

## N-Channel Super Junction Power MOSFET III

### 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.

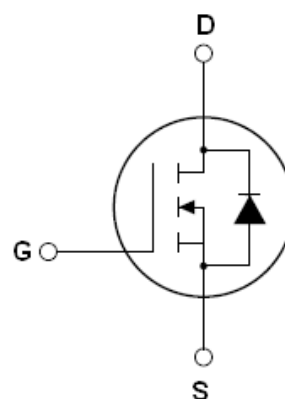
### Features

- 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)

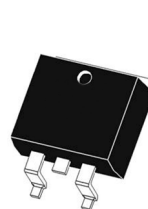
$V_{DS}$	700	V
$R_{DS(ON)TYP}$	820	m $\Omega$
$I_D$	5	A



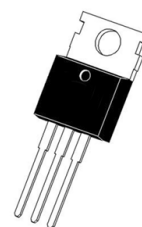
**Schematic diagram**

### Package Marking And Ordering Information

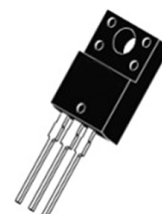
Device	Device Package	Marking
TGD70T900D	TO-263	TGD70T900D
TGD70T900	TO-220	TGD70T900
TGD70T900F	TO-220F	TGD70T900F



**TO-263**



**TO-220**



**TO-220F**

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

Parameter	Symbol	TGD70T900 TGD70T900D	TGD70T900F	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	700		V
Gate-Source Voltage ( $V_{DS}=0V$ ) AC ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$		V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	5	5*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	3	3*	A
Pulsed drain current <sup>(Note 1)</sup>	$I_{DM(pluse)}$	20	20*	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	46	29	W
Derate above $25^\circ\text{C}$		0.37	0.23	W/ $^\circ\text{C}$
Single pulse avalanche energy <sup>(Note2)</sup>	$E_{AS}$	52		mJ
Avalanche current <sup>(Note 1)</sup>	$I_{AR}$	0.9		A
Repetitive Avalanche energy , $t_{AR}$ limited by $T_{jmax}$ <sup>(Note 1)</sup>	$E_{AR}$	0.14		mJ



Parameter	Symbol	TGD70T900 TGD70T900D	TGD70T900F	Unit
Drain Source voltage slope, $V_{DS} \leq 480V$ ,	dv/dt	50		V/ns
Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	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	TGD70T900 TGD70T900D	TGD70T900F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	2.72	4.3	°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 <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	700			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =700V, V <sub>GS</sub> =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =700V, V <sub>GS</sub> =0V			50	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V			±100	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	3		4	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =2.5A		820	950	mΩ
Dynamic Characteristics						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =0V, F=1.0MHz		370		pF
Output Capacitance	C <sub>OSS</sub>			25		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			0.5		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =5A, V <sub>GS</sub> =10V		10.5	15	nC
Gate-Source Charge	Q <sub>gs</sub>			2.6		nC
Gate-Drain Charge	Q <sub>gd</sub>			5.3		nC
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =420V, I <sub>D</sub> =3A, R <sub>G</sub> =5Ω, V <sub>GS</sub> =10V		8		nS
Turn-on Rise Time	t <sub>r</sub>			4		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			55		nS
Turn-Off Fall Time	t <sub>f</sub>			11		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			5	A
Pulsed Source-drain current(Body Diode)	I <sub>SDM</sub>				20	A
Forward on voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃, I <sub>SD</sub> =5A, V <sub>GS</sub> =0V		0.9	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>j</sub> =25℃, I <sub>F</sub> =2.5A, di/dt=100A/μs		210		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.66		uC
Peak reverse recovery current	I <sub>rrm</sub>			6.5		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 for TO-220, TO-263

