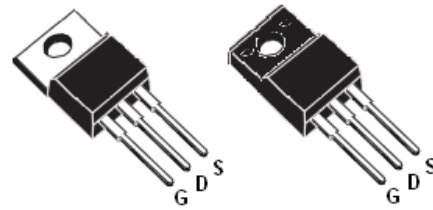




FIR20NS65APG, FIR20NS65AFG

N-Channel Super Junction Power MOSFET

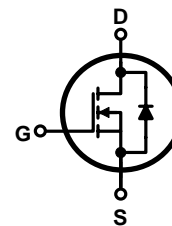
PIN Connection



TO-220

TO-220F

Schematic diagram



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)

Package Marking And Ordering Information

Device	Device Package	Marking
FIR20NS65APG	TO-220	FIR20NS65AP
FIR20NS65AFG	TO-220F	FIR20NS65AF

$V_{DS@T_{jmax}}$	650	V
$R_{DS(ON)}$	190	mΩ
I_D	20	A

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

Parameter	Symbol	FIR20NS65APG	FIR20NS65AFG	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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	20	20*	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	12.5	12.5*	A
Pulsed drain current ^(Note 1)	$I_{DM(pluse)}$	60	60*	A
Drain Source voltage slope, $V_{DS} = 480\text{ V}$, $I_D = 20\text{ A}$, $T_j = 125^\circ\text{C}$	dv/dt	50		V/ns
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	208	34.5	W
Derate above 25°C		1.67	0.28	W/°C
Single pulse avalanche energy ^(Note 2)	E_{AS}	690		mJ
Avalanche current ^(Note 1)	I_{AR}	20		A



FIR20NS65APG, FIR20NS65AFG

Parameter	Symbol	FIR20NS65APG	FIR20NS65AFG	Unit
Repetitive Avalanche energy , t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	1		mJ
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55...+150		°C

* limited by maximum junction temperature

Thermal Characteristic

Parameter	Symbol	FIR20NS65APG	FIR20NS65AFG	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	0.6	3.6	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	80	°C /W

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}	$V_{DS}=600V, V_{GS}=0V$		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	$R_{DS(ON)}$	$V_{GS}=10V, I_D=10A$		160	190	m Ω
Dynamic Characteristics						
Forward Transconductance	g_{FS}	$V_{DS} = 20V, I_D = 10A$		17.5		S
Input Capacitance	C_{ISS}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		2400		PF
Output Capacitance	C_{OSS}			180		PF
Reverse Transfer Capacitance	C_{RSS}			5.7		PF
Total Gate Charge	Q_g	$V_{DS}=480V, I_D=20A,$ $V_{GS}=10V$		55	114	nC
Gate-Source Charge	Q_{gs}			11		nC
Gate-Drain Charge	Q_{gd}			22		nC
Intrinsic gate resistance	R_G	$f = 1 MHz$ open drain		0.9		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=20A,$ $R_G=3.6\Omega, V_{GS}=10V$		10		nS
Turn-on Rise Time	t_r			5		nS
Turn-Off Delay Time	$t_{d(off)}$			67	100	nS
Turn-Off Fall Time	t_f			4	12	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^\circ C$			20	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				60	A
Forward on voltage	V_{SD}	$T_J=25^\circ C, I_{SD}=20A, V_{GS}=0V$		0.9	1.3	V
Reverse Recovery Time	t_{rr}	$T_J=25^\circ C, I_F=20A, di/dt=100A/\mu s$		500		nS
Reverse Recovery Charge	Q_{rr}				11	
Peak Reverse Recovery Current	I_{rrm}			60		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 FIR20NS65APG

