Operation Manual
Myotis conditioning unit
Used with optical fiber sensor

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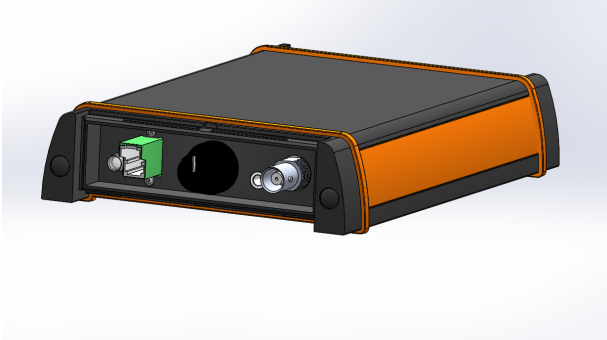
Datasheet

Fiber optic sensors conditioning unit

Myotis

Standard Version



DESCRIPTION

The signal conditioner designed by Phonoptics is intended to be used with all the sensors that Phonoptics manufactures:

- Myotis microphone
- Alpheus dynamic pressure sensor
- Tachometer
- Vibration sensors and others in the future

It integrates a light source, a photodiode and all the required electronics in order to adapt the incoming optical signal, from Phonoptics' fiber optic sensors to the industry standard voltage.

It is a plug&play sensor very easy to use and compatible with any DAQ systems, computer or oscilloscope.
It can be operated without external power supply thanks to its integrated battery for approximately 20 hours.

The wavelength is 1300nm standard but can be customized (850, 1550nm)

Conditioner input

Connector type	E2000 LSH APC
Measuring range	100 µWatt @1310nm
Bandwidth (-3dB)	800 kHz
High-pass frequency	0.9Hz (On BNC only)

Supply

Voltage power supply	5V
Rated supply power	0.5 Watt
Connector type	µUSB
Battery	18650 2600mAh

Environment

Storage temperature	-10 to 55° C
Operating temperature	0 to 45° C

Output

Connector type	BNC 50 ohm
	Jack 2.5 mm
	SMA DC signal output
Digital output	USB C audio codec
	16-bit 44kHz 20Hz-20kHz
Output voltage	±10 volts
Electrical gain	x1, x10, x100

R

Fiber optic dynamic pressure sensors Evotis

Standard version (metal)



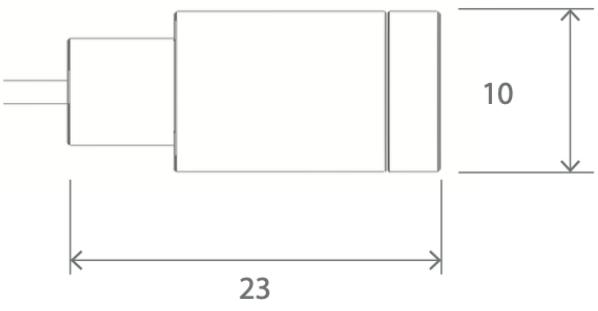
DESCRIPTION

This sensor has been designed to be used in harsh environment with high sensitivity on audible frequency range. This sensor is fully calibrated for sensitivity and frequency bandwidth.

Thanks to its small size, it makes possible the study of acoustic waves at high frequency in pipes

Typical applications:

- Crack monitoring in oven
- Non-destructive testing
- High voltage measurements (Overhead line, electrical transformer)
- MRI speech
- Measurements in ATEX environments



Acoustic

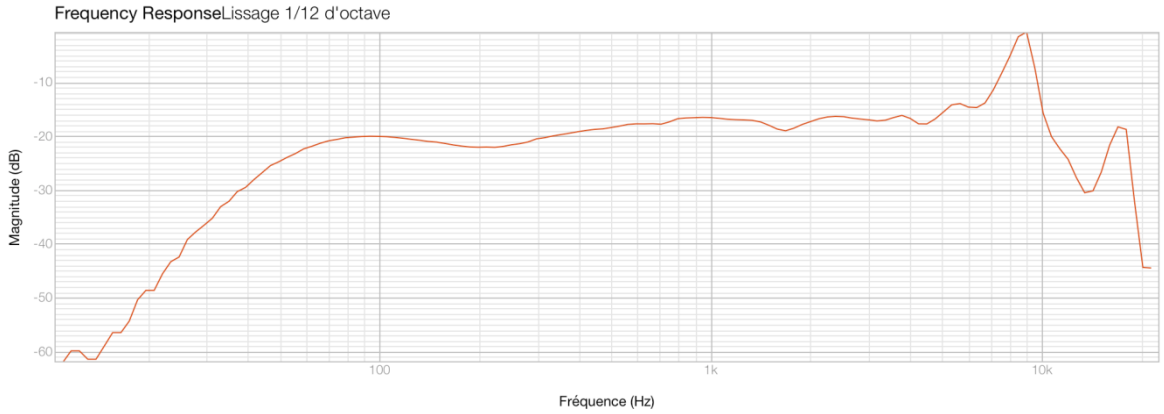
Transducer type	Silicon nitride membrane
Operational Mode	Differential (rear-vented)
Natural frequency	15kHz
Frequency range	20Hz-15kHz (-3dB)
Dynamic maximum pressure	0.05 Bar (≈167dB SPL)
Static maximum pressure	Not limited. (May change frequency response)
Self-noise	30dB SPL (BW: 1Hz, over full bandwidth). 20dB SPL with low noise conditioning unit
Damage threshold	>0.1 Bar (≈173dB SPL)
Sensitivity	10mV/Pa
Polar pattern	Omnidirectional
Sound field optimization	Free field
Calibration	Calibrated at factory. Adapter available

