

# MOSFET – N-Channel, QFET

900 V, 4.0 A, 4.2 Ω

## FQP4N90C, FQPF4N90C

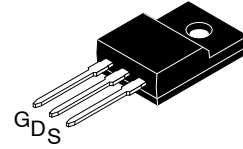
### Description

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.

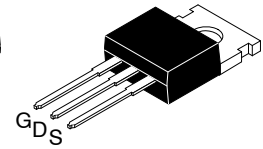
### Features

- 4.0 A, 900 V,  $R_{DS(on)} = 4.2 \Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 2.0 \text{ A}$
- Low Gate Charge (Typ. 17 nC)
- Low  $C_{rss}$  (Typ. 5.6 pF)
- 100% Avalanche Tested

$V_{DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
900 V	4.2 Ω @ 10 V	4.0 A

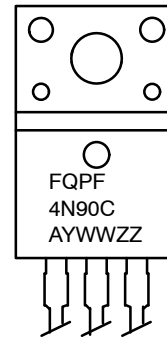


TO-220 Fullpack,  
3-Lead / TO-220F-3SG  
CASE 221AT



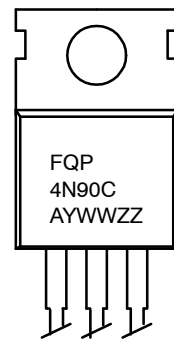
TO-220-3LD  
CASE 340AT

### MARKING DIAGRAM



FQP4N90C,  
FQPF4N90C

A  
YWW  
ZZ



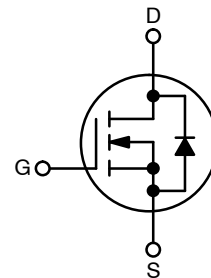
= Specific Device Code

= Assembly Location

= Date Code (Year & Week)

= Assembly Lot

### N-CHANNEL MOSFET



### ORDERING INFORMATION

Part Number	Package	Shipping
FQP4N90C	TO-220	1000 Units / Tube
FQPF4N90C	TO-220F	1000 Units / Tube

## FQP4N90C, FQPF4N90C

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

Symbol	Parameter		FQP4N90C	FQPF4N90C	Unit
$V_{DSS}$	Drain-Source Voltage		900		V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	4	4*	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	2.3	2.3*	
$I_{DM}$	Drain Current	- Pulsed (Note 1)	16	16*	A
$V_{GSS}$	Gate-Source Voltage		$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		570		mJ
$I_{AR}$	Avalanche Current (Note 1)		4		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		14		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5		V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	140	47	W
		- Derate above $25^\circ\text{C}$	1.12	0.38	
$T_J, T_{STG}$	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.  $L = 67\text{ mH}$ ,  $I_{AS} = 4\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 4\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .

### THERMAL CHARACTERISTICS

Symbol	Parameter	FQP4N90C	FQPF4N90C	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.89	2.66	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink, Max.	0.5	-	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	62.5	$^\circ\text{C}/\text{W}$

# FQP4N90C, FQPF4N90C

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	900	-	-	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	-	1.05	-	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	-	-	100	
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

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate 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> = 2 A	-	3.5	4.2	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 50 V, I <sub>D</sub> = 2 A	-	5	-	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	740	960	pF
C <sub>oss</sub>	Output Capacitance		-	65	85	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		-	5.6	7.3	pF

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 450 V, I <sub>D</sub> = 4 A, R <sub>G</sub> = 25 Ω (Note 4)	-	25	60	ns
t <sub>r</sub>	Turn-On Rise Time		-	50	110	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	40	90	ns
t <sub>f</sub>	Turn-Off Fall Time		-	35	80	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 720 V, I <sub>D</sub> = 4 A, V <sub>GS</sub> = 10 V (Note 4)	-	17	22	nC
Q <sub>gs</sub>	Gate-Source Charge		-	4.5	-	nC
Q <sub>gd</sub>	Gate-Drain Charge		-	7.5	-	nC

