

**38NM60Z**

Preliminary

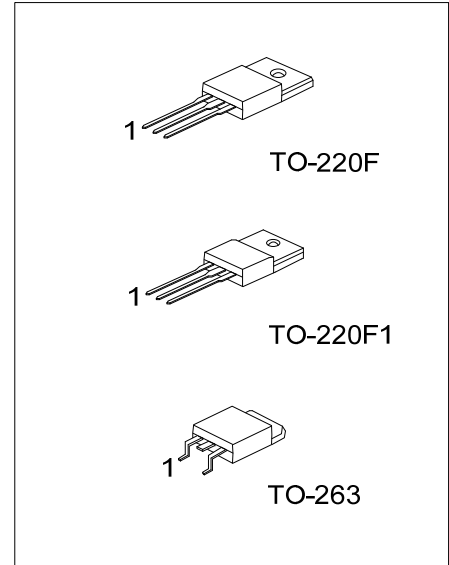
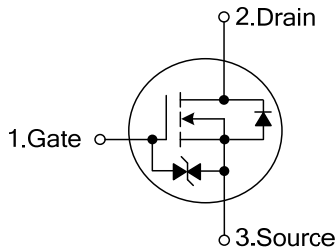
Power MOSFET

**38A, 600V N-CHANNEL  
SUPER-JUNCTION MOSFET****DESCRIPTION**

The **UTC 38NM60Z** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

**FEATURES**

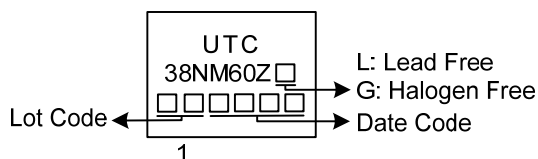
- \*  $R_{DS(ON)} \leq 85 \text{ m}\Omega$  @  $V_{GS}=10\text{V}$ ,  $I_D=9.5\text{A}$
- \* High Switching Speed
- \* 100% Avalanche Tested

**SYMBOL****ORDERING INFORMATION**

| Ordering Number |                | Package  | Pin Assignment |   |   | Packing   |
|-----------------|----------------|----------|----------------|---|---|-----------|
| Lead Free       | Halogen Free   |          | 1              | 2 | 3 |           |
| 38NM60ZL-TF1-T  | 38NM60ZG-TF1-T | TO-220F1 | G              | D | S | Tube      |
| 38NM60ZL-TF3-T  | 38NM60ZG-TF3-T | TO-220F  | G              | D | S | Tube      |
| 38NM60ZL-TQ2-T  | 38NM60ZG-TQ2-T | TO-263   | G              | D | S | Tube      |
| 38NM60ZL-TQ2-R  | 38NM60ZG-TQ2-R | TO-263   | G              | D | S | Tape Reel |

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

|  |                                                           |                                                                                                                              |
|--|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
|  | (1) Packing Type<br>(2) Package Type<br>(3) Green Package | (1) T: Tube, R: Tape Reel<br>(2) TF1: TO-220F1, TF3: TO-220F, TQ2: TO-263<br>(3) G: Halogen Free and Lead Free, L: Lead Free |
|--|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|

**MARKING**

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

| PARAMETER                 |                        | SYMBOL    | RATINGS    | UNIT               |
|---------------------------|------------------------|-----------|------------|--------------------|
| Drain-Source Voltage      |                        | $V_{DSS}$ | 600        | V                  |
| Gate-Source Voltage       |                        | $V_{GSS}$ | $\pm 20$   | V                  |
| Drain Current             | Continuous             | $I_D$     | 38         | A                  |
|                           | Pulsed (Note 2)        | $I_{DM}$  | 152        | A                  |
| Avalanche Energy          | Single Pulsed (Note 3) | $E_{AS}$  | 1105       | mJ                 |
| Peak Diode Recovery dv/dt |                        | dv/dt     | 2.45       | V/ns               |
| Power Dissipation         | TO-220F/TO-220F1       | $P_D$     | 40         | W                  |
|                           | TO-263                 |           | 130        | W                  |
| 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.  $L = 100\text{mH}$ ,  $I_{AS} = 4.7\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$

4.  $I_{SD} \leq 30\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^{\circ}\text{C}$

