



LOW NOISE FET DIFFERENTIAL AMPLIFIER

SA-440F5

INSTRUCTION MANUAL

DA00066278-002

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INSTRUCTION MANUAL

———— Preface ————

Thank you for purchasing the “LOW NOISE FET DIFFERENTIAL AMPLIFIER SA-440F5”.

For safe and correct use of this product, please read the “Safety Precautions” section that follows before attempting to use the instrument.

●Marks and symbols

For safe operation by the use and to prevent damage to the instrument, please give attention to the following marks and symbols that are used in this manual.

WARNING

This mark indicates information for preventing the possibility of death or serious personal injury from electrical shock or other hazards or damage to the instrument in the use or handling of this instrument.

———— **CAUTION** ————

This mark indicates information for preventing the possibility of injury to the use or damage to the instrument and the use for handling of this instrument.

●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-440F5.

———— Safety Precautions ————

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 instructions 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.

- 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 strange sound, 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.

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.

- 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.



Warning

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



Caution

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

- Other symbol



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

- Disposal of this product

- a) Use the services of an industrial waste disposal contractor for disposal of the entire product.
- b) This product does not include batteries.
- c) This product does not include mercury.

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1. Outline

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1.1 Overview

The SA-440F5 is a low-noise differential amplifier that has an equivalent input noise voltage density of $1.8 \text{ nV}/\sqrt{\text{Hz}}$, voltage gain of 40 dB, DC coupling, and FET input. The frequency band is from DC to 20 MHz.

The input resistance is set to 1 M Ω , 100 M Ω , or OPEN. The low-pass filter (LPF) is set to THRU or 1 MHz. These are selected with rotary switches.

The FET input enables low-noise performance over a wide range of signal source impedance.

1.2 Features

- (1) High gain, wideband
Voltage gain:
40 dB
Frequency band:
DC to 20 MHz
- (2) Low noise
Equivalent input noise voltage density:
 $1.8 \text{ nV}/\sqrt{\text{Hz}}$
- (3) Selectable input resistance
Input resistance:
1 M Ω / 100 M Ω / OPEN
- (4) Selectable low-pass filter
THRU:
No use of LPF
1 MHz:
Use of LPF (DC to 1 MHz of frequency band)
- (5) Connectors with excellent shielding characteristics
Input and output connectors:
SMA connectors

1.3 Applications

The SA-440F5 is high gain, wide-bandwidth, and low noise. It is widely used for amplification of small signals.

- (1) Preamplifier for the magnetic flux measurement by SQUID sensor, etc.
- (2) Preamplifier for small voltage after voltage conversion of SEM, etc.
- (3) Preamplifier for the sensor such as inertial, pressure, sonic, etc.
- (4) Preamplifier for biological and chemical sensor.
- (5) Improvement of noise characteristics for a lock-in amplifier.

1.4 Circuit functions

The SA-440F5 is a voltage amplifier that amplifies the voltage difference between the +INPUT and the -INPUT terminal. The gain is of 40 dB. Both input terminal has clamp diode and Rin SELECT switch. The Rin SELECT can select the input resistance.

The LPF SELECT selects from THRU (no use the LPF) or 1 MHz (use the LPF).

The output resistance is 50 Ω .

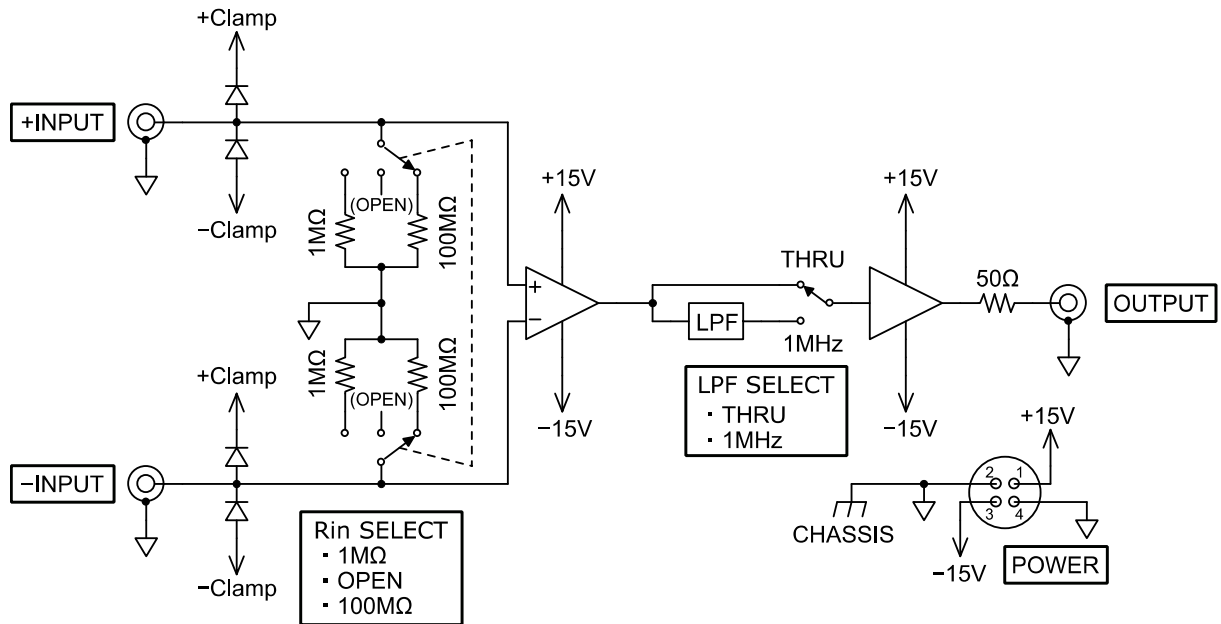


Figure 1-1 Block diagram.



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2. Preparation before Use

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2.1 Checking before use

■ Safety check

Before using this product, read the following section of this manual.

- [Safety Precautions] at the beginning of this instruction manual.
- [2.3 Power supply]

■ Check appearance and accessories

First check for any damage that may have occurred during transportation.

After unpacking, refer to “Table 2-1 List of contents” and confirm that all items are present in the quantities listed.

Table 2-1 List of contents

• SA-440F5	1
• Instruction manual	1
• Accessories	
Bottom plate	1
SMA short plug	1

- * The bottom plate is attached to the main unit by four plastic screws (M3 × 6 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

Optional items below are separately available. If required, please contact the NF corporation or one of our agents.

PA-001-2985: SMA SHORT PLUG

PA-001-2986: SMA-BNC ADAPTER

PA-001-2372: OUTPUT CABLE A (for low noise power supply LP series)

PA-001-3018: POWER SUPPLY CABLE (for DC power supply)

2.2 Conditions for installation location

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

Specifications guaranteed: 18 °C to 28 °C, 5 %RH to 85 %RH

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

Storage: -10 °C to 50 °C, 5 %RH 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 a risk of explosion. Never install or use the product in such locations.
 - Outdoors, locations exposed to direct sunlight, near fire or heat sources.

The performance may not be satisfied, or a failure may occur.
 - Locations where corrosive gases, water vapor dust, or too humid.

Malfunction or a failure may occur.
 - Near an electromagnetic field source, high-voltage product, or power line.

Noise may increase.
 - Where is a lot of vibration.

Noise may increase, or a malfunction may result.
- For heat dissipation, make sure there is a distance of at least 2 cm between the front panel (the panel on which the model name appears) and surrounding objects.

2.3 Power supply

This product operates under the following power supply conditions.

- Stabilized DC power supply with $\pm 15\text{ V} \pm 1\text{ V}$, $\pm 100\text{ mA}$ or higher.

Fluctuations in the power supply voltage affect the output signal. That effect is indicated by the PSRR (Power Supply Rejection Ratio) parameter. For example, a PSRR of 60 dB indicates that a power supply fluctuation of 100 mV produces a 0.1 mV fluctuation in the output voltage.

For accurate measurement of small signals, it is recommended to use of a DC power supply that has superior stability and noise performance.

We provide the excellent stability and low noise performance DC power supply LP series. For information on those products, please contact the NF corporation or one of our agents.

