

# MOSFET – N-Channel, QFET®

900 V, 8.0 A, 1.4 Ω

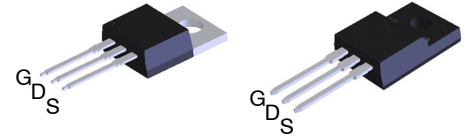
## FQP9N90C, FQPF9N90CT

### Description

This N-Channel enhancement mode power MOSFET is produced using onsemi's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

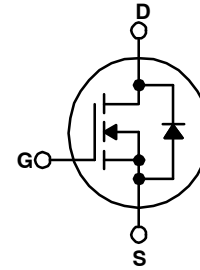
### Features

- 8 A 900 V,  $R_{DS(on)} = 1.4 \Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 4 \text{ A}$
- Low Gate Charge (Typ. 45 nC)
- Low Crss (Typ. 14 pF)
- 100% Avalanche Tested
- This Device is Pb-Free Halide, Free and RoHS Compliant.

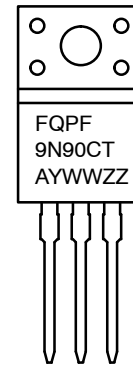


TO-220  
CASE 221A

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



### MARKING DIAGRAM



FQP9N90C,  
FQPF9N90CT = Specific Device Code  
 A = Assembly Location  
 YWW = Date Code (Year and Week)  
 ZZ = Assembly Lot Code

### ORDERING INFORMATION

Device	Package	Shipping†
FQP9N90C	TO-220 (Pb-Free)	1000 Units / Tube
FQPF9N90CT	TO-220-3F (Pb-Free)	1000 Units / Tube

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

# FQP9N90C,

## MOSFET MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted.)

Symbol	Parameter	Ratings		Units
		FQP9N90C	FQPF9N90CT	
V <sub>DSS</sub>	Drain-Source Voltage	900		V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	8.0 2.8	8.0* 2.8*	A
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	32	32*	A
V <sub>GSS</sub>	Gate-Source Voltage	±30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	900		mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	8.0		A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	20.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.0		V/ns
P <sub>D</sub>	Power Dissipation (T <sub>C</sub> = 25°C) - Derate above 25°C	205 1.64	68 0.54	W W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +175		°C
T <sub>L</sub>	Maximum lead temperature for soldering, 1/8" from case for 5 seconds	300		°C

\*Drain current limited by maximum junction temperature.

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.

## THERMAL CHARACTERISTICS

Symbol	Parameter	FDP4D5N10C	FDPF4D5N10C	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case, Max.	0.61	1.85	°C/W
R <sub>θJS</sub>	Thermal Resistance, Case-to-sink Typ, Max.	0.5	-	
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient, Max	62.5	62.5	

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	900	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	-	0.99	-	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 900 V, V <sub>GS</sub> = 0 V	-	-	10	μA
		V <sub>DS</sub> = 720 V, T <sub>C</sub> = 125°C	-	-	10	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	-	-	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	-	-	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3.0	-	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4 A	-	1.12	1.4	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 4 A	-	9.2	-	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	-	2100	2730	pF
C <sub>oss</sub>	Output Capacitance		-	175	230	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		-	14	18	pF

# FQP9N90C,

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 450\text{ V}$ , $I_D = 9.0\text{ A}$ , $R_G = 25\ \Omega$ (Note 4)	–	50	110	ns
$t_r$	Turn-On Rise Time		–	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		–	100	210	ns
$t_f$	Turn-Off Fall Time		–	75	160	ns
$Q_g$	Total Gate Charge	$V_{DS} = 720\text{ V}$ , $I_D = 9.0\text{ A}$ , $V_{GS} = 10\text{ V}$ (Note 4)	–	45	58	nC
$Q_{gs}$	Gate-Source Charge		–	13	–	nC
$Q_{gd}$	Gate-Drain Charge		–	18	–	nC
<b>Drain-Source Diode Characteristics</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		–	–	8.0	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		–	–	32.0	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 100\text{ A}$	–	–	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}$ , $V_{DD} = 50\text{ V}$ , $I_F = 100\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	–	550	–	ns
$Q_{rr}$	Reverse Recovery Charge		–	6.5	–	$\mu\text{C}$

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.

### NOTES:

1. Repetitive Rating: Pulse width-limited by maximum junction temperature.
2.  $L = 21\text{ mH}$ ,  $I_{AS} = 9\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 9.0\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature.

