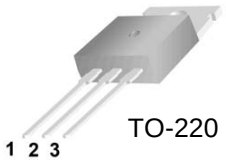
650V N-Channel COOLMOSFET

HM5NC65AP-HM5NC65AF

Features:

- ☐ Low Intrinsic Capacitances.
- ☐ Excellent Switching Characteristics.
- ☐ Extended Safe Operating Area.
- ☐ Unrivalled Gate Charge :Qg= 10nC (Typ.).
- ☐ BVDSS=650V,ID=5A
- ☐ RDS(on) : 0.9Ω (Max) @VG=10V
- ☐ 100% Avalanche Tested

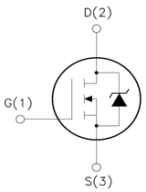
HM5NC65AP



TO-220

HM5NC65AF

TO-220F



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

Absolute Maximum Ratings (T_C=25℃)

Parameter	Symbol	HM5NC65AP	HM5NC65AF	Unit
Drain-Source Voltage (V_{GS}=0V）	V_{DS}	650		V
Gate-Source Voltage (V_{DS}=0V)	V_{GS}	±30		V
Continuous Drain Current at Tc=25°C	$I_{D\ (DC)}$	5	5*	A
Continuous Drain Current at Tc=100°C	$I_{D\ (DC)}$	3	3*	A
Pulsed drain current **(Note 1)**	$I_{DM\ (pluse)}$	15	15*	A
Drain Source voltage slope, VDS = 480 V, ID =5 A, Tj = 125 °C	dv/dt	48		V/ns
Maximum Power Dissipation(Tc=25℃) Derate above 25°C	P_D	49 0.39	29 0.23	W W/°C
Single pulse avalanche energy **(Note2)**	E_{AS}	135		mJ
Avalanche current **(Note 1)**	I_{AR}	2.5		A
Repetitive Avalanche energy ， t_{AR} limited by T_{jmax} **(Note 1)**	E_{AR}	0.4		mJ
Operating Junction and Storage Temperature Range	T_J,T_{STG}	-55...+150		°C

* limited by maximum junction temperature

Thermal Characteristic

Parameter	Symbol	HM5NC65AP	HM5NC65AF	Unit
Thermal Resistance，Junction-to-Case（Maximum）	R_{thJC}	2.55	4.3	°C /W
Thermal Resistance，Junction-to-Ambient （Maximum）	R_{thJA}	62	80	°C /W

Electrical Characteristics (TA=25℃unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V I_D=250μA	650			V
Zero Gate Voltage Drain Current(Tc=25℃)	I_{DSS}	V_{DS}=650V,V_{GS}=0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I_{DSS}	V_{DS}=650V,V_{GS}=0V			50	μA
Gate-Body Leakage Current	I_{GSS}	V_{GS}=±30V,V_{DS}=0V			±100	nA
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS}=V_{GS},I_D=250μA	2.5	3	3.5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=3A		780	900	mΩ
Dynamic Characteristics						
Forward Transconductance	g_{FS}	V_{DS} = 20V, I_D = 3A		4.8		S
Input Capacitance	C_{lss}	V_{DS}=50V,V_{GS}=0V, F=1.0MHz		460		PF
Output Capacitance	C_{oss}			45		PF
Reverse Transfer Capacitance	C_{rss}			3.5		PF
Total Gate Charge	Q_g	V_{DS}=480V,I_D=5A, V_{GS}=10V		10	20	nC
Gate-Source Charge	Q_{gs}			1.6		nC
Gate-Drain Charge	Q_{gd}			4		nC
Intrinsic gate resistance	R_G	f = 1 MHz open drain		2.5		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=380V,I_D=5A, R_G=18Ω,V_{GS}=10V		6		nS
Turn-on Rise Time	t_r			3		nS
Turn-Off Delay Time	$t_{d(off)}$			50	60	nS
Turn-Off Fall Time	t_f			9	15	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	T_C=25°C			5	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				15	A
Forward On Voltage	V_{SD}	Tj=25°C,I_{SD}=5A,V_{GS}=0V		1	1.3	V
Reverse Recovery Time	t_{rr}	Tj=25°C,I_F=5A,di/dt=100A/μs		250		nS
Reverse Recovery Charge	Q_{rr}			2.2		uC
Peak reverse recovery current	I_{rrm}			15		A

