

# N-CHANNEL GaAs MESFET NEZ1011-3E, NEZ1414-3E

### 3W X, Ku-BAND POWER GaAs MESFET

#### DESCRIPTION

The NEZ1011-3E and NEZ1414-3E 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 :  $P_{o(1\text{ dB})} = +34.0\text{ dBm typ.}$
- High Linear Gain : 8.5 dB typ. (NEZ1011-3E), 7.5 dB typ. (NEZ1414-3E)
- High Efficiency : 30 % typ.
- Input and Output Internally Matched for Optimum performance

#### ORDERING INFORMATION

Part Number	Package
NEZ1011-3E NEZ1414-3E	T-78

**Remark** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order: NEZ1011-3E, NEZ1414-3E)

#### 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	$I_{DS}$	3.0 (NEZ1011-3E) 2.5 (NEZ1414-3E)	A
Gate Forward Current	$I_{GF}$	+20	mA
Gate Reverse Current	$I_{GR}$	-20	mA
Total Power Dissipation	$P_T$	15	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>	$R_g$		100	200	200	$\Omega$

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

**[NEZ1011-3E]**

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

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	0.7	1.6	2.5	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 10\text{ mA}$	-2.5	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 10\text{ mA}$		15		V
Thermal Resistance	$R_{th}$	Channel to Case		5.5	7.0	°C/W
Linear Gain	$G_L$	$f = 10.7, 11.2, 11.7\text{ GHz}$	8.0	8.5		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 10\text{ V}$ $I_{DS} = 0.7\text{ A (RF OFF)}$ $R_g = 200\ \Omega$	33.5	34.0		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$			0.9	1.1	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$			30		%

