

Examining the Able Eye USB Uv Microscope (EHEV3-USBV)

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Introduction

As a regular attendee of the annual early January Consumer Electronics Show in Las Vegas I have learned to always ask if a particular exhibitor has a “show special.”

If I am interested in a product, especially a new one, I will often take advantage of the “show special,” and I have done this for over 40 consecutive Shows. The shows used to be held twice a year.

One of the “show specials” of CES 2011 is shown in Fig. 1. Below is a reproduction of the technical specifications from the User’s Manual on the small CD included with the product.

TECHNICAL SPECIFICATIONS - EHEV3-USBV

1. DSP: Digital Image Monarch Processor.
2. Sensor: high-quality CMOS sensor, 2M pixels
3. Resolution: 1600×1200
4. Colors: true color 24bit (RGB)
5. Interface: USB2.0.
6. Frame rate: 30 frames/sec (CIF and VGA).
7. UV excitation wavelength 375nm
8. Magnification: 50×
9. Size: 32mm in diameter, 92mm in length
10. USB cable length: 1.8 meters
11. Image freeze: just rap space bar
12. Timing snap: 10 seconds
- 13, **Weight: 127 grams**

I added #13. Note item #8 which specifies the magnification as 50x. This will be examined later. Also see related article on this website titled *Microscope Magnification*.

Description of Uv Microscope

I bought this as my 4th or 5th USB microscope in the last five years and I wanted to see how they have recently improved. There are many different styles and designs in the market place ranging from less than \$50 to hundreds of dollars. What piqued my interest in this model, they had many on display at CES, was its alternate light source of white, wt, and ultraviolet, uv, light. It was the last day of the four day show and it was the only one they had left.

See Fig. 2 on the next page. The “nose” cover was removed to take the photo. Note that there are six blue LED’s and only three white. The white ones are further from the subject (a person’s arm or face)



Fig. 1 –LED white and uv light skin USB Microscope.

and they appear to be much brighter so this makes sense.

Lighting is always a critical issue with any microscope. This model is being marketed as a medical device for personal health. You are supposed to press the nose of the microscope against the skin to see various skin conditions such as sores, ingrown hairs, blemishes, and skin damage - especially from the sun. The microscope has a knurled ring (as shown in Fig. 1) just above the white stand which is used to focus the image. The intended use is to be hand held. Hand holding a microscope is normally difficult but in this particular application it works well because it is pressed against the skin which allows you to hold it steady.

There are two buttons. The top button controls the lighting. The first press turns on the white LEDs. The second press turns off the white and turns on the blue uv LEDs. The third press turns all LEDs off. The video camera is always on.

The bottom button is a “shutter” switch that takes the photo.

The white plastic stand that comes in the very fancy box is intended to hold the microscope when not in use. Its internal shape matches the tapered nose.

I have very little interest in the skin application and I had more conventional technical applications in mind for this model when I bought it. One of the objectives I have in writing this article is to stimulate ideas for applying low cost USB microscopes so the first applications “problem” was to think of a way to use the uv hand held USB microscope in a more conventional way – not handheld.

After a bit of thinking I had an idea. Why not drill a 3/4" hole in the bottom of the stand and place the microscope stand on top of the subject being examined? The microscope will be raised by 0.27.” This turned out to be very practical and convenient. See Fig. 3. I chose the hole size to be as large as possible and still insure that there would be adequate (tapered) nose contact with the bottom of the stand to provide holding friction when turning the microscope against the forces of the significantly stiff cable.

The focusing range of the microscope easily covered the increased (0.27”) distance. The first tests I made were to determine the focusing range of the microscope and its viewable specimen size. See Fig 4.

Using the microscope in the stand is really convenient and it doesn’t involve buying, modifying, or



Fig. 2 – LEDs inside the camera with cover removed.



Fig. 3 - 3/4” hole drilled in the stand.

building an additional stand to hold the microscope in the conventional manner. The range of subject sizes is limited and the range of magnification is limited, but every microscope has limitations. One of the applications I have is magnified images (macrophotography) of small electronics parts. Another application is calculator displays and printer outputs. The third application I have is fluorescent crystals/minerals. The focusing of the microscope extended the added distance of 0.27 inches of the stand. How far will it focus? See Fig. 5. The spacers shown in Fig. 5 are from a Home Depot window blind cutting station and are 0.22" high. This represents the focus limit for my particular microscope.

Examining "flat" subjects such as coins, paper money, screens, cloth, and printer outputs is especially convenient because the microscope only takes five square inches of an-always-crowded-desk-top space. It is very convenient to just pick up the microscope and set it on the subject and take a photo. See Fig. 6.

