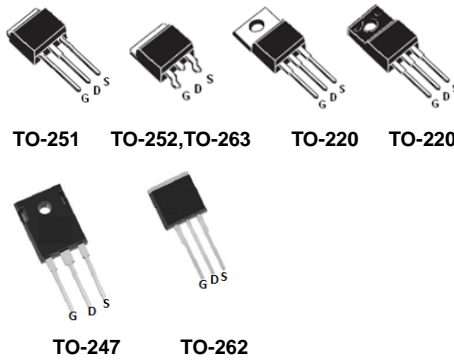
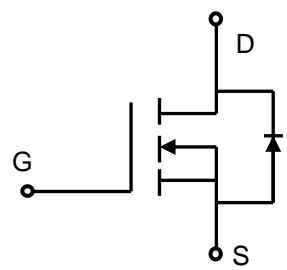



## Lonten N-channel 650V, 11A, 0.40Ω LonFET™ Power MOSFET

<p><b>Description</b> 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 style="width: 100%; border: none;"> <tr> <td><math>V_{DS} @ T_{j,max}</math></td> <td style="text-align: right;">700V</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td style="text-align: right;">0.40Ω</td> </tr> <tr> <td><math>I_{DM}</math></td> <td style="text-align: right;">30A</td> </tr> <tr> <td><math>Q_{g,typ}</math></td> <td style="text-align: right;">34nC</td> </tr> </table> <div style="text-align: center; margin-top: 10px;">  <p>TO-251    TO-252,TO-263    TO-220    TO-220MF</p> <p>TO-247    TO-262</p> </div> <div style="text-align: center; margin-top: 20px;">  <p>N-Channel MOSFET</p> </div> <div style="text-align: right; margin-top: 10px;">  </div>	$V_{DS} @ T_{j,max}$	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	$V_{DSS}$	650	V
Continuous drain current ( $T_C = 25^\circ C$ ) ( $T_C = 100^\circ C$ )	$I_D$	11	A
		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	$C_{iss}$	$V_{DS}=100V, V_{GS}=0V,$ $f=1MHz$	-	760	-	pF
Output capacitance	$C_{oss}$		-	54	-	
Reverse transfer capacitance	$C_{rss}$		-	12	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400V, I_D=4.8A$ $R_G=3.4\Omega, V_{GS}=13V$	-	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	$Q_{gs}$	$V_{DD}=480V, I_D=4.8A,$ $V_{GS}=0$ to $10V$	-	4	-	nC
Gate to drain charge	$Q_{gd}$		-	18	-	
Gate charge total	$Q_g$		-	34	-	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V
Reverse diode characteristics						
Diode forward voltage	$V_{SD}$	$V_{GS}=0V, I_F=5.5A$	-	0.9	-	V
Reverse recovery time	$t_{rr}$	$V_{DS}=400V, I_F=4.8A,$ $dI_F/dt=100A/\mu s$	-	275	-	ns
Reverse recovery charge	$Q_{rr}$		-	3.2	-	$\mu C$
Peak reverse recovery current	$I_{rm}$		-	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  $T_c = 25^\circ\text{C}$