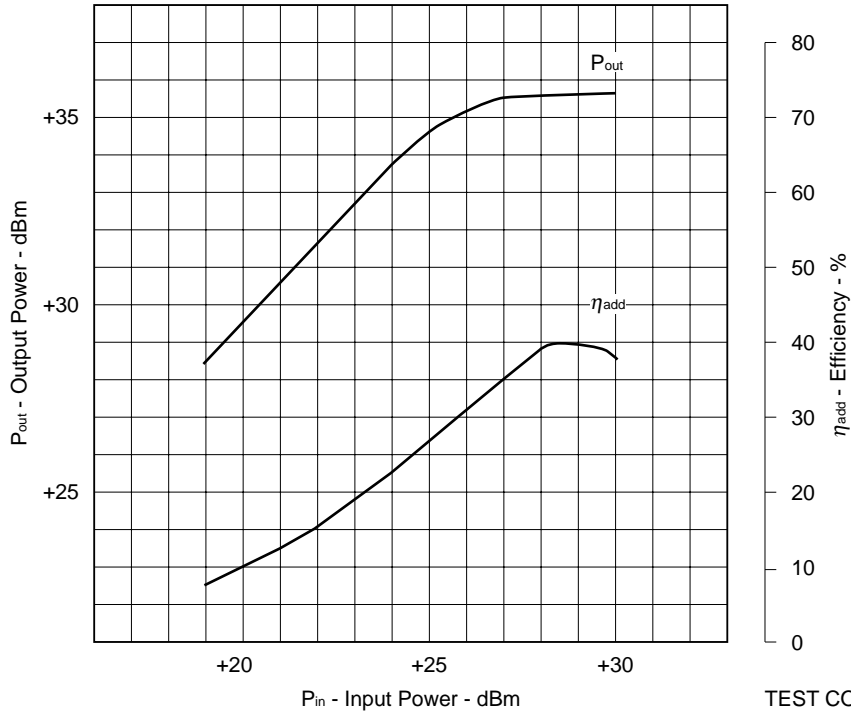
**[NEZ1414-3E]**

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

Characteristics	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturated Drain Current	$I_{DSS}$	$V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$	0.7	1.5	2.5	A
Pinch-off Voltage	$V_p$	$V_{DS} = 2.5\text{ V}, I_{DS} = 10\text{ mA}$	-3.0	-1.3	-0.5	V
Gate to Drain Breakdown Voltage	$BV_{GD}$	$I_{GD} = 10\text{ mA}$	15	18		V
Thermal Resistance	$R_{th}$	Channel to Case		5.5	7.0	°C/W
Linear Gain	$G_L$	$f = 14.0\text{ to }14.5\text{ GHz}$	7.0	7.5		dB
Output Power at 1 dB Gain Comp.	$P_o (1\text{ dB})$	$V_{DS} = 10\text{ V}$ $I_{DS} = 0.7\text{ A (RF OFF)}$ $R_g = 200\ \Omega$	33.5	34.0		dBm
Drain Current at 1 dB Gain Comp.	$I_{DS} (1\text{ dB})$			0.9	1.1	A
Power Added Efficiency at 1 dB Gain Compression Point	$\eta_{add} (1\text{ dB})$			30		%

[NEZ1011-3E] TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

OUTPUT POWER, DRAIN CURRENT AND EFFICIENCY vs. INPUT POWER



TEST CONDITIONS

$V_{ds} : 10 \text{ (V)}$

$I_{ds} : 0.7 \text{ (A)}$

[NEZ1011-3E] TYPICAL S-PARAMETERS

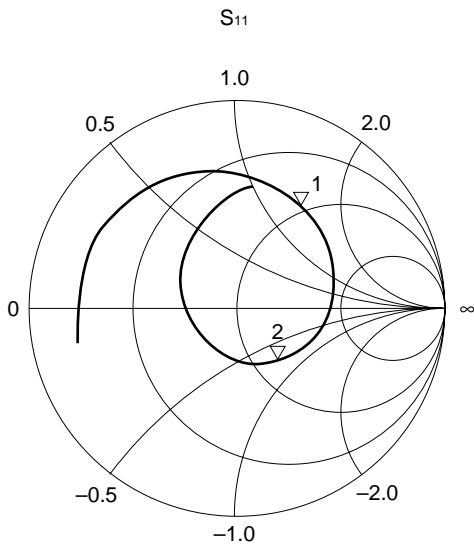
$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

