



FIR8NS65APG, FIR8NS65AFG

N-Channel Super Junction Power MOSFET

V_{DS}	650	V
$R_{DS(ON)}$	600	m Ω
I_D	7.8	A

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.

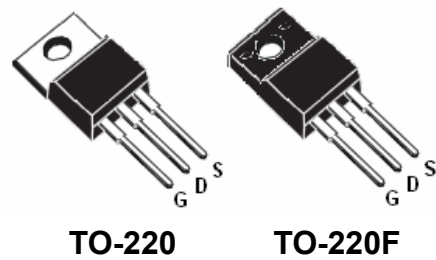
Features

- 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

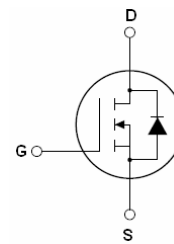
- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

PIN Connection



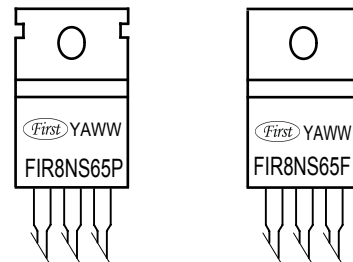
TO-220

TO-220F



Schematic diagram

Marking Diagram



Y = Year
 A = Assembly Location
 WW = Work Week
 FIR8NS65P/F = Specific Device Code

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

Parameter	Symbol	FIR8NS65APG	FIR8NS65AFG	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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	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, $V_{DS} = 480\text{ V}$, $I_D = 7.8\text{ A}$, $T_j = 125^\circ\text{C}$	dv/dt	50		V/ns
Maximum Power Dissipation($T_c=25^\circ\text{C}$) Derate above 25°C	P_D	83	32	W
		0.67	0.26	
Single pulse avalanche energy (Note 2)	E_{AS}	230		mJ
Avalanche current (Note 1)	I_{AR}	7.8		A



Parameter	Symbol	FIR8NS65APG	FIR8NS65AFG	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

Thermal Characteristic

Parameter	Symbol	FIR8NS65APG	FIR8NS65AFG	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

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}	$V_{DS}=650V, V_{GS}=0V$			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	$R_{DS(ON)}$	$V_{GS}=10V, I_D=4.5A$		540	600	m Ω
Dynamic Characteristics						
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	$V_{DS}=480V, I_D=7.8A,$ $V_{GS}=10V$		19	27	nC
Gate-Source Charge	Q_{gs}			3		nC
Gate-Drain Charge	Q_{gd}			6.5		nC
Intrinsic gate resistance	R_G	$f = 1 MHz$ open drain		1.6		Ω
Switching times						
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
Source- Drain Diode Characteristics						
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	μC
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

