

DATA SHEET

NEC

GaAs MES FET NE722S01

C to X BAND LOW NOISE, HIGH-GAIN AMPLIFIER C to X BAND OSC N-CHANNEL GaAs MES FET

FEATURES

- Power gain: $G_s = 6.0$ dB TYP. @ $f = 12$ GHz
- Output power: $P_{O(1\text{ dB})} = 15$ dBm TYP. @ $f = 12$ GHz
- Noise figure, associated gain: $NF = 0.9$ dB TYP., $G_a = 12$ dB TYP. @ $f = 4$ GHz
- Gate width: $W_g = 400$ μm
- Automatic mounting supported

APPLICATIONS

- For C to X band microwave communication and C to X band oscillator

ORDERING INFORMATION

Part Number	Marking	Supplying Form
NE722S01-T1	P	Tape & reel 1 kpcs/reel
NE722S01-T1B		Tape & reel 4 kpcs/reel

Remark To order evaluation samples, consult your NEC sales representative (Part number for sample order: NE722S01).

ABSOLUTE MAXIMUM RATINGS ($T_A = +25$ °C)

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V_{DS}	5.0	V
Gate to Source Voltage	V_{GS}	-5.0	V
Gate to Drain Voltage	V_{GD}	-6.0	V
Drain Current	I_D	I_{DSS}	mA
Total Power Dissipation	P_{tot}	250	mW
Input Power	P_{in}	40	mW
Channel Temperature	T_{ch}	125	°C
Storage Temperature	T_{stg}	-65 to +125	°C

Because this product uses high-frequency technology, avoid excessive static electricity, etc.

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 representative for availability and additional information.

RECOMMENDED OPERATING CONDITIONS (T_A = +25 °C)

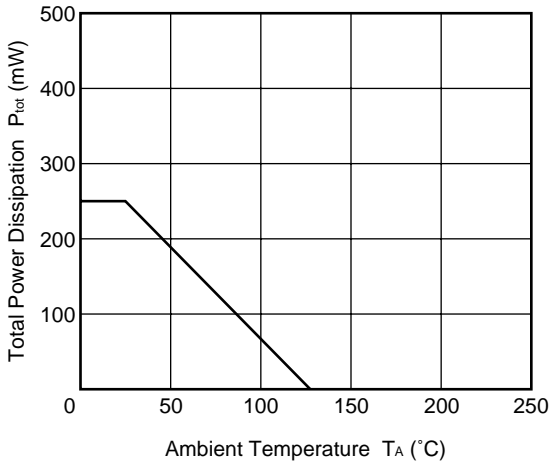
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	V _{DS}	–	3	4	V
Drain Current	I _D	–	30	40	mA

ELECTRICAL CHARACTERISTICS (T_A = +25 °C)

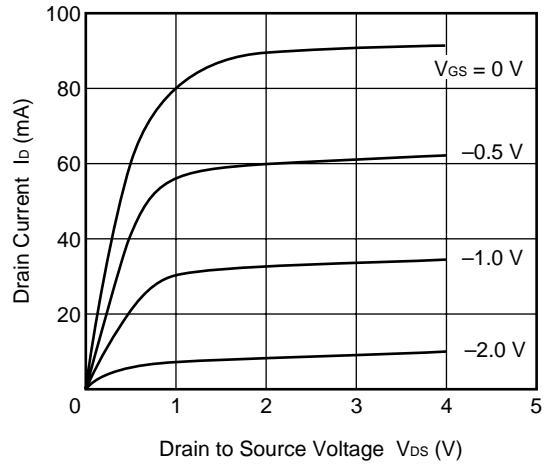
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Gate to Source Leak Current	I _{GSO}	V _{GS} = –5.0 V	–	1.0	10	μA
Saturated Drain Current	I _{DSS}	V _{DS} = 3.0 V, V _{GS} = 0 V	60	90	120	mA
Gate to Source Cutoff Voltage	V _{GS (off)}	V _{DS} = 3.0 V, I _D = 100 μA	–0.5	–	–4.0	V
Transconductance	g _m	V _{DS} = 3.0 V, I _D = 30 mA	20	45	–	mS
Power Gain	G _S	V _{DS} = 3.0 V, I _D = 30 mA, f = 12 GHz	–	6.0	–	dB
Gain 1 dB Compression Output Power	P _{O (1 dB)}		–	15	–	dBm
Noise Figure	NF	V _{DS} = 3.0 V, I _D = 10 mA, f = 4 GHz	–	0.9	–	dB
Associated Gain	G _a		–	12	–	dB

TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25 °C)

