

# N-CHANNEL GaAs MESFET NEZ1011-4E, NEZ1414-4E

### 4W X, Ku-BAND POWER GaAs MESFET

#### DESCRIPTION

The NEZ1011-4E and NEZ1414-4E are power GaAs MESFETs which provide high gain, high efficiency and high output in X, Ku-band. The internal input and output matching enables guaranteed performance to be achieved with only a 50  $\Omega$  external circuit. To reduce thermal resistance the device has a PHS (Plated Heat Sink) structure. The device incorporates a WSi (tungsten silicide) gate structure for high reliability.

#### FEATURES

- High Output Power :  $P_{o(1\text{ dB})} = +36.5$  dBm typ.
- High Linear Gain : 8.0 dB typ. (NEZ1011-4E), 7.0 dB typ. (NEZ1414-4E)
- High Efficiency : 30 % typ.
- Input and Output Internally Matched for Optimum performance

#### ORDERING INFORMATION

Part Number	Package
NEZ1011-4E NEZ1414-4E	T-78

**Remark** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order: NEZ1011-4E, NEZ1414-4E)

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

Operation in excess of any one of these parameters may result in permanent damage.

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	$V_{DS}$	15	V
Gate to Source Voltage	$V_{GS}$	-7	V
Drain Current	$I_{DS}$	4.5 (NEZ1011-4E) 5.0 (NEZ1414-4E)	A
Gate Forward Current	$I_{GF}$	+40	mA
Gate Reverse Current	$I_{GR}$	-40	mA
Total Power Dissipation	$P_T$	30	W
Channel Temperature	$T_{ch}$	175	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +175	$^\circ\text{C}$

**Caution** Please handle this device at static-free workstation, because this is an electrostatic sensitive device.

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

**RECOMMENDED OPERATING LIMITS**

Characteristics	Symbol	Test Condition	MIN.	TYP.	MAX.	Unit
Drain to Source Voltage	$V_{DS}$		9.0	9.0	9.0	V
Gain Compression	Gcomp				3	dB
Channel Temperature	$T_{ch}$				+130	°C
Gate Resistance <sup>Note</sup>	$R_g$		50	100	100	Ω

**Note**  $R_g$  is the series resistance between the gate supply and the FET gate.

**[NEZ1011-4E]**

**ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )**

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	1.0	3.0	5.0	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 20\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 20\text{ mA}$	15	18		V
Thermal Resistance	$R_{th}$	Channel to Case		4.5	5.0	°C/W
Linear Gain	$G_L$	$f = 10.7, 11.2, 11.7\text{ GHz}$	7.5	8.0		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 9.0\text{ V}$	35.5	36.5		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$	$I_{DS} = 1.0\text{ A (RF OFF)}$		1.5	2.0	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$	$R_g = 100\ \Omega$		30		%

