

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.

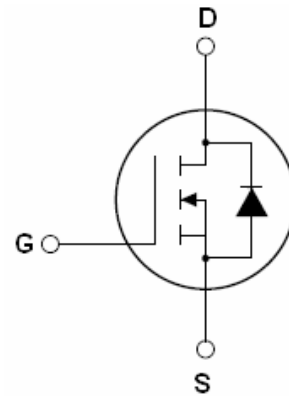
Features

- 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)

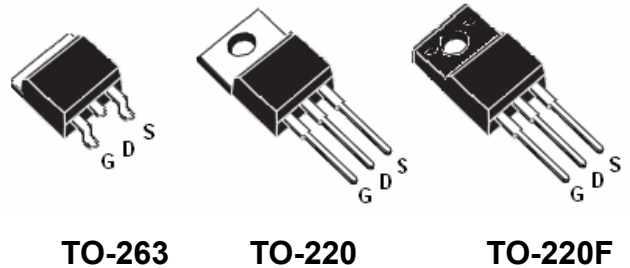
V_{DS}	650	V
$R_{DS(ON)}$	900	m Ω
I_D	5	A



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE05N65D	TO-263	
NCE05N65	TO-220	
NCE05N65F	TO-220F	



TO-263

TO-220

TO-220F

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

Parameter	Symbol	NCE05N65 NCE05N65D	NCE05N65F	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	650		V
Gate-Source Voltage ($V_{DS}=0V$)	V_{GS}	± 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 (Note 1)	$I_{DM(pluse)}$	15	15*	A
Drain Source voltage slope, $V_{DS} = 480\text{ V}$, $I_D = 5\text{ A}$, $T_j = 125^\circ\text{C}$	dv/dt	50		V/ns
Maximum Power Dissipation ($T_c=25^\circ\text{C}$)	P_D	50	31	W
Derate above 25°C		0.4	0.25	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note2)	E_{AS}	130		mJ
Avalanche current (Note 1)	I_{AR}	5		A

Parameter	Symbol	Value	Unit
Repetitive Avalanche energy , t_{AR} limited by T_{Jmax} (Note 1)	E_{AR}	0.4	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	NCE05N65 NCE05N65D	NCE05N65F	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	2.5	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_{DSS}	$V_{GS}=0V, I_D=250\mu A$	650			V
Zero Gate Voltage Drain Current($T_c=25^\circ C$)	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			1	μA
Zero Gate Voltage Drain Current($T_c=125^\circ C$)	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			50	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	$R_{DS(on)}$	$V_{GS}=10V, I_D=3A$		850	900	m Ω
Dynamic Characteristics						
Forward Transconductance	g_{FS}	$V_{DS} = 20V, I_D = 3A$		5		S
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		520		PF
Output Capacitance	C_{oss}			52		PF
Reverse Transfer Capacitance	C_{rss}			4.5		PF
Total Gate Charge	Q_g	$V_{DS}=480V, I_D=5A,$ $V_{GS}=10V$		12	25	nC
Gate-Source Charge	Q_{gs}			2.2		nC
Gate-Drain Charge	Q_{gd}			4.5		nC
Intrinsic gate resistance	R_G	$f = 1 MHz$ open drain		2.6		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5A,$ $R_G=18\Omega, V_{GS}=10V$		6		nS
Turn-on Rise Time	t_r			2.5		nS
Turn-Off Delay Time	$t_{d(off)}$			55	80	nS
Turn-Off Fall Time	t_f			9	14	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_c=25^\circ C$			5	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				15	A
Forward On Voltage	V_{SD}	$T_j=25^\circ C, I_{SD}=5A, V_{GS}=0V$		1	1.3	V
Reverse Recovery Time	t_{rr}	$T_j=25^\circ C, I_F=5A, di/dt=100A/\mu s$		200		nS
Reverse Recovery Charge	Q_{rr}			1.6		μC
Peak reverse recovery current	I_{rrm}			15		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

