Keysight Infrared Upgrade

DS1310A Infrared Upgrade

KEYSIGHT

USER MANUAL

Notices

Trademark Acknowledgments

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https://www.keysight.com/us/en/product/DS1310A/infrared-upgrade.html

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https://support.keysight.com

Information on preventing instrument damage can be found at:

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Is your product software up-to-date?

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https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security.html

Keysight also recommends that you secure your IT environments using appropriate third-party tools. For instruments that run the Microsoft Windows operating system, Keysight concurs with Microsoft's recommendations for ensuring that the instrument is protected:

— Get the latest critical Windows updates

— For network-connected instruments, use an Internet firewall (in Keysight instruments, Windows Firewalls enabled by default)

— For network-connected instruments, use up-to-date antivirus and anti-spyware software

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https://www.keysight.com/us/en/contact/responsible-disclosure-program.html

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https://www.keysight.com/us/en/about/quality-and-security/security/product-and-solution-cyber-security.html

Contents

Manufacturer Address

Keysight Technologies Netherlands Riscure B.V.

Delftechpark 49

2628 XJ Delft, The Netherlands

Safety Summary

Device Specific

Optical Safety

The Infrared Upgrade for microscope contains LEDs which make together a 2W light source. All LEDs are directed towards a single focus spot. The focus spot is on the center line of the ring light. The ring light has a working distance (WD) of 17 mm, meaning that the focus spot is 17 mm below the IR ring light. The wavelength of the IR ring light is 1060 nm. This wavelength is not visible to the human eye.

The operator of the IR ring light should observe the general precautions:

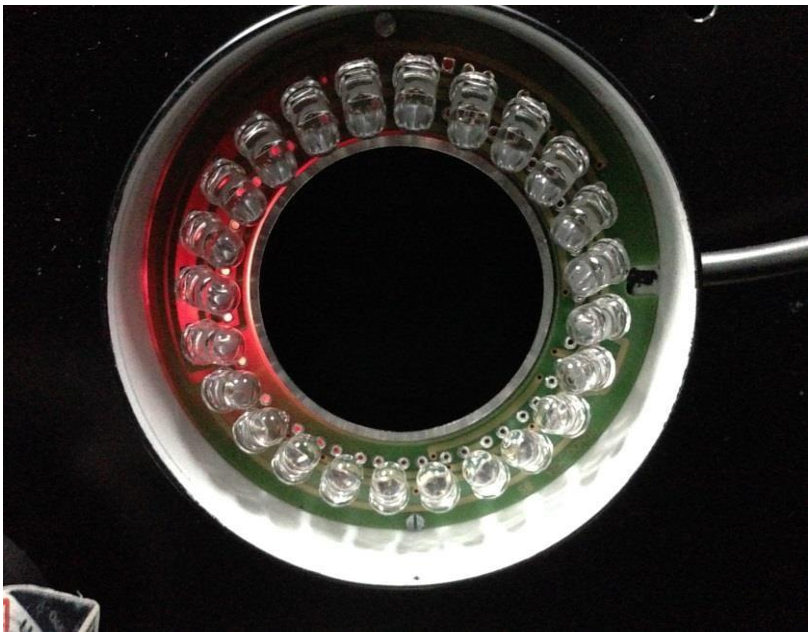
WARNING

DO NOT stare into the IR ring light when switched on.

DO NOT bring the IR ring light close to your eye (within 30 cm) when switched on.

BE WARNED by red light coming from the inside of the IR ring light indicating that the IR ring light is switched on as you will not see the IR light coming from the ring of main LEDs.

Figure 1 The red LED on the back side of the printed circuit board warns you that the IR ring light is switched on



Electrical Safety

The IR ring light must be powered by a 12V power supply unit. The AC input to the 12V power supply unit is potentially lethal and is fully contained with the power supply unit.

WARNING Do not open the 12 V power supply unit while the unit is plugged in. Opening the power supply unit may expose the operator to the unit's AC input power.

Do not make or break any electrical connections to the system while the unit is switched on.

General

WARNING This product has been manufactured and tested according to international safety standards. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

WARNING **Use only the Keysight supplied power cord or cords with the same or better electrical rating.**

Using other power cords may present a fire hazard or cause serious to deadly injury.

WARNING **Use only the Keysight supplied power supply.**

Using other power supplies may present a fire hazard or cause serious to deadly injury.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Do not Operate in Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Instrument Markings

Instrument Marking	Description
	The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.
	Direct Current
	Alternate Current

Specification

Environmental Specifications

Parameter	Description	Comment
Ambient operating temperature	10 – 30 °C	
Ambient non-operating temperature	-10 – 50 °C	
Humidity	< 90 %	Non-condensing
Operating altitude	Up to 2000 m	
Overvoltage category	II	
Pollution degree	2	For indoor use only

Electrical Specifications

For detailed power input ratings of this product please refer to the rating label placed on the product.

Electrical Specifications (AC Adaptors)

Parameter	Description	Comment
Line Voltage	100 – 240 V~	
Line Frequency	50 – 60 Hz	
Input Current	1.0 A max.	
Line Voltage Fluctuations	± 10 %	
Output Voltage	6 / 12 / 15 / 24 V⎓	Depending on model
Output power	36 W max.	

Electrical Specifications (Keysight U8002A Power Supply)

If your product is delivered with a Keysight Technologies U8002A Power Supply, please also review the U8002A Power Supply and its manual for safety markings and instructions. You must also follow these to ensure safe operation and to maintain the instrument in safe condition.

Physical Specifications

The physical specification of the product, in detail the dimensions and the weight is documented in the specific User Manual delivered with your product.

Cleaning the instrument

WARNING

To prevent electrical shock, disconnect the instrument from mains before cleaning.

Use a dry cloth slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Connections to External Circuits

All external I/O connections are supplied by non-hazardous voltages supplied by circuits of limited energy.

