



LOW NOISE DIFFERENTIAL AMPLIFIER

**SA-410F3**

---

INSTRUCTION MANUAL

**NF Corporation**



DA00062388-003

LOW NOISE DIFFERENTIAL AMPLIFIER

**SA-410F3**

INSTRUCTION MANUAL



## ———— Preface ————

Thank you for purchasing the SA-410F3 low noise differential amplifier.

Please read the "Safety Information" on the next page first to ensure the product is used in a correct and safe manner.

- Alert symbols in this manual

This manual uses the following alert symbols. The instructions next to these symbols must be carefully obeyed to ensure the equipment operator's safety and prevent damage to equipment.

---

** WARNING**

---

This contains information for avoiding electric shock and other risks when handling the equipment that could result in death or bodily injury to the operator.

---

---

** CAUTION**

---

This contains information for avoiding risks when handling the equipment that could result in minor or moderate injury to the operator or damage to property.

---

- This manual consists of the following chapters.

If using this product for the first time, start from "1. Outline"

1. Outline

This chapter gives an overview and describes the features and applications of this product and the simple operating principle of the product.

2. Preparation before Use

This chapter describes important preparations to be made before installation and operation.

3. Panel Features and Basic Operations

This chapter explains the basic operations of the panels.

4. Maintenance

This chapter describes a method for simply inspecting operation.

5. Specifications

This chapter gives specifications (functions and performance).

6. Reference Data

This chapter shows the general electrical characteristics of a normal SA-410F3.

## ———— Safety Information ————

To ensure safe use, be sure to observe the following safety precautions.

NF Corporation shall not be held liable for damages that arise from a failure to observe these safety precautions or warnings or cautions in the instruction manual.

- **Be sure to observe the information of the instruction manual.**

The instruction manual contains information for the safe operation of the product.

Be sure to read the information first before using the product.

All the warnings in the instruction manual are intended for preventing risks that may lead to serious accidents. Ensure to obey them.

- **Be sure to ground the product.**

To prevent electric shock, the enclosure must be connected to an electrical ground.

- **Check the power supply voltage.**

This product operates on the power supply voltage indicated in the instruction manual.

Prior to connecting the power supply, check that the voltage of the power supply matches the rated power supply of the product.

- **If you notice anything strange**

If this product emits smoke, an unusual smell, or abnormal noise, immediately power it off and stop using it.

If such an anomaly occurs, prevent anyone from using this product until it has been repaired, and immediately report the problem to NF Corporation or one of our representatives.

- **Do not operate in an explosive atmosphere.**

An explosion or other such hazard may result.

- **Do not remove the cover.**

The product may contain high-voltage parts. Never remove the cover.

Even when the inside of this product needs to be inspected, do not touch the inside. All such inspections are to be performed by service technicians designated by NF Corporation.

- **Do not modify the product.**

Never modify the product. Modification to the product may pose a new risk. We may refuse the repair of a modified product.

- **Ensure that water does not get into this product.**

Using the product in wet condition may cause electric shock and fire. When water etc. get into the product, immediately power it off, and contact NF Corporation or one of our representatives.

- **If lightning occurs, power off and disconnect this product.**

A lightning may cause an electric shock, a fire and a failure.

### ● Electromagnetic compatibility

This product is a CISPR 11 Group 1 Class A compliant device. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

### ● Safety symbols



#### **Caution, refer to instruction manual**

This notifies the user of potential hazards and indicates that he/she must refer to the instruction manual.



#### **Caution, possibility of electric shock**

This indicates that an electric shock may occur under specific conditions.



#### **Protective earth ground terminal**

This indicates that the terminal needs to be grounded in order to prevent electric shock accidents.

Before operating the product, ensure to connect this terminal to an earth ground.



### **WARNING** Warning

This contains information to avoid risks in equipment handling that could result in loss of life or bodily injury.



### **CAUTION** Caution

This contains information to avoid risks in equipment handling that could result in minor or moderate injury to person or damage to property or the equipment.

### ● Other symbols



This indicates that the terminal or the outer conductor of the connector is connected to the enclosure.



This indicates that the terminal or the outer conductor of the connector is connected to the signal ground.



This indicates that the terminal or the outer conductor of the connector is isolated from the enclosure.

It indicates, however, that the difference of the potential from the ground potential is restricted to 42 Vpk or less for safety (this product is used grounded so the enclosure potential and ground potential are equal).

- **Waste disposal**

This product does not include batteries and is designed in accordance with the RoHS Directive (EU).

Dispose of the product in accordance with the laws and regulations of the area where you use it.



---

# Contents

---

	Page
Preface	i
Safety Information	ii
1. Outline.....	1-1
1.1 Overview.....	1-1
1.2 Features.....	1-1
1.3 Application.....	1-1
1.4 Operating Principle.....	1-2
2. Preparation before Use.....	2-1
2.1 Checking before Use.....	2-1
2.2 Conditions for Installation Location.....	2-2
2.3 Power Supply.....	2-3
2.4 Connecting with Low Noise DC Power Supply LP Series.....	2-4
3. Panel Features and Basic Operations.....	3-1
3.1 Panel Component Names and Functions.....	3-1
3.2 Input Connection and Installation.....	3-3
3.3 Output Connection.....	3-4
3.4 Turning on Power and Warm-up Time.....	3-4
3.5 Relationship between Common-Mode Input Voltage and Maximum Output Voltage.....	3-4
3.6 Used for Single-Ended Input.....	3-4
4. Maintenance.....	4-1
4.1 Before Maintenance.....	4-1
4.2 Daily Maintenance.....	4-1
4.3 Storage, Repacking and Transportation.....	4-1
4.4 Function Test.....	4-2
4.4.1 Consumption Current (with No Signal).....	4-3
4.4.2 Non-Inverting Input Operation.....	4-3
4.4.3 Inverting Input Operation.....	4-5
4.4.4 Equivalent Input Offset Voltage.....	4-7
5. Specifications.....	5-1
5.1 Non-Destructive Maximum Ratings.....	5-1
5.2 Input.....	5-1
5.3 Output.....	5-2
5.4 Amplifier.....	5-3
5.5 Power Supply.....	5-3
5.6 General.....	5-3
5.7 Notes.....	5-4
5.8 External View.....	5-5
6. Reference Data.....	6-1
6.1 Reference Data.....	6-1

---

# Contents

---

	Page
<b>6.2</b> Equivalent Input Noise Voltage Density .....	6-1
<b>6.3</b> Equivalent Input Noise Current Density .....	6-1
<b>6.4</b> CMRR .....	6-2
<b>6.5</b> PSRR .....	6-2
<b>6.6</b> Common-Mode Input Voltage against Maximum Output Voltage .....	6-3
<b>6.7</b> Power Supply against Input Bias Current .....	6-3
<b>6.8</b> Power on Drift (Output Offset Voltage) .....	6-4
<b>6.9</b> Time Drift (Output Offset Voltage) .....	6-4
WARRANTY	

---

## Figures and Tables

---

	Page
Figure 1-1 Block diagram .....	1-2
Figure 2-1 Connecting to LP series power supply .....	2-4
Figure 3-1 Front and rear panel views .....	3-2
Figure 4-1 Connection diagram for checking non-inverting input operation .....	4-3
Figure 4-2 Non-inverting input voltage waveforms and output voltage waveforms .....	4-4
Figure 4-3 Connection diagram for checking inverting input operation .....	4-5
Figure 4-4 Inverting input voltage waveforms and output voltage waveforms .....	4-6
Figure 4-5 Connection diagram for checking equivalent input offset voltage .....	4-7
Figure 5-1 External view .....	5-5
Figure 6-1 Equivalent input noise voltage density .....	6-1
Figure 6-2 Equivalent input noise current density .....	6-1
Figure 6-3 CMRR .....	6-2
Figure 6-4 PSRR .....	6-2
Figure 6-5 Common-mode input voltage against maximum output voltage .....	6-3
Figure 6-6 Power supply against input bias current .....	6-3
Figure 6-7 Power on drift .....	6-4
Figure 6-8 Time drift .....	6-4
Table 2-1 List of contents .....	2-1



# 1. Outline

1.1 Overview .....	1-1
1.2 Features .....	1-1
1.3 Application.....	1-1
1.4 Operating Principle.....	1-2



## 1.1 Overview

The SA-410F3 is a low-noise bipolar input-type differential amplifier with  $0.75 \text{ nV}/\sqrt{\text{Hz}}$  equivalent input noise voltage density and 40 dB voltage gain. The frequency band is DC to 1 MHz. The input resistance can be selected from 1 k $\Omega$ , 10 k $\Omega$  and 100 k $\Omega$  by the rotary switch.

