

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.

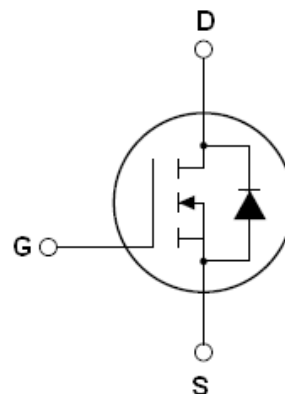
Features

- 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)

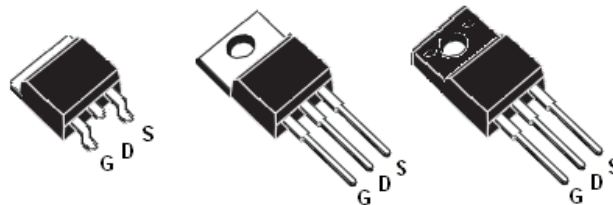
$V_{DS}@T_{jmax}$	650	V
$R_{DS(ON)MAX}$	360	mΩ
I_D	11	A



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60R360D	TO-263	NCE60R360D
NCE60R360	TO-220	NCE60R360
NCE60R360F	TO-220F	NCE60R360F



TO-263

TO-220

TO-220F

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

Parameter	Symbol	NCE60R360D NCE60R360	NCE60R360F	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	600		V
Gate-Source Voltage ($V_{DS}=0V$)	V_{GS}	± 30		V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	11	11*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	7	7*	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	33	33*	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	121	32.7	W
Derate above 25°C		0.97	0.26	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note2)	E_{AS}	280		mJ
Avalanche current (Note 1)	I_{AR}	5.5		A
Repetitive Avalanche energy , t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.5		mJ

Parameter	Symbol	NCE60R360D NCE60R360	NCE60R360F	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	NCE60R360D NCE60R360	NCE60R360F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	1.03	3.82	°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}	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current($T_c=25^{\circ}C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$		0.05	1	μA
Zero Gate Voltage Drain Current($T_c=125^{\circ}C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			100	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 30V, V_{DS}=0V$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5	3	3.5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=7A$		300	360	m Ω
Dynamic Characteristics						
Forward Transconductance	g_{FS}	$V_{DS} = 20V, I_D = 7A$		8		S
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		1030		pF
Output Capacitance	C_{oss}			87		pF
Reverse Transfer Capacitance	C_{rss}			4.5		pF
Total Gate Charge	Q_g	$V_{DS}=480V, I_D=11A,$ $V_{GS}=10V$		23	40	nC
Gate-Source Charge	Q_{gs}			5.7		nC
Gate-Drain Charge	Q_{gd}			8		nC
Intrinsic gate resistance	R_G	$f = 1\text{ MHz open drain}$		2		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5.5A,$ $R_G=6.8\Omega, V_{GS}=10V$		9		nS
Turn-on Rise Time	t_r			4		nS
Turn-Off Delay Time	$t_{d(off)}$			40	65	nS
Turn-Off Fall Time	t_f			4.5	8	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}C$			11	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				33	A
Forward on voltage	V_{SD}	$T_j=25^{\circ}C, I_{SD}=11A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	t_{rr}	$T_j=25^{\circ}C, I_F=11A, di/dt=100A/\mu s$		245		nS
Reverse Recovery Charge	Q_{rr}			2.4		μC
Peak Reverse Recovery Current	I_{rrm}			20		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

