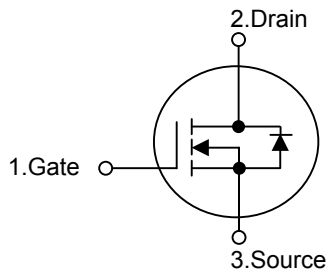


**6N65****Power MOSFET****6.2A, 650V N-CHANNEL  
POWER MOSFET****DESCRIPTION**

The UTC **6N65** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications of switching power supplies and adaptors.

**FEATURES**

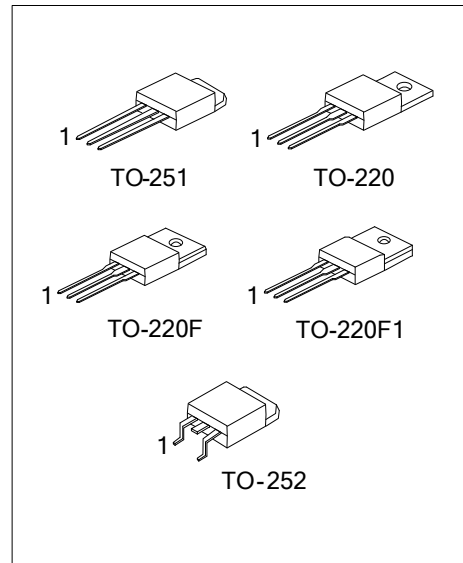
- \*  $R_{DS(ON)} = 1.7\Omega$  @  $V_{GS} = 10V$
- \* Ultra low gate charge (typical 20 nC )
- \* Low reverse transfer Capacitance (  $C_{RSS} =$  typical 10pF )
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved dv/dt capability, high ruggedness

**SYMBOL****ORDERING INFORMATION**

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing   |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |           |
| 6N65L-TA3-T     | 6N65G-TA3-T  | TO-220   | G              | D | S | Tube      |
| 6N65L-TF1-T     | 6N65G-TF1-T  | TO-220F1 | G              | D | S | Tube      |
| 6N65L-TF3-T     | 6N65G-TF3-T  | TO-220F  | G              | D | S | Tube      |
| 6N65L-TM3-T     | 6N65G-TM3-T  | TO-251   | G              | D | S | Tube      |
| 6N65L-TN3-R     | 6N65G-TN3-R  | TO-252   | G              | D | S | Tape Reel |
| 6N65L-TN3-T     | 6N65G-TN3-T  | TO-252   | G              | D | S | Tube      |

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

|                                                                                |  |                                                                                                                                                            |
|--------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>6N65L-TA3-T</p> <p>(1)Packing Type<br/>(2)Package Type<br/>(3)Lead Free</p> |  | <p>(1) T: Tube, R: Tape Reel</p> <p>(2) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F<br/>TM3: TO-251, TN3: TO-252</p> <p>(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               |                        | $V_{DSS}$ | 650        | V                |
| Gate-Source Voltage                |                        | $V_{GSS}$ | $\pm 30$   | V                |
| Avalanche Current (Note 2)         |                        | $I_{AR}$  | 6.2        | A                |
| Continuous Drain Current           |                        | $I_D$     | 6.2        | A                |
| Pulsed Drain Current (Note 2)      |                        | $I_{DM}$  | 24.8       | A                |
| Avalanche Energy                   | Single Pulsed (Note 3) | $E_{AS}$  | 440        | mJ               |
|                                    | Repetitive (Note 2)    | $E_{AR}$  | 13         | mJ               |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt     | 4.5        | ns               |
| Power Dissipation                  | TO-220                 | $P_D$     | 125        | W                |
|                                    | TO-220F/TO-220F1       |           | 40         | W                |
|                                    | TO-251/TO-252          |           | 55         | 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  $T_J$

3.  $L = 14\text{mH}$ ,  $I_{AS} = 6\text{A}$ ,  $V_{DD} = 90\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 6.2\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

| PARAMETER           |                  | SYMBOL        | RATING | UNIT                      |
|---------------------|------------------|---------------|--------|---------------------------|
| Junction to Ambient | TO-220           | $\theta_{JA}$ | 62.5   | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F/TO-220F1 |               | 62.5   | $^\circ\text{C}/\text{W}$ |
|                     | TO-251/TO-252    |               | 110    | $^\circ\text{C}/\text{W}$ |
| Junction to Case    | TO-220           | $\theta_{JC}$ | 1.0    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F/TO-220F1 |               | 3.2    | $^\circ\text{C}/\text{W}$ |
|                     | TO-251/TO-252    |               | 2.27   | $^\circ\text{C}/\text{W}$ |

■ ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25°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   |
| Breakdown Voltage Temperature Coefficient              |         | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | I <sub>D</sub> =250μA, Referenced to 25°C                                        |     | 0.53 |      | V/°C |
| ON CHARACTERISTICS                                     |         |                                     |                                                                                  |     |      |      |      |
| 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> = 3.1A                                     |     | 1.1  | 1.7  | Ω    |
| DYNAMIC CHARACTERISTICS                                |         |                                     |                                                                                  |     |      |      |      |
| Input Capacitance                                      |         | C <sub>ISS</sub>                    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>f=1.0 MHz                          |     | 770  | 1000 | pF   |
| Output Capacitance                                     |         | C <sub>OSS</sub>                    |                                                                                  |     | 95   | 120  | pF   |
| Reverse Transfer Capacitance                           |         | C <sub>RSS</sub>                    |                                                                                  |     | 10   | 13   | pF   |
| SWITCHING CHARACTERISTICS                              |         |                                     |                                                                                  |     |      |      |      |
| Turn-On Delay Time                                     |         | t <sub>D(ON)</sub>                  | V <sub>DD</sub> =325V, I <sub>D</sub> =6.2A,<br>R <sub>G</sub> =25Ω (Note 1, 2)  |     | 20   | 50   | ns   |
| Turn-On Rise Time                                      |         | t <sub>R</sub>                      |                                                                                  |     | 70   | 150  | ns   |
| Turn-Off Delay Time                                    |         | t <sub>D(OFF)</sub>                 |                                                                                  |     | 40   | 90   | ns   |
| Turn-Off Fall Time                                     |         | t <sub>F</sub>                      |                                                                                  |     | 45   | 100  | ns   |
| Total Gate Charge                                      |         | Q <sub>G</sub>                      | V <sub>DS</sub> =520V, I <sub>D</sub> =6.2A,<br>V <sub>GS</sub> =10V (Note 1, 2) |     | 20   | 25   | nC   |
| Gate-Source Charge                                     |         | Q <sub>GS</sub>                     |                                                                                  |     | 4.9  |      | nC   |
| Gate-Drain Charge                                      |         | Q <sub>GD</sub>                     |                                                                                  |     | 9.4  |      | nC   |
| DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS |         |                                     |                                                                                  |     |      |      |      |
| Drain-Source Diode Forward Voltage                     |         | V <sub>SD</sub>                     | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 6.2 A                                    |     |      | 1.4  | V    |
| Maximum Continuous Drain-Source Diode Forward Current  |         | I <sub>S</sub>                      |                                                                                  |     |      | 6.2  | A    |
| Maximum Pulsed Drain-Source Diode Forward Current      |         | I <sub>SM</sub>                     |                                                                                  |     |      | 24.8 | A    |
| Reverse Recovery Time                                  |         | t <sub>RR</sub>                     | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 6.2 A,                                   |     | 290  |      | ns   |
| Reverse Recovery Charge                                |         | Q <sub>RR</sub>                     | dI <sub>F</sub> /dt = 100 A/μs (Note 1)                                          |     | 2.35 |      | μC   |

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

D.U.T.

$V_{DS}$

$V_{GS}$

$R_G$

Driver

Same Type as D.U.T.

$L$

$V_{DD}$

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

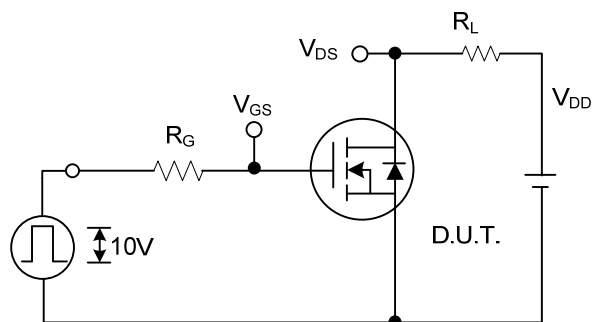
The diagram illustrates the timing relationship between three signals during a switching event:

- $V_{GS}$  (Driver):** A square wave pulse. The pulse width is labeled **P.W.** and the total duration is labeled **Period**. The duty cycle is given by  $D = \frac{P.W.}{Period}$ . The peak voltage is indicated as  $V_{GS} = 10V$ .
- $I_{SD}$  (D.U.T.):** The source-drain current. During the **Body Diode Forward Current** phase, it is a constant positive value  $I_{FM}$ . During the **Body Diode Reverse Current** phase, it is a constant negative value  $I_{RM}$ . The transition from forward to reverse current is labeled **di/dt**.
- $V_{DS}$  (D.U.T.):** The drain-source voltage. It is zero during the forward conduction phase. During the **Body Diode Recovery** phase, it rises from zero to the supply voltage  $V_{DD}$  with a slope labeled **Body Diode Recovery dv/dt**.

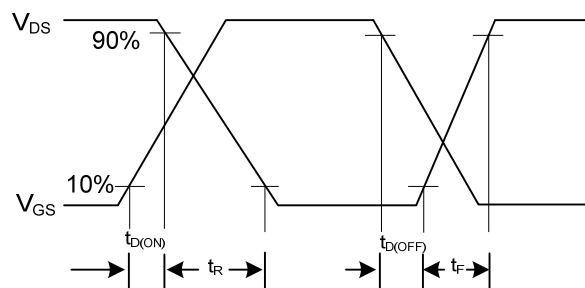
Additional labels at the bottom indicate the **Body Diode** and **Forward Voltage Drop** regions.

### Peak Diode Recovery dv/dt Waveforms

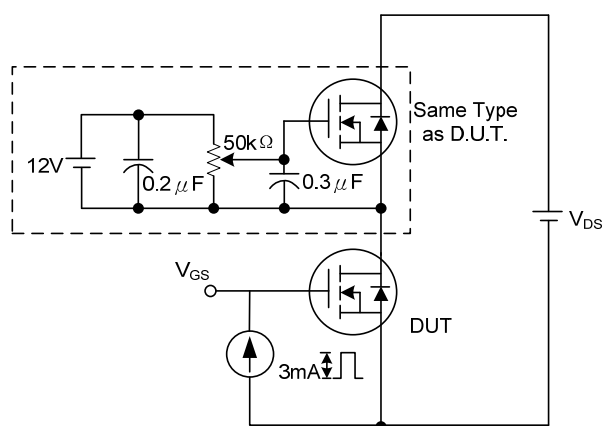
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



