



Description

The ST2309ES use 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.

General Features

$V_{DS} = -60V, I_D = -1.6A$

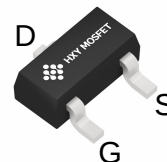
$R_{DS(ON)} < 160m\Omega @ V_{GS} = -10V$

$R_{DS(ON)} < 200m\Omega @ V_{GS} = -4.5V$

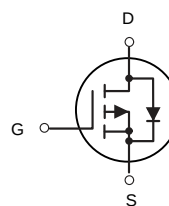
Application

Load switch

PWM application



SOT-23



P-Channel MOSFET

Package Marking and Ordering Information

Product ID	Pack	Marking	Qty(PCS)
ST2309ES	SOT-23	2309	3000

Absolute Maximum Ratings (TA=25°C unless otherwise noted)

Symbol	Parameter	Limit	Unit
V_{DS}	Drain-Source Voltage	-60	V
V_{GS}	Gate-Source Voltage	± 20	V
I_D	Drain Current-Continuous	-1.6	A
I_{DM}	Drain Current-Pulsed (Note 1)	-8	A
P_D	Maximum Power Dissipation	1.5	W
T_J, T_{STG}	Operating Junction and Storage Temperature Range	-55 To 150	°C
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 2)	83.3	°C/W



Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =-250μA	-60	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =-60V, V _{GS} =0V	-	-	-1	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =-250μA	-1.4	-2.0	-2.6	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =-10V, I _D =-1.5A	-	140	160	mΩ
		V _{GS} =-4.5V, I _D =-1.5A	-	160	200	mΩ
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	-	444.2	-	PF
Output Capacitance	C _{OSS}		-	19.6	-	PF
Reverse Transfer Capacitance	C _{RSS}		-	17.9	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =-30V, I _D =-1.5A, V _{GS} =-10V, R _G =3Ω	-	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	-	11.3	-	nC
Gate-Source Charge	Q _{gs}		-	2.7	-	nC
Gate-Drain Charge	Q _{gd}		-	1.6	-	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°C, I _F =- 1.5A	-	25		nS
Reverse Recovery Charge	Q _{rr}	di/dt = -100A/μs (Note3)	-	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



Typical Electrical and Thermal Characteristics (Curves)

