

## 20V P-Channel Enhancement Mode MOSFET

### Description

The NP3415EVR uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 1.8V. This device is suitable for use as a load switch or in PWM applications.

### General Features

- ◆  $V_{DS} = -20V$ ,  $I_D = -4A$   
 $R_{DS(ON)}(Typ.) = 38m\Omega$  @  $V_{GS} = -2.5V$   
 $R_{DS(ON)}(Typ.) = 46m\Omega$  @  $V_{GS} = -4.5V$
- ◆ High power and current handling capability
- ◆ Lead free product is acquired
- ◆ Surface mount package
- ◆ ESD Rating: 2500V HBM

### Application

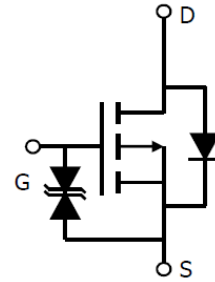
- ◆ PWM applications
- ◆ Load switch

### Package

- ◆ SOT-23

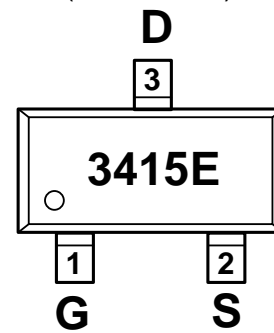


### Schematic diagram



### Marking and pin assignment

SOT-23  
(TOP VIEW)



### Ordering Information

Part Number	Storage Temperature	Package	Devices Per Reel
NP3415EVR-G	-55°C to +150°C	SOT-23	3000

### Absolute Maximum Ratings (TA=25°C unless otherwise noted)

parameter		symbol	limit	unit
Drain-source voltage		$V_{DS}$	-20	V
Gate-source voltage		$V_{GS}$	±8	V
Continuous Drain Current (TJ = 150 °C)	$T_C = 25^\circ C$	$I_D$	-4	A
	$T_C = 70^\circ C$		-3.5	
	$T_A = 25^\circ C$		-3.7 <sup>b,c</sup>	
	$T_A = 70^\circ C$		-2.9 <sup>b,c</sup>	
Continuous Source-Drain Diode Current	$T_C = 25^\circ C$	$I_S$	-1.4	
	$T_A = 25^\circ C$		-1 <sup>b,c</sup>	
Pulsed Drain Current (t = 300 μs)		$I_{DM}$	-12	

Maximum power dissipation	$T_C=25^{\circ}\text{C}$	$P_D$	1.7	W
	$T_C=70^{\circ}\text{C}$		1.1	
	$T_A=25^{\circ}\text{C}$		1 <sup>b,c</sup>	
	$T_A=70^{\circ}\text{C}$		0.6 <sup>b,c</sup>	
Operating Junction and Storage Temperature Range		$T_J, T_{STG}$	-55—150	$^{\circ}\text{C}$

## Thermal Characteristics

Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b, d</sup>	$t \leq 5 \text{ s}$	$R_{\theta JA}$	100	130	$^{\circ}\text{C/W}$
Maximum Junction-to-Foot (Drain)	Steady State	$R_{\theta JF}$	60	75	

Notes:

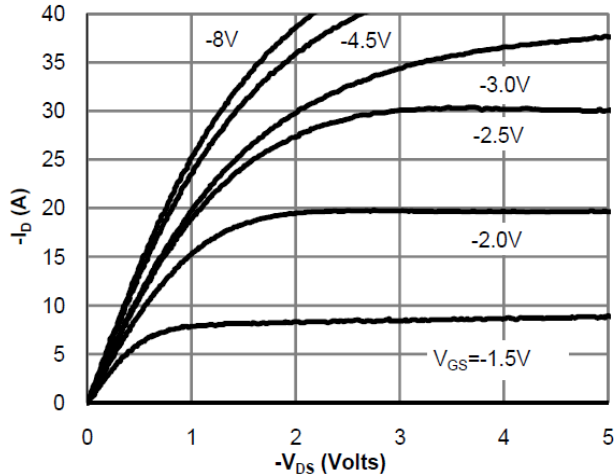
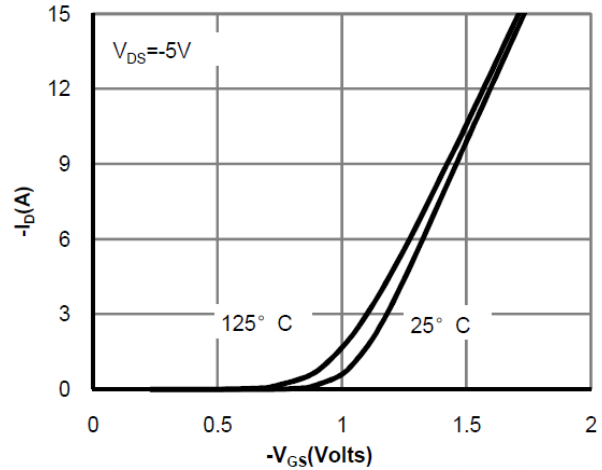
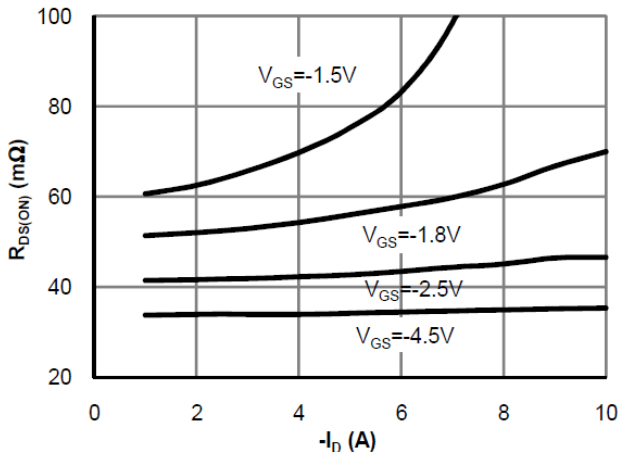
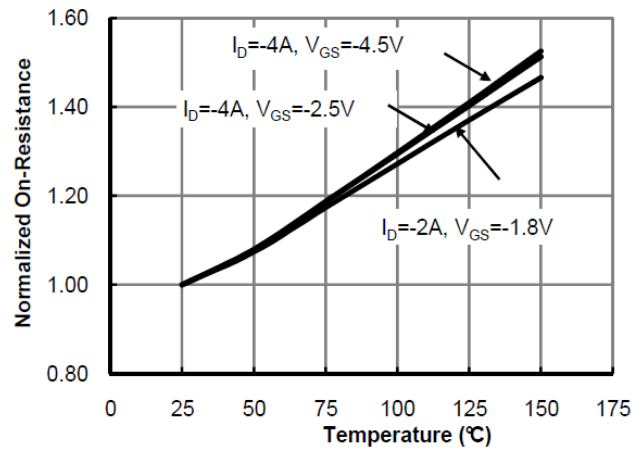
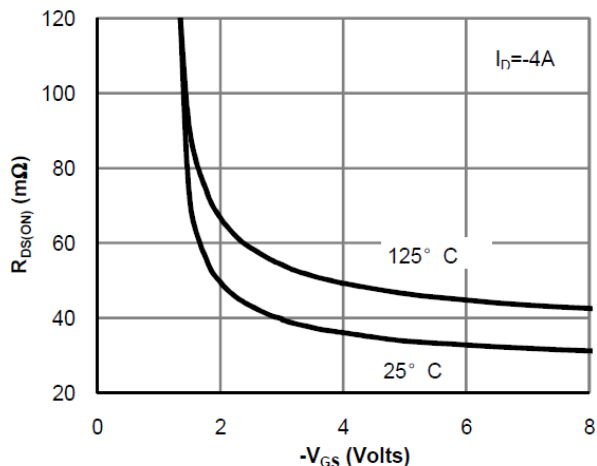
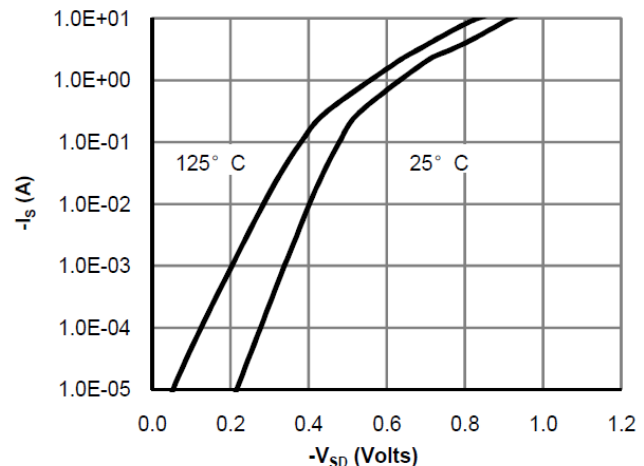
- a.  $T_C = 25^{\circ}\text{C}$ .
- b. Surface mounted on 1" x 1" FR4 board.
- c.  $t = 5 \text{ s}$ .
- d. Maximum under steady state conditions is  $175^{\circ}\text{C/W}$ .

