

MOSFET – N-Channel, SUPERFET® II

600 V, 20.6 A, 190 mΩ

FCPF190N60E-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 technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SUPERFET II MOSFET Easy drive series helps manage EMI issues and allows for easier design implementation.

Features

- 650 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 160\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 63\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss,eff} = 178\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

Applications

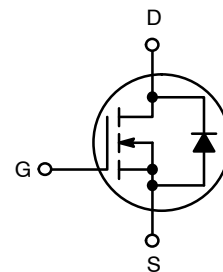
- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter



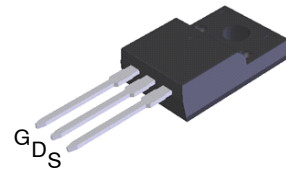
ON Semiconductor®

www.onsemi.com

V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
600 V	190 mΩ @ 10 V	20.6 A

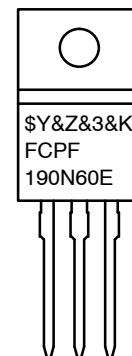


MOSFET



TO-220F Ultra Narrow Lead
CASE 221BN

MARKING DIAGRAM



- \$Y = ON Semiconductor Logo
- &Z = Assembly Plant Code
- &3 = Data Code (Year & Week)
- &K = Lot
- FCPF190N60E = Specific Device Code

ORDERING INFORMATION

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

FCPF190N60E-F154

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

Symbol	Parameter	Value	Unit
V_{DSS}	Drain to Source Voltage	600	V
V_{GSS}	Gate to Source Voltage	- DC	± 20
		- AC ($f > 1$ Hz)	± 30
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	20.6*
		- Continuous ($T_C = 100^\circ\text{C}$)	13.1*
I_{DM}	Drain Current	- Pulsed (Note 1)	61.8*
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	400	mJ
I_{AS}	Avalanche Current (Note 2)	4.0	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	2.1	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20	V/ns
	MOSFET dv/dt	100	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	39
		- Derate Above 25°C	0.31
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

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. $I_{AS} = 4$ A, $V_{DD} = 50$ V, $R_G = 25$ Ω , starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 10$ A, $di/dt \leq 200$ A/ μs , $V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

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

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Shipping
FCPF190N60E-F154	FCPF190N60E	TO-220F (Pb-Free)	50 Units / Tube

FCPF190N60E-F154

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	600	–	–	V
		V _{GS} = 0 V, I _D = 10 mA, T _J = 150°C	650	–	–	V
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 10 mA, Referenced to 25°C	–	0.67	–	V/°C
BV _{DS}	Drain-Source Avalanche Breakdown Voltage	V _{GS} = 0 V, I _D = 20 A	–	700	–	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 480 V, V _{GS} = 0 V	–	–	1.0	μA
		V _{DS} = 480 V, T _C = 125°C	–	–	10	
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±20 V, V _{DS} = 0 V	–	–	±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 250 μA	2.5	–	3.5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 10 A	–	0.16	0.19	Ω
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 10 A	–	20	–	S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz	–	2385	3175	pF
C _{oss}	Output Capacitance		–	1795	2396	pF
C _{rss}	Reverse Transfer Capacitance		–	110	165	pF
C _{oss}	Output Capacitance	V _{DS} = 380 V, V _{GS} = 0 V, f = 1 MHz	–	42	–	pF
C _{oss (eff.)}	Effective Output Capacitance	V _{DS} = 0 V to 480 V, V _{GS} = 0 V	–	178	–	pF
Q _{g(tot)}	Total Gate Charge at 10 V	V _{DS} = 380 V, I _D = 10 A, V _{GS} = 10 V (Note 4)	–	63	82	nC
Q _{gs}	Gate to Source Gate Charge		–	10	–	nC
Q _{gd}	Gate to Drain "Miller" Charge		–	24	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	5	–	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)	–	23	56	ns
t _r	Turn-On Rise Time		–	14	38	ns
t _{d(off)}	Turn-Off Delay Time		–	101	212	ns
t _f	Turn-Off Fall Time		–	15	40	ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current	–	–	20.2	A	
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current	–	–	60.6	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	–	308	–	ns
Q _{rr}	Reverse Recovery Charge		–	4.8	–	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 PERFORMANCE CHARACTERISTICS

