

## GNSS Front-End Module

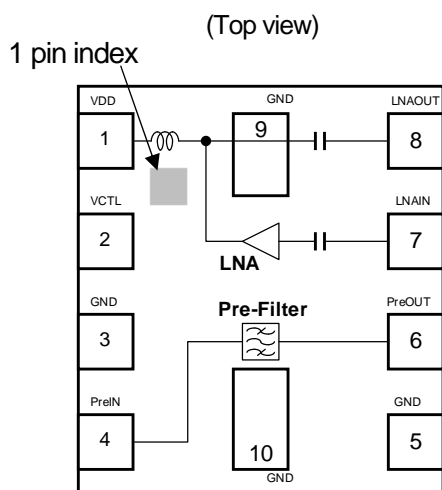
### ■ FEATURES

- AEC-Q100 grade 2 qualified
- Low supply voltage 2.8V typ.
- Low current consumption 3.7mA typ.
- High gain 16.0dB typ.
- Low noise figure
  - 1.50dB typ. @f=1575MHz
  - 1.65dB typ. @f=1597 to 1606MHz
  - 1.70dB typ. @f=1559 to 1591MHz
- High out band rejection
  - 55dBc typ. @f=704 to 915MHz, relative to 1575MHz
  - 43dBc typ. @f=1710 to 1980MHz, relative to 1575MHz
  - 51dBc typ. @f=2400 to 2500MHz, relative to 1575MHz
- Integrated pre-SAW filter and LNA
- Small package size
  - HFFP10-HH 1.5mmx1.1mm (typ.), t=0.5mm (max.)
- RoHS compliant and Halogen Free, MSL1

### ■ APPLICATION

- GNSS application for automotive
- GNSS active antenna

### ■ BLOCK DIAGRAM (HFFP10-HH)



### ■ GENERAL DESCRIPTION

The NJG1159PHH-A is a front-end module (FEM) designed for GNSS including GPS, GLONASS, BeiDou, and Galileo applications. This FEM offers low noise figure, high linearity, and high out-band rejection characteristics brought by included high performance pre-SAW filter and low noise amplifier (LNA). The stand-by mode contributes to reduce current consumption.

Its wide operating temperature range from -40 to +105°C is suitable for automotive application.

This FEM is suitable for small size application by included one SAW filter, only two external components, and very small package HFFP10-HH that is 1.5x1.1mm.

### ■ TRUTH TABLE

"H"= $V_{CTL(H)}$ , "L"= $V_{CTL(L)}$

$V_{CTL}$	Mode
H	Active mode
L	Stand-by mode

### ■ PIN CONFIGURATION

PIN NO.	SYMBOL	DESCRIPTION
1	VDD	Supply voltage terminal
2	VCTL	Control voltage terminal
3	GND	Ground terminal
4	PreIN	RF input terminal to Pre-SAW filter
5	GND	Ground terminal
6	PreOUT	RF output terminal from Pre-SAW filter
7	LNAIN	RF input terminal to LNA
8	LNAOUT	RF output terminal from LNA
9	GND	Ground terminal
10	GND	Ground terminal

## ■ PRODUCT NAME INFORMATION

<u>NJG1159</u>	<u>PHH</u>	<u>-A</u>	<u>(TE1)</u>
		L L L	L
Part number	Package	Automotive	Taping form

## ■ ORDERING INFORMATION

PART NUMBER	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs.)
NJG1159PHH-A	HFFP10-HH	Yes	Yes	Au	59A	4.6	3,000

## ■ ABSOLUTE MAXIMUM RATINGS

$T_a=+25^{\circ}\text{C}$ ,  $Z_s=Z_L=50\Omega$

PARAMETER	SYMBOL	RATINGS	UNIT
Supply voltage	$V_{DD}$	5.0	V
Control voltage	$V_{CTL}$	5.0	V
Input power	$P_{IN}(\text{inband})^{(1)}$	+10	dBm
	$P_{IN}(\text{outband})^{(2)}$	+25	dBm
Power dissipation	$P_D^{(3)}$	560	mW
Operating temperature	$T_{opr}$	-40 to +105	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-40 to +110	$^{\circ}\text{C}$

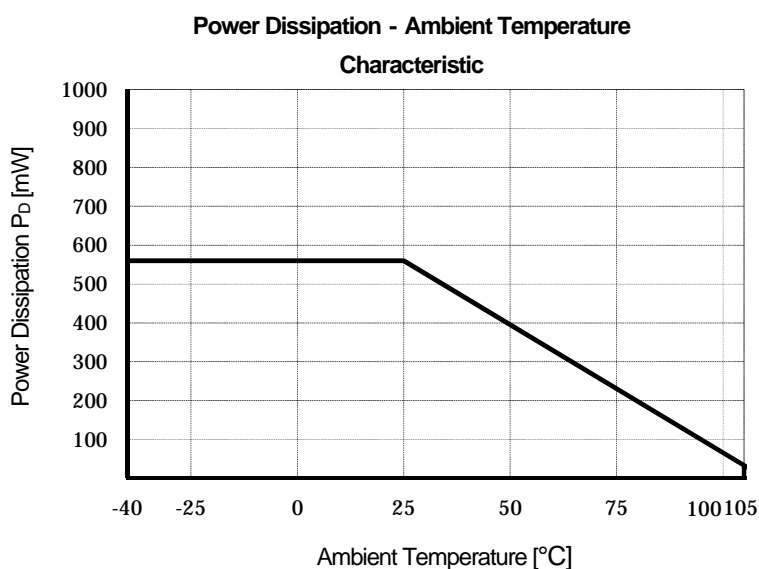
(1):  $V_{DD}=2.8\text{V}$ ,  $f=1575, 1597$  to  $1606, 1559$  to  $1591\text{MHz}$

(2):  $V_{DD}=2.8\text{V}$ ,  $f=50$  to  $1460, 1710$  to  $4000\text{MHz}$

(3): 4-layer FR4 PCB without through-hole (101.5x114.5mm),  $T_J=110^{\circ}\text{C}$

## ■ POWER DISSIPATION VS.AMBIENT TEMPERATURE

Please note small non-lead package generally has low thermal dissipation characteristic, attention is recommended in designing of thermal radiation.