## Electrical Characteristics ( $T_A=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>OFF Characteristics</b>						
Drain-source breakdown voltage	$BV_{DSS}$	$V_{GS}=0\text{V}, I_D=-250\mu\text{A}$	-20	-	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=-20\text{V}, V_{GS}=0\text{V}$	-	-	-1	$\mu\text{A}$
Gate-body leakage	$I_{GSS}$	$V_{DS}=0\text{V}, V_{GS}=\pm 8\text{V}$	-	-	$\pm 10$	$\mu\text{A}$
<b>ON Characteristics</b>						
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu\text{A}$	-0.4	-0.59	-0.9	V
Drain-source on-state resistance	$R_{DS(ON)}$	$V_{GS}=-4.5\text{V}, I_D=-4\text{A}$	-	38	45	m $\Omega$
		$V_{GS}=-2.5\text{V}, I_D=-4\text{A}$	-	46	55	
Forward transconductance	$g_{fs}$	$V_{DS}=-5\text{V}, I_D=-4\text{A}$	8	-	-	S
<b>Dynamic Characteristics</b>						
Input capacitance	$C_{ISS}$	$V_{DS}=-10\text{V}, V_{GS}=0\text{V}$ $f=1.0\text{MHz}$	-	751	-	pF
Output capacitance	$C_{OSS}$		-	115	-	
Reverse transfer capacitance	$C_{RSS}$		-	80	-	
<b>Switching Characteristics</b>						
Turn-on delay time	$t_{D(ON)}$	$V_{DD}=-10\text{V}$ $I_D=-2.8\text{A}$ $V_{GEN}=-4.5\text{V}$ $R_L=10\text{ohm}$ $R_{GEN}=-60\text{ohm}$	-	13	-	ns
Rise time	$t_r$		-	9	-	
Turn-off delay time	$t_{D(OFF)}$		-	19	-	
Fall time	$t_f$		-	29	-	
Total gate charge	$Q_g$	$V_{DS}=-10\text{V}, I_D=-3\text{A}$ $V_{GS}=-4.5\text{V}$	-	9.3	-	nC
Gate-source charge	$Q_{gs}$		-	1	-	
Gate-drain charge	$Q_{gd}$		-	2.2	-	

**DRAIN-SOURCE DIODE CHARACTERISTICS**

Diode forward voltage	$V_{SD}$	$V_{GS}=0V, I_S=-1.25A$	-	-0.81	-1.2	V
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**Typical Performance Characteristics**

