


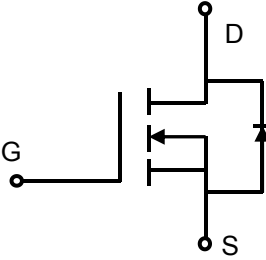



## Lonten N-channel 600V, 4A, 950mΩ LonFET™ Power MOSFET

<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 = 7.6nC</math>)</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 (PFC).</li> <li>◆ Switched mode power supplies (SMPS).</li> <li>◆ Uninterruptible power supply (UPS).</li> </ul>	<p><b>Product Summary</b></p> <table> <tr> <td><math>V_{DS} @ T_{j,max}</math></td> <td>650V</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td>950mΩ</td> </tr> <tr> <td><math>I_{DM}</math></td> <td>12A</td> </tr> <tr> <td><math>Q_{g,typ}</math></td> <td>7.6nC</td> </tr> </table> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  TO-251         </div> <div style="text-align: center;">  TO-252         </div> <div style="text-align: center;">  TO-220FT         </div> </div> <div style="text-align: center; margin-top: 20px;">  N-Channel MOSFET         </div> <div style="text-align: right; margin-top: 10px;">  </div>	$V_{DS} @ T_{j,max}$	650V	$R_{DS(on),max}$	950mΩ	$I_{DM}$	12A	$Q_{g,typ}$	7.6nC
$V_{DS} @ T_{j,max}$	650V								
$R_{DS(on),max}$	950mΩ								
$I_{DM}$	12A								
$Q_{g,typ}$	7.6nC								

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	600	V
Continuous drain current ( $T_C = 25^\circ C$ ) ( $T_C = 100^\circ C$ )	$I_D$	4	A
		2.5	A
Pulsed drain current <sup>1)</sup>	$I_{DM}$	12	A
Gate-Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	120	mJ
Avalanche energy, repetitive <sup>3)</sup>	$E_{AR}$	0.6	mJ
Avalanche current, repetitive <sup>3)</sup>	$I_{AR}$	4	A
Power Dissipation TO-220FT ( $T_C = 25^\circ C$ ) - Derate above $25^\circ C$	$P_D$	25	W
		0.20	W/ $^\circ C$
Power Dissipation TO-251/ TO-252 ( $T_C = 25^\circ C$ ) - Derate above $25^\circ C$	$P_D$	40	W
		0.32	W/ $^\circ C$
Mounting torque To-220FT ( M2.5 screws )		50	Ncm
Operating and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ C$
Continuous diode forward current	$I_S$	4	A
Diode pulse current	$I_{S,pulse}$	12	A

**Thermal Characteristics TO-251/TO-252**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.13	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	160	$^{\circ}\text{C}/\text{W}$
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	$T_{\text{sold}}$	260	$^{\circ}\text{C}$

**Thermal Characteristics TO-220FT**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	5.0	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	105	$^{\circ}\text{C}/\text{W}$
Soldering temperature, wavesoldering only allowed at leads. (1.6mm from case for 10s)	$T_{\text{sold}}$	260	$^{\circ}\text{C}$

**Package Marking and Ordering Information**

Device	Device Package	Marking	Units/Tube	Units/Real
LSDN60R950HT	TO-220FT	LSDN60R950HT	50	
LSG60R950HT	TO-252	LSG60R950HT	72	2500
LSH60R950HT	TO-251	LSH60R950HT	72	4680

