

# N0400P

R07DS0500EJ0200

Rev.2.00

Aug 19, 2011

## MOS FIELD EFFECT TRANSISTOR

### Description

The N0400P is P-channel MOS Field Effect Transistor designed for high current and 2.5 V drive switching applications.

### Features

- 2.5 V drive available
- Super low on-state resistance  
 $R_{DS(on)1} = 40 \text{ m}\Omega \text{ MAX. (} V_{GS} = -4.5 \text{ V, } I_D = -7.5 \text{ A)}$   
 $R_{DS(on)2} = 73 \text{ m}\Omega \text{ MAX. (} V_{GS} = -2.5 \text{ V, } I_D = -3.8 \text{ A)}$
- Built-in gate protection diode

### Ordering Information

PART NUMBER	LEAD PLATING	PACKING	PACKAGE
N0400P-ZK-E1-AY <sup>Note</sup>	Pure Sn (Tin)	Tape 2500 p/reel	TO-252 (MP-3ZK)
N0400P-ZK-E2-AY <sup>Note</sup>			

**Note** Pb-free (This product does not contain Pb in external electrode.)

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )

Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{DSS}$	-40	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GSS}$	$\pm 12$	V
Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\pm 15$	A
Drain Current (pulse) <sup>Note1</sup>	$I_{D(pulse)}$	$\pm 45$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	25	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T2}$	1.0	W
Channel Temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Avalanche Current <sup>Note2</sup>	$I_{AS}$	-16	A
Single Avalanche Energy <sup>Note2</sup>	$E_{AS}$	25	mJ

**Notes 1.**  $PW \leq 10 \text{ }\mu\text{s}$ , Duty Cycle  $\leq 1\%$

**2.** Starting  $T_{ch} = 25^\circ\text{C}$ ,  $V_{DD} = -20 \text{ V}$ ,  $R_G = 25 \text{ }\Omega$ ,  $V_{GS} = -12 \rightarrow 0 \text{ V}$

### Thermal Resistance

Channel to Case Thermal Resistance	$R_{th(ch-C)}$	5.0	$^\circ\text{C/W}$
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$	125	$^\circ\text{C/W}$

The mark <R> shows major revised points.

The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

Electrical Characteristics (T<sub>A</sub> = 25°C)

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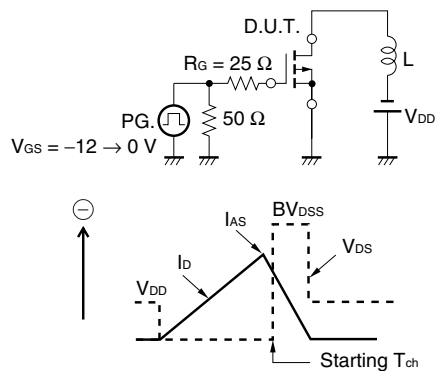
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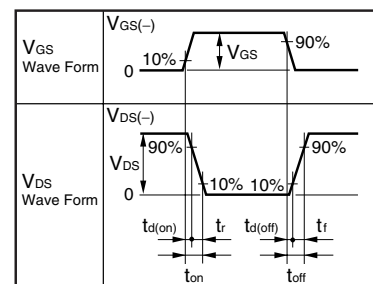
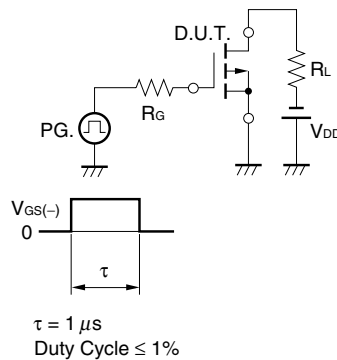
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -40 V, V <sub>GS</sub> = 0 V			-10	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±12 V, V <sub>DS</sub> = 0 V			±10	μA
Gate to Source Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 mA	-0.5	-1.0	-1.5	V
Forward Transfer Admittance <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -7.5 A	6.0			S
Drain to Source On-state Resistance <sup>Note</sup>	R <sub>DS(on)1</sub>	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -7.5 A		31	40	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -3.8 A		40	73	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = -10 V,		1400		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V,		200		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		155		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -20 V, I <sub>D</sub> = -7.5 A,		11		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = -4.5 V,		16		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		104		ns
Fall Time	t <sub>f</sub>			93		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = -32 V,		16		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = -4.5 V,		3		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = -15 A		7		nC
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = -15 A, V <sub>GS</sub> = 0 V		0.94	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = -15 A, V <sub>GS</sub> = 0 V,		31		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = -100 A/μs		33		nC

**Note** Pulsed: PW ≤ 350 μs, Duty Cycle ≤ 2%

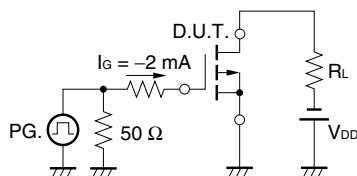
## TEST CIRCUIT 1 AVALANCHE CAPABILITY

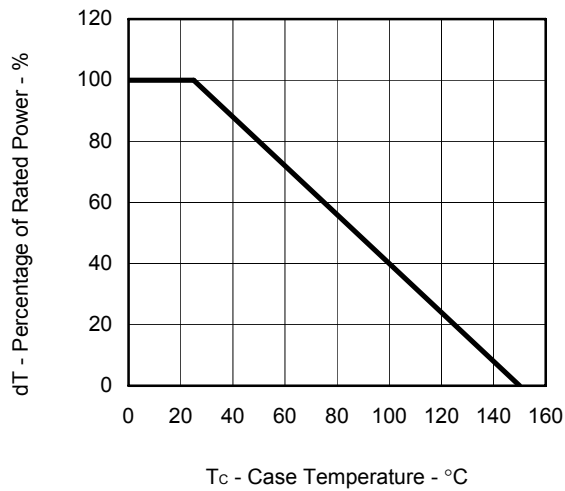
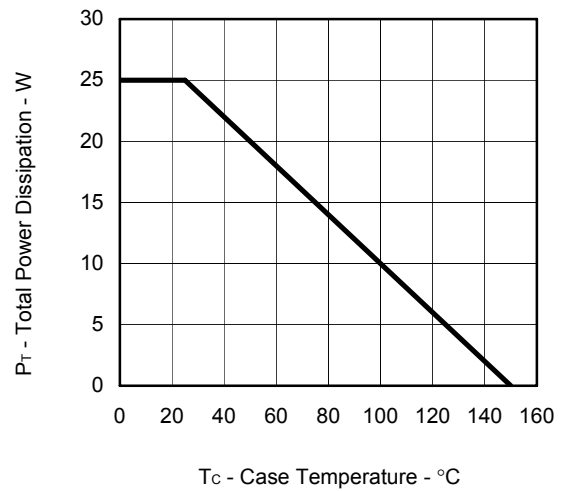


## TEST CIRCUIT 2 SWITCHING TIME

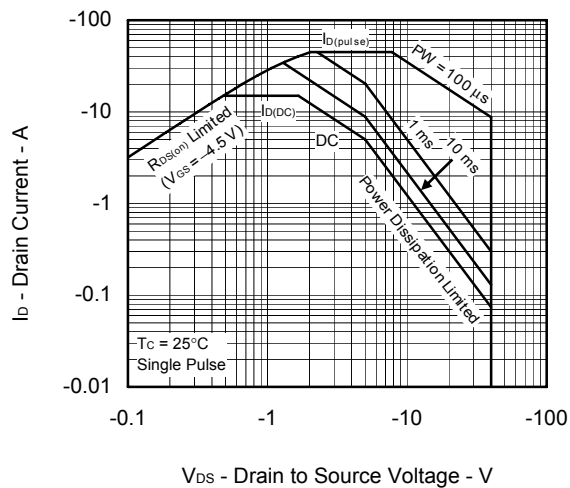


## TEST CIRCUIT 3 GATE CHARGE

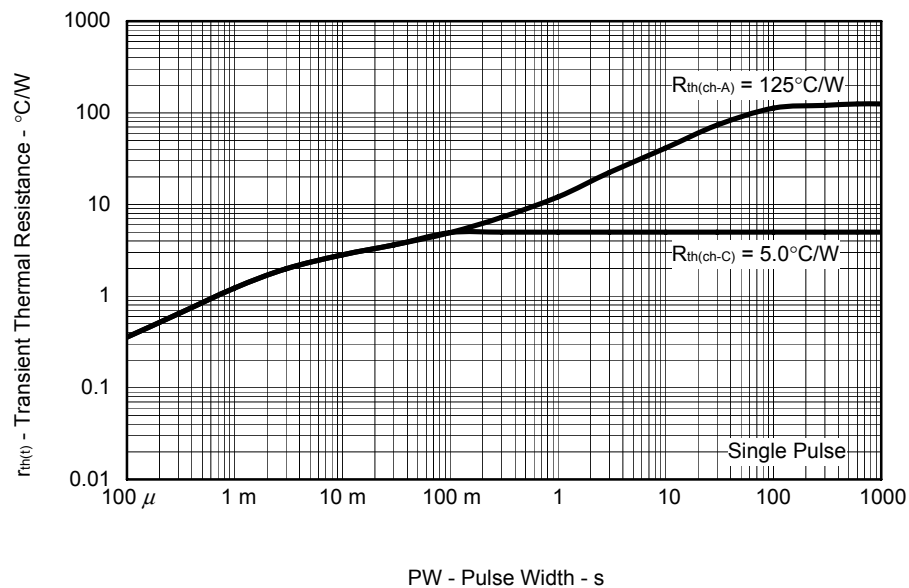


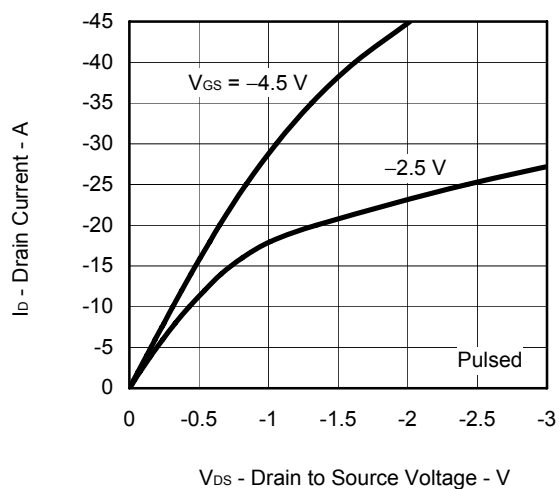
Typical Characteristics ( $T_A = 25^\circ\text{C}$ )DERATING FACTOR OF FORWARD BIAS  
SAFE OPERATING AREATOTAL POWER DISSIPATION vs.  
CASE TEMPERATURE

FORWARD BIAS SAFE OPERATING AREA

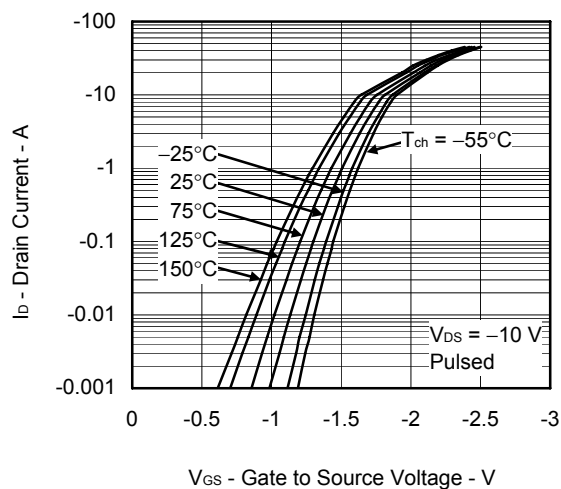
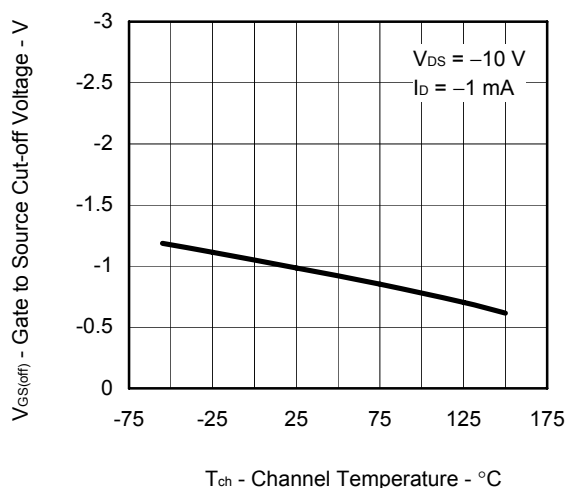
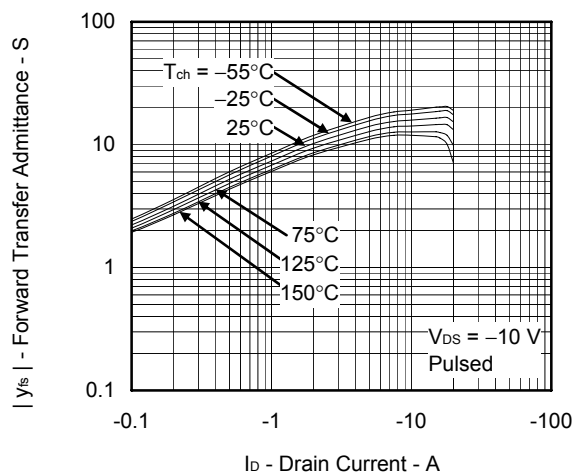
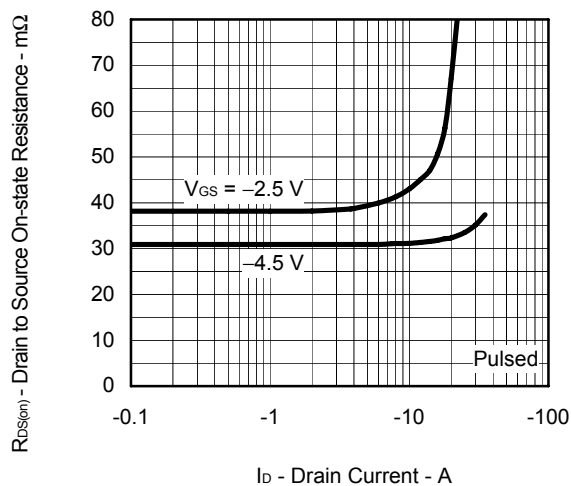
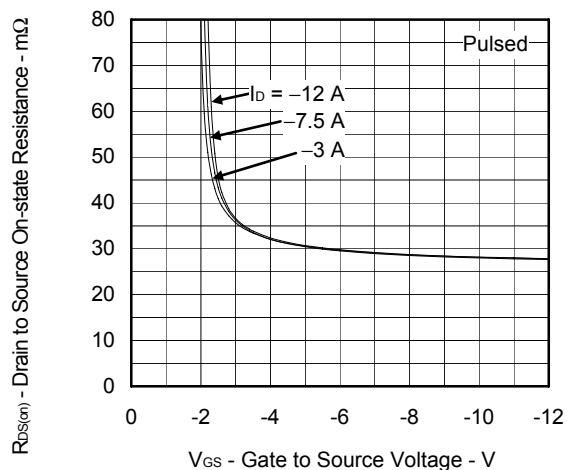


TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

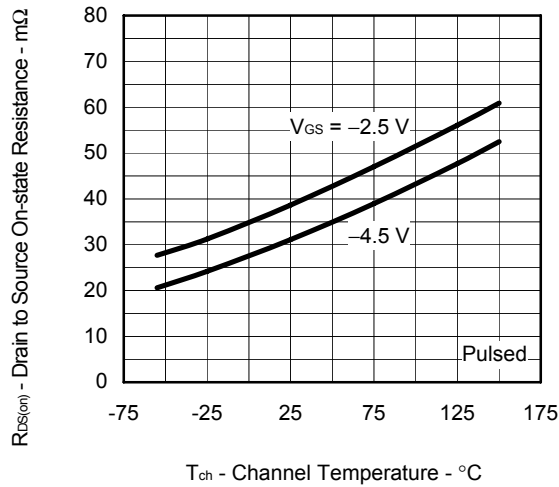


DRAIN CURRENT vs.  
DRAIN TO SOURCE VOLTAGE

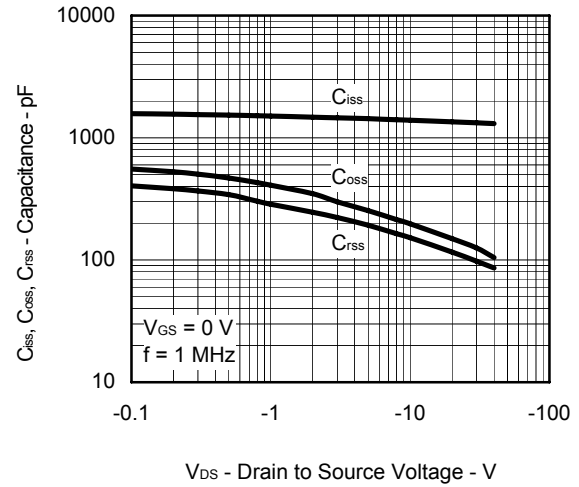
FORWARD TRANSFER CHARACTERISTICS

GATE TO SOURCE CUT-OFF VOLTAGE vs.  
CHANNEL TEMPERATUREFORWARD TRANSFER ADMITTANCE vs.  
DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.  
DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.  
GATE TO SOURCE VOLTAGE

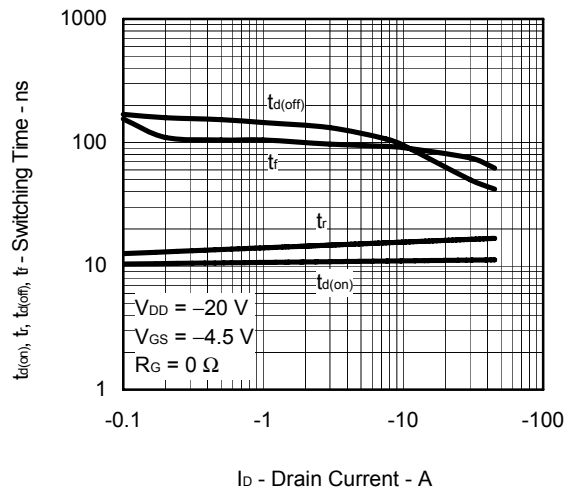
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



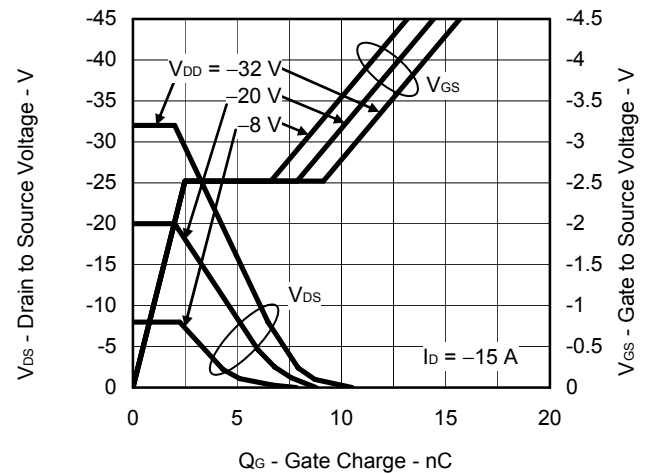
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



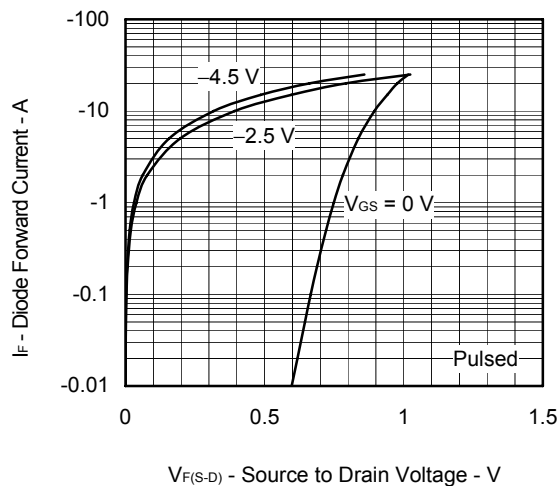
SWITCHING CHARACTERISTICS



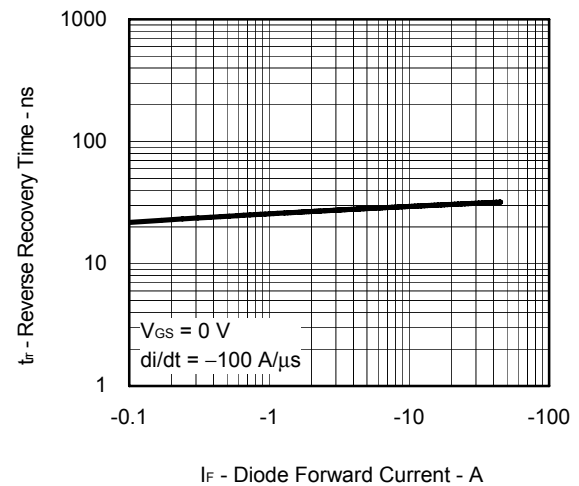
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



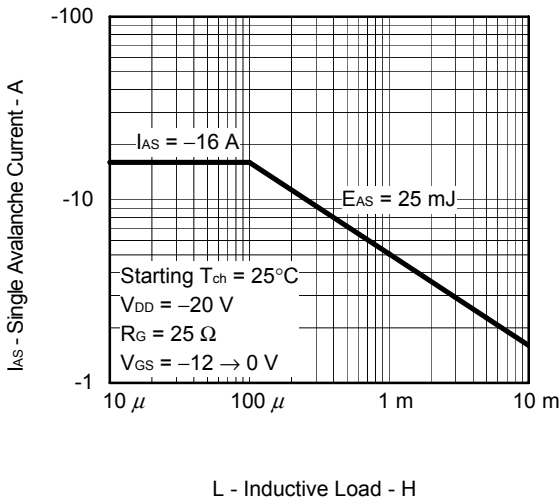
SOURCE TO DRAIN DIODE FORWARD VOLTAGE



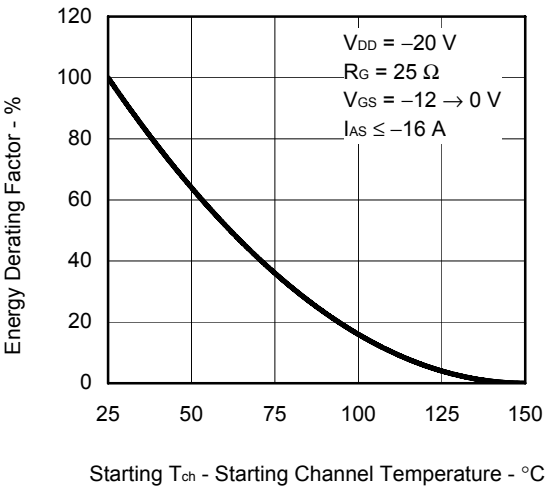
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



SINGLE AVALANCHE CURRENT vs.  
INDUCTIVE LOAD



SINGLE AVALANCHE ENERGY  
DERATING FACTOR





<b>Revision History</b>	<b>N0400P Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
–	Feb 2011	–	Previous No. : D19676EJ1V0DS00
2.00	Aug 19, 2011	p.2	Modification of <b>Electrical Characteristics</b>

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