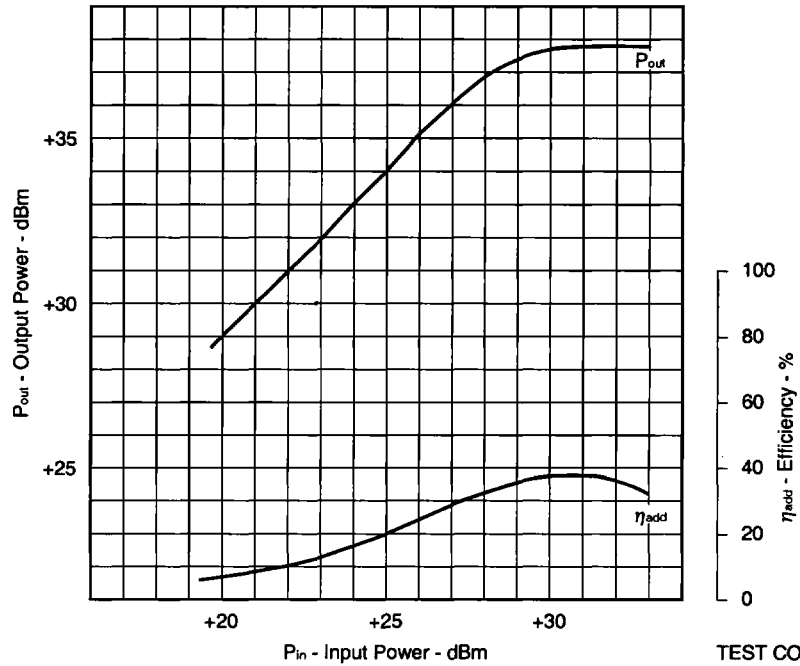
**[NEZ1414-4E]**

**ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )**

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	1.0	3.2	5.0	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 20\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 20\text{ mA}$	15	18		V
Thermal Resistance	$R_{th}$	Channel to Case		4.5	5.0	°C/W
Linear Gain	$G_L$	$f = 14.0\text{ to }14.5\text{ GHz}$	6.5	7.0		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 9.0\text{ V}$	35.5	36.5		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$	$I_{DS} = 1.0\text{ A (RF OFF)}$		1.5	2.0	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$	$R_g = 100\ \Omega$		30		%

[NEZ1011-4E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

OUTPUT POWER, DRAIN CURRENT AND EFFICIENCY vs. INPUT POWER



TEST CONDITIONS

V<sub>ds</sub> : 9.0 (V)

I<sub>ds</sub> : 1.0 (A)

[NEZ1011-4E] TYPICAL S-PARAMETERS

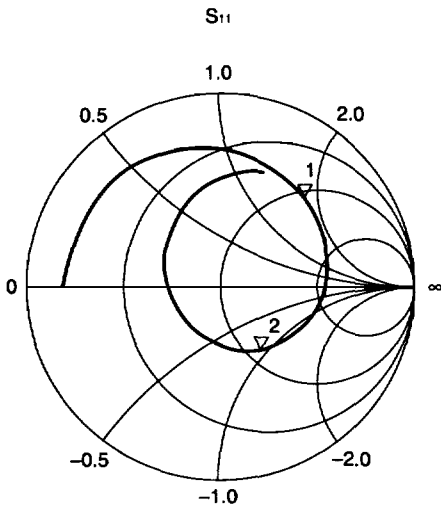
$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 1.0\text{ A}$

