

# N-CHANNEL GaAs MESFET NEZ1011-8E, NEZ1414-8E

### 8W X, Ku-BAND POWER GaAs MESFET

#### DESCRIPTION

The NEZ1011-8E and NEZ1414-8E 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 :  $P_{o(1\text{ dB})} = +39.5\text{ dBm typ.}$
- High Linear Gain : 6.5 dB typ.
- High Efficiency : 25 % typ.
- Input and Output Internally Matched for Optimum performance

#### ORDERING INFORMATION

Part Number	Package
NEZ1011-8E NEZ1414-8E	T-61

**Remark** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order: NEZ1011-8E, NEZ1414-8E)

#### 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	$I_{DS}$	10	A
Gate Forward Current	$I_{GF}$	+80	mA
Gate Reverse Current	$I_{GR}$	-80	mA
Total Power Dissipation	$P_T$	60	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	$G_{comp}$				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.

**[NEZ1011-8E]**

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

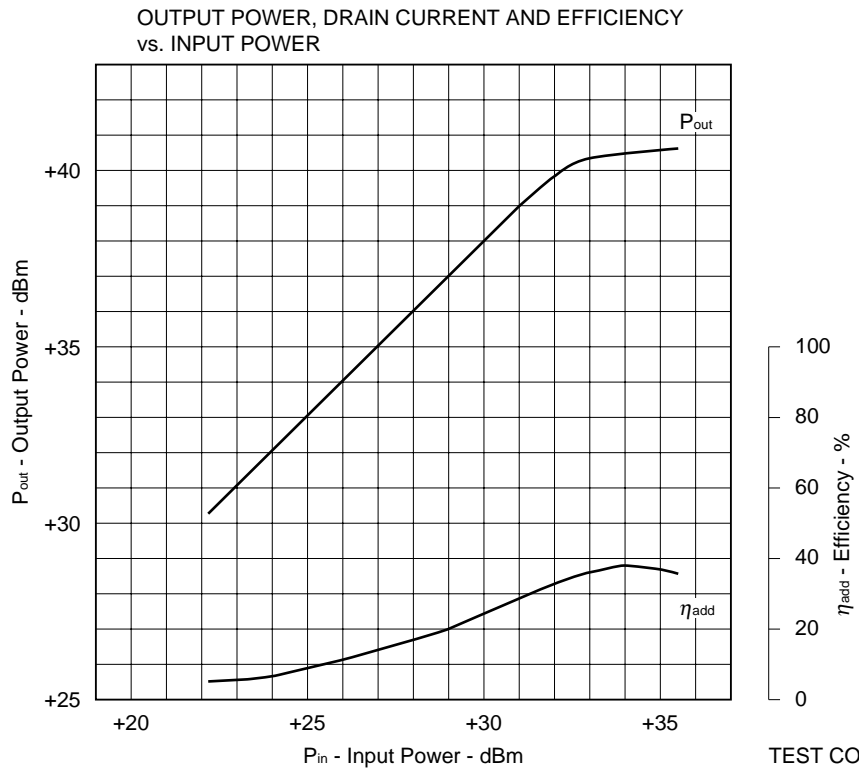
Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	2.8	6.0	10.0	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 40\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 40\text{ mA}$	15	18		V
Thermal Resistance	$R_{th}$	Channel to Case		2.0	2.5	°C/W
Linear Gain	$G_L$	$f = 10.7, 11.2, 11.7\text{ GHz}$	6.0	6.5		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 9.0\text{ V}$ $I_{DS} = 2.0\text{ A (RF OFF)}$ $R_g = 100\ \Omega$	38.5	39.5		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$			3.0	4.0	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$			25		%
3rd Order Intermodulation Distortion	$IM_3$	$P_{out} = +35\text{ dBm (2 tone)}$		-40		dBc