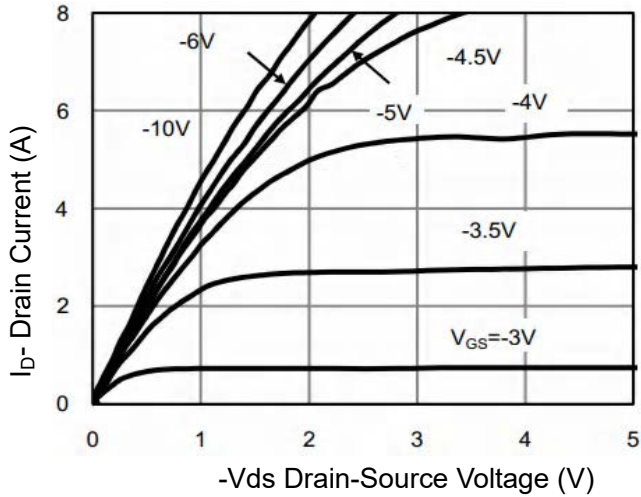


Figure 1 Output Characteristics

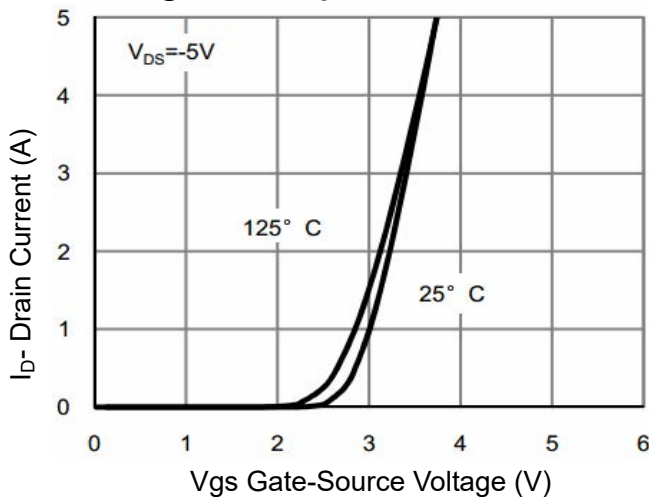


Figure 2 Transfer Characteristics

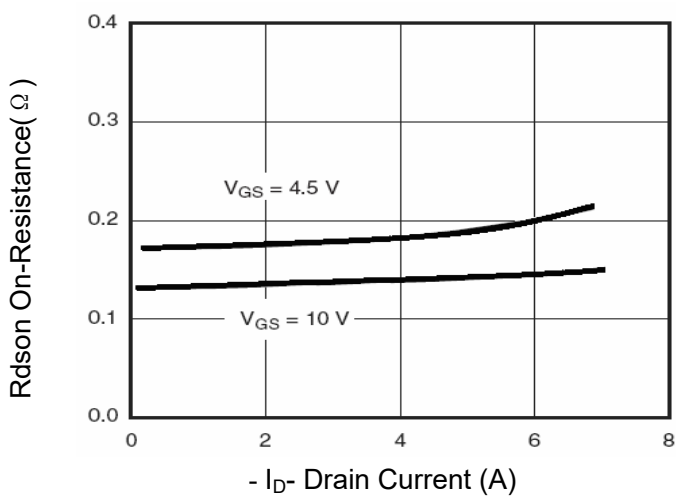


Figure 3 $R_{DS(on)}$ - Drain Current

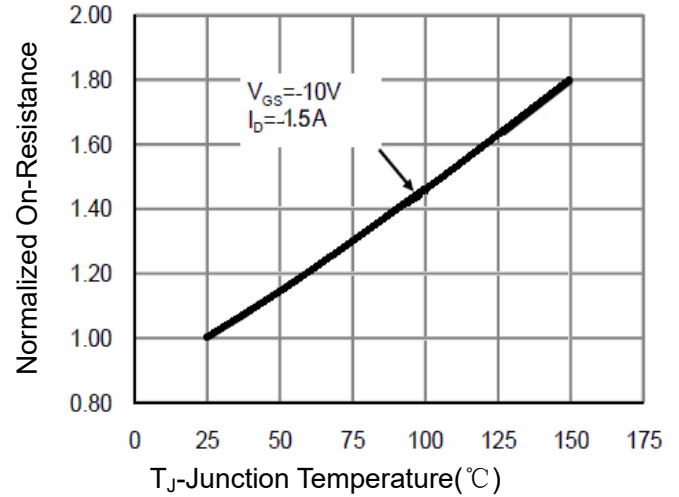