START 9.5 GHz, STOP 13 GHz, STEP 100 MHz

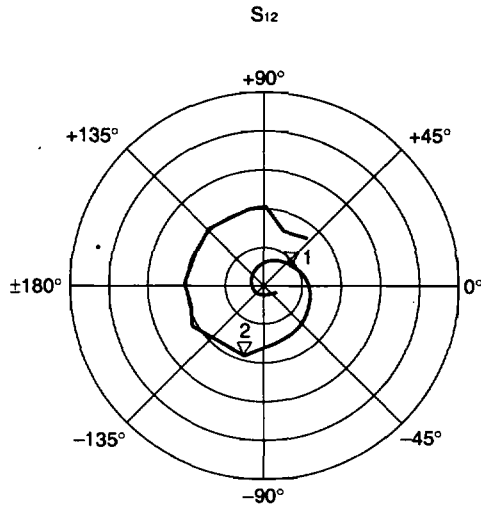
Marker

1: 10.7 GHz

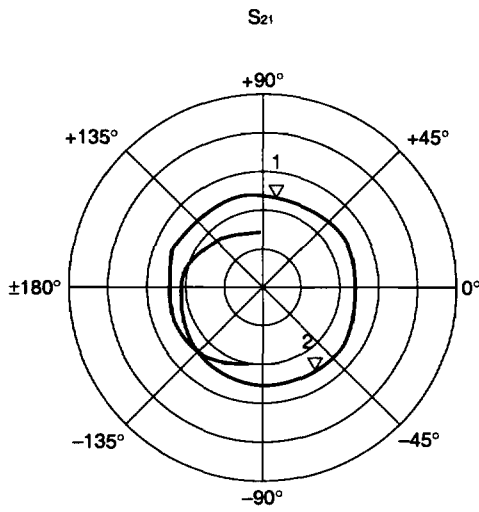
2: 11.7 GHz



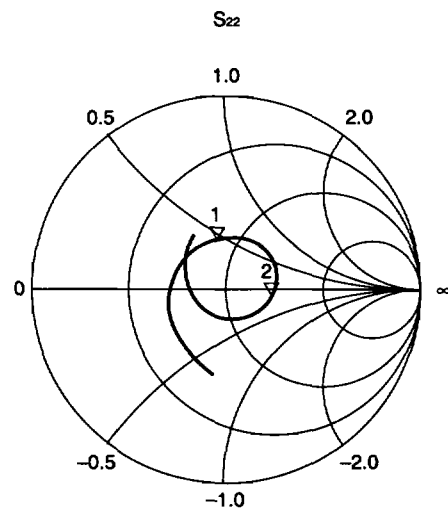
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

