

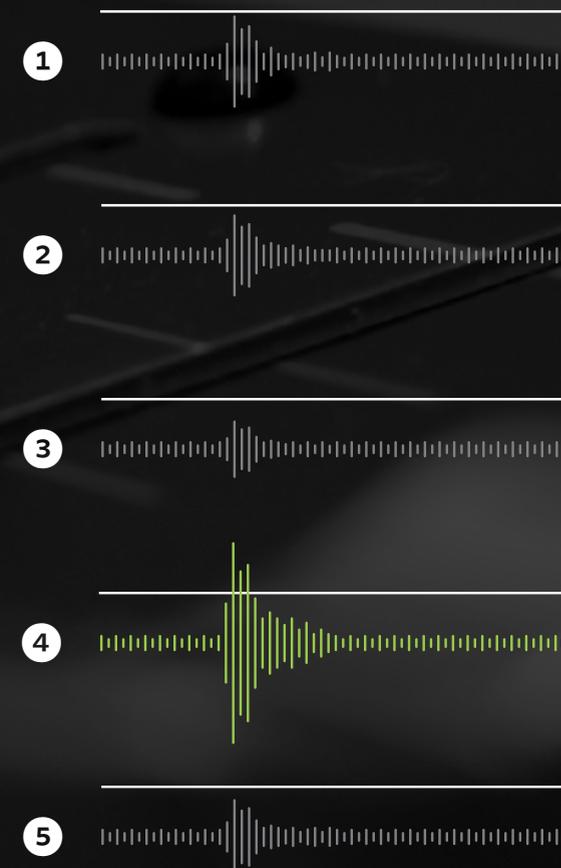
DESIGN A DEVICE TO **IMPROVE DRUM RECORDING.**

