Introduction

Thank you for purchasing UltraSoundGate 116-200. This device allows high-speed data acquisition at sampling rates of up to 750 kHz. In conjunction with the accompanying software Avisoft-RECORDER USG, sound-activated direct-to-disk recording and real-time spectrogram display is supported. The integrated high-quality analog-to-digital converter with adaptive anti-aliasing filter provides best performance. The trigger button supports remote-controlled harddisk recording. The rugged and compact design and the USB interface make this device the optimal choice for portable ultrasound recording in the field.

Installation procedure

Hardware Installation

Simply connect the UltraSoundGate to an USB port. An **USB Audio Device** and a **HID device** will be detected automatically. On the device, the green **POWER** LED should light and the amber LED labeled **REC** should flash once it is connected to the PC. There is no further user-interaction required. Only in Windows 98, the **Add New Hardware Wizard** dialog box will appear and you should follow the the instructions. To check whether the device has successfully been installed you may go to "Start->Settings->Control Panel->System->Device Manager". Check the "USB Audio Device" under "Sound, video and game controllers" and the "Input devices (Human Interface Device)". There should appear an "USB-HID (Human Interface Device)" representing the trigger button.

Software installation

If you have also purchased the recording software "Avisoft-RECORDER USG", that is required to use the trigger button, you will need to install the Avisoft software from the accompanying CD-ROM. In Windows 2000 and XP you have to log on as an Administrator. The installation program setup.exe (which usually starts automatically) will install both the Avisoft-RECORDER and the SASLab Pro software.

Getting started

The UltraSoundGate device appears to the PC as a standard audio recording interface. Therefore, any sound recording application can be used to operate this device. However, please note that only certain sampling frequencies are supported (see the table *Sampling rates, resolutions & oversampling*).

The recording software **Avisoft-RECORDER USG** is specifically adopted to this device and will support all UltraSoundGate features. After installation, this software can be launched from **Start / Programs / Avisoft / RECORDER USG** (rec_usg.exe).

First go to **Options** / **Configuration** and select the desired sampling rate from **Input-Device Settings** / **Sampling rate.** Click **Ok.** Then click at the Pause button (**Monitoring/Pause**) and the Start button (**Monitoring/Start**). You will then see the real-time spectrogram displaying data acquired by the UltraSoundGate. For details on the operation of the RECORDER software see the Avisoft-RECORDER manual and the section *Software Settings* in this guide.
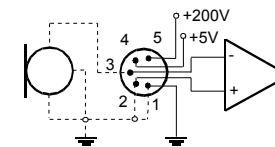
Components of the UltraSoundGate 116-200

1 XLR input connector

The 5-pole XLR input connector represents the analog input of the recording device and provides power supply voltages for external amplifiers and microphones. The connector scheme is as follows:

1   Ground
2   Positive input
3   Negative input
4   +5V supply voltage (max current 20 mA)
5   +200V polarization voltage
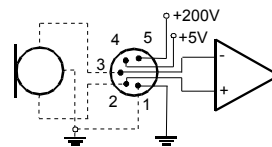
differential source   single-ended source

2 TRG REMOTE

This 2-pole (mono) 2.5 mm mini-jack connector is electrically connected to the TRIGGER button (5) and allows connecting an external trigger. This input is TTL-compatible (there is an internal pull-up resistor of 10 kOhm to +5V). Pulling this input to ground (e.g. by closing a switch) will activate the internal virtual joystick button.

3 DIGITAL IN

This 2-pole (mono) 2.5mm mini-jack connector allows to connect external digital signals. This input is TTL-compatible (internal pull-up resistor of 10 kOhm to +5V). The status of the digital input is stored in the LSB (bit 0) of the 16-bit data words that are transmitted over the USB and can be extracted afterwards by the Avisoft-SASLab Pro sound analysis software (e.g. for creating labels). The digital input is not available in the 8-bit recording mode. Once a plug is connected to this digital input, the available resolution is reduced to 15 bits (the LSB is discarded).

4 Peak level meter

These 5 LEDs indicate the peak level currently present at the AD converter input. The red LED indicates clipping (over-modulation).

