

**NEC**

# HETERO JUNCTION FIELD EFFECT TRANSISTOR

## NE434S01

### C BAND SUPER LOW NOISE AMPLIFIER

### N-CHANNEL HJ-FET

#### DESCRIPTION

The NE434S01 is a Hetero Junction FET that utilizes the hetero junction to create high mobility electrons. Its excellent low noise and high associated gain make it suitable for TVRO and another commercial systems.

#### FEATURES

- Super Low Noise Figure & High Associated Gain  
NF = 0.35 dB TYP.,  $G_a = 15.5$  dB TYP. at  $f = 4$  GHz
- Gate Width:  $W_g = 280 \mu\text{m}$

#### ORDERING INFORMATION

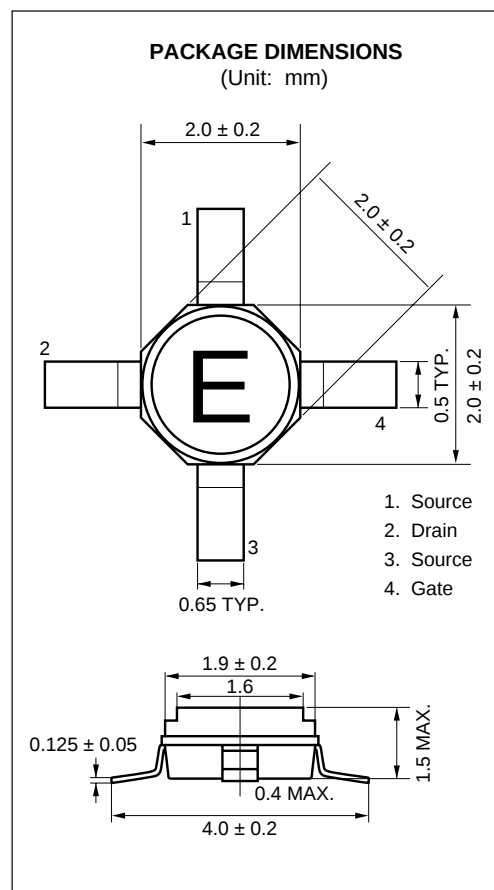
| PART NUMBER  | SUPPLYING FORM             | MARKING |
|--------------|----------------------------|---------|
| NE434S01-T1  | Tape & reel 1000 pcs./reel | E       |
| NE434S01-T1B | Tape & reel 4000 pcs./reel |         |

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

|                         |           |             |                  |
|-------------------------|-----------|-------------|------------------|
| Drain to Source Voltage | $V_{DS}$  | 4.0         | V                |
| Gate to Source Voltage  | $V_{GS}$  | -3.0        | V                |
| Drain Current           | $I_D$     | $I_{DSS}$   | mA               |
| Total Power Dissipation | $P_{tot}$ | 300         | mW               |
| Channel Temperature     | $T_{ch}$  | 125         | $^\circ\text{C}$ |
| Storage Temperature     | $T_{stg}$ | -65 to +125 | $^\circ\text{C}$ |

