

Lonten N-channel 650V, 7A, 0.65Ω LonFET™ Power MOSFET

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. Features ◆ Ultra low $R_{DS(on)}$ ◆ Ultra low gate charge (typ. $Q_g = 13.1\text{nC}$) ◆ 100% UIS tested ◆ RoHS compliant Applications ◆ Power factor correction (PFC). ◆ Switched mode power supplies (SMPS). ◆ Uninterruptible power supply (UPS).	Product Summary <table> <tr> <td>$V_{DS} @ T_{j,max}$</td><td>700V</td></tr> <tr> <td>$R_{DS(on),max}$</td><td>0.65Ω</td></tr> <tr> <td>I_{DM}</td><td>21A</td></tr> <tr> <td>$Q_{g,typ}$</td><td>13.1 nC</td></tr> </table> N-Channel MOSFET	$V_{DS} @ T_{j,max}$	700V	$R_{DS(on),max}$	0.65Ω	I_{DM}	21A	$Q_{g,typ}$	13.1 nC
$V_{DS} @ T_{j,max}$	700V								
$R_{DS(on),max}$	0.65Ω								
I_{DM}	21A								
$Q_{g,typ}$	13.1 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	7	A
($T_C = 100^\circ\text{C}$)		4.4	A
Pulsed drain current ¹⁾	I_{DM}	21	A
Gate-Source voltage	V_{GSS}	± 30	V
Avalanche energy, single pulse ²⁾	E_{AS}	120	mJ
Avalanche current, repetitive ³⁾	I_{AR}	7	A
Power Dissipation TO-220 ($T_C = 25^\circ\text{C}$)	P_D	63	W
- Derate above 25°C		0.5	W/ $^\circ\text{C}$
Power Dissipation TO-220MF/ TO-220MF Narrow Pin ($T_C = 25^\circ\text{C}$)		28	W
- Derate above 25°C		0.22	W/ $^\circ\text{C}$
Mounting torque To-220 (M3 and M3.5 screws)		60	Ncm
Mounting torque To-220F (M2.5 screws)		50	
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$
Continuous diode forward current	I_S	7	A
Diode pulse current	$I_{S,pulse}$	21	A

Thermal Characteristics TO-251/TO-252/TO-220/TO-263

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	2	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62	$^{\circ}\text{C/W}$
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	T_{sold}	260	$^{\circ}\text{C}$

Thermal Characteristics TO-220MF/ TO-220MF Narrow Pin

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	4.5	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^{\circ}\text{C/W}$
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/Tube
LSC65R650HT	TO-220	LSC65R650HT	50	
LSD65R650HT	TO-220MF	LSD65R650HT	50	
LSDN65R650HT	TO-220MF Narrow Pin	LSDN65R650HT	50	
LSE65R650HT	TO-263	LSE65R650HT		800
LSG65R650HT	TO-252	LSG65R650HT		2500
LSH65R650HT	TO-251	LSH65R650HT	72	

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}	$V_{\text{DS}}=650\text{ V}$, $V_{\text{GS}}=0\text{ V}$, $T_j = 25^{\circ}\text{C}$ $T_j = 125^{\circ}\text{C}$	- -	- 10	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	$R_{\text{DS(on)}}$	$V_{\text{GS}}=10\text{ V}$, $I_{\text{D}}=3.5\text{ A}$, $T_j = 25^{\circ}\text{C}$ $T_j = 150^{\circ}\text{C}$	- - -	 0.55 1.43	 0.65 -	Ω
Gate resistance	R_{G}	$f=1\text{ MHz}$, open drain	-	5.7	-	Ω
Dynamic characteristics						
Input capacitance	C_{iss}	$V_{\text{DS}} = 100\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $f = 250\text{ kHz}$	-	482	-	pF
Output capacitance	C_{oss}		-	20.7	-	
Reverse transfer capacitance	C_{rss}		-	1.12	-	
Turn-on delay time	$t_{\text{d(on)}}$	$V_{\text{DD}} = 300\text{ V}$, $I_{\text{D}} = 3.5\text{ A}$	-	12	-	

Rise time	t _r	R _G = 10Ω, V _{GS} =15V	-	6.13	-	ns
Turn-off delay time	t _{d(off)}		-	26	-	
Fall time	t _f		-	3.3	-	
Gate charge characteristics						
Gate to source charge	Q _{gs}	V _{DD} =480 V, I _D =3.5A, V _{GS} =0 to 10 V	-	4.2	-	nC
Gate to drain charge	Q _{gd}		-	4.0	-	
Gate charge total	Q _g		-	13.1	-	
Gate plateau voltage	V _{plateau}		-	5.1	-	V
Reverse diode characteristics						
Diode forward voltage	V _{SD}	V _{GS} =0 V, I _F =3.5A	-	0.85	-	V
Reverse recovery time	t _{rr}	V _R =50 V, I _F =3.5A, dI _F /dt=100 A/μs	-	200	-	ns
Reverse recovery charge	Q _{rr}		-	1.6	-	μC
Peak reverse recovery current	I _{rrm}		-	12.5	-	A

Notes:

1. Limited by maximum junction temperature, maximum duty cycle is 0.75.
2. $I_{AS} = 2A, V_{DD} = 50V$, Starting $T_j = 25^\circ C$.
3. Repetitive Rating: Pulse width limited by maximum junction temperature.

