



# 4N90

**Power MOSFET**

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

■ DESCRIPTION

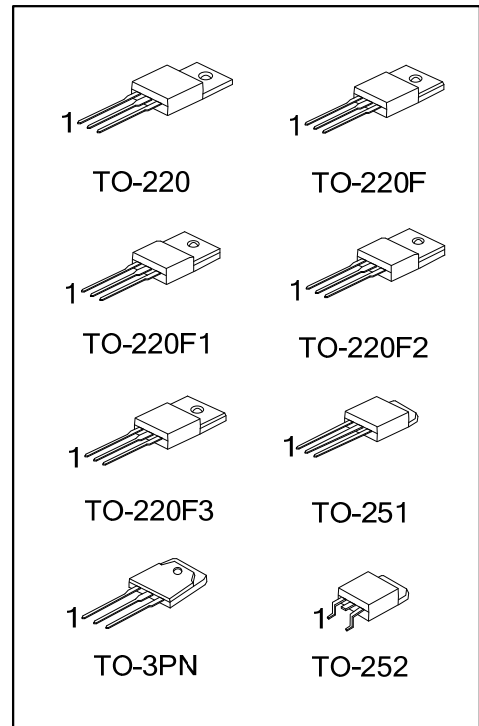
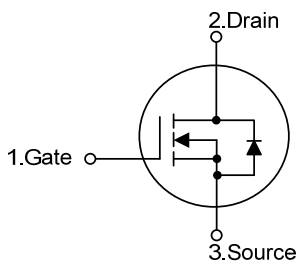
The UTC **4N90** is a N-channel enhancement MOSFET adopting UTC's advanced technology to provide customers with DMOS, planar stripe technology. This technology is designed to meet the requirements of the minimum on-state resistance and perfect switching performance. It also can withstand high energy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

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

■ FEATURES

- \*  $R_{DS(ON)} < 4.2\Omega @ V_{GS}=10V$
- \* High switching speed
- \* 100% avalanche tested
- \* Improved dv/dt capability

■ SYMBOL



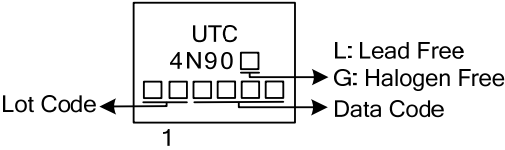
■ ORDERING INFORMATION

| 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      |
| 4N90L-TF3-T     | 4N90G-TF3-T  | TO-220F  | G              | D | S | Tube      |
| 4N90L-TF1-T     | 4N90G-TF1-T  | TO-220F1 | G              | D | S | Tube      |
| 4N90L-TF2-T     | 4N90G-TF2-T  | TO-220F2 | G              | D | S | Tube      |
| 4N90L-TF3T-T    | 4N90G-TF3T-T | TO-220F3 | G              | D | S | Tube      |
| 4N90L-TM3-T     | 4N90G-TM3-T  | TO-251   | G              | D | S | Tube      |
| 4N90L-TN3-R     | 4N90G-TN3-R  | TO-252   | G              | D | S | Tape Reel |
| 4N90L-T3N-T     | 4N90G-T3N-T  | TO-3PN   | G              | D | S | Tube      |

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

|   |   |
|---|---|
| <p>4N90L-TA3-T</p> <p>(1) Packing Type<br/>(2) Package Type<br/>(3) Lead Free</p> | <p>(1) T: Tube, R: Tape Reel<br/>(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1<br/>TF2: TO-220F2, TF3T: TO-220F3, TM3: TO-251<br/>TN3: TO-252, T3N: TO-3PN<br/>(3) L: Lead Free, G: Halogen Free</p> |
|---|---|