■ **THERMAL DATA**

| PARAMETER           |                  | SYMBOL        | RATINGS | UNIT                        |
|---------------------|------------------|---------------|---------|-----------------------------|
| Junction to Ambient |                  | $\theta_{JA}$ | 62.5    | $^{\circ}\text{C}/\text{W}$ |
| Junction to Case    | TO-220F/TO-220F1 | $\theta_{JC}$ | 3.125   | $^{\circ}\text{C}/\text{W}$ |
|                     | TO-263           |               | 0.96    | $^{\circ}\text{C}/\text{W}$ |

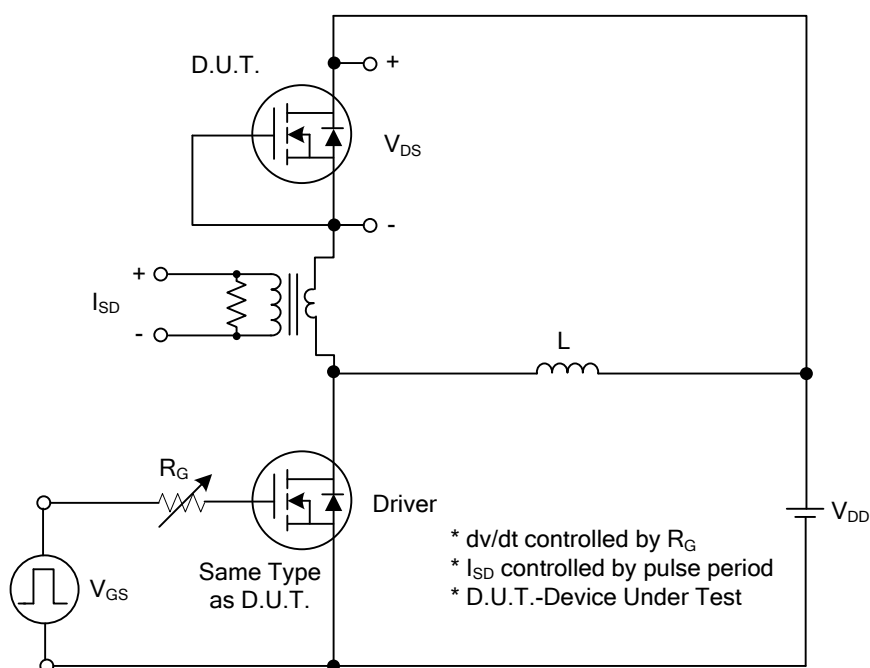
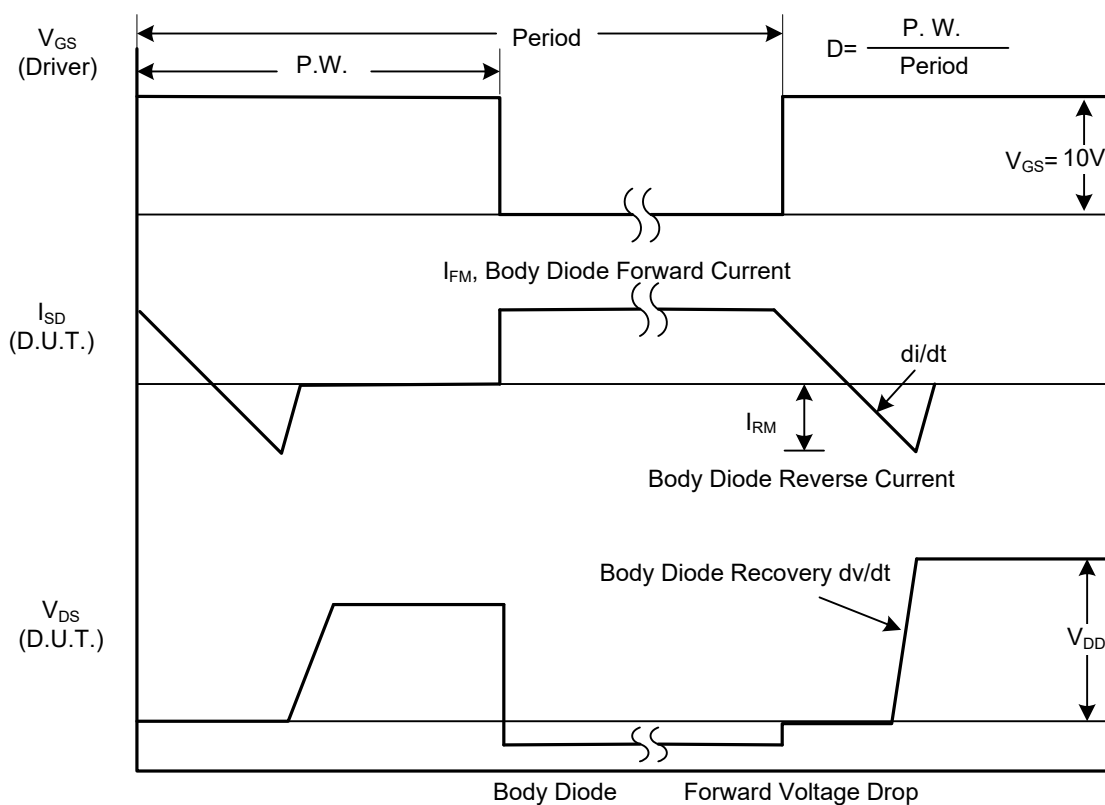
■ **ELECTRICAL CHARACTERISTICS** ( $T_J=25^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                                             |         | SYMBOL              | TEST CONDITIONS                                                                                    | MIN | TYP  | MAX | UNIT |
|-------------------------------------------------------|---------|---------------------|----------------------------------------------------------------------------------------------------|-----|------|-----|------|
| OFF CHARACTERISTICS                                   |         |                     |                                                                                                    |     |      |     |      |
| Drain-Source Breakdown Voltage                        |         | BV <sub>DSS</sub>   | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V                                                         | 600 |      |     | V    |
| Drain-Source Leakage Current                          |         | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                                                         |     |      | 10  | μA   |
| Gate- Source Leakage Current                          | Forward | I <sub>GSS</sub>    | V <sub>GS</sub> =+20V, V <sub>DS</sub> =0V                                                         |     |      | +10 | μA   |
|                                                       | Reverse |                     | V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V                                                         |     |      | -10 | μA   |
| ON CHARACTERISTICS                                    |         |                     |                                                                                                    |     |      |     |      |
| Gate Threshold Voltage                                |         | V <sub>GS(TH)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                           | 2.5 |      | 4.5 | V    |
| Static Drain-Source On-State Resistance               |         | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =9.5A                                                         |     |      | 85  | mΩ   |
| DYNAMIC PARAMETERS                                    |         |                     |                                                                                                    |     |      |     |      |
| Input Capacitance                                     |         | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1.0MHz                                                |     | 2550 |     | pF   |
