

## 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
- AEC-Q101 Qualified for Automotive Application

**GreenMOS<sup>®</sup>**



## Applications

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

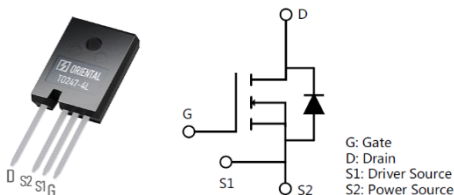
## Key Performance Parameters

| Parameter                         | Value | Unit       |
|-----------------------------------|-------|------------|
| $V_{DS}$                          | 650   | V          |
| $I_D$ , pulse                     | 240   | A          |
| $R_{DS(ON)}$ , max @ $V_{GS}=10V$ | 38    | m $\Omega$ |
| $Q_g$                             | 175   | nC         |

## Marking Information

| Product Name   | Package  | Marking       |
|----------------|----------|---------------|
| OSG65R038H4ZAF | TO247-4L | OSG65R038H4ZA |

## 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> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 80         | A                  |
| Continuous drain current <sup>1)</sup> , $T_C=100^{\circ}\text{C}$        |                       | 50         |                    |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 240        | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 80         | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 240        | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 500        | W                  |
| Single pulsed avalanche energy <sup>4)</sup>                              | $E_{AS}$              | 2900       | mJ                 |
| MOSFET dv/dt ruggedness, $V_{DS}=0\ldots 480\text{ V}$                    | dv/dt                 | 100        | V/ns               |
| Reverse diode dv/dt, $V_{DS}=0\ldots 480\text{ V}$ , $I_{SD}\leq I_D$     | dv/dt                 | 50         | 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    | $R_{\theta JC}$ | 0.25  | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient | $R_{\theta JA}$ | 62    | $^{\circ}\text{C/W}$ |

**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             | $V_{GS}=0\text{ V}$ , $I_D=2\text{ mA}$                              |
| Gate threshold voltage           | $V_{GS(th)}$ | 3.0  |       | 4.5   | V             | $V_{DS}=V_{GS}$ , $I_D=2\text{ mA}$                                  |
| Drain-source on-state resistance | $R_{DS(on)}$ |      | 0.032 | 0.038 | $\Omega$      | $V_{GS}=10\text{ V}$ , $I_D=40\text{ A}$                             |
|                                  |              |      | 0.083 |       |               | $V_{GS}=10\text{ V}$ , $I_D=40\text{ A}$ , $T_j=150^{\circ}\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$    |      |       | 100   | nA            | $V_{GS}=30\text{ V}$                                                 |
|                                  |              |      |       | -100  |               | $V_{GS}=-30\text{ V}$                                                |
| Drain-source leakage current     | $I_{DSS}$    |      |       | 10    | $\mu\text{A}$ | $V_{DS}=650\text{ V}$ , $V_{GS}=0\text{ V}$                          |
| Gate resistance                  | $R_G$        |      | 2.4   |       | $\Omega$      | $f=1\text{ MHz}$ , Open drain                                        |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ.   | Max. | Unit | Test condition                                                                              |
|------------------------------|--------------|------|--------|------|------|---------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{iss}$    |      | 8537.9 |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=50\text{ V}$ ,<br>$f=100\text{ kHz}$                       |
| Output capacitance           | $C_{oss}$    |      | 516.1  |      | pF   |                                                                                             |
| Reverse transfer capacitance | $C_{rss}$    |      | 13.7   |      | pF   |                                                                                             |
| Turn-on delay time           | $t_{d(on)}$  |      | 55.9   |      | ns   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$R_G=2\ \Omega$ ,<br>$I_D=40\text{ A}$ |
| Rise time                    | $t_r$        |      | 121.2  |      | ns   |                                                                                             |
| Turn-off delay time          | $t_{d(off)}$ |      | 114.2  |      | ns   |                                                                                             |
| Fall time                    | $t_f$        |      | 8.75   |      | ns   |                                                                                             |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ.  | Max. | Unit | Test condition                                                         |
|----------------------|---------------|------|-------|------|------|------------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 175.0 |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$I_D=40\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 40.1  |      | nC   |                                                                        |
| Gate-drain charge    | $Q_{gd}$      |      | 76.1  |      | nC   |                                                                        |
| Gate plateau voltage | $V_{plateau}$ |      | 6.4   |      | V    |                                                                        |

