

Zurich  
Instruments

# HF2CA Current Amplifier

## Differential Current Amplifier

Product Specification  
Release date: August 2014

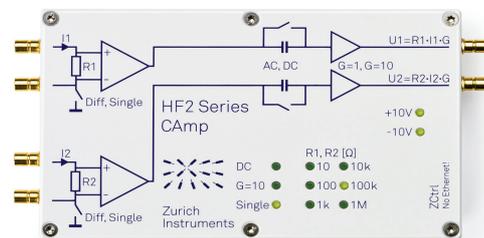
### Key Features

- 100 MHz bandwidth amplifier for highly capacitive sources
- 2 independent amplification channels
- Precision input impedance for accurate source matching
- Differential input for improved signal integrity
- Extremely low noise and low input leakage
- Single interface connector to HF2 Instruments
- Handy product design

### Summary

The HF2CA current amplifier converts a differential input current to a differential output voltage in a wide frequency range up to 100 MHz. This device functions as an active probe and is conveniently placed close to the measurement setup. It supports applications with high capacitive loads such as electric impedance spectroscopy (EIS), where a large electrode-to-electrolyte capacitance needs to be measured at high frequencies. The careful design of the HF2CA ensures stability and smooth operation over the entire frequency range.

The combination of this differential current amplifier with the differential input of the HF2 Instruments allows for very high performance measurements and insensitivity to interferences thanks to reduced parasitics.



### Hardware

#### Differential Input, Differential Output

The amplifier features 2 differential input and 2 single-ended output connectors. This permits to amplify differential and single-ended input signals, but also to combine both amplification paths into one differential output signal.

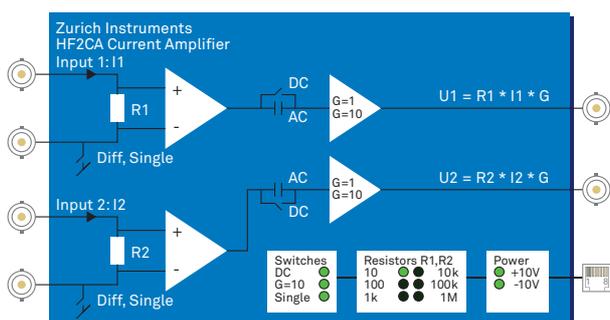
For single-ended operation the negative input connector is switched either to amplifier ground internally or to an external ground provided by the application. This permits to use the amplifier in a large common mode range.

#### JFET Input Amplifier

The HF2CA is based on JFET input amplifiers which provide very low-noise over a wide frequency range. Additionally, the ultra-low input bias current of typically 2 pA allows for precise current measurements at small signal amplitudes.

#### Single Connector to HF2 Series

The HF2CA ideally fits to the HF2 Instruments with its single connector providing both power supply and remote control. The HF2CA is automatically detected by the HF2 Series instruments when it is connected and all settings can be controlled from the graphical user interface.



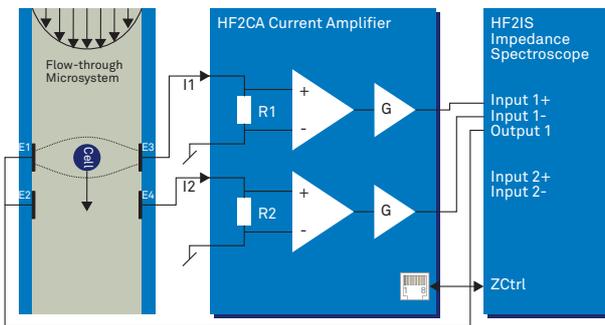
## Settings

Configurable settings include the input impedances (R1, R2), the output voltage gain (G), the switch for differential input operation (Single/Diff), and the DC coupling switch to prevent the propagation of 50/60 Hz noise.

## Example Applications

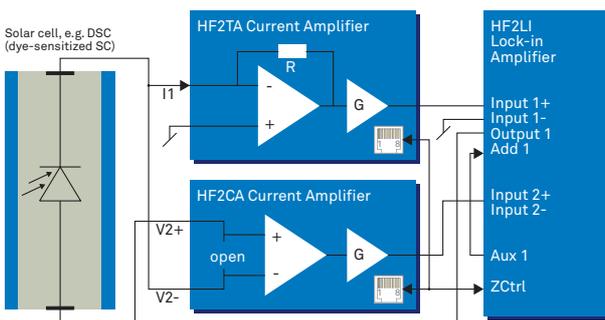
### Multi-frequency impedance measurements in flow-through microsystems (microfluidics)

The HF2CA in combination with the HF2IS impedance spectroscopy is the solution for single-cell characterization in flow-through microsystems for biology. The measurement microelectrodes can directly be connected to the current amplifier and the differential current can be analyzed at very high precision and low noise.



### Semiconductor device characterization

Accurate characterization of semiconductor devices, such as solar cells or LEDs, is possible using the HF2LI lock-in amplifier with the HF2CA and HF2TA as high-throughput testing platform. The HF2LI provides the stimuli and performs immediate response acquisition over the full operating range at a fraction of the system cost of conventional full-featured impedance analysis systems.



## Specifications

### General

dimensions	11.5 x 6 x 2.5 cm
weight	0.4 kg
storage temperature	-20°C to 65°C
operating temperature	5°C to 40°C
specification temperature	25°C
supply ranges	-15 V to -12 V, 12 V to 15 V
supply current	100 mA (max)
connectors	4 SMB input, 2 SMB output, 1 ZCtrl (RJ45)

### Frequency response (3 dB cut-off)

range with DC coupling	DC - 100 MHz
range with AC coupling	100 Hz - 100 MHz
small signal bandwidth	100 MHz (0.1 V <sub>pp</sub> , 50 pF)
large signal bandwidth	40 MHz (1.0 V <sub>pp</sub> , 50 pF)

### Input

input noise voltage (10 MHz)	6 nV/√Hz (typ)
input noise voltage (10 kHz)	7 nV/√Hz (typ)
input bias current	2 pA (typ), 20 pA (max)
common mode voltage range	-10 V to 7.5 V
input capacitance (C//R1,R2)	30 pF (typ)

### Gain

input impedance (R1, R2)	10 V/A to 1 MV/A
gain accuracy	± 0.1% (G=1)
maximum offset	1 mV
output voltage gain (G)	1 (G=1) or 10 (G=10)

### Gain dependent parameters

Input impedance (R1, R2)	Bandwidth (3dB cut-off)	Maximum input current range	Maximum input current noise
10 V/A	100 MHz	±160 mA	400 pA/√Hz
100 V/A	50 MHz	±16 mA	42 pA/√Hz
1 kV/A	5 MHz	±1.6 mA	5.6 pA/√Hz
10 kV/A	500 kHz	±160 μA	1.3 pA/√Hz
100 kV/A	50 kHz	±16 μA	400 fA/√Hz
1 MV/A	5 kHz	±1.6 μA	128 fA/√Hz

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About Zurich Instruments  
 Zurich Instruments makes lock-in amplifiers, phase-locked loops, and impedance spectroscopes that have revolutionized instrumentation in the high-frequency (HF) and ultra-high-frequency (UHF) ranges by combining frequency-domain tools and time-domain tools within each product. This reduces the complexity of laboratory setups, removes sources of problems and provides new measurement approaches that support the progress of research.

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