Electrical Characteristics Diagrams

Figure 1. On-Region Characteristics

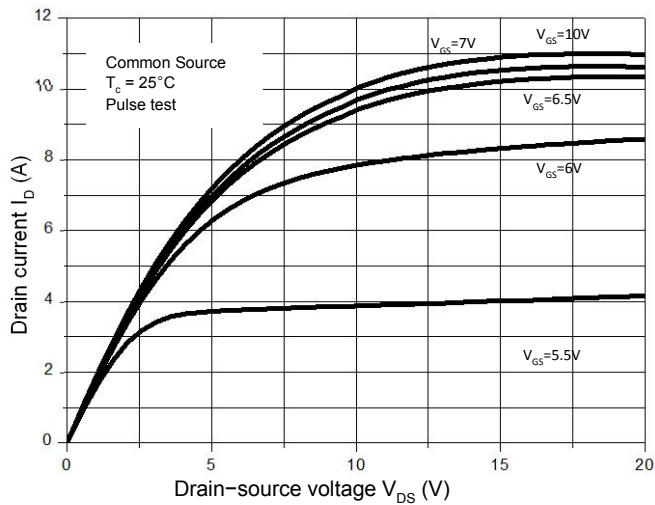


Figure 2. Transfer Characteristics

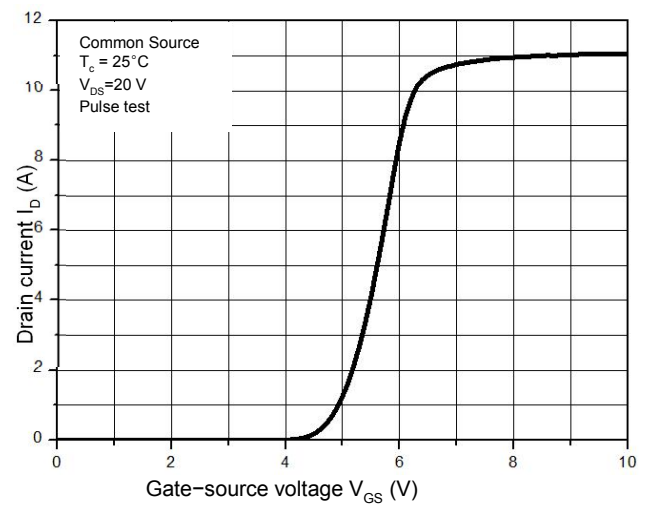


Figure 3. On-Resistance Variation vs. Drain Current

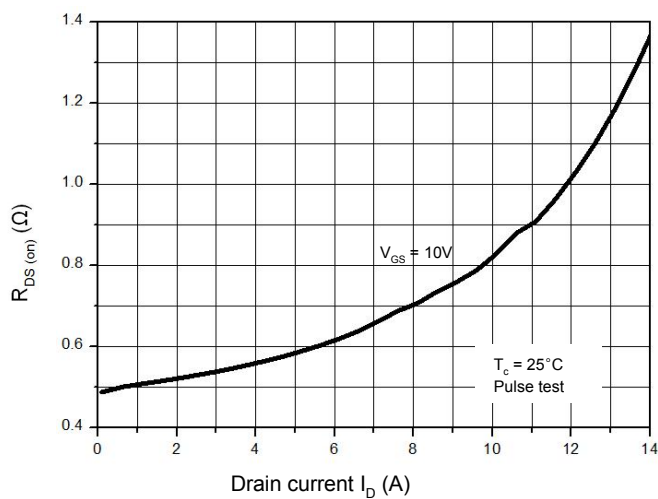


Figure 4. Threshold Voltage vs. Temperature

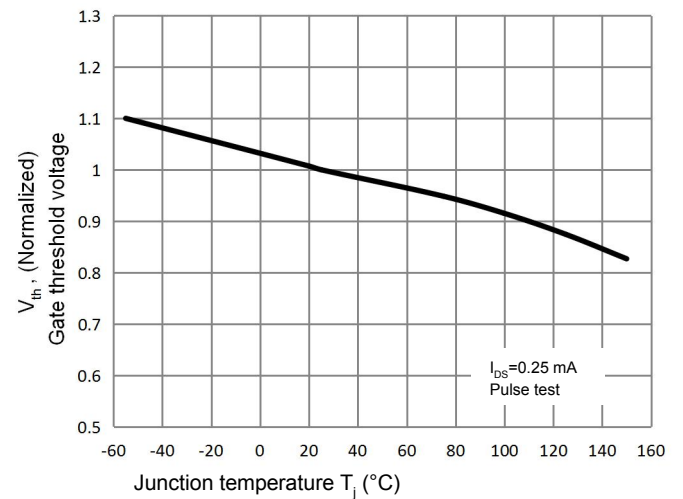


