To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas 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 Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "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.

   "High Quality": 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; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

DATA SHEET

LDMOS FIELD EFFECT TRANSISTOR
NEM091203P-28

N-CHANNEL SILICON POWER LDMOS FET FOR 135 W UHF-BAND SINGLE-END POWER AMPLIFIER

DESCRIPTION

The NEM091203P-28 is an N-channel enhancement-mode lateral diffused MOS FET designed for 850 to 960 MHz applications, such as, GSM/EDGE/N-CDMA cellular base station. Dies are manufactured using our NEWMOS technology (our WSi gate lateral MOS FET), and its nitride surface passivation and quadruple layer aluminum silicon metallization offer a high degree of reliability.

FEATURES

- High 1 dB compression output power : $P_{O\,(1\,dB)}$ = 135 W TYP. (V_{DS} = 28 V, I_{Dset} = 1 200 mA, f = 850 to 960 MHz CW)
- High linear gain : G_L = 17.0 dB TYP. (V_{DS} = 28 V, I_{Dset} = 1 200 mA, f = 850 to 960 MHz CW)
- High drain efficiency : η_d = 58% TYP. (V_{DS} = 28 V, I_{Dset} = 1 200 mA, f = 850 to 960 MHz CW)
- Low intermodulation distortion : IM_3 = –40 dBc TYP. (V_{DS} = 28 V, I_{Dset} = 1 200 mA, f = 960/960.1 MHz, P_{out} = 45 dBm (2 tones))
  : IM_3 = –40 dBc TYP. (V_{DS} = 28 V, I_{Dset} = 1 200 mA, f = 880/880.1 MHz, P_{out} = 45 dBm (2 tones))
- Internal matched (Input and Output) for ease of use
- Low cost hollow plastic packages
- 100% screening
- Integrated ESD protection
- Effective prevention against humidity
- Excellent stability against HCI (Hot Carrier Injection)

APPLICATION

- Digital cellular base station PA : GSM/EDGE/N-CDMA etc.

ORDERING INFORMATION

Part Number	Order Number	Package	Supplying Form
NEM091203P-28	NEM091203P-28-A	T-97M (3P) (Pb-Free)	ESD protective envelope

Remark To order evaluation samples, contact your nearby sales office.
The unit sample quantity is 1 pcs.

Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.

Document No. PU10539EJ01V0DS (1st edition)
Date Published June 2005 CP(K)
Printed in Japan

ABSOLUTE MAXIMUM RATINGS (T_A = +25°C, unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V_{DS}	65	V
Gate to Source Voltage	V_{GS}	±7	V
Drain Current	I_D	12	A
Total Device Dissipation	P_{tot}	292	W
Channel Temperature	T_{ch}	200	°C
Storage Temperature	T_{stg}	−65 to +150	°C

THERMAL RESISTANCE (T_A = +25°C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Thermal Resistance (Channel to case)	$R_{th\ (ch\text{-}c)}$		–	0.54	0.6	°C/W

RECOMMENDED OPERATING RANGE

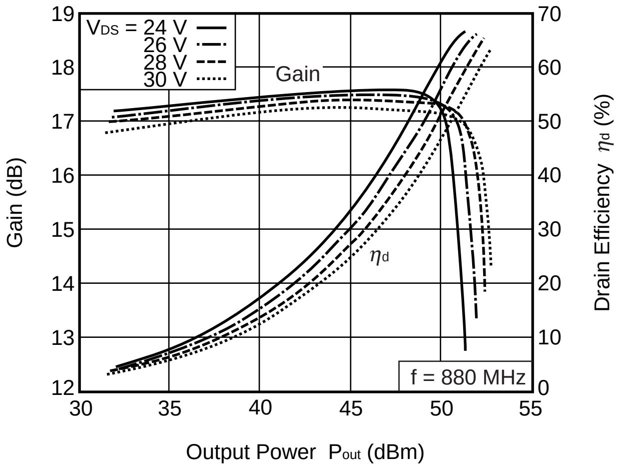
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V_{DS}	–	28	30	V
Gate to Source Voltage	V_{GS}	2.5	3.0	4.0	V
Input Power	P_{in}	–	35	38	dBm

ELECTRICAL CHARACTERISTICS (T_A = +25°C)

