

10A, 650V N-CHANNEL  
POWER MOSFET

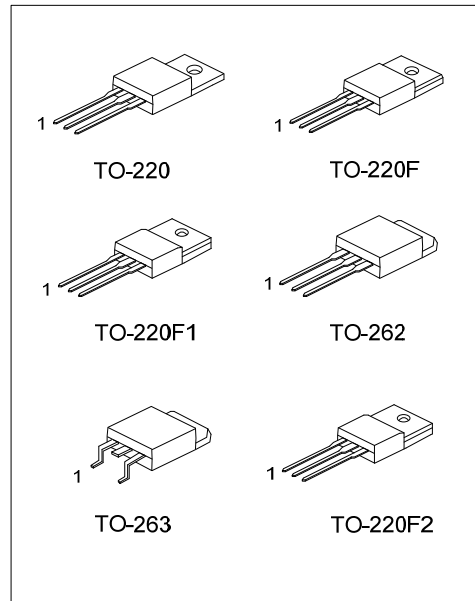
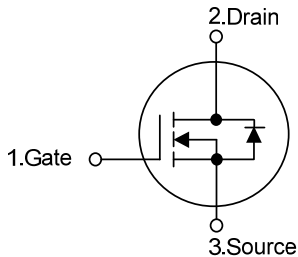
DESCRIPTION

The **10N65** is a high voltage and high current power MOSFET, 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 high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

FEATURES

- \*  $R_{DS(ON)} < 0.86\Omega @ V_{GS} = 10V$
- \* Low gate charge ( typical 44 nC)
- \* Low Crss ( typical 18 pF)
- \* Fast switching
- \* 100% avalanche tested
- \* Improved dv/dt capability

SYMBOL



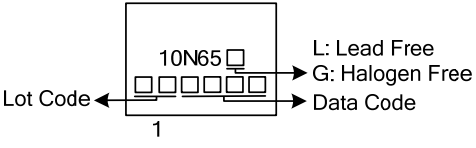
ORDERING INFORMATION

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing   |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |           |
| 10N65L-TA3-T    | 10N65G-TA3-T | TO-220   | G              | D | S | Tube      |
| 10N65L-TF1-T    | 10N65G-TF1-T | TO-220F1 | G              | D | S | Tube      |
| 10N65L-TF2-T    | 10N65G-TF2-T | TO-220F2 | G              | D | S | Tube      |
| 10N65L-TF3-T    | 10N65G-TF3-T | TO-220F  | G              | D | S | Tube      |
| 10N65L-T2Q-T    | 10N65G-T2Q-T | TO-262   | G              | D | S | Tube      |
| 10N65L-TQ2-T    | 10N65G-TQ2-T | TO-263   | G              | D | S | Tube      |
| 10N65L-TQ2-R    | 10N65G-TQ2-R | TO-263   | G              | D | S | Tape Reel |

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

|   |  |
|---|--|
| <p>10N65L-TA3-T</p> <p>(1)Packing Type<br/>(2)Package Type<br/>(3)Lead Free</p> | <p>(1) T: Tube, R: Tape Reel<br/>(2) TA3: TO-220, TF1: TO220-F1, TF2: TO-220F2<br/>TF3: TO-220F, T2Q:TO-262, TQ2: TO-263<br/>(3) L: Lead Free, G: Halogen Free</p> |
|---|--|

