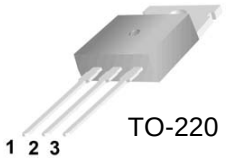
SM60R280P-P/SM60R280P-F

Features:

- ☐ Low Intrinsic Capacitances.
- ☐ Excellent Switching Characteristics.
- ☐ Extended Safe Operating Area.
- ☐ Unrivalled Gate Charge :Qg= 43nC (Typ.).
- ☐ BVDSS=600V,ID=15A
- ☐ RDS(on) : 0.28Ω (Max) @VG=10V
- ☐ 100% Avalanche Tested

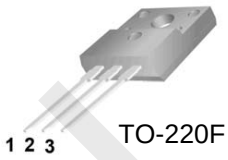
RoHS COMPLIANT

SM60R280P-P

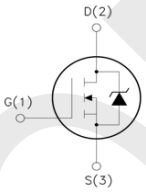


TO-220

SM60R280P-F



TO-220F



1.Gate (G)
2.Drain (D)
3.Source (S)

Absolute Maximum Ratings (TC=25℃ unless otherwise noted)

Symbol	Parameter	SM60R280P-P	SM60R280P-S	Unit
V_{DSS}	Drain-Source Voltage	600		V
I_D	Drain Current -Continuous (TC = 25℃) -Continuous (TC = 100℃)	15 9.4	15* 9.4*	A
I_{DM}	Drain Current - Pulsed (Note 1)	45	45*	A
V_{GSS}	Gate-Source voltage	±30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	284		mJ
I_{AR}	Avalanche Current (Note 1)	2.4		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	0.43		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15		V/ns
P_D	Power Dissipation (TC = 25℃)	104	32	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		℃
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		℃

* Drain current limited by maximum junction temperature. Maximum duty cycle D=0.75.

Thermal Characteristics

Symbol	Parameter	SM60R280P-P	SM60R280P-S	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.2	3.9	℃/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	-	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	80	℃/W

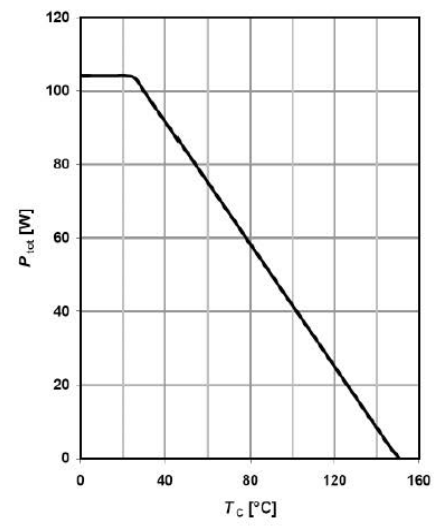
Electrical Characteristics (TC=25℃ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA, T_J = 25℃	600	-	-	V
		V_{GS} = 0V, I_D = 250μA, T_J = 150℃	-	650	-	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25℃	-	0.6	-	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V	-	-	1	μA
		-T_J = 150℃		10	-	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30V, V_{DS} = 0V	-	-	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30V, V_{DS} = 0V	-	-	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250μA	2.5	-	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 7.5A	-	0.24	0.28	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 15A	-	12	-	S
Rg	Gate resistance	f=1 MHz, open drain	-	3.5	-	Ω
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	-	800	-	pF
C_{oss}	Output Capacitance		-	340	-	pF
C_{rss}	Reverse Transfer Capacitance		-	10	-	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400V, I_D = 7.5A, R_G = 20Ω(Note 4)	-	13	-	ns
t_r	Turn-On Rise Time		-	11	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	100	-	ns
t_f	Turn-Off Fall Time		-	12	-	ns
Q_g	Total Gate Charge	V_{DS} = 480V, I_D = 7.5A, V_{GS} = 10V (Note 4)	-	43	-	nC
Q_{gs}	Gate-Source Charge		-	5	-	nC
Q_{gd}	Gate-Drain Charge		-	22	-	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		-	-	15	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		-	-	45	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0V, I_S = 7.5A	-	0.9	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_S = 7.5A, dI_F/dt =100A/μs	-	345	-	ns
Q_{rr}	Reverse Recovery Charge		-	4.5	-	μC