Figure 5. Breakdown Voltage vs. Temperature

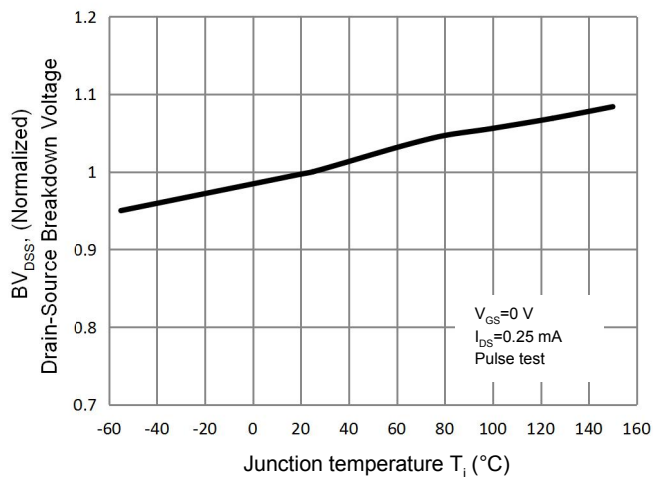


Figure 6. On-Resistance vs. Temperature

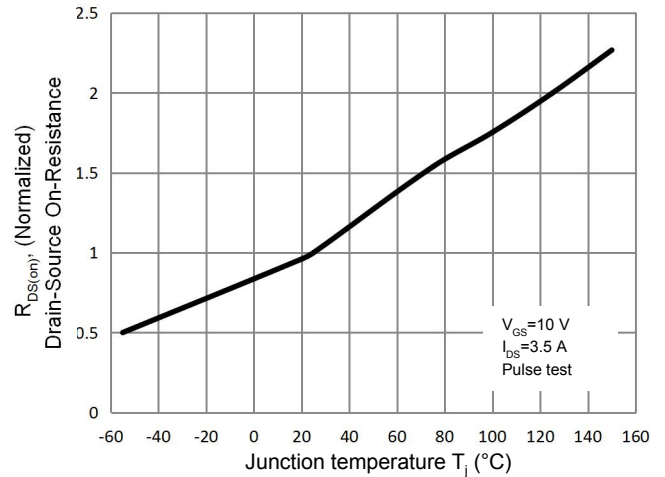


Figure 7. Capacitance Characteristics

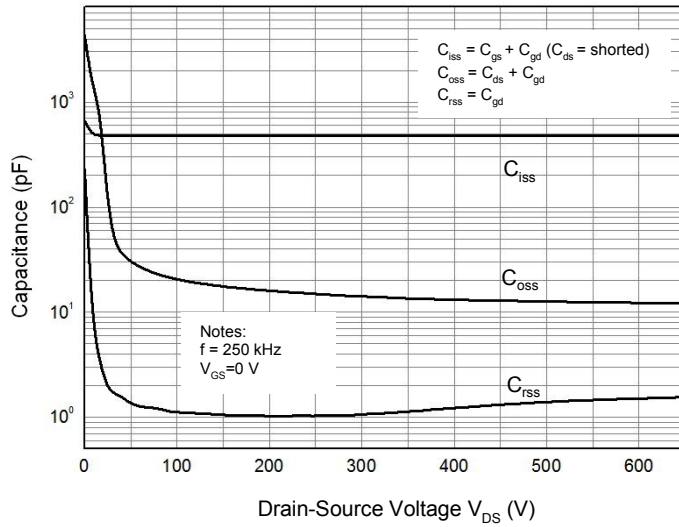


Figure 8. Gate Charge Characterist

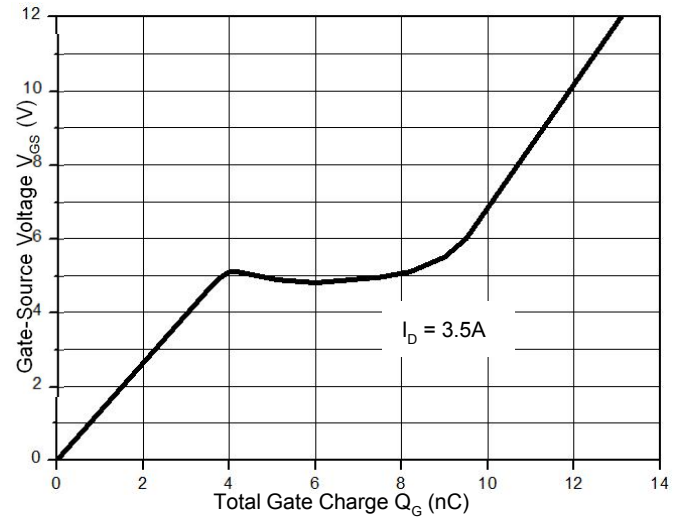


Figure 9.1 Maximum Safe Operating Area
