

MOSFET – N-Channel, SUPERFET[®], FRFET[®]

600 V, 11 A, 380 mΩ

FCPF11N60F

Description

SUPERFET MOSFET is onsemi's first generation of 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 MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SUPERFET FRFET MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.

Features

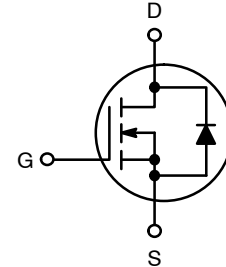
- 600 V @ $T_J = 150^{\circ}\text{C}$
- $R_{DS(on)} = 320\text{ m}\Omega$ (Typ.)
- Fast Recovery Type ($t_{rr} = 120\text{ ns}$)
- Ultra Low Gate Charge (Typ. $Q_g = 40\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 95\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

Applications

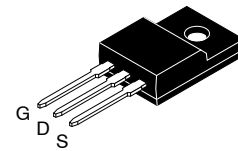
- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC-DC Power Supply

V_{DS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
600 V	380 mΩ @ 10 V	11 A*

*Drain current limited by maximum junction temperature.

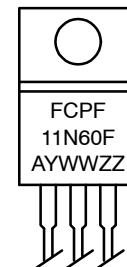


N-Channel



TO-220 FULLPAK, 3-Lead
/ TO-220F-3SG
CASE 221AT

MARKING DIAGRAM



FCPF11N60F = Specific Device Code
A = Assembly Location
YWW = Date Code (Year & Week)
ZZ = Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
FCPF11N60F	TO-220-3 FULLPAK	1000 Units / Tube

FCPF11N60F

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

Symbol	Parameter		FCPF11N60F	Unit
V_{DSS}	Drain to Source Voltage		600	V
I_D	Drain Current	– Continuous ($T_C = 25^\circ\text{C}$)	11*	A
		– Continuous ($T_C = 100^\circ\text{C}$)	7*	
I_{DM}	Drain Current	– Pulsed (Note 1)	33*	A
V_{GSS}	Gate to Source Voltage		± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		340	mJ
I_{AR}	Avalanche Current (Note 1)		11	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		12.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	36	W
		– Derate Above 25°C	0.29	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 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. $I_{AS} = 5.5$ A, $V_{DD} = 50$ V, $R_G = 25$ Ω , starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 11$ A, $di/dt \leq 200$ A/ μs , $V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

Symbol	Parameter	FCPF11N60F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	$^\circ\text{C}/\text{W}$

FCPF11N60F

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	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}, T_C = 25^\circ\text{C}$	600	–	–	V
		$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}, T_C = 150^\circ\text{C}$	–	650	–	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	–	0.6	–	V/ $^\circ\text{C}$
BV_{DS}	Drain–Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 11\text{ A}$	–	700	–	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	–	–	1	μA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	–	–	10	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	–	–	± 100	nA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	3.0	–	5.0	V
$R_{DS(on)}$	Static Drain to Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 5.5\text{ A}$	–	0.32	0.38	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 5.5\text{ A}$	–	6	–	S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	–	1148	1490	pF
C_{oss}	Output Capacitance		–	671	870	pF
C_{rss}	Reverse Transfer Capacitance		–	63	82	pF
C_{oss}	Output Capacitance	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	–	35	–	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	95	–	pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 480\text{ V}, I_D = 11\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	–	40	52	nC
Q_{gs}	Gate to Source Gate Charge		–	7.2	–	nC
Q_{gd}	Gate to Drain “Miller” Charge		–	21	–	nC

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 300\text{ V}, I_D = 11\text{ A}, R_G = 25\text{ }\Omega$ (Note 4)	–	34	80	ns
t_r	Turn–On Rise Time		–	98	205	ns
$t_{d(off)}$	Turn–Off Delay Time		–	119	250	ns
t_f	Turn–Off Fall Time		–	56	120	ns

DRAIN–SOURCE DIODE CHARACTERISTICS

I _S	Maximum Continuous Drain to Source Diode Forward Current		–	–	11	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		–	–	33	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 11 A	–	–	1.4	V
t _{rr}	Reverse Recovery Time		–	120	–	ns
Q _{rr}	Reverse Recovery Charge		–	0.8	–	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 PERFORMANCE CHARACTERISTICS

