SONY

# CXG1130AER

## Triple Low Noise Amplifier/Dual Mixer

### Description

The CXG1130AER is a triple low noise amplifier/dual mixer. This IC is designed using the Sony's GaAs J-FET process.

### Features

- Single 3V power supply operation
- 2-pin control by the on-chip logic circuit
- High gain: Gp = 16.5dB (LNA typ.)
  Gc = 10dB (MIX typ.)
- Low noise figure: NF = 1.5 to 1.6dB (LNA typ.)
  NF = 4.5dB (MIX typ.)
- Low LO input power operation
- 24-pin VQFN small package

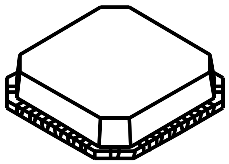
### Applications

800MHz/1.5GHz Japan digital cellular phones (PDC)

### Structure

GaAs J-FET MMIC

24 pin VQFN (Plastic)



### Absolute Maximum Ratings (Ta = 25°C)

| | | | |
|---|---|---|---|
| • Supply voltage | $V_{DD}$ | 4.5 | V |
| • Input power | $P_{IN}$ | +13 | dBm |
| • Current consumption | $I_{DD}$ | 15 | mA |
| • Operating temperature | Topr | –35 to +85 | °C |
| • Storage temperature | Tstg | –65 to +150 | °C |

### Recommended Operating Conditions

| | | | |
|---|---|---|---|
| • Supply voltage | $V_{DD}$ | 2.7 to 3.3 | V |
| • Control voltage | $V_{CTL}$ (H) | 2.4 to 3.3 | V |
| | $V_{CTL}$ (L) | 0 to 0.3 | V |

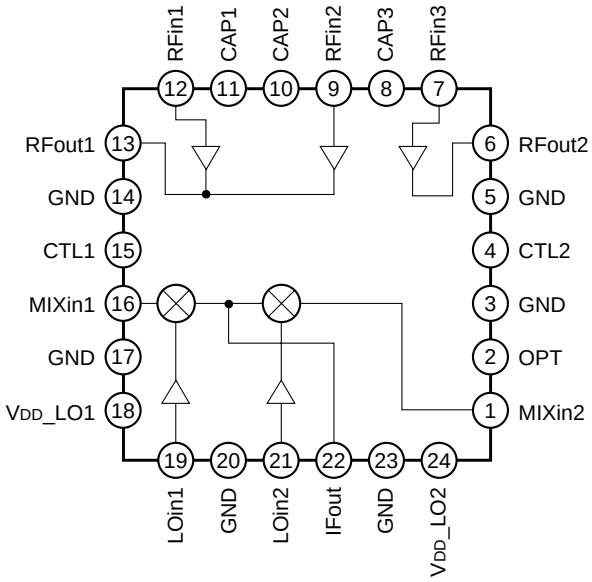
GaAs MMICs are ESD sensitive devices. Special handling precautions are required.



