

## 20V P-Channel Enhancement Mode MOSFET

### Description

The NP2305VR 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

- ◆  $V_{DS} = -20V$ ,  $I_D = -4.2A$   
 $R_{DS(ON)}(Typ.) = 49m\Omega$  @  $V_{GS} = -2.5V$   
 $R_{DS(ON)}(Typ.) = 36m\Omega$  @  $V_{GS} = -4.5V$
- ◆ High power and current handling capability
- ◆ Lead free product is acquired
- ◆ Surface mount package

### Application

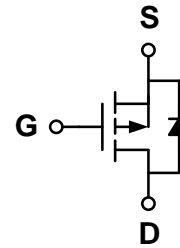
- ◆ PWM applications
- ◆ Load switch

### Package

- ◆ SOT-23

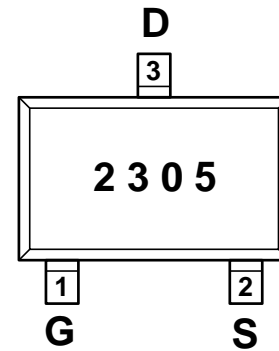


### Schematic diagram



### Marking and pin assignment

SOT-23  
(TOP VIEW)



### Ordering Information

Part Number	Storage Temperature	Package	Devices Per Reel
NP2305VR-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	$V_{GS}$	±12	V	
Continuous Drain Current (TJ = 150 °C)	$I_D$	$T_C = 25^\circ C$	-4.2	A
		$T_C = 70^\circ C$	-3.7	
		$T_A = 25^\circ C$	-3.8 <sup>b,c</sup>	
		$T_A = 70^\circ C$	-2.9 <sup>b,c</sup>	
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25^\circ C$	-1.4	
		$T_A = 25^\circ C$	-1 <sup>b,c</sup>	
Pulsed Drain Current (t = 300 μs)	$I_{DM}$	14		
Maximum power dissipation	$P_D$	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 (TA=25°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	$I_{GSS}$	$V_{DS}=0\text{V}, V_{GS}=\pm 12\text{V}$	-	-	$\pm 100$	nA
<b>ON Characteristics</b>						
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu\text{A}$	-0.5	-0.85	-1.5	V
Drain-source on-state resistance	$R_{DS(ON)}$	$V_{GS}=-4.5\text{V}, I_D=-4.2\text{A}$	-	36	46	m $\Omega$
		$V_{GS}=-2.5\text{V}, I_D=-3\text{A}$	-	49	59	
Forward transconductance	gfs	$V_{DS}=-10\text{V}, I_D=-4\text{A}$	-	5	-	S
<b>Dynamic Characteristics</b>						
Input capacitance	$C_{ISS}$	$V_{DS}=-10\text{V}, V_{GS}=0\text{V}$ $f=1.0\text{MHz}$	-	740	-	pF
Output capacitance	$C_{OSS}$		-	290	-	
Reverse transfer capacitance	$C_{RSS}$		-	190	-	
<b>Switching Characteristics</b>						
Turn-on delay time	$t_{D(ON)}$	$V_{DD}=-10\text{V}$ $I_D=-2.8\text{A}$ $V_{GEN}=-4.5\text{V}$ $R_L=10\text{ohm}$ $R_{GEN}=-60\text{ohm}$	-	12.5	-	ns
Rise time	$t_r$		-	35	-	
Turn-off delay time	$t_{D(OFF)}$		-	30	-	
Fall time	$t_f$		-	10	-	
Total gate charge	Qg	$V_{DS}=-10\text{V}, I_D=-3\text{A}$ $V_{GS}=-4.5\text{V}$	-	6.1	-	nC
Gate-source charge	Qgs		-	1.7	-	
Gate-drain charge	Qgd		-	1.2	-	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{V}, I_S=-1.25\text{A}$	-	-0.81	-1.2	V

