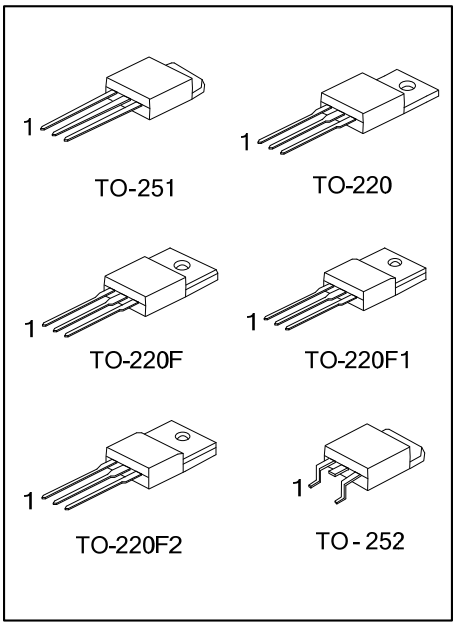
# 3A, 650V N-CHANNEL SUPER-JUNCTION MOSFET




## ■ DESCRIPTION

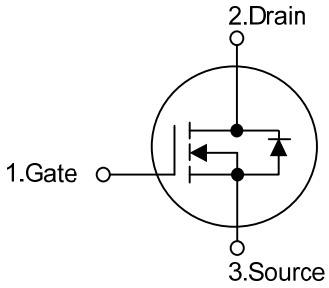
The UTC **3NM65** is an Super Junction MOSFET Structure. It uses UTC advanced planar stripe, DMOS technology to provide customers perfect switching performance, minimal on-state resistance.

The UTC **3NM65** is universally applied in electronic lamp ballasts based on half bridge topology, high efficiency switched mode power supplies, active power factor correction, etc.

## ■ FEATURES

* $R_{DS(ON)}$ < 1.86Ω @ $V_{GS}$ = 10 V, $I_D$ = 1.5 A
* Fast switching capability
* Avalanche energy specified
* Improved dv/dt capability, high ruggedness

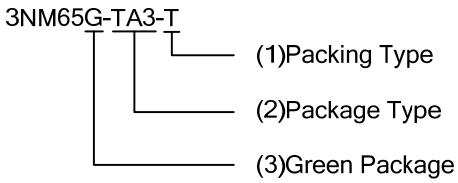
## ■ SYMBOL




## ■ ORDERING INFORMATION

| Ordering Number | | Package | Pin Assignment | | | Packing |
|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 3NM65L-TA3-T | 3NM65G-TA3-T | TO-220 | G | D | S | Tube |
| 3NM65L-TF1-T | 3NM65G-TF1-T | TO-220F1 | G | D | S | Tube |
| 3NM65L-TF2-T | 3NM65G-TF2-T | TO-220F2 | G | D | S | Tube |
| 3NM65L-TF3-T | 3NM65G-TF3-T | TO-220F | G | D | S | Tube |
| 3NM65L-TM3-T | 3NM65G-TM3-T | TO-251 | G | D | S | Tube |
| 3NM65L-TN3-R | 3NM65G-TN3-R | TO-252 | G | D | S | Tape Reel |

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

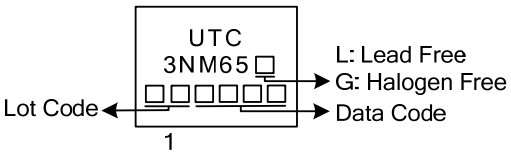



(1) T: Tube, R: Tape Reel

(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252

(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



## ■ ABSOLUTE MAXIMUM RATINGS ($T_C$ = 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 | $I_D$ | 3 | A |
| | Pulsed (Note 2) | $I_{DM}$ | 12 | A |
| Avalanche Current (Note 2) | | $I_{AR}$ | 1.2 | A |
| Avalanche Energy | Single Pulsed (Note 3) | $E_{AS}$ | 104 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 4.5 | V/ns |
| Power Dissipation | TO-220 | $P_D$ | 75 | W |
| | TO-220F/TO-220F1 | | 34 | W |
| | TO-220F2 | | 35 | W |
| | TO-251/TO-252 | | 50 | W |
| 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 maximum junction temperature.
3. L=144mH, $I_{AS}$=1.2A, $V_{DD}$=50V, $R_G$=25 Ω, Starting $T_J$ = 25°C
4. $I_{SD}$≤2.0A, di/dt≤200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C