General

Pressure Media	Any gas
Rated Optical Excitation	150 µW @1310nm
Fiber type	Multimode 50/125 OM2
Sensor head dimensions	10 mm x 23 mm
Sensor head weight	2 grams
Fiber cable length	Standard 2 meters
Material	Aluminum

Environmental

Operating Temperature Range	-40° C to 125° C
Peak short-term	150° C
Temperature influence	<1% of response sensitivity
Environmental humidity	100% RH
EMI/RFI	Full immunity. No influence
Certifications	Waterproof IP65 (with protective membrane)



Frequency response measured thanks to B&K type 4232 anechoic test box

II- Product description

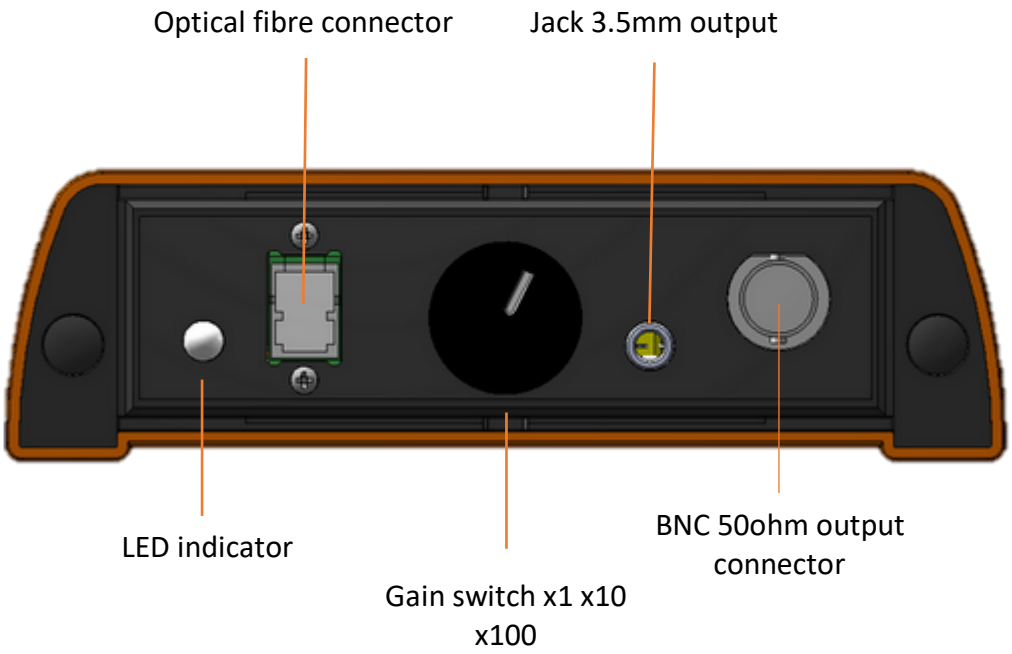


Figure 1 - Front panel

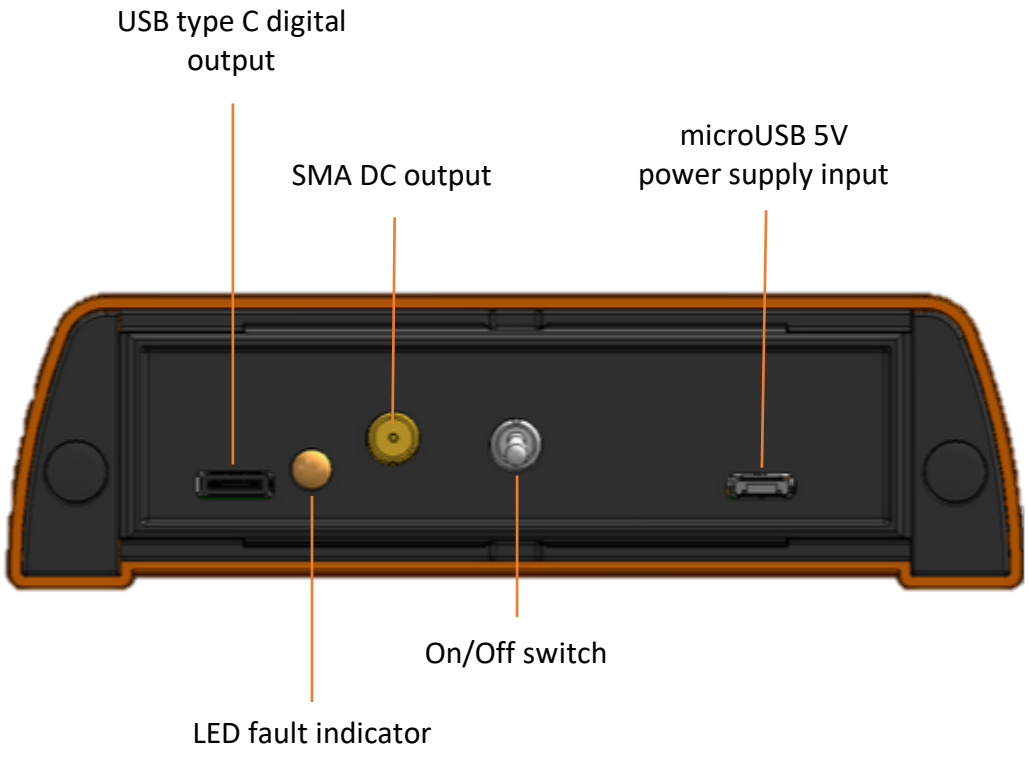


Figure 2 - Rear Panel

On the front panel:

- The LED indicator shows the state of the Myotis. It has 2 colors: Red and Green
- The optical fibre connector is an E2000 APC connector adaptor used to connect Phonoptics' sensors.
- The Gain switch has 3 positions. Turn it to increase the output voltage on the jack 3.5 and the BNC. It is x1, x10 and x100 which is equivalent to 0dB, 20dB and 40dB. If you measure the sensitivity at Gain x1, then the sensitivity will increase by the voltage gain applied, as well as the noise floor.
- The jack 3.5mm is a mini-jack connector useful to connect a headphone, a speaker or any cable. It can handle up to 8ohm impedance output.
- The BNC connector is a 50ohm output. It is symmetrical AC ±10V.

On the rear panel:

- The µUSB connector is used to power up the unit. It has to be 5V and at least 1A. It is used to recharge the integrated battery. Inside a component manages the recharge of the battery and the power supply of the electronic depending on how much the power plug can supply and how much the electronic needs.

- The On/Off switch turns on the light source and electronics inside. However, even on Off position, the battery will charge.

- The SMA output is a DC output between 0 to 10 Volts. It is not affected by the Gain. It is set to Gain x1 0dB. The mean value is proportional to the sensitivity of the sensor at fixed temperature. This signal includes also the sensor AC signal, but it could be small without amplification.

- The LED fault indicator, color yellow, turns ON if not enough signal is detected. The reason can be no sensor connected, sensor broken, fiber broken, or dirty optical connectors. It turns off when everything is fine.

- USB type C output is a digital output. An integrated codec chip digitalized the signal at 44kHz 16bit and offer a USB connectivity through the connector to a computer. It will be recognized by the computer as USB audio Codec and can be selected as input source as a microphone. It integrates antialiasing filter to ensure a proper bandwidth of 20Hz to 20kHz.