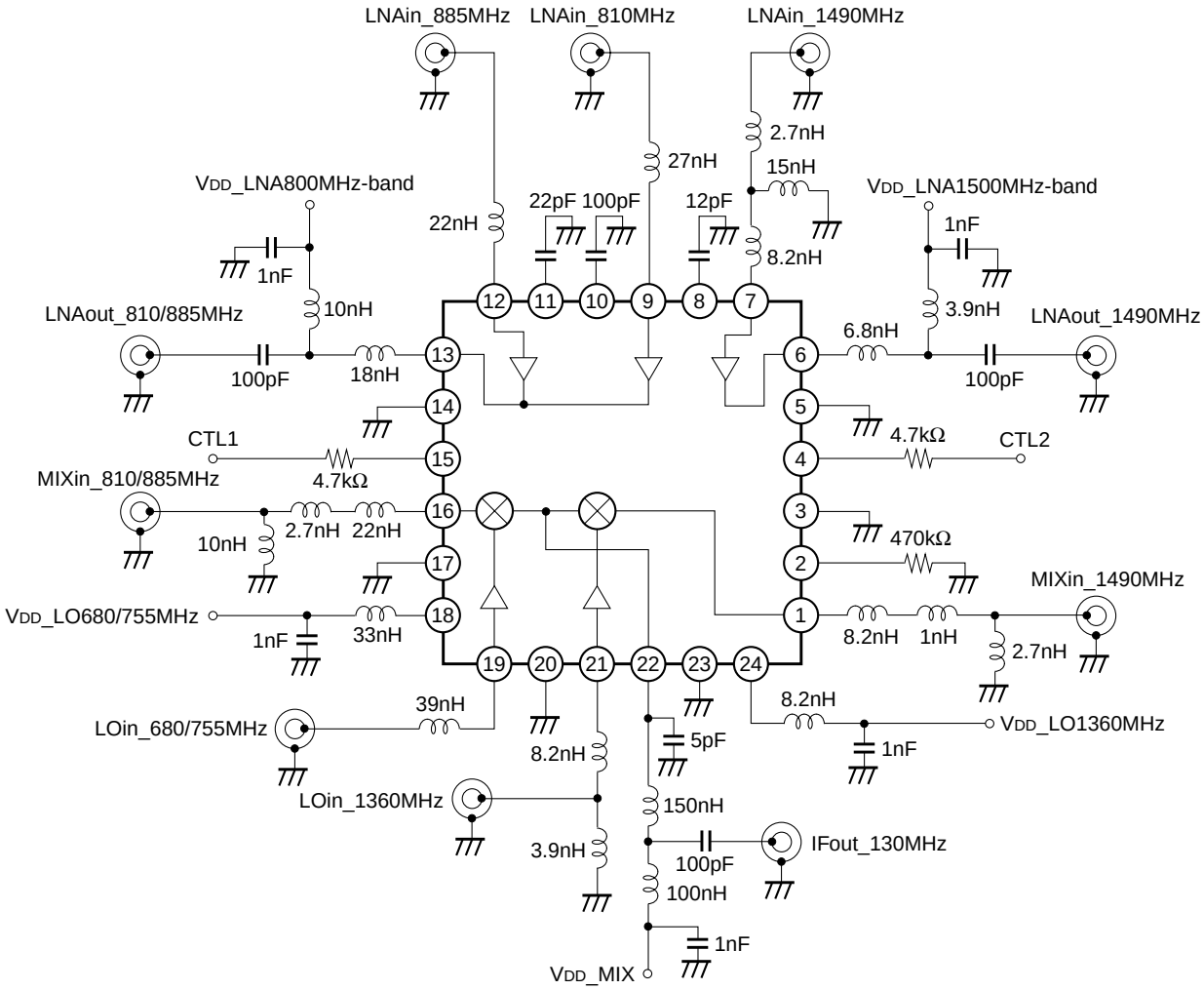


E01827-PS

## Block Diagram and Pin Configuration




## Recommended Evaluation Circuit



**Electrical Characteristics**

The normalized values are those when the Sony's recommended evaluation board is used.

**800MHz Band Low Noise Amplifier**

Conditions: Unless otherwise specified, $V_{DD}$ = 3.0V, $V_{CTL}$ (H) = 3.0V, $V_{CTL}$ (L) = 0V, $f_{RF}1$ = 885MHz, $f_{RF}2$ = 810MHz

(Ta = 25°C)

| Item | Symbol | Path | Frequency | $V_{CTL}1$ | $V_{CTL}2$ | Min. | Typ. | Max. | Unit | Measurement condition |
|---|---|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | — | — | H | L | — | 2.0 | 2.65 | mA | When no signal |
| | | | — | L | L | — | 2.0 | 2.65 | | |
| Control current | $I_{CTL}1$ | — | — | H | L | — | 60 | 90 | µA | |
| | | | — | L | L | –5 | 0 | 5 | | |
| Power gain | Gp | $RF_{IN}1 \rightarrow RF_{OUT}1$ | $f_{RF}1$ | H | L | 14.5 | 16.5 | 18.5 | dB | When a small signal |
| | | | | L | L | — | –20 | –15 | | |
| | | $RF_{IN}2 \rightarrow RF_{OUT}1$ | $f_{RF}2$ | H | L | — | –25 | –20 | | |
| | | | | L | L | 14.5 | 16.5 | 18.5 | | |
| Noise figure | NF | $RF_{IN}1 \rightarrow RF_{OUT}1$ | $f_{RF}1$ | H | L | — | 1.3 | 2.0 | dB | |
| | | $RF_{IN}2 \rightarrow RF_{OUT}1$ | $f_{RF}2$ | L | L | — | 1.5 | 2.0 | | |
| Input IP3 | IIP3 | $RF_{IN}1 \rightarrow RF_{OUT}1$ | $f_{RF}1$ | H | L | –10 | –6.5 | — | dBm | *1 |
| | | $RF_{IN}2 \rightarrow RF_{OUT}1$ | $f_{RF}2$ | L | L | –11 | –8 | — | | |
| Isolation | $I_{SO}$ | $RF_{OUT}1 \rightarrow RF_{IN}1$ | $f_{RF}1$ | H | L | 22 | 26 | — | dB | When a small signal |
| | | $RF_{OUT}1 \rightarrow RF_{IN}2$ | $f_{RF}2$ | L | L | 18 | 22 | — | | |

*1 Conversion from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –30dBm.

