

# QFET<sup>®</sup> MOSFET, N-Channel

## 400 V, 10.5 A, 530 mΩ

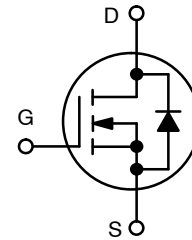
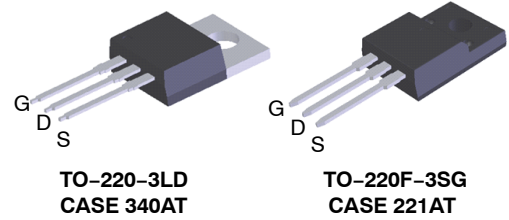
### FQP11N40C, FQPF11N40C

#### Description

This N-Channel enhancement mode power MOSFET is produced using ON Semiconductor 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

- 10.5 A, 400 V,  $R_{DS(on)} = 530 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 5.25 \text{ A}$
- Low Gate Charge (Typ. 28 nC)
- Low  $C_{rss}$  (Typ. 85 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant



#### ORDERING INFORMATION

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

# FQP11N40C, FQPF11N40C

## ORDERING INFORMATION

Device	Device Marking	Package	Shipping
FQP11N40C	FQP11N40C	TO-220 (Pb-Free)	1,000 Units / Tube
FQPF11N40C	FQPF11N40C	TO-220 Fullpack, TO-220F-3SG (Pb-Free)	1,000 Units / Tube

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

Symbol	Parameter	FQP11N40C	FQPF11N40C	Unit
$V_{DSS}$	Drain to Source Voltage	400		V
$I_D$	Drain Current –Continuous ( $T_C = 25^\circ\text{C}$ ) –Continuous ( $T_C = 100^\circ\text{C}$ )	10.5	10.5 *	A
		6.6	6.6 *	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	42	42 *	A
$V_{GSS}$	Gate to Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	360		mJ
$I_{AR}$	Avalanche Current (Note 1)	11		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	13.5		mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ ) – Derate above $25^\circ\text{C}$	135	44	W
		1.07	0.35	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 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.

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2.  $L = 5.7 \text{ mH}$ ,  $I_{AS} = 10.5 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$ ,  $R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 10.5 \text{ A}$ ,  $di/dt \leq 200 \text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

Symbol	Parameter	FQP11N40C	FQPF11N40C	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max	0.93	2.86	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max	62.5	62.5	$^\circ\text{C}/\text{W}$

# FQP11N40C, FQPF11N40C

## 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	400			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.54		V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V			1	μA
		V <sub>DS</sub> = 320 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

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0		4.0	V
r <sub>DS(on)</sub>	Static Drain–Source On–Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 5.25 A		0.43	0.53	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 5.25 A		7.1		s

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz		840	1090	pF
C <sub>oss</sub>	Output Capacitance			250	325	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			85	110	pF

### Switching Characteristics

t <sub>d(on)</sub>	Turn–On Delay Time	V <sub>DD</sub> = 200 V, I <sub>D</sub> = 10.5 A, R <sub>G</sub> = 25 Ω (Note 4)		14	40	ns
t <sub>r</sub>	Turn–On Rise Time			89	190	ns
t <sub>d(off)</sub>	Turn–Off Delay Time			81	170	ns
t <sub>f</sub>	Turn–Off Fall Time			81	170	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 320 V, I <sub>D</sub> = 10.5 A, R <sub>G</sub> = 25 Ω (Note 4)		28	35	nC
Q <sub>gs</sub>	Gate–Source Charge			4		nC
Q <sub>gd</sub>	Gate–Drain Charge			15		nC

### Drain–Source Diode Characteristics and Maximum Ratings

I <sub>S</sub>	Maximum Continuous Drain–Source Diode Forward Current				10.5	A
I <sub>SM</sub>	Maximum Pulsed Drain–Source Diode Forward Current				42	A
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10.5 A			1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10.5 A, dI <sub>F</sub> /dt = 100 A/μs		290		ns
Q <sub>rr</sub>	Reverse Recovery Charge			2.4		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.

