

## N-Channel Super Junction Power MOSFET II

### General Description

The series of devices use advanced 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.

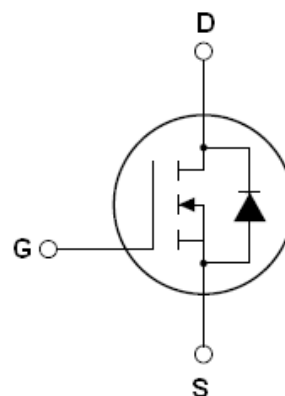
### Features

- 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)

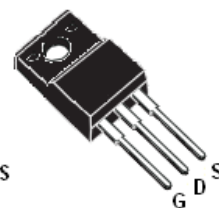
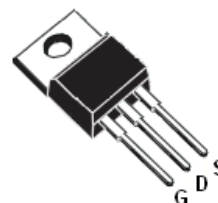
$V_{DS}$	700	V
$R_{DS(ON)TYP.}$	1200	m $\Omega$
$I_D$	4	A



**Schematic diagram**

### Package Marking And Ordering Information

Device	Device Package	Marking
TGD70R1K2	TO-220	TGD70R1K2
TGD70R1K2D	TO-263	TGD70R1K2D
TGD70R1K2F	TO-220F	TGD70R1K2F



**TO-263**

**TO-220**

**TO-220F**

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

Parameter	Symbol	TGD70R1K2 TGD70R1K2D	TGD70R1K2F	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	700		V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$		V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_D(DC)$	4	4*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_D(DC)$	2.5	2.5	A
Pulsed drain current <sup>(Note 1)</sup>	$I_{DM}(pluse)$	12	12	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	46	28.5	W
Derate above $25^\circ\text{C}$		0.37	0.23	W/ $^\circ\text{C}$
Single pulse avalanche energy <sup>(Note2)</sup>	$E_{AS}$	130		mJ
Avalanche current <sup>(Note 1)</sup>	$I_{AR}$	2		A
Repetitive Avalanche energy , $t_{AR}$ limited by $T_{jmax}$ <sup>(Note 1)</sup>	$E_{AR}$	0.2		mJ



Parameter	Symbol	TGD70R1K2 TGD70R1K2D	TGD70R1K2F	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	TGD70R1K2 TGD70R1K2D	TGD70R1K2F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	2.7	4.4	°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> =±30V, 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	2.5	3	3.5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =2.5A		1200	1400	mΩ
Dynamic Characteristics						
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 20V, I <sub>D</sub> = 2.5A		4		S
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =0V, F=1.0MHz		280		PF
Output Capacitance	C <sub>oss</sub>			26		PF
Reverse Transfer Capacitance	C <sub>rss</sub>			2.3		PF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =4A, V <sub>GS</sub> =10V		6.5	10	nC
Gate-Source Charge	Q <sub>gs</sub>			1.3		nC
Gate-Drain Charge	Q <sub>gd</sub>			2.5		nC
Intrinsic gate resistance	R <sub>G</sub>	f = 1 MHz open drain		2.5		Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V, I <sub>D</sub> =2.5A, R <sub>G</sub> =20Ω, V <sub>GS</sub> =10V		6		nS
Turn-on Rise Time	t <sub>r</sub>			3		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			48	60	nS
Turn-Off Fall Time	t <sub>f</sub>			8	15	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			4	A
Pulsed Source-drain current(Body Diode)	I <sub>SDM</sub>				12	A
Forward On Voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃, I <sub>SD</sub> =4A, V <sub>GS</sub> =0V		1	1.3	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>j</sub> =25℃, I <sub>F</sub> =4A, di/dt=100A/μs		150		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.85		uC
Peak reverse recovery current	I <sub>rrm</sub>			11		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

