

IOEaZy SW White Paper

Choosing the right hardware



Selecting proper hardware for the IOEaZy SW

This white paper describes important elements to consider before purchasing hardware intended for sound level measurement systems.

This white paper is issued due to the release of IOEaZy SW - a software only version of IOEaZy, but information provided here is valid for any sound level measurement software that does not ship with a dedicated hardware solution.

Having a sound level meter application is point less if it isn't accurate. From smart phones to laptops, a number of products exist that has a display telling you how loud a given sound is. However, in order gain a reliable and truthful measurement, it is paramount to use high quality measurement equipment (microphone and sound card) and to have the measurement chain properly calibrated. This kind of software will display values for any input, even the onboard microphone from a laptop, but this is no way near a reliable source of data, and care needs to be taken before assuming that one is doing a real sound level measurement, and not just displaying a screen with randomly flashing numbers.

With the introduction of IOEaZy SW, any PC audio hardware may be used for measurements. All other models of IOEaZy ships with high quality purpose build hardware to ensure out of the box accuracy and IEC standard compliance, but with IOEaZy SW the selection of hardware is at the hand of the user and we would like to ensure that the hardware used is selected upon a qualified and educated choice.

If strict IEC61672 compliance is a requirement, please consider one of the IOEaZy products that ships complete with hardware, as this is by far the best way to guarantee that the measurements performed are calibrated and accurate time after time.

If strict IEC compliance is not a requisite or you are all ready the owner of a quality sound card and measurement microphone, then using normal consumer hardware may be a viable solution.

The following pages will try to sum up some of the most important points in choosing the right hardware for the job.

Choosing a proper microphone

The microphones that ships with I0EaZy, I0EaZy DIN and I0EaZy RT are specialized microphones used in the measurement industry. They are capable of handling large sound pressure levels and maintain a flat frequency response along with a stable sensitivity over a wide range of temperature and humidity conditions.

This is necessary to comply with the strict requirements of IEC61672 for both class 1 and class 2.

There are a lot of demands in these standards, put there to ensure that measurements are reliable and that it is possible to reproduce the result with any sound level meter that complies with this standard

Microphones sold as “measurement microphones” in the consumer market ships at a price range from 80 € to 1500 € and needless to say there is a major difference between the two extremes.

As with any other task at hand, it is a matter of choosing the right tool.

One of the main requirements of a measurement microphone is a flat frequency response. Even the cheapest measurement microphone handles this requirement fairly well, so this is not a major issue.

We will focus on two other vital points in the following:

- SPL handling
- Possibility of calibration

SPL handling:

If the measurements performed with a software only version of a sound level meter application is to be of any use in terms of accuracy, the microphone needs to be able to handle the sound pressure level, or SPL, at the measurement point.

It is not uncommon for peak values to reach in excess of 130 dB at the mixing desk or in the DJ booth. Most of the cheap measurement microphones are manufactured to be used in measurement of room acoustics, and to tune a loudspeaker set up at much lower SPL's, and as such a wide variety of these microphones will start to distort when exposed to the SPL's experienced in a live sound situation. Distortion is adding harmonics to the signal and as such they also add to the measurement resulting in inaccurate measurement.

This is why cheap measurement microphones are NOT recommended for sound level measurements in a reinforced sound situation.

Higher quality measurement microphones from vendors such as Earthworks and DPA are capable of handling very high SPL's and as such are a much better, but also way more expensive tool for this task.

Below is an example of the consequence of using microphones of various qualities.

The microphone in question was inserted into a calibrator providing a steady sine wave at 1 kHz with a SPL of 114 dB. The frequency response from the soundcard was logged using an RTA application. Our reference, the microphone used with 10EaZy and 10EaZy DIN is at figure 1. As expected only a single frequency shows up – the 1 kHz test tone.

In figure 2 with a microphone at 250 € and a sound card of high quality and fully capable of handling the signal an additional 2 kHz component is showing up – a sign of distortion!

As the SPL increases this microphone capsule will produce more and more distortion, thus the measurement results displayed at typical live sound levels, will not be correct!

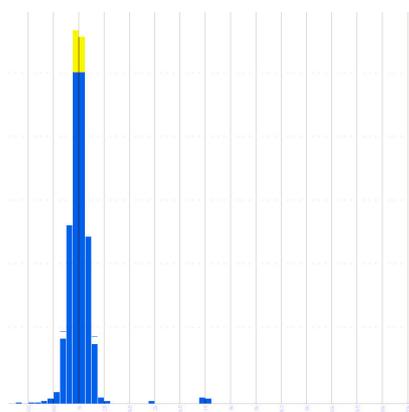


Figure 1: 114 dB at 1kHz measured with 10EaZy HW.
Notice the single frequency present. This is a clean signal with no distortion

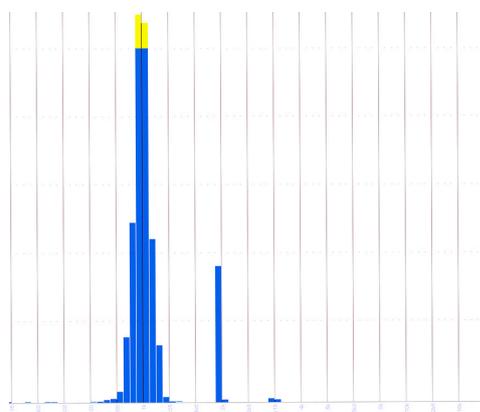


Figure 2: 114 @ 1kHz measured with a 250 € consumer measurement mic and quality soundcard.

