

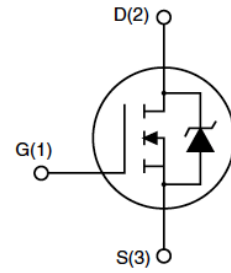
Features

V_{DSS}	$R_{DS(ON)}$ @ 10V (typ)	I_D
400V	0.515Ω	9A

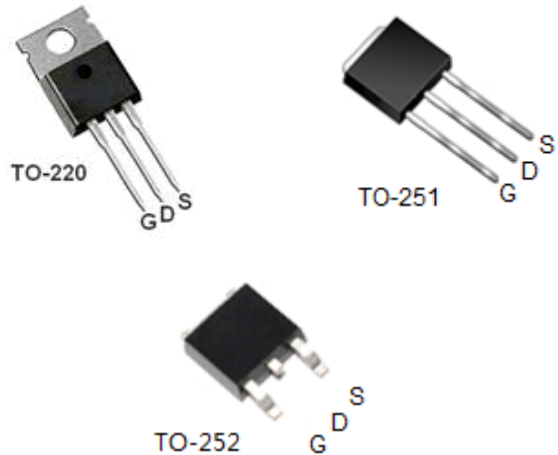
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS Compliant

Application

- DC-DC & DC-AC Converters for telecom, industrial and consumer environment
- Uninterruptible Power Supply (UPS)
- Switch Mode Low Power Supplies
- Industrial Actuators



Schematic diagram



Ordering Information

Part Number	Marking	Case	Packaging
9N40	9N40	TO-220	50pcs/Tube
9N40	9N40	TO-251	72pcs/Tube
9N40	9N40	TO-252	2500pcs/Reel

Absolute Maximum Ratings $T_C=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter		Max.			Units
			TO-220	TO-251	TO-252	
V_{DSS}	Drain-Source Voltage		400			V
V_{GSS}	Gate-Source Voltage		± 30			V
I_D	Continuous Drain Current	$T_C = 25^\circ\text{C}$	9	9*	9*	A
		$T_C = 100^\circ\text{C}$	5.75	5.75*	5.75*	A
I_{DM}	Pulsed Drain Current ^{note1}		36	36*	36*	A
E_{AS}	Single Pulsed Avalanche Energy ^{note2}		220			mJ
dv/dt	Peak Diode Recovery Energy ^{note3}		8			V/ns
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	100	59.5	59.5	W
	Linear Derating Factor	$T_C > 25^\circ\text{C}$	0.89	0.53	0.53	W/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case		1.25	2.1	2.1	°C/W
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150			°C

*Drain current limited by maximum junction temperature

Electrical Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise specified

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
Off Characteristic						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250Ma	400	-	-	V
△V _{(BR)DSS} / △T _J	Breakdown Voltage Temperature Coefficient	Reference to 25℃, I _D = 250μA	-	0.3	-	V/℃
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 400V, V _{GS} = 0V	-	-	1	μA
		V _{DS} = 320V, T _C = 125℃	-	-	10	μA
I _{GSS}	Gate to Body Leakage Current	V _{DS} = 0V, V _{GS} = ±30V	-	-	±100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage ^{note4}	V _{DS} = V _{GS} , I _D = 250μA	2	-	4	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} =10V, I _D = 4.5A	-	0.515	0.607	Ω
g _{FS}	Forward Transconductance	V _{DS} =30V, I _D = 4.5A	-	8	-	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	-	740	-	pF
C _{oss}	Output Capacitance		-	82.8	-	pF
C _{rss}	Reverse Transfer Capacitance		-	8.75	-	pF
Q _g	Total Gate Charge	V _{DD} = 320V, I _D = 9A, V _{GS} = 10V	-	22.13	-	nC
Q _{gs}	Gate-Source Charge		-	3.6	-	nC
Q _{gd}	Gate-Drain("Miller") Charge		-	9.57	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 200V, I _D = 9A, R _G = 5Ω, V _{GS} = 10V	-	12.4	-	ns
t _r	Turn-On Rise Time		-	20.1	-	ns
t _{d(off)}	Turn-Off Delay Time		-	38.5	-	ns
t _f	Turn-Off Fall Time		-	10.8	-	ns
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain to Source Diode Forward Current		-	-	9	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	36	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0V, I _S = 4.5A	-	-	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _F = 9A,	-	320	-	ns
Q _{rr}	Reverse Recovery Charge	di/dt =100A/μs	-	1345	-	nC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 10\text{mH}$, $I_{AS} = 6.5A$, $V_{DD} = 50V$, $R_G = 25\Omega$, Starting $T_J = 25^{\circ}\text{C}$
3. $I_{SD} \leq 9A$, $di/dt \leq 200A/\mu\text{s}$, $V_{DD} \leq V_{DSS}$, Starting $T_J = 25^{\circ}\text{C}$
4. Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.