**1.5GHz Band Low Noise Amplifier**

Conditions: Unless otherwise specified, $V_{DD}$ = 3.0V, $V_{CTL}$ (H) = 3.0V, $V_{CTL}$ (L) = 0V, $f_{RF}3$ = 1490MHz

(Ta = 25°C)

| Item | Symbol | Path | Frequency | $V_{CTL}1$ | $V_{CTL}2$ | Min. | Typ. | Max. | Unit | Measurement condition |
|---|---|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | — | — | — | H | — | 2.9 | 3.7 | mA | When no signal |
| Control current | $I_{CTL}2$ | — | — | — | H | — | 90 | 120 | µA | |
| Power gain | Gp | $RF_{IN}3 \rightarrow RF_{OUT}2$ | $f_{RF}3$ | — | H | 14 | 16 | 18 | dB | When a small signal |
| Noise figure | NF | $RF_{IN}3 \rightarrow RF_{OUT}2$ | $f_{RF}3$ | — | H | — | 1.6 | 2.1 | dB | |
| Input IP3 | IIP3 | $RF_{IN}3 \rightarrow RF_{OUT}2$ | $f_{RF}3$ | — | H | –9 | –6 | — | dBm | *1 |
| Isolation | $I_{SO}$ | $RF_{OUT}2 \rightarrow RF_{IN}3$ | $f_{RF}3$ | — | H | 20 | 23 | — | dB | When a small signal |

*1 Conversion from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –30dBm.

**800MHz Band Mixer**

Conditions: Unless otherwise specified, $V_{DD}$ = 3.0V, $V_{CTL}$ (H) = 3.0V, $V_{CTL}$ (L) = 0V,
$f_{RF}1$ = 885MHz, $f_{RF}2$ = 810MHz, $f_{LO} = f_{RF} - 130$MHz, $P_{LO}$ = –15dBm
(Ta = 25°C)

| Item | Symbol | RF frequency | $V_{CTL}1$ | $V_{CTL}2$ | Min. | Typ. | Max. | Unit | Measurement condition |
|---|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | — | — | L | — | 5 | 6.5 | mA | When no signal |
| Control current | $I_{CTL}2$ | — | — | L | –5 | 0 | 5 | µA | |
| Conversion gain | Gc | $f_{RF}1$ | — | L | 9 | 10 | 11.5 | dB | When a small signal |
| | | $f_{RF}2$ | — | L | 8.5 | 9.5 | 11 | | |
| Noise figure | NF | $f_{RF}1$ | — | L | — | 5 | 6.5 | dB | |
| | | $f_{RF}2$ | — | L | — | 4 | 5.5 | | |
| Input IP3 | IIP3 | $f_{RF}1$ | — | L | –1 | +2 | — | dBm | *1 |
| | | $f_{RF}2$ | — | L | –0.5 | +2.5 | — | | |
| LO → RF leak | Plk | $f_{RF}1$ | — | L | — | –21 | –18 | dBm | $f_{LO}$ = 755MHz |
| | | $f_{RF}2$ | — | L | — | –24 | –21 | | $f_{LO}$ = 680MHz |

*1 Conversion from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –25dBm.

**1.5GHz Band Mixer**

Conditions: Unless otherwise specified, $V_{DD}$ = 3.0V, $V_{CTL}$ (H) = 3.0V, $V_{CTL}$ (L) = 0V,
$f_{RF}3$ = 1490MHz, $f_{LO}$ = 1360MHz, $P_{LO}$ = –15dBm (Ta = 25°C)

| Item | Symbol | RF frequency | $V_{CTL}1$ | $V_{CTL}2$ | Min. | Typ. | Max. | Unit | Measurement condition |
|---|---|---|---|---|---|---|---|---|---|
| Current consumption | $I_{DD}$ | — | — | H | — | 5.5 | 7.5 | mA | When no signal |
| Control current | $I_{CTL}2$ | — | — | H | — | 90 | 120 | µA | |
| Conversion gain | Gc | $f_{RF}3$ | — | H | 9 | 10 | 11.5 | dB | When a small signal |
| Noise figure | NF | $f_{RF}3$ | — | H | — | 4.5 | 6 | dB | |
| Input IP3 | IIP3 | $f_{RF}3$ | — | H | –1 | +2 | — | dBm | *1 |
| LO → RF leak | Plk | $f_{RF}3$ | — | H | — | –24 | –21 | dBm | $f_{LO}$ = 1360MHz |

*1 Conversion from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –25dBm.

