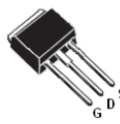

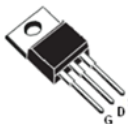
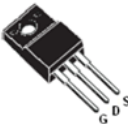
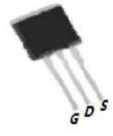
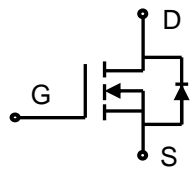



Lonten N-channel 650V, 4A Power MOSFET

| | | | | | | | | | |
|---|---|-----------|------|-------|----|------------------|---------------|-------------|-------|
| <p>Description The Power MOSFET is fabricated using the advanced planar VDMOS technology. The resulting device has low conduction resistance, superior switching performance and high avalanche energy.</p> <p>Features</p> <ul style="list-style-type: none"> ◆ Low $R_{DS(on)}$ ◆ Low gate charge (typ. $Q_g = 12 \text{ nC}$) ◆ 100% UIS tested ◆ RoHS compliant <p>Applications</p> <ul style="list-style-type: none"> ◆ Power factor correction. ◆ Switched mode power supplies. ◆ LED driver. | <p>Product Summary</p> <table> <tr> <td>V_{DSS}</td> <td>650V</td> </tr> <tr> <td>I_D</td> <td>4A</td> </tr> <tr> <td>$R_{DS(on),max}$</td> <td>2.70Ω</td> </tr> <tr> <td>$Q_{g,typ}$</td> <td>12 nC</td> </tr> </table> <div style="display: flex; justify-content: space-around; align-items: center;">      </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p>TO-251</p> <p>TO-252</p> <p>TO-220</p> <p>TO-220F</p> <p>TO-262</p> </div> <div style="text-align: center;">  <p>N-Channel MOSFET</p> </div> <div style="text-align: right;">  </div> | V_{DSS} | 650V | I_D | 4A | $R_{DS(on),max}$ | 2.70 Ω | $Q_{g,typ}$ | 12 nC |
| V_{DSS} | 650V | | | | | | | | |
| I_D | 4A | | | | | | | | |
| $R_{DS(on),max}$ | 2.70 Ω | | | | | | | | |
| $Q_{g,typ}$ | 12 nC | | | | | | | | |

Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|----------------|-------------|---------------------|
| Drain-Source Voltage | V_{DSS} | 650 | V |
| Continuous drain current ($T_C = 25^\circ\text{C}$) | I_D | 4 | A |
| ($T_C = 100^\circ\text{C}$) | | 2.5 | A |
| Pulsed drain current ¹⁾ | I_{DM} | 16 | A |
| Gate-Source voltage | V_{GSS} | ± 30 | V |
| Avalanche energy, single pulse ²⁾ | E_{AS} | 198 | mJ |
| Peak diode recovery dv/dt ³⁾ | dv/dt | 5 | V/ns |
| Power Dissipation TO-220F ($T_C = 25^\circ\text{C}$) | P_D | 32 | W |
| Derate above 25°C | | 0.26 | W/ $^\circ\text{C}$ |
| Power Dissipation TO-220\ TO-251\ TO-252\ TO-262 ($T_C = 25^\circ\text{C}$) | P_D | 77 | W |
| Derate above 25°C | | 0.61 | W/ $^\circ\text{C}$ |
| Operating junction and storage temperature range | T_J, T_{STG} | -55 to +150 | $^\circ\text{C}$ |
| Continuous diode forward current | I_S | 4 | A |
| Diode pulse current | $I_{S,pulse}$ | 16 | A |

Thermal Characteristics

| Parameter | Symbol | Value | | Unit |
|---|-----------------|---------|-----------------------------|--------------------|
| | | TO-220F | TO-220\TO-251\TO-252\TO-262 | |
| Thermal resistance, Junction-to-case | $R_{\theta JC}$ | 3.8 | 1.62 | $^\circ\text{C/W}$ |
| Thermal resistance, Junction-to-ambient | $R_{\theta JA}$ | 62.5 | 110 | $^\circ\text{C/W}$ |

Package Marking and Ordering Information

| Device | Device Package | Marking | Units/Tube | Units/Real |
|---------|----------------|---------|------------|------------|
| LNC4N65 | TO-220 | LNC4N65 | 50 | |
| LND4N65 | TO-220F | LND4N65 | 50 | |
| LNG4N65 | TO-252 | LNG4N65 | | 3000 |
| LNH4N65 | TO-251 | LNH4N65 | 80 | |
| LNF4N65 | TO-262 | LNF4N65 | 50 | |

