



# 1A, 500V N-CHANNEL POWER MOSFET

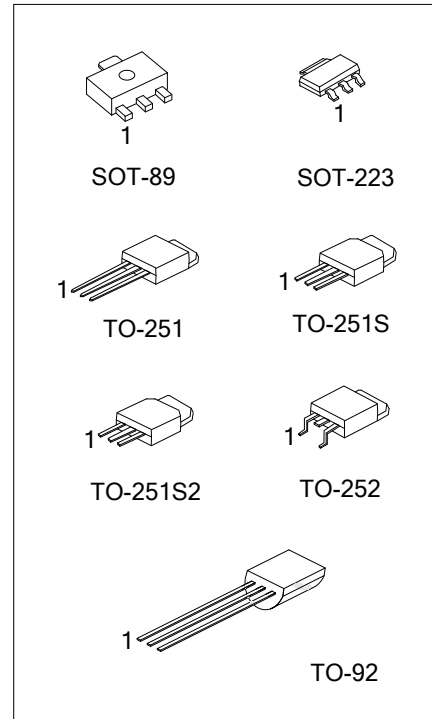
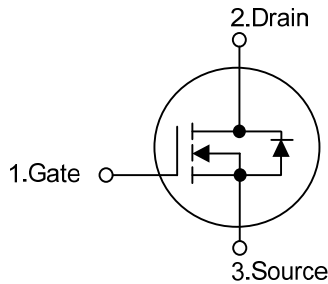
## DESCRIPTION

The UTC 1N50-CB is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

## FEATURES

- \*  $R_{DS(ON)} < 12\Omega$  @  $V_{GS}=10V, I_D=0.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

## SYMBOL



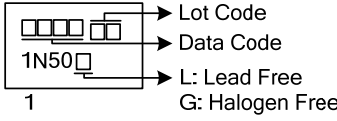
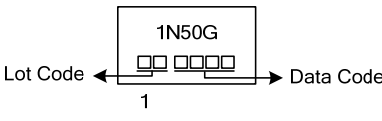
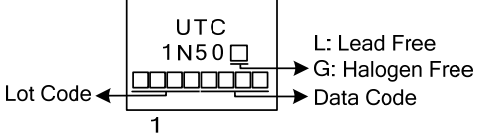
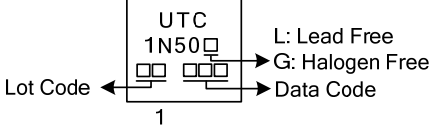
## ORDERING INFORMATION

| Ordering Number |              | Package  | Pin Assignment |   |   | Packing   |
|-----------------|--------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free |          | 1              | 2 | 3 |           |
| 1N50L-AA3-R     | 1N50G-AA3-R  | SOT-223  | G              | D | S | Tape Reel |
| 1N50L-AB3-R     | 1N50G-AB3-R  | SOT-89   | G              | D | S | Tape Reel |
| 1N50L-TM3-T     | 1N50G-TM3-T  | TO-251   | G              | D | S | Tube      |
| 1N50L-TMS-T     | 1N50G-TMS-T  | TO-251S  | G              | D | S | Tube      |
| 1N50L-TMS2-T    | 1N50G-TMS2-T | TO-251S2 | G              | D | S | Tube      |
| 1N50L-TN3-R     | 1N50G-TN3-R  | TO-252   | G              | D | S | Tape Reel |
| 1N50L-T92-B     | 1N50G-T92-B  | TO-92    | G              | D | S | Tape Box  |
| 1N50L-T92-K     | 1N50G-T92-K  | TO-92    | G              | D | S | Bulk      |

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

|  |   |
|--|---|
| <p>1N50G-AA3-R</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Green Package</p> | <p>(1) R: Tape Reel, T: Tube, B: Tape Box, K: Bulk</p> <p>(2) AA3: SOT-223, AB3: SOT-89, TM3: TO-251</p> <p>TMS: TO-251S, TMS2: TO-251S2,</p> <p>TN3: TO-252, T92: TO-92</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|--|---|

