

## N-Channel 60V MOSFET

### E060N2P3AL1

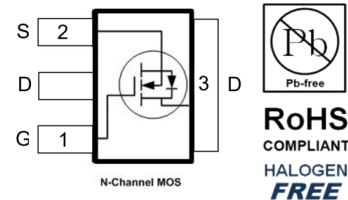
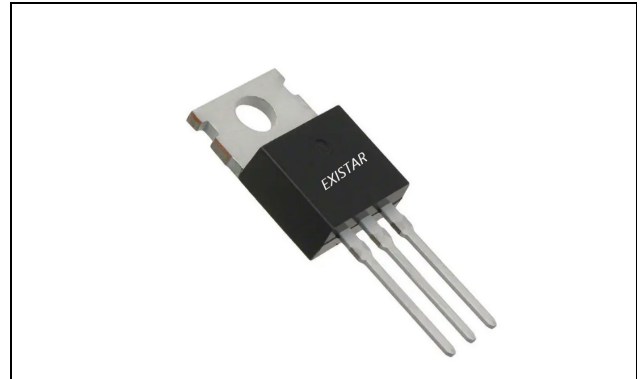
$V_{DS}$ (V)	$R_{DS(on),max}$ (m $\Omega$ )	$I_D$ (A)
60V	2.3 @ $V_{GS} = 10V$	180

### Features

- Low  $R_{DS(on)}$  trench technology
- Low thermal impedance
- Fast switching speed
- 100% avalanche tested

### Applications

- DC/DC conversion
- Power switch
- PD charger
- Moto driver

**TO220**


### Package And Ordering Information

Ordering code	Package	Marking
E060N2P3AL1	TO220	E060N2P3AL1

### Ordering Information

Package	Packing	MOQ
TO220	Tube	1000ea

**Key Performance Parameters**

Parameter	Value	Unit
VDS, min @ Tj(max)	60	V
ID, pulse	720	A
RDS(ON), max @ VGS=10V	2.3	mΩ
Qg	103.5	nC

**Absolute Maximum Ratings at Tj=25°C Unless Otherwise Noted**

Parameter	Symbol	Limit	Unit
Drain-source voltage	V <sub>DS</sub>	60	V
Gate-source voltage	V <sub>GS</sub>	±20	
Continuous drain current	I <sub>D</sub>	T <sub>C</sub> =25°C	180
		T <sub>C</sub> =100°C	-
Pulsed drain current	I <sub>D,pulse</sub>	720	A
Avalanche energy, single pulse	E <sub>AS</sub>	240	mJ
Power dissipation	P <sub>D</sub>	T <sub>C</sub> =25°C	132
		T <sub>A</sub> =25°C	-
Operating junction and storage temperature range	T <sub>J</sub> , T <sub>stg</sub>	-55 to 150	°C

