

# MOS FIELD EFFECT TRANSISTOR $\mu$ PA1870B

### N-CHANNEL MOS FIELD EFFECT TRANSISTOR FOR SWITCHING

#### **DESCRIPTION**

The  $\mu$ PA1870B is a switching device which can be driven directly by a 2.5 V power source.

The  $\mu$ PA1870B features a low on-state resistance and excellent switching characteristics, and is suitable for applications such as power switch of portable machine and so on.

#### **FEATURES**

- 2.5 V drive available
- · Low on-state resistance

RDS(on)1 = 16.0 m $\Omega$  TYP. (VGS = 4.5 V, ID = 3.0 A)

RDS(on)2 = 16.5 m $\Omega$  TYP. (VGS = 4.0 V, ID = 3.0 A)

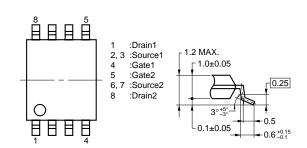
RDS(on)3 = 20.0 m $\Omega$  TYP. (VGS = 2.5 V, ID = 3.0 A)

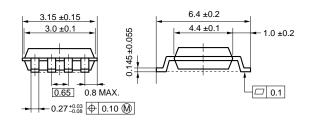
• Built-in G-S protection diode against ESD

#### ORDERING INFORMATION

PART NUMBER	PACKAGE
μPA1870BGR-9JG	Power TSSOP8

#### PACKAGE DRAWING (Unit: mm)

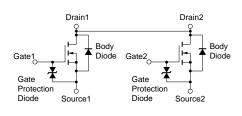




#### ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

Drain to Source Voltage (Vgs = 0 V)	VDSS	20.0	V
Gate to Source Voltage (Vps = 0 V)	Vgss	±12.0	V
Drain Current (DC) Note 1	ID(DC)	±6.0	Α
Drain Current (pulse) Note 2	D(pulse)	±80.0	Α
Total Power Dissipation Note 1	Рт	2.0	W
Channel Temperature	Tch	150	°C
Storage Temperature	$T_{stg}$	-55 to +150	°C
		2	

#### **EQUIVALENT CIRCUIT**



**Notes 1.** Mounted on ceramic substrate of 50 cm<sup>2</sup> x 1.1 mm

**2.** PW  $\leq$  10  $\mu$ s, Duty Cycle  $\leq$  1%

**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.

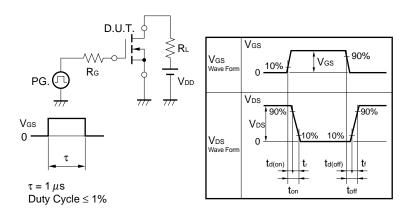
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

#### **ELECTRICAL CHARACTERISTICS (TA = 25°C)**

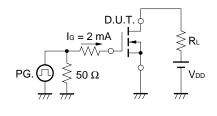
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	IDSS	V <sub>DS</sub> = 20.0 V, V <sub>GS</sub> = 0 V			1.0	μΑ
Gate Leakage Current	Igss	$V_{GS} = \pm 12.0  \text{V},  V_{DS} = 0  \text{V}$			±10.0	μΑ
Gate Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10.0 V, I <sub>D</sub> = 1.0 mA	0.5	1.0	1.5	V
Forward Transfer Admittance Note	y <sub>fs</sub>	V <sub>DS</sub> = 10.0 V, I <sub>D</sub> = 3.0 A	5			S
Drain to Source On-state Resistance Note	RDS(on)1	Vgs = 4.5 V, ID = 3.0 A	12.0	16.0	20.0	mΩ
	R <sub>DS(on)2</sub>	Vgs = 4.0 V, ID = 3.0 A	13.0	16.5	21.0	mΩ
	R <sub>DS(on)3</sub>	Vgs = 2.5 V, ID = 3.0 A	15.0	20.0	27.0	mΩ
Input Capacitance	Ciss	V <sub>DS</sub> = 10.0 V		720		pF
Output Capacitance	Coss	Vgs = 0 V		166		pF
Reverse Transfer Capacitance	Crss	f = 1.0 MHz		125		pF
Turn-on Delay Time	t <sub>d(on)</sub>	VDD = 10.0 V, ID = 3.0 A		48		ns
Rise Time	tr	Vgs = 4.0 V		245		ns
Turn-off Delay Time	td(off)	$R_G = 10 \Omega$		315		ns
Fall Time	tf			305		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 16.0 V		8.0		nC
Gate to Source Charge	Qgs	ID = 6.0 A		1.7		nC
Gate to Drain Charge	Q <sub>GD</sub>	Vgs = 4.0 V		3.5		nC
Body Diode Forward Voltage Note	V <sub>F(S-D)</sub>	IF = 6.0 A, VGS = 0 V		0.8		V
Reverse Recovery Time	trr	IF = 6.0 A, VGS = 0 V		295		ns
Reverse Recovery Charge	Qrr	$di/dt = 50 A/\mu s$		450		nC

**Note** Pulsed: PW  $\leq$  350  $\mu$ s, Duty Cycle  $\leq$  2%

#### **TEST CIRCUIT 1 SWITCHING TIME**

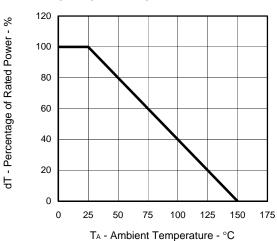


#### **TEST CIRCUIT 2 GATE CHARGE**

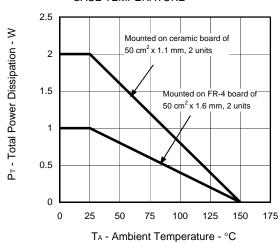


#### TYPICAL CHARACTERISTICS (TA = 25°C)

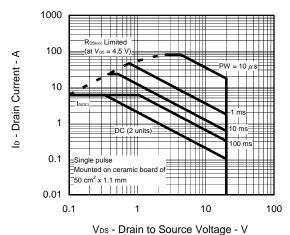
#### DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA

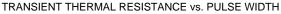


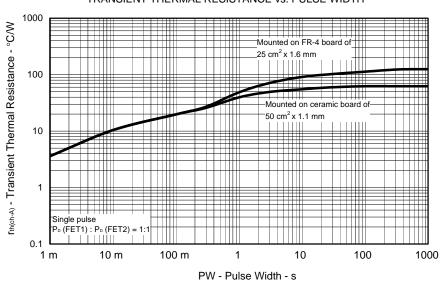
#### TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



#### FORWARD BIAS SAFE OPERATING AREA



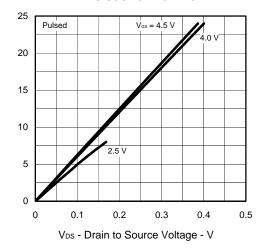




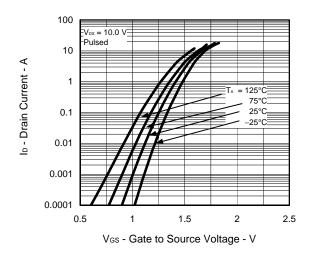
Ip - Drain Current - A

Ves(off) - Gate Cut-off Voltage - V

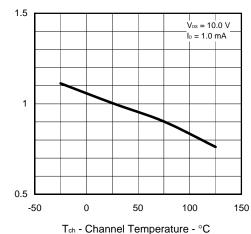
## DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



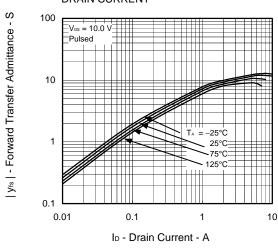
#### FORWARD TRANSFER CHARACTERISTICS



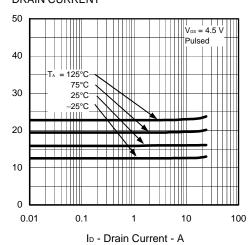
## GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



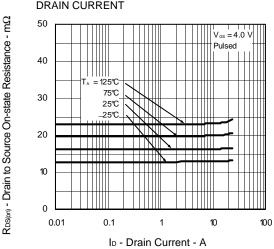
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



## DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



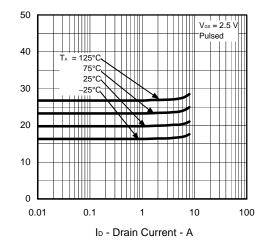
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



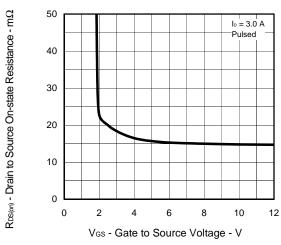
R<sub>DS(m)</sub> - Drain to Source On-state Resistance - mΩ

 $\mathsf{Rbs}_{(\varpi)}$  - Drain to Source On-state Resistance -  $m\Omega$ 

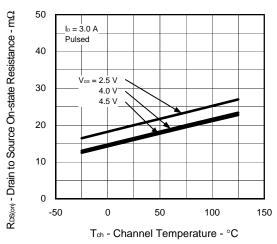
## DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



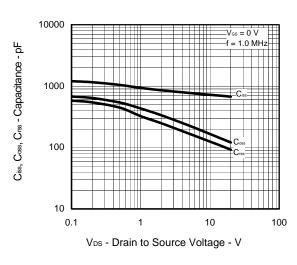
## DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



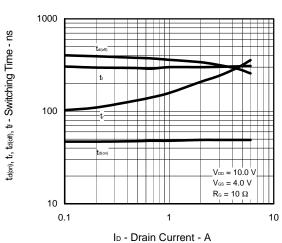
## DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



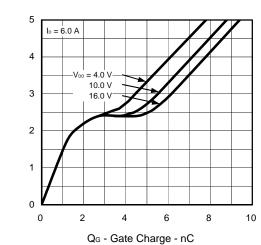
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



#### SWITCHING CHARACTERISTICS

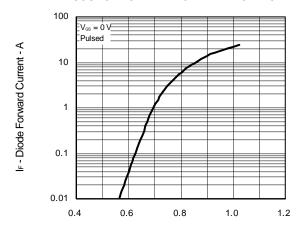


DYNAMIC INPUT CHARACTERISTICS



Ves - Gate to Source Voltage - V

#### SOURCE TO DRAIN FORWARD VOLTAGE



 $V_{\text{F(S-D)}}$  - Source to Drain Voltage - V

NEC  $\mu$  PA1870B

 The information in this document is current as of October, 2003. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

- No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC Electronics does not assume any liability for infringement of patents, copyrights or other intellectual
  property rights of third parties by or arising from the use of NEC Electronics products listed in this document
  or any other liability arising from the use of such products. No license, express, implied or otherwise, is
  granted under any patents, copyrights or other intellectual property rights of NEC Electronics or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative
  purposes in semiconductor product operation and application examples. The incorporation of these
  circuits, software and information in the design of a customer's equipment shall be done under the full
  responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by
  customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".

The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics product before using it in a particular application.

- "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots.
- "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.
- (2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).