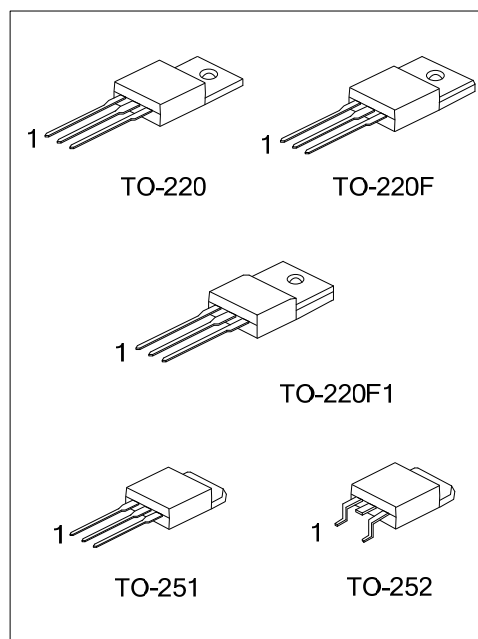
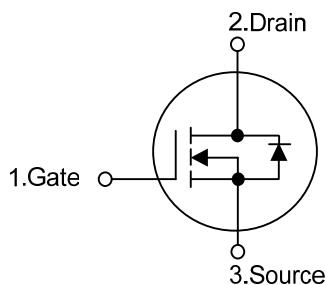


**8NM65-U2****Power MOSFET****8A, 650V N-CHANNEL  
SUPER-JUNCTION MOSFET****DESCRIPTION**

The **UTC 8NM65-U2** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

**FEATURES**

- \*  $R_{DS(ON)} \leq 0.9 \Omega$  @  $V_{GS}=10V$ ,  $I_D=4.0A$
- \* Fast Switching Capability
- \* Avalanche Energy Tested
- \* Improved dv/dt Capability, High Ruggedness

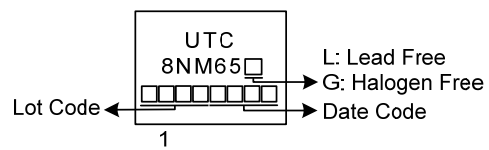
**SYMBOL****ORDERING INFORMATION**

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing   |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |           |
| 8NM65L-TA3-T    | 8NM65G-TA3-T | TO-220   | G              | D | S | Tube      |
| 8NM65L-TF3-T    | 8NM65G-TF3-T | TO-220F  | G              | D | S | Tube      |
| 8NM65L-TF1-T    | 8NM65G-TF1-T | TO-220F1 | G              | D | S | Tube      |
| 8NM65L-TM3-T    | 8NM65G-TM3-T | TO-251   | G              | D | S | Tube      |
| 8NM65L-TN3-R    | 8NM65G-TN3-R | TO-252   | G              | D | S | Tape Reel |

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

|                                                                                        |                                                                                                                                                                    |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>8NM65G-TA3-T</p> <p>(1) Packing Type<br/>(2) Package Type<br/>(3) Green Package</p> | <p>(1) T: Tube, R: Tape Reel<br/>(2) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F<br/>TM3: TO-251, TN3: TO-252<br/>(3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## ■ MARKING



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

| PARAMETER                          |                        | SYMBOL    | RATINGS    | UNIT             |
|------------------------------------|------------------------|-----------|------------|------------------|
| Drain-Source Voltage               |                        | $V_{DSS}$ | 650        | V                |
| Gate-Source Voltage                |                        | $V_{GSS}$ | $\pm 30$   | V                |
| Drain Current                      | Continuous             | $I_D$     | 8.0        | A                |
|                                    | Pulsed (Note 2)        | $I_{DM}$  | 32         | A                |
| Avalanche Current (Note 2)         |                        | $I_{AR}$  | 2.7        | A                |
| Avalanche Energy                   | Single Pulsed (Note 3) | $E_{AS}$  | 39.2       | mJ               |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt     | 4.1        | V/ns             |
| Power Dissipation                  | TO-220                 | $P_D$     | 74         | W                |
|                                    | TO-220F/TO-220F1       |           | 26         | W                |
|                                    | TO-251/TO-252          |           | 48         | W                |
| Junction Temperature               |                        | $T_J$     | +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.  $L=10\text{mH}$ ,  $I_{AS}=2.8\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 8\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

| PARAMETER           |                  | SYMBOL        | RATINGS | UNIT                      |
|---------------------|------------------|---------------|---------|---------------------------|
| Junction to Ambient | TO-220/TO-220F   | $\theta_{JA}$ | 62.5    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F1         |               |         |                           |
|                     | TO-251/TO-252    |               | 110     |                           |
| Junction to Case    | TO-220           | $\theta_{JC}$ | 1.68    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F/TO-220F1 |               | 4.8     |                           |
|                     | TO-251/TO-252    |               | 2.6     |                           |

