600V N-Channel MOSFET

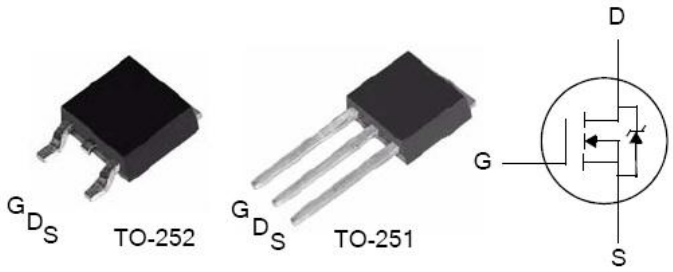
BV_{DSS}	$R_{DS(ON)}$ (Max.)	I_D
600V	2.8Ω	3.6A

General Features

- Low ON Resistance
- Low Gate Charge (typical 14.7nC)
- Fast Switching
- 100% Avalanche Tested
- RoHS Compliant/Lead Free

Applications

- High Efficiency SMPS
- Adaptor/Charger
- Active PFC
- LCD Panel Power



Ordering Information

Part Number	Package	Marking
FTU04N60	TO-251	FTU04N60
FTD04N60	TO-252	FTD04N60

Absolute Maximum Ratings

T_C=25℃ unless otherwise specified

Symbol	Parameter	FTU04N60	FTD04N60	Unit
V_{DSS}	Drain-to-Source Voltage[1]	600		V
I_D	Continuous Drain Current	3.6	3.6*	A
I_D@100℃	Continuous Drain Current	Figure 3		
I_{DM}	Pulsed Drain Current, V_{GS}@10V[2]	Figure 6		
P_D	Power Dissipation	89.3		W
	Derating Factor above 25℃	0.71		W/℃
V_{GS}	Gate-to-Source Voltage	±30		V
E_{AS}	Single Pulse Avalanche Energy L=28mH, I_D=3.6A	181		mJ
dv/dt	Peak Diode Recovery dv/dt[3]	4.5		V/ns
T_L	Soldering Temperature Distance of 1.6mm from case for 10 seconds	300		℃
T_J and T_{STG}	Operating and Storage Temperature Range	-55 to 150		

**Drain Current limited by Maximum Junction Temperature.*
Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

Thermal Characteristics

Symbol	Parameter	FTU04N60	FTD04N60	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.4		℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	100		

Electrical Characteristics

OFF Characteristics

T_C =25℃ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	600	--	--	V	V_{GS}=0V, I_D=250μA
$\triangle BV_{DSS}/\triangle T_J$	Breakdown Voltage Temperature Coefficient	--	0.6	--	V/℃	Reference to 25℃, I_D=250μA
I_{DSS}	Drain-to-Source Leakage Current	--	--	20	μA	V_{DS}=600V, V_{GS}=0V
		--	--	100		V_{DS}=480V, V_{GS}=0V, T_C=125℃
I_{GSS}	Gate-to-Source Leakage Current	--	--	100	Na	V_{GS}=+30V
		--	--	-100		V_{GS}=-30V

ON Characteristics

T_C =25℃ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance	--	2.4	2.8	Ω	V_{GS}=10V, I_D=2.2A[4]
$V_{GS(TH)}$	Gate Threshold Voltage	2.0	--	4.0	V	V_{DS} = V_{GS}, I_D=250μA
gfs	Forward Transconductance	--	2.85	--	S	V_{DS} =15V, I_D=3.6A[4]

Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
C_{ISS}	Input Capacitance	--	498	--	pF	V_{GS}=0V V_{DS}=25V f=1.0MHz Figure 14
C_{OSS}	Output Capacitance	--	39	--		
C_{RSS}	Reverse Transfer Capacitance	--	7.5	--		
Q_G	Total Gate Charge	--	14.7	--	nC	V_{DD}=300V I_D=3.6A Figure 15
Q_{GS}	Gate-to-Source Charge	--	2.1	--		
Q_{GD}	Gate-to-Drain (Miller) Charge	--	7.0	--		

Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	14	--	ns	V_{DD}=300V I_D=3.6A V_{GS}=10V R_G=20Ω
t_{rise}	Rise Time	--	33	--		
$t_{d(OFF)}$	Turn-off Delay Time	--	34	--		
t_{fall}	Fall Time	--	31	--		

Source-Drain Diode Characteristics

T_C=25℃ unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Units	Test Conditions
I_{SD}	Continuous Source Current (Body Diode)	--	--	3.6	A	Integral P-N diode in MOSFET
I_{SM}	Maximum Pulsed Current(Body Diode)	--	--	14.5	A	
V_{SD}	Diode Forward Voltage	--	--	1.2	V	I_S=3.6A, V_{GS}=0V
t_{rr}	Reverse Recovery Time	--	224	--	ns	V_{GS}=0V I_F=3.6A,di/dt=100A/μs
Q_{rr}	Reverse Recovery Charge	--	960	--	nC	

NOTE:

[1] T_J=+25℃ to +150℃
[2] Repetitive rating, pulse width limited by maximum junction temperature.
[3] I_{SD}=3.6A, di/dt≤100A/μs, V_{DD}≤BV_{DSS}, T_J=+150℃
[4] Pulse width≤380μs; duty cycle≤2%.

