

CSUN
ASSISTIVE TECHNOLOGY
CONFERENCE

3D-Printed Keyguards -
Your Gateway to 3D-Printed
Assistive Technology

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Welcome, and thank you for choosing to watch my presentation.

My name is Ken Hackbarth, and my presentation will demonstrate the value of 3D-printed assistive technology and why 3D-printed keyguards are the best way for you to get started with this new technology.

Email me and I'll send you a copy of this presentation – with notes. Remember there are two "s" in Volksswitch.

3D-Printed Keyguards - Your Gateway to 3D-Printed Assistive Technology



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The People's AT

On this slide, I've tried to represent my proposal as a picture, and at the same time call out the two arguments that I need to convince you of.

First, I need to convince you that there is a wealth of high value, freely available, 3D-printable, assistive technology designs that you can take advantage of right now.

Even if you already believe that, you may believe that there's an impenetrable technological and financial wall between you and those devices.

My second goal will be to convince you that there's a gateway through that technological and financial wall called 3D-printed keyguards.

But first some context: “What is 3D Printing?”



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But first, a little context.

Let's all get on the same page as to what someone means when they use the words "3D Printing".

What is 3D Printing?

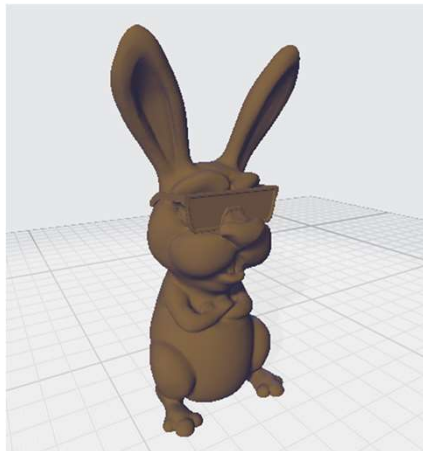
3D printing takes a digital model and, layer by layer, turns it into a physical object.



The simplest definition of 3D printing that I can think of is “3D printing takes a digital model and, layer by layer, turns it into a physical object.”

Start with a 3-dimensional digital model

3D printing takes a digital model and, layer by layer, turns it into a physical object.



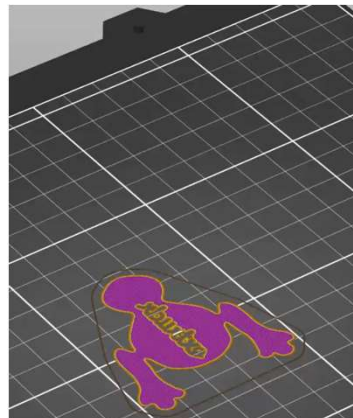
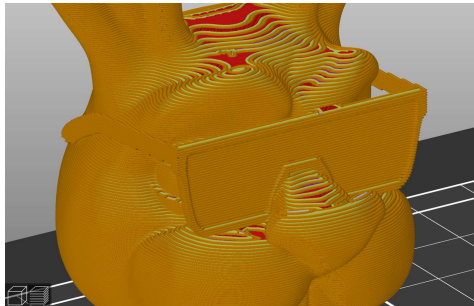
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
A digital model is a virtual object created using specialized software called “computer-aided design” or CAD software.

In this example, someone has created a virtual rabbit wearing sunglasses.

Slice the model horizontally into layers

3D printing takes a digital model and, layer by layer, turns it into a physical object.



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That digital model is then sliced into a series of horizontal layers by another piece of software called, of all things, a “slicer”.

- The slicer then tells a 3D printer to print each layer on top of the previous, starting at the bottom.

Printing the layers produces a physical object

3D printing takes a digital model and, layer by layer, turns it into a physical object.

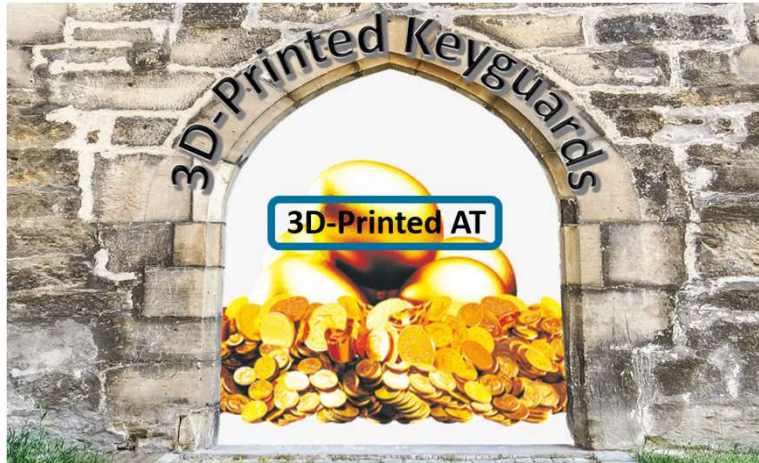


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A 3D printer uses thermoplastic filament or photo-sensitive resin to create the final physical object.

The instructions can be repeated over and over to create additional copies.

Examples of Free, 3D-Printable AT Designs



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With that context, let's look at actual examples of freely available assistive technology designs.

[“Quick-Zip” Zipper Aid](#)



Cost of plastic: **3¢**



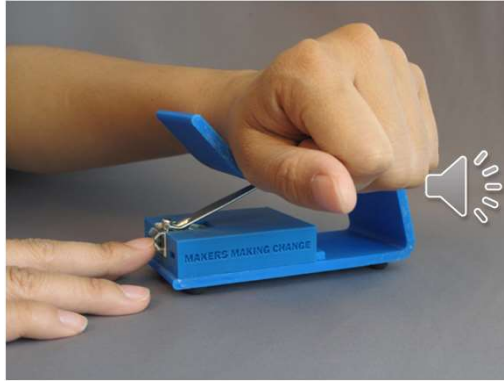
I'm going to quickly cycle through several examples. Each example will include a picture of the device and the cost of the plastic required to print one.

The title of each slide includes a hyperlink to the 3D model.

Remember, if you send me an email message, I'll send you a copy of this presentation with notes – including URLs.