Electrical Characteristics
 $T_c = 25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|--------------------------------------|---------------|--|------|------|----------|---------------|
| Static characteristics | | | | | | |
| Drain-source breakdown voltage | BV_{DSS} | $V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$ | 650 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=0.25\text{ mA}$ | 2 | - | 4 | V |
| Drain cut-off current | I_{DSS} | $V_{DS}=650\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$ | - | - | 1 100 | μA |
| Gate leakage current, Forward | I_{GSSF} | $V_{GS}=30\text{ V}, V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Gate leakage current, Reverse | I_{GSSR} | $V_{GS}=-30\text{ V}, V_{DS}=0\text{ V}$ | - | - | -100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=2\text{ A}$ | - | 2.50 | 2.70 | Ω |
| Dynamic characteristics | | | | | | |
| Input capacitance | C_{iss} | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$ | - | 600 | - | pF |
| Output capacitance | C_{oss} | | - | 55 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 3.2 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 325\text{ V}, I_D = 4\text{ A}$ $R_G = 10\ \Omega, V_{GS}=15\text{ V}$ | - | 12 | - | ns |
| Rise time | t_r | | - | 31 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 42 | - | |
| Fall time | t_f | | - | 15 | - | |
| Gate charge characteristics | | | | | | |
| Gate to source charge | Q_{gs} | $V_{DD}=520\text{ V}, I_D=4\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 3.2 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 5.1 | - | |
| Gate charge total | Q_g | | - | 12 | - | |
| Gate plateau voltage | $V_{plateau}$ | | - | 6 | - | V |
| Reverse diode characteristics | | | | | | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=4\text{ A}$ | - | - | 1.5 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=4\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 282 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 1.4 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 10 | - | A |

Notes:

- Pulse width limited by maximum junction temperature.
- $L=10\text{mH}, I_{AS} = 6.3\text{A}$, Starting $T_j = 25^\circ\text{C}$.
- $I_{SD} = 4\text{A}, di/dt \leq 100\text{A}/\mu\text{s}, V_{DD} \leq BV_{DS}$, Starting $T_j = 25^\circ\text{C}$.

Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

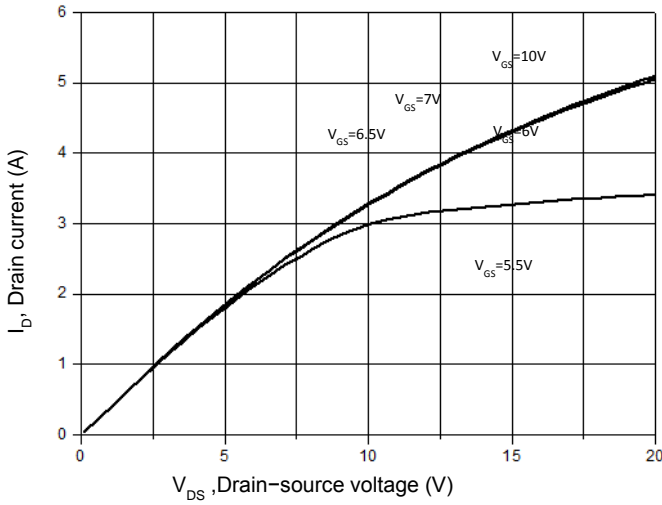


Figure 2. Transfer Characteristics

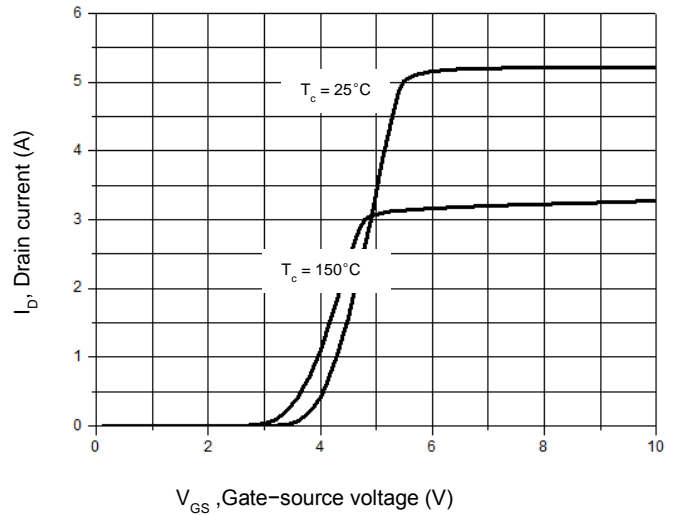


Figure 3. On-Resistance Variation vs. Drain Current

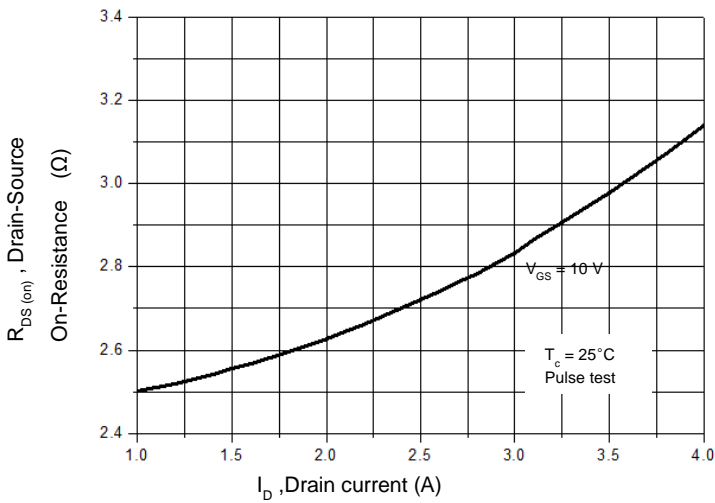


Figure 4. Threshold Voltage vs. Temperature

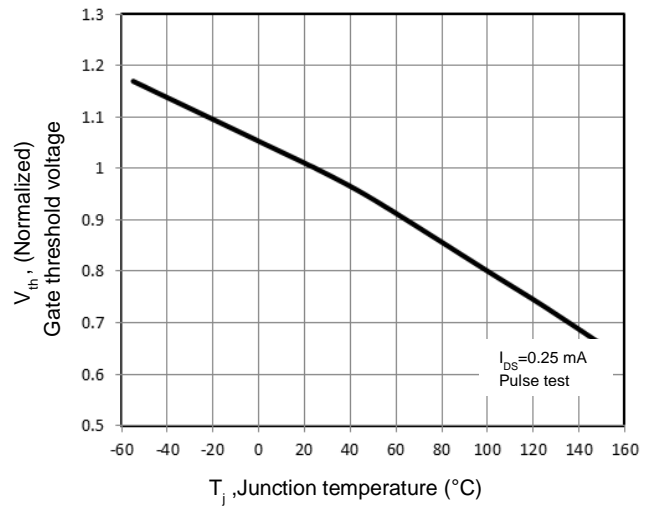


Figure 5. Breakdown Voltage vs. Temperature

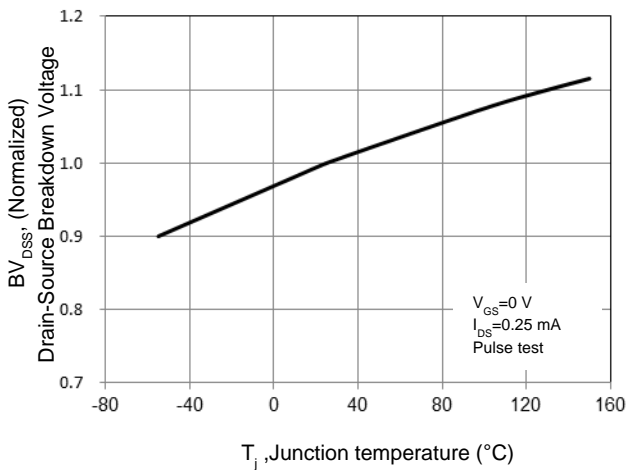


Figure 6. On-Resistance vs. Temperature

