# Lonten N-channel 650V, 4A Power MOSFET

## Description

The Power MOSFET is fabricated using the advanced planar VDMOS technology. The resulting device has low conduction resistance, superior switching performance and high avalance energy.

## Features

- Low $R_{DS(on)}$
- Low gate charge (typ. $Q_g$ = 12 nC)
- 100% UIS tested
- RoHS compliant

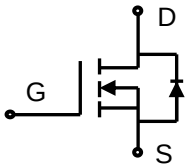
## Applications

- Power faction correction.
- Switched mode power supplies.
- LED driver.

## Product Summary

| | |
|---|---|
| $V_{DSS}$ | 650V |
| $I_D$ | 4A |
| $R_{DS(on),max}$ | 2.70Ω |
| $Q_{g,typ}$ | 12 nC |

**TO-251** **TO-252** **TO-220** **TO-220F** **TO-262**




N-Channel MOSFET

## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 650 | V |
| Continuous drain current ( $T_C$ = 25°C ) | $I_D$ | 4 | A |
| ( $T_C$ = 100°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°C ) | $P_D$ | 32 | W |
| Derate above 25°C | | 0.26 | W/°C |
| Power Dissipation TO-220\ TO-251\ TO-252\TO-262 ( $T_C$ = 25°C ) | | 77 | W |
| Derate above 25°C | | 0.61 | W/°C |
| Operating juncition and storage temperature range | $T_J$, $T_{STG}$ | -55 to +150 | °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 | °C/W |
| Thermal resistance, Junction-to-ambient | $R_{\theta JA}$ | 62.5 | 110 | °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°C unless otherwise noted

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| Drain-source breakdown voltage | $BV_{DSS}$ | $V_{GS}$=0 V, $I_D$=0.25 mA | 650 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=0.25 mA | 2 | - | 4 | V |
| Drain cut-off current | $I_{DSS}$ | $V_{DS}$=650 V, $V_{GS}$=0 V,<br>$T_j$ = 25°C<br>$T_j$ = 125°C | <br>-<br>- | <br>- | <br>1<br>100 | <br>μA |
| Gate leakage current, Forward | $I_{GSSF}$ | $V_{GS}$=30 V, $V_{DS}$=0 V | - | - | 100 | nA |
| Gate leakage current, Reverse | $I_{GSSR}$ | $V_{GS}$=-30 V, $V_{DS}$=0 V | - | - | -100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10 V, $I_D$=2 A | - | 2.50 | 2.70 | Ω |
| **Dynamic characteristics** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, | - | 600 | - | pF |
| Output capacitance | $C_{oss}$ | f = 1 MHz | - | 55 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 3.2 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$ = 325 V, $I_D$ = 4 A | - | 12 | - | ns |
| Rise time | $t_r$ | $R_G$ = 10 Ω, $V_{GS}$=15 V | - | 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 V, $I_D$=4 A, | - | 3.2 | - | nC |
| Gate to drain charge | $Q_{gd}$ | $V_{GS}$=0 to 10 V | - | 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 V, $I_F$=4 A | - | - | 1.5 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=400 V, $I_F$=4 A, | - | 282 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | $dI_F/dt$=100 A/μs | - | 1.4 | - | μC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 10 | - | A |

Notes:

1. Pulse width limited by maximum junction temperature.

2. L=10mH, $I_{AS}$ = 6.3A, Starting $T_j$= 25°C.

3. $I_{SD}$ = 4A, di/dt≤100A/us, $V_{DD}$≤$BV_{DS}$, Starting $T_j$= 25°C.

## Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

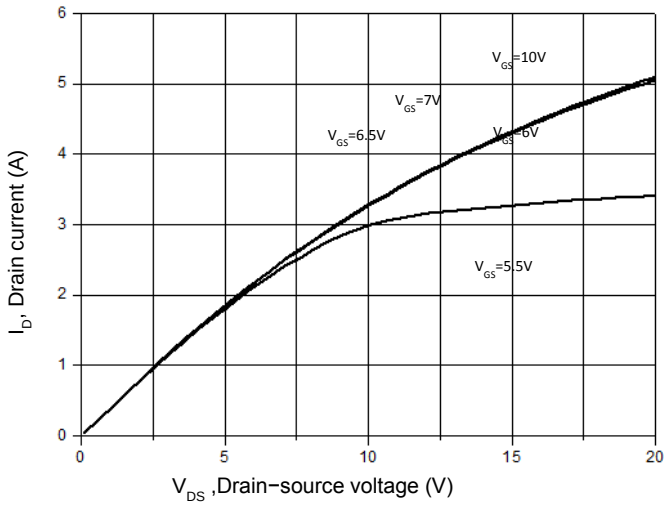



Figure 2. Transfer Characteristics

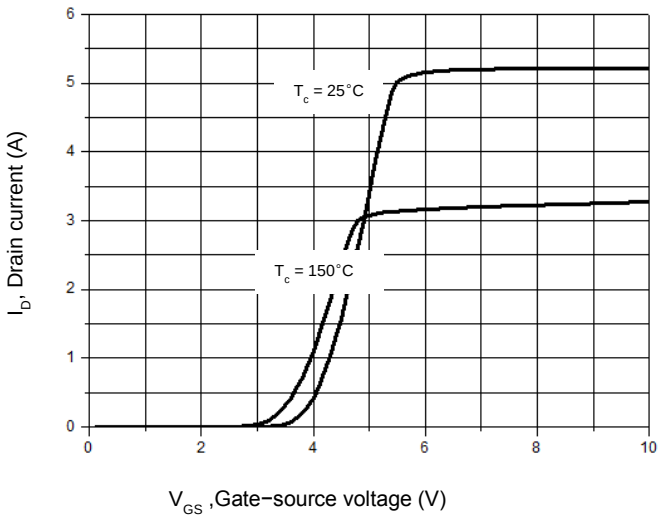



Figure 3. On-Resistance Variation vs. Drain Current

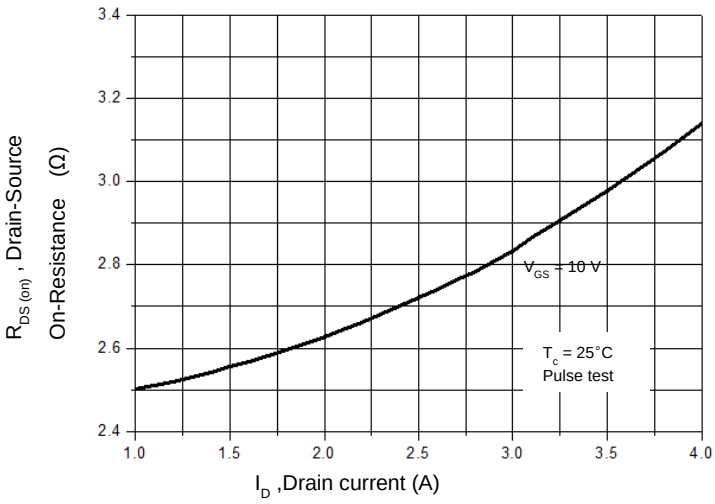



Figure 4. Threshold Voltage vs. Temperature

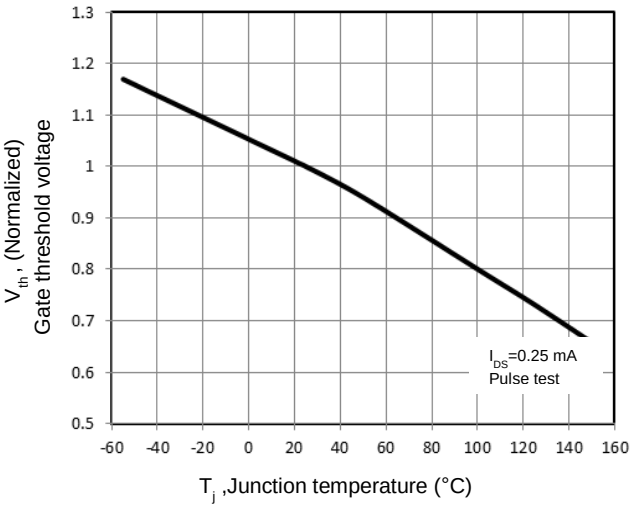