#### RECOMMENDED OPERATING CONDITION ( $T_A = 25^\circ\text{C}$ )

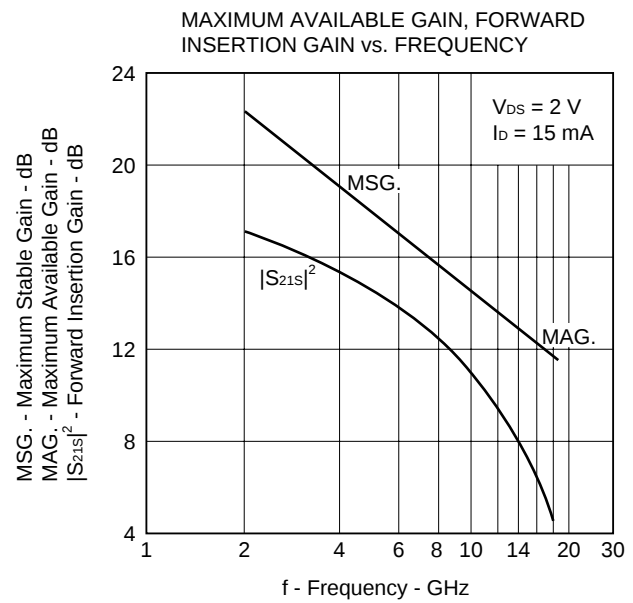
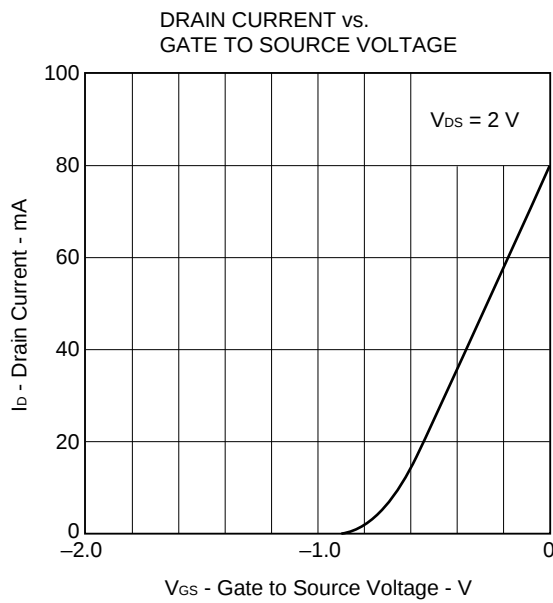
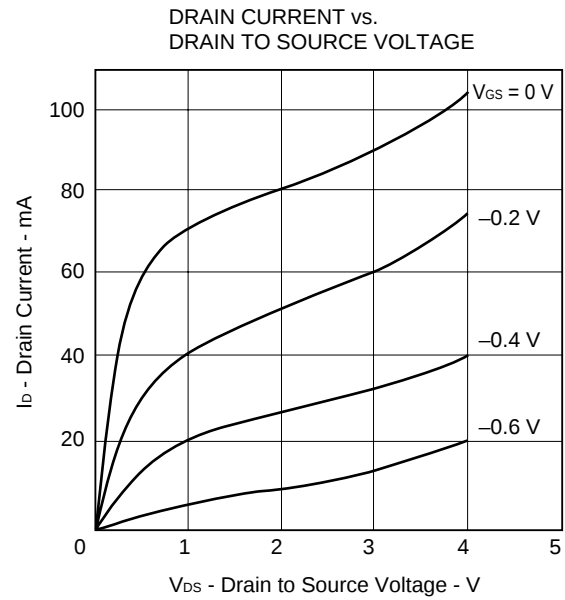
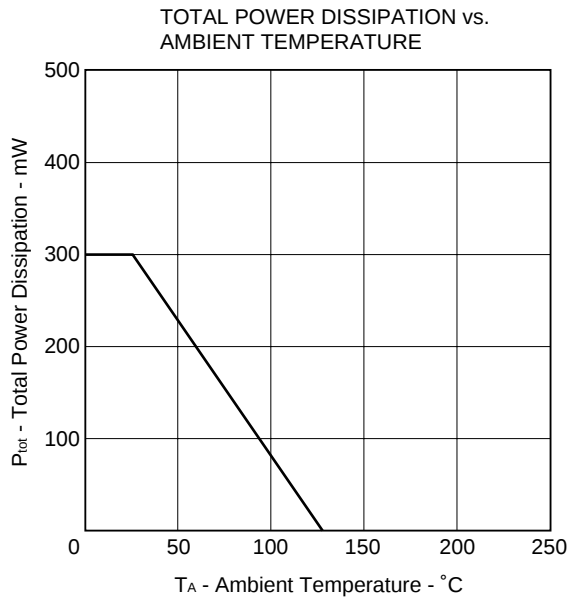
| CHARACTERISTIC          | SYMBOL   | MIN. | TYP. | MAX. | Unit |
|-------------------------|----------|------|------|------|------|
| Drain to Source Voltage | $V_{DS}$ |      | 2    | 2.5  | V    |
| Drain Current           | $I_D$    |      | 15   | 20   | mA   |
| Input Power             | $P_{in}$ |      |      | 0    | dBm  |



**ELECTRO-OPTICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

| PARAMETER                     | SYMBOL               | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS                                             |
|-------------------------------|----------------------|------|------|------|------|-------------------------------------------------------------|
| Gate to Source Leak Current   | I <sub>SGO</sub>     |      | 0.5  | 10   | μA   | V <sub>GS</sub> = −3 V                                      |
| Saturated Drain Current       | I <sub>DSS</sub>     | 20   | 80   | 150  | mA   | V <sub>DS</sub> = 2 V, V <sub>GS</sub> = 0 V                |
| Gate to Source Cutoff Voltage | V <sub>GS(off)</sub> | −0.2 | −0.9 | −2.5 | V    | V <sub>DS</sub> = 2 V, I <sub>D</sub> = 100 μA              |
| Transconductance              | g <sub>m</sub>       | 70   | 85   |      | mS   | V <sub>DS</sub> = 2 V, I <sub>D</sub> = 14 mA               |
| Noise Figure                  | NF                   |      | 0.35 | 0.45 | dB   | V <sub>DS</sub> = 2 V, I <sub>D</sub> = 15 mA,<br>f = 4 GHz |
| Associated Gain               | G <sub>a</sub>       | 13.0 | 15.5 |      | dB   |                                                             |

