



3N60K

Power MOSFET

3A, 600V N-CHANNEL POWER MOSFET

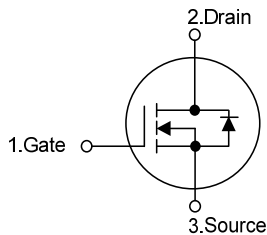
■ DESCRIPTION

The UTC **3N60K** 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 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

- * $V_{DS} = 600V$, $I_D = 3A$
- * $R_{DS(ON)} < 3.6\Omega @ V_{GS} = 10V$
- * Fast switching capability
- * Avalanche energy specified
- * Improved dv/dt capability, high ruggedness

■ SYMBOL



■ ORDERING INFORMATION

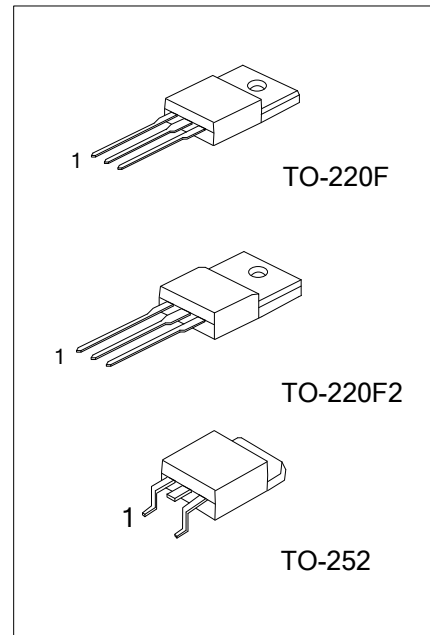
| Ordering Number | | Package | Pin Assignment | | | Packing |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 3N60KL-TF2-T | 3N60KG-TF2-T | TO-220F2 | G | D | S | Tube |
| 3N60KL-TF3-T | 3N60KG-TF3-T | TO-220F | G | D | S | Tube |
| 3N60KL-TN3-R | 3N60KG-TN3-R | TO-252 | G | D | S | Tape Reel |

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

| | |
|---------------------|---|
| <p>3N60KL-TF2-T</p> | <p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF2: TO-220F2, TF3: TO-220F, TN3: TO-252</p> <p>(3) L: Lead Free, G: Halogen Free</p> |
|---------------------|---|

■ MARKING INFORMATION

| PACKAGE | MARKING |
|-------------------------------|---------|
| TO-220F2 TO-220F TO-252 | |



■ 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} | ± 30 | V |
| Avalanche Current (Note 2) | | I_{AR} | 3.0 | A |
| Continuous Drain Current | | I_D | 3.0 | A |
| Pulsed Drain Current (Note 2) | | I_{DM} | 12 | A |
| Avalanche Energy | Single Pulsed (Note 3) | E_{AS} | 150 | mJ |
| | Repetitive (Note 2) | E_{AR} | 7.5 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 4.5 | V/ns |
| Power Dissipation | TO-220F | P_D | 34 | W |
| | TO-220F2 | | 35 | |
| | TO-252 | | 50 | |
| 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 T_J .

3. $L=33\text{mH}$, $I_{AS}=3\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD}\leq 3.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD}\leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

| PARAMETER | | SYMBOL | RATING | UNIT |
|---------------------|------------------|---------------|--------|---------------------------|
| Junction to Ambient | TO-220F/TO-220F2 | θ_{JA} | 62.5 | $^\circ\text{C}/\text{W}$ |
| | TO-252 | | 110 | |
| Junction to Case | TO-220F | θ_{JC} | 3.68 | $^\circ\text{C}/\text{W}$ |
| | TO-220F2 | | 3.58 | |
| | TO-252 | | 2.5 | |