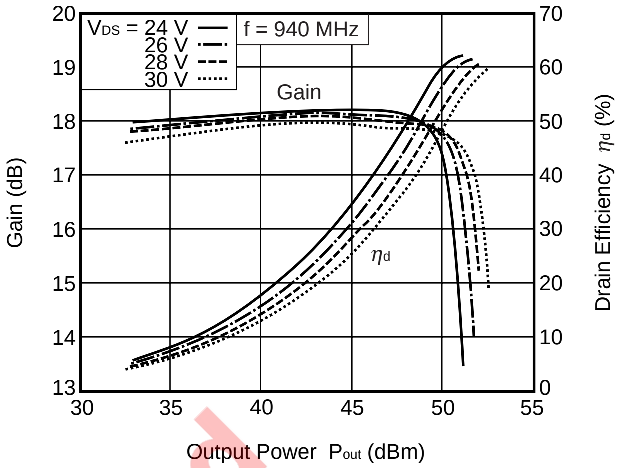
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Gate to Source Leak Current	I_{GSS}	V_{GSS} = 5V	–	–	1	μA
Drain to Source Leakage Current (Zero Gate Voltage Drain Current)	I_{DSS}	V_{DSS} = 65 V	–	–	1	mA
Gate Threshold Voltage	V_{th}	V_{DS} = 10 V, I_{DS} = 1 mA	1.7	2.2	2.8	V
Transconductance	g_m	V_{DS} = 20 V, I_{DS} = 1.2±0.1 A	–	5.6	–	S
Drain to Source Breakdown Voltage	BV_{DSS}	I_{DSS} = 10 μA	65	75	–	V
RF Characteristics						
Output Power	P_{out}	f = 920 to 960 MHz, P_{in} = 35 dBm, V_{DS} = 28 V, I_{Dset} = 1 200 mA	50.8	51.3	–	dBm
Gain 1 dB Compression Output Power	$P_{O\ (1\ dB)}$		–	51.3	–	dBm
Drain Efficiency	η_d		50	58	–	%
Power Added Efficiency	η_{add}		–	57	–	%
Linear Gain	G_L	P_{in} = 25 dBm	16.5	18.0	–	dB
3rd Order Intermodulation Distortion	IM_3	f = 960/960.1 MHz, V_{DS} = 28 V, I_{Dset} = 1 200 mA, 2 tones P_{out} = 45 dBm	–	–40	–	dBc
Output Power	P_{out}	f = 880 MHz, P_{in} = 35 dBm, V_{DS} = 28 V, I_{Dset} = 1 200 mA	–	52.0	–	dBm
Gain 1 dB Compression Output Power	$P_{O\ (1\ dB)}$		–	51.8	–	dBm
Drain Efficiency	η_d		–	60	–	%
Power Added Efficiency	η_{add}		–	58	–	%
Linear Gain	G_L	P_{in} = 29 dBm	–	17.0	–	dB
3rd Order Intermodulation Distortion	IM_3	f = 880/880.1 MHz, V_{DS} = 28 V, I_{Dset} = 1 200 mA, 2 tones P_{out} = 45 dBm	–	–40	–	dBc

TYPICAL CHARACTERISTICS (T_A = +25°C, V_{DS} = 28 V, I_{Dset} = 1 200 mA, unless otherwise specified)

