



**ALPHA & OMEGA**  
SEMICONDUCTOR

**AO4456**

**N-Channel Enhancement Mode Field Effect Transistor**

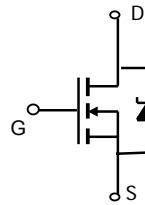
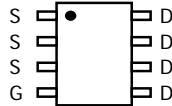


**General Description**

The AO4456 uses advanced trench technology with a monolithically integrated Schottky diode to provide excellent  $R_{DS(ON)}$  and low gate charge. This device is suitable for use as a low side FET in SMPS, load switching and general purpose applications. *Standard Product AO4456 is Pb-free (meets ROHS & Sony 259 specifications). AO4456 is a Green Product ordering option. AO4456 and AO4456 are electrically identical.*

**Features**

- $V_{DS}$  (V) = 30V
- $I_D = 20A$  ( $V_{GS} = 10V$ )
- $R_{DS(ON)} < 4.6m\Omega$  ( $V_{GS} = 10V$ )
- $R_{DS(ON)} < 5.6m\Omega$  ( $V_{GS} = 4.5V$ )



**Absolute Maximum Ratings  $T_A=25^\circ C$  unless otherwise noted**

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	30	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	V
Continuous Drain Current <sup>A</sup>	$I_{DSM}$	$T_A=25^\circ C$	20
		$T_A=70^\circ C$	16
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	120	
Power Dissipation	$P_{DSM}$	$T_A=25^\circ C$	3.1
		$T_A=70^\circ C$	2.0
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	$^\circ C$

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Units	
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	$t \leq 10s$	31	40	$^\circ C/W$
		Steady-State	59	75	$^\circ C/W$
Maximum Junction-to-Lead <sup>C</sup>	$R_{\theta JL}$	16	24	$^\circ C/W$	

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=1\text{mA}, V_{GS}=0\text{V}$	30			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=24\text{V}, V_{GS}=0\text{V}$ $T_J=125^\circ\text{C}$		0.008 9	0.1 20	mA
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}, V_{GS}=\pm 12\text{V}$			0.1	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	1.4	1.8	2.4	V
$I_{D(ON)}$	On state drain current	$V_{GS}=10\text{V}, V_{DS}=5\text{V}$	120			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}, I_D=20\text{A}$ $T_J=125^\circ\text{C}$		3.8 5.9	4.6 7.4	m $\Omega$
		$V_{GS}=4.5\text{V}, I_D=20\text{A}$		4.5	5.6	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=5\text{V}, I_D=20\text{A}$		112		S
$V_{SD}$	Diode Forward Voltage	$I_S=1\text{A}, V_{GS}=0\text{V}$		0.37	0.5	V
$I_S$	Maximum Body-Diode + Schottky Continuous Current				5	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=15\text{V}, f=1\text{MHz}$		6430	7716	pF
$C_{oss}$	Output Capacitance			756		pF
$C_{riss}$	Reverse Transfer Capacitance			352		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$		0.9	1.4	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}, V_{DS}=15\text{V}, I_D=20\text{A}$		96	115	
$Q_g(4.5\text{V})$	Total Gate Charge			44	53	nC
$Q_{gs}$	Gate Source Charge			17		nC
$Q_{gd}$	Gate Drain Charge			13		nC
$t_{D(on)}$	Turn-On Delay Time	$V_{GS}=10\text{V}, V_{DS}=15\text{V}, R_L=0.75\Omega,$ $R_{GEN}=3\Omega$		17.5		ns
$t_r$	Turn-On Rise Time			10		ns
$t_{D(off)}$	Turn-Off Delay Time			56		ns
$t_f$	Turn-Off Fall Time			10.5		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=20\text{A}, dI/dt=300\text{A}/\mu\text{s}$		20	25	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=20\text{A}, dI/dt=300\text{A}/\mu\text{s}$		26		nC

A: The value of  $R_{\theta JA}$  is measured with the device in a still air environment with  $T_A=25^\circ\text{C}$ . The power dissipation  $P_{DSM}$  and current rating  $I_{DSM}$  are based on  $T_J(\text{MAX})=150^\circ\text{C}$ , using  $t \leq 10\text{s}$  junction-to-ambient thermal resistance.