## 1.2 Features

- (1) High gain, Wideband  
Voltage gain: 40 dB, Frequency band: DC to 1 MHz
- (2) Low noise  
Equivalent input noise voltage density:  $0.75 \text{ nV}/\sqrt{\text{Hz}}$
- (3) Low temperature coefficient of input offset voltage  
Temperature characteristic of equivalent input offset voltage:  $\pm 0.2 \text{ }\mu\text{V}/^\circ\text{C}$
- (4) Selectable input resistance  
Input resistance: 1 k / 10 k / 100 k $\Omega$
- (5) Connector with excellent shielding characteristic  
Input and output connectors: SMA connectors

## 1.3 Application

This product, owing to its characteristics of high gain, wide-bandwidth, and small equivalent input noise voltage density, can be widely used for amplification of small signals.

- a) Preamplifier for high-speed and high-accuracy temperature measurement using a thermocouple
- b) Preamplifier for the magnetic flux measurement by SQUID sensor etc.
- c) Preamplifier for the sensor (after voltage conversion) of an ion current measurement
- d) Improvement of noise characteristics of a voltage amplifier incorporated in a lock-in amplifier

## 1.4 Operating Principle

This is a voltage amplifier that amplifies the voltage difference between the +INPUT terminal and the -INPUT terminal by the gain of 40 dB. The input resistance can be selected from 1 k $\Omega$ , 10 k $\Omega$  and 100 k $\Omega$  by the rotary switch (Rin SELECT). The output resistance is 50  $\Omega$ .

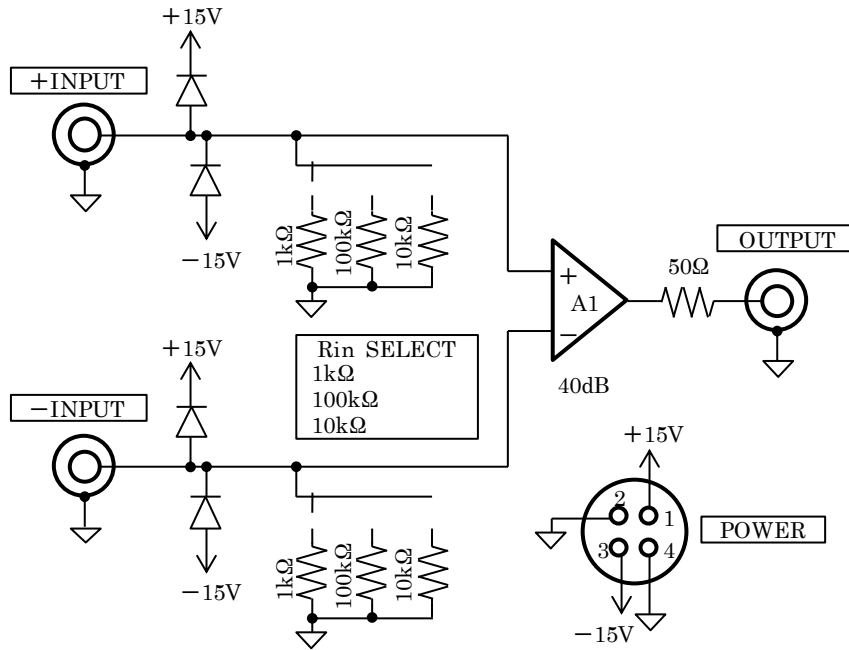


Figure 1-1 Block diagram



## 2. Preparation before Use

2.1	Checking before Use.....	2-1
2.2	Conditions for Installation Location .....	2-2
2.3	Power Supply.....	2-3
2.4	Connecting with Low Noise DC Power Supply LP Series.....	2-4



## 2.1 Checking before Use

### ■ Safety check

To ensure the safety of the user, be sure to read the following sections of the instruction manual first.

- "Safety Information" (at the beginning of this instruction manual)
- [2.3 Power Supply]

### ■ Check appearance and accessories

If you notice that something is out of order on the outside of the packing box (such as a deep scratch or dent), closely check that the product is not affected when you remove it from the box.

When you take the contents out of the box, check them. If you find a deep scratch or dent on the product or an accessory is missing, report the problem to the NF Corporation or one of our agents.

#### ● Appearance check

Check that there are no deep scratches or dents on the panel surfaces, connectors, etc.

#### ● Product configuration check

Table 2-1 shows the list of contents. Check that the quantities are correct and that there are no deep scratches or dents.

Table 2-1 List of contents

● SA-410F3 .....	1
● Instruction manual .....	1
● Accessories	
Bottom plate .....	1
SMA short plug .....	1

\* The bottom plate is mounted to the main unit by four plastic screws (M3 × 8 mm).

\* The SMA short plug is attached to –INPUT.

\* The supplied SMA short plug is the same as the PA-001-2985 SMA short plug (optional item).

#### ● Optional Item

The SMA short plug and SMA to BNC adapter are separately available as optional items. If you required, please contact NF or one of our agents.

PA-001-2985 : SMA short plug

PA-001-2986 : SMA to BNC adapter

## 2.2 Conditions for Installation Location

- The installation location shall meet the following temperature and humidity conditions.

Specification guarantee condition:  $+23 \pm 5$  °C, 5 to 85 %RH

Operating conditions: 0 to +40 °C, 5 to 85 %RH

Storage conditions: -10 to +50 °C, 5 to 95 %RH

However, do not use the product if condensation is present.

- Use the product indoors at an altitude of up to 2000 m.

- Do not install the product in the following locations:

- Locations where flammable gases may be present

There is risk of explosion. Never install or use the product in such locations.

- Outdoors, locations exposed to direct sunlight, or near fire or heat sources

The expected performance of this product may not be exhibited, or a malfunction may result.

- Location where corrosive gases, water vapor, or dust may be present or humid locations

This product may corrode or malfunction.

- Near an electromagnetic field source, high-voltage product, or power line

Noise may increase.

- Location where there is a lot of vibration

Noise may increase, or a malfunction may result.

## 2.3 Power Supply

This product operates under the following power supply conditions. To obtain the best noise characteristics, we recommend Low Noise DC Power Supply LP series.

If you would like to purchase to our LP series power supply, please contact NF or one of our agents.

- Stabilized DC power supply with  $\pm 15\text{ V} \pm 1\text{ V}$ ,  $\pm 75\text{ mA}$  or higher, ripple noise  $1\text{ V}_{\text{rms}}$  or lower.  
(a switching power supply is not recommended).

---

### Attention

---

- Supplying a voltage greater than  $\pm 18\text{ V}$  will damage the internal circuits of this product.
-

## 2.4 Connecting with Low Noise DC Power Supply LP Series

The output cable A (PA-001-2372) is available to connect this product to LP series power supply. If you require the cable, please contact NF or one of our agents.

The following figure shows connection using the output cable A. Output of LP series power supply is set as  $\pm 15$  V.

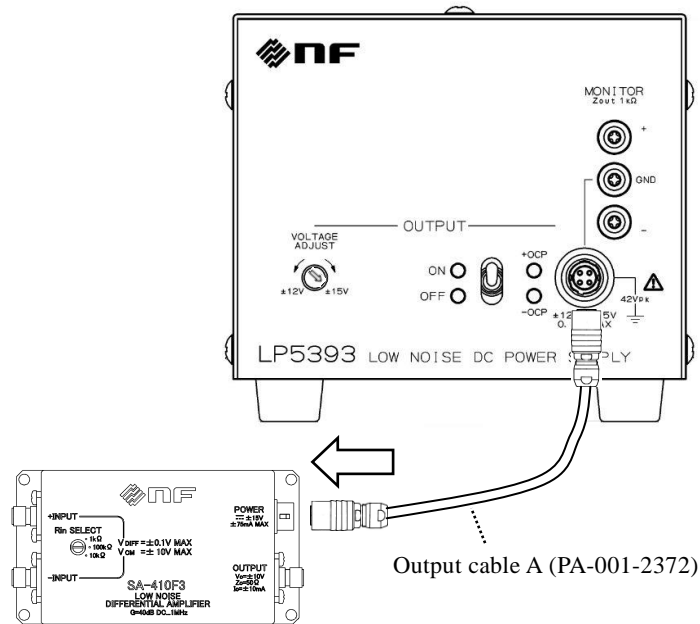


Figure 2-1 Connecting to LP series power supply

### Attention

- Do not disconnect and connect the output cable A when the power supply is on. This product may be damaged.

## **3. Panel Features and Basic Operations**

<b>3.1</b>	Panel Component Names and Functions .....	3-1
<b>3.2</b>	Input Connection and Installation .....	3-3
<b>3.3</b>	Output Connection .....	3-4
<b>3.4</b>	Turning on Power and Warm-up Time .....	3-4
<b>3.5</b>	Relationship between Common-Mode Input Voltage and Maximum Output Voltage.	3-4
<b>3.6</b>	Used for Single-Ended Input .....	3-4





### 3.1 Panel Component Names and Functions

See Figure 3-1, Front and rear panel views.

#### ① +INPUT

#### ② –INPUT

+INPUT is a non-inverting input connector of this product, and an SMA connector is adopted.