# FQP11N40C, FQPF11N40C

## TYPICAL PERFORMANCE CHARACTERISTICS

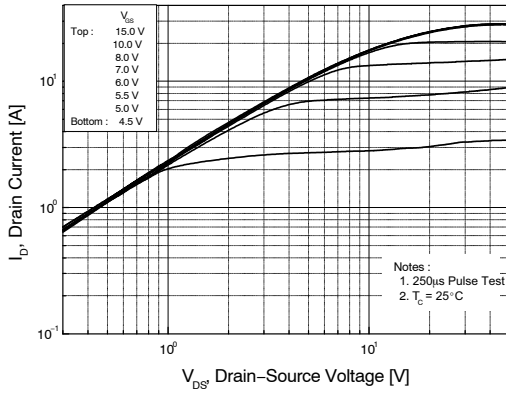


Figure 1. On-Region Characteristics

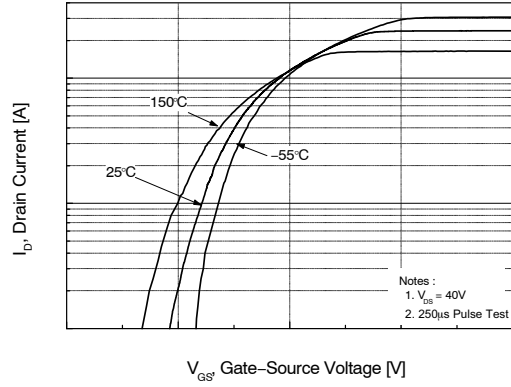


Figure 2. Transfer Characteristics

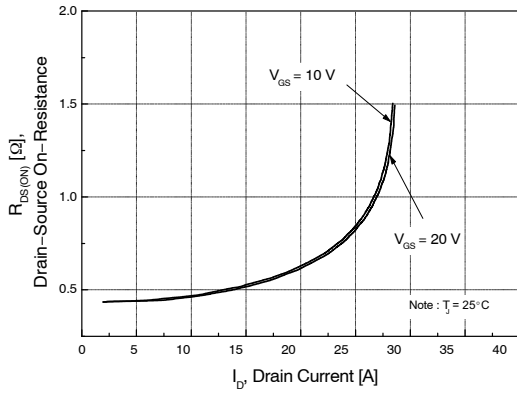


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

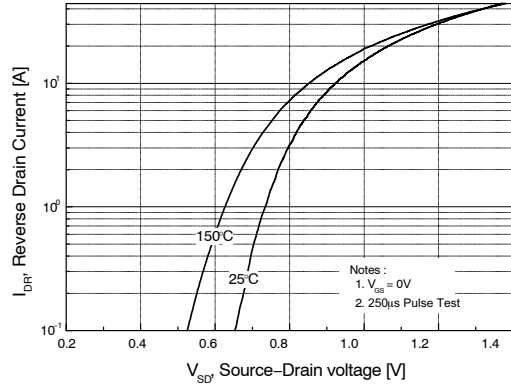


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

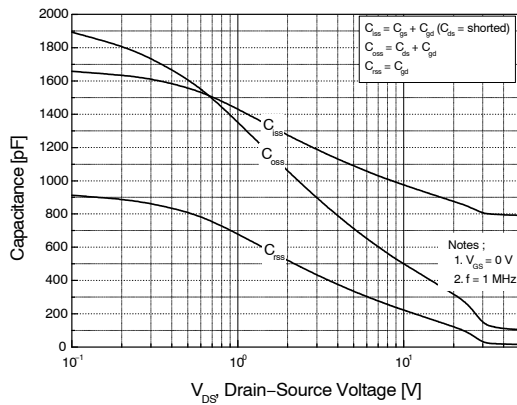


Figure 5. Capacitance Characteristics

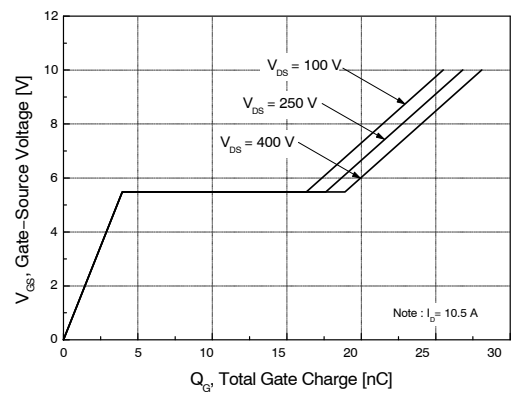
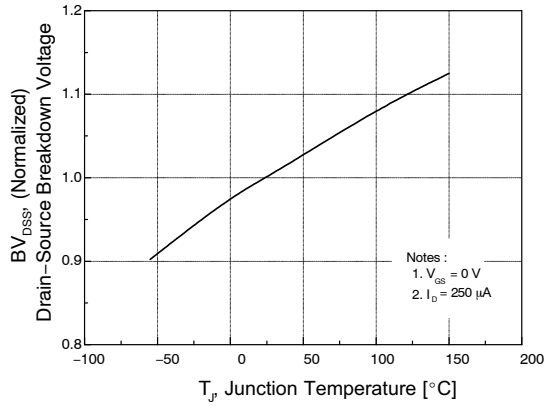


