

HM4N65 / HM4N65F

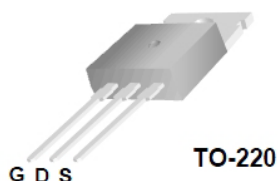
650V N-Channel MOSFET

General Description

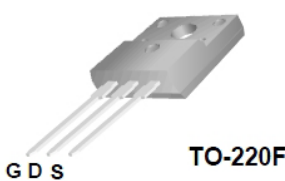
This Power MOSFET is produced using SL semi's advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for low voltage applications such as DC/DC converters and high efficiency switching for power management in portable and battery operated products.

Features

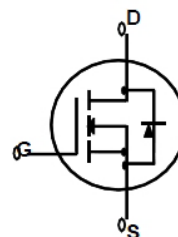
- 4.0A, 650V, $R_{DS(on)} = 3.0\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 15nC)
- High ruggedness
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



TO-220



TO-220F



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	HM4N65	HM4N65F	Units
V_{DSS}	Drain-Source Voltage	650		V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	4.0	4.0 *	A
	- Continuous ($T_C = 100^\circ\text{C}$)	2.4	2.4 *	A
I_{DM}	Drain Current - Pulsed (Note 1)	16	16 *	A
V_{GSS}	Gate-Source Voltage	± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	180		mJ
E_{AR}	Repetitive Avalanche Energy (Note 1)	10		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	104	34	W
	- Derate above 25°C	0.83	0.27	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		$^\circ\text{C}$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	HM4N65	HM4N65F	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.2	3.65	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C/W}$

Electrical Characteristics

$T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	650	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	--	0.6	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}$	--	2.5	3.0	Ω

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	560	--	pF
C_{oss}	Output Capacitance		--	55	--	pF
C_{rss}	Reverse Transfer Capacitance		--	7	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 325\text{ V}, I_D = 4.0\text{ A},$ $R_G = 25\text{ }\Omega$ (Note 4, 5)	--	10	--	ns
t_r	Turn-On Rise Time		--	40	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	40	--	ns
t_f	Turn-Off Fall Time		--	50	--	ns
Q_g	Total Gate Charge	$V_{DS} = 520\text{ V}, I_D = 4.0\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4, 5)	--	16	-	nC
Q_{gs}	Gate-Source Charge		--	2.5	--	nC
Q_{gd}	Gate-Drain Charge		--	6.5	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	4.0	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	16	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 4.0 A	--	--	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 4.0 A,	--	300	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F / dt = 100 A/μs (Note 4)	--	2.0	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 22\text{ mH}, I_{AS} = 4.0\text{ A}, V_{DD} = 25\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 4.0\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

