

# MOSFET - N-Channel QFET®

600 V, 3.4 Ω, 3.0 A

## FQP3N60C

### General Description

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

- 3.0 A, 600 V,  $R_{DS(on)} = 3.4 \Omega$  (Max.) at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 1.5 \text{ A}$
- Low Gate Charge (Typ. 10.5 nC)
- Low  $C_{rss}$  (Typ. 5.0 pF)
- 100% Avalanche Tested
- This is a Pb-Free Device

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

Symbol	Parameter	Ratings	Unit	
$V_{DSS}$	Drain-Source Voltage	600	V	
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V	
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ\text{C}$ )	3	A
		Continuous ( $T_C = 100^\circ\text{C}$ )	1.8	
$I_{DM}$	Drain Current	Pulsed (Note 1)	12	A
$E_{AS}$	Single Pulse Avalanche Energy (Note 2)	150	mJ	
$I_{AR}$	Avalanche Current (Note 1)	3	A	
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	7.5	mJ	
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns	
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	75	W
		Derate above $25^\circ\text{C}$	0.62	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.

1. Repetitive rating: pulse-width limited by maximum junction temperature
2.  $L = 30 \text{ mH}$ ,  $I_{AS} = 3 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$ ,  $R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 3 \text{ A}$ ,  $di/dt \leq 200 \text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$

### THERMAL CHARACTERISTICS

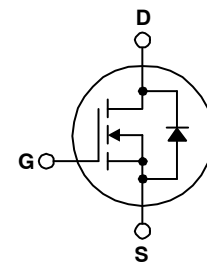
Symbol	Parameter	Ratings	Unit
$R_{\theta JC}$	Maximum Thermal Resistance, Junction to Case	1.67	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Maximum Thermal Resistance, Junction to Ambient	62.5	$^\circ\text{C}/\text{W}$



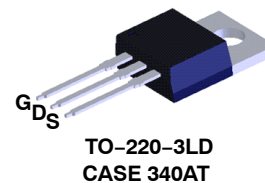
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

$V_{DS}$	$R_{DS(on)} \text{ MAX}$	$I_D \text{ MAX}$
600 V	$3.4 \Omega @ 10 \text{ V}$	3.0 A

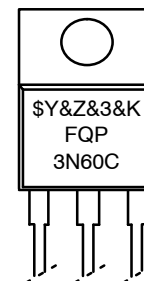


N-Channel MOSFET



TO-220-3LD  
CASE 340AT

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Data Code (Year & Week)  
&K = Lot Code  
FQP3N60C = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping
FQP3N60C	TO-220-3LD (Pb-Free)	50 Units/Tube

# FQP3N60C

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
--------	-----------	----------------	------	------	------	------

### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	600	–	–	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	–	0.6	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V	–	–	1	μA
		V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125 °C	–	–	10	
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>GS</sub> = V <sub>DS</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> = 1.5 A	–	2.8	3.4	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 1.5 A	–	3.5	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	435	565	pF
C <sub>oss</sub>	Output Capacitance		–	45	60	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		–	5	8	pF

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 3 A, R <sub>G</sub> = 25 Ω (Note 4)	–	12	34	ns
t <sub>r</sub>	Turn–On Rise Time		–	30	70	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	35	80	ns
t <sub>f</sub>	Turn–Off Fall Time		–	35	80	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 3 A, V <sub>GS</sub> = 10 V (Note 4)	–	10.5	14	nC
Q <sub>gs</sub>	Gate–Source Charge		–	2.1	–	nC
Q <sub>gd</sub>	Gate–Drain Charge		–	4.5	–	nC

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

I <sub>S</sub>	Maximum Continuous Drain–Source Diode Forward Current		–	–	3	A
I <sub>SM</sub>	Maximum Pulsed Drain–Source Diode Forward Current		–	–	12	A
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3 A	–	–	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3 A, dI <sub>F</sub> /dt = 100 A/μs	–	260	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	1.6	–	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.

