

Programmable Current Amplifier

CA5351

**Various applications from beam position monitoring
in synchrotron radiation to quantum electronics,
semiconductor, MEMS and Biochemistry research.**



High Gain	10^3 V/A to 10^{10} V/A (8 ranges, 10-time step)
Wide Bandwidth	DC to 500 kHz (10^6 V/A), DC to 70 kHz (10^9 V/A)
Fast Response	0.7 μ s (10^6 V/A)
Low Noise	2.5 fA / $\sqrt{\text{Hz}}$ (10^{10} V/A, at 55 Hz)
Current Suppression	± 8 nA to ± 8 mA (7 ranges)

High sensitive detection of signals from current output sensor such as PD, APD and PMT.

Photodiode

Avalanche
Photodiode

Photomultiplier
Tube

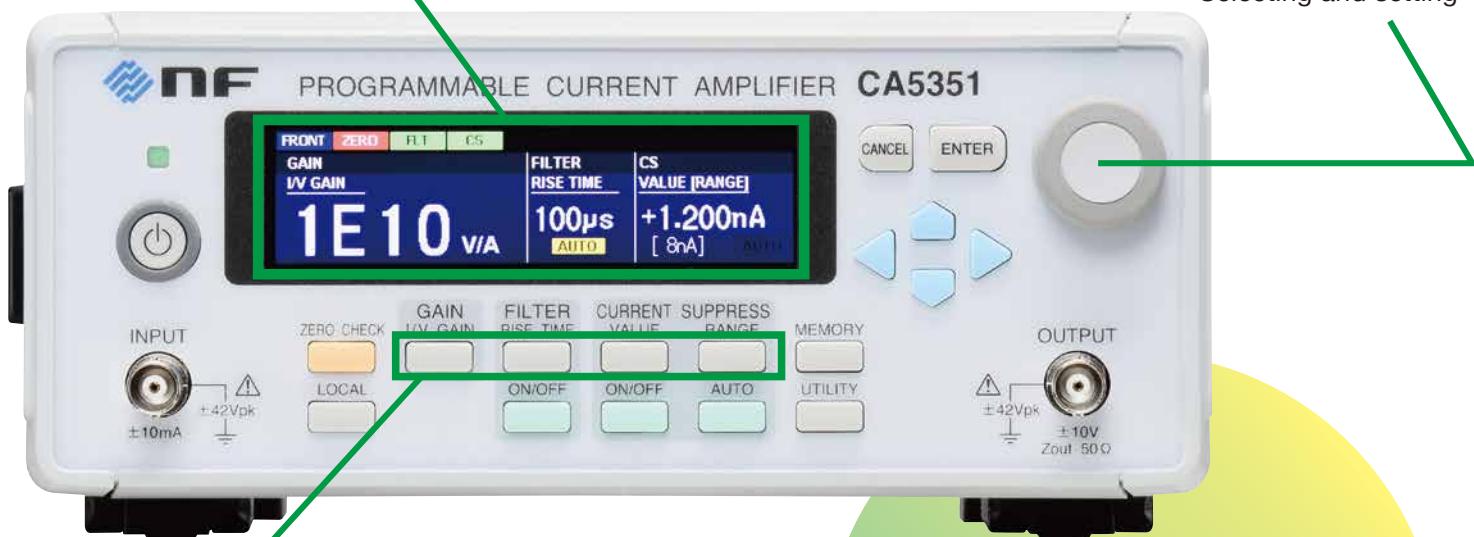
Excellent Operability

Large color LCD display

Gain, filter and current suppression settings are always on display

Easy

Selecting and setting



One-Push Access

To the most frequently used functions

Fulfill high needs from synchrotron radiation facilities

Application

With high gain, wide bandwidth, fast response and low noise features, The CA5351 is ideal for a variety of small current measurements

Synchrotron Radiation Facilities

Detection of small current signals generated from ion chamber

Biochemistry

Measurement of particles suspended in electrolyte by the Coulter method

Automotive

Light distribution measurement of PWM lighting LED headlight:
Amplification of small photo current of photoconductive cells

