

## N-Channel Super Junction Power MOSFET

### 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.

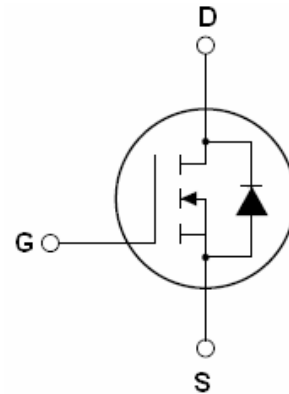
### Features

- 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)

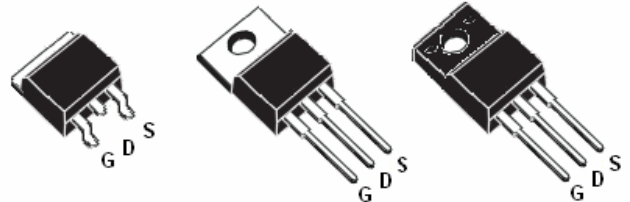
$V_{DS@T_{jmax}}$	560	V
$R_{DS(ON)}$	600	mΩ
$I_D$	7.8	A



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE08N50D	TO-263	NCE08N50D
NCE08N50	TO-220	NCE08N50
NCE08N50F	TO-220F	NCE08N50F



TO-263

TO-220

TO-220F

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

Parameter	Symbol	NCE08N50D NCE08N50	NCE08N50F	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	500		V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$		V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	7.8	7.8*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	5	5*	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	23.4	23.4*	A
Drain Source voltage slope, $V_{DS} = 400\text{ V}$ , $I_D = 7.8\text{ A}$ , $T_j = 125^\circ\text{C}$	dv/dt	50		V/ns
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	83	32	W
Derate above $25^\circ\text{C}$		0.67	0.26	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	230		mJ
Avalanche current (Note 1)	$I_{AR}$	7.8		A

Parameter	Symbol	NCE08N50D NCE08N50	NCE08N50F	Unit
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{Jmax}$ (Note 1)	$E_{AR}$	0.5		mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150		°C

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	NCE08N50D NCE08N50	NCE08N50F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	1.5	3.9	°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
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	500			V
Zero Gate Voltage Drain Current( $T_c=25^\circ C$ )	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$			1	$\mu A$
Zero Gate Voltage Drain Current( $T_c=125^\circ C$ )	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$			100	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$			$\pm 100$	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	$R_{DS(on)}$	$V_{GS}=10V, I_D=4.5A$		540	600	m $\Omega$
<b>Dynamic Characteristics</b>						
Forward Transconductance	$g_{FS}$	$V_{DS} = 20V, I_D = 4.5A$		6		S
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		860		pF
Output Capacitance	$C_{oss}$			68		pF
Reverse Transfer Capacitance	$C_{rss}$			5		pF
Total Gate Charge	$Q_g$	$V_{DS}=400V, I_D=7.8A,$ $V_{GS}=10V$		19.5	27	nC
Gate-Source Charge	$Q_{gs}$			3		nC
Gate-Drain Charge	$Q_{gd}$			7		nC
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		1.6		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=7.8A,$ $R_G=12\Omega, V_{GS}=10V$		6		nS
Turn-on Rise Time	$t_r$			3.5		nS
Turn-Off Delay Time	$t_{d(off)}$			60	100	nS
Turn-Off Fall Time	$t_f$			7	15	nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_c=25^\circ C$			7.8	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				23.4	A
Forward on voltage	$V_{SD}$	$T_j=25^\circ C, I_{SD}=7.8A, V_{GS}=0V$		0.9	1.3	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^\circ C, I_F=7.8A, di/dt=100A/\mu s$		250		nS
Reverse Recovery Charge	$Q_{rr}$			2.6		$\mu C$
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

