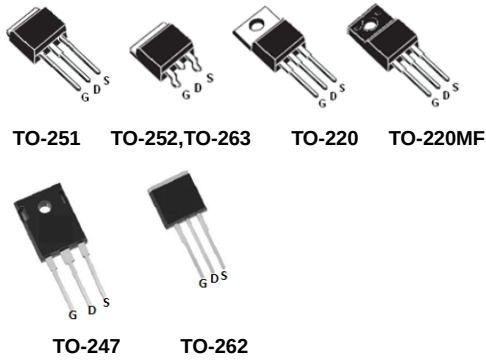
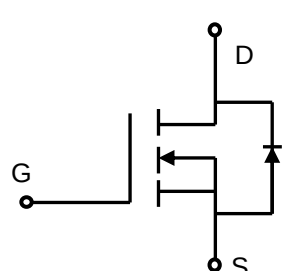


## Lonten N-channel 650V, 11A, 0.40Ω LonFET™ Power MOSFET

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |      |                  |       |          |     |             |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|------------------|-------|----------|-----|-------------|------|
| <p><b>Description</b></p> <p>LonFET™ Power MOSFET is fabricated using advanced super junction technology. The resulting device has extremely low on resistance, making it especially suitable for applications which require superior power density and outstanding efficiency.</p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>◆ Ultra low <math>R_{DS(on)}</math></li> <li>◆ Ultra low gate charge (typ. <math>Q_g = 34nC</math>)</li> <li>◆ High body diode ruggedness</li> <li>◆ Easy to use</li> <li>◆ 100% UIS tested</li> <li>◆ RoHS compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>◆ PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, Adapter, LCD &amp; PDP TV, LED Driver, Server, Telecom and UPS.</li> </ul> | <p><b>Product Summary</b></p> <table> <tr> <td><math>V_{DS} @ T_{j,max}</math></td><td>700V</td></tr> <tr> <td><math>R_{DS(on),max}</math></td><td>0.40Ω</td></tr> <tr> <td><math>I_{DM}</math></td><td>30A</td></tr> <tr> <td><math>Q_{g,typ}</math></td><td>34nC</td></tr> </table>  <p>TO-251 TO-252,TO-263 TO-220 TO-220MF</p> <p>TO-247 TO-262</p>  <p>N-Channel MOSFET</p> | $V_{DS} @ T_{j,max}$ | 700V | $R_{DS(on),max}$ | 0.40Ω | $I_{DM}$ | 30A | $Q_{g,typ}$ | 34nC |
| $V_{DS} @ T_{j,max}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 700V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |      |                  |       |          |     |             |      |
| $R_{DS(on),max}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.40Ω                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |      |                  |       |          |     |             |      |
| $I_{DM}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 30A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |      |                  |       |          |     |             |      |
| $Q_{g,typ}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 34nC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |      |                  |       |          |     |             |      |

### Absolute Maximum Ratings

| Parameter                                               | Symbol         | Value       | Unit       |
|---------------------------------------------------------|----------------|-------------|------------|
| Drain-Source Voltage                                    | $V_{DS}$       | 650         | V          |
| Continuous drain current ( $T_C = 25^\circ C$ )         | $I_D$          | 11          | A          |
| ( $T_C = 100^\circ C$ )                                 |                | 7           | A          |
| Pulsed drain current <sup>1)</sup>                      | $I_{DM}$       | 30          | A          |
| Gate-Source voltage                                     | $V_{GSS}$      | $\pm 20$    | V          |
| Avalanche energy, single pulse <sup>2)</sup>            | $E_{AS}$       | 210         | mJ         |
| Avalanche energy, repetitive <sup>3)</sup>              | $E_{AR}$       | 0.32        | mJ         |
| Avalanche current, repetitive <sup>3)</sup>             | $I_{AR}$       | 1.8         | A          |
| Power Dissipation TO-220 ( $T_C = 25^\circ C$ )         | $P_D$          | 83          | W          |
| Power Dissipation TO-220MF ( $T_C = 25^\circ C$ )       | $P_D$          | 31          | W          |
| Operating and Storage Temperature Range                 | $T_j, T_{STG}$ | -55 to +150 | $^\circ C$ |
| Continuous diode forward current ( $T_C = 25^\circ C$ ) | $I_S$          | 11          | A          |
| Diode pulse current ( $T_C = 25^\circ C$ )              | $I_{S,pulse}$  | 30          | A          |

**Thermal Characteristics TO-247/TO-220/TO-263/TO262/TO-252/TO-251**

| Parameter                               | Symbol          | Value | Unit          |
|-----------------------------------------|-----------------|-------|---------------|
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 1.5   | $^{\circ}C/W$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 62    | $^{\circ}C/W$ |

**Thermal Characteristics TO-220MF**

| Parameter                               | Symbol          | Value | Unit          |
|-----------------------------------------|-----------------|-------|---------------|
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 4.0   | $^{\circ}C/W$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 80    | $^{\circ}C/W$ |

**Package Marking and Ordering Information**

| Device    | Device Package | Marking   |
|-----------|----------------|-----------|
| LSB11N65E | TO-247         | LSB11N65E |
| LSC11N65E | TO-220         | LSC11N65E |
| LSD11N65E | TO-220MF       | LSD11N65E |
| LSE11N65E | TO-263         | LSE11N65E |
| LSG11N65E | TO-252         | LSG11N65E |
| LSH11N65E | TO-251         | LSH11N65E |
| LSF11N65E | TO-262         | LSF11N65E |

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

| Parameter                        | Symbol       | Test Condition                                         | Min. | Typ. | Max. | Unit     |
|----------------------------------|--------------|--------------------------------------------------------|------|------|------|----------|
| <b>Static characteristics</b>    |              |                                                        |      |      |      |          |
| Drain-source breakdown voltage   | $BV_{DSS}$   | $V_{GS}=0V, I_D=0.25mA$                                | 650  | -    | -    | V        |
| Gate threshold voltage           | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=0.25mA$                            | 2.5  | 3    | 3.5  | V        |
| Drain cut-off current            | $I_{DSS}$    | $V_{DS}=650V, V_{GS}=0V,$                              | -    | -    | 1    | $\mu A$  |
| Gate leakage current, Forward    | $I_{GSSF}$   | $V_{GS}=20V, V_{DS}=0V$                                | -    | -    | 100  | nA       |
| Gate leakage current, Reverse    | $I_{GSSR}$   | $V_{GS}=-20V, V_{DS}=0V$                               | -    | -    | -100 | nA       |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=5.5A$                                 | -    | -    | -    | $\Omega$ |
|                                  |              | $T_j = 25^{\circ}C$                                    | -    | 0.35 | 0.40 |          |
|                                  |              | $T_j = 150^{\circ}C$                                   | -    | 0.89 | -    |          |
| Gate resistance                  | $R_G$        | $f=1MHz, \text{open drain}$                            | -    | 8.5  | -    | $\Omega$ |
| <b>Dynamic characteristics</b>   |              |                                                        |      |      |      |          |
| Input capacitance                | $C_{iss}$    | $V_{DS}=100V, V_{GS}=0V,$<br>$f=1MHz$                  | -    | 760  | -    | pF       |
| Output capacitance               | $C_{oss}$    |                                                        | -    | 54   | -    |          |
| Reverse transfer capacitance     | $C_{rss}$    |                                                        | -    | 12   | -    |          |
| Turn-on delay time               | $t_{d(on)}$  | $V_{DD}=400V, I_D=4.8A$<br>$R_G=3.4\Omega, V_{GS}=13V$ | -    | 11   | -    | ns       |
| Rise time                        | $t_r$        |                                                        | -    | 9    | -    |          |
| Turn-off delay time              | $t_{d(off)}$ |                                                        | -    | 56   | -    |          |
| Fall time                        | $t_f$        |                                                        | -    | 8    | -    |          |

