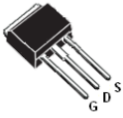

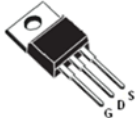
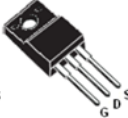
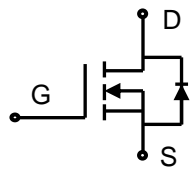



## Lonten N-channel 600V, 4A Power MOSFET

|   |   |           |      |       |    |                  |              |             |         |
|---|---|-----------|------|-------|----|------------------|--------------|-------------|---------|
| <p><b>Description</b><br/>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><b>Features</b></p> <ul style="list-style-type: none"> <li>◆ Low <math>R_{DS(on)}</math></li> <li>◆ Low gate charge (typ. <math>Q_g = 12.8</math> nC)</li> <li>◆ 100% UIS tested</li> <li>◆ RoHS compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>◆ Power factor correction.</li> <li>◆ Switched mode power supplies.</li> <li>◆ LED driver.</li> </ul> | <p><b>Product Summary</b></p> <table> <tr> <td><math>V_{DSS}</math></td> <td>600V</td> </tr> <tr> <td><math>I_D</math></td> <td>4A</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td>2.4<math>\Omega</math></td> </tr> <tr> <td><math>Q_{g,typ}</math></td> <td>12.8 nC</td> </tr> </table> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <br/>TO-251         </div> <div style="text-align: center;"> <br/>TO-252         </div> <div style="text-align: center;"> <br/>TO-220         </div> <div style="text-align: center;"> <br/>TO-220F         </div> </div> <div style="text-align: center; margin-top: 20px;"> <br/>N-Channel MOSFET         </div> <div style="text-align: right; margin-top: 10px;">  </div> | $V_{DSS}$ | 600V | $I_D$ | 4A | $R_{DS(on),max}$ | 2.4 $\Omega$ | $Q_{g,typ}$ | 12.8 nC |
| $V_{DSS}$   | 600V  |           |      |       |    |                  |              |             |         |
| $I_D$   | 4A  |           |      |       |    |                  |              |             |         |
| $R_{DS(on),max}$  | 2.4 $\Omega$  |           |      |       |    |                  |              |             |         |
| $Q_{g,typ}$   | 12.8 nC   |           |      |       |    |                  |              |             |         |

### Absolute Maximum Ratings

| Parameter   | Symbol         | Value       | Unit                |
|---|----------------|-------------|---------------------|
| Drain-Source Voltage  | $V_{DSS}$      | 600         | 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 <sup>1)</sup>                                  | $I_{DM}$       | 16          | A                   |
| Gate-Source voltage   | $V_{GSS}$      | $\pm 30$    | V                   |
| Avalanche energy, single pulse <sup>2)</sup>                        | $E_{AS}$       | 245         | mJ                  |
| Peak diode recovery dv/dt <sup>3)</sup>                             | dv/dt          | 5           | V/ns                |
| Power Dissipation TO-220F ( $T_C = 25^\circ\text{C}$ )              | $P_D$          | 32          | W                   |
| Derate above $25^\circ\text{C}$                                     |                | 0.26        | W/ $^\circ\text{C}$ |
| Power Dissipation TO-220\TO-251\TO-252 ( $T_C = 25^\circ\text{C}$ ) |                | 77          | W                   |
| Derate above $25^\circ\text{C}$                                     |                | 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 |                           |
| Thermal resistance, Junction-to-case    | $R_{\theta JC}$ | 3.8     | 1.62                 | $^\circ\text{C}/\text{W}$ |
| Thermal resistance, Junction-to-ambient | $R_{\theta JA}$ | 62.5    | 110                  | $^\circ\text{C}/\text{W}$ |

**Package Marking and Ordering Information**

| Device  | Device Package | Marking | Units/Tube | Units/Real |
|---------|----------------|---------|------------|------------|
| LNC4N60 | TO-220         | LNC4N60 | 50         |            |
| LND4N60 | TO-220F        | LND4N60 | 50         |            |
| LNG4N60 | TO-252         | LNG4N60 |            | 3000       |
| LNH4N60 | TO-251         | LNH4N60 | 80         |            |