Figure 1. Maximum Effective Thermal Impedance, Junction-to-Case

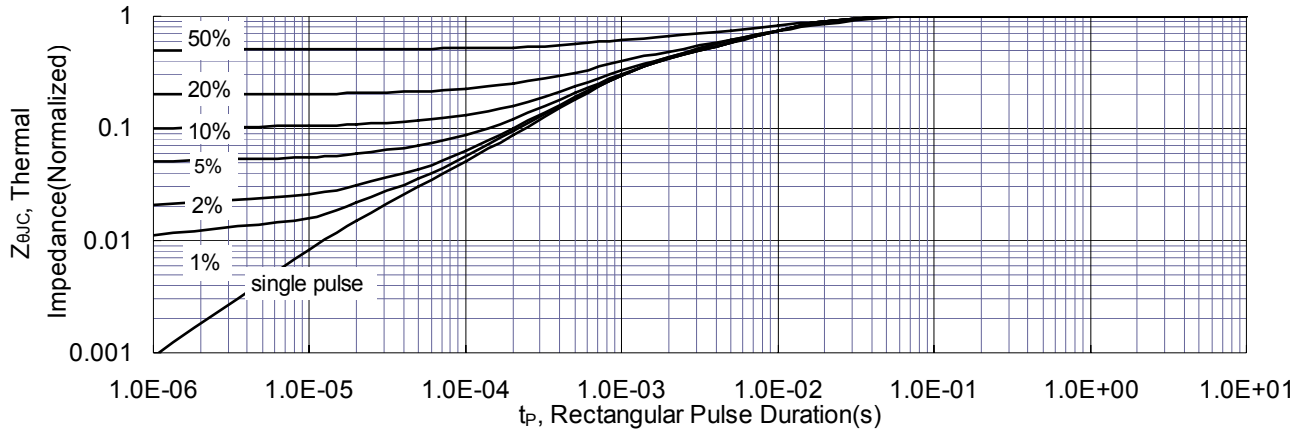


Figure 2. Maximum Power Dissipation vs. Case Temperature

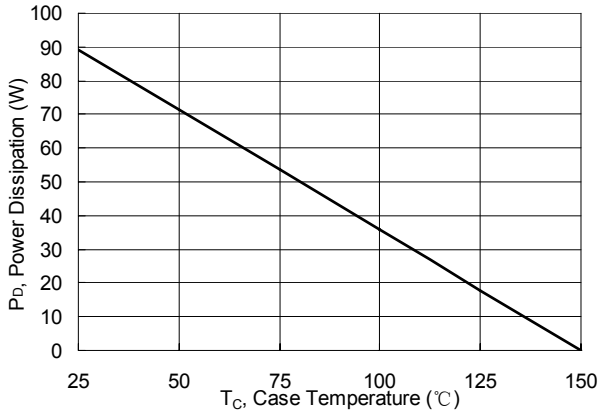


Figure 3. Maximum Continuous Drain Current vs Case Temperature

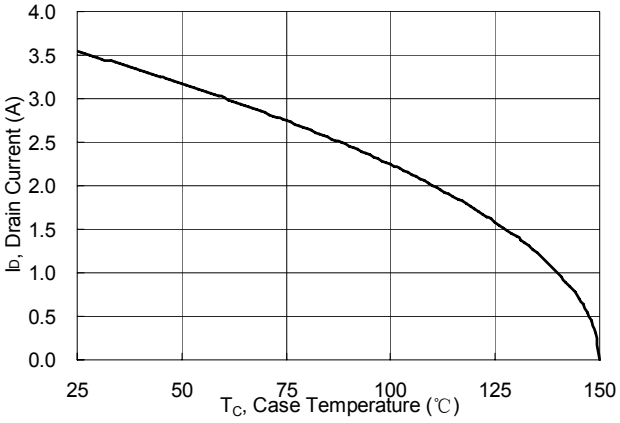


Figure 4. Typical Output Characteristics

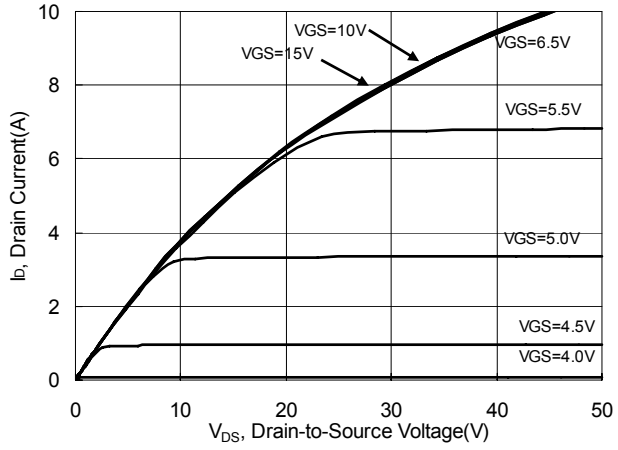


Figure 5. Typical Drain-to-Source ON Resistance vs. Gate Voltage and Drain Current