| Gate charge characteristics   |                      |                                                                                 |   |     |   |    |
|-------------------------------|----------------------|---------------------------------------------------------------------------------|---|-----|---|----|
| Gate to source charge         | Q <sub>gs</sub>      | V <sub>DD</sub> =480V, I <sub>D</sub> =4.8A,<br><br>V <sub>GS</sub> =0 to 10V   | - | 4   | - | nC |
| Gate to drain charge          | Q <sub>gd</sub>      |                                                                                 | - | 18  | - |    |
| Gate charge total             | Q <sub>g</sub>       |                                                                                 | - | 34  | - |    |
| Gate plateau voltage          | V <sub>plateau</sub> |                                                                                 | - | 5.2 | - | V  |
| Reverse diode characteristics |                      |                                                                                 |   |     |   |    |
| Diode forward voltage         | V <sub>SD</sub>      | V <sub>GS</sub> =0V, I <sub>F</sub> =5.5A                                       | - | 0.9 | - | V  |
| Reverse recovery time         | t <sub>rr</sub>      | V <sub>DS</sub> =400V, I <sub>F</sub> =4.8A,<br><br>dI <sub>F</sub> /dt=100A/μs | - | 275 | - | ns |
| Reverse recovery charge       | Q <sub>rr</sub>      |                                                                                 | - | 3.2 | - | μC |
| Peak reverse recovery current | I <sub>rrm</sub>     |                                                                                 | - | 23  | - | A  |

**Notes:**

1. Limited by maximum junction temperature, maximum duty cycle is 0.75.
2.  $I_{AS} = 1.8A$ ,  $V_{DD} = 50V$ , Starting  $T_j = 25^\circ C$ .
3. Repetitive Rating: Pulse width limited by maximum junction temperature.