**[NEZ1414-8E]**

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

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	2.8	6.0	10.0	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 40\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 40\text{ mA}$	15	18		V
Thermal Resistance	$R_{th}$	Channel to Case		2.0	2.5	°C/W
Linear Gain	$G_L$	$f = 14.0\text{ to }14.5\text{ GHz}$	6.0	6.5		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 9.0\text{ V}$ $I_{DS} = 2.8\text{ A (RF OFF)}$ $R_g = 50\ \Omega$	38.5	39.5		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$			3.0	4.0	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$			25		%

[NEZ1011-8E] TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )



TEST CONDITIONS

$V_{ds} : 9.0 \text{ (V)}$

$I_{ds} : 2.0 \text{ (A)}$

**[NEZ1011-8E] TYPICAL S-PARAMETERS**

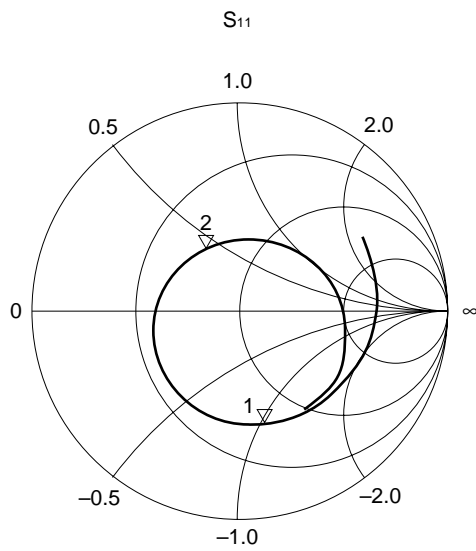
$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 2.0\text{ A}$