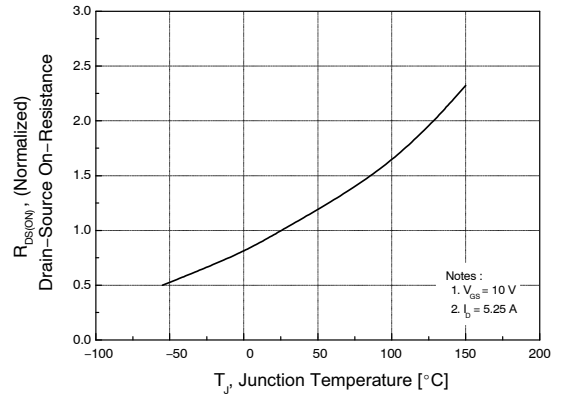
Figure 6. Gate Charge Characteristics

# FQP11N40C, FQPF11N40C

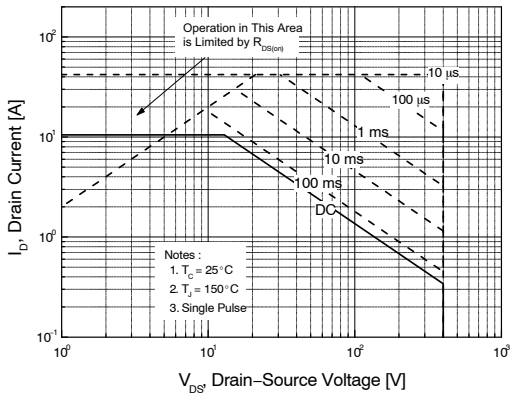
## TYPICAL PERFORMANCE CHARACTERISTICS



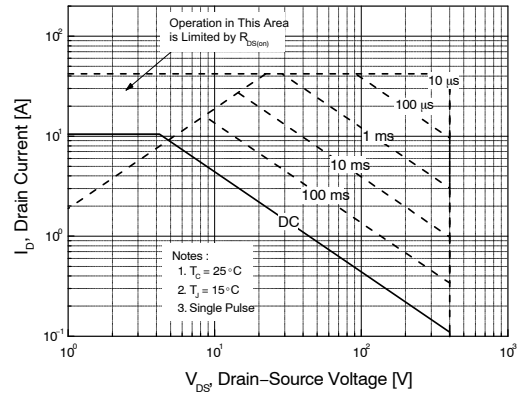
**Figure 7. Breakdown Voltage Variation vs. Temperature**



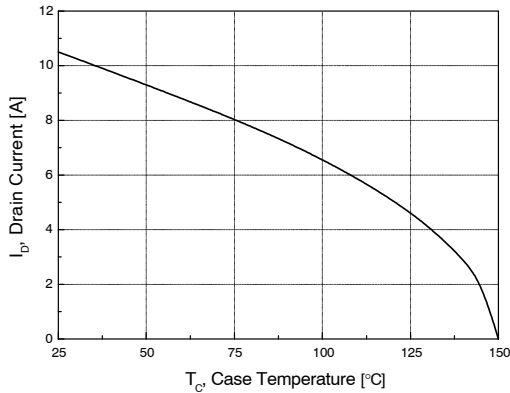
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area of FQP11N40C**