Figure 5. Breakdown Voltage vs. Temperature

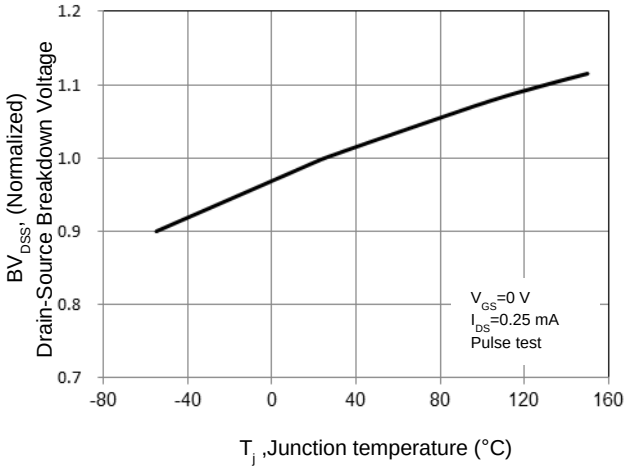



Figure 6. On-Resistance vs. Temperature

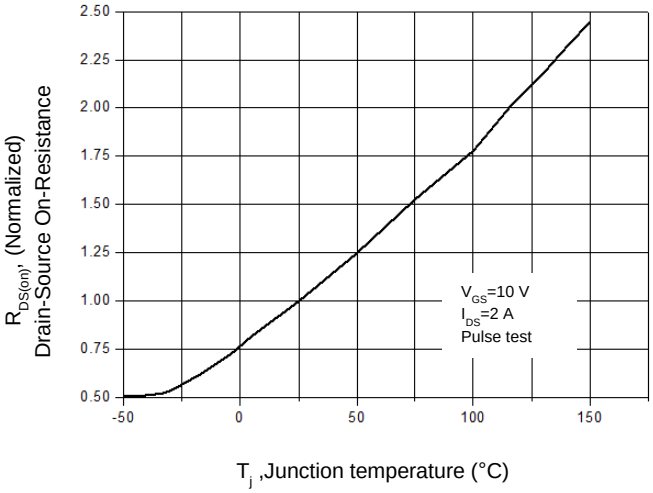


Figure 7. Capacitance Characteristics

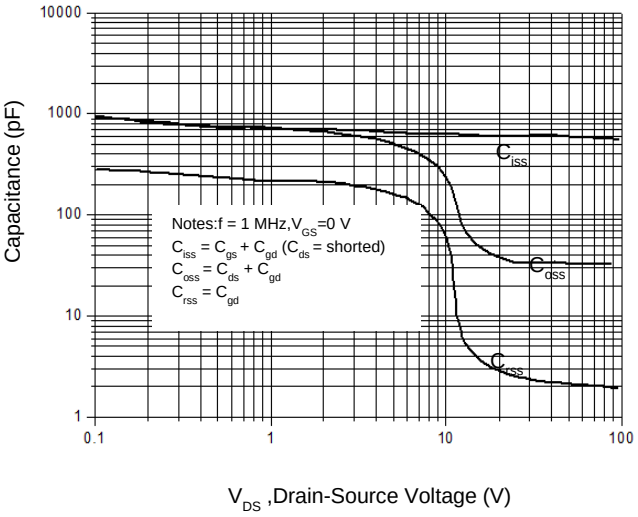



Figure 8. Gate Charge Characterist

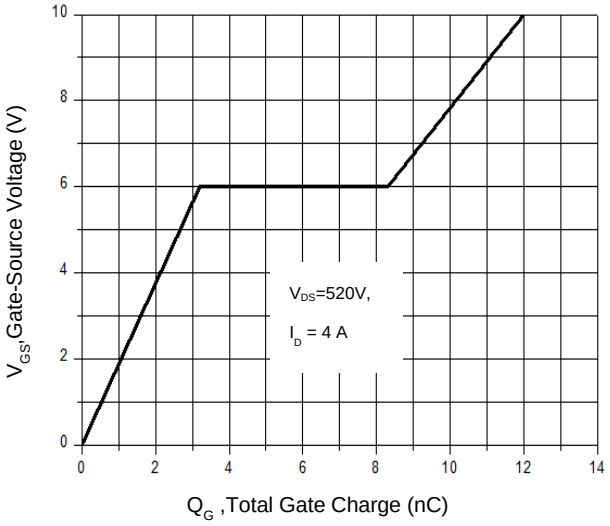



Figure 9. Maximum Safe Operating Area

TO-220F

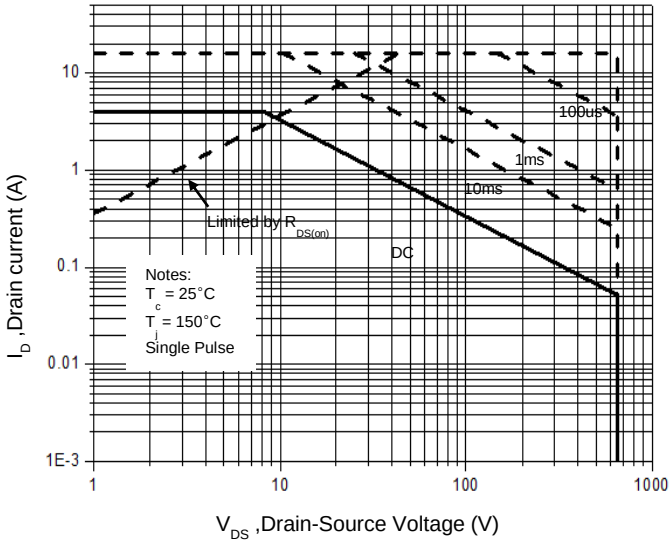



