

MOSFET – Power, N-Channel, SUPERFET® III, FAST

650 V, 190 mΩ, 16 A

NTPF190N65S3H

Description

SUPERFET III MOSFET is onsemi's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provides superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III FAST MOSFET series helps minimize various power systems and improve system efficiency.

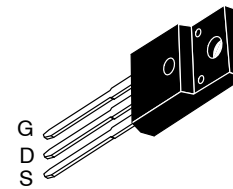
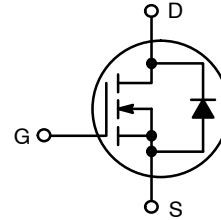
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 156\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 31\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 292\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

Applications

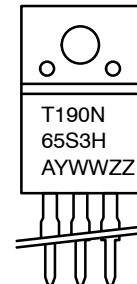
- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter

V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	190 mΩ @ 10 V	16 A



TO-220 FULLPAK
CASE 221D

MARKING DIAGRAM



T190N65S3H = Specific Device Code
A = Assembly Location
YWW = Date Code (Year & Week)
ZZ = Assembly Lot

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

NTPF190N65S3H

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, Unless otherwise specified)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	Gate to Source Voltage	DC	± 30	V
		AC ($f > 1\text{ Hz}$)	± 30	V
I_D	Drain Current	Continuous ($T_C = 25^\circ\text{C}$)	16*	A
		Continuous ($T_C = 100^\circ\text{C}$)	10*	
I_{DM}	Drain Current	Pulsed (Note 1)	45*	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		142	mJ
I_{AS}	Avalanche Current (Note 2)		3.6	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		1.29	mJ
dv/dt	MOSFET dv/dt		120	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	32	W
		Derate Above 25°C	0.25	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, 1/8" from Case for 5 s		260	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

*Drain current limited by maximum junction temperature.

1. Repetitive rating; pulse-width limited by maximum junction temperature.

2. $I_{AS} = 3.6\text{ A}$, $R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.

3. $I_{SD} \leq 8\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.88	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Shipping
NTPF190N65S3H	T190N65S3H	TO-220 FULLPAK	1000 Units / Tube

NTPF190N65S3H

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C	650			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	700			V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 10 mA, Referenced to 25°C		0.63		V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			1	μA
		V _{DS} = 520 V, T _C = 125°C		0.8		
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 1.4 mA	2.4		4.0	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 8 A		156	190	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 8 A		18		S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	V _{DS} = 400 V, V _{GS} = 0 V, f = 250 kHz		1600		pF
C _{oss}	Output Capacitance			23		pF
C _{oss(eff.)}	Effective Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		292		pF
C _{oss(er.)}	Energy Related Output Capacitance	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		41		pF
Q _{g(tot)}	Total Gate Charge at 10 V	V _{DS} = 400 V, I _D = 8 A, V _{GS} = 10 V (Note 4)		31		nC
Q _{gs}	Gate to Source Gate Charge			7.1		nC
Q _{gd}	Gate to Drain "Miller" Charge			7.9		nC
ESR	Equivalent Series Resistance	f = 1 MHz		1.1		Ω

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 400 V, I _D = 8 A, V _{GS} = 10 V, R _g = 10 Ω (Note 4)		19		ns
t _r	Turn-On Rise Time			7.8		ns
t _{d(off)}	Turn-Off Delay Time			61		ns
t _f	Turn-Off Fall Time			3.5		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current			16	A
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current			45	A
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 8 A		1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 8 A, dI _F /dt = 100 A/μs		259	ns
Q _{rr}	Reverse Recovery Charge			3.2	μC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS

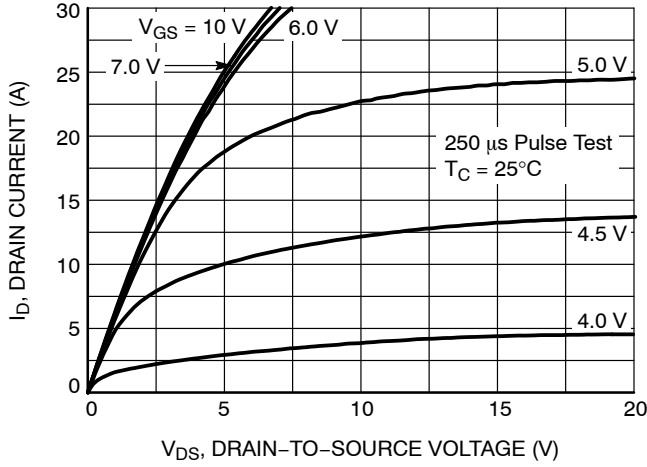


Figure 1. On-Region Characteristics

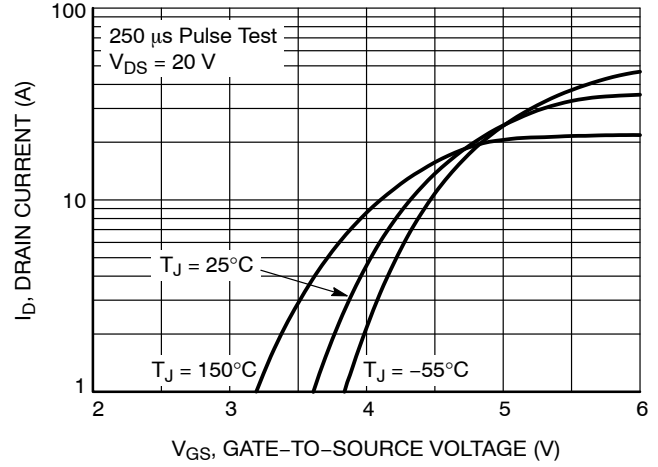


Figure 2. Transfer Characteristics

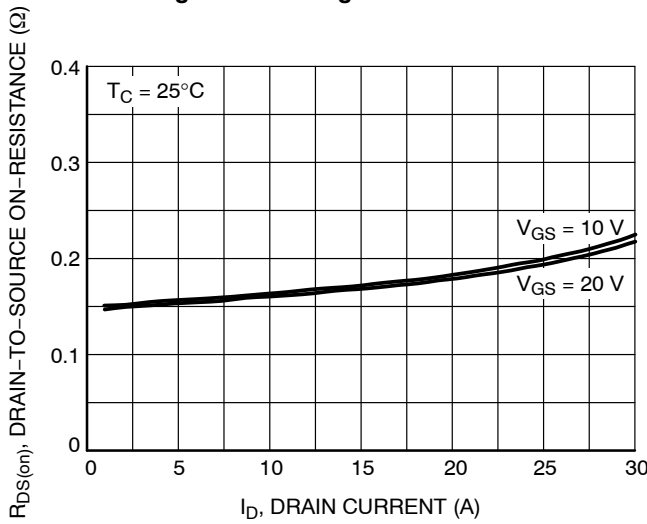


Figure 3. On Resistance Variation vs. Drain Current and Gate Voltage

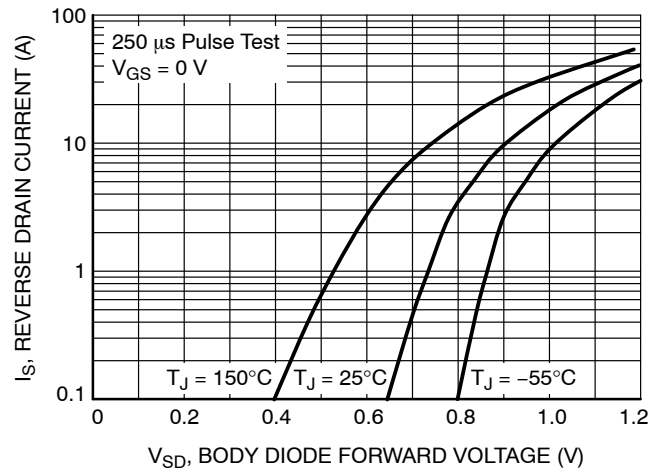


