

N-Channel Super Junction Power MOSFET

General Description

The series of devices use advanced trench gate super junction technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

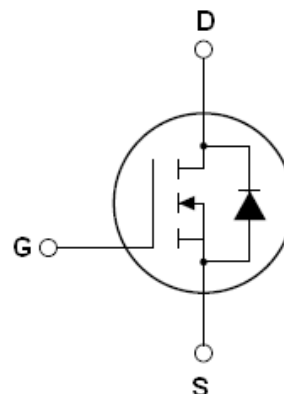
Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

Application

- Power factor correction(PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply(UPS)

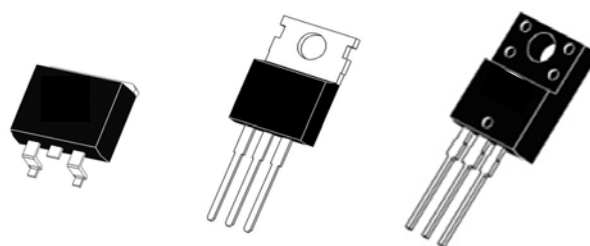
V_{DS}	650	V
$R_{DS(ON)TYP}$	600	mΩ
I_D	7	A



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
FTK65T680DD	TO-263	NCE65T680D
FTK65T680P	TO-220	NCE65T680
FTK65T680F	TO-220F	NCE65T680F



TO-263

TO-220

TO-220F

Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

Parameter	Symbol	FTK65T680DD FTK65T680P	FTK65T680F	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	650		V
Gate-Source Voltage ($V_{DS}=0V$) AC ($f>1\text{ Hz}$)	V_{GS}	± 30		V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_D (DC)$	7	7*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_D (DC)$	4.5	4.5*	A
Pulsed drain current (Note 1)	$I_{DM} (pluse)$	28	28*	A
Maximum Power Dissipation ($T_c=25^\circ\text{C}$) Derate above 25°C	P_D	60 0.48	31.4 0.25	W W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	E_{AS}	101		mJ
Avalanche current (Note 1)	I_{AR}	1.5		A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.28		mJ



FTK65T680DD/P/F

Parameter	Symbol	FTK65T680DD FTK65T680P	FTK65T680F	Unit
Drain Source voltage slope, $V_{DS} \leq 480$ V,	dv/dt	50		V/ns
Reverse diode dv/dt, $V_{DS} \leq 480$ V, $I_{SD} < I_D$	dv/dt	15		V/ns
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55...+150		°C

* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	FTK65T680DD FTK65T680P	FTK65T680F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	2.08	3.98	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	80	°C /W

Table 3. Electrical Characteristics (TA=25°C 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°C)	I _{DSS}	V _{DS} =650V, V _{GS} =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125°C)	I _{DSS}	V _{DS} =650V, V _{GS} =0V			100	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V, V _{DS} =0V			±100	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	3		4	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =3.5A		600	680	mΩ
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{DS} =50V, V _{GS} =0V, F=1.0MHz		435		pF
Output Capacitance	C _{oss}			28		pF
Reverse Transfer Capacitance	C _{rss}			3.3		pF
Total Gate Charge	Q _g	V _{DS} =480V, I _D =7A, V _{GS} =10V		11		nC
Gate-Source Charge	Q _{gs}			3.5		nC
Gate-Drain Charge	Q _{gd}			5		nC
Switching times						
Turn-on Delay Time	t _{d(on)}	V _{DD} =380V, I _D =3.5A, R _G =4.7Ω, V _{GS} =10V		8		nS
Turn-on Rise Time	t _r			7		nS
Turn-Off Delay Time	t _{d(off)}			58	75	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			7	A
Pulsed Source-drain current(Body Diode)	I _{SDM}				28	A
Forward On Voltage	V _{SD}	T _j =25°C, I _{SD} =7A, V _{GS} =0V		0.9	1.2	V
Reverse Recovery Time	t _{rr}	T _j =25°C, I _F =3.5A, di/dt=100A/μs		210		nS
Reverse Recovery Charge	Q _{rr}			0.85		uC
Peak Reverse Recovery Current	I _{rrm}			8		A

