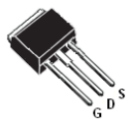

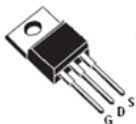

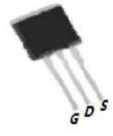
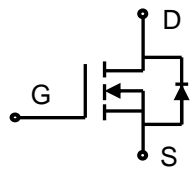



## Lonten N-channel 650V, 4A Power MOSFET

<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 \text{ nC}</math>)</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>650V</td> </tr> <tr> <td><math>I_D</math></td> <td>4A</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td>2.70<math>\Omega</math></td> </tr> <tr> <td><math>Q_{g,typ}</math></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 $\Omega$	$Q_{g,typ}$	12 nC
$V_{DSS}$	650V								
$I_D$	4A								
$R_{DS(on),max}$	2.70 $\Omega$								
$Q_{g,typ}$	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 <sup>1)</sup>	$I_{DM}$	16	A
Gate-Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	198	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\ TO-262 ( $T_C = 25^\circ\text{C}$ )	$P_D$	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\TO-262	
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
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
<b>Static characteristics</b>						
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	$\mu\text{A}$
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	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=2\text{ A}$	-	2.50	2.70	$\Omega$
<b>Dynamic characteristics</b>						
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	-	
<b>Gate charge characteristics</b>						
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
<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	$t_{rr}$	$V_R=400\text{ V}, I_F=4\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	282	-	ns
Reverse recovery charge	$Q_{rr}$		-	1.4	-	$\mu\text{C}$
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

