



1N60

Power MOSFET

## 1.2A, 600V N-CHANNEL POWER MOSFET

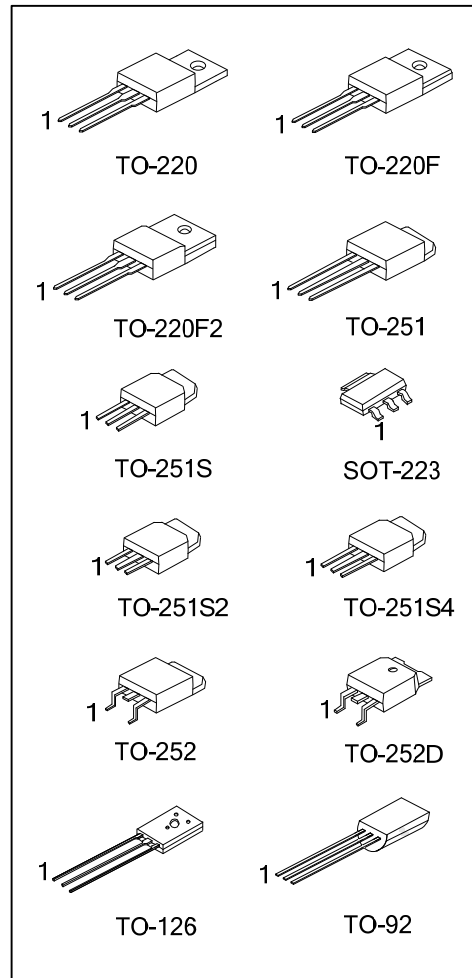
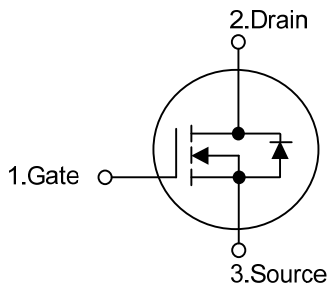
### DESCRIPTION

The UTC 1N60 is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

### FEATURES

- \*  $R_{DS(ON)} < 11.5\Omega @ V_{GS}=10V, I_D=0.6A$
- \* Ultra Low gate charge (typical 5.0nC)
- \* Low reverse transfer capacitance ( $C_{RSS} = \text{typical } 3.0 \text{ pF}$ )
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

### SYMBOL



## ORDERING INFORMATION

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing   |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |           |
| 1N60L-AA3-R     | 1N60G-AA3-R  | SOT-223  | G              | D | S | Tape Reel |
| 1N60L-TA3-T     | 1N60G-TA3-T  | TO-220   | G              | D | S | Tube      |
| 1N60L-TF2-T     | 1N60G-TF2-T  | TO-220F2 | G              | D | S | Tube      |
| 1N60L-TF3-T     | 1N60G-TF3-T  | TO-220F  | G              | D | S | Tube      |
| 1N60L-TM3-T     | 1N60G-TM3-T  | TO-251   | G              | D | S | Tube      |
| 1N60L-TMS-T     | 1N60G-TMS-T  | TO-251S  | G              | D | S | Tube      |
| 1N60L-TMS2-T    | 1N60G-TMS2-T | TO-251S2 | G              | D | S | Tube      |
| 1N60L-TMS4-T    | 1N60G-TMS4-T | TO-251S4 | G              | D | S | Tube      |
| 1N60L-TN3-R     | 1N60G-TN3-R  | TO-252   | G              | D | S | Tape Reel |
| 1N60L-TND-R     | 1N60G-TND-R  | TO-252D  | G              | D | S | Tape Reel |
| 1N60L-T60-K     | 1N60G-T60-K  | TO-126   | G              | D | S | Bulk      |
| 1N60L-T92-B     | 1N60G-T92-B  | TO-92    | G              | D | S | Tape Box  |
| 1N60L-T92-K     | 1N60G-T92-K  | TO-92    | G              | D | S | Bulk      |

Note: Pin Assignment: G: Gate D: Drain S: Source

|  |  |
|--|--|
| <p>1N60G-AA3-R</p> <p>(1)Packing Type<br/>(2)Package Type<br/>(3)Green Package</p> | <p>(1) B: Tape Box, K: Bulk, T: Tube, R: Tape Reel<br/>(2) AA3: SOT-223, T92: TO-92, TA3: TO-220, TF2: TO-220F2, TF3: TO-220F, TM3: TO-251, TMS: TO-251S, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TND: TO-252D, T60: TO-126<br/>(3) L: Lead Free, G: Halogen Free and Lead Free</p> |
|--|--|