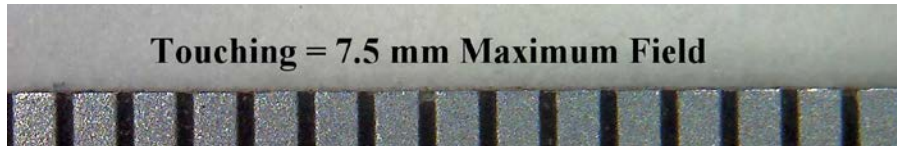


Fig. 4a – Microscope hand held on 0.5 mm scale.



Fig. 4b – Microscope in its stand using 0.5 mm scale.

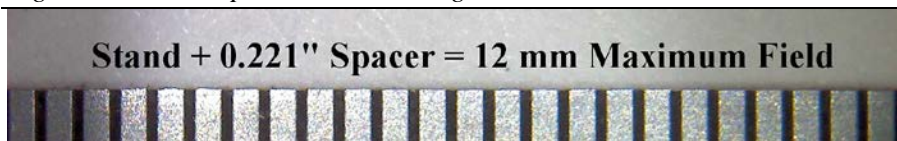


Fig. 4c – Microscope in stand on spacers. See Fig. 5.



Fig. 5 – Microscope stand on plastic spacers 0.221" (maximum) height.

Fig. 6 illustrates the two choices of LED lighting, white, wt, and 375 nm ultraviolet, uv. Note the LED bright light spot reflection in the left center of Fig. 6a. This imbalance may seem as a flaw in the design. While it obviously is a flaw it may also be used to advantage if the subject is rotated 90 degrees counter clock wise to have the bright spot at the top of the photo which is what we, as humans, are used to. This is often referred to as Rembrandt lighting. I have used it as emphasis lighting for certain subjects.

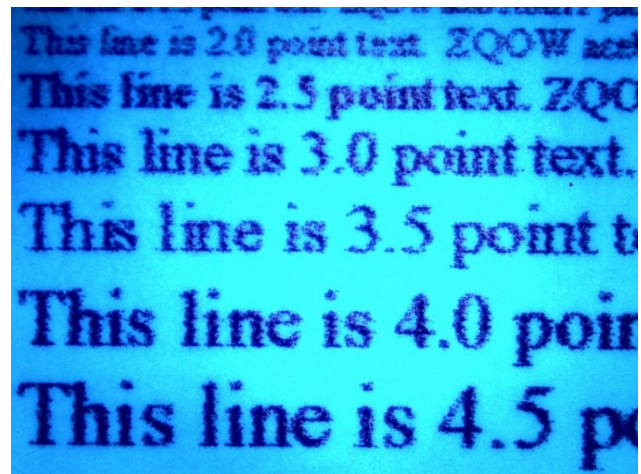
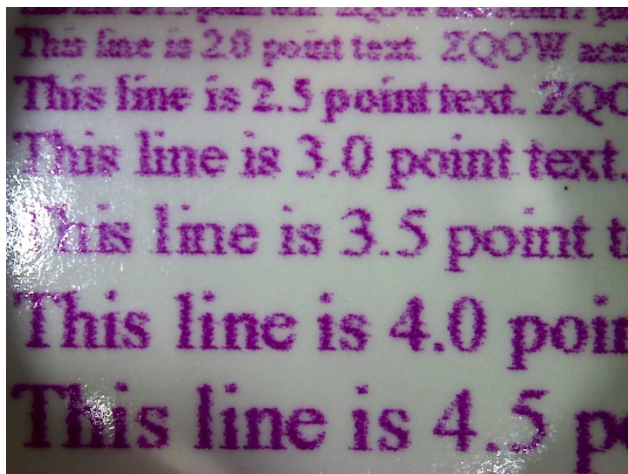


Fig. 6a - Photo of a photo paper printed test text, white. Fig. 6b - Photo of a photo paper printed test text, uv.

Also note that the left corners are dark. Note that the uv version of the same photo, Fig. 6b, is more uniformly lit but with a brighter spot in the center. The subject is violet inkjet text on photo paper to emphasize this lighting and as you will see in other sample photos, you would hardly notice these effects. We only see this because we are varying the specimen distance which is assumed fixed for this skin design.

Magnification Range of 2.2:1

Before I show you various image examples I will suggest an idea to further extend the magnification/focus range of this microscope. Fig. 4 suggests a magnification range of 12 mm/7.5 mm or 1.6 to one. How far into the microscope may a specimen be and still be in focus? Inserting the specimen increases the magnification.

To do this I made an adjustable stage by buying a small bag of 3/4" long flat head #10-32 machine screws. Press the nut into the wood to secure it in a 9/32" hole drilled through the wood base. Secure a disc to the head with super glue, by soldering, etc. Make one disc slightly less than the 3/4 inch diameter hole in the base and the other slightly smaller than the 0.475 inch diameter hole in the nose; a 3/8" diameter works very well. In fact the machine screw head is just slightly less than 3/8" and you may simply glue (or use double sided tape) a piece of a business card to the top and just cut around the head. You could make three or four of these; one with black paper, and another with white paper. Use a coated material. I also made one with a fine grid and one with glossy photo paper.

