

# MOSFET – N-Channel, QFET®

**600 V, 1.9 A, 4,7 Ω**

## FQD2N60C / FQU2N60C

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

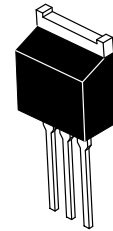
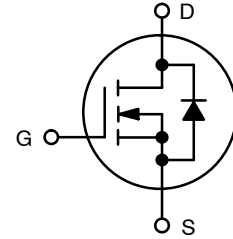
- 1.9 A, 600 V,  $R_{DS(on)} = 4.7 \Omega$  (Max.) @  $V_{GS} = 10$  V,  $I_D = 0.95$  A
- Low Gate Charge (Typ. 8.5 nC)
- Low  $C_{rss}$  (Typ. 4.3 pF)
- 100% Avalanche Tested
- These Devices are Halid Free and are RoHS Compliant

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

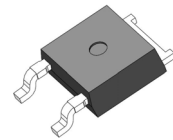
Symbol	Rating	Value	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ ) – Continuous ( $T_C = 100^\circ\text{C}$ )	1.9	A
		1.14	
$I_{DM}$	Drain Current – Pulsed (Note 1)	7.6	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	120	mJ
$I_{AR}$	Avalanche Current (Note 1)	1.9	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	4.4	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) * – Derate above $25^\circ\text{C}$	2.5	W
		44 0.35	W 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 Purposes, 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.

$V_{DSS}$	$R_{DS(ON)}$ MAX	$I_D$ MAX
600 V	4.7 $\Omega$ @ 10 V	1.9 A

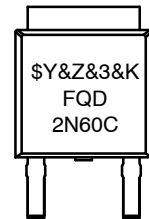
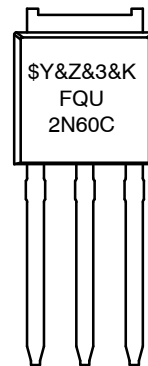


DPAK3 (IPAK)  
CASE 369AR



DPAK3 (TO-252 3 LD)  
CASE 369AS

### MARKING DIAGRAMS



FQD2N60C,  
FQU2N60C = Device Code  
 \$Y = onsemi Logo  
 &Z = Assembly Location  
 &3 = Date Code  
 &K = Lot Run Traceability Code

### ORDERING INFORMATION

Device	Package	Shipping†
FQD2N60CTM	DPAK3 (TO-252 3 LD) (Pb-Free)	2500 / Tape & Reel
FQU2N60CTU	DPAK3 (IPAK) (Pb-Free)	70 Units / Tube

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

# FQD2N60C / FQU2N60C

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	2.87	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (minimum pad of 2 oz copper), Max.	110	$^{\circ}\text{C}/\text{W}$
	Thermal Resistance, Junction-to-Ambient (* 1 in <sup>2</sup> pad of 2 oz copper), Max.	50	

## ELECTRICAL CHARACTERISTICS ( $T_C = 25^{\circ}\text{C}$ unless otherwise specified)

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

$BV_{DSS}$	Drain-to-Source Breakdown Voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0 \text{V}$	600	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^{\circ}\text{C}$	-	0.6	-	$\text{V}/^{\circ}\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600 \text{V}, V_{GS} = 0 \text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480 \text{V}, T_C = 125^{\circ}\text{C}$	-	-	10	
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30 \text{V}, V_{DS} = 0 \text{V}$	-	-	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30 \text{V}, V_{DS} = 0 \text{V}$	-	-	-100	nA

### ON CHARACTERISTICS

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10 \text{V}, I_D = 0.95 \text{A}$	-	3.6	4.7	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40 \text{V}, I_D = 0.95 \text{A}$	-	5.0	-	S

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 25 \text{V}, V_{GS} = 0 \text{V}, f = 1.0 \text{MHz}$	-	180	235	pF
$C_{oss}$	Output Capacitance		-	20	25	
$C_{rss}$	Reverse Transfer Capacitance		-	4.3	5.6	

### SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300 \text{V}, I_D = 2 \text{A}, R_G = 25 \Omega$ (Note 4)	-	9	28	ns
$t_r$	Turn-On Rise Time		-	25	60	
$t_{d(off)}$	Turn-Off Delay Time		-	24	58	
$t_f$	Turn-Off Fall Time		-	28	66	
$Q_g$	Total Gate Charge	$V_{DS} = 480 \text{V}, I_D = 2 \text{A}, V_{GS} = 10 \text{V}$ (Note 4)	-	8.5	12	nC
$Q_{gs}$	Gate-Source Charge		-	1.3	-	
$Q_{gd}$	Gate-Drain Charge		-	4.1	-	

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

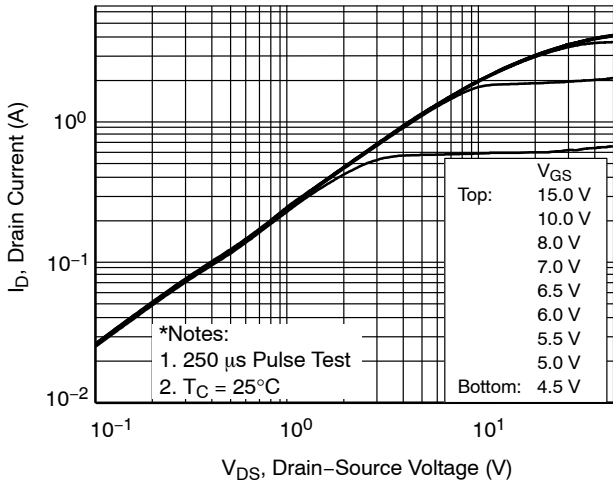
$I_S$	Maximum Continuous Drain-Source Diode Forward Current	-	-	1.9	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	-	-	7.6	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{V}, I_S = 1.6 \text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0 \text{V}, I_S = 2 \text{A}, di/dt = 100 \text{A}/\mu\text{s}$	-	230	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	1.0	-	$\mu\text{C}$

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.

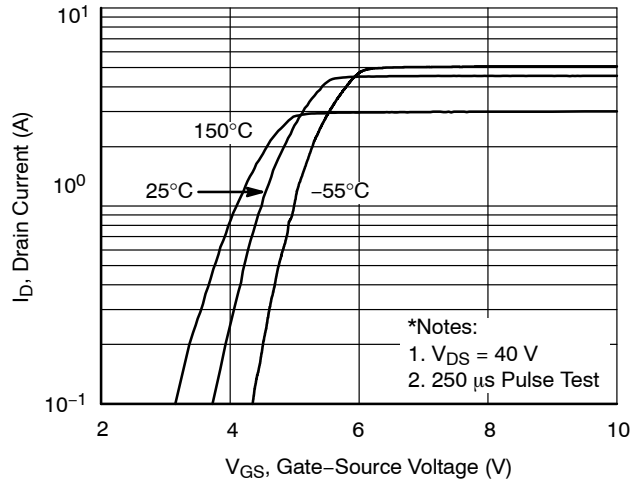
1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2.  $L = 56 \text{mH}, I_{AS} = 2 \text{A}, V_{DD} = 50 \text{V}, R_G = 25 \Omega$ , Starting  $T_J = 25^{\circ}\text{C}$ .
3.  $I_{SD} \leq 2.0 \text{A}, di/dt \leq 200 \text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^{\circ}\text{C}$ .
4. Essentially independent of operating temperature.