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

| Parameter                            | Symbol        | Test Condition   | Min. | Typ. | Max.     | Unit          |
|--------------------------------------|---------------|--|------|------|----------|---------------|
| <b>Static characteristics</b>        |               |  |      |      |          |               |
| Drain-source breakdown voltage       | $BV_{DSS}$    | $V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$  | 600  | -    | -        | V             |
| Gate threshold voltage               | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=0.25\text{ mA}$  | 2    | -    | 4        | V             |
| Drain cut-off current                | $I_{DSS}$     | $V_{DS}=600\text{ V}, V_{GS}=0\text{ V},$<br>$T_j = 25^\circ\text{C}$<br>$T_j = 125^\circ\text{C}$ | -    | -    | 1<br>100 | $\mu\text{A}$ |
| 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     | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=2\text{ A}$   | -    | 2.0  | 2.4      | $\Omega$      |
| <b>Dynamic characteristics</b>       |               |  |      |      |          |               |
| Input capacitance                    | $C_{iss}$     | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$                                 | -    | 580  | -        | pF            |
| Output capacitance                   | $C_{oss}$     |  | -    | 50   | -        |               |
| Reverse transfer capacitance         | $C_{rss}$     |  | -    | 3    | -        |               |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{DD} = 300\text{ V}, I_D = 4\text{ A}$<br>$R_G = 10\ \Omega, V_{GS}=15\text{ V}$                | -    | 13   | -        | ns            |
| Rise time                            | $t_r$         |  | -    | 31   | -        |               |
| Turn-off delay time                  | $t_{d(off)}$  |  | -    | 38   | -        |               |
| Fall time                            | $t_f$         |  | -    | 17   | -        |               |
| <b>Gate charge characteristics</b>   |               |  |      |      |          |               |
| Gate to source charge                | $Q_{gs}$      | $V_{DD}=480\text{ V}, I_D=4\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$                         | -    | 3.1  | -        | nC            |
| Gate to drain charge                 | $Q_{gd}$      |  | -    | 5.5  | -        |               |
| Gate charge total                    | $Q_g$         |  | -    | 12.8 | -        |               |
| Gate plateau voltage                 | $V_{plateau}$ |  | -    | 5    | -        | V             |
| <b>Reverse diode characteristics</b> |               |  |      |      |          |               |
| Diode forward voltage                | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=4\text{ A}$  | -    | -    | 1.5      | V             |
| Reverse recovery time                | $t_{rr}$      | $V_R=400\text{ V}, I_F=4\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$                          | -    | 275  | -        | ns            |
| Reverse recovery charge              | $Q_{rr}$      |  | -    | 1.43 | -        | $\mu\text{C}$ |
| Peak reverse recovery current        | $I_{rrm}$     |  | -    | 10.4 | -        | A             |

**Notes:**

- Pulse width limited by maximum junction temperature.
- $L=10\text{mH}, I_{AS} = 7\text{A},$  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

