

"Getting our product out first, and making sure it's the right product, is really important at Fender. The ability to do rapid prototyping in-house with the Eden350V has had a huge impact on both fronts"

**Shawn Greene,**  
Senior Industrial Designer, Fender



## Case Study

### At a Glance

- Company:** Fender Musical Instruments Corporation  
**URL:** [www.fender.com](http://www.fender.com)  
**Location:** Scottsdale, Ariz.  
**Industry:** Designer and manufacturer of stringed instruments and amplifiers

### Challenges

- Get prototypes faster, accelerate product introductions and reduce cost of outsourcing prototypes

### Solution

Objet Eden350V™ 3D  
Printing System

### Results

- Prototypes can now be created in a few hours, product development cycles accelerated by as much as 6-12 months, and rapid prototyping costs cut in half

## Fender Cuts Rapid Prototyping Costs in Half with Objet 3D Printer

Musical instruments company leverages Objet's Eden350V to speed product development, improve quality of designs

Fender Musical Instruments Corporation designs and manufactures stringed instruments and amplifiers, such as solid-body electric guitars, including the Stratocaster and the Telecaster. The company makes acoustic guitars, electric basses, mandolins, banjos, and violins, as well as guitar amplifiers, bass amplifiers, and PA (public address) equipment. Avril Lavigne, Elvis Costello, Eric Clapton, Pete Townsend and Sting are among the artists known for using Fender equipment.

While engineers focus on how instruments should sound, a group of industrial designers at Fender work on how they will look. Design is an extremely important element of Fender's business. The company maintains its own in-house design center complete with a model shop to explore new concepts, create designs, prototype and test. Shawn Greene, Senior Industrial Designer for Fender, plays a key role in that effort.

"We're dealing with artists, and often professional musicians, so all of our instruments and equipment need to look great as well as sound great," says Greene. "Our design group works closely with marketing to explore different colors, graphics and the types of metal and plastic parts used. Before we spend anything on a product we do a lot of concept work and research to make sure it's the right fit and product."

### Rising volume, costs cause Fender to bring rapid prototyping in-house

3D rapid prototyping has been a part of Fender's design process for years, and until recently the company outsourced this work to service bureaus. However, Greene and his team were frustrated by the time and expense of outsourcing. It often took one to two weeks to get a "rapid" prototype back, a time lapse that



really slowed down projects. By late 2007, Fender's volume had grown to a point where Greene recommended that they bring rapid prototyping technology in house.

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**"I calculated the cost of outsourcing prototypes for one year, and then the cost of bringing it in house. Even after factoring in the cost of the equipment and materials as well as staff time, I still concluded that we could significantly reduce our costs by doing it ourselves," explains Greene.**

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His manager agreed and Greene was tasked with evaluating 3D printing system vendors. "Detail was the most important criteria for us," recalls Greene. "The nature of our work requires very tight detail. Ease of use was #2, and cost was #3. We also needed to make sure the system could handle a variety of part sizes and materials, because our parts range from the size of a dime up to a full guitar body."

### **Service bureaus recommend Objet as the best choice for 3D printers**

Greene consulted with the service bureaus Fender had used for suggestions on 3D printer vendors. The most common recommendation by far was Objet.

"We were familiar with the equipment our service bureaus were using, and had learned to distinguish parts made on certain printers," he says. "There was one brand of printer that produced what we called 'fuzzy parts' because the finish was so raw – so we dismissed that vendor right off the bat. On the other hand, we'd always been happiest with parts from Objet printers."

Greene ultimately chose Objet's Eden350V 3D Printing System. Built on Objet's advanced Eden platform, this machine delivers the market's most productive, flexible and high-quality way to compress the product design-to-manufacturing cycle. PolyJet™ photopolymer jetting technology found in the Eden350V enables horizontal layers of just 16-microns (0.0006"), producing prototypes with exceptionally fine details and ultra-thin walls down to 0.1-0.3mm thick.

The Eden350V is designed to provide high-quality 3D models quickly and conveniently throughout the CAD/CAM process. With a full 350 x 350 x 200mm build size, it offers the flexibility to produce a single large model or multiple smaller models in one build.

With its Eden350V, says Greene, the Fender design team can prototype a part within hours versus weeks – so they are doing a lot more of it. "We print anything from small guitar parts and amp knobs up to amp chassis and new guitar body designs," he explains. "We do a lot of overnight printing – we set it before we leave and when we get back in the morning the parts are ready. When we're cranking on a project, getting those prototypes back quickly really helps keep the momentum going. When you outsource and have to wait a week or two for a prototype, sometimes it causes you to lose your steam."

Greene and his team are extremely happy with the finish and detail of parts printed on their Eden350V. "We can even put text on very small parts and it shows. We get very sharp radiuses. And it's very easy to switch out materials – we've used every one that Objet offers."

Greene cites four main benefits to having the Objet 350V printer in-house:

- Accelerated time-to-market for new products and product enhancements
- Lower risk for new product introduction
- Better, more creative product designs
- Prototyping costs cut in half even though Fender now does much more rapid prototyping than it did in the past



## Rapid prototyping in house with Objet 3D printer gets new amplifier to market 6 to 12 months faster

Fender now uses its Objet 3D printer to create parts, mockups and prototypes for almost every product. One recent success prototyped on the Eden350V is its G-DEC® (Guitar Digital Entertainment Center) amplifier, named “Best New Instrument Amplifier” by Music & Sound Retailer.