## ■ ELECTRICAL CHARACTERISTICS 1 (DC)

(General conditions:  $T_a = 25^\circ\text{C}$ , with application circuit)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	$V_{DD}$		1.5	2.8	3.3	V
Control Voltage (High)	$V_{CTL(H)}$		1.5	1.8	3.3	V
Control Voltage (Low)	$V_{CTL(L)}$		0	0	0.3	V
Supply Current 1	$I_{DD1}$	RF OFF, $V_{DD}=2.8\text{V}$ , $V_{CTL}=1.8\text{V}$	-	3.7	6.5	mA
Supply Current 2	$I_{DD2}$	RF OFF, $V_{DD}=2.8\text{V}$ , $V_{CTL}=0\text{V}$	-	0.1	5.0	$\mu\text{A}$
Control Current	$I_{CTL}$	$V_{CTL}=1.8\text{V}$	-	5.0	15.0	$\mu\text{A}$

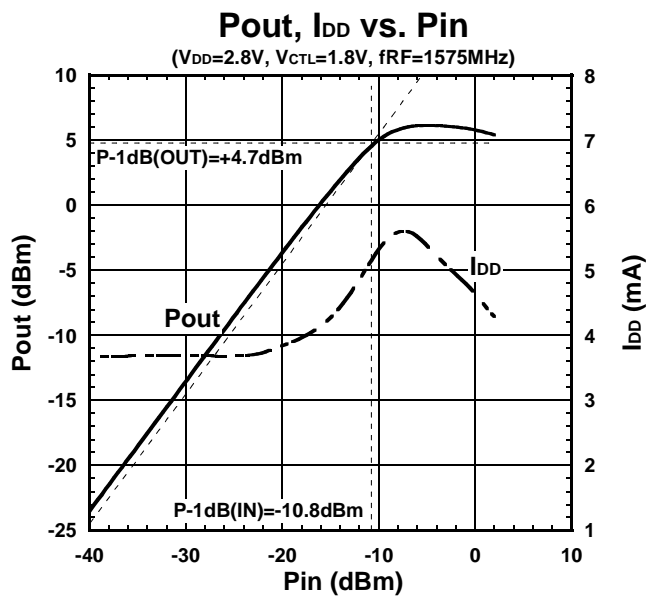
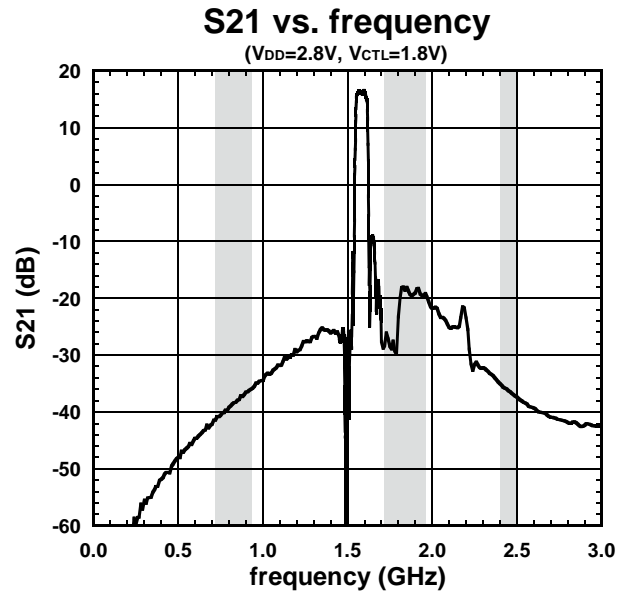
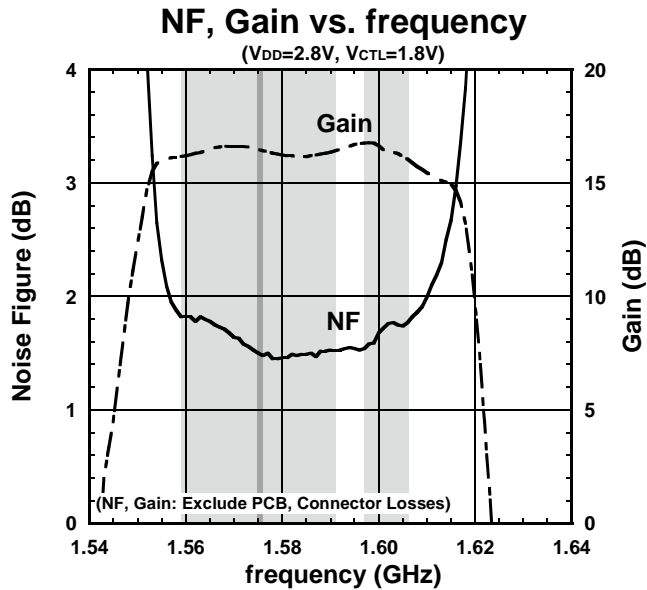
## ■ ELECTRICAL CHARACTERISTICS 2 (RF)

General conditions:  $V_{DD}=2.8\text{V}$ ,  $V_{CTL}=1.8\text{V}$ ,  $f_{RF}=1575\text{MHz}$ , 1597 to 1606MHz, 1559 to 1591MHz,  
 $T_a=+25^\circ\text{C}$ ,  $Z_s=Z_l=50\Omega$ , with application circuit