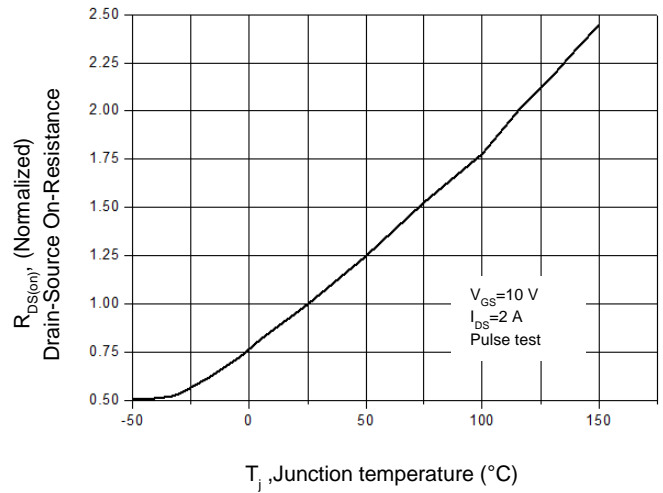


Figure 7. Capacitance Characteristics

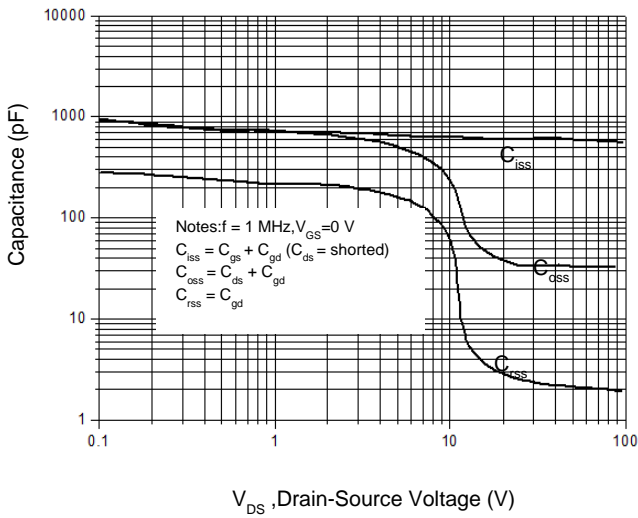


Figure 8. Gate Charge Characterist

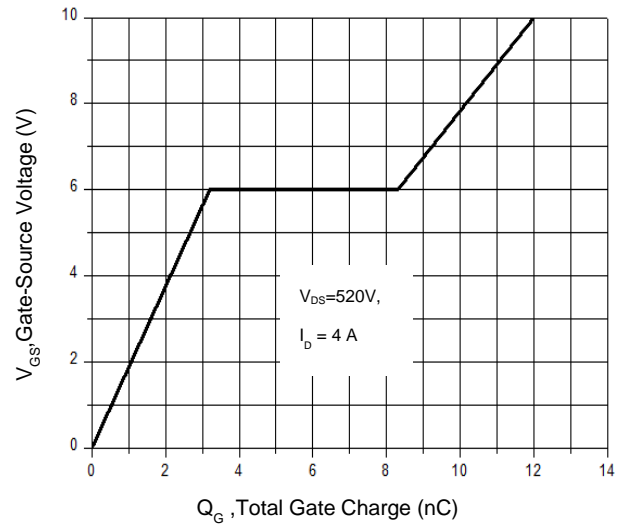


Figure 9. Maximum Safe Operating Area
TO-220F

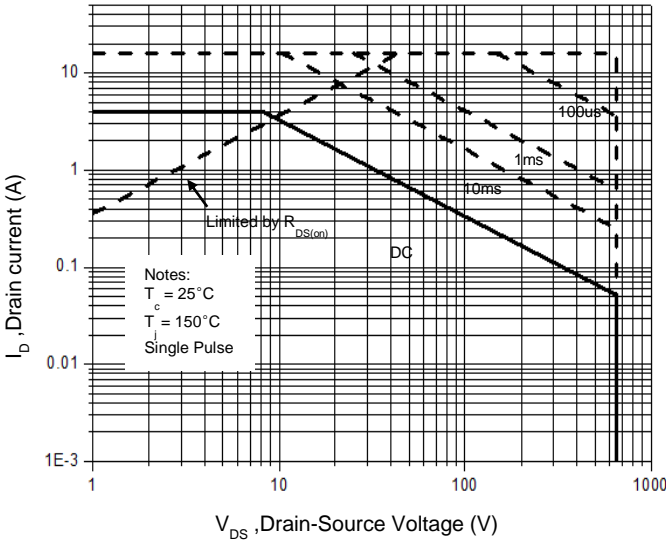


Figure 10. Maximum Safe Operating Area
TO-220/ TO-251/TO-252/TO-262

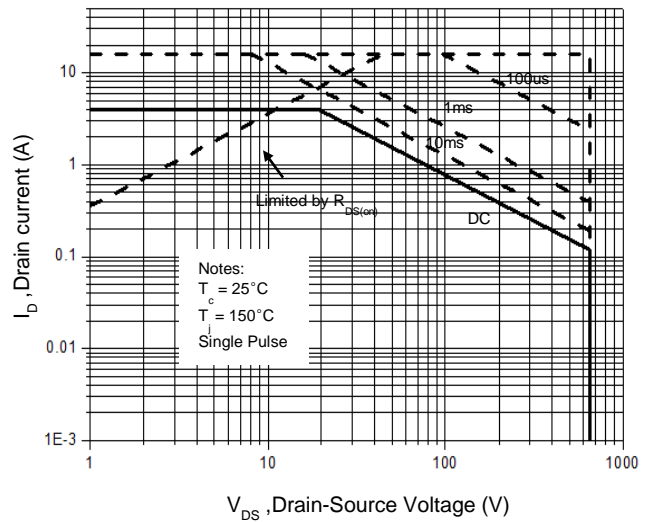


Figure 11. Power Dissipation vs. Temperature
TO-220F

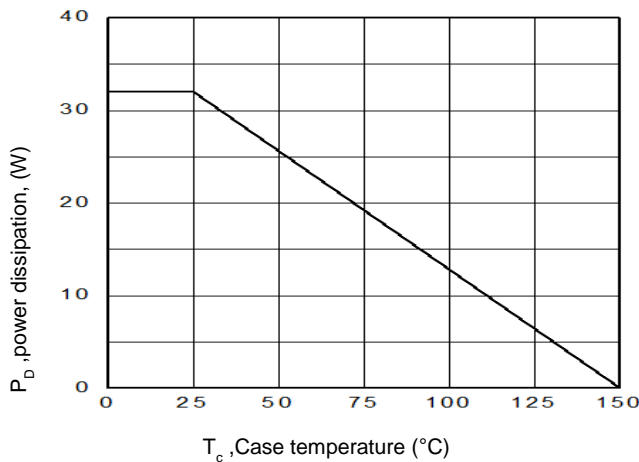