CLIENT: SENNHEISER ELECTRONICS

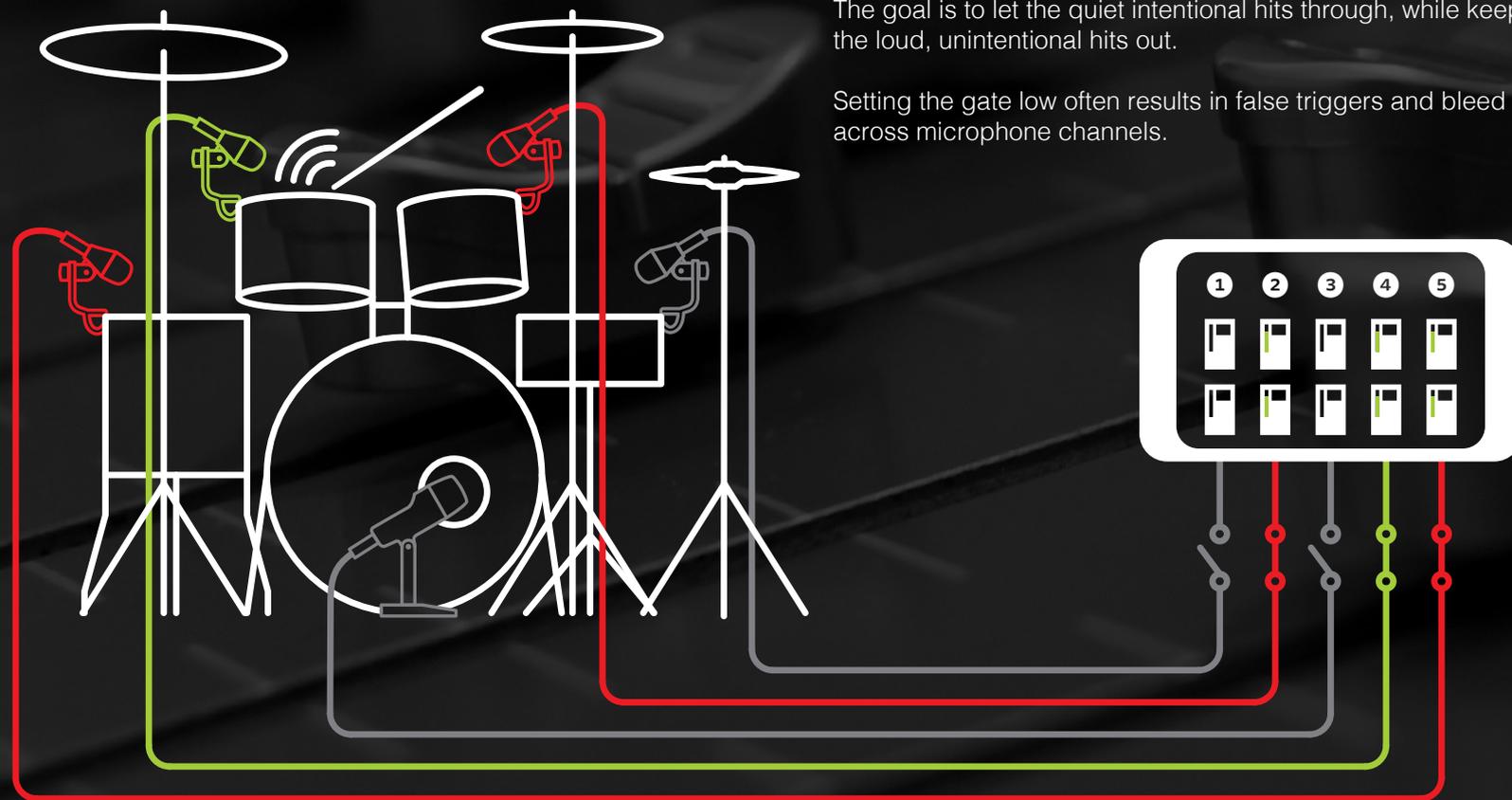
SAN FRANCISCO, CA

# ISOLATING DRUM HITS IS DIFFICULT.

In both live and studio environments, sound engineers use a gate, setting a threshold to trigger the microphones to turn on when a certain decible level is reached.



# THE REALITY: BLEED



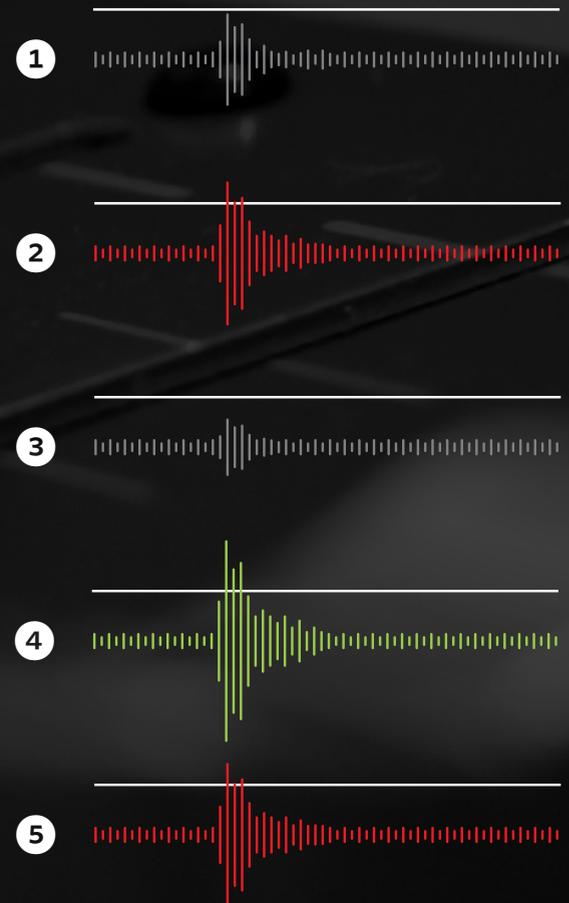
The goal is to let the quiet intentional hits through, while keeping the loud, unintentional hits out.

Setting the gate low often results in false triggers and bleed across microphone channels.

