



TM2309

P-CHANNEL ENHANCEMENT MOSFET

General Description

The TM2309 uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This device is well suited for use as a load switch or in PWM applications.

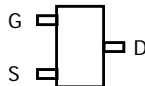
Product Summary

V_{DS} -60V
 I_D (at $V_{GS}=-10V$) -1.6A
 $R_{DS(ON)}$ (at $V_{GS}=-10V$) < 330m Ω

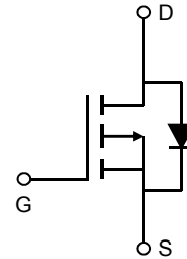
100% UIS Tested
 100% R_g Tested



SOT-23
 Top View



MARKING: E11 or 2309z



Absolute Maximum Ratings ($T_C=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	-60	V
Gate-Source Voltage	V_{GS}	± 20	V
Drain Current-Continuous	I_D	-1.6	A
Pulsed Drain Current	I_{DM}	-8	A
Maximum Power Dissipation	P_D	1.5	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 To 150	$^\circ C$

Thermal Characteristic

Thermal Resistance, Junction-to-Ambient ^(Note 2)	$R_{\theta JA}$	83.3	$^\circ C/W$
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Electrical Characteristics ($T_C=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=-250\mu A$	-60	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=-60V, V_{GS}=0V$	-	-	-1	μA

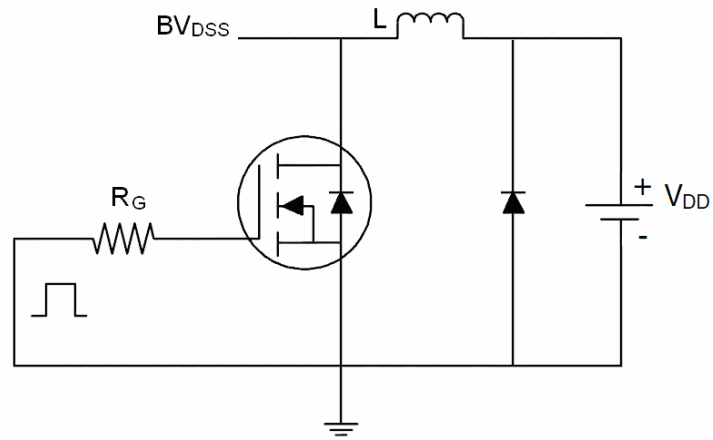
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-2	-2.8	-3.5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-1.5A$	-	270	330	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=-5V, I_D=-1.5A$	-	3	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C_{iss}	$V_{DS}=-30V, V_{GS}=0V,$ $F=1.0MHz$	-	370	-	PF
Output Capacitance	C_{oss}		-	31.5	-	PF
Reverse Transfer Capacitance	C_{rss}		-	5	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-30V, I_D=1.5A,$ $V_{GS}=-10V, R_G=3\Omega$	-	40	-	nS
Turn-on Rise Time	t_r		-	35	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	15	-	nS
Turn-Off Fall Time	t_f		-	10	-	nS
Total Gate Charge	Q_g	$V_{DS}=-30, I_D=-1.5A,$ $V_{GS}=-10V$	-	14.3	-	nC
Gate-Source Charge	Q_{gs}		-	2.2	-	nC
Gate-Drain Charge	Q_{gd}		-	3.2	-	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V_{SD}	$V_{GS}=0V, I_S=-1.5A$	-		-1.2	V
Diode Forward Current (Note 2)	I_S		-	-	-1.6	A
Reverse Recovery Time	t_{rr}	$T_J = 25^\circ C, I_F = -1.5A$ $di/dt = -100A/\mu s$ (Note3)	-	25		nS
Reverse Recovery Charge	Q_{rr}		-	31		nC

Notes:

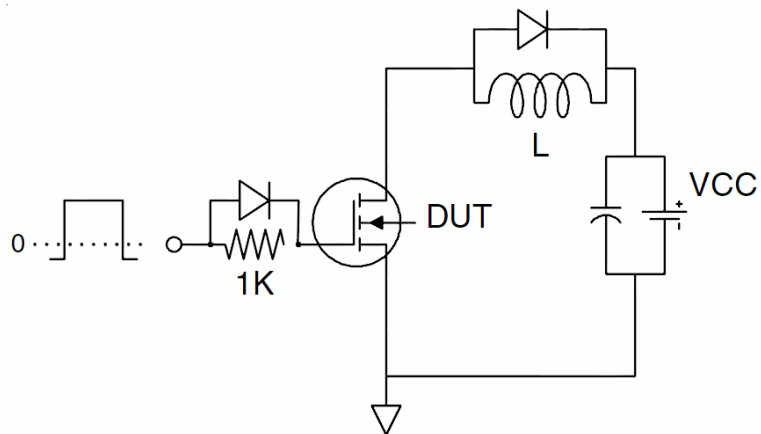
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production