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. Tj=25℃,VDD=50V,VG=10V, R_G=25Ω

Typical Characteristics

Figure1. Safe operating area for TO-220

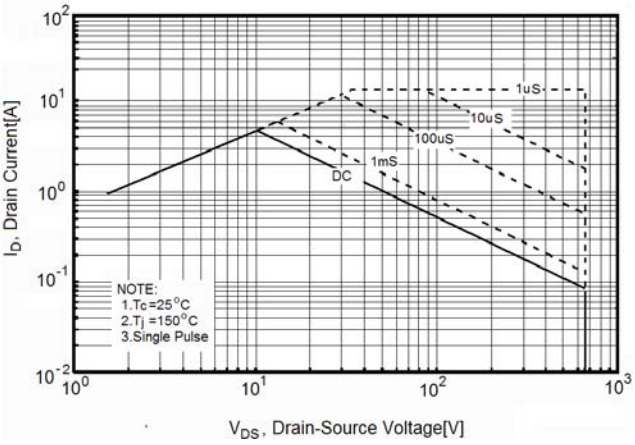


Figure2. Safe operating area for TO-220F

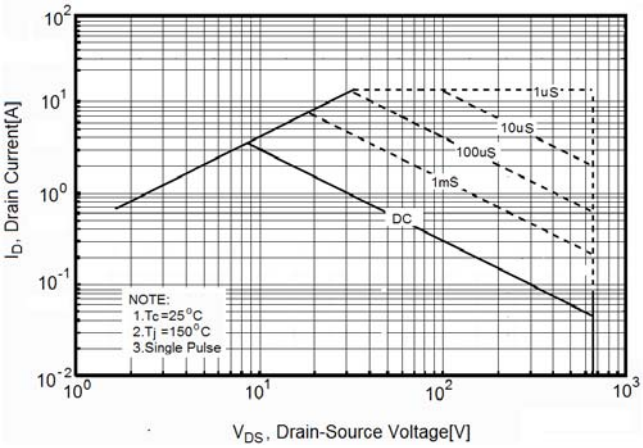


Figure3. Source-Drain Diode Forward Voltage

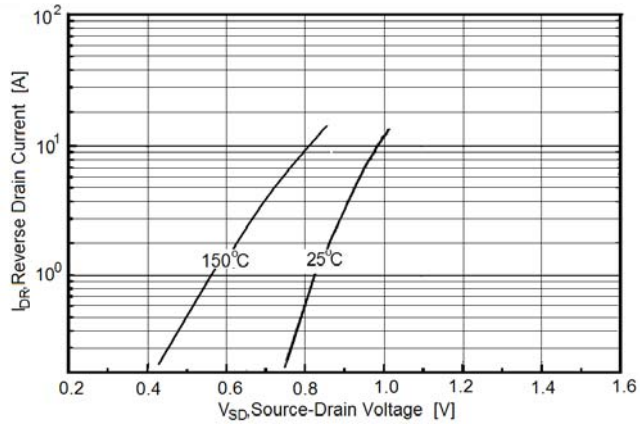


Figure4. Output characteristics

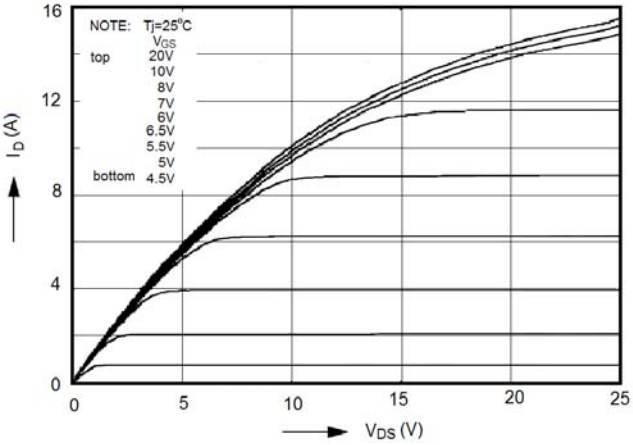


Figure5. Transfer characteristics

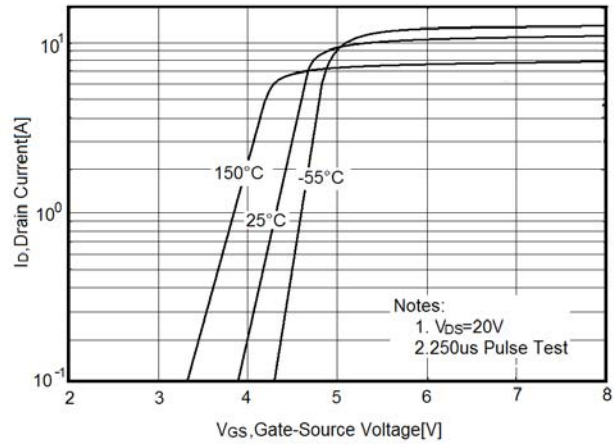
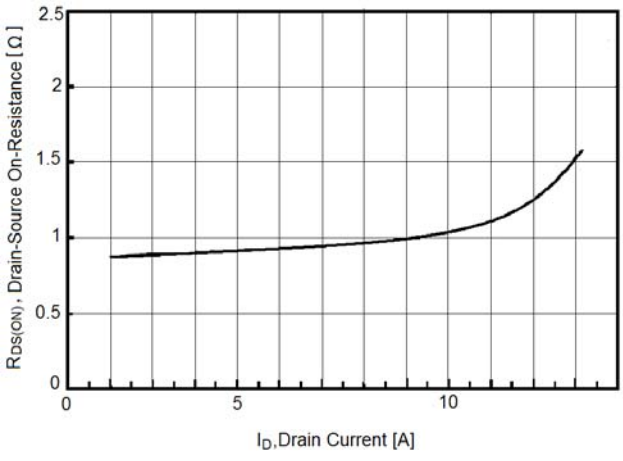


