

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.

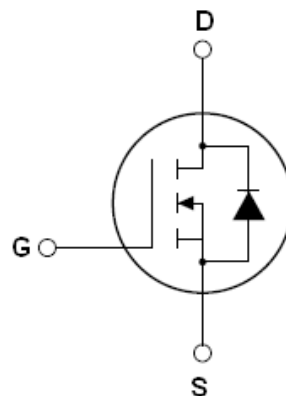
Features

- Optimized body diode reverse recovery performance
- 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)
- LLC Half-bridge

V_{DS}	650	V
$R_{DS(ON)TYP}$	96	mΩ
I_D	29	A



Schematic diagram

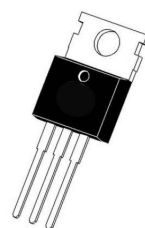
✧ Intrinsic fast-recovery body diode

Package Marking And Ordering Information

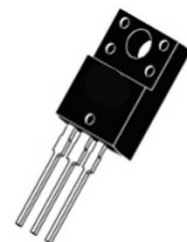
Device	Device Package	Marking
HMS29N65D	TO-263	HMS29N65D
HMS29N65	TO-220	HMS29N65
HMS29N65F	TO-220F	HMS29N65F



TO-263



TO-220



TO-220F

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

Parameter	Symbol	HMS29N65D HMS29N65	HMS29N65F	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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	29	29*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	20	20*	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	87	87*	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	260	35	W
Derate above 25°C		2.08	0.28	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	E_{AS}	676		mJ
Avalanche current (Note 1)	I_{AR}	5.2		A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	3.2		mJ

Parameter	Symbol	HMS29N65D HMS29N65	HMS29N65F	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	50		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	HMS29N65D HMS29N65	HMS29N65F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	0.48	3.57	°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℃)	I _{DSS}	V _{DS} =650V,V _{GS} =0V			3	μA
Zero Gate Voltage Drain Current(Tc=125℃)	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	2.0		4.0	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =14A		96	110	mΩ
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{DS} =50V,V _{GS} =0V, F=1.0MHz		2070		pF
Output Capacitance	C _{oss}			120		pF
Effective output capacitance, energy related	C _{o(er)}	V _{GS} =0 V,V _{DS} =0...480 V		60		pF
Effective output capacitance, time related	C _{o(tr)}	ID=constant, V _{GS} =0 V V _{DS} =0...480V		311		pF
Total Gate Charge	Q _g	V _{DS} =480V,I _D =29A, V _{GS} =10V		37.5		nC
Gate-Source Charge	Q _{gs}			13		nC
Gate-Drain Charge	Q _{gd}			11.5		nC
Switching times						
Turn-on Delay Time	t _{d(on)}	V _{DD} =380V,I _D =14A, R _G =2.3Ω,V _{GS} =10V		14		nS
Turn-on Rise Time	t _r			12		nS
Turn-Off Delay Time	t _{d(off)}			65		nS
Turn-Off Fall Time	t _f			11		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I _{SD}	T _C =25℃			29	A
Pulsed Source-drain current(Body Diode)	I _{SDM}				87	A
Forward On Voltage	V _{SD}	T _j =25℃,I _{SD} =29A,V _{GS} =0V		0.9	1.2	V
Reverse Recovery Time	t _{rr}	T _j =25℃,I _F =14A,di/dt=100A/μs		190		nS
Reverse Recovery Charge	Q _{rr}			2		uC
Peak Reverse Recovery Current	I _{rrm}			21		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