<https://pinshape.com/items/25738-3d-printed-zipper-aid-and-easy-keychain-ring>

Nail Clipper Holder



Cost of plastic: **\$1.23**

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<https://www.thingiverse.com/thing:2810056>

Nail Cutter for One Hand



Cost of plastic: **\$1.19**



<https://www.thingiverse.com/thing:2937655>

Kobayashi Fidget Cube



Cost of plastic: **75¢**



<https://www.thingiverse.com/thing:1269699>

Arm Spork



Cost of plastic: **53¢**

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<https://www.thingiverse.com/thing:640839>

Thumb Prosthesis



Cost of plastic: **89¢**

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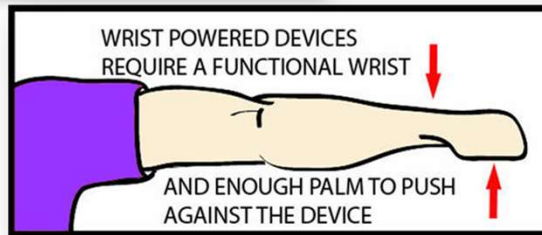
<https://www.thingiverse.com/thing:2246592>

Wrist-Powered Prosthetic Hand



Cost of plastic: **\$3.00**

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<http://enablingthefuture.org/upper-limb-prosthetics/cyborg-beast/>

Disability Friendly Pen Holder



Cost of plastic: **68¢**

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<https://www.thingiverse.com/thing:1324235>

Drawer Opening Assistive Device



Cost of plastic: **68¢**



<https://pinshape.com/items/25355-3d-printed-drawer-opening-assitive-device>

Smart One-Handed Bottle Opener



Cost of plastic: **46¢**

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<https://www.youmagine.com/designs/smart-one-handed-bottle-opener>

Universal Cuff Stylus

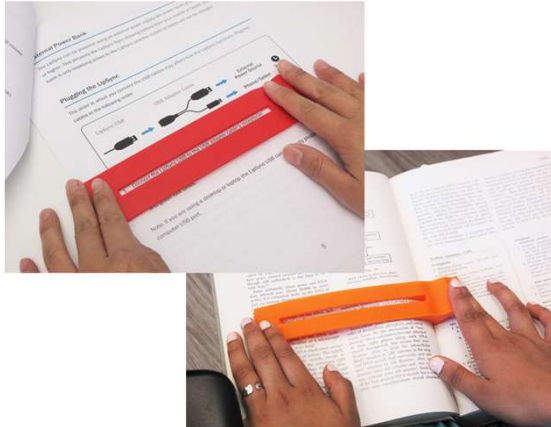


Cost of plastic: **75¢**

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<https://www.thingiverse.com/thing:3490198>

Dyslexia Reading Bar



Cost of plastic: **35¢**

 Volksswitch.org
The People's AT

<https://www.thingiverse.com/thing:2802065>

Sixth Finger/Toe Stylus



Cost of plastic: **17¢**

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<https://www.thingiverse.com/thing:3483326>

Bottle Opener



Cost of plastic: **50¢**

 Volksswitch.org
The People's AT

<https://www.thingiverse.com/thing:2801157>

Pop-top Can and Bottle Opener



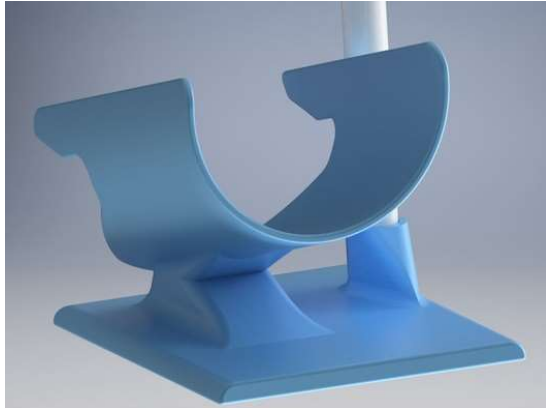
Cost of plastic: **75¢**



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<https://www.thingiverse.com/thing:3043598>

Sock Helper Mobility Aid



Cost of plastic: **\$4.69**

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<https://www.thingiverse.com/thing:2482788>

Magnetic Shoelaces



Cost of plastic: **25¢**

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<https://www.thingiverse.com/thing:3028911>

Beverage Holder



Cost of plastic: **\$3.50**

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<https://www.myminifactory.com/object/3d-print-the-next-beverage-holder-57768>

Head Pointer



Cost of plastic: **\$1.15**

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<https://www.thingiverse.com/thing:2542267>

LipSync



Cost of plastic: **\$1.84**



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<https://www.thingiverse.com/thing:2800937>

Ergonomic and USB Adaptable Switch



Cost of plastic: **\$1.46**

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<https://www.thingiverse.com/thing:3191057>

DIYAT Switch V1



Cost of plastic: **57¢**



<https://www.thingiverse.com/thing:2792191>

Volkswitch - the People's AT Switch



Cost of plastic: **\$1.46**



<https://www.thingiverse.com/thing:3819575>

Round Flexure Switch



Cost of plastic: **\$2.00**

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<https://www.makersmakingchange.com/project/round-flexure-switch-60mm/>

ATMakers MX Switch



Cost of plastic: **17¢**



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<https://www.thingiverse.com/thing:3230906>

Universal Wireless Switch Access



Cost of plastic: **34¢**



<https://pinshape.com/items/25409-3d-printed-universal-wireless-switch-access>

Microwave Door Opener



Cost of plastic: **\$1.37**

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<https://www.thingiverse.com/thing:642874>

Scale Model of the Eros Asteroid



Cost of plastic: **83¢**

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<http://nasa3d.arc.nasa.gov/detail/eros>

Open Assistive Technology - Key Turner



Cost of plastic: **15¢**

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<https://www.thingiverse.com/thing:1852950>

Toothbrush Adapter



Cost of plastic: **62¢**

 Volksswitch.org
The People's AT

<https://www.thingiverse.com/thing:2394134>

Easy Grip Hand Support

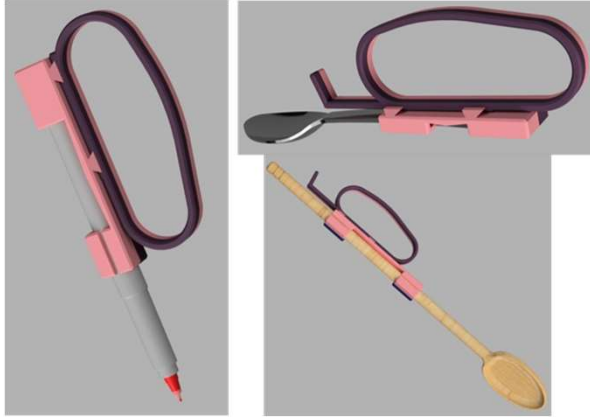


Cost of plastic: **40¢**

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<https://www.thingiverse.com/thing:1086395>