**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	$BV_{DSS}$	$V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.25\text{ mA}$	2.5	3.5	4.5	V
Drain cut-off current	$I_{DSS}$	$V_{DS}=600\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^{\circ}\text{C}$ $T_j = 125^{\circ}\text{C}$	-	-	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	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=2\text{ A}$ $T_j = 25^{\circ}\text{C}$ $T_j = 150^{\circ}\text{C}$	-	0.86	0.95	$\Omega$
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{open drain}$	-	8	-	$\Omega$
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$ $f = 250\text{ kHz}$	-	317	-	pF
Output capacitance	$C_{oss}$		-	14.1	-	
Reverse transfer capacitance	$C_{rss}$		-	1.36	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 2\text{ A}$ $R_G = 10\Omega, V_{GS}=15\text{ V}$	-	16.1	-	ns
Rise time	$t_r$		-	27	-	
Turn-off delay time	$t_{d(off)}$		-	46	-	
Fall time	$t_f$		-	36.4	-	

<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=480\text{ V}$ , $I_D=2\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$	-	2.5	-	nC
Gate to drain charge	$Q_{gd}$		-	2.6	-	
Gate charge total	$Q_g$		-	7.6	-	
	$V_{plateau}$		-	6	-	V
<b>Reverse diode characteristics</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}$ , $I_F=2\text{ A}$	-	1.0	-	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}$ , $I_F=2\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$	-	153	-	ns
Reverse recovery charge	$Q_{rr}$		-	0.8	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	10.5	-	A

**Notes:**

1. Limited by maximum junction temperature, maximum duty cycle is 0.75.
2.  $I_{AS} = 2\text{ A}$ ,  $V_{DD} = 60\text{ V}$ , Starting  $T_j = 25^\circ\text{C}$ .
3. Repetitive Rating: Pulse width limited by maximum junction temperature.