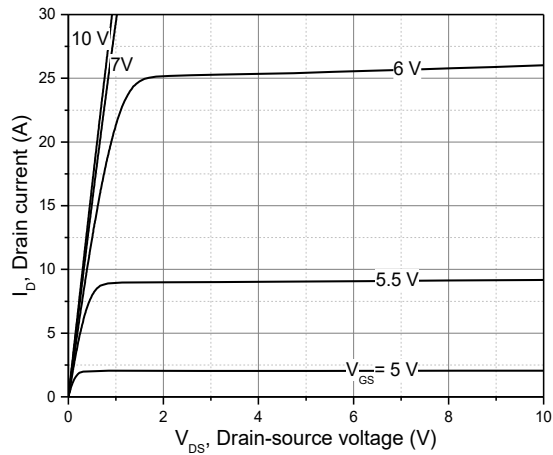
### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit          | Test condition                                          |
|-------------------------------|-----------|------|------|------|---------------|---------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |      | 1.3  | V             | $I_S=80\text{ A}$ ,<br>$V_{GS}=0\text{ V}$              |
| Reverse recovery time         | $t_{rr}$  |      | 180  |      | ns            | $I_S=30\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 1.5  |      | $\mu\text{C}$ |                                                         |
| Peak reverse recovery current | $I_{rrm}$ |      | 15.2 |      | A             |                                                         |

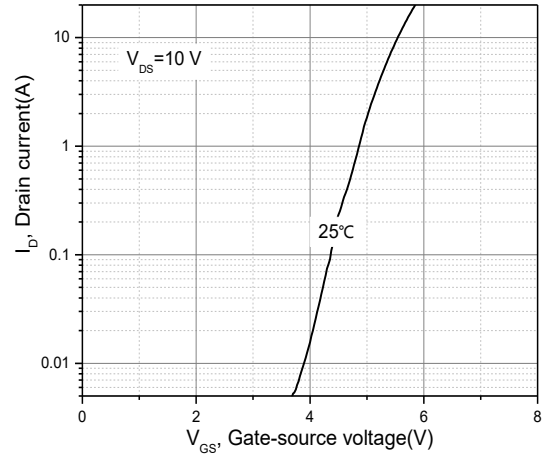
### Note

- 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)  $V_{DD}=100\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=80\text{ mH}$ , starting  $T_J=25\text{ }^\circ\text{C}$ .

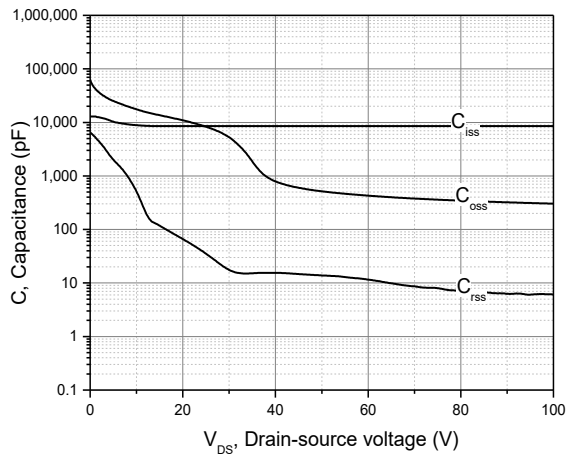
## Electrical Characteristics Diagrams



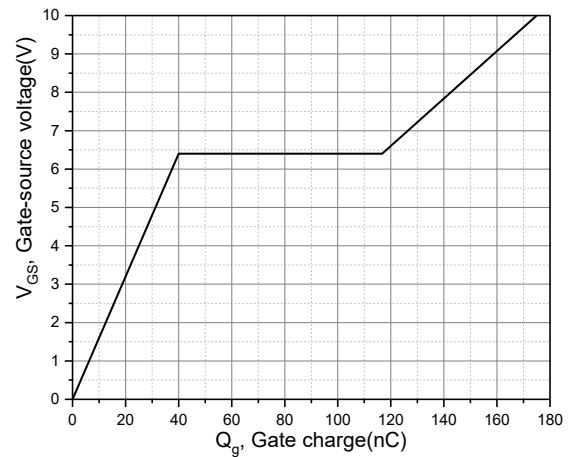
**Figure 1. Typ. output characteristics**



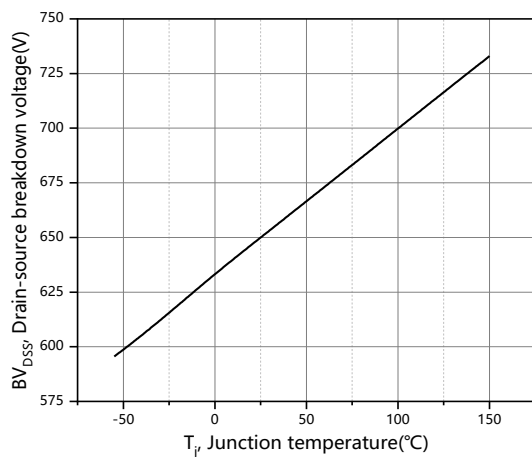
**Figure 2. Typ. transfer characteristics**



