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.

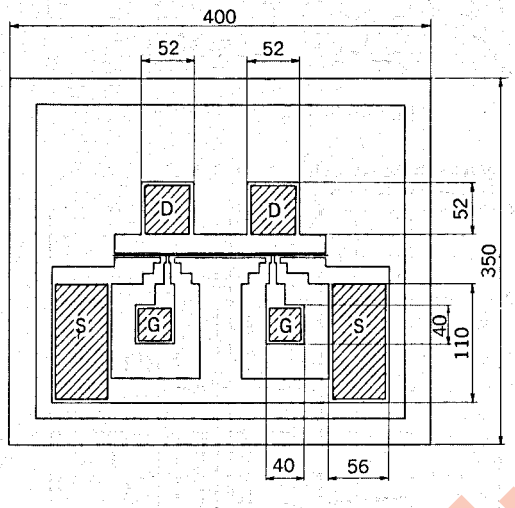
RENESAS

HETERO JUNCTION FIELD EFFECT TRANSISTOR

NE20200

X to Ka BAND SUPER LOW NOISE AMPLIFIER
AlGaAs/GaAs HETERO JUNCTION FIELD EFFECT TRANSISTOR CHIP

CHIP DIMENSIONS
(Unit : μm)



Thickness = 140 ± 10 μm

D : Drain
G : Gate
S : Source
▨ : BONDING AREA

FEATURES

- Super Low Noise Figure
  1.0 dB TYP. at f = 12 GHz
- High Associated Gain
  12 dB TYP. at f = 12 GHz
- n^+ AlGaAs/Undoped GaAs Hetero-structure
- Gate Length : Lg = 0.3 μm
- Gate Width : Wg = 200 μm

ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

Drain to Source Voltage	V_{DS}	4.0	V
Gate to Source Voltage	V_{GS}	−3.0	V
Drain Current	I_D	60	mA
Gate Current	I_G	10	μA
Total Power Dissipation*	P_{tot}	200	mW
Channel Temperature	T_{on}	175	°C
Storage Temperature	T_{stg}	−65 to +175	°C

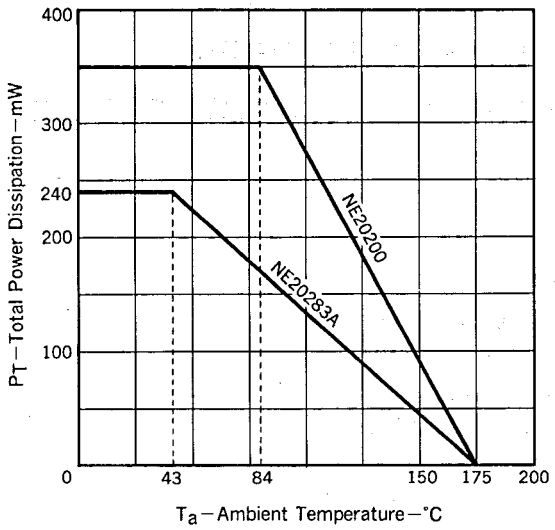
* : P_{tot} for chip mounted on a Alumina heatsink (size : 3 x 3 x 0.6^t mm).

ELECTRICAL CHARACTERISTICS (T_a = 25 °C)

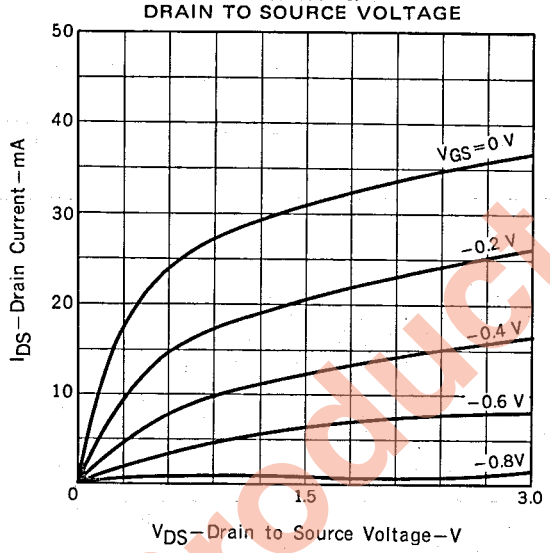
PART NUMBER		NE20200			NE20200 −1.4			UNIT	TEST CONDITIONS
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Drain to Source Leak Current	I_{DSX}			100			100	μA	V_{DS} = 4 V, V_{GS} = −2 V
Gate to Source Leak Current	I_{GSO}		1	10		1	10	μA	V_{GS} = −3 V
Drain Current	I_{DSS}	12	30	60	12	30	60	mA	V_{DS} = 2.0 V, V_{GS} = 0
Gate to Source Cutoff Voltage	$V_{GS(off)}$	−0.3	−0.8	−2.0	−0.3	−0.8	−2.0	V	V_{DS} = 2.0 V, I_D = 100 μA
Transconductance	g_m	30	45		30	45		mS	V_{DS} = 2.0 V, I_D = 10 mA
Noise Figure	NF		1.0	1.2		1.2	1.4	dB	V_{DS} = 2.0 V, I_D = 10 mA f = 12 GHz
Associated Gain	G_a	11.0	12.0		10.0	11.0		dB	
Noise Figure	NF			1.2			1.4	dB	V_{DS} = 3.0 V, I_D = 10 mA f = 12 GHz
Associated Gain	G_a	11.0			10.0			dB	