⚠ WARNING

Do not connect this product to an AC outlet, because doing so is dangerous.

⚠ CAUTION

- Incorrect voltage polarity of the power supply will damage this product.
 - Supplying a voltage greater than $\pm 18\text{ V}$ will damage this product.
 - This product does not operate by single power supply ($+30\text{ V} / \text{GND}$). Be sure to use a dual power supply ($+15\text{ V} / \text{GND} / -15\text{ V}$).
-

2.3.1 Connecting to 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 the NF corporation or one of our agents.

The following figure shows the connection using the OUTPUT CABLE A. The output of LP series power supply is set as $\pm 15\text{ V}$.

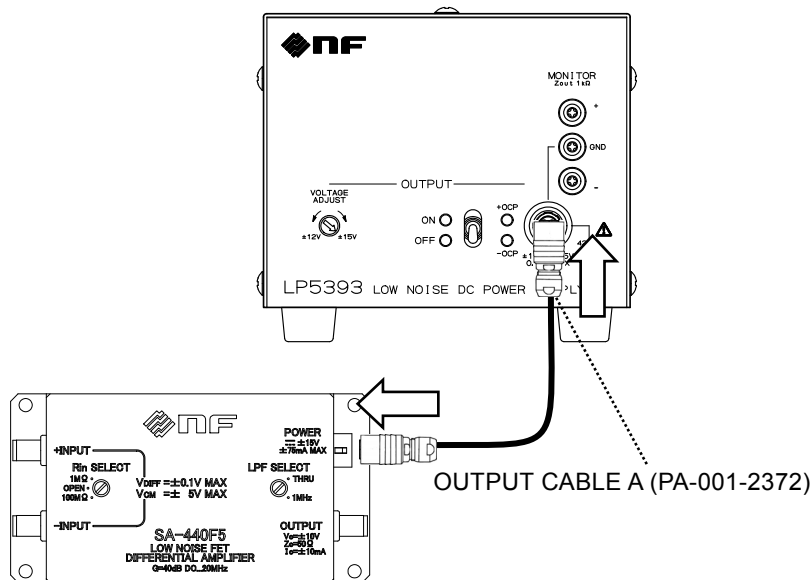


Figure 2-1 Connecting to LP Series power supply.

CAUTION

- Do not plug / unplug the output cable A while the power supply is turned on. This product may be damaged.
-

2.3.2 Connecting to DC power supply

When connecting this product to a stabilized DC power supply, it is convenient to use the PA-001-3018 POWER SUPPLY CABLE that is available for separate purchase. For information on this cable, please contact the NF corporation or one of our agents.

The following figure is the connection diagram for PA-001-3018 POWER SUPPLY CABLE. Set the output voltage of the stabilized DC power supply to ± 15 V for use with this product. For the connection on the power supply side, the cable has three insulated wires. Strip the insulation from the ends of the wires for connection to the power supply.

The power supply output terminals may require that banana-plugs, crimped terminals or special connectors be attached to the ends of the wires. Please refer to the instruction manual for the stabilized DC power supply.

Insulated wires

PINK: +15 V (AWG24)

BLACK: GND (AWG24)

WHITE: -15 V (AWG24)

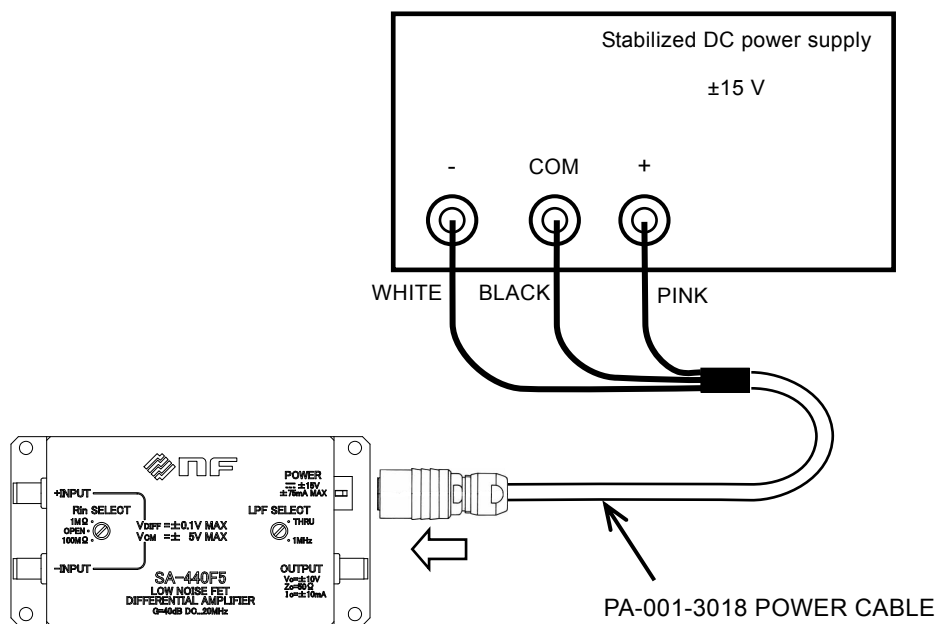


Figure 2-2 Connecting to DC Power Supply.

- Supplying a voltage greater than ± 18 V will damage this product.
 - Incorrect voltage polarity of the power supply will damage this product.
 - Before connecting this product to the power supply, re-check the polarity and voltage of the power supply.
 - This product does not operate by single power supply (+30 V / GND). Be sure to use a dual power supply (+15 V / GND / -15 V).
 - Do not plug / unplug the power cable while the power supply is turned on. That may result in damage to this product.
-



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3. Panel Features and Basic Operations

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3.1 Panel component names and functions

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

① +INPUT

② -INPUT

The +INPUT is a non-inverting input connector of this product. The -INPUT is inverting input connector. Both connectors are SMA connectors.

Differential signal input voltage range is ± 0.1 V. Common-mode input voltage range is ± 5 V.

③ OUTPUT

This is an output connector of this product, which is SMA connector.

The output impedance is 50Ω .

The maximum output voltage is ± 10 V (with $1 \text{ k}\Omega$ load). The maximum output current is ± 10 mA.

Note that the output of this product cannot drive a 50Ω load directly.

④ POWER

This is the power input connector of this product.

The operating supply voltage is ± 15 V.

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

⑤ Rin SELECT

This is a rotary switch that selects the input resistance between the +INPUT to GND and between the -INPUT to GND. The input resistance can be selected from $1 \text{ M}\Omega$, $100 \text{ M}\Omega$, or OPEN.

Using a screwdriver whose tip does not match or applying excessive force may cause damage. The recommended tip size of screwdriver is 1.8 to 2.0 mm of width and 0.4 to 0.5 mm of thickness. The adjustment torque is 10 mN·m maximum.

⑥ LPF SELECT

This is a rotary switch that selects the low-pass filter setting.

When set to THRU, the low-pass filter is not used.

When set to 1 MHz, the low-pass filter limits the bandwidth to 1 MHz.

Using a screwdriver whose tip does not match or applying excessive force may cause damage. The recommended tip size of screwdriver is 1.8 to 2.0 mm of width and 0.4 to 0.5 mm of thickness. The adjustment torque is 10 mN·m maximum.

⑦ Holes

These holes are used to mount this product to the chassis, etc. with the bottom plate mounted to it. The hole size is for M3 screw. This product can be mounted to the chassis while they are electrically insulated.

⑧ Screws / Holes to mount this product

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

Note that if the bottom plate is removed, there is an electrical connection between this product and the object to which this product mounted.

The bottom plate is mounted using M3 × 6 mm plastic screws.