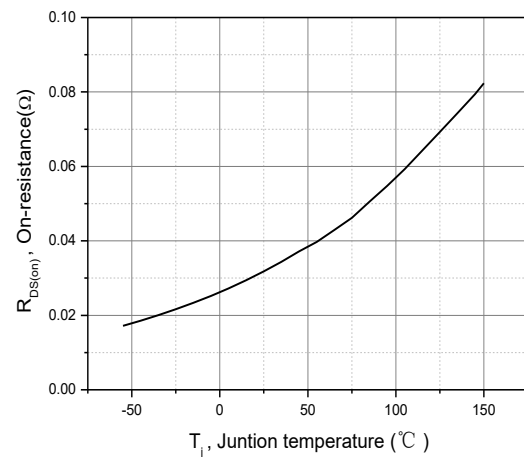
**Figure 3. Typ. capacitances**



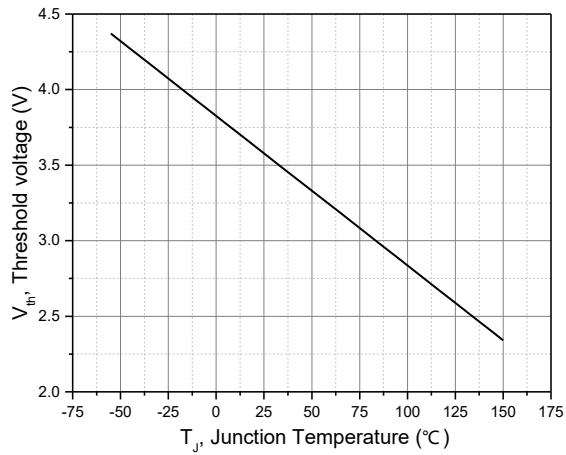
**Figure 4. Typ. gate charge**



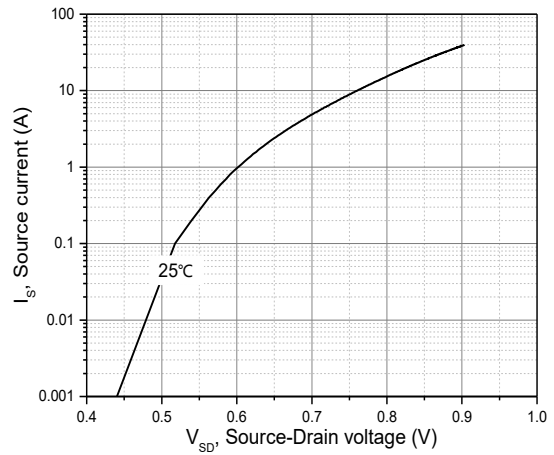
**Figure 5. Drain-source breakdown voltage**



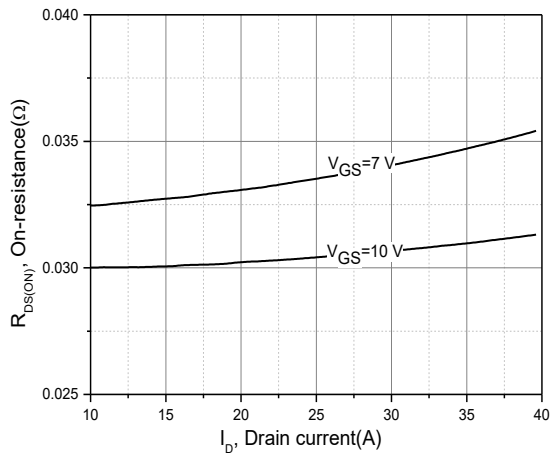
**Figure 6. Drain-source on-state resistance**