Figure 10. Maximum Safe Operating Area

TO-220/ TO-251/TO-252/TO-262

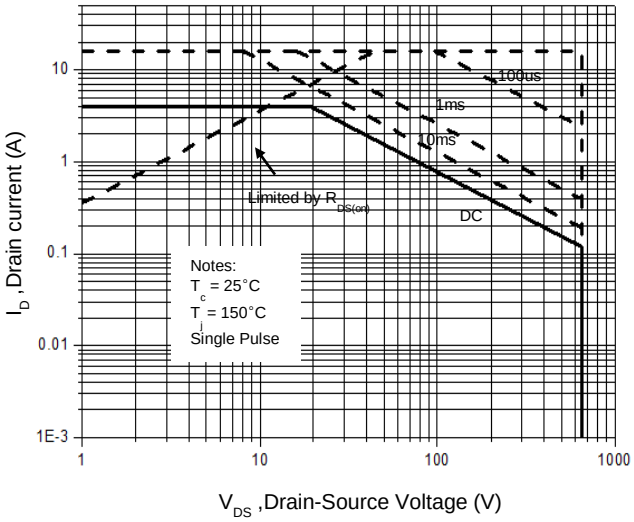



Figure 11. Power Dissipation vs. Temperature

TO-220F

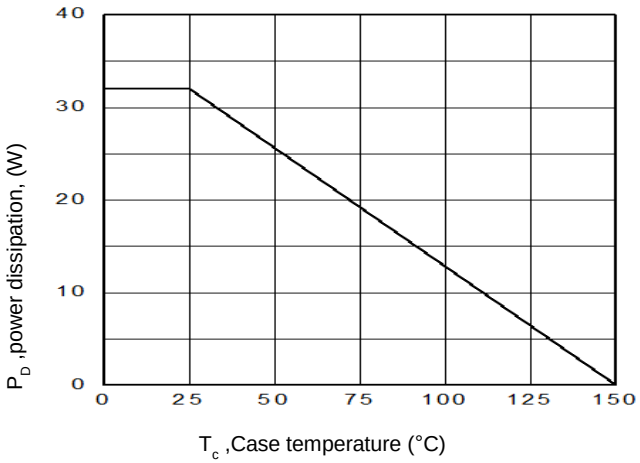



Figure 12. Power Dissipation vs. Temperature

TO-220/ TO-251/TO-252/TO-262

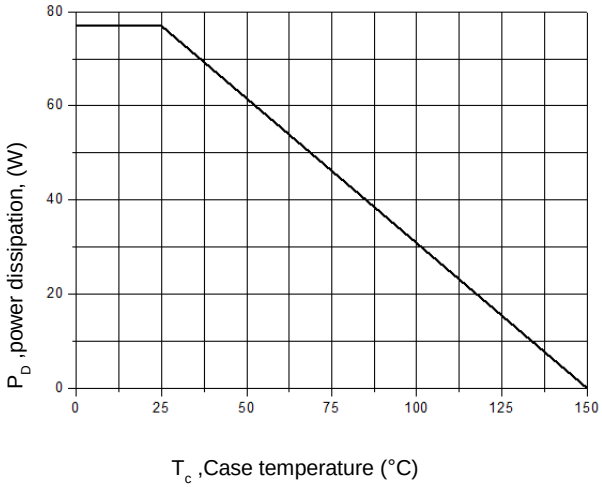


Figure 13. Continuous Drain Current vs. Temperature

