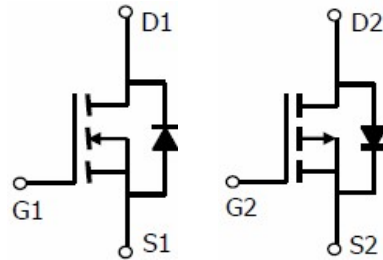


# AP2003

## Nand P-Channel Power MOSFET

### Description

The AP2003 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge . The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.



N-channel

P-channel

### General Features

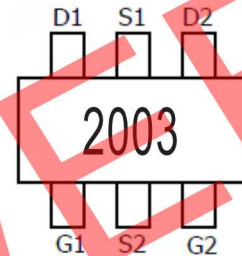
● **N-Channel**

- $V_{DS} = 20V, I_D = 3A$
- $R_{DS(ON)} < 35m\Omega @ V_{GS}=4.5V$
- $R_{DS(ON)} < 55m\Omega @ V_{GS}=2.5V$

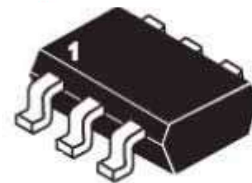
● **P-Channel**

- $V_{DS} = -20V, I_D = -3A$
- $R_{DS(ON)} < 75m\Omega @ V_{GS}=-4.5V$
- $R_{DS(ON)} < 100m\Omega @ V_{GS}=-2.5V$

- High power and current handing capability
- Lead free product is acquired
- Surface mount package
- Halogen-free



Marking and pin Assignment



SOT-23-6L top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
2003	AP2003	SOT-23-6L	Ø180mm	8mm	3000 units

### Absolute Maximum Ratings ( $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	$V_{DS}$	20	-20	V	
Gate-Source Voltage	$V_{GS}$	$\pm 12$	$\pm 12$	V	
Continuous Drain Current	$I_D$	$T_A=25^\circ C$	3	-3	A
		$T_A=70^\circ C$	2.4	-2.4	
Pulsed Drain Current <sup>(Note 1)</sup>	$I_{DM}$	13	-13	A	
Maximum Power Dissipation	$P_D$	0.8	0.8	W	
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	-55 To 150	$^\circ C$	

### Thermal Characteristic

Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup>	$R_{\theta JA}$	N-Ch	156	$^\circ C/W$
Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup>	$R_{\theta JA}$	P-Ch	156	$^\circ C/W$

**AP2003**
**Nand P-Channel Power MOSFET**
**N-CH Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	20	22	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±12V, V <sub>DS</sub> =0V	-	-	±100	nA
<b>On Characteristics</b> (Note 3)						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	0.5	0.75	1.2	V
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =2.5V, I <sub>D</sub> =2.8A	-	29	55	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A	-	23	35	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =3A	-	8	-	S
<b>Dynamic Characteristics</b> (Note4)						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =10V, V <sub>GS</sub> =0V, F=1.0MHz	-	260	-	PF
Output Capacitance	C <sub>OSS</sub>		-	48	-	PF
Reverse Transfer Capacitance	C <sub>RSS</sub>		-	27	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =10V, R <sub>L</sub> =3.3Ω V <sub>GS</sub> =4.5V, R <sub>GEN</sub> =6Ω	-	2.5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	3.2	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	21	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	3	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =3A, V <sub>GS</sub> =4.5V	-	2.9	5	nC
Gate-Source Charge	Q <sub>gs</sub>		-	0.4	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	0.6	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =3 A	-	-	1.2	V
Diode Forward Current (Note 2)	I <sub>S</sub>		-	-	3	A

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production

**AP2003**

**Nand P-Channel Power MOSFET**

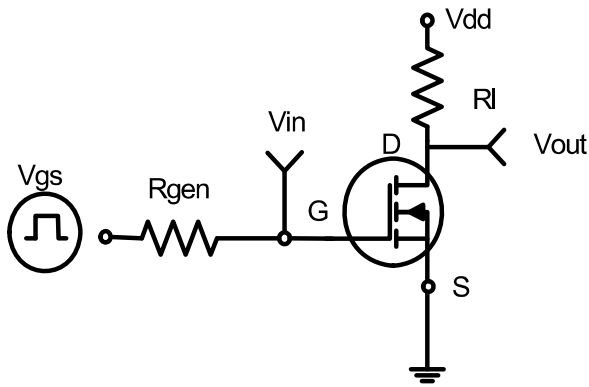
**P-CH Electrical Characteristics (TA=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=-250\mu A$	-20		-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=-20V, V_{GS}=0V$	-	-	-1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 12V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics</b> (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-0.4	-0.7	-1	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=-4.5V, I_D=-2.5 A$	-	66	75	m $\Omega$
		$V_{GS}=-2.5V, I_D=-2A$	-	81	100	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=-5V, I_D=-2.5A$	-	9.5	-	S
<b>Dynamic Characteristics</b> (Note 4)						
Input Capacitance	$C_{iss}$	$V_{DS}=-10V, V_{GS}=0V,$ $F=1.0MHz$	-	325	-	PF
Output Capacitance	$C_{oss}$		-	63	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	37	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-10V, R_L=5\Omega$ $V_{GS}=-4.5V, R_{GEN}=3\Omega$	-	11	-	nS
Turn-on Rise Time	$t_r$		-	5.5	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	22	-	nS
Turn-Off Fall Time	$t_f$		-	8	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-10V, I_D=-2A,$ $V_{GS}=-4.5V$	-	3.2	-	nC
Gate-Source Charge	$Q_{gs}$		-	0.6	-	nC
Gate-Drain Charge	$Q_{gd}$		-	0.9	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=-3A$	-	-	-1.2	V
Diode Forward Current	$I_S$		-	-	-3	A

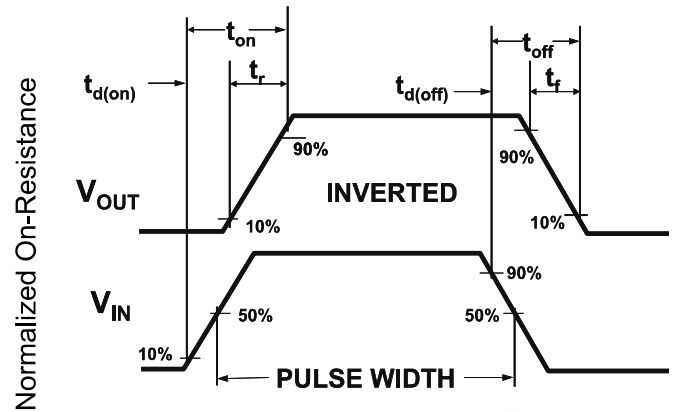
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

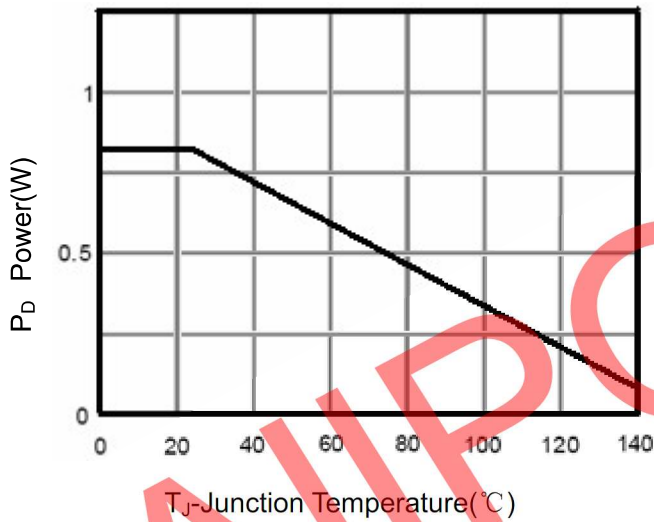
**N- Channel Typical Electrical and Thermal Characteristics (Curves)**



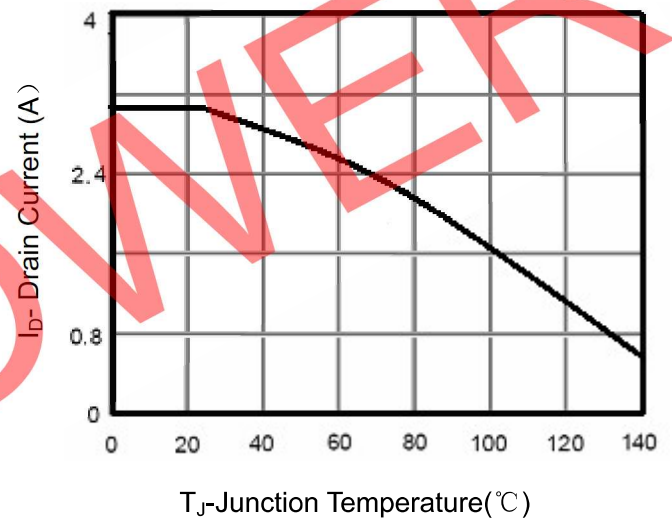
**Figure 1: Switching Test Circuit**



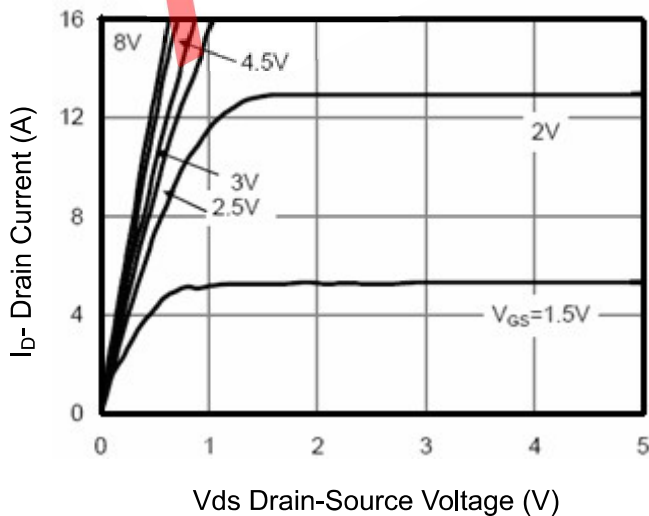
**Figure 2: Switching Waveforms**



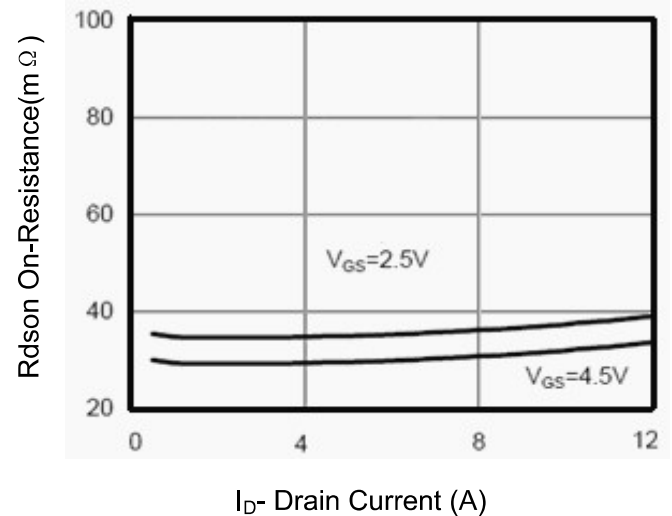
**Figure 3 Power Dissipation**



**Figure 4 Drain Current**



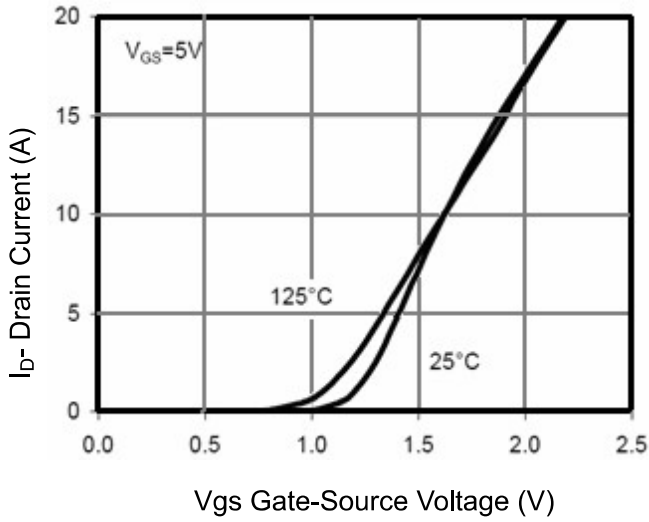
**Figure 5 Output Characteristics**



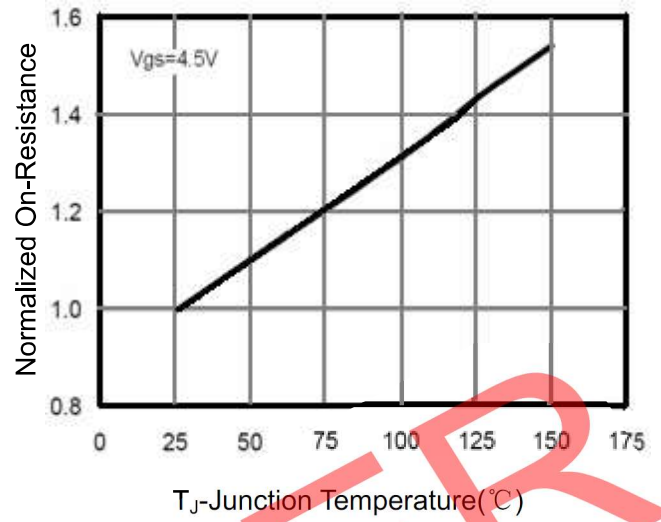
**Figure 6 Drain-Source On-Resistance**

**Nand P-Channel Power MOSFET**

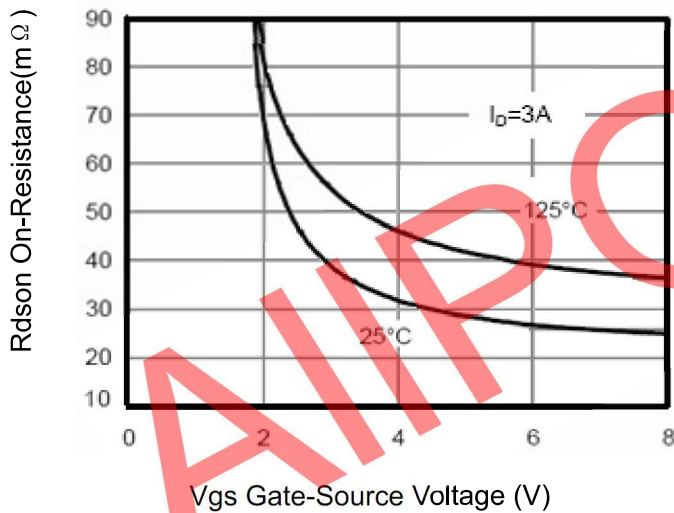
**N- Channel Typical Electrical and Thermal Characteristics (Curves)**



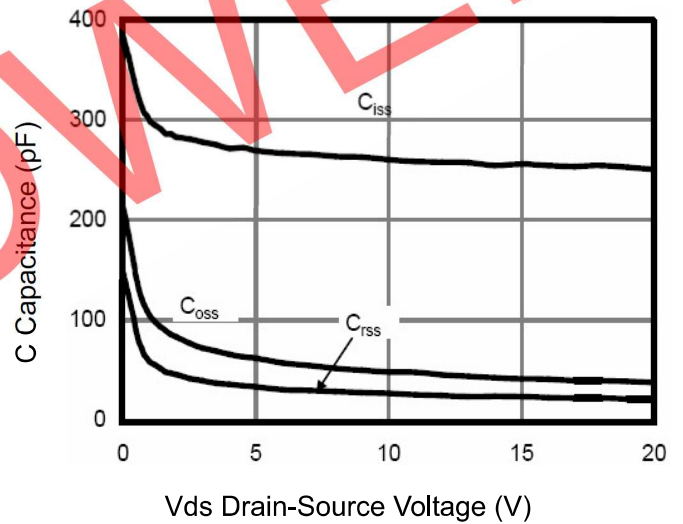
**Figure 7 Transfer Characteristics**



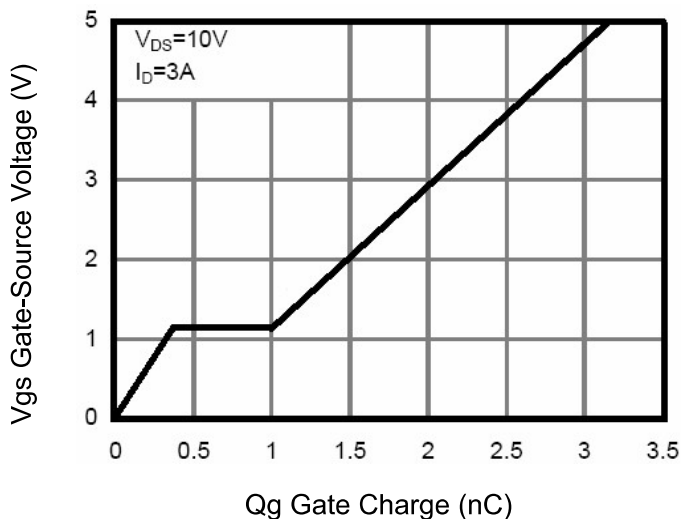
**Figure 8 Drain-Source On-Resistance**



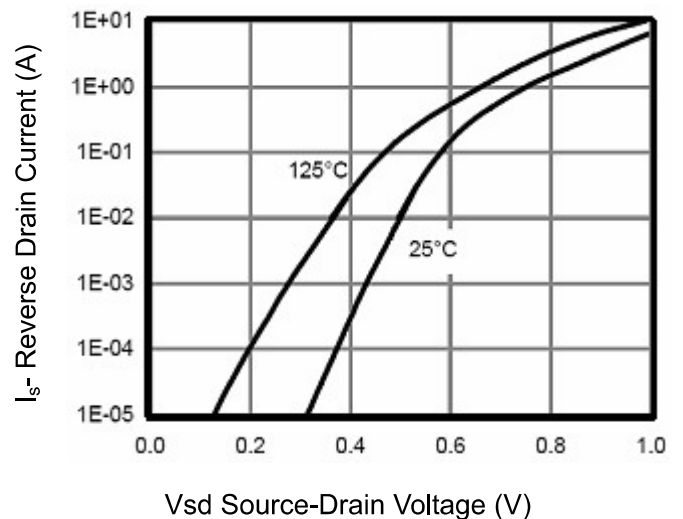
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**

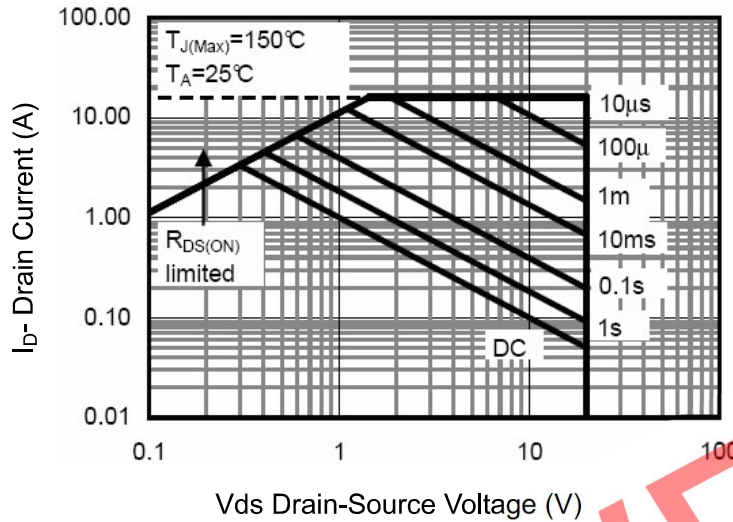


**Figure 11 Gate Charge**

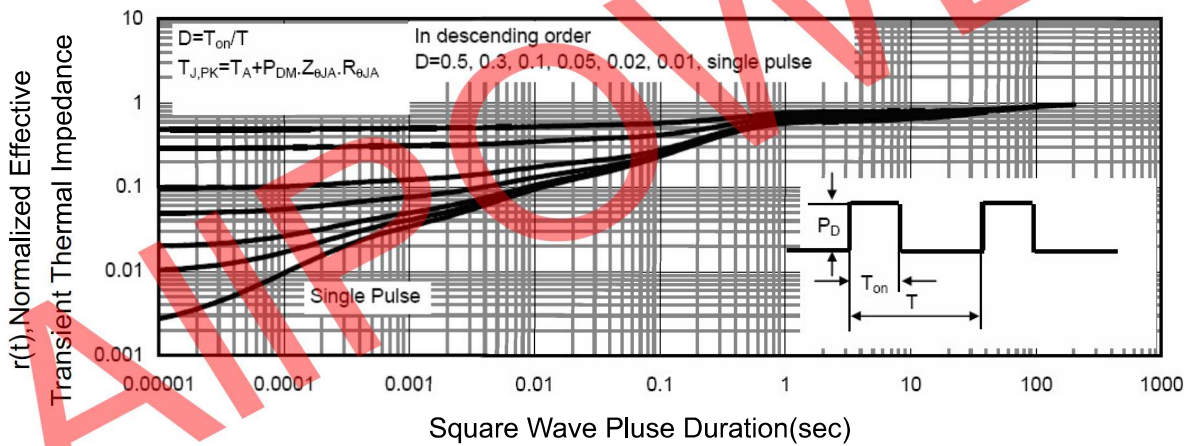


**Figure 12 Source- Drain Diode Forward**

**N- Channel Typical Electrical and Thermal Characteristics (Curves)**

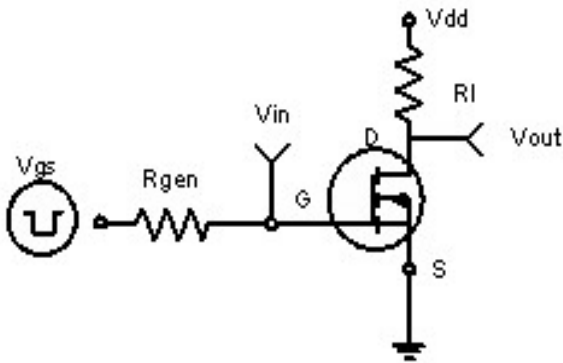


**Figure 13 Safe Operation Area**

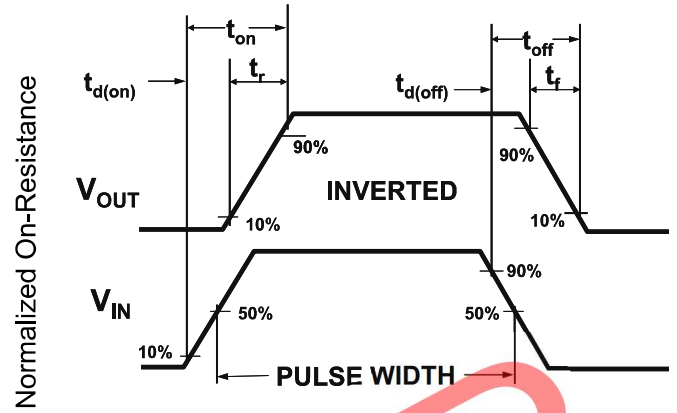


**Figure 14 Normalized Maximum Transient Thermal Impedance**

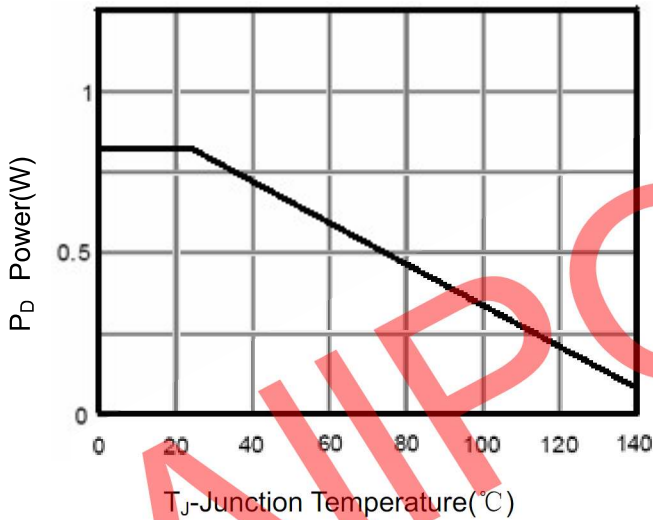
**P- Channel Typical Electrical and Thermal Characteristics (Curves)**



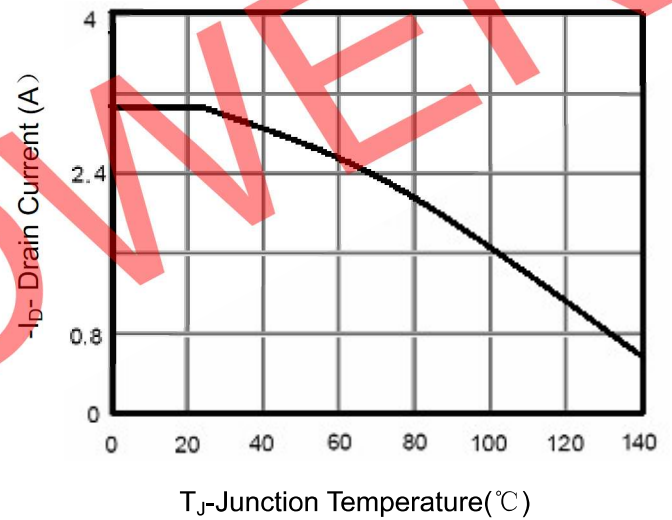
**Figure 1: Switching Test Circuit**



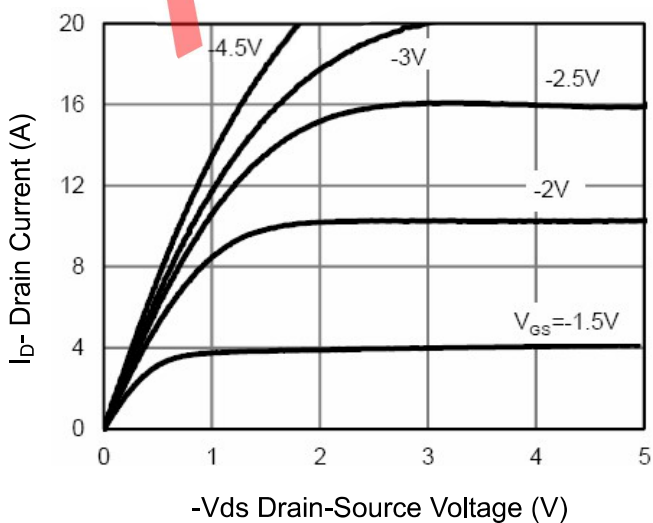
**Figure 2: Switching Waveforms**



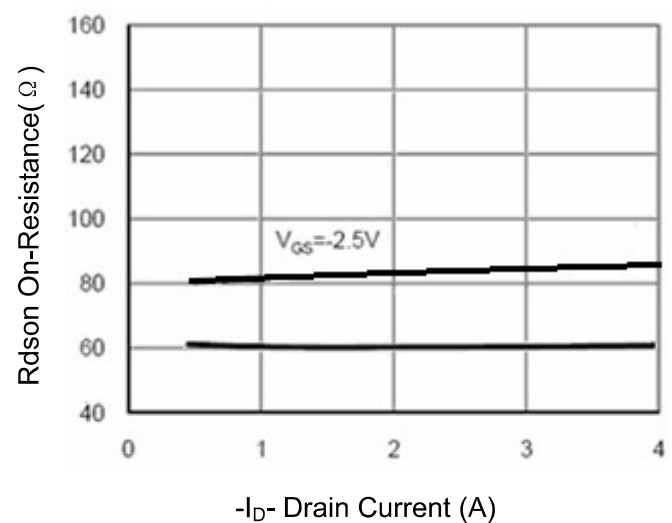
**Figure 3 Power Dissipation**



**Figure 4 Drain Current**

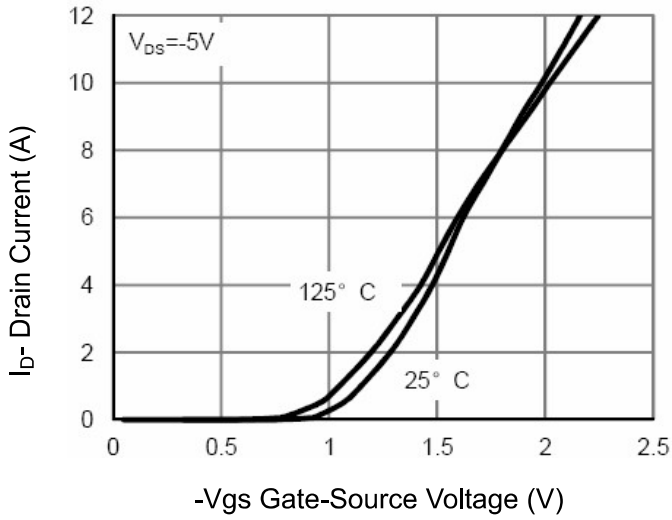


**Figure 5 Output Characteristics**

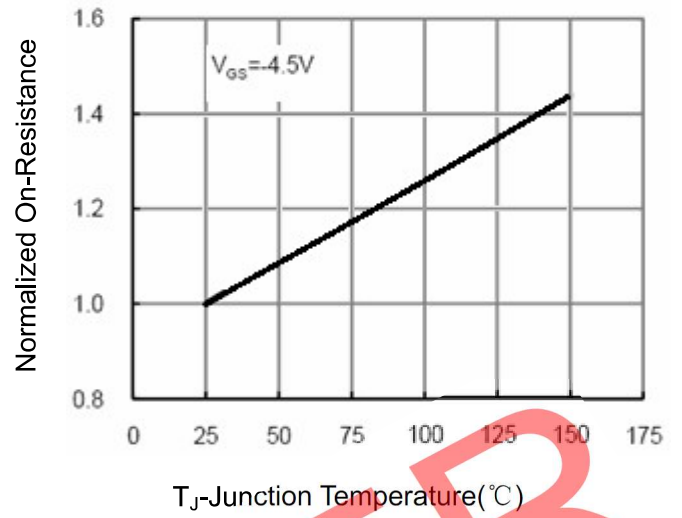


**Figure 6 Drain-Source On-Resistance**

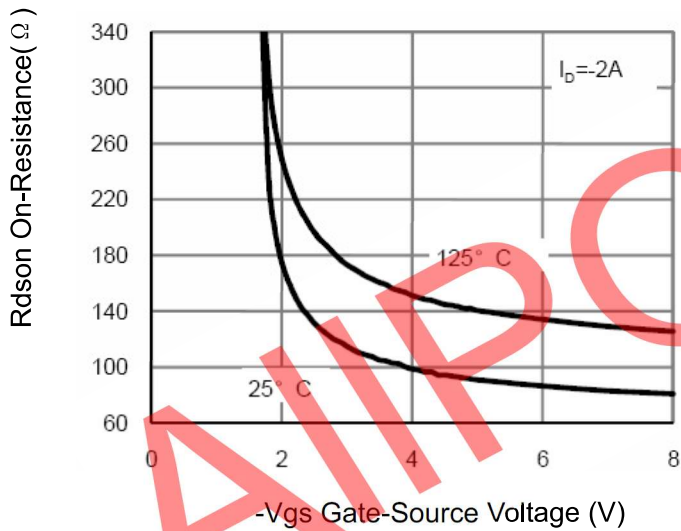
**P- Channel Typical Electrical and Thermal Characteristics (Curves)**



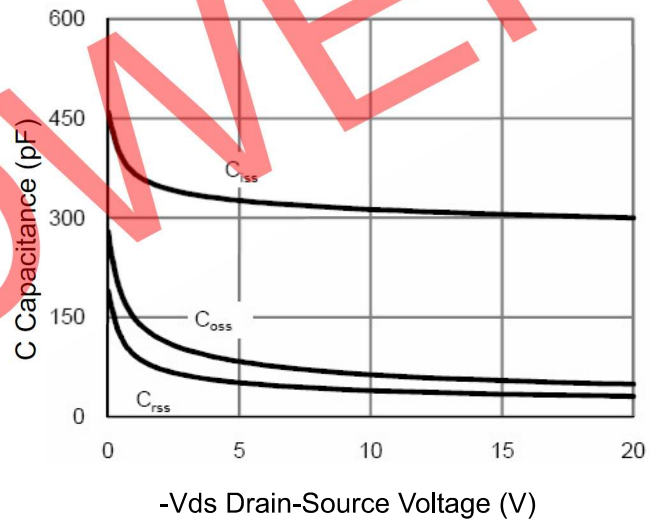
**Figure 7 Transfer Characteristics**



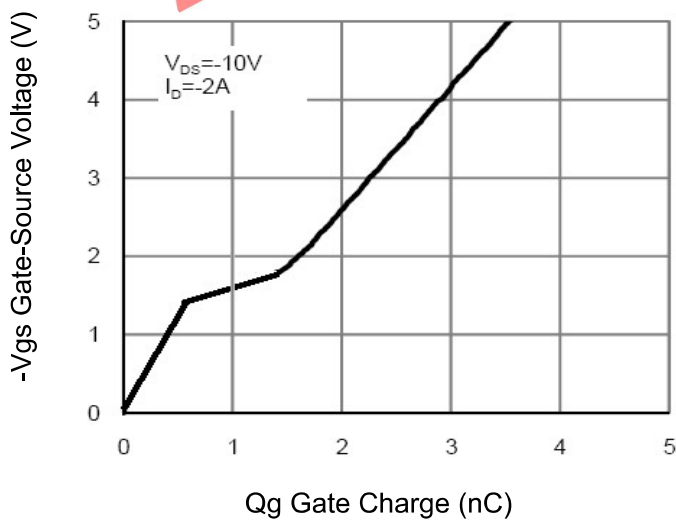
**Figure 8 Drain-Source On-Resistance**



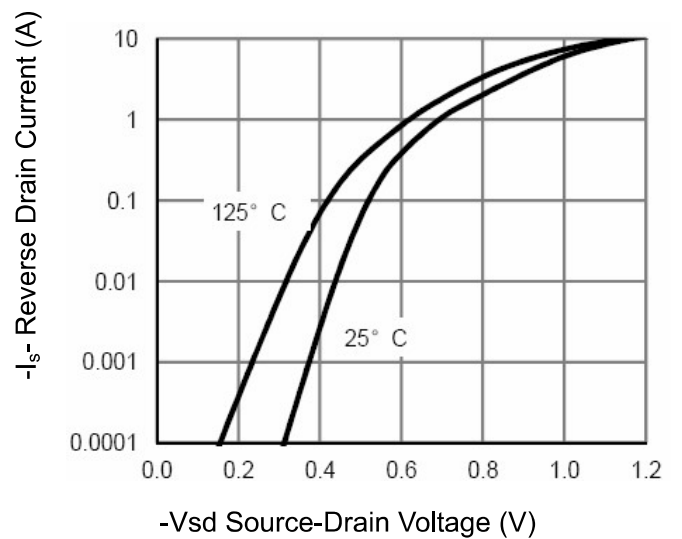
**Figure 9 Rdson vs Vgs**



**Figure 10 Capacitance vs Vds**



**Figure 11 Gate Charge**

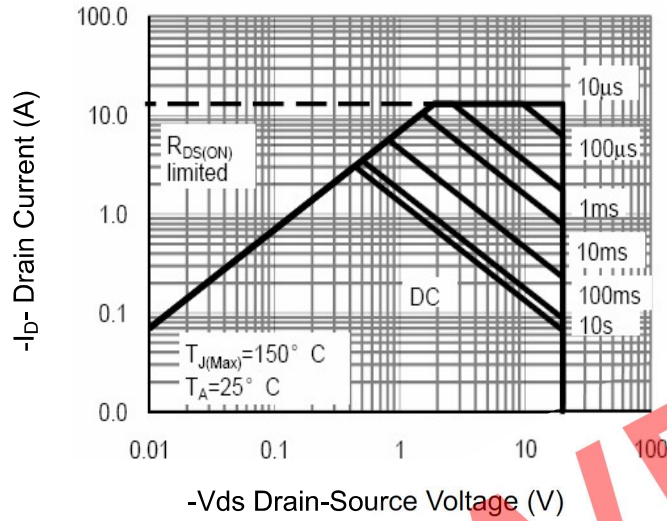


**Figure 12 Source- Drain Diode Forward**

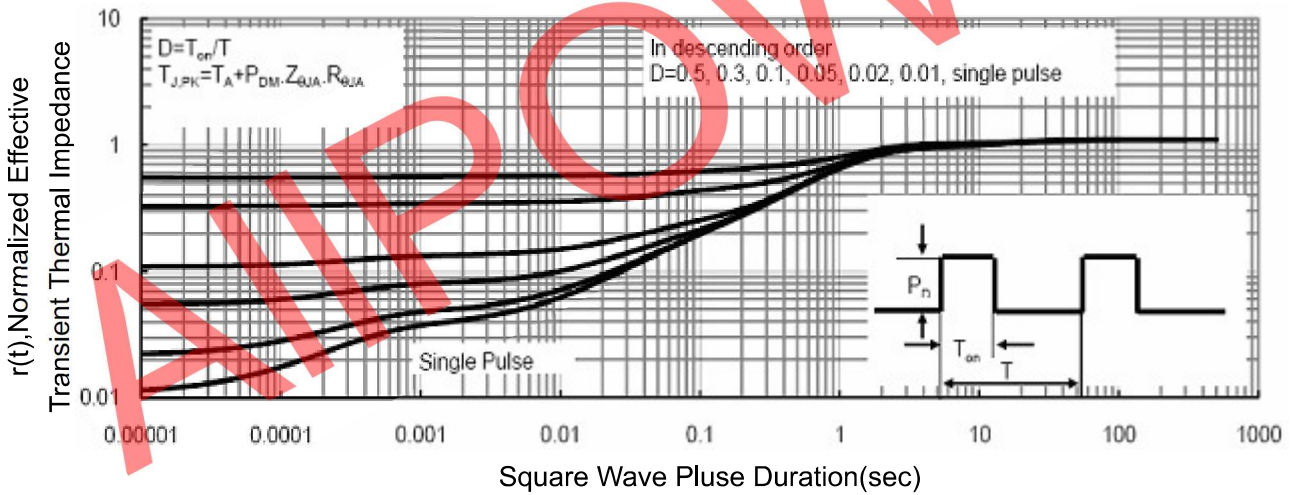


**Nand P-Channel Power MOSFET**

**P- Channel Typical Electrical and Thermal Characteristics (Curves)**



**Figure 13 Safe Operation Area**

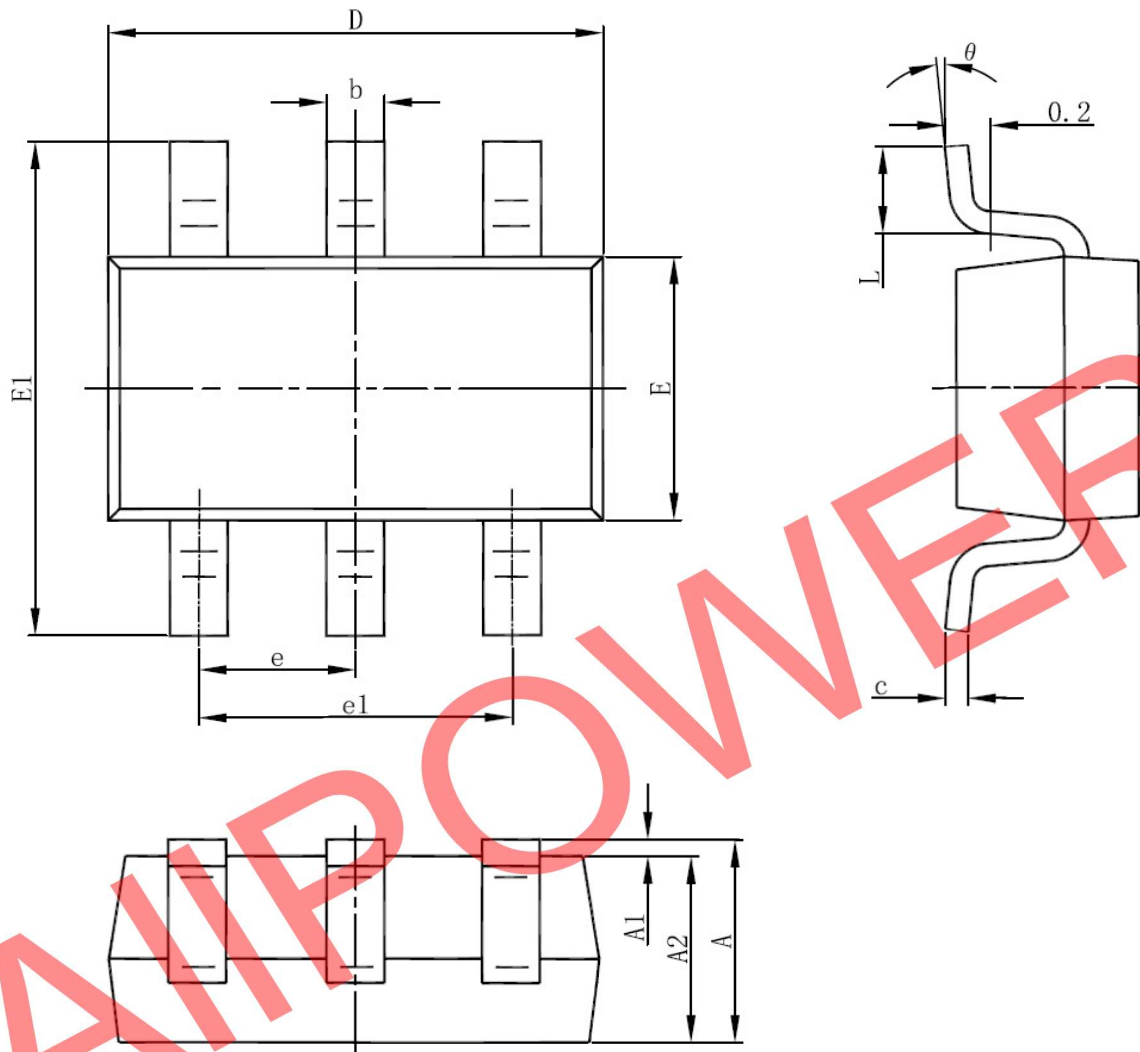


**Figure 14 Normalized Maximum Transient Thermal Impedance**

**AP2003**

**Nand P-Channel Power MOSFET**

**SOT23-6L Package Information**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
theta	0°	8°	0°	8°