



## 4N60-MH

Power MOSFET

### 4A, 600V N-CHANNEL POWER MOSFET

#### DESCRIPTION

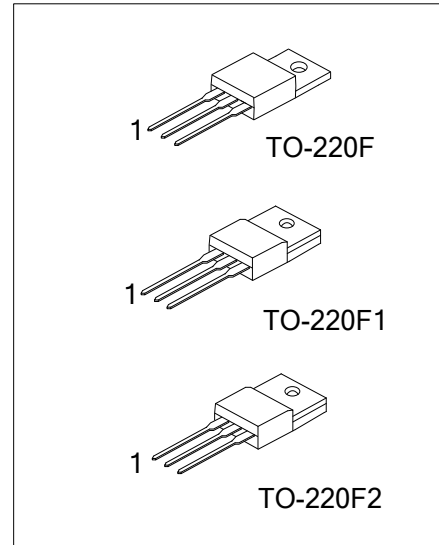
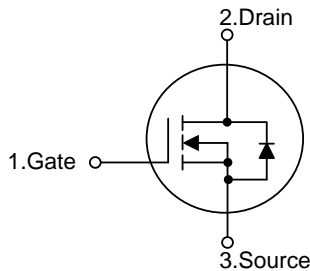
The UTC 4N60-MH is a N-channel mode power MOSFET using UTC's advanced technology to provide customers with planar stripe and DMOS technology. This technology allows a minimum on-state resistance and superior switching performance. It also can withstand high energy pulse in the avalanche and commutation mode.

The UTC 4N60-MH is generally applied in high efficiency switch mode power supplies.

#### FEATURES

- \*  $R_{DS(ON)} \leq 2.4 \Omega @ V_{GS}=10V, I_D=2.0A$
- \* High Switching Speed

#### SYMBOL



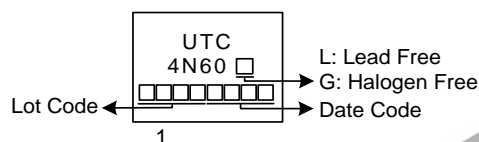
#### ORDERING INFORMATION

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing |
|-----------------|--------------|----------|----------------|---|---|---------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |         |
| 4N60L-TF1-T     | 4N60G-TF1-T  | TO-220F1 | G              | D | S | Tube    |
| 4N60L-TF2-T     | 4N60G-TF2-T  | TO-220F2 | G              | D | S | Tube    |
| 4N60L-TF3-T     | 4N60G-TF3-T  | TO-220F  | G              | D | S | Tube    |

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

|                    |   |
|--------------------|---|
| <p>4N60G-TF1-T</p> | <p>(1) T: Tube</p> <p>(2) TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|--------------------|---|

#### MARKING



## ■ ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, unless otherwise specified)

| PARAMETER                          |                        | SYMBOL           | RATINGS    | UNIT |
|------------------------------------|------------------------|------------------|------------|------|
| Drain-Source Voltage               |                        | V <sub>DSS</sub> | 600        | V    |
| Gate-Source Voltage                |                        | V <sub>GSS</sub> | ± 30       | V    |
| Drain Current                      | Continuous             | I <sub>D</sub>   | 4          | A    |
|                                    | Pulsed (Note 2)        | I <sub>DM</sub>  | 8          | A    |
| Avalanche Energy                   | Single Pulsed (Note 3) | E <sub>AS</sub>  | 194        | mJ   |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt            | 3.5        | V/ns |
| Power Dissipation                  |                        | P <sub>D</sub>   | 32         | W    |
| Junction Temperature               |                        | T <sub>J</sub>   | +150       | °C   |
| Storage Temperature                |                        | T <sub>STG</sub> | -55 ~ +150 | °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 = 30mH, I<sub>AS</sub> = 3.6A, V<sub>DD</sub> = 100V, R<sub>G</sub> = 25 Ω Starting T<sub>J</sub> = 25°C  
 4. I<sub>SD</sub> ≤ 2.0A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C