START 9.5 GHz, STOP 13 GHz, STEP 100 MHz

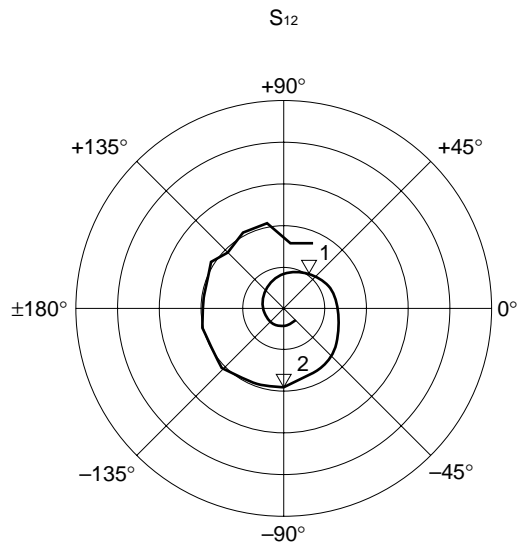
Marker

1: 10.7 GHz

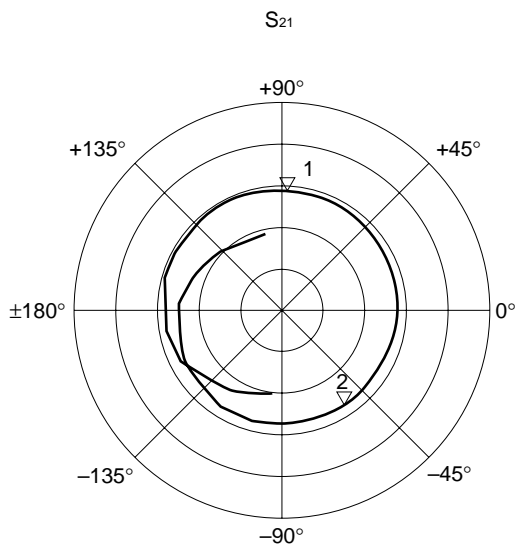
2: 11.7 GHz



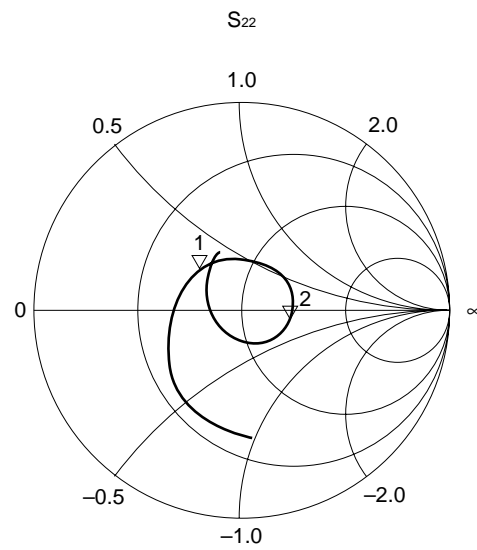
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

[NEZ1011-3E] TYPICAL S-PARAMETERS

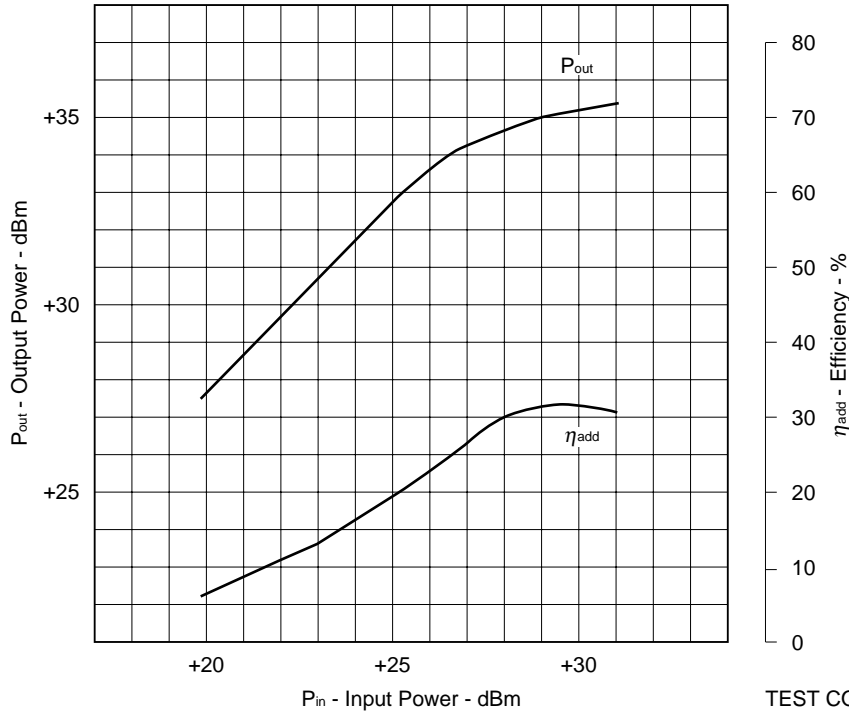
MAG. AND ANG.

