

## 650V N-Channel MOSFET

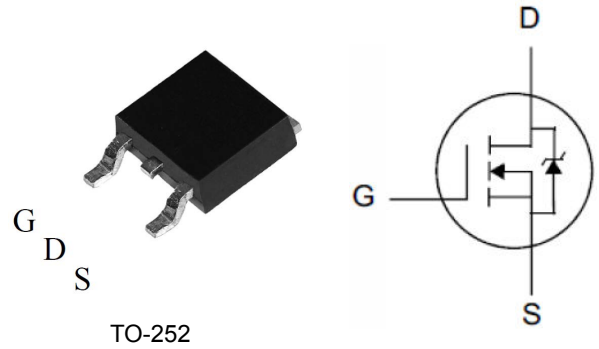
$BV_{DSS}$	$R_{DS(ON),typ.}$	$I_D$
650V	0.85Ω	9A

### General Features

- Proprietary New Planar Technology
- $R_{DS(ON),typ.}=0.85\ \Omega@V_{GS}=10V$
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

### Applications

- Adaptor
- TV Main Power
- SMPS Power Supply
- LCD Panel Power



Package No to Scale

### Absolute Maximum Ratings

$T_C=25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	SK10N65E	Unit
$V_{DSS}$	Drain-to-Source Voltage <sup>[1]</sup>	650	V
$V_{GSS}$	Gate-to-Source Voltage	±30	
$I_D$	Continuous Drain Current	9	A
$I_{D@T_C=100^\circ\text{C}}$	Continuous Drain Current @ $T_C=100^\circ\text{C}$	Figure 3	
$I_{DM}$	Pulsed Drain Current at $V_{GS}=10V$ <sup>[2]</sup>	Figure 6	
$E_{AS}$	Single Pulse Avalanche Energy	450	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ <sup>[3]</sup>	5.0	V/ns
$P_D$	Power Dissipation	120	W
	Derating Factor above $25^\circ\text{C}$	0.96	W/ $^\circ\text{C}$
$T_L$ $T_{PAK}$	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds	300 260	$^\circ\text{C}$
$T_J$ & $T_{STG}$	Operating and Storage Temperature Range	-55 to 150	

Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

### Thermal Characteristics

Symbol	Parameter	SK10N65E	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.04	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	75	

## Electrical Characteristics

### OFF Characteristics $T_J = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	650	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	1	$\mu A$	$V_{DS}=650V, V_{GS}=0V$
		--	--	100		$V_{DS}=520V, V_{GS}=0V,$ $T_J=125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Leakage Current	--	--	+100	$nA$	$V_{GS}=+30V, V_{DS}=0V$
		--	--	-100		$V_{GS}=-30V, V_{DS}=0V$

### ON Characteristics

 $T_J = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance <sup>[4]</sup>	--	0.85	1.3	$\Omega$	$V_{GS}=10V, I_D=4.5A$
$V_{GS(TH)}$	Gate Threshold Voltage	2.0	--	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$
gfs	Forward Transconductance <sup>[4]</sup>	--	10	--	S	$V_{DS}=20V, I_D=9A$

### Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$C_{iss}$	Input Capacitance	--	1600	--	$pF$	$V_{GS}=0V,$ $V_{DS}=25V,$ $f=1.0MHz$
$C_{rSS}$	Reverse Transfer Capacitance	--	14	--		
$C_{oss}$	Output Capacitance	--	120	--		
$Q_g$	Total Gate Charge	--	30	--	$nC$	$V_{DD}=325V,$ $I_D=9A, V_{GS}=0$ to 10V
$Q_{gs}$	Gate-to-Source Charge	--	8.0	--		
$Q_{gd}$	Gate-to-Drain (Miller) Charge	--	10	--		

### Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	12	--	$nS$	$V_{DD}=325V,$ $I_D=9A,$ $V_{GS}=10V$ $R_G=4.7\Omega$
$t_{rise}$	Rise Time	--	15	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	40	--		
$t_{fall}$	Fall Time	--	17	--		

## Source-Drain Body Diode Characteristics

$T_J=25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Unit	Test Conditions
$I_{SD}$	Continuous Source Current <sup>[4]</sup>	--	--	9	A	Integral PN-diode in MOSFET
$I_{SM}$	Pulsed Source Current <sup>[4]</sup>	--	--	36		
$V_{SD}$	Diode Forward Voltage	--	--	1.5	V	$I_S=9\text{A}$ , $V_{GS}=0\text{V}$
$t_{rr}$	Reverse recovery time	--	460	--	ns	$V_{GS}=0\text{V}$ , $I_F=9\text{A}$ , $di_F/dt=100\text{A}/\mu\text{s}$
$Q_{rr}$	Reverse recovery charge	--	1.5	--	uC	

### Note:

[1]  $T_J=+25^\circ\text{C}$  to  $+150^\circ\text{C}$

[2] Repetitive rating; pulse width limited by maximum junction temperature.