WARNING

All external inputs connected to ports shall provide reinforced or double insulation against hazardous voltages for protection against electric shock and shall have voltage below 30 Vrms and 42.4 Vpeak or 60 VDC.

CAUTION

Connecting an instrument to voltages other than rated may introduce excessive voltage and damage the device. Excessive voltage can lead to thermal stress, breakdown of insulating materials, or direct electrical failure, necessitating repairs or replacements. Always refer to product model specifications to avoid such damage.

Setup Instructions

The basic setup instructions are as follows:

Mounting the camera

Figure 2 Mounting of IDS UI-1240E-NIR-GL camera on camera tube of microscope

The camera is shipped with a dust protection cover. This cover needs to be removed. An aluminum c-mount adapter interfaces between the camera and the camera tube. The camera should be mounted to the adapter using the thread. The adapter is fixed in the camera tube by three hexagonal screws. After untightening these screws, the camera can be rotated to align the top of the camera image to the top of the die. After alignment, the screws should be tightened. The USB cable connects the camera to the PC. When the proper driver is installed, the LED on the camera will switch from red to green after several seconds.

Assembly of 17 mm WD ring lights to objective

Figure 3 Mounting of magnet ring on 5x objective by tightening socket screws.

Fix the magnet ring with hexagonal socket screws to the objective by tightening the screws as indicated in the picture.

Figure 4 Attaching 17 mm WD IR ring light to magnet ring on 5x objective

Screw the magnet ring with screw thread to the 17 mm WD ring light and connect both to the objective by aligning the magnets.

Connect the 12 V power supply to the ring light and to mains.

Removing of beam splitter (LS2)

With the LS2 to have an optimal light path from the IR camera to the target surface, remove the beam splitter from the body of the LS-2 by unscrewing the two screws underneath the Fault Injection Laser System logo.

WARNING

Place the beam splitter back in the Fault Injection Laser System when using the laser again. This will prevent emission of laser beam radiation to escape the beam splitter aperture.

Figure 5 Fault Injection Laser System body with Beam splitter mounted.

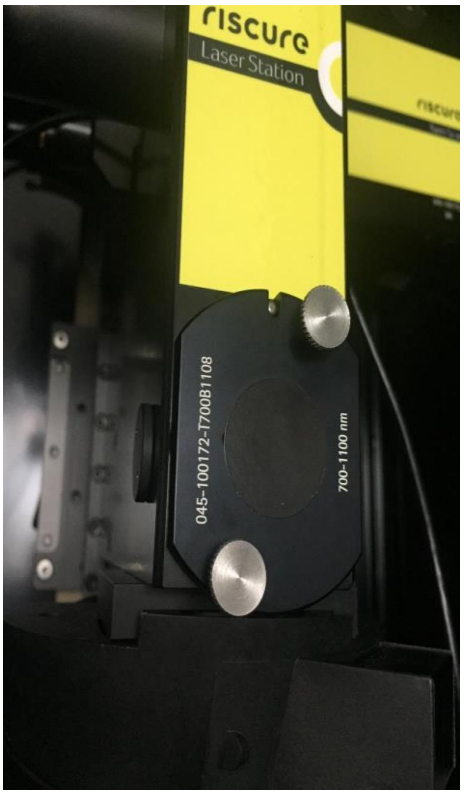


Figure 6 Beam splitter Installation of camera software

Installation of camera software

This section describes the steps necessary to install and configure the uEye camera for use with Inspector or for use with the IDS tools like uEye Cockpit.

Make sure all installers are copied to a local drive, because during installation the network will disconnect.

DirectX

Install DirectX 9.0c end-user runtime from June 2010.

1. Start directx_June2010_redist\dxsetup.exe.
2. Accept license agreement and click Next.
3. Click Next.
4. Click Finish.

Driver

Download the IDS Software Suite 4.41 64-bit from: http://en.ids-imaging.com/download-ueye.html (registration is required). The download contains the uEye64_44100.exe installer.

Install the uEye driver bundle for 64-bit systems. Instructions between brackets are only relevant if a previous version of the uEye driver was installed.

1. Start uEye64_44100.exe.
2. Choose Remove and click Next.
3. Click Yes.
4. Click Yes.
5. Click OK.
6. Select “Yes, I want to restart my computer now” and click Finish.
7. Start uEye64_44100.exe again.
8. Select “English (United States)” and click Next.
9. Click Check USB bus.
10. Check for green text stating “USB 2.0 compatible Host controller found”.

11. Click Exit.
12. Choose “Install driver”.
13. Choose “1. Complete” and click Next.
14. Click Next.
15. Click Next.
16. Click Install.
17. Click OK.
18. Uncheck “Show quickstart HTML” and click Next.
19. If a warning about Intel Core i7 appears click OK.
20. Click Finish.
21. Reboot computer.

DirectShow

Download the DirectShow driver for uEye cameras 4.41 (32 and 64 bit) from https://en.idshttp://en.ids-imaging.com/download-ueye-interfaces.htmlimaging.com/download-ueye-interfaces.html . The download contains the uEye_DirectShow_44100.exe installer.

Install the DirectShow interface for uEye. Instructions between brackets are only relevant if a previous version of the uEye DirectShow interface was installed.

1. Start uEye_DirectShow_44100.exe.
2. Select “Remove uEye DirectShow completely” and click “Next”.
3. Click Yes (twice if necessary).
4. Select “Yes, I want to restart my computer now” and click Finish.
5. Start uEye_DirectShow_44100.exe again.
6. Select “English (United States)” and click Next.
7. Click Next.
8. Check “Register cameras on connect” and “Use camera names” and click Next.