## Electrical Characteristics Diagrams

Figure 1. Output Characteristics  $T_c = 25^\circ\text{C}$

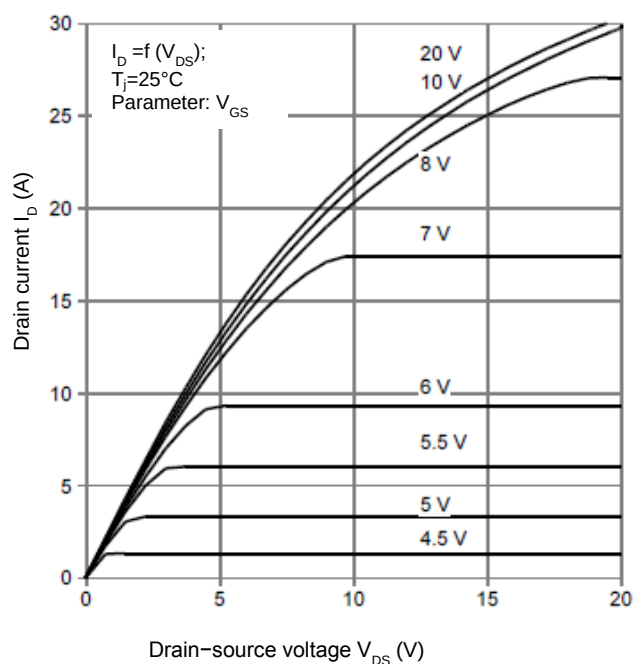


Figure 2. Output Characteristics  $T_c = 125^\circ\text{C}$

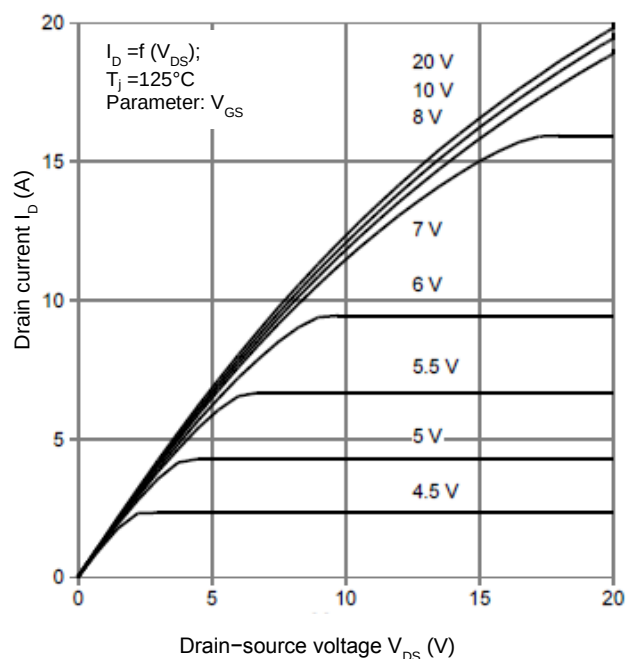


Figure 3. On-Resistance Variation vs. Drain Current

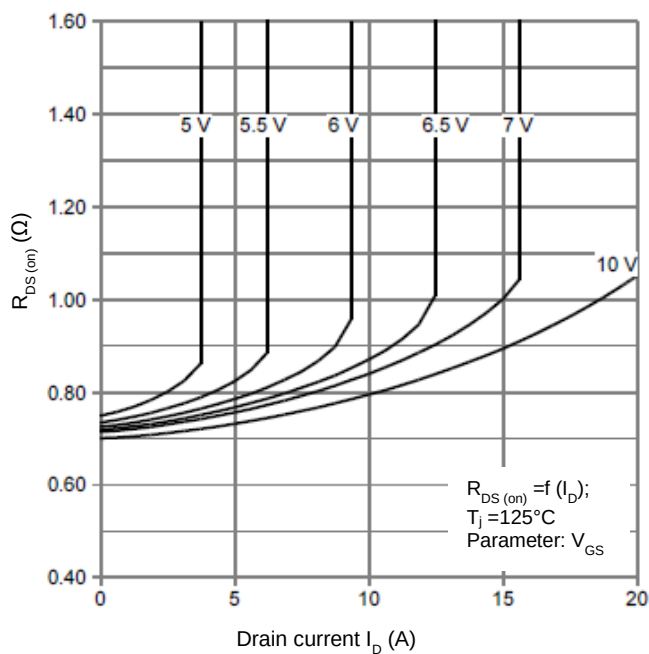


Figure 4. On-Resistance Variation vs. Temperature

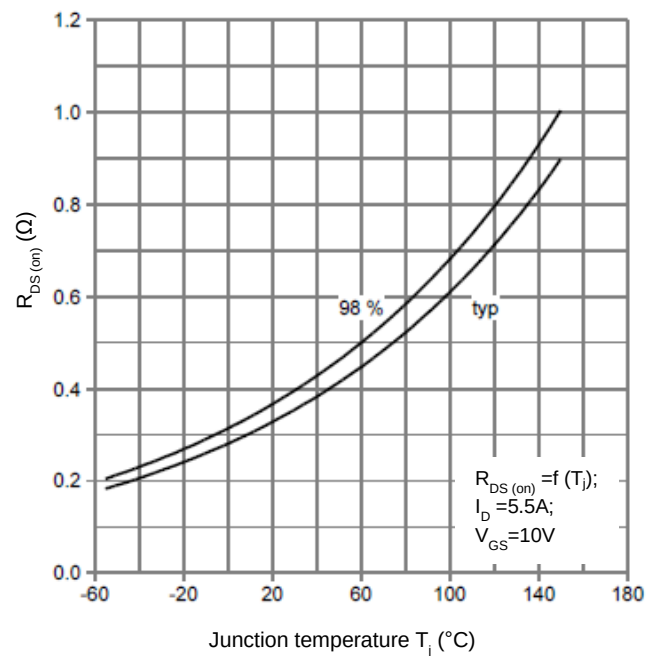


Figure 5. Transfer Characteristics

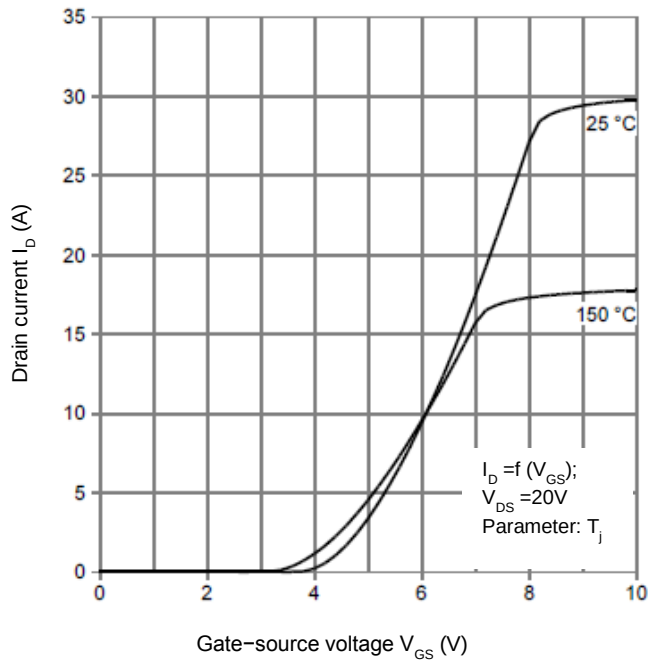


Figure 6. Breakdown Voltage vs. Temperature

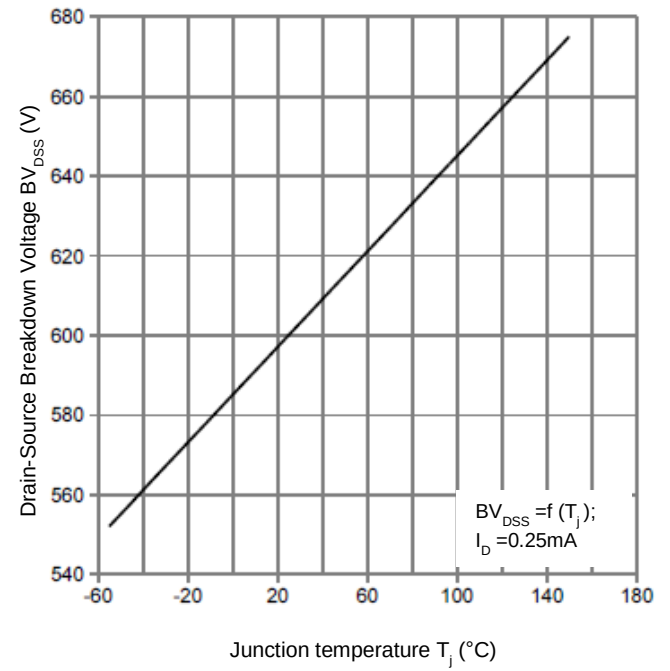


Figure 7. Capacitance Characteristics

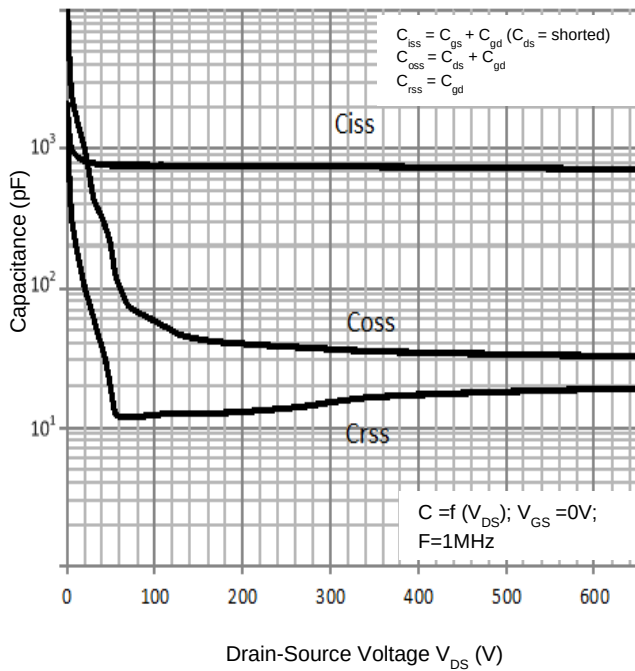


Figure 8. Gate Charge Characteristics

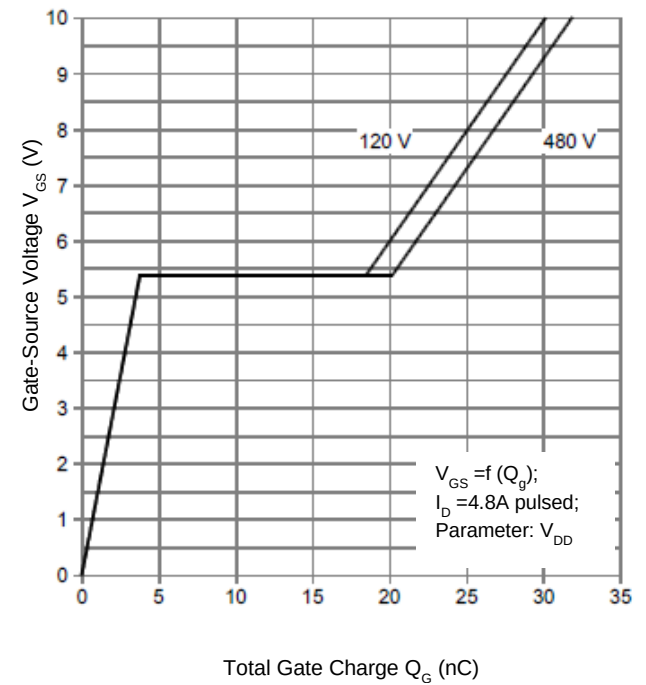


Figure 9. Power Dissipation (Non FullPAK)

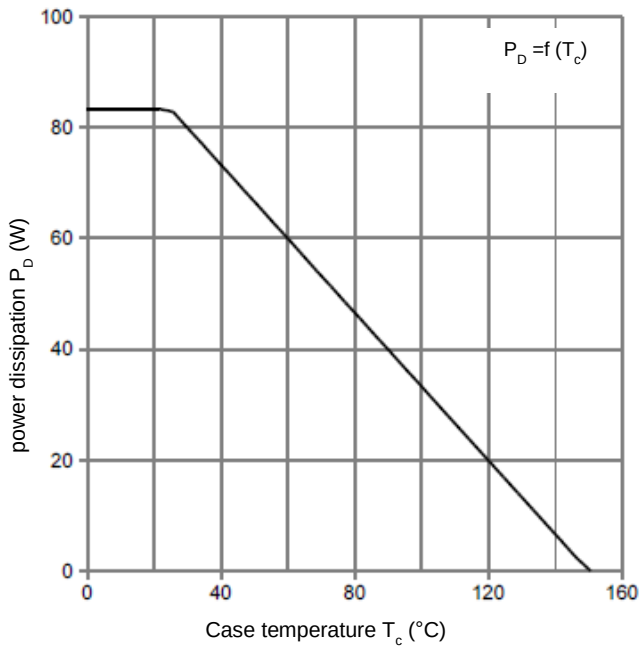


Figure 10. Power Dissipation (FullPAK)