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Small Signal Gain (GPS)	GainGPS	$f=1575\text{MHz}$ (GPS) Exclude PCB, Connector Losses (0.17dB)	13.5	16.0	-	dB
Small Signal Gain (GLONASS)	GainGLN	$f=1597$ to $1606\text{MHz}$ (GLONASS) Exclude PCB, Connector Losses (0.17dB)	13.0	16.5	-	dB
Small Signal Gain (BeiDou, Galileo)	GainBG	$f=1559$ to $1591\text{MHz}$ (BeiDou, Galileo) Exclude PCB, Connector Losses (0.17dB)	13.0	16.0	-	dB
Noise Figure (GPS)	NFGPS	$f=1575\text{MHz}$ (GPS) Exclude PCB, Connector Losses (0.09dB)	-	1.50	2.35	dB
Noise Figure (GLONASS)	NFGLN	$f=1597$ to $1606\text{MHz}$ (GLONASS) Exclude PCB, Connector Losses (0.09dB)	-	1.65	2.70	dB
Noise Figure (BeiDou, Galileo)	NFBG	$f=1559$ to $1591\text{MHz}$ (BeiDou, Galileo) Exclude PCB, Connector Losses (0.09dB)	-	1.70	2.80	dB
Input Power at 1dB Gain Compression Point	P-1dB(IN)	$f=1575$ , 1597 to 1606, 1559 to 1591MHz	-15.0	-10.0	-	dBm
Low Band Rejection	BR_L	$f=704$ to $915\text{MHz}$ , relative to 1575MHz	41	55	-	dBc
High Band Rejection	BR_H	$f=1710$ to $1980\text{MHz}$ , relative to 1575MHz	23	43	-	dBc
WLAN Band Rejection	BR_W	$f=2400$ to $2500\text{MHz}$ , relative to 1575MHz	38	51	-	dBc

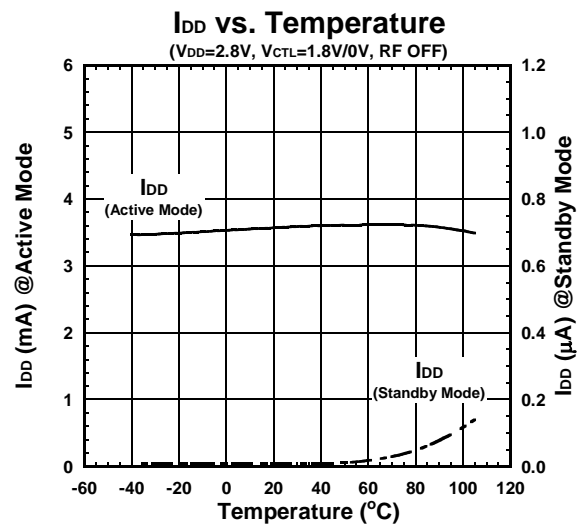
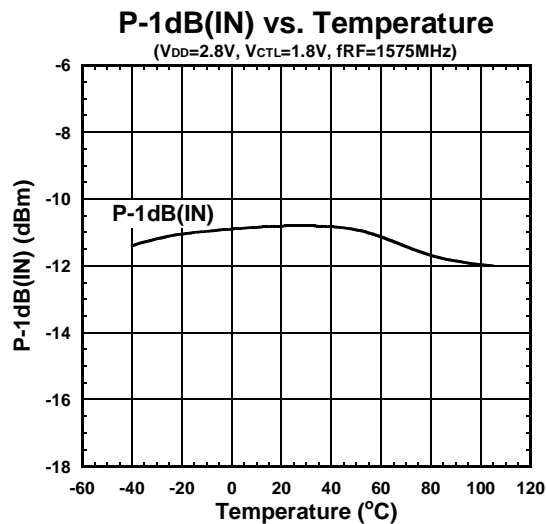
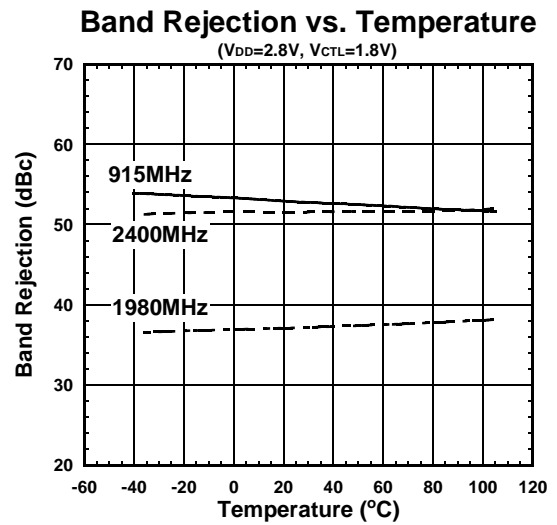
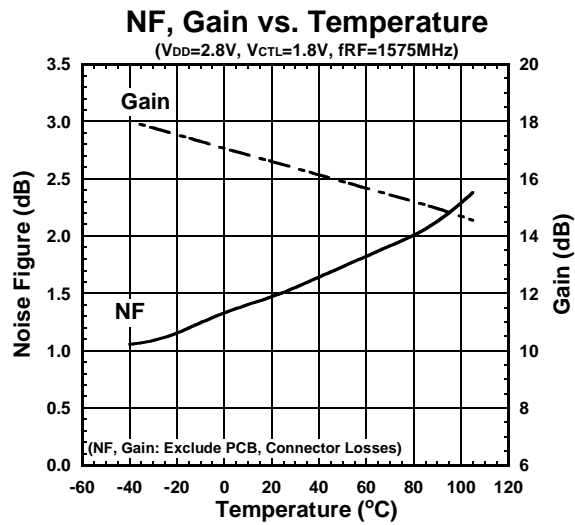
## ■ ELECTRICAL CHARACTERISTICS

Conditions:  $V_{DD}=2.8V$ ,  $V_{CTL}=1.8V$ ,  $T_a=25^\circ C$ ,  $Z_s=Z_L=50\Omega$ , with application circuit



