

## SWITCHING REGULATOR APPLICATIONS

### Features

- High Voltage :  $BV_{DSS}=650V(\text{Min.})$
- Low  $C_{rss}$  :  $C_{rss}=16pF(\text{Typ.})$
- Low gate charge :  $Qg=35nC(\text{Typ.})$
- Low  $R_{DS(on)}$  :  $R_{DS(on)}=0.85\Omega(\text{Max.})$

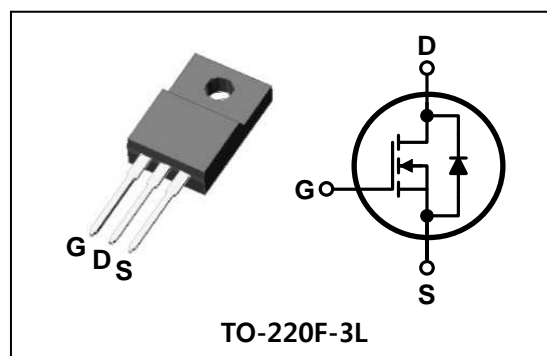
### Ordering Information

Type No.	Marking	Package Code
SMK0965F	SMK0965	TO-220F-3L
SMK0965F (HF)	SMK0965	TO-220F-3L

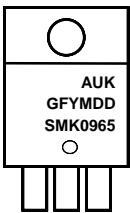
\* SMK0965F : Pb Free Product

\* SMK0965F (HF) : Halogen Free Product

### PIN Connection



### Marking Diagram

	Column 1 : Manufacturer
	Column 2 : Production Information e.g.) GFYMDD
	- . G : Option Code (H : Halogen Free) - . F : Factory Management Code - . YMDD : Date Code (Year, Month, Date)
	Column 3 : Device Code

### Absolute maximum ratings ( $T_C=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Rating	Unit	
Drain-source voltage	$V_{DSS}$	650	V	
Gate-source voltage	$V_{GSS}$	$\pm 30$	V	
Drain current (DC) *	$I_D$	$T_C=25^\circ\text{C}$	9	A
		$T_C=100^\circ\text{C}$	5.5	A
Drain current (Pulsed) *	$I_{DM}$	36	A	
Power dissipation	$P_D$	40	W	
Avalanche current (Single) ②	$I_{AS}$	9	A	
Single pulsed avalanche energy ②	$E_{AS}$	250	mJ	
Avalanche current (Repetitive) ①	$I_{AR}$	9	A	
Repetitive avalanche energy ①	$E_{AR}$	11.6	mJ	
Junction temperature	$T_J$	150	$^\circ\text{C}$	
Storage temperature range	$T_{stg}$	-55~150		

\* Limited by maximum junction temperature

Characteristic	Symbol	Typ.	Max.	Unit	
Thermal resistance	Junction-case	$R_{th(J-C)}$	-	3.1	$^\circ\text{C/W}$
	Junction-ambient	$R_{th(J-A)}$	-	62.5	

## Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
Drain-source breakdown voltage	BV <sub>DSS</sub>	I <sub>D</sub> =250μA, V <sub>GS</sub> =0V	650	-	-	V	
Gate threshold voltage	V <sub>GS(th)</sub>	I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>	2.0	-	4.0	V	
Drain-source cut-off current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V	-	-	1	μA	
Gate leakage current	I <sub>GSS</sub>	V <sub>DS</sub> =0V, V <sub>GS</sub> =±30V	-	-	±100	nA	
Drain-source on-resistance ④	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =4.5A	-	0.72	0.85	Ω	
Forward transfer conductance ④	g <sub>fs</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =4.5A	-	11	-	S	
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V f=1 MHz	-	2040	2550	pF	
Output capacitance	C <sub>oss</sub>		-	153	192		
Reverse transfer capacitance	C <sub>rss</sub>		-	16	20		
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> =300V, I <sub>D</sub> =9A R <sub>G</sub> =25Ω	-	23	-	ns	
Rise time	t <sub>r</sub>		-	69	-		
Turn-off delay time	t <sub>d(off)</sub>		③④	-	144		-
Fall time	t <sub>f</sub>		-	77	-		
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> =520V, V <sub>GS</sub> =10V I <sub>D</sub> =9A	-	35	57	nC	
Gate-source charge	Q <sub>gs</sub>		③④	-	10		-
Gate-drain charge	Q <sub>gd</sub>		-	9	-		