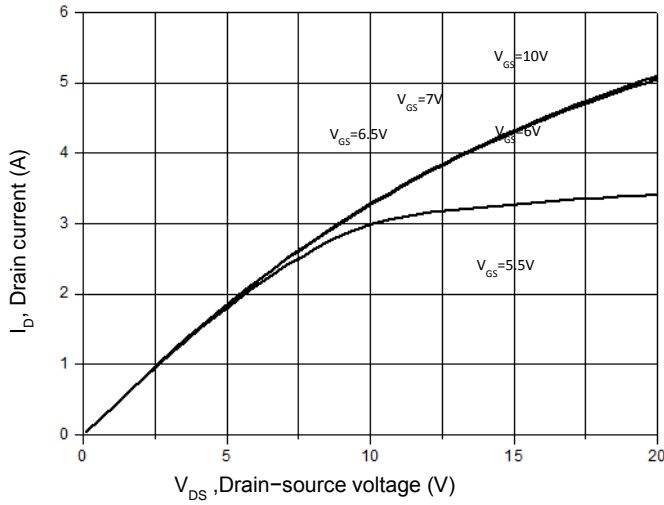


Figure 2. Transfer Characteristics

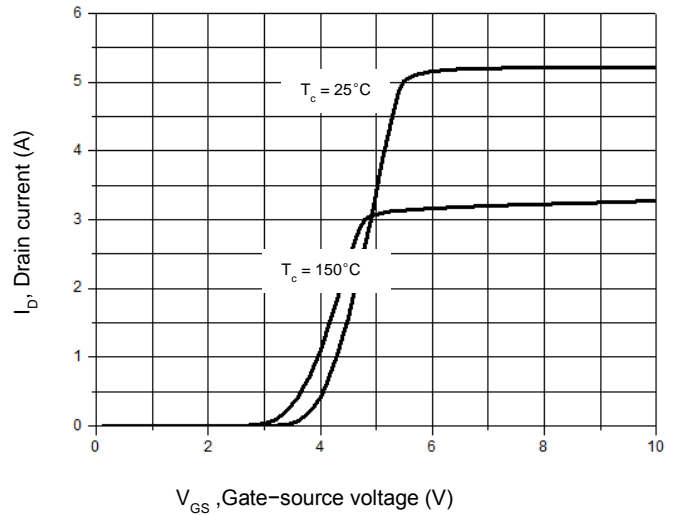


Figure 3. On-Resistance Variation vs. Drain Current

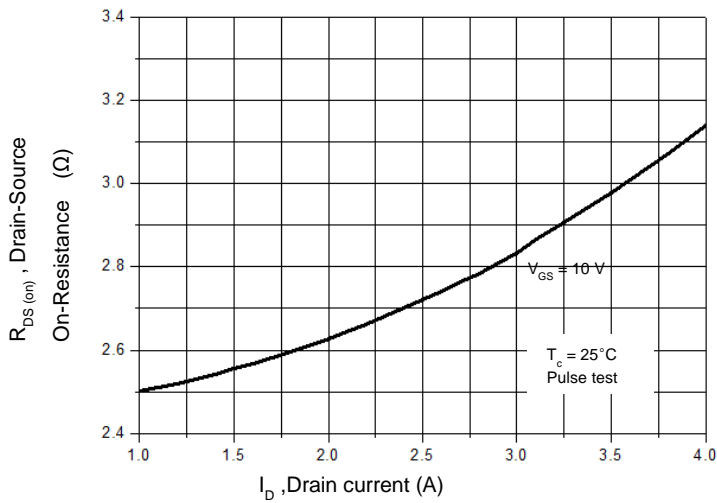


Figure 4. Threshold Voltage vs. Temperature

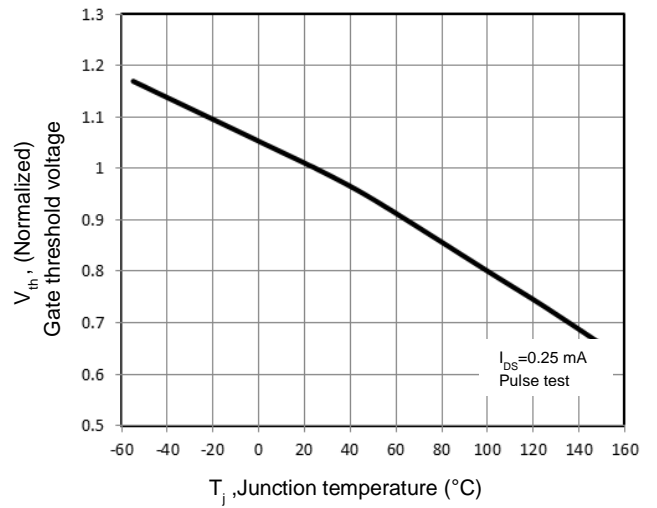


Figure 5. Breakdown Voltage vs. Temperature

