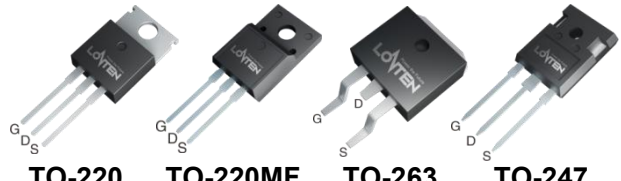
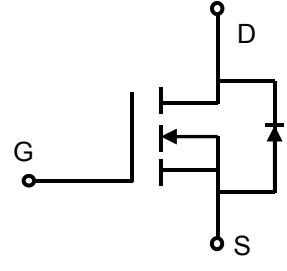


Lonten N-channel 650V, 40A, 0.099Ω LonFET™ Power MOSFET

<p>Description 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>Features</p> <ul style="list-style-type: none"> ◆ Ultra low $R_{DS(on)}$ ◆ Ultra low gate charge (typ. $Q_g = 56\text{nC}$) ◆ 100% UIS tested ◆ RoHS compliant <p>Applications</p> <ul style="list-style-type: none"> ◆ Power factor correction (PFC). ◆ Switched mode power supplies (SMPS). ◆ Uninterruptible power supply (UPS). 	<p>Product Summary</p> <p>$V_{DS} @ T_{j,max}$ 700V</p> <p>$R_{DS(on),max}$ 0.099Ω</p> <p>I_{DM} 120A</p> <p>$Q_{g,typ}$ 56nC</p>  <p style="text-align: center;">TO-220 TO-220MF TO-263 TO-247</p>  <p style="text-align: center;">N-Channel MOSFET (Pb)</p>
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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	40	A
($T_C = 100^\circ\text{C}$)		26	A
Pulsed drain current ¹⁾	I_{DM}	120	A
Gate-Source voltage	V_{GSS}	± 30	V
Avalanche energy, single pulse ²⁾	E_{AS}	980	mJ
Power Dissipation TO-247/TO-220/TO-263 ($T_C = 25^\circ\text{C}$) - Derate above 25°C	P_D	248	W
		2.0	$\text{W}/^\circ\text{C}$
Power Dissipation TO-220MF ($T_C = 25^\circ\text{C}$) - Derate above 25°C		34.8	W
		0.28	$\text{W}/^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$
Continuous diode forward current	I_S	40	A
Diode pulse current	$I_{S,pulse}$	120	A

Thermal Characteristics TO-247/TO-263/TO-220

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.5	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62	$^{\circ}\text{C}/\text{W}$
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	T_{sold}	260	$^{\circ}\text{C}$

Thermal Characteristics TO-220MF

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.6	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^{\circ}\text{C}/\text{W}$
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	T_{sold}	260	$^{\circ}\text{C}$

Package Marking and Ordering Information

Device	Device Package	Marking	Units/Tube	Units/Reel
LSB60R099HT	TO-247	LSB60R099HT	30	
LSD60R099HT	TO-220MF	LSD60R099HT	50	
LSE60R099HT	TO-263-2L	LSE60R099HT		800
LSC60R099HT	TO-220	LSC60R099HT	50	