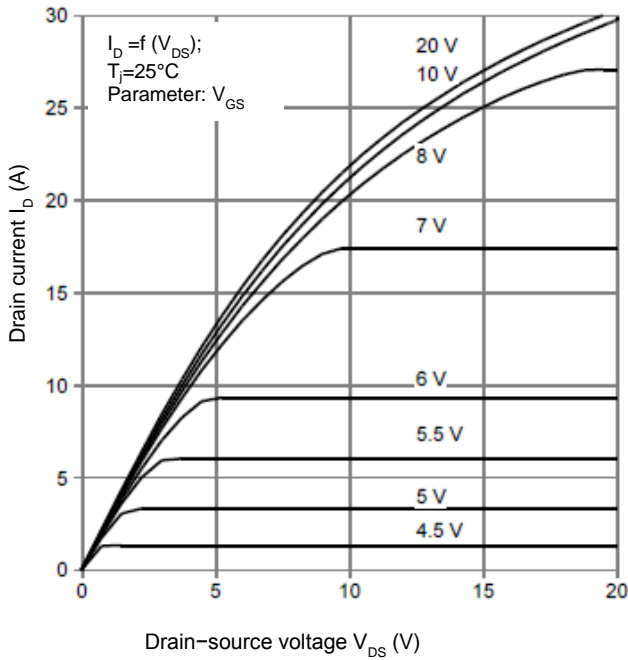


Figure 2. Output Characteristics  $T_c = 125^\circ\text{C}$

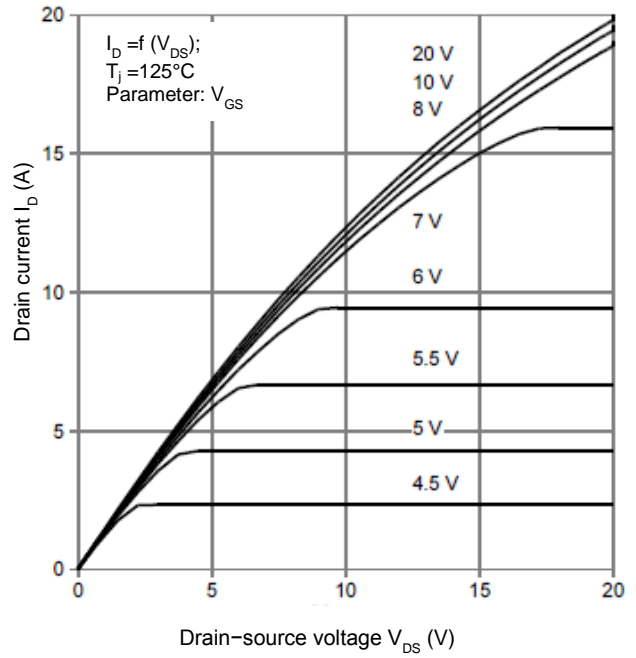


Figure 3. On-Resistance Variation vs. Drain Current

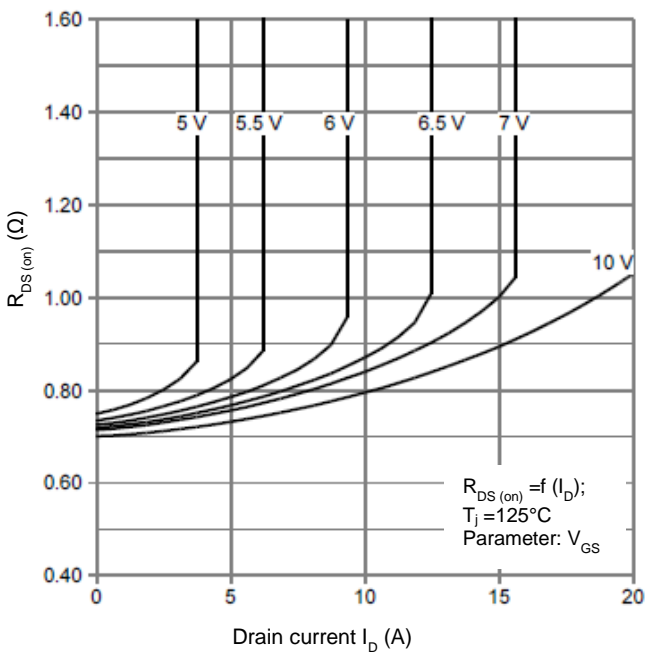


Figure 4. On-Resistance Variation vs. Temperature