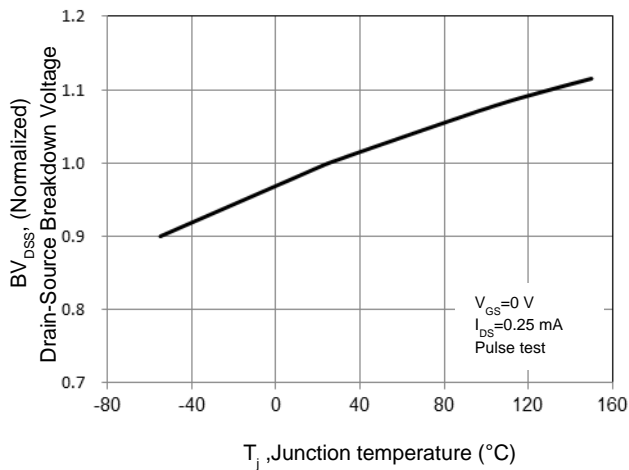


Figure 6. On-Resistance vs. Temperature

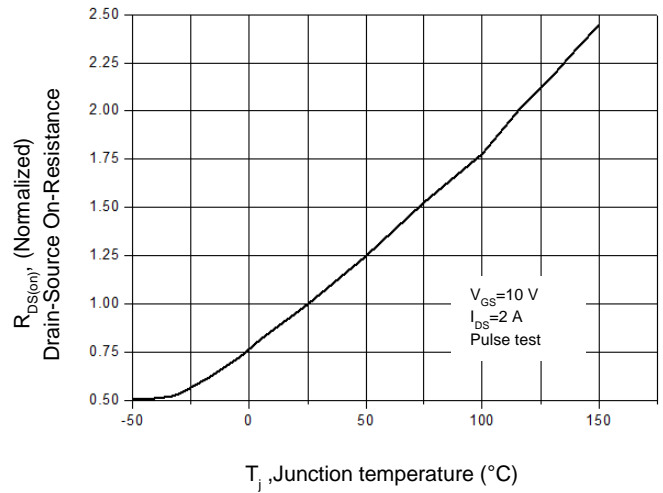


Figure 7. Capacitance Characteristics

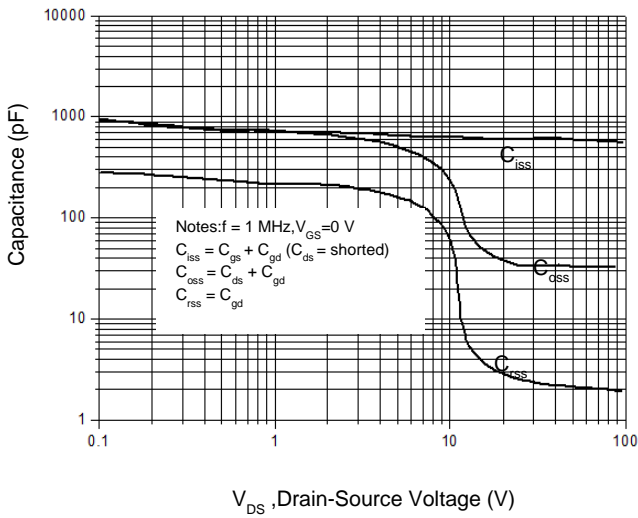


Figure 8. Gate Charge Characteristic

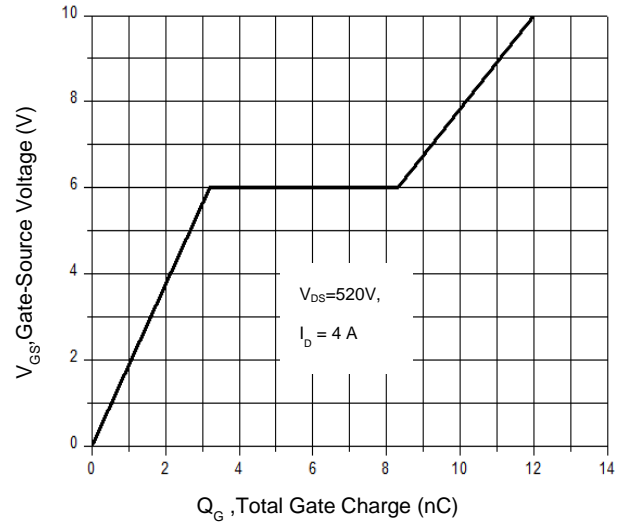


Figure 9. Maximum Safe Operating Area  
TO-220F

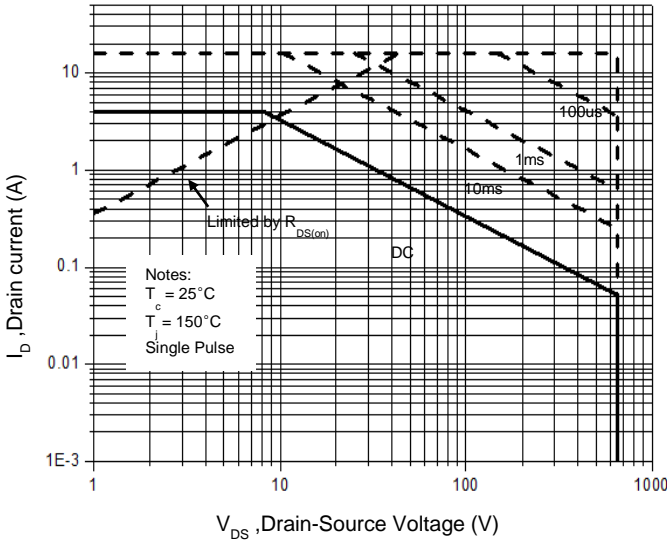