## ■ THERMAL DATA

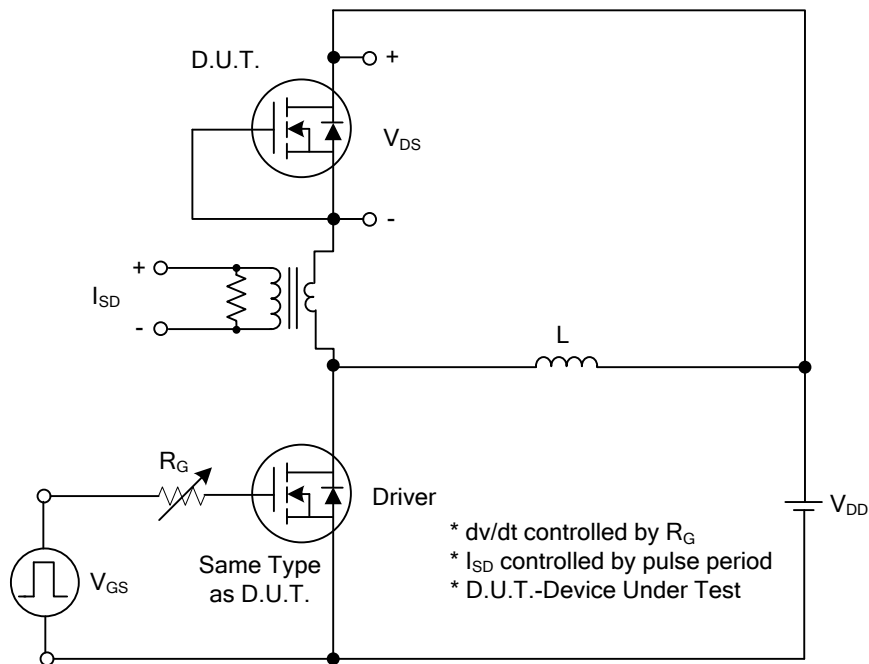
| PARAMETER           | SYMBOL          | RATING | UNIT |
|---------------------|-----------------|--------|------|
| Junction to Ambient | θ <sub>JA</sub> | 62.5   | °C/W |
| Junction to Case    | θ <sub>JC</sub> | 3.9    | °C/W |