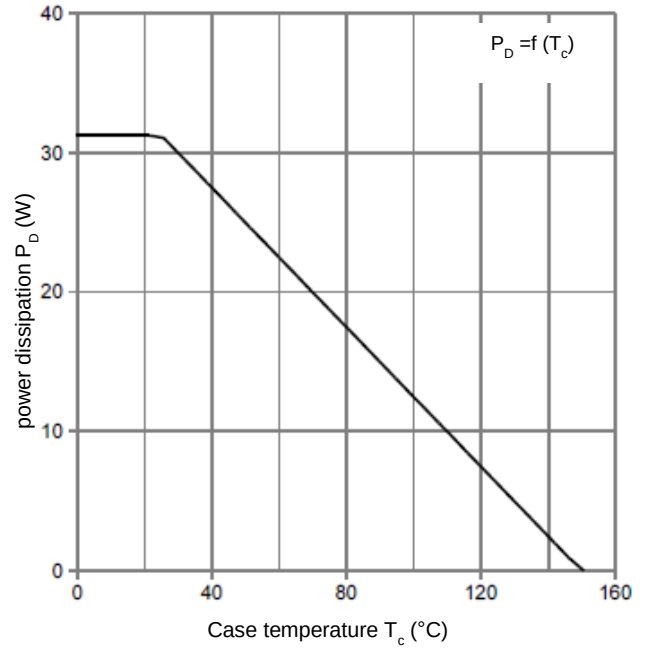


Figure 11. Safe Operating Area (Non FullPAK)

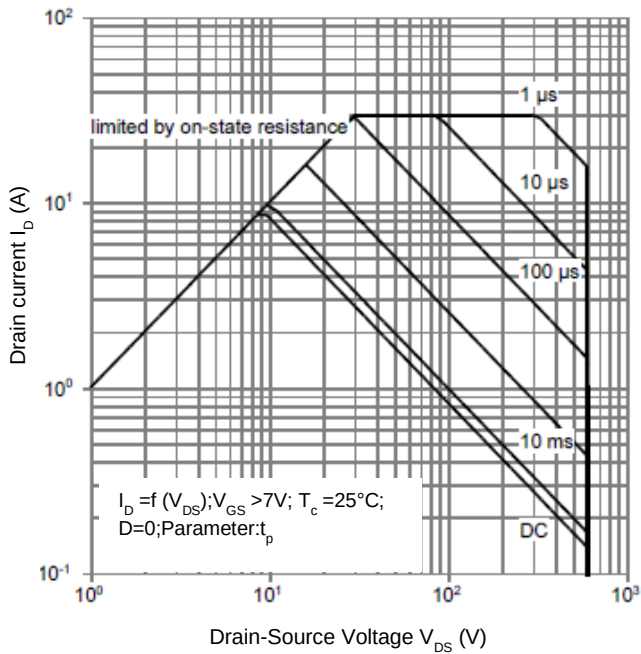


Figure 12. Safe Operating Area (FullPAK)

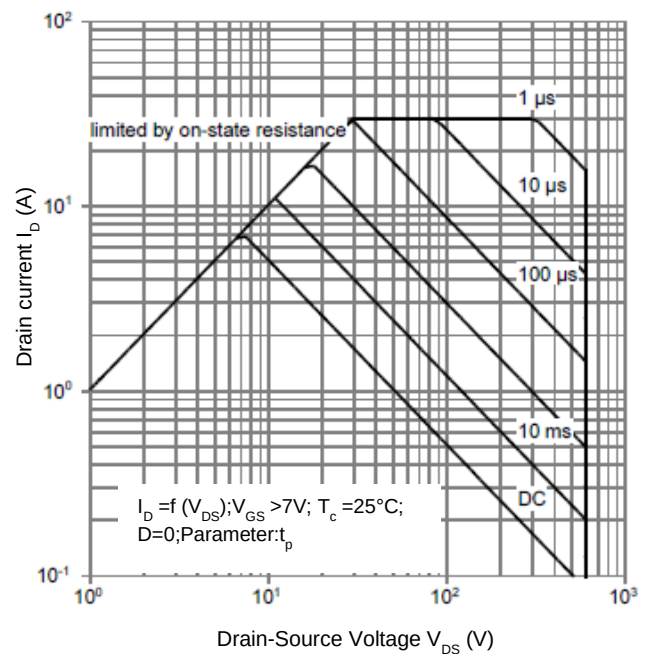


Figure 13. Transient Thermal impedance  
(Non FullPAK)

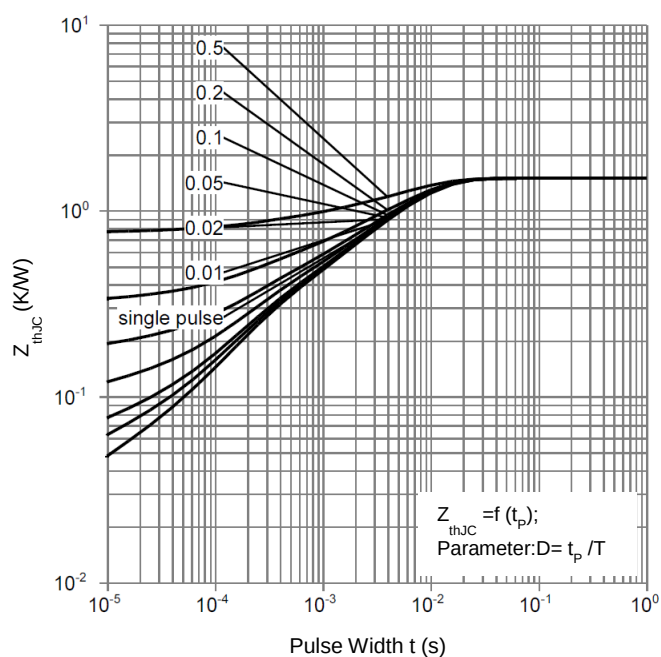
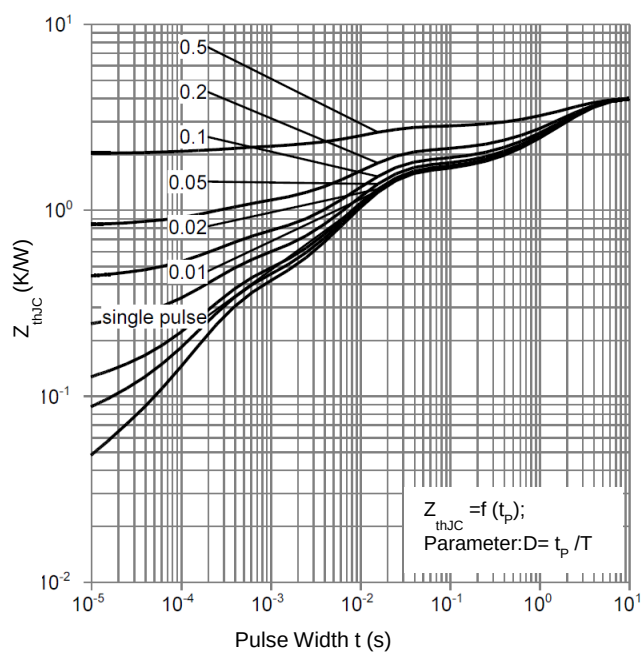
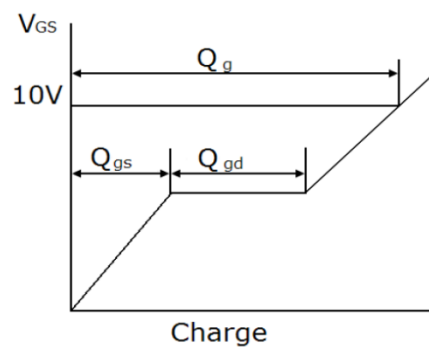
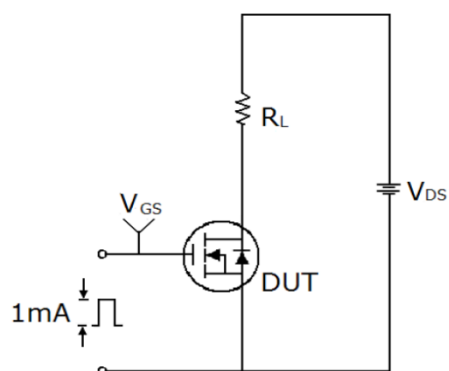


