

# MOSFET – P-Channel, QFET®

**-200 V, -11.5 A, 470 mΩ**

## FQB12P20

### General Description

These P-Channel enhancement mode power field effect transistors are produced using onsemi's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switching DC/DC converters.

### Features

- -11.5 A, -200 V,  $R_{DS(on)} = 0.47 \Omega$  @  $V_{GS} = -10$  V
- Low Gate Charge (Typical 31 nC)
- Low  $C_{rss}$  (typical 30 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- These Devices are Pb-Free and are RoHS Compliant

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

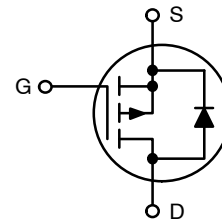
| Symbol         | Parameter                                                                     | FQB12P20    | Unit                |
|----------------|-------------------------------------------------------------------------------|-------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                          | -200        | V                   |
| $I_D$          | Drain Current – Continuous ( $T_C = 25^\circ\text{C}$ )                       | -11.5       | A                   |
|                | – Continuous ( $T_C = 100^\circ\text{C}$ )                                    | -7.27       | A                   |
| $I_{DM}$       | Drain Current – Pulsed (Note 1)                                               | -46         | A                   |
| $V_{GSS}$      | Gate-Source Voltage                                                           | +30         | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                       | 810         | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                                    | -11.5       | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                          | 12          | mJ                  |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)                                            | -5.5        | V/ns                |
| $P_D$          | Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *                              | 3.13        | W                   |
|                | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 120         | W                   |
|                | – Derate above $25^\circ\text{C}$                                             | 0.96        | 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.

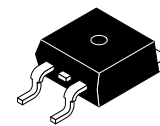
\*When mounted on the minimum pad size recommended (PCB Mount)

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 9.2$  mH,  $I_{AS} = -11.5$  A,  $V_{DD} = -50$  V,  $R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq -11.5$  A,  $di/dt \leq 300$  A/ $\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

| $V_{DSS}$ | $R_{DS(on)}$ MAX      | $I_D$ MAX |
|-----------|-----------------------|-----------|
| -200 V    | $0.47 \Omega$ @ -10 V | -11.5 A   |

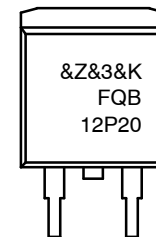


P-CHANNEL MOSFET



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

### MARKING DIAGRAM



FQB12P20 = Specific Device Code  
&Z = Assembly Plant Code  
&3 = Digit Date Code  
&K = Lot Run Traceability Code

### ORDERING INFORMATION

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

**THERMAL RESISTANCE MAXIMUM RATINGS**

| Symbol          | Parameter                                 | Typ | Max  | Unit |
|-----------------|-------------------------------------------|-----|------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case      | –   | 1.04 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient * | –   | 40   | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient   | –   | 62.5 | °C/W |

\*When mounted on the minimum pad size recommended (PCB Mount)

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

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

**OFF CHARACTERISTICS**

|                                |                                           |                                                                    |      |   |      |               |
|--------------------------------|-------------------------------------------|--------------------------------------------------------------------|------|---|------|---------------|
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$               | -200 | – | –    | V             |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ | –    | – | –    | V/°C          |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = -200\text{ V}, V_{GS} = 0\text{ V}$                      | –    | – | -1   | $\mu\text{A}$ |
|                                |                                           | $V_{DS} = -160\text{ V}, T_C = 125^\circ\text{C}$                  | –    | – | -10  | $\mu\text{A}$ |
| $I_{GSSF}$                     | 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            | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$       | -3.0 | –    | -5.0 | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = -10\text{ V}, I_D = -5.75\text{ A}$          | –    | 0.36 | 0.47 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = -40\text{ V}, I_D = -5.75\text{ A}$ (Note 4) | –    | 6.4  | –    | S        |

**DYNAMIC CHARACTERISTICS**

|           |                              |                                                                  |   |     |      |    |
|-----------|------------------------------|------------------------------------------------------------------|---|-----|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | – | 920 | 1200 | pF |
| $C_{oss}$ | Output Capacitance           |                                                                  | – | 190 | 250  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                  | – | 30  | 40   | pF |

