

# WTM504N031L-AH

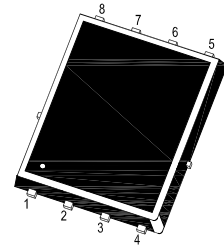
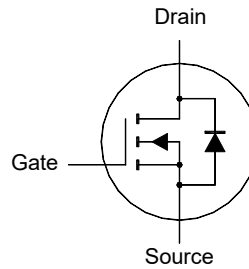
## N-Channel Enhancement Mode MOSFET

### Features

- AEC-Q101 Qualified
- 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. Source 2. Source 3. Source 4. Gate  
5. Drain 6. Drain 7. Drain 8. Drain  
DFN5060 Plastic Package

### Key Parameters

Parameter	Value	Unit
$BV_{DSS}$	40	V
$R_{DS(ON)}$ Max	3.3 @ $V_{GS} = 10\text{ V}$	m $\Omega$
	4.9 @ $V_{GS} = 4.5\text{ V}$	m $\Omega$
$V_{GS(th)}$ typ	1.5	V
$Q_g$ typ	45 @ $V_{GS} = 10\text{ V}$	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	$V_{GS}$	$\pm 20$	V
Continuous Drain Current	$I_D$	75	A
		47	
Peak Drain Current <sup>1)</sup>	$I_{DM}$	420	A
Avalanche Current	$I_{AS}$	40	A
Single Pulse Avalanche Energy <sup>2)</sup>	$E_{AS}$	80	mJ
Power Dissipation	$P_D$	27.8	W
		11	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$

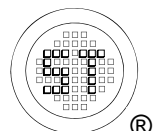
### Thermal Characteristics

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	4.5	$^\circ\text{C/W}$
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  $\leq 100\text{ }\mu\text{s}$ , 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  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_D = 40\text{ A}$ ,  $V_{GS} = 10\text{ V}$ .

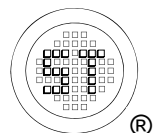
<sup>3)</sup> Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.



# WTM504N031L-AH

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 $V_{GS} = 4.5\ \text{V}$ , $I_D = 40\ \text{A}$	$R_{DS(on)}$	- -	2.8 -	3.3 4.9	$\text{m}\Omega$
<b>DYNAMIC PARAMETERS</b>					
Gate resistance at $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$	$R_g$	-	2.2	-	$\Omega$
Forward Transconductance at $V_{DS} = 5\ \text{V}$ , $I_D = 40\ \text{A}$	$g_{fs}$	-	25	-	S
Input Capacitance at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{iss}$	-	2225	-	pF
Output Capacitance at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$	$C_{oss}$	-	956	-	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 $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$	$Q_g$	- -	45 23	- -	nC
Gate to Source Charge at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$	$Q_{gs}$	-	8	-	nC
Gate to Drain Charge at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$	$Q_{gd}$	-	13	-	nC
Turn-On Delay Time at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ , $R_g = 4.7\ \Omega$	$t_{d(on)}$	-	29	-	nS
Turn-On Rise Time at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ , $R_g = 4.7\ \Omega$	$t_r$	-	107	-	nS
Turn-Off Delay Time at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ , $R_g = 4.7\ \Omega$	$t_{d(off)}$	-	22	-	nS
Turn-Off Fall Time at $V_{DS} = 20\ \text{V}$ , $I_D = 40\ \text{A}$ , $V_{GS} = 4.5\ \text{V}$ , $R_g = 4.7\ \Omega$	$t_f$	-	37	-	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	$I_{SM}$	-	-	420	A
Body Diode Reverse Recovery Time at $I_S = 40\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$	$t_{rr}$	-	30	-	nS
Body Diode Reverse Recovery Charge at $I_S = 40\ \text{A}$ , $di/dt = 100\ \text{A} / \mu\text{s}$	$Q_{rr}$	-	17	-	nC