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

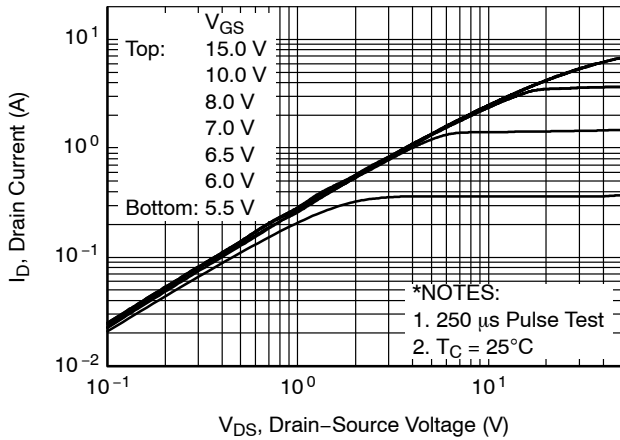
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current	-	-	4	A	
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current	-	-	16	A	
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 4 A	-	-	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 4 A, dI <sub>F</sub> /dt = 100 A/μs	-	450	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	3.5	-	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.

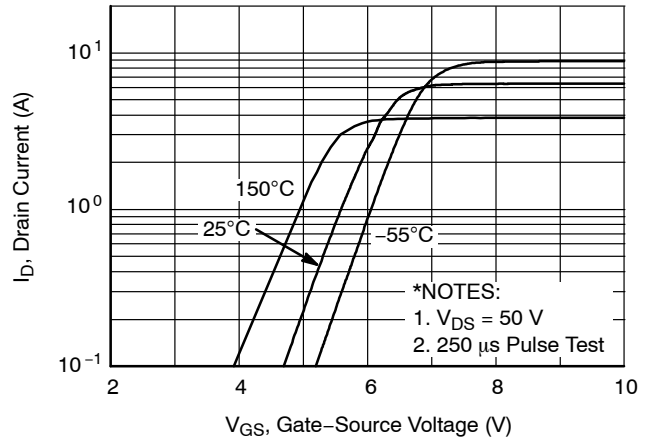
4. Essentially independent of operating temperature.

