

**9NM65Z-U3**

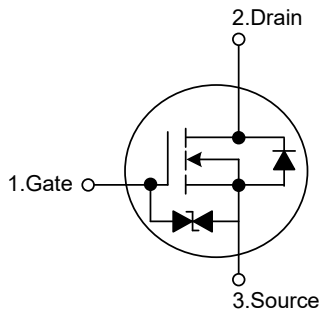
Preliminary

**Power MOSFET****9.0A, 650V N-CHANNEL  
SUPER-JUNCTION MOSFET****DESCRIPTION**

The **UTC 9NM65Z-U3** 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**

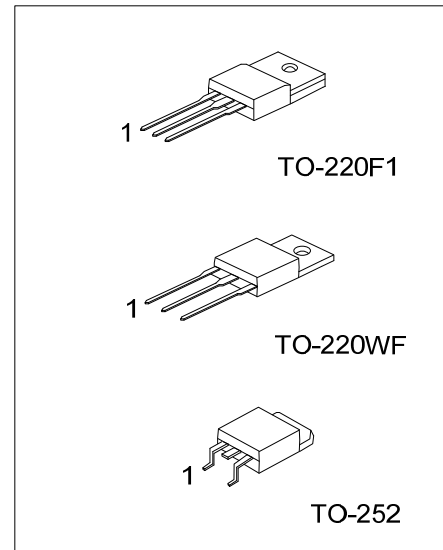
- \*  $R_{DS(ON)} \leq 0.7 \Omega$  @  $V_{GS}=10V$ ,  $I_D=2.5A$
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved dv/dt capability, high ruggedness
- \* With ESD protection

**SYMBOL****ORDERING INFORMATION**

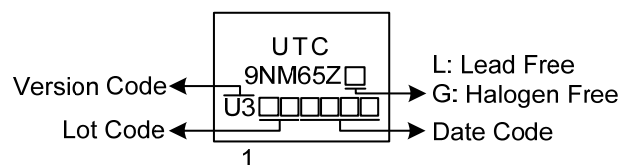
| Ordering Number  |                  | Package  | Pin Assignment |   |   | Packing   |
|------------------|------------------|----------|----------------|---|---|-----------|
| Lead Free        | Halogen Free     |          | 1              | 2 | 3 |           |
| 9NM65ZL-U3-TF1-T | 9NM65ZG-U3-TF1-T | TO-220F1 | G              | D | S | Tube      |
| 9NM65ZL-U3-TW1-T | 9NM65ZG-U3-TW1-T | TO-220WF | G              | D | S | Tube      |
| 9NM65ZL-U3-TN3-R | 9NM65ZG-U3-TN3-R | TO-252   | G              | D | S | Tape Reel |

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

|                  |                                                                           |                                                                                                                                                 |
|------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 9NM65ZG-U3-TF1-T | (1)Packing Type<br>(2)Package Type<br>(3)Version Code<br>(4)Green Package | (1) T: Tube, R: Tape Reel<br>(2) TF1: TO-220F1, TW1: TO-220WF, TN3: TO-252<br>(3) Version U3<br>(4) 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                 |                        | $V_{DS}$  | 650        | V                |
| Gate-Source Voltage                  |                        | $V_{GS}$  | $\pm 20$   | V                |
| Drain Current                        | Continuous             | $I_D$     | 9          | A                |
|                                      | Pulsed (Note 2)        | $I_{DM}$  | 27         | A                |
| Avalanche Energy                     | Single Pulsed (Note 3) | $E_{AS}$  | 110        | mJ               |
| Peak Diode Recovery $dv/dt$ (Note 4) |                        | $dv/dt$   | 1.3        | V/ns             |
| Power Dissipation                    | TO-220F1/TO-220WF      | $P_D$     | 28         | W                |
|                                      | TO-252                 |           | 54         | 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.  $L = 100\text{mH}$ ,  $I_{AS} = 1.5\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$  Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 9.0\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

| PARAMETER           |                   | SYMBOL        | RATINGS     | UNIT                      |
|---------------------|-------------------|---------------|-------------|---------------------------|
| Junction to Ambient | TO-220F1/TO-220WF | $\theta_{JA}$ | 62.5        | $^\circ\text{C}/\text{W}$ |
|                     | TO-252            |               | 110         | $^\circ\text{C}/\text{W}$ |
| Junction to Case    | TO-220F1/TO-220WF | $\theta_{JC}$ | 4.46        | $^\circ\text{C}/\text{W}$ |
|                     | TO-252            |               | 2.31 (Note) | $^\circ\text{C}/\text{W}$ |

Note: Device mounted on FR-4 substrate  $P_c$  board, 2oz copper, with 1inch square copper plate.

