

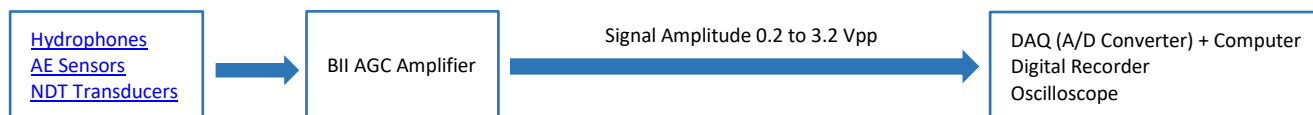
BII2000 Series AGC (Automatic Gain Control) Amplifier: 100 dB Gain Dynamic Range, 100Hz to 1MHz Bandwidth.

BII's Automatic Gain Control (AGC) amplifier is a dynamic adaptive electronic system whose gain changes automatically with input levels of continuous waveform (CW) or pulsed signals such as SINE pulses, Chirp/FM pulses, BFSK/FSK, etc. Its output signal level is always in detectable range for DAQ modules (A/D Converters) although the input signal levels vary in a wide range. That is, the AGC effectively attenuates the strong input signals to avoid saturation and amplifies weak signal to be in the range of Volt. BII AGCs are necessary components in acoustic systems to automatically compensate the propagation losses in water, air, and solids.

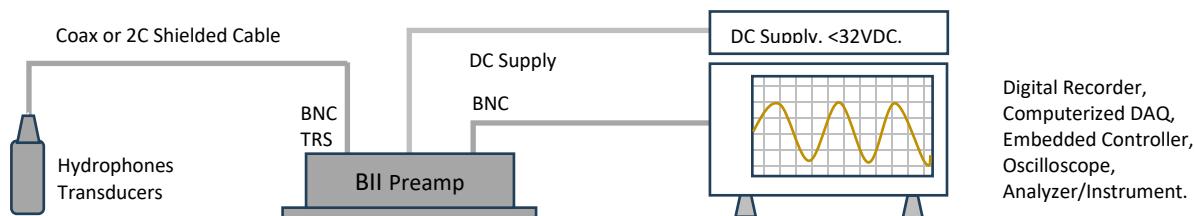
Typical Applications:

Underwater Communication/Pinger/Beacons/Transponder.	Acoustic Modem, BFSK/FSK Signal Conditioning.
Echosounding, Marine Mammal Research, Bioacoustics.	Navigation, Positioning, Acoustic Tag.
Doppler SONAR, Speed Measurement, Artificial Acoustic Target.	Ultrasonic Pulsing System, NDT, AE, Diagnostic Ultrasound, Material Study.

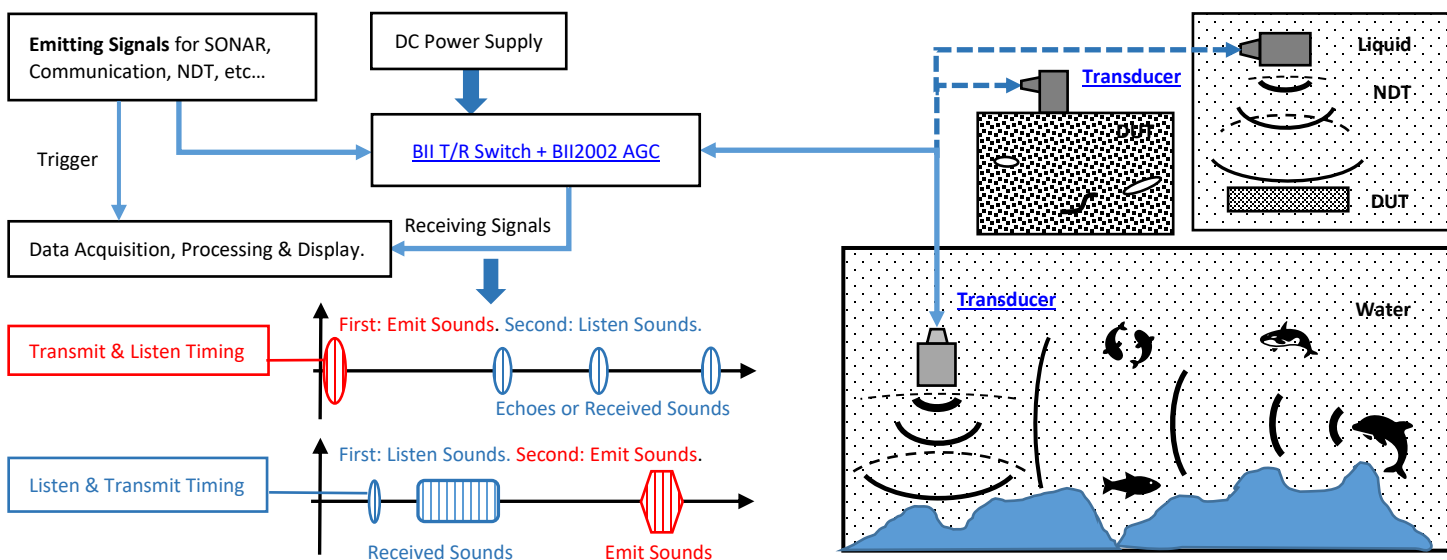
System Setup (DC Power Supply is not shown.)



