



## N-Channel Super Junction MOSFET, 650V, 3.4Ω

### General Description

The VAS65R3K4 Super Junction (SJ) Power MOSFETs is designed to provide best cost-performance switch solution for various application fields, such as consumer and lighting markets. It is available in DPAK, IPAK and SOT223 packages.

### Features

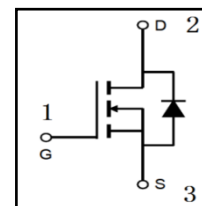
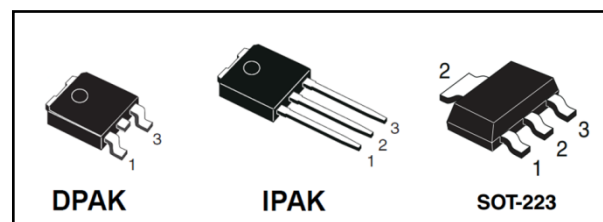
- High Efficiency
- Low Gate Charge
- High Body Diode Ruggedness
- 100% EAS Guaranteed
- Halogen-Free

### Application

Adapter, TV, LED Lighting, PFC stages, hard switching PWM stages and resonant switching stages.

### Product Summary

$V_{DS}@T_{j,max}$	650 V
$R_{DS(on)}@V_{GS}=10V$	3.4 Ω
$I_D$ Continuous Current	3 A
$V_{(GS)th}$	3.0 V
$Q_{g,typ}$	4.6 nC



### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	Condition
Drain-Source Voltage	$V_{DS}$	650	V	
Continuous drain current <sup>(1)</sup>	$I_D$	3 2	A	$T_C=25^\circ C$ $T_C=100^\circ C$
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V	Static
Pulsed drain current <sup>(2)</sup>	$I_{DM}$	3.9	A	$T_C=25^\circ C$
Avalanche energy, single pulse	$E_{AS}$	6	mJ	$I_D=0.3A$ ; $V_{DD}=50V$ ; see Figure 13
Avalanche energy, repetitive	$E_{AR}$	0.04	mJ	$I_D=0.3A$ ; $V_{DD}=50V$ ; see Figure 13
Avalanche current, repetitive	$I_{AR}$	0.3	A	
Power dissipation TO-252	$P_{tot,TO}$	29	W	$T_C=25^\circ C$
Power dissipation SOT223	$P_{tot,SOT}$	5	W	$T_C=25^\circ C$
Continuous diode forward current	$I_S$	1.8	A	$T_C=25^\circ C$
Diode pulse current <sup>(2)</sup>	$I_{S,pulse}$	4	A	$T_C=25^\circ C$

(1) Limited by  $T_{j,max}$ . Maximum duty cycle  $D=0.4$

(2) Pulse width  $T_p$  limited by  $T_{j,max}$



### Thermal characteristics

Symbol	Parameter	Value			Unit
		TO-252	TO-251	SOT223	
$R_{thj-case}$	Thermal resistance, junction-case, max	4.26	4.26	25	°C/W
$R_{thJA}$	Thermal resistance, junction-ambient, max	62	62	75 <sup>(3)</sup>	°C/W
$T_{sold}$	Soldering temperature, max	260	260	260	°C

(3) Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.

### Package and Ordering Information

Device	Package	Marking
VAS65R3K4D	TO-252	VAS65R3K4D
VAS65R3K4I	TO-251	VAS65R3K4I
VAS65R3K4S	SOT223	VAS65R3K4S



**Electrical Characteristics** ( $T_j=25^{\circ}\text{C}$ , unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
<b>Static Characteristic</b>						
Drain-Source breakdown Voltage	$V_{(BR)DSS}$	650			V	$V_{GS}=0\text{V}, I_D=0.25\text{mA}$
Gate Threshold Voltage	$V_{(GS)th}$	2.5	3.0	3.5	V	$V_{DS}=V_{GS}, I_D=0.06\text{mA}$
Drain-Source on resistance	$R_{(DS)on}$		3.17	3.4	$\Omega$	$V_{GS}=10\text{V}, I_D=0.76\text{A}, T_j=25^{\circ}\text{C}$
			8.22		$\Omega$	$V_{GS}=10\text{V}, I_D=0.76\text{A}, T_j=150^{\circ}\text{C}$
Zero gate voltage drain current	$I_{DSS}$			1	$\mu\text{A}$	$V_{DS}=650\text{V}, V_{GS}=0\text{V}, T_j=25^{\circ}\text{C}$
			10		$\mu\text{A}$	$V_{DS}=650\text{V}, V_{GS}=0\text{V}, T_j=150^{\circ}\text{C}$
Gate-Source leakage current	$I_{GSS}$			100	nA	$V_{GS}=20\text{V}, V_{DS}=0\text{V}$
Gate resistance	$R_g$		7.5		$\Omega$	$f=1\text{MHz}$ , open drain
<b>Dynamic Characteristic</b>						
Input Capacitance	$C_{iss}$		94		pF	$V_{GS}=0\text{V}, V_{DS}=100\text{V}, f=1\text{MHz}$
Output Capacitance	$C_{oss}$		9		pF	$V_{GS}=0\text{V}, V_{DS}=100\text{V}, f=1\text{MHz}$
Turn-on delay time	$T_{d(on)}$		8		nS	$V_{DD}=400\text{V}, V_{GS}=13\text{V}, I_D=0.6\text{A}, R_G=20\Omega$ ; See Figure 14
Rise time	$T_r$		10		nS	
Turn-off delay time	$T_{d(off)}$		40		nS	
Fall time	$T_f$		60		nS	
<b>Gate Charge Characteristic</b>						
Gate to source charge	$Q_{gs}$		0.5		nC	$V_{DD}=480\text{V}, I_D=0.6\text{A}, V_{GS}=0\text{ to }10\text{V}$
Gate to drain charge	$Q_{gd}$		2.6		nC	
Gate charge total	$Q_g$		4.6		nC	
Gate plateau voltage	$V_{plateau}$		5.4		V	
<b>Reverse diode characteristic</b>						
Diode forward voltage	$V_{FD}$		0.9		V	$V_{GS}=0\text{V}, I_F=0.6\text{A}, T_j=25^{\circ}\text{C}$
Reverse recovery time	$t_{rr}$		160		nS	$V_R=400\text{V}, I_F=0.6\text{A}, dI_F/dt=100\text{A}/\mu\text{S}$
Reverse recovery charge	$Q_{rr}$		0.42		$\mu\text{C}$	
Peak reverse recovery current	$I_{rrm}$		5.1		A	



