

Features

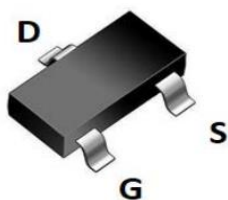
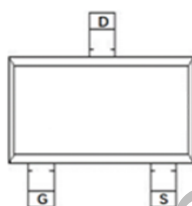
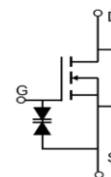
- Excellent $R_{DS(ON)}$ and Low Gate Charge
- 100% UIS Tested
- 100% ΔV_{ds} Tested
- Halogen-free; RoHS-compliant
- Pb-free plating
- ESD Protected, HBM>2KV

Applications

- Load Switch
- PWM Application
- Power Management

Product Summary

Parameters	Value	Unit
V_{DSS}	60	V
$V_{GS(th_Typ)}$	1.5	V
$I_D(@V_{GS}=10V)$	0.4	A
$R_{DS(ON_Typ)}(@V_{GS}=10V)$	1788	mΩ
$R_{DS(ON_Typ)}(@V_{GS}=4.5V)$	1968	mΩ

**SOT-23 Top View****Pin Assignment****Schematic Diagram****Ordering Information**

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
2N7002KS	72K	3	Tape&Reel	SOT-23	3000	120000

Absolute Maximum Ratings (@ $T_A = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit
V_{DS}	Drain-to-Source Voltage	60	V
V_{GS}	Gate-to-Source Voltage	± 20	V
I_D	Continuous Drain Current	$T_A = 25^\circ\text{C}$ $T_A = 100^\circ\text{C}$	A
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4	A
P_D	Power Dissipation	$T_A = 25^\circ\text{C}$ $T_A = 100^\circ\text{C}$	W
T_J, T_{STG}	Junction & Storage Temperature Range	-55 to 150	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Max	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient ⁽²⁾	176	$^\circ\text{C/W}$

60V, 0.4A, 1968m Ω N-channel Power Trench MOSFETElectrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	I _D = 250μA, V _{GS} = 0V	60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 60V, V _{GS} = 0V	-	-	1.0	μA
I _{GSS}	Gate-Body Leakage Current	V _{DS} = 0V, V _{GS} = ±20V	-	-	±10	μA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	1.1	1.5	2.0	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽³⁾	V _{GS} = 10V, I _D = 0.3A	-	1788	2200	mΩ
		V _{GS} = 4.5V, I _D = 0.2A	-	1968	2870	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	12	-	Ω
C _{iSS}	Input Capacitance	V _{GS} = 0V, V _{DS} = 30V, f = 1MHz	-	18.5	-	pF
C _{oss}	Output Capacitance		-	4.6	-	pF
C _{rss}	Reverse Transfer Capacitance		-	1.5	-	pF
Q _g	Total Gate Charge	V _{GS} = 0 to 4.5V V _{DS} = 10V, I _D = 1A	-	0.5	-	nC
Q _{gs}	Gate Source Charge		-	0.4	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	0.1	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = 10V, V _{DD} = 15V I _D = 0.2A, R _{GEN} = 3Ω	-	0.6	-	ns
t _r	Turn-On Rise Time		-	1.9	-	ns
t _{d(off)}	Turn-Off DelayTime		-	3.8	-	ns
t _f	Turn-Off Fall Time		-	3.3	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	0.4	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	1.5	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = 0.3A	-		1.2	V
trr	Body Diode Reverse Recovery Time	I _F = 0.5A, di/dt = 100A/us	-	18	-	ns
Qrr	Body Diode Reverse Recovery Charge		-	3.5	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. $R_{\theta JA}$ is measured with the device mounted on a 1inch² pad of 2oz copper FR4 PCB.
 3. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 0.5\%$.