TO-220MF/TO-220MF Narrow Pin

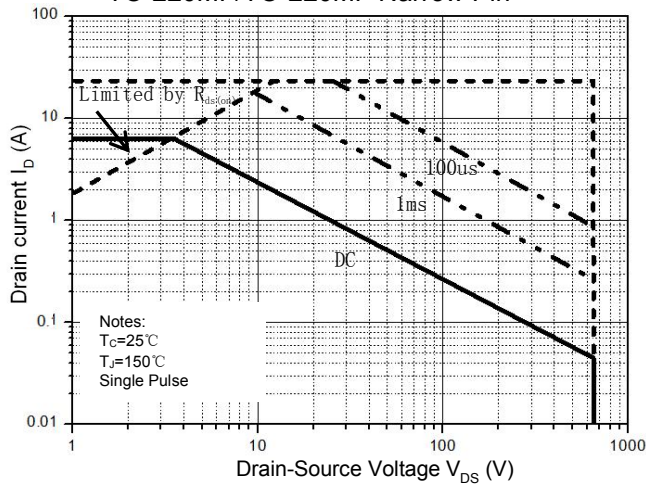


Figure 9.2 Maximum Safe Operating Area

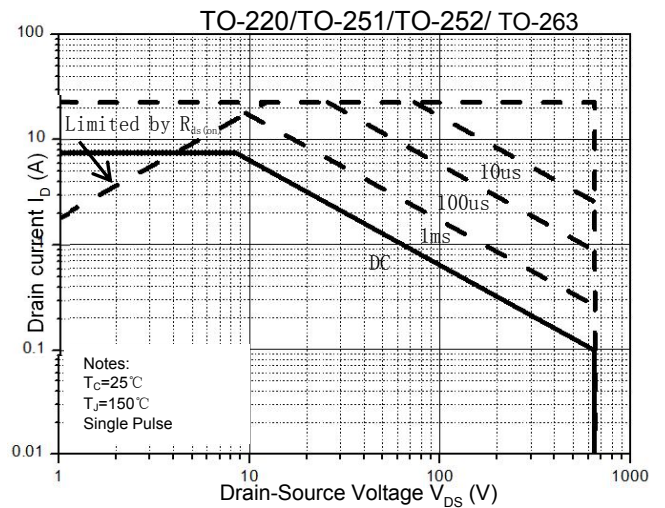


Figure 10.1 Power Dissipation vs. Temperature
TO-220MF/TO-220MF Narrow Pin

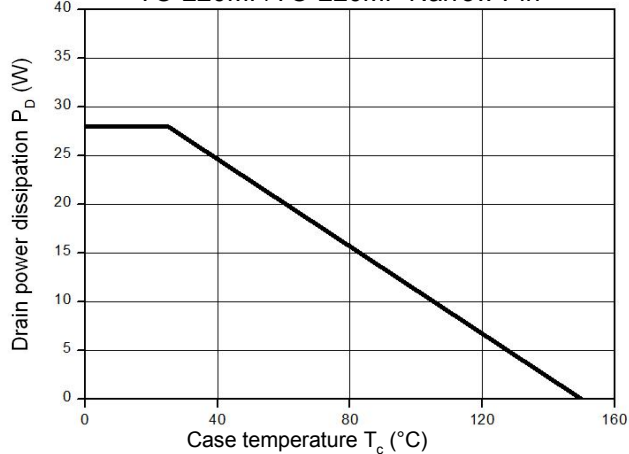
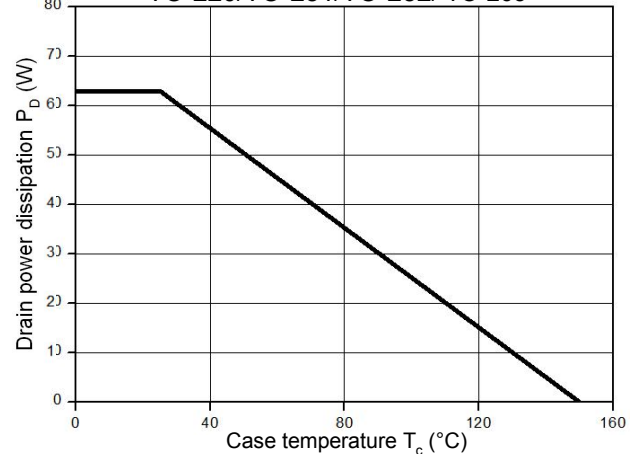
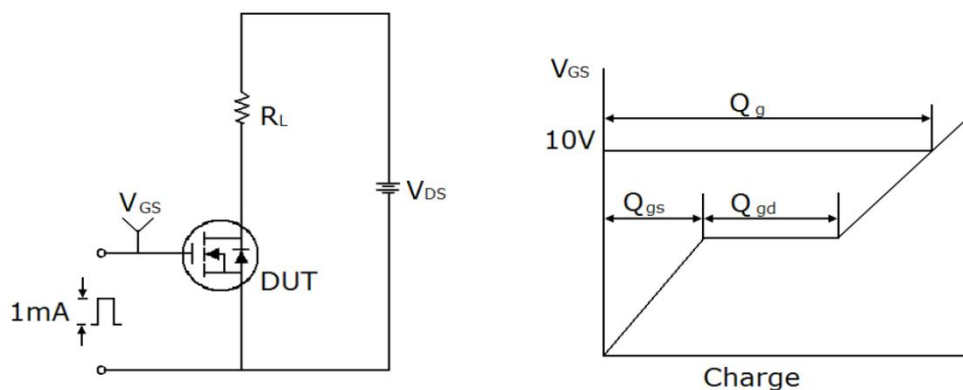