# FQD2N60C / FQU2N60C

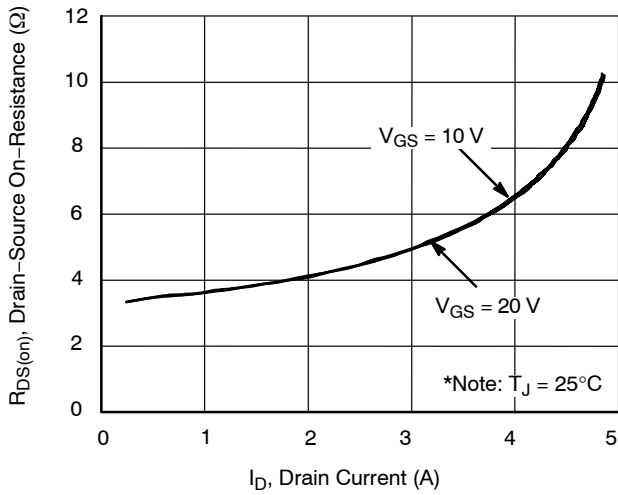
## TYPICAL CHARACTERISTICS



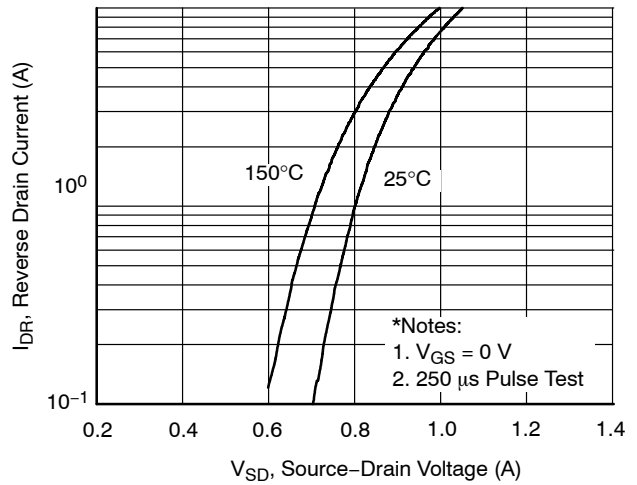
**Figure 1. On-Region Characteristics**



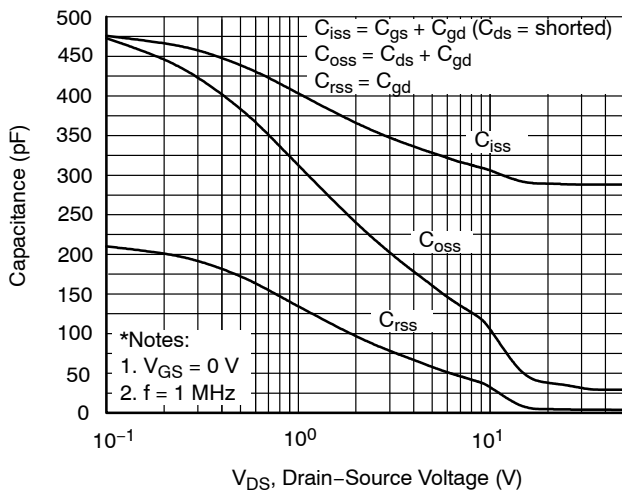
**Figure 2. Transfer Characteristics**



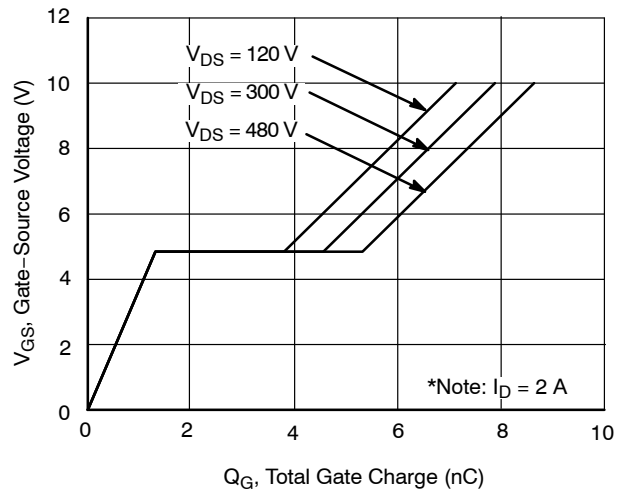
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



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



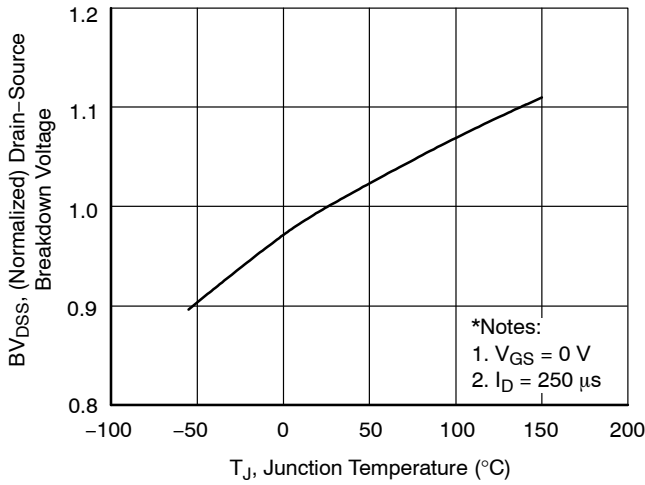
**Figure 5. Capacitance Characteristics**