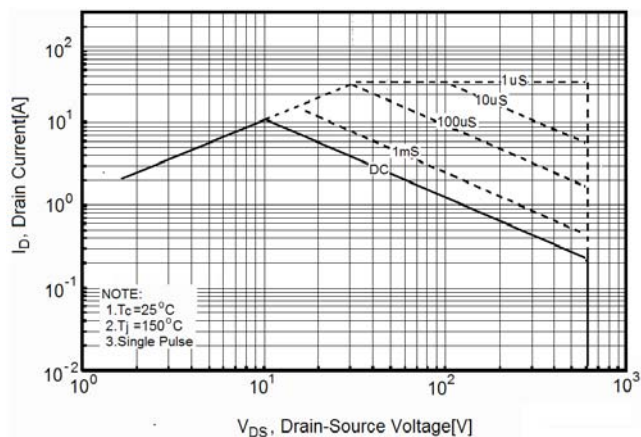


Figure2. Safe operating area for TO-220F

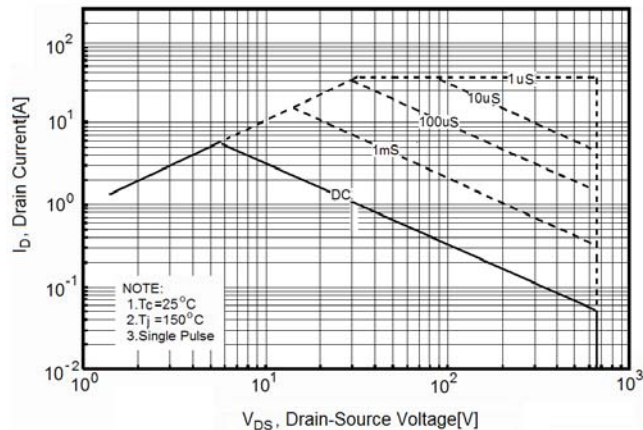


Figure3. Source-Drain Diode Forward Voltage

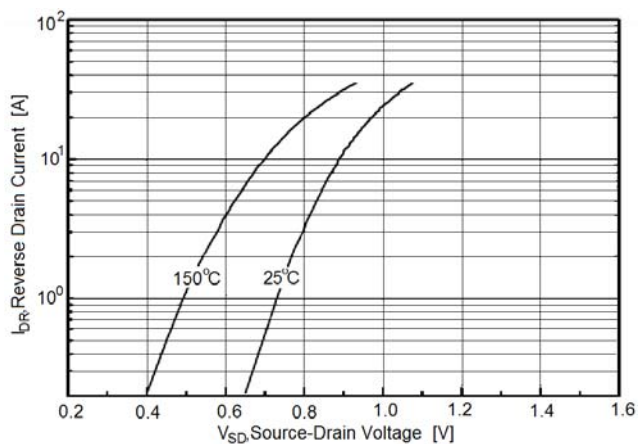


Figure4. Output characteristics

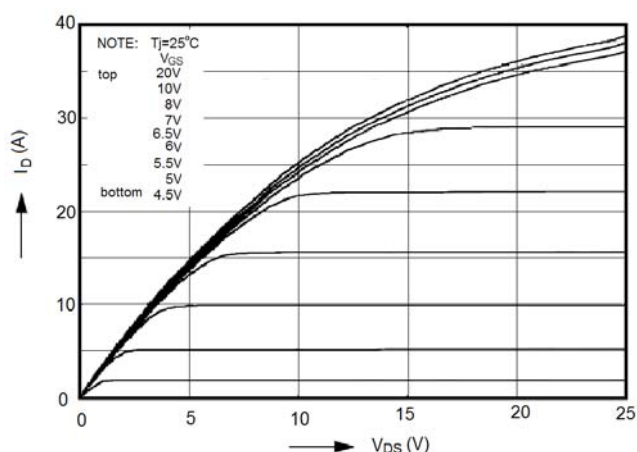


Figure5. Transfer characteristics

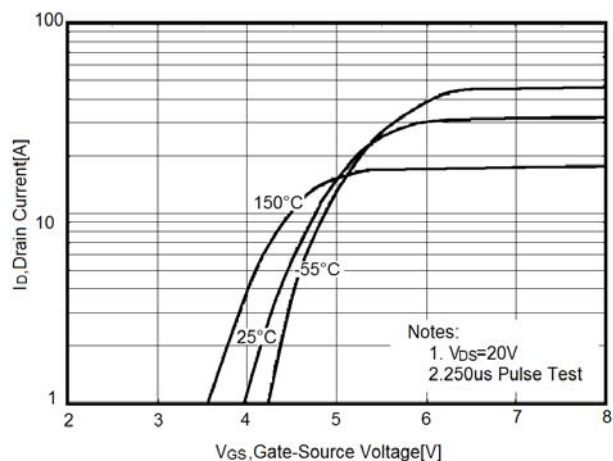