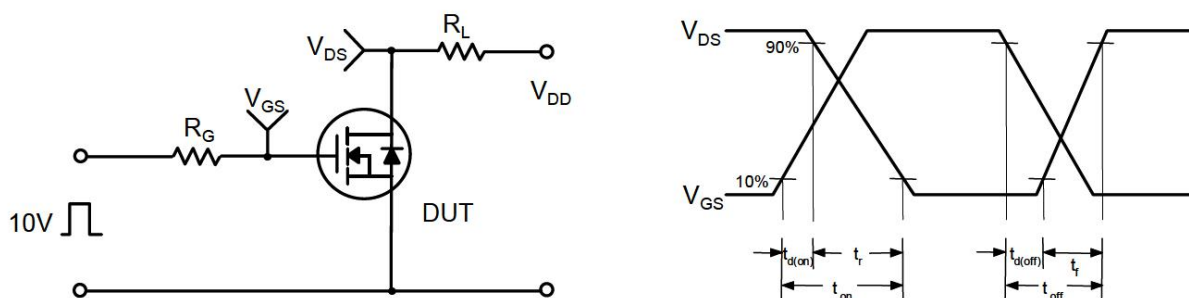
Figure 10.2 Power Dissipation vs. Temperature
TO-220/TO-251/TO-252/ TO-263



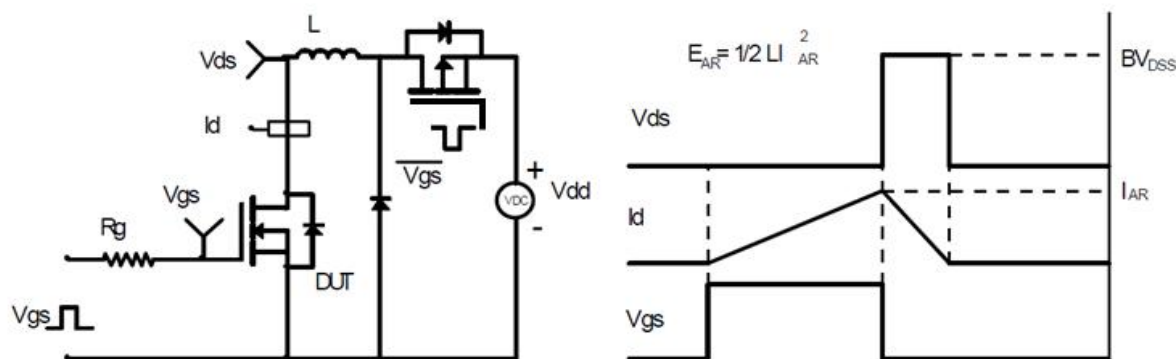
Gate Charge Test Circuit & Waveform



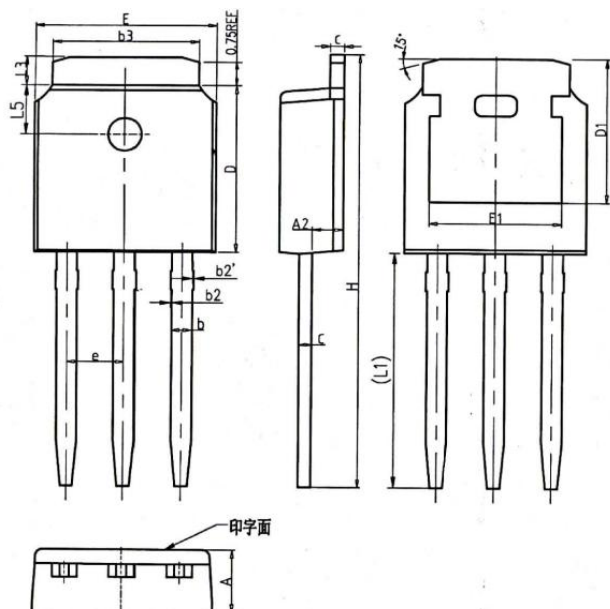
Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