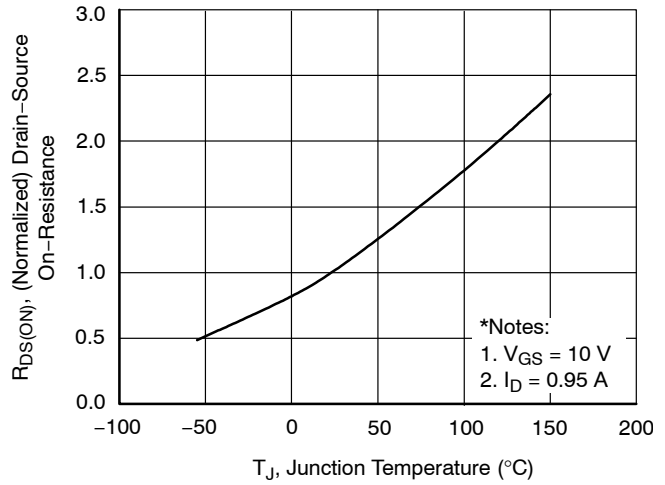
**Figure 6. Gate Charge Characteristics**

# FQD2N60C / FQU2N60C

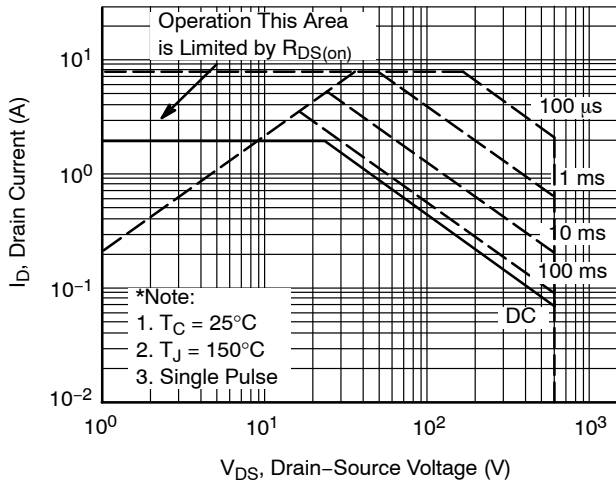
## TYPICAL CHARACTERISTICS (continued)



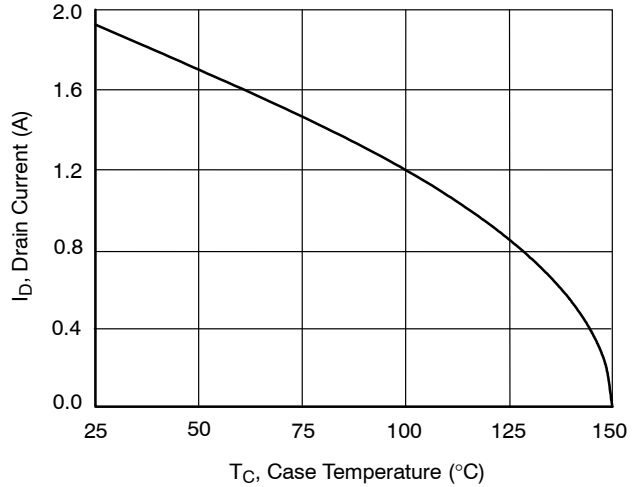
**Figure 7. Breakdown Voltage Variation vs. Temperature**