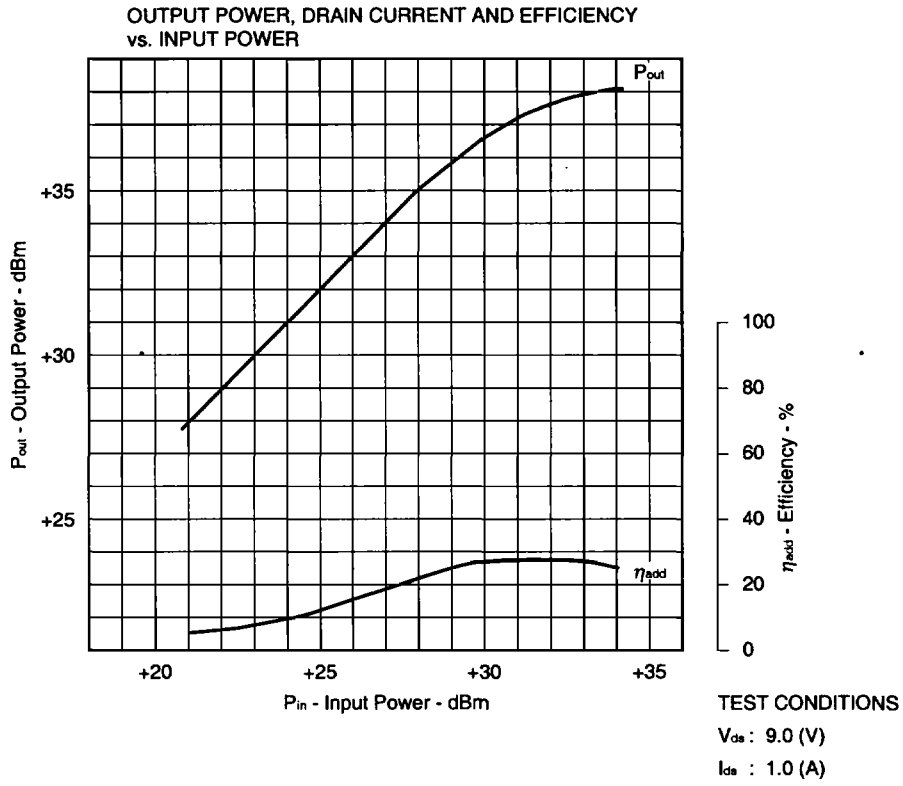
**[NEZ1011-4E] TYPICAL S-PARAMETERS**

MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 1.0\text{ A}$

FREQUENCY GHz	S <sub>11</sub>		S <sub>12</sub>		S <sub>21</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
9.50	0.808	179.055	0.019	-18.853	2.066	-102.998	0.447	-95.846
9.60	0.804	168.383	0.017	-38.301	2.197	-118.883	0.421	-105.299
9.70	0.798	158.051	0.015	-62.578	2.269	-132.026	0.394	-114.514
9.80	0.789	146.727	0.012	-93.344	2.352	-144.473	0.367	-125.039
9.90	0.780	135.662	0.011	-131.118	2.471	-161.198	0.337	-136.795
10.0	0.766	124.043	0.012	-174.154	2.482	-176.783	0.310	-149.479
10.1	0.749	112.652	0.015	151.687	2.461	168.247	0.285	-163.977
10.2	0.731	100.935	0.019	124.921	2.510	153.100	0.265	179.944
10.3	0.710	89.862	0.024	99.883	2.488	138.455	0.251	162.988
10.4	0.691	78.878	0.029	84.103	2.474	124.010	0.241	145.277
10.5	0.669	67.945	0.034	66.265	2.475	109.525	0.239	128.314
10.6	0.650	57.863	0.039	50.653	2.454	95.033	0.243	112.141
10.7	0.627	47.469	0.044	35.150	2.431	81.189	0.250	97.192
10.8	0.609	37.803	0.049	20.157	2.429	67.353	0.258	83.465
10.9	0.588	27.688	0.054	5.015	2.407	53.239	0.269	71.625
11.0	0.566	18.069	0.058	-9.340	2.408	39.911	0.277	60.635
11.1	0.550	8.220	0.062	-21.464	2.432	25.663	0.282	49.711
11.2	0.524	-1.893	0.066	-36.585	2.426	11.430	0.287	39.742
11.3	0.506	-11.790	0.070	-48.432	2.418	-2.187	0.289	29.876
11.4	0.478	-22.938	0.073	-61.285	2.481	-16.224	0.284	19.752
11.5	0.451	-33.982	0.079	-75.815	2.470	-31.745	0.279	10.004
11.6	0.417	-47.047	0.081	-88.501	2.461	-46.165	0.267	-0.072
11.7	0.379	-60.571	0.093	-104.010	2.480	-59.674	0.253	-10.327
11.8	0.341	-76.768	0.093	-118.795	2.506	-76.725	0.236	-21.965
11.9	0.304	-95.779	0.098	-134.939	2.478	-92.963	0.216	-34.361
12.0	0.274	-118.124	0.104	-149.771	2.464	-109.064	0.194	-48.732
12.1	0.263	-145.737	0.094	-165.658	2.435	-124.801	0.169	-66.384
12.2	0.271	-172.724	0.102	178.664	2.290	-142.774	0.147	-87.640
12.3	0.303	162.348	0.096	165.648	2.240	-158.173	0.134	-113.117
12.4	0.357	141.947	0.094	150.336	2.185	-172.841	0.134	-142.110
12.5	0.407	125.337	0.105	132.447	2.033	169.758	0.148	-167.786
12.6	0.460	111.286	0.097	120.080	1.885	153.319	0.173	170.682
12.7	0.513	99.419	0.102	103.224	1.800	138.636	0.205	153.313
12.8	0.561	89.321	0.105	84.711	1.672	125.618	0.237	139.218
12.9	0.598	79.619	0.077	71.048	1.507	111.708	0.272	127.162
13.0	0.630	71.300	0.081	52.286	1.519	98.212	0.310	115.475

[NEZ1414-4E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



[NEZ1414-4E] TYPICAL S-PARAMETERS

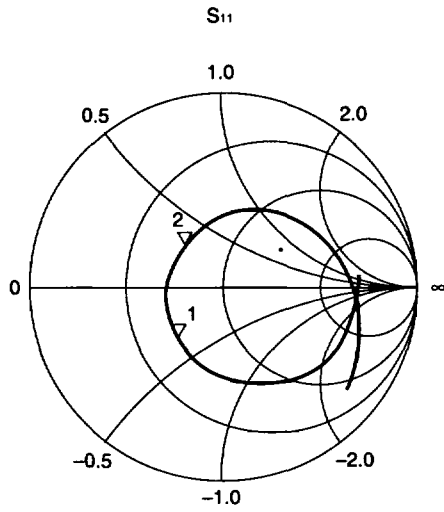
$V_{ds} = 9.0 \text{ V}$ ,  $I_{ds} = 1.0 \text{ A}$