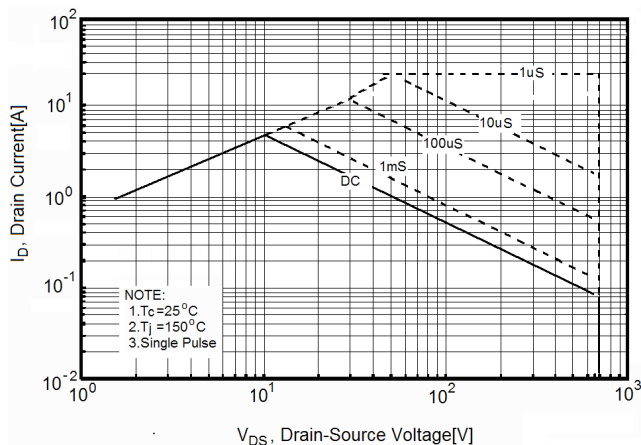


Figure2. Safe operating area for TO-220F

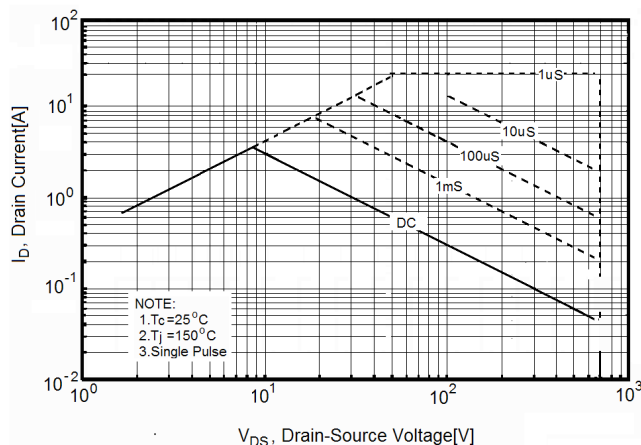


Figure3. Source-Drain Diode Forward Voltage

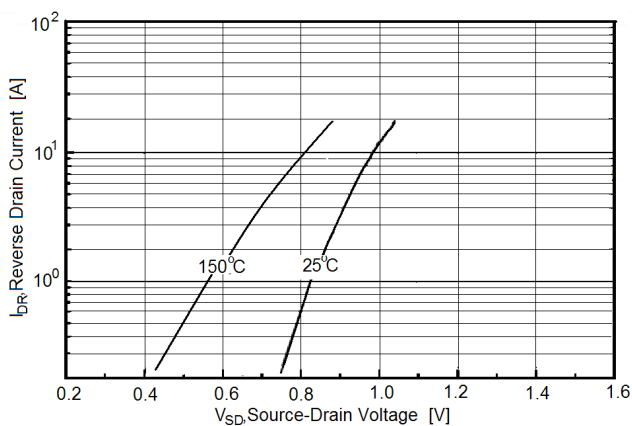


Figure4. Output characteristics

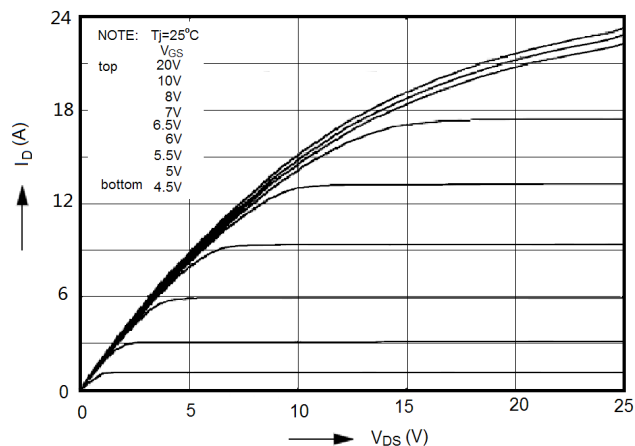