Figure 10. Maximum Safe Operating Area  
TO-220/ TO-251/TO-252/TO-262

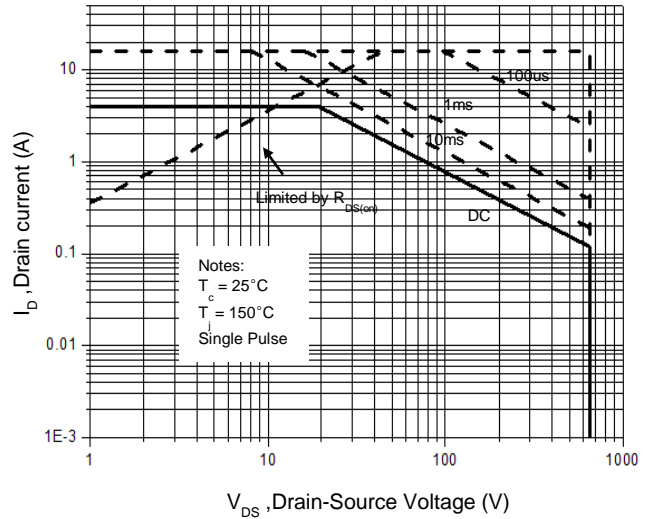


Figure 11. Power Dissipation vs. Temperature  
TO-220F

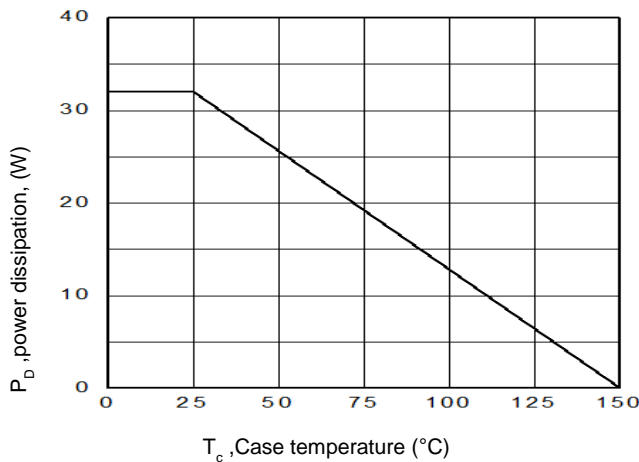


Figure 12. Power Dissipation vs. Temperature  
TO-220/ TO-251/TO-252/TO-262

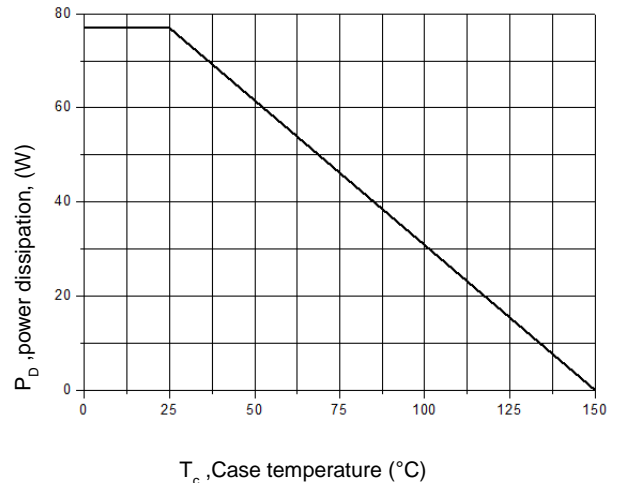


Figure 13. Continuous Drain Current vs. Temperature