Universal Cuff Utensil Holder



Cost of plastic: **50¢**

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The People's AT

<https://www.thingiverse.com/thing:3492411>

Doorknob Lever Adapter



Cost of plastic: **\$1.52**

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<https://www.thingiverse.com/thing:640852>

C-Clamp Threaded Mounting Adapter



Cost of plastic: **15¢**



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<https://www.thingiverse.com/thing:3541114>

50mm Piko Button Camera Mount



Cost of plastic: **10¢**

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The People's AT

<https://www.thingiverse.com/thing:3197435>

Lateral Leg Support for Wheelchair



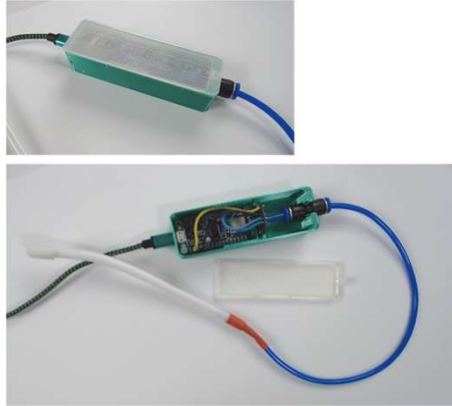
Cost of plastic: **63¢**



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<https://www.thingiverse.com/thing:2257895>

Sip and Puff Interface

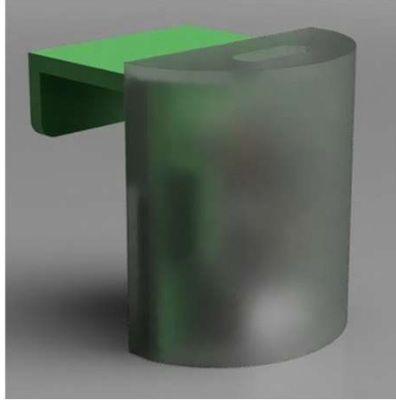


Cost of plastic: **36¢**

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<https://www.thingiverse.com/thing:3458117>

Little HandRaiser Housing



Cost of plastic: **15¢**



<https://www.thingiverse.com/thing:3172905>

Feeding Tube Holder



Cost of plastic: **77¢**

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<https://www.thingiverse.com/thing:2804715>

Urinary Catheter Carrier



Cost of plastic: **\$2.62**

 Volkswitch.org
The People's AT

<https://www.thingiverse.com/thing:3299750>

Urinary Sampling Pocket Holder




Cost of plastic: **\$2.22**

 Volksswitch.org
The People's AT

<https://www.thingiverse.com/thing:2849882>

Sampling/Contributing to the World of AT Designs

- Thingiverse.com
- MyMiniFactory.com
- MakersMakingChange.com
- ATMakers.org
- OpenAssistive.org
- MakersHelpCare.de



The image displays a collection of logos for various maker and assistive technology websites. At the top right is the Thingiverse logo in blue. Below it is the MyMiniFactory logo, which includes a green 'M' icon and the text 'MyMiniFactory'. To the right of that is a black and white icon of a 3D printer with a red cross on its print bed. Below the MyMiniFactory logo is the Makers Making Change logo, featuring a red gear with a lightbulb inside and the text 'NEIL SQUIRE SOCIETY'S Makers Making Change'. To the right of that is the ATMakers.org logo, which is green and white and includes the text 'ATMakers.org Helping Makers Help Others'. At the bottom left is the Volksswitch.org logo, which features a switch icon and the text 'Volksswitch.org The People's AT'. In the center is the Open Assistive logo, which features a purple gear icon and the text 'Open Assistive'.

Here's a compilation of some of the best sites to visit if you're looking for AT designs.

The first two sites are repositories of 3D models in general. You'll need to search specifically for assistive devices, but they have hundreds of designs.

The remaining sites focus entirely on assistive technology.

If you get into modeling AT, I encourage you to post your designs at least to Thingiverse and Makers Making Change to share with others.

3D-Printed Keyguards



 Volksswitch.org
The People's AT

I hope I've piqued your interest regarding what's possible with a 3D printer.

What's the quickest and easiest way to get there?

I believe the answer is 3D-printed keyguards.

What is a Keyguard?

- A keyguard is a plate which sits over a keyboard or touch screen, with spaces that a user can put their fingers or a pointer through to hit the keys.
- Users who have trouble with fine motor control often find that keyguards help them to hit the key they're aiming for.
- Users who have weakness or fatigue that makes it difficult to hold up their arm can rest their hand on the keyguard while pressing keys.
- Keyguards can make a big difference to a user's accuracy and ability to hit the part of the screen they're aiming for.



-Courtesy of ATMac



I'm sure that many of you are already familiar with keyguards.

- For those who aren't, a keyguard is a plastic plate that sits on top of a keyboard – or now, much more often, a tablet. The plastic limits access to only those places where openings have been cut in the plate.
- Keyguards help people with limited fine motor-control to more effectively interact with the app on their tablet.
- They also allow people who are easily fatigued to rest their hand on the tablet without triggering some action within the app.
- They can make a huge difference in a user's productivity.

How Many Keyguards Do I Really Need?

- **As a therapist** you will need a set of evaluation keyguards. These keyguards will need to support each of the tablets and cases you recommend, each of the apps you recommend and each of the app configurations you recommend.
- If you only recommend 2 different tablets, each with two different cases, running 2 different apps in 4 possible configurations you will need **$2 \times 2 \times 2 \times 4 = 32$ evaluation keyguards**. If 25% of those are lost or broken over time, you will need an additional 8 keyguards for a total of **40 evaluation keyguards**.
- **As an individual** using a tablet with a keyguard, you will need a keyguard for each app you use and additional keyguards as your skills improve or decline.
- What about the development of new tablets, cases, and apps?
- *How many would you need if you could reduce the cost by 99%?*



How many keyguards do you need?