# FQP9N90C,

## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

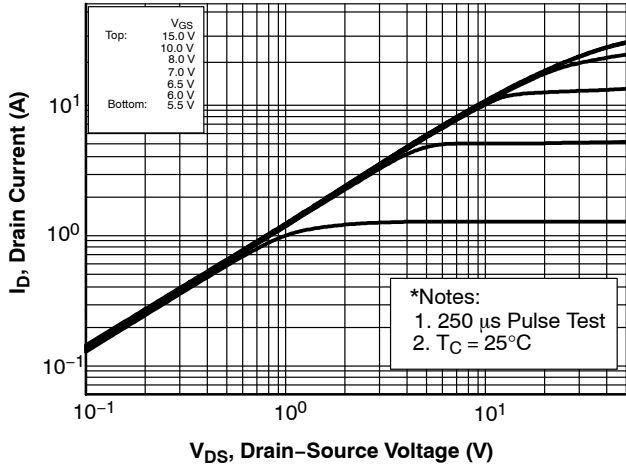


Figure 1. On-Region Characteristics

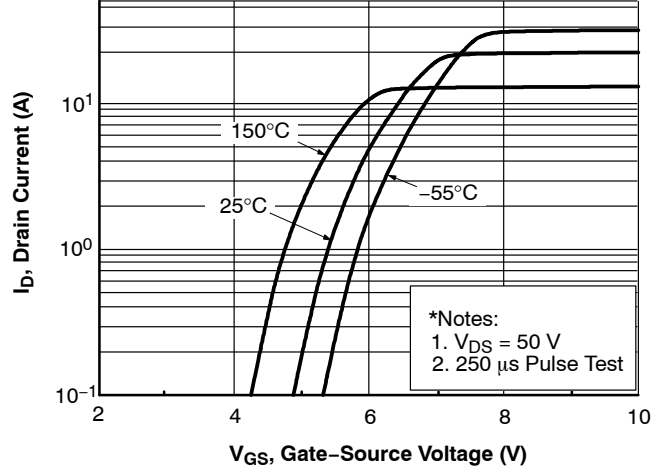


Figure 2. Transfer Characteristics

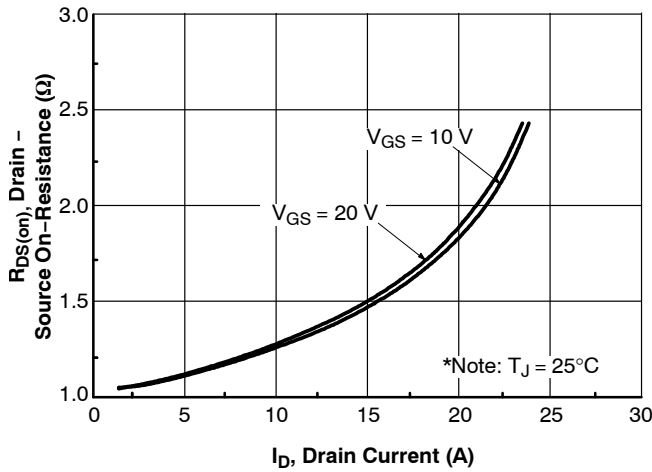


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

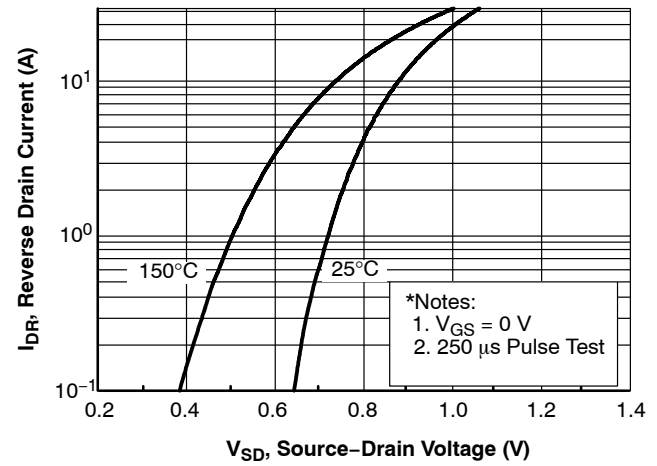


Figure 4. Body Diode Forward Voltage Variation With Source Current and Temperature