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

2. $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

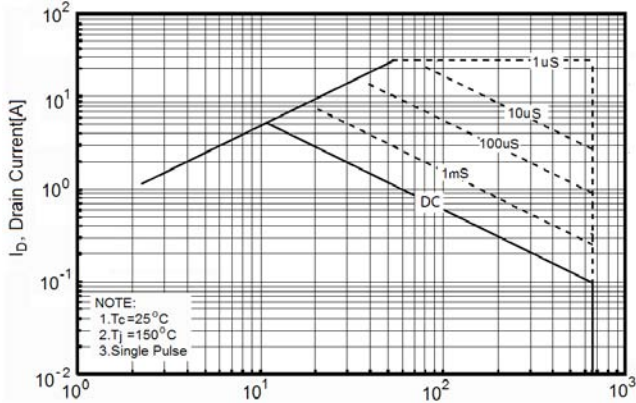


Figure2. Safe operating area for TO-220F

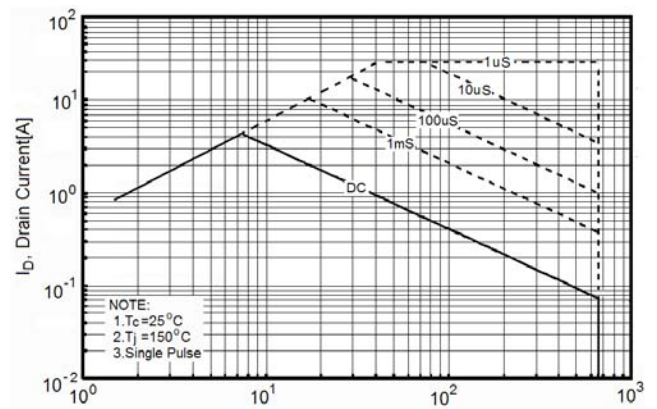


Figure3. Source-Drain Diode Forward Voltage

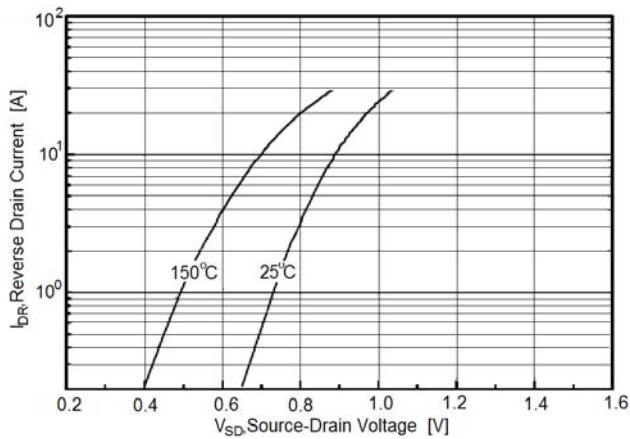