9. Close WhatsNew.
10. Click Finish.
11. Reboot computer.

Configure

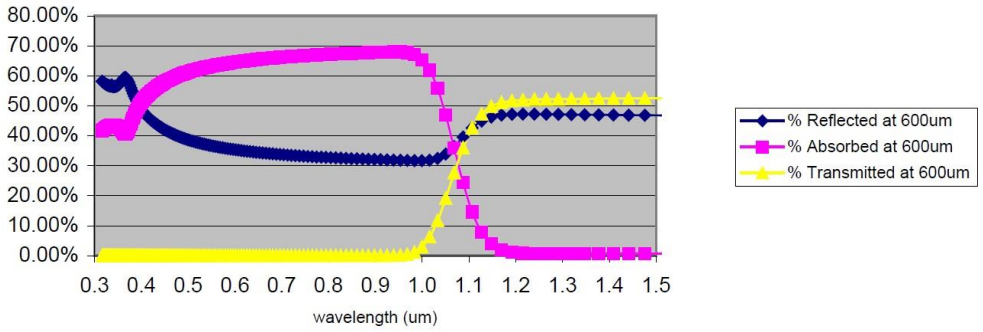
Configure the IDS camera software.

1. Start IDS Camera Manager.
2. When asked about network service click Cancel.
3. Click “Additional functions”.
4. Under “CPU idle states” check “Disable (mains power)”.
5. Click Close

Design Considerations

Wavelength of IR LEDS

Figure 7 Optical characteristics of silicon versus wavelength



The choice for the 1060 nm LED is a trade-off between two effects:

— The silicon substrate is transparent for 1060 nm and longer wavelengths [1], see figure above.

— CCD cameras are sensitive to 1060 nm and shorter wavelengths.

Comparison of cameras

— We compared three camera types: Color camera for visible light (IDS 100-DC-C1130511) which is the standard option for the diode laser station. This camera is equipped with an IR filter and is not suitable for 1060 nm wavelength.

— Monochrome camera for near infrared light (IDS UI-1240E-NIR-GL) which is intended for use with the IR ring light. The IDS UI-1240E-NIR-GL camera has increased sensitivity for NIR light compared to IDS 100-DC-C1130511.

— Monochrome camera for near infrared light with cooled CCD sensor (SXVR-H9) which is selected for comparison. The cooling of the sensor reduces background noise.

The following images were taken under similar conditions.

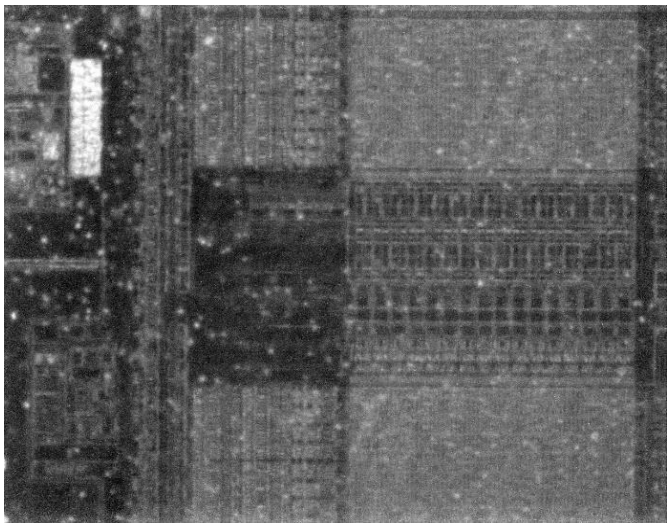


Image captured with monochrome NIR camera which is intended for use with the IR ring light

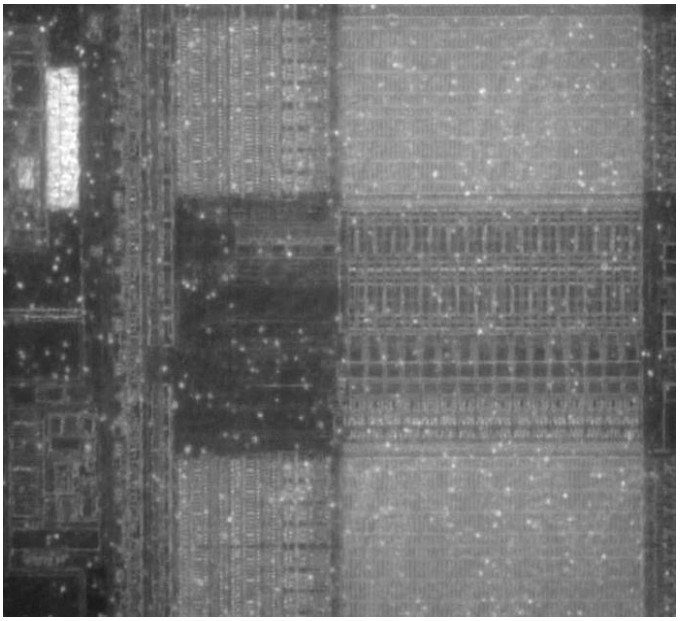


Image captured with cooled monochrome NIR camera

Comparison of the two images shows that the images of the NIR and cooled NIR camera have approximately similar image quality. The sensor cooling does not seem to be necessary given the light intensity of the IR ring light. We selected the IDS UI-1240E-NIR-GL for use with the IR ring light for
backside navigation.