START 9.5 GHz, STOP 13 GHz, STEP 100 MHz

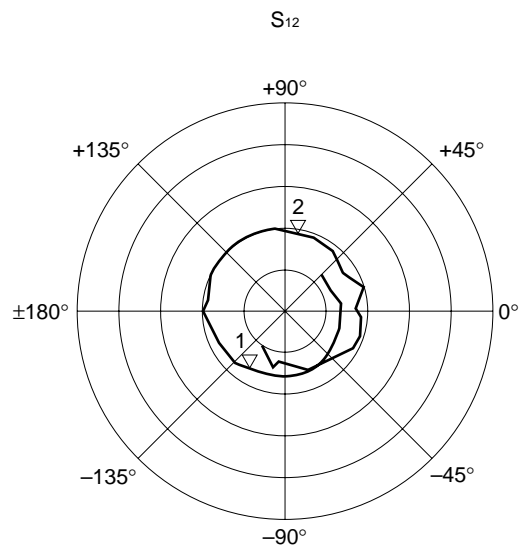
Marker

1: 10.7 GHz

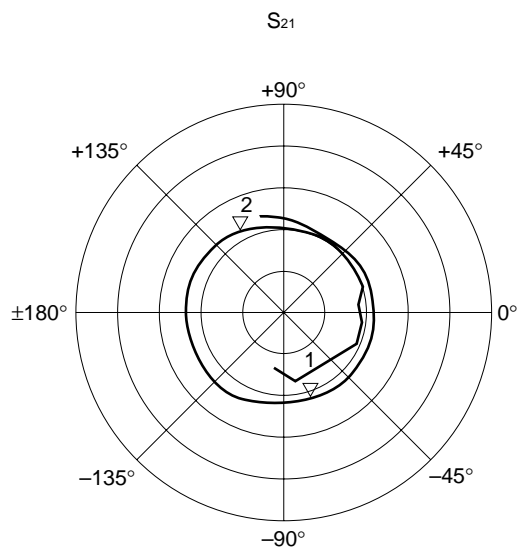
2: 11.7 GHz



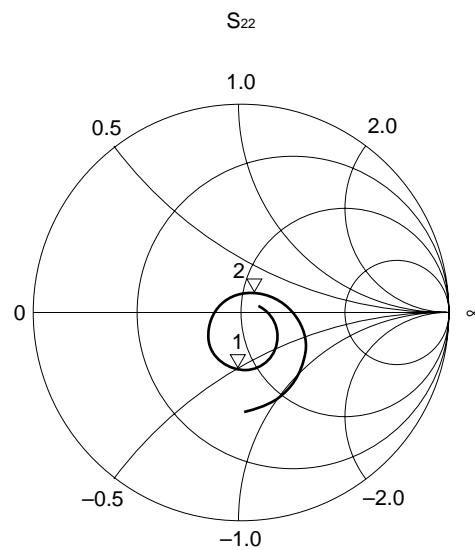
$R_{max} = 1$



$R_{max} = 1.25$



$R_{max} = 5$



$R_{max} = 1$

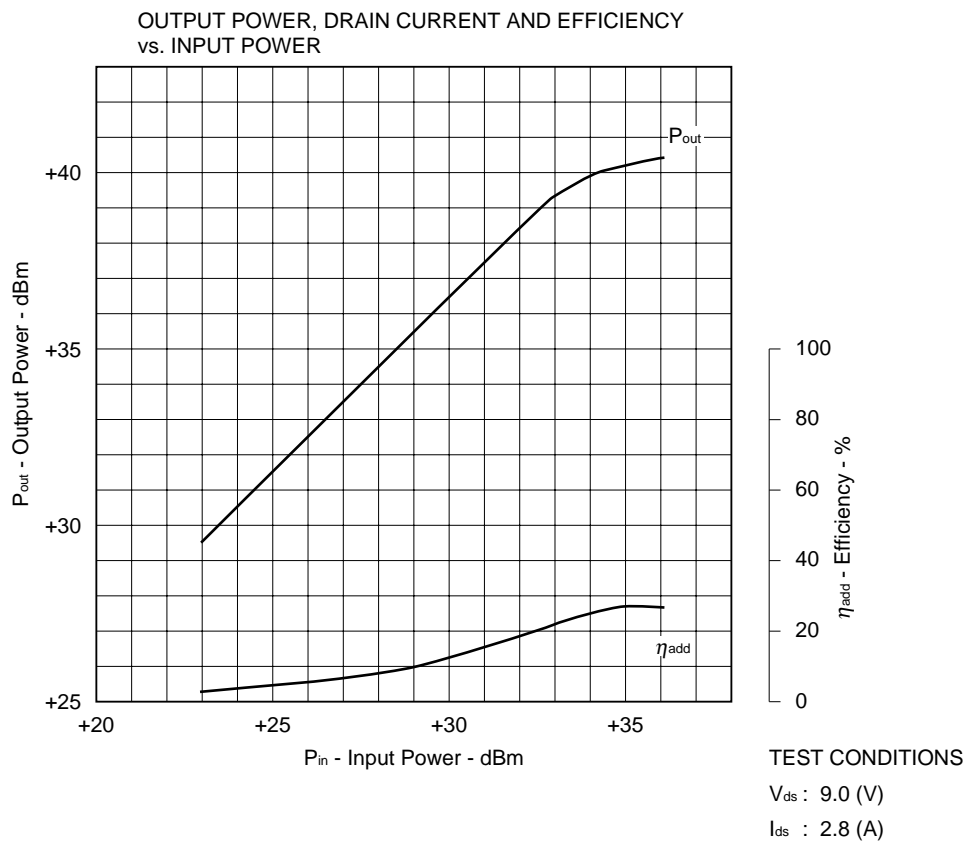
[NEZ1011-8E] TYPICAL S-PARAMETERS

MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 2.0\text{ A}$

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	0.727	29.554	0.061	49.394	2.416	101.075	0.123	16.609
9.60	0.717	19.366	0.061	32.211	2.379	85.352	0.154	3.506
9.70	0.707	10.017	0.062	16.953	2.297	69.447	0.184	-7.383
9.80	0.697	1.221	0.066	3.572	2.194	54.428	0.207	-16.617
9.90	0.681	-7.330	0.064	-16.830	2.182	40.517	0.228	-25.262
10.0	0.669	-15.631	0.067	-25.967	2.159	25.306	0.245	-33.785
10.1	0.651	-23.940	0.068	-42.735	2.157	9.631	0.258	-41.160
10.2	0.633	-31.970	0.070	-54.626	2.113	-3.713	0.268	-48.333
10.3	0.615	-40.075	0.071	-65.648	2.124	-17.972	0.277	-55.412
10.4	0.600	-48.156	0.076	-80.522	2.160	-31.941	0.284	-63.112
10.5	0.590	-57.169	0.077	-94.352	2.168	-46.564	0.286	-71.222
10.6	0.575	-66.560	0.079	-108.905	2.194	-61.585	0.281	-79.151
10.7	0.563	-76.461	0.082	-122.327	2.225	-76.377	0.271	-87.488
10.8	0.547	-87.670	0.085	-137.200	2.283	-91.375	0.258	-96.273
10.9	0.529	-99.371	0.086	-150.698	2.355	-107.667	0.240	-105.618
11.0	0.504	-112.403	0.089	-164.614	2.383	-123.937	0.214	-116.124