# FQP4N90C, FQPF4N90C

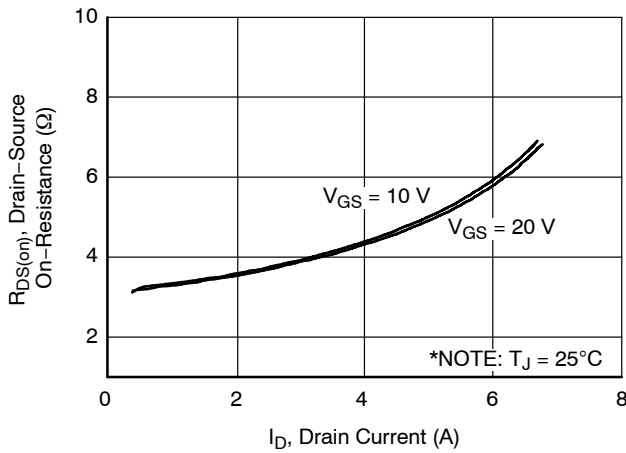
## TYPICAL CHARACTERISTICS



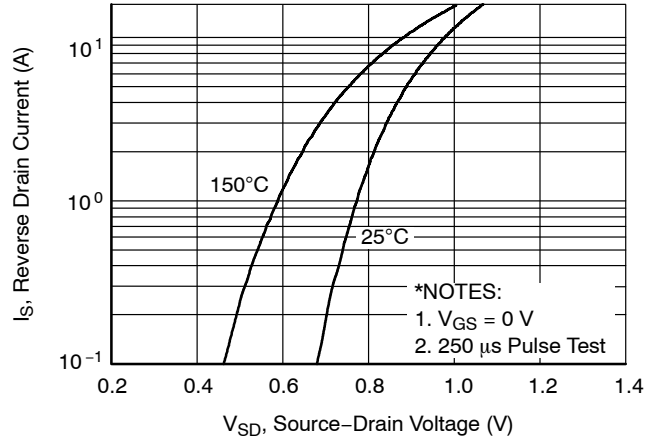
**Figure 1. On-Region Characteristics**



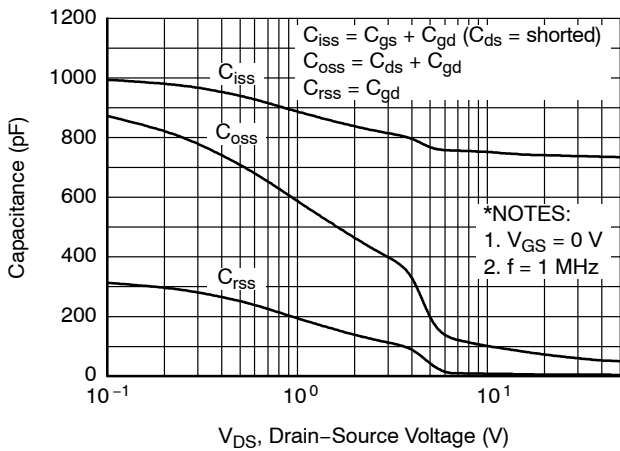
**Figure 2. Transfer Characteristics**



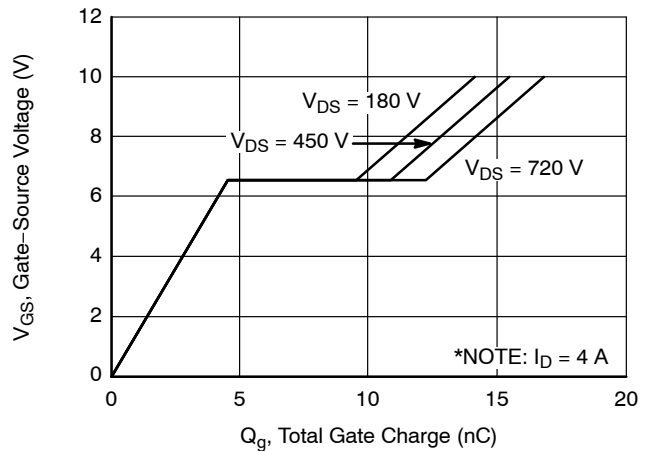
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



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



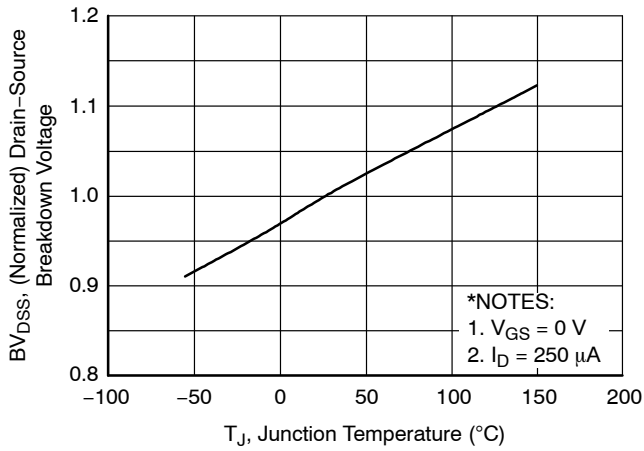
**Figure 5. Capacitance Characteristics**



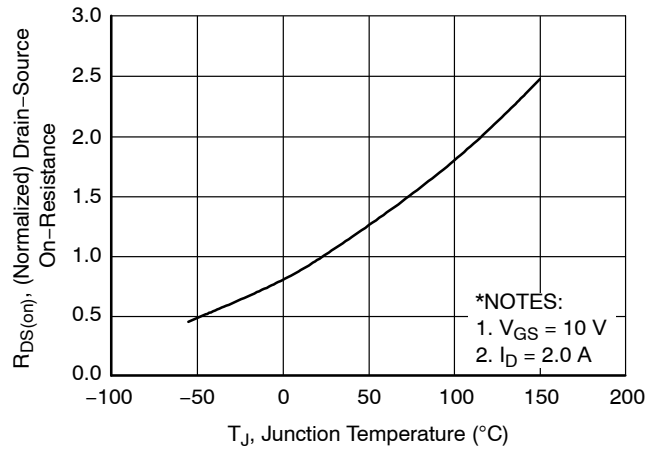
**Figure 6. Gate Charge Characteristics**

