

# N-CHANNEL GaAs MESFET NEZ1011-2E, NEZ1414-2E

### 2W X, Ku-BAND POWER GaAs MESFET

#### DESCRIPTION

The NEZ1011-2E and NEZ1414-2E 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. (NEZ1011-2E), 7.5 dB typ. (NEZ1414-2E)
- High Efficiency : 30 % typ.
- Input and Output Internally Matched for Optimum performance

#### ORDERING INFORMATION

| Part Number              | Package |
|--------------------------|---------|
| NEZ1011-2E<br>NEZ1414-2E | T-78    |

**Remark** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order: NEZ1011-2E, NEZ1414-2E)

#### 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 (NEZ1011-2E)<br>2.5 (NEZ1414-2E) | 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         | $V_{DS}$   |                | 9.0  | 9.0  | 9.0  | V        |
| Gain Compression                | $G_{comp}$ |                |      |      | 3    | dB       |
| Channel Temperature             | $T_{ch}$   |                |      |      | +130 | °C       |
| Gate Resistance <sup>Note</sup> | $R_g$      |                | 200  | 1000 | 1000 | $\Omega$ |

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

**[NEZ1011-2E]**

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

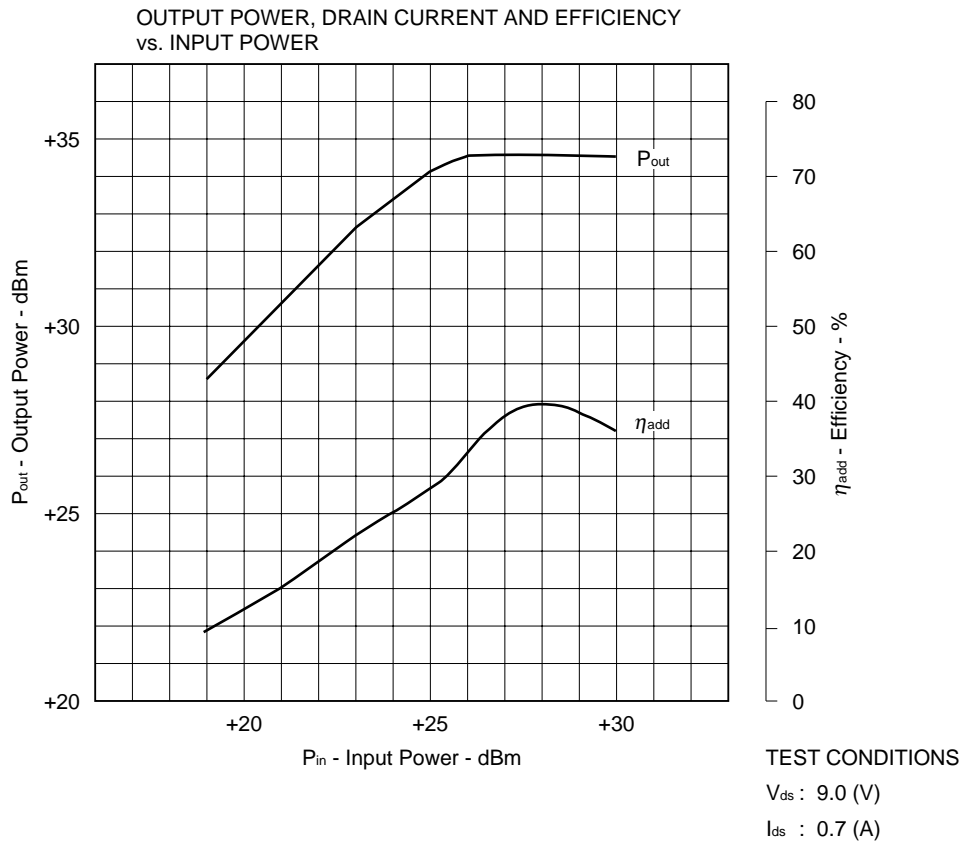
| Characteristics                                       | Symbol                     | Test Conditions   | MIN. | TYP. | MAX. | Unit |
|---|----------------------------|---|------|------|------|------|
| Saturated Drain Current                               | $I_{DSS}$                  | $V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$                | 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.                       | $P_o (1\text{ dB})$        | $V_{DS} = 9.0\text{ V}$<br>$I_{DS} = 0.7\text{ A (RF OFF)}$ | 33.0 | 34.0 |      | dBm  |
| Drain Current at 1 dB Gain Comp.                      | $I_{DS} (1\text{ dB})$     | $R_g = 1\text{ k}\Omega$                                    |      | 0.8  | 1.0  | A    |
| Power Added Efficiency at 1 dB Gain Compression Point | $\eta_{add} (1\text{ dB})$ |   |      | 30   |      | %    |
| 3rd Order Intermodulation Distortion                  | $IM_3$                     | $P_{out} = +27.5\text{ dBm (2 tone)}$                       |      | -40  |      | dBc  |