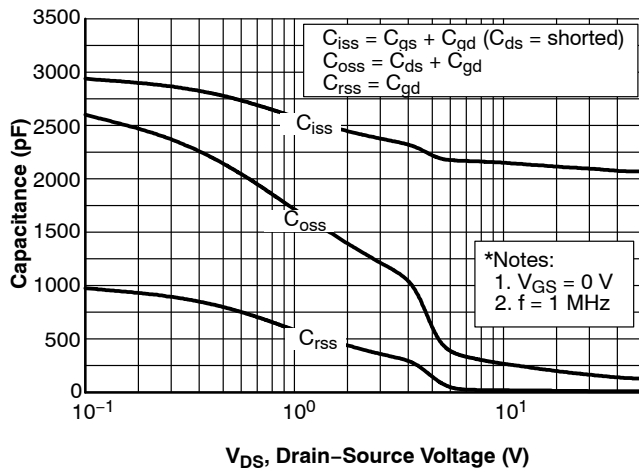


Figure 5. Capacitance Characteristics

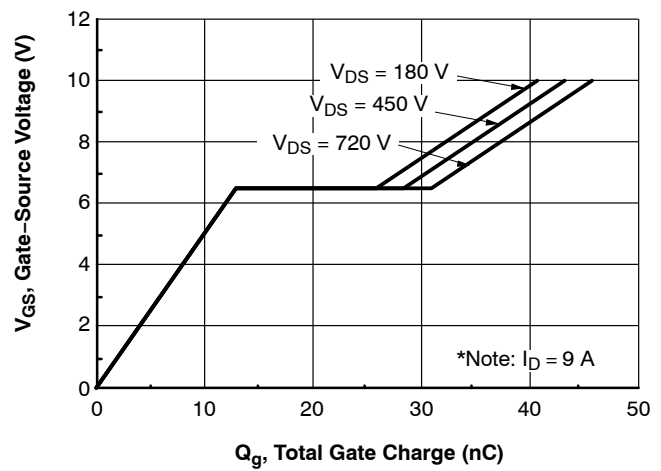


Figure 6. Gate Charge Characteristics

# FQP9N90C,

## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (CONTINUED)

