
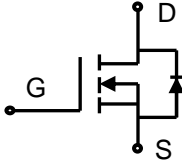



## Lonten N-channel 600V, 4A Power MOSFET

<p><b>Description</b> 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 style="width: 100%; border: none;"> <tr> <td style="padding: 2px;"><math>V_{DSS}</math></td> <td style="padding: 2px;">600V</td> </tr> <tr> <td style="padding: 2px;"><math>I_D</math></td> <td style="padding: 2px;">4A</td> </tr> <tr> <td style="padding: 2px;"><math>R_{DS(on),max}</math></td> <td style="padding: 2px;">2.4<math>\Omega</math></td> </tr> <tr> <td style="padding: 2px;"><math>Q_{g,typ}</math></td> <td style="padding: 2px;">12.8 nC</td> </tr> </table> <div style="text-align: center; margin-top: 10px;">  <p style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>TO-251</span> <span>TO-252</span> <span>TO-220</span> <span>TO-220F</span> </p> </div> <div style="text-align: center; margin-top: 20px;">  <p style="margin-top: 5px;">N-Channel MOSFET</p> </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 ( $T_C = 25^\circ\text{C}$ ) ( $T_C = 100^\circ\text{C}$ )	$I_D$	4	A
		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 ( $T_C = 25^\circ\text{C}$ ) Derate above $25^\circ\text{C}$	$P_D$	32	W
		0.26	W/ $^\circ\text{C}$
Power Dissipation TO-220\TO-251\TO-252 ( $T_C = 25^\circ\text{C}$ ) Derate above $25^\circ\text{C}$	$P_D$	77	W
		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	$I_{DSS}$	$V_{DS}=600\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$	-	-	1 100	$\mu\text{A}$
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	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	580	-	pF
Output capacitance	$C_{oss}$		-	50	-	
Reverse transfer capacitance	$C_{rss}$		-	3	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{ V}, I_D = 4\text{ A}$ $R_G = 10\ \Omega, V_{GS}=15\text{ V}$	-	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	$Q_{gs}$	$V_{DD}=480\text{ V}, I_D=4\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	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	$t_{rr}$	$V_R=400\text{ V}, I_F=4\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	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