Typical Performance Characteristics

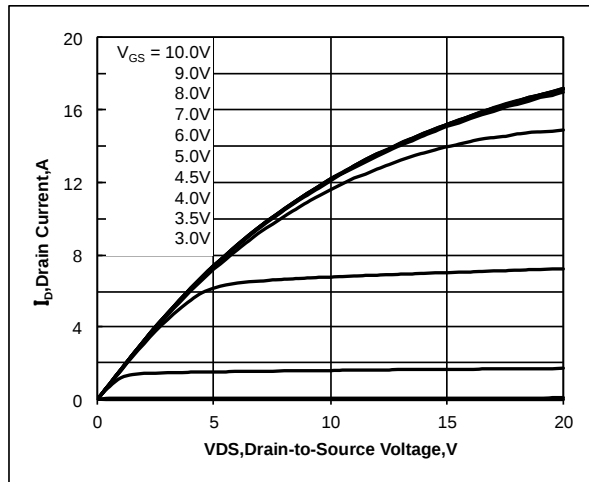


Figure 1. Output Characteristics

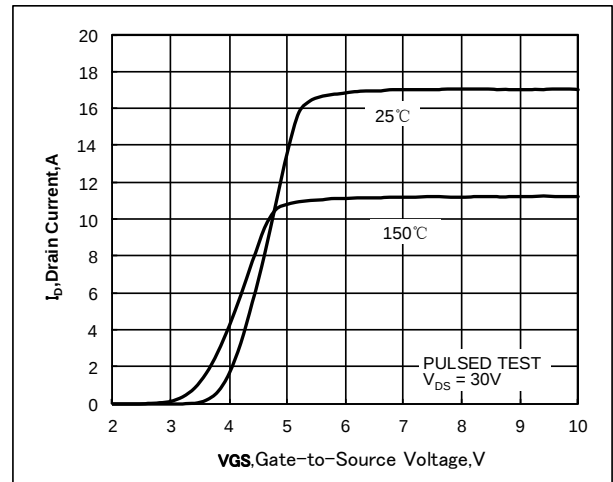


Figure 2. Transfer Characteristics

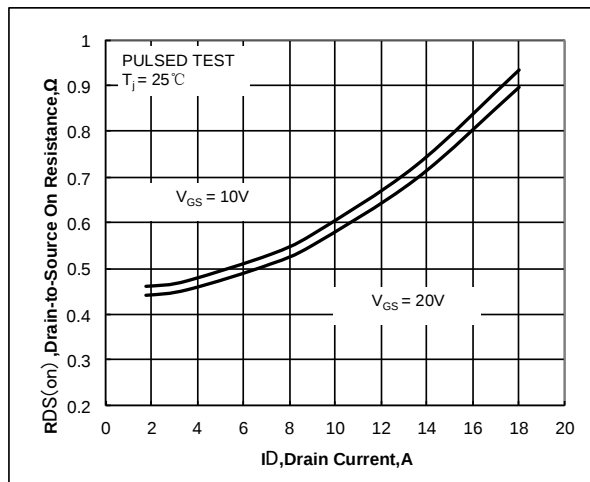


Figure 3. Drain-to-Source On Resistance vs. Drain Current and Gate Voltage

