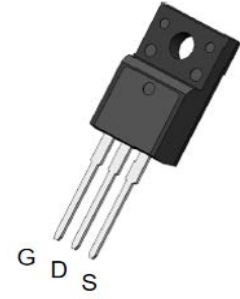


N-channel Enhancement Mode Power MOSFET

Description

Features

- 650V, 4A
 $R_{DS(ON)} < 2.64\Omega @ V_{GS} = 10V$
- Fast Switching
- Improved dv/dt Capability

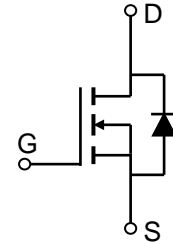


TO-220FP-3L Top View

Applications

- Load Switch
- PWM Application
- Power Management

100% UIS TESTED!
100% ΔV_{ds} TESTED!



Schematic Diagram

Package Marking and Ordering Information

Device Marking	Device	Outline	Package	TUBE (pcs)	Inner Box (pcs)	Per Carton (pcs)
HNS4N65F	HNS4N65F	TUBE	TO-220FP-3L	50	1000	5000

Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Units
V_{DS}	Drain-to-Source Voltage	650	V
V_{GS}	Gate-to-Source Voltage	± 30	V
I_D	Continuous Drain Current	$T_C = 25^\circ\text{C}$	4
		$T_C = 100^\circ\text{C}$	3
I_{DM}	Pulsed Drain Current ⁽¹⁾	16	A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	125	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	27
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient ⁽³⁾	62.5	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case	4.7	
T_J, T_{STG}	Junction & Storage Temperature Range	-55 to 150	°C

Electrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	650	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{V}, V_{GS} = 0\text{V}$	-	-	1.0	μA
I_{GSS}	Gate-Body Leakage Current	$V_{DS} = 0\text{V}, V_{GS} = \pm 30\text{V}$	-	-	± 100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	2	3	4	V
$R_{DS(ON)}$	Static Drain-Source ON-Resistance ⁽⁴⁾	$V_{GS} = 10\text{V}, I_D = 2\text{A}$	-	2.22	2.64	Ω
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{GS} = 0\text{V}, V_{DS} = 25\text{V}, f = 1\text{MHz}$	-	587	-	pF
C_{oss}	Output Capacitance		-	59	-	pF
C_{rss}	Reverse Transfer Capacitance		-	10	-	pF
Q_g	Total Gate Charge	$V_{GS} = 0 \text{ to } 10\text{V}$ $V_{DS} = 520\text{V}, I_D = 4\text{A}$	-	15	-	nC
Q_{gs}	Gate Source Charge		-	3.5	-	nC
Q_{gd}	Gate Drain("Miller") Charge		-	6	-	nC
Switching Characteristics						
$t_{d(on)}$	Turn-On DelayTime	$V_{GS} = 10\text{V}, V_{DD} = 320\text{V}$ $I_D = 4\text{A}, R_{GEN} = 24\Omega$	-	13	-	ns
t_r	Turn-On Rise Time		-	22	-	ns
$t_{d(off)}$	Turn-Off DelayTime		-	43	-	ns
t_f	Turn-Off Fall Time		-	27	-	ns
Drain-Source Diode Characteristics and Max Ratings						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	4	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	16	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = 4\text{A}$	-	-	1.2	V
t_{rr}	Body Diode Reverse Recovery Time	$I_F = 4\text{A}, di/dt = 100\text{A}/\mu\text{s}$	-	280	-	ns
Q_{rr}	Body Diode Reverse Recovery Charge		-	2	-	μC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J=25^\circ\text{C}$, $V_{DD}=50\text{V}$, $V_G=10\text{V}$, $R_G=25\text{ohm}$, $L=10\text{mH}$, $I_{AS}=5\text{A}$
 3. $R_{\theta JA}$ is measured with the device mounted on a minimum recommended pad of 2oz copper FR4 PCB
 4. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 0.5\%$.