■ MARKING INFORMATION

| PACKAGE   | MARKING  |
|---|--|
| TO-220<br>TO-220F<br>TO-220F1<br>TO-220F2<br>TO-262<br>TO-263 |  <p>             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               |                        | $V_{DSS}$ | 650        | V                |
| Gate-Source Voltage                |                        | $V_{GSS}$ | $\pm 30$   | V                |
| Avalanche Current (Note 2)         |                        | $I_{AR}$  | 10         | A                |
| Drain Current                      | Continuous             | $I_D$     | 10         | A                |
|                                    | Pulsed (Note 2)        | $I_{DM}$  | 38         | A                |
| Avalanche Energy                   | Single Pulsed (Note 3) | $E_{AS}$  | 700        | mJ               |
|                                    | Repetitive (Note 2)    | $E_{AR}$  | 15.6       | mJ               |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt     | 4.5        | V/ns             |
| Power Dissipation                  | TO-220                 | $P_D$     | 156        | W                |
|                                    | TO-220F/TO-220F1       |           | 50         | W                |
|                                    | TO-220F2               |           | 52         | W                |
|                                    | TO-262                 |           | 156        | W                |
|                                    | TO-263                 |           | 178        | W                |
| Junction Temperature               |                        | $T_J$     | +150       | $^\circ\text{C}$ |
| 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.  $L = 14.2\text{mH}$ ,  $I_{AS} = 10\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$  Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 9.5\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

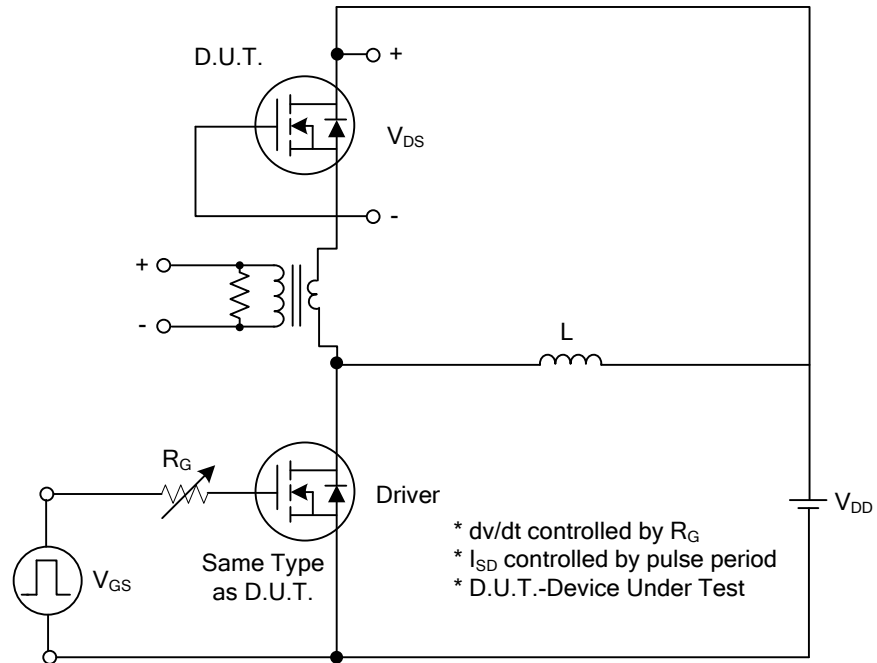
| PARAMETER           |                  | SYMBOL        | RATING | UNIT                      |
|---------------------|------------------|---------------|--------|---------------------------|
| Junction to Ambient |                  | $\theta_{JA}$ | 62.5   | $^\circ\text{C}/\text{W}$ |
| Junction to Case    | TO-220           | $\theta_{JC}$ | 0.8    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F/TO-220F1 |               | 2.5    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F2         |               | 2.4    | $^\circ\text{C}/\text{W}$ |
|                     | TO-262           |               | 0.8    | $^\circ\text{C}/\text{W}$ |
|                     | TO-263           |               | 0.7    | $^\circ\text{C}/\text{W}$ |