**Thermal Characteristics**

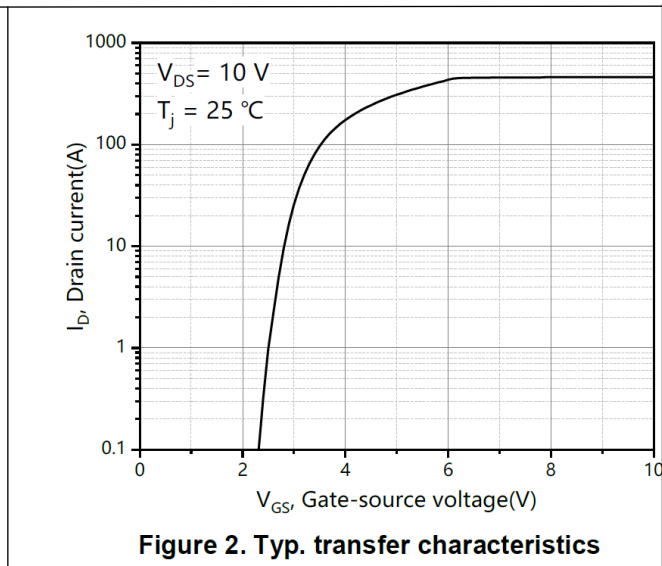
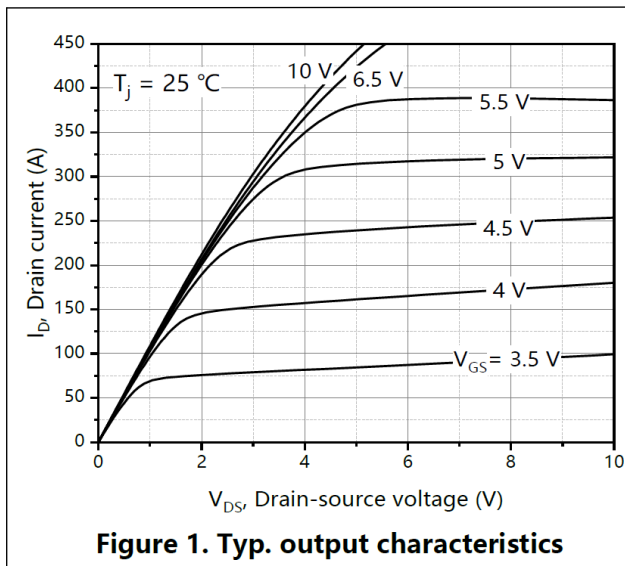
Parameter	Symbol	Max.	Unit
Thermal resistance, junction-to-case	R <sub>θJC</sub>	0.95	°C/W
Thermal resistance, junction-to-ambient	R <sub>θJA</sub>	50	

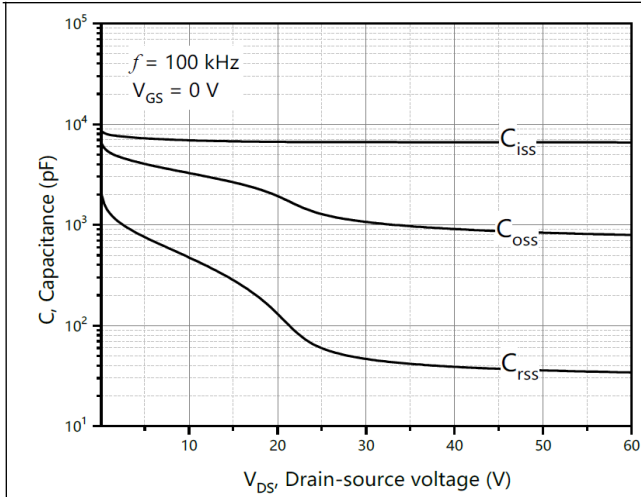
**Electrical Characteristics at Tj=25°C unless otherwise specified**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions
<b>Static</b>						
Drain to source breakdown voltage	V <sub>(BR)DSS</sub>	60			V	V <sub>GS</sub> = 0, I <sub>D</sub> = 250 μA
Gate-source threshold voltage	V <sub>GS(th)</sub>	1.0		2.3	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA
Gate-body leakage	I <sub>GSS</sub>			±100	nA	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V
Zero gate voltage drain current	I <sub>DSS</sub>			1	μA	V <sub>DS</sub> = 45 V, V <sub>GS</sub> = 0 V
Drain-source on-resistance	R <sub>DS(on)</sub>		2.1	2.3	mΩ	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A
Drain-source on-resistance	R <sub>DS(on)</sub>		2.4	2.8	mΩ	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 30 A