■ MARKING

|  |  |
|--|--|
| <p style="text-align: center;">SOT-89</p>  <p style="text-align: center;">1</p> | <p style="text-align: center;">SOT-223</p>  <p style="text-align: center;">1</p> |
| <p style="text-align: center;">TO-251 / TO-251S<br/>TO-251S2 / TO-252</p>  | <p style="text-align: center;">TO-92</p>   |
|  <p style="text-align: center;">1</p>   |  <p style="text-align: center;">1</p>  |

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 www.flying1688.com

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

| PARAMETER                                       |                        | SYMBOL    | RATINGS    | UNIT             |
|---|------------------------|-----------|------------|------------------|
| Drain-Source Voltage                            |                        | $V_{DSS}$ | 500        | V                |
| Gate-Source Voltage                             |                        | $V_{GSS}$ | $\pm 30$   | V                |
| Avalanche Current (Note 2)                      |                        | $I_{AR}$  | 1.0        | A                |
| Continuous Drain Current                        |                        | $I_D$     | 1.0        | A                |
| Pulsed Drain Current (Note 2)                   |                        | $I_{DM}$  | 4.0        | A                |
| Avalanche Energy                                | Single Pulsed (Note 3) | $E_{AS}$  | 80         | mJ               |
|   | Repetitive (Note 2)    | $E_{AR}$  | 4.0        | mJ               |
| Peak Diode Recovery dv/dt (Note 4)              |                        | dv/dt     | 5.6        | V/ns             |
| Power Dissipation<br>( $T_C=25^\circ\text{C}$ ) | SOT-223                | $P_D$     | 7.8        | W                |
|   | SOT-89                 |           | 8.0        | W                |
|   | TO-251/TO-251S         |           | 25         | W                |
|   | TO-251S2/TO-252        |           |            |                  |
|   | TO-92                  |           | 1.56       | W                |
| Junction Temperature                            |                        | $T_J$     | +150       | $^\circ\text{C}$ |
| Operating Temperature                           |                        | $T_{OPR}$ | -55 ~ +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.  $L = 159\text{mH}$ ,  $I_{AS} = 1.0\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 1.0\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

| PARAMETER           |                 | SYMBOL        | RATINGS | UNIT                      |
|---------------------|-----------------|---------------|---------|---------------------------|
| Junction to Ambient | SOT-223         | $\theta_{JA}$ | 150     | $^\circ\text{C}/\text{W}$ |
|                     | SOT-89          |               | 160     | $^\circ\text{C}/\text{W}$ |
|                     | TO-251/TO-251S  |               | 110     | $^\circ\text{C}/\text{W}$ |
|                     | TO-251S2/TO-252 |               |         |                           |
|                     | TO-92           |               | 180     | $^\circ\text{C}/\text{W}$ |
| Junction to Case    | SOT-223         | $\theta_{JC}$ | 16      | $^\circ\text{C}/\text{W}$ |
|                     | SOT-89          |               | 15.6    | $^\circ\text{C}/\text{W}$ |
|                     | TO-251/TO-251S  |               | 5       | $^\circ\text{C}/\text{W}$ |
|                     | TO-251S2/TO-252 |               |         |                           |
|                     | TO-92           |               | 80      | $^\circ\text{C}/\text{W}$ |

■ **ELECTRICAL CHARACTERISTICS** ( $T_C=25^\circ\text{C}$ , unless otherwise specified.)