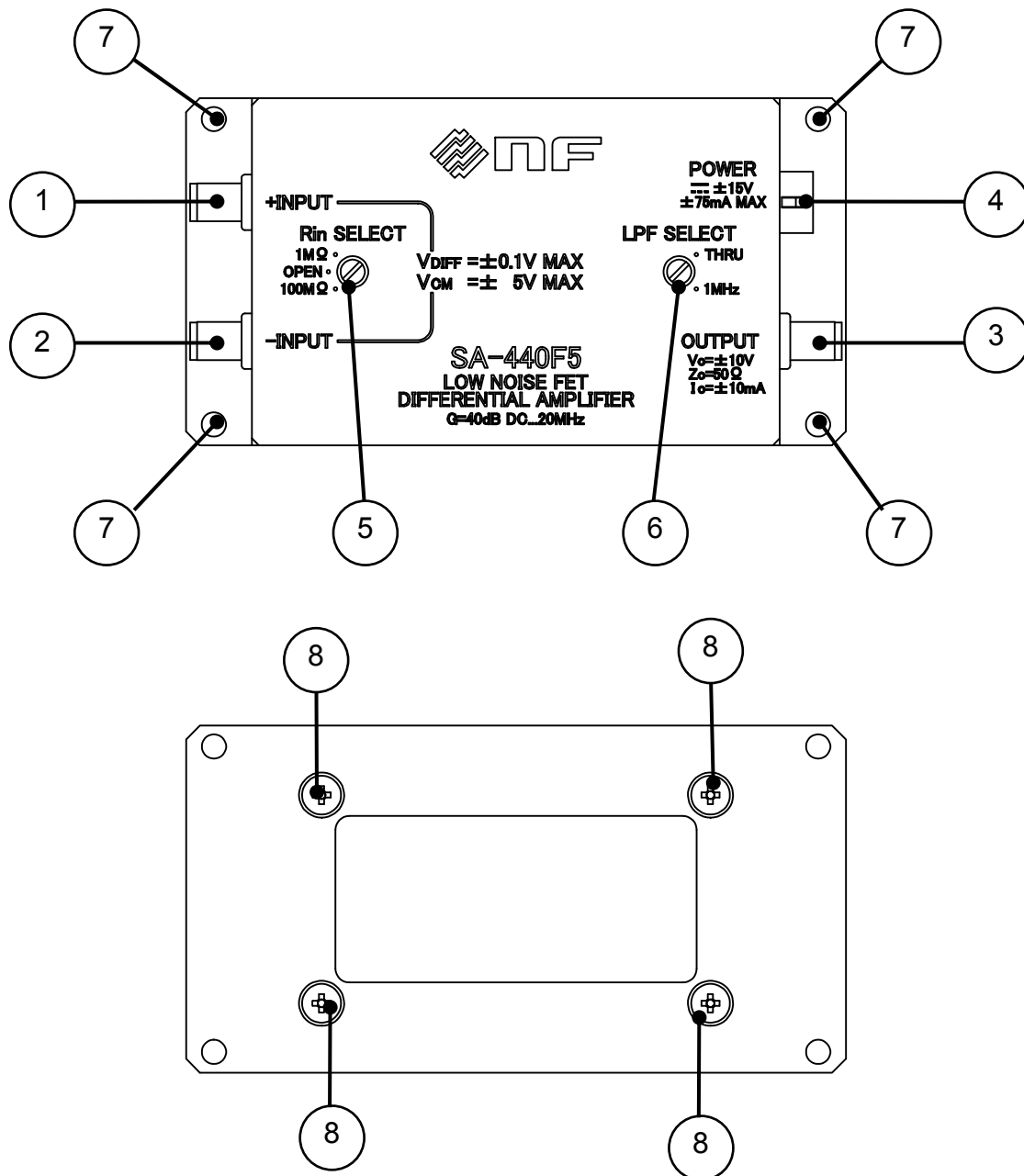


Figure 3-1 Front and rear panel views.

3.2 Input connection and installation

For the best noise characteristics, it is important that the shielding of the input cable and the method for connecting and installing the product. Follow the instructions below to connect and install this product.

- Install this product as close as possible to the sensor or signal source. 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.
- For reducing disturbance and noise from the outside, the semi-rigid cable is useful.
- 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. Coupling the input and output may cause oscillation and instability.
- The longer output cable or power supply one may cause more disturbance and noise. Be sure to make the cables length 2 m or shorter.
- For installing on conductors such as metals, the bottom plate can be used for insulator. It is useful to reduce the GND loop noise through the placed conductors.
- Install this product and sensors as far away as possible from some products including a transformer, such as a DC power supply.
- Install this product in a location where is as little vibration as possible. For small signal detections, it may be subject to the influence of microphonic noise generated by the vibration of the cable.
- Secure this product in a stable location.

⚠ WARNING

Do not connect this product to an AC outlet, because doing so is dangerous.

⚠ CAUTION

- 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 product 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. For more highly accurate measurement, it is allowed to warm up for at least 10 minutes before use.

3.5 For single-ended input use

This product is the differential input amplifier. Also, it is possible to be used as a single-ended input amplifier by short-circuiting either of the input terminals with the supplied SMA shot plug.

Short-circuiting the +INPUT makes an inverting amplifier. Conversely, a non-inverting amplifier is made by short-circuiting -INPUT.

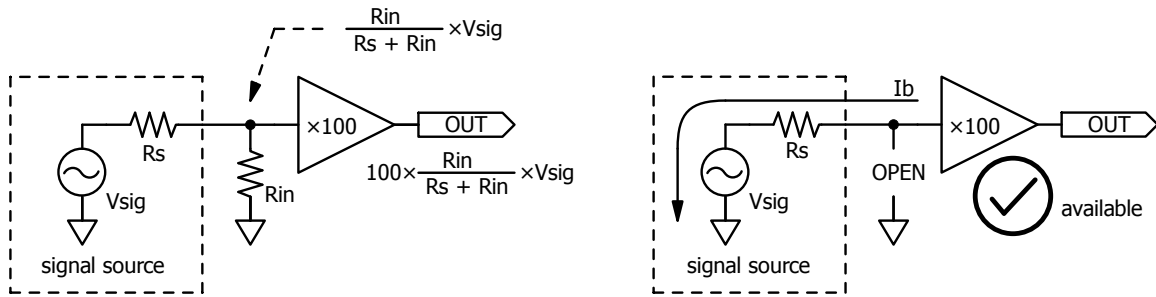
3.6 Configuration of Rin SELECT

This product should usually be used with the input resistance (R_{in}) set to $100\text{ M}\Omega$. However, other settings may be more suitable for some conditions of use.

Figure 3-2 (a) shows the voltage division of the V_{sig} (signal source voltage from sensors) by R_s (the output resistance) and R_{in} (the input resistance). If the R_s is large such as $1\text{ M}\Omega$ or more, it may be possible to reduce the decrease in signal level by using the OPEN setting.

However, if the OPEN setting is used, a signal path must be provided for the input bias current. Figure 3-2 (b) shows the flow of the bias current into the signal source.

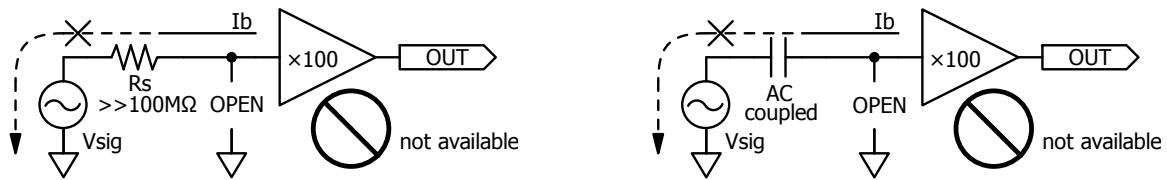
Figure 3-3 (a) and Figure 3-3 (b) shows the example of incorrect connections for the OPEN setting. Please note that if there is no path for the bias current, the output voltage saturates and operation is not possible.



(a) Voltage splitting by R_s and R_{in} .

(b) Bias current path for the OPEN setting.

Figure 3-2 Notes for the signal source resistance and the OPEN setting.



(a) Higher signal source resistance.

(b) AC-coupling.

Figure 3-3 Examples of incorrect connection for OPEN setting.

The input bias current tends to increase as temperature increases. The input bias current flows into the input resistance and is converted to voltage as shown in Figure 3-4.

Therefore, a larger output offset voltage is generated in a higher temperature environment. By switching the Rin setting from 100MΩ to 1MΩ, the effects of the input bias current can be suppressed by a factor of 1/100.