Test Circuit

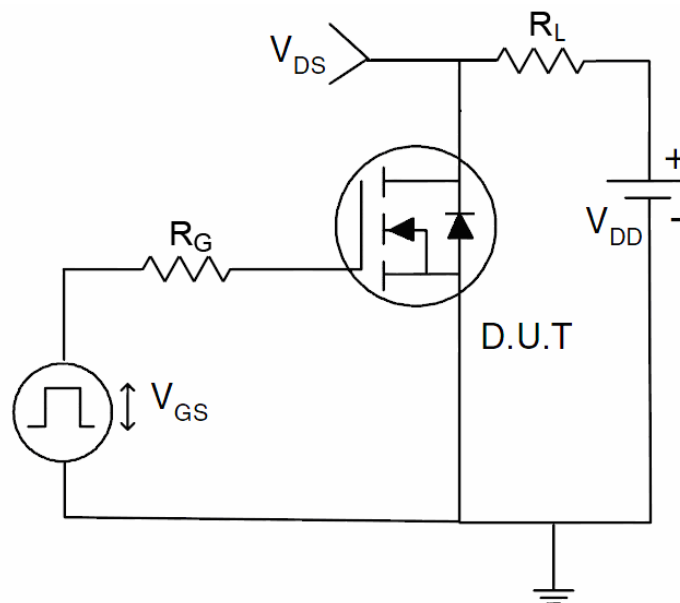
1) E_{AS} test Circuit



2) Gate charge test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

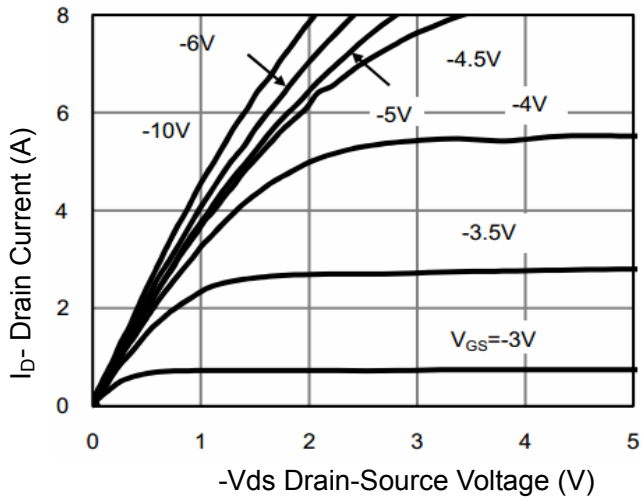


Figure 1 Output Characteristics

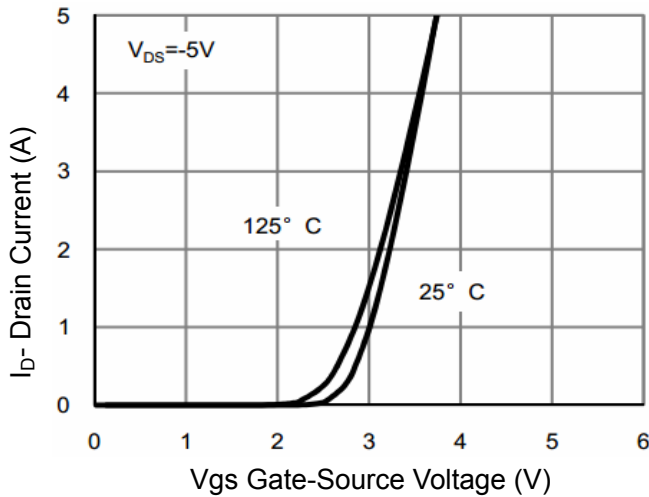


Figure 2 Transfer Characteristics

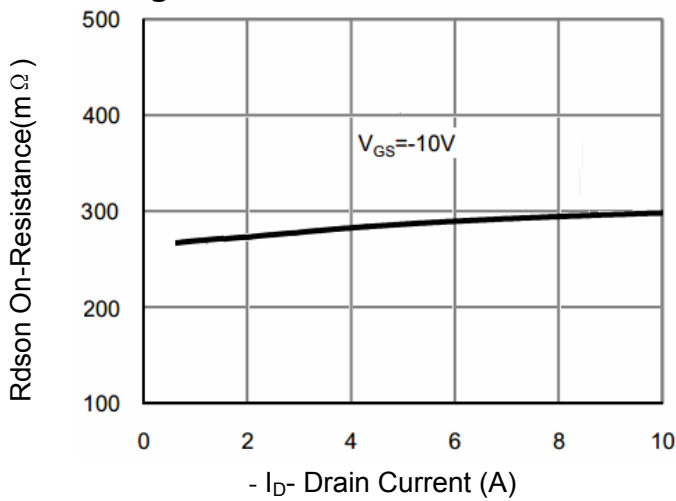