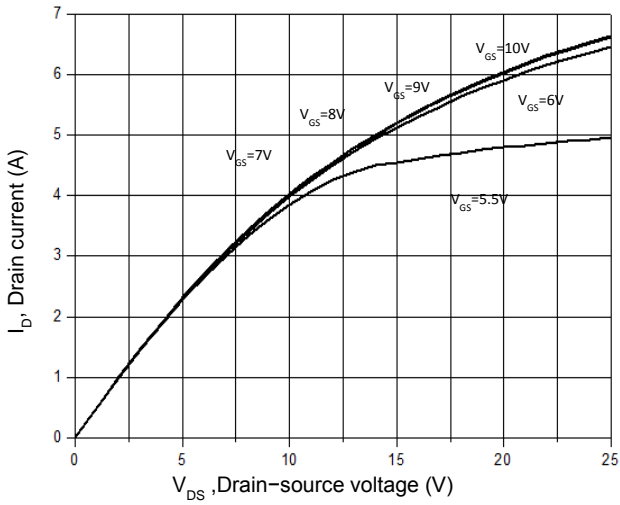


Figure 2. Transfer Characteristics

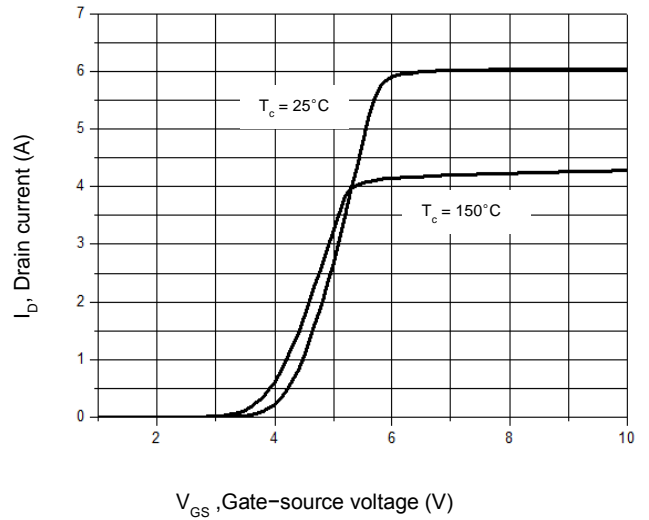


Figure 3. On-Resistance Variation vs. Drain Current

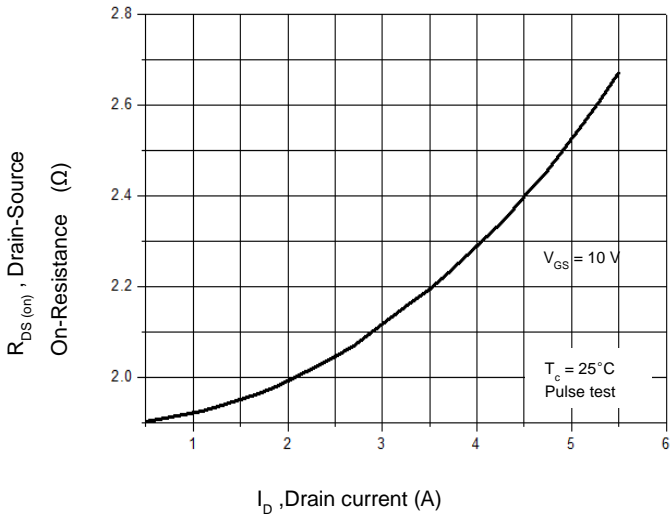


Figure 4. Threshold Voltage vs. Temperature

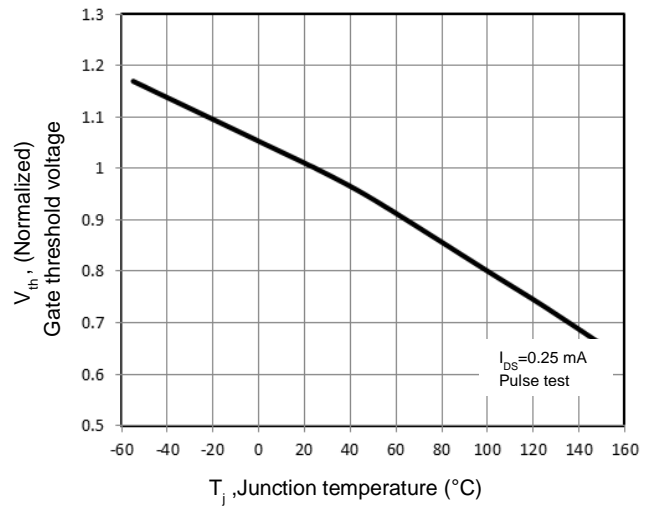


