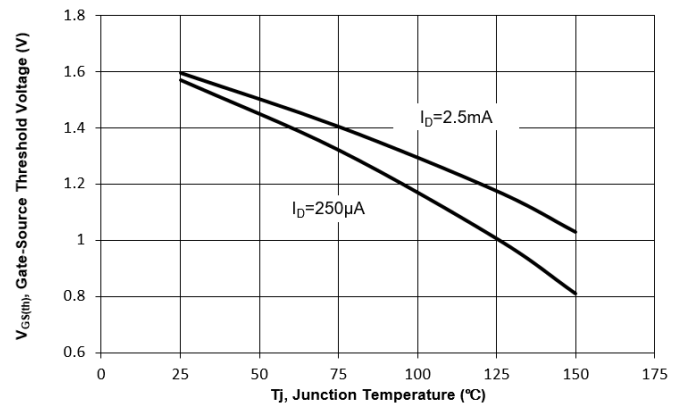


Fig. 11 Gate Charge

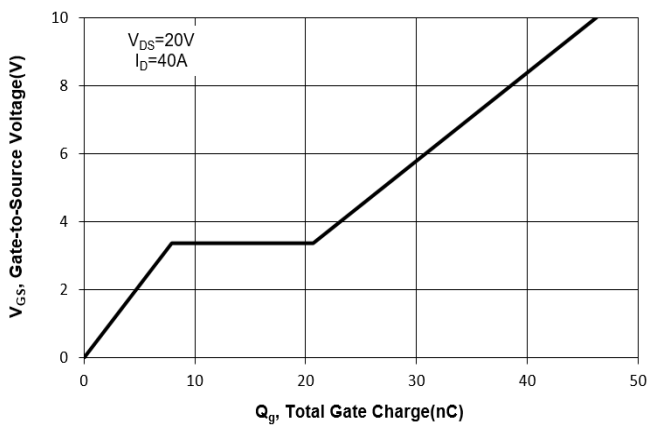
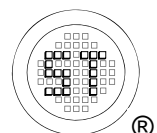
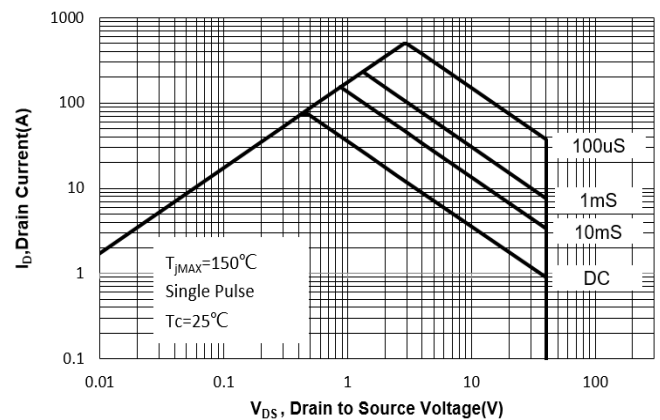


Fig. 12 Safe Operation Area



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## Electrical Characteristics Curves