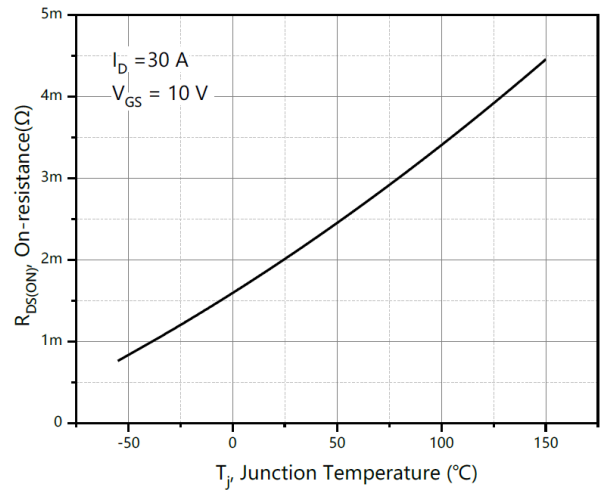
Forward transconductance	$g_{fs}$		-		S	$V_{DS} = 5\text{ V}, I_D = 30\text{ A}$
Gate resistance	$R_g$		2.3		$\Omega$	$f = 1\text{ MHz}$
<b>Gate Charge</b>						
Total gate charge	$Q_g$		104		nC	$V_{DS} = 50\text{ V}, I_D = 50\text{ A}, V_{GS} = 10\text{ V}$
Gate-source charge	$Q_{gs}$		17			
Gate-drain charge	$Q_{gd}$		16.8			
<b>Dynamic</b>						
Turn-on delay time	$t_{d(on)}$		32.2		ns	$V_{DS} = 50\text{ V}, I_D = 50\text{ A}, V_{GS} = 10\text{ V}, R_{GEN} = 2\ \Omega$
Rise time	$t_r$		53.3			
Turn-off delay time	$t_{d(off)}$		93.2			
Fall time	$t_f$		25.3			
Input capacitance	$C_{iss}$		6638		pF	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 100\text{ kHz}$
Output capacitance	$C_{oss}$		1275			
Reverse transfer capacitance	$C_{rss}$		58.1			
<b>Body Diode</b>						
Diode forward voltage	$V_{SD}$			1.3	V	$V_{GS} = 0\text{ V}, I_F = 20\text{ A}$
Reverse recovery time	$t_{rr}$		86.8		ns	$V_R = 50\text{ V}, I_S = 50\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		130		nC	

