

Enhancement Mode N-Channel Power MOSFET

Features

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

Applications

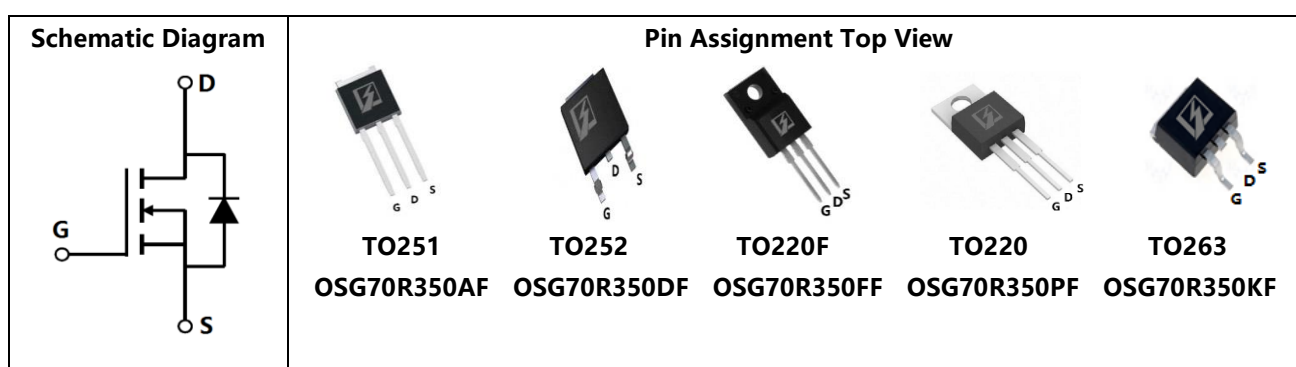
- ◆ Lighting
- ◆ Hard switching PWM
- ◆ Server power supply
- ◆ Charger

■ General Description

OSG70R350xF use advanced GreenMOSTTM 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.

| | |
|-----------------------------------|---------|
| ◆ $V_{DS, min@T_{jmax}}$ | 750 V |
| ◆ $I_{D, pulse}$ | 36 A |
| ◆ $R_{DS(ON), max @ V_{GS}=10 V}$ | 350 mΩ |
| ◆ Q_g | 16.7 nC |

■ Schematic and Package Information



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

| Parameter | Symbol | Value | Unit |
|---|----------------|------------|-------------|
| Drain source voltage | V_{DS} | 700 | V |
| Gate source voltage | V_{GS} | ± 30 | V |
| Continuous drain current ¹⁾ , $T_C=25^{\circ}C$ | I_D | 12 | A |
| Continuous drain current ¹⁾ , $T_C=100^{\circ}C$ | | 5.5 | |
| Pulsed drain current ²⁾ , $T_C=25^{\circ}C$ | $I_{D, pulse}$ | 36 | A |
| Power dissipation ³⁾ for TO251, TO252, TO220, TO263, $T_C=25^{\circ}C$ | P_D | 104 | W |
| Power dissipation ³⁾ for TO220F, $T_C=25^{\circ}C$ | | 32 | |
| Single pulsed avalanche energy ⁵⁾ | E_{AS} | 400 | mJ |
| MOSFET dv/dt ruggedness, $V_{DS}=0...480 V$ | dv/dt | 50 | V/ns |
| Reverse diode dv/dt, $V_{DS}=0...480 V$, $I_{SD} \leq I_D$ | dv/dt | 15 | V/ns |
| Operation and storage temperature | T_{stg}, T_j | -55 to 150 | $^{\circ}C$ |

■ Thermal Characteristics

| Parameter | Symbol | Value | | Unit |
|--|-----------------|-------------------------|--------|------|
| | | TO251/TO252/TO220/T0263 | TO220F | |
| Thermal resistance, junction-case | $R_{\theta JC}$ | 1.2 | 3.9 | °C/W |
| Thermal resistance, junction-ambient ⁴⁾ | $R_{\theta JA}$ | 62.5 | 62 | °C/W |

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

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test condition |
|----------------------------------|--------------|------|------|------|---------------|---|
| Drain-source breakdown voltage | BV_{DSS} | 700 | | | V | $V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$ |
| | | 750 | 820 | | | $V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$ $T_j=150\text{ }^{\circ}\text{C}$ |
| Gate threshold voltage | $V_{GS(th)}$ | 2.0 | | 4.0 | V | $V_{DS}=V_{GS}$, $I_D=250\text{ }\mu\text{A}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | | 0.3 | 0.35 | Ω | $V_{GS}=10\text{ V}$, $I_D=6\text{ A}$ |
| | | | 0.78 | | | $V_{GS}=10\text{ V}$, $I_D=6\text{ A}$, $T_j=150\text{ }^{\circ}\text{C}$ |
| 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 | μA | $V_{DS}=700\text{ V}$, $V_{GS}=0\text{ V}$ |