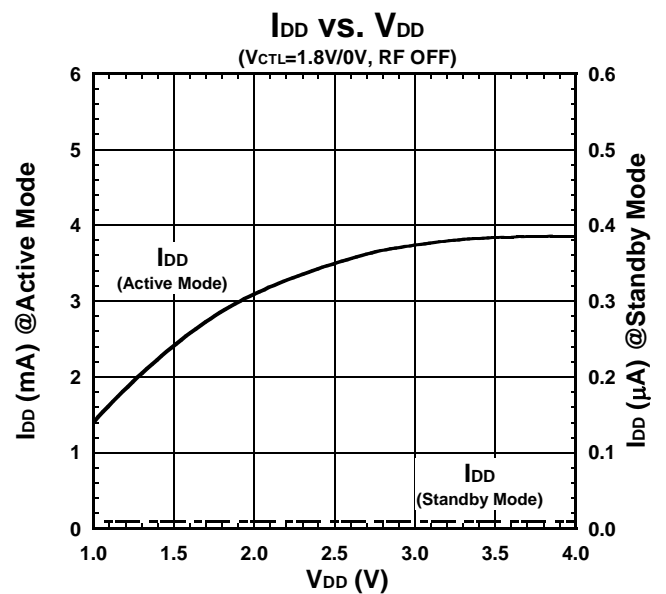
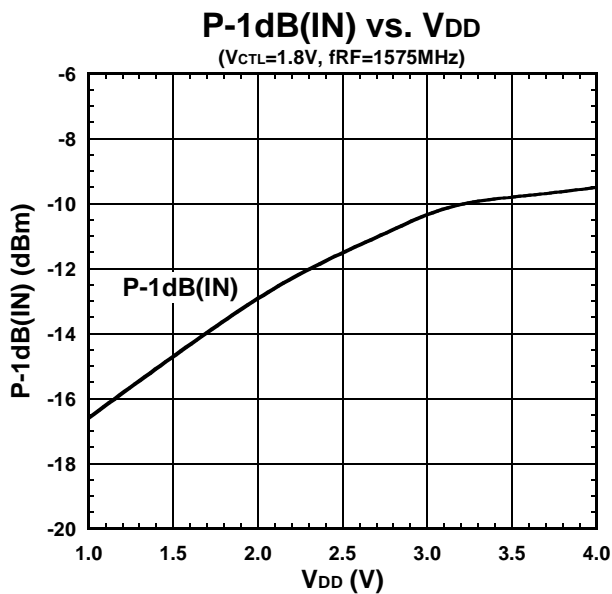
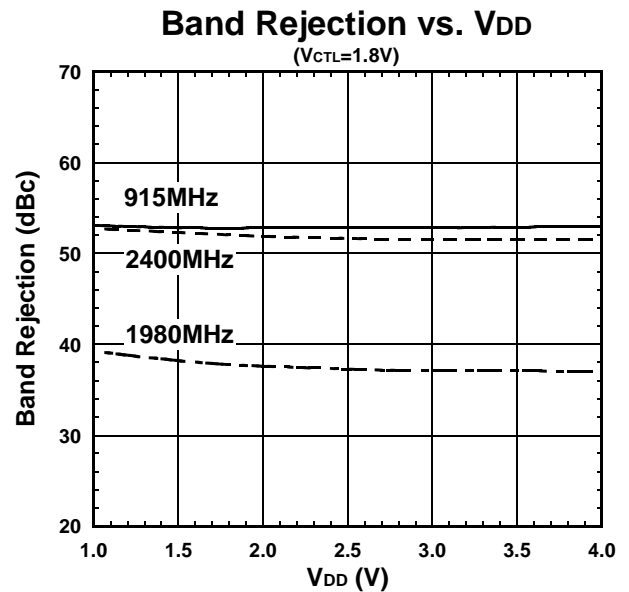
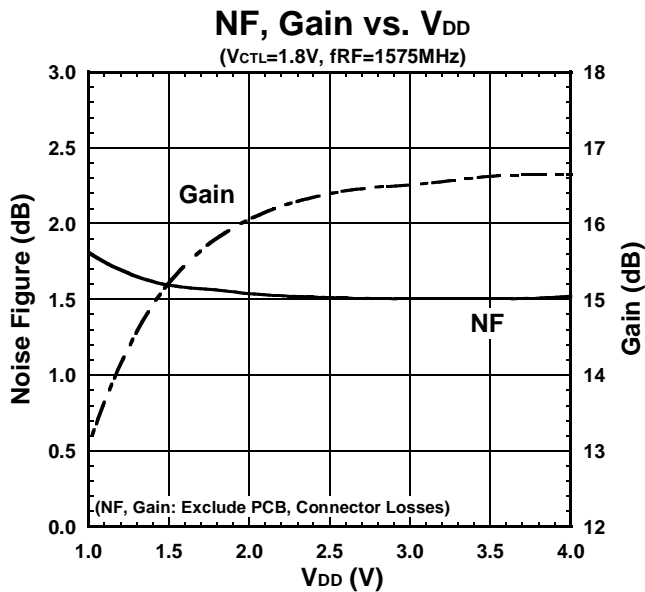
## ■ ELECTRICAL CHARACTERISTICS

Conditions:  $V_{DD}=2.8V$ ,  $V_{CTL}=1.8V$ ,  $Z_s=Z_L=50\Omega$ , with application circuit