## MARKING

| PACKAGE  | MARKING  |  |
|--|--|--|
| SOT-223  | <p>L: Lead Free<br/>G: Halogen Free<br/>Data Code</p>                  |  |
| TO-220<br>TO-220F<br>TO-220F2<br>TO-251<br>TO-251S | TO-251S2<br>TO-251S4<br>TO-252<br>TO-252D                              | <p>UTC<br/>1N60<br/>L: Lead Free<br/>G: Halogen Free<br/>Data Code</p> <p>Lot Code ←</p> |
| TO-126   | <p>UTC<br/>1N60<br/>Data Code<br/>L: Lead Free<br/>G: Halogen Free</p> |  |
| TO-92  | <p>UTC<br/>1N60<br/>L: Lead Free<br/>G: Halogen Free<br/>Data Code</p> |  |

■ **ABSOLUTE MAXIMUM RATINGS** ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                            |  | SYMBOL    | RATINGS    | UNIT             |
|--------------------------------------|--|-----------|------------|------------------|
| Drain-Source Voltage                 |  | $V_{DSS}$ | 600        | V                |
| Gate-Source Voltage                  |  | $V_{GSS}$ | $\pm 30$   | V                |
| Avalanche Current (Note 2)           |  | $I_{AR}$  | 1.2        | A                |
| Continuous Drain Current             |  | $I_D$     | 1.2        | A                |
| Pulsed Drain Current (Note 2)        |  | $I_{DM}$  | 4.8        | A                |
| Avalanche Energy                     | Single Pulsed (Note 3)                                 | $E_{AS}$  | 50         | mJ               |
|                                      | Repetitive (Note 2)                                    | $E_{AR}$  | 4.0        | mJ               |
| Peak Diode Recovery $dv/dt$ (Note 4) |  | $dv/dt$   | 4.5        | V/ns             |
| Power Dissipation                    | SOT-223  | $P_D$     | 8          | W                |
|                                      | TO-251/TO-252<br>TO-252D/TO-251S<br>TO-251S2/ TO-251S4 |           | 28         |                  |
|                                      | TO-220   |           | 40         |                  |
|                                      | TO-220F  |           | 21         |                  |
|                                      | TO-220F2   |           | 23         |                  |
|                                      | TO-92( $T_A=25^\circ\text{C}$ )                        |           | 1          |                  |
|                                      | TO-126   |           | 12.5       |                  |
|                                      | Junction Temperature                                   |           | $T_J$      |                  |
| Operating Temperature                |  | $T_{OPR}$ | -55 ~ +150 | $^\circ\text{C}$ |
| Storage Temperature                  |  | $T_{STG}$ | -55 ~ +150 | $^\circ\text{C}$ |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature

3.  $L = 60\text{mH}$ ,  $I_{AS} = 1\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 1.2\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

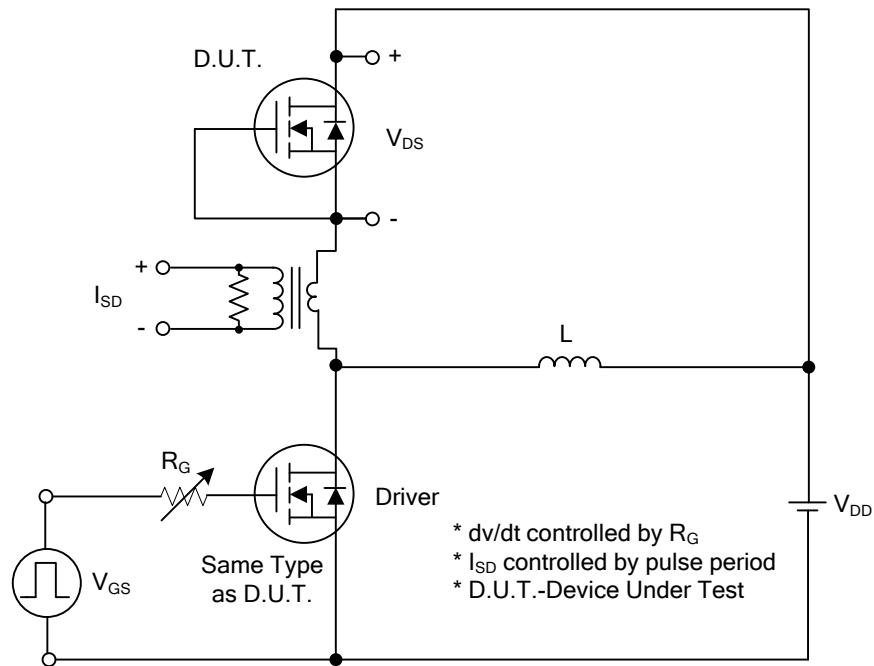
| PARAMETER           |  | SYMBOL        | RATINGS  | UNIT                      |               |      |                           |
|---------------------|--|---------------|--|---------------------------|---------------|------|---------------------------|
| Junction to Ambient | SOT-223  | $\theta_{JA}$ | 150  | $^\circ\text{C}/\text{W}$ |               |      |                           |
|                     | TO-251/TO-252<br>TO-252D/TO-251S<br>TO-251S2/ TO-251S4 |               | 110  |                           |               |      |                           |
|                     | TO-220/TO-220F   |               | 62.5   |                           |               |      |                           |
|                     | TO-220F2   |               | 62.5   |                           |               |      |                           |
|                     | TO-92  |               | 140  |                           |               |      |                           |
|                     | TO-126   |               | 132  |                           |               |      |                           |
|                     | Junction to Case                                       |               | SOT-223  |                           | $\theta_{JC}$ | 14   | $^\circ\text{C}/\text{W}$ |
|                     |  |               | TO-251/TO-252<br>TO-252D/TO-251S<br>TO-251S2/ TO-251S4 |                           |               | 4.53 |                           |
| TO-220              |  | 3.13          |  |                           |               |      |                           |
| TO-220F             |  | 5.95          |  |                           |               |      |                           |
| TO-220F2            |  | 5.43          |  |                           |               |      |                           |
| TO-92               |  | 80            |  |                           |               |      |                           |
| TO-126              |  | 10            |  |                           |               |      |                           |