- That will depend on the number of tablets and apps you will use or recommend, how many ways the apps can be configured, and how many tablet-cases you may use, now and in the future.
- If you only recommend two different tablets, each in two different cases, running two different apps, and four different configurations for those apps, you will need 2 times 2 times 2 times 4, or 32 evaluation keyguards. If a quarter of those break or are lost over time, you'll need an additional 8 keyguards for a total of 40.
- Users will need new keyguards as their skills improve or degrade over time.
- And there are bound to be new tablets, cases, and apps in the future... I know what

you're thinking. You're thinking that there's no way you could possibly afford 40 keyguards. So that's simply crazy.

- But would it be crazy if you could cut the cost of a keyguard by 99%?

Evaluation Keyguards printed for Imagine! Colorado –

2 tablets, 2+1 Cases, 1 AAC App, 4 Configurations



 Volkswitch.org
The People's AT

I designed and printed evaluation keyguards for an SLP at Imagine Colorado.

They support 2 different tablets, one of which could be placed in two different cases. Just one app – Go Talk Now, and 4 possible layouts of the app.

She needed a total of 10 keyguards to perform evaluations.

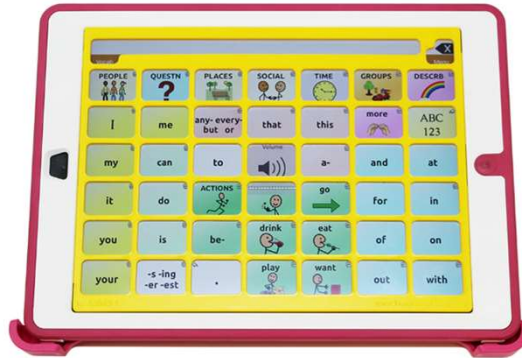
How Much Does a Keyguard Cost?

- [A Commercial Keyguard](#)



**TouchChat
Keyguard**

Final Cost: \$71

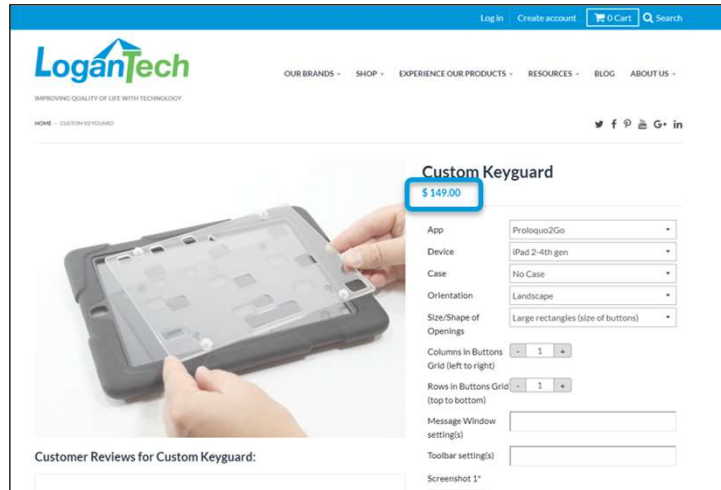


How much does a commercial keyguard cost?

Here's a page from the Keyguard AT website. Keyguard AT is the largest producer of laser-cut keyguards in the US and possibly globally.

I purchased a keyguard from them for the TouchChat app running on an iPad 2 - and the final cost was \$71.

The Cost Could Be Much More than \$71



LoganTech sells keyguards for their systems and this one costs \$149.

What if I design the keyguard myself
and have it 3D-printed?



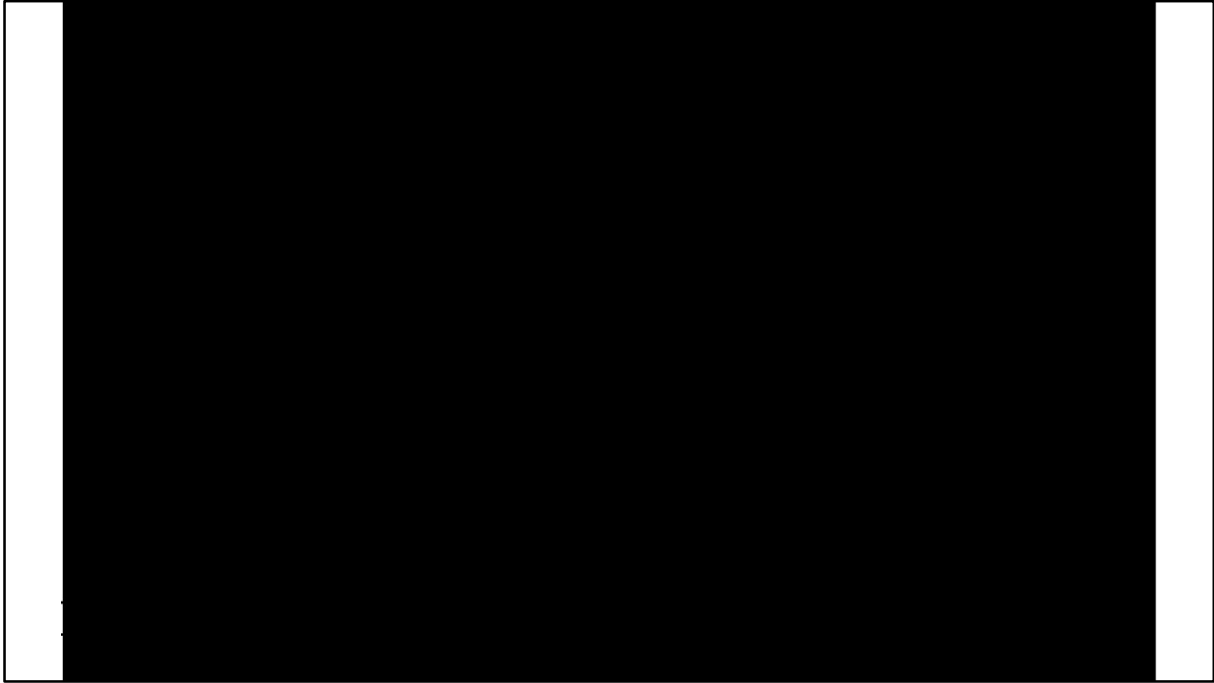
So, what if I designed and 3D-printed that TouchChat keyguard myself?

How hard is it to design a keyguard?



First, how hard is it to design a keyguard?

The folks at Volkswitch have created a keyguard designer to make the design process easy.