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

| PARAMETER                                       |         | SYMBOL              | TEST CONDITIONS                                                                                  | MIN | TYP  | MAX  | UNIT |
|-------------------------------------------------|---------|---------------------|--------------------------------------------------------------------------------------------------|-----|------|------|------|
| OFF CHARACTERISTICS                             |         |                     |                                                                                                  |     |      |      |      |
| Drain-Source Breakdown Voltage                  |         | BV <sub>DSS</sub>   | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                     | 650 |      |      | V    |
| Drain-Source Leakage Current                    |         | I <sub>DSS</sub>    | V <sub>DS</sub> = 650V, 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   |
| ON CHARACTERISTICS                              |         |                     |                                                                                                  |     |      |      |      |
| Gate Threshold Voltage                          |         | V <sub>GS(TH)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                       | 2.5 |      | 4.5  | V    |
| Static Drain-Source On-State Resistance         |         | R <sub>DS(ON)</sub> | V <sub>GS</sub> = 10V, I <sub>D</sub> = 4.0A                                                     |     | 0.67 | 0.9  | Ω    |
| DYNAMIC CHARACTERISTICS                         |         |                     |                                                                                                  |     |      |      |      |
| Input Capacitance                               |         | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0 MHz                                             |     | 422  |      | pF   |
| Output Capacitance                              |         | C <sub>OSS</sub>    |                                                                                                  |     | 336  |      | pF   |
| Reverse Transfer Capacitance                    |         | C <sub>RSS</sub>    |                                                                                                  |     | 32   |      | pF   |
| SWITCHING CHARACTERISTICS                       |         |                     |                                                                                                  |     |      |      |      |
| Total Gate Charge (Note 1)                      |         | Q <sub>G</sub>      | V <sub>DS</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =8A, I <sub>G</sub> =1mA (Note 1, 2) |     | 21   |      | nC   |
| Gate to Source Charge                           |         | Q <sub>GS</sub>     |                                                                                                  |     | 3.5  |      | nC   |
| Gate to Drain Charge                            |         | Q <sub>GD</sub>     |                                                                                                  |     | 7    |      | nC   |
| Turn-ON Delay Time (Note 1)                     |         | t <sub>D(ON)</sub>  | V <sub>DD</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =8A, R <sub>G</sub> =25Ω (Note 1, 2) |     | 6.4  |      | ns   |
| Rise Time                                       |         | t <sub>TR</sub>     |                                                                                                  |     | 20   |      | ns   |
| Turn-OFF Delay Time                             |         | t <sub>D(OFF)</sub> |                                                                                                  |     | 50   |      | ns   |
| Fall-Time                                       |         | t <sub>F</sub>      |                                                                                                  |     | 31   |      | ns   |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS |         |                     |                                                                                                  |     |      |      |      |
| Maximum Body-Diode Continuous Current           |         | I <sub>S</sub>      |                                                                                                  |     |      | 8    | A    |
| Maximum Body-Diode Pulsed Current               |         | I <sub>SM</sub>     |                                                                                                  |     |      | 32   | A    |
| Drain-Source Diode Forward Voltage (Note 1)     |         | V <sub>SD</sub>     | I <sub>S</sub> =8.0A, V <sub>GS</sub> =0V                                                        |     |      | 1.4  | V    |
| Body Diode Reverse Recovery Time (Note 1)       |         | t <sub>rr</sub>     | I <sub>S</sub> =8.0A, V <sub>GS</sub> =0V,                                                       |     | 316  |      | ns   |
| Body Diode Reverse Recovery Charge              |         | Q <sub>rr</sub>     | dl <sub>F</sub> /dt=100A/μs                                                                      |     | 3.4  |      | μC   |

Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

D.U.T.

$V_{DS}$

$I_{SD}$

$L$

$R_G$

Driver

$V_{GS}$

Same Type as D.U.T.