## Source-Drain Diode Ratings and Characteristics (T<sub>C</sub>=25°C unless otherwise noted)

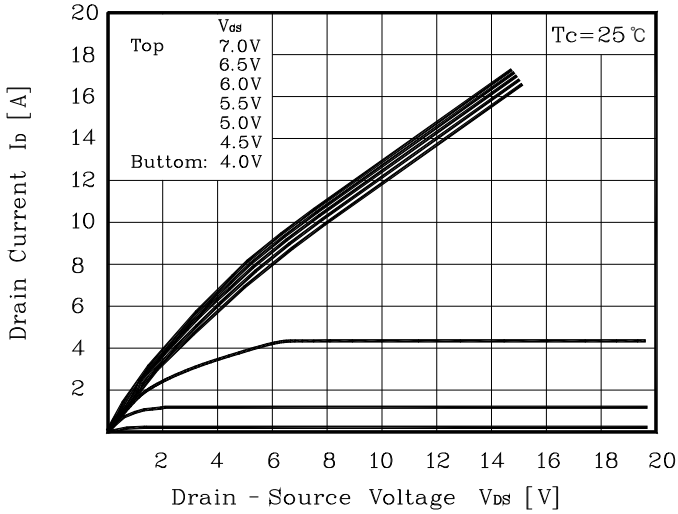
Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Source current (DC)	I <sub>S</sub>	Integral reverse diode in the MOSFET	-	-	9	A
Source current (Pulsed) ①	I <sub>SM</sub>		-	-	36	
Forward voltage ④	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =9A	-	-	1.4	V
Reverse recovery time	t <sub>rr</sub>	I <sub>S</sub> =9A, V <sub>GS</sub> =0V dI <sub>F</sub> /dt=100A/μs	-	420	-	ns
Reverse recovery charge	Q <sub>rr</sub>		-	4.2	-	μC

Note ;

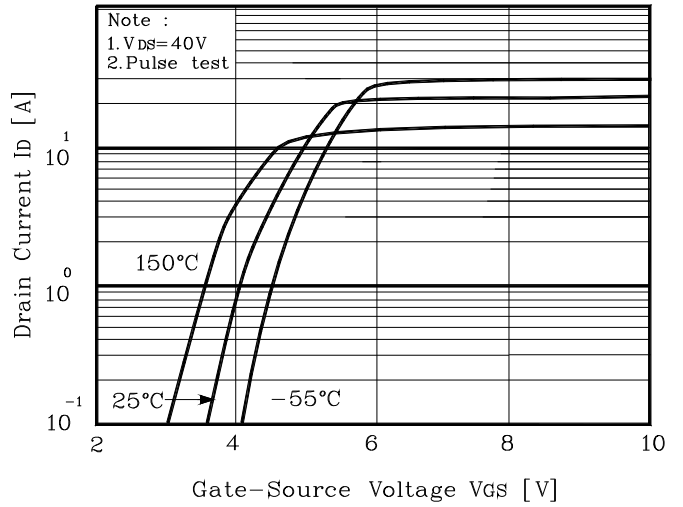
- ① Repetitive rating : Pulse width limited by maximum junction temperature
- ② L=5.7mH, I<sub>AS</sub>=9A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C
- ③ Pulse Test : Pulse width≤300μs, Duty cycle≤2%
- ④ Essentially independent of operating temperature