Figure 3 Rdson- Drain Current

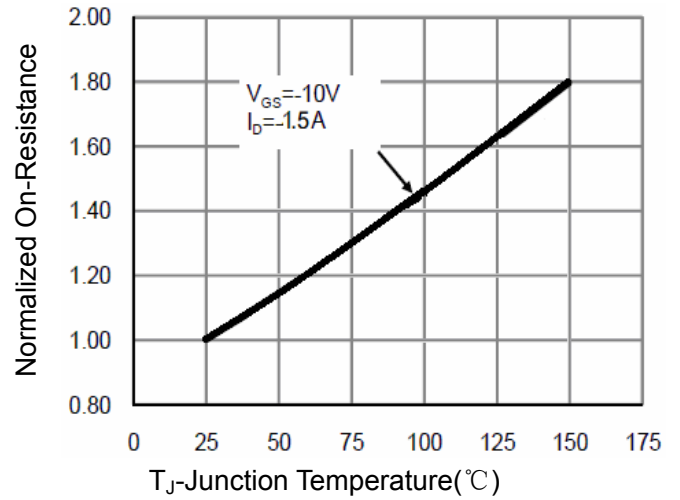


Figure 4 Rdson-Junction Temperature

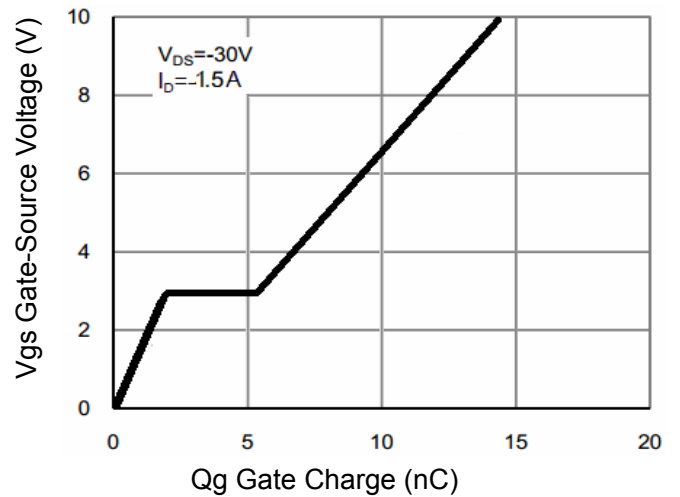


Figure 5 Gate Charge

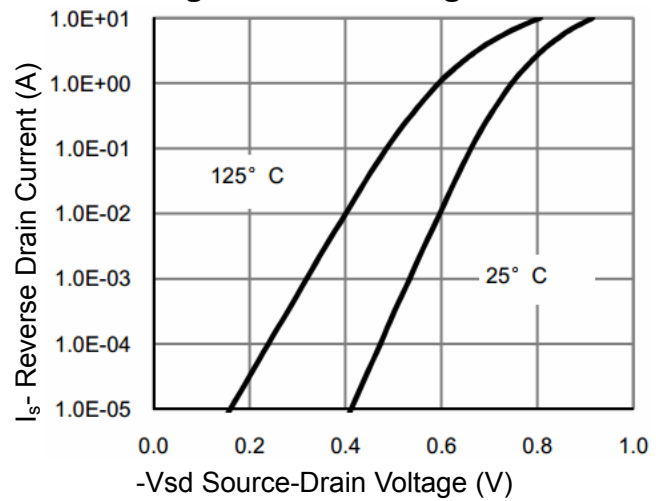


Figure 6 Source- Drain Diode Forward

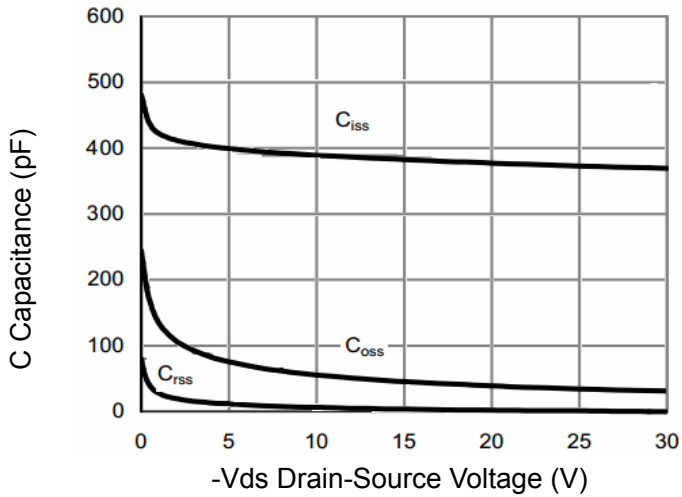


Figure 7 Capacitance vs Vds

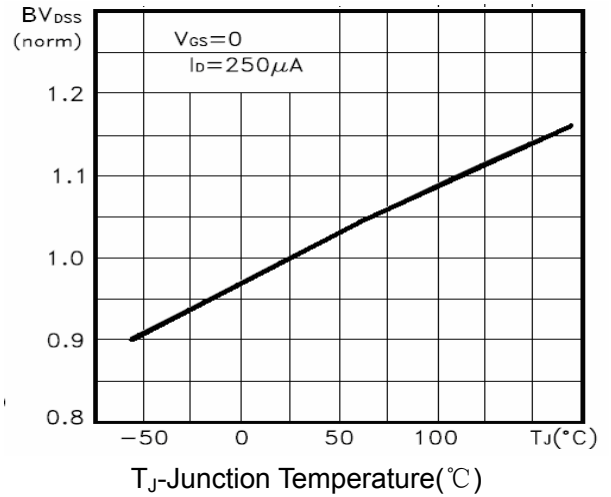