The height of the machine screw stage may be adjusted as needed. The larger disc makes up for the 0.27" base thickness which allows the microscope to "sit" on the specimen and still be stable in the holder. This would be the same magnification, I will call it HI Mag., as intended for skin use.

The smaller (3/8") disc allows the specimen to be raised into the nose of the microscope for maximum magnification. I found this to be about 8 turns or 0.40." I call this Extra Hi mag. See Fig. 7.

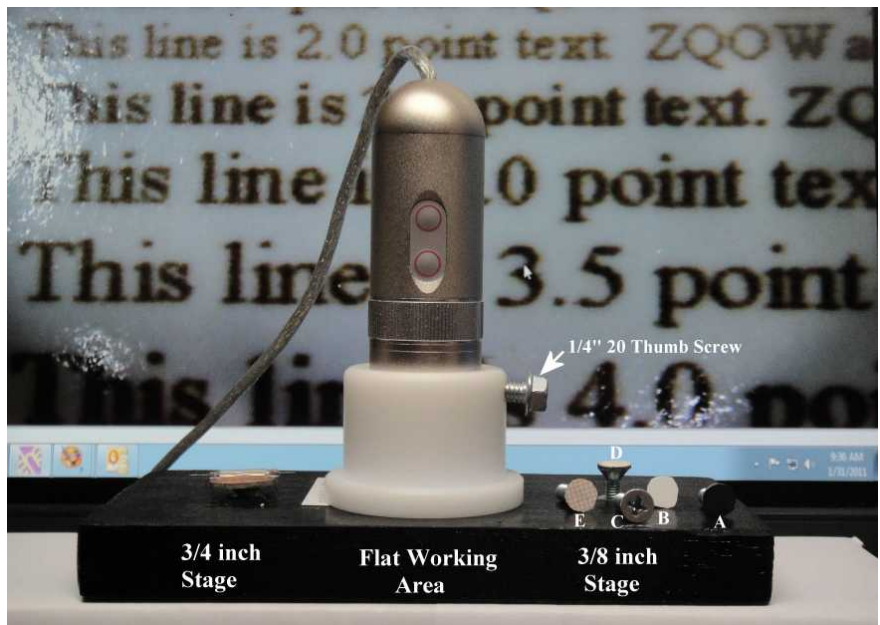


Fig. 7 – Modified plastic holder and wood base with two adjustable stages.

The 3/8" stages are:	B – White Photo paper.	D – White card stock.
A – Black paper.	C – Bare screw head.	E – 0.05" orange grid.

Another possible stand improvement is to drill and tap a hole in the side of the holder. Properly located (3/16" from the top) it would eliminate the need for a spacer as shown in Fig. 5. I used a 1/4"-20 screw because I had one in my "junk box." You will need a No. 7 drill for this thread.

Using the base I more accurately determined the minimum/maximum magnification range. I used the specimen measurements shown in Fig. 8 to accurately measure the range. The physical specimen size is

103 mils/2.6 mm. See Fig. 8a.

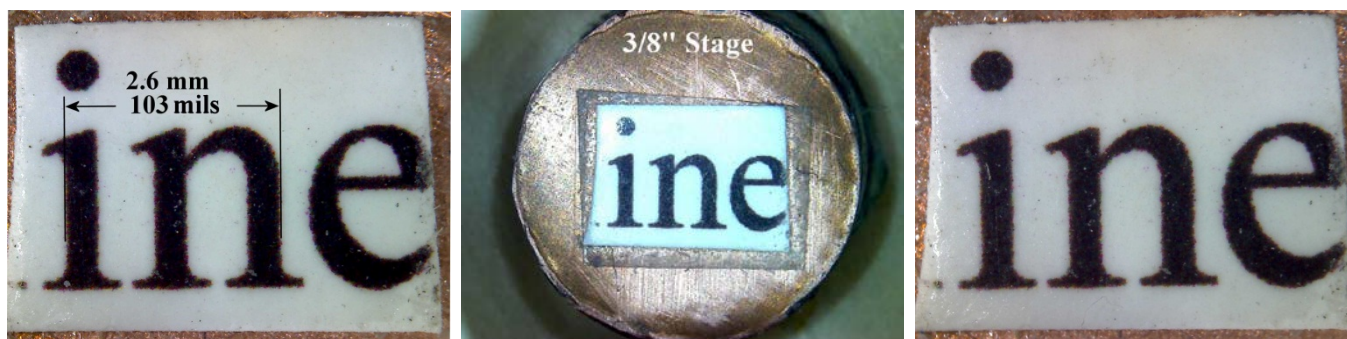


Fig. 8a – Test specimen dimension.

Fig. 8b – Low specimen magnification.

Fig. 8c –Ex Hi specimen magnification.

Viewing Fig. 8b and 8c at 2x using Paint Shop Pro on my 37.5 cm wide LCD monitor I measured the outside edges of “i” and “n” as shown in fig. 8a as follows: Fig. 8b = 100.42 mm. Fig. 8c = 224.46 mm.

