

**MOSFET – N-Channel,
SUPERFET® II****800 V, 23 A, 220 mΩ****FCPF220N80****Description**

SuperFET II 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 technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

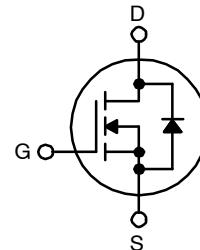
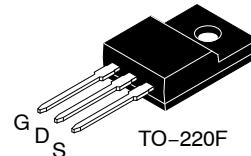
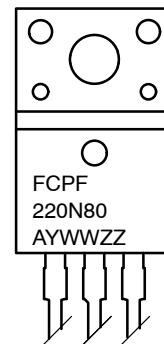
Features

- Typ. $R_{DS(on)} = 188 \text{ mΩ}$
- Ultra Low Gate Charge (Typ. $Q_g = 78 \text{ nC}$)
- Low E_{oss} (Typ. $7.5 \mu\text{J}$ @ 400 V)
- Low Effective Output Capacitance (Typ. $C_{oss(\text{eff.})} = 304 \text{ pF}$)
- 100% Avalanche Tested
- RoHS Compliant
- ESD Improved Capability

Applications

- AC-DC Power Supply
- LED Lighting

V_{DSS}	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
800 V	220 mΩ @ 10 V	23 A

**N-Channel MOSFET****TO-220 Fullpack, 3-Lead / TO-220F-3SG
CASE 221AT****MARKING DIAGRAM**

FCPF220N80 = Specific Device Code

A = Assembly Location

YWW = Date Code (Year & Work Week)

ZZ = Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
FCPF220N80	TO-220-3 (Pb-Free)	1000 Units / Tube

FCPF220N80

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise specified)

Symbol	Parameter		FCPF220N80	Unit
V _{DSS}	Drain to Source Voltage		800	V
V _{GSS}	Gate to Source Voltage	– DC	±20	V
		– AC (f > 1 Hz)	±30	
I _D	Drain Current	– Continuous (T _C = 25°C)	23*	A
		– Continuous (T _C = 100°C)	14.6*	
I _{DM}	Drain Current	– Pulsed (Note 1)	57*	A
E _{AS}	Single Pulsed Avalanche Energy (Note 2)		645	mJ
I _{AR}	Avalanche Current (Note 1)		4.6	A
E _{AR}	Repetitive Avalanche Energy (Note 1)		27.8	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
P _D	Power Dissipation	(T _C = 25°C)	44	W
		– Derate above 25°C	0.35	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.

*Drain current limited by maximum junction temperature.

1. Repetitive rating: pulse width limited by maximum junction temperature
2. I_{AS} = 4.6 A, V_{DD} = 50 V, R_G = 25 Ω, starting T_J = 25°C
3. I_{SD} ≤ 23 A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C

THERMAL CHARACTERISTICS

Symbol	Characteristic	FCPF220N80	Unit
R _{0JC}	Thermal Resistance, Junction to Case, Max.	2.8	°C/W
R _{0JA}	Thermal Resistance, Junction to Ambient, Max.	62.5	

FCPF220N80

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

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV_{DSS}	Drain to Source Breakdown Voltage	$\text{V}_{\text{GS}} = 0 \text{ V}$, $\text{I}_D = 1 \text{ mA}$, $T_J = 25^\circ\text{C}$	800	—	—	V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$\text{I}_D = 1 \text{ mA}$, Referenced to 25°C	—	0.8	—	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$\text{V}_{\text{DS}} = 800 \text{ V}$, $\text{V}_{\text{GS}} = 0 \text{ V}$	—	—	25	μA
		$\text{V}_{\text{DS}} = 640 \text{ V}$, $T_C = 125^\circ\text{C}$	—	—	250	
I_{GSS}	Gate to Body Leakage Current	$\text{V}_{\text{GS}} = \pm 20 \text{ V}$, $\text{V}_{\text{DS}} = 0 \text{ V}$	—	—	± 100	nA