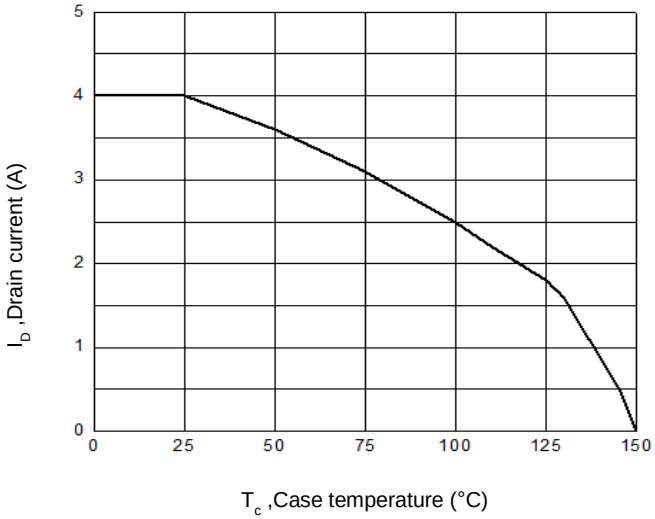



Figure 14. Body Diode Transfer Characteristics

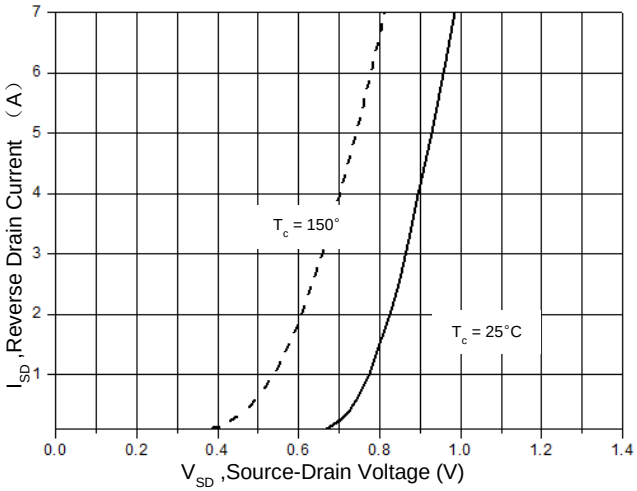



Figure 15 Transient Thermal Impendance,Junction to Case, TO-220F

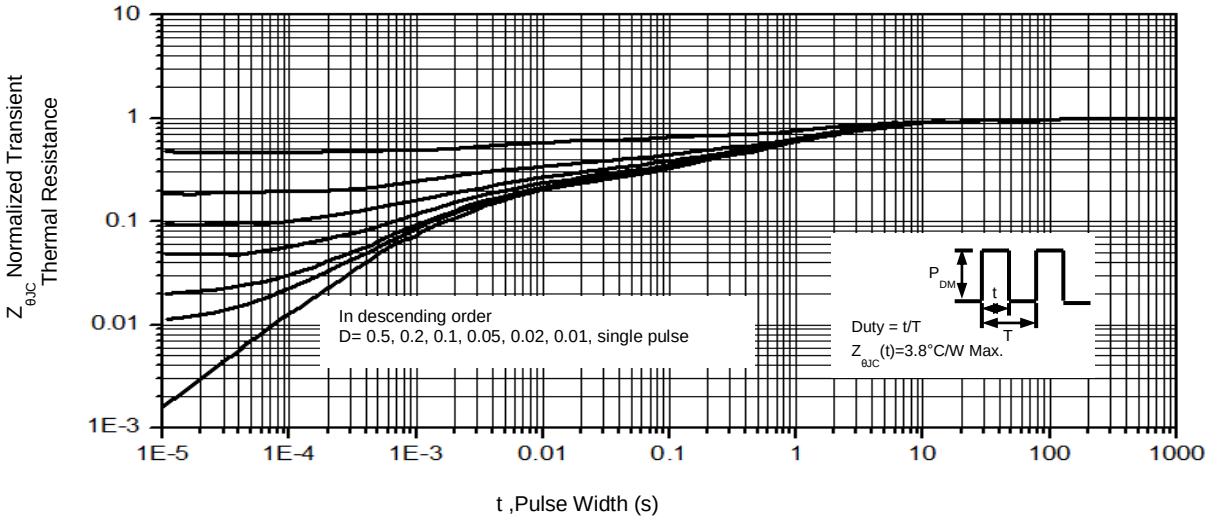
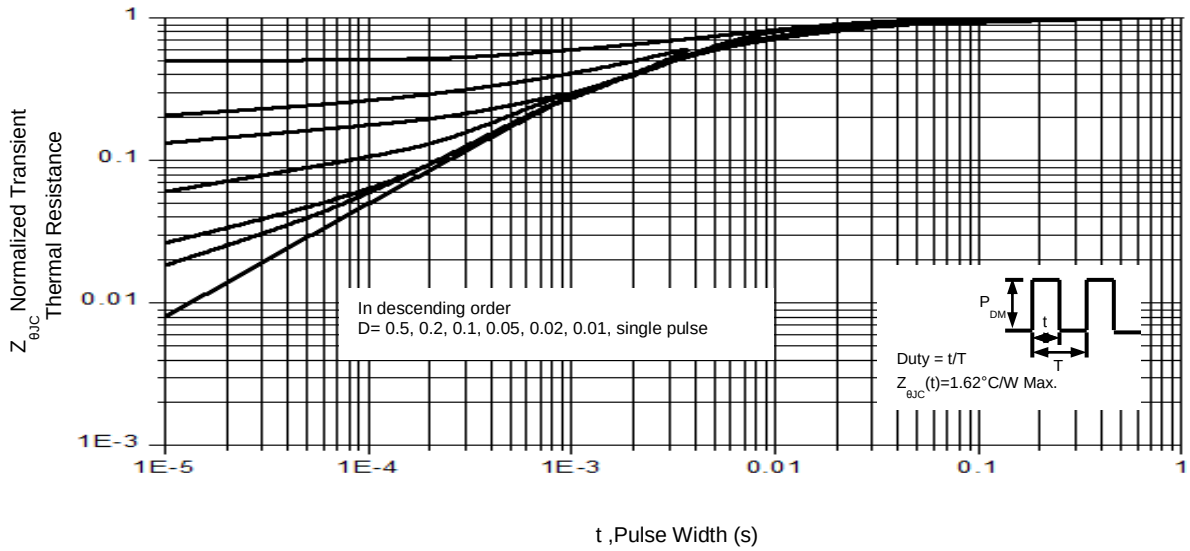
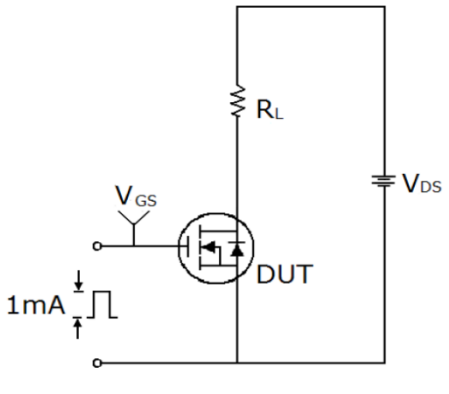
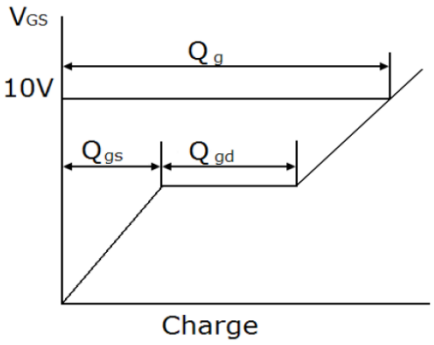