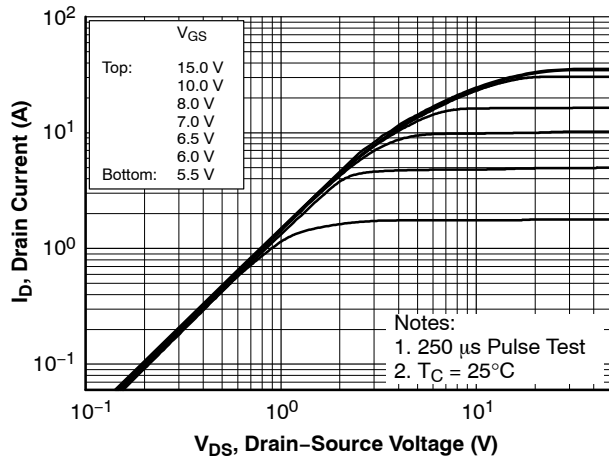


Figure 1. On-Region Characteristics

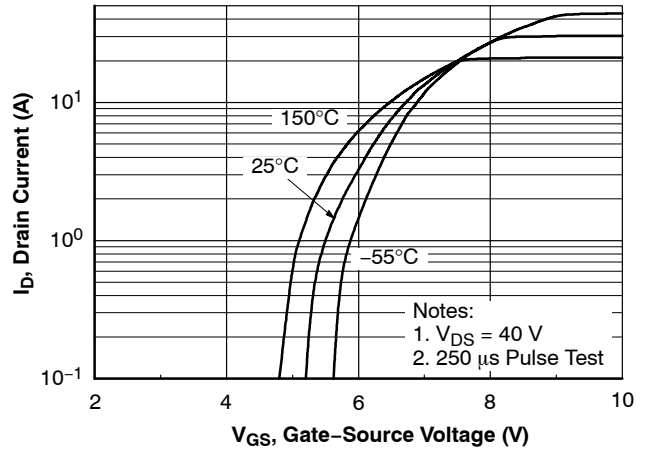


Figure 2. Transfer Characteristics

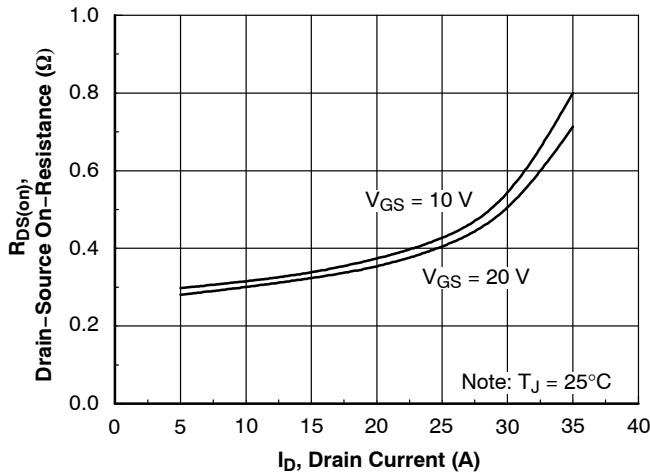


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

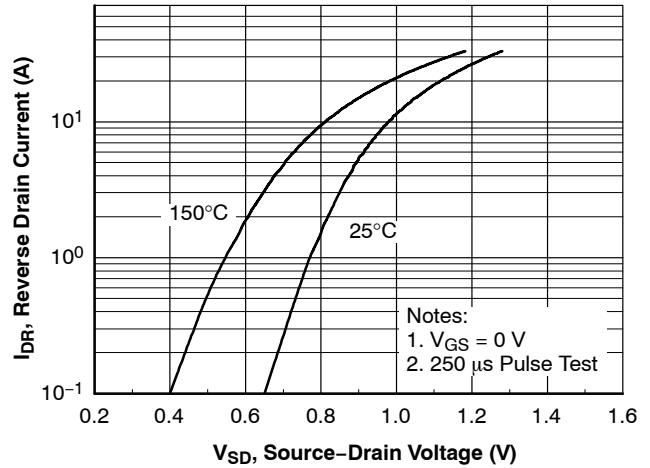


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

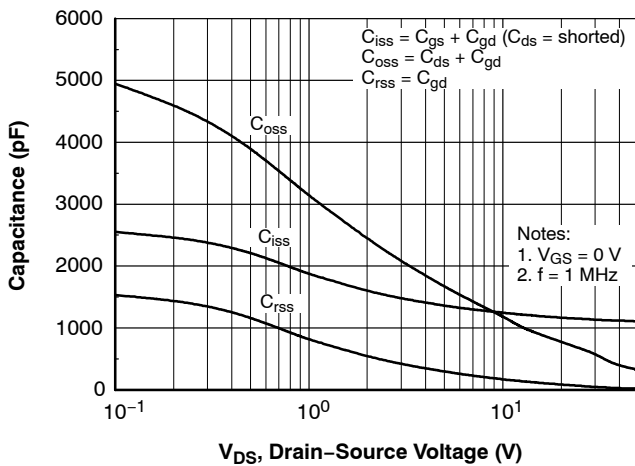


Figure 5. Capacitance Characteristics

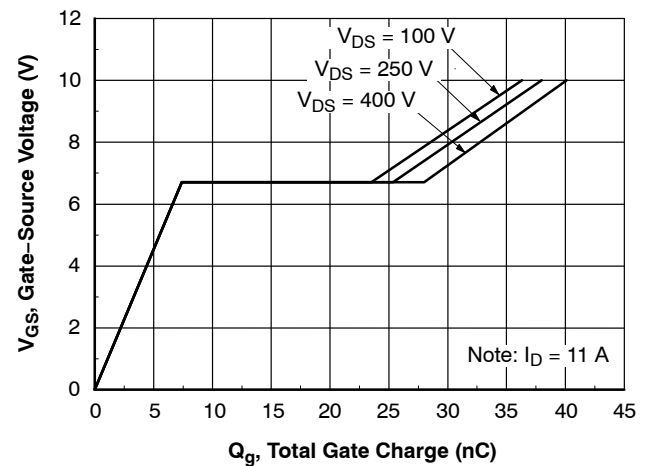


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

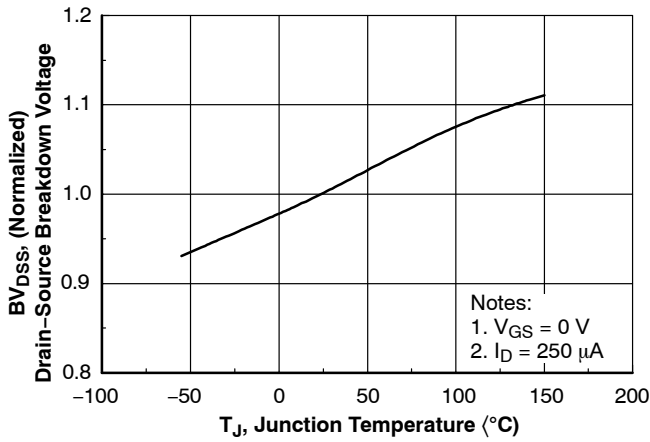