Notice the introduction of a secondary frequency component. This is the first harmonic added by slight distortion. The component is too small to influence the measurement, but it is a sign of a system at its limit

Possibility of calibration

First a bit of dry theory – In order for a sound level measurement to truthfully display the correct dB values, a calibration needs to be performed. This is typically done using a “calibrator”, which is a handheld unit producing a very stable 1kHz tone at 94 or 114 dB. To calculate a SPL value the sound pressure at the microphone, measured in Pascal (Pa) is first converted into a voltage by the microphones preamp, and then sampled into digital values by the soundcard. The combinations of microphones, gain structure of the sound cards, and the software are many an unknown. As such it is not possible to know the relation between sound pressure and digital sample value without a proper reference. This is why a calibrator is needed. Inserting the microphone into the chamber of the calibrator will present the microphone with the 94 / 114 dB signal and the software can use its calibration routine to calculate the required calibration value. Once the calibration routine is completed the software should display a value of 94 / 114 dB at the slow / fast settings and 97 / 117 dB at the Peak C weighted value.



Figure 4: Example of a calibrator

A small problem exists.

The calibrator is designed to work with measurement industry standard microphones, that all complies with the same form factor and are fitted with either 1/2 or 1/4" capsules.

This is also the kind of microphone you get with a 10EaZy or 10EaZy RT system.

However, consumer microphones do not comply with this standard and as such will not fit 100% correctly into the calibrator. Most of the microphones however, have a capsule that is roughly the size of either 1/2 or 1/4 of an inch. As long as the capsule is capable of being inserted into the calibrator and cover a majority of the cavity, the performed calibration should be with an accuracy around 1 – 1.5 dB. For this type of setup, the inaccuracy must be tolerated and with the amount of other variables that influences on the measurement it may be considered to be insignificant.



Figure 5: Example of consumer and 1/2" measurement microphones

Alternate calibration method:

For every right way to do a thing, there is also a wrong. Having a handheld sound level meter and adjust the gain of the sound card until it displays the same value as the handheld meter is a VERY inaccurate way of performing a calibration, and it kind of defies the purpose of measuring in the first place. It is more or less like drawing your own ruler by free hand - so it is highly recommended to avoid this approach.

Additional considerations

Selecting the proper sound card

As with the microphone, the sound card needs to be able to handle the input voltage produced by the microphone when measuring at high SPL's.

Most sound cards are equipped with a gain button and / or pad button to ensure enough headroom in the input stage. Failure to have a sound card capable of handling a high enough input voltage will lead to input stage distorting and thus ruin the measurement. Cheap sound cards usually have a rather limited area of gain, and it may be impossible to reduce the gain enough on the card to avoid input distortion. If this is the case, consider buying a sound card with a higher quality and the ability to control the gain over a wider range. Another option may be to buy an XLR adaptor that provides a -20 dB pad, but make sure it is passive, as the phantom power from the sound card to the microphone needs to be delivered thru the pad as well.

Once the microphone and the sound card have been connected and the software has run the calibration routine it is vital that no changes are made to the gain of the sound card.

Any changes to the gain button, or in the gain sliders of the control panel in windows will result in changes in the measured values and will require a recalibration for the system to be accurate.

Microphone placement

Please note that in order to perform an accurate measurement the microphone needs to be in free field, away from walls, ceilings and other obstacles. At least keep 1 meter of clearance all the way around the microphone. Failure to do so may introduce sound reflected from the nearby surfaces into the microphone, and add to the measured SPL, yielding higher values than is really the case.

Stability

One of the things that add to the cost of a dedicated high quality measurement microphone is its ability to perform equally in a wide range of temperature and humidity conditions.

This is usually not a concern for a consumer microphone as it sits in a studio or in the living room, and as such experiences mainly a climate of 20c and about 50 % humidity.

However, bringing the microphone to the venue, outdoors or nightclub means large variations in temperature and humidity. This fact will have an influence on both the sensitivity of the microphone and the frequency response, and for cheaper microphones this may be significant and will lead to inaccurate measurements.

Conclusion

Doing sound level measurements with consumer products is possible, but it requires hardware of a high quality + the use of a calibrator, and the knowledge of putting it all together to obtain a proper gain structure and the ability to handle high SPL's.

Unless you all ready have the required equipment, buying a 10EaZy or 10EaZy RT system that includes fully calibrated plug'n'play hardware could prove a better and maybe even cheaper solution.

We provide a very high quality of hardware, specified to meet all the considerations listed in this white paper + ensuring a locked measurement chain, where there a no buttons to touch, and as such no way of altering the calibration, ensuring years and years of accurate, reliable and IEC compliant measurements.

Check out the range of 10EaZy products at www.10EaZy.com and feel free to drop any questions you may have at the contacts form on the webpage.