Solutions to test imageQuality

Image Engineering Product Catalog

2021

Dear Image Quality Professionals,

We thank you for your continued support over the years and, more importantly, for your pursuit of the highest level of image quality.

Since our founding in 1997, we have become a global leader in image quality testing. We have helped companies from various industries around the world improve their imaging devices by utilizing our image quality tests, equipment, and knowledge. Today, we house the industry's largest independent test laboratory and have become one of the world's leading suppliers for image quality test equipment and solutions.

Our products and solutions are centered around the 250+ test charts that are expertly designed for the assessment of the many different image quality factors, including camera resolution, distortion, flare, etc. Our illumination devices, many of which are based on iQ-LED technology, provide uniform illumination of the test chart or test scene.

We also provide various measurement devices for accurately measuring the different functions of a camera system, such as shutter time lag or image stabilization. We have also developed advanced solutions such as the iQ-Automator, which fully automates testing with just one click. Finally, a full analysis of the image quality test results can be done using the iQ-Analyzer analysis software.

All of the equipment and software is regularly used in our test lab and adheres to international standards when applicable. We are actively engaged in many international committees responsible for defining and updating industry standards for image quality. Currently, we are involved with (see website for full list):

- ISO Technical Committee 42 – responsible for standardization of still picture imaging
- IEEE-P2020 - developing an industry standard for automotive ADAS systems
- IEC 62676-5 – the first industry standard for security and surveillance systems

Since our founding, our mission has always been to prepare the ground to create images that change the world. We believe the right solutions can lead to a future with the highest level of image quality.

Thank you for your interest in Image Engineering. We look forward to helping you on your journey to improved image quality!

Best Regards,
Your Image Engineering Team

For worldwide delivery, you can find a list of all distributors on our website:
www.image-engineering.com/company/resellers

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Contents

iQ-Teststand

Upgrade your test lab with a customized camera test stand

Choose from an extensive variety of components to design a camera test stand that is right for your test lab. A proper camera test stand will quickly improve the effectiveness of your image quality testing.

Basic iQ-Teststand

Main Features

- Fully customizable
- With and without motorization
- Control software (for automated version)
- API available (for automated version)

Basic vs. Automated

There are two different types of the iQ-Teststand. First is the basic version, this version is without motorization and requires manual movement of the camera and camera mount. The second is the automated iQ-Teststand that uses motorization to align the camera under test to the various testing devices.This version includes control software. There is also an API* that is available as an option.

Automated iQ-Teststand

*API sold separately

Designing your iQ-Teststand

There are seven different product groups with various solutions to guide you through the customization process. Once you have decided upon the basic or the automated test stand, you can now fill out your setup with other required products.

1 Chart mounting

Choose from simple wall and table mounts to an automated chart mount.

iQ-Chartmount-V


iQ-Chartmount-H V2

2 Camera distance and alignment

Select from manual to fully automatic for the camera distance and alignment system.


iQ-Monopod

iQ-Bench

3 Camera alignment

Choose from manual to automatic camera alignment.


3-Way tripod head


iQ-Cameramount


iQ-Robot

4 Reflective chart illumination

Multiple lighting options for reflective charts. A pair is always required for uniform illumination.


LED Studio Light

iQ-Flatlight with iQ- LEDs


Tungsten halogen light

5 Transparent chart illumination

Multiple lighting options such as halogen or iQ-LED for uniform illumination of transparent test charts.

LE7

LG3

LG4

Vega

6 Analysis and control software

The iQ-Analyzer-X is available for image quality analysis. Control software and APIs are also available.

7 iQ-Housing

Customized housing for your test setup to block out all stray light from the surrounding environment.

Dynamic Test Stand – DTS

Test the performance and effectiveness of ADAS camera systems

The DTS uses contrast detection probability (CDP) and other methods to determine the capability of an automotive camera to differentiate and detect objects within its field of view.

The DTS has been developed to coincide with the objectives of the IEEE-P2020* working group.

Main Features

- Contrast Detection Probability (CDP)
- Color Separation Probability (CSP)
- Modulated Light Mitigation Probability (MMP)
- Motion Artifacts (Blurring)
- Mounting for distortion compensation

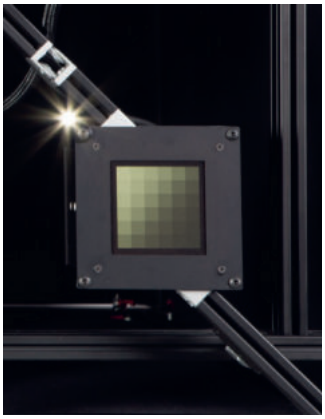
iQ-LED TECHNOLOGY

Software INCLUDED

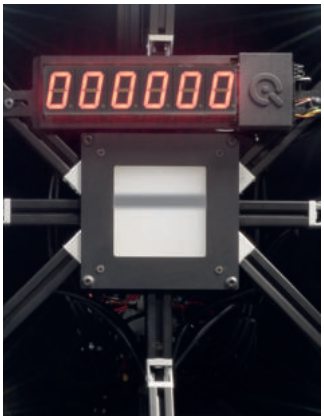
Test key performance indicators (KPIs)

The DTS uses six white LED light sources and two iQ-LED-powered CAL2 devices to simulate different lighting situations, including various flicker frequencies, in an automotive environment.

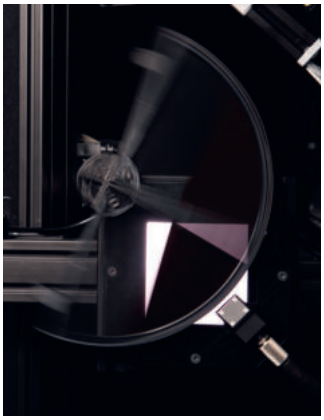
This device is capable of providing a flexible high dynamic scene to the device under test. HDR rendering can be tested and characterized.



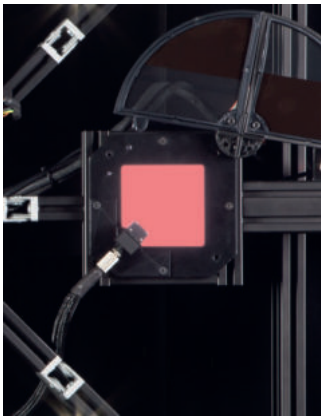
Contrast Detection



Modulated Light Mitigation (Flicker)



Motion Artifacts



Color Separation

Hardware setup

The six CDP targets are each made up of 36 grey patches for a possible 216 different intensities for differentiating multiple objects in the field of view. The two integrated CAL2 iQ-LED devices produce different colors for analyzing the color separation capabilities of the camera under test.

Use the modulated light mitigation (flicker mode) to analyze the response time of a camera. Varying levels of flicker intensities can be generated using the middle box and the six CDP (performance similar to LG3) boxes. There are also four single LED lights for analyzing local flicker. In front of the LED lightboxes, there are two rotating off-axis slanted edge targets that provide a way to measure a cameras response to various blurring and motion effects.

Software Features

- DTS-Sequence Generator
  - ▸Generate custom test sequence
- DTS-Control
  - ▸Control the hardware and manage sequences
- DTS-Evaluation
  - ▸Quickly analyze your test results

The DTS-Sequence Generator software

At a Glance	DTS
Principle	Versatile, dynamic test stand. Automated, sequence-based measurement of multiple performance indicators.
Light source	7 x high intensity LED light sources based on LG3 technology and dimmable at 32 kHz, 2 x CAL2 based on iQ-LED technology
Flicker frequency	10 - 500 Hz, 0.1 Hz steps (10 - 200 Hz), 0.2 Hz steps (200 - 500 Hz)
Flicker duty cycle	1 - 99% in 1% steps
Field of View	Variable mechanical distortion compensation 25° - 160° (depending on the distortion of the DUT)
Contrast charts	216 Greyscale patches (6 x 36)
Dynamic range	Approx. 120 dB
Metrics	Contrast Detection Probability Modulated Light Mitigation Probability (Flicker) Color Separation Probability - Releasing soon Motion Artifacts (Blurring) - Planning stage
Motion	Motion artifacts measured on a rotating, translucent, slanted edge test chart
Software	Sequence-based measurement divided into three steps: DTS-Sequence Generation, DTS-Control, DTS-Evaluation

*For more information on CDP and IEEE-P2020, please follow: https://doi.org/10.2352/ISSN.2470-1173.2018.17.AVM-148

iQ-Automator Solution

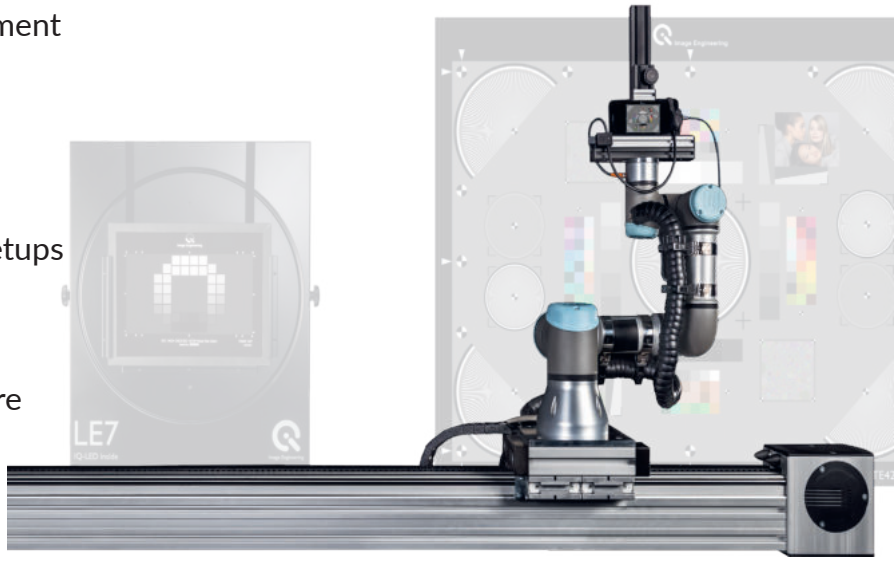
A fully automated camera test is now just one click away

The combination of the iQ-Automator software and the iQ-Robot creates a more efficient and time-effective way to automatically test and provide feedback about the image quality of a mobile phone camera.