ON CHARACTERISTICS

$\text{V}_{\text{GS}(\text{th})}$	Gate Threshold Voltage	$\text{V}_{\text{GS}} = \text{V}_{\text{DS}}$, $\text{I}_D = 2.3 \text{ mA}$	2.5	—	4.5	V
$\text{R}_{\text{DS}(\text{on})}$	Static Drain to Source On Resistance	$\text{V}_{\text{GS}} = 10 \text{ V}$, $\text{I}_D = 11.5 \text{ A}$	—	188	220	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$\text{V}_{\text{DS}} = 20 \text{ V}$, $\text{I}_D = 11.5 \text{ A}$	—	25	—	S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$\text{V}_{\text{DS}} = 100 \text{ V}$, $\text{V}_{\text{GS}} = 0 \text{ V}$, $f = 1 \text{ MHz}$	—	3430	4560	pF
C_{oss}	Output Capacitance		—	100	135	pF
C_{rss}	Reverse Transfer Capacitance		—	0.3	—	pF
C_{oss}	Output Capacitance	$\text{V}_{\text{DS}} = 480 \text{ V}$, $\text{V}_{\text{GS}} = 0 \text{ V}$, $f = 1 \text{ MHz}$	—	49	—	pF
$\text{C}_{\text{oss}(\text{eff.})}$	Effective Output Capacitance	$\text{V}_{\text{DS}} = 0 \text{ V}$ to 480 V , $\text{V}_{\text{GS}} = 0 \text{ V}$	—	304	—	pF
$\text{Q}_{\text{g}(\text{tot})}$	Total Gate Charge at 10 V	$\text{V}_{\text{DS}} = 640 \text{ V}$, $\text{I}_D = 23 \text{ A}$, $\text{V}_{\text{GS}} = 10 \text{ V}$ (Note 4)	—	78	105	nC
Q_{gs}	Gate to Source Gate Charge		—	16	—	nC
Q_{gd}	Gate to Drain "Miller" Charge		—	28	—	nC
ESR	Equivalent Series Resistance	$f = 1 \text{ MHz}$	—	0.78	—	Ω

SWITCHING CHARACTERISTICS

$\text{t}_{\text{d}(\text{on})}$	Turn-On Delay Time	$\text{V}_{\text{DD}} = 400 \text{ V}$, $\text{I}_D = 23 \text{ A}$, $\text{V}_{\text{GS}} = 10 \text{ V}$, $\text{R}_G = 4.7 \Omega$ (Note 4)	—	27	64	ns
t_r	Turn-On Rise Time		—	19	48	ns
$\text{t}_{\text{d}(\text{off})}$	Turn-Off Delay Time		—	75	160	ns
t_f	Turn-Off Fall Time		—	2.6	15	ns

DRAIN-SOURCE DIODE CHARACTERISTICS

I_S	Maximum Continuous Drain to Source Diode Forward Current	—	—	23	A	
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current	—	—	57	A	
V_{SD}	Drain to Source Diode Forward Voltage	$\text{V}_{\text{GS}} = 0 \text{ V}$, $\text{I}_{\text{SD}} = 23 \text{ A}$	—	—	1.2	V
t_{rr}	Reverse Recovery Time	$\text{V}_{\text{GS}} = 0 \text{ V}$, $\text{I}_{\text{SD}} = 23 \text{ A}$, $d\text{I}_F / dt = 100 \text{ A}/\mu\text{s}$	—	560	—	ns
Q_{rr}	Reverse Recovery Charge		—	14	—	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

