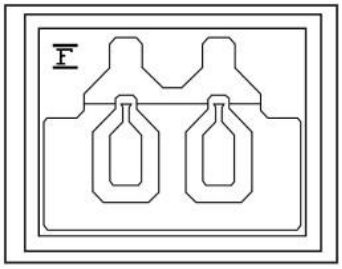
# FHX13X, FHX14X

## GaAs HEMT Chips

### FEATURES

- Low Noise Figure: 0.45dB (Typ.)@f=12GHz (FHX13)
- High Associated Gain: 13.0dB (Typ.)@f=12GHz
- Lg ≤ 0.15um, Wg = 200um
- Gold Gate Metallization for High Reliability



### DESCRIPTION

The FHX13X, FHX14X are Super High Electron Mobility Transistor (SuperHEMT™) intended for general purpose, ultra-low noise and high gain amplifiers in the 2 to 18GHz frequency range. The devices are well suited for telecommunication, DBS, TVRO, VSAT or other low noise applications.
Sumitomo Electric stringent Quality Assurance Program assures the highest reliability and consistent performance.

**ABSOLUTE MAXIMUM RATING (Ambient Temperature Ta=25deg.C)**

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 3.5 | V |
| Gate-Source Voltage | $V_{GS}$ | -3.0 | V |
| Total Power Dissipation | $P_{t*}$ | 180 | mW |
| Storage Temperature | $T_{stg}$ | -65 to +175 | deg.C |
| Channel Temperature | $T_{ch}$ | 175 | deg.C |

*Note: Mounted on $Al_2O_3$ board (30 x 30 x 0.65mm)

Sumitomo Electric recommends the following conditions for the reliable operation of GaAs FETs:

1. The drain-source operating voltage ($V_{DS}$) should not exceed 2 volts.
2. The forward and reverse gate currents should not exceed 0.2 and -0.05mA respectively with gate resistance of 4000ohm.
3. The operating channel temperature ($T_{ch}$) should not exceed 80deg.C.

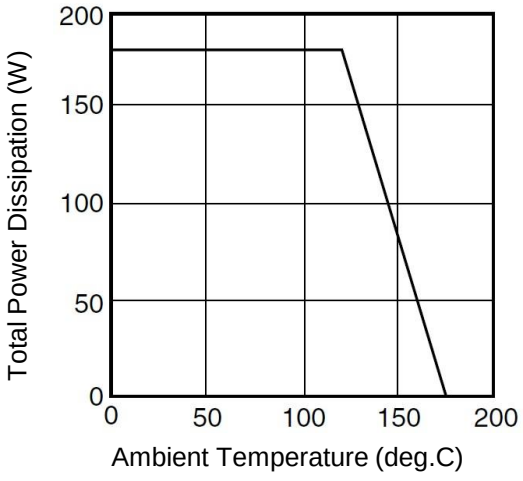
**ELECTRICAL CHARACTERISTICS (Ambient Temperature Ta=25deg.C)**

| Item | | Symbol | Test Conditions | Limit | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Saturated Drain Current | | $I_{DSS}$ | $V_{DS}$ = 2V, $V_{GS}$ = 0V | 10 | 30 | 60 | mA |
| Transconductance | | gm | $V_{DS}$ = 2V, $I_{DS}$ = 10mA | 35 | 50 | - | mS |
| Pinch-off Voltage | | Vp | $V_{DS}$ = 2V, $I_{DS}$ = 1mA | -0.1 | -0.7 | -1.5 | V |
| Gate Source Breakdown Voltage | | $V_{GSO}$ | $I_{GS}$ = -10uA | -3.0 | - | - | V |
| Noise Figure | FHX13X | NF | $V_{DS}$ = 2V, $I_{DS}$ = 10mA, f = 12GHz | - | 0.45 | 0.50 | dB |
| Associated Gain | FHX13X | $G_{as}$ | $V_{DS}$ = 2V, $I_{DS}$ = 10mA, f = 12GHz | 11.0 | 13.0 | - | dB |
| Noise Figure | FHX14X | NF | $V_{DS}$ = 2V, $I_{DS}$ = 10mA, f = 12GHz | - | 0.55 | 0.60 | dB |
| Associated Gain | FHX14X | $G_{as}$ | $V_{DS}$ = 2V, $I_{DS}$ = 10mA, f = 12GHz | 11.0 | 13.0 | - | dB |
| Thermal Resistance | | $R_{th}$ | Channel to Case | - | 220 | 300 | deg.C/W |

