



4N65-U

Power MOSFET

4A, 650V N-CHANNEL POWER MOSFET

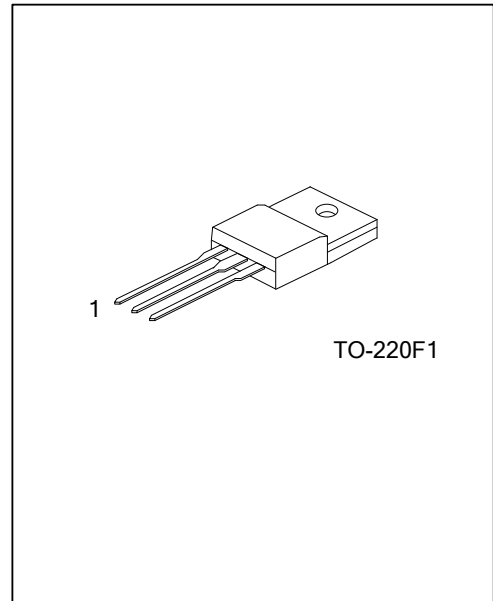
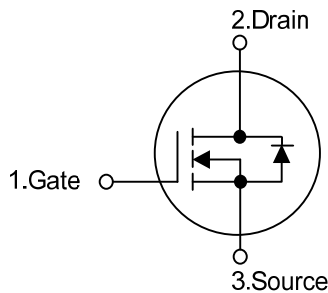
■ DESCRIPTION

The UTC **4N65-U** is a high voltage 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 characteristic. This power MOSFET is usually used in high speed switching applications including power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

■ FEATURES

- * $R_{DS(ON)} < 2.5\Omega @ V_{GS}=10V$
- * 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 | |
| 4N65L- TF1-T | 4N65G-TF1-T | TO-220F1 | G | D | S | Tube |

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

| | |
|---|---|
| <p>4N65L-TF1-T</p> <ul style="list-style-type: none"> (1)Packing Type (2)Package Type (3)Lead Free | <ul style="list-style-type: none"> (1) T: Tube (2) TF1: TO-220F1 (3) L: Lead Free, G: Halogen Free |
|---|---|

■ MARKING INFORMATION

| PACKAGE | MARKING |
|----------|---------|
| TO-220F1 | |

■ 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} | ± 30 | V |
| Avalanche Current (Note2) | | I_{AR} | 4.4 | A |
| Drain Current | Continuous | I_D | 4.0 | A |
| | Pulsed (Note2) | I_{DM} | 16 | A |
| Avalanche Energy | Single Pulsed (Note3) | E_{AS} | 240 | mJ |
| | Repetitive (Note2) | E_{AR} | 10.6 | mJ |
| Peak Diode Recovery dv/dt (Note4) | | dv/dt | 4.5 | V/ns |
| Power Dissipation | | P_D | 36 | W |
| Junction Temperature | | T_J | +150 | $^\circ\text{C}$ |
| Operating Temperature | | T_{OPR} | -55 ~ +150 | $^\circ\text{C}$ |
| Storage Temperature | | T_{STG} | -55 ~ +150 | $^\circ\text{C}$ |

Note: 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. $L = 30\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 4.4\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

| PARAMETER | SYMBOL | RATING | UNIT |
|---------------------|---------------|--------|---------------------------|
| Junction to Ambient | θ_{JA} | 62.5 | $^\circ\text{C}/\text{W}$ |
| Junction to Case | θ_{JC} | 3.47 | $^\circ\text{C}/\text{W}$ |