5 TRIGGER button

The silver-colored trigger button is represented to the operating system as a standard joystick button that can be used to start and stop harddisk recording in conjunction with the Avisoft-RECORDER software. To enable this mode of operation, the trigger type *Joystick button1 / USG Button* must be selected from the Configuration dialog (menu **Options/Configuration**). If the TRIGGER button is pressed for more than two seconds, the virtual joystick button1 will be activated permanently. This is indicated by the flashing REC indicator (6). The virtual button1 can then be reset (stop recording) by pressing the TRIGGER button again (the amber LED will be switched off). This feature may be useful for recording longer sequences. If this auto-hold behavior is not desired, one of the other virtual joystick buttons may be used instead:

button1:   represents the state of the button for the first 2 seconds, then auto-hold mode
button2:   represents the state of the TRIGGER button (no auto-hold)
button3:   represents the inverse state of the TRIGGER button (no auto-hold)
button4 :   changes its state each time the TRIGGER button is pressed (toggle mode)

6 REC indicator

This amber LED will flash once the device is connected to the PC. It will be switched off permanently when a sound recording application is streaming audio data. It will light again permanently as long as the TRIGGER button is being pressed (representing the state of the joystick button). If the TRIGGER button is pressed for more than 2 seconds, it will start to flash.

7 POWER indicator

This green LED will light as long as the device is connected to the USB. In case the computer or HUB is unable to provide the required supply current (because there are other devices connected or the batteries of the laptop are empty), this LED will be switched off.

8 Acoustic monitor volume control

This control knob adjusts the volume of the acoustic monitor (headphone jack, 10)

9 Recording level control

This control knob adjusts the analog input recording level.

10 Headphone jack

A set of headphones or a speaker can be connected here to monitor input signals. Even ultrasonic signals that are originally not audible will be perceptible. This is possible by a 10-fold under-sampling technique, which will lead to desired aliasing effects.

11 USB cable

Software Settings

Avisoft-RECORDER

For higher sampling rates it may be useful to reduce the buffer size under **Options/Configuration/Input Device Settings/Buffer**. Smaller values for this **Buffer** parameter will increase the update rate of the real-time displays.

Sound-activated recording can be arranged by selecting the **Trigger** option *level of this channel*. For remote-controlled triggering via the trigger button on the device, the trigger option *joystick button1 / USG button* should be used. The joystick buttons 2, 3 and 4, which behave differently, may also be used. For triggering by a logic signal attached to **DIGITAL IN**, select *UltraSoundGate DI*.

In order to simplify the operation of the Avisoft-RECORDER software in the field, a link to **RECORDER USG** may be added to the Windows *Autostart* folder (*Start->Programs->Autostart*). Additionally, the Avisoft-RECORDER option *Monitoring/Autostart* should be activated. This arrangement will start the monitoring process automatically after booting the laptop (the UltraSoundGate device must be attached to the USB port prior to booting Windows).

Avisoft-SASLab Pro

For recording from the main window recording command (**File/Record**) or from the real-time spectrograph window (menu **File/Real Time Spectrogram...**) first open the **Sound Card Settings** dialog box (menu **Parameters**). Select the *Avisoft-UltraSoundGate 116* (or **USB Audio Device** in Windows 2000, ME, 98) from the **active Sound Card** list box. Then select the desired sampling rate from the **Sampling Frequency** list box (see the table on the right for valid rates). Additionally, launch the **Buffer Size** dialog box from the **Parameters** menu. Activate the option *Enable Joystick button#1 / USG button*. The **Refreshing interval [%]** parameter can be reduced in order to get a smoother real-time display.

Depending on the computer power, the maximum FFT overlap for the real-time spectrogram may be limited at high sampling rates (>300 kHz). In such cases it may happen that the recording mode cannot be stopped. This problem can be solved by reducing the overlap parameter.

Please refer to the Avisoft-RECORDER and Avisoft-SASLab Pro manuals or the online help files for further details.

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Specifications

Sampling rates, resolutions & oversampling

Sampling rates [Hz]	8 Bit	16 Bit	32-fold
750000	+		
500000	+	+	
384000	+	+	+
375000	+	+	+
300000	+	+	
250000	+	+	+
214285	+	+	
192000	+	+	+
187500	+	+	+
166666	+	+	
150000	+	+	+
125000	+	+	
96000	+	+	+
75000	+	+	+
62500	+	+	+
50000	+	+	+

This table lists the available bit depths and oversampling ratios for each sampling rate. The oversampling ratio will be 16-fold for those rates not marked in the 32-fold column. 32-fold oversampling will provide slightly better signal-to-noise ratios and better anti-aliasing performance.