Figure 4. Diode Forward Voltage Variation vs. Source Current and Temperature

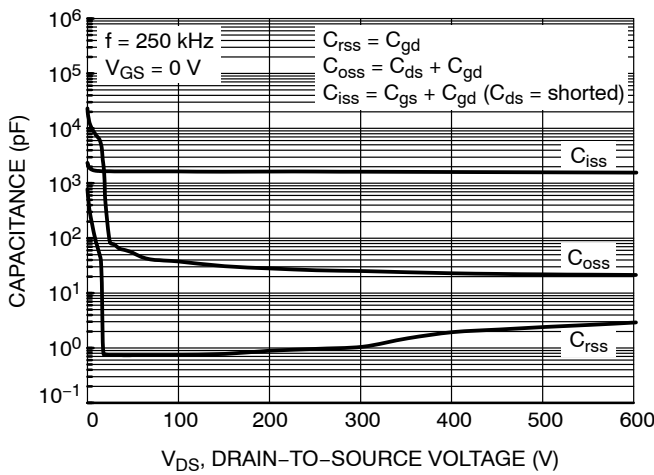


Figure 5. Capacitance Characteristics

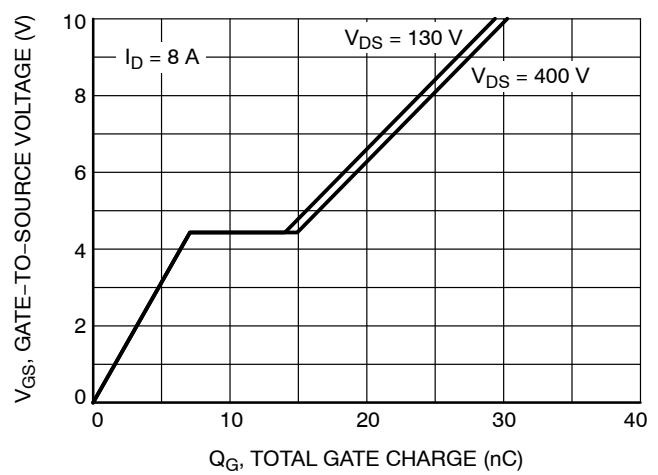


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

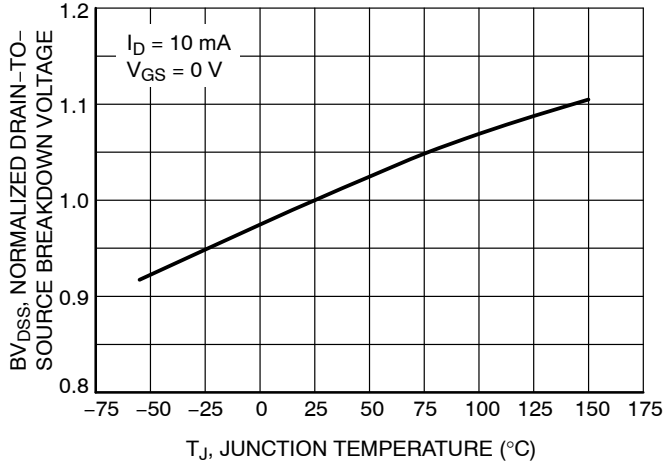


