

# 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 ON Semiconductor'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 Crss (typical 30 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- These Devices are Pb-Free and are RoHS Compliant

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

| Symbol         | Parameter   | FQB12P20    | Unit          |
|----------------|---|-------------|---------------|
| $V_{DSS}$      | Drain-Source Voltage  | -200        | V             |
| $I_D$          | Drain Current – Continuous ( $T_C = 25^\circ C$ )                             | -11.5       | A             |
|                | – Continuous ( $T_C = 100^\circ C$ )  | -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 ( $T_A = 25^\circ C$ ) *                                    | 3.13        | W             |
|                | Power Dissipation ( $T_C = 25^\circ C$ )                                      | 120         | W             |
|                | – Derate above $25^\circ C$   | 0.96        | W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                       | -55 to +150 | $^\circ C$    |
| $T_L$          | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300         | $^\circ C$    |

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)

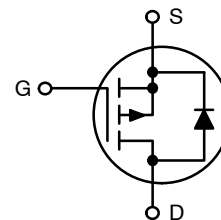
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 9.2 mH, I_{AS} = -11.5 A, V_{DD} = -50 V, R_G = 25 \Omega, \text{Starting } T_J = 25^\circ C$
3.  $I_{SD} \leq -11.5 A, di/dt \leq 300 A/\mu s, V_{DD} \leq BV_{DSS}, \text{Starting } T_J = 25^\circ C$



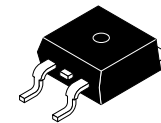
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| $V_{DSS}$ | $R_{DS(ON)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|-----------|--------------------------|-------------------|
| -200 V    | $0.47 \Omega @ -10 V$    | -11.5 A           |

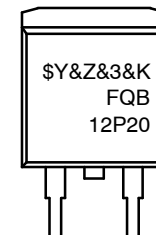


P-CHANNEL MOSFET



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

### MARKING DIAGRAM



FQB12P20 = Specific Device Code  
\$Y = ON Semiconductor Logo  
&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.

# FQB12P20

## THERMAL RESISTANCE MAXIMUM RATINGS

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

\*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            | $V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$                 | -200 | - | -    | V                           |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\ \mu\text{A}$ , Referenced to $25^{\circ}\text{C}$ | -    | - | -    | $\text{V}/^{\circ}\text{C}$ |
| $I_{DSS}$                      | 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            | $V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$             | -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  | $V_{DD} = -100\text{ V}, I_D = -11.5\text{ A}, R_G = 25\ \Omega$ (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   | $V_{DS} = -160\text{ V}, I_D = -11.5\text{ A}, V_{GS} = -10\text{ V}$ (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

|          |   |  |   |       |      |               |
|----------|---|--|---|-------|------|---------------|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current | -  | - | -11.5 | A    |               |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     | -  | - | -46   | A    |               |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = -11.5\text{ A}$  | - | -     | -5.0 | V             |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}, I_S = -11.5\text{ A}, dI_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4) | - | 180   | -    | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                               |  | - | 1.44  | -    | $\mu\text{C}$ |

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.