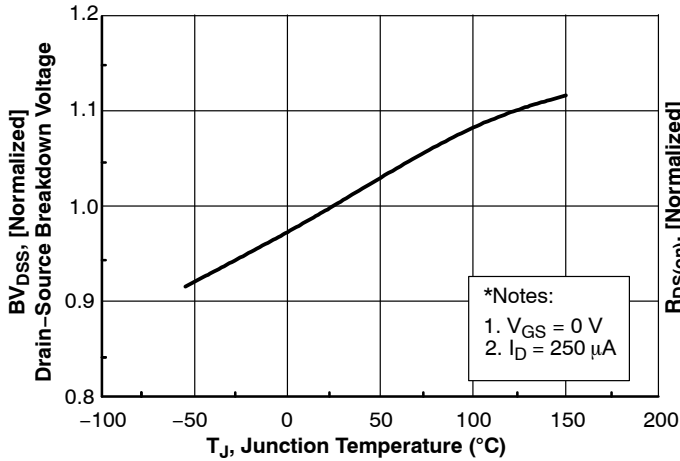


Figure 7. Breakdown Voltage Variation vs Temperature

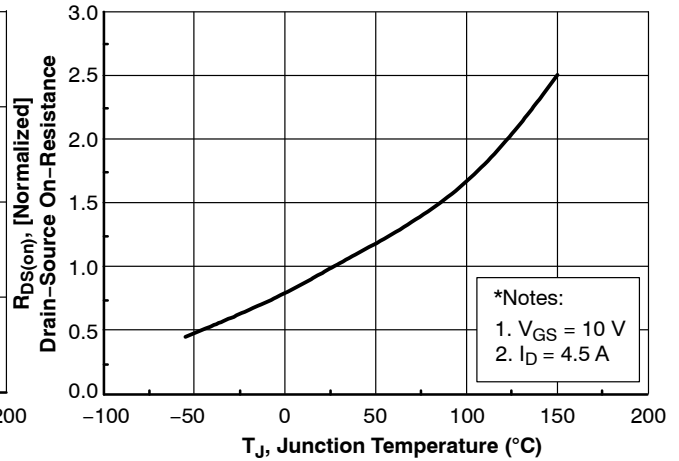


Figure 8. On-Resistance Variation vs Temperature

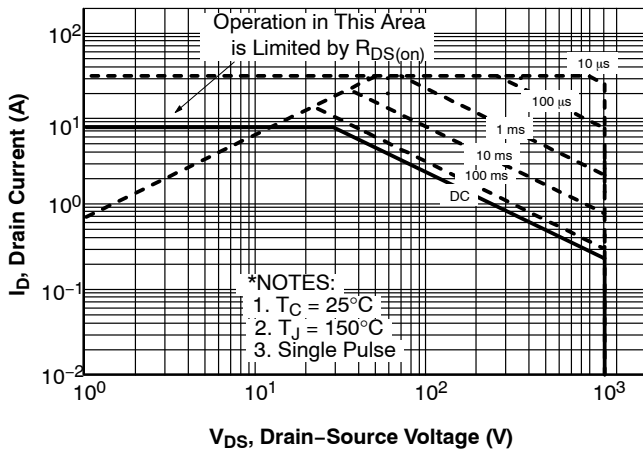


Figure 9. Maximum Safe Operating Area for FQP9N90C

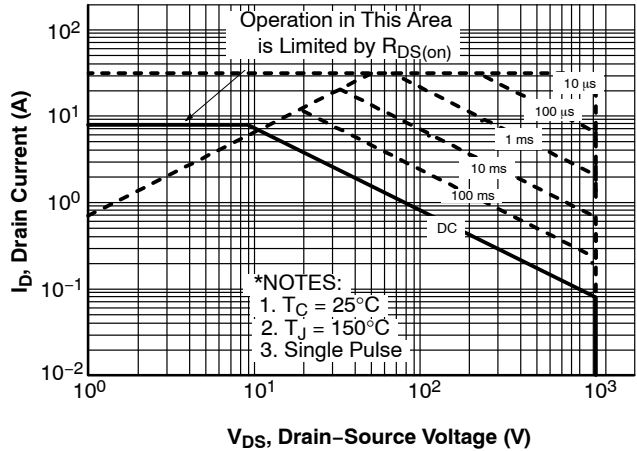


Figure 10. Maximum Safe Operating Area for FQPF9N90CT

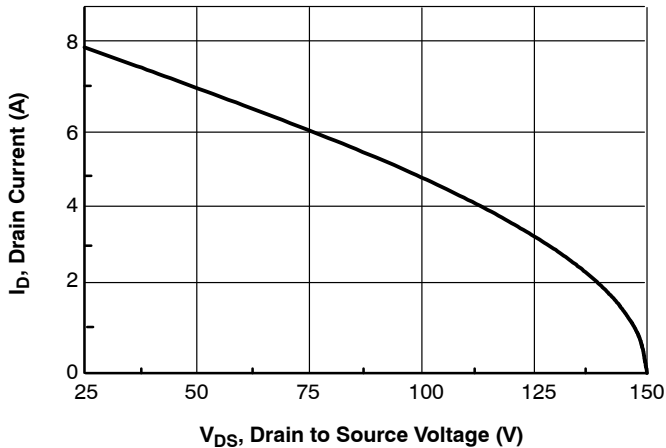


Figure 11. Maximum Drain Current vs Case Temperature

# FQP9N90C,

## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (CONTINUED)