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

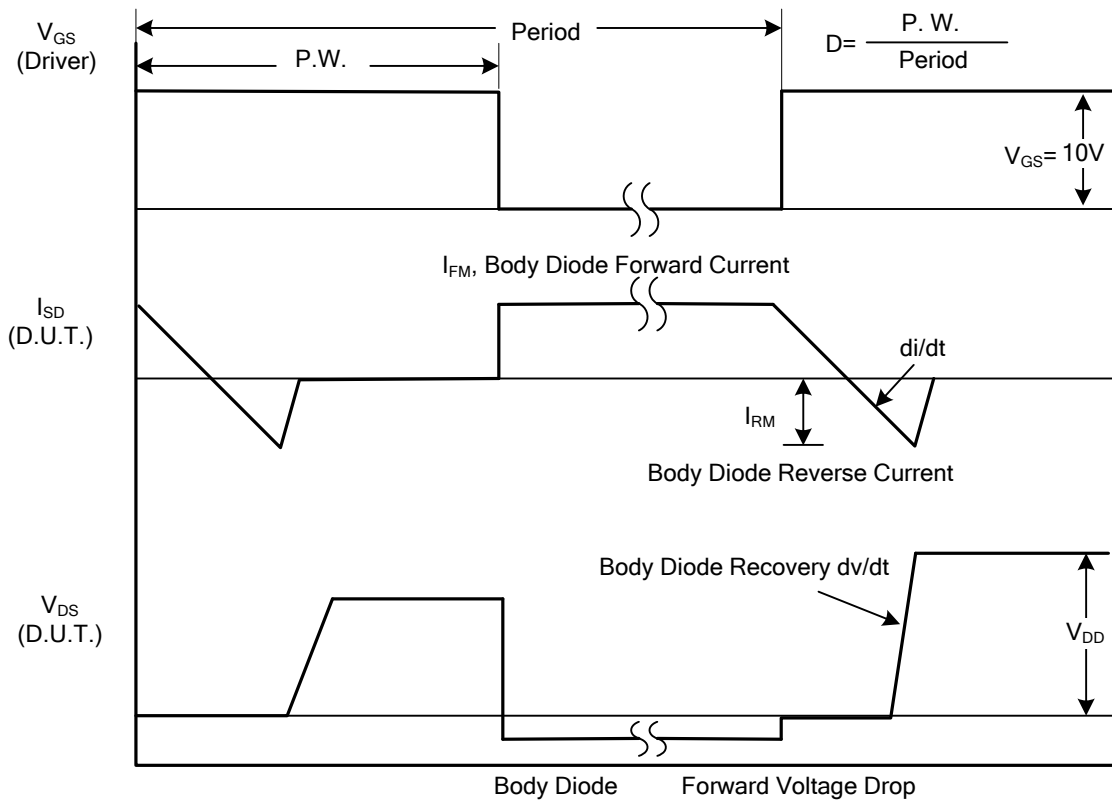
| PARAMETER   | SYMBOL                       | TEST CONDITIONS  | MIN | TYP  | MAX  | UNIT               |
|---|------------------------------|--|-----|------|------|--------------------|
| <b>OFF CHARACTERISTICS</b>                                    |                              |  |     |      |      |                    |
| Drain-Source Breakdown Voltage                                | $BV_{DSS}$                   | $V_{GS}=0V, I_D=250\mu A$  | 650 |      |      | V                  |
| Drain-Source Leakage Current                                  | $I_{DSS}$                    | $V_{DS}=650V, V_{GS}=0V$   |     |      | 1    | $\mu A$            |
| Gate-Source Leakage Current                                   | Forward                      | $I_{GSS}$<br>$V_{GS}=30V, V_{DS}=0V$<br>$V_{GS}=-30V, V_{DS}=0V$ |     |      | 100  | nA                 |
|   | Reverse                      |  |     |      | -100 | nA                 |
| Breakdown Voltage Temperature Coefficient                     | $\Delta BV_{DSS}/\Delta T_J$ | $I_D=250\mu A$ , Referenced to $25^\circ\text{C}$                |     | 0.7  |      | $V/^\circ\text{C}$ |
| <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                       | $R_{DS(ON)}$                 | $V_{GS}=10V, I_D=4.75A$  |     | 0.72 | 0.86 | $\Omega$           |
| <b>DYNAMIC CHARACTERISTICS</b>                                |                              |  |     |      |      |                    |
| Input Capacitance   | $C_{ISS}$                    | $V_{DS}=25V, V_{GS}=0V, f=1.0\text{ MHz}$                        |     | 1570 | 2040 | pF                 |
| Output Capacitance  | $C_{OSS}$                    |  |     | 166  | 215  | pF                 |
| Reverse Transfer Capacitance                                  | $C_{RSS}$                    |  |     | 18   | 24   | pF                 |