**FALSE TRIGGER**

**INTENDED HIT**

**FALSE TRIGGER**



LET'S USE **LASERS** TO DETECT VIBRATION



CLEANER SOUND



QUICKER SETUP



EASIER MIXING

## THE LASER DRUM MICROPHONE

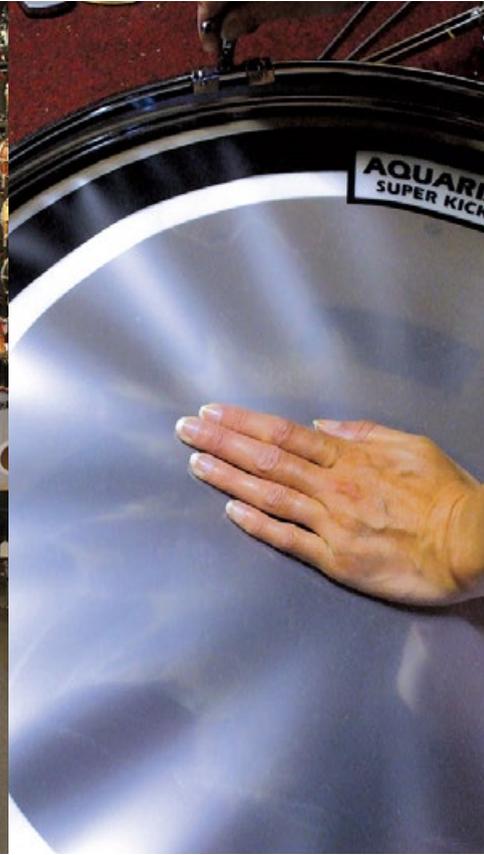


## DESIGN CONSTRAINTS



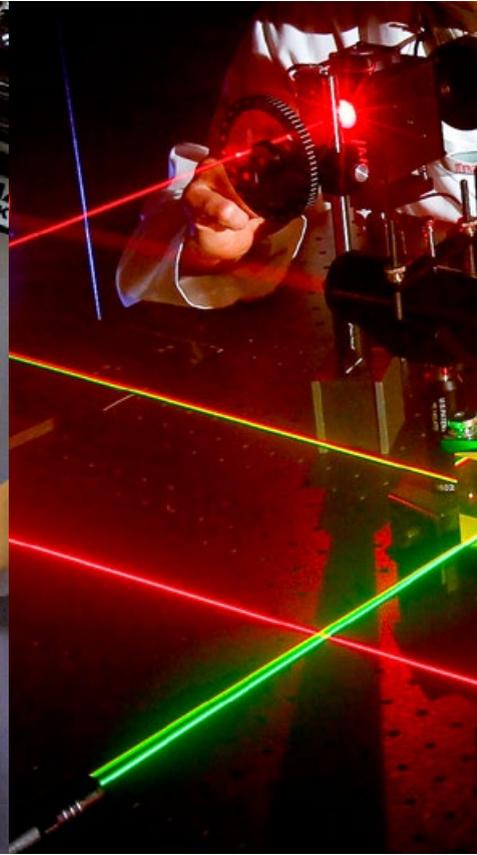
### *drum variation*

drum hoops vary in size and geometry, making precise mounting a challenge



### *untouched acoustics*

using lasers without touching the drum head allows for a true drum sound



### *laser alignment*

quantification of laser performance informed optimal alignment and mounting tolerances



### *simple calibration*

minimal physical adjustment reduces the chance of user error when setting up the lasers



