

# Enhancement Mode N-Channel Power MOSFET

## Features

- ◆ Low  $R_{DS(on)}$  & FOM
- ◆ Extremely low switching loss
- ◆ Excellent stability and uniformity
- ◆ Easy to drive

## Applications

- ◆ Lighting
- ◆ Hard switching PWM
- ◆ Server power supply
- ◆ Charger

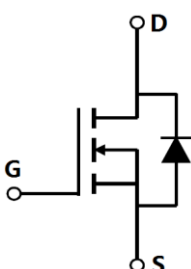



## ■ General Description

OSG70R750xF use advanced GreenMOSTM technology to provide low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. This device is suitable for active power factor correction and switching mode power supply applications.

|                                   |        |
|-----------------------------------|--------|
| ◆ $V_{DS, min@Tjmax}$             | 750 V  |
| ◆ $I_D, pulse$                    | 21 A   |
| ◆ $R_{DS(ON), max @ V_{GS}=10 V}$ | 750 mΩ |
| ◆ $Q_g$                           | 9.2 nC |

## ■ Schematic and Package Information

|  |  |                    |                    |               |              |                    |                    |                    |                    |
|--|--|--------------------|--------------------|---------------|--------------|--------------------|--------------------|--------------------|--------------------|
| <p><b>Schematic Diagram</b></p>  | <p><b>Pin Assignment Top View</b></p>    |                    |                    |               |              |                    |                    |                    |                    |
|  | <table border="0"> <tr> <td><b>TO251</b></td> <td><b>TO252</b></td> <td><b>TO220F</b></td> <td><b>TO220</b></td> </tr> <tr> <td><b>OSG70R750AF</b></td> <td><b>OSG70R750DF</b></td> <td><b>OSG70R750FF</b></td> <td><b>OSG70R750PF</b></td> </tr> </table> | <b>TO251</b>       | <b>TO252</b>       | <b>TO220F</b> | <b>TO220</b> | <b>OSG70R750AF</b> | <b>OSG70R750DF</b> | <b>OSG70R750FF</b> | <b>OSG70R750PF</b> |
| <b>TO251</b>   | <b>TO252</b>   | <b>TO220F</b>      | <b>TO220</b>       |               |              |                    |                    |                    |                    |
| <b>OSG70R750AF</b>   | <b>OSG70R750DF</b>   | <b>OSG70R750FF</b> | <b>OSG70R750PF</b> |               |              |                    |                    |                    |                    |

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

| Parameter   | Symbol         | Value      | Unit             |
|---|----------------|------------|------------------|
| Drain source voltage  | $V_{DS}$       | 700        | V                |
| Gate source voltage   | $V_{GS}$       | $\pm 30$   | V                |
| Continuous drain current <sup>1)</sup> , $T_C=25^\circ\text{C}$                 | $I_D$          | 7          | A                |
| Continuous drain current <sup>1)</sup> , $T_C=100^\circ\text{C}$                |                | 4.4        |                  |
| Pulsed drain current <sup>2)</sup> , $T_C=25^\circ\text{C}$                     | $I_{D, pulse}$ | 21         | A                |
| Power dissipation <sup>3)</sup> for TO251, TO252, TO220, $T_C=25^\circ\text{C}$ | $P_D$          | 63         | W                |
| Power dissipation <sup>3)</sup> for TO220F, $T_C=25^\circ\text{C}$              |                | 28         |                  |
| Single pulsed avalanche energy <sup>5)</sup>                                    | $E_{AS}$       | 190        | mJ               |
| MOSFET dv/dt ruggedness, $V_{DS}=0\dots 480 V$                                  | dv/dt          | 50         | V/ns             |
| Reverse diode dv/dt, $V_{DS}=0\dots 480 V, I_{SD}\leq I_D$                      | 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                        |
|--|-----------------|-------------------|--------|-----------------------------|
|  |                 | TO251/TO252/TO220 | TO220F |                             |
| Thermal resistance, junction-case                  | $R_{\theta JC}$ | 2                 | 4.5    | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, junction-ambient <sup>4)</sup> | $R_{\theta JA}$ | 62                | 62.5   | $^{\circ}\text{C}/\text{W}$ |

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

| Parameter                        | Symbol       | Min. | Typ. | Max. | Unit          | Test condition   |
|----------------------------------|--------------|------|------|------|---------------|--|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 700  |      |      | V             | $V_{GS}=0\text{ V}, I_D=250\ \mu\text{A}$                          |
|                                  |              | 750  | 810  |      |               | $V_{GS}=0\text{ V}, I_D=250\ \mu\text{A}, T_j=150^{\circ}\text{C}$ |
| Gate threshold voltage           | $V_{GS(th)}$ | 2.0  |      | 4.0  | V             | $V_{DS}=V_{GS}, I_D=250\ \mu\text{A}$                              |
| Drain-source on-state resistance | $R_{DS(on)}$ |      | 0.65 | 0.75 | $\Omega$      | $V_{GS}=10\text{ V}, I_D=4\text{ A}$                               |
|                                  |              |      | 1.8  |      |               | $V_{GS}=10\text{ V}, I_D=4\text{ A}, T_j=150^{\circ}\text{C}$      |
| 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    | $\mu\text{A}$ | $V_{DS}=700\text{ V}, V_{GS}=0\text{ V}$                           |