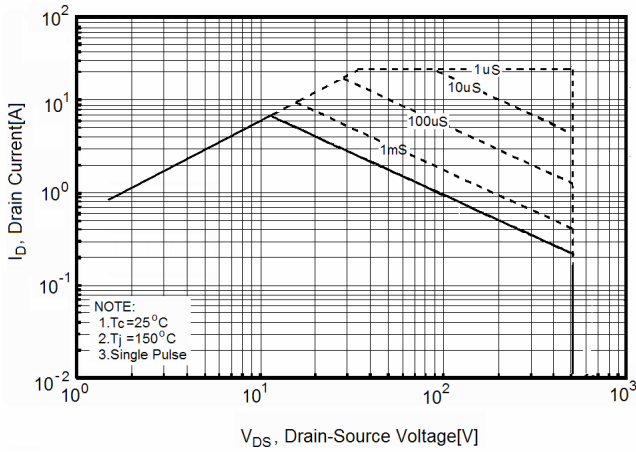


Figure2. Safe operating area for NCE08N50F

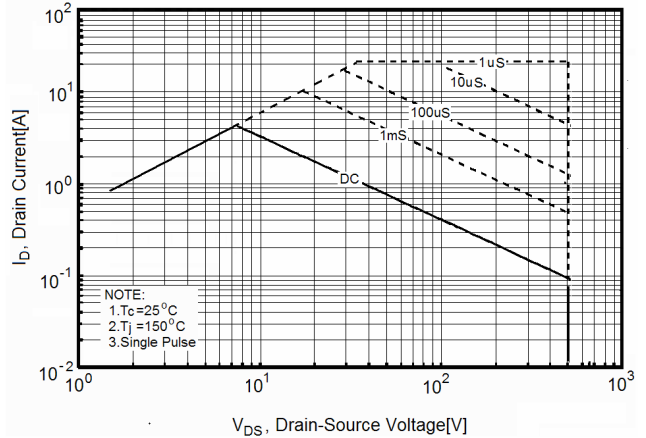


Figure3. Source-Drain Diode Forward Voltage

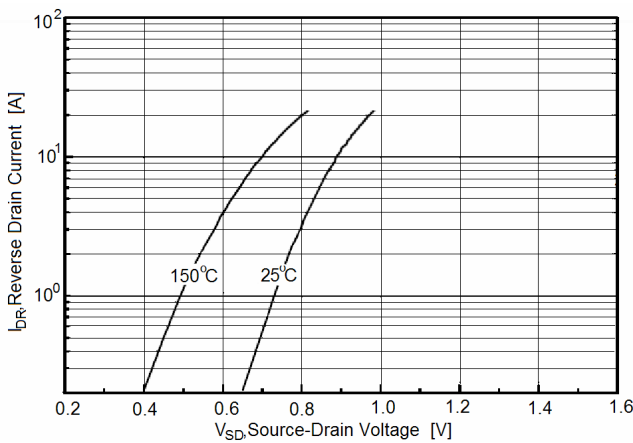


Figure4. Output characteristics

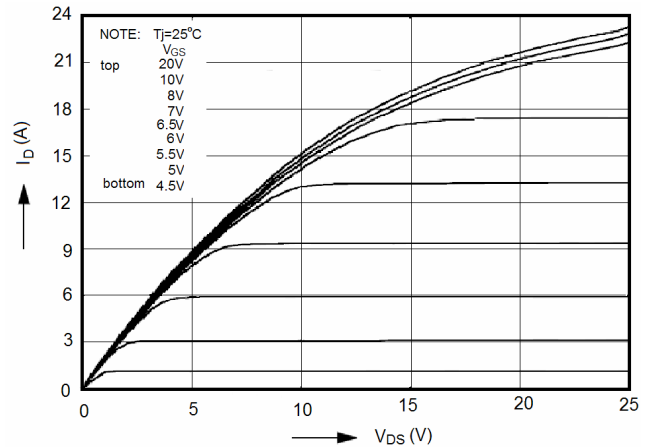


Figure5. Transfer characteristics