Figure 12. Power Dissipation vs. Temperature
TO-220/ TO-251/TO-252/TO-262

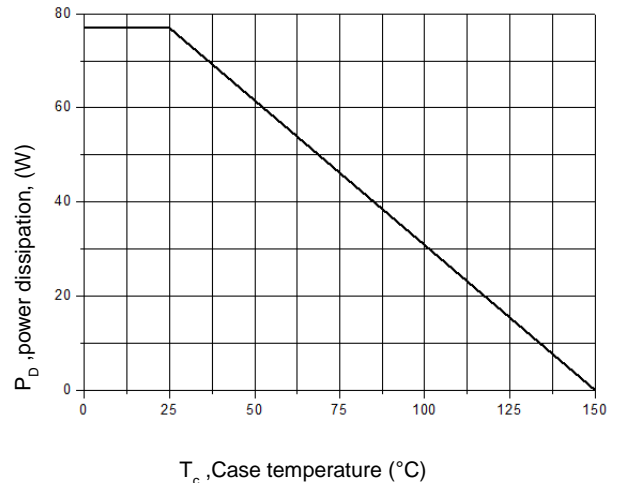


Figure 13. Continuous Drain Current vs. Temperature

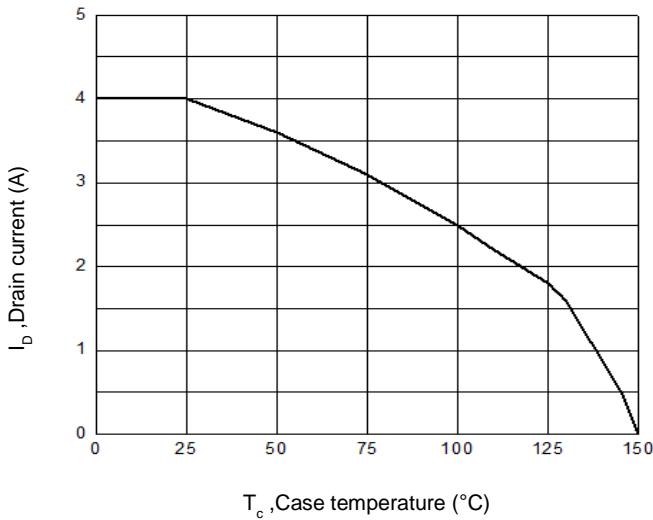


Figure 14. Body Diode Transfer Characteristics

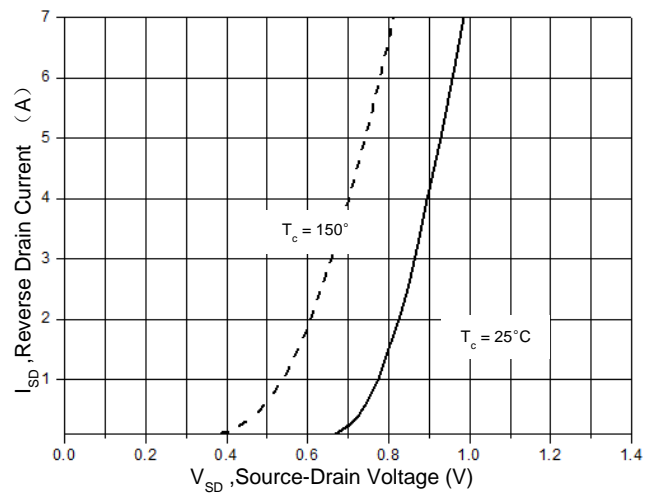


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

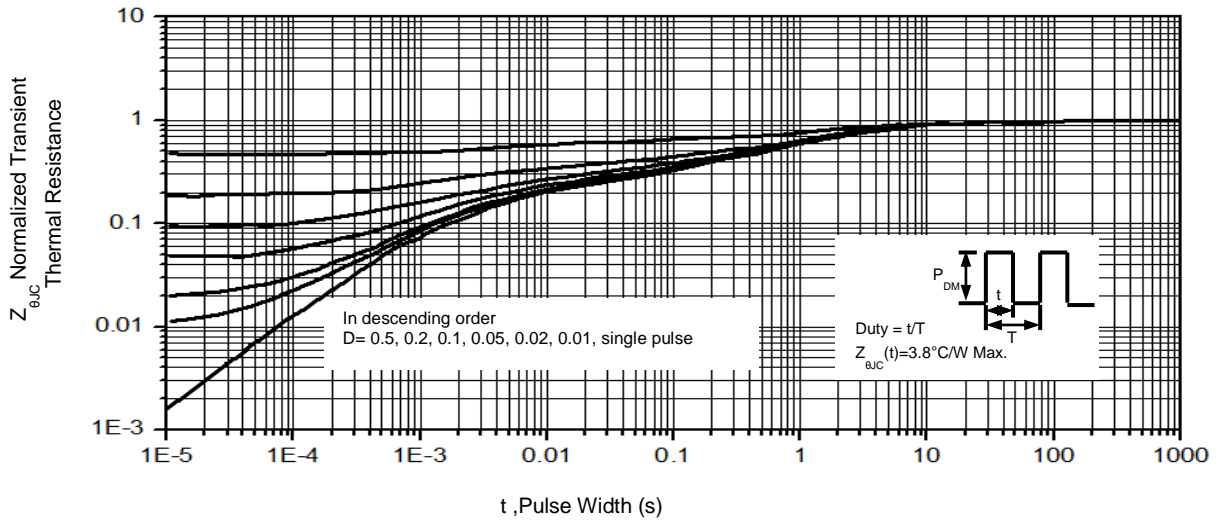
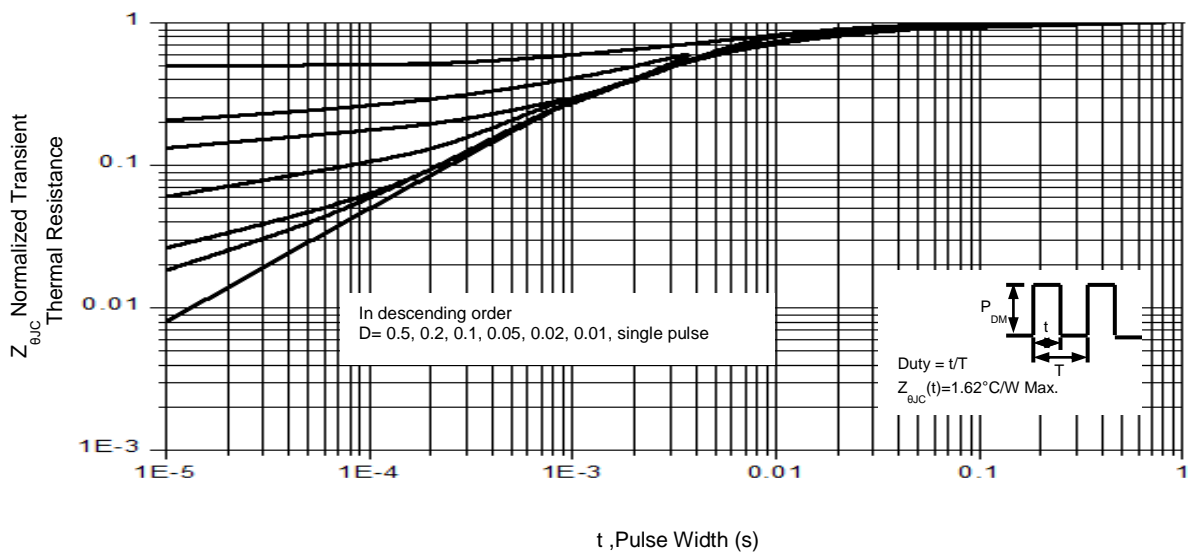
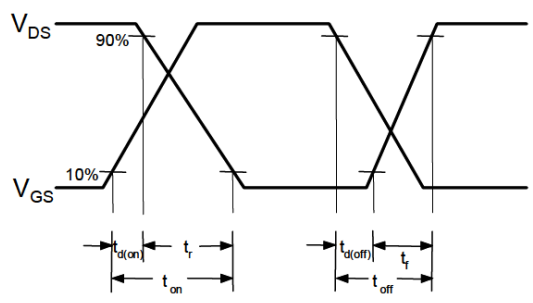
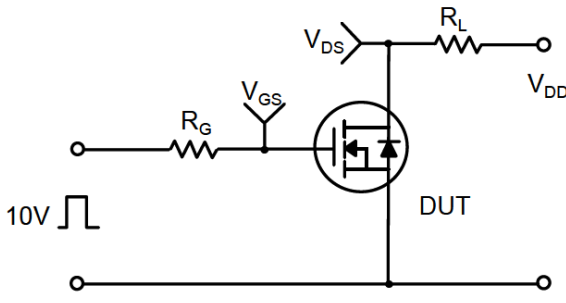