NOTES:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS}=2.4A, VDD=50V, Starting TJ=25 ℃
3. I_{SD}≤ID, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting TJ = 25 ℃
4. Essentially Independent of Operating Temperature Typical Characteristics

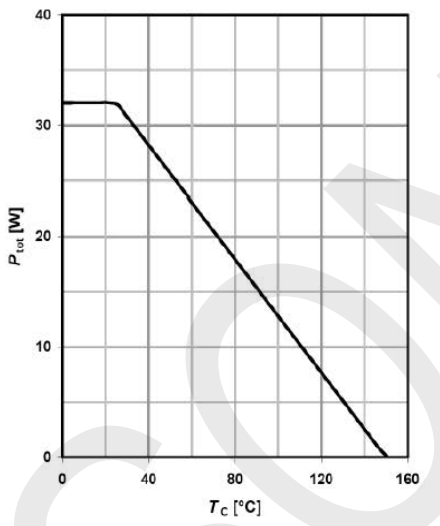
Typical Characteristics

Power dissipation
TO-220



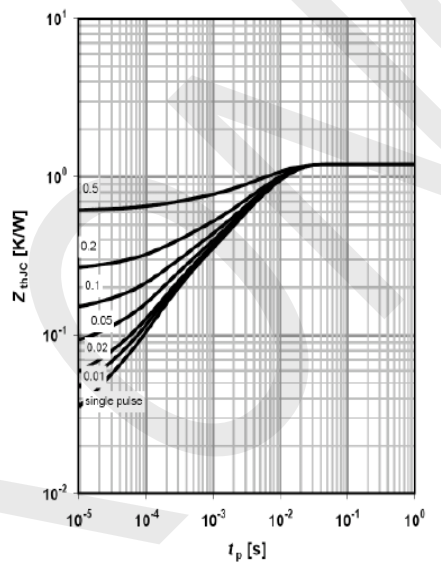
$P_{tot} = f(T_C)$

Power dissipation
TO-220 FullPAK



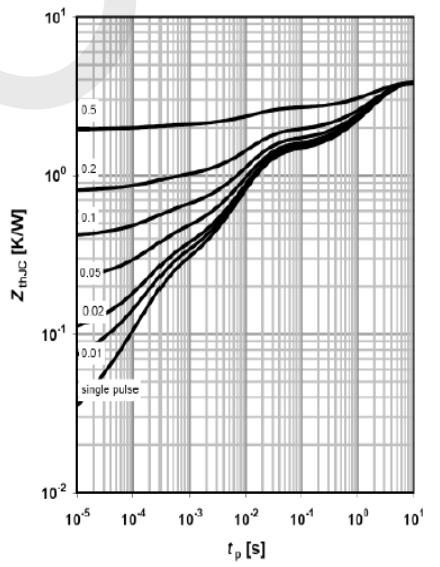
$P_{tot} = f(T_C)$

Max. transient thermal impedance
TO-220



$Z_{(thJC)}$=f(tp); parameter: $D=t_p/T$

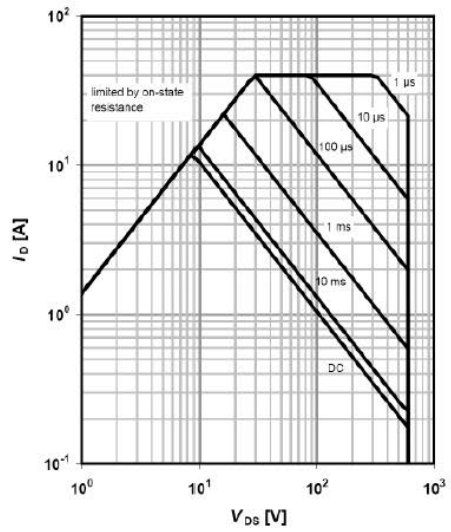
Max. transient thermal impedance
TO-220 FullPAK