–INPUT is an inverting input connector of this product, and an SMA connector is adopted.

Maximum differential input voltage is  $\pm 0.1$  V, maximum common-mode input voltage is  $\pm 10$  V.

#### ③ OUTPUT

An SMA connector is used for the output terminal of this product.

The output impedance is  $50 \Omega$ , and the maximum output current is  $\pm 10$  mA.

(Load:  $1 \text{ k}\Omega$  or higher)

Note that the output of this product cannot drive a  $50 \Omega$  load directly.

#### ④ POWER

This is the power input connector of this product, which uses a HR10-7R-4P (73).

DC  $\pm 15$  V is supplied by connecting the output cable A with this connector.

#### ⑤ Rin SELECT

This is a rotary switch that selects input resistance (Between the non-inverting input and GND, between the inverting input and GND).

The input resistance can be selected from 1 k, 10 k and 100 k $\Omega$ .

Using a screwdriver whose tip does not match or applying excessive force may cause damage.

#### ⑥ Mounting holes

These holes (M3) are used to mount this product to the chassis, etc. with the bottom plate mounted to it. This product can be mounted to the chassis while they are electrically insulated.

#### ⑦ Holes to mount this product

To remove the bottom plate and mount this product directly to the chassis, etc., use these screw holes (M3) (the length of the screws should be 6 mm or lower).

Note that if the bottom plate is removed, this product and the object to which this product is mounted are electrically connected. The bottom plate is mounted to this product using 8 mm plastic screws (M3).

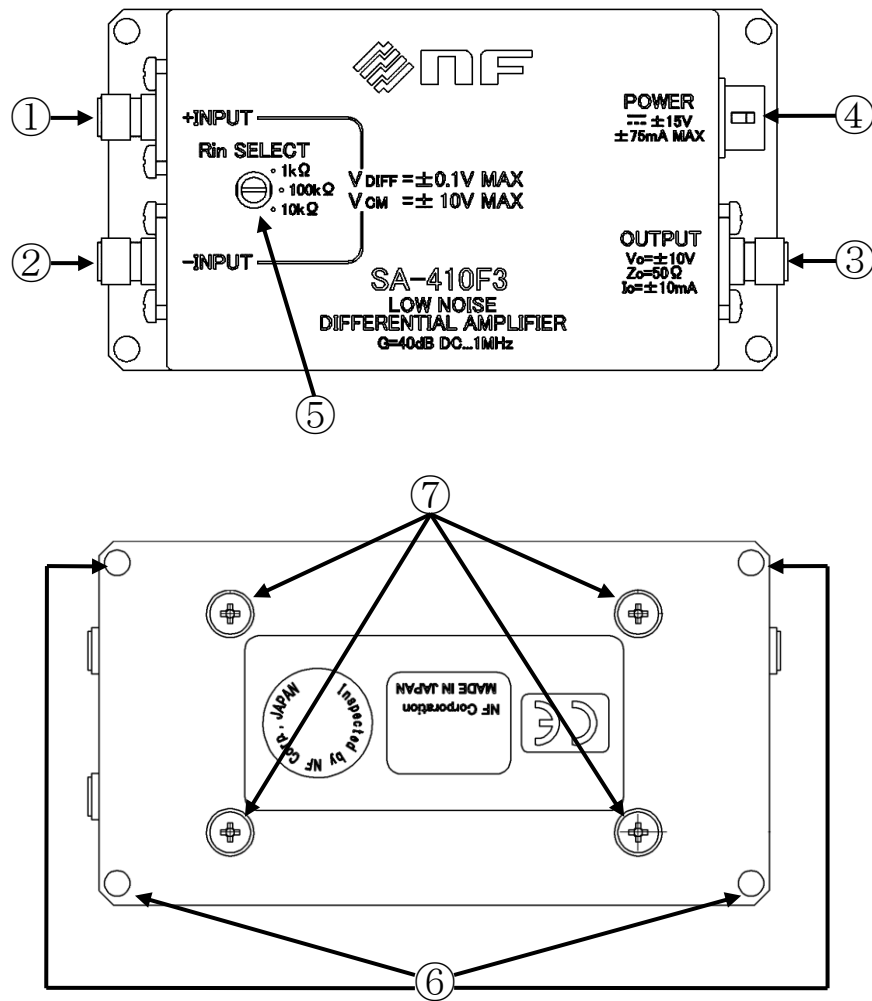


Figure 3-1 Front and rear panel views

---

## 3.2 Input Connection and Installation

The shielding of the input cable and the method for connecting and installing the product are important for using this product with the best noise characteristics. Follow the instructions below to connect and install this product.

- Install this product as close as possible to the sensor or signal source and make the input cable as short as possible. Even if the product cannot be installed near the sensor or signal source, make the input cable length 2 m or shorter.
- An SMA connector and semi-rigid cable are useful for reducing disturbance and noise from the outside.
- Be sure to use shielded cables such as coaxial cables for input and output. Furthermore, install the input cable and output cable as far away from each other as possible (input and output coupling may cause oscillation and instability).
- Installing this product with the bottom plate connected to it on conductors, such as metals, insulates the product from the object to which it is connected, so GND loop noise can be reduced.
- If there is a product that includes a transformer, such as a DC power supply, install the sensor and this product as far away as possible from it.
- Install this product in a location where there is as little vibration as possible. When a small signal is detected, it may be subject to the influence of microphonic noise generated by the vibration of the cable.
- To avoid the signal drift by temperature shift, use the product in an environment with less ambient temperature changes. Especially the input connector section is sensitive for signal drift by temperature change.
- Secure this product in a stable location.

---

### Attention

- Do not connect this product to an AC outlet, because doing so is dangerous.
  - The signal GND and case have the same electric potential. Caution is required when giving a potential to the case or signal GND because doing so may cause electric shock.
-

### 3.3 Output Connection

The output impedance of this device is  $50\ \Omega$ , while the maximum output current is 10 mA. If you need  $\pm 10\ \text{V}$  output, use a load resistance greater than  $1\ \text{k}\Omega$ .

Note that if the output of this device is terminated with a  $50\ \Omega$ , the rated output voltage cannot be obtained. Also note that when the output current exceeds 10 mA, damage to the internal circuits and deterioration of the characteristics may occur.

### 3.4 Turning on Power and Warm-up Time

This product exhibits the specified performance immediately after the power is turned on, but if you need highly accurate measurement, allow the device to warm up for at least 20 minutes before use.

### 3.5 Relationship between Common-Mode Input Voltage and Maximum Output Voltage

If a high common-mode input voltage is applied to this product, the internal circuit does not operate. To output the  $\pm 10\ \text{V}$  as maximum output voltage, the common-mode input voltage must be within  $\pm 5\ \text{V}$ . If you use this product while applying a voltage exceeding  $\pm 5\ \text{V}$ , please refer to the data of output range in Figure 6-5.

### 3.6 Used for Single-Ended Input

This product is an amplifier by the differential input. However, it is possible to be used as a single-ended input amplifier by short-circuiting either of the input terminals by using the supplied SMA short plug. When +INPUT is short-circuited, it will become an inverting amplifier, and when -INPUT is short-circuited, it will become a non-inverting amplifier. If you use a short plug other than supplied one, this product might affect the performance.

## 4. Maintenance

4.1 Before Maintenance .....	4-1
4.2 Daily Maintenance .....	4-1
4.3 Storage, Repacking and Transportation .....	4-1
4.4 Function Test.....	4-2
4.4.1 Consumption Current (with No Signal) .....	4-3
4.4.2 Non-Inverting Input Operation .....	4-3
4.4.3 Inverting Input Operation .....	4-5
4.4.4 Equivalent Input Offset Voltage .....	4-7



## 4.1 Before Maintenance

- This chapter describes the following instructions.
  - Daily maintenance
  - Precautions and storage method when the product is not used for a long period of time
  - Precautions for repacking and transportation
  - Function test that is necessary for periodical inspection, incoming inspection, or function check after repair

If the results of function test are not satisfactory, please contact NF or one of our agents to request calibration or repair.

## 4.2 Daily Maintenance

- If the panels and cases are dirty

Wipe off the dirt with a soft cloth. To remove persistent contamination, wipe with a cloth that has been soaked in neutral detergent and then wrung out.

Never use any volatile solvents like thinner or benzene or a chemical cleaning cloth, as they may cause the surface finish to deteriorate or peel off.

## 4.3 Storage, Repacking and Transportation

- Storage when not used for a long period of time

- Disconnect the power supply from this product.
- Store the product in a location free from falling objects and dust, such as a shelf or rack.  
If dust may be present, cover the product with a cloth or polyethylene cover.
- The environmental conditions for storage are  $-10$  to  $+50$  °C and 5 to 95 %RH.

However, avoid a location where the temperature fluctuates significantly or where the product will be exposed to direct sunlight, and store it in an environment as close to room temperature as possible.

- Repacking and Transportation

When repacking the product to transport or send it for repairs, pay attention to the following instructions.

