

## Lonten N-channel 500V, 13A 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 = 33</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>◆ Electronic ballast</li> <li>◆ Switched mode power supplies.</li> <li>◆ UPS.</li> </ul>	<p><b>Product Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"><math>V_{DSS}</math></td> <td>500V</td> </tr> <tr> <td><math>I_D</math></td> <td>13A</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td>0.46<math>\Omega</math></td> </tr> <tr> <td><math>Q_{g,typ}</math></td> <td>33 nC</td> </tr> </table> <div style="text-align: center; margin-top: 10px;"> <p style="margin: 0;"><b>TO-220      TO-220F</b></p> <p style="margin: 0;"><b>N-Channel MOSFET</b></p> </div>	$V_{DSS}$	500V	$I_D$	13A	$R_{DS(on),max}$	0.46 $\Omega$	$Q_{g,typ}$	33 nC
$V_{DSS}$	500V								
$I_D$	13A								
$R_{DS(on),max}$	0.46 $\Omega$								
$Q_{g,typ}$	33 nC								

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	500	V
Continuous drain current ( $T_C = 25^\circ\text{C}$ ) ( $T_C = 100^\circ\text{C}$ )	$I_D$	13	A
		8	A
Pulsed drain current <sup>1)</sup>	$I_{DM}$	52	A
Gate-Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	845	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 $25^\circ\text{C}$	$P_D$	50	W
		0.4	W/ $^\circ\text{C}$
Power Dissipation TO-220 ( $T_C = 25^\circ\text{C}$ ) Derate above $25^\circ\text{C}$	$P_D$	212	W
		1.69	W/ $^\circ\text{C}$
Operating junction and storage temperature range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$
Continuous diode forward current	$I_S$	13	A
Diode pulse current	$I_{S,pulse}$	52	A

### Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO-220F	TO-220	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	2.5	0.59	$^\circ\text{C}/\text{W}$
Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	62.5	62.5	$^\circ\text{C}/\text{W}$

**Package Marking and Ordering Information**

Device	Device Package	Marking	Units/Tube	Units/Reel
LNC13N50	TO-220	LNC13N50	50	
LND13N50	TO-220F	LND13N50	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	$BV_{DSS}$	$V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$	500	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.25\text{ mA}$	2	-	4	V
Drain cut-off current	$I_{DSS}$	$V_{DS}=500\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$	-	-	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	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=6.5\text{ A}$	-	0.37	0.46	$\Omega$
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	1960	-	pF
Output capacitance	$C_{oss}$		-	185	-	
Reverse transfer capacitance	$C_{rss}$		-	3	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 13\text{ A}$ $R_G = 10\ \Omega, V_{GS}=15\text{ V}$	-	13	-	ns
Rise time	$t_r$		-	36	-	
Turn-off delay time	$t_{d(off)}$		-	62	-	
Fall time	$t_f$		-	13	-	
<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=13\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	8.5	-	nC
Gate to drain charge	$Q_{gd}$		-	10.3	-	
Gate charge total	$Q_g$		-	33	-	
Gate plateau voltage	$V_{plateau}$		-	5	-	V
<b>Reverse diode characteristics</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=13\text{ A}$	-	-	1.3	V
Reverse recovery time	$t_{rr}$	$V_R=250\text{ V}, I_F=13\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	305	-	ns
Reverse recovery charge	$Q_{rr}$		-	3.4	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	22	-	A

**Notes:**

- Pulse width limited by maximum junction temperature.
- $L=10\text{mH}, I_{AS} = 13\text{A}$ , Starting  $T_j= 25^\circ\text{C}$ .
- $I_{SD} = 13\text{A}, di/dt \leq 100\text{A}/\mu\text{s}, V_{DD} \leq BV_{DS}$ , Starting  $T_j= 25^\circ\text{C}$ .

## Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

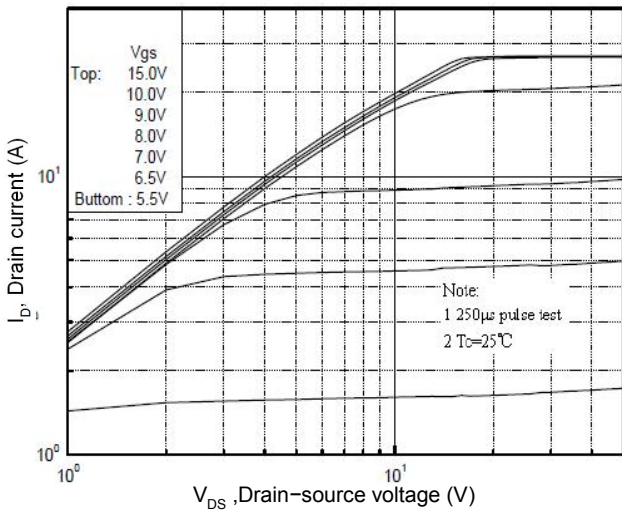


Figure 3. On-Resistance Variation vs. Drain Current

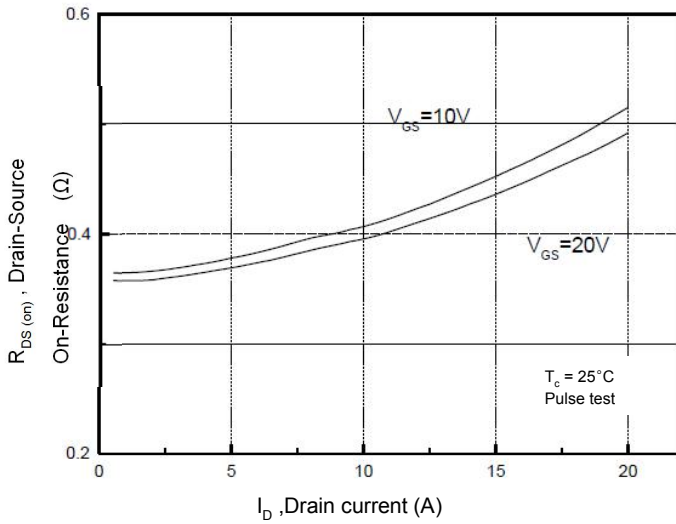


Figure 5. Breakdown Voltage vs. Temperature

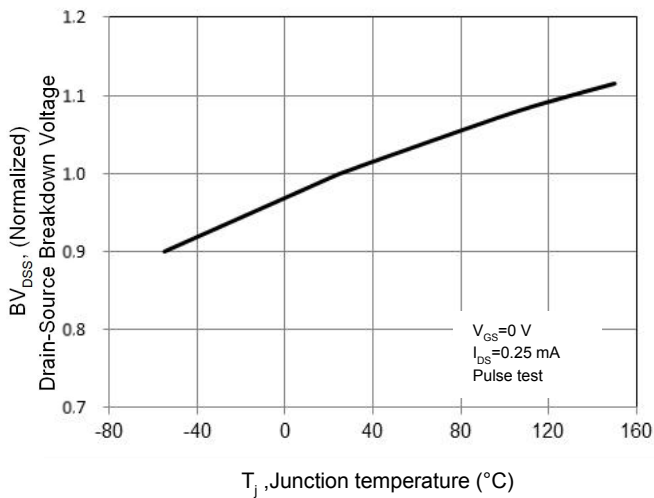