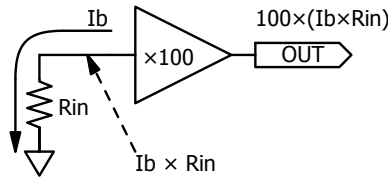
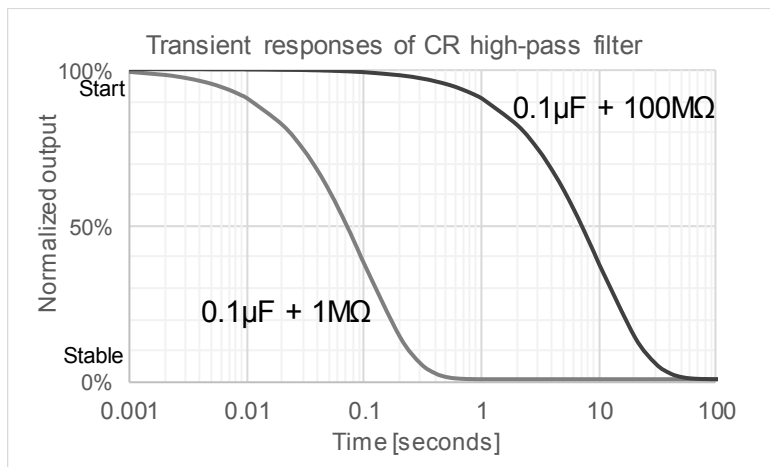
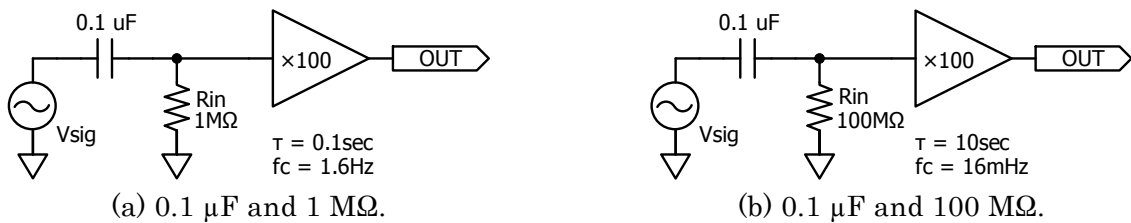


Figure 3-4 Relationship between the input bias current and the offset voltage.

When a capacitor is connected to the input of this product for AC coupling, the time constant can be adjusted by selecting between the Rin settings of 1 MΩ and 100 MΩ.

As shown in Figure 3-5 (a) for example, if a high-pass filter for AC coupling is created with values of 0.1 μF and 1 MΩ, the time constant is 0.1 s. As shown in Figure 3-5 (b), it is possible to pass signals of even lower frequency with the setting of 100 MΩ, but the time constant is increase to 10 s such as Figure 3-5 (c).

Please note that, even with AC coupling, the generated output offset voltage is $100 \times I_b \times R_{in}$, as shown in Figure 3-4.



(c) Comparison of transient responses.

Figure 3-5 Stability time for AC coupling.

4. Maintenance

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4.1 Before maintenance

- This chapter describes the following instructions.
 - Daily maintenance.
 - Precautions and storage methods 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 the NF corporation or one of our agents to request calibration or repair.

4.2 Dairy maintenance

- If the panels and cases are dirty.

Wipe with a soft cloth to clean. To remove stubborn soiling, wipe with a cloth wrung out with neutral detergent. Never use any volatile solvent like thinner, 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.
 - Unplug 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°C to 50°C and 5 %RH 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 cardboard box that can well withstand the weight of the product and is of a large enough size to accommodate it.
- Fill the cardboard 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, calibration or repair is required.

- For the function test, the following instrument devices are required.
 - a) Digital multimeter
0.1 mV DC voltage to be measurable.
 - b) DC power supply
 ± 15 V, ± 100 mA or higher.
 - c) Signal generator
200 mV_{p-p} (70.7 mV_{rms}), sine wave at 1kHz.
 - d) Oscilloscope
Frequency band: 100 MHz or higher.
 - e) Jigs
SMA short plug $\times 2$
SMA to BNC conversion adapter $\times 2$
BNC divider $\times 1$

- Check the following before the function test.
 - Is the power supply voltage 15 V within ± 0.1 V?
 - Is the ambient temperature within 18 °C to 28 °C, and is the ambient humidity within 5 % to 85 %RH?
 - Is there non-condensation?
 - Have 10 minutes or more passed after the power is activated?

4.4.1 Consumption Current (with No Signal)

Check the consumption current if the power supply has a current monitor.

Set the short plug to +INPUT and -INPUT. If the consumption current is within 35 mA to 55 mA, this product is good.

4.4.2 +INPUT (Non-inverting) input operation

Make connections as shown in Figure 4-1.

The signal generator outputs a sine wave with an output voltage of $200\text{ mV}_{\text{p-p}}$ ($70.7\text{ mV}_{\text{rms}}$), offset of 0 mV and frequency of 1 kHz . If waveforms like those in Figure 4-2 are displayed on the oscilloscope, this product is good.

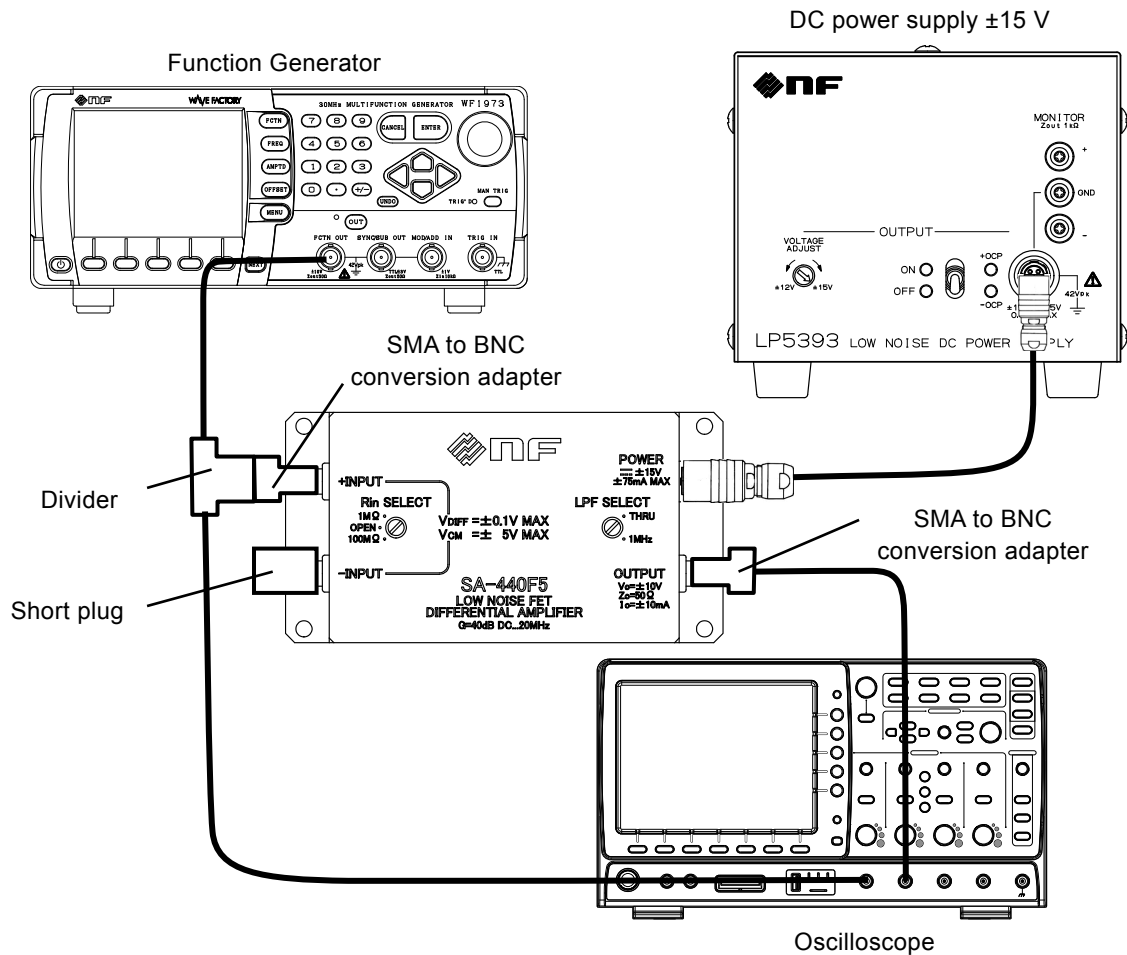


Figure 4-1 Connection diagram for checking non-inverting input operation.