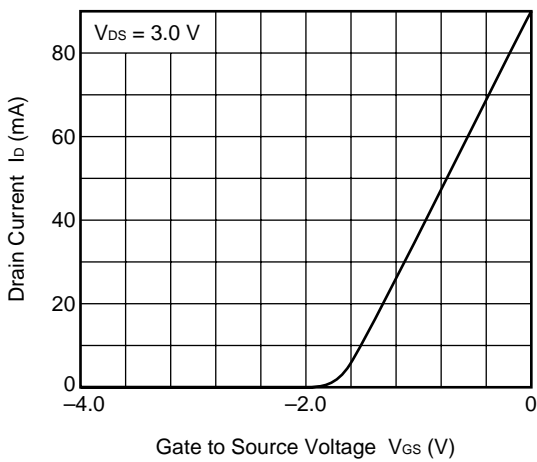
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



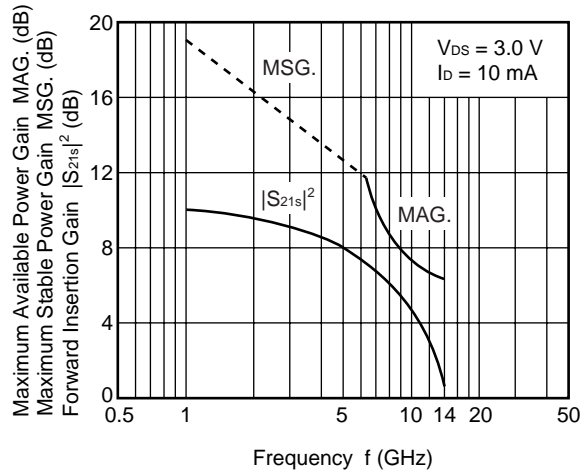
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



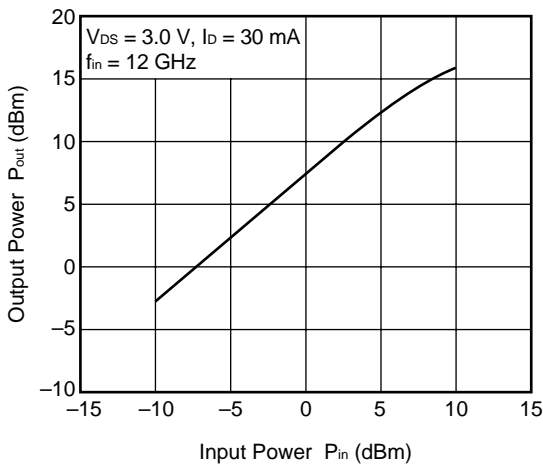
DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



MAXIMUM AVAILABLE POWER GAIN, MAXIMUM STABLE POWER GAIN, FORWARD INSERTION GAIN vs. FREQUENCY



OUTPUT POWER vs. INPUT POWER



Gain Calculations

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

$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad \Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$$

Remark The graphs indicate nominal characteristics.