System Wirings of Standalone Preamp.



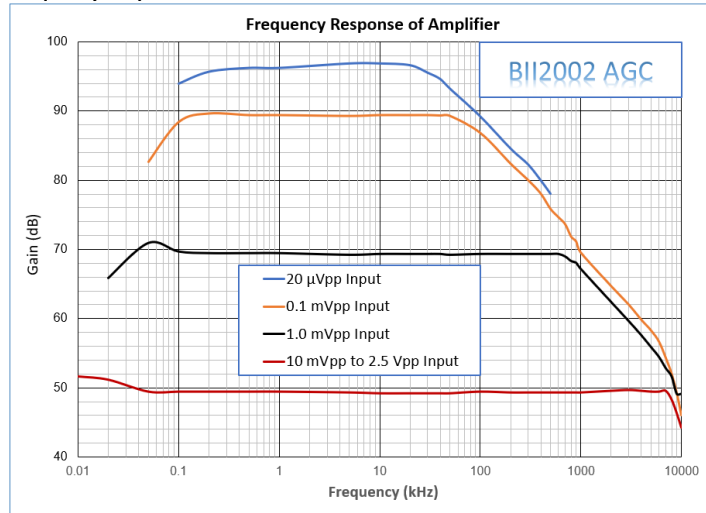
System Block Diagram of Acoustic Pulse-echo and Communication Systems