Analog-to-digital converter type	sigma-delta with anti-aliasing filter
Number of channels	1
ADC resolutions	8 or 16 bit
Number of digital inputs	1
Analog input impedance	50kOhm
Frequency response (+-3dB)	0.05... 340 kHz
Maximum input sensitivity	+-20mV
Supply current drawn from USB	180 mA
Physical dimensions (W/H/D)	56*35*140 mm
Weight	300 g

In the interest of product improvement, the specifications and/or appearance of this unit are subject to change without notice.

System requirements

IBM-compatible PC, Pentium||, 230MHz or more with at least one USB port (1.1 or 2.0), running Windows98/Me/2000/XP (Windows3.1 and Windows95 are not supported).

Avisoft ULTRASOUNDGATE

User's Guide USG 116-200

End-user Agreement

This a legal agreement between Avisoft Bioacoustics and the buyer. By operating this device and the accompanying software, the buyer accepts the terms of this agreement.

1. The Device and the accompanying software is warranted to perform substantially in accordance with the operating manual for a period of 12 month from the date of shipment.

2. EXCEPT AS SET FORTH IN THE EXPRESS WARRANTY ABOVE, THE DEVICE IS PROVIDED WITH NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE VENDOR EXCLUDES ALL IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTIBILITY AND FITNESS FOR A PARTICULAR PURPOSE.

3. The Vendor's entire liability and the Buyer's exclusive remedy shall be, at the Vendor's SOLE DISCRETION, either (1) return of the device and refund of purchase price or (2) repair or replacement of the device.

4. THE VENDOR WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES HEREUNDER, INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA OR INFORMATION OF ANY KIND, ARISING OUT OF THE USE OF OR INABILITY TO USE THE DEVICE IN NO EVENT SHALL THE VENDOR BE LIABLE FOR ANY AMOUNT IN EXCESS OF THE PURCHASE PRICE.

5. This agreement is the complete and exclusive agreement between the Vendor and the Buyer concerning the device.

Condenser Microphone CM16/CMPA

The condenser microphone consists of two pieces. The cylindric preamplifier module with the 5-pole XLR connector (1 - CMPA) is connected to the microphone capsule (2 - CM16) via a 2.5 mm thread. This allows to replace the capsule easily. For proper operation, both this 2.5 mm thread and the 17 mm thread on the preamplifier module must be fastened. However, use only moderate forces in order to prevent mechanical damages.
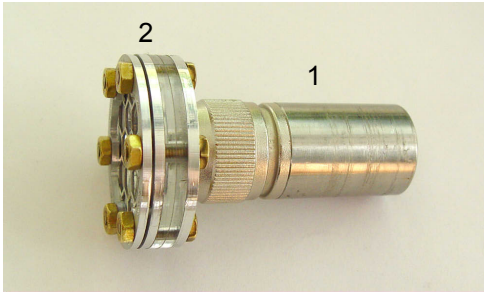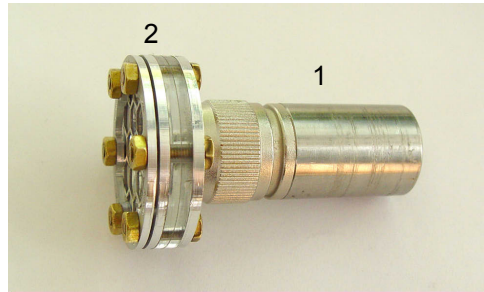
The integrated pre-amplifier has an internal compensation circuit that slightly boosts frequencies above 50 kHz.
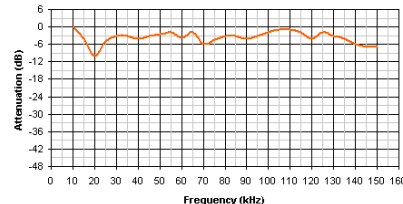
Due to the principle of the amplifier, the actual gain depends on the capacitance of the microphone capsule. Therefore, larger diaphragms (e.g. the Polaroid transducer) will provide higher output voltages than the smaller CM16 capsule.

The integrated polarization voltage generator will take up to 20 seconds after switch-on until the full voltage of about 200V (and the maximum sensitivity) is reached.