# FQP3N60C

## TYPICAL PERFORMANCE CHARACTERISTICS

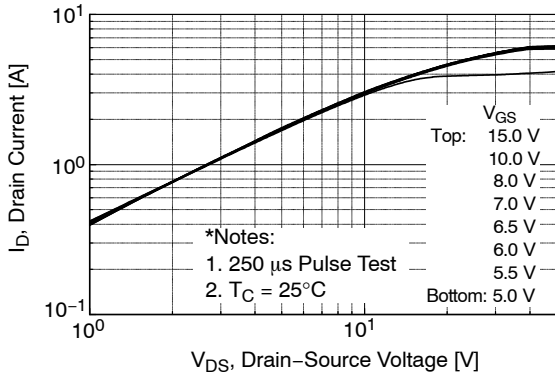


Figure 1. On-Region Characteristics

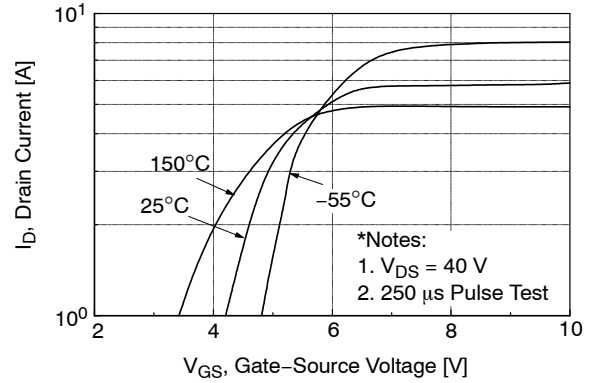


Figure 2. Transfer Characteristics

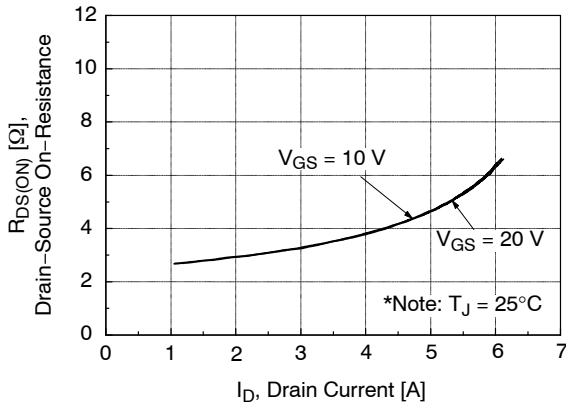


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

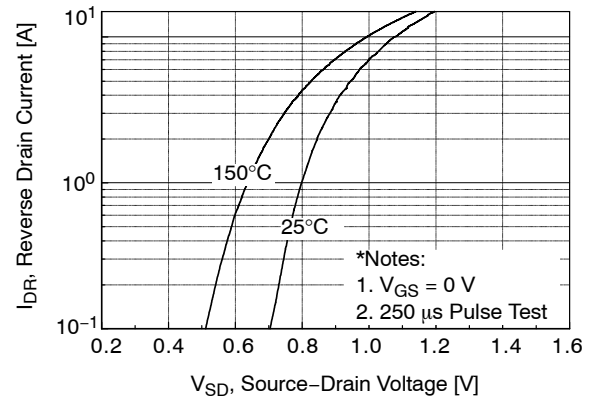


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

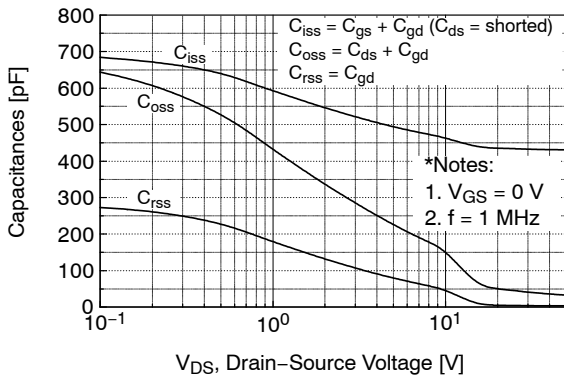


Figure 5. Capacitance Characteristics

