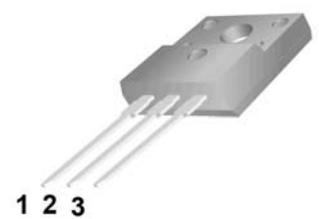
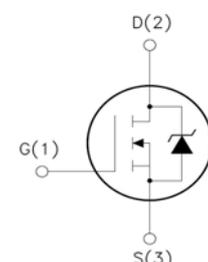


<p><b>TK12N65SE</b></p> <p><b>Features:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Low Intrinsic Capacitances</li> <li><input type="checkbox"/> Excellent Switching Characteristics</li> <li><input type="checkbox"/> Extended Safe Operating Area</li> <li><input type="checkbox"/> Unrivalled Gate Charge :Qg= 44nC (Typ.)</li> <li><input type="checkbox"/> BVDSS=650V, ID=12A</li> <li><input type="checkbox"/> <math>R_{DS(on)}</math> :0.68 <math>\Omega</math> (Max) @VG=10V</li> <li><input type="checkbox"/> 100% Avalanche Tested</li> </ul>	<p style="text-align: center;"><b>TO-220F</b></p> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: right; margin-top: 10px;"> <p>1.Gate (G)</p> <p>2.Drain (D)</p> <p>3.Source (S)</p> </div>
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**Absolute Maximum Ratings** (Ta=25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	650	V
$I_D$	Drain Current	$T_j=25^\circ\text{C}$	12
		$T_j=100^\circ\text{C}$	7.9
$V_{GS(TH)}$	Gate Threshold Voltage	$\pm 30$	V
$E_{AS}$	Single Pulse Avalanche Energy (note1)	660	mJ
$I_{AR}$	Avalanche Current (note2)	12	A
$P_D$	Power Dissipation ( $T_j=25^\circ\text{C}$ )	44	W
$T_j$	Junction Temperature(Max)	150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature	-55~+150	$^\circ\text{C}$
TL	Maximum lead temperature for soldering purpose, 1/8 $\mu\text{S}$ from case for 5 seconds	300	$^\circ\text{C}$

**Thermal Characteristics**

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	2.8	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	62.5	$^\circ\text{C}/\text{W}$

**Electrical Characteristics** (Ta=25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =250μA , V <sub>GS</sub> =0	650	-	-	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> =250μA , Reference to 25°C	-	0.71	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V	-	-	10	μA
		V <sub>DS</sub> =520V, T <sub>j</sub> =125°C	-	-	100	
I <sub>GSSF</sub>	Gate-body leakage Current, Forward	V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V	-	-	100	nA
I <sub>GSSR</sub>	Gate-body leakage Current, Reverse	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V	-	-	-100	
<b>On Characteristics</b>						
V <sub>GS(TH)</sub>	Gate Threshold Voltage	I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>	2	-	4	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	I <sub>D</sub> =6.0A, V <sub>GS</sub> =10V	-	-	0.68	Ω
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =25V , V <sub>GS</sub> =0 , f=1.0MHz	-	1890	-	pF
C <sub>oss</sub>	Output Capacitance		-	150	-	
C <sub>rss</sub>	Reverse Transfer Capacitance		-	18	-	
<b>Switching Characteristics</b>						
T <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> =300V , I <sub>D</sub> =12A R <sub>G</sub> =25Ω (Note 3,4)	-	30	70	ns
T <sub>r</sub>	Turn-On Rise Time		-	80	165	
T <sub>d(off)</sub>	Turn-Off Delay Time		-	144	300	
T <sub>f</sub>	Turn-Off Rise Time		-	77	165	
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =520V, V <sub>GS</sub> =10V , I <sub>D</sub> =12A (Note 3,4)	-	44	47	nC
Q <sub>gs</sub>	Gate-Source Charge		-	6.7	-	
Q <sub>gd</sub>	Gate-Drain Charge		-	18.5	-	
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Max. Diode Forward Current	-	-	-	12	A
I <sub>SM</sub>	Max. Pulsed Forward Current	-	-	-	48	
V <sub>SD</sub>	Diode Forward Voltage	I <sub>D</sub> =12A	-	-	1.4	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>S</sub> =12A, V <sub>GS</sub> =0V diF/dt=100A/μs (Note3)	-	380	-	nS
Q <sub>rr</sub>	Reverse Recovery Charge		-	3.5	-	μC