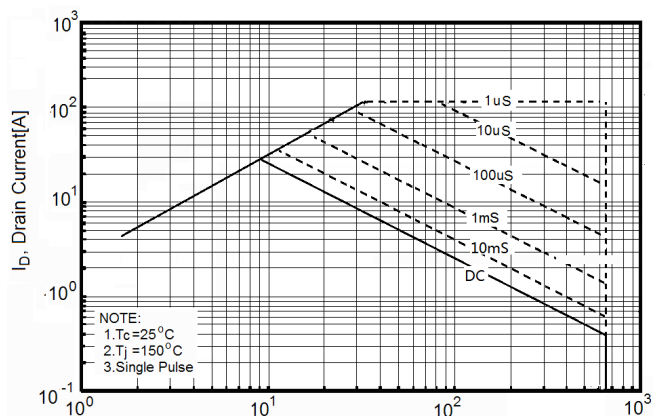


Figure2. Safe operating area for TO-220F

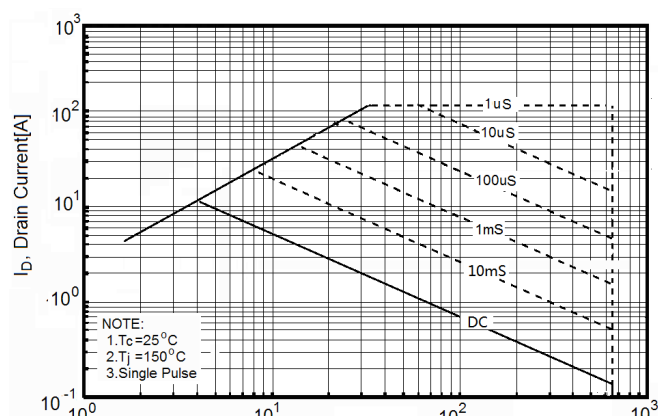


Figure3. Source-Drain Diode Forward Voltage

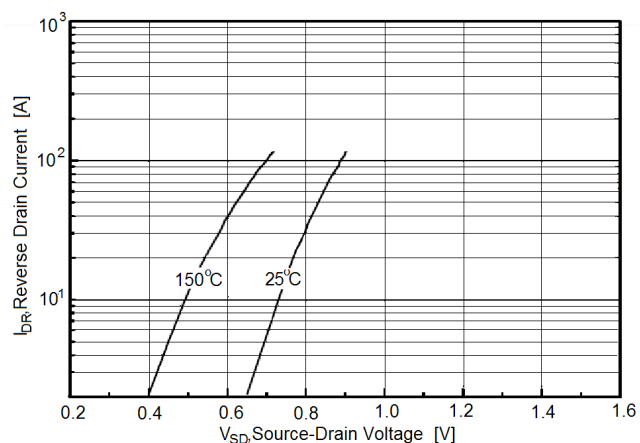


Figure4. Output characteristics

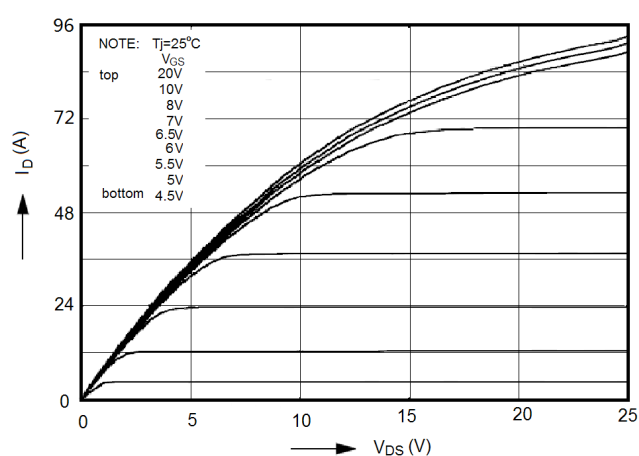


Figure5. Transfer characteristics