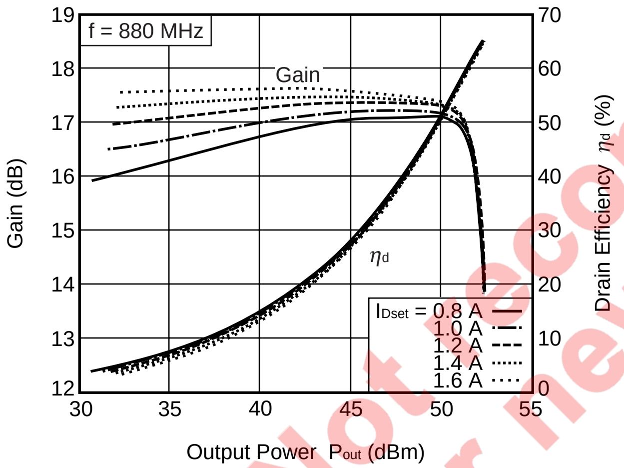
GAIN, DRAIN EFFICIENCY vs. OUTPUT POWER



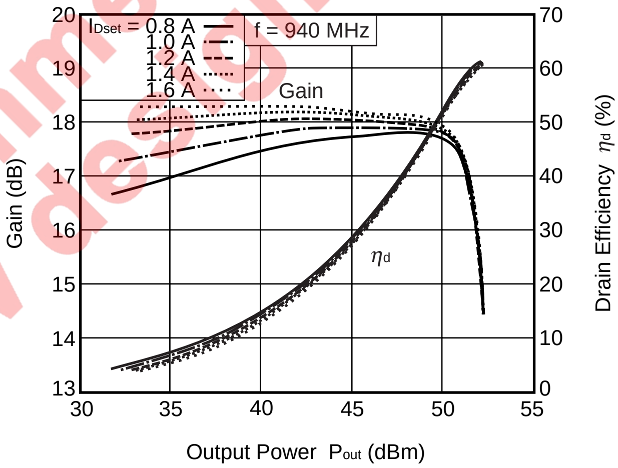
GAIN, DRAIN EFFICIENCY vs. OUTPUT POWER



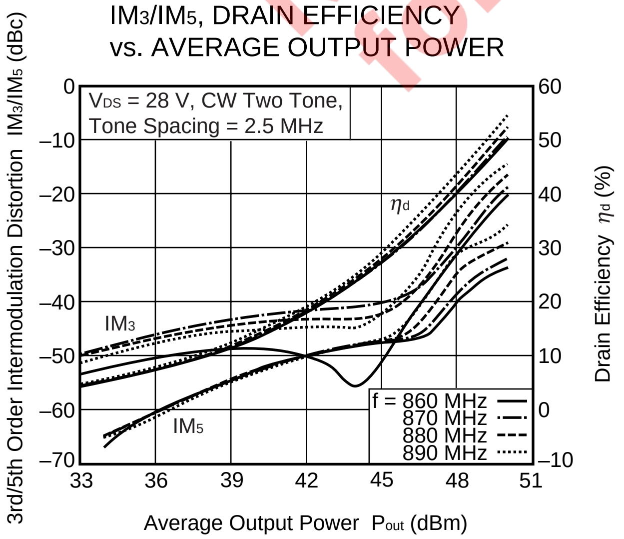
GAIN, DRAIN EFFICIENCY vs. OUTPUT POWER



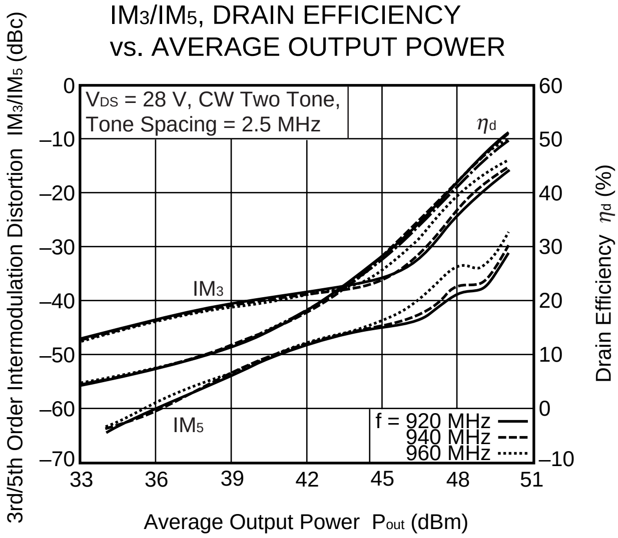
GAIN, DRAIN EFFICIENCY vs. OUTPUT POWER



IM3/IM5, DRAIN EFFICIENCY
vs. AVERAGE OUTPUT POWER

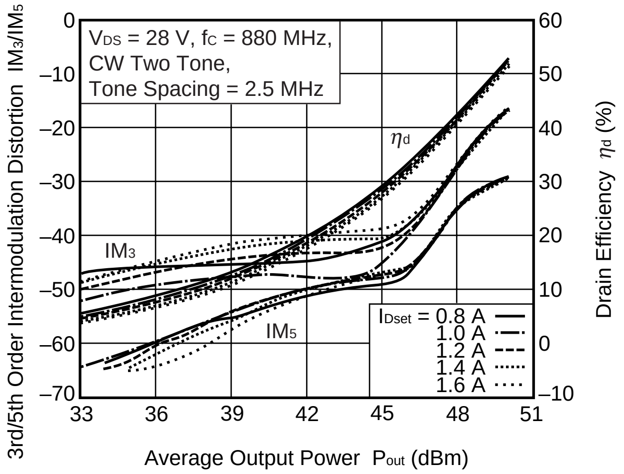


IM3/IM5, DRAIN EFFICIENCY
vs. AVERAGE OUTPUT POWER

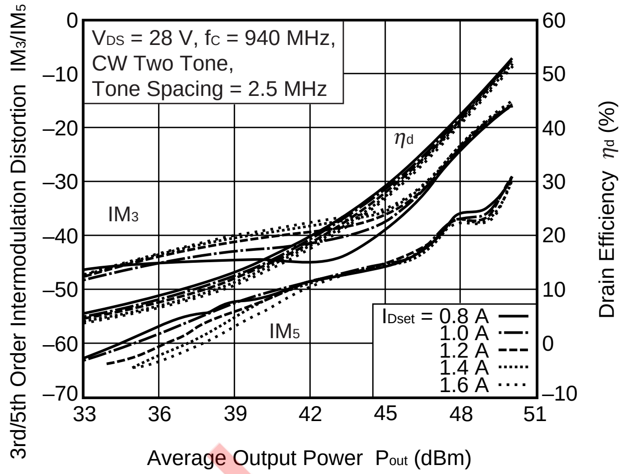


Remark The graphs indicate nominal characteristics.

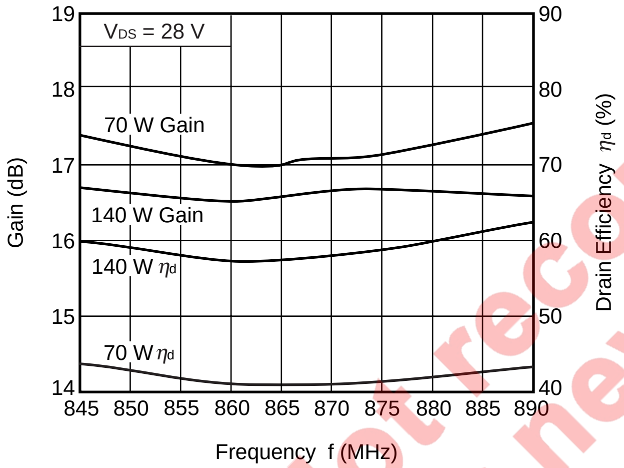
IM3/IM5, DRAIN EFFICIENCY
vs. AVERAGE OUTPUT POWER



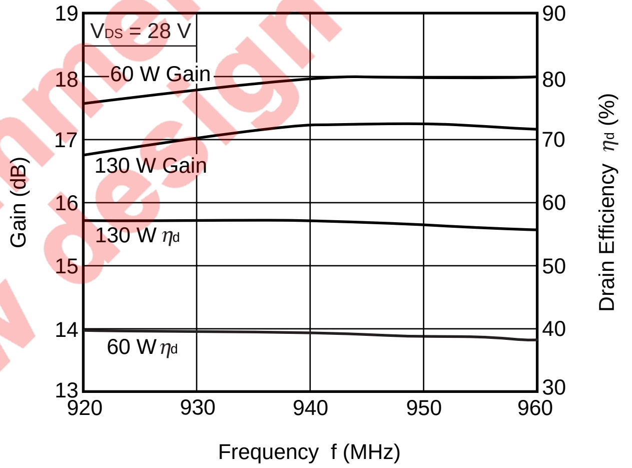
IM3/IM5, DRAIN EFFICIENCY
vs. AVERAGE OUTPUT POWER



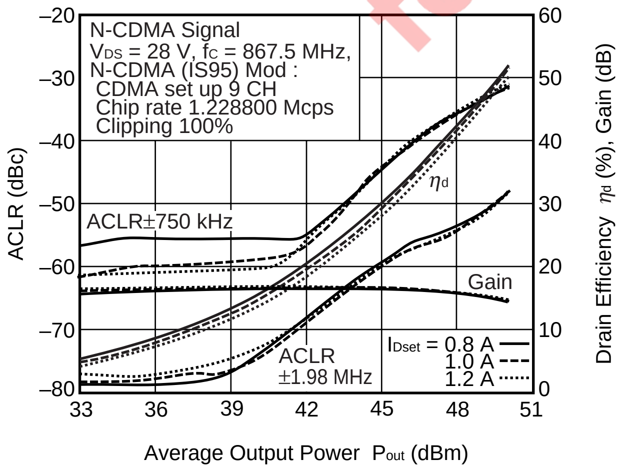
GAIN, DRAIN EFFICIENCY vs. FREQUENCY



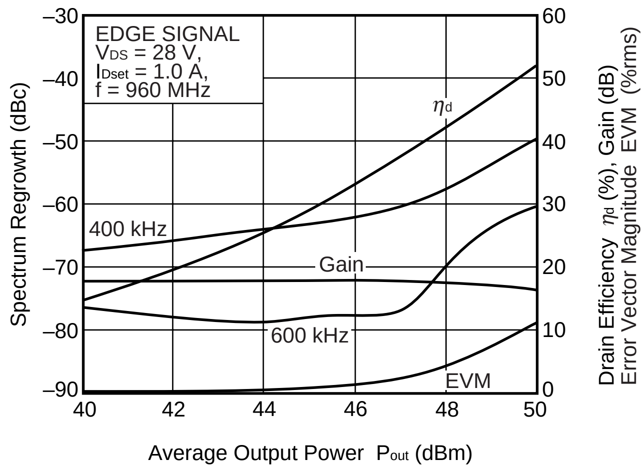
GAIN, DRAIN EFFICIENCY vs. FREQUENCY



ACLR, DRAIN EFFICIENCY, GAIN
vs. AVERAGE OUTPUT POWER

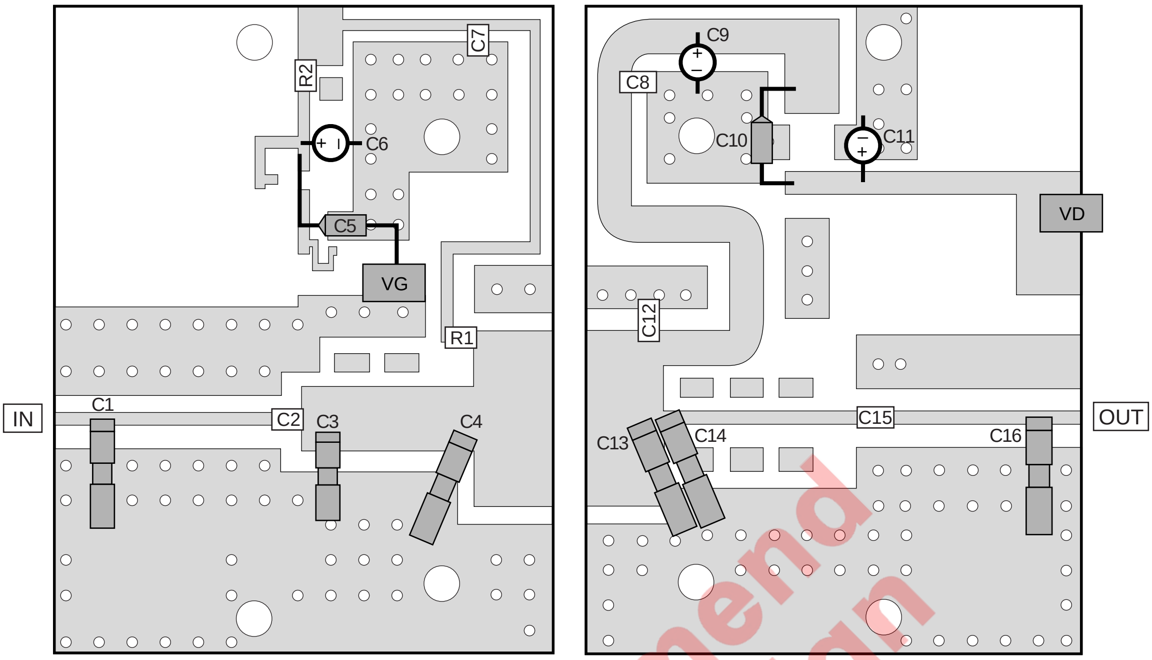


SPECTRUM REGROWTH, ηd, GAIN
EVM vs. AVERAGE OUTPUT POWER

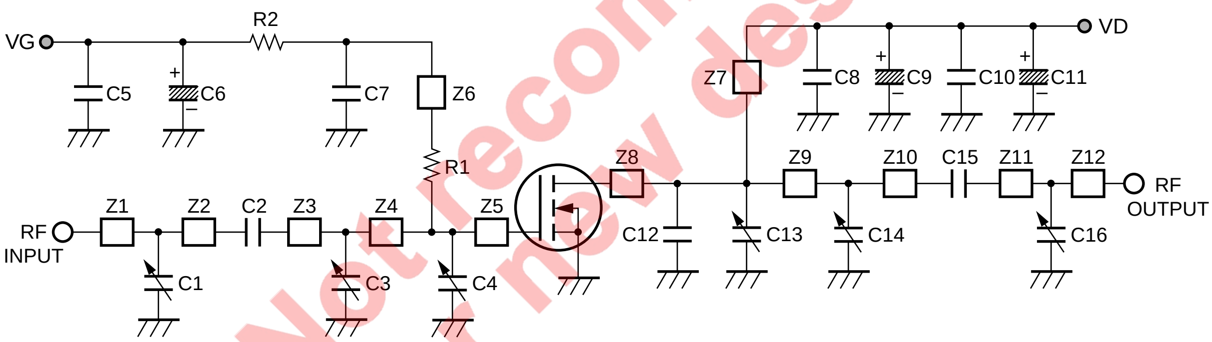


Remark The graphs indicate nominal characteristics.

COMPONENT LAYOUT OF TEST CIRCUIT FOR 920 TO 960 MHz



TEST CIRCUIT SCHMATIC FOR 920 TO 960 MHz



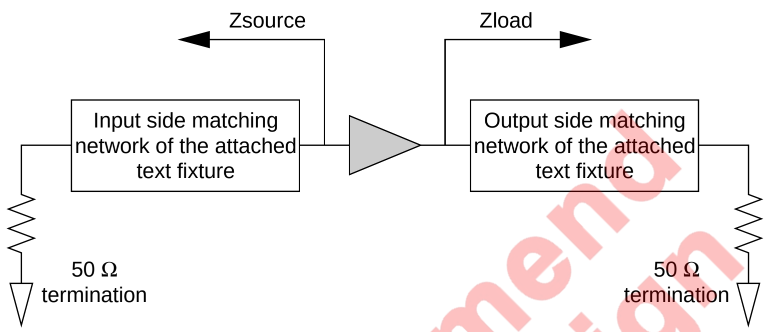
Symbol	Value	Symbol	Value
C2	43 pF Chip Capacitor	Z1	Line, 6.0 × 1.0 mm
C15	47 pF Chip Capacitor	Z2	Line, 16.4 × 1.0 mm
C7, C8	0.1 μF Chip Capacitor	Z3	Line, 1.9 × 5.5 mm
C12	6 pF Chip Capacitor	Z4	Line, 13.7 × 5.5 mm
C3	0.4 to 4 pF Variable Capacitor	Z5	Line, 7.0 × 15.0 mm
C1, C4, C13, C14, C16	0.8 to 8 pF Variable Capacitor	Z6	Line, 39.5 × 1.0 mm
C5, C10	1 000 pF EMI Suppression Filter	Z7	Line, 42.5 × 3.0 mm
C6, C11	47 μF Electrolytic Capacitor	Z8	Line, 5.7 × 15.0 mm
C9	1 μF Electrolytic Capacitor	Z9	Line, 3.0 × 1.0 mm
R1	10 Ω Chip Resistor	Z10	Line, 17.2 × 1.0 mm
R2	100 Ω Chip Resistor	Z11	Line, 12.4 × 1.0 mm
Circuit Board	Rogers 4350, εr = 3.55, Thickness 0.51 mm	Z12	Line, 3.5 × 1.0 mm

LARGE SIGNAL IMPEDANCE OF TEST BOARD FOR 920 TO 960 MHz

Measurement Condition: V_{DS} = 28 V, I_{Dset} = 1.2 A

f (MHz)	Z_{in} (Ω)	Z_{out} (Ω)
920	5.20+j1.78	1.36+j0.91
940	5.18+j2.20	1.15+j0.60
960	5.06+j2.56	1.05+j0.23

Remark Z_{in} = Conjugate of Zsource, Z_{out} = Conjugate of Zload



S-PARAMETERS

S-parameters/Noise parameters are provided on the NEC Compound Semiconductor Devices Web site in a form (S2P) that enables direct import to a microwave circuit simulator without keyboard input.

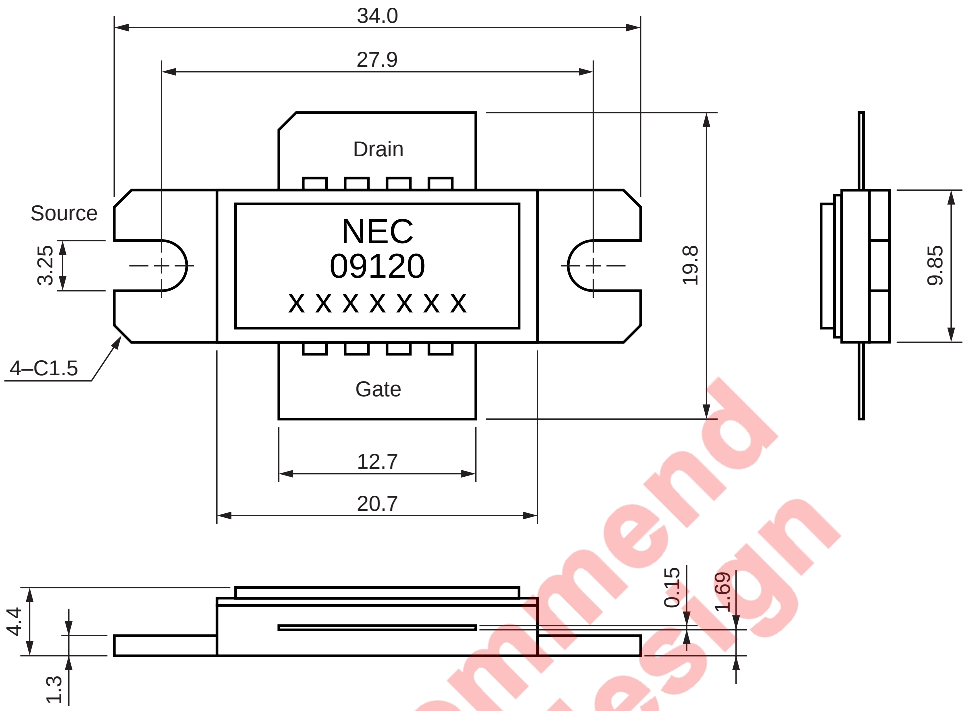
Click here to download S-parameters.

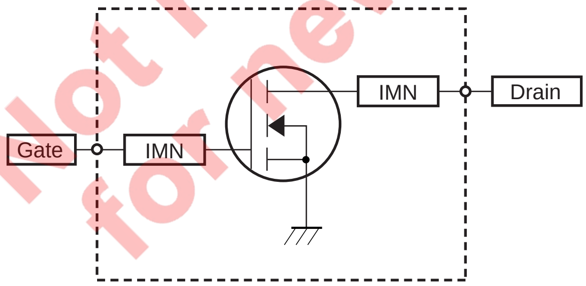
[RF and Microwave] → [Device Parameters]

URL http://www.ncsd.necel.com/

PACKAGE DIMENSIONS

T-97M (3P) (UNIT: mm)





IMN : Internal Matching Network

RECOMMENDED MOUNTING CONDITIONS FOR CORRECT USE

(1) Fix to a heat sink or mount surface completely with screws at the two holes of the flange.

(2) The recommended torque strength of the screws is 29.4 N·cm typical using M3 type screws.

(3) The recommended flatness of the mount surface is less than ±10 μm (roughness of surface is ∇∇∇).

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		Condition Symbol
Partial Heating	Peak temperature (terminal temperature) Soldering time (per terminal of device) Maximum chlorine content of rosin flux (% mass)	: 350°C or below : 3 seconds or less : 0.2%(Wt.) or below	HS350-P3

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

When the product(s) listed in this document is subject to any applicable import or export control laws and regulation of the authority having competent jurisdiction, such product(s) shall not be imported or exported without obtaining the import or export license.

- **The information in this document is current as of June, 2005. 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

▶For further information, please contact

NEC Compound Semiconductor Devices, Ltd. **http://www.ncsd.necel.com/**
E-mail: salesinfo@ml.ncsd.necel.com (sales and general)
techinfo@ml.ncsd.necel.com (technical)
Sales Division TEL: +81-44-435-1573 FAX: +81-44-435-1579

NEC Compound Semiconductor Devices Hong Kong Limited
E-mail: ncsd-hk@elhk.nec.com.hk (sales, technical and general)

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: +82-2-558-2120	FAX: +82-2-558-5209

NEC Electronics (Europe) GmbH **http://www.ee.nec.de/**
TEL: +49-211-6503-0 FAX: +49-211-6503-1327

California Eastern Laboratories, Inc. **http://www.cel.com/**
TEL: +1-408-988-3500 FAX: +1-408-988-0279

0504