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/ TO-251/TO-252/TO-262



Gate Charge Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveforms



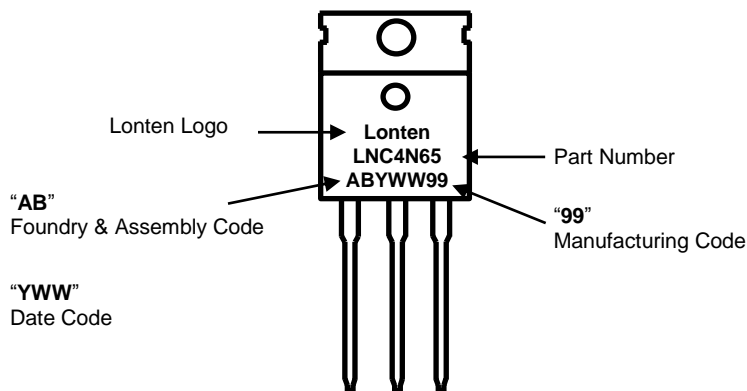
Mechanical Dimensions for TO-220



UNIT: mm

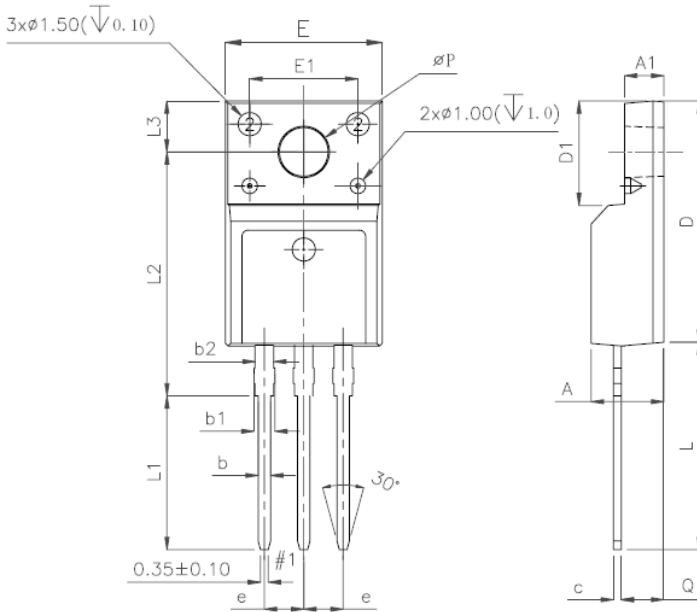
| SYMBOL | MIN | NOM | MAX |
|----------|------|------|------|
| A | 4 | | 4.8 |
| B | 1.2 | | 1.4 |
| B1 | 1 | | 1.4 |
| b1 | 0.75 | | 0.95 |
| c | 0.4 | | 0.55 |
| D | 15 | | 16.5 |
| D1 | 5.9 | | 6.9 |
| E | 9.9 | | 10.7 |
| e | 2.44 | 2.54 | 2.64 |
| F | 1.1 | | 1.4 |
| L | 12.5 | | 14.5 |
| L1 | 3 | 3.5 | 4 |
| ϕP | 3.7 | 3.8 | 3.9 |
| Q | 2.5 | | 3 |
| Q1 | 2 | | 2.9 |
| Y | 8.02 | 8.12 | 8.22 |