**S-PARAMETERS
MAG. AND ANG.**

V_{DS} = 3.0 V, I_D = 10 mA

Frequency MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
2000	0.912	-44.0	3.100	136.2	0.077	59.0	0.659	-30.2
2500	0.876	-56.1	3.037	124.9	0.091	51.2	0.629	-38.0
3000	0.828	-68.0	2.935	113.9	0.105	42.9	0.597	-46.4
3500	0.784	-79.3	2.819	103.7	0.115	36.2	0.570	-53.5
4000	0.737	-89.5	2.696	94.2	0.124	30.0	0.546	-60.9
4500	0.699	-99.3	2.589	85.3	0.130	24.7	0.529	-67.2
5000	0.660	-109.0	2.499	76.6	0.136	19.1	0.514	-73.6
5500	0.620	-119.0	2.420	67.9	0.140	14.1	0.495	-79.6
6000	0.583	-130.6	2.355	59.4	0.146	9.1	0.475	-85.2
6500	0.547	-143.8	2.283	50.1	0.148	3.8	0.447	-91.5
7000	0.516	-158.5	2.196	41.0	0.151	-1.6	0.408	-97.0
7500	0.496	-173.7	2.098	32.2	0.149	-6.6	0.366	-103.7
8000	0.500	172.6	2.016	23.7	0.152	-10.1	0.331	-110.8
8500	0.510	159.9	1.920	15.3	0.150	-13.6	0.298	-120.4
9000	0.526	148.4	1.834	7.2	0.151	-17.3	0.274	-133.2
9500	0.540	138.4	1.749	-0.6	0.151	-20.3	0.265	-147.9
10000	0.553	129.9	1.676	-7.9	0.152	-23.2	0.275	-160.7
10500	0.566	120.6	1.608	-15.8	0.156	-26.3	0.297	-172.7
11000	0.576	111.3	1.542	-23.5	0.157	-29.8	0.312	178.5
11500	0.592	101.8	1.470	-31.1	0.157	-32.9	0.328	171.0
12000	0.608	92.8	1.401	-38.4	0.158	-35.7	0.340	163.5
12500	0.640	85.2	1.325	-45.7	0.159	-38.0	0.339	155.6
13000	0.665	79.1	1.256	-52.7	0.160	-41.3	0.341	145.5
13500	0.693	73.3	1.183	-59.7	0.158	-44.5	0.356	133.8
14000	0.718	69.3	1.111	-66.4	0.162	-47.0	0.386	122.3
14500	0.744	64.8	1.045	-73.3	0.163	-49.5	0.421	111.6
15000	0.759	59.6	0.966	-79.7	0.159	-53.4	0.474	104.4
15500	0.756	55.5	0.896	-85.4	0.159	-55.8	0.516	98.7
16000	0.750	51.0	0.839	-91.0	0.160	-57.6	0.563	95.8
16500	0.738	45.4	0.777	-96.7	0.158	-61.4	0.601	92.8
17000	0.728	40.9	0.714	-101.5	0.158	-63.1	0.624	89.4
17500	0.721	36.4	0.676	-105.7	0.156	-65.9	0.628	86.9
18000	0.721	32.5	0.624	-109.8	0.158	-68.4	0.625	82.2

AMPLIFIER PARAMETERS

V_{DS} = 3.0 V, I_D = 10 mA

Frequency MHz	GU _{max} dB	GA _{max} dB	S ₂₁ ² dB	S ₁₂ ² dB	K	Delay ns	Mason's U dB	G1 dB	G2 dB
2000	20.03		9.83	-22.33	0.33	0.063	22.869	7.73	2.47
2500	18.15		9.65	-20.78	0.39	0.063	21.724	6.32	2.18
3000	16.28		9.35	-19.59	0.47	0.061	19.681	5.02	1.91
3500	14.84		9.00	-18.77	0.54	0.057	18.675	4.14	1.71
4000	13.55		8.62	-18.14	0.61	0.053	17.646	3.40	1.54
4500	12.60		8.26	-17.74	0.67	0.049	17.128	2.92	1.43
5000	11.77		7.96	-17.30	0.73	0.049	16.513	2.49	1.33
5500	11.01		7.68	-17.08	0.80	0.048	15.891	2.11	1.22
6000	10.36		7.44	-16.72	0.85	0.048	15.547	1.80	1.11
6500	9.68		7.17	-16.58	0.92	0.051	14.950	1.55	0.97
7000	8.97		6.83	-16.40	1.00	0.051	13.975	1.34	0.79
7500	8.28	9.54	6.43	-16.53	1.10	0.049	12.900	1.23	0.62
8000	7.84	9.00	6.09	-16.38	1.14	0.047	12.834	1.25	0.50
8500	7.38	8.42	5.67	-16.46	1.19	0.047	12.442	1.31	0.40
9000	7.01	8.04	5.27	-16.40	1.21	0.045	12.314	1.41	0.34
9500	6.67	7.69	4.86	-16.41	1.24	0.044	12.162	1.50	0.32
10000	6.42	7.51	4.49	-16.34	1.23	0.040	12.345	1.59	0.34
10500	6.21	7.46	4.13	-16.15	1.20	0.044	12.985	1.68	0.40
11000	5.96	7.25	3.76	-16.08	1.20	0.043	12.949	1.75	0.45
11500	5.71	7.05	3.35	-16.10	1.20	0.042	12.814	1.87	0.49
12000	5.47	6.83	2.93	-16.05	1.19	0.041	12.568	2.01	0.53
12500	5.27	6.71	2.44	-16.00	1.17	0.040	12.552	2.29	0.53
13000	5.05	6.53	1.98	-15.93	1.16	0.039	12.254	2.53	0.54
13500	4.89	6.43	1.46	-16.04	1.15	0.039	11.968	2.85	0.59
14000	4.76	6.69	0.91	-15.79	1.07	0.038	12.907	3.15	0.70
14500	7.72	7.43	0.38	-15.74	1.01	0.038	13.924	3.50	0.85
15000	4.53		-0.30	-15.96	0.98	0.035	14.062	3.72	1.10
15500	4.07	6.98	-0.95	-15.96	1.01	0.032	11.684	3.68	1.34
16000	3.72	7.08	-1.52	-15.92	1.00	0.031	10.559	3.59	1.65
16500	3.17	5.59	-2.19	-16.01	1.05	0.032	8.781	3.42	1.95
17000	2.49	4.31	-2.93	-16.01	1.13	0.027	6.546	3.28	2.14
17500	1.96	3.40	-3.40	-16.16	1.25	0.023	5.032	3.19	2.18
18000	1.25	2.40	-4.09	-16.04	1.36	0.023	3.473	3.19	2.15