Figure6. Static drain-source on resistance

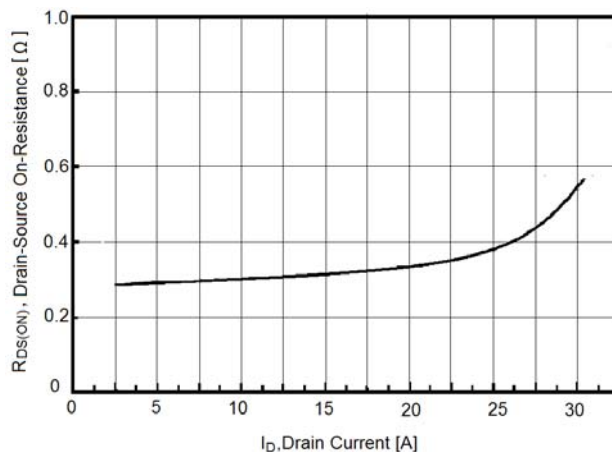


Figure7. $R_{DS(ON)}$ vs Junction Temperature

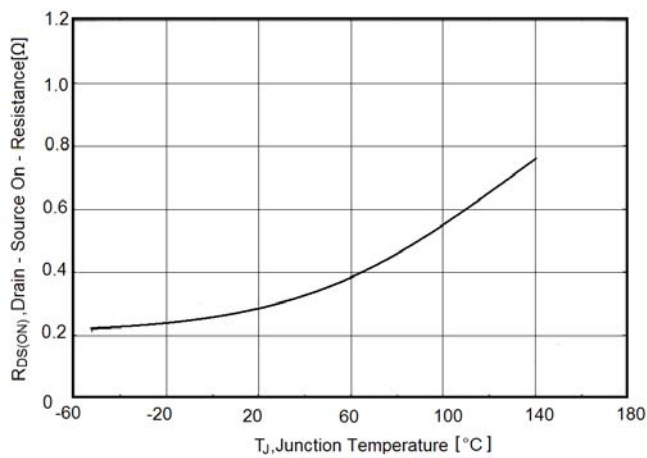


Figure8. BV_{DSS} vs Junction Temperature

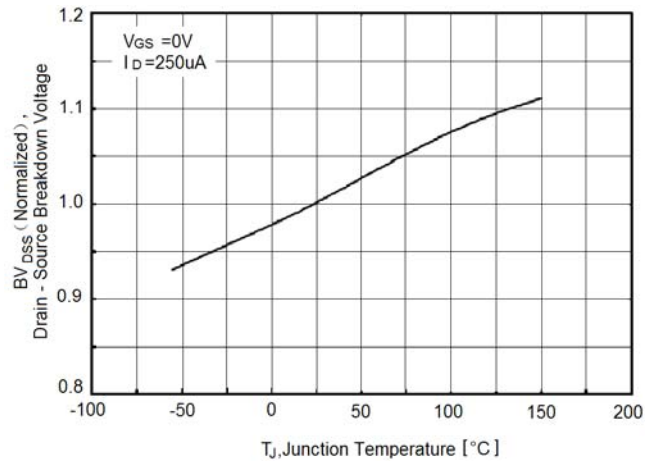


Figure9. Maximum I_D vs Junction Temperature

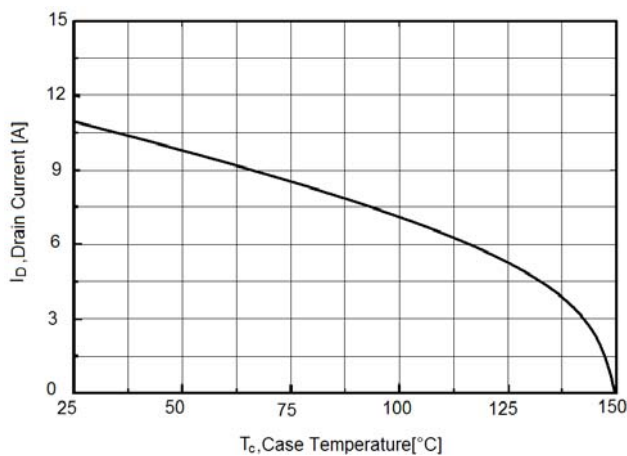


