



## 3N70

Power MOSFET

### 3 AMPS, 700 VOLTS N-CHANNEL POWER MOSFET

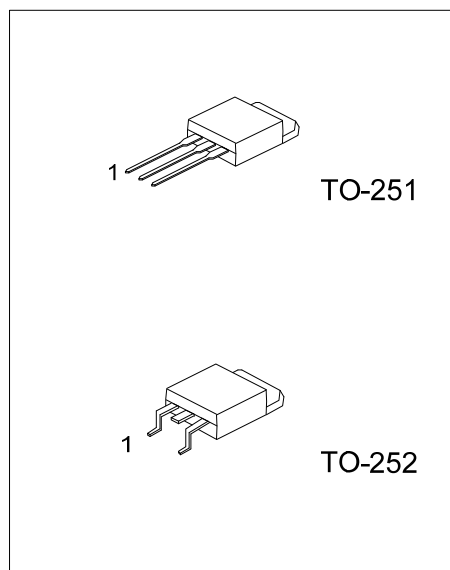
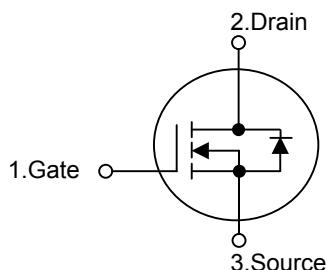
#### DESCRIPTION

The UTC **3N70** 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

- \*  $R_{DS(ON)} \leq 4.0\Omega$  @  $V_{GS} = 10V$
- \* Ultra low gate charge ( typical 10 nC )
- \* Low reverse transfer capacitance
- \* 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 |           |
| 3N70L-TM3-T     | 3N70G-TM3-T  | TO-251  | G              | D | S | Tube      |
| 3N70L-TN3-R     | 3N70G-TN3-R  | TO-252  | G              | D | S | Tape Reel |

|                    |  |   |
|--------------------|--|---|
| <p>3N70L-TM3-T</p> | <p>(1)Packing Type<br/>(2)Package Type<br/>(3)Lead Plating</p> | <p>(1) R: Tape Reel, T: Tube<br/>(2) TM3: TO-251, TN3: TO-252<br/>(3) G: Halogen Free, L: Lead Free</p> |
|--------------------|--|---|

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

| PARAMETER                          |                        | SYMBOL    | RATINGS    | UNIT             |
|------------------------------------|------------------------|-----------|------------|------------------|
| Drain-Source Voltage               |                        | $V_{DSS}$ | 700        | V                |
| Gate-Source Voltage                |                        | $V_{GSS}$ | $\pm 30$   | 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) | $E_{AS}$  | 200        | mJ               |
|                                    | Repetitive (Note 2)    | $E_{AR}$  | 7.5        | mJ               |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt     | 4.5        | V/ns             |
| Power Dissipation                  |                        | $P_D$     | 50         | 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.  $L = 64\text{mH}$ ,  $I_{AS} = 2.4\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , 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 | $\theta_{JA}$ | 110    | $^\circ\text{C}/\text{W}$ |
| Junction to Case    | $\theta_{JC}$ | 2.5    | $^\circ\text{C}/\text{W}$ |