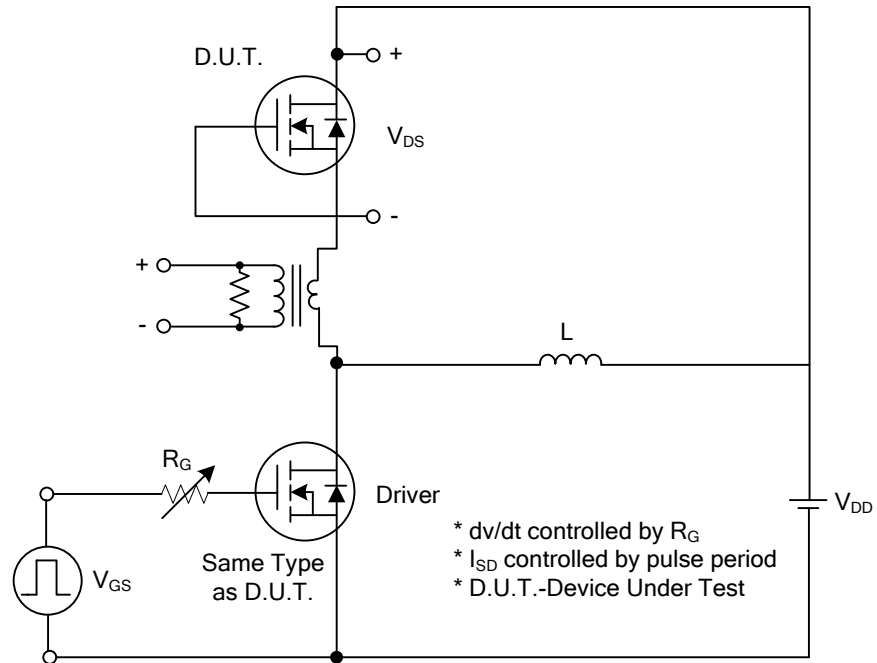
■ ELECTRICAL CHARACTERISTICS (T_C=25°C, unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|-------------------------------------|---|-----|-----|-----|------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | V _{GS} = 0 V, I _D = 250 μA | 600 | | | V |
| Drain-Source Leakage Current | I _{DSS} | V _{DS} = 600 V, V _{GS} = 0 V | | | 10 | μA |
| Gate-Source Leakage Current | Forward | I _{GSS} | | | 100 | nA |
| | Reverse | | | | | |
| Breakdown Voltage Temperature Coefficient | ΔBV _{DSS} /ΔT _J | I _D = 250 μA, Referenced to 25°C | | 0.6 | | V/°C |
| ON CHARACTERISTICS | | | | | | |
| Gate Threshold Voltage | V _{GS(TH)} | V _{DS} = V _{GS} , I _D = 250 μA | 3.0 | | 5.0 | V |
| Static Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} = 10 V, I _D = 1.5A | | 3.3 | 3.6 | Ω |
| DYNAMIC CHARACTERISTICS | | | | | | |
| Input Capacitance | C _{ISS} | V _{DS} = 25 V, V _{GS} = 0 V, f = 1MHz | | 350 | 450 | pF |
| Output Capacitance | C _{OSS} | | | 50 | 65 | pF |
| Reverse Transfer Capacitance | C _{RSS} | | | 5.5 | 7.5 | pF |
| SWITCHING CHARACTERISTICS | | | | | | |
| Turn-On Delay Time | t _{D(ON)} | V _{DD} = 30V, I _D = 0.5 A, R _G = 25Ω (Note 1, 2) | | 40 | 60 | ns |
| Turn-On Rise Time | t _R | | | 28 | 50 | ns |
| Turn-Off Delay Time | t _{D(OFF)} | | | 65 | 70 | ns |
| Turn-Off Fall Time | t _F | | | 40 | 70 | ns |
| Total Gate Charge | Q _G | V _{DS} = 50V, I _D = 1.3A, V _{GS} = 10 V (Note 1, 2) | | 13 | 16 | nC |
| Gate-Source Charge | Q _{GS} | | | 4.9 | | nC |
| Gate-Drain Charge | Q _{GD} | | | 2.5 | | nC |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS | | | | | | |
| Drain-Source Diode Forward Voltage | V _{SD} | V _{GS} = 0 V, I _S = 3.0 A | | | 1.4 | V |
| Maximum Continuous Drain-Source Diode Forward Current | I _S | | | | 3.0 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | I _{SM} | | | | 12 | A |
| Reverse Recovery Time | t _{RR} | V _{GS} = 0 V, I _S = 3.0 A, | | 210 | | ns |
| Reverse Recovery Charge | Q _{RR} | di _F /dt = 100 A/μs (Note 1) | | 1.2 | | μC |