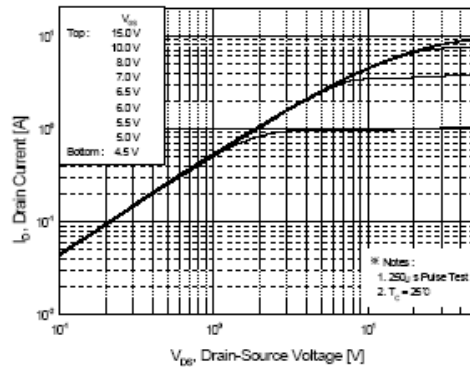


Figure 1. On-Region Characteristics

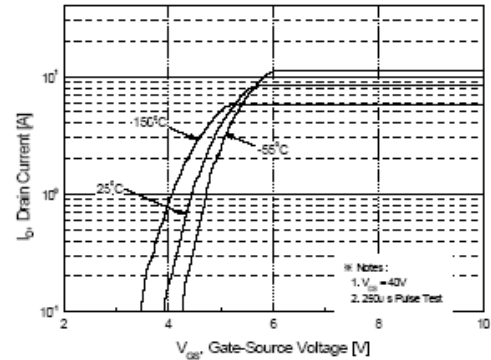


Figure 2. Transfer Characteristics

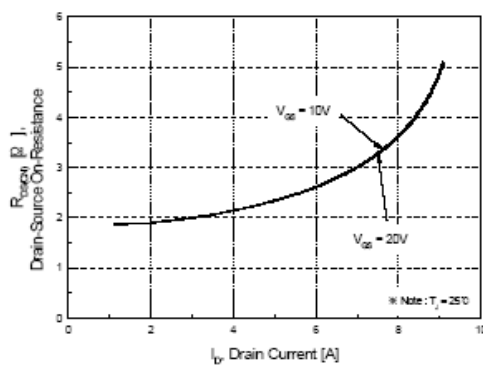


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

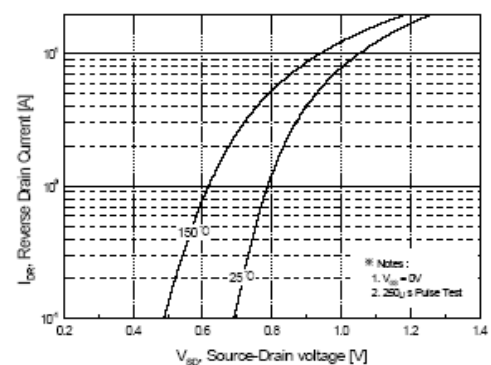


Figure 4. Body Diode Forward Voltage Variation with Source Current

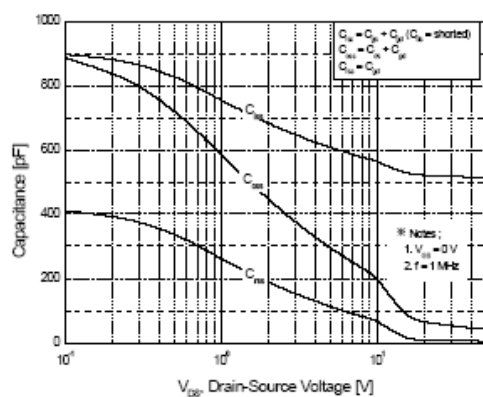


Figure 5. Capacitance Characteristics

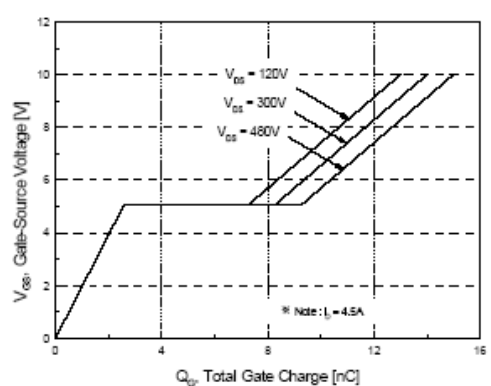