**[NEZ1414-2E]**

**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  | 3.0  | 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   |      | 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.                       | $P_o (1\text{ dB})$        | $V_{DS} = 9.0\text{ V}$<br>$I_{DS} = 0.7\text{ A (RF OFF)}$ | 33.0 | 34.0 |      | dBm  |
| Drain Current at 1 dB Gain Comp.                      | $I_{DS} (1\text{ dB})$     | $R_g = 1\text{ k}\Omega$                                    |      | 0.8  | 1.0  | A    |
| Power Added Efficiency at 1 dB Gain Compression Point | $\eta_{add} (1\text{ dB})$ |   |      | 30   |      | %    |

[NEZ1011-2E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



[NEZ1011-2E] TYPICAL S-PARAMETERS

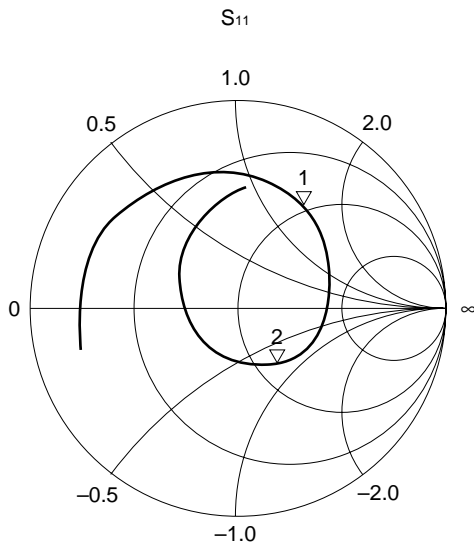
$V_{ds} = 9.0 \text{ V}$ ,  $I_{ds} = 0.7 \text{ A}$