[3]  $I_{SD}=9\text{A}$   $di/dt < 100\text{A}/\mu\text{s}$ ,  $V_{DD} < BV_{DSS}$ ,  $T_J=+150^\circ\text{C}$ .

[4] Pulse width  $\leq 380\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

## Typical Characteristics

Figure 1. Maximum Effective Thermal Impedance, Junction-to-Case

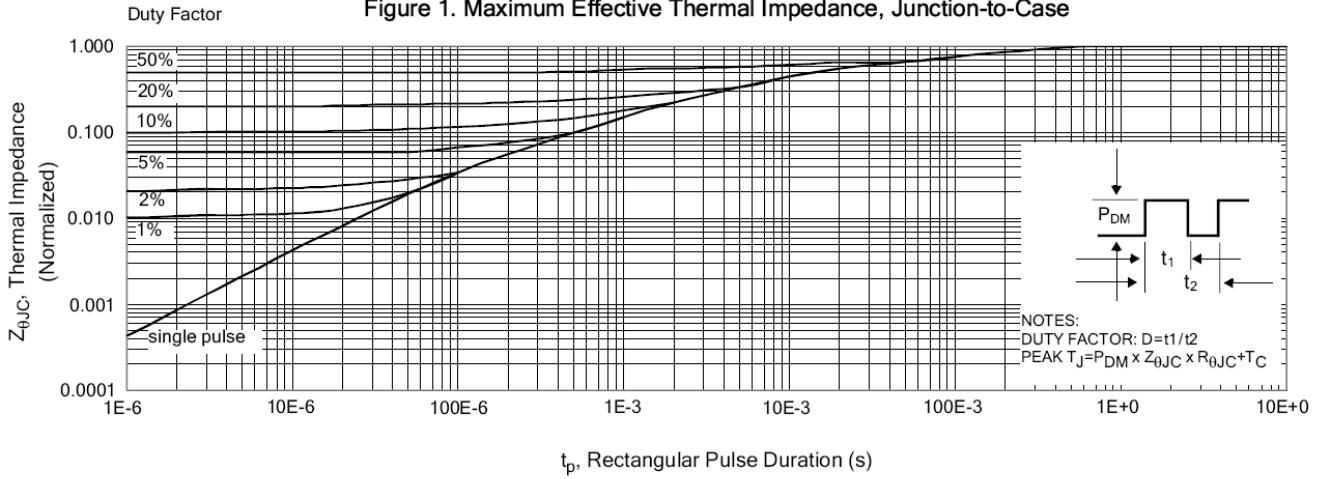