**Operation Logic**

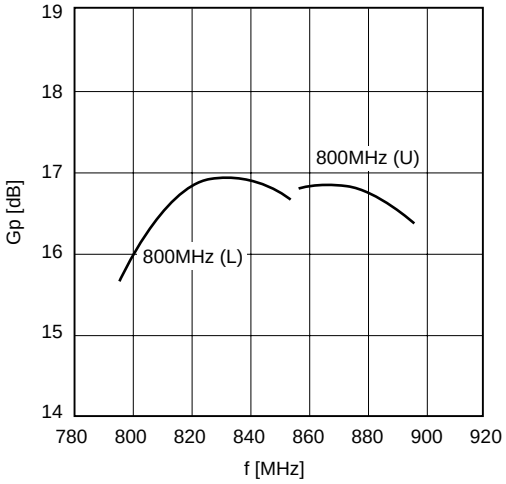
| $V_{CTL}1$ | $V_{CTL}2$ | LNA1 (800MHz_U) | LNA2 (800MHz_L) | LNA3 (1.5GHz) | MIX1 (800MHz) | MIX2 (1.5GHz) |
|---|---|---|---|---|---|---|
| H | L | ON | OFF | OFF | ON | OFF |
| L | L | OFF | ON | OFF | ON | OFF |
| — | H | OFF | OFF | ON | OFF | ON |

## Example of Representative Characteristics

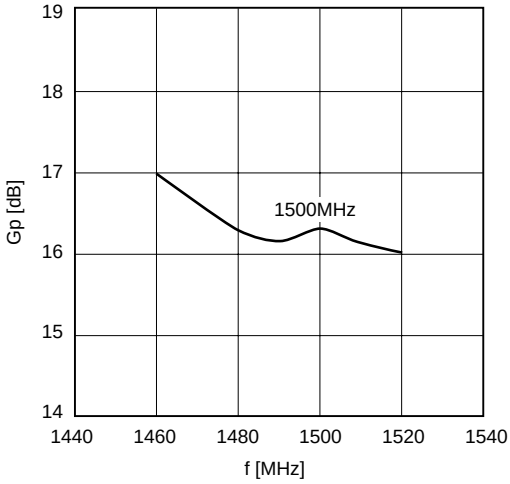
### 1. CXG1130AER frequency characteristics of main items in LNA block (25°C)

[Condition] $V_{DD}$ = 3V, 800MHz_L (Pin 9 input → Pin 13 output): $V_{CTL}1$ = 0V, $V_{CTL}2$ = 0V,
800MHz_U (Pin 12 input → Pin 13 output): $V_{CTL}1$ = 3V, $V_{CTL}2$ = 0V,
1500MHz (Pin 7 input → Pin 6 output): $V_{CTL}2$ = 3V
Gp and NF are those when a small signal is input. The input IP3 is converted from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –30dBm.

