

μ PA2593

R07DS0012EJ0200

Rev.2.00

Sep 10, 2010

MOS FIELD EFFECT TRANSISTOR

Description

The μPA2593 is N- and P-channel MOSFETs designed for DC/DC converters and power management applications of portable equipments.

N- and P-channel MOSFETs are assembled in one package, to contribute minimize the equipments.

Features

- 4.5 V drive available
- Low on-state resistance
 - N-channel
 - $R_{DS(on)1} = 58 \text{ m}\Omega \text{ MAX.}$ ($V_{GS} = 10 \text{ V}$, $I_D = 2 \text{ A}$)
 - $R_{DS(on)2} = 103 \text{ m}\Omega \text{ MAX.}$ ($V_{GS} = 4.5 \text{ V}$, $I_D = 2 \text{ A}$)
 - P-channel
 - $R_{DS(on)1} = 140 \text{ m}\Omega \text{ MAX.}$ ($V_{GS} = -10 \text{ V}$, $I_D = -2 \text{ A}$)
 - $R_{DS(on)2} = 195 \text{ m}\Omega \text{ MAX.}$ ($V_{GS} = -4.5 \text{ V}$, $I_D = -2 \text{ A}$)
- Built-in gate protection diode
- Small and surface mount package (8-pin VSO (2429))

Ordering Information

Part No.	LEAD PLATING	PACKING	Package
μ PA2593T1H-T1-AT *1	Pure Sn (Tin)	8 mm embossed taping	8-pin VSO (2429)
μ PA2593T1H-T2-AT *1		3000 p/reel	

Note: *1. Pb-free (This product does not contain Pb in the external electrode and other parts.)

Marking: 2593

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

Item	Symbol	N-CHANNEL	P-CHANNEL	Unit
Drain to Source Voltage ($V_{GS} = 0 \text{ V}$)	V_{DSS}	40	-40	V
Gate to Source Voltage ($V_{DS} = 0 \text{ V}$)	V_{GSS}	± 18	∓ 18	V
Drain Current (DC)	$I_{D(DC)}$	± 4.5	∓ 3.5	A
Drain Current (pulse) *1	$I_{D(pulse)}$	± 18	∓ 18	A
Total Power Dissipation (1 unit, 5 s) *2	P_{T1}	1.5		W
Total Power Dissipation (2 unit, 5 s) *2	P_{T2}	1.24		W
Channel Temperature	T_{ch}	150		$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150		$^\circ\text{C}$

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

*2. Mounted on FR-4 board of 25.4 mm x 25.4 mm x 0.8 mm

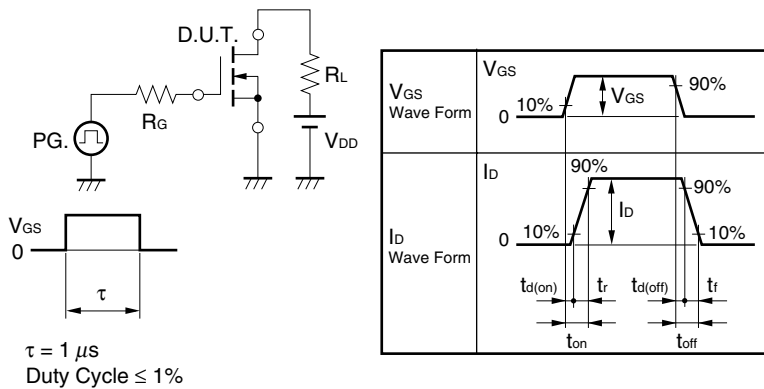
Electrical Characteristics (T_A = 25°C)

N-channel MOSFET

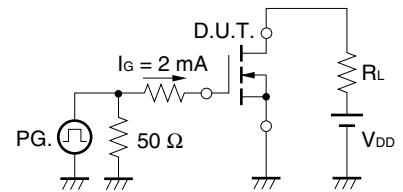
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Zero Gate Voltage Drain Current	I _{DSS}			1	μA	V _{DS} = 40 V, V _{GS} = 0 V
Gate Leakage Current	I _{GSS}			±10	μA	V _{GS} = ±14 V, V _{DS} = 0 V
Gate Cut-off Voltage	V _{GS(off)}	1.0		2.5	V	V _{DS} = 10 V, I _D = 1 mA
Forward Transfer Admittance *1	y _{fs}	2.0			S	V _{DS} = 5 V, I _D = 2 A
Drain to Source On-state Resistance *1	R _{DS(on)1}		50	58	mΩ	V _{GS} = 10 V, I _D = 2 A
	R _{DS(on)2}		70	103	mΩ	V _{GS} = 4.5 V, I _D = 2 A
Input Capacitance	C _{iss}		315		pF	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz
Output Capacitance	C _{oss}		70		pF	
Reverse Transfer Capacitance	C _{rss}		38		pF	
Turn-on Delay Time	t _{d(on)}		5		ns	V _{DD} = 20 V, I _D = 2 A, V _{GS} = 10 V, R _G = 6 Ω
Rise Time	t _r		3		ns	
Turn-off Delay Time	t _{d(off)}		21		ns	
Fall Time	t _f		3		ns	
Total Gate Charge	Q _G		7		nC	V _{DD} = 32 V, V _{GS} = 10 V I _D = 4.5 A
Body Diode Forward Voltage *1	V _{F(S-D)}		0.9		V	I _F = 4.5 A, V _{GS} = 0 V