4. Pulse Test: Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

TYPICAL CHARACTERISTICS

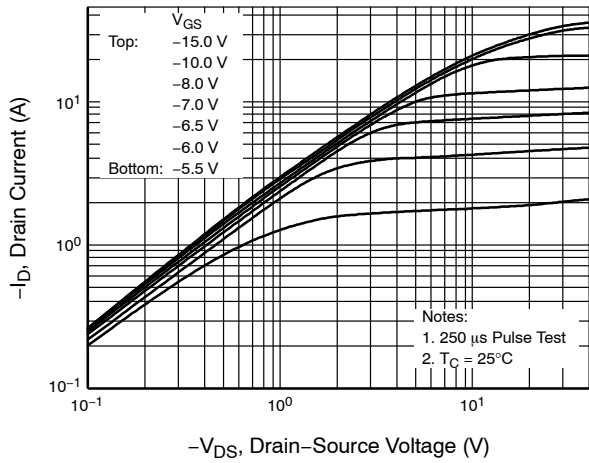


Figure 1. On Characteristics

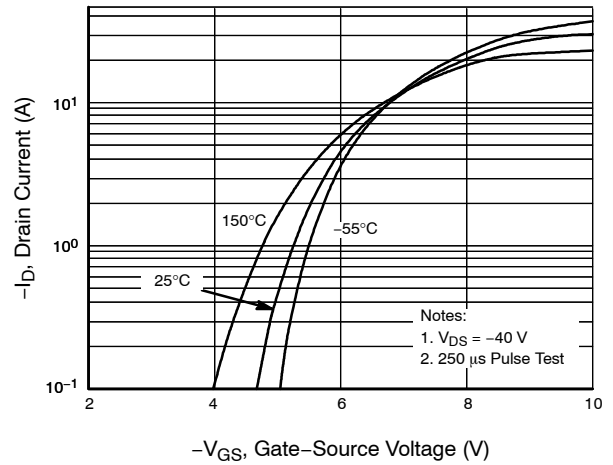


Figure 2. Transfer Characteristics

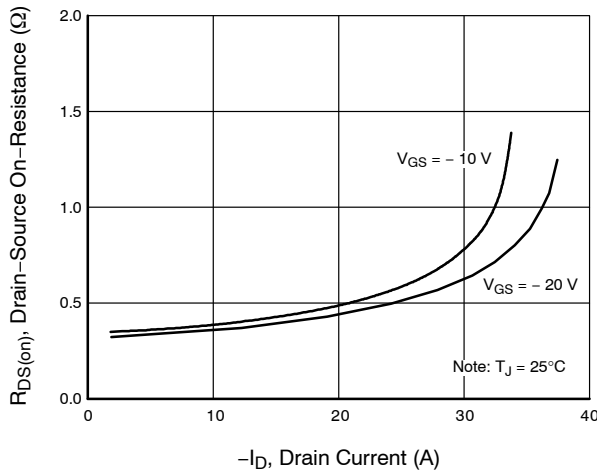


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

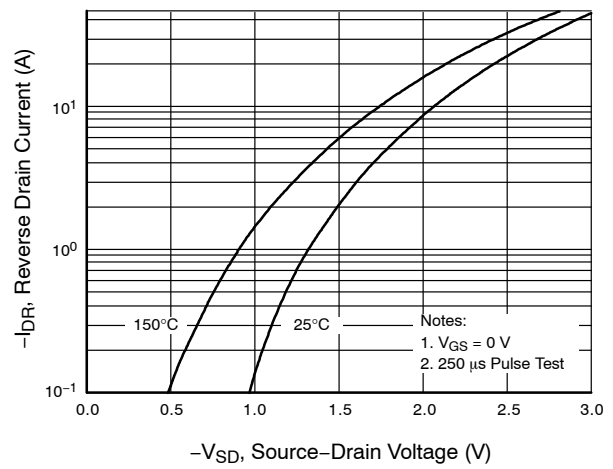


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