**SWITCHING CHARACTERISTICS**

|              |                     |                                                                                            |   |     |     |    |
|--------------|---------------------|--------------------------------------------------------------------------------------------|---|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = -100\text{ V}, I_D = -11.5\text{ A},$<br>$R_G = 25\text{ }\Omega$<br>(Note 4, 5) | – | 20  | 50  | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                            | – | 195 | 400 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                            | – | 40  | 90  | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                            | – | 60  | 130 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = -160\text{ V}, I_D = -11.5\text{ A},$<br>$V_{GS} = -10\text{ V}$<br>(Note 4, 5)  | – | 31  | 40  | nC |
| $Q_{gs}$     | Gate-Source Charge  |                                                                                            | – | 8.1 | –   | nC |
| $Q_{gd}$     | Gate-Drain Charge   |                                                                                            | – | 16  | –   | nC |

**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

|                 |                                                       |                                                                                              |   |      |       |    |
|-----------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------|---|------|-------|----|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                                                              | – | –    | –11.5 | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain–Source Diode Forward Current     |                                                                                              | – | –    | –46   | A  |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = –11.5 A                                              | – | –    | –5.0  | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = –11.5 A,<br>dI <sub>F</sub> / dt = 100 A/μs (Note 4) | – | 180  | –     | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                                                              | – | 1.44 | –     | 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. Pulse Test: Pulse width  $\leq 300\text{ }\mu\text{s}$ , Duty cycle  $\leq 2\%$

