

# N-CHANNEL GaAs MESFET NEZ1011-5E, NEZ1414-5E

### 5W X, Ku-BAND POWER GaAs MESFET

#### DESCRIPTION

The NEZ1011-5E and NEZ1414-5E 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 :  $P_{o(1\text{ dB})} = +37.0\text{ dBm typ.}$
- High Linear Gain : 8.0 dB typ. (NEZ1011-5E), 7.0 dB typ. (NEZ1414-5E)
- High Efficiency : 30 % typ.
- Input and Output Internally Matched for Optimum performance

#### ORDERING INFORMATION

Part Number	Package
NEZ1011-5E NEZ1414-5E	T-78

**Remark** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order: NEZ1011-5E, NEZ1414-5E)

#### 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 (NEZ1011-5E) 5.0 (NEZ1414-5E)	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	$V_{DS}$		10	10	10	V
Gain Compression	$G_{comp}$				3	dB
Channel Temperature	$T_{ch}$				+130	°C
Gate Resistance <sup>Note</sup>	$R_g$		25	50	50	$\Omega$

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

**[NEZ1011-5E]**

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

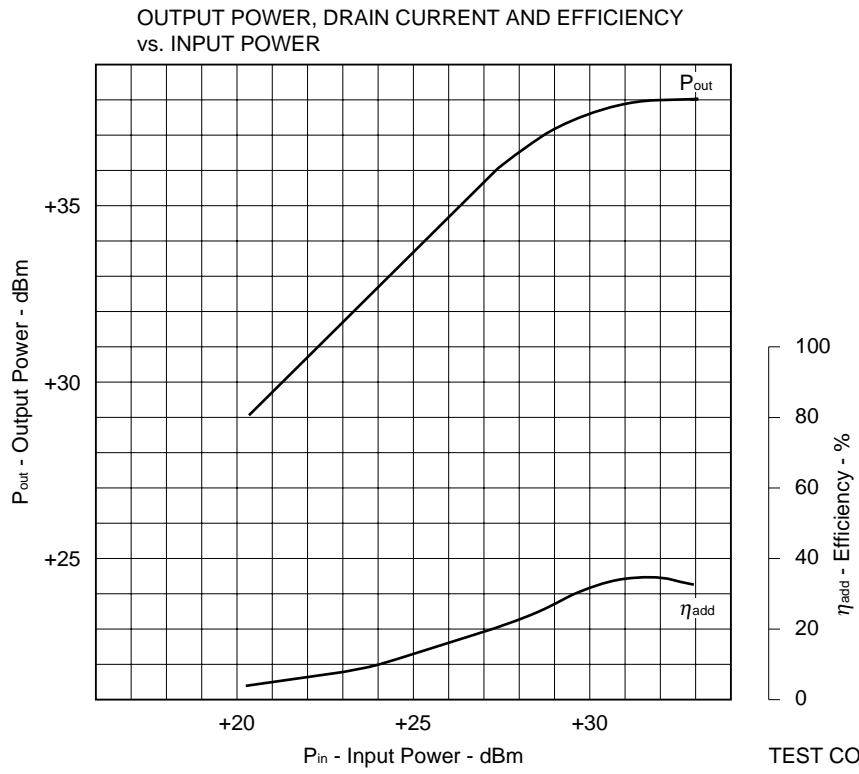
Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	1.5	3.0	5.0	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 20\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 20\text{ mA}$	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.	$P_o(1\text{ dB})$	$V_{DS} = 10\text{ V}$ $I_{DS} = 1.5\text{ A (RF OFF)}$	36.0	37.0		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS}(1\text{ dB})$	$R_g = 50\ \Omega$		2.0	2.3	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add}(1\text{ dB})$			30		%