### *beta testing*

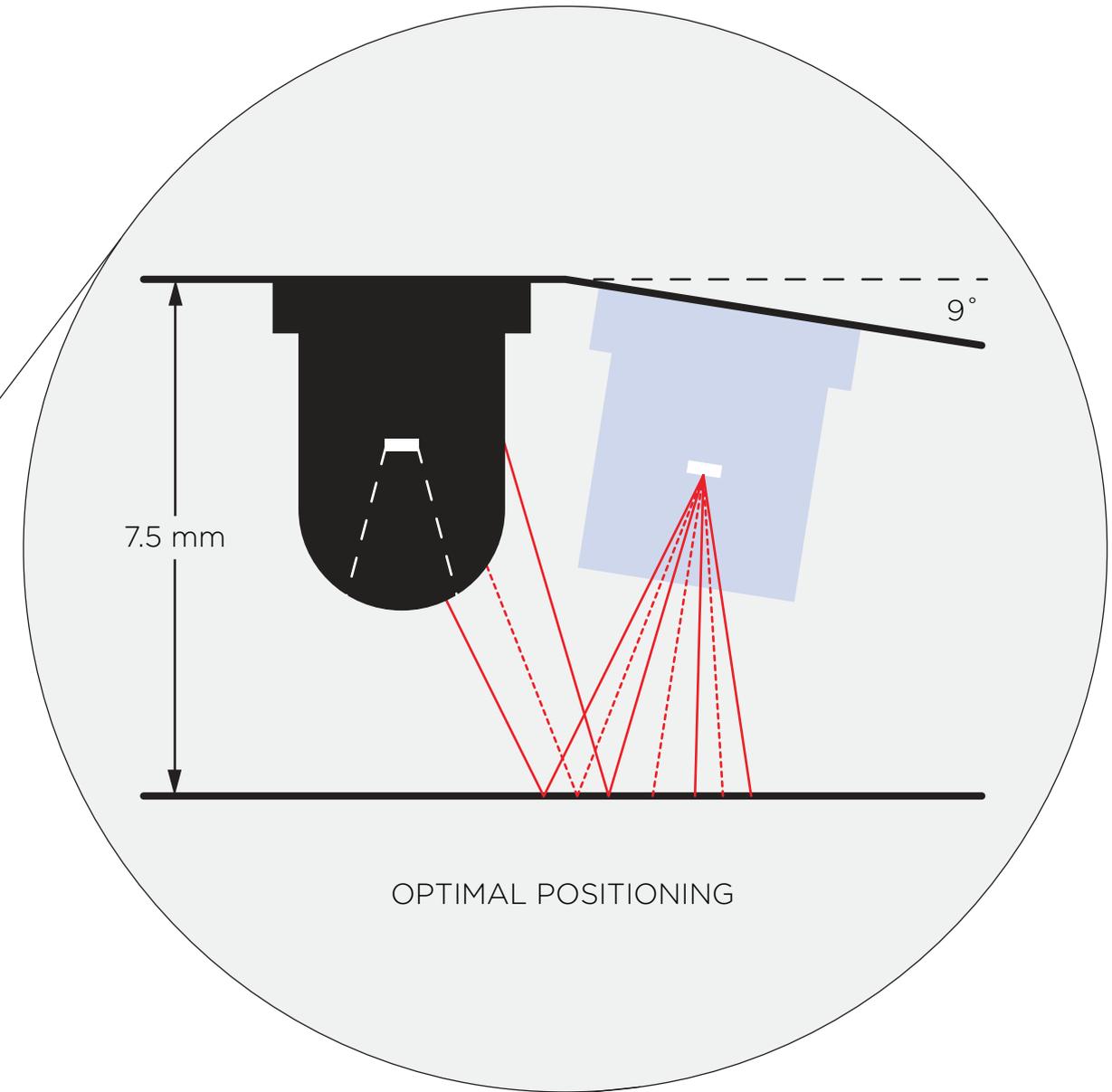
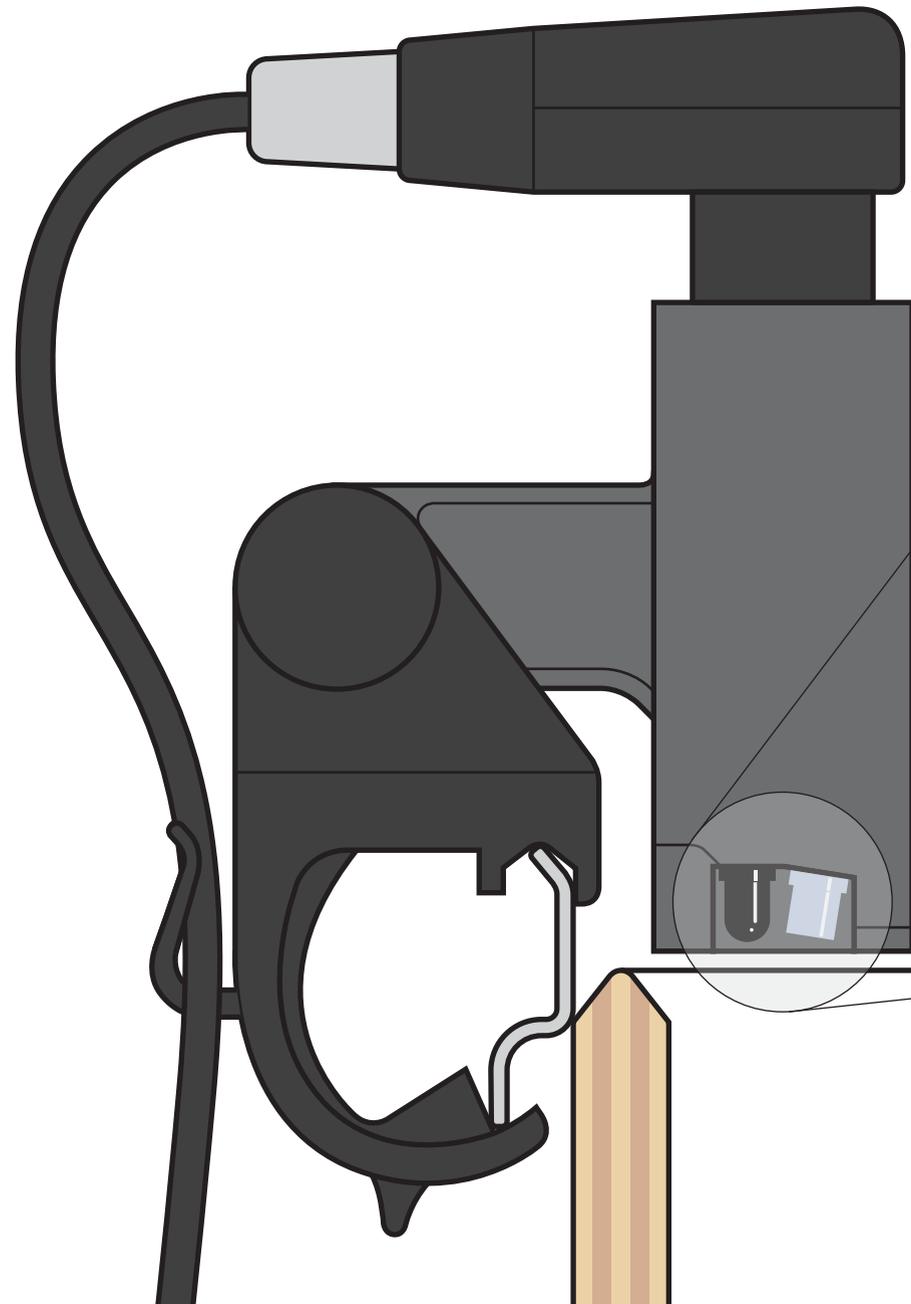
this iteration is intended to be produced by a small series team for beta testing and validation