- Beam position monitoring for synchrotrons and storage rings
- I-V characteristics measurement for organic thin film devices
- Gate leakage current measurement of FET and IGBT
- Detection of STM (scanning tunneling microscope) tunnel current
- Conductive probe current detection of AFM (atomic force microscope)
- As a pre-amplifier for lock-in amplifiers





High Gain · Wide Bandwidth

10^{10} V/A: DC to 14 kHz, 10^9 V/A : DC to 70 kHz

The model CA5351 achieves a measurement system with both high gain and wide bandwidth, that cannot be found elsewhere. The bandwidth is from DC to 500kHz with a response time of 0.7 μ s (gain: 10^6 V/A or less), so high-speed signal amplification is possible.



Adjustable Gains 10^3 to 10^{10} V/A

$10^3/10^4/10^5/10^6/10^7/10^8/10^9/10^{10}$ (V/A) 8 selectable amplification ranges in decade increments, which allows the most suitable gain setting according to the sensor used and measurement environment.



Fast Response · Stable Operation

A high-speed response of 0.7 μ s is possible with a gain of 10^6 V/A.

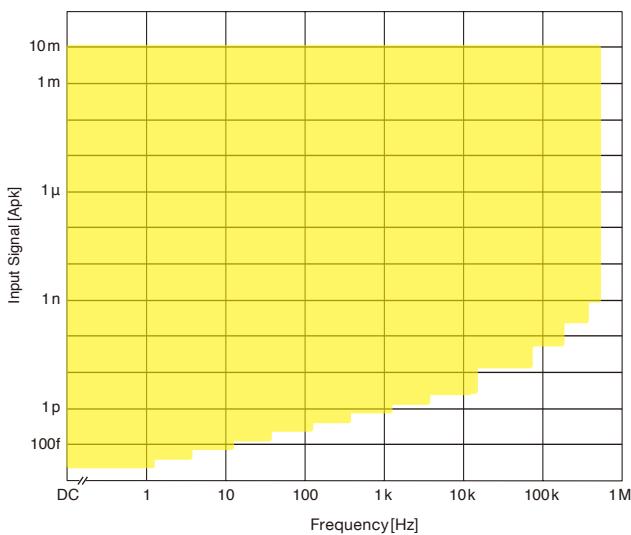
Model CA5351 can process fast pulse signals in optical system measurements.

Resonance does not occur even in the presence of cable or sensor capacitance because of its unique input circuit design and technology.

Also there is no overshoot or ringing in the response of pulse input.

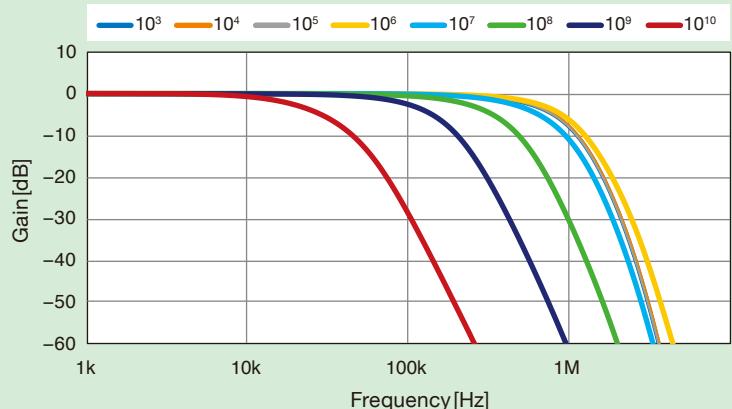
Fast response, wide bandwidth and stability towards input capacitance makes this model suitable for various types of sensors.