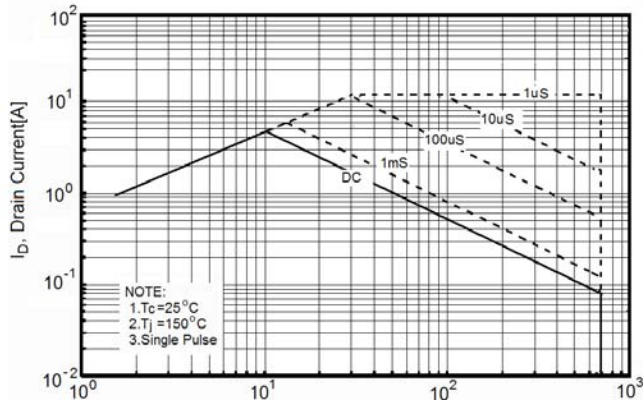


Figure2. Source-Drain Diode Forward Voltage

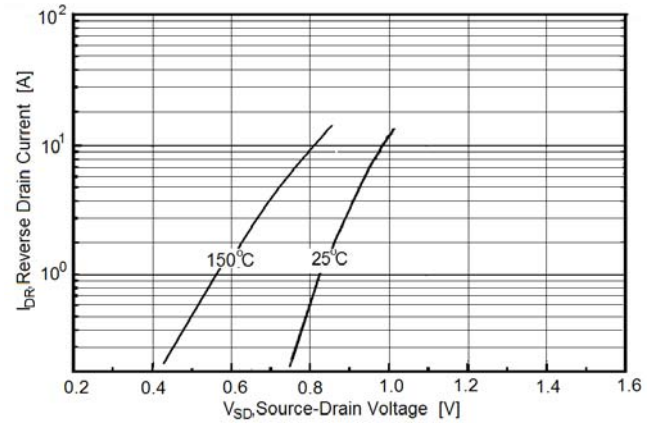


Figure3. Output characteristics

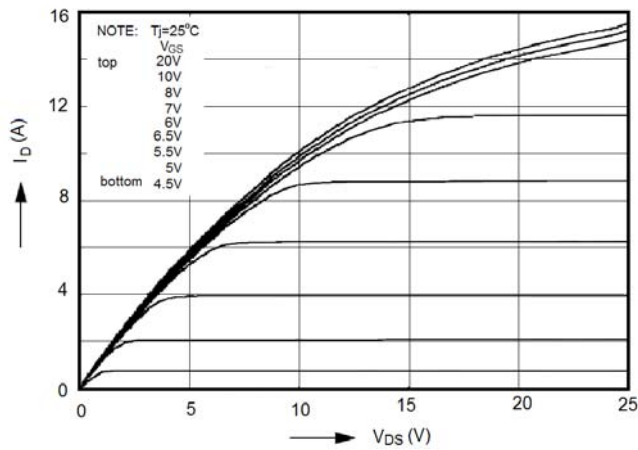


Figure4. Transfer characteristics