### Electrical Characteristic Diagrams

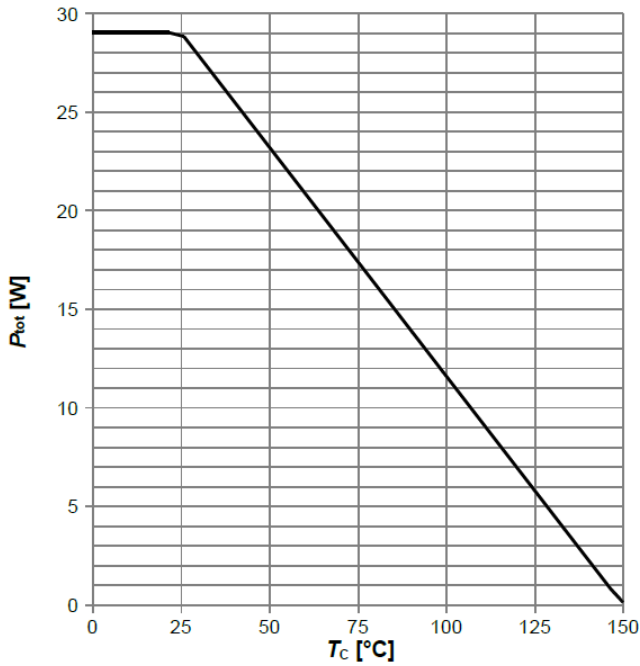


Figure 1 Power Dissipation

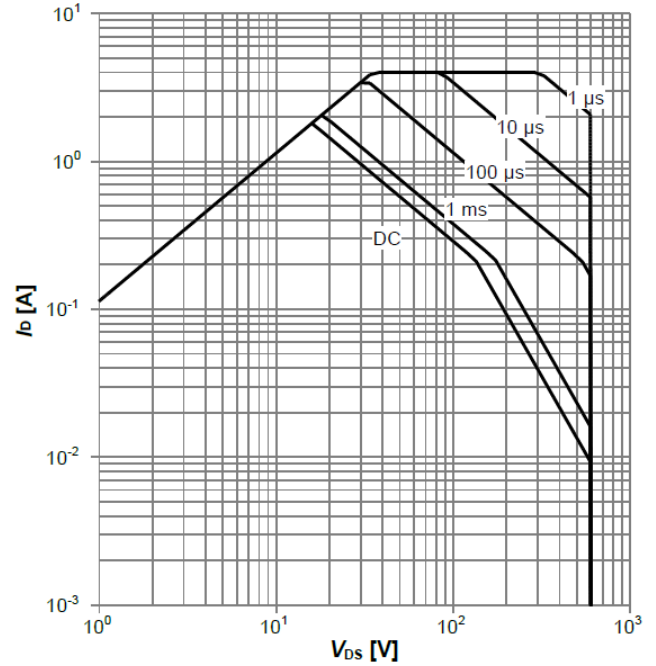


Figure 2 Safe Operation Area @T<sub>c</sub>=25 °C

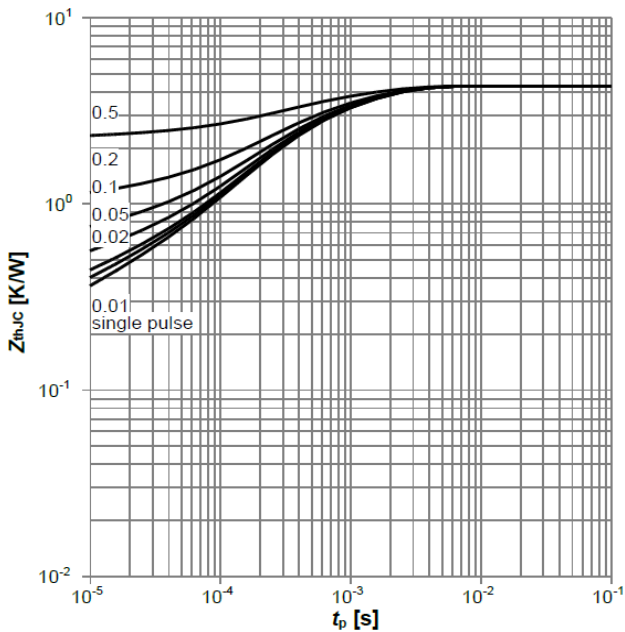


Figure 3 Maximum Transient thermal impedance