Typical Performance Characteristics

Figure 1: Output Characteristics

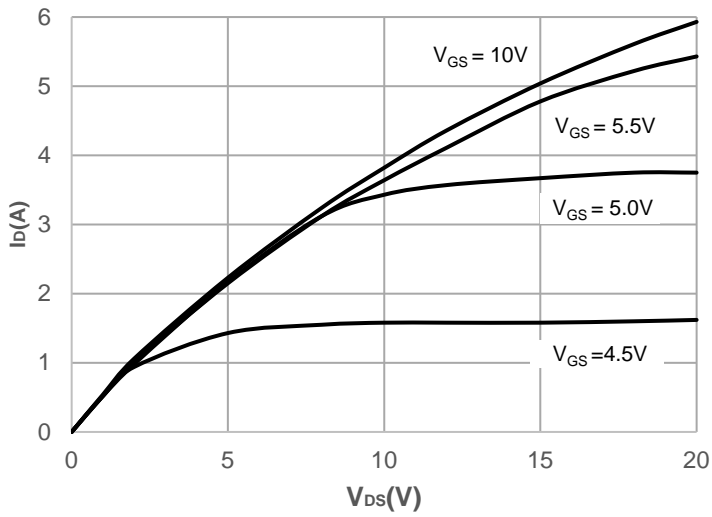


Figure 2: Typical Transfer Characteristics

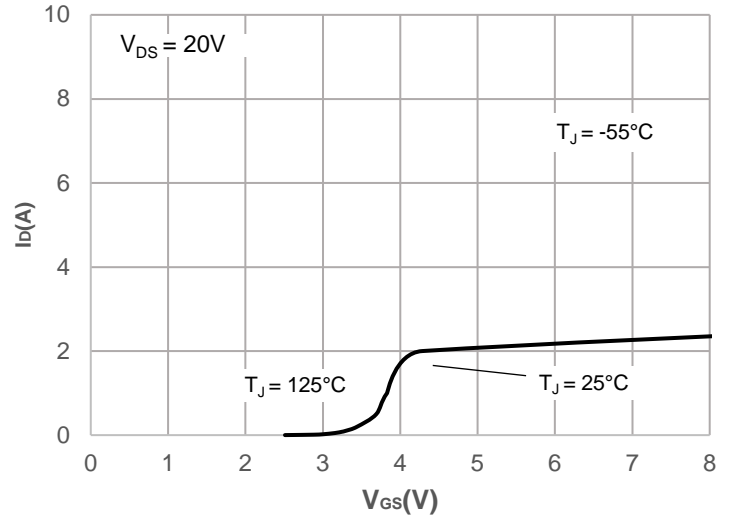


Figure 3: On-resistance vs. Drain Current

