

## Lonten N-channel 650V, 12A Power MOSFET

<p><b>Description</b> The Power MOSFET is fabricated using the advanced planer 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 = 41.9</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="width: 30%;"><math>V_{DSS}</math></td><td>650V</td></tr> <tr><td><math>I_D</math></td><td>12A</td></tr> <tr><td><math>R_{DS(on),max}</math></td><td>0.8<math>\Omega</math></td></tr> <tr><td><math>Q_{g,typ}</math></td><td>41.9 nC</td></tr> </table> <div style="text-align: center; margin-top: 10px;"> <p style="margin: 0;"><b>TO-262    TO-263    TO-220    TO-220F</b></p> <p style="margin: 0;"><b>TO-220F Narrow Pin</b></p> <p style="margin: 0; text-align: right;"><b>N-Channel MOSFET</b> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">Pb</span></p> </div>	$V_{DSS}$	650V	$I_D$	12A	$R_{DS(on),max}$	0.8 $\Omega$	$Q_{g,typ}$	41.9 nC
$V_{DSS}$	650V								
$I_D$	12A								
$R_{DS(on),max}$	0.8 $\Omega$								
$Q_{g,typ}$	41.9 nC								

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	650	V
Continuous drain current ( $T_C = 25^\circ\text{C}$ ) ( $T_C = 100^\circ\text{C}$ )	$I_D$	12	A
		7.5	A
Pulsed drain current <sup>1)</sup>	$I_{DM}$	48	A
Gate-Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	500	mJ
Peak diode recovery $dv/dt$ <sup>3)</sup>	$dv/dt$	5	V/ns
Power Dissipation TO-220F/TO-220F Narrow Pin ( $T_C = 25^\circ\text{C}$ ) Derate above $25^\circ\text{C}$	$P_D$	42	W
		0.34	W/ $^\circ\text{C}$
Power Dissipation TO-220\ TO-262\ TO-263 ( $T_C = 25^\circ\text{C}$ ) Derate above $25^\circ\text{C}$	$P_D$	150	W
		1.2	W/ $^\circ\text{C}$
Operating junction and storage temperature range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$
Continuous diode forward current	$I_S$	12	A
Diode pulse current	$I_{S,pulse}$	48	A

### Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO-220F\TO-220F Narrow Pin	TO-220\TO-262\TO-263	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	2.98	0.83	$^\circ\text{C}/\text{W}$

Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	110	62.5	$^{\circ}\text{C/W}$
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**Package Marking and Ordering Information**

Device	Device Package	Marking	Units/Tube	Units/Reel
LNC12N65	TO-220	LNC12N65	50	
LND12N65	TO-220F	LND12N65	50	
LNE12N65	TO-263	LNE12N65		800
LNF12N65	TO-262	LNF12N65	50	
LNDN12N65	TO-220F Narrow Pin	LNDN12N65	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	$\mu\text{A}$
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	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=6\text{ A}$	-	0.64	0.8	$\Omega$
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	2000	-	pF
Output capacitance	$C_{oss}$		-	164	-	
Reverse transfer capacitance	$C_{rss}$		-	7.4	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 325\text{ V}, I_D = 12\text{ A}$ $R_G = 10\ \Omega, V_{GS}=15\text{ V}$	-	14.6	-	ns
Rise time	$t_r$		-	37.8	-	
Turn-off delay time	$t_{d(off)}$		-	69.3	-	
Fall time	$t_f$		-	15.8	-	
<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=520\text{ V}, I_D=12\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	10.8	-	nC
Gate to drain charge	$Q_{gd}$		-	15	-	
Gate charge total	$Q_g$		-	41.9	-	
Gate plateau voltage	$V_{plateau}$		-	5	-	V
<b>Reverse diode characteristics</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=12\text{ A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}$	$V_R=325\text{ V}, I_F=12\text{ A},$ $di/dt=100\text{ A}/\mu\text{s}$	-	450.4	-	ns
Reverse recovery charge	$Q_{rr}$		-	4.75	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}$		-	21.1	-	A

**Notes:**

- Pulse width limited by maximum junction temperature.
- $L=10\text{mH}, I_{AS} = 10\text{A},$  Starting  $T_j= 25^{\circ}\text{C}.$
- $I_{SD} = 12\text{A}, di/dt \leq 100\text{A}/\mu\text{s}, V_{DD} \leq BV_{DS},$  Starting  $T_j= 25^{\circ}\text{C}.$

## Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

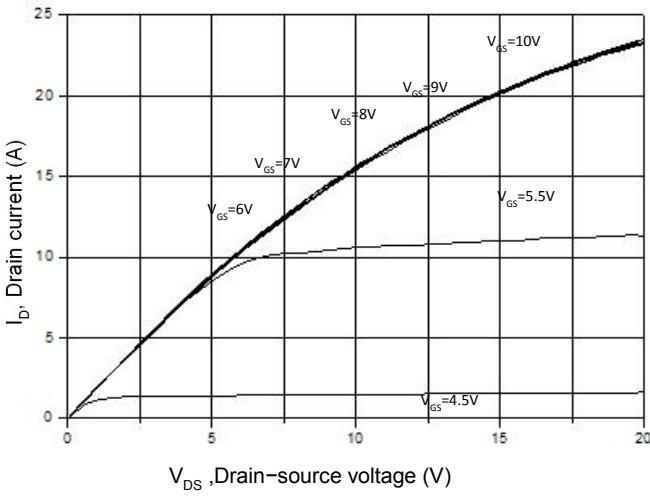


Figure 2. Transfer Characteristics

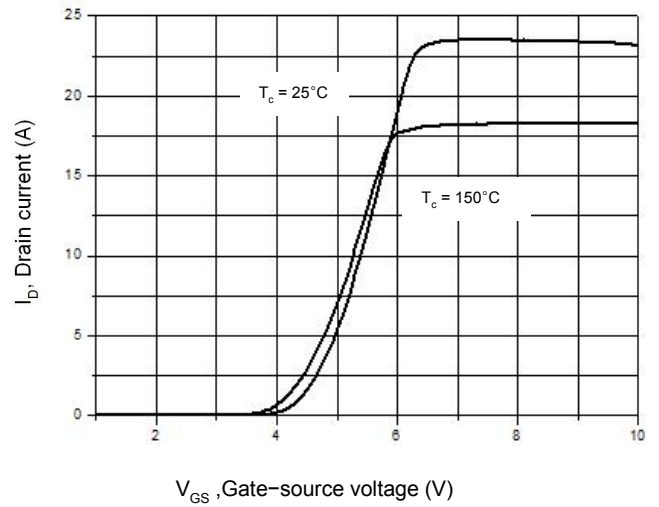


Figure 3. On-Resistance Variation vs. Drain Current

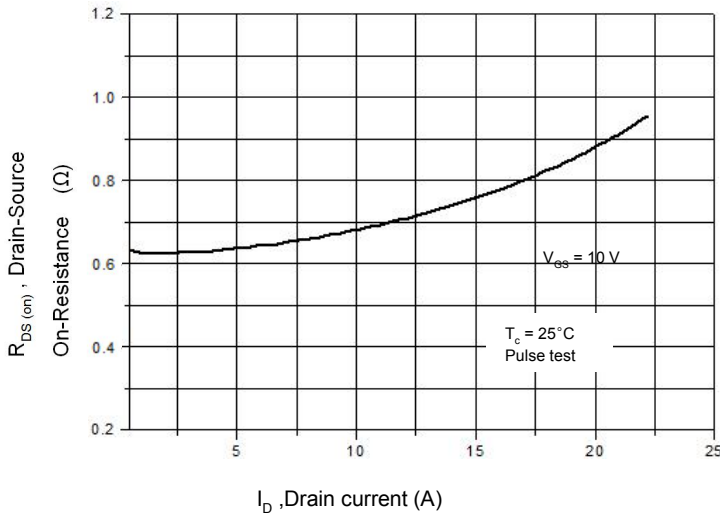


Figure 4. Threshold Voltage vs. Temperature

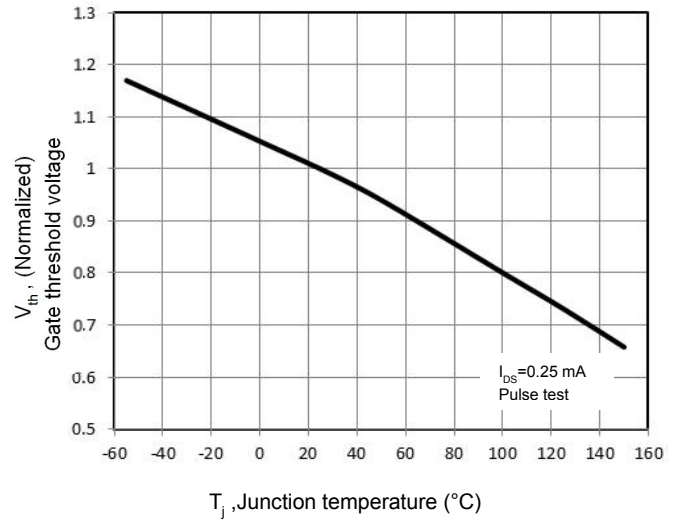


Figure 5. Breakdown Voltage vs. Temperature