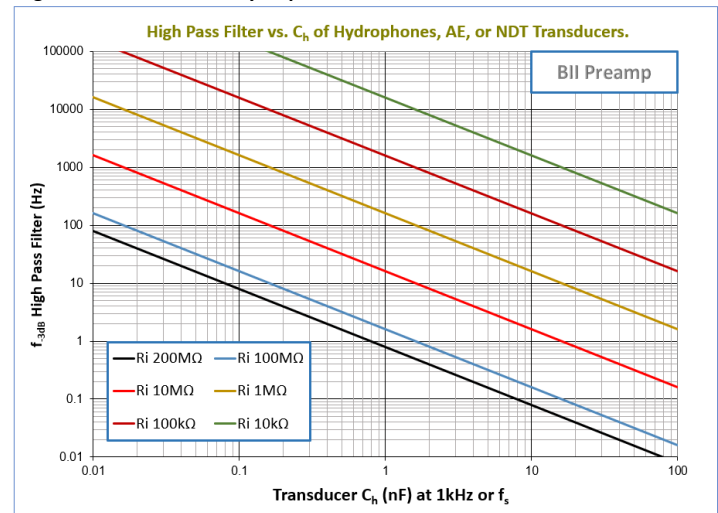
SPECIFICATION

AGC Amplifier	BII2002
Signal Types:	Sine Pulses, Chirp/FM Pulses, BFSK/FSK, Continuous Signals, etc. Pulse duration of pulsed/burst signals such as SONAR and NDT signals should be greater than 10μs to achieve stable output signal.
Automatic Gain Range:	-20 to 80 dB
High Pass Filter:	Built-in. Specify -3dB cut-off frequency when ordering. White noise level is proportional to the square root of bandwidth. Second Order. Compensation of High Pass Filter at input refer to Input Circuit Model .
-3dB Bandwidth:	100 Hz ~ 1 MHz, Input level dependant. Refer to Frequency Response . Filters of Preamps. Both oceanic ambient noises and the self-noises of electronic devices decrease when frequency increases. It is recommended to choose a built-in high pass filter to reject noises in low frequency range. For example, if you are interested in the signals greater than 10 kHz, you may specify a high pass filter of a preamp with -3dB cut-off frequency 1 kHz to improve signal to noise ratio of the signals of the interest. More info on High Pass Filter: Frequency Response of BII2002 AGC Core is 100Hz to 1 or 10MHz (Input level dependant) and BII2002 amplifies and tracks peak voltages of arbitrary signals. A proper high pass filter attenuates low frequency noise level and ensures that signal levels of useful signals are significant and dominate which are amplified and tracked by the AGC Amplifier.
Settling Time:	3 μs to 0.1%, Output Step 10 Vpp.
Input Level Range V_i:	20 μVpp to 20 Vpp, or -103 to +17 dB Vrms.
Input Range of Receiver:	(V_i dB Vrms - Receiver Sensitivity dB V/μPa), in μPa. For example, a hydrophone has FFVS of -190 dB V/μPa, Detection range = (-103 +190) to (17 + 190) = 87 to 207 dB μPa.
Input Impedance: (Differential Input Signal)	(1) R_i 5 MΩ in series with C_i 0.5 nF for 100 Hz high pass filter. (2) R_i 0.5 MΩ in series with C_i 0.5 nF for 1 kHz high pass filter. (3) R_i 50 kΩ in series with C_i 0.5 nF for 10 kHz high pass filter. When input signal is single-ended, Input Impedance R_i is half stated value. Input Impedance affects high pass filter, Refer to R_iC_i Filter and Input Circuit Model .
Input Couling:	AC
Input Signal Type:	Differential (DF) and Single ended (SE) are acceptable.
Input Referred Noise: (at $f \geq 1$ kHz)	$e_n = 10.0$ nV/√Hz, $i_n = 0.8$ fA/√Hz. Roughly, electronic noise density at input, $V_n^2 = e_n^2 + [i_n \cdot \text{impedance of the transducer (or hydrophone)}]^2$.
Input Dynamic Range:	≥ 90 dB
Output Level:	0.2 to 3.2 Vpp, or -23 to 1.07 dB Vrms.
Output Type:	Single Ended
Output Impedance:	50 Ω
Output Couling:	AC
Capability of Driving Cable:	50 m
Supply Voltage V_s:	+16 to +32 VDC
Current (Quiescent):	21.3 mA
Suggested DC Supply:	+9VDC Battery, Marine Battery, Automobile Battery, Fixed DC Linear Power Supply, Not Included. DO NOT use variable power supply whose maximum supply voltage is higher than the above rated voltage. DO NOT use switching mode DC power supply.
Operating Temperature:	-40°C to 60°C, or -40°F to 140°F.
Storage Temperature:	-20°C to 60°C, or -4°F to 140°F.
Package	Coated PCB with Wires and Wire Leads
Input Wiring:	5cm wires, twisted. Differential Input Wiring: Red: Input Signal +, Blue: Input Signal -, and Use Power Supply Common as input signal common. Single-ended Input Wiring: Red: Input Signal, Blue: Input Common and wire Blue Wire to Power Supply Common .
Output Wiring:	5cm wires. Twisted, White: Output Signal, Black: Output Common.
Power Supply Wiring:	5cm wires, twisted. Red: +VDC, Black: Common. Use this common as differential input common.
Weight:	20 grams
Size:	ΦDxH = Φ48x15 mm
Package	Metal or Plastic Housing with four mounting holes
Input Connector:	1. XLR Plug with 3 Sockets for Differential Input. 2. TRS Jack for Differential Input. 3. BNC Jack for Single-ended Input.
Output Connector:	BNC Jack
Power Supply Connector:	Power Connector Jack
Power Supply Cable:	DCBP24 , DCWL24 .
Weight:	0.25 kg
Size:	LxWxH = 95x59x47mm (Metal Enclosure), or 109.4x83.4x67mm (Plastic Enclosure).