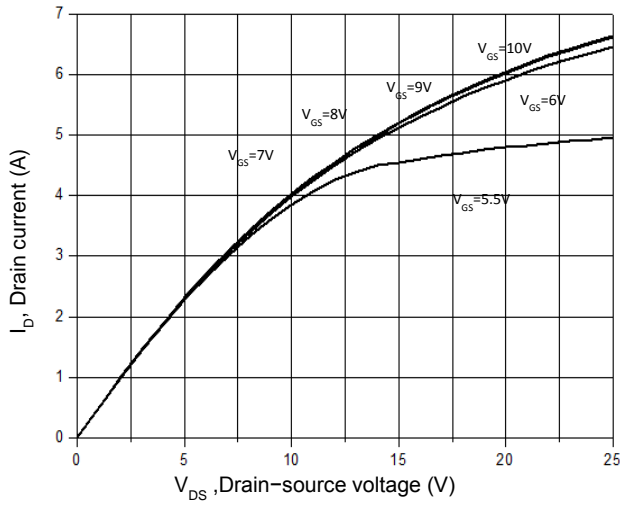


Figure 2. Transfer Characteristics

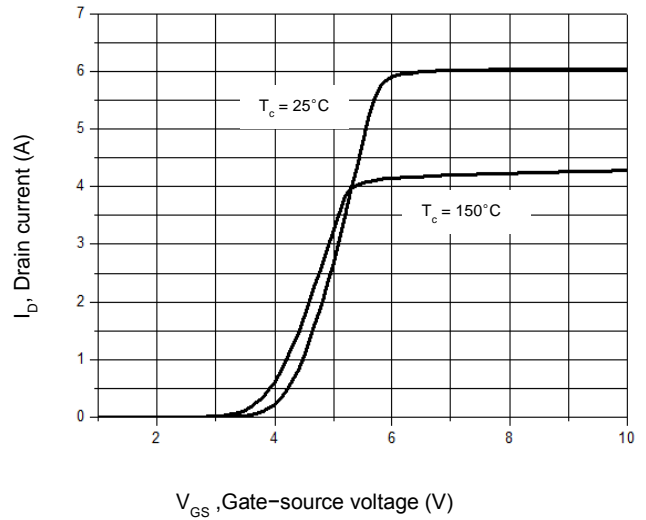


Figure 3. On-Resistance Variation vs. Drain Current

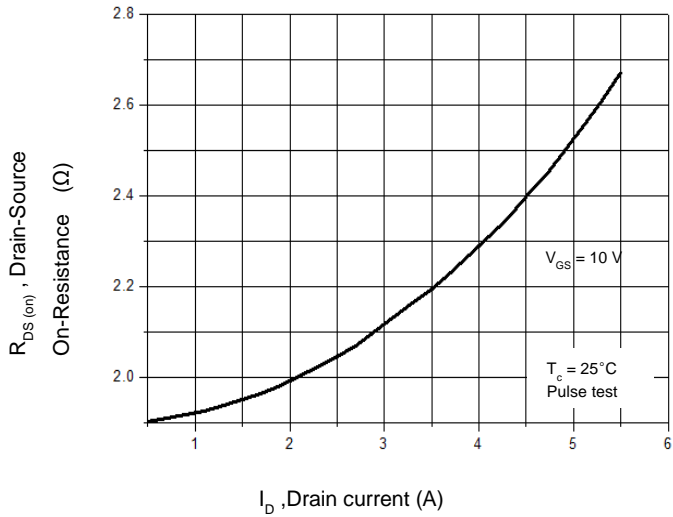


Figure 4. Threshold Voltage vs. Temperature

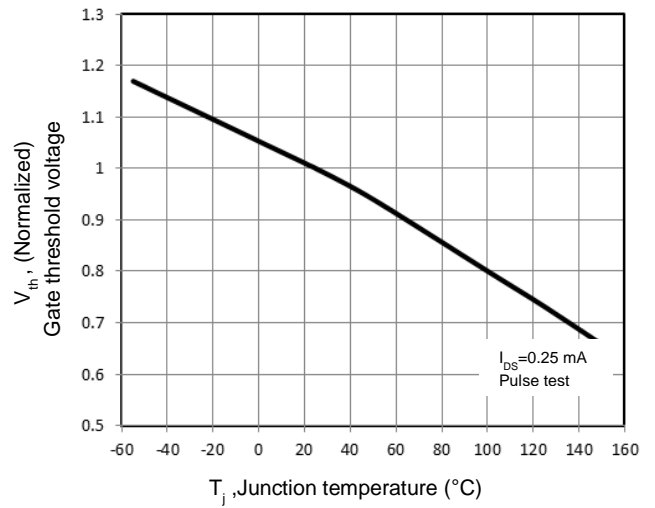


Figure 5. Breakdown Voltage vs. Temperature

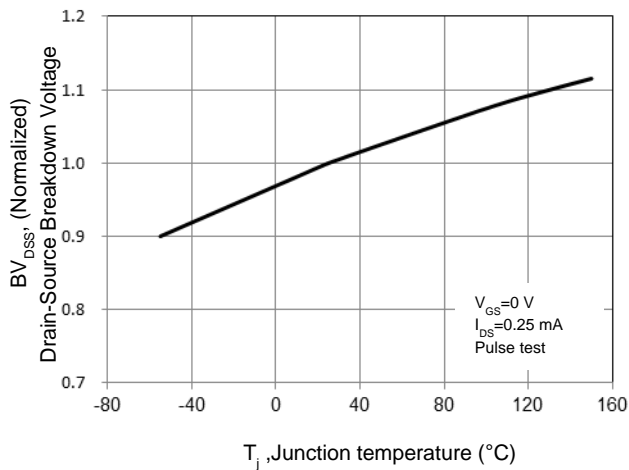


Figure 6. On-Resistance vs. Temperature