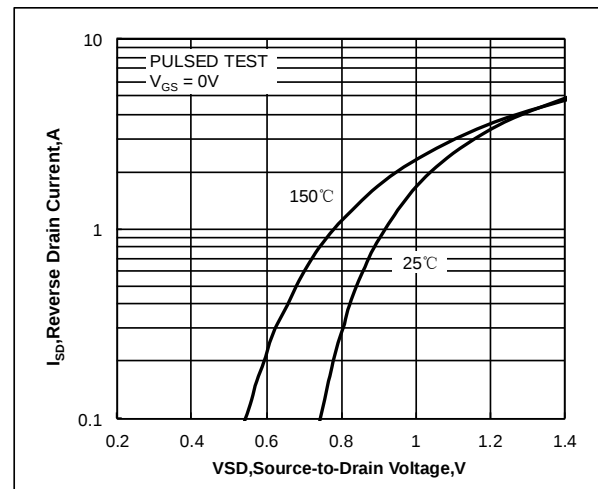


Figure 4. Body Diode Forward Voltage vs. Source Current and Temperature

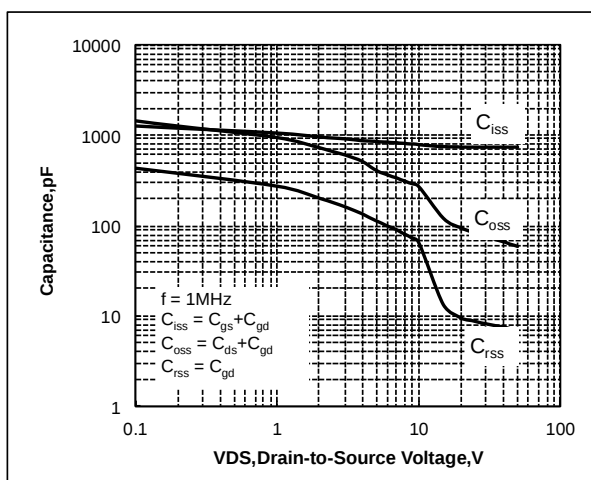


Figure 5. Capacitance Characteristics

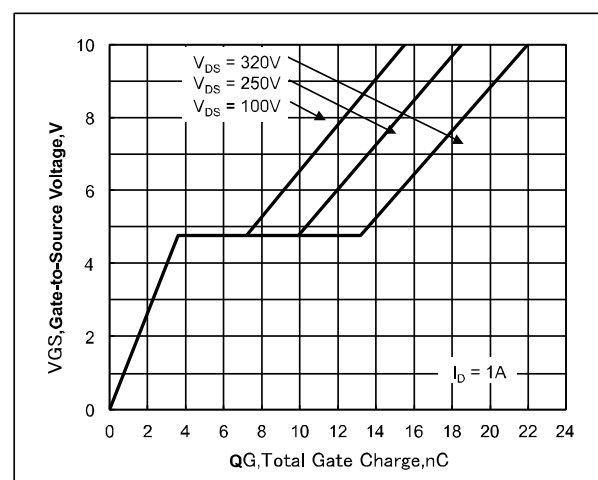


Figure 6. Gate Charge Characteristics