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

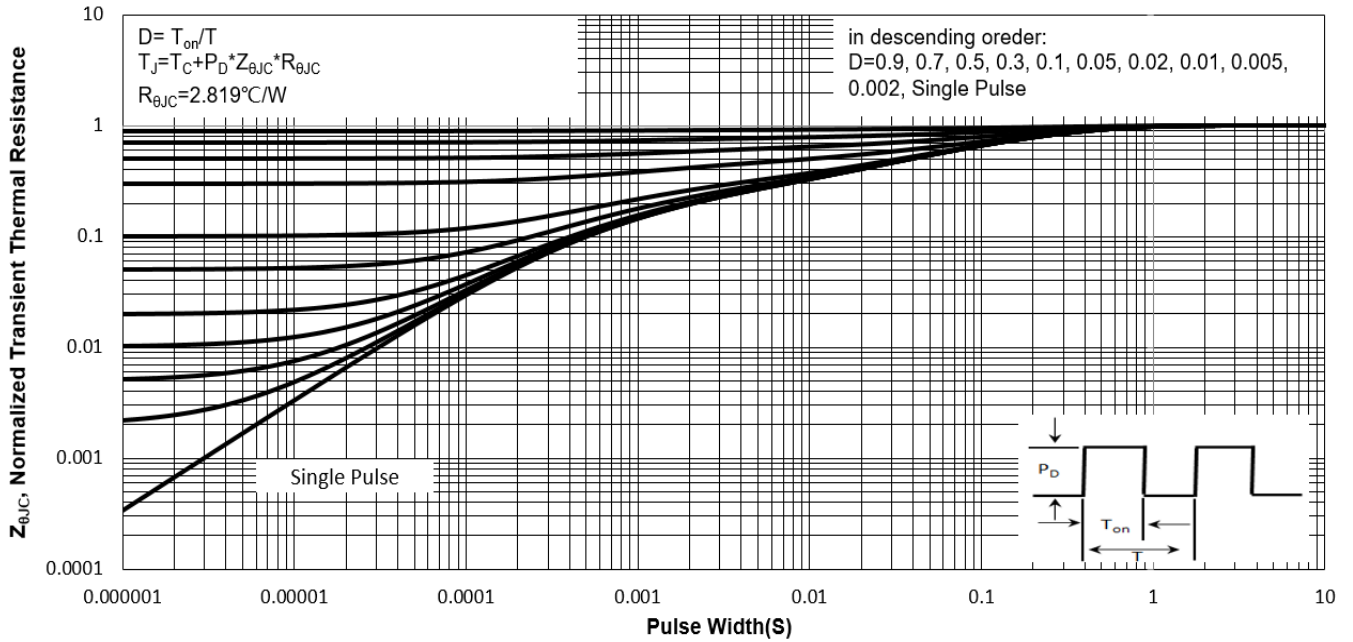
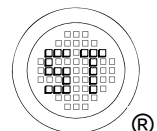
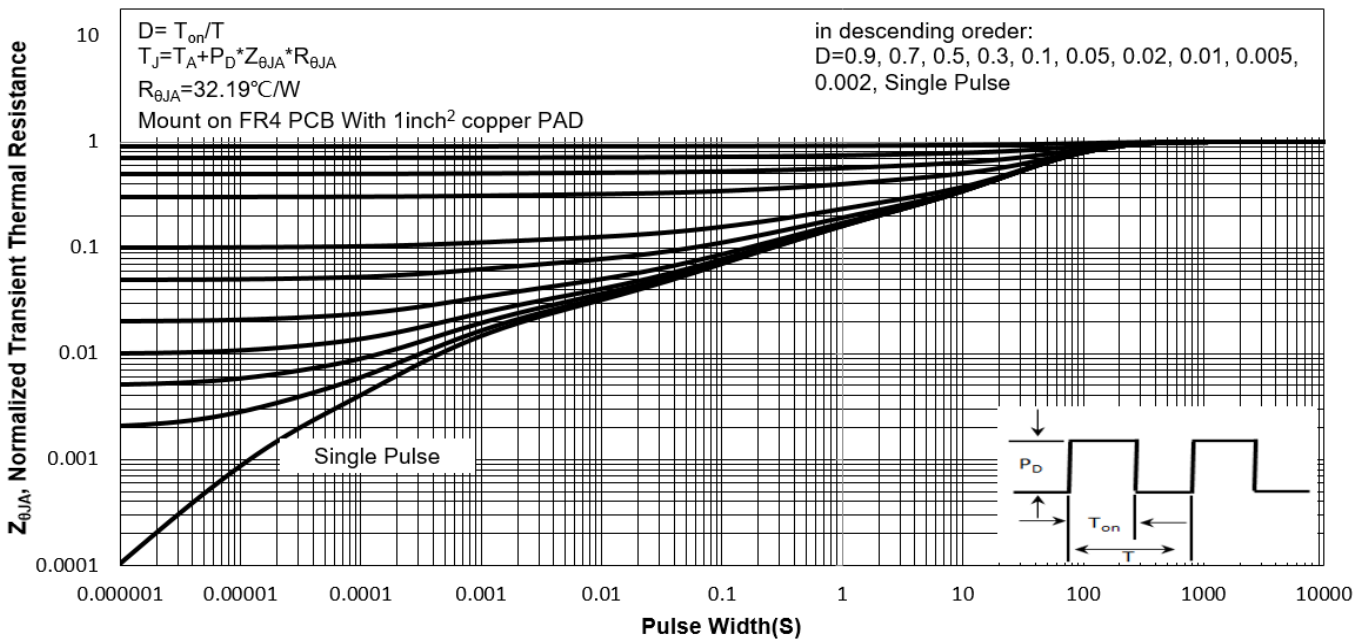


