

# MOSFET – N-Channel, POWERTRENCH®

**100 V, 5.6 A, 160 mΩ**

## FDT1600N10ALZ

### General Description

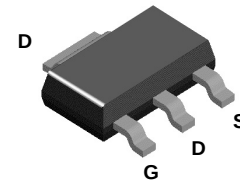
This N-Channel MOSFET is produced using onsemi's advanced POWERTRENCH process that has been tailored to minimize the on-state resistance and maintain superior switching performance.

### Features

- $R_{DS(on)} = 121 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 2.8 \text{ A}$
- $R_{DS(on)} = 156 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 5 \text{ V}$ ,  $I_D = 1.8 \text{ A}$
- Low Gate Charge (Typ. 2.9 nC)
- Low  $C_{RSS}$  (Typ. 2.04 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- ESD Protection Level: HBM > 5.2 kV, MM > 400 V, CDM > 1.5 kV
- RoHS Compliant

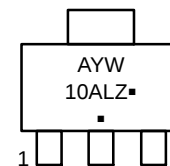
### Applications

- Consumer Appliances
- LED TV and Monitor
- Synchronous Rectification
- Uninterruptible Power Supply
- Micro Solar Inverter



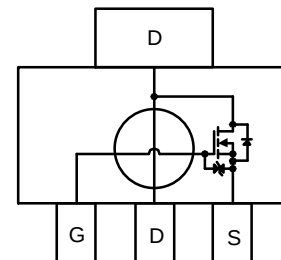
SOT-223  
CASE 318H

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
W = Work Week  
10ALZ = Specific Device Code  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### PIN ASSIGNMENT



### ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

# FDT1600N10ALZ

## MOSFET MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

| Symbol                            | Parameter                                                            |                                       | FDT1600N10ALZ | Unit |
|-----------------------------------|----------------------------------------------------------------------|---------------------------------------|---------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage                                              |                                       | 100           | V    |
| V <sub>GSS</sub>                  | Gate to Source Voltage                                               |                                       | ±20           | V    |
| I <sub>D</sub>                    | Drain Current                                                        | – Continuous (T <sub>C</sub> = 25°C)  | 5.6           | A    |
|                                   |                                                                      | – Continuous (T <sub>C</sub> = 100°C) | 3.5           |      |
| I <sub>DM</sub>                   | Drain Current                                                        | – Pulsed (Note 2)                     | 11.2          | A    |
| E <sub>AS</sub>                   | Single Pulse Avalanche Energy (Note 3)                               |                                       | 9.2           | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 4)                                   |                                       | 6.0           | V/ns |
| P <sub>D</sub>                    | Power Dissipation                                                    | (T <sub>C</sub> = 25°C)               | 10.42         | W    |
|                                   |                                                                      | – Derate Above 25°C                   | 0.083         | °C   |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Junction Temperature Range                     |                                       | –55 to +150   | °C   |
| T <sub>L</sub>                    | 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.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                         |  | FDT1600N10ALZ | Unit |
|------------------|---------------------------------------------------|--|---------------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case (Note 1)     |  | 12            | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1a) |  | 60            |      |

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

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

### OFF CHARACTERISTICS

|                                      |                                           |                                                                       |     |     |     |      |
|--------------------------------------|-------------------------------------------|-----------------------------------------------------------------------|-----|-----|-----|------|
| BV <sub>DSS</sub>                    | Drain to Source Breakdown Voltage         | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V                        | 100 | –   | –   | V    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C                           | –   | 0.1 | –   | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 80 V, V <sub>GS</sub> = 0 V                         | –   | –   | 1   | μA   |
|                                      |                                           | V <sub>DS</sub> = 80 V, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C | –   | –   | 500 |      |
| I <sub>GSS</sub>                     | Gate to Source Leakage Current            | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V                        | –   | –   | ±10 | μA   |

### ON CHARACTERISTICS

|                     |                                      |                                                             |     |      |     |    |
|---------------------|--------------------------------------|-------------------------------------------------------------|-----|------|-----|----|
| V <sub>GS(th)</sub> | Gate to Source Threshold Voltage     | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA | 1.4 | –    | 2.8 | V  |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.8 A              | –   | 121  | 160 | mΩ |
|                     |                                      | V <sub>GS</sub> = 5 V, I <sub>D</sub> = 1.8 A               | –   | 156  | 375 |    |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 5.6 A              | –   | 26.1 | –   | S  |