$Z_{(thJC)}$=f(tp); parameter: $D=t_p/T$

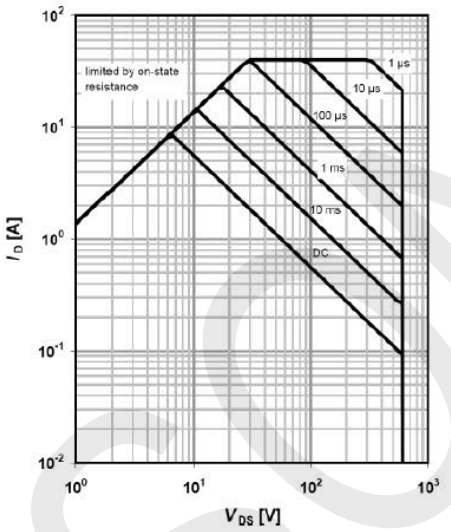
Typical Characteristics

Safe operating area T_C=25 °C
TO-220



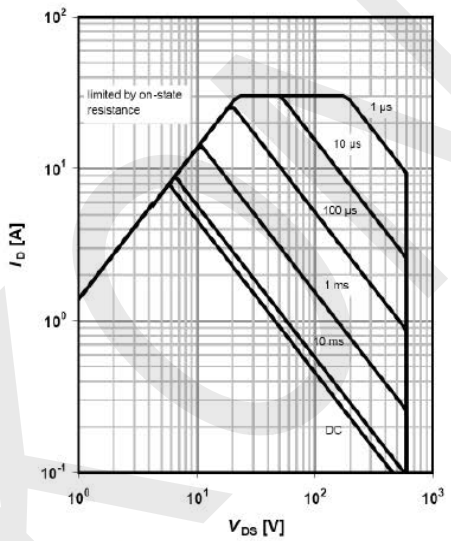
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=25 °C
TO-220 FullPAK



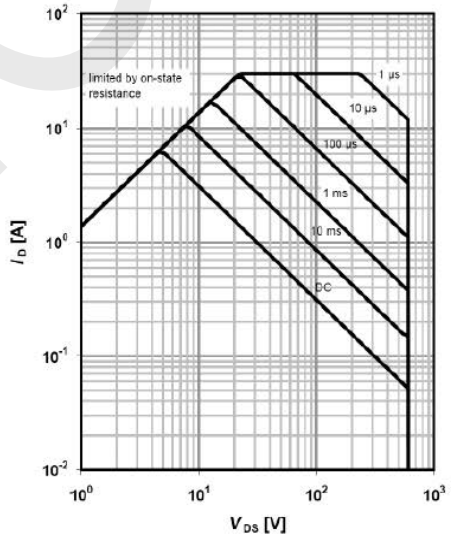
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=80 °C
TO-220



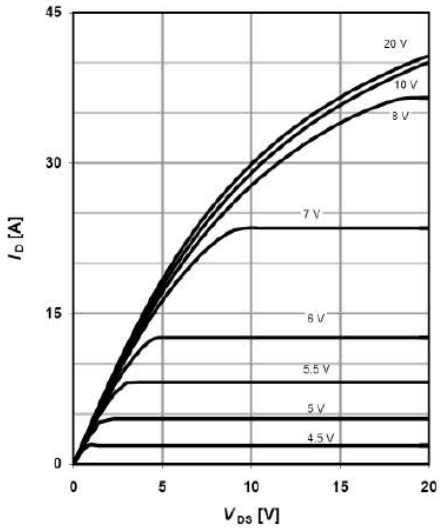
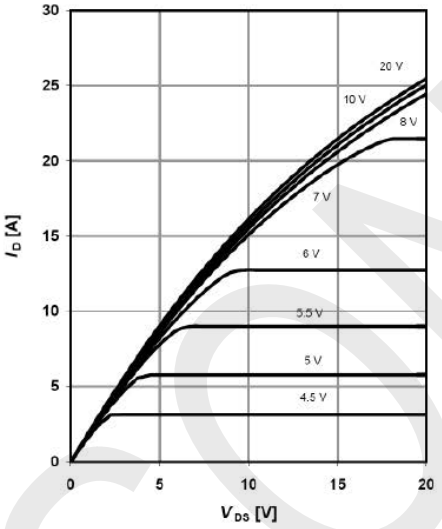
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