Figure 2. Maximum Power Dissipation vs Case Temperature

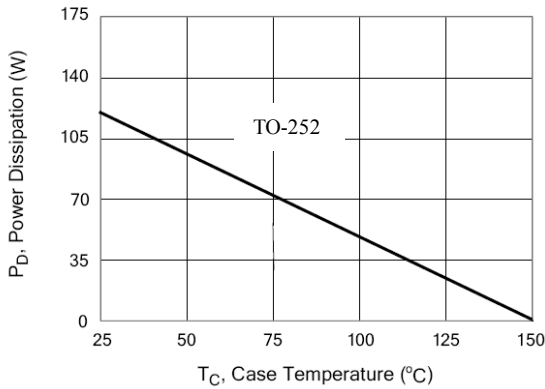


Figure 3. Maximum Continuous Drain Current vs  $T_C$

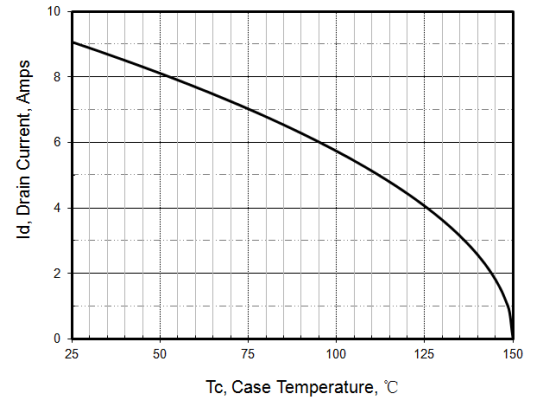


Figure 4. Typical Output Characteristics

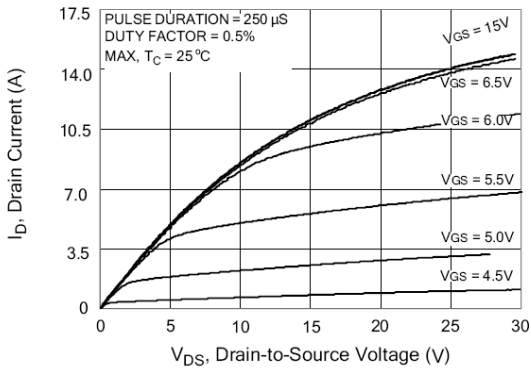
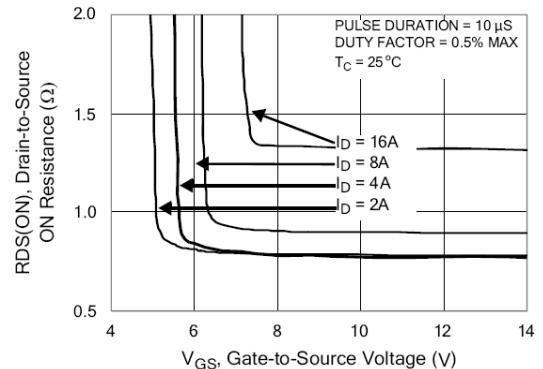
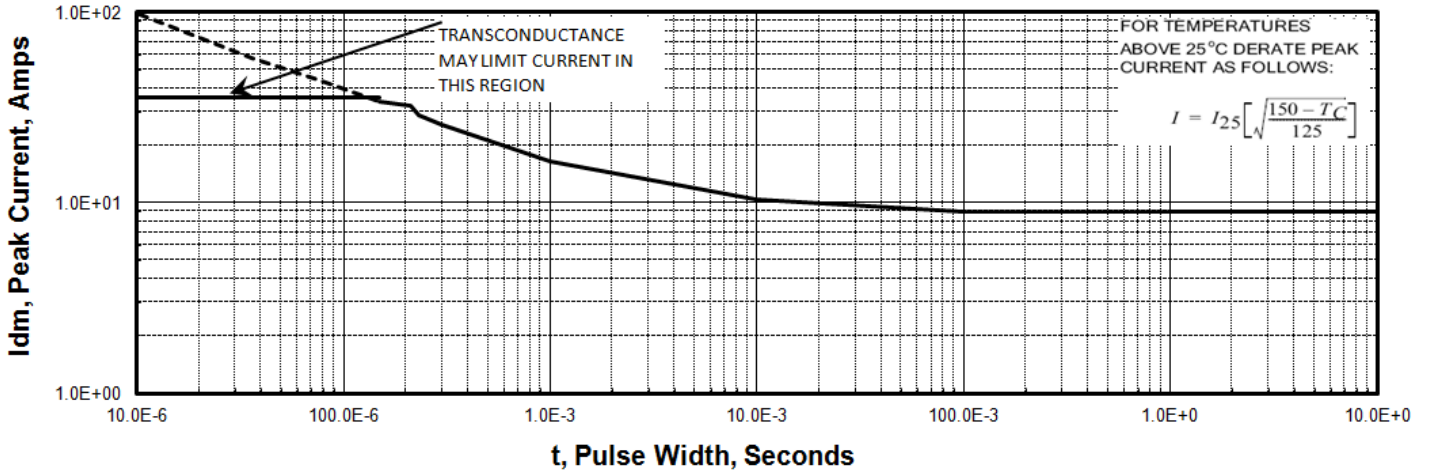


Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current

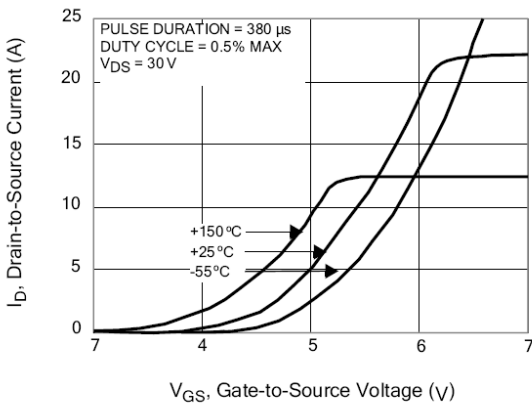


## Typical Characteristics(Cont.)

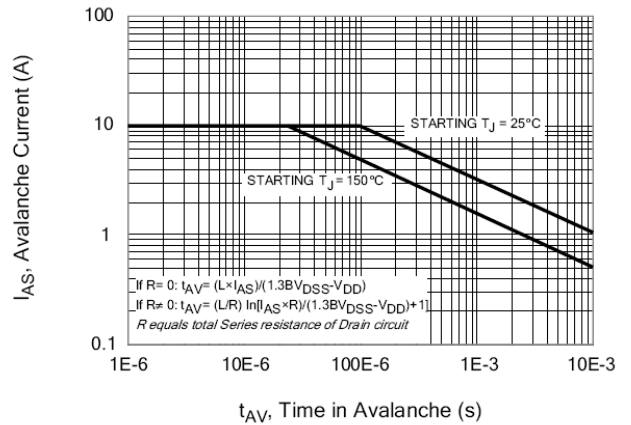
### Figure 6. Peak Current Capability



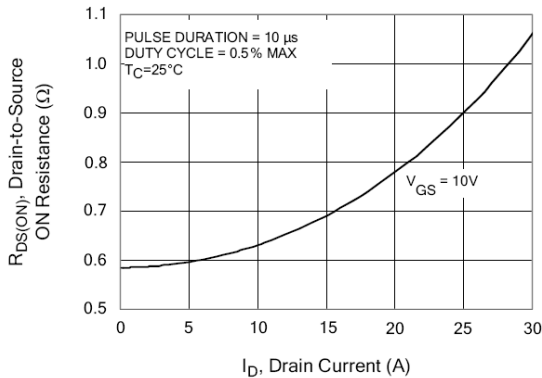
### Figure 7. Typical Transfer Characteristics



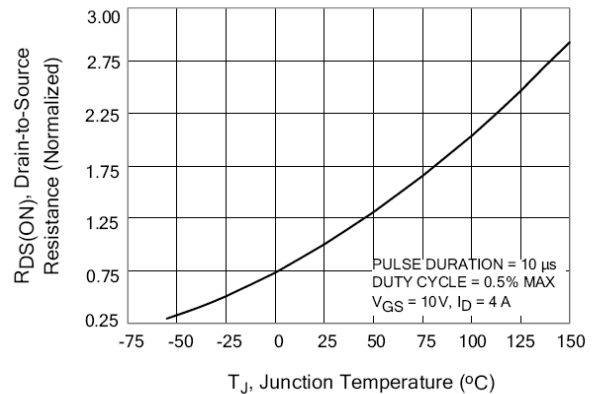
### Figure 8. Unclamped Inductive Switching Capability



### Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current



### Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature



## Typical Characteristics(Cont.)

Figure 11. Typical Breakdown Voltage vs Junction Temperature

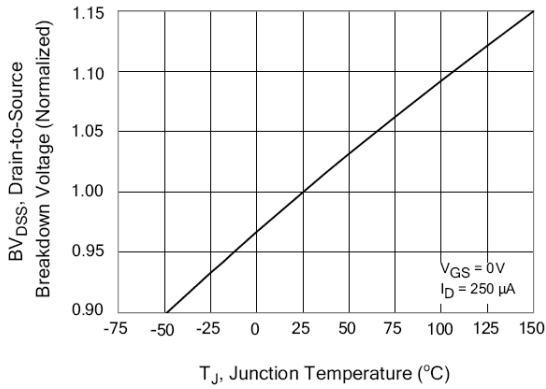


Figure 12. Typical Threshold Voltage vs Junction Temperature

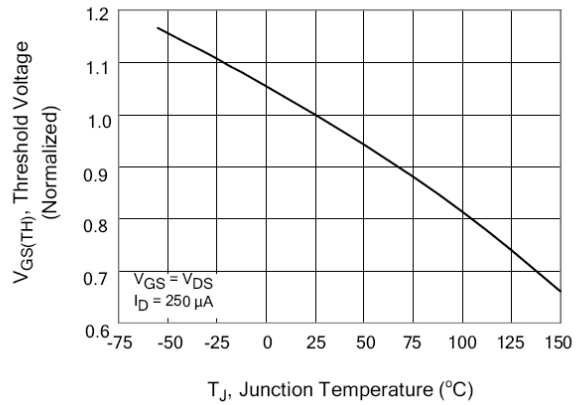


Figure 13. Maximum Safe Operating Area

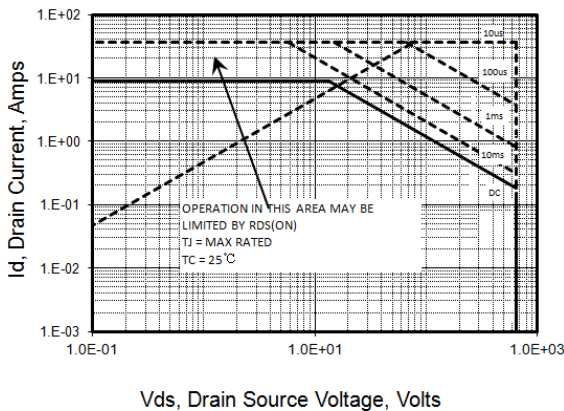


Figure 14. Typical Capacitance vs Drain-to-Source Voltage

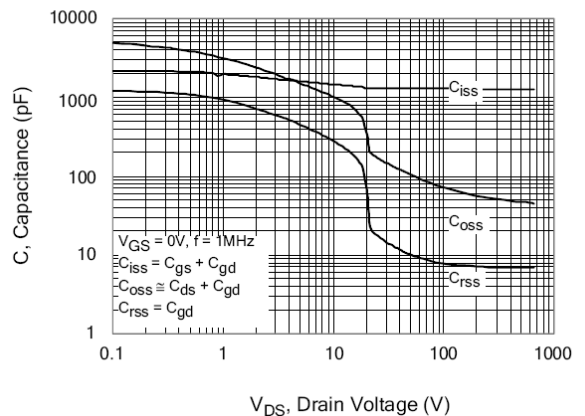


Figure 15. Typical Gate Charge vs Gate-to-Source Voltage

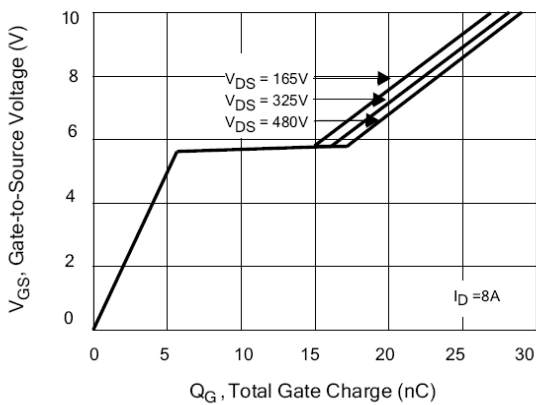
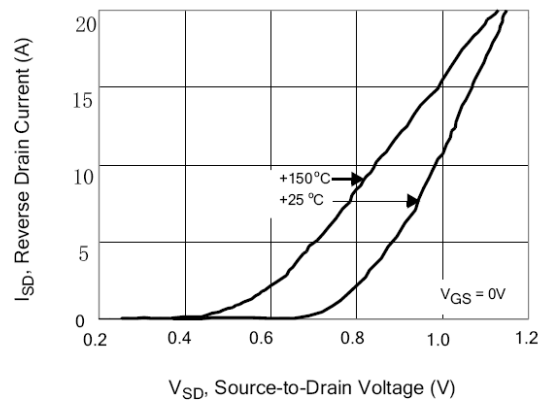