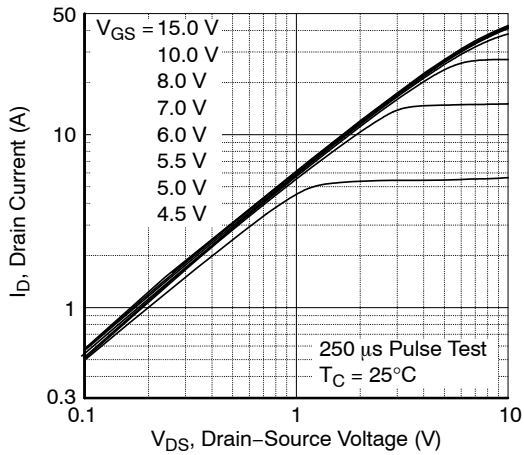


Figure 1. On-Region Characteristics

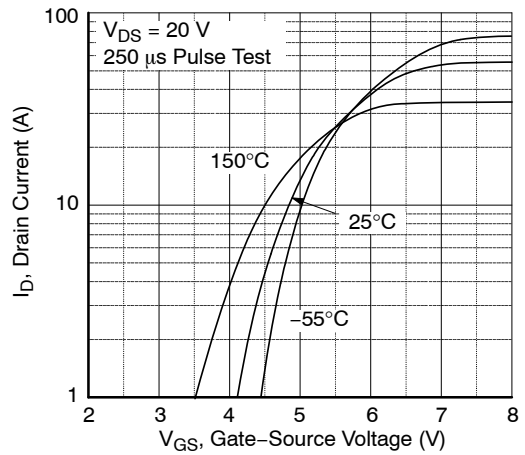


Figure 2. Transfer Characteristics

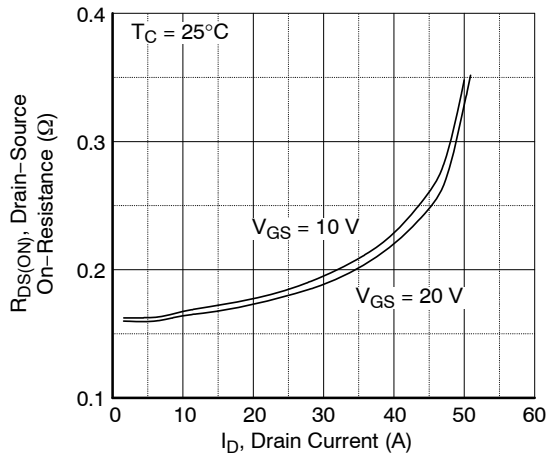


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

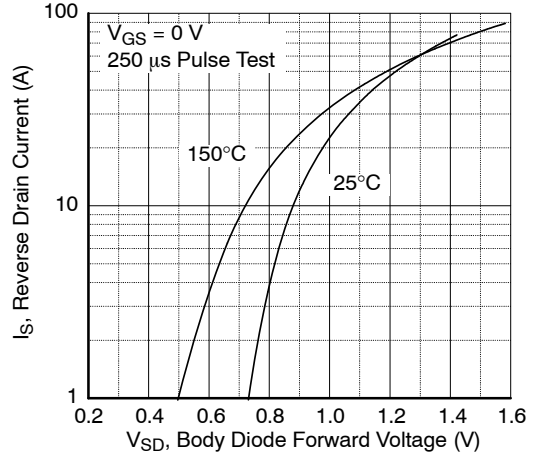


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

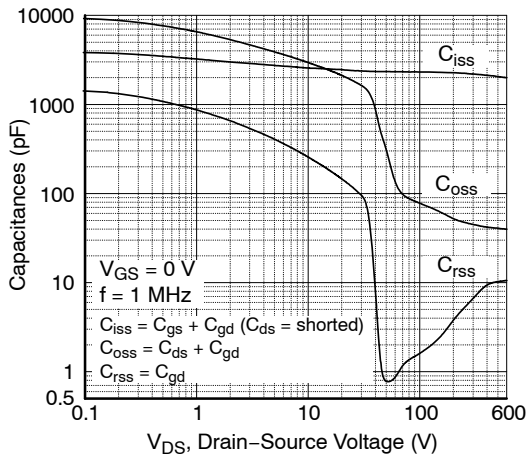


Figure 5. Capacitance Characteristics

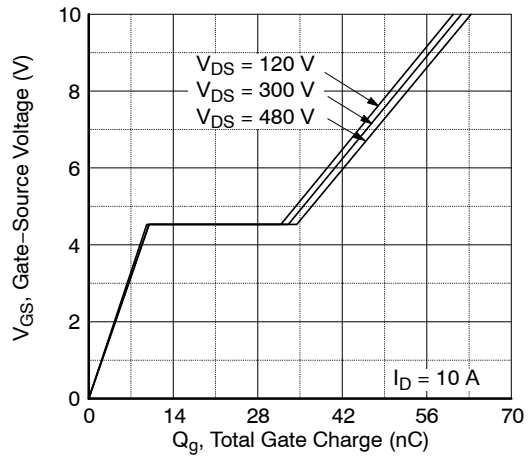


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