$V_{DD}$

- \*  $dv/dt$  controlled by  $R_G$
- \*  $I_{SD}$  controlled by pulse period
- \* D.U.T.-Device Under Test

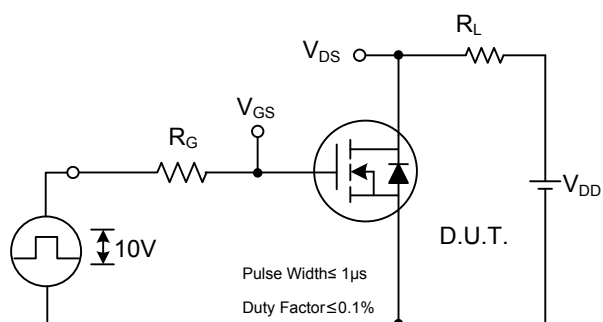
Timing diagram for a MOSFET switching a load inductor. The diagram shows three waveforms:  $V_{GS}$  (Driver),  $I_{SD}$  (D.U.T.), and  $V_{DS}$  (D.U.T.).

- $V_{GS}$  (Driver): A square wave with pulse width (P.W.) and period (Period). The duty cycle is defined as  $D = \frac{P.W.}{Period}$ . The gate-source voltage is  $V_{GS} = 10V$ .
- $I_{SD}$  (D.U.T.): The drain current. It shows forward current  $I_{FM}$  (Body Diode Forward Current) during the on-time and reverse current  $I_{RM}$  (Body Diode Reverse Current) during the recovery phase. The recovery slope is labeled  $di/dt$ .
- $V_{DS}$  (D.U.T.): The drain-source voltage. It shows the voltage drop during the on-time and the recovery  $dv/dt$  during the off-time. The supply voltage is  $V_{DD}$ .

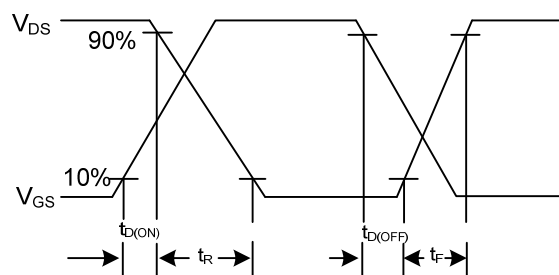
The MOSFET is labeled "Body Diode" and the load is labeled "Forward Voltage Drop".

5 of 9  
QW-R205-324.D

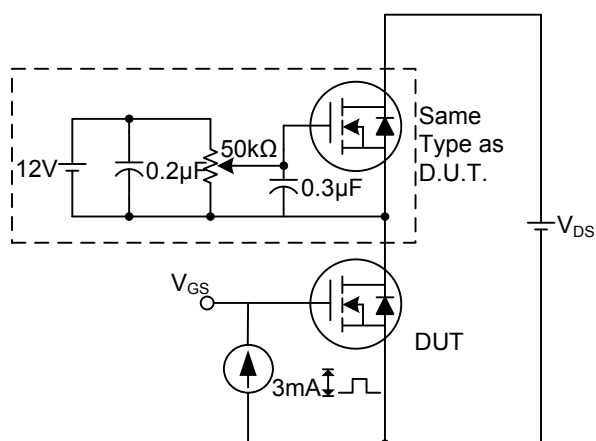
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