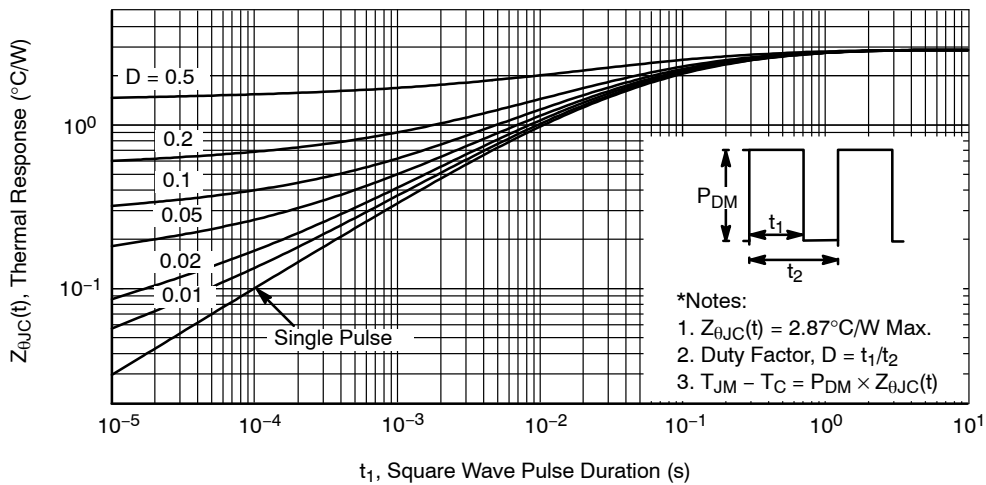
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