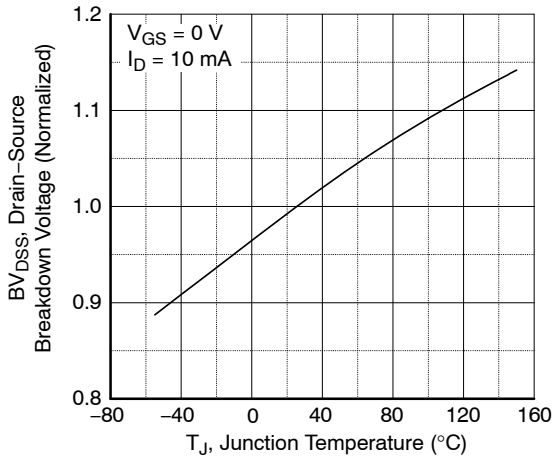


Figure 7. Breakdown Voltage Variation vs. Temperature

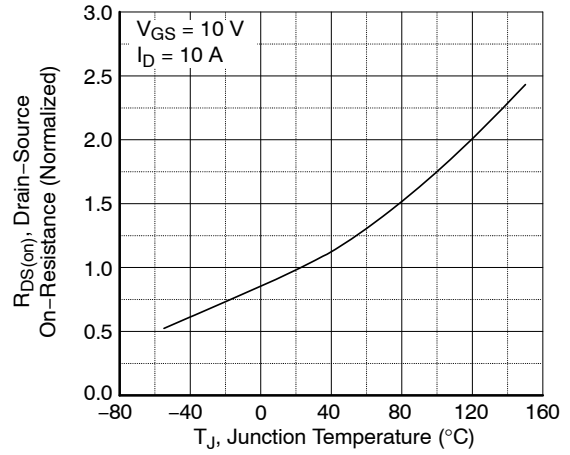


Figure 8. On-Resistance Variation vs. Temperature

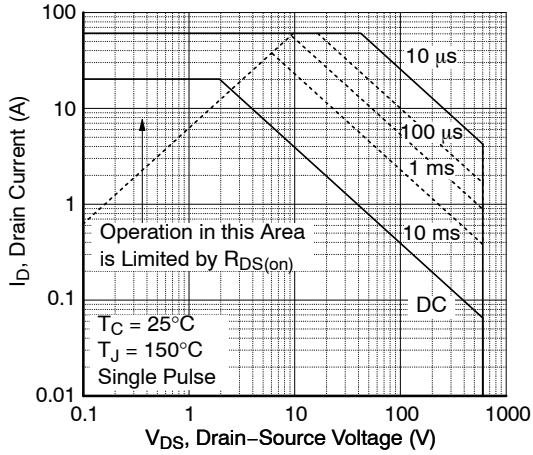


Figure 9. Maximum Safe Operating Area

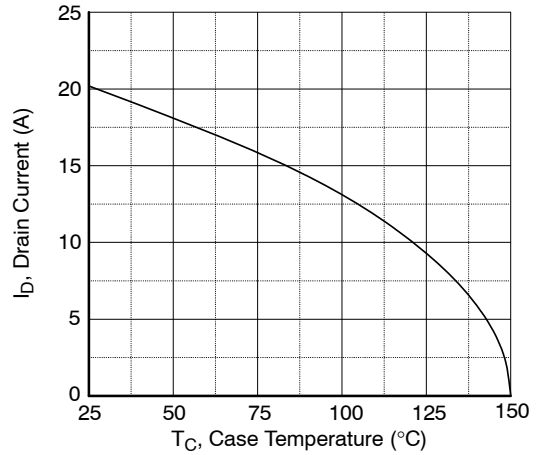


Figure 10. Maximum Drain Current vs. Case Temperature

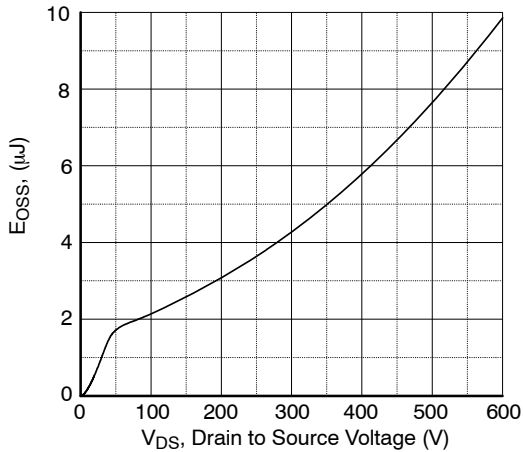


Figure 11. E_{OSS} vs. Drain-to-Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