Wide Input Current Range Coverage For Various Types of Sensors



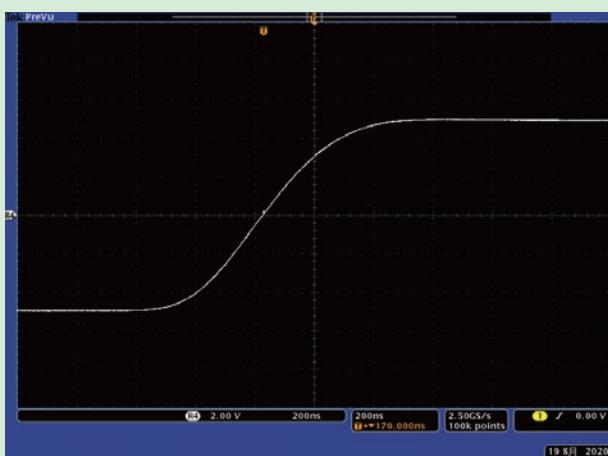
Input current range of CA5351 (S/N ratio: 20dB or more)

Gain-Frequency Response



Fast Response

When gain is 10^6 V/A, the rise time is 0.480 μ s.



X-axis : 200 ns/div. Y-axis : 2 V/div.

Pulse Response

Gain : 10^9 V/A

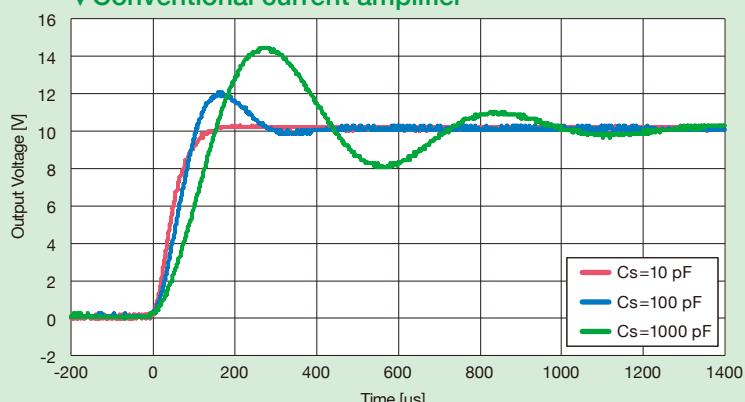
Cs : Input-GND capacitance

VCA5351



No overshoot or ringing

Conventional current amplifier





Current Suppression ±8 nA to ±8 mA

In photoelectric conversion elements such as photodiode and phototransistor, a small current called dark current flows through even when there is no incident light.

In high-gain current amplifiers, when a small DC current input is amplified to a large voltage output, the amplifier becomes saturated, which makes the measurement impossible.

The model CA5351 also incorporates a stable and low noise suppression current supply with high resolution. This current supply can add or offset the input current. For example, by eliminating dark current or leakage current, it can cause higher SN ratio to make the signals detectable. The "Auto Suppression" function automatically changes the current suppression range even if unwanted DC current fluctuates.

Example: When 10 μ A DC current superimposed on the signal

● No Current Suppression

Output saturates when the gain is more than 10⁶ V/A

● With Current Suppression

By eliminating 10 μ A of the current, the gain can be set to 10⁶ V/A, therefore it becomes possible to measure more detailed fluctuations of signals.



Low Noise

Built-in Variable Filter and Low Noise DC Power Supply

It has achieved the ultimate low noise with an equivalent input noise of 2.5 fA/ $\sqrt{\text{Hz}}$ (at 10¹⁰ V/A, 55 Hz)

In addition, it incorporates a built-in filter with 12 setting in 1 to 3 sequences within the response speed of 1 μ s to 300 ms, which eliminates the noise and improves the SN ratio.

The optimum SN ratio and response speed can be used for different applications.

Furthermore, the incorporated DC low noise power supply utilized NF's very unique technology in order to pursue and qualify the required low noise level for small current amplifications.

Other Functions

■ Display Backlight Brightness

4 levels of brightness adjustable or OFF

It can be used in experiments that are sensitive to light.

■ Saved Settings up to 10 memories

■ Overdetection

Detect excessive signals and display the conditions.

Detect current-voltage converted signals (input overdetection) and output connector signals (output overdetection) and display them separately.