Electrical Characteristics $T_c = 25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV_{DSS}	$V_{\text{GS}}=0\text{ V}, I_{\text{D}}=0.25\text{ mA}$	650	-	-	V
Gate threshold voltage	$V_{\text{GS(th)}}$	$V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=0.25\text{ mA}$	2.5	3.5	4.5	V
Drain cut-off current	I_{DSS}	$V_{\text{DS}}=650\text{ V}, V_{\text{GS}}=0\text{ V},$ $T_{\text{J}} = 25^{\circ}\text{C}$ $T_{\text{J}} = 125^{\circ}\text{C}$	-	-	1	μA
Gate leakage current, Forward	I_{GSSF}	$V_{\text{GS}}=30\text{ V}, V_{\text{DS}}=0\text{ V}$	-	-	100	nA
Gate leakage current, Reverse	I_{GSSR}	$V_{\text{GS}}=-30\text{ V}, V_{\text{DS}}=0\text{ V}$	-	-	-100	nA
Drain-source on-state resistance	$R_{\text{DS(on)}}$	$V_{\text{GS}}=10\text{ V}, I_{\text{D}}=20\text{ A}$ $T_{\text{J}} = 25^{\circ}\text{C}$ $T_{\text{J}} = 150^{\circ}\text{C}$	-	0.088	0.099	Ω
Gate resistance	R_{G}	$f=1\text{ MHz}, \text{open drain}$	-	2.0	-	Ω
Dynamic characteristics						
Input capacitance	C_{iss}	$V_{\text{DS}} = 100\text{ V}, V_{\text{GS}} = 0\text{ V},$ $f = 250\text{ kHz}$	-	2872	-	pF
Output capacitance	C_{oss}		-	105	-	
Reverse transfer capacitance	C_{rss}		-	2.4	-	
Turn-on delay time	$t_{\text{d(on)}}$	$V_{\text{DD}} = 400\text{ V}, I_{\text{D}} = 20\text{ A}$ $R_{\text{G}} = 10\ \Omega, V_{\text{GS}}=10\text{ V}$	-	20	-	ns
Rise time	t_{r}		-	44	-	
Turn-off delay time	$t_{\text{d(off)}}$		-	98	-	
Fall time	t_{f}		-	12	-	

Gate charge characteristics						
Gate to source charge	Q_{gs}	$V_{DD}=480\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$	-	16.8	-	nC
Gate to drain charge	Q_{gd}		-	17.4	-	
Gate charge total	Q_g		-	56	-	
Gate plateau voltage	$V_{plateau}$		-	5	-	V
Reverse diode characteristics						
Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}$, $I_F=20\text{ A}$	-	-	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}$, $I_F=20\text{ A}$, $di_F/dt=100\text{ A}/\mu\text{s}$	-	380	-	ns
Reverse recovery charge	Q_{rr}		-	6.46	-	μC
Peak reverse recovery current	I_{rrm}		-	34	-	A

Notes:

- Limited by maximum junction temperature, maximum duty cycle is 0.75.
- $I_{AS} = 7\text{ A}$, $V_{DD} = 60\text{ V}$, Starting $T_J = 25^\circ\text{C}$.
- Repetitive Rating: Pulse width limited by maximum junction temperature.