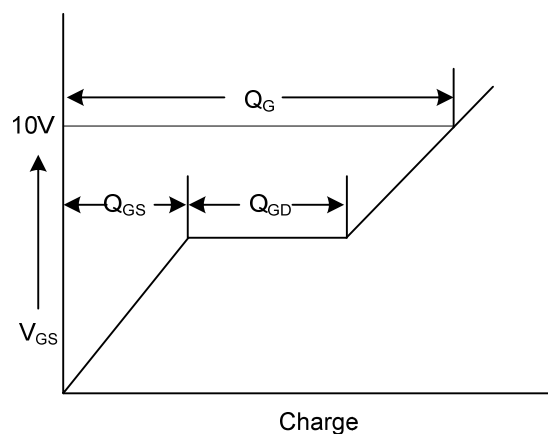
Switching Test Circuit



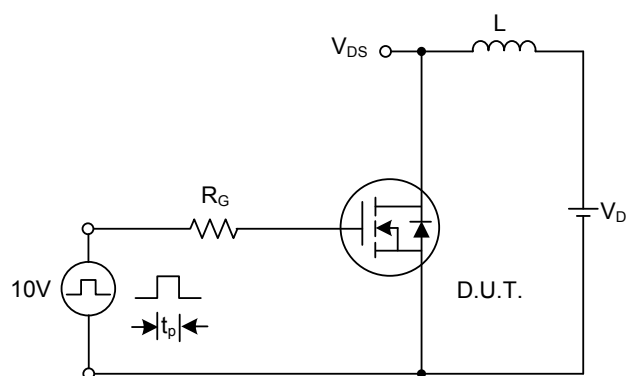
Switching Waveforms



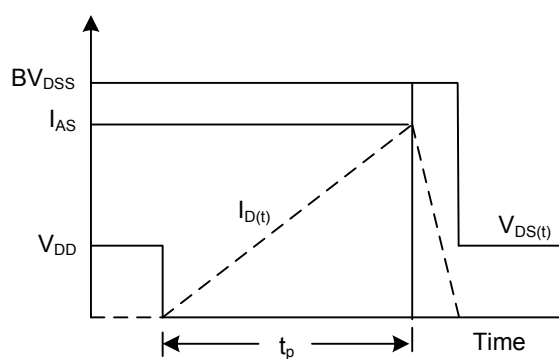
Gate Charge Test Circuit



Gate Charge Waveform