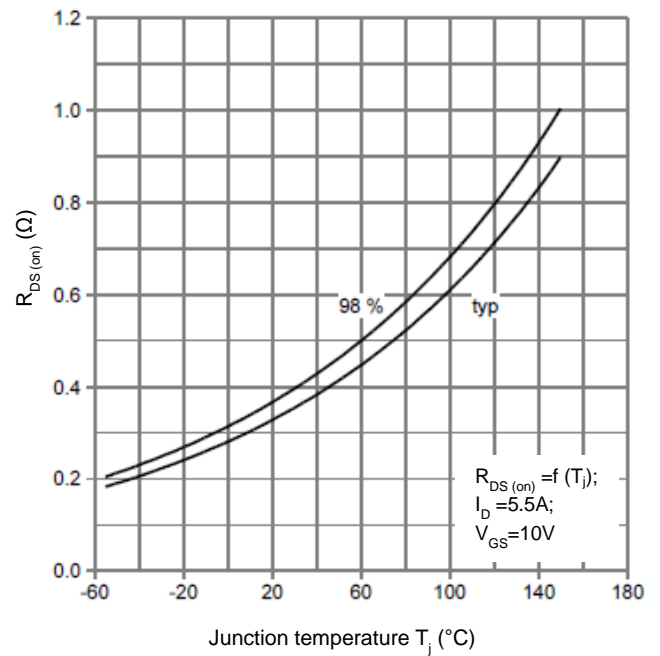


Figure 5. Transfer Characteristics

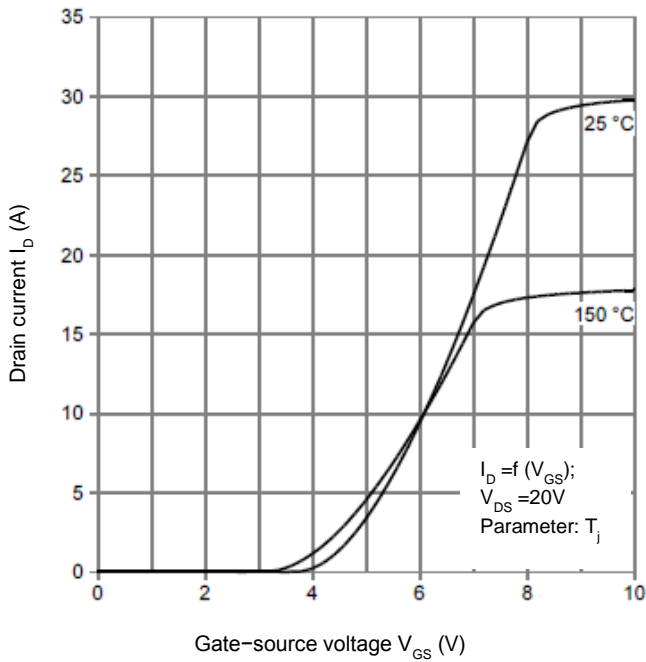


Figure 6. Breakdown Voltage vs. Temperature

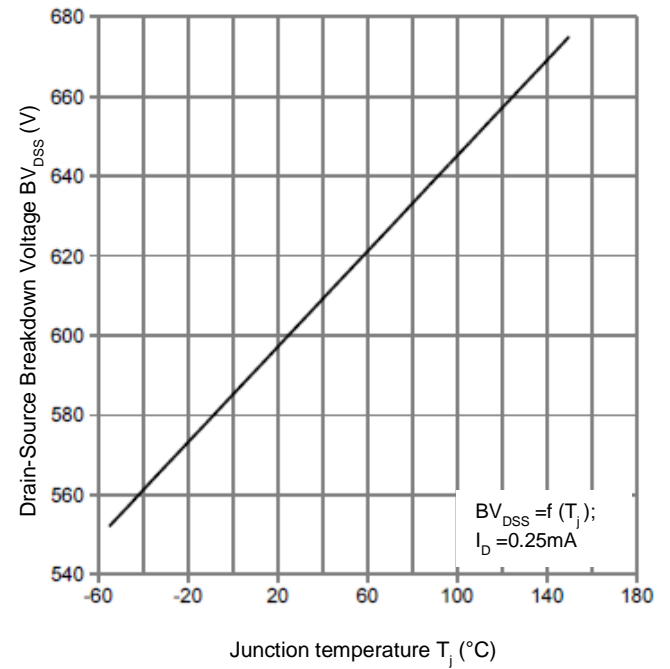


Figure 7. Capacitance Characteristics

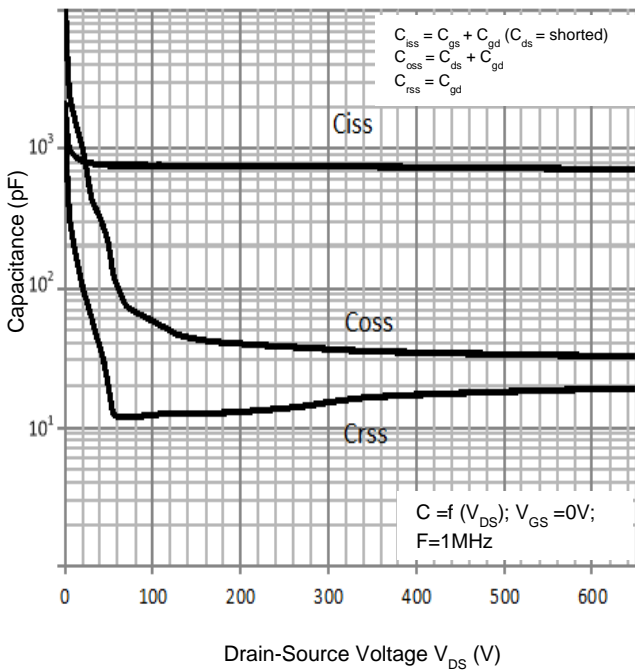