■ **Dynamic Characteristics**

| Parameter                    | Symbol       | Min. | Typ. | Max. | Unit | Test condition  |
|------------------------------|--------------|------|------|------|------|---|
| Input capacitance            | $C_{iss}$    |      | 459  |      | pF   | $V_{GS}=0\text{ V}, V_{DS}=50\text{ V}, f=1\text{ MHz}$                   |
| Output capacitance           | $C_{oss}$    |      | 33.8 |      | pF   |   |
| Reverse transfer capacitance | $C_{rss}$    |      | 1.44 |      | pF   |   |
| Turn-on delay time           | $t_{d(on)}$  |      | 17   |      | ns   | $V_{GS}=10\text{ V}, V_{DS}=400\text{ V}, R_G=25\ \Omega, I_D=4\text{ A}$ |
| Rise time                    | $t_r$        |      | 10.1 |      | ns   |   |
| Turn-off delay time          | $t_{d(off)}$ |      | 28.9 |      | ns   |   |
| Fall time                    | $t_f$        |      | 23.6 |      | ns   |   |



## ■ Gate Charge Characteristics

| Parameter            | Symbol               | Min. | Typ. | Max. | Unit | Test condition  |
|----------------------|----------------------|------|------|------|------|---|
| Total gate charge    | $Q_g$                |      | 9.2  |      | nC   | $I_D=4\text{ A}$ ,<br>$V_{DS}=400\text{ V}$ ,<br>$V_{GS}=10\text{ V}$ |
| Gate-source charge   | $Q_{gs}$             |      | 2.4  |      | nC   |   |
| Gate-drain charge    | $Q_{gd}$             |      | 3.5  |      | nC   |   |
| Gate plateau voltage | $V_{\text{plateau}}$ |      | 5.6  |      | V    |   |

## ■ Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit          | Test condition  |
|-------------------------------|-----------|------|------|------|---------------|---|
| Diode forward current         | $I_S$     |      |      | 7    | A             | $V_{GS} < V_{th}$   |
| Pulsed source current         | $I_{SP}$  |      |      | 21   |               |   |
| Diode forward voltage         | $V_{SD}$  |      |      | 1.3  | V             | $I_S=4\text{ A}$ , $V_{GS}=0\text{ V}$                                      |
| Reverse recovery time         | $t_{rr}$  |      | 212  |      | ns            | $V_R=400\text{ V}$ , $I_S=4\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 1.7  |      | $\mu\text{C}$ |   |
| Peak reverse recovery current | $I_{rrm}$ |      | 14.2 |      | 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) 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)  $V_{DD}=100\text{ V}$ ,  $R_G=25\text{ }\Omega$ ,  $L=10\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .



## Electrical Characteristics Diagrams

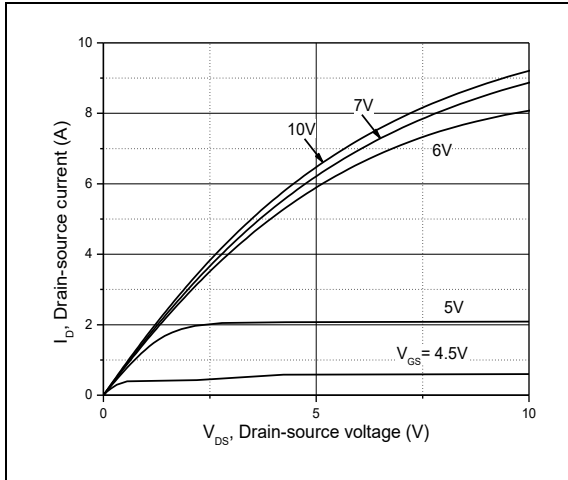


Figure 1, Typ. output characteristics

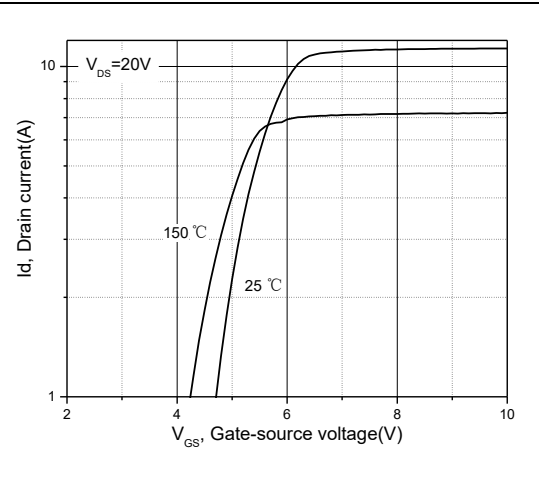


Figure 2, Typ. transfer characteristics

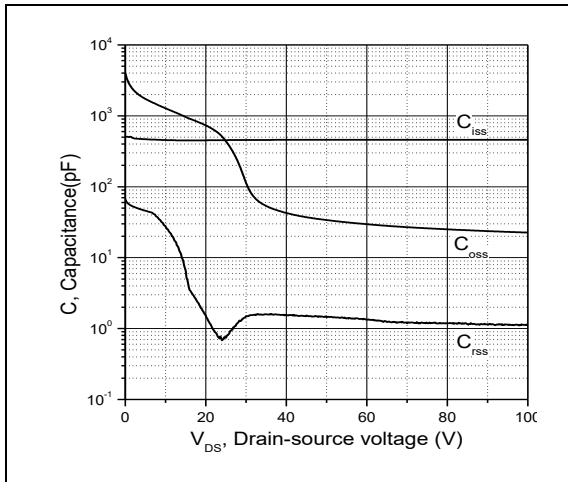


Figure 3, Typ. capacitances

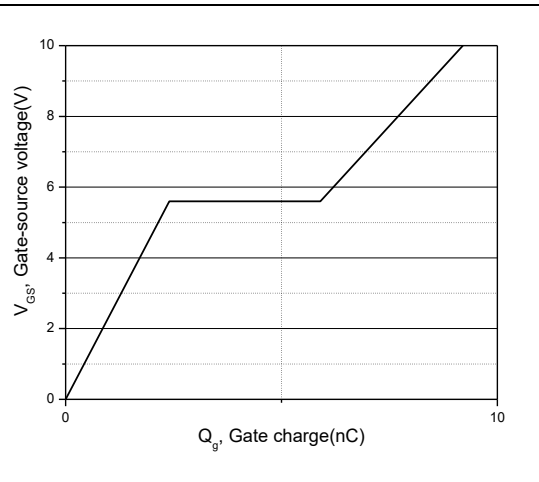


Figure 4, Typ. gate charge

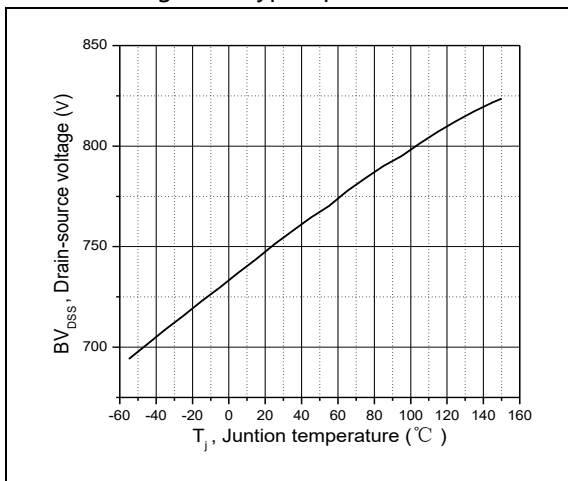


Figure 5, Drain-source breakdown voltage

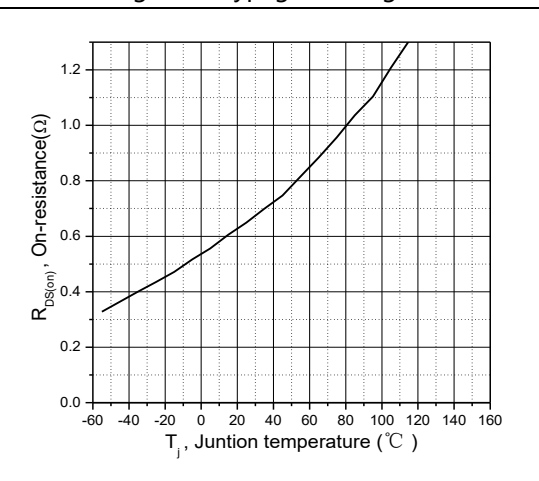


Figure 6, Drain-source on-state resistance

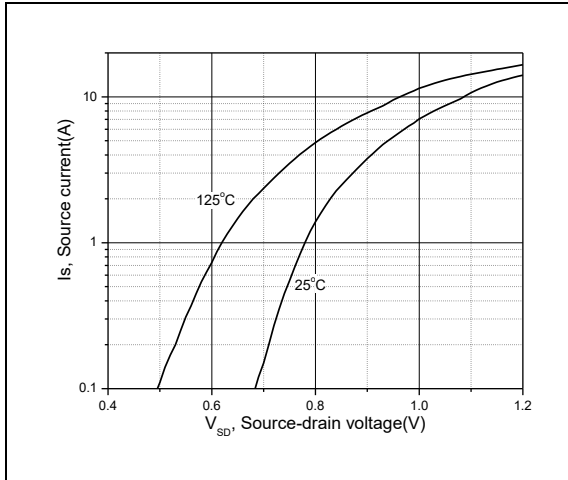


Figure 7, Forward characteristic of body diode

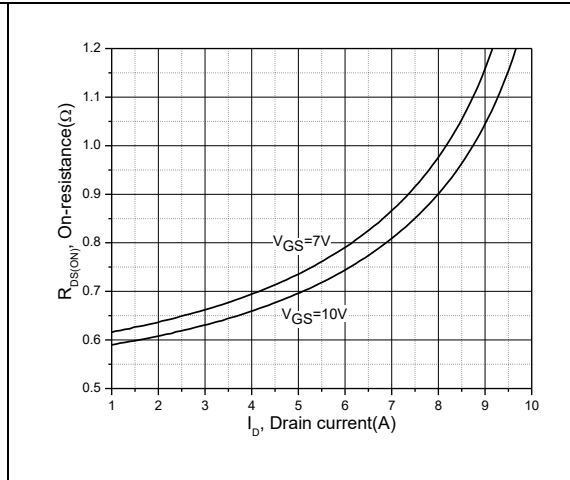


Figure 8, Drain-source on-state resistance

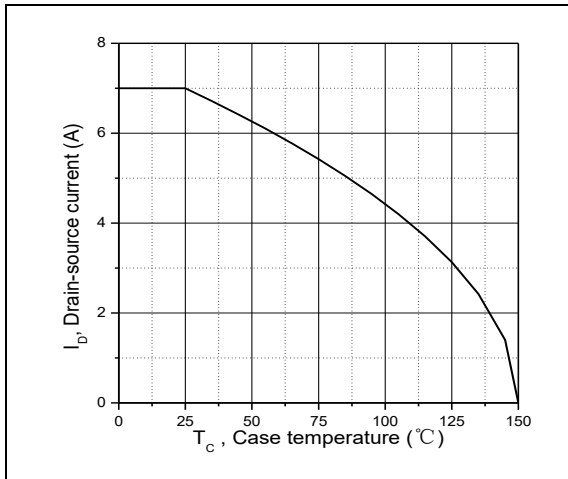


Figure 9, Drain current

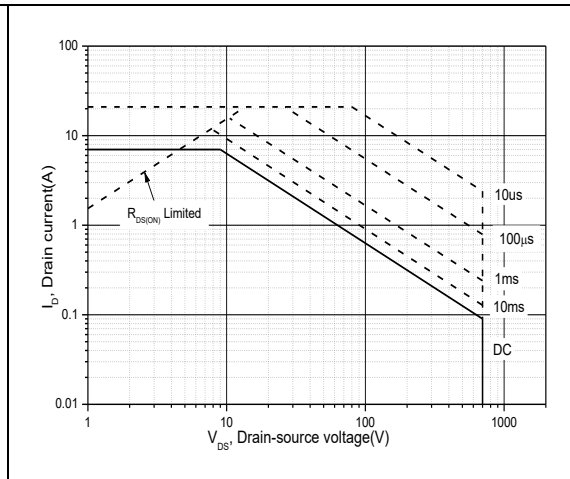


Figure 10, Safe operation area for  