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



**Gain Calculations**

$$\text{MSG} = \frac{|S_{21}|}{|S_{12}|} \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$$

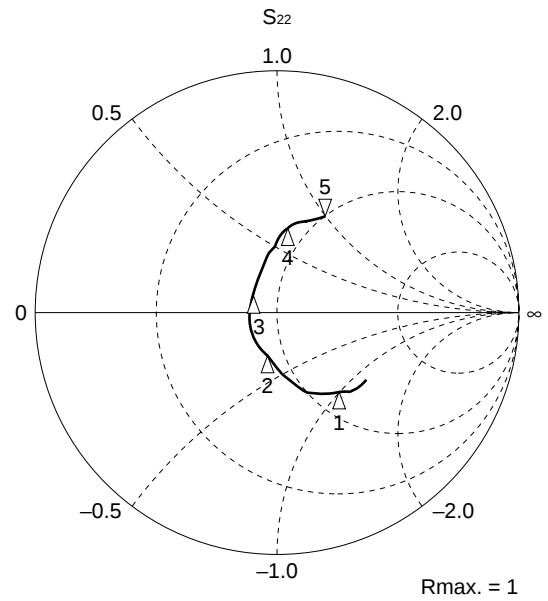
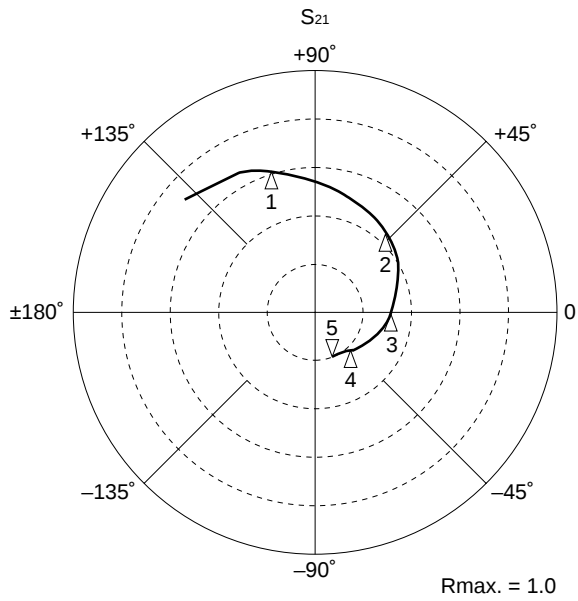
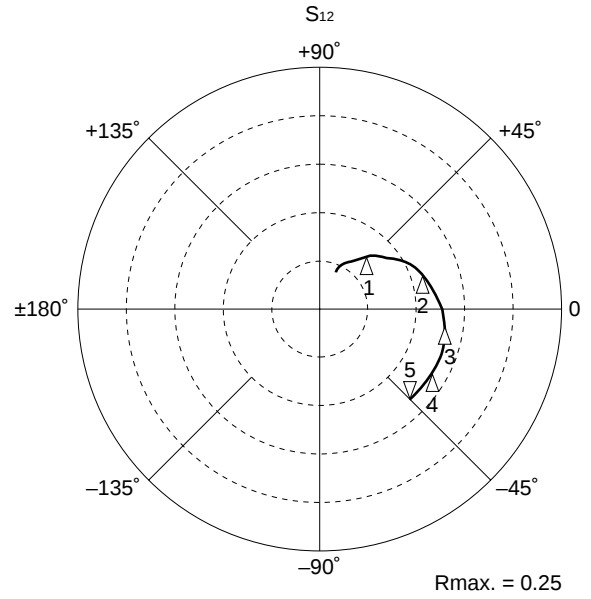
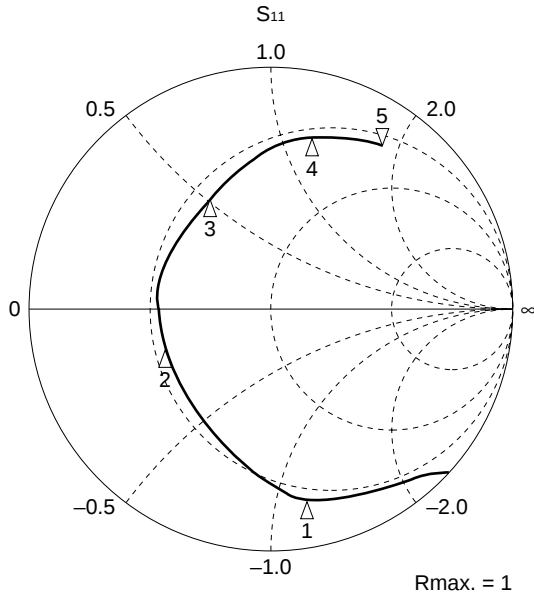
$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad \Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$$