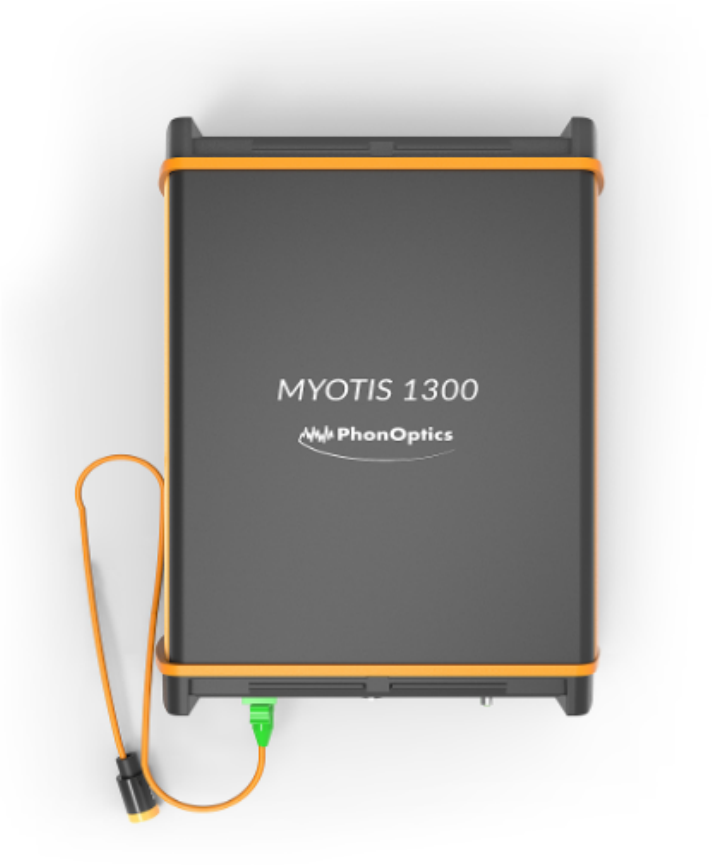


Figure 3 - Upside view with sensor

III- Operating the Myotis

A- Connection and operation

This step is only when not using the standalone battery mode

First insert the microUSB plug inside the appropriate connector.
You will see the front panel indicator LED turned RED. If not, please check if the microUSB connector is correctly inserted as well as the wall plug adapter.



Figure 4 – µUSB power supply connection

You will notice that the Status LED turned RED on.



Figure 5 - Myotis correctly power supplied

Then you can turn on by pushing up the button.



Figure 6 - Switch on ON position and Err LED ON

At the back, after few seconds, you will see that the Err LED will turn ON yellow, which means no sensor is detected. At the front, you will see the LED turns GREEN.



Figure 7 - Myotis powered ON

Next step is to plug the sensor:



Figure 8 - sensor plugged in

You should hear a click when the connector is well plugged in. Be careful about the insertion direction.



Figure 9 - Err LED turned OFF

Now the Err LED should had turned OFF. If not, please refer to Troubleshooting chapter.

The first setup is completed. Now you should connect the right cable to the right connector depending on what should be measured:

- For general measurement, one should use the BNC connector and then connect it to ADC, DAQ or oscilloscopes.
- Then you can control the amplification level with the Gain switch.
- The DC Out SMA connector should be use in case you want to track the average power level of the sensor. Moreover, if one is using an ADC or DAQ which can support only positive voltage, this output is recommended.
- The Jack 3.5mm can be used to plug and listen with a headphone. Or it can be used to use an audio soundcard such as computer mic input jack.
- Last but not least: the USB C digital output can be used to measure and record sound on a computer using software such as Audacity®.

B- Increasing fiber length with patch cable

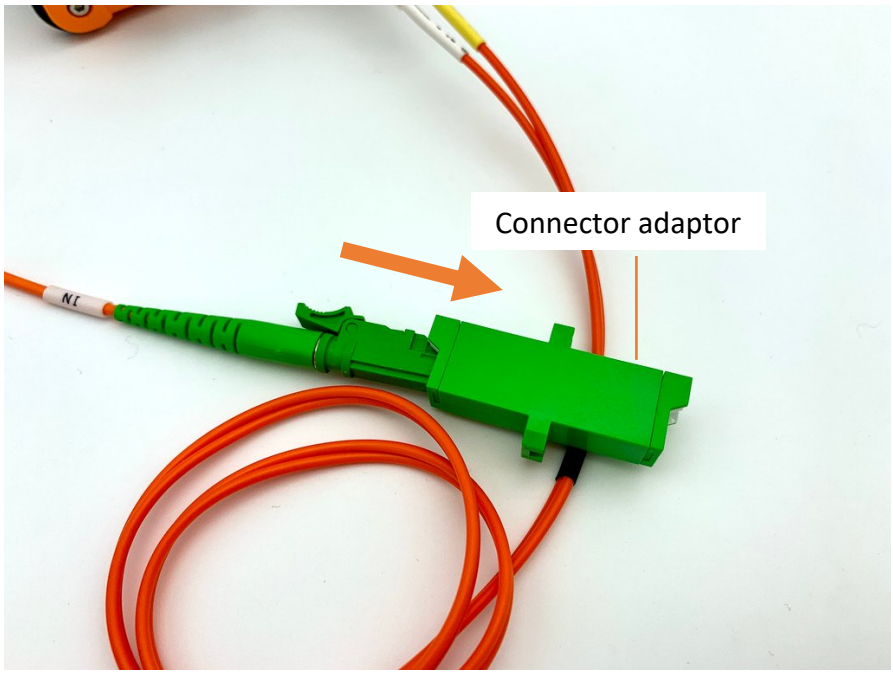
Phonoptics sensor technology is very convenient to use because it is not wavelength dependent nor length dependent.