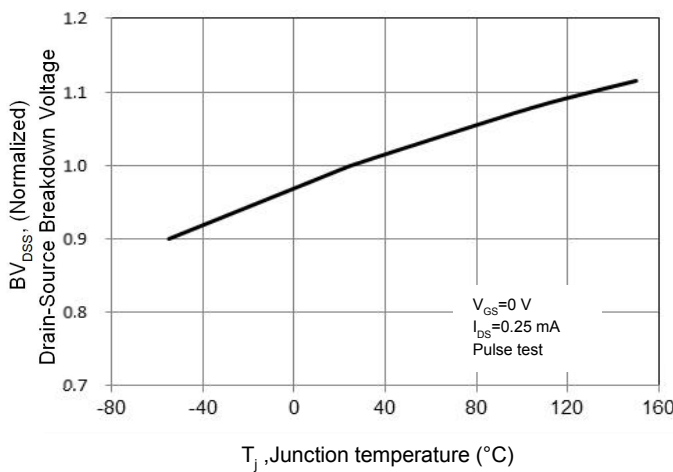


Figure 6. On-Resistance vs. Temperature

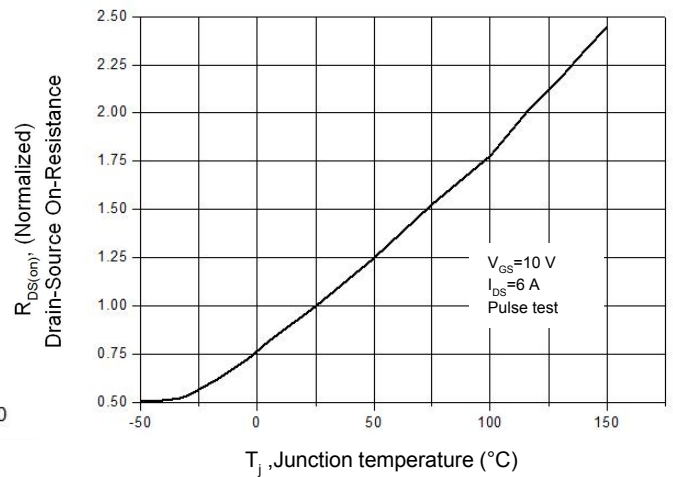


Figure 7. Capacitance Characteristics

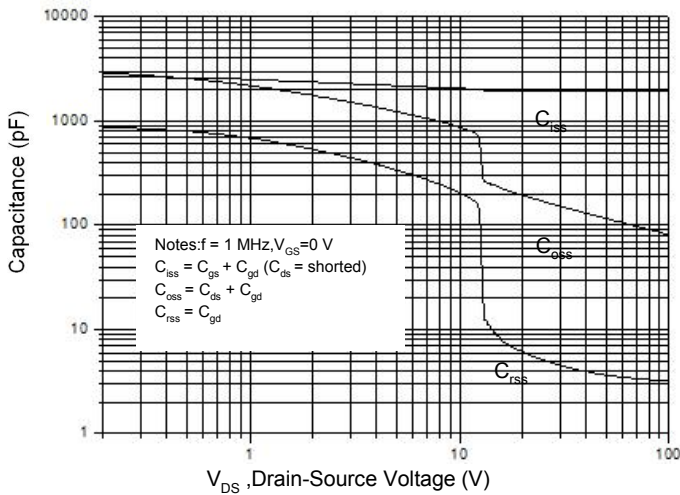


Figure 8. Gate Charge Characteristics

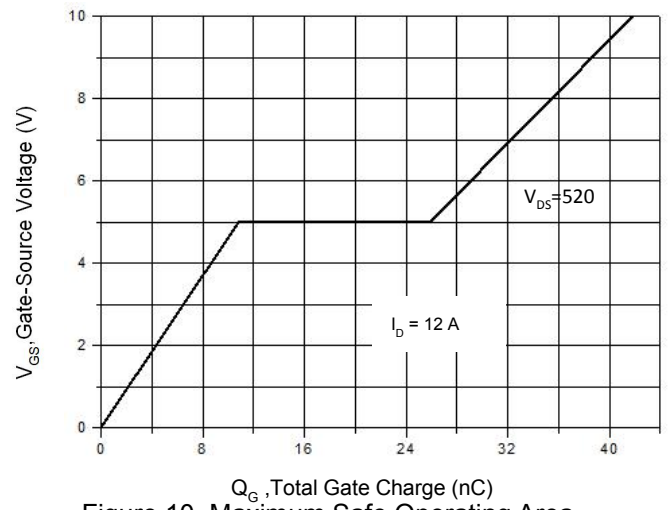


Figure 9. Maximum Safe Operating Area

TO-220F/TO-220F Narrow Pin

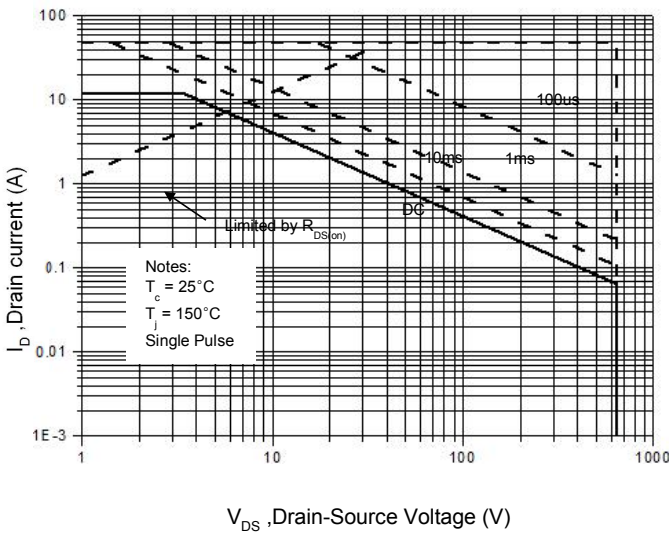