Figure 7. Breakdown Voltage Variation vs. Temperature

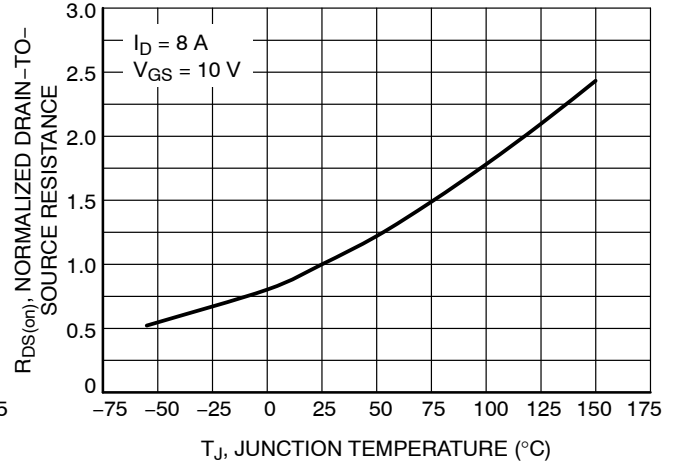


Figure 8. On-Resistance Variation vs. Temperature

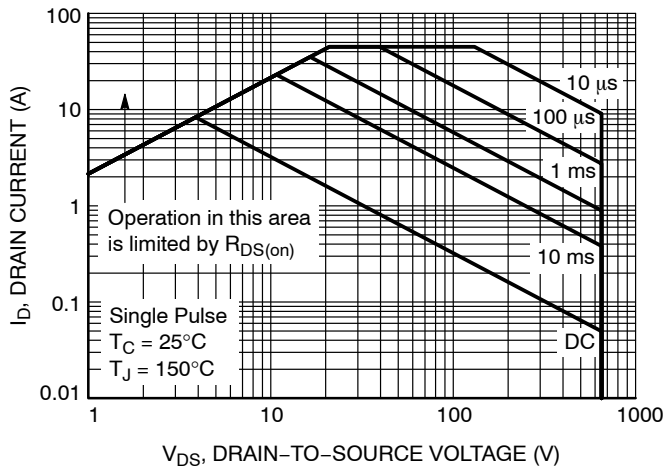


Figure 9. Maximum Safe Operating Area

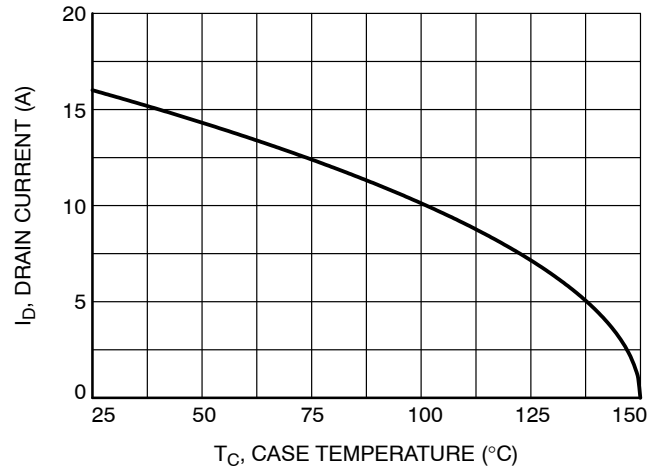


Figure 10. Maximum Drain Current vs. Case Temperature