| <b>SWITCHING CHARACTERISTICS</b>                              |                              |  |     |      |      |                    |
| Turn-On Delay Time  | $t_{D(ON)}$                  | $V_{DD}=325V, I_D=10A, R_G=25\Omega$<br>(Note1, 2)               |     | 23   | 55   | ns                 |
| Turn-On Rise Time   | $t_R$                        |  |     | 69   | 150  | ns                 |
| Turn-Off Delay Time   | $t_{D(OFF)}$                 |  |     | 144  | 300  | ns                 |
| Turn-Off Fall Time  | $t_F$                        |  |     | 77   | 165  | ns                 |
| Total Gate Charge   | $Q_G$                        | $V_{DS}=520V, I_D=10A, V_{GS}=10V$<br>(Note1, 2)                 |     | 44   | 57   | nC                 |
| Gate-Source Charge  | $Q_{GS}$                     |  |     | 6.7  |      | nC                 |
| Gate-Drain Charge   | $Q_{GD}$                     |  |     | 18.5 |      | nC                 |
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b> |                              |  |     |      |      |                    |
| Drain-Source Diode Forward Voltage                            | $V_{SD}$                     | $V_{GS}=0V, I_S=10A$   |     |      | 1.4  | V                  |
| Maximum Continuous Drain-Source Diode Forward Current         | $I_S$                        |  |     |      | 10   | A                  |
| Maximum Pulsed Drain-Source Diode Forward Current             | $I_{SM}$                     |  |     |      | 38   | A                  |
| Reverse Recovery Time   | $t_{rr}$                     | $V_{GS}=0V, I_S=10A,$  |     | 420  |      | ns                 |
| Reverse Recovery Charge                                       | $Q_{RR}$                     | $di_F/dt=100A/\mu s$ (Note1)                                     |     | 4.2  |      | $\mu C$            |