Figure 5. Breakdown Voltage vs. Temperature

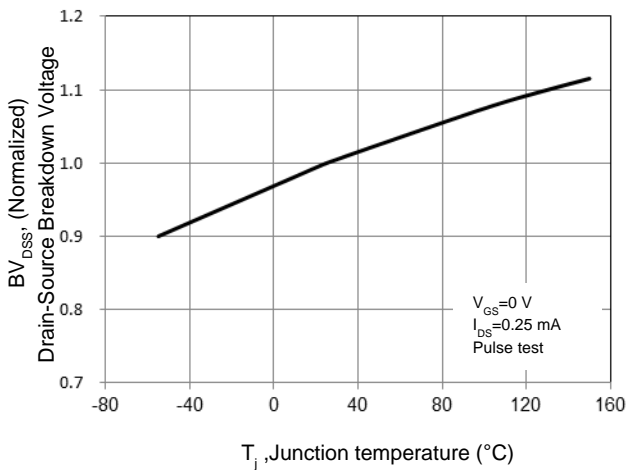


Figure 6. On-Resistance vs. Temperature

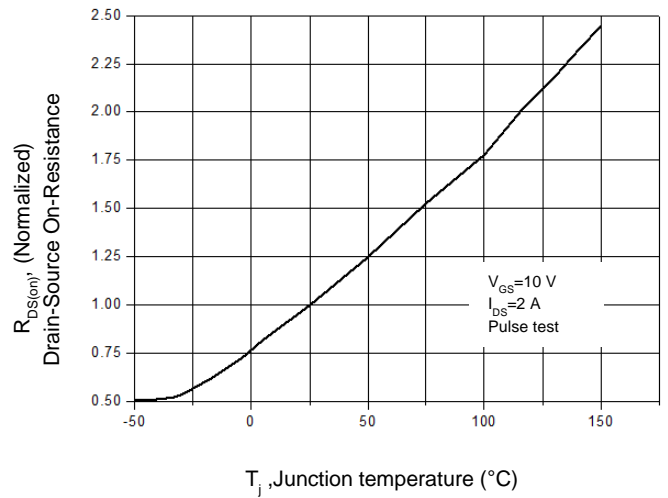


Figure 7. Capacitance Characteristics

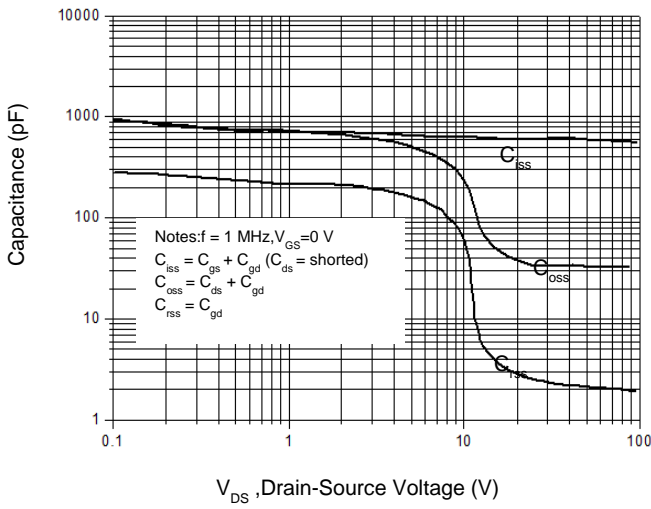


Figure 8. Gate Charge Characterist