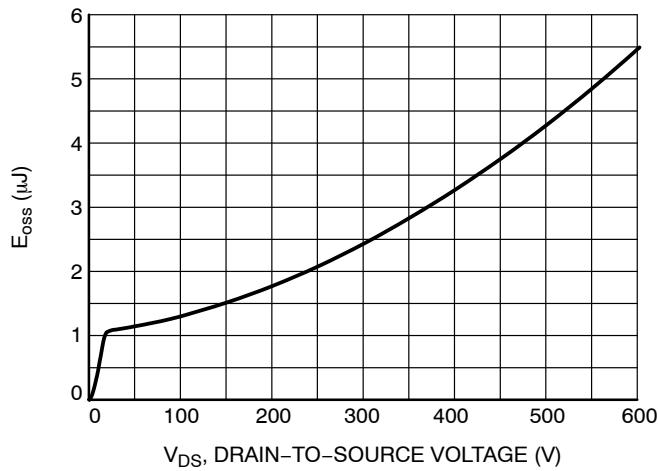


Figure 11. E_{oss} vs. Drain-to-Source Voltage

NTPF190N65S3H

TYPICAL CHARACTERISTICS

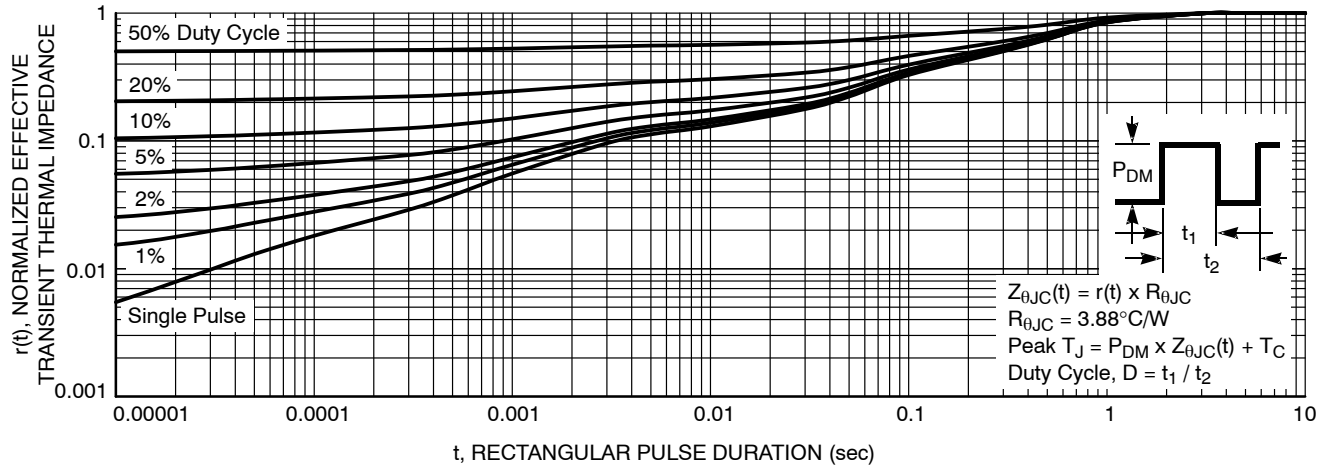


Figure 12. Transient Thermal Response Curve

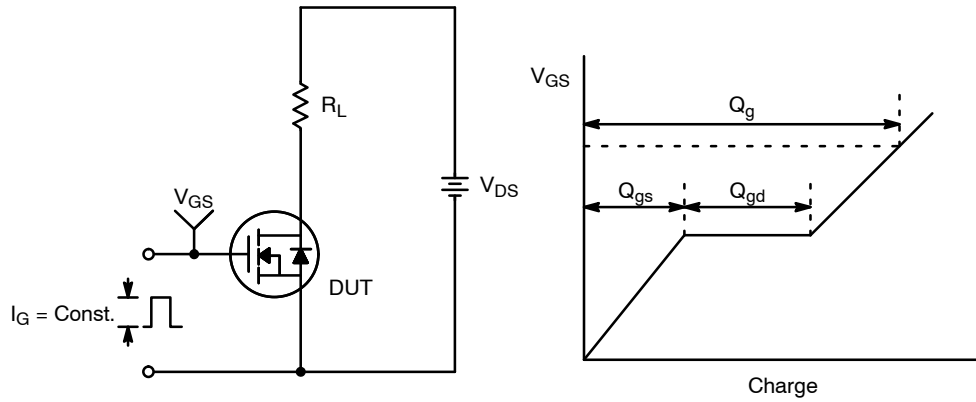


Figure 13. Gate Charge Test Circuit & Waveform