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

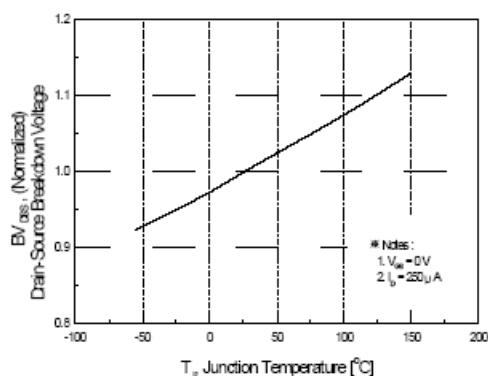


Figure 7. Breakdown Voltage Variation vs Temperature

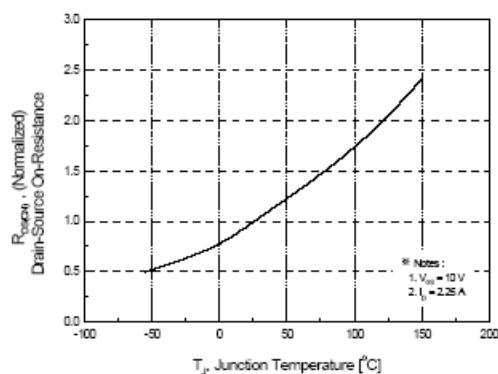


Figure 8. On-Resistance Variation vs Temperature

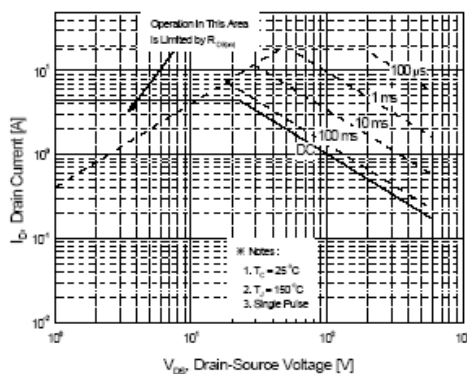


Figure 9-1. Maximum Safe Operating Area for HM4N65

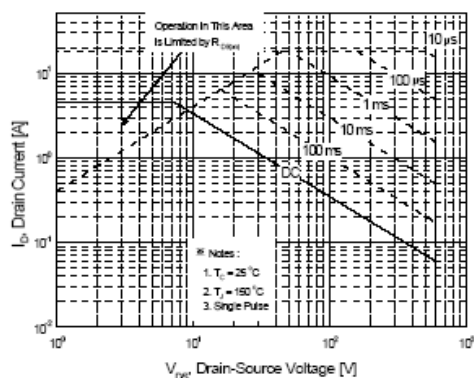


Figure 9-2. Maximum Safe Operating Area for HM4N65F

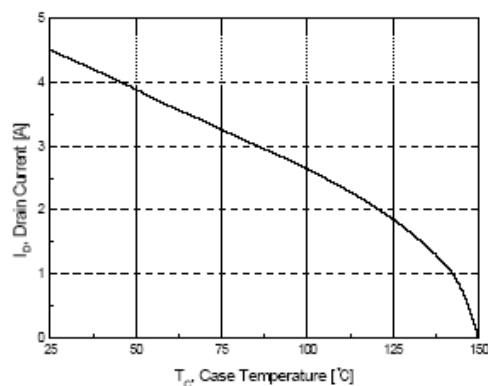


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