### DYNAMIC CHARACTERISTICS

|                      |                                   |                                                             |                                                                   |   |      |      |    |
|----------------------|-----------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------|---|------|------|----|
| C <sub>iss</sub>     | Input Capacitance                 | V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz |                                                                   | – | 169  | 225  | pF |
| C <sub>oss</sub>     | Output Capacitance                |                                                             |                                                                   | – | 43   | 55   | pF |
| C <sub>rss</sub>     | Reverse Transfer Capacitance      |                                                             |                                                                   | – | 2.04 | –    | pF |
| C <sub>oss(er)</sub> | Energy Related Output Capacitance | V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V               |                                                                   | – | 85   | –    | pF |
| Q <sub>g(tot)</sub>  | Total Gate Charge at 10 V         | V <sub>GS</sub> = 10 V                                      | V <sub>DD</sub> = 50 V,<br>I <sub>D</sub> = 5.6 A<br><br>(Note 5) | – | 2.9  | 3.77 | nC |
| Q <sub>g(tot)</sub>  | Total Gate Charge at 5 V          | V <sub>GS</sub> = 5 V                                       |                                                                   | – | 1.6  | 2.08 | nC |
| Q <sub>gs</sub>      | Gate to Source Gate Charge        |                                                             |                                                                   | – | 0.7  | –    | nC |
| Q <sub>gd</sub>      | Gate to Drain “Miller” Charge     |                                                             |                                                                   | – | 0.64 | –    | nC |
| V <sub>plateau</sub> | Gate Plateau Volatge              |                                                             |                                                                   | – | 3.81 | –    | V  |
| Q <sub>sync</sub>    | Total Gate Charge Sync.           | V <sub>DS</sub> = 0 V, I <sub>D</sub> = 2.8 A               |                                                                   | – | 2.45 | –    | nC |
| Q <sub>oss</sub>     | Output Charge                     | V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V               |                                                                   | – | 5.2  | –    | nC |

# FDT1600N10ALZ

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Symbol | Parameter                          | Test Conditions    | Min | Typ | Max | Unit     |
|--------|------------------------------------|--------------------|-----|-----|-----|----------|
| ESR    | Equivalent Series Resistance (G-S) | $f = 1\text{ MHz}$ | –   | 2.1 | –   | $\Omega$ |

## SWITCHING CHARACTERISTICS

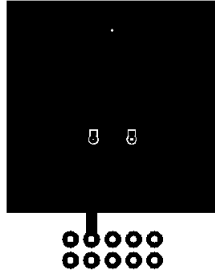
|              |                     |                                                                                                                 |   |      |      |    |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------------|---|------|------|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 50\text{ V}$ , $I_D = 5.6\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_G = 4.7\ \Omega$<br><br>(Note 5) | – | 7.4  | 24.8 | ns |
| $t_r$        | Rise Time           |                                                                                                                 | – | 2.5  | 15   | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                                 | – | 13.5 | 37   | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                                                 | – | 2.4  | 14.8 | ns |

## DRAIN-SOURCE DIODE CHARACTERISTICS

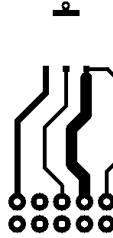
|                 |                                                          |                                                                                                          |   |      |      |    |
|-----------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---|------|------|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |                                                                                                          | – | –    | 5.6  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                                                          | – | –    | 11.2 | A  |
| V <sub>SD</sub> | Source to Drain Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5.6 A                                                            | – | –    | 1.3  | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 5.6 A, V <sub>DD</sub> = 50 V<br>dI <sub>F</sub> /dt = 100 A/μs | – | 34.1 | –    | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |                                                                                                          | – | 32.7 | –    | nC |

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.

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a.  $60^\circ\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b.  $118^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper

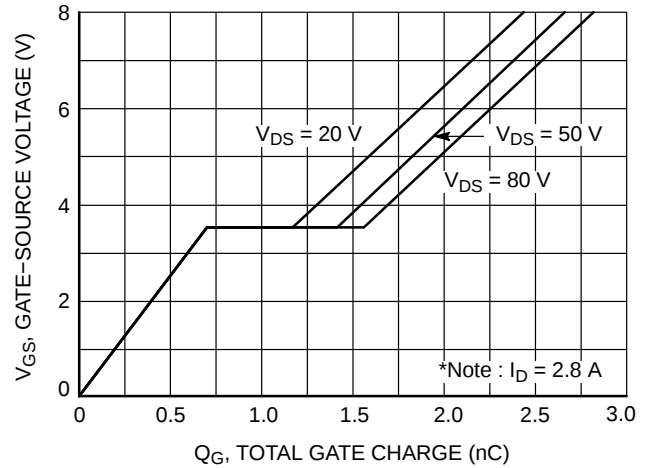
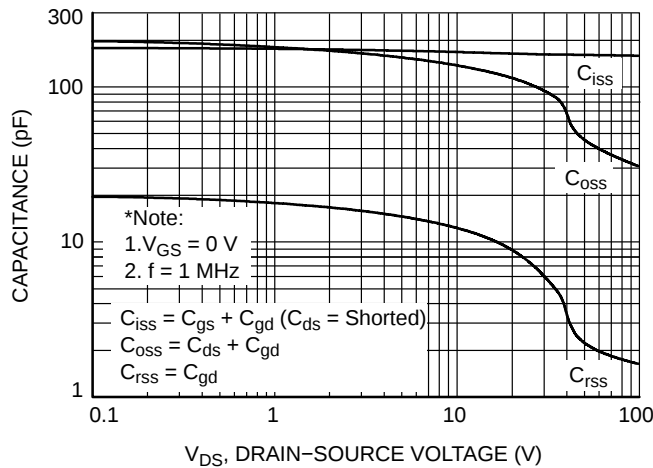
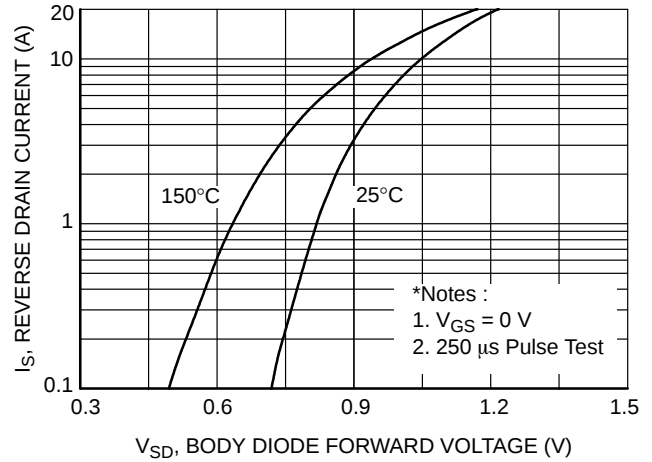
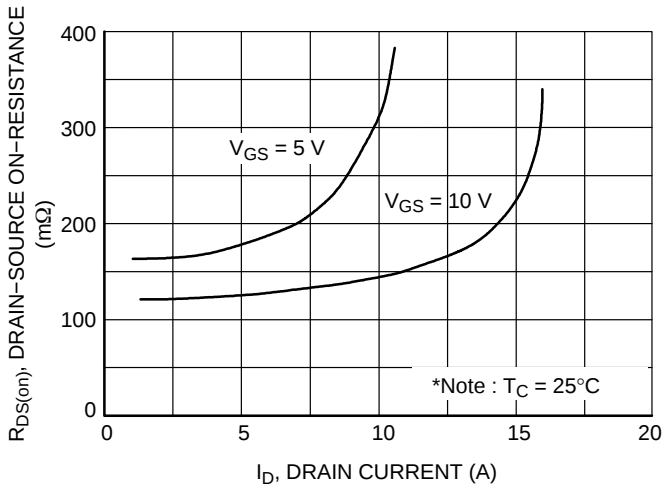
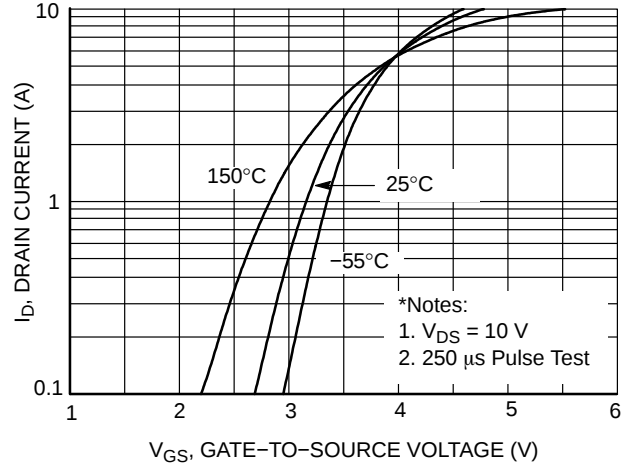
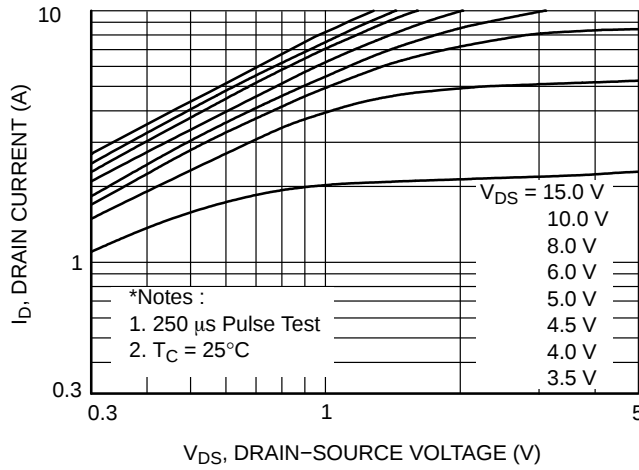
- Repetitive rating: pulse-width limited by maximum junction temperature.
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{ mH}$ ,  $I_{AS} = 2.47\text{ A}$ .
- $I_{SD} \leq 5.6\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
- Essentially independent of operating temperature typical characteristics.