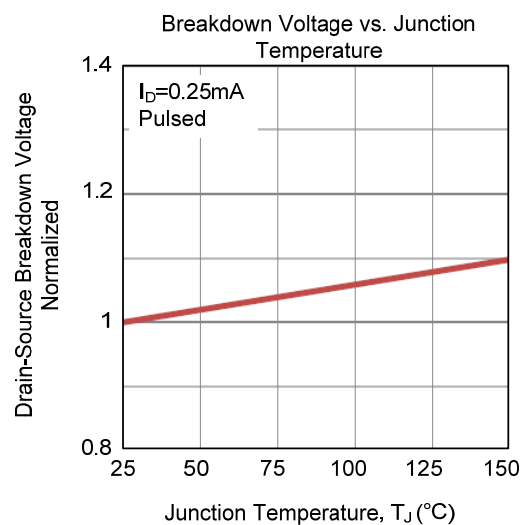
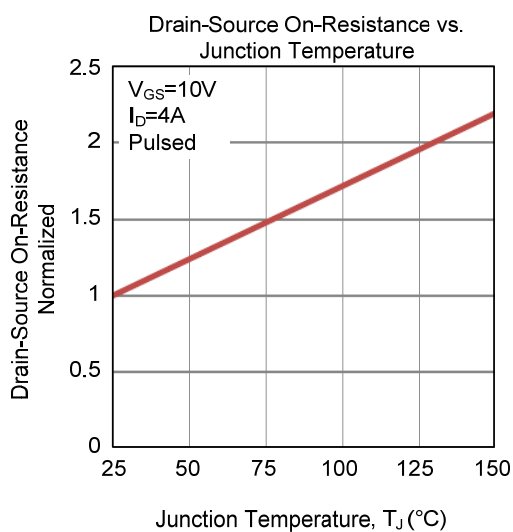
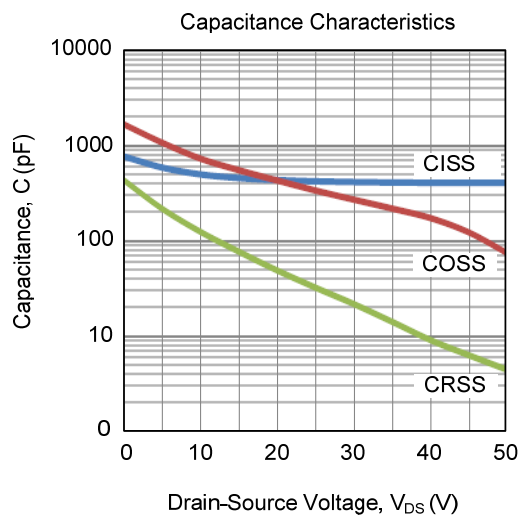
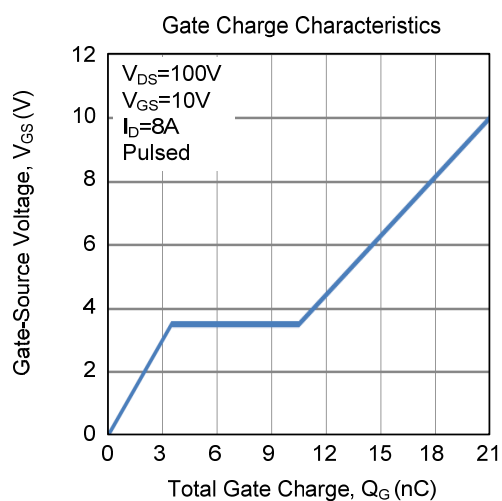
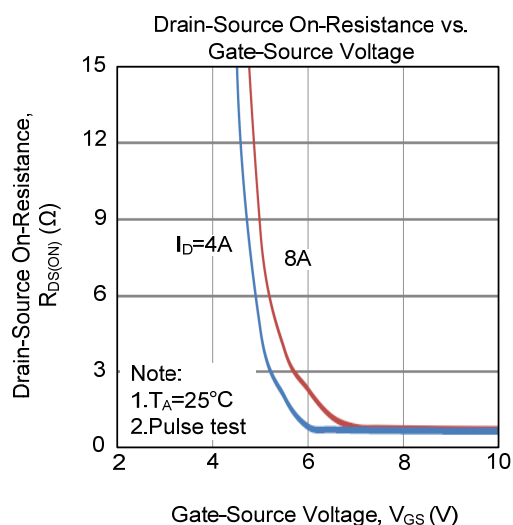
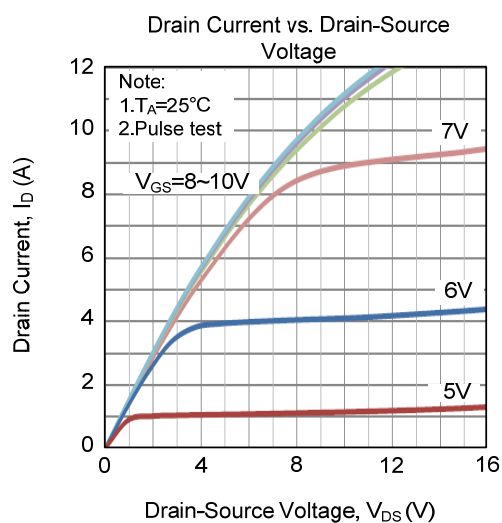