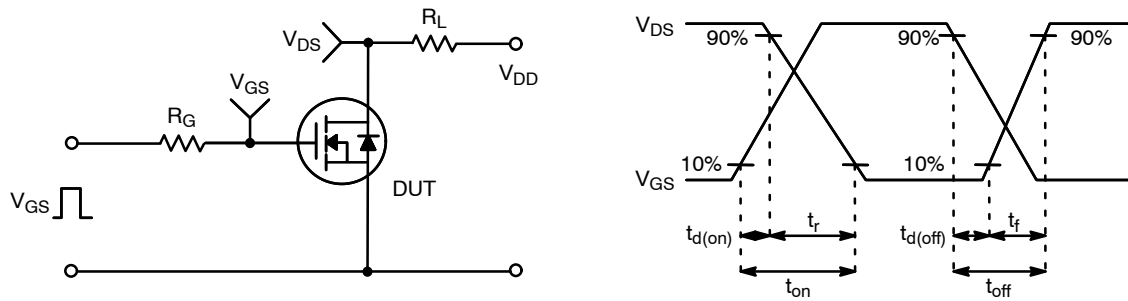


Figure 14. Resistive Switching Test Circuit & Waveforms

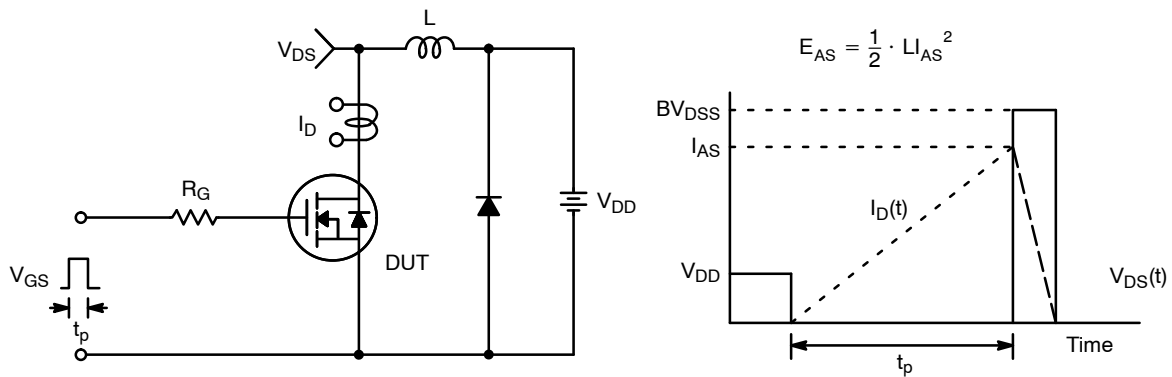


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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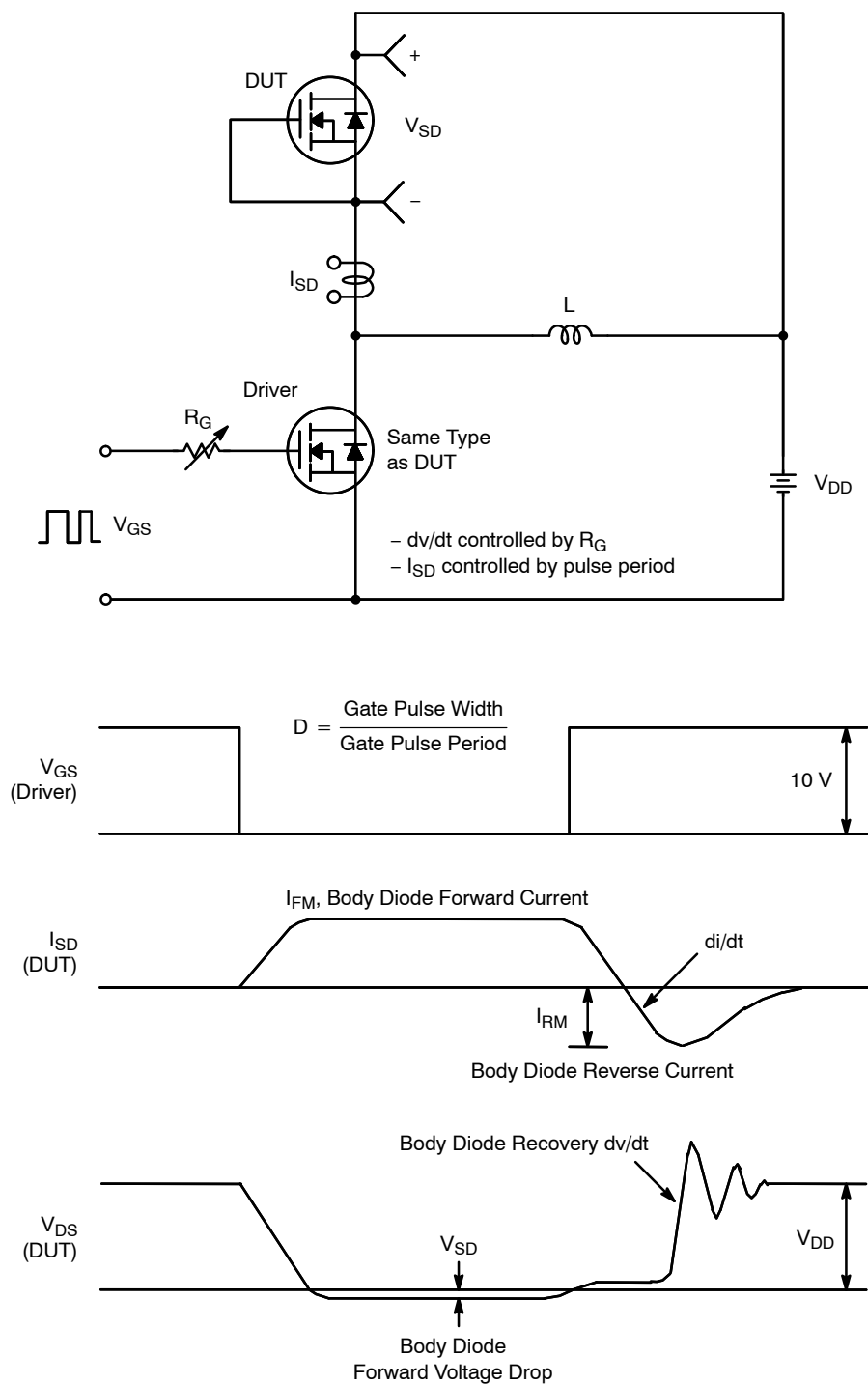
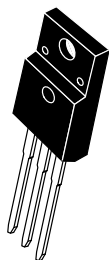