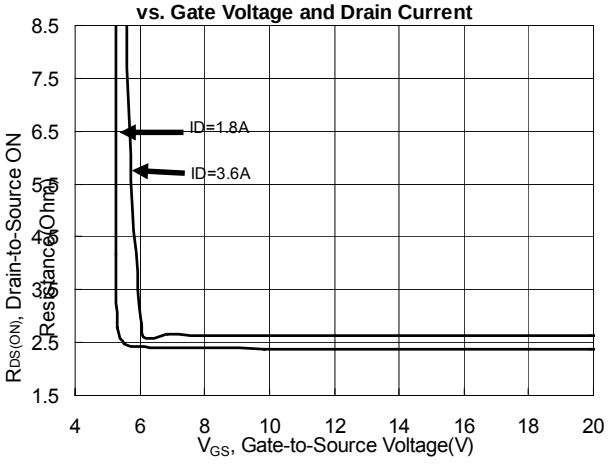


Figure 6. Maximum Peak Current Capability

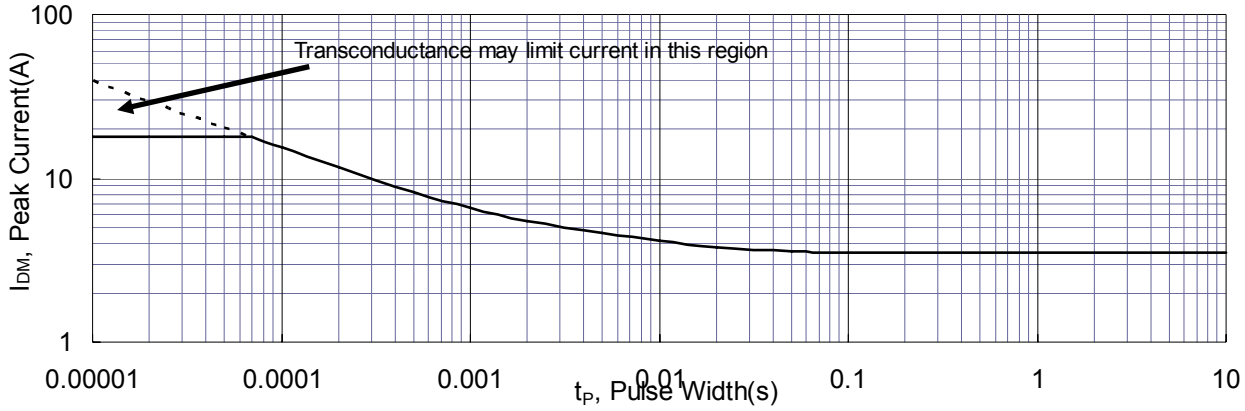


Figure 7. Typical Transfer Characteristics

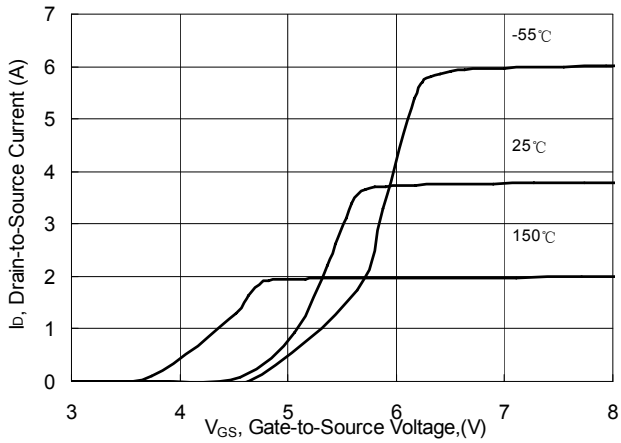


Figure 8. Unclamped Inductive Switching Capability

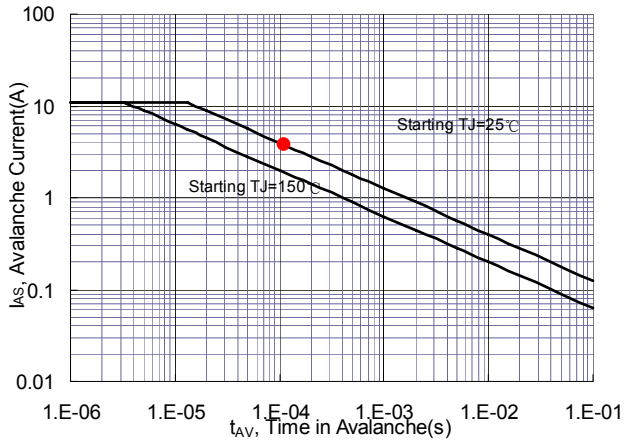


Figure 9. Typical Drain-to-Source ON Resistance

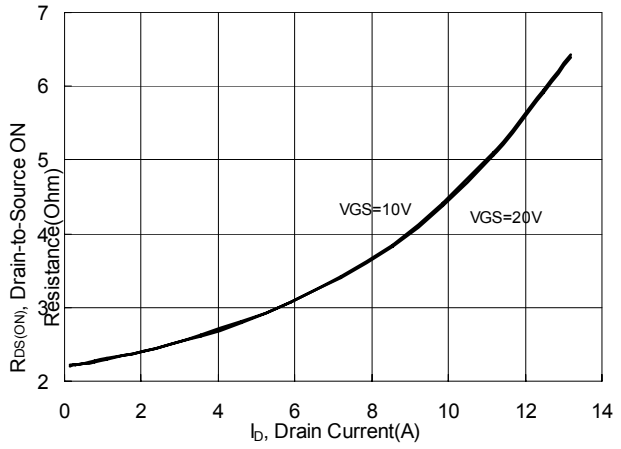


Figure 10. Typical Drain-to-Source On Resistance vs. Junction Temperature

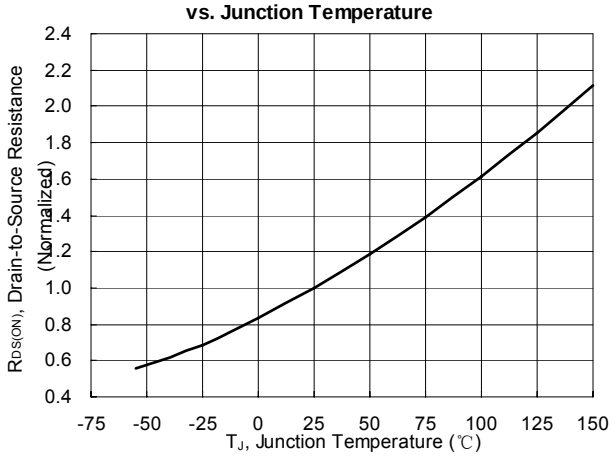