Electrical Characteristics Diagrams

Figure 1. On-Region Characteristics

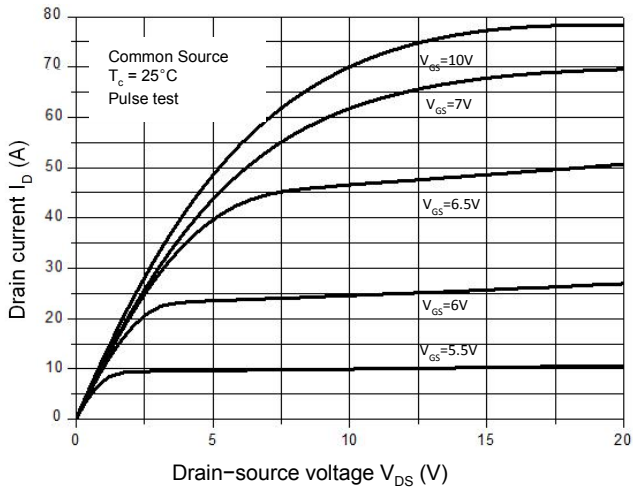


Figure 2. Transfer Characteristics

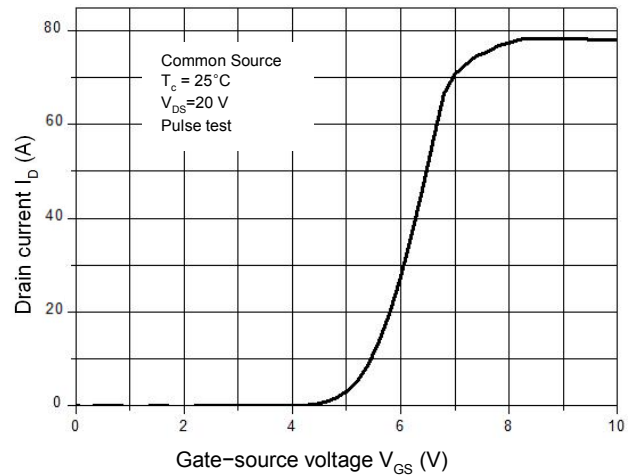


Figure 3. On-Resistance Variation vs. Drain Current

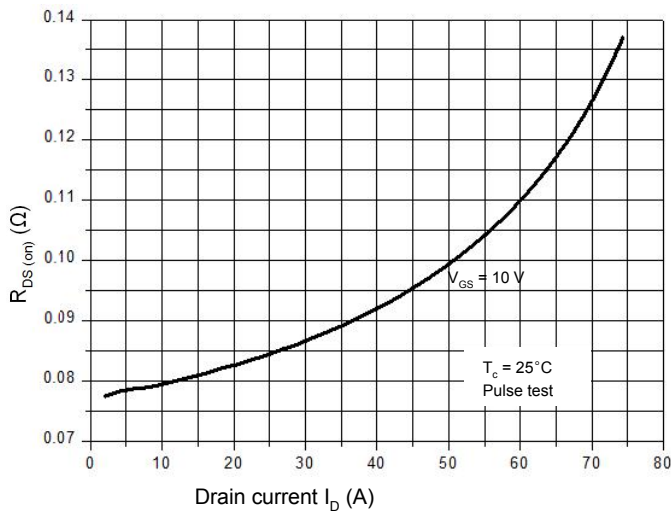


Figure 4. Threshold Voltage vs. Temperature

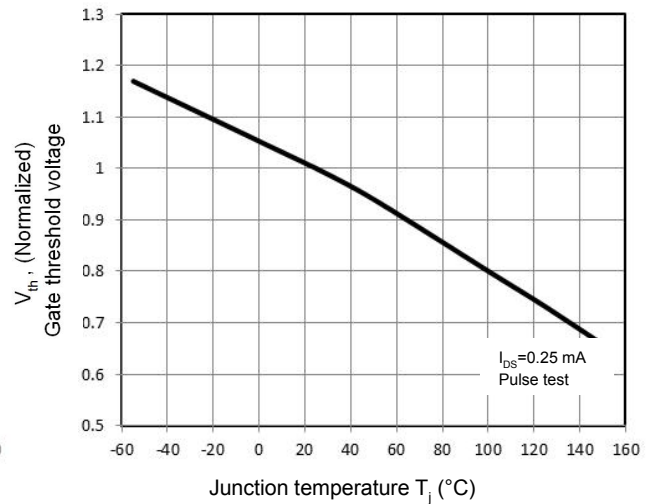


Figure 5. Breakdown Voltage vs. Temperature