5. Essentially independent of operating temperature



TYPICAL CHARACTERISTICS

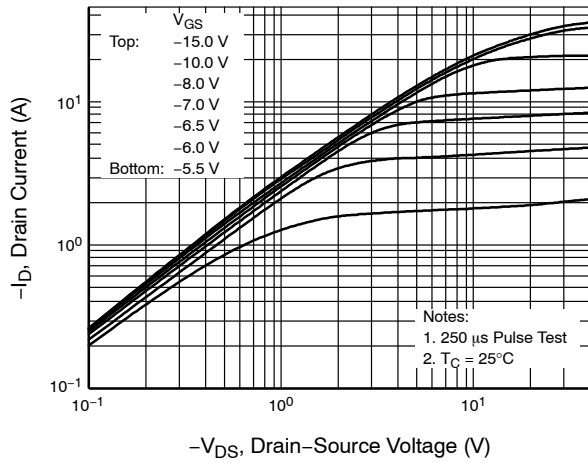


Figure 1. On Characteristics

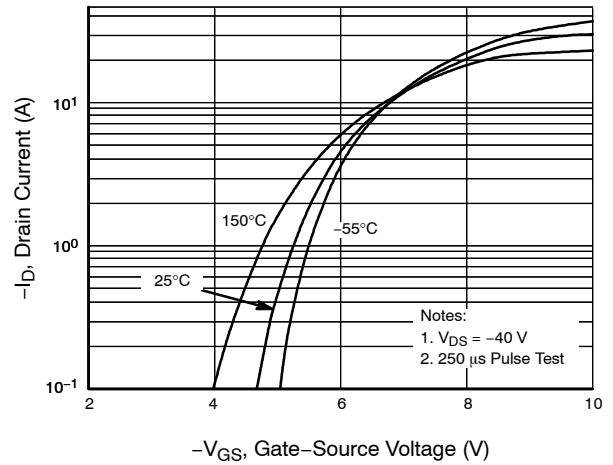


Figure 2. Transfer Characteristics

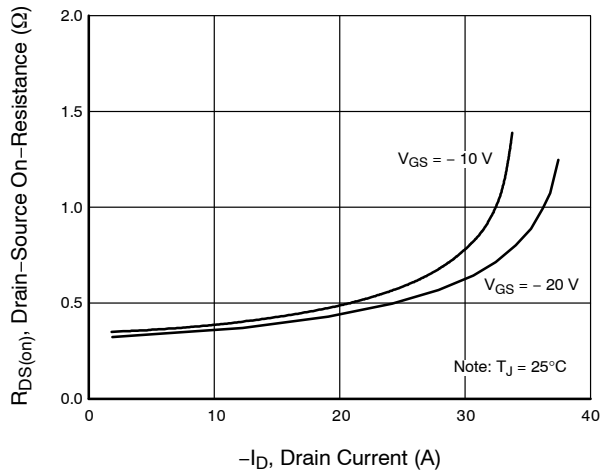


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

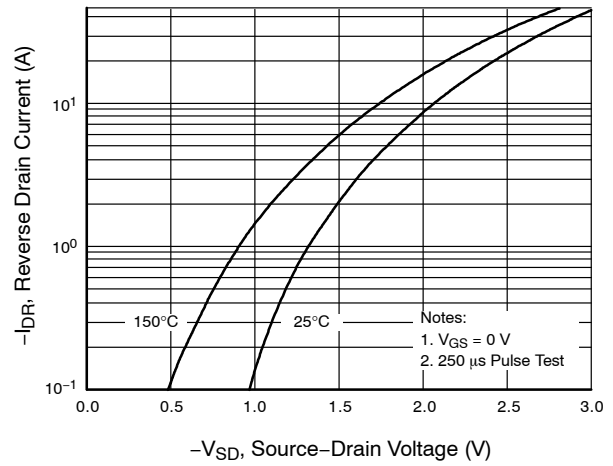


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

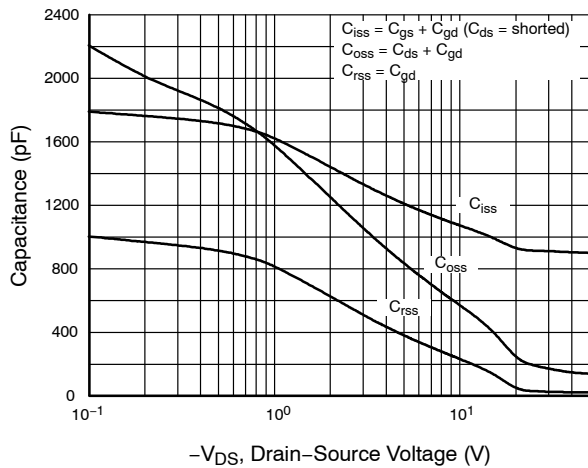


Figure 5. Capacitance Characteristics

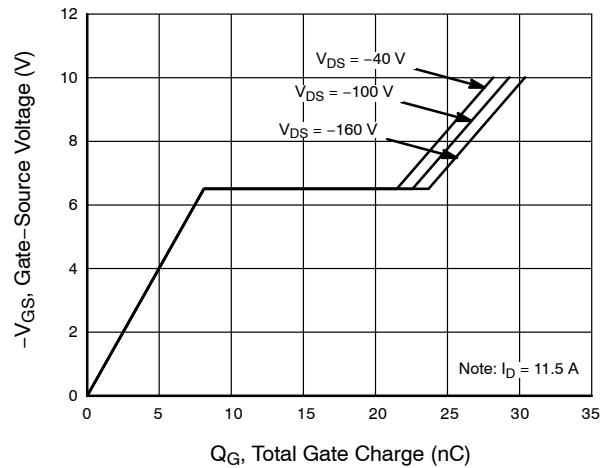


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS (continued)