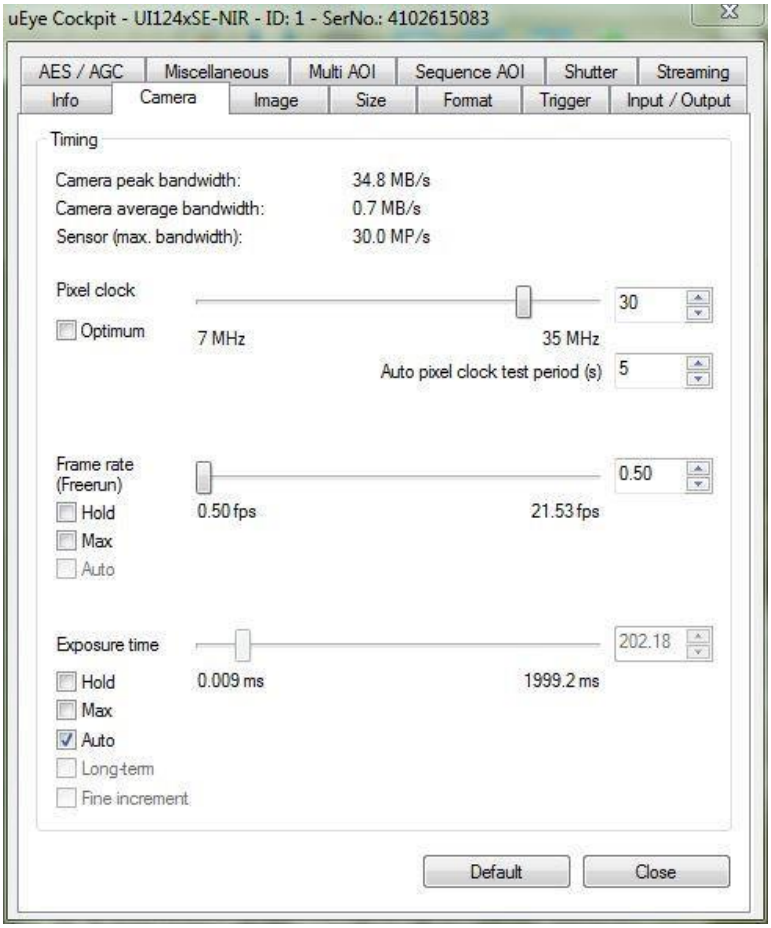
Operating Tips

The images in this chapter are taken from a smart card chip used in training card 2, 3, 6, or 4. The chip's package is opened. For some images, the back side is polished but not significantly thinned. We estimate the thickness of the silicon substrate to be more than 200 µm. The image area for the 5x objective is approximately 1 x 1 mm.

Taking images and camera exposure time

Images can be taken via the uEye Cockpit camera software by IDS. After starting uEye Cockpit, select the monochrome option. The exposure time for the camera should be between 0.5 and 2 s. The settings can be entered via uEye > properties, see screenshot below.

Figure 8 Screenshot of camera properties in uEye Cockpit



Improving image quality with immersion oil

The image quality strongly depends on the quality of the back side surface. A surface with scratches and dents blurs the image. A way to improve the image quality is to fill the dents and scratches with a fluid with the same refractive index as the silicon substrate. However, the refractive index of silicon is approximately 4 and fluids have a refractive index up to approximately 1.5.

The images below are taken with and without silicone oil. Silicone oil has a refractive index of approximately 1.5. The effect of covering the surface with silicon oil is minimal.

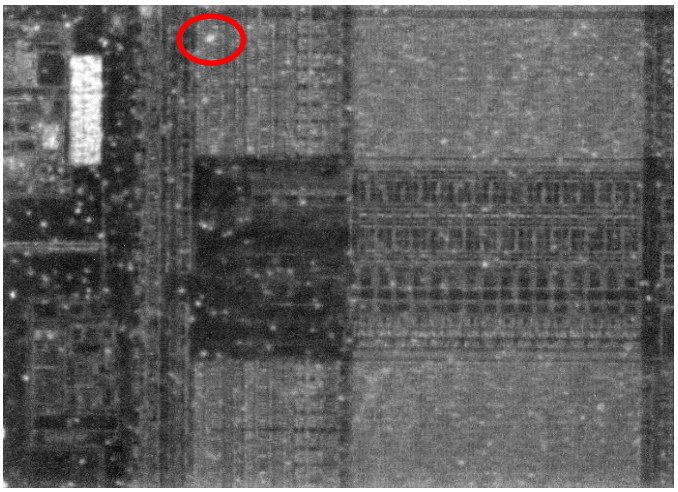


Image captured with monochrome NIR camera.

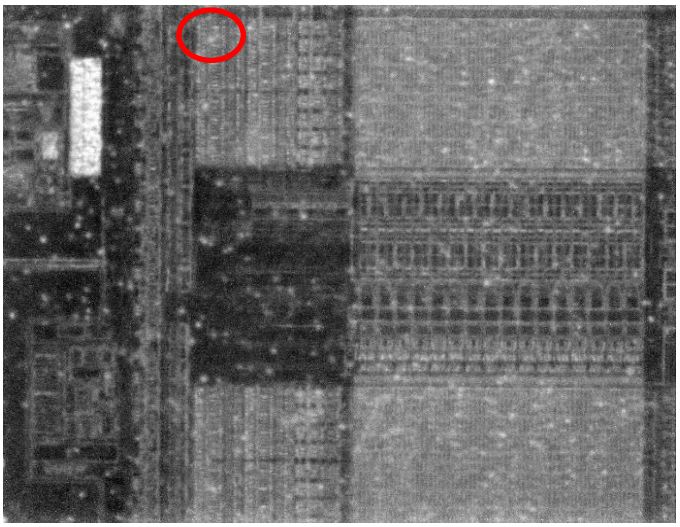
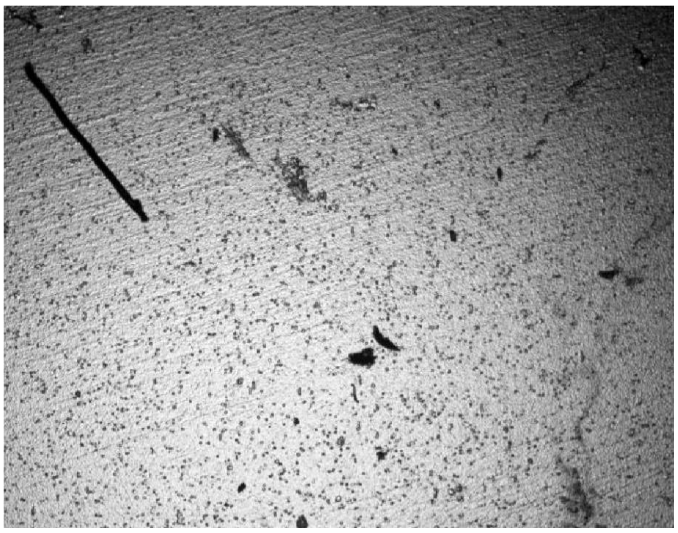


Image captured with monochrome NIR camera and surface covered with silicon oil.