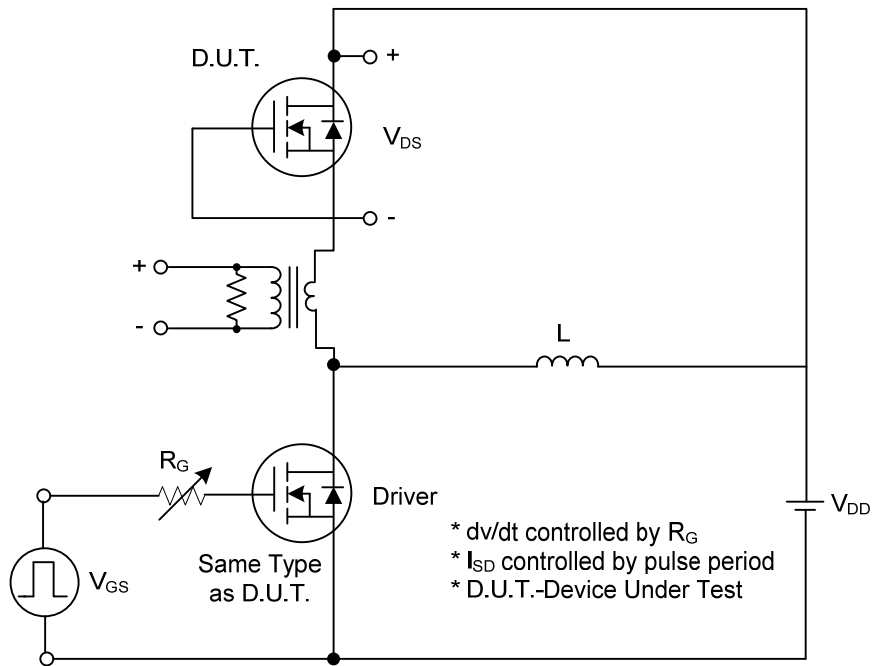
■ ELECTRICAL CHARACTERISTICS (T_C=25°C, unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|-------------------------------------|---|-----|-----|------|------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | V _{GS} = 0 V, I _D = 250μA | 650 | | | V |
| Drain-Source Leakage Current | I _{DSS} | V _{DS} = 650 V, V _{GS} = 0 V | | | 10 | μA |
| | | V _{DS} = 520 V, T _C = 125°C | | | 100 | μA |
| Gate-Source Leakage Current | I _{GSS} | V _{GS} = 30 V, V _{DS} = 0 V | | | 100 | nA |
| | | V _{GS} = -30 V, V _{DS} = 0 V | | | -100 | nA |
| Breakdown Voltage Temperature Coefficient | ΔBV _{DSS} /ΔT _J | I _D =250μA, Referenced to 25°C | | 0.6 | | V/°C |
| ON CHARACTERISTICS | | | | | | |
| Gate Threshold Voltage | V _{GS(TH)} | V _{DS} = V _{GS} , I _D = 250μA | 2.0 | | 4.0 | V |
| Static Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} = 10 V, I _D = 2.2A | | 2.4 | 2.5 | Ω |
| DYNAMIC CHARACTERISTICS | | | | | | |
| Input Capacitance | C _{ISS} | V _{DS} = 25 V, V _{GS} = 0V, f = 1MHz | | 980 | 1120 | pF |
| Output Capacitance | C _{OSS} | | | 55 | 70 | pF |
| Reverse Transfer Capacitance | C _{RSS} | | | 44 | 55 | pF |
| SWITCHING CHARACTERISTICS | | | | | | |
| Turn-On Delay Time | t _{D(ON)} | V _{DS} = 30V, I _D = 1.0A, R _G = 25Ω (Note 1, 2) | | 68 | 108 | ns |
| Turn-On Rise Time | t _R | | | 210 | 250 | ns |
| Turn-Off Delay Time | t _{D(OFF)} | | | 104 | 144 | ns |
| Turn-Off Fall Time | t _F | | | 35 | 80 | ns |
| Total Gate Charge | Q _G | V _{DS} =120V, I _D =4.0A, I _G =3.3mA, V _{GS} =10V (Note 1, 2) | | 96 | | nC |
| Gate-Source Charge | Q _{GS} | | | 11 | | nC |
| Gate-Drain Charge | Q _{GD} | | | 45 | | nC |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS | | | | | | |
| Drain-Source Diode Forward Voltage | V _{SD} | V _{GS} = 0 V, I _S = 4A | | | 1.4 | V |
| Maximum Continuous Drain-Source Diode Forward Current | I _S | | | | 4 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | I _{SM} | | | | 16 | A |
| Reverse Recovery Time | t _{rr} | V _{GS} = 0V, I _S = 4A, | | 250 | | ns |
| Reverse Recovery Charge | Q _{RR} | di _F /dt = 100 A/μs (Note 1) | | 1.5 | | μC |