Typical Performance Characteristics

Figure 1: Power De-rating

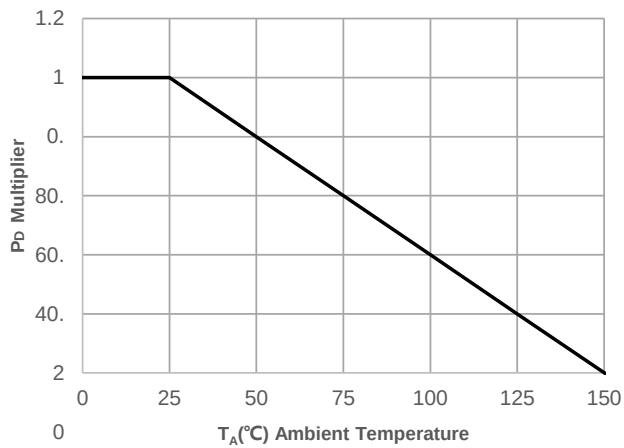


Figure 2: Current De-rating

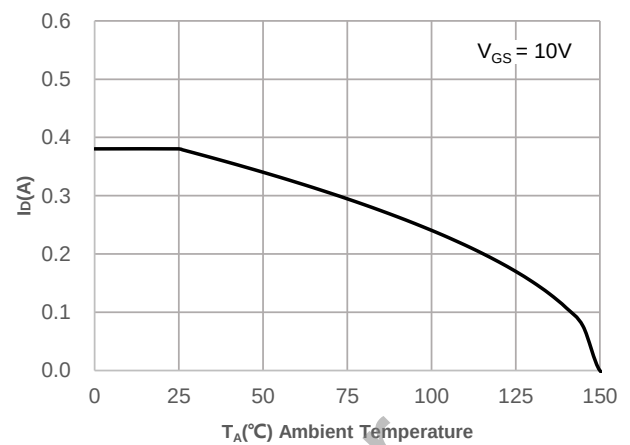


Figure 3: Normalized Maximum Transient Thermal Impedance

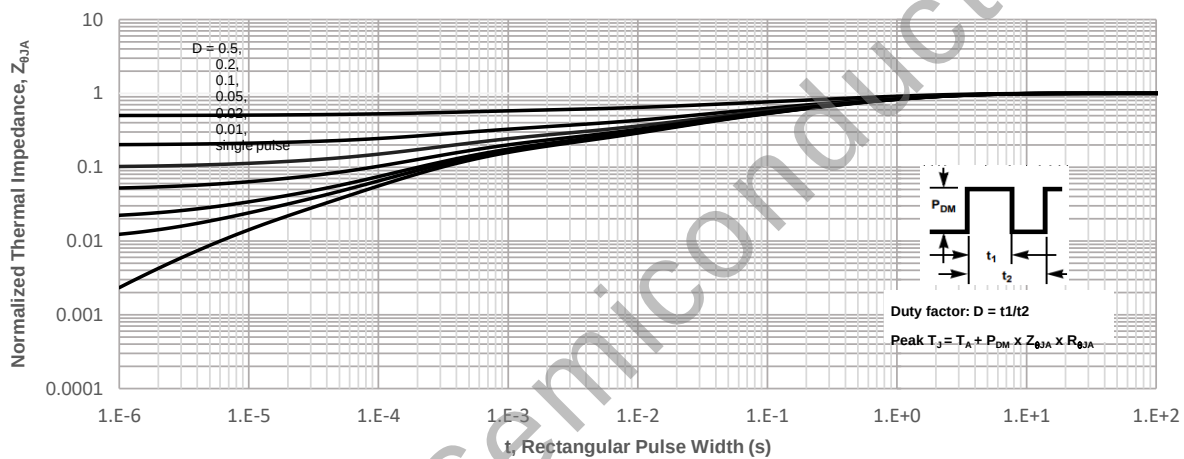
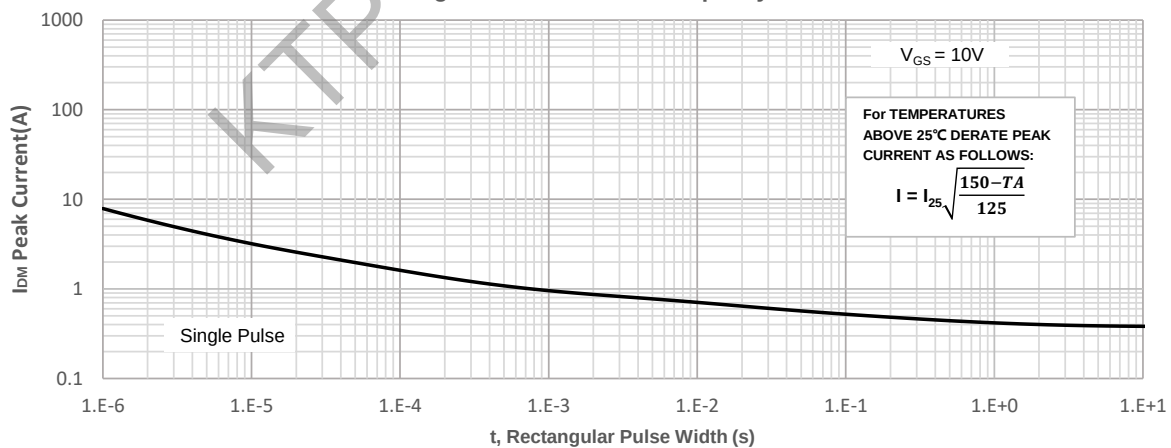