Unclamped Inductive Switching Test Circuit

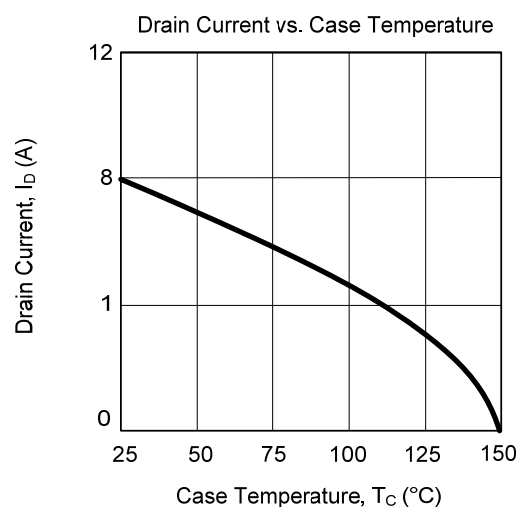
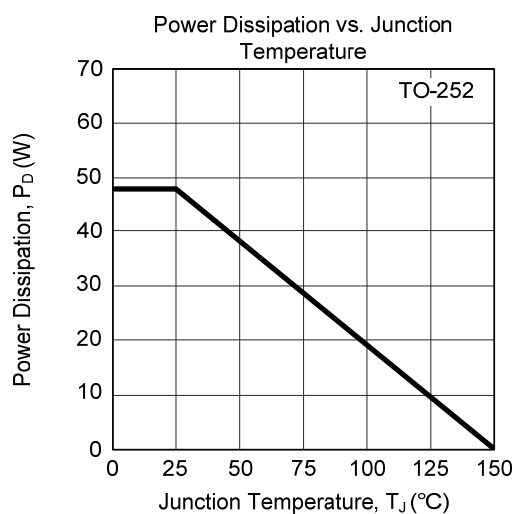
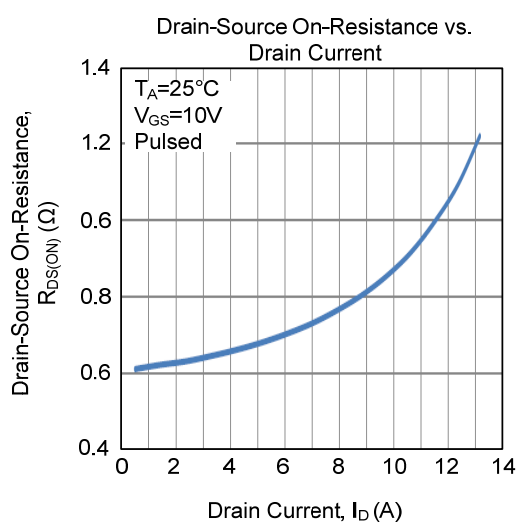
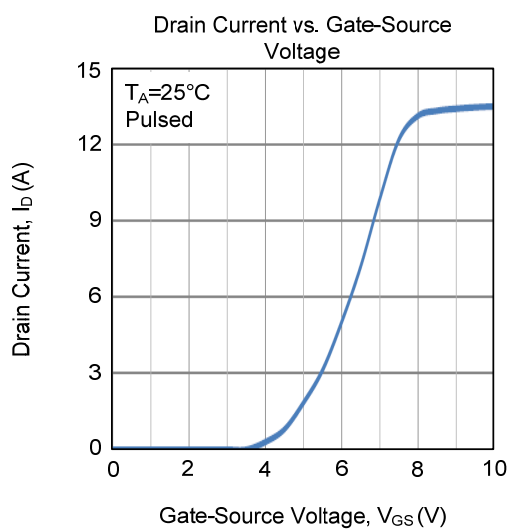
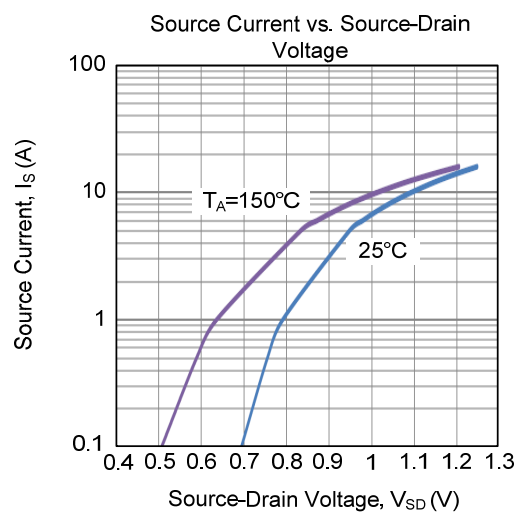
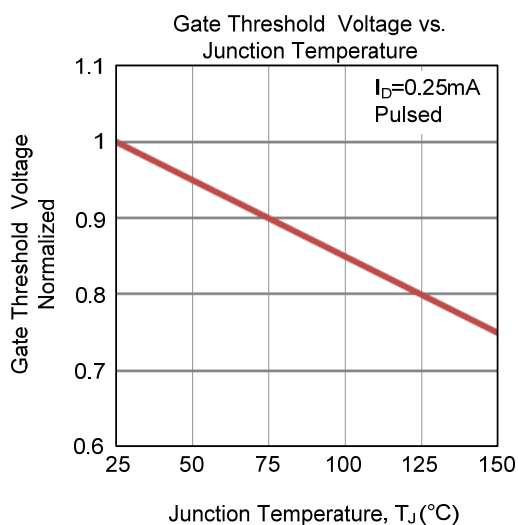


Unclamped Inductive Switching Waveforms

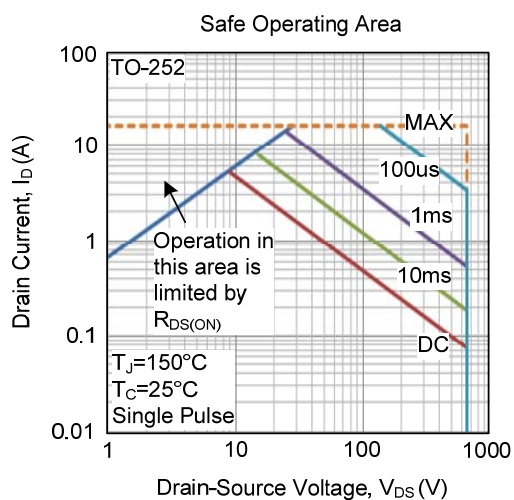
## TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS (Cont.)



## ■ TYPICAL CHARACTERISTICS (Cont.)



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