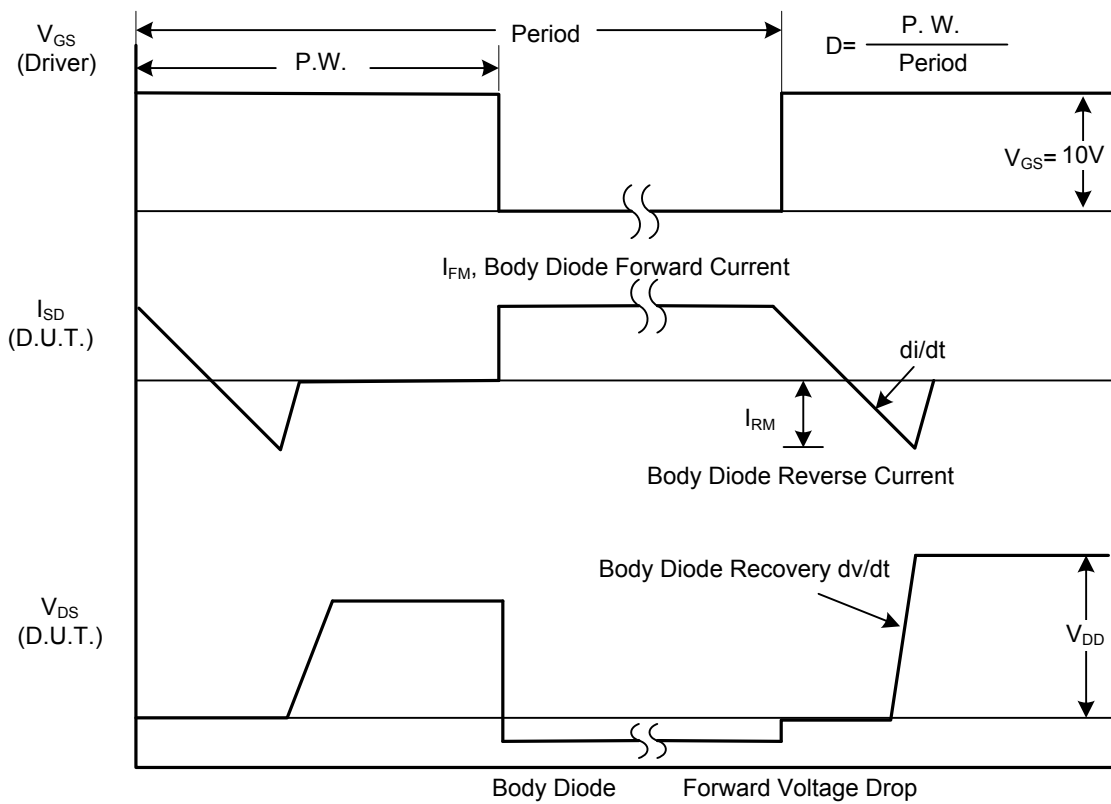
Note: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

