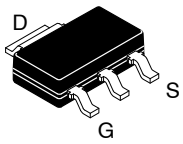
# MOSFET – N-Channel QFET®

## 600 V, 0.2 A, 11.5 Ω

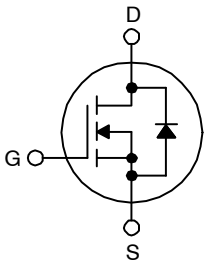
# FQT1N60CTF-WS

ON Semiconductor®

www.onsemi.com




**SOT−223**
**CASE 318H−01**




### 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

- 0.2 A, 600 V, $R_{DS(on)}$ = 9.3 Ω (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 0.1 A
- Low Gate Charge (Typ. 4.8 nC)
- Low Crss (Typ. 3.5 pF)
- 100% Avalanche Tested
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### ABSOLUTE MAXIMUM RATINGS

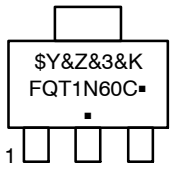
($T_C$ = 25°C unless otherwise noted*)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | 600 | V |
| $V_{GSS}$ | Gate to Source Voltage | ±30 | V |
| $I_D$ | Drain Current<br>Continuous ($T_C$ = 25°C)<br>Continuous ($T_C$ = 100°C) | <br>0.2<br>0.12 | A |
| $I_{DM}$ | Drain Current − Pulsed (Note 1) | 0.8 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | 33 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | 0.2 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | 0.2 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | V/ns |
| $P_D$ | Power Dissipation<br>($T_C$ = 25°C)<br>Derate above 25°C | <br>2.1<br>0.02 | <br>W<br>W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | −55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 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 = 59 mH, $I_{AS}$ = 1.1 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, Starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 0.2 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C.

### MARKING DIAGRAM




| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = 3−Digit Date Code Format |
| &K | = 2−Digit Lot Run Traceability Code |
| FQT1N60C | = Specific Device Code |
| ▪ | = Pb−Free Package |

(Note: Microdot may be in either location)

### ORDERING INFORMATION

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

## THERMAL CHARACTERISTICS

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction−to−Ambient* | − | 60 | °C/W |

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

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTIC** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V, $T_J$ = 25°C | 600 | − | − | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | − | 0.6 | − | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | − | − | 25 | μA |
| | | $V_{DS}$ = 480 V, $T_C$ = 125°C | − | − | 250 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | − | − | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 2.0 | − | 4.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On−Resistance | $V_{GS}$ = 10 V, $I_D$ = 0.1 A | − | 9.3 | 11.5 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 0.1 A (Note 4) | − | 0.75 | − | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | − | 130 | 170 | pF |
| $C_{oss}$ | Output Capacitance | | − | 19 | 25 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | − | 3.5 | 6 | pF |
| $Q_g$ | Total Gate Charge at 10 V | $V_{DS}$ = 480 V, $I_D$ = 1 A, $V_{GS}$ = 10 V (Note 4 and 5) | − | 4.8 | 6.2 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | − | 0.7 | − | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | − | 2.7 | − | nC |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn−On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 1 A, $R_G$ = 25 Ω (Note 4 and 5) | − | 7 | 24 | ns |
| $t_r$ | Turn−On Rise Time | | − | 21 | 52 | ns |
| $t_{d(off)}$ | Turn−Off Delay Time | | − | 13 | 36 | ns |
| $t_f$ | Turn−Off Fall Time | | − | 27 | 64 | ns |
| **DRAIN−SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | − | − | 0.2 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | − | − | 0.8 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 0.2 A | − | − | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 1 A, $dI_F/dt$ = 100 A/μs (Note 4) | − | 190 | − | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | − | 0.53 | − | 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 ≤ 300 μs, Duty Cycle ≤ 2%.
5. Essentially Independent of Operating Temperature Typical Characteristics.