- Wrap the product in a polyethylene bag or sheet.
- Prepare a carton box that can well withstand the weight of the product and is of a large enough size to accommodate it.
- Fill the carton box with a cushioning material so that the six sides of the product can be protected.
- When making a request for transportation, inform the transport operator that the product is a precision instrument.

---

## 4.4 Function Test

- The function test is to be executed to confirm failures of this product. This function test is to be executed in the incoming inspection, periodic inspection, and when the function check is required after a repair. If the results of the function test do not meet the specifications as follows in section 4.4.1 and 4.4.4, calibration or repair is required.
  
- For the function test, the following instrument devices are required.
  - a) Digital multi-meter  
0.1 mV DC voltage to be measurable
  - b) DC power supply  
 $\pm 15$  V,  $\pm 0.1$  A or higher
  - c) Signal generator  
 $\pm 100$  mV ( $70.7$  mV<sub>rms</sub>) at 1 kHz sine wave to be output
  - d) Oscilloscope  
Frequency band: 100 MHz or higher  
Input impedance: 1 M $\Omega$
  - e) Jigs  
SMA short plug  $\times 2$   
SMA to BNC conversion adapter  $\times 2$   
BNC T-type divider  $\times 1$
  
- Check the following before the function test.
  - Is the power supply voltage  $\pm 15$  V within  $\pm 0.1$  V?
  - Is the ambient temperature within 18 to 28 °C, and is the ambient humidity within 5 to 85 % RH?
  - Is there non-condensation?
  - Have 20 minutes or more passed after the power is activated?



#### 4.4.1 Consumption Current (with No Signal)

Check the consumption current used by a current monitor is incorporated in the used power supply.

This product is normal if the consumption current is  $\pm 45$  mA within  $\pm 10$  mA when both inputs are open.

#### 4.4.2 Non-Inverting Input Operation

Make connections as shown in Figure 4-1. For your information, it is convenient to use the SMA-BNC conversion adapter and the BNC-BNC cable for input and output connection of this product. The SMA-BNC conversion adapter (PA-001-2986) is available as an optional item, so please contact NF or one of our agents.

The signal generator outputs a sine wave with an output voltage of  $\pm 100$  mV ( $70.7$  mV<sub>rms</sub>) and frequency of 1 kHz. If waveforms like those in Figure 4-2 are displayed on the oscilloscope, this is normal.

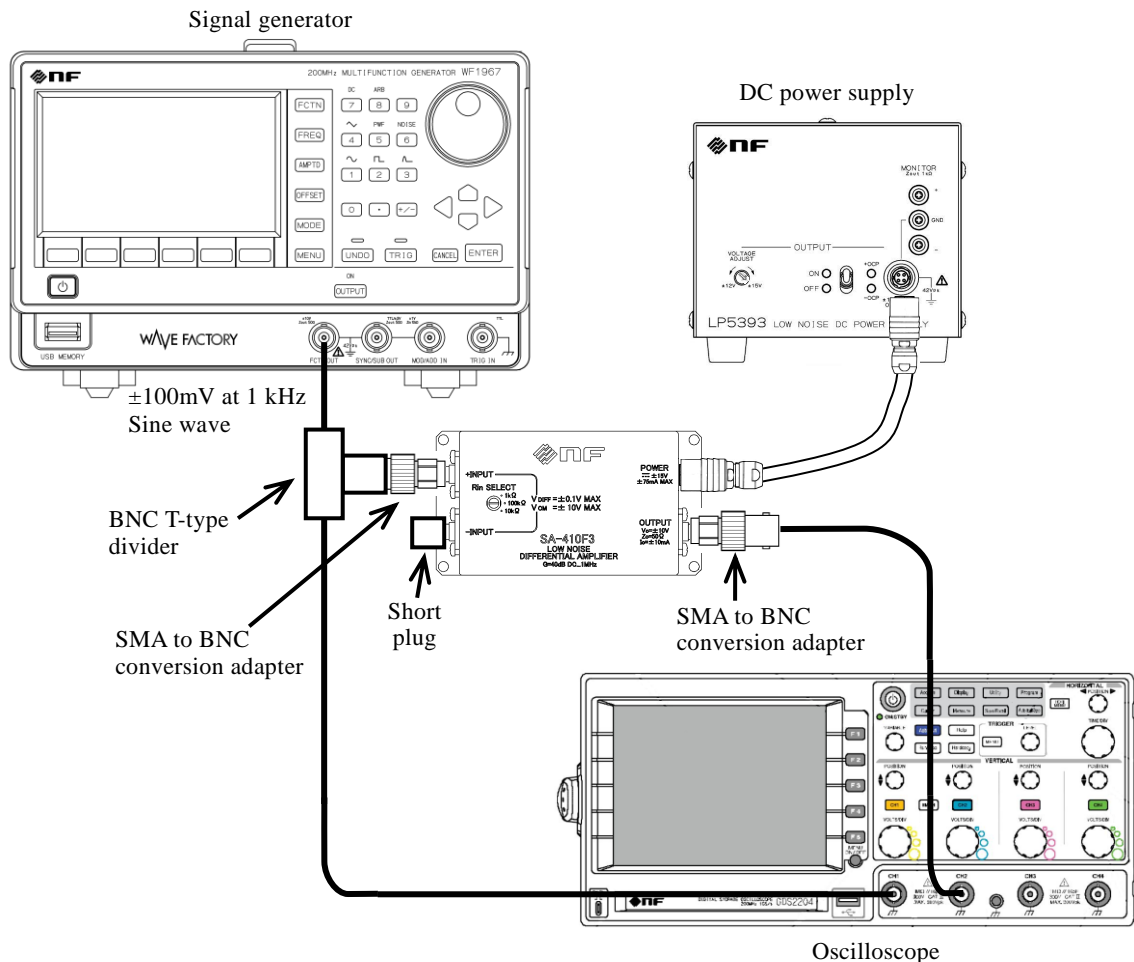


Figure 4-1 Connection diagram for checking non-inverting input operation

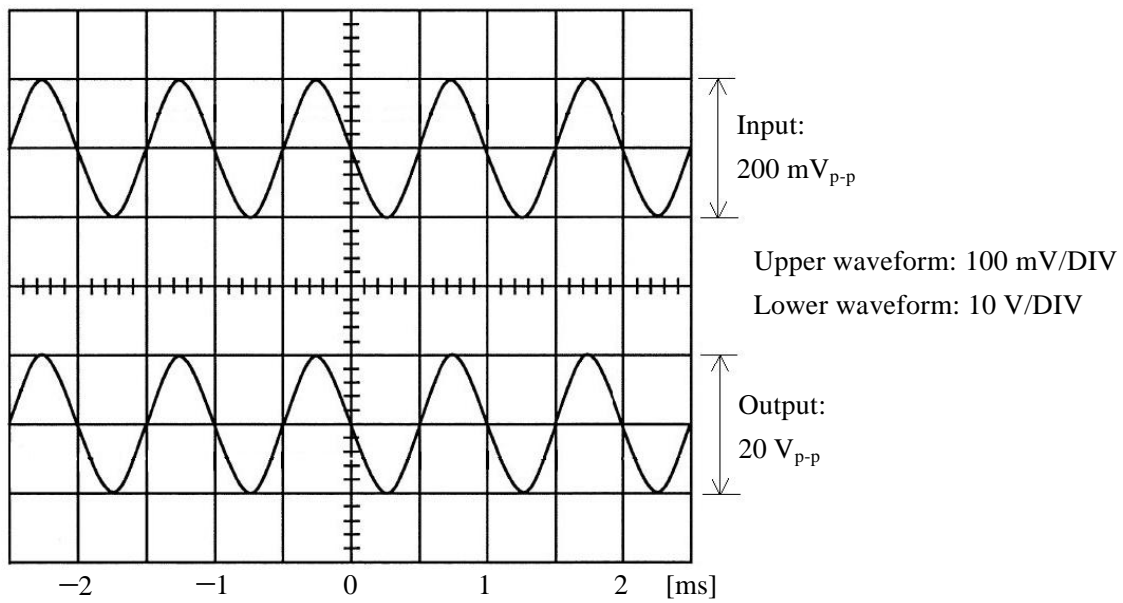


Figure 4-2 Non-inverting input voltage waveforms and output voltage waveforms

### 4.4.3 Inverting Input Operation

Make connections as shown in Figure 4-3.

The signal generator outputs a sine wave with an output voltage of  $\pm 100$  mV ( $70.7$  mV<sub>rms</sub>) and frequency of 1 kHz. If waveforms like those in Figure 4-4 are displayed on the oscilloscope, this is normal.

