

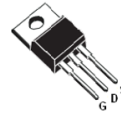
600V N-Channel Super Junction power MOSFET

DESCRIPTION

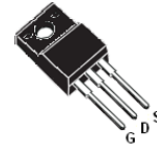
SJ MOSFET is an advanced technology for high voltage power MOSFETs, designed according to the super junction principle by Xinyuan semiconductor. The offered devices provide all benefits of a fast switching and low on resistance, making it especially suitable for applications which require more efficient, more compact, LED Lighting, High Performance Adapter etc..

| | | |
|--------------|-----|------------|
| V_{DS} | 600 | V |
| $R_{DS(ON)}$ | 180 | m Ω |
| I_D | 20 | A |

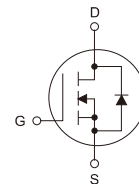
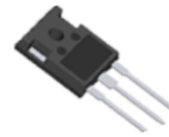
TO-220



TO-220F



TO-247



Features

- Extremely low losses due to very low $R_{dson} * Q_g$
- Superior Avalanche Rugged Technology
- Fast switching capability
- 100% Avalanche Tested
- Pb-free lead plating; ROHS compliant

APPLICATIONS

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- High Performance Adapter
- LED Lighting Power

ORDERING INFORMATION

| Temperature Range | Package | | Orderable Device | Package Qty. |
|-------------------|---------|---------|------------------|--------------|
| -55°C ~ +125°C | TO-220 | Pb-Free | CWS60R180 AC | 50 PCS/Tube |
| | TO-220F | | CWS60R180 AF | 50 PCS/Tube |
| | TO-247 | | CWS60R180 AZ | 30 PCS/Tube |



ABSOLUTE MAXIMUM RATINGS

($T_j=25^{\circ}\text{C}$, unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|----------------|--|--------------------|
| Drain-Source Voltage ($V_{GS}=0\text{V}$) | V_{DSS} | 600 | V |
| Gate-Source Voltage ($V_{DS}=0\text{V}$, static) | V_{GS} | ± 30 | V |
| Continuous Drain Current ($T_C=25^{\circ}\text{C}$)(Note 1) | $I_{D(DC)}$ | 20 | A |
| Continuous Drain Current ($T_C=100^{\circ}\text{C}$) (Note 1) | $I_{D(DC)}$ | 13 | A |
| Pulsed Drain Current (Note 2) | I_{DM} | 60 | A |
| MOSFET dv/dt ruggedness, $V_{DS}\leq 480\text{V}$ | dv/dt | 50 | V/nS |
| Single Pulsed Avalanche Energy (Note 3) | E_{AS} | 500 | mJ |
| Avalanche Energy, Repetitive (Note 1) | E_{AR} | 1.3 | mJ |
| Avalanche Current, Repetitive (Note 1) | I_{AR} | 10 | A |
| Maximum Power Dissipation ($T_C=25^{\circ}\text{C}$) | P_D | TO-220: 96 TO-220F: 33 TO-247: 130 | W |
| Operating, Storage Temperature Range | T_J, T_{STG} | -55~150 | $^{\circ}\text{C}$ |

THERMAL CHARACTERISTICS

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---|------------|------|------|--|-----------------------------|
| Thermal Resistance, Junction-to-Case | R_{thJC} | - | - | TO-220: 1.3 TO-220F: 3.75 TO-247: 0.96 | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient | R_{thJA} | - | - | TO-220: 62 TO-220F: 80 TO-247: 57 | $^{\circ}\text{C}/\text{W}$ |

ELECTRICAL CHARACTERISTICS

($T_j = 25^{\circ}\text{C}$, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min. | TYP. | Max. | Unit |
|----------------------------------|--------------|---|------|------|-----------|---------------|
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0\text{V}, I_D=250\mu\text{A}$ | 600 | - | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=600\text{V}, V_{GS}=0\text{V}$ | - | - | 10 | μA |
| Gate-Source Leakage Current | I_{GSS} | $V_{GS}=\pm 30\text{V}, V_{DS}=0\text{V}$ | - | - | ± 100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$ | 2.0 | 3.0 | 4.0 | V |
| Drain-Source On-state Resistance | $R_{DS(on)}$ | $V_{GS}=10\text{V}, I_D=10\text{A}$ | - | 0.15 | 0.18 | Ω |
| Gate Resistance | R_g | F=1MHZ, open drain | - | 5.3 | - | Ω |



Dynamic Characteristics(T_j = 25°C, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|------------------------------|---------------------|--|------|------|------|-------|
| Input capacitance | C _{iss} | V _{DS} =100V, V _{GS} =0V, f=1MHz | - | 1580 | - | pF |
| Output capacitance | C _{oss} | | - | 60.9 | - | |
| Reverse transfer capacitance | C _{rss} | | - | 2.73 | - | |
| Turn-on delay Time | t _{d(on)} | V _{DD} =480V, I _D =20A R _G =6.8Ω, V _{GS} =10V | - | 40 | - | ns |
| Rise time | t _r | | - | 173 | | |
| Turn-off delay time | t _{d(off)} | | - | 72 | | |
| Fall time | t _f | | - | 137 | | |

Gate charge characteristics(T_j = 25°C, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|-----------------------|----------------------|---|------|------|------|-------|
| Gate to Source Charge | Q _{gs} | V _{DD} =480V, I _D =20A V _{GS} =0 to 10V | - | 11 | - | nC |
| Gate to Drain Charge | Q _{gd} | | - | 12 | - | |
| Gate Charge Total | Q _g | | - | 37.1 | - | |
| Gate Plateau Voltage | V _{plateau} | | - | 6.4 | - | V |

Reverse diode characteristics(T_j = 25°C, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|-------------------------------|------------------|--|------|------|------|-------|
| Body Diode Forward Voltage | V _{SD} | V _{GS} =0V, I _{SD} =20A | - | 0.9 | - | V |
| Reverse Recovery Time | t _{rr} | V _R =480V, I _F =20A di _F /dt=100A/μs | - | 103 | - | nS |
| Reverse Recovery Charge | Q _{rr} | | - | 1.1 | - | μC |
| Peak Reverse Recovery Current | I _{rrm} | | - | 12.2 | - | A |

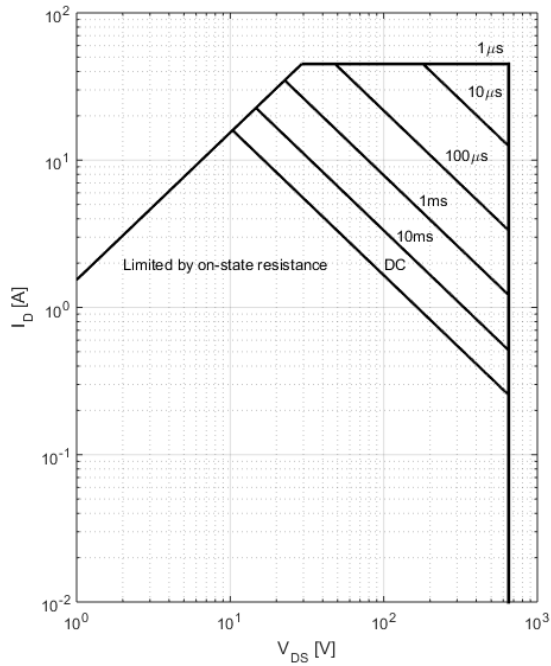
Notes:

- Limited by maximum junction temperature;
- Pulse width limited by maximum junction temperature;
- I_{AS} = 10 A, V_{DD} = 50 V, R_G = 25 Ω, Starting T_J = 25°C.



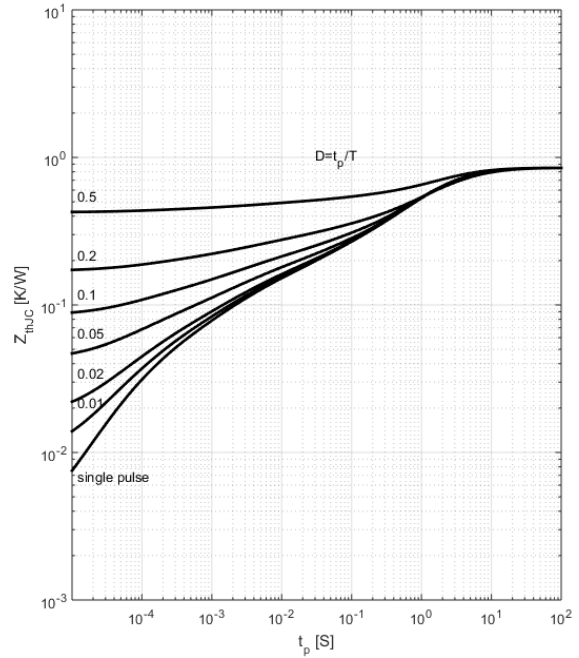
Electrical Characteristics Diagrams

Figure 1. Safe operating area



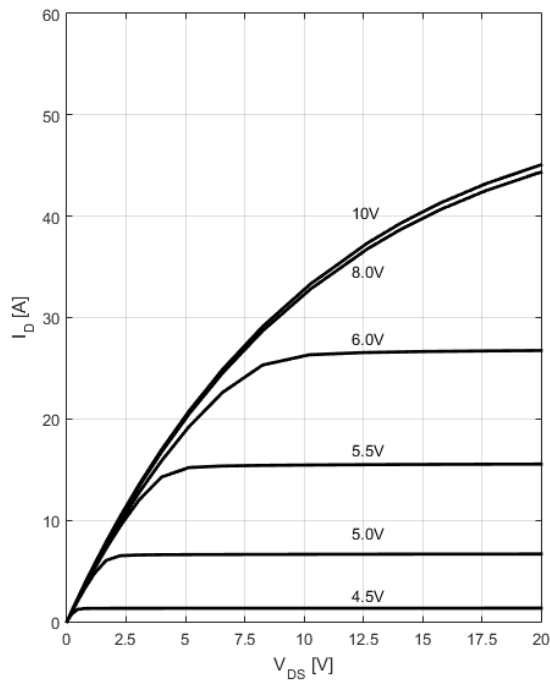
$I_D=f(V_{DS})$; $T_c=25\text{ }^\circ\text{C}$; parameter t_p

Figure 2. Transient thermal impedance



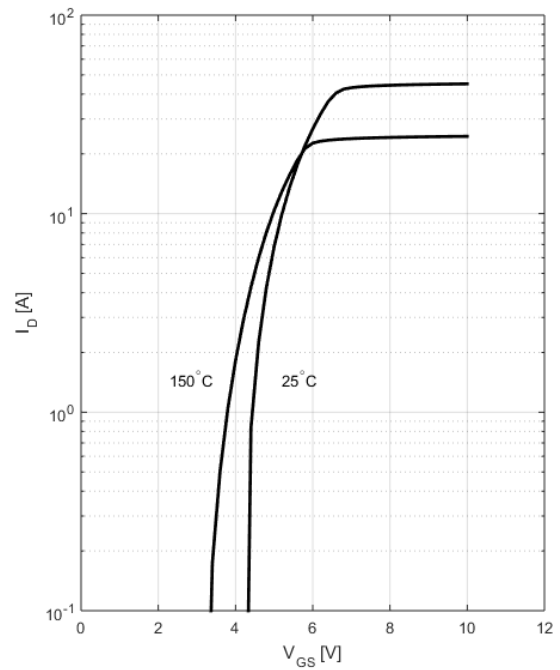
$Z_{(thJC)}=f(t_p)$; parameter: $D=t_p/T$

Figure3. Typ. output characteristics



$I_D=f(V_{DS})$; $T_j=25\text{ }^\circ\text{C}$; parameter: V_{GS}

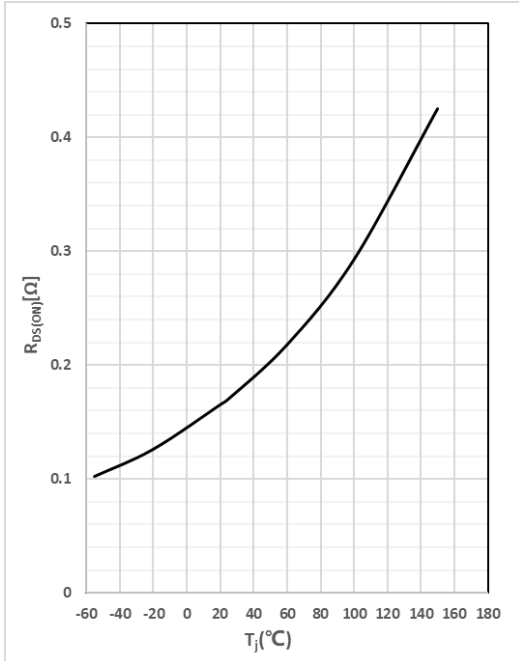
Figure 4. Typ. transfer characteristics



$I_D=f(V_{GS})$; $V_{DS}=20\text{V}$

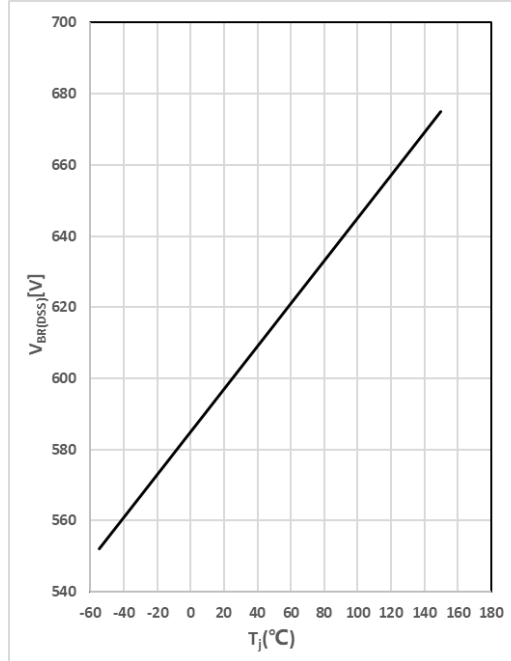


Figure 5. Drain-source on-state resistance



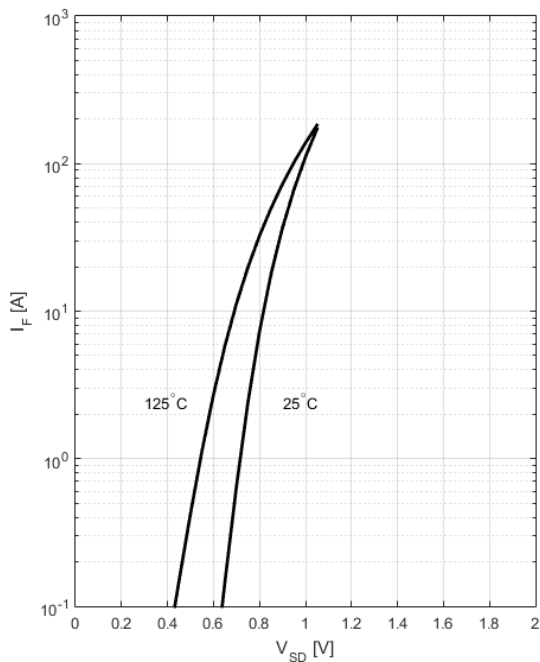
$R_{DS(ON)}=f(T_j)$; $I_D=20A$; $V_{GS}=10V$

Figure6. Drain-source breakdown voltage



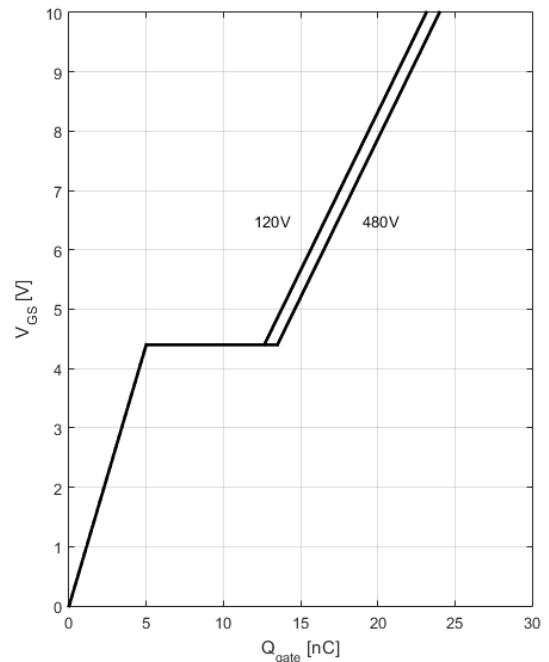
$V_{BR(DSS)}=f(T_j)$; $I_D=10mA$

Figure7. Forward characteristics of reverse diode



$I_F=f(V_{SD})$; parameter: T_j

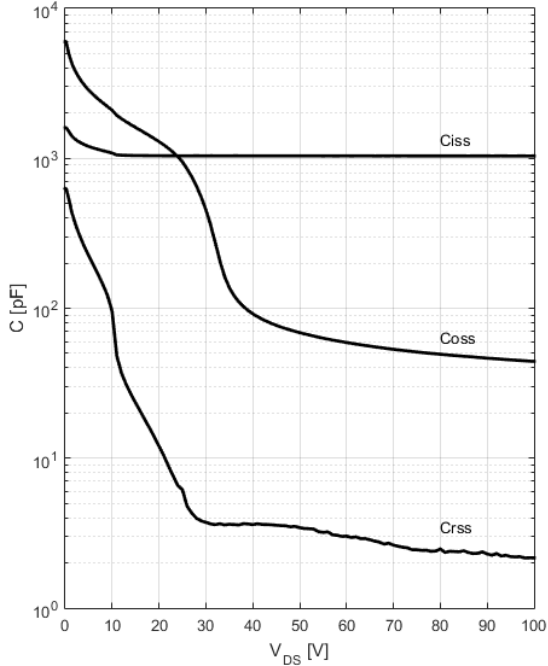
Figure 8. Typ. gate charge



$V_{GS}=f(Q_{gate})$, $I_D=20A$ pulsed

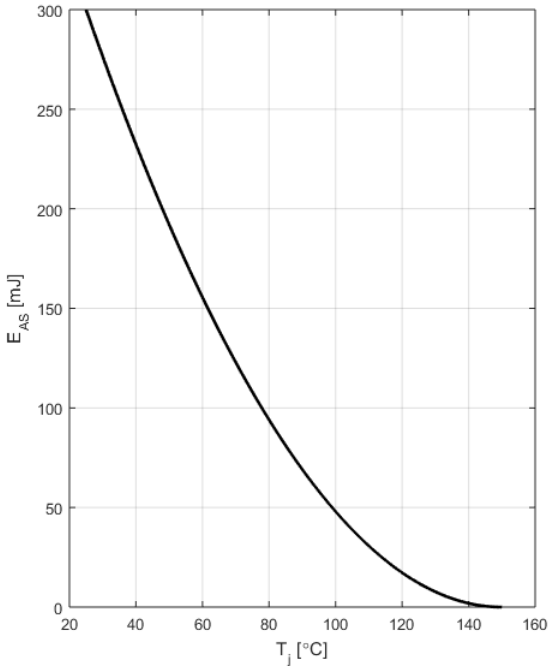


Figure 9: Typ. capacitances



$C=f(V_{DS}); V_{GS}=0; f=1\text{MHz}$

Figure 10: Avalanche energy

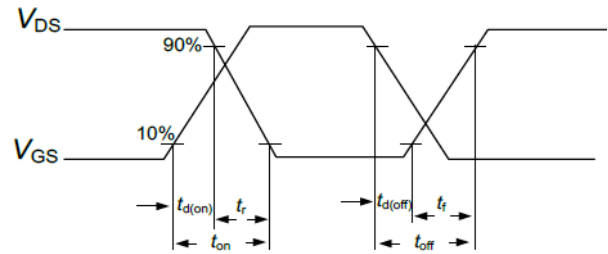
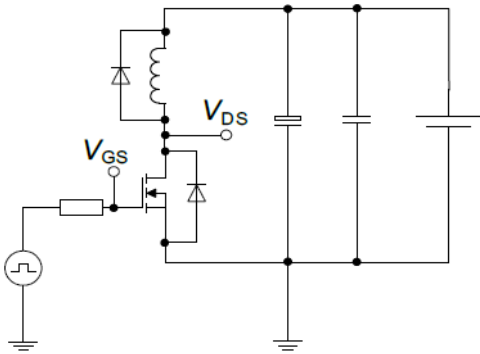


$E_{AS}=f(T_j); I_D=10\text{A}; V_{DD}=50\text{V}$

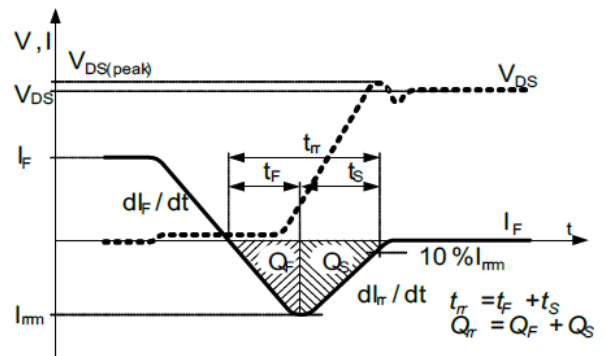
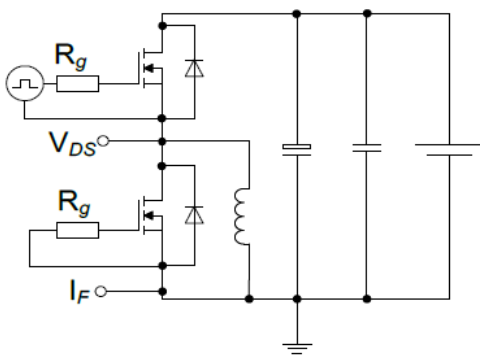


Test Circuits

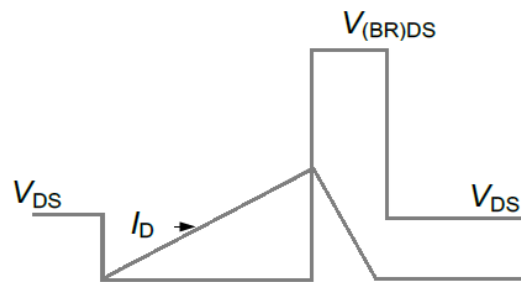
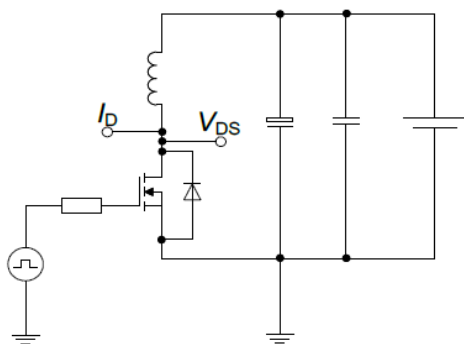
Switch time test circuit



Reverse diode characteristics test circuit and waveform

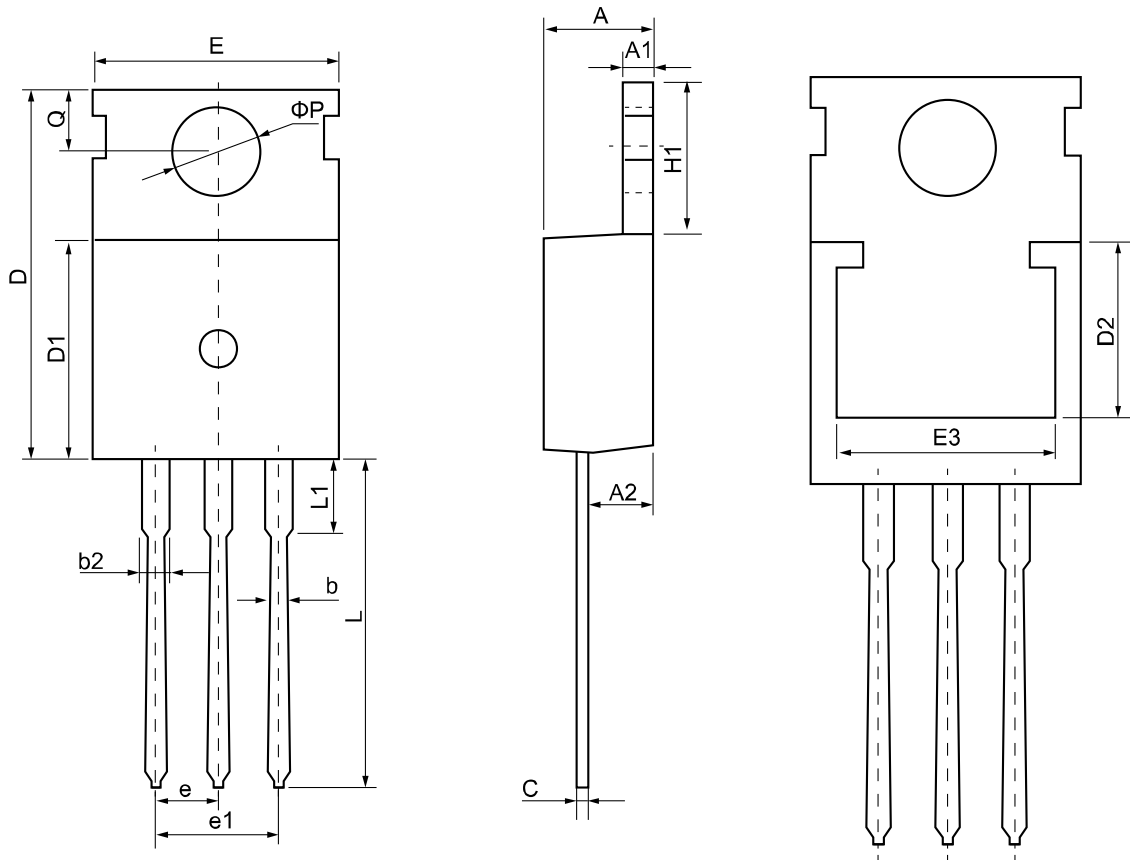


Unclamped inductive switching test circuit & waveform



PHYSICAL DIMENSIONS

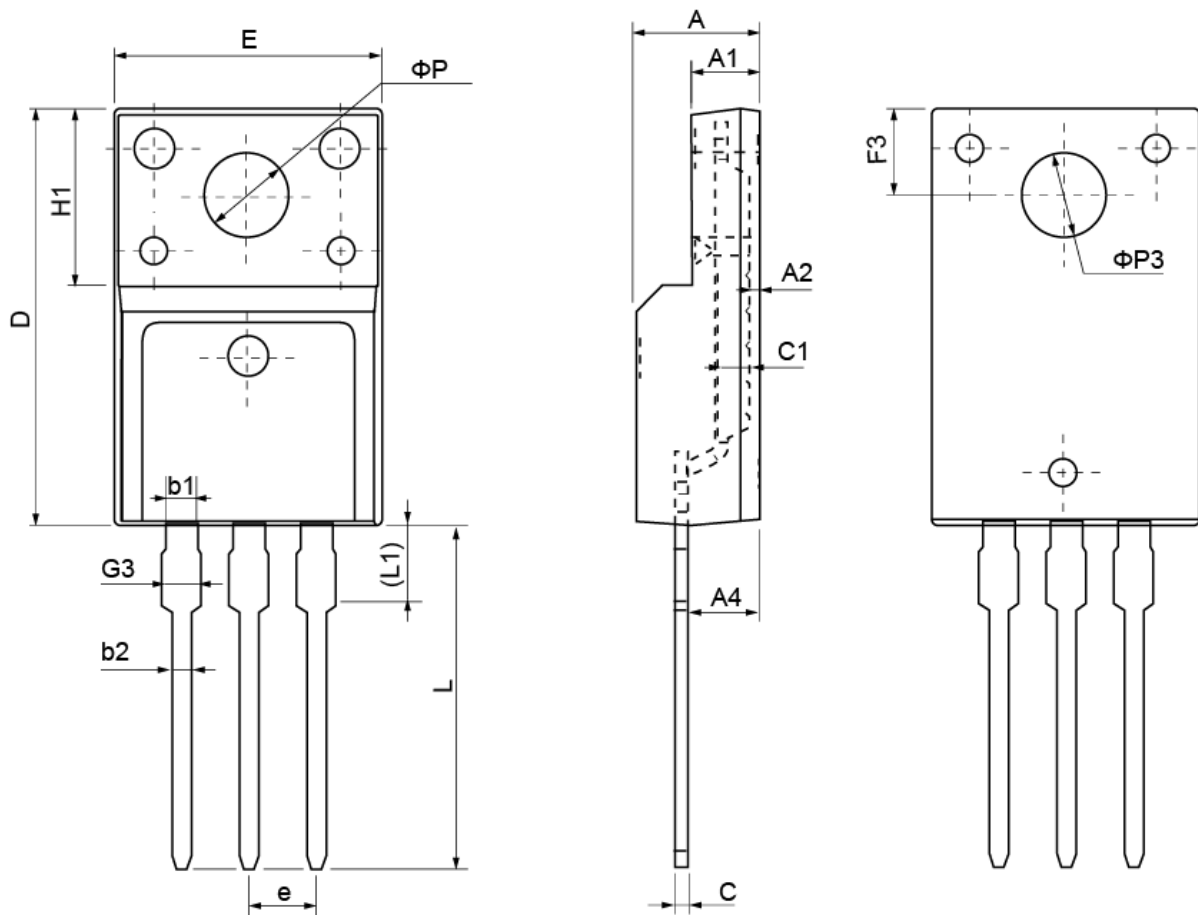
TO-220



| Symbol | Dimension (mm) | | | Symbol | Dimension (mm) | | |
|--------|----------------|-------|-------|--------|----------------|-------|-------|
| | Min | Nom | Max | | Min | Nom | Max |
| A | 4.37 | 4.57 | 4.77 | E | 9.80 | 10.00 | 10.20 |
| A1 | 1.25 | 1.30 | 1.45 | E3 | 7.00 | - | - |
| A2 | 2.20 | 2.40 | 2.60 | e | 2.54(BSC) | | |
| b | 0.70 | 0.80 | 0.95 | e1 | 5.08(BSC) | | |
| b2 | 1.17 | 1.27 | 1.47 | H1 | 6.30 | 6.50 | 6.80 |
| c | 0.40 | 0.50 | 0.65 | L | 12.75 | 13.50 | 13.80 |
| D | 15.30 | 15.60 | 15.90 | L1 | - | 3.10 | 3.40 |
| D1 | 8.90 | 9.10 | 9.30 | ΦP | 3.40 | 3.60 | 3.80 |
| D2 | 5.50 | - | - | Q | 2.60 | 2.80 | 3.00 |



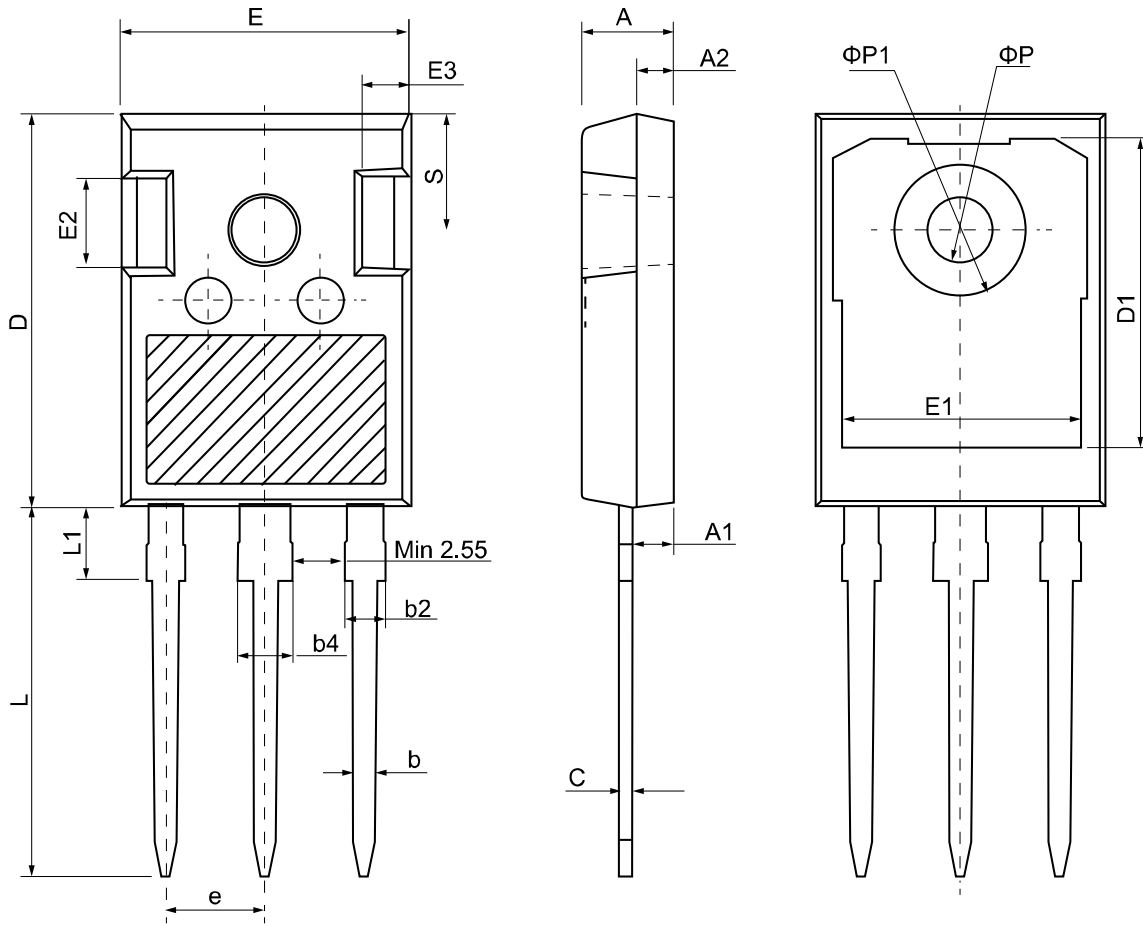
TO-220F



| Symbol | Dimension (mm) | | | Symbol | Dimension (mm) | | |
|--------|----------------|-------|-------|-----------|----------------|-------|-------|
| | Min | Nom | Max | | Min | Nom | Max |
| E | 9.96 | 10.16 | 10.36 | e | 2.54(BSC) | | |
| A | 4.50 | 4.70 | 4.90 | L | 12.68 | 12.98 | 13.28 |
| A1 | 2.34 | 2.54 | 2.74 | L1 | 2.93 | 3.03 | 3.13 |
| A2 | 0.30 | 0.45 | 0.60 | ΦP | 3.03 | 3.18 | 3.38 |
| A4 | 2.56 | 2.76 | 2.96 | $\Phi P3$ | 3.15 | 3.45 | 3.65 |
| c | 0.40 | 0.50 | 0.65 | F3 | 3.15 | 3.30 | 3.45 |
| c1 | 1.20 | 1.30 | 1.35 | G3 | 1.25 | 1.35 | 1.55 |
| D | 15.57 | 15.87 | 16.17 | b1 | 1.18 | 1.28 | 1.43 |
| H1 | 6.70(REF) | | | b2 | 0.70 | 0.80 | 0.95 |



TO-247



| Symbol | Dimension (mm) | | | Symbol | Dimension (mm) | | |
|--------|----------------|-------|-------|--------|----------------|-------|-------|
| | Min | Nom | Max | | Min | Nom | Max |
| A | 4.80 | 5.00 | 5.20 | E1 | 13.00 | 13.30 | 13.60 |
| A1 | 2.21 | 2.41 | 2.59 | E2 | 4.80 | 5.00 | 5.20 |
| A2 | 1.85 | 2.00 | 2.15 | E3 | 2.30 | 2.50 | 2.70 |
| b | 1.11 | 1.21 | 1.36 | e | 5.44(BSC) | | |
| b2 | 1.91 | 2.01 | 2.21 | L | 19.82 | 19.92 | 20.22 |
| b4 | 2.91 | 3.01 | 3.21 | L1 | - | - | 4.30 |
| c | 0.51 | 0.61 | 0.75 | ΦP | 3.40 | 3.60 | 3.80 |
| D | 20.80 | 21.00 | 21.30 | ΦP1 | - | - | 7.30 |
| D1 | 16.25 | 16.55 | 16.85 | S | 6.15(BSC) | | |
| E | 15.50 | 15.80 | 16.10 | - | - | - | - |

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