Figure 10. Maximum Safe Operating Area

TO-220/ TO-262/TO-263

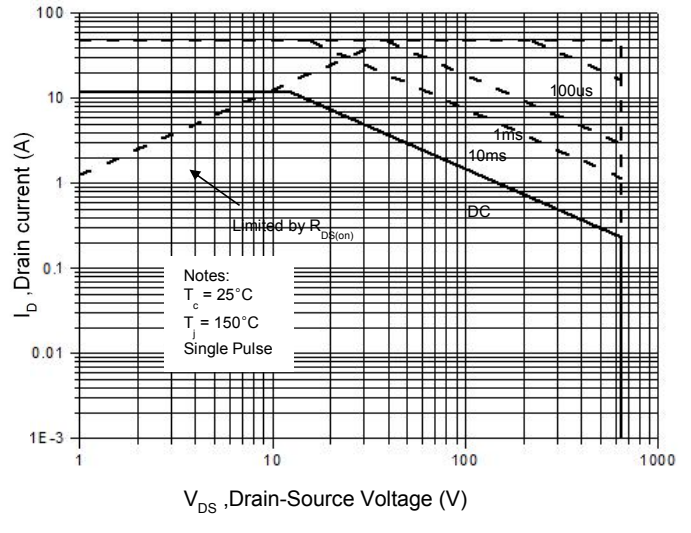


Figure 11. Power Dissipation vs. Temperature

TO-220F/TO-220F Narrow Pin

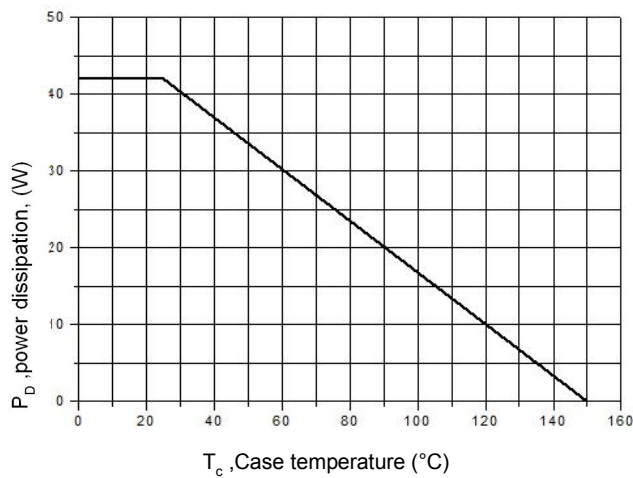


Figure 12. Power Dissipation vs. Temperature

TO-220/ TO-262/TO-263

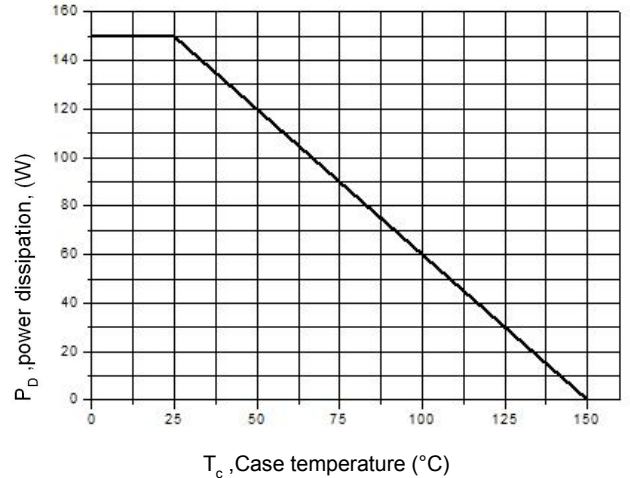


Figure 13. Continuous Drain Current vs. Temperature