$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

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	0.758	-167.394	0.016	-38.869	2.070	-95.765	0.646	-84.187
9.60	0.756	-178.080	0.017	-61.597	2.270	-112.000	0.622	-91.487
9.70	0.753	171.534	0.017	-85.661	2.354	-124.079	0.596	-98.423
9.80	0.747	160.110	0.018	-111.750	2.443	-134.989	0.566	-106.284
9.90	0.741	148.582	0.021	-134.473	2.673	-151.686	0.531	-114.977
10.0	0.729	136.701	0.023	-166.059	2.724	-167.752	0.491	-124.124
10.1	0.716	124.861	0.027	172.305	2.712	176.255	0.448	-134.075
10.2	0.699	112.554	0.030	148.721	2.838	161.634	0.407	-145.607
10.3	0.681	100.951	0.034	124.787	2.852	145.982	0.365	-158.261
10.4	0.663	89.422	0.039	108.584	2.871	130.974	0.320	-172.715
10.5	0.641	77.975	0.043	89.470	2.903	116.200	0.283	170.970
10.6	0.622	67.465	0.048	72.734	2.901	101.015	0.252	153.109
10.7	0.594	56.596	0.052	55.926	2.877	86.322	0.230	133.047
10.8	0.575	46.627	0.056	39.231	2.883	71.797	0.220	112.266
10.9	0.552	36.251	0.061	23.037	2.855	56.973	0.221	92.840
11.0	0.526	26.669	0.064	7.384	2.840	42.964	0.227	74.999
11.1	0.506	16.606	0.068	-5.912	2.859	28.788	0.236	58.649
11.2	0.477	6.699	0.072	-21.590	2.845	14.134	0.249	44.182
11.3	0.456	-3.133	0.074	-34.562	2.827	0.090	0.258	30.971
11.4	0.421	-13.553	0.077	-47.800	2.874	-14.501	0.266	19.236
11.5	0.394	-23.840	0.082	-62.818	2.845	-29.761	0.273	7.519
11.6	0.358	-36.372	0.084	-76.490	2.814	-44.123	0.273	-3.614
11.7	0.318	-48.904	0.094	-91.324	2.828	-57.372	0.270	-14.579
11.8	0.279	-64.303	0.094	-106.787	2.845	-74.316	0.264	-25.846
11.9	0.238	-83.347	0.099	-122.489	2.802	-90.229	0.253	-37.420
12.0	0.207	-106.265	0.104	-137.246	2.794	-105.992	0.238	-49.841
12.1	0.196	-137.799	0.096	-154.077	2.770	-121.151	0.217	-64.490
12.2	0.206	-166.807	0.102	-169.139	2.602	-139.284	0.195	-80.310
12.3	0.247	167.143	0.097	177.258	2.579	-153.949	0.170	-98.820
12.4	0.303	147.107	0.095	161.786	2.518	-167.663	0.151	-121.496
12.5	0.355	131.677	0.104	145.134	2.375	174.497	0.139	-147.026
12.6	0.412	118.317	0.096	132.629	2.236	158.167	0.143	-175.150
12.7	0.463	107.592	0.101	117.730	2.136	143.526	0.160	159.252
12.8	0.515	98.516	0.106	100.775	2.000	129.810	0.187	137.814
12.9	0.554	89.205	0.082	85.179	1.833	115.840	0.223	120.093
13.0	0.592	81.593	0.088	67.387	1.844	101.315	0.263	104.506

[NEZ1414-3E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

OUTPUT POWER, DRAIN CURRENT AND EFFICIENCY vs. INPUT POWER



TEST CONDITIONS

V<sub>ds</sub> : 10 (V)

I<sub>ds</sub> : 0.7 (A)

[NEZ1414-3E] TYPICAL S-PARAMETERS

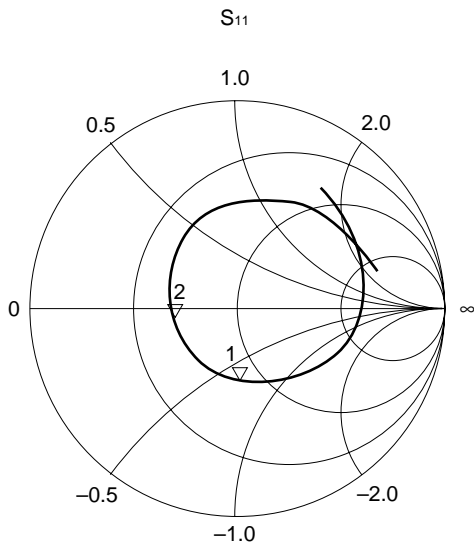
$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