Figure 2. Transfer Characteristics

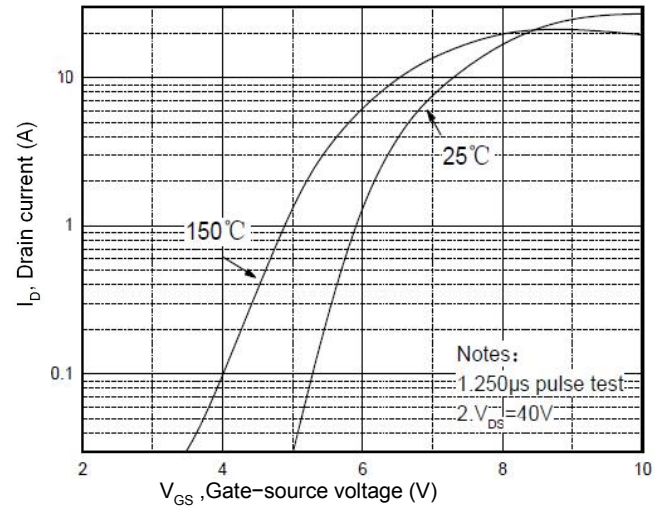


Figure 4. Threshold Voltage vs. Temperature

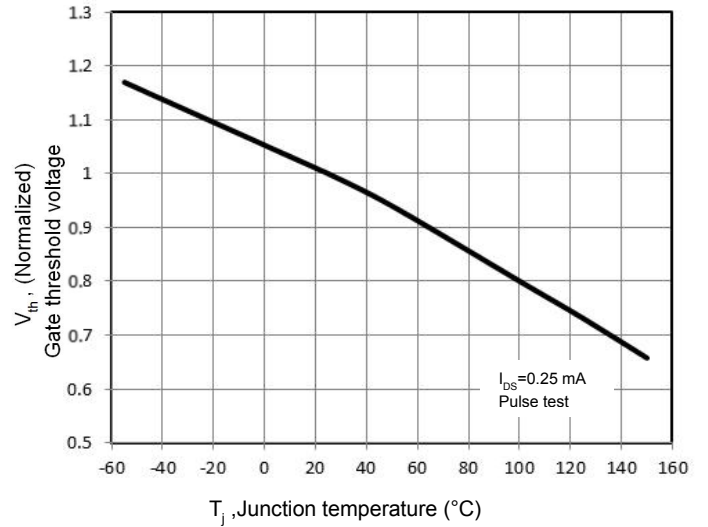


Figure 6. On-Resistance vs. Temperature

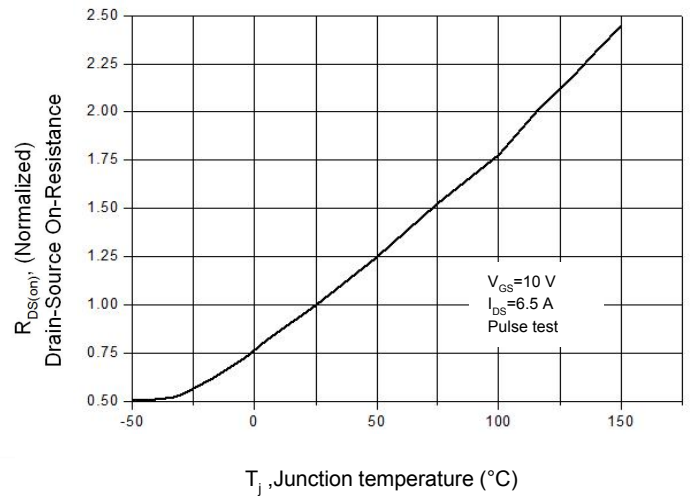


Figure 7. Capacitance Characteristics

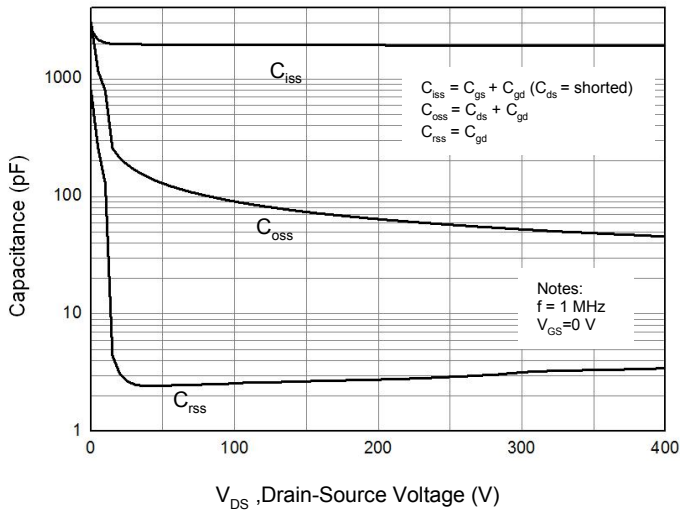