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

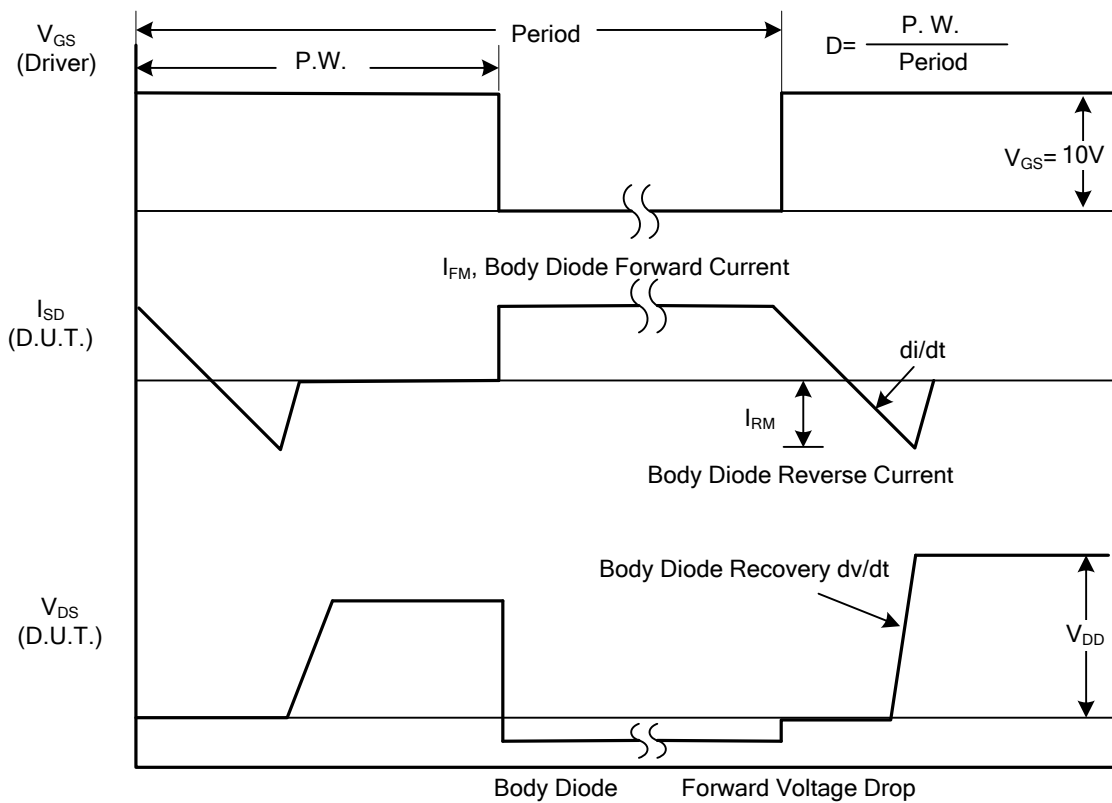
| PARAMETER   | SYMBOL                       | TEST CONDITIONS                                     | MIN | TYP | MAX  | UNIT                  |
|---|------------------------------|---|-----|-----|------|-----------------------|
| <b>OFF CHARACTERISTICS</b>                            |                              |   |     |     |      |                       |
| Drain-Source Breakdown Voltage                        | $BV_{DSS}$                   | $V_{GS}=0V, I_D=250\mu A$                           | 600 |     |      | V                     |
| Drain-Source Leakage Current                          | $I_{DSS}$                    | $V_{DS}=600V, V_{GS}=0V$                            |     |     | 10   | $\mu A$               |
| Gate-Source Leakage Current                           | Forward                      | $I_{GSS}$   |     |     | 100  | nA                    |
|   | Reverse                      |   |     |     | -100 | nA                    |
| Breakdown Voltage Temperature Coefficient             | $\Delta BV_{DSS}/\Delta T_J$ | $I_D=250\mu A$                                      |     | 0.4 |      | $^\circ\text{C}^{-1}$ |
| <b>ON CHARACTERISTICS</b>                             |                              |   |     |     |      |                       |
| Gate Threshold Voltage                                | $V_{GS(TH)}$                 | $V_{DS}=V_{GS}, I_D=250\mu A$                       | 2.0 |     | 4.0  | V                     |
| Static Drain-Source On-State Resistance               | $R_{DS(ON)}$                 | $V_{GS}=10V, I_D=0.6A$                              |     | 9.3 | 11.5 | $\Omega$              |
| <b>DYNAMIC CHARACTERISTICS</b>                        |                              |   |     |     |      |                       |
| Input Capacitance                                     | $C_{ISS}$                    | $V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$              |     | 120 | 150  | pF                    |
| Output Capacitance                                    | $C_{OSS}$                    |   | 20  | 25  | pF   |                       |
| Reverse Transfer Capacitance                          | $C_{RSS}$                    |   | 3.0 | 4.0 | pF   |                       |
| <b>SWITCHING CHARACTERISTICS</b>                      |                              |   |     |     |      |                       |
| Total Gate Charge                                     | $Q_G$                        | $V_{DS}=480V, V_{GS}=10V, I_D=1.2A$<br>(Note 2,3)   |     | 5.0 | 6.0  | nC                    |
| Gate-Source Charge                                    | $Q_{GS}$                     |   | 1.0 |     | nC   |                       |
| Gate-Drain Charge                                     | $Q_{GD}$                     |   | 2.6 |     | nC   |                       |
| Turn-On Delay Time                                    | $t_{D(ON)}$                  | $V_{DD}=300V, I_D=1.2A, R_G=50\Omega$<br>(Note 2,3) |     | 5   | 20   | ns                    |
| Turn-On Rise Time                                     | $t_R$                        |   | 25  | 60  | ns   |                       |
| Turn-Off Delay Time                                   | $t_{D(OFF)}$                 |   | 7   | 25  | ns   |                       |
| Turn-Off Fall Time                                    | $t_F$                        |   | 25  | 60  | ns   |                       |
| <b>SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS</b> |                              |   |     |     |      |                       |
| Drain-Source Diode Forward Voltage                    | $V_{SD}$                     | $V_{GS}=0V, I_S=1.2A$                               |     |     | 1.4  | V                     |
| Maximum Continuous Drain-Source Diode Forward Current | $I_S$                        |   |     |     | 1.2  | A                     |
| Maximum Pulsed Drain-Source Diode Forward Current     | $I_{SM}$                     |   |     |     | 4.8  | A                     |
| Reverse Recovery Time                                 | $t_{rr}$                     | $V_{GS}=0V, I_S=1.2A$                               |     | 160 |      | ns                    |
| Reverse Recovery Charge                               | $Q_{rr}$                     | $dI_F/dt=100A/\mu s$ (Note 1)                       |     | 0.3 |      | $\mu C$               |

- Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature  
 2. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$   
 3. Essentially Independent of Operating Temperature

