# UTC UNISONIC TECHNOLOGIES CO., LTD

## 4N90      Preliminary      *Power MOSFET*

# 4 Amps, 900 Volts
# N-CHANNEL MOSFET
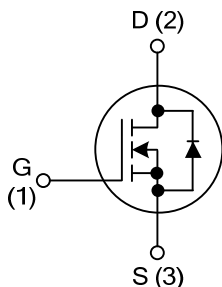
TO-220

### ■ DESCRIPTION

The UTC **4N90** is a N-channel enhancement MOSFET adopting UTC's advanced technology to provide customers with DMOS, planar stripe technology. This technology is designed to meet the requirements of the minimum on-state resistance and perfect switching performance. It also can withstand high energy pulse in the avalanche and communication mode.

The UTC **4N90** is particularly applied in high efficiency switch mode power supplies.

### ■ FEATURES

* Typically 17nC low gate charge
* High switching speed
* 4A, 900V, $R_{DS(ON)}$=4.2Ω @ $V_{GS}$=10V
* Typically 5.6pF low $C_{RSS}$
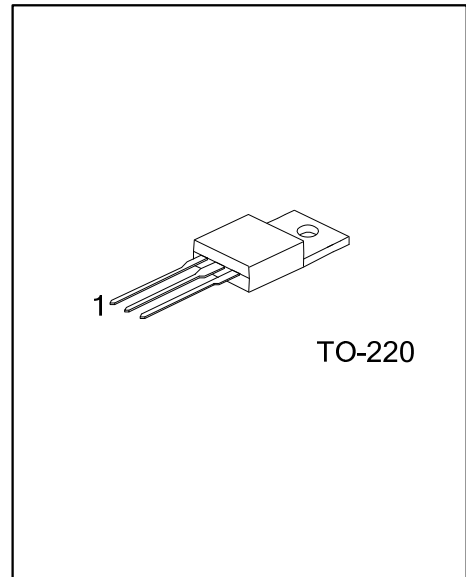* 100% avalanche tested
* Improved dv/dt capability

### ■ SYMBOL

D (2)

G (1)

S (3)

### ■ ORDERING INFORMATION

| Ordering Number | | Package | Pin Assignment | | | Packing |
|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 4N90L-TA3-T | 4N90G-TA3-T | TO-220 | G | D | S | Tube |

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

4N90L - TA3 - T

(1) Packing Type    (1) T: Tube

(2) Package Type    (2) TA3: TO-220

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

■ **ABSOLUTE MAXIMUM RATINGS** ($T_C$=25°C, unless otherwise specified)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Drain to Source Voltage | | $V_{DSS}$ | 900 | V |
| Gate to Source Voltage | | $V_{GSS}$ | ±30 | V |
| Avalanche Current (Note 1) | | $I_{AR}$ | 4 | A |
| Continuous Drain Current | Continuous | $I_D$ | 4 | A |
| | Pulsed (Note 1) | $I_{DM}$ | 16 | A |
| Avalanche Energy | Single Pulsed (Note 2) | $E_{AS}$ | 570 | mJ |
| | Repetitive (Note 1) | $E_{AR}$ | 14 | mJ |
| Peak Diode Recovery dv/dt (Note 3) | | dv/dt | 4.5 | V/ns |
| Power Dissipation | | $P_D$ | 140 | W |
| Operating Junction Temperature | | $T_J$ | +150 | °C |
| Storage Temperature | | $T_{STG}$ | -55 ~ +150 | °C |

Note : 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.