Data

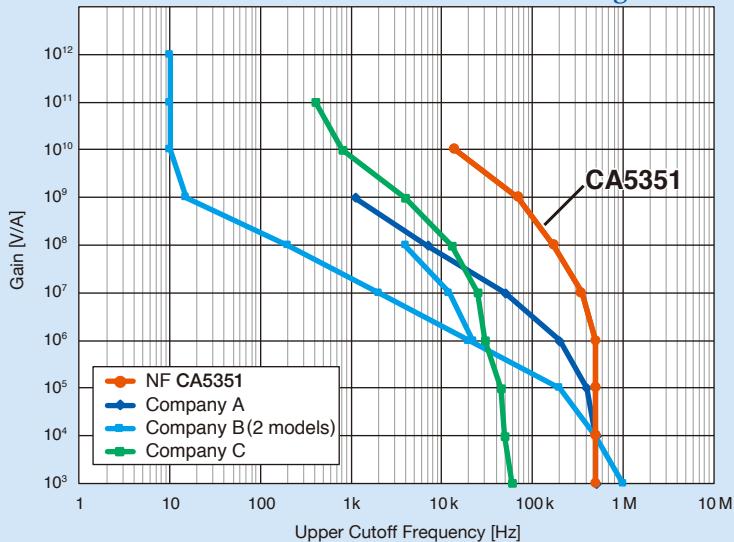
High-quality Performance Supported with Data

The Model CA5351 offers wide bandwidth, high gain and low noise all at the same time, which allows the greatest performance in making tradeoffs.

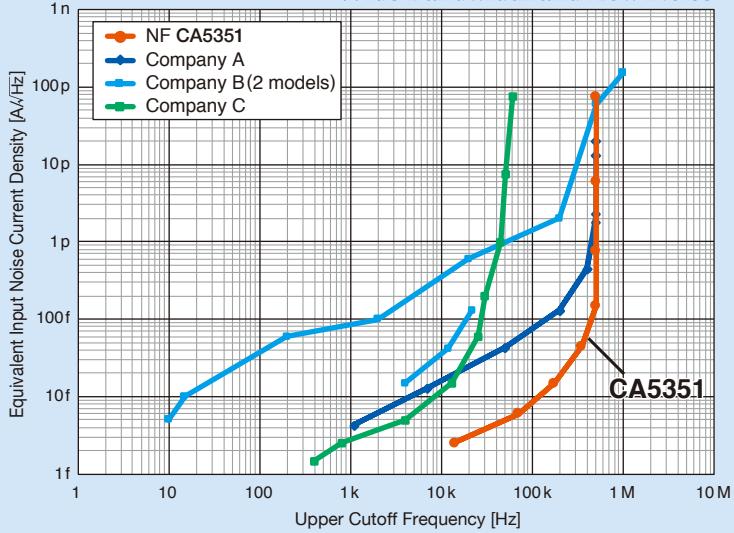
In below graph, it shows the comparison data of the Model CA5351 and products of other manufacturers.

Horizontal axis shows the higher the cutoff frequency is, the wider the bandwidth is.

Wide Bandwidth and High Gain

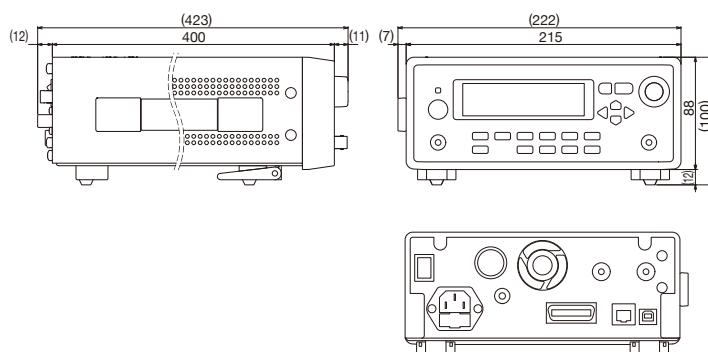


Wide Bandwidth and Low Noise



(Data by NF, September 2020)

Dimensions unit : mm



Specifications

Programmable Current Amplifier CA5351

■ INPUT

Input Type	DC coupling unbalanced input
Input Connector	BNC receptacle, front panel/rear panel switchable
Non-destructive Maximum Input Current	±30 mA

