

# MOSFET – N-Channel, QFET

600 V, 7.4 A, 1.0 Ω

## FQB7N60, FQI7N60

### 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

- 7.4 A, 600 V,  $R_{DS(on)}$  = 1.0 Ω (Max.) @  $V_{GS}$  = 10 V,  $I_D$  = 3.7 A
- Low Gate Charge (Typ. 29 nC)
- Low  $C_{rss}$  (Typ. 16 pF)
- 100% Avalanche Tested
- This Device is Pb-Free, Halide Free and is RoHS Compliant

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

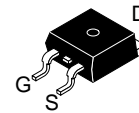
Symbol	Parameter	FQB7N60TM FQI7N60TU	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ ) – Continuous ( $T_C = 100^\circ\text{C}$ )	7.4	A
		4.7	A
$I_{DM}$	Drain Current – Pulsed (Note 1)	29.6	A
$V_{GSS}$	Gate-Source Voltage	±30	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	580	mJ
$I_{AR}$	Avalanche Current (Note 1)	7.4	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	14.2	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) * Power Dissipation ( $T_C = 25^\circ\text{C}$ ) – Derate above $25^\circ\text{C}$	3.13	W
		142	W
		1.14	W/°C
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	°C
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	°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.

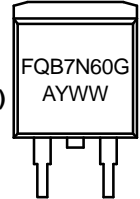
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $L = 19.5$  mH,  $I_{AS} = 7.4$  A,  $V_{DD} = 50$  V,  $R_G = 25$  Ω, starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 7.4$  A,  $di/dt \leq 200$  A/μs,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .

$V_{DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
600 V	1.0 Ω @ 10 V	7.4 A

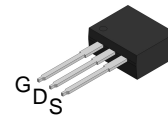
### MARKING DIAGRAM



D<sup>2</sup>PAK-3  
(TO-263, 3-LEAD)  
CASE 418AJ



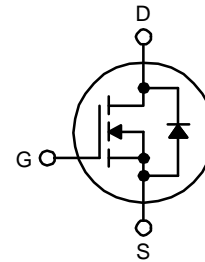
FQB7N60 = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package



I2PAK  
(TO-262 3 LD)  
CASE 418AV

&Z&3&K  
FQI  
7N60

&Z = Assembly Plant Code  
&3 = 3-Digit Date Code  
&K = 2-Digits Lot Run Traceability Code  
FQI7N60 = Device Code



N-Channel MOSFET

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

# FQB7N60, FQI7N60

## THERMAL CHARACTERISTICS

Symbol	Parameter	FQB7N60TM FQI7N60TU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.88	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	62.5	
	Thermal Resistance, Junction to Ambient (*1 in <sup>2</sup> Pad of 2-oz Copper), Max.	40	

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

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

$BV_{DSS}$	Drain–Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	600	–	–	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to 25°C	–	0.67	–	V/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	–	–	10	μA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	–	–	100	μA
$I_{GSSF}$	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	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	–	5.0	V
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 3.7\text{ A}$	–	0.8	1.0	Ω
$g_{FS}$	Forward Transconductance	$V_{DS} = 50\text{ V}, I_D = 3.7\text{ A}$	–	6.4	–	S

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	–	1100	1430	pF
$C_{oss}$	Output Capacitance		–	135	175	pF
$C_{rss}$	Reverse Transfer Capacitance		–	16	21	pF

### SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 300\text{ V}, I_D = 7.4\text{ A}, R_G = 25\ \Omega$ (Note 4)	–	30	70	ns
$t_r$	Turn–On Rise Time		–	80	170	ns
$t_{d(off)}$	Turn–Off Delay Time		–	65	140	ns
$t_f$	Turn–Off Fall Time		–	60	130	ns
$Q_g$	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 7.4\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	–	29	38	nC
$Q_{gs}$	Gate–Source Charge		–	7	–	nC
$Q_{gd}$	Gate–Drain Charge		–	14.5	–	nC

### DRAIN–SOURCE CHARACTERISTICS

$I_S$	Maximum Continuous Drain–Source Diode Forward Current	–	–	7.4	A	
$I_{SM}$	Maximum Pulsed Drain–Source Diode Forward Current	–	–	29.6	A	
$V_{SD}$	Drain–Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 7.4\text{ A}$	–	–	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 7.4\text{ A},$ $dI_F / dt = 100\text{ A}/\mu\text{s}$	–	320	–	ns
$Q_{rr}$	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.