Notes: 1. Pulse Test : Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$   
 2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

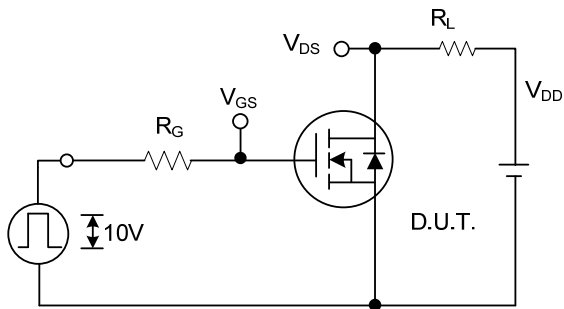


Peak Diode Recovery dv/dt Test Circuit

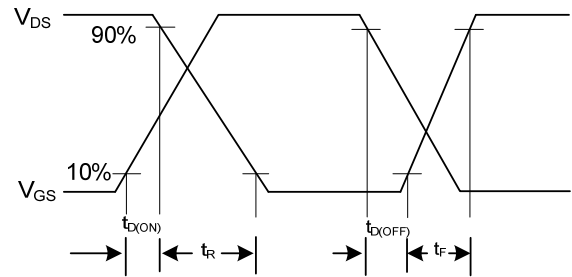


Peak Diode Recovery dv/dt Waveforms

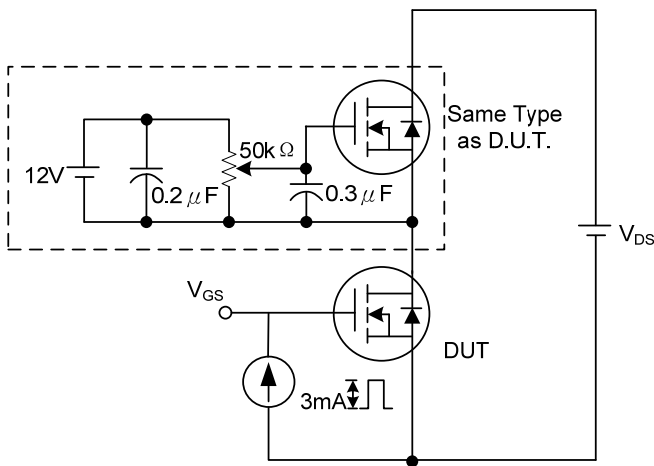
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



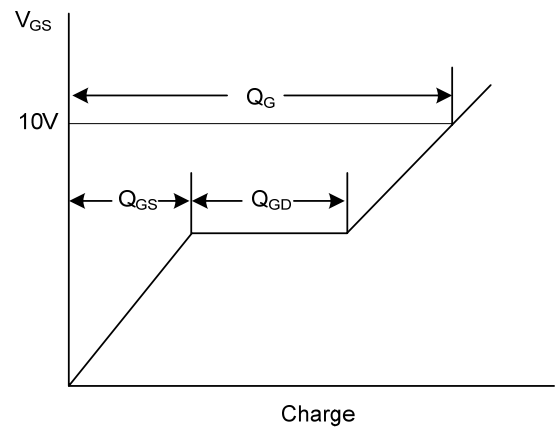
**Switching Test Circuit**



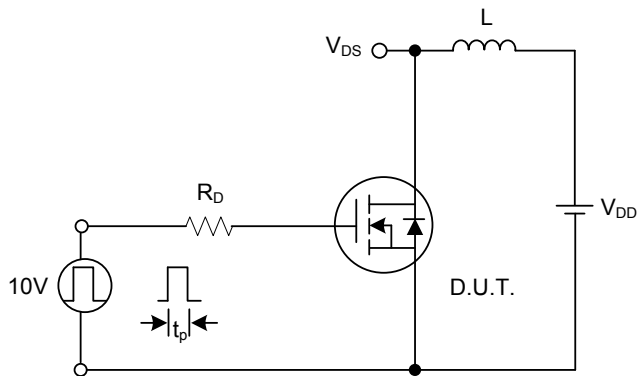
**Switching Waveforms**



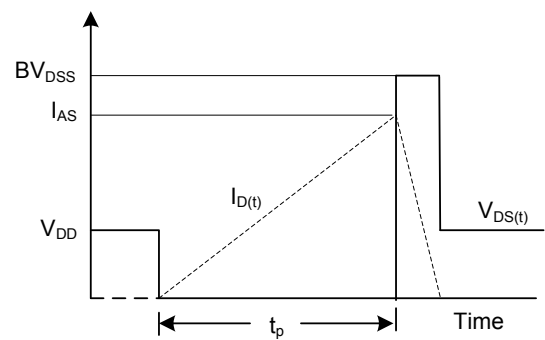
**Gate Charge Test Circuit**



**Gate Charge Waveform**



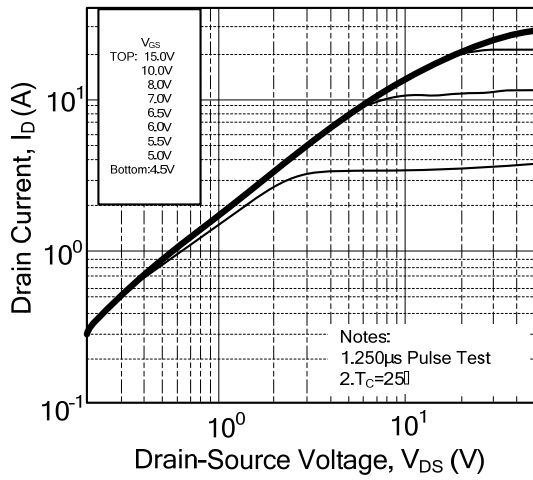
**Unclamped Inductive Switching Test Circuit**