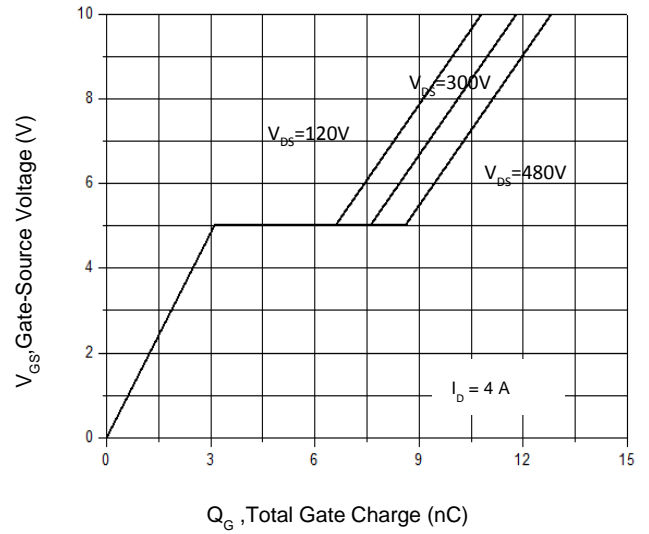


Figure 9. Maximum Safe Operating Area  
TO-220F

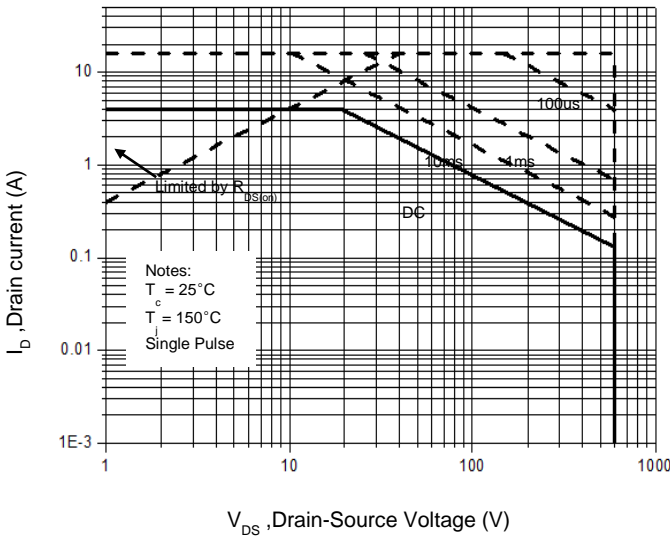


Figure 10. Maximum Safe Operating Area  
TO-220/TO-251/TO-252

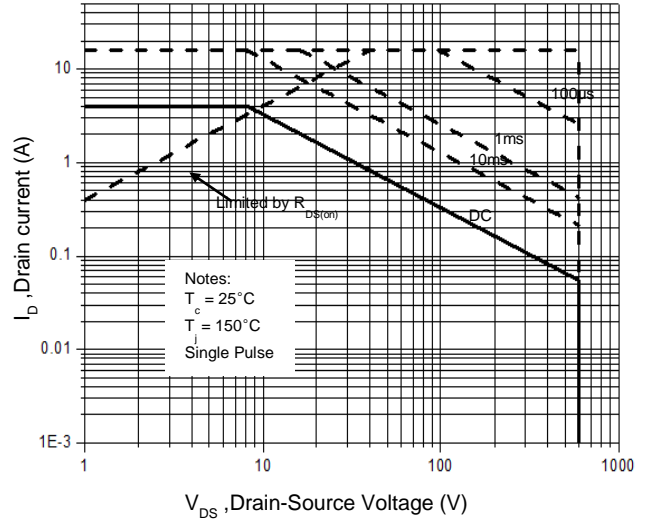


Figure 11. Power Dissipation vs. Temperature  