Frequency Response

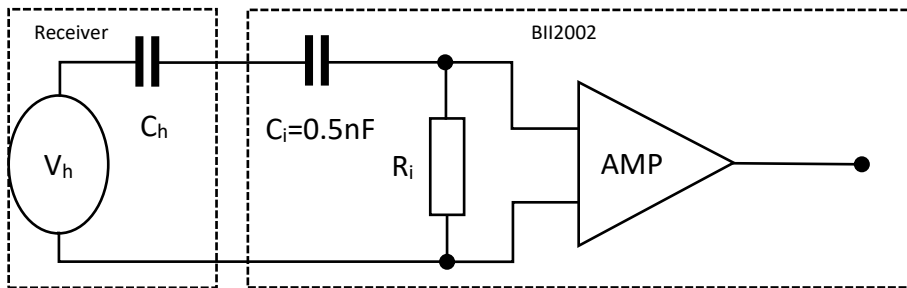


High Pass Filter vs. Ch of Hydrophone, AE, or NDT Transducer.



Equivalent Input Circuit Model of BII2002 AGC Amplifier.

V_h : Voltage of Receiver under sound Pressure; C_h : Capacitance of piezoelectric hydrophone/sensor/transducer at 1 kHz (non-resonance measurement) or f_s (resonance measurement such as NDT pulsing system). R_i : Input Resistance or Impedance of Preamp.

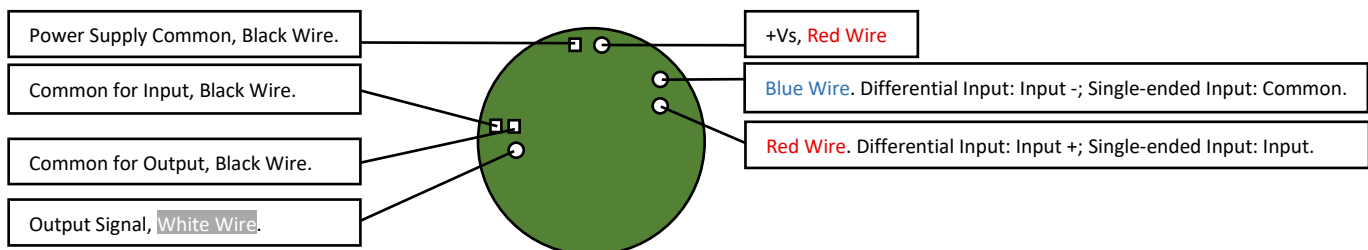


-3dB frequency of High Pass Filter at input
 $= 1/(2\pi \cdot R_i \cdot C_h \cdot C_i / (C_h + C_i))$

Standard Coated PCB. BII keeps standard parts in stock.

Part Number	-HPF High Pass Filter	-PCB
BII2002	100 Hz, 1 kHz, 10 kHz.	PCB: Coated PCB
High Pass Filter of the preamp is the combination of <u>RiCh High Pass Filter</u> and <u>HPF High Pass Filter</u> . RiCh High Pass Filter is determined by Hydrophone C_h .		
More info on High Pass Filter: Frequency Response of BII2002 AGC Core is 100Hz to 1 or 10MHz (Input level dependant) and BII2002 amplifies and tracks peak voltages of arbitrary signals. A proper high pass filter attenuates low frequency noise level and ensures that signal levels of useful signals are significant and dominate which are amplified and tracked by the AGC Amplifier.		
Example:	Description:	
BII2002-100Hz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 100Hz, PCB.	
BII2002-1kHz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 1kHz, PCB.	
BII2002-10kHz-PCB:	BII2002, AGC Amplifier, -3dB High Pass Filter: 10kHz, PCB.	

Coated PCB Layout and Wiring.



Standard Metal Housing. BII keeps standard parts in stock.

Part Number	-HPF High Pass Filter	-Input Connector
BII2002	100 Hz, 1 kHz, 10 kHz.	BNC: BNC Jack. TRS: 3.5mm TRS Jack. XLR: XLR Plug with 3 Sockets.
Note: High Pass Filter of the preamp is the combination of <u>RiCh High Pass Filter</u> and <u>HPF High Pass Filter</u> . RiCh High Pass Filter is determined by Hydrophone C_h .		
Example:	Description:	
BII2002-100Hz-XLR:	BII2002, AGC Amplifier, -3dB High Pass Filter: 100Hz, Input: XLR Plug with 3 Sockets.	
BII2002-1kHz-XLR:	BII2002, AGC Amplifier, -3dB High Pass Filter: 1kHz, Input: XLR Plug with 3 Sockets.	
BII2002-10kHz-BNC:	BII2002, AGC Amplifier, -3dB High Pass Filter: 10kHz, Input: BNC Jack.	