TO251/TO252  $T_c=25^\circ\text{C}$

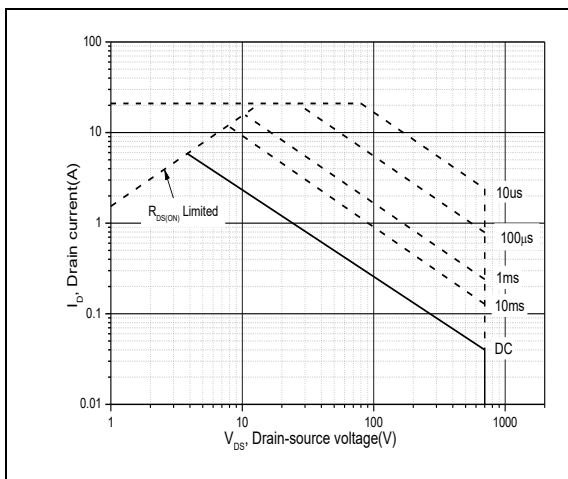


Figure 11, Safe operation area for TO220F  
 $T_c=25^\circ\text{C}$



■ Test circuits and waveforms

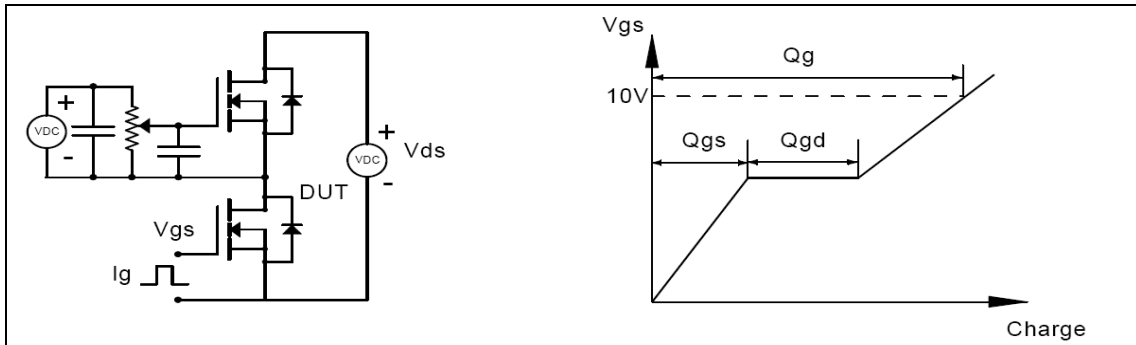


Figure 1, Gate charge test circuit & waveform

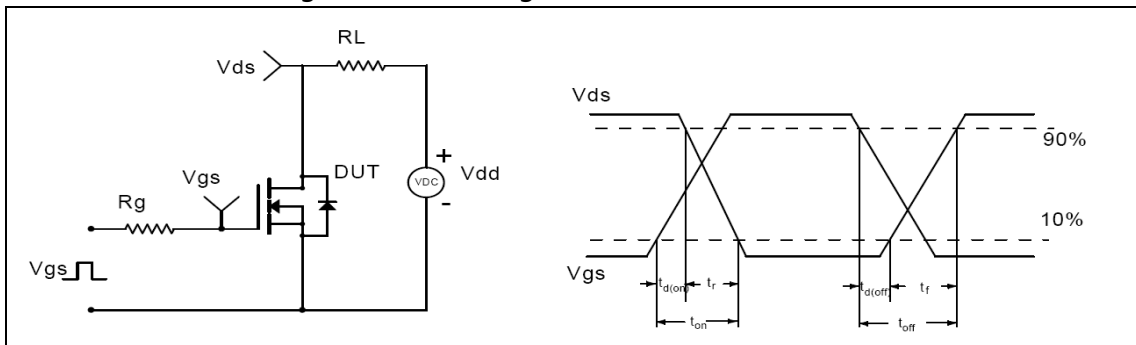


Figure 2, Switching time test circuit & waveforms

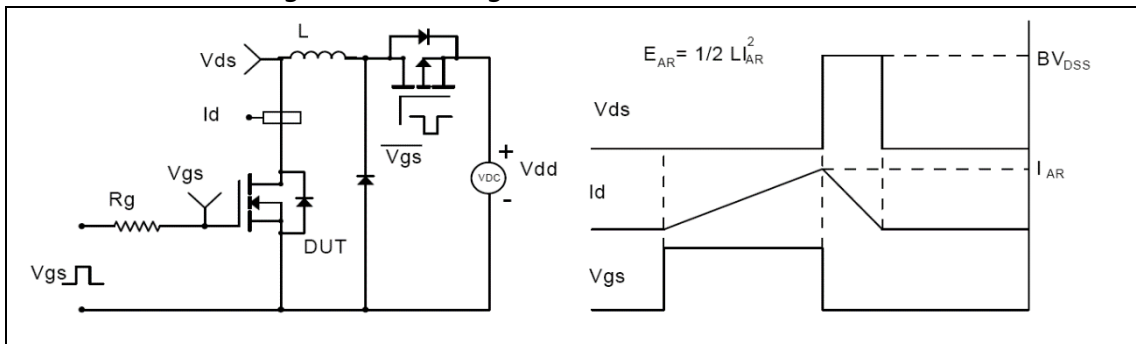


Figure 3, Unclamped inductive switching (UIS) test circuit & waveforms

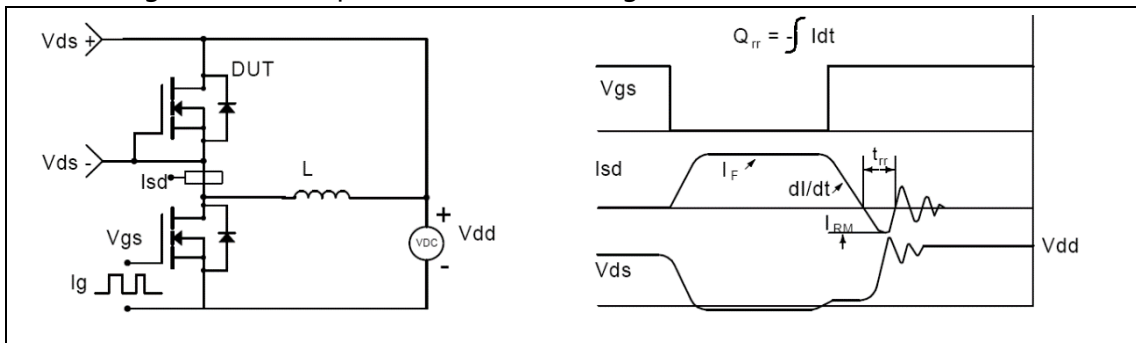
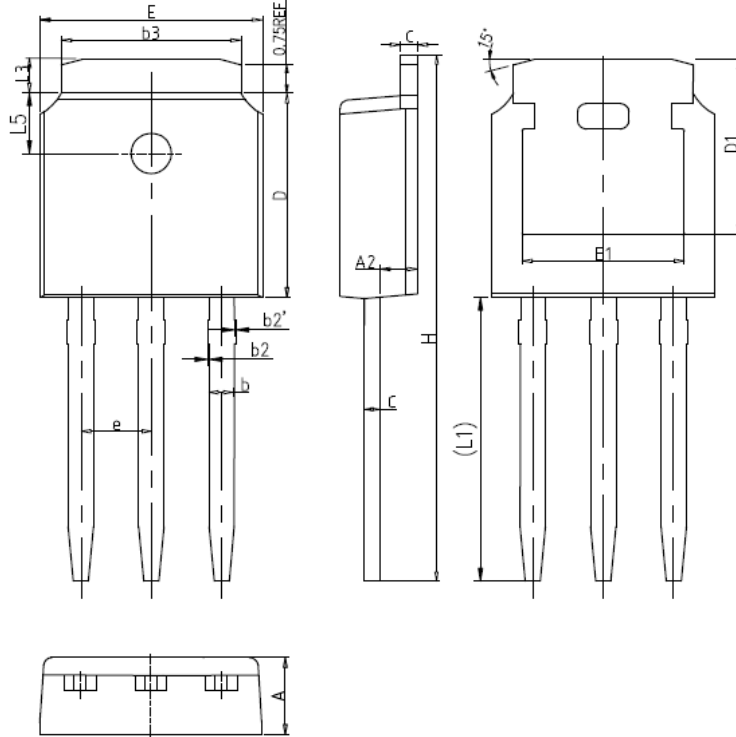


Figure 4, Diode reverse recovery test circuit & waveforms



■ Package Information

Figure1, TO251 package outline dimension



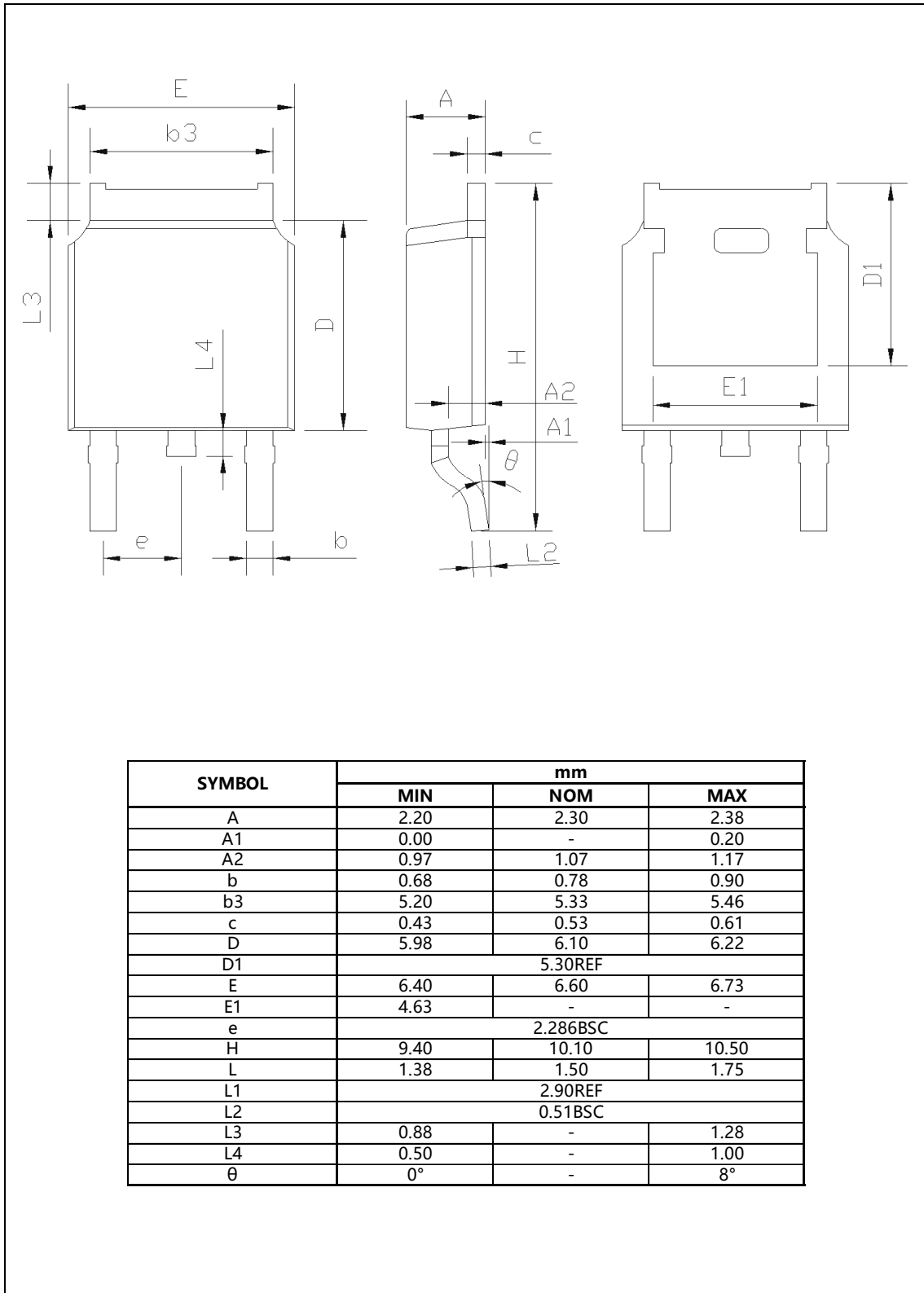
| Symbol | Dimension In Millimeters |        |        | Dimension In Inches |       |       |