TO-220 Part Marking Information



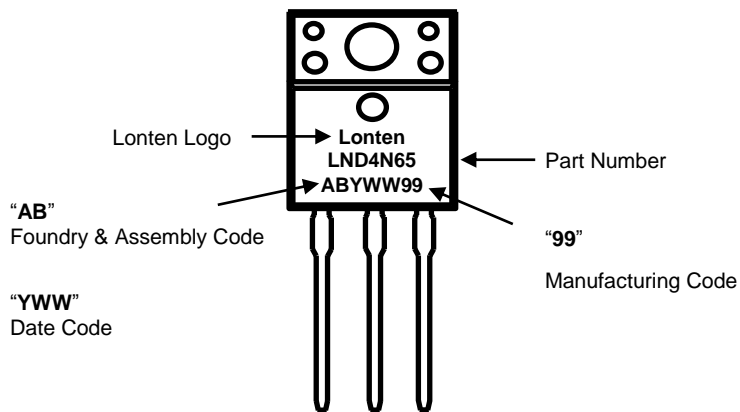
Mechanical Dimensions for TO-220F

UNIT: mm



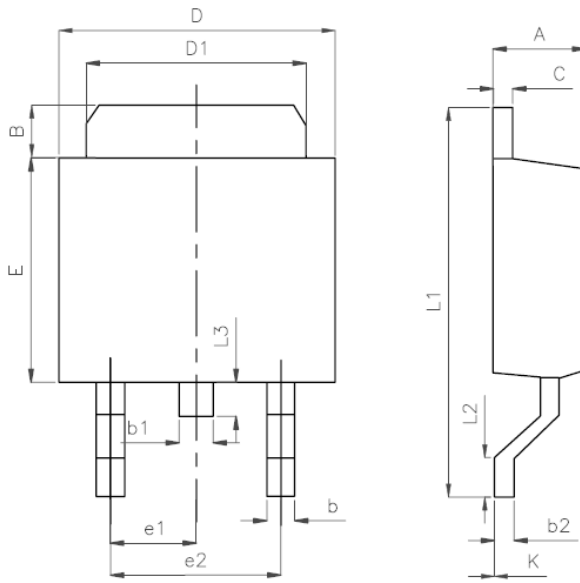
| SYMBOL | MIN | NOM | MAX |
|--------|------|------|-------|
| A | 4.5 | | 4.9 |
| A1 | 2.3 | | 2.9 |
| b | 0.65 | | 0.9 |
| b1 | 1.1 | | 1.7 |
| b2 | 1.2 | | 1.4 |
| c | 0.35 | | 0.65 |
| D | 14.5 | | 16.5 |
| D1 | 6.1 | | 6.9 |
| E | 9.6 | | 10.3 |
| E1 | 6.5 | 7 | 7.5 |
| e | 2.44 | 2.54 | 2.64 |
| L | 12.5 | | 14.3 |
| L1 | 9.45 | | 10.05 |
| L2 | 15 | | 16 |
| L3 | 3.2 | | 4.4 |
| φP | 3 | | 3.3 |
| Q | 2.5 | | 2.9 |

TO-220F Part Marking Information



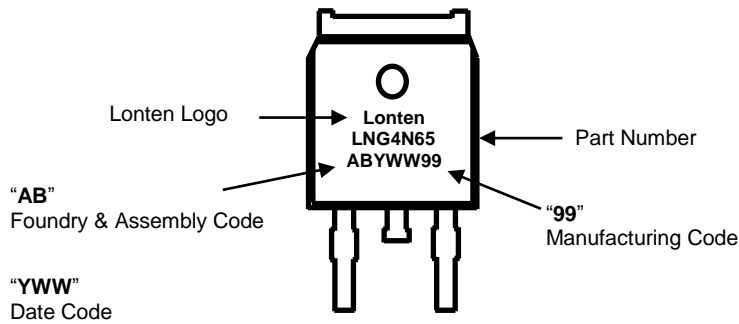
Mechanical Dimensions for TO-252

UNIT: mm



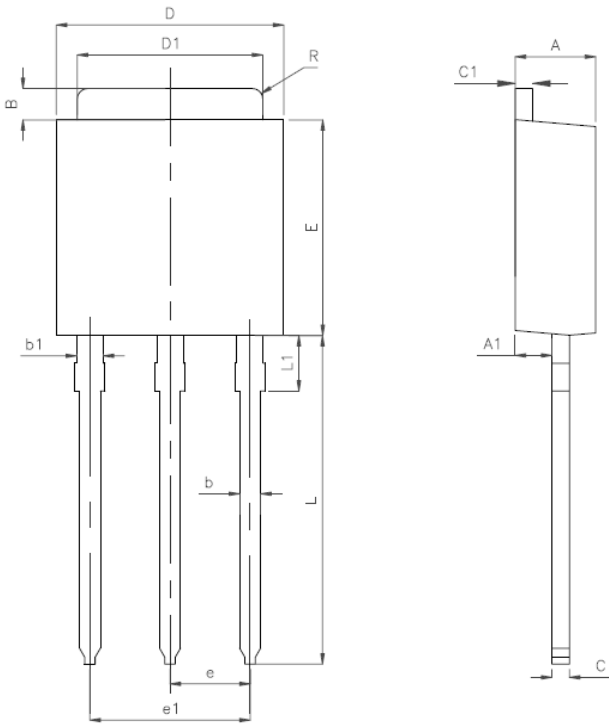
| SYMBOL | MIN | NOM | MAX |
|--------|------|------|-------|
| A | 2.10 | | 2.50 |
| B | 0.80 | | 1.25 |
| b | 0.50 | | 0.85 |
| b1 | 0.50 | | 0.90 |
| b2 | 0.45 | | 0.60 |
| C | 0.45 | | 0.60 |
| D | 6.35 | | 6.75 |
| D1 | 5.10 | | 5.50 |
| E | 5.80 | | 6.30 |
| e1 | 2.25 | 2.30 | 2.35 |
| e2 | 4.45 | | 4.75 |
| L1 | 9.50 | | 10.20 |
| L2 | 0.90 | | 1.45 |
| L3 | 0.60 | | 1.10 |
| K | -0.1 | | 0.10 |