Figure 11.Typical Breakdown Voltage vs. Junction Temperature

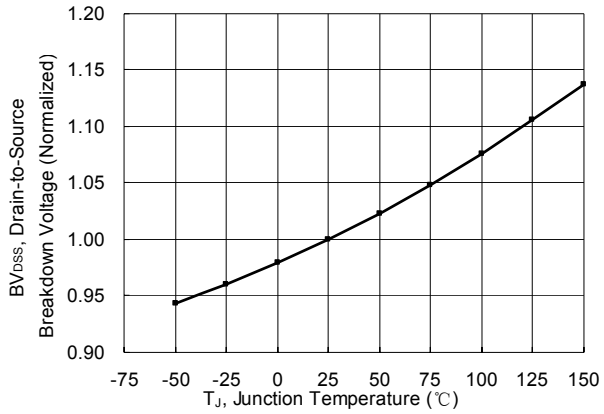


Figure 12.Typical Threshold Voltage vs. Junction Temperature

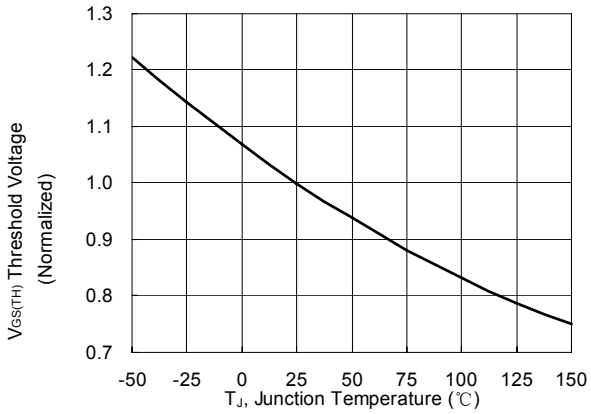


Figure 13. Maximum Forward Safe Operation Area

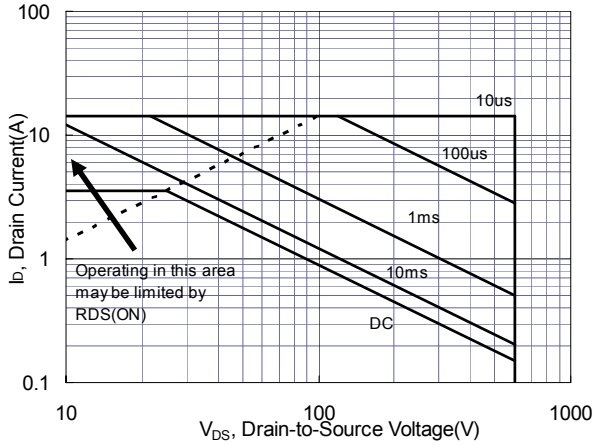


Figure 14. Typical Capacitance vs. Drain-to-Source Voltage

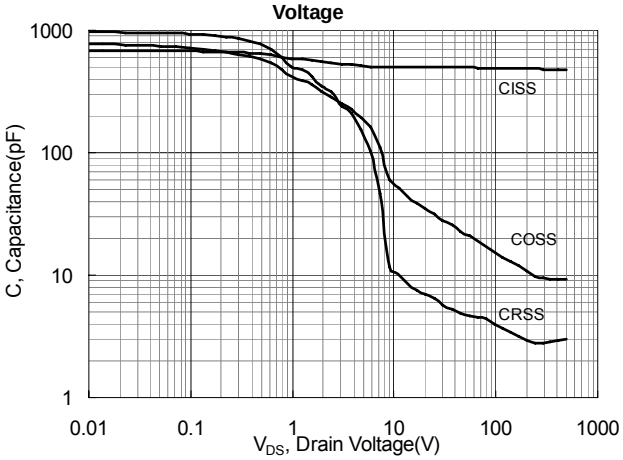


Figure 15. Typical Gate Charge vs. Gate-to-Source Voltage

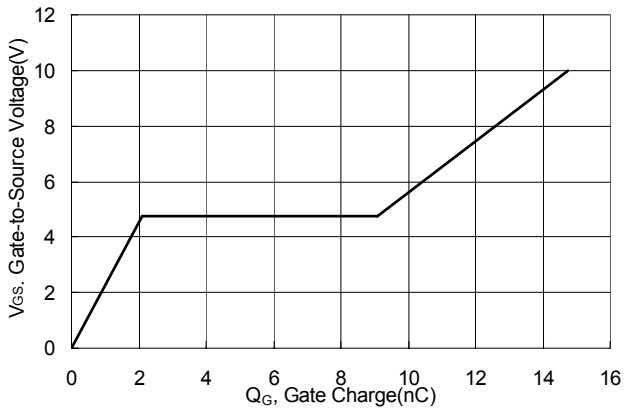
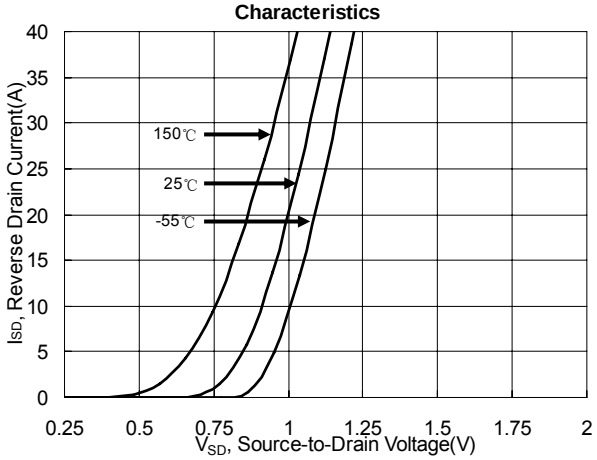