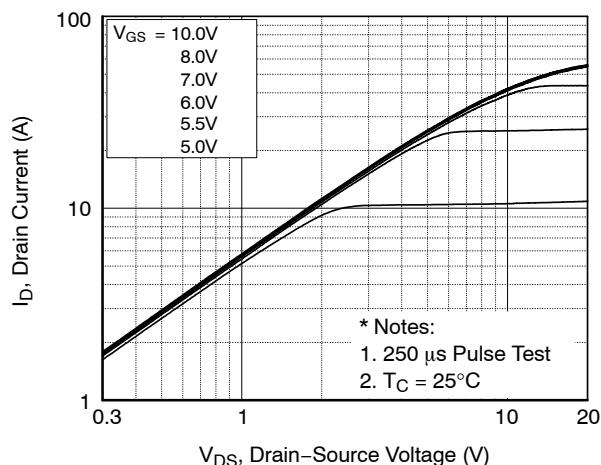


Figure 1. On-Region Characteristics

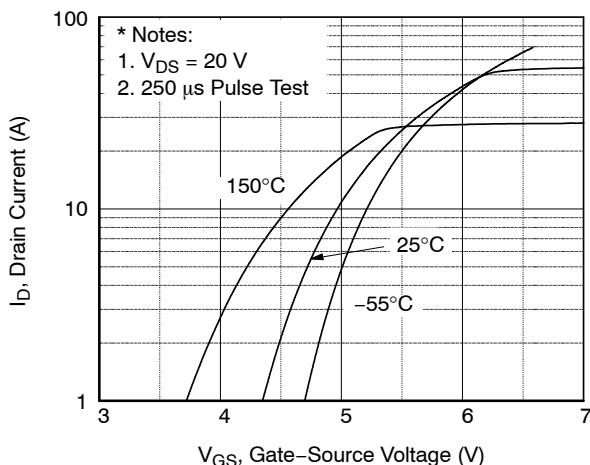


Figure 2. Transfer Characteristics

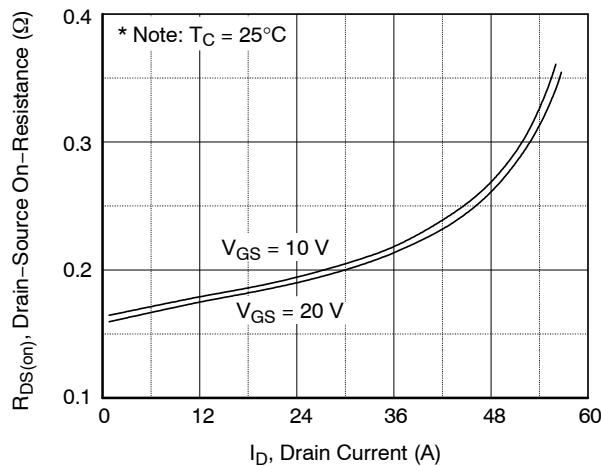


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

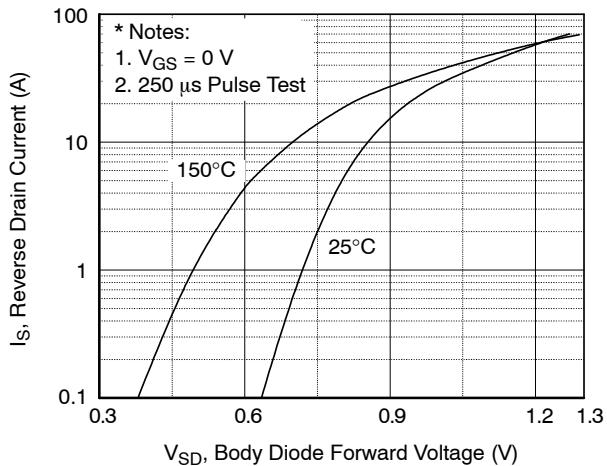


Figure 4. Body Diode Forward Voltage Variation vs. Source Current