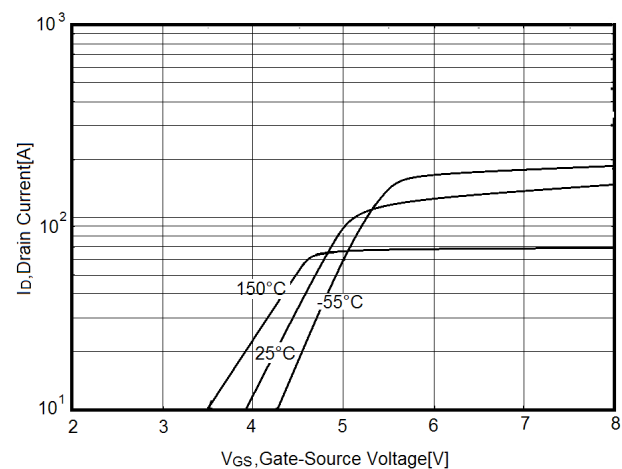


Figure6. Static drain-source on resistance

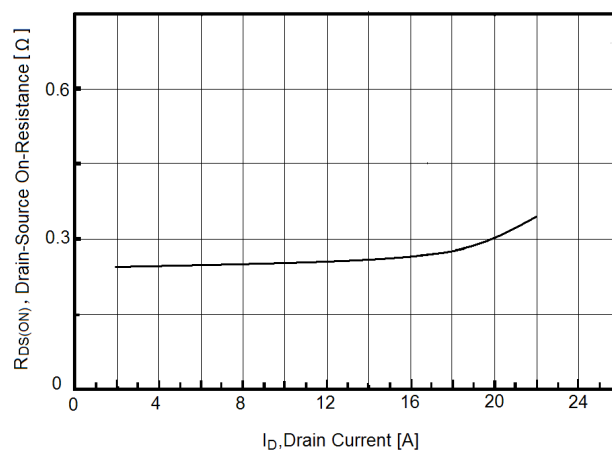


Figure7. $R_{DS(on)}$ vs Junction Temperature

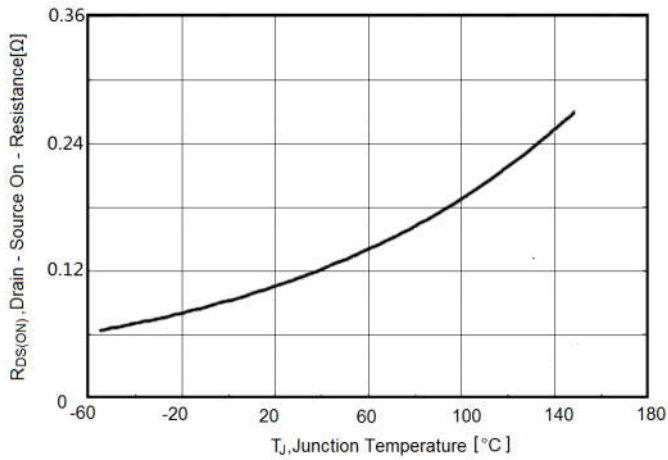


Figure8. BV_{DSS} vs Junction Temperature

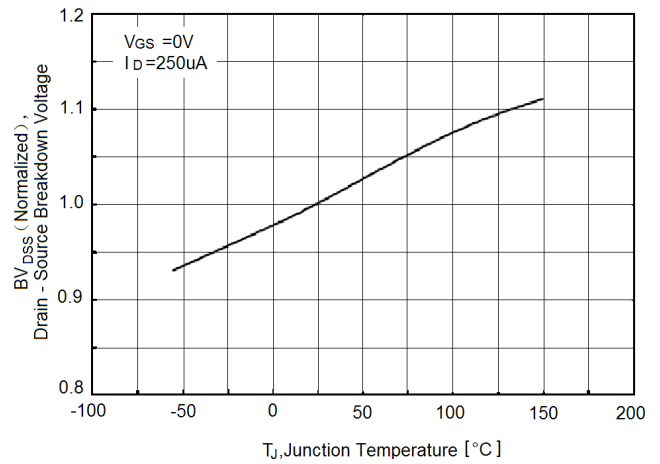


Figure9. Maximum I_D vs Junction Temperature