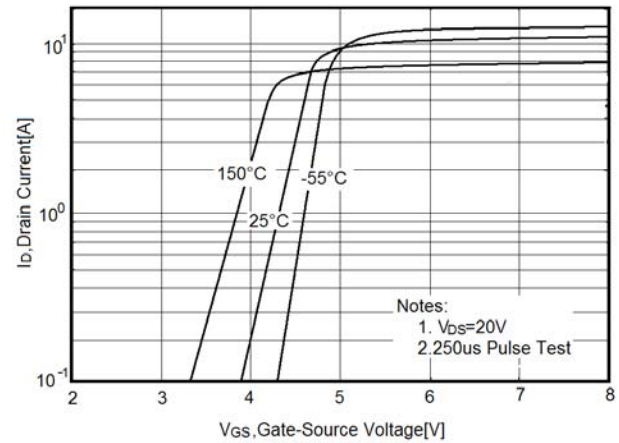
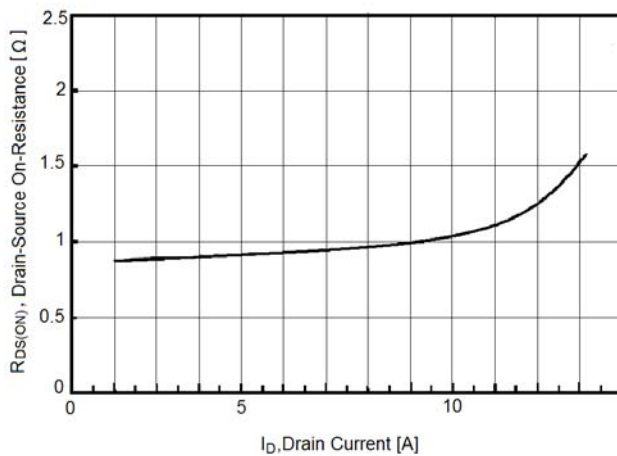
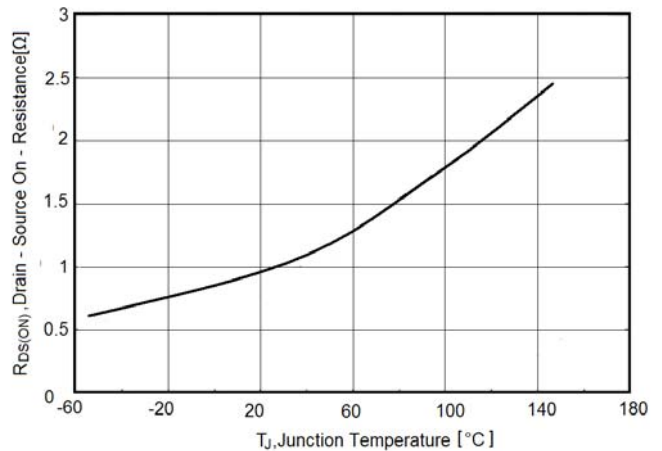
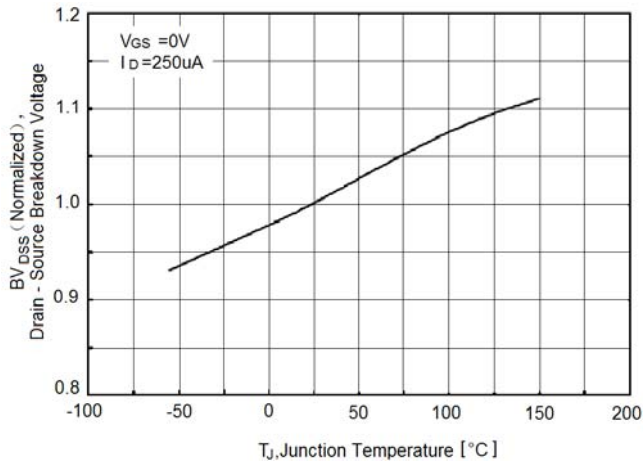


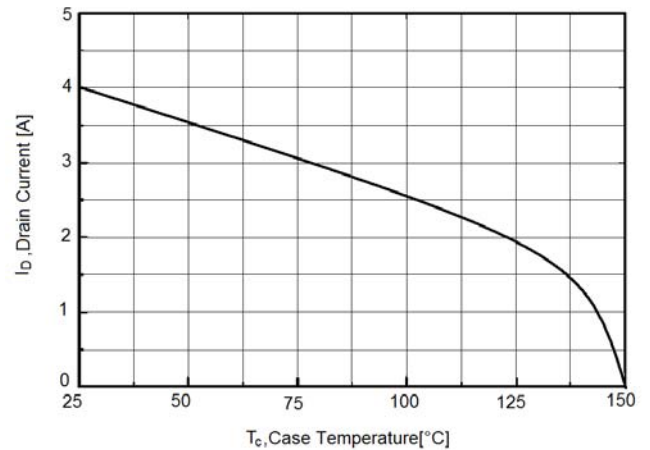
Figure5. Static drain-source on resistance


