

## 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
- AEC-Q101 Qualified for Automotive Application

**GreenMOS<sup>®</sup>**



## Applications

- LED lighting
- Adapter
- Telecom
- Solar/UPS
- Sever

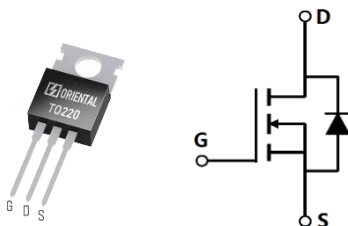
## Key Performance Parameters

| Parameter                         | Value | Unit       |
|-----------------------------------|-------|------------|
| $V_{DS}$                          | 650   | V          |
| $I_D$ , pulse                     | 120   | A          |
| $R_{DS(ON)}$ , max @ $V_{GS}=10V$ | 99    | m $\Omega$ |
| $Q_g$                             | 54    | nC         |

## Marking Information

| Product Name    | Package | Marking        |
|-----------------|---------|----------------|
| OSG65R099PT3ZAF | TO220   | OSG65R099PT3ZA |

## 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> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 40         | A                  |
| Continuous drain current <sup>1)</sup> , $T_C=100^{\circ}\text{C}$        |                       | 25.3       |                    |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 120        | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 40         | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 120        | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 220        | W                  |
| Single pulsed avalanche energy <sup>4)</sup>                              | $E_{AS}$              | 360        | mJ                 |
| MOSFET dv/dt ruggedness, $V_{DS}=0 \dots 400 \text{ V}$                   | dv/dt                 | 100        | V/ns               |
| Reverse diode dv/dt, $V_{DS}=0 \dots 400 \text{ V}$ , $I_{SD} \leq I_D$   | 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    | $R_{\theta JC}$ | 0.57  | $^{\circ}\text{C/W}$ |
| 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             | $V_{GS}=0 \text{ V}$ , $I_D=1 \text{ mA}$                              |
| Gate threshold voltage           | $V_{GS(th)}$ | 3.0  |      | 5.0  | V             | $V_{DS}=V_{GS}$ , $I_D=1 \text{ mA}$                                   |
| Drain-source on-state resistance | $R_{DS(on)}$ |      | 81   | 99   | m $\Omega$    | $V_{GS}=10 \text{ V}$ , $I_D=20 \text{ A}$                             |
|                                  |              |      | 213  |      |               | $V_{GS}=10 \text{ V}$ , $I_D=20 \text{ A}$ , $T_j=150^{\circ}\text{C}$ |
| 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                  | $R_G$        |      | 15   |      | $\Omega$      | $f=1 \text{ MHz}$ , Open drain                                         |

### Dynamic Characteristics

| Parameter                                    | Symbol       | Min. | Typ. | Max. | Unit | Test condition                                                                              |
|----------------------------------------------|--------------|------|------|------|------|---------------------------------------------------------------------------------------------|
| Input capacitance                            | $C_{iss}$    |      | 2895 |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=50\text{ V}$ ,<br>$f=100\text{ kHz}$                       |
| Output capacitance                           | $C_{oss}$    |      | 139  |      | pF   |                                                                                             |
| Reverse transfer capacitance                 | $C_{rss}$    |      | 3    |      | pF   |                                                                                             |
| Effective output capacitance, energy related | $C_{o(er)}$  |      | 90   |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=0\text{ V}-400\text{ V}$                                   |
| Effective output capacitance, time related   | $C_{o(tr)}$  |      | 505  |      | pF   |                                                                                             |
| Turn-on delay time                           | $t_{d(on)}$  |      | 38   |      | 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                                    | $t_r$        |      | 136  |      | ns   |                                                                                             |
| Turn-off delay time                          | $t_{d(off)}$ |      | 66   |      | ns   |                                                                                             |
| Fall time                                    | $t_f$        |      | 50   |      | ns   |                                                                                             |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ. | Max. | Unit | Test condition                                                         |
|----------------------|---------------|------|------|------|------|------------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 54   |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$I_D=40\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 20   |      | nC   |                                                                        |
| Gate-drain charge    | $Q_{gd}$      |      | 18.5 |      | nC   |                                                                        |
| Gate plateau voltage | $V_{plateau}$ |      | 7.8  |      | V    |                                                                        |

### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit | Test condition                                                                  |
|-------------------------------|-----------|------|------|------|------|---------------------------------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |      | 1.3  | V    | $I_S=40\text{ A}$ ,<br>$V_{GS}=0\text{ V}$                                      |
| Reverse recovery time         | $t_{rr}$  |      | 155  |      | ns   | $V_R=400\text{ V}$ ,<br>$I_S=40\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 633  |      | nC   |                                                                                 |
| Peak reverse recovery current | $I_{rrm}$ |      | 7.8  |      | 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

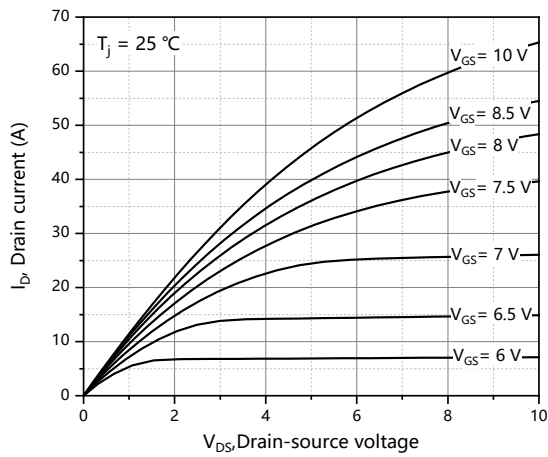


Figure 1. Typ. output characteristics

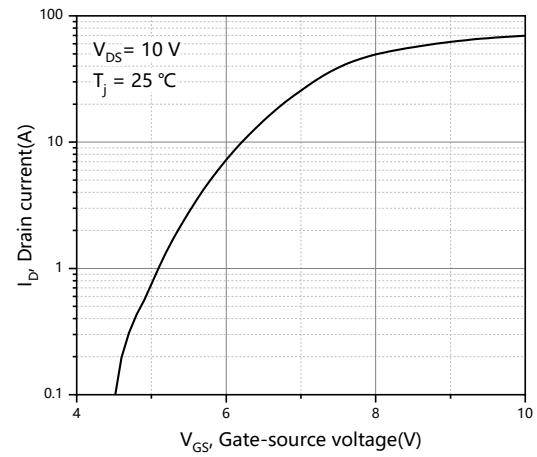


Figure 2. Typ. transfer characteristics

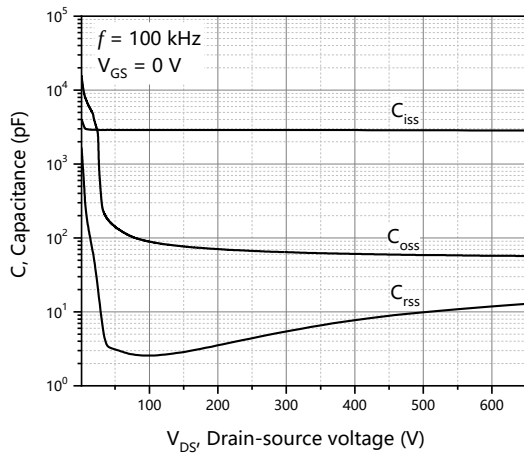


Figure 3. Typ. capacitances

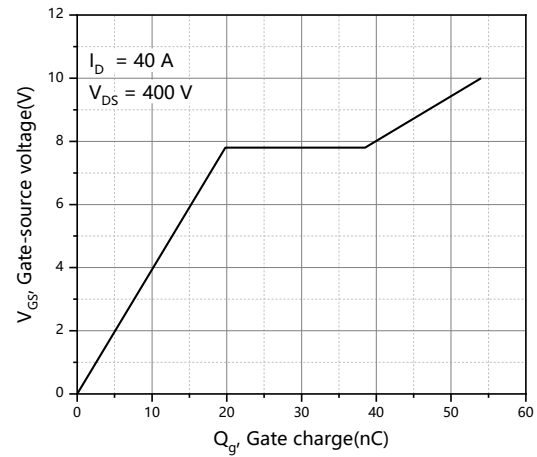


Figure 4. Typ. gate charge

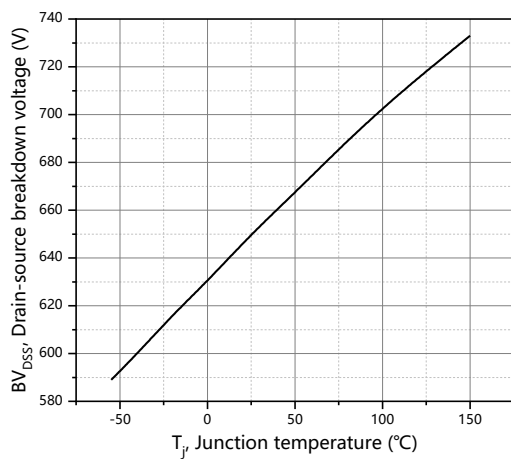


Figure 5. Drain-source breakdown voltage

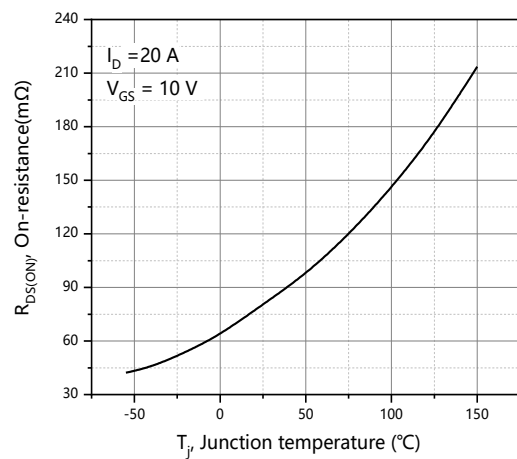
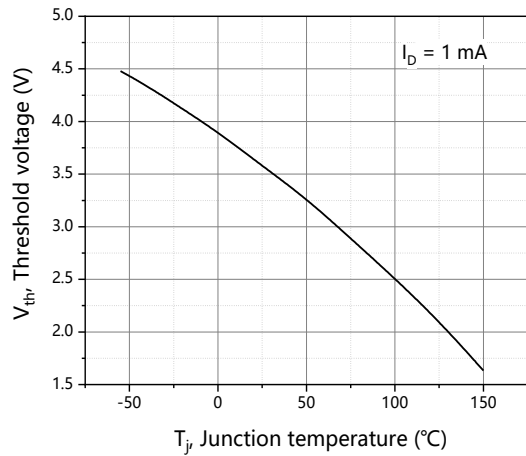
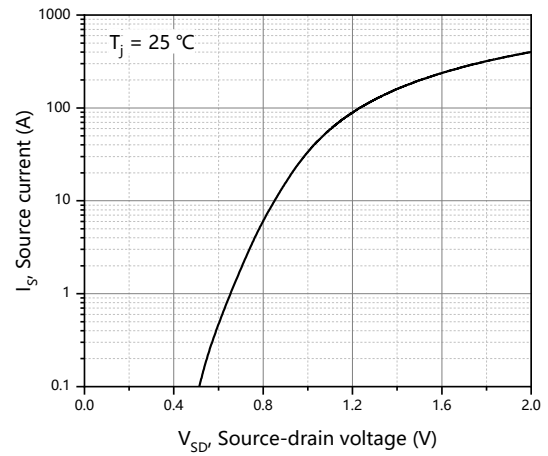


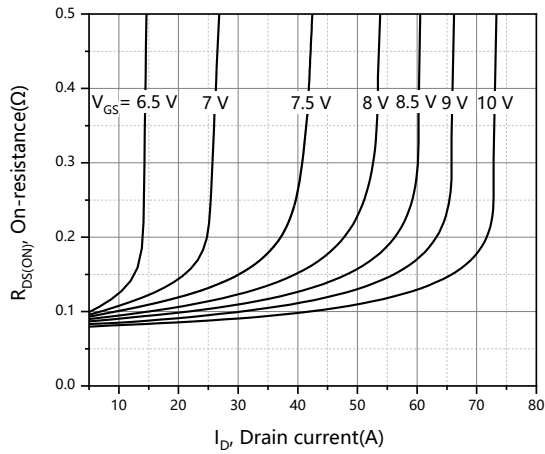
Figure 6. Drain-source on-state resistance