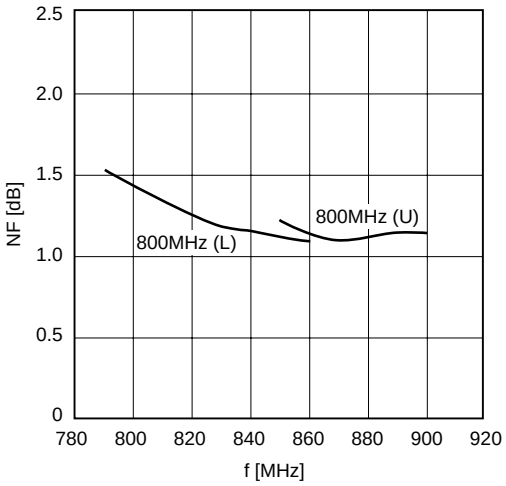
**Power gain Gp**



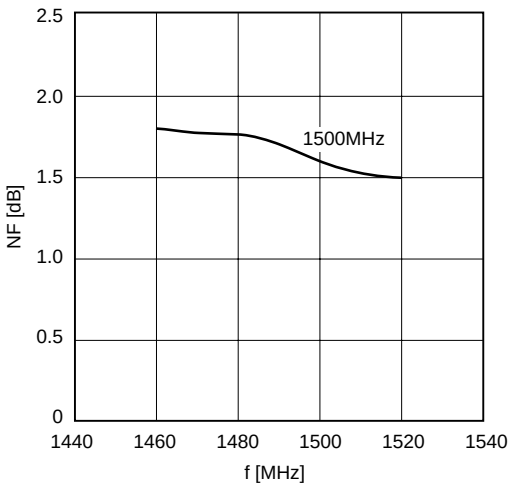

**Power gain Gp**



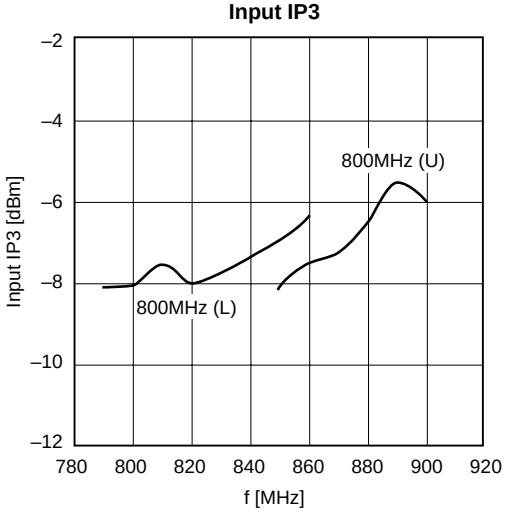

**Noise figure NF**



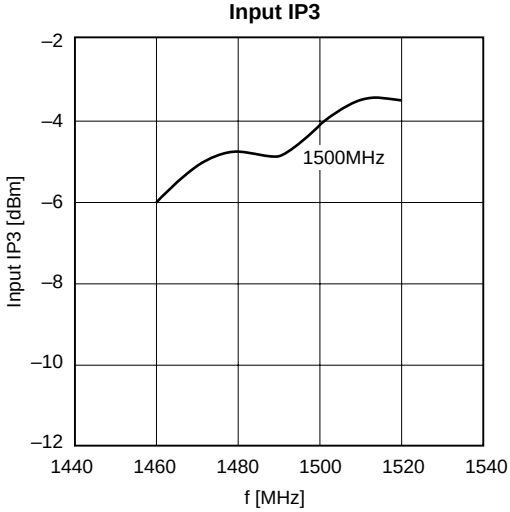

**Noise figure NF**




**Input IP3**



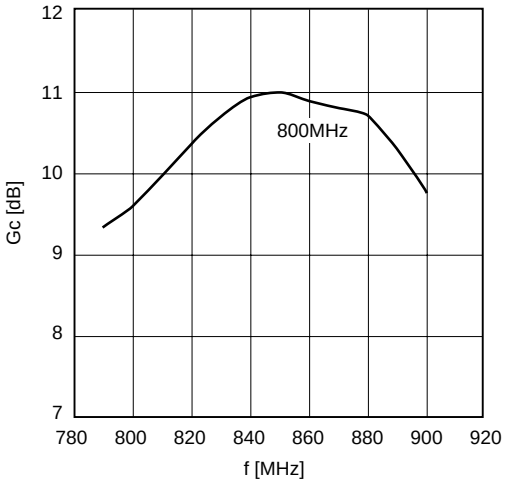

**Input IP3**



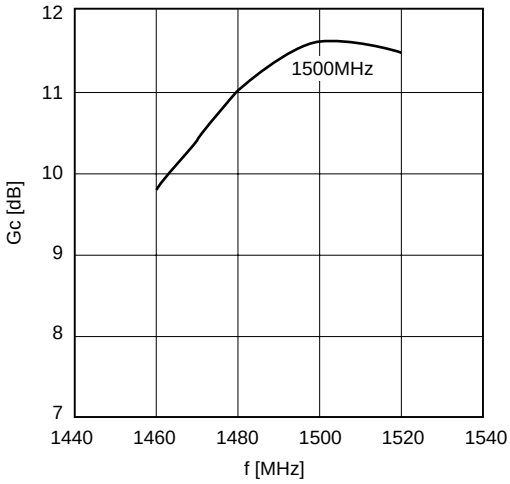
**2. CXG1130AER frequency characteristics of main items in MIX block (25°C)**

[Condition] $V_{DD}$ = 3V, $f_{LO} = f_{RF}$ – 130MHz, $P_{LO}$ = –15dBm, 800MHz: $V_{CTL}2$ = 0V, 1500MHz: $V_{CTL}2$ = 3V
Gc and NF are those when a small signal is input. The input IP3 is converted from the IM3 suppression ratio for two-wave input: $f_{RF}$offset = 100kHz, $P_{RF}$ = –25dBm.