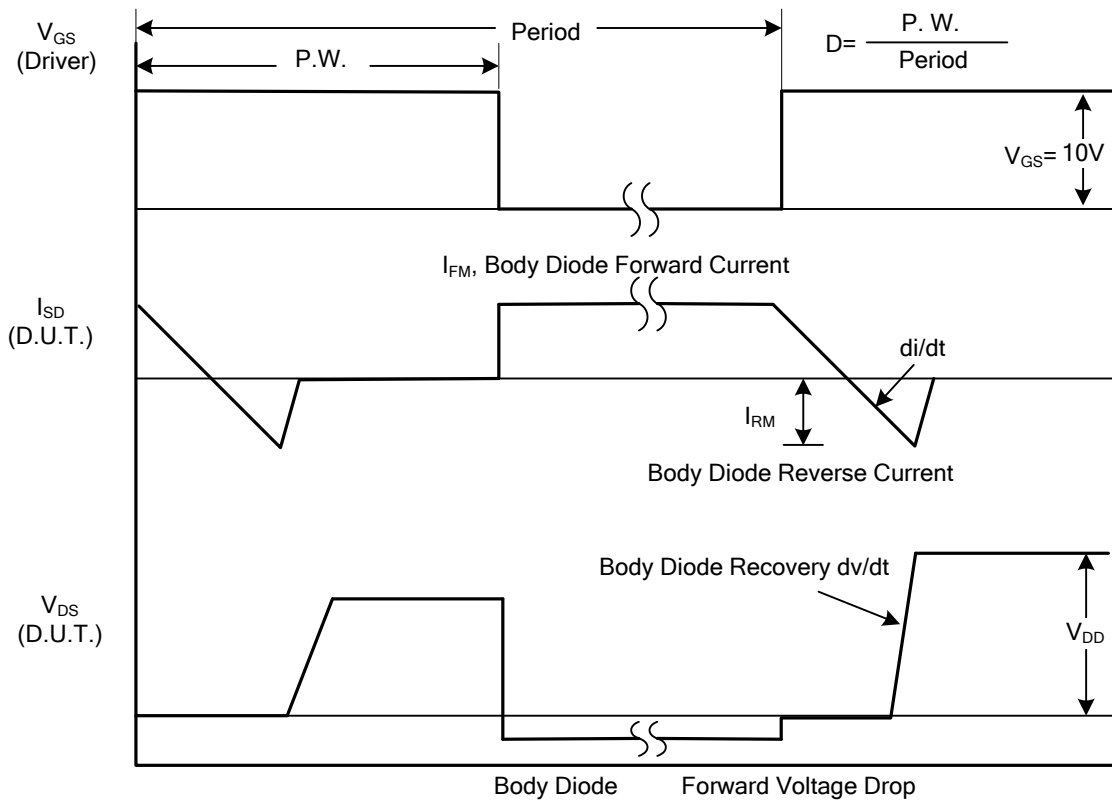
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