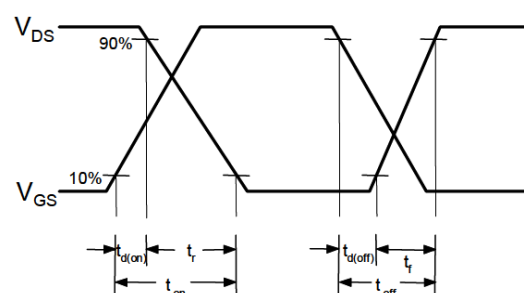
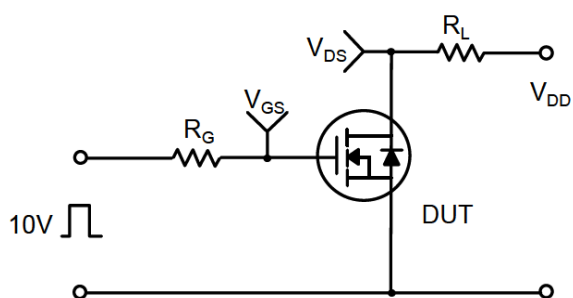
Figure 14. Transient Thermal impedance  
(FullPAK)



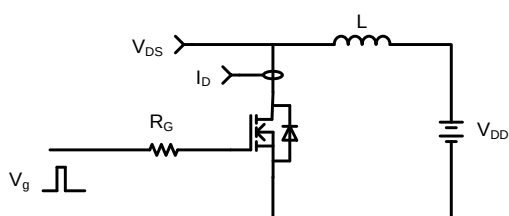
### Gate Charge Test Circuit & Waveform



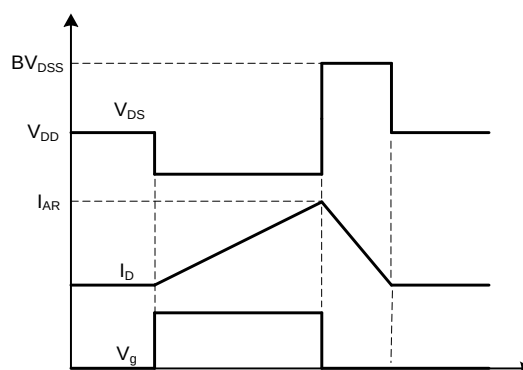
### Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms

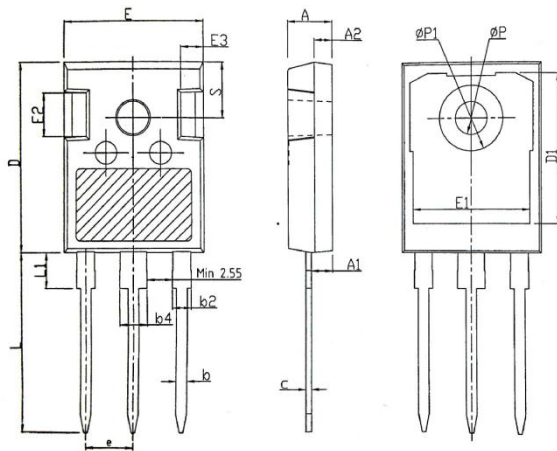


$$E_{AR} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



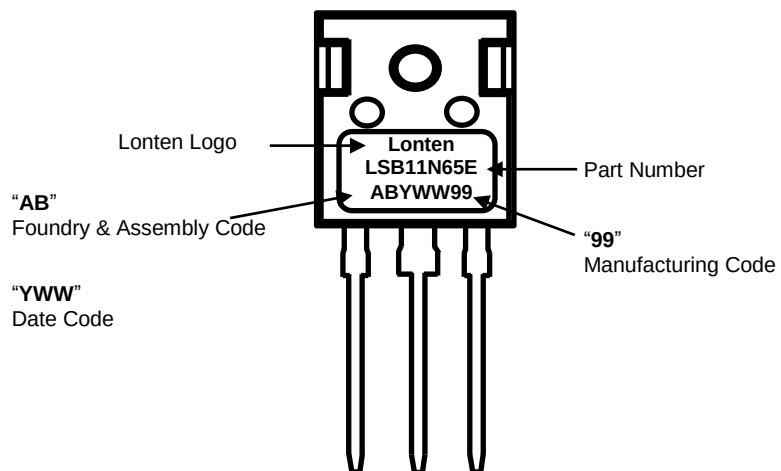


## Mechanical Dimensions for TO-247

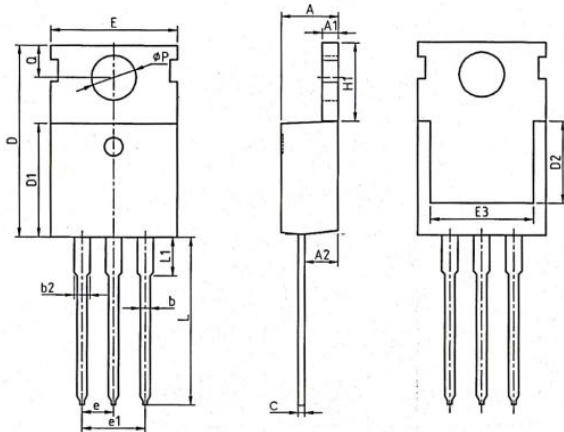


| SYMBOL | mm      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A      | 4.80    | 5.00  | 5.20  |
| A1     | 2.21    | 2.41  | 2.59  |
| A2     | 1.85    | 2.00  | 2.15  |
| b      | 1.11    | 1.21  | 1.36  |
| b2     | 1.91    | 2.01  | 2.21  |
| b4     | 2.91    | 3.01  | 3.21  |
| c      | 0.51    | 0.61  | 0.75  |
| D      | 20.80   | 21.00 | 21.30 |
| D1     | 16.25   | 16.55 | 16.85 |
| E      | 15.50   | 15.80 | 16.10 |
| E1     | 13.00   | 13.30 | 13.60 |
| E2     | 4.80    | 5.00  | 5.20  |
| E3     | 2.30    | 2.50  | 2.70  |
| e      | 5.44BSC |       |       |
| L      | 19.82   | 19.92 | 20.22 |
| L1     | —       | —     | 4.30  |
| ØP     | 3.40    | 3.60  | 3.80  |
| ØP1    | —       | —     | 7.30  |
| S      | 6.15BSC |       |       |