**[NEZ1414-5E]**

**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.	$P_o(1\text{ dB})$	$V_{DS} = 10\text{ V}$ $I_{DS} = 1.5\text{ A (RF OFF)}$	36.0	37.0		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS}(1\text{ dB})$	$R_g = 50\ \Omega$		2.0	2.3	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add}(1\text{ dB})$			30		%

[NEZ1011-5E] TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )



TEST CONDITIONS

$V_{ds}$  : 10 (V)

$I_{ds}$  : 1.5 (A)

[NEZ1011-5E] TYPICAL S-PARAMETERS

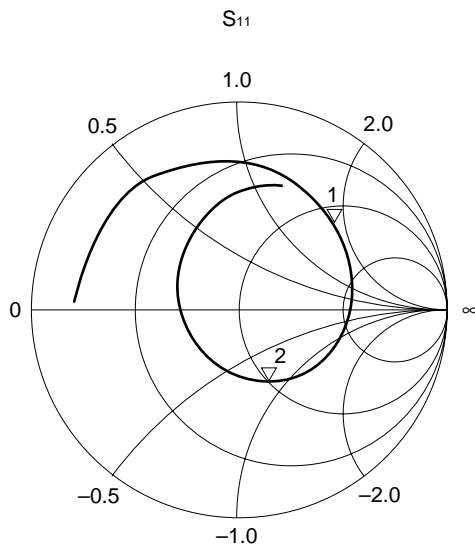
$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 1.5\text{ A}$

START 9.5 GHz, STOP 13 GHz, STEP 100 MHz

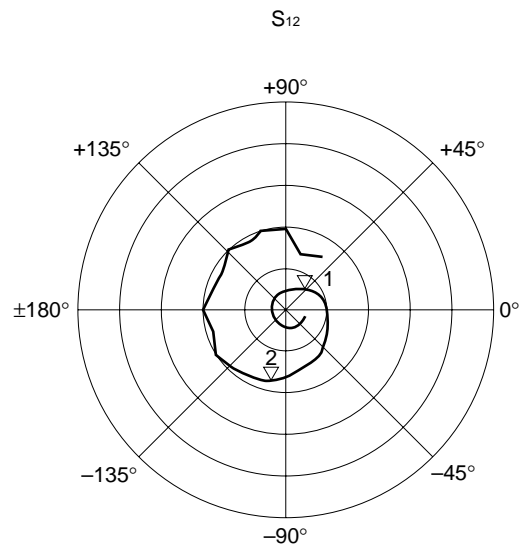
Marker

1: 10.7 GHz

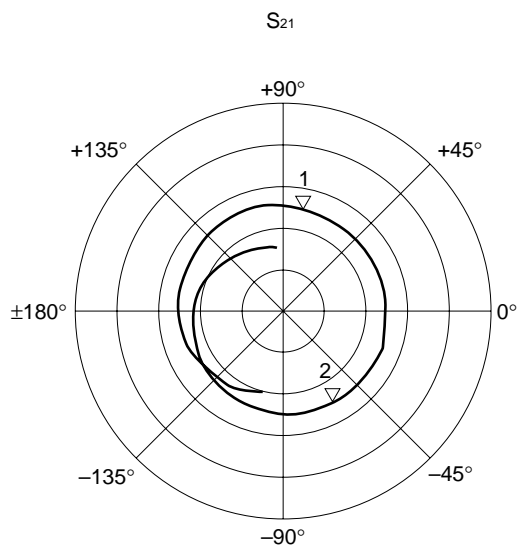
2: 11.7 GHz



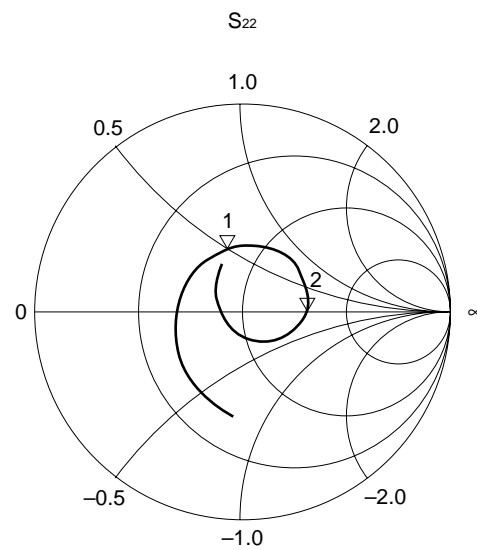
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