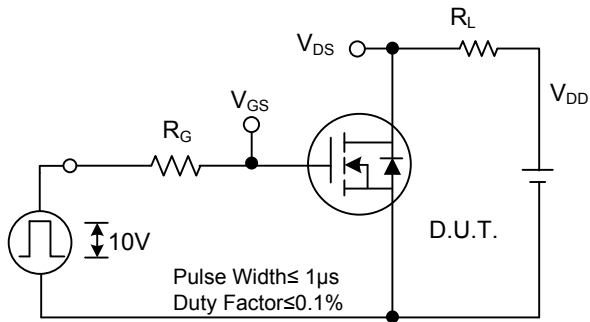


Peak Diode Recovery dv/dt Test Circuit

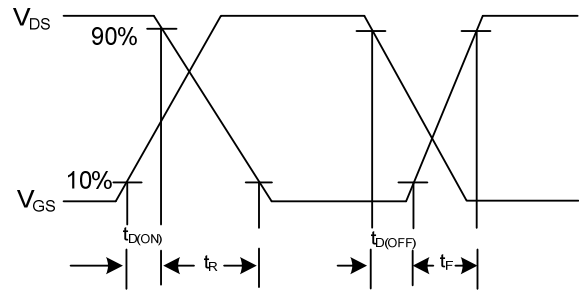


Peak Diode Recovery dv/dt Waveforms

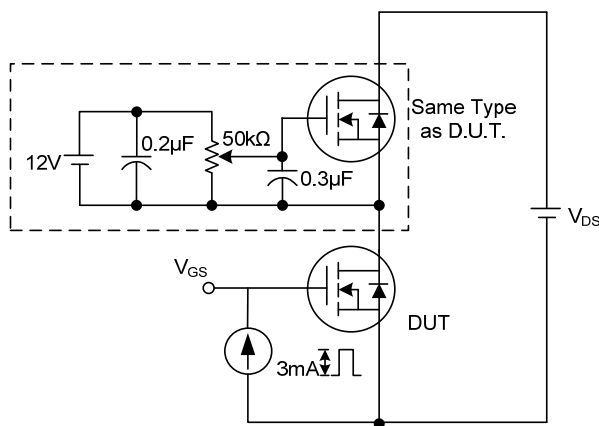
TEST CIRCUITS AND WAVEFORMS (Cont.)



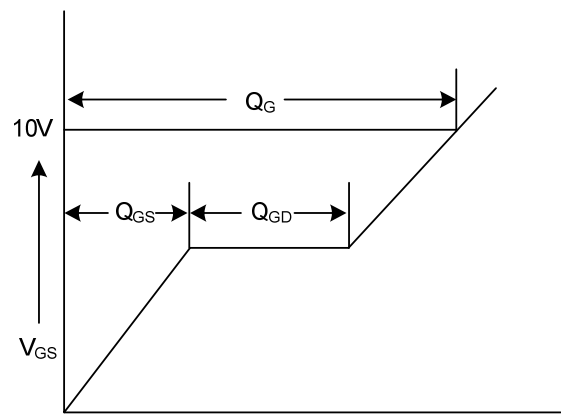
Switching Test Circuit



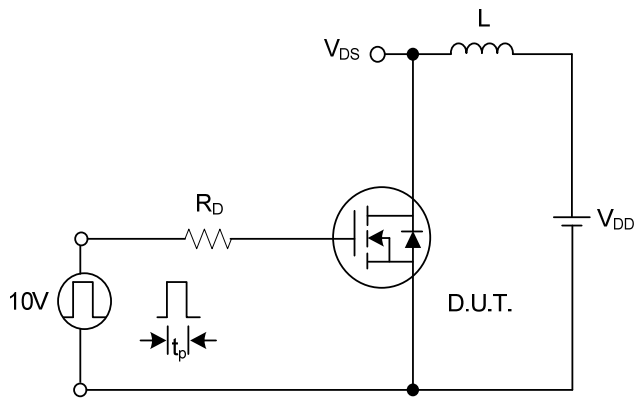
Switching Waveforms



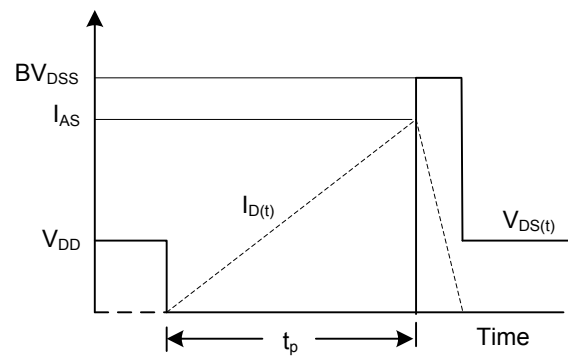
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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