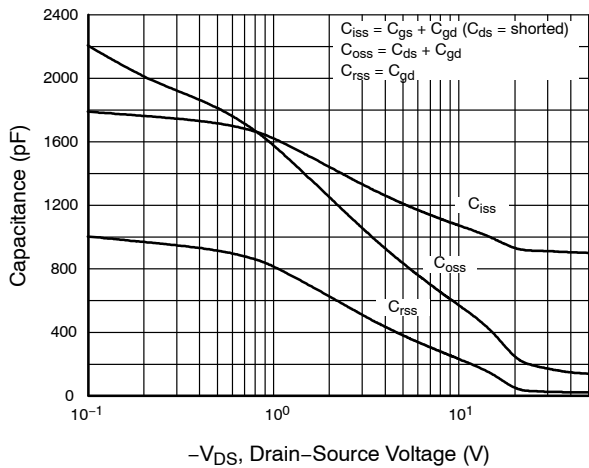


Figure 5. Capacitance Characteristics

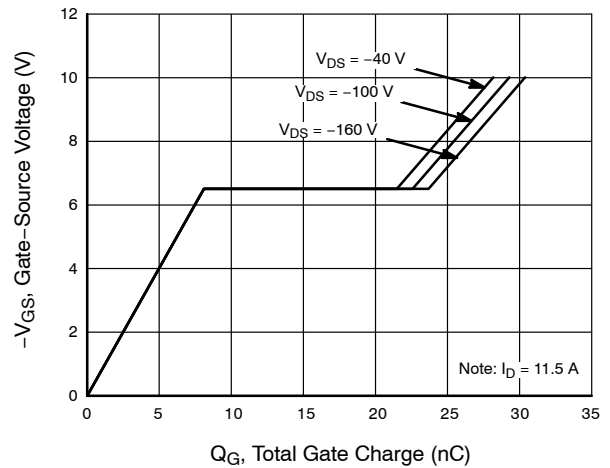
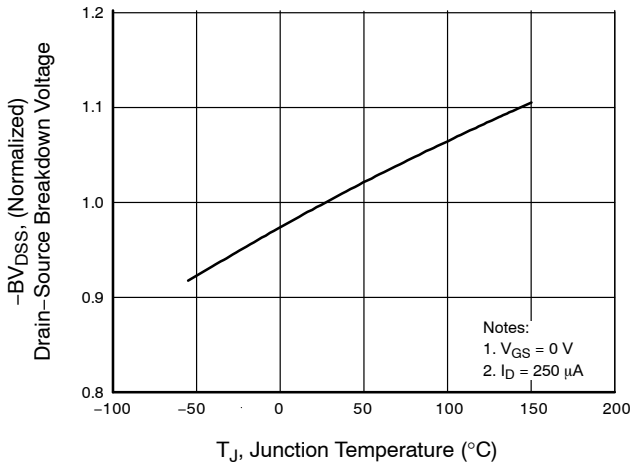


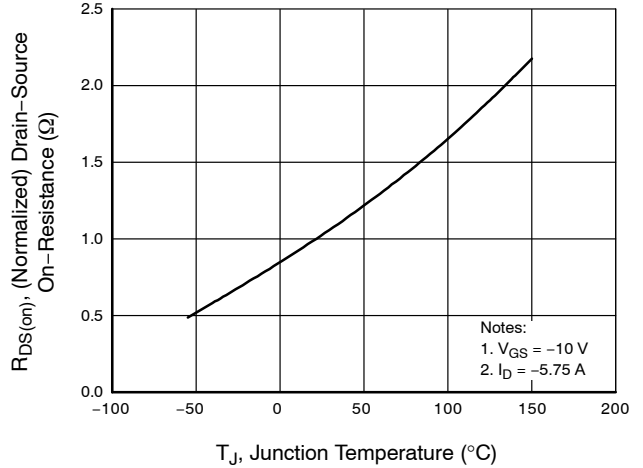
Figure 6. Gate Charge Characteristics

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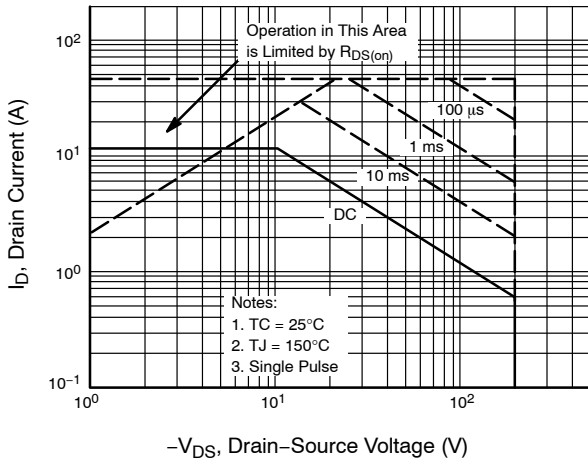
## TYPICAL CHARACTERISTICS (continued)



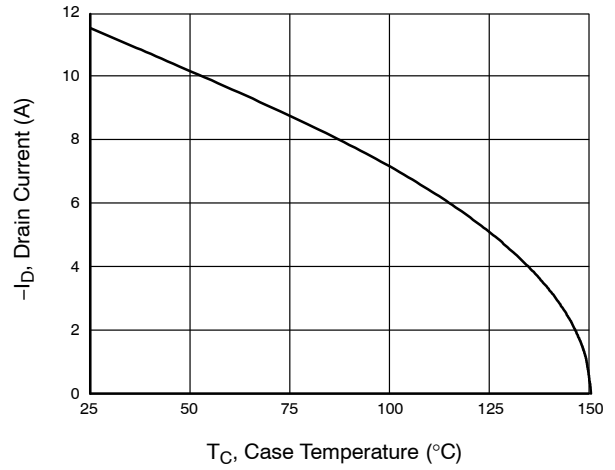
**Figure 7. Breakdown Voltage Variation vs. Temperature**



