

## General Description

The GreenMOS<sup>®</sup> high voltage MOSFET utilizes charge balance technology to achieve outstanding low on-resistance and lower gate charge. It is engineered to minimize conduction loss, provide superior switching performance and robust avalanche capability.

The GreenMOS<sup>®</sup> Z series is integrated with fast recovery diode (FRD) to minimize reverse recovery time. It is suitable for resonant switching topologies to reach higher efficiency, higher reliability and smaller form factor.

## Features

- Low  $R_{DS(ON)}$  & FOM
- Extremely low switching loss
- Excellent stability and uniformity
- Ultra-fast and robust body diode

GreenMOS<sup>®</sup>

RoHS  
compliant

## Applications

- PC power
- Telecom power
- Server power
- EV Charger
- Motor driver

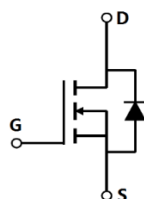
## Key Performance Parameters

| Parameter                       | Value | Unit       |
|---------------------------------|-------|------------|
| $V_{DS, \min} @ T_{j(max)}$     | 700   | V          |
| $I_D, \text{pulse}$             | 30    | A          |
| $R_{DS(ON), \max} @ V_{GS}=10V$ | 460   | m $\Omega$ |
| $Q_g$                           | 11.5  | nC         |

## Marking Information

| Product Name    | Package   | Marking     |
|-----------------|-----------|-------------|
| OSG65R460FZF_NB | TO220F_NL | OSG65R460FZ |

## Package & Pin Information



**Absolute Maximum Ratings** at  $T_j=25^{\circ}\text{C}$  unless otherwise noted

| Parameter                                                                 | Symbol                | Value      | Unit               |
|---------------------------------------------------------------------------|-----------------------|------------|--------------------|
| Drain-source voltage                                                      | $V_{DS}$              | 650        | V                  |
| Gate-source voltage                                                       | $V_{GS}$              | $\pm 30$   | V                  |
| Continuous drain current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 10         | A                  |
| Continuous drain current <sup>1)</sup> , $T_C=100^{\circ}\text{C}$        |                       | 6.3        |                    |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 30         | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 10         | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 30         | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 31         | W                  |
| Single pulsed avalanche energy <sup>5)</sup>                              | $E_{AS}$              | 272        | mJ                 |
| MOSFET dv/dt ruggedness, $V_{DS}=0 \dots 480 \text{ V}$                   | dv/dt                 | 50         | V/ns               |
| Reverse diode dv/dt, $V_{DS}=0 \dots 480 \text{ V}$ , $I_{SD} \leq I_D$   | dv/dt                 | 15         | V/ns               |
| Operation and storage temperature                                         | $T_{stg}, T_j$        | -55 to 150 | $^{\circ}\text{C}$ |

**Thermal Characteristics**

| Parameter                                          | Symbol          | Value | Unit                 |
|----------------------------------------------------|-----------------|-------|----------------------|
| Thermal resistance, junction-case                  | $R_{\theta JC}$ | 4     | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient <sup>4)</sup> | $R_{\theta JA}$ | 62.5  | $^{\circ}\text{C/W}$ |