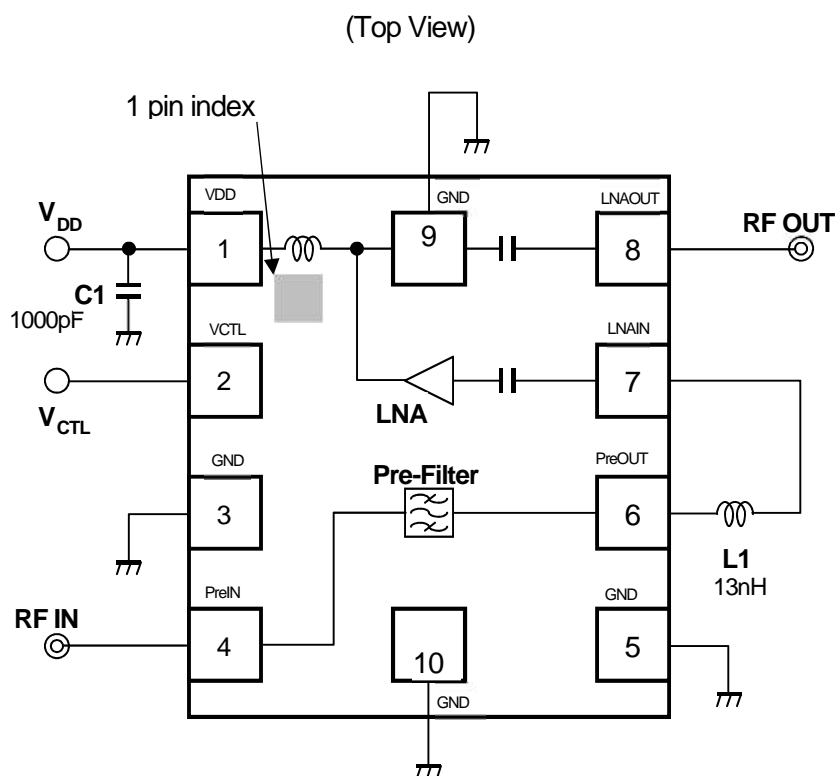


## ■ ELECTRICAL CHARACTERISTICS

Conditions:  $V_{CTL}=1.8V$ ,  $T_a=25^{\circ}C$ ,  $Z_S=Z_L=50\Omega$ , with application circuit



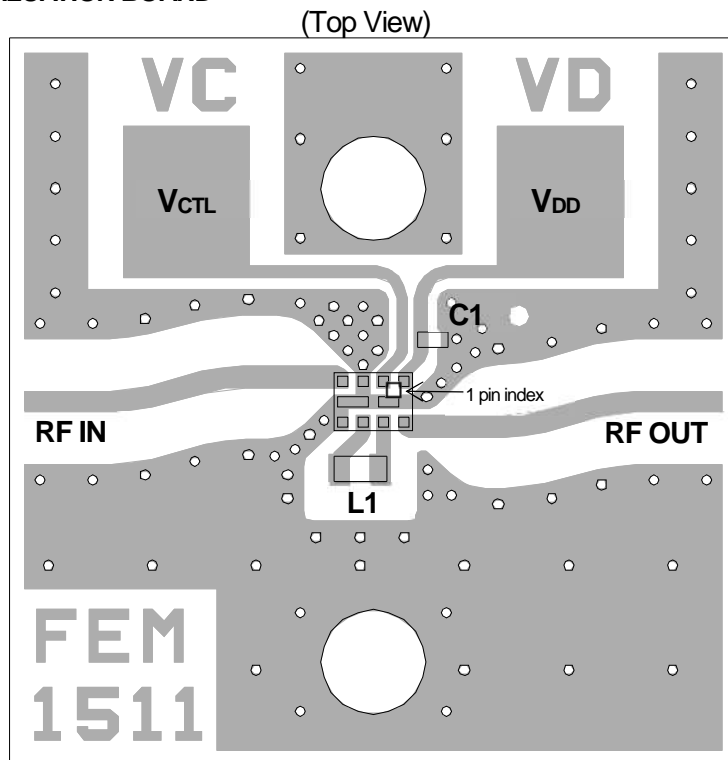
## ■ APPLICATION CIRCUIT



## <PARTS LIST>

Part ID	Note
L1	LQW15AN_00 Series (MURATA)
C1	GRM03 Series (MURATA)

## ■ EVALUATION BOARD



### PCB

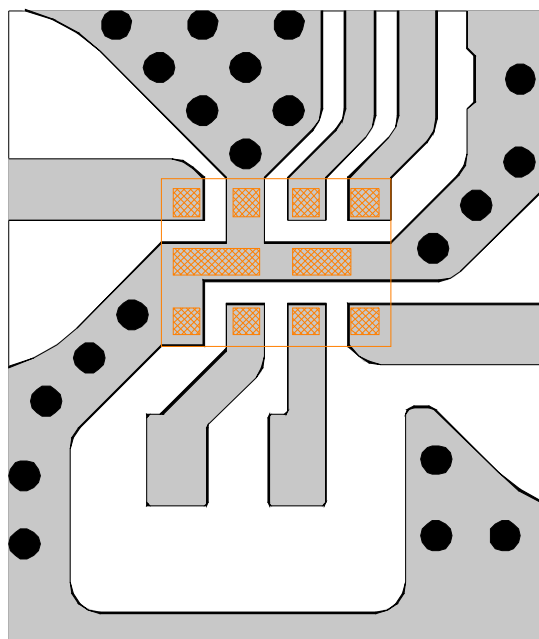
Substrate: FR-4

Thickness: 0.2mm

Microstrip line width: 0.4mm ( $Z_0=50\Omega$ )

Size: 14.0mm x 14.0mm

## <PCB LAYOUT GUIDELINE>



- PCB
- PKG Terminal
- PKG Outline
- GND Via Hole  
Diameter  $\phi=0.2\text{mm}$

## PRECAUTIONS

- Please layout ground pattern under this FEM in order not to couple with RFIN and RFOUT terminal.
- All external parts should be placed as close as possible to the FEM.
- For good RF performance, all GND terminals must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the FEM.