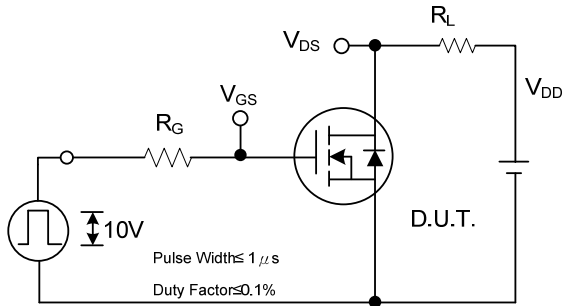


Peak Diode Recovery dv/dt Test Circuit

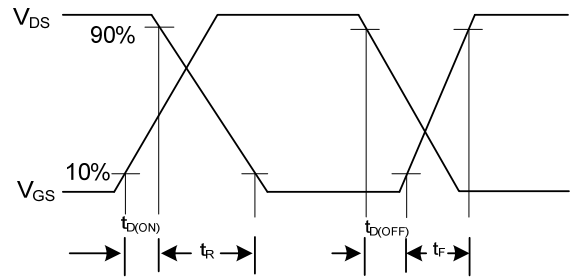


Peak Diode Recovery dv/dt Waveforms

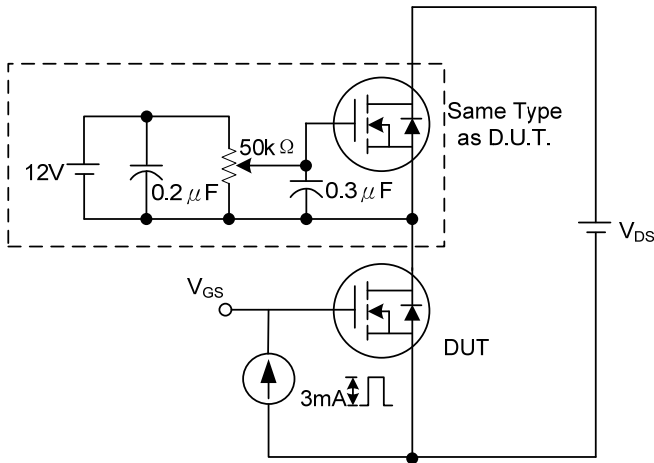
TEST CIRCUITS AND WAVEFORMS (Cont.)