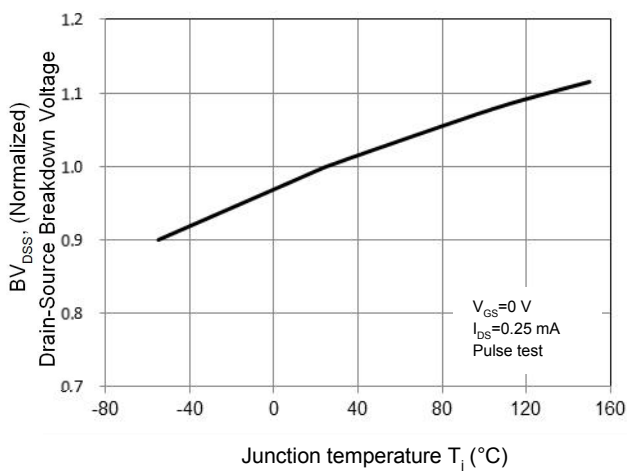


Figure 6. On-Resistance vs. Temperature

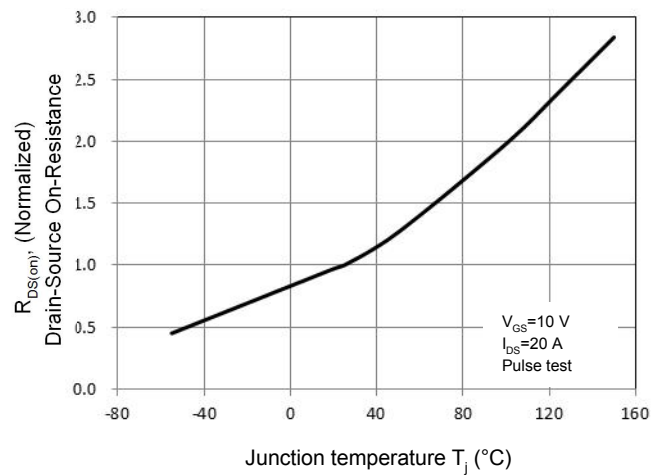


Figure 7. Capacitance Characteristics

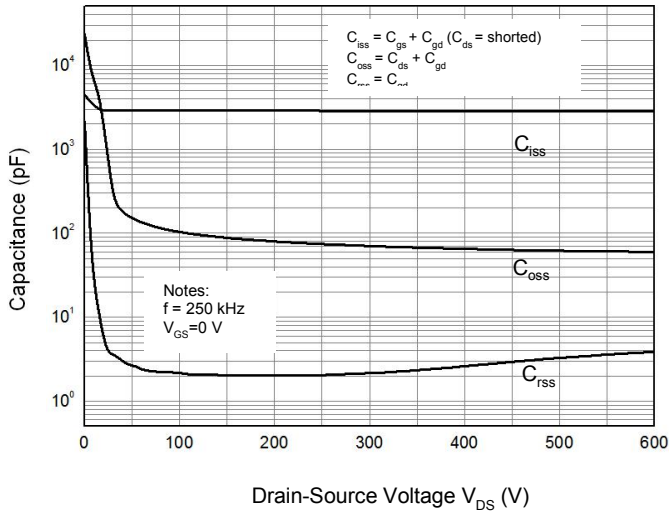


Figure 8. Gate Charge Characterist

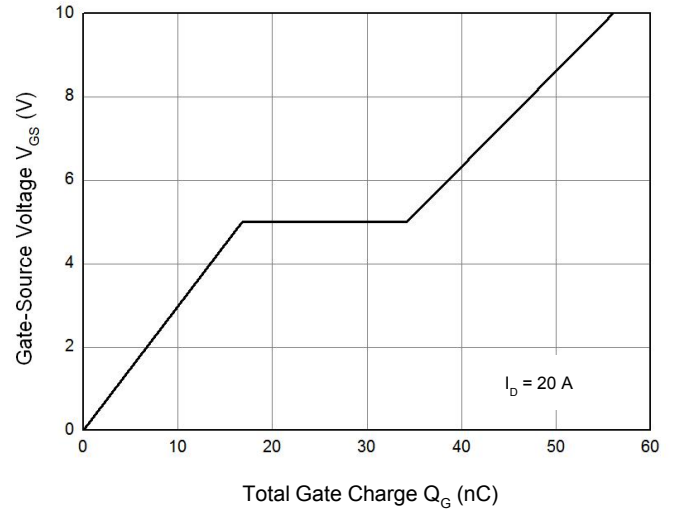


Figure 9.1 Maximum Safe Operating Area

TO-220MF

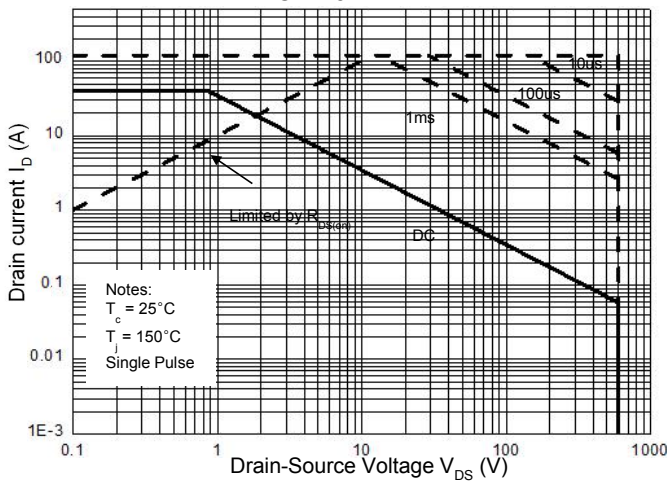