Figure 8. Gate Charge Characteristics

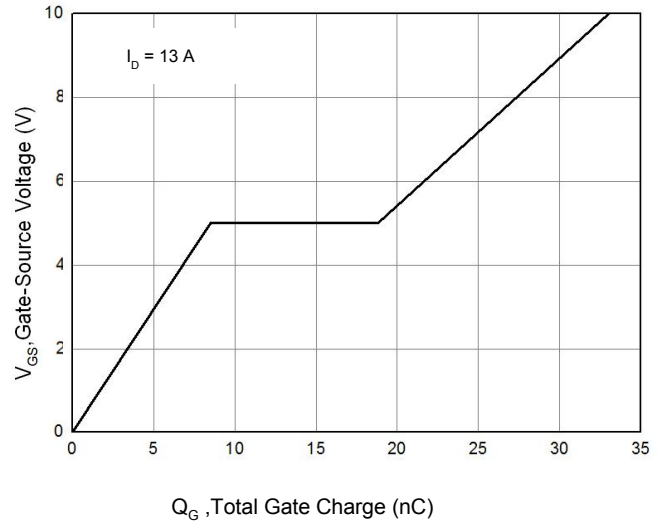


Figure 9. Maximum Safe Operating Area  
TO-220F

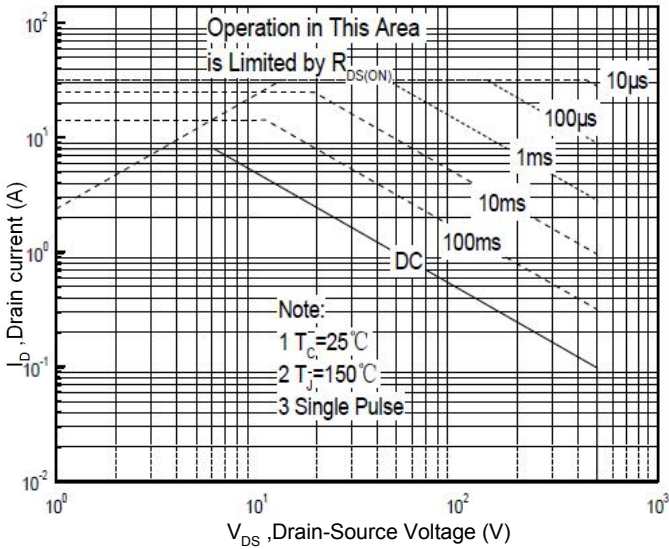


Figure 10. Maximum Safe Operating Area  
TO-220

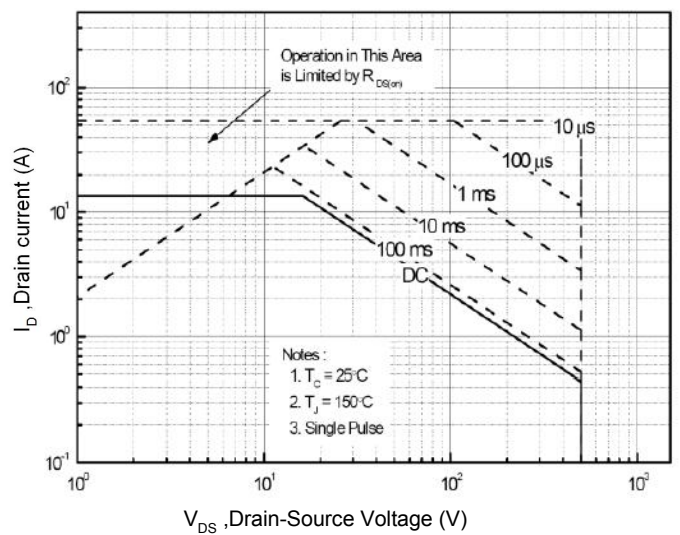


