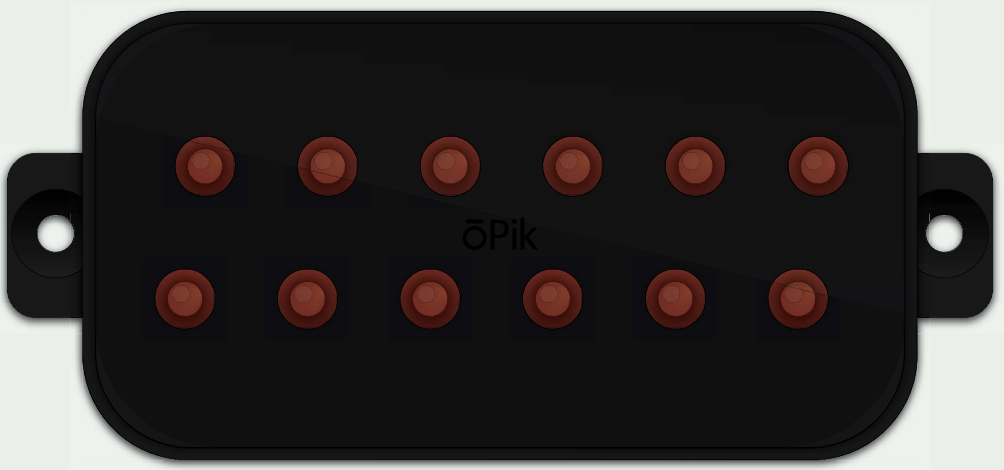
ōPik



THE ŌPIK

WHY THE ŌPIK HAS A FASTER RESPONSE THAN MAGNETIC PICKUPS

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THE SHORT ANSWER

It's true that electric and magnetic fields do propagate at the speed of light, and light in turn iselectromagnetic radiation. However, there is one main reason that the ōPik responds fasterthan magnetic pickups do, and a few other much more subtle reasons as well.

The main reason for the ōPik's faster response is that it is a "position sensor", while magneticpickups are "speed sensors". This means that the ōPik responds to changes in the position ofthe string, even very small ones, while magnetic pickups respond to the speed at which the string is moving as it vibrates. Therefore, with a magnetic pickup, there's very little or no signal at the initial moment of the plucking of the string because it's not moving very fast. But with the ōPik, a signal is generated immediately when the string is touched.

THE GORY DETAILS

MAGNETIC PICKUPS

A typical magnetic pickup is a set of magnets, usually one positioned below each string, with a coil of wire wrapped around the entire set of magnets. Magnetic pickups require ferrometal guitar strings for them to work because the strings themselves must have magnetic properties to interact with the magnetic field from the pickup magnets. The signal strength from a magnetic pickup depends on how fast the string is moving because they work by Faraday's Law which states that the EMF (basically, a voltage) produced in a wire coil is proportional to the time rate of change of the magnetic flux (strength of the magnetic field) "flowing" through the coil, and the number of turns of the coil. If you're interested in delving more into the physics of Faraday's law, and induction, check out these references:

http://hyperphysics.phy-astr.gsu.edu/hbase/electric/farlaw.html
https://en.wikipedia.org/wiki/Faraday%27s_law_of_induction

As the string moves, the magnetic domains within the ferrometal in the stings interact with the magnetic field from the pickup magnets, and this causes a small variation in the magnetic flux as the string vibrates. The rate of change in this flux depends on the speed at which the string is moving. The faster the string is moving, the larger the voltage in the coil. This varying voltage is the signal is that gets sent down the cable to the amplifier.

THE ŌPIK

The ōPik instead uses light to sense the position of the string in two dimensions, and has active internal electronics to convert that information into the desired output signal. One advantage of this design, by the way, is that ferrometal strings are not required, and any string material can be used. The ōPik uses infrared LEDs to shine light up onto each string, and the reflected light is detected by photosensors. The optics are designed so that the amount of reflected light varies as the string is displaced, thus changing the amount of light received by the photosensors. That change in the light signal is converted to a voltage, and pre-amplified to produce the signal that goes to the guitar amp. It's important to mention here that the audio signal path in the ōPik is pure analog. That means that all electronics involved with sensing the string motion, amplifying the signal, and any processing of the signal, such as applying filters, are all analog! However, the settings of the electronics are programmable, and can be saved and called up as needed to create different tones.

EVEN MORE GORY DETAILS

As mentioned above, there are some much more subtle, and less-impactful factors on the response time for both the ōPik, and magnetic pickups. They're worth mentioning without delving too deeply here, just for completeness, but they are far less important than the main difference described above. Here's a list of some (but probably not all) of those factors for both magnetic pickups, and the ōPik:

Magnetic Pickups:

1. Inductance in the pickup coil.
   - This has to do with the number of turns in the coil, the coil shape, and a few other things.

2. Impedance of the overall audio signal path.
   - This includes the electronics and wiring in the guitar, the cable and amplifier input circuitry.

3. Response time (relaxation time) of the magnetic domains in the metal of the strings.
   - This will affect the changing magnetic flux as the string vibrates, and depends on the properties of the metal in the string, but should be a relatively very small effect.

The ōPik:

Slew rate of the internal pre-amplifier circuits.
- The ōPik uses very fast, low-noise op-amps and optimized components to ensure the response is super fast.

Impedance of the overall audio signal path (including the cable and amplifier).
- Same as above with magnetic pickups, however, the ōPik is an active pickup, so the electronics are tuned to optimize the impedance match as best as possible.