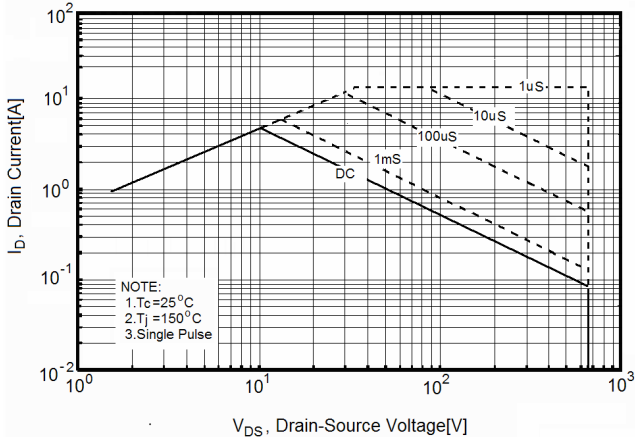


Figure2. Safe operating area for NCE05N65F

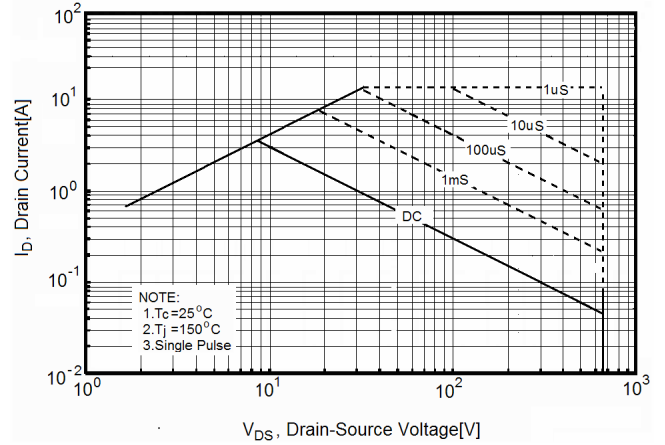


Figure3. Source-Drain Diode Forward Voltage

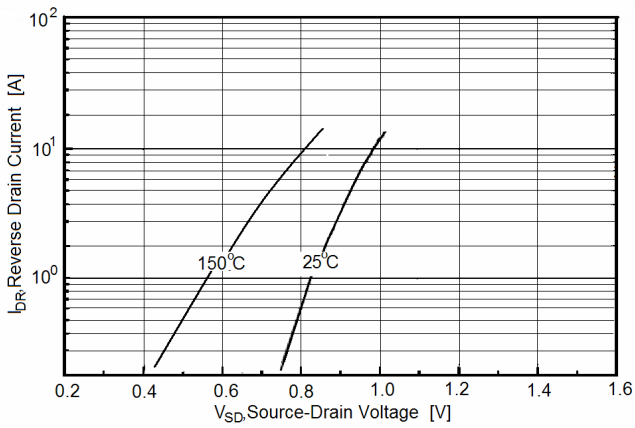


Figure4. Output characteristics

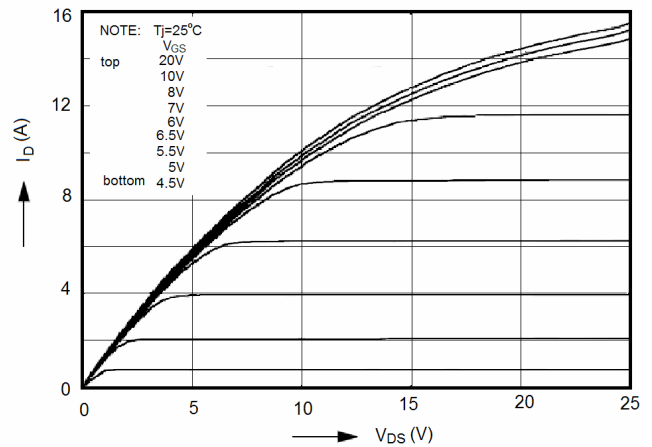


Figure5. Transfer characteristics