### *mass production*

the design should be streamlined for injection molding in mass production

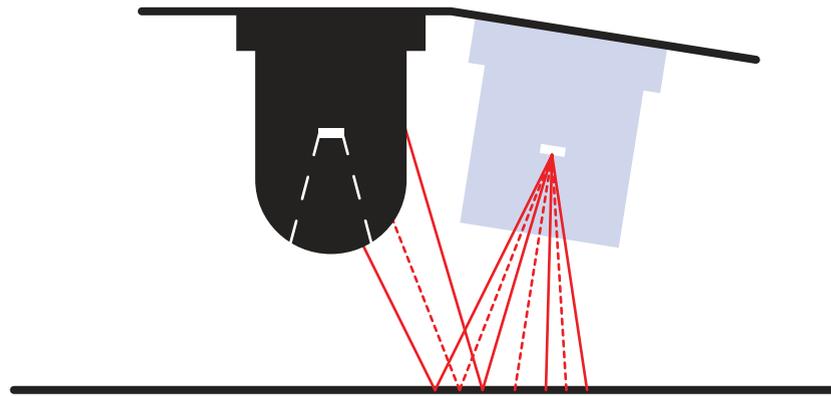
# QUANTIFIED OPTICAL ALIGNMENT



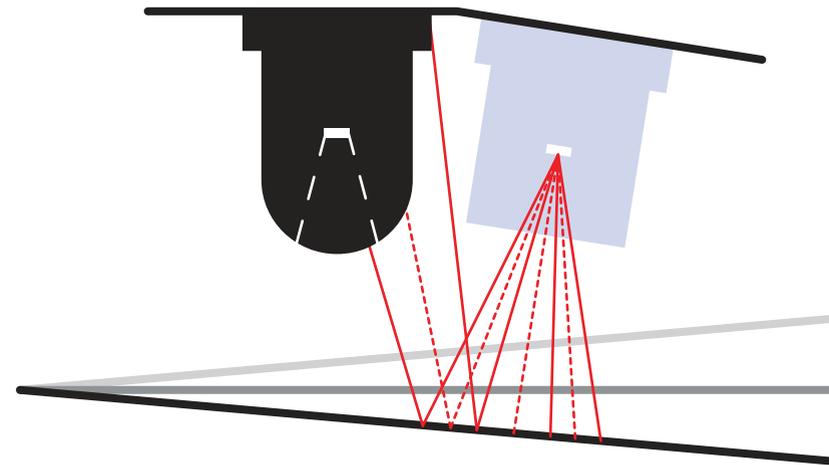
## LASER VIBROMETER SIMULATION

The precise angle of the laser (emitter) and photodiode (detector) keep the light from the laser positioned at the same spot on the photodiode as the drum head is displaced.

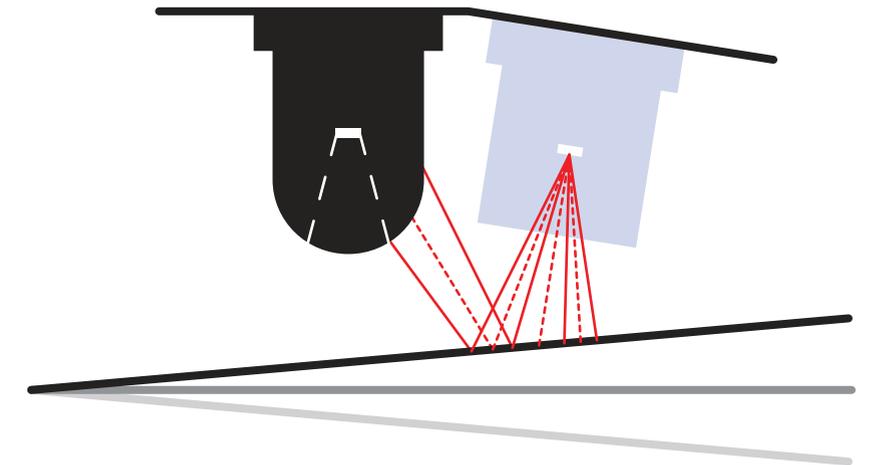
As the drum vibrates, the light travels at varying distances, creating the recognizable wave form signal based on the amount of photons detected by the photodiode, triggering the microphone to turn on.