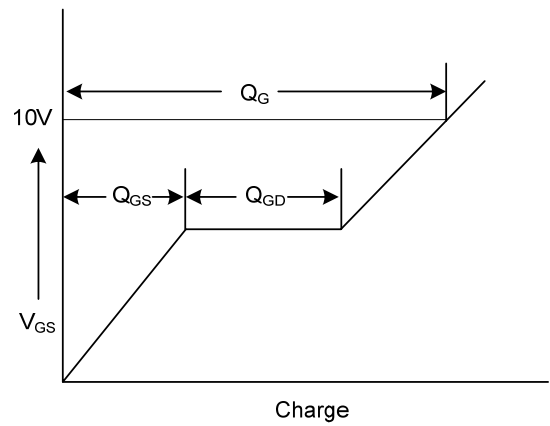
Switching Test Circuit



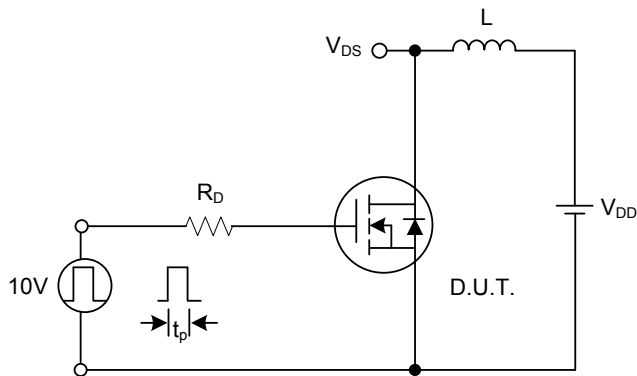
Switching Waveforms



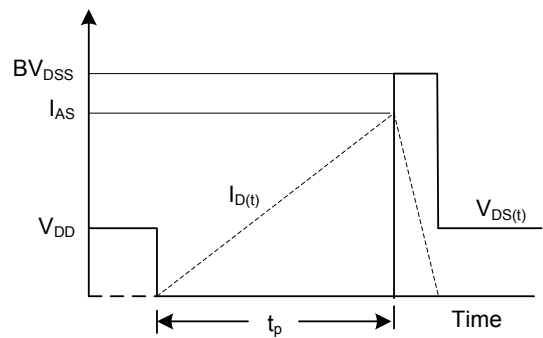
Gate Charge Test Circuit



Gate Charge Waveform



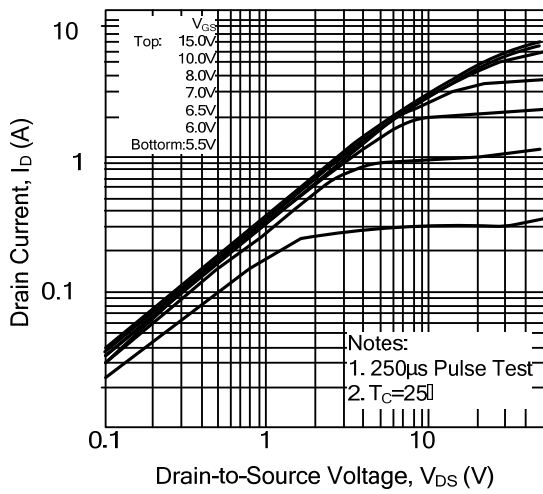
Unclamped Inductive Switching Test Circuit



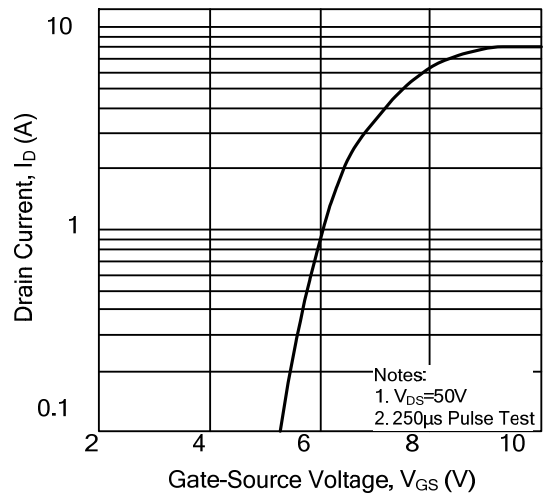
Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