## PACKAGE MARKING AND ORDERING INFORMATION

| Part Number   | Top Mark | Package | Reel Size | Tape Width | Shipping <sup>†</sup> |
|---------------|----------|---------|-----------|------------|-----------------------|
| FDT1600N10ALZ | 10ALZ    | SOT-223 | 13"       | 12 mm      | 4000/ 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](#).

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (continued)

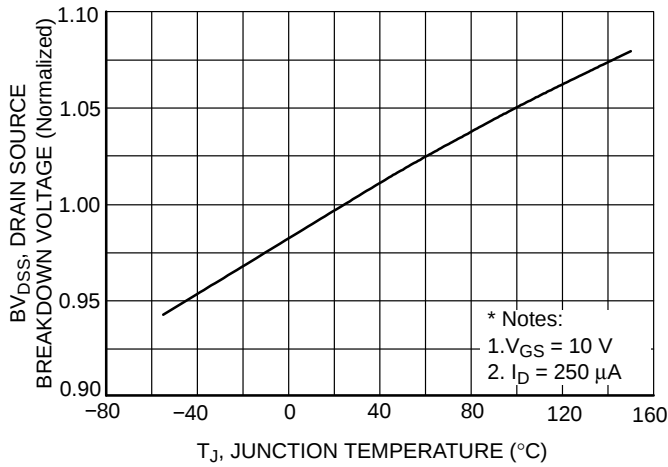


Figure 7. Breakdown Voltage Variation vs. Temperature

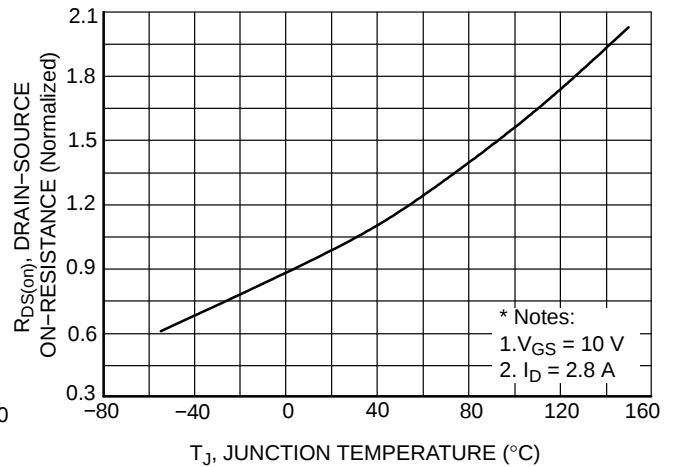


Figure 8. On-Resistance Variation vs. Temperature

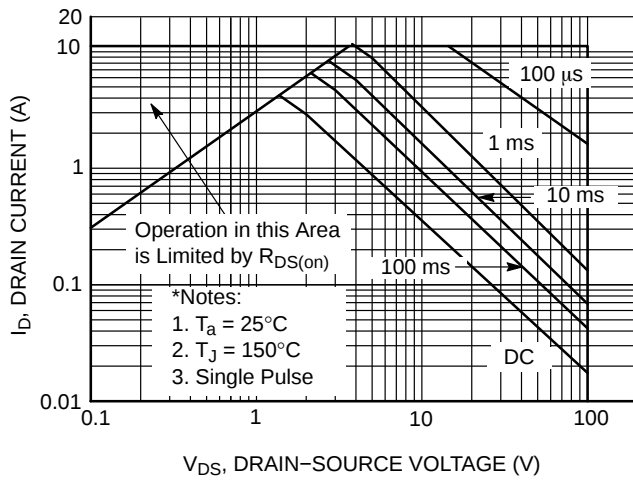


Figure 9. Maximum Safe Operating Area

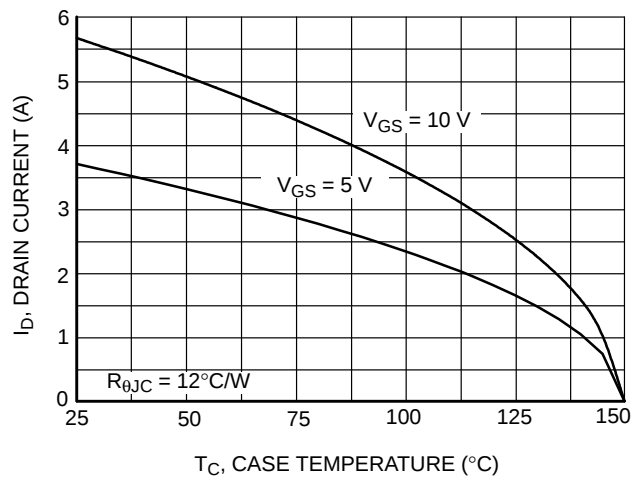


Figure 10. Maximum Drain Current vs. Case Temperature

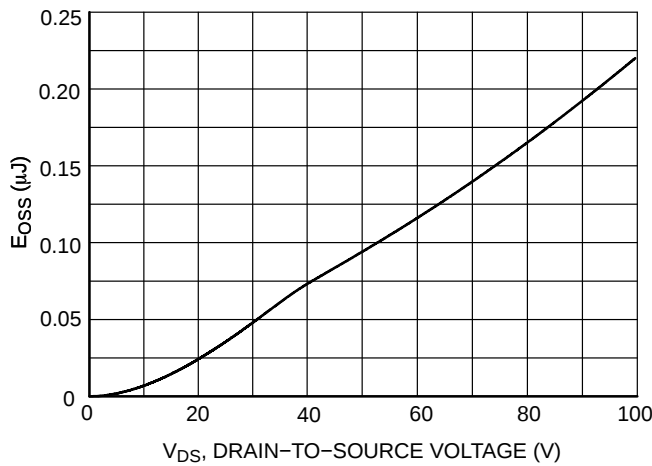


Figure 11.  $E_{OSS}$  vs. Drain-to-Source Voltage

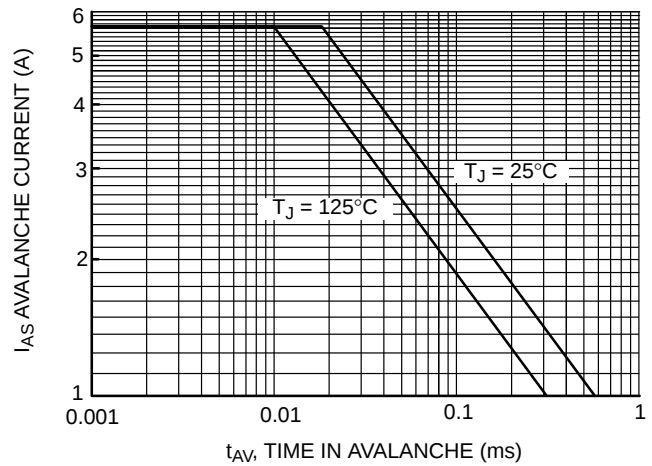


Figure 12. Unclamped Inductive Switching Capability

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## TYPICAL CHARACTERISTICS (continued)