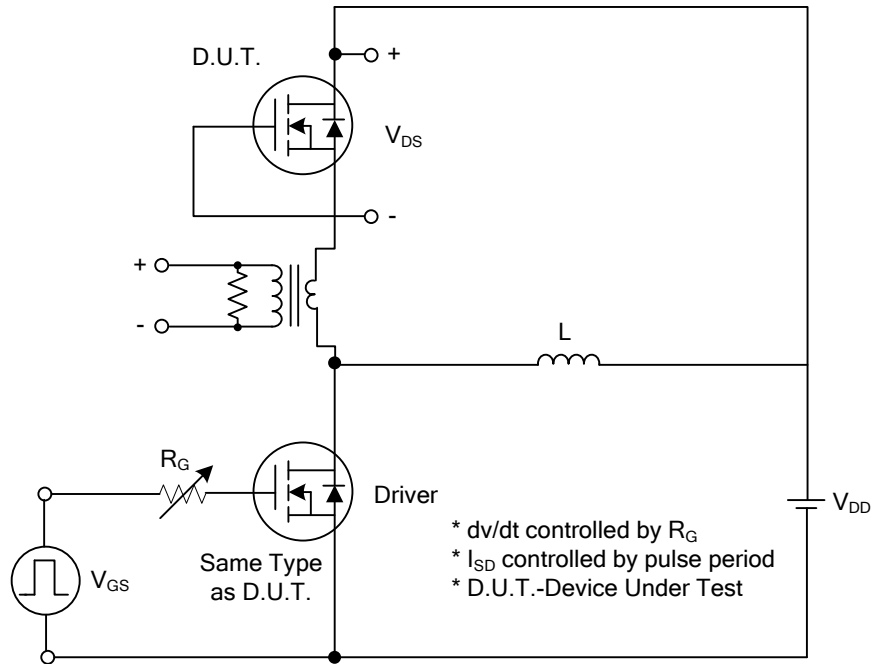
| PARAMETER   | SYMBOL                       | TEST CONDITIONS  | MIN | TYP  | MAX  | UNIT         |
|---|------------------------------|--|-----|------|------|--------------|
| <b>OFF CHARACTERISTICS</b>                            |                              |  |     |      |      |              |
| Drain-Source Breakdown Voltage                        | $BV_{DSS}$                   | $V_{GS}=0V, I_D=250\mu A$  | 500 |      |      | V            |
| Drain-Source Leakage Current                          | $I_{DSS}$                    | $V_{DS}=500V, V_{GS}=0V$   |     |      | 10   | $\mu A$      |
| Gate-Source Leakage Current                           | Forward                      | $I_{GSS}$  |     |      | 100  | nA           |
|   | Reverse                      |  |     |      | -100 | nA           |
| Breakdown Voltage Temperature Coefficient             | $\Delta BV_{DSS}/\Delta T_J$ | $I_D=250\mu A$   |     | 0.4  |      | $V/^\circ C$ |
| <b>ON CHARACTERISTICS</b>                             |                              |  |     |      |      |              |
| Gate Threshold Voltage                                | $V_{GS(TH)}$                 | $V_{DS}=V_{GS}, I_D=250\mu A$  | 2.0 |      | 4.0  | V            |
| Static Drain-Source On-State Resistance               | $R_{DS(ON)}$                 | $V_{GS}=10V, I_D=0.5A$   |     |      | 12   | $\Omega$     |
| <b>DYNAMIC CHARACTERISTICS</b>                        |                              |  |     |      |      |              |
| Input Capacitance                                     | $C_{ISS}$                    | $V_{DS}=25V, V_{GS}=0V, f=1MHz$                                      |     | 120  |      | pF           |
| Output Capacitance                                    | $C_{OSS}$                    |  |     | 22   |      | pF           |
| Reverse Transfer Capacitance                          | $C_{RSS}$                    |  |     | 4.7  |      | pF           |
| <b>SWITCHING CHARACTERISTICS</b>                      |                              |  |     |      |      |              |
| Total Gate Charge                                     | $Q_G$                        | $V_{DS}=50V, V_{GS}=10V,$<br>$I_D=1.3A, I_G=250\mu A$<br>(Note 1, 2) |     | 10.1 |      | nC           |
| Gate-Source Charge                                    | $Q_{GS}$                     |  |     | 1.2  |      | nC           |
| Gate-Drain Charge                                     | $Q_{GD}$                     |  |     | 0.5  |      | nC           |
| Turn-On Delay Time                                    | $t_{D(ON)}$                  | $V_{DD}=30V, V_{GS}=10V, I_D=0.5A,$<br>$R_G=25\Omega$ (Note 1, 2)    |     | 24   |      | ns           |
| Turn-On Rise Time                                     | $t_R$                        |  |     | 18   |      | ns           |
| Turn-Off Delay Time                                   | $t_{D(OFF)}$                 |  |     | 56   |      | ns           |
| Turn-Off Fall Time                                    | $t_F$                        |  |     | 27   |      | ns           |
| <b>SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS</b> |                              |  |     |      |      |              |
| Maximum Continuous Drain-Source Diode Forward Current | $I_S$                        |  |     |      | 1.0  | A            |
| Maximum Pulsed Drain-Source Diode Forward Current     | $I_{SM}$                     |  |     |      | 4.8  | A            |
| Drain-Source Diode Forward Voltage                    | $V_{SD}$                     | $V_{GS}=0V, I_S=1.0A$  |     |      | 1.4  | V            |
| Reverse Recovery Time                                 | $t_{rr}$                     | $V_{GS}=0V, I_S=1.0A$<br>$di_f/dt=100A/\mu s$ (Note 1)               |     | 110  |      | ns           |
| Reverse Recovery Charge                               | $Q_{RR}$                     |  |     | 0.28 |      | $\mu C$      |