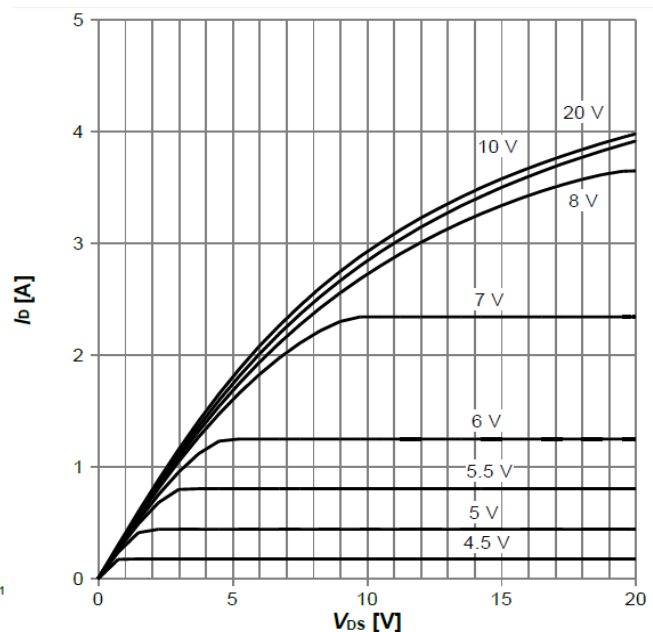


Figure 4 Typical Output Characteristics @T<sub>c</sub>=25 °C

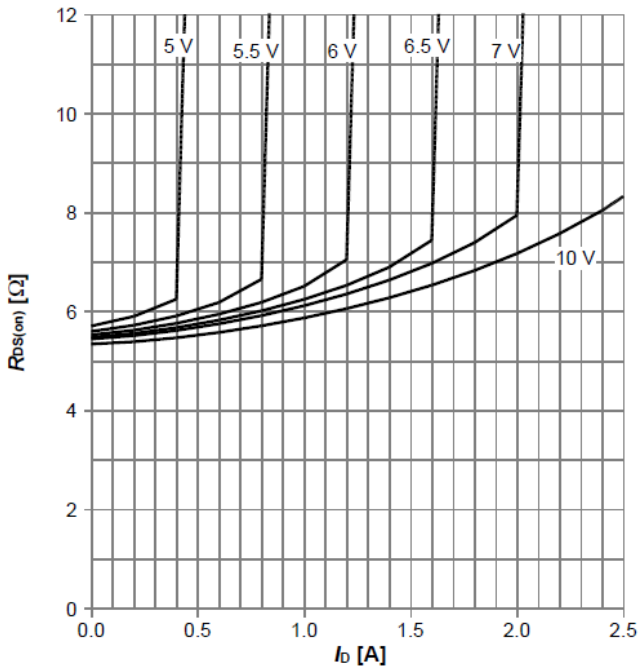


Figure 5 Typical Drain-Source on resistance@ $T_j=125^\circ\text{C}$

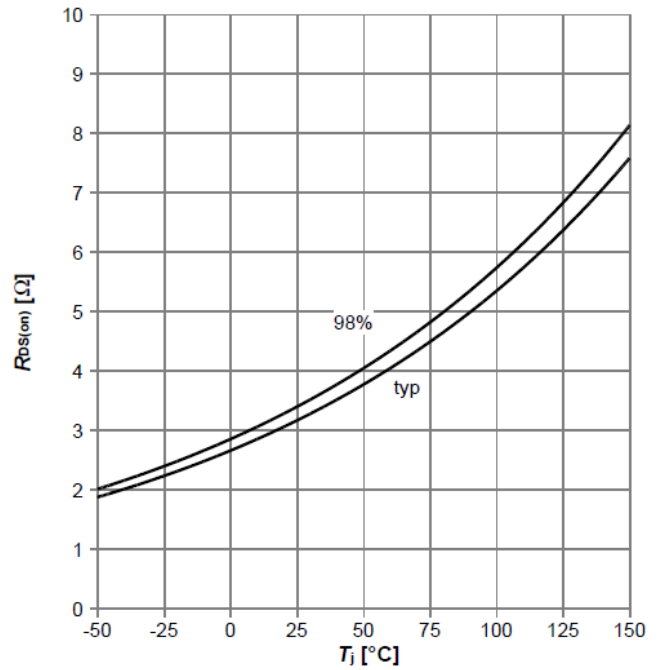


Figure 6 On resistance Temp Characteristic