Figure 4: Peak Current Capacity



Typical Performance Characteristics

Figure 5: Output Characteristics

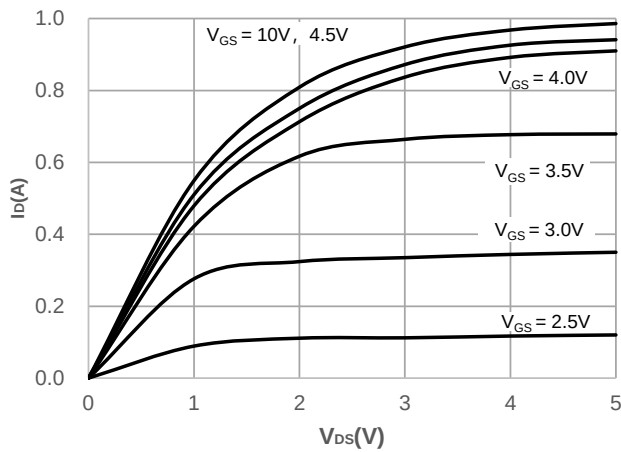


Figure 6: Typical Transfer Characteristics

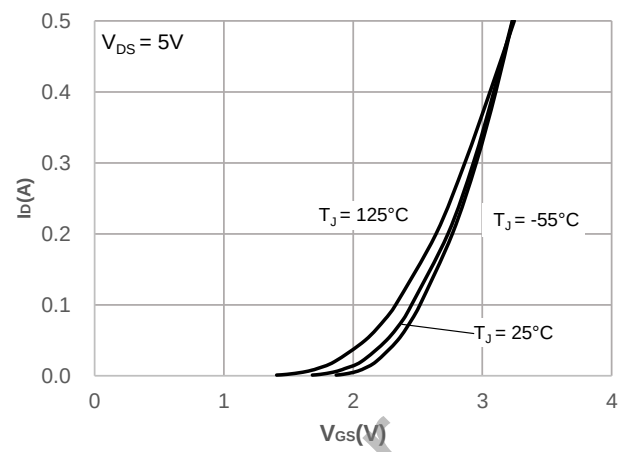


Figure 7: On-resistance vs. Drain Current