START 9.5 GHz, STOP 13 GHz, STEP 100 MHz

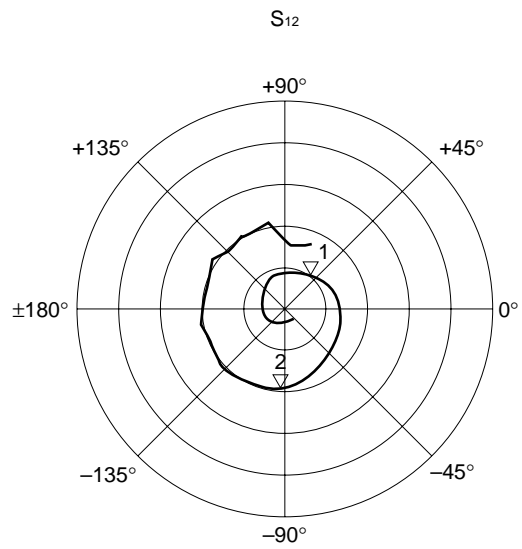
Marker

1: 10.7 GHz

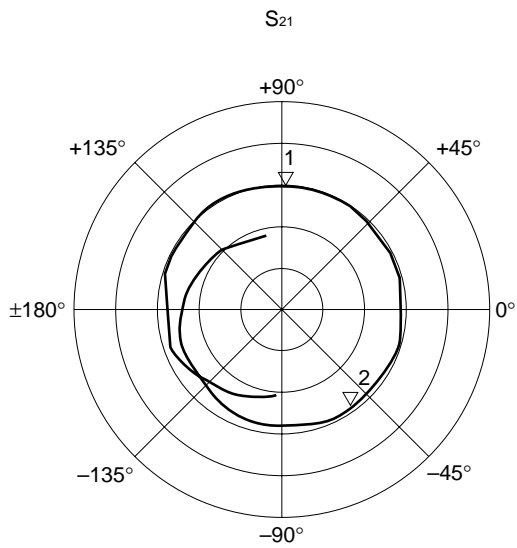
2: 11.7 GHz



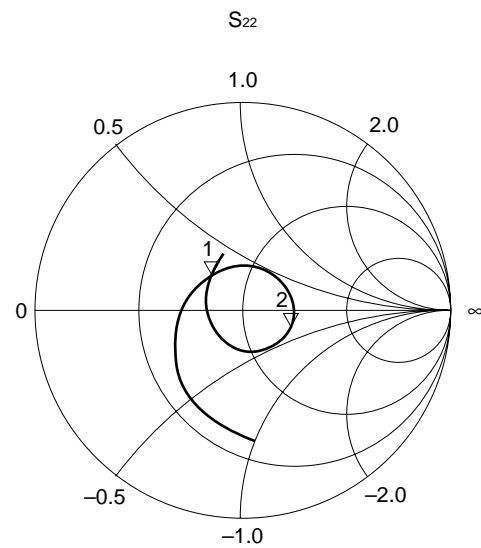
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

