ALPHA & OMEGA
SEMICONDUCTOR, INC.

March 2003

AOP604

Complementary Enhancement Mode Field Effect Transistor

General Description

The AOP604 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs form a high-speed power inverter, suitable for a multitude of applications. A Schottky diode in parallel with the n-channel FET reduces body diode related losses.

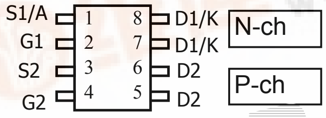
Features

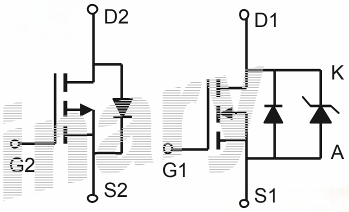
n-channel	p-channel
V_{DS} (V) = 30V	-30V
I_D = 7.5A	-6.6A
$R_{DS(ON)}$	
< 28mΩ	< 35mΩ (V_{GS} = 10V)
< 43mΩ	< 58mΩ (V_{GS} = 4.5V)

Schottky

V_{DS}=30V, I_F=3A, V_F<0.5V@1A

PDIP-8





Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Max n-channel	Max p-channel	Units
Drain-Source Voltage		V_{DS}	30	-30	V
Gate-Source Voltage		V_{GS}	±20	±20	V
Continuous Drain Current [A]	T_A=25°C	I_D	7.5	-6.6	A
	T_A=70°C		6	-5.3	
Pulsed Drain Current [B]		I_{DM}	30	-30	
Power Dissipation	T_A=25°C	P_D	2.5	2.5	W
	T_A=70°C		1.6	1.6	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	-55 to 150	°C

Parameter		Symbol	Maximum Schottky	Units
Reverse Voltage		V_{DS}	30	V
Continuous Forward Current [A]	T_A=25°C	I_D	4	A
	T_A=70°C		2.7	
Pulsed Forward Current [B]		I_{DM}	20	
Power Dissipation [A]	T_A=25°C	P_D	2.5	W
	T_A=70°C		1.6	
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C

Thermal Characteristics: n-channel					
Parameter		**Symbol**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient [A]	$t \le 10s$	$R_{\theta JA}$	40	50	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		67	80	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	33	40	°C/W

Thermal Characteristics: p-channel					
Parameter		**Symbol**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient [A]	$t \le 10s$	$R_{\theta JA}$	38	50	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		66	80	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	30	40	°C/W

Thermal Characteristics: Schottky					
Parameter		**Symbol**	**Typ**	**Max**	**Units**
Maximum Junction-to-Ambient [A]	$t \le 10s$	$R_{\theta JA}$	42	50	°C/W
Maximum Junction-to-Ambient [A]	Steady-State		70	80	°C/W
Maximum Junction-to-Lead [C]	Steady-State	$R_{\theta JL}$	34	40	°C/W

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The value in any a given application depends on the user's specific board design. The current rating is based on the $t \le 10s$ thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

D. The static characteristics in Figures 1 to 6 are obtained using 80 µs pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The SOA curve provides a single pulse rating.

n-channel MOSFET Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=250µA, V_{GS}=0V	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=24V, V_{GS}=0V			1	µA
		T_J=55°C			5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±20V			100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=250µA	1	1.8	3	V
$I_{D(ON)}$	On state drain current	V_{GS}=10V, V_{DS}=5V	30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=7.5A		22.6	28	mΩ
		T_J=125°C				
		V_{GS}=4.5V, I_D=6.0A		33	43	mΩ
g_{FS}	Forward Transconductance	V_{DS}=5V, I_D=7.5A	12	16		S
V_{SD}	Schottky+ Body Diode Forward Voltage	I_S=1A		0.45	0.5	V
I_S	Maximum Body-Diode+Schottky Continuous Current				4	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=15V, f=1MHz		680		pF
C_{oss}	Output Capacitance. (Schottky+FET)			102		pF
C_{rss}	Reverse Transfer Capacitance			77		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		3		Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge	V_{GS}=4.5V, V_{DS}=15V, I_D=7.5A		13.84		nC
Q_g	Total Gate Charge			6.74		nC
Q_{gs}	Gate Source Charge			1.82		nC
Q_{gd}	Gate Drain Charge			3.2		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=15V, R_L=2.0Ω, R_{GEN}=6Ω		4.6		ns
t_r	Turn-On Rise Time			4.1		ns
$t_{D(off)}$	Turn-Off DelayTime			20.6		ns
t_f	Turn-Off Fall Time			5.2		ns
t_{rr}	Body Diode Reverse Recovery time	I_F=7.5A, dI/dt=100A/µs		16.5		ns
Q_{rr}	Body Diode Reverse Recovery charge	I_F=7.5A, dI/dt=100A/µs		7.8		nC
SCHOTTKY PARAMETERS						
V_F	Forward Voltage Drop	I_F=1.0A		0.45	0.5	V
I_{rm}	Maximum reverse leakage current	V_R=30V		0.007	0.05	mA
		V_R=30V, T_J=125°C		3.2	10	
		V_R=30V, T_J=150°C		12	20	
C_T	Junction Capacitance	V_R=15V		37		pF

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The value in any a given application depends on the user's specific board design. The current rating is based on the t ≤ 10s thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