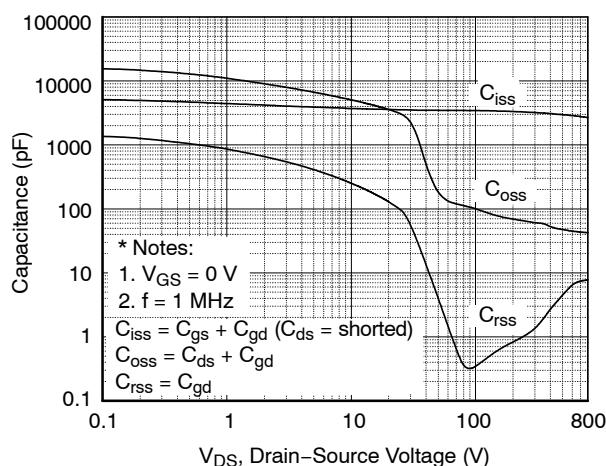


Figure 5. Capacitance Characteristics

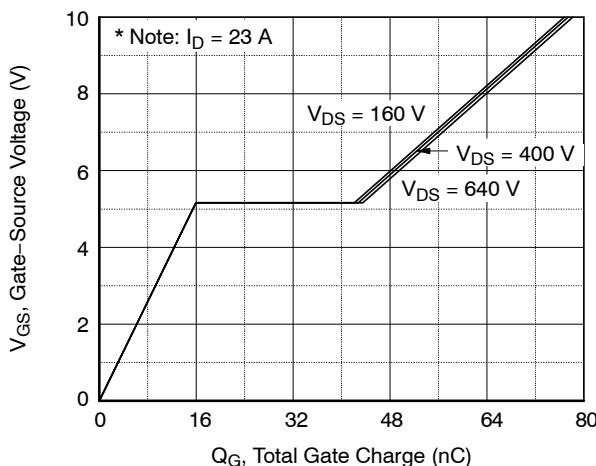


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

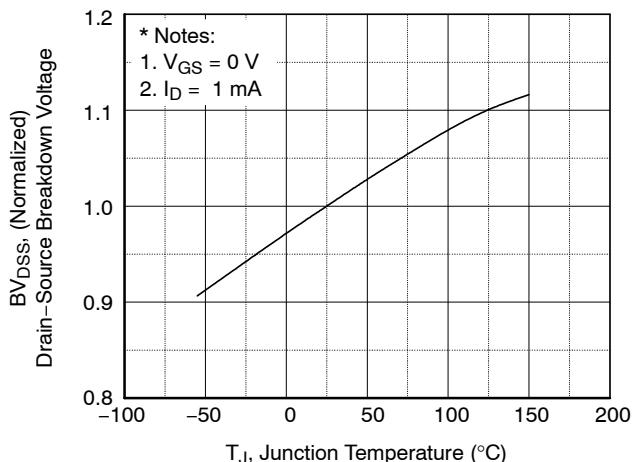


Figure 7. Breakdown Voltage Variation vs. Temperature

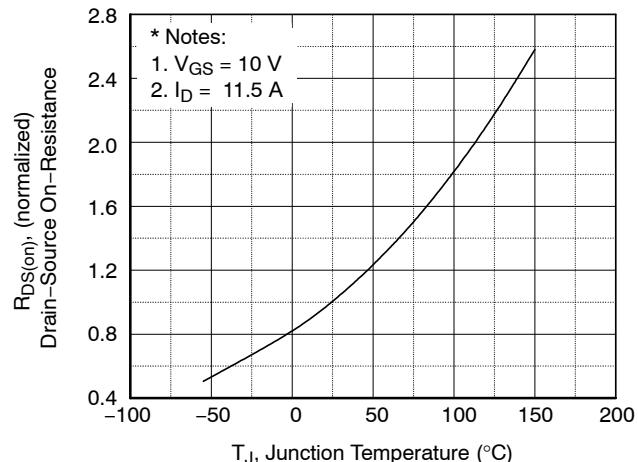