| Output Capacitance                                    |         | C <sub>OSS</sub>    |                                                                                                    |     | 272  |     | pF   |
| Reverse Transfer Capacitance                          |         | C <sub>RSS</sub>    |                                                                                                    |     | 8.9  |     | pF   |
| SWITCHING PARAMETERS                                  |         |                     |                                                                                                    |     |      |     |      |
| Total Gate Charge                                     |         | Q <sub>G</sub>      | V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =38A<br>(Note1, 2)                     |     | 139  |     | nC   |
| Gate to Source Charge                                 |         | Q <sub>GS</sub>     |                                                                                                    |     | 26   |     | nC   |
| Gate to Drain Charge                                  |         | Q <sub>GD</sub>     |                                                                                                    |     | 64.5 |     | nC   |
| Turn-ON Delay Time                                    |         | t <sub>D(ON)</sub>  | V <sub>DS</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =38A,<br>R <sub>G</sub> =3Ω (Note1, 2) |     | 11   |     | ns   |
| Rise Time                                             |         | t <sub>R</sub>      |                                                                                                    |     | 23   |     | ns   |
| Turn-OFF Delay Time                                   |         | t <sub>D(OFF)</sub> |                                                                                                    |     | 94   |     | ns   |
| Fall-Time                                             |         | t <sub>F</sub>      |                                                                                                    |     | 32   |     | ns   |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS       |         |                     |                                                                                                    |     |      |     |      |
| Maximum Continuous Drain-Source Diode Forward Current |         | I <sub>S</sub>      |                                                                                                    |     |      | 38  | A    |
| Drain-Source Diode Forward Voltage                    |         | V <sub>SD</sub>     | I <sub>S</sub> =38A, V <sub>GS</sub> =0V                                                           |     |      | 1.4 | V    |
| Body Diode Reverse Recovery Time                      |         | t <sub>rr</sub>     | I <sub>S</sub> =30A, V <sub>GS</sub> =0V,                                                          |     | 432  |     | ns   |
| Body Diode Reverse Recovery Charge                    |         | Q <sub>rr</sub>     | dl <sub>F</sub> /dt=100A/μs (Note 1)                                                               |     | 7.29 |     | μC   |

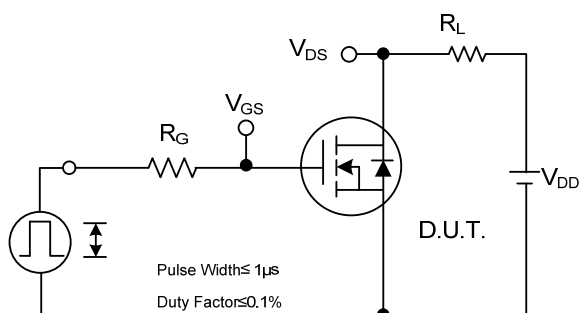
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating ambient temperature.