**S-PARAMETERS
MAG. AND ANG.**

V_{DS} = 3.0 V, I_D = 30 mA

Frequency MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
2000	0.896	-48.3	3.721	134.0	0.063	59.9	0.547	-29.6
2500	0.851	-61.5	3.606	122.4	0.077	53.2	0.519	-37.4
3000	0.799	-74.1	3.449	111.3	0.086	45.1	0.489	-45.4
3500	0.753	-86.1	3.275	101.1	0.095	39.6	0.464	-52.4
4000	0.705	-97.0	3.102	91.6	0.102	34.1	0.443	-59.5
4500	0.666	-107.3	2.957	82.7	0.106	29.5	0.431	-65.5
5000	0.625	-117.5	2.834	74.0	0.111	24.9	0.419	-71.5
5500	0.586	-128.3	2.724	65.3	0.115	20.6	0.406	-76.9
6000	0.553	-140.6	2.627	56.8	0.122	17.0	0.390	-82.2
6500	0.521	-154.2	2.522	47.7	0.125	12.6	0.366	-88.2
7000	0.497	-169.4	2.402	39.0	0.128	8.5	0.334	-93.4
7500	0.489	175.8	2.281	30.5	0.128	5.0	0.296	-99.7
8000	0.501	162.9	2.176	22.5	0.131	1.8	0.267	-106.8
8500	0.519	151.0	2.062	14.5	0.135	-1.2	0.234	-117.8
9000	0.540	140.4	1.963	6.8	0.139	-3.4	0.209	-132.7
9500	0.562	131.2	1.865	-0.7	0.142	-6.8	0.206	-150.0
10000	0.575	123.2	1.786	-7.8	0.146	-9.9	0.221	-164.3
10500	0.589	114.3	1.709	-15.4	0.151	-12.8	0.246	-177.2
11000	0.602	105.5	1.637	-22.9	0.156	-16.7	0.265	173.7
11500	0.619	96.4	1.554	-30.2	0.161	-20.5	0.285	166.1
12000	0.633	88.0	1.480	-37.4	0.163	-23.9	0.299	158.1
12500	0.666	80.9	1.400	-44.5	0.168	-27.4	0.303	149.9
13000	0.690	75.2	1.321	-51.1	0.171	-30.5	0.307	139.4
13500	0.715	70.0	1.241	-57.9	0.173	-33.9	0.326	127.4
14000	0.740	66.4	1.169	-64.2	0.173	-37.3	0.358	116.2
14500	0.769	62.0	1.101	-70.8	0.174	-41.0	0.396	106.2
15000	0.780	57.0	1.021	-77.1	0.178	-45.3	0.450	99.5
15500	0.778	52.5	0.945	-82.6	0.175	-48.6	0.494	94.8
16000	0.774	48.2	0.888	-88.0	0.176	-51.4	0.540	92.0
16500	0.759	42.7	0.824	-93.4	0.176	-56.1	0.578	89.4
17000	0.750	38.1	0.767	-98.3	0.174	-58.3	0.601	86.3
17500	0.739	33.9	0.721	-102.3	0.175	-61.1	0.604	84.0
18000	0.741	30.2	0.672	-106.6	0.176	-63.3	0.599	79.2