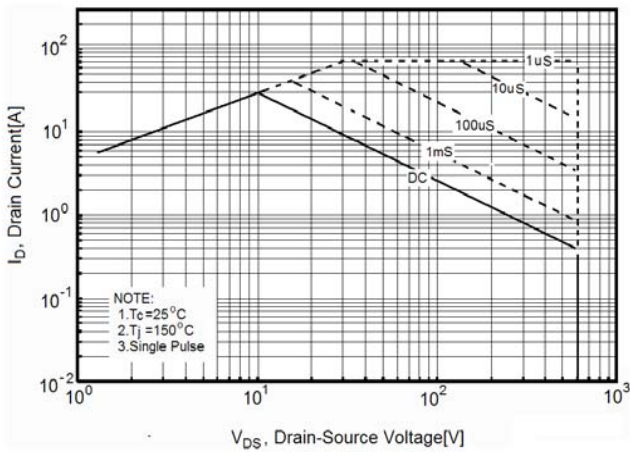


Figure2. Safe operating area for FIR20NS65AFG

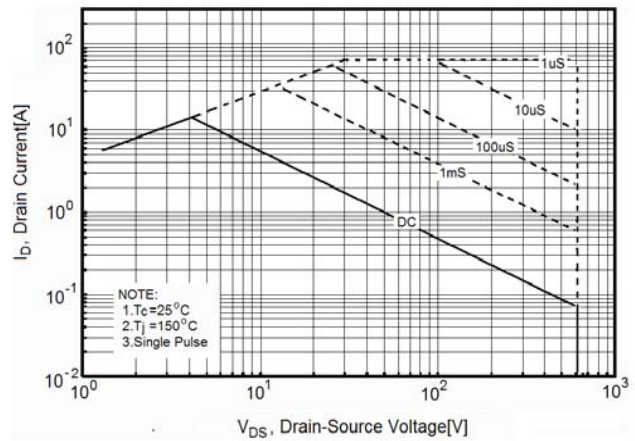


Figure3. Source-Drain Diode Forward Voltage

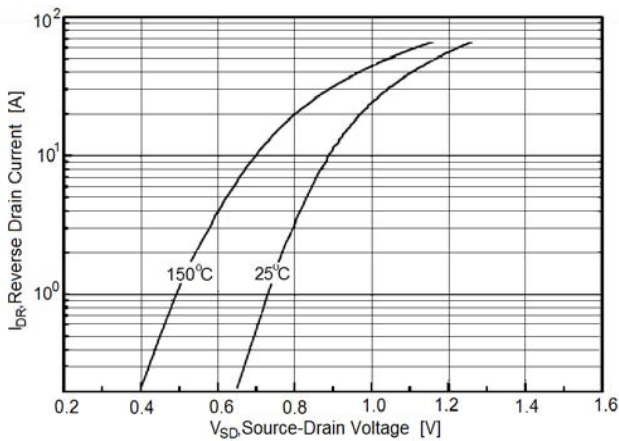


Figure4. Output characteristics

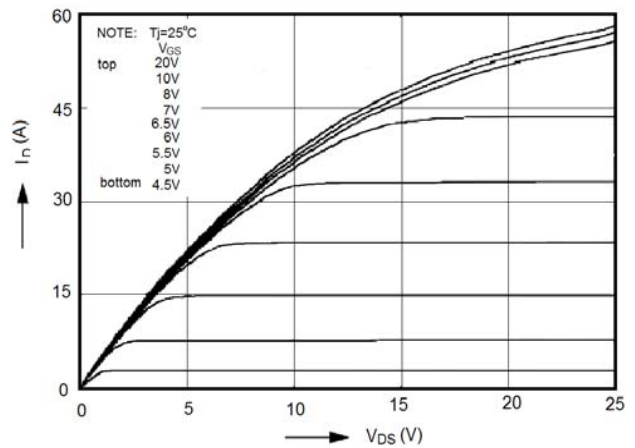