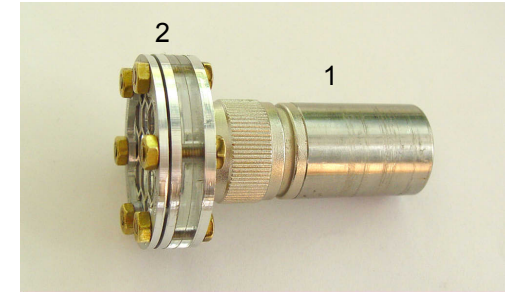# Condenser Microphone Capsule CM16

The microphone capsule consists of a thin metallized polyester film and a metal back plate. Do not touch the diaphragm because its metallization could be destroyed. It is recommended to use the capsule always with the protective grid. However, depending on the grid type, the frequency response may be degraded in some way. Therefore, it is possible to remove or replace the grid by releasing the nuts on the front side (use the supplied 5.5 mm box spanner).

Due to its thin metallization, the diaphragm may deteriorate especially under humid conditions. Therefore, it is recommended to store the microphone in a dry place. Spare capsules are available on request and deteriorated diaphragms will be replaced by Avisoft Bioacoustics at a small fee. With some skill, it would also be possible to replace the membrane foil on your own (by releasing the screws on the back of the capsule).
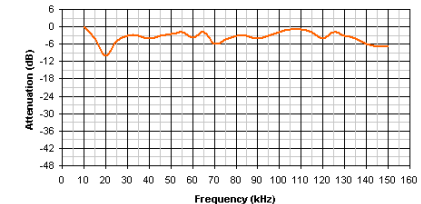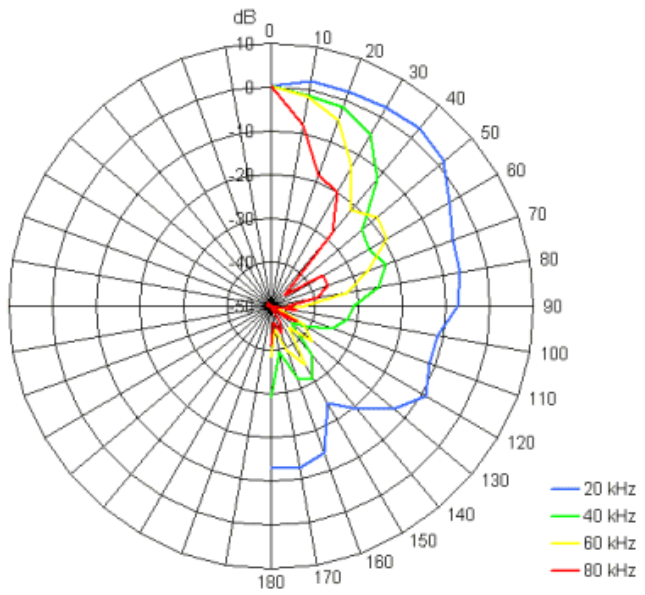
Polar Diagram
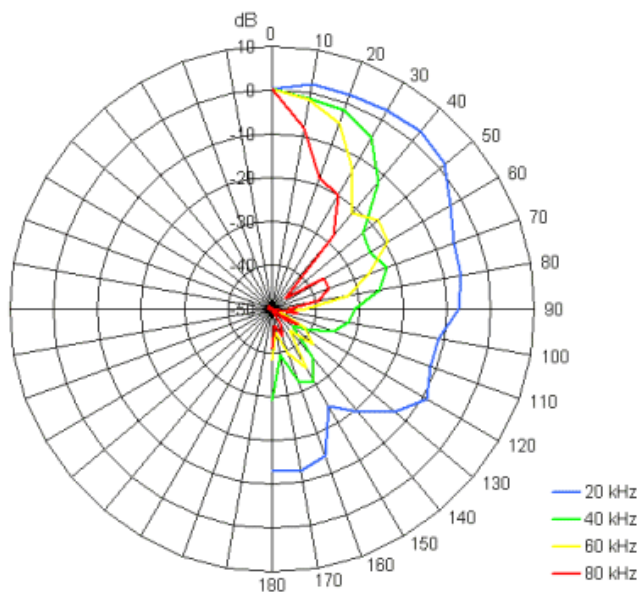
Polar Diagram

Polar Diagram

UltraSoundGate Charge Amplifier with adjustable Hi-Pass Filter

The UltraSoundGate Charge Amplifier can be used to connect a hydrophone to the UltraSoundGate 116 (or 416) main unit. The integrated adjustable high-pass filter allows rejecting unwanted low-frequency noise.