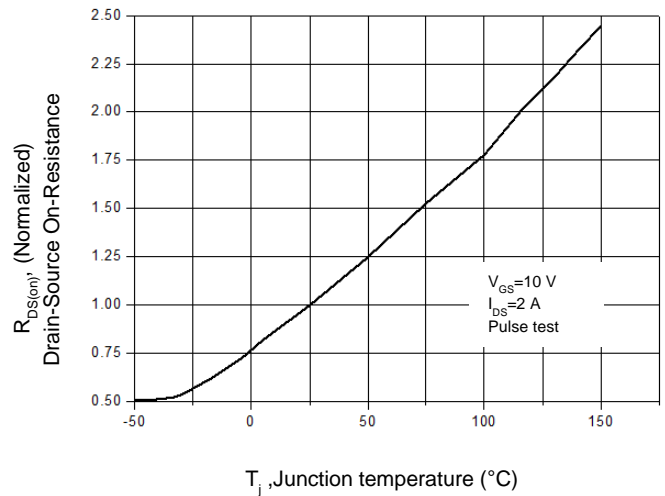


Figure 7. Capacitance Characteristics

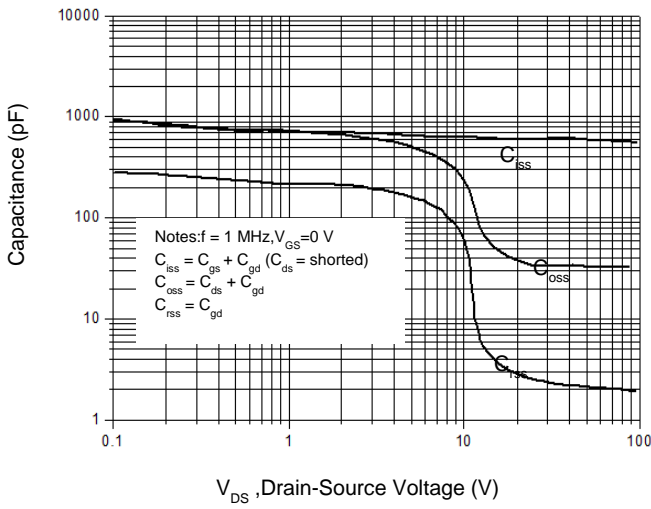


Figure 8. Gate Charge Characterist

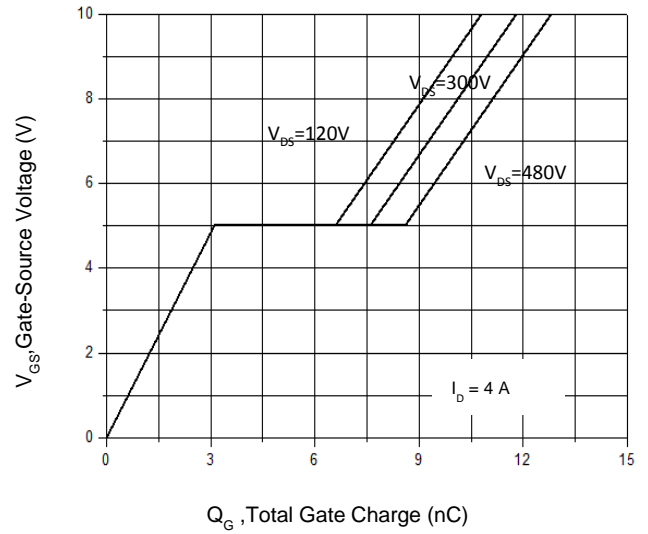


Figure 9. Maximum Safe Operating Area  
TO-220F

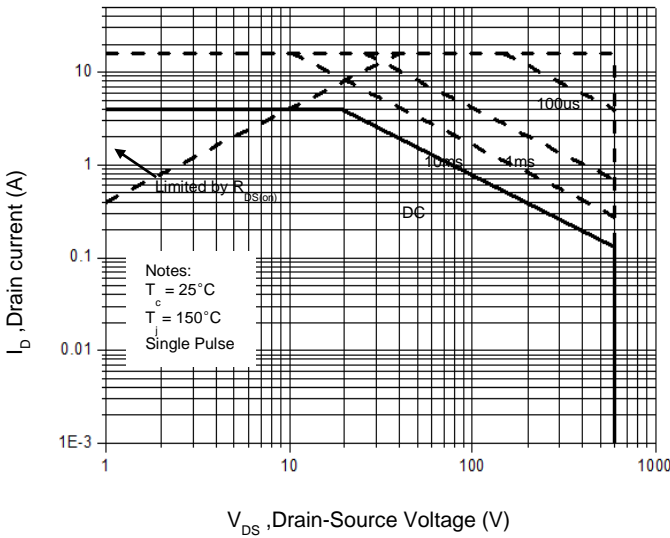


Figure 10. Maximum Safe Operating Area  
TO-220/TO-251/TO-252

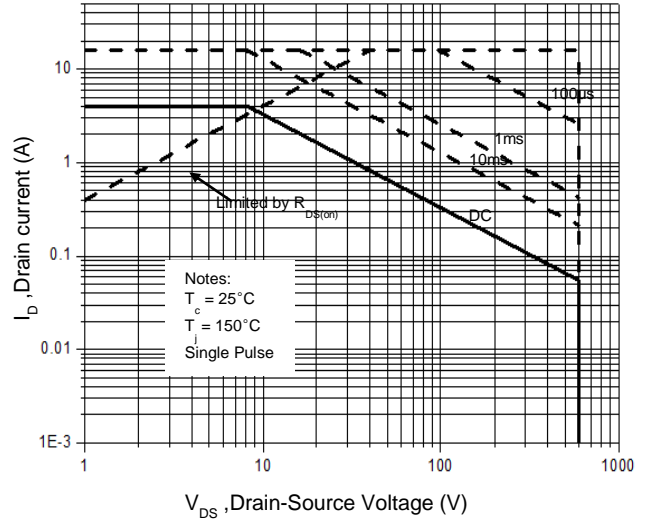