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

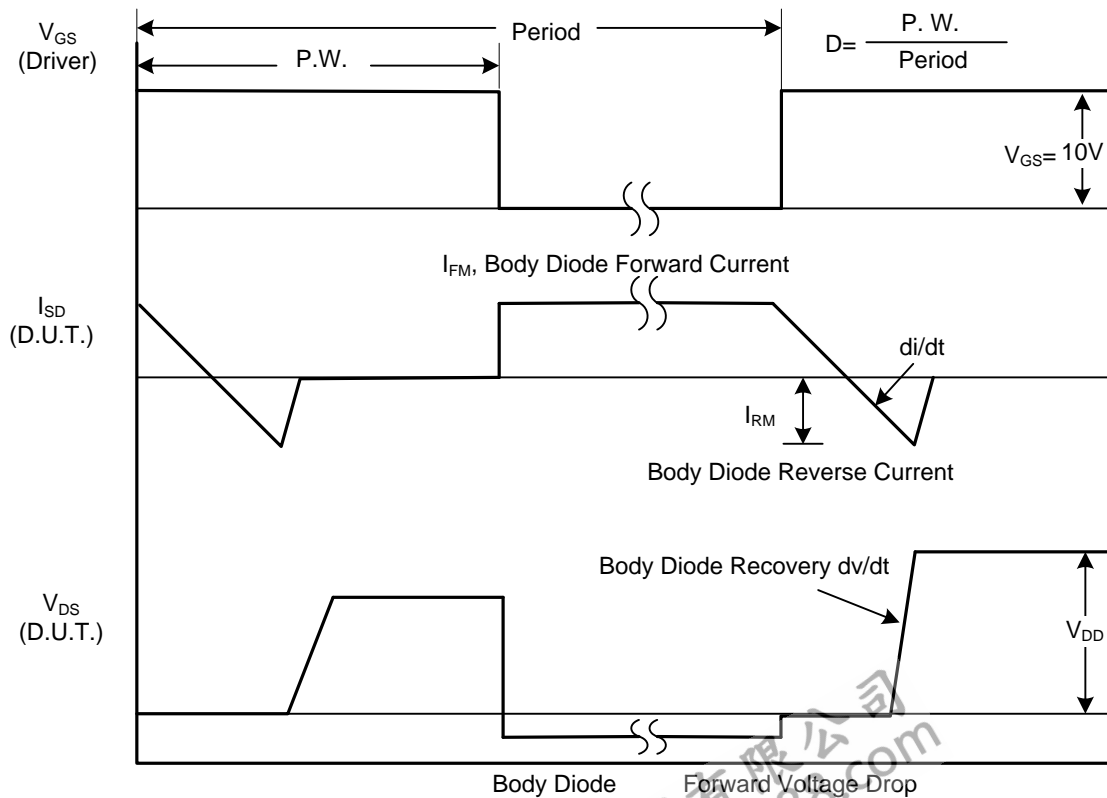
| PARAMETER  |         | SYMBOL              | TEST CONDITIONS   | MIN | TYP  | MAX  | UNIT |
|--|---------|---------------------|---|-----|------|------|------|
| <b>OFF CHARACTERISTICS</b>                             |         |                     |   |     |      |      |      |
| Drain-Source Breakdown Voltage                         |         | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> = 250μA   | 600 |      |      | V    |
| Drain-Source Leakage Current                           |         | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V  |     |      | 10   | μA   |
| Gate-Source Leakage Current                            | Forward | I <sub>GSS</sub>    | V <sub>GS</sub> =30V, V <sub>DS</sub> =0V   |     |      | 100  | nA   |
|  | Reverse |                     | V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V  |     |      | -100 | nA   |
| <b>ON CHARACTERISTICS</b>                              |         |                     |   |     |      |      |      |
| Gate Threshold Voltage                                 |         | V <sub>GS(TH)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA  | 2.0 |      | 4.0  | V    |
| Static Drain-Source On-State Resistance                |         | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =2.0A  |     |      | 2.4  | Ω    |
| <b>DYNAMIC CHARACTERISTICS</b>                         |         |                     |   |     |      |      |      |
| Input Capacitance                                      |         | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0 MHz  |     | 455  |      | pF   |
| Output Capacitance                                     |         | C <sub>OSS</sub>    |   |     | 60   |      | pF   |
| Reverse Transfer Capacitance                           |         | C <sub>RSS</sub>    |   |     | 7.5  |      | pF   |
| <b>SWITCHING CHARACTERISTICS</b>                       |         |                     |   |     |      |      |      |
| Total Gate Charge (Note 1)                             |         | Q <sub>G</sub>      | V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =4.0A<br>I <sub>G</sub> =1mA (Note 1, 2)  |     | 13.3 |      | nC   |
| Gate-source Charge                                     |         | Q <sub>GS</sub>     |   |     | 3.5  |      | nC   |
| Gate-Drain Charge                                      |         | Q <sub>GD</sub>     |   |     | 3    |      | nC   |
| Turn-on Delay Time (Note 1)                            |         | t <sub>D(ON)</sub>  | V <sub>DS</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =4.0A,<br>R <sub>G</sub> =25Ω (Note 1, 2) |     | 6    |      | ns   |
| Rise Time  |         | t <sub>R</sub>      |   |     | 17   |      | ns   |
| Turn-off Delay Time                                    |         | t <sub>D(OFF)</sub> |   |     | 45   |      | ns   |
| Fall-Time  |         | t <sub>F</sub>      |   |     | 24   |      | ns   |
| <b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b> |         |                     |   |     |      |      |      |
| Maximum Body-Diode Continuous Current                  |         | I <sub>S</sub>      |   |     |      | 4    | A    |
| Maximum Body-Diode Pulsed Current                      |         | I <sub>SM</sub>     |   |     |      | 8    | A    |
| Drain-Source Diode Forward Voltage (Note 1)            |         | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =4.0A   |     |      | 1.4  | V    |
| Reverse Recovery Time (Note 1)                         |         | t <sub>rr</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =4.0A   |     | 244  |      | ns   |
| Reverse Recovery Charge                                |         | Q <sub>rr</sub>     | di/dt=100A/μs (Note1)   |     | 3.9  |      | μC   |

- Notes: 1. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%.  
 2. Essentially independent of operating temperature.