### Electrical Characteristics Diagrams

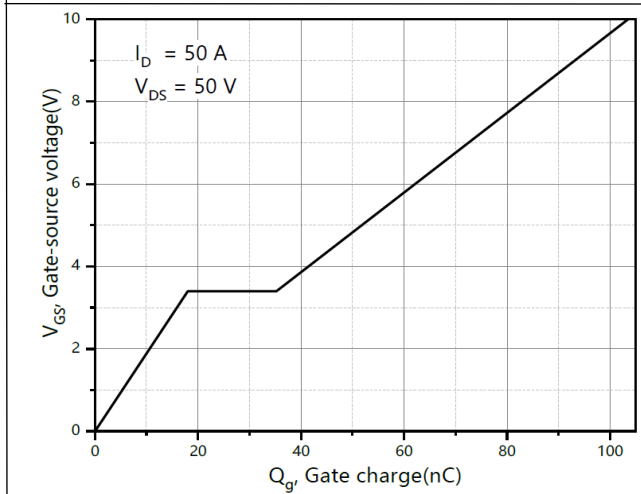




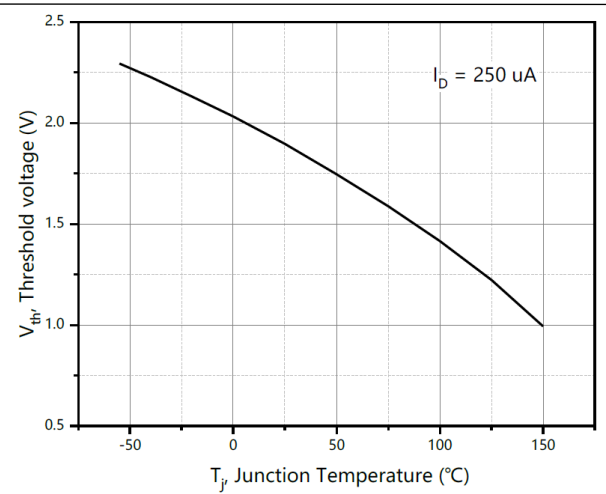
**Figure 3. Typ. capacitances**



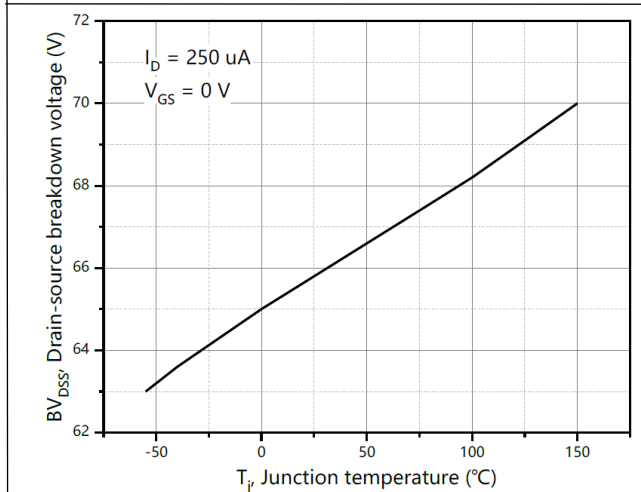
**Figure 4. Drain-source on-state resistance**