Figure 11. Power Dissipation vs. Temperature  
TO-220F

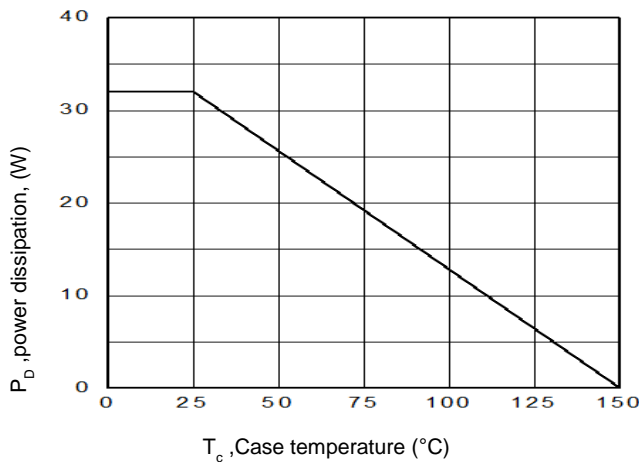


Figure 12. Power Dissipation vs. Temperature  
TO-220/TO-251/TO-252

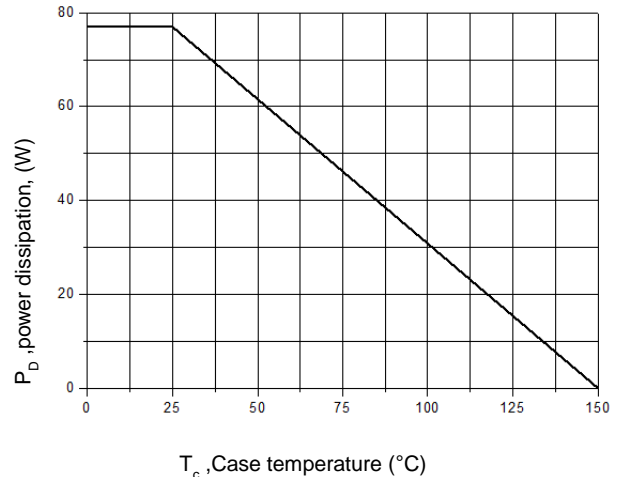


Figure 13. Continuous Drain Current vs. Temperature

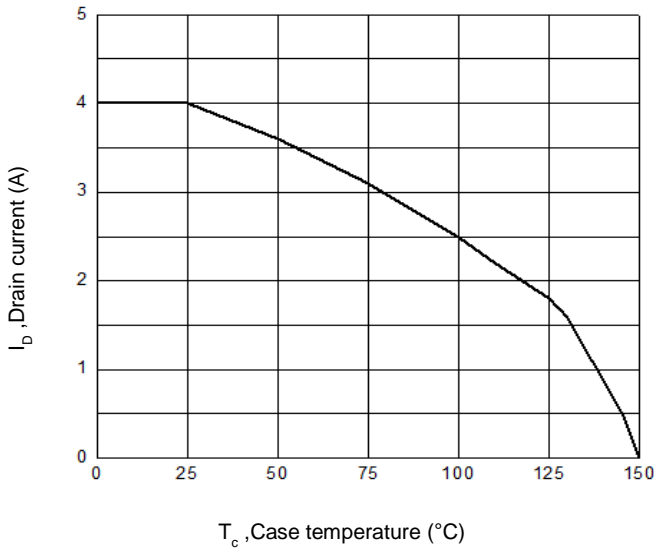


Figure 14. Body Diode Transfer Characteristics

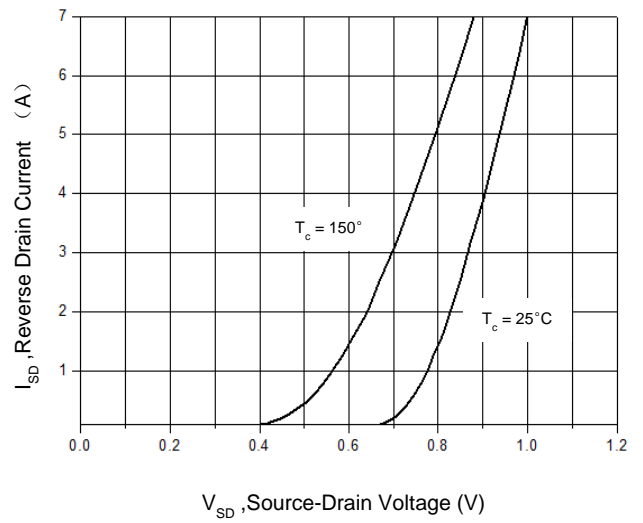


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