**Figure 10. Maximum Safe Operating Area of FQPF11N40C**



**Figure 11. Maximum Drain Current**

# FQP11N40C, FQPF11N40C

## TYPICAL PERFORMANCE CHARACTERISTICS

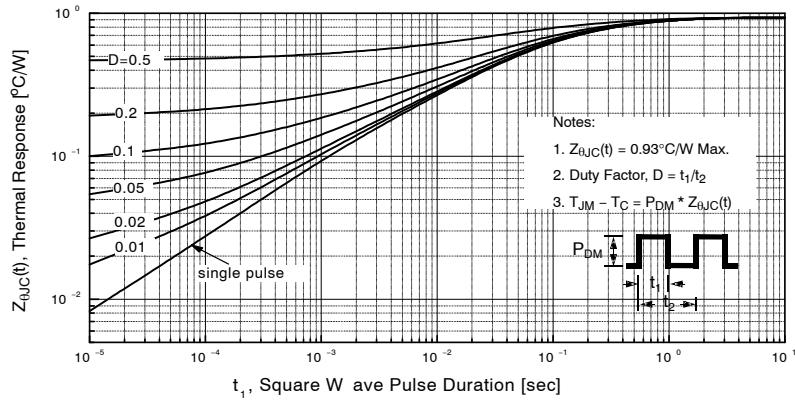


Figure 12. Transient Thermal Response Curve of FQP11N40C

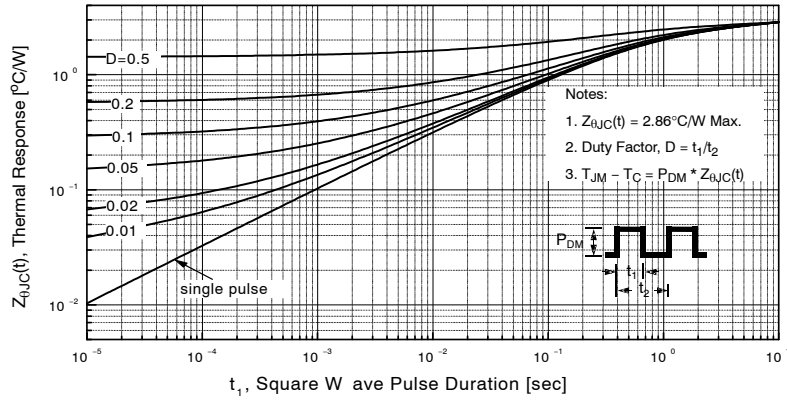