Figure4. Output characteristics

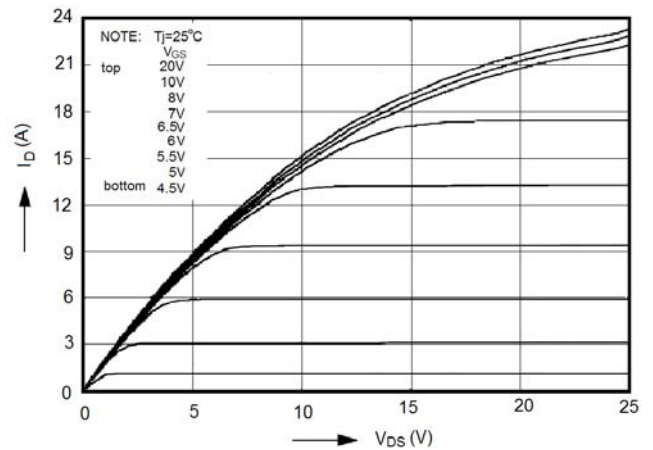


Figure5. Transfer characteristics

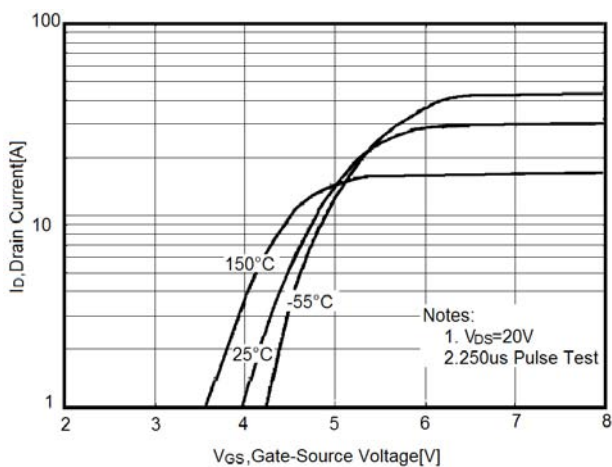


Figure6. Static drain-source on resistance

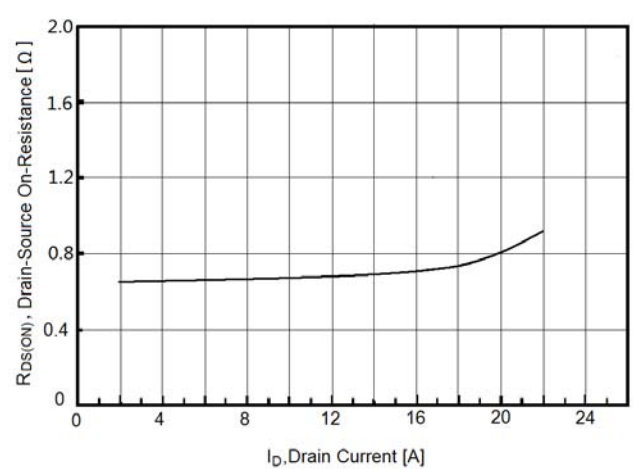


Figure7. $R_{DS(ON)}$ vs Junction Temperature

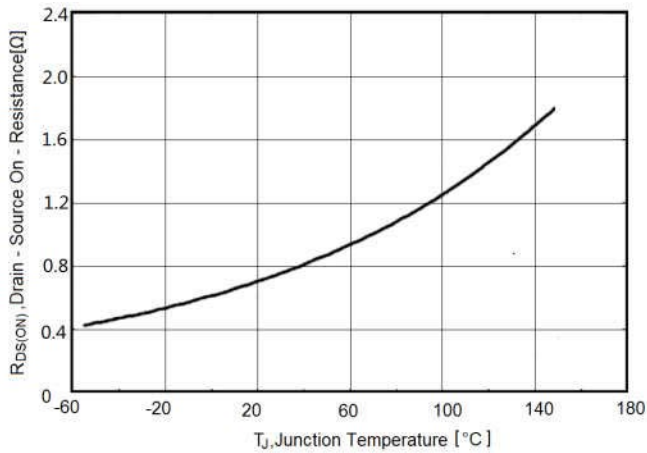