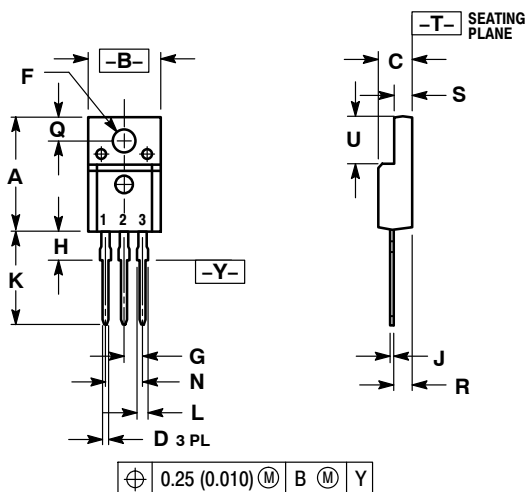
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



SCALE 1:1

TO-220 FULLPAK
CASE 221D-03
ISSUE K

DATE 27 FEB 2009

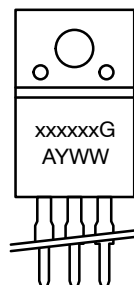


NOTES:

- 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

MARKING DIAGRAMS



Bipolar



Rectifier

STYLE 1:	STYLE 2:	STYLE 3:
PIN 1. GATE	PIN 1. BASE	PIN 1. ANODE
2. DRAIN	2. COLLECTOR	2. CATHODE
3. SOURCE	3. EMITTER	3. ANODE

STYLE 4:	STYLE 5:	STYLE 6:
PIN 1. CATHODE	PIN 1. CATHODE	PIN 1. MT 1
2. ANODE	2. ANODE	2. MT 2
3. CATHODE	3. GATE	3. GATE

xxxxxx = Specific Device Code
G = Pb-Free Package
A = Assembly Location
Y = Year
WW = Work Week

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Y = Year
WW = Work Week
xxxxxx = Device Code
G = Pb-Free Package
AKA = Polarity Designator

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