### Electrical Characteristics Diagrams

Figure 1. On-Region Characteristics

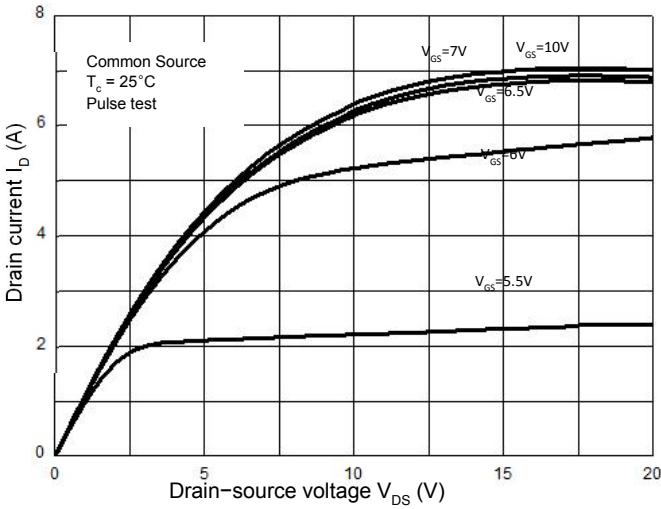


Figure 2. Transfer Characteristics

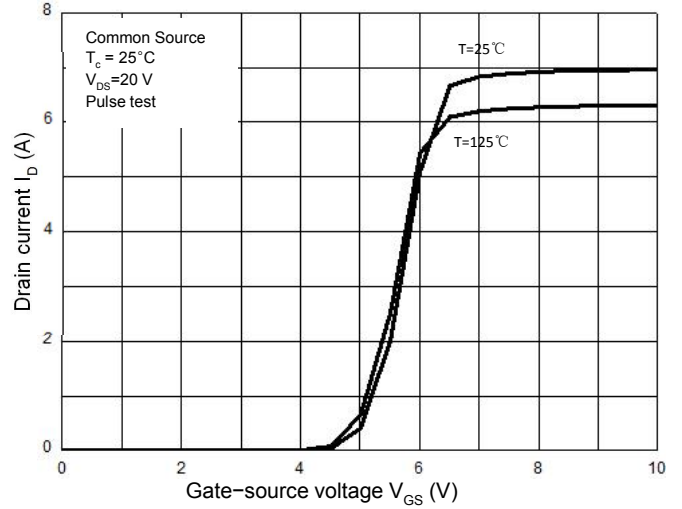


Figure 3. On-Resistance Variation vs. Drain Current

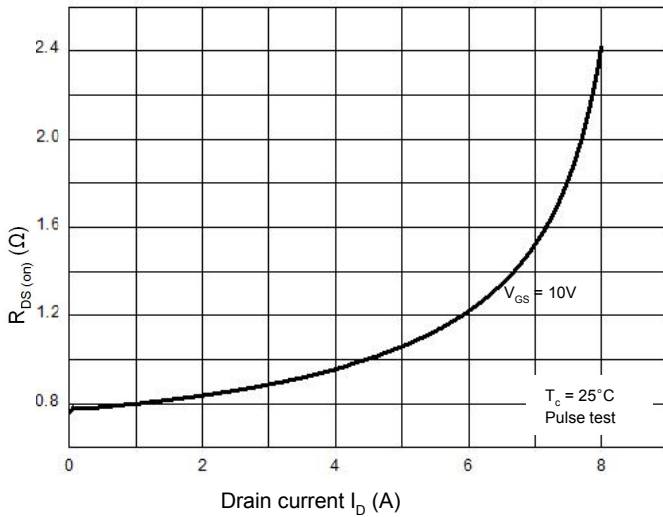