Figure6.  $R_{DS(ON)}$  vs Junction Temperature


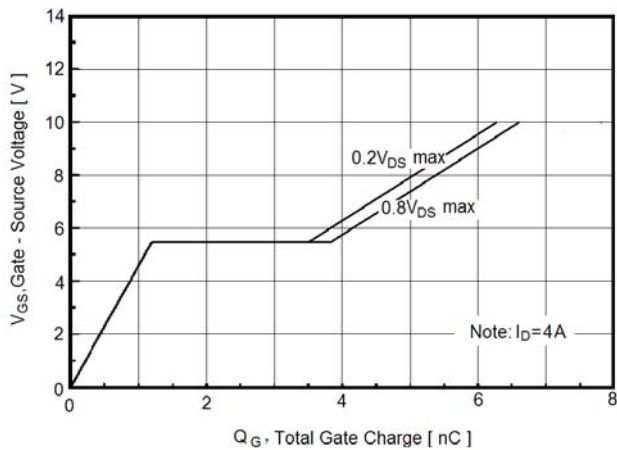
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



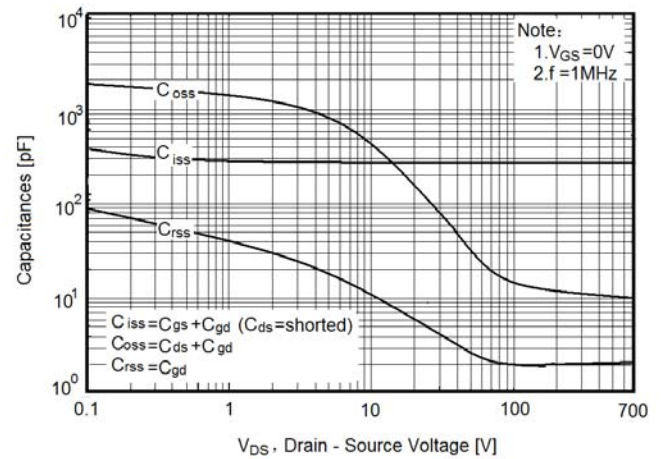
**Figure8. Maximum  $I_D$  vs Junction Temperature**