Figure5. Transfer characteristics

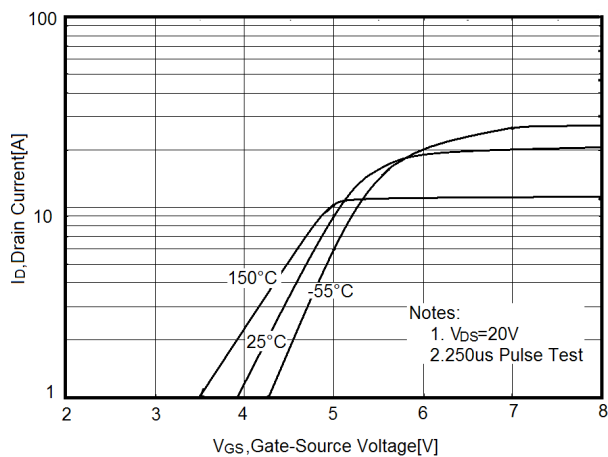


Figure6. Static drain-source on resistance

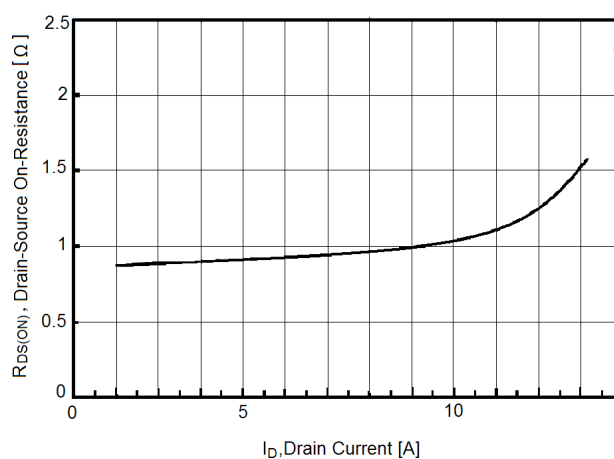


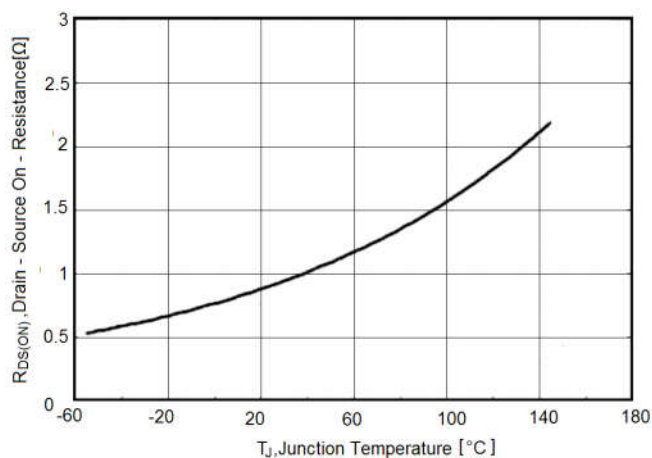
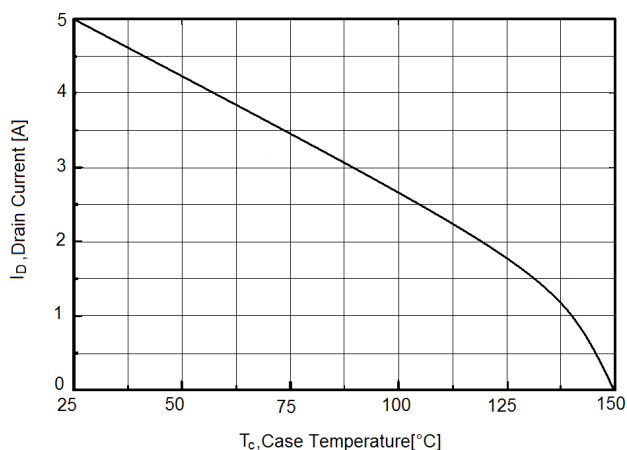
Figure7.  $R_{DS(ON)}$  vs Junction Temperature