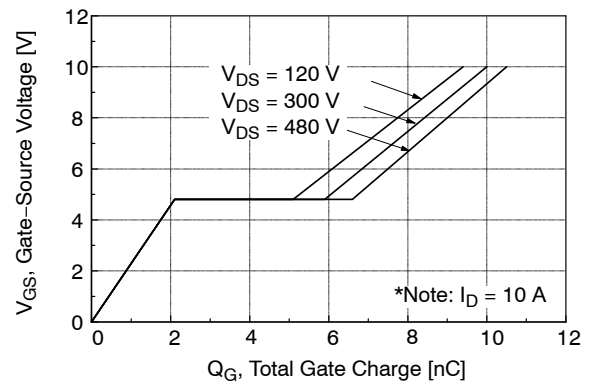
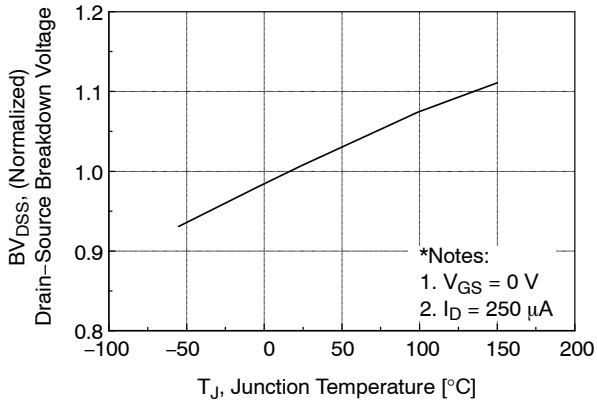


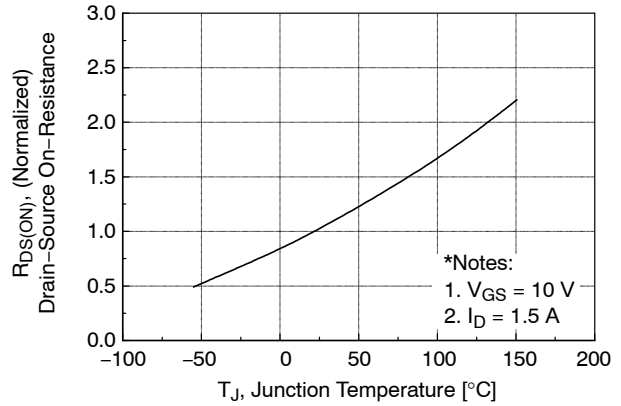
Figure 6. Gate Charge Characteristics

# FQP3N60C

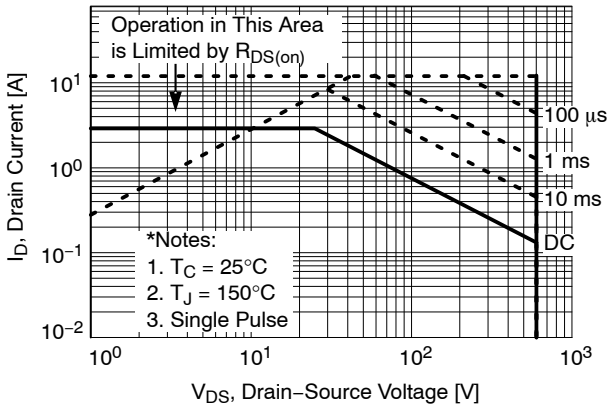
## TYPICAL PERFORMANCE CHARACTERISTICS



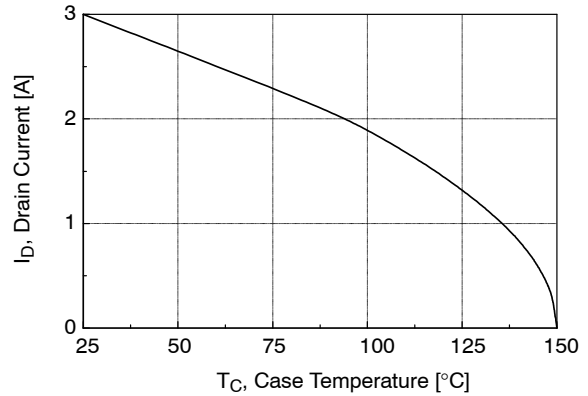
**Figure 7. Breakdown Voltage Variation vs. Temperature**



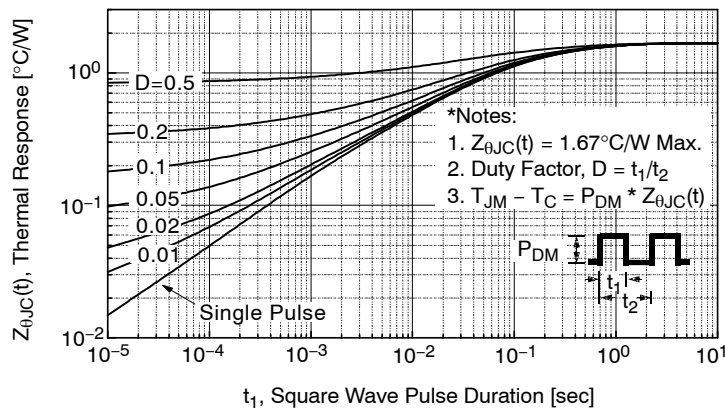
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum Drain Current vs. Case Temperature**