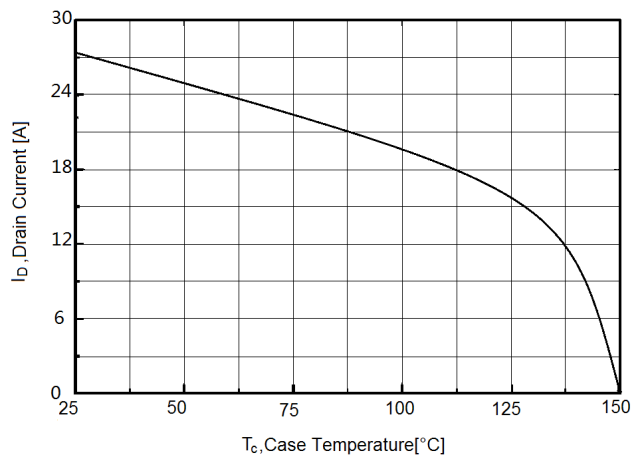


Figure10. Gate charge waveforms

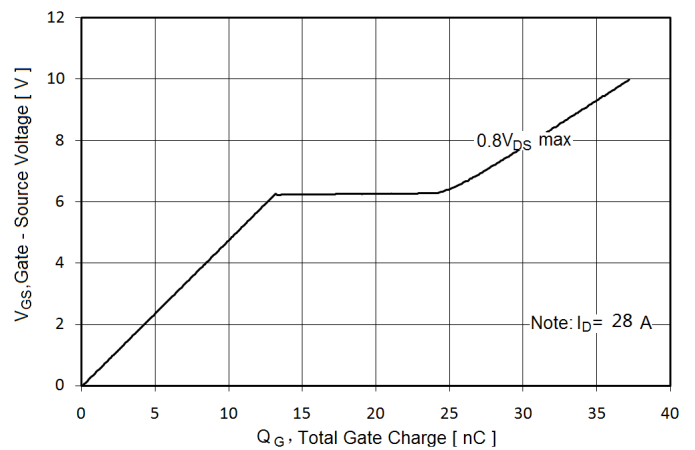


Figure11. Capacitance

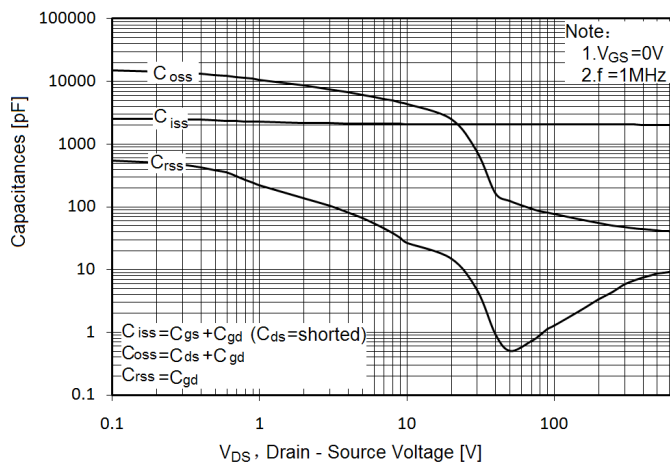


Figure12. Transient Thermal Impedance

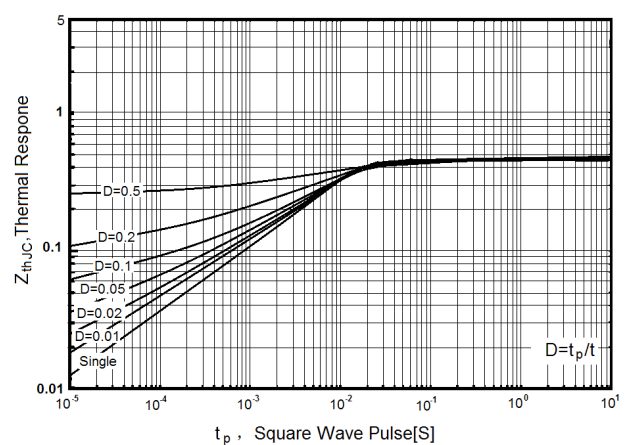
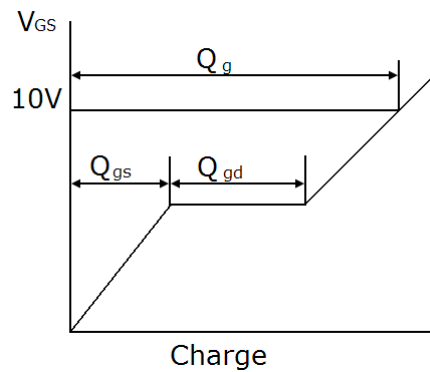
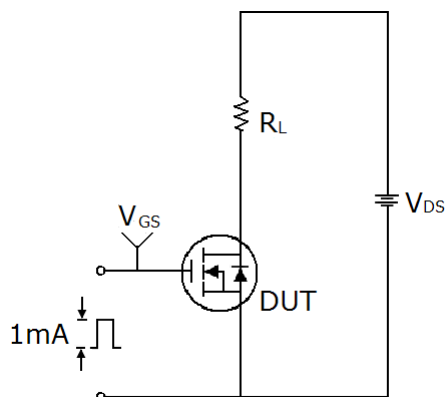