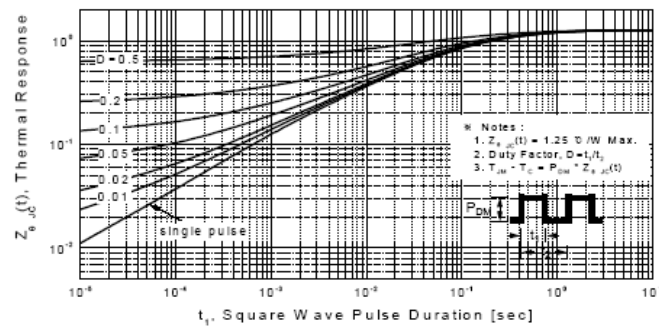


Figure 11-1. Transient Thermal Response Curve
for HM4N65

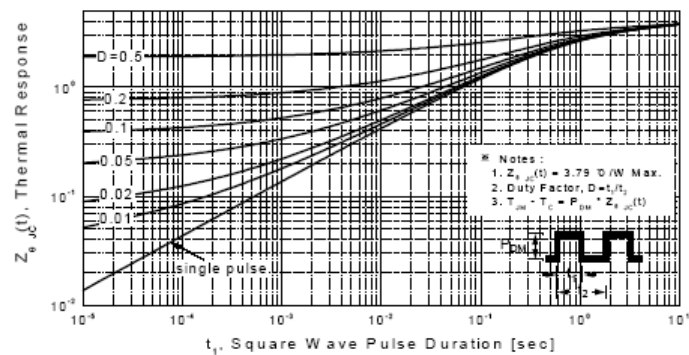
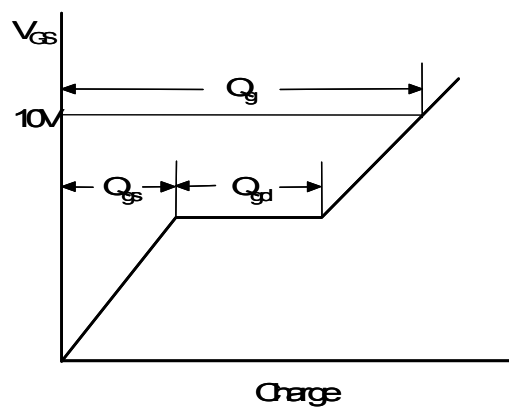
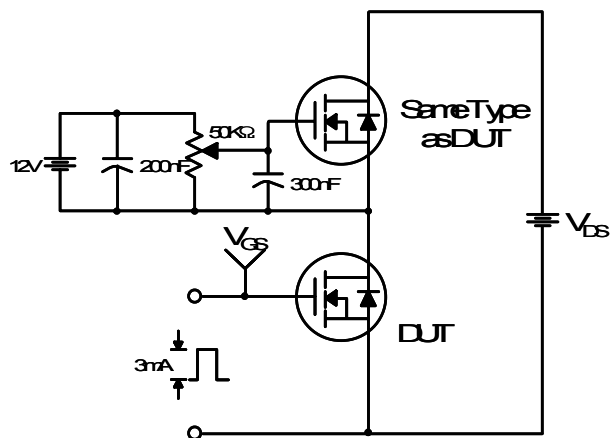
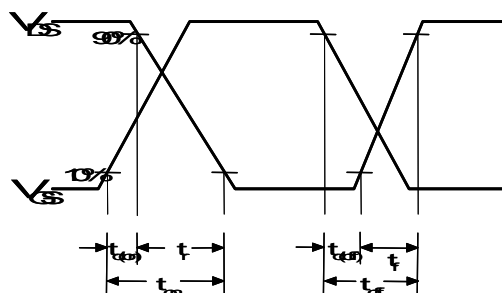
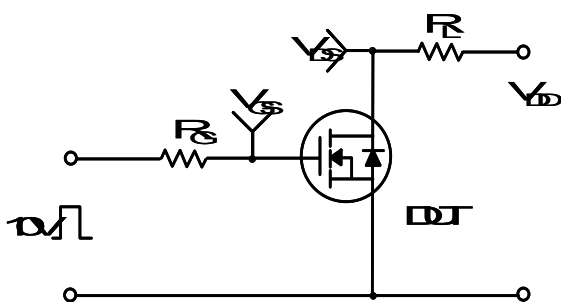


Figure 11-2. Transient Thermal Response Curve
for HM4N65F

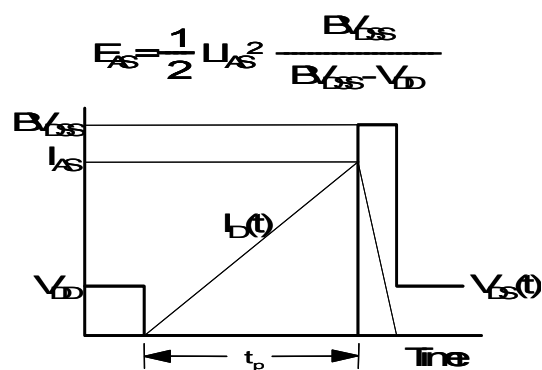
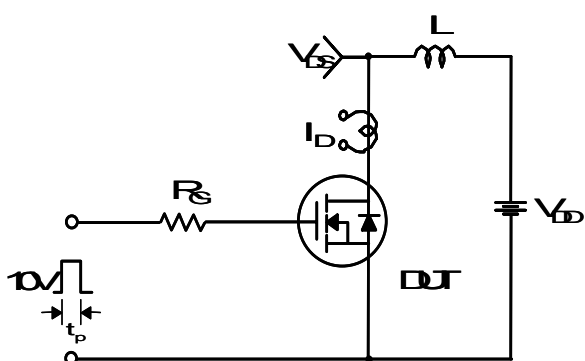
Gate Charge Test Circuit & Waveform