TYPICAL CHARACTERISTICS

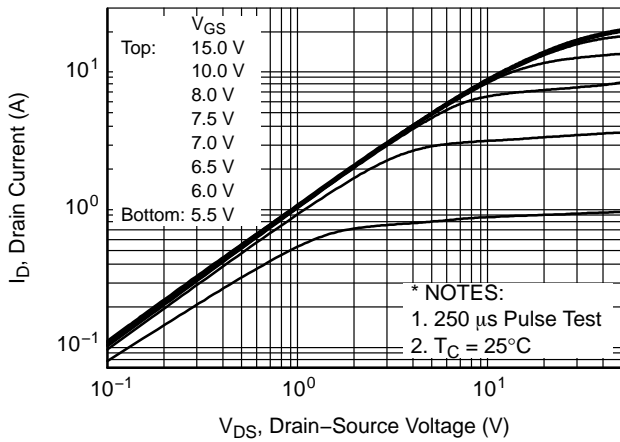


Figure 1. On-Region Characteristics

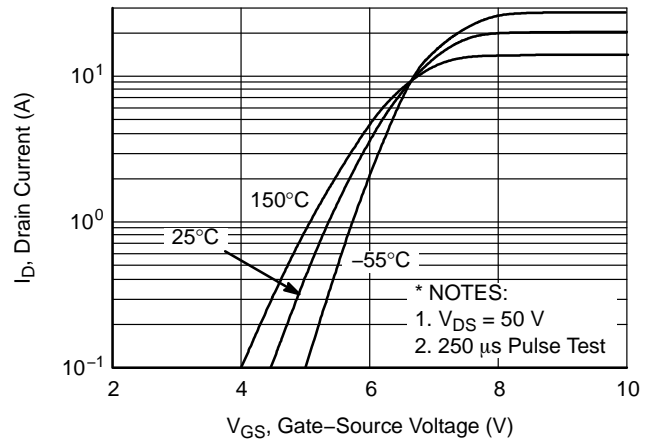


Figure 2. Transfer Characteristics

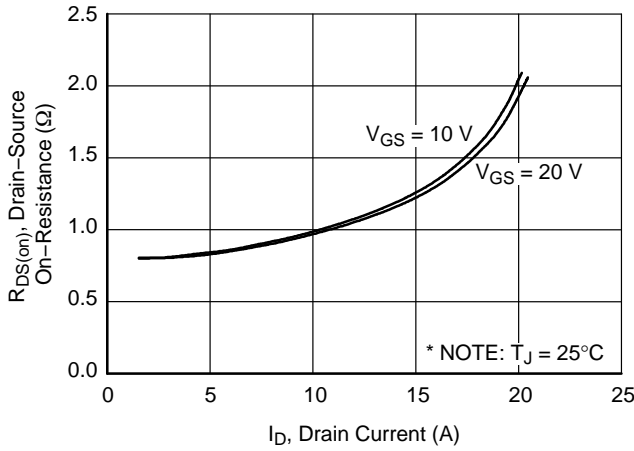


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