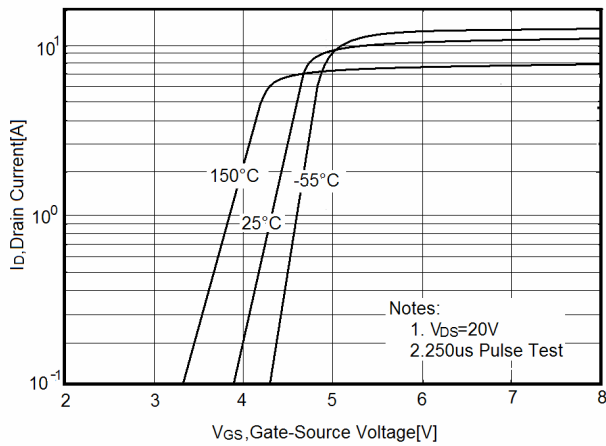


Figure6. Static drain-source on resistance

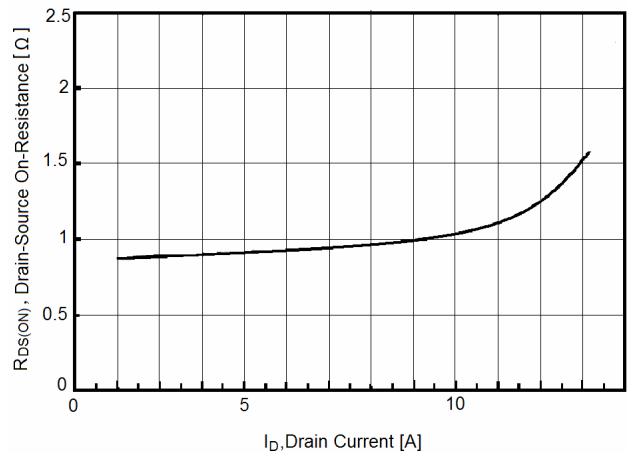


Figure7. $R_{DS(ON)}$ vs Junction Temperature

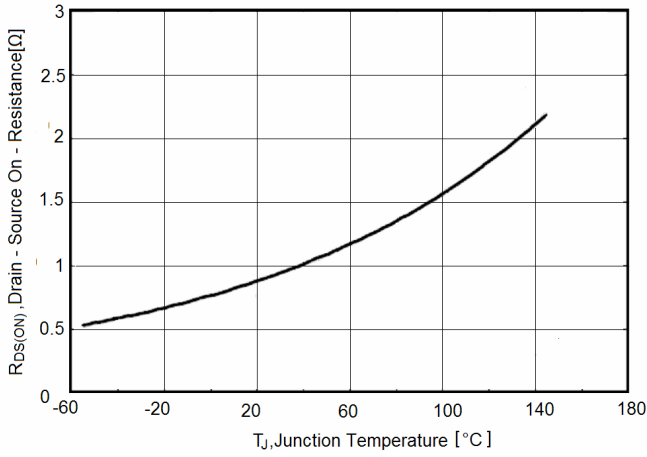


Figure8. BV_{DSS} vs Junction Temperature

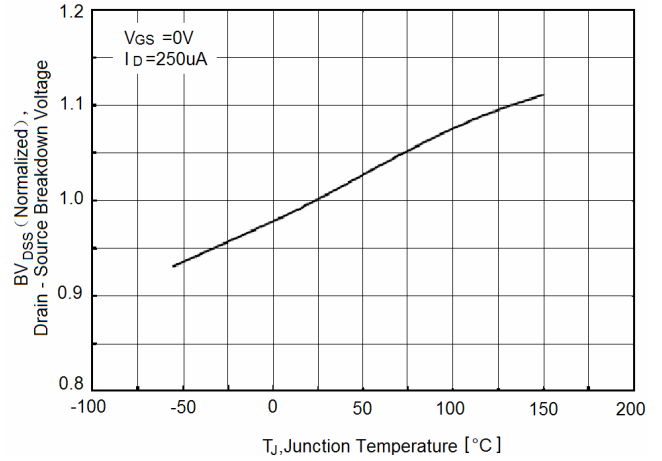


Figure9. Maximum I_D vs Junction Temperature