Under these conditions the ratio is $224.46/100.42 = 2.2$. The respective “magnifications” of the images as seen on my screen are: Fig. 8b = 38.6x and Fig. 8c = 86x. It is more reasonable (accurate) to use the 1x numbers or half of these for the “true” magnification. Fig. 8b = 19.3x and Fig. 8c = 43x. Of course this is only based on the screen size (See article titled *Microscope Magnification*).

The “revised” focus range numbers are 0.40” for the 3/8” stage, 0.27” for the base thickness, and 0.22” for the highest useable spacers (see Fig. 5) = 0.89” or 22.6 mm. That is about $7/8^{\text{th}}$ of an inch. Keep in mind that these numbers are for a product sampling of one and that other products will vary slightly. From a practical perspective you want the adjustment ring to be able to go slightly past the focus and you “back up” to confirm the best focus.

Magnification

Basically the uv microscope as used in the stand and on a wood base (Fig. 7) has four magnifications.

EH: The highest magnification is the closest position to the camera. This would be on the 3/8” stage and this is a limit to the physical size that may be viewed. The specimen may not extend outside the 3/8” circle. This is suitable for small electrical parts, ants, small bugs & beetles, and specimens that may be cut to fit on the 3/8” diameter stage. I call this extra high, EH, magnification.

HI: The microscope may be used without the stand (handheld) for normal magnification. There is no limit on the specimen size. I call this high, HI, magnification.

MD: The next magnification is on the 3/4" stage and this also places a limit to the specimen size that may be viewed. The same limitations for extra high magnification (in the stand) also apply except that the physical size limit is twice that of extra high magnification. I call this medium, MD, magnification.

LO: The lowest magnification is that obtained with the subject furthest from the camera and still be in focus. This is when the microscope is raised up on a spacer of 0.22” as shown in Fig. 5 or held up with the added thumb screw. I will call this low, LO, magnification.

As I mentioned above the range of the low to high magnification is about 2.2:1

Now that we have a good idea of the working (and modified) mechanics of the USB uv skin microscope let's look at a few example photos.

Example Photos

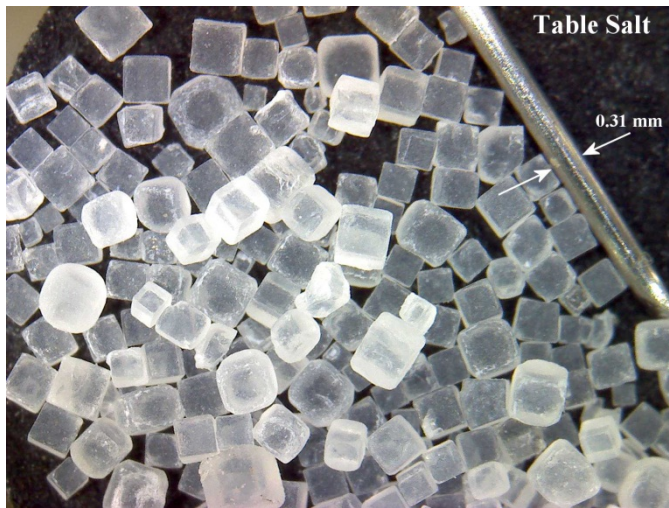


Fig. 9 – Table salt viewed at maximum magnification.

At the left is a classic low power microscope specimen example. Fig. 9 shows common table salt. I have also included a size scale as indicated. It is a 30 Ga. Syringe needle. The outside diameter is 12.0 mils or 0.305 mm. You may measure your printed or viewed image and calculate the effective “digital magnification.”

Most of the uv microscope images shown so far use white light. As any CSI TV viewer knows uv is used to better see biological specimens and materials that fluoresce. I will show both white and uv versions for most of the photos that follow.

Another “easy” class of items to look at and photograph is “flat” items such as coins and currency. Fig. 10 shows a US dime. The interesting point of the uv image in this example is to show the lint that wasn't noticed when viewed using white light. I have not taken the time to blow off the subjects for these images to make them look especially “pretty.”



Fig. 10a – US dime magnified to see the two letters – “JS.”



Fig. 10b – Same as 10a except using uv light. Note lint.

The man demonstrating the microscopes at CES used Chinese currency to show how fluorescent inks are used to reduce counterfeiting. Because the color was so bright I “needed” one for myself so a 5 Yuan note became part of the “deal.” Another USB microscope was used to take an over view photo for context. Fig. 11 shows the area of the note of interest. This USB microscope is also examined in another article found on this website.

The dramatic difference of what is seen in uv light compared to white light may be seen in Fig. 13. Note that the big digit 5 in black in the upper half of the photo is not even visible in white light. Also note that

a large area is highlighted in yellow, also not seen in white light. Fig. 13 was taken with the low magnification (stand on the spacer). You may also detect blue fluorescence on the note in Fig. 13b. Small blue “specs” are scattered around on both sides.