Figure 9.2 Maximum Safe Operating Area

TO-247/TO-263

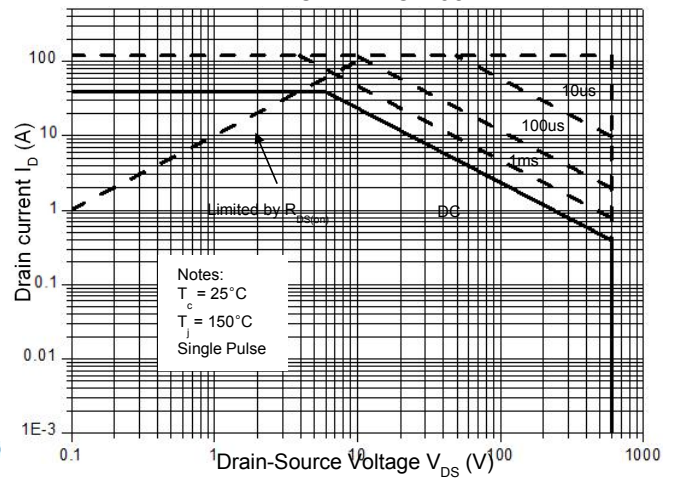


Figure 10.1 Power Dissipation vs. Temperature

TO-220MF

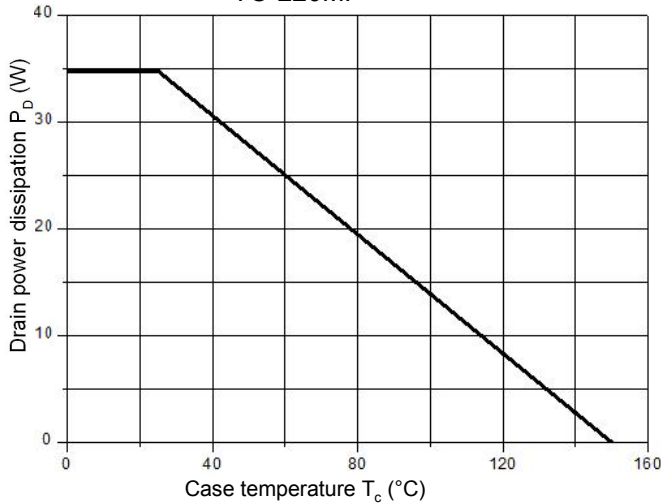
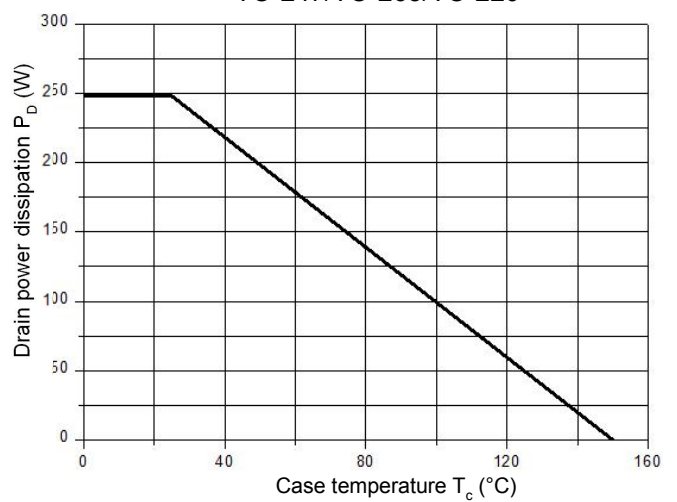
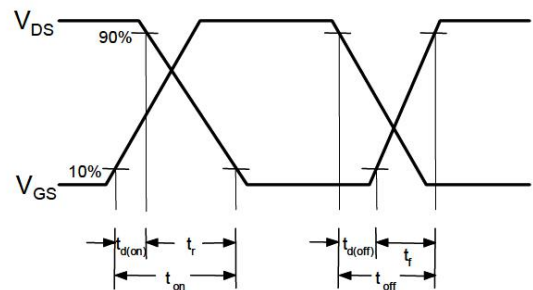
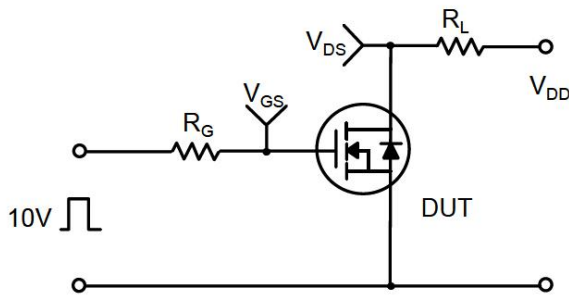
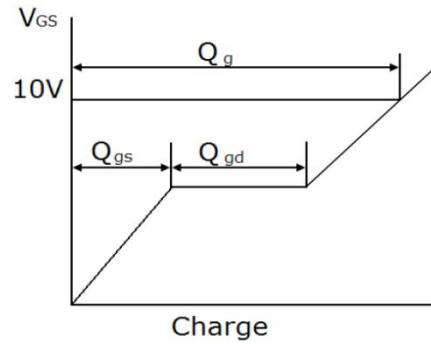
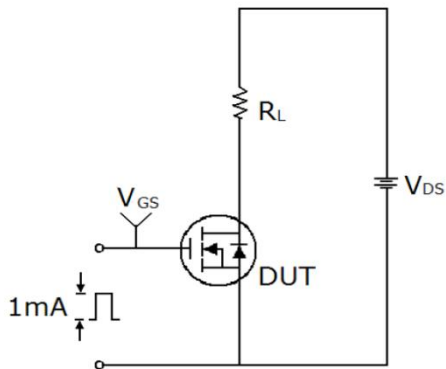