Figure 13. Transient Thermal Response Curve of FQPF11N40C

# FQP11N40C, FQPF11N40C

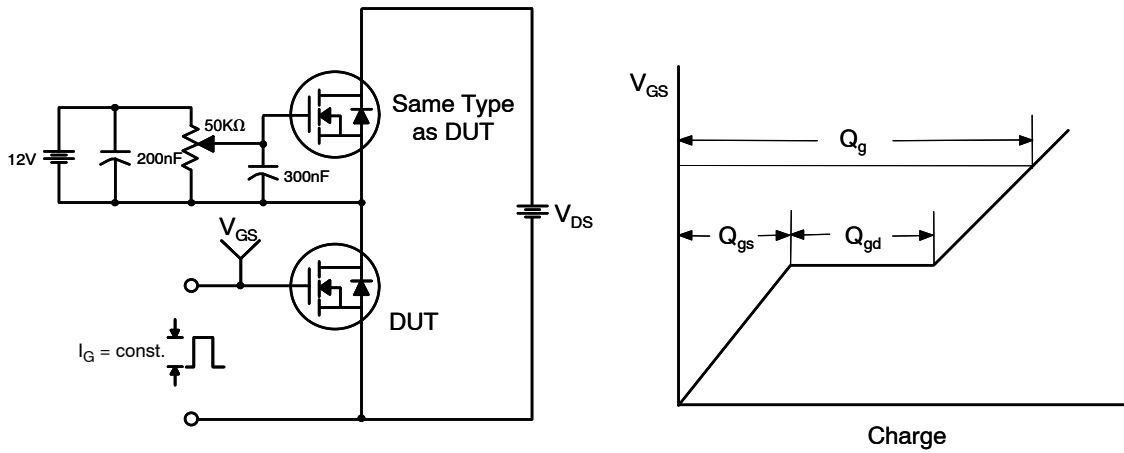


Figure 14. Gate Charge Test Circuit & Waveform

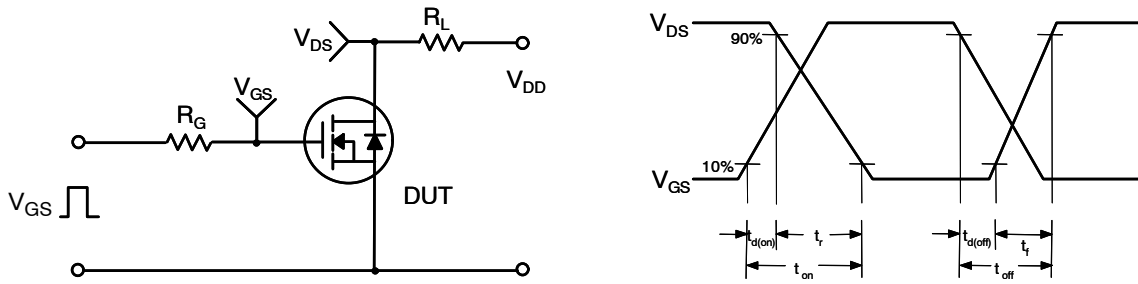


Figure 15. Resistive Switching Test Circuit & Waveforms

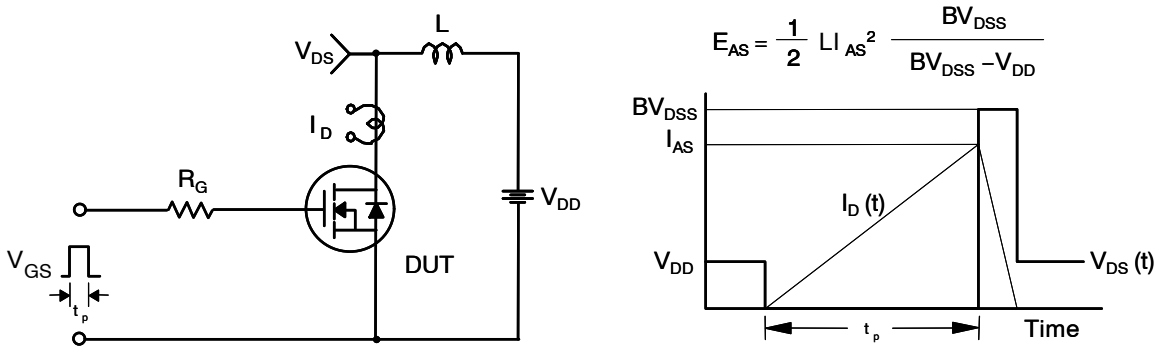