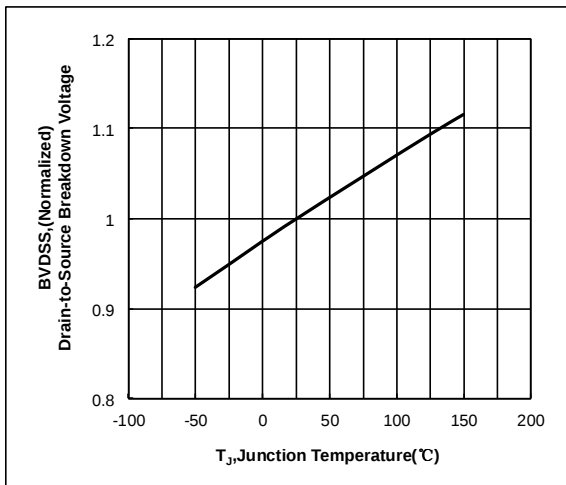


Figure 7. Normalized Breakdown Voltage vs. Junction Temperature

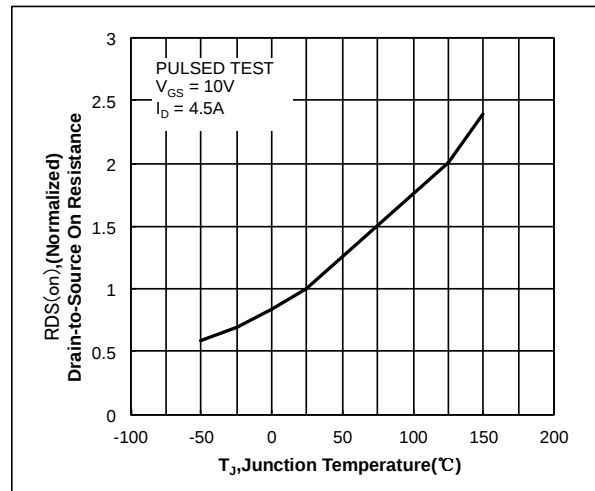


Figure 8. Normalized On Resistance vs. Junction Temperature

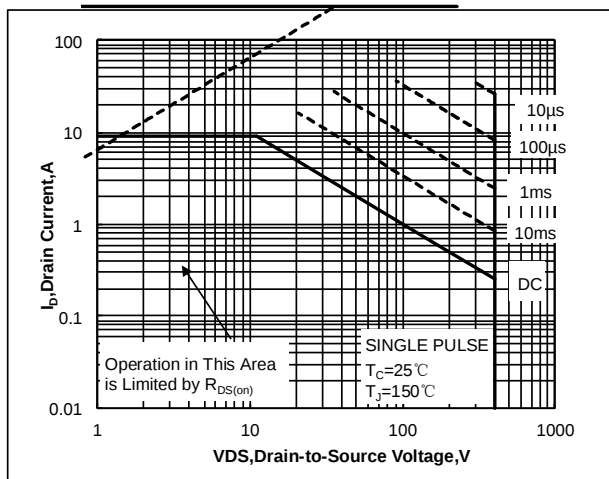


Figure 9. Maximum Safe Operating Area