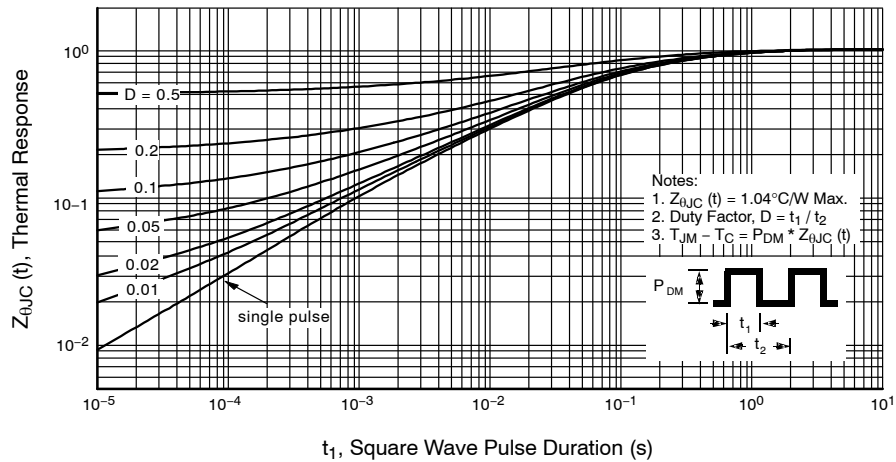
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



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



**Figure 11. Capacitance Characteristics**

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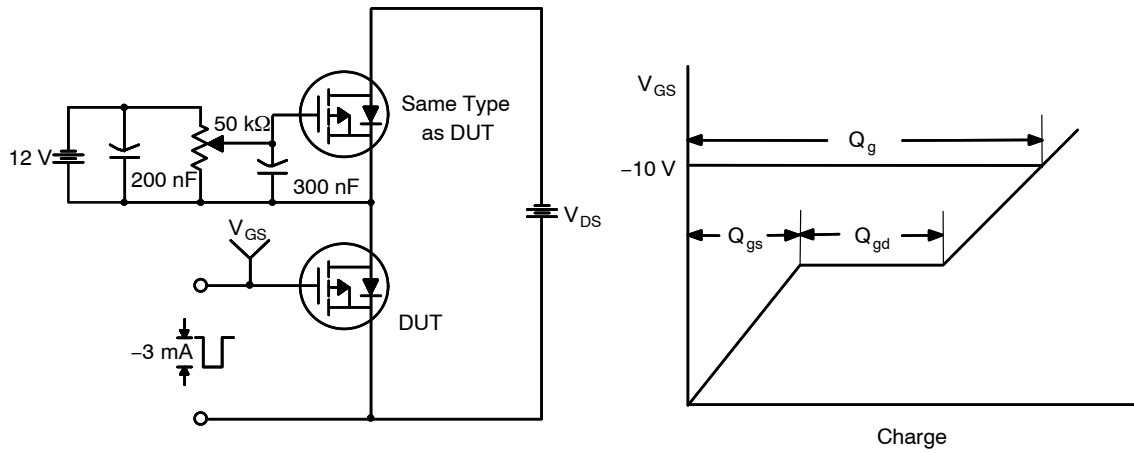