D. The static characteristics in Figures 1 to 6 are obtained using 80 µs pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The SOA curve provides a single pulse rating.

p-channel MOSFET Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=-250µA, V_{GS}=0V	-30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=-24V, V_{GS}=0V			-1	µA
		T_J=55°C			-5	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±20V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS} I_D=-250µA	-1.2	-2	-2.4	V
$I_{D(ON)}$	On state drain current	V_{GS}=-10V, V_{DS}=-5V	30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=-10V, I_D=-6.6A		28	35	mΩ
		T_J=125°C		37	45	
		V_{GS}=-4.5V, I_D=-5A		44	58	mΩ
g_{FS}	Forward Transconductance	V_{DS}=-5V, I_D=-6.6A		13		S
V_{SD}	Diode Forward Voltage	I_S=-1A,V_{GS}=0V		-0.76	-1	V
I_S	Maximum Body-Diode Continuous Current				-4.2	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=-15V, f=1MHz		920		pF
C_{oss}	Output Capacitance			190		pF
C_{rss}	Reverse Transfer Capacitance			122		pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz		3.6		Ω
SWITCHING PARAMETERS						
Q_g(10V)	Total Gate Charge (10V)	V_{GS}=-10V, V_{DS}=-15V, I_D=-6.6A		18.5		nC
Q_g(4.5V)	Total Gate Charge (4.5V)			9.6		nC
Q_{gs}	Gate Source Charge			2.7		nC
Q_{gd}	Gate Drain Charge			4.5		nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=-10V, V_{DS}=-15V, R_L=2.3Ω, R_{GEN}=3Ω		7.7		ns
t_r	Turn-On Rise Time			5.7		ns
$t_{D(off)}$	Turn-Off DelayTime			20.2		ns
t_f	Turn-Off Fall Time			9.5		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=-6.6A, dI/dt=100A/µs		20		ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=-6.6A, dI/dt=100A/µs		8.8		nC

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A =25°C. The value in any a given application depends on the user's specific board design. The current rating is based on the t≤ 10s thermal resistance rating.

B: Repetitive rating, pulse width limited by junction temperature.

C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.

D. The static characteristics in Figures 1 to 6,12,14 are obtained using 80µs pulses, duty cycle 0.5% max.

E. These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C. The SOA curve provides a single pulse rating.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