Figure10. Gate charge waveforms

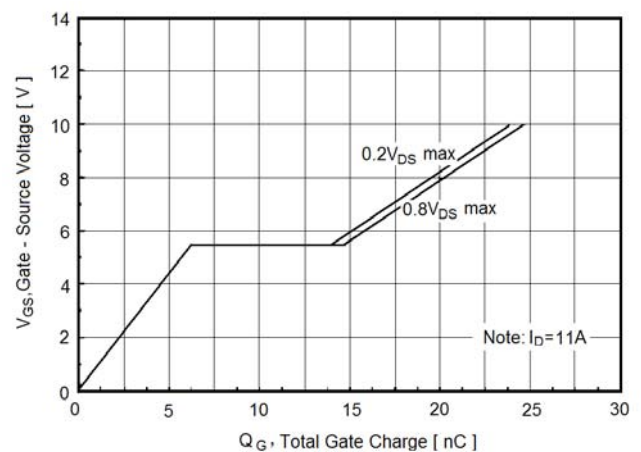


Figure11. Capacitance

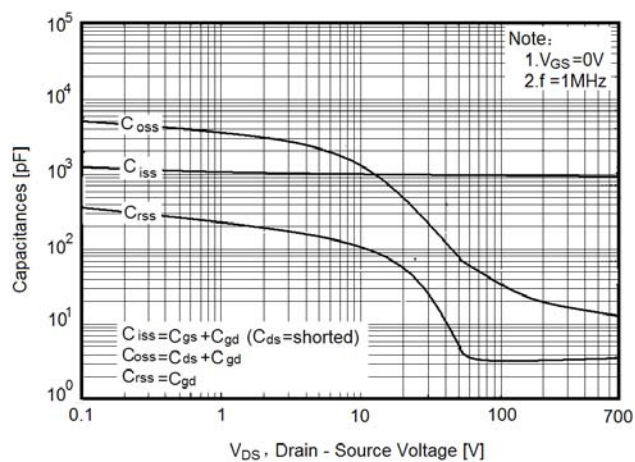


Figure12. Transient Thermal Impedance

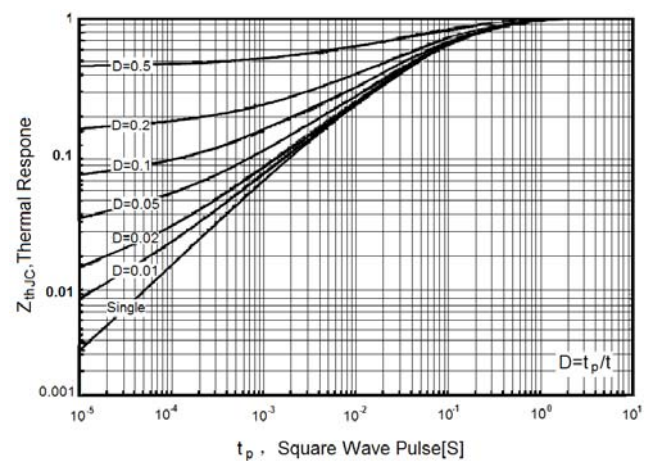
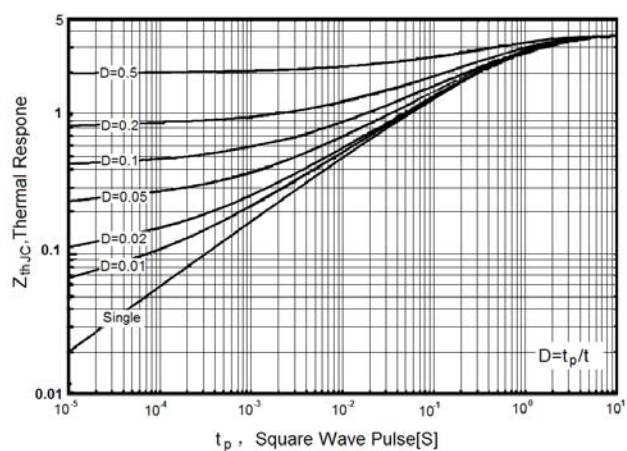
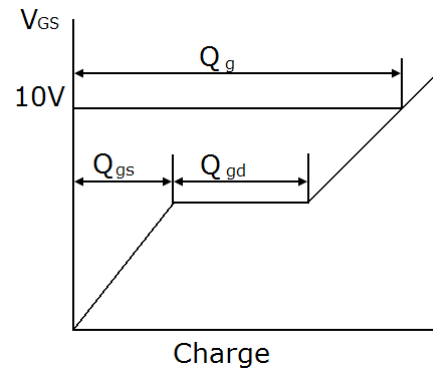
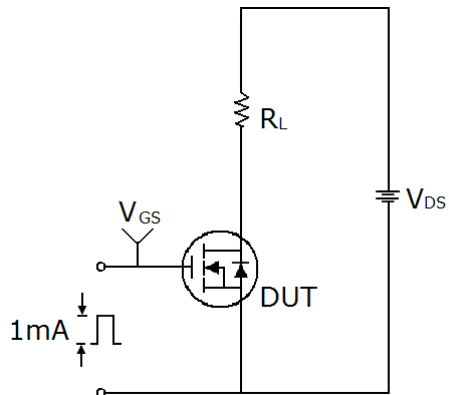