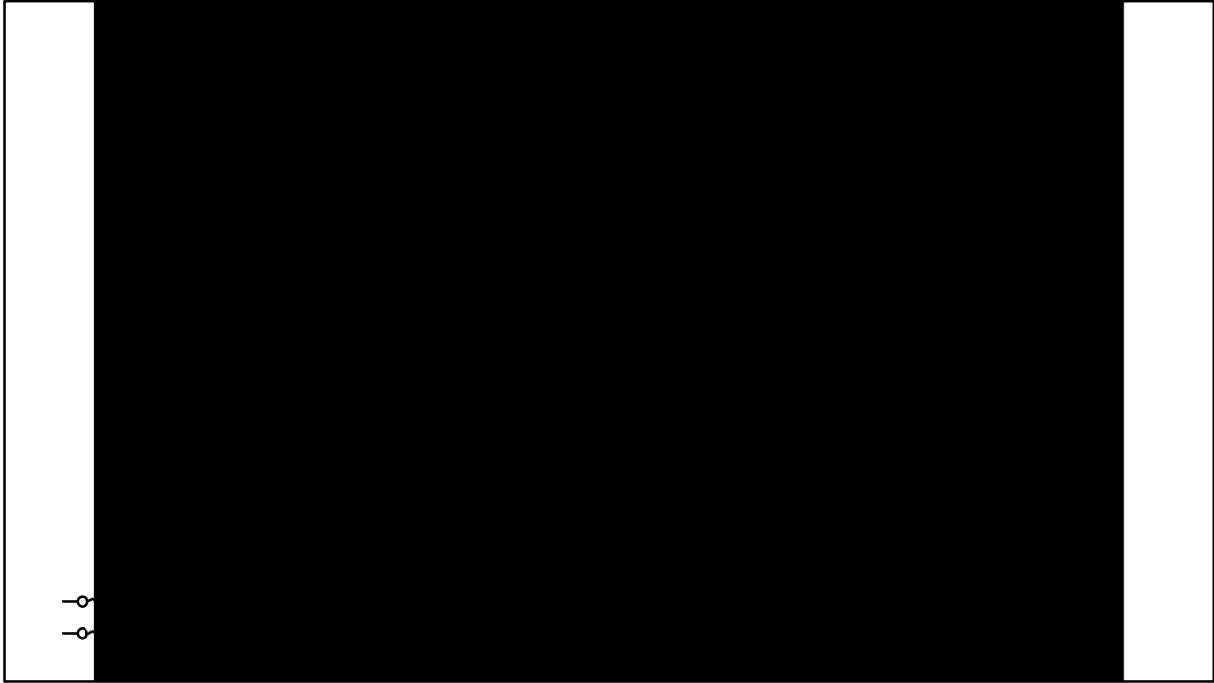


- <https://youtu.be/UgonofNVDS4>

Is it difficult to 3D-print a keyguard?

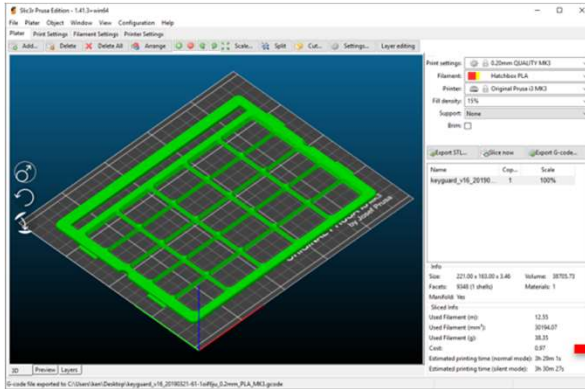


And, how difficult is it to 3D-print a keyguard?



- <https://youtu.be/JIRfpSQjnV8>

How much did it cost to print that keyguard?



Cost:

0.97

How much did it cost to print that keyguard?

Well, it depends on how much plastic-filament was used.

This is a screen capture from the slicer program.

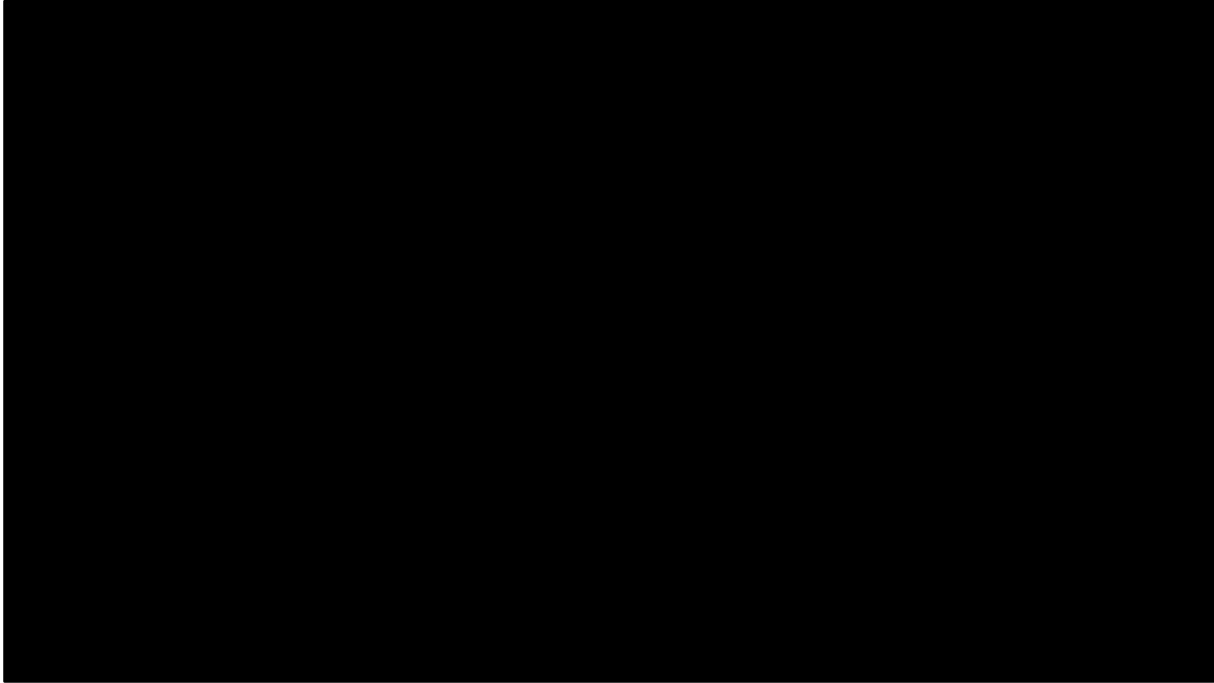
If you tell the slicer how much you pay for a kg of filament, the program will tell you how many grams of filament your print will require and will calculate the cost of the print.