Figure5. Transfer characteristics

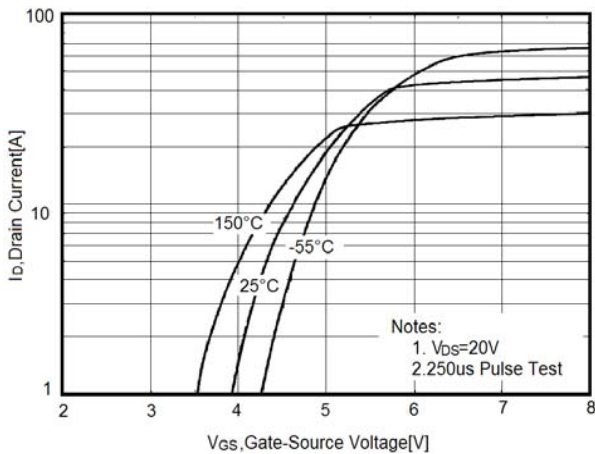


Figure6. Static drain-source on resistance

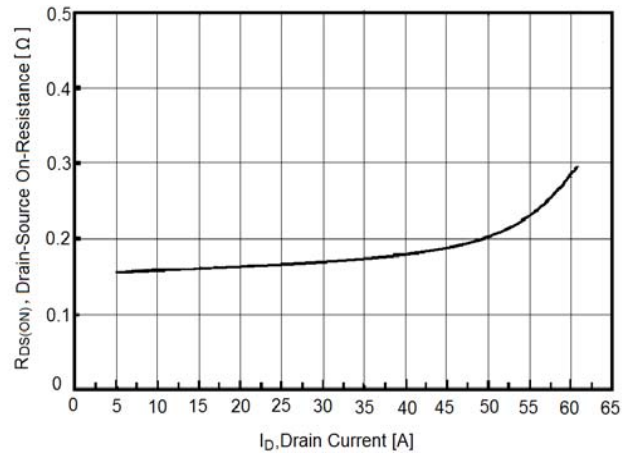


Figure7. $R_{DS(ON)}$ vs Junction Temperature

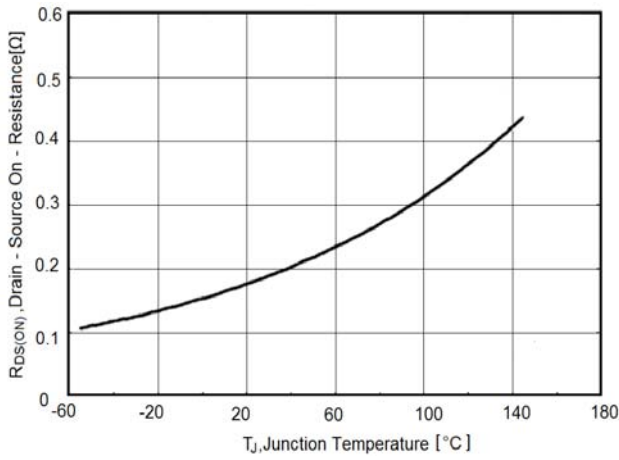


Figure8. BV_{DSS} vs Junction Temperature