Figure 16. Typical Body Diode Transfer Characteristics



Test Circuit

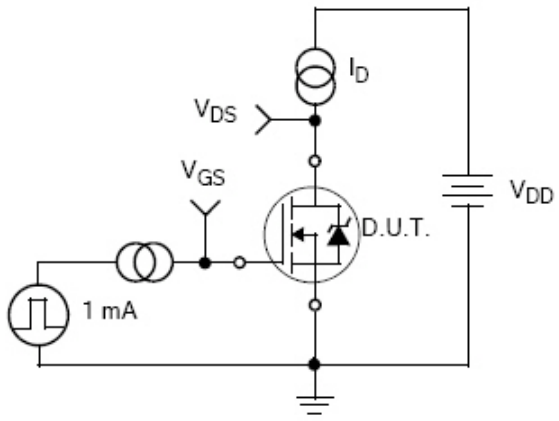


Figure 17. Gate Charge Test Circuit

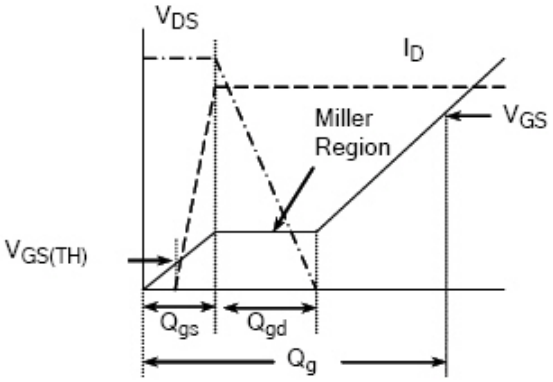


Figure 18. Gate Charge Waveform

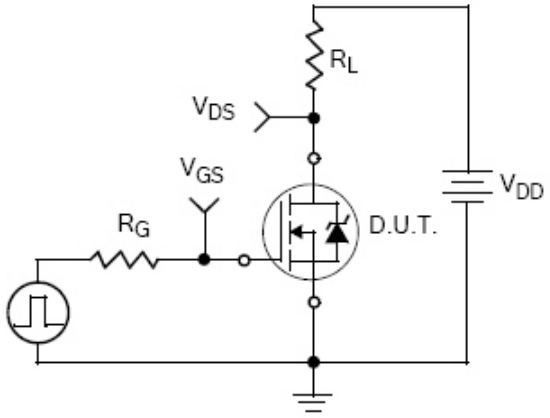