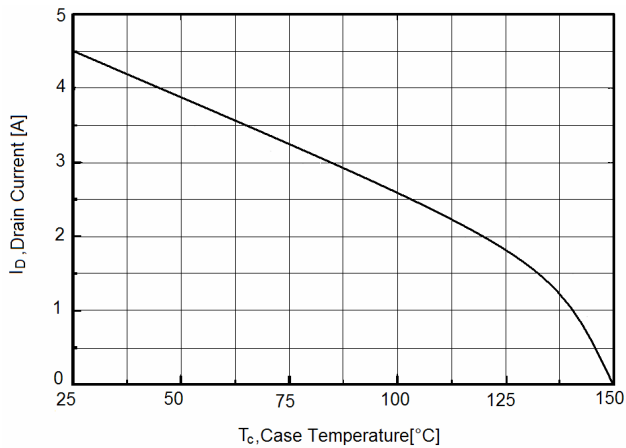


Figure10. Gate charge waveforms

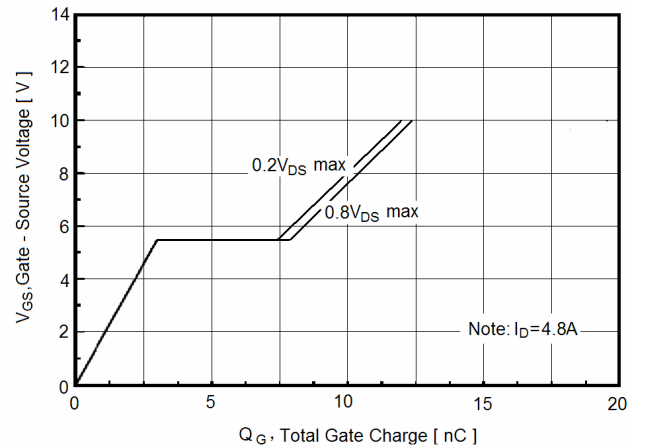


Figure11. Capacitance

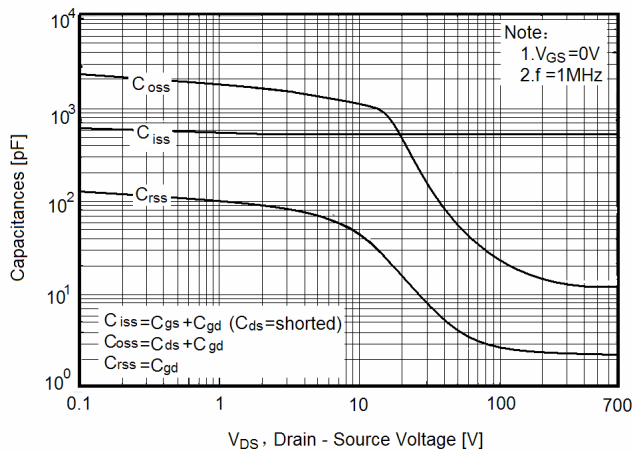


Figure12. Transient Thermal Impedance

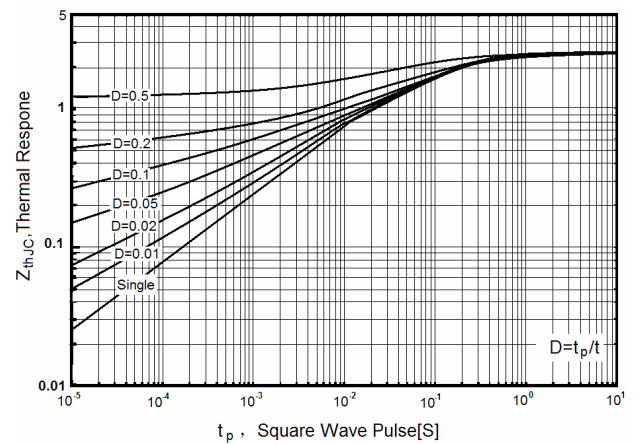
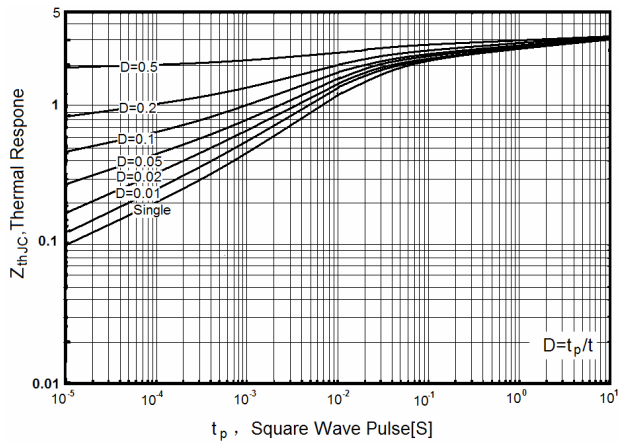
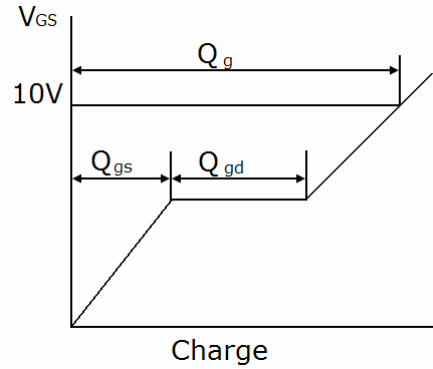