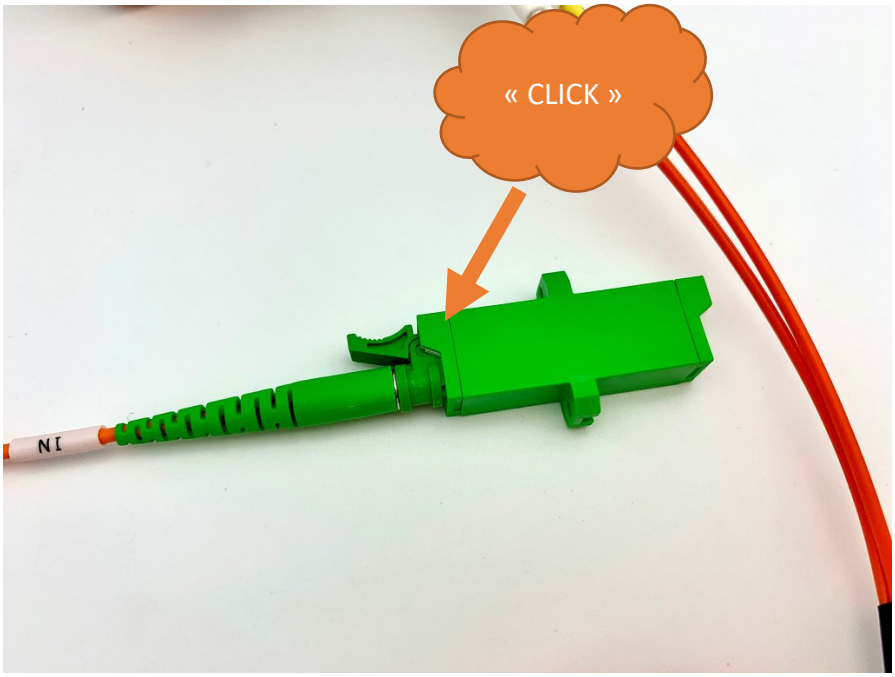
The user can add extra length between the sensor and the Myotis as long as the the fiber is the same core size as the fiber used for the sensor and inside the Myotis.
Standard fiber used is **OM2 50/125 multimode fiber**. OM3, OM4 and OM5 can be used as well since it is 50microns core fiber.
OM1 can be used but performance can decrease.
Single mode fiber (OS1, OS2) **cannot** be used.

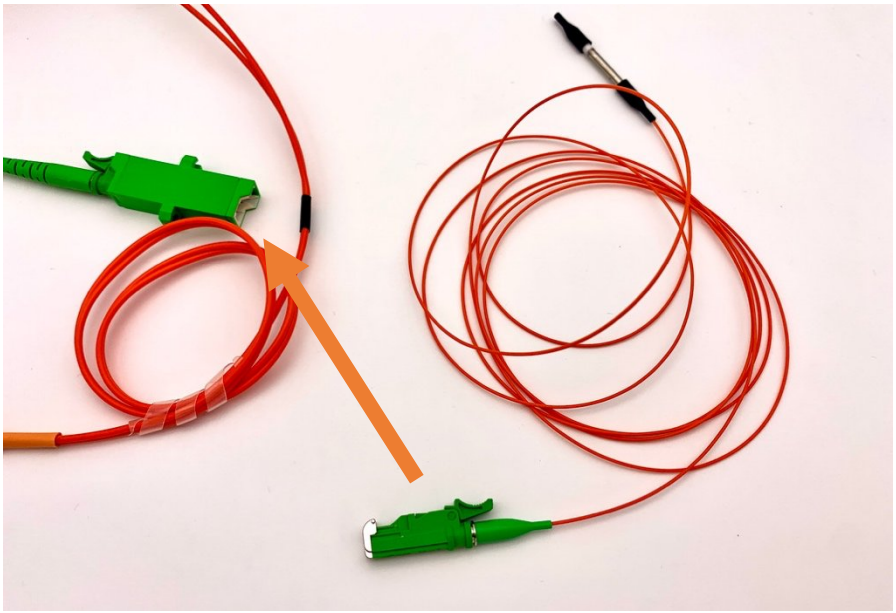
One can buy fiber from any reseller, or Phonoptics can supply it with best performances.

To add extra length patch cable, the optical fiber cable should have the same connectors has the Myotis optical connector and the sensor connector. Standard connector is **E2000 APC**.

Optical connectors are always male style. To connect two optical connectors together, an optical connector adopter must be used as shown on the following picture:







Maximum length possible is higher than 2kms.
Be sure when adding extra length cable that the DC voltage on the SMA DC output connector, is still high enough.
Please note that when you add extra length cable, the sensitivity of the sensor may have changed. A quick calibration is recommended.

C- Cutting and reconnection of fiber

For some application, when one needs to insert the fiber through a pipe or a hole, the connector can be too big.
In such cases, cutting the fiber in two parts with one part the sensor, and the other part the connector, is possible.
This is a way to add extra length as well between the two parts.