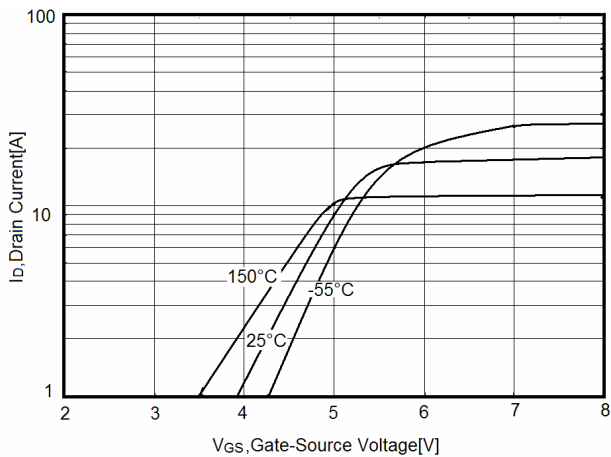
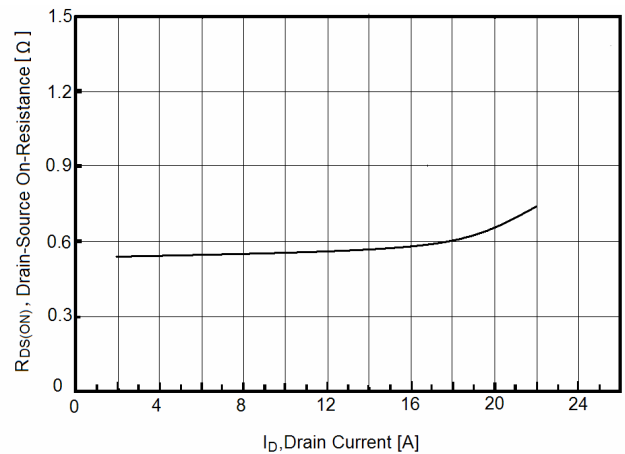
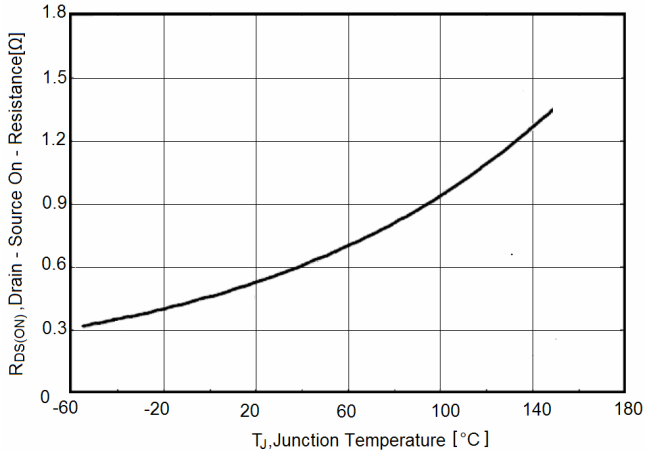


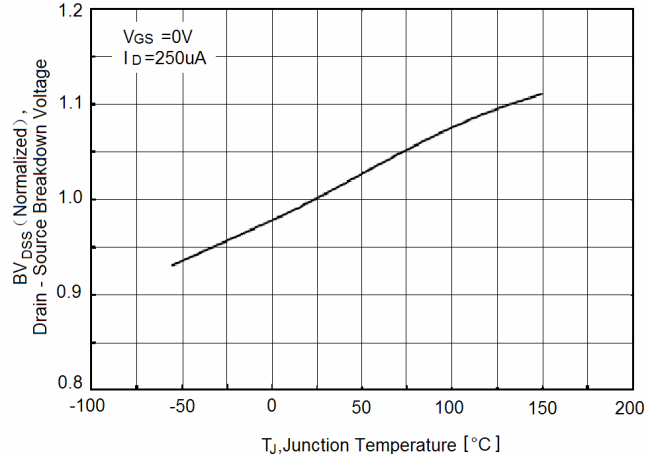
Figure6. Static drain-source on resistance



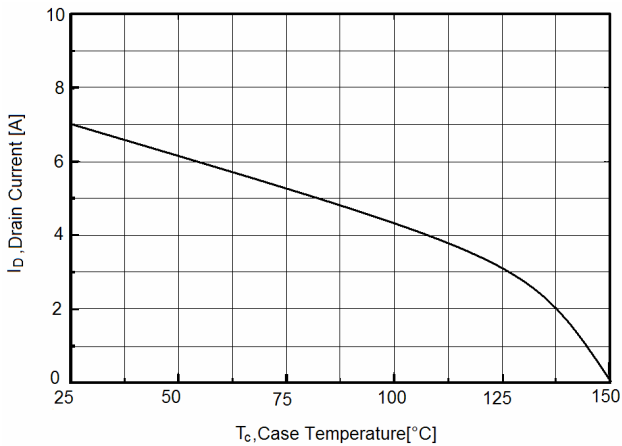
**Figure7.  $R_{DS(ON)}$  vs Junction Temperature**