## Electrical Characteristic Curves

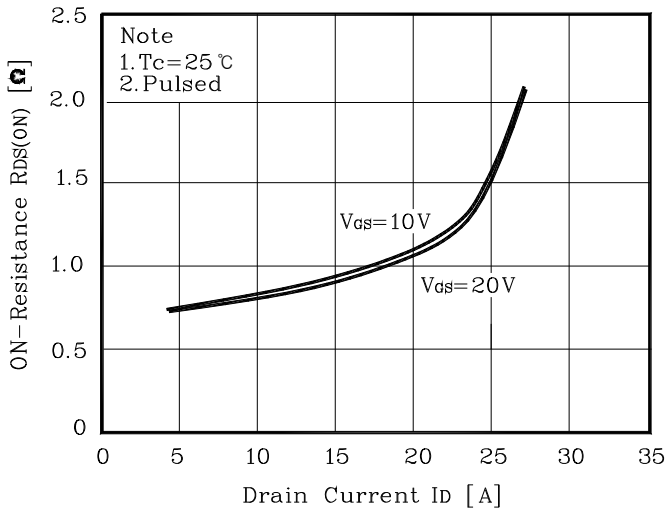
**Fig. 1  $I_D - V_{DS}$**



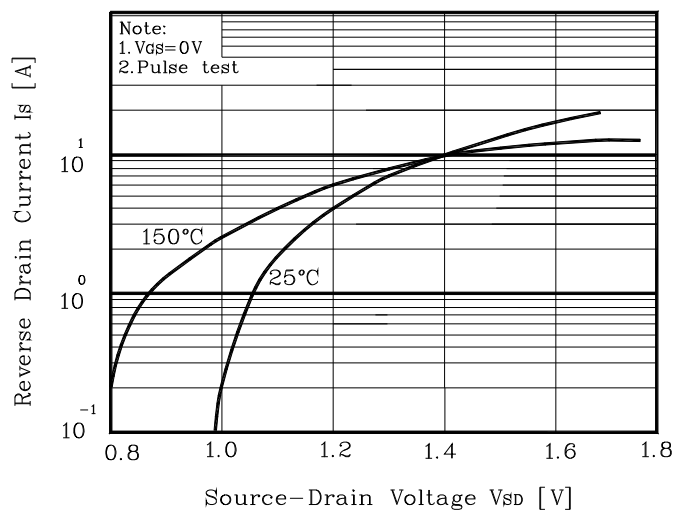
**Fig. 2  $I_D - V_{GS}$**



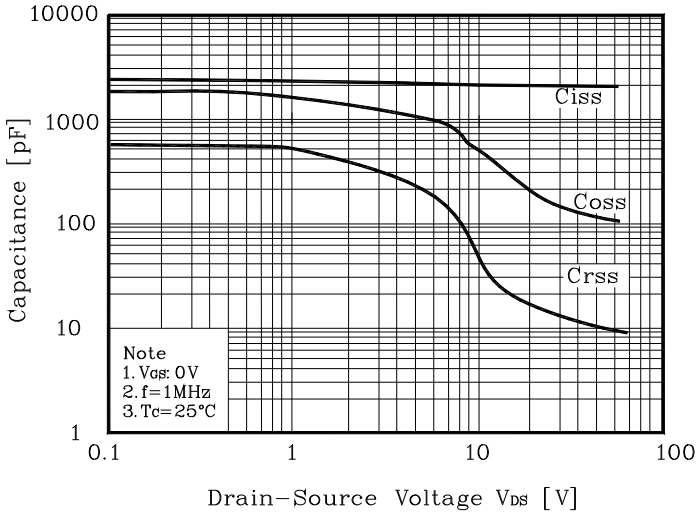
**Fig. 3  $R_{DS(on)} - I_D$**



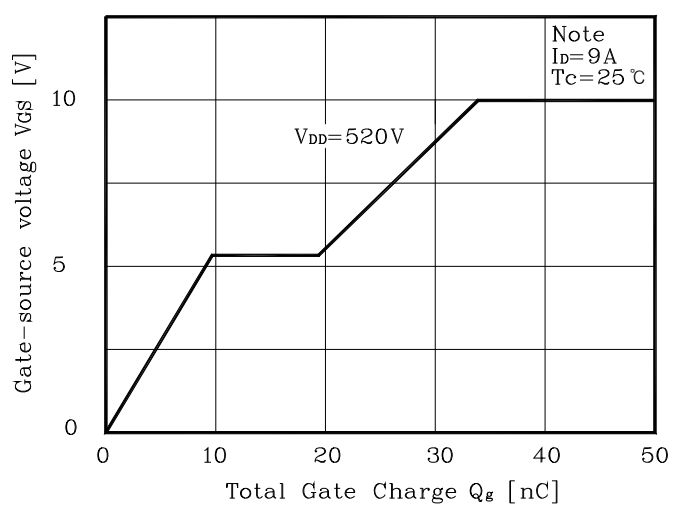
