ON Semiconductor

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MOSFET – N-Channel, SUPERFET® II, FRFET®
650 V, 20.6 A, 190 mΩ

FCPF190N65FL1-F154

Description

SUPERFET II MOSFET is ON Semiconductor'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, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SUPERFET II MOSFET is very suitable for the various power system for miniaturization and higher efficiency. SUPERFET II FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

Features

- 700 V @ T_J = 150°C
- $R_{DS(on)}$ = 168 mΩ (Typ.)
- Ultra Low Gate Charge (Typ. Q_g = 60 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 304 pF)
- 100% Avalanche Tested
- These Devices are Pb−Free and are RoHS Compliant

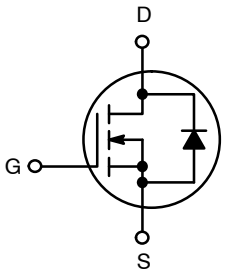
Applications

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

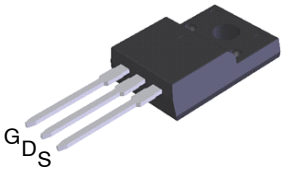
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V_{DSS}	$R_{DS(ON)}$ MAX	I_D MAX
650 V	190 mΩ @ 10 V	20.6 A

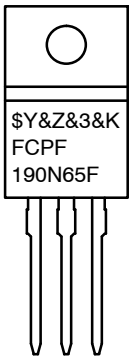


MOSFET



TO−220F Ultra Narrow Lead
CASE 221BN

MARKING DIAGRAM



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
FCPF190N65F	= Specific Device Code

ORDERING INFORMATION

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

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ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise noted)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	Gate to Source Voltage	− DC	±20	V
		− AC (f > 1 Hz)	±30	
I_D	Drain Current	− Continuous (T_C = 25°C)	20.6	A
		− Continuous (T_C = 100°C)	13.1	
I_{DM}	Drain Current	− Pulsed (Note 1)	61.8	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		400	mJ
I_{AS}	Avalanche Current (Note 2)		4	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		0.39	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P_D	Power Dissipation	(T_C = 25°C)	39	W
		− Derate Above 25°C	0.31	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		−55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8″ from Case for 5 Seconds		300	°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.

1. Repetitive rating: pulse width limited by maximum junction temperature.
2. I_{AS} = 4A, R_G = 25 Ω, starting T_J = 25°C.
3. $I_{SD} \le$ 10 A, di/dt ≤ 200 A/μs, $V_{DD} \le$ 380 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Shipping
FCPF190N65FL1−F154	FCPF190N65F	TO−220F (Pb−Free)	50 Units / Tube

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
OFF CHARACTERISTICS						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 10 mA, T_J = 25°C	650	–	–	V
		V_{GS} = 0 V, I_D = 10 mA, T_J = 150°C	700	–	–	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C	–	0.72	–	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650 V, V_{GS} = 0 V	–	–	10	μA
		V_{DS} = 520 V, V_{GS} = 0 V, T_C = 125°C	–	60	–	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	–	–	±100	μA
ON CHARACTERISTICS						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 2 mA	3	–	5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 10 A	–	168	190	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 10 A	–	18	–	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz	–	2350	3055	pF
C_{oss}	Output Capacitance		–	77	100	pF
C_{rss}	Reverse Transfer Capacitance		–	0.68	–	pF
C_{oss}	Output Capacitance	V_{DS} = 380 V, V_{GS} = 0 V, f = 1 MHz	–	44	–	pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V	–	304	–	pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	V_{DS} = 380 V, I_D = 10 A, V_{GS} = 10 V (Note 4)	–	60	78	nC
Q_{gs}	Gate to Source Gate Charge		–	12	–	nC
Q_{gd}	Gate to Drain “Miller” Charge		–	25	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	0.6	–	Ω
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 380 V, I_D = 10 A, V_{GS} = 10 V, R_g = 4.7 Ω (Note 4)	–	25	60	ns
t_r	Turn-On Rise Time		–	11	32	ns
$t_{d(off)}$	Turn-Off Delay Time		–	62	134	ns
t_f	Turn-Off Fall Time		–	4.2	18	ns
SOURCE−DRAIN DIODE CHARACTERISTICS						
I_S	Maximum Continuous Source to Drain Diode Forward Current		–	–	20.6	A
I_{SM}	Maximum Pulsed Source to Drain Diode Forward Current		–	–	61.8	A
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 10 A	–	–	1.2	V
t_{rr}	Reverse Recovery Time	V_{DD} = 400 V, I_{SD} = 10 A, dI_F/dt = 100 A/μs	–	105	–	ns
Q_{rr}	Reverse Recovery Charge		–	515	–	nC