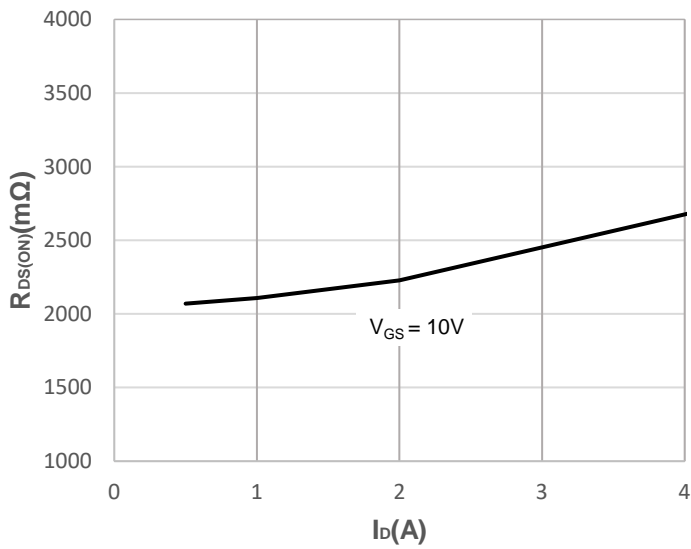


Figure 4: Body Diode Characteristics

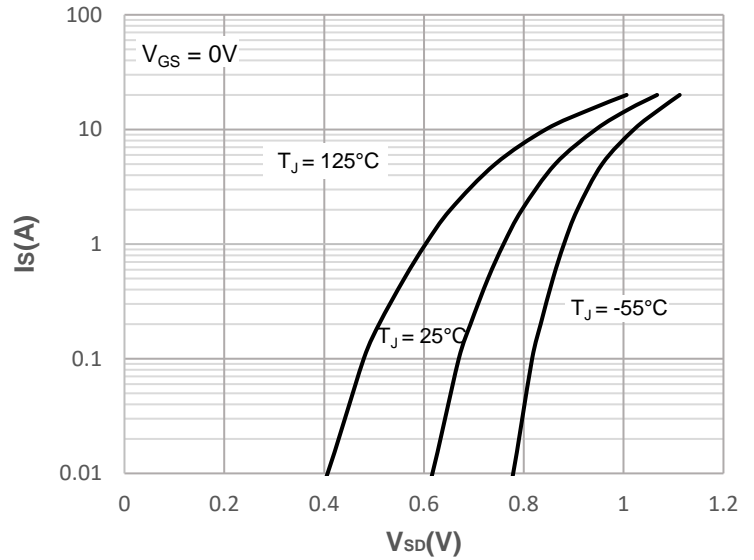


Figure 5: Gate Charge Characteristics

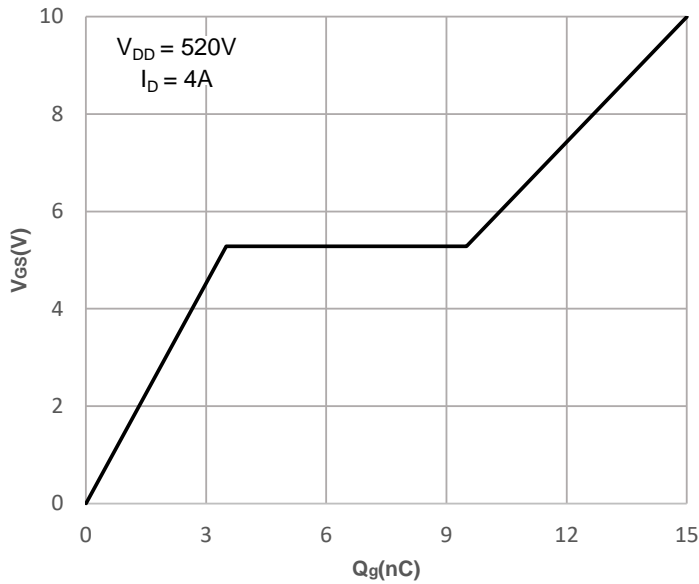
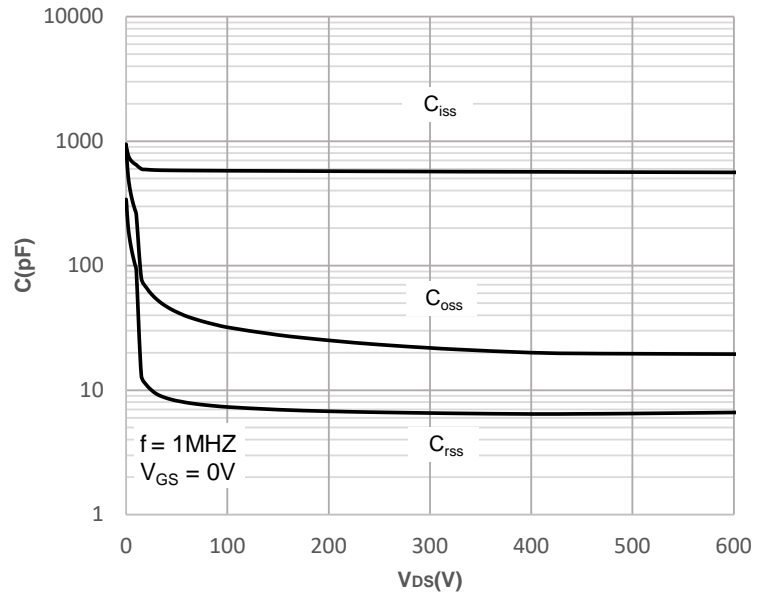