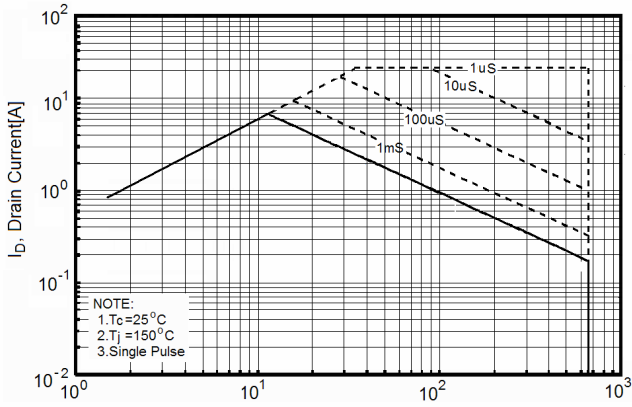


Figure2. Safe operating area for FIR8NS65AFG

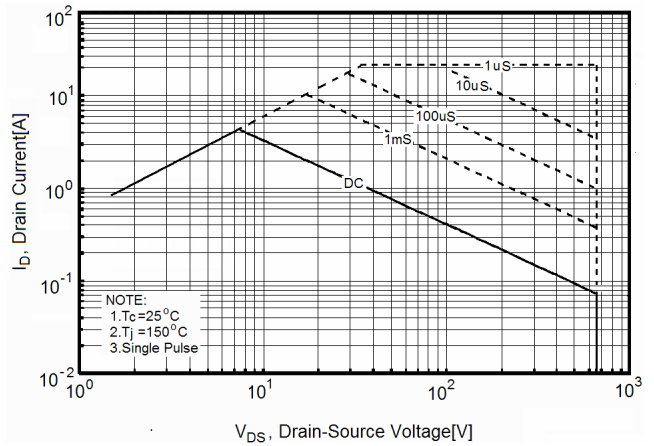


Figure3. Source-Drain Diode Forward Voltage

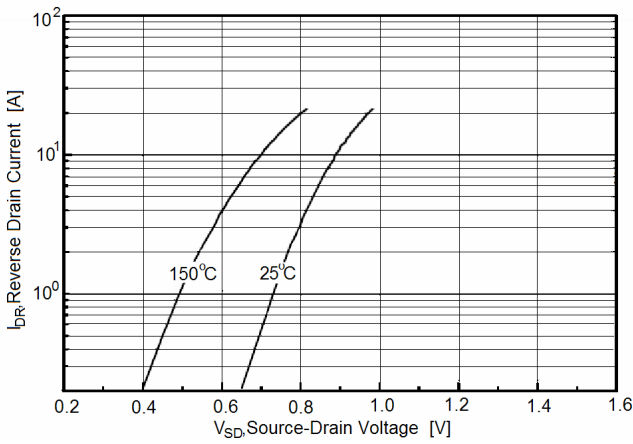


Figure4. Output characteristics

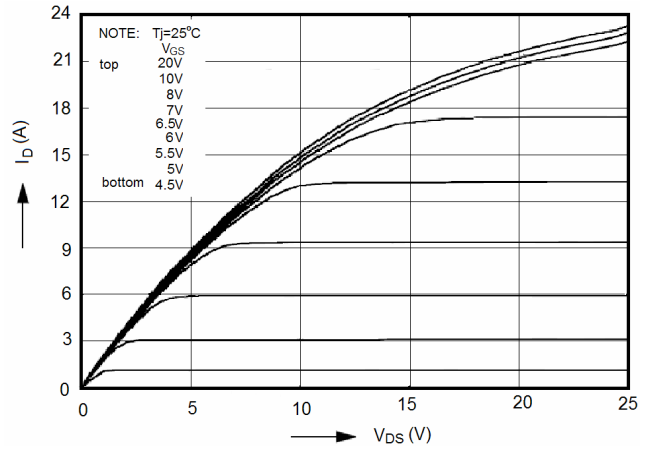


Figure5. Transfer characteristics

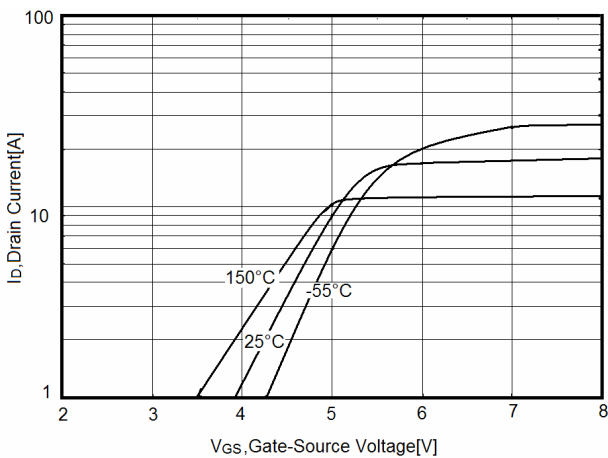