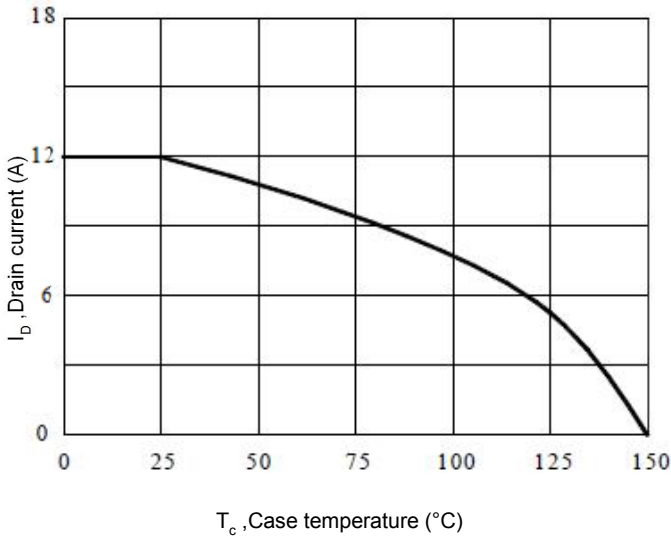


Figure 14. Body Diode Transfer Characteristics

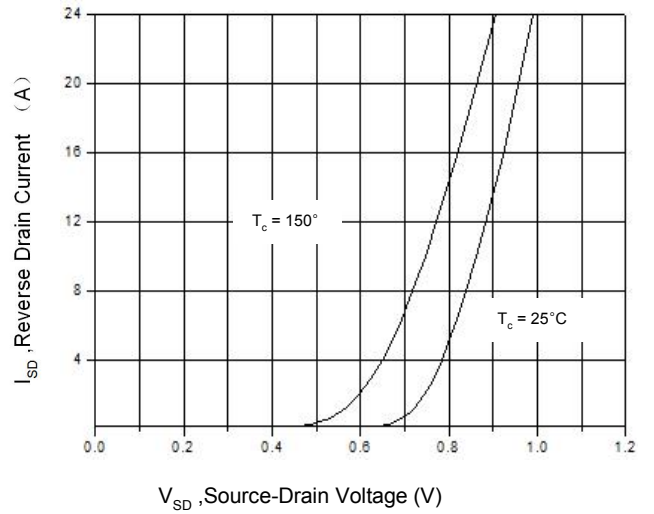


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F/TO-220F Narrow Pin

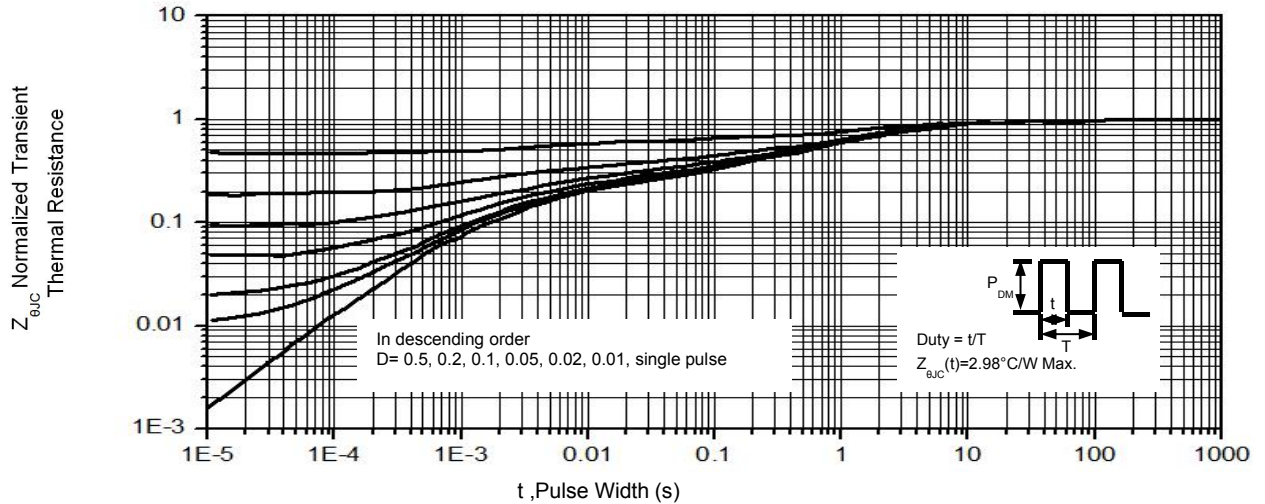
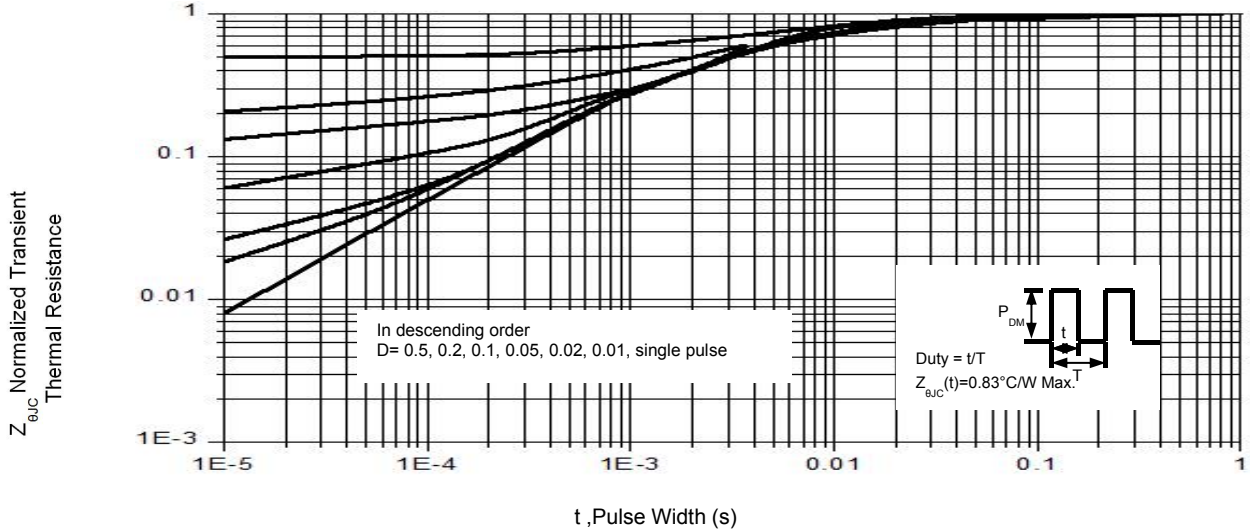
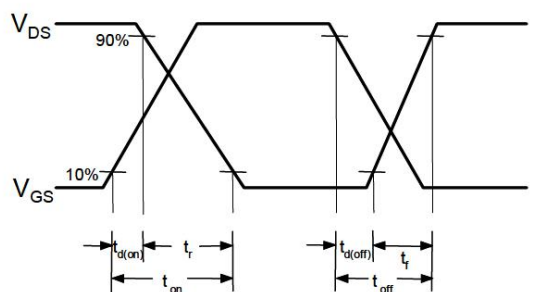
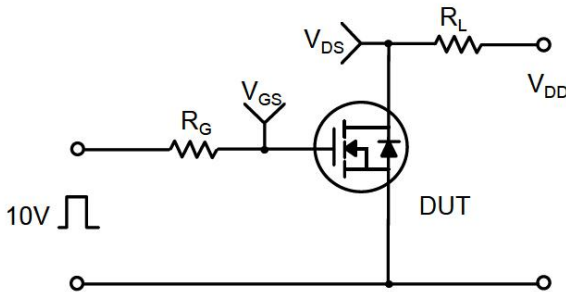
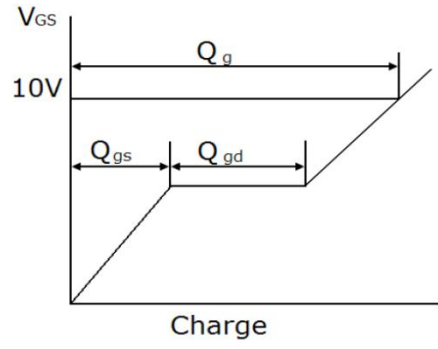