Figure8. BV_{DSS} vs Junction Temperature

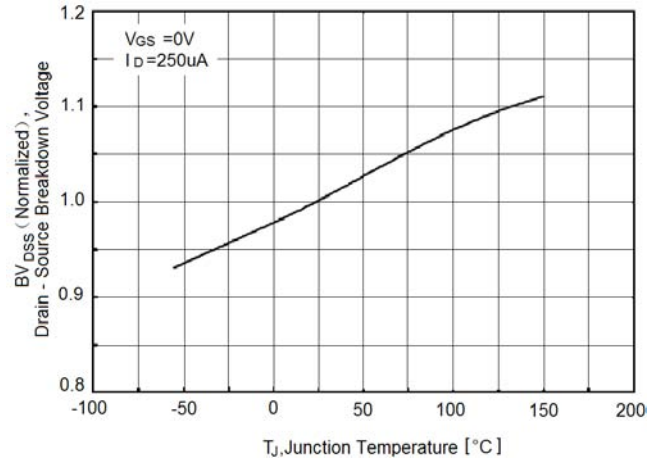


Figure9. Maximum I_D vs Junction Temperature

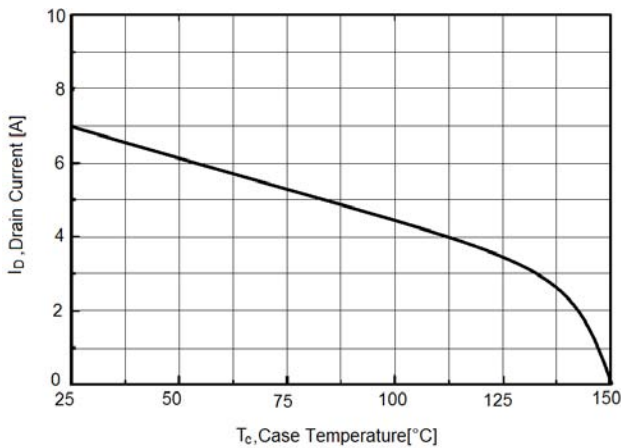


Figure10. Capacitance

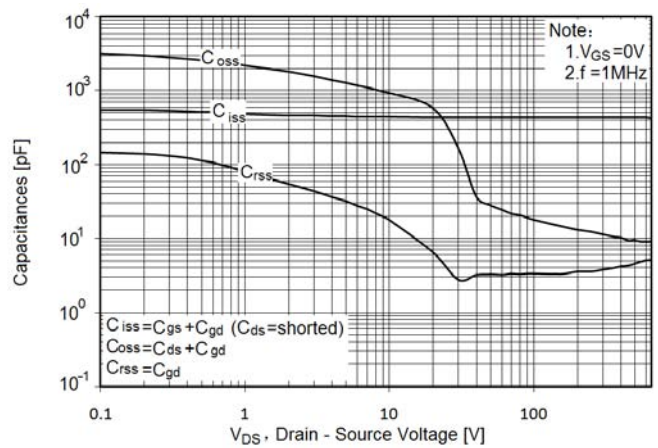


Figure11. Gate charge waveforms

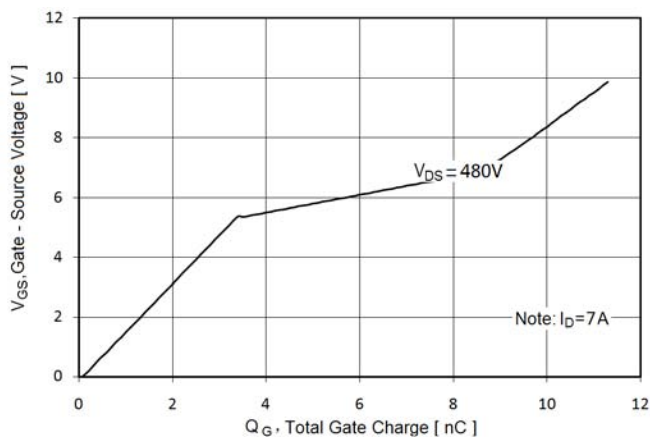