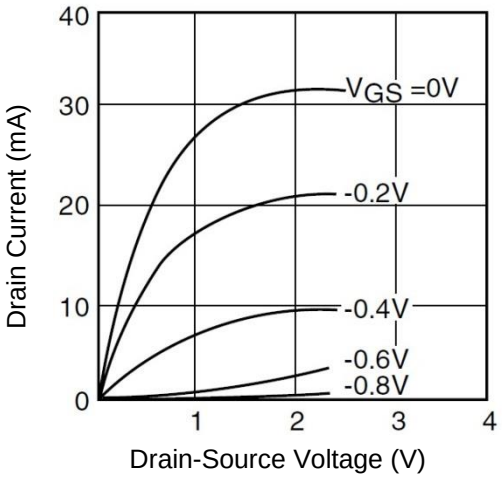
**Note:** RF parameter sample size 10pcs. criteria (accept/reject)=(2/3)
The chip must be enclosed in a hermetically sealed environment for optimum performance and reliability.

| RoHS Compliance | Yes |
|---|---|

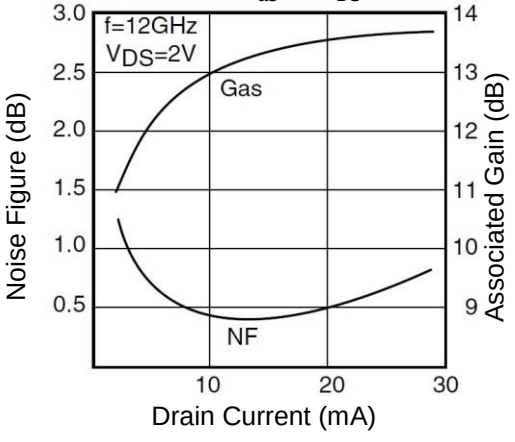
### POWER DERATING CURVE



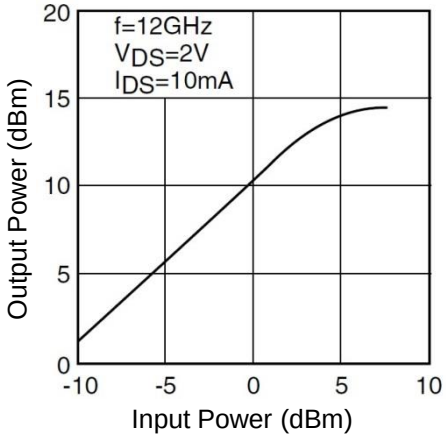

### DRAIN CURRENT vs. DRAIN-SOURCE VOLTAGE




### NF & $G_{as}$ vs. $I_{DS}$




### OUTPUT POWER vs. INPUT POWER

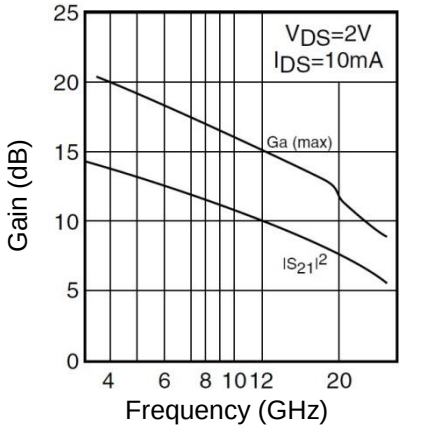


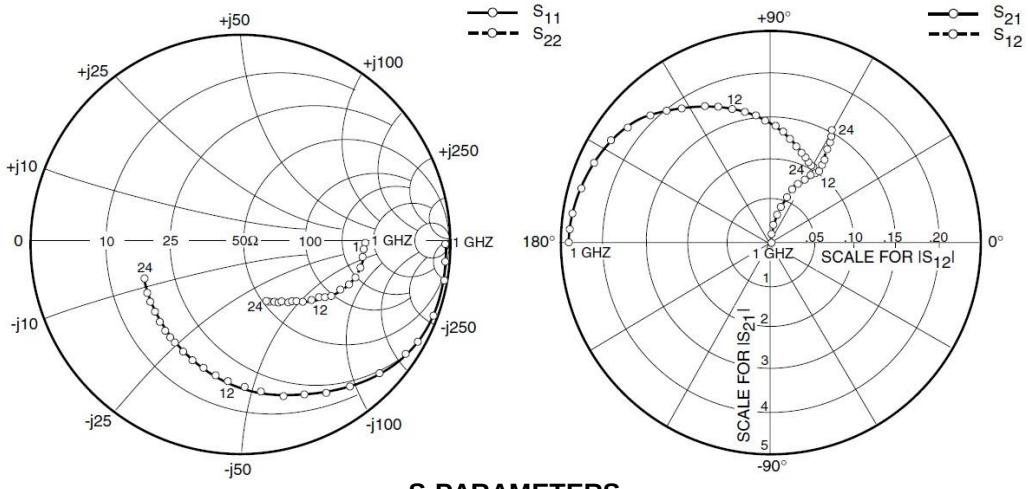

### NOISE PARAMETERS

$V_{DS}$ = 2V, $I_{DS}$ = 10mA

| Freq. (GHz) | Γ opt (MAG) | Γ opt (ANG) | NFmin (dB) | Rn/50 |
|---|---|---|---|---|
| 2 | 0.92 | 13 | 0.28 | 0.65 |
| 4 | 0.84 | 25 | 0.30 | 0.54 |
| 6 | 0.77 | 38 | 0.32 | 0.41 |
| 8 | 0.71 | 51 | 0.34 | 0.31 |
| 10 | 0.66 | 65 | 0.39 | 0.23 |
| 12 | 0.61 | 79 | 0.45 | 0.17 |
| 14 | 0.58 | 93 | 0.56 | 0.12 |
| 16 | 0.56 | 108 | 0.68 | 0.09 |
| 18 | 0.54 | 122 | 0.86 | 0.07 |
| 20 | 0.52 | 136 | 1.03 | 0.07 |
| 22 | 0.50 | 150 | 1.22 | 0.07 |
| 24 | 0.46 | 162 | 1.43 | 0.07 |