Note: *1. Pulsed

TEST CIRCUIT 1 SWITCHING TIME



TEST CIRCUIT 2 GATE CHARGE

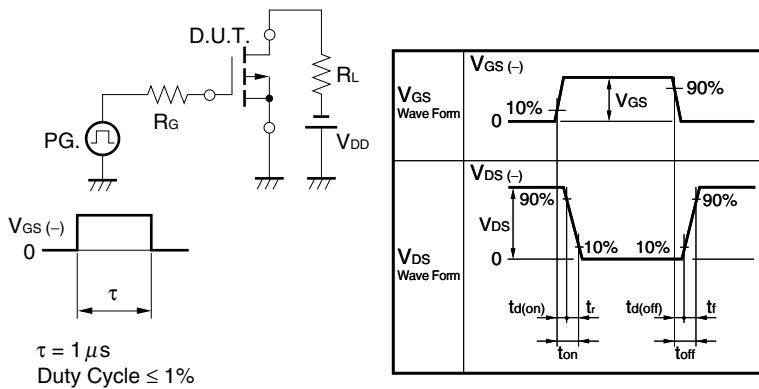


P-channel MOSFET

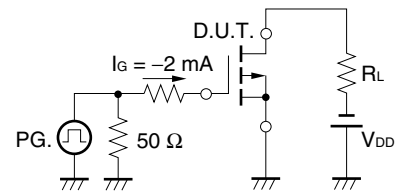
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Zero Gate Voltage Drain Current	I_{DSS}			-1	μA	$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$
Gate Leakage Current	I_{GSS}			±10	μA	$V_{GS} = \mp 14\text{ V}, V_{DS} = 0\text{ V}$
Gate Cut-off Voltage	$V_{GS(off)}$	-1.0		-2.5	V	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$
Forward Transfer Admittance *1	$ y_{fs} $	2.0			S	$V_{DS} = -5\text{ V}, I_D = -2\text{ A}$
Drain to Source On-state Resistance *1	$R_{DS(on)1}$		115	140	mΩ	$V_{GS} = -10\text{ V}, I_D = -2\text{ A}$
	$R_{DS(on)2}$		135	195	mΩ	$V_{GS} = -4.5\text{ V}, I_D = -2\text{ A}$
Input Capacitance	C_{iss}		350		pF	$V_{DS} = -10\text{ V},$ $V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$
Output Capacitance	C_{oss}		60		pF	
Reverse Transfer Capacitance	C_{rss}		47		pF	
Turn-on Delay Time	$t_{d(on)}$		5.5		ns	$V_{DD} = -20\text{ V}, I_D = -2\text{ A},$ $V_{GS} = -10\text{ V},$ $R_G = 6\ \Omega$
Rise Time	t_r		3.5		ns	
Turn-off Delay Time	$t_{d(off)}$		40		ns	
Fall Time	t_f		8		ns	
Total Gate Charge	Q_G		8		nC	$V_{DD} = -32\text{ V}, V_{GS} = -10\text{ V}$ $I_D = -3.5\text{ A}$
Body Diode Forward Voltage *1	$V_{F(S-D)}$		0.95		V	$I_F = -3.5\text{ A}, V_{GS} = 0\text{ V}$

Note: *1. Pulsed

TEST CIRCUIT 1 SWITCHING TIME



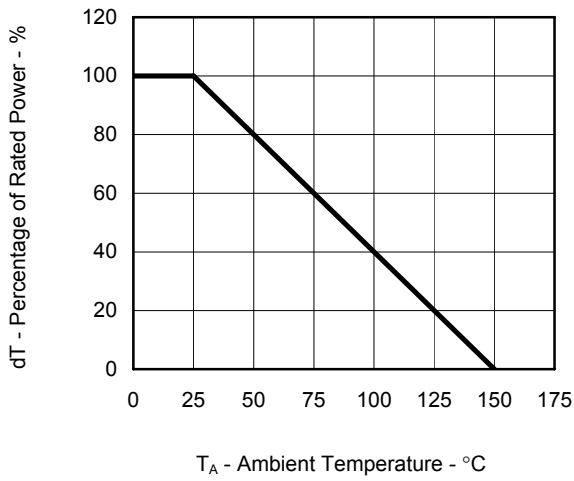
TEST CIRCUIT 2 GATE CHARGE



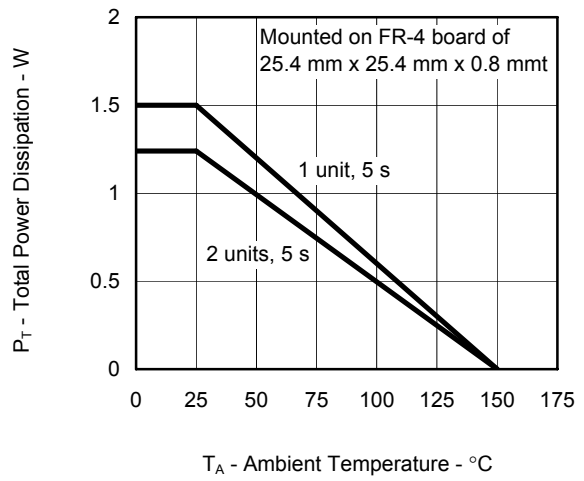
Typical Characteristics (T_A = 25°C)

(1) N-channel MOSFET

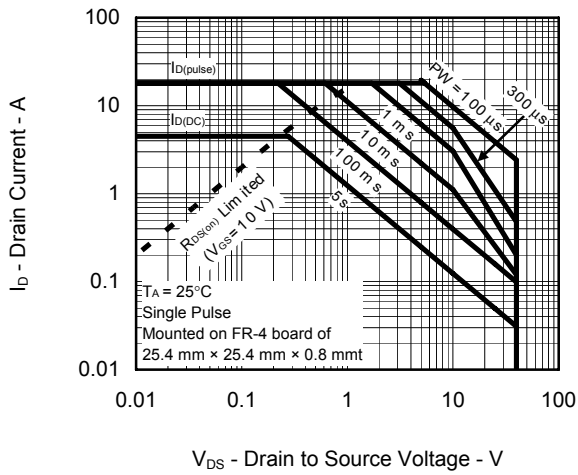
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



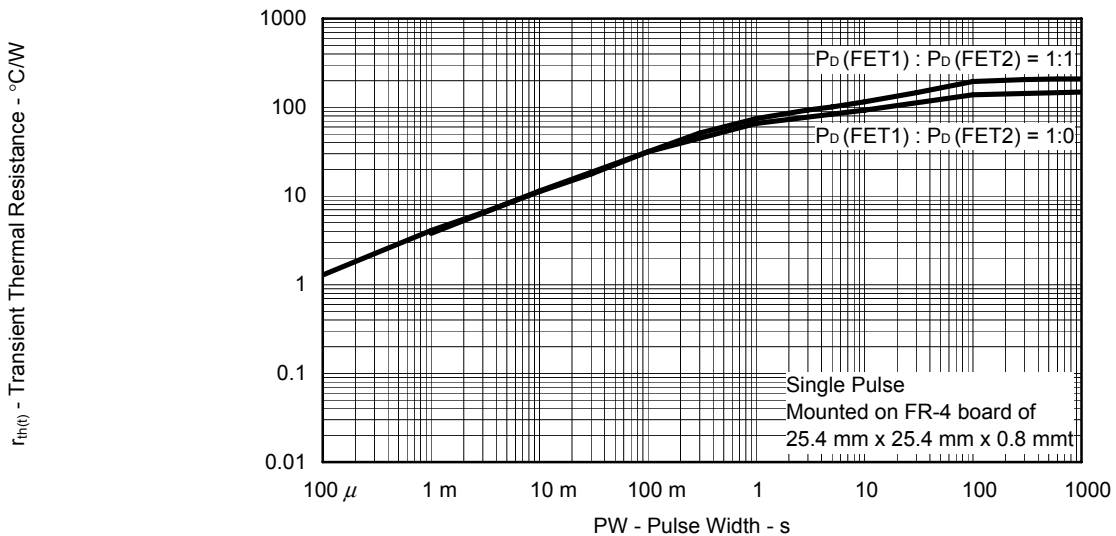
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



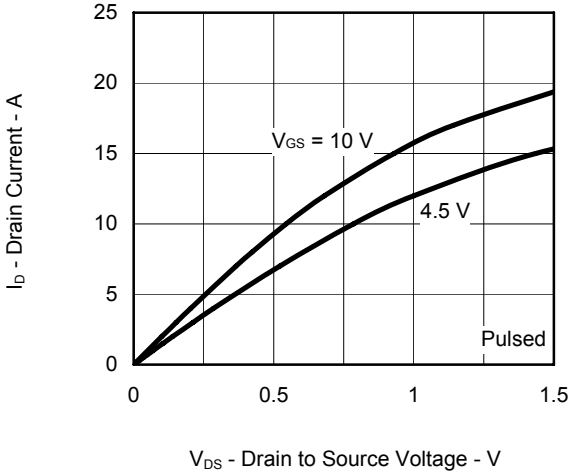
FORWARD BIAS SAFE OPERATING AREA



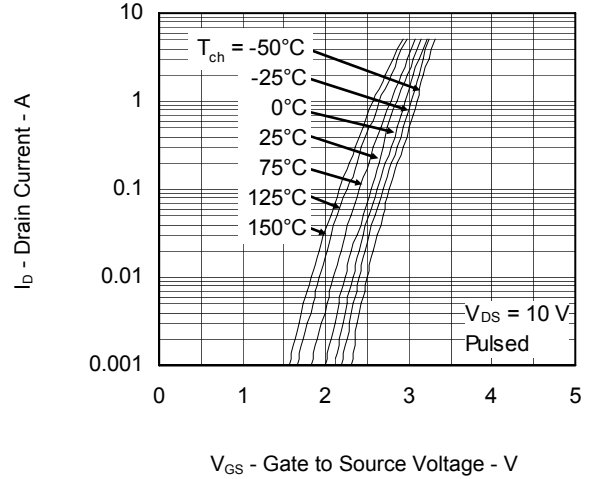
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



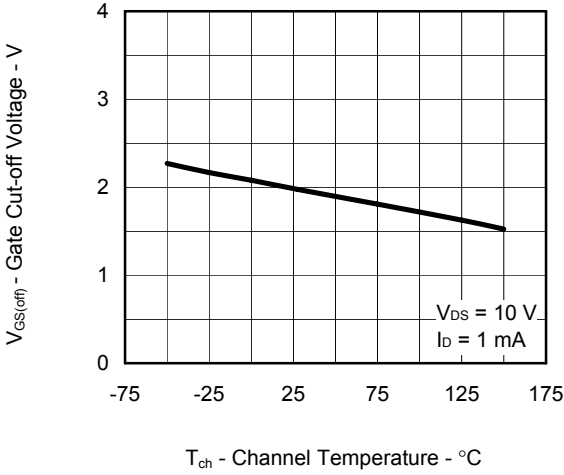
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



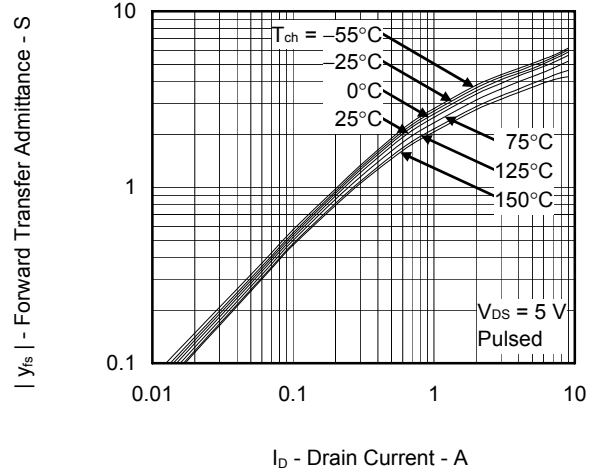
FORWARD TRANSFER CHARACTERISTICS



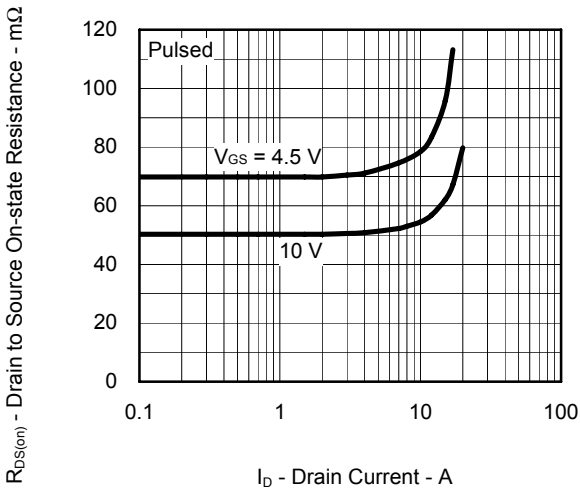
GATE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATURE



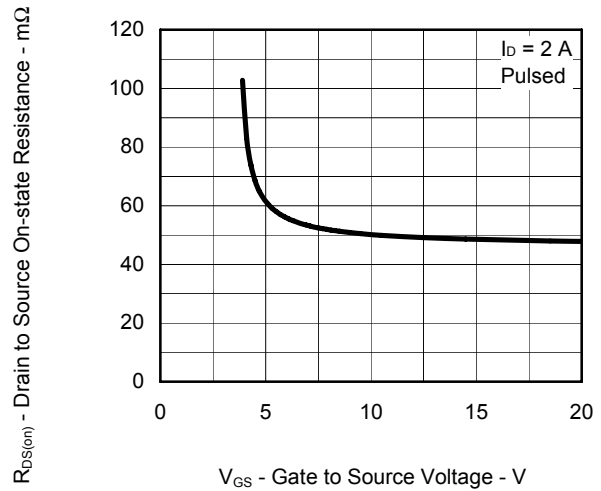
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



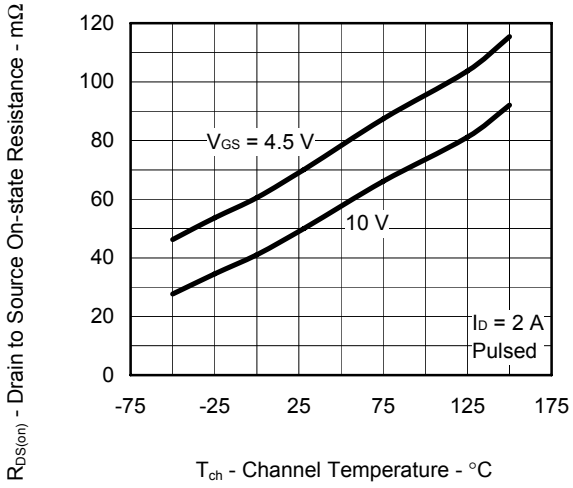
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
DRAIN CURRENT



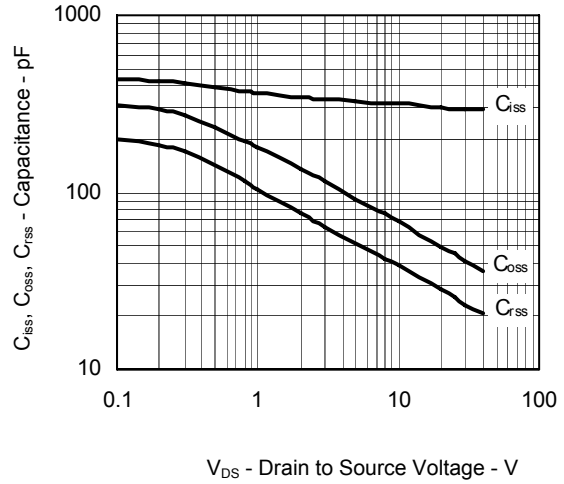
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



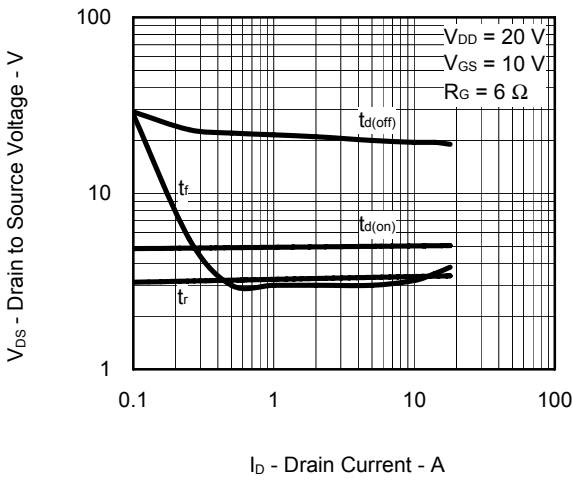
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



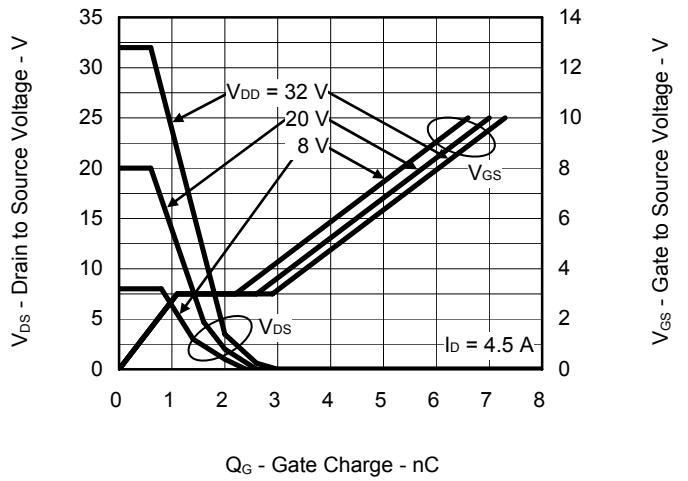
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



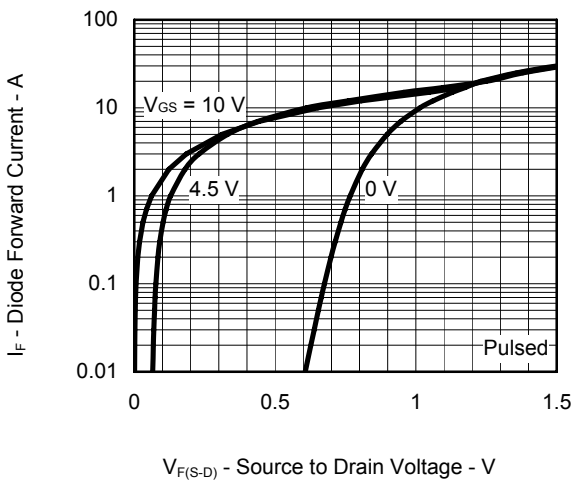
SWITCHING CHARACTERISTICS



DYNAMIC INPUT/OUTPUT CHARACTERISTICS

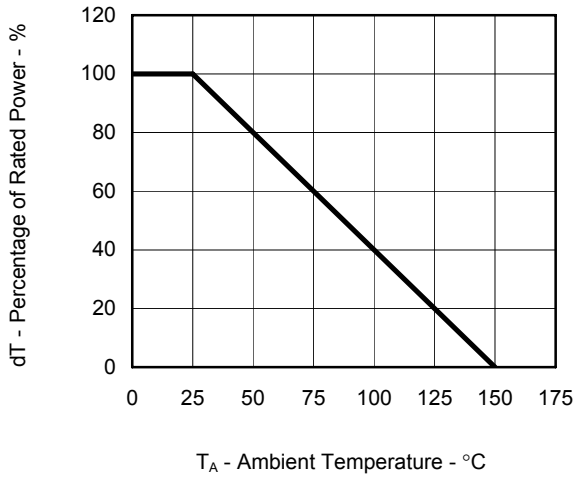


SOURCE TO DRAIN DIODE FORWARD VOLTAGE

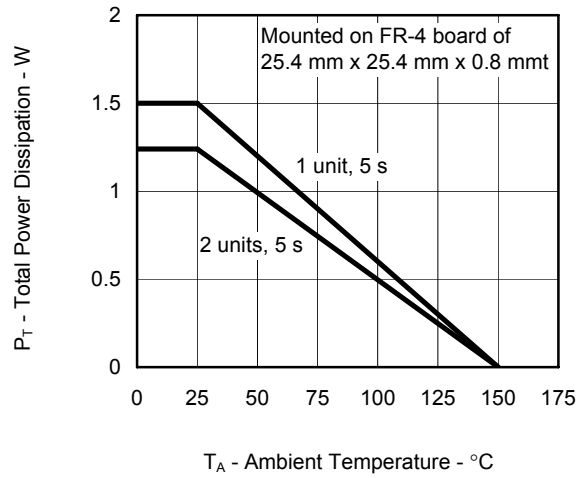


(2) P-channel MOSFET

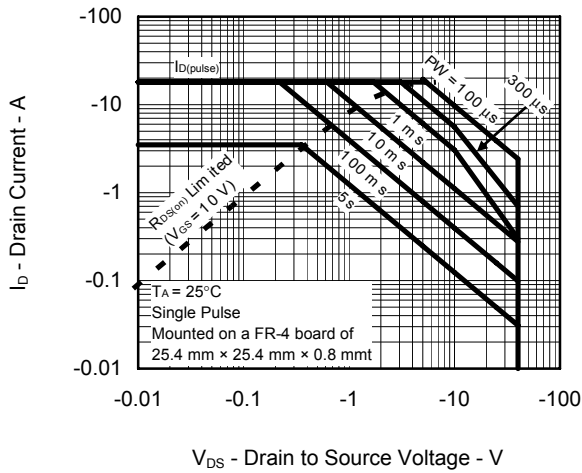
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



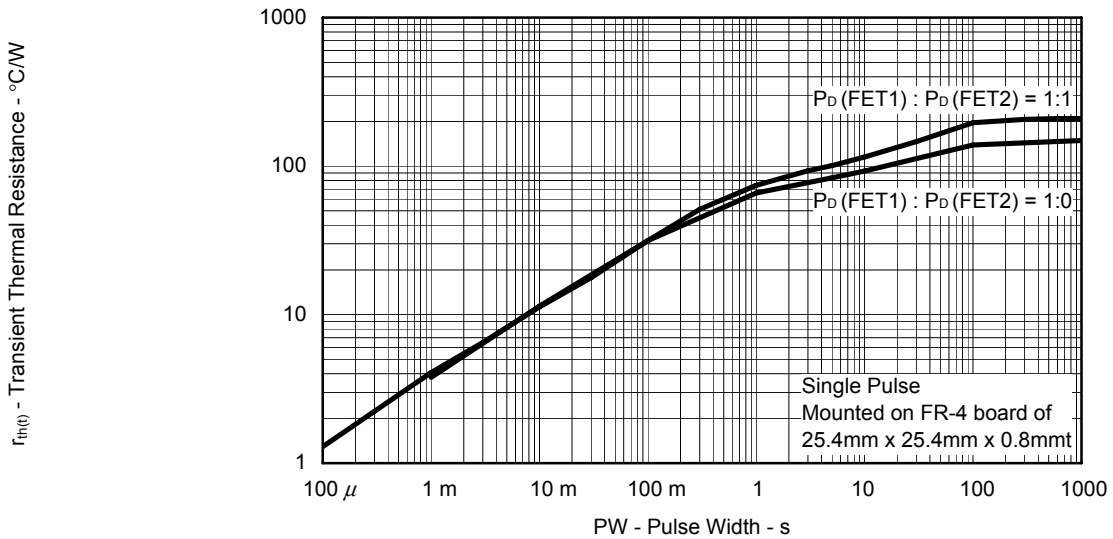
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



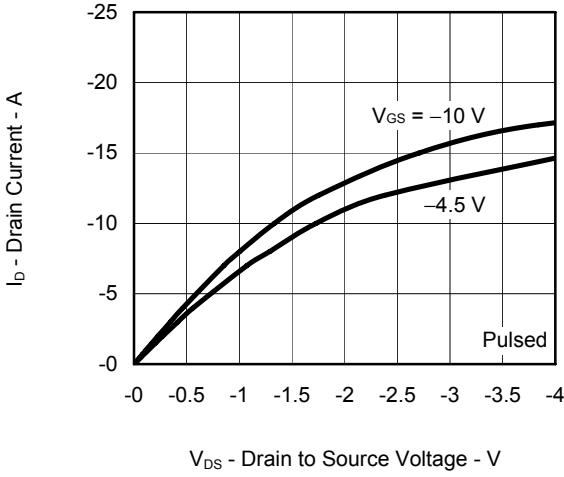
FORWARD BIAS SAFE OPERATING AREA



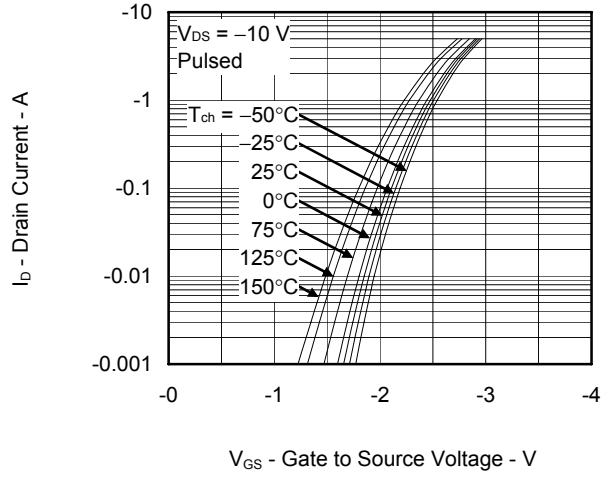
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



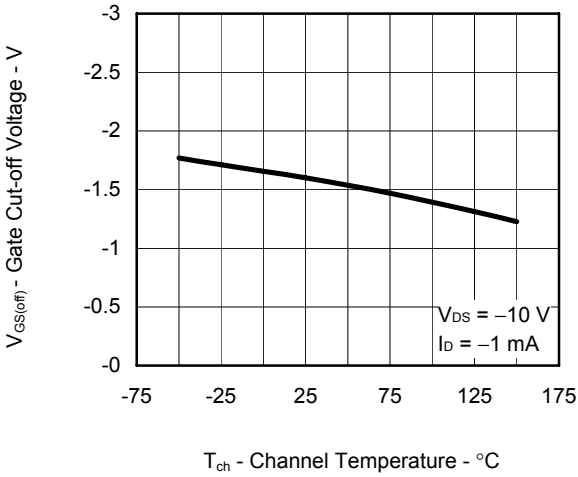
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



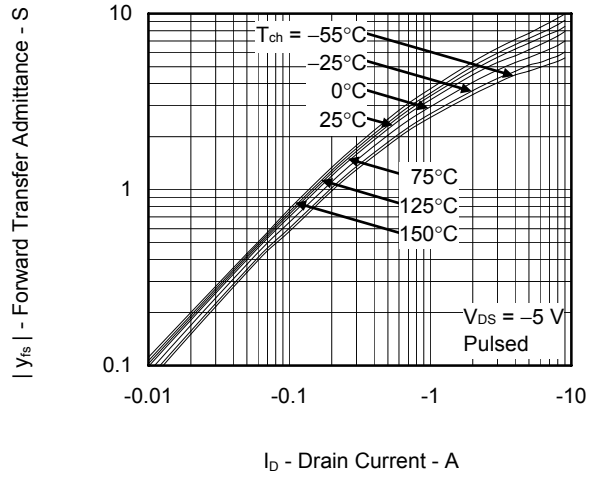
FORWARD TRANSFER CHARACTERISTICS



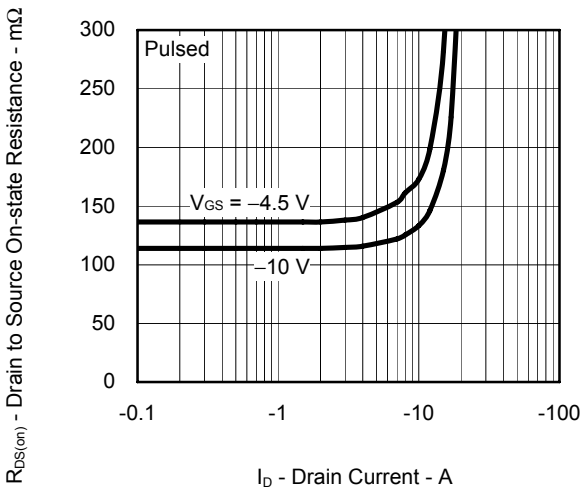
GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



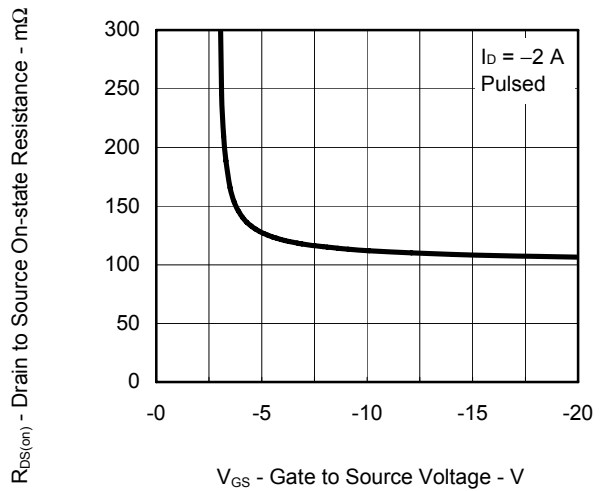
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



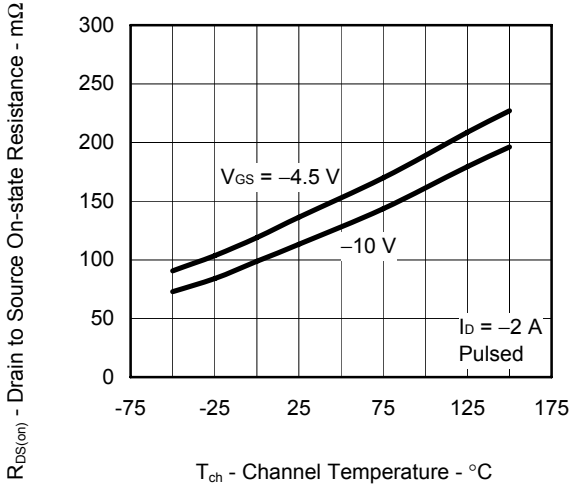
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



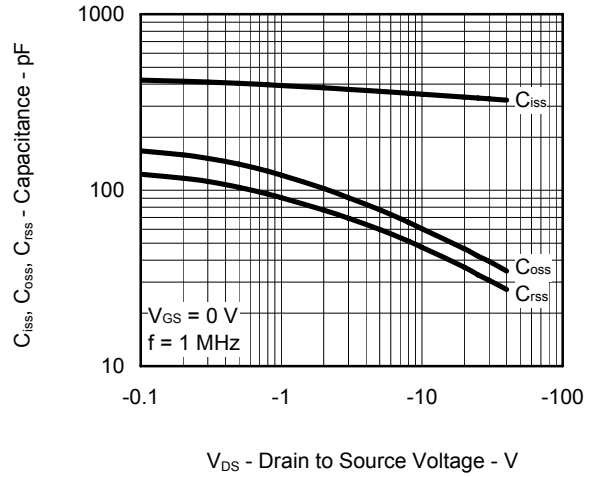
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



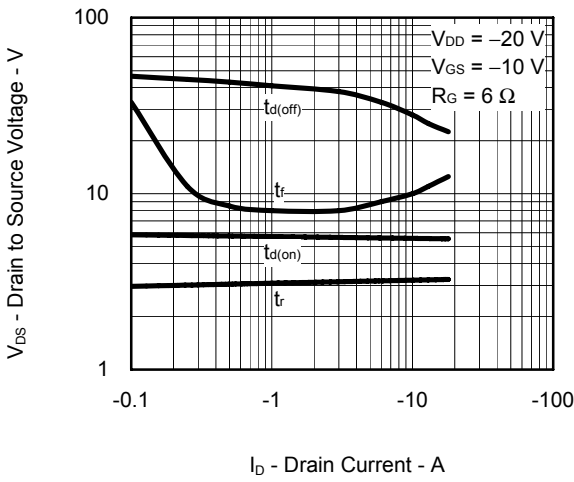
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



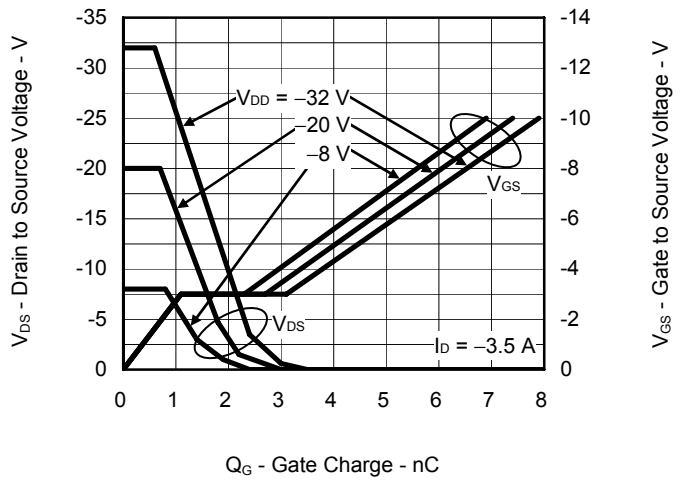
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



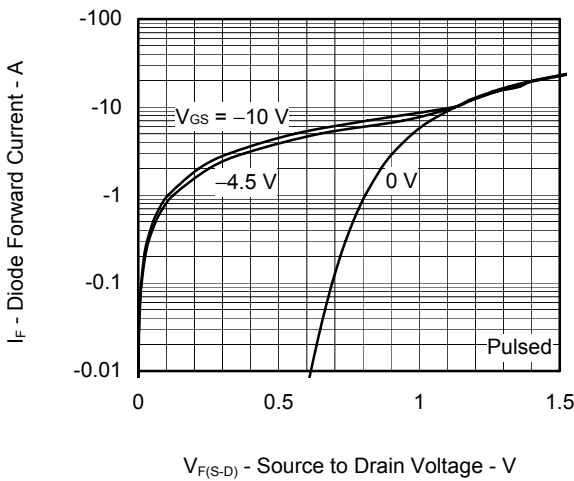
SWITCHING CHARACTERISTICS



DYNAMIC INPUT/OUTPUT CHARACTERISTICS

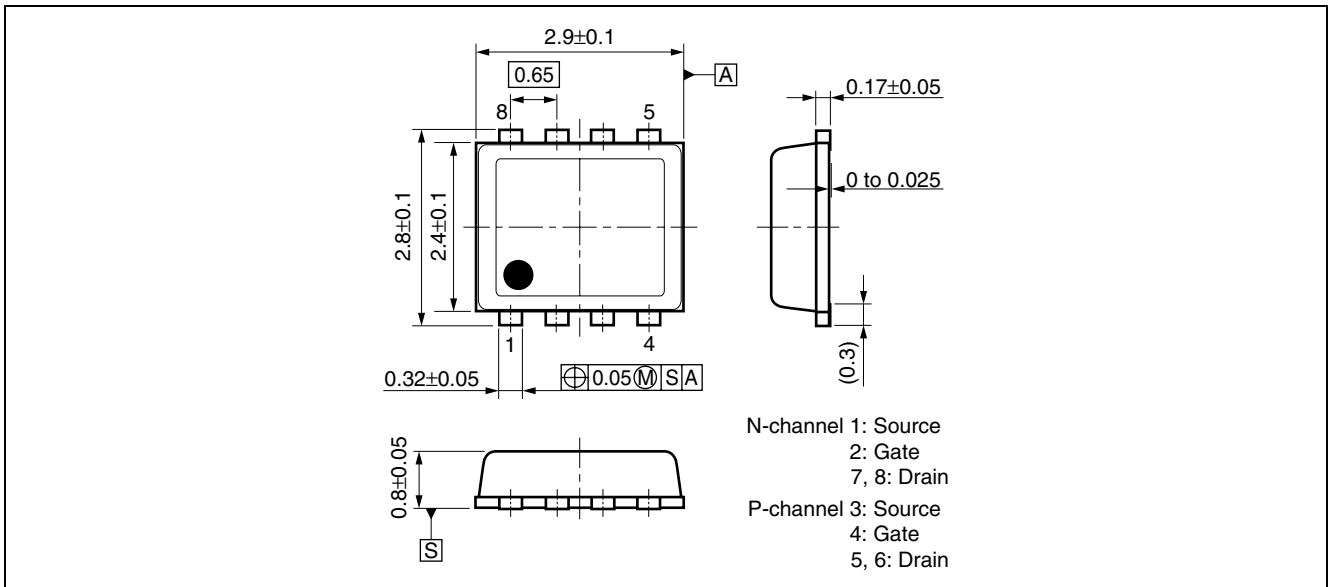


SOURCE TO DRAIN DIODE FORWARD VOLTAGE

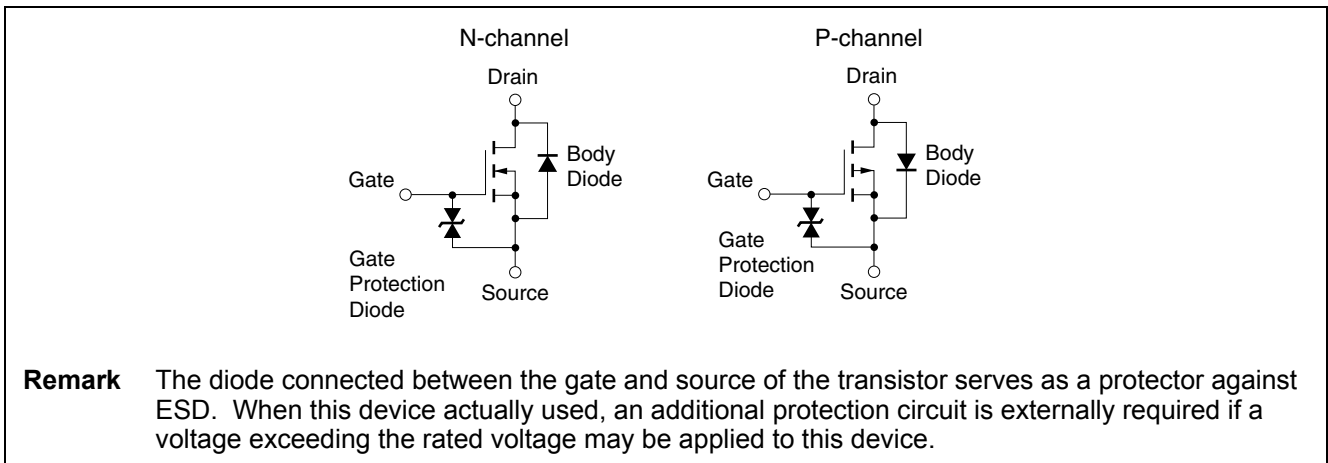


Package Drawings (Unit: mm)

8-pin VSOF (2429)



Equivalent Circuit



Revision History	μPA2593
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Rev.	Date	Description	
		Page	Summary
1.00	Jul 01, 2010	–	First Eddition Issued
2.00	Sep 10,2010	5, 6	Change of graphs

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Renesas Electronics America Inc.

2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited

1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.

Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited

Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.

7F, No. 363 Fu Shing North Road Taipei, Taiwan, R.O.C.
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11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
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