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

# FQP11N40C, FQPF11N40C

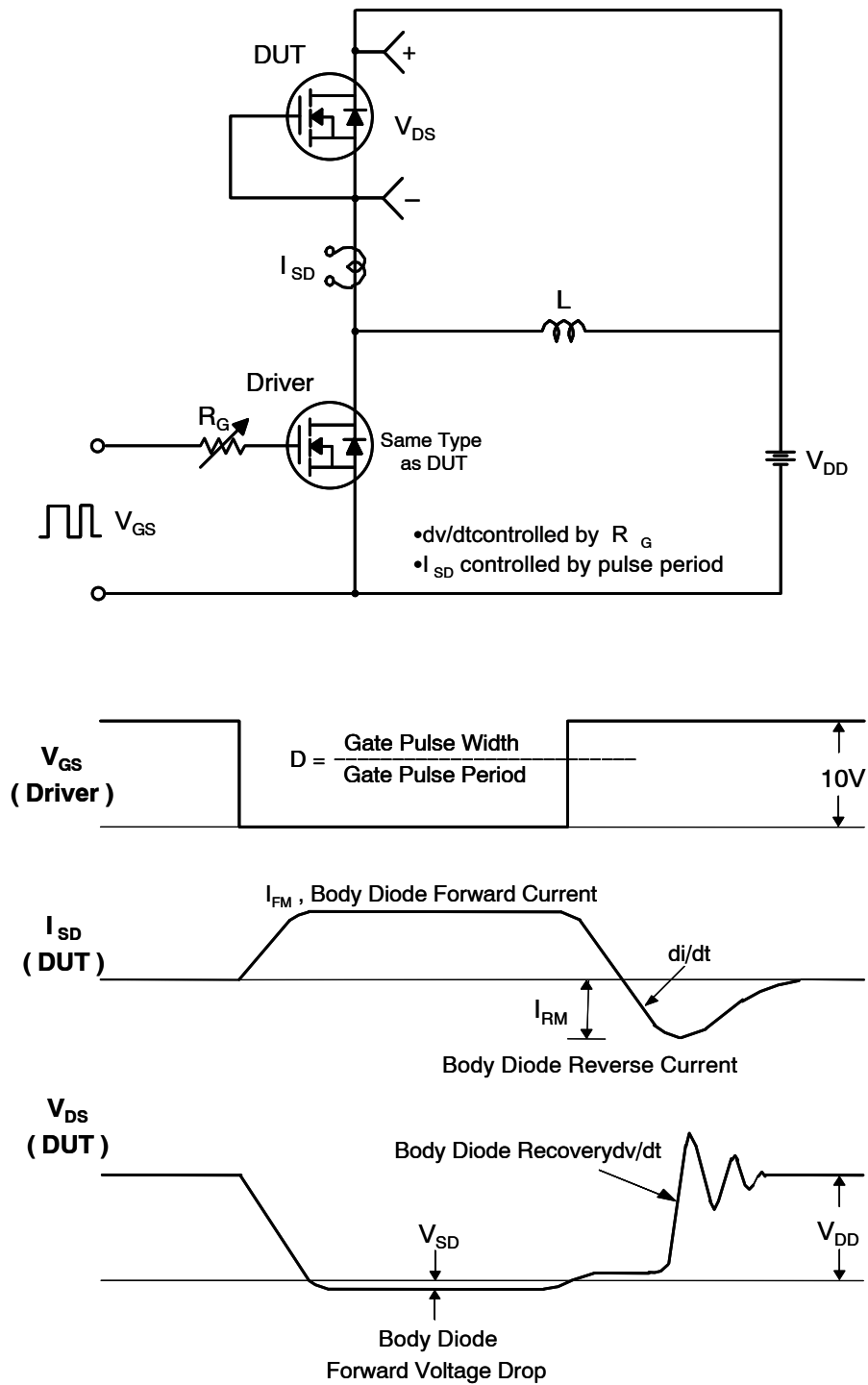


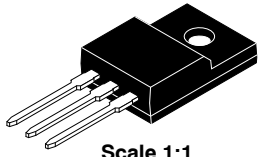
Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

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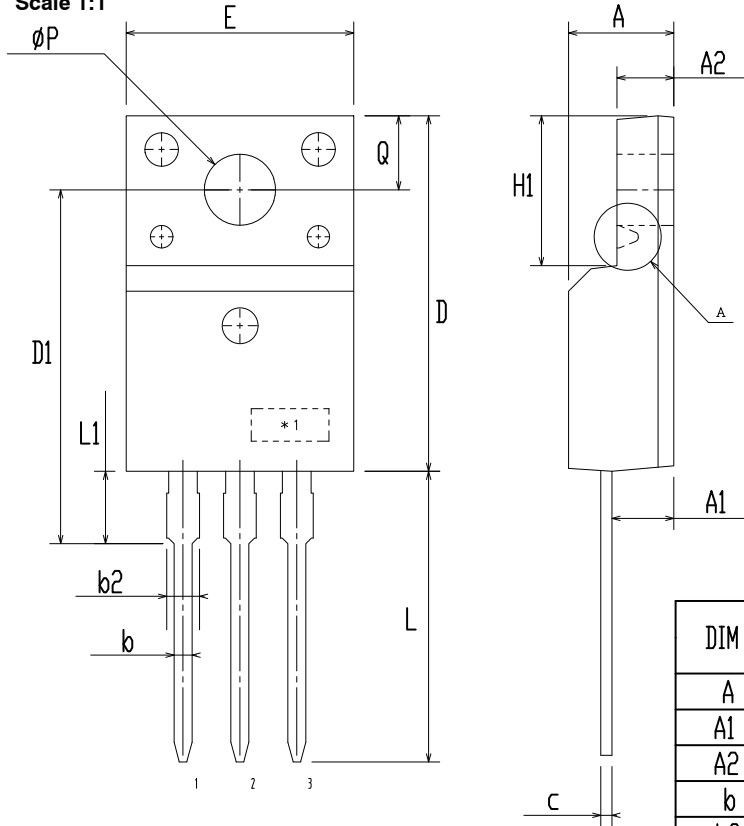