**Figure 11. Transient Thermal Response Curve**

# FQP3N60C

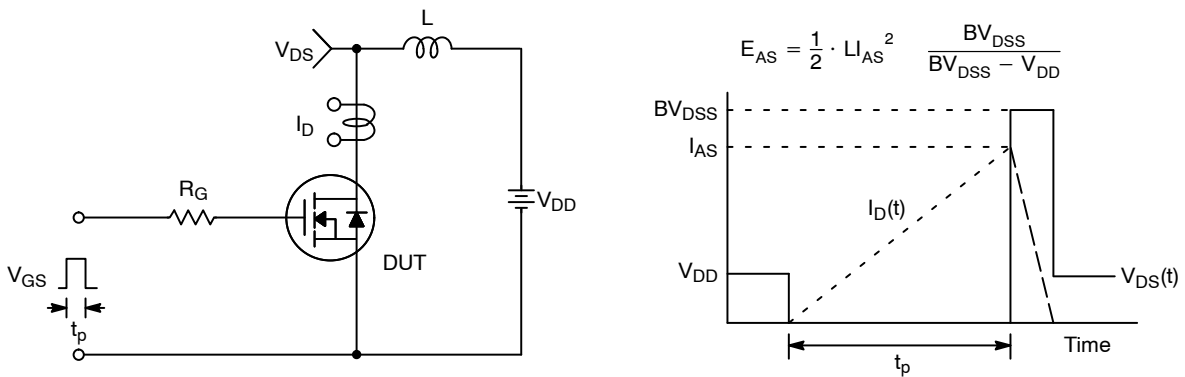