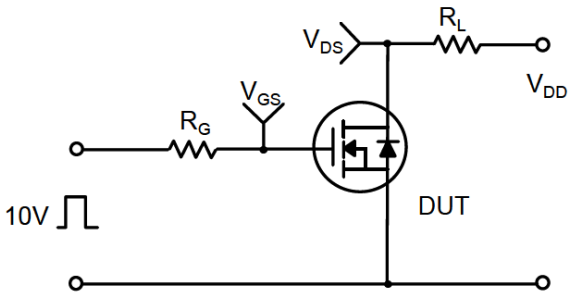

Figure 16. Transient Thermal Impendance,Junction to Case, TO-220/ TO-251/TO-252/TO-262

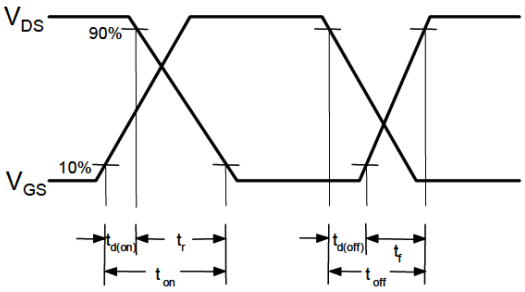


## Gate Charge Test Circuit & Waveform

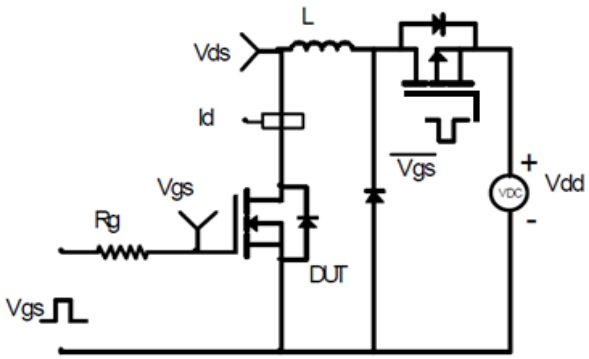


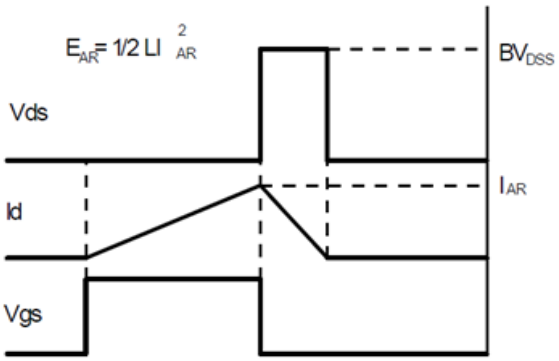



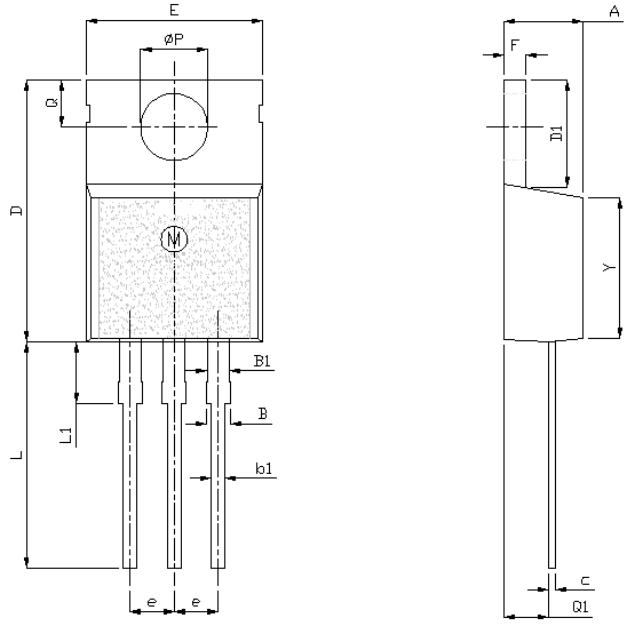