Figure 16. Typical Body Diode Transfer Characteristics



## Test Circuits and Waveforms

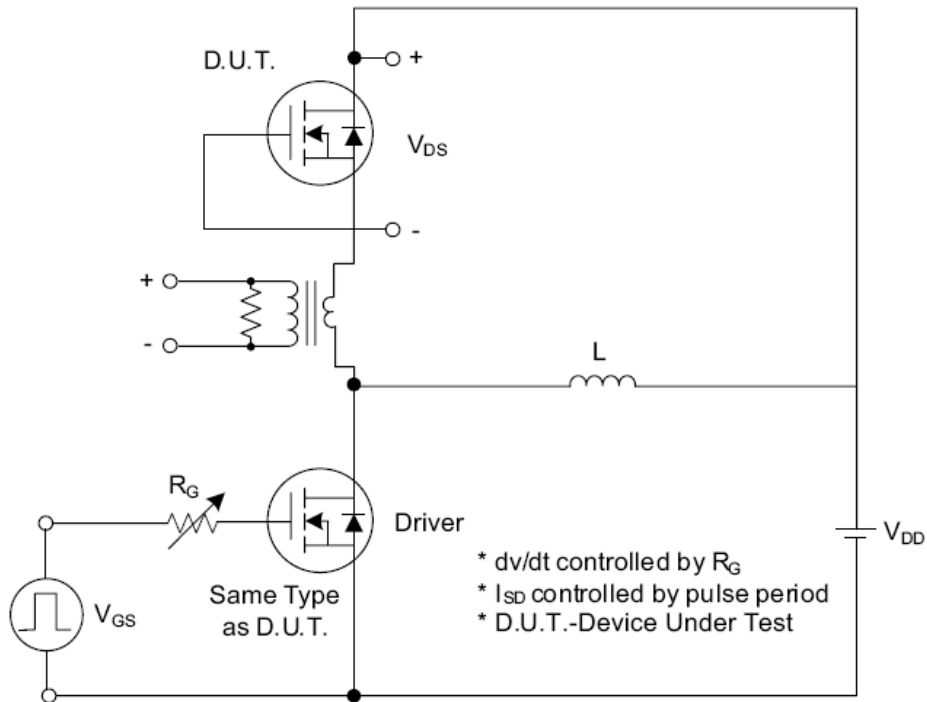


Fig. 1.1 Peak Diode Recovery  $dv/dt$  Test Circuit

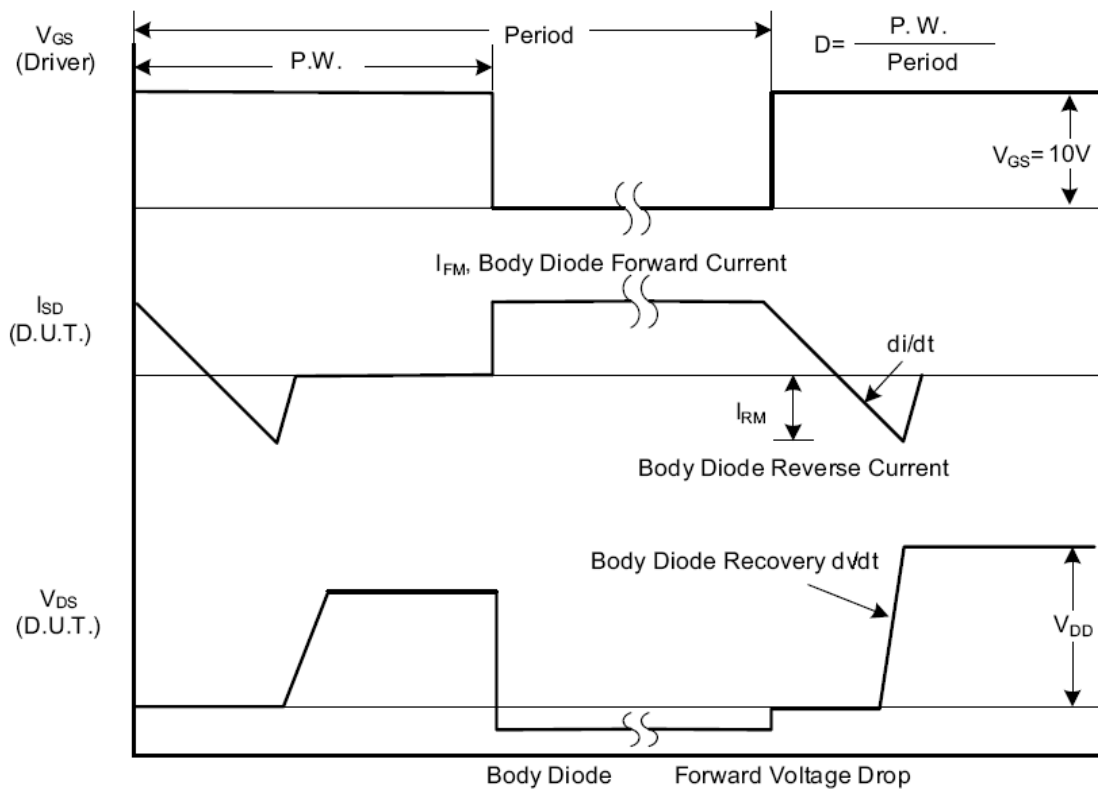


Fig. 1.2 Peak Diode Recovery  $dv/dt$  Waveforms

## Test Circuits and Waveforms (Cont.)

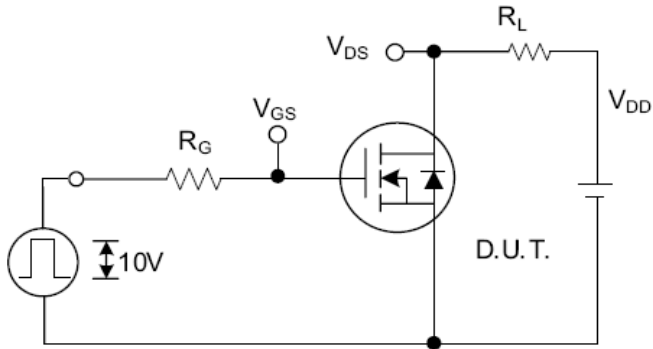


Fig. 2.1 Switching Test Circuit

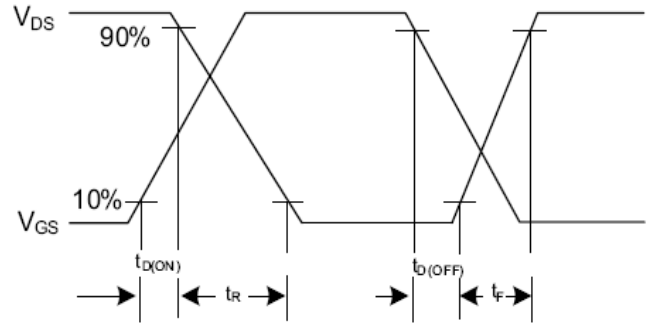