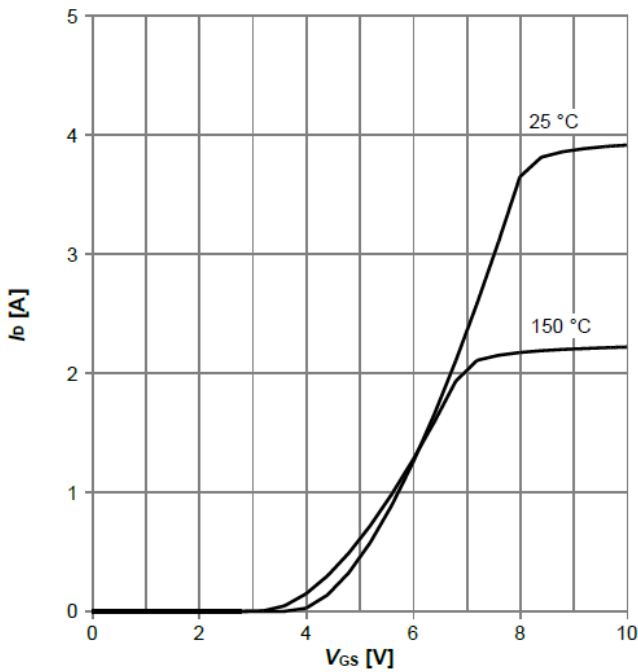


Figure 7 Typical Transfer characteristic@ $V_{DS}=20\text{V}$

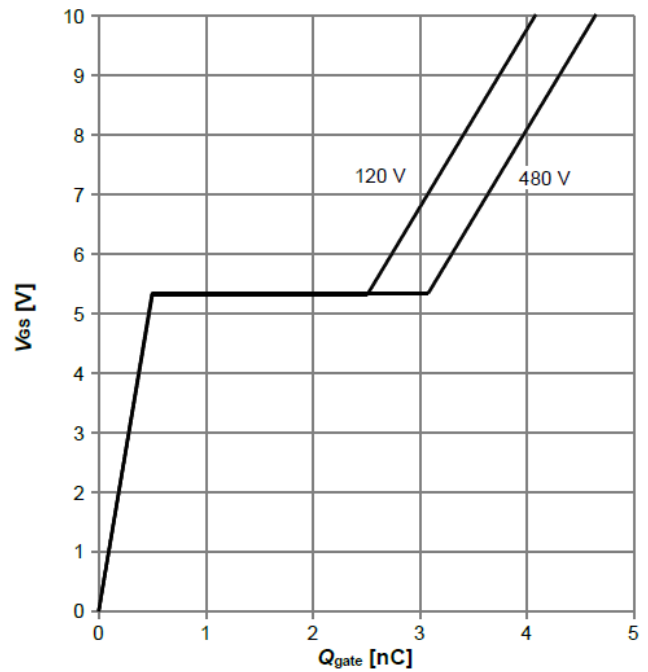


Figure 8 Typical Gate charge plot @ $I_D=0.9\text{A}$

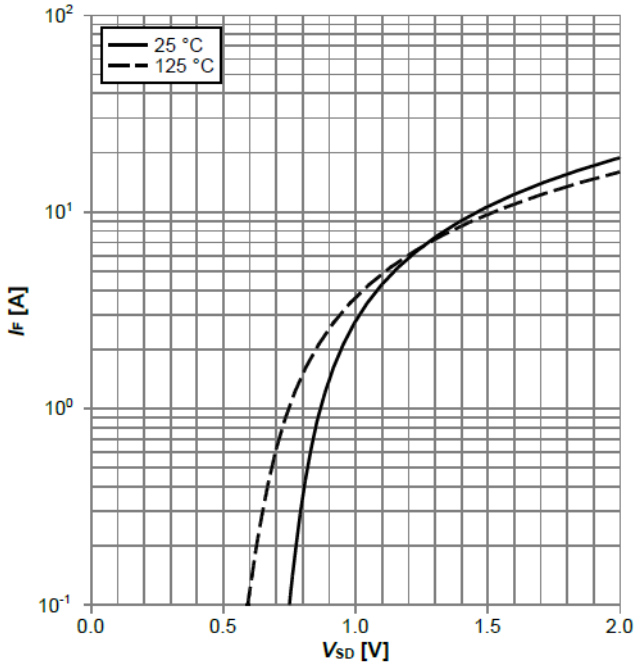


Figure 9 Reverse diode forward characteristic