|--------|--------------------------|--------|--------|---------------------|-------|-------|
|        | Min                      | Nom    | Max    | Min                 | Nom   | Max   |
| A      | 2.200                    | 2.300  | 2.400  | 0.087               | 0.091 | 0.094 |
| A2     | 0.970                    | 1.070  | 1.170  | 0.038               | 0.042 | 0.046 |
| b      | 0.680                    | 0.780  | 0.900  | 0.027               | 0.031 | 0.035 |
| b2     | 0.000                    | 0.040  | 0.100  | 0.000               | 0.002 | 0.004 |
| b2'    | 0.000                    | 0.040  | 0.100  | 0.000               | 0.002 | 0.004 |
| b3     | 5.200                    | 5.330  | 5.500  | 0.205               | 0.210 | 0.217 |
| c      | 0.430                    | 0.530  | 0.630  | 0.017               | 0.021 | 0.025 |
| D      | 5.980                    | 6.100  | 6.220  | 0.235               | 0.240 | 0.245 |
| D1     | 5.300REF                 |        |        | 0.209REF            |       |       |
| E      | 6.400                    | 6.600  | 6.800  | 0.252               | 0.260 | 0.268 |
| E1     | 4.630                    | -      | -      | 0.182               | -     | -     |
| e      | 2.286BSC                 |        |        | 0.090BSC            |       |       |
| H      | 16.220                   | 16.520 | 16.820 | 0.639               | 0.650 | 0.662 |
| L1     | 9.150                    | 9.400  | 9.650  | 0.360               | 0.370 | 0.380 |
| L3     | 0.880                    | 1.020  | 1.280  | 0.035               | 0.040 | 0.050 |
| L5     | 1.650                    | 1.800  | 1.950  | 0.065               | 0.071 | 0.077 |