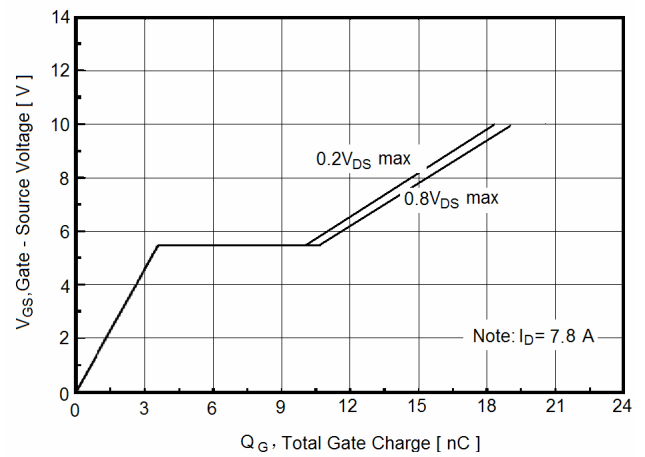
**Figure8.  $BV_{DSS}$  vs Junction Temperature**



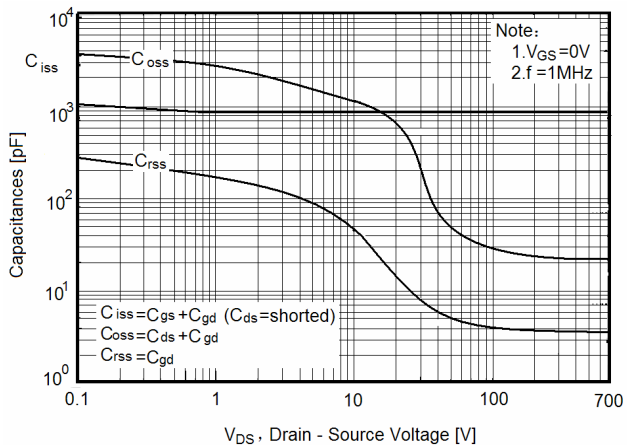
**Figure9. Maximum  $I_D$  vs Junction Temperature**



**Figure10. Gate charge waveforms**



**Figure11. Capacitance**



**Figure12. Transient Thermal Impedance**

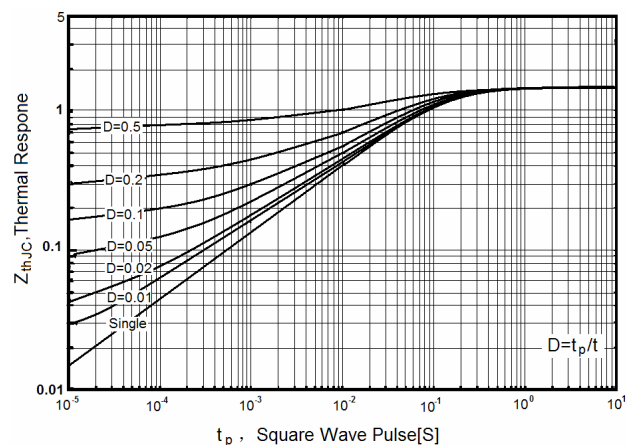
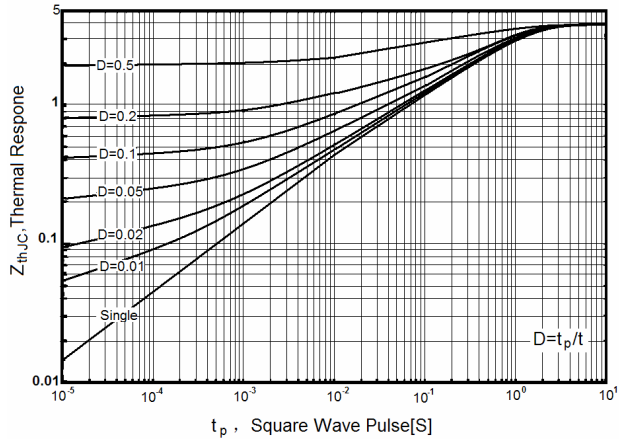
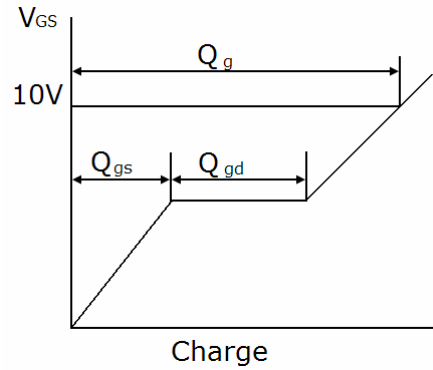
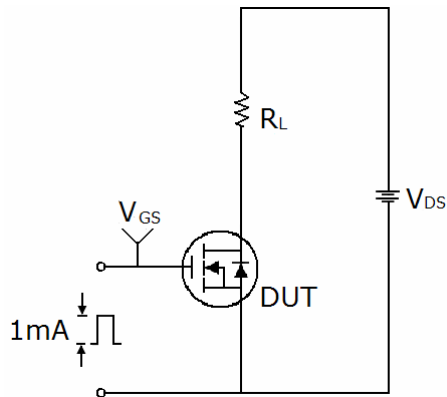