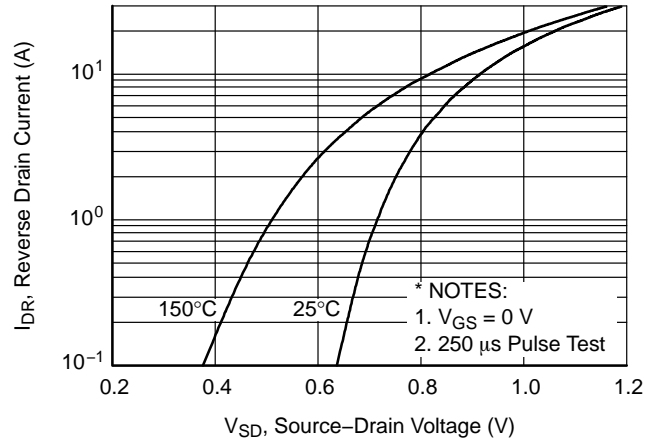


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

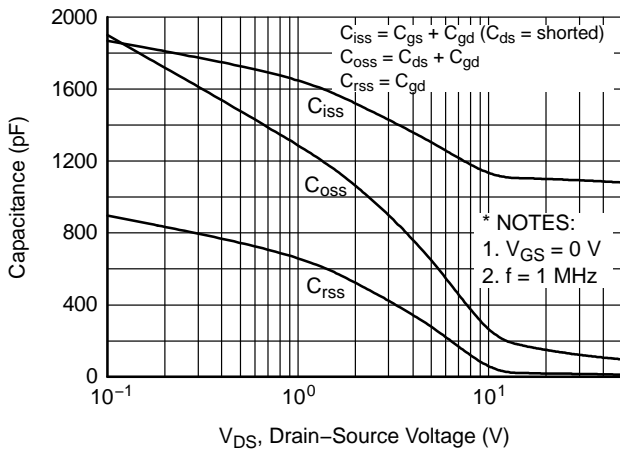


Figure 5. Capacitance Characteristics

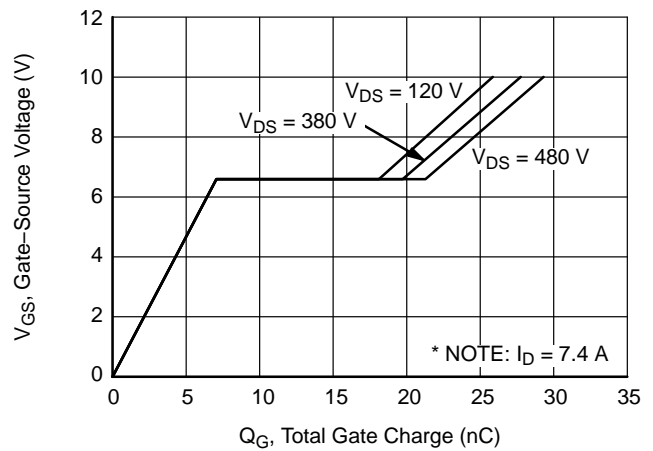
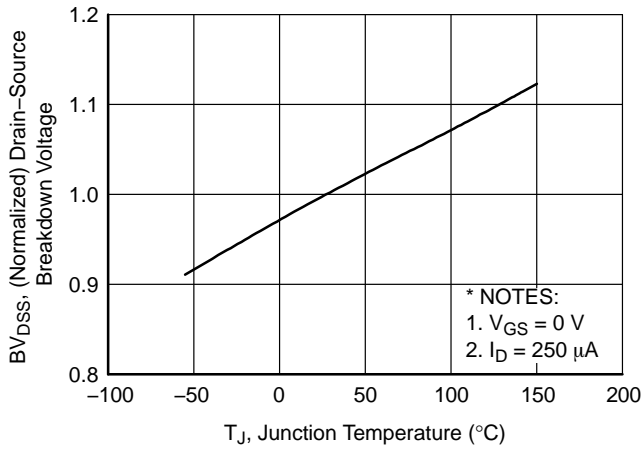


