

## 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> S series is optimized for its switching characteristics to achieve aggressive EMI standards. It is easy to use for smaller power supply systems to meet the both efficiency and EMI standards.

## Features

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

GreenMOS<sup>®</sup>



## Applications

- LED lighting
- Charger
- Adapter
- Telecom power
- Server power
- Solar/UPS

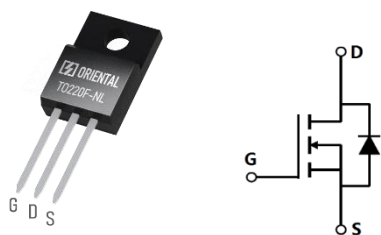
## Key Performance Parameters

| Parameter                         | Value | Unit       |
|-----------------------------------|-------|------------|
| $V_{DS}$                          | 650   | V          |
| $I_D$ , pulse                     | 24    | A          |
| $R_{DS(ON)}$ , max @ $V_{GS}=10V$ | 600   | m $\Omega$ |
| $Q_g$                             | 12.7  | nC         |

## Marking Information

| Product Name    | Package   | Marking     |
|-----------------|-----------|-------------|
| OSG65R600FSF_NB | TO220F_NL | OSG65R600FS |

## 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> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 8          | A                  |
| Continuous drain current <sup>1)</sup> , $T_C=100^{\circ}\text{C}$        |                       | 4.5        |                    |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 24         | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 8          | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 24         | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 28         | W                  |
| Single pulsed avalanche energy <sup>4)</sup>                              | $E_{AS}$              | 129        | mJ                 |
| MOSFET dv/dt ruggedness, $V_{DS}=0\ldots 480\text{ V}$                    | dv/dt                 | 50         | V/ns               |
| Reverse diode dv/dt, $V_{DS}=0\ldots 480\text{ V}$ , $I_{SD}\leq I_D$     | 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    | $R_{\theta JC}$ | 4.46  | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient | $R_{\theta JA}$ | 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             | $V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$                  |
| Gate threshold voltage           | $V_{GS(th)}$ | 2.9  |      | 3.9  | V             | $V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$                      |
| Drain-source on-state resistance | $R_{DS(on)}$ |      | 0.54 | 0.6  | $\Omega$      | $V_{GS}=10\text{ V}$ , $I_D=4\text{ A}$                             |
|                                  |              |      | 1.34 |      |               | $V_{GS}=10\text{ V}$ , $I_D=4\text{ A}$ , $T_j=150^{\circ}\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$    |      |      | 100  | nA            | $V_{GS}=30\text{ V}$                                                |
|                                  |              |      |      | -100 |               | $V_{GS}=-30\text{ V}$                                               |
| Drain-source leakage current     | $I_{DSS}$    |      |      | 1    | $\mu\text{A}$ | $V_{DS}=650\text{ V}$ , $V_{GS}=0\text{ V}$                         |
| Gate resistance                  | $R_G$        |      | 10.3 |      | $\Omega$      | $f=1\text{ MHz}$ , Open drain                                       |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ. | Max. | Unit | Test condition                                                                             |
|------------------------------|--------------|------|------|------|------|--------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{iss}$    |      | 551  |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=50\text{ V}$ ,<br>$f=100\text{ kHz}$                      |
| Output capacitance           | $C_{oss}$    |      | 41   |      | pF   |                                                                                            |
| Reverse transfer capacitance | $C_{rss}$    |      | 1.6  |      | pF   |                                                                                            |
| Turn-on delay time           | $t_{d(on)}$  |      | 20.9 |      | ns   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$R_G=2\ \Omega$ ,<br>$I_D=4\text{ A}$ |
| Rise time                    | $t_r$        |      | 7.6  |      | ns   |                                                                                            |
| Turn-off delay time          | $t_{d(off)}$ |      | 40.3 |      | ns   |                                                                                            |
| Fall time                    | $t_f$        |      | 11.3 |      | ns   |                                                                                            |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ. | Max. | Unit | Test condition                                                        |
|----------------------|---------------|------|------|------|------|-----------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 12.7 |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$I_D=4\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 4.7  |      | nC   |                                                                       |
| Gate-drain charge    | $Q_{gd}$      |      | 3.2  |      | nC   |                                                                       |
| Gate plateau voltage | $V_{plateau}$ |      | 5.4  |      | V    |                                                                       |