Figure13. Transient Thermal Impedance for TO-220F

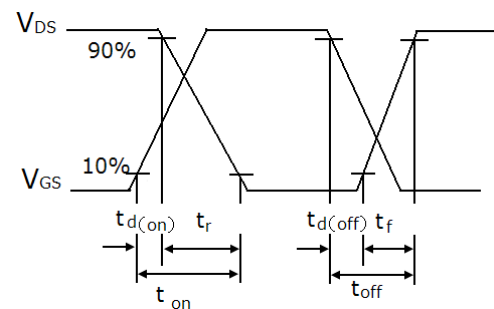
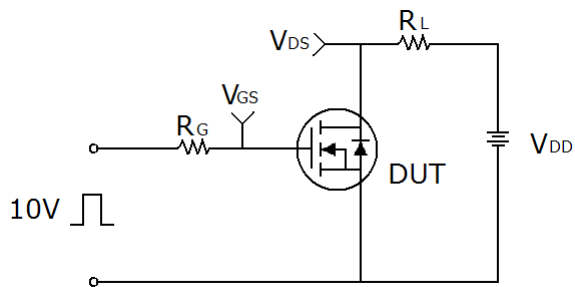


Test circuit

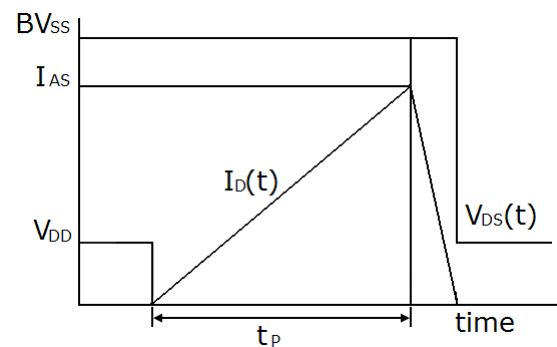
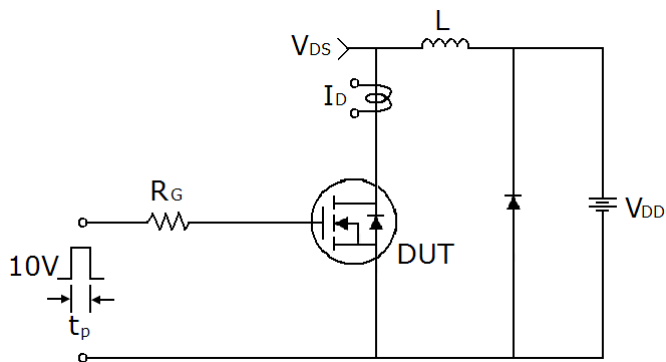
1) Gate charge test circuit & Waveform