- Notes : 1, L=0.5mH, I<sub>AS</sub>=12A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub> =25°C  
 2, Repetitive Rating : Pulse width limited by maximum junction temperature  
 3, Pulse Test : Pulse Width ≤ 300μs, Duty Cycle ≤ 2%  
 4, Essentially Independent of Operating Temperature

### Typical Characteristics

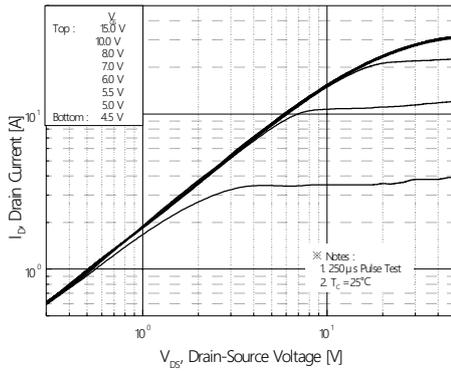


Figure 1. On-Region Characteristics

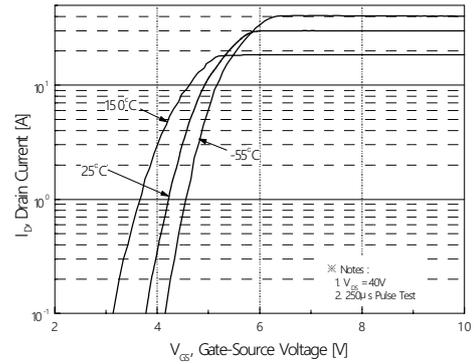


Figure 2. Transfer Characteristics

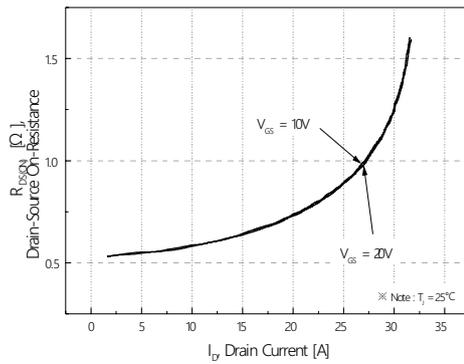


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

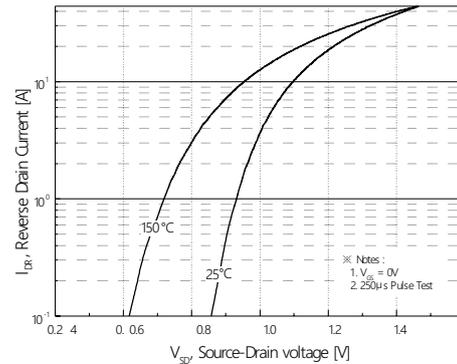


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