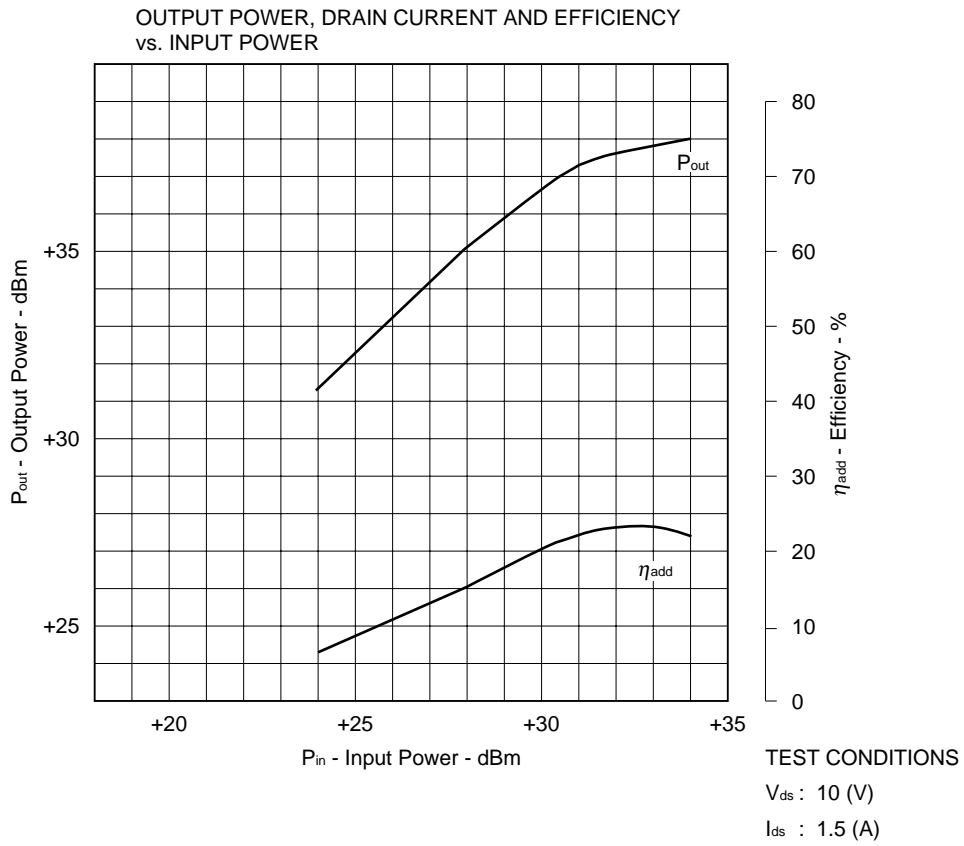
[NEZ1011-5E] TYPICAL S-PARAMETERS

MAG. AND ANG.