**Electrical Characteristics** at  $T_j=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                        | Symbol       | Min. | Typ. | Max. | Unit          | Test condition                                                           |
|----------------------------------|--------------|------|------|------|---------------|--------------------------------------------------------------------------|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 650  |      |      | V             | $V_{GS}=0 \text{ V}$ , $I_D=250 \mu\text{A}$                             |
|                                  |              | 700  | 770  |      |               | $V_{GS}=0 \text{ V}$ , $I_D=250 \mu\text{A}$ , $T_j=150^{\circ}\text{C}$ |
| Gate threshold voltage           | $V_{GS(th)}$ | 3.0  |      | 4.5  | V             | $V_{DS}=V_{GS}$ , $I_D=250 \mu\text{A}$                                  |
| Drain-source on-state resistance | $R_{DS(on)}$ |      | 0.4  | 0.46 | $\Omega$      | $V_{GS}=10 \text{ V}$ , $I_D=5 \text{ A}$                                |
|                                  |              |      | 1.12 |      |               | $V_{GS}=10 \text{ V}$ , $I_D=5 \text{ A}$ , $T_j=150^{\circ}\text{C}$    |
| Gate-source leakage current      | $I_{GSS}$    |      |      | 100  | nA            | $V_{GS}=30 \text{ V}$                                                    |
|                                  |              |      |      | -100 |               | $V_{GS}=-30 \text{ V}$                                                   |
| Drain-source leakage current     | $I_{DSS}$    |      |      | 5    | $\mu\text{A}$ | $V_{DS}=650 \text{ V}$ , $V_{GS}=0 \text{ V}$                            |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ.  | Max. | Unit | Test condition                                                                              |
|------------------------------|--------------|------|-------|------|------|---------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{iss}$    |      | 761.1 |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=100\text{ V}$ ,<br>$f=1\text{ MHz}$                        |
| Output capacitance           | $C_{oss}$    |      | 32.9  |      | pF   |                                                                                             |
| Reverse transfer capacitance | $C_{rss}$    |      | 1.06  |      | pF   |                                                                                             |
| Turn-on delay time           | $t_{d(on)}$  |      | 38.4  |      | ns   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$R_G=25\ \Omega$ ,<br>$I_D=5\text{ A}$ |
| Rise time                    | $t_r$        |      | 18.8  |      | ns   |                                                                                             |
| Turn-off delay time          | $t_{d(off)}$ |      | 29.5  |      | ns   |                                                                                             |
| Fall time                    | $t_f$        |      | 15.8  |      | ns   |                                                                                             |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ. | Max. | Unit | Test condition                                                        |
|----------------------|---------------|------|------|------|------|-----------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 11.5 |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$I_D=5\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 3.9  |      | nC   |                                                                       |
| Gate-drain charge    | $Q_{gd}$      |      | 4.0  |      | nC   |                                                                       |
| Gate plateau voltage | $V_{plateau}$ |      | 6.0  |      | V    |                                                                       |

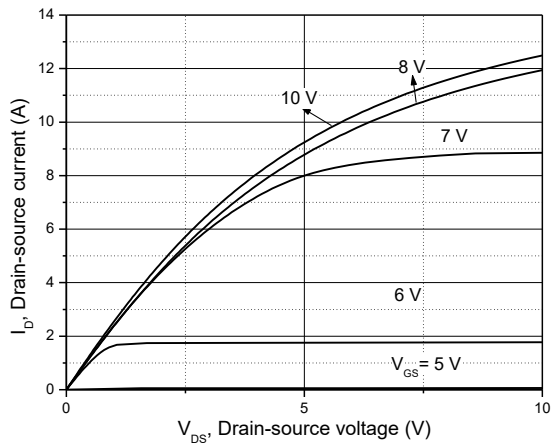
### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ.  | Max. | Unit | Test condition                                         |
|-------------------------------|-----------|------|-------|------|------|--------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |       | 1.4  | V    | $I_S=10\text{ A}$ ,<br>$V_{GS}=0\text{ V}$             |
| Reverse recovery time         | $t_{rr}$  |      | 97.2  |      | ns   | $I_S=5\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 426.8 |      | nC   |                                                        |
| Peak reverse recovery current | $I_{rrm}$ |      | 8.25  |      | A    |                                                        |

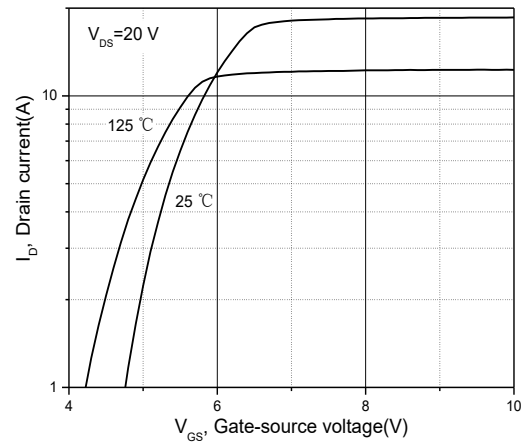
### Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.
- 4) The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_a=25\text{ }^\circ\text{C}$ .
- 5)  $V_{DD}=50\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=20\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .

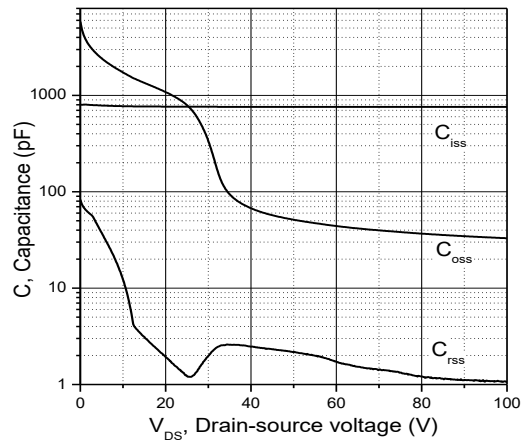
## Electrical Characteristics Diagrams



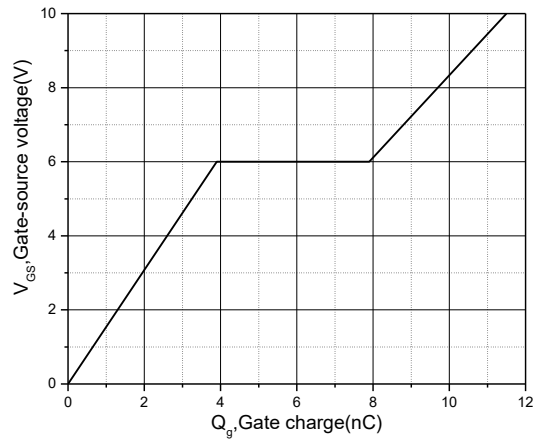
**Figure 1. Typ. output characteristics**



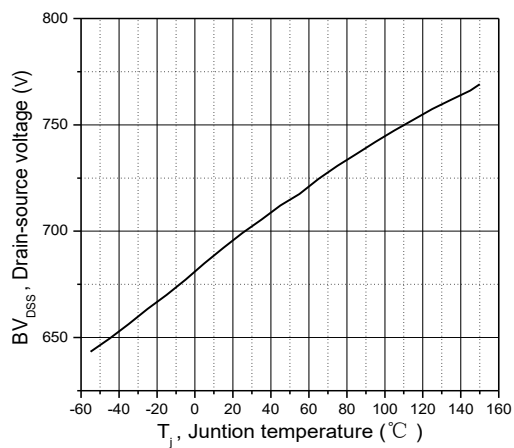
**Figure 2. Typ. transfer characteristics**