Figure 9 BV_{DSS} vs Junction Temperature

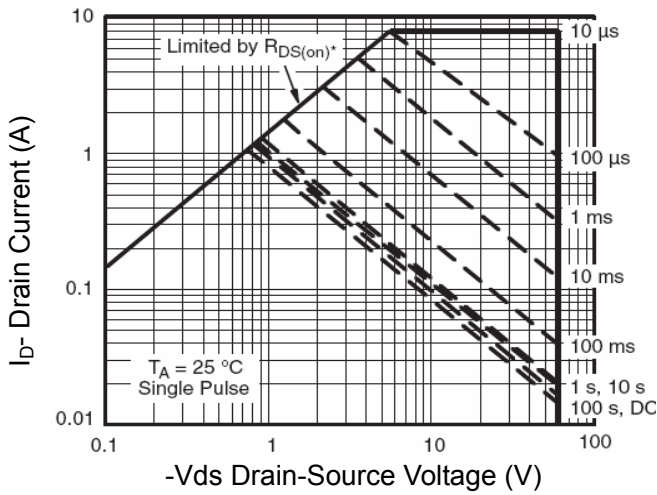


Figure 8 Safe Operation Area

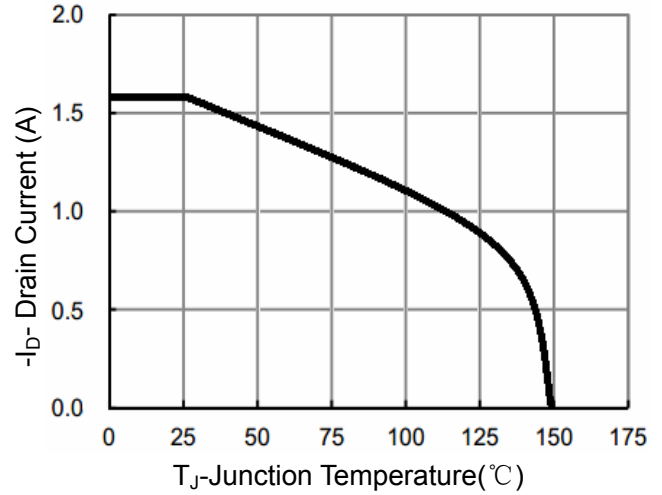


Figure 10 I_D Current De-rating

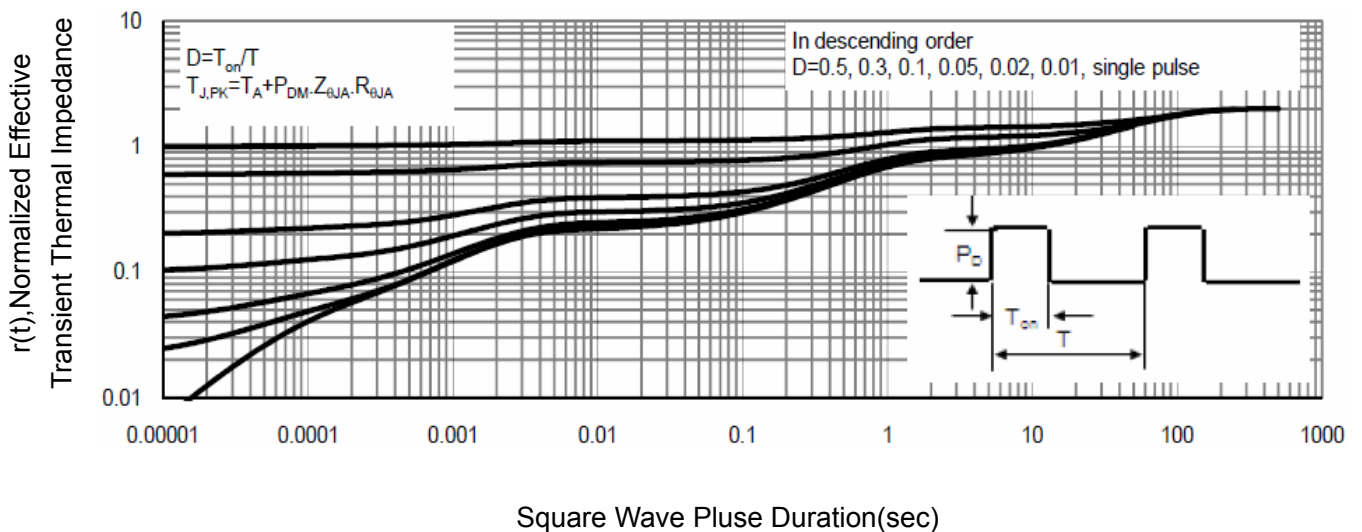
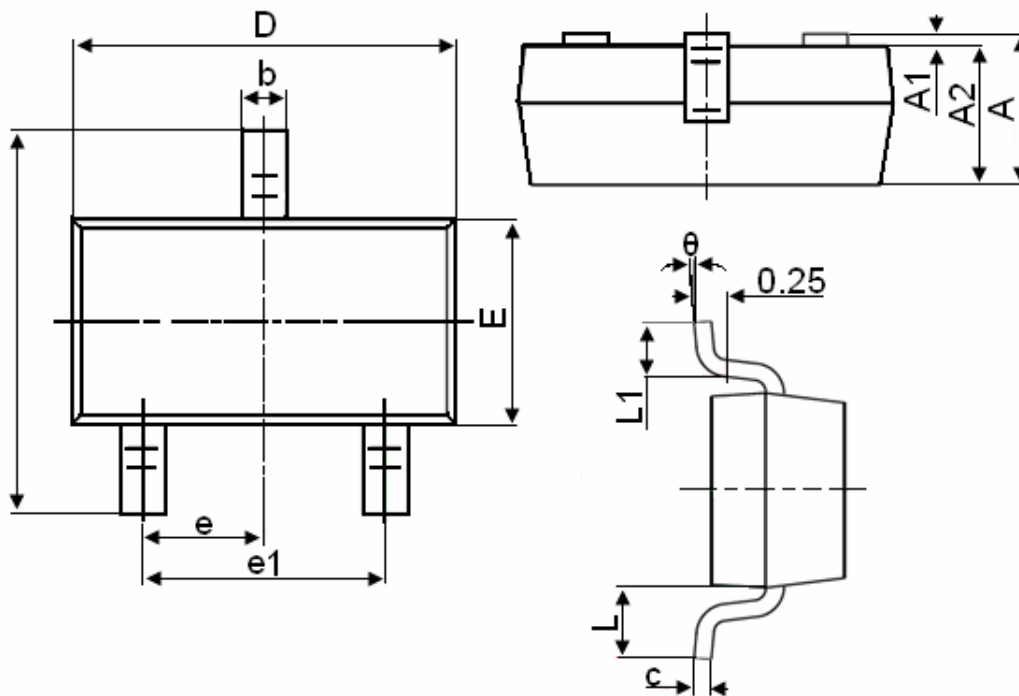


Figure 11 Normalized Maximum Transient Thermal Impedance

SOT-23 Package Information



Symbol	Dimensions in Millimeters	
	MIN.	MAX.
A	0.900	1.150
A1	0.000	0.100
A2	0.900	1.050
b	0.300	0.500
c	0.080	0.150
D	2.800	3.000
E	1.200	1.400
E1	2.250	2.550
e	0.950TYP	
e1	1.800	2.000
L	0.550REF	
L1	0.300	0.500
θ	0°	8°

Notes

1. All dimensions are in millimeters.
2. Tolerance $\pm 0.10\text{mm}$ (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.