■ TEST CIRCUITS AND WAVEFORMS

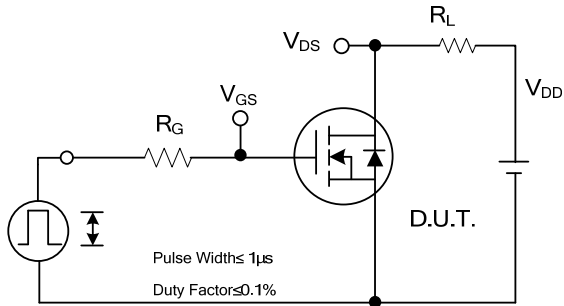


Peak Diode Recovery dv/dt Test Circuit

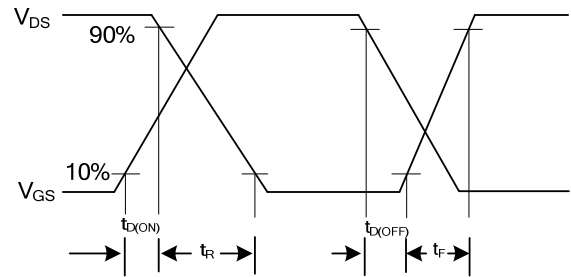


Peak Diode Recovery dv/dt Waveforms

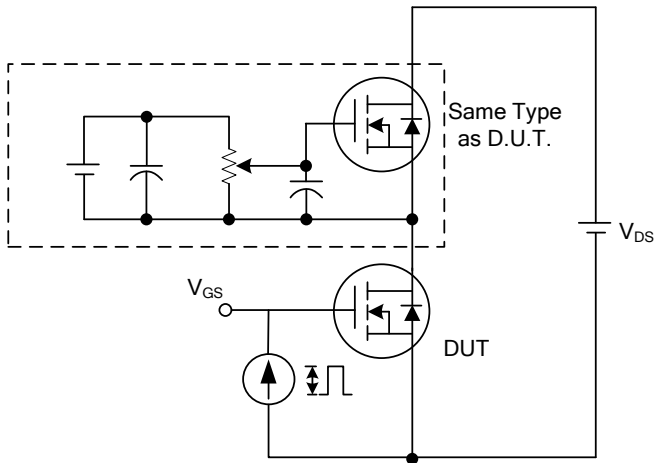
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