# FQP4N90C, FQPF4N90C

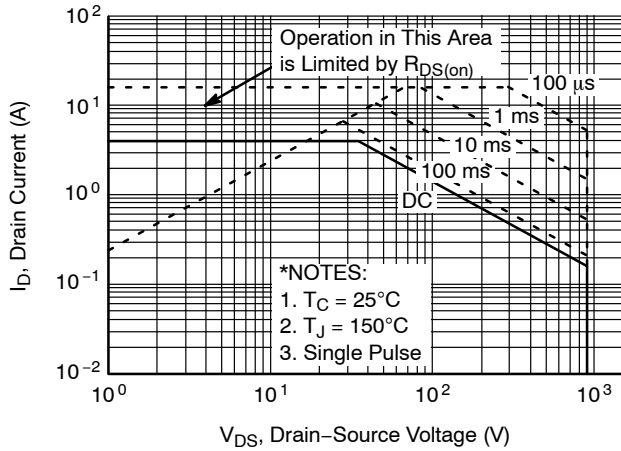
## TYPICAL CHARACTERISTICS (CONTINUED)



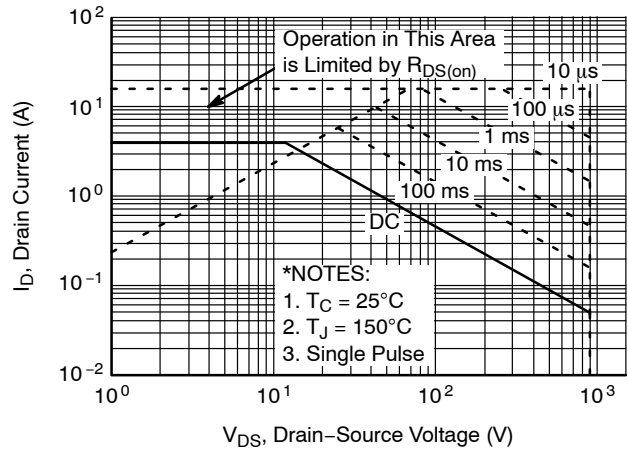
**Figure 7. Breakdown Voltage Variation vs. Temperature**



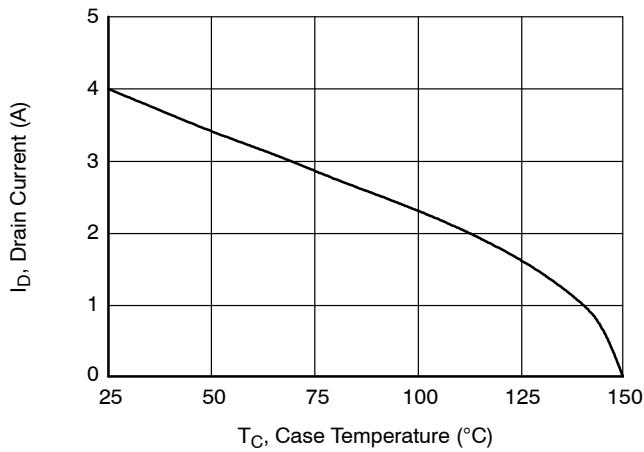
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area for FQP4N90C**



