



HOW IT WORKS, AND WHY IT'S DIFFERENT
**THE ōPIK OPTICAL STRINGED
INSTRUMENT PICKUP**

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INTRODUCTION

The idea to use light and optics to create a pickup for guitar is about 80 years old. The earliest serious attempt to create an optical pickup came in the 1960s when Ron Hoag introduced his optical guitar pickup. Since then, others have developed new designs, most of which are similar to the original, while a few others are different. All of them are very cool, clever designs, and a few are currently available on the market in one form or another, but there's never been a pickup like the \bar{o} Pik. Our optical pickup is unique in a number of ways, and makes it possible for any guitarist to create new tones, and to customize the voicing and setup of the guitar in ways that were not possible before.

HOW THE \bar{o} PIK WORKS (AT A HIGH LEVEL)

Unlike most optical pickups that are available today, the \bar{o} Pik works in reflection mode (RM), while most other optical pickups that are on the market work in transmission mode (TM). Before going on to explain, it's important to mention here that both the \bar{o} Pik, and most of the other optical pickups on the market are "real" pickups. That means they (and the \bar{o} Pik in particular) are not just detecting what string or note is being played. They are actually "measuring" the string motion in some way, and transducing that motion into a voltage that varies with the same, or very similar pattern as the string motion itself. Now, here's what I mean by RM and TM:

TRANSMISSION MODE (TM)

In TM, there's a light source on one side of each string, and a light sensor on the other side of the string. The string blocks part of the light traveling across the gap in which the string is sitting, and as the string moves back and forth as it vibrates, it either blocks more, or less of the light. The varying brightness of the light is picked up by the sensor, and that is converted to an oscillating voltage that goes to the amplifier. This is a bit like an optical "trip wire" that might be found in garage door safety systems, or burglar alarm systems, but more sophisticated because it's not just a simple on/off switch. The pickup must sense, and transmit the actual pattern of movement of the string.

REFLECTION MODE (RM)

In RM, there's a light source that shines light onto each string from one direction, and there's a sensor that receives the reflected light from that string. The source and sensor are usually pointed at the same side of the string, and may be angled to improve the signal reception. In RM, there must be something in the design of the optical system that causes the reflected light signal going to the sensor to vary as the string vibrates. That's one of the many tricky things about creating a reflection mode pickup, and part of why the *ōPik* is so special. Again, as with TM pickups, the movement of the string as it vibrates must be accurately represented by the pickup, not simply detected.

All of the TM style pickups I know of are built into a special bridge, or add-on device that must be mounted in, or right at the bridge of the guitar. This usually means that to use one of these pickups, you must buy a special guitar with the pickup, and supporting electronics built in. That's mainly because, with a TM design, only a very small range of motion of the strings can be tolerated. The string must always be partially blocking the beam in such a way that when it moves, it allows either a little more, or a little less light to pass. It must never leave, or obscure the beam altogether, or travel inside of a large beam so that its motion does not change the total amount of light arriving at the sensor. That also means that if you adjust the action by raising or lowering the height of the strings, or change the gauge of your strings, or perhaps make some other adjustment to the setup of your guitar, most likely you'll have to "recalibrate" your pickup. The nice thing about having the pickup in the bridge is that the sensors can be covered, keeping most stray light out, and the optical design can be relatively very simple.

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Another important, and tricky aspect of designing an RM style optical pickup is that by its nature, must be open to ambient light. This is perhaps the main reason why there are no other RM optical pickups on the market today. The \bar{o} Pik solves that problem using a combination of special optical and electronic filters. It works in room light, stage lighting, and outdoors in the sun, too. These filters also suppress the effects of hand motion that can also be detected by RM optical pickups. You can see from our demo videos here on our website how well the \bar{o} Pik works.

Check them out here: <https://www.light4sound.com/videos>

WHY THE OPIK IS DIFFERENT

The \bar{o} Pik is even more than a unique optical guitar pickup. It's also unique in other ways that make it very user friendly, and allow you to do some new things with your guitar that were not possible until now. Here's a list of the key features of the \bar{o} Pik:

- 1. It's a drop-in replacement for a standard humbucker.** That means it not only fits into your favorite guitar, it also wires in exactly like a magnetic pickup, and all the electronics in your guitar still work the same way they're supposed to work.

2. **It works with a wide range of string types** including ferrous metal, nylon, other plastics, rubber, non-ferrous metal, and just about anything that works as a guitar string, including combinations of different string materials on one guitar setup.
3. **It is the world's first and only programmable guitar pickup.** Using your mobile device (like a cell phone or tablet), you can set the volumes of each string independently, adjust the overall output gain, set high and low-pass filters, and all settings can be saved and recalled when needed.
4. **The \bar{o} Pik is a true analog pickup.** It is sensing the actual string motion, and outputting a voltage waveform that corresponds to the vibration of the string, similar to what any standard pickup does. It is NOT detecting the note, and substituting a sampled tone. The audio path is pure analog. There is no lag, and there is no digital processing in the audio signal.
5. **There is no magnetic drag** so the sustain of notes and chords is excellent, especially if it is the only pickup installed.
6. **It has a wider frequency response than any magnetic pickup**, both in highs and lows. The lows are especially broad, and this can be controlled by the setting of the high-pass filter.
7. **It has a higher output gain than magnetic pickups** because it's an active pickup with all the electronics built into the pickup housing itself that include preamps, and that gain setting can be programmed through the mobile app.
8. **It responds faster than any magnetic pickup** because it's a true analog optical pickup, and the optical sensing is much faster than magnetic sensing method used by standard pickups which is based on Faraday's Law.
9. **The \bar{o} Pik is a position sensor** which measures the position of the string as it vibrates. This is different from magnetic pickups which essentially sense the speed of the string motion as it vibrates. Again, this property of magnetic pickups comes from Faraday's Law. This gives the \bar{o} Pik a unique, and very rich tone, and allows it to sense much lower frequencies, and deliver a much

There are a few other interesting things that make the ōPik unique as well, but the main differences are listed above. The combination of all these features together in one pickup make the ōPik a powerful new tool for expanding the range of things you can do with your guitar. It's as easy to install as a typical magnetic pickup, so you can put it into any guitar that accepts a standard humbucker without modifications, and start experimenting with the programmable features, and different string types, and combinations of strings to create new sounds.

The first ōPik model is designed only for the bridge position in electric guitars, but we are working on models for the neck position, bass guitar and acoustic guitar, and we are thinking of exploring models for other instruments in the future such as upright bass, violin, cello, and perhaps even some others. Try the ōPik! And stay tuned at our website for more information and updates! [**www.light4sound.com**](http://www.light4sound.com)