Figure 4. Threshold Voltage vs. Temperature

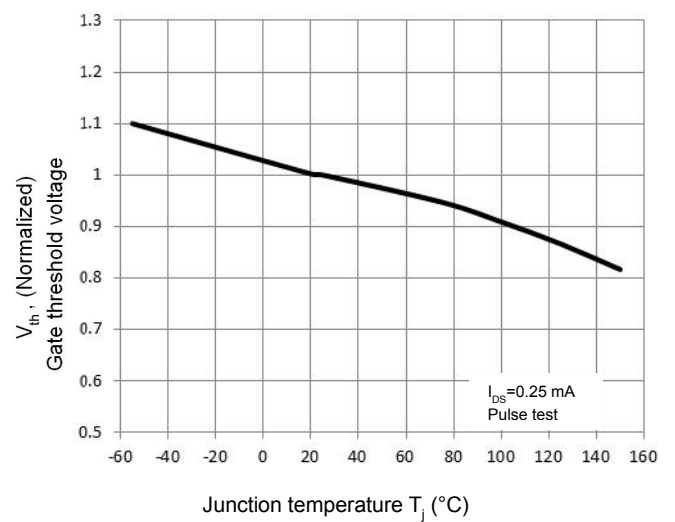


Figure 5. Breakdown Voltage vs. Temperature

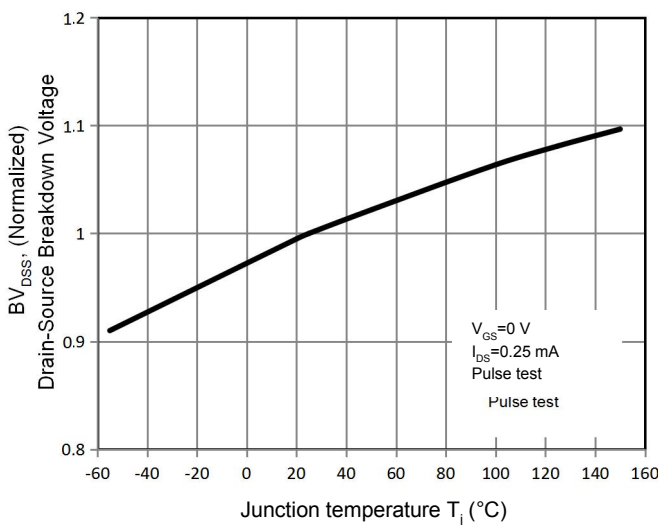


Figure 6. On-Resistance vs. Temperature

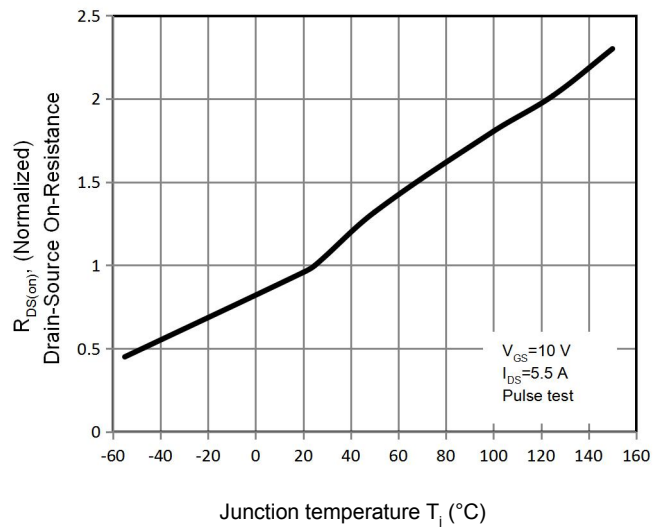


Figure 7. Capacitance Characteristics

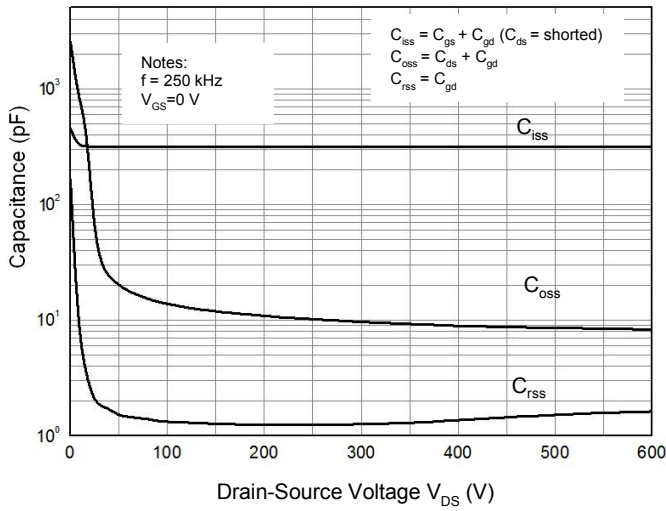