V<sub>ds</sub> = 10 V, I<sub>ds</sub> = 1.5 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	0.795	177.097	0.025	-12.624	2.102	-104.596	0.497	-97.121
9.60	0.791	166.158	0.025	-30.059	2.238	-121.060	0.474	-106.699
9.70	0.783	155.492	0.021	-49.370	2.311	-134.131	0.450	-116.031
9.80	0.774	144.184	0.017	-73.646	2.405	-146.297	0.425	-126.474
9.90	0.765	133.012	0.016	-97.929	2.534	-163.554	0.400	-138.312
10.0	0.751	121.078	0.012	-135.797	2.539	-179.266	0.375	-150.582
10.1	0.734	109.490	0.012	-174.066	2.502	165.681	0.352	-164.453
10.2	0.715	97.542	0.015	147.007	2.564	150.428	0.333	-179.454
10.3	0.695	86.492	0.018	115.190	2.529	135.648	0.320	164.767
10.4	0.676	75.113	0.023	95.322	2.516	121.356	0.306	149.021
10.5	0.653	64.124	0.027	74.089	2.529	106.739	0.302	133.607
10.6	0.636	53.940	0.033	56.001	2.507	92.067	0.304	118.951
10.7	0.612	43.369	0.038	39.778	2.484	78.134	0.307	104.803
10.8	0.594	33.428	0.042	23.174	2.478	64.151	0.312	91.645
10.9	0.575	22.866	0.047	7.059	2.450	49.875	0.320	79.861
11.0	0.552	13.083	0.050	-7.479	2.447	36.338	0.325	69.008
11.1	0.535	2.903	0.055	-19.924	2.482	22.306	0.327	58.242
11.2	0.508	-7.593	0.059	-34.841	2.473	7.750	0.330	48.324
11.3	0.491	-17.574	0.062	-47.246	2.454	-5.943	0.328	38.476
11.4	0.461	-28.983	0.067	-59.558	2.516	-20.088	0.323	29.580
11.5	0.436	-39.932	0.073	-74.611	2.506	-35.678	0.318	20.003
11.6	0.404	-53.797	0.075	-87.343	2.487	-50.074	0.304	10.526
11.7	0.366	-67.625	0.086	-103.128	2.488	-63.579	0.291	1.340
11.8	0.332	-84.471	0.086	-117.892	2.524	-80.559	0.273	-8.817
11.9	0.298	-104.679	0.091	-133.955	2.495	-96.940	0.250	-19.520
12.0	0.277	-127.328	0.097	-149.424	2.484	-112.774	0.225	-31.204
12.1	0.277	-155.200	0.089	-164.876	2.444	-128.256	0.194	-45.526
12.2	0.294	179.432	0.096	178.362	2.318	-147.074	0.162	-62.370
12.3	0.332	156.155	0.091	165.150	2.256	-161.800	0.131	-83.016
12.4	0.386	136.598	0.087	150.149	2.158	-176.089	0.108	-110.989
12.5	0.432	121.126	0.097	131.057	2.043	166.479	0.103	-144.299
12.6	0.481	107.861	0.088	119.739	1.910	150.431	0.116	-175.501
12.7	0.527	96.419	0.093	103.730	1.812	135.781	0.143	160.657
12.8	0.572	87.008	0.097	86.355	1.687	121.963	0.177	142.955
12.9	0.608	77.455	0.073	73.273	1.539	107.849	0.213	129.094
13.0	0.640	69.455	0.077	53.973	1.531	94.247	0.250	117.013

[NEZ1414-5E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



[NEZ1414-5E] TYPICAL S-PARAMETERS

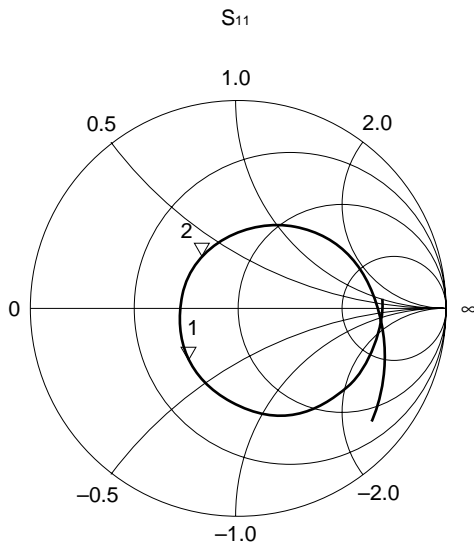
$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 1.5\text{ A}$