## TYPICAL CHARACTERISTICS

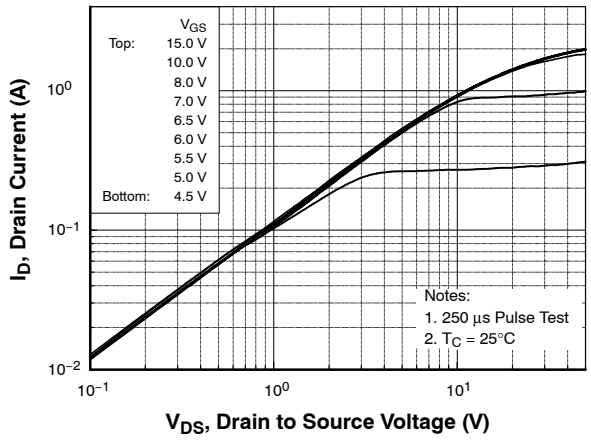



**Figure 1. On−Region Characteristics**

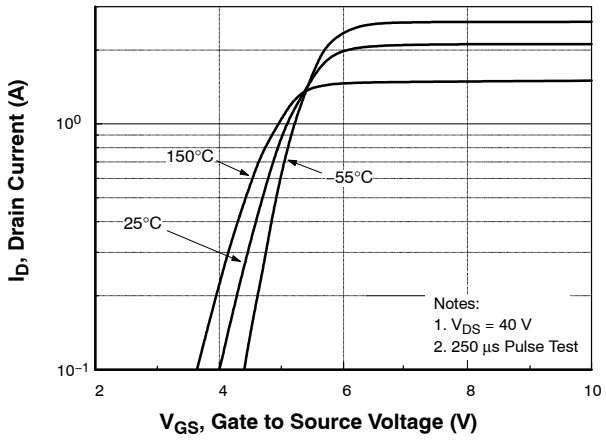



**Figure 2. Transfer Characteristics**

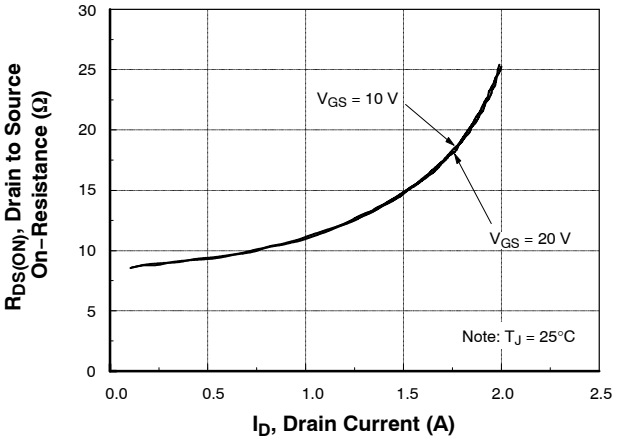



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

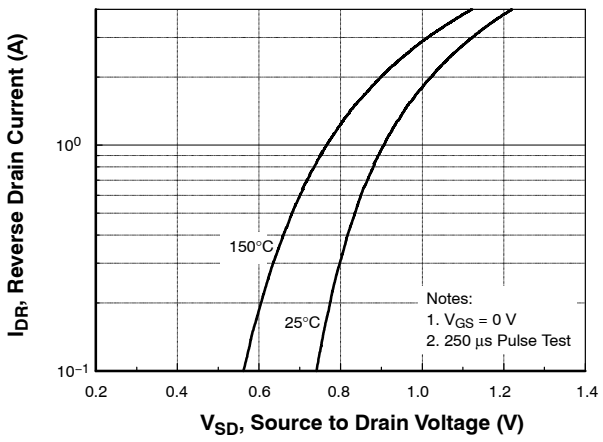