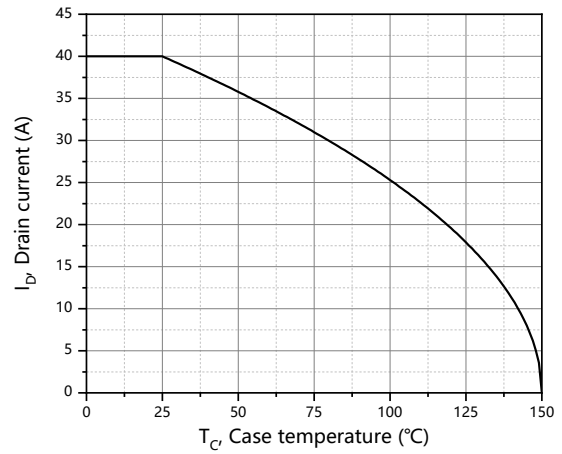
**Figure 7. Threshold voltage**



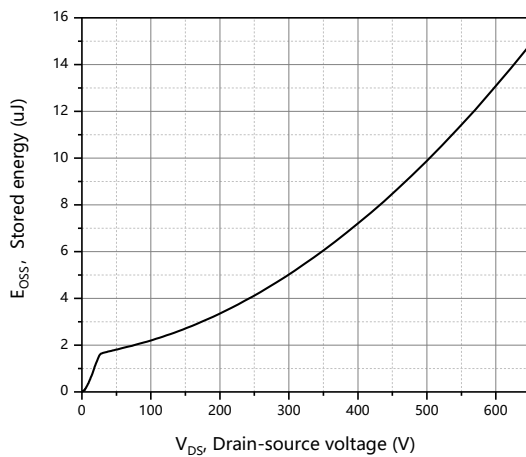
**Figure 8. Forward characteristic of body diode**



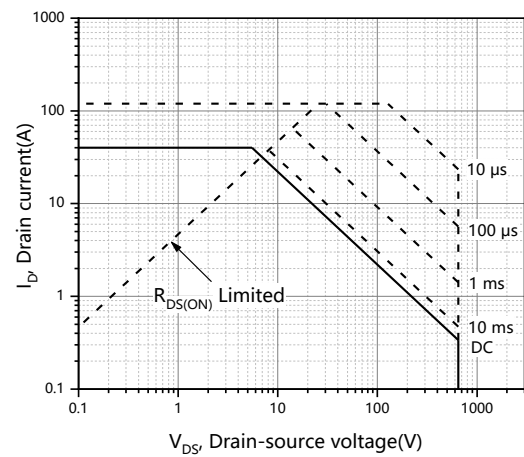
**Figure 9. Drain-source on-state resistance**