## TEST CIRCUITS AND WAVEFORMS

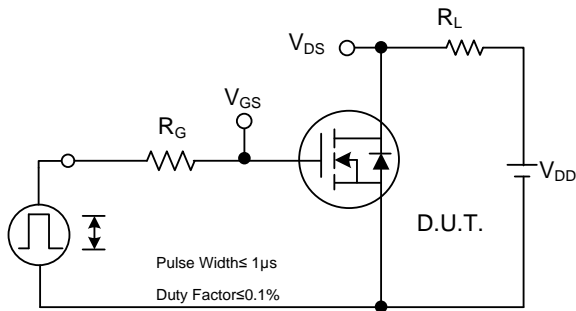


Peak Diode Recovery dv/dt Test Circuit

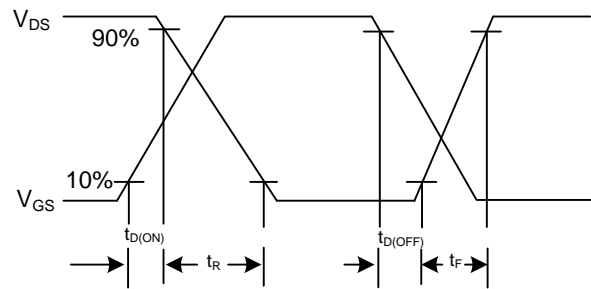


Peak Diode Recovery dv/dt Waveforms

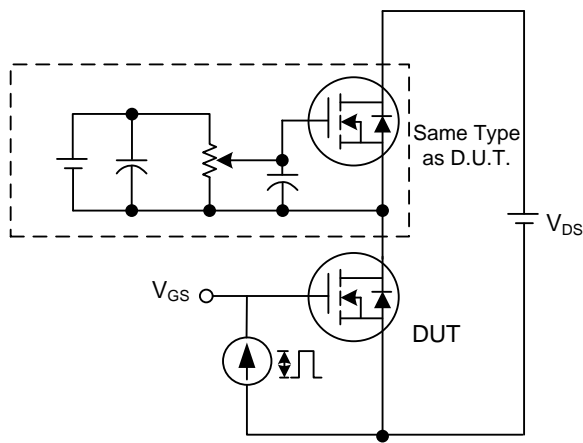
## TEST CIRCUITS AND WAVEFORMS



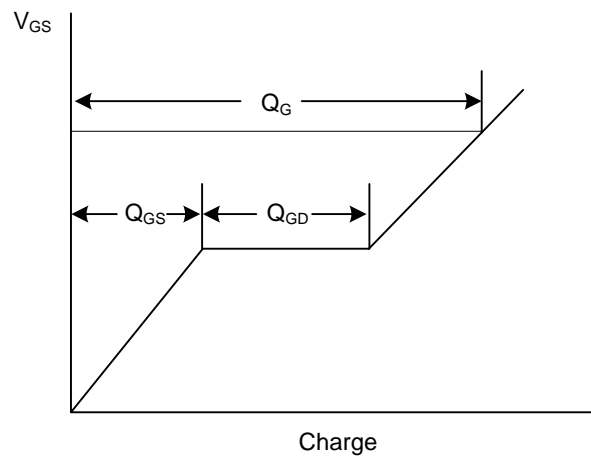
Switching Test Circuit



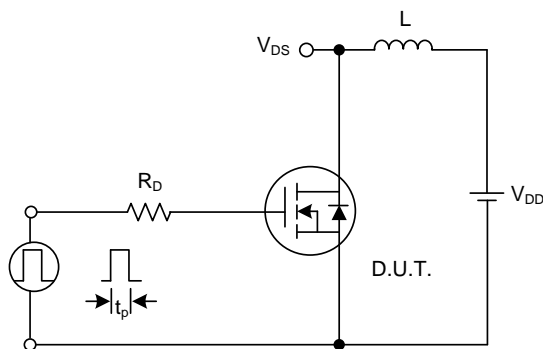