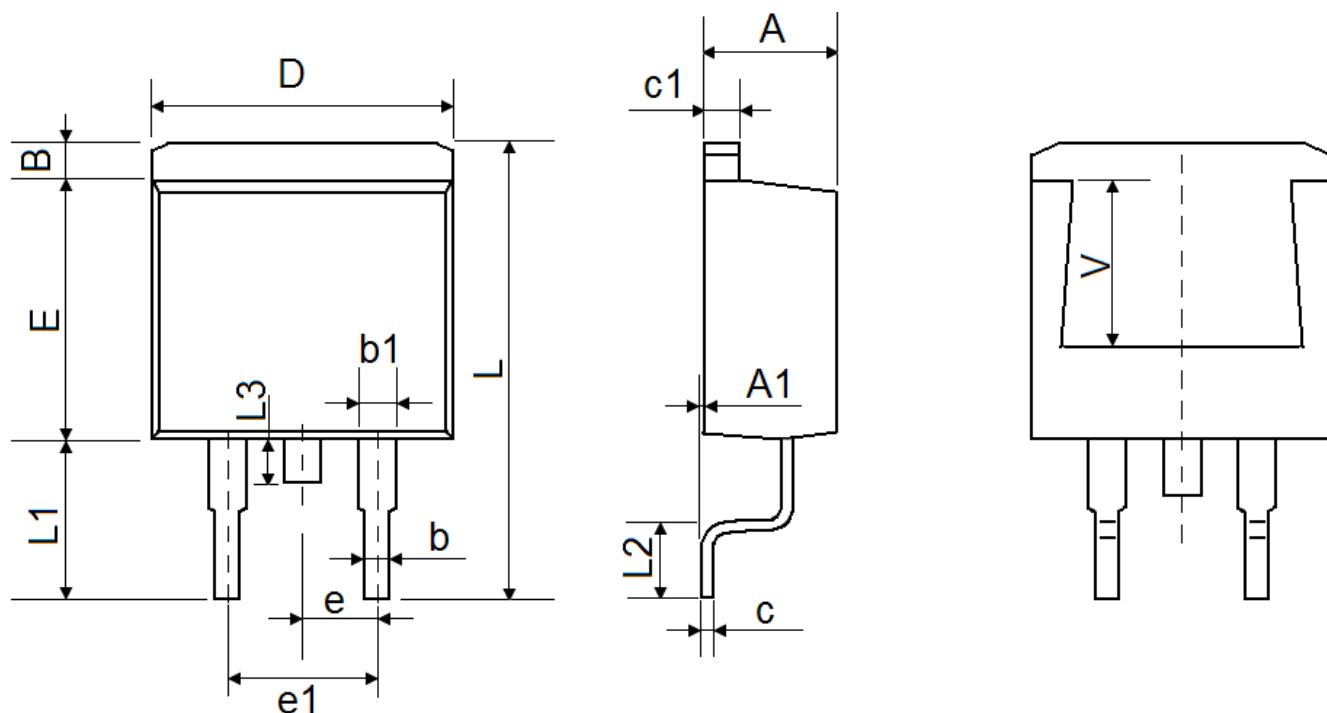
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