Figure 8. Gate Charge Characteristics

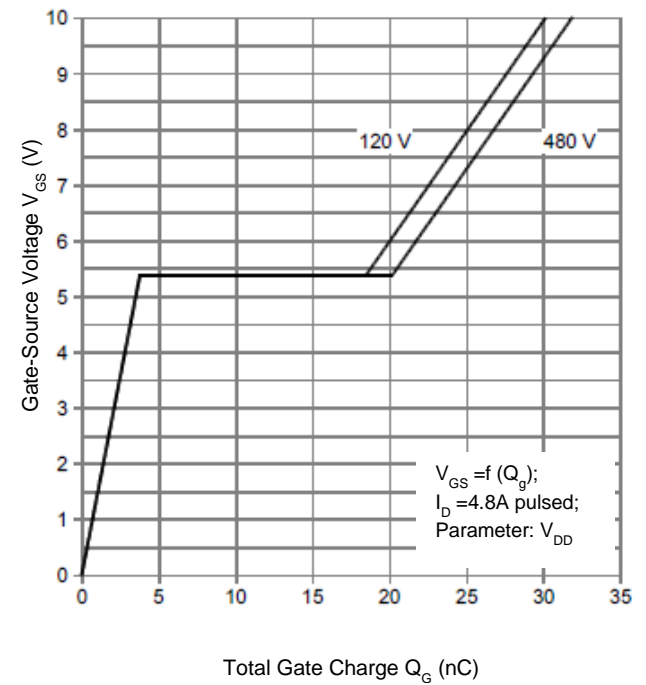


Figure 9. Power Dissipation (Non FullPAK)

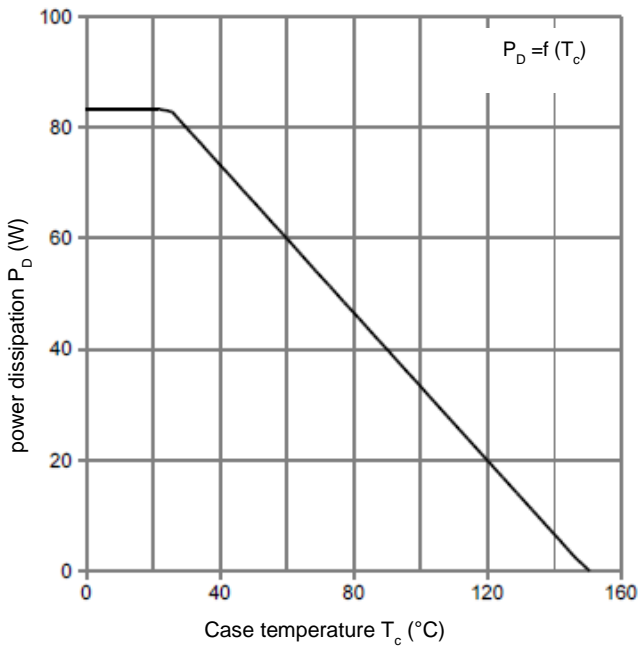


Figure 10. Power Dissipation (FullPAK)

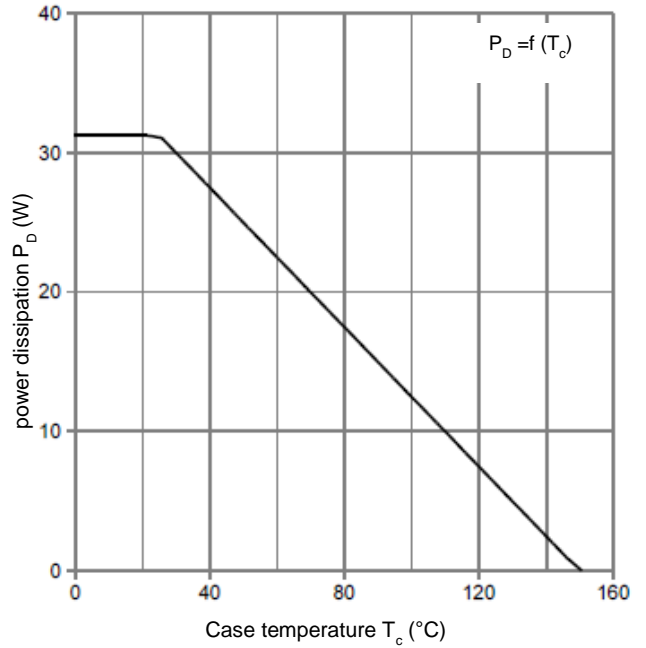


Figure 11. Safe Operating Area (Non FullPAK)