11.1	0.472	-126.595	0.094	177.842	2.383	-140.142	0.184	-128.678
11.2	0.441	-141.927	0.094	162.856	2.419	-156.755	0.149	-142.948
11.3	0.401	-158.639	0.100	146.114	2.441	-173.945	0.112	-161.741
11.4	0.371	-177.181	0.100	129.091	2.418	168.826	0.080	169.285
11.5	0.341	161.832	0.098	112.914	2.399	151.919	0.068	122.798
11.6	0.326	140.637	0.099	96.568	2.355	134.838	0.087	79.892
11.7	0.327	118.354	0.092	80.503	2.292	118.389	0.123	53.880
11.8	0.338	97.661	0.093	65.329	2.258	101.371	0.166	36.764
11.9	0.362	79.871	0.091	50.589	2.198	84.496	0.208	23.286
12.0	0.391	63.483	0.085	35.117	2.152	68.413	0.250	11.758
12.1	0.420	49.351	0.097	19.695	2.081	53.466	0.289	1.857
12.2	0.451	35.770	0.084	4.460	2.062	33.009	0.324	-8.099
12.3	0.473	23.977	0.091	-12.616	2.009	20.173	0.355	-17.427
12.4	0.505	12.820	0.091	-26.785	1.761	7.324	0.384	-26.354
12.5	0.524	1.167	0.074	-47.445	1.885	-10.696	0.406	-36.071
12.6	0.542	-10.274	0.079	-62.095	1.943	-26.022	0.429	-45.862
12.7	0.558	-21.957	0.070	-81.900	1.730	-43.492	0.450	-55.707
12.8	0.568	-33.558	0.061	-99.035	1.669	-65.419	0.469	-65.401
12.9	0.577	-44.917	0.068	-104.322	1.711	-83.874	0.483	-75.637
13.0	0.580	-56.927	0.057	-122.085	1.435	-101.076	0.496	-85.711

[NEZ1414-8E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



[NEZ1414-8E] TYPICAL S-PARAMETERS

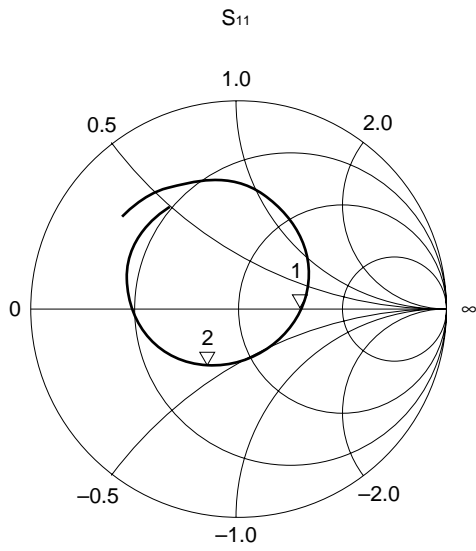
$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 2.8\text{ A}$