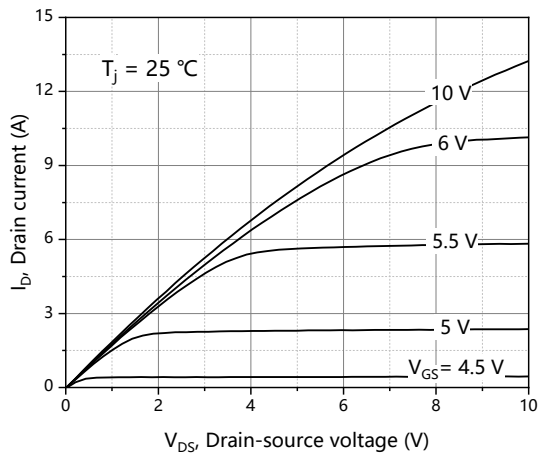
### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit          | Test condition                                                                 |
|-------------------------------|-----------|------|------|------|---------------|--------------------------------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |      | 1.3  | V             | $I_S=8\text{ A}$ ,<br>$V_{GS}=0\text{ V}$                                      |
| Reverse recovery time         | $t_{rr}$  |      | 217  |      | ns            | $V_R=400\text{ V}$ ,<br>$I_S=4\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 1.8  |      | $\mu\text{C}$ |                                                                                |
| Peak reverse recovery current | $I_{rrm}$ |      | 15.1 |      | A             |                                                                                |

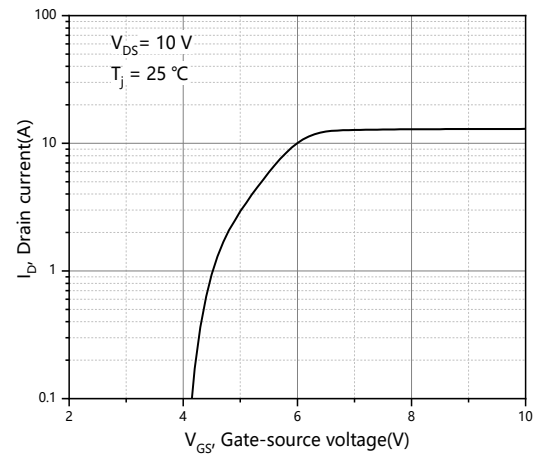
### Note

- 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)  $V_{DD}=100\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=79.9\text{ mH}$ , starting  $T_J=25\text{ }^\circ\text{C}$ .

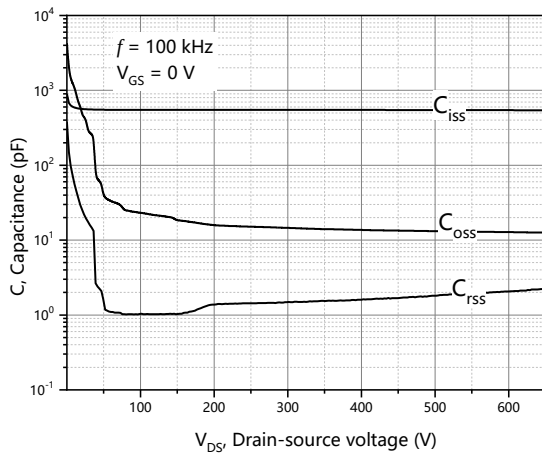
## Electrical Characteristics Diagrams



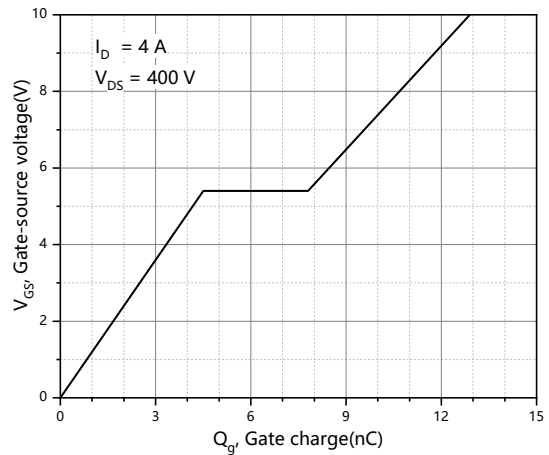
**Figure 1. Typ. output characteristics**