TYPICAL CHARACTERISTICS (T_a = 25 °C)

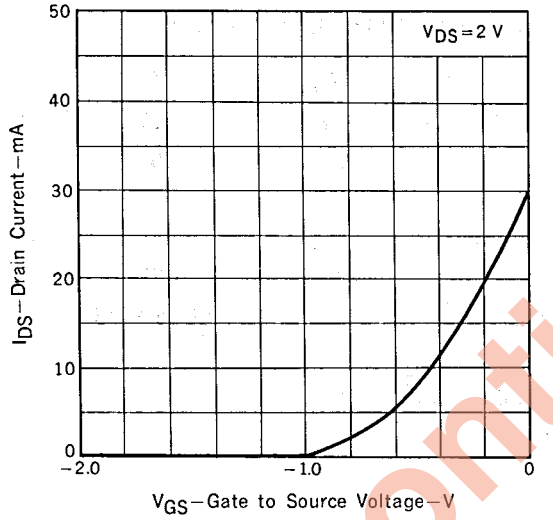
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



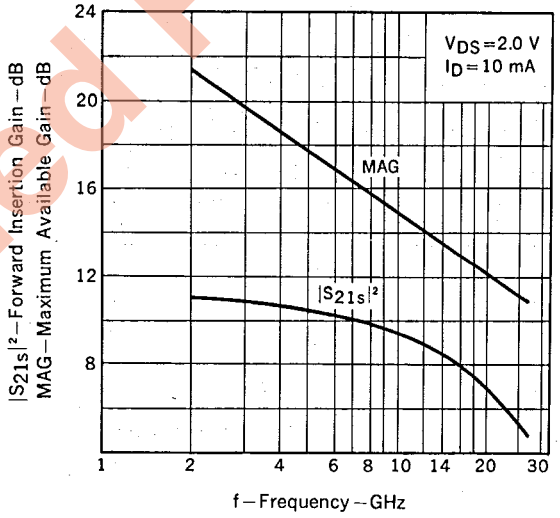
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



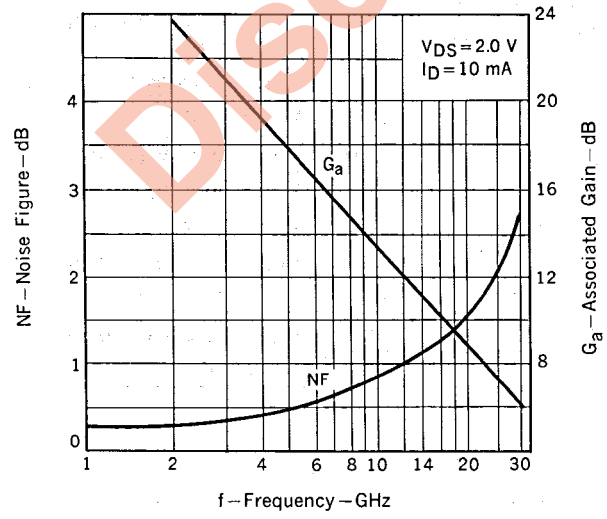
DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



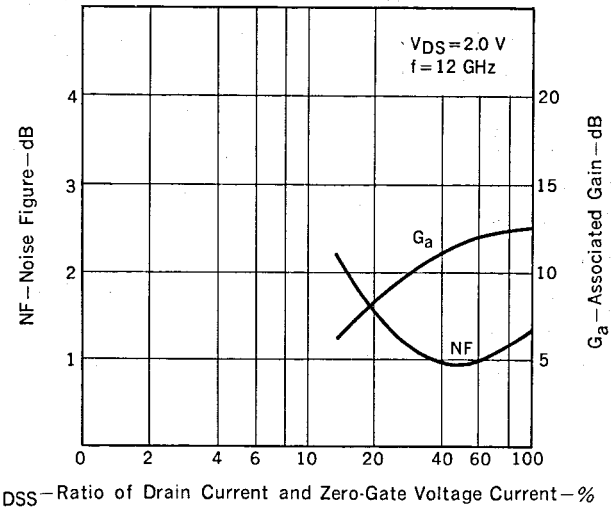
MAXIMUM AVAILABLE GAIN, FORWARD INSERTION GAIN vs. FREQUENCY