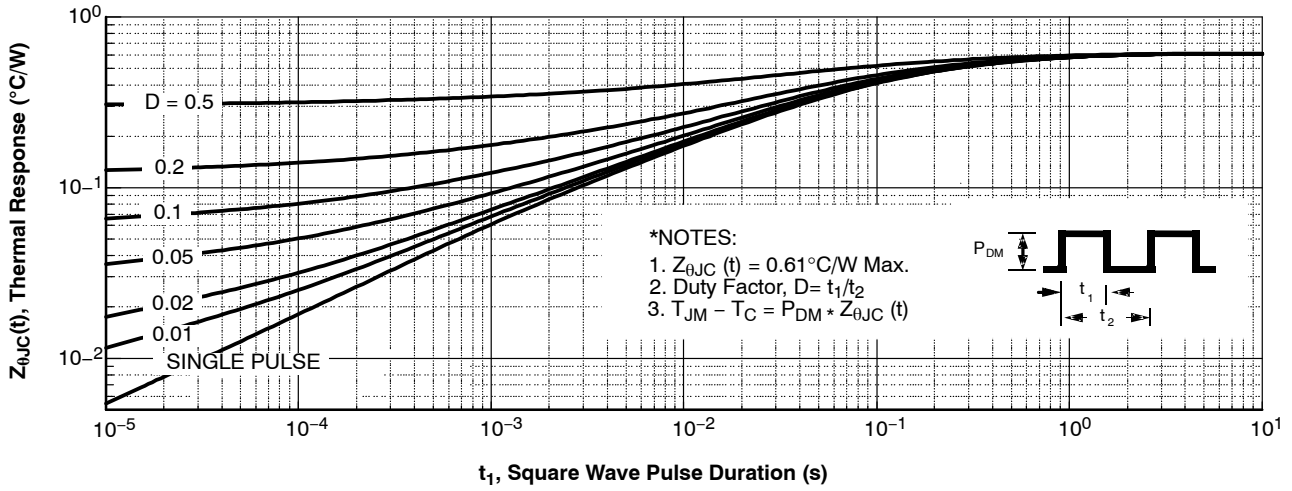


Figure 12. Transient Thermal Response Curve For FQP9N90C

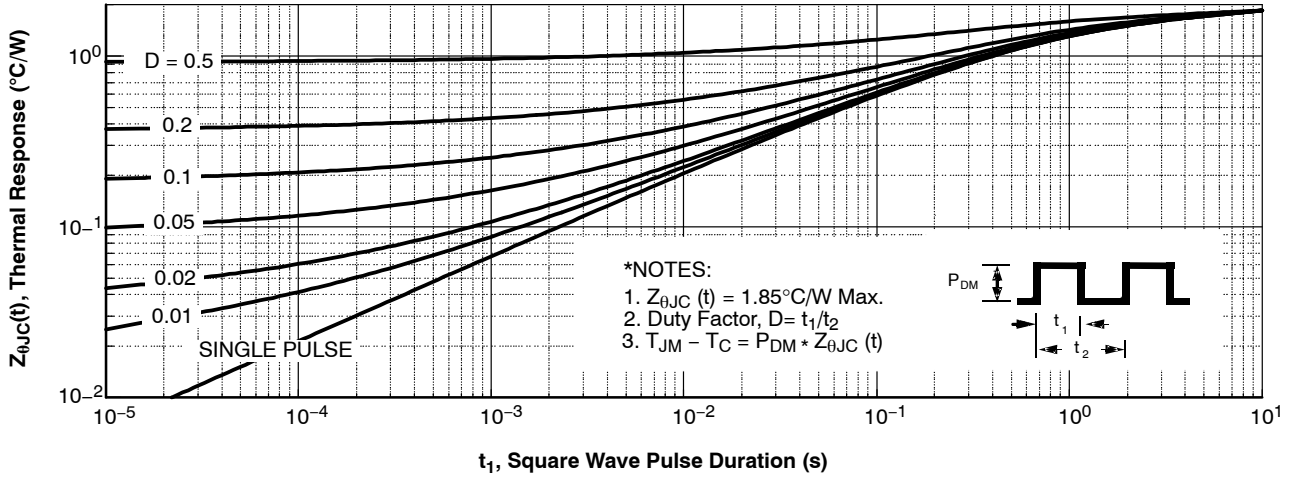


Figure 13. Transient Thermal Response Curve For FQPF9N90CT

# FQP9N90C,

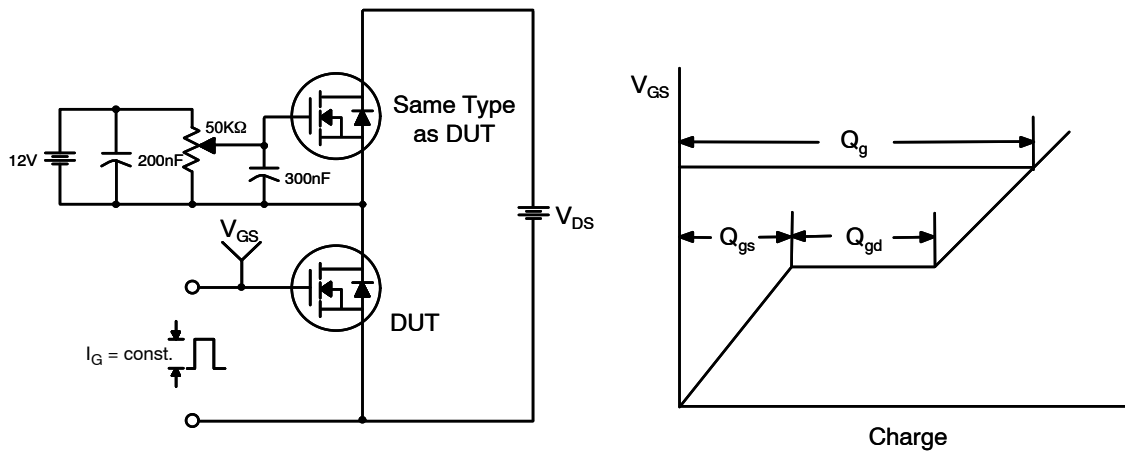