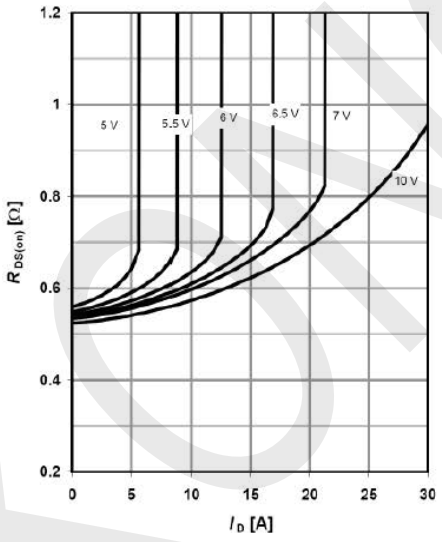
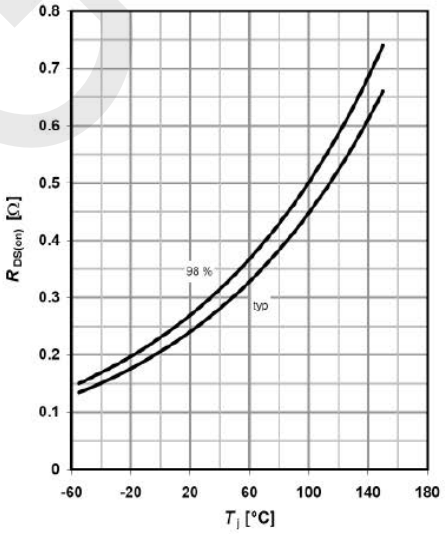
Safe operating area T_C=80 °C
TO-220 FullPAK



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

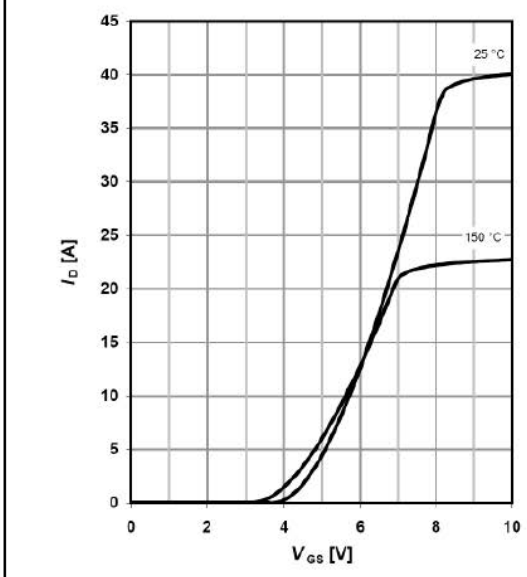
Typical Characteristics

Typ. output characteristics T_j=25 °C	Typ. output characteristics T_j=125 °C
	
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}	I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance	Drain-source on-state resistance
	
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}	$R_{DS(on)}$=f(T_j); I_D=6.5 A; V_{GS}=10 V

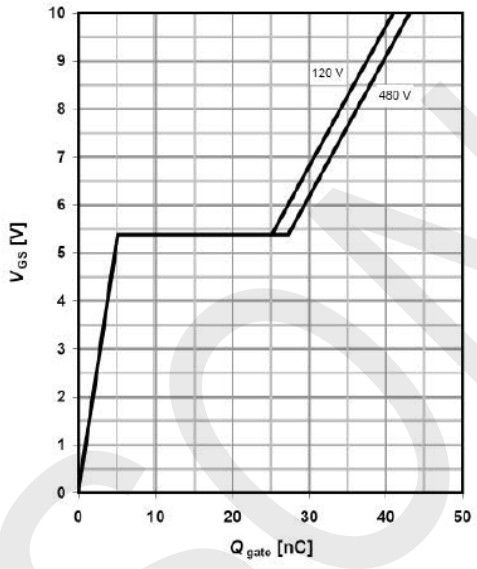
Typical Characteristics

Typ. transfer characteristics



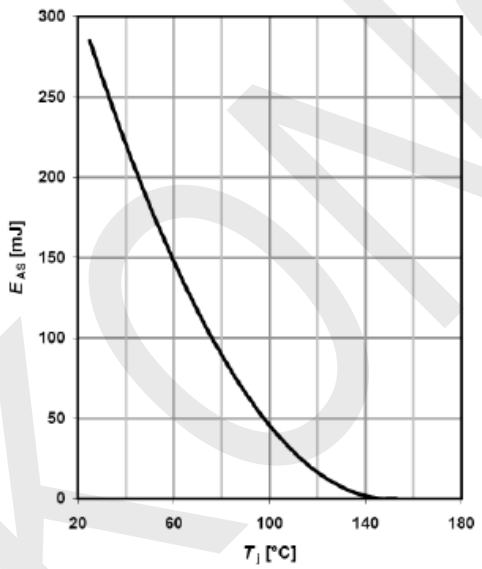
$I_D=f(V_{GS})$; $V_{DS}=20V$

Typ. gate charge



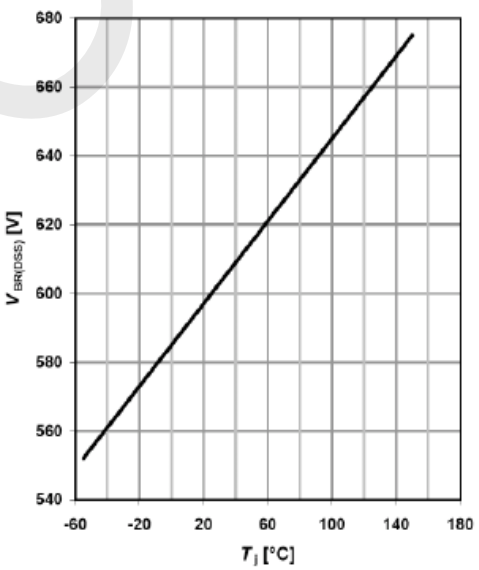
$V_{GS}=f(Q_{gate})$, $I_D=6.5A$ pulsed

Avalanche energy



$E_{AS}=f(T_j)$; $I_D=2.4$ A; $V_{DD}=50$ V

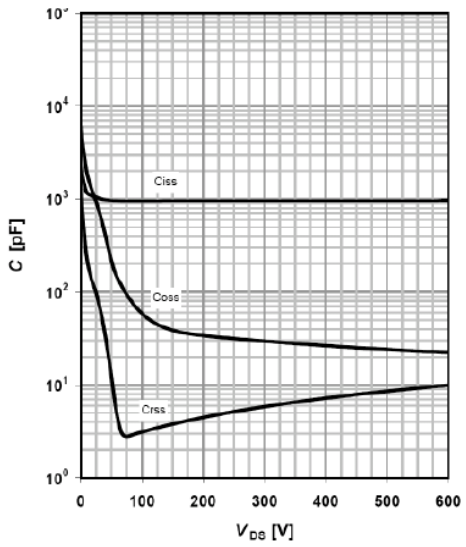
Drain-source breakdown voltage



$V_{BR(DSS)}=f(T_j)$; $I_D=0.25$ mA

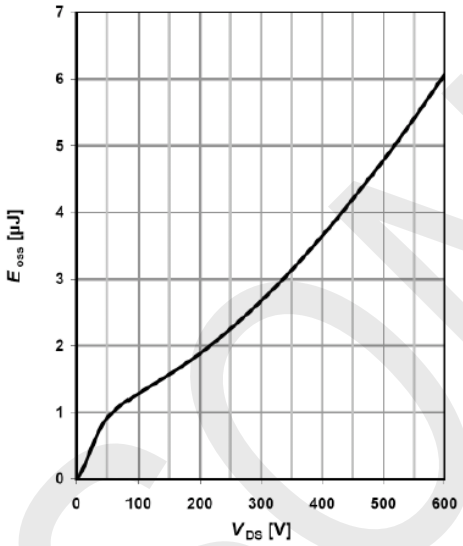
Typical Characteristics

Typ. capacitances



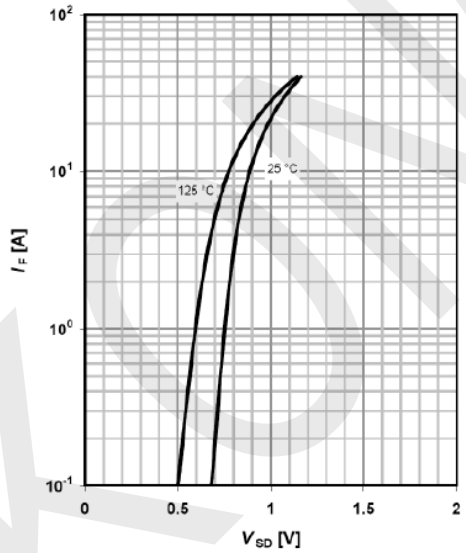
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. C_{oss} stored energy