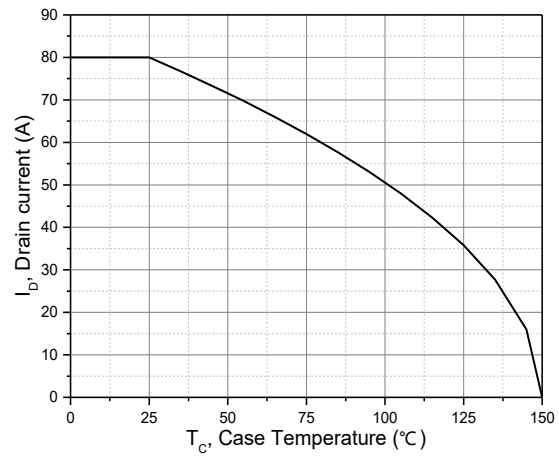
**Figure 7. Threshold voltage**



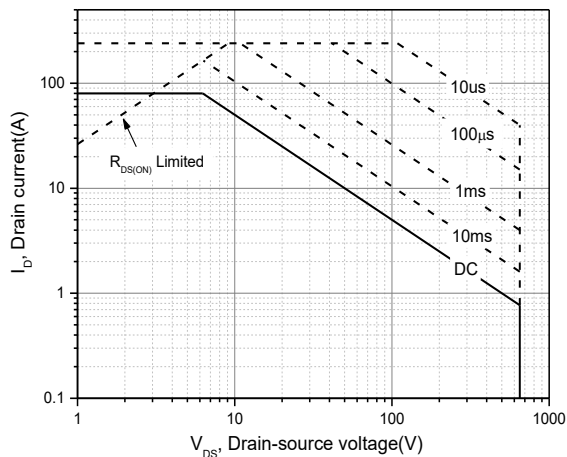
**Figure 8. Forward characteristic of body diode**



**Figure 9. Drain-source on-state resistance**



**Figure 10. Drain current**



**Figure 7. Safe operation area  $T_C=25^\circ\text{C}$**

## Test circuits and waveforms



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



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

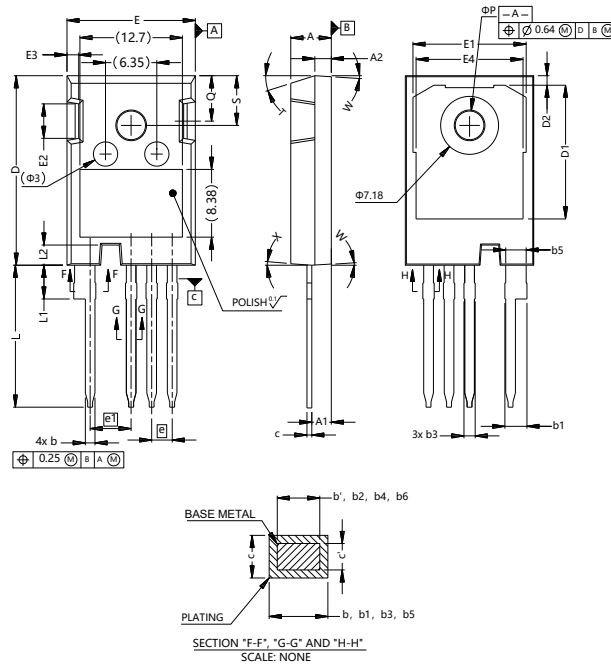


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



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

## Package Information



| Symbol | mm        |       |
|--------|-----------|-------|
|        | Min       | Max   |
| A      | 4.83      | 5.21  |
| A1     | 2.29      | 2.54  |
| A2     | 1.91      | 2.16  |
| b'     | 1.07      | 1.28  |
| b      | 1.07      | 1.33  |
| b1     | 2.39      | 2.94  |
| b2     | 2.39      | 2.84  |
| b3     | 1.07      | 1.60  |
| b4     | 1.07      | 1.50  |
| b5     | 2.39      | 2.69  |
| b6     | 2.39      | 2.64  |
| c'     | 0.55      | 0.65  |
| c      | 0.55      | 0.68  |
| D      | 23.30     | 23.60 |
| D1     | 16.25     | 17.65 |
| D2     | 0.95      | 1.25  |
| E      | 15.75     | 16.13 |
| E1     | 13.10     | 14.15 |
| E2     | 3.68      | 5.10  |
| E3     | 1.00      | 1.90  |
| E4     | 12.38     | 13.43 |
| e      | 2.54 BSC  |       |
| e1     | 5.08 BSC  |       |
| N      | 4         |       |
| L      | 17.31     | 17.82 |
| L1     | 3.97      | 4.37  |
| L2     | 2.35      | 2.65  |
| ΦP     | 3.51      | 3.65  |
| Q      | 5.49      | 6.00  |
| S      | 6.04      | 6.30  |
| T      | 17.5° REF |       |
| W      | 3.5° REF  |       |
| X      | 4° REF    |       |

Version: TO247-4L-S package outline dimension

## Ordering Information

| Package Type | Units/ Tube | Tubes/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TO247-4L-S   | 30          | 15               | 450              | 4                       | 1800              |

## Product Information

| Product        | Package  | Pb Free | RoHS | Halogen Free |
|----------------|----------|---------|------|--------------|
| OSG65R038H4ZAF | TO247-4L | yes     | yes  | yes          |

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