MARKING



■ ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                                       |                        | SYMBOL    | RATINGS    | UNIT                |
|---|------------------------|-----------|------------|---------------------|
| Drain to Source Voltage                         |                        | $V_{DSS}$ | 900        | V                   |
| Gate to Source Voltage                          |                        | $V_{GSS}$ | $\pm 30$   | V                   |
| Avalanche Current (Note 2)                      |                        | $I_{AR}$  | 4          | A                   |
| Continuous Drain Current                        | Continuous             | $I_D$     | 4          | A                   |
|   | Pulsed (Note 2)        | $I_{DM}$  | 16         | A                   |
| Avalanche Energy                                | Single Pulsed (Note 3) | $E_{AS}$  | 570        | mJ                  |
|   | Repetitive (Note 2)    | $E_{AR}$  | 14         | mJ                  |
| Peak Diode Recovery dv/dt (Note 4)              |                        | dv/dt     | 4.5        | V/ns                |
| Power Dissipation<br>( $T_C=25^\circ\text{C}$ ) | TO-220                 | $P_D$     | 140        | W                   |
|   | TO-220F/TO-220F1       |           | 38         |                     |
|   | TO-220F3               |           |            |                     |
|   | TO-220F2               |           | 40         |                     |
|   | TO-251/TO-252          |           | 54         |                     |
| TO-3PN  | 208                    |           |            |                     |
| Derate above $25^\circ\text{C}$                 | TO-220                 |           | 1.12       | W/ $^\circ\text{C}$ |
|   | TO-220F/TO-220F1       |           | 0.304      |                     |
|   | TO-220F3               |           |            |                     |
|   | TO-220F2               |           | 0.322      |                     |
|   | TO-251/TO-252          | 0.43      |            |                     |
| TO-3PN  | 1.66                   |           |            |                     |
| Operating Junction Temperature                  |                        | $T_J$     | +150       | $^\circ\text{C}$    |
| Storage Temperature                             |                        | $T_{STG}$ | -55 ~ +150 | $^\circ\text{C}$    |

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.  $L=67\text{mH}$ ,  $I_{AS}=4\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$

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

■ THERMAL DATA

| PARAMETER           |                   | SYMBOL        | RATINGS | UNIT                      |
|---------------------|-------------------|---------------|---------|---------------------------|
| Junction to Ambient | TO-220/TO-220F    | $\theta_{JA}$ | 62.5    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F1/TO-220F2 |               |         |                           |
|                     | TO-220F3          |               | 110     |                           |
|                     | TO-251/TO-252     |               |         |                           |
| TO-3PN              | 40                |               |         |                           |
| Junction to Case    | TO-220            | $\theta_{JC}$ | 0.89    | $^\circ\text{C}/\text{W}$ |
|                     | TO-220F/TO-220F1  |               | 3.25    |                           |
|                     | TO-220F3          |               |         |                           |
|                     | TO-220F2          |               | 3.1     |                           |
|                     | TO-251/TO-252     |               | 2.3     |                           |
| TO-3PN              | 0.6               |               |         |                           |

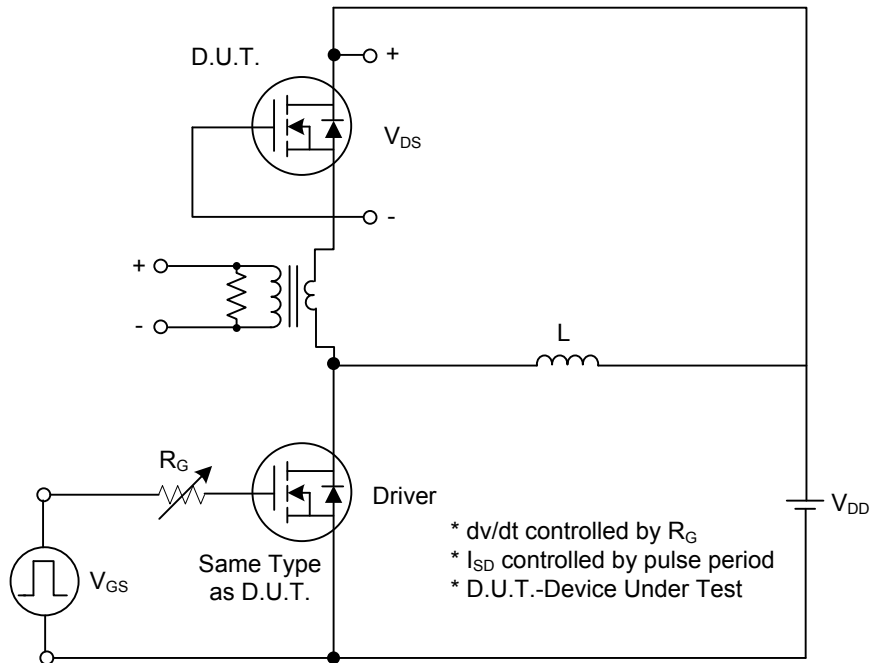
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified)