## Electrical Characteristics Curves

Fig. 1 Typical Output Characteristic

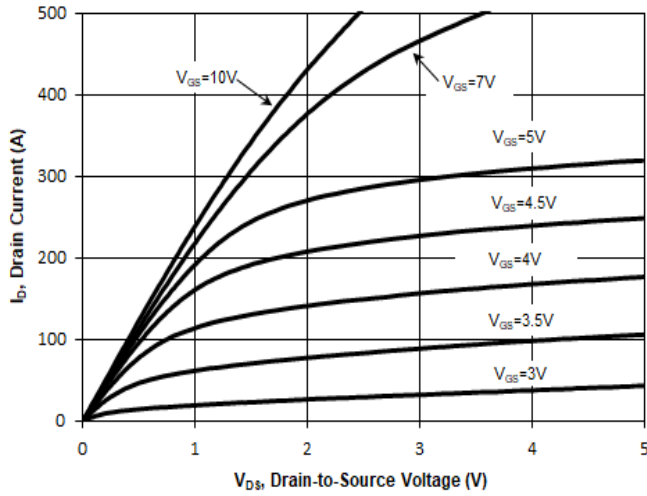


Fig. 2 Typical Transfer Characteristic

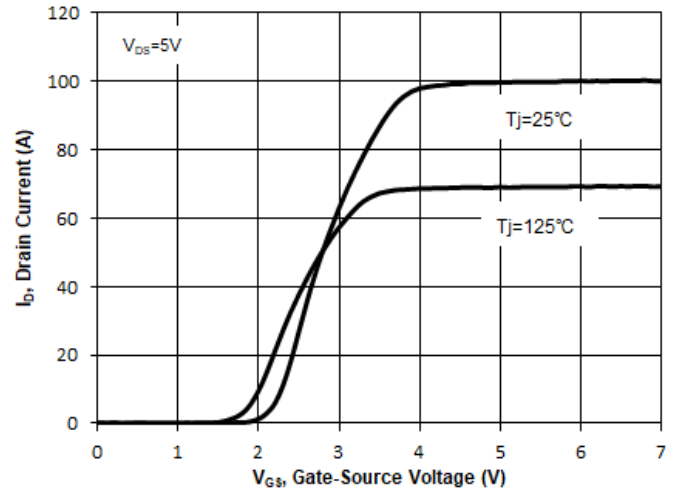


Fig. 3 on-Resistance vs. Drain Current