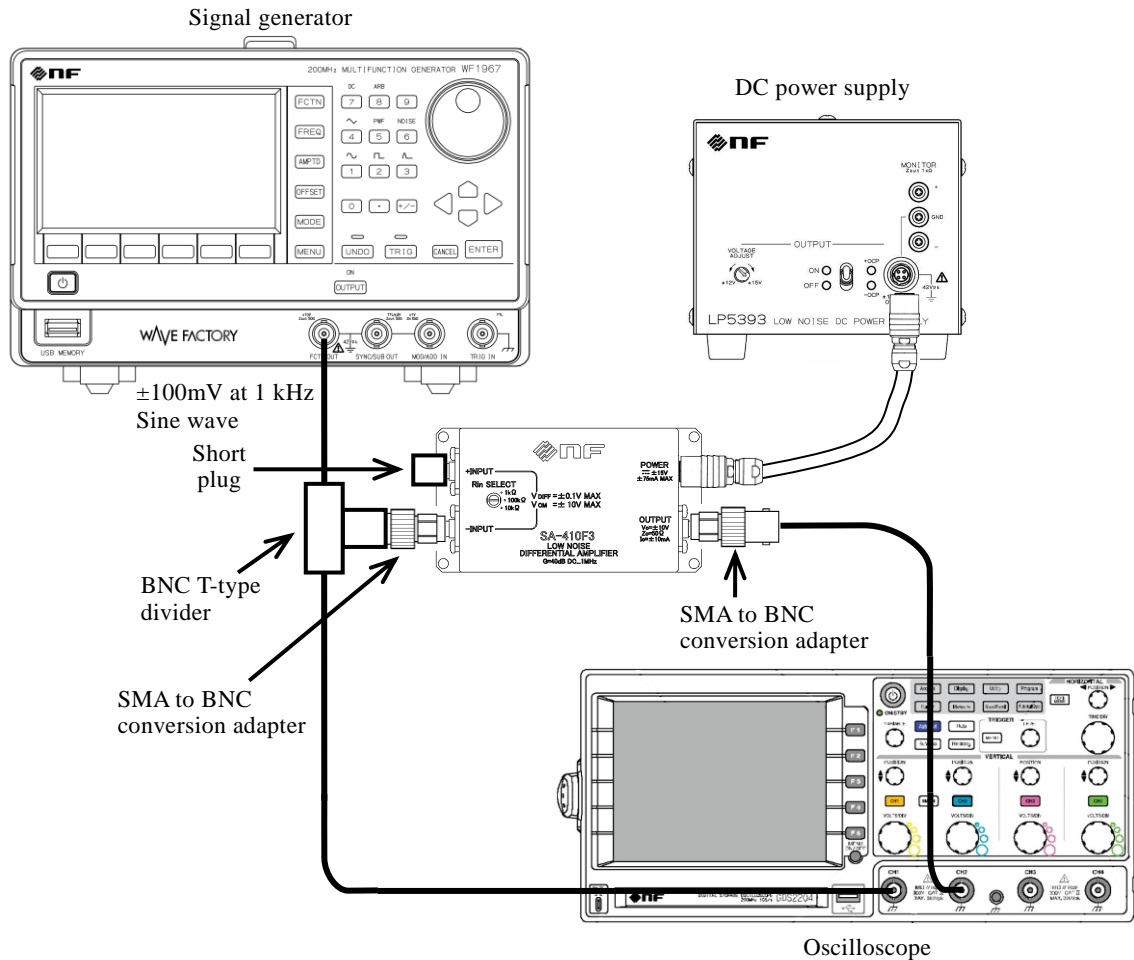


Figure 4-3 Connection diagram for checking inverting input operation

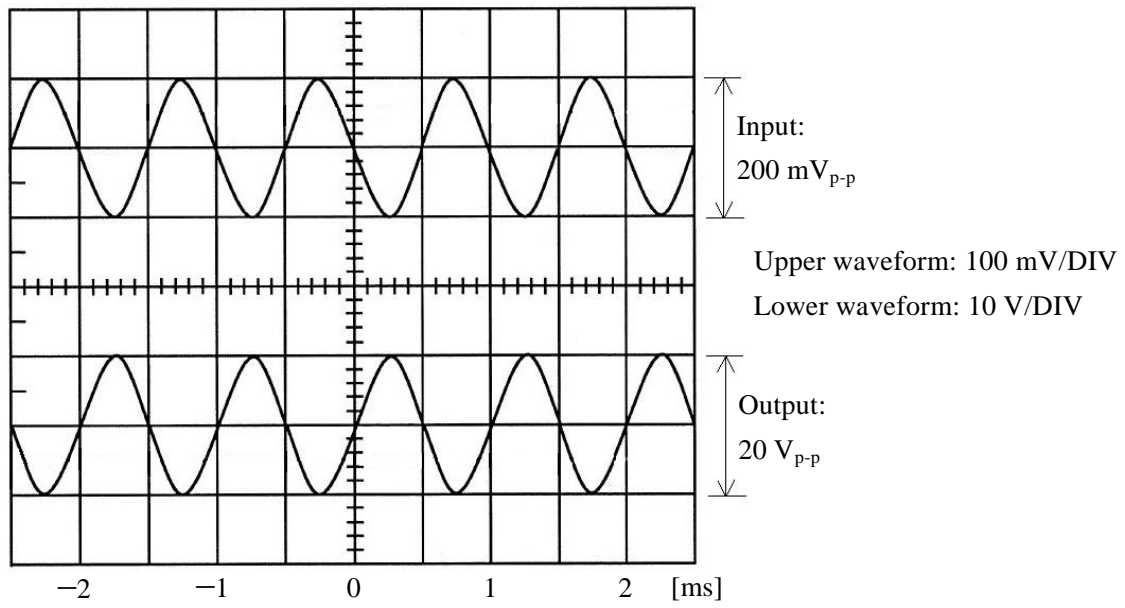


Figure 4-4 Inverting input voltage waveforms and output voltage waveforms

4.4.4 Equivalent Input Offset Voltage

Make connections as shown in Figure 4-5 and measure the output DC voltage (output offset voltage) of this product by using a digital multi-meter.

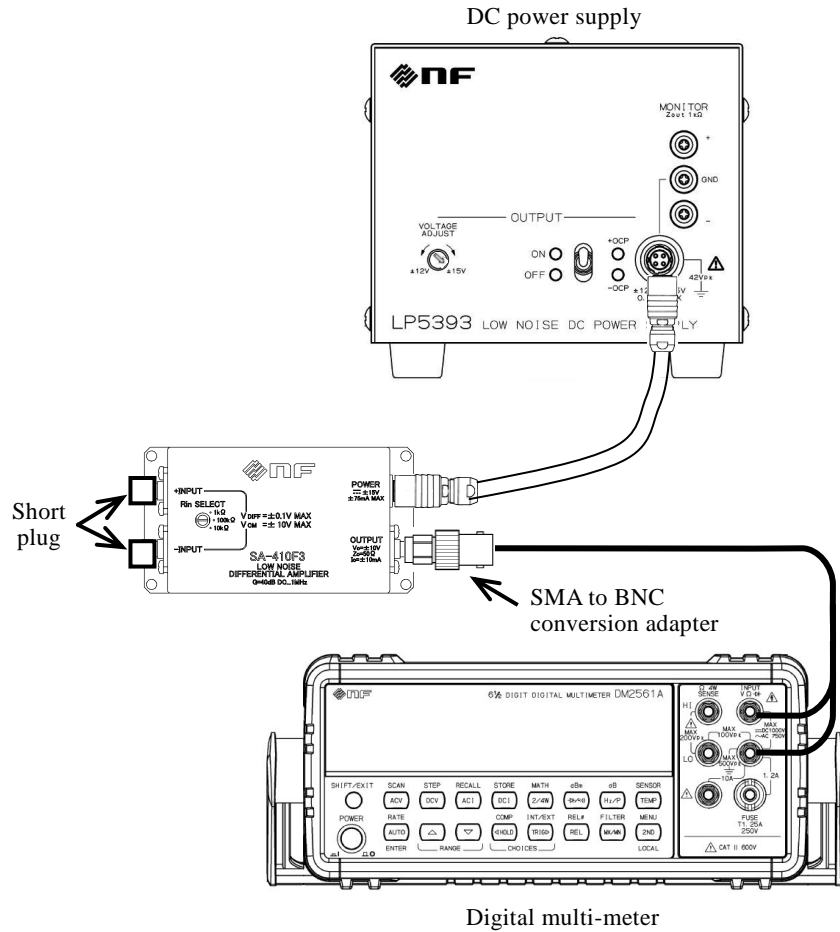


Figure 4-5 Connection diagram for checking equivalent input offset voltage

Calculate the equivalent input offset voltage by the expression below, and if the equivalent input offset voltage is within  $\pm 10 \mu\text{V}$ , this is normal.

$$\text{Equivalent input offset voltage } [\mu\text{V}] = \frac{\text{Output offset voltage } [\mu\text{V}]}{100 \text{ [times]}}$$



## 5. Specifications

5.1 Non-Destructive Maximum Ratings .....	5-1
5.2 Input .....	5-1
5.3 Output.....	5-2
5.4 Amplifier.....	5-3
5.5 Power Supply.....	5-3
5.6 General .....	5-3
5.7 Notes .....	5-4
5.8 External View.....	5-5





The specification value, which specified as range, is indicated as guaranteed values. On the other hand, the specification value, which does not specified as range, is typical value just for reference.