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

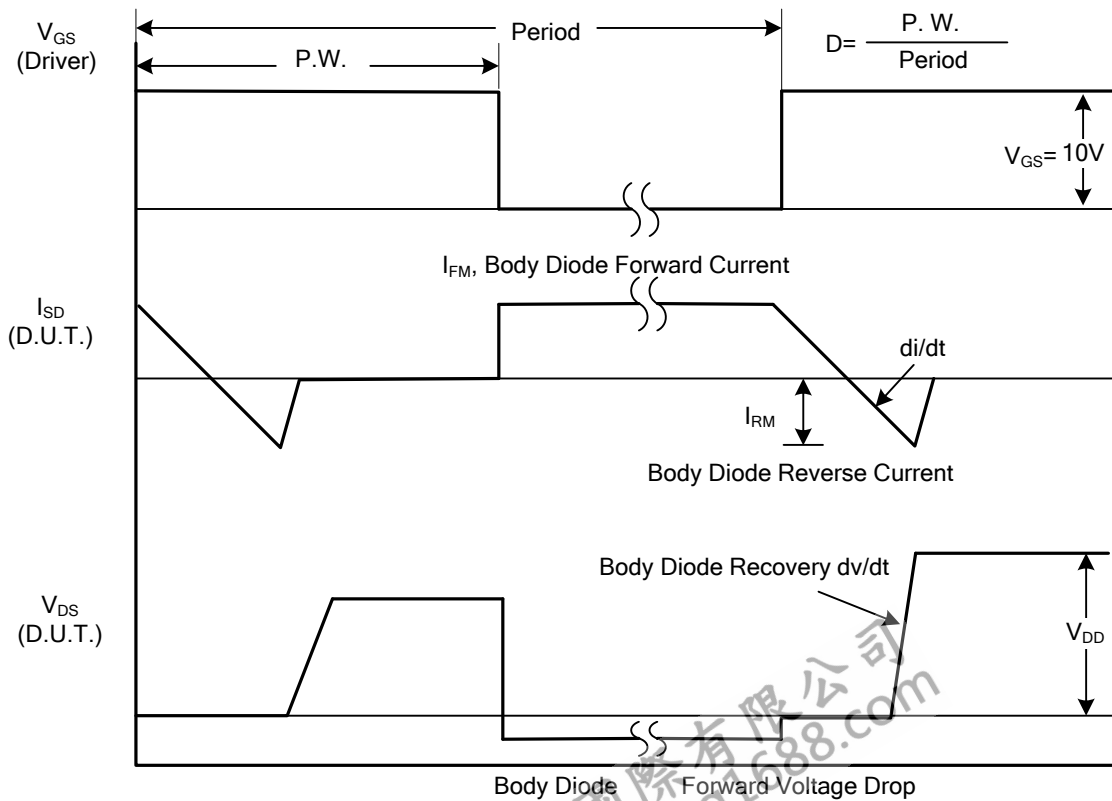
2. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$