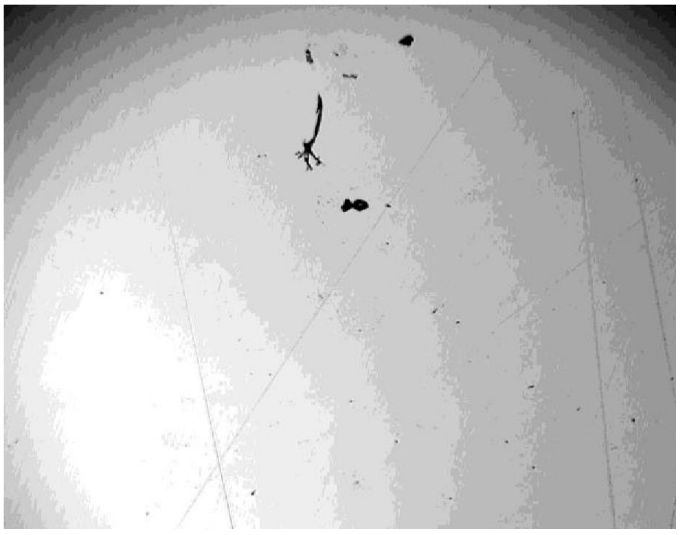
Improving image quality by surface polishing

As the image quality strongly depends on the quality of the back side surface and polishing helps to reduce dents and scratches, polishing will improve image quality. The images below show the surface and transistor layer for unpolished and polished samples. The polishing was done in two phases:

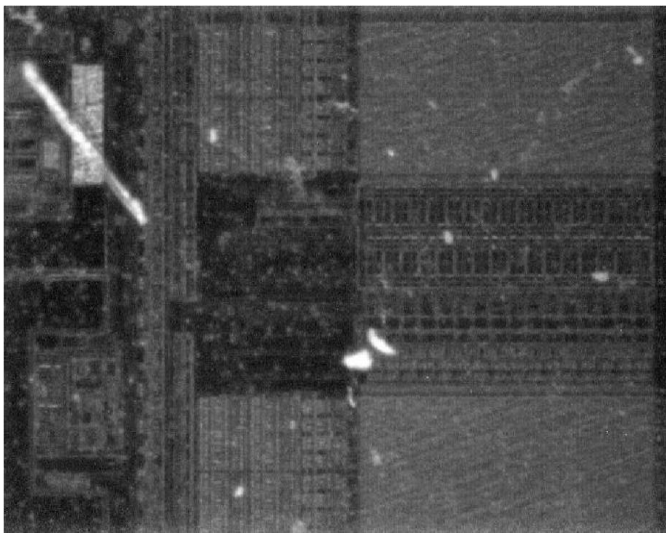
- With a dry 1 µm polishing disc. Unfortunately, this caused additional long and deep scratches.
- With glycol based 0,05 µm polycrystatalline diamond suspension.



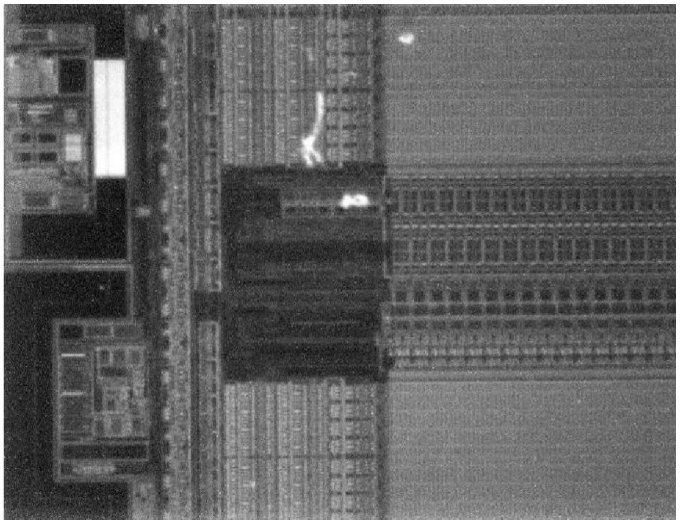
Surface image of unpolished sample at location A.



Surface image of polished sample at location A.

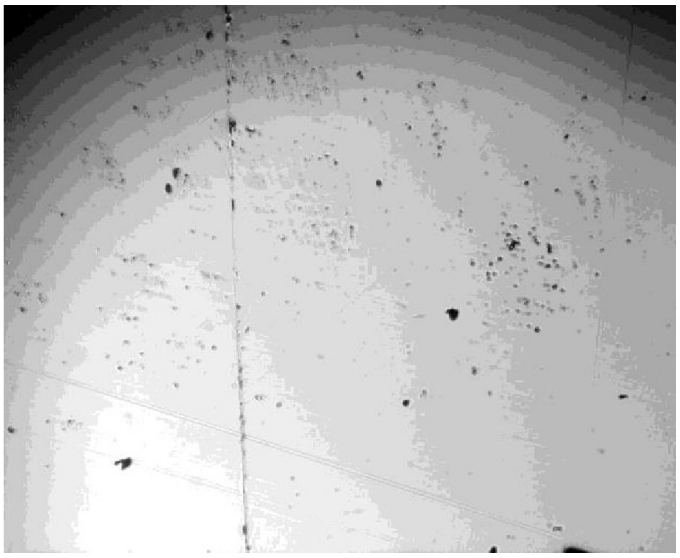


Transistor layer of unpolished sample at location A.