Figure13. Transient Thermal Impedance for NCE08N50F

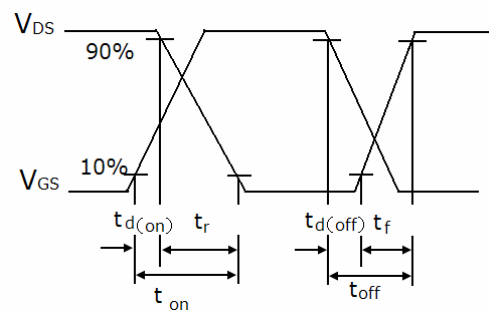
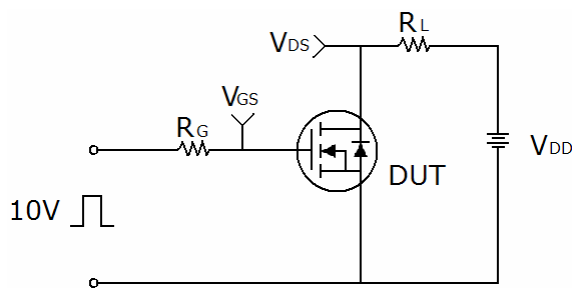


## Test circuit

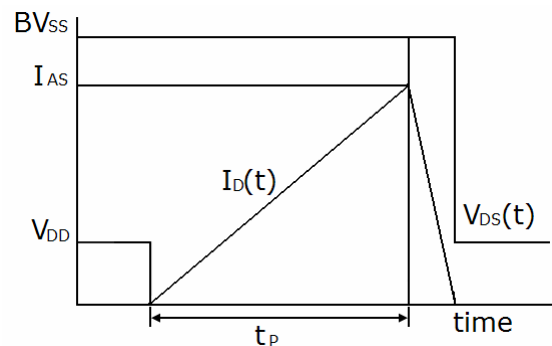
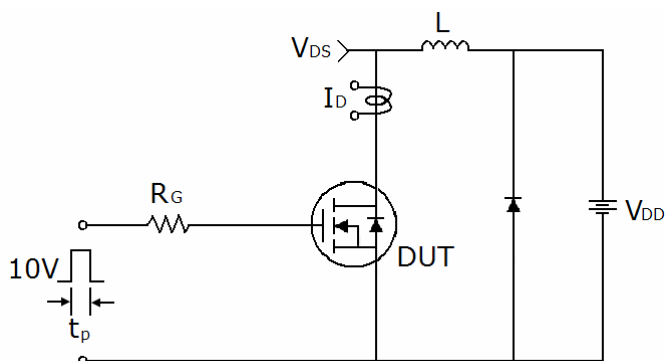
### 1) Gate charge test circuit & Waveform