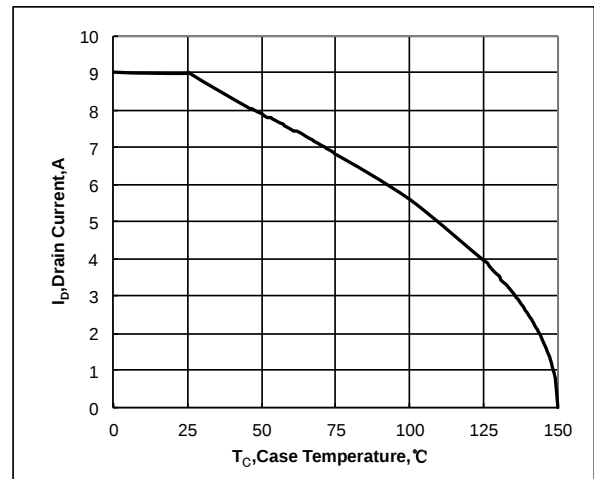


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

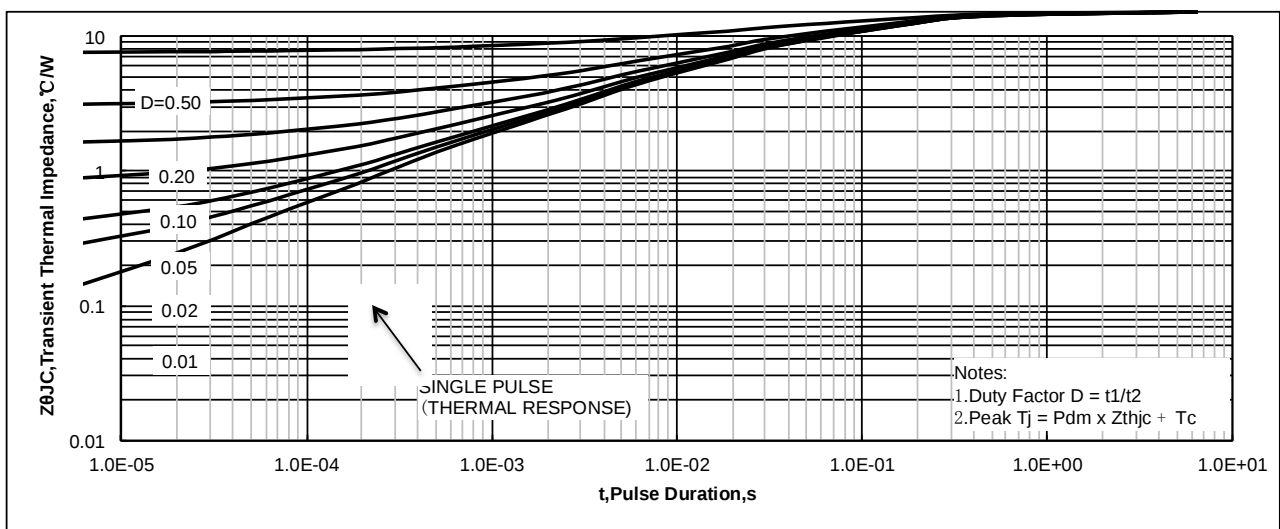


Figure 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

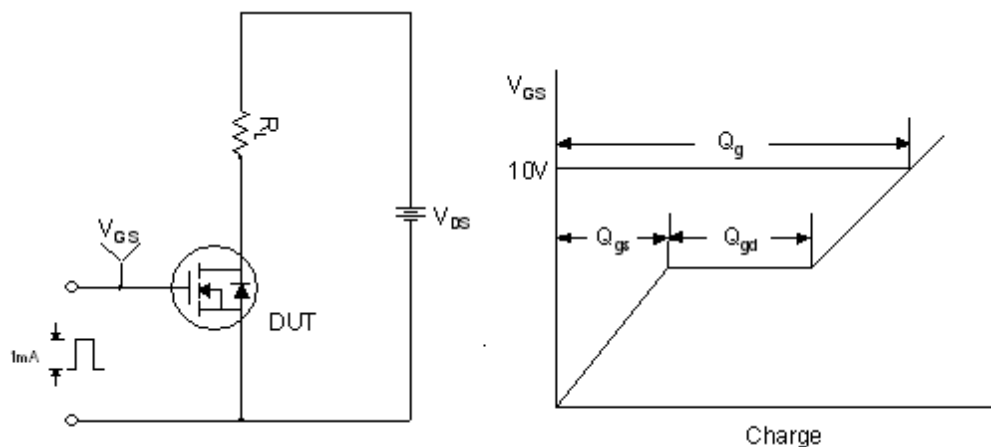


Figure 12. Gate Charge Test Circuit & Waveform

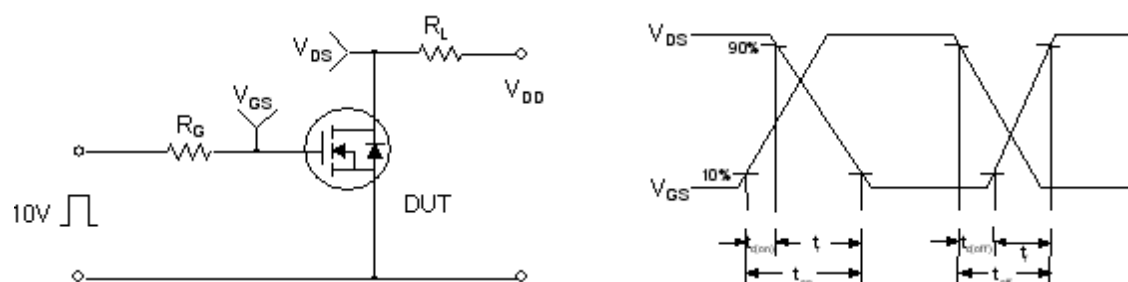


