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)

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HETERO JUNCTION FIELD EFFECT TRANSISTOR

NE32984D

X to Ka BAND SUPER LOW NOISE AMPLIFIER N-CHANNEL HJ-FET

DESCRIPTION

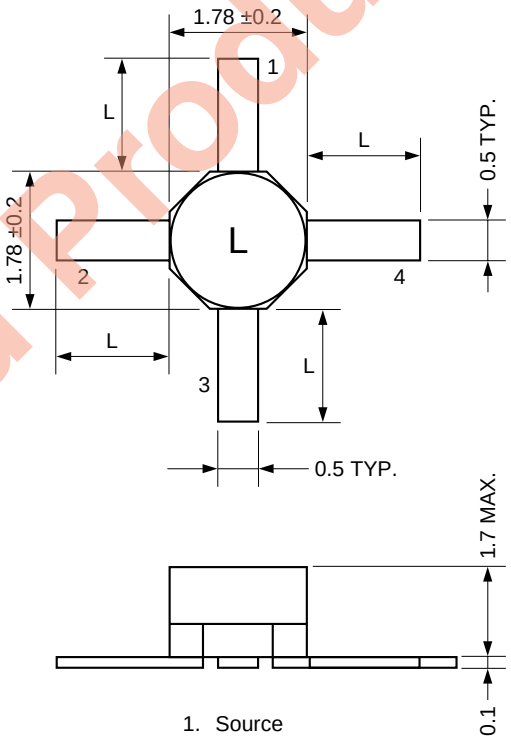
The NE32984D is a Hetero Junction FET that utilizes the hetero junction to create high mobility electrons. Its excellent low noise and high associated gain make it suitable for DBS and another commercial systems.

FEATURES

- Super Low Noise Figure & High Associated Gain
  NF = 0.40 dB TYP., G_a = 12.5 dB TYP. at f = 12 GHz
- Gate Length : $L_g \leq 0.20$ μm
- Gate Width : W_g = 200 μm

PACKAGE DIMENSIONS

(Unit: mm)



1. Source
2. Drain
3. Source
4. Gate

ORDERING INFORMATION

PART NUMBER	SUPPLYING FORM	LEAD LENGTH	MARKING
NE32984D-SL	STICK	L = 1.7 mm MIN.	L
NE32984D-T1	Tape & reel 1000 pcs./reel	L = 1.0 ± 0.2 mm	
NE32984D-T1A	Tape & reel 5000 pcs./reel	L = 1.0 ± 0.2 mm	

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	I_{DSS}	mA
Gate Current	I_G	100	μA
Total Power Dissipation	P_{tot}	165	mW
Channel Temperature	T_{ch}	150	°C
Storage Temperature	T_{stg}	–65 to +150	°C

RECOMMENDED OPERATING CONDITION (T_A = 25 °C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V_{DS}		2	3	V
Drain Current	I_D		10	20	mA
Input Power	P_{in}			0	dBm

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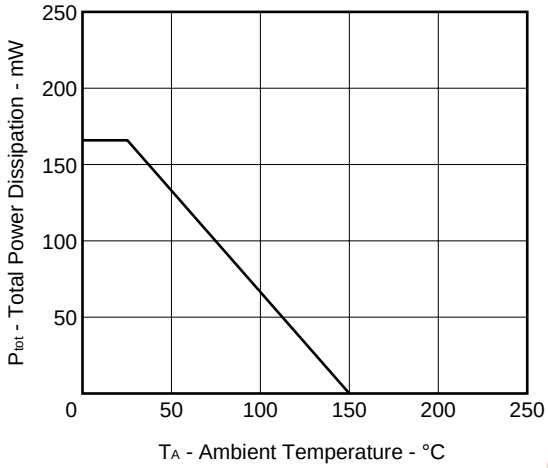
ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

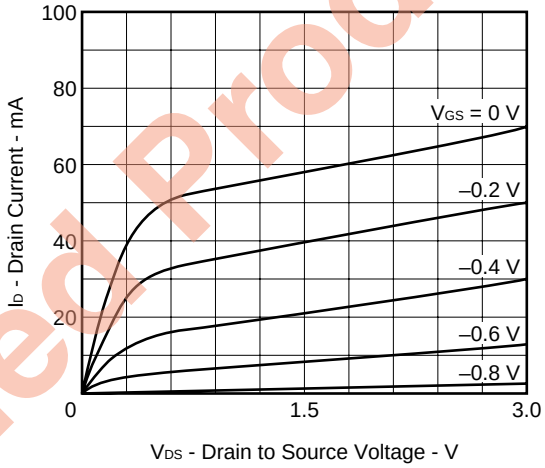
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Gate to Source Leak Current	I_{GSO}		0.5	10	μA	V_{GS} = –3 V
Saturated Drain Current	I_{DSS}	20	60	90	mA	V_{DS} = 2 V, V_{GS} = 0 V
Gate to Source Cutoff Voltage	$V_{GS(off)}$	–0.2	–0.7	–2.0	V	V_{DS} = 2 V, I_D = 100 μA
Transconductance	g_m	45	60		mS	V_{DS} = 2 V, I_D = 10 mA
Noise Figure	NF		0.40	0.50	dB	V_{DS} = 2 V, I_D = 10 mA, f = 12 GHz
Associated Gain	G_a	11.0	12.5		dB	

TYPICAL CHARACTERISTICS (T_A = 25 °C)

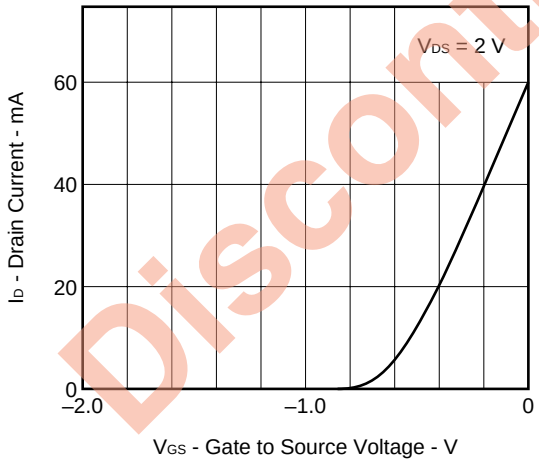
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



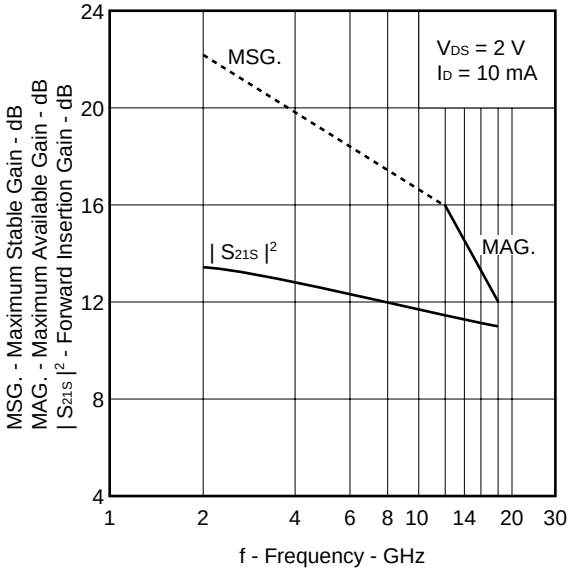
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



MAXIMUM AVAILABLE GAIN, FORWARD INSERTION GAIN vs. FREQUENCY

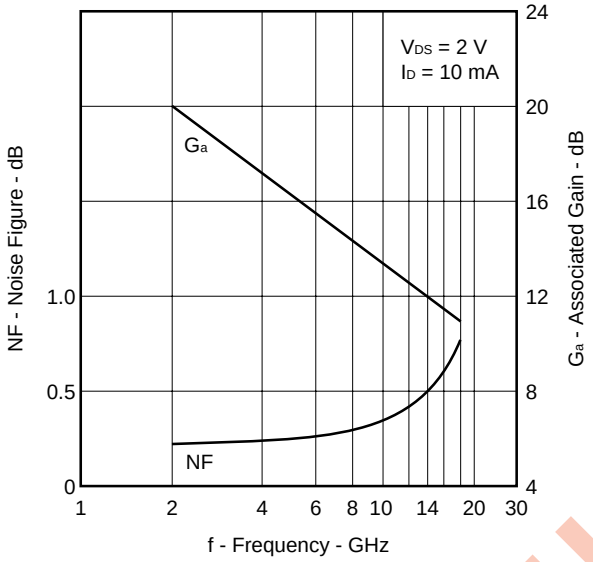


Gain Calculations

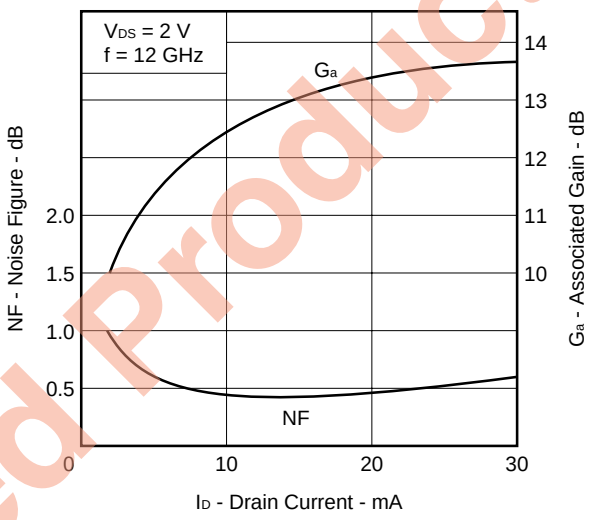
$$MSG. = \frac{|S_{21}|}{|S_{12}|} \qquad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$$

$$MAG. = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right) \qquad \Delta = S_{11} \bullet S_{22} - S_{21} \bullet S_{12}$$

NOISE FIGURE, ASSOCIATED GAIN vs. FREQUENCY



NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN CURRENT



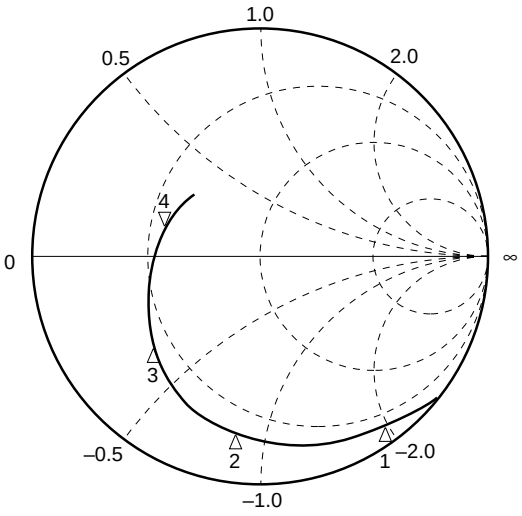
S-PARAMETERS

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

START 2 GHz, STOP 18 GHz, STEP 500 MHz

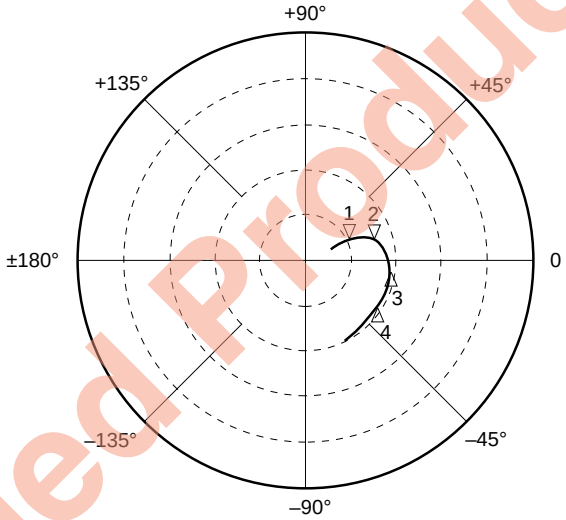
Marker
1 : 4 GHz
2 : 8 GHz
3 : 12 GHz
4 : 16 GHz

S_{11}



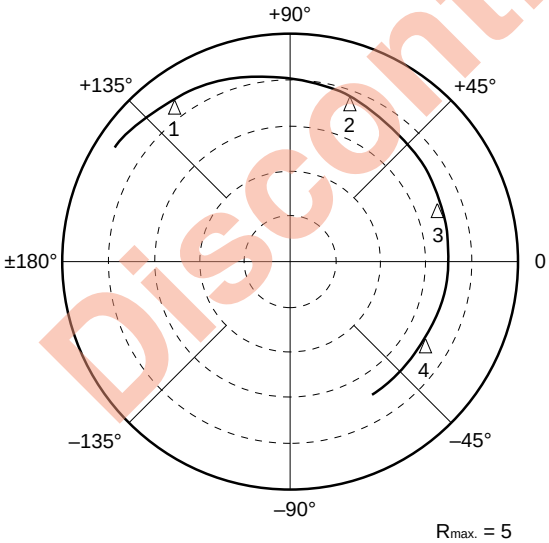
$R_{max.}$ = 1

S_{12}



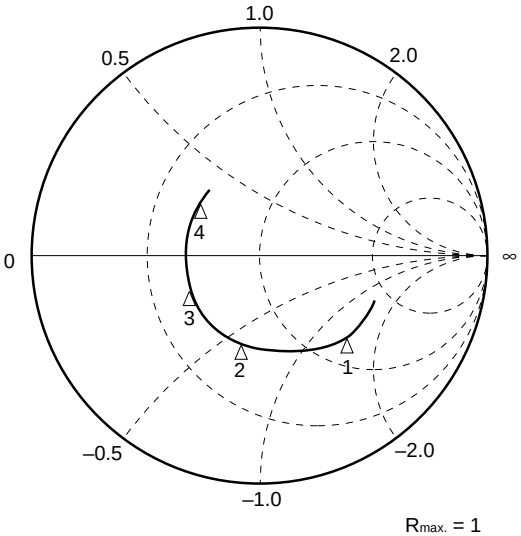
$R_{max.}$ = 0.25

S_{21}



$R_{max.}$ = 5

S_{22}



$R_{max.}$ = 1

S-PARAMETER

MAG. AND ANG.

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

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
2.0	.988	–27.9	4.628	149.5	.028	71.2	.562	–22.6
2.5	.959	–33.1	4.521	142.2	.034	65.1	.553	–28.6
3.0	.959	–39.3	4.512	135.4	.040	60.1	.536	–33.5
3.5	.956	–46.8	4.513	128.9	.045	56.8	.517	–40.7
4.0	.936	–52.4	4.497	121.5	.050	51.2	.505	–46.0
4.5	.913	–59.9	4.429	114.6	.055	48.4	.480	–53.0
5.0	.913	–66.8	4.335	106.9	.060	43.3	.464	–58.3
5.5	.874	–71.3	4.269	100.0	.064	39.3	.450	–64.2
6.0	.846	–78.3	4.135	92.4	.069	35.6	.423	–73.4
6.5	.843	–85.0	4.101	85.9	.071	31.7	.417	–78.6
7.0	.800	–89.4	4.006	80.1	.075	27.5	.404	–85.1
7.5	.779	–94.5	3.889	74.0	.077	23.5	.384	–92.7
8.0	.782	–98.7	3.830	67.3	.079	21.8	.374	–98.5
8.5	.744	–105.5	3.809	62.1	.079	17.8	.367	–104.8
9.0	.723	–108.5	3.695	55.3	.082	14.5	.358	–111.6
9.5	.736	–115.0	3.746	49.7	.084	12.7	.349	–118.1
10.0	.698	–120.1	3.654	43.7	.085	7.9	.348	–124.7
10.5	.681	–124.5	3.646	36.7	.085	5.9	.341	–133.5
11.0	.662	–130.3	3.534	31.1	.087	2.5	.331	–139.7
11.5	.633	–135.5	3.543	24.4	.088	–.7	.341	–147.8
12.0	.613	–139.7	3.467	18.9	.089	–3.0	.334	–155.1
12.5	.590	–144.2	3.459	12.9	.091	–6.5	.331	–162.1
13.0	.568	–149.0	3.432	7.2	.089	–10.1	.343	–168.6
13.5	.541	–153.8	3.436	.9	.092	–13.3	.343	–177.0
14.0	.536	–159.4	3.425	–4.8	.092	–16.8	.350	178.2
14.5	.508	–166.0	3.437	–11.4	.092	–20.3	.362	171.3
15.0	.487	–171.6	3.452	–17.9	.095	–24.1	.367	165.1
15.5	.471	180.0	3.483	–24.7	.095	–28.8	.378	159.8
16.0	.448	171.7	3.499	–31.5	.096	–33.7	.388	153.5
16.5	.433	164.0	3.486	–38.5	.096	–37.9	.394	147.2
17.0	.421	153.4	3.523	–46.0	.097	–43.9	.399	140.8
17.5	.399	143.1	3.537	–53.3	.094	–50.2	.399	135.1
18.0	.379	130.8	3.560	–61.8	.095	–56.1	.401	128.5

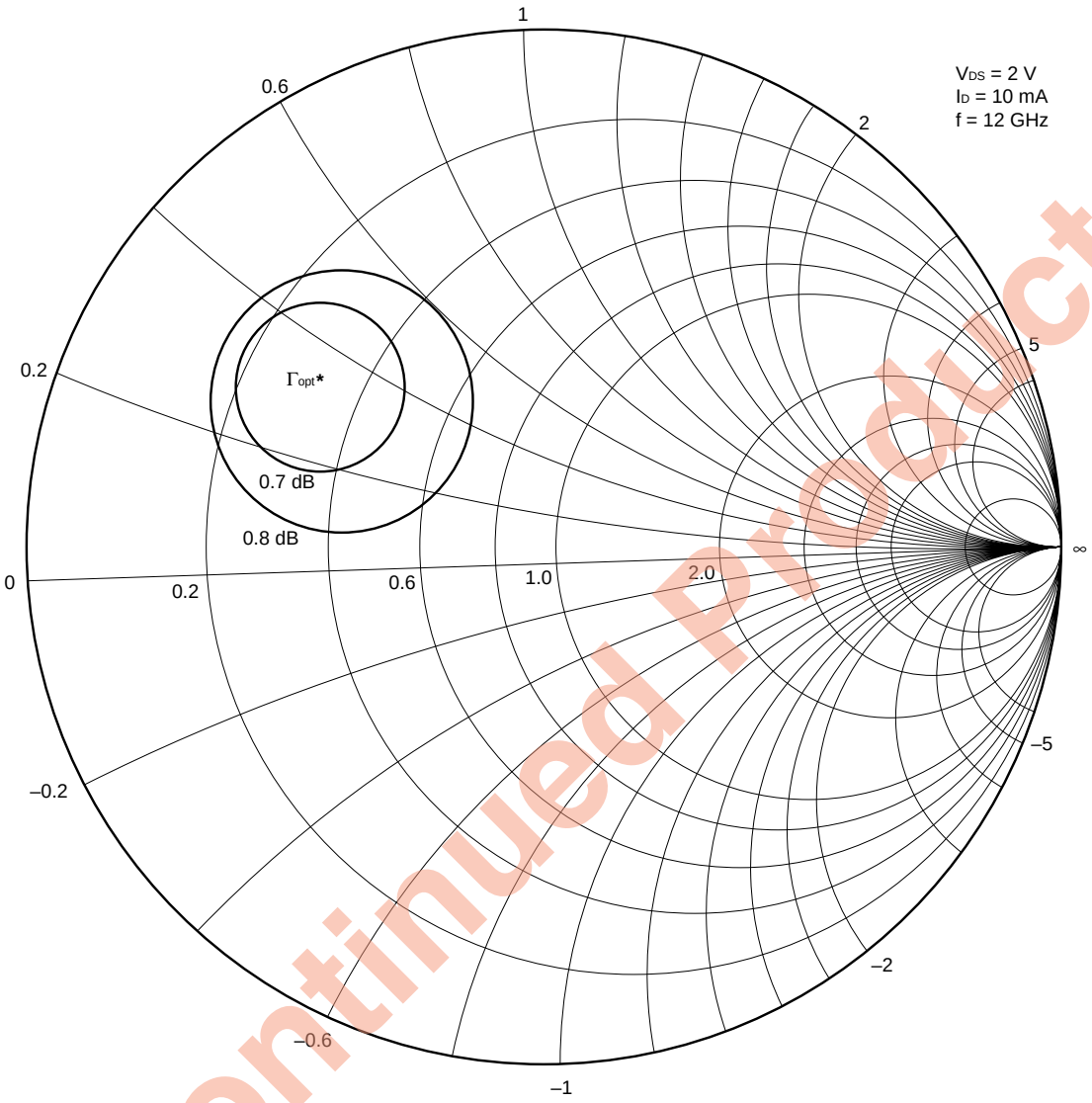
AMP. PARAMETER

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

FREQUENCY GHz	GUmax. dB	GAmax. dB	$\|S_{21}\|^2$ dB	$\|S_{12}\|^2$ dB	K	Delay ns	Mason's U dB	G1 dB	G2 dB
2.0	31.08		13.31	–31.16	.12	.041		16.12	1.65
2.5	25.66		13.10	–29.25	.27	.041	31.919	10.98	1.58
3.0	25.49		13.09	–28.01	.26	.038	37.109	10.93	1.47
3.5	25.05		13.09	–27.01	.23	.036		10.61	1.35
4.0	23.38		13.06	–25.98	.31	.041		9.05	1.28
4.5	21.85		12.93	–25.12	.34	.038		7.79	1.13
5.0	21.58		12.74	–24.43	.34	.043		7.79	1.05
5.5	19.84		12.61	–23.83	.45	.038		6.25	.98
6.0	18.66		12.33	–23.20	.49	.043		5.47	.86
6.5	18.48		12.26	–22.99	.49	.036		5.39	.83
7.0	17.26		12.05	–22.49	.58	.032		4.43	.77
7.5	16.54		11.80	–22.25	.63	.034		4.05	.69
8.0	16.42		11.66	–22.02	.62	.037		4.10	.65
8.5	15.74		11.62	–22.05	.70	.029		3.50	.63
9.0	15.16		11.35	–21.74	.75	.038		3.22	.60
9.5	15.43		11.47	–21.56	.69	.031		3.40	.56
10.0	14.71		11.26	–21.37	.77	.033		2.89	.56
10.5	14.48		11.24	–21.44	.80	.039		2.71	.54
11.0	13.98		10.97	–21.23	.85	.031		2.51	.51
11.5	13.75		10.99	–21.09	.87	.037		2.23	.54
12.0	13.36		10.80	–20.99	.92	.030		2.04	.51
12.5	13.14		10.78	–20.80	.94	.033	41.799	1.86	.51
13.0	12.95		10.71	–20.98	.99	.032	27.081	1.69	.54
13.5	12.77	15.37	10.72	–20.70	1.00	.035	27.187	1.51	.55
14.0	12.73	15.26	10.69	–20.70	1.01	.032	28.158	1.47	.57
14.5	12.63	14.66	10.72	–20.71	1.03	.037	26.287	1.29	.61
15.0	12.57	14.68	10.76	–20.42	1.02	.036	27.862	1.18	.63
15.5	12.60	14.67	10.84	–20.47	1.03	.038	27.895	1.09	.67
16.0	12.56	14.53	10.88	–20.39	1.03	.038	27.180	.97	.71
16.5	12.48	14.37	10.85	–20.34	1.04	.039	26.314	.90	.73
17.0	12.54	14.56	10.94	–20.24	1.03	.042	27.747	.85	.75
17.5	12.48	14.01	10.97	–20.54	1.08	.040	23.317	.75	.75
18.0	12.46	13.93	11.03	–20.48	1.09	.047	22.734	.67	.76

NOISE PARAMETER

<TYPICAL CONSTANT NOISE FIGURE CIRCLE>



<NOISE PARAMETER>

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

Freq. (GHz)	$NF_{min.}$ (dB)	G_a (dB)	$\Gamma_{opt.}$		$R_n/50$
			MAG.	ANG. (deg.)	
2.0	0.29	20.0	0.85	20	0.30
4.0	0.30	18.3	0.75	41	0.28
6.0	0.31	16.5	0.68	63	0.20
8.0	0.34	15.0	0.61	86	0.13
10.0	0.37	13.6	0.56	111	0.09
12.0	0.40	12.5	0.52	137	0.05
14.0	0.49	12.0	0.47	164	0.04
16.0	0.63	11.8	0.40	–168	0.04
18.0	0.81	11.5	0.31	–139	0.07

RECOMMENDED SOLDERING CONDITIONS

The following conditions (see table below) must be met when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

<TYPES OF SURFACE MOUNT DEVICE>

For more details, refer to our document "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (C10535E).

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1, Exposure limit[Note]: None	IR30-00
Partial heating method	Terminal temperature: 230 °C or below, Flow time: 10 seconds or below, Exposure limit[Note]: None	

Note Exposure limit before soldering after dry-pack package is opened.
Storage conditions: 25 °C and relative humidity at 65 % or less.

Caution Do not apply more than a single process at once, except for "Partial heating method".

PRECAUTION Avoid high static voltage and electric fields, because this device is Hetero Junction field effect transistor with shottky barrier gate.

Caution

The Great Care must be taken in dealing with the devices in this guide.
The reason is that the material of the devices is GaAs (Gallium Arsenide), which is designated as harmful substance according to the law concerned.
Keep the law concerned and so on, especially in case of removal.

[MEMO]

[MEMO]

[MEMO]