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

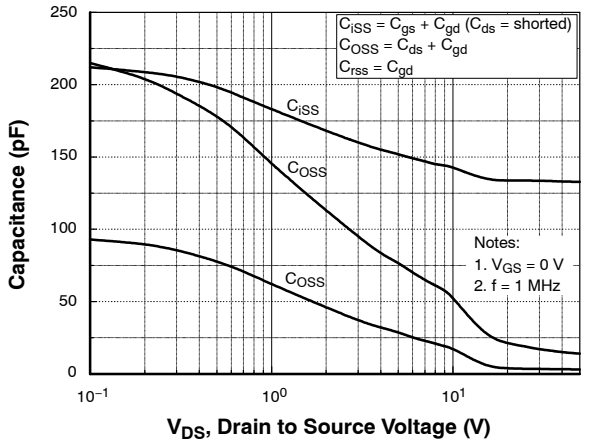



**Figure 5. Capacitance Characteristics**

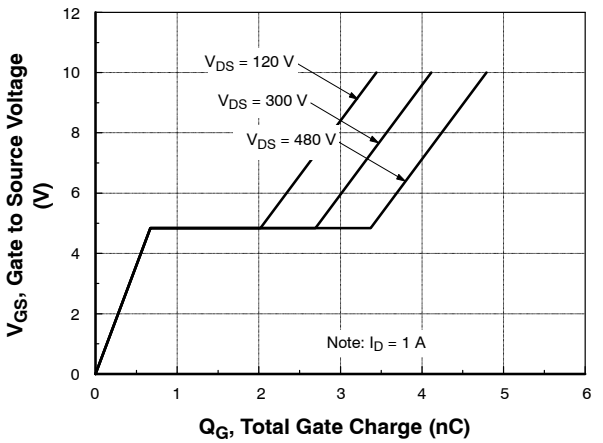



**Figure 6. Gate Charge Characteristics**

## TYPICAL CHARACTERISTICS (Continued)

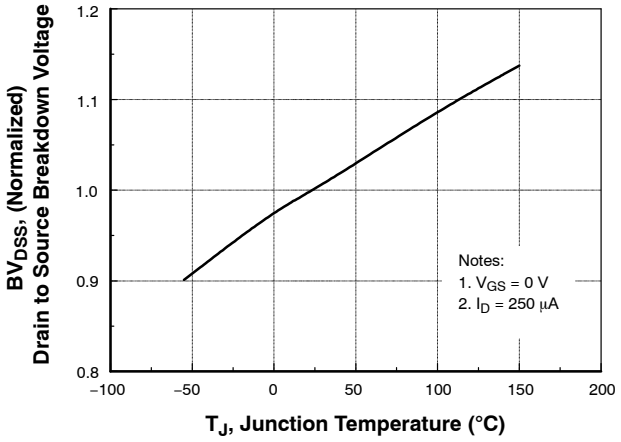