■ 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            | $BV_{DSS}$                   | $V_{GS} = 0\text{V}$ , $I_D = 250\ \mu\text{A}$                                     | 700   |     |      | V                         |
| Drain-Source Leakage Current              | $I_{DSS}$                    | $V_{DS} = 700\text{V}$ , $V_{GS} = 0\text{V}$                                       |   |     | 10   | $\mu\text{A}$             |
| Gate-Source Leakage Current               | Forward<br>Reverse           | $I_{GSS}$   | $V_{GS} = 30\text{V}$ , $V_{DS} = 0\text{V}$  |     | 100  | nA                        |
|   |                              |   | $V_{GS} = -30\text{V}$ , $V_{DS} = 0\text{V}$ |     | -100 | nA                        |
| Breakdown Voltage Temperature Coefficient | $\Delta BV_{DSS}/\Delta T_J$ | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$                         |   | 0.6 |      | $\text{V}/^\circ\text{C}$ |
| <b>ON CHARACTERISTICS</b>                 |                              |   |   |     |      |                           |
| Gate Threshold Voltage                    | $V_{GS(TH)}$                 | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$  | 2.0   |     | 4.0  | V                         |
| Static Drain-Source On-State Resistance   | $R_{DS(ON)}$                 | $V_{GS} = 10\text{V}$ , $I_D = 1.5\text{A}$   |   | 2.8 | 4.0  | $\Omega$                  |
| <b>DYNAMIC CHARACTERISTICS</b>            |                              |   |   |     |      |                           |
| Input Capacitance                         | $C_{ISS}$                    | $V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$                    |   | 350 | 450  | pF                        |
| Output Capacitance                        | $C_{OSS}$                    |   |   | 50  | 65   | pF                        |
| Reverse Transfer Capacitance              | $C_{RSS}$                    |   |   | 5.5 | 32   | pF                        |
| <b>SWITCHING CHARACTERISTICS</b>          |                              |   |   |     |      |                           |
| Turn-On Delay Time                        | $t_{D(ON)}$                  | $V_{DD} = 30\text{V}$ , $I_D = 1.0\text{A}$ , $R_G = 25\ \Omega$<br>(Note 1, 2)     |   | 10  | 40   | ns                        |
| Turn-On Rise Time                         | $t_R$                        |   |   | 30  | 70   | ns                        |
| Turn-Off Delay Time                       | $t_{D(OFF)}$                 |   |   | 20  | 100  | ns                        |
| Turn-Off Fall Time                        | $t_F$                        |   |   | 30  | 70   | ns                        |
| Total Gate Charge                         | $Q_G$                        | $V_{DS} = 480\text{V}$ , $I_D = 3.0\text{A}$ , $V_{GS} = 10\text{V}$<br>(Note 1, 2) |   | 10  | 13   | nC                        |
| Gate-Source Charge                        | $Q_{GS}$                     |   |   | 2.7 |      | nC                        |
| Gate-Drain Charge                         | $Q_{DD}$                     |   |   | 4.9 |      | nC                        |

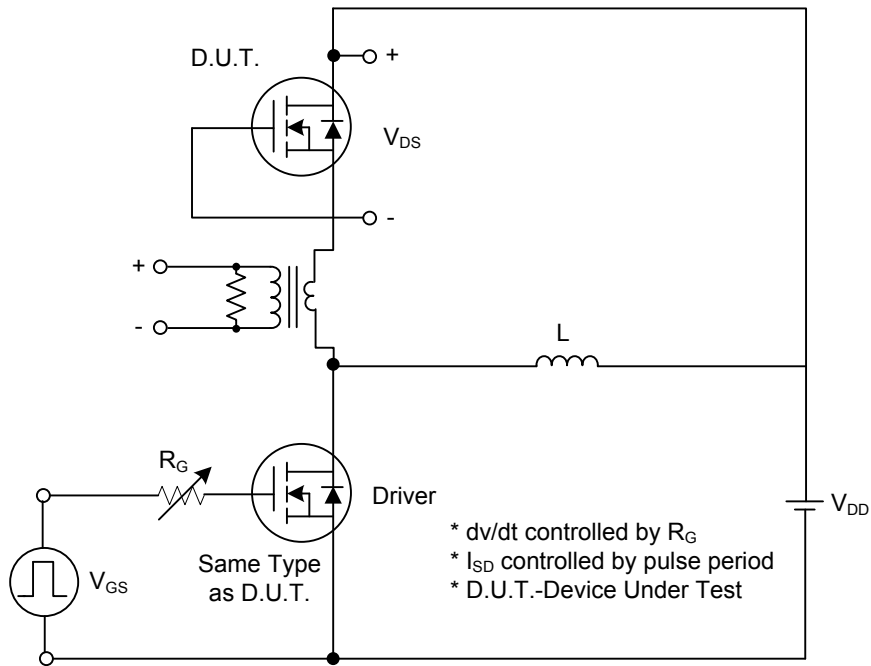
■ ELECTRICAL CHARACTERISTICS(Cont.)

| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS       |          |   |  |     |               |
|---|----------|---|--|-----|---------------|
| Drain-Source Diode Forward Voltage                    | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 3.0\text{ A}$   |  | 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                                 | $t_{RR}$ | $V_{GS} = 0\text{ V}, I_S = 3.0\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ (Note 1) |  | 210 | ns            |
| Reverse Recovery Charge                               | $Q_{RR}$ |   |  | 1.2 | $\mu\text{C}$ |