**Fig. 4  $I_S - V_{SD}$**



**Fig. 5 Capacitance -  $V_{DS}$**

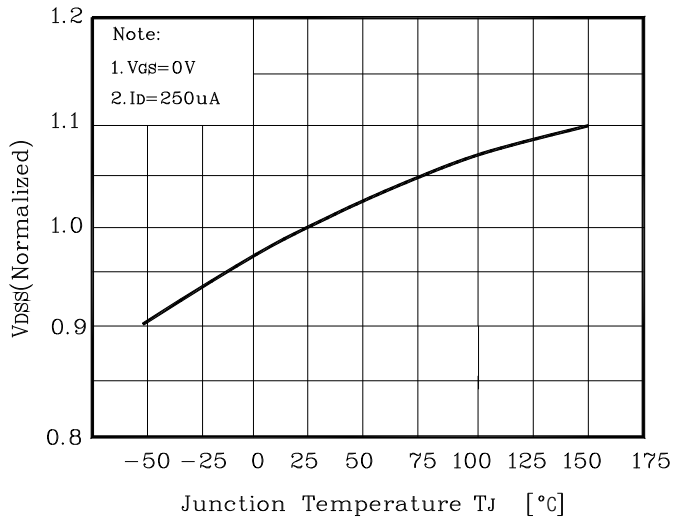


**Fig. 6  $V_{GS} - Q_G$**

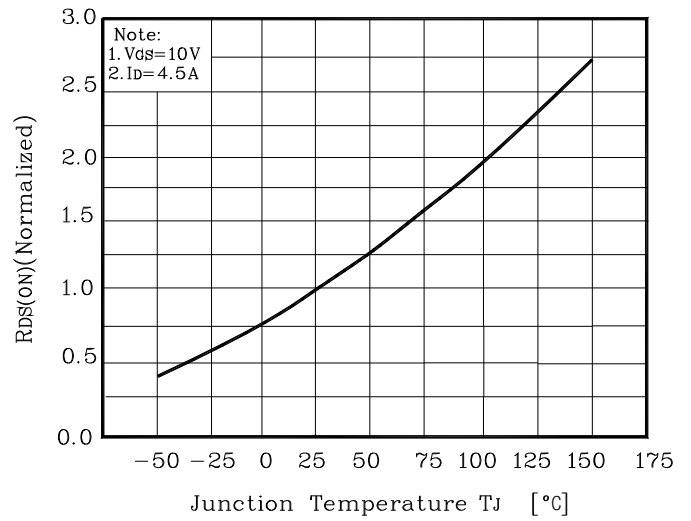


## Electrical Characteristic Curves

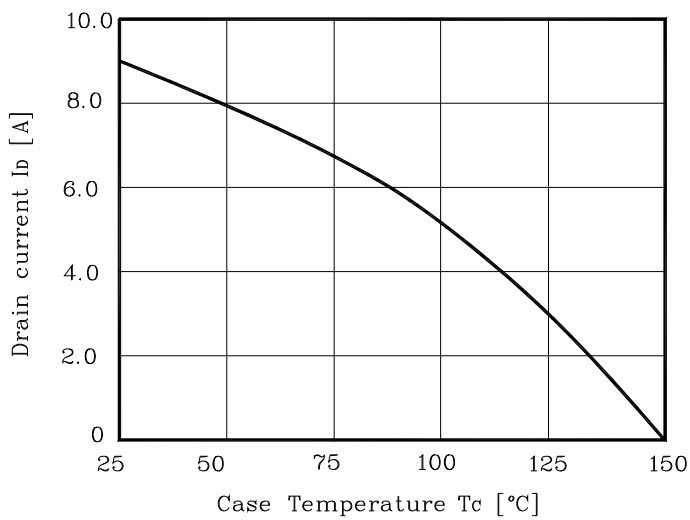