The gain of the charge amplifier depends both on the nominal capacitance of the connected hydrophone and the selected input capacitan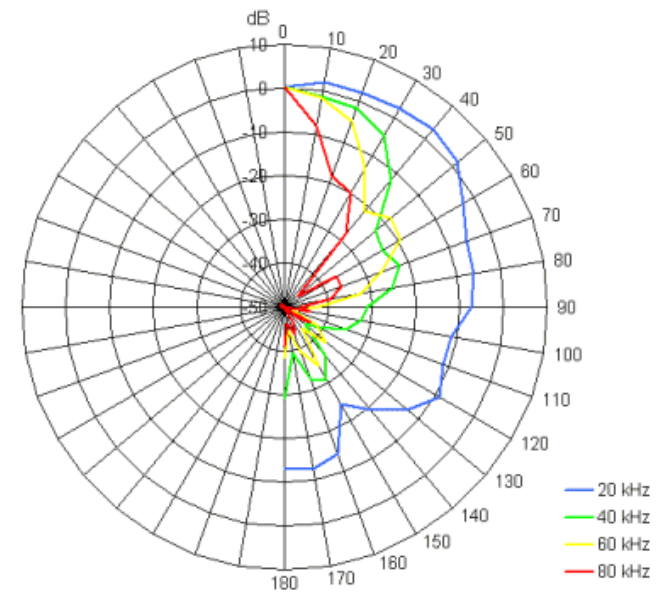ce of the amplifier (Gain = 20 log (capacitance of the hydrophone / selected input capacitance)). A hydrophone capacitance of 3nF and an input capacitance of 1nF would provide a gain of approximately 10 dB. The alternate input capacitance of 100pF would rise the gain to 30 dB.

The black rotary knob selects the cut-off frequency of the high-pass filter. The filter attenuation is 6dB / octave below the selected cut-off frequency. The labels are valid for an input capacitance of 1nF. If the alternate 100pF setting has been selected, all frequency labels must be multiplied by factor 10.

High-pass cut-of frequencies and input impedance

rotary switch setting	cut-off frequency at 1nF	cut-off frequency at 100 pF (*)	input impedance
10	10 Hz	100 Hz	15 MOhm
25	25 Hz	250 Hz	6.8 MOhm
50	50 Hz	500 Hz	3,3 MOhm
100	100 Hz	1 kHz	1.5 MOhm
250	250 Hz	2.5 kHz	680 kOhm
500	500 Hz	5 kHz	330 kOhm
1k	1 kHz	10 kHz	150 kOhm
2.5k	2.5 kHz	25 kHz	68 kOhm
5k	5 kHz	50 kHz	33 kOhm
10k	10 kHz	100 kHz	15 kOhm
25k	25 kHz	250 kHz	6.8 kOhm
50k	50 kHz	500 kHz	3.3 kOhm

Care should be taken while connecting the hydrophone to the charge amplifier. Under some circumstances it is possible that the hydrophone or its cable have been electrostatically charged with high voltages (several thousands volts). These high voltages may damage the sensitive input stage of the amplifier (ESD). In order to maintain the maximum possible sound quality (low noise), there is no full ESD protection circuit at the amplifier input. Therefore, the hydrophone and its cable should be discharged before connecting them to the charge amplifier. This can be done by short-circuiting the hydrophone connector. Additionally, the amplifier should be switched off (either by disconnecting the amplifier from the USG main unit or by disconnecting the USG device from the PC) before connecting the hydrophone cable and the input impedance should be reduced by selecting a high cut-off frequency (greater than about 1 kHz). Once the hydrophone is connected to the amplifier, there is no further danger because any potential high voltages would be terminated by the internal resistors of the amplifier.