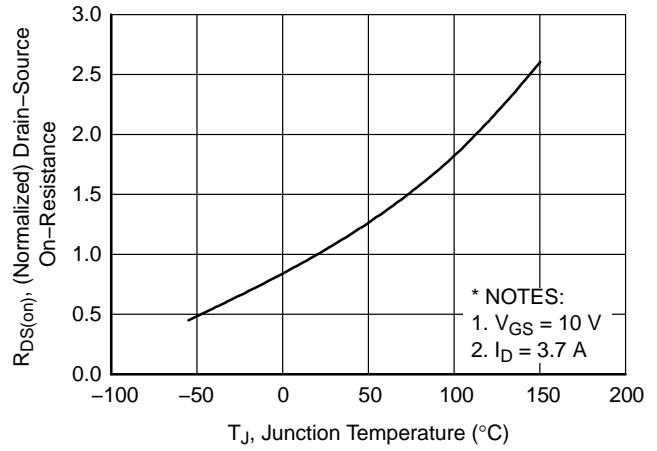
Figure 6. Gate Charge Characteristics

# FQB7N60, FQI7N60

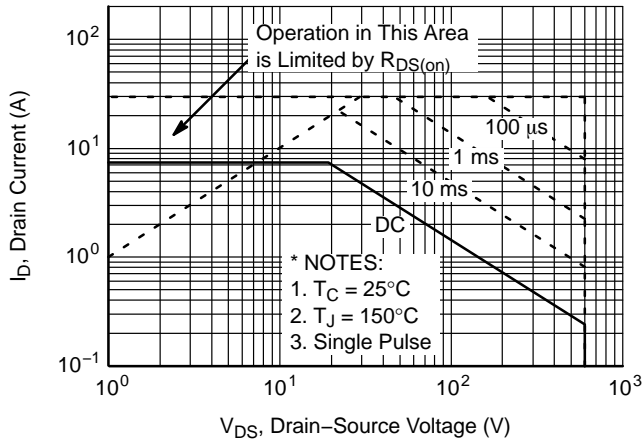
## TYPICAL CHARACTERISTICS (CONTINUED)



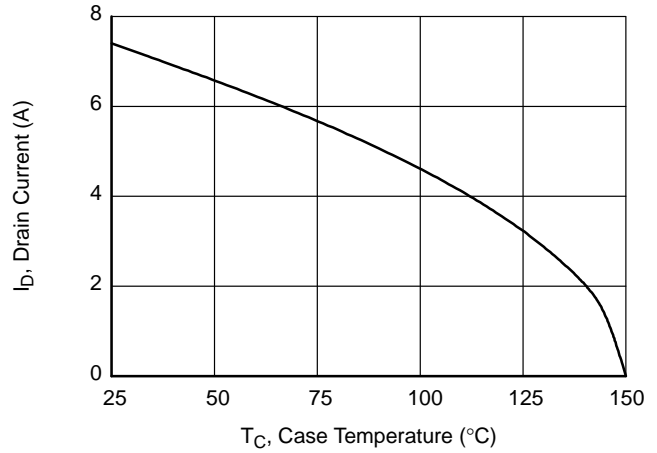
**Figure 7. Breakdown Voltage Variation vs. Temperature**



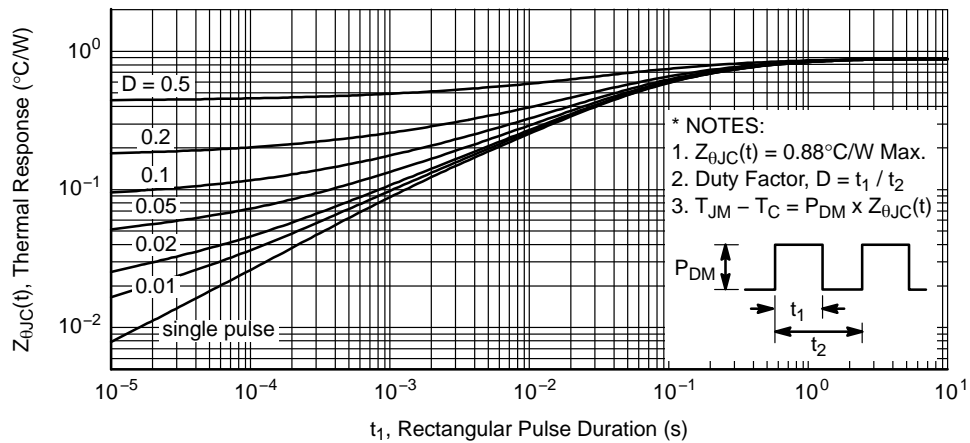
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