Fluorescence is exhibited by many minerals. I wanted to see how a few small particles would photograph under uv light. The result is shown in Fig. 14. The details of how the surfaces are shaped may be discerned better by comparing the two images. Obviously a sample that had a mix of fluorescent materials would stand out very well.



Fig. 11 – Portion of 5 Yuan Chinese note showing a big “5.”

Another, unknown, mineral sample is shown in Fig. 15. I found this in my back yard which is in the Desert Sonoran. It fluoresces a different color - red/orange. The example uv images show green, blue, yellow and red/orange. Of course you may use a uv flashlight with your normal microscope but being able to instantly switch between white and uv is especially convenient for comparing identical images.



Fig. 12a – 5 Yuan note showing space above the “five.”

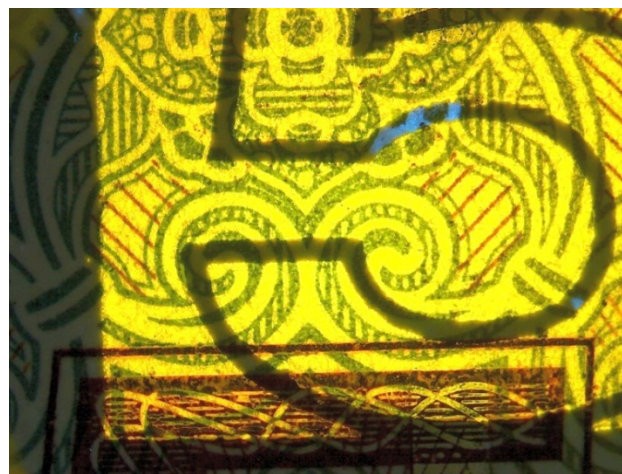


Fig. 12b – Same view as Fig 12a in uv light.

Fig. 15 shows a 6.35 mm diameter toroid transformer. Is the insulation damaged in the center from inserting a mounting bolt? Fig. 15a is with the 3/8” stage low. Fig. 15b is with the stage at its highest useable position and Fig 15c is the uv lighting view. Note the lint. Why doesn’t the fuzz, shown at the top of the toroid in Fig. 16a not fluoresce like the other three pieces of lint?

Fig. 17 shows a glass diode. Whenever a metal lead must pass through glass (usually quartz) the metal has to be as close as possible to the thermal expansion of the glass in order to avoid cracking and leaking. The red areas around the ends of the leads is a special material that is applied to the leads during manufacture to aid in equaling the thermal expansion characteristics of the metal-glass joint. See photos on page 9.

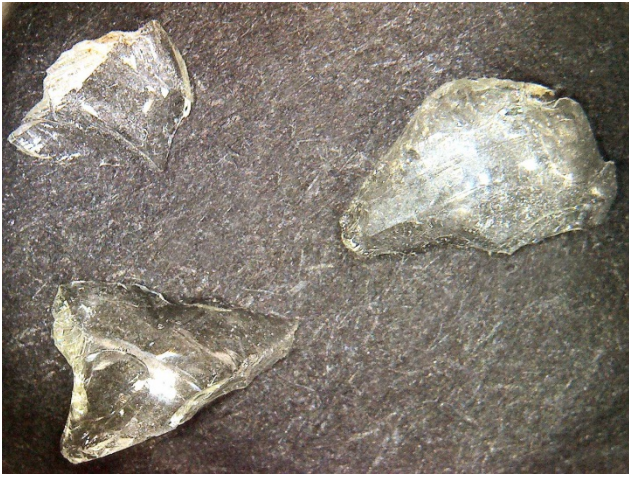


Fig. 13a – Uranium glass particles in white light.

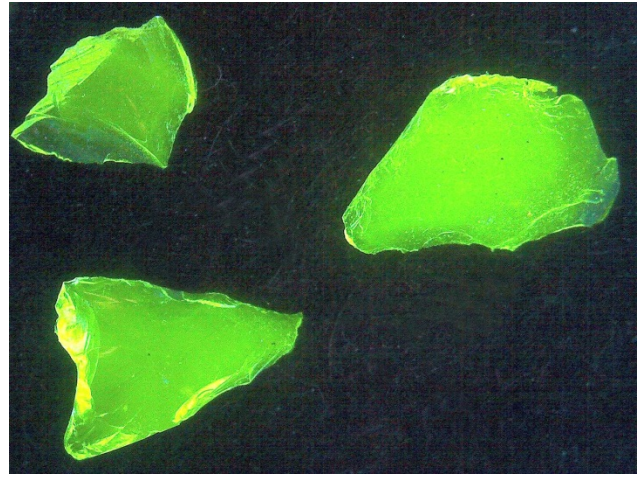


Fig. 13b – Uranium glass particles in uv light.



Fig. 14a – Mineral sample found to have fluorescence.