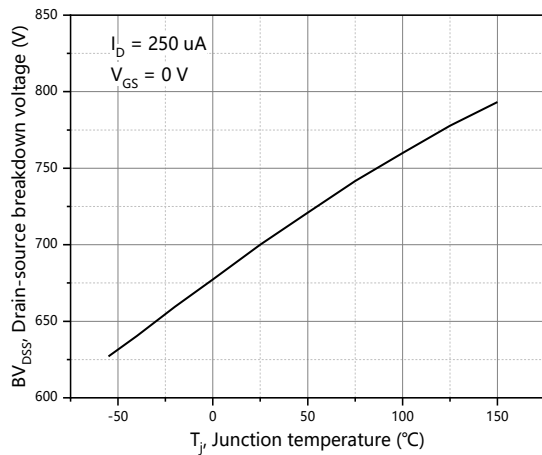
**Figure 2. Typ. transfer characteristics**



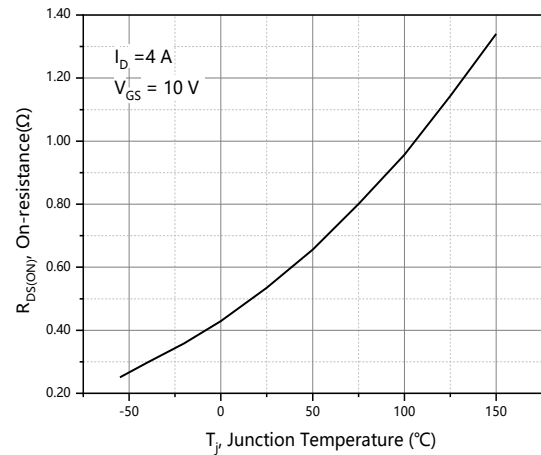
**Figure 3. Typ. capacitances**



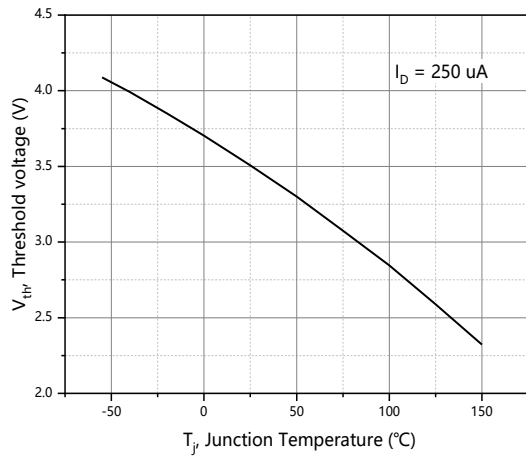
**Figure 4. Typ. gate charge**



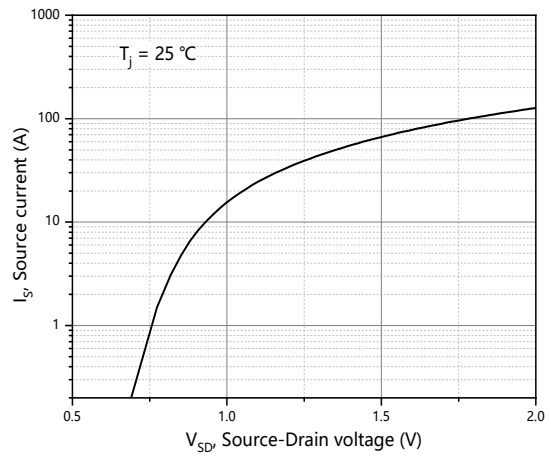
**Figure 5. Drain-source breakdown voltage**