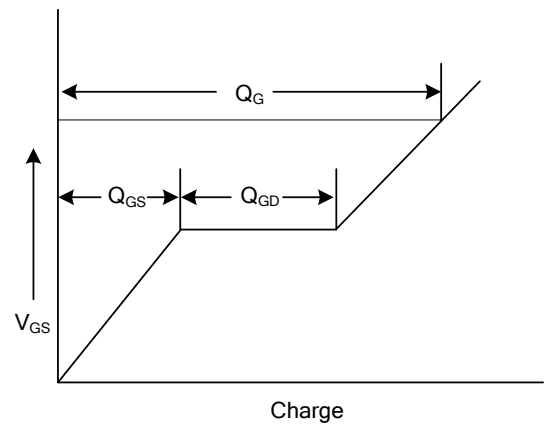
Switching Test Circuit



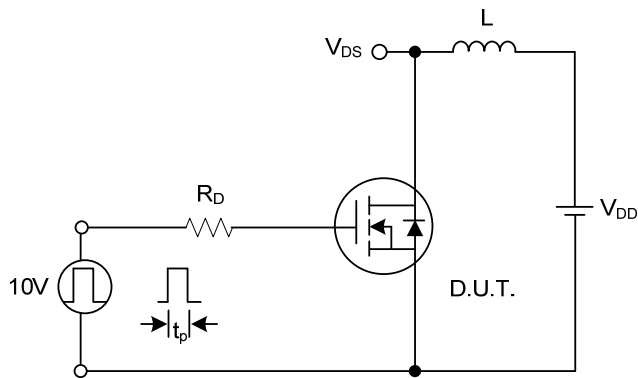
Switching Waveforms



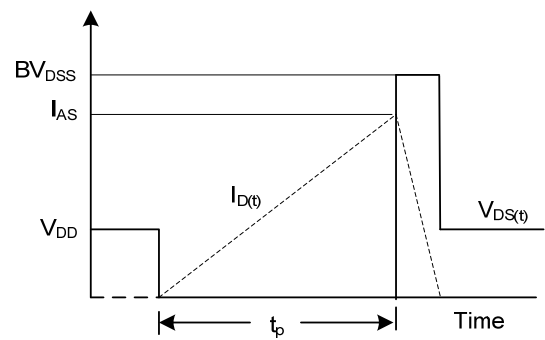
Gate Charge Test Circuit



Gate Charge Waveform