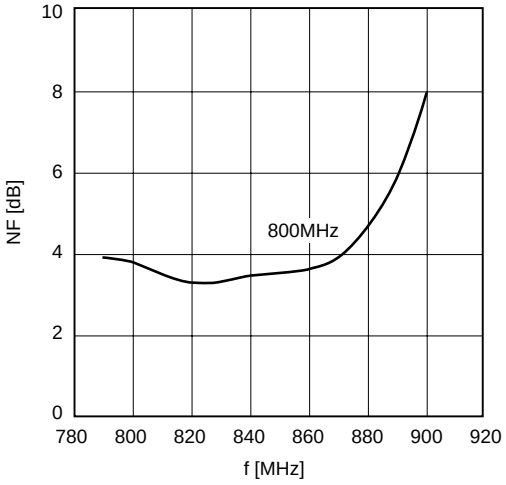
**Conversion gain Gc**



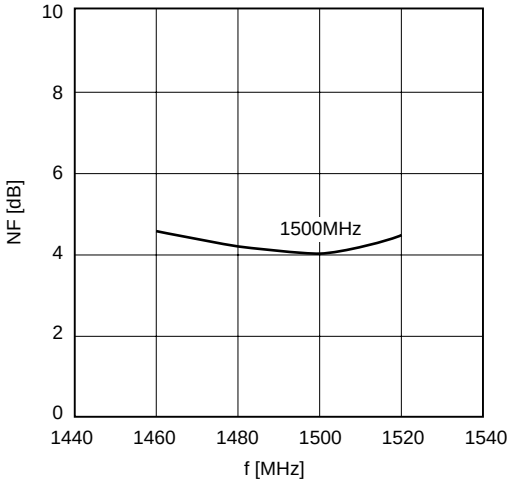

**Conversion gain Gc**



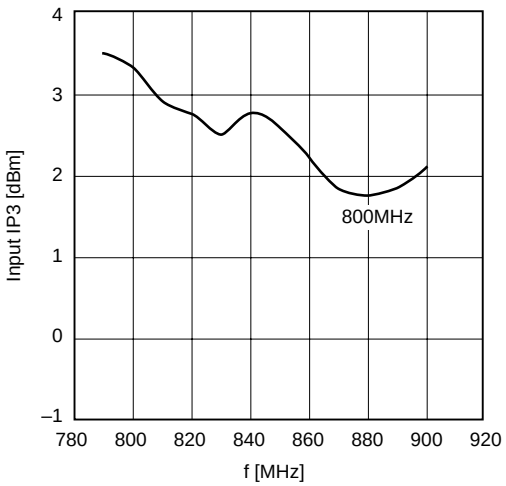

**Noise figure NF**



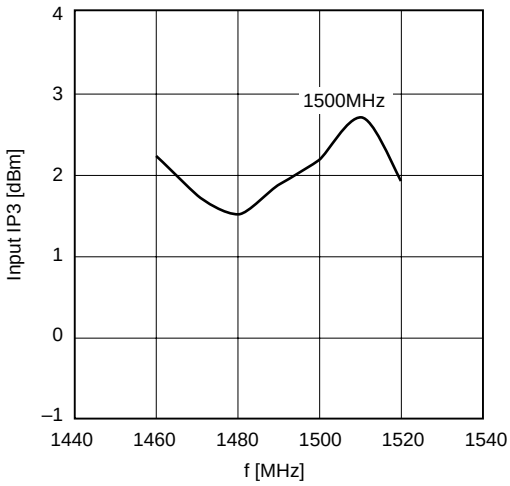