“We were able to prototype a lot of parts and knobs on the amp long before we spent any money on tooling, and had finished a mockup of the first G-DEC within one month,” says Greene. “Then we worked with marketing to do some focus groups with musicians and retailers to make sure the product was on target. After some tweaking, we were able to go right to tooling. The whole process took about six months.”

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“Prior to having the Eden350V, the mockup alone would have taken 6 to 12 months. Then the changes we got from marketing would have added even more time to the project, as we waited for new prototypes. The bottom line is that having the Objet 3D printer in house helped Fender get the G-DEC amplifier to market 6 to 12 months faster,” Greene explains.

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A more common project for Greene’s team is designing new features for an existing product. Recently, Fender’s marketing team asked Greene to design a new ergonomic knob for an amp. Prior to having the Eden350V in house, Greene would have created some alternatives using CAD software and shown the CAD drawings to marketing for them to choose from. For the ergonomic knob project, Greene was able to create 10 alternatives using CAD, print out and paint prototypes of each and put them on real amps. “The finish on the printed prototype was so good that I was able to install the knobs right on real amps in our office and let the marketing staff try each one to see which one looked and felt the best. It was a much better experience for the marketing team – our internal customer – and resulted in a much better product for consumers,” says Greene. “It also saved us a ton of time, money and risk. We didn’t have to guess which knob would be best for this purpose.”

### More frequent prototyping helps prove product designs

The Eden350V has also helped Fender avoid rework and retooling. One notable example was a light-up front panel for an amp. Greene designed the parts, and then printed a prototype of the front panel with Objet’s FullCure® 720 Transparent Material. After he installed the prototype on the front of an existing amp and tested it with different types of lights, he discovered that light didn’t deflect the way they thought it would. As a result, he went back and adjusted the design significantly. “In the past, we would not have done a prototype for that kind of part because it would have taken too long and cost too much money,” says Greene. “So by the time we noticed that problem we would have already paid for tooling, and then we would have had to pay for amendments for the tool. The ability to rapid prototype in-house saved us a fortune just on that one project.”

“Getting our product out first, and making sure it’s the right product, is really important at Fender,” he adds. “The ability to do rapid prototyping in-house with the Eden350V has had a huge impact on both fronts.”

According to Greene, sometimes Fender designers even print samples of real parts, for a mockup or for another product they’re testing, on the Objet 3D printer if they are out of stock. “Instead of ordering from the factory and then waiting, we just print the part on our Eden350V,” says Greene. “It’s fast and easy, plus that way we’re not taking away from customer stock.”



## Objet printer helps design team explore new ideas quickly

Greene says the greatest benefit to having the Objet printer in-house is that it has given his team the ability to explore new ideas really quickly. "Having the Eden350V

in-house means we can experiment more. It's given us a lot of freedom and creative latitude. If I have an idea for something new and edgy, I can design it and have a prototype in just a few hours. If it doesn't work out, I've only used an afternoon instead of a week."

**"We call the Objet printer 'our favorite toy'" he adds. "When people come to Fender for tours we always show it off."**

Fender's marketing staff is ecstatic with the Objet 3D printer. "We'll leave a meeting with marketing and have a working prototype to show them the next day," says Greene. "They are amazed at how quickly we can now go from concept to reality."

"You can show something on paper all day long," adds Greene, "but when you give them something real they can touch, people really get excited." Greene also believes that the Eden350V has helped Fender provide better products to its customers. "We prototype so much more now and I feel it's absolutely had an impact on the quality of our designs, because often the prototypes cause us to make little tweaks throughout the design process to improve the look, feel and functionality of a part."

## Even with increase in volume, rapid prototyping costs are half of what they were when Fender outsourced

Even with the significant increase in the amount of rapid prototyping Fender now does, Greene says its costs are half of what they were when the company outsourced the work. And despite its frequent use, the performance of Fender's Eden350V has been rock solid. "In 18 months it has not gone down even once," says Greene.

## About Objet Geometries

Objet Geometries Ltd., the innovation leader in 3D printing, develops, manufactures and globally markets ultra-thin-layer, high-resolution 3-dimensional printing systems and materials that utilize PolyJet™ polymer jetting technology, to print ultra-thin 16-micron layers.

The market-proven Eden™ line of 3D Printing Systems and the Alaris™30 3D desktop printer are based on Objet's patented office-friendly PolyJet™ Technology. The Connex™ family is based on Objet's PolyJet Matrix™ Technology, which jets multiple model materials simultaneously and creates composite Digital Materials™ on the fly. All Objet systems use Objet's FullCure® materials to create accurate, clean, smooth, and highly detailed 3D parts.

Objet's solutions enable manufacturers and industrial designers to reduce cost of product development and dramatically shorten time-to-market of new products. Objet systems are in use by world leaders in many industries, such as Education, Medical / Medical Devices & Dental, Consumer Electronics, Automotive, Toys, Consumer Goods, and Footwear industries in North America, Europe, Asia, Australia, and Japan.

Founded in 1998, Objet serves its growing worldwide customer base through offices in USA, Mexico, Europe, Japan, China and Hong Kong, and a global network of distribution partners. Objet owns more than 50 patents and patent pending inventions. Visit [www.objet.com](http://www.objet.com).

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