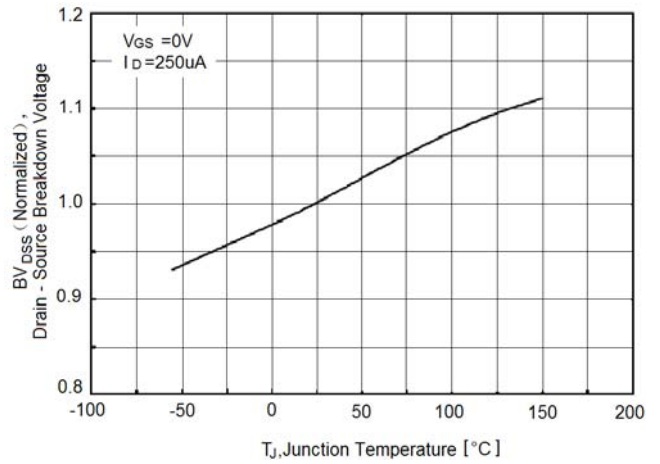


Figure9. Maximum I_D vs Junction Temperature

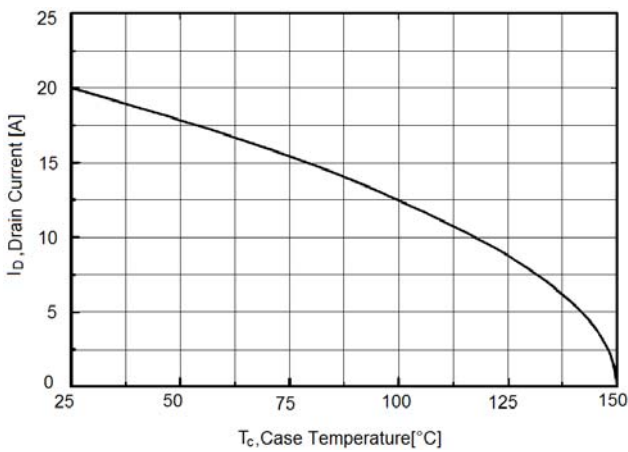


Figure10. Gate charge waveforms

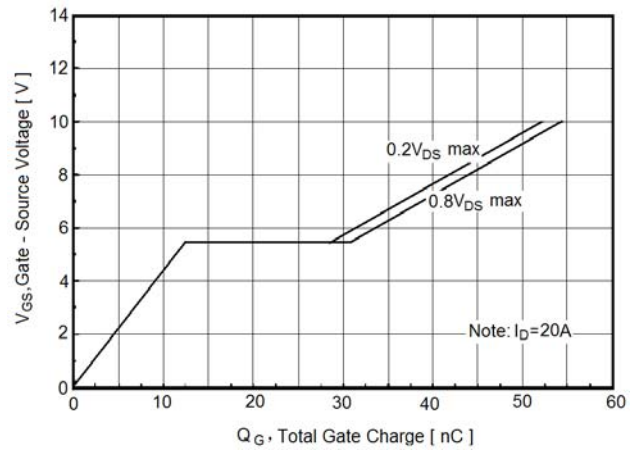


Figure11. Capacitance

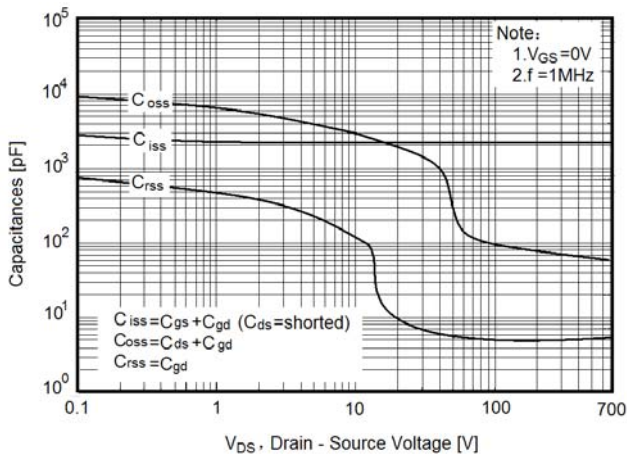


Figure12. Transient Thermal Impedance for FIR20NS65APG