## TO-247 Part Marking Information

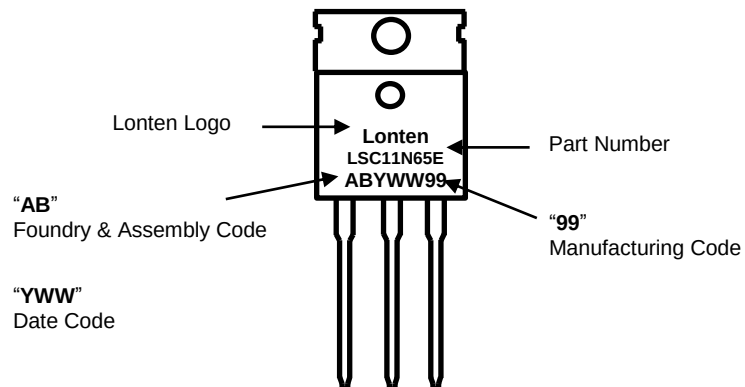


## Mechanical Dimensions for TO-220

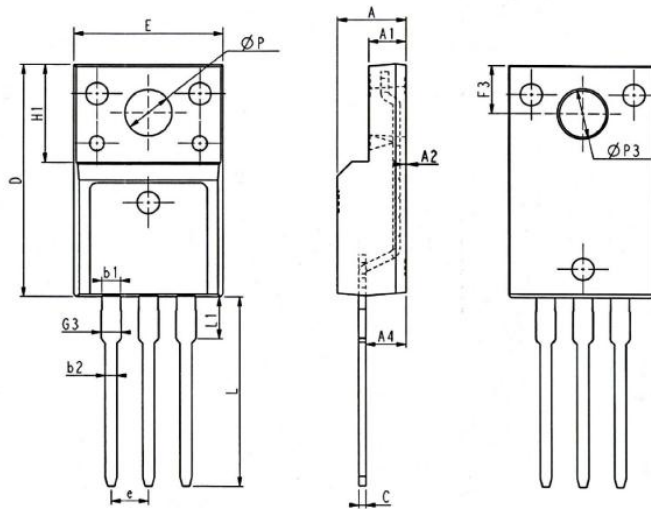


| COMMON DIMENSIONS |         |       |       |        |       |       |
|-------------------|---------|-------|-------|--------|-------|-------|
| SYMBOL            | MM      |       |       | INCH   |       |       |
|                   | MIN     | NOM   | MAX   | MIN    | NOM   | MAX   |
| A                 | 4.37    | 4.57  | 4.70  | 0.172  | 0.180 | 0.185 |
| A1                | 1.25    | 1.30  | 1.40  | 0.049  | 0.051 | 0.055 |
| A2                | 2.20    | 2.40  | 2.60  | 0.087  | 0.094 | 0.102 |
| b                 | 0.70    | 0.80  | 0.95  | 0.028  | 0.031 | 0.037 |
| b2                | 1.17    | 1.27  | 1.47  | 0.046  | 0.050 | 0.058 |
| c                 | 0.45    | 0.50  | 0.60  | 0.018  | 0.020 | 0.024 |
| D                 | 15.10   | 15.60 | 16.10 | 0.594  | 0.614 | 0.634 |
| D1                | 8.80    | 9.10  | 9.40  | 0.346  | 0.358 | 0.370 |
| D2                | 5.50    | —     | —     | 0.217  | —     | —     |
| E                 | 9.70    | 10.00 | 10.30 | 0.382  | 0.394 | 0.406 |
| E3                | 7.00    | —     | —     | 0.276  | —     | —     |
| e                 | 2.54BSC |       |       | 0.1BSC |       |       |
| e1                | 5.08BSC |       |       | 0.2BSC |       |       |
| H1                | 6.25    | 6.50  | 6.85  | 0.246  | 0.256 | 0.270 |
| L                 | 12.75   | 13.50 | 13.80 | 0.502  | 0.531 | 0.543 |
| L1                | —       | 3.10  | 3.40  | —      | 0.122 | 0.134 |
| Øp                | 3.40    | 3.60  | 3.80  | 0.134  | 0.142 | 0.150 |
| Q                 | 2.60    | 2.80  | 3.00  | 0.102  | 0.110 | 0.118 |

## TO-220 Part Marking Information

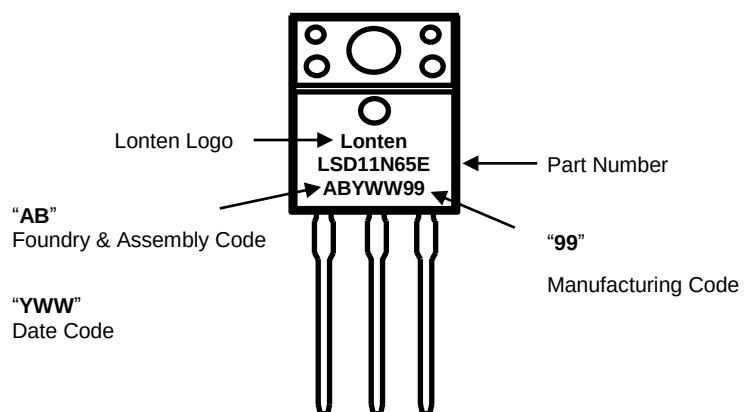


## Mechanical Dimensions for TO-220MF

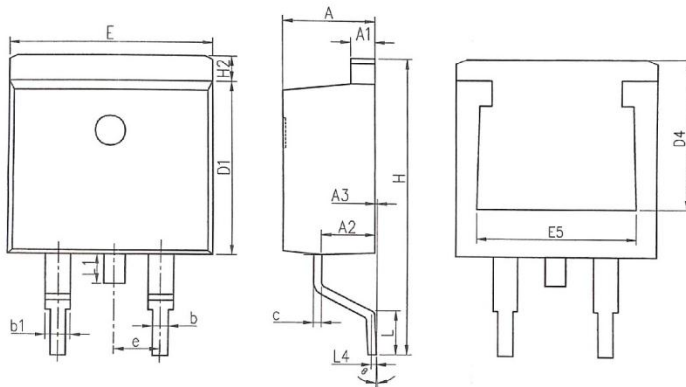


| SYMBOL | COMMON DIMENSIONS |       |       |          |       |       |
|--------|-------------------|-------|-------|----------|-------|-------|
|        | MM                |       |       | INCH     |       |       |
|        | MIN               | NOM   | MAX   | MIN      | NOM   | MAX   |
| E      | 9.96              | 10.16 | 10.36 | 0.392    | 0.400 | 0.408 |
| A      | 4.50              | 4.70  | 4.90  | 0.177    | 0.185 | 0.193 |
| A1     | 2.34              | 2.54  | 2.74  | 0.092    | 0.100 | 0.108 |
| A2     | 0.30              | 0.45  | 0.60  | 0.012    | 0.002 | 0.024 |
| A4     | 2.65              | 2.76  | 2.96  | 0.104    | 0.109 | 0.117 |
| C      | 0.40              | 0.50  | 0.65  | 0.016    | 0.020 | 0.026 |
| D      | 15.57             | 15.87 | 16.17 | 0.613    | 0.625 | 0.637 |
| H1     | 6.70REF           |       |       | 0.264REF |       |       |
| e      | 2.54BSC           |       |       | 0.1BSC   |       |       |
| ØP     | 3.03              | 3.18  | 3.38  | 0.119    | 0.125 | 0.133 |
| L      | 12.68             | 12.98 | 13.28 | 0.499    | 0.511 | 0.523 |
| L1     | 2.88              | 3.03  | 3.18  | 0.113    | 0.119 | 0.125 |
| ØP3    | 3.15REF           |       |       | 0.124REF |       |       |
| F3     | 3.15              | 3.30  | 3.45  | 0.124    | 0.130 | 0.136 |
| G3     | 1.25              | 1.35  | 1.55  | 0.049    | 0.053 | 0.061 |
| b1     | 1.18              | 1.28  | 1.43  | 0.046    | 0.050 | 0.056 |
| b2     | 0.70              | 0.80  | 0.95  | 0.028    | 0.031 | 0.037 |