START 12.5 GHz, STOP 16 GHz, STEP 100 MHz

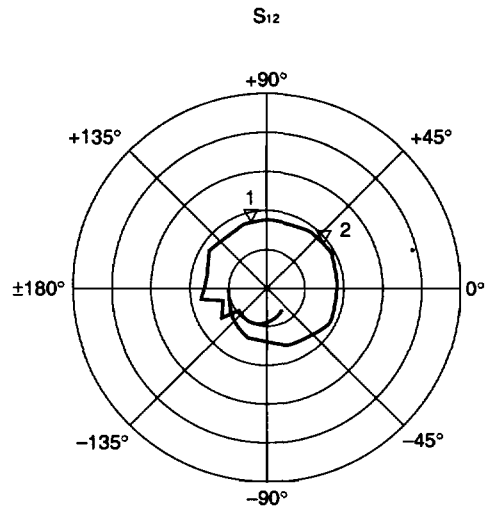
Marker

1: 14.0 GHz

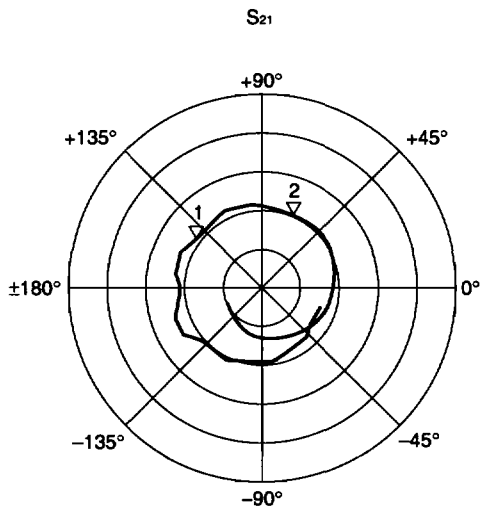
2: 14.5 GHz



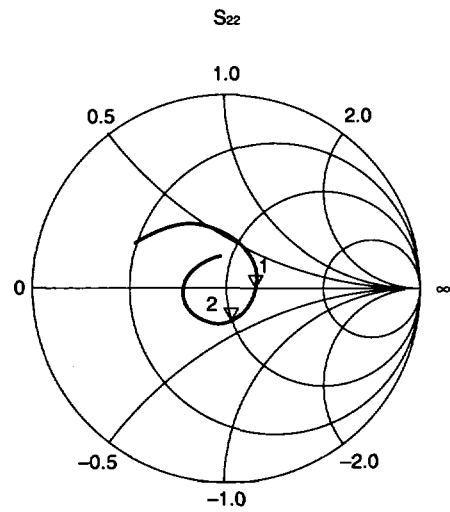
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

**[NEZ1414-4E] TYPICAL S-PARAMETERS**

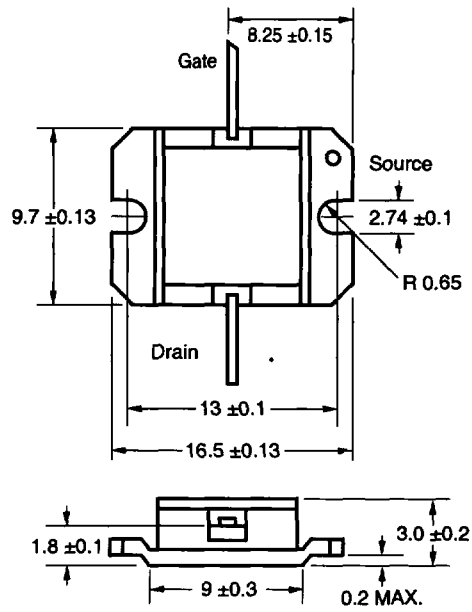
MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 1.0\text{ A}$