Main Features

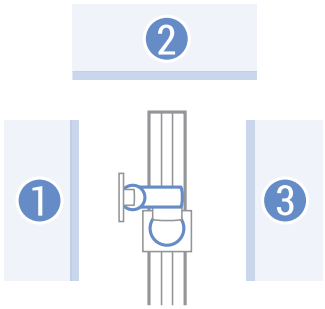
- Automatic and accurate alignment
  - ▸ to measurement devices
  - ▸ to test charts
- Manage different hardware setups
- Customize test workflows
- Drag and drop control software

Software INCLUDED



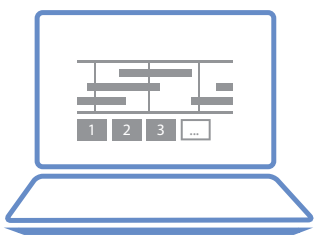
iQ-Automator software

This solution is centered around the advanced iQ-Automator software. With this software, you can design custom workflows and then automatically align the device under test with many of our illumination and measurement devices.



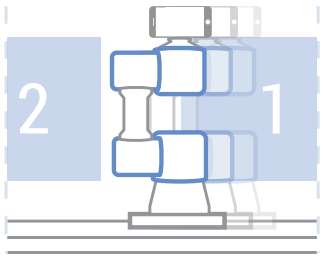
1 Setup test scene

Arrange various illumination and measurement devices around the iQ-Testbench and robotic arm.



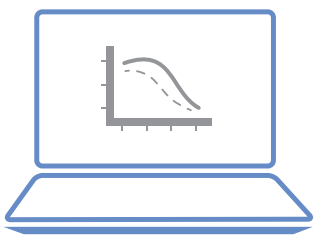
2 Create test procedure

Drag and drop control software to create a full test procedure for automated testing.



3 Run test

The DUT is automatically aligned in front of the measuring devices according to the test procedure.



4 Optional: Analysis

Automatic transfer of images from the DUT to your computer for analysis using the iQ-Analyzer software or your in-house analysis solutions.

The iQ-Automator hardware setup

To align the device under test, we use the iQ-Robot and a motorized iQ-Bench. The iQ-Robot has six rotating joints that allow the device the freedom to efficiently align to the various test charts and other measurement devices. The iQ-Robot is attached to a motorized iQ-Bench, which can be customized for length.

Multiple hardware setups can be stored and managed using the iQ-Automator software without any additional on-site software development. As a result, the iQ-Automator Solution can be integrated into your test lab right away without any additional development.

iQ-Automator

At a Glance	iQ-Robot
Principle	Camera positioning and alignment
Robot Arm	UR3
Max. payload	3 kg
Max. arm radius	500 mm
Degrees of freedom	6 rotating joints
Hardware APIs	Component APIs available on request

At a Glance	iQ-Bench
Principle	Camera to chart distance
Length	3730 mm (movement range + 730 mm)

At a Glance	iQ-Automator
Principle	Control Software
Version	C++ API available (OS Windows) iQ-Drive API* iQ-LED API*

At a Glance	iQ-Analyzer
Principle	Image quality analysis software

*APIs sold separately.

iQ-Depth Calibrator

A Time-of-Flight (ToF) camera calibration device

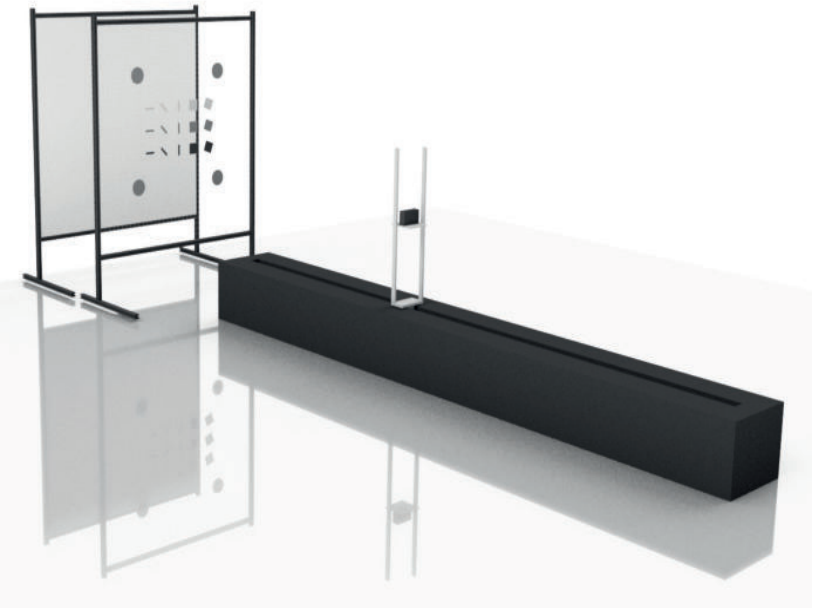
The iQ-Depth Calibrator is a highly advanced test stand designed for depth map calibration and depth performance characterization of a time-of-flight (ToF) camera system.

Main Features

- Evaluate ToF camera systems
- Custom designed test chart
- Motorized camera alignment
- Built with light absorbing material

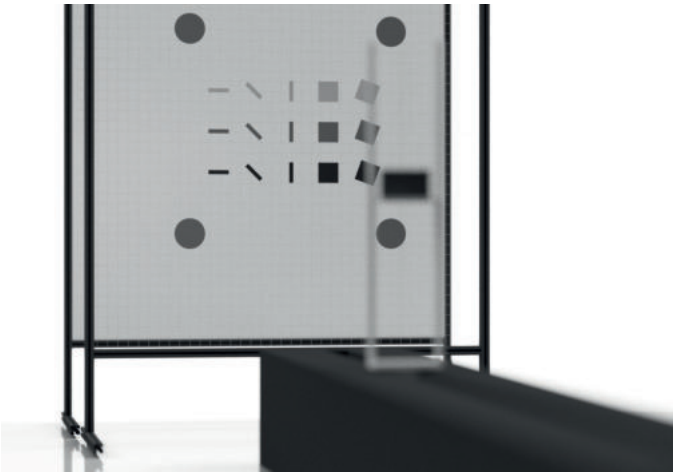
Software INCLUDED

API AVAILABLE



A unique test chart

This device comes with a uniquely designed test chart that includes homogenously reflective test targets and a perpendicular laser to ensure its accuracy. Once set up, test images are recorded with the exact position of the DUT so that the ground truth is always known and any calibration errors can be identified*. You can customize the chart with different shapes, materials, object planes, and reflectivity.



Custom designed test charts

At a Glance	iQ-Depth Calibrator
Principle	Fixed orthogonal alignment of a motorized bench and a homogeneous chart with defined reflection for depth map calibration
Movement range	3000 mm (custom on request, min 1000 mm)
Min. distance to chart	400 mm
Velocity**	max 1 m/s
Acceleration**	max 2.5 m/s²
Chart size	2 x 2 m
Reflectivity	900 x 500 x 3730 mm (without camera mounting)

*The ground truth for a ToF depth measurement is determined by the homogenously reflecting test target.
**Only applicable for motorized version (iQ-Bench-M)

VCX Solutions

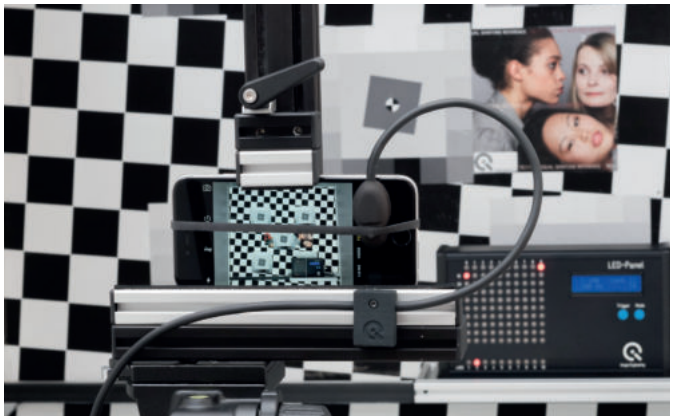
Mobile phone testing according to VCX

VCX is a non-profit organization dedicated to objective image quality testing of mobile phone cameras. Each phone that is submitted for testing undergoes an independent evaluation and receives a numeric score. The camera is tested for its image quality and other performance indicators under a variety of factors, including bright light conditions, low light conditions, and zoom, among others. The final score is a weighted sum of the image quality and performance factors. The VCX organization frequently revises the VCX score, and the current version is VCX v2020.
See detailed information at www.vcx-forum.org.