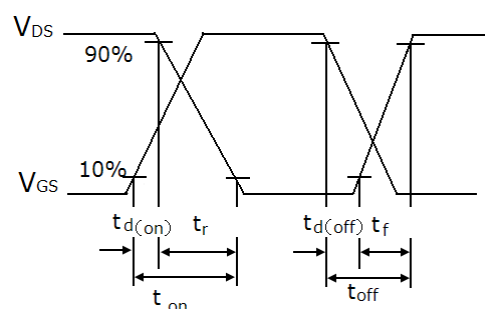
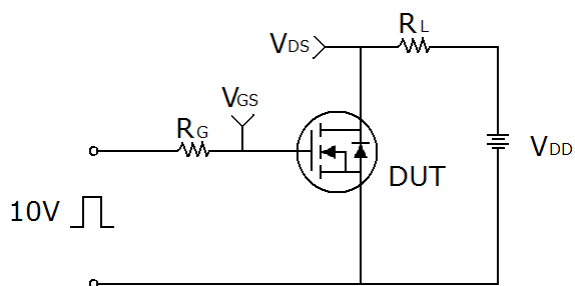
Figure 1 is a log-log plot showing the Thermal Response (Z_{thJC}) on the y-axis (ranging from 0.01 to 5) versus the Square Wave Pulse duration (t_p) on the x-axis (ranging from 10^{-5} to 10^1). The plot displays several curves corresponding to different values of the parameter D (0.01, 0.02, 0.05, 0.1, 0.2, 0.5). A curve labeled "Single" is also shown. The curves indicate that the thermal response increases with pulse duration and decreases as the parameter D increases. The parameter D is defined as $D = t_p/t$.

Test circuit

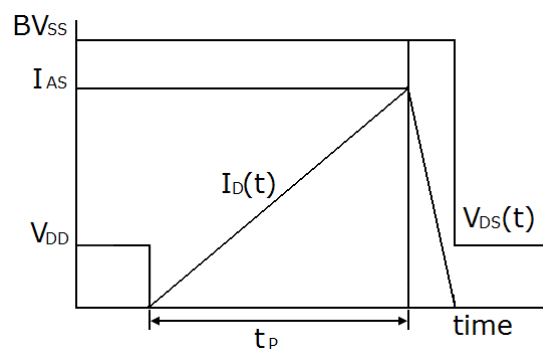
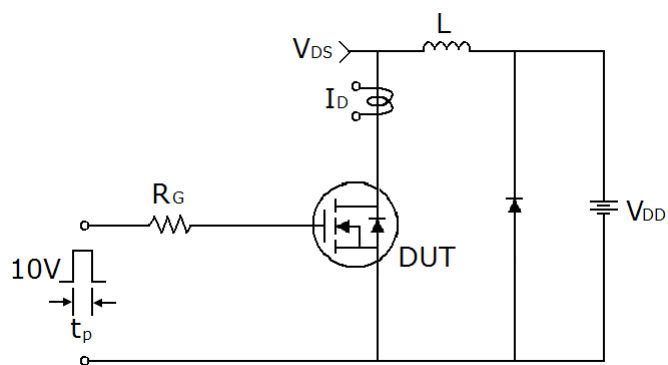
1) Gate charge test circuit & Waveform