Figure 10.2 Power Dissipation vs. Temperature

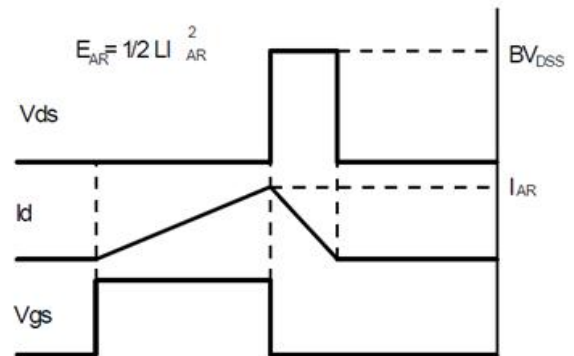
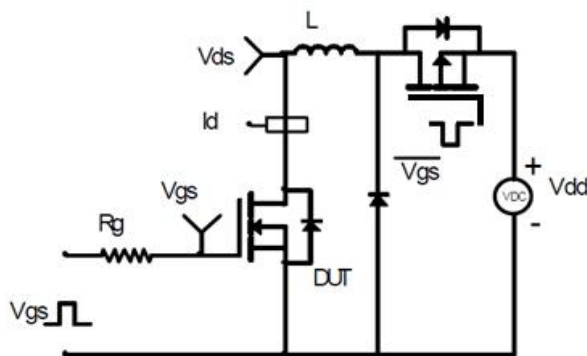
TO-247/TO-263/TO-220