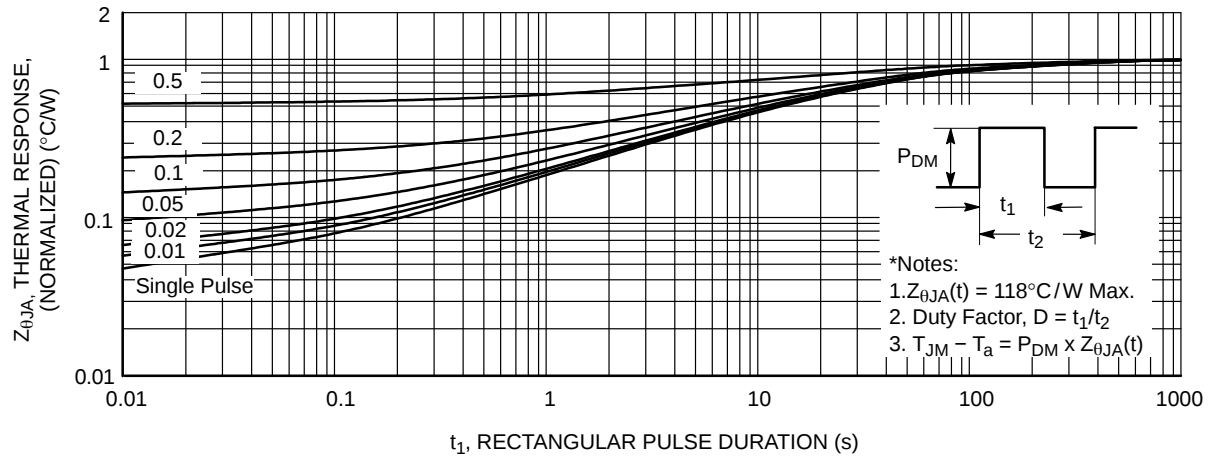


Figure 13. Transient Thermal Response Curve

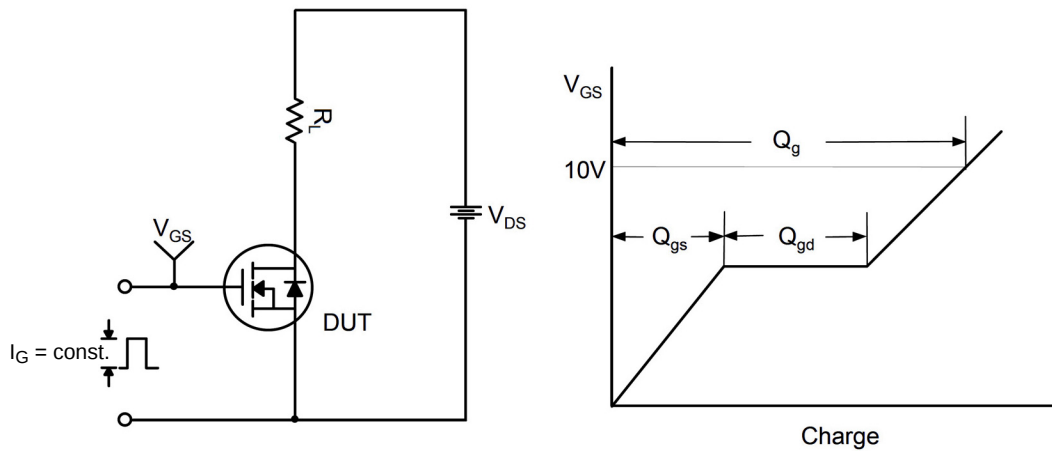


Figure 14. Gate Charge Test Circuit & Waveform