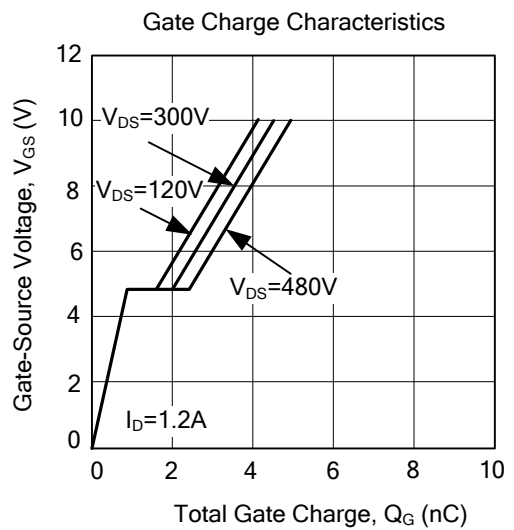
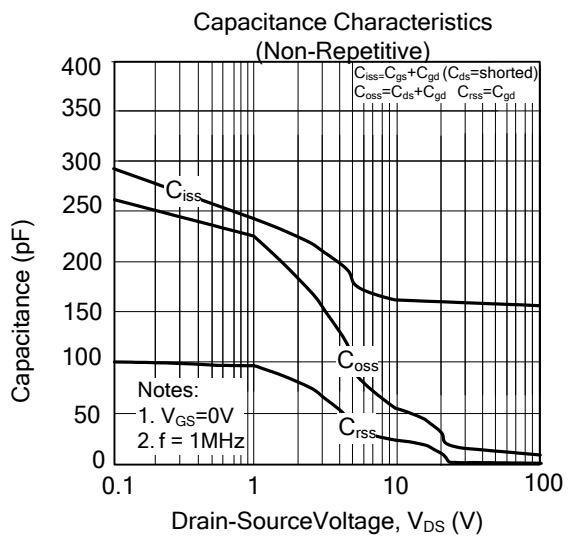
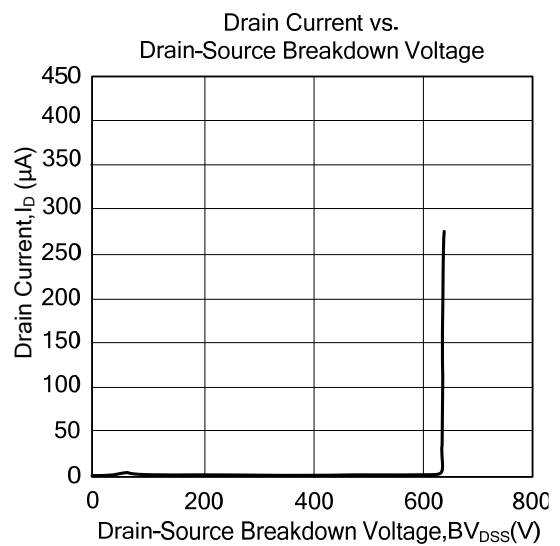
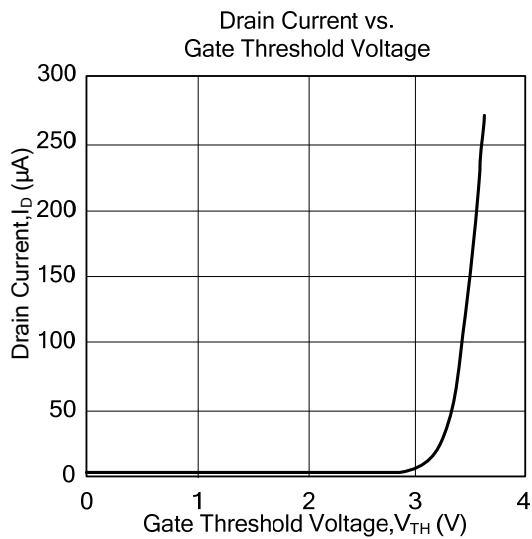
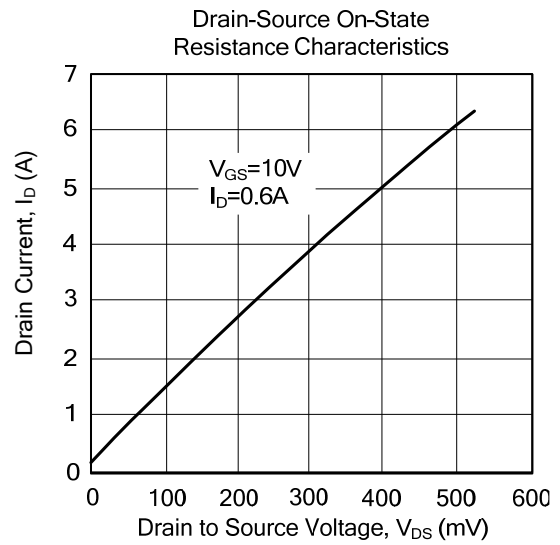
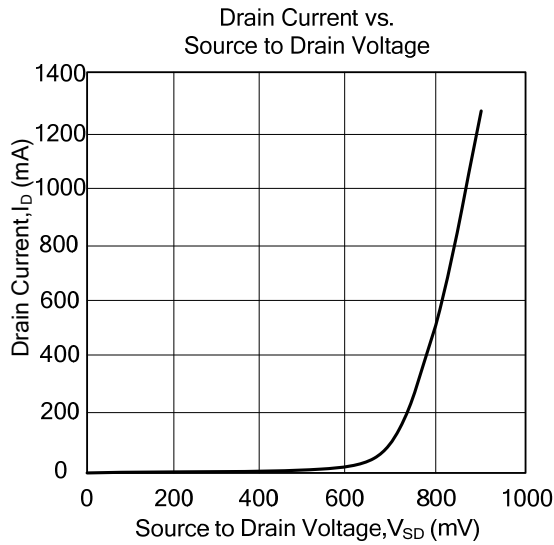