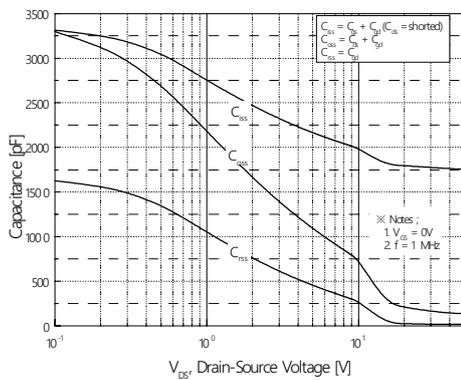


Figure 5. Capacitance Characteristics

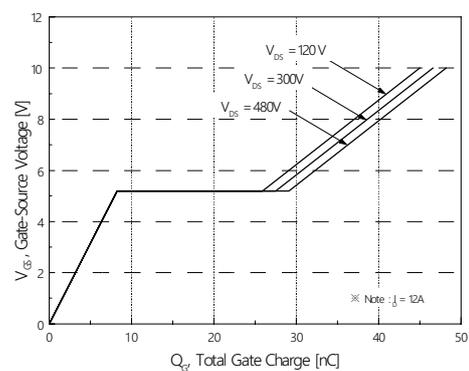


Figure 6. Gate Charge Characteristics

### Typical Characteristics (Continued)

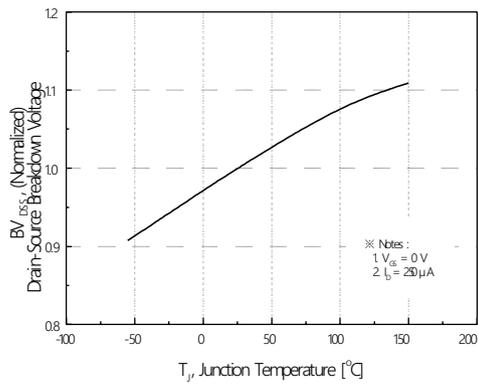


Figure 7. Breakdown Voltage Variation vs Temperature

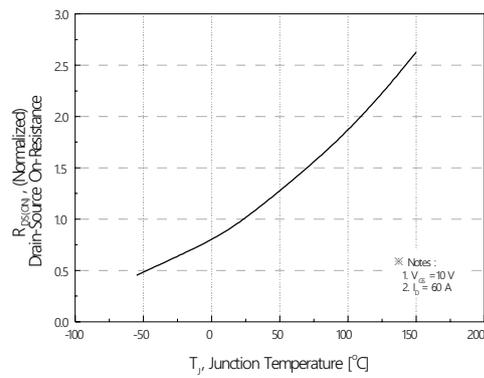


Figure 8. On-Resistance Variation vs Temperature

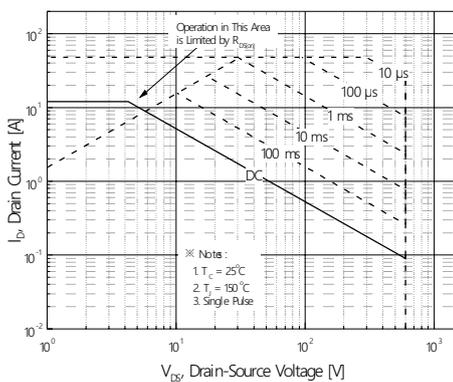


Figure 9-2. Maximum Safe Operating Area

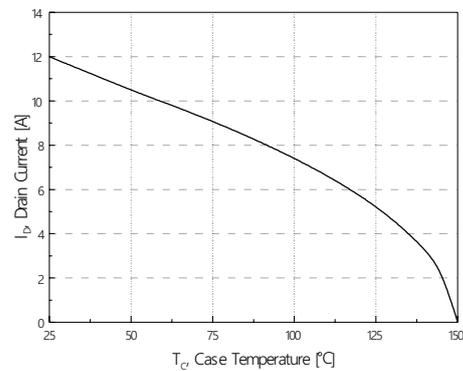


Figure 10. Maximum Drain Current vs Case Temperature

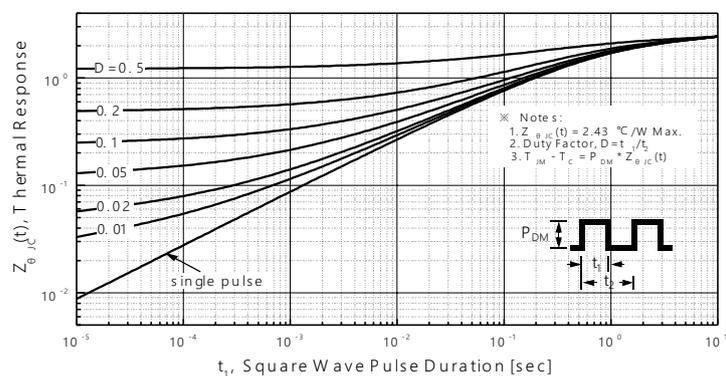
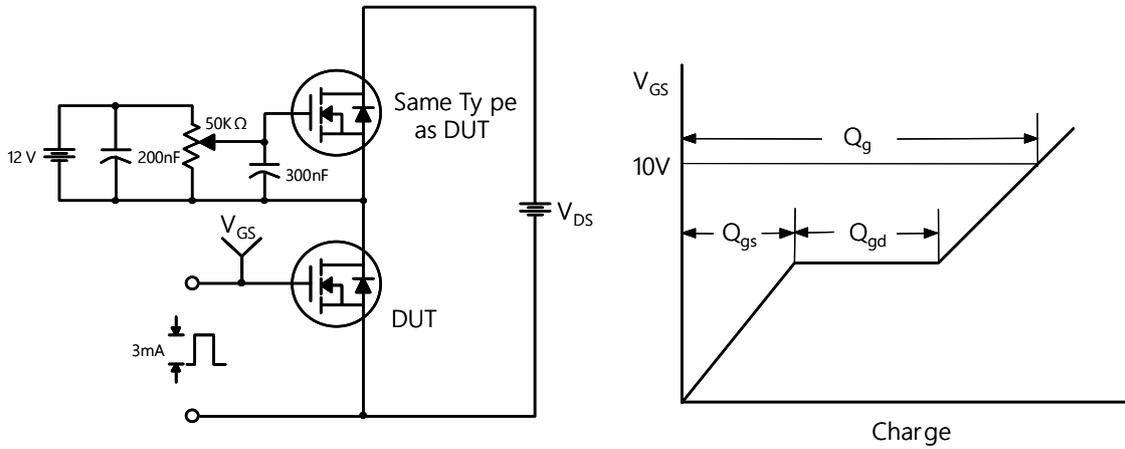
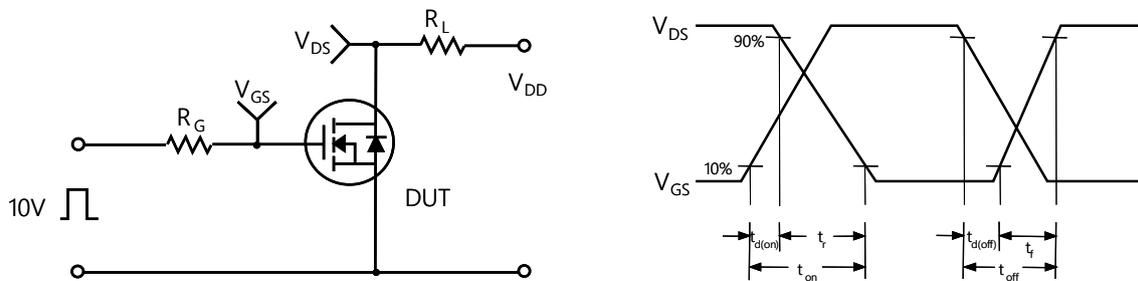