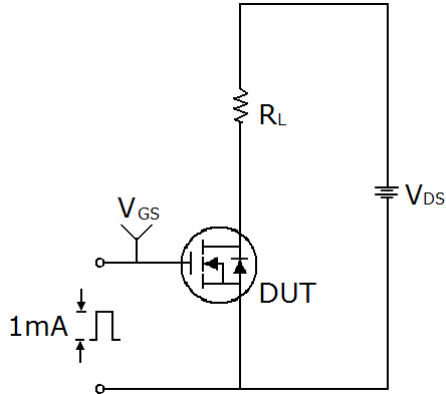


Figure13. Transient Thermal Impedance for NCE05N65F

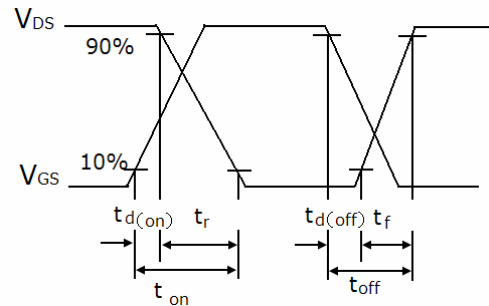
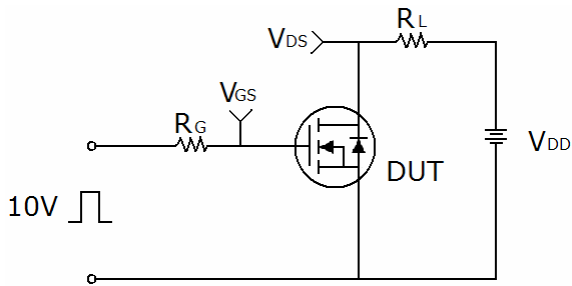


Test circuit

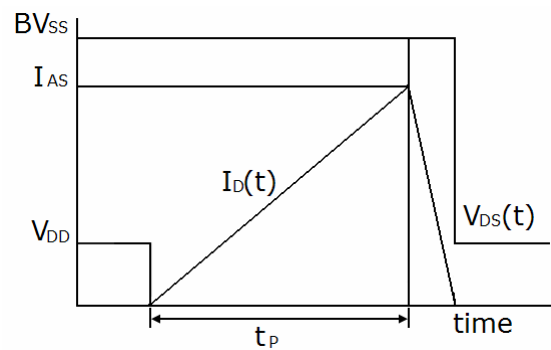
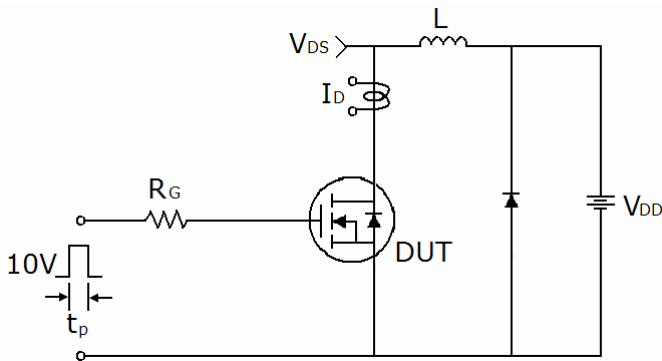
1) Gate charge test circuit & Waveform