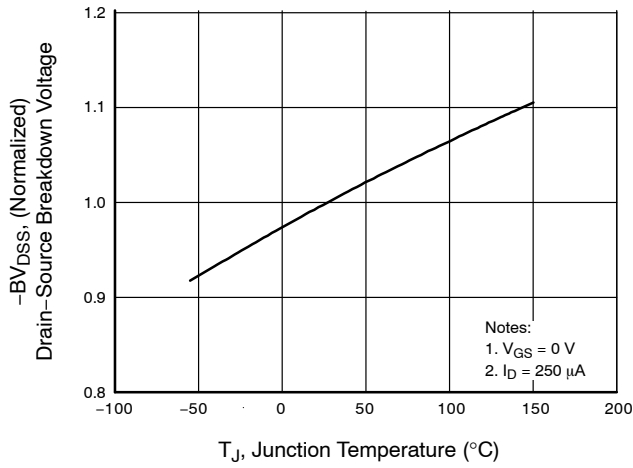


Figure 7. Breakdown Voltage Variation vs. Temperature

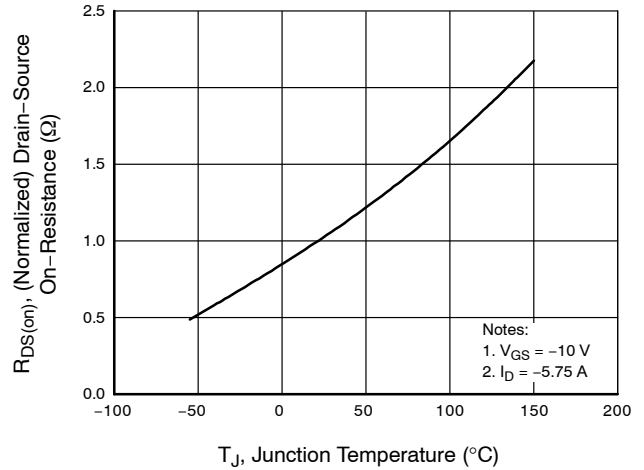


Figure 8. On-Resistance Variation vs. Temperature

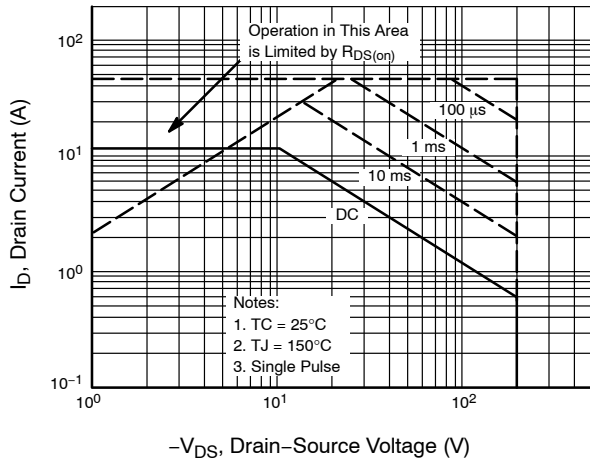


Figure 9. Maximum Safe Operating Area

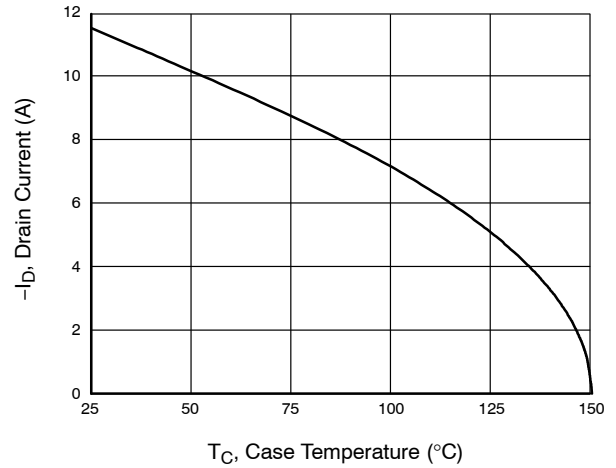