Figure12. Transient Thermal Impedance

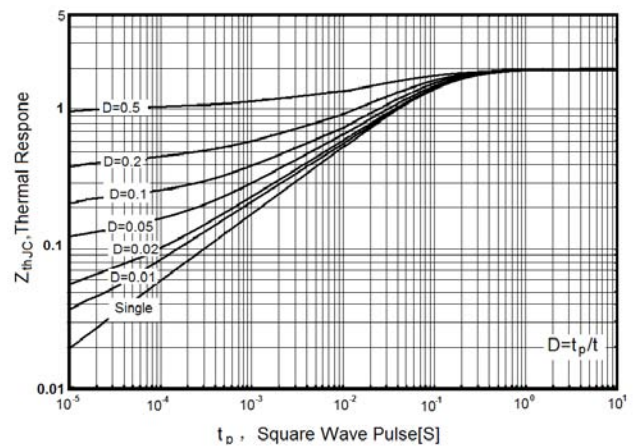
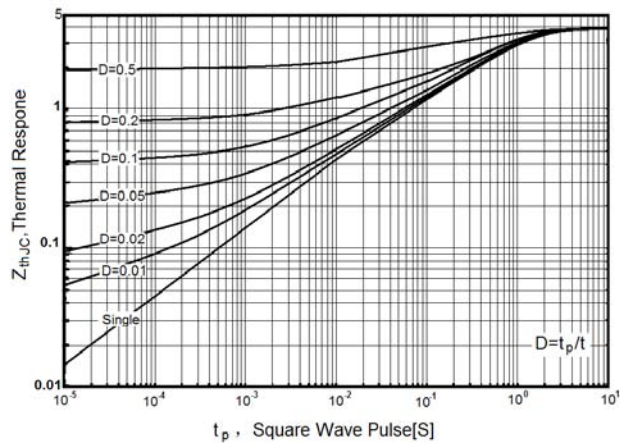
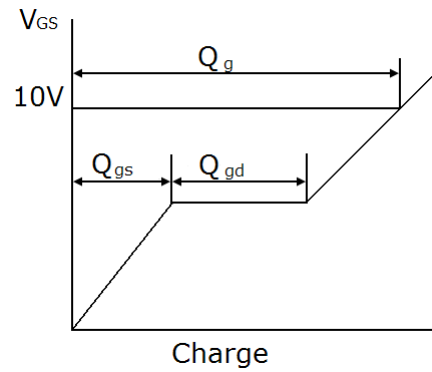
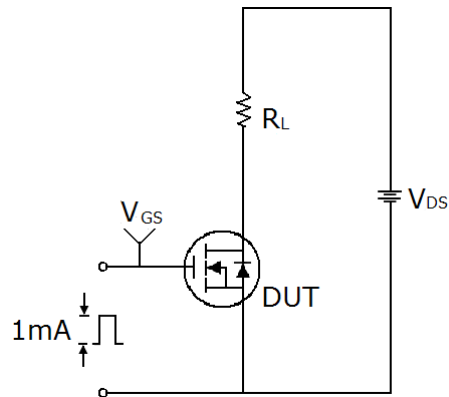


Figure13. Transient Thermal Impedance for TO-220F

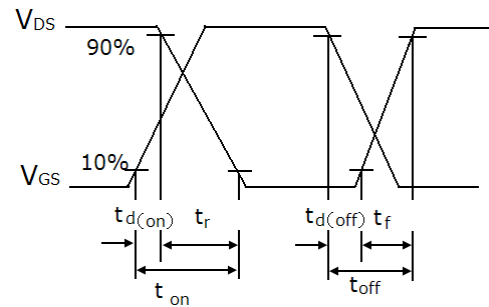
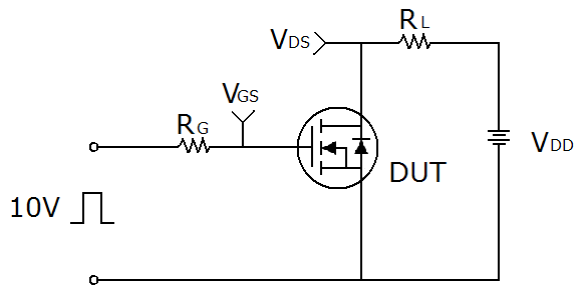