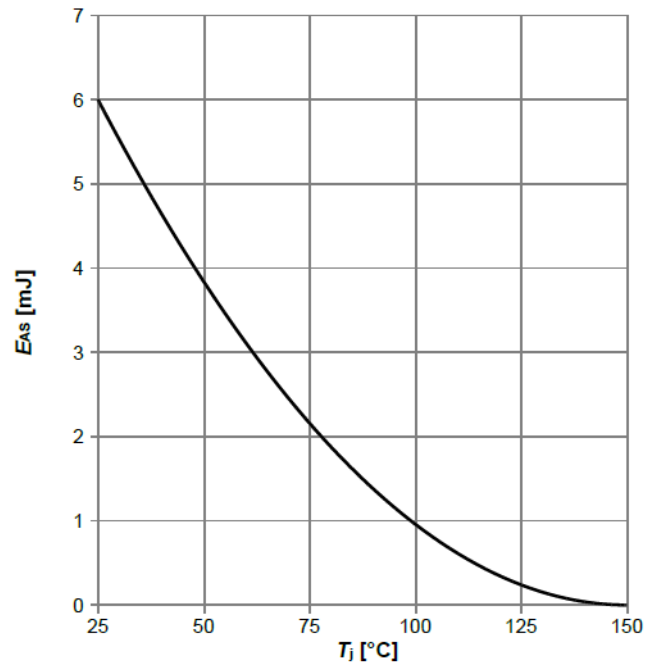


Figure 10 Avalanche Energy @  $V_{DD}=50V$

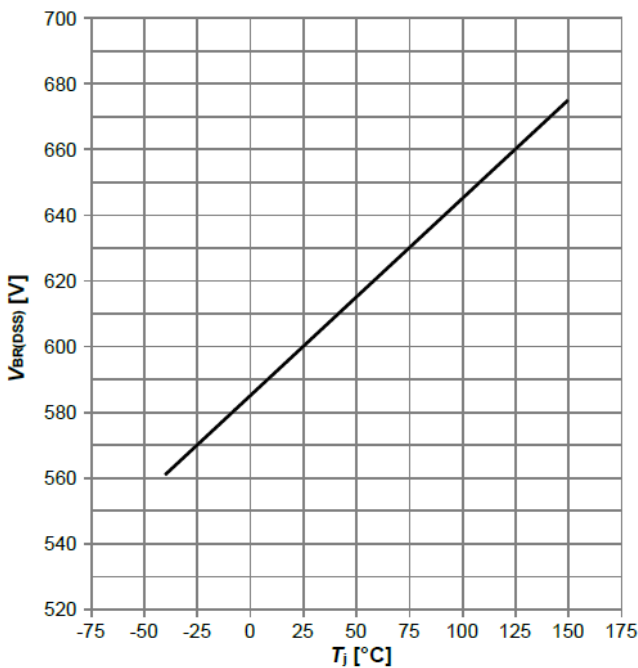


Figure 11 Drain-Source breakdown voltage

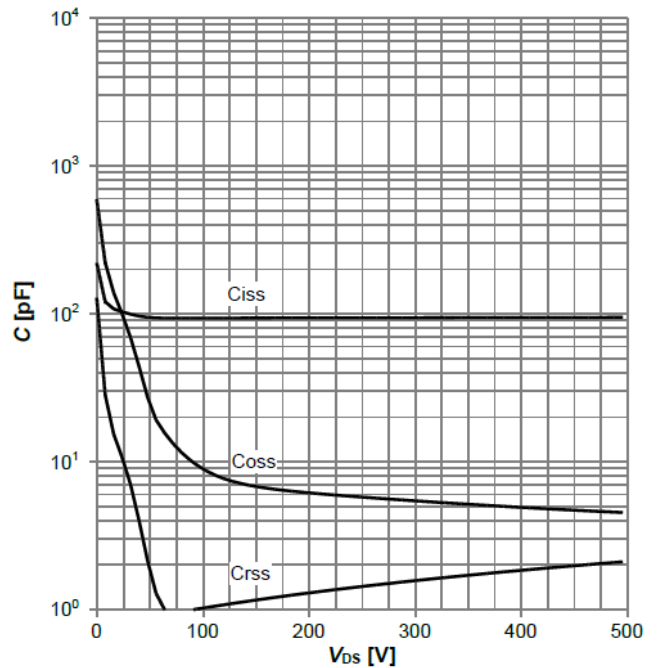


Figure 12 Capacitance characteristics

### Parameter Test Circuits

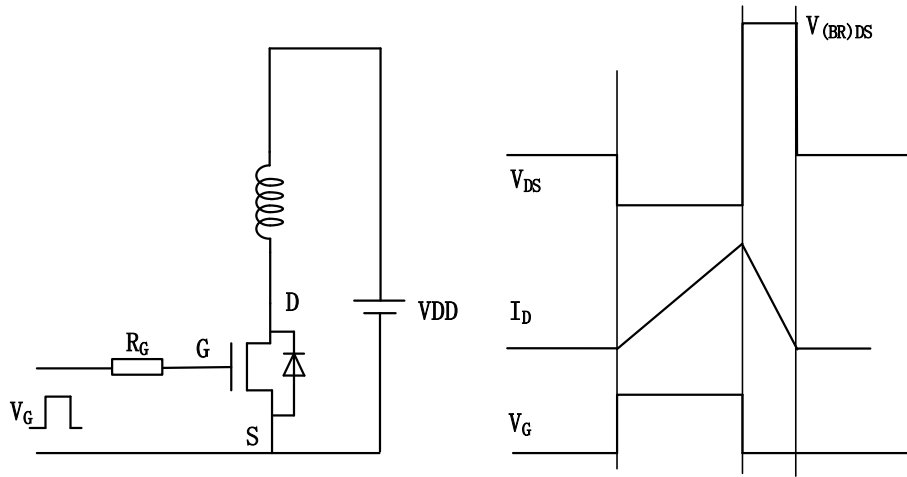