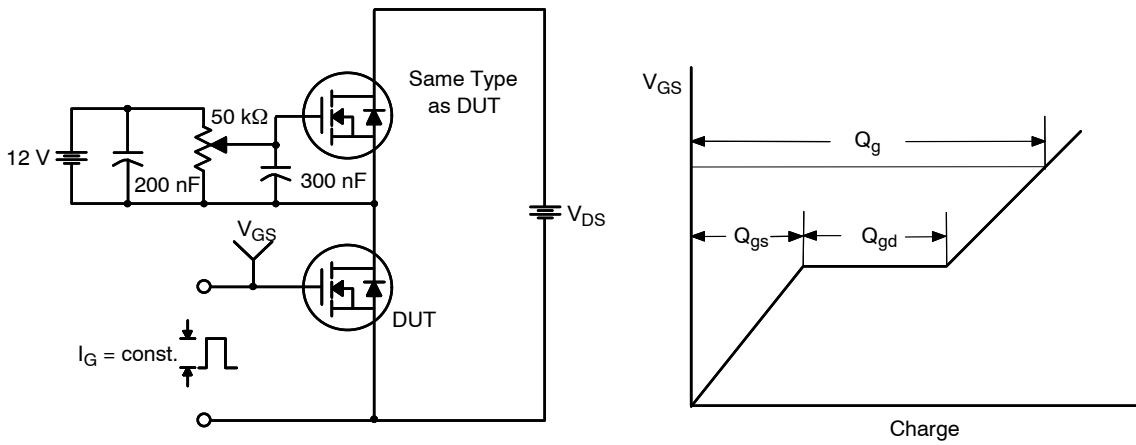


**Figure 10. Maximum Drain Current vs. Case Temperature**

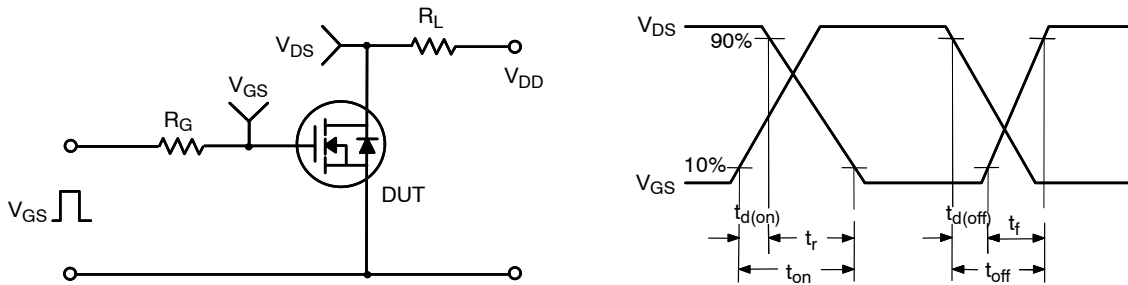


**Figure 11. Transient Thermal Response Curve**

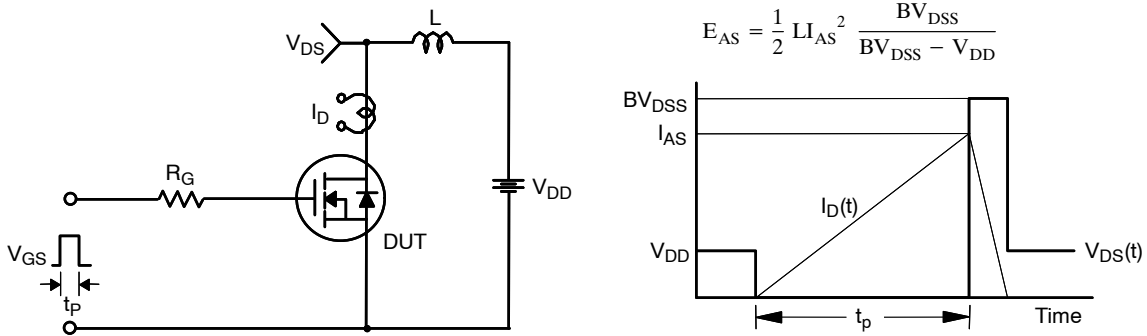
## FQD2N60C / FQU2N60C



**Figure 12. Gate Charge Test Circuit & Waveform**

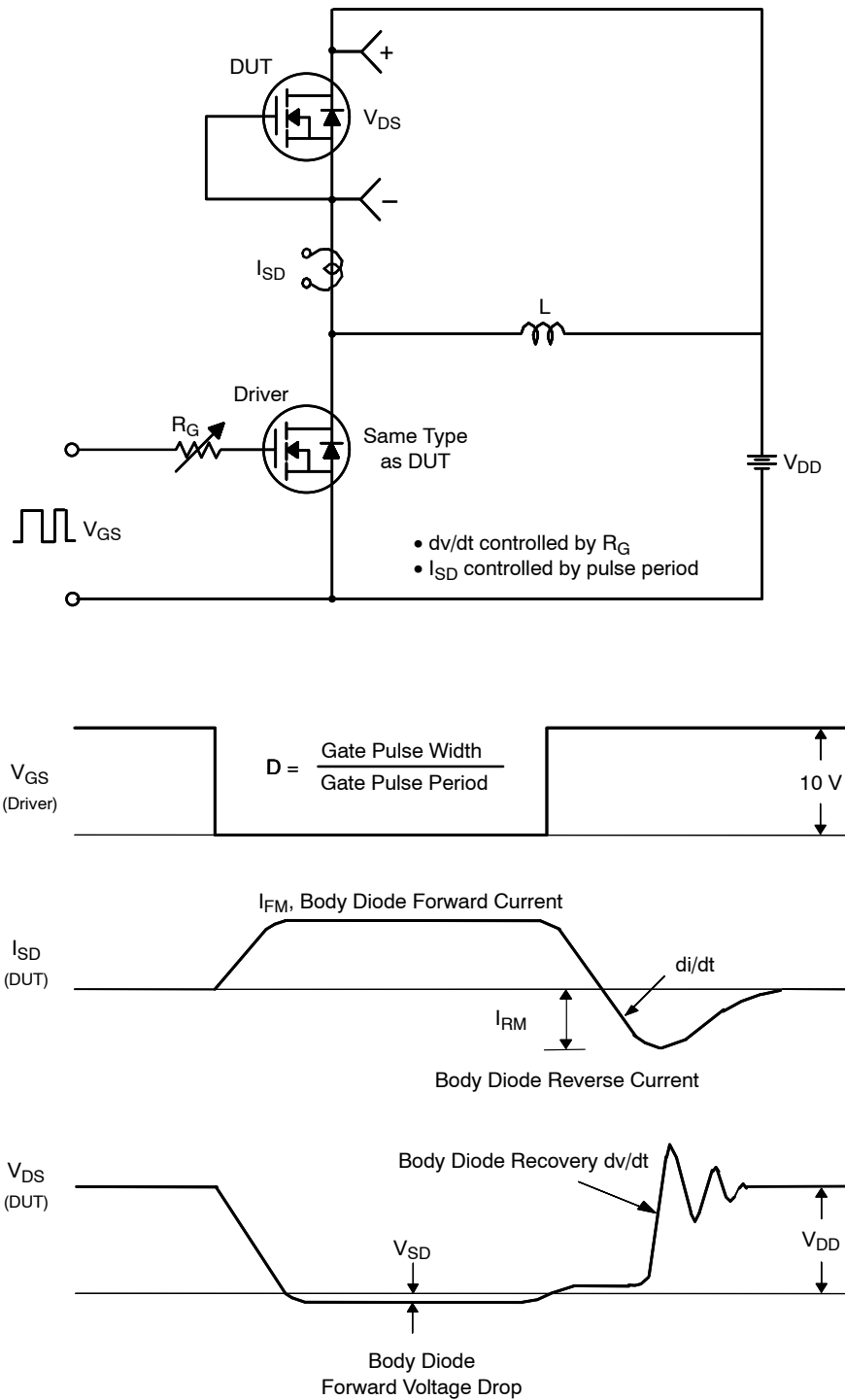


**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

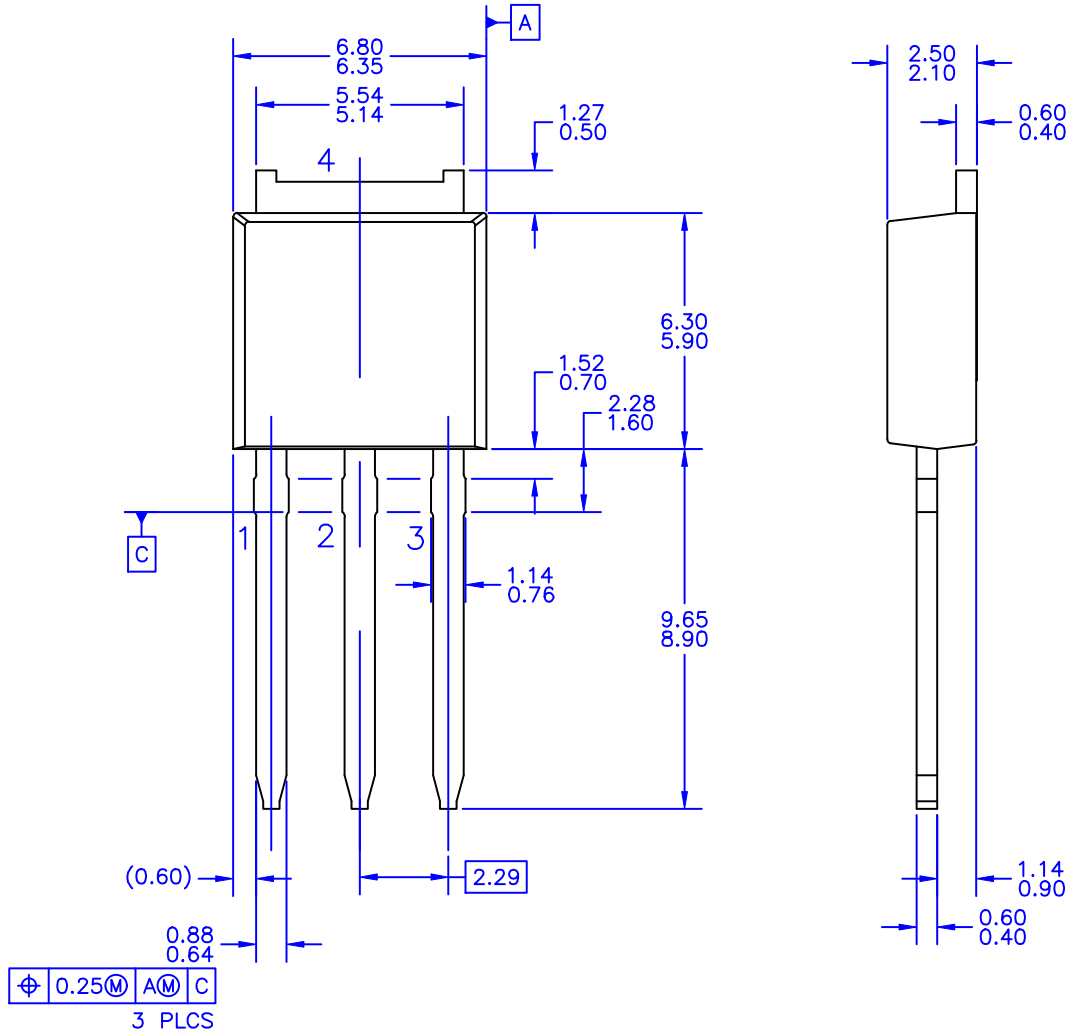
# FQD2N60C / FQU2N60C



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

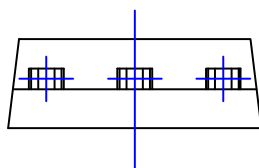
**DPAK3 (IPAK)**  
CASE 369AR  
ISSUE O

DATE 30 SEP 2016



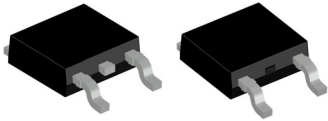
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- B) THIS PACKAGE CONFORMS TO JEDEC, TO-251, ISSUE C, VARIATION AA, DATED SEP 1988.
- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.



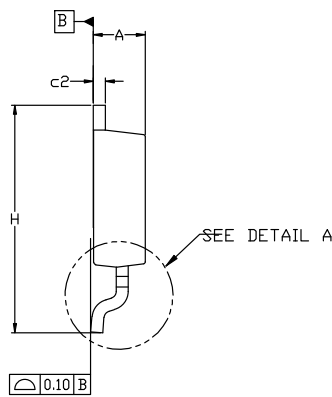
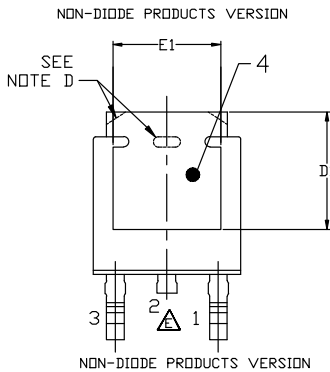
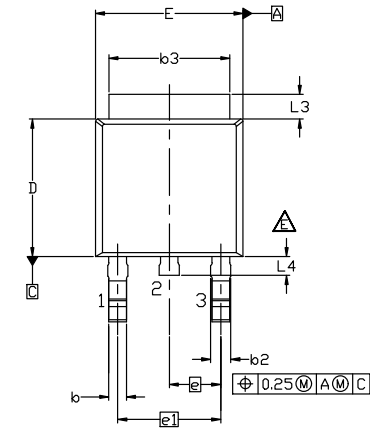
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<b>DESCRIPTION:</b>	<b>DPAK3 (IPAK)</b>	<b>PAGE 1 OF 1</b>

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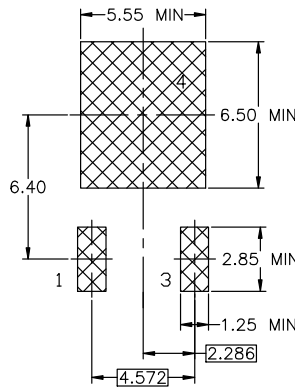
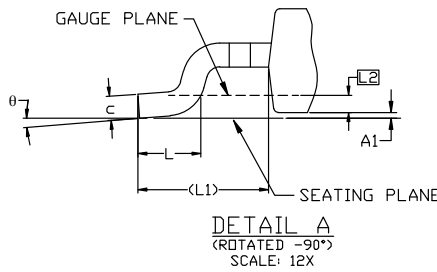


**DPAK3 6.10x6.54x2.29, 4.57P  
CASE 369AS  
ISSUE B**

DATE 20 DEC 2023



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 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.  
 D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.  
 E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.  
 F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.  
 G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.

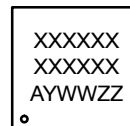


**LAND PATTERN RECOMMENDATION**

\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	2.18	2.29	2.39
A1	0.00	-	0.127
b	0.64	0.77	0.89
b2	0.76	0.95	1.14
b3	5.21	5.34	5.46
c	0.45	0.53	0.61
c2	0.45	0.52	0.58
D	5.97	6.10	6.22
D1	5.21	---	---
E	6.35	6.54	6.73
E1	4.32	---	---
e	2.286 BSC		
e1	4.572 BSC		
H	9.40	9.91	10.41
L	1.40	1.59	1.78
L1	2.90 REF		
L2	0.51 BSC		
L3	0.89	1.08	1.27
L4	---	---	1.02
θ	0°	---	10°

**GENERIC MARKING DIAGRAM\***



\*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.

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

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