Figure 12. Gate Charge Test Circuit & Waveform

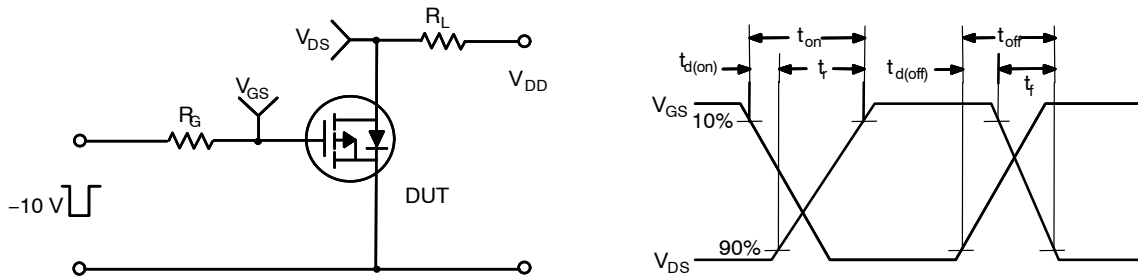
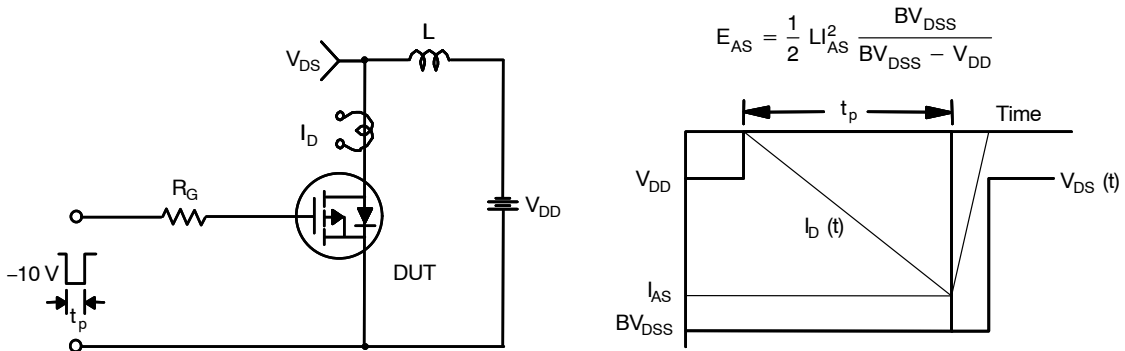


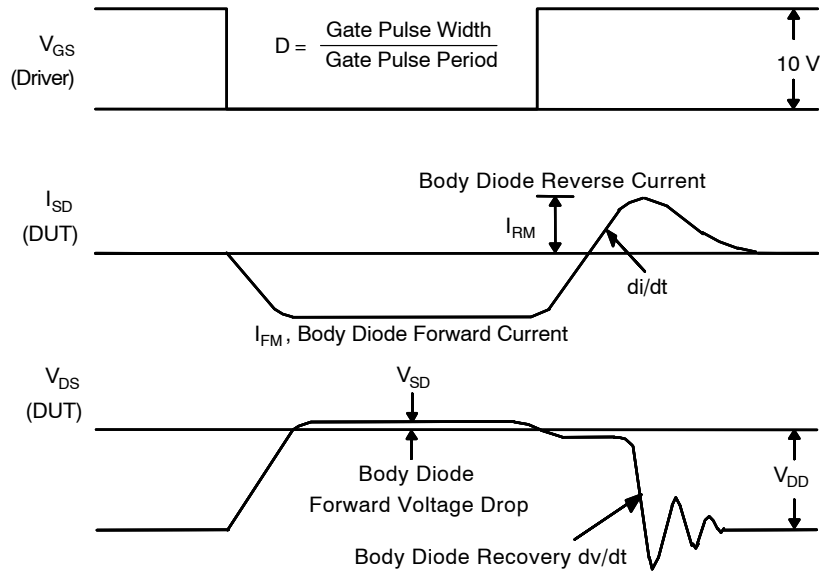
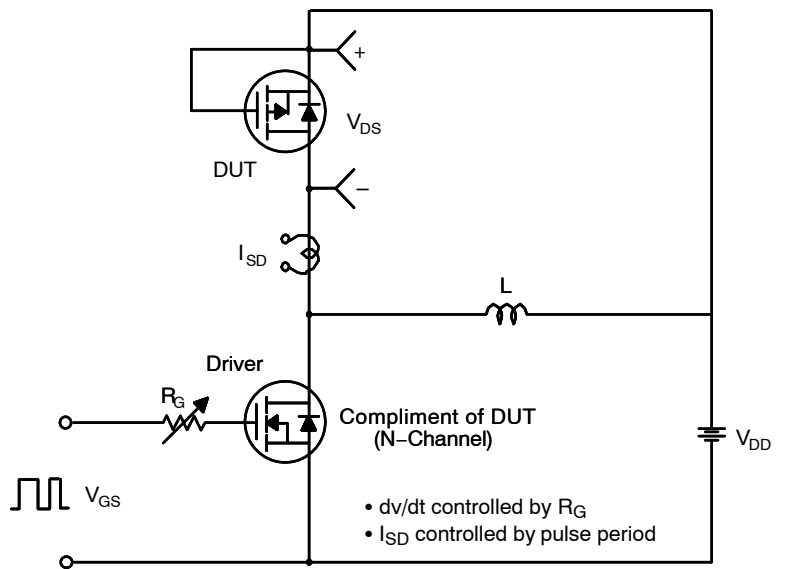
Figure 13. Resistive Switching Test Circuit & Waveforms