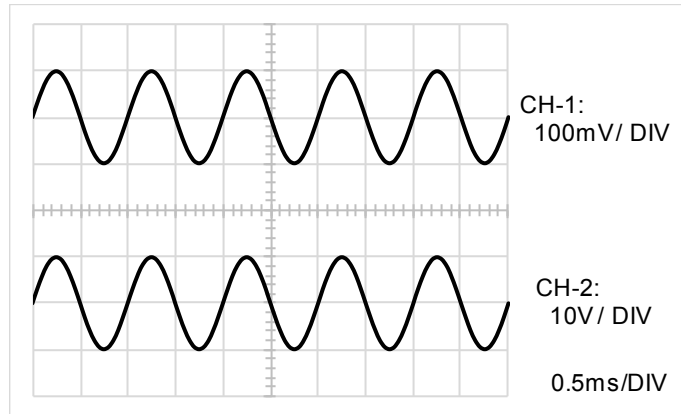


Figure 4-2 Non-inverting input / output voltage waveform.

4.4.3 -INPUT (Inverting) input operation

Make connections as shown in Figure 4-3.

The signal generator outputs a sine wave with an output voltage of $200\text{ mV}_{\text{p-p}}$ ($70.7\text{ mV}_{\text{rms}}$), offset of 0 mV and frequency of 1 kHz . If waveforms like those in Figure 4-4 are displayed on the oscilloscope, this product is good.

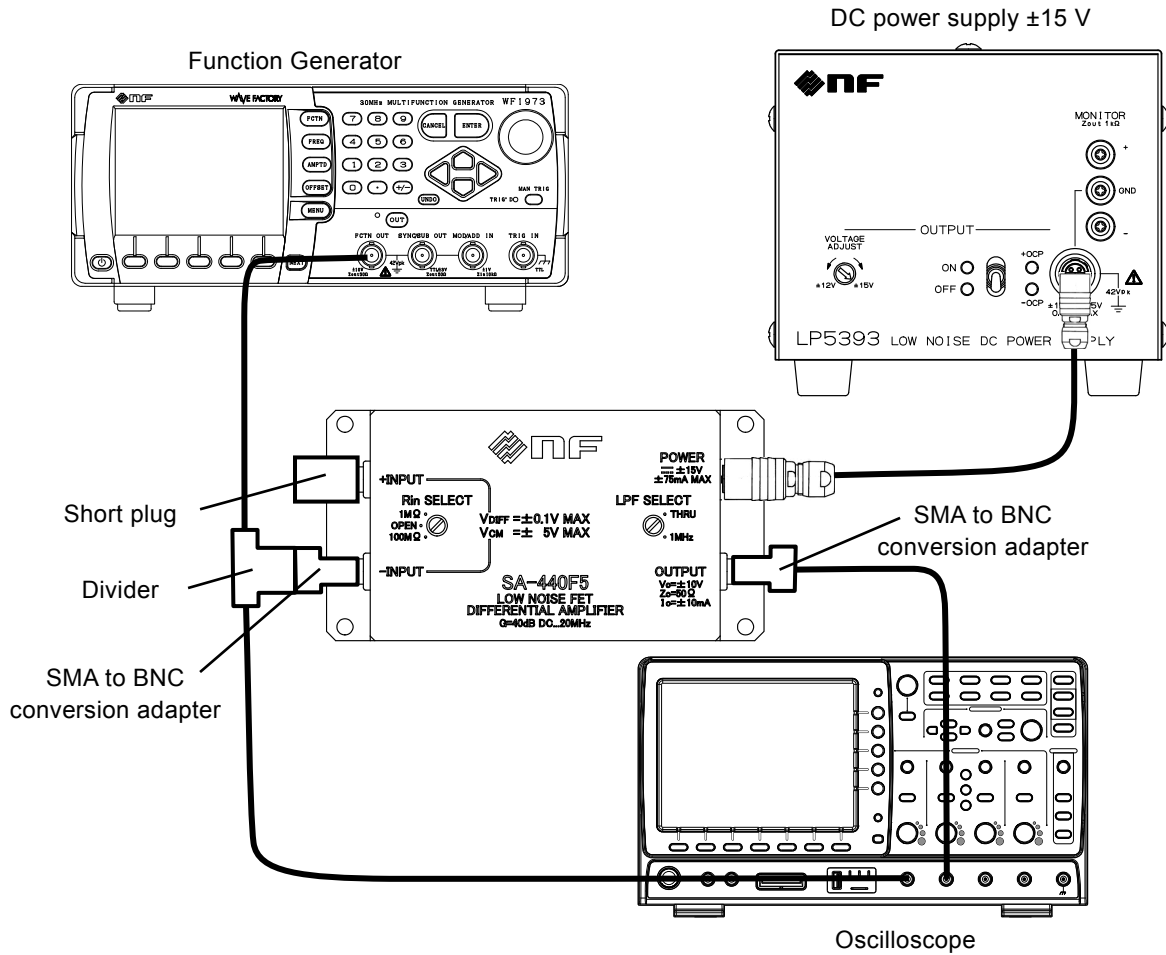


Figure 4-3 Connection diagram for checking inverting input operation.

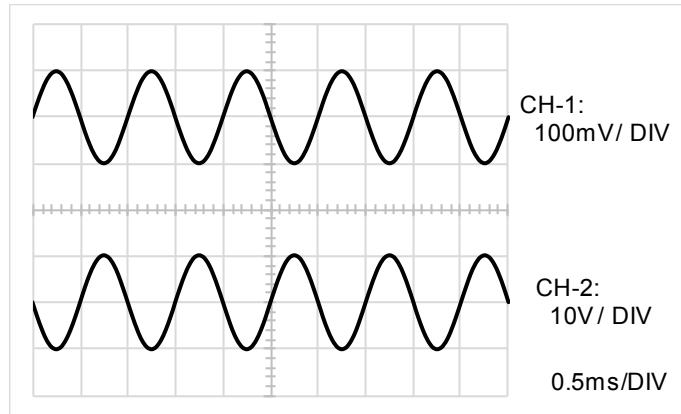


Figure 4-4 Inverting input / output voltage waveform.

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 multimeter.

Calculate the equivalent input offset voltage by the expression below, and if the equivalent input offset voltage is within $\pm 100 \mu\text{V}$, this is good.