Figure 4 $R_{DS(on)}$ -Junction Temperature

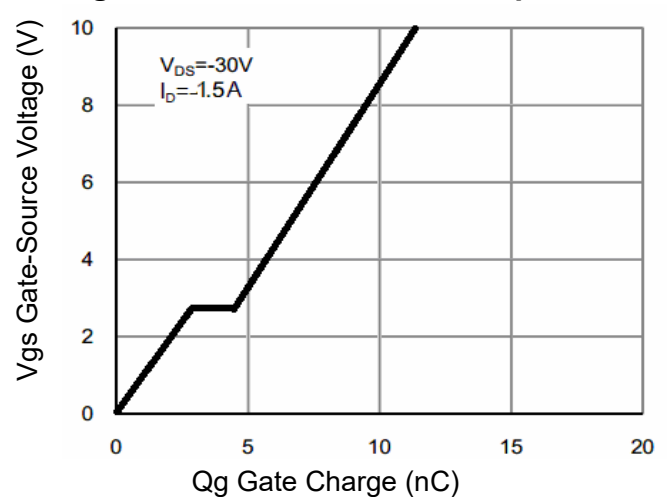


Figure 5 Gate Charge

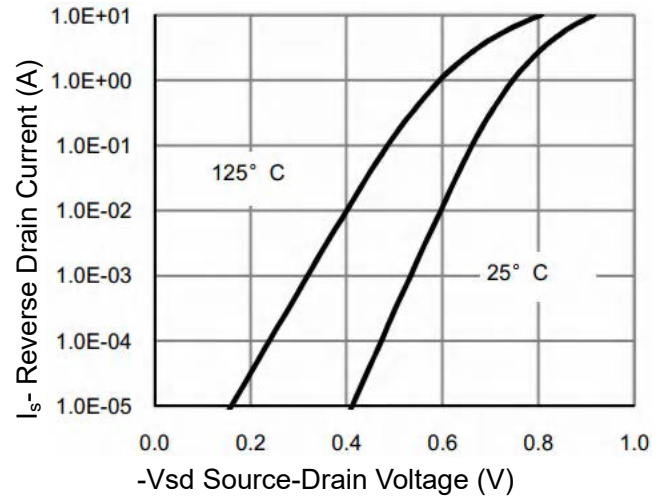


Figure 6 Source- Drain Diode Forward

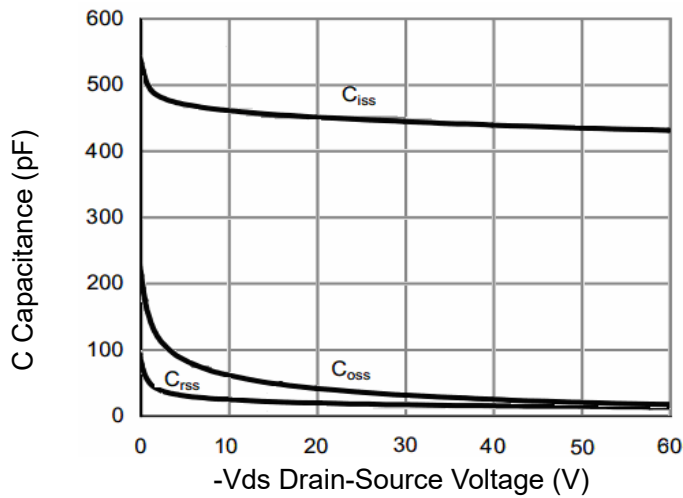


Figure 7 Capacitance vs Vds

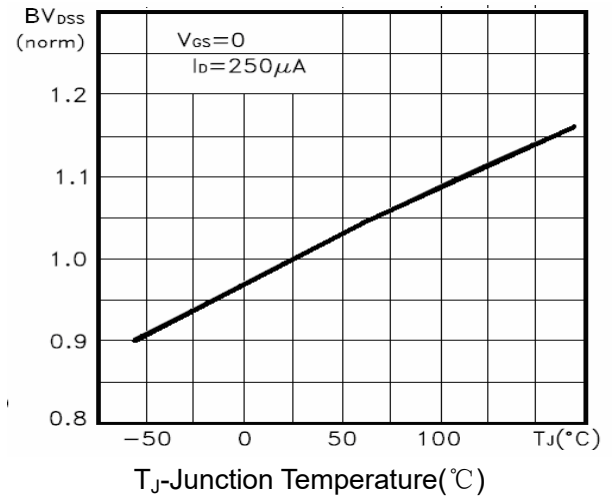