Figure 13 Unclamped Inductive Switching (UIS) Test circuit and waveforms

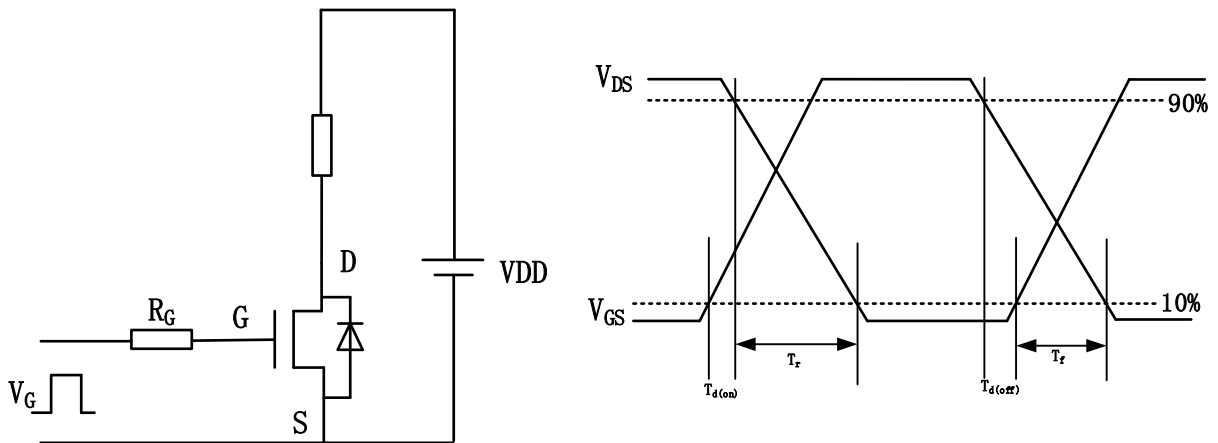


Figure 14 Resistive Switching time Test circuit and waveforms

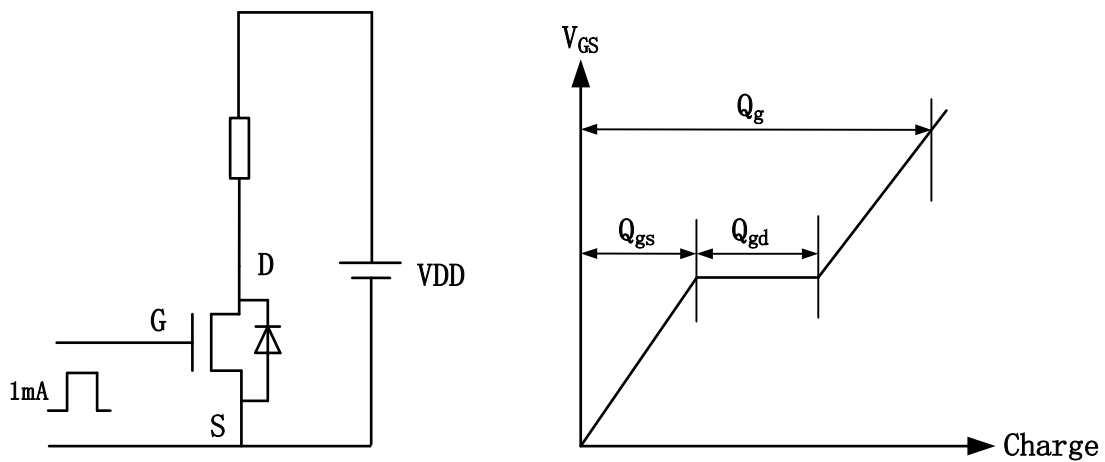
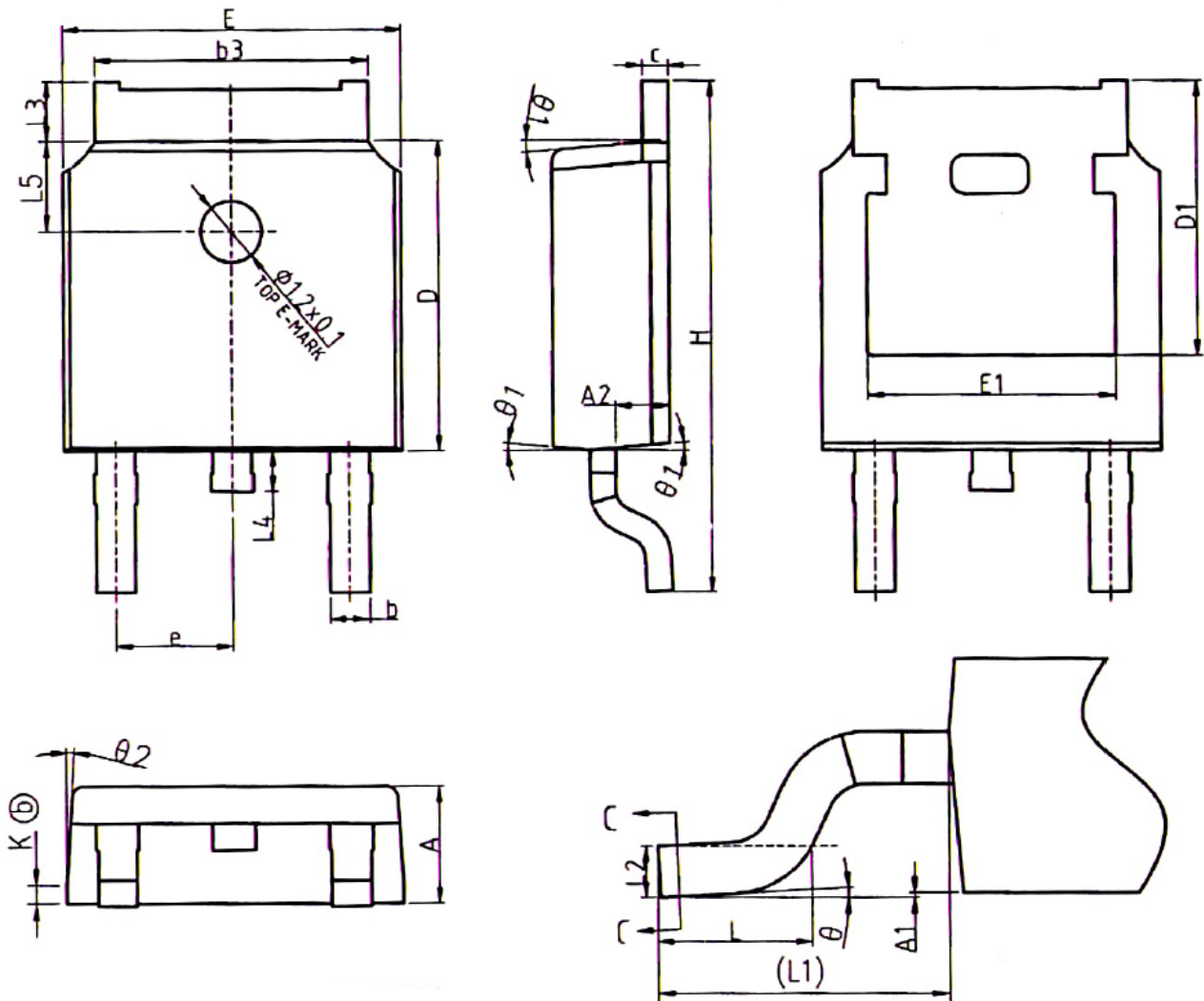