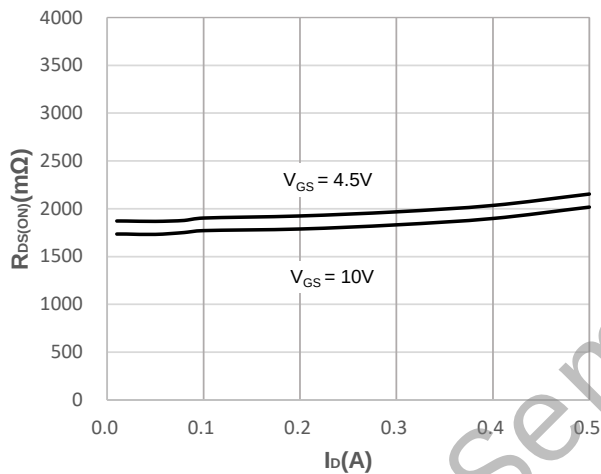


Figure 8: Body Diode Characteristics

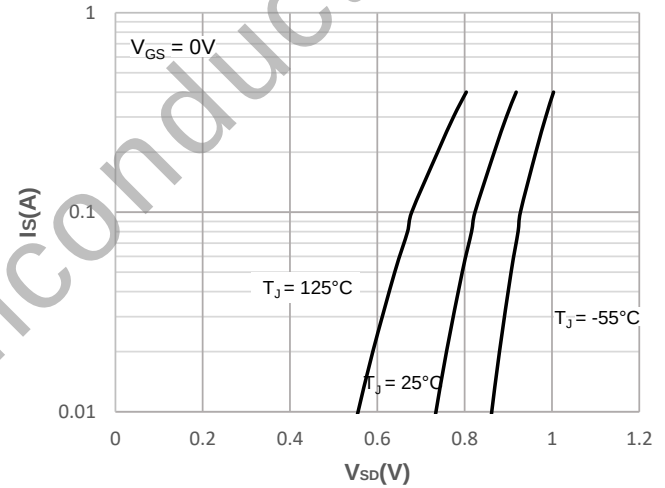


Figure 9: Gate Charge Characteristics

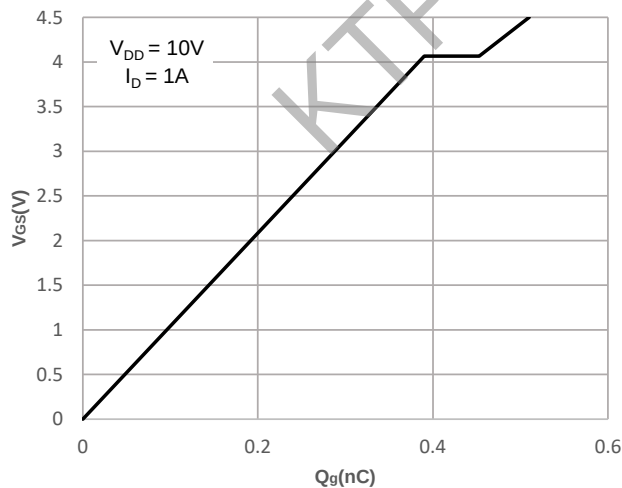
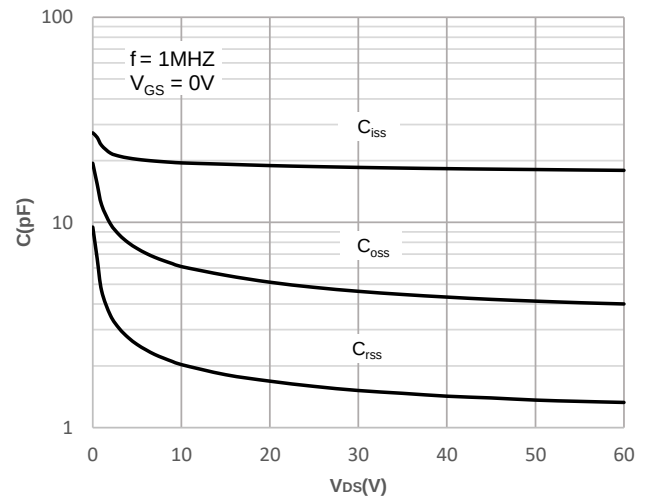