FREQUENCY GHZ	S <sub>11</sub>		S <sub>12</sub>		S <sub>21</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
12.5	0.710	5.854	0.035	-51.698	1.691	-18.771	0.534	152.677
12.6	0.706	-1.451	0.039	-59.965	1.652	-34.833	0.507	146.706
12.7	0.702	-8.933	0.041	-74.802	1.759	-40.700	0.481	140.530
12.8	0.694	-16.167	0.045	-94.861	1.787	-49.347	0.454	134.371
12.9	0.684	-24.314	0.041	-91.082	1.795	-67.342	0.425	127.218
13.0	0.668	-32.206	0.046	-109.131	1.915	-78.177	0.396	119.741
13.1	0.652	-40.198	0.045	-118.640	1.956	-92.835	0.368	112.317
13.2	0.624	-48.517	0.046	-132.469	2.067	-111.821	0.337	103.608
13.3	0.603	-56.795	0.068	-144.425	2.046	-123.801	0.310	94.595
13.4	0.572	-66.211	0.061	-163.193	2.033	-136.230	0.283	84.222
13.5	0.536	-73.816	0.086	-169.956	2.253	-150.794	0.258	74.018
13.6	0.496	-83.375	0.079	175.557	2.308	-161.327	0.232	62.258
13.7	0.464	-93.712	0.086	149.580	2.108	-177.346	0.212	47.865
13.8	0.425	-105.017	0.082	143.513	2.190	168.591	0.191	32.941
13.9	0.383	-116.933	0.085	115.220	2.166	155.522	0.175	16.435
14.0	0.346	-131.623	0.084	104.014	2.083	139.486	0.163	-1.633
14.1	0.312	-146.773	0.084	92.742	2.115	126.023	0.156	-19.078
14.2	0.291	-165.802	0.086	75.665	2.183	110.404	0.154	-37.253
14.3	0.270	173.854	0.088	67.427	2.169	94.615	0.155	-54.975
14.4	0.273	152.140	0.092	53.834	2.086	79.954	0.159	-71.407
14.5	0.288	129.738	0.090	36.718	2.093	64.738	0.166	-87.012
14.6	0.317	109.673	0.095	24.122	2.088	49.906	0.175	-101.570
14.7	0.357	90.989	0.093	4.922	2.028	35.341	0.184	-114.672
14.8	0.399	74.602	0.088	-13.630	2.002	20.599	0.192	-126.772
14.9	0.450	59.655	0.090	-27.101	1.937	4.118	0.201	-137.968
15.0	0.495	46.224	0.082	-47.151	1.818	-12.303	0.207	-147.601
15.1	0.545	33.500	0.078	-56.443	1.697	-27.670	0.213	-157.291
15.2	0.587	22.098	0.075	-70.871	1.616	-42.673	0.215	-165.987
15.3	0.628	11.759	0.071	-83.671	1.494	-59.125	0.216	-174.257
15.4	0.665	1.712	0.067	-94.660	1.384	-74.120	0.213	177.449
15.5	0.700	-6.849	0.068	-110.735	1.285	-86.966	0.208	169.969
15.6	0.736	-14.840	0.062	-122.904	1.192	-100.324	0.199	162.164
15.7	0.764	-22.150	0.059	-138.482	1.107	-114.343	0.191	154.917
15.8	0.796	-29.088	0.055	-150.217	1.018	-127.006	0.178	145.779
15.9	0.820	-34.695	0.051	-164.596	0.934	-140.279	0.163	136.442
16.0	0.844	-40.155	0.047	-177.292	0.870	-152.445	0.152	125.025



PACKAGE DIMENSIONS (UNIT: mm)



**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered 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
Partial Heating	Pin temperature: 260°C Time: 5 seconds or less (per pin row)	-

For details of recommended soldering conditions, please contact your local NEC sales office.

[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.**

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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:** Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.