Switching Waveforms



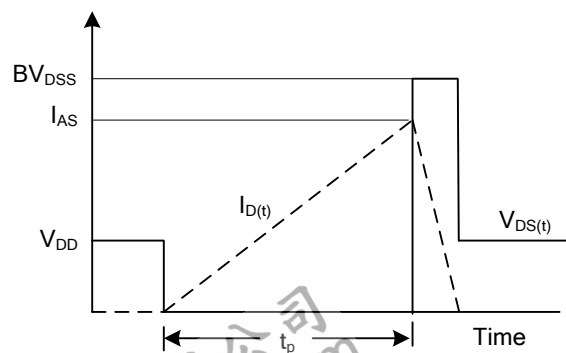
Gate Charge Test Circuit



Gate Charge Waveform

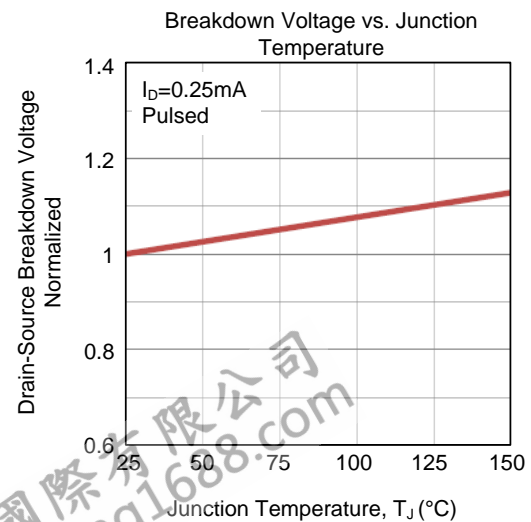
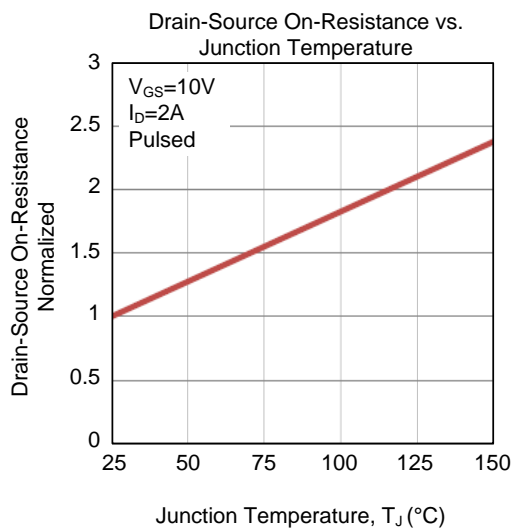
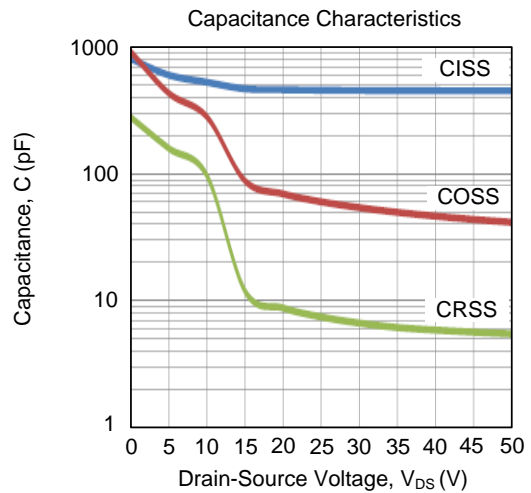
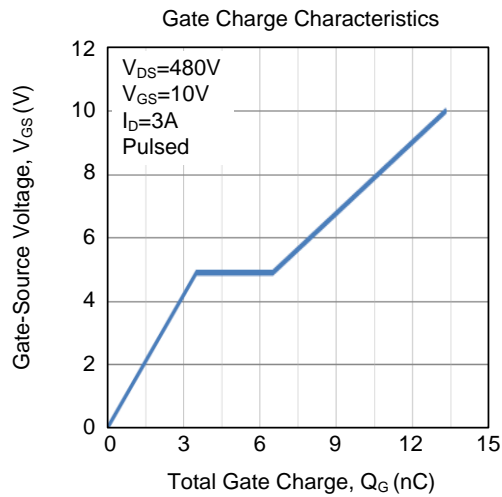
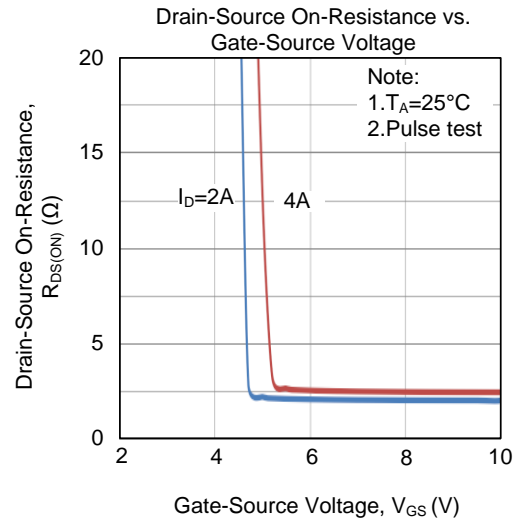
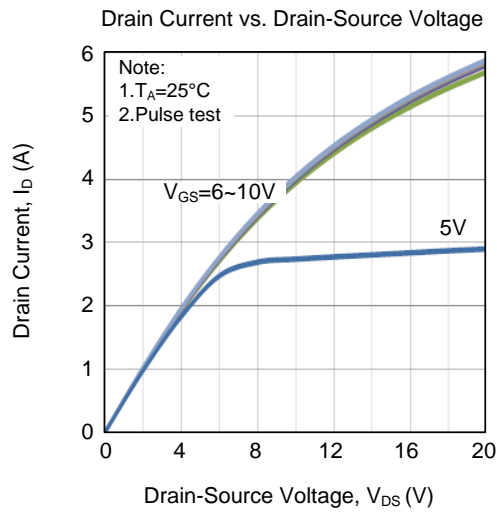