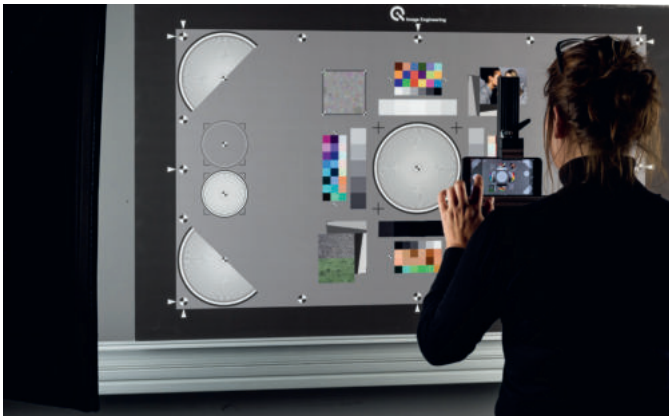
VCX 41/100

VCX testing lab

Image Engineering is one of the few trusted VCX testing labs. Using our test equipment, we have set up our lab in line with the specifications outlined by the VCX white paper. As VCX is an open and independent testing organization, any lab can request the white paper to conduct in-house testing on its own. As a result, we have also made our test setup available for any test lab that wishes to test for themselves or aspires to become an officially certified test lab of VCX.



Timing measurement setup



VCX testing with the TE42 multipurpose chart

VCX v2020-Automated

The VCX v2020 automated solution covers all of the performance indicators outlined in the standard and includes the proper equipment for a fully automated setup and evaluation of a VCX test.

VCX v2020-Manual

The VCX v2020 manual solution covers all of the performance indicators outlined in the standard and includes the proper equipment that we utilize in our test lab when performing a manual VCX test.

VCX Solutions / Products*	Product Description	Manual	Automated
Test charts			
Universal Multipurpose			
TE42-LL	Multipurpose test chart · 1 x A1066 · 2 x A460	3 X	3 X
TE42-LL Timing	Multipurpose test chart with 2x LED-Panel	X	X
TE269-BX	An OECF chart with 36 gray patches	X	X
Mounting			
Chart Mounting			
iQ-Chartmount-VM	Automatic positioning and storage of up to eight different test charts		X
iQ-Chartmount-H V2	Mount multiple charts for testing	X	
Camera and Illumination Mounting		X	
iQ-Monopod	Floor rail (4 m) - ensure camera stabilization with a proper rail setup	X	
iQ-Bench	For mounting iQ-Robot		X
iQ-Robot	Automated alignment of mobile phone		X
iQ-Anchor	A stabilization mount for STEVE	X	X
iQ-Mobilemount	Mount for mobile phones and tablets under test	2 X	2 X
Honeycomb Breadboard	A heavy stabilized board for securely attaching STEVE	X	X
Illumination Devices			
LE7-2x	Transparent chart illumination	X	X
iQ-Flatlight	Reflective chart illumination with iQ-LED technology	2 X	2 X
Measurement Devices			
STEVE-6DL	Stabilization and handshake measurements	X	X
iQ-Trigger /-T	Timing the shutter release	X	X
Software			
iQ-Analyzer	Image quality analysis software	X	X
STEVE 2.0	Analysis software - evaluating camera stabilization	X	X
iQ-Automator	Control software for the automated test setup		X
iQ-Drive API	Smooth implementation into custom test setups		X

*Our current VCX solutions and products are subject to change with updates to the VCX testing procedure.

iQ-LED

Generate custom spectra with the all-in-one light source

iQ-LED technology* recreates other light sources in a controlled lab environment. This technology, in its second generation (V2), can be found in many of our illumination devices and can replicate almost any light source for a more accurate camera characterization and calibration.

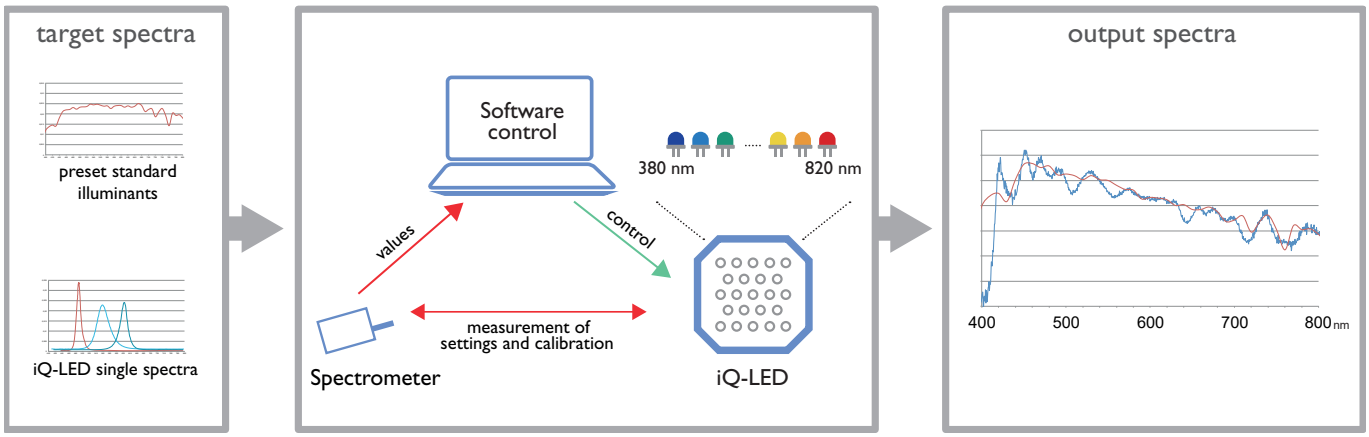
Main Features

- Spectrally tunable light source
- 20 individual spectral channels
- High frequency PWM with up to 128 kHz
- Wavelength range of 380 – 820 nm
- Direct device management without a PC
- Connect multiple iQ-LED devices
- Long term stability via temperature control
- Short term high intensity and spectral stability via temperature control

iQ-LED TECHNOLOGY | Software INCLUDED | API AVAILABLE

The iQ-LED device workflow

Each of our iQ-LED illumination devices has iQ-LED control software and a spectrometer to ensure you have proper illumination over the entire lifetime of the device. iQ-LED can recreate various spectra, including everything from standard light sources to different color patches.



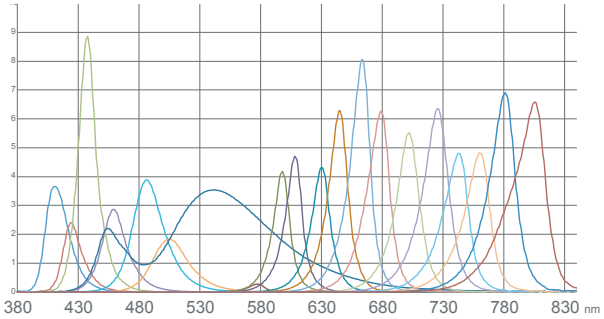
iQ-LED workflow

*The full overview described in the first two pages applies to all of our iQ-LED devices. Information on the devices themselves can be found on the respective product page.

Advanced image quality testing

iQ-LED technology* can generate custom spectra by the optical mixing of emitted radiation from spectrally different LEDs. The standard module consists of 20 different channels generated from 41 high-power SMD LEDs on a 10 x 10 cm board.

iQ-LED technology uses a NIST traceable calibrated spectrometer and iQ-LED control software to calibrate and correctly generate the spectra. Once correctly calibrated, the illuminant can be stored on the device and used without a PC. Up to 44 illuminants and one sequence can be stored on the device.



20 individual spectral channels

iQ-LED software main screen

At a Glance	iQ-LED V2
Principle	High-power SMD-LED based spectral broadband light module used in our iQ-LED devices. It can also be used to build your own spectral programmable illumination device
Light sources	41 SMD high-power LEDs / separated in 20 color channels / spectral range: 380 – 820 nm / intensity controlled via 4000 steps per channel and 32 kHz PWM (switchable to 1000 steps with 128 kHz)
Spectral measurement	Closed loop functionality with calibrated mini spectrometer via control software Spectral Range: 350 – 870 nm / Resolution: 2048 pixel / FWHM: 2.4 nm
Control system	Software-based control system via USB (included with all iQ-LED devices), C++ API available** Storage of up to 44 different illuminants, one sequence, and default light source, controllable via microswitch controller (without connected PC)
Included reference illuminants	D50, D55, D65, D75, A, B, C, E / Planckian spectral curve by selected temperature (1900 - 18000 K) / The iQ-LED technology is optimized for the best spectral match and allows CRI values up to 99, depending on illuminant and intensity
Illumination stability	+/- 1% when stabilized (2% after switching D illuminants during the first 5 s) for most applications
Response time	< 50 ms (switch illuminant)
Production line integration feature	Operation hour counter Self-diagnosis
Software requirements	PC with Windows 7 operating system (or higher) and USB port
Additional functions	• Auto-generation of standard illuminants or externally measured spectra • Save and load function of self-defined spectral arrangements or intensities • Storage of illuminants/sequences on device • Creation of test sequences • Real-time display of spectral measurement • Real-time calculation of CCT, CRI, curve fit and illumination level

*The iQ-LED V2 module is built into our LED illumination devices. We also offer it as a stand-alone component module for independently designed light sources. This option is sold as a bundle that includes one iQ-LED module and a spectrometer. Additional modules can be purchased.