**Figure 7. Breakdown Voltage Variation vs. Temperature**

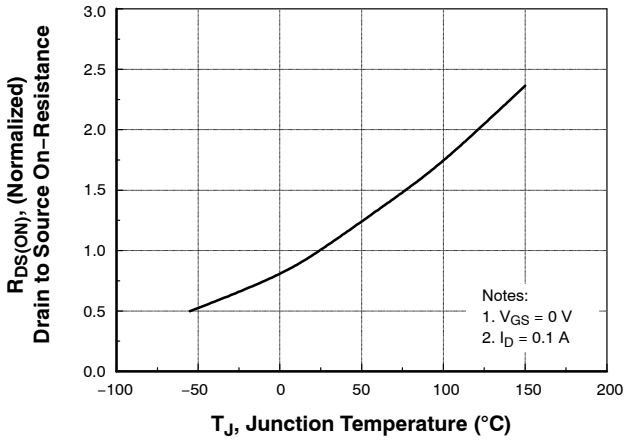



**Figure 8. On−Resistance Variation vs. Temperature**

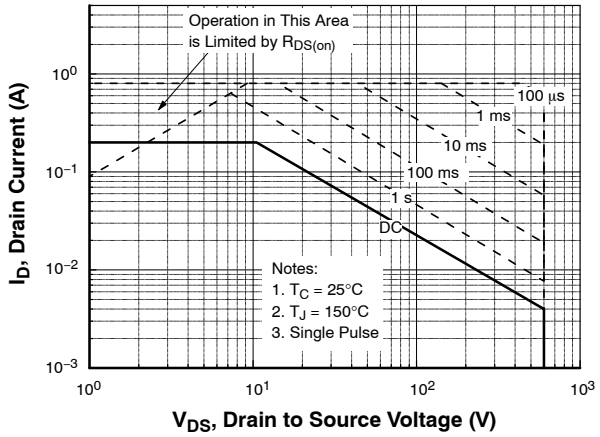



**Figure 9. Maximum Safe Operating Area**

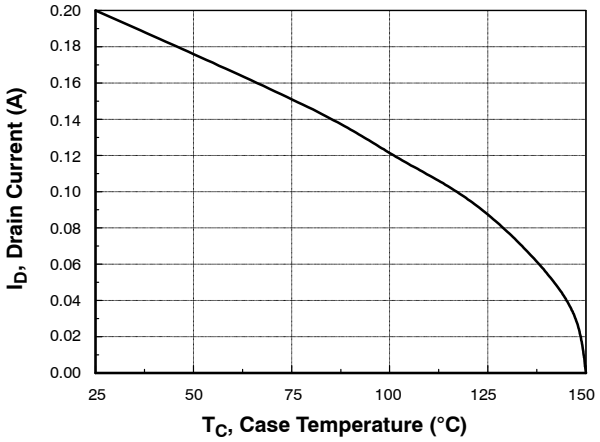