Figure9. Maximum  $I_D$  vs Junction Temperature


Figure11. Capacitance

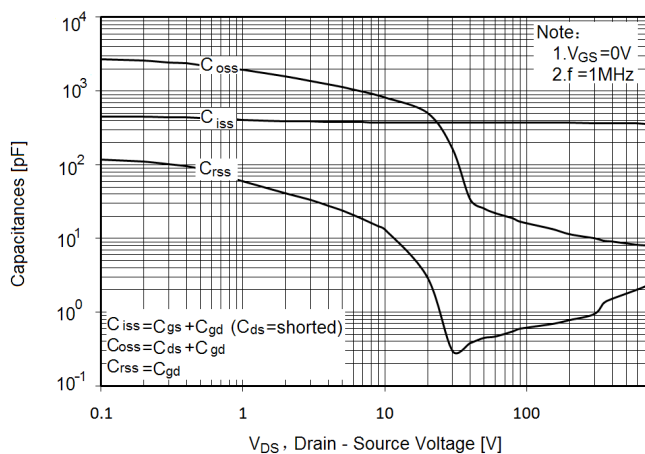
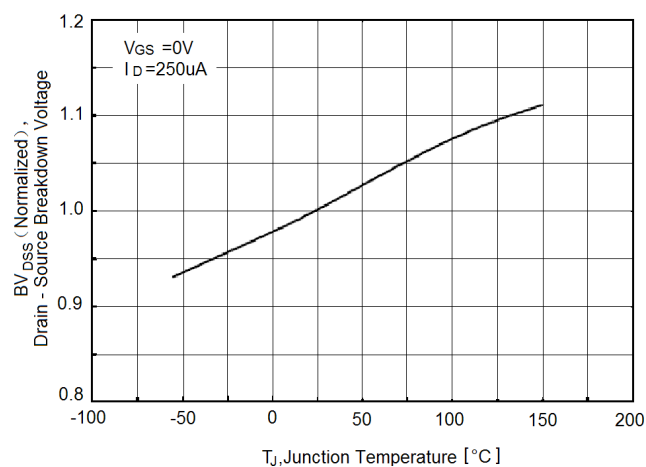

Figure8.  $BV_{DSS}$  vs Junction Temperature


Figure10. Gate charge waveforms

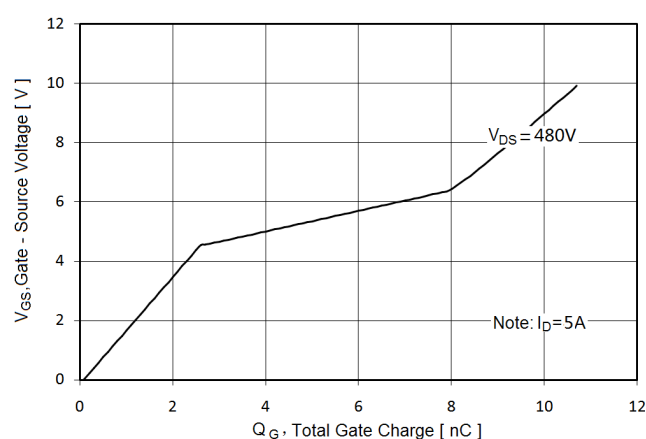


Figure12. Transient Thermal Impedance

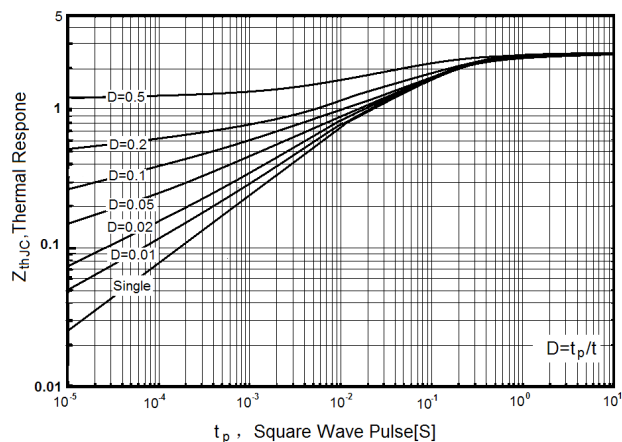
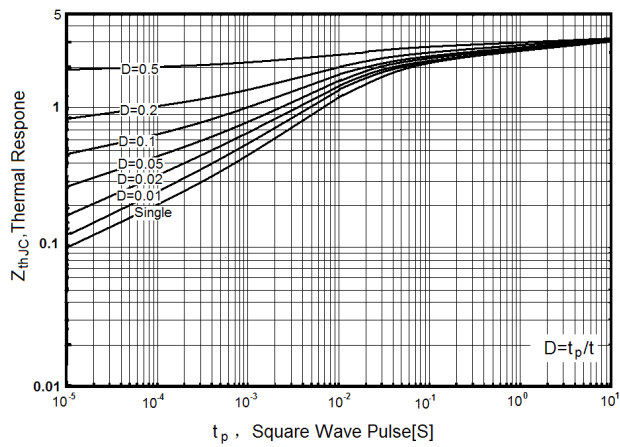
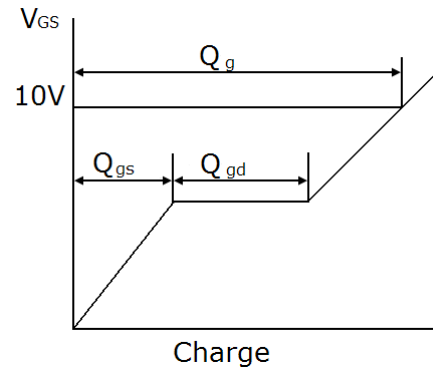
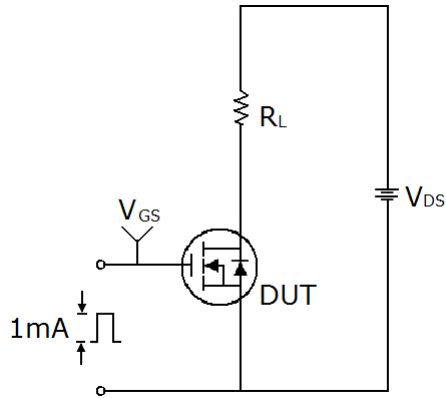