Figure 8. Gate Charge Characterist

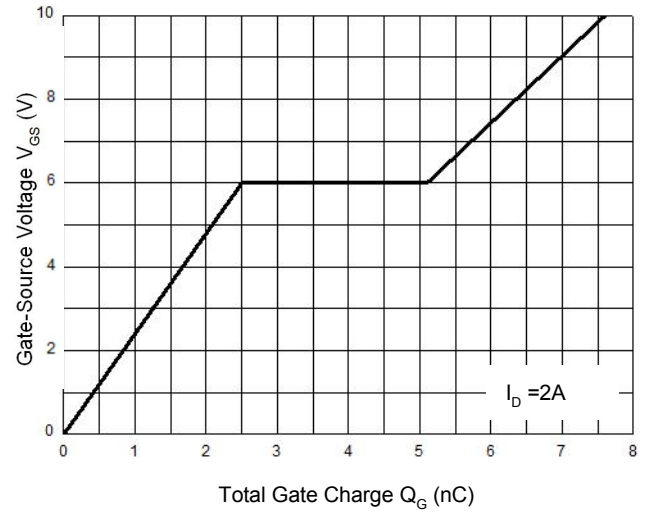


Figure 9.1 Maximum Safe Operating Area TO-220FT

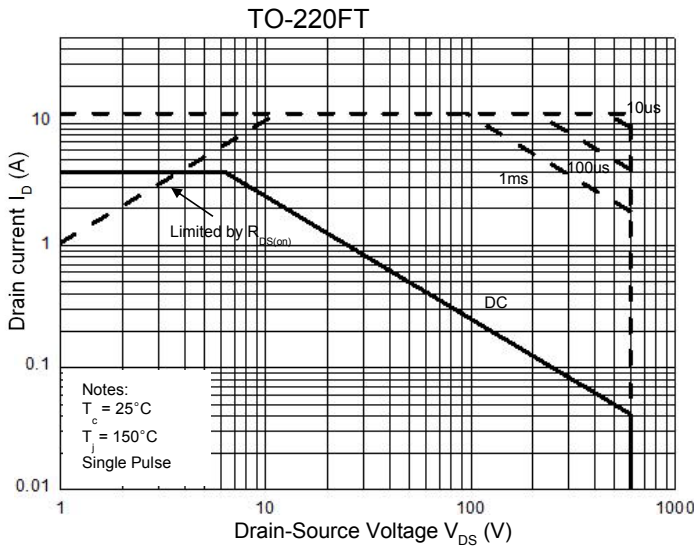


Figure 9.2 Maximum Safe Operating Area TO-251/TO-252

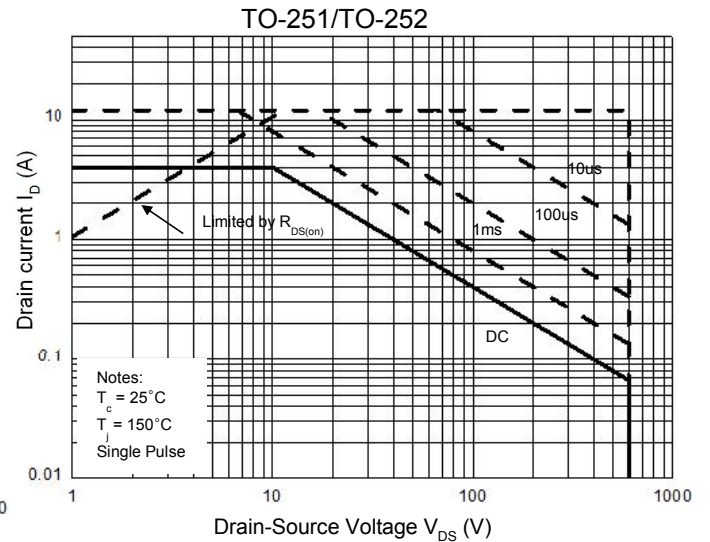


Figure 10.1 Power Dissipation vs. Temperature TO-220FT