Figure 9 BV_{DSS} vs Junction Temperature

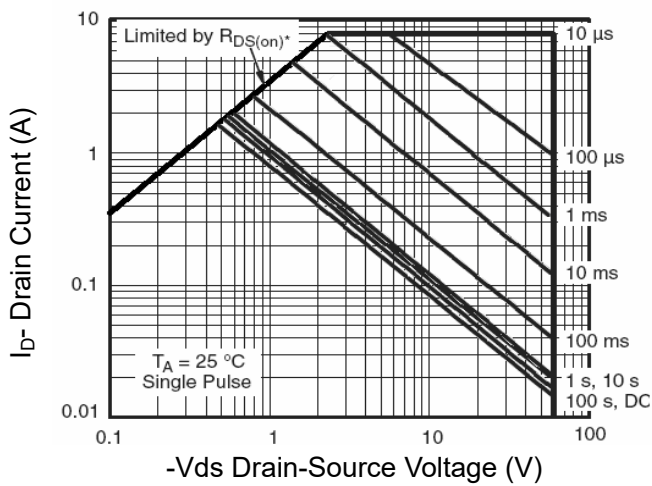


Figure 8 Safe Operation Area

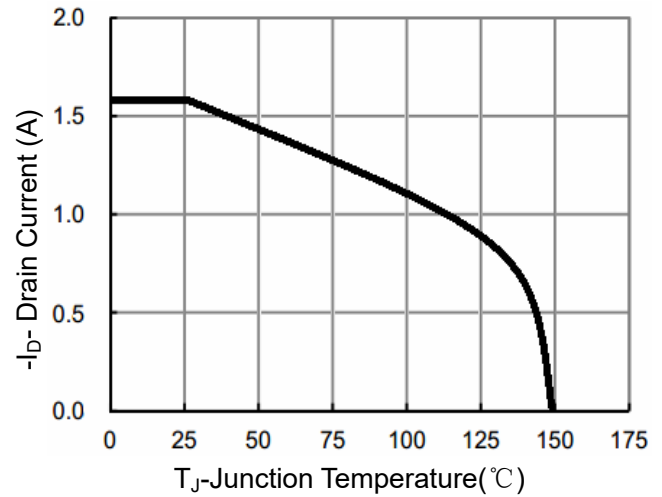


Figure 10 I_D Current De-rating

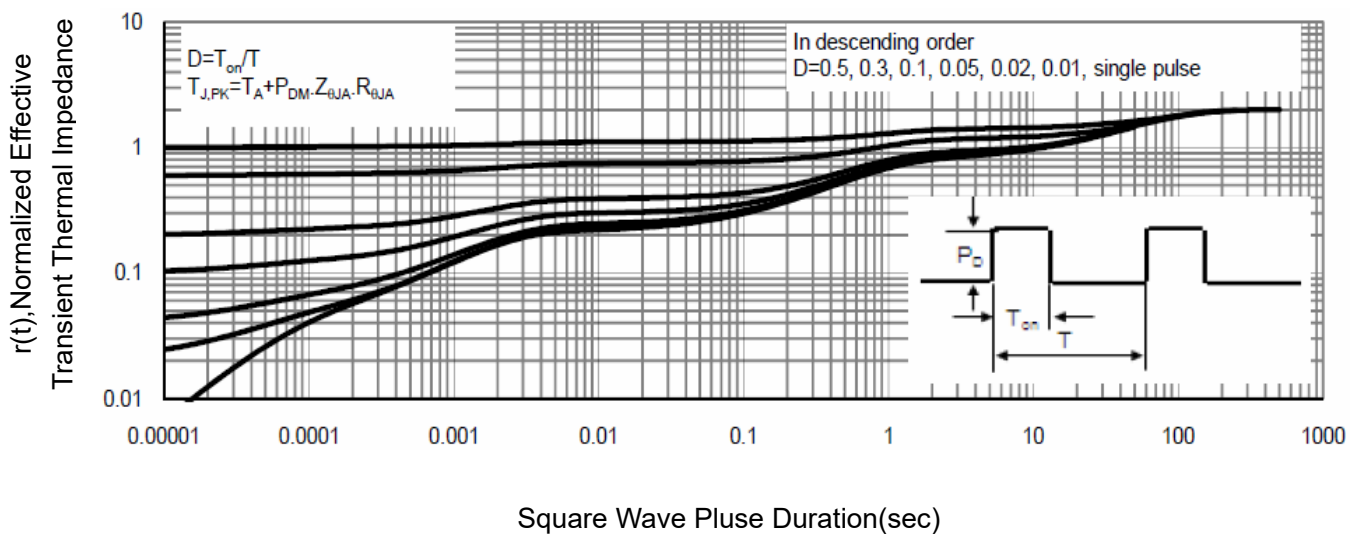
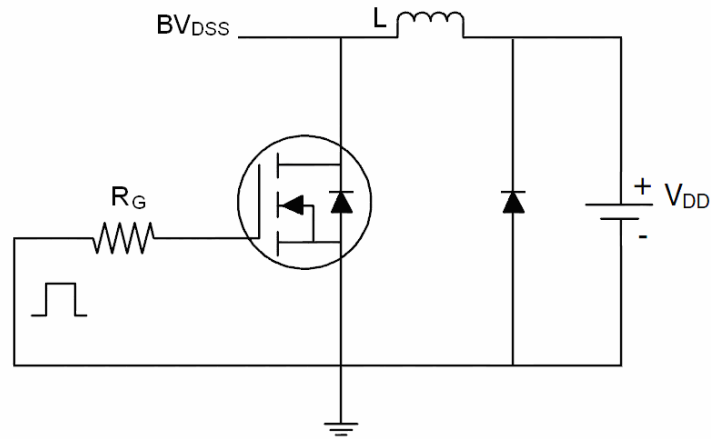