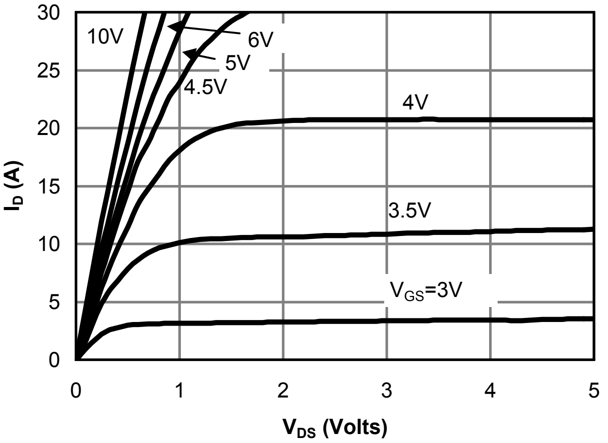


Fig 1: On-Region Characteristics

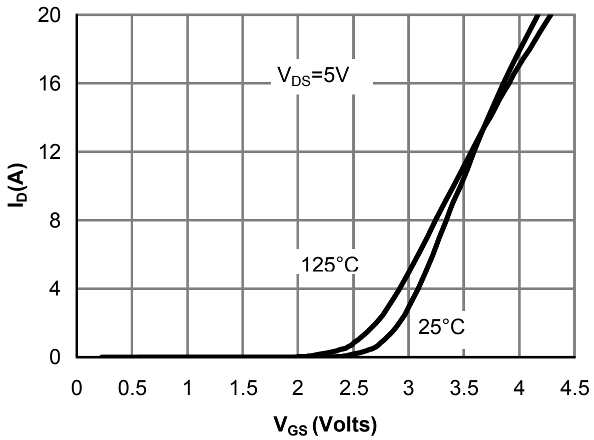


Figure 2: Transfer Characteristics

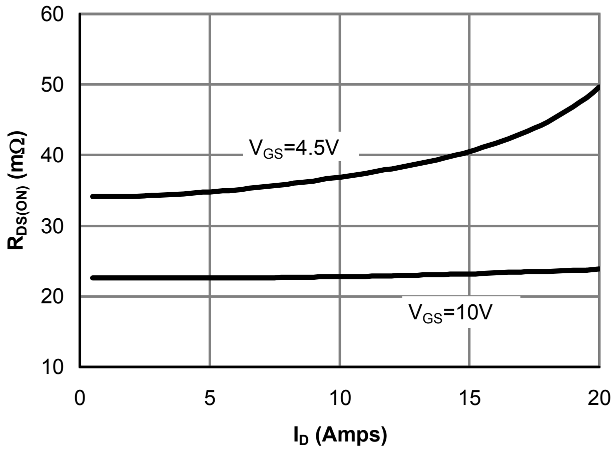


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

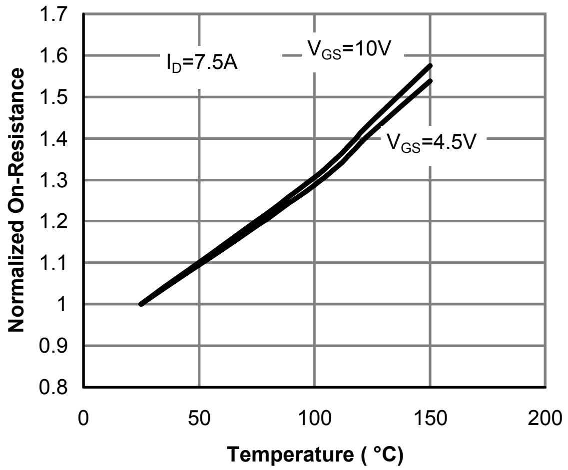


Figure 4: On-Resistance vs. Junction Temperature

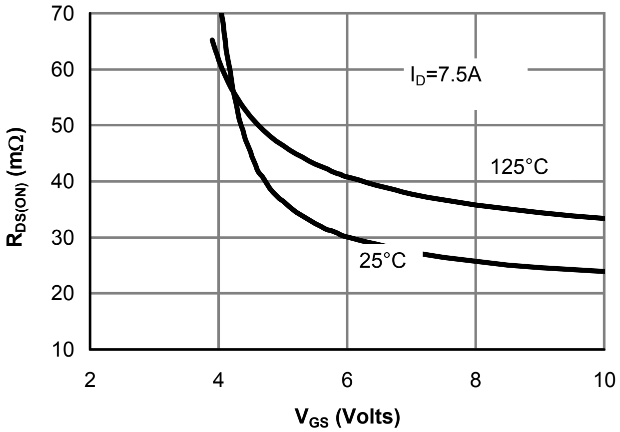


Figure 5: On-Resistance vs. Gate-Source Voltage

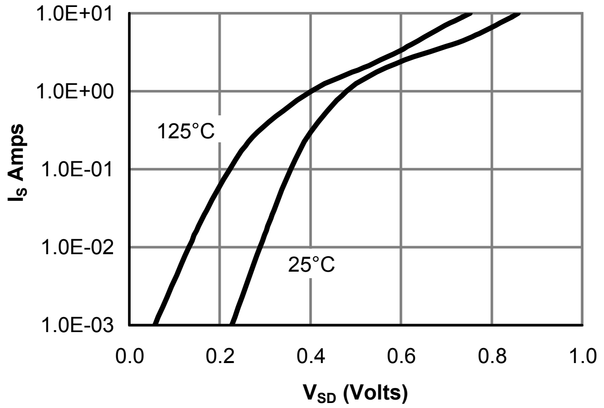


Figure 6: Body diode characteristics MOSFET+Schottky

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

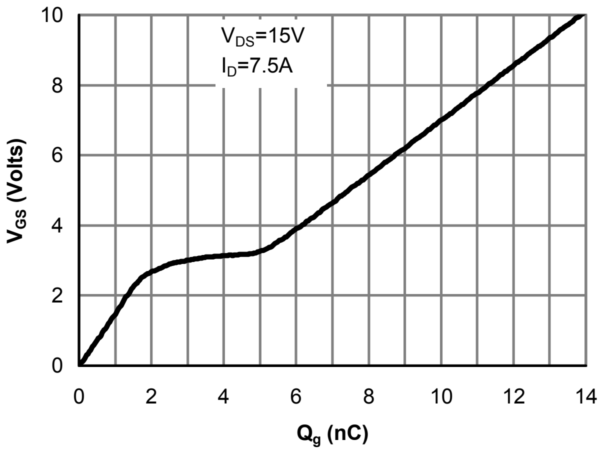