Unclamped Inductive Switching Test Circuit



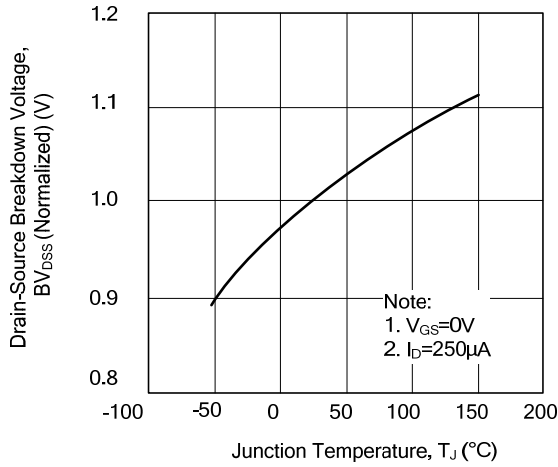
Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

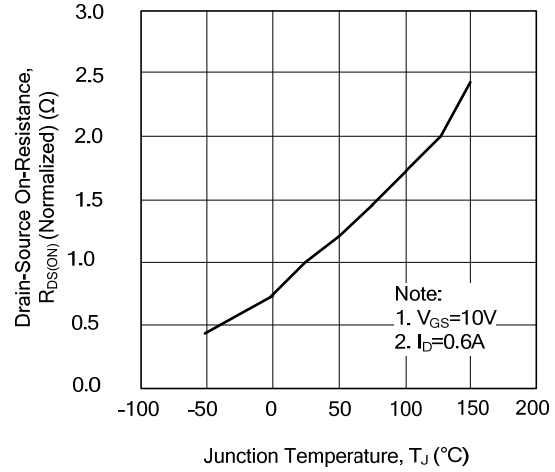


## ■ TYPICAL CHARACTERISTICS (Cont.)

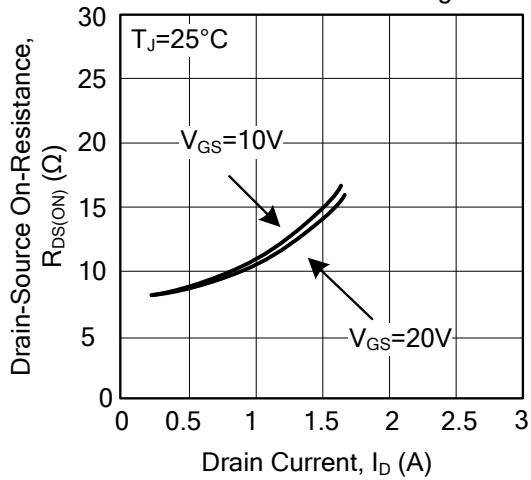
Breakdown Voltage Variation vs. Temperature



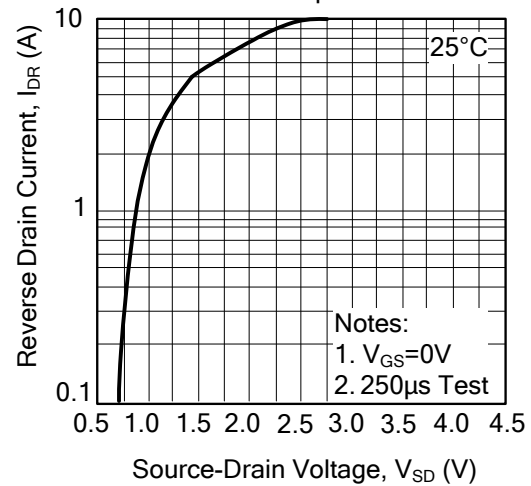
On-Resistance Junction Temperature



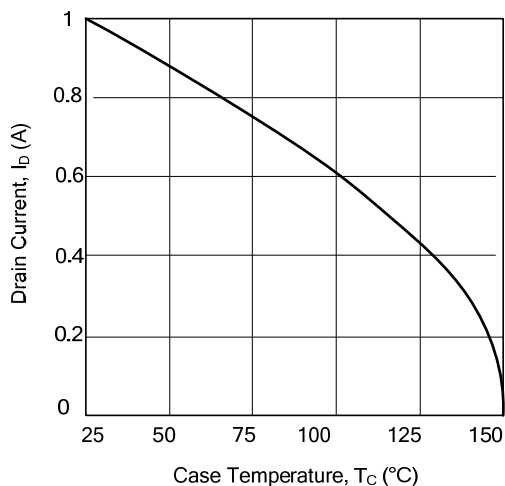
On-Resistance Variation vs. Drain Current and Gate Voltage