■ **THERMAL DATA**

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Junction-to-Ambient | $\theta_{JA}$ | 62.5 | °C/W |
| Junction-to-Case | $\theta_{JC}$ | 0.89 | °C/W |

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

| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250µA | 900 | | | V |
| Breakdown Voltage Temperature Coefficient | | $\Delta BV_{DSS}/\Delta T_J$ | $I_D$=250µA, Referenced to 25°C | | 1.05 | | V/°C |
| Drain-Source Leakage Current | | $I_{DSS}$ | $V_{DS}$=900V, $V_{GS}$=0V | | | 10 | µA |
| | | | $V_{DS}$=720V, $T_C$=125°C | | | 100 | µA |
| Gate- Source Leakage Current | Forward | $I_{GSS}$ | $V_{GS}$=+30V, $V_{DS}$=0V | | | +100 | nA |
| | Reverse | $I_{GSS}$ | $V_{GS}$=-30V, $V_{DS}$=0V | | | -100 | nA |
| **ON CHARACTERISTICS** | | | | | | | |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250µA | 3.0 | | 5.0 | V |
| Drain-Source On-State Resistance | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=2A | | 3.5 | 4.2 | Ω |
| Forward Transconductance | | $g_{FS}$ | $V_{DS}$=50V, $I_D$=2A  (Note 4) | | 5 | | S |
| **DYNAMIC PARAMETERS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | | | 740 | 960 | pF |
| Output Capacitance | | $C_{OSS}$ | $V_{DS}$=25V,$V_{GS}$=0V,f=1.0MHz | | 65 | 85 | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 5.6 | 7.3 | pF |
| **SWITCHING PARAMETERS** | | | | | | | |
| Total Gate Charge | | $Q_G$ | | | 17 | 22 | nC |
| Gate-Source Charge | | $Q_{GS}$ | $V_{DS}$=720V, $V_{GS}$=10V, $I_D$=4A (Note 4,5) | | 4.5 | | nC |
| Gate-Drain Charge | | $Q_{GD}$ | | | 7.5 | | nC |
| Turn-ON Delay Time | | $t_{D(ON)}$ | | | 25 | 60 | ns |
| Turn-ON Rise Time | | $t_R$ | $V_{DD}$=450V,  $I_D$=4A,  $R_G$=25Ω (Note 4,5) | | 50 | 110 | ns |
| Turn-OFF Delay Time | | $t_{D(OFF)}$ | | | 40 | 90 | ns |
| Turn-OFF Fall Time | | $t_F$ | | | 35 | 80 | ns |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Body-Diode Continuous Current | | $I_S$ | | | | 4 | A |
| Maximum Body-Diode Pulsed Current | | $I_{SM}$ | | | | 16 | A |
| Drain-Source Diode Forward Voltage | | $V_{SD}$ | $I_S$ =4A, $V_{GS}$=0V | | | 1.4 | V |
| Body Diode Reverse Recovery Time | | $t_{RR}$ | $V_{GS}$=0V, $I_S$=4A, dI$_F$/dt=100A/µs (Note 4) | | 450 | | ns |
| Body Diode Reverse Recovery Charge | | $Q_{RR}$ | | | 3.5 | | µC |

Notes : 1. Repetitive Rating: Pulse width limited by maximum junction temperature

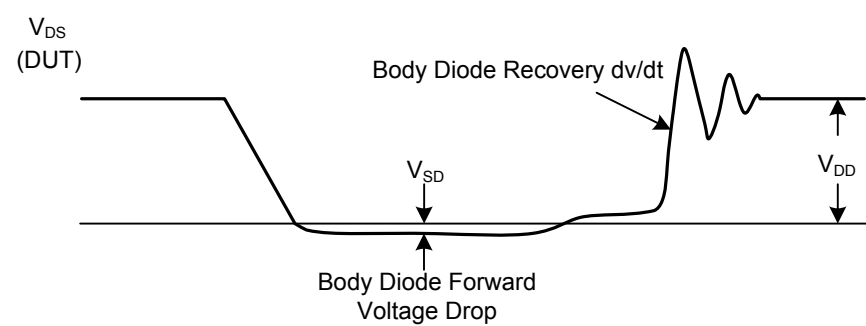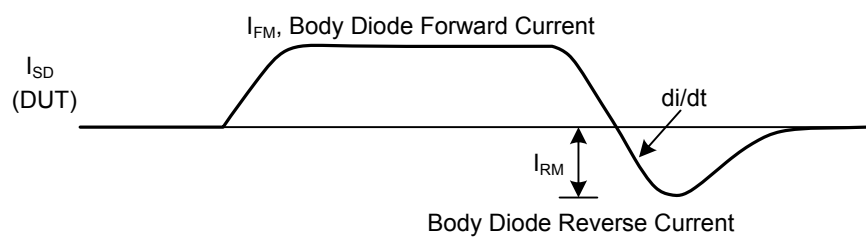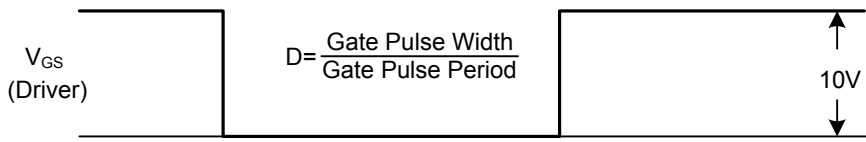       2. L=67mH, $I_{AS}$=4A, $V_{DD}$=50V, $R_G$=25Ω,  Starting $T_J$=25°C