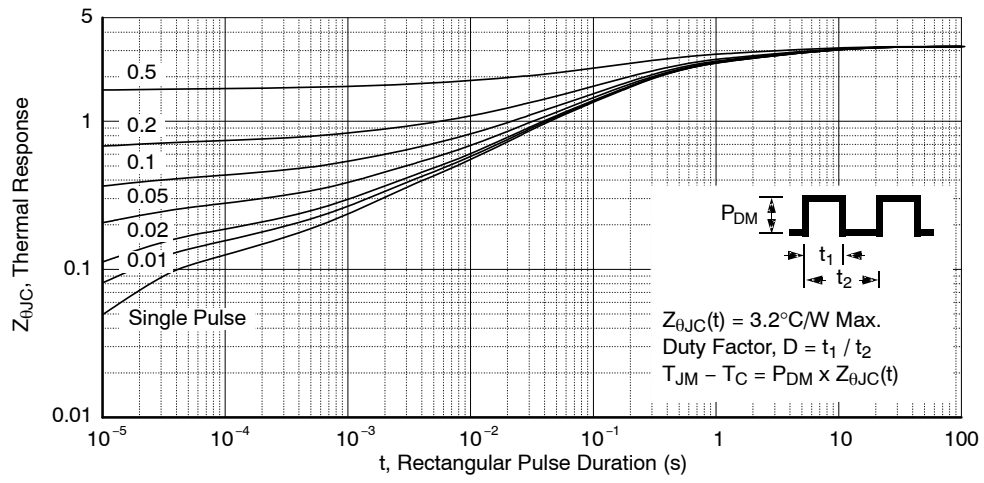


Figure 12. Transient Thermal Response Curve

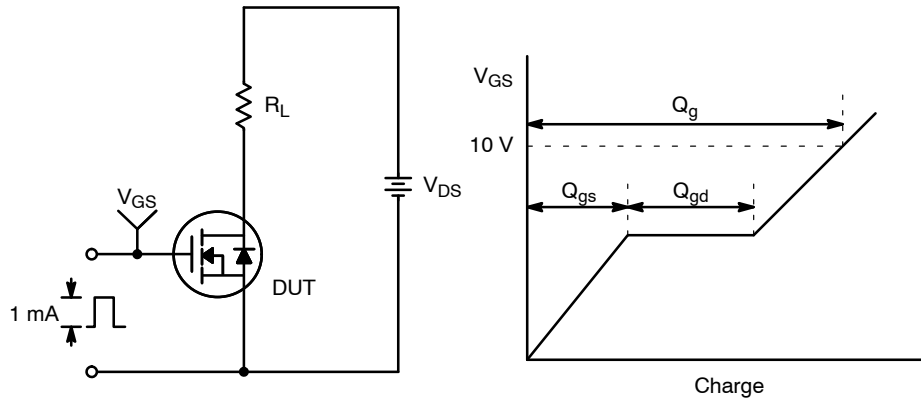


Figure 13. Gate Charge Test Circuit & Waveform

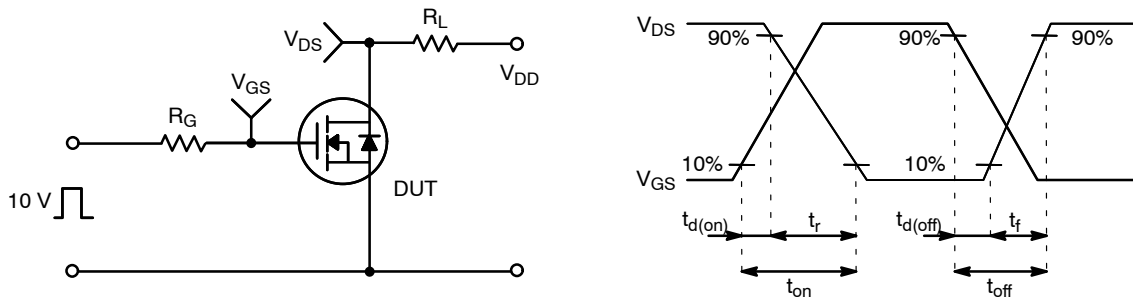


Figure 14. Resistive Switching Test Circuit & Waveforms