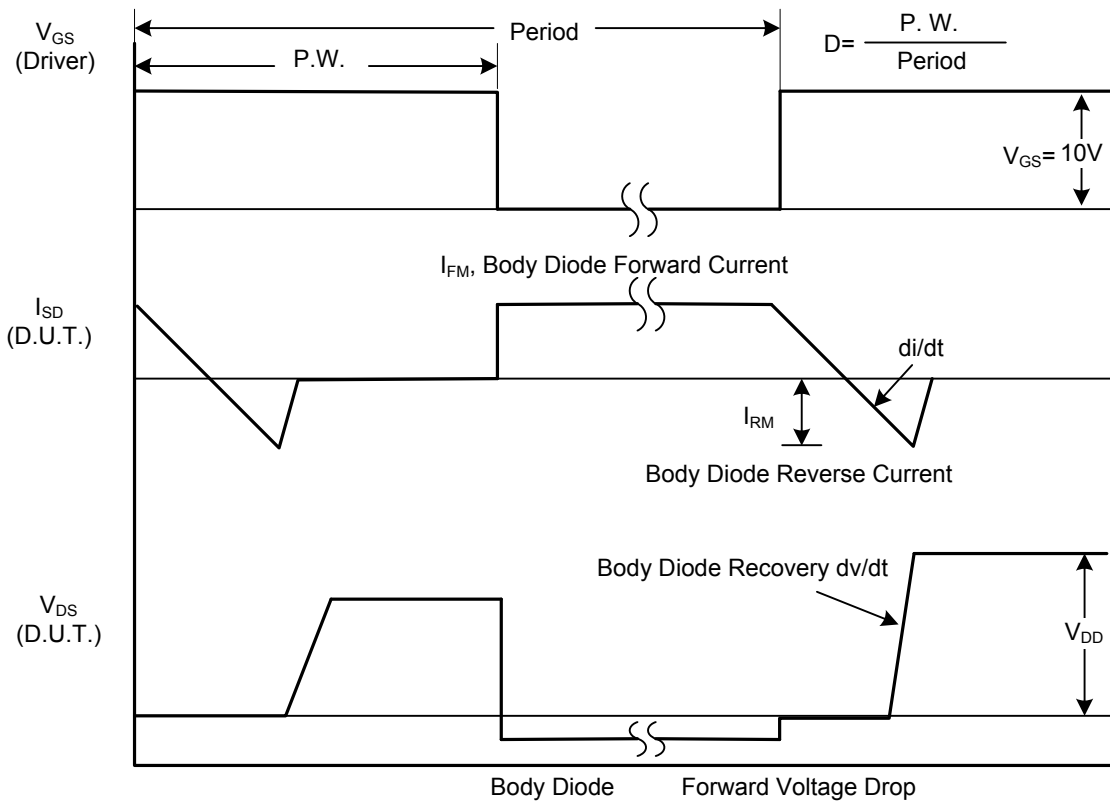
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