To do so, there are two way to proceed to re-connection:

a) Using a fusion splicer
b) Using an optical domino

The splicer is the most expensive, but it is the best quality method. Moreover, the price of the splicer dropped significantly recently and starts from 1000 EUR.



Figure 10 - Optical fiber fusion splicer

After the operation the fiber will look like this:

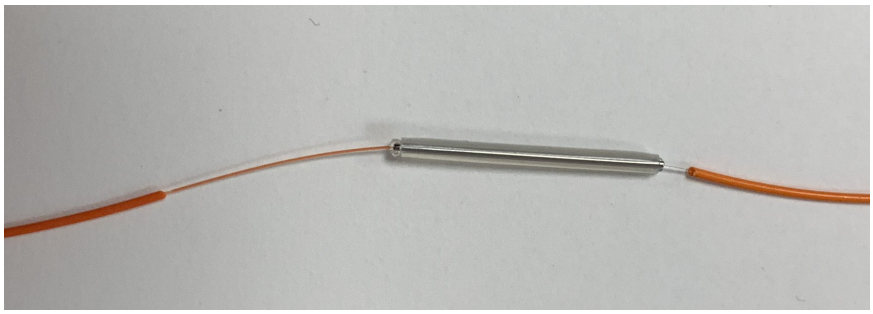


Figure 11 - Fiber spliced with protective heatshrink tube

The optical domino is a mechanical splice method similar to electrical domino. One need to insert the fibers inside the domino and then clamp it to ensure proper and stable connection. However, there are no certainty about the quality of the connection. Such method is low cost and easy to do.



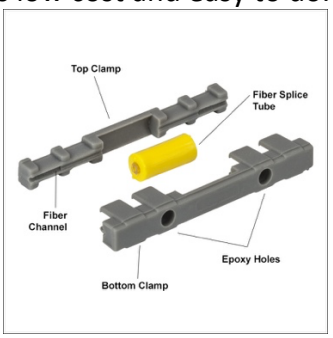


Figure 12 - mechanical fiber splicer "domino" sold by Thorlabs®

After installation, the fiber will look like this:

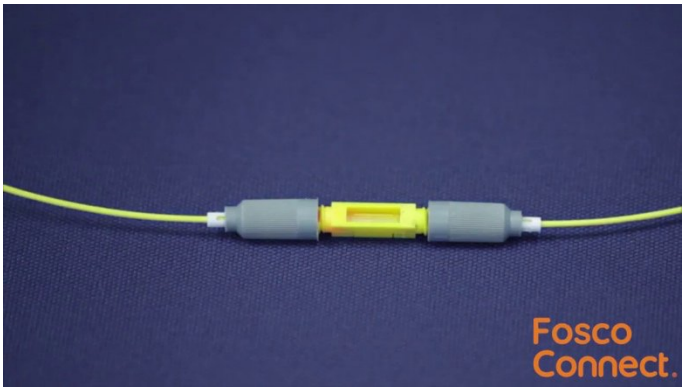


Figure 13 - mechanical fiber splice domino

For more information, please ask us directly or one can find information on internet.

IV- Calibration

Phonoptics deliver with each sensor a calibration sheet which is composed of:

- Frequency response between 100Hz and 10kHz, thanks to the B&K® type 4232 Anechoic Test Box.
- Sensitivity calibration thanks to B&K® type 4231 sound calibrator at 94dB or 114dB 1kHz.

A- Sensitivity

The acoustic or pressure sensitivity is the value that tells the output voltage according to the input pressure. It is usually express in mV/Pa for acoustic, or V/Bar for dynamic pressure sensor.

To know the sensitivity of the sensor, one should use for example an acoustic calibrator which send 94dB SPL at 1kHz on the sensor. Sometimes, for lower sensitivity sensor, it is possible to use a 114dB SPL calibrator.

Standard calibrators are made for 1 inch or 1/2inch microphone. Some adapters can be used for different size.
Phonoptics supplies such adaptors for its sensors.