# S-PARAMETERS

$V_{DS} = 2\text{ V}$ ,  $I_D = 15\text{ mA}$

START 2 GHz, STOP 18 GHz, STEP 500 Mhz

Marker  
1: 4 GHz  
2: 8 GHz  
3: 12 GHz  
4: 16 GHz  
5: 18 GHz



**S-Parameters****MAG. AND ANG.****V<sub>DS</sub> = 2 V, I<sub>D</sub> = 15 mA**

| FREQUENCY<br>MHz | S <sub>11</sub> |                | S <sub>21</sub> |                | S <sub>12</sub> |                | S <sub>22</sub> |                |
|------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
|                  | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) | MAG.            | ANG.<br>(deg.) |
| 2000             | .998            | -41.7          | 7.162           | 140.1          | .042            | 68.4           | .415            | -27.5          |
| 2500             | .927            | -47.5          | 6.856           | 133.6          | .050            | 65.9           | .479            | -35.8          |
| 3000             | .860            | -61.3          | 6.603           | 122.0          | .057            | 57.5           | .423            | -43.0          |
| 3500             | .829            | -69.9          | 6.305           | 114.4          | .064            | 54.1           | .429            | -47.9          |
| 4000             | .802            | -79.2          | 6.033           | 106.8          | .071            | 49.6           | .426            | -51.7          |
| 4500             | .716            | -87.5          | 5.687           | 98.5           | .075            | 45.8           | .406            | -56.2          |
| 5000             | .659            | -93.9          | 5.415           | 91.6           | .081            | 41.1           | .394            | -59.7          |
| 5500             | .601            | -99.7          | 5.184           | 84.7           | .085            | 38.9           | .374            | -63.3          |
| 6000             | .592            | -108.5         | 5.050           | 77.6           | .091            | 35.2           | .340            | -68.1          |
| 6500             | .550            | -118.5         | 4.912           | 70.5           | .096            | 30.8           | .311            | -73.0          |
| 7000             | .514            | -130.2         | 4.774           | 63.0           | .102            | 27.3           | .279            | -79.1          |
| 7500             | .488            | -144.5         | 4.600           | 55.4           | .107            | 22.0           | .232            | -87.5          |
| 8000             | .464            | -158.9         | 4.401           | 47.9           | .109            | 18.6           | .189            | -97.7          |
| 8500             | .463            | -171.7         | 4.187           | 41.0           | .113            | 14.9           | .155            | -109.3         |
| 9000             | .468            | 176.6          | 3.997           | 34.1           | .114            | 11.5           | .134            | -126.9         |
| 9500             | .472            | 166.4          | 3.812           | 27.7           | .118            | 7.7            | .121            | -142.8         |
| 10000            | .472            | 156.2          | 3.628           | 21.5           | .119            | 4.7            | .111            | -156.2         |
| 10500            | .476            | 147.0          | 3.477           | 15.6           | .122            | 1.0            | .103            | -170.1         |
| 11000            | .476            | 137.8          | 3.351           | 9.6            | .124            | -2.5           | .098            | 174.4          |
| 11500            | .488            | 127.7          | 3.251           | 3.5            | .125            | -5.8           | .093            | 157.9          |
| 12000            | .518            | 118.1          | 3.150           | -2.9           | .128            | -9.2           | .105            | 137.6          |
| 12500            | .552            | 109.6          | 3.036           | -9.7           | .130            | -12.9          | .131            | 121.0          |
| 13000            | .593            | 101.9          | 2.875           | -16.4          | .131            | -16.7          | .177            | 107.0          |
| 13500            | .635            | 95.2           | 2.714           | -22.7          | .129            | -21.2          | .223            | 97.8           |
| 14000            | .661            | 90.1           | 2.546           | -28.1          | .126            | -22.5          | .259            | 91.0           |
| 14500            | .688            | 86.1           | 2.418           | -32.6          | .124            | -24.9          | .284            | 87.0           |
| 15000            | .707            | 82.2           | 2.327           | -37.0          | .127            | -27.4          | .316            | 86.0           |
| 15500            | .719            | 79.7           | 2.240           | -41.8          | .126            | -28.8          | .332            | 83.3           |
| 16000            | .730            | 76.1           | 2.168           | -46.8          | .129            | -31.6          | .352            | 81.7           |
| 16500            | .752            | 71.3           | 2.100           | -52.7          | .131            | -33.2          | .380            | 77.4           |
| 17000            | .771            | 65.5           | 2.021           | -58.4          | .130            | -38.5          | .398            | 72.4           |
| 17500            | .803            | 60.4           | 1.930           | -65.1          | .134            | -42.2          | .422            | 66.5           |
| 18000            | .817            | 55.7           | 1.814           | -70.5          | .128            | -44.3          | .445            | 62.9           |