■ Dynamic Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test condition |
|------------------------------|--------------|------|--------|------|------|---|
| Input capacitance | C_{iss} | | 1007.1 | | pF | $V_{GS}=0\text{ V}$, $V_{DS}=50\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance | C_{oss} | | 63.8 | | pF | |
| Reverse transfer capacitance | C_{rss} | | 2.1 | | pF | |
| Turn-on delay time | $t_{d(on)}$ | | 31.1 | | ns | $V_{GS}=10\text{ V}$, $V_{DS}=400\text{ V}$, $R_G=25\text{ }\Omega$, $I_D=6\text{ A}$ |
| Rise time | t_r | | 16.8 | | ns | |
| Turn-off delay time | $t_{d(off)}$ | | 55.4 | | ns | |
| Fall time | t_f | | 24.5 | | ns | |

■ Gate Charge Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test condition |
|----------------------|----------------------|------|------|------|------|---|
| Total gate charge | Q_g | | 16.7 | | nC | $I_D=6\text{ A}$, $V_{DS}=400\text{ V}$, $V_{GS}=10\text{ V}$ |
| Gate-source charge | Q_{gs} | | 4.8 | | nC | |
| Gate-drain charge | Q_{gd} | | 5.3 | | nC | |
| Gate plateau voltage | V_{plateau} | | 5.6 | | V | |

■ Body Diode Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test condition |
|-------------------------------|-----------|------|-------|------|---------------|---|
| Diode forward current | I_S | | | 12 | A | $V_{GS} < V_{th}$ |
| Pulsed source current | I_{SP} | | | 36 | | |
| Diode forward voltage | V_{SD} | | | 1.4 | V | $I_S=12\text{ A}$, $V_{GS}=0\text{ V}$ |
| Reverse recovery time | t_{rr} | | 284.5 | | ns | $V_R=400\text{ V}$, $I_S=6\text{ A}$, $di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge | Q_{rr} | | 2.9 | | μC | |
| Peak reverse recovery current | I_{rrm} | | 19.4 | | 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**