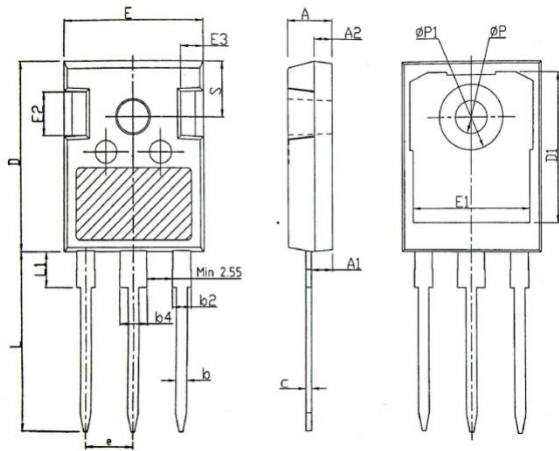
Gate Charge Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveforms

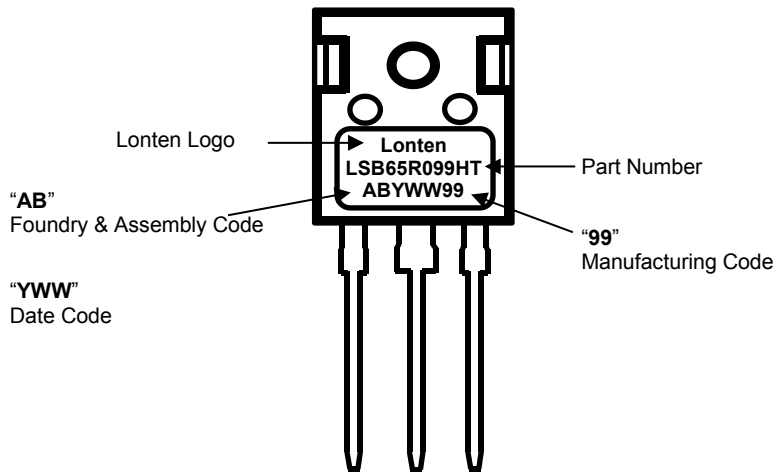


Mechanical Dimensions for TO-247

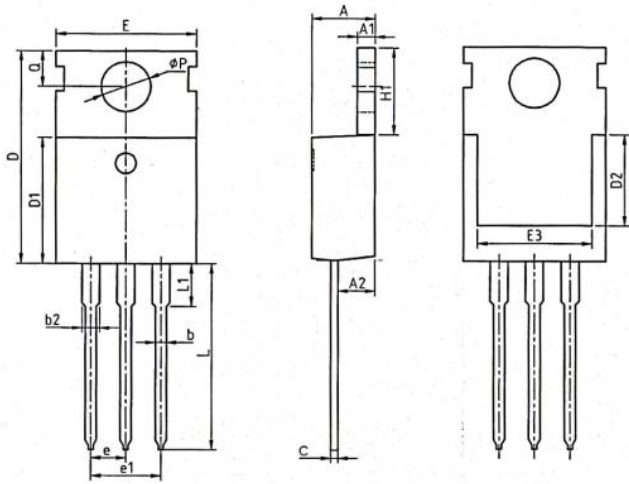


SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.80	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.82	19.92	20.22
L1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