Figure13. Transient Thermal Impedance for TO-220F

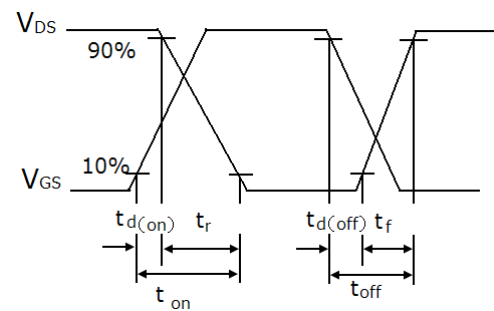
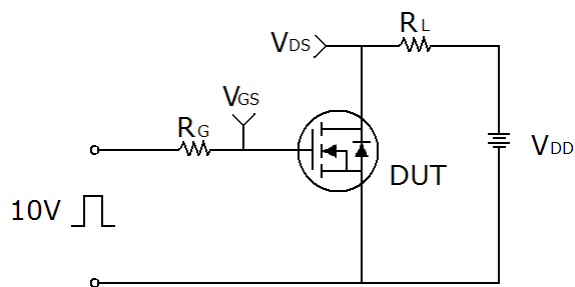


## Test circuit

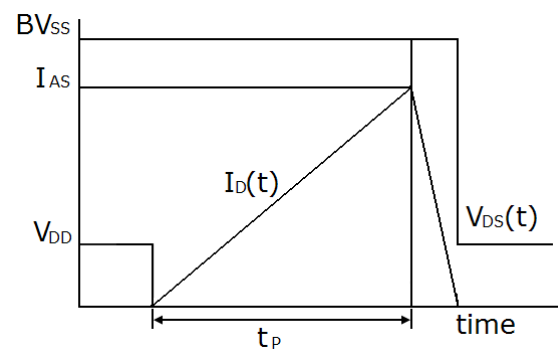
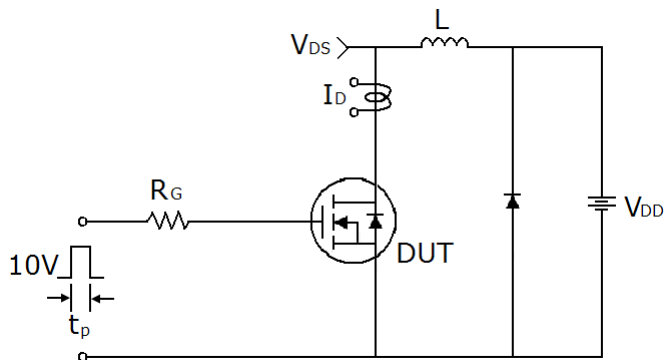
### 1) Gate charge test circuit & Waveform