**API sold separately

LE 7

Uniform chart illumination with iQ-LED

The LE7 is a uniform lightbox that uses iQ-LED technology to increase the effectiveness of image quality camera testing with transparent test charts. With five different product variations, the LE7 can generate an extensive range of light intensities for more comprehensive camera testing.

Main Features

- Includes all features from iQ-LED
- Uniformity of > 97% in active chart area
- Available with two, four, or six iQ-LED modules
- Control single modules to expand intensity range*
- Acurate low-light testing with LE7-6x-E

iQ-LED TECHNOLOGY

API AVAILABLE

LE7-IR, LE7-E and camSPECS plate

The LE7-IR uses two normal iQ-LED modules and four iQ-LED IR elements to extend the spectral range from 380 – 1050 nm.

The LE7-E is capable of creating a dynamic range of up to 1:100,000. Such a wide dynamic expands the testing possibilities, especially low-light testing.

Using the camSPECS plate (TE292) with the LE7 creates an iQ-LED solution for spectral sensitivity measurements and camera color calibration.

At a Glance	LE7-2x / LE7-4x / LE7-6x / LE7-IR / LE7-E
Principle	An integrating sphere to illuminate transparent test charts based on iQ-LED technology (includes micro-spectrometer) / 500 mm diameter integrating sphere
Output window	290 x 220 mm output window / dual slot for D280 sized test charts
Light source	**LE7-2x**: 2 x iQ-LED V2: 82 SMD high-power LEDs **LE7-4x**: 4 x iQ-LED V2: 164 SMD high-power LEDs **LE7-IR**: 2 x iQ-LED V2 plus 4 x iQ-LED IR: 402 SMD high-power LEDs **LE7-6x**: 6 x iQ-LED V2: 246 SMD high-power LEDs **LE7-E**: 5 x iQ-LED V2 plus 1 x iQ-LED V2 with 1.8 ND filter: 246 SMD high-power LEDs
Uniformity	> 97 % for active chart area, 280.0 x 157.5 mm (for standard D illuminants) > 96 % for full chart area, 290.0 x 220.0 mm (for standard D illuminants)
Maximum / Minimum illumination level	**LE7-2x / LE7-IR**: 25 lx up to 8000 lx **LE7-4x**: 100 lx up to 16000 lx **LE7-6x**: 25 lx up to 24000 lx **LE7-E**: 0.25 lx up to 20000 lx For standard illuminant D55 (illuminating a TE291 D calibration chart)

*iQ-LED software version 3.2.0 or higher required for single module control.

iQ-Flatlight

The most advanced light source for camera testing

Powered by iQ-LED technology, the iQ-Flatlight uses ten iQ-LED elements to recreate almost any light source for test chart or scene illumination. This all-in-one light source greatly expands the capabilities of a test lab.

Main Features

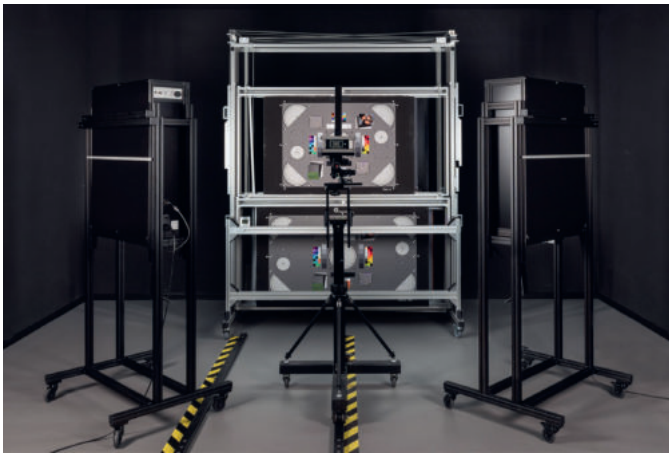
- Includes all features from iQ-LED
- Spectrally tunable light source for camera tests
- Used for illuminating the VCX test setup
- Uniformity of a large test chart > 90% (sample setup)
- Fluorescent light option

iQ-LED TECHNOLOGY

API AVAILABLE

Sample Setup

The iQ-Flatlight is always sold as a pair of two to ensure illumination uniformity of the test chart or test scene. A sample test setup normally positions each light 1.5 m away from the test chart, as seen in the image below.



Sample setup

At a Glance	iQ-Flatlight
Principle	Diffuse light panel for illuminating reflective test charts and surfaces
Light area	620 x 780 mm
Light source	10 x iQ-LED V2: 41 SMD high-power LEDs
Uniformity on plane	Up to 90% (with two iQ-Flatlights in ~1,5 m distance, depending on test setup)
Maximum / Minimum illumination level	Single iQ-Flatlight / 400 mm distance: 25 lx up to 7800 lx Two iQ-Flatlights / in ~1,5 m distance, 1 lx up to 2000 lx depending on test setup (for standard D illuminants)

iQ-Chart Box

Uniform illumination of reflective test charts

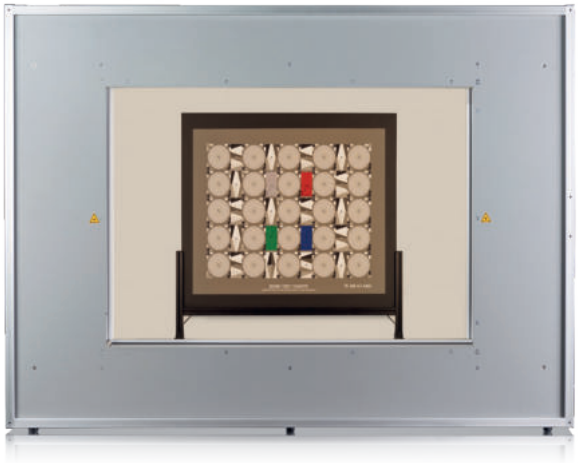
The iQ-Chart Box has a compact design with eight built-in iQ-LED elements and four fluorescent light sources for illuminating reflective test charts in size A460 and under. Each light is aligned and fixed to ensure test charts are always homogeneously illuminated.

Main Features

- Includes all features from iQ-LED
- Uniformity > 95% (chart size A460)
- Size A460 and A280 reflective test charts
- Fluorescent light option
- Designed for labs with limited space

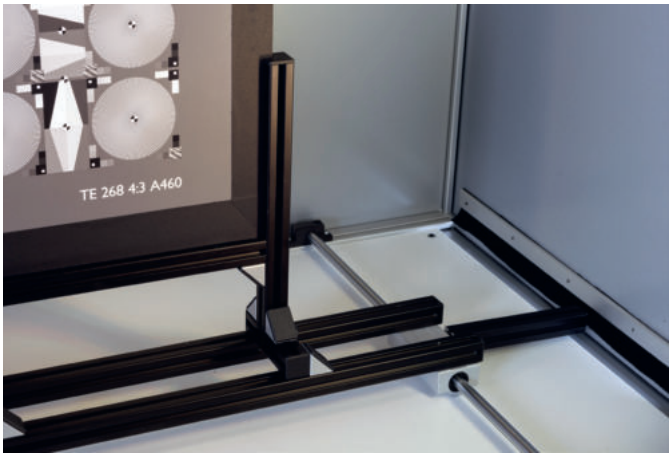
iQ-LED TECHNOLOGY

API AVAILABLE



Designed for smaller test labs

The iQ-Chart Box is designed for smaller test labs where the iQ-Flatlight is not as convenient. Now, instead of having a full chart mount and two or more free-standing lights to illuminate the test chart, you can have all of the same illumination features in a practical size that can be placed anywhere in your lab.



Easily switch test charts

At a Glance	iQ-Chart Box
Principle	Compact device to illuminate reflective test charts based on iQ-LED technology
Front opening	820 mm x 530 mm
Light source	8 x iQ-LED V2: 328 SMD high-power LEDs 4 x 18 W fluorescent lamps, D50
Uniformity on chart plane	> 95 % (A280 picture size) > 90 % (A460 picture size)* only for iQ-LED light source; illuminance on chart plane for selected standard illuminant (D50) at 400 lx
Maximum / Minimum illumination level	25 lx up to 2000 lx (for standard D illuminants) / depending on illuminant and required curve fit / CRI / with ND filters down to 1.5 lux

*measured at center of A460 sized chart

CAL Product Line

iQ-LED light sources for camera calibration and characterization

The CAL product line uses our multispectral iQ-LED technology for flexible camera calibration and characterization. A full calibration can be performed in as little as a few seconds due to the short response time of the iQ-LEDs.