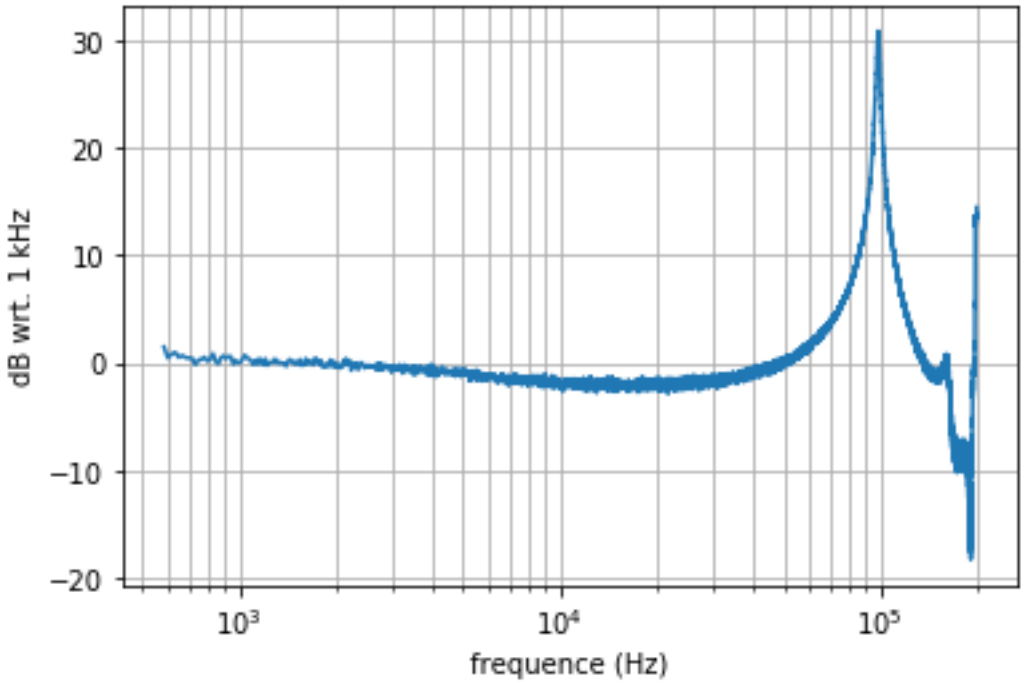
To run a new sensitivity calibration, follow these steps:

- First turn on the Myotis and plug the sensor.
- Then insert the sensor inside the acoustic calibrator with the right adaptor.
- Turn on the calibrator
- Measure the output voltage on the BNC or SMA connector.

Warning: if the acoustic calibrator, such as the B&L 4231 is an RMS calibrator, then the output measure voltage should be the RMS one.
If you measure the RMS peak to peak voltage, then the sensitivity will be peak to peak value.
If you measure the peak, then the sensitivity will be a peak value.

B- Frequency response

The frequency response is the behavior of the sensor at each frequency. It is generally referenced at 1kHz and then the variation in dB is represented on a graph, as the following one:



This graph shows that the sensor behaves the same from 100Hz to 50kHz and then the resonance of the sensor amplifies the response.
This means that for the same input level signal, the output signal will be the same between 100Hz to 50kHz but then higher while the input signal is not higher.

Another way to phrase it is:

- If a sensitivity is measured with sound calibrator at 1kHz, then to know the sensitivity at the other frequencies, one needs to add the dB value red on the graph to the sensitivity at 1kHz.

For example, according to the previous graph, at 85kHz, the level is 10dB higher than at 1kHz. If the sensitivity is 1mV/Pa at 1kHz, the sensitivity at 85kHz will be around 3.2 times higher leading to a value of 3.2mV/Pa at 85kHz.
So for an input pressure signal of 1Pa at 1kHz, the output voltage will be 1mV; while for the same input pressure at 85kHz, the output voltage will be 3.2mV even though the pressure is still 1Pa.

Is it important to know that this frequency response is done at 25°C, 1 Bar, 40% humidity and that the change of temperature, ambient pressure and humidity affect the frequency response. Phonoptics has the capability to measure theses effects and already did it, so please ask us if you need to know more about it.

V- Signal analysis

A- Acquire the signal

You can measure the output signal with different material:

- Acquisition board, such as National Instrument NI® USB-6001
- DAQ system such as Sirius® from Dewesoft®
- Professional audio acquisition board
- Micro-controller ADC such as Arduino®, Teensy®, Raspberry®, etc.

- Oscilloscope
- Spectrum analyzer

Be cautious to frequency and resolution limitation. The minimum sampling frequency should be two times the bandwidth frequency.

The Myotis Standard has a 16bit 44kHz ADC integrated which is recognized as USB audio DAC by any computer or smartphone. Use the supplied USB C cable.