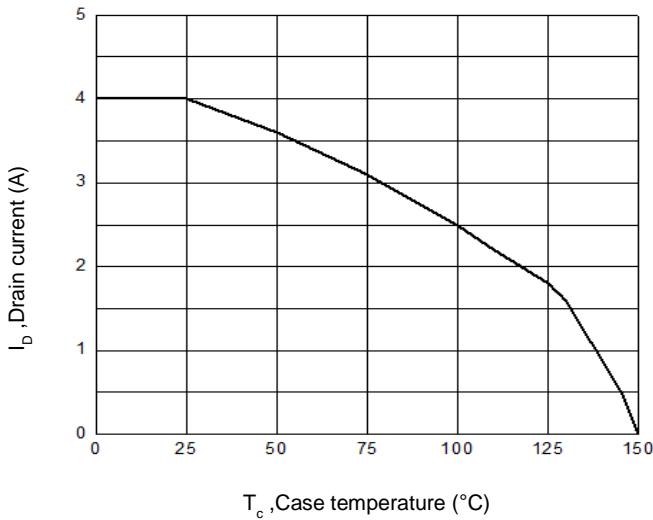


Figure 14. Body Diode Transfer Characteristics

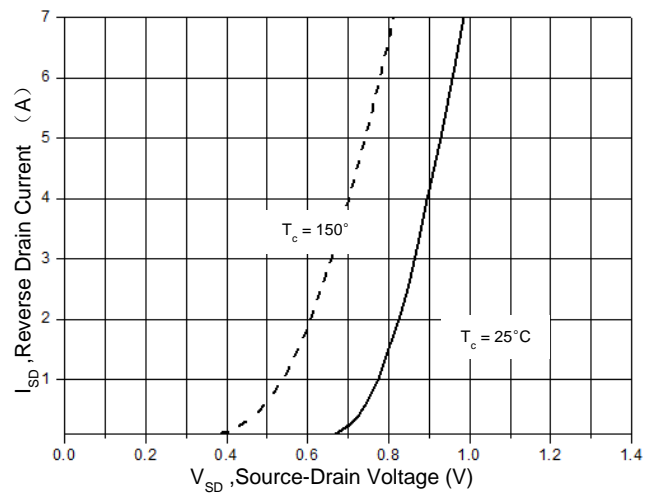


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

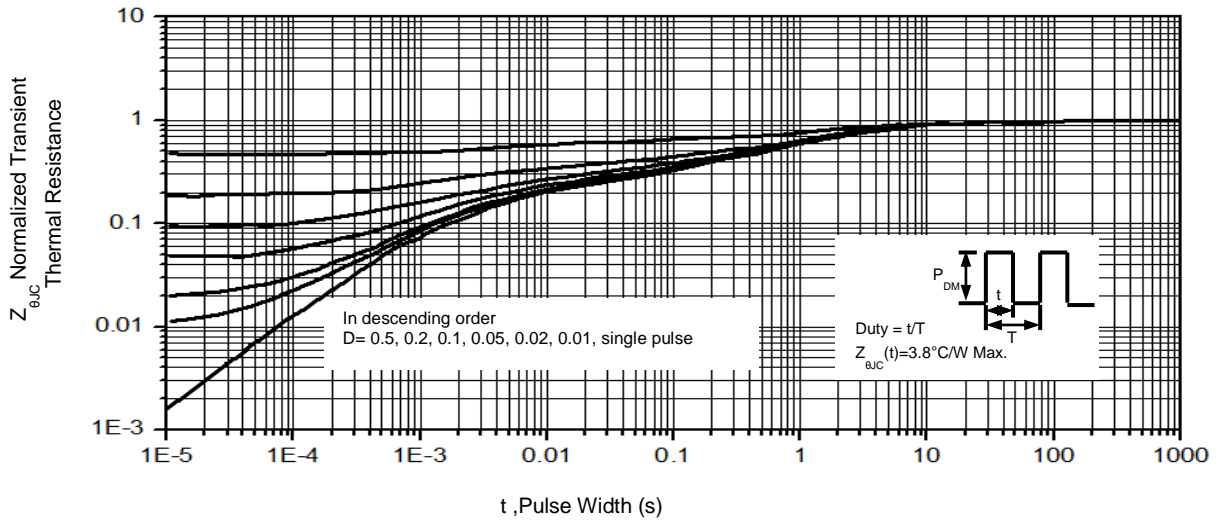
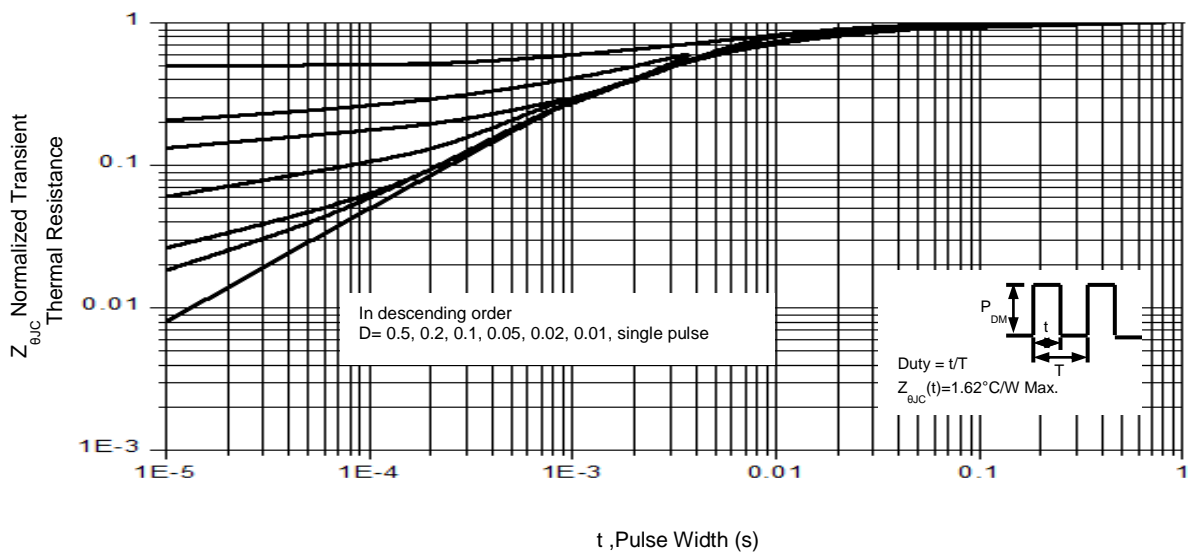
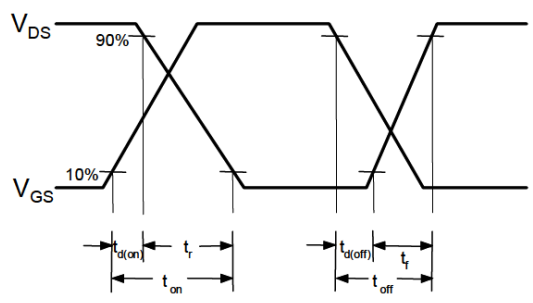
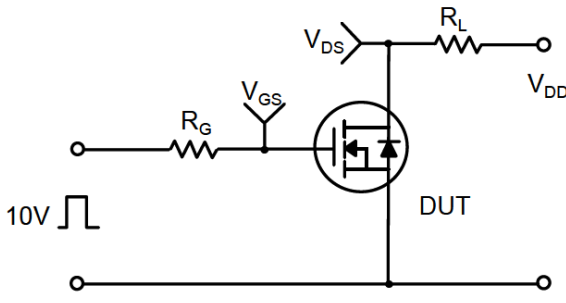


Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/ TO-251/TO-252/TO-262



**Gate Charge Test Circuit & Waveform**



**Unclamped Inductive Switching Test Circuit & Waveforms**



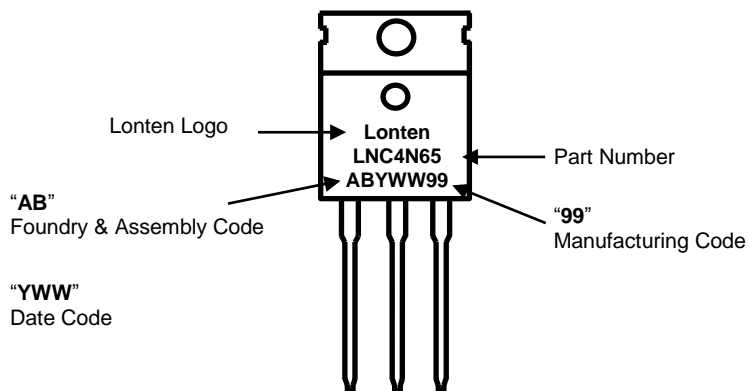
**Mechanical Dimensions for TO-220**



UNIT: mm

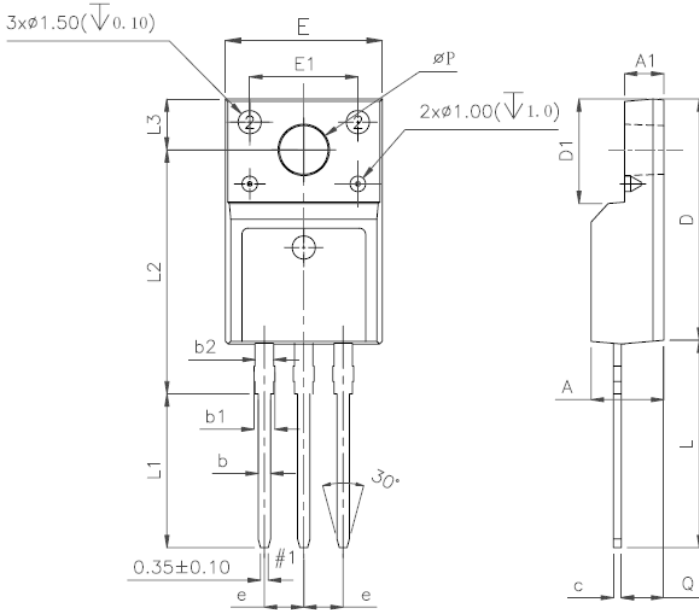
SYMBOL	MIN	NOM	MAX
A	4		4.8
B	1.2		1.4
B1	1		1.4
b1	0.75		0.95
c	0.4		0.55
D	15		16.5
D1	5.9		6.9
E	9.9		10.7
e	2.44	2.54	2.64
F	1.1		1.4
L	12.5		14.5
L1	3	3.5	4
$\phi P$	3.7	3.8	3.9
Q	2.5		3
Q1	2		2.9
Y	8.02	8.12	8.22