## ■ RECOMMENDED FOOTPRINT PATTERN (HFFP10-HH Package) <Reference>

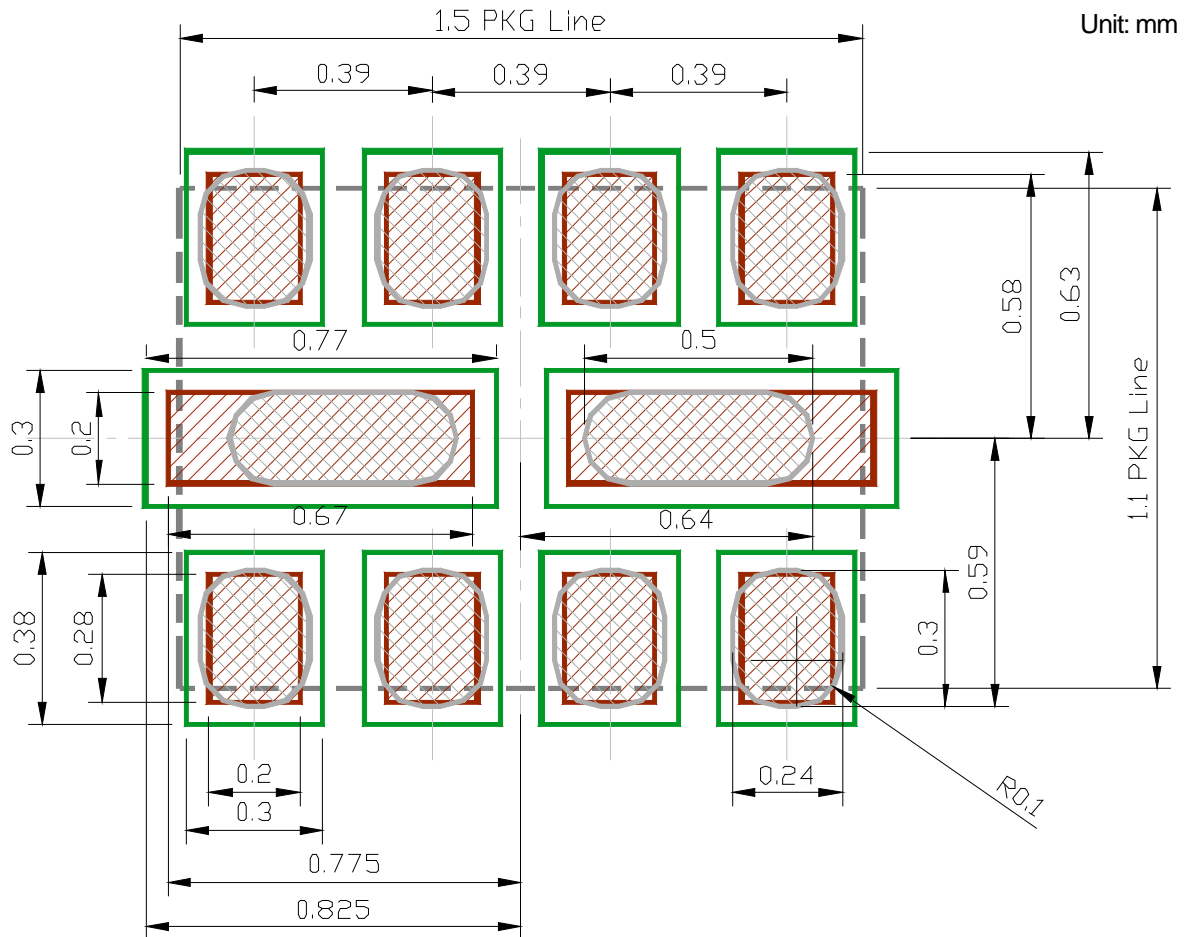
PKG : 1.5mm x 1.1mm

Pin pitch : 0.39mm

: Land

: Mask (Open area) \*Metal mask thickness : 100μm

: Resist (Open area)