Figure 10: Capacitance Characteristics



Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

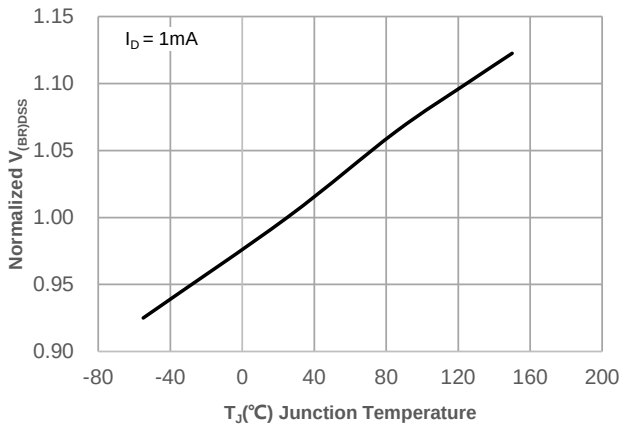


Figure 12: Normalized on Resistance vs. Junction Temperature

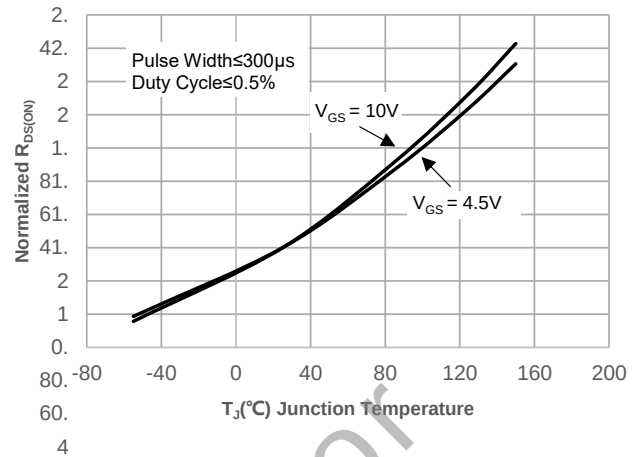


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

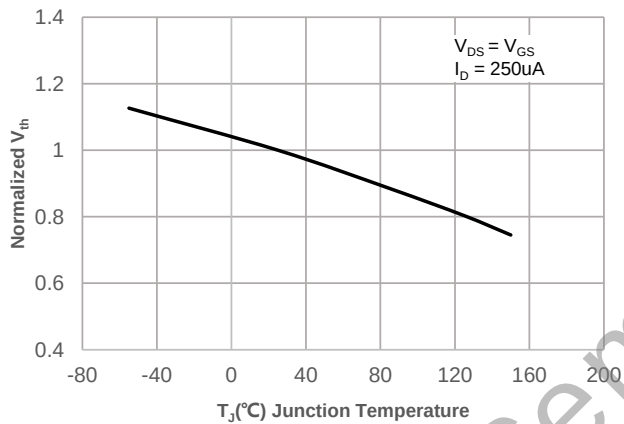


Figure 14: $R_{DS(on)}$ vs. V_{GS}

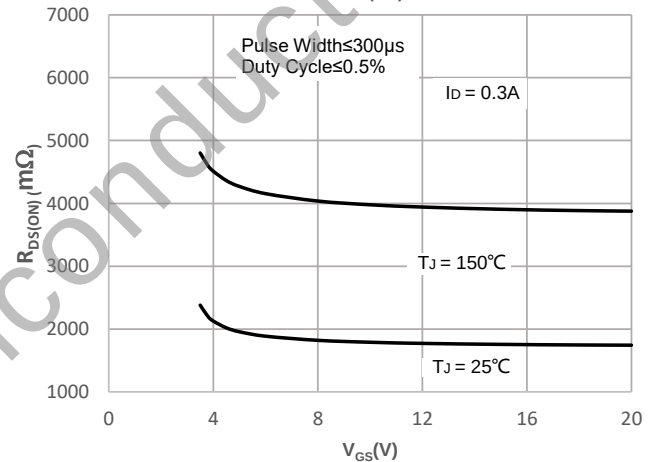
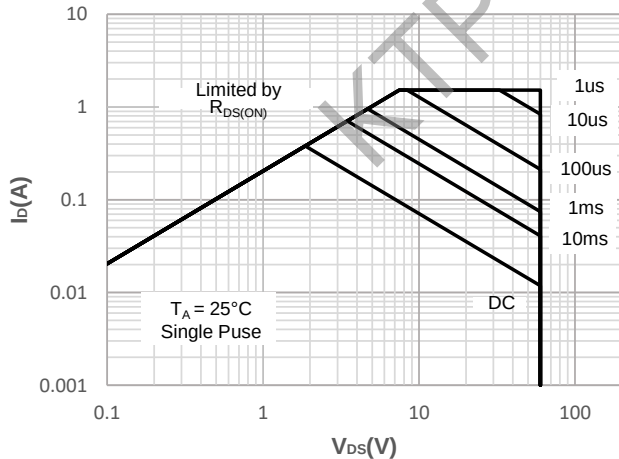