Figure 11. Power Dissipation vs. Temperature  
TO-220F

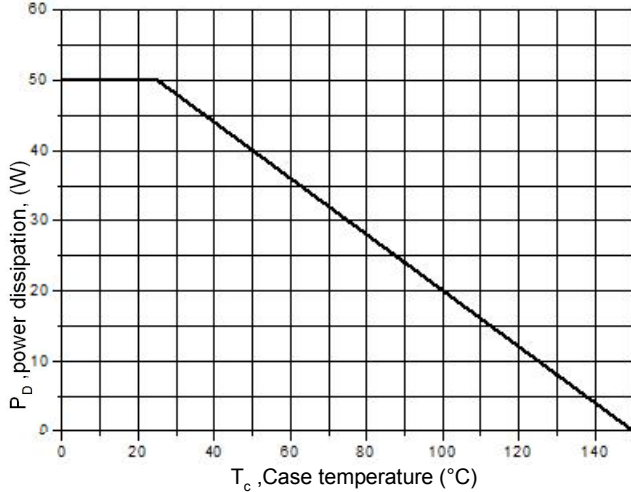


Figure 12. Power Dissipation vs. Temperature  
TO-220

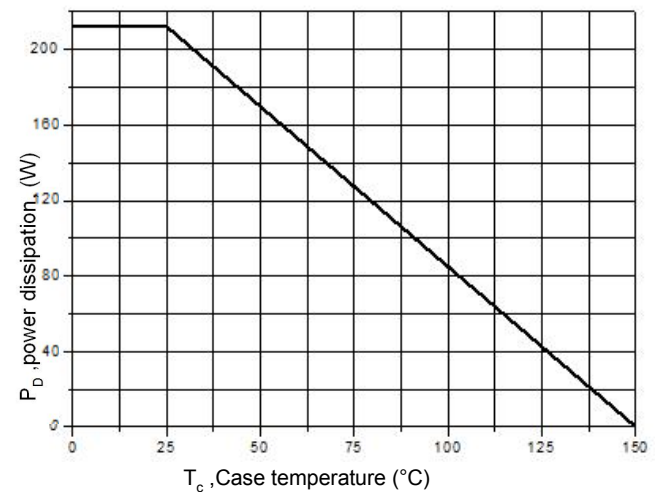


Figure 13. Continuous Drain Current vs. Temperature

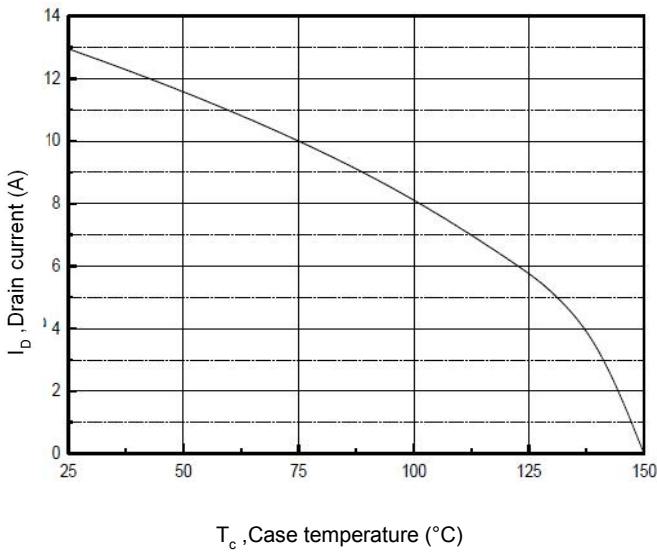