Unless otherwise specified, 23 °C,  $\pm 15$  V, 100 k $\Omega$  (Rin SELECT), load resistance of 1 M $\Omega$ , and common-mode input of 0 V.

## 5.1 Non-Destructive Maximum Ratings

Supply voltage ( $\pm V_s$ )	$\pm 18$ V
Signal input voltage	Differential input: $\pm 1$ V Common-mode input: $\pm V_s$

\* If a stress exceeding the above-mentioned absolute maximum rating is applied, permanent damage can be caused to the product.

## 5.2 Input

Input form

DC coupling and Differential input

Input connector

Two SMA connectors

Input resistance

1 k / 10 k / 100 k $\Omega$  within  $\pm 5$  %      f=100 Hz,  
Between the non-inverting input and GND,  
Between the inverting input and GND,  
Possible selection by the rotary switch

Input capacitance

100 pF      Between the non-inverting input and GND,  
Between the inverting input and GND

Differential signal input voltage range

Within  $\pm 0.1$  V

Common-mode signal input voltage range

Within  $\pm 10$  V

Input bias current

Within  $\pm 100$  nA

Input offset current

Within  $\pm 30$  nA

## CMRR

110 dB or higher

55 Hz, input level 20 V<sub>p-p</sub>

80 dB

100 kHz, input level 20 V<sub>p-p</sub>

## Equivalent input noise voltage density

0.75 nV/ $\sqrt{\text{Hz}}$ 

f=1 kHz, input terminal short circuit

## Equivalent input noise current density

4.5 pA/ $\sqrt{\text{Hz}}$ 

f=10 kHz

## Equivalent input offset voltage

Within  $\pm 10 \mu\text{V}$ 

Input terminal short circuit

 $\pm 0.2 \mu\text{V}/^\circ\text{C}$ 

Input terminal short circuit, 0 to 40 °C

**5.3 Output**

## Output form

DC coupling and unbalanced single-ended output

## Output connector

SMA connector

## Maximum output voltage

 $\pm 10 \text{ V}$ f=1 kHz, output load 1 k $\Omega$  or higher

## Maximum output current

 $\pm 10 \text{ mA}$ f=1 kHz, output load 1 k $\Omega$  or higher

## Slew rate

22 V/ $\mu\text{s}$ 

## Output impedance

50  $\Omega$  within  $\pm 5 \%$ 

f=100 Hz

## 5.4 Amplifier

### Voltage gain

40 dB within  $\pm 0.2$  dB

f=1 kHz

-70 ppm/°C

f=1 kHz, 0 to 40 °C

### Voltage gain frequency characteristic

DC to 1 MHz

+0.5 dB / -3.0 dB,

Output level 2 V<sub>p-p</sub>,

The reference frequency is 1 kHz

### Total harmonic distortion

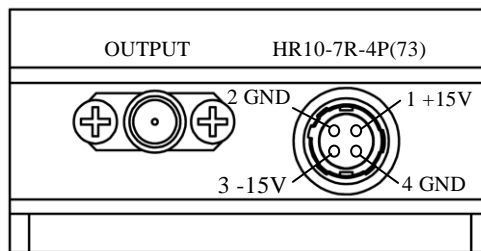
0.004 %

Output level 20 V<sub>p-p</sub>, f=1 kHz

## 5.5 Power Supply

### Power supply connector

HIROSE Co., Ltd. HR10-7R-4P(73)



\*The matching plug is HR10-7P-4S(73)

### Operating supply voltage range

 $\pm 15$  V within  $\pm 1$  V

### Consumption current

 $\pm 45$  mA

No signal

Within  $\pm 75$  mAMaximum output voltage, output load 1 k $\Omega$ 

## 5.6 General

### Specified temperature range

23 °C within  $\pm 5$  °C

### Operating temperature and humidity ranges

0 to 40 °C, 5 to 85 %RH, non-condensation

### Storage temperature and humidity ranges

-10 to 50 °C, 5 to 95 %RH, non-condensation

### Pollution degree

2 (indoor use)

## Altitude

2000 m or lower

## External dimensions

76 × 50 × 21.1 mm

without protrusions and bottom plate

92 × 50 × 25.1 mm

without protrusions, with bottom plate

## Weight

Approx. 105 g

without bottom plate

Approx. 125 g

with bottom plate

## RoHS

Directive 2011/65/EU

## EMC

EN61326-1

Models with CE marking on the rear panel  
only

## Safety

EN61010-1

Models with CE marking on the rear panel  
only

## 5.7 Notes

- A reverse connection of the power supply will damage the internal circuit of this product.
- This product does not operate by a single power supply (+30 V / GND). Be sure to use a dual power supply (+15 V / GND / -15 V).
- Short circuit of the output terminal is not allowed. Output short circuit or overload drive may damage the internal circuit and deteriorate the performance.
- Use beyond the absolute maximum ratings and operating temperature range may lead to characteristic deterioration or damage on the internal circuit.
- Static electricity may cause characteristic deterioration or damage.

5.8 External View

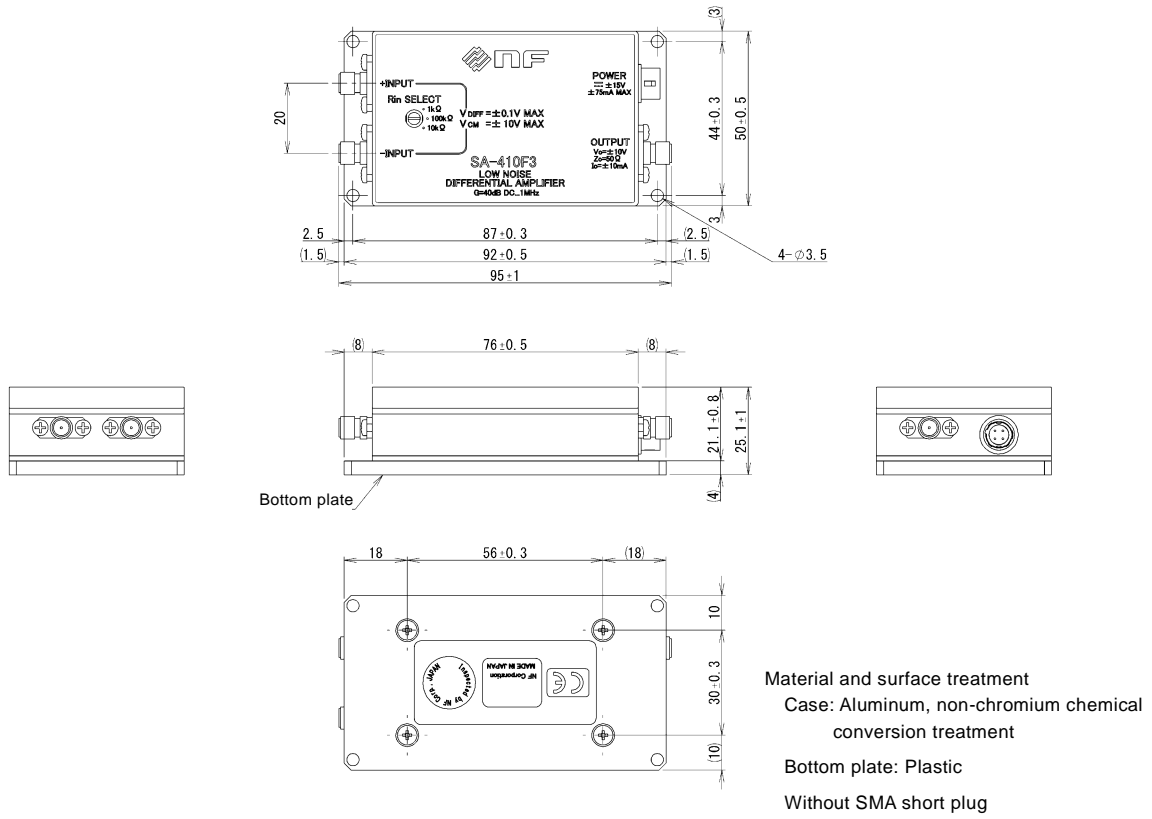


Figure 5-1 External view



## 6. Reference Data

<b>6.1</b>	Reference Data .....	6-1
<b>6.2</b>	Equivalent Input Noise Voltage Density .....	6-1
<b>6.3</b>	Equivalent Input Noise Current Density .....	6-1
<b>6.4</b>	CMRR.....	6-2
<b>6.5</b>	PSRR.....	6-2
<b>6.6</b>	Common-Mode Input Voltage against Maximum Output Voltage .....	6-3
<b>6.7</b>	Power Supply against Input Bias Current .....	6-3
<b>6.8</b>	Power on Drift (Output Offset Voltage) .....	6-4
<b>6.9</b>	Time Drift (Output Offset Voltage) .....	6-4





## 6.1 Reference Data

This chapter shows the general electrical characteristics of a normal SA-410F3. These data show the average values obtained by measuring the performance of individual products. The performance of this product may not achieve the level of these data, but all products have been strictly tested before shipment to check that they meet the specifications.