Figure 11-2. Transient Thermal Response Curve

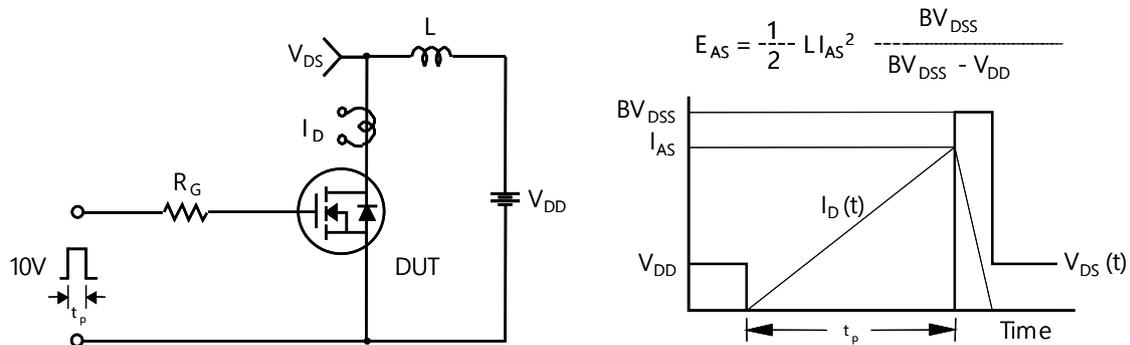
Gate Charge Test Circuit & Waveform



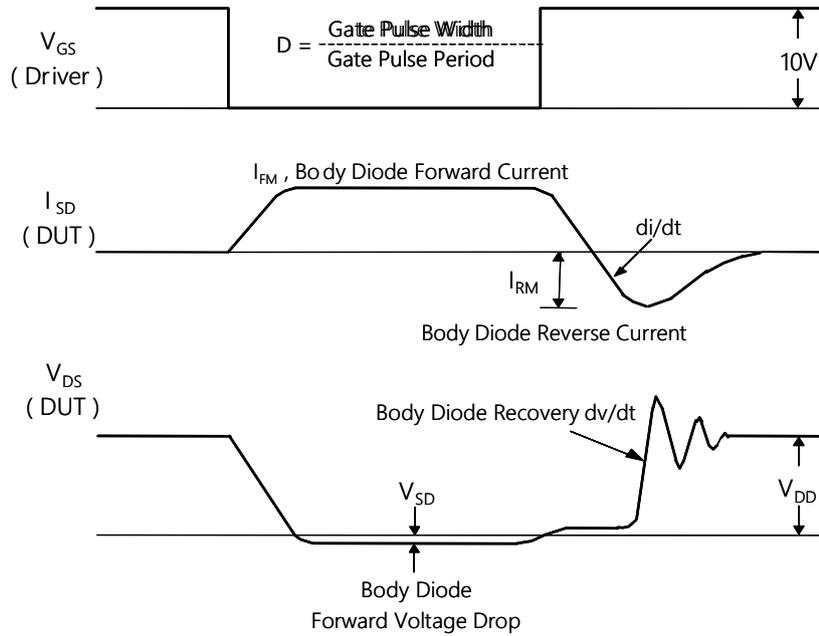
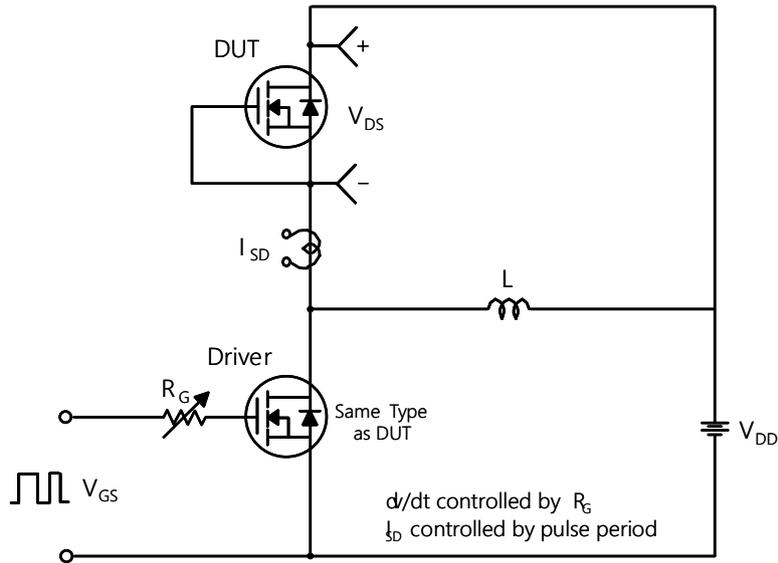
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