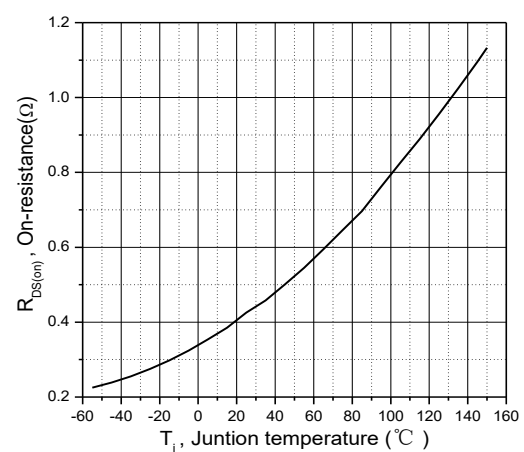
**Figure 3. Typ. capacitances**



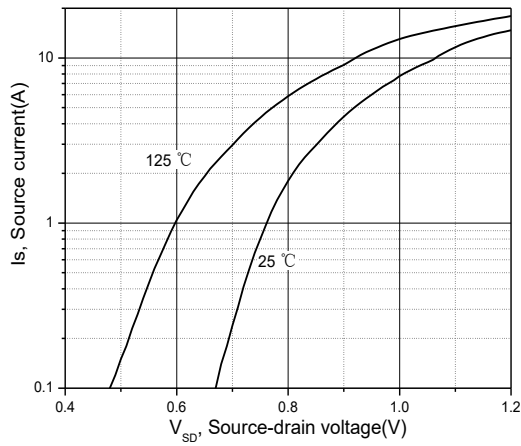
**Figure 4. Typ. gate charge**



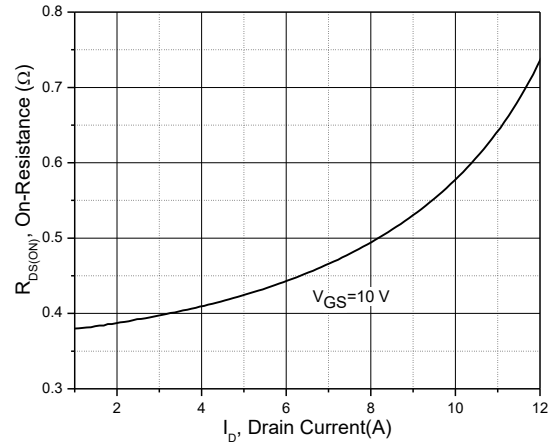
**Figure 5. Drain-source breakdown voltage**



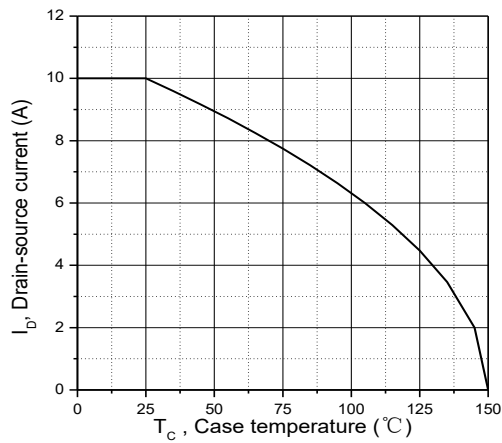
**Figure 6. Drain-source on-state resistance**



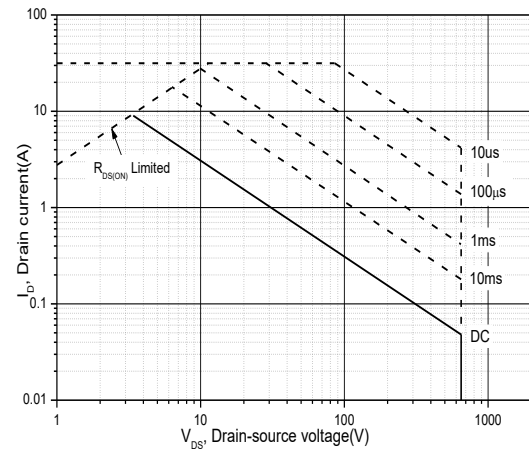
**Figure 7. Forward characteristic of body diode**