Figure 8. On-Resistance Variation vs. Temperature

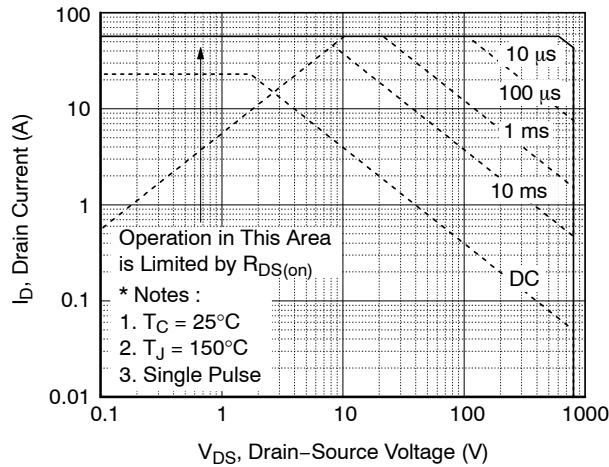


Figure 9. Maximum Safe Operating Area

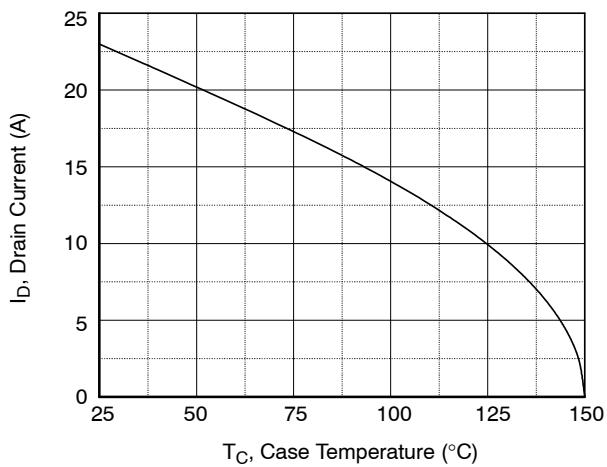


Figure 10. Maximum Drain Current vs. Case Temperature

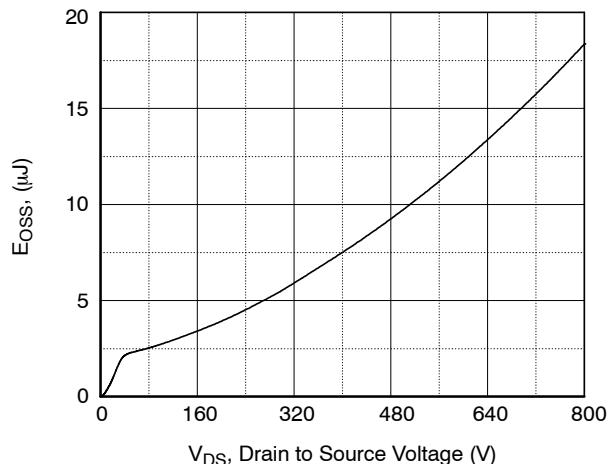


Figure 11. E_{oss} vs. Drain to Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