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



**Figure 11. Transient Thermal Response Curve**

# FQB7N60, FQI7N60

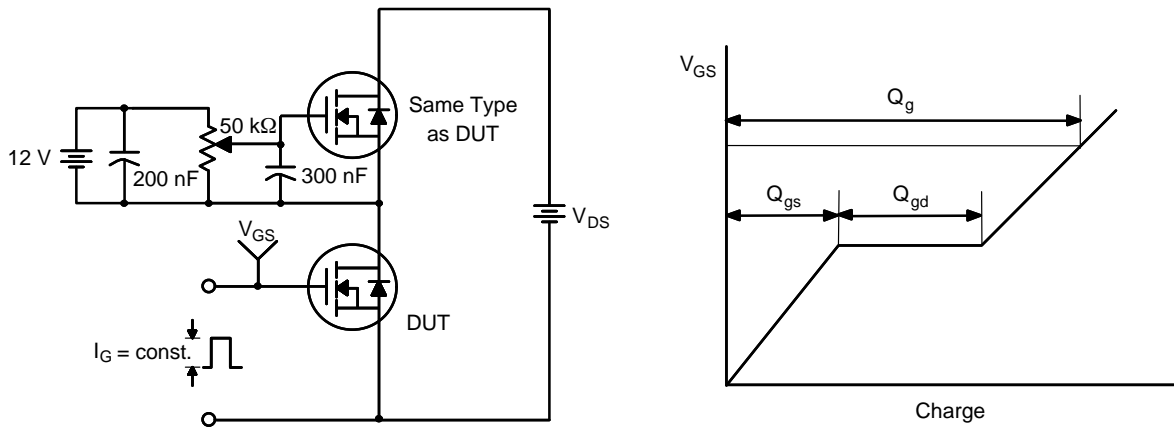


Figure 12. Gate Charge Test Circuit & Waveform

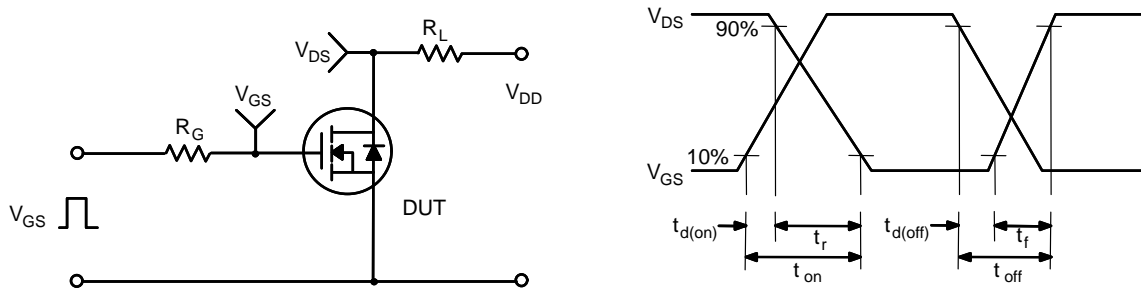


Figure 13. Resistive Switching Test Circuit & Waveforms

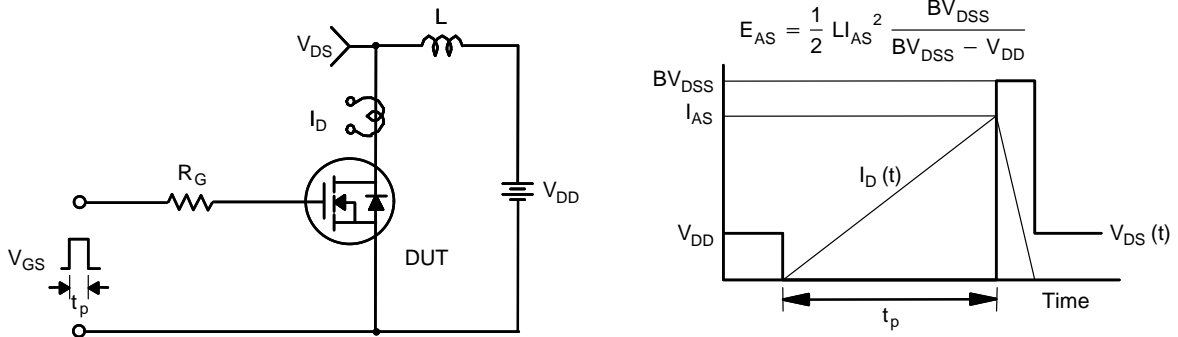


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

## FQB7N60, FQI7N60

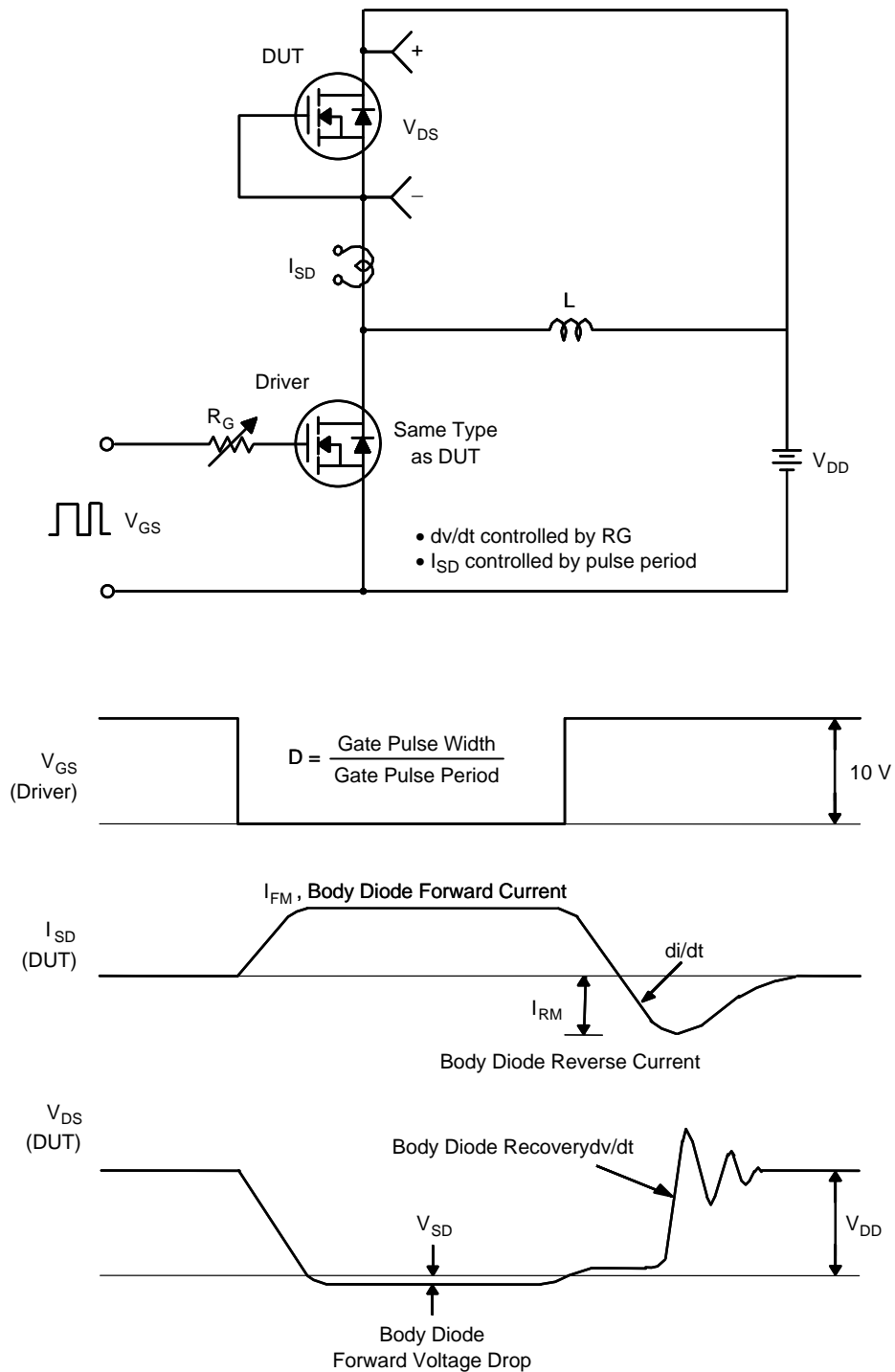
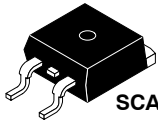


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

### ORDERING INFORMATION

Part Number	Top Mark	Package	Reel Size	Tape Width	Shipping <sup>†</sup>
FQB7N60TM	FQB7N60	D <sup>2</sup> PAK-3	330 mm	24 mm	800 Units / Tape & Reel
FQI7N60TU	FQI7N60	I2PAK	N/A	N/A	50 Units / Tube

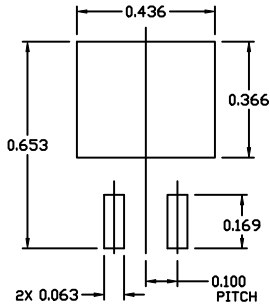
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 1:1