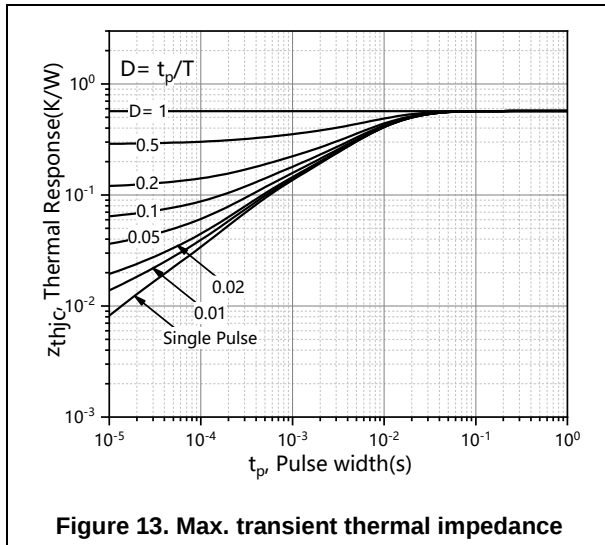
**Figure 10. Drain current**



**Figure 11. Typ. Coss stored energy**



**Figure 12. Safe operation area T<sub>C</sub>=25°C**



**Figure 13. Max. transient thermal impedance**

## Test circuits and waveforms



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



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

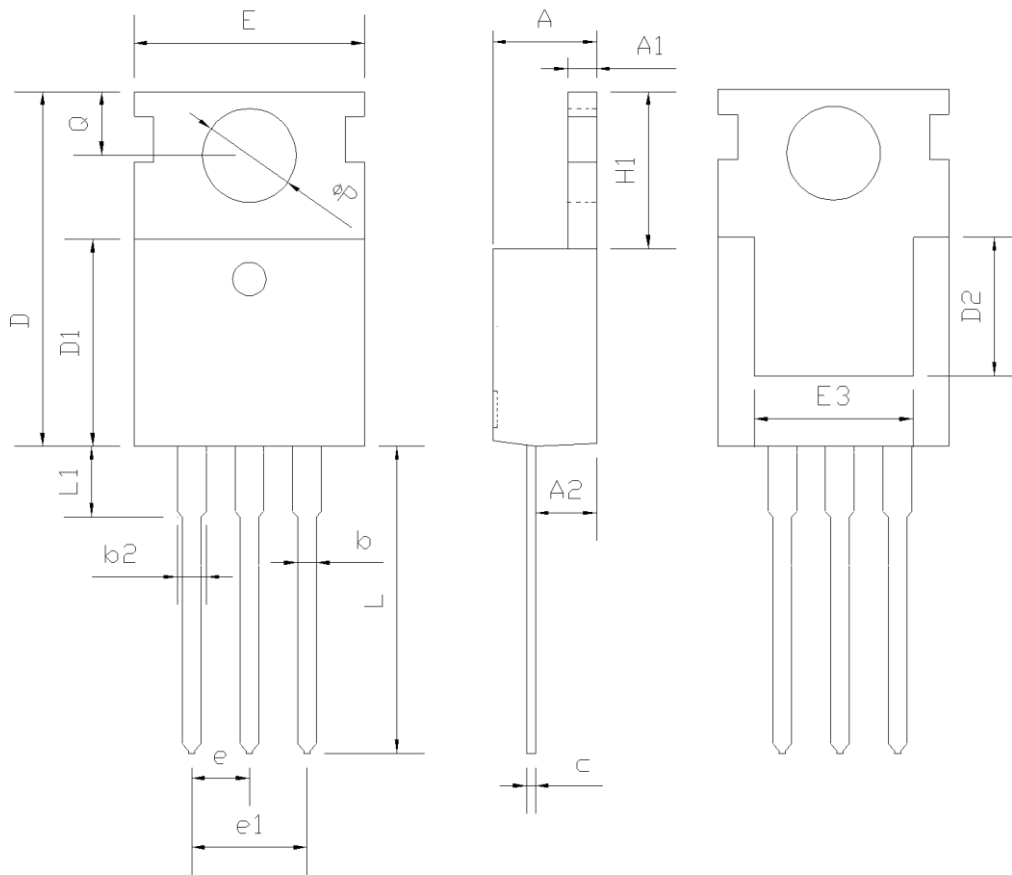


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



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

## Package Information



| Symbol   | mm       |       |       |
|----------|----------|-------|-------|
|          | Min      | Nom   | Max   |
| A        | 4.37     | 4.57  | 4.77  |
| A1       | 1.25     | 1.30  | 1.45  |
| A2       | 2.20     | 2.40  | 2.60  |
| b        | 0.70     | 0.80  | 0.95  |
| b2       | 1.17     | 1.27  | 1.47  |
| c        | 0.40     | 0.50  | 0.65  |
| D        | 15.10    | 15.60 | 16.10 |
| D1       | 8.80     | 9.10  | 9.40  |
| D2       | 5.50     | -     | -     |
| E        | 9.70     | 10.00 | 10.30 |
| E3       | 7.00     | -     | -     |
| e        | 2.54 BSC |       |       |
| e1       | 5.08 BSC |       |       |
| H1       | 6.25     | 6.50  | 6.85  |
| L        | 12.75    | 13.50 | 13.80 |
| L1       | -        | 3.10  | 3.40  |
| $\Phi P$ | 3.40     | 3.60  | 3.80  |
| Q        | 2.60     | 2.80  | 3.00  |

Version: TO220-P package outline dimension

**Ordering Information**

| Package Type | Units/ Tube | Tubes/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TO220-P      | 50          | 20               | 1000             | 6                       | 6000              |

**Product Information**

| Product         | Package | Pb Free | RoHS | Halogen Free |
|-----------------|---------|---------|------|--------------|
| OSG65R099PT3ZAF | TO220   | yes     | yes  | yes          |

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