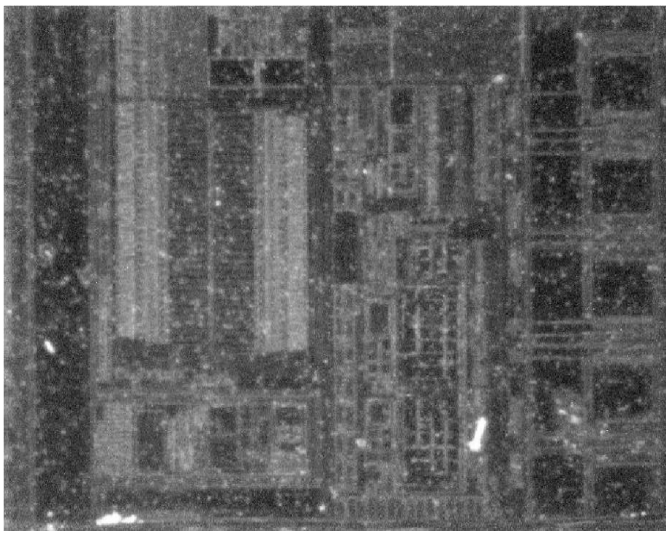


Transistor layer of polished sample at location A.

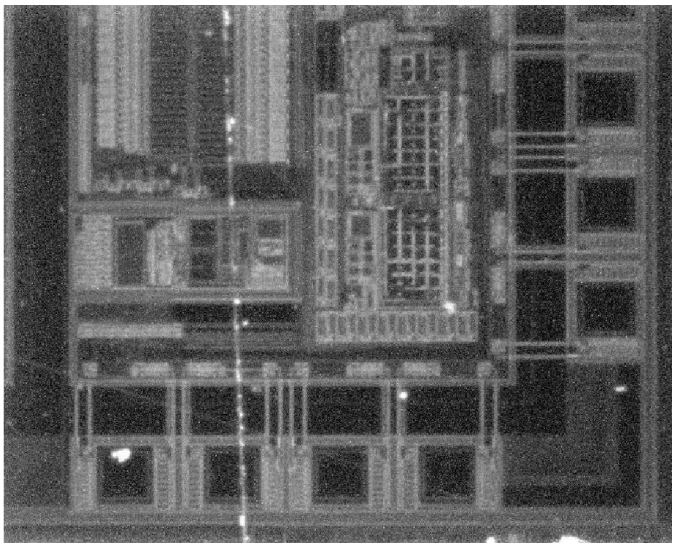
Surface image of unpolished sample at location B.



Surface image of polished sample at location B.



Transistor layer of unpolished sample at location B.



Transistor layer of polished sample at location B.

The effect of surface polishing is significant.

Focusing

Focusing the 5x objective

The focus distances between the object and the microscope's objective are approximately the same for:

— Focusing on the back side surface with visible light.

— Focusing on the transistor layer through the back side with 1060 nm IR light.

This is illustrated by the following two images which are taken without intermediate adjustment of the focus distance.

Hence, an easy procedure to find the focus distance for the transistor level is to first find the focus distance for the back side surface using visible light. The explanation of this phenomenon is two-fold:

— The refractive index of the silicon substrate is approximately 4 compared to a refractive index of air of approximately 1. The change of direction of light at the surface between silicon and air due to the large difference in refraction indices shifts the focus level in the direction of the surface.

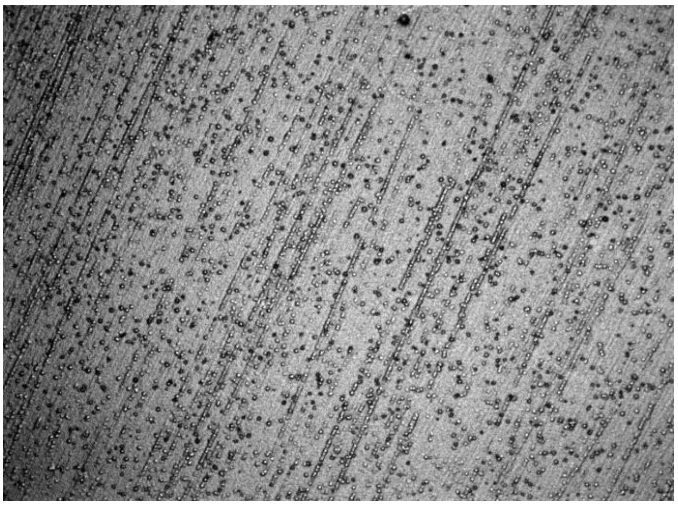


Image of back side surface with visible white light. Dents and scratches of the unpolished backside are visible.

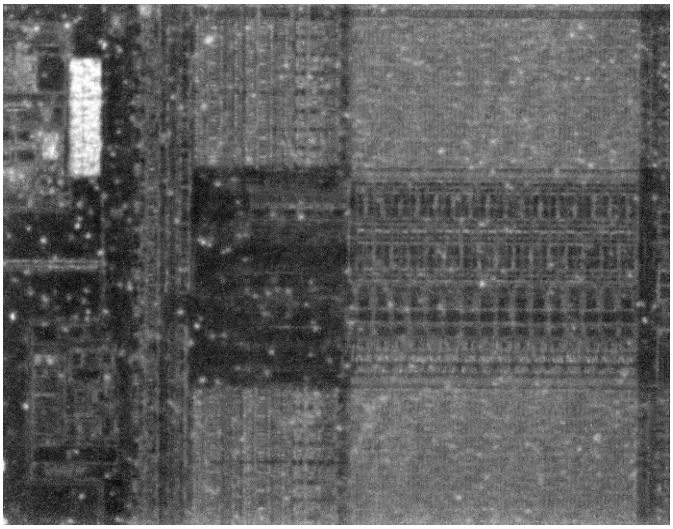


Image of transistor layer with 1060 nm IR light and 5x objective. The unpolished surface blurs the image to some extent.