Wiring

Input			Output	Power Supply
BNC Jack	TRS Jack	XLR Plug with 3 Sockets	BNC Jack	Power Jack
Center: Signal Shield: Common	Tip: Signal +, Positive or Hot. Ring: Signal -, Negative or Cold. Sleeve: Common/Ground.	Pin 2, Positive/Hot. Pin 3, Negative/Cold. Pin 1, Shield/Ground.	Center: Signal Shield: Common	Center Contact: +VDC Shell: Common

DC Supply Cable: DCBP24. One 1m DC supply cable with Red and Black Banana Plugs, and DC Power Plug.

To Terminals of DC Supply:

- One Red 4mm Banana Plug.
- One Black 4mm Banana Plug.

Default 1m. Bespoke Length Available.



DC Power Plug.
To DC Power Jack of the Device.



Red Banana Plug: +VDC. **Black Banana Plug:** Common.

One 1m DC supply cable. One end of the cable is with DC Power Plug, another end is Red and Black Banana Plugs. Depending on output terminals of buyer's DC Supply, buyer may assemble other type of connectors to DC supply cable at buyer's cost.

DC Supply Cable: DCWL24. One 1m DC supply cable with Wire Leads and DC Power Plug.

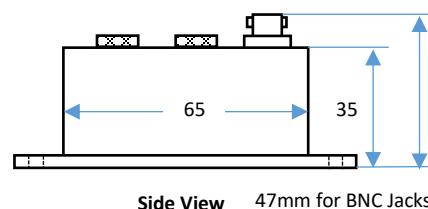
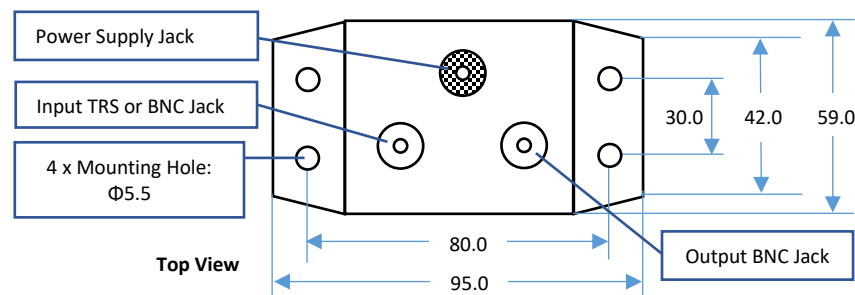
Default 1m. Bespoke Length Available.

To Clamp Terminals of DC Supply:

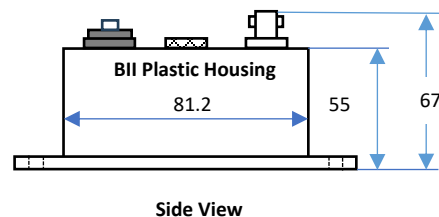
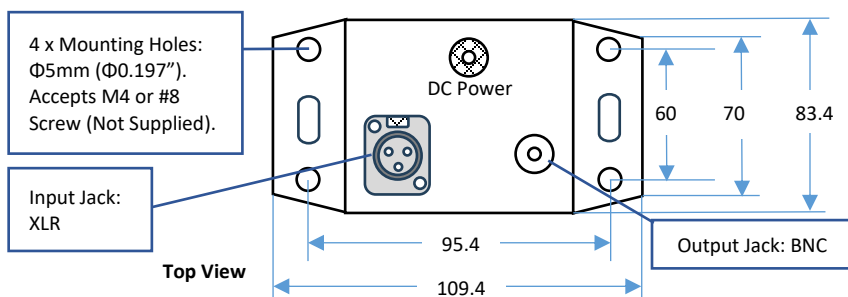


DC Power Plug.
To DC Power Jack of the Device.

Outline Dimensions (Metal Enclosure) (mm)



Plastic Housings Outline Dimensions (mm), Illustration only, the scale is not 1:1.