Figure6. Static drain-source on resistance



Typical Characteristics

Figure7. $R_{DS(ON)}$ vs Junction Temperature

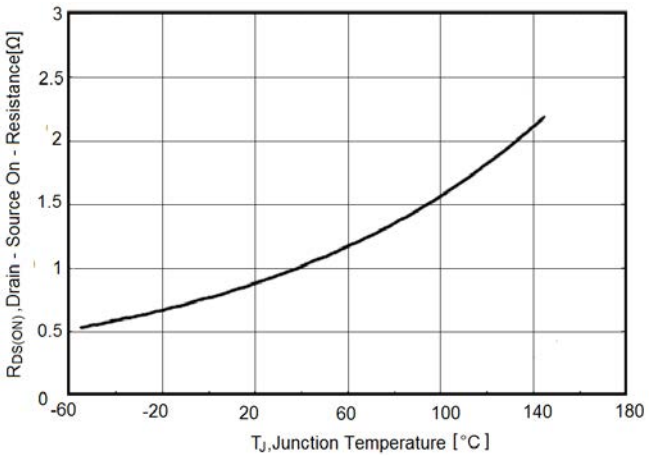


Figure8. BV_{DSS} vs Junction Temperature

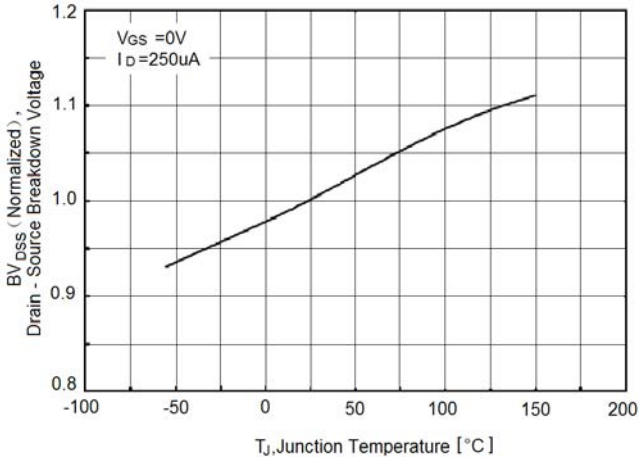


Figure9. Maximum I_D vs Junction Temperature