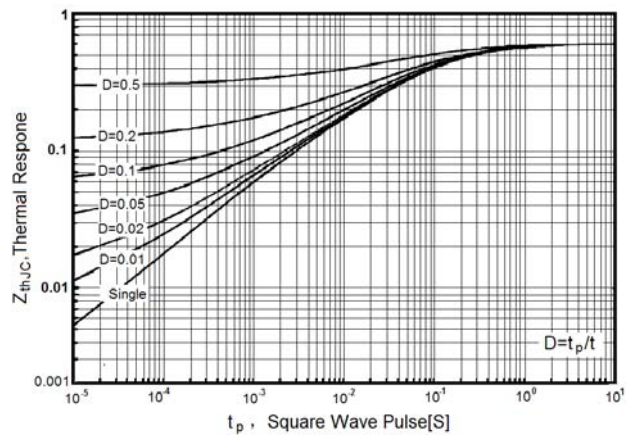
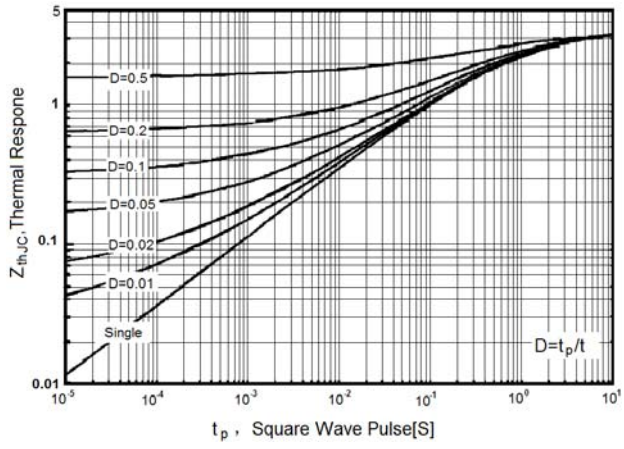
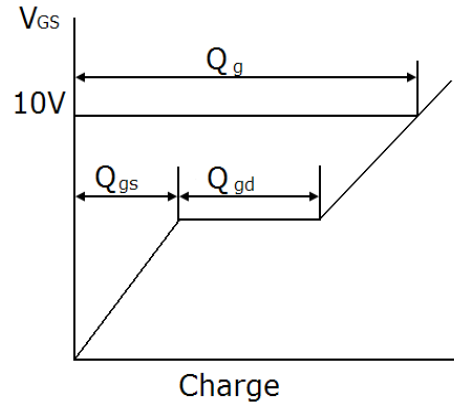
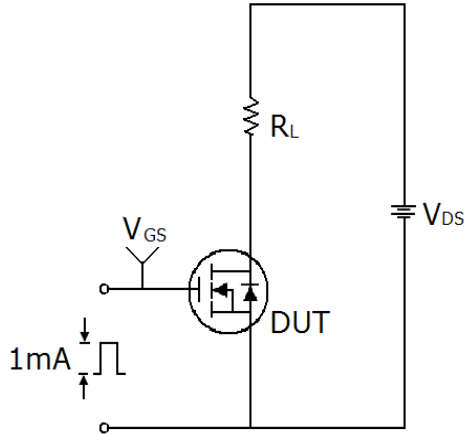


Figure13. Transient Thermal Impedance for FIR20NS65AFG

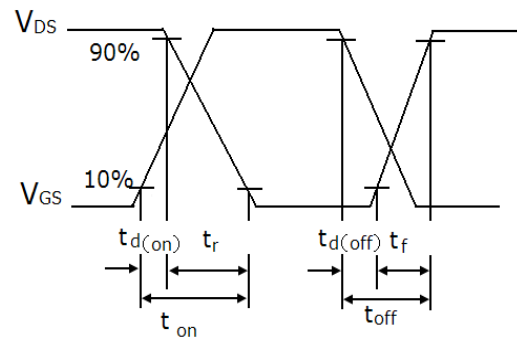
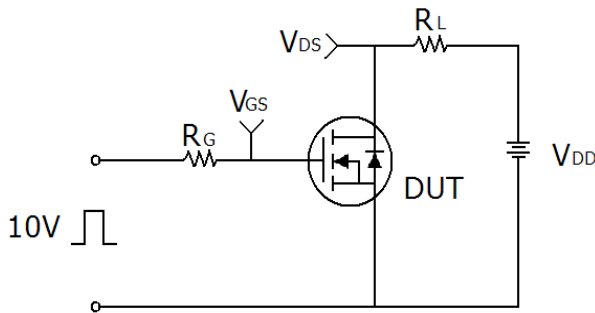