Figure 14. Gate Charge Test Circuit & Waveform

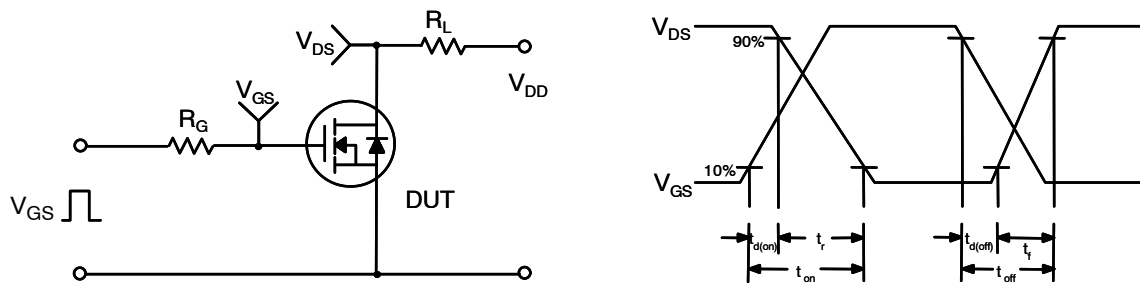


Figure 15. Resistive Switching Test Circuit & Waveforms

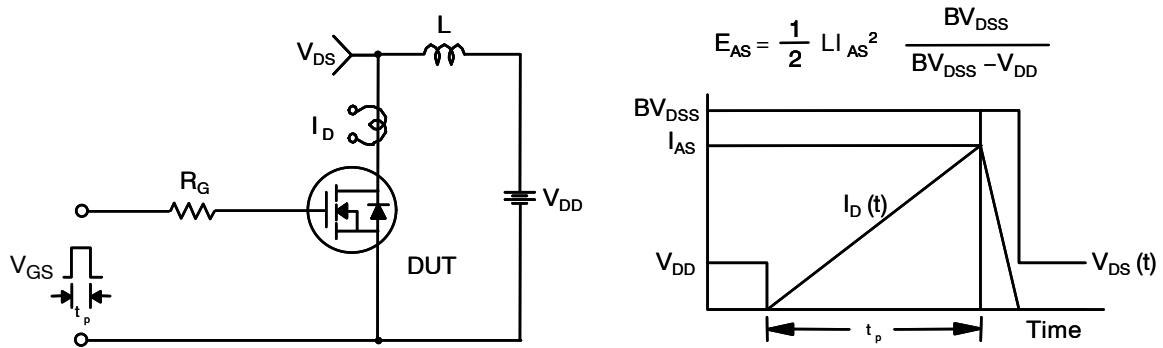
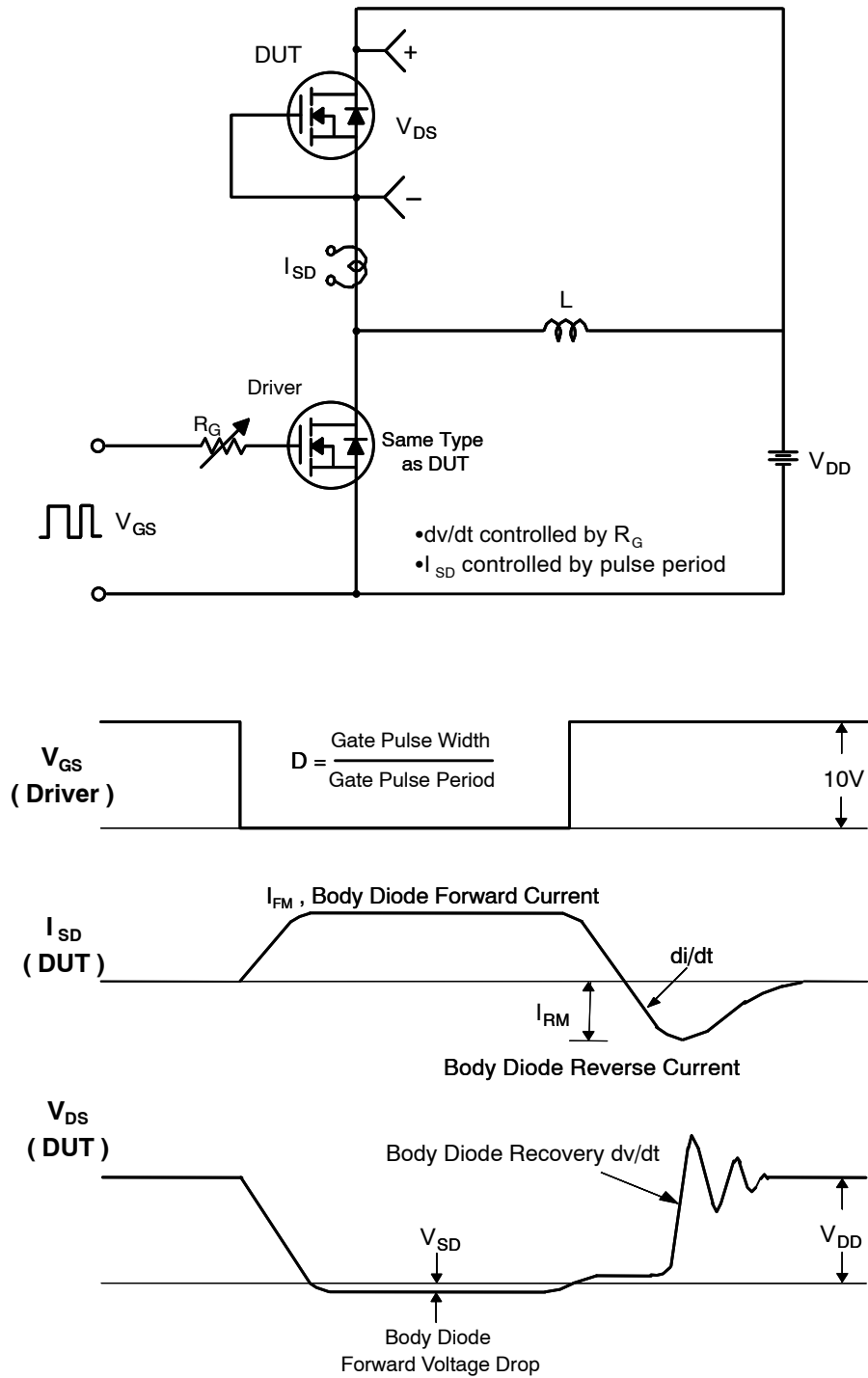


