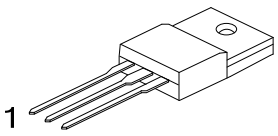
# 9A, 650V N-CHANNEL POWER MOSFET




TO-220F2

## ■ DESCRIPTION

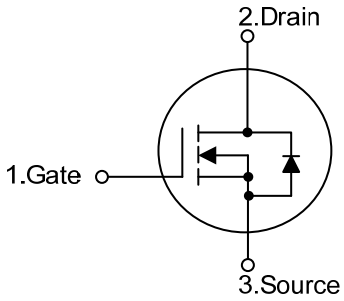
The UTC **9N65K-MT** is an N-channel mode power MOSFET using UTC's advanced technology to provide customers with planar stripe and DMOS technology. This technology allows a minimum on-state resistance and superior switching performance. It also can withstand high energy pulse in the avalanche and commutation mode.

The UTC **9N65K-MT** is generally applied in high efficiency switch mode power supplies and uninterruptible power supplies.

## ■ FEATURES

* $R_{DS(ON)}$ < 1.1 Ω @ $V_{GS}$ = 10 V, , $I_D$ = 5.1 A
* High Switching Speed
* Improved dv/dt Capability
* 100% Avalanche Tested

## ■ SYMBOL



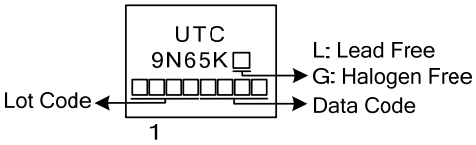

## ■ ORDERING INFORMATION

| Ordering Number | | Package | Pin Assignment | | | Packing |
|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 9N65K-L-TF2-T | 9N65K-G-TF2-T | TO-220F2 | G | D | S | Tube |

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

| | |
|---|---|
| 9N65KL-TF2-T<br>(1)Packing Type<br>(2)Package Type<br>(3)Green Package | (1) T: Tube<br>(2) TF2: TO-220F2<br>(3) L: Lead Free, G: Halogen Free and Lead Free |

## ■ MARKING



## ■ ABSOLUTE MAXIMUM RATINGS ($T_J$=25°C, unless otherwise specified)

| PARAMETER | | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 650 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±30 | V |
| Drain Current | Continuous, $V_{GSS}$@10V | @$T_C$=25°C | $I_D$ | 9 | A |
| | | @$T_C$=100°C | | 5.4 | A |
| | Pulsed (Note 2) | | $I_{DM}$ | 36 | A |
| Avalanche Energy | Repetitive (Note 3) | | $E_{AS}$ | 375 | mJ |
| Peak Diode Recovery dv/dt (Note 3) | | | dv/dt | 2.8 | V/ns |
| Power Dissipation | | | $P_D$ | 49 | W |
| Derate above 25°C | | | | 0.39 | W/°C |
| Junction Temperature | | | $T_J$ | +150 | °C |
| Storage Temperature | | | $T_{STG}$ | -55~+150 | °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 max. junction temperature.
3. L=9.25mH, $I_{AS}$=9A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$ = 25°C
4. $I_{SD}$≤5.2A, di/dt≤90A/μs, $V_{DD}$≤$BV_{DSS}$, $T_J$≤150°C
5. Drain current limited by maximum junction temperature

## ■ THERMAL DATA

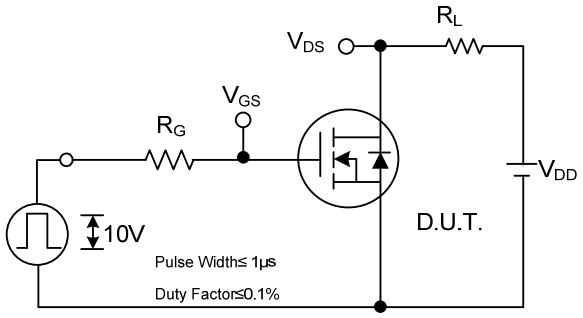
| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Junction to Ambient | $\theta_{JA}$ | 62.5 | °C/W |
| Junction to Case | $\theta_{JC}$ | 2.54 | °C/W |