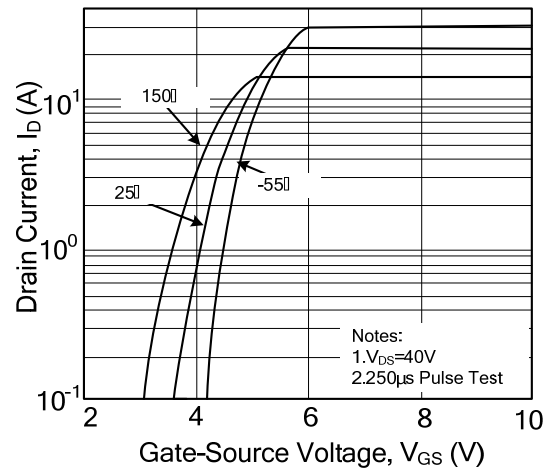
**Unclamped Inductive Switching Waveforms**

## TYPICAL CHARACTERISTICS

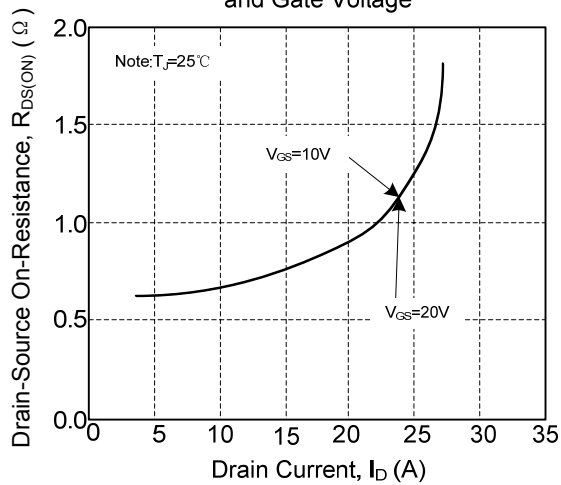
### On-Region Characteristics



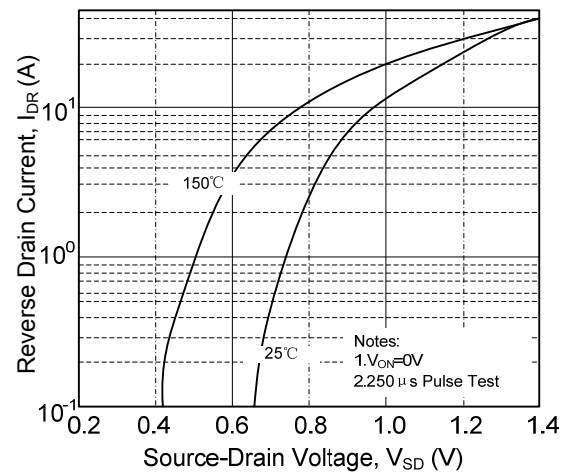
### Transfer Characteristics



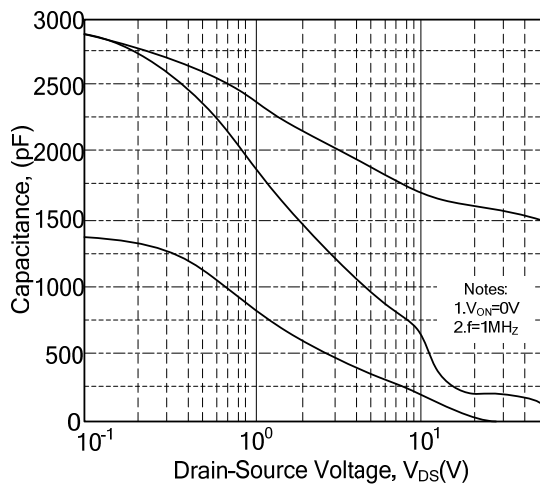
### On-Resistance Variation vs. Drain Current and Gate Voltage