**Figure 10. Maximum Safe Operating Area for FQPF4N90C**



**Figure 11. Maximum Drain Current vs. Case Temperature**

# FQP4N90C, FQPF4N90C

## TYPICAL CHARACTERISTICS (CONTINUED)

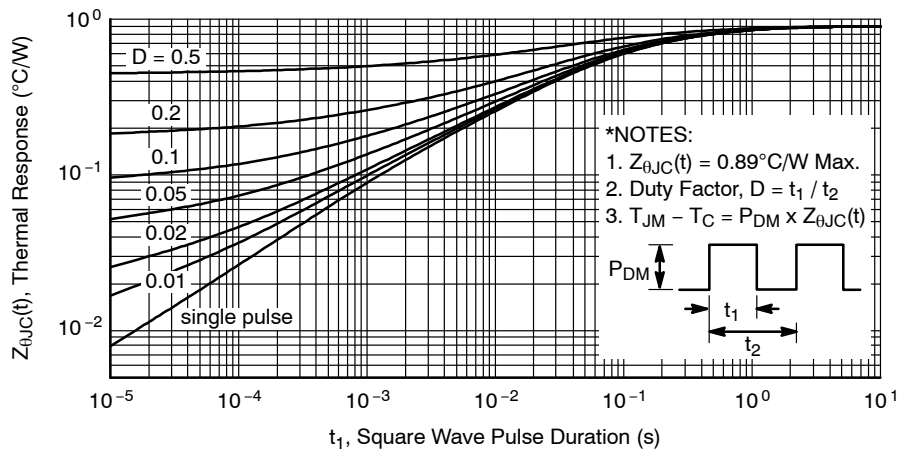


Figure 12. Transient Thermal Response Curve for FQP4N90C

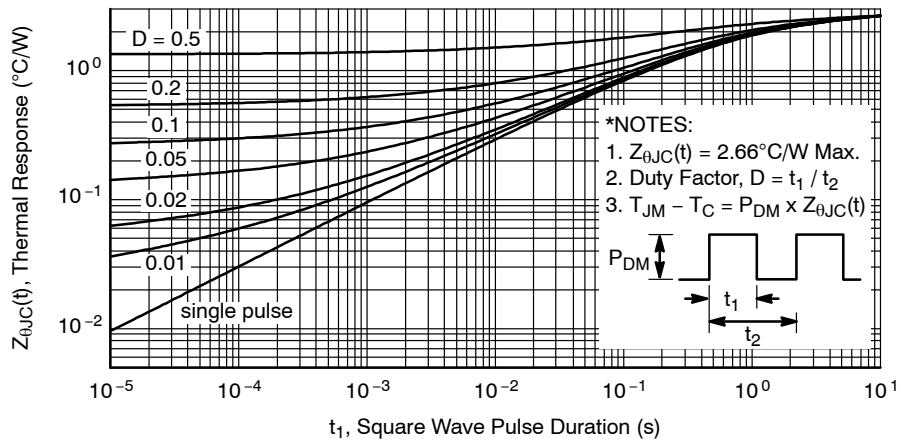
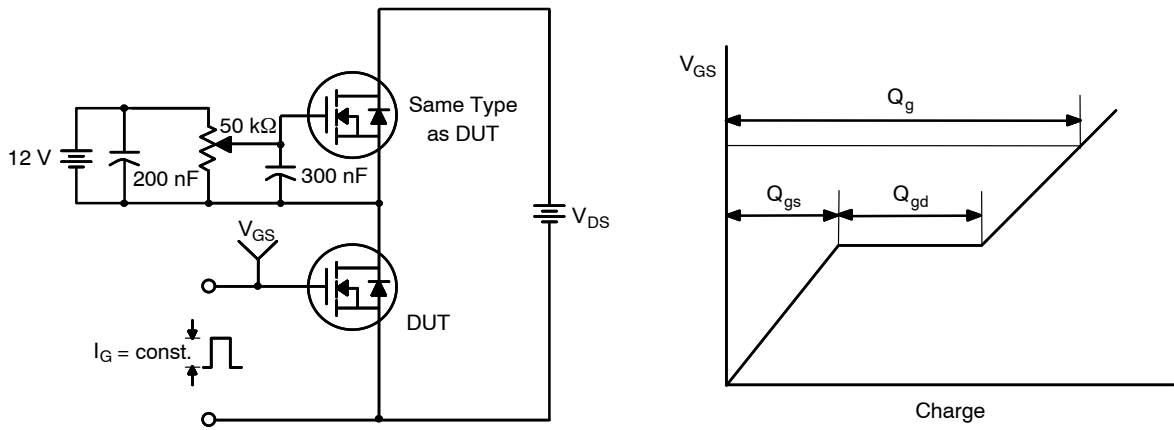
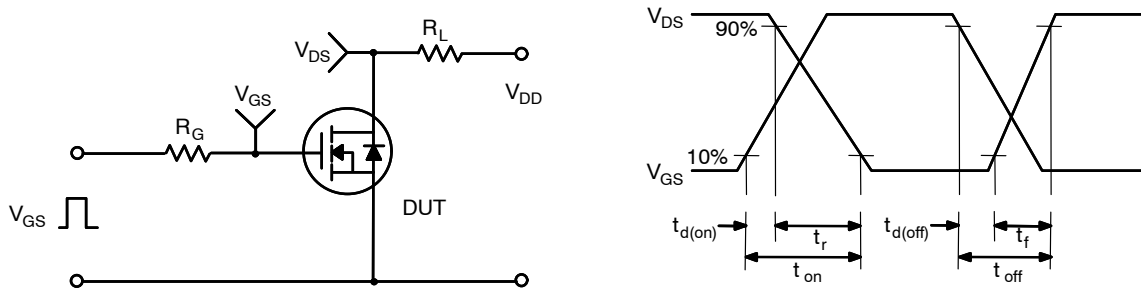