■ Package Information

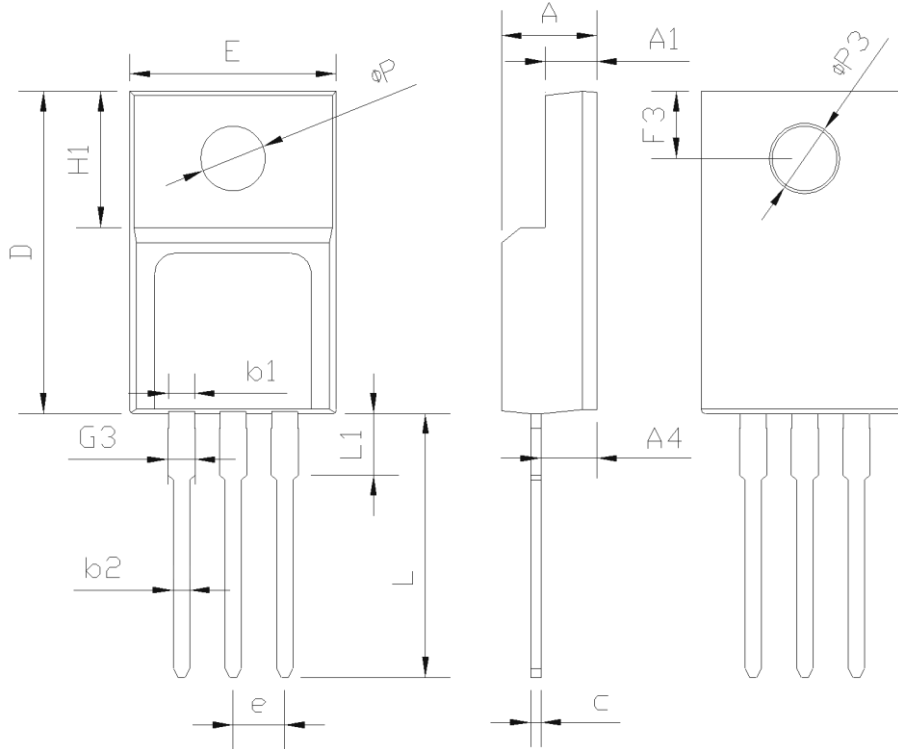
Figure2, TO252 package outline dimension