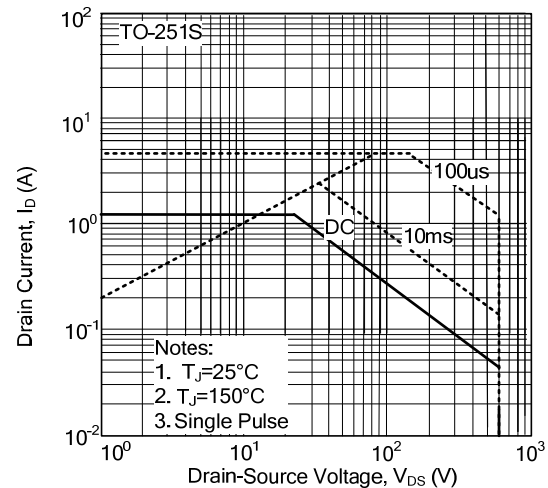
On State Current vs. Allowable Case Temperature



Maximum Drain Current vs. Case Temperature

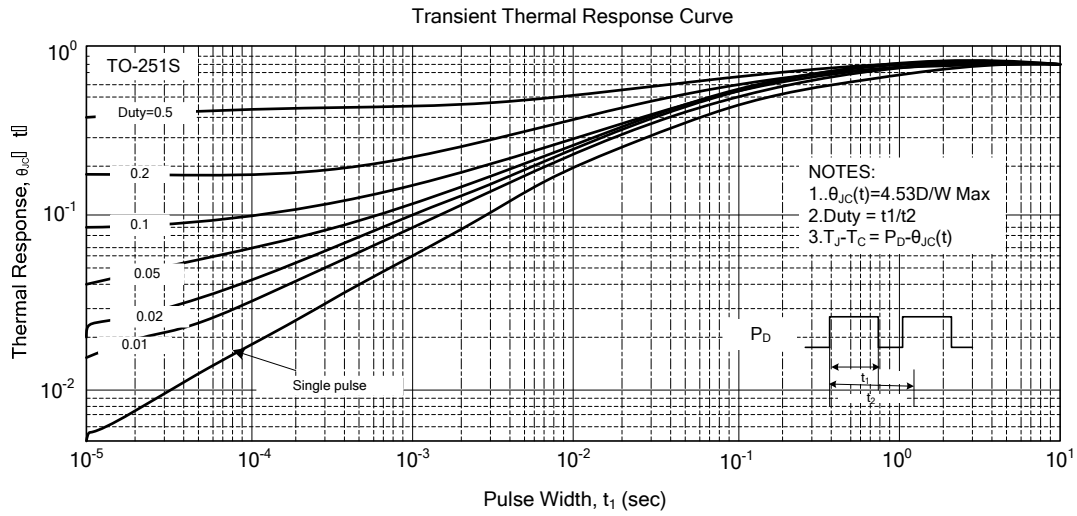


Safe Operating Area





■ TYPICAL CHARACTERISTICS (Cont.)



UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.

## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for [MOSFET](#) category:*

*Click to view products by [Unisonic](#) manufacturer:*

Other Similar products are found below :

[614233C](#) [648584F](#) [IRFD120](#) [IRFF430](#) [JANTX2N5237](#) [2N7000](#) [FCA20N60\\_F109](#) [FDZ595PZ](#) [2SK2267\(Q\)](#) [2SK2545\(Q,T\)](#) [405094E](#)  
[423220D](#) [MIC4420CM-TR](#) [VN1206L](#) [614234A](#) [715780A](#) [SSM6J414TU,LF\(T](#) [751625C](#) [PSMN4R2-30MLD](#) [TK31J60W5,S1VQ\(O](#)  
[2SK2614\(Te16L1,Q\)](#) [DMN1017UCP3-7](#) [EFC2J004NUZTDG](#) [FCAB21350L1](#) [P85W28HP2F-7071](#) [DMN1053UCP4-7](#) [NTE2384](#) [NTE2969](#)  
[NTE6400A](#) [DMN61D9UWQ-13](#) [US6M2GTR](#) [DMN31D5UDJ-7](#) [SSM6P54TU,LF](#) [DMP22D4UFO-7B](#) [IPS60R3K4CEAKMA1](#)  
[DMN1006UCA6-7](#) [DMN16M9UCA6-7](#) [STF5N65M6](#) [STU5N65M6](#) [C3M0021120D](#) [DMN13M9UCA6-7](#) [BSS340NWH6327XTSA1](#)  
[MCM3400A-TP](#) [IPS60R1K0PFD7SAKMA1](#) [IPS60R360PFD7SAKMA1](#) [IPS60R600PFD7SAKMA1](#) [IPS60R210PFD7SAKMA1](#)  
[DMN2990UFB-7B](#) [ISZ040N03L5ISATMA1](#) [IPS60R280PFD7SAKMA1](#)