Figure 13. Transient Thermal Response Curve for FQPF4N90C

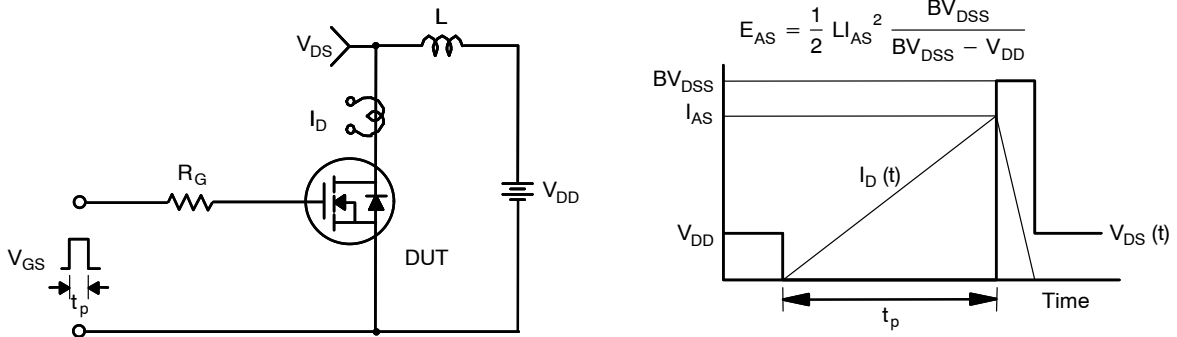
## FQP4N90C, FQPF4N90C



**Figure 14. Gate Charge Test Circuit & Waveform**



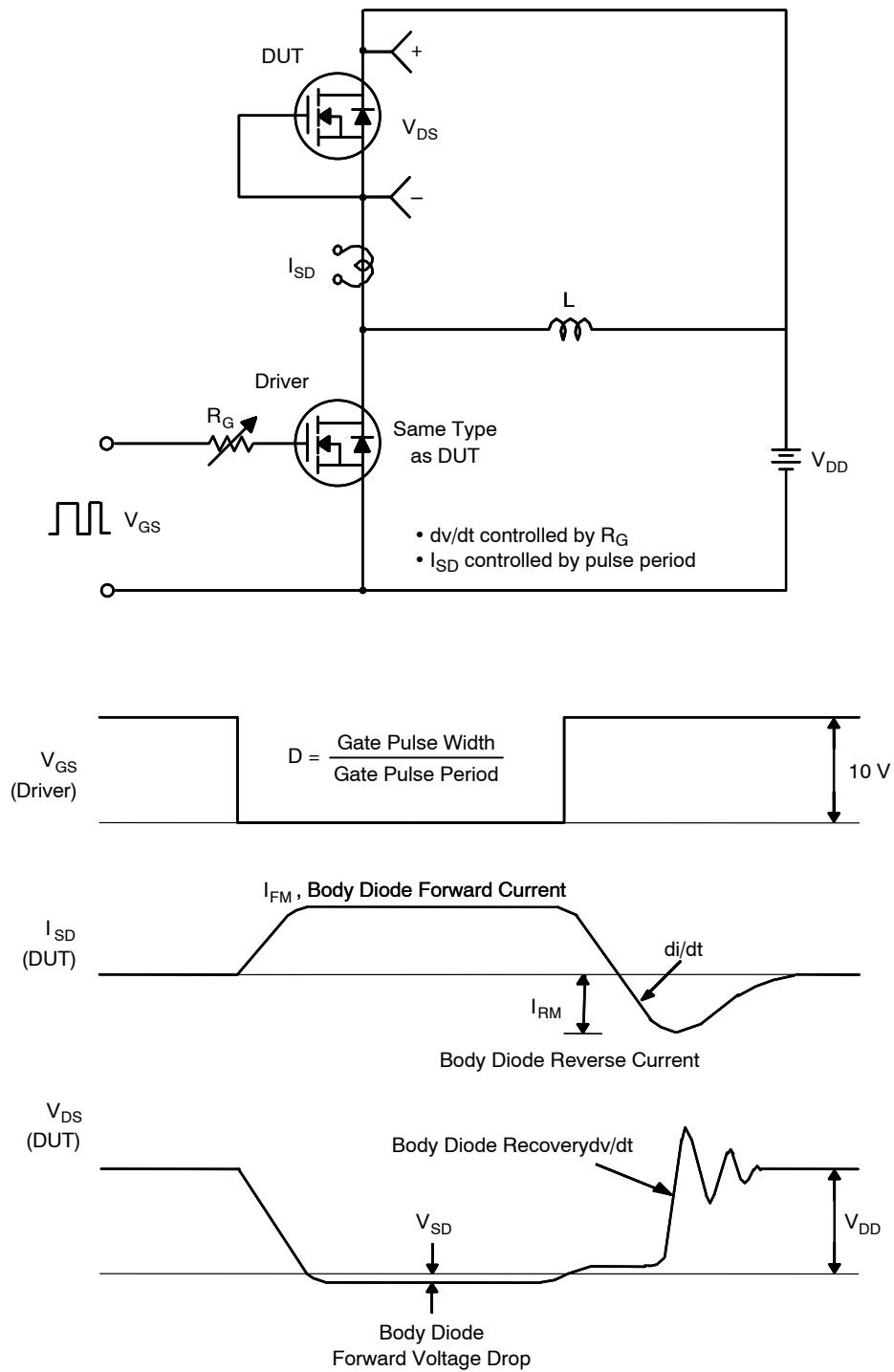
**Figure 15. Resistive Switching Test Circuit & Waveforms**



**Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms**

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

# FQP4N90C, FQPF4N90C

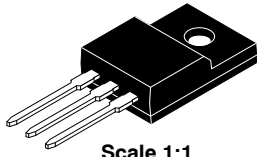


**Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**

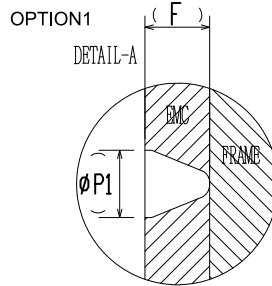
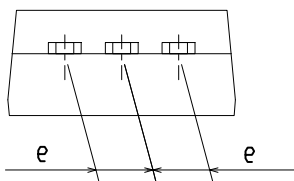
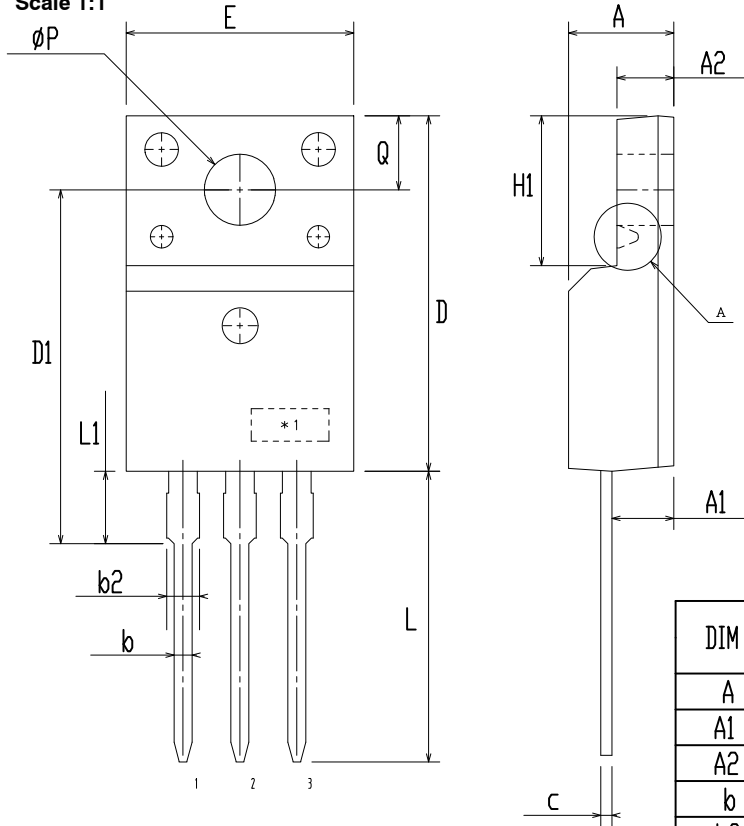