Figure 10. Maximum Drain Current vs. Case Temperature

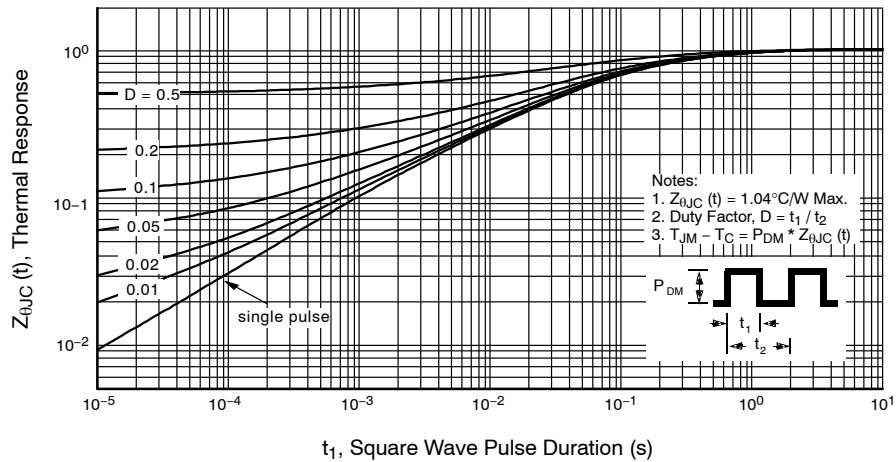


Figure 11. Capacitance Characteristics

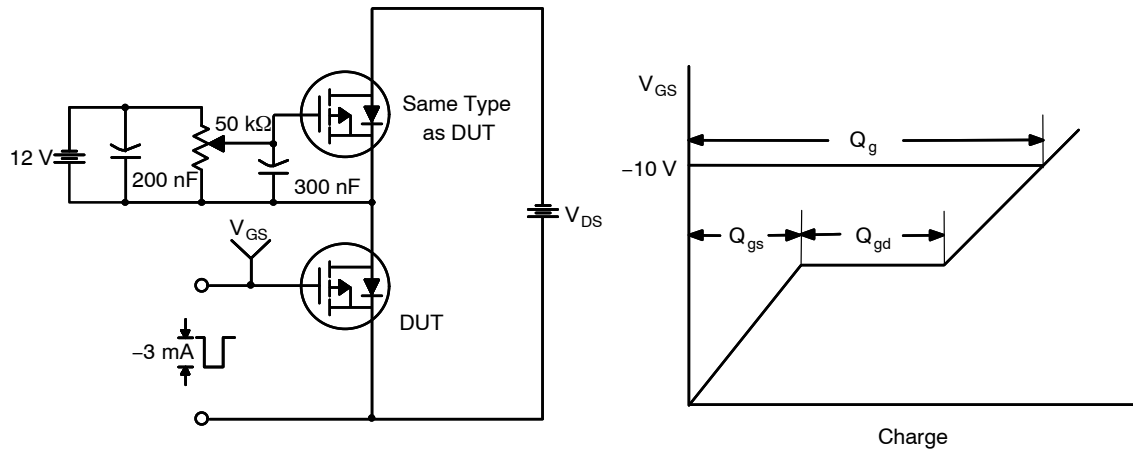


Figure 12. Gate Charge Test Circuit & Waveform

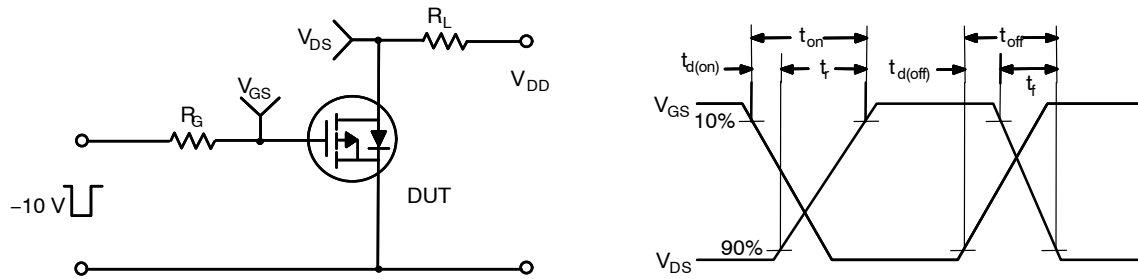