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 PERFORMANCE CHARACTERISTICS

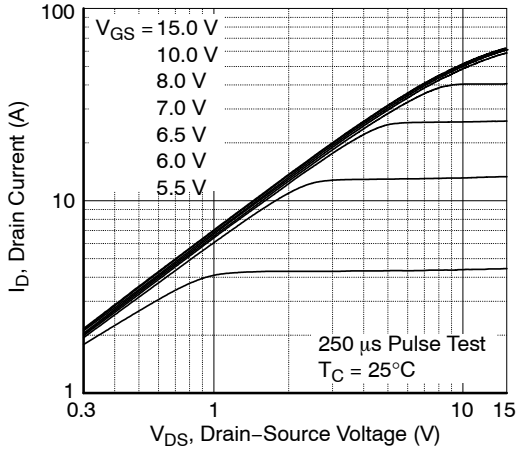


Figure 1. On−Region Characteristics

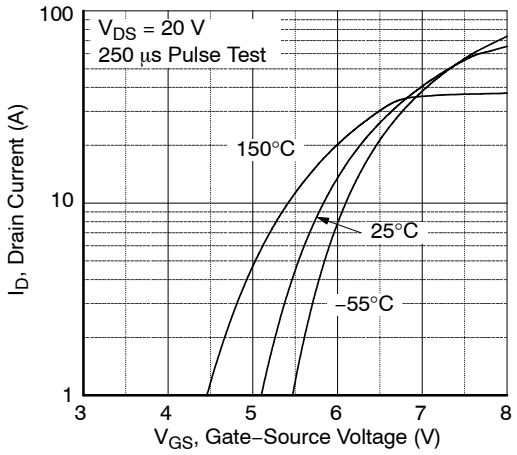


Figure 2. Transfer Characteristics

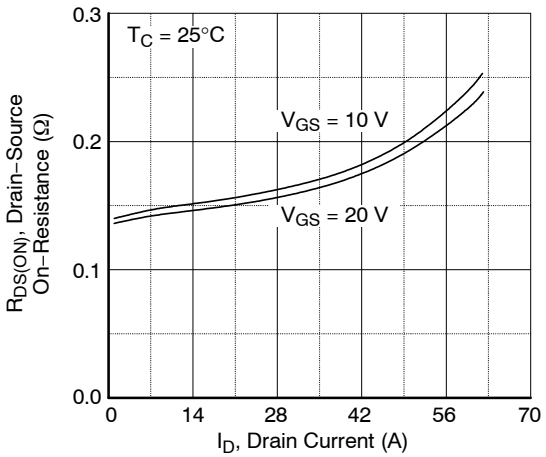


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

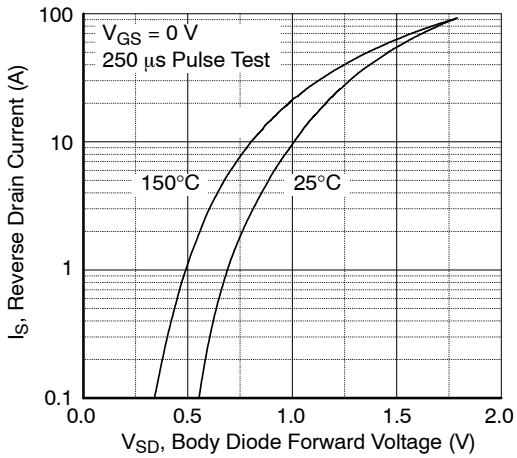


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

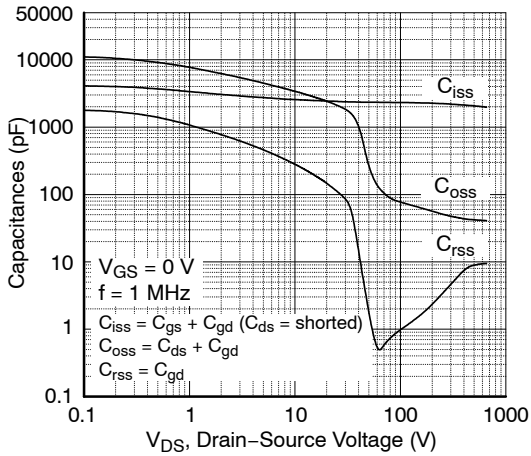


Figure 5. Capacitance Characteristics

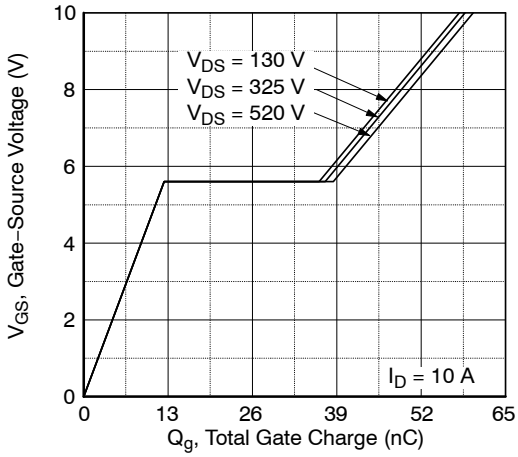