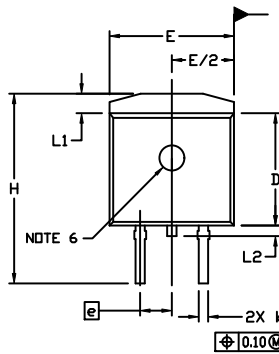
D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)  
CASE 418AJ  
ISSUE F

DATE 11 MAR 2021



RECOMMENDED  
MOUNTING FOOTPRINT

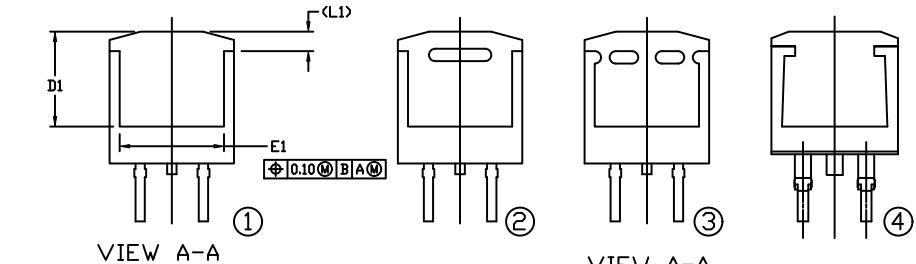
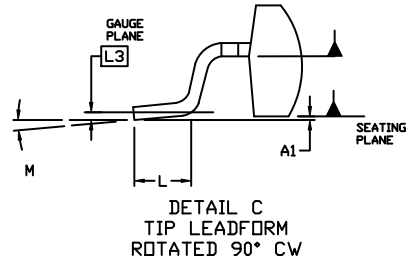
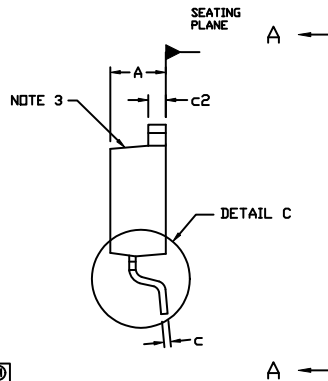
For additional information on our Pb-free strategy and soldering details, please download the IN Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.



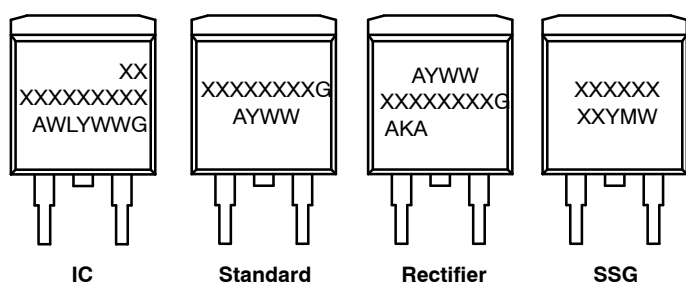
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: INCHES
- CHAMFER OPTIONAL.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
- THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
- OPTIONAL MOLD FEATURE.
- ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100	BSC	2.54	BSC
H	0.575	0.625	14.60	15.88
L	0.070	0.110	1.78	2.79
L1	---	0.066	---	1.68
L2	---	0.070	---	1.78
L3	0.010	BSC	0.25	BSC
M	0°	8°	0°	8°



GENERIC MARKING DIAGRAMS\*

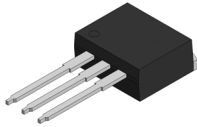


- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- W = Week Code (SSG)
- M = Month Code (SSG)
- G = Pb-Free Package
- AKA = Polarity Indicator

\*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.

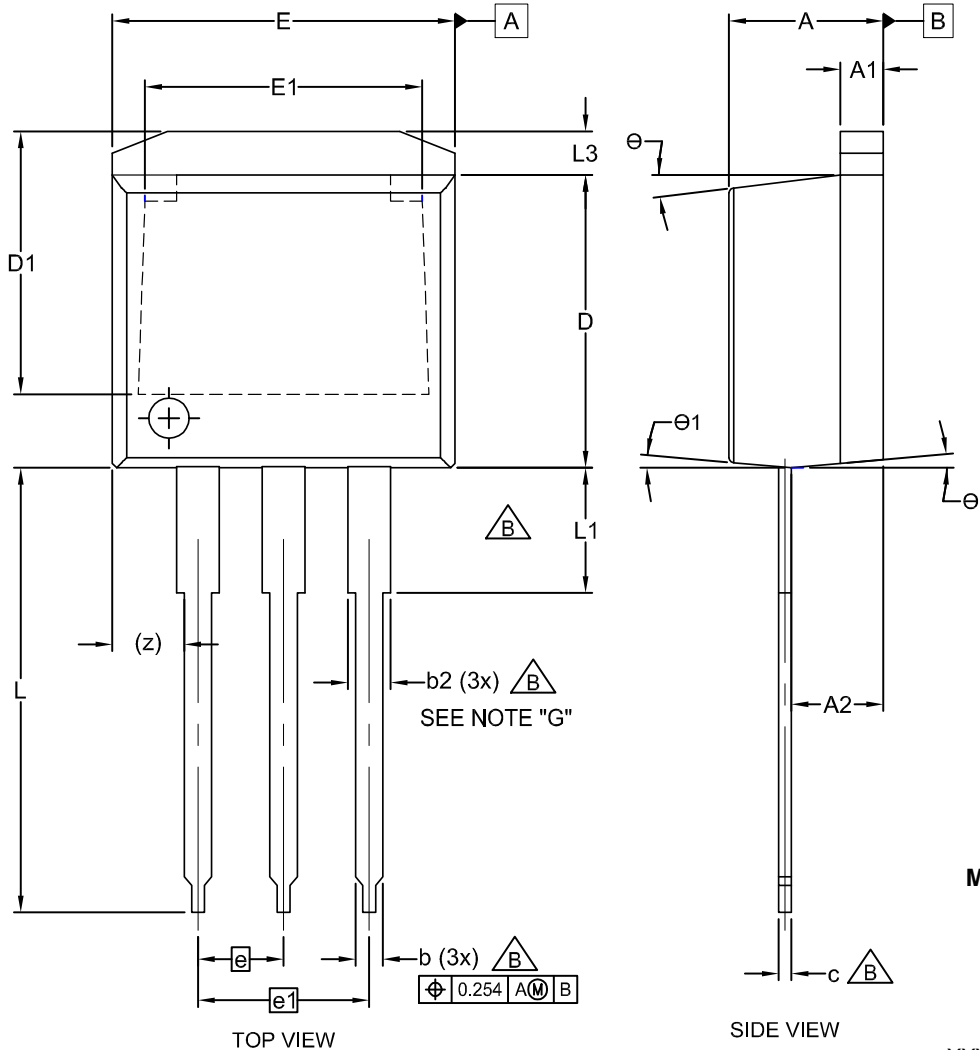
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DESCRIPTION:	D <sup>2</sup> PAK-3 (TO-263, 3-LEAD)	PAGE 1 OF 1

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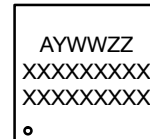
**I2PAK (TO-262 3 LD)  
CASE 418AV  
ISSUE A**

DATE 30 AUG 2022



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.06	4.45	4.83
A1	1.14	1.27	1.40
A2	2.03	2.41	2.79
b	0.64	0.77	0.90
b2	1.14	1.46	1.78
c	0.33	0.49	0.64
D	8.64	9.15	9.65
D1	6.86	7.37	7.88
E	9.65	9.97	10.29
E1	6.22	7.28	8.33
e	2.54 BSC		
e1	5.08 BSC		
L	12.70	13.72	14.73
L1	2.80	3.38	3.96
L3	1.00	1.20	1.40
z	2.13 REF		
θ	0°	--	7°
θ1	0°	--	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. EXCEPT WHERE NOTED CONFORMS TO T0262 JEDEC VARIATION AA.
- B. DOES NOT COMPLY JEDEC STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ANSI Y14.5-1994.
- F. LOCATION OF PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF PACKAGE)
- G. MAXIMUM WIDTH FOR F102 DEVICE = 1.35 MAX.

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<b>DESCRIPTION:</b>	<b>I2PAK (TO-262 3 LD)</b>	<b>PAGE 1 OF 1</b>

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