Figure 7. Breakdown Voltage Variation vs. Temperature

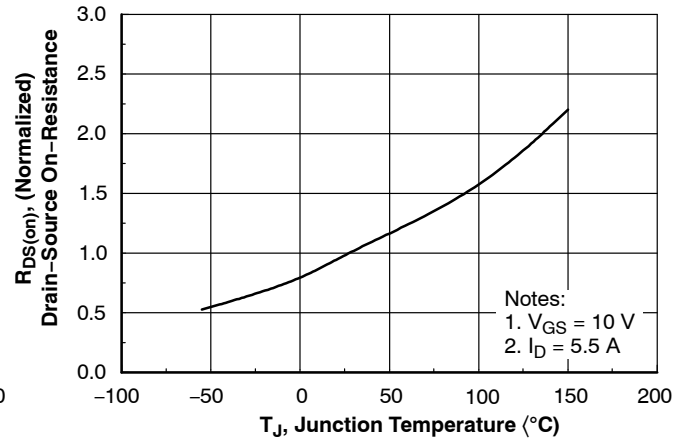


Figure 8. On-Resistance Variation vs. Temperature

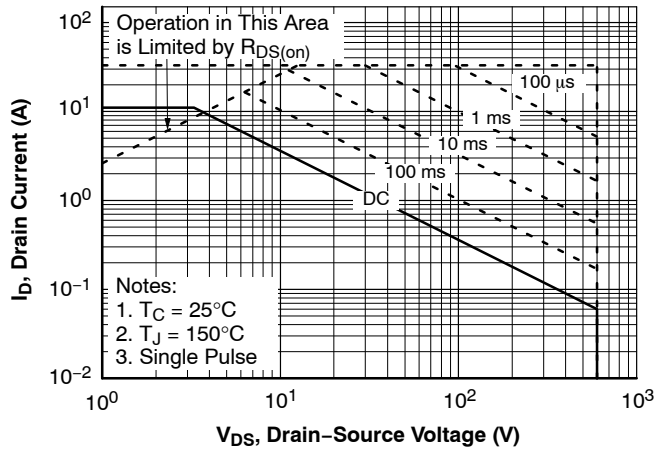


Figure 9. Safe Operating Area

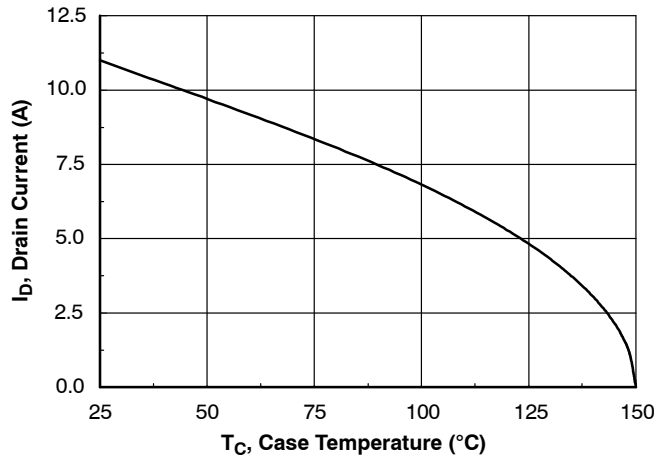


Figure 10. Maximum Drain Current vs. Case Temperature

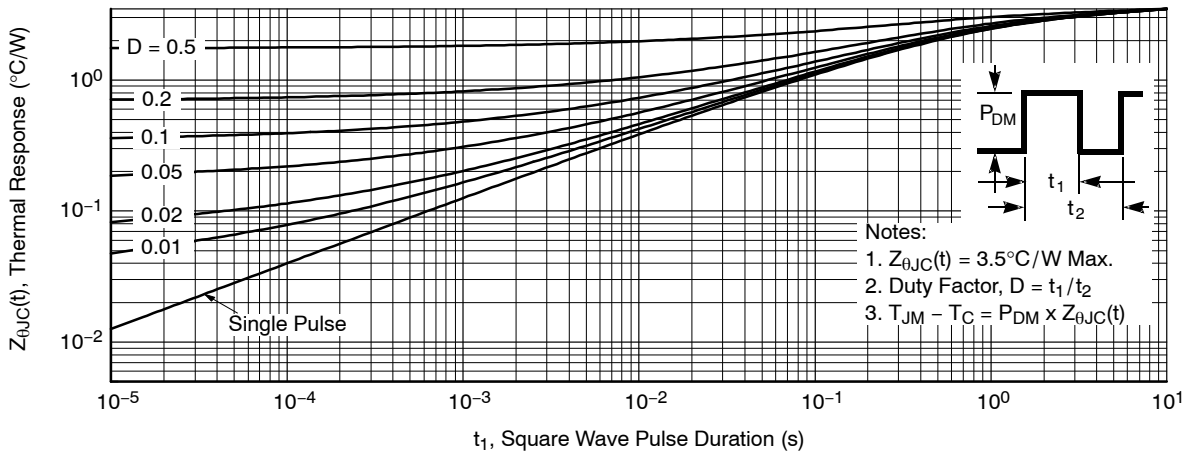


Figure 11. Transient Thermal Response Curve

FCPF11N60F

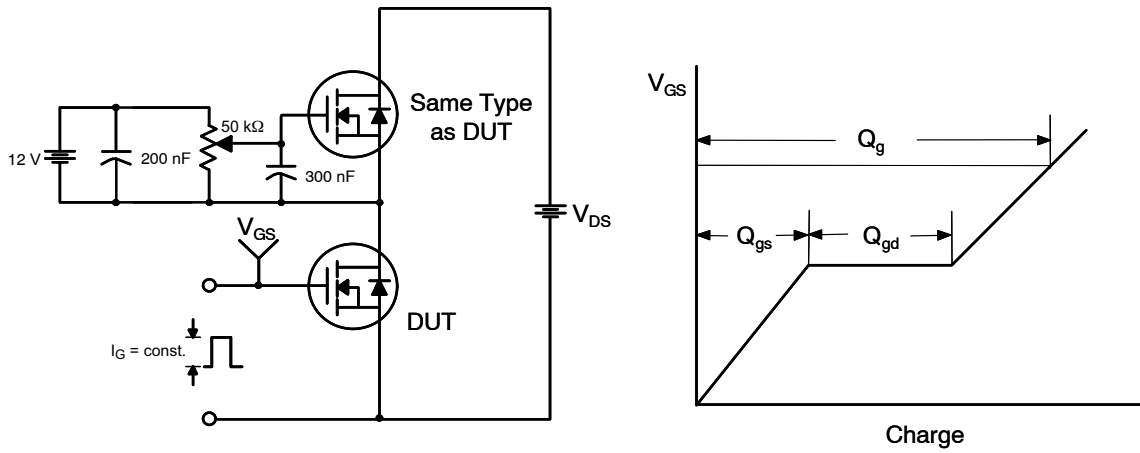


Figure 12. Gate Charge Test Circuit & Waveform

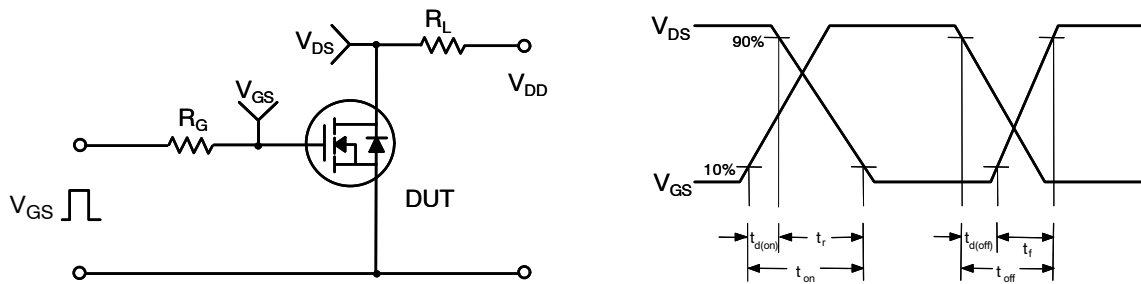


Figure 13. Resistive Switching Test Circuit & Waveforms