## Unclamped Inductive Switching Test Circuit & Waveforms



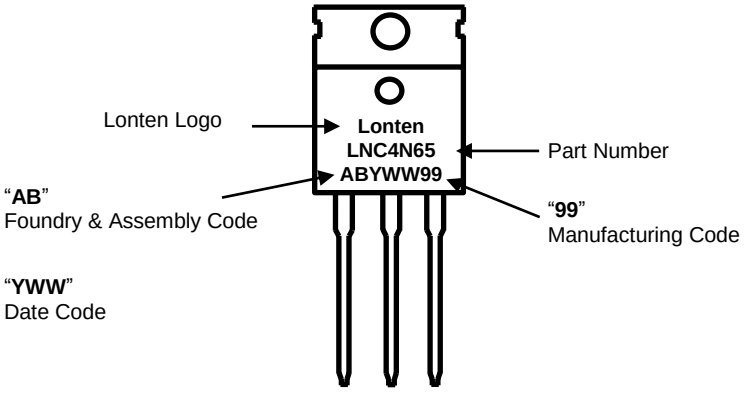
## Mechanical Dimensions for TO-220



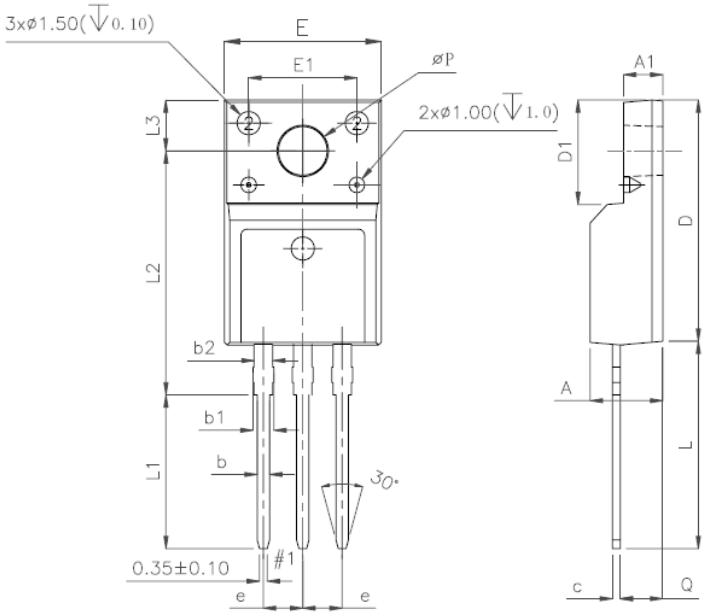

UNIT：mm

| 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



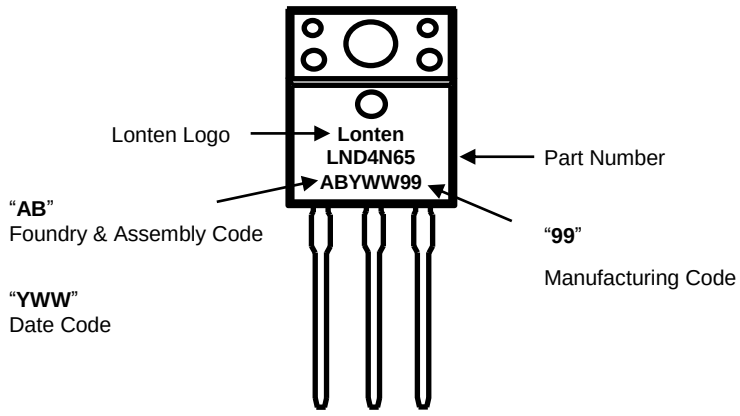
## Mechanical Dimensions for TO-220F



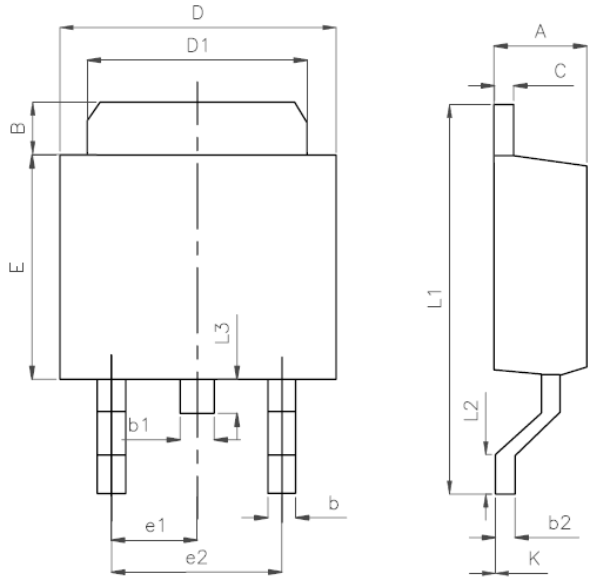

UNIT：mm

| 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