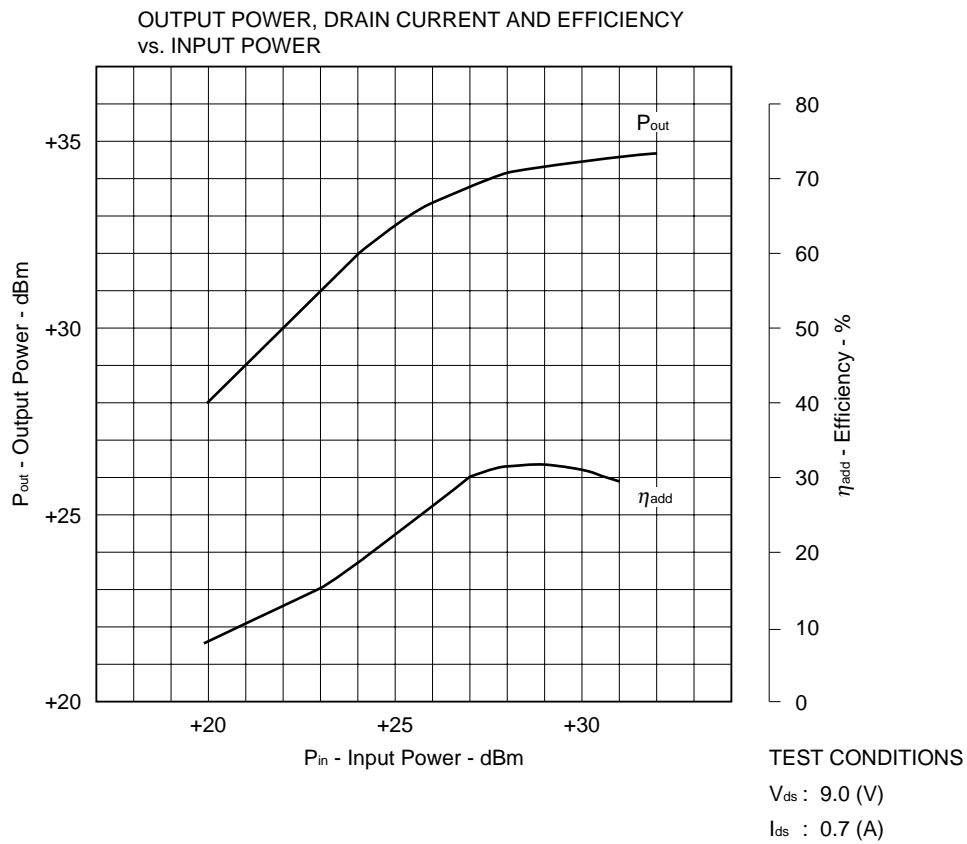
[NEZ1011-2E] TYPICAL S-PARAMETERS

MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

| FREQUENCY<br>GHZ | S <sub>11</sub> |                | S <sub>12</sub> |                | S <sub>21</sub> |                | S <sub>22</sub> |                |
|------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
|                  | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) |
| 9.50             | 0.764           | -167.277       | 0.015           | -43.230        | 2.130           | -95.531        | 0.635           | -83.968        |
| 9.60             | 0.761           | -178.028       | 0.016           | -65.634        | 2.340           | -111.739       | 0.611           | -91.286        |
| 9.70             | 0.758           | 171.529        | 0.016           | -91.498        | 2.425           | -123.950       | 0.584           | -98.187        |
| 9.80             | 0.753           | 160.103        | 0.017           | -118.516       | 2.517           | -134.894       | 0.553           | -106.003       |
| 9.90             | 0.746           | 148.570        | 0.021           | -141.838       | 2.750           | -151.673       | 0.516           | -114.652       |
| 10.0             | 0.736           | 136.528        | 0.024           | -171.701       | 2.799           | -167.695       | 0.476           | -123.658       |
| 10.1             | 0.722           | 124.575        | 0.028           | 167.511        | 2.790           | 176.393        | 0.432           | -133.644       |
| 10.2             | 0.706           | 112.284        | 0.032           | 144.823        | 2.912           | 161.709        | 0.388           | -145.015       |
| 10.3             | 0.686           | 100.666        | 0.035           | 121.478        | 2.927           | 146.204        | 0.344           | -157.688       |
| 10.4             | 0.668           | 89.224         | 0.040           | 105.970        | 2.942           | 131.119        | 0.299           | -172.088       |
| 10.5             | 0.645           | 77.773         | 0.044           | 87.091         | 2.970           | 116.345        | 0.260           | 171.488        |
| 10.6             | 0.624           | 67.151         | 0.050           | 70.741         | 2.970           | 101.187        | 0.229           | 152.876        |
| 10.7             | 0.598           | 56.412         | 0.054           | 54.078         | 2.945           | 86.551         | 0.208           | 131.672        |
| 10.8             | 0.578           | 46.466         | 0.059           | 37.806         | 2.944           | 72.072         | 0.200           | 109.753        |
| 10.9             | 0.554           | 36.030         | 0.062           | 21.296         | 2.917           | 57.262         | 0.202           | 89.248         |
| 11.0             | 0.528           | 26.451         | 0.066           | 6.098          | 2.906           | 43.390         | 0.212           | 70.797         |
| 11.1             | 0.507           | 16.580         | 0.070           | -7.465         | 2.920           | 29.090         | 0.222           | 54.193         |