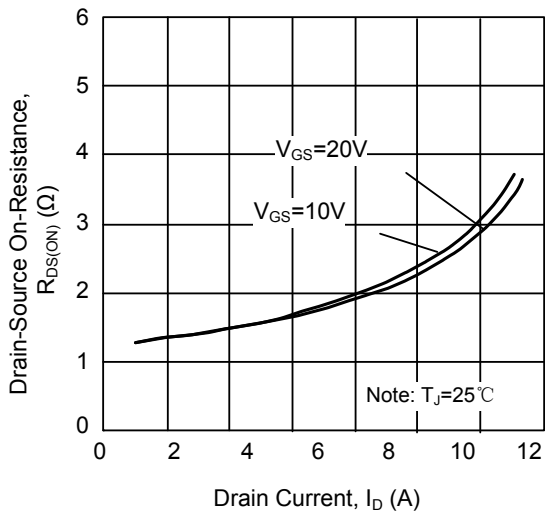
On-State Characteristics



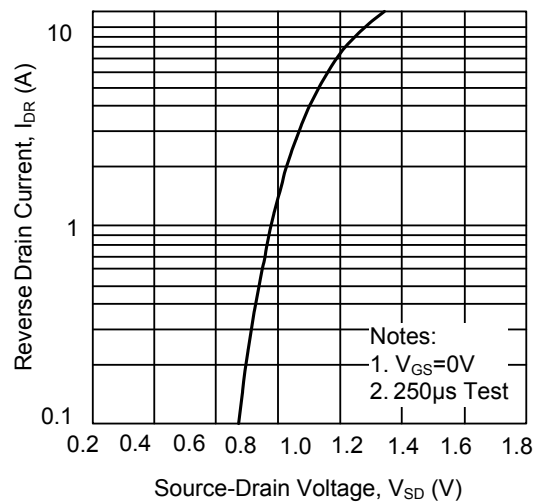
Transfer Characteristics



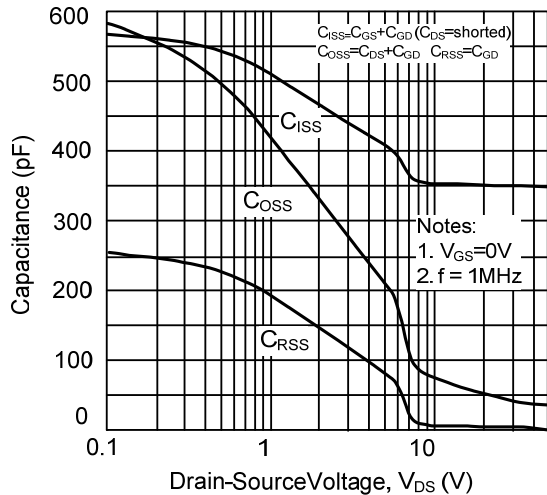
On-Resistance Variation vs. Drain Current and Gate Voltage



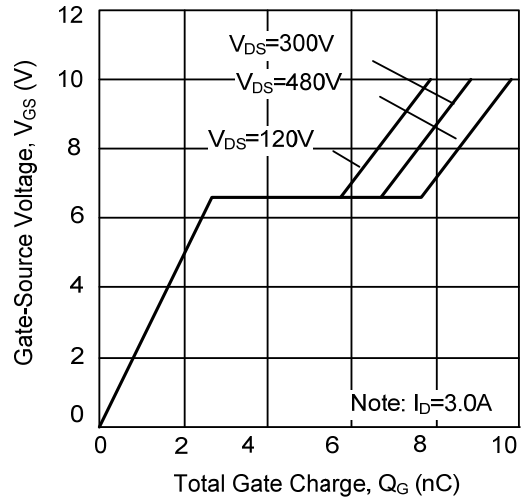
On State Current vs. Allowable Case Temperature