## TO-220MF Part Marking Information

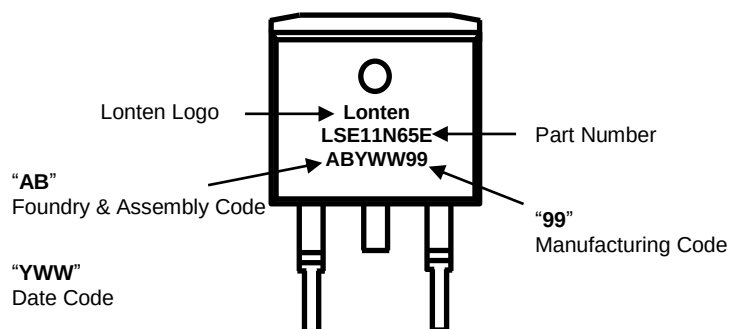


## Mechanical Dimensions for TO-263

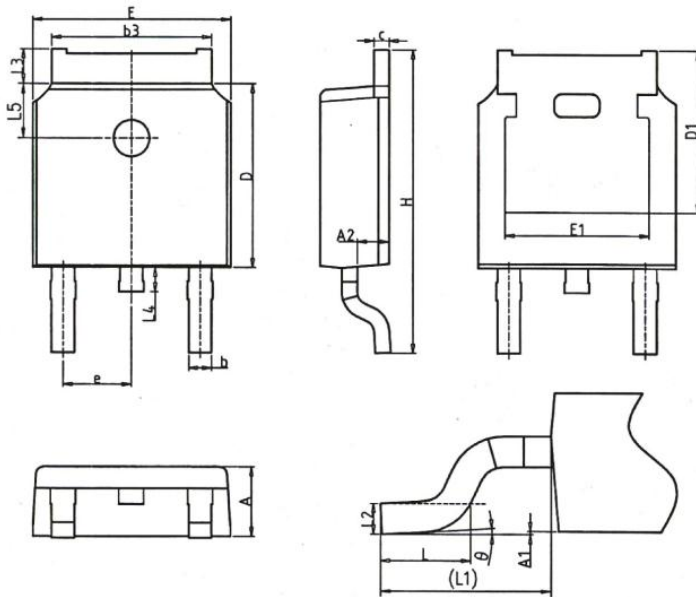


| COMMON DIMENSIONS |          |       |       |           |        |        |
|-------------------|----------|-------|-------|-----------|--------|--------|
| SYMBOL            | MM       |       |       | INCH      |        |        |
|                   | MIN      | NOM   | MAX   | MIN       | NOM    | MAX    |
| A                 | 4.37     | 4.57  | 4.77  | 0.172     | 0.180  | 0.188  |
| A1                | 1.22     | 1.27  | 1.42  | 0.048     | 0.050  | 0.056  |
| A2                | 2.49     | 2.89  | 2.89  | 0.098     | 0.114  | 0.114  |
| A3                | 0.00     | 0.13  | 0.25  | 0.000     | 0.005  | 0.010  |
| b                 | 0.70     | 0.81  | 0.96  | 0.028     | 0.032  | 0.034  |
| b1                | 1.17     | 1.27  | 1.47  | 0.046     | 0.050  | 0.058  |
| c                 | 0.30     | 0.38  | 0.53  | 0.012     | 0.015  | 0.021  |
| D1                | 8.50     | 8.70  | 8.90  | 0.335     | 0.343  | 0.350  |
| D4                | 6.60     | —     | —     | 0.260     | —      | —      |
| E                 | 9.86     | 10.16 | 10.36 | 0.389     | 0.400  | 0.408  |
| E5                | 7.06     | —     | —     | 0.278     | —      | —      |
| e                 | 2.54 BSC |       |       | 0.100 BSC |        |        |
| H                 | 14.70    | 15.10 | 15.50 | 0.579     | 0.594  | 0.610  |
| H2                | 1.07     | 1.27  | 1.47  | 0.042     | 0.050  | 0.058  |
| L                 | 2.00     | 2.30  | 2.60  | 0.079     | 0.091  | 0.102  |
| L1                | 1.40     | 1.55  | 1.70  | 0.055     | 0.061  | 0.067  |
| L4                | 0.25 BSC |       |       | 0.010 BSC |        |        |
| θ                 | 0°       | 5°    | 9°    | 0°        | 0.197° | 0.354° |