| PARAMETER  | SYMBOL                              | TEST CONDITIONS  | MIN | TYP  | MAX  | UNIT |
|--|-------------------------------------|--|-----|------|------|------|
| <b>OFF CHARACTERISTICS</b>                             |                                     |  |     |      |      |      |
| Drain-Source Breakdown Voltage                         | BV <sub>DSS</sub>                   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                     | 900 |      |      | V    |
| Breakdown Voltage Temperature Coefficient              | ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | I <sub>D</sub> =250μA,<br>Referenced to 25°C                                   |     | 1.05 |      | V/°C |
| Drain-Source Leakage Current                           | I <sub>DSS</sub>                    | V <sub>DS</sub> =900V, V <sub>GS</sub> =0V                                     |     |      | 10   | μA   |
|  |                                     | V <sub>DS</sub> =720V, T <sub>C</sub> =125°C                                   |     |      | 100  | μA   |
| Gate- Source Leakage Current                           | Forward                             | I <sub>GSS</sub> V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V                    |     |      | +100 | nA   |
|  | Reverse                             | I <sub>GSS</sub> V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V                    |     |      | -100 | nA   |
| <b>ON CHARACTERISTICS</b>                              |                                     |  |     |      |      |      |
| Gate Threshold Voltage                                 | V <sub>GS(TH)</sub>                 | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                       | 3.0 |      | 5.0  | V    |
| Drain-Source On-State Resistance                       | R <sub>DS(ON)</sub>                 | V <sub>GS</sub> =10V, I <sub>D</sub> =2A                                       |     | 2.1  | 4.2  | Ω    |
| <b>DYNAMIC PARAMETERS</b>                              |                                     |  |     |      |      |      |
| Input Capacitance                                      | C <sub>ISS</sub>                    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHz                            |     | 1000 | 1400 | pF   |
| Output Capacitance                                     | C <sub>OSS</sub>                    |  |     | 49   | 85   | pF   |
| Reverse Transfer Capacitance                           | C <sub>RSS</sub>                    |  |     | 13   | 18   | pF   |
| <b>SWITCHING PARAMETERS</b>                            |                                     |  |     |      |      |      |
| Total Gate Charge                                      | Q <sub>G</sub>                      | V <sub>DS</sub> =50V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.3A<br>(Note 1,2) |     | 33   | 50   | nC   |
| Gate-Source Charge                                     | Q <sub>GS</sub>                     |  |     | 8.9  |      | nC   |
| Gate-Drain Charge                                      | Q <sub>GD</sub>                     |  |     | 10   |      | nC   |
| Turn-ON Delay Time                                     | t <sub>D(ON)</sub>                  | V <sub>DD</sub> =30V, I <sub>D</sub> =0.5A, R <sub>G</sub> =25Ω<br>(Note 1,2)  |     | 70   | 100  | ns   |
| Turn-ON Rise Time                                      | t <sub>R</sub>                      |  |     | 188  | 220  | ns   |
| Turn-OFF Delay Time                                    | t <sub>D(OFF)</sub>                 |  |     | 188  | 220  | ns   |
| Turn-OFF Fall Time                                     | t <sub>F</sub>                      |  |     | 88   | 120  | ns   |
| <b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b> |                                     |  |     |      |      |      |
| Maximum Body-Diode Continuous Current                  | I <sub>S</sub>                      |  |     |      | 4    | A    |
| Maximum Body-Diode Pulsed Current                      | I <sub>SM</sub>                     |  |     |      | 16   | A    |
| Drain-Source Diode Forward Voltage                     | V <sub>SD</sub>                     | I <sub>S</sub> =4A, V <sub>GS</sub> =0V  |     |      | 1.4  | V    |