START 12.5 GHz, STOP 16 GHz, STEP 100 MHz

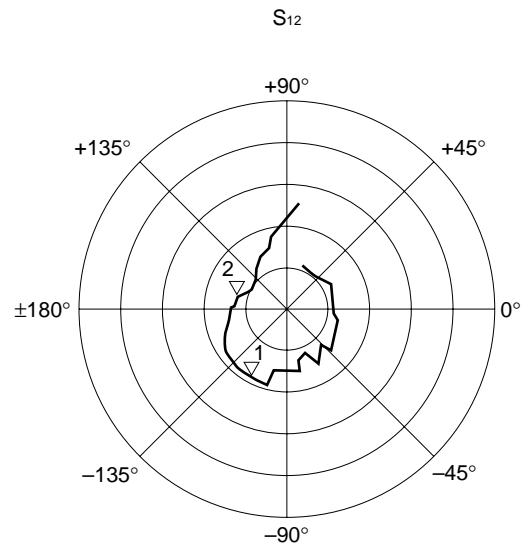
Marker

1: 14.0 GHz

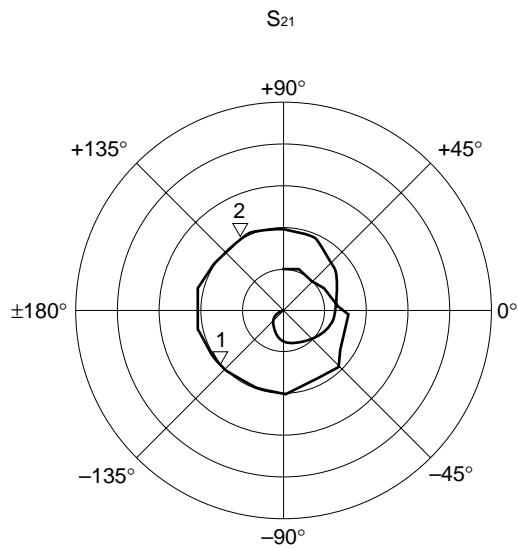
2: 14.5 GHz



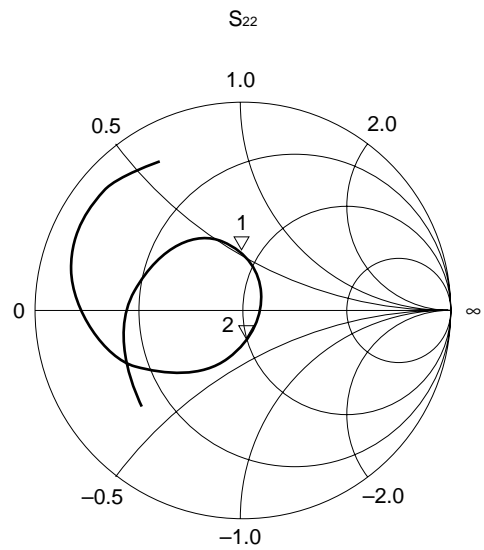
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

[NEZ1414-8E] TYPICAL S-PARAMETERS

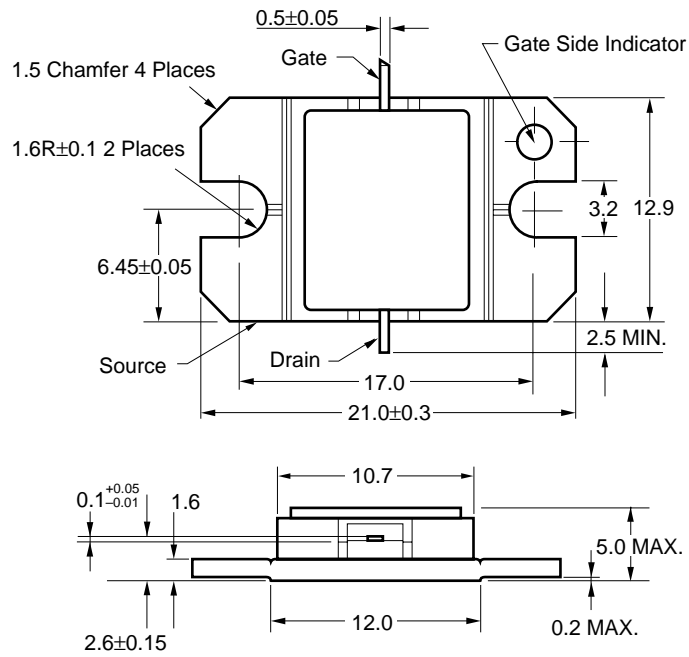
MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 2.8\text{ A}$