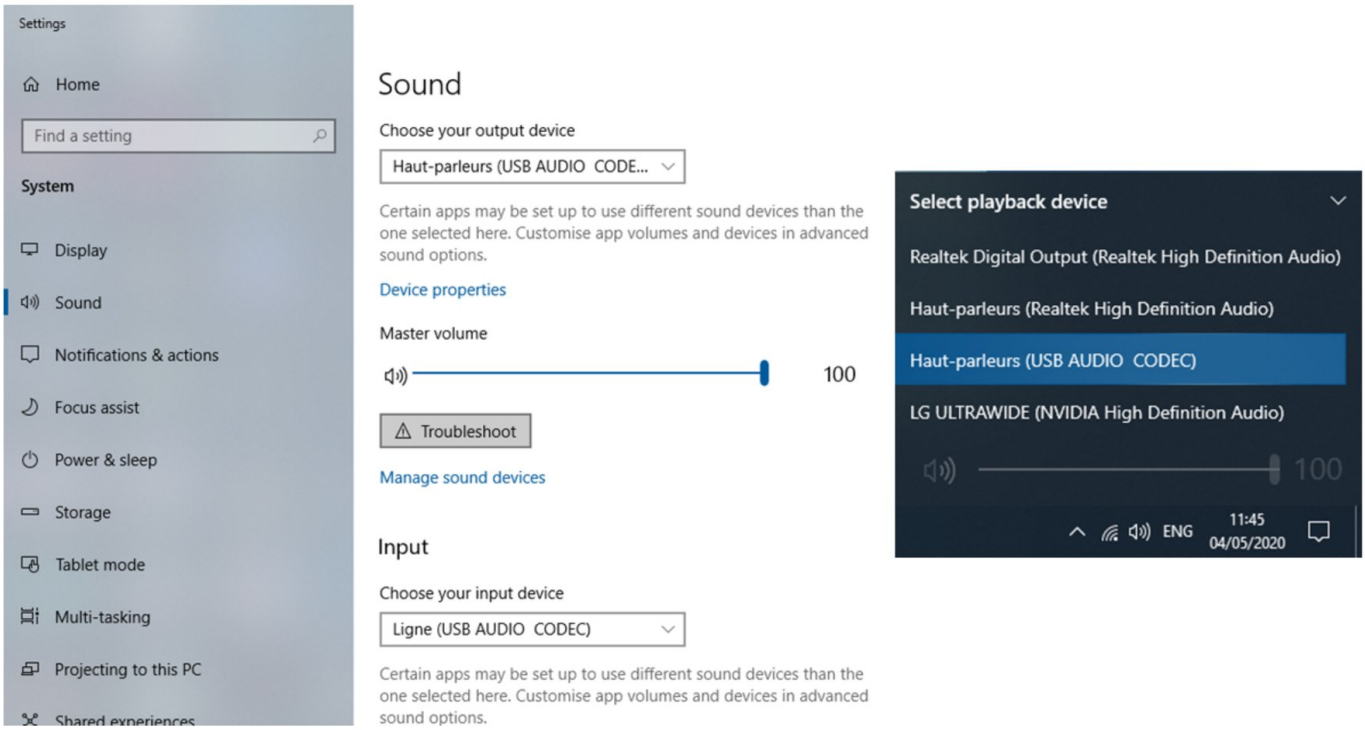


Figure 14 - Using the USB C digital output with a computer

B- Filtering

It is important to have in mind that the Aliasing can be a real issue for your acquisition board.
The analog bandwidth of the Myotis is 850kHz.

If you use a DAQ with sampling frequency lower than 1700kHz, you should use analog anti-aliasing filtering. Some devices integrate already AA filtering, which can be fixed or selectable.
If the user does not use the AA filtering, the noise floor will be higher than specifications and the signal could be corrupted by artefact.

If the DAQ system does not integrate AA filtering, you can use a simple RC filter between the Myotis output and the DAQ input. You can make your own or buy it from Phonoptics or any specialized company (such as Thorlabs® EF low pass electrical filter series)

Please refer to Anti-aliasing filtering subject on internet to learn more about this important point.

VI- Troubleshooting

Status LED not turning RED ON:

- Please check if the On/Off button is up side on the ON position
- Please verify the microUSB is inserted correctly
- Check if the wall plug adaptor is working properly

Status LED not turning GREEN ON:

- Check if the PWR LED is ON
- In some conditions, the light source can require a lot of current to initialize. In this case and if the battery is empty, the supply current could be too low and the Myotis will not turn ON. In this case, plug the power supply to myotis, be sure the status LED is turned on RED, and wait few minutes to let the battery recharge a bit. Then try again to switch ON.

No signal from output connectors / Err LED is turned ON:

- Please check if the Status LED is GREEN on
- Please check if the Err LED is turned ON. If it is, then unplug and plug back the sensor optical connector.
- If Err LED is still turned ON, please check the offset voltage on the SMA DC output connector. If the offset voltage is lower than 100mV, it will not work properly. Reason may be the optical connectors are dirty, the fiber is broken, or the sensor's membrane is broken.
- Please check visually if the membrane is broken.
- Check if the fiber is broken somewhere. To help find this, visual fault locator (VLT) can be used.
- Check with a high magnification microscope if the connector is dirty. If you can check that or if it is dirty, you can use optical connector cleaning tool to clean the connector. Then reconnect the sensor. If you don't have cleaning tool, you can use a tissue with some IPA (alcohol) without forgetting to dry it.

If these steps do not work, please feel free to contact us for support.

VII- Contact

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