**Figure 10. Maximum Drain Current vs. Case Temperature**

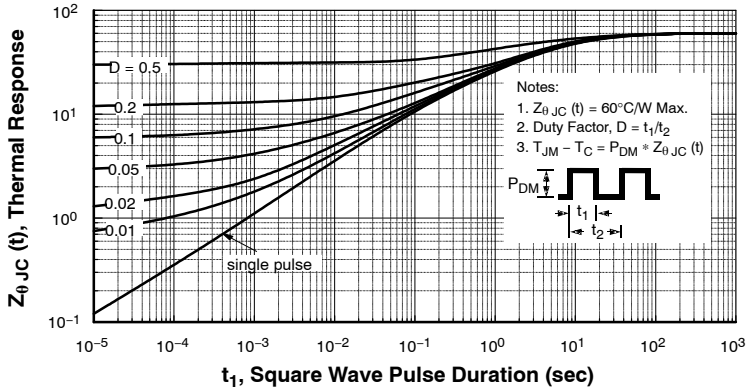



**Figure 11. Transient Thermal Response Curve**

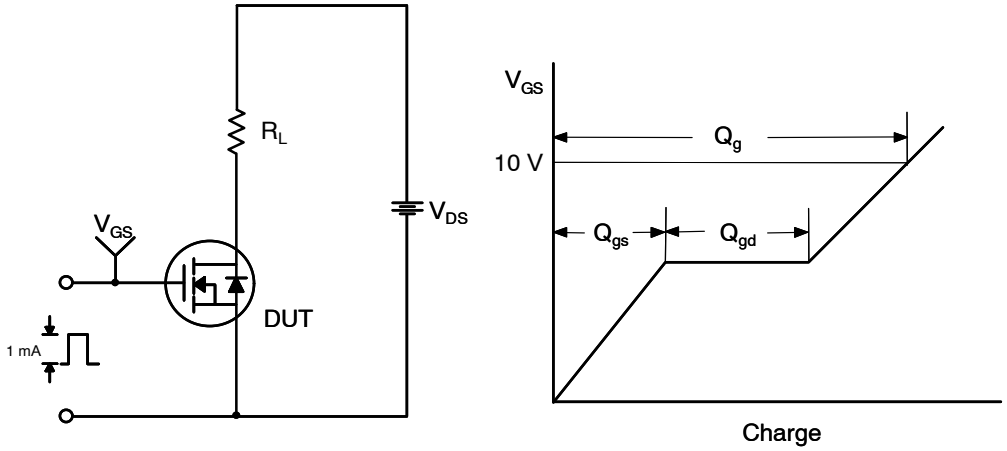



**Figure 12. Gate Charge Test Circuit & Waveforms**

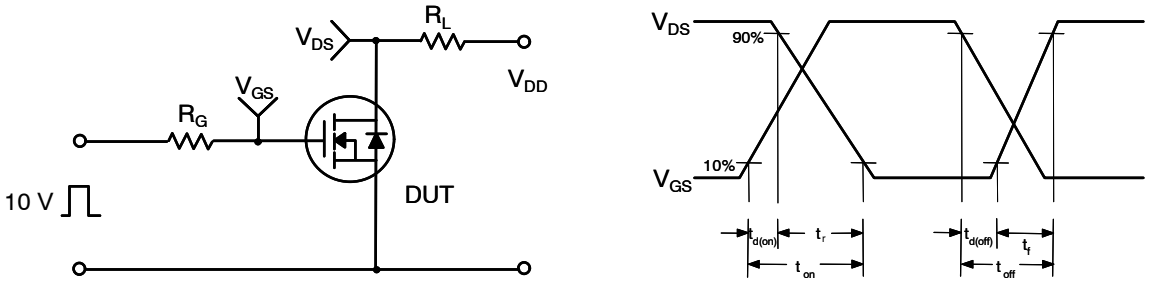



**Figure 13. Resistive Switching Test Circuit & Waveforms**

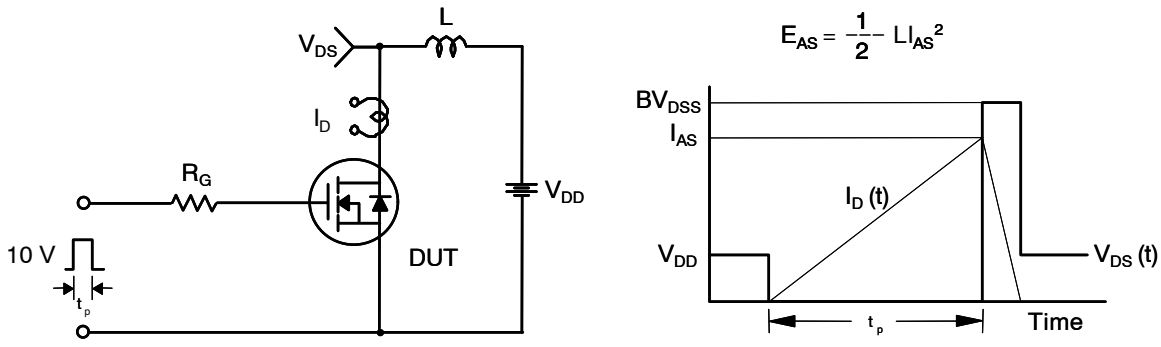