Figure 19. Resistive Switching Test Circuit

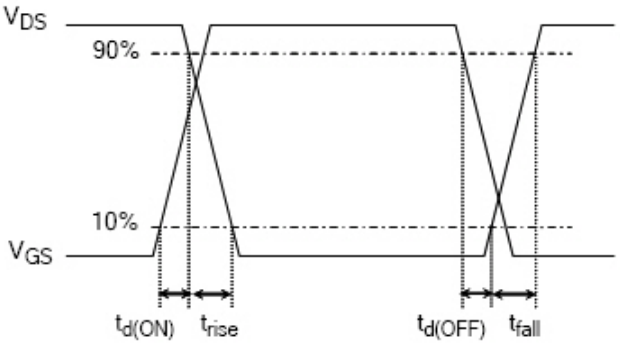


Figure 20. Resistive Switching Waveforms

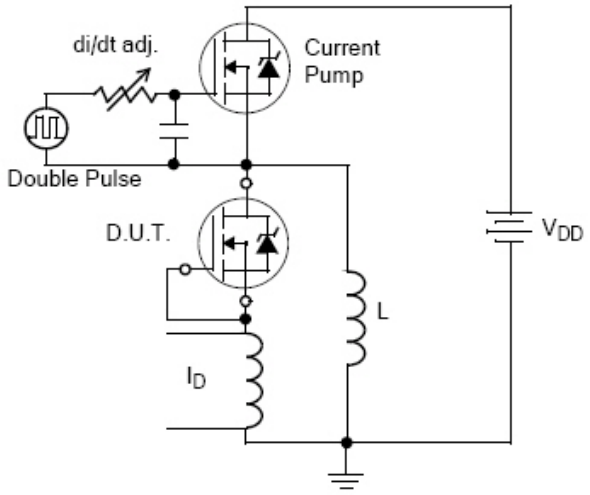


Figure 21. Diode Reverse Recovery Test Circuit

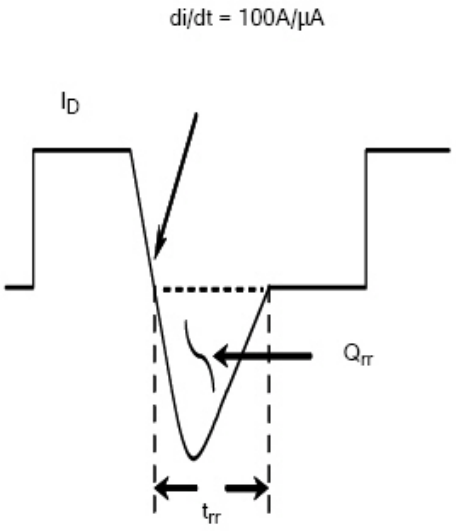