Gain Setting (V/A)	Maximum Input Current	Input Impedance *1	Recommended Signal-source Resistance *1	Equivalent Input Noise Current Density *1*2
1E10(10 ¹⁰)	±1 nA	30 kΩ (@100 Hz)	1 GΩ or more	2.5 fA/√Hz(@55 Hz)
1E09(10 ⁹)	±10 nA	10 kΩ (@1kHz)	100 MΩ or more	6 fA/√Hz (@200 Hz)
1E08(10 ⁸)	±100 nA	3 kΩ (@1 kHz)	10 MΩ or more	15 fA/√Hz (@200 Hz)
1E07(10 ⁷)	±1 μA	1 kΩ (@1 kHz)	1 MΩ or more	45 fA/√Hz (@1 kHz)
1E06(10 ⁶)	±10 μA	400 Ω (@1kHz)	100 kΩ or more	150 fA/√Hz (@1 kHz)
1E05(10 ⁵)	±100 μA	300 Ω (@1 kHz)	10 kΩ or more	750 fA/√Hz (@1 kHz)
1E04(10 ⁴)	±1 mA	10 Ω (@1 kHz)	1 kΩ or more	6 pA/√Hz (@1 kHz)
1E03(10 ³)	±10 mA	3 Ω (@1 kHz)	100 Ω or more	75 pA/√Hz(@1 kHz)

*1 Supplemental value *2 When input is open with front input, no source capacitance, and filter is on(Auto filtering).

■ CURRENT SUPPRESSION

Current Suppression	ON or OFF
Range	7 ranges (8 nA, 80 nA, 800 nA, 8 μA, 80 μA, 800 μA, 8 mA)
Range Setting	Manual Setting, Auto Setting
Setting Range	8 nA -8.000 nA to +8.000 nA Setting resolution 1 pA
	80 nA -80.00 nA to +80.00 nA Setting resolution 10 pA
	800 nA -800.0 nA to +800.0 nA Setting resolution 100 pA
	8 μA -8.000 μA to +8.000 μA Setting resolution 1 nA
	80 μA -80.00 μA to +80.00 μA Setting resolution 10 nA
	800 μA -800.0 μA to +800.0 μA Setting resolution 100 nA
	8 mA -8.000 mA to +8.000 mA Setting resolution 1 μA
Setting Accuracy (Supplemental Value)	8 nA ± (3.0% of Setting + 0.15% of Range)
	80 nA ± (1.5% of Setting + 0.15% of Range)
	800 nA ± (0.8% of Setting + 0.15% of Range)
	8 μA or above ± (0.6% of Setting + 0.15% of Range)

* Auto suppression function is available to automatically select/set current values for input current elimination.

■ AMPLIFICATION

• Gain/Accuracy(DC)/Frequency Response (When filter is off, and no source capacitance)

Gain Setting (V/A)	Gain/Accuracy	Frequency Response +0.5 dB/-3.0 dB or less	Response Speed*3*4
1E10(10 ¹⁰)	1×10 ¹⁰ ±1.0%	DC to 14 kHz*5	25 μs
1E09(10 ⁹)	1×10 ⁹ ±1.0%	DC to 70 kHz*6	5 μs
1E08(10 ⁸)	1×10 ⁸ ±0.5%	DC to 175 kHz*6	2 μs
1E07(10 ⁷)	1×10 ⁷ ±0.3%	DC to 350 kHz*6	1 μs
1E06(10 ⁶)	1×10 ⁶ ±0.25%	DC to 500 kHz*6	0.7 μs
1E05(10 ⁵)	1×10 ⁵ ±0.25%		
1E04(10 ⁴)	1×10 ⁴ ±0.25%		
1E03(10 ³)	1×10 ³ ±0.25%		

*3 Square waveform output rise time (10%–90%) *4 Supplemental values for reference