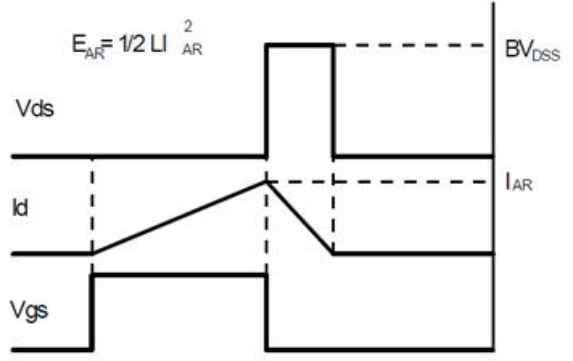
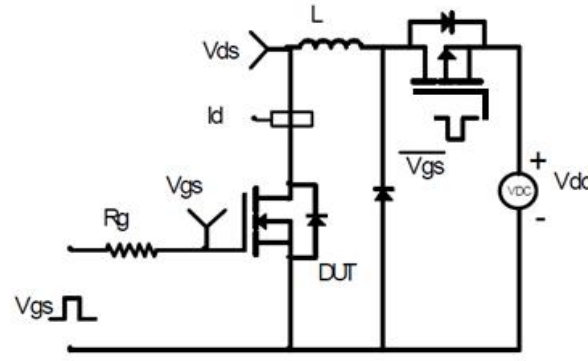
Figure 16. Transient Thermal Impedance, Junction to Case, TO-220/ TO-262/TO-263