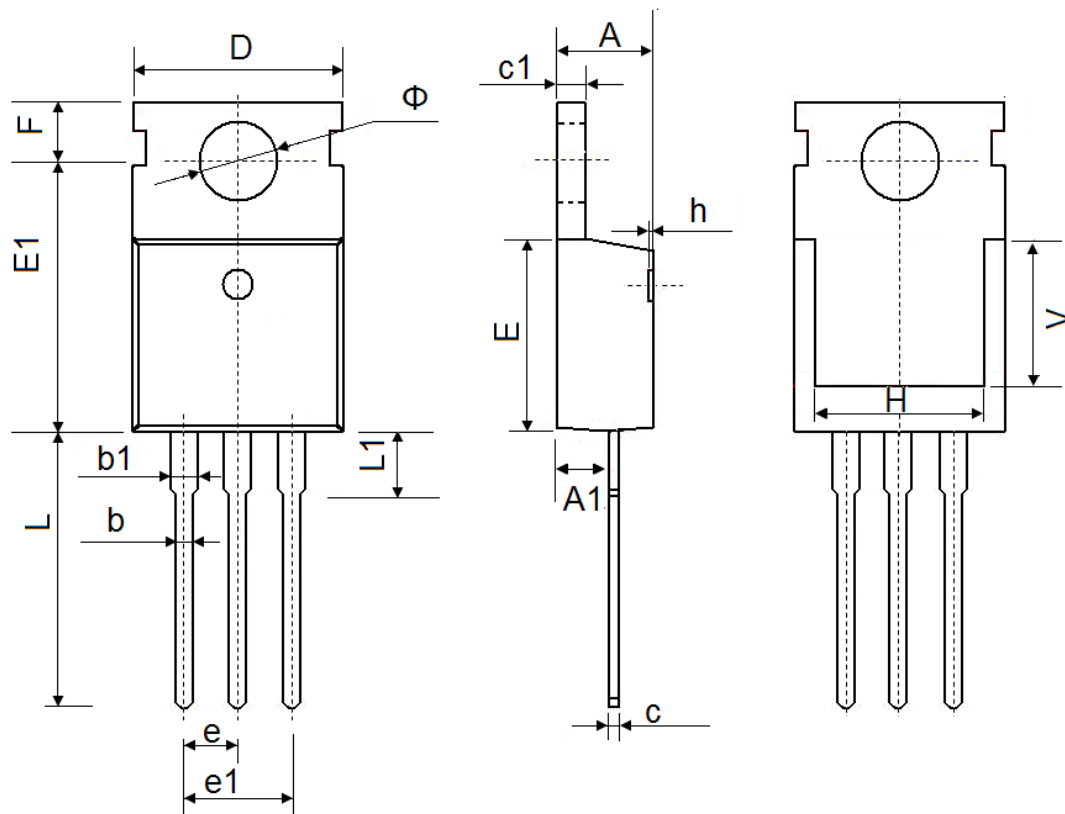


TO-263-2L Package Information



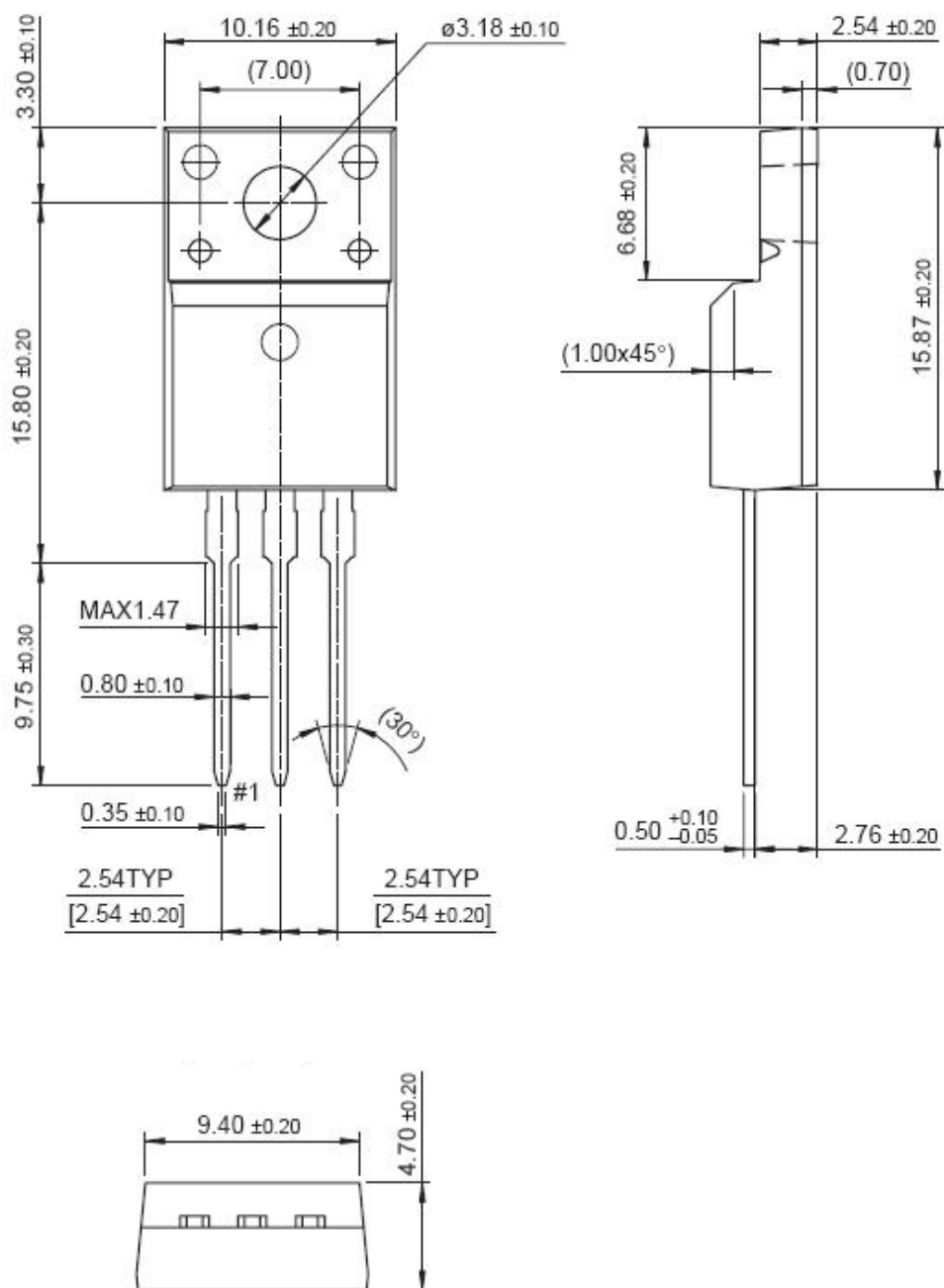
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.170	1.370	0.046	0.054
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	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

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