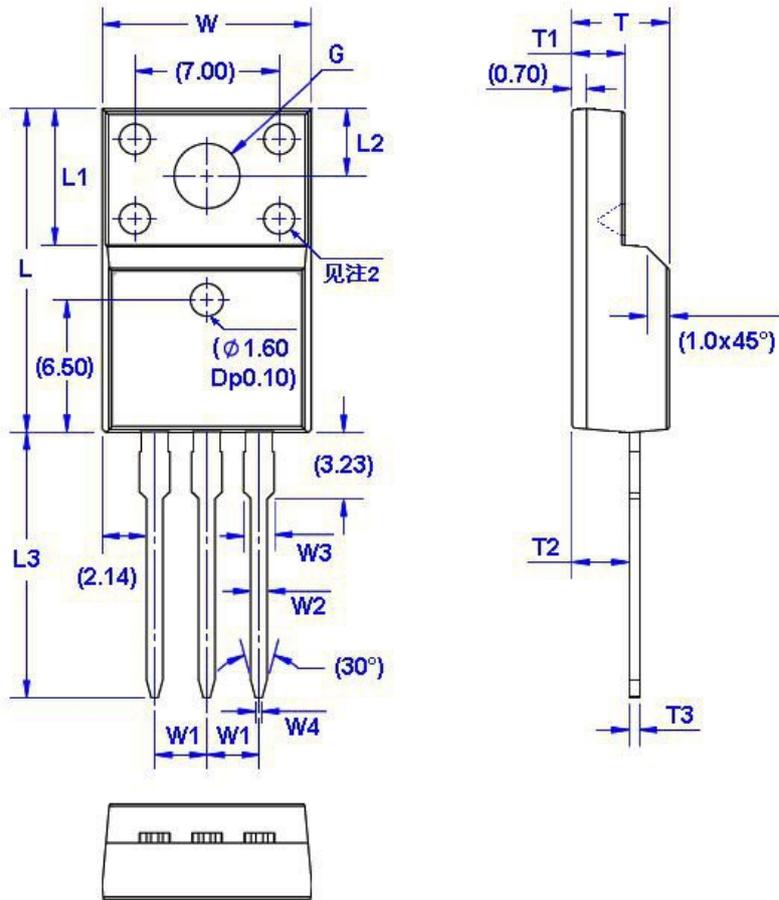


Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Package Dimension

Unit: mm



Symbol	Size		Symbol	Size		Symbol	Size		Symbol	Size	
	Min	ax M		Min	Max		Min	Max		Min	Max
W	9.96	10.36	W4	0.25	0.45	L3	12.78	13.18	T3	0.45	0.60
W1	2.54	(TYP)	L	15.67	16.07	T	4.50	4.90	G(Φ)	3.08	3.28
W2	0.70	0.90	L1	6.48	6.88	T1	2.34	2.74			
W3	1.24	1.47	L2	3.20	3.40	T2	2.56	2.96			