TO-252 Part Marking Information



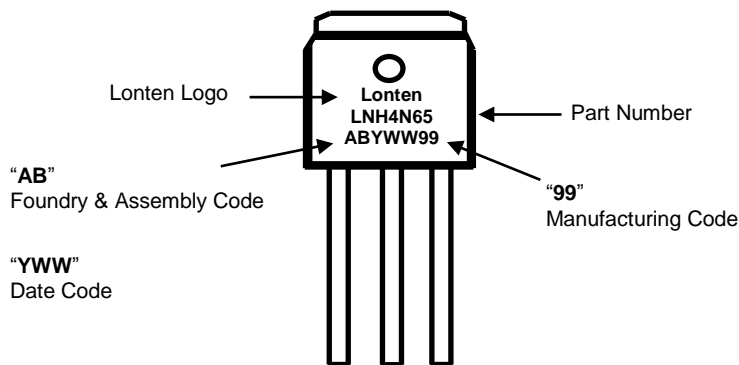
Mechanical Dimensions for TO-251

UNIT: mm

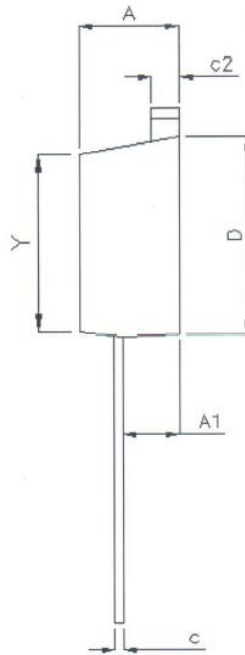
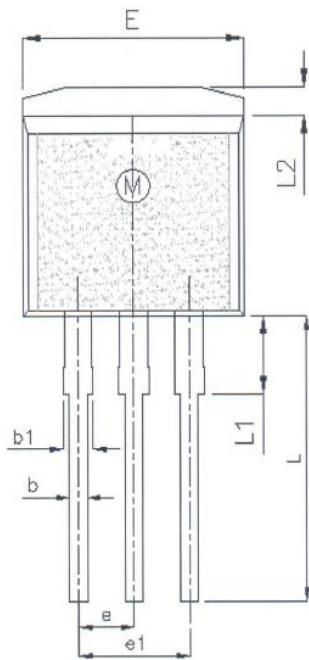


| SYMBOL | MIN | NOM | MAX |
|--------|------|------|------|
| A | 2.10 | | 2.50 |
| A1 | 0.95 | | 1.30 |
| B | 0.80 | | 1.25 |
| b | 0.50 | | 0.80 |
| b1 | 0.70 | | 0.90 |
| C | 0.45 | | 0.60 |
| C1 | 0.45 | | 0.60 |
| D | 6.35 | | 6.75 |
| D1 | 5.10 | | 5.50 |
| E | 5.80 | | 6.30 |
| e | 2.25 | 2.30 | 2.35 |
| L | 7.70 | | 8.50 |
| L1 | 1.45 | | 1.95 |
| R | | 0.30 | |

TO-251 Part Marking Information



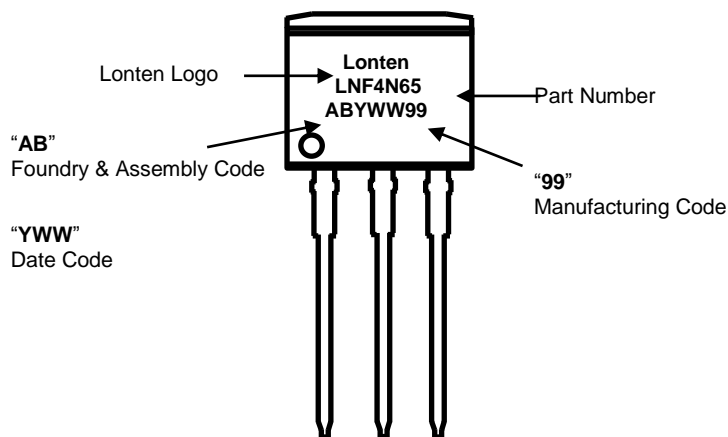
Mechanical Dimensions for TO-262



UNIT: mm

| SYMBOL | MIN | NOM | MAX |
|--------|-------|------|-------|
| A | 4.42 | | 4.72 |
| A1 | 2.40 | | 2.80 |
| b | 0.76 | | 0.86 |
| b1 | 1.22 | | 1.40 |
| c | 0.33 | | 0.43 |
| c2 | 1.22 | | 1.35 |
| D | 8.99 | | 9.29 |
| e | 2.44 | 2.54 | 2.64 |
| e1 | 4.98 | | 5.18 |
| E | 9.95 | | 10.25 |
| L | 12.50 | | 13.60 |
| L1 | 3.30 | 3.50 | 3.80 |
| L2 | 1.22 | | 1.40 |
| Y | 8.02 | 8.12 | 8.22 |

TO-262 Part Marking Information



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Dec. 2018 Revision 1.4

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