TO-220F

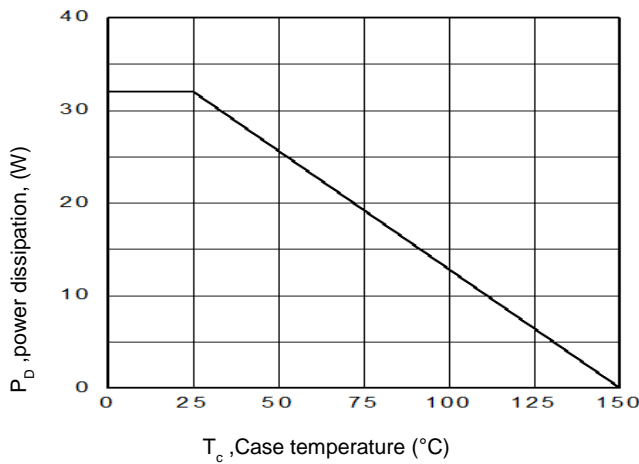


Figure 12. Power Dissipation vs. Temperature  
TO-220/TO-251/TO-252

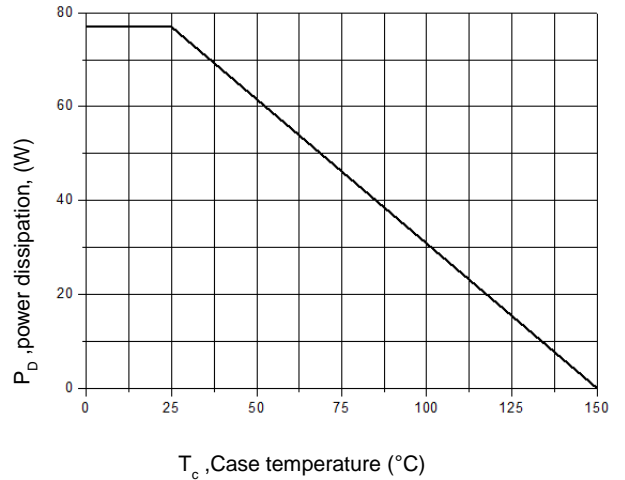


Figure 13. Continuous Drain Current vs. Temperature

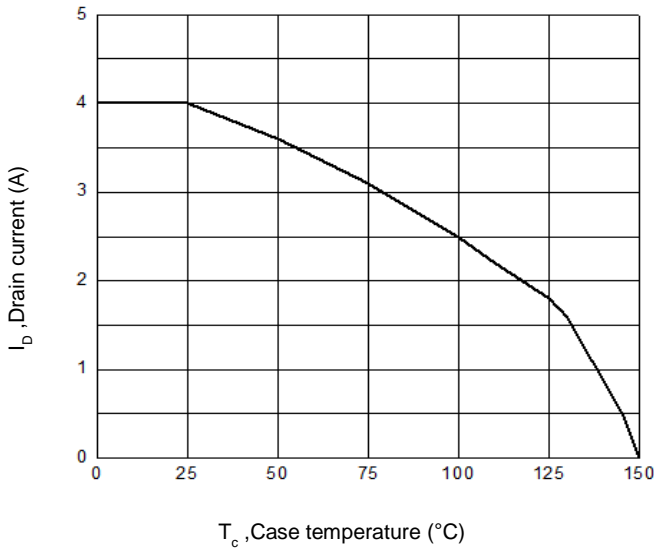