**Fig 1: On-Region Characteristics (Note E)**

**Figure 2: Transfer Characteristics (Note E)**

**Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)**

**Figure 4: On-Resistance vs. Junction Temperature (Note E)**

**Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)**

**Figure 6: Body-Diode Characteristics (Note E)**

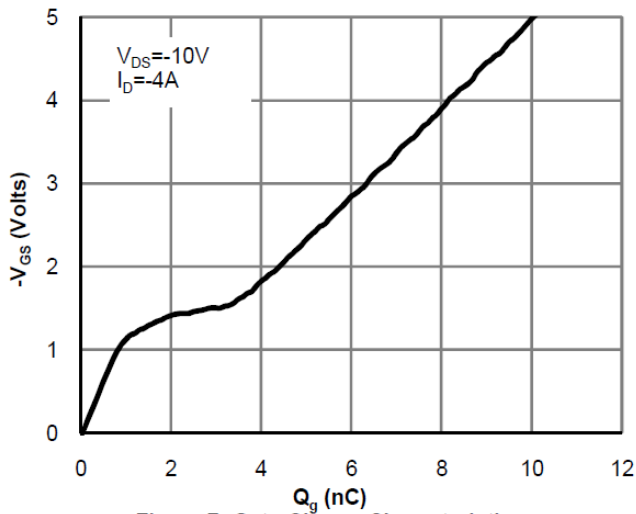


Figure 7: Gate-Charge Characteristics

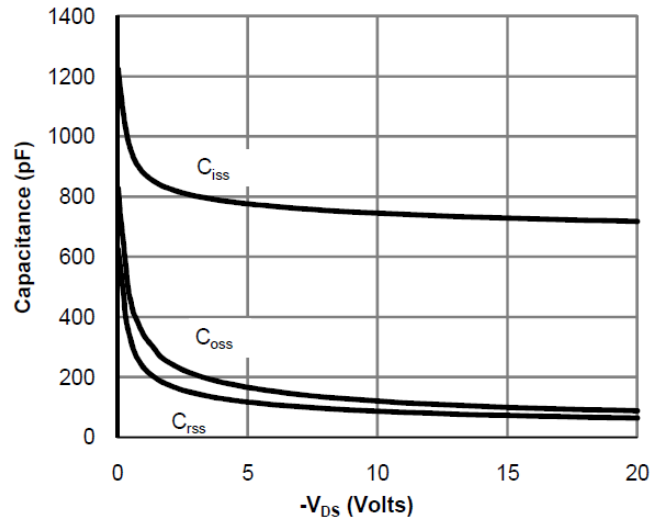


Figure 8: Capacitance Characteristics

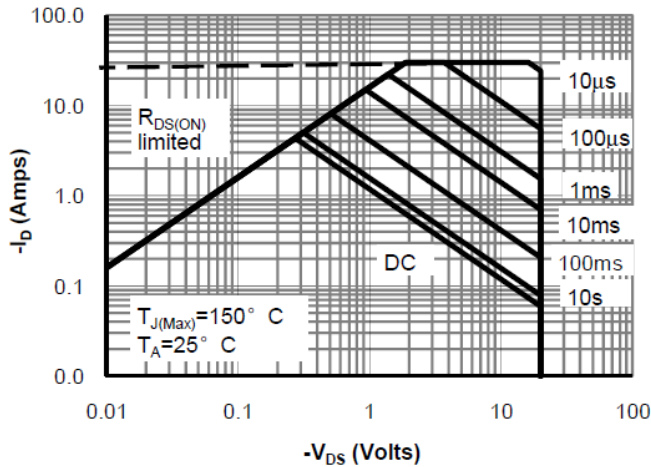


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

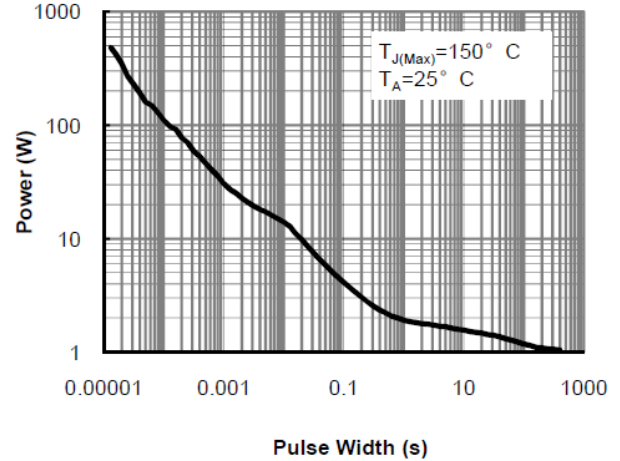


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note F)