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

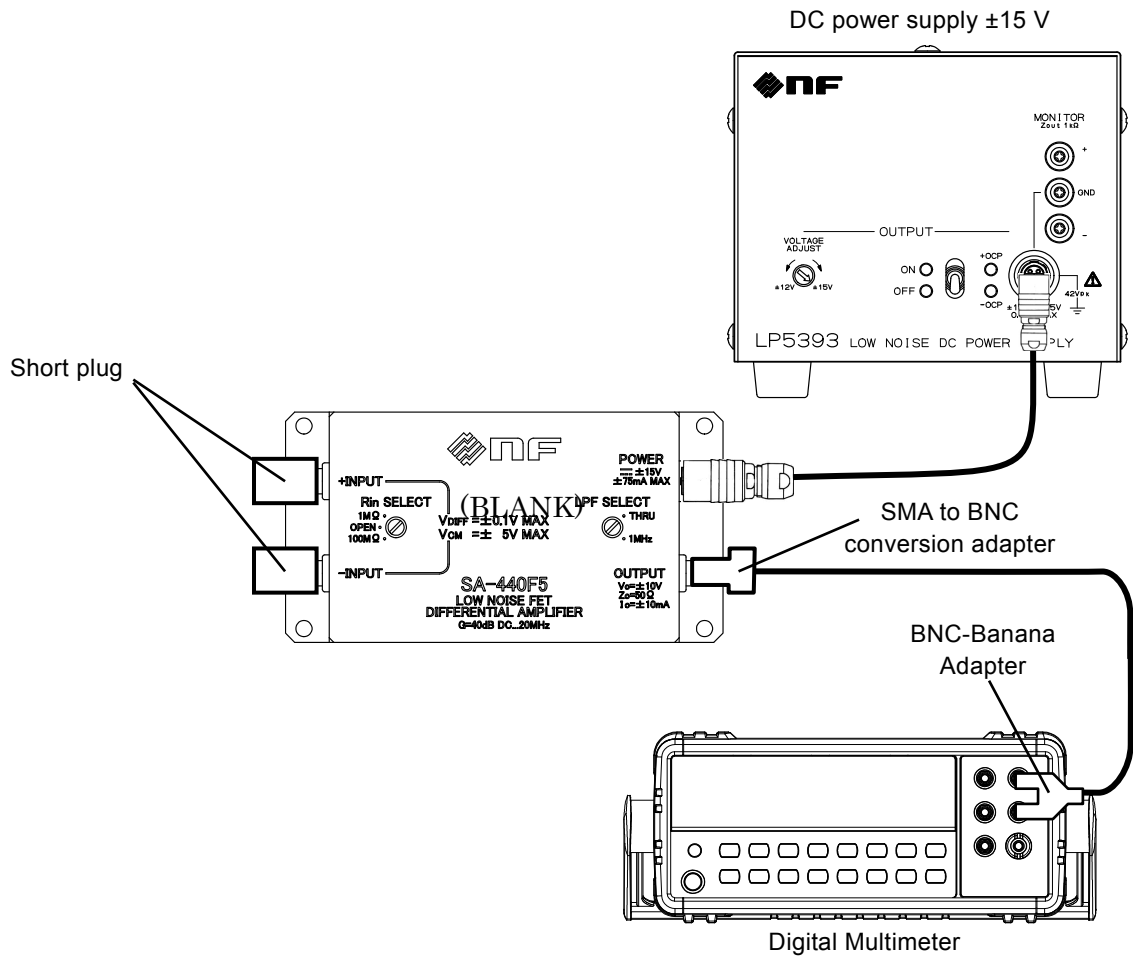


Figure 4-5 Connecting diagram for checking equivalent input offset voltage.

5. Specifications

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Unless otherwise specified, ± 15 V (the LP5393: low noise DC power supply, or equivalent is used), load resistance of 1 M Ω , and low-pass filter of THRU.

Numerical values that have accuracy ranges indicated (“and above”, “and below”, “within”, etc.) are guaranteed.

The values that do not have accuracy ranges indicated are reference values.

5.1 Absolute maximum ratings

Supply voltage ($\pm V_s$)	± 18 V
Signal input range	
Differential input	power ON ± 1 V
	power OFF ± 0.7 V
Common-mode input	power ON ± 7.5 V
	power OFF ± 0.7 V
Signal input current	± 10 mA

* 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, Differential input	
Input connector	two SMA connectors	+INPUT / -INPUT
Input resistance	1 M Ω / 100 M Ω / OPEN	Set with rotary switch.
Input capacitance	60 pF	Each INPUT to GND.
Differential signal input voltage range	Within ± 0.1 V	
Common-mode signal input voltage range (V_{CM})	Within ± 5 V	
Input clamp voltage	± 7 V	
Input bias current	± 200 pA	Doubled by 10 °C rise
Input offset current	± 50 pA	Doubled by 10 °C rise
CMRR	90 dB	f = 10 Hz to 10 kHz, Input level 10 V _{pp}
	60 dB	f = 1 MHz, Input level 10 V _{pp}
Equivalent input noise voltage density	1.8 nV/ $\sqrt{\text{Hz}}$	f = 1 kHz, input shorted.
Equivalent input noise current density	25 fA/ $\sqrt{\text{Hz}}$	f = 100 Hz
Equivalent input offset voltage	within ± 100 μ V	Input shorted.
	± 5 μ V/°C	0 °C to 40 °C

5.3 Output

Output form	DC coupled, unbalanced single-ended output	
Output connector	SMA connector	
Maximum output voltage	± 10 V	$f = 1$ kHz, Output load 1 k Ω or higher.
Maximum output current	± 10 mA	$f = 1$ kHz
Slew rate	± 600 V/ μ s	LPF = THRU
	± 44 V/ μ s	LPF = 1 MHz
Output impedance	50 Ω	$f = 1$ kHz

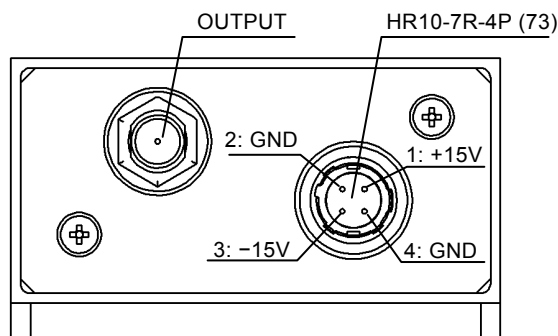
5.4 Amplifier

Voltage gain	40 dB within ± 0.1 dB	$f = 1$ kHz
	± 100 ppm/ $^{\circ}$ C	0 $^{\circ}$ C to 40 $^{\circ}$ C
	-1000 ppm/V	V_{CM} -5 V to 5 V
Voltage gain frequency characteristic	DC to 20 MHz	$+0.5$ dB / -3.0 dB, Output level 2 V_{p-p} , Reference frequency 1 kHz. Set with rotary switch.
	Low-pass filter (LPF)	
	THRU / 1 MHz	
	THRU	no use of LPF
	1 MHz	use of LPF
		Cutoff frequency (-3 dB) of 1 MHz. Reference frequency of 1 kHz
Total harmonic distortion (THD)	0.006 %	$f = 1$ kHz, output level 2 V_{p-p} Sum up to 5 th harmonic. Noise is not included.

5.5 Power supply

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

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



Operating supply voltage range

± 15 V within ± 1 V

Consumption current

± 55 mA

No signal

Within ± 75 mA

Maximum Output voltage,

Output load 1 k Ω .

5.6 General

Specified temperature range

23 °C within ± 5 °C

Operating temperature and humidity ranges

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

Storage temperature and humidity ranges

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

Pollution degree

2 (indoor use)

Altitude

2000 m or lower

External dimensions

76 × 50 × 25 mm

Without protrusions,
without bottom plate.

95 × 50 × 29 mm

Without protrusions,
with bottom plate.

Weight

Approx. 120 g

Without bottom plate.

Approx. 140 g

With bottom plate.

RoHS

Directive 2011/65/EU

EMC

EN61326-1

(note 1.)

EN61326-2-1

(note 1.)

Safety

EN61010-1

(note 1.)

Note 1: Applies to products that have a CE marking displayed on the rear panel.