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	0.721	139.415	0.063	65.789	1.090	90.045	0.648	-135.265
12.6	0.708	132.772	0.060	49.865	1.189	72.305	0.627	-142.873
12.7	0.692	126.118	0.061	38.512	1.072	63.885	0.604	-150.787
12.8	0.679	119.449	0.068	31.414	1.012	51.496	0.583	-158.823
12.9	0.662	112.727	0.062	1.636	1.162	35.162	0.560	-167.023
13.0	0.646	105.975	0.065	-6.348	1.168	25.472	0.538	-175.622
13.1	0.627	98.571	0.067	-23.775	1.251	10.965	0.521	176.137
13.2	0.611	91.070	0.072	-37.200	1.517	-2.589	0.505	167.049
13.3	0.586	82.834	0.057	-37.231	1.519	-18.701	0.482	158.613
13.4	0.558	74.382	0.070	-53.072	1.532	-34.930	0.467	149.864
13.5	0.529	64.540	0.054	-56.314	1.728	-43.120	0.451	140.419
13.6	0.494	55.184	0.061	-74.305	1.688	-56.186	0.433	132.405
13.7	0.448	43.623	0.071	-76.429	1.798	-83.164	0.407	123.168
13.8	0.402	30.135	0.069	-99.610	1.904	-97.068	0.379	113.048
13.9	0.352	14.210	0.084	-102.548	1.895	-116.284	0.347	102.547
14.0	0.304	-4.327	0.082	-119.795	2.076	-140.185	0.306	91.198
14.1	0.269	-27.205	0.081	-136.199	2.078	-157.244	0.253	76.864
14.2	0.250	-53.572	0.080	-148.309	2.172	-173.417	0.188	58.116
14.3	0.256	-79.363	0.072	-162.986	2.227	165.716	0.126	25.259
14.4	0.286	-103.241	0.066	-173.622	2.154	143.074	0.110	-37.318
14.5	0.322	-122.532	0.064	173.480	2.098	121.360	0.180	-85.219
14.6	0.366	-138.154	0.056	166.468	2.048	99.845	0.285	-111.360
14.7	0.407	-151.177	0.056	156.879	1.904	79.398	0.396	-129.289
14.8	0.444	-161.592	0.055	149.490	1.832	59.640	0.504	-143.650
14.9	0.477	-171.208	0.048	145.649	1.666	35.789	0.598	-156.091
15.0	0.503	-178.844	0.050	143.612	1.375	12.636	0.681	-166.923
15.1	0.526	174.212	0.047	137.404	1.149	-6.188	0.747	-176.864
15.2	0.544	167.849	0.049	136.461	1.021	-25.470	0.796	174.066
15.3	0.562	162.291	0.052	131.212	0.825	-47.459	0.835	165.850
15.4	0.572	156.702	0.056	122.258	0.682	-67.206	0.852	157.773
15.5	0.584	151.882	0.060	122.717	0.621	-82.501	0.866	150.892
15.6	0.591	147.100	0.069	113.154	0.535	-100.688	0.865	144.212
15.7	0.598	142.592	0.076	109.553	0.458	-122.328	0.866	138.057
15.8	0.606	138.519	0.082	100.716	0.396	-143.083	0.849	130.919
15.9	0.624	133.547	0.095	96.384	0.326	-169.106	0.810	124.834
16.0	0.603	124.123	0.135	81.547	0.212	168.591	0.830	118.132



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.