E_{oss}=f(V_{DS})

Forward characteristics of reverse diode

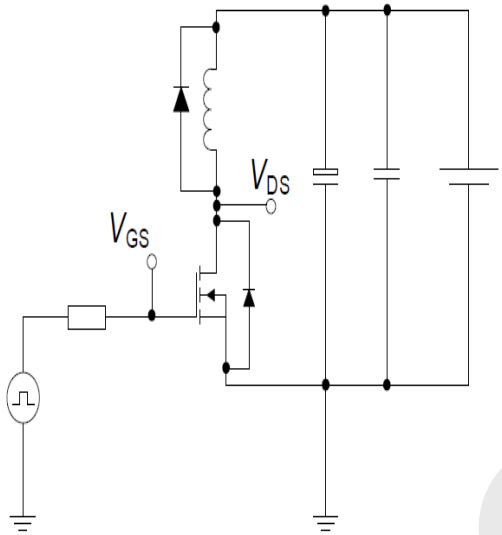


I_F=f(V_{SD}); parameter: T_j

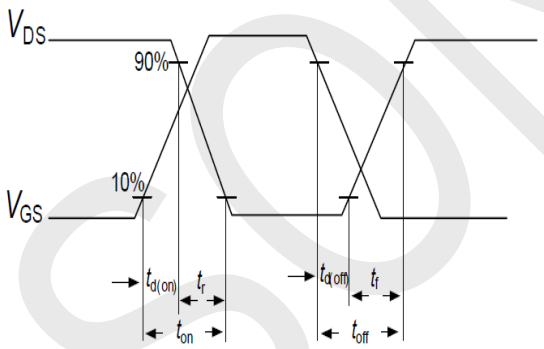
Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