## Typical Performance Characteristics

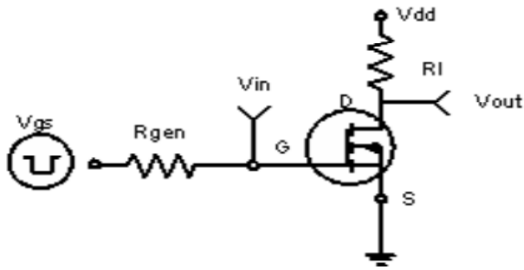


Figure 1: Switching Test Circuit

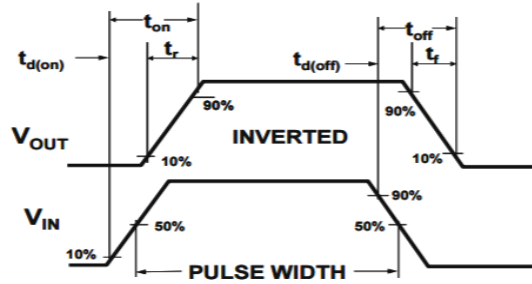


Figure 2: Switching Waveforms

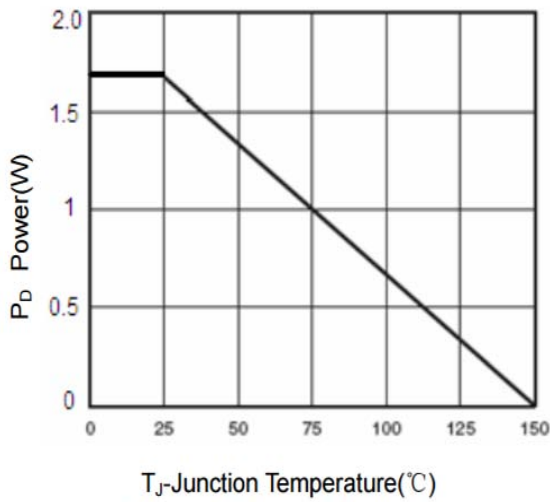


Figure 3 Power Dissipation