| 11.2             | 0.478           | 6.600          | 0.074           | -22.940        | 2.902           | 14.522         | 0.237           | 39.808         |
| 11.3             | 0.456           | -3.277         | 0.075           | -35.751        | 2.889           | 0.451          | 0.248           | 26.634         |
| 11.4             | 0.422           | -13.834        | 0.079           | -49.149        | 2.933           | -14.070        | 0.256           | 14.662         |
| 11.5             | 0.394           | -24.217        | 0.084           | -63.862        | 2.901           | -29.339        | 0.264           | 3.065          |
| 11.6             | 0.358           | -36.871        | 0.086           | -77.583        | 2.874           | -43.606        | 0.265           | -8.418         |
| 11.7             | 0.318           | -49.672        | 0.096           | -92.366        | 2.890           | -56.908        | 0.262           | -19.614        |
| 11.8             | 0.279           | -65.213        | 0.096           | -107.789       | 2.905           | -73.786        | 0.257           | -31.209        |
| 11.9             | 0.240           | -84.430        | 0.100           | -123.743       | 2.857           | -89.725        | 0.246           | -43.300        |
| 12.0             | 0.209           | -107.600       | 0.105           | -138.506       | 2.845           | -105.536       | 0.233           | -55.965        |
| 12.1             | 0.200           | -138.676       | 0.097           | -155.009       | 2.824           | -120.676       | 0.214           | -71.338        |
| 12.2             | 0.212           | -167.414       | 0.103           | -170.320       | 2.638           | -138.590       | 0.193           | -87.955        |
| 12.3             | 0.252           | 166.906        | 0.098           | 175.893        | 2.617           | -153.421       | 0.174           | -107.656       |
| 12.4             | 0.309           | 147.122        | 0.095           | 160.769        | 2.572           | -167.311       | 0.160           | -130.767       |
| 12.5             | 0.361           | 131.557        | 0.105           | 143.930        | 2.409           | 174.881        | 0.155           | -155.714       |
| 12.6             | 0.416           | 118.401        | 0.097           | 131.537        | 2.256           | 158.493        | 0.163           | 178.469        |
| 12.7             | 0.469           | 107.640        | 0.102           | 116.588        | 2.162           | 143.945        | 0.183           | 155.527        |
| 12.8             | 0.519           | 98.604         | 0.106           | 99.572         | 2.023           | 130.613        | 0.211           | 135.870        |
| 12.9             | 0.559           | 89.444         | 0.082           | 84.259         | 1.844           | 116.717        | 0.246           | 119.252        |
| 13.0             | 0.597           | 81.722         | 0.088           | 66.604         | 1.863           | 102.174        | 0.287           | 104.110        |