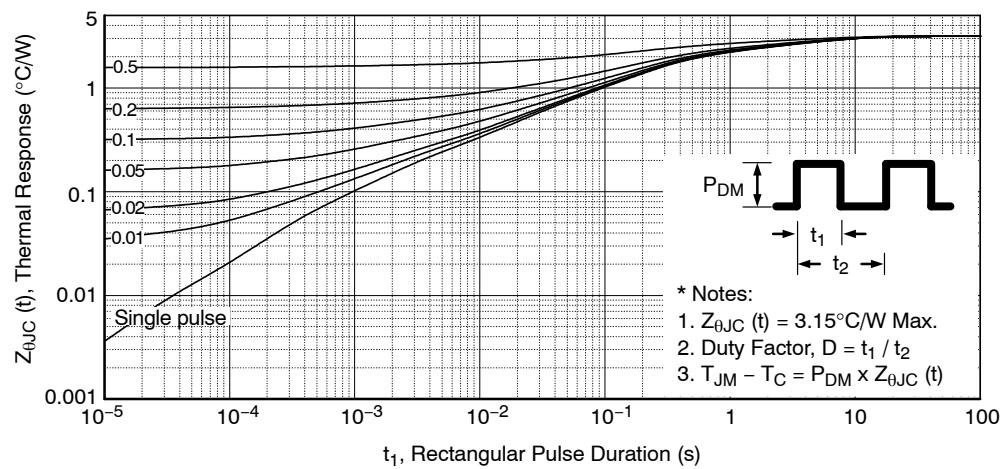


Figure 12. Transient Thermal Response Curve

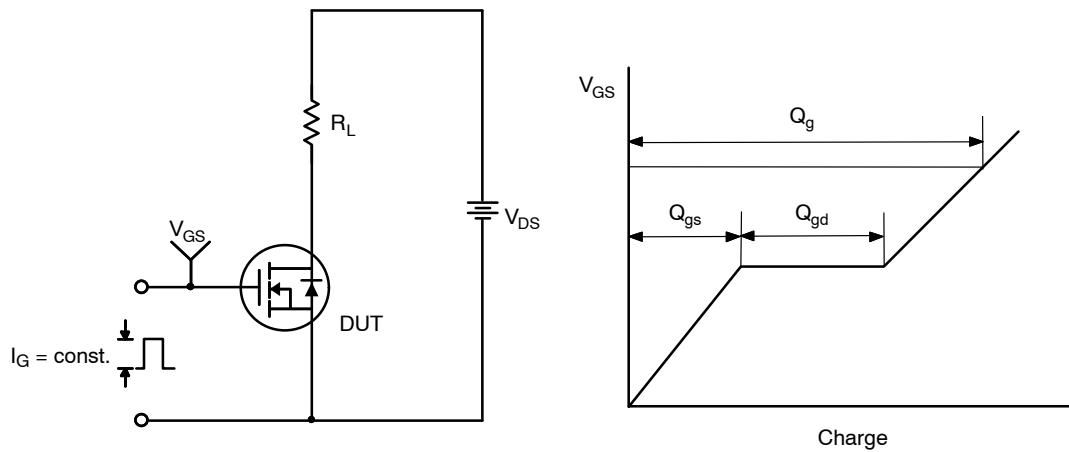


Figure 13. Gate Charge Test Circuit & Waveform

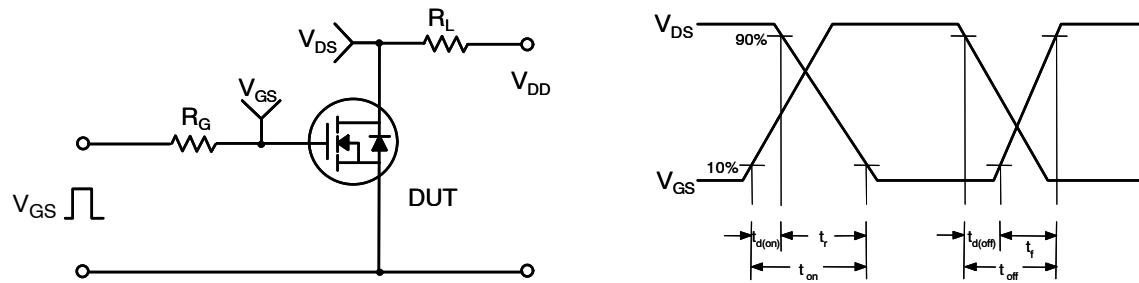


Figure 14. Resistive Switching Test Circuit & Waveforms