Figure6. Static drain-source on resistance

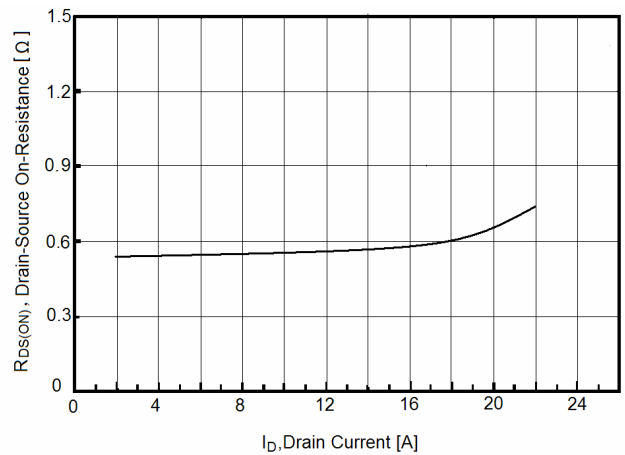


Figure7. $R_{DS(ON)}$ vs Junction Temperature

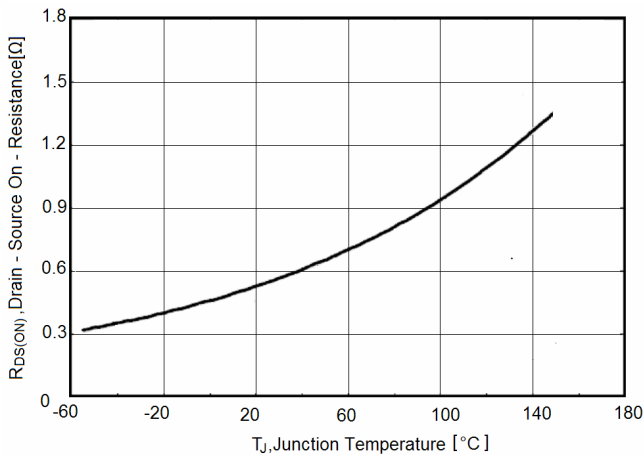


Figure8. BV_{DSS} vs Junction Temperature

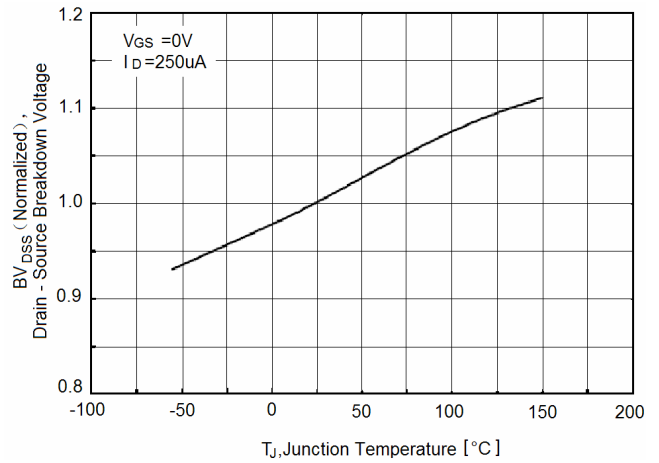


Figure9. Maximum I_D vs Junction Temperature

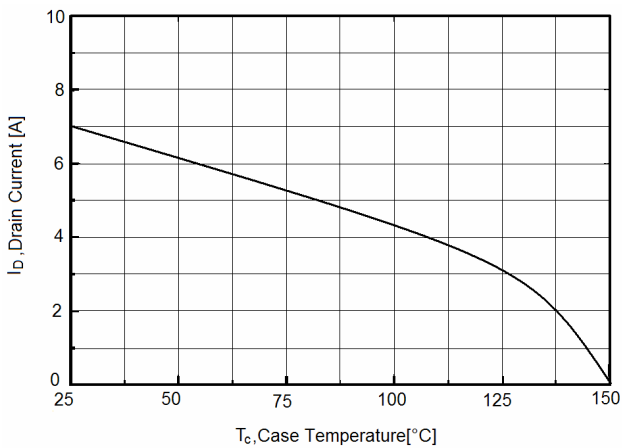