Figure 13. Resistive Switching Test Circuit & Waveforms

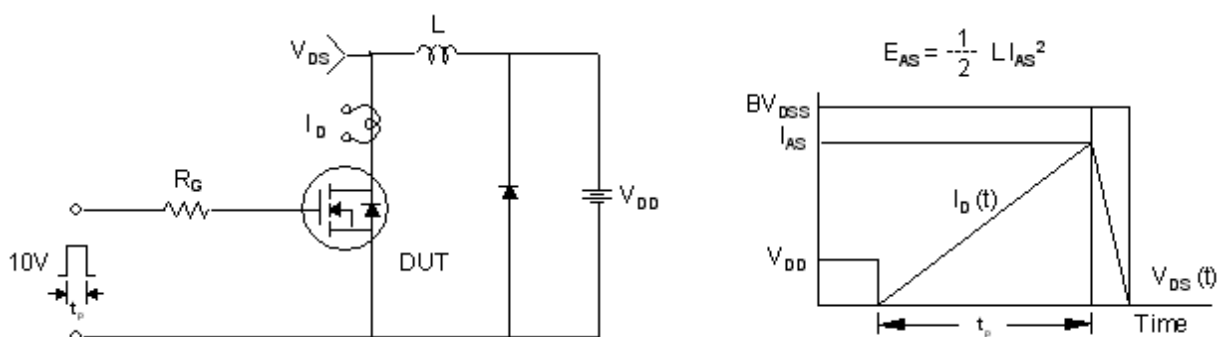


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

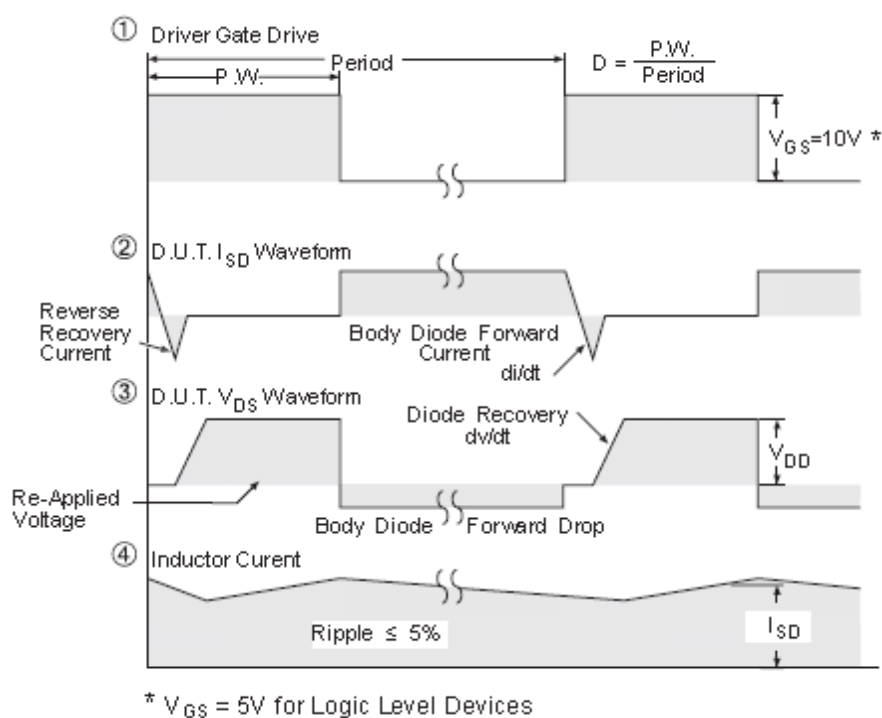
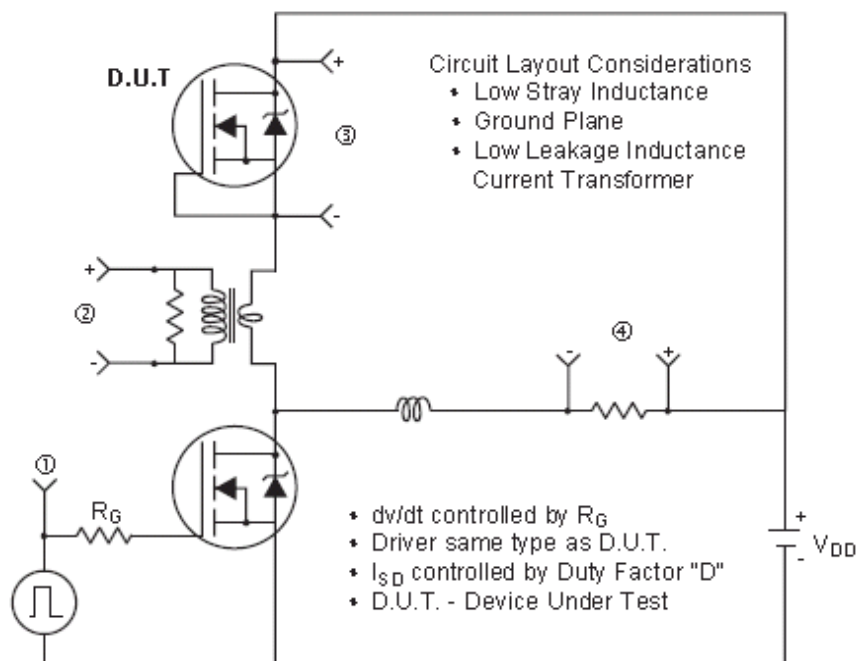
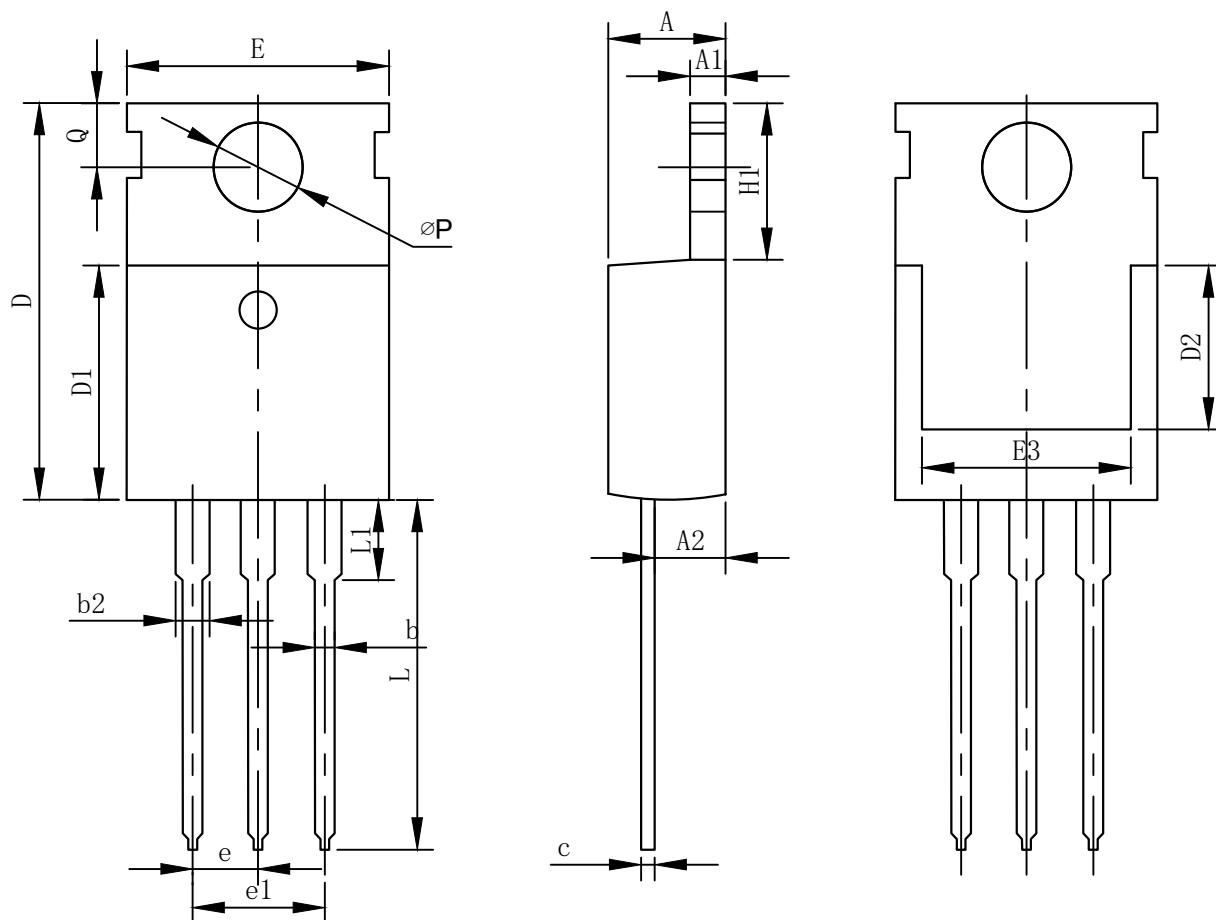