Fig. 14b – Mineral sample found to have fluorescence.

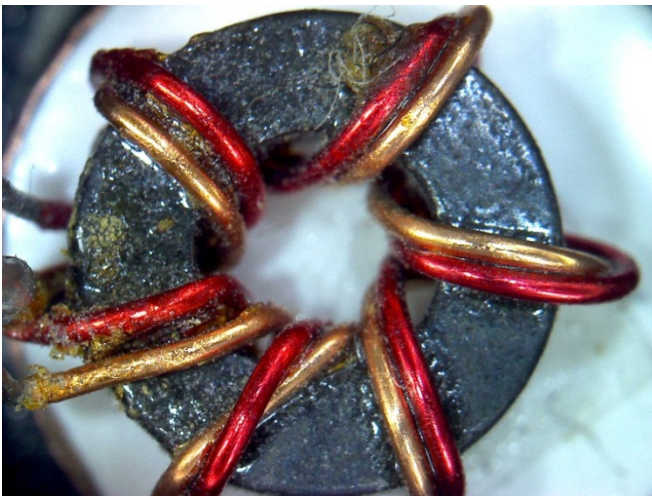


Fig. 15a – Toroid transformer with 3/8" stage fully down.

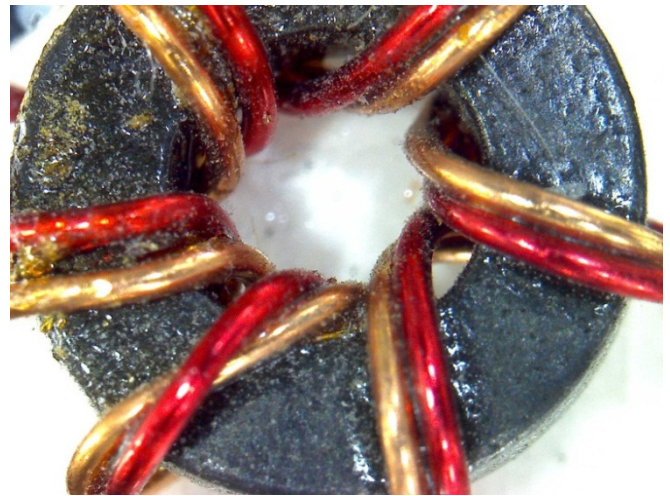


Fig. 15b – Toroid transformer with 3/8" stage fully up.

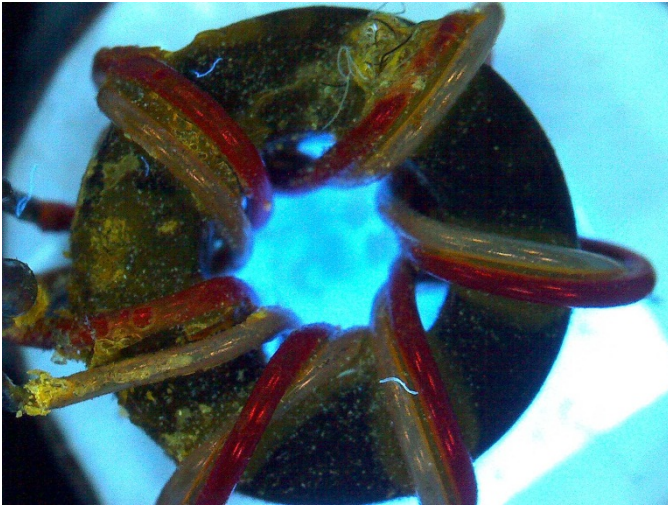


Fig. 15c – Toroid with uv lighting.

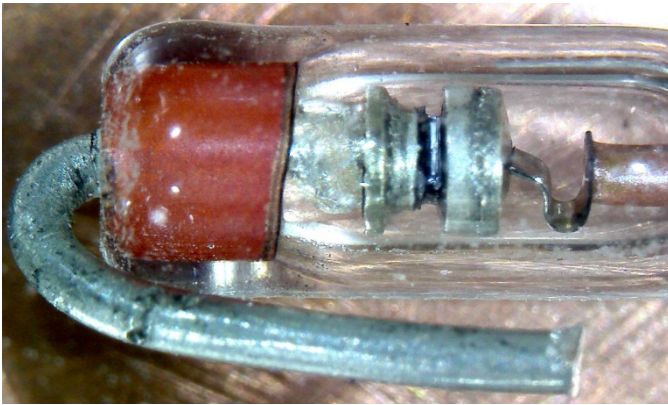


Fig. 16b – Highest magnification showing die and contact.