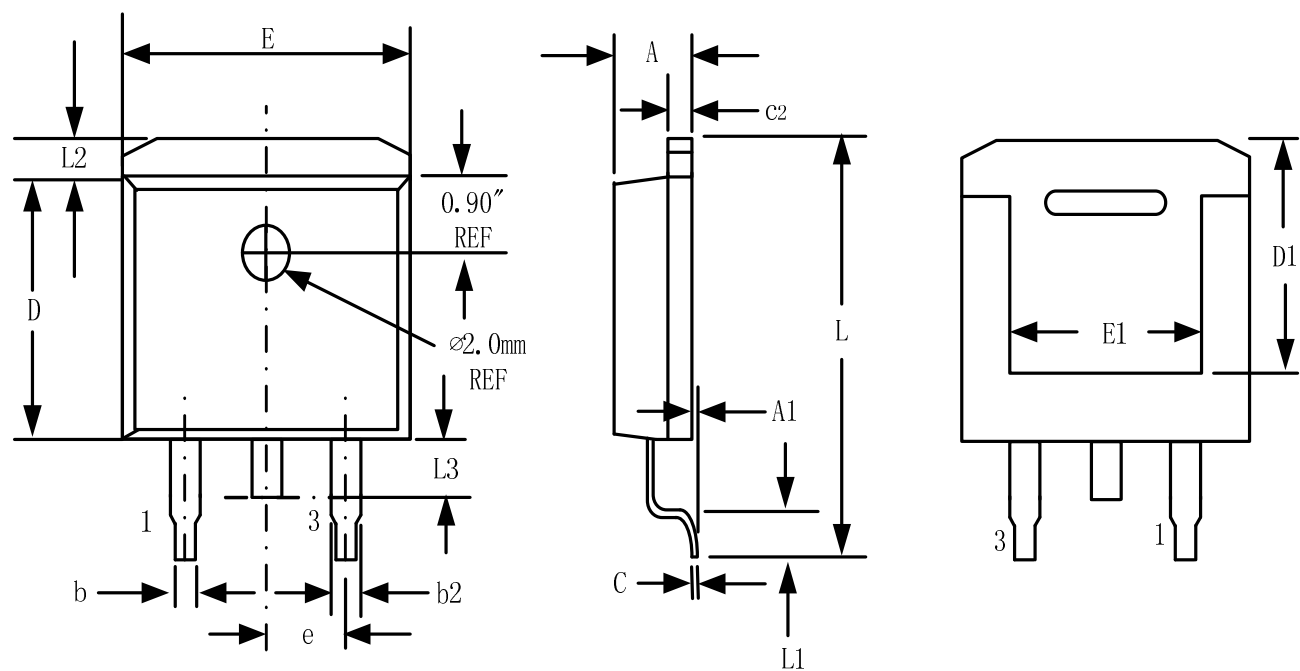
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