## AMP. PARAMETERS

 $V_{DS} = 2\text{ V}$ ,  $I_D = 15\text{ mA}$ 

| FREQUENCY | GUmax | GAmax | $ S_{21} ^2$ | $ S_{12} ^2$ | K    | Delay | Mason's U | G1    | G2   |
|-----------|-------|-------|--------------|--------------|------|-------|-----------|-------|------|
| MHz       | dB    | dB    | dB           | dB           |      | ns    | dB        | dB    | dB   |
| 2000      | 41.82 |       | 17.10        | -27.61       | .10  | .036  |           | 23.90 | .82  |
| 2500      | 26.36 |       | 16.72        | -26.05       | .23  | .036  |           | 8.50  | 1.13 |
| 3000      | 23.09 |       | 16.39        | -24.82       | .39  | .064  |           | 5.83  | .86  |
| 3500      | 21.91 |       | 15.99        | -23.94       | .42  | .042  |           | 5.04  | .88  |
| 4000      | 20.95 |       | 15.61        | -22.95       | .45  | .042  |           | 4.47  | .87  |
| 4500      | 19.00 |       | 15.10        | -22.49       | .60  | .046  |           | 3.12  | .78  |
| 5000      | 17.88 |       | 14.67        | -21.87       | .69  | .038  | 27.689    | 2.47  | .73  |
| 5500      | 16.89 |       | 14.29        | -21.41       | .78  | .038  | 25.567    | 1.94  | .65  |
| 6000      | 16.47 |       | 14.07        | -20.78       | .79  | .039  | 27.520    | 1.87  | .54  |
| 6500      | 15.83 |       | 13.83        | -20.36       | .84  | .040  | 25.660    | 1.56  | .44  |
| 7000      | 15.26 |       | 13.58        | -19.85       | .87  | .041  | 25.850    | 1.33  | .35  |
| 7500      | 14.68 |       | 13.25        | -19.40       | .91  | .043  | 24.669    | 1.18  | .24  |
| 8000      | 14.08 |       | 12.87        | -19.24       | .96  | .041  | 23.510    | 1.05  | .16  |
| 8500      | 13.59 |       | 12.44        | -18.94       | .98  | .039  | 23.291    | 1.05  | .11  |
| 9000      | 13.19 | 15.01 | 12.03        | -18.84       | 1.00 | .038  | 23.059    | 1.08  | .08  |
| 9500      | 12.78 | 14.21 | 11.62        | -18.57       | 1.02 | .036  | 22.736    | 1.09  | .06  |
| 10000     | 12.34 | 13.37 | 11.19        | -18.48       | 1.06 | .034  | 21.540    | 1.09  | .05  |
| 10500     | 11.99 | 12.86 | 10.82        | -18.28       | 1.08 | .033  | 20.889    | 1.12  | .05  |
| 11000     | 11.66 | 12.36 | 10.50        | -18.14       | 1.10 | .033  | 19.984    | 1.12  | .04  |
| 11500     | 11.46 | 12.06 | 10.24        | -18.05       | 1.12 | .034  | 19.642    | 1.18  | .04  |
| 12000     | 11.37 | 11.98 | 9.97         | -17.83       | 1.10 | .035  | 20.331    | 1.36  | .05  |
| 12500     | 11.30 | 11.92 | 9.65         | -17.73       | 1.08 | .038  | 20.980    | 1.58  | .08  |
| 13000     | 11.19 | 11.79 | 9.17         | -17.63       | 1.07 | .037  | 21.543    | 1.88  | .14  |
| 13500     | 11.14 | 11.70 | 8.67         | -17.81       | 1.06 | .035  | 21.748    | 2.25  | .22  |
| 14000     | 10.92 | 11.29 | 8.12         | -17.97       | 1.08 | .030  | 20.156    | 2.50  | .30  |
| 14500     | 10.82 | 11.17 | 7.67         | -18.12       | 1.08 | .025  | 19.965    | 2.79  | .37  |
| 15000     | 10.80 | 11.30 | 7.33         | -17.94       | 1.05 | .025  | 21.257    | 3.00  | .46  |
| 15500     | 10.67 | 11.20 | 7.01         | -17.99       | 1.04 | .027  | 20.523    | 3.15  | .51  |
| 16000     | 10.60 | 11.55 | 6.72         | -17.76       | 1.01 | .028  | 21.974    | 3.30  | .58  |
| 16500     | 10.74 |       | 6.45         | -17.68       | .98  | .033  | 22.748    | 3.62  | .68  |
| 17000     | 10.78 |       | 6.11         | -17.72       | .96  | .032  | 25.818    | 3.92  | .75  |
| 17500     | 11.05 |       | 5.71         | -17.46       | .89  | .037  |           | 4.49  | .85  |
| 18000     | 10.92 |       | 5.17         | -17.88       | .91  | .030  | 27.860    | 4.78  | .96  |