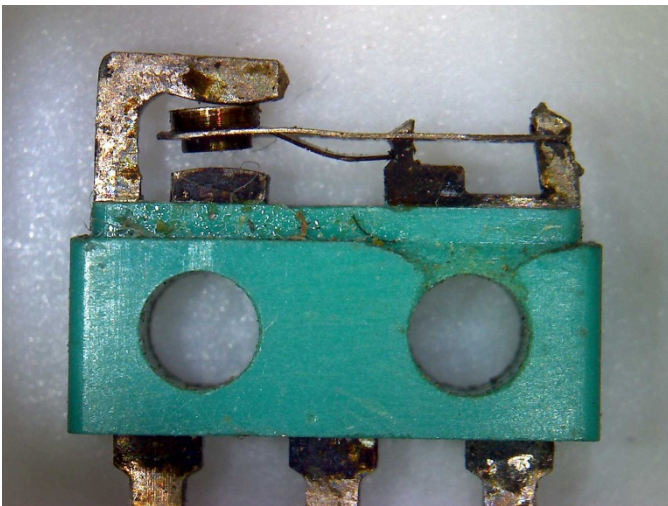


Fig. 17a – Precision micro sized snap action switch.

The Fig. 16b photo was taken from the opposite side of the diode. This better shows the spring contact of this germanium point contact diode.

The magnification and depth of field of this USB

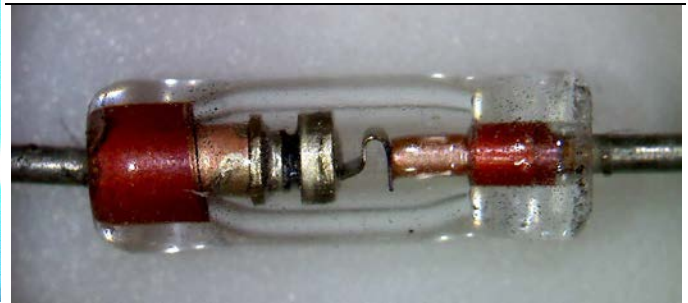


Fig. 16a – Glass diode. Note spring type contact.
microscope works well for examining small electronic components like this.

I worked for a company (Hi –TEK) that developed the world's smallest "microswitch." In addition to it only being 0.300 inches wide it had a very long life. These were test samples that I have had in my "junk box" for over 30 years.

I have only included a few photos of the dozens of components that I have examined with this USB microscope.

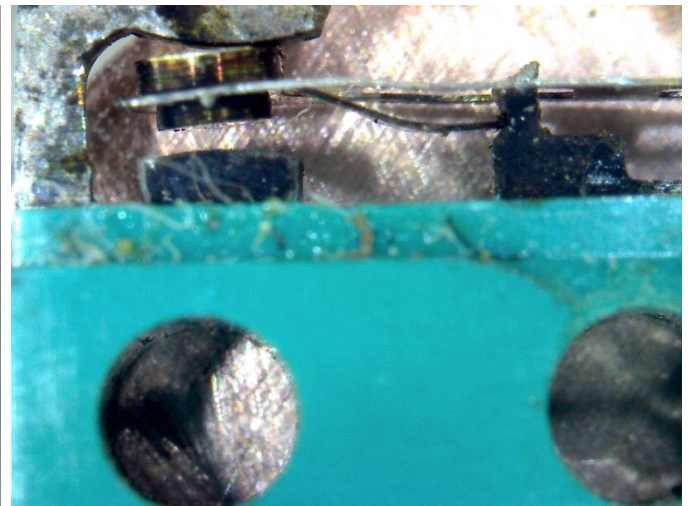


Fig. 17b – Close up of contacts of switch in Fig. 18a.

The examples of the images shown here have covered just a few subjects. Even with the lighting provided by the microscope it is possible to take some very effective photographs. Ease and convenience is what makes this USB microscope so attractive, but what about the intended body use of the uv microscope?

Fig. 18 shows hair. Is someone going gray? Is that lint I see in Fig. 18b? WOW! Fig. 18b is under uv

light. This is chest hair and the lint is probably from the cotton T shirt. Soap increases the fluorescence.



Fig. 18a – Human hair as seen by the USB uv microscope.



Fig. 18b – Same as Fig. 18a using uv light.

I started looking around my body for a few examples of images to illustrate how the uv microscope was intended to be used. Figs. 19 and 20 will provide a hint of what you may see with (the intended use of) this microscope.

You may also photograph areas that you normally don't see such as your teeth, in your ears, or your scalp.

Fig. 20 is a good example of sun "skin damage." The uv light shows red spots, not visible in white light, that I am told are due to excessive exposure to sunlight. I don't see these on areas of skin not normally exposed to sunlight. The nose shows more spots than other areas of the face. Is this because it is more normal to sunlight? I wonder what is the age of a person when these show up?

