

To our customers,

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## Old Company Name in Catalogs and Other Documents

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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Not recommended  
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# MOS FIELD EFFECT TRANSISTOR

# $\mu$ PA2591T1H

## N- AND P-CHANNEL MOSFET FOR SWITCHING

### DESCRIPTION

The  $\mu$ PA2591T1H 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

- 2.5 V drive available
- Low on-state resistance

N-channel  $R_{DS(on)1} = 55 \text{ m}\Omega \text{ MAX.}$  ( $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 2 \text{ A}$ )

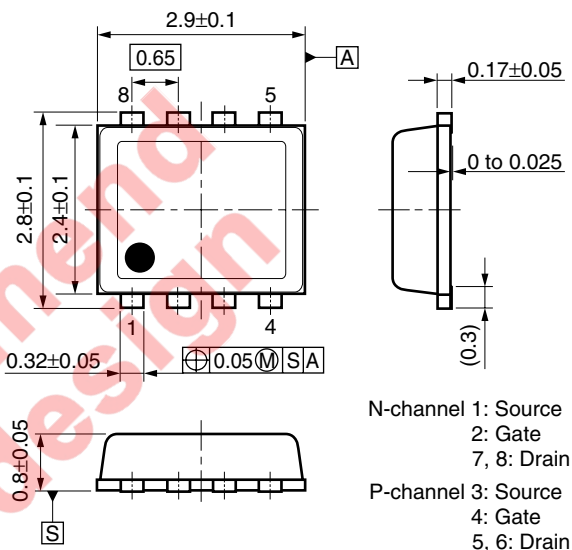
$R_{DS(on)2} = 70 \text{ m}\Omega \text{ MAX.}$  ( $V_{GS} = 2.5 \text{ V}$ ,  $I_D = 2 \text{ A}$ )

P-channel  $R_{DS(on)1} = 88 \text{ m}\Omega \text{ MAX.}$  ( $V_{GS} = -4.5 \text{ V}$ ,  $I_D = -2 \text{ A}$ )

$R_{DS(on)2} = 150 \text{ m}\Omega \text{ MAX.}$  ( $V_{GS} = -2.5 \text{ V}$ ,  $I_D = -1 \text{ A}$ )

- Built-in gate protection diode
- Small and surface mount package (8-pin VSOF (2429))

### PACKAGE DRAWING (Unit: mm)



### ORDERING INFORMATION

PART NUMBER	LEAD PLATING	PACKING	PACKAGE
$\mu$ PA2591T1H-T1-AT <small>Note</small>	Pure Sn	8 mm embossed taping	8-pin VSOF (2429)
$\mu$ PA2591T1H-T2-AT <small>Note</small>		3000 p/reel	

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

**Marking: 2591**

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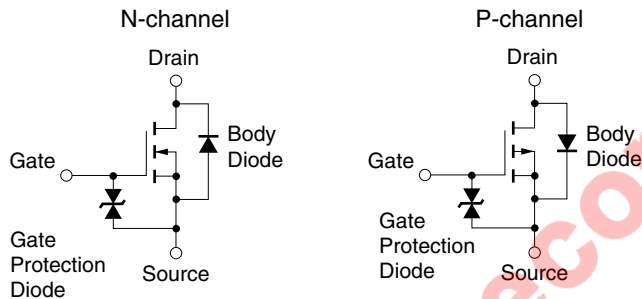
**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)**

PARAMETER	SYMBOL	N-CHANNEL	P-CHANNEL	UNIT
Drain to Source Voltage (V <sub>GS</sub> = 0 V)	V <sub>DSS</sub>	30	-30	V
Gate to Source Voltage (V <sub>DS</sub> = 0 V)	V <sub>GSS</sub>	±12	∓12	V
Drain Current (DC)	I <sub>D(DC)</sub>	±4.0	∓3.0	A
Drain Current (pulse) <sup>Note1</sup>	I <sub>D(pulse)</sub>	±16	∓12	A
Total Power Dissipation (1 unit, 5 s) <sup>Note2</sup>	P <sub>T1</sub>	1.5		W
Total Power Dissipation (2 units, 5 s) <sup>Note2</sup>	P <sub>T2</sub>	1.24		W
Channel Temperature	T <sub>ch</sub>	150		°C
Storage Temperature	T <sub>stg</sub>	-55 to +150		°C

**Notes** 1. PW ≤ 10 μs, Duty Cycle ≤ 1%

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

**EQUIVALENT CIRCUIT**



**Remark** The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

**Caution** This product is electrostatic-sensitive device due to low ESD capability and should be handled with caution for electrostatic discharge.