Figure 14. Body Diode Transfer Characteristics

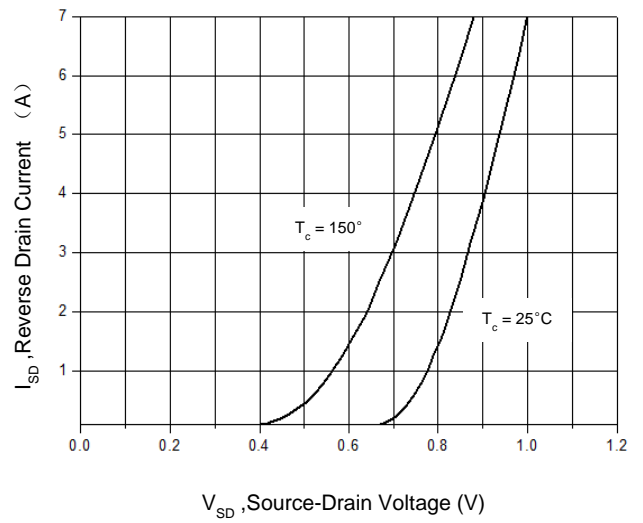


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

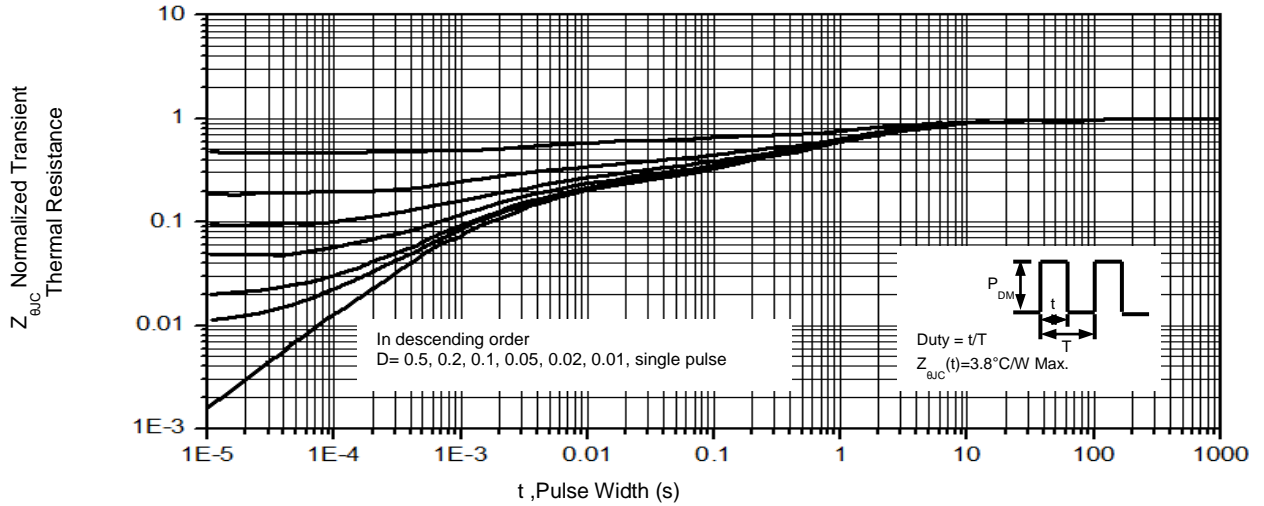
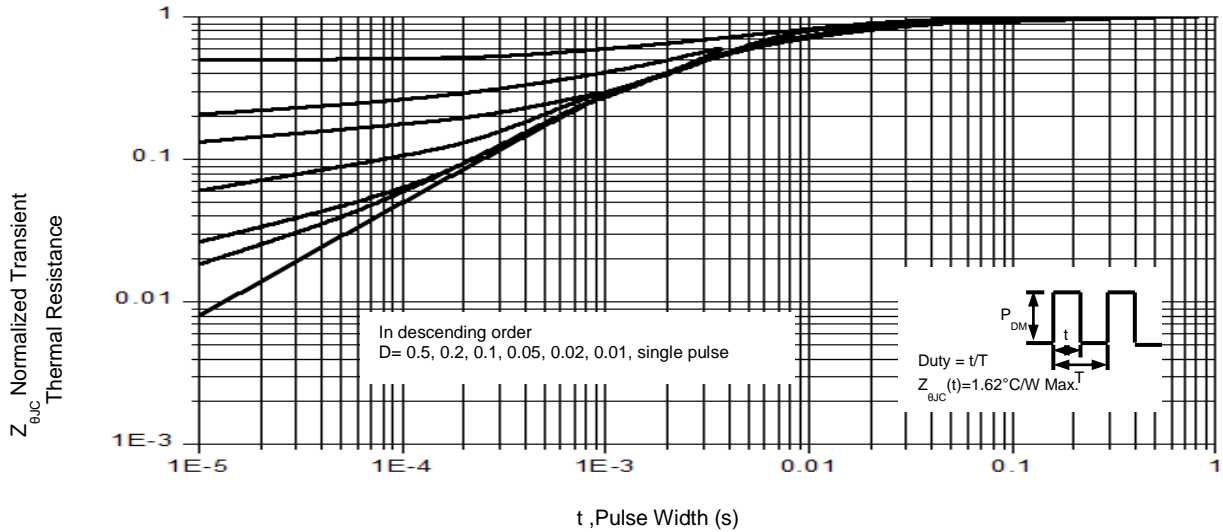
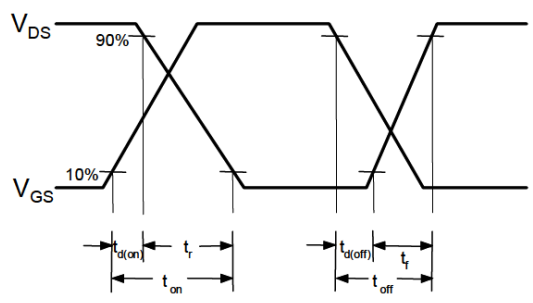
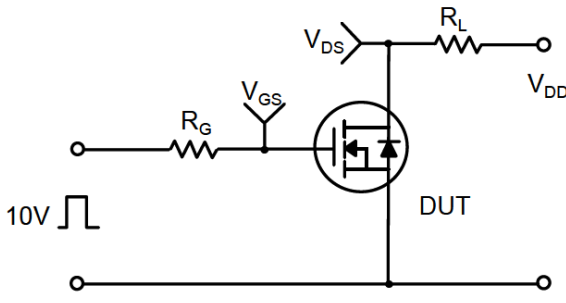