**Figure 8. Drain-source on-state resistance**



**Figure 9. Drain current**

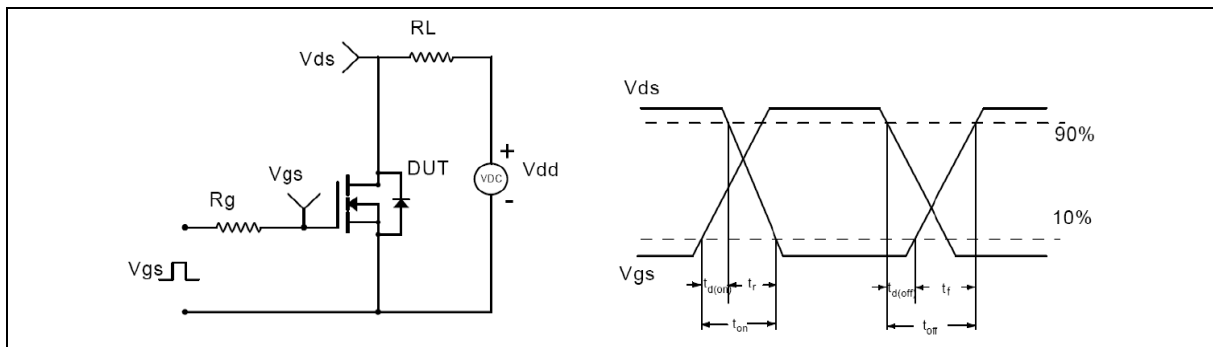


**Figure 10. Safe operation area  $T_C = 25$  °C**

## Test circuits and waveforms



**Figure 1. Gate charge test circuit & waveform**



**Figure 2. Switching time test circuit & waveforms**

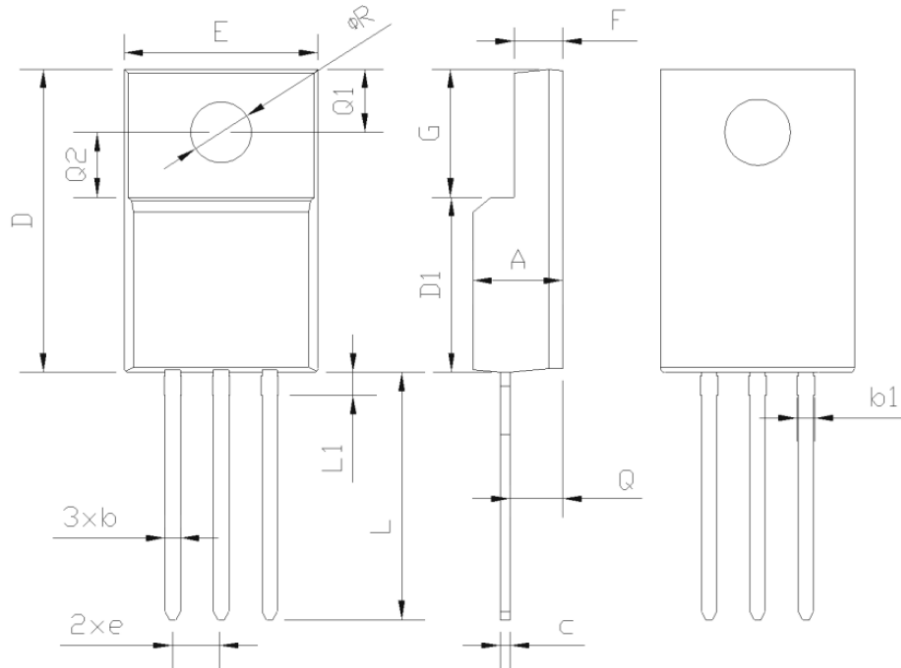


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



**Figure 4. Diode reverse recovery test circuit & waveforms**

## Package Information



| Symbol   | mm      |       |       |
|----------|---------|-------|-------|
|          | Min     | Nom   | Max   |
| A        | 4.30    | 4.50  | 4.70  |
| b        | 0.60    | 0.70  | 0.80  |
| b1       | 0.60    | 0.80  | 0.90  |
| c        | 0.45    | 0.50  | 0.60  |
| D        | 14.70   | 15.00 | 15.30 |
| D1       | 8.50REF |       |       |
| e        | 2.60BSC |       |       |
| E        | 9.70    | 10.00 | 10.30 |
| F        | 2.50    | 2.70  | 2.90  |
| G        | 6.30    | 6.50  | 6.70  |
| L        | 13.40   | 13.60 | 13.80 |
| L1       | 1.00    | 1.10  | 1.20  |
| Q        | 2.50    | 2.60  | 2.70  |
| Q1       | 2.90    | 3.00  | 3.10  |
| Q2       | 3.50REF |       |       |
| $\Phi R$ | 3.00    | 3.20  | 3.40  |

Version 1: TO220F\_NL-M package outline dimension

## Ordering Information

| Package Type | Units/ Tube | Tubes/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TO220F_NL-M  | 50          | 20               | 1000             | 6                       | 6000              |

## Product Information

| Product         | Package   | Pb Free | RoHS | Halogen Free |
|-----------------|-----------|---------|------|--------------|
| OSG65R460FZF_NB | TO220F_NL | yes     | yes  | yes          |

## Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Oriental Semiconductor hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

For further information on technology, delivery terms and conditions and prices, please contact the Oriental Semiconductor sales representatives ([www.orientalsemi.com](http://www.orientalsemi.com)).

© Oriental Semiconductor Co.,Ltd. All Rights Reserved 