TO-247 Part Marking Information

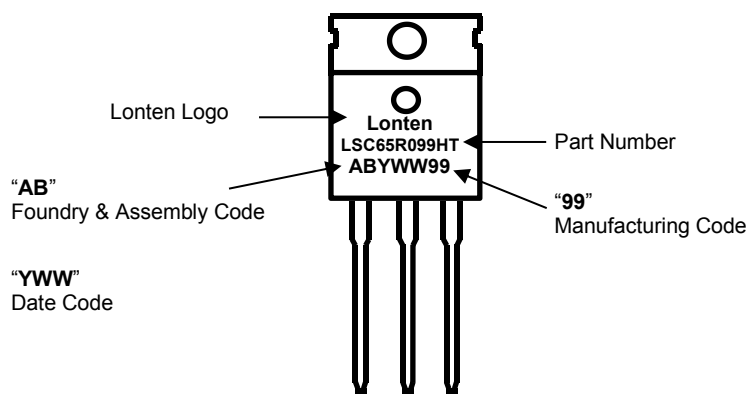


Mechanical Dimensions for TO-220

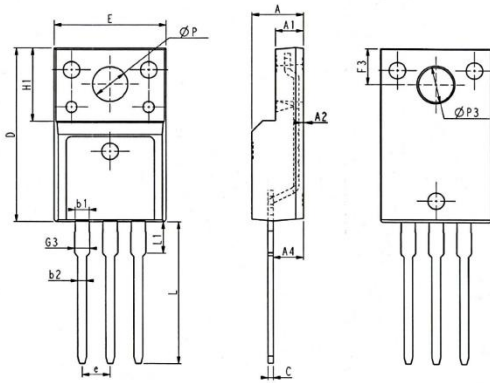


COMMON DIMENSIONS						
SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.70	0.172	0.180	0.185
A1	1.25	1.30	1.40	0.049	0.051	0.055
A2	2.20	2.40	2.60	0.087	0.094	0.102
b	0.70	0.80	0.95	0.028	0.031	0.037
b2	1.17	1.27	1.47	0.046	0.050	0.058
c	0.45	0.50	0.60	0.018	0.020	0.024
D	15.10	15.60	16.10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

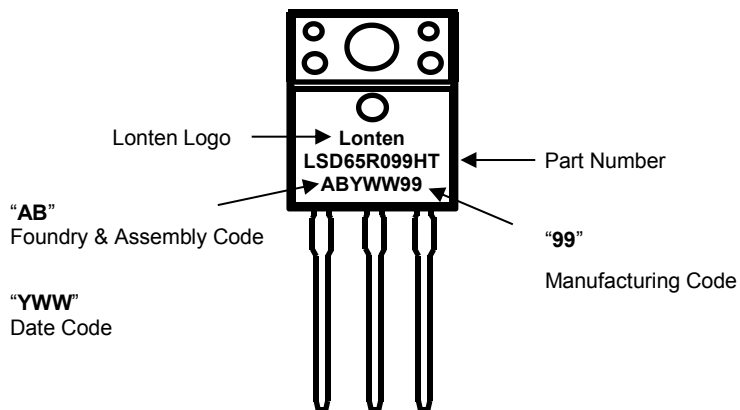


Mechanical Dimensions for TO-220MF

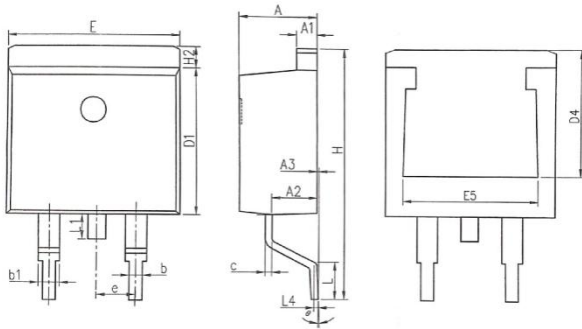


SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
E	9.96	10.16	10.36	0.392	0.400	0.408
A	4.50	4.70	4.90	0.177	0.185	0.193
A1	2.34	2.54	2.74	0.092	0.100	0.108
A2	0.30	0.45	0.60	0.012	0.002	0.024
A4	2.65	2.76	2.96	0.104	0.109	0.117
C	0.40	0.50	0.65	0.016	0.020	0.026
D	15.57	15.87	16.17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

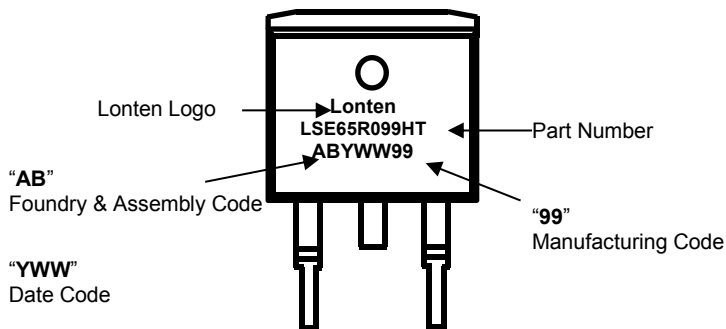


Mechanical Dimensions for TO-263



SYMBOL	COMMON DIMENSIONS					
	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



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