## TO-263 Part Marking Information

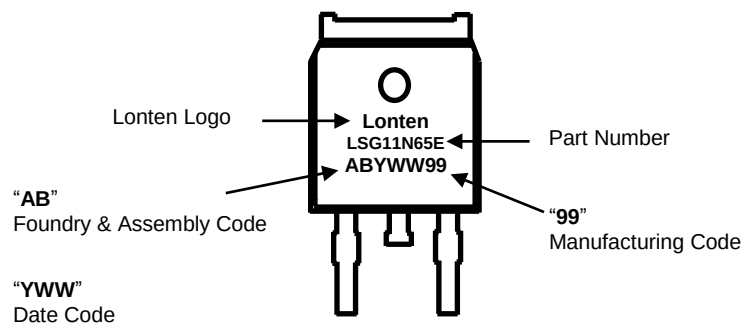


## Mechanical Dimensions for TO-252

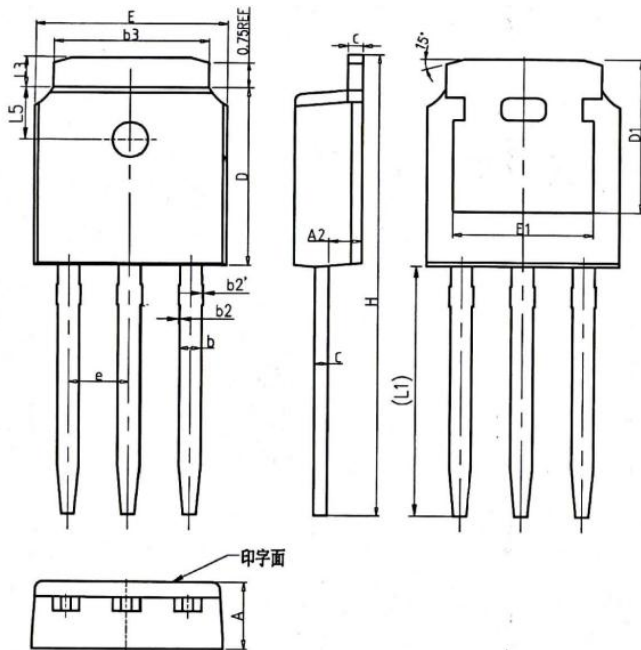


| COMMON DIMENSIONS |          |       |       |
|-------------------|----------|-------|-------|
| SYMBOL            | mm       |       |       |
|                   | MIN      | NOM   | MAX   |
| A                 | 2.20     | 2.30  | 2.38  |
| A1                | 0.00     | —     | 0.20  |
| A2                | 0.97     | 1.07  | 1.17  |
| b                 | 0.68     | 0.78  | 0.90  |
| b3                | 5.20     | 5.33  | 5.46  |
| c                 | 0.43     | 0.53  | 0.61  |
| D                 | 5.98     | 6.10  | 6.22  |
| D1                | 5.30REF  |       |       |
| E                 | 6.40     | 6.60  | 6.73  |
| E1                | 4.63     | —     | —     |
| e                 | 2.286BSC |       |       |
| H                 | 9.40     | 10.10 | 10.50 |
| L                 | 1.38     | 1.50  | 1.75  |
| L1                | 2.90REF  |       |       |
| L2                | 0.51BSC  |       |       |
| L3                | 0.88     | —     | 1.28  |
| L4                | 0.50     | —     | 1.00  |
| L5                | 1.65     | 1.80  | 1.95  |
| θ                 | 0°       | —     | 8°    |

## TO-252 Part Marking Information

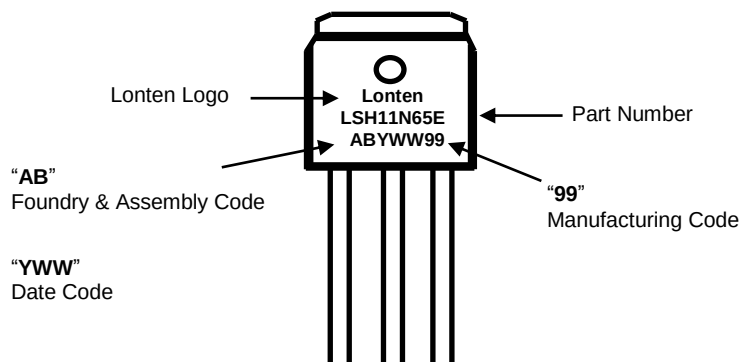


## Mechanical Dimensions for TO-251

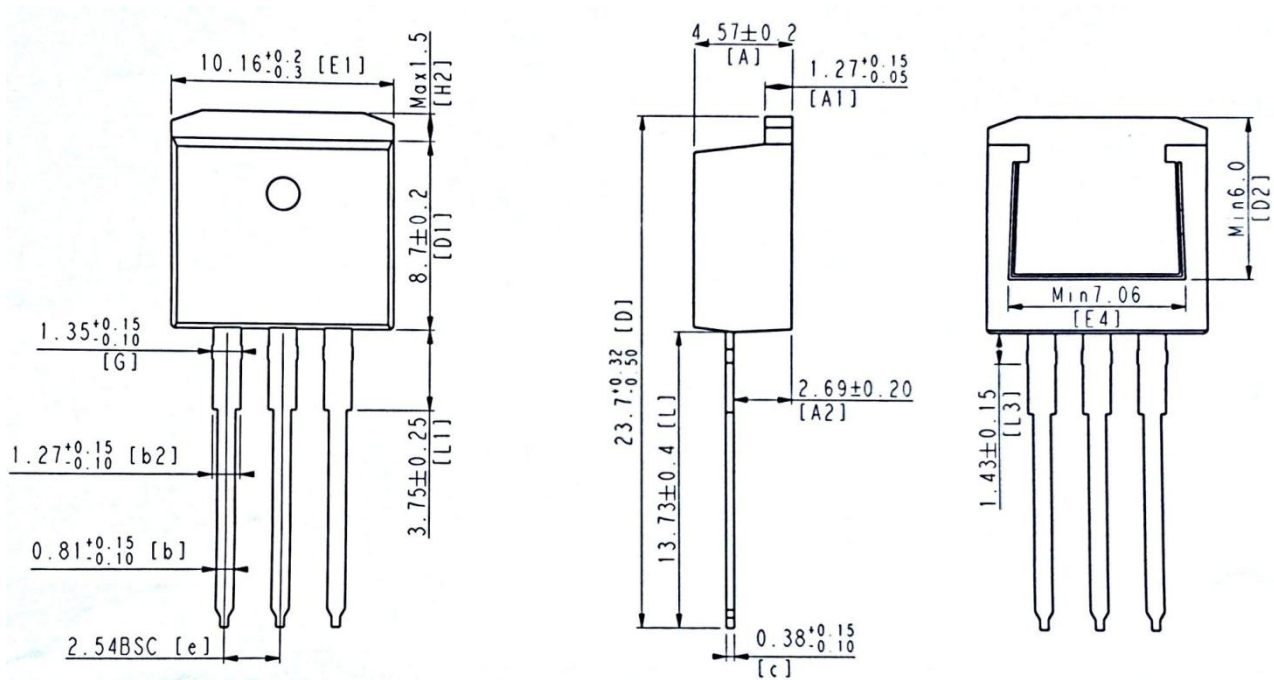


| COMMON DIMENSIONS |          |       |       |
|-------------------|----------|-------|-------|
| SYMBOL            | MM       |       |       |
|                   | MIN      | NOM   | MAX   |
| A                 | 2.20     | 2.30  | 2.38  |
| A2                | 0.97     | 1.07  | 1.17  |
| b                 | 0.68     | 0.78  | 0.90  |
| b2                | 0.00     | 0.04  | 0.10  |
| b2'               | 0.00     | 0.04  | 0.10  |
| b3                | 5.20     | 5.33  | 5.46  |
| c                 | 0.43     | 0.53  | 0.61  |
| D                 | 5.98     | 6.10  | 6.22  |
| D1                | 5.30REF  |       |       |
| E                 | 6.40     | 6.60  | 6.73  |
| E1                | 4.63     | —     | —     |
| e                 | 2.286BSC |       |       |
| H                 | 16.22    | 16.52 | 16.82 |
| L1                | 9.15     | 9.40  | 9.65  |
| L3                | 0.88     | 1.02  | 1.28  |
| L5                | 1.65     | 1.80  | 1.95  |

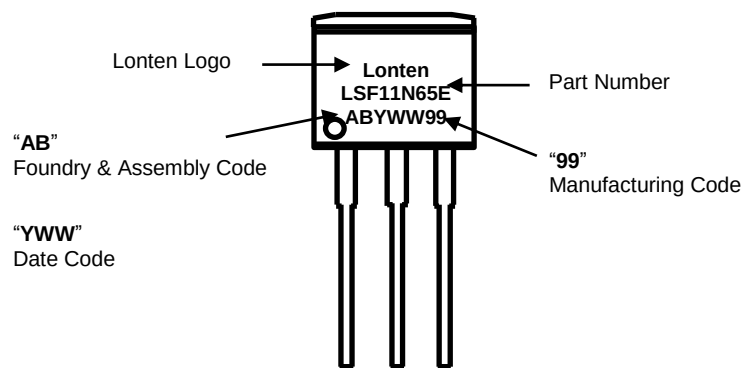
## TO-251 Part Marking Information



## Mechanical Dimensions for TO-262



## TO-262 Part Marking Information



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