Test circuit

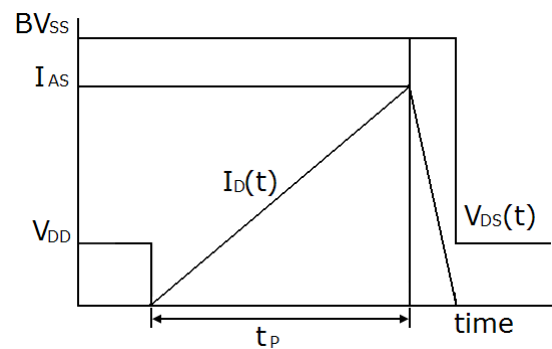
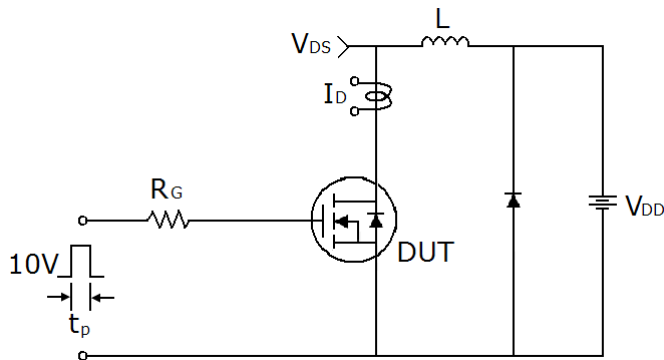
1) Gate charge test circuit & Waveform