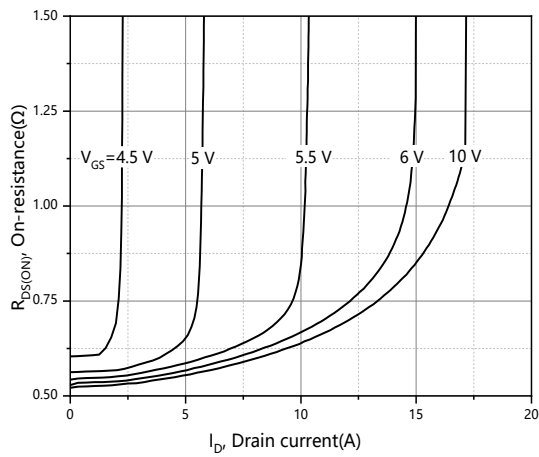
**Figure 6. Drain-source on-state resistance**



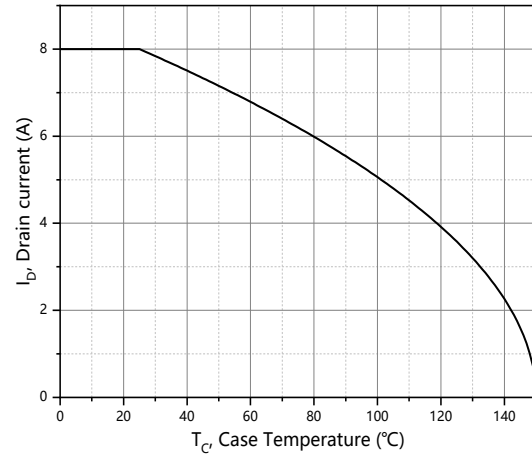
**Figure 7. Threshold voltage**



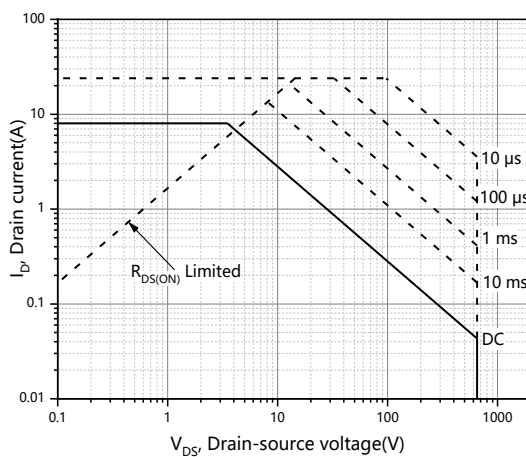
**Figure 8. Forward characteristic of body diode**



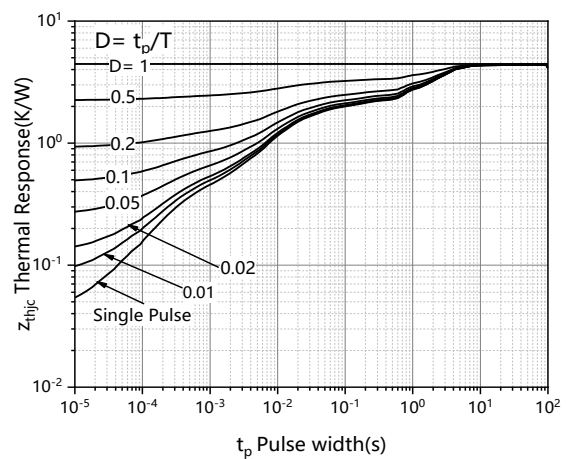
**Figure 9. Drain-source on-state resistance**