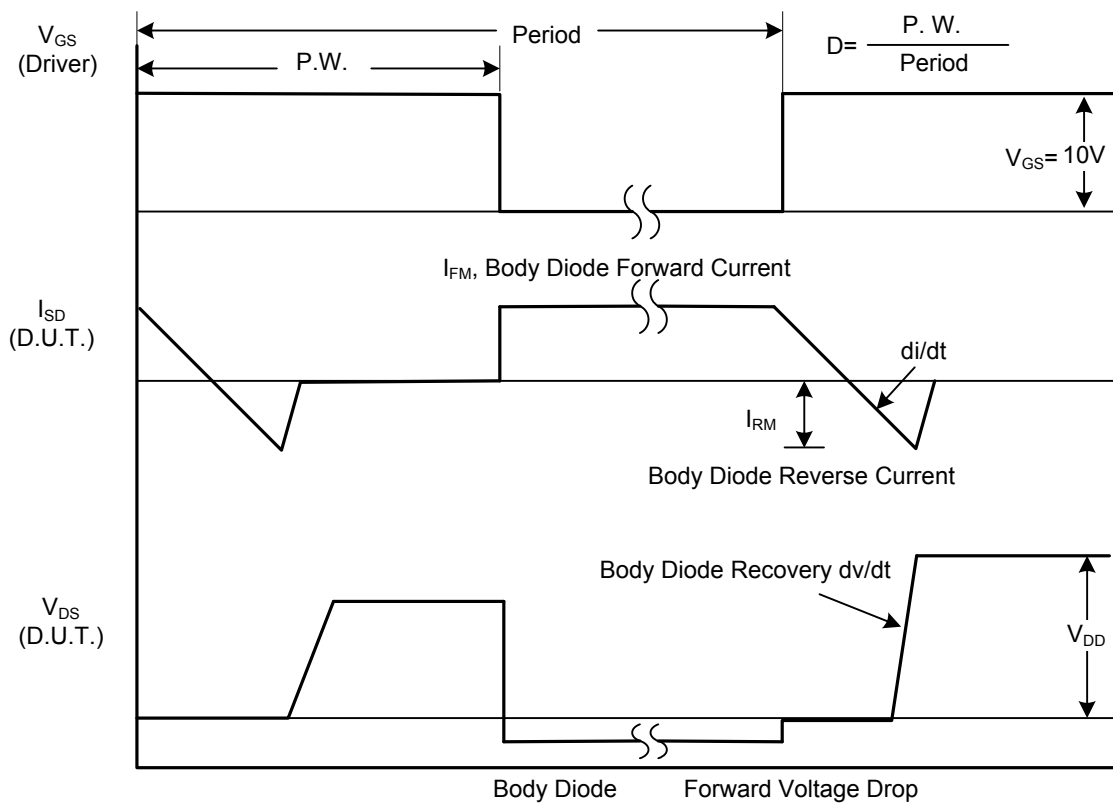
Notes: 1. Pulse Test : Pulse width≤300μs, Duty cycle≤2%

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

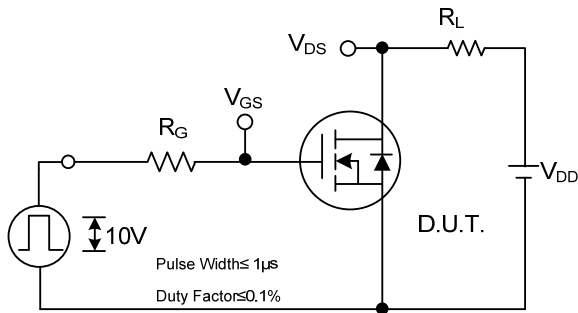


Peak Diode Recovery dv/dt Test Circuit



Peak Diode Recovery dv/dt Waveforms

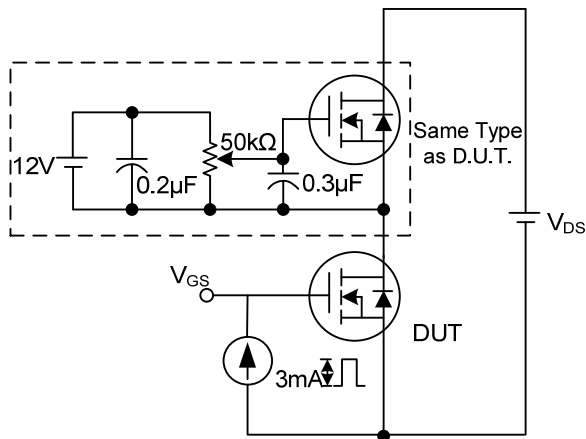
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