## ■ THERMAL DATA

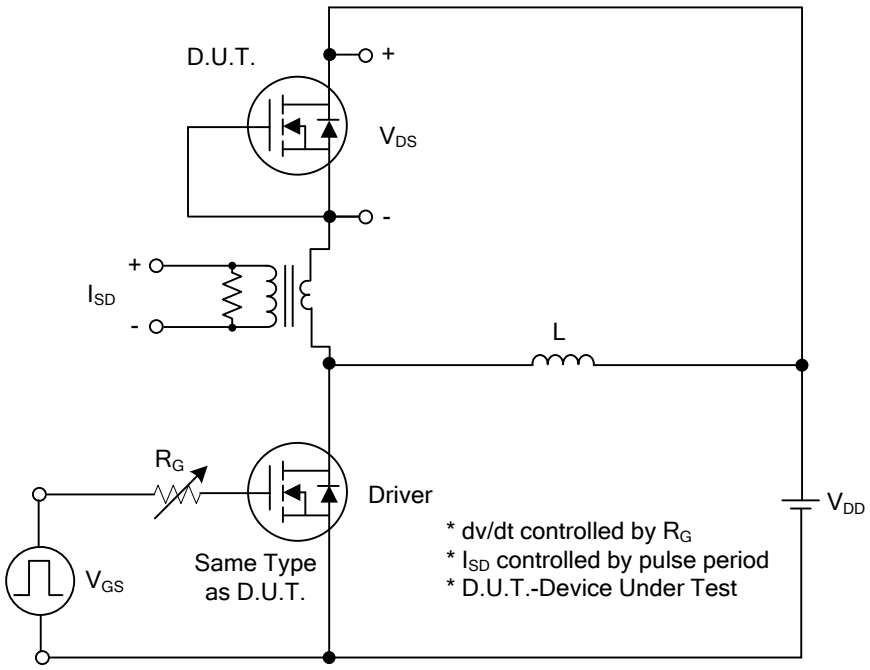
| PARAMETER | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Junction to Ambient | TO-220/TO-220F<br>TO-220F1/TO-220F2 | $θ_{JA}$ | 62.5 | °C/W |
| | TO-251/TO-252 | | 110 | |
| Junction to Case | TO-220 | $θ_{JC}$ | 1.67 | °C/W |
| | TO-220F/TO-220F1 | | 3.68 | |
| | TO-220F2 | | 3.58 | |
| | TO-251/TO-252 | | 2.5 | |