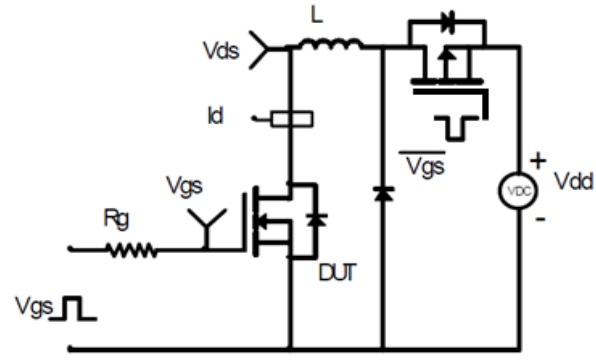
Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/TO-251/TO-252



**Gate Charge Test Circuit & Waveform**



**Unclamped Inductive Switching Test Circuit & Waveforms**



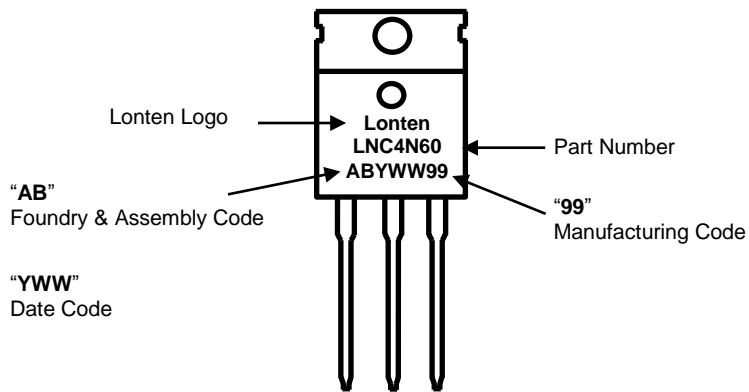
**Mechanical Dimensions for TO-220**



UNIT: mm

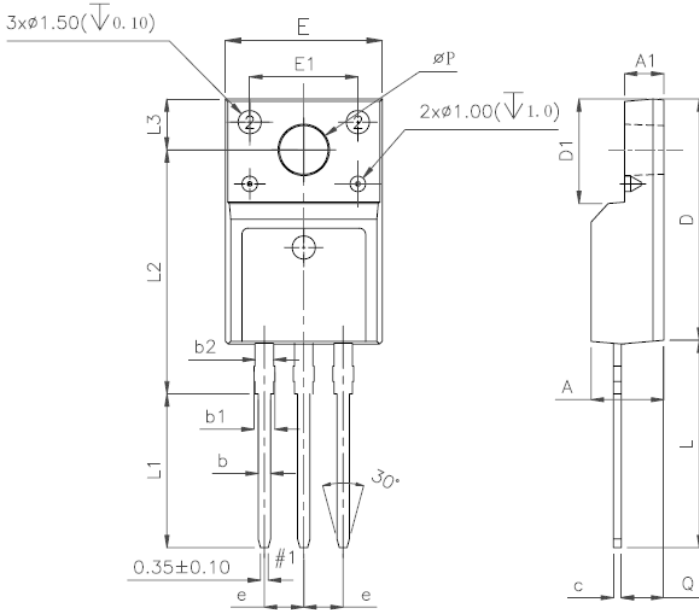
SYMBOL	MIN	NOM	MAX
A	4		4.8
B	1.2		1.4
B1	1		1.4
b1	0.75		0.95
c	0.4		0.55
D	15		16.5
D1	5.9		6.9
E	9.9		10.7
e	2.44	2.54	2.64
F	1.1		1.4
L	12.5		14.5
L1	3	3.5	4
ΦP	3.7	3.8	3.9
Q	2.5		3
Q1	2		2.9
Y	8.02	8.12	8.22