Figure 15 Gate charge Test circuit and waveforms

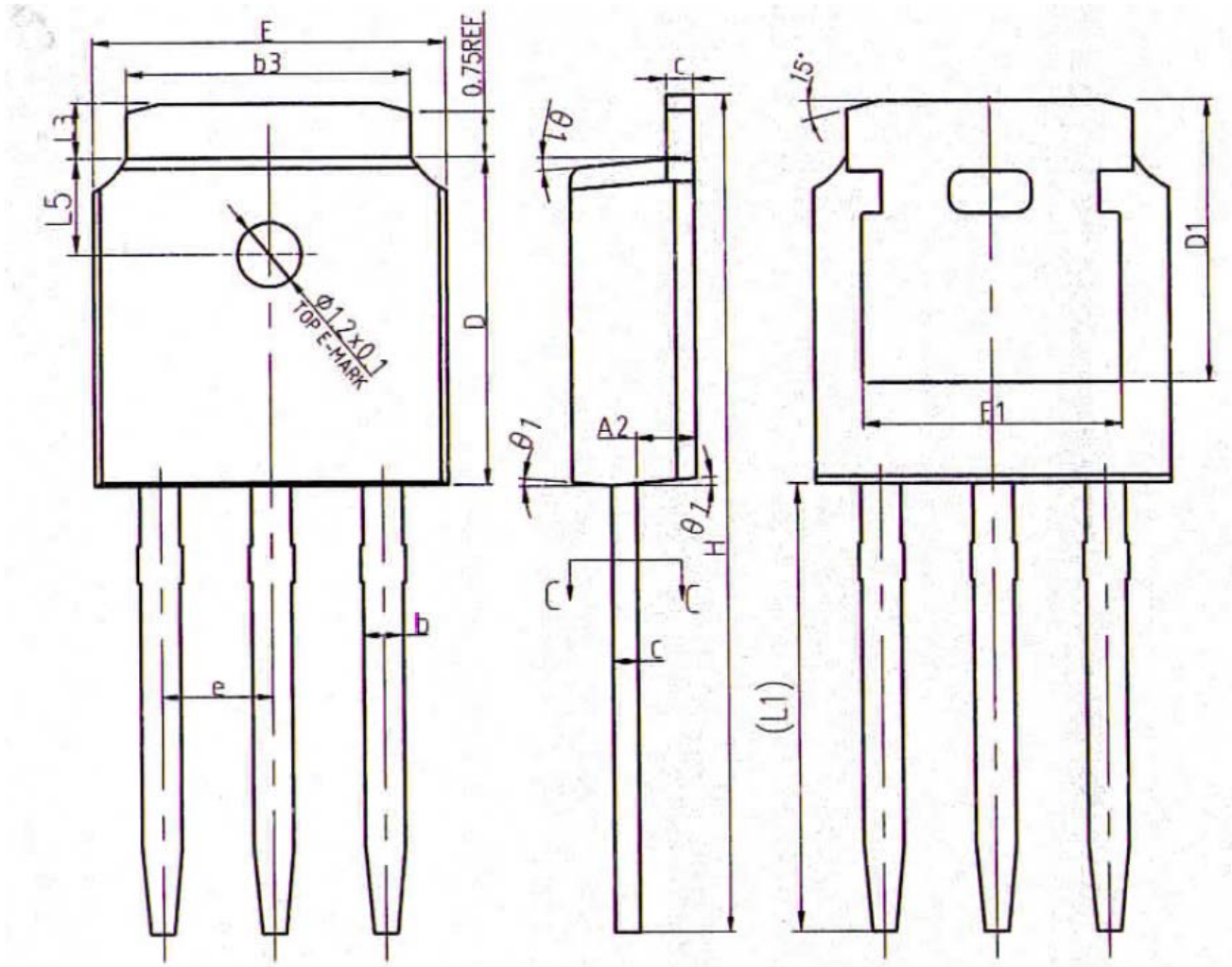


Package Information



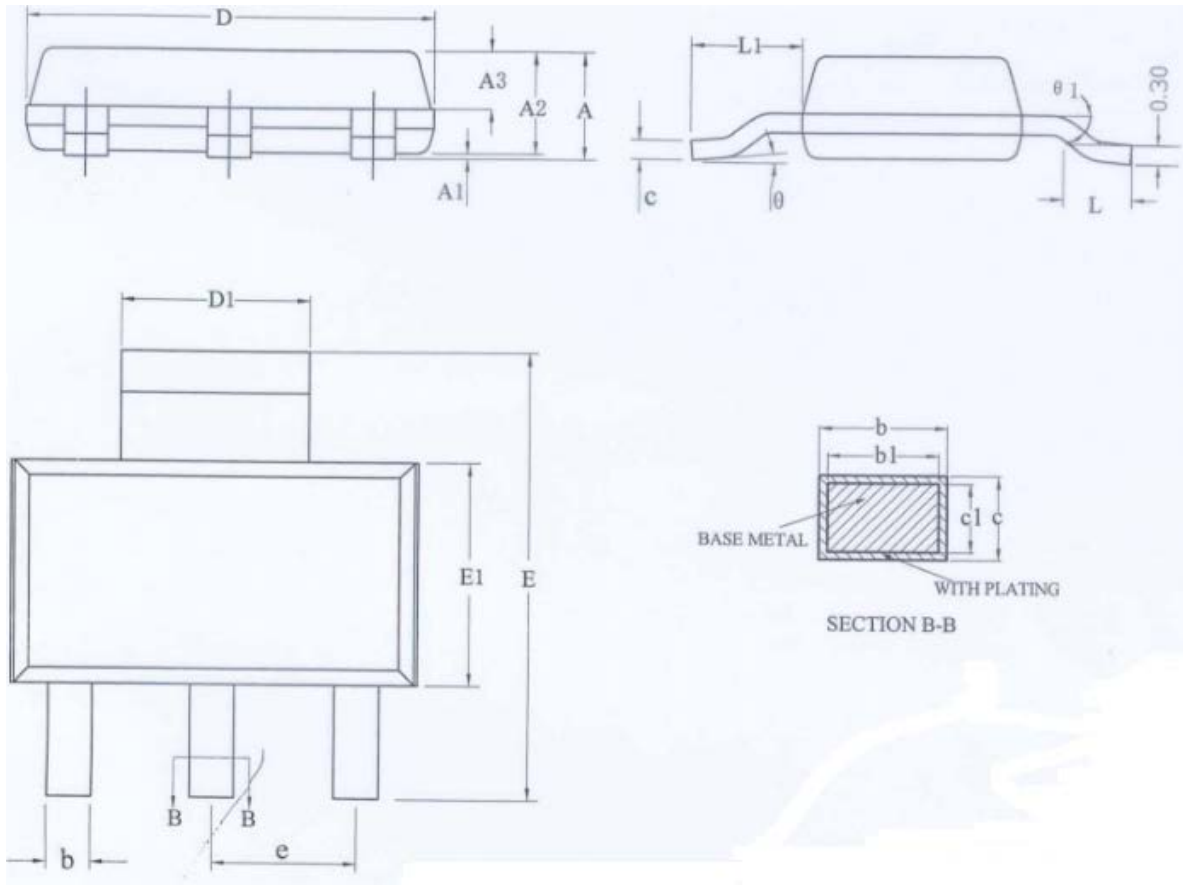
TO-252 Common dimensions							
SYMBOL	Unit: mm			SYMBOL	Unit: mm		
	MIN	NOM	MAX		MIN	NOM	MAX
A	2.20	2.30	2.38	e	2.286BSC		
A1	0.00	-	0.10	H	9.90	10.10	10.30
A2	0.97	1.07	1.17	L	1.40	1.50	1.70
b	0.72	0.78	0.85	L1	2.90REF		
b1	0.71	0.76	0.81	L2	0.51BSC		
b3	5.23	5.33	5.46	L3	0.90		1.25
c	0.47	0.53	0.58	L4	0.60	0.80	1.00
c1	0.46	0.51	0.56	L5	1.70	1.80	1.90
D	6.00	6.10	6.20	theta	0°		8°
D1	5.30REF			theta1	5°	7°	9°
E	6.50	6.60	6.70	theta2	5°	7°	9°
E1	4.70	4.83	4.92	K	0.40REF		





TO-251 Common dimensions

SYMBOL	Unit: mm			SYMBOL	Unit: mm		
	MIN	NOM	MAX		MIN	NOM	MAX