B: Repetitive rating, pulse width limited by junction temperature  $T_J(\text{MAX})=150^\circ\text{C}$ .

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

D: The static characteristics in Figures 1 to 6 are obtained using  $<300\text{ms}$  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  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

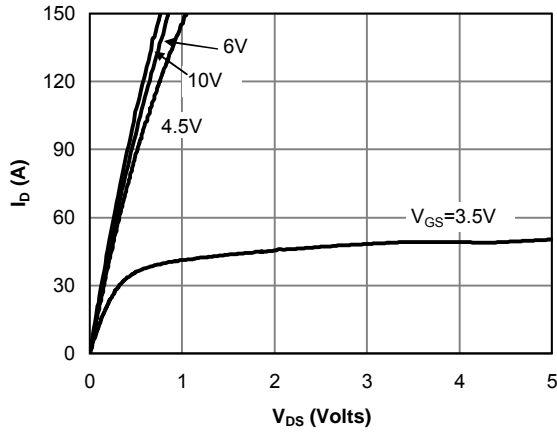


Fig 1: On-Region Characteristics

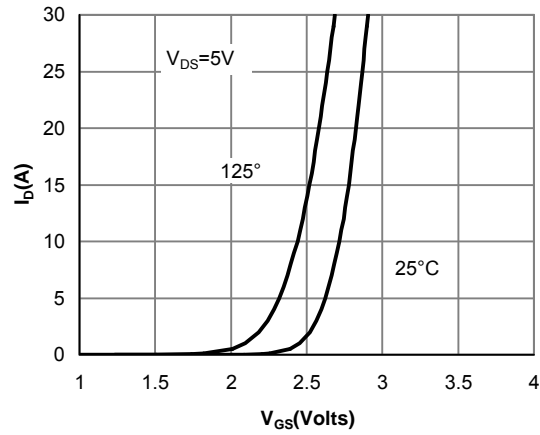


Figure 2: Transfer Characteristics

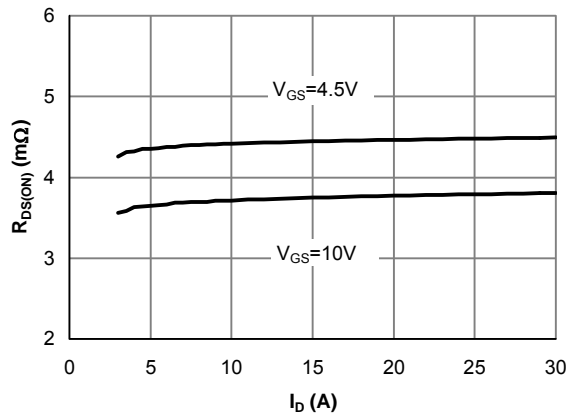


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

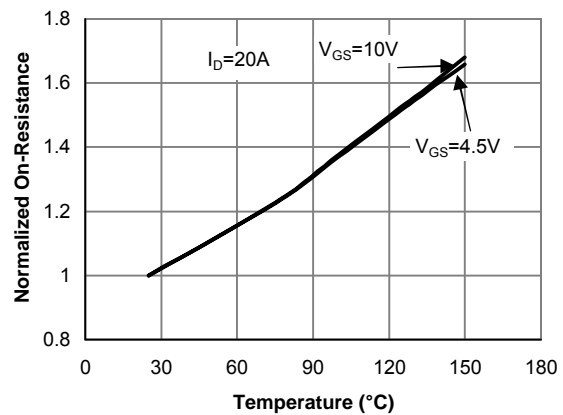


Figure 4: On-Resistance vs. Junction Temperature

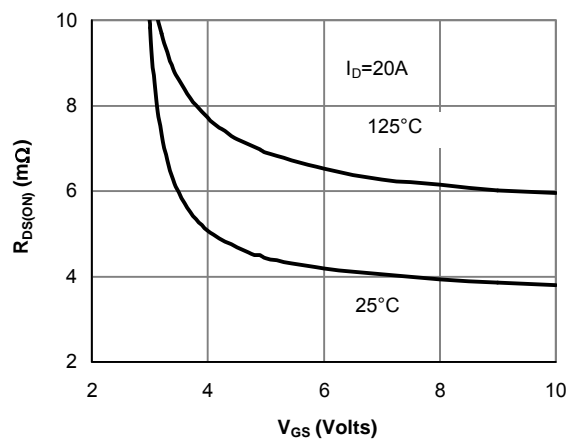


Figure 5: On-Resistance vs. Gate-Source Voltage

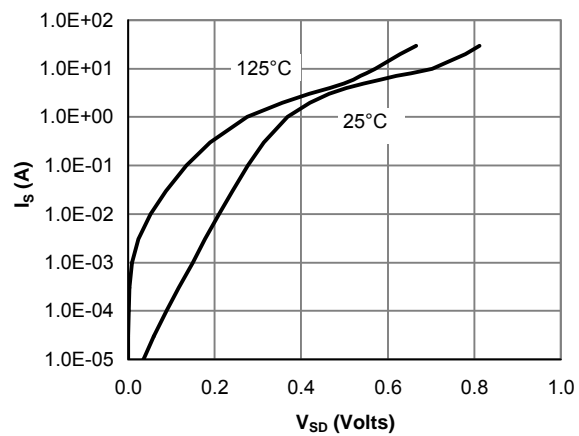


Figure 6: Body-Diode Characteristics

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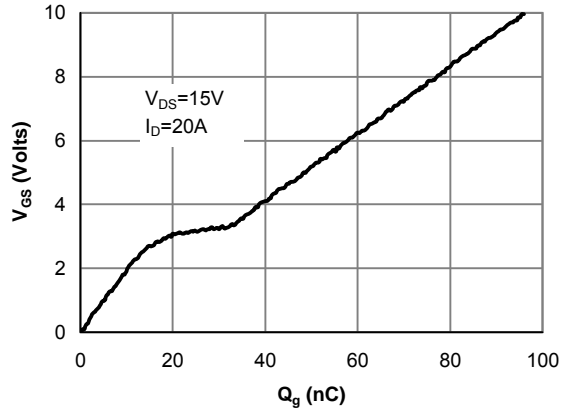


Figure 7: Gate-Charge Characteristics

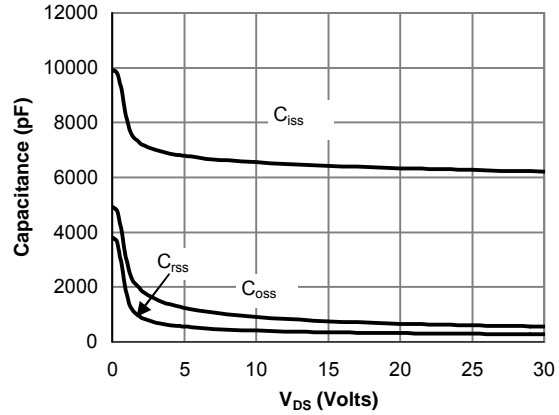


Figure 8: Capacitance Characteristics

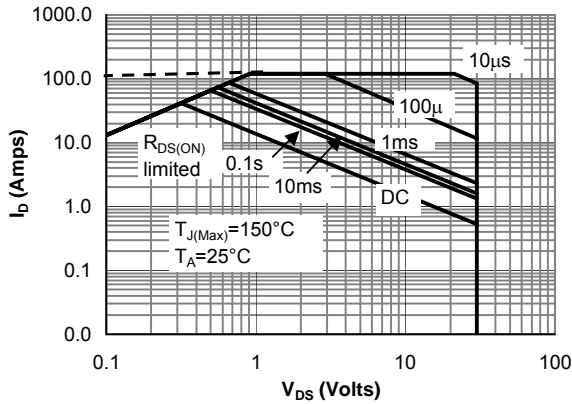


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

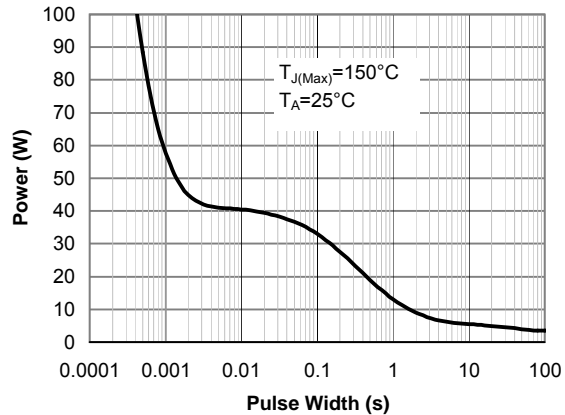


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

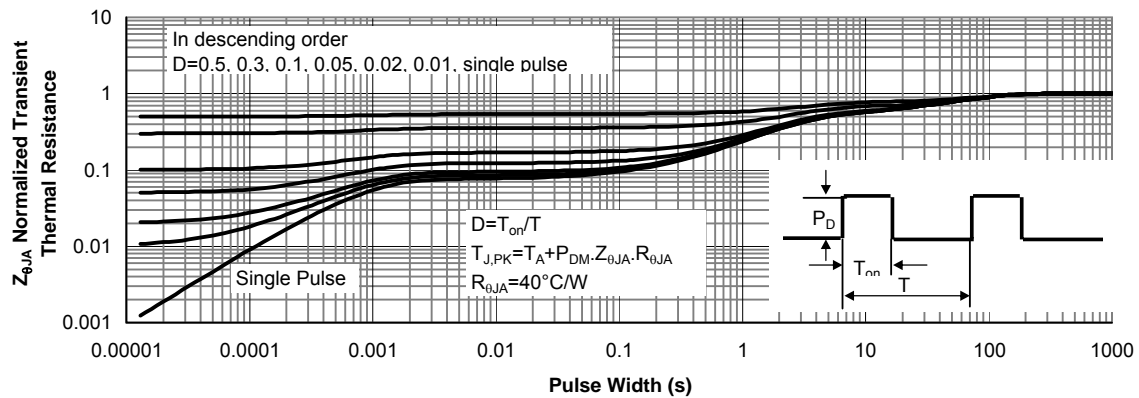


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

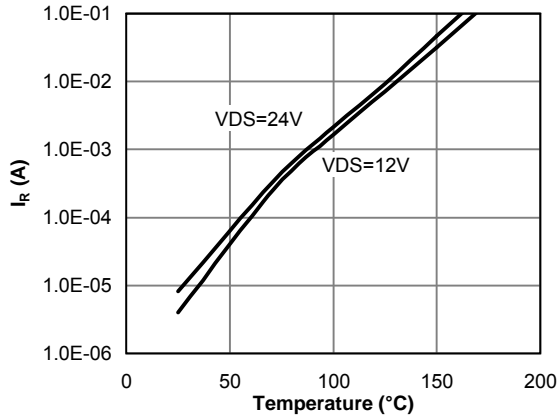


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

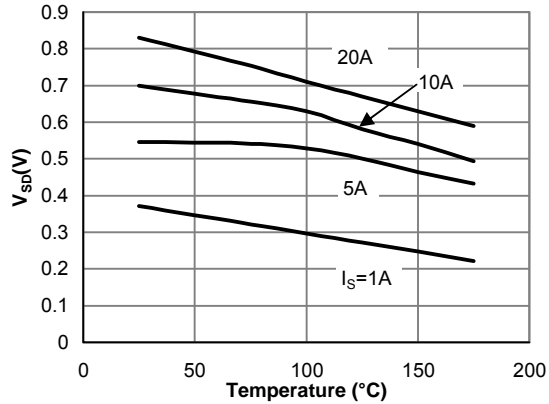


Figure 13: Diode Forward voltage vs. Junction Temperature

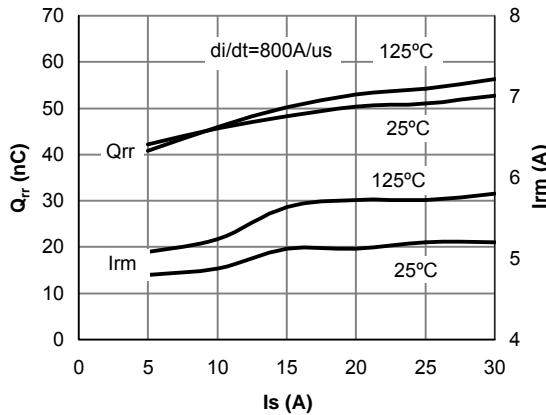


Figure 14: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current

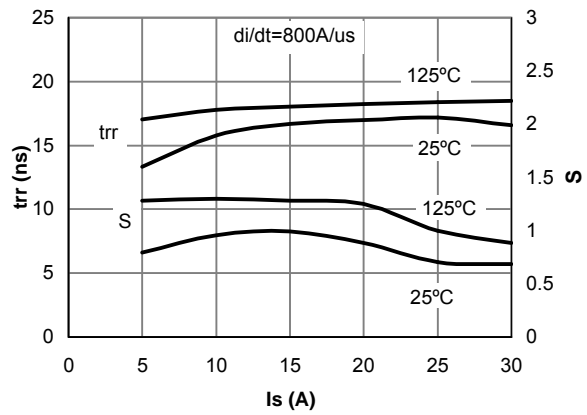


Figure 15: Diode Reverse Recovery Time and Soft Coefficient vs. Conduction Current

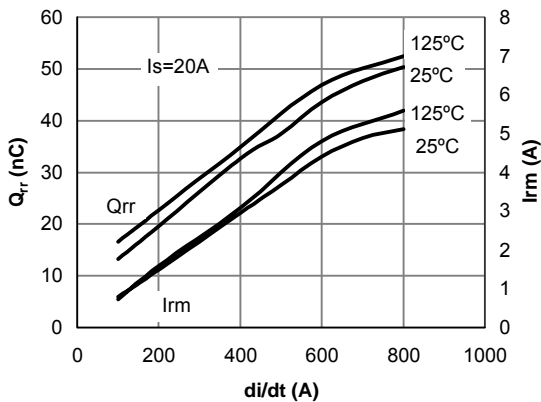


Figure 16: Diode Reverse Recovery Charge and Peak Current vs. di/dt

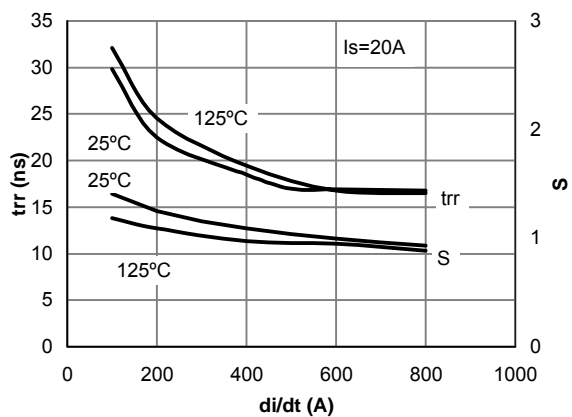


Figure 17: Diode Reverse Recovery Time and Soft Coefficient vs. di/dt