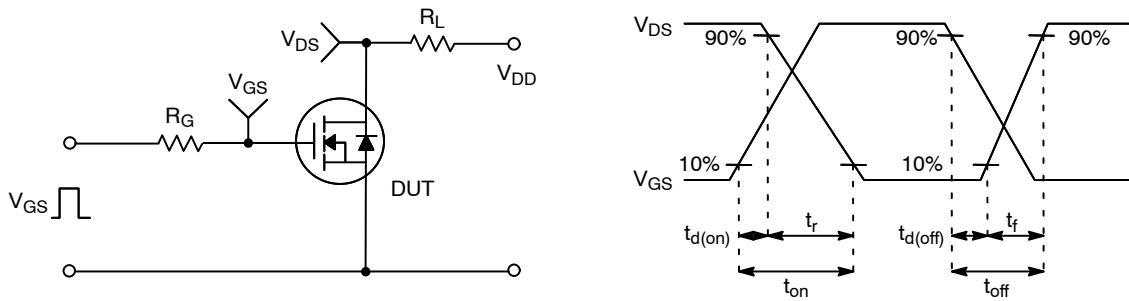
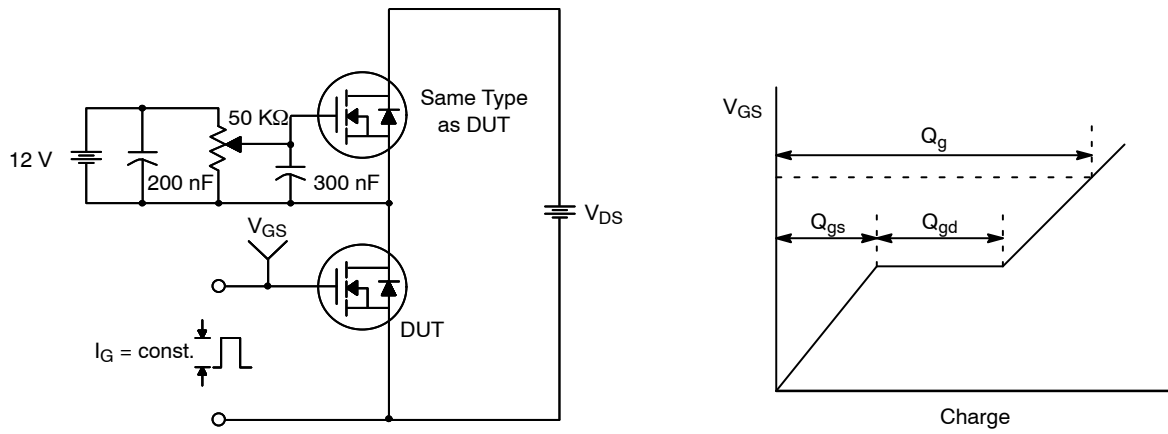
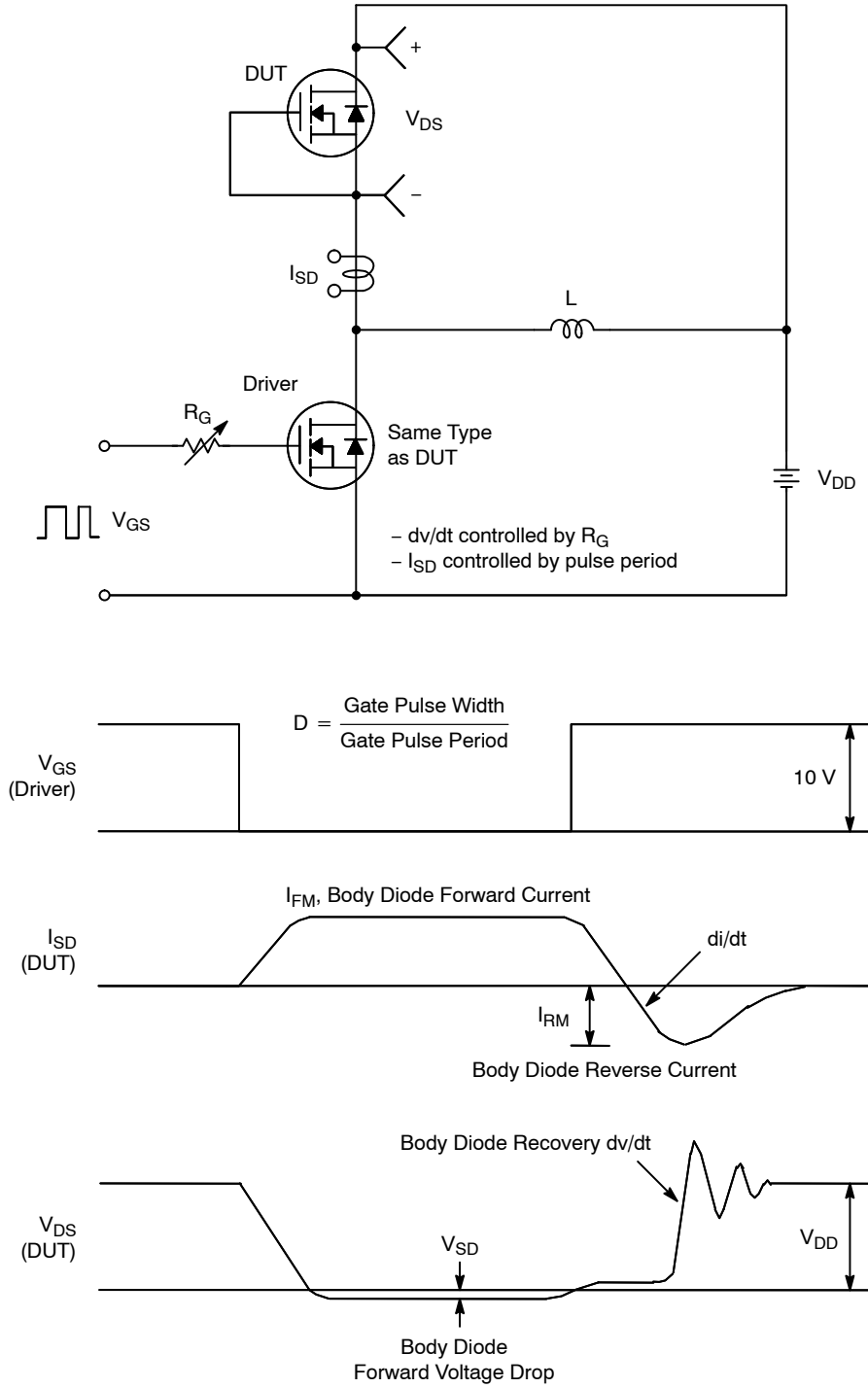