**Fig. 7  $V_{DS}$  -  $T_J$**



**Fig.8  $R_{DS(on)}$  -  $T_J$**



**Fig. 9  $I_D$  -  $T_C$**



**Fig. 10 Safe Operating Area**

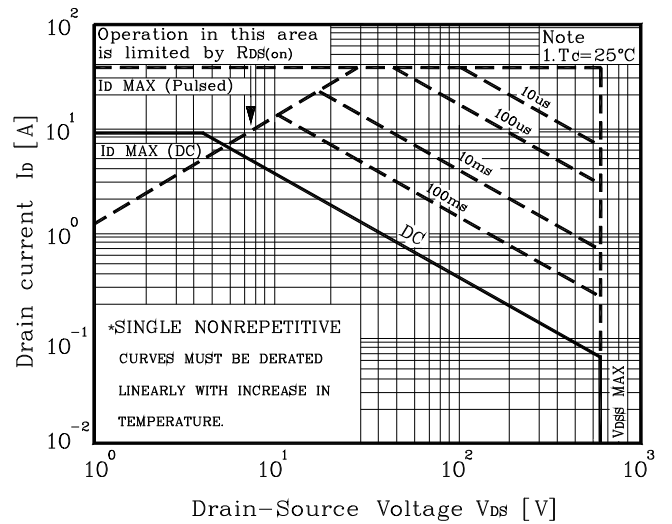


Fig. 11 Gate Charge Test Circuit & Waveform

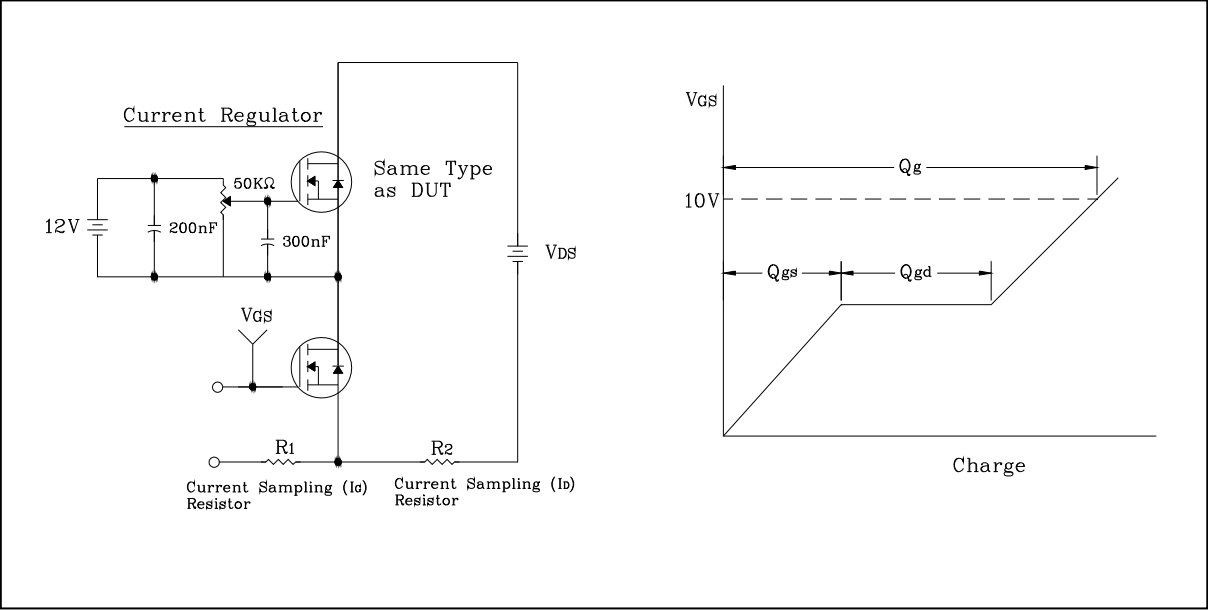