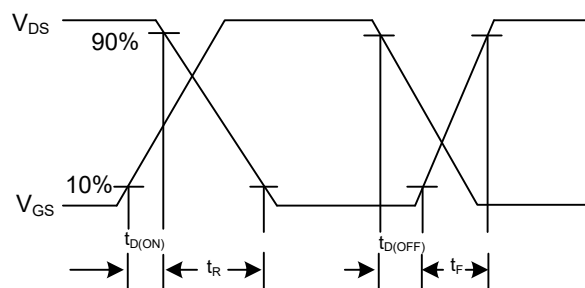
## ■ TEST CIRCUITS AND WAVEFORMS

Peak Diode Recovery  $dv/dt$  Test CircuitPeak Diode Recovery  $dv/dt$  Waveforms

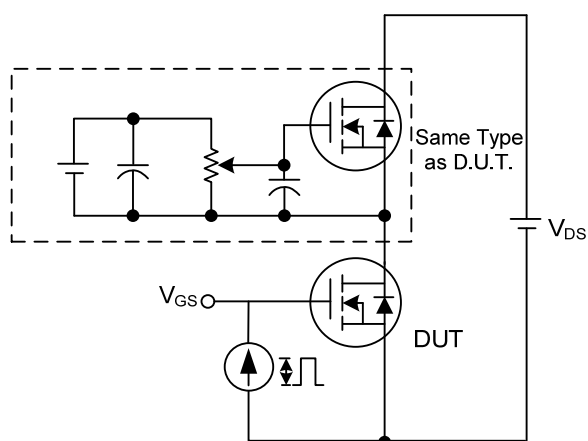
## ■ TEST CIRCUITS AND WAVEFORMS



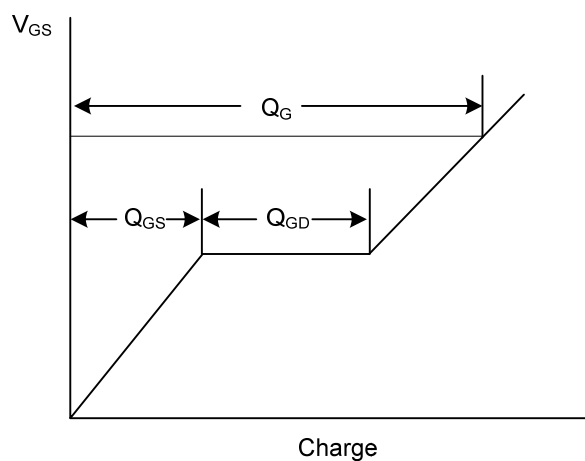
Switching Test Circuit



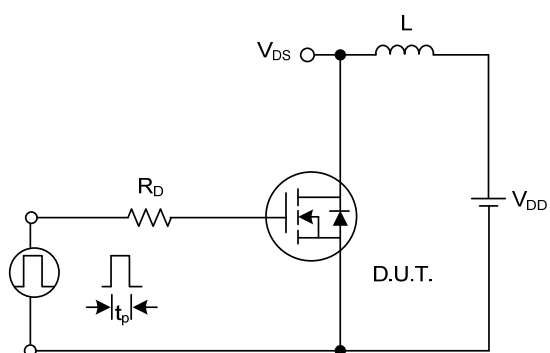
Switching Waveforms



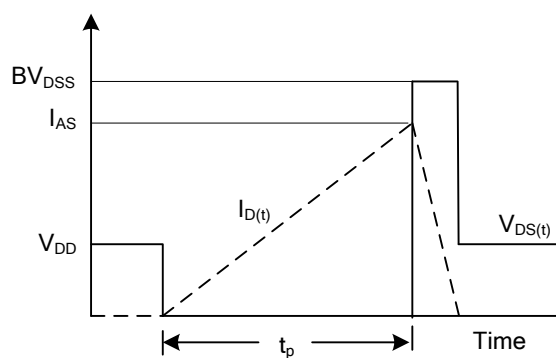
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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