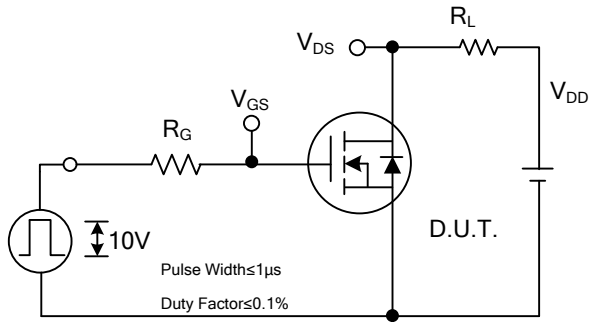


1A Peak Diode Recovery dv/dt Test Circuit

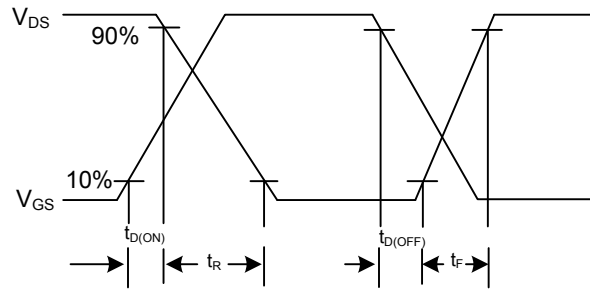


1B Peak Diode Recovery dv/dt Waveforms

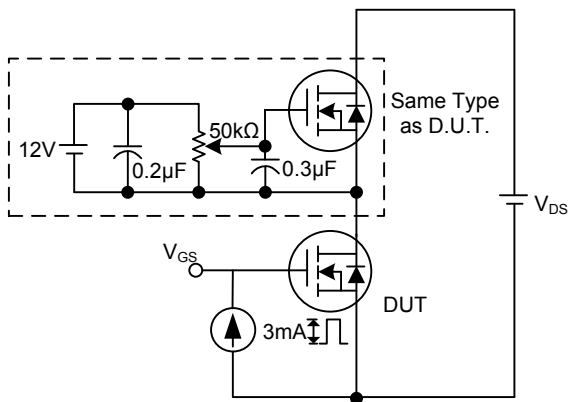
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



