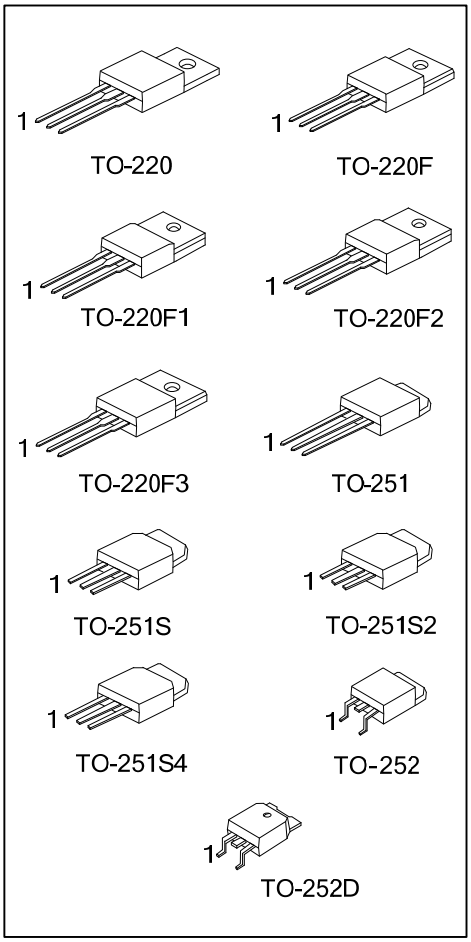
# 1 Amps, 900 Volts
# N-CHANNEL POWER MOSFET




## ■ DESCRIPTION

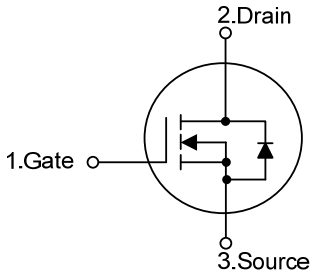
The UTC **1N90** is an N-channel mode power MOSFET, using UTC's advanced technology to provide costomers planar stripe and DMOS technology. This technology specializes in allowing a minimum on-state resistance, superior switching performance. It also can withstand high energy pulse in the avalanche and commutation mode.

The UTC **1N90** is universally applied in high efficiency switch mode power supply.

## ■ FEATURES

* $R_{DS(on)}$ < 16Ω @ $V_{GS}$=10V, $I_D$ = 0.5A
* High switching speed
* Improved dv/dt capability
* 100% avalanche tested

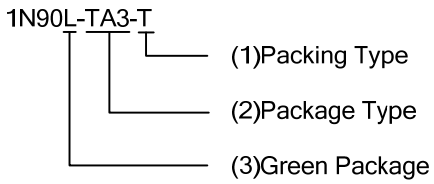
## ■ SYMBOL



## ■ ORDERING INFORMATION

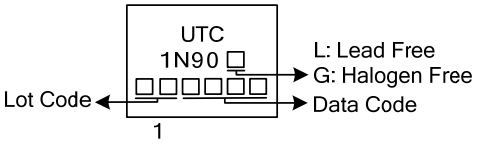
| Ordering Number | | Package | Pin Assignment | | | Packing |
|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 1N90L-TA3-T | 1N90G-TA3-T | TO-220 | G | D | S | Tube |
| 1N90L-TF3-T | 1N90G-TF3-T | TO-220F | G | D | S | Tube |
| 1N90L-TF1-T | 1N90G-TF1-T | TO-220F1 | G | D | S | Tube |
| 1N90L-TF2-T | 1N90G-TF2-T | TO-220F2 | G | D | S | Tube |
| 1N90L-TF3-T | 1N90G-TF3-T | TO-220F3 | G | D | S | Tube |
| 1N90L-TM3-T | 1N90G-TM3-T | TO-251 | G | D | S | Tube |
| 1N90L-TMS-T | 1N90G-TMS-T | TO-251S | G | D | S | Tube |
| 1N90L-TMS2-T | 1N90G-TMS2-T | TO-251S2 | G | D | S | Tube |
| 1N90L-TMS4-T | 1N90G-TMS4-T | TO-251S4 | G | D | S | Tube |
| 1N90L-TN3-R | 1N90G-TN3-R | TO-252 | G | D | S | Tape Reel |
| 1N90L-TND-R | 1N90G-TND-R | TO-252D | 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, TF3: TO-220F3, TM3: TO-251 TMS: TO-251S, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TND: TO-252D
(3) L: Lead Free, G: Halogen Free and Lead Free