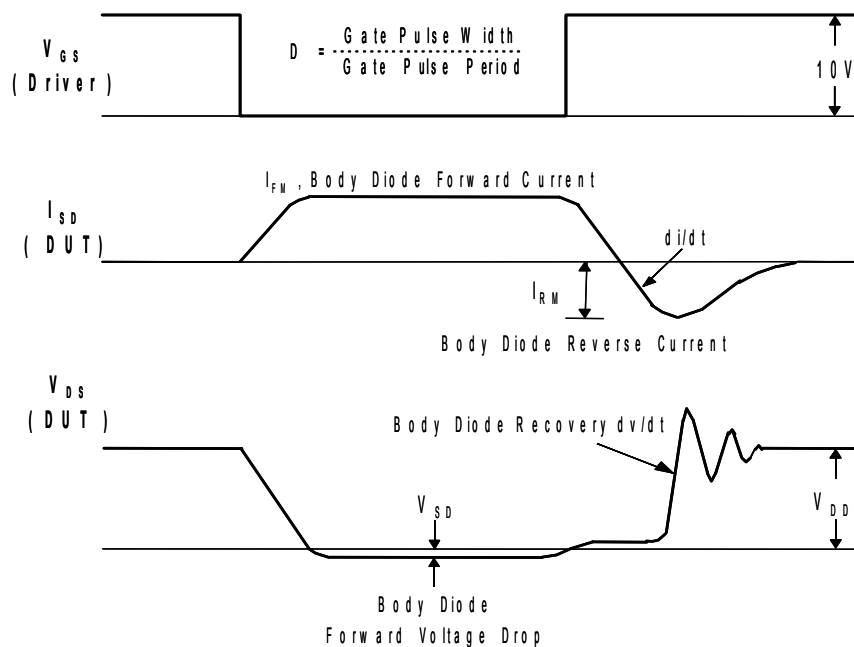
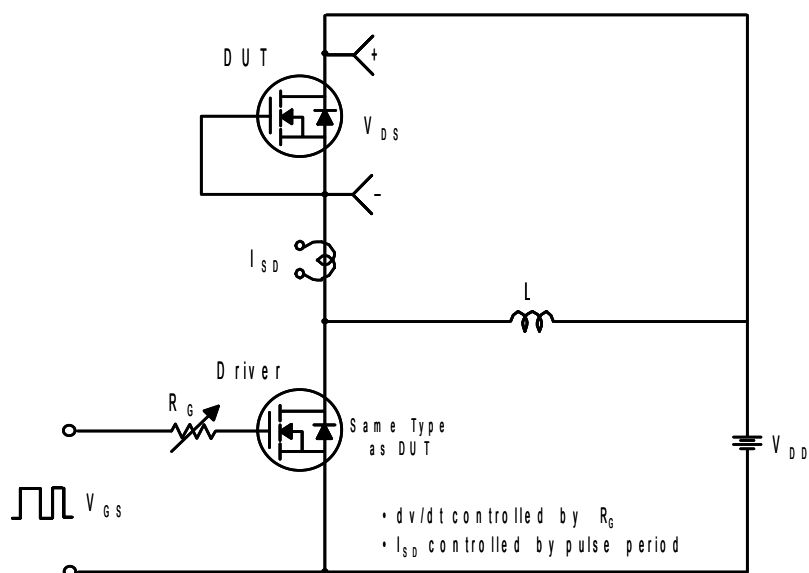
Resistive Switching Test Circuit & Waveforms