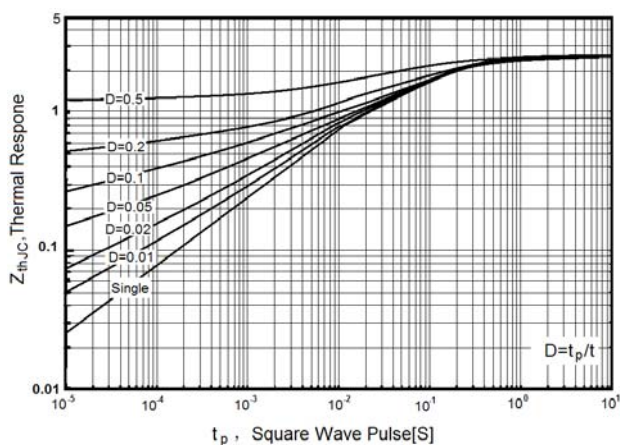
**Figure9. Gate charge waveforms**



**Figure10. Capacitance**



**Figure11. Transient Thermal Impedance for TO-220,TO-263**



**Figure12. Safe operating area for TO-220F**

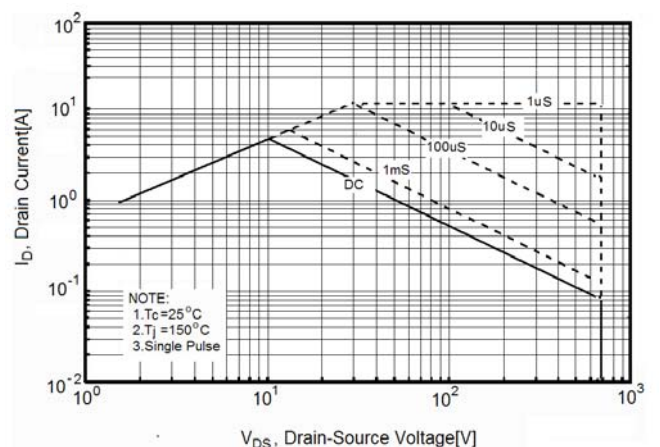
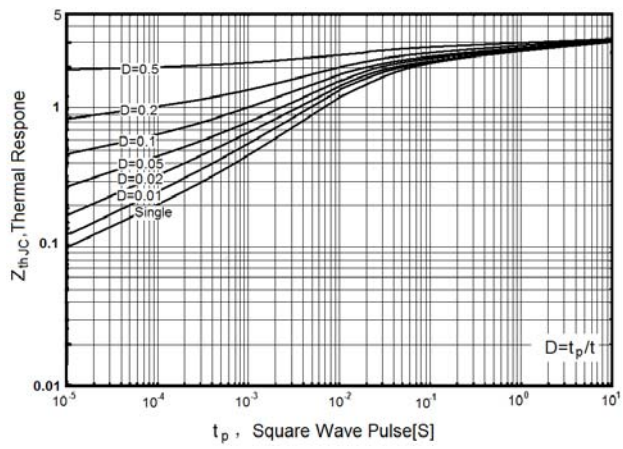
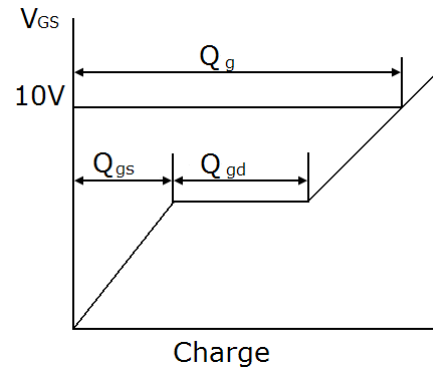
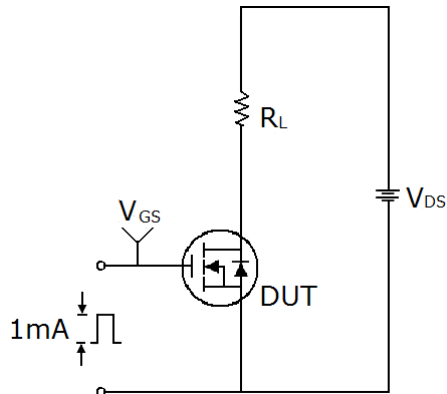


Figure13. Transient Thermal Impedance for TO-220F

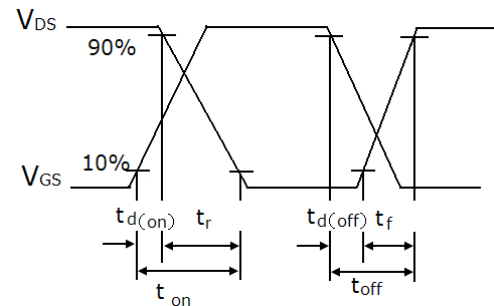
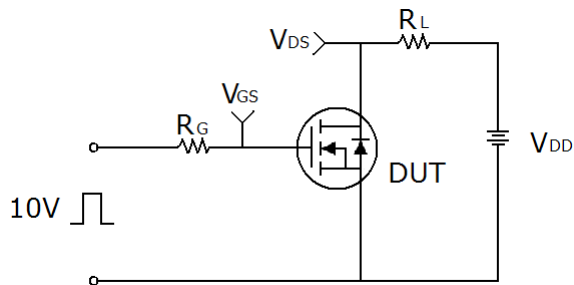