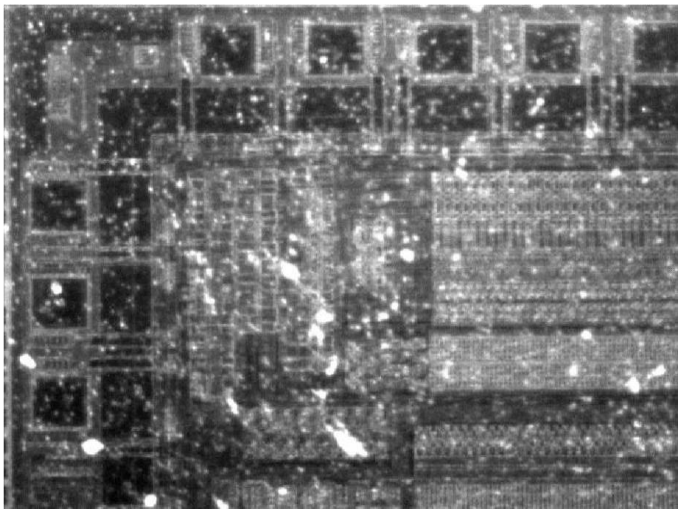
Focusing the 20x and 50x objective

The focus depth of the 20x and 50x objective is significantly smaller compared to the 5x objective. Focusing of the backside surface and transistor layer cannot be performed simultaneously. Starting with the backside surface focused, the user needs to slide down the 20x or 50x objectives to get the transistor layer into focus.

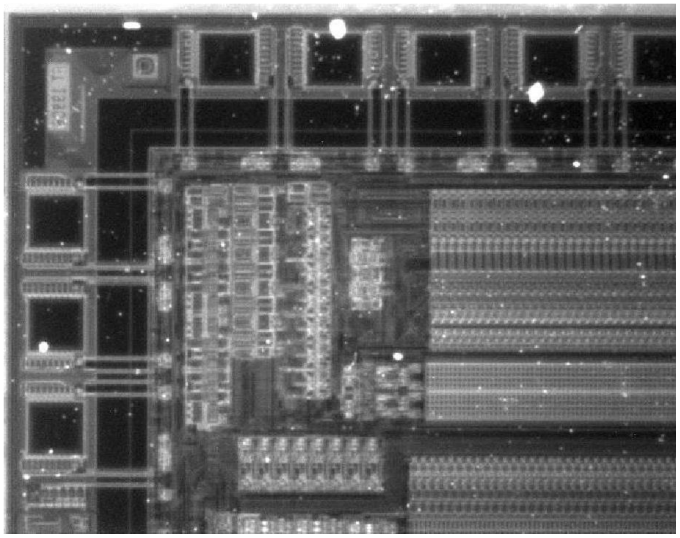
Making use of limited focus depth of 20x and 50x objectives

The limited focus depth of the 20x and 50x objectives is useful to blur the irregularities of the backside image while observing the details of the transistor layer. The 5x, 20x, and 50x images below of an unpolished sample illustrate this. As a reference, the images of a polished sample are also given.

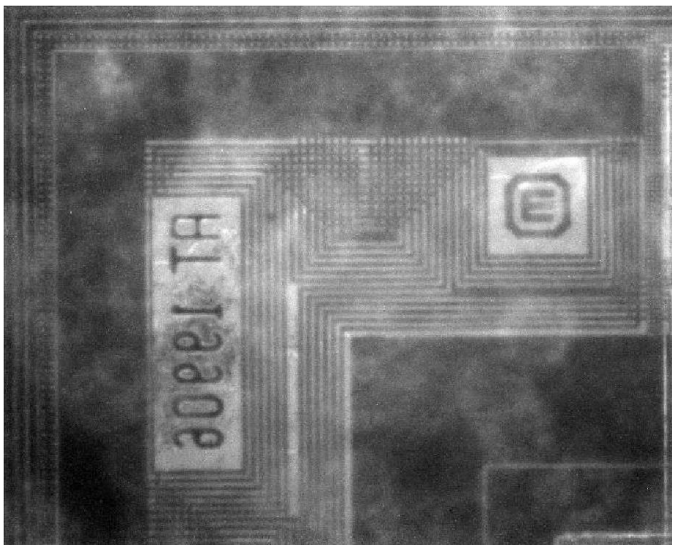
The image quality difference between unpolished and polished is very clear for the 5x objects and much less clear for the 50x objective.



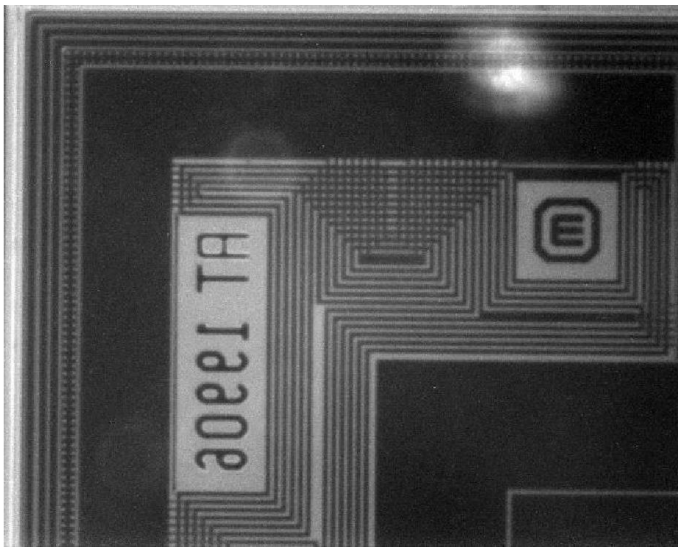
Unpolished sample with 5x objective.