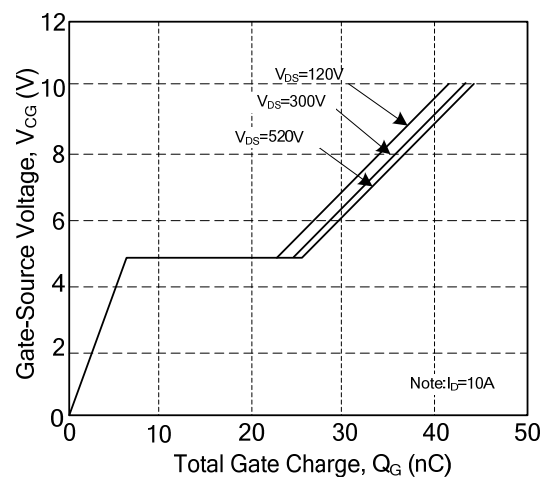
### Body Diode Forward Voltage Variation with Source Current and Temperature



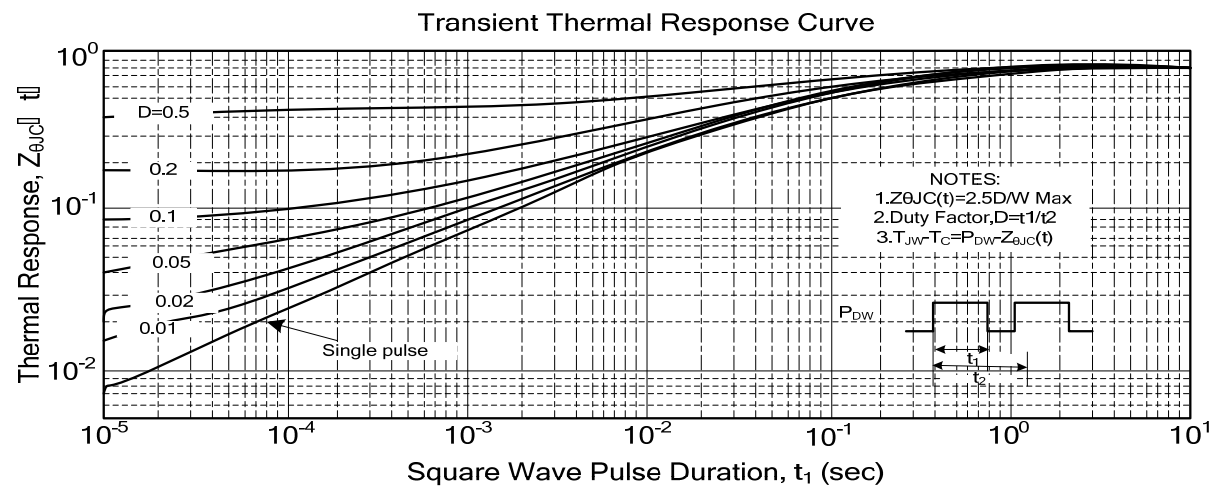
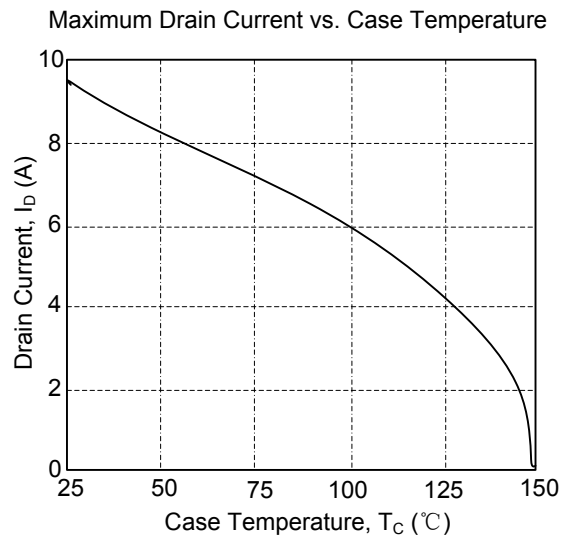
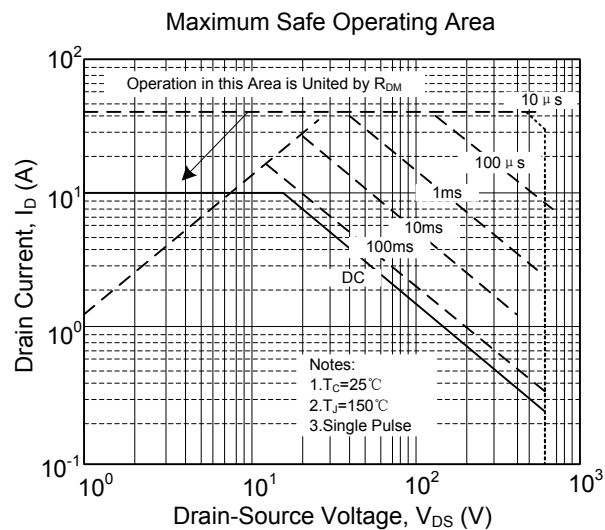