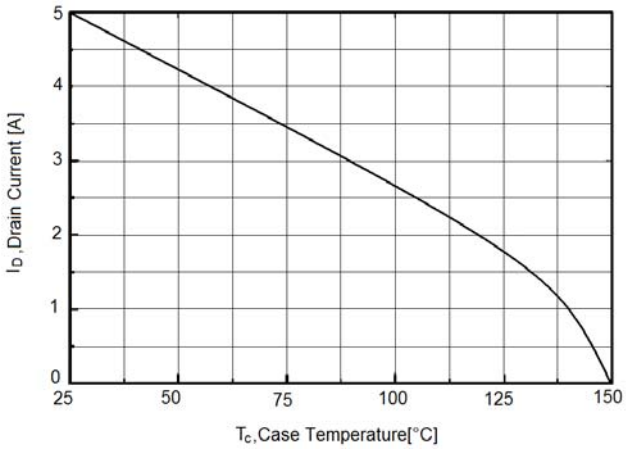


Figure10. Gate charge waveforms

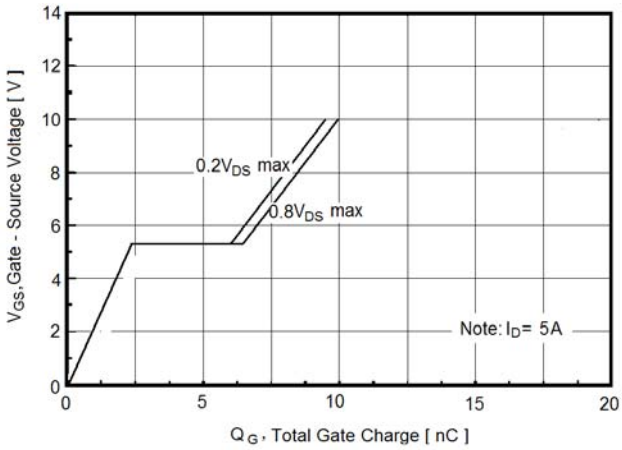


Figure11. Capacitance

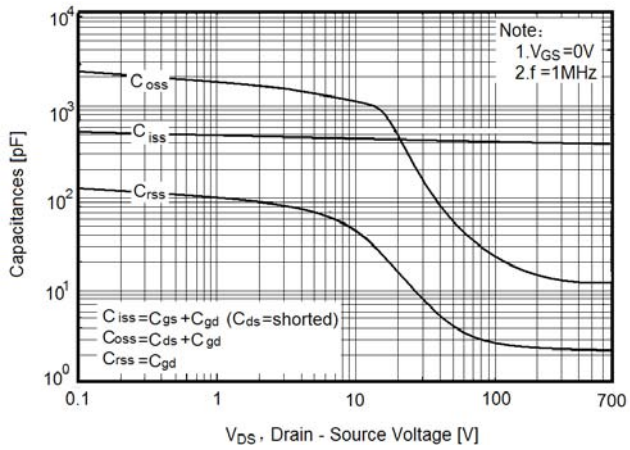
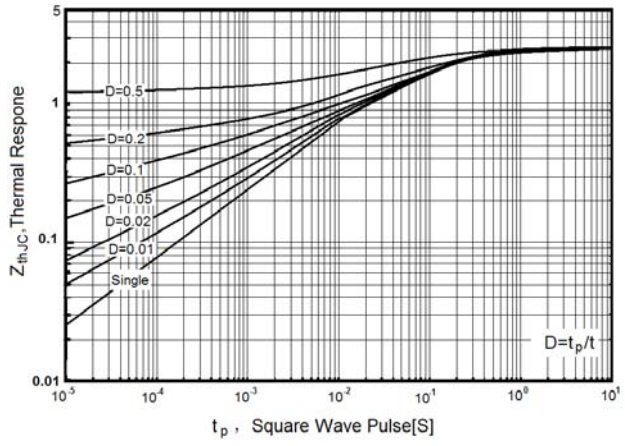
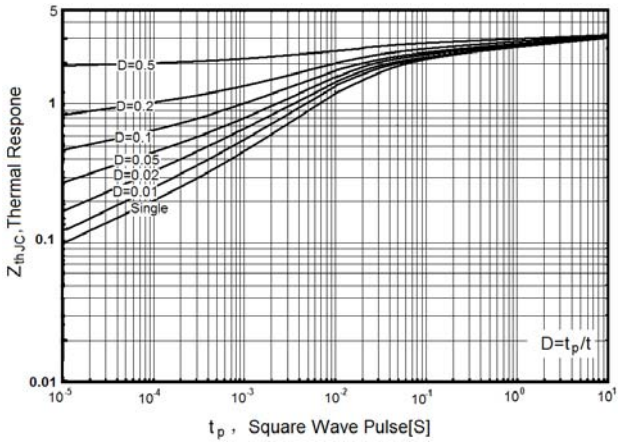


Figure12. Transient Thermal Impedance



Typical Characteristics

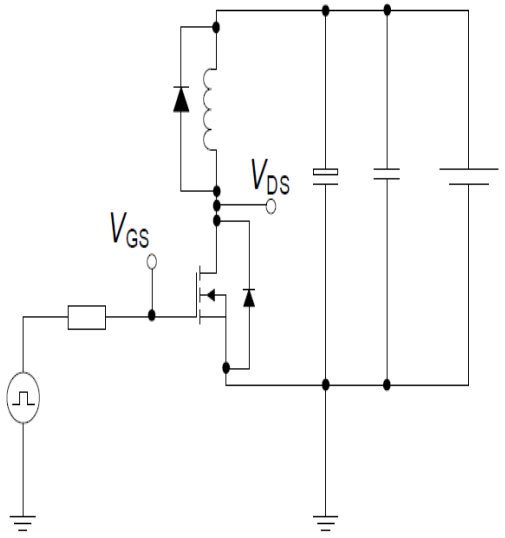
Figure13. Transient Thermal Impedance for TO-220F



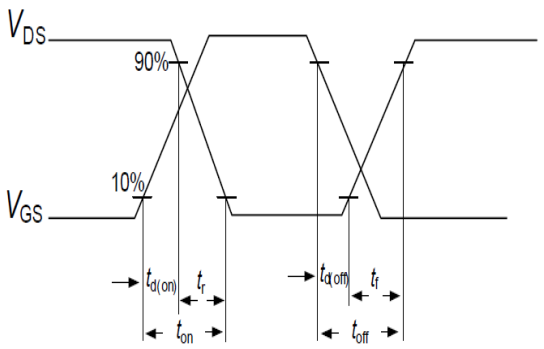
Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