Main Features

- Includes all of the features from iQ-LED
- Measurement of the spectral sensitivity
- Calibration of gain/sensitivity for exposure
- Calibrate luminance and color shading
- Check white balance under various light sources
- Optimized for production line integration
- Detection of defect pixels

iQ-LED TECHNOLOGY

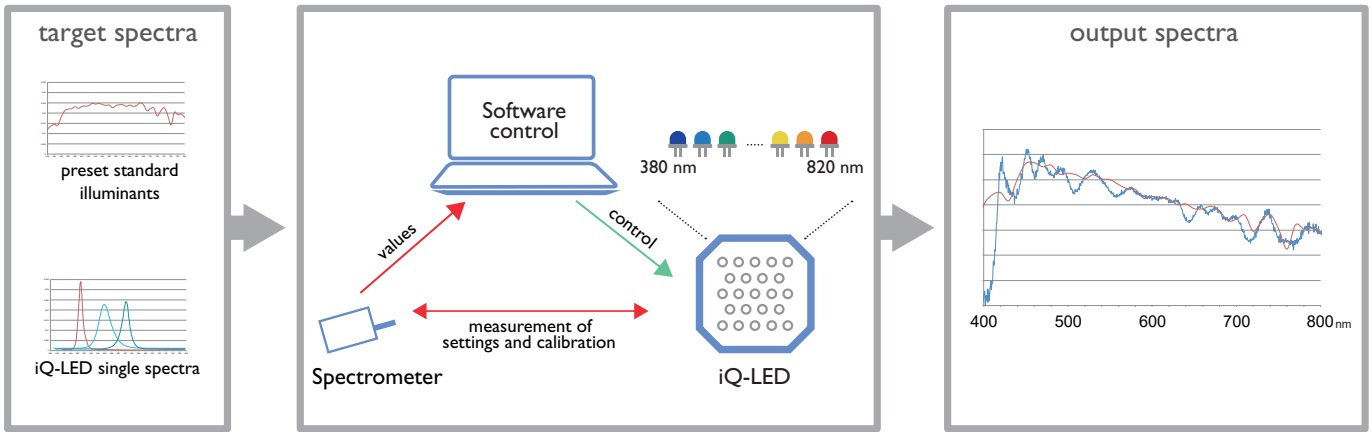
API AVAILABLE

Software INCLUDED

Example of the CAL1

Only one light source

Each of our CAL devices has iQ-LED control software and a spectrometer to ensure you have proper illumination over the lifetime of the device. Using iQ-LED, the CAL devices can recreate various spectra, including everything from standard light sources to different color patches.

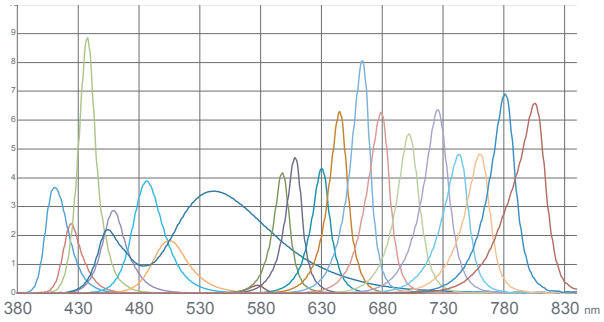


iQ-LED workflow

Advanced features of the CAL line

Each CAL product is uniquely designed using a non-reflecting special diffuser filter to ensure even light distribution on the measuring plane. So, as long as the image processing and transfer of the camera are fast enough, a full camera calibration can be completed in a matter of seconds. This capability is what makes the CAL products ideal for calibrating cameras on production lines.

The devices are controlled with the iQ-LED control software. We also offer an iQ-LED C++ API for easy integration into your designs. A built-in spectrometer is also included with each device.



20 individual spectral channels

iQ-LED software main screen

At a Glance	iQ-LED V2 in CAL product line
Principle	High-power SMD-LED based spectral broadband light module for spectral programmable camera calibration and characterization devices
Light sources	41 SMD high-power LEDs / separated in 20 color channels / spectral range: 380 – 820 nm / intensity controlled via 4000 steps per channel and 32 kHz PWM (switchable to 1000 steps with 128 kHz)
Spectral measurement	Closed loop functionality with calibrated mini spectrometer via control software Spectral Range: 350 – 870 nm / Resolution: 2048 pixel / FWHM: 2.4 nm
Control system	Software-based control system via USB (included with all CAL devices), C++ API available* Storage of up to 44 different illuminants, one sequence, and default light source / controllable via microswitch controller (without connected PC)
Included reference illuminants	D50, D55, D65, D75, A, B, C, E Planckian spectral curve by selected temperature (1900 - 18000 K) The iQ-LED technology is optimized for the best spectral match and allows CRI values up to 99, depending on illuminant and intensity
Output data	Real-time measurement of the spectral trend, CCT, CRI, illumination, and radiant power, with closed loop link with micro-spectrometer
Production line integration	Operation hour counter Self-diagnosis Self-calibration with calibrated spectrometer
Software requirements	PC with Windows 7 operating system (or higher) and USB port
Additional functions	• Auto-generation of standard illuminants or externally measured spectra • Save and load function of self-defined spectral arrangements or intensities • Storage of illuminants/sequences on device • Creation of test sequences • Real-time display of spectral measurement • Real-time calculation of CCT, CRI, curve fit and illumination level

*API sold separately

CAL1

Our original uniform light source for camera calibration

The CAL1 is a 0.3 m integrating sphere that uses iQ-LED technology to illuminate a 70 mm opening for camera characterization and calibration. A non-reflective diffuser filter with improved Lambertian characteristics on the sphere opening ensures illumination uniformity.

Main Features

- Includes all of the features from iQ-LED
- Uniformity of > 98%
- Camera calibration in less than one second
- Improved non-reflective diffuser filter

iQ-LED TECHNOLOGY

API AVAILABLE

How to use the CAL1

The CAL1 can be used as a stand-alone testing device for single-camera testing in a lab. It can also be integrated into a production line for more efficient calibration and characterization of multiple cameras.

A modified CAL1 for size D35 transparent test charts

At a Glance	CAL1
Principle	Integrating sphere with uniform illumination for camera calibration and characterization.
Output window	70 mm diameter, circular output window
Light source	1 x iQ-LED V2: 41 SMD high-power LEDs
Uniformity	> 98 % (70 mm diameter)
Maximum / Minimum illumination level	25 lx up to 8000 lx (for standard D illuminants) / depending on illuminant and required curve fit / CRI

CAL2

The highly adaptable camera calibration light source

This ultra-compact light source is based on iQ-LED technology and can adapt to many different areas of measurement. Its edge box design makes it particularly suited for calibrating cameras on a production line. A non-reflective diffuser filter with improved Lambertian characteristics on the box opening ensures illumination uniformity.

Main Features

- Includes all of the features from iQ-LED
- Uniformity of > 96%
- Camera calibration within seconds
- Improved non-reflective diffuser filters
- Optimized for production line integration
- Small compact design

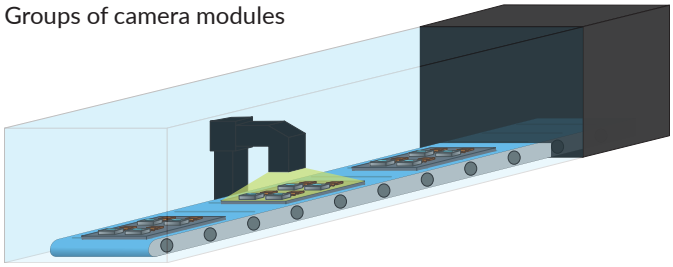
iQ-LED TECHNOLOGY

API AVAILABLE

Production line integration

The CAL2 and the accompanying LED software can substitute for multiple calibration and testing devices on a production line, making mass camera calibration and characterization far more efficient. We provide a separate spectrometer for the CAL2 when it is integrated into a production line.

Groups of camera modules



An example of the CAL2 calibrating multiple camera modules at the same time

At a Glance	CAL2
Principle	Highly adaptable edge box for camera calibration and characterization on a production line
Output window	60 mm x 60 mm output window
Light source	1 x iQ-LED V2: 41 SMD high-power LEDs
Uniformity	> 96% (60 x 60 mm output window)
Maximum / Minimum illumination level	25 lx up to 8000 lx (for standard D illuminants) / depending on illuminant and required curve fit / CRI

CAL3

Camera calibration light source for wide-angle lenses

The CAL3 is a 0.3 m integrating sphere that uses iQ-LED technology to illuminate a 38 mm concave curved opening. The curved opening, as opposed to flat (CAL1), is more suited for wide-angle cameras. A bowl-shaped non-reflective diffuser filter on the sphere opening ensures illumination uniformity.

Main Features

- Includes all of the features from iQ-LED
- Small compact design
- Uniformity of > 95%*
- For cameras with a 180-degree field of view
- Production line integration

iQ-LED TECHNOLOGY

API AVAILABLE

Production line integration

As a result of the short response time of iQ-LED, a full calibration can be performed in less than a second making it ideal for integration into a production line.

Production line integration for camera control testing within the CamTest Spectral module from Trioptics GmbH

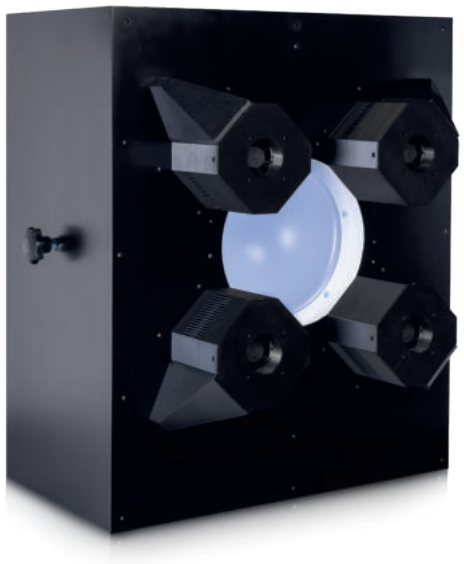
At a Glance	CAL3
Principle	Integrating sphere with uniform illumination for camera calibration and characterization of high field of view cameras.
Output window	38 mm diameter circular output window with bowl shaped diffuser
Light source	1 x iQ-LED V2: 41 SMD high-power LEDs
Uniformity	> 95%* for FOV < 160° at min. 10 mm depth inside diffuser for 160°-180° FOV at min. 20 mm depth inside diffuser
Maximum / Minimum illumination level	25 lx up to 7000 lx (for standard D illuminants) / depending on illuminant and required curve fit / CRI

*Measurement performed in the center of diffuser, standard illuminant D65

CAL3-XL

A calibration light source for ultra-wide-angle cameras

The CAL3-XL is an iQ-LED integrating sphere with a circular 196 mm opening and a bowl-shaped diffuser for illumination uniformity. It is ideal for camera calibration and testing of large cameras with wide-angles.