Figure 15: Maximum Safe Operating Area



Test Circuit

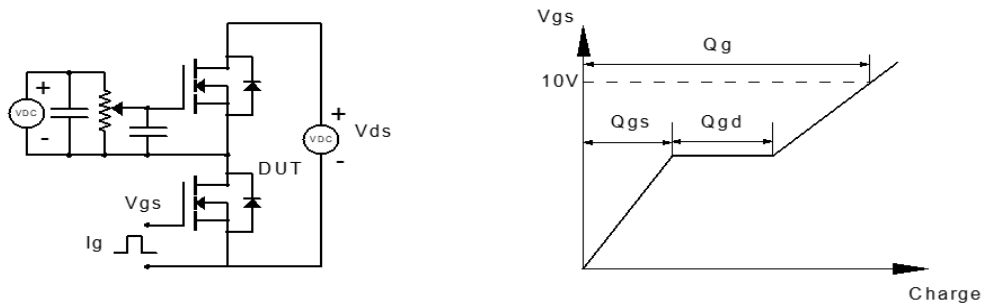


Figure 1: Gate Charge Test Circuit & Waveform

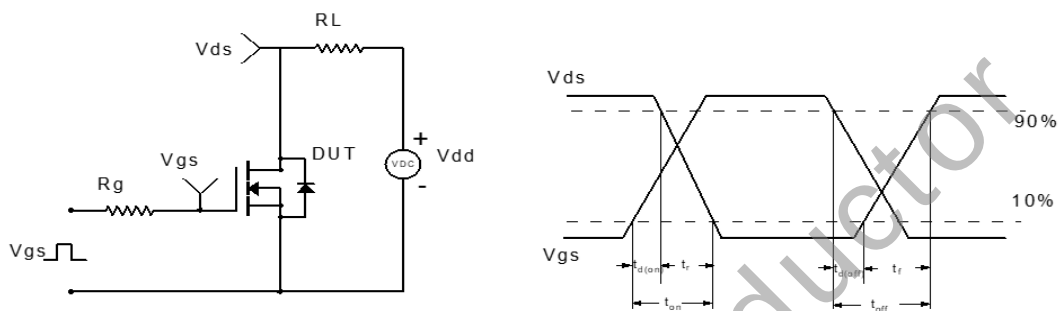


Figure 2: Resistive Switching Test Circuit & Waveform

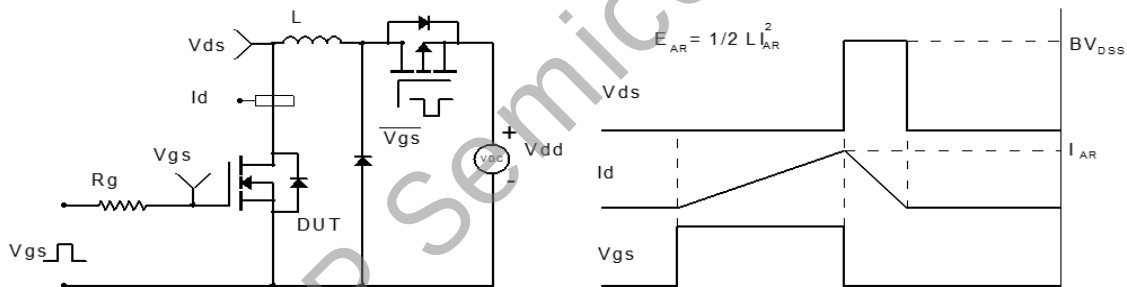


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

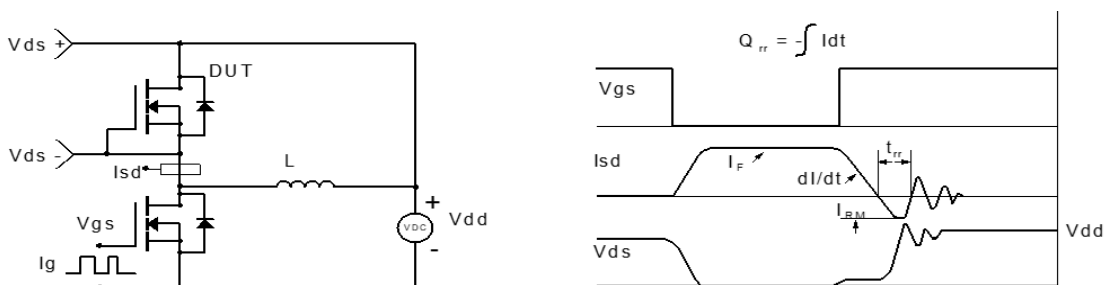
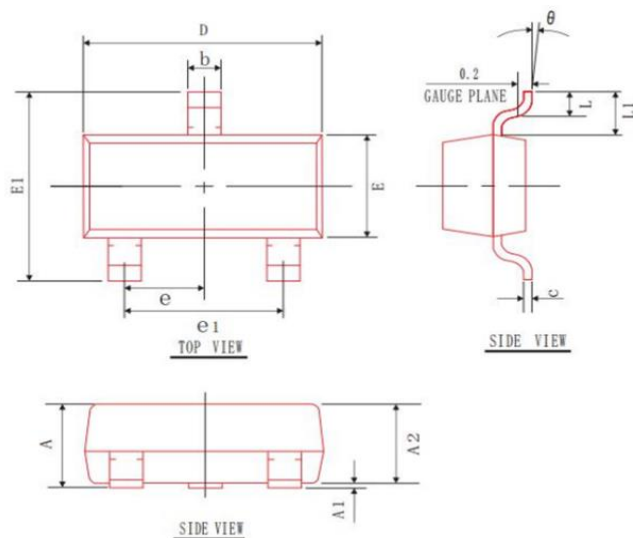


Figure 4: Diode Recovery Test Circuit & Waveform

Package Mechanical Data(SOT-23)

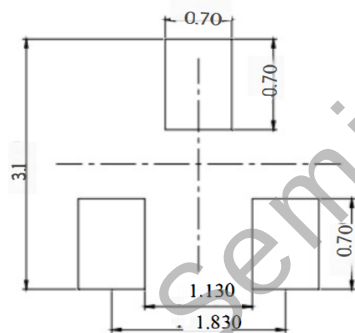
Package Outline



COMMON DIMENSIONS
(UNITS OF MEASURE=mm)

SYMBOL	MIN	NOM	MAX
A	0.90	1.05	1.20
A1	0.00	0.05	0.10
A2	0.90	1.00	1.10
b	0.30	0.40	0.50
c	0.08	0.10	0.15
D	2.80	2.90	3.00
E	1.20	1.30	1.40
E1	2.30	2.40	2.50
L	0.30	0.40	0.50
θ	0°	5°	10°
L1	0.55 REF		
e	0.95 BSC		
e1	1.90 REF		

Recommended Footprint



DIMENSIONS:MILLIMETERS