Figure10. Gate charge waveforms

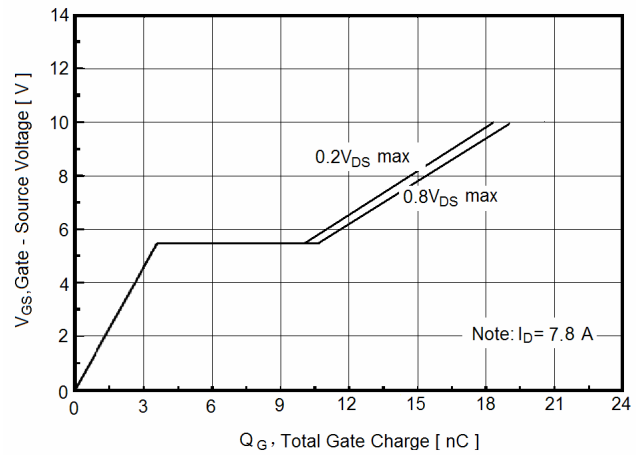


Figure11. Capacitance

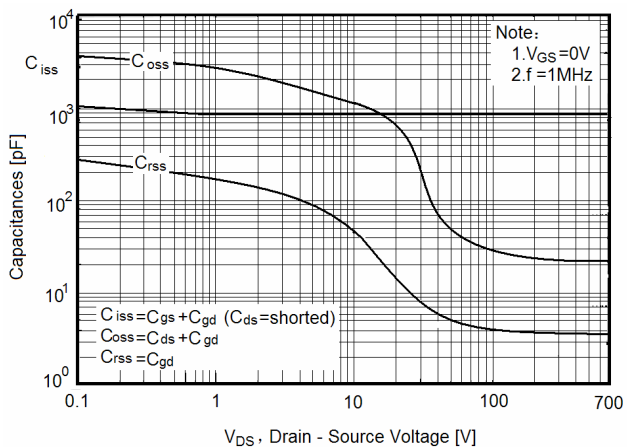


Figure12. Transient Thermal Impedance

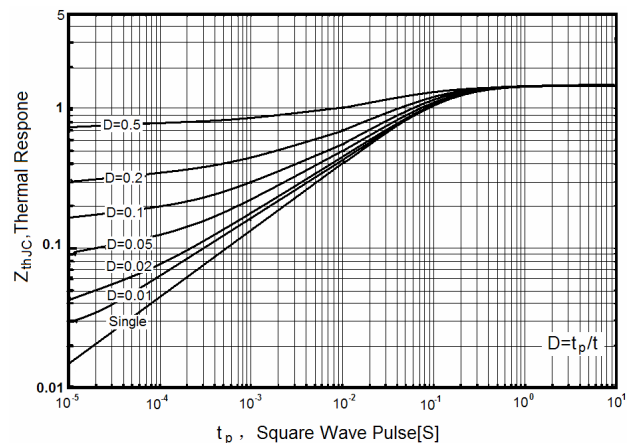
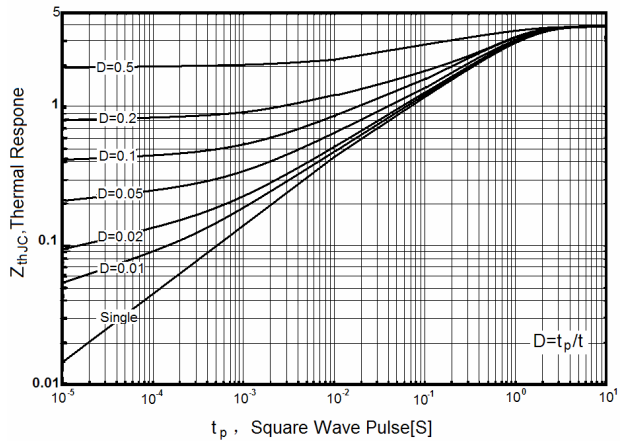
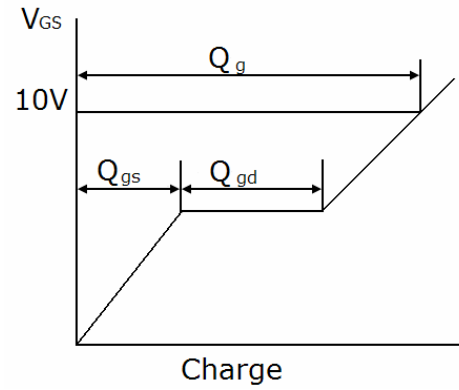
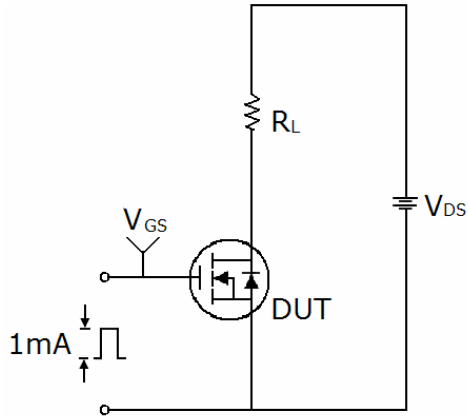