Main Features

- Includes all of the features from iQ-LED
- Test large cameras with a wide-angle
- Uniformity of > 90%*
- 500 mm diameter of integrating sphere
- For cameras with a 180-degree field of view

iQ-LED TECHNOLOGY

API AVAILABLE

CAL3-XL design

Due to its size, the CAL3-XL uses four iQ-LED elements instead of the only one used by the normal CAL3. Four elements are necessary to ensure illumination uniformity with a much wider opening.

At a Glance	CAL3-XL
Principle	Integrating sphere with uniform illumination for camera calibration and characterization of cameras with wide-angles of view.
Output window	196 mm diameter circular output window with bowl shaped diffuser
Light source	4x iQ-LED V2: 164 SMD high-power LEDs
Uniformity	> 90%* at a depth of approx. 65 - 85 mm inside diffuser
Maximum / Minimum illumination level	10 lx up to 4500 lx / (for standard D illuminants)

*Measurement performed in the center of diffuser with standard illuminant D65

CAL4-E

Test endoscopic light sources in the medical area

The CAL4* is a 0,3 m integrating sphere capable of testing endoscopic light sources. It provides uniform illumination over the 50 mm chart plane. The CAL4 includes four different types of adapters for various endoscopic light sources.

Main Features

- Adaptable to most projectors
- Uniformity of > 97%
- High temperature resistant cold light cable

Test for various image quality factors

Specially designed test charts (size D35) are available for more accurate measurements of resolution, color, OECF, dynamic range, and noise of endoscopic light sources.

A few available charts and adapters

At a Glance	CAL4-E
Principle	Integrating sphere for the measurement of light sources in the medical area. (light source not included)
Output window	50 mm x 50 mm output window, with slot for D35 sized test charts
Uniformity of luminance	> 97% in active area
Connection for light source	High temperature resistant cold-light cable, XENON approved

*CAL4 is not powered by iQ-LED

iQ-Multispectral

Using iQ-LED to enhance digitalization and preservation

The iQ-Multispectral is a multispectral illumination device based on iQ-LED technology to enhance digitalization and the preservation of documents, texts, or images.

Main Features

- Includes all of the features from iQ-LED
- Uses the narrowband light source method
- Spectral range between 380 and 1050 nm
- UV LED (at 365 nm) with bandpass filter
- Setup based around a reprographic stand

iQ-LED TECHNOLOGY

Software INCLUDED

The advantages of iQ-LED for the archiving industry

iQ-LED technology provides the iQ-Multispectral with many advantages when compared to traditional archiving illumination. Each iQ-LED light source has 19 channels in the visible range,11 channels in the IR range, and one UV LED, all of which can be controlled with the iQ-LED software to generate specific spectral distributions.

The iQ-Multispectral provides an exceptional level of control over spectral light distribution, and through this capability enables enhanced digitization and preservation.

At a Glance	iQ-Multispectral
Principle	Diffuse light panels that use iQ-LED technology (includes a micro-spectrometer) to illuminate a reproducible scene for multispectral imaging.
Light source	2 x iQ-LED V2 each with 41 SMD high-power LEDs separated into 20 color channels and a spectral range of 380 - 820 nm 3 x iQ-LED IR each with 11 additional channels and a spectral range of 380 - 1050 nm 2 x iQ-LED UV each with 2 SMD high-power LEDs (365 nm plus bandpass filter)
Bandpass filter for UV channel (optional)	350 nm hard coated bandpass interference filter 50 nm FWHM 365 nm hard coated bandpass interference filter 10 nm FWHM
Uniformity	Up to 90% for A2 space
Illumination stability	+/- 1% when stabilized (2% after switching D illuminants in the first 5 s)
Dimmable	iQ-LED: Software-based by presetting the intensity, or by selecting different pre-stored intensity illuminants directly on the device

lightSTUDIO

Real scene illumination and testing

Many image quality factors are best measured with test charts. However, a few, such as white balance, that are better analyzed using a real scene. The lightSTUDIO contains multiple objects of various colors and textures for an accurate visual analysis.

Main Features

- iQ-LED, fluorescent, and halogen light options
- Same interior for easy comparison between labs
- Moving targets to measure motion artifacts
- Evaluate high contrast scenes
- Includes control software for all components

iQ-LED TECHNOLOGY

API AVAILABLE

Software INCLUDED

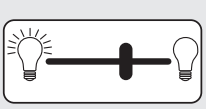
lightSTUDIO lighting options

Every lightSTUDIO is delivered with the same objects to make cross lab testing and comparison more efficient. However, the standard light head can be exchanged for an iQ-LED light head known as the lightSTUDIO-L. This option can spectrally tune the light to a very accurate standard, e.g., A, D50, D65 illumination.

The lightSTUDIO offers many different options for performing numerous measurements and comparisons within a small compact space. It is also possible to control all components of the lightSTUDIO with an API.

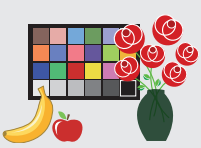
Standard features of the lightSTUDIO

USB interface



dimmable

several illuminants



interior inclusive

lightSTUDIO-M with moving targets

lightSTUDIO-H with HDR option

lightSTUDIO-T with twin option

lightSTUDIO setup options

The lightSTUDIO-M has built-in moving targets, including a moving frame for different test charts. These features are beneficial when measuring motion artifacts and blur in photos and videos.

The lightSTUDIO-H or HDR option has two LG4 lightboxes to create and test a high contrast scene. This setup can provide a contrast ratio of > 65,000:1.

The lightSTUDIO-T or twin option has a dividing wall in the middle of the scene for an easy side-by-side comparison of two independent illuminants.

Subjective assessment of image quality by visual comparison of the lightSTUDIO interior*

1. Resolution
2. Texture loss
3. Sharpness
4. Near infrared sensitivity
5. Details in highlights
6. Details in shadows
7. Moiré
8. Distortion
9. Human skin tone color reproduction
10. Color reproduction
11. Natural and known colors
12. Low contrast details

*This is a sample image, you can download the current lightSTUDIO interior list from our lightSTUDIO product page.

LG3

A flexible lightbox with high power and flicker generation

Get more out of high dynamic range test targets by illuminating them with over 150000 lux to see the differences in camera designs. The LG3 can also simulate flickering light sources, making it one of the most powerful and flexible lightboxes for your image quality test lab.

Main Features

- High intensity > 150000 lx
- Adjust flicker in frequency, duty cycle and phase.
- Dimmable in fine steps
- Expand range of testing
- Relative illumination stability > 98%

Software INCLUDED

Related products and features

The LG3 works in sync with our high dynamic range test targets, such as TE269C. Targets with such high dynamic range require powerful illumination to generate a realistic signal for the camera under test. Flickering light sources (e.g., PWM-driven LEDs) are an issue for cameras in many applications. The LG3 can generate these light sources in your test lab to evaluate how well a camera can handle these light situations.

LG3 with OECF test chart TE269C

A wide range of light frequencies that are capable of being recreated with the LG3

LED-powered light source

The main function of the LG3 is to illuminate transparent test charts. Unlike more standard light-boxes, the LG3 has extremely high intensity capable of illuminating a high dynamic range test target with over 150000 lx*. Generation of low-light situations is also possible due to its flexible dimming function.

The other main feature of the LG3 is the flicker mode. Choose between a range of 10 to 500 Hz and variable duty cycle when using flicker. This feature allows for greater simulation possibilities of light sources with variable frequencies. The flicker mode can be adjusted in frequency and duty cycle. The LG3 is controlled with a connected remote for easy adjustment.

Two illumination methods can be selected in three intensity ranges:

1. Pulse width modulation of 32 kHz
2. Flicker mode with 10 - 500 Hz

Each with

❇ Low mode:

0 - 100% 32 kHz / 10 to 6500 lx

❇ Normal mode:

0 - 100% 32 kHz / 100 to 65000 lx

❇ High mode:

100% max. 60 s lighting duration / 150000 lx

LG3 with support

At a Glance	LG3
Principle	Light source with a wide range of intensities and special flicker mode
Light source	432 LEDs
Color temperature	approx. 5000 K +/-5%
Maximum / Minimum illumination values	Low mode: < 10 to > 6500 lx Normal mode: < 100 to > 65000 lx High mode: > 150,000 lx
Uniformity of illumination	> 95% for active chart area**, 280 x 157.5 mm > 95% for full output window**, 290 x 220 mm > 95% (70 mm diameter circle)** approx. 90% at very low intensity (intensity <1%)
Dimmable	approx. 1000 steps in 2 modes, feedback of illumination level in [%], illuminance [lux] or luminance [cd/m²] 32 kHz PWM

*We recommend using a PRC Krochmann RadioLux for measuring the exact intensity.
**Measured on a chart plane.