Figure 7: Gate-Charge characteristics

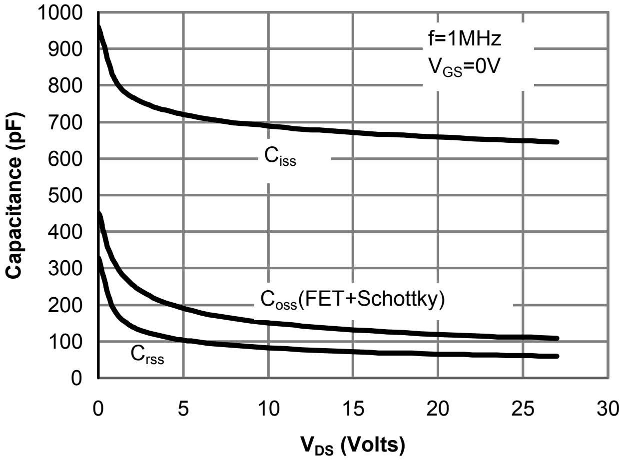


Figure 8: Capacitance Characteristics

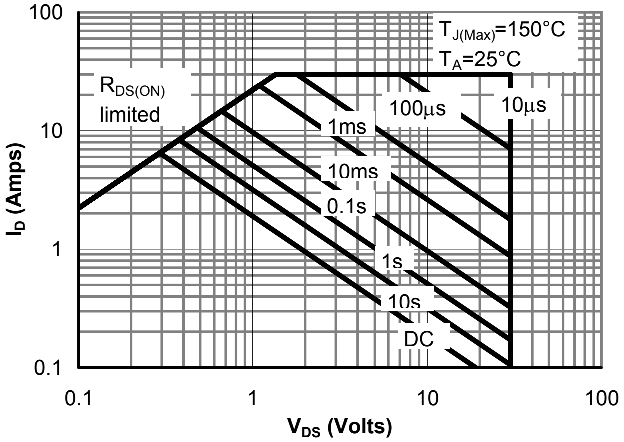


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

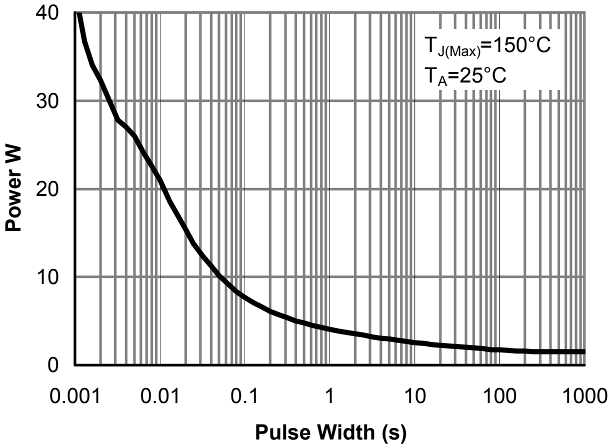


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

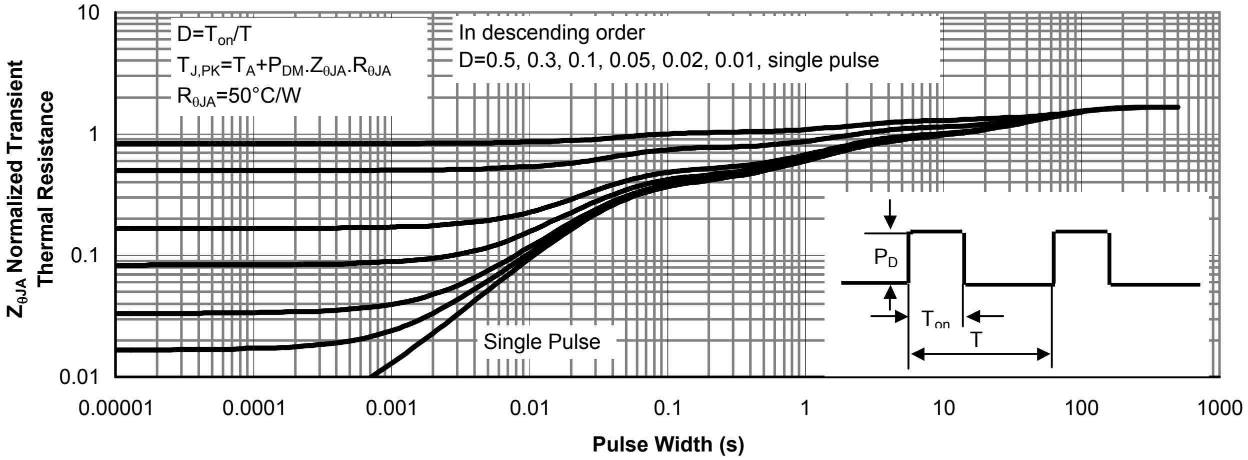
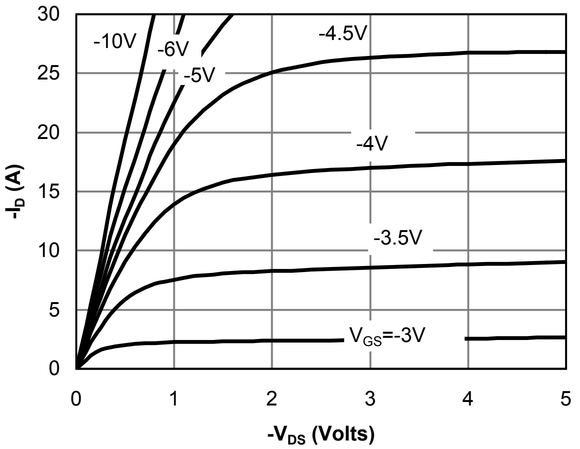


Figure 11: Normalized Maximum Transient Thermal Impedance

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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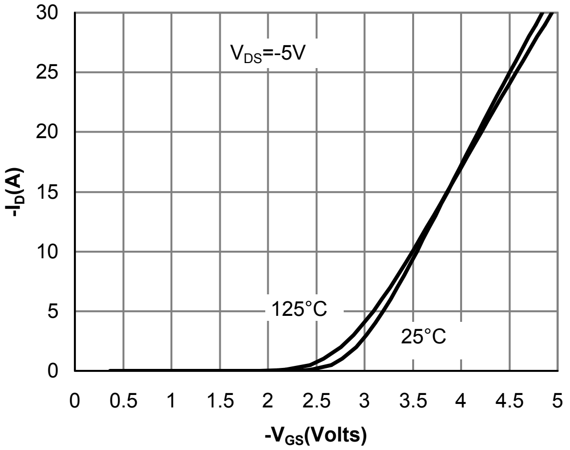