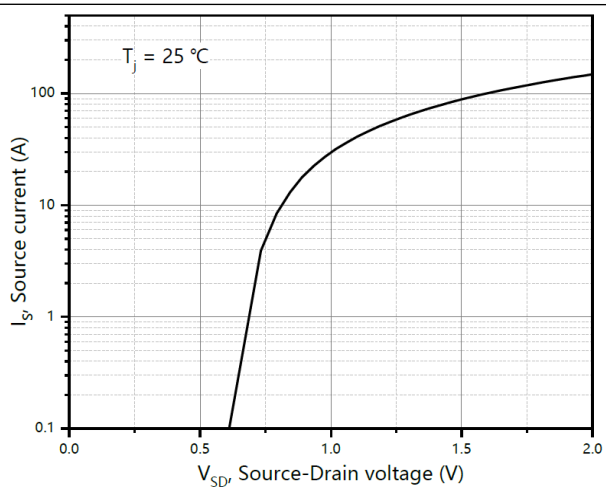
**Figure 5. Typ. gate charge**



**Figure 6. Threshold voltage**



**Figure 7. Drain-source breakdown voltage**



**Figure 8. Forward characteristic of body diode**



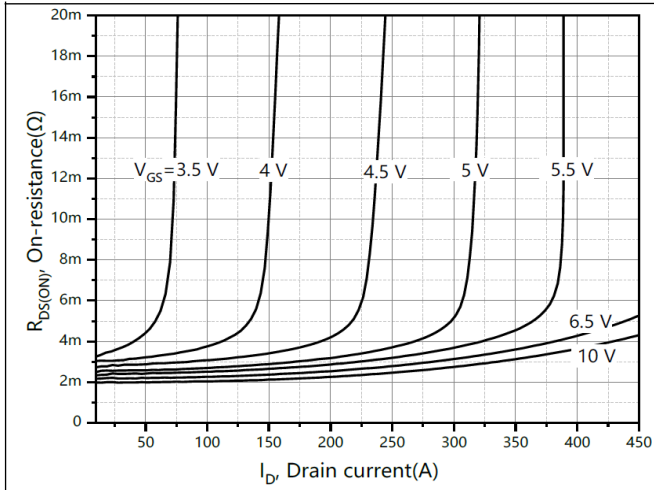


Figure 9. Drain-source on-state resistance

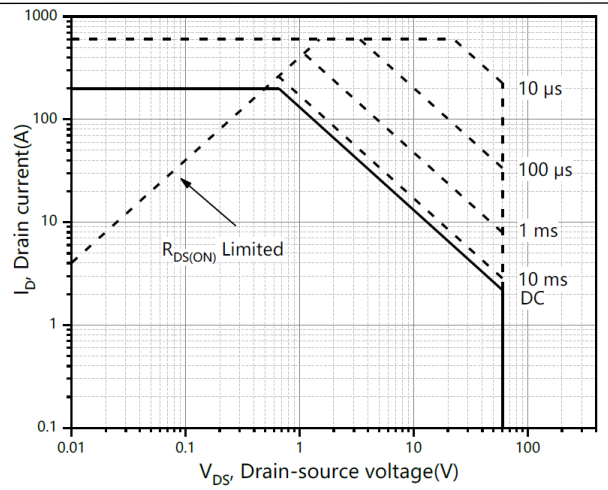


Figure 10. Safe operation area for  $T_C=25\text{ °C}$

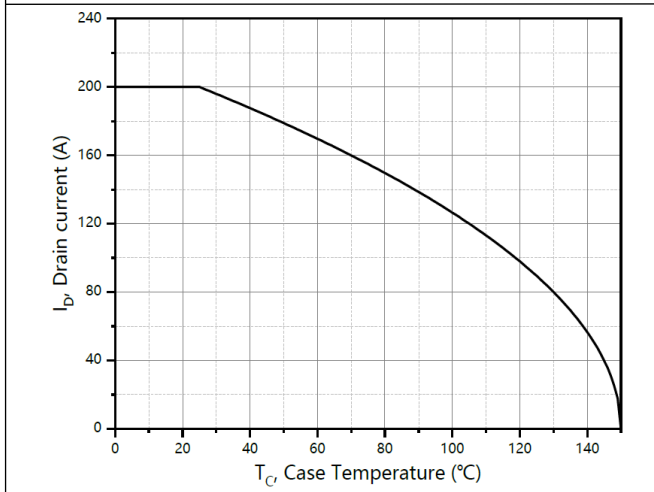


Figure 11. Drain current

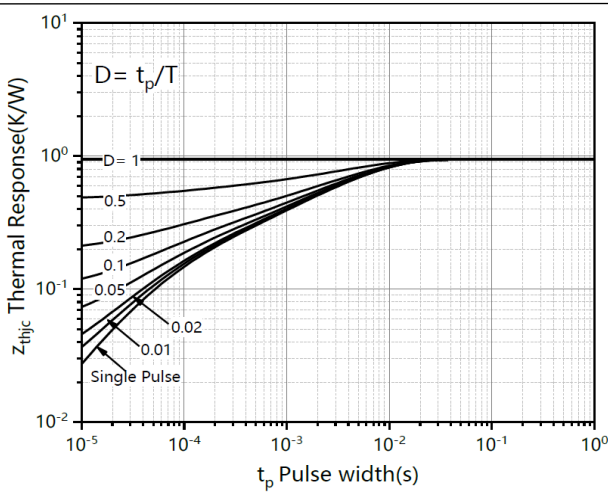