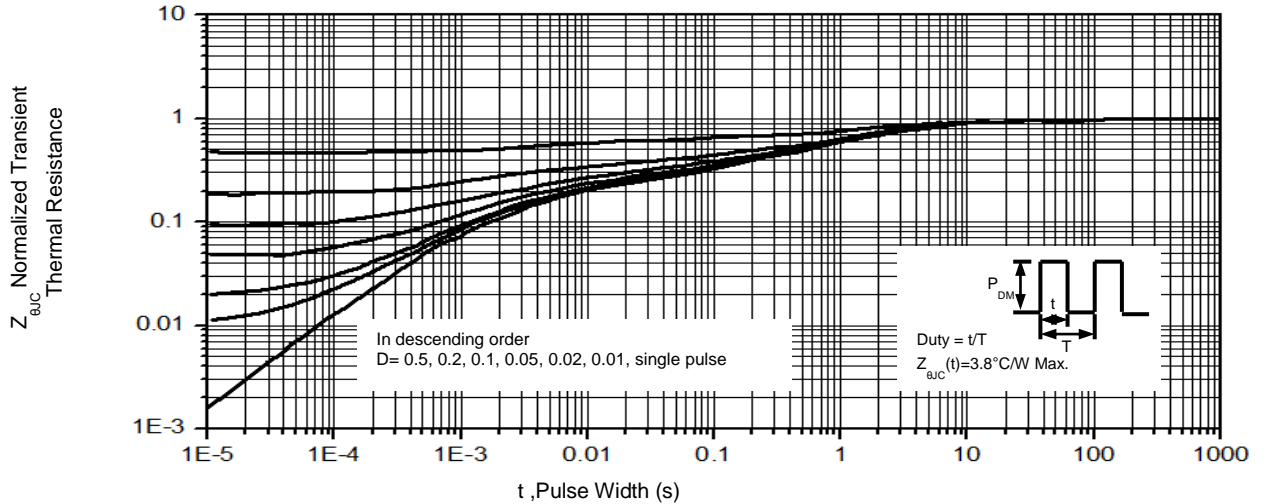
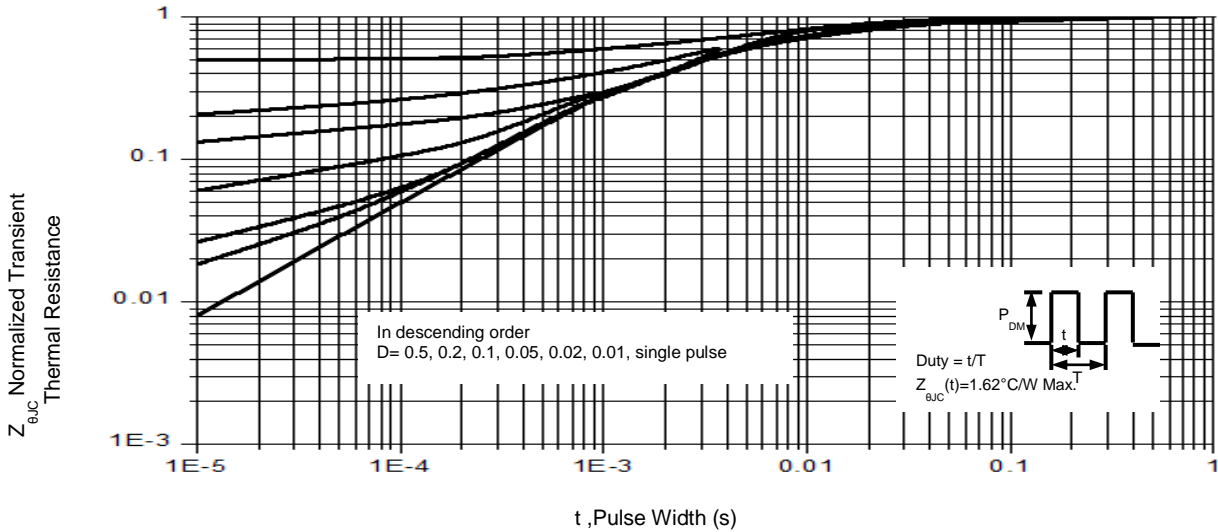
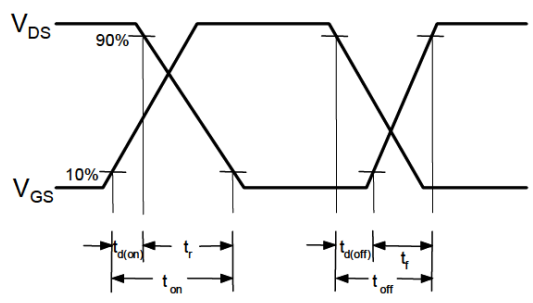
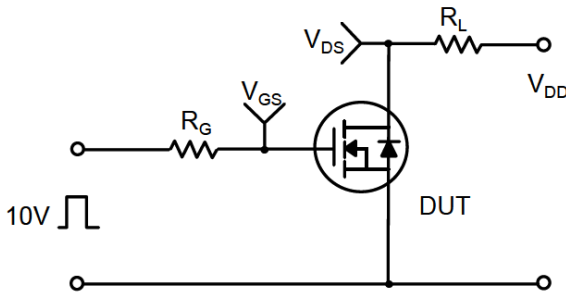
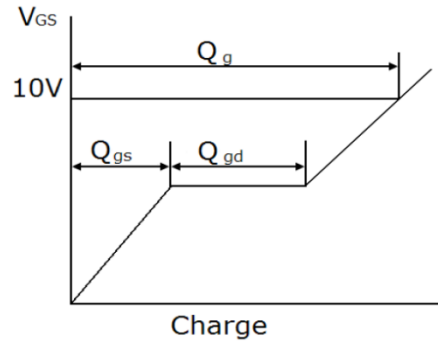
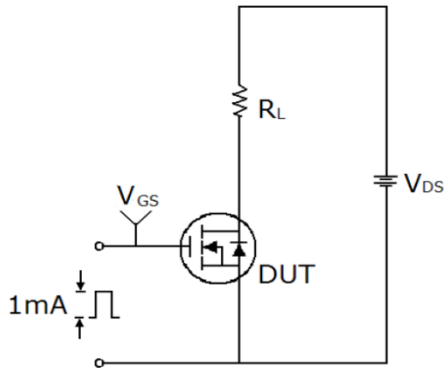


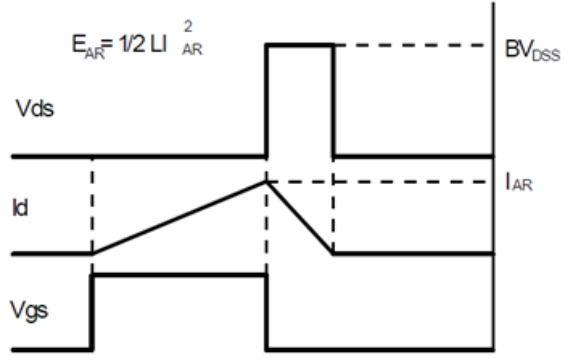
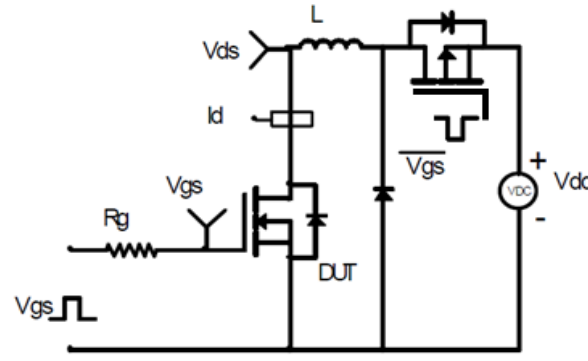
Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/TO-251/TO-252