START 12.5 GHz, STOP 16 GHz, STEP 100 MHz

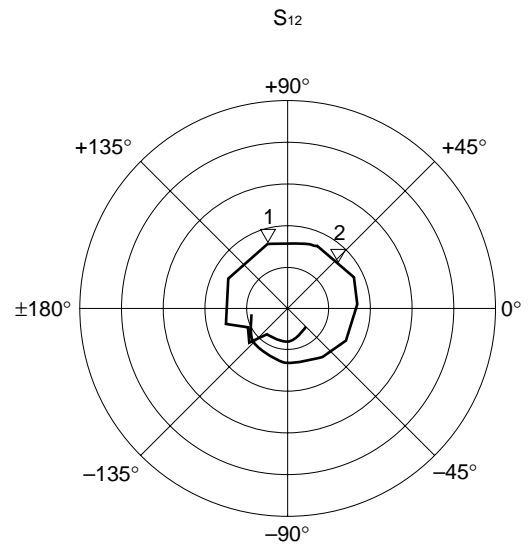
Marker

1: 14.0 GHz

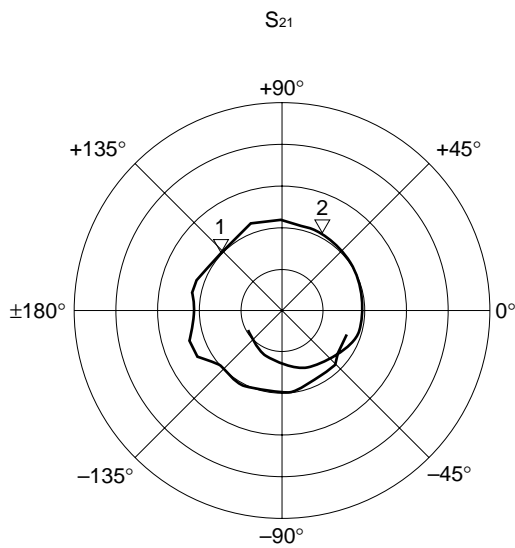
2: 14.5 GHz



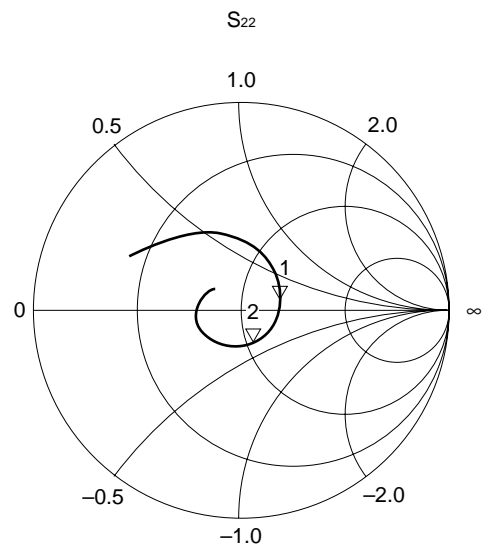
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

[NEZ1414-5E] TYPICAL S-PARAMETERS

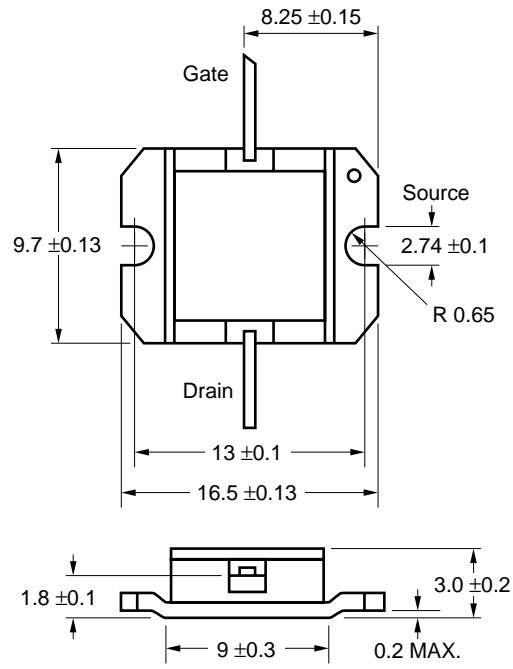
MAG. AND ANG.