In this example, the keyguard cost me 97 cents.

Hands-on with some 3D-printed keyguards

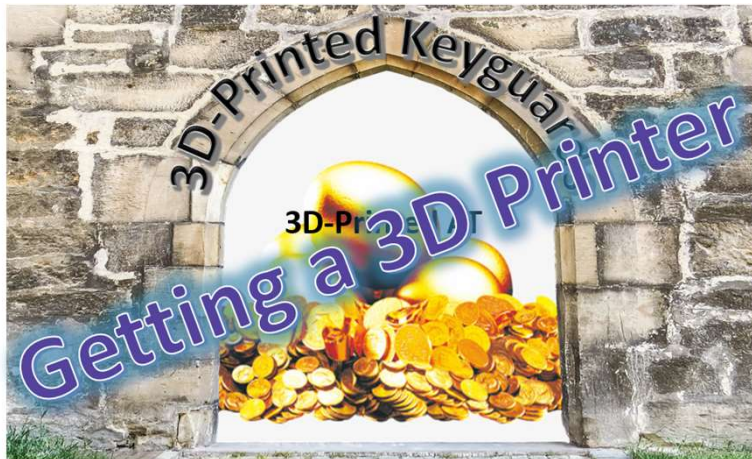


Let's look at the kinds of keyguards that are possible to create with the Volkswitch keyguard designer.



- <https://youtu.be/LLOPouYxjMo>

Can I Afford a 3D Printer?



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I hope I've created some excitement for you around the idea of getting a 3D printer?

If so, then let's look at some options.

How much does a 3D Printer cost?



Build surface:
300 x 300

Artillery (Evnovo) Sidewinder X1: \$450



Build surface:
250 x 210

Prusa i3 MK3S: \$749 (kit),
\$999 (assembled)

 Volkswitch.org
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A high-quality 3D printer may be much cheaper than you think.

I've owned several 3D printers over the last 3 years and here are my two current favorites.

The first is the Artillery Sidewinder X1 which sells for around \$450.

The second is the Prusa i3 MK3S which you can get in kit form for \$750 and fully assembled for about \$1000.

(By the way, I highly recommend assembling your printer from a kit when you can.

What you learn in the process, will make you much more confident when you encounter issues in the future.)

The Sidewinder has a 300 mm by 300 mm build surface while the Prusa has a 250 mm by 210 mm build surface.

If you think you'll be making keyguards with your printer, I recommend that you purchase one with a build surface that is at least 250 mm on one dimension.

Both printers are more than capable of printing keyguards.

How can I justify purchasing a 3D printer?

- If you need to invest in keyguards, the cost differential between commercially purchased keyguards and 3D printed keyguards, is sufficient to justify purchasing a 3D printer after 5 to 10 keyguards.
- With a 3D printer you can explore the full range of free pre-designed AT.
- Based on this information can you put together a business case, a grant proposal, a bake sale?



Can you justify purchasing a 3D printer?

- If you save, on average, \$90 for every keyguard that you print rather than purchase, you can justify the cost of a 3D printer in as few as 5 to 10 keyguards.
- Once you have a 3D printer, you can begin to explore the full range of free, pre-designed, assistive technology along with designing and printing your own solutions – which could lead to even more cost savings.
- How difficult would it be to use this information to put together a business case?

Are there any ways to obtain 3D-printed AT without a 3D printer?



What if the barrier is still too great or maybe you're not ready to make that kind of commitment?

How can you get access to 3D-printed AT without a 3D Printer?

The school district's STEM teacher(s)

A few of the Colorado school districts:



In the STEM Lab at Englewood Middle School in Englewood, Colorado, eighth graders

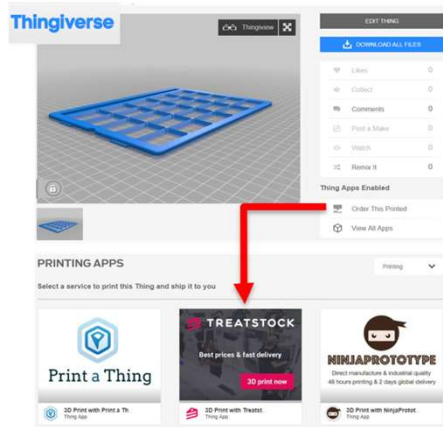


If you're employed in a school district, or even just a member, many districts offer STEM and STEAM programs.

These middle school and high school STEM classes often have 3D printers that are sitting mostly idle.

You can give the teachers and students a reason to dust off those printers and CAD software to produce devices that will change people's lives.

Online Printing Services



Keyguard AT \$71

Print a Thing \$23 (\$47 savings)

TreatStock \$17 (\$50 savings)

NinjaPrototype \$20 (\$51 savings)