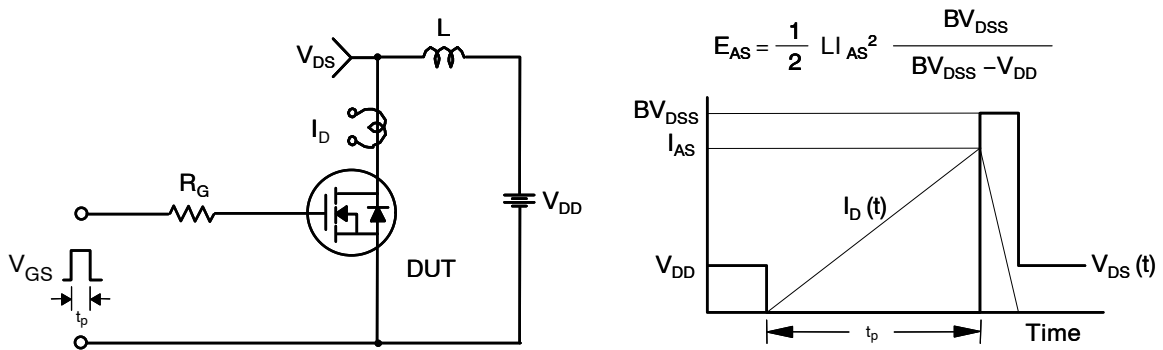


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

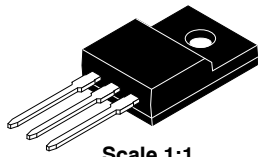
The circuit diagram shows a MOSFET (DUT) with its drain connected to V_{DD} and its source connected to a driver MOSFET. The driver MOSFET's gate is driven by a square wave V_{GS} through a resistor R_G . The driver MOSFET's drain is connected to the DUT's source through an inductor L . The DUT's drain is connected to V_{DD} . The DUT's source is connected to the driver MOSFET's drain. The DUT's body is connected to its source. The