Unclamped Inductive Switching Test Circuit

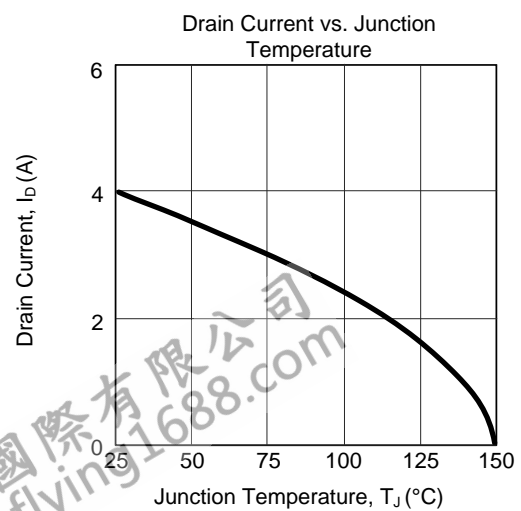
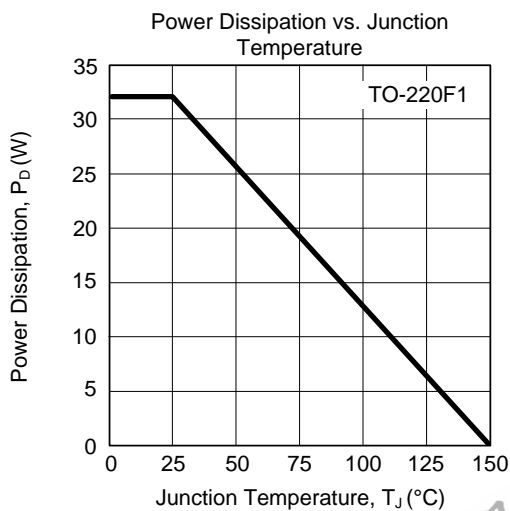
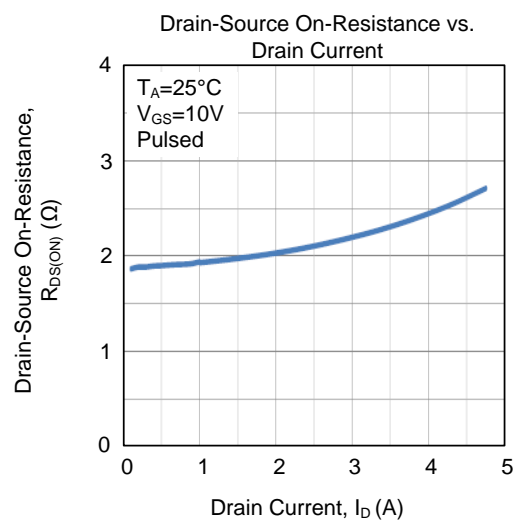
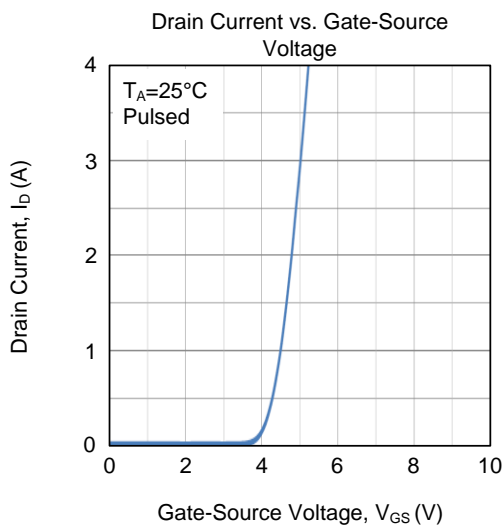
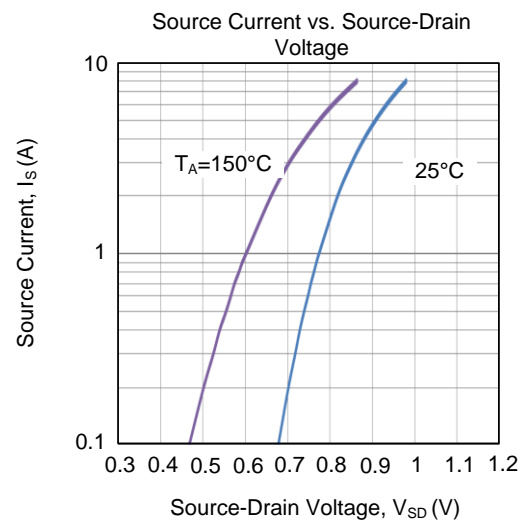