Figure 13. Resistive Switching Test Circuit & Waveforms

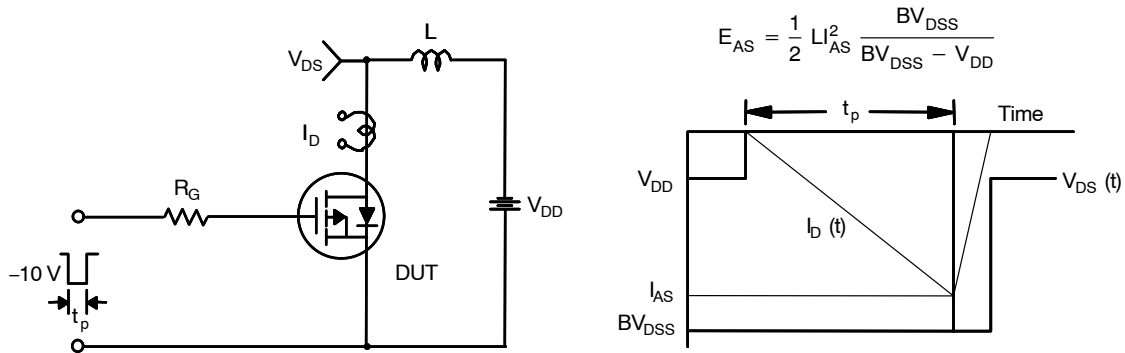


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

## FQB12P20

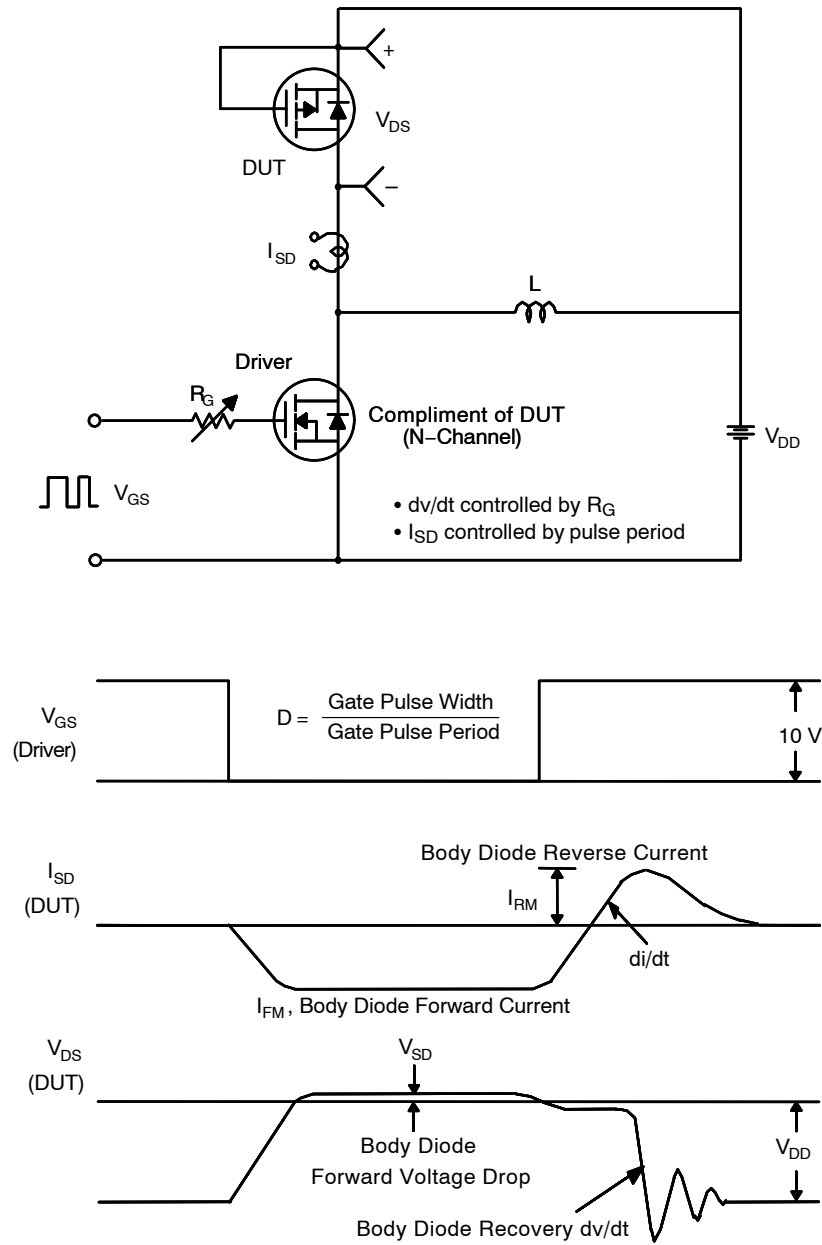


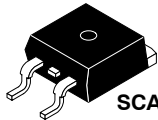
Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