## ■ NOISE FIGURE MEASUREMENT BLOCK DIAGRAM

### Measuring instruments

NF Analyzer : Keysight N8973A  
Noise Source : Keysight 346A

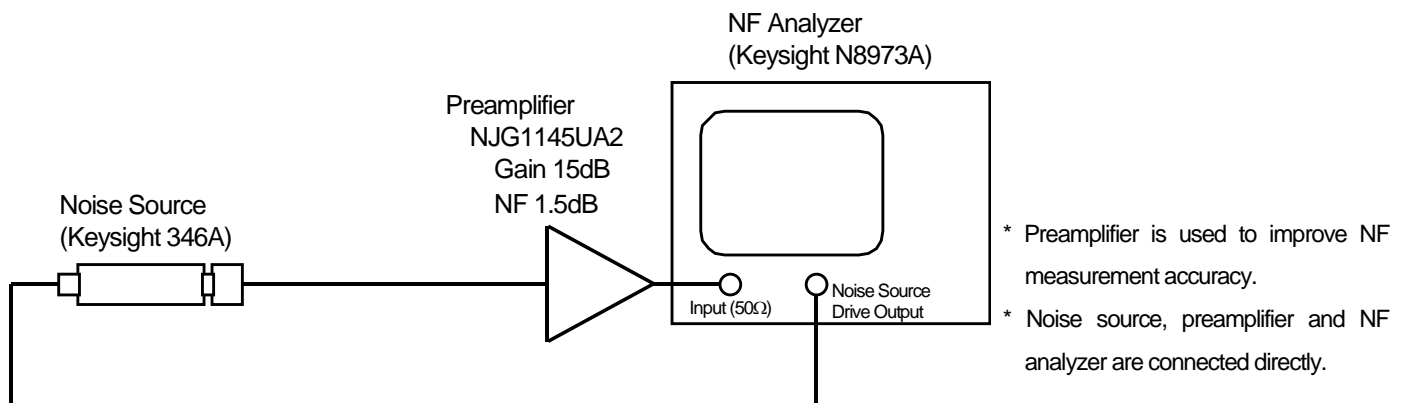
### Setting the NF analyzer

Measurement mode form

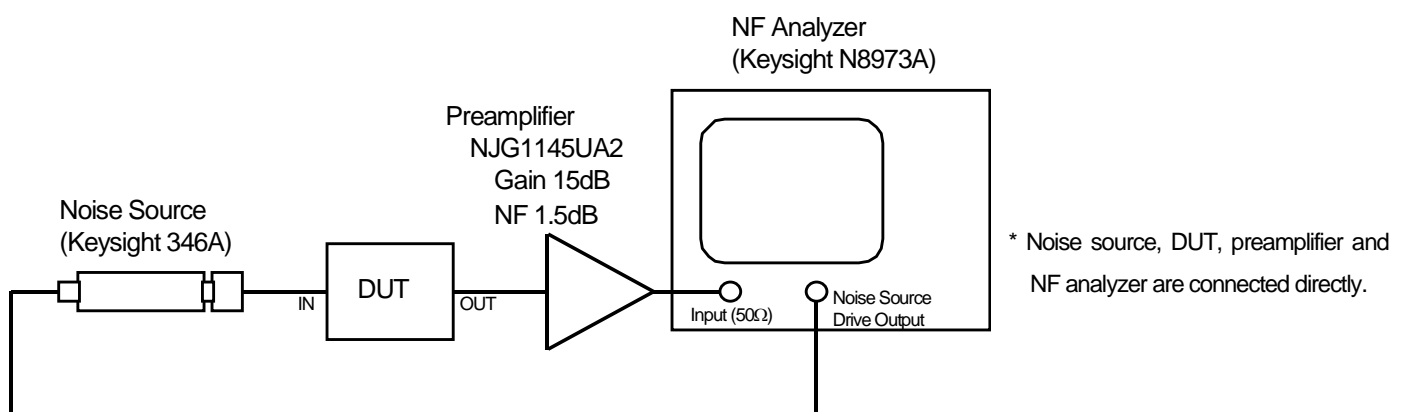
Device under test : Amplifier  
System downconverter : off

Mode setup form

Sideband : LSB  
Averages : 16  
Average mode : Point  
Bandwidth : 4MHz  
Loss comp : off  
Tcold : setting the temperature of noise source (303.15K)

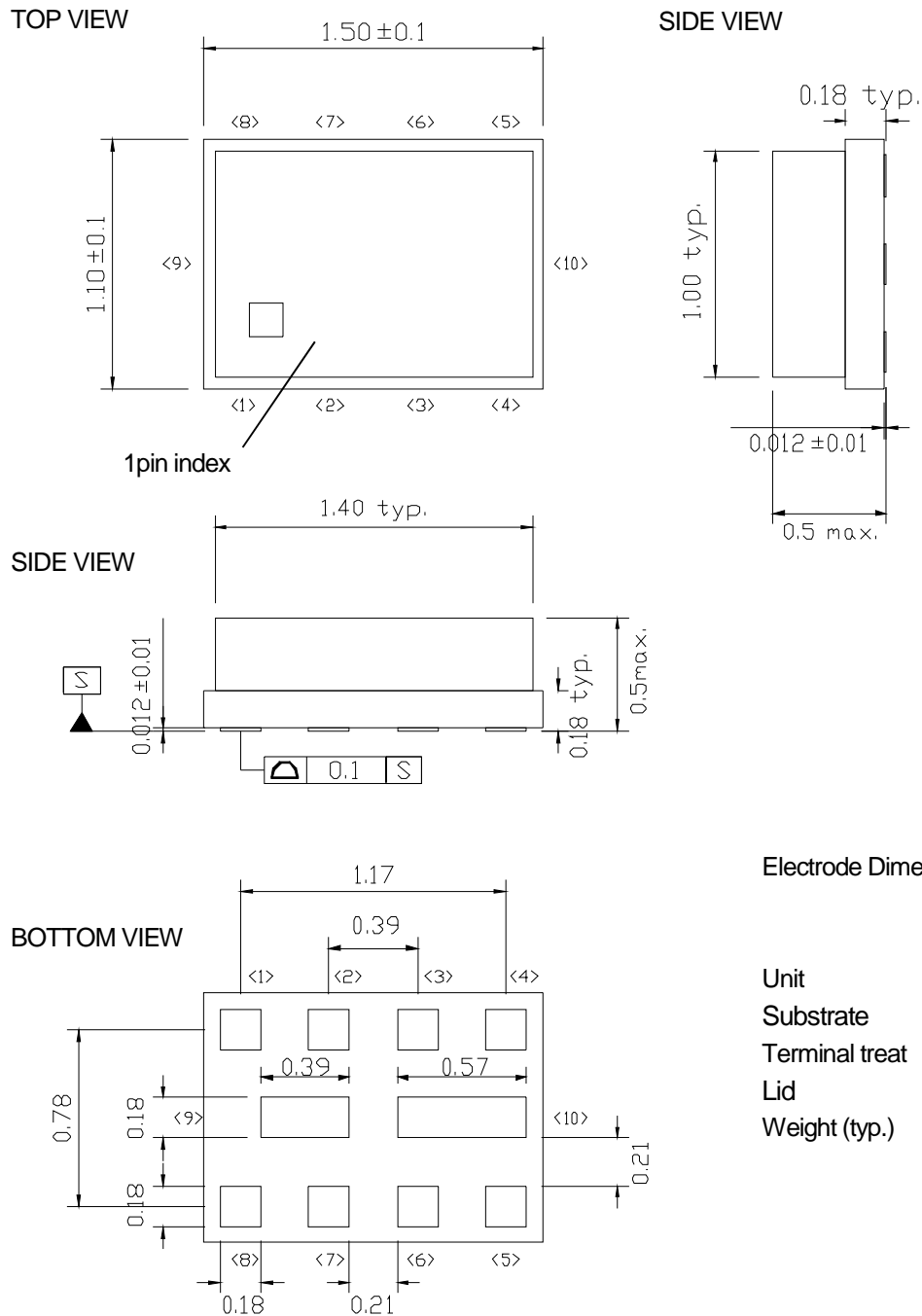


Calibration setup



Measurement Setup

## ■ PACKAGE OUTLINE (HFFP10-HH)



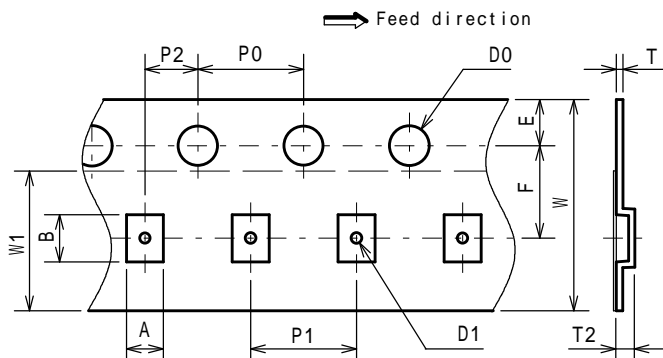
Electrode Dimensions clearance  
:  $\pm 0.05$ mm