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

# FQP3N60C

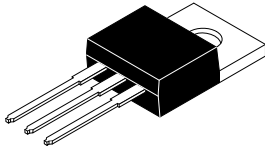


**Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

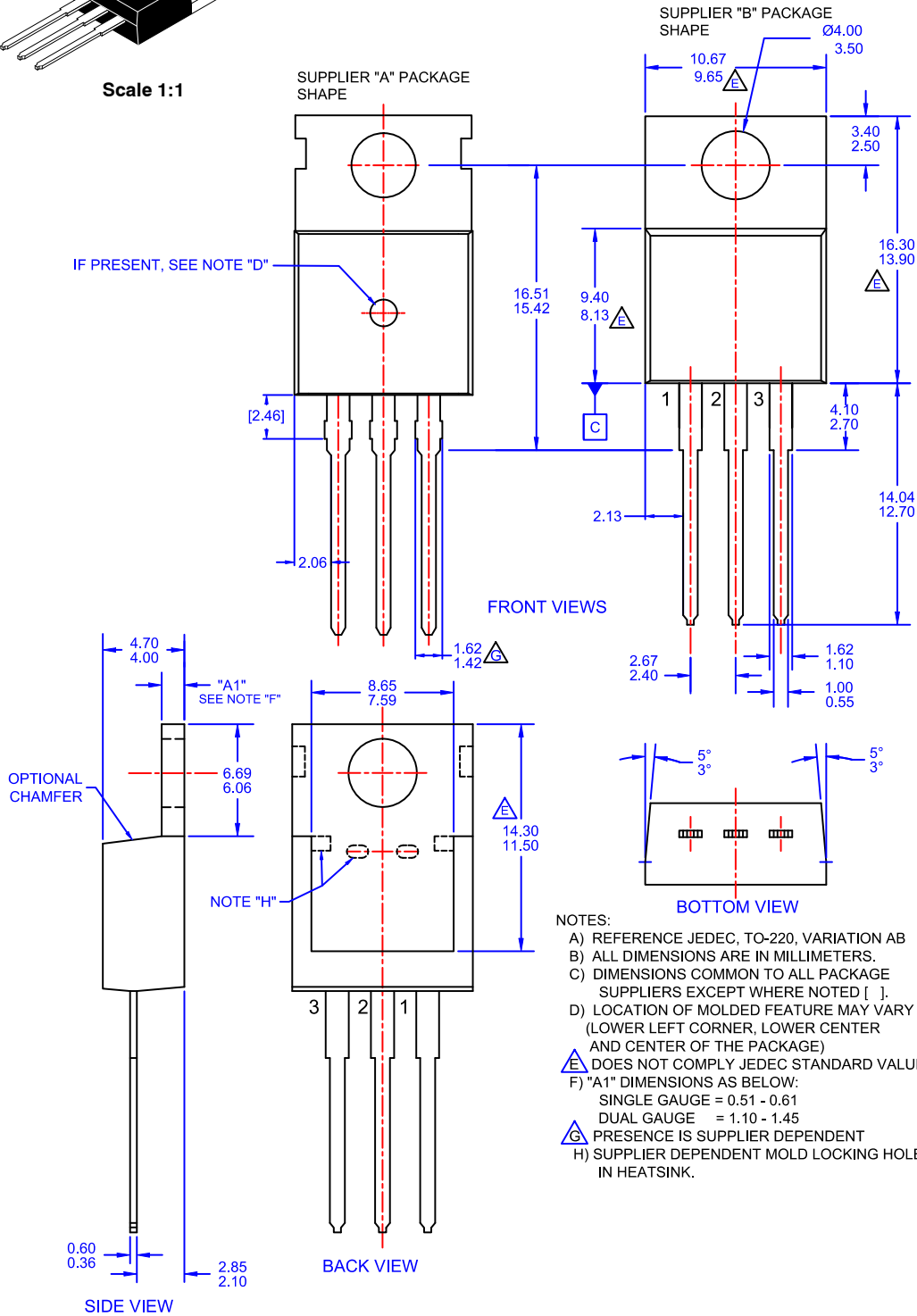
ON Semiconductor®



Scale 1:1

### TO-220-3LD CASE 340AT ISSUE A

DATE 03 OCT 2017



- 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)
  - E) DOES NOT COMPLY JEDEC STANDARD VALUE.
  - F) "A1" DIMENSIONS AS BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.10 - 1.45
  - G) PRESENCE IS SUPPLIER DEPENDENT
  - H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

<b>DOCUMENT NUMBER:</b>	<b>98AON13818G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>TO-220-3LD</b>	<b>PAGE 1 OF 1</b>

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)