Figure 22. Diode Reverse Recovery Waveform

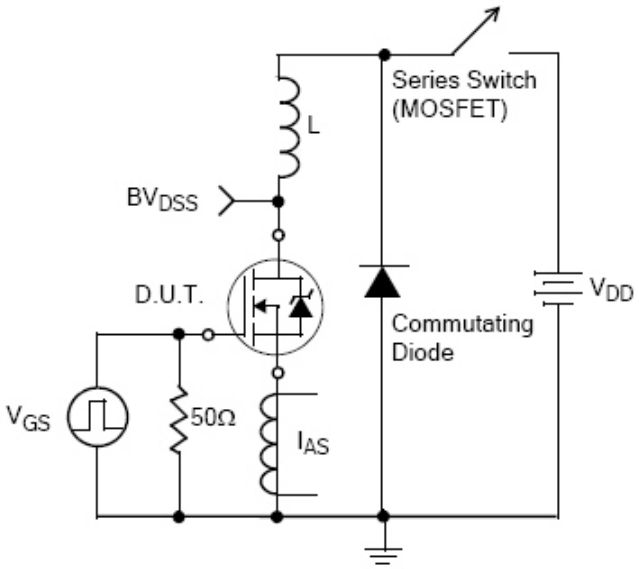


Figure 23. Unclamped Inductive Switching Test Circuit

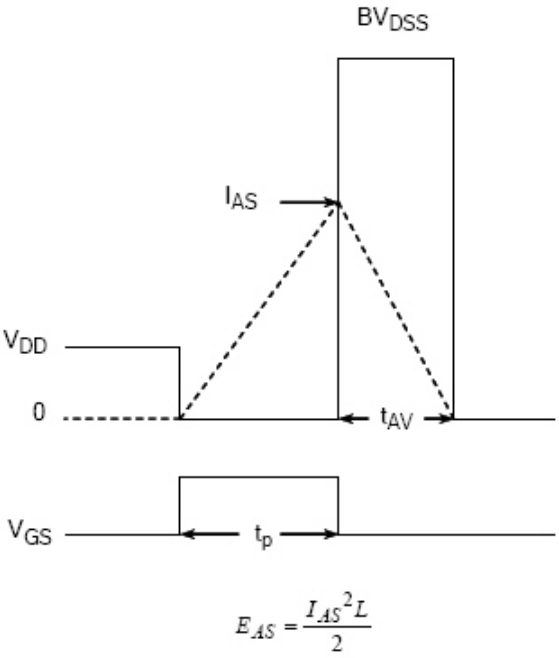
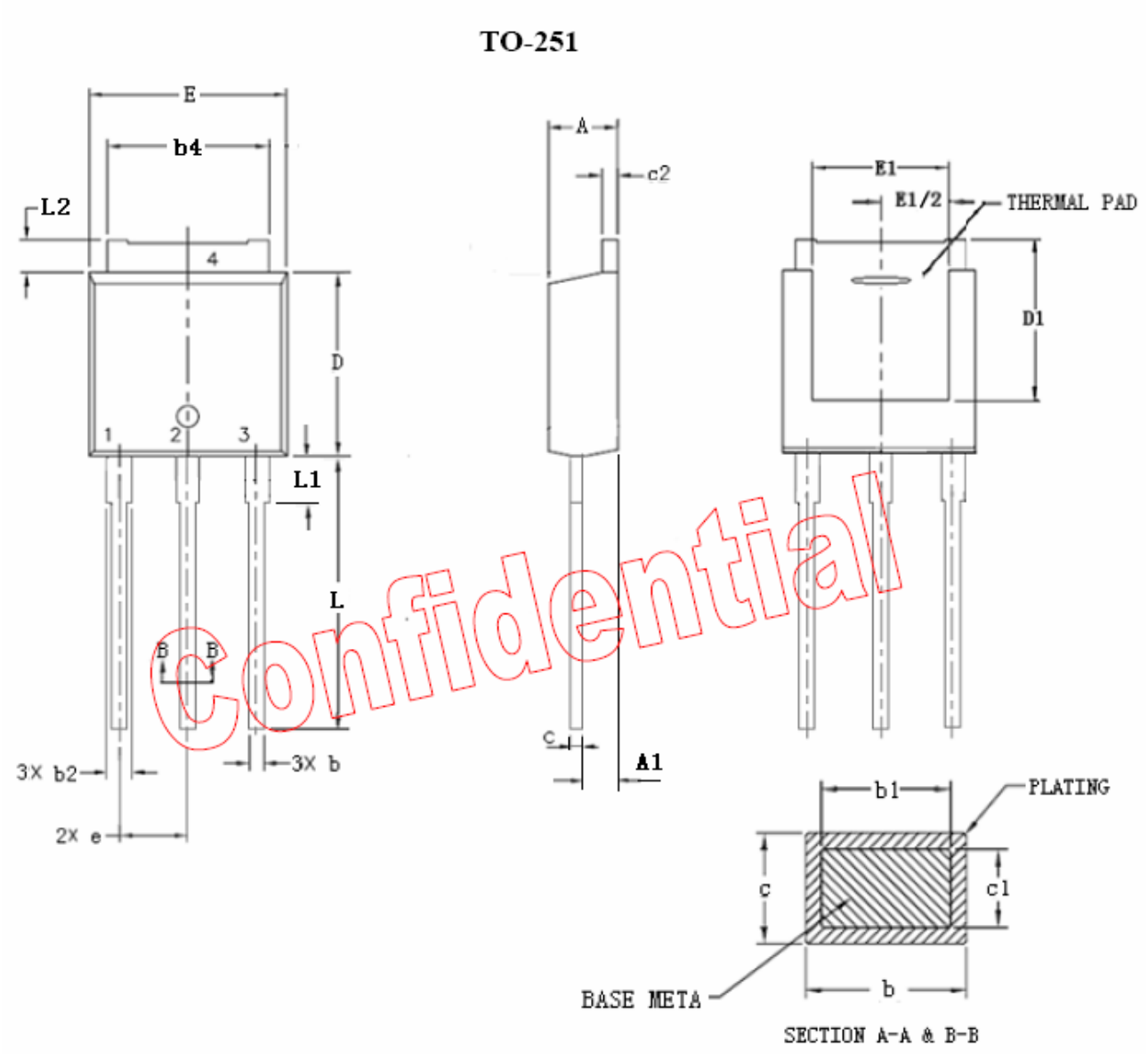
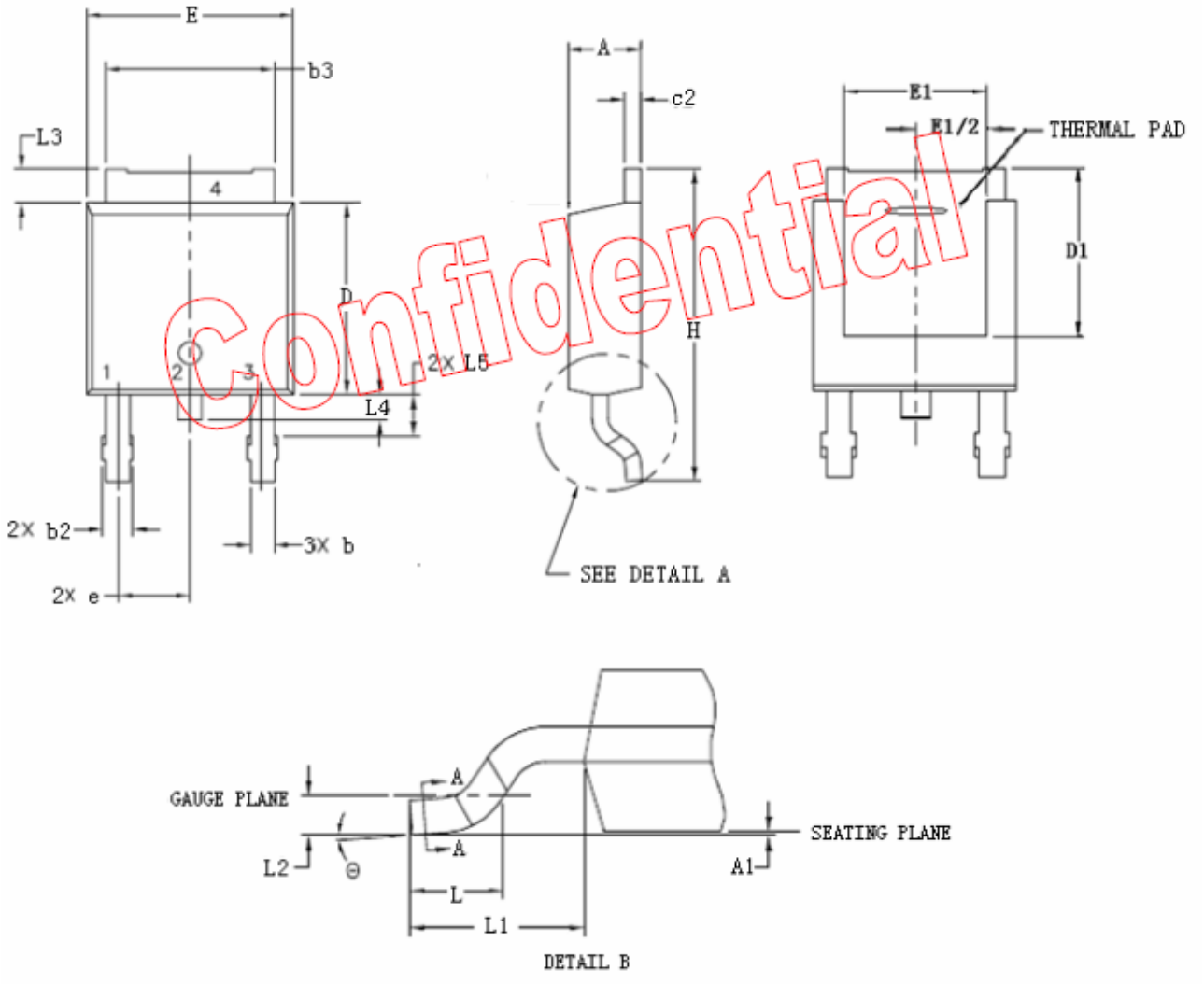