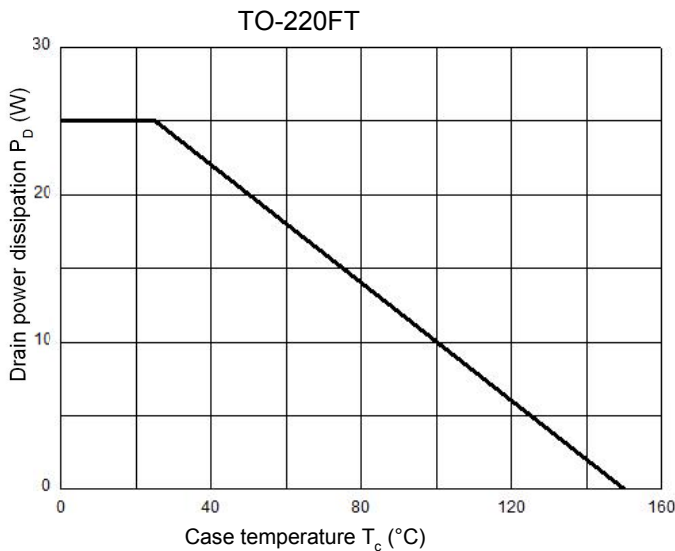
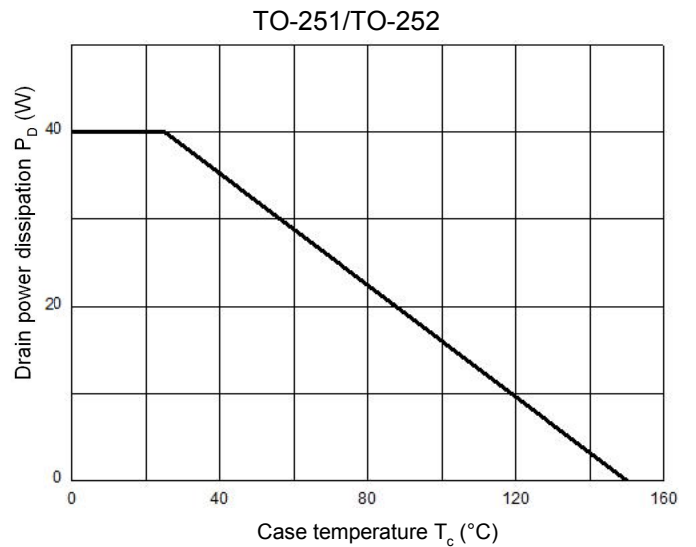
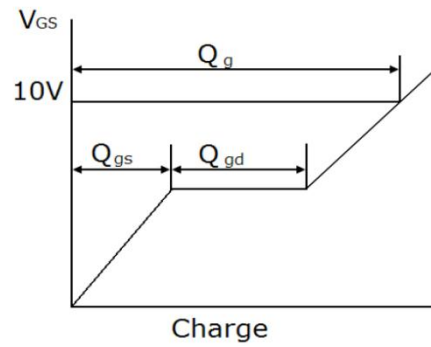
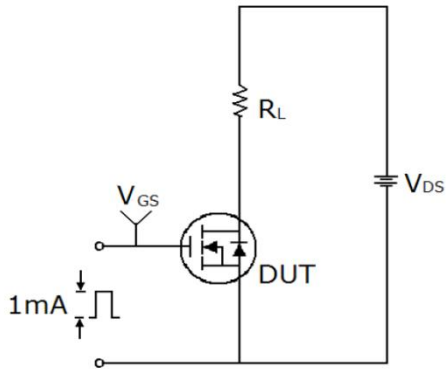


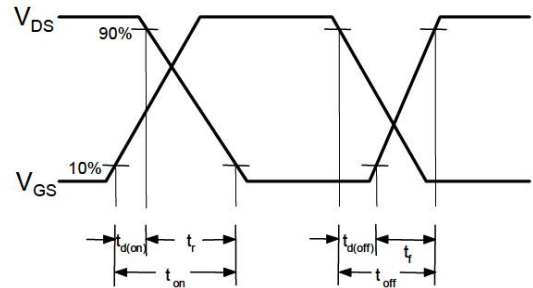
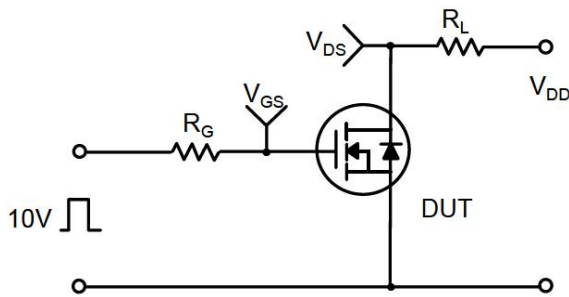
Figure 10.2 Power Dissipation vs. Temperature TO-251/TO-252