Unless otherwise specified, 23 °C,  $\pm 15$  V(Use the LP5393), 100 k $\Omega$  (Rin SELECT), load resistance of 1 M $\Omega$ , and common-mode input of 0 V.

## 6.2 Equivalent Input Noise Voltage Density

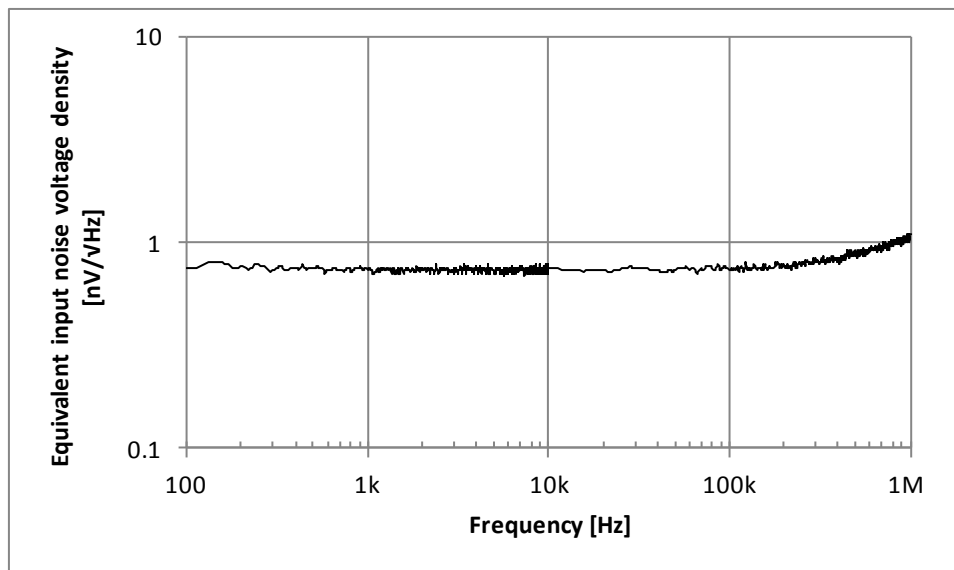


Figure 6-1 Equivalent input noise voltage density

\*Input terminal short circuit

## 6.3 Equivalent Input Noise Current Density

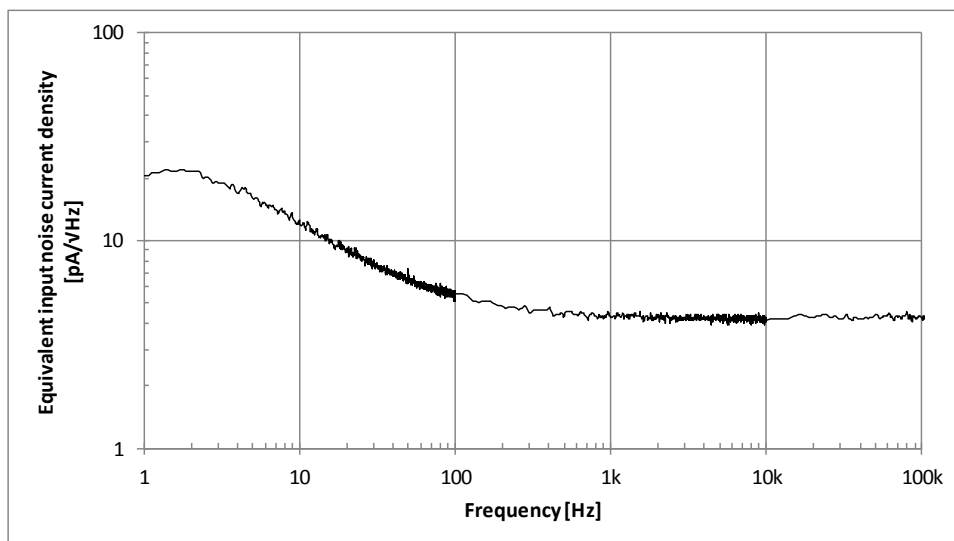


Figure 6-2 Equivalent input noise current density

## 6.4 CMRR

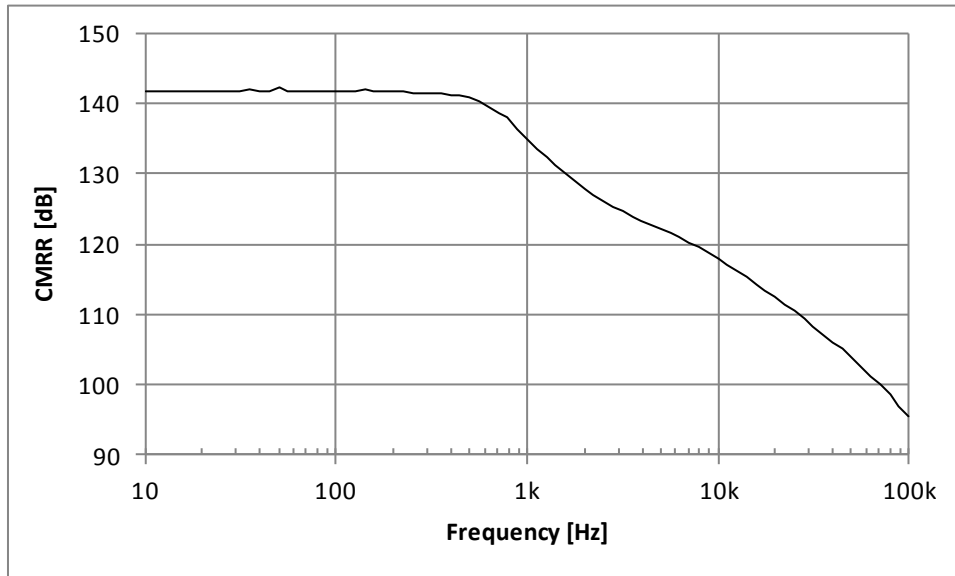
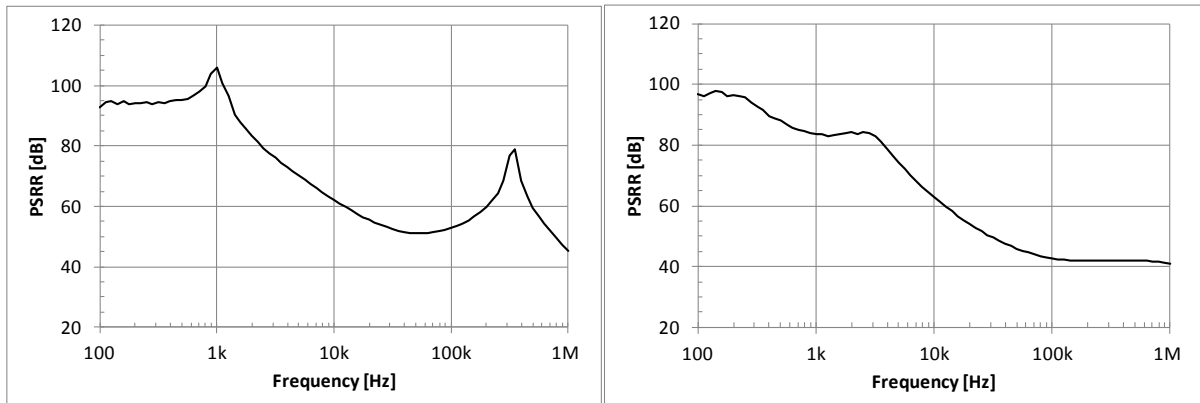


Figure 6-3 CMRR

## 6.5 PSRR



(a) The positive power supply

(b) The negative power supply

Figure 6-4 PSRR

## 6.6 Common-Mode Input Voltage against Maximum Output Voltage

Figure 6-5 shows the maximum output voltage ( $V_{pk}$ ) that satisfies the output voltage total harmonic distortion ( $THD$ )  $\leq -70$  dB when a sine wave is applied as the differential input voltage to the input terminals.