Figure 2: Transfer Characteristics

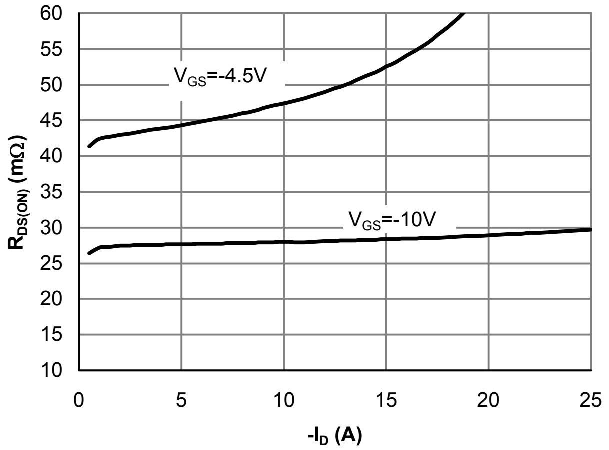


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

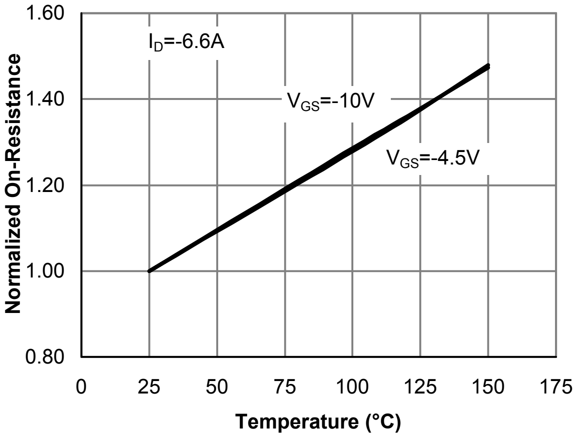


Figure 4: On-Resistance vs. Junction Temperature

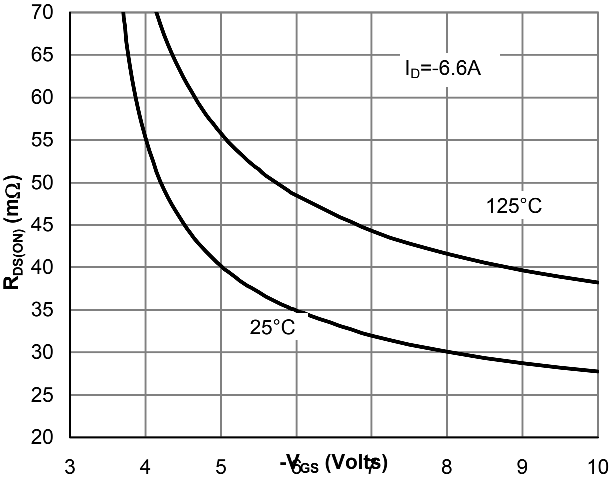


Figure 5: On-Resistance vs. Gate-Source Voltage

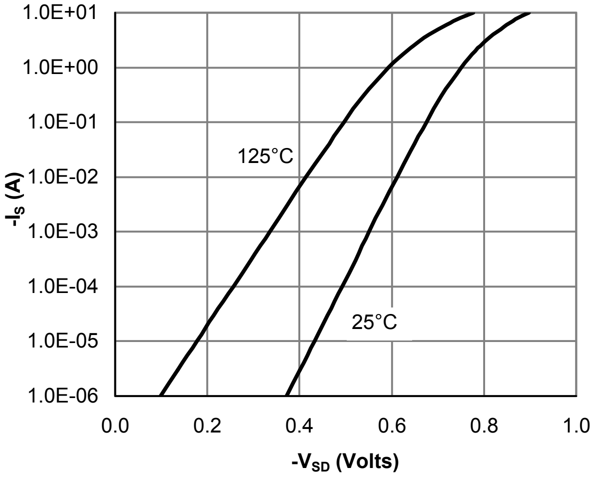


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

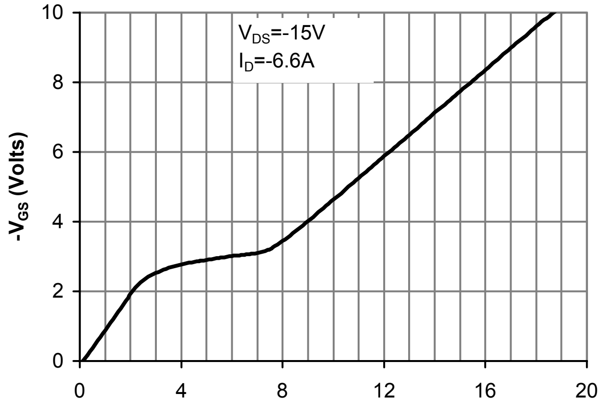


Figure 7: Gate-Charge Characteristics

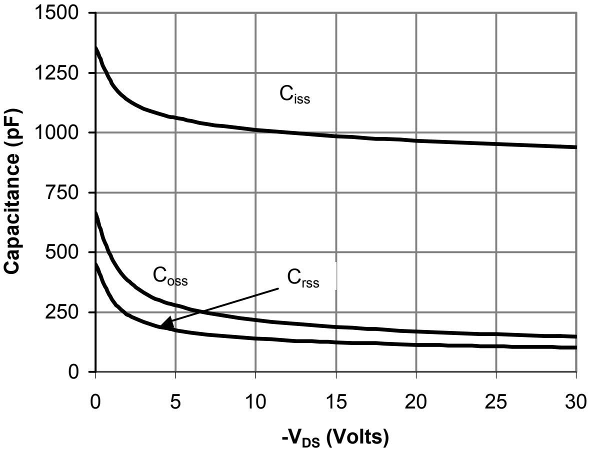


Figure 8: Capacitance Characteristics

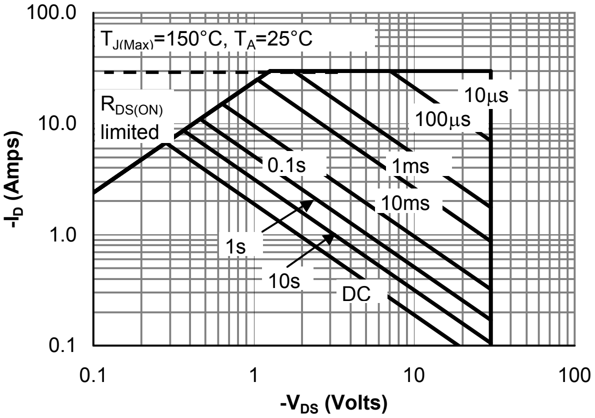


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

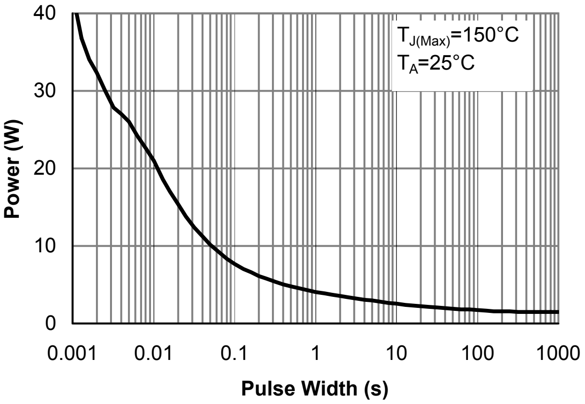


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

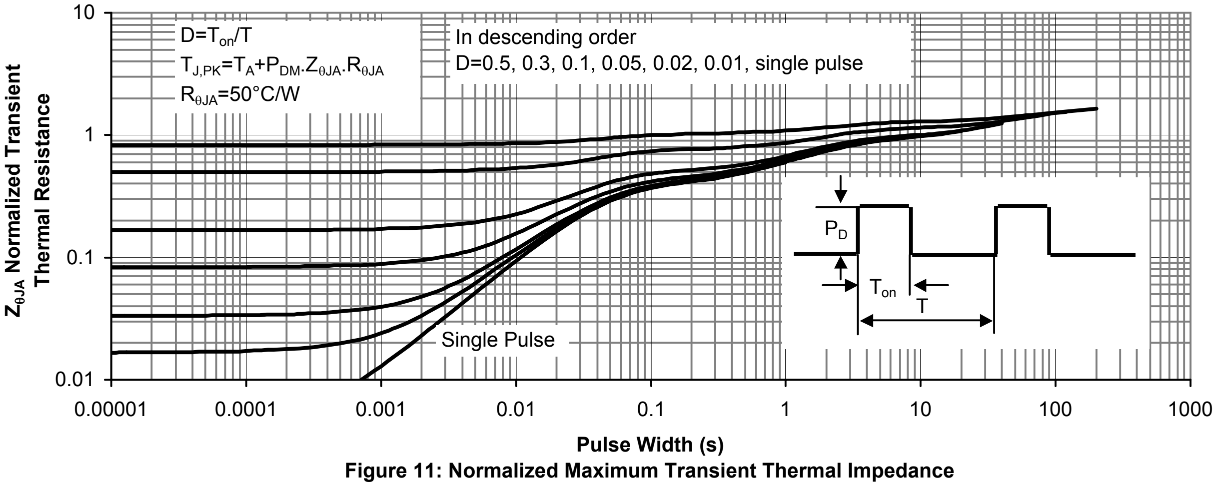


Figure 11: Normalized Maximum Transient Thermal Impedance

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: SCHOTTKY

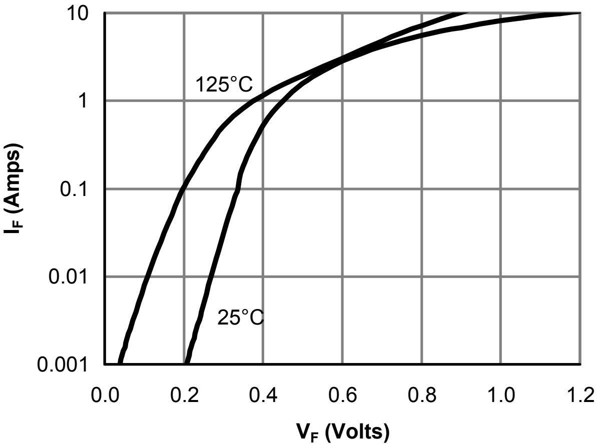


Figure 12: Schottky Forward Characteristics

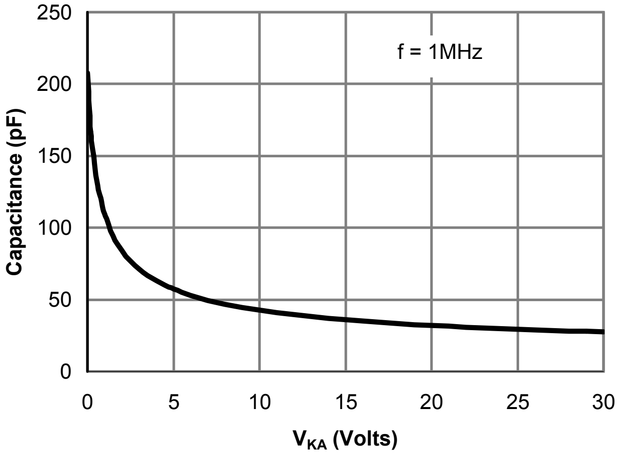


Figure 13: Schottky Capacitance Characteristics

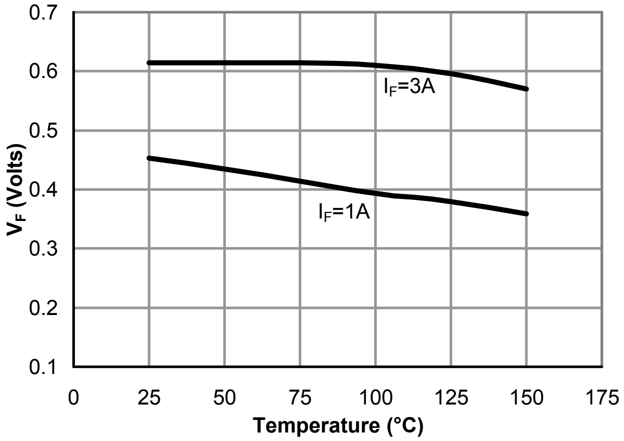


Figure 14: Schottky Forward Drop vs. Junction Temperature

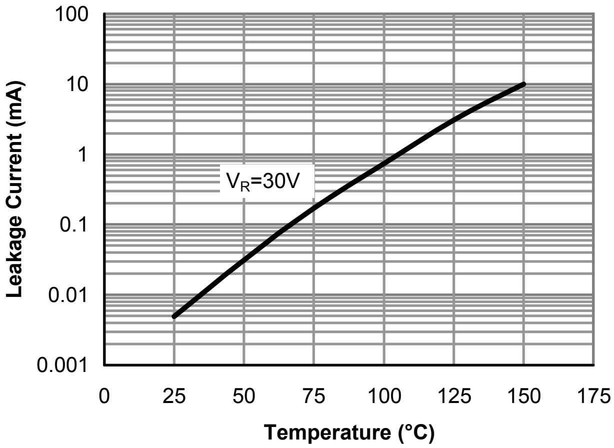


Figure 15: Schottky Leakage current vs. Junction Temperature

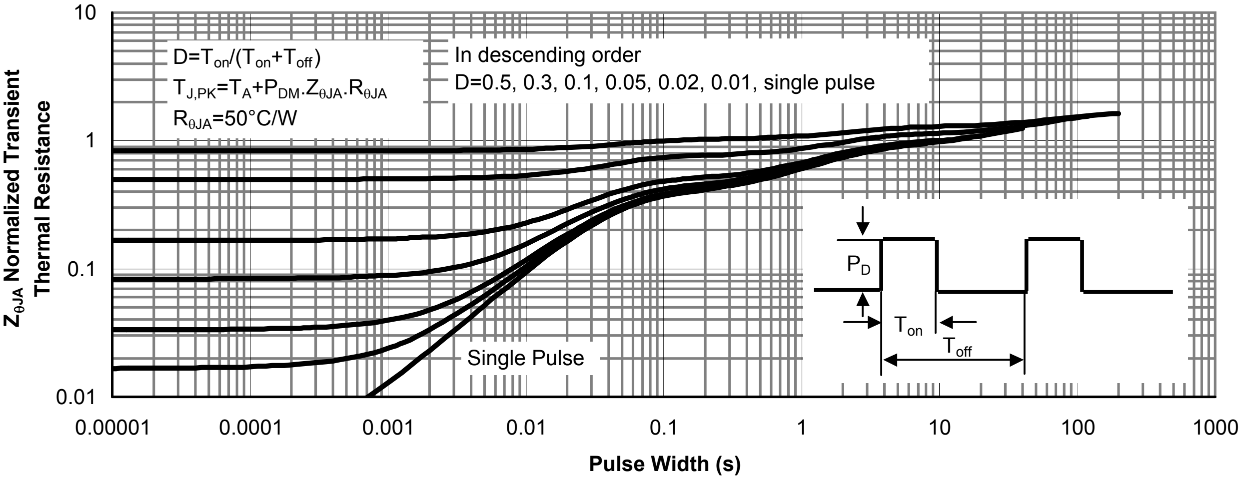
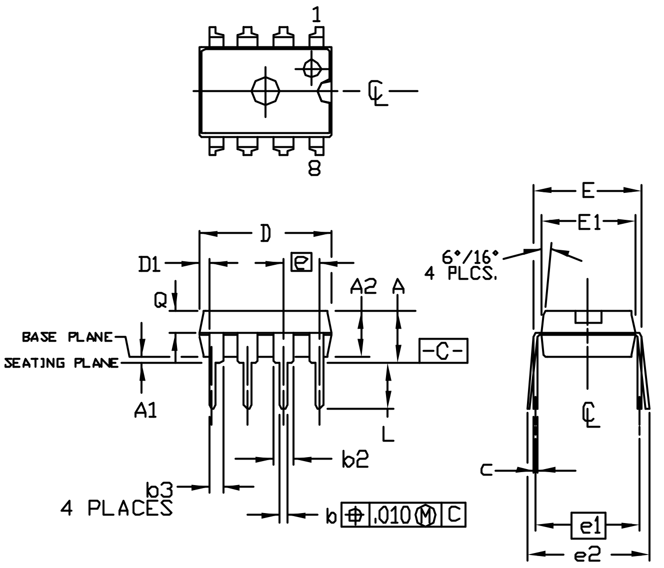


Figure 15: Schottky Normalized Maximum Transient Thermal Impedance

ALPHA & OMEGA

SEMICONDUCTOR, INC.

PDIP-8 (300) Package Data



SYMBOL	INCHES			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			4.32			.170
A1	.38			.015		
A2	2.92	3.30	4.95	.115	.130	.195
b	0.41	0.46	0.51	.016	.018	.020
b1	0.36	0.46	0.51	.014	.018	.020
b2	1.40	1.52	1.65	.055	.060	.065
b3	0.76	0.99	1.14	.030	.039	.045
c	0.20	0.25	0.30	.008	.010	.012
c1	0.20	0.25	0.28	.008	.010	.011
D	9.14	9.27	9.65	.360	.365	.380
D1	0.46	0.58	0.71	.018	.023	.028
E	7.62		8.26	.300		.325
E1	6.10	6.40	6.60	.240	.252	.260
e	2.54 BSC			.100 BSC		
e1	7.62 BSC			.300 BSC		
e2			10.92			.430
L	3.18		3.43	.125		.135
N	8			8		
Q	1.40	1.52	1.65	.055	.060	.065

NOTE:
1. LEAD FINISH: 150 MICROINCHES (3.8 um) MIN. THICKNESS OF Tin/Lead (SOLDER) PLATED ON LEAD
2. TOLERANCE ±0.100 mm (4 mil) UNLESS OTHERWISE SPECIFIED
3. COPLANARITY : 0.1000 mm
4. DIMENSION L IS MEASURED IN GAGE PLANE

PACKAGE MARKING DESCRIPTION

NOTE:

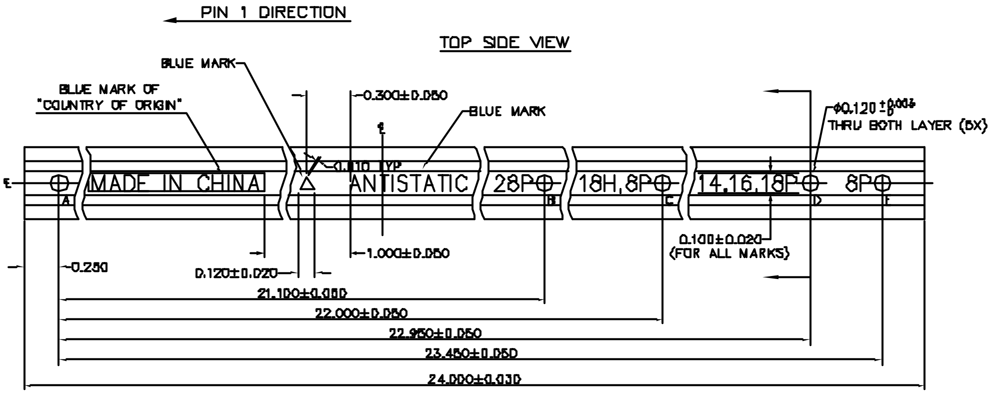
LG	- AOS LOGO
PARTN	- PART NUMBER CODE.
F	- FAB LOCATION
A	- ASSEMBLY LOCATION
Y	- YEAR CODE
W	- WEEK CODE.
L N	- ASSEMBLY LOT CODE

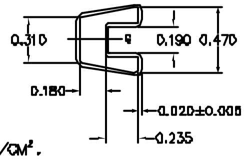
PDIP-8 PART NO. CODE

PART NO.	CODE	PART NO.	CODE	PART NO.	CODE
AOP604	P604				

PDIP-8 (300) Tube Data

PDIP-8 Tube





NOTES:

1. PLASTIC CARRIER THERMAL REQUIREMENTS TO 125°F WITHOUT DISTORTION OR DETERIORATION IN ANTI-STATIC PROPERTIES.
2. CLARITY : PARTS IN TUBE TO BE CLEARLY VISIBLE IN DAYLIGHT TO THE NAKED EYE.
3. TUBE TO BE COATED (INSIDE AND OUT) WITH ANTI-STATIC AGENTS (PI-23820) AND THE SURFACE RESISTIVITY SHALL BE BETWEEN 10^5 TO 10^{12} OHM/CM^2.
4. MAT'L : MODIFIED ACRYLIC OR RIGID PVC.
5. FLATNESS ; TUBE TO BE FLAT WITH 1/32 INCH.
6. BLUE MARK OF "△ ANTISTATIC 28P 8P 14, 16, 18P " SHALL BE PUT ON TOP SURFACE OF TUBE AND SHALL PASS*COTTON BRUSH TEST. (5 CYCLES)*
7. TUBE WITH RIPPLE SURFACE AT PACKAGE LOADING AREA THAT AFFECT PACKAGE VISIBILITY SHALL BE REJECTABLE.
8. ALL DIMENSION ARE IN INCH.