Fig.14 Normalized Maximum Transient Thermal Impedance( $z_{\theta JA}$ )



## Test Circuits

Fig.1-1 Switching times test circuit

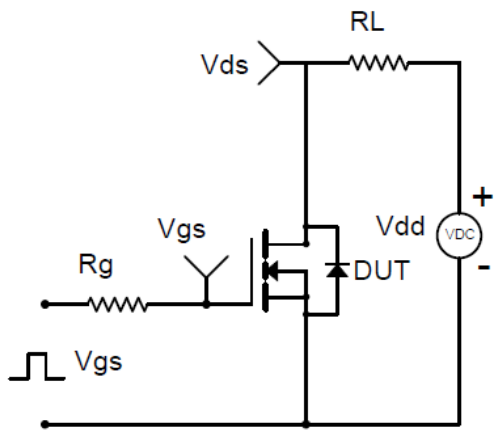


Fig.1-2 Switching Waveform

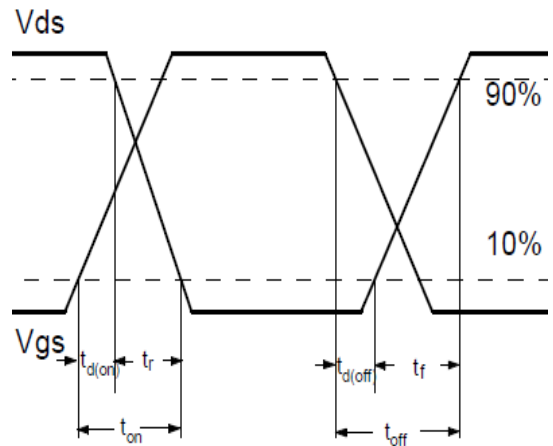


Fig.2-1 Gate charge test circuit

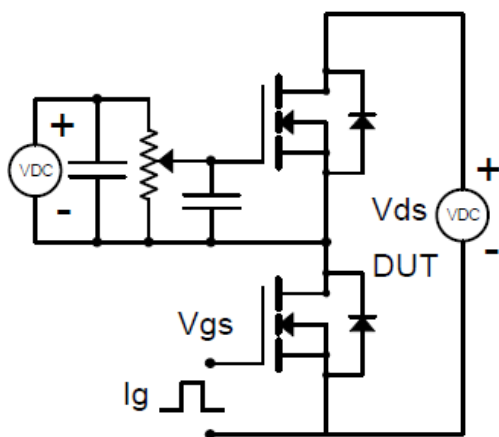


Fig.2-2 Gate charge waveform

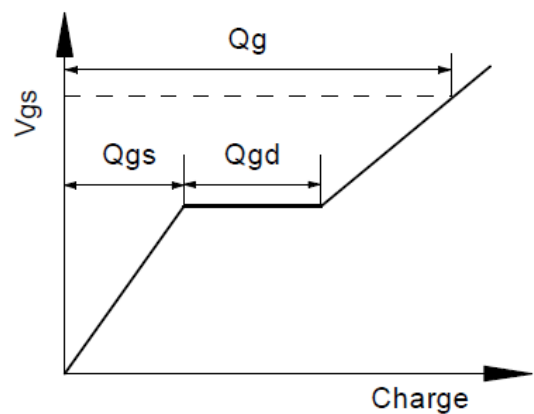


Fig.3-1 Avalanche test circuit

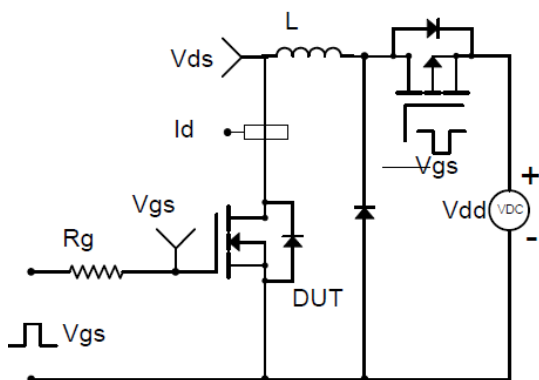
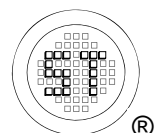
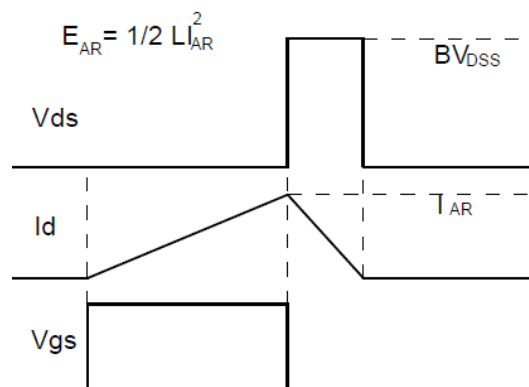