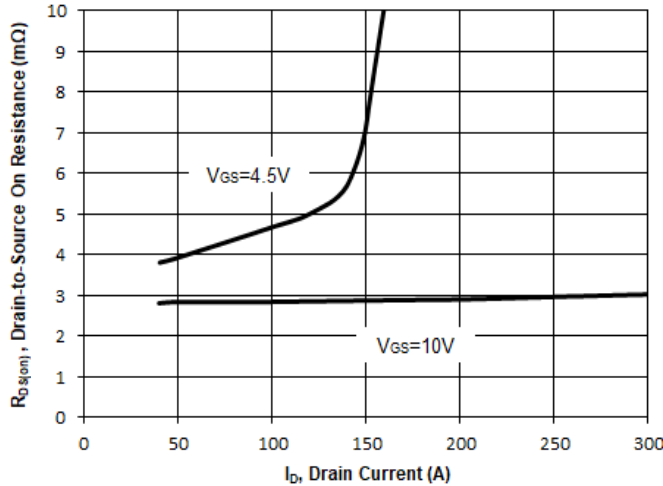


Fig. 4 on-Resistance vs. Gate Voltage

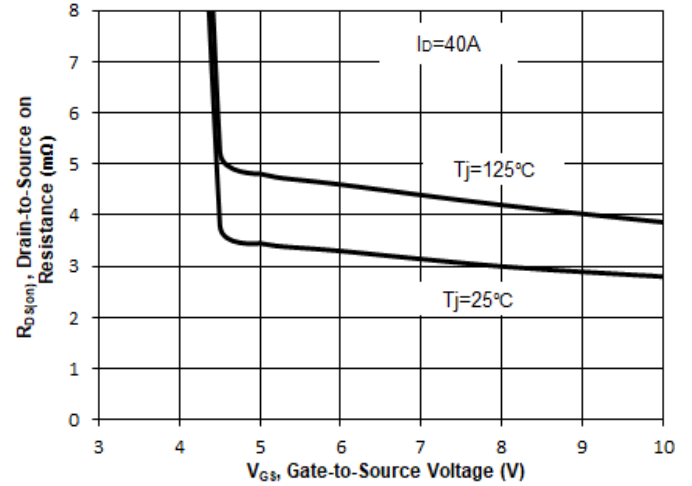


Fig. 5 on-Resistance vs. TJ

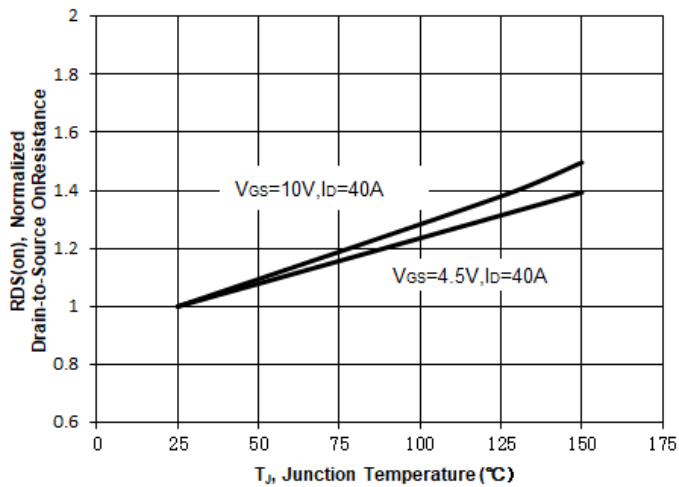
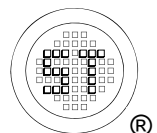
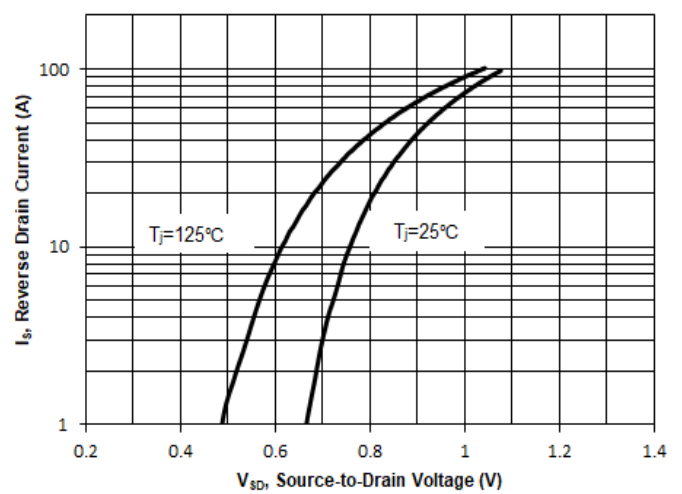