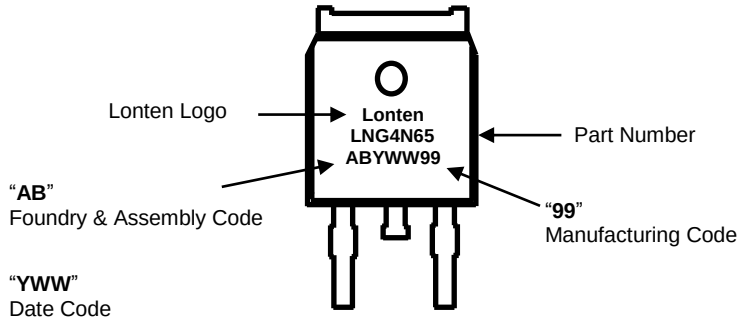
## Mechanical Dimensions for TO-252



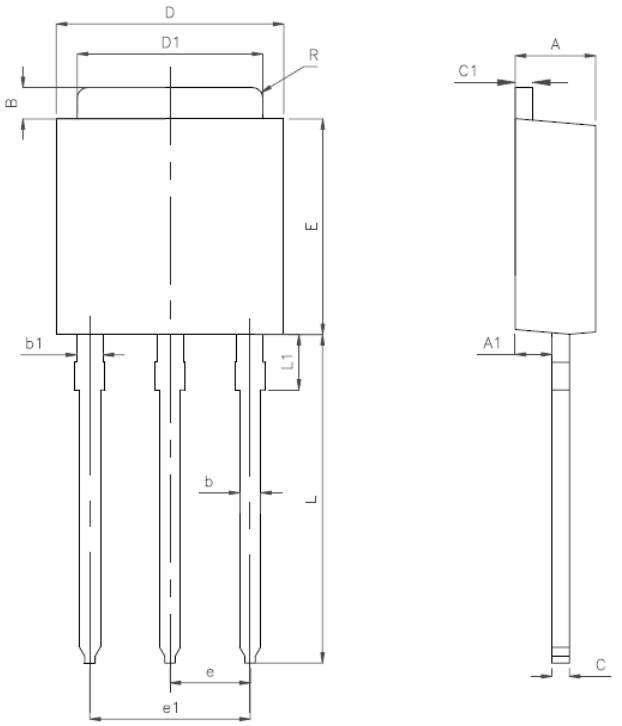

UNIT：mm

| 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



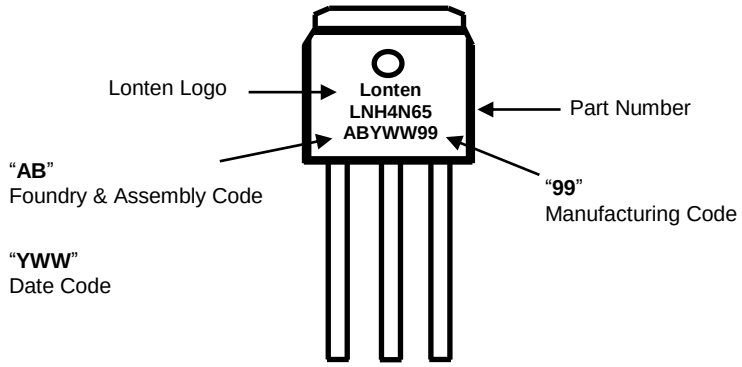
## Mechanical Dimensions for TO-251



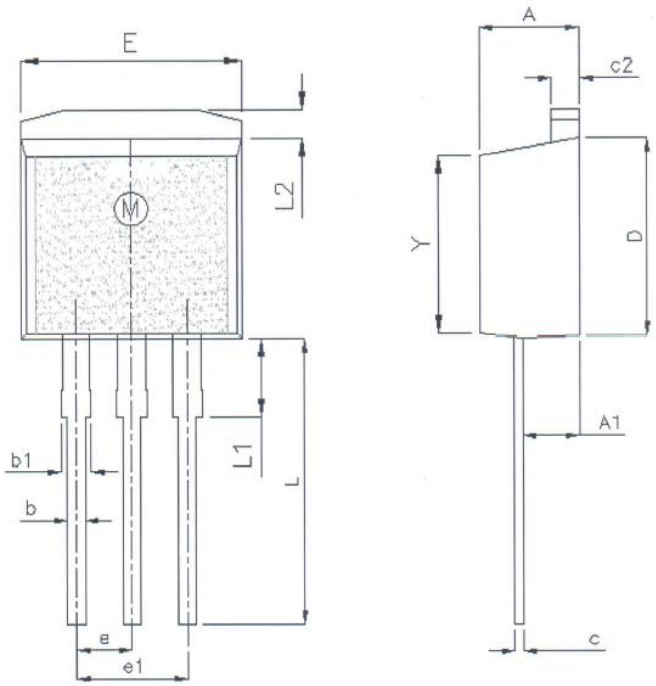

UNIT：mm

| 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