

### 0.4 W L-BAND POWER GaAs HJ-FET

#### DESCRIPTION

The NE651R479A is a 0.4 W GaAs HJ-FET designed for middle power transmitter applications for mobile communication and wireless PC LAN systems. It is capable of delivering 0.4 W of output power (CW) with high linear gain, high efficiency and excellent distortion and as a driver amplifier for our NE6510179A and NE6510379A.

Reliability and performance uniformity are assured by NEC's stringent quality and control procedures.

#### FEATURES

- GaAs HJ-FET structure
- High output power :  $P_{out} = +27.0$  dBm TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 900$  MHz,  $P_{in} = +13$  dBm  
 $P_{out} = +27.0$  dBm TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = +15$  dBm  
 $P_{out} = +29.5$  dBm TYP. @  $V_{DS} = 5.0$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = +15$  dBm
- High linear gain :  $G_L = 14.0$  dB TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 900$  MHz,  $P_{in} = 0$  dBm  
 $G_L = 12.0$  dB TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = 0$  dBm  
 $G_L = 12.0$  dB TYP. @  $V_{DS} = 5.0$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = 0$  dBm
- High power added efficiency : 60 % TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 900$  MHz,  $P_{in} = +13$  dBm  
60 % TYP. @  $V_{DS} = 3.5$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = +15$  dBm  
58 % TYP. @  $V_{DS} = 5.0$  V,  $I_{Dset} = 50$  mA,  $f = 1.9$  GHz,  $P_{in} = +15$  dBm

#### ORDERING INFORMATION

Part Number	Package	Supplying Form
NE651R479A-T1	79A	<ul style="list-style-type: none"> <li>• 12 mm wide embossed taping</li> <li>• Qty 1 kpcs/reel</li> </ul>

**Remark** To order evaluation samples, contact your nearby sales office.

Part number for sample order: NE651R479A

**Caution** Please handle this device at static-free workstation, because this is an electrostatic sensitive 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 devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

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

Operation in excess of any one of these parameters may result in permanent damage.

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V <sub>DS</sub>	8	V
Gate to Source Voltage	V <sub>GSO</sub>	-4	V
Drain Current	I <sub>D</sub>	1.0	A
Gate Forward Current	I <sub>GF</sub>	10	mA
Gate Reverse Current	I <sub>GR</sub>	10	mA
Total Power Dissipation	P <sub>tot</sub>	2.5	W
Channel Temperature	T <sub>ch</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C

★ **RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V <sub>DS</sub>		-	3.5	6.0	V
Gain Compression	G <sub>comp</sub>		-	-	3.0	dB
Channel Temperature	T <sub>ch</sub>		-	-	+125	°C

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = +25 °C, unless otherwise specified, using NEC standard test fixture.)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 2.5 V, V <sub>GS</sub> = 0 V	-	0.7	-	A
Pinch-off Voltage	V <sub>p</sub>	V <sub>DS</sub> = 2.5 V, I <sub>D</sub> = 5 mA	-2.0	-	-0.4	V
Gate to Drain Break Down Voltage	BV <sub>gd</sub>	I <sub>gd</sub> = 5 mA	12	-	-	V
Thermal Resistance	R <sub>th</sub>	Channel to Case	-	30	50	°C/W
Output Power	P <sub>out</sub>	f = 1.9 GHz, V <sub>DS</sub> = 3.5 V,	26.0	27.0	-	dBm
Drain Current	I <sub>D</sub>	P <sub>in</sub> = +15 dBm, R <sub>g</sub> = 1 kΩ,	-	220	-	mA
Power Added Efficiency	η <sub>add</sub>	I <sub>Dset</sub> = 50 mA (RF OFF)	52	60	-	%
Linear Gain <sup>Note 1</sup>	G <sub>L</sub>	<b>Note 2</b>	-	12.0	-	dB

**Notes 1.** P<sub>in</sub> = 0 dBm

- DC performance is 100 % testing. RF performance is testing several samples per wafer. Wafer rejection criteria for standard devices is 1 reject for several samples.

**TYPICAL RF PERFORMANCE FOR REFERENCE (NOT SPECIFIED)**

( $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise specified, using NEC standard test fixture.)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Output Power	$P_{out}$	$f = 900\text{ MHz}$ , $V_{DS} = 3.5\text{ V}$ , $P_{in} = +13\text{ dBm}$ , $R_g = 1\text{ k}\Omega$ , $I_{Dset} = 50\text{ mA}$ (RF OFF)	–	27.0	–	dBm
Drain Current	$I_D$		–	230	–	mA
Power Added Efficiency	$\eta_{add}$		–	60	–	%
Linear Gain <sup>Note</sup>	$G_L$		–	14.0	–	dB

**Note**  $P_{in} = 0\text{ dBm}$

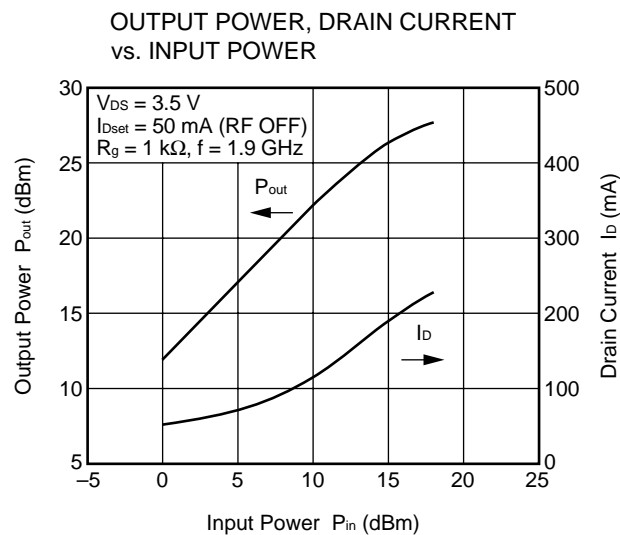
**TYPICAL RF PERFORMANCE FOR REFERENCE (NOT SPECIFIED)**

( $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise specified, using NEC standard test fixture.)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Output Power	$P_{out}$	$f = 1.9\text{ GHz}$ , $V_{DS} = 5.0\text{ V}$ , $P_{in} = +15\text{ dBm}$ , $R_g = 1\text{ k}\Omega$ , $I_{Dset} = 50\text{ mA}$ (RF OFF)	–	29.5	–	dBm
Drain Current	$I_D$		–	350	–	mA
Power Added Efficiency	$\eta_{add}$		–	58	–	%
Linear Gain <sup>Note</sup>	$G_L$		–	12.0	–	dB

**Note**  $P_{in} = 0\text{ dBm}$

**TYPICAL CHARACTERISTICS ( $T_A = +25\text{ }^\circ\text{C}$ )**



**Remark** The graph indicates nominal characteristics.

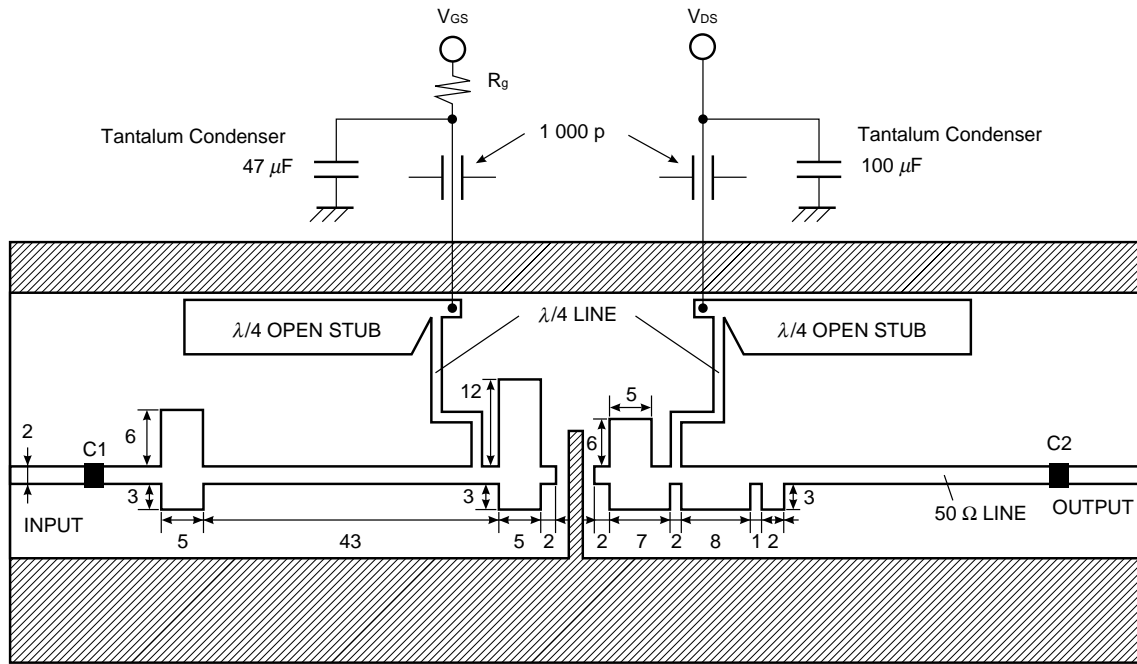
**S-PARAMETERS**

Test Conditions:  $V_{DS} = 3.5\text{ V}$ ,  $I_{Dset} = 50\text{ mA}$  (RF OFF)

Frequency GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
600	0.868	-168.8	6.120	96.9	0.046	15.7	0.536	-170.3
700	0.866	-172.7	5.225	95.0	0.046	14.9	0.537	-173.9
800	0.864	-176.9	4.641	93.0	0.045	14.8	0.541	-177.1
900	0.863	-179.4	4.145	91.6	0.045	15.4	0.540	-179.6
1000	0.868	176.6	3.730	89.4	0.045	15.8	0.541	178.0
1100	0.862	173.6	3.359	88.3	0.045	16.6	0.542	175.5
1200	0.860	170.8	3.152	87.5	0.046	16.6	0.542	173.4
1300	0.861	168.3	2.894	85.8	0.047	15.7	0.535	171.9
1400	0.859	165.4	2.695	85.2	0.047	15.5	0.533	170.1
1500	0.861	162.2	2.527	84.2	0.046	16.1	0.533	167.8
1600	0.862	159.3	2.387	82.9	0.046	17.0	0.533	165.9
1700	0.857	156.7	2.261	82.8	0.047	17.1	0.532	163.8
1800	0.855	153.5	2.229	80.9	0.046	17.0	0.537	161.1
1900	0.856	150.0	2.093	77.8	0.046	16.6	0.538	158.4
2000	0.860	146.7	1.946	76.9	0.045	16.3	0.537	156.0
2100	0.860	142.9	1.884	75.5	0.045	16.9	0.533	154.0
2200	0.863	140.1	1.785	73.6	0.045	18.4	0.533	149.6

APPLICATION CIRCUIT EXAMPLE

f = 1.9 GHz (Unit: mm)



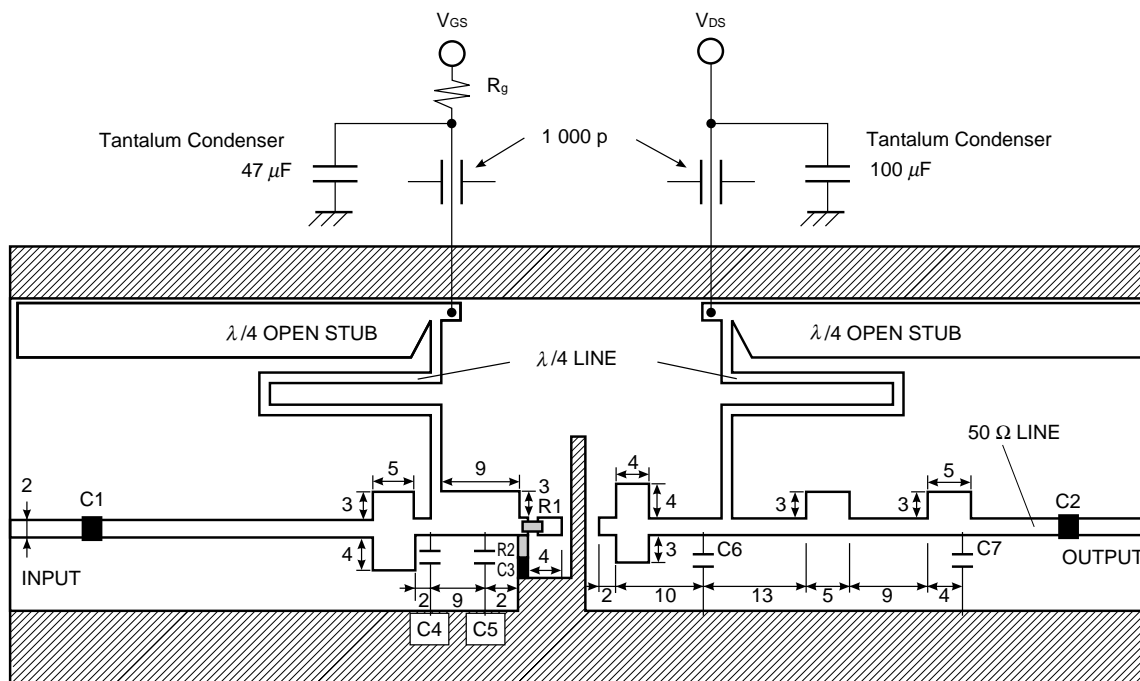
f = 1.9 GHz  
 V<sub>DS</sub> = 3.5 V  
 I<sub>Dset</sub> = 50 mA (RF OFF)

C1 = 30 pF  
 C2 = 30 pF  
 R<sub>g</sub> = 1 kΩ

Legend: GND  
 Substrate: Teflon glass (εr = 2.6)  
 t = 0.8 mm

APPLICATION CIRCUIT EXAMPLE

f = 900 MHz (Unit: mm)



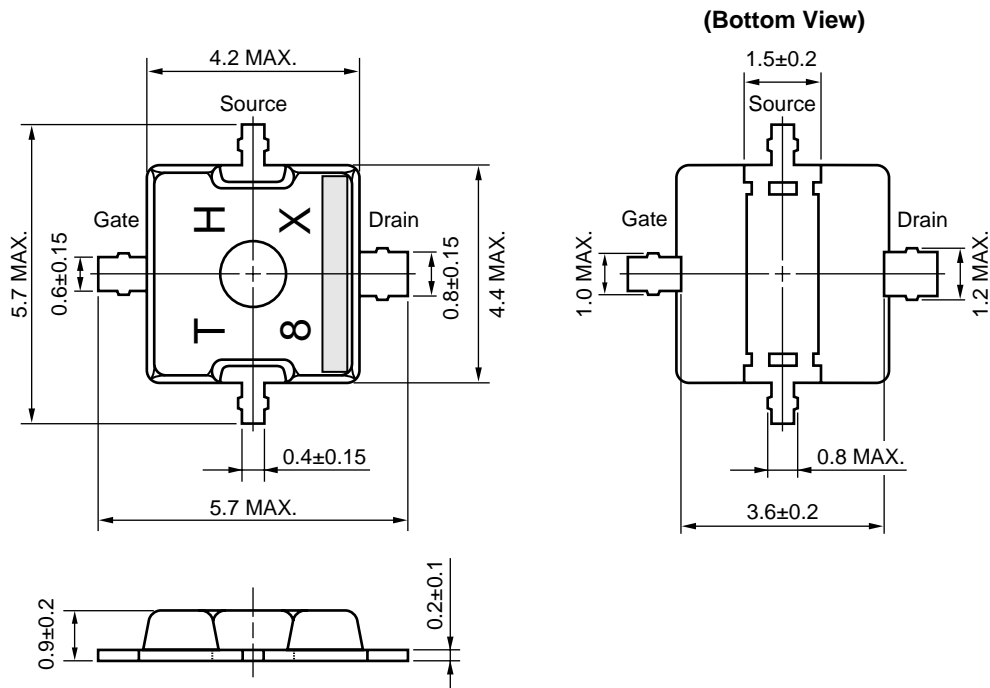
f = 900 MHz  
 V<sub>DS</sub> = 3.5 V  
 I<sub>Dset</sub> = 50 mA (RF OFF)

C1 = 30 pF  
 C2 = 30 pF  
 C3 = 1 000 pF  
 C4 = 6 pF  
 C5 = 3 pF  
 C6 = 6 pF  
 C7 = 1 pF  
 R1 = 5.1 Ω  
 R2 = 30 Ω  
 R<sub>g</sub> = 1 kΩ

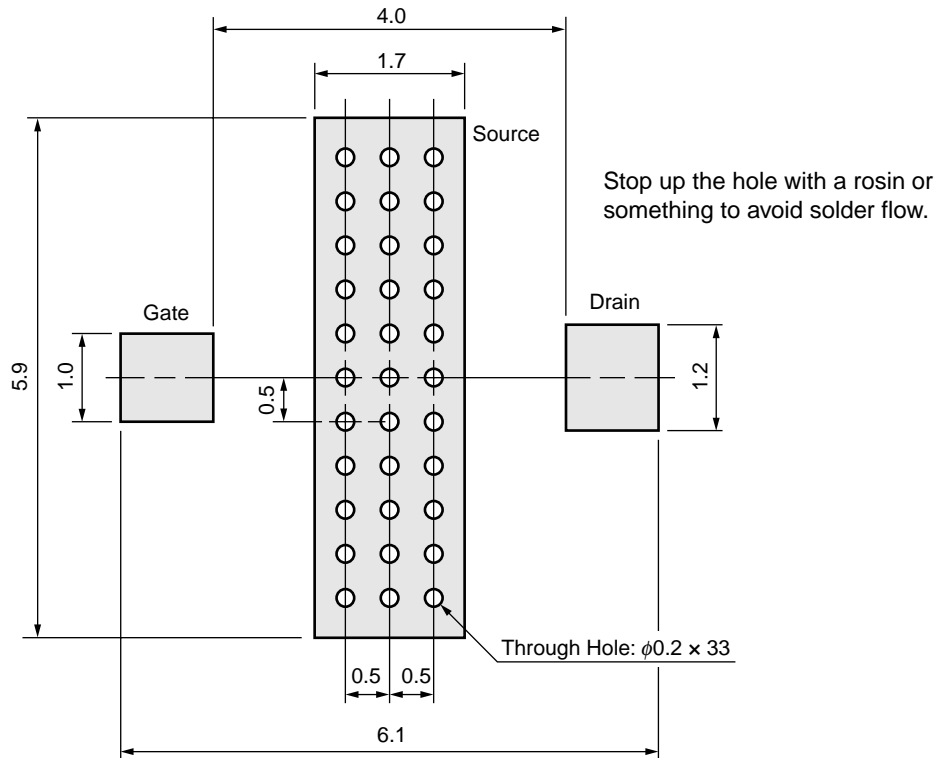
Legend: GND  
 Substrate: Teflon glass (εr = 2.6)  
 t = 0.8 mm

PACKAGE DIMENSIONS

79A (UNIT: mm)



79A PACKAGE RECOMMENDED P.C.B. LAYOUT (UNIT: mm)



**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 235 °C or below, Time: 30 seconds or less (at 210 °C or higher), Count: 2 times or less, Exposure: limit: None <sup>Note</sup>	IR35-00-2
Partial Heating	Pin temperature: 260 °C or below, Time: 5 seconds or less (per pin row) Exposure: limit: None <sup>Note</sup>	—

**Note** After opening the dry pack, store it at 25 °C or less and 65 % RH or less for the allowable storage period.

**Caution** Do not use different soldering methods together (except for partial heating).

- **The information in this document is current as of November, 2001. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC 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 prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
  - NEC 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 semiconductor 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 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 customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
  - While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor 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 semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
  - NEC semiconductor products are classified into the following three quality grades:  
"Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor 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 semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.
- (Note)
- (1) "NEC" as used in this statement means NEC Corporation, NEC Compound Semiconductor Devices, Ltd. and also includes its majority-owned subsidiaries.
  - (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00.4-0110



**SAFETY INFORMATION ON THIS PRODUCT**

<div style="border: 1px solid black; padding: 2px; display: inline-block;"><b>Caution</b></div>	<p>GaAs Products</p>	<p>The product contains gallium arsenide, GaAs. GaAs vapor and powder are hazardous to human health if inhaled or ingested.</p> <ul style="list-style-type: none"> <li>• Do not destroy or burn the product.</li> <li>• Do not cut or cleave off any part of the product.</li> <li>• Do not crush or chemically dissolve the product.</li> <li>• Do not put the product in the mouth.</li> </ul> <p>Follow related laws and ordinances for disposal. The product should be excluded from general industrial waste or household garbage.</p>
---	----------------------	---

► **Business issue**

**NEC Compound Semiconductor Devices, Ltd.**

5th Sales Group, Sales Division TEL: +81-3-3798-6372 FAX: +81-3-3798-6783 E-mail: salesinfo@csd-nec.com

**NEC Compound Semiconductor Devices Hong Kong Limited**

Hong Kong Head Office TEL: +852-3107-7303 FAX: +852-3107-7309  
 Taipei Branch Office TEL: +886-2-8712-0478 FAX: +886-2-2545-3859  
 Korea Branch Office TEL: +82-2-528-0301 FAX: +82-2-528-0302

**NEC Electron Devices European Operations** <http://www.nec.de/>

TEL: +49-211-6503-101 FAX: +49-211-6503-487

**California Eastern Laboratories, Inc.** <http://www.cel.com/>

TEL: +1-408-988-3500 FAX: +1-408-988-0279

► **Technical issue**

**NEC Compound Semiconductor Devices, Ltd.** <http://www.csd-nec.com/>

Sales Engineering Group, Sales Division  
 E-mail: techinfo@csd-nec.com FAX: +81-44-435-1918