*benchmark density*



*dispersed light*



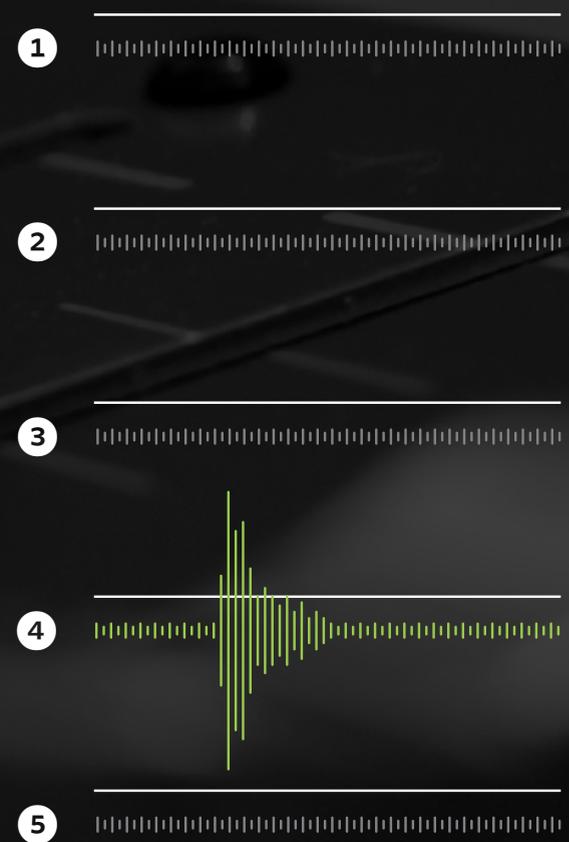
*focused light*

# COMPLETE ISOLATION.

By using the laser signal to trigger the microphones, there is significantly more separation between intentional and bled drum hits, making it much easier to set the threshold on the gate.