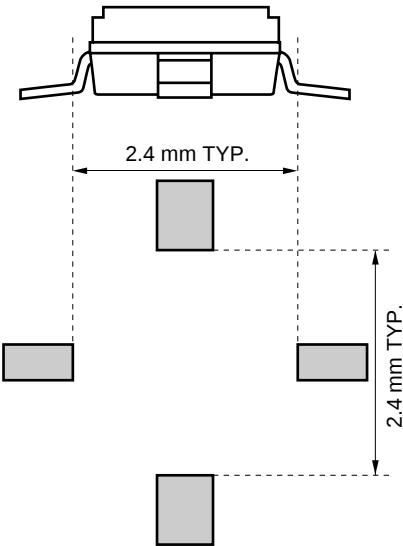
Noise Parameters

<Noise Parameters>

$V_{DS} = 2 \text{ V}$ ,  $I_D = 15 \text{ mA}$

| Freq (GHz) | NF <sub>min</sub> (dB) | Ga (dB) | $\Gamma_{opt}$ |             | R <sub>n</sub> /50 |
|------------|------------------------|---------|----------------|-------------|--------------------|
|            |                        |         | MAG.           | ANG. (deg.) |                    |
| 2.0        | 0.32                   | 16.5    | 0.77           | 15          | 0.19               |
| 4.0        | 0.35                   | 15.5    | 0.58           | 43          | 0.18               |
| 6.0        | 0.40                   | 14.2    | 0.43           | 82          | 0.13               |
| 8.0        | 0.46                   | 13.1    | 0.32           | 127         | 0.08               |
| 10.0       | 0.56                   | 12.0    | 0.27           | 175         | 0.07               |
| 12.0       | 0.67                   | 10.9    | 0.27           | -139        | 0.10               |
| 14.0       | 0.80                   | 9.9     | 0.34           | -100        | 0.17               |
| 16.0       | 0.94                   | 8.9     | 0.48           | -70         | 0.29               |
| 18.0       | 1.10                   | 8.0     | 0.69           | -56         | 0.46               |

TYPICAL MOUNT PAD LAYOUT



**RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see table below) must be met when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

**<TYPES OF SURFACE MOUNT DEVICE>**

For more details, refer to our document "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (C10535E)

| Soldering process      | Soldering conditions                                                                                                                                         | Symbol  |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Infrared ray reflow    | Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1, Exposure limit*: None | IR30-00 |
| Partial heating method | Terminal temperature: 230 °C or below, Flow time: 10 seconds or below, Exposure limit*: None                                                                 |         |

\*: Exposure limit before soldering after dry-pack package is opened.

Storage conditions: 25 °C and relative humidity at 65 % or less.

**Note:** Do not apply more than a single process at once, except for "Partial heating method".

**PRECAUTION:** Avoid high static voltage and electric fields, because this device is Hetero Junction field effect transistor with shottky barrier gate.

[MEMO]

[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.