       3. $I_{SD}$ ≤4A, di/dt ≤200A/µs, $V_{DD}$ ≤$BV_{DSS}$, Starting $T_J$=25°C

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

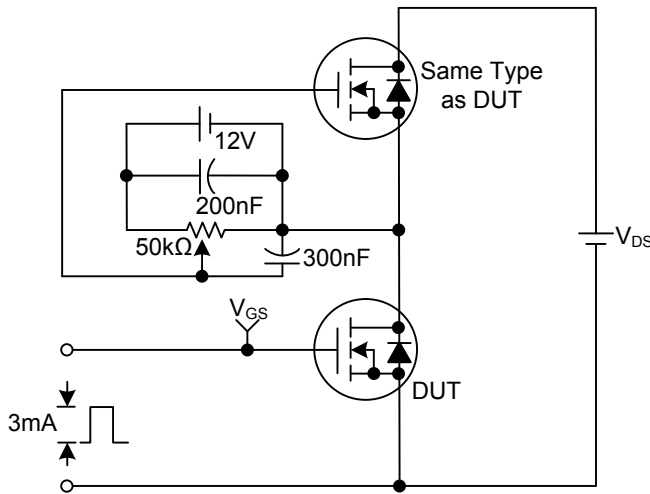       5. Essentially independent of operating temperature

■ **TEST CIRCUITS AND WAVEFORMS**
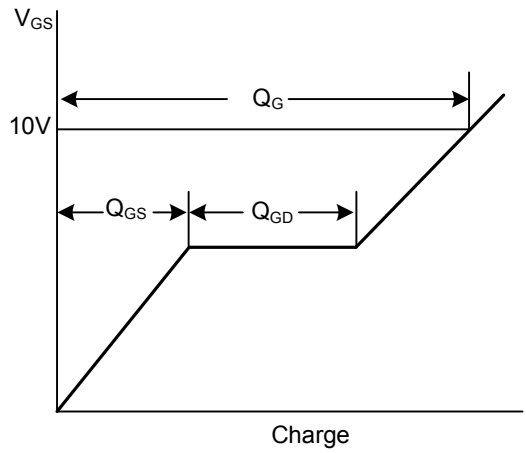
Peak Diode Recovery dv/dt Test Circuit & Waveforms



dv/dt controlled by $R_G$
$I_{SD}$ controlled by pulse period

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

$V_{GS}$ (Driver)    10V

$I_{SD}$ (DUT)

$I_{FM}$, Body Diode Forward Current

di/dt

$I_{RM}$

Body Diode Reverse Current

$V_{DS}$ (DUT)