3. Essentially Independent of Operating Temperature

■ TEST CIRCUITS AND WAVEFORMS

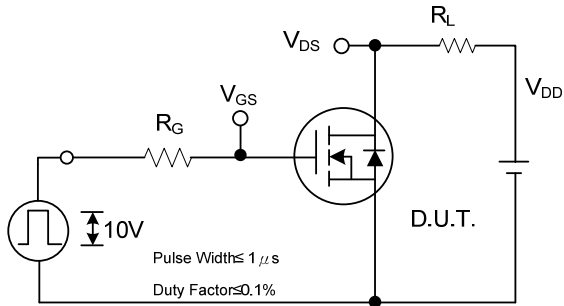


Peak Diode Recovery  $dv/dt$  Test Circuit

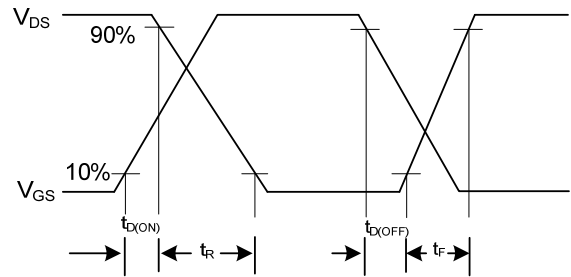


Peak Diode Recovery  $dv/dt$  Waveforms

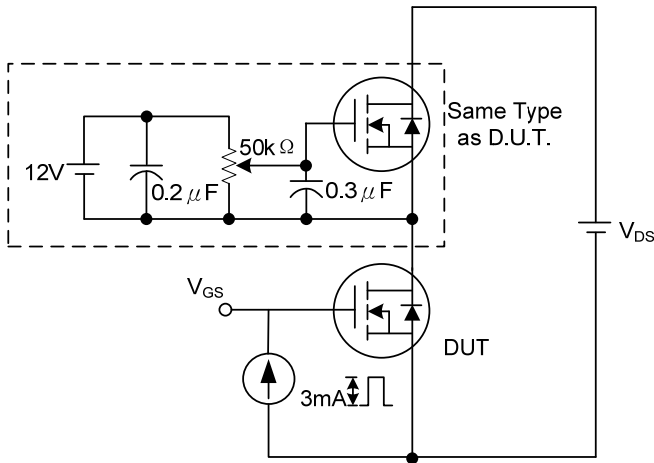
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



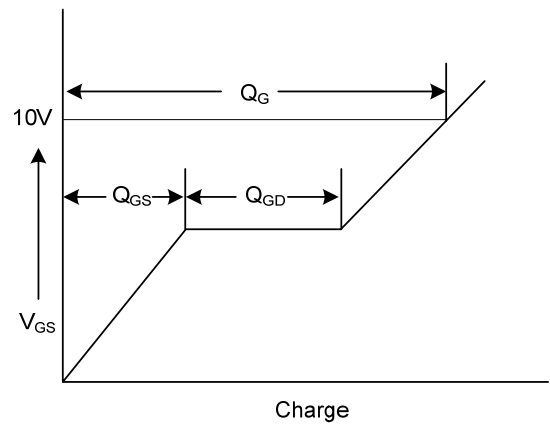
Switching Test Circuit



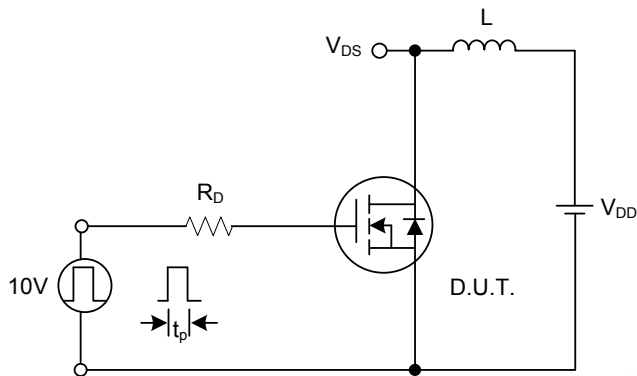
Switching Waveforms



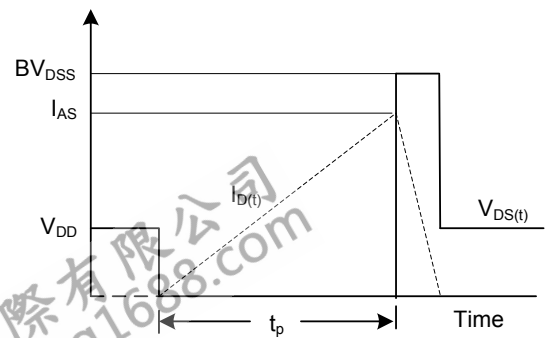
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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