Unit : mm  
 Substrate : Ceramic  
 Terminal treat : Au  
 Lid : SnAg/Kovar/Ni  
 Weight (typ.) : 4.6mg

## PACKING SPECIFICATION (HFFP10-HH)

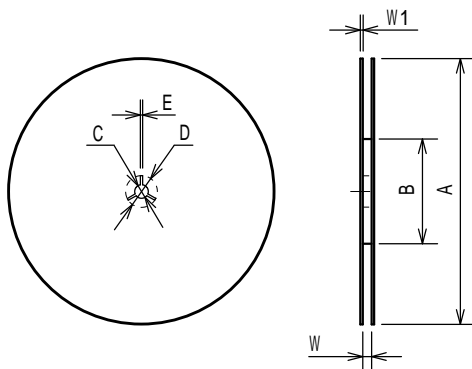
Unit: mm

### TAPING DIMENSIONS



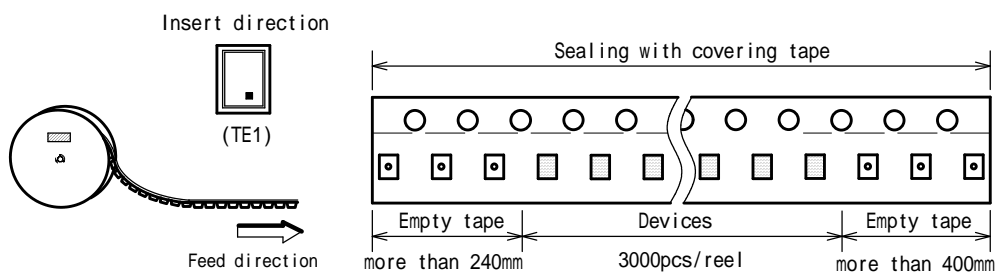
SYMBOL	DIMENSION	REMARKS
A	$1.4 \pm 0.1$	BOTTOM DIMENSION
B	$1.8 \pm 0.1$	BOTTOM DIMENSION
D0	$1.5^{+0.1}_0$	
D1	$0.5 \pm 0.05$	
E	$1.75 \pm 0.1$	
F	$3.5 \pm 0.05$	
P0	$4.0 \pm 0.1$	
P1	$4.0 \pm 0.1$	
P2	$2.0 \pm 0.05$	
T	$0.25 \pm 0.05$	
T2	$0.7 \pm 0.1$	
W	$8.0 \pm 0.2$	
W1	$5.3 \pm 0.2$	THICKNESS 100 $\mu$ m max

### REEL DIMENSIONS

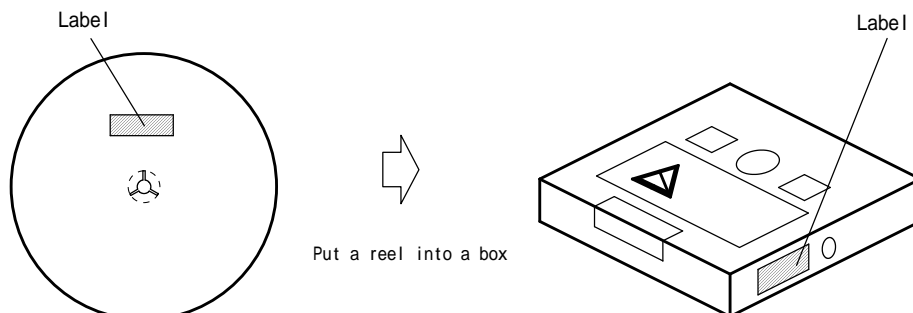


SYMBOL	DIMENSION
A	$180^{0}_{-1.5}$
B	$66 \pm 0.5$
C	$13 \pm 0.2$
D	$21 \pm 0.8$
E	$2 \pm 0.5$
W	$9^{+1.0}_0$
W1	1.2

### TAPING STATE



### PACKING STATE



## ■ REVISION HISTORY

Date	Revision	Changes
15.Nov.2016	Ver.1.0	New Release Automotive spec
19.Jul.2017	Ver.1.1	Changed package suffix from H to A Updated ELECTRICAL CHARACTERISTICS 1 (DC) Updated ELECTRICAL CHARACTERISTICS 2 (RF) Added packing specification
19.Oct.2018	Ver.1.2	Revised features Revised caution
08.Nov.2018	Ver.1.3	Revised MARK INFORMATION Revised ORDERING INFORMATION Revised weight
08.Jan.2019	Ver.1.4	Revised features Added APPLICATION Revised PRODUCT NAME INFORMATION Revised ORDERING INFORMATION Revised ELECTRICAL CHARACTERISTICS 2 (RF) Added POWER DISSIPATION VS.AMBIENT TEMPERATURE Revised caution

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9. This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.
10. This product is hollow seal package type, and it is with the structure susceptible to stress from the outside. Therefore, note the following in relation to the contents, after conducting an evaluation, please use.
 

After mounting this product, to implement the potting and transfer molding, please the confirmation of resistance to temperature changes and shrinkage stress involved in the molding.

When mounted on the product, collet diameter please use more than 1mmφ. In addition, the value of static load is recommended mounting less than 5N.

For dynamic load at the time of mounting, please use it after confirming in consideration of the contact area / speed / load.
11. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.



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