Figure 24. Unclamped Inductive Switching Waveforms

Package Dimensions



TO-252



Mechanical Dimensions(Continued) :

Symbol	VARIATION							
	TO-252				TO-251			
	Millimeters		Inches		Millimeters		Inches	
	Min	Max	Min	Max	Min	Max	Min	Max
A	2.220	2.420	0.087	0.095	2.220	2.420	0.087	0.095
A1	0	0.125	0	0.005	0.890	1.140	0.035	0.045
b	0.550	0.670	0.022	0.026	0.550	0.670	0.022	0.026
b1	0.550	0.650	0.022	0.025	0.550	0.650	0.022	0.025
b2	0.760	0.960	0.030	0.038	0.760	0.960	0.030	0.038
b3	5.200	5.400	0.205	0.213	—	—	—	—
b4	—	—	—	—	5.200	5.400	0.205	0.213
c	0.460	0.570	0.018	0.023	0.460	0.570	0.018	0.023
c1	0.450	0.550	0.018	0.022	0.450	0.550	0.018	0.022
c2	0.450	0.550	0.018	0.022	0.450	0.550	0.018	0.022
D	5.950	6.250	0.234	0.246	5.950	6.250	0.234	0.246
D1	4.200	4.500	0.165	0.177	4.200	4.500	0.165	0.177
E	6.400	6.700	0.252	0.264	6.400	6.700	0.252	0.264
E1	4.900	5.000	0.193	0.197	4.900	5.000	0.193	0.197
e	2.28 REF		0.090 REF		2.28 REF		0.090 REF	
H	9.220	9.720	0.363	0.383	—	—	—	—
L	1.370	1.670	0.054	0.066	8.900	9.650	0.350	0.380
L1	2.590	2.890	0.102	0.114	1.900	2.290	0.075	0.090
L2	0.500 REF		0.020 REF		0.500	0.800	0.020	0.031
L3	0.500	0.800	0.020	0.031	—	—	—	—
L4	0.650	0.950	0.026	0.037	—	—	—	—
L5	1.140	1.520	0.045	0.060	—	—	—	—
θ	0°	6°	0°	6°	—	—	—	—

NOTE:

REFERENCE JEDEC TO-252 . ISSUE E .,DATED JUNE,2004 and JEDEC TO-251D. ISSUE D, DATED JUNE , 2002 .

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