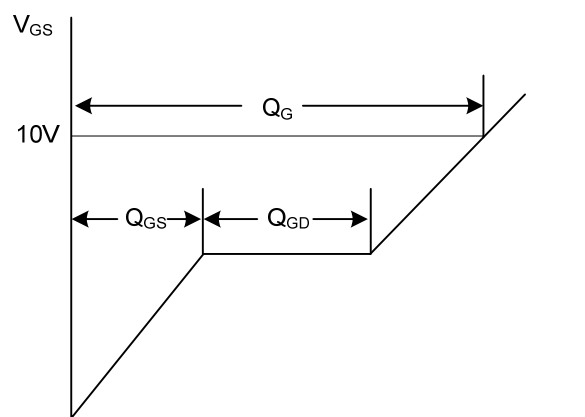
Switching Test Circuit



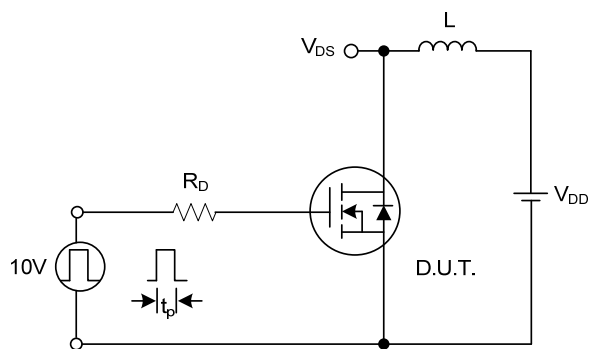
Switching Waveforms



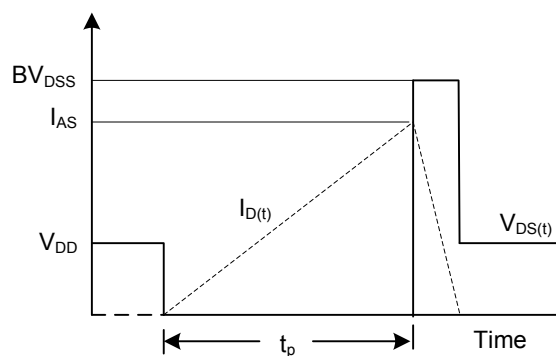
Gate Charge Test Circuit



Charge  
Gate Charge Waveform

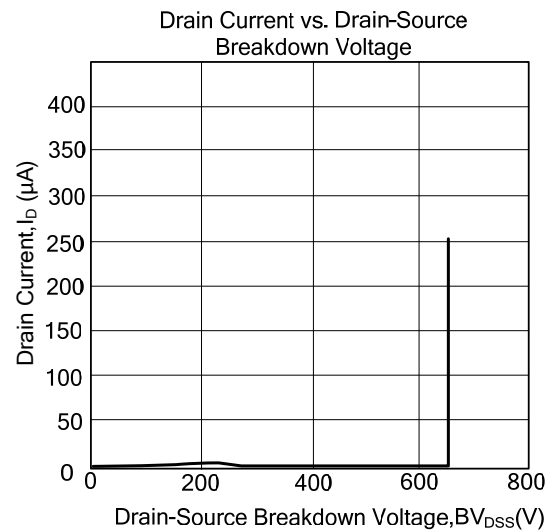
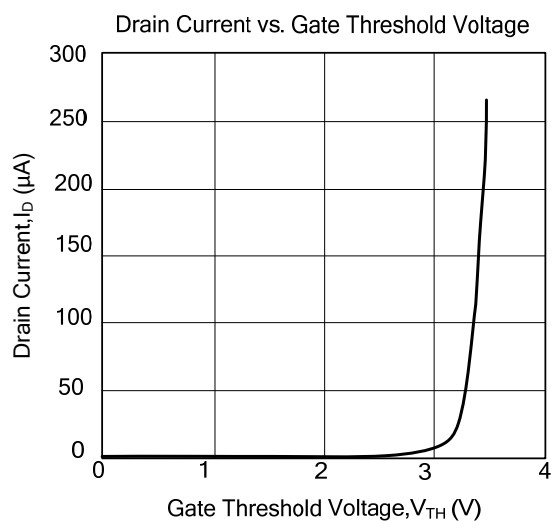
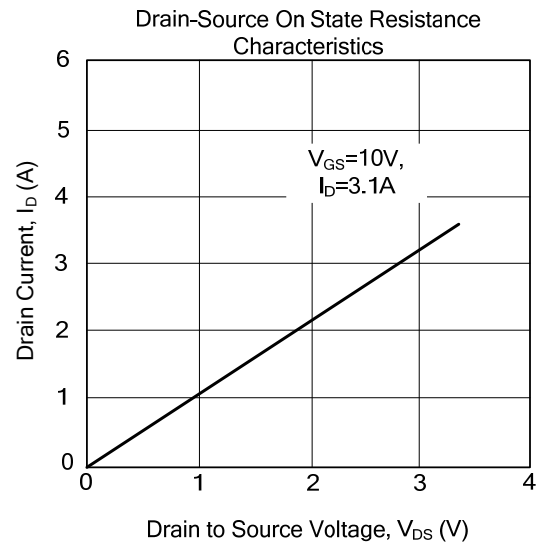
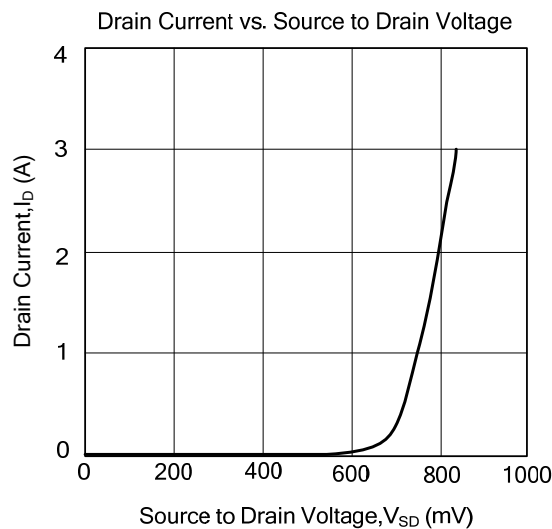


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

## ■ TYPICAL CHARACTERISTICS



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