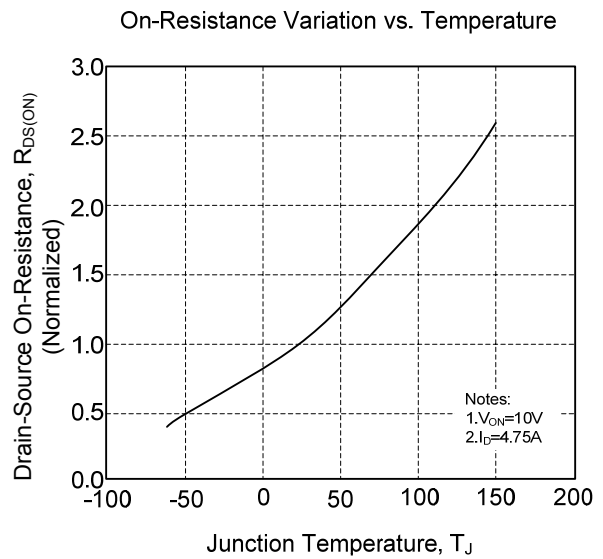
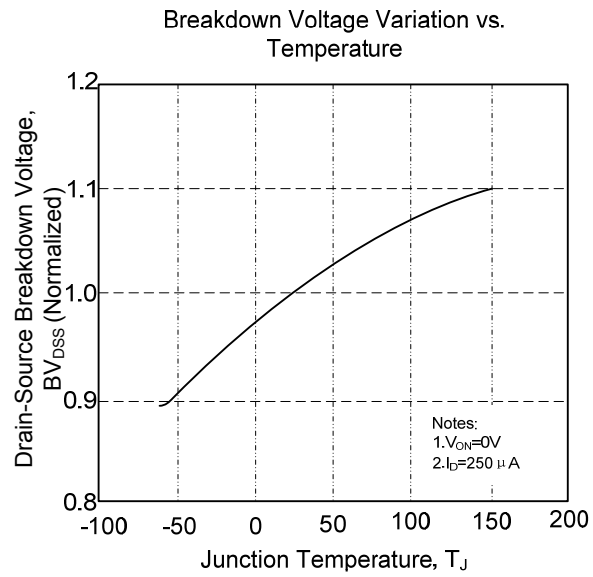
### Capacitance Characteristics



### Gate Charge Characteristics



## TYPICAL CHARACTERISTICS(Cont.)





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