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

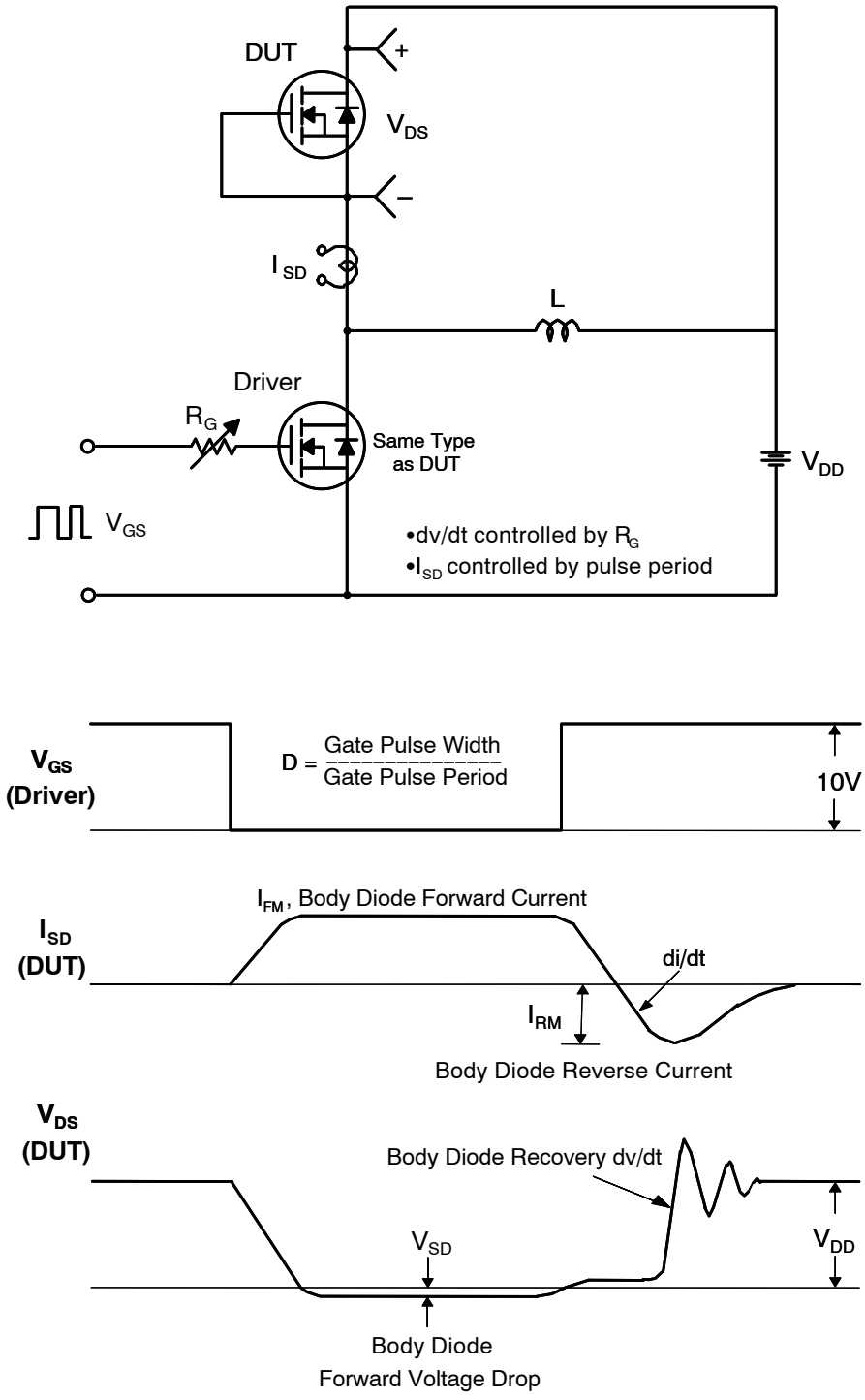



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FQT1N60C | FQT1N60CTF−WS | SOT−223 | 330 mm | 12 mm | 4000 |

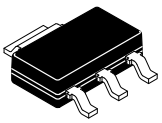
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