■ **Package Information**

Figure3, TO220F package outline dimension

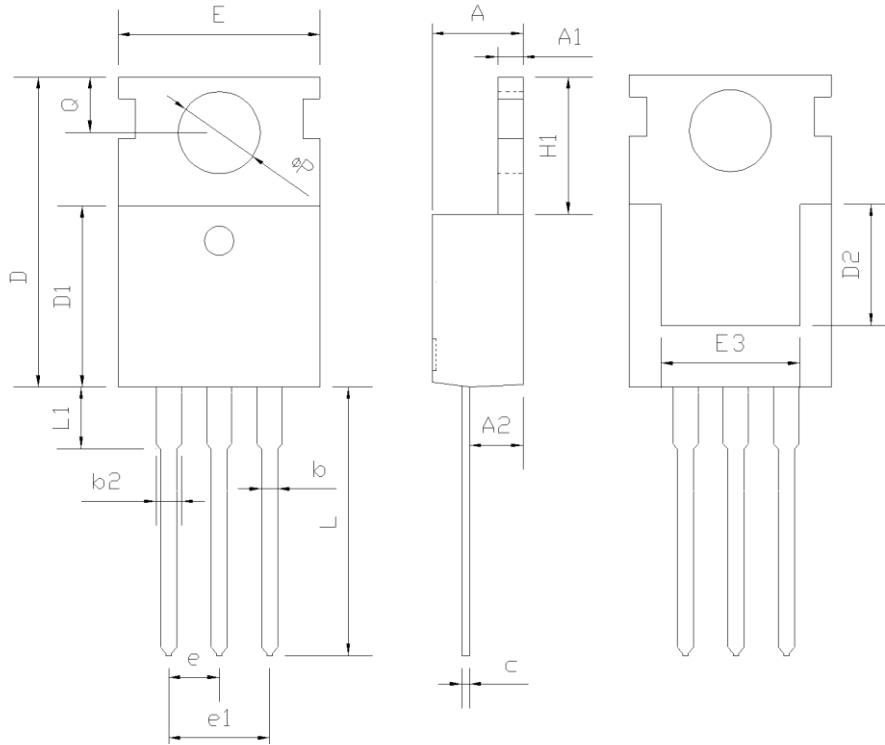


| SYMBOL | mm      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| E      | 9.96    | 10.16 | 10.36 |
| A      | 4.50    | 4.70  | 4.90  |
| A1     | 2.34    | 2.54  | 2.74  |
| A2     | 0.30    | 0.45  | 0.60  |
| A4     | 2.56    | 2.76  | 2.96  |
| c      | 0.40    | 0.50  | 0.65  |
| c1     | 1.20    | 1.30  | 1.35  |
| D      | 15.57   | 15.87 | 16.17 |
| H1     | 6.70REF |       |       |
| e      | 2.54BSC |       |       |
| L      | 12.68   | 12.98 | 13.28 |
| L1     | 2.88    | 3.03  | 3.18  |
| ΦP     | 3.03    | 3.18  | 3.38  |
| ΦP3    | 3.15    | 3.45  | 3.65  |
| F3     | 3.15    | 3.30  | 3.45  |
| G3     | 1.25    | 1.35  | 1.55  |
| b1     | 1.18    | 1.28  | 1.43  |
| b2     | 0.70    | 0.80  | 0.95  |



■ **Package Information**

Figure3, TO220 package outline dimension



| Symbol | 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  |
| ΦP     | 3.40     | 3.60  | 3.80  |
| Q      | 2.60     | 2.80  | 3.00  |



## ■ Ordering Information

| Package | Units/Tube | Tubes/Inner Box | Units/Inner Box | Inner Box/Carton Box | Units/Carton Box |
|---------|------------|-----------------|-----------------|----------------------|------------------|
| TO251   | 75         | 66              | 4950            | 6                    | 29700            |
| TO220F  | 50         | 20              | 1000            | 6                    | 6000             |
| TO220   | 50         | 20              | 1000            | 6                    | 6000             |

| Package | Units/Tape | Tapes/Inner Box | Units/Inner Box | Inner Box/Carton Box | Units/Carton Box |
|---------|------------|-----------------|-----------------|----------------------|------------------|
| TO252   | 2500       | 2               | 5000            | 5                    | 25000            |

## ■ Product Information

| Product     | Package | Pb Free | RoHS | Halogen Free |
|-------------|---------|---------|------|--------------|
| OSG70R750AF | TO251   | yes     | yes  | yes          |
| OSG70R750DF | TO252   | yes     | yes  | yes          |
| OSG70R750FF | TO220F  | yes     | yes  | yes          |
| OSG70R750PF | TO220   | yes     | yes  | yes          |