**TO-220 Fullpack, 3-Lead / TO-220F-3SG**  
**CASE 221AT**  
**ISSUE B**

DATE 19 JAN 2021



Scale 1:1



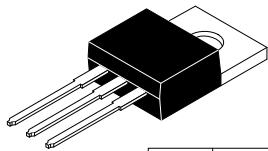
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
∅ P	2.98	3.18	3.38
∅ P1	~	1.00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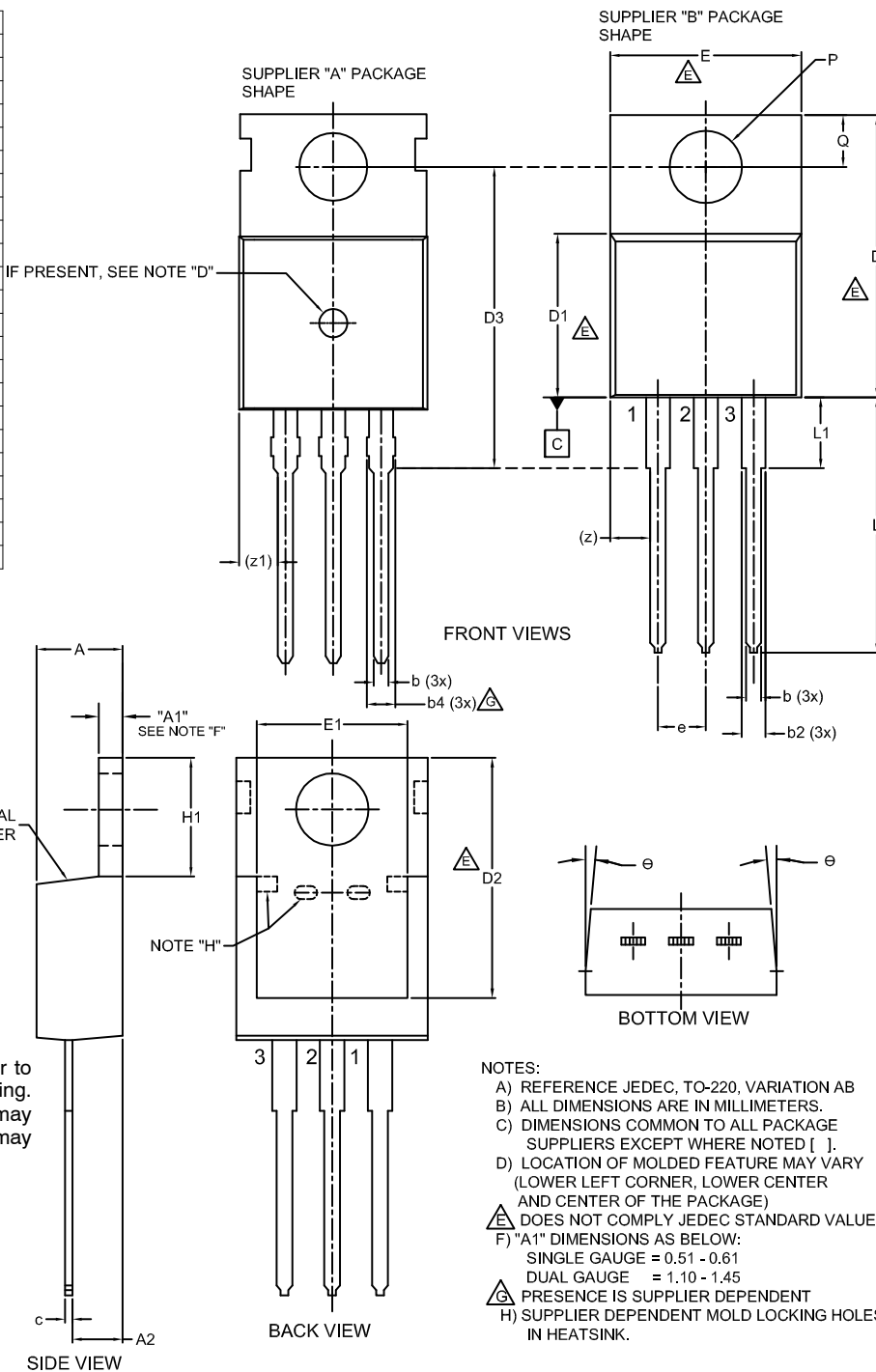
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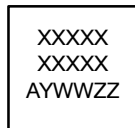
TO-220-3LD  
CASE 340AT  
ISSUE B

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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