LG4

A lightbox for transparent chart illumination

The LG4 is our standard compact lightbox designed for easy transportation and set up for uniform illumination of transparent test charts.

Main Features

- > 95% uniformity
- Intensity range of 100 to 65000 lx
- Dim function of 32 kHz PWM
- Software control

API AVAILABLE

Software INCLUDED

LG technology

432 LEDs illuminate the LG4 with a range of 100 to 65000 lx and a dim function of 32 kHz PWM. Control software comes with the device as well as the option for the LG C++ API. The LG4 is also incorporated into the HDR lightSTUDIO for real scene testing.

The Controller Areas Network (CAN) system allows up to 99 LG4s to be connected and controlled by the LG software.

LG4 with OECF test chart TE269

At a Glance	LG4
Principle	Uniform illuminator for transparent charts based on LED technology
Light source	432 LEDs
Color temperature	approx. 5000 K +/-5%
Maximum / Minimum illumination values	100 to 65000 lx
Uniformity of illumination	> 95% for active chart area*, 280 x 157.5 mm > 95% (70 mm diameter circle)*
Dimmable	32 kHz PWM

*Measured on a chart plane

Vega

A unique DC-driven LED light source for all your testing requirements

Vega is a light source developed for high precision measurements of camera systems, including those with extremely short exposure times. It uses LEDs that are driven by DC (direct current) technology making it one of our most sophisticated and unique light sources ever developed.

Main Features

- DC-driven LED technology
- Extremely high stability
- Temperature stability within half a degree
- Advanced flicker capabilities
- Sine, triangular, and square waveforms

DC TECHNOLOGY

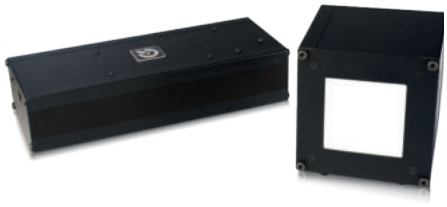
API AVAILABLE

Software INCLUDED

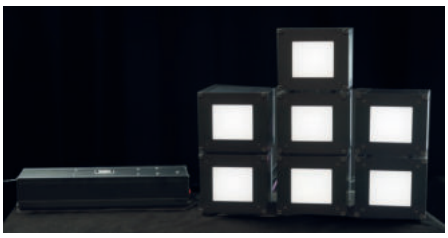
When to utilize Vega?

Vega is best utilized for high-intensity measurements such as contrast detection probability (CDP), modulated light mitigation probability (MMP), noise, and tone curve measurements. These measurements are very beneficial for automotive-grade cameras and other systems with high demands on accuracy.

Vega is available as a starter set that includes one light source, a flicker set with three light sources, and a CDP set with seven sources. Every set comes with a controller and control software.



Vega Starter Set



Vega CDP Set

A Vega test chart

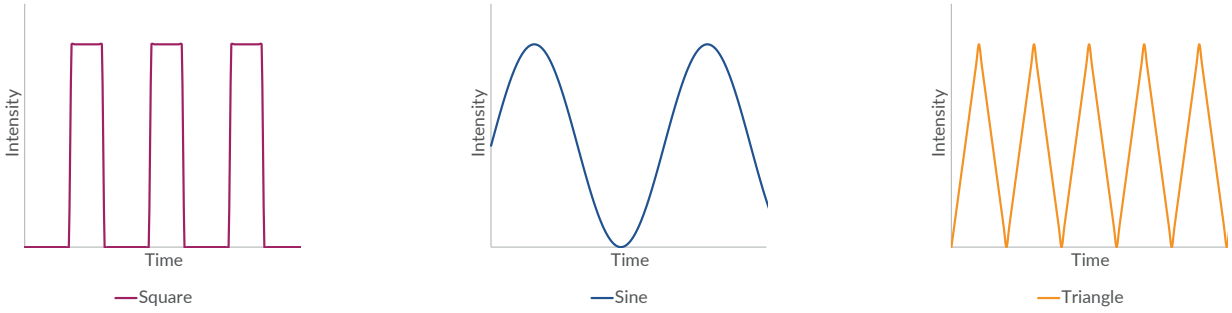
*API sold separately

Why Vega over other light sources?

Unlike PWM-controlled light sources, where intensity is regulated by the high-frequency of switching the LEDs on/off, Vega regulates the intensity by the amount of current. Vega offers 1,000,000 equal-width steps for intensity control. In addition, the DC driver does not affect temperature regulation and can achieve temperature stability within half a degree. The temperature system works both ways (i.e., heating and cooling), and it will remain consistent even when turning on/off different light sources or changing the intensities.

Generate flicker functionality

Vega also has advanced flicker capabilities and can be generated from a more comprehensive frequency range. We have further developed the low-frequency functionality to include sine, triangular, and square waveforms, which allows us to cover nearly all real-world scenarios.



At a Glance	Vega
Principle	Temperature stabilized, DC controlled, dimmable light source
Light sources	36 Temperature controlled LEDs based on iQ-DC technology
Uniformity (active area)	> 95% (for Intensity > 5%) > 90% (for Intensity < 5%)
Illumination stability	+/- 0,5%
Correlated Color Temperature (CCT)	To be specified in final data sheet
Color Rendering Index (CRI)	> 95
Minimum luminance	0,4 cd/m2 (To be specified in final data sheet)
Maximum luminance	38,000 cd/m² (To be specified in final data sheet)
Dim function	• Software based • 10^6 steps
Flicker frequency range	1 – 1000 Hz (Square) 10 – 500 Hz (Sine) 10 – 500 Hz (Triangle)
Flicker frequency step width	0.1 Hz (1 – 200 Hz) 0.2 Hz (200 – 500 Hz) 0.5 Hz (500 – 1000 Hz)
Software requirements	PC with Windows 10 operating system (or higher) USB port
Functions	• Intensity • Frequency • Duty cycle • Mode selection
API (C++)*	Optional

*API sold separately

LE6

Uniform chart illumination for transparent test charts

The LE6 is our original integrating sphere illuminated with a halogen light and coated with a special white diffuse coating on the inside. The window of the LE6 is 280 x 210 mm.

Main Features

- 96% homogeneity
- Halogen light illumination
- Dimmable down to 1% of max. illumination without changing the spectral distribution

LE6-50 and LE6-100

The LE6 is available in two different versions. The first version is the LE6-50 with a 50 W halogen bulb and has a max. intensity of 3000 lx. The second version is the LE6-100 with a 100 W halogen bulb and a max. intensity of 8000 lx. The LE6-50S and the LE6-100S are similar but cheaper versions that have the same max. intensities but do not include an illuminance meter or the dimming feature.

At a Glance	LE6-50	LE6-100
Principle	Dimmable halogen light source with constant color temparture	Dimmable halogen light source with constant color temparture
Light source	12 V / 50 W halogen bulb	12 V / 100 W halogen bulb
Color temperature	3200 K +/- 50 K	3200 K +/- 50 K
Maximum / Minimum illumination values	Approx. 30 - 3000 lx	Approx. 80 - 8000 lx
Uniformity of illumination	> 96%	> 96%

GEOCAL

Geometric camera calibration

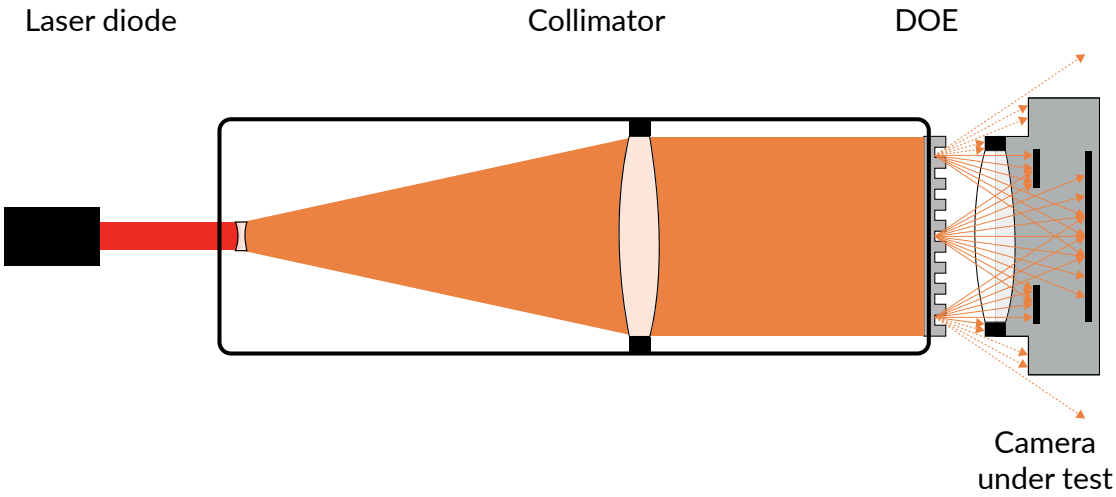
GEOCAL is a geometric camera calibration device that uses a beam expanded laser in combination with a diffractive optical element (DOE). This device introduces a new dimension in geometric camera calibration.

Main Features

- Create a regular grid of light spots from infinity
- Camera position is translation invariant*
- Easily manage the angle of camera rotation
- No relay lens required
- A very compact design
- Calibrate large field-of-view cameras
- Stereo camera alignments and adjustments

The importance of geometric calibration

Geometric calibration is essential for camera systems that rely on detecting objects in a moving scene, e.g., ADAS or security camera systems. A geometrically calibrated camera will be able to measure distances more accurately, detect objects, compensate for high levels of distortion, and align stereo camera pairs.