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

# FQP9N90C,



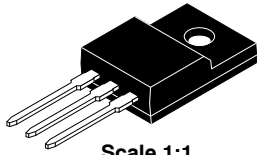
**Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**

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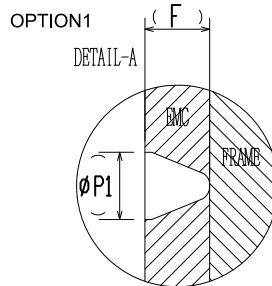
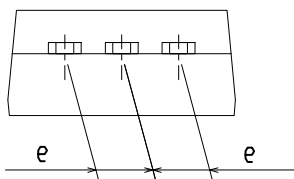
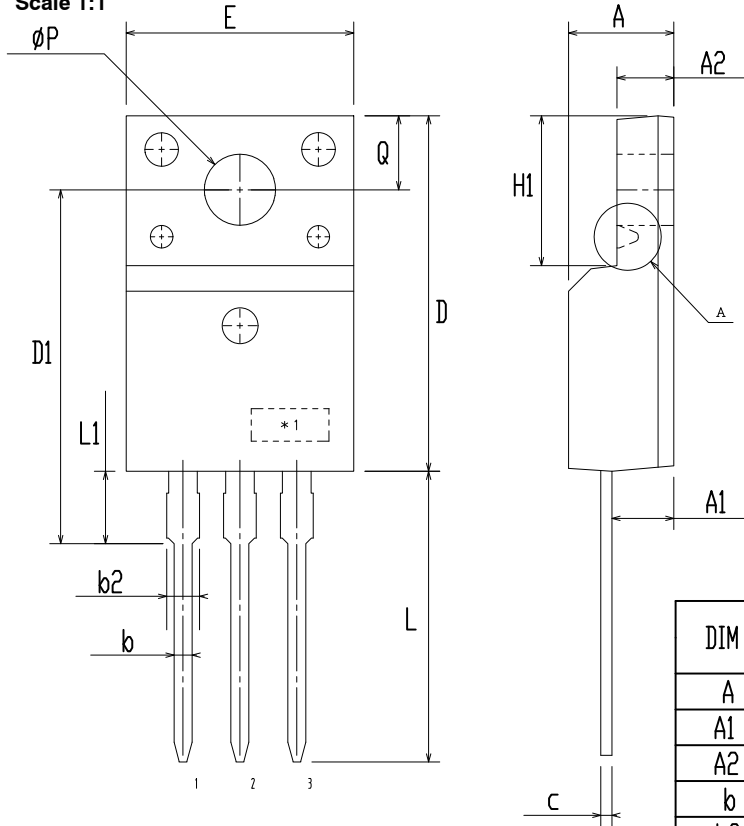


**TO-220 Fullpack, 3-Lead / TO-220F-3SG**  
**CASE 221AT**  
**ISSUE B**

DATE 19 JAN 2021



Scale 1:1



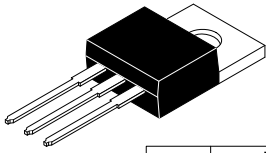
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
∅ P	2.98	3.18	3.38
∅ P1	~	1.00	~
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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<b>DESCRIPTION:</b>	<b>TO-220 FULLPACK, 3-LEAD / TO-220F-3SG</b>	<b>PAGE 1 OF 1</b>