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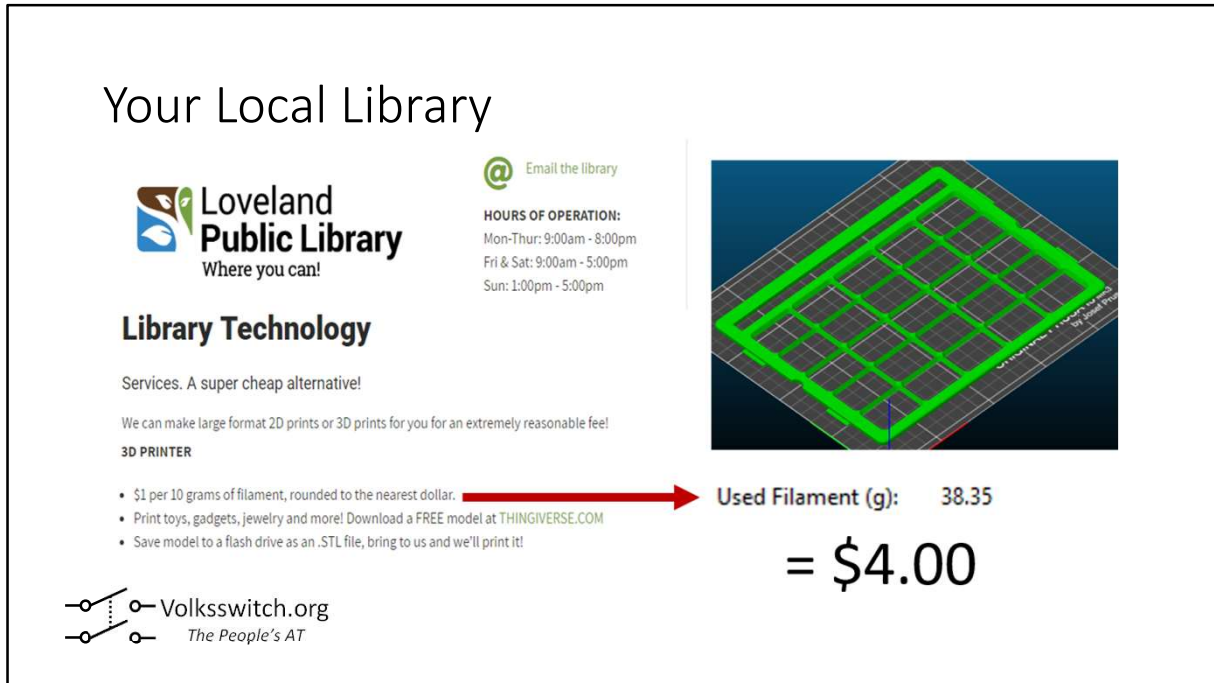
There are several online companies who will print your design.

Thingiverse supports submission of designs to 3 different services.

I sent my TouchChat keyguard design to all three to find out what they would charge.

The prices vary somewhat, but on average, represent a 2/3 savings over purchasing the same keyguard from Keyguard AT.

Your Local Library



Loveland Public Library
Where you can!

Library Technology

Services. A super cheap alternative!

We can make large format 2D prints or 3D prints for you for an extremely reasonable fee!

3D PRINTER

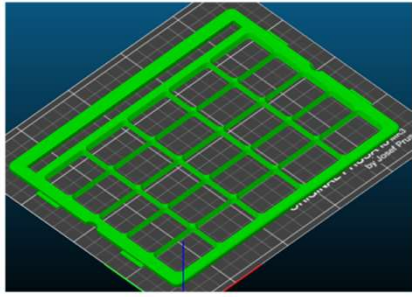
- \$1 per 10 grams of filament, rounded to the nearest dollar.
- Print toys, gadgets, jewelry and more! Download a FREE model at THINGIVERSE.COM
- Save model to a flash drive as an .STL file, bring to us and we'll print it!

Used Filament (g): 38.35
= \$4.00

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HOURS OF OPERATION:
Mon-Thur: 9:00am - 8:00pm
Fri & Sat: 9:00am - 5:00pm
Sun: 1:00pm - 5:00pm

Email the library



You also may have a local library with a 3D printing service.

This library is located a few miles from me, and they charge just 10 cents per gram to print a design.

Remember that my slicer program told me that the TouchChat keyguard requires 40 grams of filament.

That's a total of \$4.00 for a keyguard, and I didn't have to purchase or maintain the printer, nor did I have to purchase and store the filament.

3D-Printing Facebook Groups

(29) Active Groups Dedicated to Generic 3D Printing:

3D printing, 3D Printing Stls, 3D Printing RC, 3D Printing Miniatures and Terrain, [3D Printing Useful Things!](#), Functional 3D Printing, 3D Printing For Beginners, 3D Printing Club 3DPC.tech, 3dfigureprints.com 3D Printing Models STL, 3D Printing Geeks, The Tabletop 3D Printing Guild, 3d printing things, 3D Printing, Creativity CR-10s 3D Printer User Group, 3DHeals: 3D printing in Healthcare, 3D Printing - Show & Tell, 3D Printing For Everyone, 3D Printing For Christmas Light Enthusiast Group., Forward 3D printing, Anet A6 3D printer (RepRap Prusa i3), 3D Printing Egypt, XYZ Da Vinci 3D Printer Users Group, Dazz3D Printing Group, 3D Printing United Kingdom, 3D Printing Malaysia, 3D PRINTING PHILIPPINES, 3D Printing South Africa, 3D Printing Australia, Bristowne 3D Hobby Prints, St. Louis 3d Printing Society

(26) Active Groups Dedicated to the Prusa line of Printers:

Prusa 3D Printer Owners, Original Prusa i3 MK3 Support and Discussion, Prusa i3 mk3 users group, Original Prusa i3 MK3 Print Showcase, Anet A6 3D printer (RepRap Prusa i3), Prusa Prints, Geeetech Prusa i3, Prusa Community Useful Products, Geeetech Prusa 3D Printer, Prusa MK2S Owners (post/ask Anything, Uncensored), FLSUN 3D PRINTERS DELTA PRUSA I3 & CUBE, Original Prusa i3 MK3 Makers, U3dprintshop 3d printing community, 3DHeals: 3D printing in Healthcare, RepRap Prusa i3 3D Printer Support Group, Anet prusa i3 3D printer Malaysia (Official), Anet A8 y Prusa i3 en español, impresion 3D, Original Průša i3 Mk2/S/MK3/MMU komunita, Estado51PRUSA, Prusa Bear Argentina, ESTADO PRUSA (ESTADIDAD AHORA), Stampanti 3D Anet e Cloni Prusa i3 - Stampa 3D Italia, Oryginalna Prusa i3 MK1/MK2/MK3 Polska, TEVO Tarantula Prusa i3 Deutsch, die ORIGINAL-Gruppe;-), Imprimante 3D - Anet A8, clone Prusa, impression 3d Prusa i3 anet a8 fr, Prusa i3 Portugal

(33) Active Groups Dedicated to the Artillery line of Printers:

Artillery Sidewinder X1 3D Printer Owners Group [Official], Artillery Sidewinder X1(EVNOVO)/mod/fix international group, Artillery Sidewinder X1 works show, Artillery Sidewinder X1 3d Printer, Artillery Sidewinder X1, Artillery Sidewinder X-1 Files Only, Artillery 3D Printer Sidewinde X1r, Artillery Sidewinder X1 & Genius FR Francophone imprimante 3D, ARTILLERY Sidewinder X1 3des España/Spain, Artillery (Sidewinder X1, Genius, etc.) Aide Francophone (imprimante 3D), Artillery Sidewinder X1 Grupo de propietarios Español, Artillery Sidewinder X1 3D Drucker für den deutschsprachigen Raum, Artillery Sidewinder X1 PBR Português, Artillery Sidewinder X1 & Genius - Deutsche Gruppe, Artillery Sidewinder x1 Ultimate Mod, Artillery Sidewinder X1 & Genius Italia New Generation - © Official Group, Artillery Sidewinder X1 3D Printer België / Nederland, Artillery Sidewinder X1 pour les nuls Aide et conseils, Artillery sidewinder x1 , Genius , Entraide Amélioration Familiale, Artillery sidewinder x1, Artillery Sidewinder X-1, Artillery Sidewinder X1 3D Drucker Germany, Artillery Sidewinder X1 Middle East Group, Artillery GENIUS 3D Printer Owners Group [Official], Artillery Sidewinder & Genius BEGINNERS Group, Artillery Sidewinder X1 Australian Support, Artillery (Evnovo) SX1 / Genius - FR, Artillery Sidewinder PT, Artillery Sidewinder / Genius 3D printing beginners (Noobs), Artillery Sidewinder X1 - Deutschland - Österreich - Schweiz, ARTILLERY SIDEWINDER ARGENTINA, Artillery Sidewinder 3D Printer Owners Group Philippines, Artillery Sidewinder X1 Deutsche Gruppe, Artillery Sidewinder X1 Polska (SWX1)



This eye-chart is a listing of Facebook Groups that focus on 3D printing in general... the Prusa line of printers... and the Artillery line of printers.

Most of the people in these groups are excited about 3D printing as a technology but they've tired of printing Yoda heads and Baby Groots.

Their shelves are full of decorative items and they're wondering if that's all there is to this technology.

If you post to a few of these groups and describe your need, I guarantee you'll hear from someone who is dying to finally use their printer to create something of real value.

You may need to reimburse them for the filament and postage but, then again, you may not.

Join a Parent's Group and Pool Resources



 Volksswitch.org
The People's AT

Are you a member of a parent's group?

Could the members of the group pool their resources and purchase a 3D printer and filament?

I suspect that every parent's group harbors a father who'd love to do the research, purchase and house the printer, and become an expert in its use.

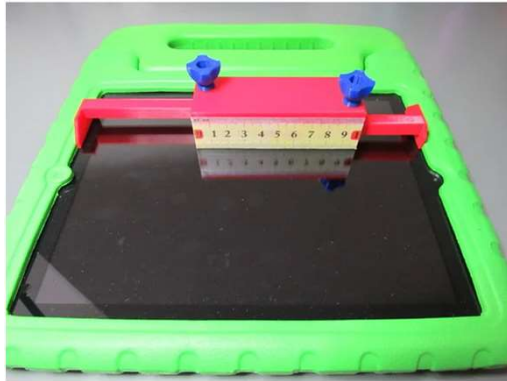
Wrapping Up



 Volksswitch.org
The People's AT

Time for a couple of final thoughts.

Easy Measurement Tool



Cost of plastic:



If you're planning to create some 3D-printed keyguards, two of the most important measurements are the height and width of the opening in the case.

Unfortunately, it's very hard to take these measurements accurately with a ruler.

We've created a 3D-printable tool, our Easy Measurement Tool, expressly designed for this purpose.

- How much does it cost?
- If you email me and request an Easy Measurement Tool, I'll send you one for free.

Questions?

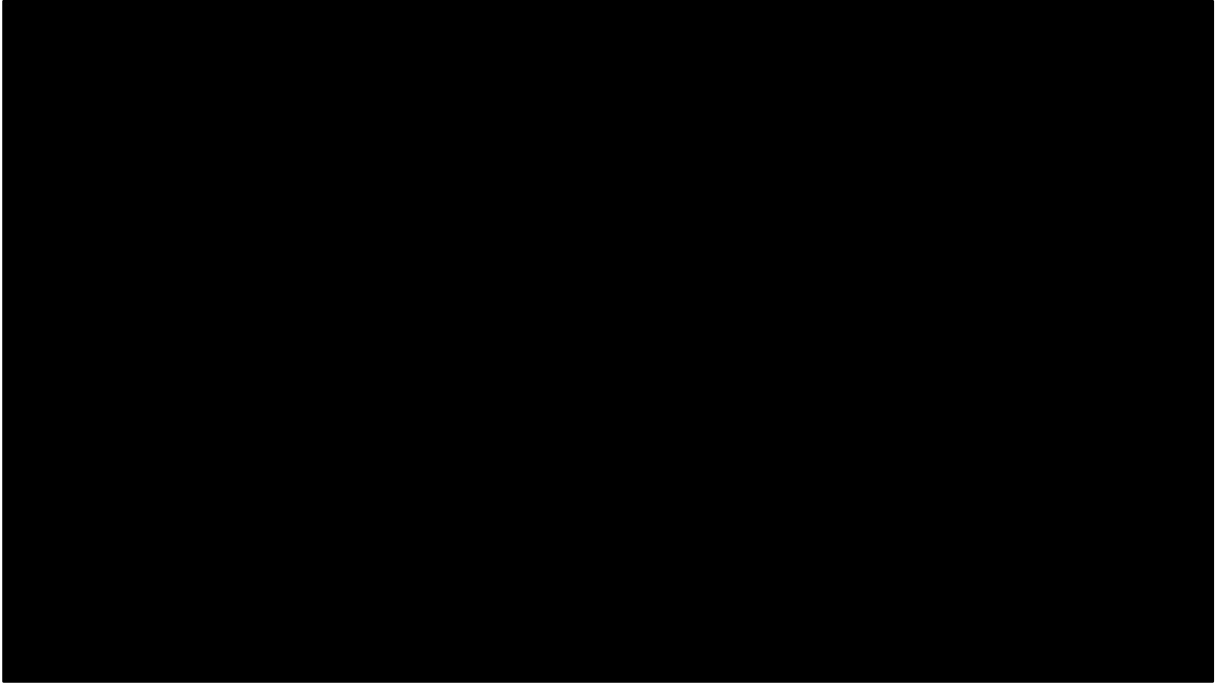
Send an email message to **ken@volkswitch.org** to ask follow-up questions, receive a copy of this presentation, and make suggestions.



At this point in the presentation, I'd normally open the discussion to questions from the audience.

But since that won't be possible, I'd like to encourage you to send me your questions.

I really want you to be successful so don't hesitate to contact me.



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