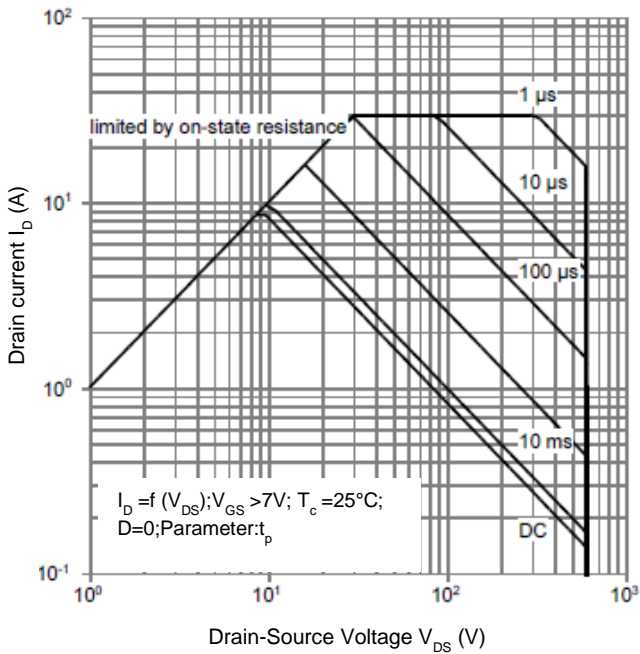


Figure 12. Safe Operating Area (FullPAK)

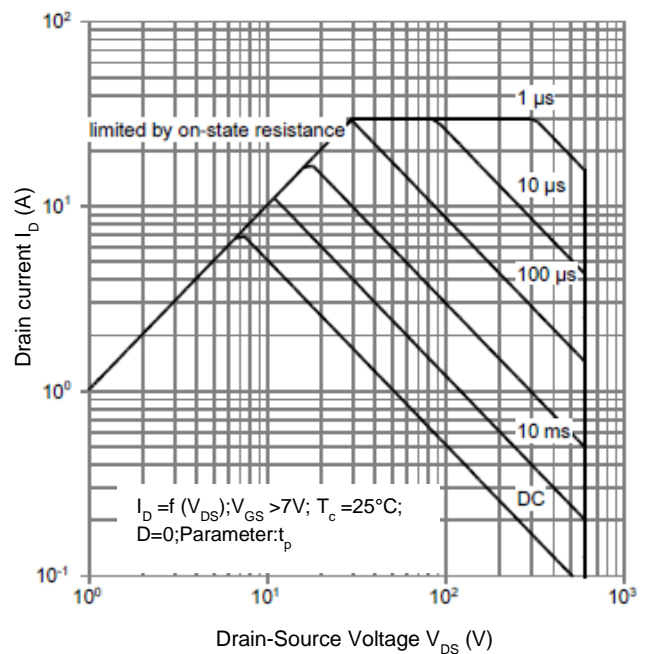


Figure 13. Transient Thermal impedance  
 (Non FullPAK)

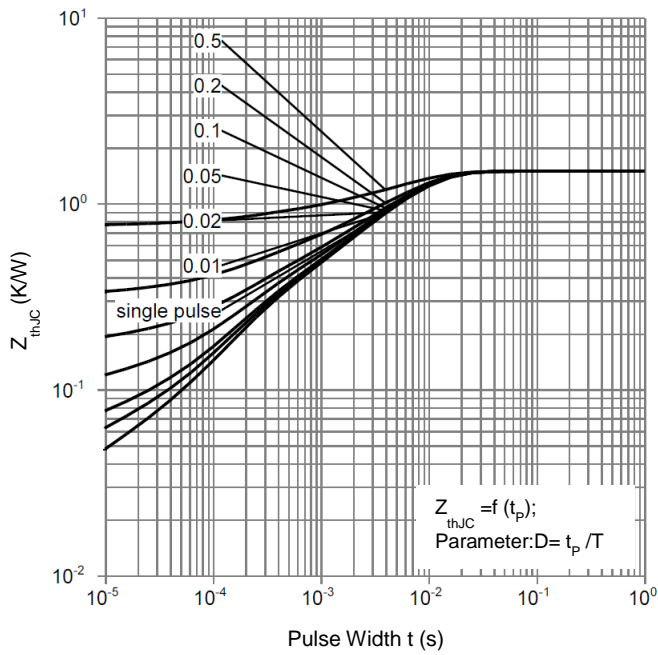
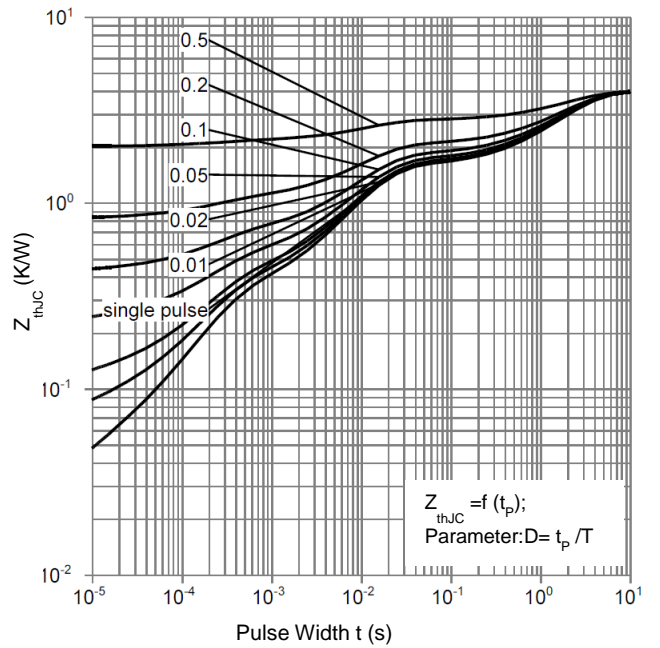
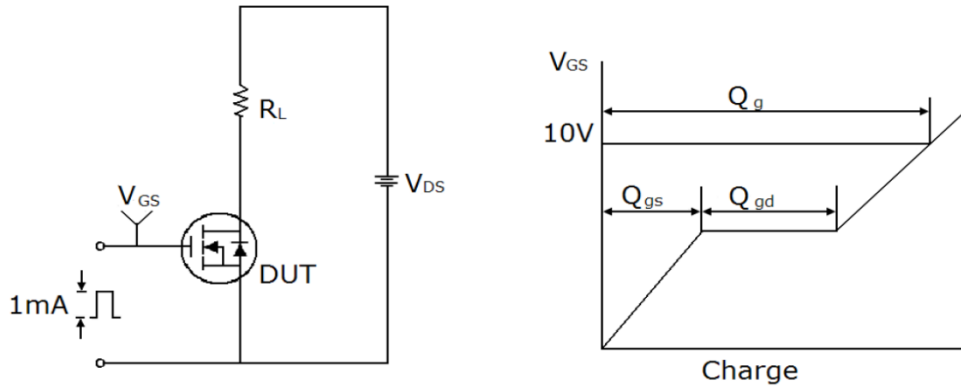