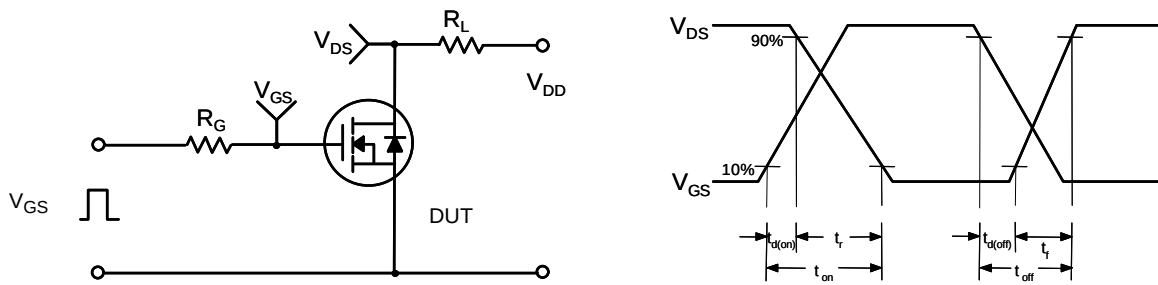


Figure 15. Resistive Switching Test Circuit & Waveforms

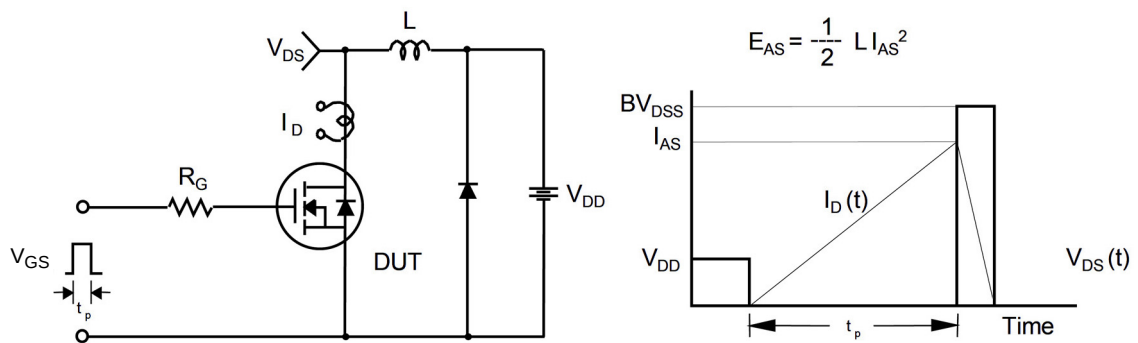


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