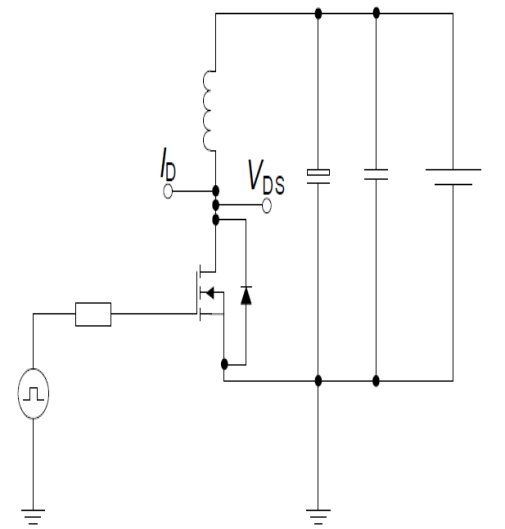


Switching time waveform

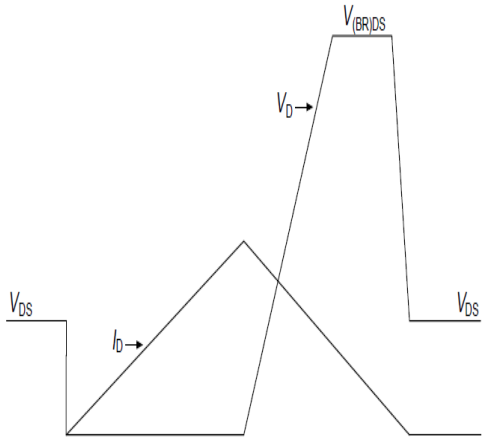


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit



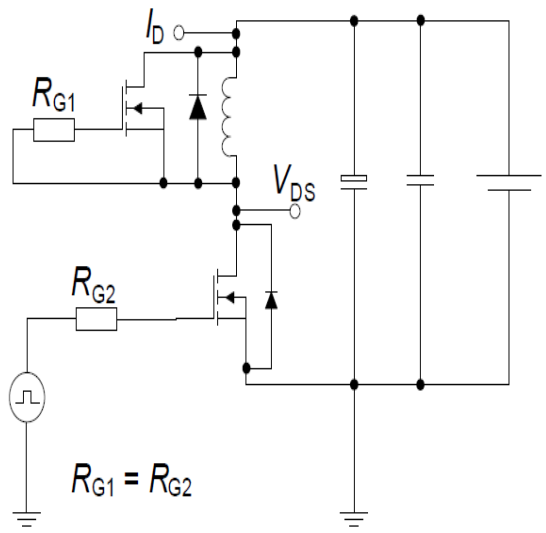
Unclamped inductive waveform



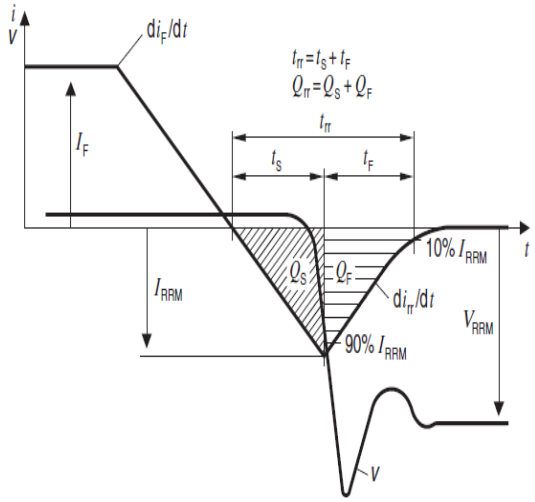
Test circuits

Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



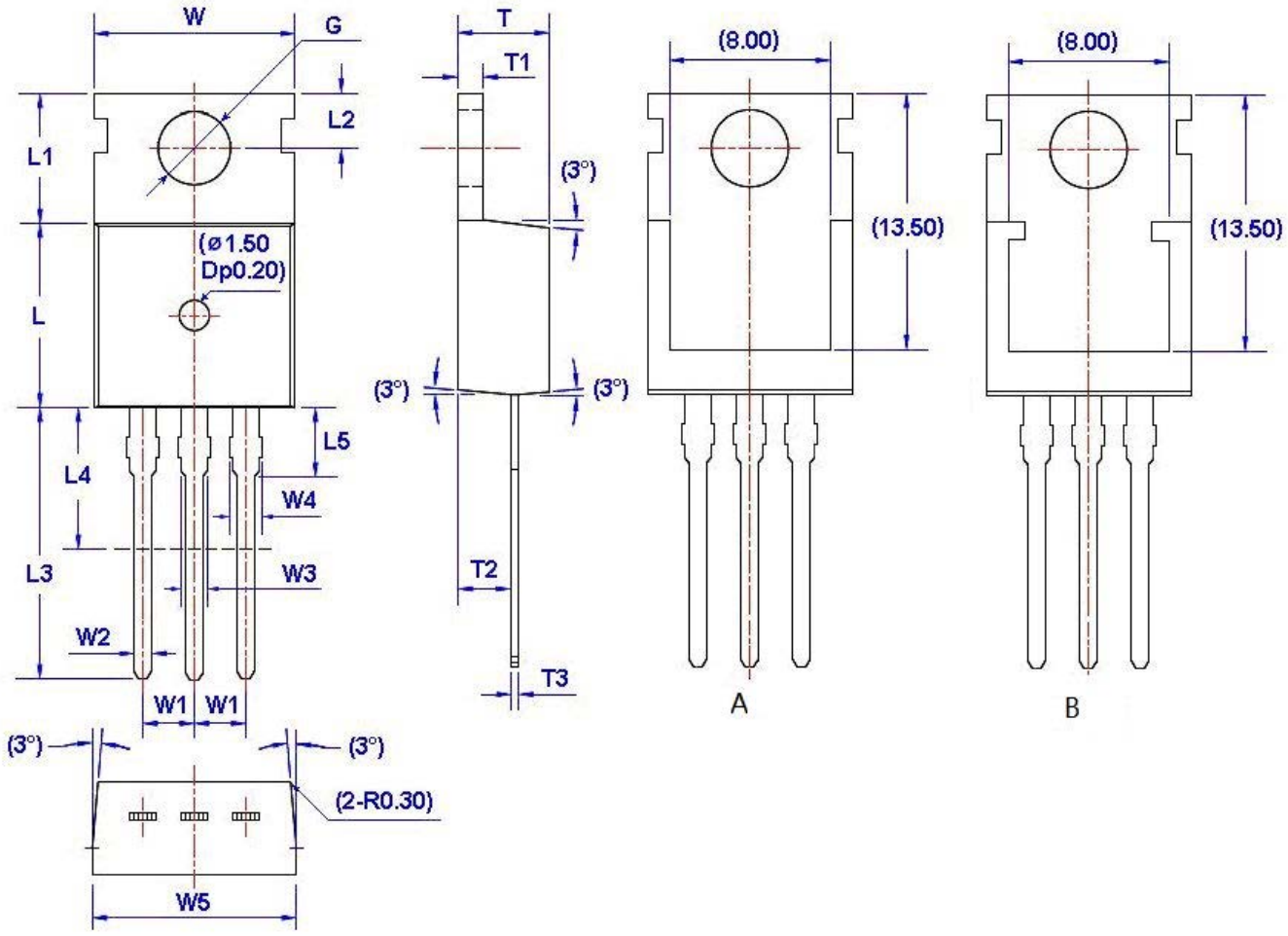
Diode recovery waveform