**Noise figure NF**



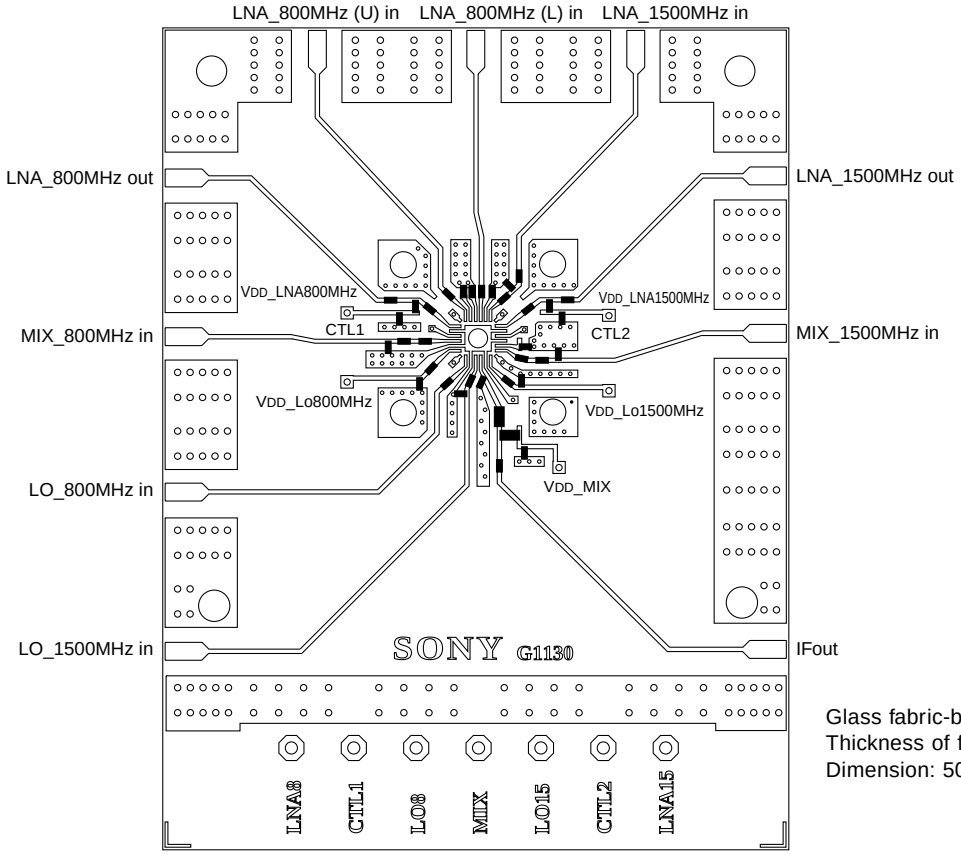

**Input IP3**




**Input IP3**

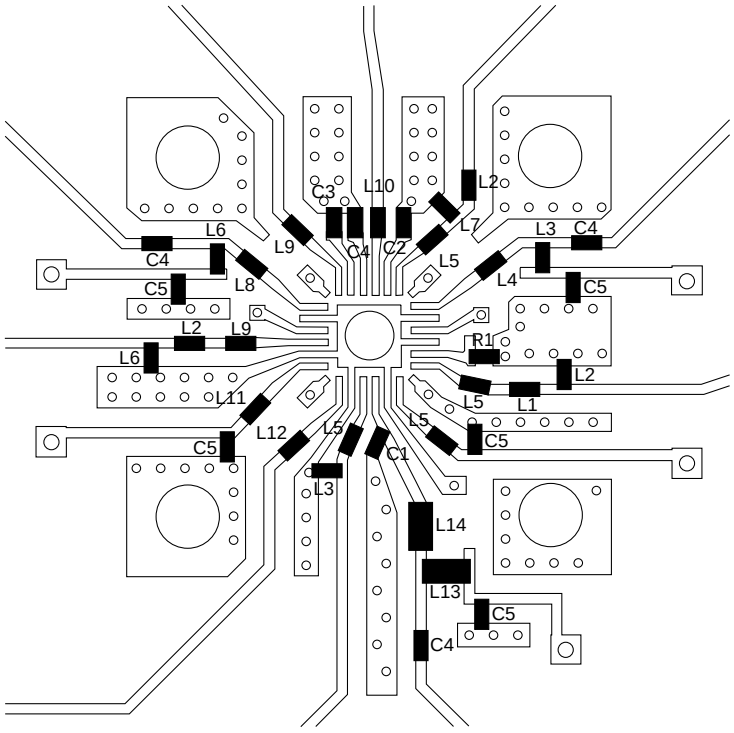


## Recommended Evaluation Board




Glass fabric-base 4-layer epoxy board
Thickness of film between layers 1 and 2: 0.2mm
Dimension: 50mm × 66mm