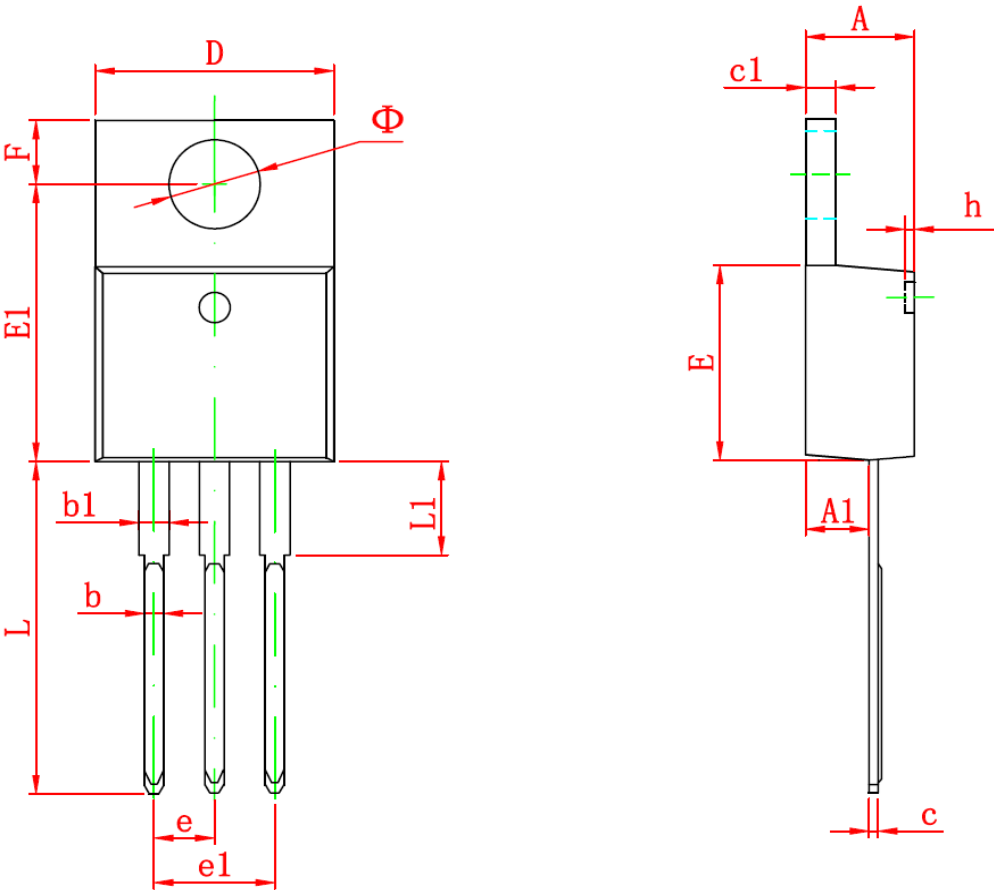
Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms



TO-220-3L PACKAGE OUTLINE DIMENSIONS

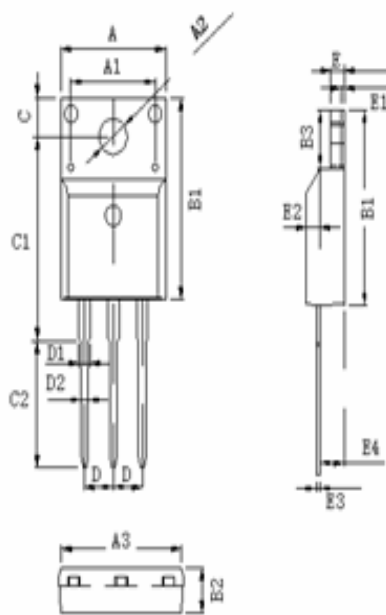


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.470	4.670	0.176	0.184
A1	2.520	2.820	0.099	0.111
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
E1	12.060	12.460	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	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
Φ	3.735	3.935	0.147	0.155

Package Dimensions

TO-220F

TO-220F 外形尺寸图



DIM.	MILLIMETERS	
A	10.03 ± 0.20	
A1	7.00	
A2	3.12 ± 0.10	
A3	9.70 ± 0.20	
B1	15.75 ± 0.20	
B2	4.72 ± 0.20	
B3	6.70 ± 0.20	
C	3.30 ± 0.10	
C1	15.80 ± 0.20	
C2	9.80 ± 0.2	
D	Typical 2.54	
D1	1.47 (MAX)	
D2	0.80 ± 0.10	
E	2.55 ± 0.20	
E1	0.70	
E2	1.00 × 45°	
E3	0.50	+0.1
		-0.05
E4	2.80 ± 0.20	