Fig. 6 Typical Forward Characteristic



# WTM504N031L-AH

## Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

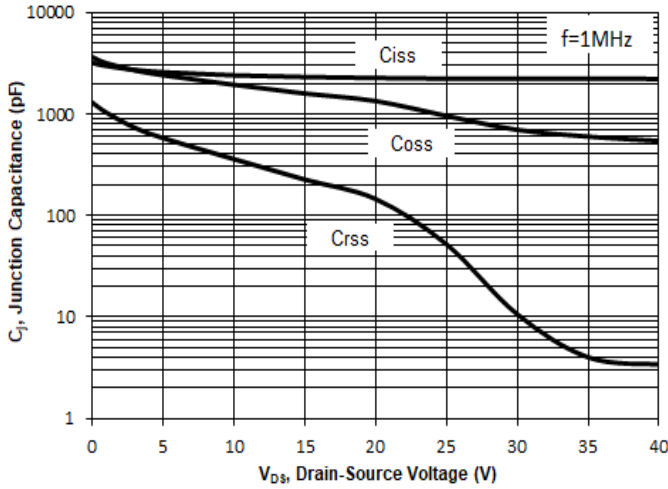


Fig. 8 Drain-Source Leakage Current vs.  $T_j$

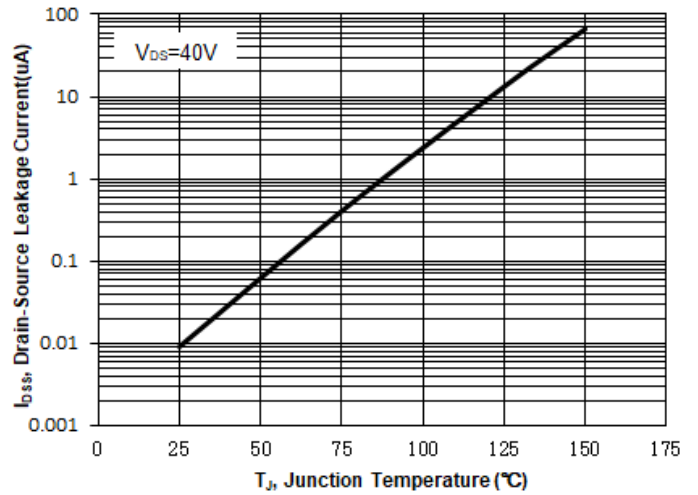


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