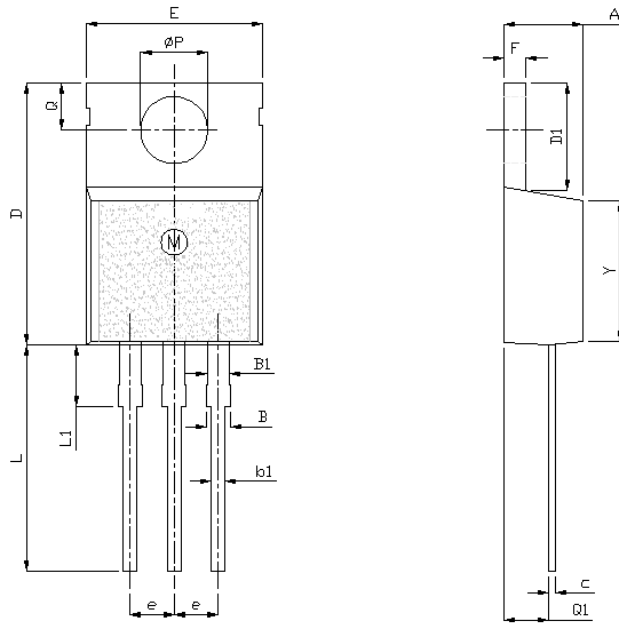
**Gate Charge Test Circuit & Waveform**



**Unclamped Inductive Switching Test Circuit & Waveforms**



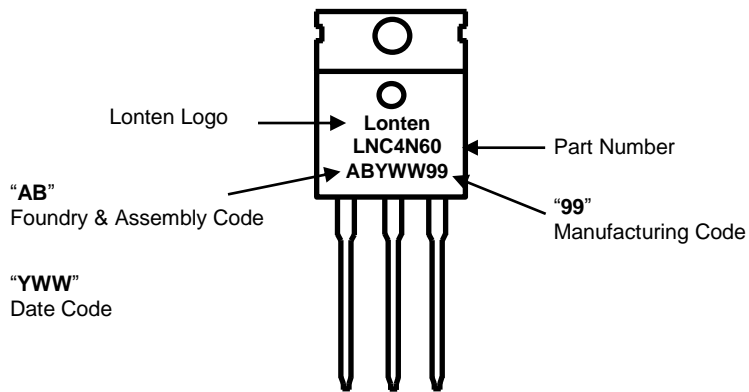
**Mechanical Dimensions for TO-220**



UNIT: mm

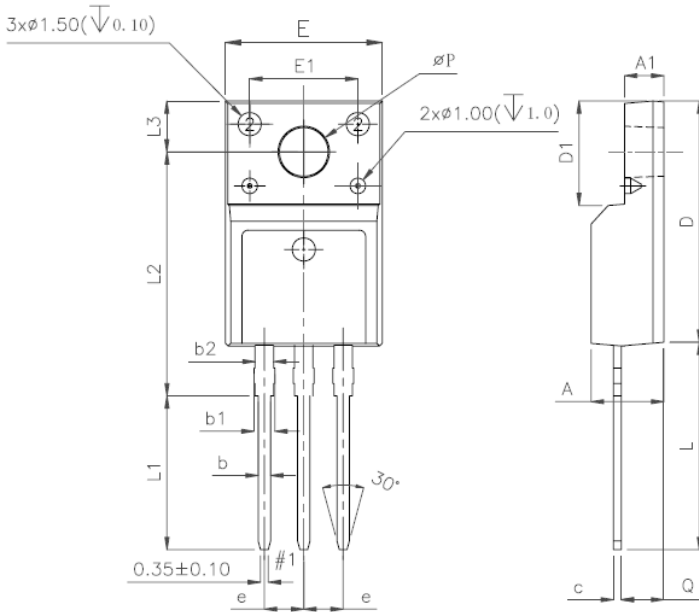
| SYMBOL | MIN  | NOM  | MAX  |
|--------|------|------|------|
| A      | 4    |      | 4.8  |
| B      | 1.2  |      | 1.4  |
| B1     | 1    |      | 1.4  |
| b1     | 0.75 |      | 0.95 |
| c      | 0.4  |      | 0.55 |
| D      | 15   |      | 16.5 |
| D1     | 5.9  |      | 6.9  |
| E      | 9.9  |      | 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**