Fig. 2.2 Switching Waveforms

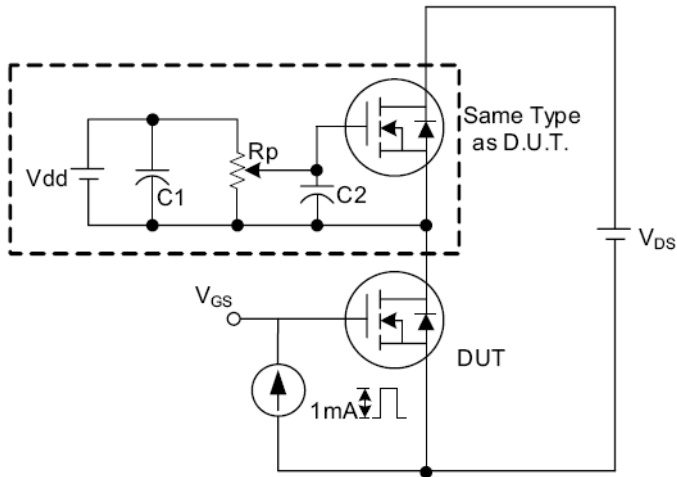


Fig. 3.1 Gate Charge Test Circuit

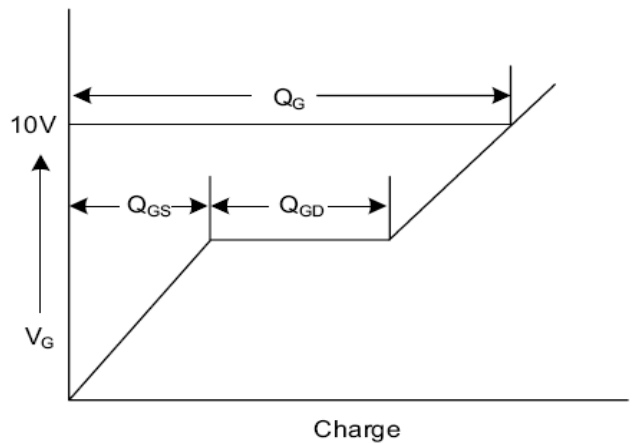


Fig. 3.2 Gate Charge Waveform

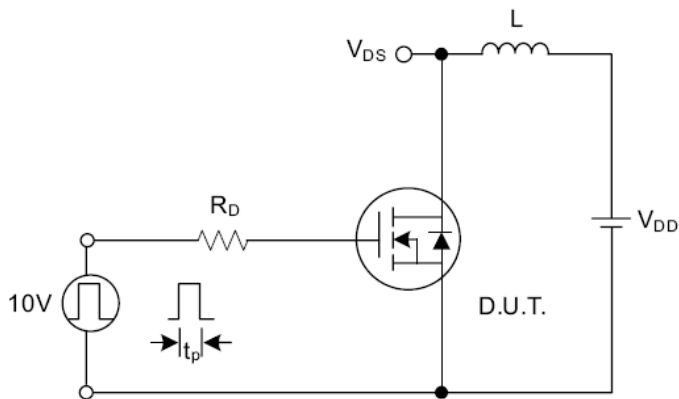


Fig. 4.1 Unclamped Inductive Switching Test Circuit

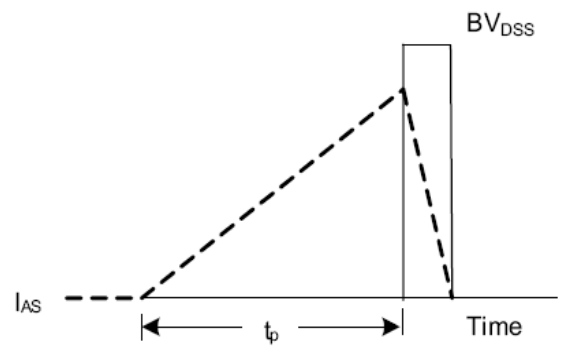
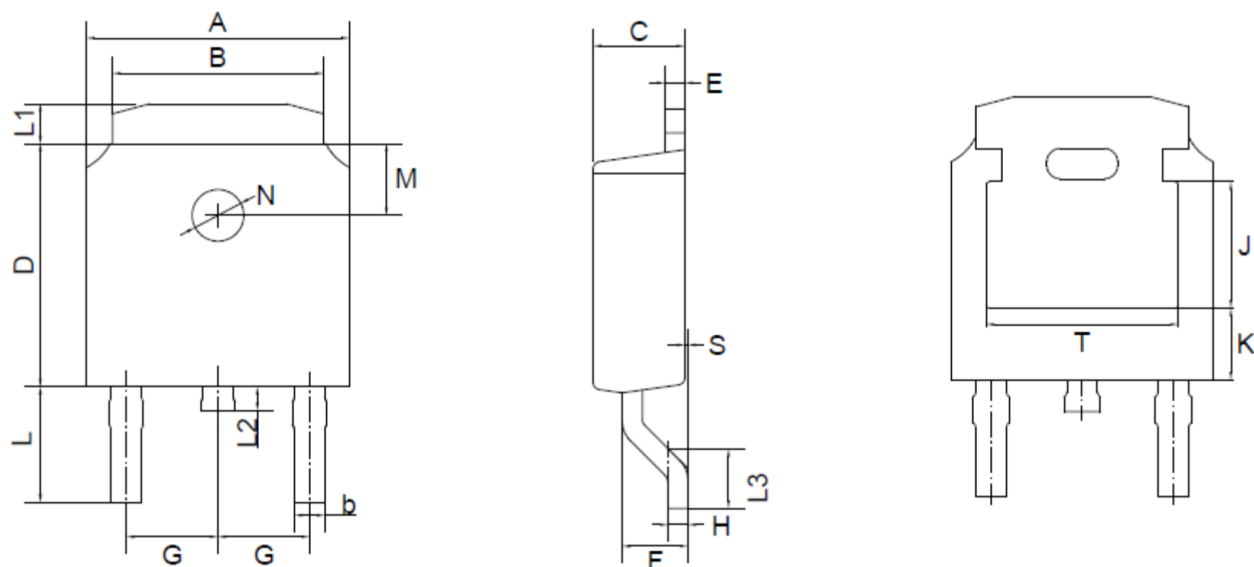


Fig. 4.2 Unclamped Inductive Switching Waveforms



## PACKAGE OUTLINE

TO-252(D-PAK)



TO-252(D-PAK) mechanical data

UNIT	A	B	b	C	D	E	F	G	H	L	L1	L2	L3	S	M	N	J	K	T	
mm	max	6.7	5.5	0.8	2.5	6.3	0.6	1.8	2.29	0.55	3.1	1.2	1.0	1.75	0.1	1.8	1.3	3.16	1.80	4.83
	min	6.3	5.1	0.3	2.1	5.9	0.4	1.3		TYPICAL	0.45	2.7	0.8	0.6	1.40					
mil	max	264	217	31	98	248	24	71	90	22	122	47	39	69	4	71	51	124	71	190
	min	248	201	12	83	232	16	51		TYPICAL	18	106	31	24	55					