**Figure 10. Drain current**



**Figure 11. Safe operation area Tc=25 °C**



**Figure 12. Max. transient thermal impedance**

## Test circuits and waveforms



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



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

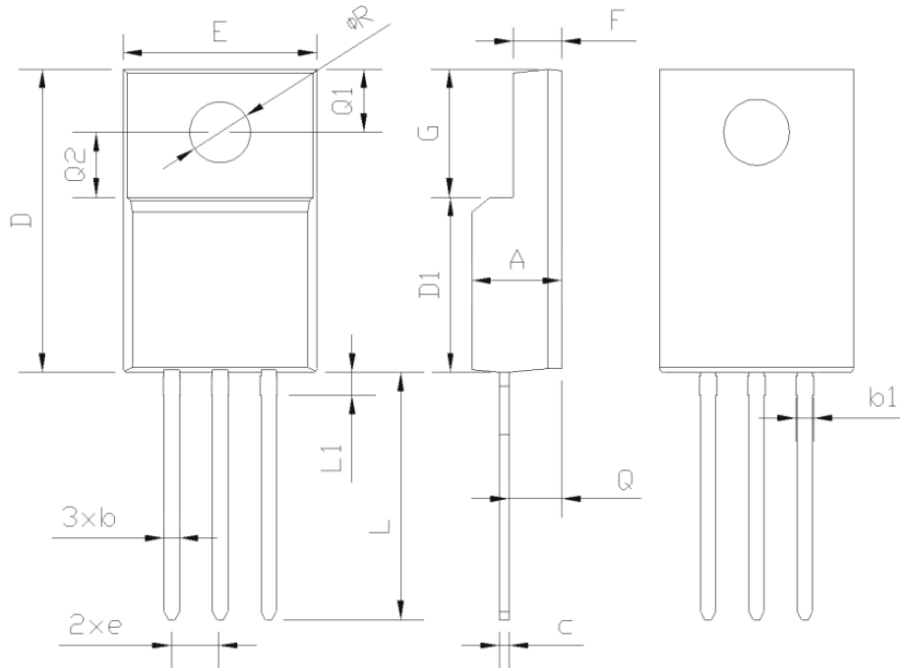


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



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

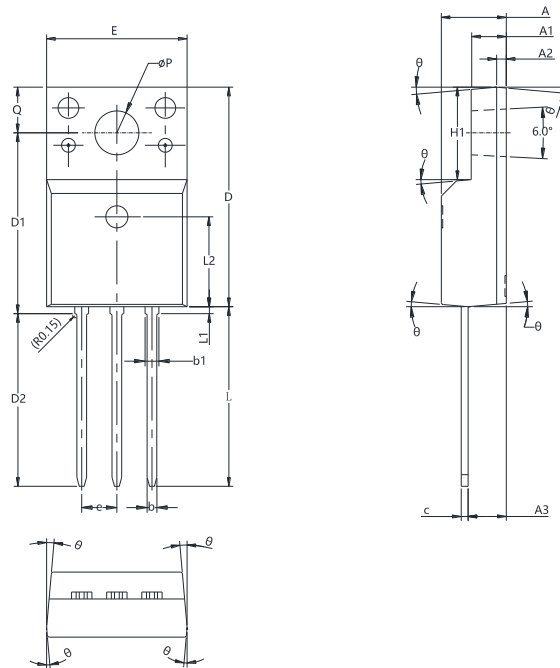
## Package Information



| Symbol   | mm      |       |       |
|----------|---------|-------|-------|
|          | Min     | Nom   | Max   |
| A        | 4.30    | 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

## Package Information



| Symbol   | mm       |       |       |
|----------|----------|-------|-------|
|          | Min      | Nom   | Max   |
| A        | 4.5      | 4.7   | 4.83  |
| A1       | 2.34     | 2.54  | 2.74  |
| A2       | 0.70 REF |       |       |
| A3       | 2.56     | 2.76  | 2.93  |
| b        | 0.6      | -     | 0.8   |
| b1       | 0.9      | -     | 1.1   |
| c        | 0.45     | 0.5   | 0.6   |
| D        | 15.67    | 15.87 | 16.07 |
| D1       | 12.87    | 13.07 | 13.27 |
| D2       | 12.28    | 12.48 | 12.68 |
| E        | 9.96     | 10.16 | 10.36 |
| e        | 2.54 BSC |       |       |
| H1       | 6.48     | 6.68  | 6.88  |
| L        | 12.68    | 12.98 | 13.28 |
| L1       | -        | -     | 0.85  |
| L2       | 6.50 REF |       |       |
| $\phi P$ | 3.08     | 3.18  | 3.28  |
| Q        | 3.20     | -     | 3.40  |
| $\theta$ | 1°       | 3°    | 5°    |

Version 2: TO220F\_NL-J 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              |
| TO220F_NL-J  | 50          | 20               | 1000             | 5                       | 5000              |

## Product Information

| Product         | Package   | Pb Free | RoHS | Halogen Free |
|-----------------|-----------|---------|------|--------------|
| OSG65R600FSF_NB | TO220F_NL | yes     | yes  | yes          |

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