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

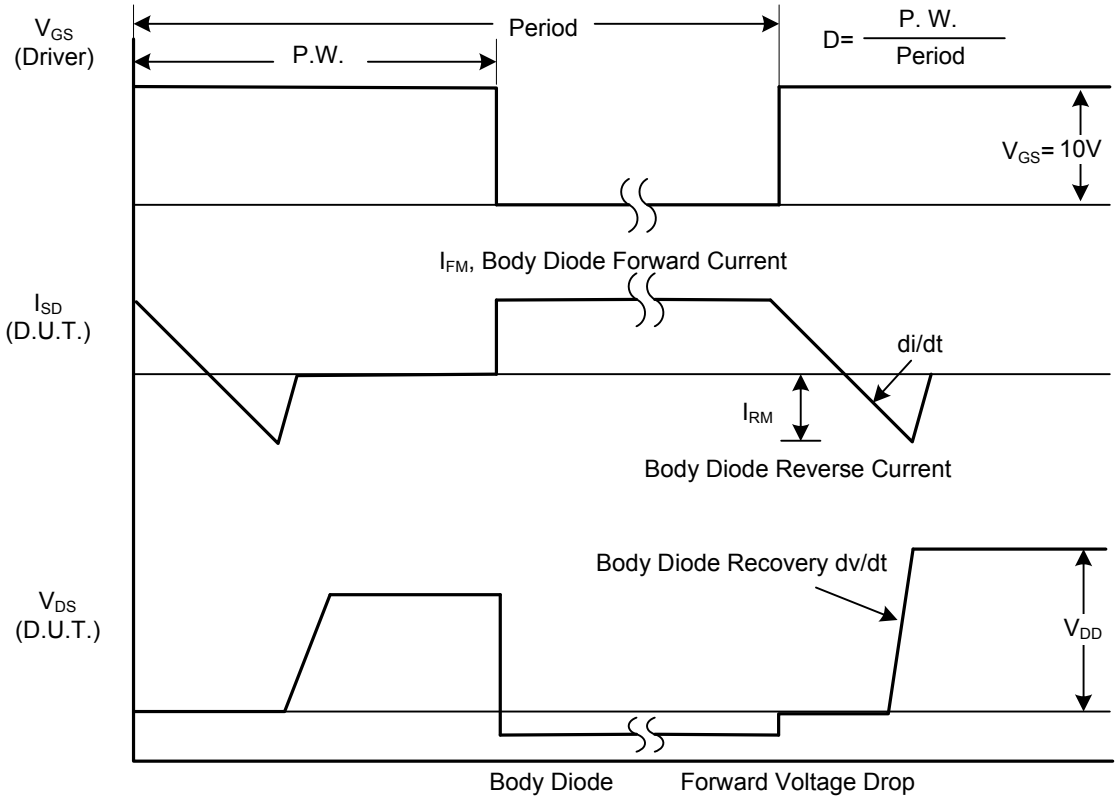
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250μA | 650 | | | V |
| Drain-Source Leakage Current | | $I_{DSS}$ | $V_{DS}$=650V, $V_{GS}$=0V | | | 10 | μA |
| Gate-Source Leakage Current | Forward | $I_{GSS}$ | $V_{GS}$=30V, $V_{DS}$=0V | | | 100 | nA |
| | Reverse | | $V_{GS}$=-30V, $V_{DS}$=0V | | | -100 | nA |
| **ON CHARACTERISTICS** | | | | | | | |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250μA | 2.5 | | 4.5 | V |
| Static Drain-Source On-State Resistance | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$= 1.5A | | | 1.86 | Ω |
| **DYNAMIC CHARACTERISTICS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{GS}$=0V, $V_{DS}$=25V, f=1MHz | | 210 | | pF |
| Output Capacitance | | $C_{OSS}$ | | | 95 | | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 16 | | pF |
| **SWITCHING CHARACTERISTICS** | | | | | | | |
| Total Gate Charge (Note 1) | | $Q_G$ | $V_{DS}$=50V, $V_{GS}$=10 V, $I_D$=1.3A, $I_G$ =100 μA (Note 1, 2) | | 22.6 | | nC |
| Gate-Source Charge | | $Q_{GS}$ | | | 2.1 | | nC |
| Gate-Drain Charge | | $Q_{DD}$ | | | 7.4 | | nC |
| Turn-On Delay Time (Note 1) | | $t_{D(ON)}$ | $V_{DD}$=30V, $V_{GS}$=10 V, $I_D$=0.5A, $R_G$=25Ω (Note 1, 2) | | 32 | | ns |
| Turn-On Rise Time | | $t_R$ | | | 58 | | ns |
| Turn-Off Delay Time | | $t_{D(OFF)}$ | | | 84 | | ns |
| Turn-Off Fall Time | | $t_F$ | | | 36 | | ns |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Continuous Drain-Source Diode Forward Current | | $I_S$ | | | | 3.0 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | | $I_{SM}$ | | | | 12 | A |
| Drain-Source Diode Forward Voltage (Note 1) | | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 3.0 A | | | 1.4 | V |
| Body Diode Reverse Recovery Time (Note 1) | | $t_{rr}$ | $V_{GS}$=0V, $I_S$=3.0A, $dI_F/dt$=100A/μs | | 236 | | ns |
| Body Diode Reverse Recovery Charge | | $Q_{rr}$ | | | 1.5 | | nC |