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

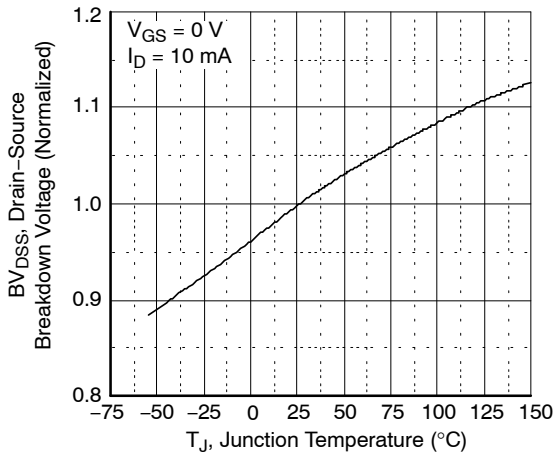


Figure 7. Breakdown Voltage Variation vs. Temperature

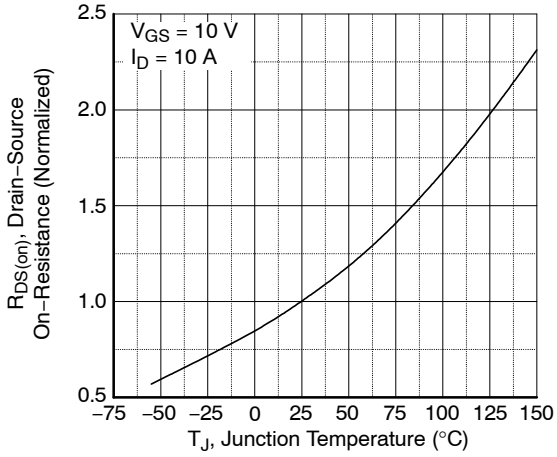


Figure 8. On−Resistance Variation vs. Temperature

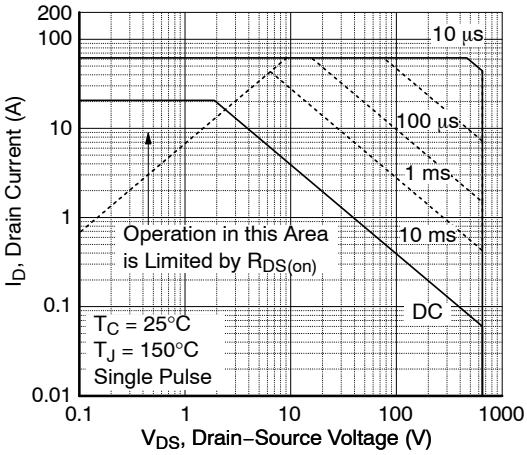


Figure 9. Maximum Safe Operating Area

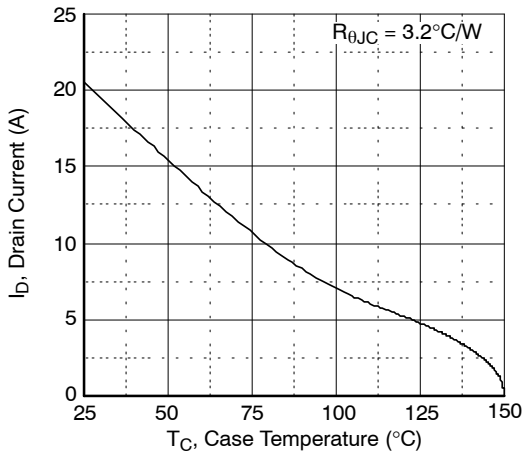


Figure 10. Maximum Drain Current vs. Case Temperature

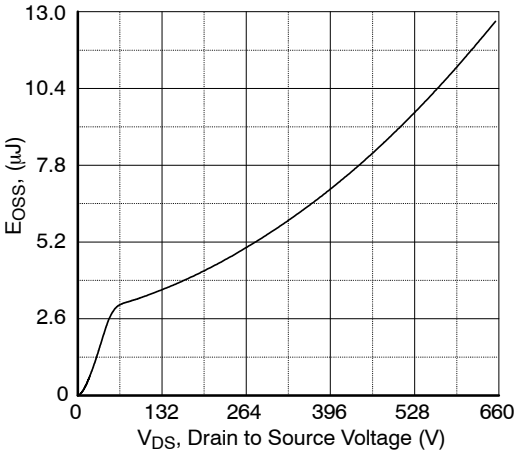


Figure 11. E_{OSS} vs. Drain to Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