NOISE FIGURE, ASSOCIATED GAIN vs. FREQUENCY

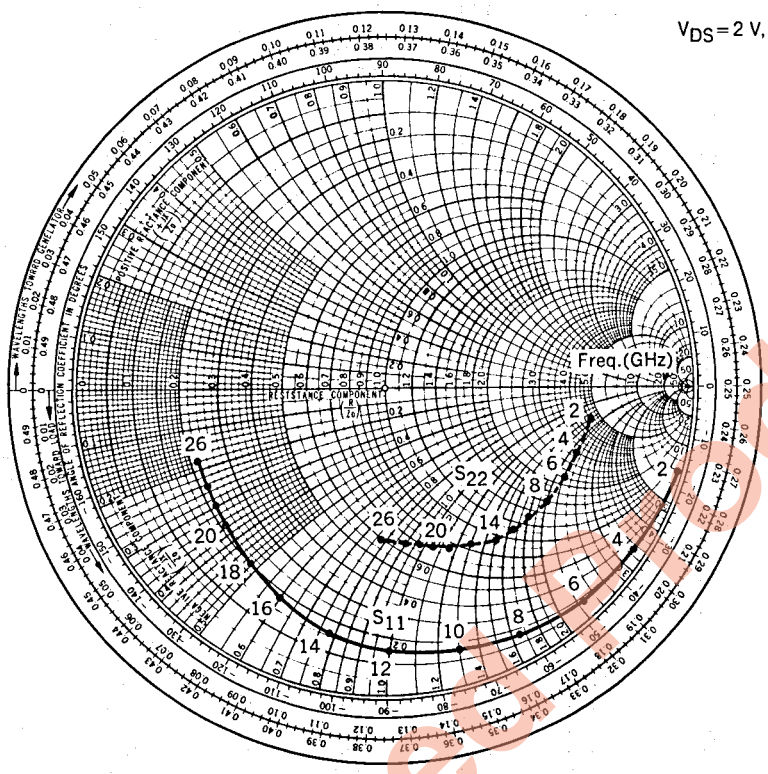


NOISE FUGURE, ASSOCIATED GAIN vs. RATIO OF DRAIN CURRENT AND ZERO-GATE VOLTAGE CURRENT



S-PARAMETERS

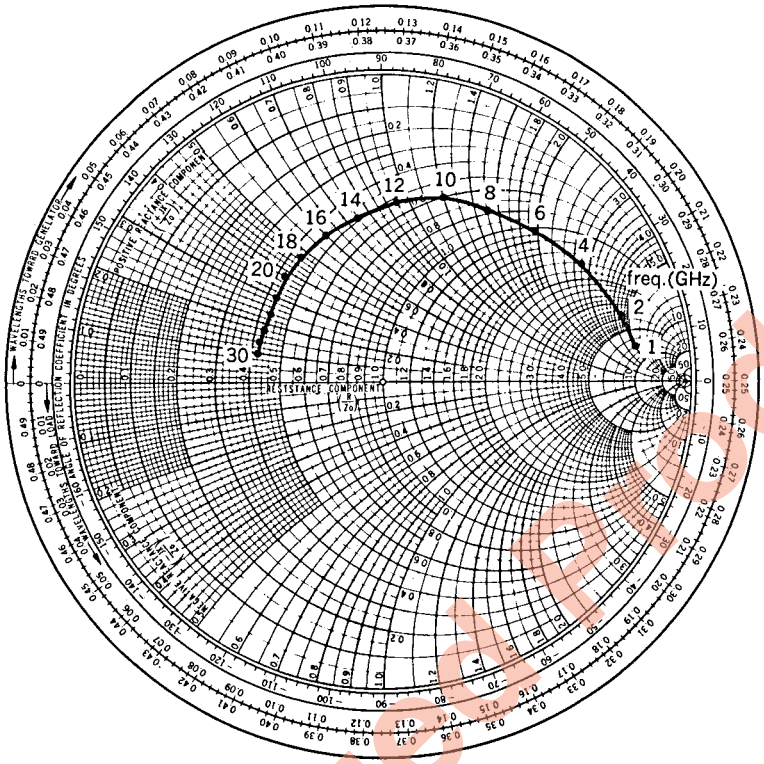
V_{DS} = 2 V, I_D = 10 mA



S-PARAMETERS V_{DS} = 2 V, I_D = 10 mA

Freq.	S_{11}		S_{21}		S_{12}		S_{22}		K	$G_{max.}$
	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase		
2000	0.995	–16	3.497	165	0.025	81	0.686	–9	–0.02	21.4
2500	0.995	–21	3.500	160	0.035	75	0.671	–13	0.02	20.8
3000	0.997	–27	3.505	155	0.037	73	0.664	–15	0.04	20.0
3500	0.980	–30	3.415	153	0.041	72	0.655	–17	0.12	19.3
4000	0.972	–34	3.373	150	0.047	70	0.658	–19	0.15	18.6
4500	0.965	–37	3.338	147	0.052	68	0.657	–20	0.18	18.1
5000	0.957	–41	3.301	144	0.058	64	0.651	–23	0.21	17.5
5500	0.952	–45	3.284	141	0.063	61	0.647	–24	0.22	17.2
6000	0.952	–48	3.245	138	0.068	61	0.658	–26	0.20	16.8
6500	0.949	–51	3.208	135	0.072	55	0.648	–29	0.24	16.5
7000	0.942	–56	3.213	131	0.076	53	0.640	–32	0.24	16.3
7500	0.929	–59	3.175	128	0.078	51	0.631	–34	0.27	16.1
8000	0.915	–62	3.101	124	0.080	50	0.626	–36	0.31	15.9
8500	0.915	–65	3.058	121	0.083	48	0.618	–38	0.31	15.7
9000	0.913	–68	3.000	118	0.086	46	0.623	–39	0.33	15.4
9500	0.924	–71	3.000	115	0.087	45	0.634	–40	0.28	15.4
10000	0.929	–75	2.984	113	0.091	44	0.633	–43	0.23	15.2
10500	0.918	–79	2.962	109	0.094	43	0.626	–45	0.25	15.0
11000	0.887	–83	2.925	105	0.097	40	0.613	–46	0.34	14.8
11500	0.875	–86	2.913	102	0.096	40	0.610	–47	0.36	14.8
12000	0.871	–89	2.857	98	0.102	40	0.614	–48	0.36	15.5
12500	0.864	–92	2.814	96	0.104	38	0.612	–50	0.36	14.3
13000	0.852	–96	2.773	91	0.108	36	0.611	–51	0.39	14.1
13500	0.838	–99	2.756	88	0.111	35	0.610	–53	0.41	14.0
14000	0.823	–103	2.724	86	0.114	33	0.605	–54	0.43	13.8
14500	0.813	–106	2.648	83	0.115	32	0.603	–56	0.45	13.6
15000	0.787	–110	2.631	79	0.118	29	0.601	–60	0.48	13.5
15500	0.784	–113	2.629	76	0.120	27	0.586	–61	0.50	13.4
16000	0.778	–117	2.602	74	0.120	26	0.579	–62	0.51	13.4
16500	0.751	–120	2.531	71	0.122	23	0.574	–64	0.57	13.2
17000	0.734	–123	2.454	69	0.124	21	0.562	–65	0.62	13.0
17500	0.725	–126	2.422	66	0.123	20	0.556	–67	0.64	12.9
18000	0.705	–128	2.396	65	0.124	17	0.543	–69	0.69	12.9
18500	0.694	–131	2.302	63	0.121	16	0.533	–70	0.74	12.8
19000	0.680	–133	2.256	62	0.123	15	0.521	–71	0.79	12.6
19500	0.682	–135	2.239	59	0.120	14	0.515	–73	0.79	12.7
20000	0.679	–138	2.248	58	0.122	13	0.515	–74	0.79	12.6
20500	0.677	–140	2.187	55	0.123	12	0.510	–76	0.80	12.5
21000	0.663	–141	2.107	53	0.119	12	0.509	–76	0.87	12.5
21500	0.684	–144	2.087	51	0.119	11	0.495	–78	0.85	12.4
22000	0.688	–144	2.077	49	0.120	10	0.506	–78	0.83	12.4
22500	0.683	–148	2.036	47	0.131	9	0.492	–80	0.79	11.9
23000	0.672	–149	1.920	44	0.124	9	0.500	–81	0.92	11.9
23500	0.652	–151	1.865	40	0.126	8	0.487	–82	1.00	11.7
24000	0.655	–150	1.829	38	0.122	7	0.504	–83	1.01	11.1
24500	0.644	–153	1.818	38	0.125	8	0.501	–84	0.99	11.6
25000	0.655	–152	1.761	36	0.129	9	0.515	–86	0.95	11.4
25500	0.656	–155	1.728	34	0.128	10	0.511	–88	0.97	11.3
26000	0.662	–159	1.719	29	0.137	11	0.505	–92	0.89	11.0
26500	0.655	–163	1.780	29	0.141	11	0.495	–95	0.83	11.0
(GHz)		(deg)		(deg)		(deg)		(deg)		(dB)

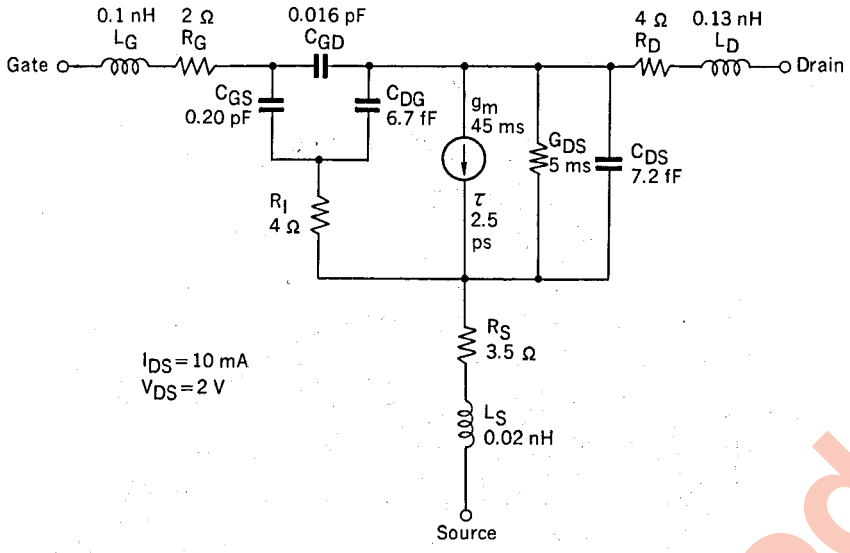
NOISE PARAMETERS



freq. (GHz)	$NF_{opt.}$ (dB)	G_a (dB)	$\Gamma_{opt.}$ Mag.	$\Gamma_{opt.}$ Ang.	$R_n/50$
1	0.30	26.2	0.82	8	0.75
2	0.30	23.6	0.80	15	0.60
4	0.37	19.1	0.74	31	0.55
6	0.52	16.5	0.70	44	0.50
8	0.68	14.6	0.66	58	0.45
10	0.84	13.2	0.62	72	0.42
12	1.00	12.0	0.58	86	0.40
14	1.15	11.0	0.54	98	0.38
16	1.31	10.1	0.51	110	0.36
18	1.47	9.4	0.48	122	0.34
20	1.63	8.7	0.46	132	0.32
22	1.82	8.0	0.44	141	0.30
24	2.03	7.5	0.42	148	0.27
26	2.22	7.0	0.42	156	0.25
28	2.43	6.5	0.42	161	0.22
30	2.70	6.0	0.41	167	0.20

Note: $\Gamma_{opt.}$ includes Bond Wired.
Bond Wires used during testing:
Gate: 2 Wires total, 1 per bond pad, 0.013" long each wire.
Drain: 2 Wires total, 1 per bond pad, 0.015" long each wire.
Source: 4 Wires total, 2 per side, 0.007" long each wire.

EQUIVALENT CIRCUIT



Note: Inductance of bonding wires are included.

20 μm φ Au wire
Gate: Total 2 Wires, 1 per Bond Pad, 0.013" Long each Wire.
Drain: Total 2 Wires, 1 per Bond Pad, 0.015" Long each Wire.
Source: Total 4 Wires, 2 per side, 0.007" Long each Wire.

CHIP HANDLING

DIE ATTACHMENT

Die attach operation can be accomplished with Au-Sn (within a 300 °C — 10 s) performs in a forming gas environment.
Epoxy die attach is not recommend.

BONDING

Bonding wires should be minimum length, semi hard gold wire (3–8 % elongation) 20 microns in diameter.
Bonding should be performed with a wedge tip that has a taper of approximately 15 %. Bonding time should be kept to a minimum.
As a general rule, the bonding operation should be kept within a 280 °C, 2 minutes for all bonding wires.
If longer periods are required, the temperature should be lowered.

PRECAUTIONS

The user must operate in a clean, dry environment. The chip channel is glassivated for mechanical protection only and does not preclude the necessity of a clean environment.
The bonding equipment should be periodically checked for sources of surge voltage and should be properly grounded at all times. In fact, all test and handling equipment should be grounded to minimize the possibilities of static discharge.