### $G_a$(max) & $|S_{21}|^2$ vs. FREQUENCY






## S-PARAMETERS

$V_{DS}$ = 2V, $I_{DS}$ = 10mA

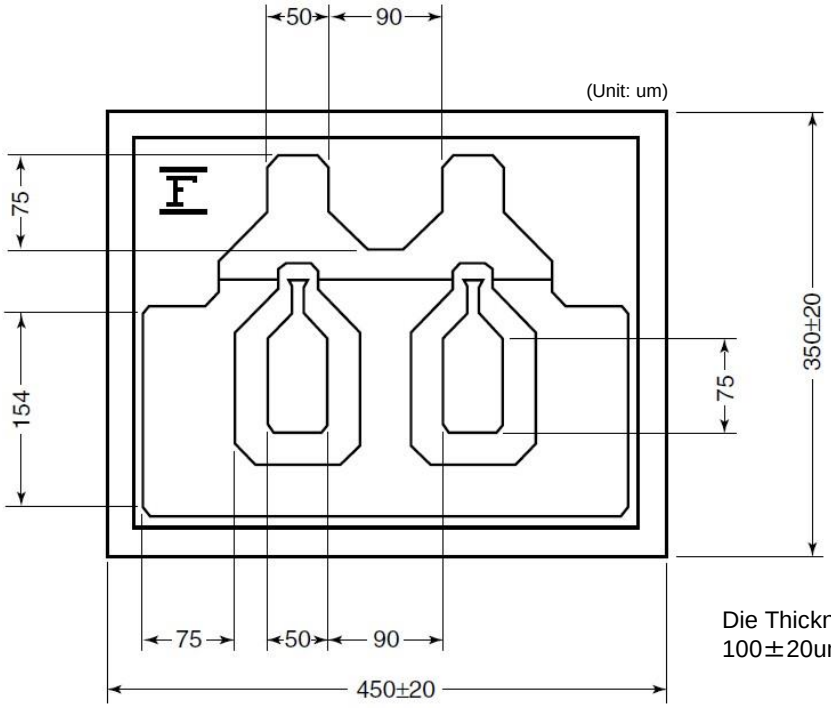
| Freq | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| (MHz) | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100 | 1.000 | -0.9 | 4.899 | 179.2 | 0.001 | 89.5 | 0.601 | -0.5 |
| 500 | 0.999 | -4.7 | 4.894 | 175.9 | 0.006 | 87.7 | 0.601 | -2.3 |
| 1000 | 0.995 | -9.4 | 4.876 | 171.9 | 0.013 | 85.5 | 0.599 | -4.6 |
| 2000 | 0.981 | -18.6 | 4.806 | 163.9 | 0.025 | 81.1 | 0.591 | -9.2 |
| 3000 | 0.958 | -27.7 | 4.696 | 156.1 | 0.037 | 77.0 | 0.580 | -13.5 |
| 4000 | 0.929 | -36.4 | 4.555 | 148.6 | 0.048 | 73.2 | 0.565 | -17.7 |
| 5000 | 0.895 | -44.9 | 4.392 | 141.5 | 0.057 | 69.8 | 0.548 | -21.5 |
| 6000 | 0.860 | -53.0 | 4.215 | 134.8 | 0.066 | 66.8 | 0.530 | -25.0 |
| 7000 | 0.823 | -60.7 | 4.034 | 128.4 | 0.074 | 64.2 | 0.512 | -28.3 |
| 8000 | 0.786 | -68.1 | 3.852 | 122.4 | 0.080 | 62.0 | 0.493 | -31.3 |
| 9000 | 0.751 | -75.3 | 3.675 | 116.8 | 0.086 | 60.2 | 0.475 | -34.0 |
| 10000 | 0.718 | -82.1 | 3.506 | 111.5 | 0.092 | 58.9 | 0.458 | -36.6 |
| 11000 | 0.687 | -88.7 | 3.345 | 106.5 | 0.096 | 57.8 | 0.442 | -39.0 |
| 12000 | 0.659 | -95.0 | 3.194 | 101.8 | 0.101 | 57.1 | 0.426 | -41.3 |
| 13000 | 0.633 | -101.2 | 3.054 | 97.3 | 0.105 | 56.6 | 0.412 | -43.6 |
| 14000 | 0.610 | -107.2 | 2.923 | 93.0 | 0.108 | 56.4 | 0.399 | -45.8 |
| 15000 | 0.590 | -113.0 | 2.801 | 88.9 | 0.112 | 56.4 | 0.386 | -47.9 |
| 16000 | 0.572 | -118.7 | 2.688 | 85.0 | 0.116 | 56.6 | 0.375 | -50.1 |
| 17000 | 0.556 | -124.2 | 2.584 | 81.3 | 0.120 | 56.9 | 0.364 | -52.3 |
| 18000 | 0.543 | -129.6 | 2.487 | 77.7 | 0.124 | 57.3 | 0.353 | -54.6 |
| 19000 | 0.532 | -134.9 | 2.397 | 74.2 | 0.129 | 57.8 | 0.344 | -56.9 |
| 20000 | 0.523 | -140.0 | 2.314 | 70.8 | 0.133 | 58.4 | 0.335 | -59.4 |
| 21000 | 0.516 | -145.0 | 2.236 | 67.5 | 0.138 | 58.9 | 0.326 | -62.0 |
| 22000 | 0.511 | -149.8 | 2.164 | 64.4 | 0.144 | 59.5 | 0.318 | -64.7 |