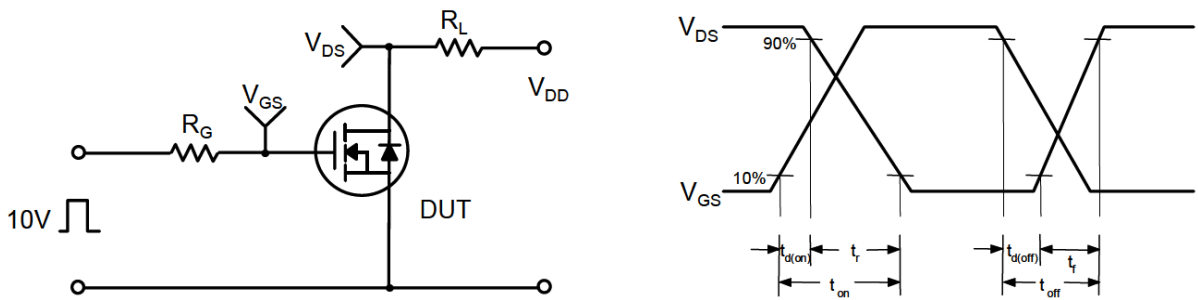
Figure 14. Transient Thermal impedance  
 (FullPAK)



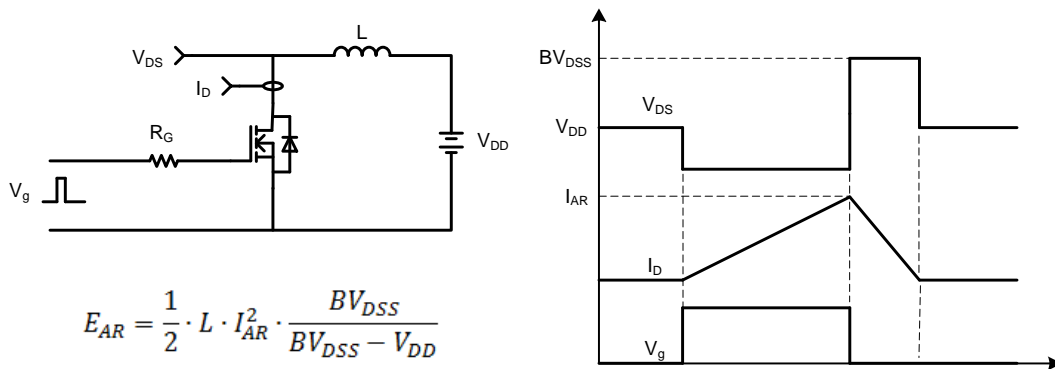
### Gate Charge Test Circuit & Waveform



### Switching Test Circuit & Waveforms

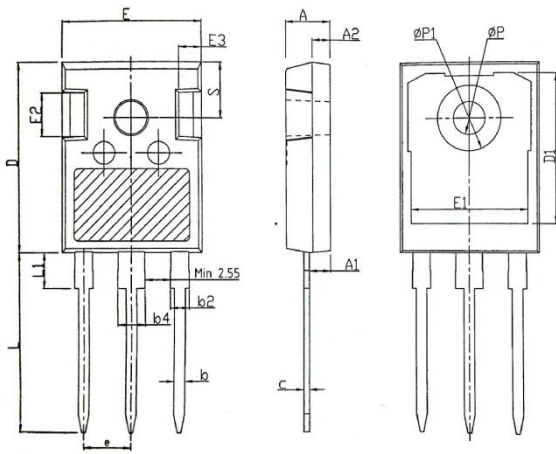


### Unclamped Inductive Switching Test Circuit & Waveforms



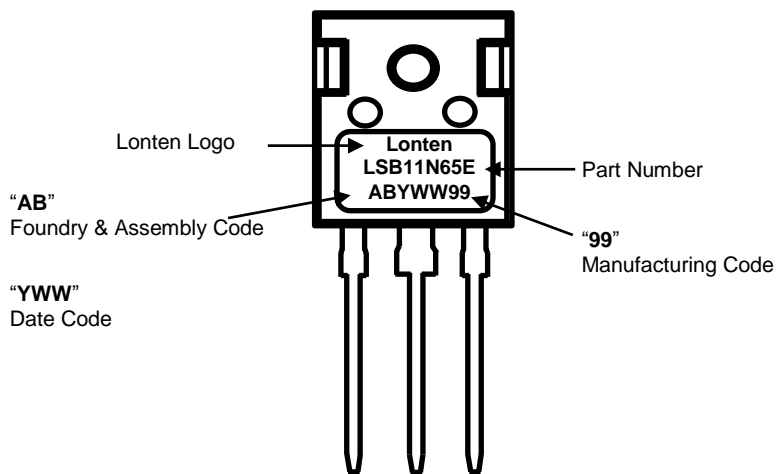


**Mechanical Dimensions for TO-247**

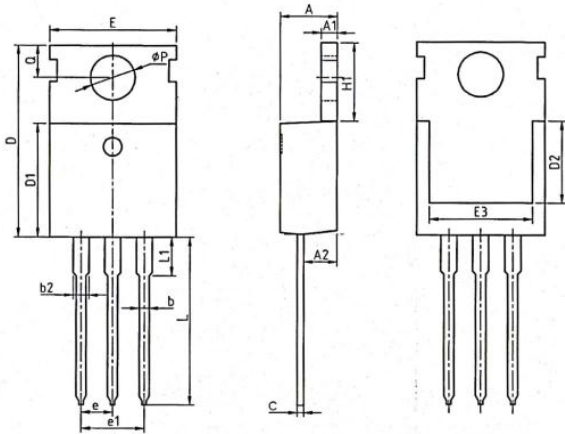


SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.80	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.82	19.92	20.22
L1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

**TO-247 Part Marking Information**

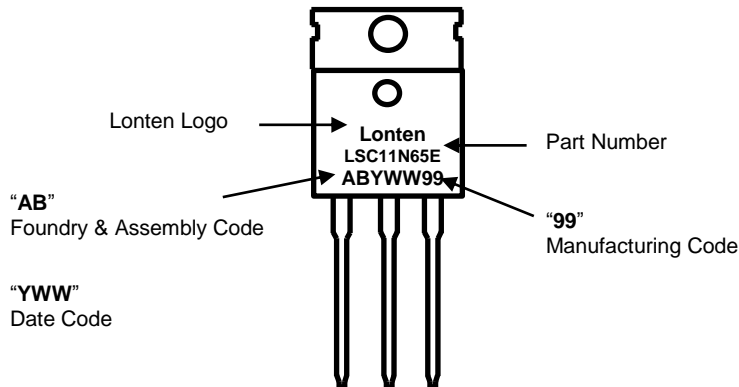


**Mechanical Dimensions for TO-220**

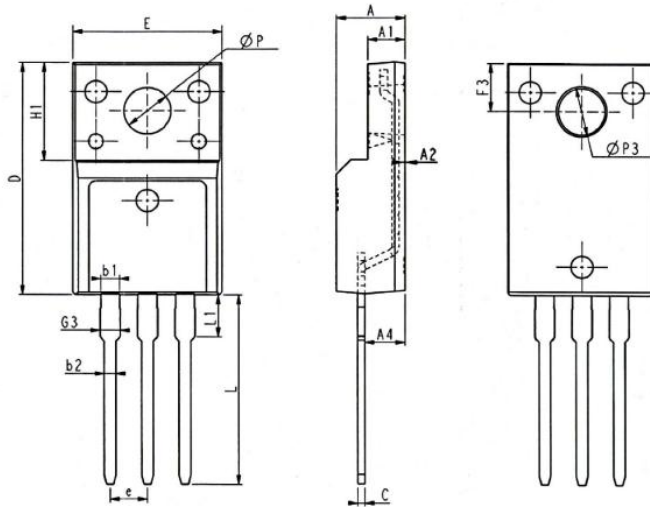


COMMON DIMENSIONS						
SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.70	0.172	0.180	0.185
A1	1.25	1.30	1.40	0.049	0.051	0.055
A2	2.20	2.40	2.60	0.087	0.094	0.102
b	0.70	0.80	0.95	0.028	0.031	0.037
b2	1.17	1.27	1.47	0.046	0.050	0.058
c	0.45	0.50	0.60	0.018	0.020	0.024
D	15.10	15.60	16.10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