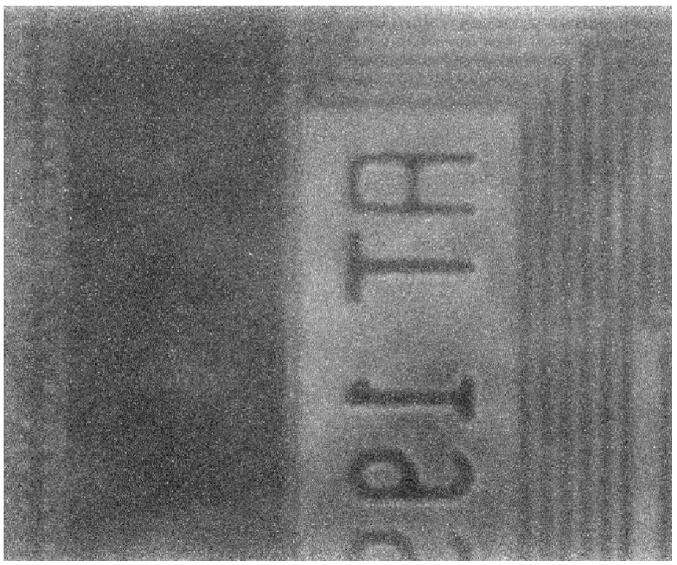
Polished sample with 5x objective.



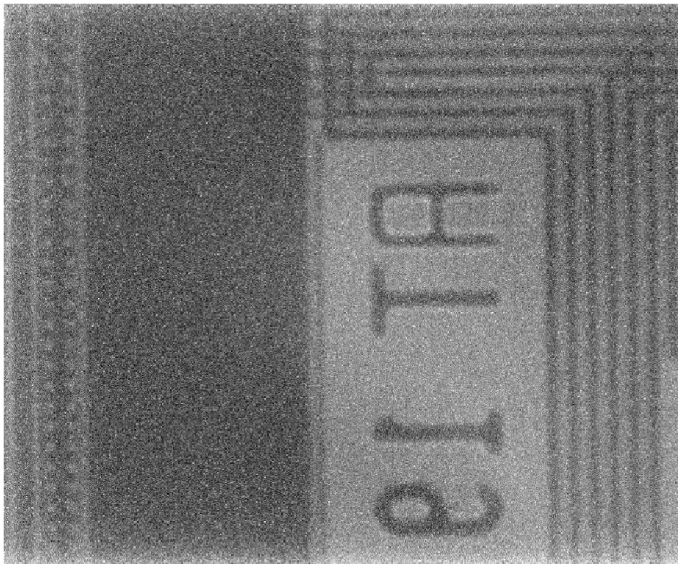
Unpolished sample with 20x objective.



Polished sample with 20x objective.



Unpolished sample with 50x objective.



Polished sample with 50x objective.

Image example of TC4 (provided as part of package)

This example on the TC4 is done without need of polishing the surface.

The pictures are taken under an LS2 without a beam splitter.

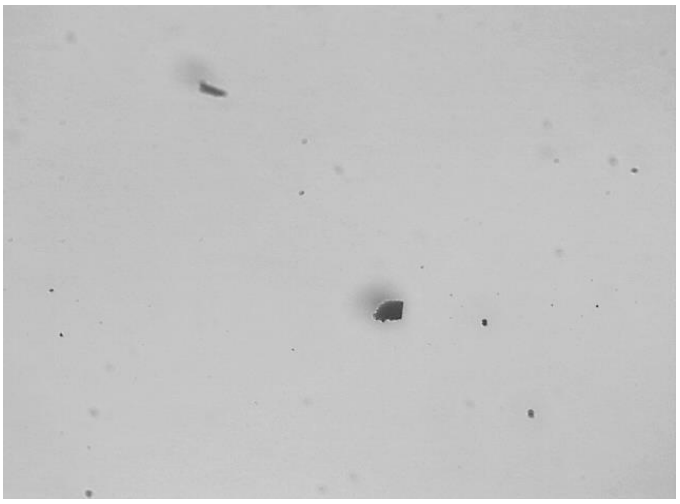
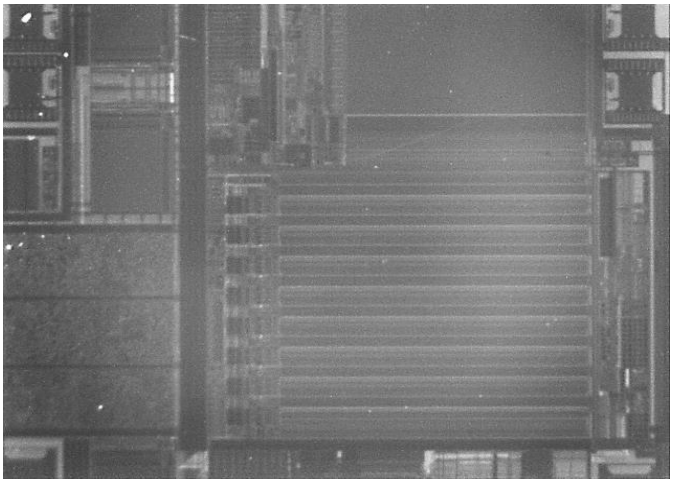


Image of back side surface with visible white light.



Unpolished TC4 with 5x objective.

Support

Installation questions can be posted through our support portal at https://support.keysight.com.

References

[1] Optical properties of silicon, Virginia Semiconductor, Inc.

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