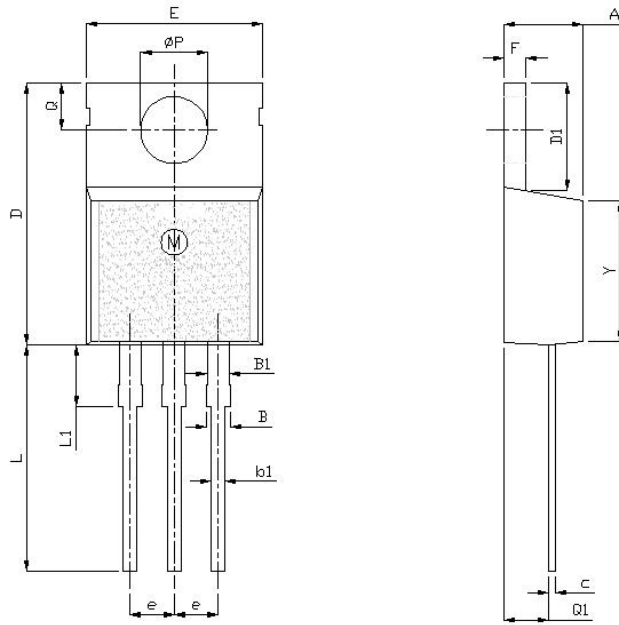
**Gate Charge Test Circuit & Waveform**



**Unclamped Inductive Switching Test Circuit & Waveforms**



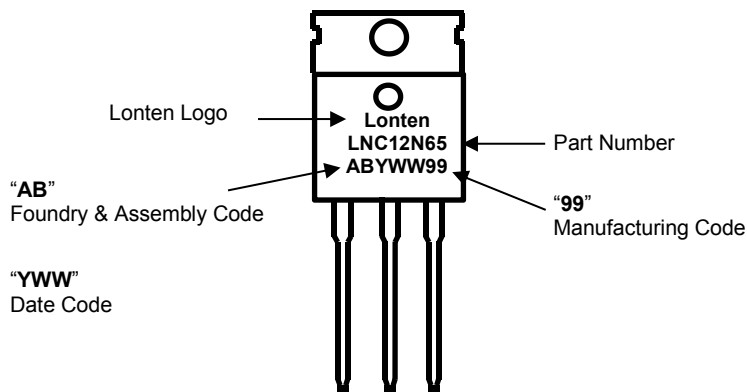
**Mechanical Dimensions for TO-220**



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

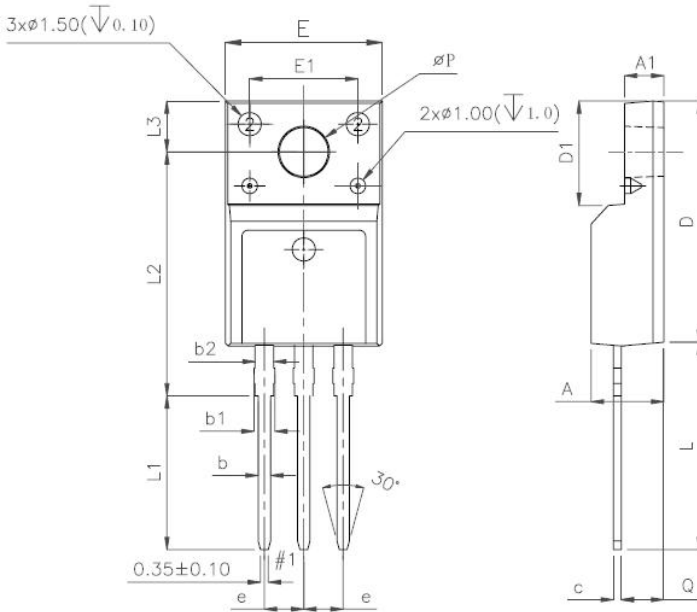
**TO-220 Part Marking Information**





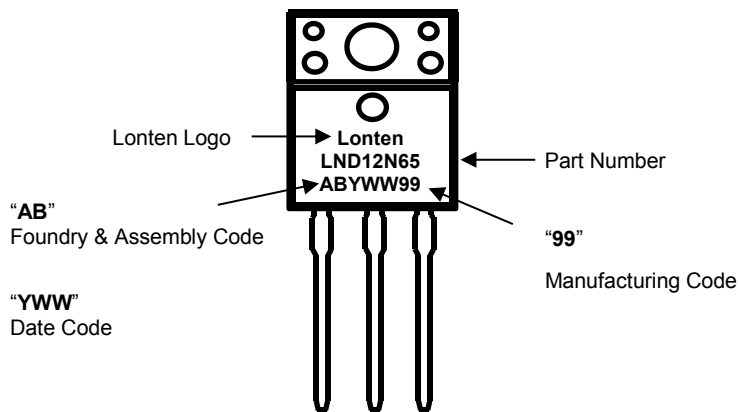
**Mechanical Dimensions for TO-220F**

UNIT: mm



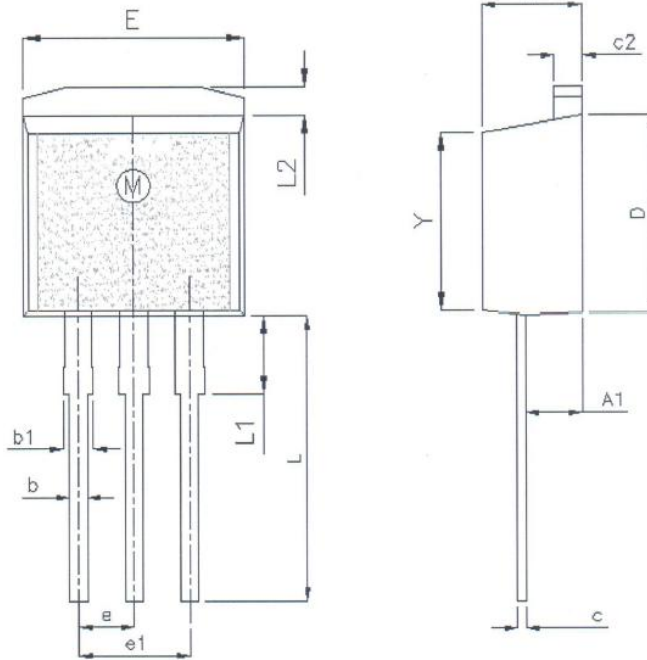
SYMBOL	MIN	NOM	MAX
A	4.5		4.9
A1	2.3		2.9
b	0.65		0.9
b1	1.1		1.7
b2	1.2		1.4
c	0.35		0.65
D	14.5		16.5
D1	6.1		6.9
E	9.6		10.3
E1	6.5	7	7.5
e	2.44	2.54	2.64
L	12.5		14.3
L1	9.45		10.05
L2	15		16
L3	3.2		4.4
φP	3		3.3
Q	2.5		2.9

**TO-220F Part Marking Information**





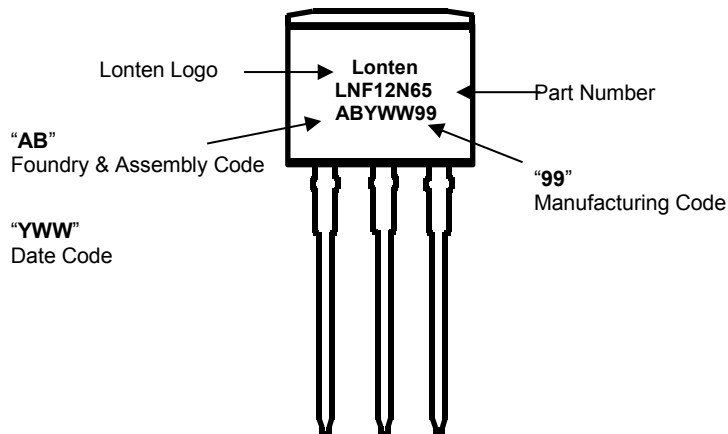
**Mechanical Dimensions for TO-262**



UNIT: mm

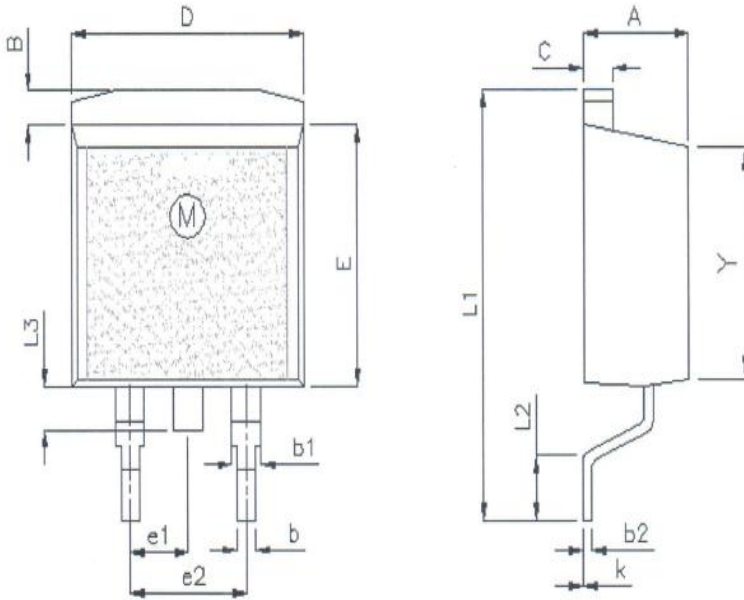
SYMBOL	MIN	NOM	MAX
A	4.42		4.72
A1	2.40		2.80
b	0.76		0.86
b1	1.22		1.40
c	0.33		0.43
c2	1.22		1.35
D	8.99		9.29
e	2.44	2.54	2.64
e1	4.98		5.18
E	9.95		10.25
L	12.50		13.60
L1	3.30	3.50	3.80
L2	1.22		1.40
Y	8.02	8.12	8.22