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

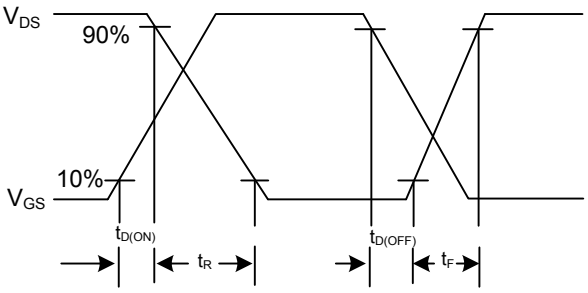
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $I_D$=250μA, $V_{GS}$=0V | 650 | | | V |
| Breakdown Voltage Temperature Coefficient | | $\Delta BV_{DSS}/\Delta T_J$ | Reference to 25°C, $I_D$=1mA | | 0.67 | | V/°C |
| Drain-Source Leakage Current | | $I_{DSS}$ | $V_{DS}$=650V, $V_{GS}$=0V | | | 25 | μA |
| | | | $V_{DS}$=520V, $V_{GS}$=0V, $T_J$=125°C | | | 250 | |
| Gate- Source Leakage Current | Forward | $I_{GSS}$ | $V_{GS}$=+30V | | | +100 | nA |
| | Reverse | | $V_{GS}$=-30V | | | -100 | nA |
| **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 | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=5.1A | | | 1.1 | Ω |
| **DYNAMIC PARAMETERS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{DS}$=25V, $V_{GS}$=0V, f=1.0MHz | | 870 | | pF |
| Output Capacitance | | $C_{OSS}$ | | | 122 | | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 10 | | pF |
| **SWITCHING PARAMETERS** | | | | | | | |
| Turn-ON Delay Time | | $t_{D(ON)}$ | $V_{DD}$=30V, $I_D$=0.5A, $R_G$=25Ω, $R_D$ = 62Ω (Note 1, 2) | | 65 | | ns |
| Rise Time | | $t_R$ | | | 80 | | ns |
| Turn-OFF Delay Time | | $t_{D(OFF)}$ | | | 160 | | ns |
| Fall-Time | | $t_F$ | | | 84 | | ns |
| Total Gate Charge | | $Q_G$ | $V_{DS}$=50V, $V_{GS}$=10V, $I_D$=1.3A (Note 1, 2) | | 29.8 | | nC |
| Gate to Source Charge | | $Q_{GS}$ | | | 8.6 | | nC |
| Gate to Drain ("Miller") Charge | | $Q_{GD}$ | | | 7.3 | | nC |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Body-Diode Continuous Current | | $I_S$ | | | | 9 | A |
| Maximum Body-Diode Pulsed Current (Note 1) | | $I_{SM}$ | | | | 36 | A |
| Drain-Source Diode Forward Voltage | | $V_{SD}$ | $T_J$=25°C, $I_S$=9A,$V_{GS}$=0V(Note 2) | | | 1.5 | V |

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

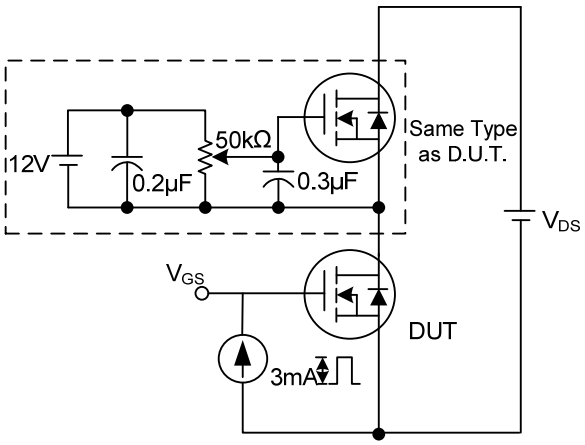
## ■ TEST CIRCUITS AND WAVEFORMS



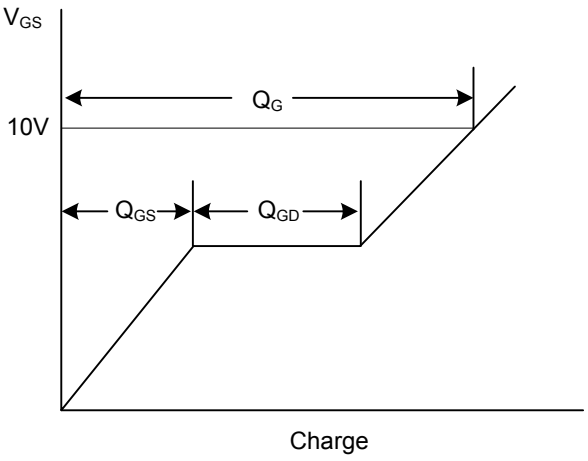

**Switching Test Circuit**



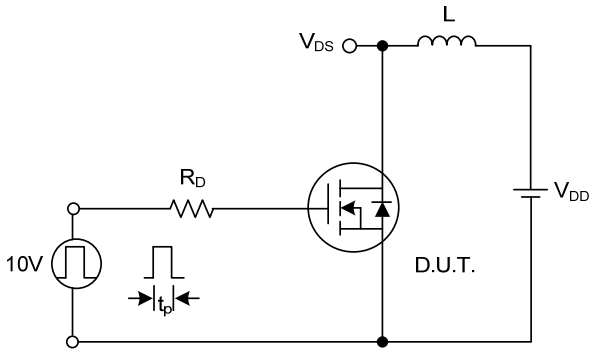

**Switching Waveforms**



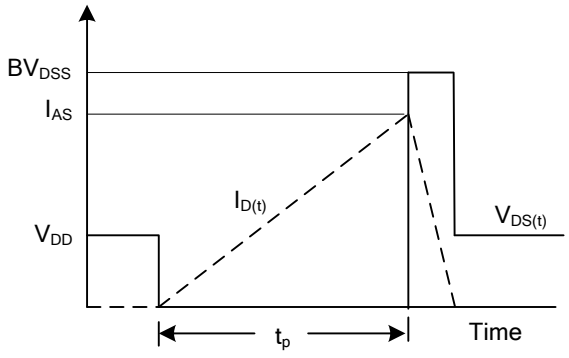

**Gate Charge Test Circuit**




**Gate Charge Waveform**




**Unclamped Inductive Switching Test Circuit**




**Unclamped Inductive Switching Waveforms**