Figure 6: Capacitance Characteristics



Typical Performance Characteristics

Figure 7: Normalized Breakdown voltage vs. Junction Temperature

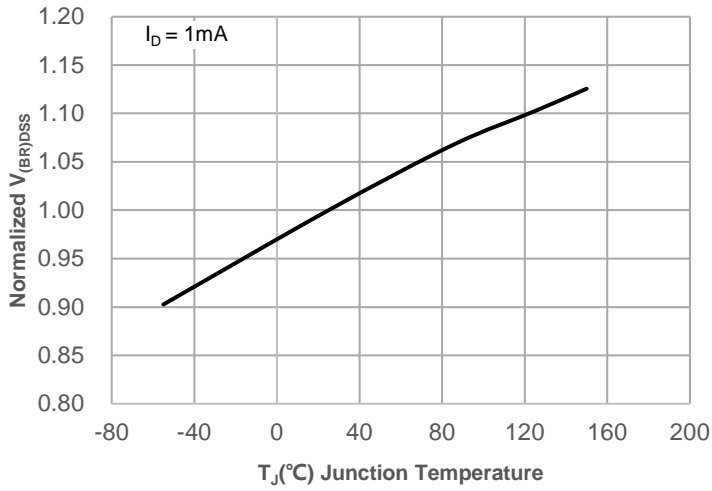


Figure 8: Normalized on Resistance vs. Junction Temperature

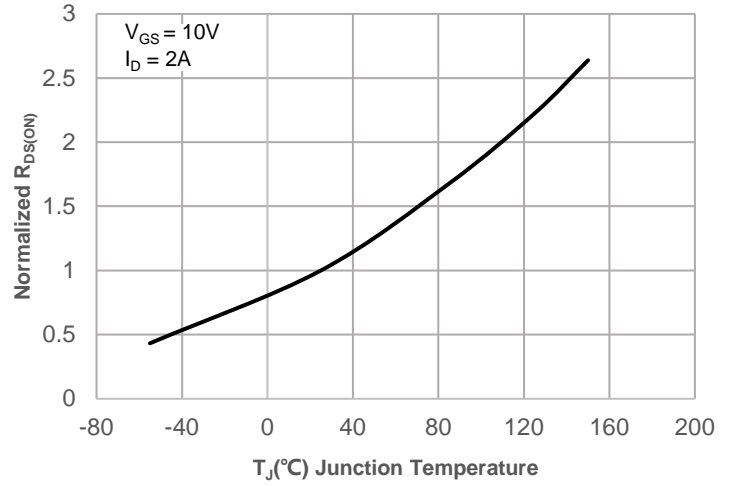


Figure 9: Maximum Safe Operating Area