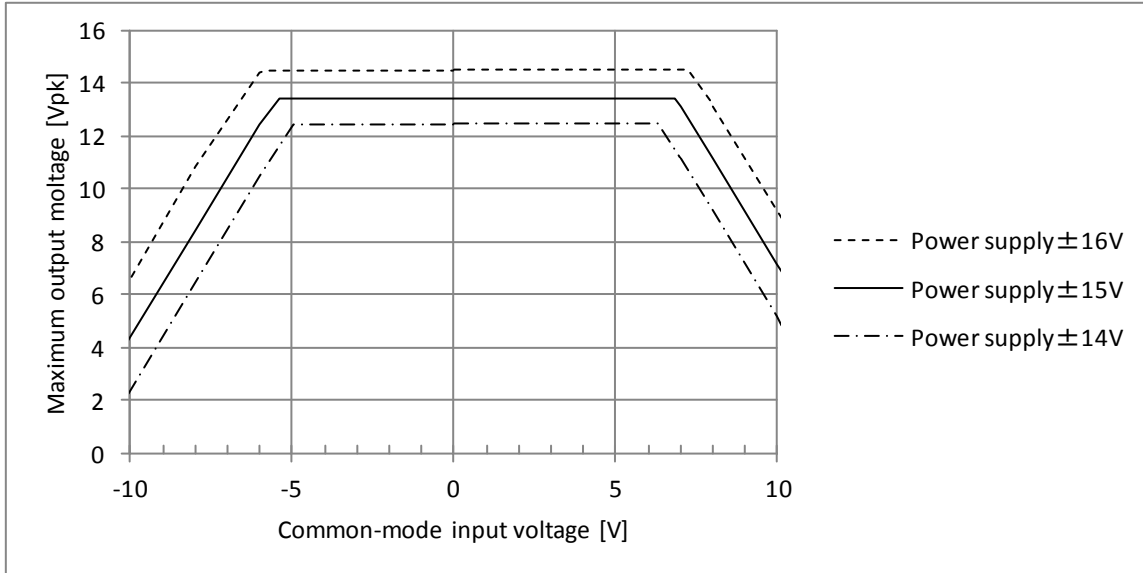


Figure 6-5 Common-mode input voltage against maximum output voltage

## 6.7 Power Supply against Input Bias Current

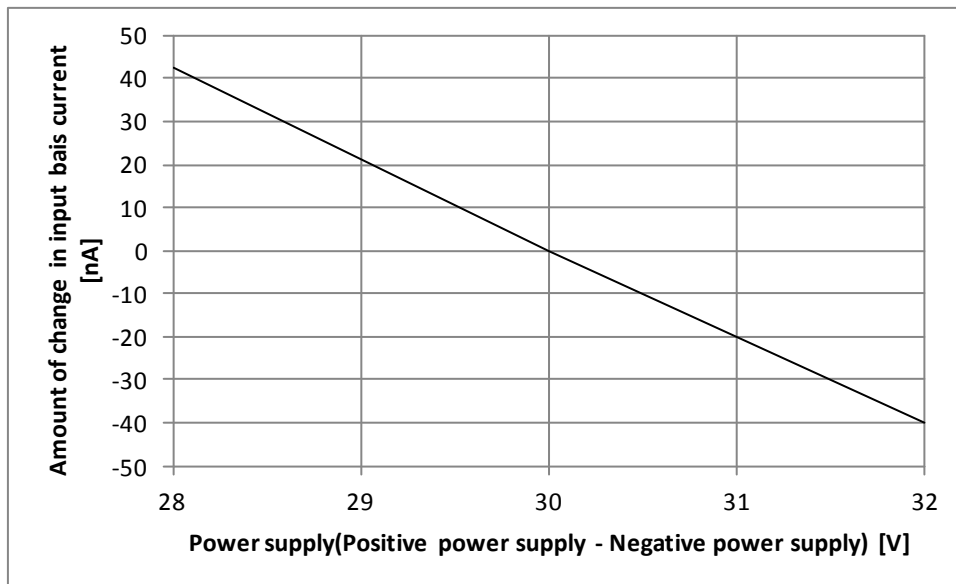


Figure 6-6 Power supply against input bias current

\*The polarity of the bias current is positive in the direction in which it is discharged from the input of the amplifier.

\*Reference power supply is 30 V ( $\pm 15$  V).

## 6.8 Power on Drift (Output Offset Voltage)

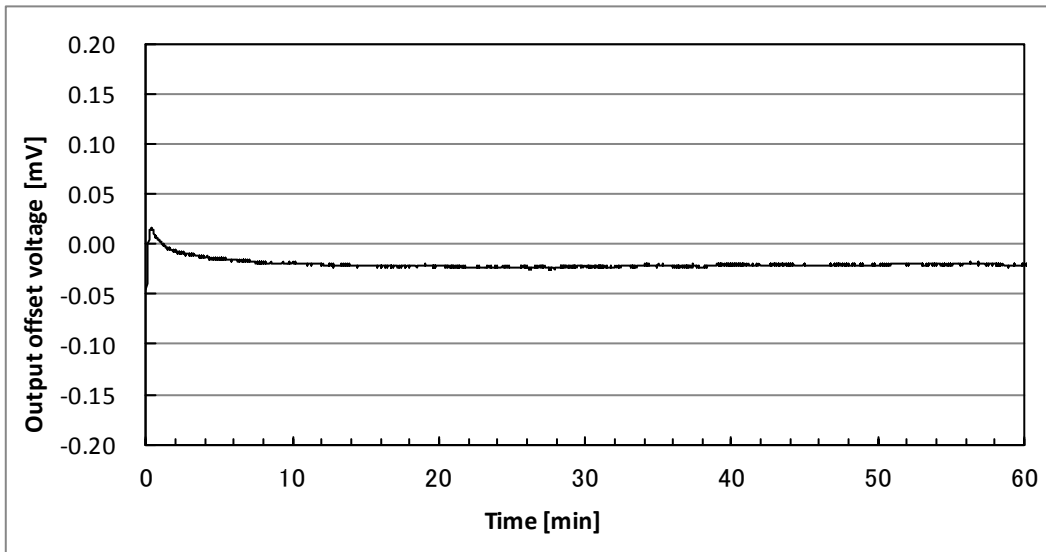


Figure 6-7 Power on drift  
\*Input terminal short circuit

## 6.9 Time Drift (Output Offset Voltage)

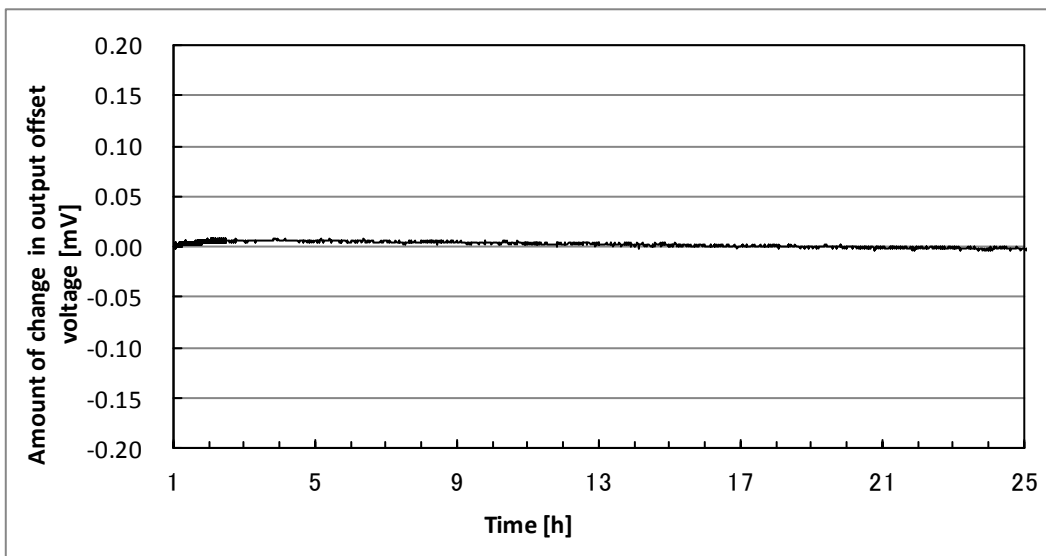


Figure 6-8 Time drift  
\*The reference voltage is 1 hour after turning on the power supply  
\*Input terminal short circuit

# WARRANTY

The **NF Corporation** certifies that this product was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period, **NF** will repair a defective product without any charge for the parts and labor. For repair service under warranty, the product must be returned to either **NF** or an agent designated by **NF**. The purchaser shall prepay for all shipping charges, duties, and taxes for the product to either **NF** or an agent from another country, and the shipping charge for returning the product to the purchaser shall be paid by **NF**.

This warranty shall not apply to any defect, failure, or damage caused by a) improper use; b) improper or inadequate maintenance and care; or c) modifications made by the purchaser or personnel other than **NF** representatives.

**NF Corporation**



If there are any misplaced or missing pages, we will replace the manual. Please contact a sales representative.

#### NOTES

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

Copyright 2017, **NF Corporation**

#### SA-410F3 INSTRUCTION MANUAL

### **NF Corporation**

6-3-20, Tsunashima Higashi, Kohoku-ku, Yokohama  
223-8508 JAPAN

Phone: +81-45-545-8111 Fax: +81-45-545-8191