$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

## FQB12P20



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

### PACKAGE MARKING AND ORDERING INFORMATION

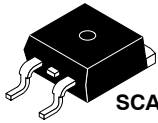
| Device     | Marking  | Package                         | Reel Size | Tape Width | Shipping†         |
|------------|----------|---------------------------------|-----------|------------|-------------------|
| FQB12P20TM | FQB12P20 | D <sup>2</sup> PAK<br>(Pb-Free) | 330 mm    | 24 mm      | 800 /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

†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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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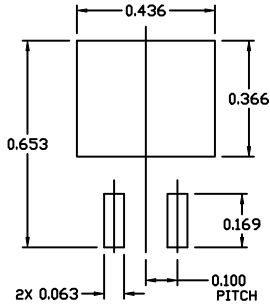
SCALE 1:1

### D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)

#### CASE 418AJ

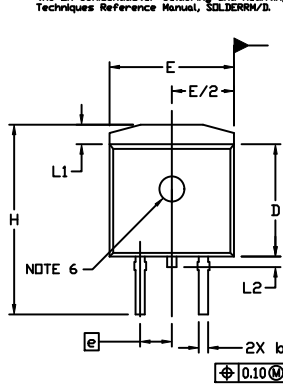
#### ISSUE F

DATE 11 MAR 2021



#### RECOMMENDED MOUNTING FOOTPRINT

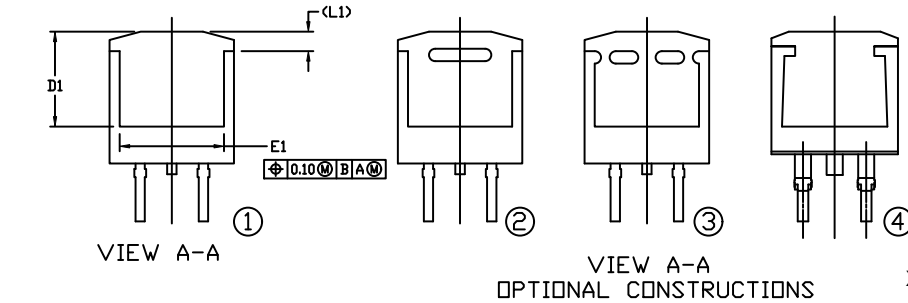
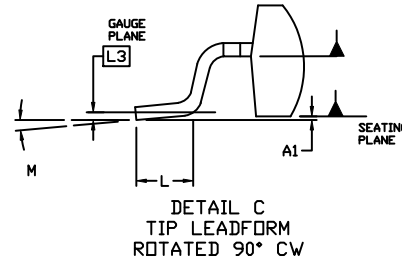
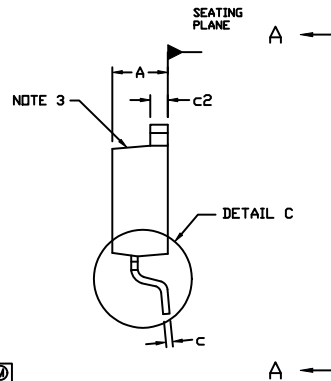
For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



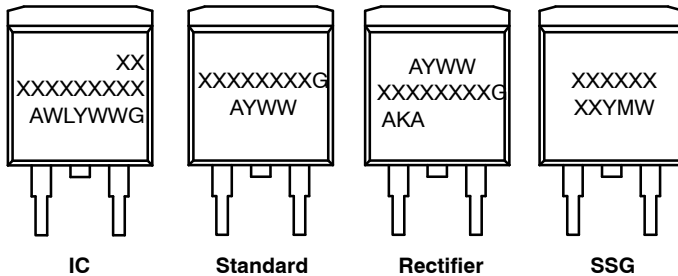
#### NOTES:

- 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.

|                  |                                       |  |
|------------------|---------------------------------------|--|
| DOCUMENT NUMBER: | 98AON56370E                           | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | D <sup>2</sup> PAK-3 (TO-263, 3-LEAD) | PAGE 1 OF 1  |

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**Europe, Middle East and Africa Technical Support:**

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