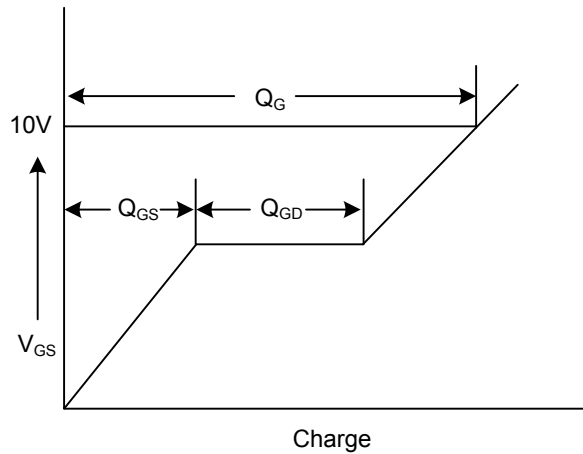
2A Switching Test Circuit



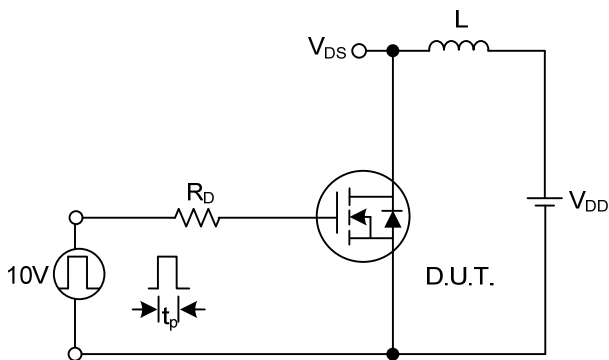
2B Switching Waveforms



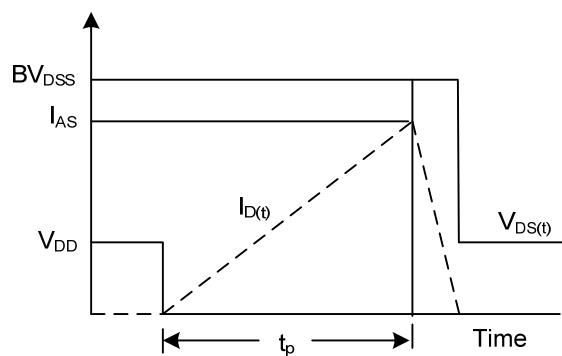
3A Gate Charge Test Circuit



3B Gate Charge Waveform

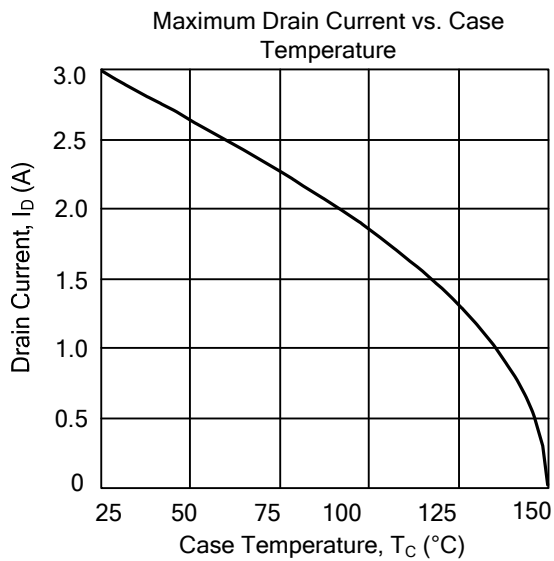
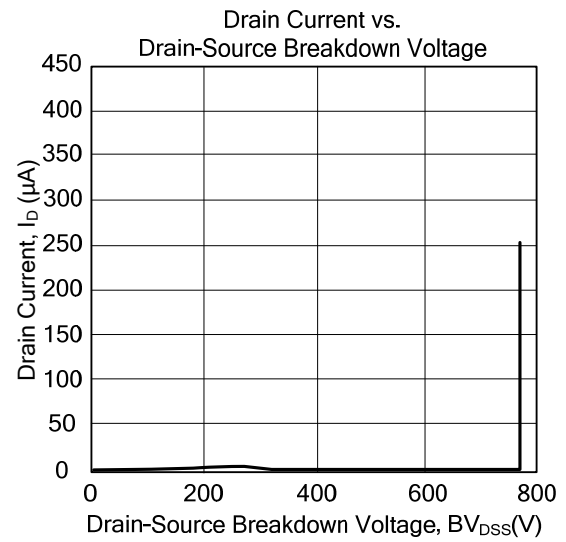
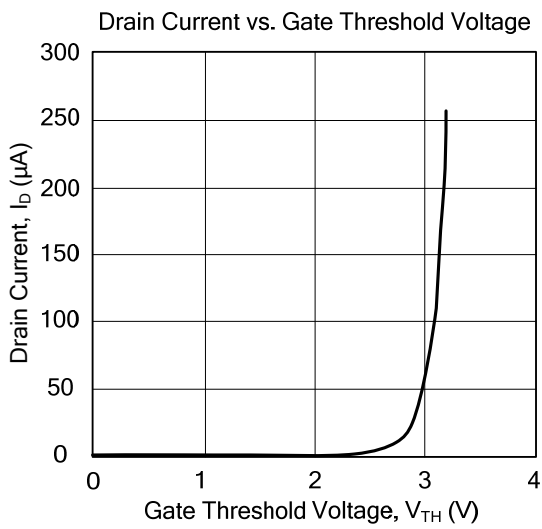
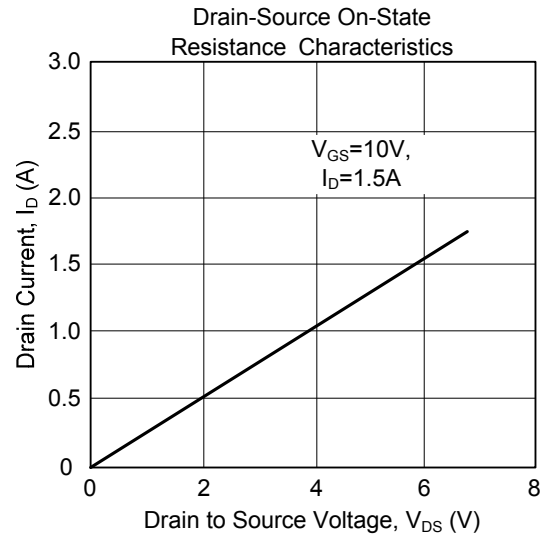
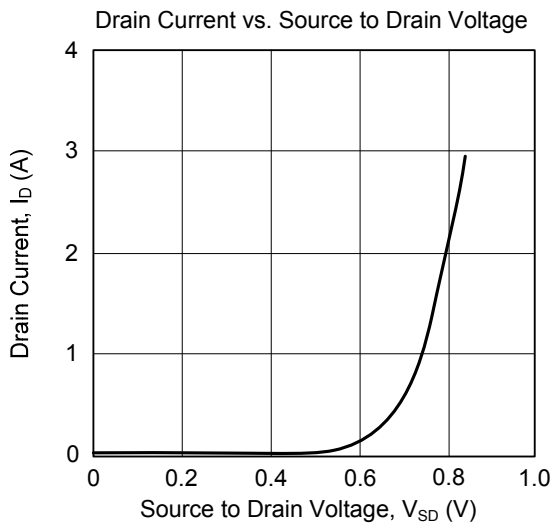


4A Unclamped Inductive Switching Test Circuit



4B Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS



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