# FDT1600N10ALZ

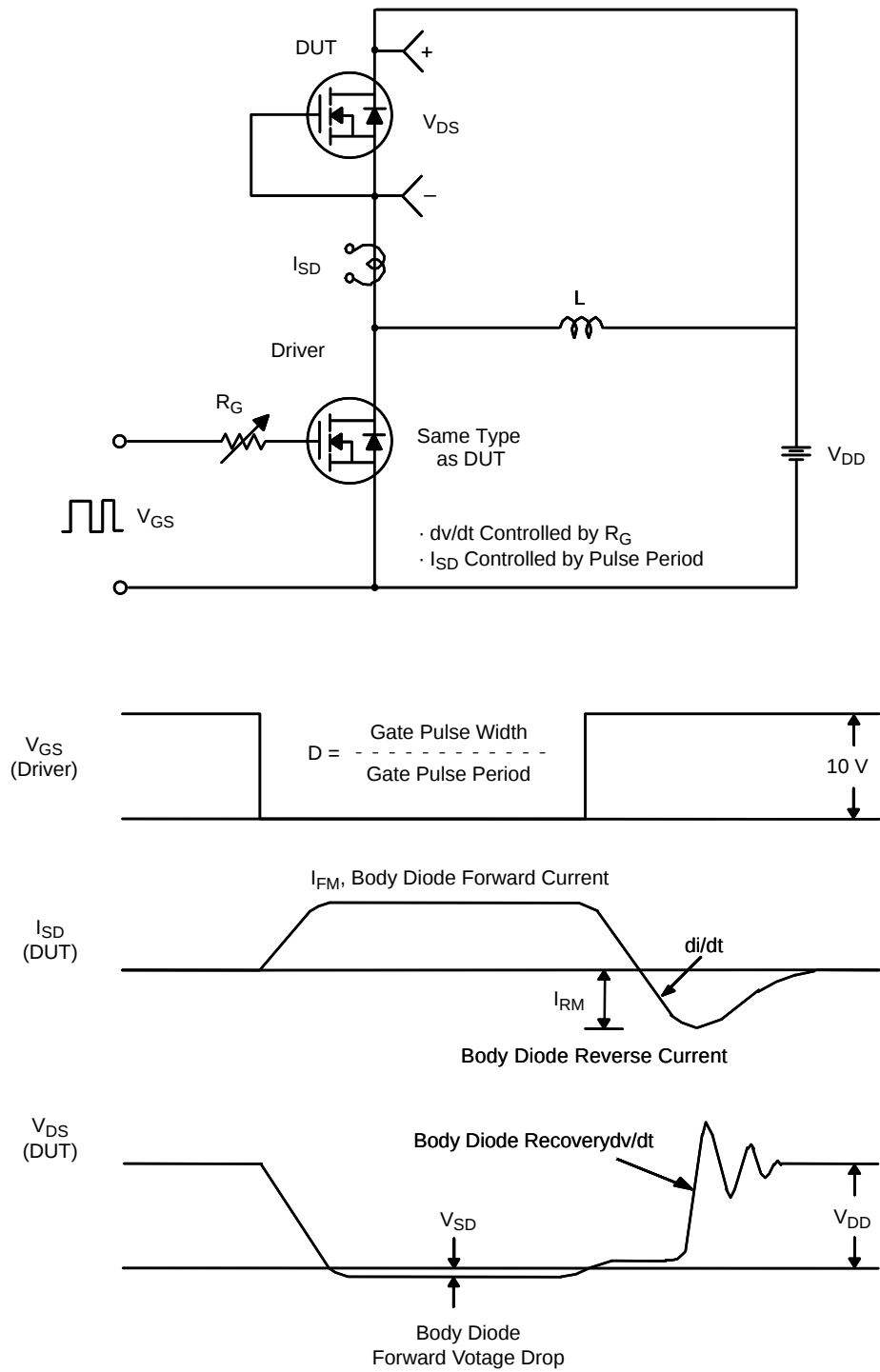


Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

# FDT1600N10ALZ

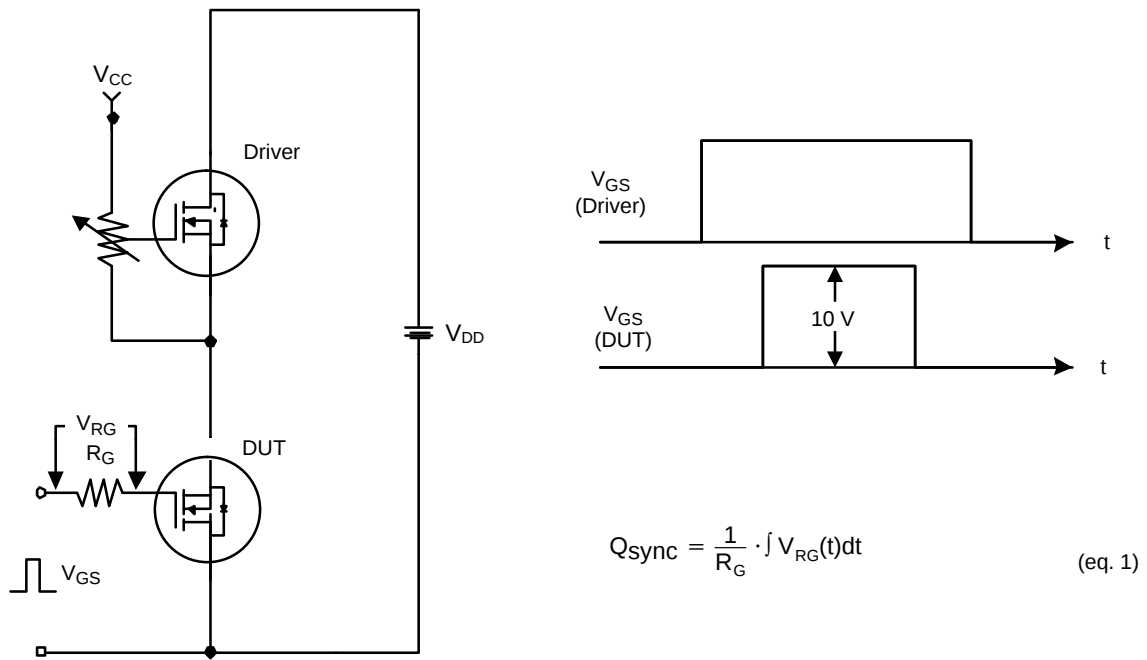
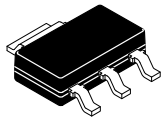