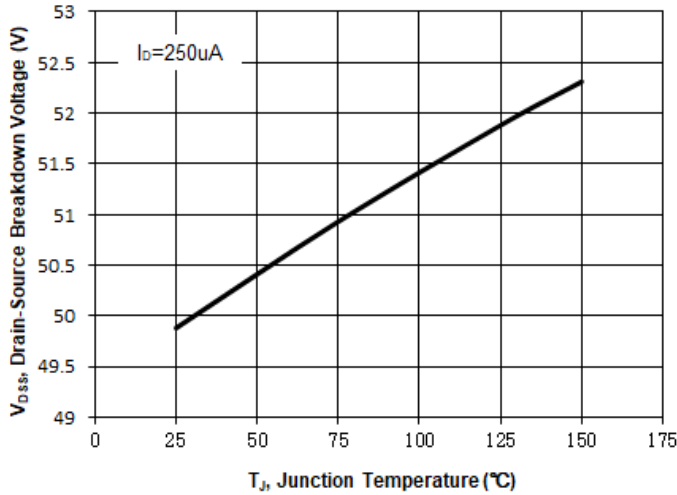


Fig. 10 Gate Threshold Variation vs.  $T_j$

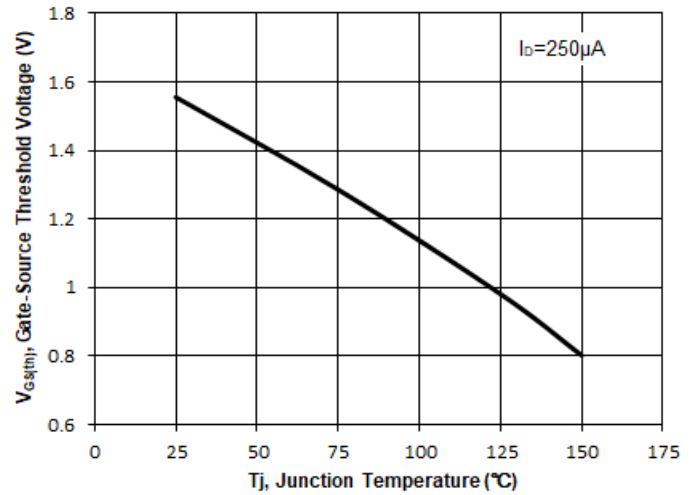


Fig. 11 Gate Charge

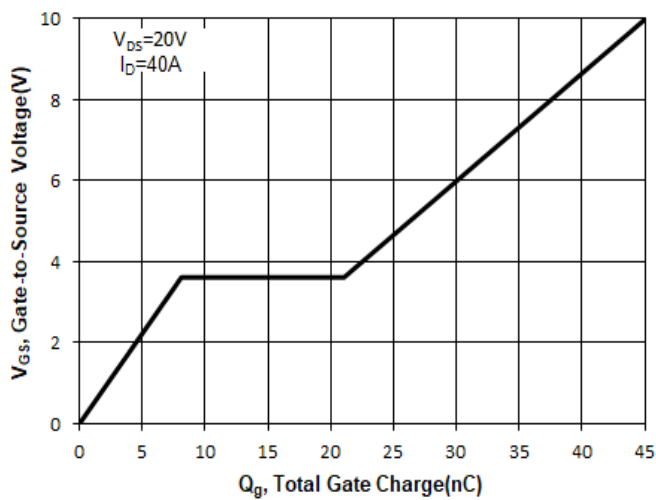
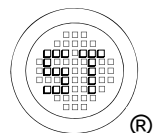
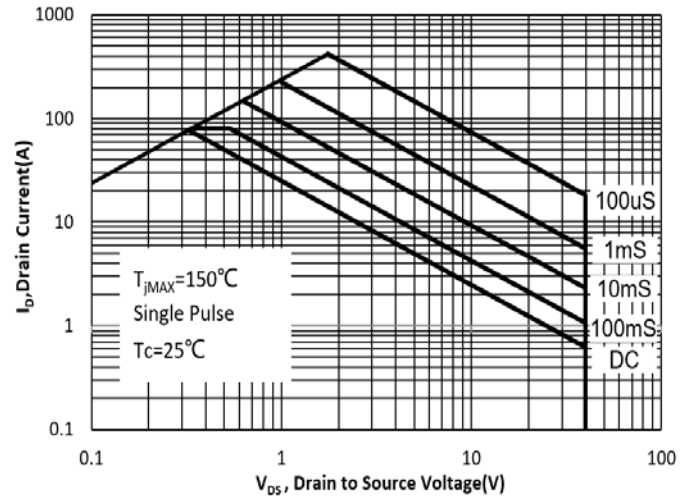


Fig. 12 Safe Operation Area



## Electrical Characteristics Curves

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

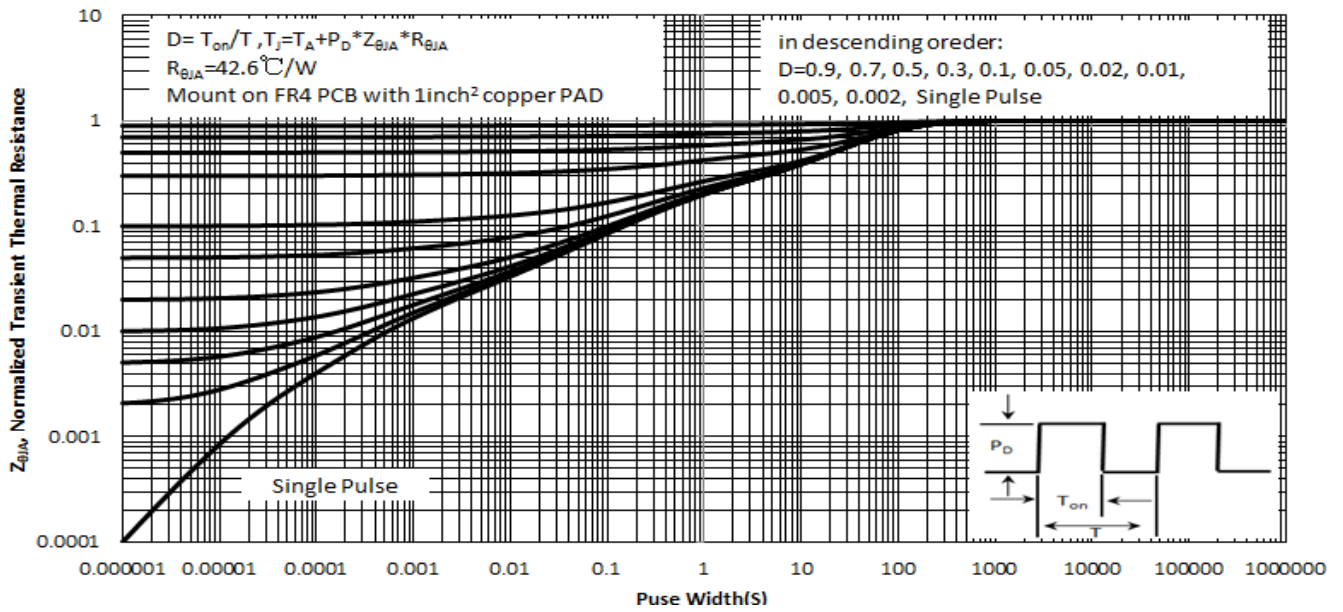
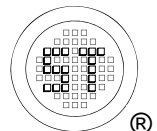
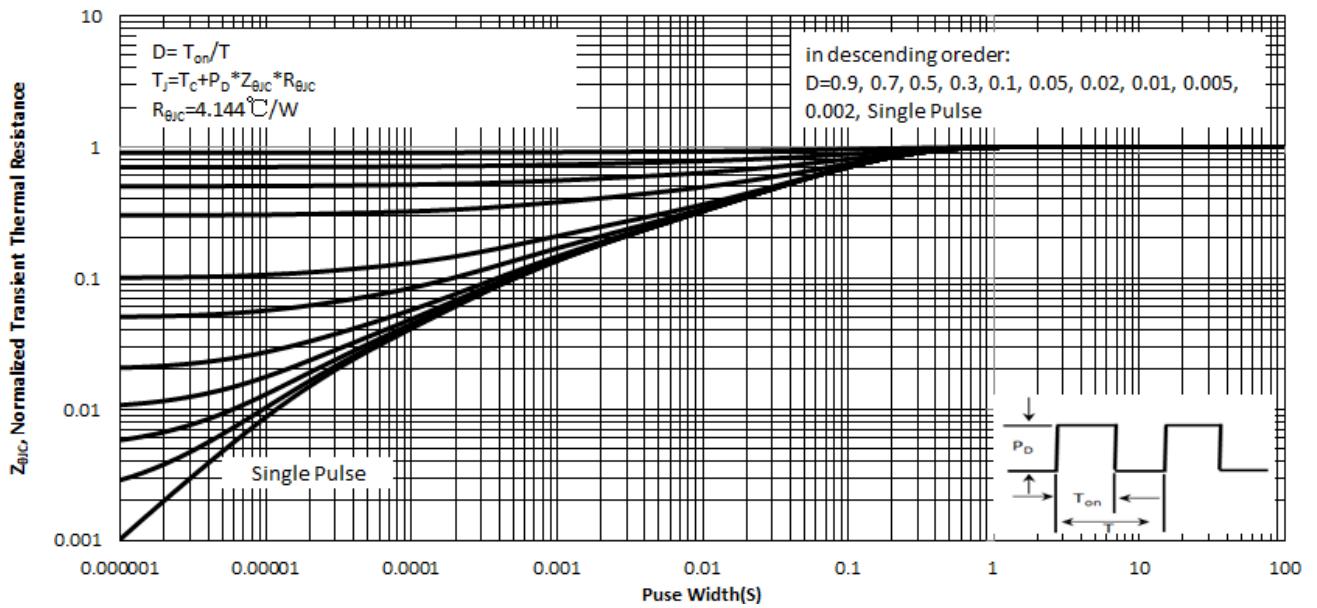


Fig.14 Normalized Maximum Transient Thermal Impedance( $z_{\theta JC}$ )



## Test Circuits

Fig.1-1 Switching times test circuit

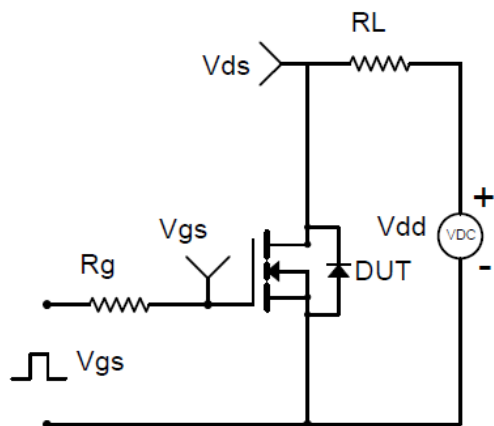


Fig.1-2 Switching Waveform

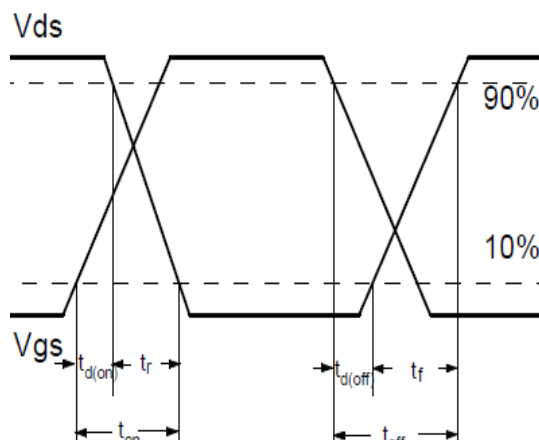


Fig.2-1 Gate charge test circuit

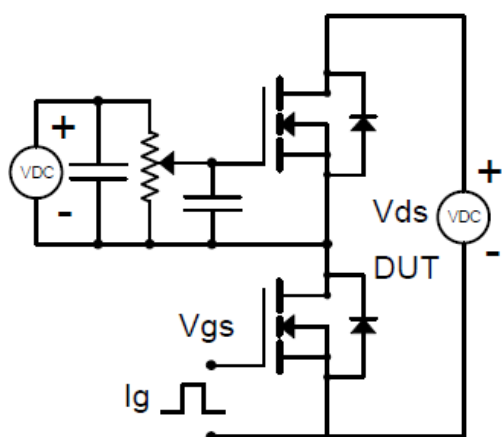


Fig.2-2 Gate charge waveform

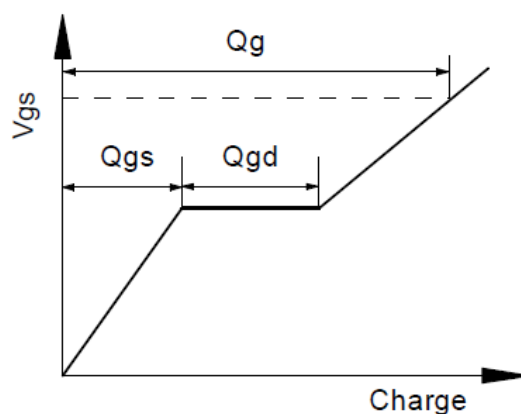


Fig.3-1 Avalanche test circuit

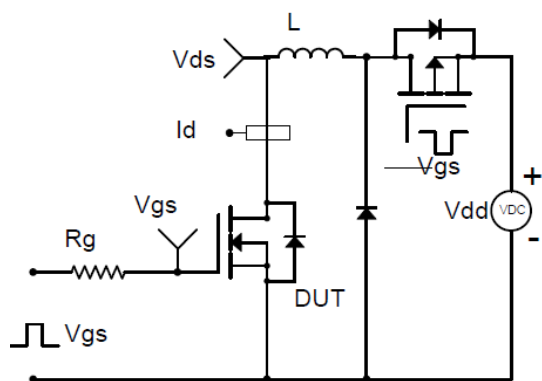
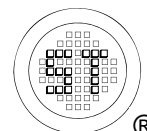
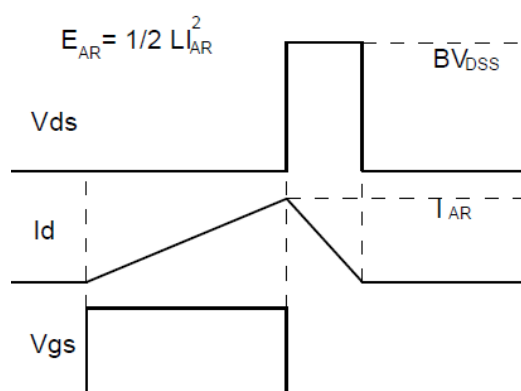


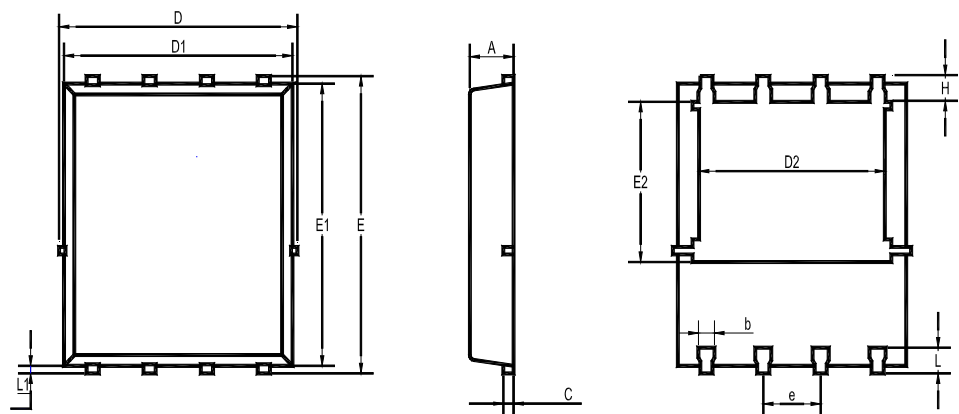
Fig.3-2 Avalanche waveform



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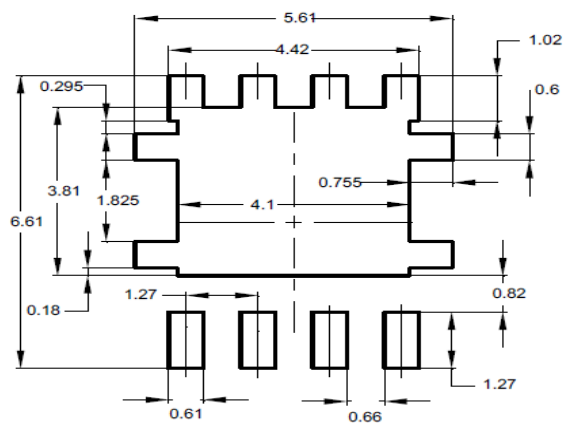
## Package Outline Dimensions (Units: mm)

DFN5060



UNIT	A	b	C	D	D1	D2	E	E1	E2	e	L	L1	H
mm	1.12	0.51	0.34	5.26	5.1	4.5	6.25	6	3.66	1.37	0.71	0.2	0.71
	0.9	0.33	0.11	4.7	4.7	3.56	5.75	5.6	3.18	1.17	0.35	0.06	0.35

## Recommended Soldering Footprint

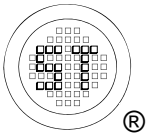
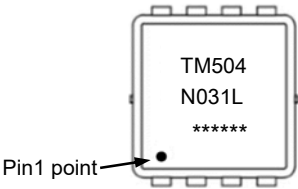


## Packing information

Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
DFN5060	12	8 ± 0.1	0.315 ± 0.004	330	13	3,000

## Marking information

" TM504N031L " = Part No.  
" \*\*\*\*\* " = Date Code Marking  
Font type: Arial



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