[NEZ1414-2E] TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



[NEZ1414-2E] TYPICAL S-PARAMETERS

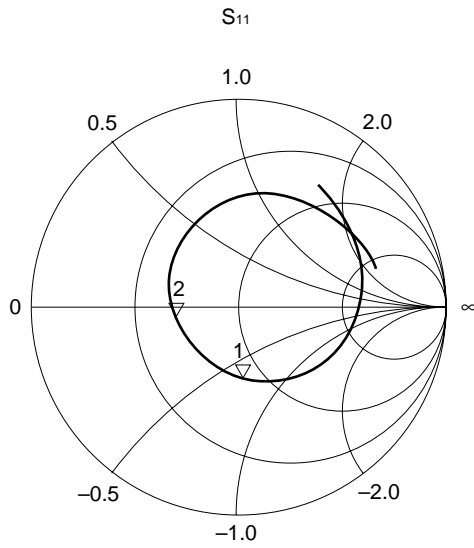
$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

START 12.5 GHz, STOP 16 GHz, STEP 100 MHz

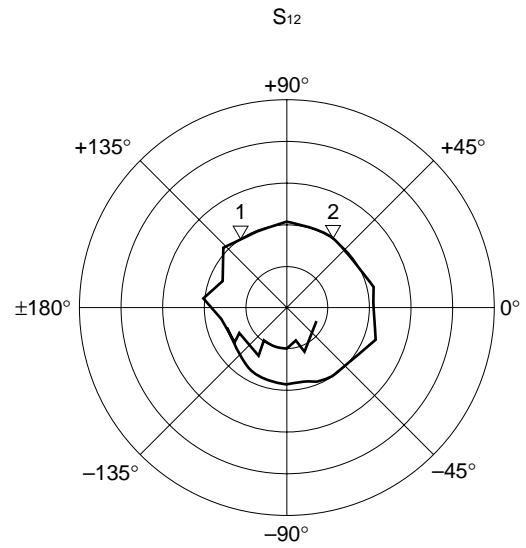
Marker

1: 14.0 GHz

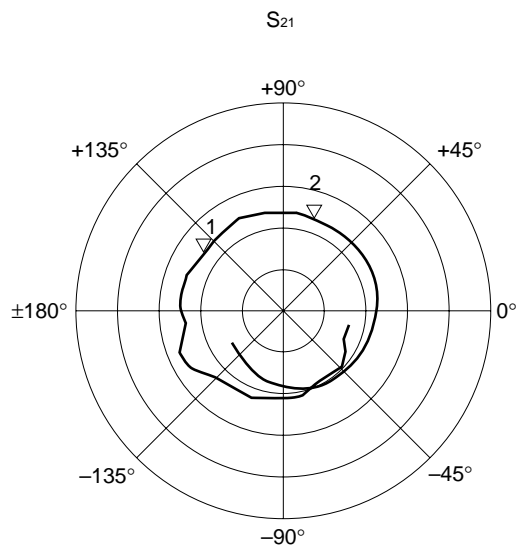
2: 14.5 GHz



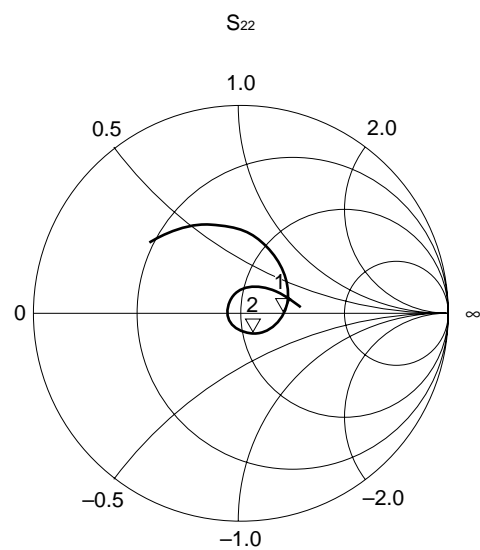
$R_{max} = 1$



$R_{max} = 0.25$



$R_{max} = 5$



$R_{max} = 1$

[NEZ1414-2E] TYPICAL S-PARAMETERS

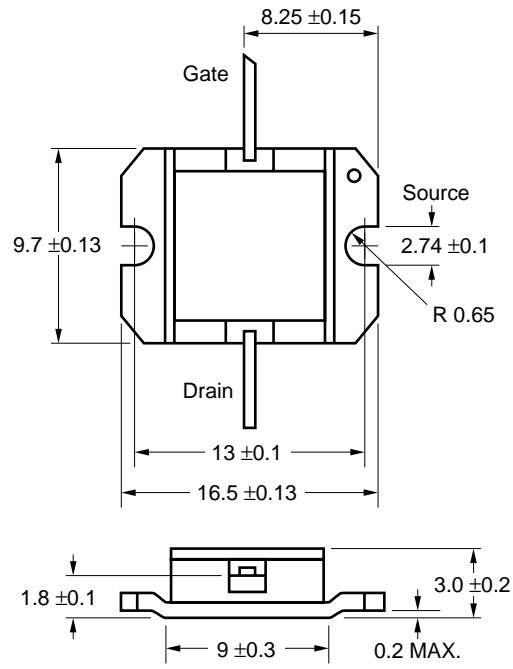
MAG. AND ANG.