Figure 18. Total Gate Charge  $Q_{\text{sync}}$ . Test Circuit & Waveforms



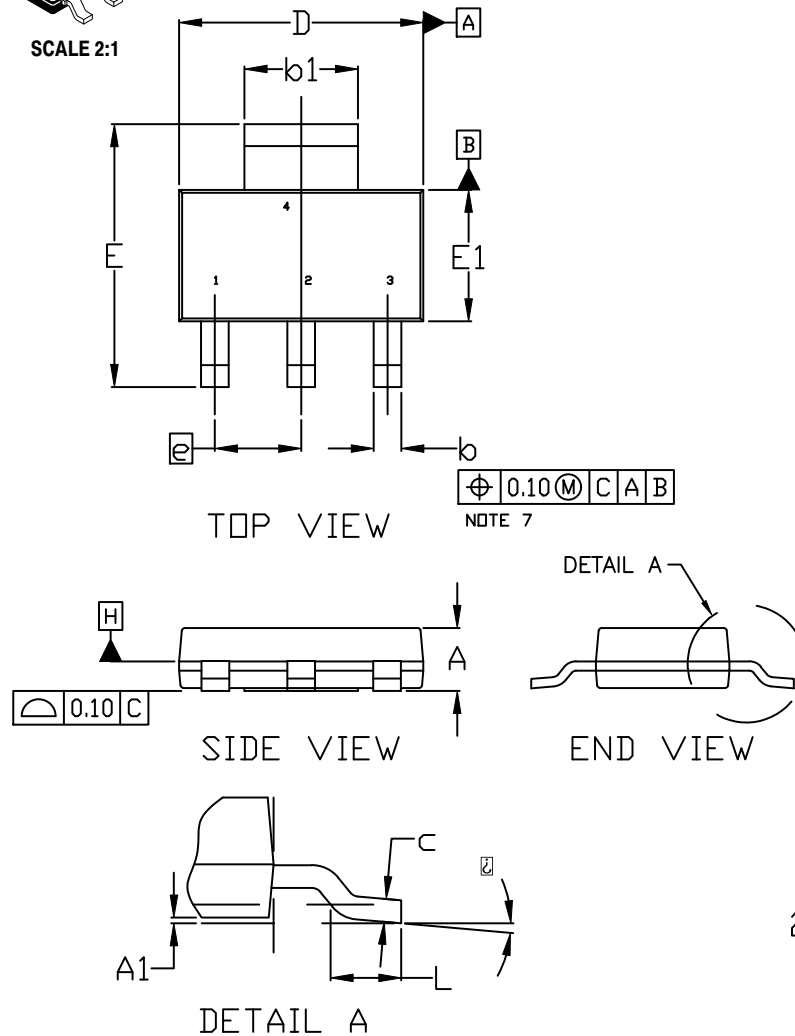
SCALE 2:1

**SOT-223**  
**CASE 318H**  
**ISSUE B**

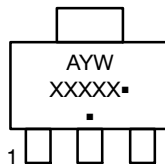
DATE 13 MAY 2020

## 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 DAMBAR 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.



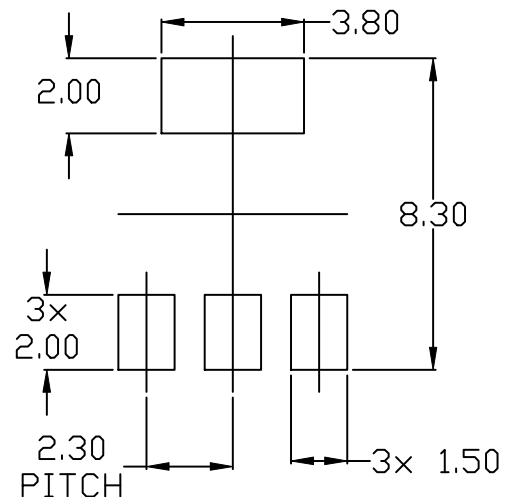
| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | ---         | ---  | 1.80 |
| A1  | 0.02        | 0.06 | 0.11 |
| b   | 0.60        | 0.74 | 0.88 |
| b1  | 2.90        | 3.00 | 3.10 |
| c   | 0.24        | ---  | 0.35 |
| D   | 6.30        | 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        | ---  | ---  |
| ⌀   | 0°          | ---  | 10°  |

**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.


**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.

|                         |                    |                                                                                                                                                                                  |
|-------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>SOT-223</b>     | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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