### PACKAGE MARKING AND ORDERING INFORMATION

| Device     | Marking  | Package                      | Reel Size | Tape Width | Shipping <sup>†</sup> |
|------------|----------|------------------------------|-----------|------------|-----------------------|
| FQB12P20TM | FQB12P20 | D <sup>2</sup> PAK (Pb-Free) | 330 mm    | 24 mm      | 800 / Tape & Reel     |

<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.

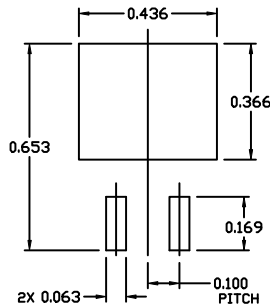
QFET is a registered trademark of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.



SCALE 1:1

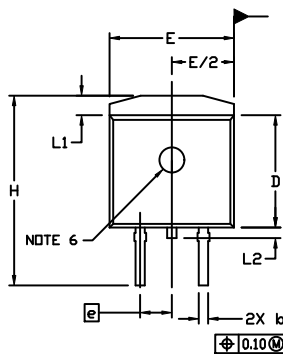
**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
CASE 418AJ  
ISSUE F

DATE 11 MAR 2021



**RECOMMENDED  
MOUNTING FOOTPRINT**

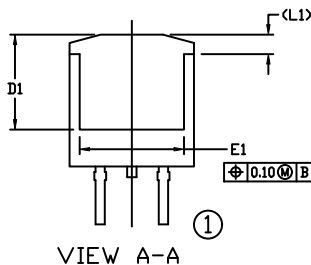
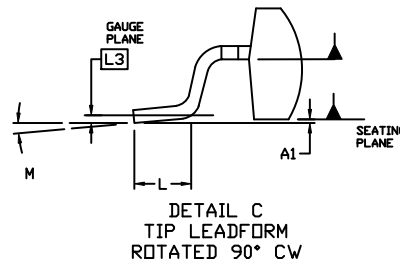
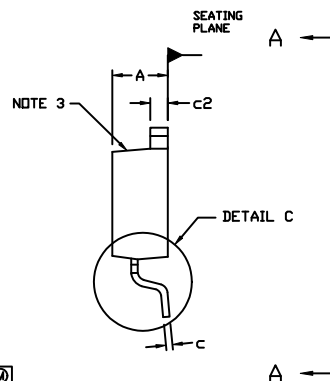
For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



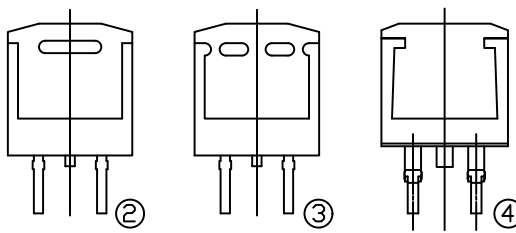
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. 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.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. 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°    |

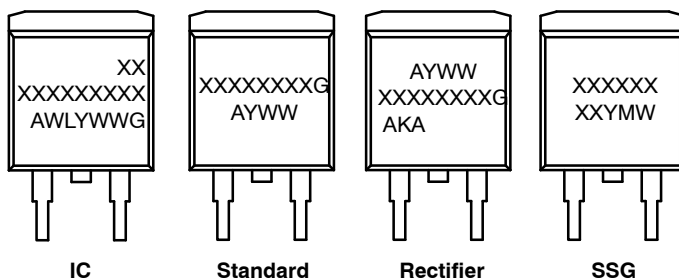


VIEW A-A



VIEW A-A  
OPTIONAL CONSTRUCTIONS

**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.

|                         |                                            |                                                                                                                                                                                  |
|-------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON56370E</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>D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

onsemi and Onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the 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. onsemi 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)