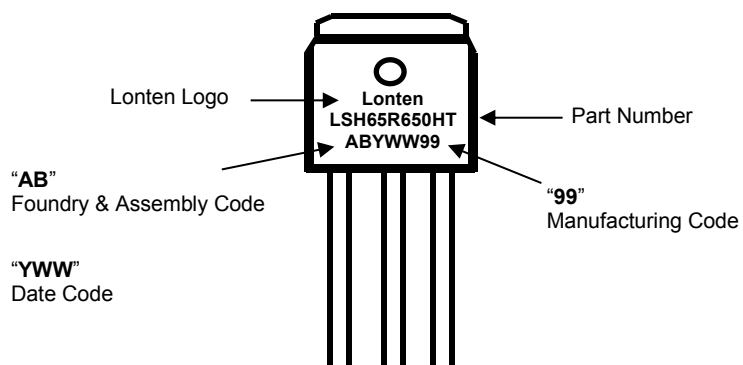


Mechanical Dimensions for TO-251

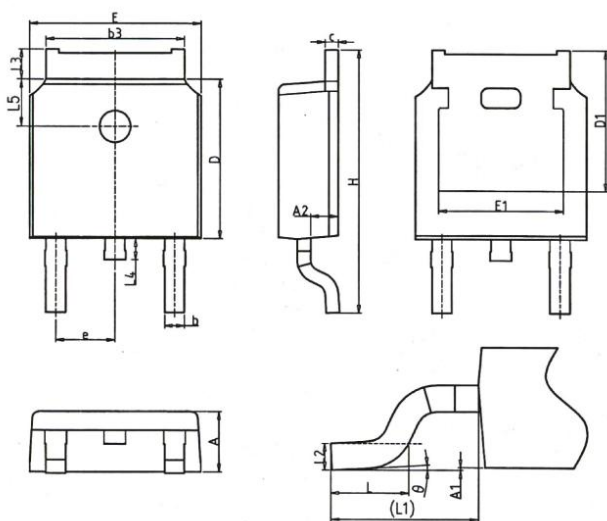


COMMON DIMENSIONS			
SYMBOL	MM		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b2	0.00	0.04	0.10
b2'	0.00	0.04	0.10
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	—	—
e	2.286BSC		
H	16.22	16.52	16.82
L1	9.15	9.40	9.65
L3	0.88	1.02	1.28
L5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

TO-251 Part Marking Information

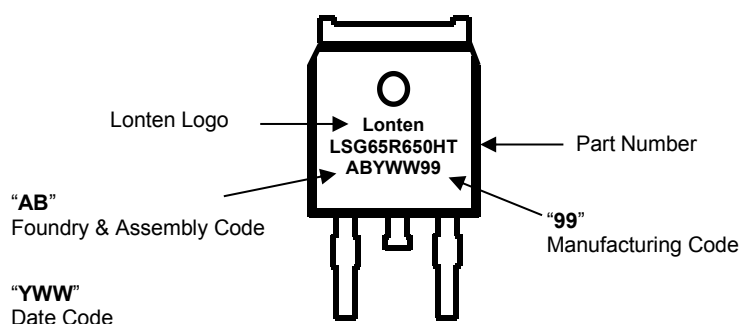


Mechanical Dimensions for TO-252

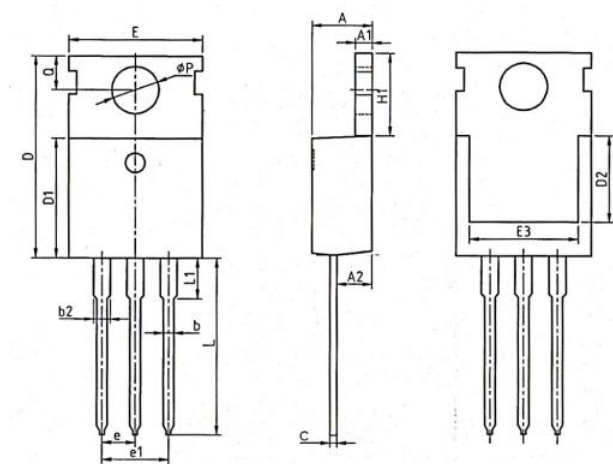


COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.00	—	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	—	—
e	2.286BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90REF		
L2	0.51BSC		
L3	0.88	—	1.28
L4	0.50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