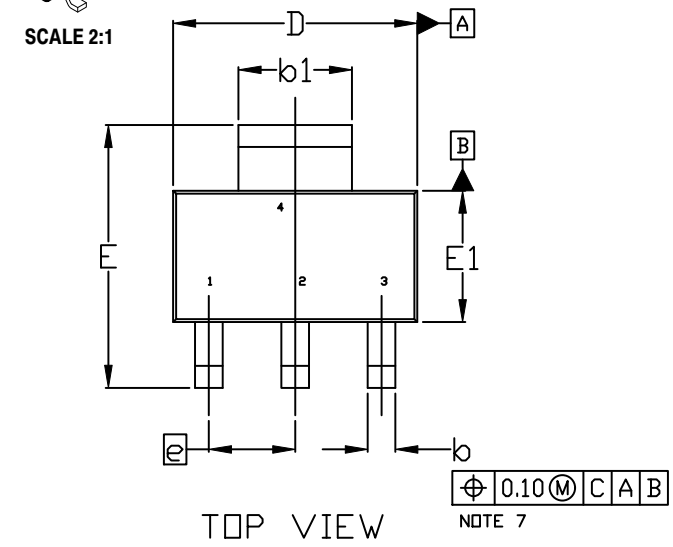
ON Semiconductor®

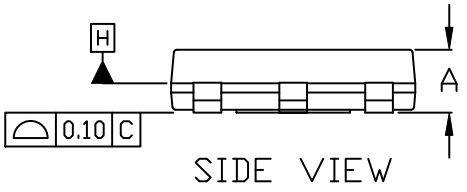
**SOT−223**
CASE 318H
ISSUE B

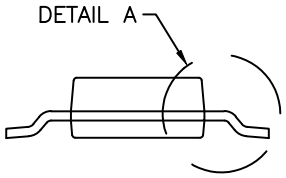
DATE 13 MAY 2020

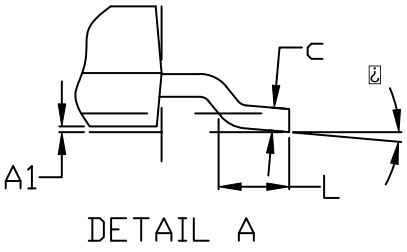


SCALE 2:1



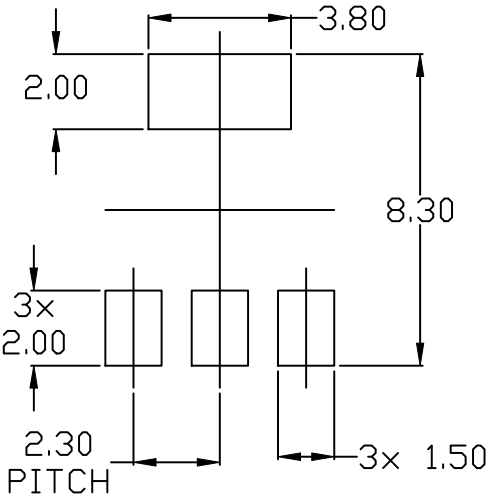




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E1 ARE DETERMINED AT DATUM H. DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. SHALL NOT EXCEED 0.23mm PER SIDE.
4. LEAD DIMENSIONS b AND b1 DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBBAR PROTRUSION IS 0.08mm PER SIDE.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
7. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

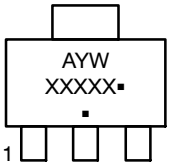
| | MILLIMETERS | | |
|---|---|---|---|
| DIM | MIN. | NOM. | MAX. |
| A | --- | --- | 1.80 |
| A1 | 0.02 | 0.06 | 0.11 |
| b | 0.60 | 0.74 | 0.88 |
| b1 | 2.90 | 3.00 | 3.10 |
| c | 0.24 | --- | 0.35 |
| D | 6.30 | 6.50 | 6.70 |
| E | 6.70 | 7.00 | 7.30 |
| E1 | 3.30 | 3.50 | 3.70 |
| e | 2.30 BSC | | |
| L | 0.25 | --- | --- |
| θ | 0° | --- | 10° |




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.

**GENERIC MARKING DIAGRAM***




A = Assembly Location
Y = Year
W = Work Week
XXXXX = Specific Device Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*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:** | **SOT−223** | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
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**onsemi Website:** www.onsemi.com

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**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales