

# PRELIMINARY PRODUCT INFORMATION



## HETERO JUNCTION FIELD EFFECT TRANSISTOR

# NE3509M04

### L to S BAND LOW NOISE AMPLIFIER N-CHANNEL HJ-FET

#### FEATURES

- Super Low Noise Figure & Associated Gain :  
NF=0.4dB TYP. Ga=17.5dB TYP. @f=2GHz, VDS=2V, ID=10mA
- Flat-lead 4-pin tin-type super mini-mold(M04) package (Pb-Free T. )

#### APPLICATIONS

- Satellite Radio(SDARS, DMB, etc.) antenna LNA
- GPS antenna LNA
- LNA for Micro-wave communication system

#### ORDERING INFORMATION

Part Number	Order Number	Quantity	Marking	Supplying Form
NE3509M04	NE3509M04-A	50pcs (Non reel)	V80	- 8 mm wide emboss taping - Pin1(Source), Pin2(Drain) face the perforation side of the tape
NE3509M04-T2	NE3509M04-T2-A	3 Kpcs/reel		

**Remark** To order evaluation samples, please contact your local NEC sales office.

Part number for sample order: NE3509M04

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

PARAMETER	SYMBOL	RATINGS	UNIT
Drain to Source Voltage	VDS	4.0	V
Gate to Source Voltage	VGS	-3.0	V
Drain Current	ID	IDSS	mA
Gate Current	IG	200	μA
Total Power Dissipation	Ptot <sup>Note</sup>	150	mW
Channel Temperature	Tch	+150	°C
Storage Temperature	Tstg	- 65 to +150	°C

**Note** Mounted on 1.08cm<sup>2</sup> X 1.0mm(t) glass epoxy PCB

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**RECOMMENDED OPERATING CONDITIONS(TA = +25 °C)**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Drain to Source Voltage	VDS	---	2	3	V
Drain Current	ID	---	10	20	mA
Input Power	Pin	---	---	0	dBm

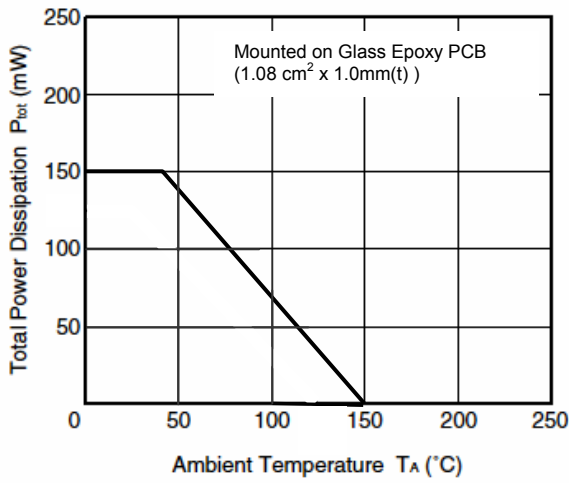
**ELECTRICAL CHARACTERISTICS (TA = +25 °C)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Gate to Source Leak Current	IGSO	VGS=-3V	---	0.5	10	uA
Saturated Drain Current	IDSS	VDS=2V, VGS=0V	30	45	60	mA
Gate to Source Cutoff Voltage	VGS(off)	VDS=2V, ID=50μA	-0.35	-0.5	-0.65	V
Trans conductance	gm	VDS=2V, ID=10mA	80	---	---	mS
Noise Figure	NF	VDS=2V, ID=10mA f=2GHz	---	0.4	0.8	dB
Associated Gain	Ga		14.5	17.5	---	dB
Output Power at 1dB Gain Compression Point	Po(1dB)	VDS=2V, ID=10mA(Non-RF) f=2GHz	---	11	---	dBm

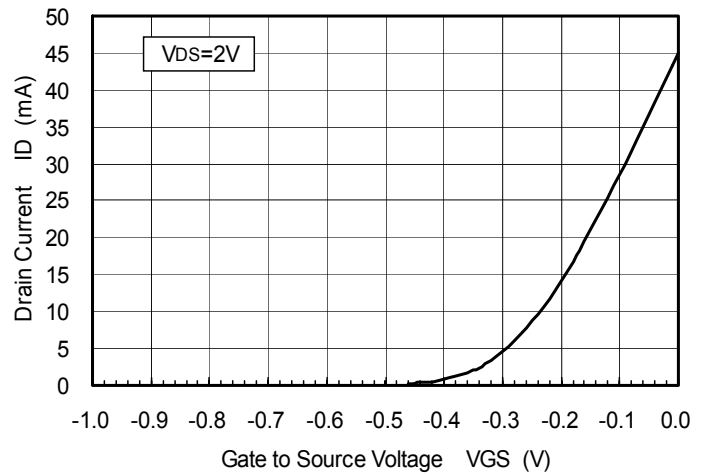
The information in this document is subject to change without notice.

TYPICAL CHARACTERISTICS (TA = +25 °C)

TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE

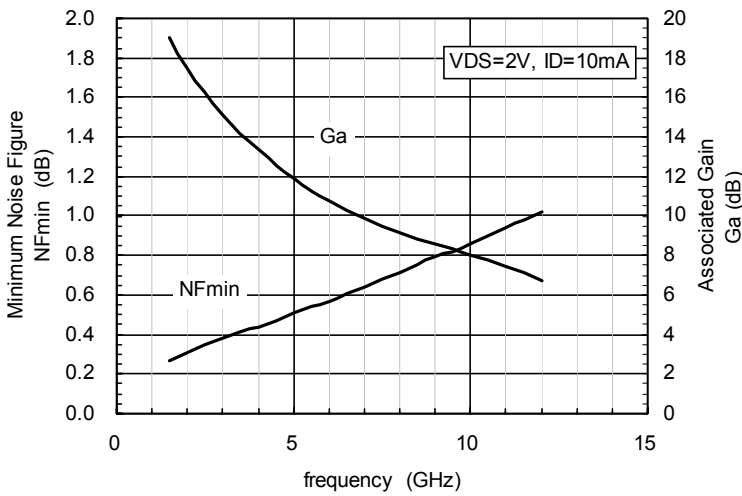


DRAIN CURRENT vs. GATE to SOURCE VOLTAGE

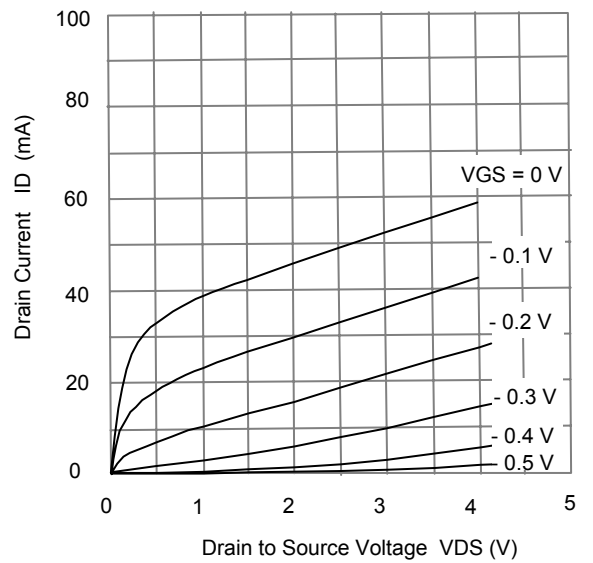


Note) Under examination

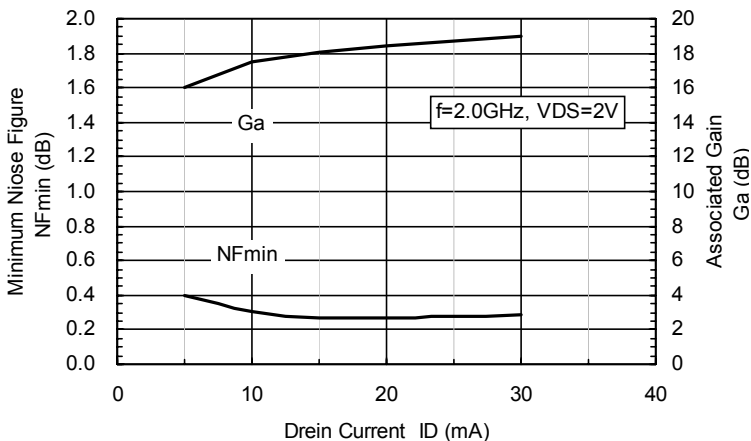
MINIMUM NOISE FIGURE, ASSOCIATED GAIN vs. FREQUENCY



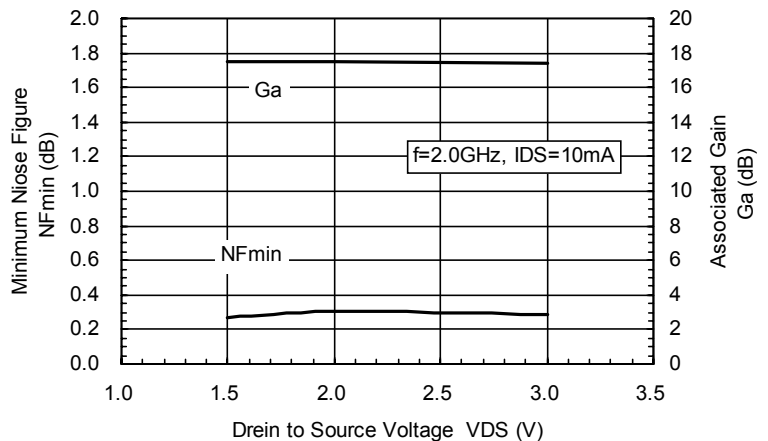
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



MINIMUM NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN CURRENT

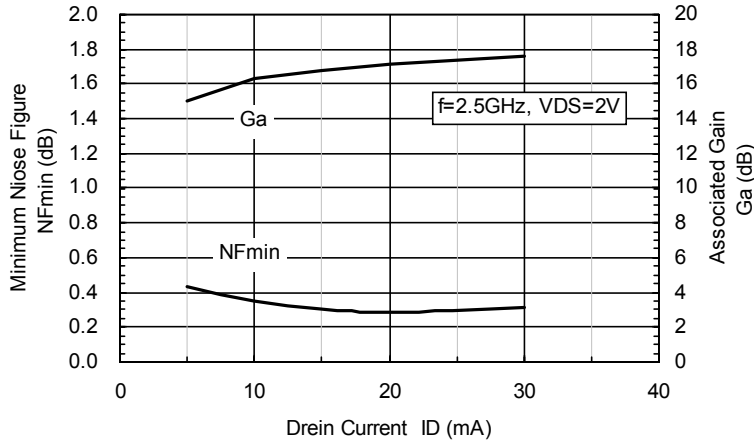


MINIMUM NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN TO SOURCE VOLTAGE

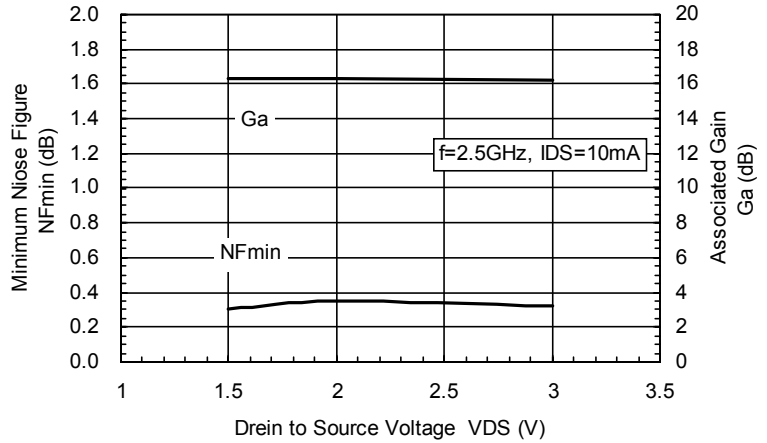


REFERENCE DATA

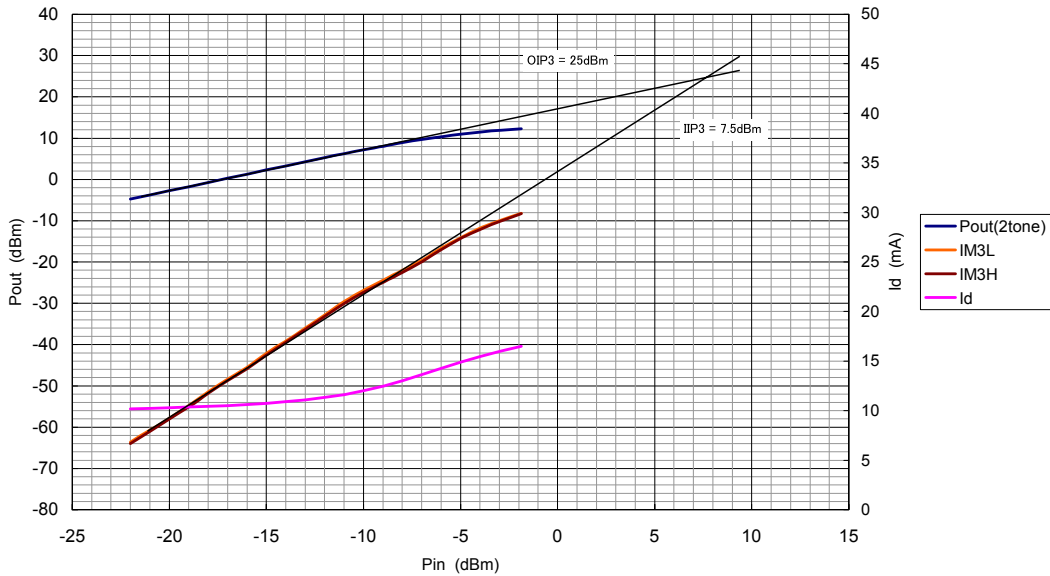
MINIMUM NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN CURRENT



MINIMUM NOISE FIGURE, ASSOCIATED GAIN vs. DRAIN TO SOURCE VOLTAGE

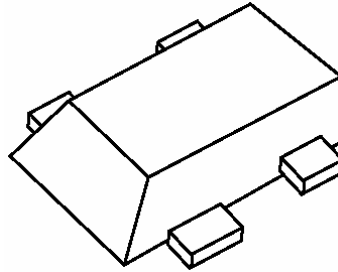


@f=2.4GHz, VDS=2V, ID=10mA(non-RF)

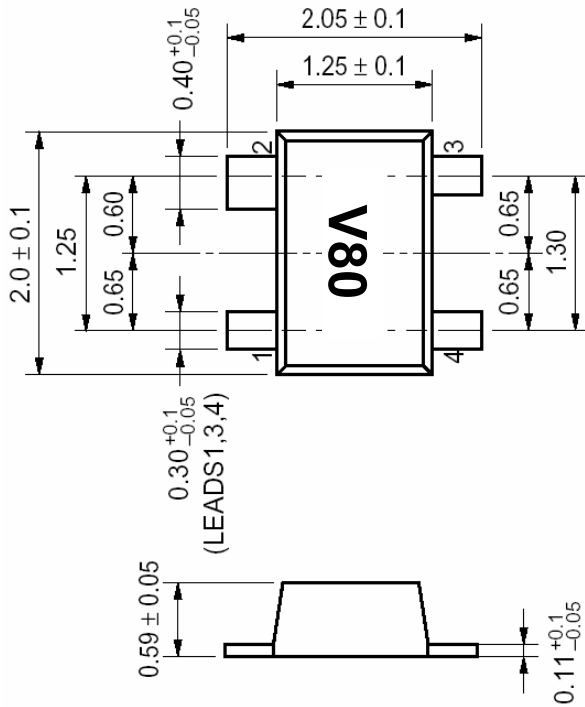


**PACKAGE DIMENSIONS**

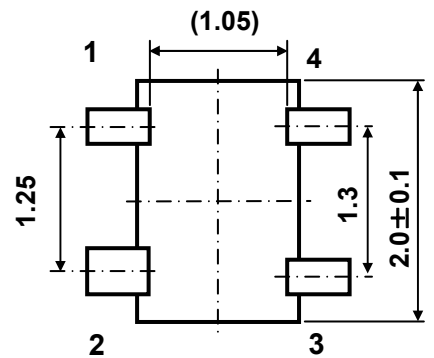
**FLAT-LEAD 4-PIN THIN SUPER MINI-MOLD (unit : mm)**



**( Top View )**



**( Bottom View )**



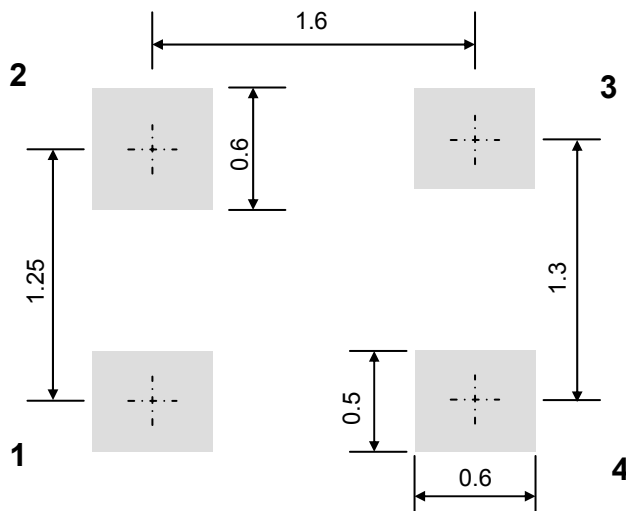
**Pin Connections**

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

**MOUNTING PAD DIMENSIONS**

**FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD(M04) PACKAGE (UNIT: mm)**

( Reference Only )



**Reference Data****NE3509M04**

S-parameter

VDS=2V ID=10mA

freq (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.1	0.998	-3.1	7.095	176.9	0.004	84.8	0.543	-2.3
0.2	0.997	-6.1	7.103	174.1	0.008	87.3	0.541	-4.4
0.3	0.992	-9.1	7.072	171.2	0.012	85.9	0.539	-6.5
0.4	0.989	-12.0	7.043	168.4	0.016	83.3	0.537	-8.5
0.5	0.982	-15.0	6.994	165.5	0.020	81.7	0.534	-10.5
0.6	0.975	-18.0	6.961	162.6	0.024	79.0	0.531	-12.5
0.7	0.967	-20.8	6.913	159.9	0.028	77.7	0.527	-14.6
0.8	0.954	-24.4	6.801	156.4	0.032	75.7	0.524	-17.0
0.9	0.943	-27.7	6.703	153.3	0.036	73.9	0.521	-19.1
1.0	0.933	-30.6	6.615	150.6	0.040	72.3	0.518	-21.0
1.1	0.924	-33.2	6.535	148.0	0.043	70.8	0.515	-22.8
1.2	0.916	-35.5	6.462	145.8	0.045	69.5	0.513	-24.3
1.3	0.908	-37.7	6.395	143.7	0.048	68.3	0.511	-25.8
1.4	0.898	-40.4	6.319	141.1	0.051	67.2	0.503	-27.5
1.5	0.893	-43.0	6.256	138.5	0.054	65.4	0.493	-29.1
1.6	0.876	-45.7	6.189	136.0	0.057	64.3	0.488	-31.0
1.7	0.860	-48.5	6.118	133.5	0.060	62.9	0.483	-32.7
1.8	0.848	-51.4	6.032	131.1	0.063	61.1	0.475	-34.3
1.9	0.839	-54.7	5.977	128.9	0.066	59.9	0.472	-35.1
2.0	0.830	-57.5	5.897	126.6	0.069	59.2	0.465	-36.4
2.1	0.819	-59.9	5.831	124.2	0.072	58.0	0.456	-38.3
2.2	0.805	-63.0	5.752	122.0	0.074	56.7	0.452	-39.6
2.3	0.788	-65.0	5.665	119.5	0.077	55.4	0.446	-41.5
2.4	0.775	-68.1	5.602	117.4	0.079	54.5	0.437	-42.3
2.5	0.766	-69.9	5.517	115.3	0.081	53.0	0.428	-44.6
2.6	0.748	-73.0	5.444	113.0	0.084	52.0	0.421	-45.3
2.7	0.731	-76.1	5.375	111.0	0.087	51.3	0.414	-46.1
2.8	0.724	-77.4	5.280	108.9	0.088	50.3	0.406	-47.7
2.9	0.704	-80.4	5.221	106.4	0.091	48.6	0.398	-49.7
3.0	0.694	-82.5	5.144	104.5	0.093	48.0	0.391	-51.0
3.1	0.680	-84.5	5.062	102.4	0.095	46.7	0.384	-52.3
3.2	0.671	-87.9	5.001	100.6	0.097	46.3	0.379	-52.9
3.3	0.660	-89.0	4.914	98.5	0.099	45.1	0.368	-54.7
3.4	0.646	-92.1	4.850	96.6	0.101	44.3	0.366	-55.4
3.5	0.639	-95.0	4.797	94.6	0.104	43.3	0.357	-56.6
3.6	0.619	-96.1	4.711	92.7	0.104	42.6	0.349	-58.4
3.7	0.609	-98.2	4.645	91.0	0.106	41.6	0.339	-59.1
3.8	0.599	-101.3	4.581	89.0	0.108	40.7	0.335	-60.7
3.9	0.588	-103.8	4.525	87.3	0.110	40.1	0.327	-61.5
4.0	0.578	-105.3	4.454	85.3	0.112	38.9	0.321	-63.0
4.1	0.573	-107.9	4.394	83.6	0.114	38.5	0.313	-64.0
4.2	0.563	-110.3	4.337	81.7	0.116	37.4	0.307	-65.4
4.3	0.558	-112.5	4.283	80.0	0.118	36.6	0.300	-66.7
4.4	0.545	-114.4	4.219	78.4	0.119	35.8	0.294	-68.0
4.5	0.541	-117.1	4.165	76.7	0.121	35.2	0.287	-68.7
4.6	0.531	-119.2	4.109	74.8	0.122	34.4	0.280	-70.2
4.7	0.524	-121.7	4.057	73.2	0.124	33.7	0.274	-70.9
4.8	0.511	-124.0	4.005	71.5	0.126	33.0	0.268	-72.2
4.9	0.506	-126.4	3.952	69.8	0.128	32.3	0.263	-73.6
5.0	0.496	-129.3	3.894	68.0	0.130	31.4	0.256	-75.5
5.1	0.491	-131.6	3.851	66.5	0.131	30.7	0.251	-76.0
5.2	0.485	-133.5	3.798	64.8	0.133	30.0	0.244	-77.6
5.3	0.477	-136.2	3.755	63.3	0.134	29.3	0.238	-78.5
5.4	0.470	-138.3	3.709	61.8	0.136	28.4	0.233	-79.7
5.5	0.464	-140.4	3.663	60.2	0.138	28.1	0.226	-81.0
5.6	0.456	-142.9	3.621	58.7	0.139	27.2	0.221	-82.5
5.7	0.453	-144.7	3.572	57.1	0.141	26.5	0.213	-83.1

5.8	0.449	-147.4	3.530	55.6	0.142	25.9	0.208	-85.1
5.9	0.444	-150.4	3.486	54.0	0.144	25.0	0.203	-86.1
6.0	0.440	-152.4	3.451	52.5	0.146	24.3	0.197	-87.8
6.1	0.432	-154.6	3.406	51.0	0.147	23.6	0.193	-89.0
6.2	0.429	-156.8	3.365	49.5	0.148	23.1	0.186	-90.2
6.3	0.429	-159.7	3.326	48.0	0.150	22.3	0.181	-91.4
6.4	0.425	-161.6	3.294	46.5	0.152	21.7	0.175	-93.7
6.5	0.423	-164.5	3.250	45.1	0.153	21.0	0.169	-94.7
6.6	0.418	-166.6	3.215	43.7	0.154	20.4	0.164	-96.1
6.7	0.414	-168.6	3.186	42.3	0.157	19.6	0.160	-97.9
6.8	0.416	-171.1	3.146	40.8	0.158	19.1	0.153	-99.5
6.9	0.414	-173.2	3.114	39.3	0.160	18.4	0.149	-101.2
7.0	0.410	-175.8	3.081	37.9	0.161	17.5	0.144	-103.0
7.1	0.410	-177.8	3.049	36.5	0.163	17.0	0.138	-105.0
7.2	0.412	179.4	3.016	35.0	0.164	16.3	0.133	-106.6
7.3	0.410	177.0	2.981	33.8	0.166	15.7	0.129	-108.4
7.4	0.411	175.1	2.957	32.3	0.167	14.9	0.126	-110.6
7.5	0.407	172.9	2.932	31.0	0.169	14.3	0.120	-112.4
7.6	0.409	170.0	2.909	29.4	0.171	13.6	0.119	-114.9
7.7	0.405	167.8	2.867	27.9	0.173	12.7	0.113	-119.1
7.8	0.406	164.8	2.843	26.4	0.173	12.0	0.108	-123.1
7.9	0.404	164.1	2.809	25.2	0.175	11.2	0.102	-125.5
8.0	0.408	161.2	2.779	23.6	0.177	10.5	0.096	-128.3
8.1	0.412	159.1	2.750	22.4	0.178	9.9	0.093	-132.6
8.2	0.410	157.4	2.725	21.2	0.180	9.0	0.089	-136.6
8.3	0.409	154.7	2.701	19.7	0.181	8.7	0.086	-139.1
8.4	0.411	152.9	2.665	18.5	0.183	7.8	0.083	-143.2
8.5	0.415	150.4	2.647	17.2	0.184	7.2	0.080	-147.3
8.6	0.415	148.5	2.627	15.7	0.186	6.3	0.079	-152.0
8.7	0.416	146.3	2.594	14.4	0.187	5.5	0.076	-157.6
8.8	0.417	144.5	2.573	13.1	0.188	4.8	0.074	-162.5
8.9	0.418	142.4	2.549	11.7	0.190	4.1	0.072	-167.0
9.0	0.424	140.7	2.522	10.4	0.191	3.4	0.072	-173.6
9.1	0.423	138.8	2.496	9.3	0.193	2.8	0.071	-179.9
9.2	0.429	136.8	2.479	8.0	0.194	1.8	0.073	175.4
9.3	0.431	135.2	2.451	6.6	0.196	1.3	0.072	169.3
9.4	0.436	133.2	2.434	5.3	0.197	0.7	0.075	164.2
9.5	0.436	130.9	2.408	4.1	0.197	-0.2	0.075	159.5
9.6	0.442	129.1	2.390	2.6	0.200	-0.9	0.078	155.2
9.7	0.444	126.8	2.370	1.2	0.201	-1.5	0.081	149.7
9.8	0.446	125.4	2.345	0.1	0.203	-2.3	0.083	145.5
9.9	0.450	123.8	2.327	-1.3	0.204	-3.1	0.087	140.3
10.0	0.458	121.9	2.295	-2.5	0.205	-3.8	0.090	136.5
10.1	0.459	120.5	2.284	-3.9	0.207	-4.5	0.095	132.5
10.2	0.462	119.0	2.260	-4.9	0.208	-5.3	0.098	128.7
10.3	0.468	117.0	2.237	-6.2	0.209	-6.0	0.103	125.0
10.4	0.474	115.2	2.219	-7.3	0.211	-6.8	0.109	121.6
10.5	0.476	113.9	2.205	-8.6	0.212	-7.4	0.112	118.9
10.6	0.479	112.3	2.175	-10.0	0.213	-8.2	0.117	116.8
10.7	0.485	110.6	2.164	-11.3	0.215	-9.0	0.121	114.4
10.8	0.490	109.1	2.148	-12.5	0.216	-9.7	0.128	111.6
10.9	0.493	107.5	2.128	-13.6	0.217	-10.5	0.133	108.7
11.0	0.496	106.0	2.106	-14.9	0.219	-11.2	0.137	106.6
11.1	0.502	104.4	2.091	-16.1	0.220	-11.9	0.143	104.6
11.2	0.505	103.0	2.071	-17.2	0.221	-12.7	0.148	102.6
11.3	0.512	101.7	2.051	-18.5	0.222	-13.5	0.153	100.6
11.4	0.514	99.8	2.038	-19.8	0.224	-14.3	0.159	98.9
11.5	0.520	98.4	2.023	-21.0	0.225	-15.0	0.165	96.7
11.6	0.528	97.1	2.007	-22.1	0.227	-15.6	0.171	95.4
11.7	0.535	95.3	1.990	-23.4	0.227	-16.7	0.176	93.3
11.8	0.540	94.5	1.977	-24.6	0.229	-17.4	0.181	91.9
11.9	0.546	92.7	1.950	-25.8	0.230	-18.2	0.187	90.6
12.0	0.549	91.2	1.947	-27.1	0.232	-19.0	0.193	88.4



## REFERENCE DATA

### NE3509M04

Noise-parameter

VDS=2 V ID=10mA

freq (GHz)	Fmin (dB)	Gammaopt		Rn/50 -
		MAG	ANG	
1.5	0.27	0.788	26.6	0.181
2.0	0.31	0.740	30.8	0.176
2.5	0.35	0.692	35.0	0.171
3.0	0.38	0.644	40.5	0.165
3.5	0.41	0.596	47.1	0.156
4.0	0.44	0.549	54.9	0.146
4.5	0.47	0.504	63.6	0.134
5.0	0.51	0.461	73.3	0.121
5.5	0.54	0.421	83.9	0.107
6.0	0.57	0.383	95.2	0.095
6.5	0.61	0.349	107.2	0.083
7.0	0.64	0.319	119.9	0.074
7.5	0.68	0.294	133.0	0.067
8.0	0.71	0.274	146.6	0.062
8.5	0.75	0.260	160.6	0.060
9.0	0.79	0.251	174.9	0.060
9.5	0.82	0.249	-170.7	0.063
10.0	0.86	0.255	-156.1	0.068
10.5	0.90	0.268	-141.5	0.076
11.0	0.94	0.290	-126.9	0.088
11.5	0.98	0.320	-112.4	0.106
12.0	1.02	0.359	-98.2	0.130

**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
Infrared Reflow	Peak temperature (package surface temperature) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Partial Heating	Peak temperature (pin temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	HS350

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

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

**Important Information and Disclaimer:** Information provided by CEL on its website or in other communications concerning the substance content of its products represents knowledge and belief as of the date that it is provided. CEL bases its knowledge and belief on information provided by third parties and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. CEL has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. CEL and CEL suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall CEL’s liability arising out of such information exceed the total purchase price of the CEL part(s) at issue sold by CEL to customer on an annual basis.

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