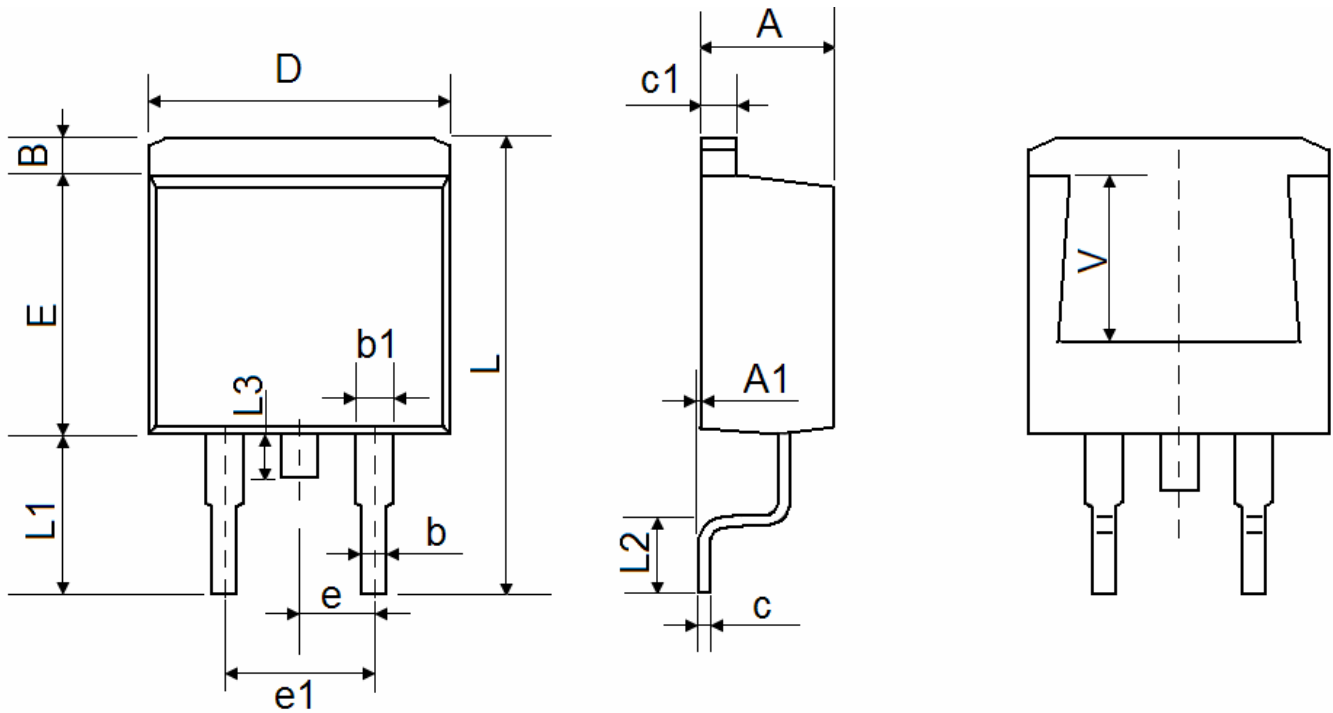
### 2) Switch Time Test Circuit:



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

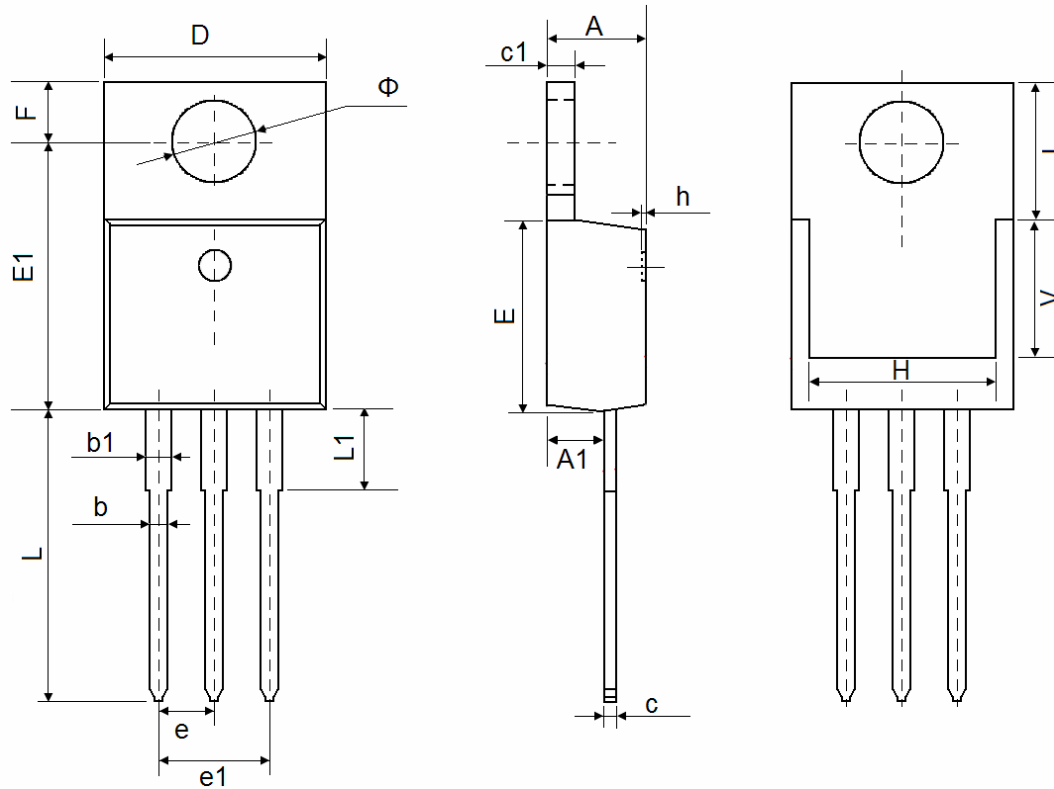


## TO-263-2L Package Information



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	

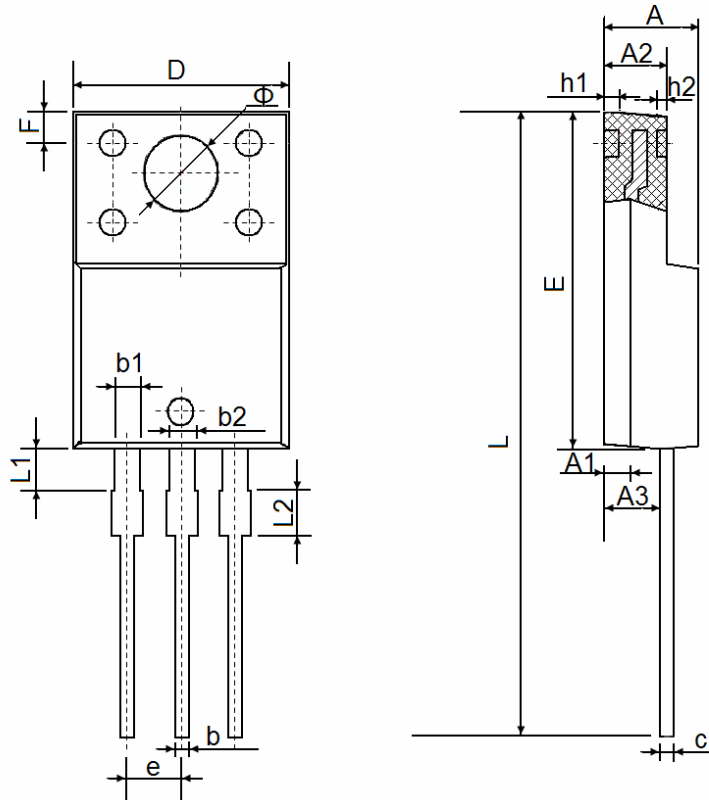
## TO-220-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	2.520	2.820	0.099	0.111
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	10.010	10.350	0.394	0.407
E	8.500	8.900	0.335	0.350
E1	12.060	12.460	0.475	0.491
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.590	2.890	0.102	0.114
H	8.440 REF.		0.332 REF.	
h	0.000	0.300	0.000	0.012
L	13.400	13.800	0.528	0.543
L1	3.560	3.960	0.140	0.156
V	6.060 REF.		0.239 REF.	
l	6.600 REF.		0.260 REF.	
$\Phi$	3.735	3.935	0.147	0.155



## TO-220F Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300REF		0.051REF	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540TYP.		0.100TYP	
F	2.700REF		0.106REF	
$\Phi$	3.500REF		0.138REF	
h1	0.800REF		0.031REF	
h2	0.500REF		0.020REF	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	1.900	2.100	0.075	0.083

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