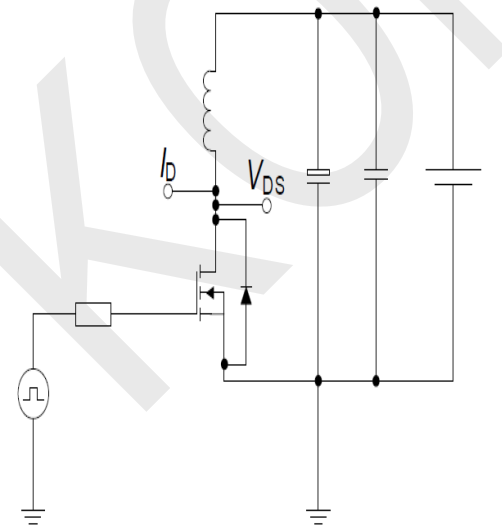


Switching time waveform

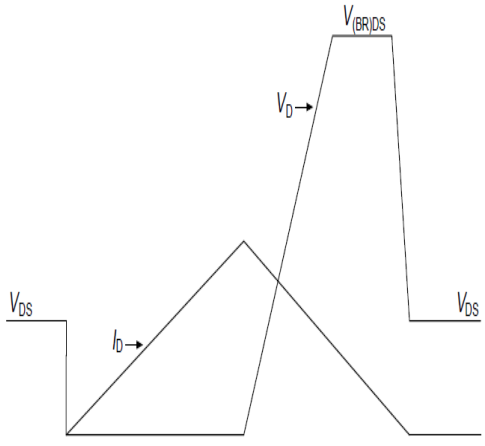


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit



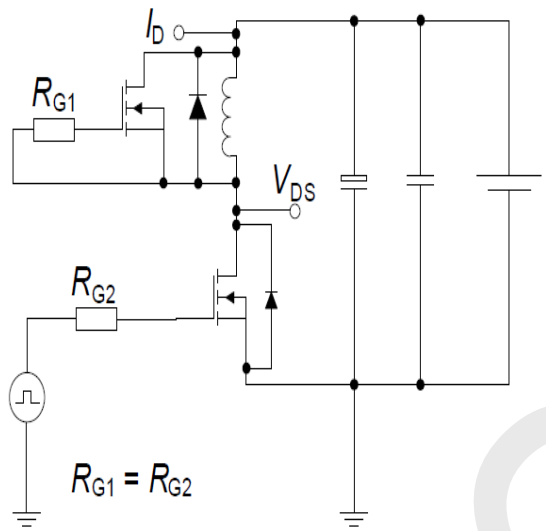
Unclamped inductive waveform



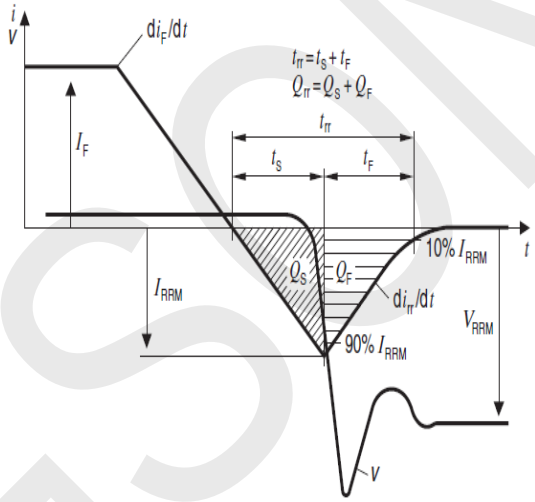
Test circuits

Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



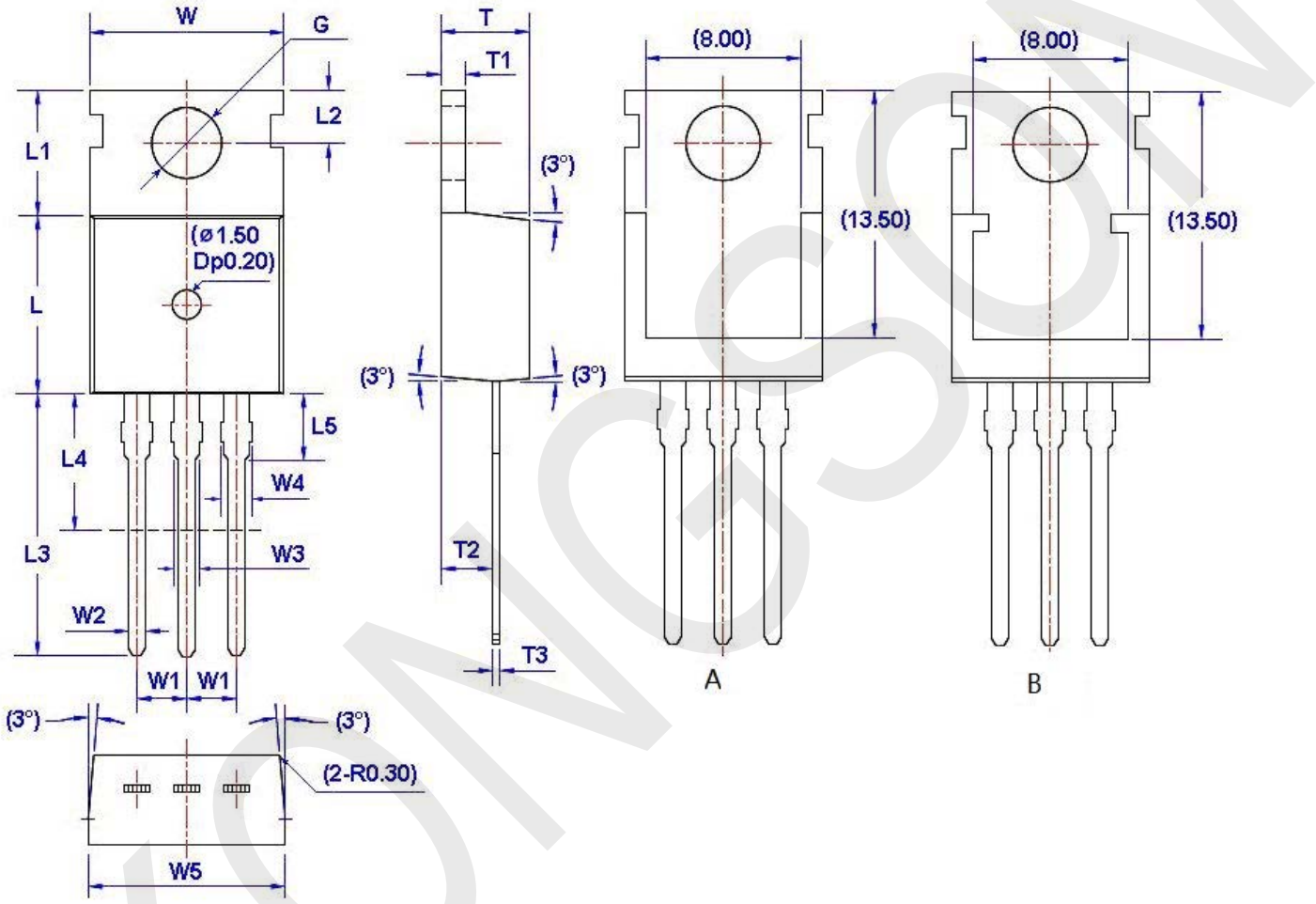
Diode recovery waveform



Package Dimension

TO-220

Unit: mm

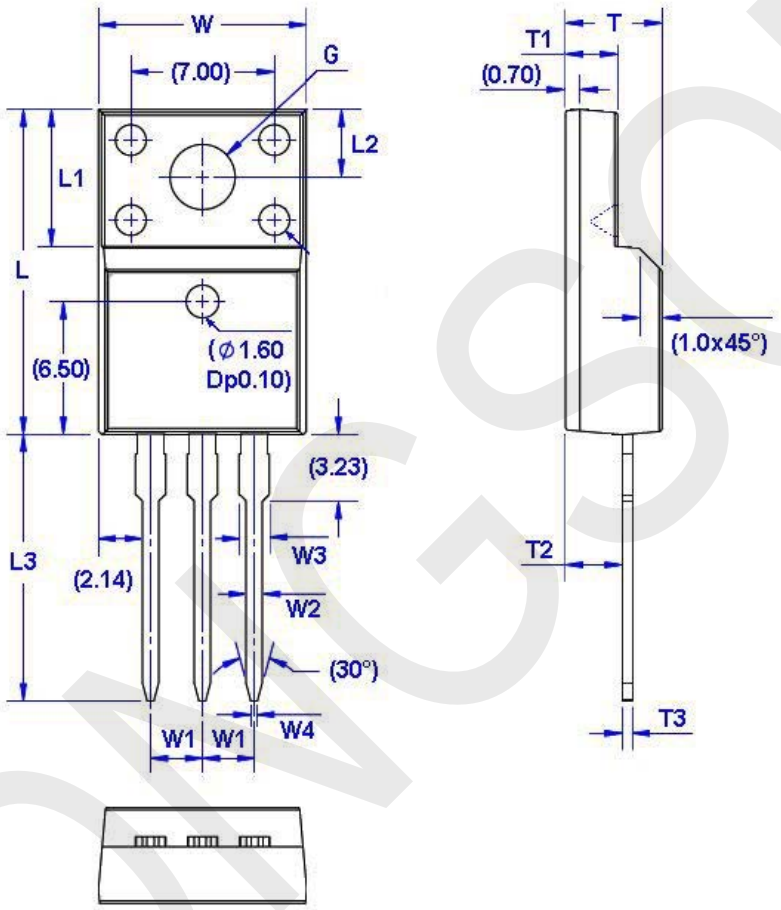


Symbol	Size		Symbol	Size		Symbol	Size		Symbol	Size	
	Min	Max		Min	Max		Min	Max		Min	Max
W	9.66	10.28	W5	9.80	10.20	L4**	6.20	6.60	T3	0.45	0.60
W1	2.54（TYP）		L	9.00	9.40	L5	2.79	3.30	G(Φ)	3.50	3.70
W2	0.70	0.95	L1	6.40	6.80	T	4.30	4.70			
W3	1.17	1.37	L2	2.70	2.90	T1	1.15	1.40			
W4*	1.32	1.72	L3	12.70	14.27	T2	2.20	2.60			

Package Dimension

TO-220F

Unit: mm



Symbol	Size		Symbol	Size		Symbol	Size		Symbol	Size	
	Min	Max		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			