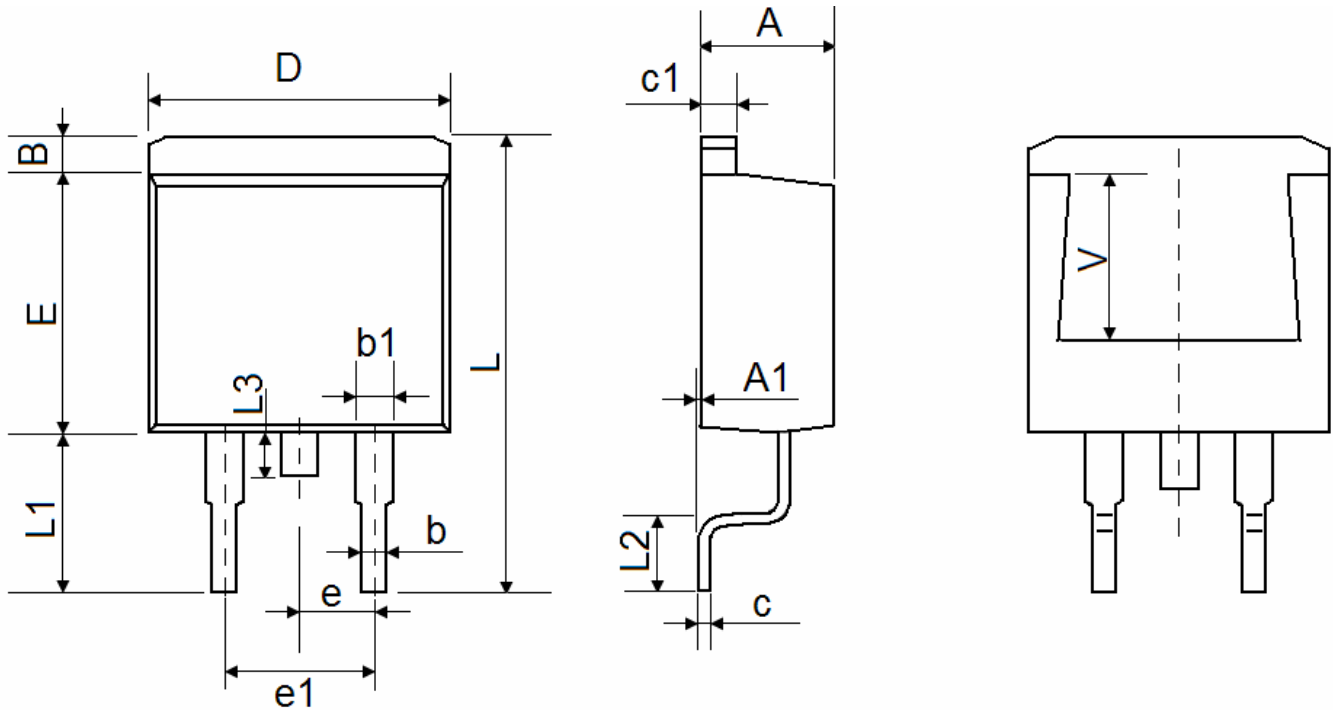
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