## Enlarged Diagram of External Circuit Block

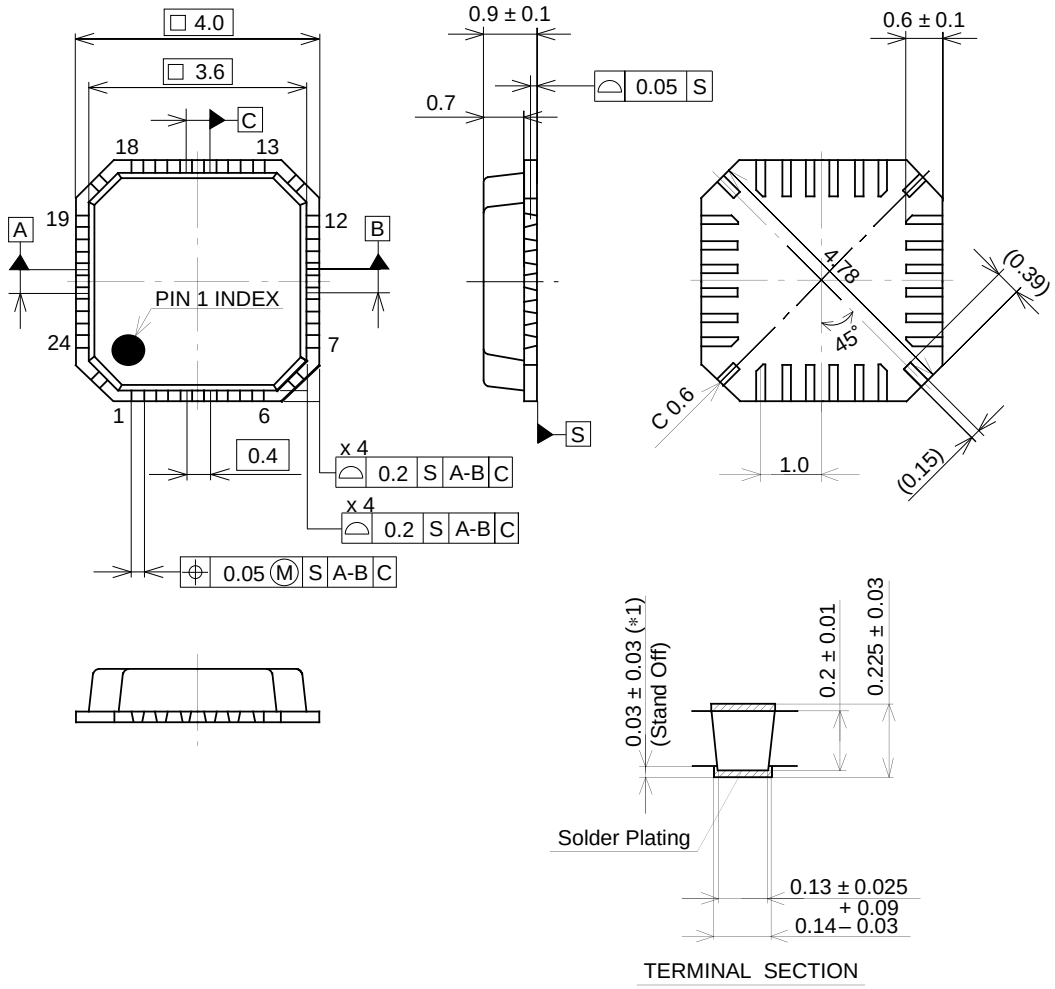



| | |
|---|---|
| L1 = 1nH | C1 = 5pF |
| L2 = 2.7nH | C2 = 12pF |
| L3 = 3.9nH | C3 = 22pF |
| L4 = 6.8nH | C4 = 100pF |
| L5 = 8.2nH | C5 = 1nF |
| L6 = 10nH | |
| L7 = 15nH | R1 = 470Ω |
| L8 = 18nH | |
| L9 = 22nH | |
| L10 = 27nH | |
| L11 = 33nH | |
| L12 = 39nH | |
| L13 = 100nH | |
| L14 = 150nH | |

Series resistors of 4.7kΩ to CTL1 and CTL2 are attached on the solder side of the board.

**Package Outline** Unit: mm

24PIN VQFN(PLASTIC)




PACKAGE STRUCTURE

| | |
|---|---|
| PACKAGE MATERIAL | EPOXY RESIN |
| LEAD TREATMENT | SOLDER PLATING |
| LEAD MATERIAL | COPPER ALLOY |
| PACKAGE MASS | 0.04g |

| | |
|---|---|
| SONY CODE | VQFN-24P-03 |
| EIAJ CODE | ———— |
| JEDEC CODE | ———— |

**LEAD SPECIFICATIONS**

| ITEM | SPEC. |
|---|---|
| LEAD MATERIAL | COPPER ALLOY |
| SOLDER PLATING | Sn-Bi Bi:1-4wt% |
| LEAD TREATMENT THICKNESS | 5-18µm |