Switching Test Circuit



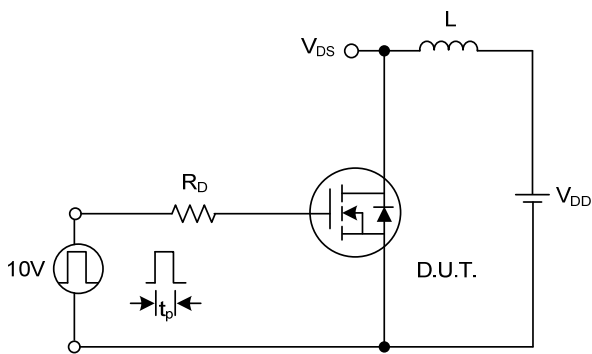
Switching Waveforms



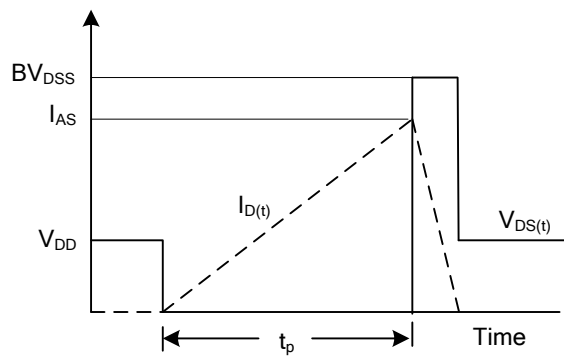
Gate Charge Test Circuit



Gate Charge Waveform

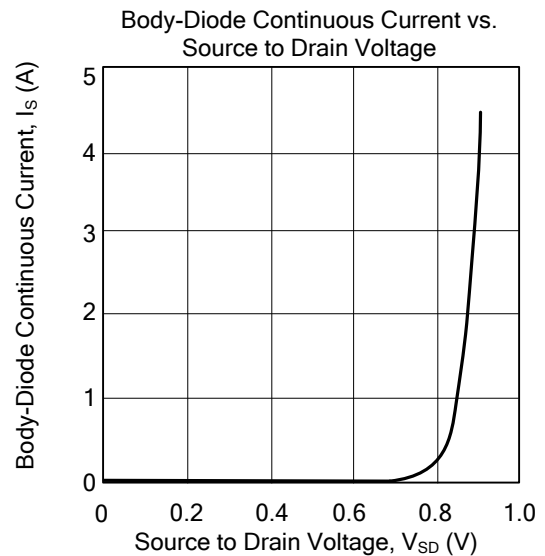
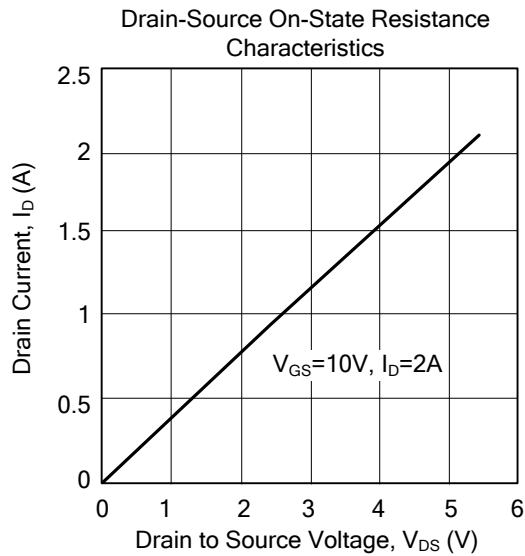
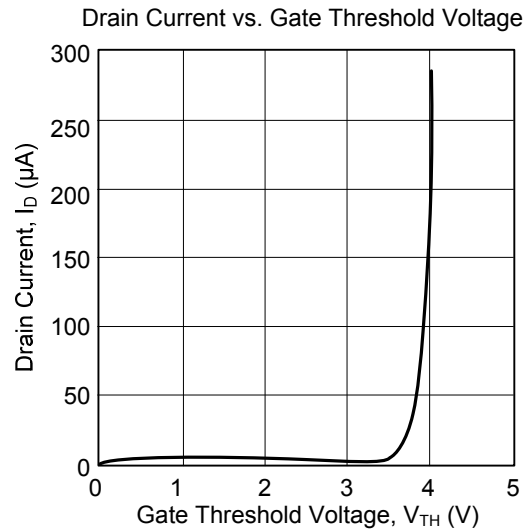
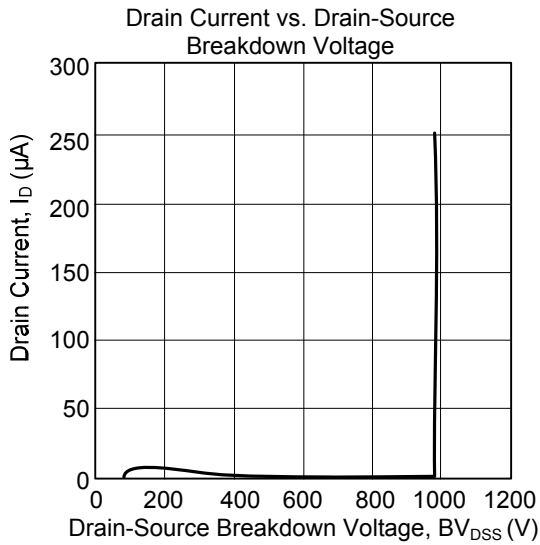


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS



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