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms (For N-channel)

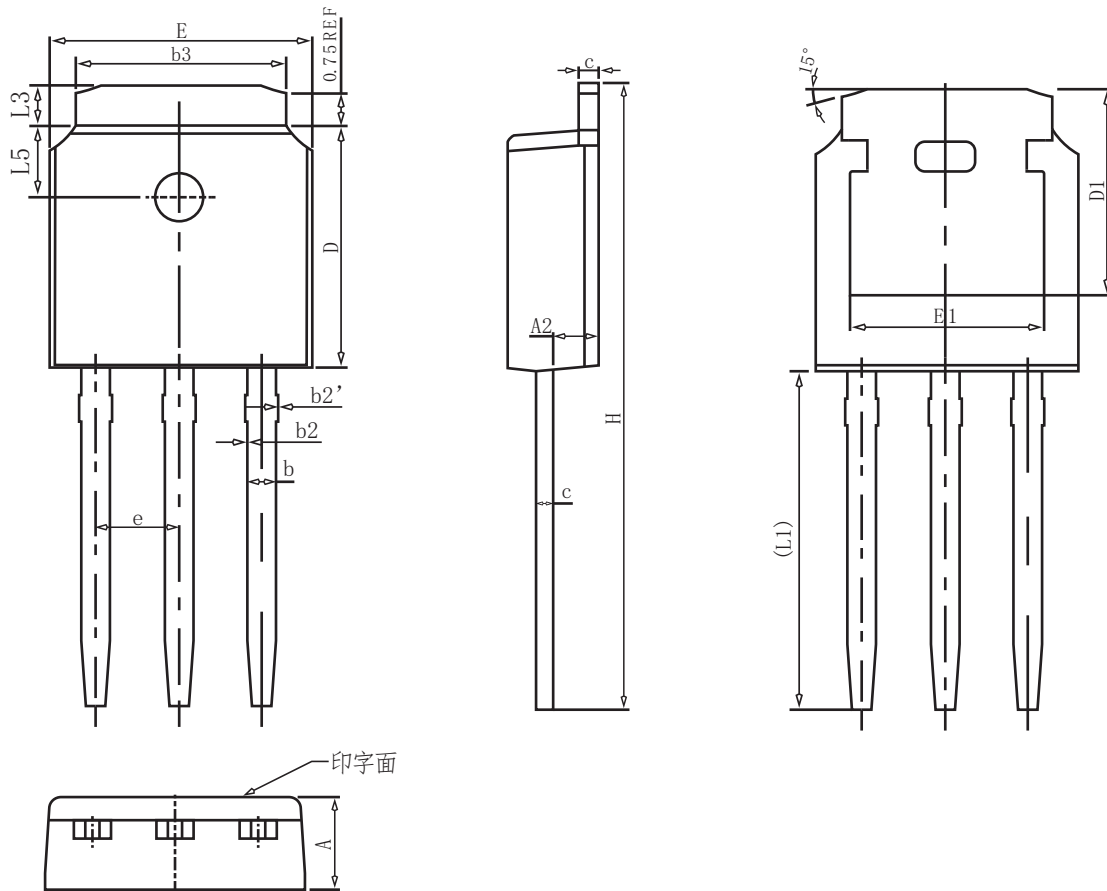
TO-220 Package information



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.70	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	—	—
E	9.70	10.00	10.30
E3	7.00	—	—
e	2.54BSC		
e1	5.08BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	—	3.10	3.40
øP	3.40	3.60	3.80
Q	2.60	2.80	3.00

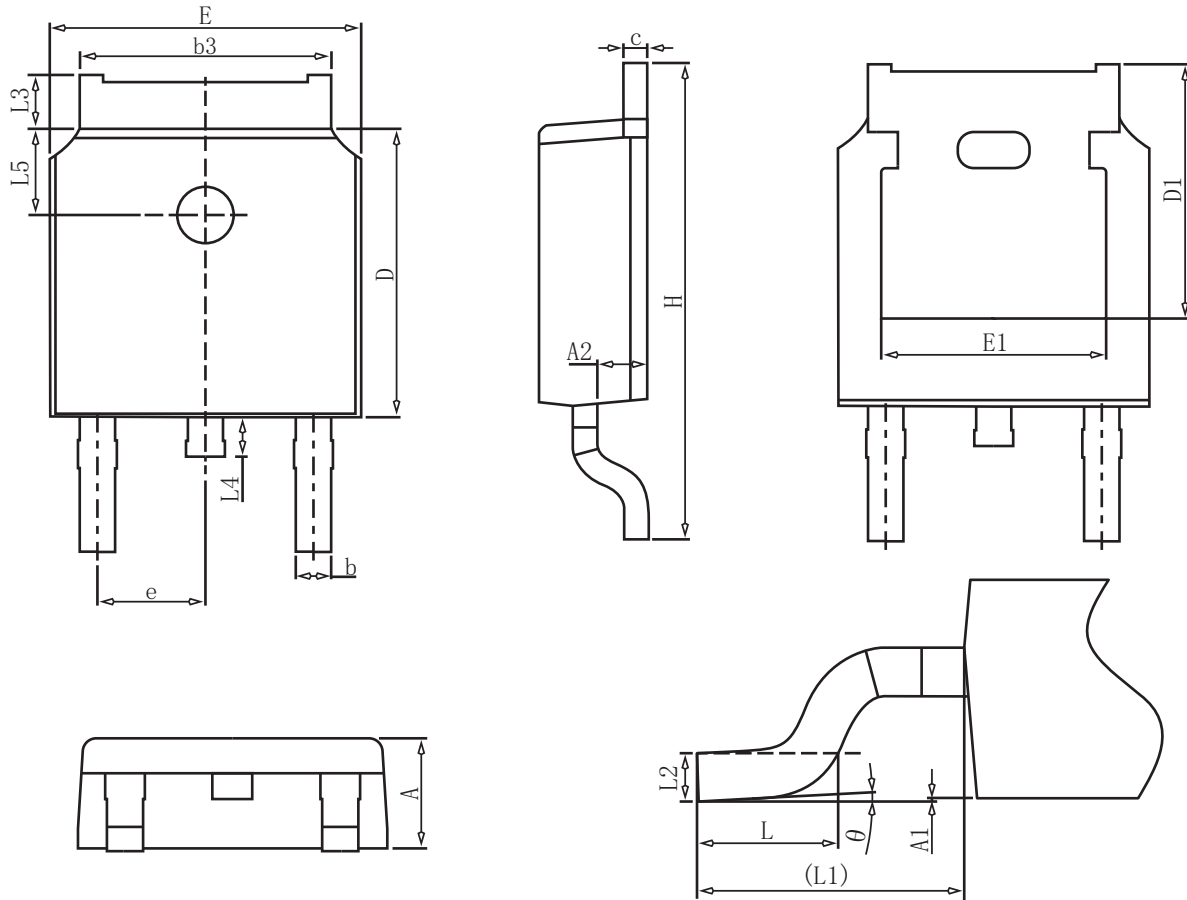
TO-251 Package information



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
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	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
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-252 Package information



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A1	0.00	—	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
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°