**TO-220 Fullpack, 3-Lead / TO-220F-3SG**  
**CASE 221AT**  
**ISSUE B**

DATE 19 JAN 2021



Scale 1:1



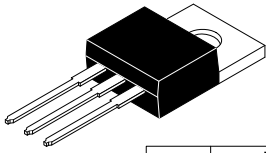
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
∅ P	2.98	3.18	3.38
∅ P1	~	1.00	~
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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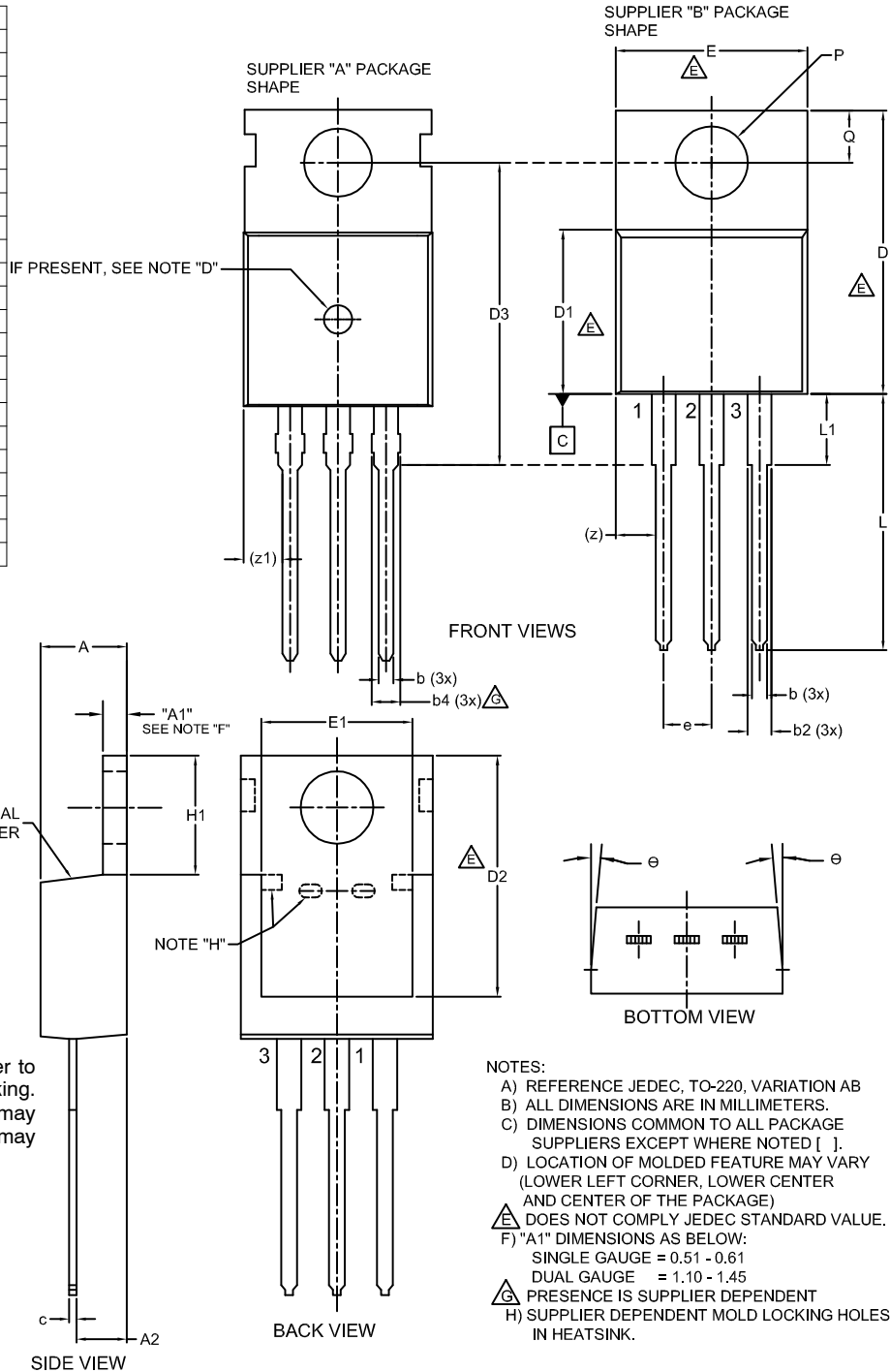
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TO-220-3LD  
CASE 340AT  
ISSUE B

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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