Figure 14. Body Diode Transfer Characteristics

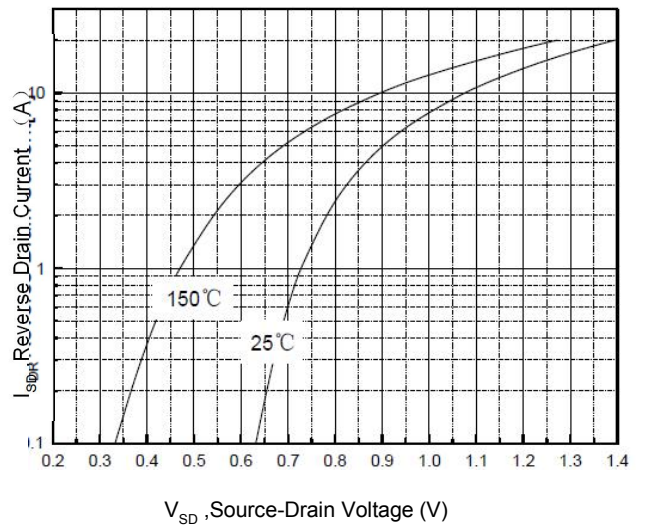


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F

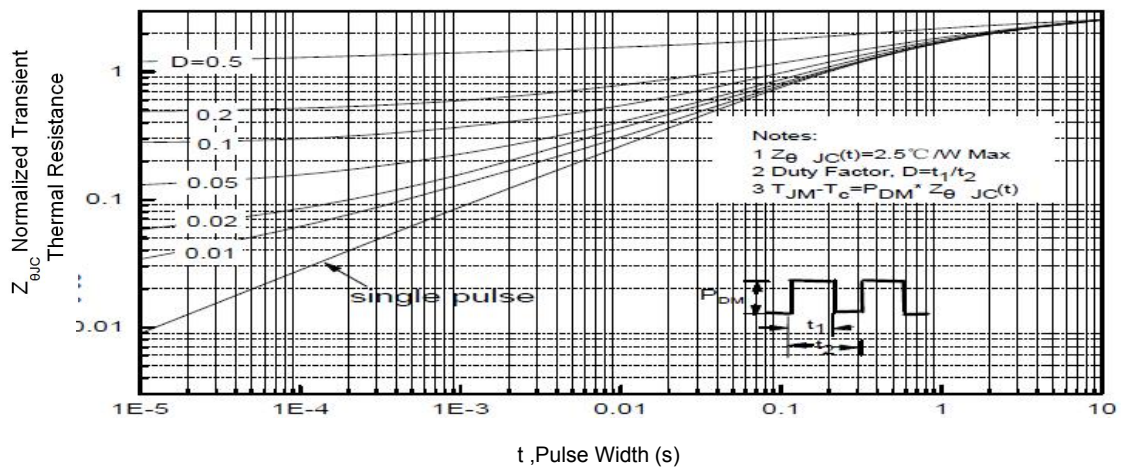
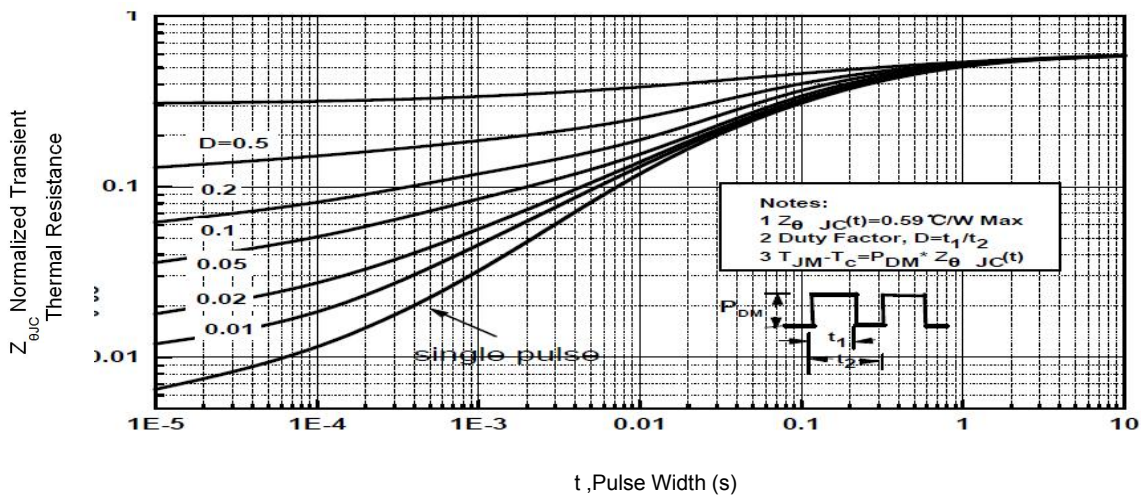
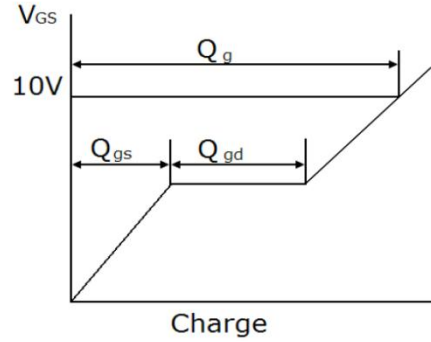
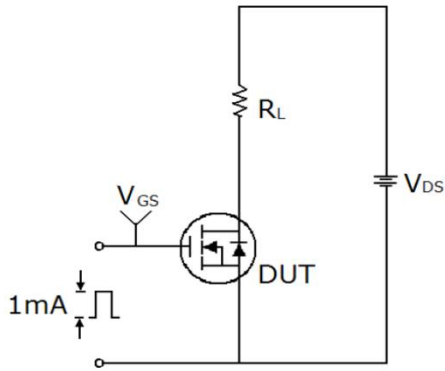