START 12.5 GHz, STOP 16 GHz, STEP 100 MHz

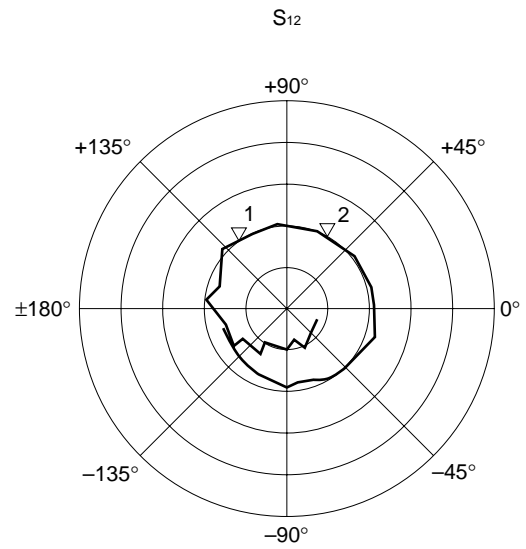
Marker

1: 14.0 GHz

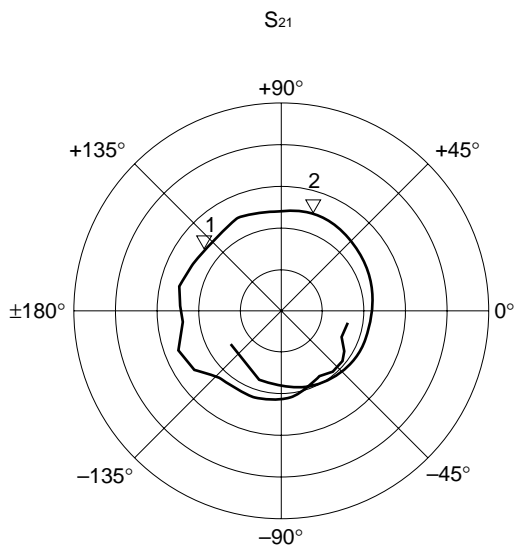
2: 14.5 GHz



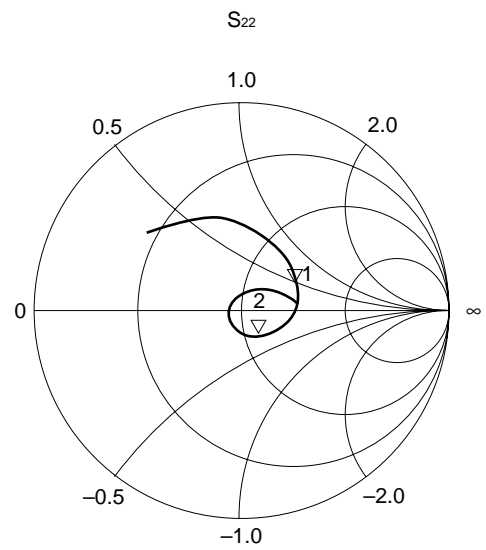
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

[NEZ1414-3E] TYPICAL S-PARAMETERS

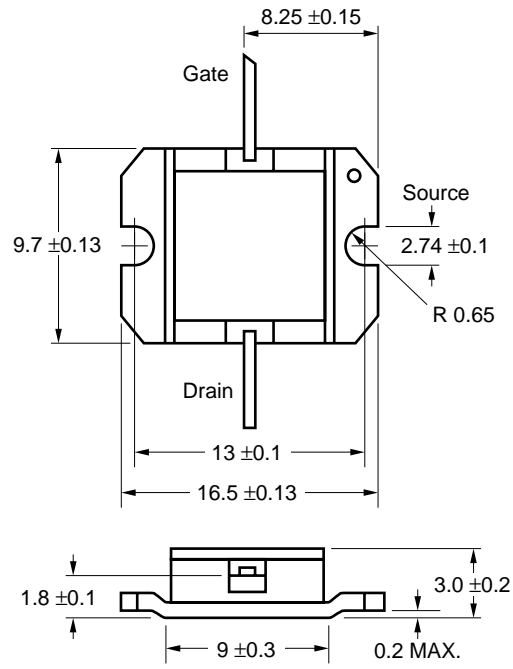
MAG. AND ANG.