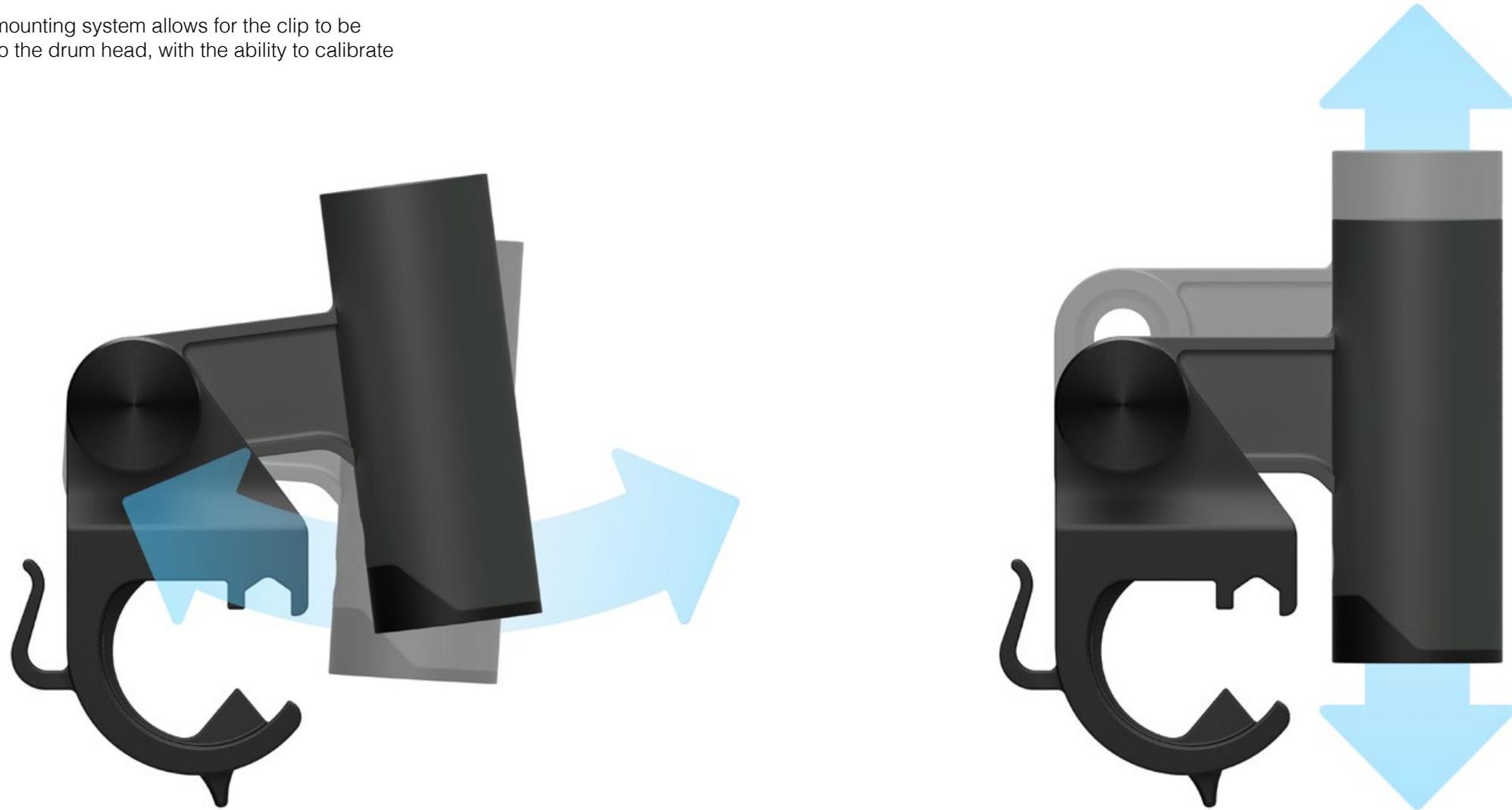
**INTENDED HIT** →



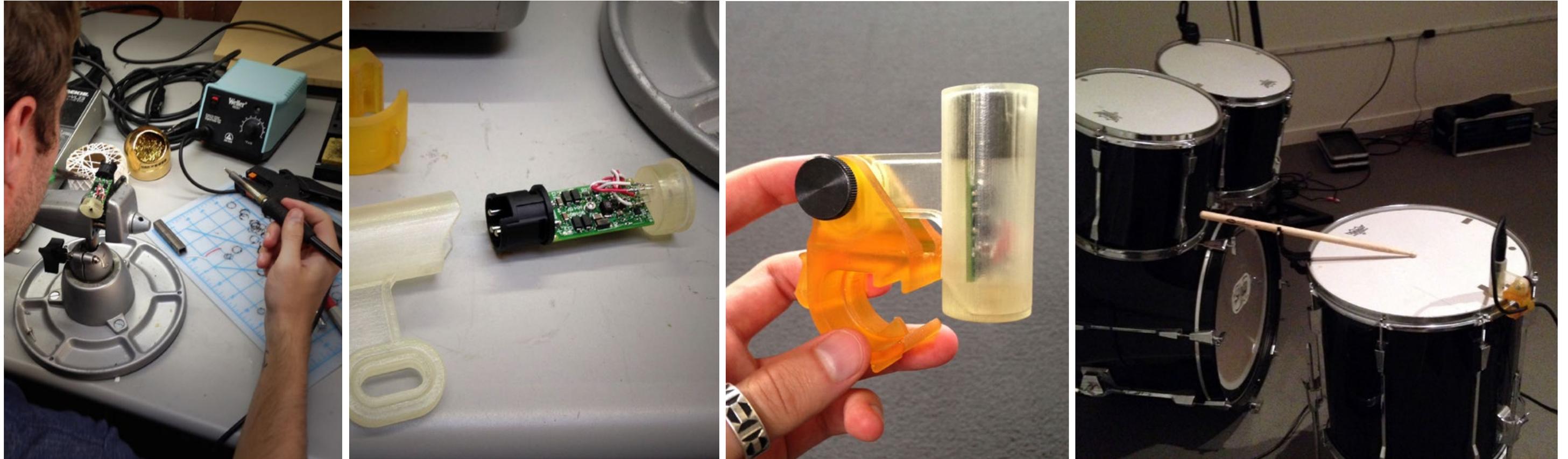
## CALIBRATION

As drum hoop geometries and drum head tuning varies dramatically, a wide range of motion is necessary to ensure that the Laser Drum Mic can be used on virtually any drum kit.

The mechanical design of the mounting system allows for the clip to be mounted at any angle relative to the drum head, with the ability to calibrate the laser freely.



## VALIDATION



A functional prototype was constructed of SLA printed and urethane-cast parts, with a production-ready PCB and custom XLR connector.

We tested by recording consistent, light hits on the drum with the laser, and simulated extreme sympathetic vibration by striking the other drums very firmly. The signal of the light hit was at least 10 decibels louder than the sympathetic hits, and was tested on all drums. It worked.

## FIVE-PIECE KIT

The full kit will include four tom/snare mics, and one for the kick drum.