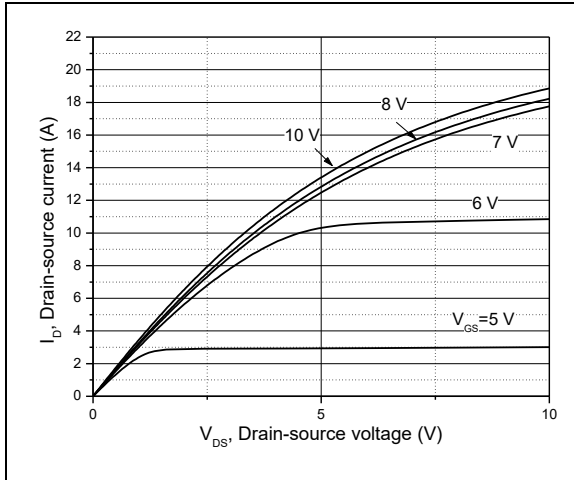


Figure 1, Typ. output characteristics

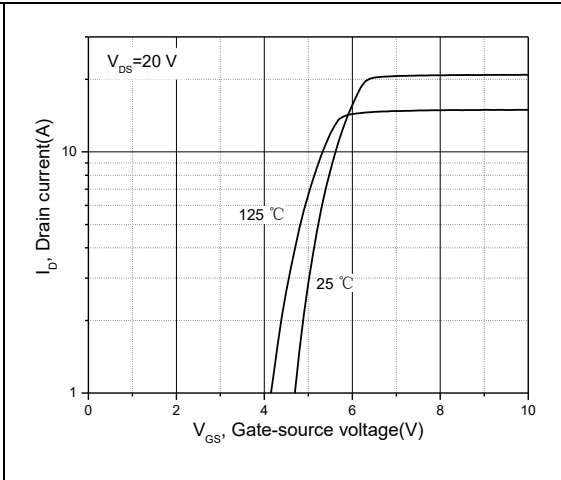


Figure 2, Typ. transfer characteristics

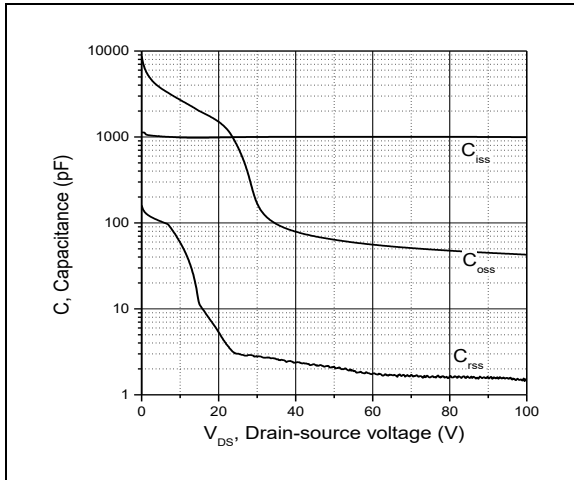


Figure 3, Typ. capacitances

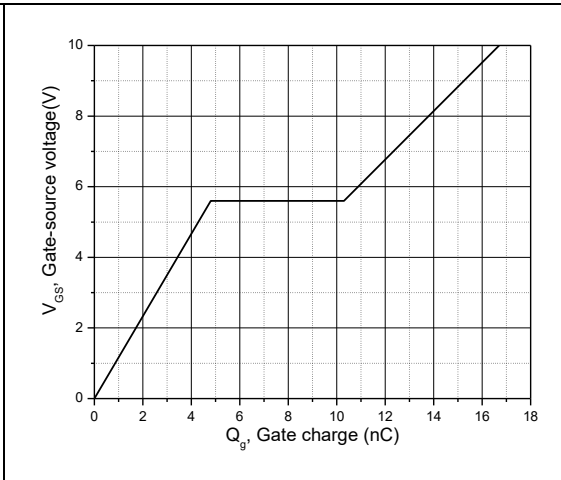


Figure 4, Typ. gate charge

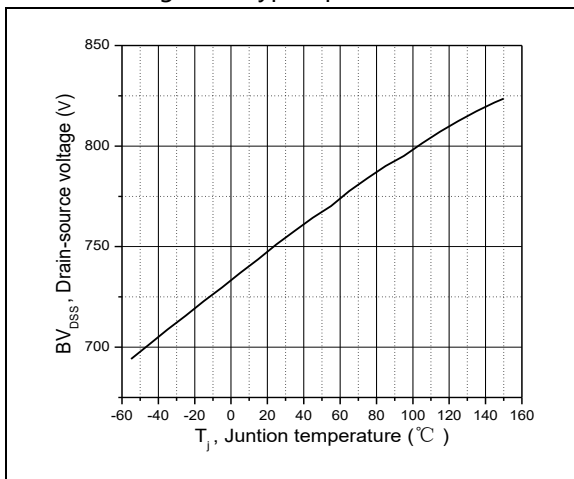


Figure 5, Drain-source breakdown voltage

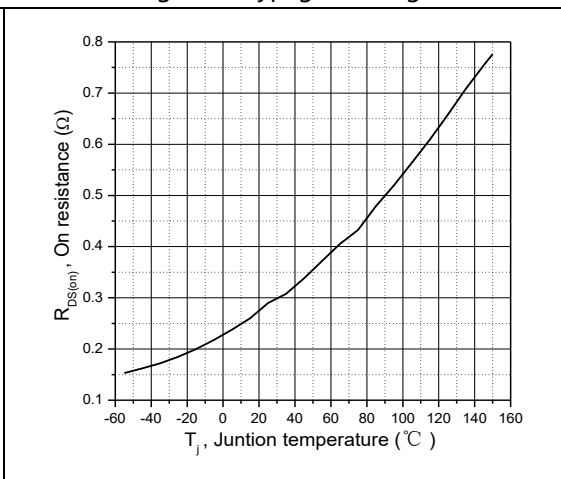


Figure 6, Drain-source on-state resistance

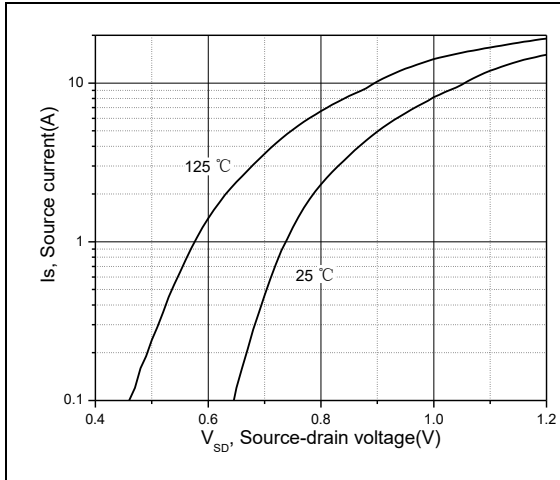


Figure 7, Forward characteristic of body diode

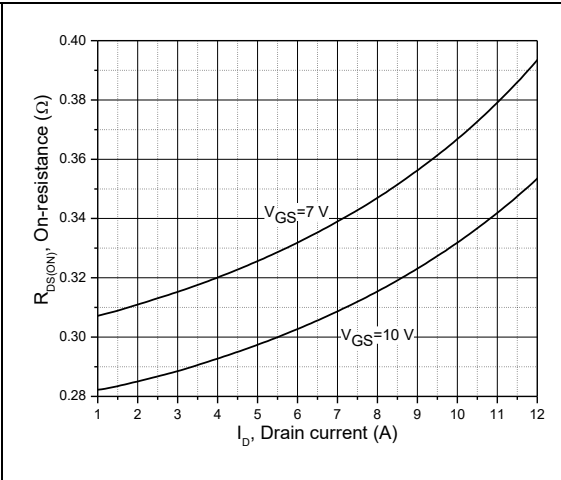


Figure 8, Drain-source on-state resistance

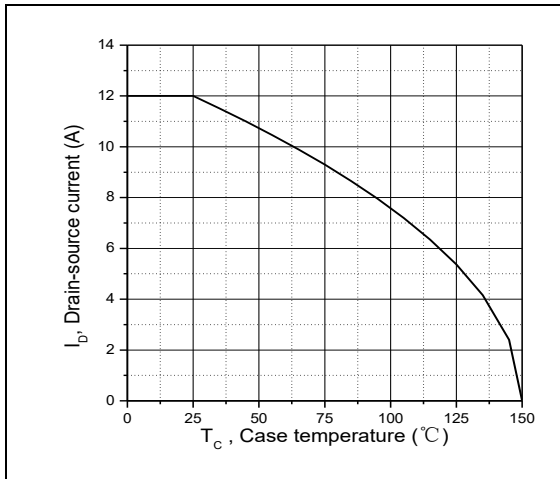


Figure 9, Drain current

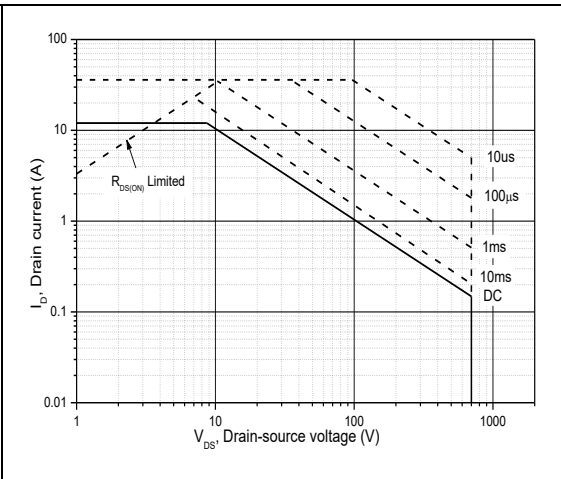


Figure 10, Safe operation area for TO251/TO252/TO220/TO263 $T_C=25\text{ }^\circ\text{C}$

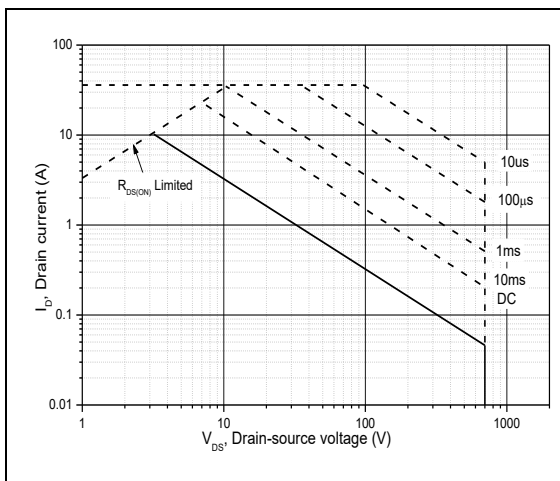


Figure 11, Safe operation area for TO220F $T_C=25\text{ }^\circ\text{C}$

■ Test circuits and waveforms

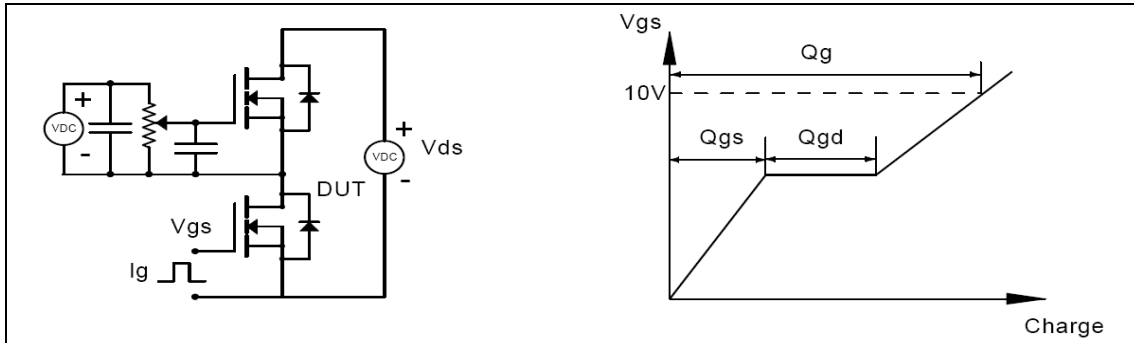


Figure 1, Gate charge test circuit & waveform

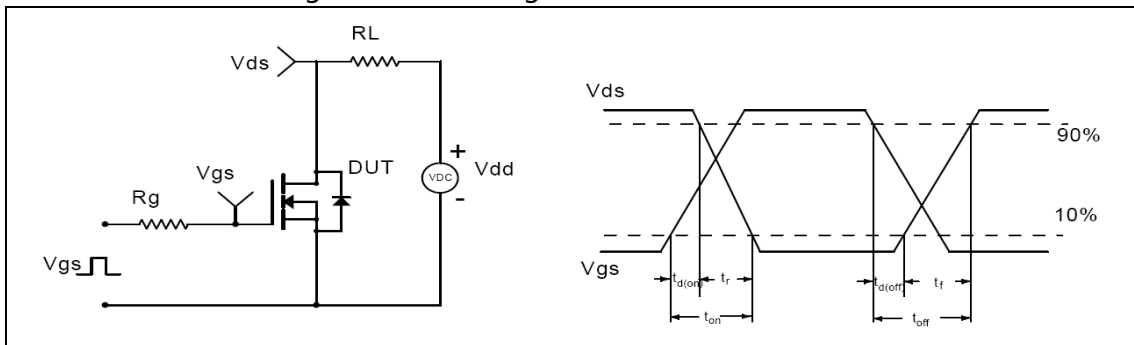


Figure 2, Switching time test circuit & waveforms

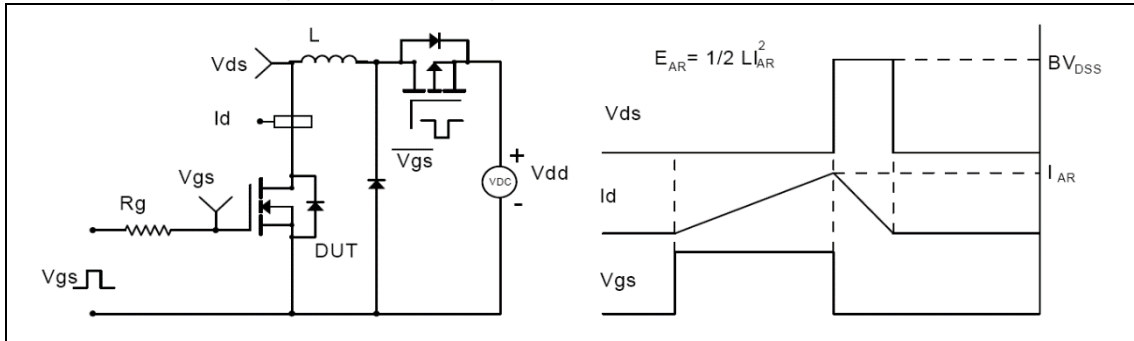


Figure 3, Unclamped inductive switching (UIS) test circuit & waveforms

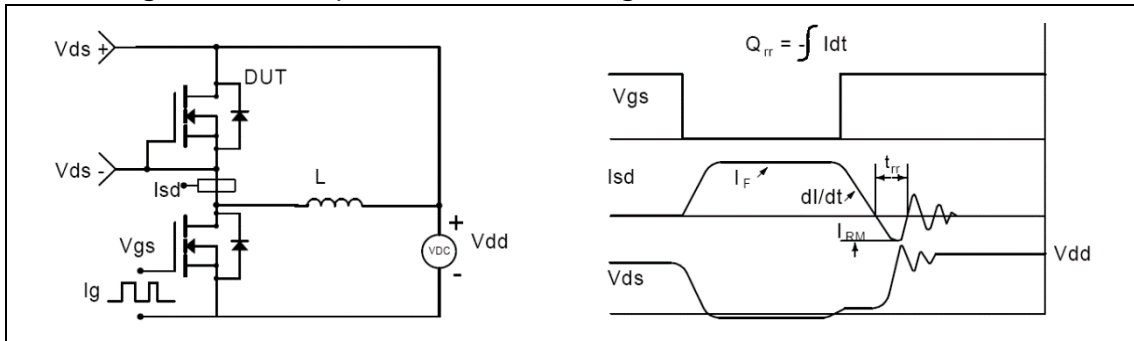
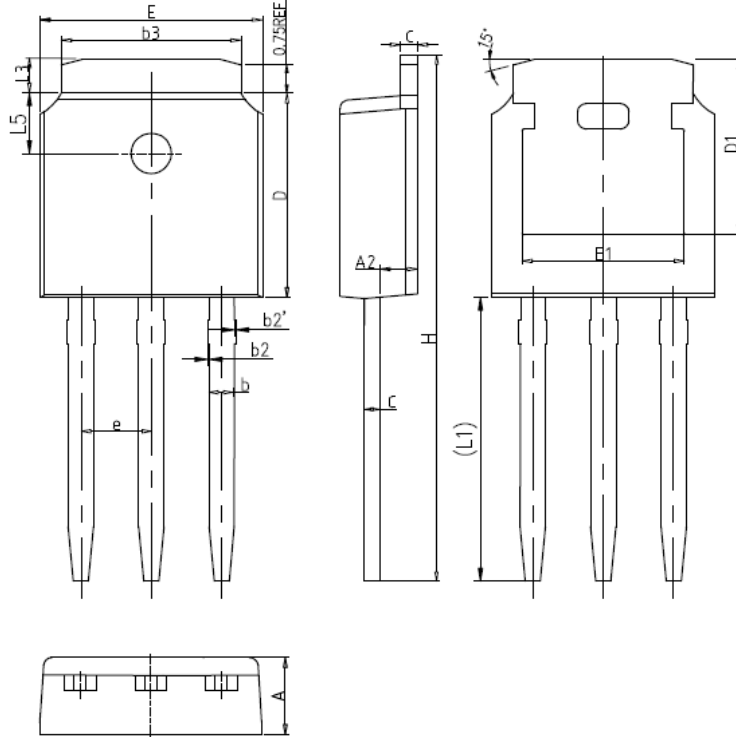


Figure 4, Diode reverse recovery test circuit & waveforms

■ Package Information

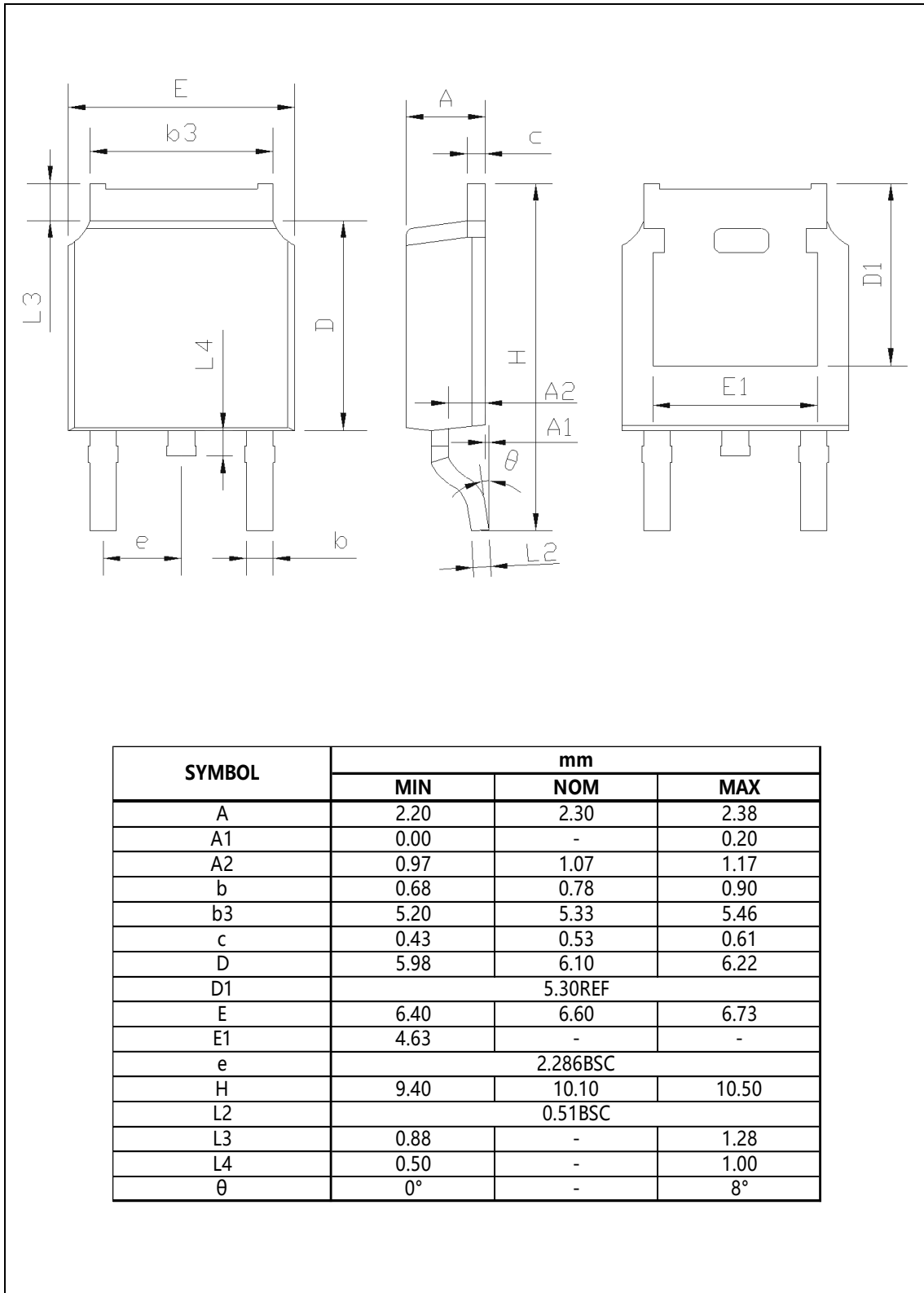
Figure1, TO251 package outline dimension



| SYMBOL | mm | | |
|--------|----------|-------|-------|
| | MIN | NOM | MAX |
| A | 2.20 | 2.30 | 2.38 |
| A2 | 0.97 | 1.07 | 1.17 |
| b | 0.68 | 0.78 | 0.90 |
| b2 | 0.00 | 0.04 | 0.10 |
| b2' | 0.00 | 0.04 | 0.10 |
| b3 | 5.20 | 5.33 | 5.46 |
| c | 0.43 | 0.53 | 0.61 |
| D | 5.98 | 6.10 | 6.22 |
| D1 | 5.30REF | | |
| E | 6.40 | 6.60 | 6.73 |
| E1 | 4.63 | - | - |
| e | 2.286BSC | | |
| H | 16.22 | 16.52 | 16.82 |
| L1 | 9.15 | 9.40 | 9.65 |
| L3 | 0.88 | 1.02 | 1.28 |
| L5 | 1.65 | 1.80 | 1.95 |

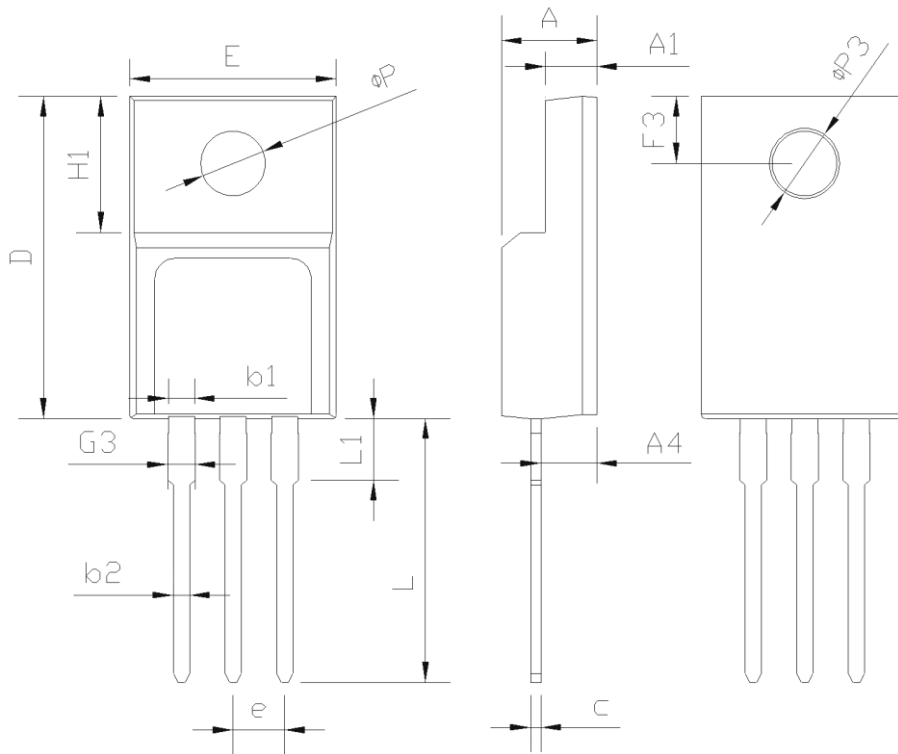
■ Package Information

Figure2, TO252 package outline dimension



■ Package Information

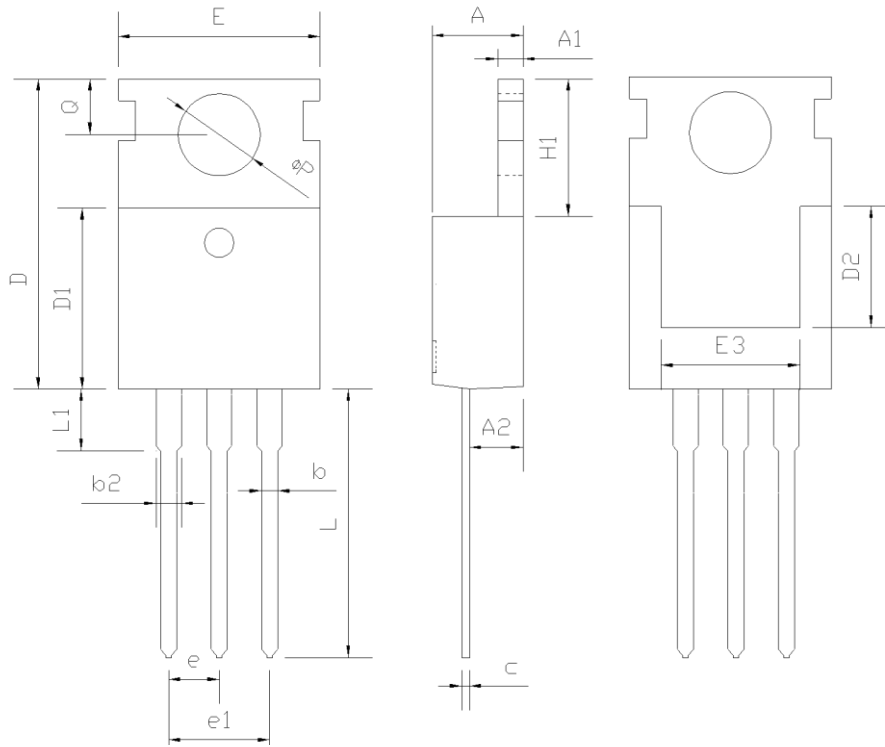
Figure3, TO220F package outline dimension