TO-252 Part Marking Information

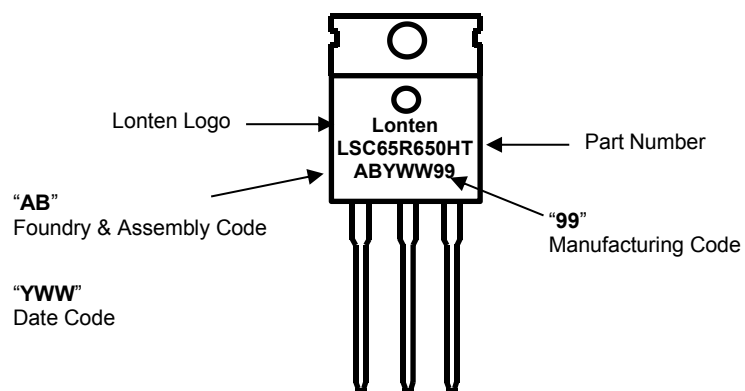


Mechanical Dimensions for TO-220

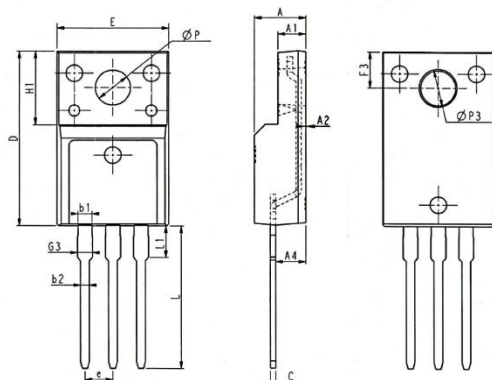


SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.70	0.172	0.180	0.185
A1	1.25	1.30	1.40	0.049	0.051	0.055
A2	2.20	2.40	2.60	0.087	0.094	0.102
b	0.70	0.80	0.95	0.028	0.031	0.037
b2	1.17	1.27	1.47	0.046	0.050	0.058
c	0.45	0.50	0.60	0.018	0.020	0.024
D	15.10	15.60	16.10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

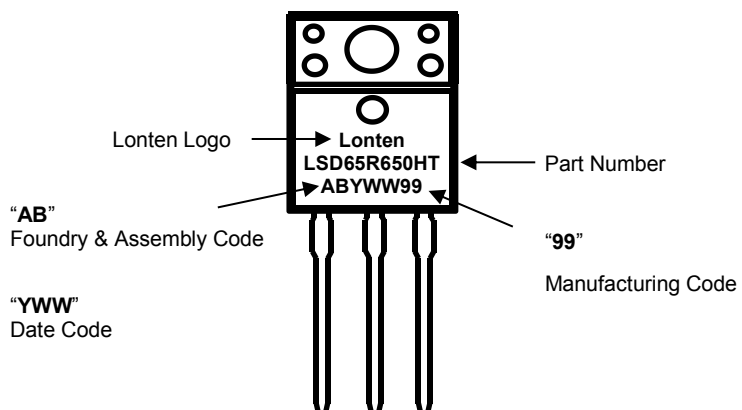


Mechanical Dimensions for TO-220MF

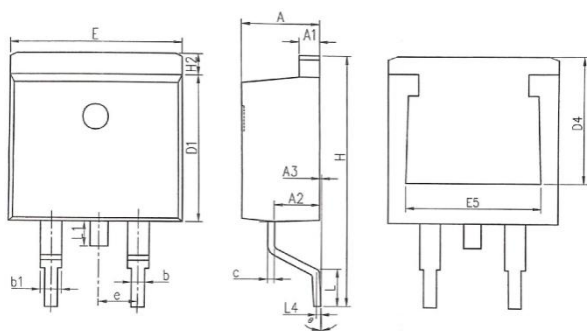


SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
E	9.96	10.16	10.36	0.392	0.400	0.408
A	4.50	4.70	4.90	0.177	0.185	0.193
A1	2.34	2.54	2.74	0.092	0.100	0.108
A2	0.30	0.45	0.60	0.012	0.002	0.024
A4	2.65	2.76	2.96	0.104	0.109	0.117
C	0.40	0.50	0.65	0.016	0.020	0.026
D	15.57	15.87	16.17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