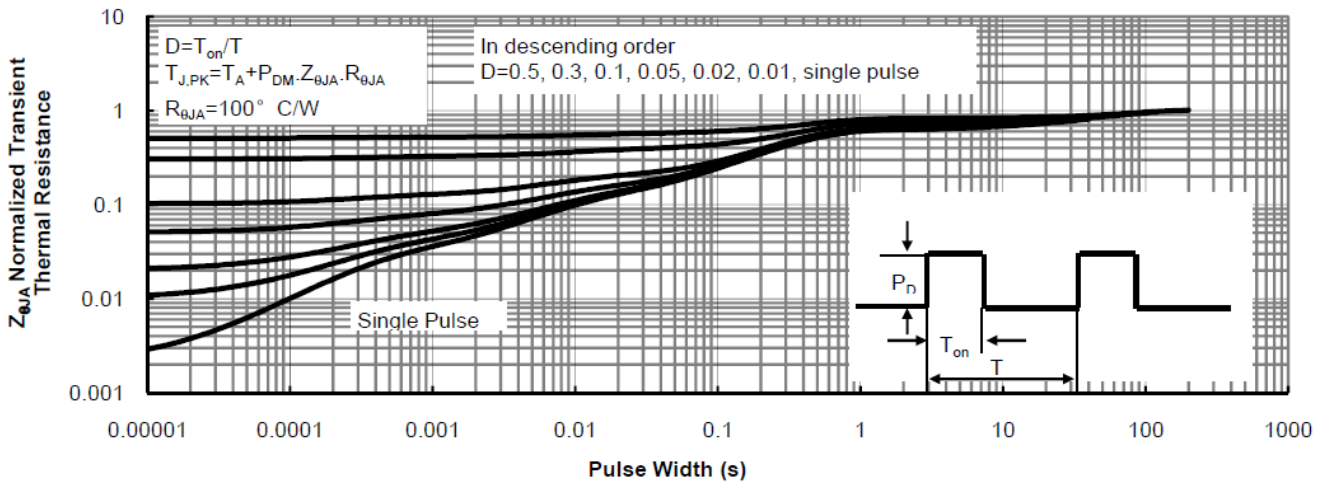
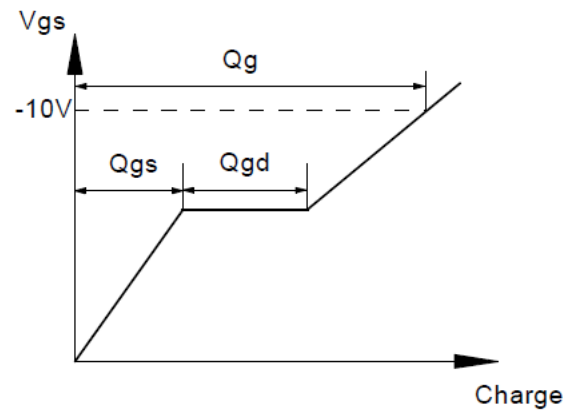
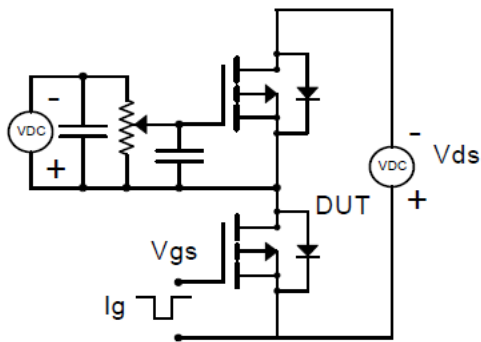
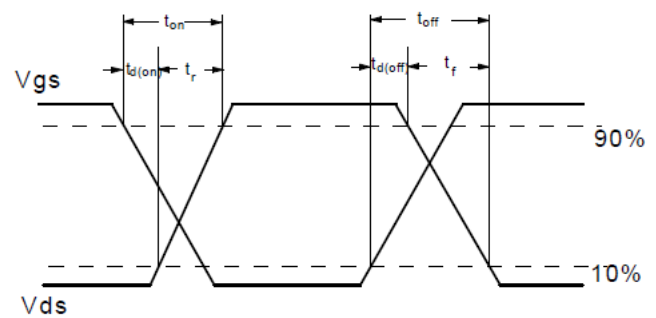
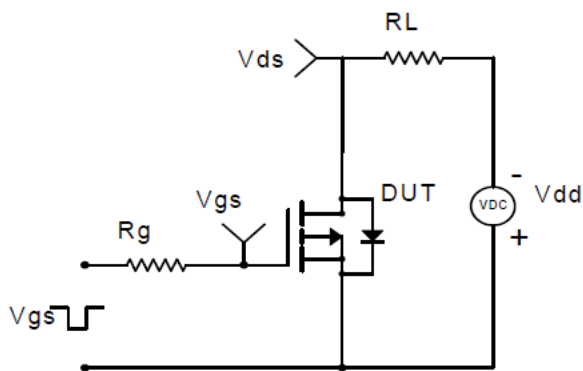


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

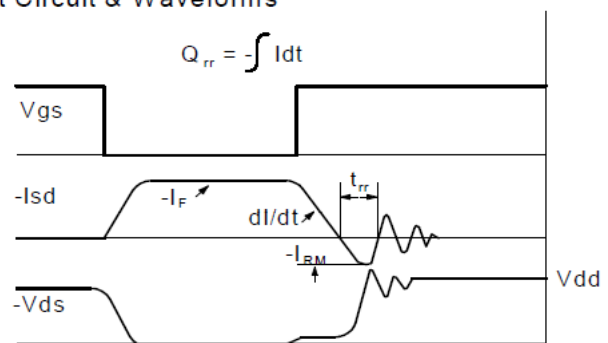
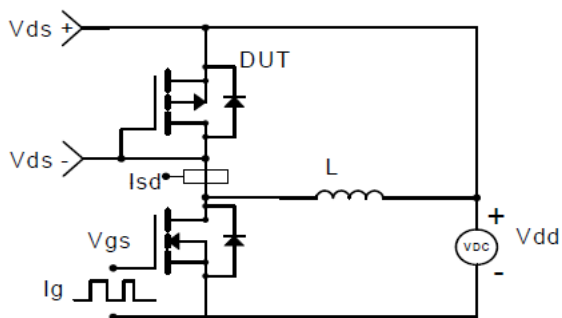
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms

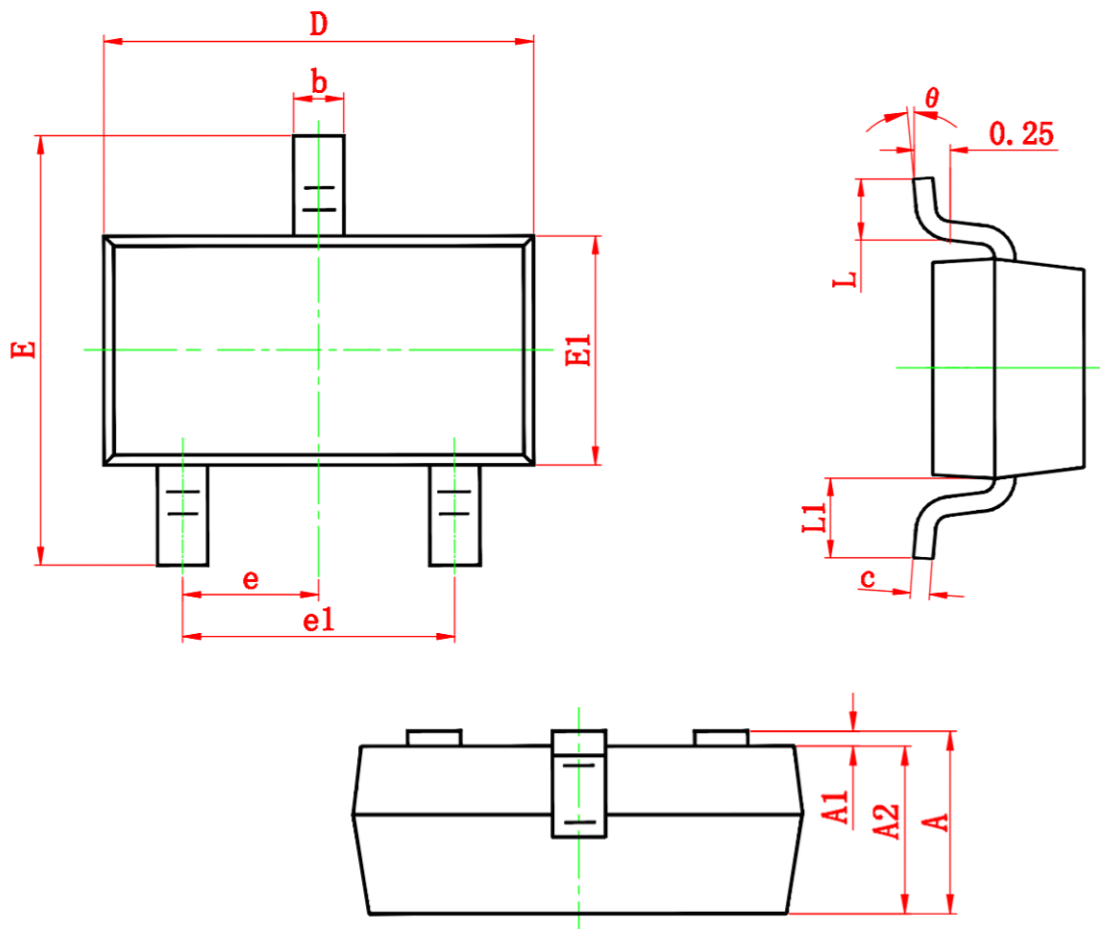


Diode Recovery Test Circuit & Waveforms



**Package Information**

- SOT-23



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	2.250	2.550	0.089	0.100
E1	1.200	1.400	0.047	0.055
e	0.950 TYP.		0.037 TYP.	
e1	1.800	2.000	0.071	0.079
L	0.300	0.500	0.012	0.020
L1	0.550 REF.		0.022 REF.	
$\theta$	0°	8°	0°	8°