**TO-220 Part Marking Information**



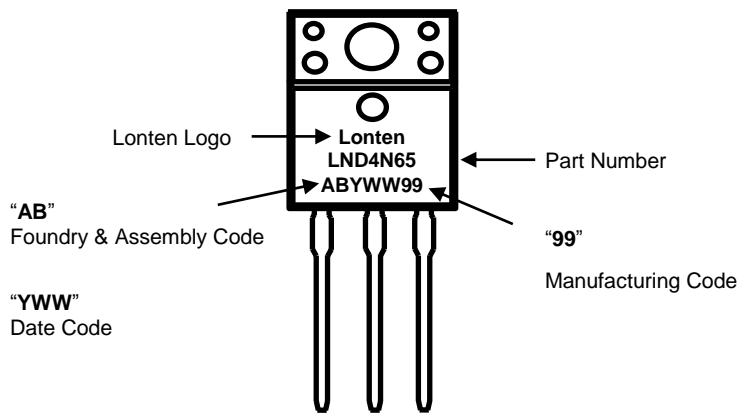
**Mechanical Dimensions for TO-220F**

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

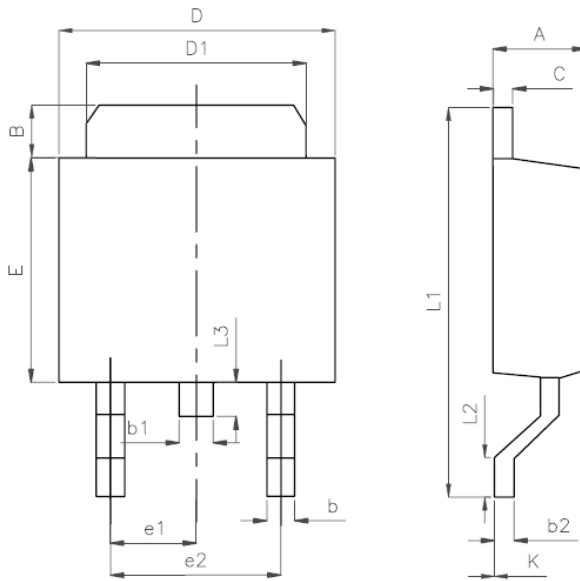
**TO-220F Part Marking Information**





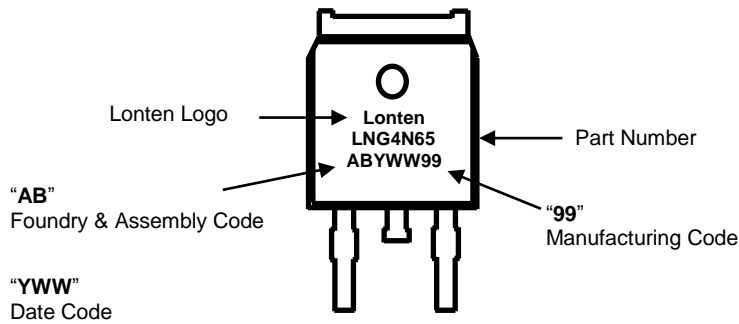
**Mechanical Dimensions for TO-252**

UNIT: mm



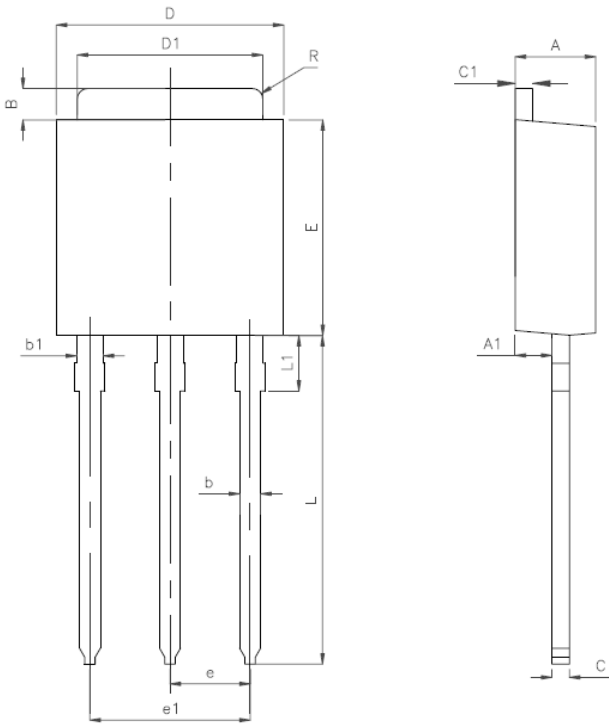
SYMBOL	MIN	NOM	MAX
A	2.10		2.50
B	0.80		1.25
b	0.50		0.85
b1	0.50		0.90
b2	0.45		0.60
C	0.45		0.60
D	6.35		6.75
D1	5.10		5.50
E	5.80		6.30
e1	2.25	2.30	2.35
e2	4.45		4.75
L1	9.50		10.20
L2	0.90		1.45
L3	0.60		1.10
K	-0.1		0.10