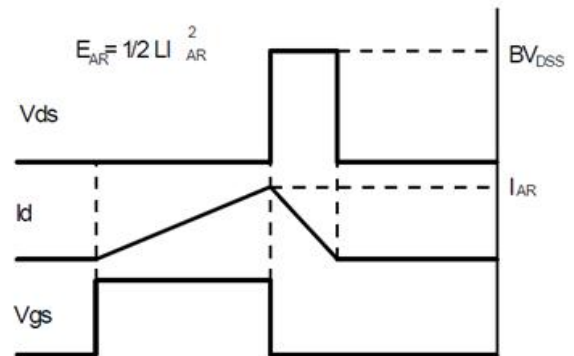
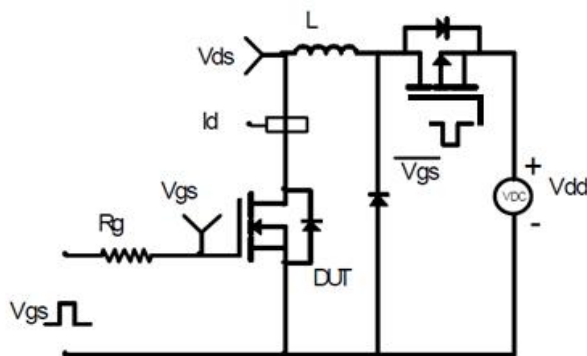
**Gate Charge Test Circuit & Waveform**



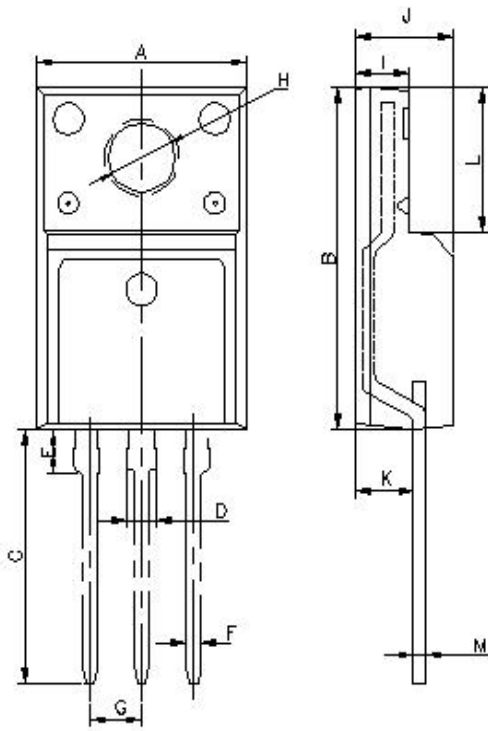
**Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