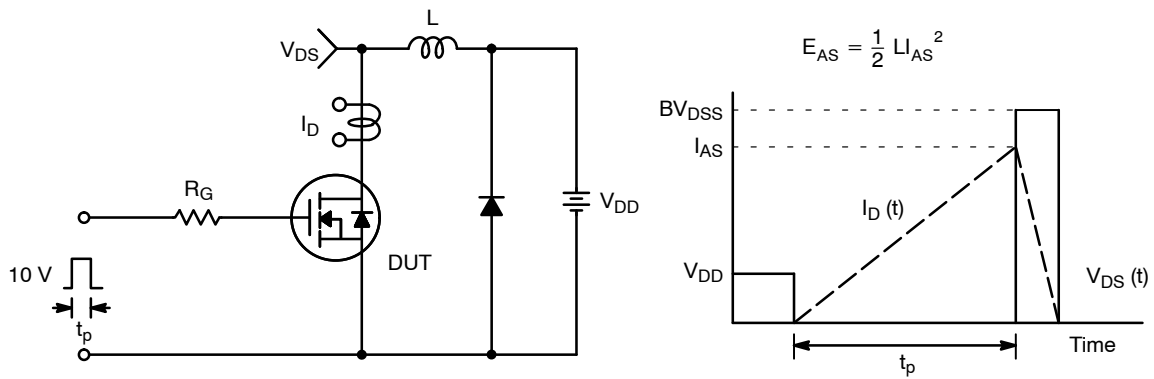


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

FCPF190N60E-F154

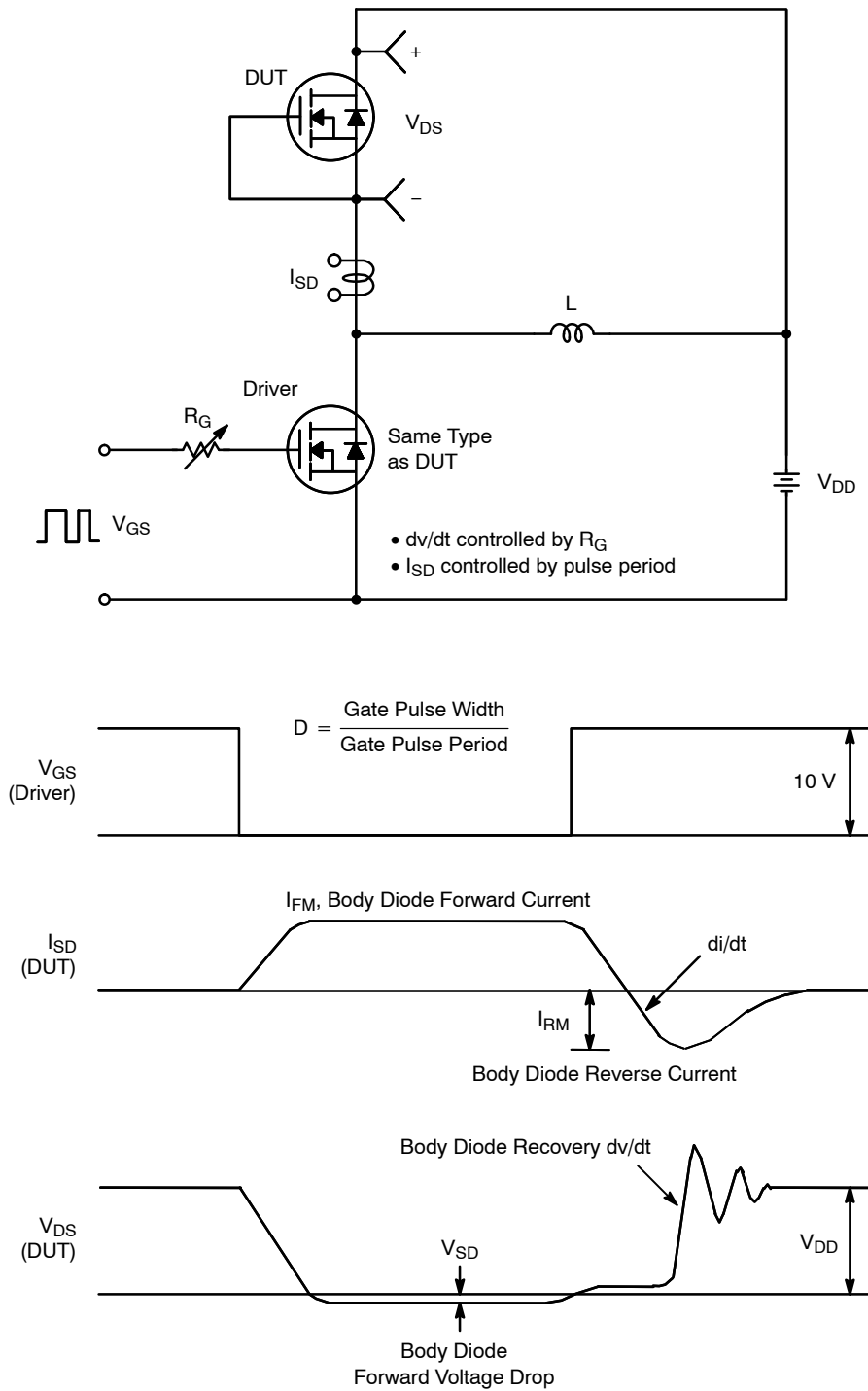
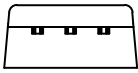


Figure 16. Peak Recovery dv/dt Test Circuit & Waveforms

FCPF190N60E-F154