DUT's body diode is represented by a diode symbol. The DUT's body diode is labeled "Same Type as DUT". The DUT's body diode is labeled "dv/dt controlled by R_G " and " I_{SD} controlled by pulse period".

The waveforms show the gate voltage V_{GS} (Driver) as a square wave with a pulse width $D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$ and a pulse height of 10 V. The source-drain current I_{SD} (DUT) shows the body diode forward current I_{FM} and the body diode reverse current I_{RM} during the switching transient. The drain-source voltage V_{DS} (DUT) shows the body diode forward voltage drop V_{SD} and the body diode recovery dv/dt during the switching transient.

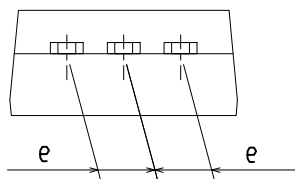
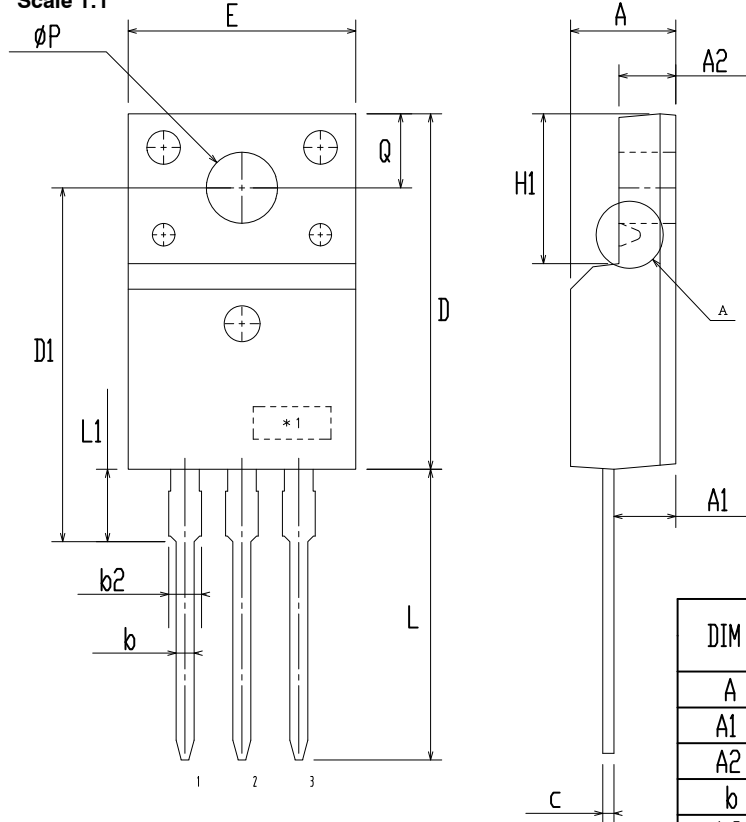
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TO-220 Fullpack, 3-Lead / TO-220F-3SG
CASE 221AT
ISSUE B

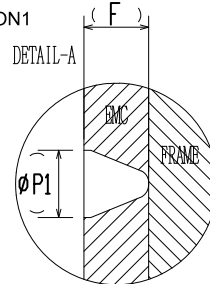
DATE 19 JAN 2021



Scale 1:1



OPTION1



DIM	MILLIMETERS		
	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 PROTRUCTIONS.

C. OPTION 1 - WITH SUPPORT PIN HOLE

OPTION 2 - NO SUPPORT PIN HOLE

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