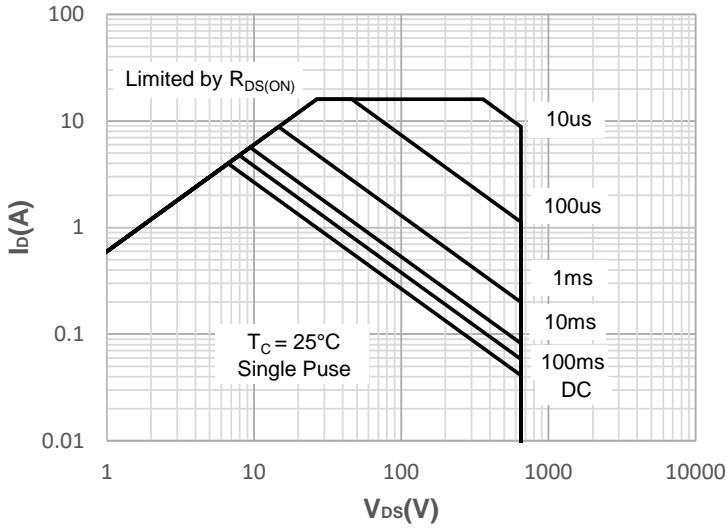


Figure 10: Maximum Continuous Driant Current vs. Case Temperature

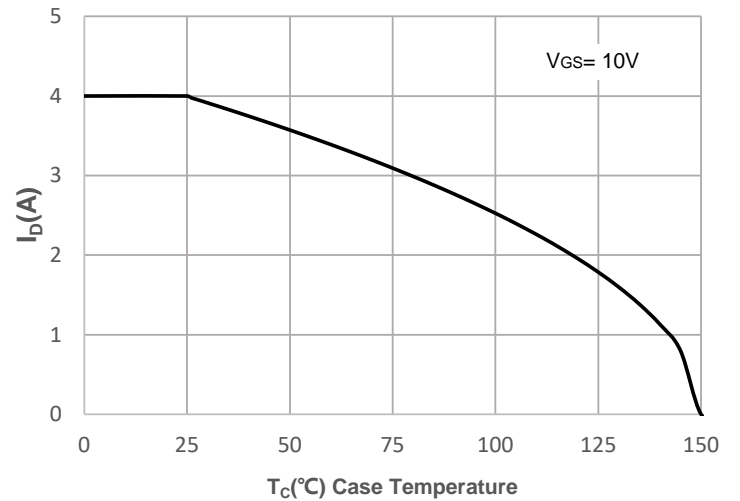


Figure 11: Normalized Maximum Transient Thermal Impedance

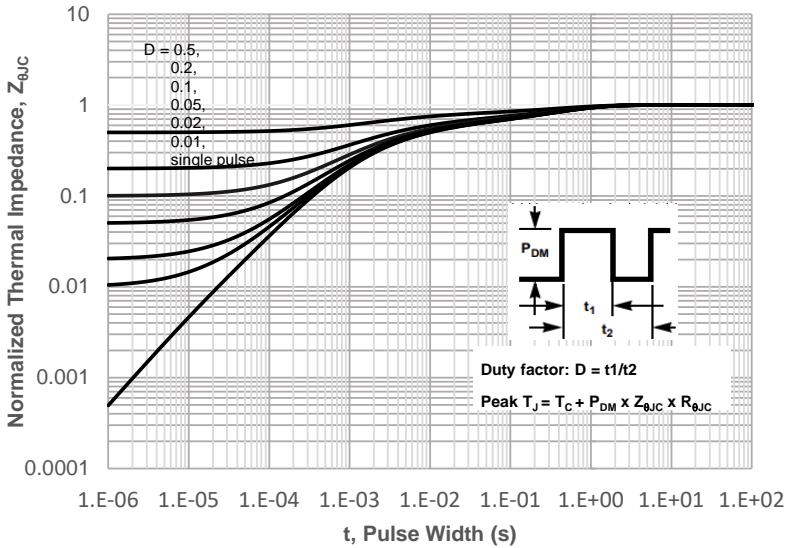
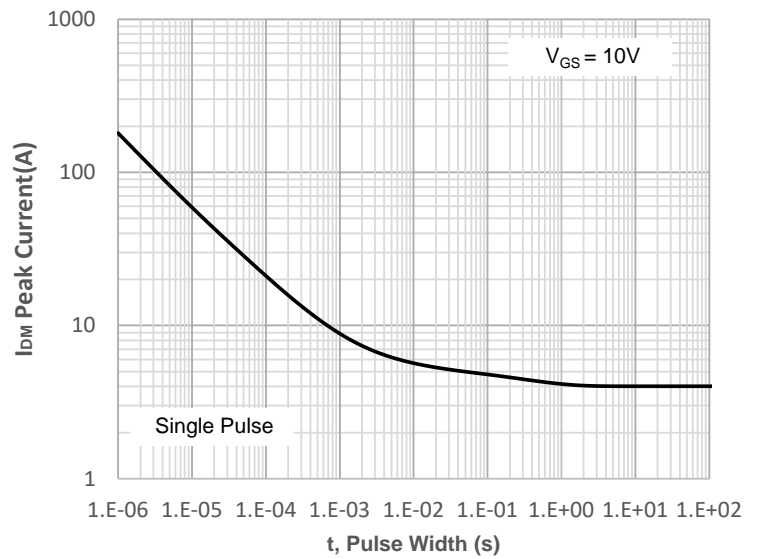