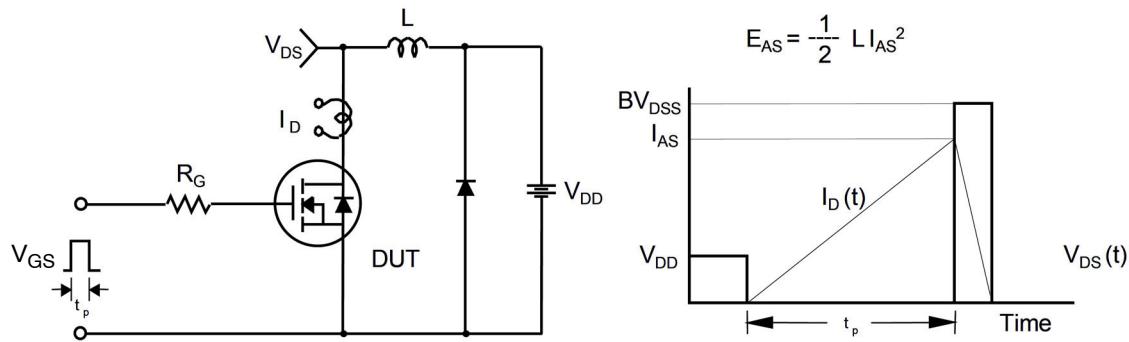


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

FCPF220N80

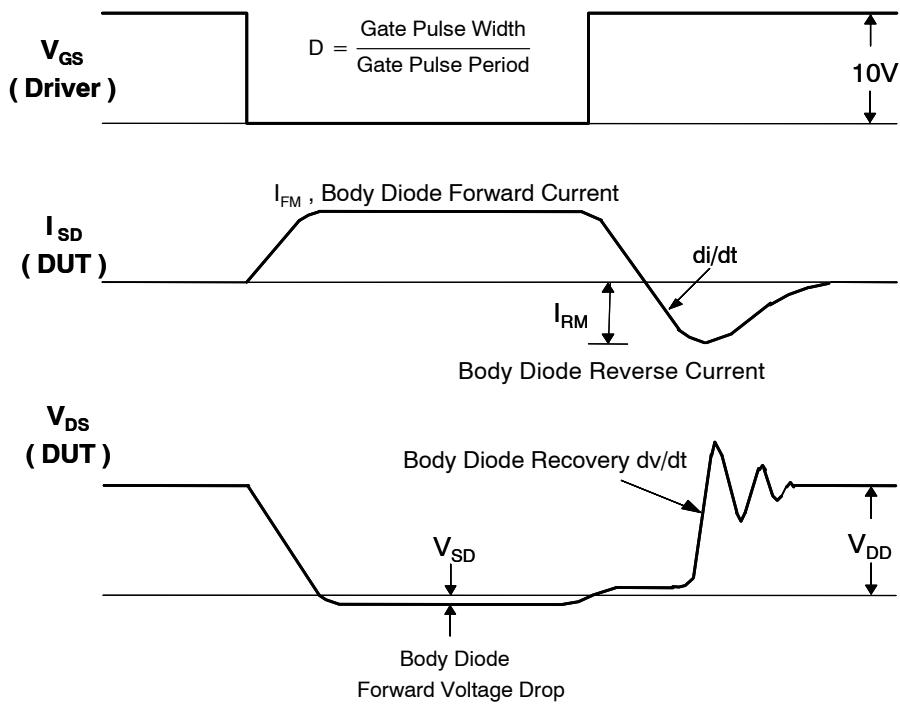
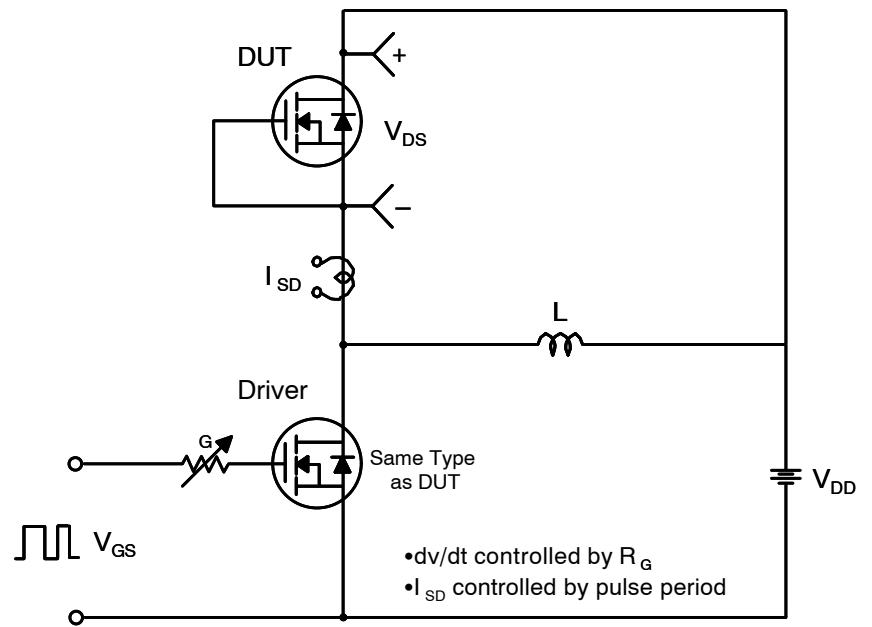
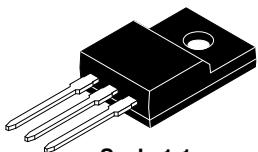