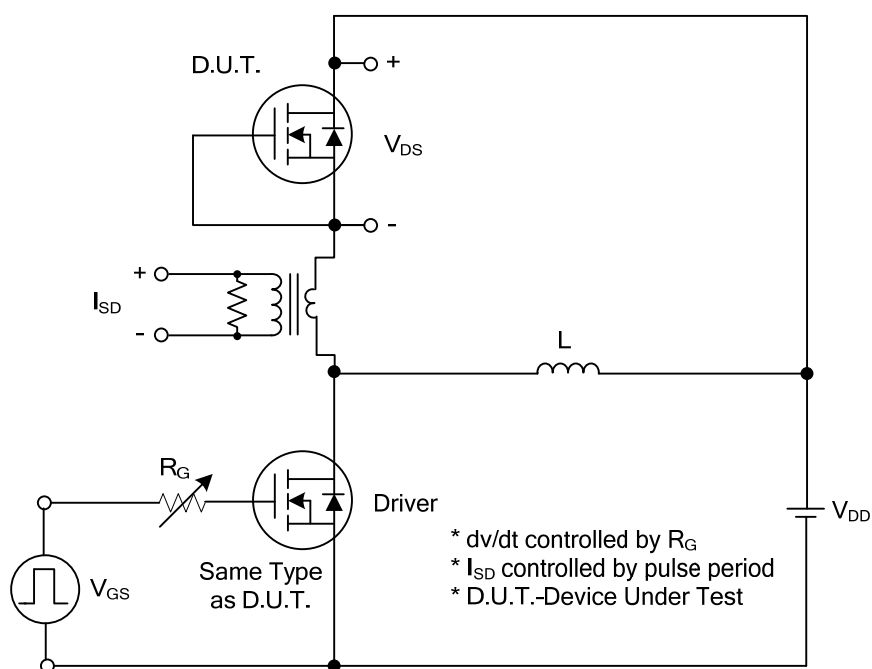
■ **ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                                             | SYMBOL              | TEST CONDITIONS                                                                                       | MIN | TYP  | MAX | UNIT |
|-------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| OFF CHARACTERISTICS                                   |                     |                                                                                                       |     |      |     |      |
| Drain-Source Breakdown Voltage                        | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                                            | 650 |      |     | V    |
| Drain-Source Leakage Current                          | I <sub>DSS</sub>    | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V                                                            |     |      | 10  | μA   |
| Gate-Source Leakage Current                           | I <sub>GSS</sub>    | 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> =2.5A                                                            |     |      | 0.7 | Ω    |
| DYNAMIC CHARACTERISTICS                               |                     |                                                                                                       |     |      |     |      |
| Input Capacitance                                     | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1MHz                                                     |     | 522  |     | pF   |
| Output Capacitance                                    | C <sub>OSS</sub>    |                                                                                                       |     | 85   |     | pF   |
| Reverse Transfer Capacitance                          | C <sub>RSS</sub>    |                                                                                                       |     | 4    |     | pF   |
| SWITCHING CHARACTERISTICS                             |                     |                                                                                                       |     |      |     |      |
| Total Gate Charge (Note 1)                            | Q <sub>G</sub>      | V <sub>DS</sub> =520V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.0A<br>(Note 1, 2)                      |     | 22   |     | nC   |
| Gate-Source Charge                                    | Q <sub>GS</sub>     |                                                                                                       |     | 5.8  |     | nC   |
| Gate-Drain Charge                                     | Q <sub>DD</sub>     |                                                                                                       |     | 5.3  |     | nC   |
| Turn-On Delay Time (Note 1)                           | t <sub>D(ON)</sub>  | V <sub>DD</sub> =100V, V <sub>GS</sub> =10V<br>I <sub>D</sub> =3.25A, R <sub>G</sub> =25Ω (Note 1, 2) |     | 7    |     | ns   |
| Turn-On Rise Time                                     | t <sub>R</sub>      |                                                                                                       |     | 20   |     | ns   |
| Turn-Off Delay Time                                   | t <sub>D(OFF)</sub> |                                                                                                       |     | 50   |     | ns   |
| Turn-Off 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>      |                                                                                                       |     |      | 9   | A    |
| Drain-Source Diode Forward Voltage (Note 1)           | V <sub>SD</sub>     | I <sub>S</sub> =9.0A, V <sub>GS</sub> =0V                                                             |     |      | 1.4 | V    |
| Body Diode Reverse Recovery Time (Note 1)             | t <sub>rr</sub>     | I <sub>S</sub> =9.0A, V <sub>GS</sub> =0V,<br>dI <sub>F</sub> /dt=100A/μs                             |     | 220  |     | nS   |
| Body Diode Reverse Recovery Charge                    | Q <sub>rr</sub>     |                                                                                                       |     | 1779 |     | nC   |