| 23000 | 0.507 | -154.6 | 2.096 | 61.3 | 0.150 | 60.0 | 0.310 | -67.5 |
| 24000 | 0.505 | -159.2 | 2.033 | 58.3 | 0.156 | 60.5 | 0.303 | -70.5 |

NOTE:* The data includes bonding wires.

n: number of wires

| | |
|---|---|
| Gate | n=2 (0.3mm length, 20um Dia Au wire) |
| Drain | n=2 (0.3mm length, 20um Dia Au wire) |
| Source | n=4 (0.3mm length, 20um Dia Au wire) |

## CHIP OUTLINE




Die Thickness:
100±20um

## ■ BARE DIE INDEMNIFICATION

**All devices are DC probed and visually inspected at SEI, and non-compliant devices are removed. The RF electrical characteristics of the bare dice are warranted by the sampling inspection procedures. The standard sampling inspection procedure shall include the number of the sampling dice, position of the sampling dice in the wafer and RF electrical characteristics of the sampling dice measured in the test fixture. Customer shall understand that all the bare dice will not be 100% RF tested by SEI. It is the customer responsibility to verify performance of the devices.**

**Customer shall comply with the storage and handling requirements for condition and period of storage of the bare dice agreed by customer and SEI. Warranty will not apply when customer disregards the storage and handling requirements.**

**Warranty will not apply to the electrical characteristics and product quality to the bare dice after assembly by customer.**

**SEI will indemnify customer for warranty failures, provided however that the indemnification to customer shall be limited to supply of bare dice for substitution.**

**CAUTION**

Sumitomo Electric Device Innovations, Inc. products contain **gallium arsenide (GaAs)** which can be hazardous to the human body and the environment. For safety, observe the following procedures:

・Do not put these products into the mouth.

・Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.

・Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.