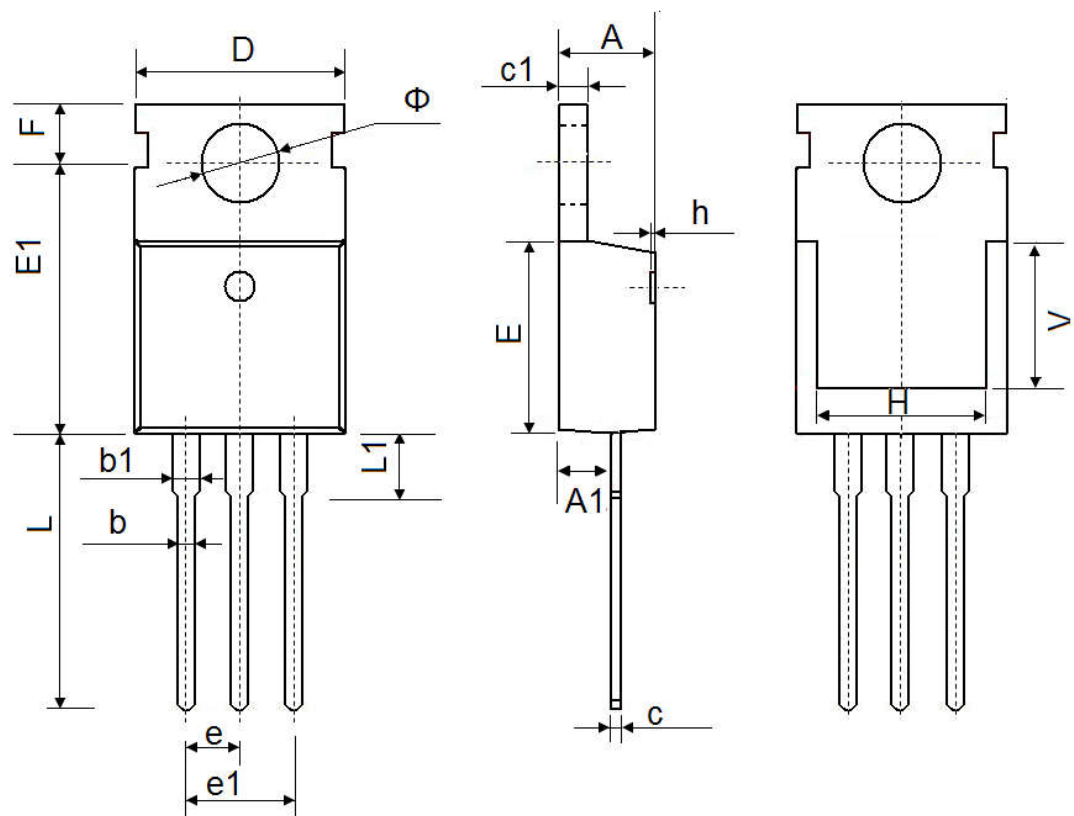


TO-263-3L Package Information



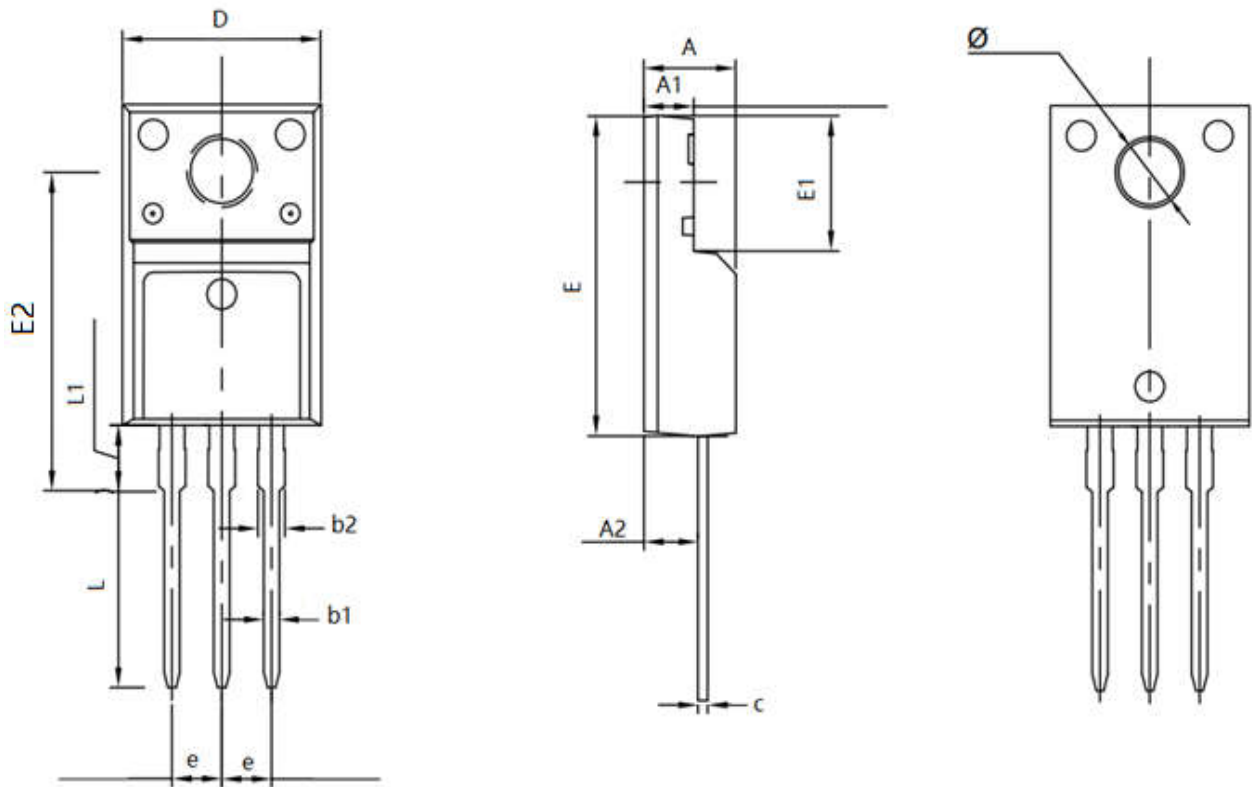
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.57	0.170	0.180
A1	-	0.25		0.010
b	0.71	0.94	0.028	0.037
b2	1.15	1.40	0.045	0.055
c	0.46	0.61	0.018	0.024
c2	1.22	1.40	0.048	0.055
D	8.89	9.40	0.350	0.370
D1	8.01	8.23	0.315	0.324
E	10.04	10.28	0.395	0.405
E1	7.88	8.08	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