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

## ■ TEST CIRCUITS AND WAVEFORMS

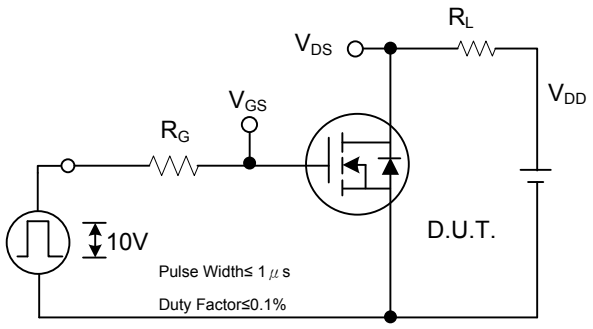



**Peak Diode Recovery dv/dt Test Circuit**

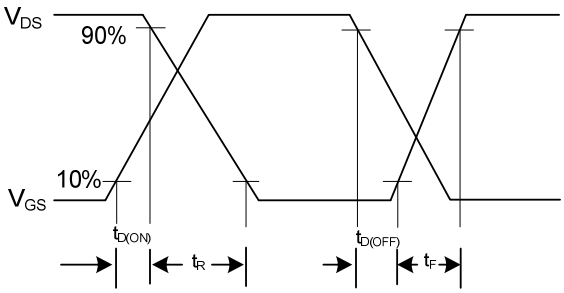



**Peak Diode Recovery dv/dt Waveforms**

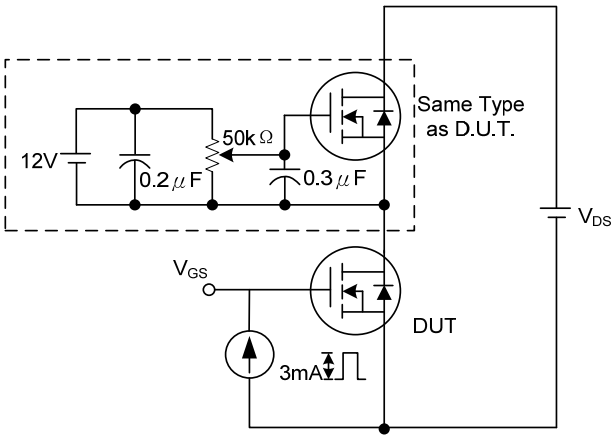
## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



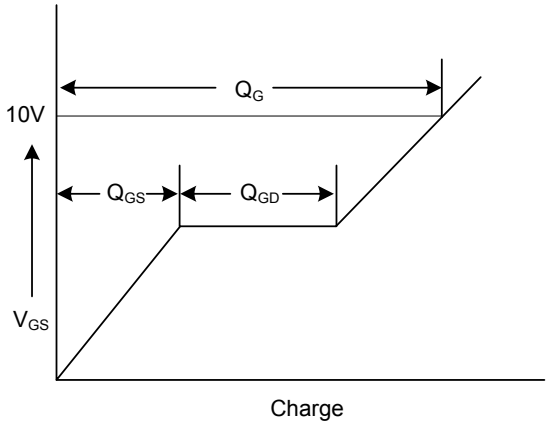

**Switching Test Circuit**



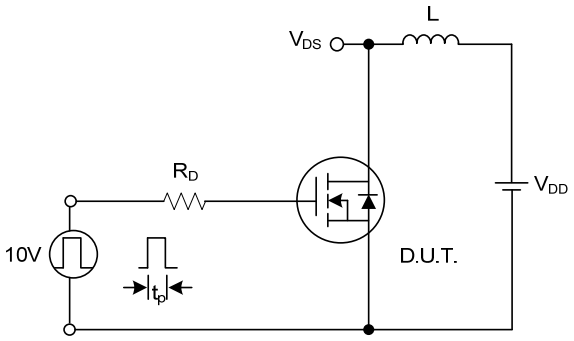

**Switching Waveforms**



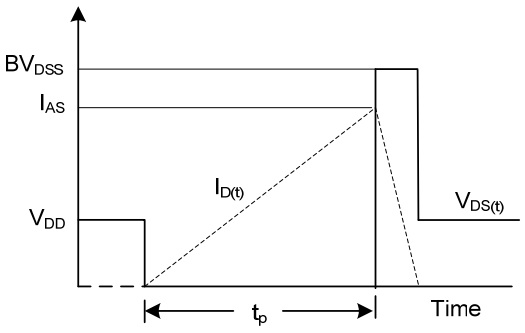

**Gate Charge Test Circuit**




**Gate Charge Waveform**




**Unclamped Inductive Switching Test Circuit**




**Unclamped Inductive Switching Waveforms**