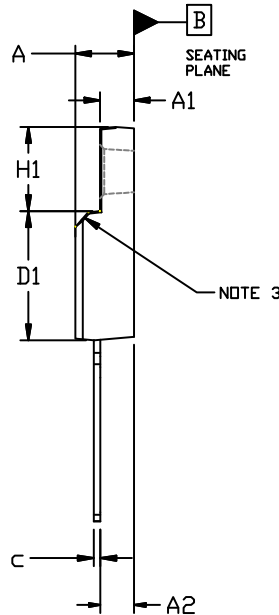
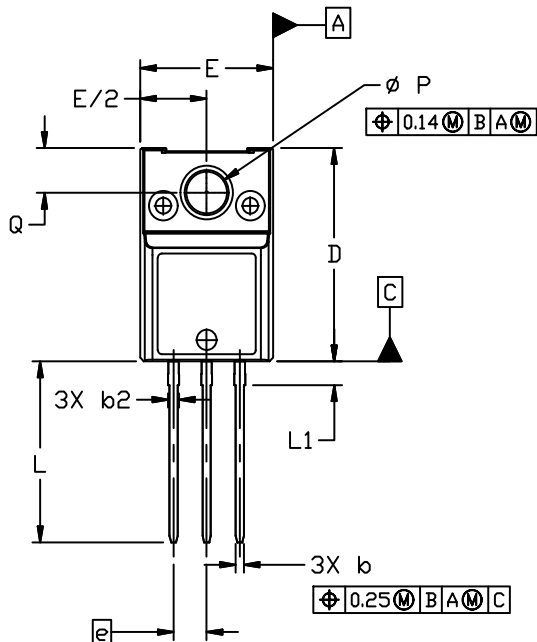
PACKAGE DIMENSIONS

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

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800-282-9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative