



650V Super-junction Power MOSFET

Description

650V Super-junction Power MOSFET

Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs, designed according to the SJ principle. The deep trench SJ MOSFET provide an extremely low switching, commutation and conduction losses device with highest robustness make especially resonant switching applications more reliable, more efficient, lighter and cooler, designed by Wuxi Unigroup Microelectronics Company.

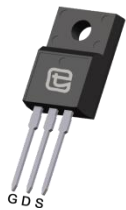
Features

- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- Easy to use/drive
- RoHS compliant

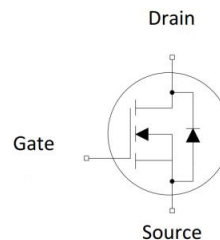
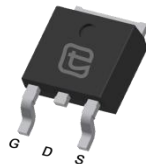
Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- Charger

TO-220F



TO-252



Device Marking and Package Information

| Device | Package | Marking |
|------------|---------|---------|
| TPA65R520D | TO-220F | 65R520D |
| TPD65R520D | TO-252 | 65R520D |

Key Performance Parameters

| Parameter | Value | Unit |
|----------------------|-------|----------|
| $V_{DS} @ T_{j,max}$ | 700 | V |
| $R_{DS(on),max}$ | 0.52 | Ω |
| $Q_{g,typ}$ | 12.5 | nC |
| I_D | 7 | A |
| $I_{D,pulse}$ | 21 | A |
| $E_{OSS} @ 400V$ | 1.66 | μJ |



| Absolute Maximum Ratings $T_C = 25^\circ\text{C}$, unless otherwise noted | | | | |
|---|---------------------------|----------------|------------------|------------------|
| Parameter | | Symbol | Values | Unit |
| Continuous Drain Current | $T_C = 25^\circ\text{C}$ | I_D | 7 | A |
| | $T_C = 100^\circ\text{C}$ | | 4 | |
| Pulsed Drain Current | (note1) | $I_{D,pulse}$ | 21 | A |
| Gate-Source Voltage | | V_{GSS} | $\pm 30\text{V}$ | V |
| Single Pulse Avalanche Energy | (note2) | E_{AS} | 45 | mJ |
| Repetitive Avalanche Energy | (note2) | E_{AR} | 0.28 | mJ |
| Avalanche Current | | I_{AR} | 3 | A |
| MOSFET dv/dt Ruggedness, $V_{DS} = 0 \dots 480\text{V}$ | | dv/dt | 50 | V/ns |
| Power Dissipation For TO-220F | | P_D | 28 | W |
| Power Dissipation For TO-252 | | | 62.5 | |
| Continuous Diode Forward Current | | I_S | 7 | A |
| Diode Pulsed Current | (note1) | $I_{S,pulse}$ | 21 | |
| Reverse Diode dv/dt | (note3) | dv/dt | 5 | V/ns |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55~+150 | $^\circ\text{C}$ |

| Thermal Resistance For TO-220F | | | |
|---|------------|-------|---------------------------|
| Parameter | Symbol | Value | Unit |
| Thermal Resistance, Junction-to-Case | R_{thJC} | 4.5 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient | R_{thJA} | 80 | |

| Thermal Resistance For TO-252 | | | |
|---|------------|-------|---------------------------|
| Parameter | Symbol | Value | Unit |
| Thermal Resistance, Junction-to-Case | R_{thJC} | 2 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient | R_{thJA} | 62 | |



| Electrical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted | | | | | | |
|--|---------------|--|-------|------|-----------|---------------|
| Parameter | Symbol | Test Conditions | Value | | | Unit |
| | | | Min. | Typ. | Max. | |
| Static Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = 250\mu\text{A}$ | 650 | -- | -- | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$ | -- | -- | 1 | μA |
| | | $V_{DS} = 650V, V_{GS} = 0V, T_J = 150^\circ\text{C}$ | -- | -- | 100 | |
| Gate-Source Leakage Current | I_{GSS} | $V_{GS} = \pm 30V$ | -- | -- | ± 100 | nA |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\mu\text{A}$ | 2.5 | -- | 4.0 | V |
| Drain-Source On-State-Resistance | $R_{DS(on)}$ | $V_{GS} = 10V, I_D = 3A$ | -- | 0.44 | 0.52 | Ω |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$ | -- | 564 | -- | μF |
| Output Capacitance | C_{oss} | | -- | 22 | -- | |
| Reverse Transfer Capacitance | C_{rss} | | -- | 0.5 | -- | |
| Total Gate Charge | Q_g | $V_{DD} = 520V, I_D = 7A,$ $V_{GS} = 10V$ | -- | 12.5 | -- | nC |
| Gate-Source Charge | Q_{gs} | | -- | 5 | -- | |
| Gate-Drain Charge | Q_{gd} | | -- | 3.2 | -- | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD} = 400V, I_D = 7A,$ $R_G = 25\Omega$ | -- | 52 | -- | ns |
| Turn-on Rise Time | t_r | | -- | 62 | -- | |
| Turn-off Delay Time | $t_{d(off)}$ | | -- | 84 | -- | |
| Turn-off Fall Time | t_f | | -- | 50 | -- | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Body Diode Forward Voltage | V_{SD} | $T_J = 25^\circ\text{C}, I_{SD} = 7A, V_{GS} = 0V$ | -- | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $V_R = 400V, I_S = 3A,$ $di_F/dt = 100\text{A}/\mu\text{s}$ | -- | 200 | -- | ns |
| Reverse Recovery Charge | Q_{rr} | | -- | 1.6 | -- | μC |
| Peak Reverse Recovery Current | I_{rrm} | | -- | 3.2 | -- | A |

Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_D = 10A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. Identical low side and high side switch with identical R_G



Typical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted

Figure 1. Output Characteristics

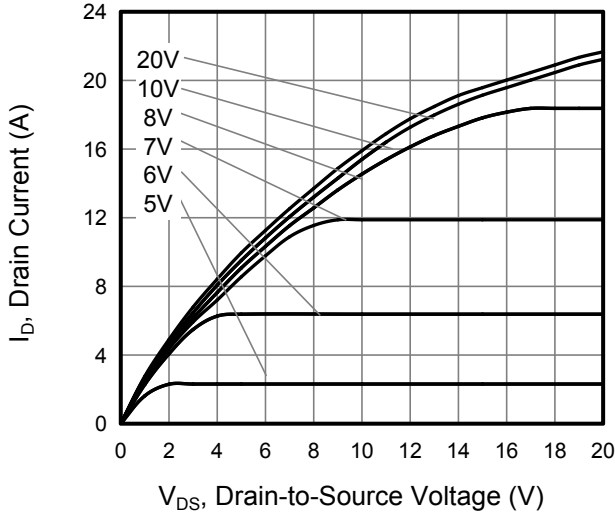


Figure 2. Transfer Characteristics

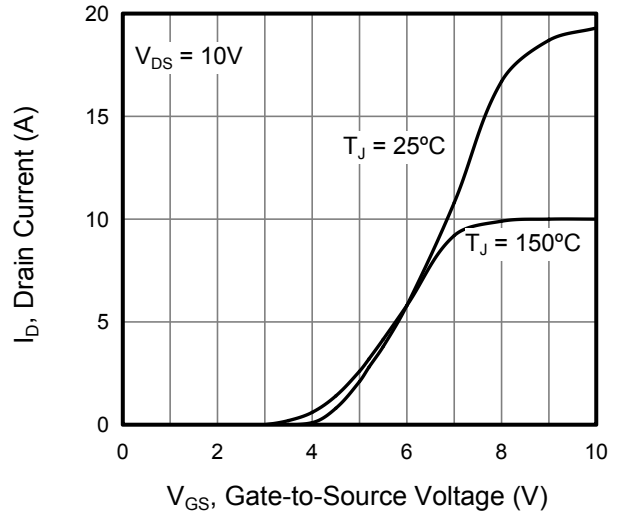


Figure 3 . On-Resistance vs. Drain Current

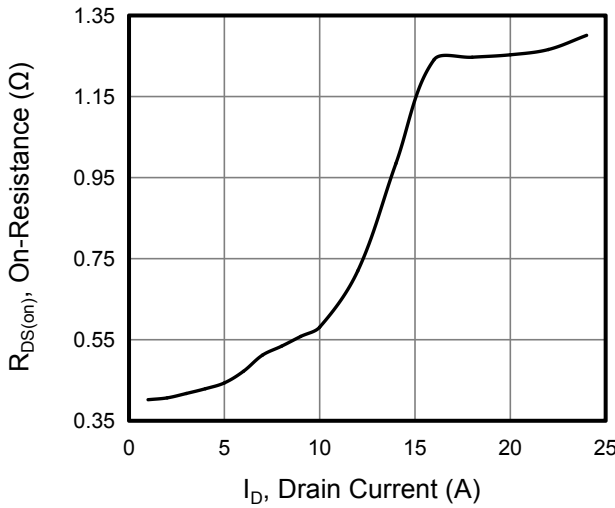


Figure 4. Capacitance

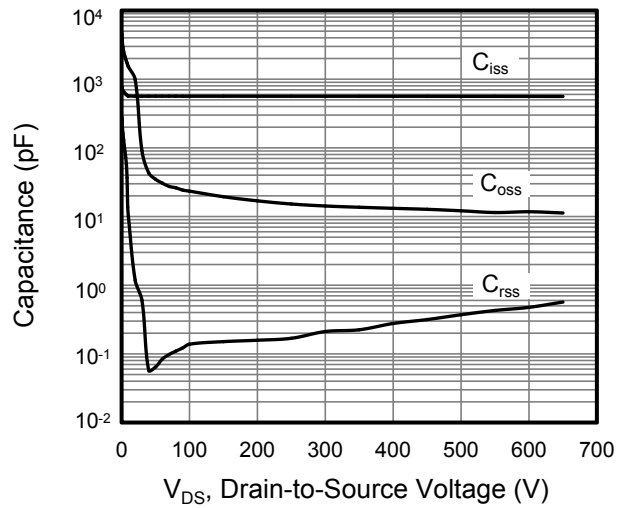


Figure 5. Gate Charge

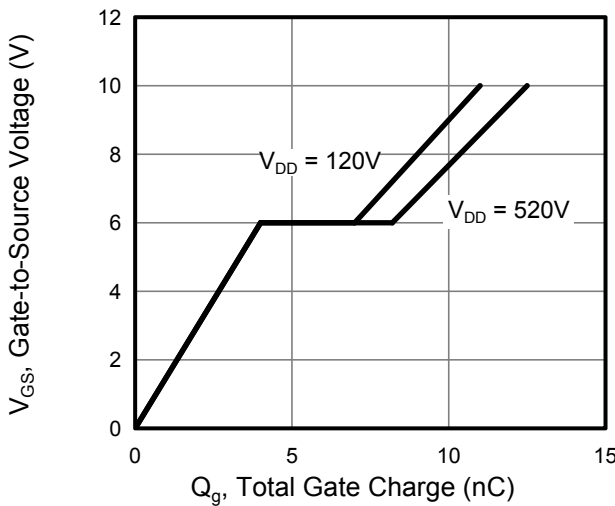


Figure 6. Body Diode Forward Voltage

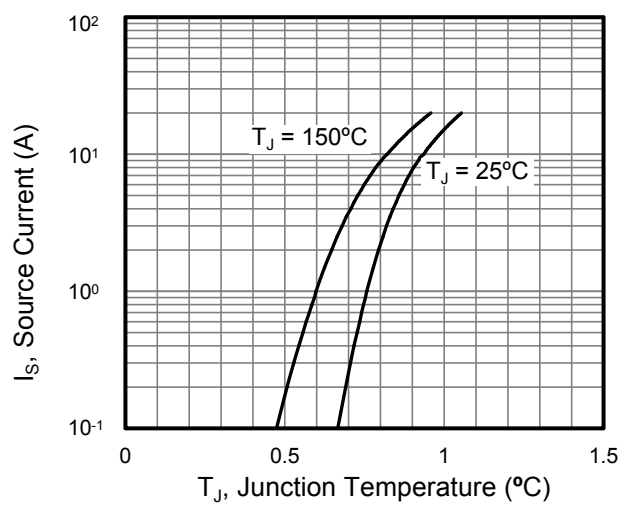




Figure 7. On-Resistance vs. Temperature

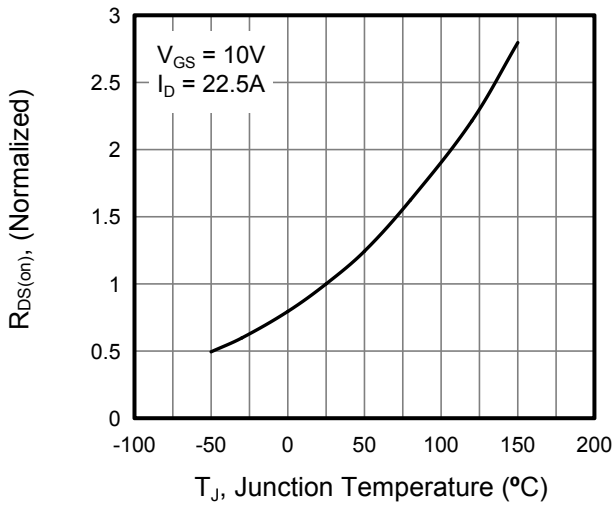


Figure 8. Breakdown voltage vs. Junction Temperature

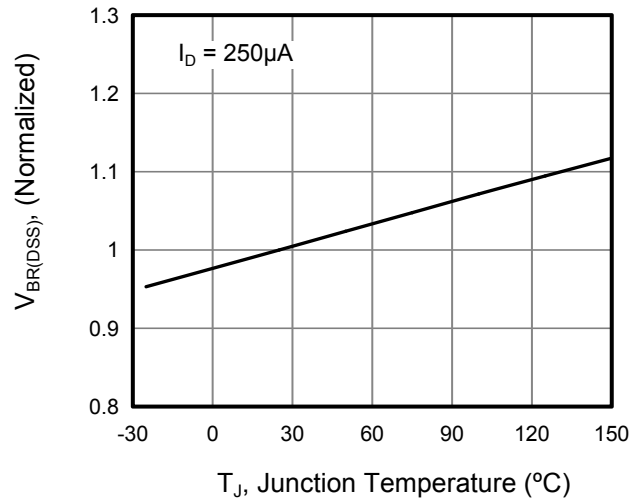


Figure 9. Transient Thermal Impedance For TO-252

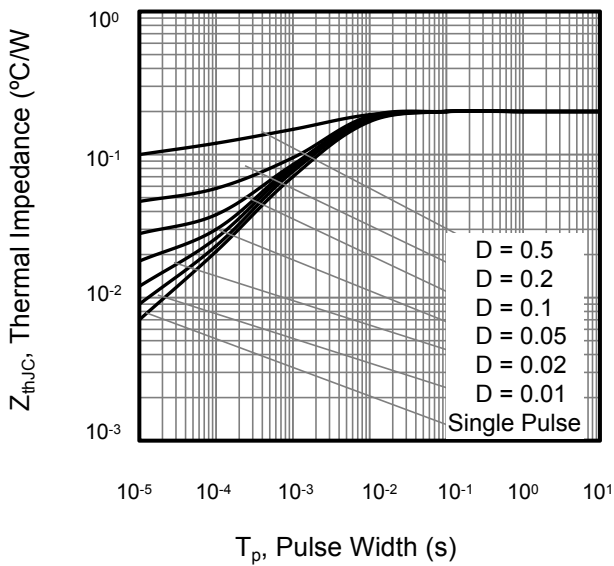


Figure 10. Safe Operation Area For TO-252

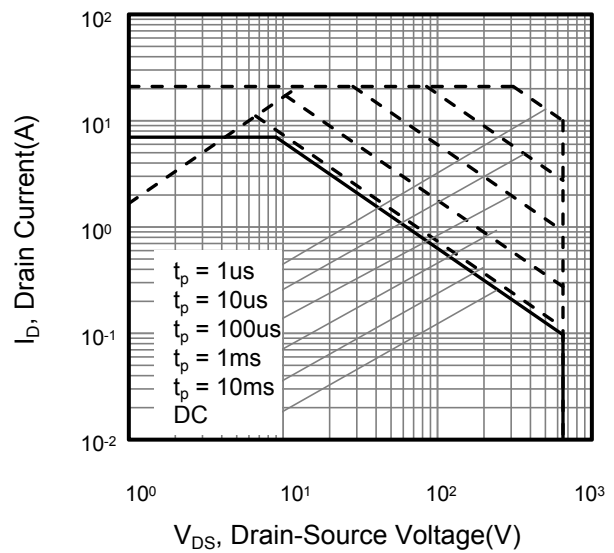


Figure 11. Transient Thermal Impedance For TO-220F

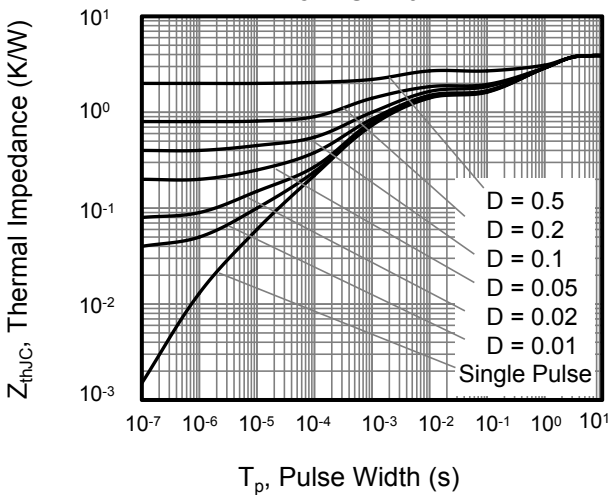
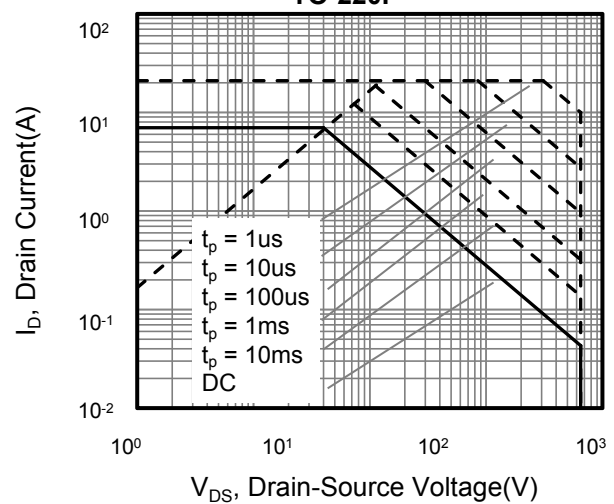


Figure 12. Safe Operation Area For TO-220F





Typical Characteristics $T_J = 25^{\circ}\text{C}$, unless otherwise noted

Figure 13. Typ. Coss Stored Energy

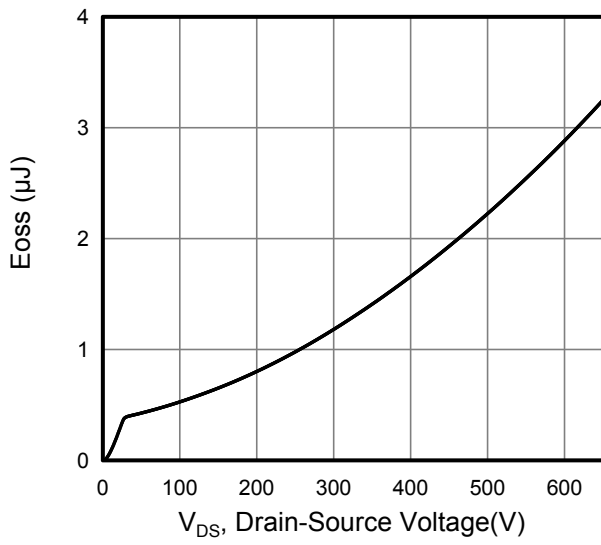




Figure A: Gate Charge Test Circuit and Waveform

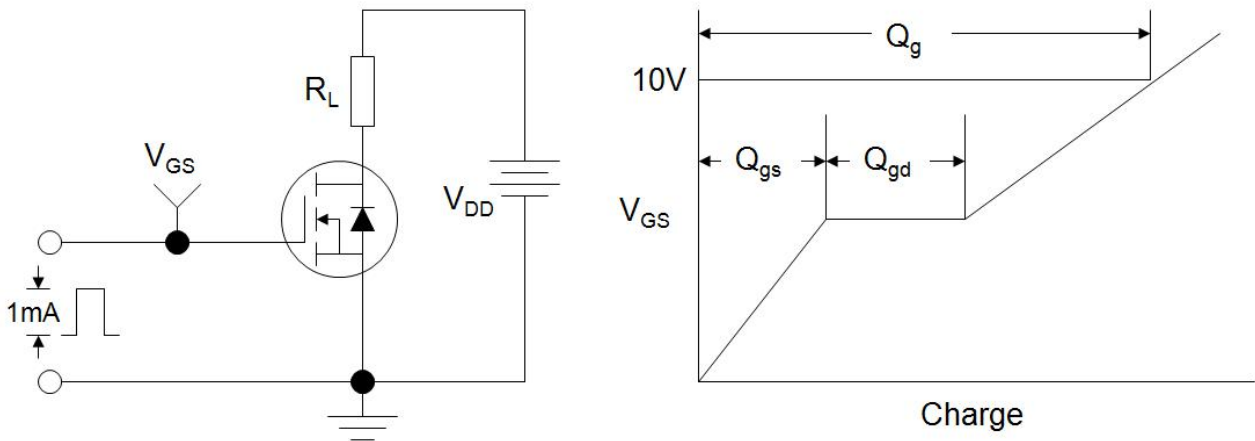


Figure B: Resistive Switching Test Circuit and Waveform

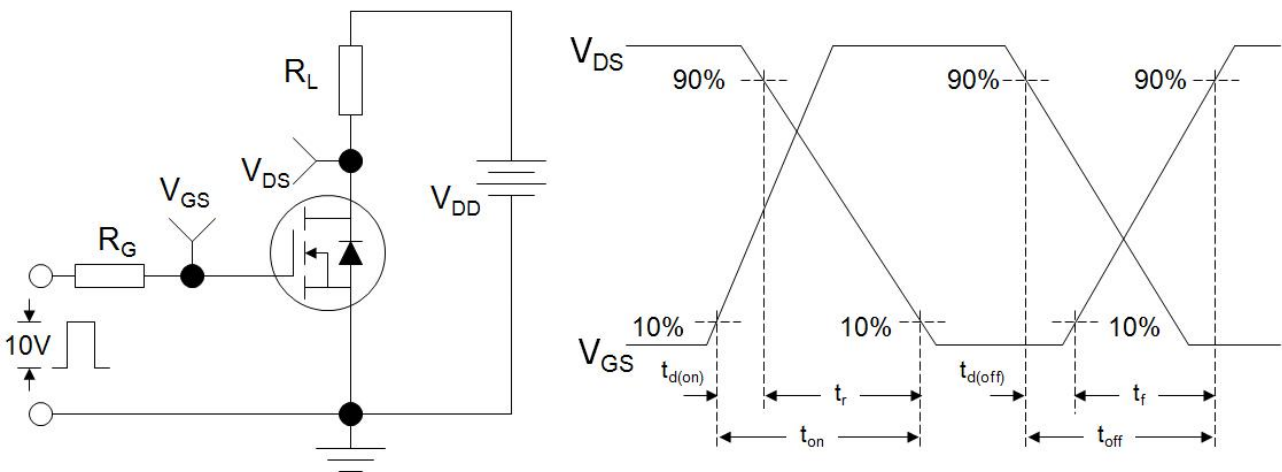
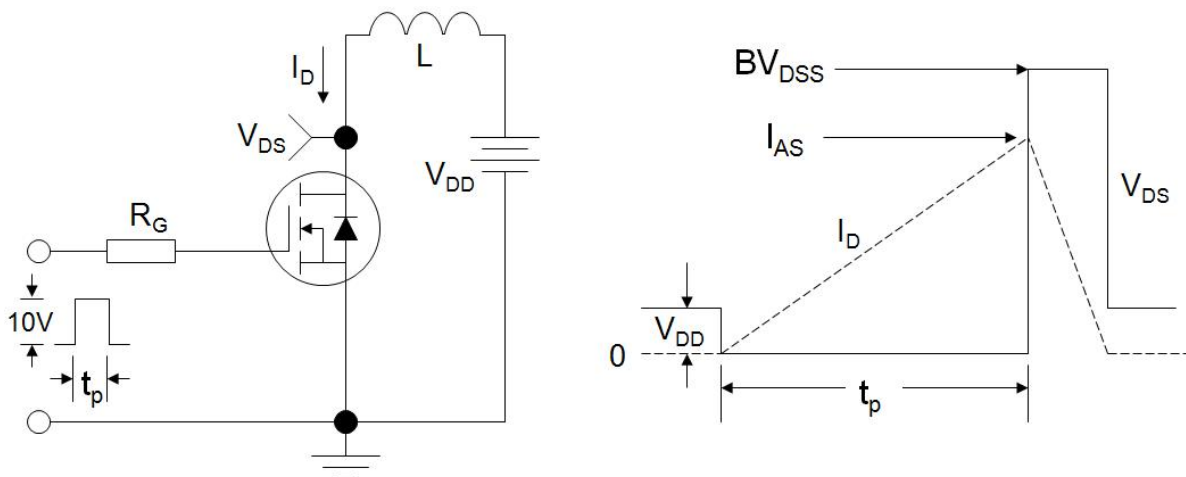
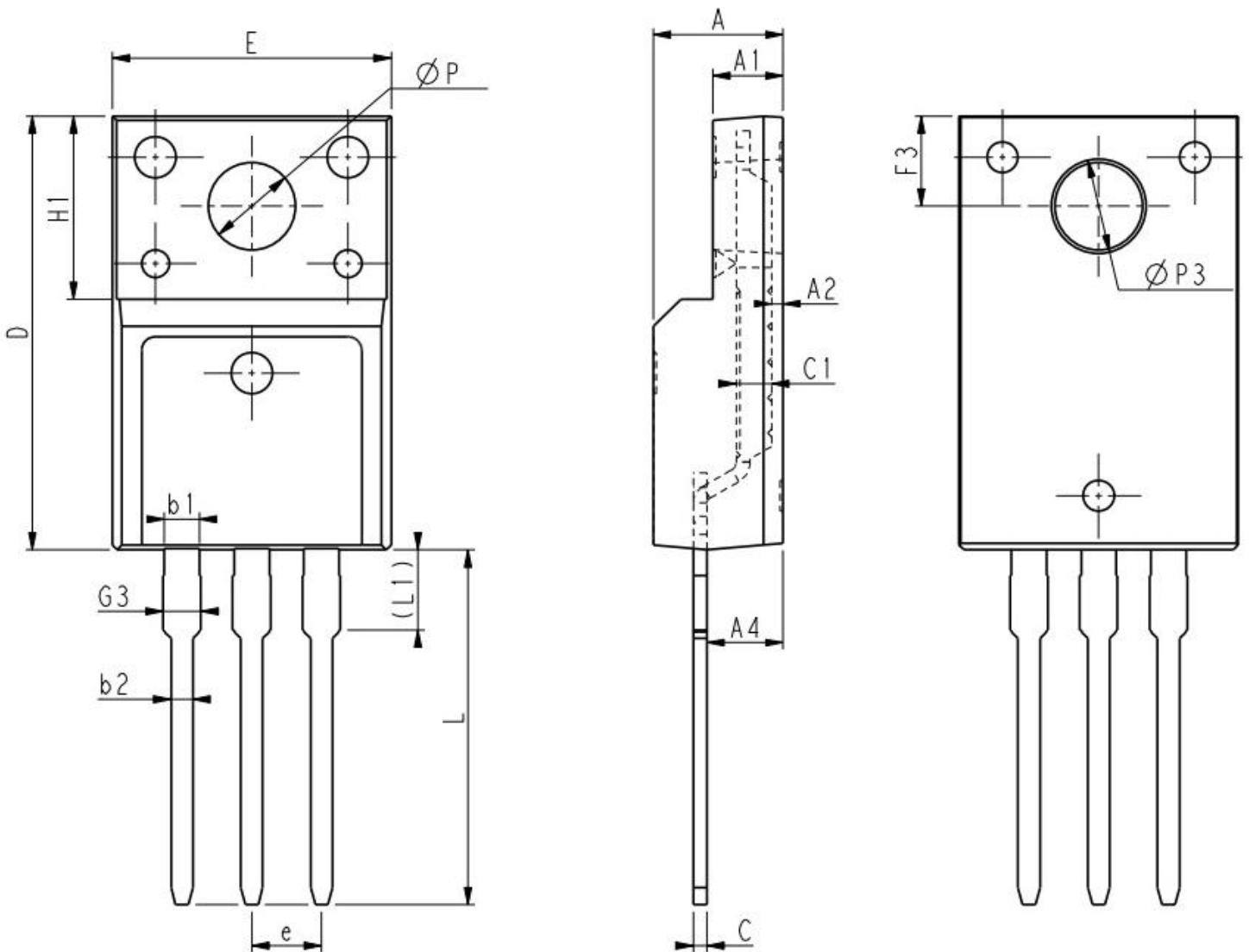


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-220F

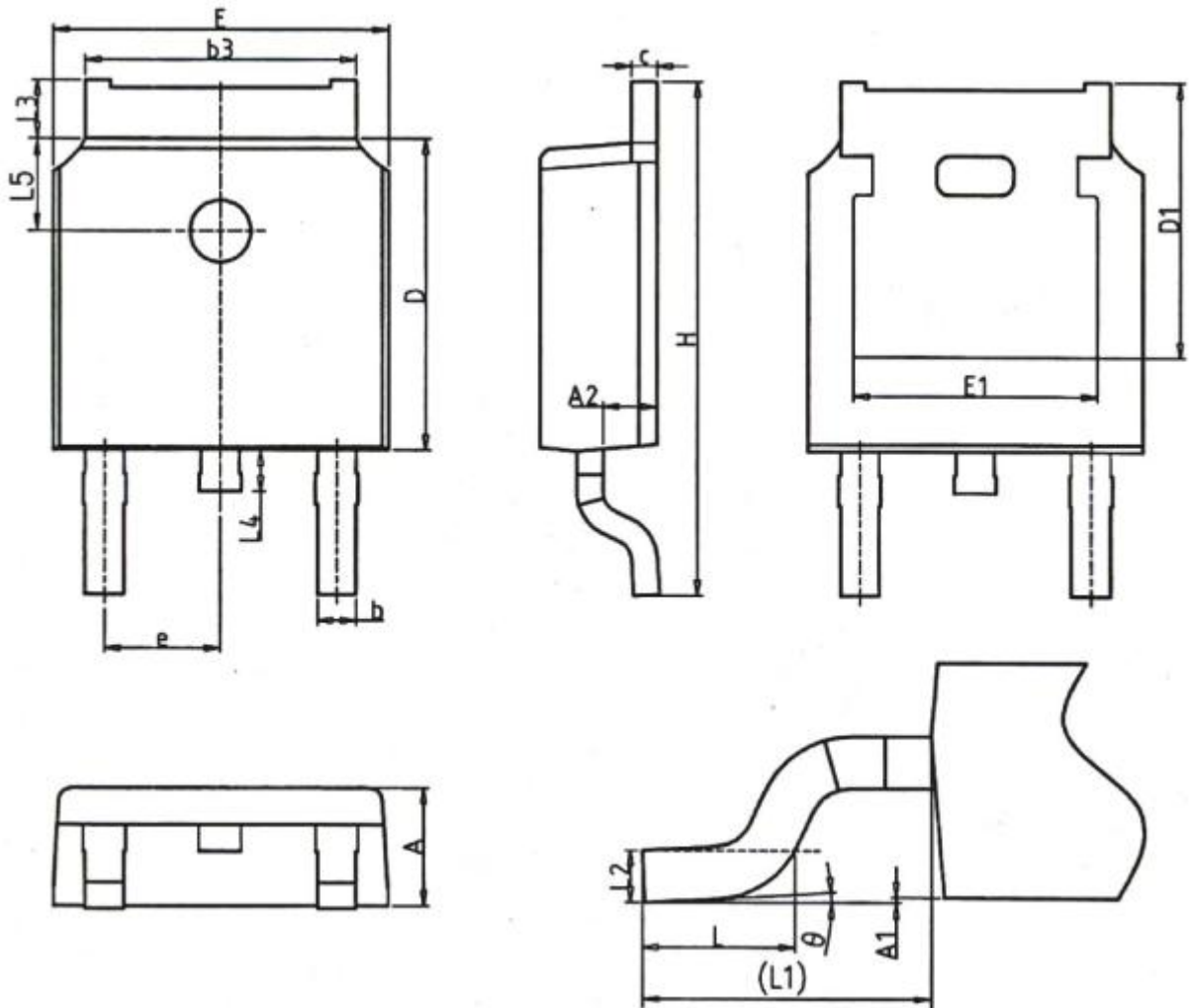


| Unit:mm | | | |
|---------|---------|-------|-------|
| Symbol | Min. | Nom | Max. |
| E | 9.96 | 10.16 | 10.36 |
| A | 4.50 | 4.70 | 4.90 |
| A1 | 2.34 | 2.54 | 2.74 |
| A2 | 0.30 | 0.45 | 0.60 |
| A4 | 2.56 | 2.76 | 2.96 |
| c | 0.40 | 0.50 | 0.65 |
| c1 | 1.20 | 1.30 | 1.35 |
| D | 15.57 | 15.87 | 16.17 |
| H1 | 6.70REF | | |

| Unit:mm | | | |
|-----------|---------|-------|-------|
| Symbol | Min. | Nom | Max. |
| e | 2.54BSC | | |
| L | 12.68 | 12.98 | 13.28 |
| L1 | 2.93 | 3.03 | 3.13 |
| ΦP | 3.03 | 3.18 | 3.38 |
| $\Phi P3$ | 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 |



TO-252



| Unit:mm | | | |
|---------|----------|------|------|
| Symbol | Min. | Nom | Max. |
| A | 2.20 | 2.30 | 2.40 |
| A1 | 0.00 | - | 0.20 |
| A2 | 0.97 | 1.07 | 1.17 |
| b | 0.68 | 0.78 | 0.90 |
| b3 | 5.20 | 5.33 | 5.50 |
| c | 0.43 | 0.53 | 0.63 |
| D | 5.98 | 6.10 | 6.22 |
| D1 | 5.30 REF | | |
| E | 6.40 | 6.60 | 6.80 |
| E1 | 4.63 | - | - |

| Unit:mm | | | |
|---------|-----------|-------|-------|
| Symbol | Min. | Nom | Max. |
| e | 2.286 BSC | | |
| H | 9.40 | 10.10 | 10.50 |
| L | 1.38 | 1.50 | 1.75 |
| L1 | 2.90 REF | | |
| L2 | 0.51 BSC | | |
| L3 | 0.88 | - | 1.28 |
| L4 | - | - | 1.00 |
| L5 | 1.65 | 1.80 | 1.95 |
| θ | 0° | - | 8° |



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