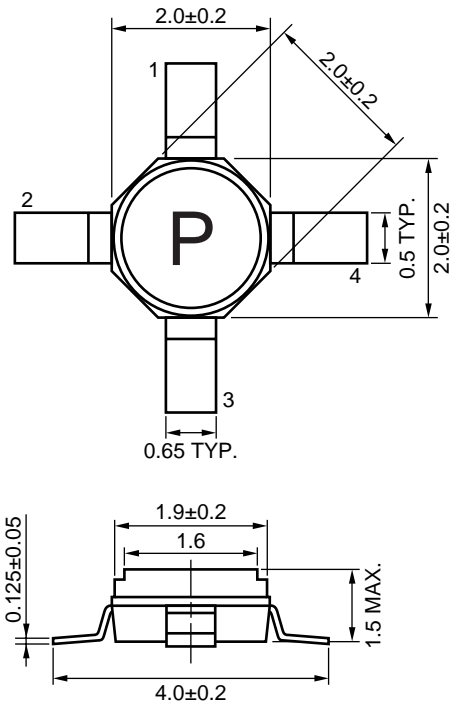
AMPLIFIER PARAMETERS

V_{DS} = 3.0 V, I_D = 30 mA

Frequency MHz	GU _{max} dB	GA _{max} dB	S ₂₁ ² dB	S ₁₂ ² dB	K	Delay ns	Mason's U dB	G1 dB	G2 dB
2000	20.01		11.41	-23.99	0.40	0.065	23.811	7.06	1.54
2500	18.10		11.14	-22.29	0.47	0.065	23.159	5.60	1.36
3000	16.35		10.75	-21.29	0.57	0.061	20.687	4.41	1.19
3500	14.99		10.30	-20.47	0.65	0.057	19.964	3.63	1.05
4000	13.77		9.83	-19.85	0.73	0.053	18.817	2.99	0.95
4500	12.85		9.42	-19.48	0.80	0.050	18.146	2.54	0.89
5000	12.04		9.05	-19.06	0.87	0.048	17.435	2.15	0.84
5500	11.31		8.70	-18.76	0.94	0.048	16.785	1.83	0.78
6000	10.70		8.39	-18.26	0.98	0.048	16.764	1.59	0.72
6500	10.04	11.65	8.04	-18.03	1.05	0.050	15.975	1.38	0.63
7000	9.36	10.52	7.61	-17.84	1.13	0.049	14.981	1.23	0.51
7500	8.75	9.65	7.16	-17.86	1.23	0.047	13.971	1.19	0.40
8000	8.33	9.20	6.75	-17.65	1.25	0.044	13.739	1.26	0.32
8500	7.89	8.73	6.28	-17.41	1.27	0.044	13.421	1.36	0.24
9000	7.55	8.41	5.86	-17.13	1.26	0.043	13.393	1.50	0.19
9500	7.25	8.14	5.41	-16.94	1.26	0.042	13.322	1.65	0.19
10000	7.00	7.96	5.04	-16.68	1.23	0.039	13.437	1.74	0.22
10500	6.77	7.84	4.66	-16.41	1.20	0.042	13.725	1.85	0.27
11000	6.55	7.72	4.28	-16.15	1.17	0.042	13.902	1.96	0.32
11500	6.30	7.60	3.83	-15.86	1.14	0.041	14.122	2.10	0.37
12000	6.04	7.34	3.40	-15.76	1.14	0.040	13.425	2.23	0.41
12500	5.89	7.45	2.92	-15.51	1.08	0.039	14.083	2.55	0.42
13000	5.66	7.29	2.42	-15.33	1.07	0.037	13.583	2.81	0.43
13500	5.47	7.21	1.88	-15.24	1.05	0.038	13.093	3.11	0.49
14000	5.40	7.63	1.36	-15.26	1.01	0.035	13.283	3.45	0.60
14500	5.47		0.84	-15.17	0.94	0.037	15.175	3.89	0.74
15000	5.24		0.18	-15.01	0.90	0.035	16.541	4.08	0.98
15500	4.76		-0.49	-15.12	0.93	0.030	13.021	4.03	1.22
16000	4.45		-1.03	-15.08	0.91	0.030	12.154	3.98	1.50
16500	3.82		-1.68	-15.10	0.96	0.030	10.086	3.73	1.77
17000	3.23	5.38	-2.30	-15.21	1.03	0.027	7.695	3.59	1.95
17500	2.56	4.05	-2.84	-15.16	1.12	0.023	5.895	3.43	1.97
18000	1.94	3.05	-3.45	-15.11	1.21	0.023	4.349	3.46	1.93

PACKAGE DIMENSIONS

S01 (UNIT: mm)



PIN CONNECTIONS

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

PRECAUTION

Because this product uses high-frequency technology, sufficient care must be taken regarding static electricity and strong electric fields.

Take measures against static electricity and make sure the body is earthed when mounting the device.

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 NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 230 °C or below, Time: 30 seconds or less (at 210 °C or higher), Count: 1 time, Exposure limit: None	IR30-00-1
Partial Heating	Pin temperature: 230 °C or below, Time: 10 seconds or less, Exposure limit: None	—

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

For the details the recommended soldering conditions, refer to the document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

[MEMO]

[MEMO]

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.

- **The information in this document is current as of August, 2000. 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 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).