5.7 Notes

- Incorrect voltage polarity of the power supply will damage this product.
- This product does not operate by 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 of 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

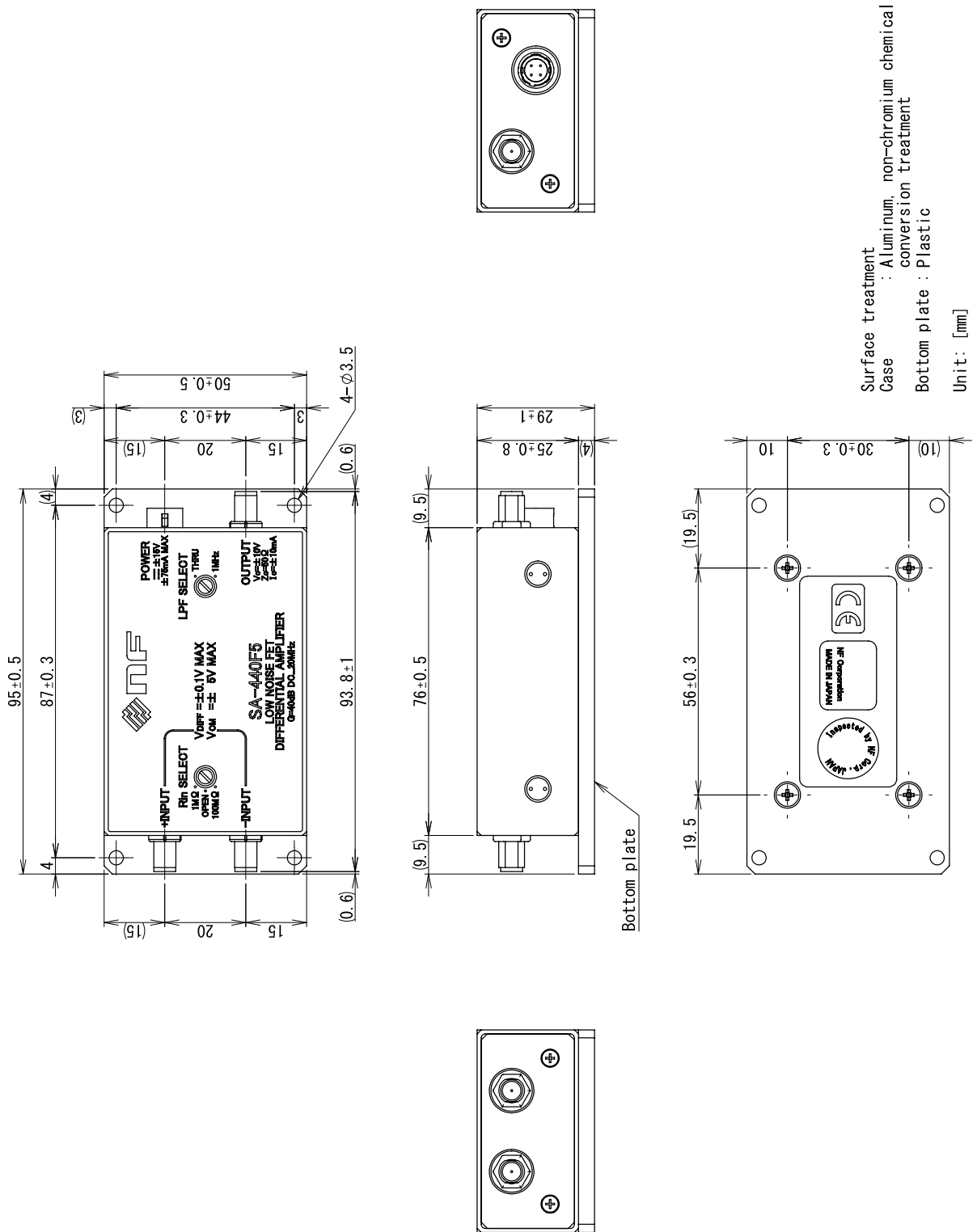


Figure 5-1 External view.

6. Reference Data

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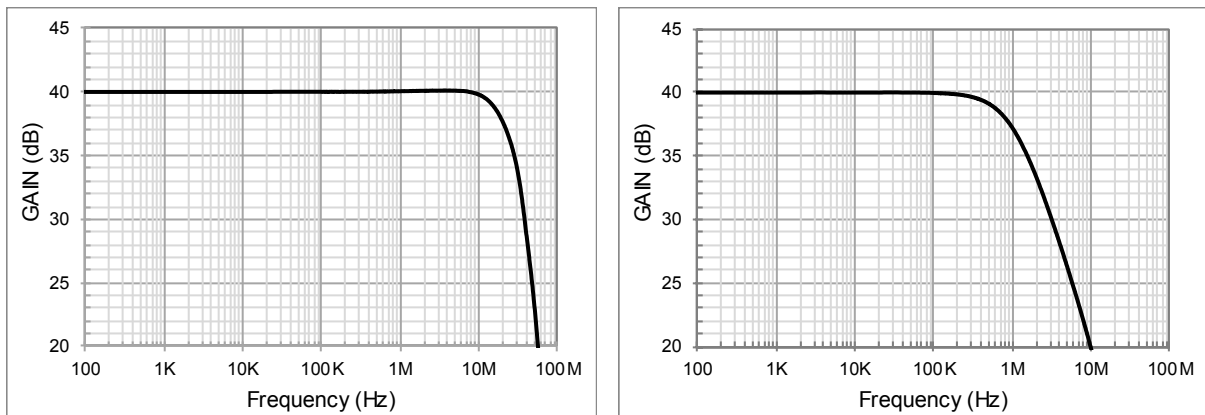
6.1 Reference data

This chapter shows the general electrical characteristics of this product.

These data are not guaranteed the product performance. Therefore, some performance of product could differ from data.

Unless otherwise specified, $\pm 15\text{ V}$ (the LP5393: low noise DC power supply, or equivalent is used), load resistance of $1\text{ M}\Omega$, and low-pass filter of THRU.

6.2 Voltage gain frequency characteristic



(a) LPF SELECT: THRU

(b) LPF SELECT: 1 MHz

Figure 6-1 Voltage gain frequency characteristic ($2\text{ V}_{\text{p-p}}$ output).

6.3 Pulse response

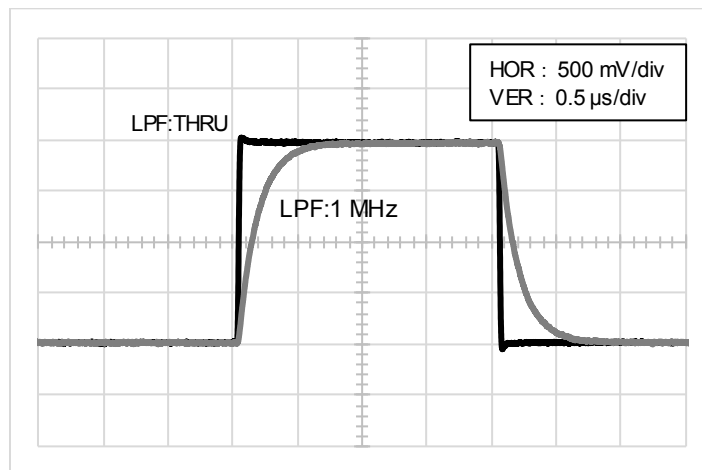


Figure 6-2 Pulse response ($20\text{ mV}_{\text{p-p}}$ square waveform input).

6.4 Equivalent input noise voltage density

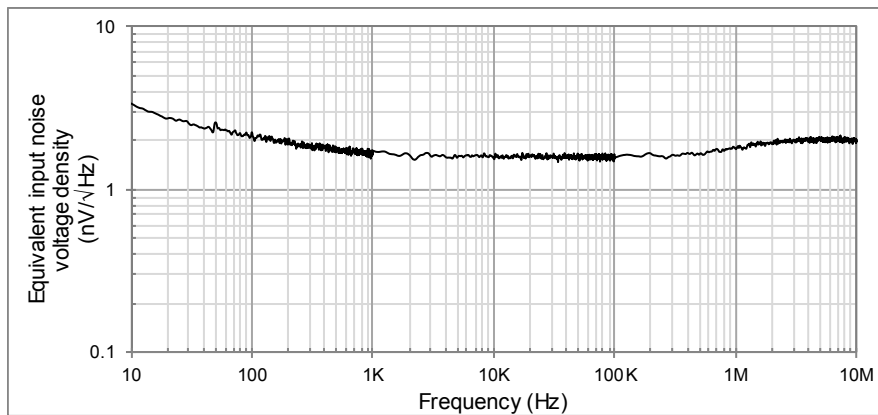


Figure 6-3 Equivalent input noise voltage density (input shorted).