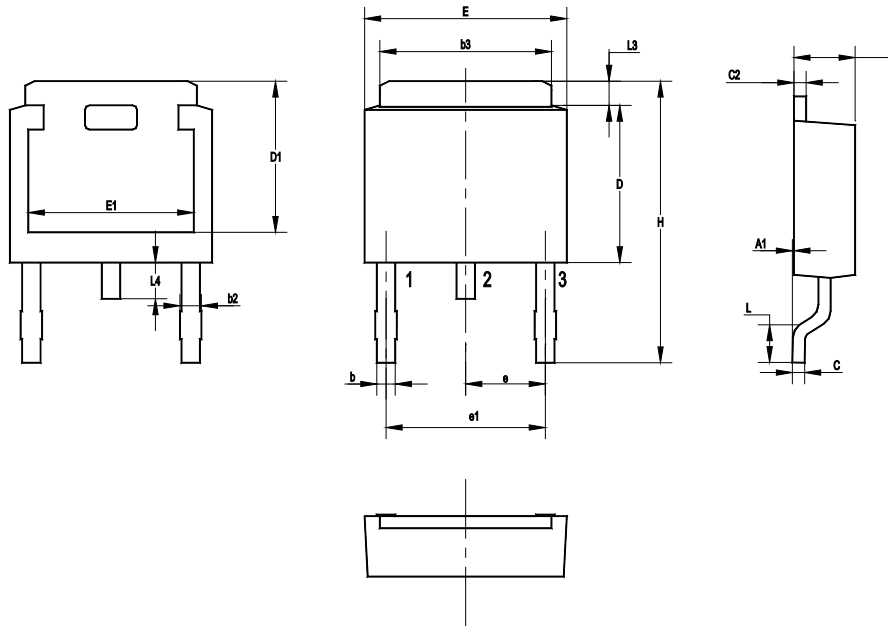
Fig.3-2 Avalanche waveform



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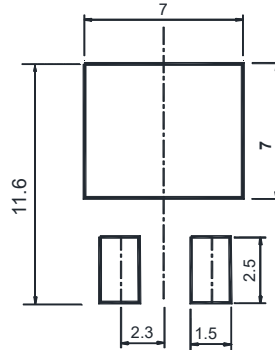
## Package Outline (Dimensions in mm)

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

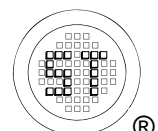
Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
TO-252	12	8 ± 0.1	0.315 ± 0.004	330	13	2,500

## Marking information

" DR04N042L " = Part No.

" \*\*\*\*\* " = Date Code Marking

Font type: Arial



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