Body Diode Recovery dv/dt

$V_{SD}$

$V_{DD}$

Body Diode Forward
Voltage Drop
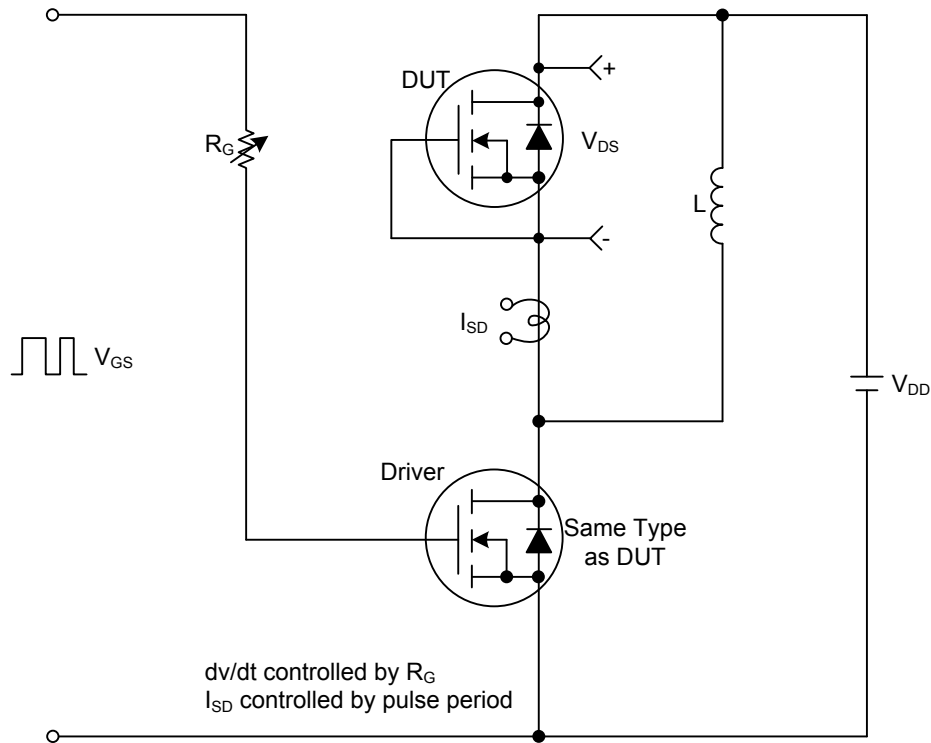
## Gate Charge Test Circuit

## Gate Charge Waveforms

$$Q_G$$

$$Q_{GS} \quad Q_{GD}$$

## Resistive Switching Test Circuit
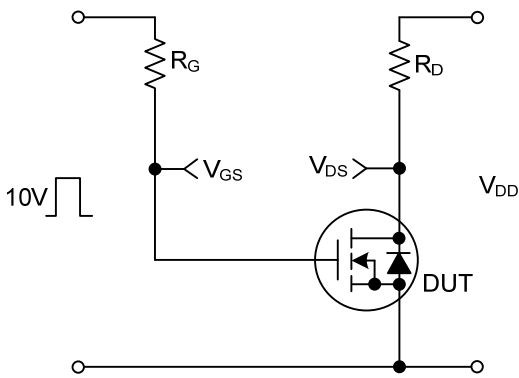
## Resistive Switching Waveforms

$t_{d(ON)}$ $t_R$ $t_{d(OFF)}$ $t_F$

$t_{ON}$ $t_{OFF}$
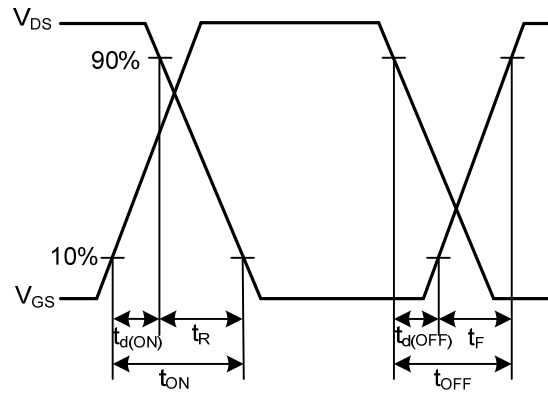
## Unclamped Inductive Switching Test Circuit

## Unclamped Inductive Switching Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

$I_D(t)$

$V_{DS}(t)$

$t_P$

Time