Refurbishing Kit for the Condenser Microphone Capsule CM16

The refurbishing kit allows to replace deteriorated diaphragms of the CM16 condenser microphone capsules. The supplied mounting frame enables a proper assembly. However, a moderate level of skill is required for this procedure.
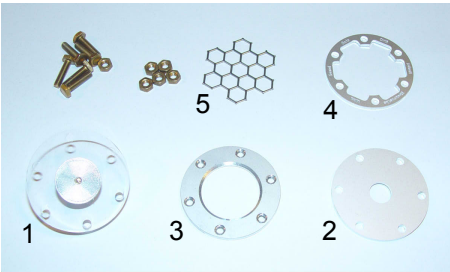
1. First remove the 6 nuts from the front of the CM16 capsule and remove the protective grid by using the supplied M3 nut driver.


2. Remove the M3 screws from the back of the CM16 capsule.

The capsule is now completely disassembled (except of the aluminum back plate that is still mounted on the acrylic disk). The old diaphragm foil can be thrown away.


3. Place one of the supplied diaphragm foils onto the mounting ring with with the thread holes. The non-conductive side of the foil that is marked by a red cross should be on top. Handle the foil on its edges only.
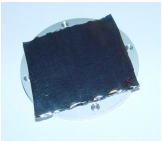

4. Put the second mounting frame ring (the one without threads) onto the foil and align the mounting holes. Make sure that there are no wrinkles on the foil.
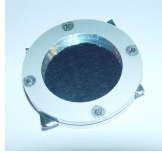

5. Fix the foil between the two rings by fastening the supplied screws.
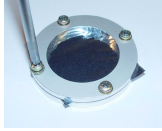
6. Place the acrylic disk [1] onto the non-conductive (marked) side of the foil and add the aluminum disk [2]. The lowering of that disk must be outside. Align the mounting holes of the two disks.
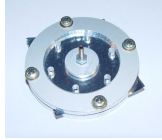
7. Turn the entire arrangement, add the aluminum ring [3] and align it to the holes of the two disks on the opposite side. First insert one screw from the back side and fasten it while applying a moderate tension to the diaphragm. Then add the other 5 screws one after another.
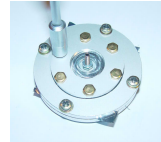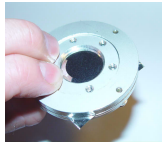
8. Push the newly mounted capsule down and pull it out of the mounting frame.

9. Center the protective grid [5] on the capsule and fasten it by the cover ring [4] using the 6 six nuts.
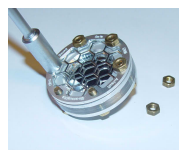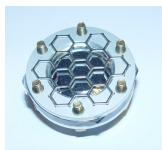
P48 Charge Amplifier with adjustable Hi-Pass Filter

The Avisoft Bioacoustics Charge Amplifier can be used to connect a passive hydrophone to any microphone input that supplies 48V phantom power at 10 mA. The integrated adjustable high-pass filter allows rejecting unwanted low-frequency noise.

The gain of the charge amplifier depends both on the nominal capacitance of the connected hydrophone and the selected input capacitance of the amplifier (Gain = 20 log (capacitance of the hydrophone / selected input capacitance)). A hydrophone capacitance of 3nF and an input capacitance of 1nF would provide a gain of approximately 10 dB. The alternate input capacitance of 100pF would rise the gain to 30 dB.

The black rotary knob selects the cut-off frequency of the high-pass filter. The filter attenuation is 6dB / octave below the selected cut-off frequency. The labels are valid for an input capacitance of 1nF. If the alternate 100pF setting has been selected, all frequency labels must be multiplied by factor 10.

High-pass cut-of frequencies and input impedance

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10k	10 kHz	100 kHz	15 kOhm
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50k	50 kHz	500 kHz	3.3 kOhm

Care should be taken while connecting the hydrophone to the charge amplifier. Under some circumstances it is possible that the hydrophone or its cable have been electrostatically charged with high voltages (several thousands volts). These high voltages may damage the sensitive input stage of the amplifier (ESD). In order to maintain the maximum possible sound quality (low noise), there is no full ESD protection circuit at the amplifier input. Therefore, the hydrophone and its cable should be discharged before connecting them to the charge amplifier. This can be done by short-circuiting the hydrophone connector. Additionally, the amplifier should be switched off (either by disconnecting the amplifier from the recording device or by switching off the recorder) before connecting the hydrophone cable and the input impedance should be reduced by selecting a high cut-off frequency (greater than about 1 kHz). Once the hydrophone is connected to the amplifier, there is no further danger because any potential high voltages would be terminated by the internal resistors of the amplifier.