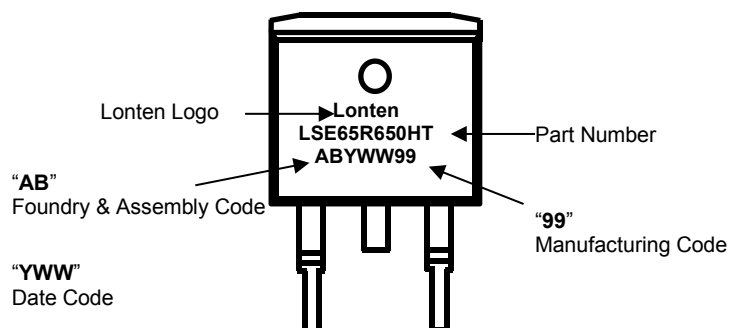


Mechanical Dimensions for TO-263

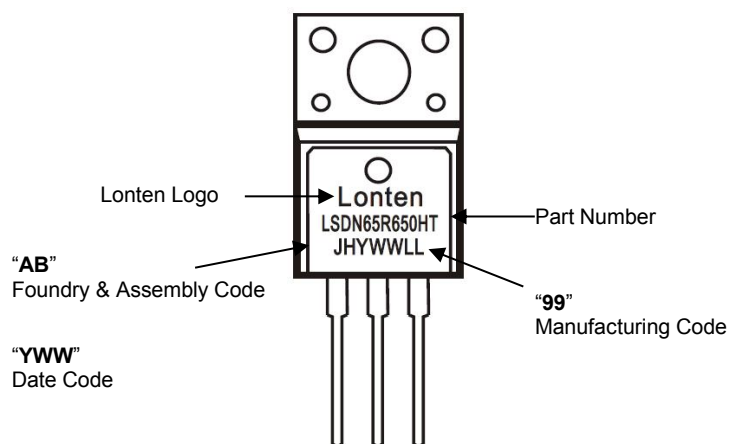
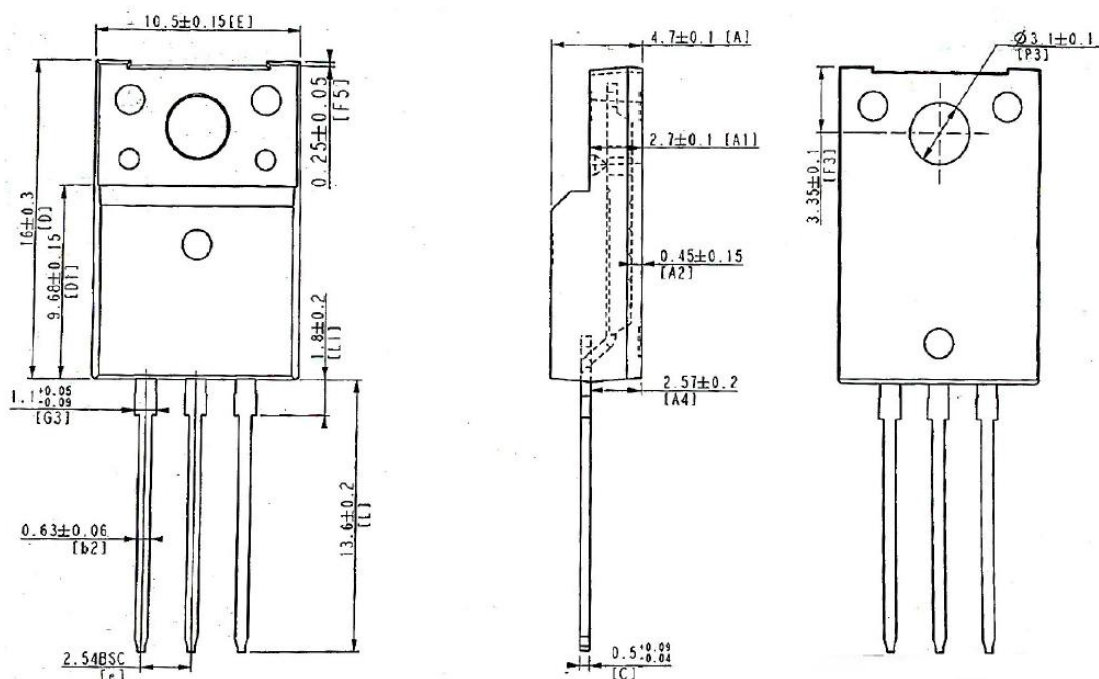


SYMBOL	COMMON DIMENSIONS					
	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	4.37	4.57	4.77	0.172	0.180	0.188
A1	1.22	1.27	1.42	0.048	0.050	0.056
A2	2.49	2.89	2.89	0.098	0.114	0.114
A3	0.00	0.13	0.25	0.000	0.005	0.010
b	0.70	0.81	0.96	0.028	0.032	0.034
b1	1.17	1.27	1.47	0.046	0.050	0.058
c	0.30	0.38	0.53	0.012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



Mechanical Dimensions for TO-220MF Narrow Pin



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