## ■ MARKING



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

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 900 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±30 | V |
| Drain Current | Continuous | $I_D$ | 1.0 | A |
| | Pulsed (Note 2) | $I_{DM}$ | 4.0 | A |
| Avalanche Current (Note 2) | | $I_{AR}$ | 1.0 | A |
| Avalanche Energy | Single Pulsed (Note 3) | $E_{AS}$ | 90 | mJ |
| | Repetitive (Note 2) | $E_{AR}$ | 4.5 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 4.0 | V/ns |
| Power Dissipation | TO-220 | $P_D$ | 40 | W |
| | TO-220F/TO-220F1<br>TO-220F3 | | 23 | W |
| | TO-220F2 | | 24 | W |
| | TO-251/TO-251S<br>TO-251S2/TO-251S4<br>TO-252/TO-252D | | 28 | 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=170mH, $I_{AS}$=1.0A, $V_{DD}$= 50V, $R_G$=25Ω, Starting $T_J$=25°C
4. $I_{SD}$ ≤1.0A, di/dt ≤200A/μs, $V_{DD}$ ≤$BV_{DSS}$, Starting $T_J$=25°C

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Junction to Ambient | TO-220 | $\theta_{JA}$ | 62.5 | °C/W |
| | TO-220F/TO-220F1<br>TO-220F2/TO-220F3 | | 62.5 | °C/W |
| | TO-251/TO-251S<br>TO-251S2/TO-251S4<br>TO-252/TO-252D | | 110 | °C/W |
| Junction to Case | TO-220 | $\theta_{JC}$ | 3.13 | °C/W |
| | TO-220F/TO-220F1<br>TO-220F3 | | 5.35 | °C/W |
| | TO-220F2 | | 5.3 | °C/W |
| | TO-251/TO-251S<br>TO-251S2/TO-251S4<br>TO-252/TO-252D | | 4.53 | °C/W |

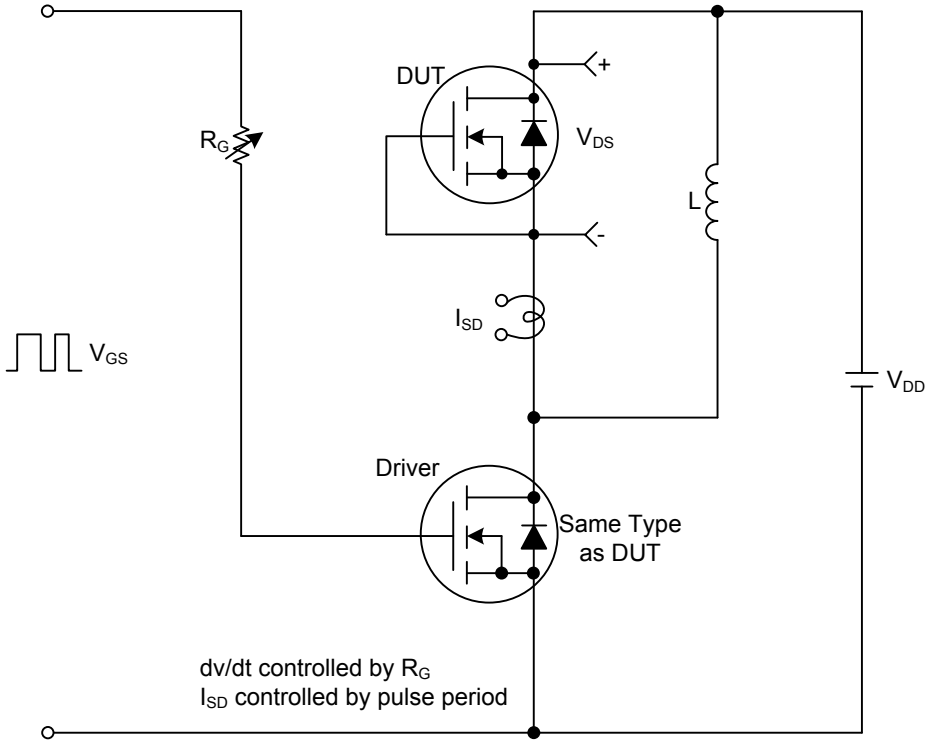
## ■ ELECTRICAL CHARACTERISTICS ($T_C$=25°C, unless otherwise specified)

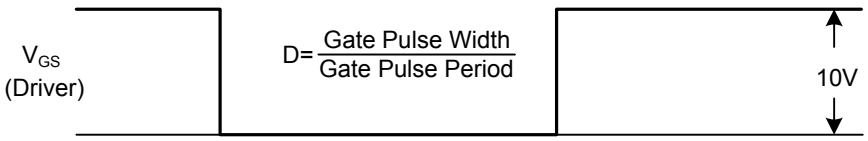
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250μA | 900 | | | V |
| Breakdown Voltage Temperature Coefficient | | $\Delta BV_{DSS}/\Delta T_J$ | $I_D$=250μA, Referenced to 25°C | | 1.0 | | 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 | $I_{GSS}$ | $V_{DS}$=0V ,$V_{GS}$=30V | | | 100 | nA |
| | Reverse | | $V_{DS}$=0V ,$V_{GS}$=-30V | | | -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, $I_D$=0.5A | | 12 | 16 | Ω |
| Forward Transconductance | | $g_{FS}$ | $V_{DS}$=50V, $I_D$=0.5A (Note 1) | | 0.75 | | S |
| **DYNAMIC PARAMETERS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{DS}$=25V,$V_{GS}$=0V,f=1.0MHz | | 200 | 250 | pF |
| Output Capacitance | | $C_{OSS}$ | | | 22 | 26 | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 5 | 7 | pF |
| **SWITCHING PARAMETERS** | | | | | | | |
| Turn-ON Delay Time | | $t_{D(ON)}$ | $V_{DD}$=30V, $I_D$=1.0A, $R_G$=25Ω (Note 1,2) | | 37 | 45 | ns |
| Turn-ON Rise Time | | $t_R$ | | | 10 | 40 | ns |
| Turn-OFF Delay Time | | $t_{D(OFF)}$ | | | 50 | 60 | ns |
| Turn-OFF Fall Time | | $t_F$ | | | 26 | 60 | ns |
| Total Gate Charge | | $Q_G$ | $V_{DS}$=120V, $V_{GS}$=10V, $I_D$=1.0A (Note 1,2) | | 25 | 35 | nC |
| Gate-Source Charge | | $Q_{GS}$ | | | 3 | | nC |
| Gate-Drain Charge | | $Q_{GD}$ | | | 4 | | nC |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Body-Diode Continuous Current | | $I_S$ | | | | 1.0 | A |
| Maximum Body-Diode Pulsed Current | | $I_{SM}$ | | | | 4.0 | A |
| Drain-Source Diode Forward Voltage | | $V_{SD}$ | $I_S$ =1.0A, $V_{GS}$=0V | | | 1.4 | V |
| Body Diode Reverse Recovery Time | | $t_{RR}$ | $V_{GS}$=0V, $I_S$=1.0A, $dI_F/dt$=100A/μs (Note 1) | | 300 | | ns |
| Body Diode Reverse Recovery Charge | | $Q_{RR}$ | | | 0.6 | | μC |

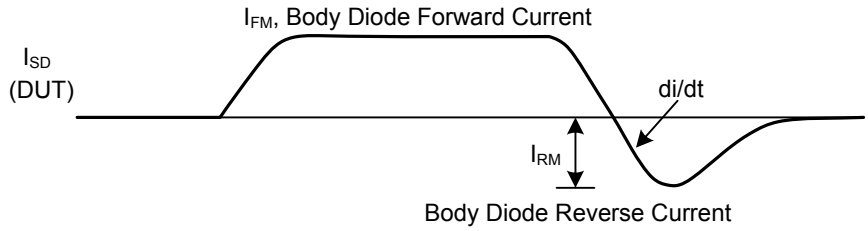
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%
2. Essentially independent of operating temperature.