## Test circuit

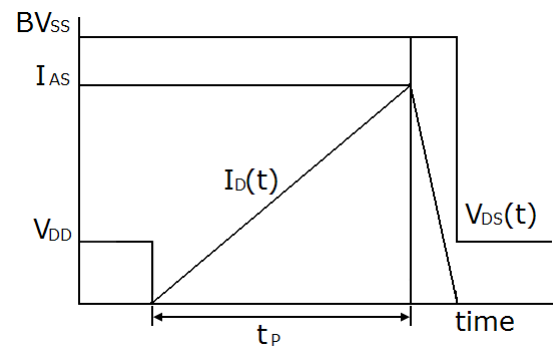
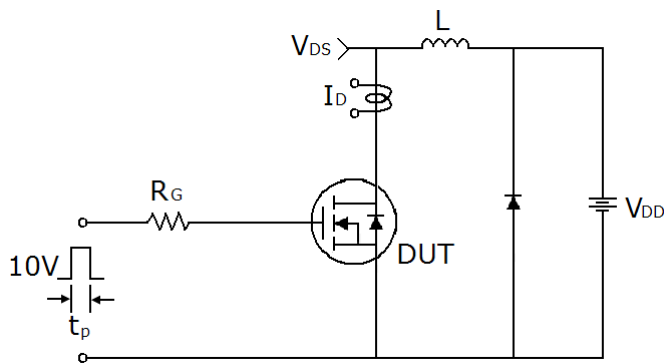
### 1) Gate charge test circuit & Waveform



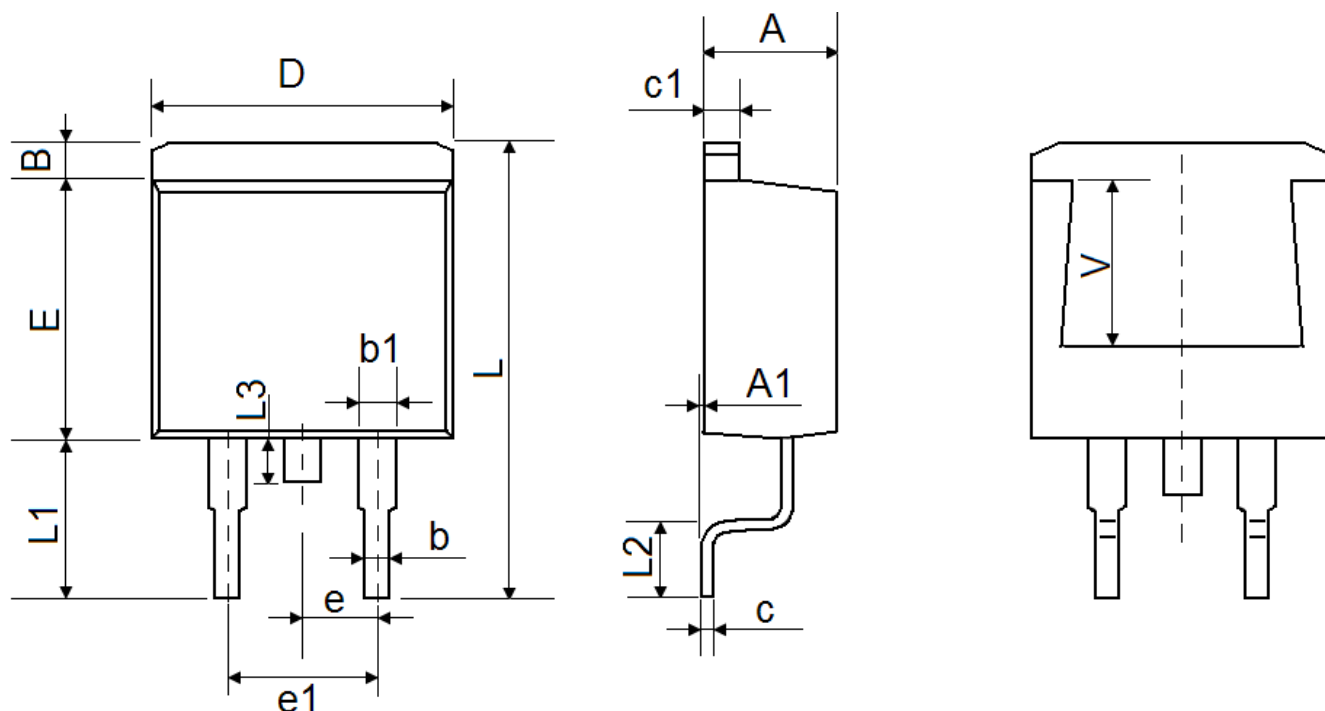
### 2) Switch Time Test Circuit:



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

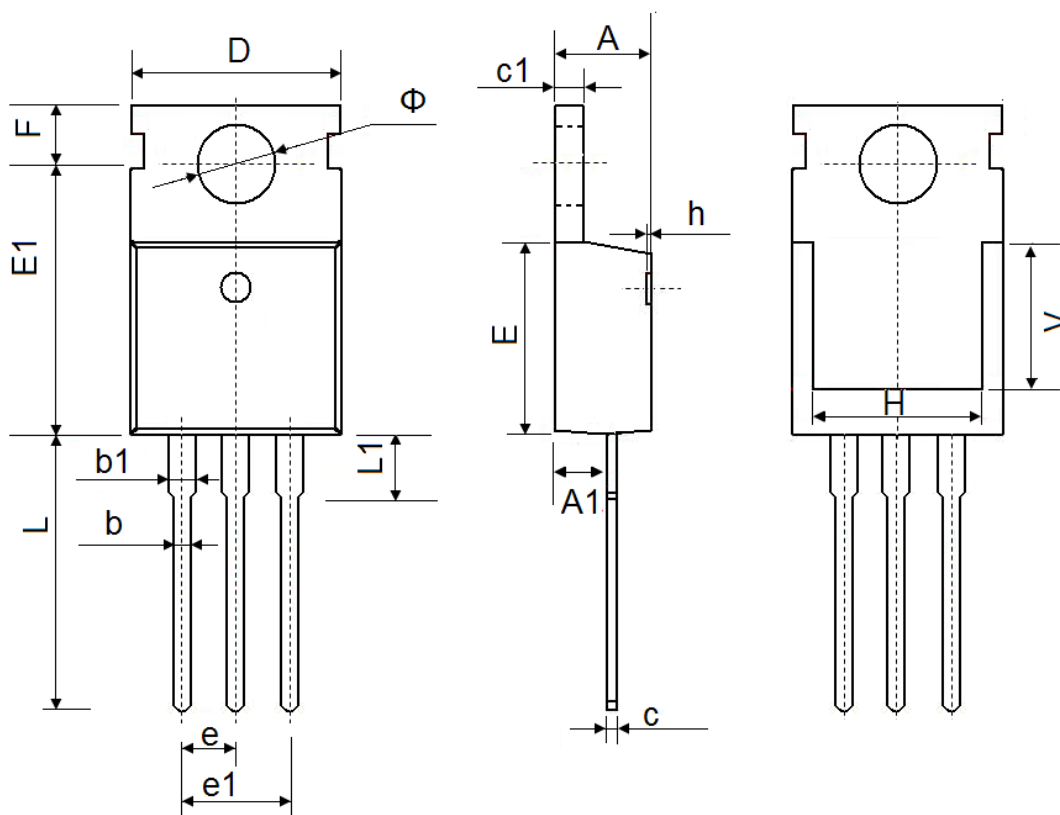


## TO-263-2L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.170	1.370	0.046	0.054
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
L	15.050	15.450	0.593	0.608
L1	5.080	5.480	0.200	0.216
L2	2.340	2.740	0.092	0.108
L3	1.300	1.700	0.051	0.067
V	5.600 REF		0.220 REF	