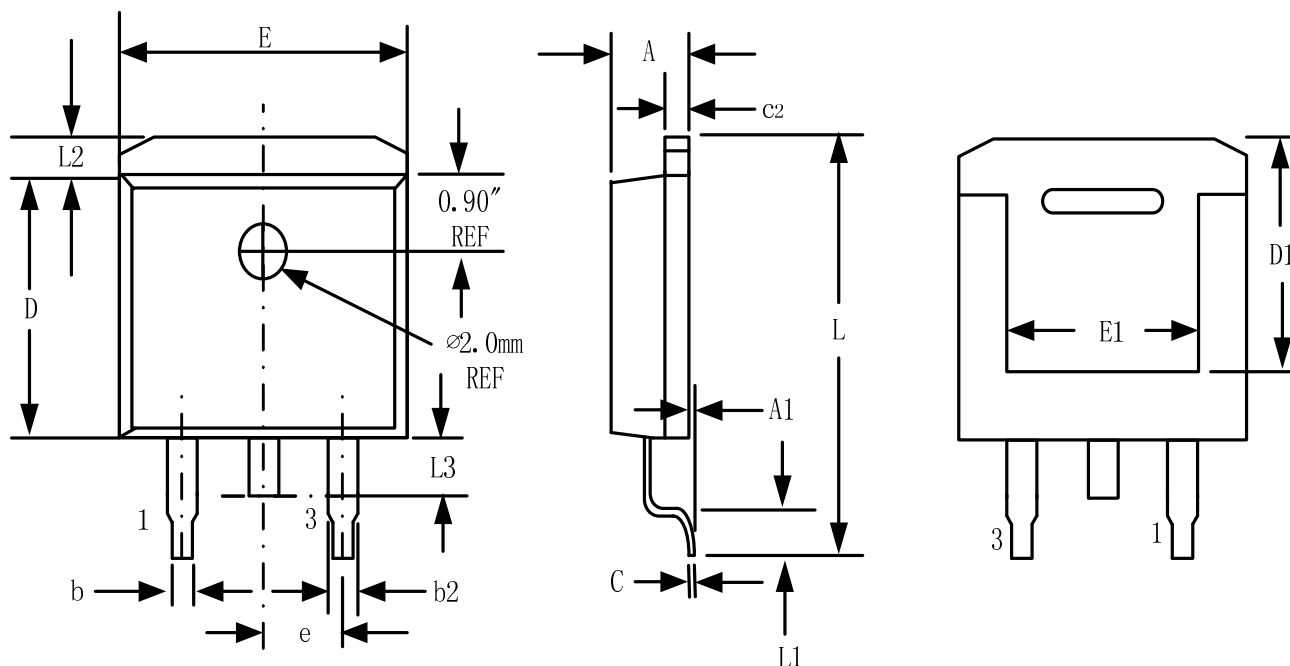
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