Package Dimension

TO-220

Unit: mm

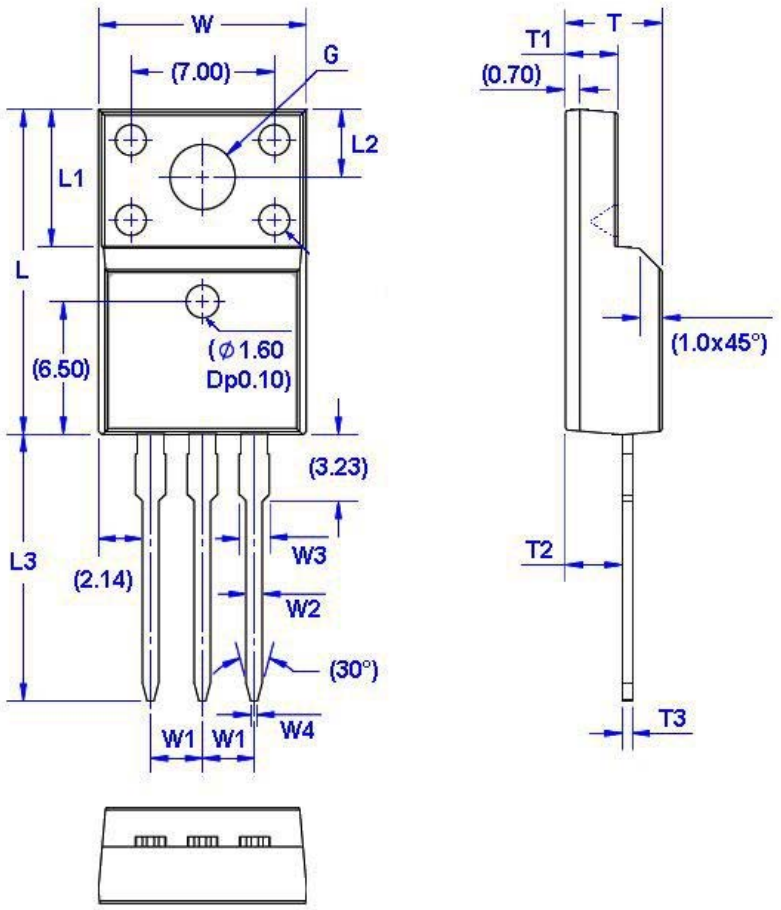


Symbol	Size		Symbol	Size		Symbol	Size		Symbol	Size	
	Min	Max		Min	Max		Min	Max		Min	Max
W	9.66	10.28	W5	9.80	10.20	L4**	6.20	6.60	T3	0.45	0.60
W1	2.54（TYP）		L	9.00	9.40	L5	2.79	3.30	G(Φ)	3.50	3.70
W2	0.70	0.95	L1	6.40	6.80	T	4.30	4.70			
W3	1.17	1.37	L2	2.70	2.90	T1	1.15	1.40			
W4*	1.32	1.72	L3	12.70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