**TO-252 Part Marking Information**



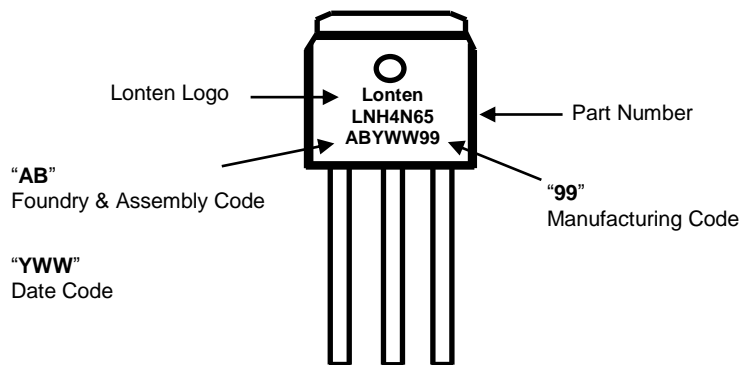
**Mechanical Dimensions for TO-251**

UNIT: mm

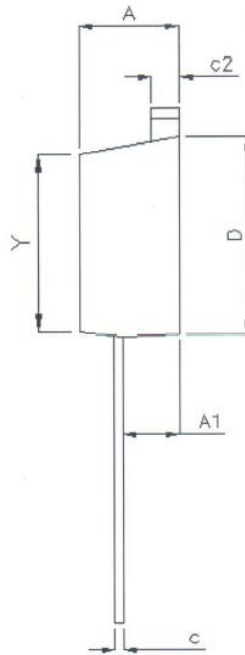
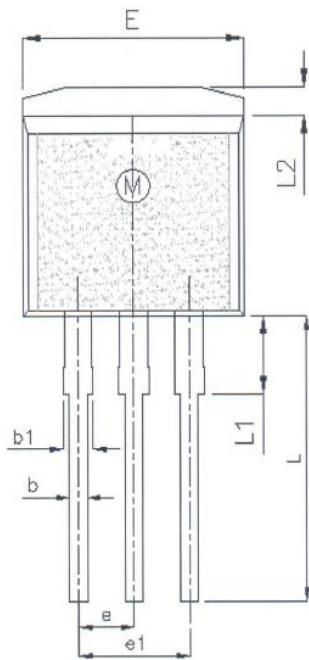


SYMBOL	MIN	NOM	MAX
A	2.10		2.50
A1	0.95		1.30
B	0.80		1.25
b	0.50		0.80
b1	0.70		0.90
C	0.45		0.60
C1	0.45		0.60
D	6.35		6.75
D1	5.10		5.50
E	5.80		6.30
e	2.25	2.30	2.35
L	7.70		8.50
L1	1.45		1.95
R		0.30	

**TO-251 Part Marking Information**



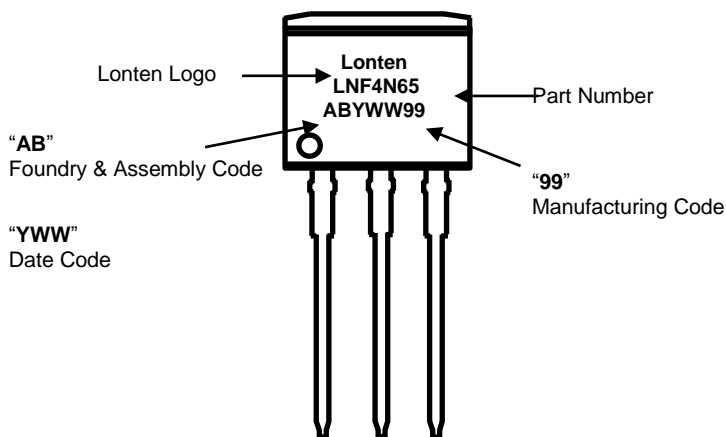
**Mechanical Dimensions for TO-262**



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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