$V_{ds} = 9.0\text{ V}$ ,  $I_{ds} = 0.7\text{ A}$

| FREQUENCY<br>GHz | S <sub>11</sub> |                | S <sub>12</sub> |                | S <sub>21</sub> |                | S <sub>22</sub> |                |
|------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
|                  | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) |
| 12.5             | 0.720           | 54.026         | 0.041           | -23.488        | 1.670           | -12.914        | 0.559           | 139.492        |
| 12.6             | 0.714           | 47.272         | 0.042           | -33.909        | 1.618           | -27.927        | 0.536           | 132.577        |
| 12.7             | 0.703           | 40.563         | 0.046           | -49.053        | 1.805           | -33.613        | 0.513           | 125.731        |
| 12.8             | 0.694           | 33.714         | 0.054           | -67.659        | 1.905           | -41.620        | 0.489           | 118.906        |
| 12.9             | 0.681           | 25.911         | 0.042           | -75.730        | 1.883           | -59.438        | 0.469           | 110.831        |
| 13.0             | 0.665           | 18.142         | 0.049           | -91.627        | 2.076           | -70.774        | 0.444           | 102.528        |
| 13.1             | 0.647           | 10.006         | 0.048           | -106.322       | 2.139           | -85.459        | 0.423           | 94.278         |
| 13.2             | 0.619           | 1.522          | 0.050           | -123.298       | 2.226           | -106.292       | 0.397           | 85.041         |
| 13.3             | 0.598           | -7.303         | 0.065           | -121.906       | 2.244           | -117.709       | 0.376           | 76.035         |
| 13.4             | 0.564           | -16.994        | 0.066           | -147.244       | 2.269           | -129.798       | 0.354           | 66.079         |
| 13.5             | 0.528           | -25.513        | 0.078           | -144.394       | 2.572           | -146.964       | 0.331           | 56.921         |
| 13.6             | 0.489           | -35.940        | 0.076           | -164.810       | 2.705           | -157.354       | 0.308           | 46.382         |
| 13.7             | 0.458           | -46.827        | 0.094           | 174.594        | 2.394           | -172.475       | 0.291           | 35.057         |
| 13.8             | 0.417           | -58.735        | 0.083           | 160.842        | 2.514           | 172.741        | 0.267           | 23.990         |
| 13.9             | 0.379           | -71.139        | 0.104           | 137.769        | 2.483           | 160.220        | 0.245           | 12.747         |
| 14.0             | 0.345           | -86.020        | 0.098           | 123.598        | 2.337           | 143.589        | 0.222           | 0.830          |
| 14.1             | 0.316           | -100.664       | 0.095           | 110.275        | 2.380           | 130.321        | 0.199           | -10.034        |
| 14.2             | 0.299           | -117.676       | 0.100           | 95.196         | 2.475           | 115.146        | 0.177           | -21.527        |
| 14.3             | 0.283           | -135.202       | 0.094           | 85.165         | 2.473           | 100.169        | 0.155           | -33.131        |
| 14.4             | 0.286           | -153.247       | 0.096           | 73.113         | 2.387           | 85.738         | 0.132           | -45.132        |
| 14.5             | 0.294           | -171.013       | 0.098           | 56.700         | 2.393           | 72.248         | 0.113           | -57.855        |
| 14.6             | 0.316           | 172.686        | 0.099           | 46.372         | 2.363           | 58.619         | 0.092           | -72.397        |
| 14.7             | 0.341           | 157.476        | 0.103           | 29.217         | 2.329           | 44.378         | 0.074           | -89.862        |
| 14.8             | 0.371           | 143.634        | 0.108           | 13.049         | 2.311           | 30.331         | 0.059           | -113.198       |
| 14.9             | 0.404           | 130.878        | 0.107           | 0.943          | 2.279           | 15.402         | 0.048           | -143.105       |
| 15.0             | 0.434           | 119.410        | 0.113           | -17.401        | 2.226           | 0.717          | 0.046           | -178.465       |
| 15.1             | 0.470           | 107.612        | 0.104           | -31.285        | 2.173           | -13.915        | 0.054           | 147.862        |
| 15.2             | 0.500           | 96.950         | 0.102           | -45.363        | 2.138           | -28.618        | 0.068           | 121.138        |
| 15.3             | 0.535           | 86.060         | 0.099           | -59.856        | 2.067           | -43.793        | 0.087           | 100.050        |
| 15.4             | 0.563           | 75.185         | 0.091           | -74.474        | 2.002           | -58.791        | 0.109           | 81.796         |
| 15.5             | 0.592           | 64.542         | 0.093           | -86.447        | 1.930           | -74.024        | 0.134           | 65.785         |
| 15.6             | 0.614           | 54.164         | 0.089           | -101.479       | 1.858           | -88.826        | 0.162           | 51.196         |
| 15.7             | 0.643           | 43.880         | 0.089           | -115.807       | 1.768           | -104.195       | 0.197           | 38.392         |
| 15.8             | 0.667           | 33.519         | 0.085           | -129.917       | 1.668           | -119.138       | 0.231           | 26.433         |
| 15.9             | 0.693           | 24.111         | 0.081           | -143.437       | 1.558           | -134.157       | 0.268           | 15.119         |
| 16.0             | 0.714           | 14.872         | 0.076           | -159.317       | 1.473           | -148.375       | 0.311           | 5.747          |



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<br>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.