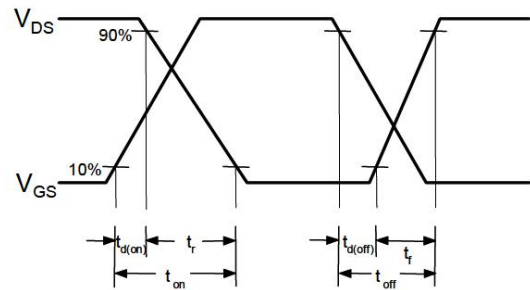
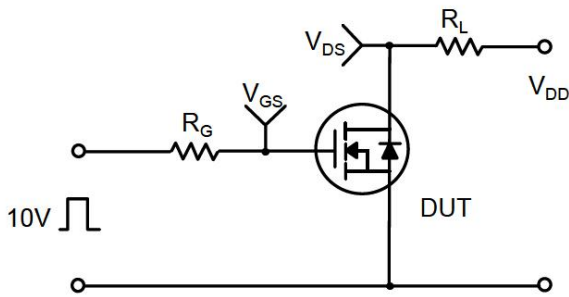
Figure 16. Transient Thermal Impedance, Junction to Case, TO-220



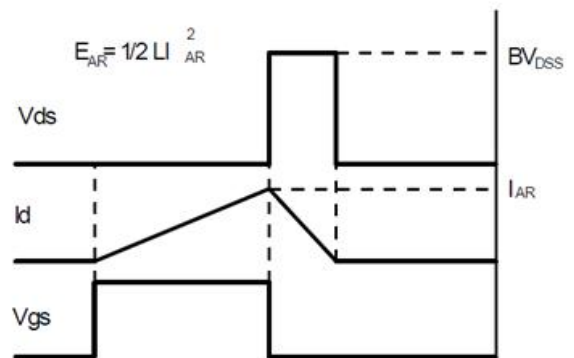
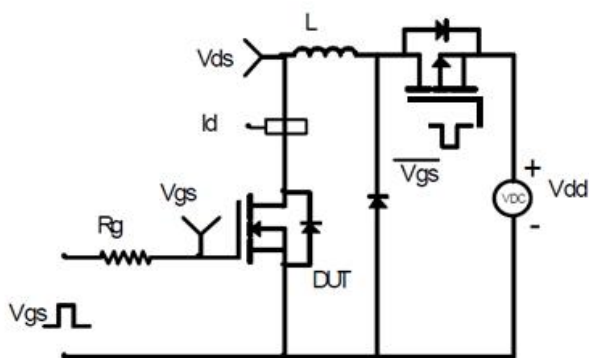
**Gate Charge Test Circuit & Waveform**



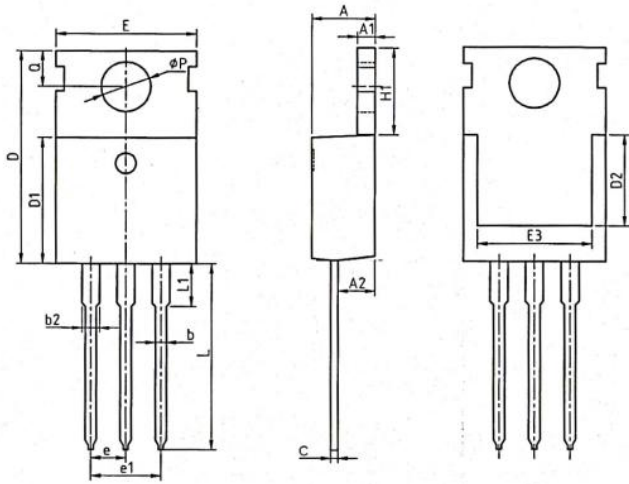
**Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