Figure13. Transient Thermal Impedance for FIR8NS65AFG

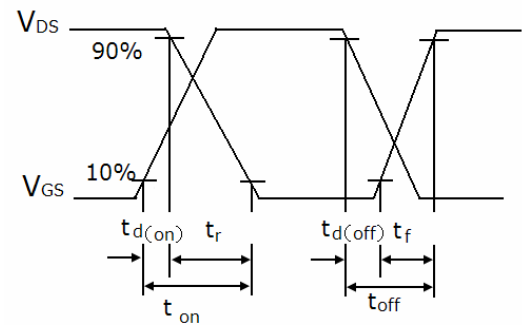
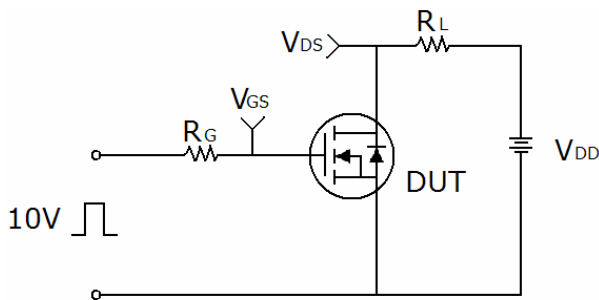


Test circuit

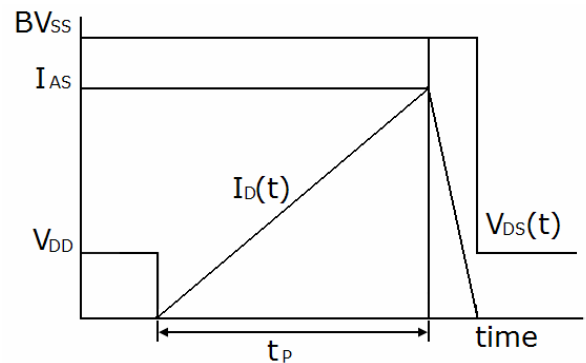
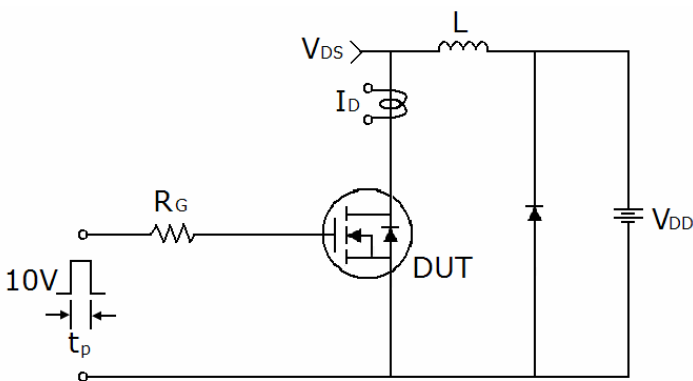
1) Gate charge test circuit & Waveform



2) Switch Time Test Circuit:

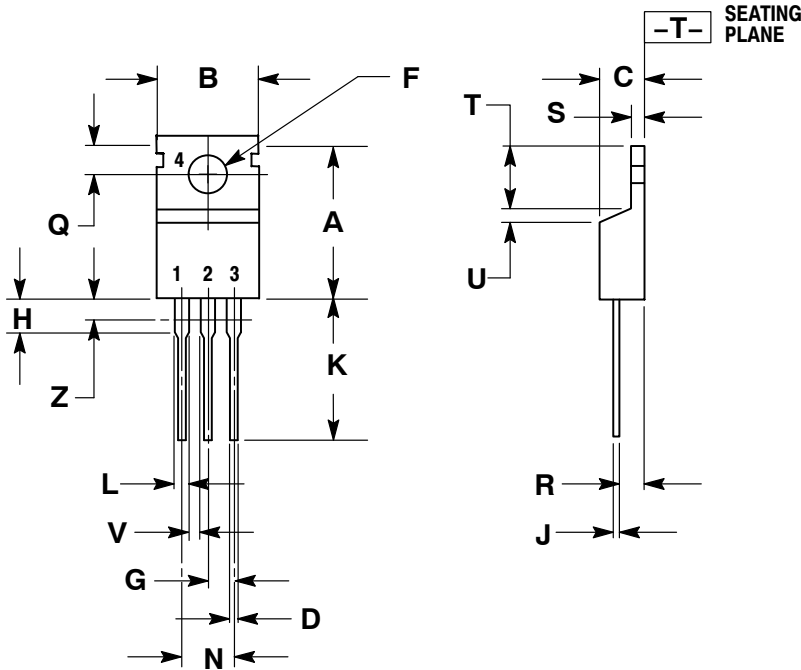


3) Unclamped Inductive Switching Test Circuit & Waveforms



Package Dimensions

TO-220



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

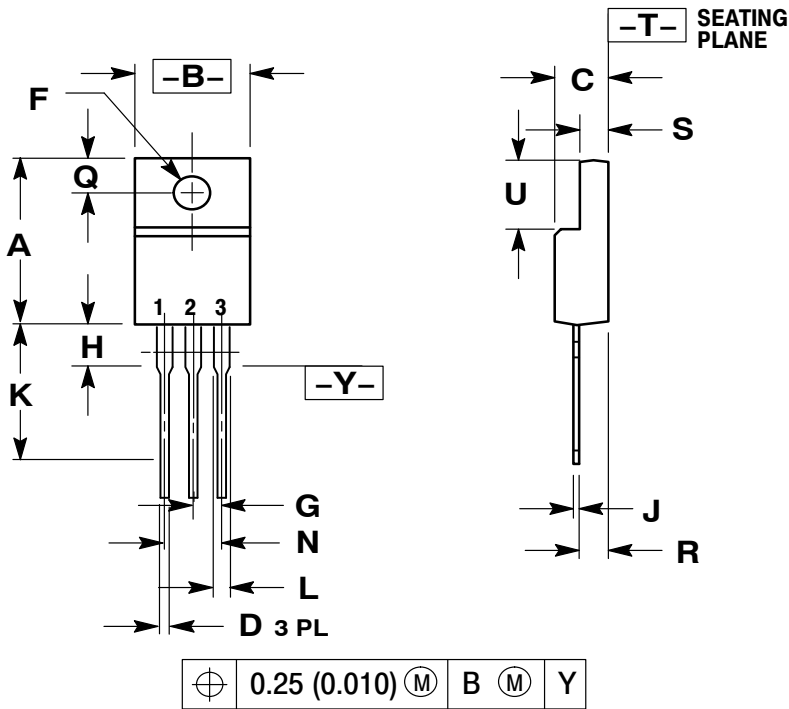
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.161	3.61	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.014	0.025	0.36	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

STYLE 6:

- PIN 1. ANODE
- 2. CATHODE
- 3. ANODE
- 4. CATHODE

Package Dimensions

TO-220F



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88