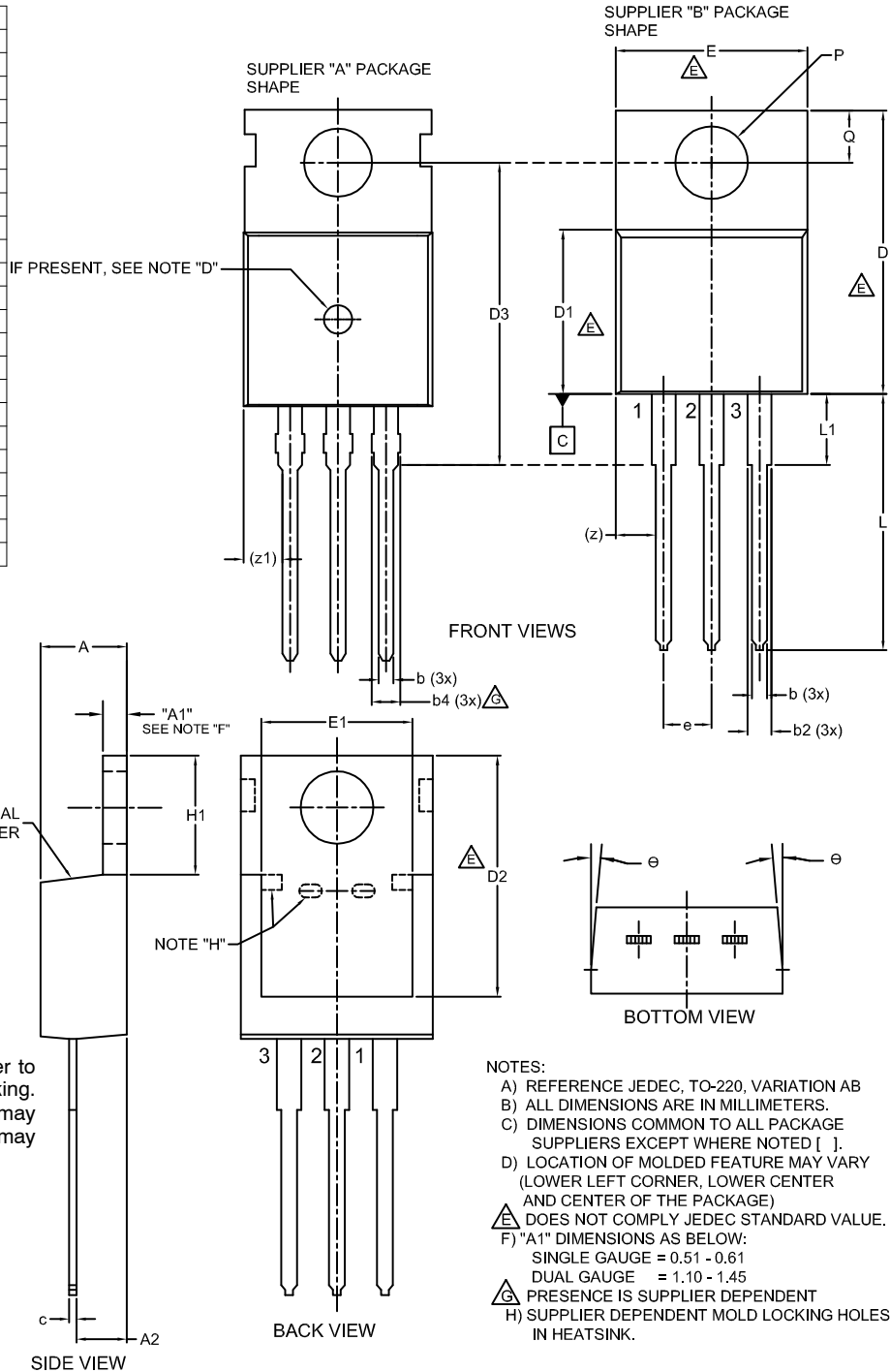
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TO-220-3LD  
CASE 340AT  
ISSUE B

DATE 08 AUG 2022

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.00	--	4.70
A1	SEE NOTE "F"		
A2	2.10	--	2.85
b	0.55	--	1.00
b2	1.10	--	1.62
b4	1.42	--	1.62
c	0.36	--	0.60
D	13.90	--	16.30
D1	8.13	--	9.40
D2	11.50	--	14.30
D3	15.42	--	16.51
E	9.65	--	10.67
E1	7.59	--	8.65
e	2.40	--	2.67
H1	6.06	--	6.69
L	12.70	--	14.04
L1	2.70	--	4.10
P	3.50	--	4.00
Q	2.50	--	3.40
z	2.13 REF		
z1	2.06 REF		
θ	3°	--	5°



GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

NOTES:

- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- ⚠ DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.10 - 1.45
- ⚠ PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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DESCRIPTION:	TO-220-3LD	PAGE 1 OF 1

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