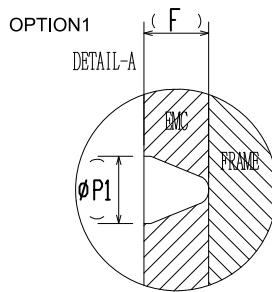
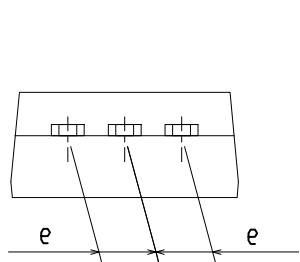
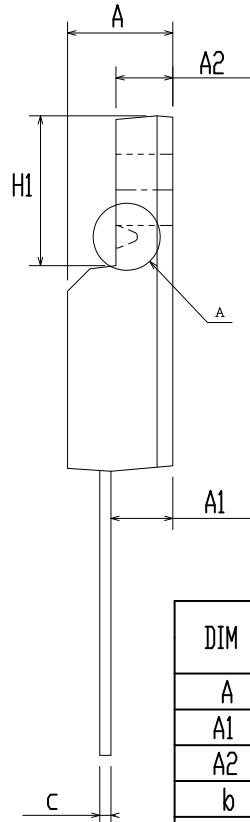
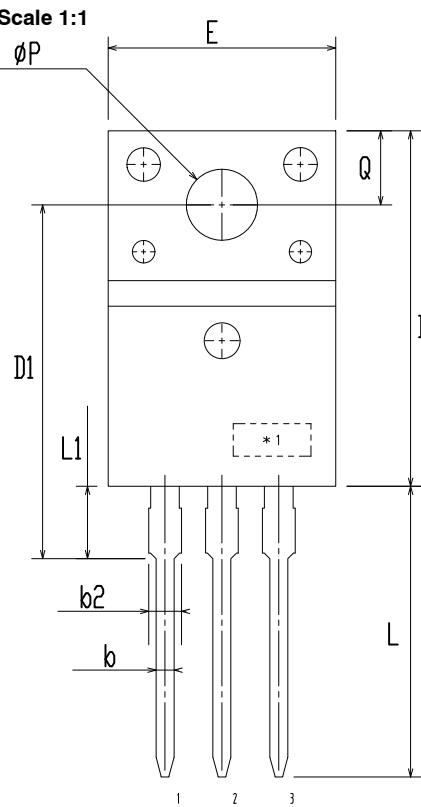
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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TO-220 Fullpack, 3-Lead / TO-220F-3SG
CASE 221AT
ISSUE B

DATE 19 JAN 2021



DIM	MILLIMITERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
C	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
Ø P	2.98	3.18	3.38
Ø P1	~	1.00	~
Q	3.20	3.30	3.40

NOTES:

- A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- C. OPTION 1 - WITH SUPPORT PIN HOLE
- OPTION 2 - NO SUPPORT PIN HOLE

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