$V_{ds} = 10\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

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	0.719	53.886	0.040	-21.073	1.623	-13.398	0.572	138.754
12.6	0.711	47.149	0.041	-31.351	1.571	-28.325	0.550	132.075
12.7	0.701	40.458	0.045	-46.830	1.757	-33.874	0.527	125.104
12.8	0.692	33.576	0.053	-65.105	1.859	-41.761	0.505	118.247
12.9	0.679	26.020	0.042	-73.678	1.833	-59.610	0.485	110.343
13.0	0.663	18.249	0.049	-88.910	2.026	-70.949	0.461	101.940
13.1	0.644	10.160	0.047	-103.967	2.086	-85.573	0.440	93.894
13.2	0.618	1.646	0.049	-120.923	2.173	-106.664	0.417	84.674
13.3	0.595	-7.111	0.064	-120.017	2.187	-118.017	0.395	75.637
13.4	0.563	-16.548	0.065	-145.066	2.210	-129.939	0.374	65.729
13.5	0.526	-25.145	0.077	-142.359	2.522	-147.418	0.352	56.686
13.6	0.489	-35.526	0.075	-163.290	2.662	-157.868	0.330	45.913
13.7	0.456	-46.154	0.093	176.132	2.337	-172.992	0.314	34.867
13.8	0.416	-57.915	0.082	162.566	2.464	172.138	0.290	23.930
13.9	0.377	-70.286	0.103	139.665	2.434	159.722	0.269	12.656
14.0	0.343	-85.075	0.098	125.092	2.275	143.024	0.247	0.903
14.1	0.313	-99.701	0.095	111.685	2.325	129.758	0.224	-9.557
14.2	0.294	-116.892	0.100	96.429	2.433	114.563	0.203	-20.611
14.3	0.279	-134.554	0.094	86.105	2.439	99.326	0.180	-31.631
14.4	0.280	-152.981	0.095	74.312	2.345	84.796	0.158	-42.823
14.5	0.290	-170.788	0.097	57.873	2.353	71.364	0.137	-54.744
14.6	0.311	172.755	0.099	47.734	2.331	57.886	0.117	-67.351
14.7	0.335	157.567	0.103	30.419	2.289	43.831	0.097	-81.497
14.8	0.365	143.616	0.107	13.941	2.271	29.748	0.079	-98.629
14.9	0.399	130.905	0.107	2.025	2.246	14.939	0.064	-119.130
15.0	0.429	119.275	0.113	-16.130	2.194	4.129E-03	0.051	-146.249
15.1	0.464	107.553	0.103	-30.134	2.143	-14.722	0.047	179.696
15.2	0.494	96.624	0.102	-44.244	2.107	-29.373	0.050	143.024
15.3	0.527	85.758	0.099	-58.636	2.045	-44.663	0.063	112.003
15.4	0.557	74.761	0.092	-72.875	1.981	-59.754	0.083	88.873
15.5	0.585	63.969	0.094	-85.272	1.914	-74.732	0.107	69.553
15.6	0.609	53.504	0.089	-100.362	1.841	-89.690	0.135	53.228
15.7	0.637	43.075	0.090	-114.497	1.754	-104.952	0.170	39.561
15.8	0.662	32.905	0.085	-128.650	1.652	-119.894	0.205	26.756
15.9	0.689	23.314	0.081	-143.080	1.549	-134.935	0.242	15.205
16.0	0.712	14.183	0.077	-158.527	1.464	-149.340	0.285	5.958



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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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.