**TO-220 Part Marking Information**



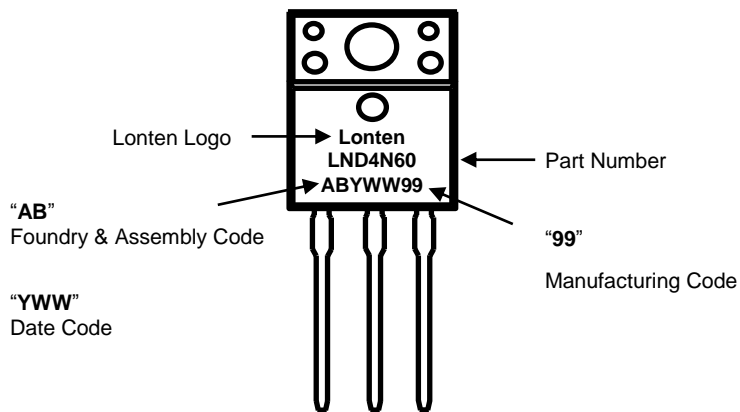
**Mechanical Dimensions for TO-220F**

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

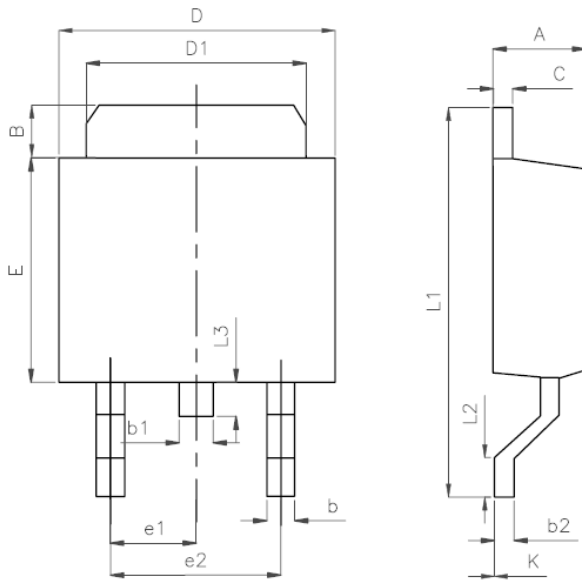
**TO-220F Part Marking Information**





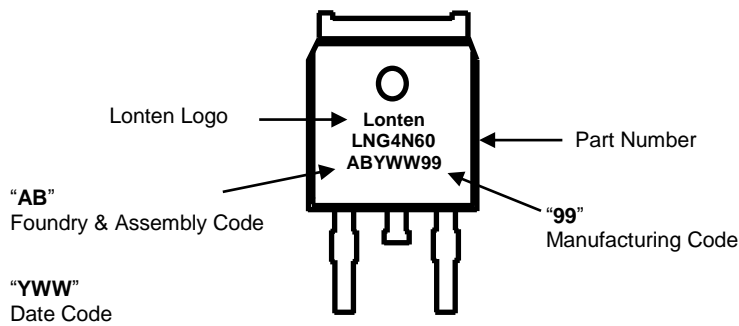
**Mechanical Dimensions for TO-252**

UNIT: mm



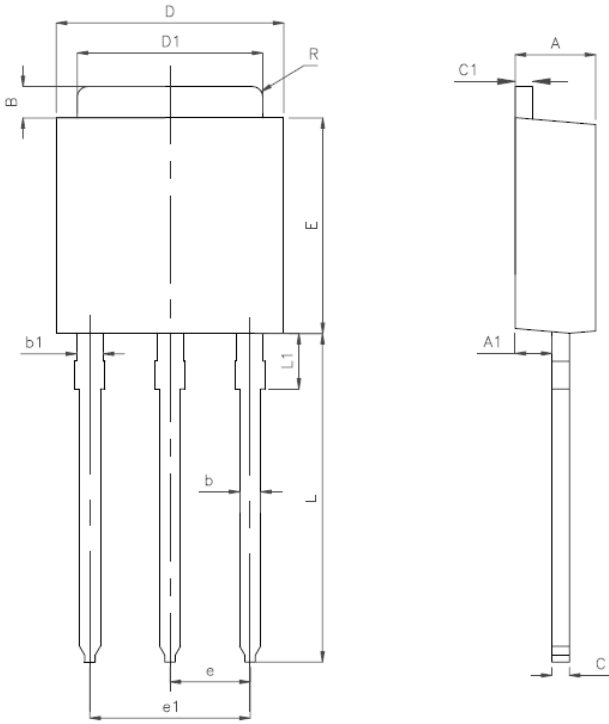
SYMBOL	MIN	NOM	MAX
A	2.10		2.50
B	0.80		1.25
b	0.50		0.85
b1	0.50		0.90
b2	0.45		0.60
C	0.45		0.60
D	6.35		6.75
D1	5.10		5.50
E	5.80		6.30
e1	2.25	2.30	2.35
e2	4.45		4.75
L1	9.50		10.20
L2	0.90		1.45
L3	0.60		1.10
K	-0.1		0.10

**TO-252 Part Marking Information**



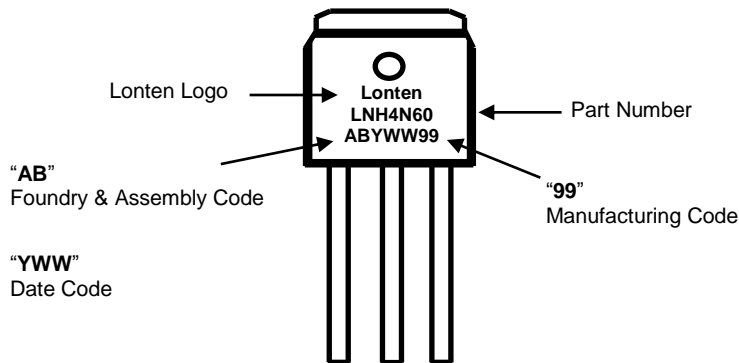
**Mechanical Dimensions for TO-251**

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**



**Disclaimer**

The content specified herein is for the purpose of introducing LONTEN's products (hereinafter "Products"). The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

LONTEN does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of the Products or technical information described in this document.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). LONTEN shall bear no responsibility in any way for use of any of the Products for the above special purposes.

Although LONTEN endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a LONTEN product.

The content specified herein is subject to change for improvement without notice. When using a LONTEN product, be sure to obtain the latest specifications.

Dec. 2018 Revision 1.1