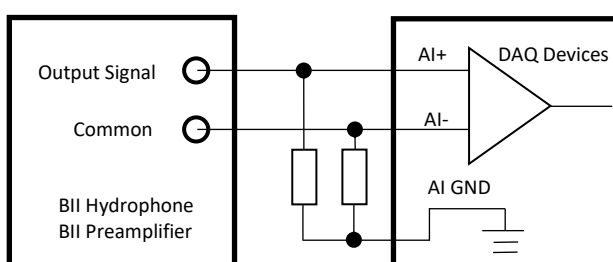
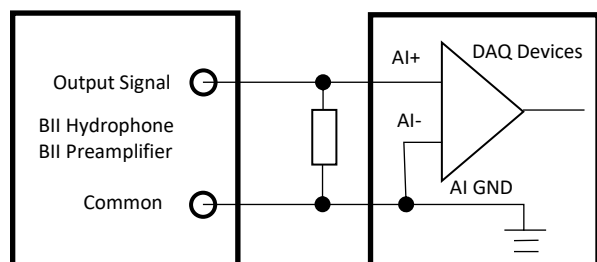


Preamplifier Wirings to DAQ (Data Acquisition): DAQ: Data Acquisition Hardware; AI: Analog Input; CH: Channel; GND: Ground.

BII's Single-Ended Output to Single-Ended Input of a DAQ

BII's Single-Ended Output to Differential Input of a DAQ

If input impedance of a DAQ device is greater than 100M Ω , use following wiring with one 100k Ω to 1M Ω resistor.



Questions

Frequencies of my pingers (transponder, or beacon) range from 20 kHz to 100 kHz, what are the gains of BII AGC to amplify the signals automatically? Gain-bandwidth of BII AGC is 250MHz. that is, BII AGC can amplify 20 kHz signals with 80 dB (x10000 times) and amplify 100 kHz signals with 66 dB (x2000 times).

What if the connector of my transducer/sensor is SMA or SMC Connector? Buyer may order a SMA (or SMC) to BNC (Male) adaptor from local electronic distributors in buyer's country. BII may ship the adaptor as accessory of the device. Please specify this request when ordering. **By default, BII does NOT supply the adaptor as accessories.**

How do I wire 50Ω transducer/sensor to BII AGC Amplifier? BII AGC Amplifier has non-50Ω input resistance. One T type BNC adaptor and one 50Ω BNC terminal are necessary between 50Ω transducer/sensor and BII AGC to change the impedance of BII AGC to be 50Ω. BII may ship T type BNC adaptor and one 50Ω BNC terminal as accessories of the device. Please specify this request when ordering. **By default, BII does NOT supply these two parts as accessories.**

How do I wire BII AGC Amplifier to audio connectors (XLR or TRS) of my recording devices? BII AGC Amplifier has panel mount BNC jack as output connector. Therefore, one cable assembly from male BNC to XLR or male BNC to TRS plug are necessary between BII AGC and the recording devices. BII may ship the cable assembly as accessory of the device. Please specify this request when ordering. **By default, BII does NOT supply the cable assembly as accessories.**

My acoustic sensors generate differential signals in MHz range, are TRS connectors of BII preamps suitable for my applications? Our test shows the TRS connectors (Plug and Jack) of BII preamps can be used up to 20 MHz. Test Conditions: TRS Jack with 0.2m cable and TRS plug with 1m cable. Oscilloscope: 1MΩ || 30pF, Signal Source: DDS Signal Generator.

Can 3.5mm (1/8") TRS be configured for single-ended signal of a hydrophone/transducer which does not have built-in preamplifier? Yes, the preamp with differential-input TRS can accept single-ended signals from hydrophones/transducers whose TRS wiring should be like followings:

TRS Tip: Signal. **TRS Ring and Sleeve:** Both terminals are soldered together for Signal Common and Shielding. Common and shielding should be "one-point" contact.

Can BII explain why the capacitance of my hydrophone/transducer affect high pass filtering? (1). Hydrophone/transducer is high impedance devices in low frequency range. Its simplified complex impedance = $j/(2\pi f C_h)$, C_h is the capacitance of hydrophone/transducer, f is frequency in Hz. This impedance is in series with preamp R_i and can reach several MΩ to hundreds MΩ depending on C_h and f . (2). Most high-performance operational amplifiers (IC chips) can use input resistors R_i up to 1 to 200 MΩ to avoid bumping into saturation issue.