A	2.20	2.30	2.38	e	2.286BSC		
A2	0.97	1.07	1.17	H	16.10	16.40	16.60
b	0.72	0.78	0.85	L1	9.20	9.40	9.60
b1	0.71	0.76	0.81	L3	0.90	1.02	1.25
b3	5.23	5.33	5.46	L5	1.70	1.80	1.90
c	0.47	0.53	0.58	θ1	5°	7°	9°
c1	0.46	0.51	0.56	θ2	5°	7°	9°
D	6.00	6.10	6.20	K	0.40REF		
D1	5.30REF						
E	6.50	6.60	6.70				
E1	4.70	4.83	4.92				



SOT223 Common dimensions							
SYMBOL	Unit: mm			SYMBOL	Unit: mm		
	MIN	NOM	MAX		MIN	NOM	MAX
A	1.50	1.65	1.80	e	2.30BSC		
A1	0.03	0.06	0.09	L1	1.75BSC		
A2	1.45	1.60	1.75	theta	0		7°
A3	0.80	0.90	1.00	theta1	37.5 REF		
b	0.69		0.78				
b1	0.68	0.71	0.74				
c	0.30		0.35				
c1	0.29	0.30	0.31				
D	6.30	6.50	6.70				
D1	3.00REF						
E	6.80	7.00	7.20				
E1	3.40	3.50	3.60				

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