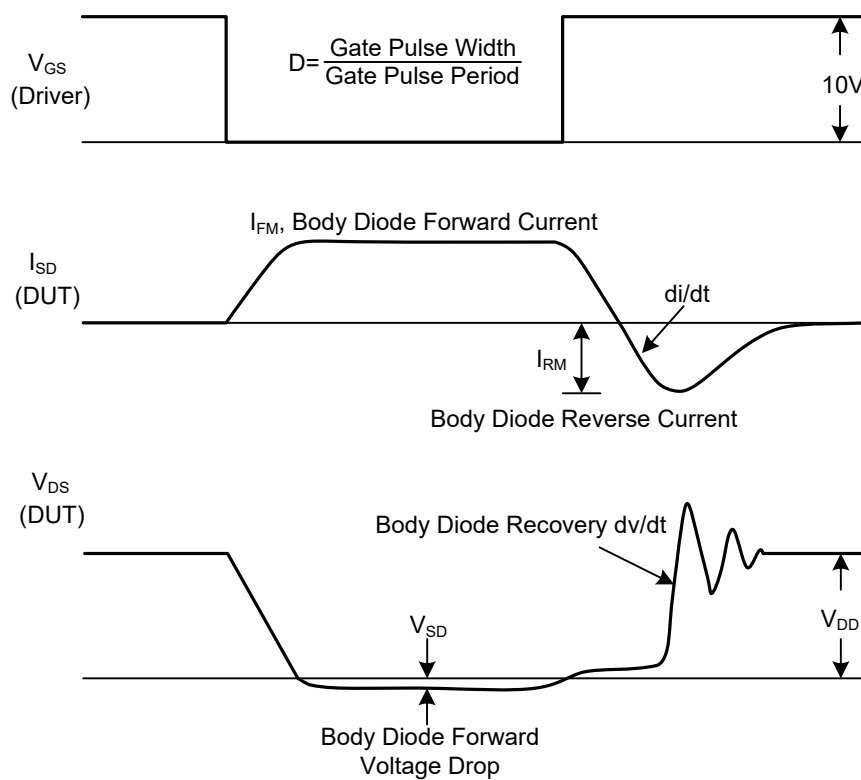
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