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

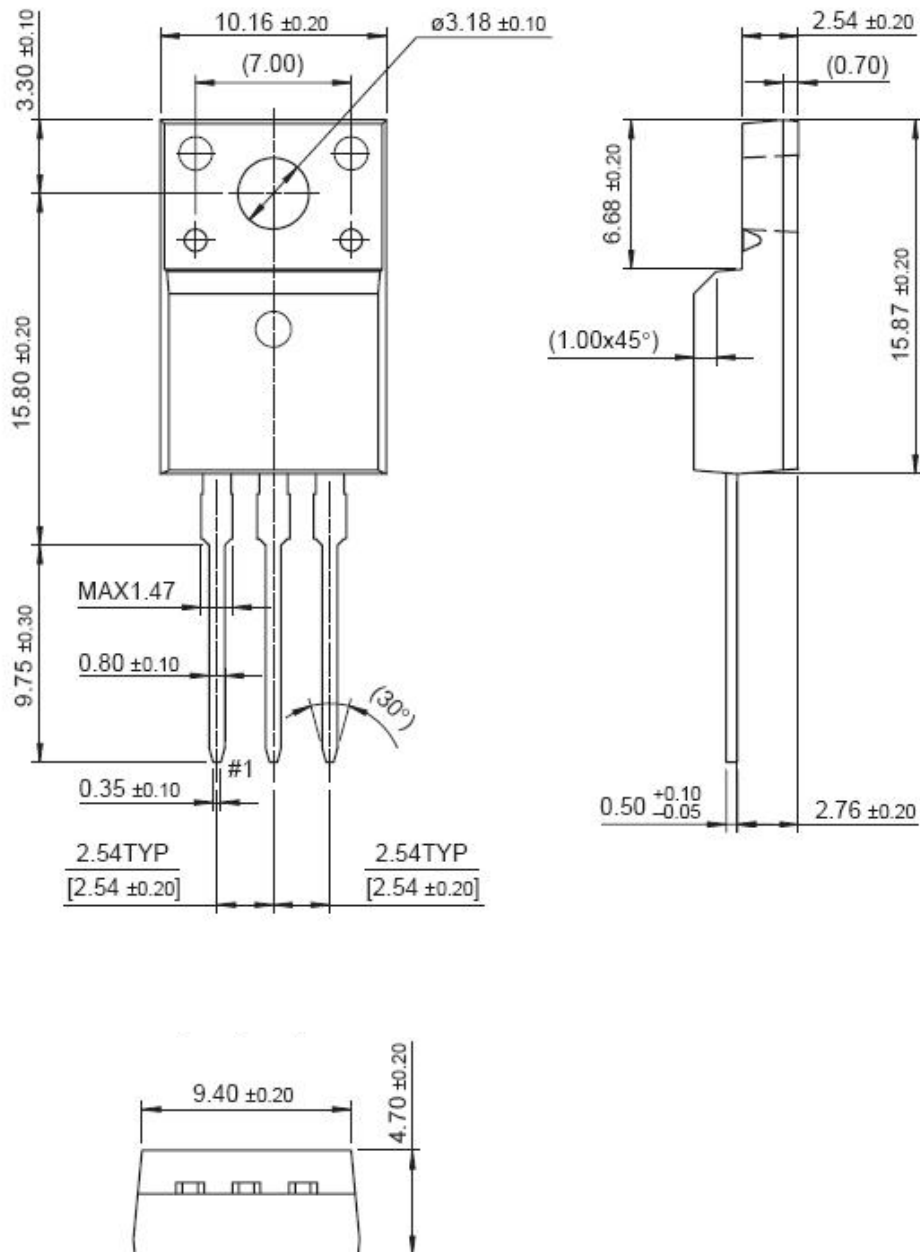


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	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



Dimensions in Millimeters