Test Circuit

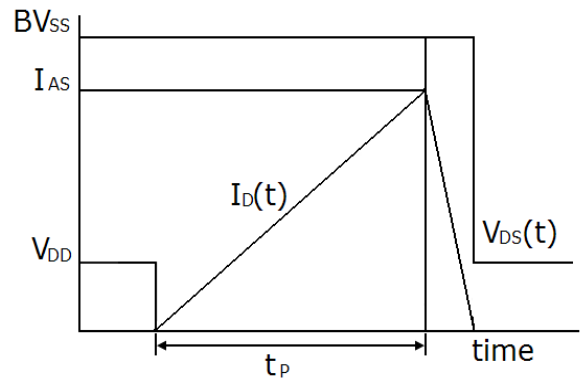
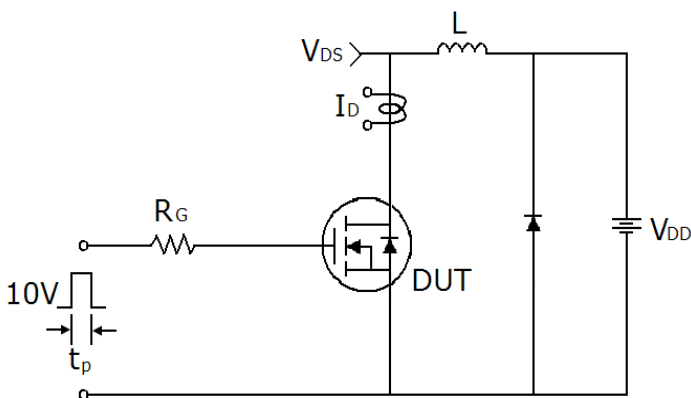
1) Gate charge test circuit & Waveform



2) Switch Time Test Circuit:

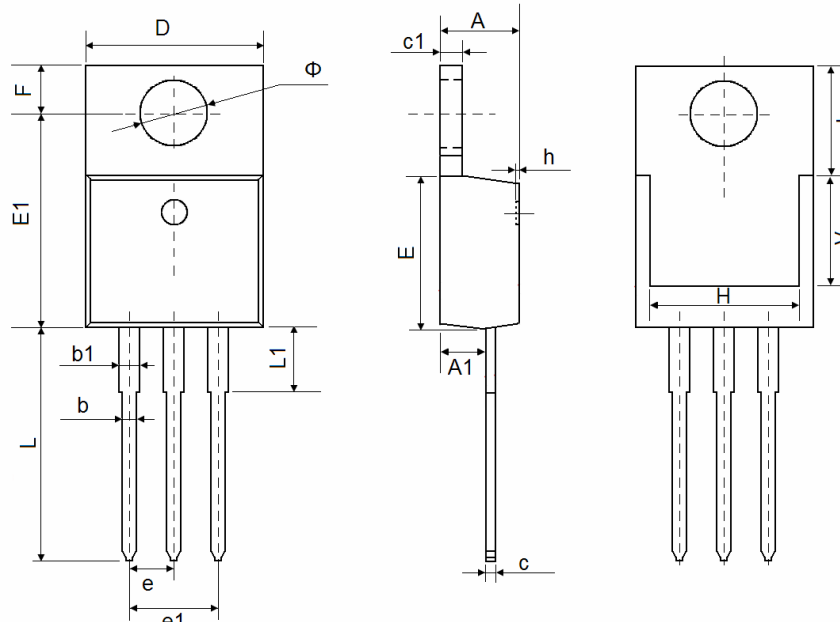


3) Unclamped Inductive Switching Test Circuit & Waveforms



Package Information

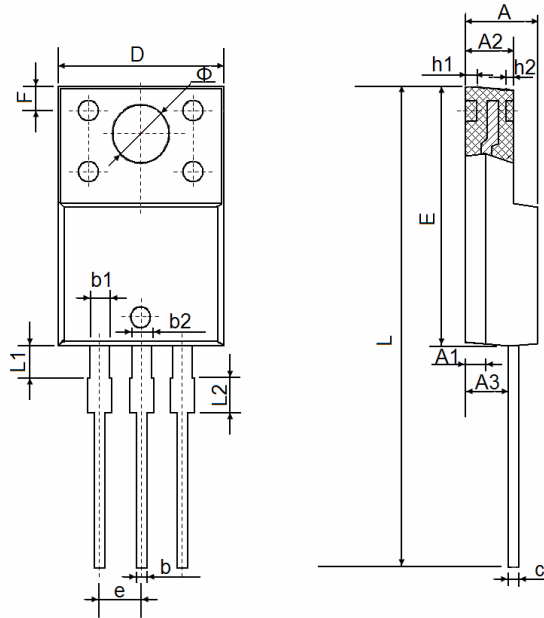
TO-220-3L



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

Package Information

TO-220F



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