## ■ TEST CIRCUITS AND WAVEFORMS

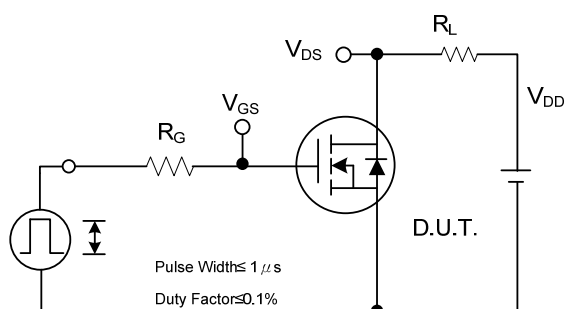


Peak Diode Recovery  $dv/dt$  Test Circuit

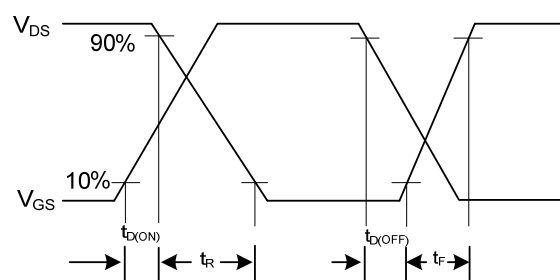


Peak Diode Recovery  $dv/dt$  Waveforms

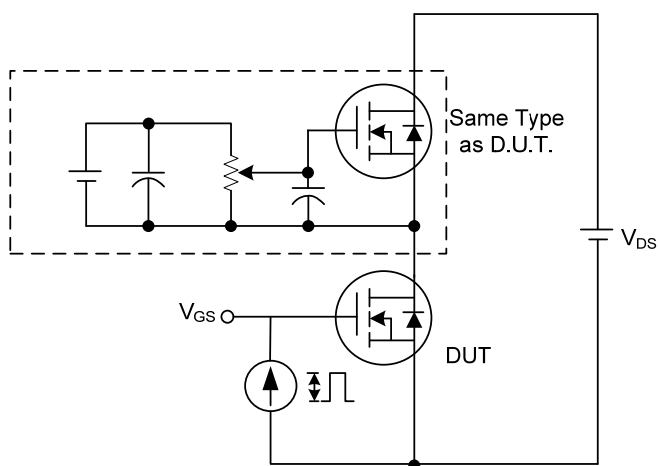
### ■ TEST CIRCUITS AND WAVEFORMS



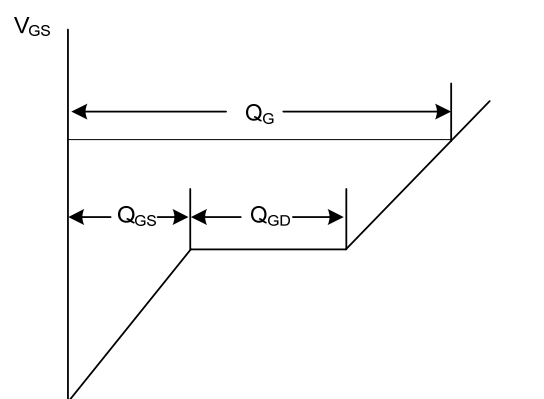
Switching Test Circuit



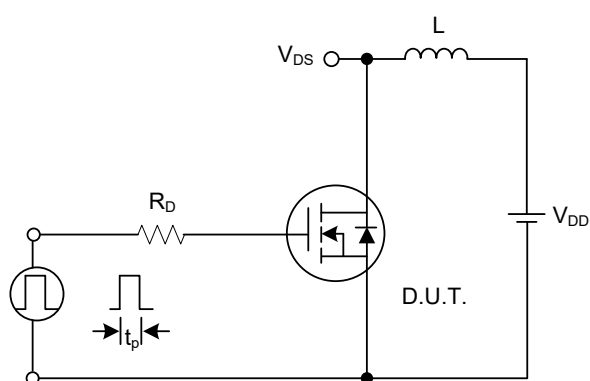
Switching Waveforms



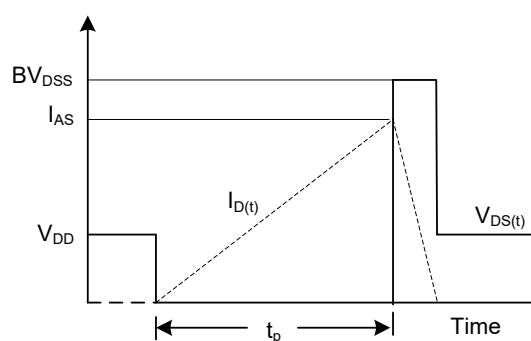
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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