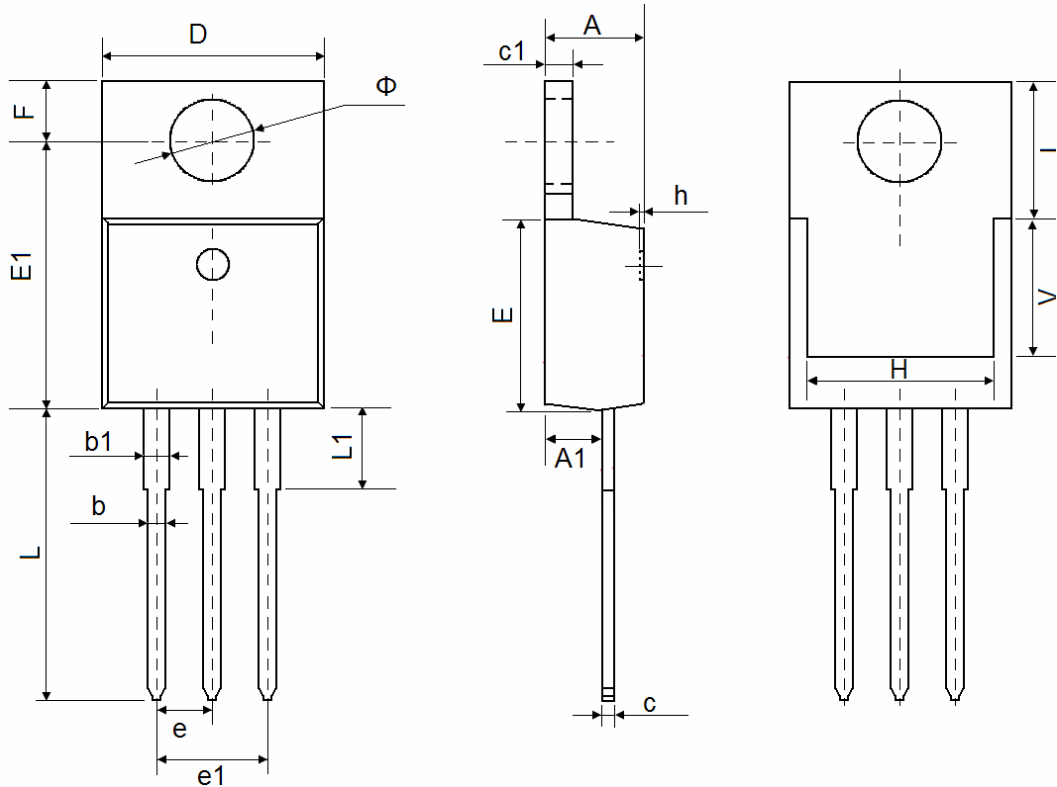


TO-263-2L Package Information



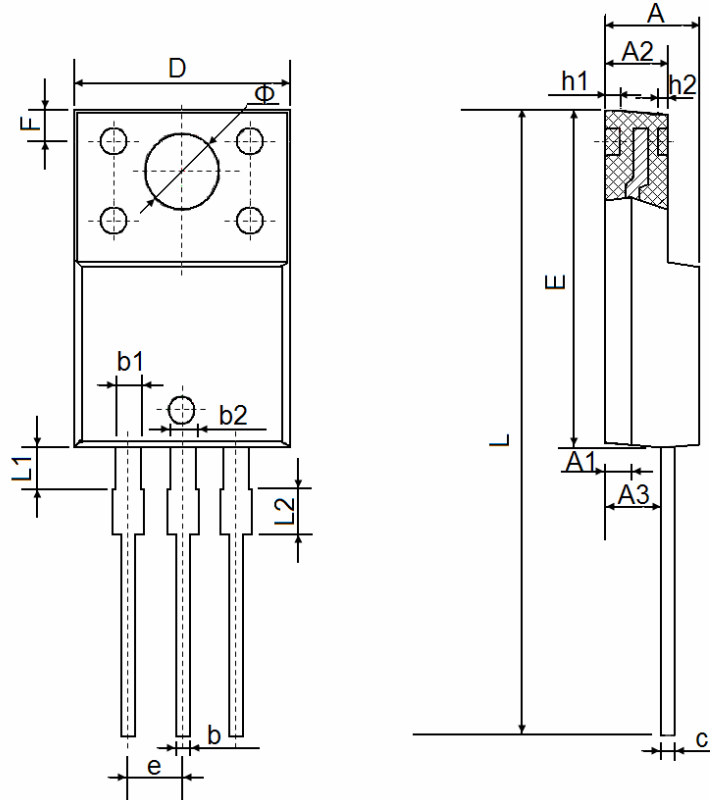
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.170	1.370	0.046	0.054
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900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