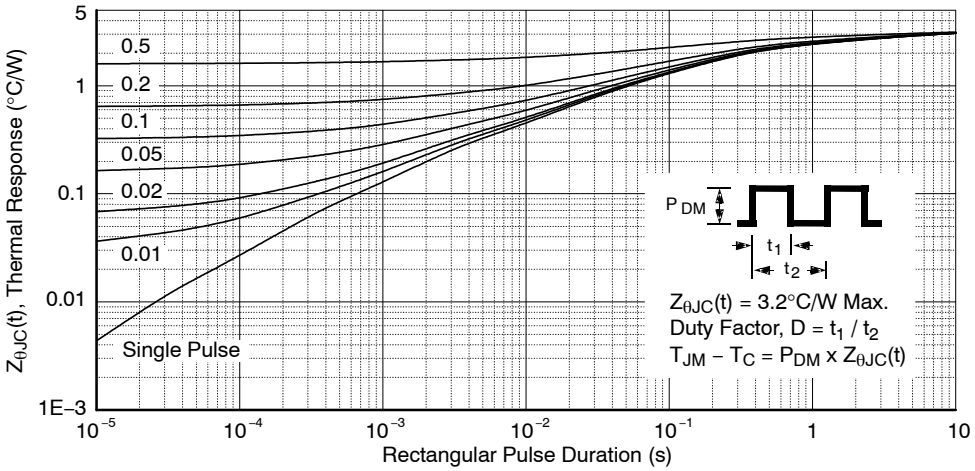


Figure 12. Transient Thermal Response Curve

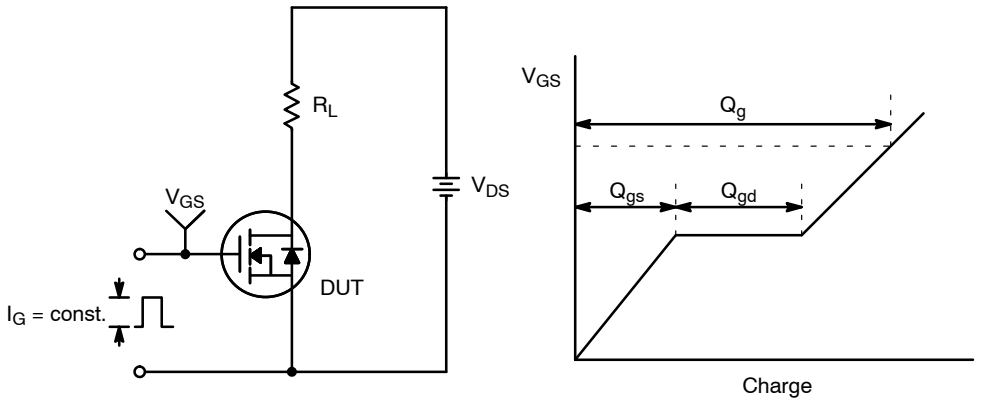


Figure 13. Gate Charge Test Circuit & Waveform

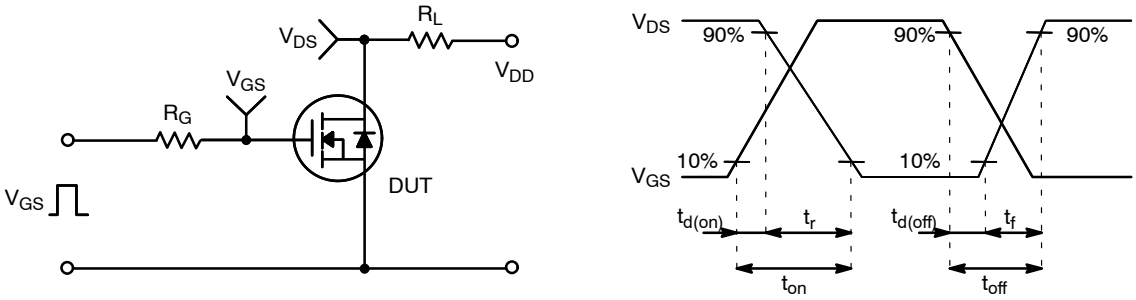


Figure 14. Resistive Switching Test Circuit & Waveforms

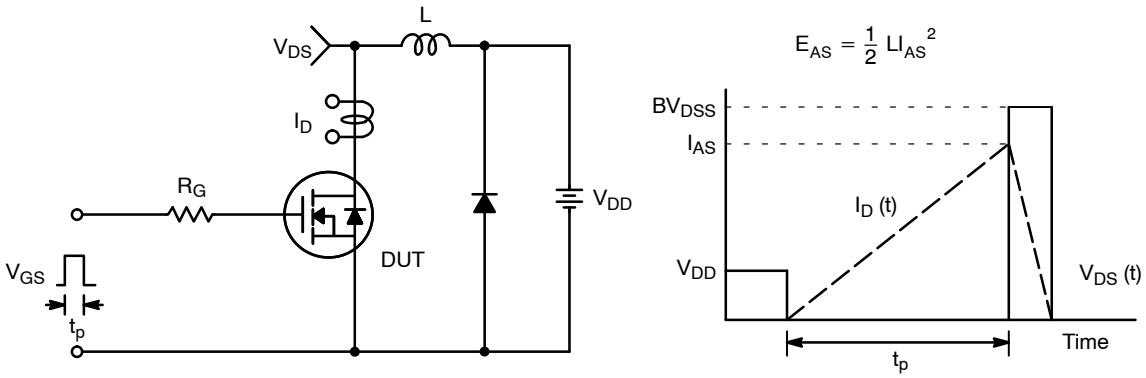


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

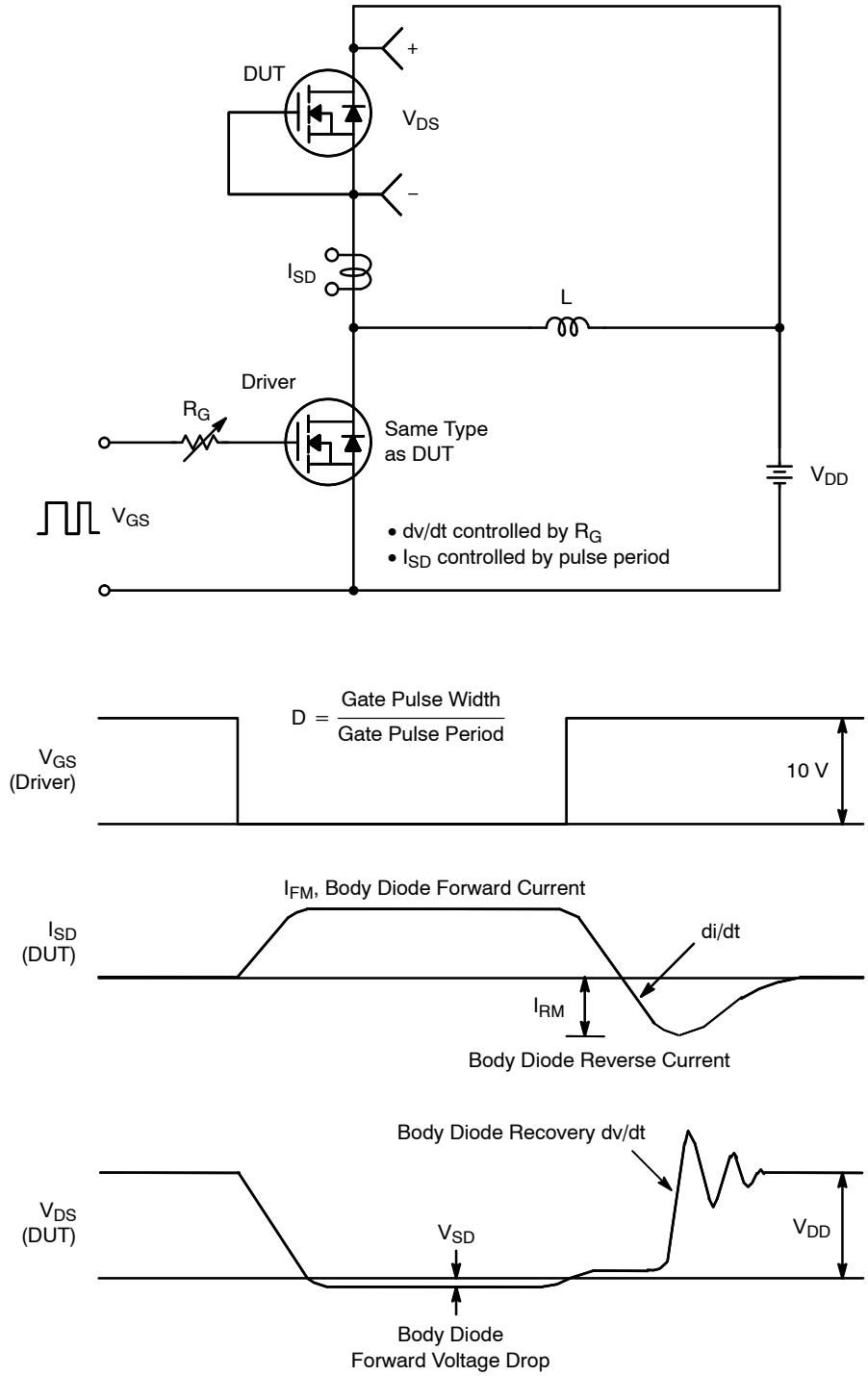