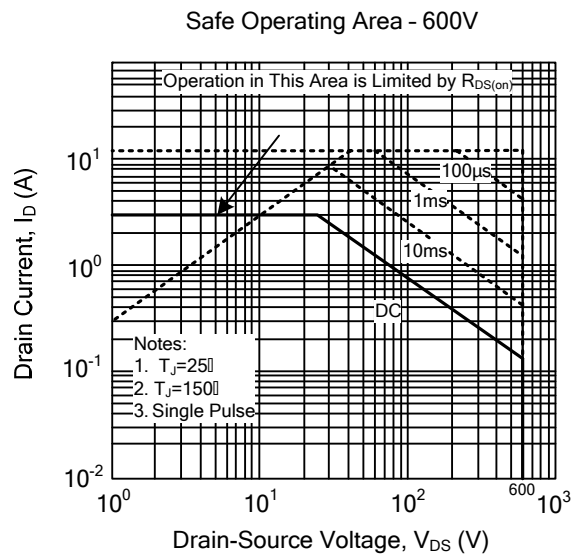
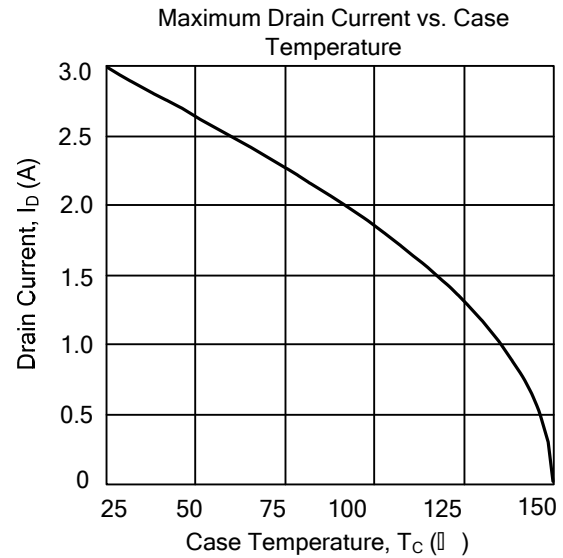
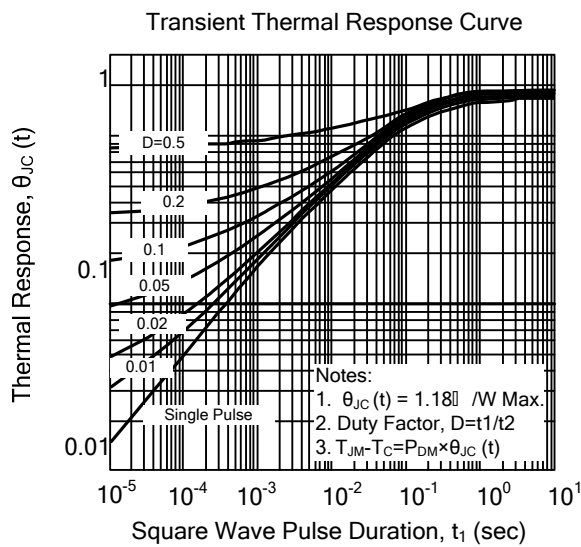
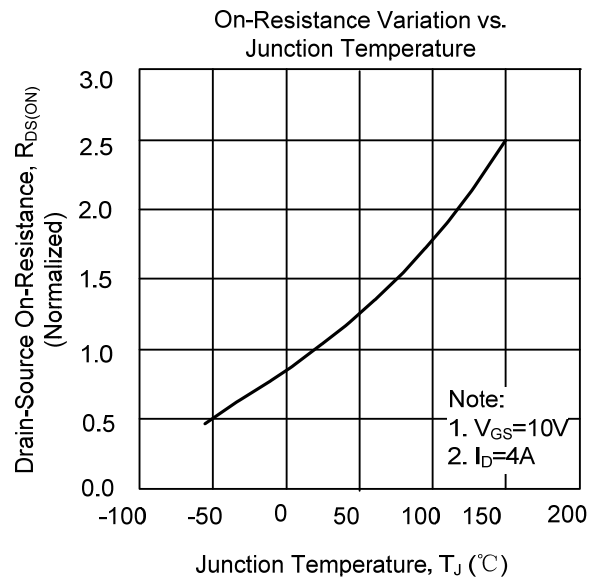
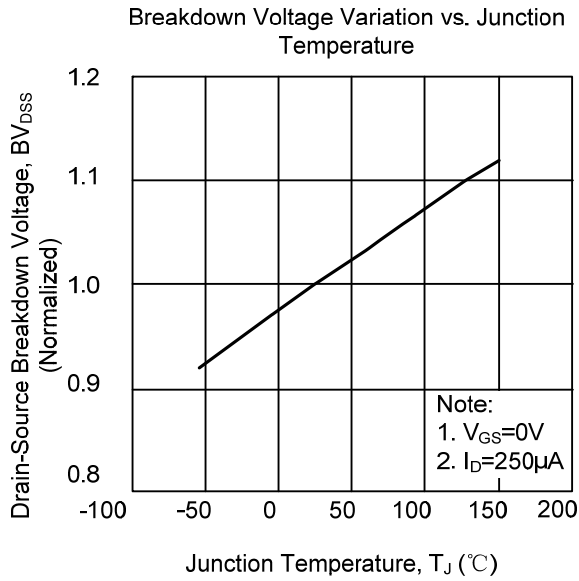
Capacitance Characteristics (Non-Repetitive)



Gate Charge Characteristics



TYPICAL CHARACTERISTICS(Cont.)



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