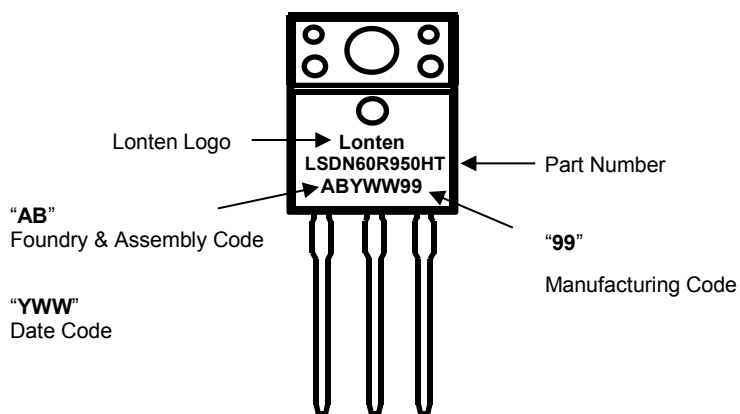


**Mechanical Dimensions for TO-220FT**

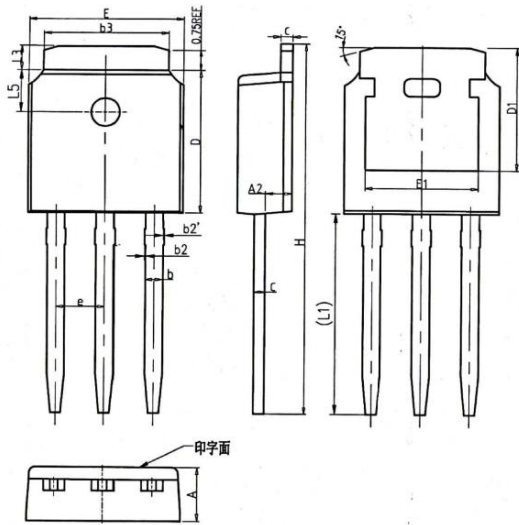


Dim.	mm		
	min.	typ.	max.
A	9.96	10.16	10.36
B	15.67	15.87	16.07
C	12.70	13.00	13.30
D	1.07	1.22	1.37
E	1.85	2.00	2.15
F	0.46	0.69	0.79
G		2.54	
H	3.08	3.18	3.28
I	2.34	2.54	2.74
J	4.50	4.70	4.90
K	2.61	2.76	2.91
L	6.50	6.70	6.90
M	0.40	0.50	0.60

**TO-220FT Part Marking Information**

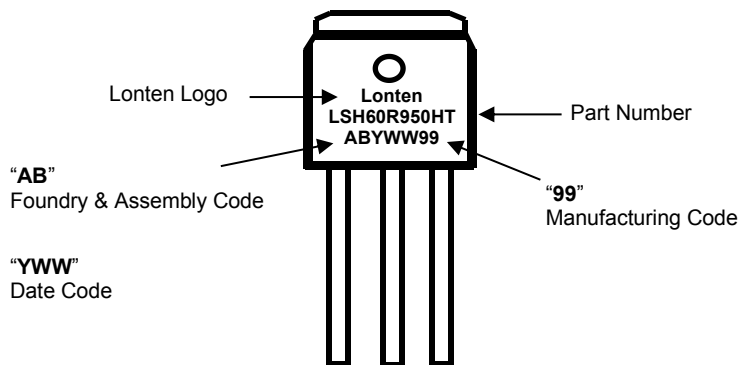


**Mechanical Dimensions for TO-251**



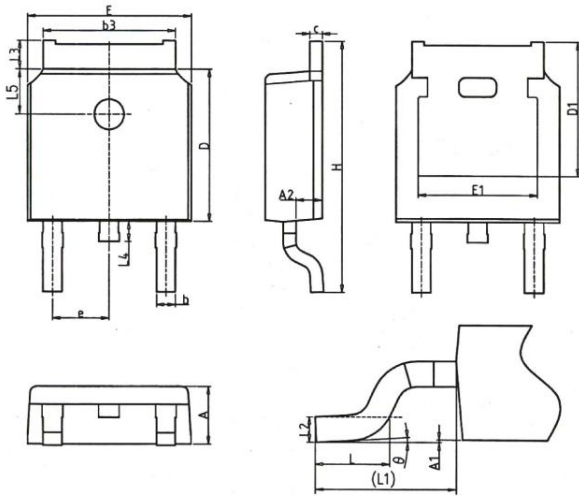
COMMON DIMENSIONS			
SYMBOL	MM		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b2	0.00	0.04	0.10
b2'	0.00	0.04	0.10
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	—	—
e	2.286BSC		
H	16.22	16.52	16.82
L1	9.15	9.40	9.65
L3	0.88	1.02	1.28
L5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

**TO-251 Part Marking Information**



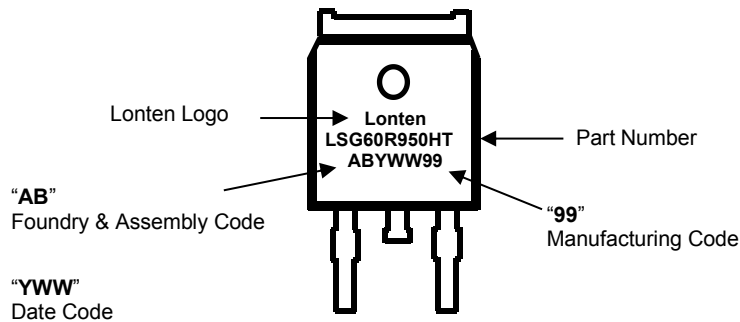


**Mechanical Dimensions for TO-252**



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**



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