Figure 11 Normalized Maximum Transient Thermal Impedance

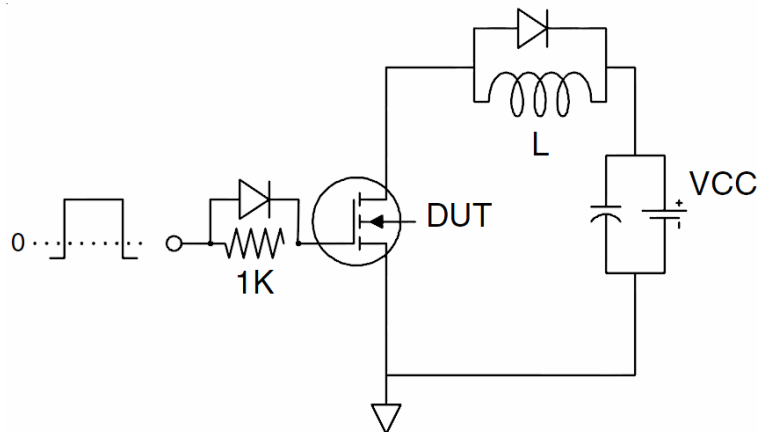


Test Circuit

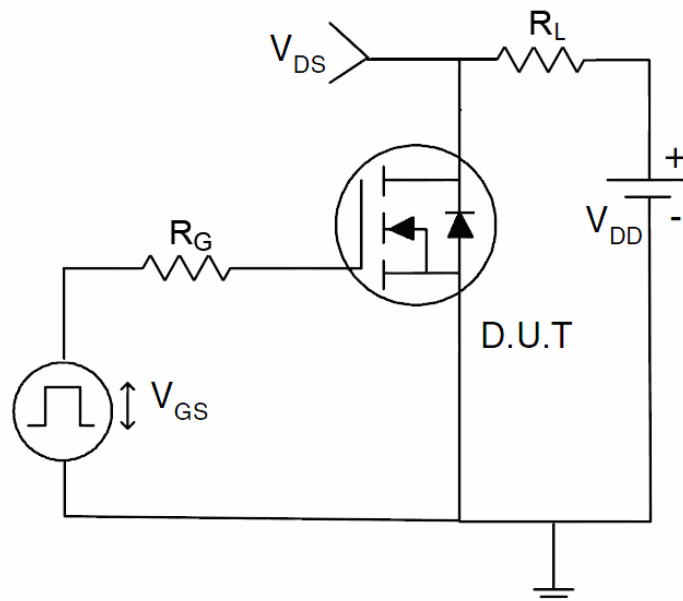
1) E_{AS} test Circuit



2) Gate charge test Circuit

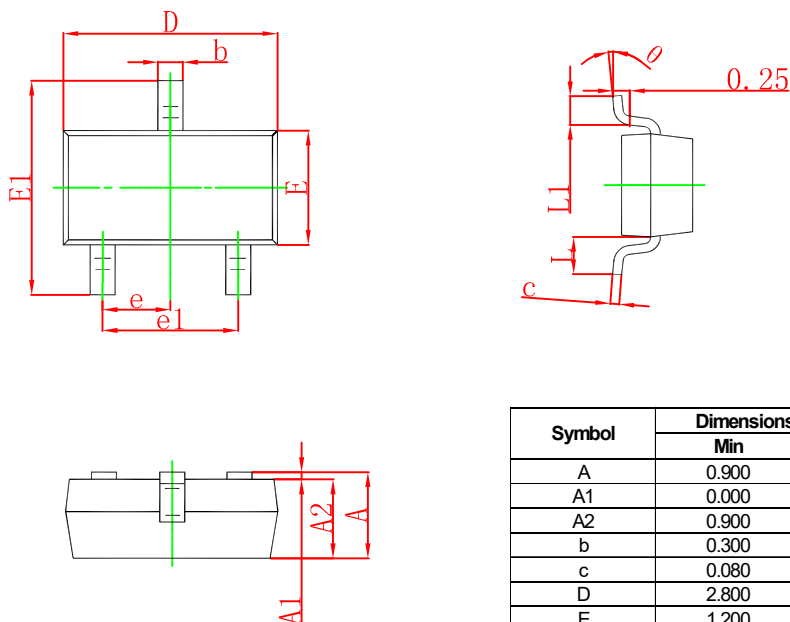


3) Switch Time Test Circuit





SOT-23 Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.550 REF		0.022 REF	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	8°

SOT-23 Suggested Pad Layout



Note:
1. Controlling dimension: in millimeters.
2. General tolerance: $\pm 0.05\text{mm}$.
3. The pad layout is for reference purposes only.



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