Fig. 12 Resistive Switching Test Circuit & Waveform

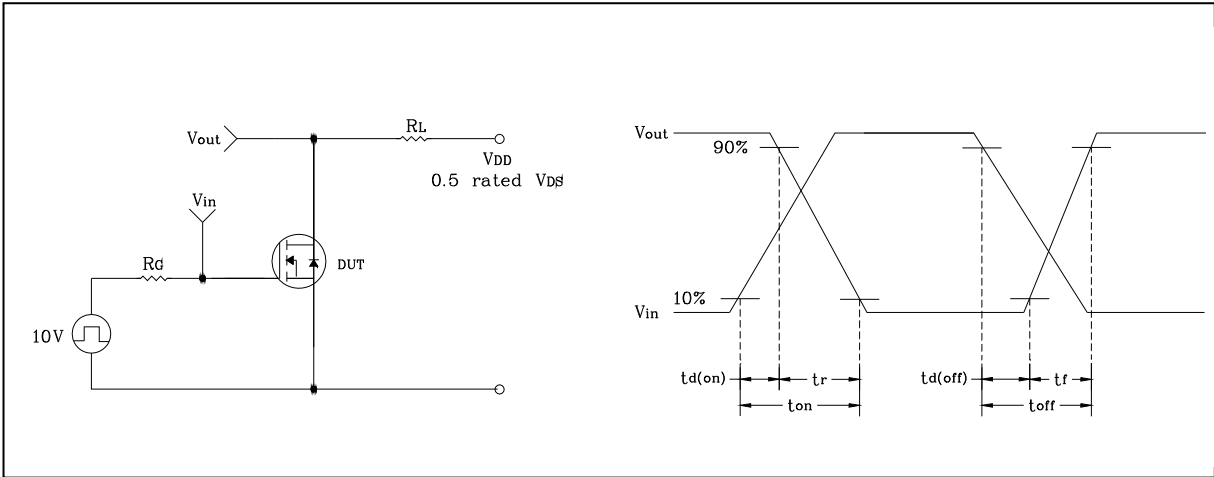


Fig. 13  $E_{AS}$  Test Circuit & Waveform

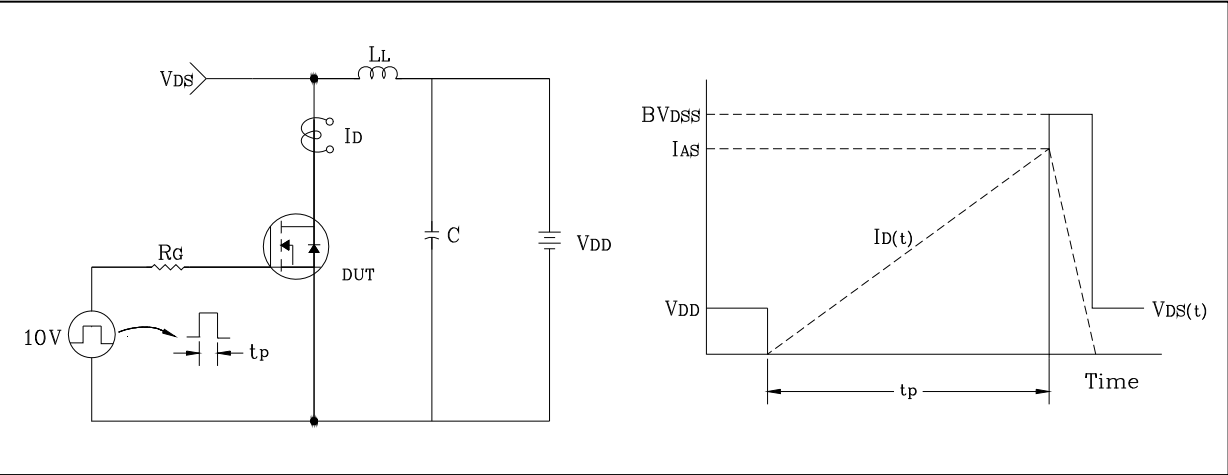
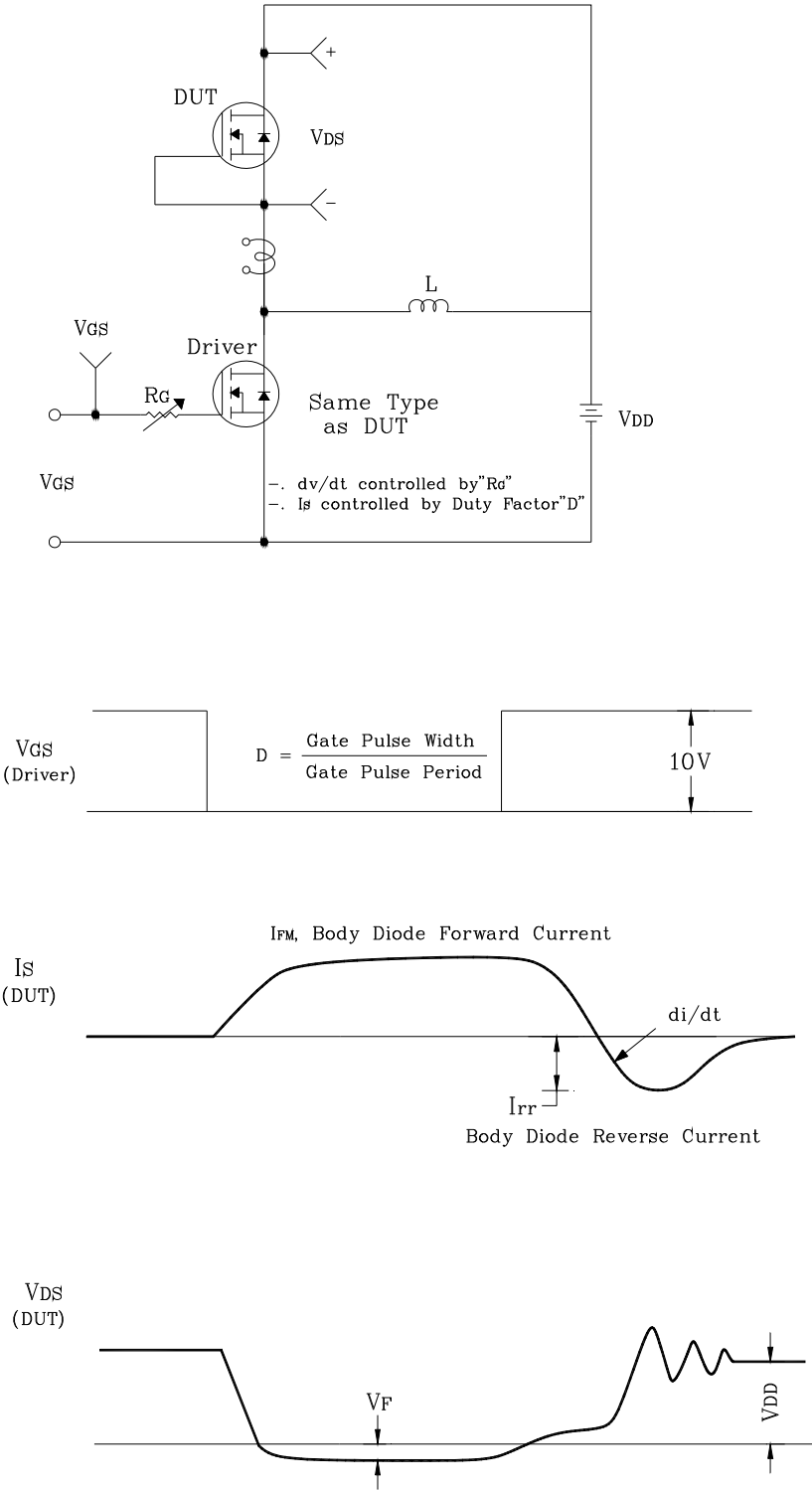
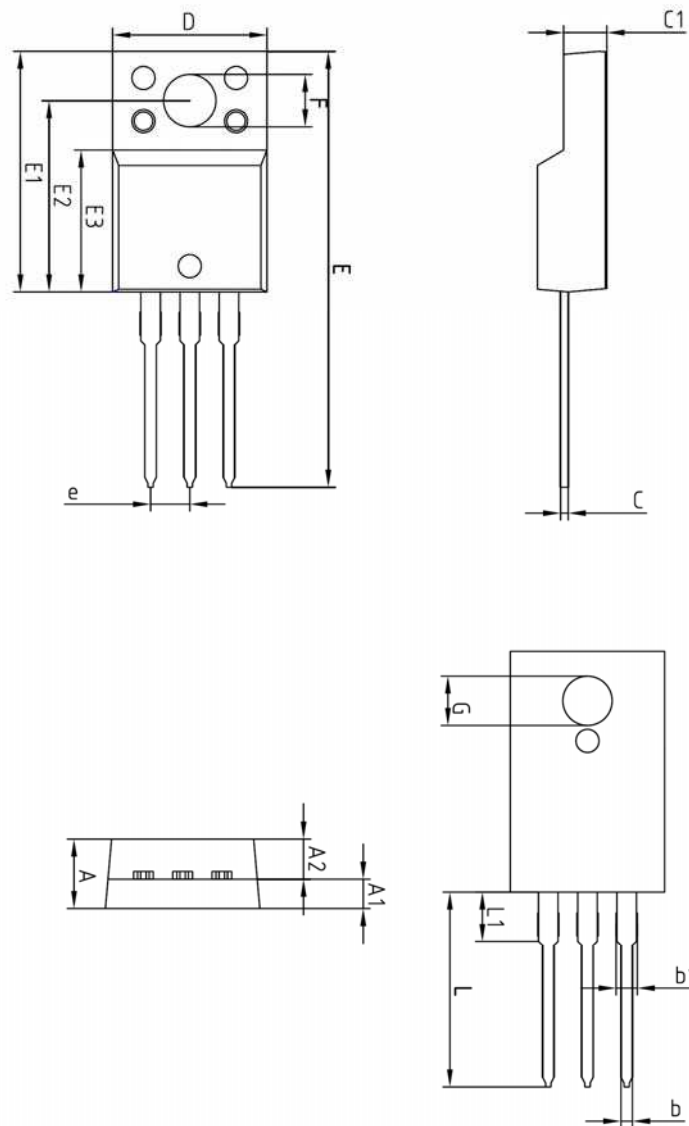


Fig. 14 Diode Reverse Recovery Time Test Circuit & Waveform



## Outline Dimension

unit: mm



SYMBOL	MILLIMETERS			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A	-	-	4.60	
A1	2.45	2.50	2.55	
A2	1.95	2.00	2.05	
b	0.65	0.75	0.85	
b1	1.07	1.27	1.47	
C	0.40	0.50	0.60	
C1	2.70	2.80	2.90	
D	9.90	10.00	10.10	
E	28.00	-	28.60	
E1	15.50	15.60	15.70	
E2	12.30	12.40	12.50	
E3	9.15	9.20	9.25	
F	3.30	3.40	3.50	
G	3.10	3.20	3.30	
e	2.54 BSC			
L	12.40	-	13.00	
L1	3.46 BSC			

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