Figure 12: Peak Current Capacity



Test Circuit

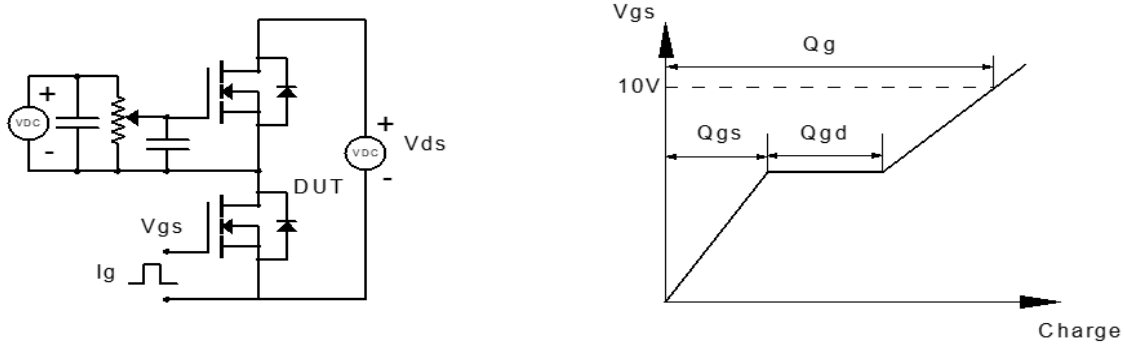


Figure 1: Gate Charge Test Circuit & Waveform

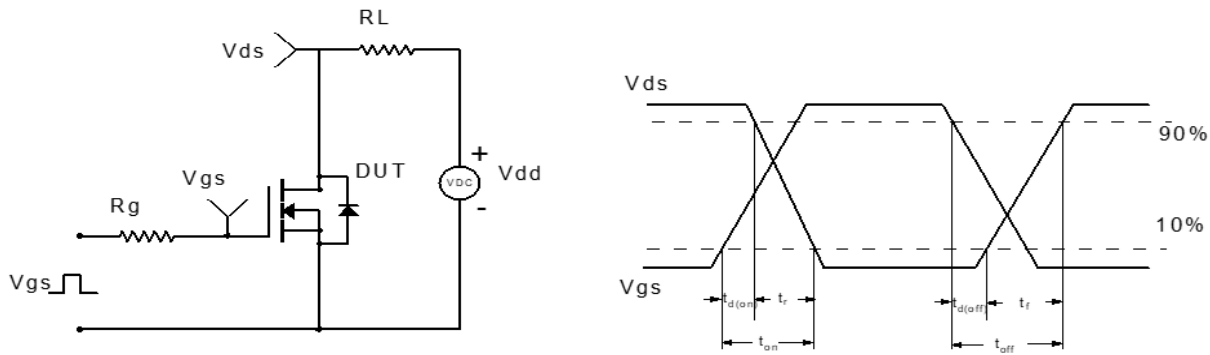


Figure 2: Resistive Switching Test Circuit & Waveform

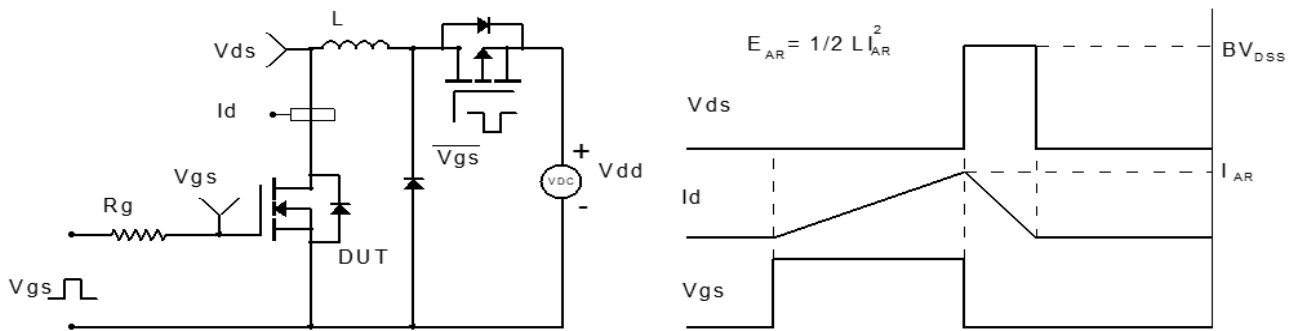


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

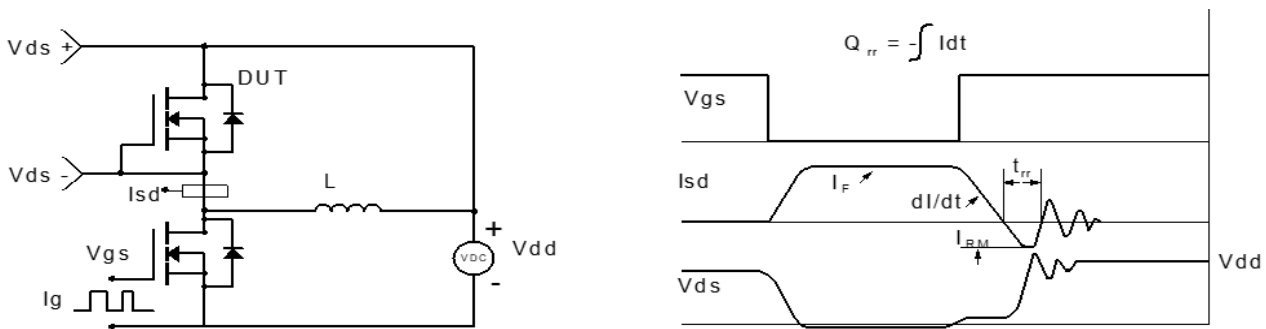
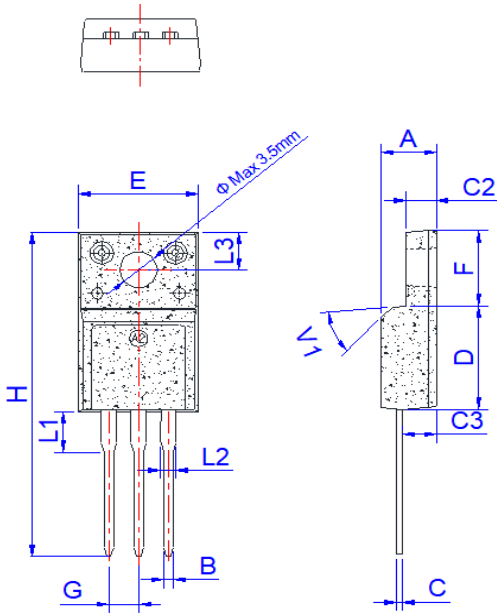


Figure 4: Diode Recovery Test Circuit & Waveform

Package Mechanical Data(TO-220FP-3L)



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.50		4.90	0.177		0.193
B	0.74	0.80	0.83	0.029	0.031	0.033
C	0.47		0.65	0.019		0.026
C2	2.45		2.75	0.096		0.108
C3	2.60		3.00	0.102		0.118
D	8.80		9.30	0.346		0.366
E	9.80		10.4	0.386		0.410
F	6.40		6.80	0.252		0.268
G		2.54			0.1	
H	28.0		29.8	1.102		1.173
L1		3.63			0.143	
L2	1.14		1.70	0.045		0.067
L3		3.30			0.130	
V1		45°			45°	