| 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 |
| A4 | 2.56 | 2.76 | 2.96 |
| c | 0.40 | 0.50 | 0.65 |
| 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

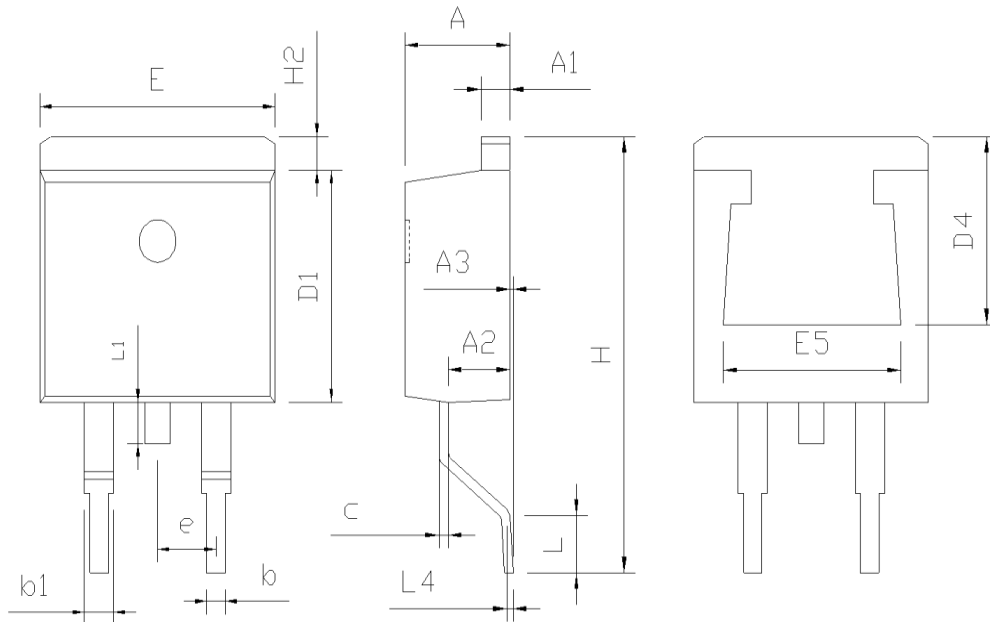
Figure4, TO220 package outline dimension



| SYMBOL | mm | | |
|--------|----------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.37 | 4.57 | 4.70 |
| A1 | 1.25 | 1.30 | 1.40 |
| A2 | 2.20 | 2.40 | 2.60 |
| b | 0.70 | 0.80 | 0.95 |
| b2 | 1.17 | 1.27 | 1.47 |
| c | 0.45 | 0.50 | 0.60 |
| 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 |

■ Package Information

Figure5, TO263 package outline dimension



| SYMBOL | mm | | |
|--------|----------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.37 | 4.57 | 4.77 |
| A1 | 1.22 | 1.27 | 1.42 |
| A2 | 2.49 | 2.69 | 2.89 |
| A3 | 0.00 | 0.13 | 0.25 |
| b | 0.70 | 0.81 | 0.96 |
| b1 | 1.17 | 1.27 | 1.47 |
| c | 0.30 | 0.38 | 0.53 |
| D1 | 8.50 | 8.70 | 8.90 |
| D4 | 6.60 | - | - |
| E | 9.86 | 10.16 | 10.36 |
| E5 | 7.06 | - | - |
| e | 2.54 BSC | | |
| H | 14.70 | 15.10 | 15.50 |
| H2 | 1.07 | 1.27 | 1.47 |
| L | 2.00 | 2.30 | 2.60 |
| L1 | 1.40 | 1.55 | 1.70 |
| L4 | 0.25 BSC | | |

■ 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 |
| TO263 | 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 |
|-------------|---------|---------|------|--------------|
| OSG70R350AF | TO251 | yes | yes | yes |
| OSG70R350DF | TO252 | yes | yes | yes |
| OSG70R350FF | TO220F | yes | yes | yes |
| OSG70R350PF | TO220 | yes | yes | yes |
| OSG70R350KF | TO263 | yes | yes | yes |

■ Reflow Profile