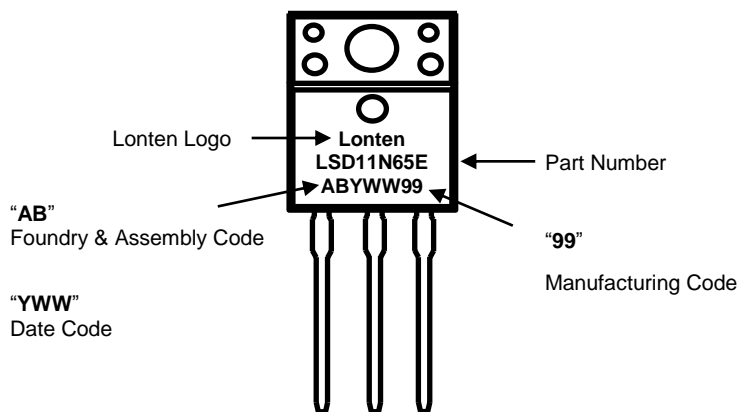


**Mechanical Dimensions for TO-220MF**

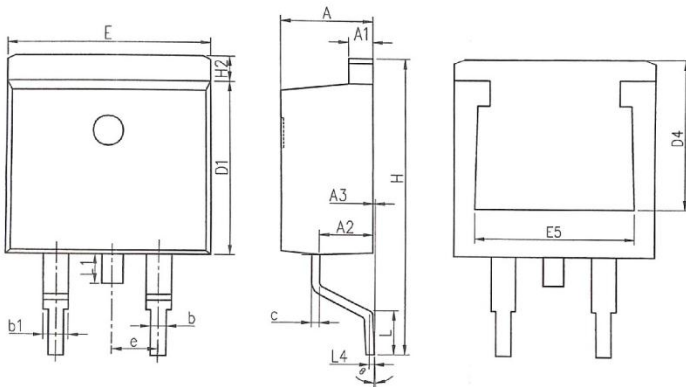


SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
E	9.96	10.16	10.36	0.392	0.400	0.408
A	4.50	4.70	4.90	0.177	0.185	0.193
A1	2.34	2.54	2.74	0.092	0.100	0.108
A2	0.30	0.45	0.60	0.012	0.002	0.024
A4	2.65	2.76	2.96	0.104	0.109	0.117
C	0.40	0.50	0.65	0.016	0.020	0.026
D	15.57	15.87	16.17	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**

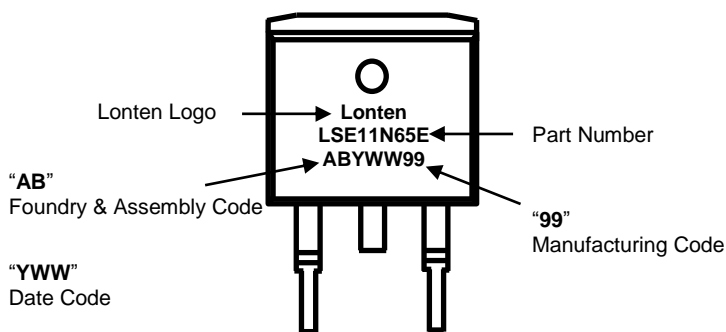


**Mechanical Dimensions for TO-263**

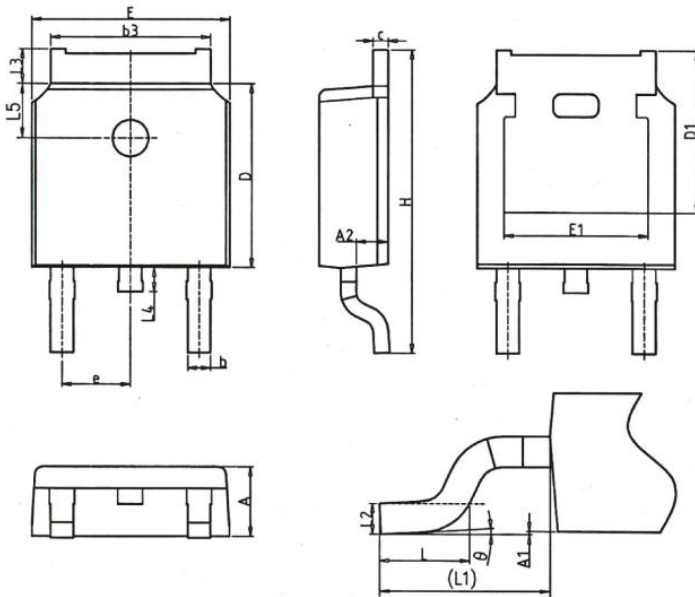


COMMON DIMENSIONS						
SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.77	0.172	0.180	0.188
A1	1.22	1.27	1.42	0.048	0.050	0.056
A2	2.49	2.89	2.89	0.098	0.114	0.114
A3	0.00	0.13	0.25	0.000	0.005	0.010
b	0.70	0.81	0.96	0.028	0.032	0.034
b1	1.17	1.27	1.47	0.046	0.050	0.058
c	0.30	0.38	0.53	0.012	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**

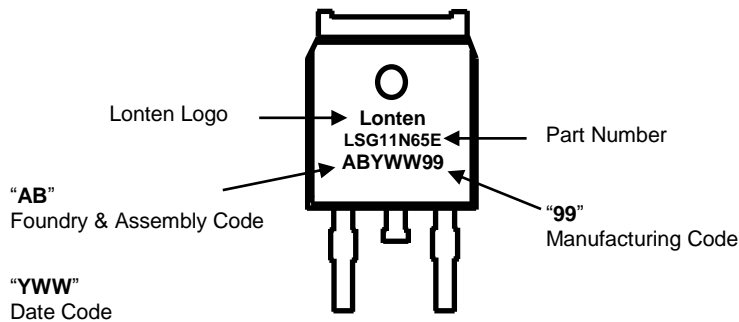


**Mechanical Dimensions for TO-252**

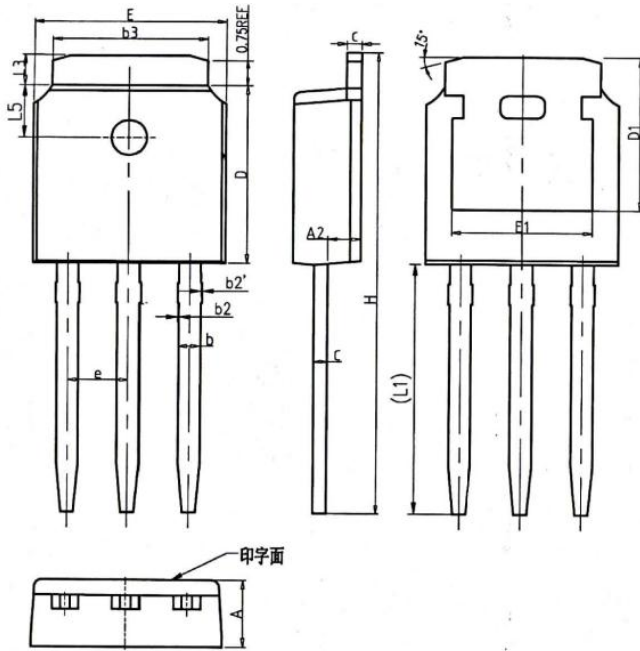


COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.00	—	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	—	—
e	2.286BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90REF		
L2	0.51BSC		
L3	0.88	—	1.28
L4	0.50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