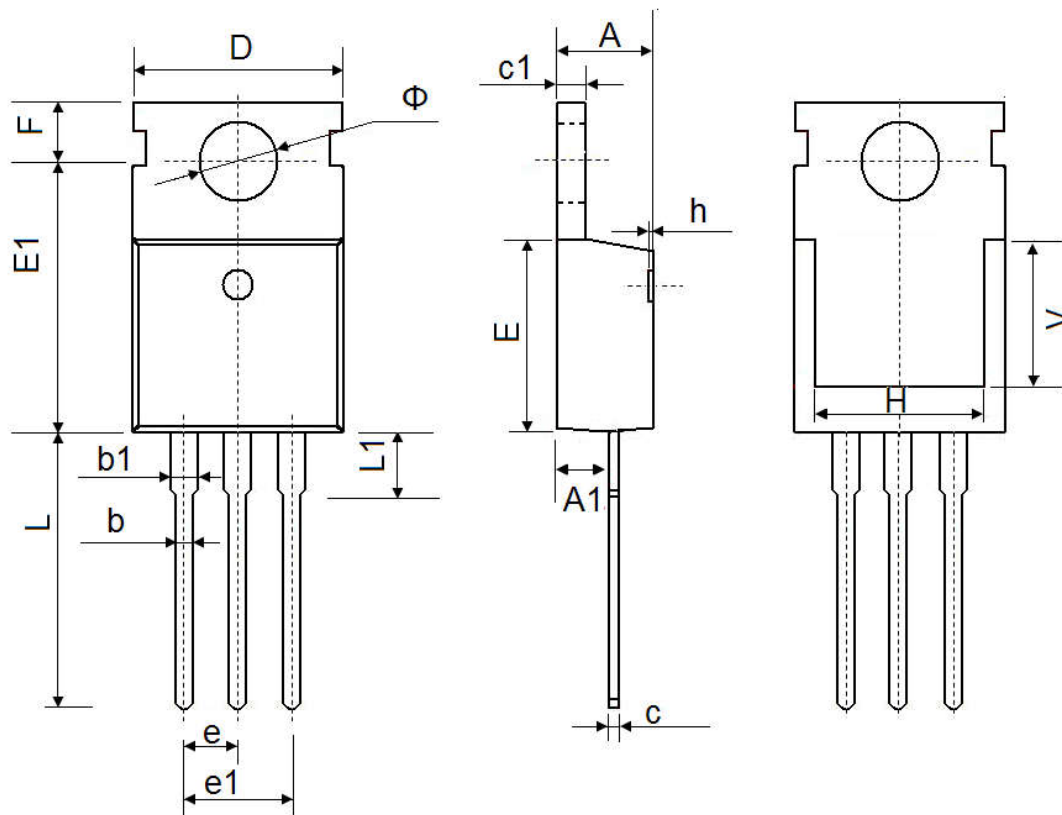


## TO-263-3L Package Information



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

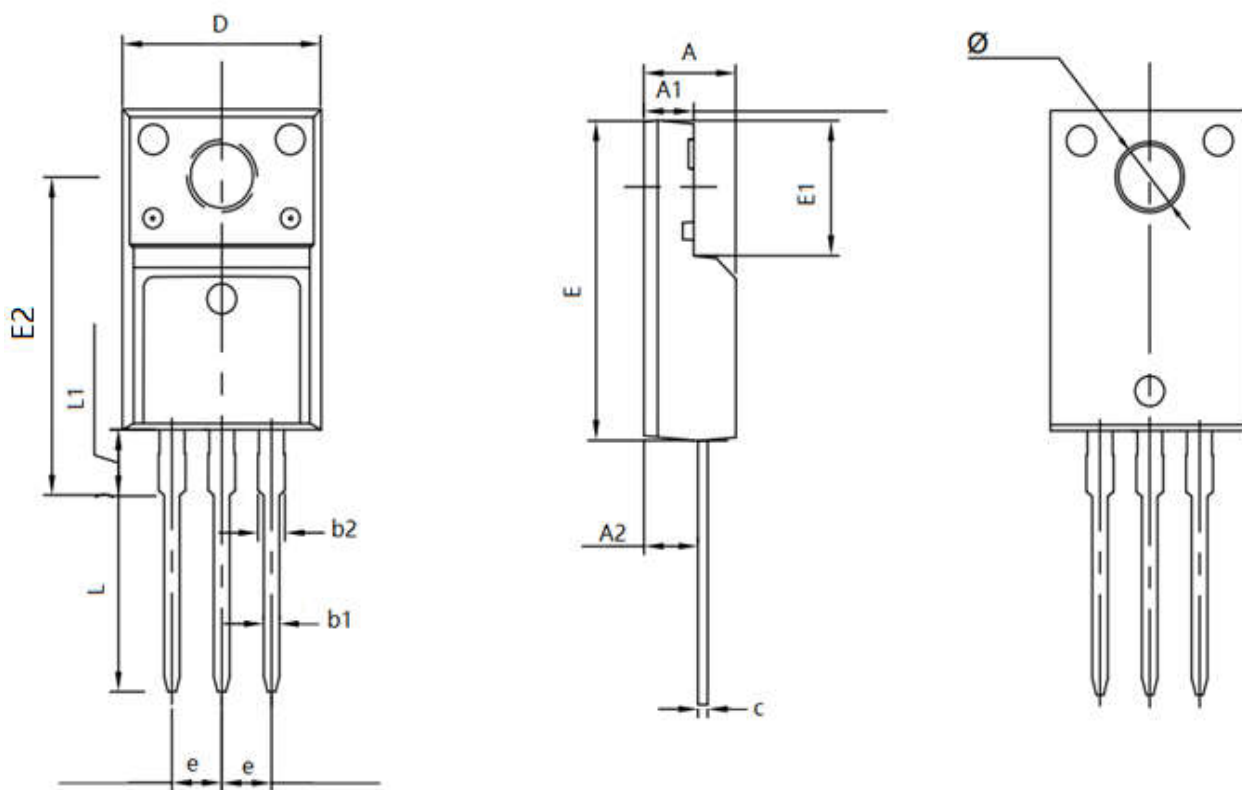
## TO-220-3L-C Package Information



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