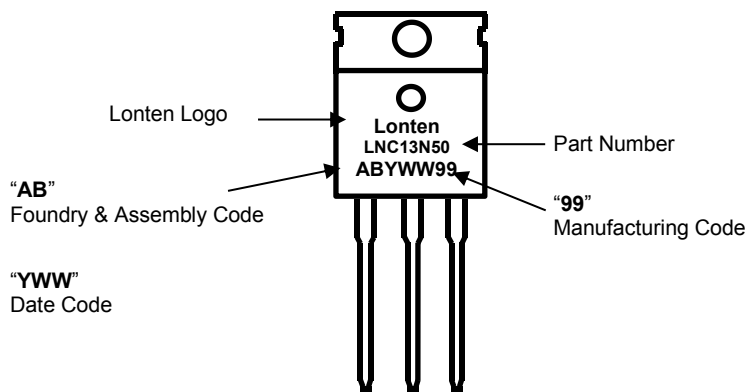


**Mechanical Dimensions for TO-220**

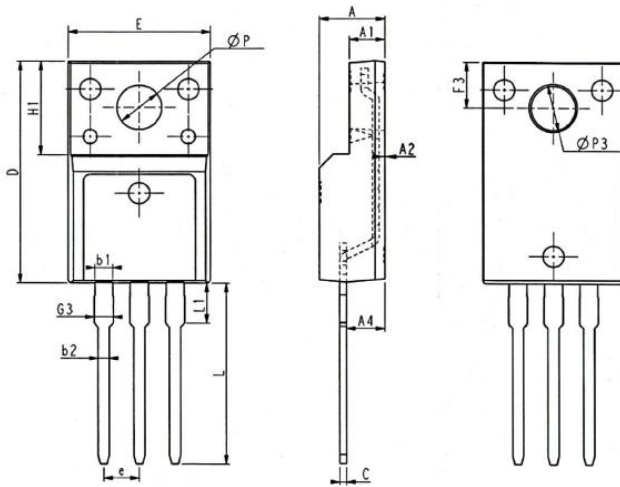


COMMON DIMENSIONS						
SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.70	0.172	0.180	0.185
A1	1.25	1.30	1.40	0.049	0.051	0.055
A2	2.20	2.40	2.60	0.087	0.094	0.102
b	0.70	0.80	0.95	0.028	0.031	0.037
b2	1.17	1.27	1.47	0.046	0.050	0.058
c	0.45	0.50	0.60	0.018	0.020	0.024
D	15.10	15.60	16.10	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**

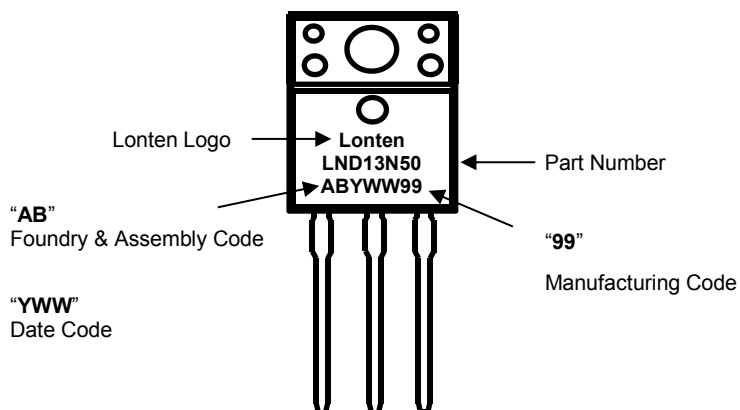


**Mechanical Dimensions for TO-220F**



SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NO	MA
E	9.96	10.1	10.3	0.39	0.40	0.40
A	4.50	4.70	4.90	0.17	0.18	0.19
A1	2.34	2.54	2.74	0.09	0.10	0.10
A2	0.30	0.45	0.60	0.01	0.00	0.02
A4	2.65	2.76	2.96	0.10	0.10	0.11
C	0.40	0.50	0.38	0.01	0.02	0.02
D	15.57	15.8	16.1	0.61	0.62	0.63
H1	6.70REF			0.264REF		
e	2.54BSC			0.1BSC		
ØP	3.03	3.18	3.38	0.11	0.12	0.13
L	12.68	12.9	13.2	0.49	0.51	0.52
L1	2.88	3.03	3.18	0.11	0.11	0.12
ØP3	3.15REF			0.124REF		
F3	3.15	3.30	3.45	0.12	0.13	0.13
G3	1.25	1.35	1.55	0.04	0.05	0.06
b1	1.18	1.28	1.43	0.04	0.05	0.05
b2	0.70	0.80	0.95	0.02	0.03	0.03

**TO-220MF Part Marking Information**





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