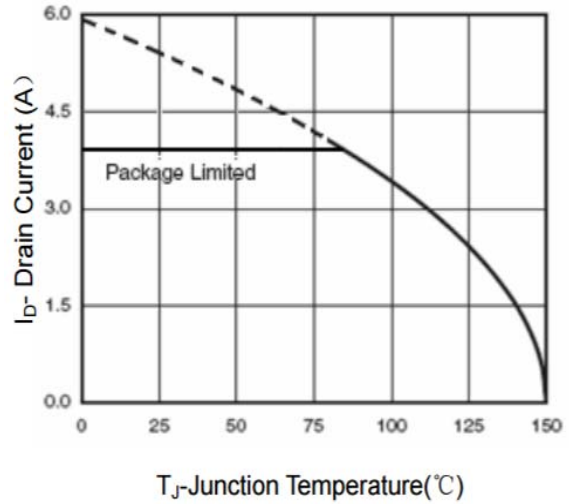


Figure 4 Drain Current

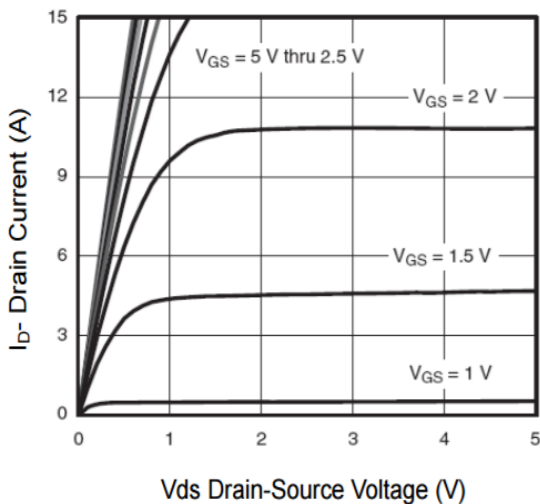


Figure 5 Output Characteristics

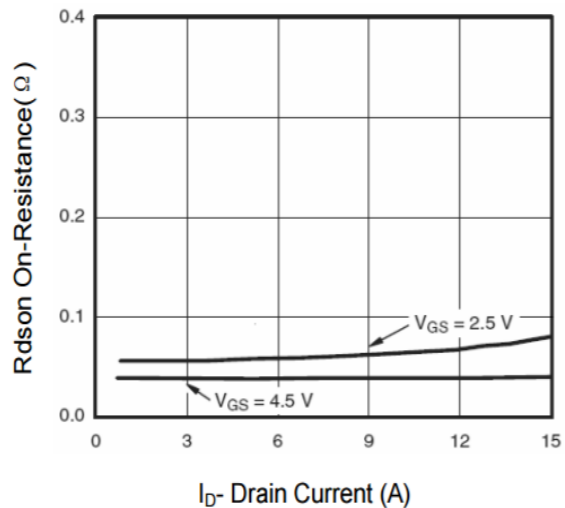
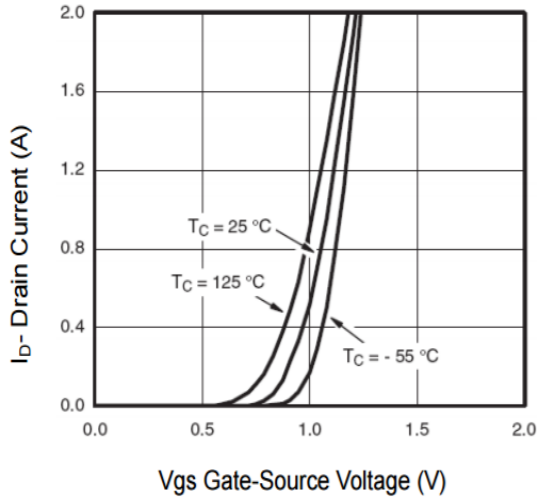
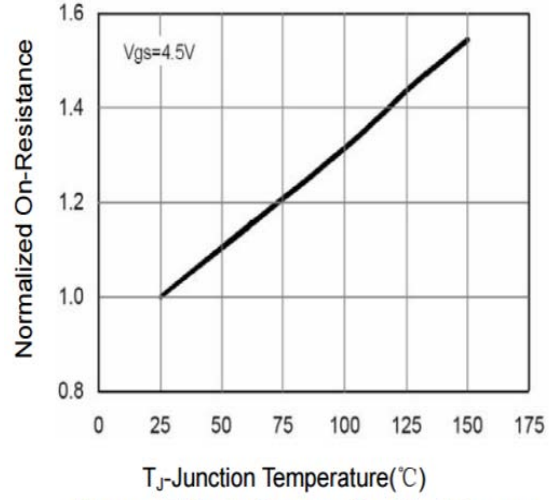


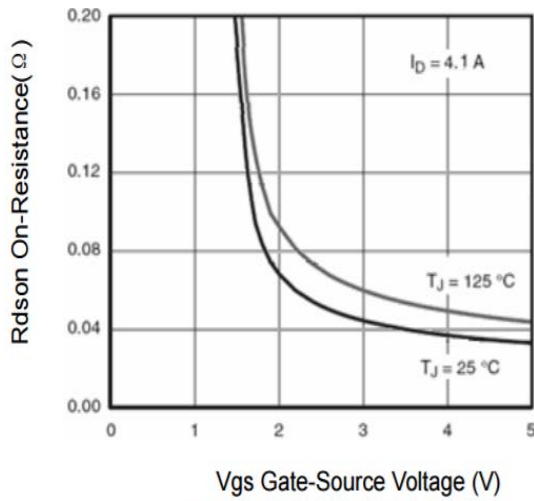
Figure 6 Drain-Source On-Resistance



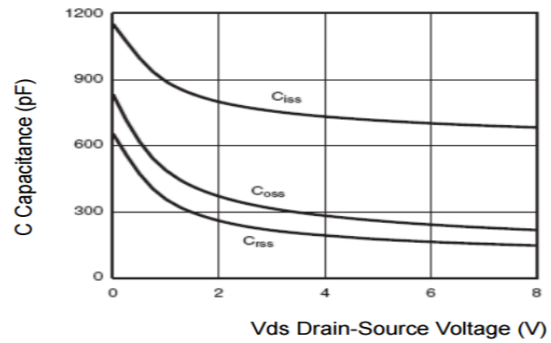
**Figure 7 Transfer Characteristics**



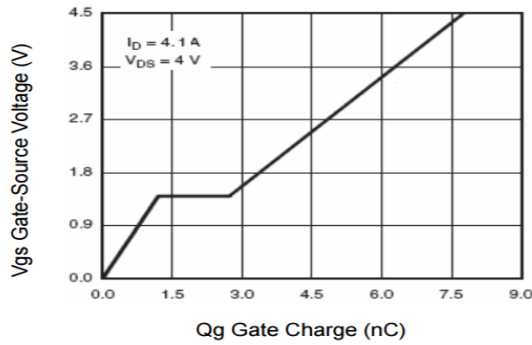
**Figure 8 Drain-Source On-Resistance**



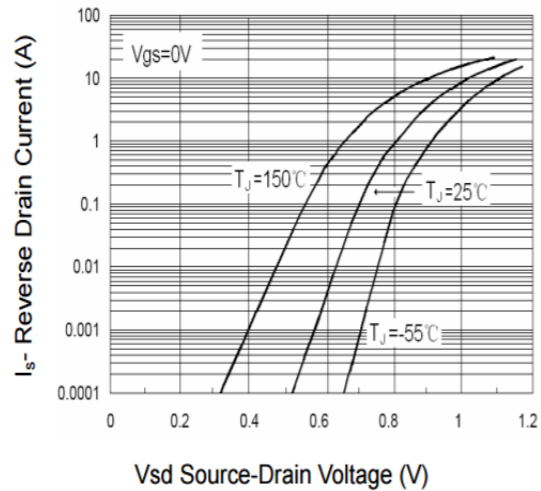
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**



**Figure 11 Gate Charge**



**Figure 12 Source- Drain Diode Forward**

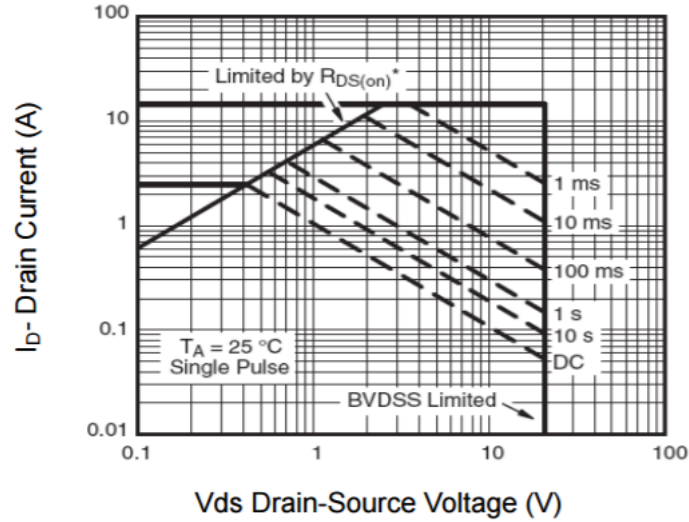


Figure 13 Safe Operation Area

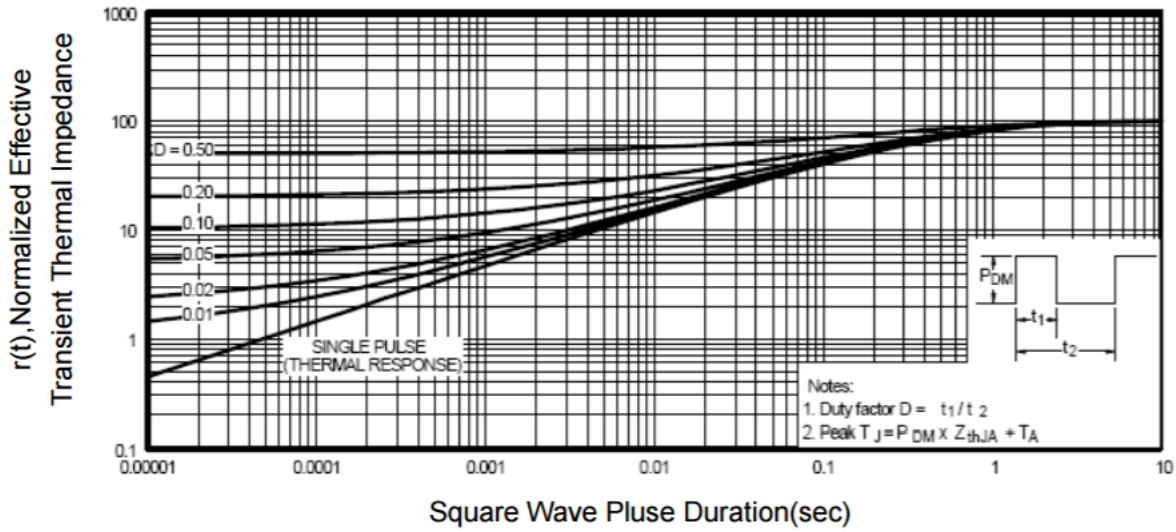
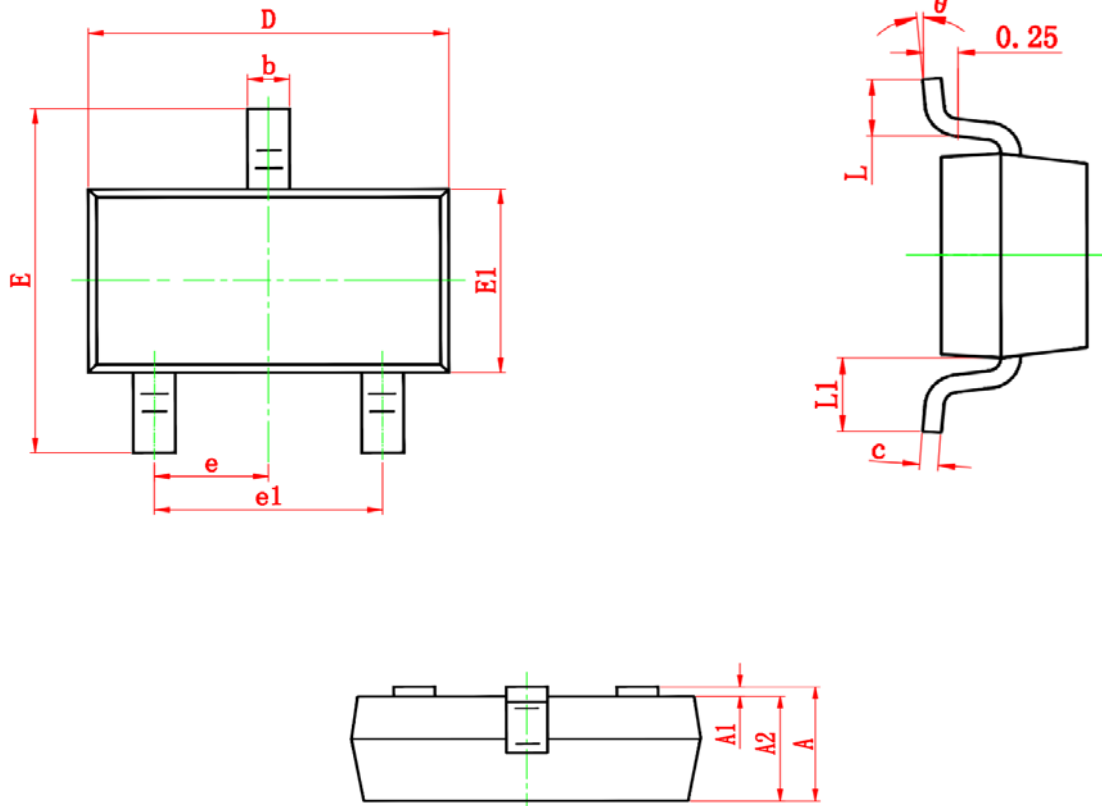


Figure 14 Normalized Maximum Transient Thermal Impedance

## 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°