Figure 12. Max transient thermal impedance



Test circuits and waveforms

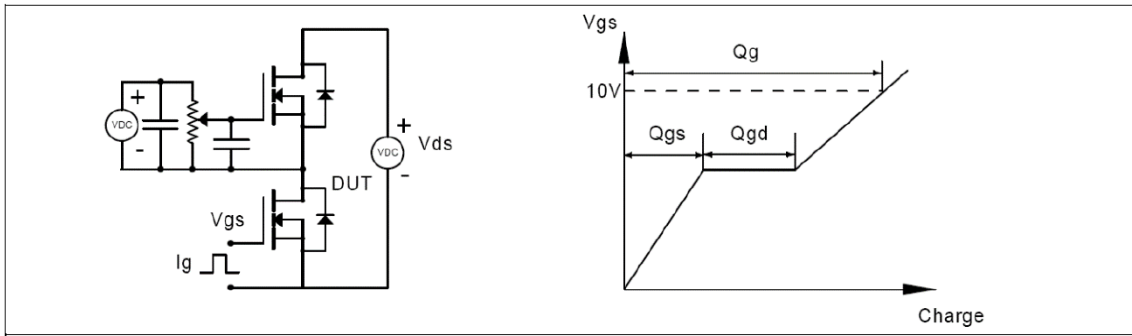


Figure 1. Gate charge test circuit & waveform

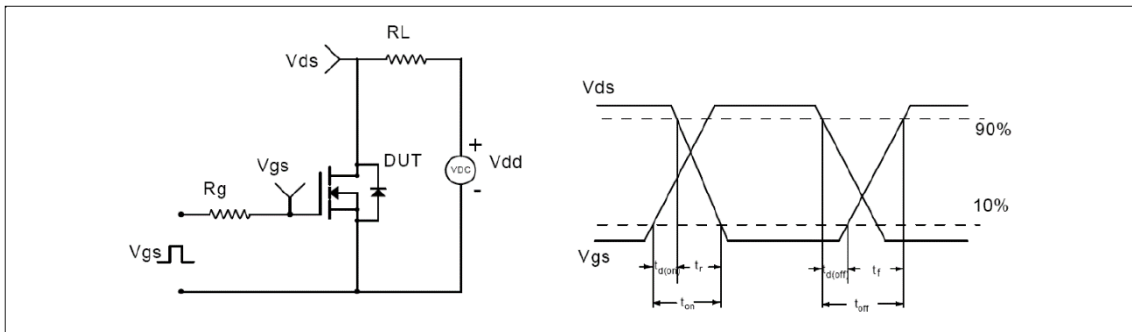


Figure 2. Switching time test circuit & waveforms

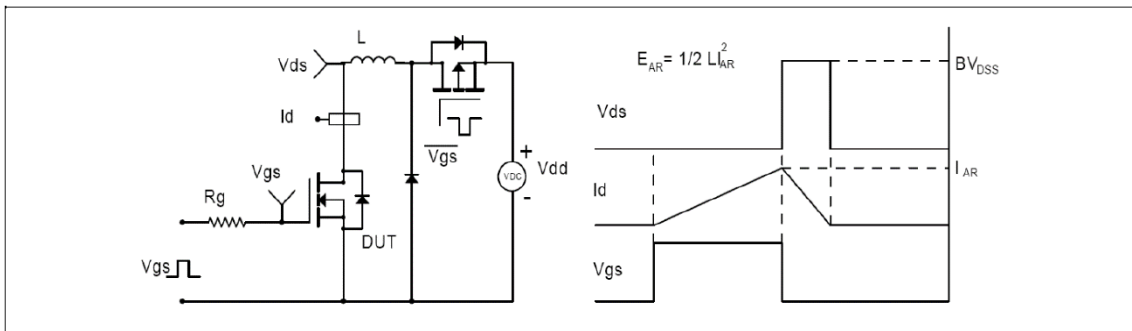


Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms

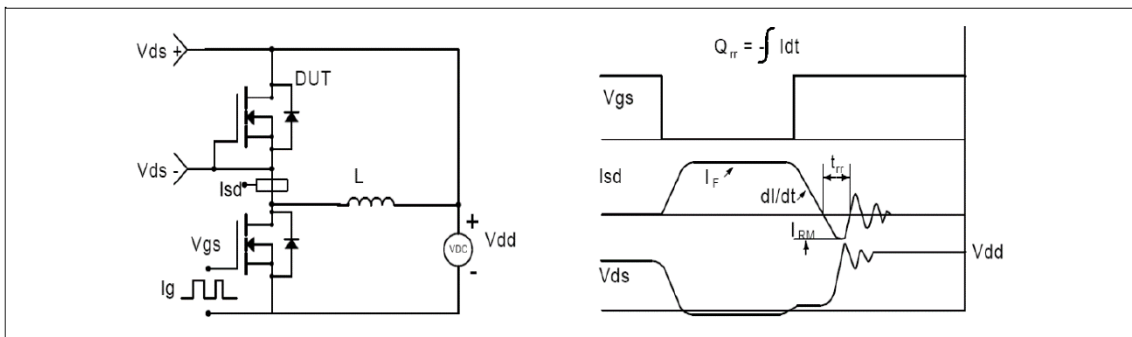
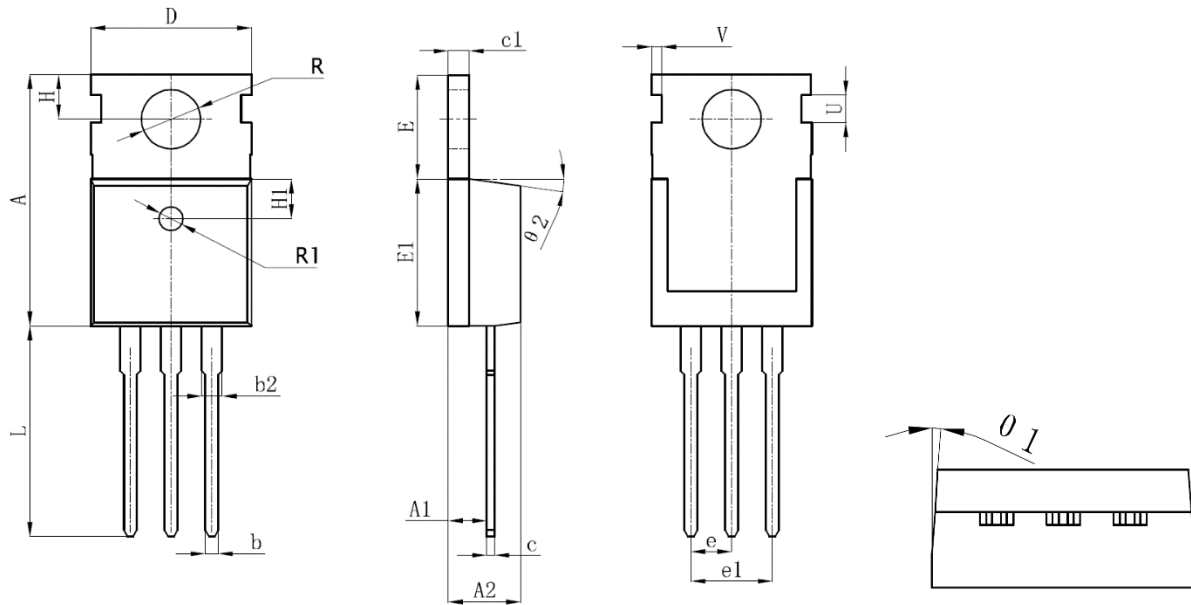


Figure 4. Diode reverse recovery test circuit & waveforms

**Package Outline Dimensions**


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	15.400	15.600	15.800
A1	2.350	2.400	2.500
A2	4.400	4.500	4.700
b	0.700	0.800	0.900
b2	1.180	1.310	1.440
c	0.480	0.500	0.560
c1	1.290	1.300	1.320
D	9.800	10.000	10.200
E	6.400	6.500	6.600
E1	9.000	9.100	9.200
e	2.420	2.540	2.660
e1	4.840	5.080	5.320
H	2.730	2.800	2.870
H1	2.400	2.500	2.600
L	12.750	13.100	13.450
R	3.500	3.600	3.630
R1	1.400	1.500	1.600
U	1.650	1.750	1.850
V	0.580	0.680	0.780
θ 1	2°	2.5°	3°
θ 2	6.5°	7°	7.5°

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