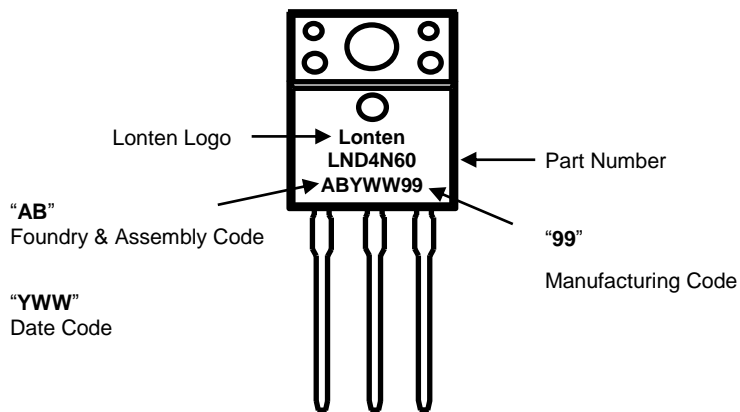
**Mechanical Dimensions for TO-220F**

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   |

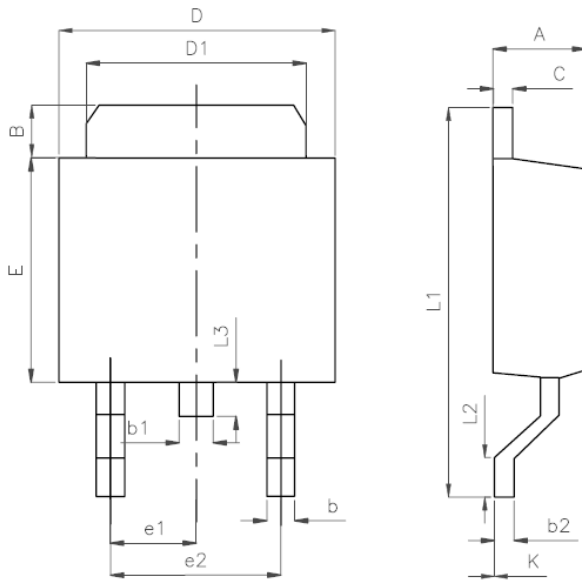
**TO-220F Part Marking Information**





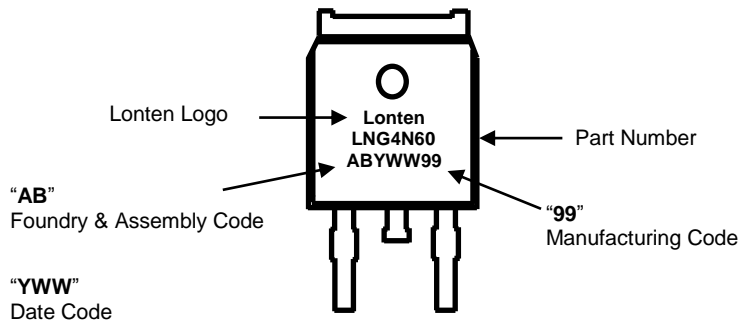
**Mechanical Dimensions for TO-252**

UNIT: mm



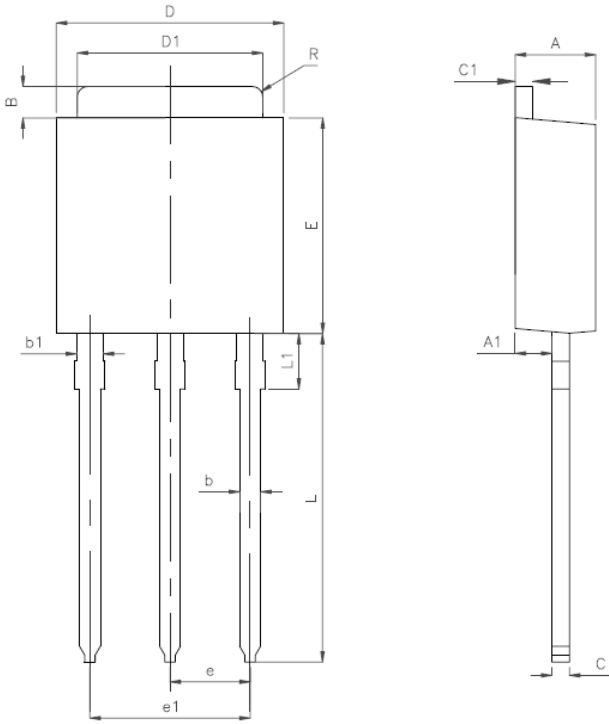
| SYMBOL | MIN  | NOM  | MAX   |
|--------|------|------|-------|
| A      | 2.10 |      | 2.50  |
| B      | 0.80 |      | 1.25  |
| b      | 0.50 |      | 0.85  |
| b1     | 0.50 |      | 0.90  |
| b2     | 0.45 |      | 0.60  |
| C      | 0.45 |      | 0.60  |
| D      | 6.35 |      | 6.75  |
| D1     | 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**



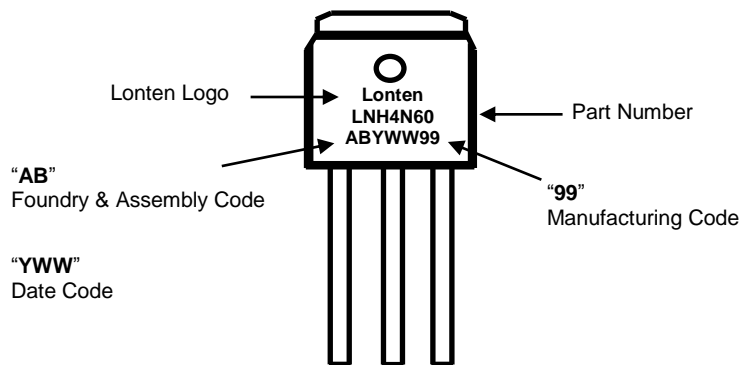
**Mechanical Dimensions for TO-251**

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**



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Dec. 2018 Revision 1.1

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