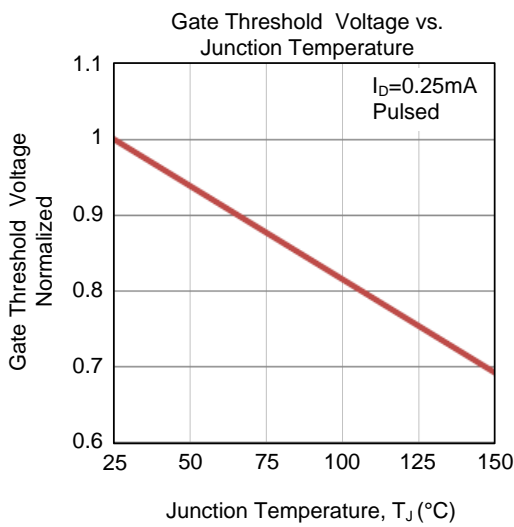


Unclamped Inductive Switching Waveforms

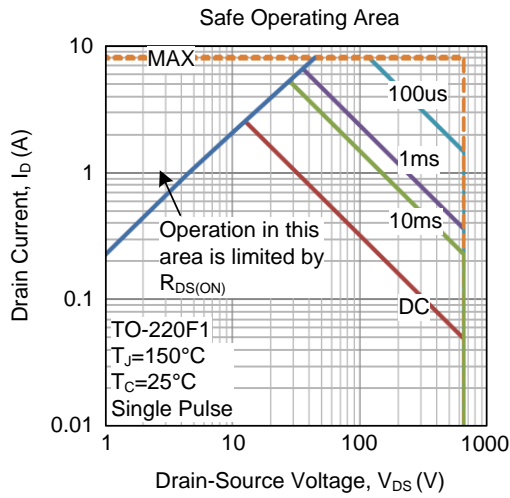
## TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS (Cont.)



## ■ TYPICAL CHARACTERISTICS (Cont.)



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