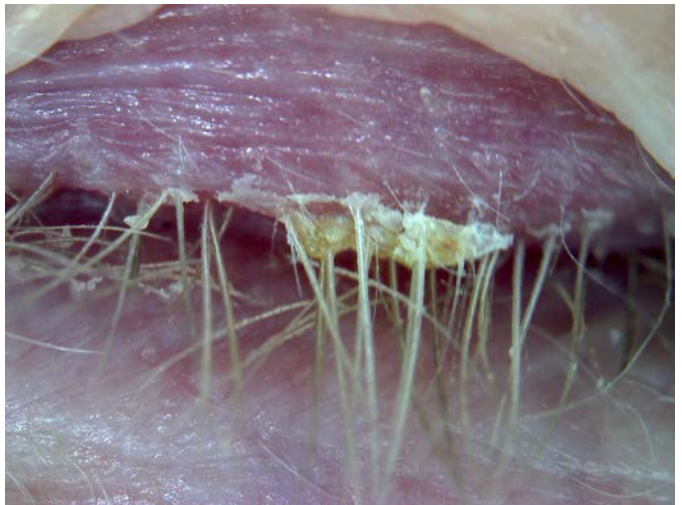


Fig. 19 – Human eye lid with dead(?) cells on eyelash.



Fig. 20a – Facial nose skin in white light.

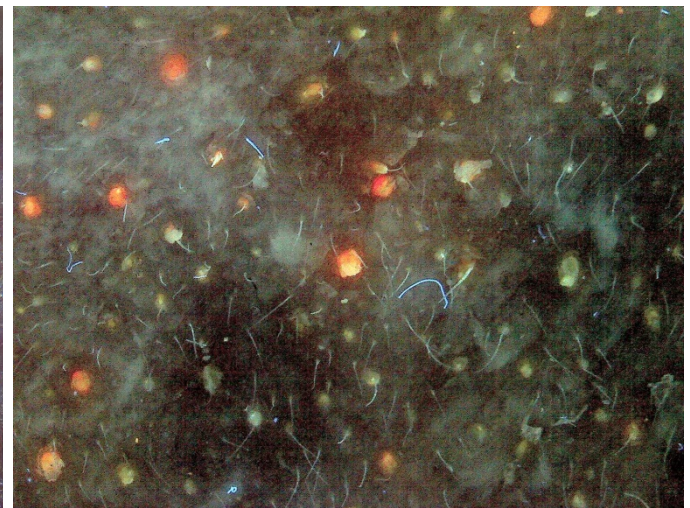


Fig. 20b – Facial nose skin in uv light.

As Fig. 1 shows a small sized CD is included. This CD has the manuals for 14 models and the instructions for copying the two files you need to use the USB microscope. Note that I said copying NOT installing. I just copied the ehe.exe and msucr100.dll files to the desktop and everything works as intended. I have used the software on my laptop using Vista and my desktop using Windows 7. I have also used the same software on other (competitors) USB microscopes.

I will not review the software here. It is adequate and simple.

Observations and Conclusions

The Able Eye EHEV3-USBV USB UV Microscope was designed for personal skin care use to better see sores, ingrown hairs, blemishes, and skin (especially sun) damage using white and 375 nm ultraviolet light. It is designed to be used hand held with two “control” buttons to change the lighting and take a photo at a fixed magnification. A white plastic stand internally shaped to match the tapered nose is modified to convert it into a more conventional microscope. The range of magnification was measured as 2.2. The nearly one full turn focusing ring allows the uv microscope to focus from 0.40” (10.2 mm) into the nose hole and 0.20 inches (5.0 mm) from it. A simple wood base was made to take advantage of this focusing range as shown in Fig. 7. The microscope image on the LCD screen serves as a background. Two adjustable stages are used, as shown in Fig. 7, to get the maximum range of magnification. Adding the thumb screw eliminates the need for spacers as described in the text and shown in Fig. 5. Several categories of subjects are photographed as examples ranging from printed text, table salt, a US dime, currency, minerals, a toroid transformer, glass diode, snap action switch, hair, eye lid, skin, syringe needle, ink, and SMT resistor.

Fig. 21 – Examples of highest magnification of typical technical specimens for a technical writer. The quality is acceptable and the USB uv microscope makes taking these easy and convenient.

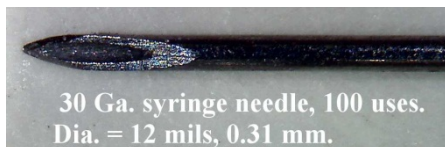


Fig. 21a – Syringe needle; good for size. Fig. 21b – Black ink on photo paper. Fig. 21c – Common SMT resistor.

Empty magnification is a common claim for most low end USB microscope suppliers. The technology is improving and the future is clear. Have you really seen your specimens if you haven’t photographed them? A similar model, the EHE-USB500, is rated at ten times the magnification (500x) and it does not have the uv feature. It also offers variable level lighting. The modifications suggested here would also apply to it.

The convenience and small space required for small subject photography requiring a magnification range of 10x to 30x in a 1600 x 1200 pixel image makes this USB microscope an useful tool for a technical writer. Google the Images for “glass diode” to see how Fig. 16 compares to what is on the Internet. In that perspective Fig. 16 is very impressive indeed.