**TO-252 Part Marking Information**

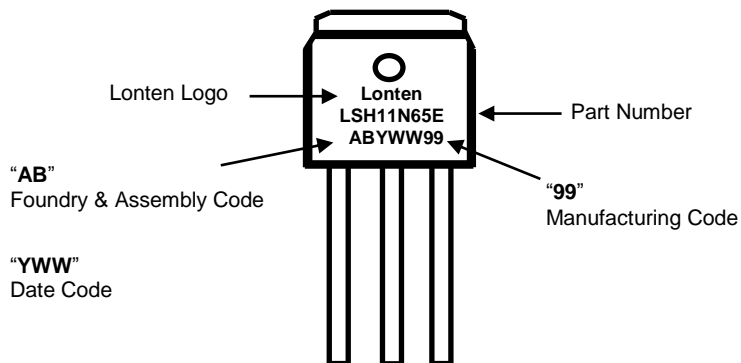


Mechanical Dimensions for TO-251

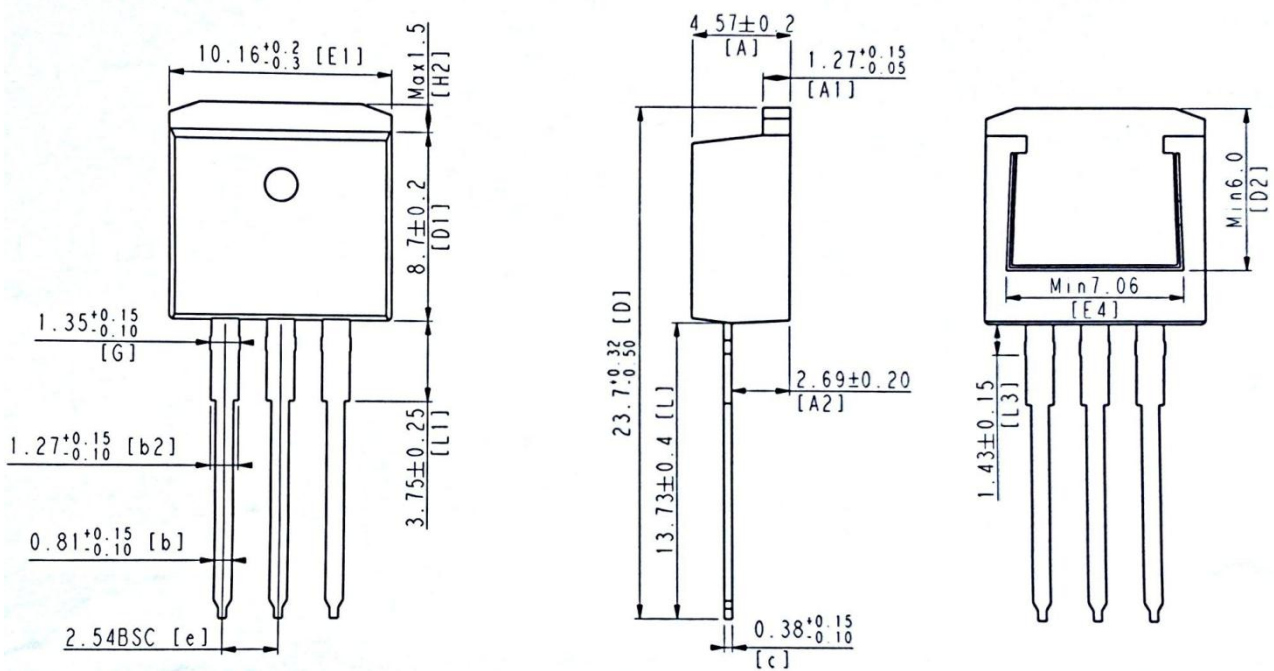


SYMBOL	COMMON DIMENSIONS		
	MM		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b2	0.00	0.04	0.10
b2'	0.00	0.04	0.10
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	—	—
e	2.286BSC		
H	16.22	16.52	16.82
L1	9.15	9.40	9.65
L3	0.88	1.02	1.28
L5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

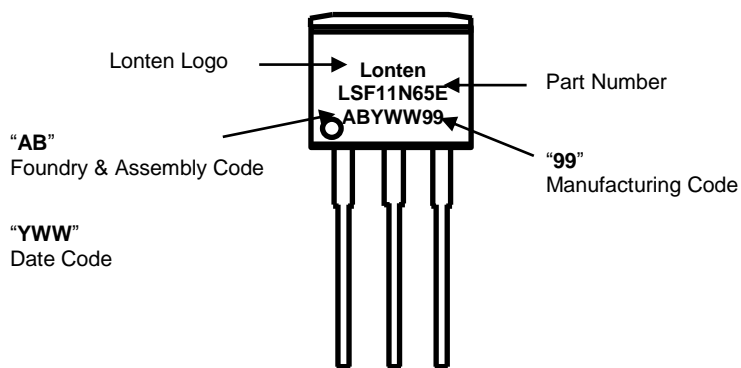
TO-251 Part Marking Information



**Mechanical Dimensions for TO-262**



**TO-262 Part Marking Information**



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Jan. 2017 Revision 3.0