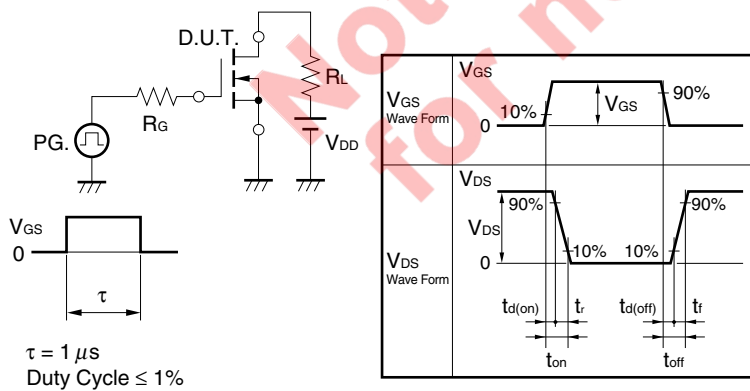
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

**N-channel MOSFET**

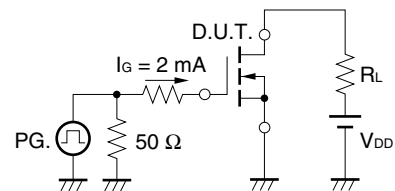
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V			1	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±12 V, V <sub>DS</sub> = 0 V			±10	μA
Gate to Source Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	0.5		1.5	V
Forward Transfer Admittance <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 2 A	1			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> = 2 A		38	55	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 2 A		48	70	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V,		475		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V,		62		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1.0 MHz		34		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 15 V, I <sub>D</sub> = 2 A,		7		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 4.5 V,		6		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 6 Ω		22		ns
Fall Time	t <sub>f</sub>			5		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 24 V, V <sub>GS</sub> = 4.5 V,		5.4		nC
Gate to Source Charge	Q <sub>GS</sub>	I <sub>D</sub> = 4 A		0.8		nC
Gate to Drain Charge	Q <sub>GD</sub>			1.5		nC
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 4 A, V <sub>GS</sub> = 0 V		0.85		V

**Note** Pulsed

**TEST CIRCUIT 1 SWITCHING TIME**



**TEST CIRCUIT 2 GATE CHARGE**

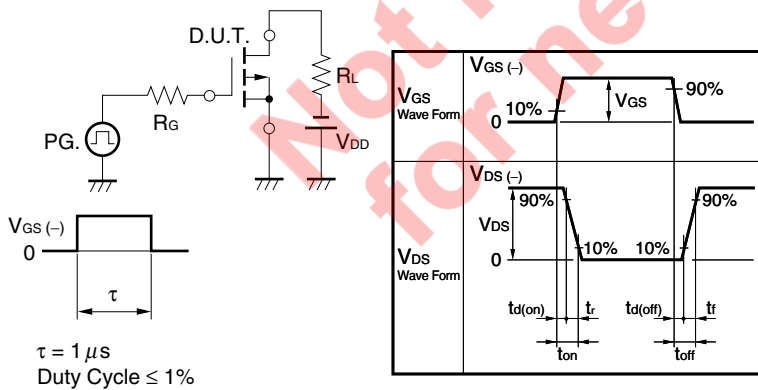


P-channel MOSFET

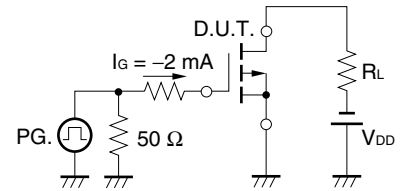
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
Gate Leakage Current	$I_{GSS}$	$V_{GS} = \pm 12\text{ V}, V_{DS} = 0\text{ V}$			$\mp 10$	$\mu\text{A}$
Gate to Source Cut-off Voltage	$V_{GS(off)}$	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$	-0.5		-1.5	V
Forward Transfer Admittance <sup>Note</sup>	$ y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -1.5\text{ A}$	1.5			S
Drain to Source On-state Resistance <sup>Note</sup>	$R_{DS(on)1}$	$V_{GS} = -4.5\text{ V}, I_D = -2\text{ A}$		66	88	$\text{m}\Omega$
	$R_{DS(on)2}$	$V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$		98	150	$\text{m}\Omega$
Input Capacitance	$C_{iss}$	$V_{DS} = -10\text{ V},$		450		pF
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V},$		77		pF
Reverse Transfer Capacitance	$C_{rss}$	$f = 1.0\text{ MHz}$		63		pF
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = -15\text{ V}, I_D = -1.5\text{ A},$		12		ns
Rise Time	$t_r$	$V_{GS} = -4.5\text{ V},$		5		ns
Turn-off Delay Time	$t_{d(off)}$	$R_G = 6\ \Omega$		37		ns
Fall Time	$t_f$			27		ns
Total Gate Charge	$Q_G$	$V_{DD} = -24\text{ V}, V_{GS} = -4.5\text{ V},$		5.2		nC
Gate to Source Charge	$Q_{GS}$	$I_D = -3\text{ A}$		1.1		nC
Gate to Drain Charge	$Q_{GD}$			2.3		nC
Body Diode Forward Voltage <sup>Note</sup>	$V_{F(S-D)}$	$I_F = -3\text{ A}, V_{GS} = 0\text{ V}$		0.89		V

Note Pulsed

TEST CIRCUIT 1 SWITCHING TIME

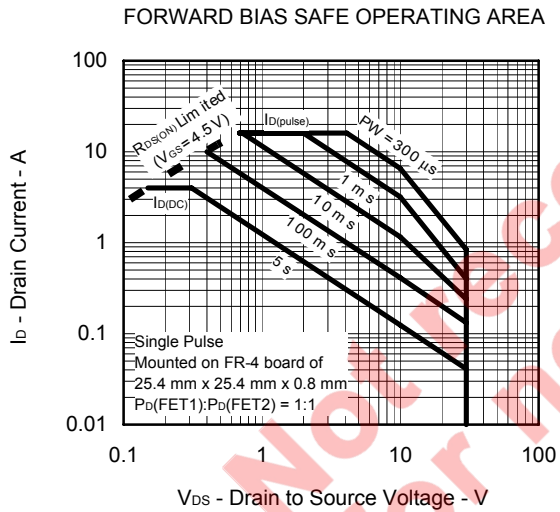
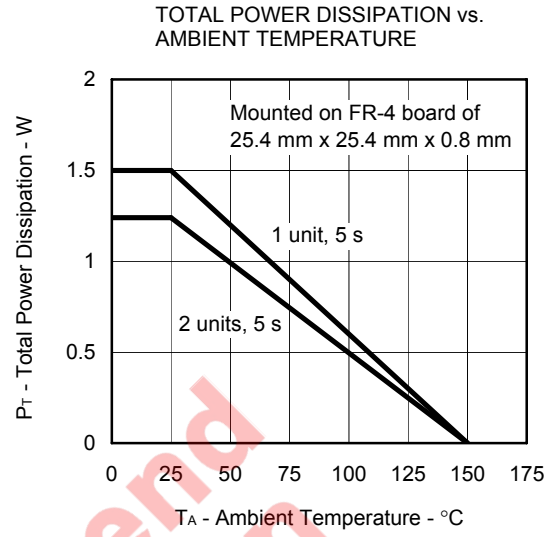
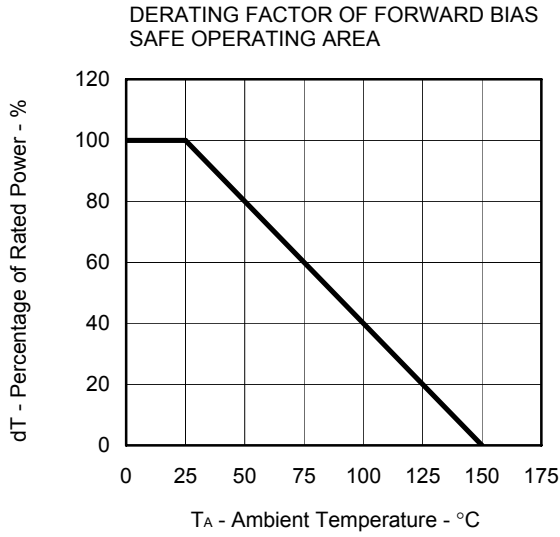


TEST CIRCUIT 2 GATE CHARGE

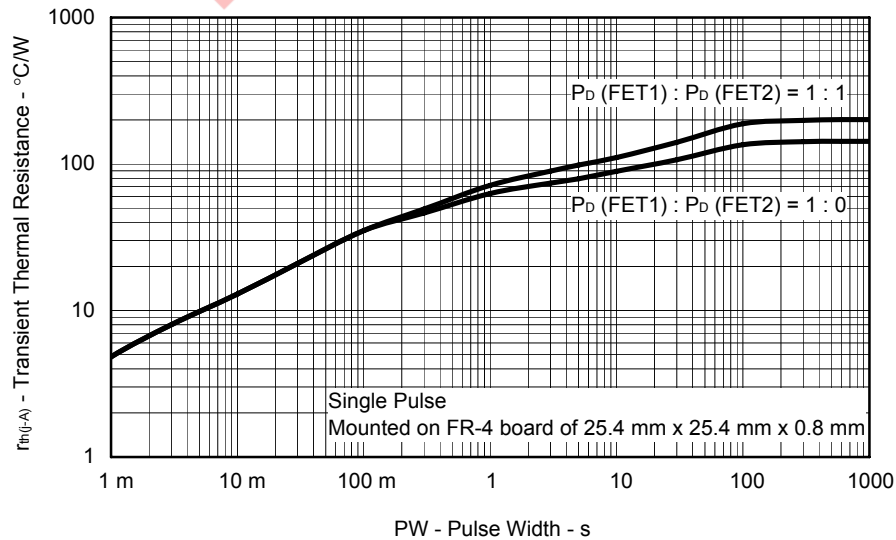


TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

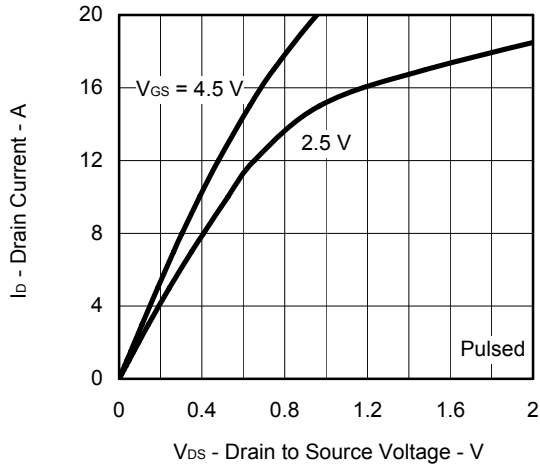
(1) N-channel MOSFET



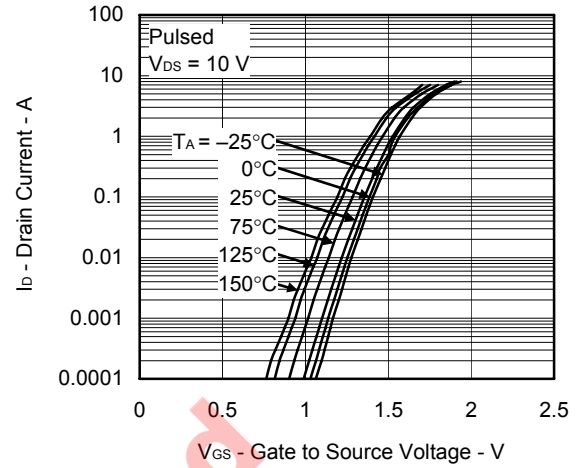
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



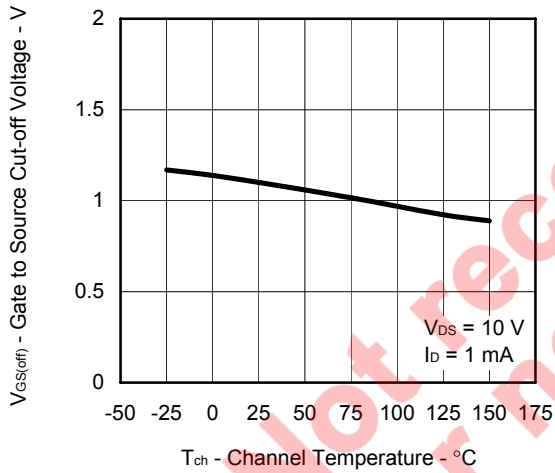
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



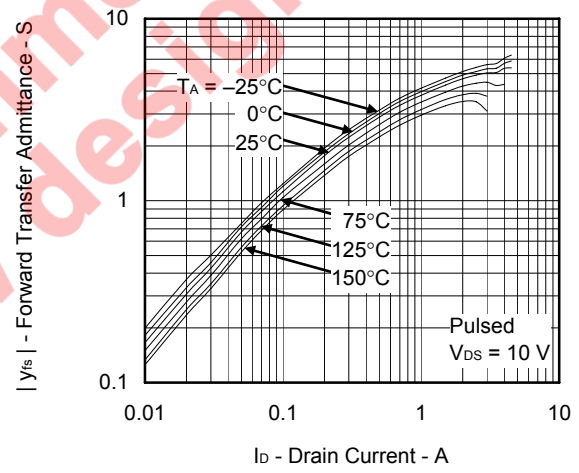
FORWARD TRANSFER CHARACTERISTICS



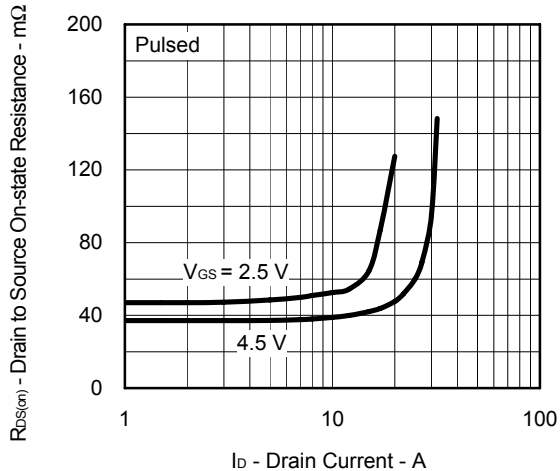
GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



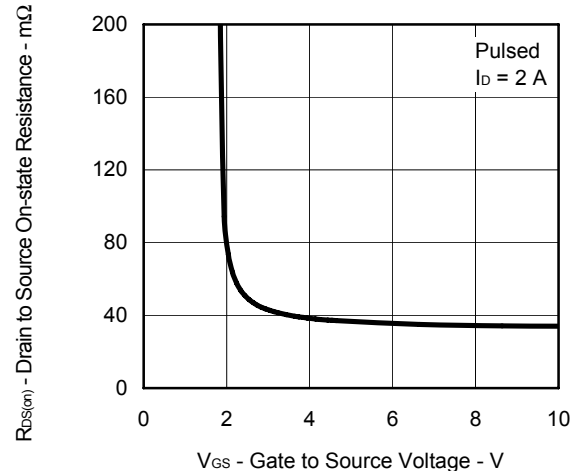
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

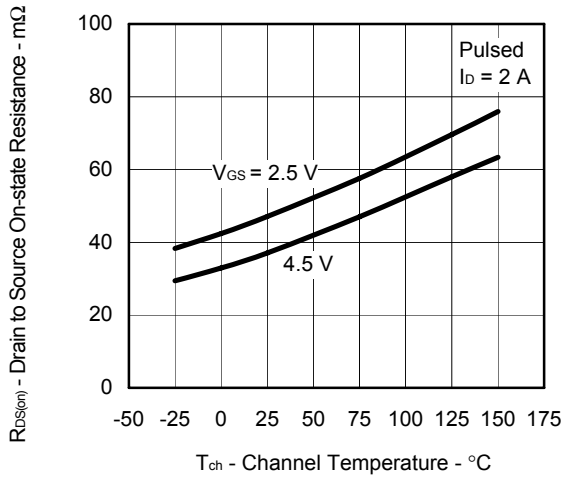


DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

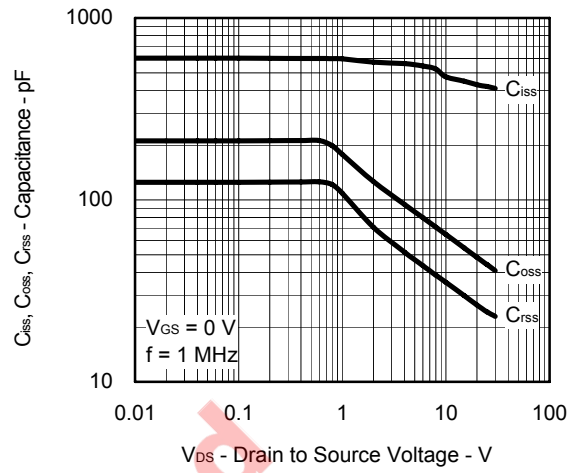




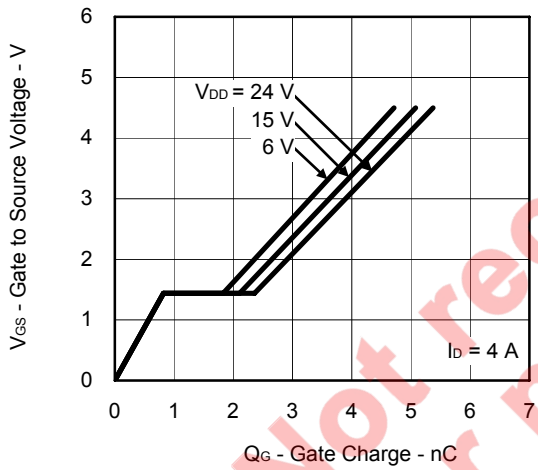
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



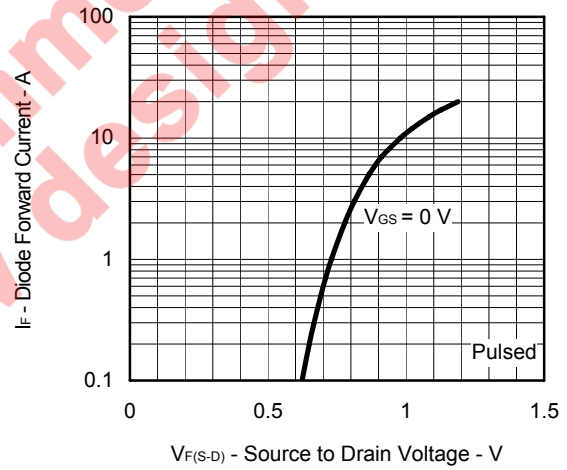
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



DYNAMIC INPUT CHARACTERISTICS

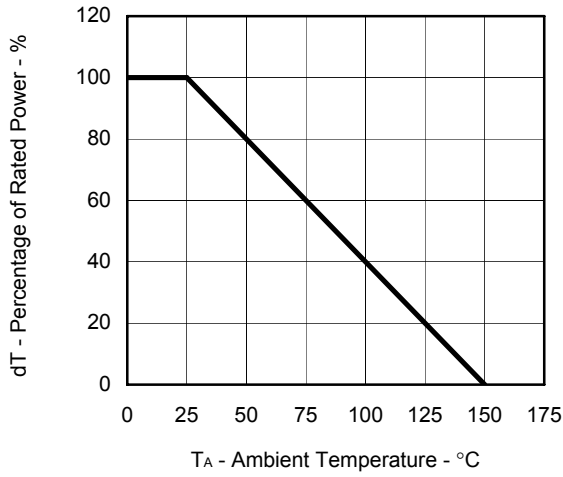


SOURCE TO DRAIN DIODE FORWARD VOLTAGE

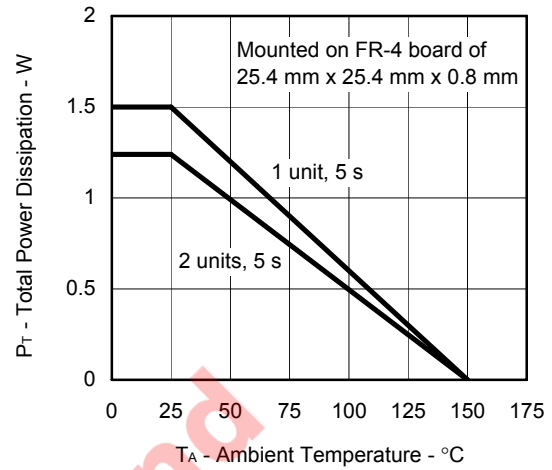


(2) P-channel MOSFET

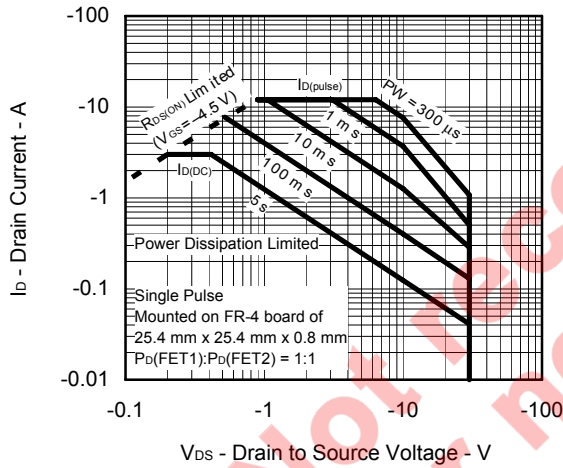
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



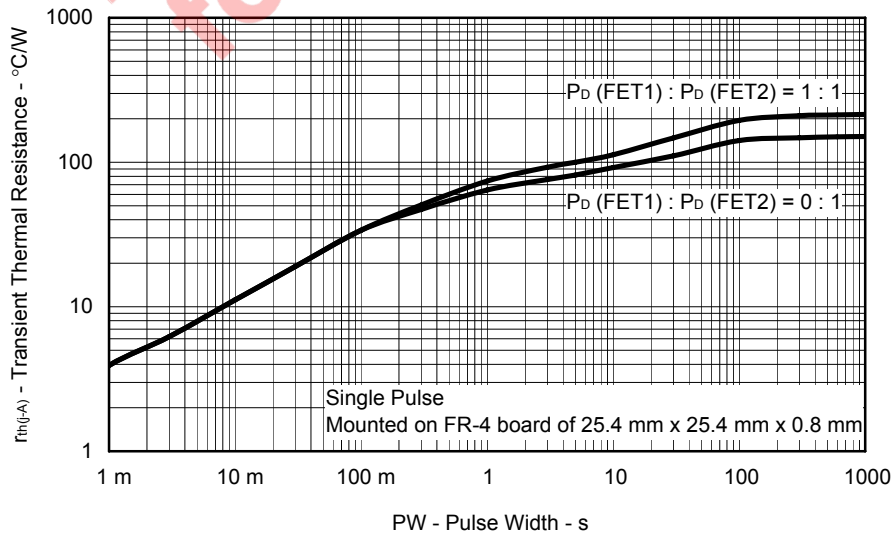
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



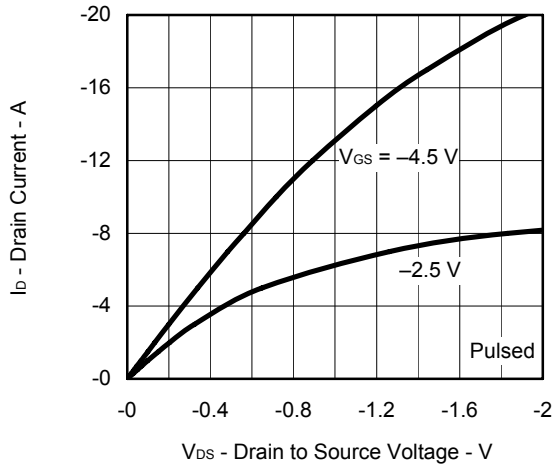
FORWARD BIAS SAFE OPERATING AREA



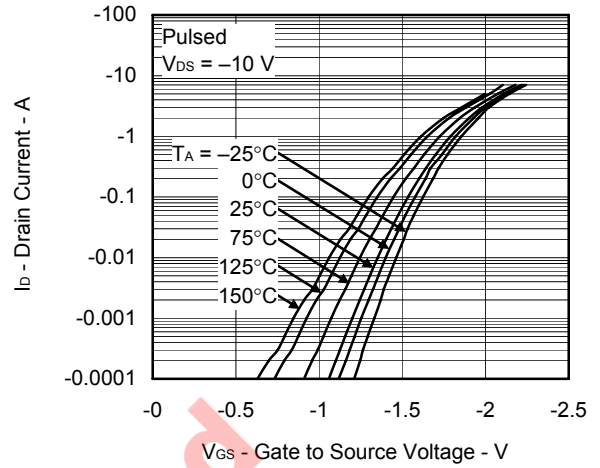
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



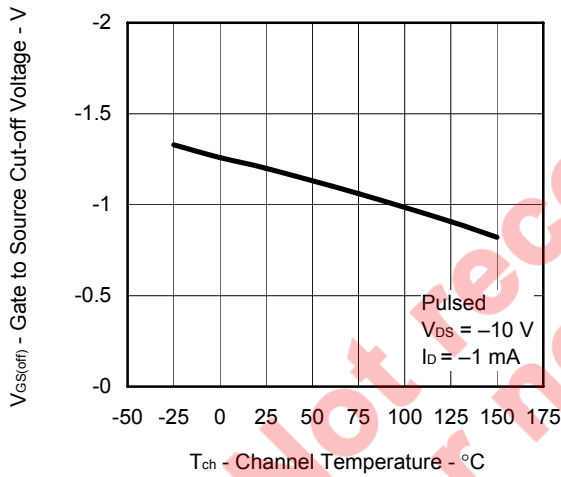
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



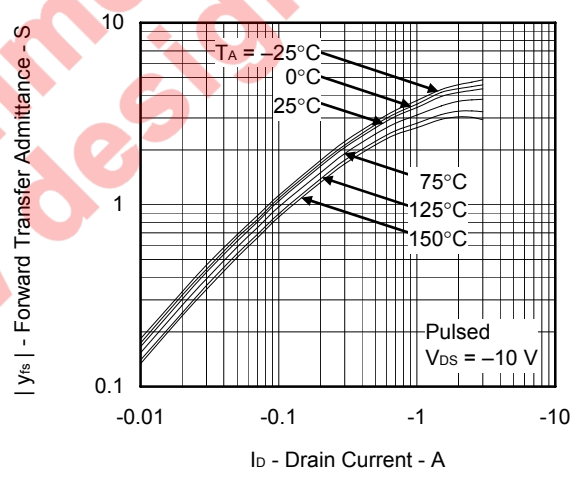
FORWARD TRANSFER CHARACTERISTICS



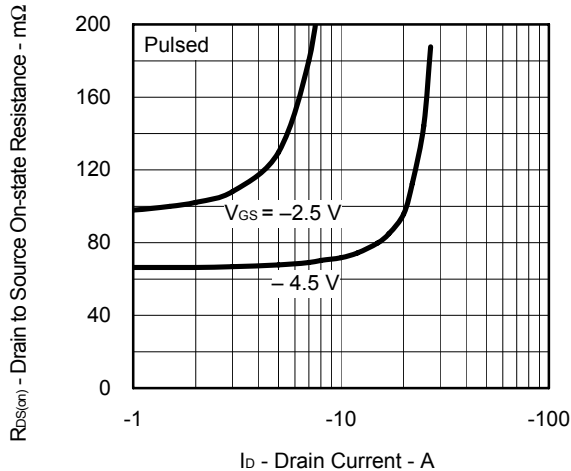
GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



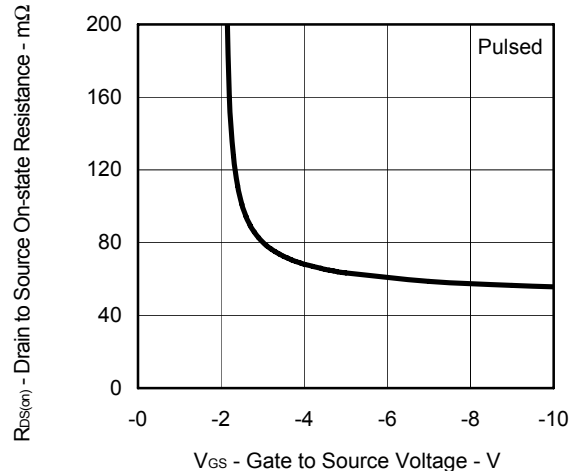
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



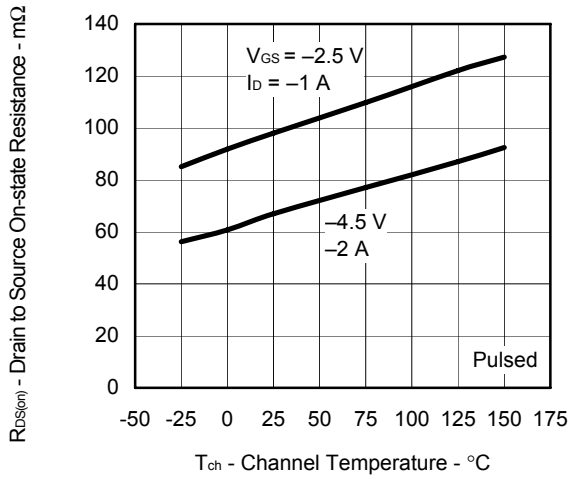
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



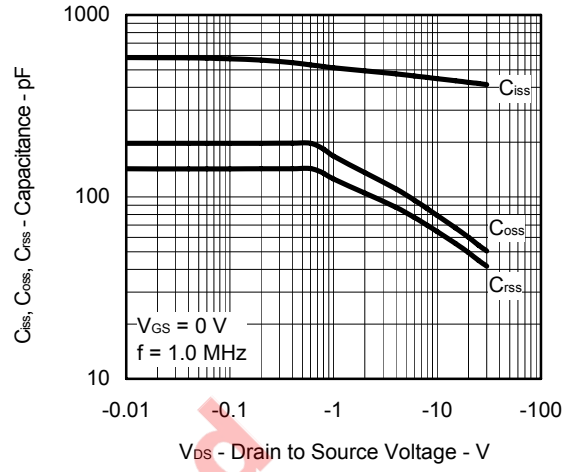
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



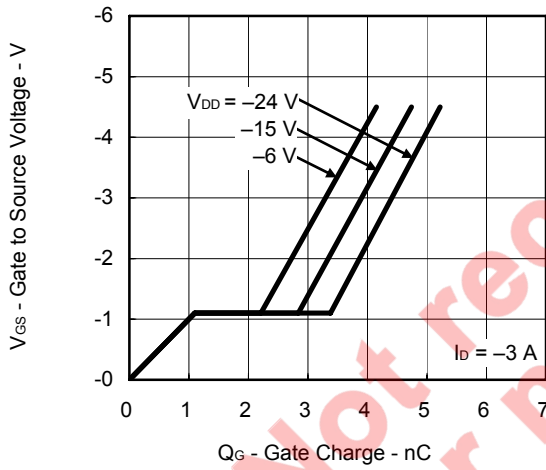
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



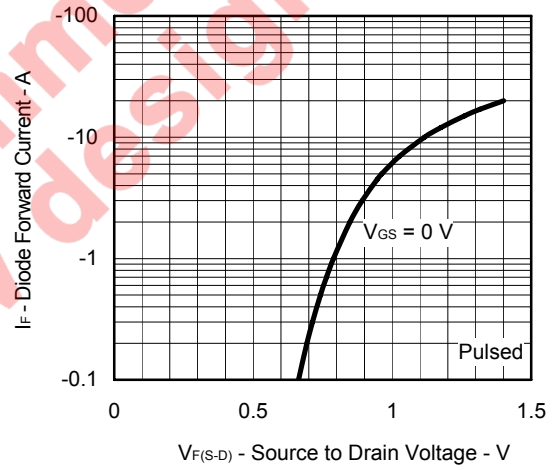
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



DYNAMIC INPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



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    - "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support).
    - "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.
- The quality grade of NEC Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.
- (Note 1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.
- (Note 2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).