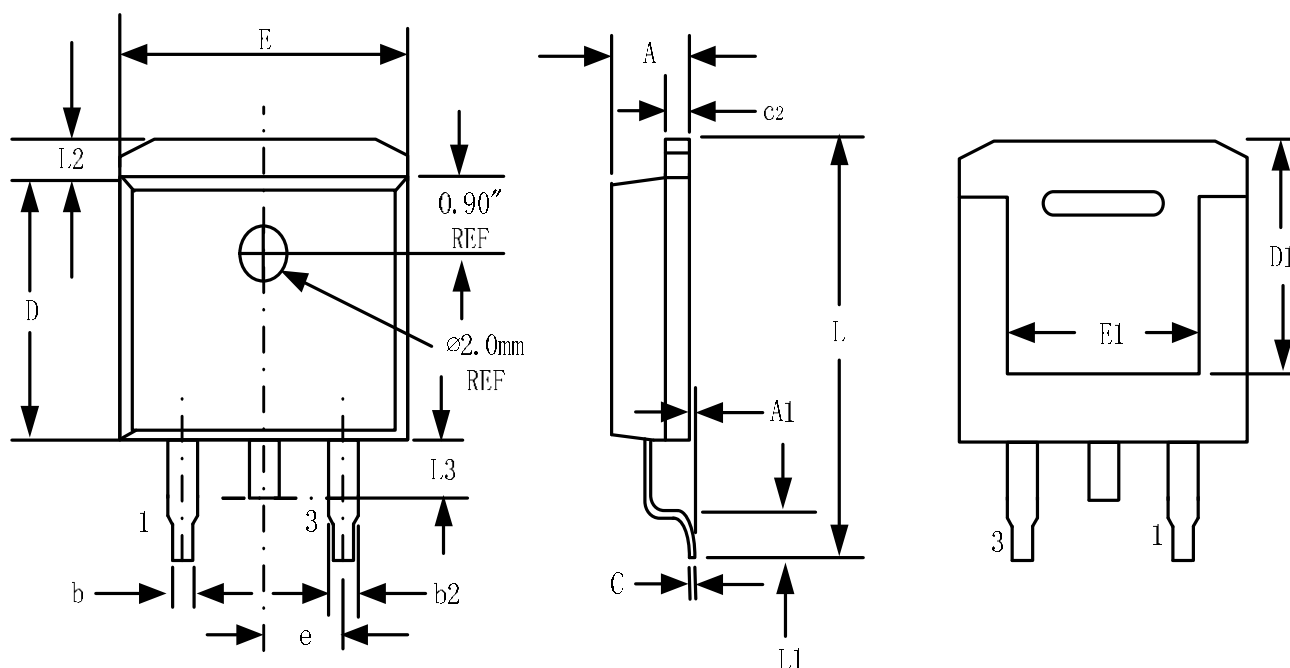
2) Switch Time Test Circuit



3) Unclamped Inductive Switching Test Circuit & Waveforms

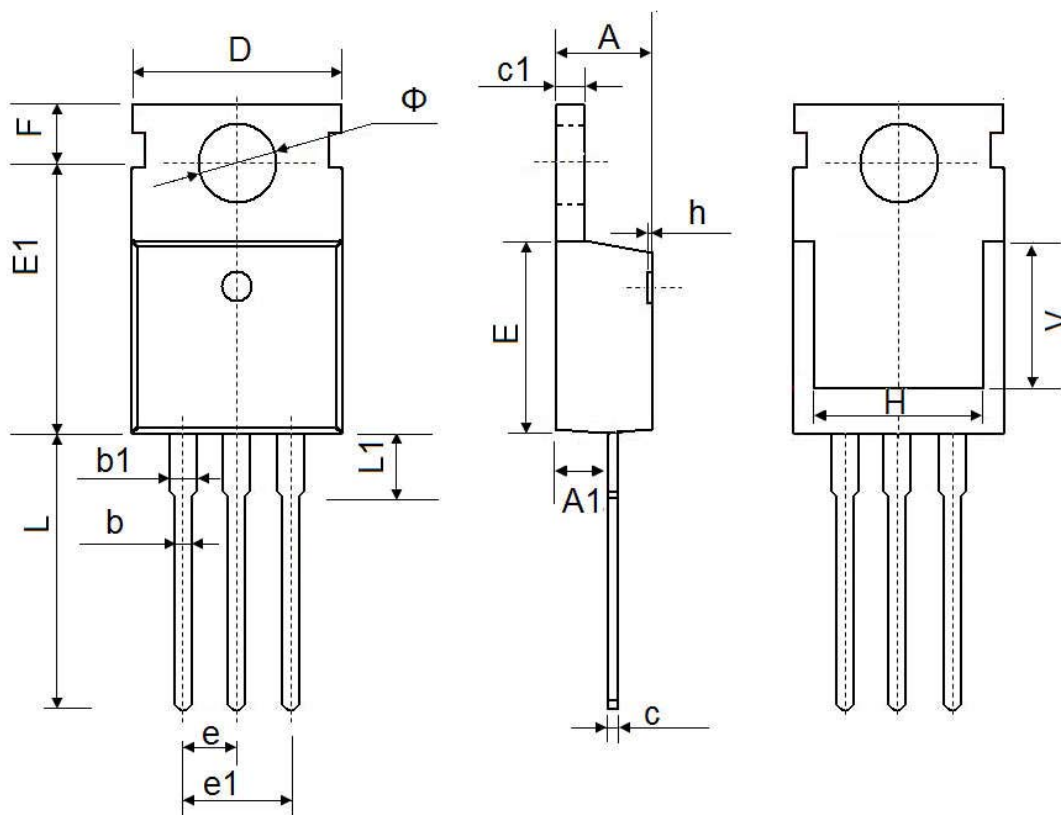


TO-263 Package Information



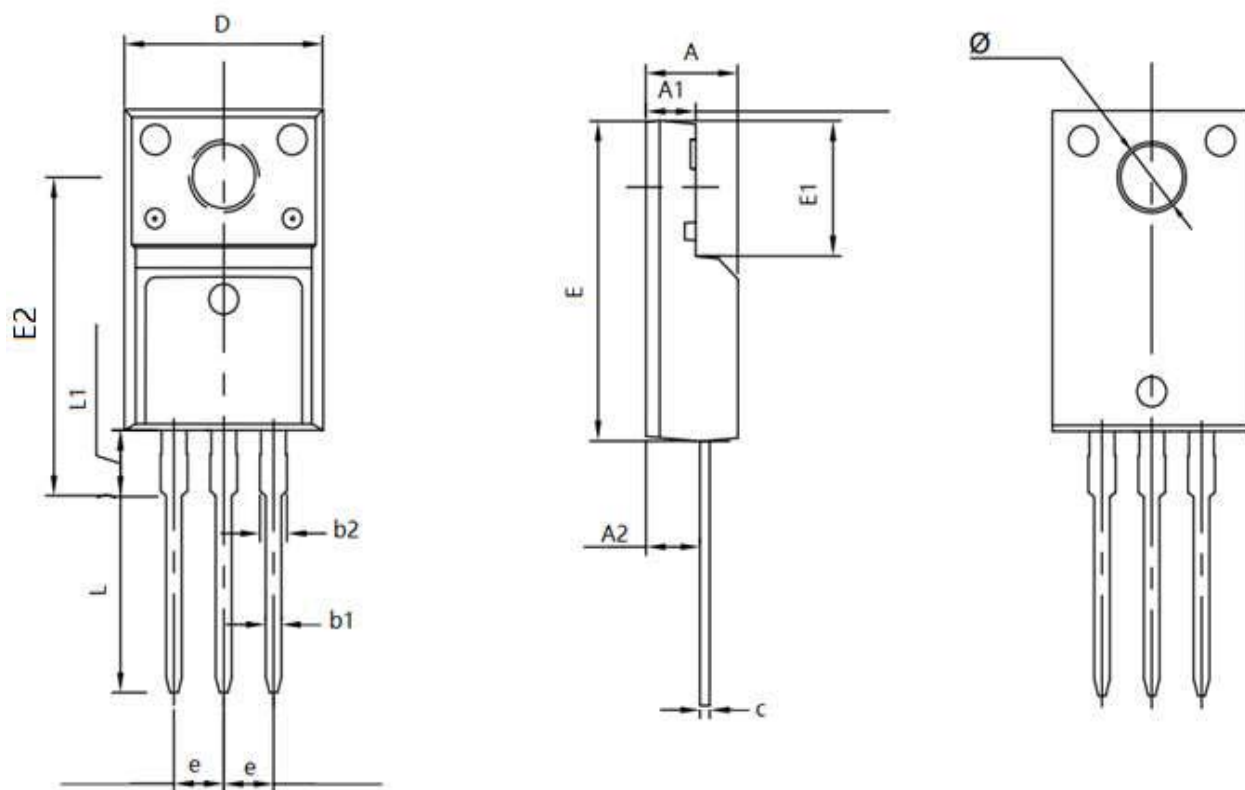
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.57	0.170	0.180
A1	-	0.25	-	0.010
b	0.71	0.94	0.028	0.037
b2	1.15	1.40	0.045	0.055
c	0.46	0.61	0.018	0.024
c2	1.22	1.40	0.048	0.055
D	8.89	9.40	0.350	0.370
D1	8.01	8.23	0.315	0.324
E	10.04	10.28	0.395	0.405
E1	7.88	8.08	0.310	0.318
e	2.54 BSC		0.100 BSC	
L	14.73	15.75	0.580	0.620
L1	2.29	2.79	0.090	0.110
L2	1.15	1.39	0.045	0.055
L3	1.27	1.77	0.050	0.070

TO-220 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
Φ	3.400	3.800	0.134	0.150

TO-220F Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.500	4.900	0.177	0.193
A1	2.340	2.740	0.092	0.108
A2	2.560	2.960	0.101	0.117
b1	0.700	0.900	0.028	0.035
b2	1.180	1.580	0.046	0.062
c	0.400	0.600	0.016	0.024
D	9.960	10.360	0.392	0.408
E	15.670	15.970	0.617	0.629
E1	6.500	6.900	0.256	0.272
E2	15.500	16.100	0.610	0.634
e	2.540 TYP		0.100 TYP	
Φ	3.080	3.280	0.121	0.129
L	12.640	13.240	0.498	0.521
L1	3.030	3.430	0.119	0.135