**TO-262 Part Marking Information**



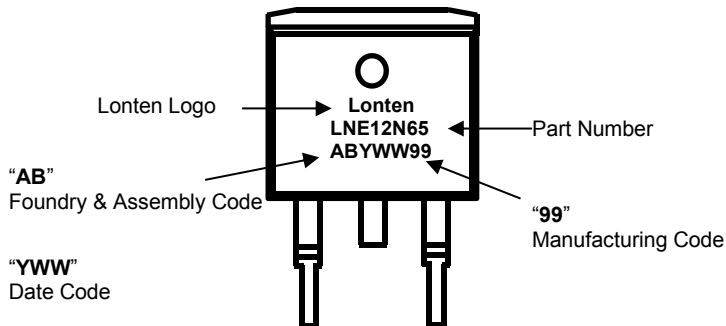
**Mechanical Dimensions for TO-263**

UNIT: mm

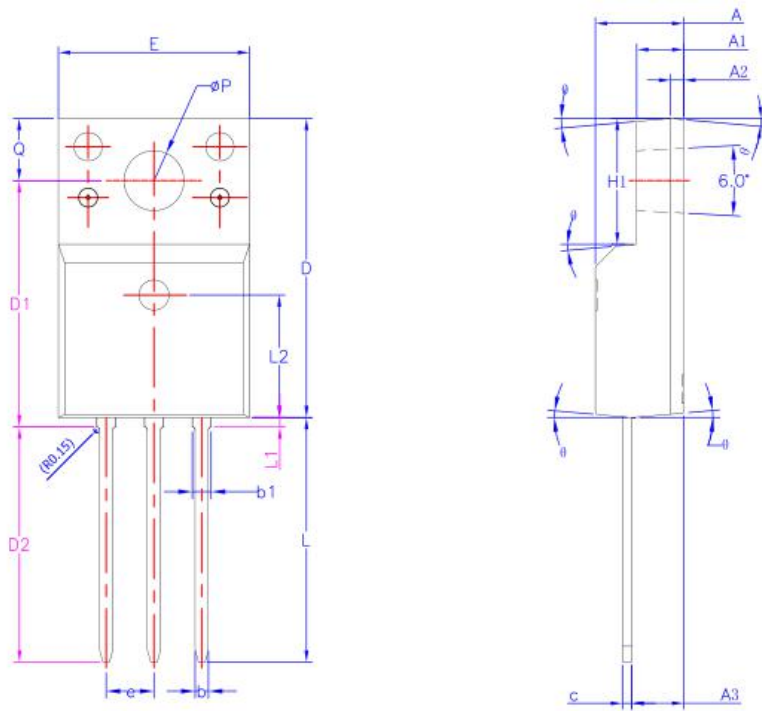


SYMBOL	MIN	NOM	MAX
A	4.42		4.72
B	1.22		1.4
b	0.76		0.86
b1	1.22		1.4
b2	0.33		0.43
C	1.22		1.35
D	9.95		10.25
E	8.99		9.29
e1	2.44	2.54	2.64
e2	4.98		5.18
L1	14.7	15.1	15.5
L2	2	2.3	2.6
L3	1.5		2
K	-0.1		0.1
Y	8.02	8.12	8.22

**TO-263 Part Marking Information**



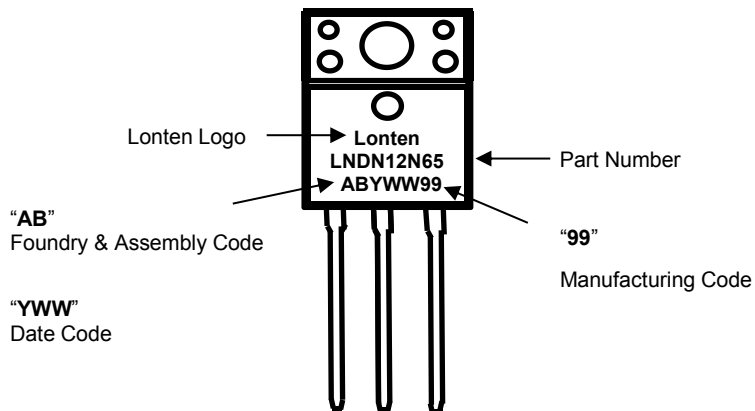
**Mechanical Dimensions for TO-220F Narrow Pin**



(UNITS:mm)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.60	—	0.80
b1	0.90	—	1.10
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	12.87	13.07	13.27
D2	12.28	12.48	12.68
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	—	—	0.85
L2	6.50REF		
$\phi P$	3.08	3.18	3.28
Q	3.20	—	3.40
$\theta 1$	1°	3°	5°

**TO-220F Narrow Pin Part Marking Information**



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