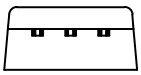
Figure 16. Peak Recovery dv/dt Test Circuit & Waveforms

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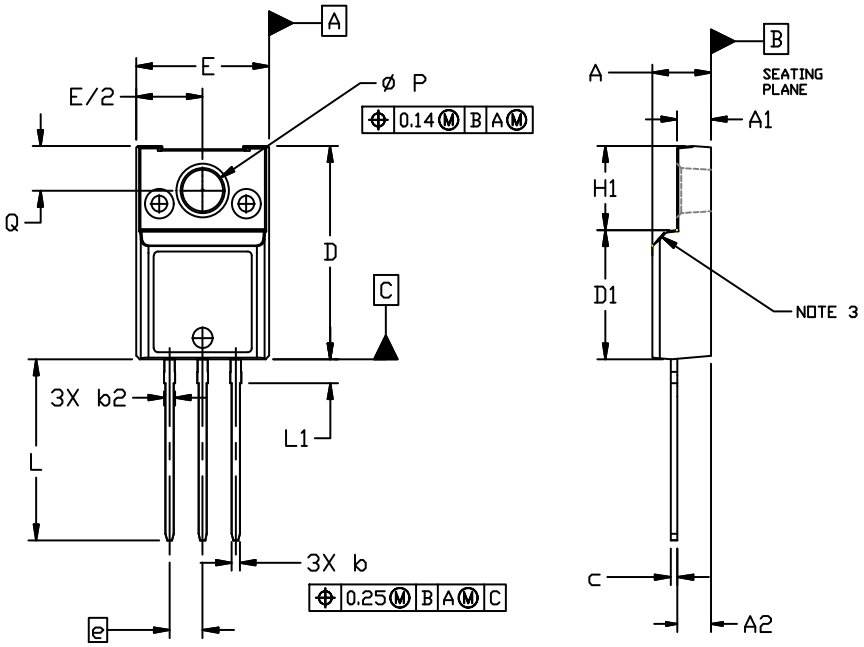
FCPF190N65FL1−F154

PACKAGE DIMENSIONS

TO−220 FULLPACK, 3−LEAD
CASE 221BN
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. CONTOUR UNCONTROLLED IN THIS AREA.
4. DIMENSIONS EXCLUDE BURRS, MOLD FLASH, AND TIE BAR PROTRUSIONS.



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.60	4.70	4.80
A1	2.50	2.60	2.70
A2	2.47	2.57	2.67
b	0.56	0.63	0.69
b2	---	---	0.90
c	0.46	0.53	0.59
D	15.80	16.00	16.20
D1	9.58	9.68	9.78
E	10.00	10.20	10.40
e	2.54 BSC		
H1	6.32 REF		
L	13.45	13.60	13.75
L1	1.70	1.80	1.90
P	3.00	3.10	3.20
Q	3.25	3.35	3.45

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