$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 1.5\text{ A}$

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	0.699	3.559	0.031	-41.913	1.697	-20.548	0.566	152.460
12.6	0.695	-3.802	0.034	-52.127	1.654	-36.716	0.540	146.569
12.7	0.690	-11.184	0.037	-67.308	1.764	-42.190	0.514	140.115
12.8	0.681	-18.618	0.039	-88.046	1.795	-50.520	0.488	134.089
12.9	0.672	-26.662	0.037	-84.384	1.800	-68.967	0.461	126.832
13.0	0.655	-34.582	0.041	-102.427	1.927	-79.629	0.434	119.491
13.1	0.639	-42.797	0.041	-112.704	1.970	-94.358	0.407	111.931
13.2	0.611	-51.193	0.041	-126.775	2.096	-113.946	0.379	103.332
13.3	0.588	-59.626	0.061	-139.703	2.067	-125.912	0.353	94.382
13.4	0.557	-69.196	0.055	-158.117	2.049	-138.219	0.327	84.364
13.5	0.522	-77.096	0.078	-166.125	2.307	-152.954	0.304	74.656
13.6	0.484	-86.960	0.073	179.398	2.370	-162.851	0.279	63.510
13.7	0.452	-97.571	0.078	153.313	2.129	-179.398	0.260	50.342
13.8	0.414	-109.286	0.076	147.461	2.228	166.598	0.239	37.056
13.9	0.374	-121.896	0.077	118.899	2.190	153.662	0.221	22.479
14.0	0.340	-137.204	0.077	107.834	2.090	136.741	0.207	7.390
14.1	0.309	-153.071	0.077	96.178	2.123	123.419	0.196	-7.712
14.2	0.292	-172.490	0.079	78.839	2.219	107.969	0.189	-23.544
14.3	0.278	166.873	0.082	70.581	2.221	91.922	0.184	-39.366
14.4	0.286	145.748	0.086	56.694	2.121	76.787	0.182	-54.746
14.5	0.306	124.347	0.083	39.400	2.125	61.811	0.182	-69.708
14.6	0.338	105.283	0.089	26.464	2.109	47.575	0.185	-84.246
14.7	0.380	87.665	0.085	7.358	2.035	32.601	0.188	-97.425
14.8	0.422	71.876	0.081	-11.616	1.993	17.984	0.192	-109.879
14.9	0.472	57.486	0.082	-24.978	1.933	1.611	0.196	-121.259
15.0	0.516	44.460	0.075	-44.832	1.821	-14.908	0.199	-131.271
15.1	0.564	32.150	0.071	-53.732	1.697	-30.531	0.204	-141.090
15.2	0.604	20.796	0.068	-68.262	1.609	-45.413	0.205	-149.703
15.3	0.643	10.574	0.064	-80.913	1.494	-61.564	0.206	-157.952
15.4	0.679	0.953	0.061	-91.417	1.385	-76.676	0.204	-165.427
15.5	0.711	-7.486	0.061	-107.934	1.277	-89.461	0.199	-172.212
15.6	0.745	-15.456	0.056	-119.624	1.184	-102.706	0.194	-179.138
15.7	0.772	-22.622	0.054	-134.763	1.103	-116.634	0.185	174.393
15.8	0.801	-29.497	0.051	-146.936	1.013	-129.176	0.174	166.875
15.9	0.825	-35.121	0.047	-160.342	0.931	-142.415	0.159	158.567
16.0	0.849	-40.556	0.044	-173.424	0.867	-154.460	0.146	149.601



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.**

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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.