*5 Reference frequency 1Hz *6 Reference frequency 10Hz

• Filter

Filter	ON or OFF		
Setting Range	Response Speed (Rise Time) : 1 μs to 300 ms, In 1, 3 sequences, auto filtering		
Setting Accuracy	Within ±20% of set time (10%–90% rise time)(Supplemental Value)		
Filter Characteristics	Low pass filter(LPF), Phase linear type		
Attenuation(slope)	12 dB/oct		
Auto Filtering	Filter setting is based on gain setting. If the gain setting is changed during auto filtering, the filter setting will change automatically as well.		
Gain Setting (V/A)	Filter Setting	Gain Setting (V/A)	Filter Setting
1E10(10 ¹⁰)	100 μs	1E06(10 ⁶)	10 μs
1E09(10 ⁹)	100 μs	1E05(10 ⁵)	3 μs
1E08(10 ⁸)	30 μs	1E04(10 ⁴)	1 μs
1E07(10 ⁷)	10 μs	1E03(10 ³)	1 μs

• Phase between Input and Output

Phase between Input and Output	Reverse phase (when current flows in input connectors, output potential becomes negative)
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■ OUTPUT

Output Type	DC coupling unbalanced output
Output Connectors	BNC receptacle , Front/Rear panel, Front and rear connectors output the same signals
Maximum Output Voltage	±10 V (No load)
Maximum Output Current	±10 mA Total current of front and rear connectors
Output Impedance	50 Ω (Supplemental Value)
Output Offset Voltage	±30 mV or less (Gain setting 1E10 V/A) ±20 mV or less (Gain setting 1E03 to 1E09 V/A) (Open input, Current suppression OFF)

■ GENERAL

Display	3.9 inch, TFT color LCD 4 levels of backlight brightness and OFF
Saved Settings	10 memories (1 memory is for resume. Memory is saved just before the power source is off and the settings will be recalled after restarting.)
Input/Output Grounds	Input and output signal grounds are isolated from chassis (signal grounds are common) Signal ground -Withstand voltage between chassis : 42 Vpk (DC+ACpeak)
Overdetection	Detects excessive signal and displays conditions on LCD screen. Overdetection is to detect current-voltage converted signals and output connectors signals and display them separately.
External Control	USB : USB1.1, Device class CDC GPIB : IEEE488.2 LAN : 10BASE-T / 100BASE-T, TCP/IP(socket communication)
Power Supply	AC100 V±10% / 120 V±10% / 230 V±10%, -14% (250 V or less) 50 Hz/60 Hz ±2 Hz, Power consumption: 40 VA or less Oversupply Category : II
Chassis Cooling	Forced air cooling, Rear Exhaust.
Environmental Conditions	Operation 0°C to +40°C, 5% to 85%RH (Absolute humidity is 1 to 25 g/m ³ , no condensation)
	Performance 23°C±5°C, 5% to 85%RH (Absolute humidity is 1 to 25 g/m ³ , no condensation)
	Storage -10°C to +50°C, 5% to 95%RH (Absolute humidity is 1 to 29 g/m ³ , no condensation)
Pollution Degree	2 (offices, laboratories, test stations)
Warm-up Time	30 min
RoHS	Directive 2011/65/EU
Safety Regulations and EMC	EN 61010-1, EN 61010-2-030 EN 61326-1(Group1, ClassA), EN 61326-2-1
Dimensions	215(W)×88(H)×400(D) mm (excluding protrusions)
Weight	approx. 4.5 kg (excluding accessories)
Accessories	Power cord set (3 pin, 2 m) 1, fuse*7 (1 A/250 V time lag, φ5.2×20 mm) 1, instruction manual 1

*7 Spare fuse. There are 2 fuses in the inlet, 1 working fuse and 1 spare fuse.

■ OPTIONS

- PA-001-3512 Rackmount Kit (EIA, 1 unit)
- PA-001-3513 Rackmount Kit (EIA, 2 units)
- PA-001-3514 Rackmount Kit (JIS, 1 unit)
- PA-001-3515 Rackmount Kit (JIS, 2 units)

*Note: The contents of this catalog are current as of October 14th, 2020.

Product appearance and specifications are subject to change without notice.

Before purchase, contact us to confirm the latest specifications, price and delivery date.