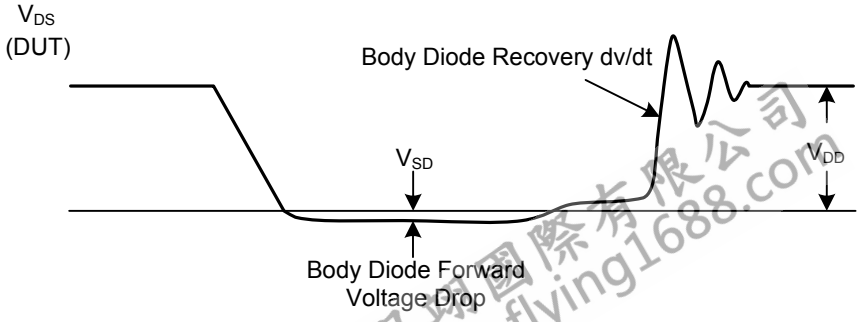
## ■ TEST CIRCUITS AND WAVEFORMS

Peak Diode Recovery dv/dt Test Circuit & Waveforms



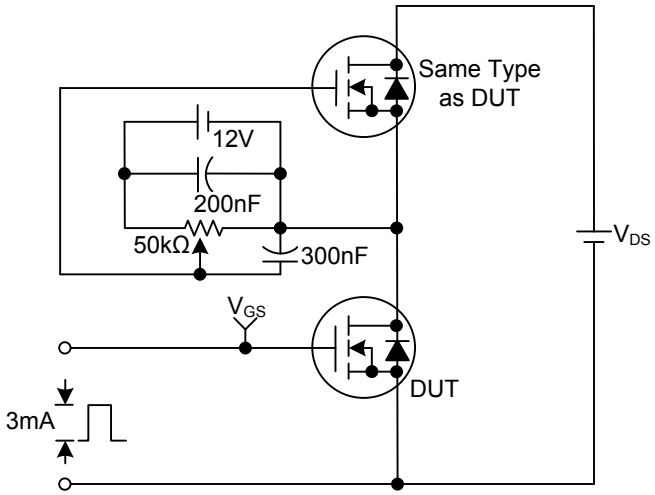



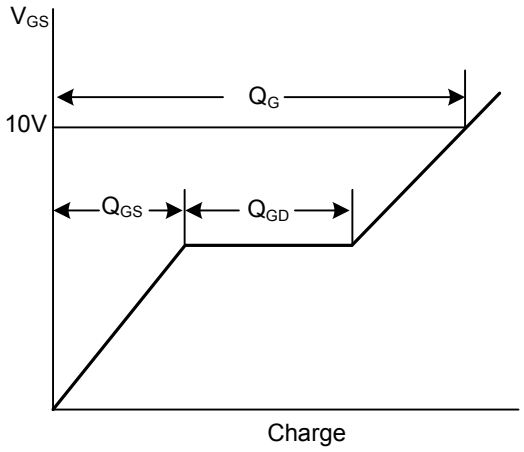



## ■ TEST CIRCUITS AND WAVEFORMS(Cont.)

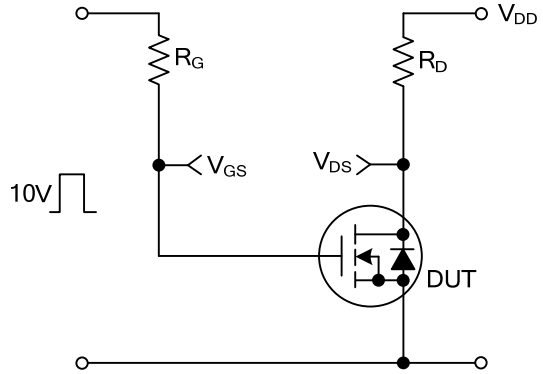
Gate Charge Test Circuit



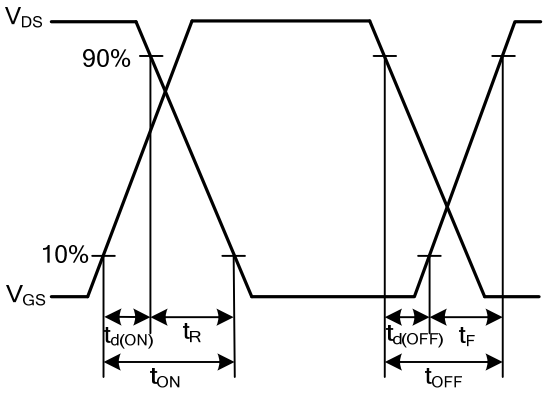

Gate Charge Waveforms



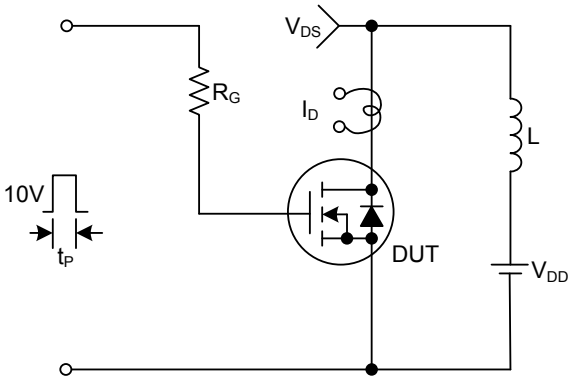

Resistive Switching Test Circuit




Resistive Switching Waveforms

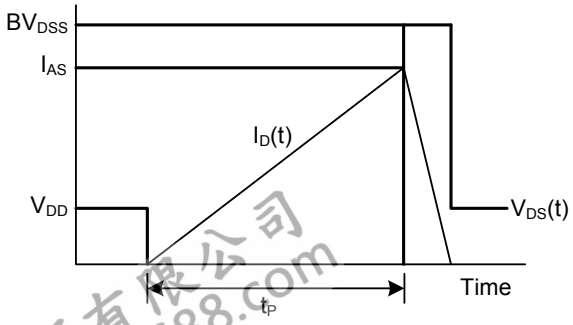