6.5 Voltage gain drift depend on common-mode voltage input

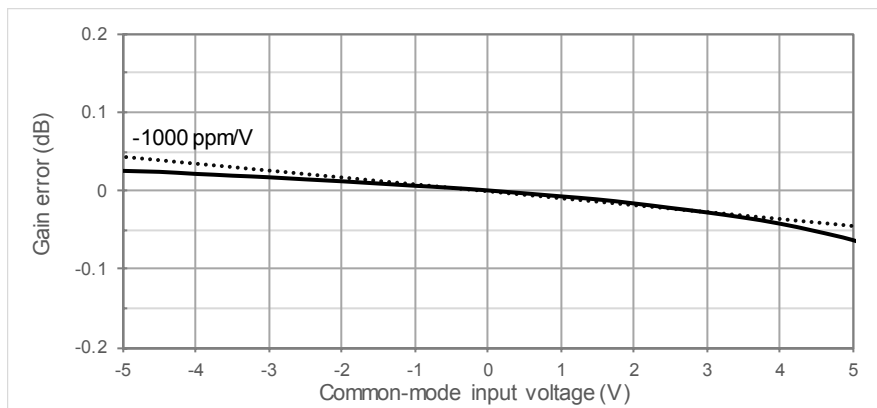


Figure 6-4 Voltage gain drift depend on common-mode voltage input.

6.6 CMRR (Common-mode Rejection Ratio)

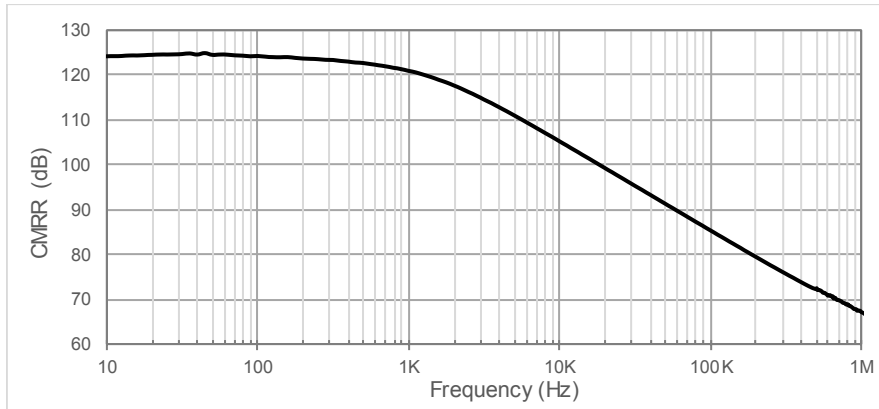
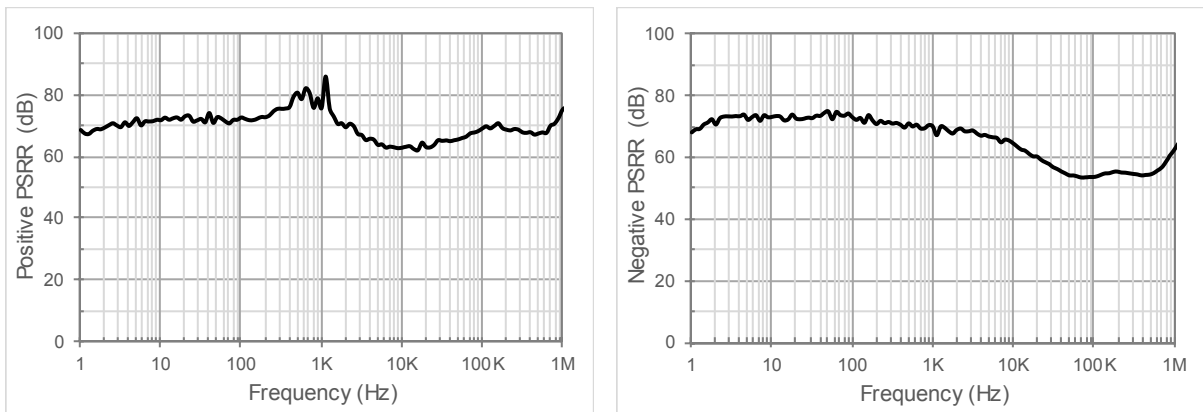


Figure 6-5 CMRR.

6.7 PSRR (Power Supply Rejection Ratio)



(a) Positive power supply.

(b) Negative power supply.

Figure 6-6 PSRR.

6.8 Power-on drift (output offset voltage)

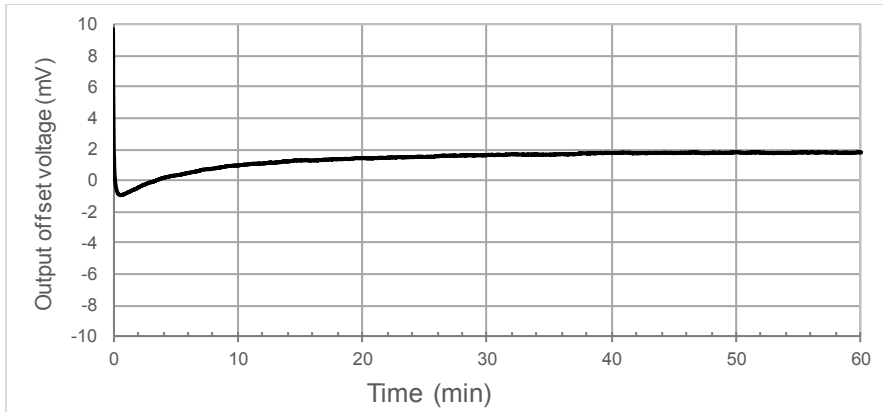


Figure 6-7 Power-on drift.

6.9 Time drift (output offset voltage)

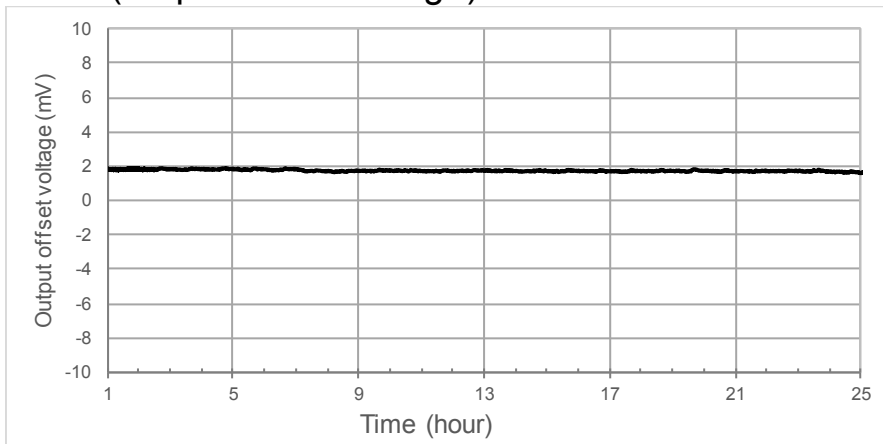


Figure 6-8 Time drift.

WARRANTY

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. In the unlikely event that you experience an issue during use, please contact our company or agency of our company from which you purchased the product.

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 the 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 all shipping cost, duties and taxes for the product to NF from another country, and NF shall pay shipping charges to return the product to the purchaser.

This warranty shall not apply when corresponding to following particulars.

- A) Failure caused by improper handling or use of the product in a manner that does not conform with the provisions of the Instruction Manual.
- B) Failure or damage caused by transport, dropping, or other handling of the product after purchase.
- C) Failure caused by repair, adjustment, or modification of the product by a company, organization, or individual not approved by NF.
- D) Failure caused by abnormal voltage or the influence of equipment connected to this product.
- E) Failure caused by the influence of supply parts from the customer.
- F) Failure caused by such as corrosion that originate in the use of causticity gas, organic solvent, and chemical.
- G) Failure caused by the insect or small animal that invaded from the outside.
- H) Failure or damage caused by fire, earthquakes, flood damage, lightning, war, or other uncontrollable accident.
- I) Failure caused by the reason that was not able to be foreseen by the science and technology level when shipped from our company.
- J) Replacement and replenishment of consumables such as batteries.

NF Corporation

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

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- We assume no responsibility for influences resulting from the operations in this manual.

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SA-440F5 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