Unclamped Inductive Switching Test Circuit



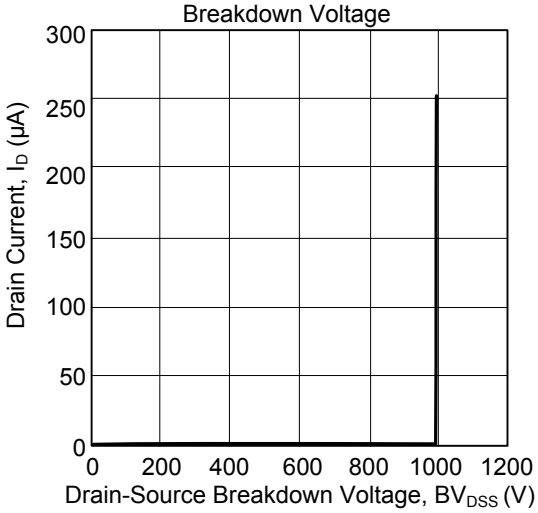

Unclamped Inductive Switching Waveforms

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

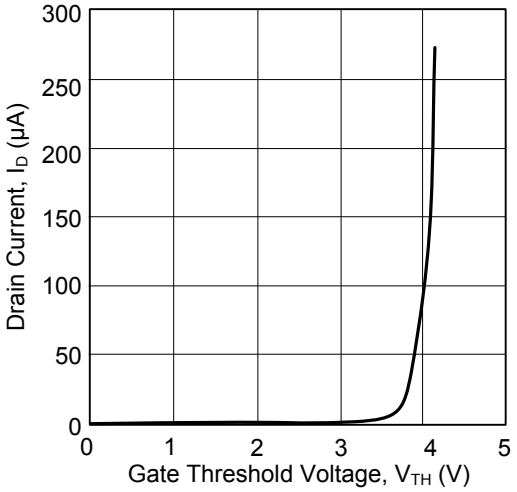


## ■ TYPICAL CHARACTERISTICS

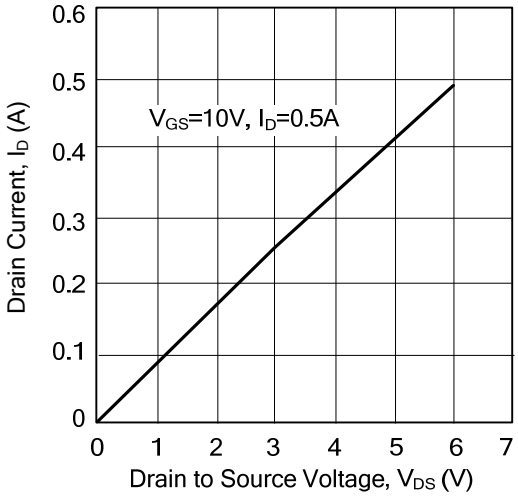
Drain Current vs. Drain-Source Breakdown Voltage




Drain Current vs. Gate Threshold Voltage




Drain-Source On-State Resistance Characteristics




Body-Diode Continuous Current vs. Source to Drain Voltage