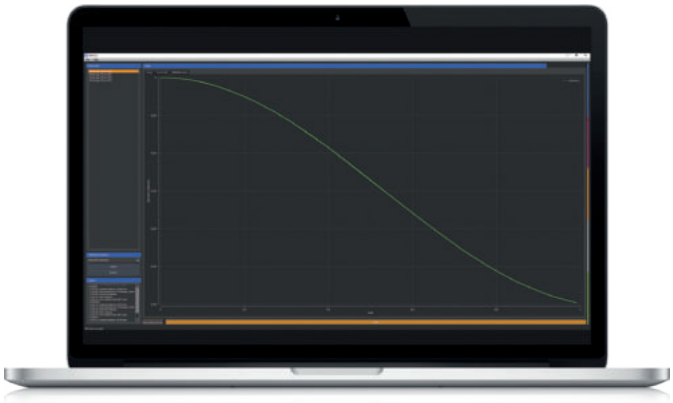


An example of how the GEOCAL functions

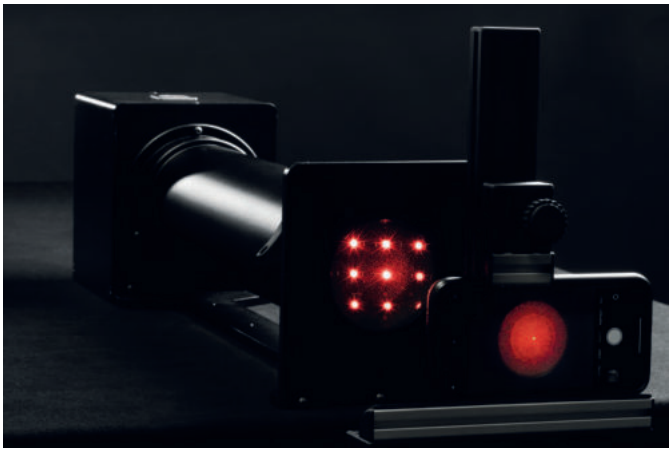
*在一定程度上

GEOCAL evaluation software

GEOCAL has a standalone software with a GUI interface for evaluating test results. An API is also available for those wishing to apply the solution to custom software.



GEOCAL software distortion curve



A mobile phone under test

Why GEOCAL over traditional geometric calibration methods?

Traditional geometric calibration methods rely on test charts with regular patterns, but these patterns need to be scaled depending on the field of view and the intended object distance. As a result, relay lenses must be utilized for accurate calibration, but these lenses cannot calibrate from infinity. GEOCAL, however, is a compact device that avoids using relay lenses and test charts altogether while calibrating from infinity and thereby improving the accuracy of the calibration.

At a Glance	GEOCAL
Principle	DOE-based geometric calibration of digital cameras
Light source	Frequency-stabilized diode laser
Wavelength	632.8 nm
Diffractive optical element (DOE)	Generates a very evenly distributed point grid of 71x71 points (continued by higher diffraction orders), virtually originating from infinity
Output window	Usable aperture: Ø 75 mm (camera lens needs to have an equal or smaller diameter)
Usable FoV	Approx. 30 – 120° (more extreme values still need to be tested)
Software system requirements	PC with Windows 7 operating system (or higher) USB port
Functions	• Load multiple images • View selected image • Perform calibration • Overlay detected point grid • Distortion visualization (graph) • Export results (CSV and XML)

camSPECS

Advanced spectral sensitivity measurements

The camSPECS combines all interference filters into one “test chart” to improve the effectiveness of camera spectral sensitivity measurements. This device makes spectral sensitivity measurements much faster and more convenient.

Main Features

- Spectral sensitivity measurements
- 39 high quality interference filters
- Advanced analysis software included
- Color transform generation
- Visual evaluation of ICC profiles with real images

Software INCLUDED

camSPECS XL and TE292

The camSPECS XL uses the same interference filters, but now each has a diameter of 22 mm, making it more suitable for wide-angle cameras from industries such as automotive or security.

The TE292* has been adapted from the front plate of the camSPECS device. This chart has been developed to be used primarily with the LE7 for camera calibration with iQ-LED illumination.

LE7 with the TE292 XL chart

camSPECS XL

*See page 60 for more details on TE292.

camSPECS software

Both of the camSPECS options come with evaluation software. This software calculates the spectral sensitivity with the images and the calibration data of the filters as a direct measurement. The software also includes a module that can be used to evaluate the color correction matrix (CCM) for the camera.

Color transform generation is possible once the spectral sensitivities are determined. This process is done by converting camera values to color metric values.

Software Features

- Measuring spectral sensitivity
- Creation of ICC profiles
- Support for 2D and 3D-MLUT color transforms
- CIECAM16 implementation
- Calculation of spectral sensitivity with images of iQ-LED devices

Color transform evaluation

At a Glance	camSPECS	camSPECS XL
Principle	Illumination box with narrow-band interference filters	Illumination box with narrow-band interference filters
Light source	Halogen (24 V / 250 W) Osram 64657 HLX	Halogen (24 V / 250 W) Osram 64657 HLX
Durability of light source	300 h	300 h
Wavelength range	380 - 760 nm (10 nm steps)	380 - 760 nm (10 nm steps)
Bandwidth	10 nm	10 nm
Diameter interference filters	10 mm	22 mm
Diameter ND filters	6 mm	12 mm
Software system requirements	PC with Windows 7 operating system (or higher)	
Additional functions	• Spectral measurement with iQ-LED technology • Test procedure for evaluating CCMs with different training data • Digital camera RAW file processing / dark frame subtraction / batch processing • Validation by comparing camera and predicted RGB values • Calibration with an included calibration spectro radiometer • Side by side comparison of images with separate ICC profiles • Export all results to XML or plain text files	

LED-Panel

Accurate camera timing measurements

Measure and analyze all of the relevant timing features and evaluate the autofocus performance of your digital camera.

Main Features

- Measure all timing parameters
- Measurement accuracy greater than one ms
- Applicable to ISO 15781 and IEC 62676-5
- Command line interface and control software
- Customize peak wavelength

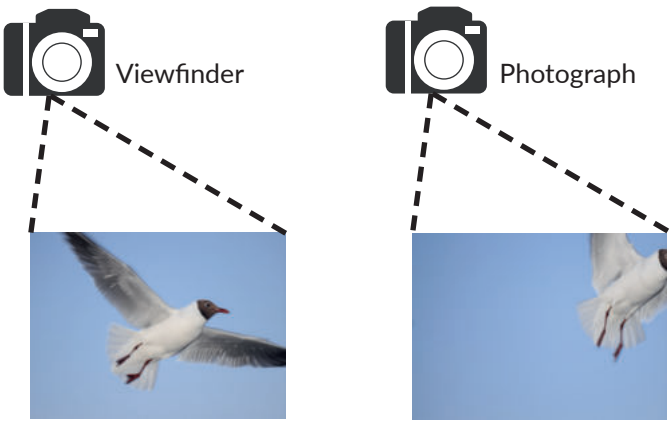
Software INCLUDED

API AVAILABLE

Standard COMPLIANT

LED-Panel IR and custom wavelengths

The LED-Panel IR expands the testing range to the infra-red region. It is available with a peak wavelength of either 850 nm or 940 nm. We also offer the LED-Panel with custom wavelengths for those with special requirements.



Shooting time lag, subject missed

Timing measurement solution

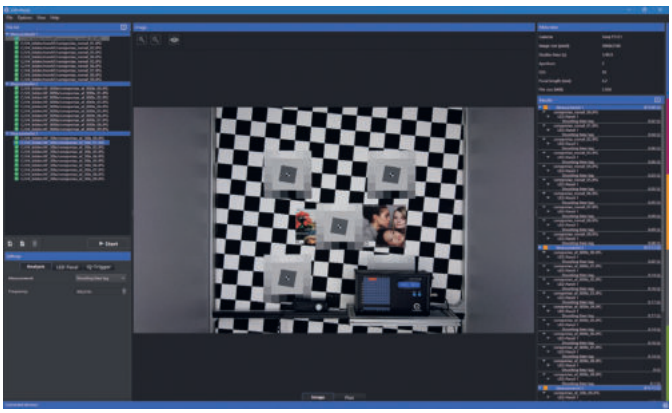
Timing measurement device

The primary function of the LED-Panel is to determine the most important timing values for a digital camera system. You can separately measure shooting time lag and shutter release time lag and then subtract them from one another to determine the precise autofocus performance of the camera.

The LED-Panel uses control software, command-line software, and a USB interface to control the device. The device consists of a 10 x 10 LED light board that can be adjusted for different frequencies to suit testing needs.

Measurable Parameters

- Shooting time lag
- Shutter lag with and without autofocus
- Autofocus time
- Negative shooting time lag
- Burst frame rate
- Display refresh rate
- Exposure time
- Rolling shutter speed



LED-Panel software

At a Glance	LED-Panel / LED-Panel IR
Principle	Array of LEDs to perform timing measurements on digital cameras.
Number of LEDs	110 (array of 10 x 10 LEDs, 1 row with 10 LEDs for multiplying counts)
Accuracy	< 0.06% (1 ms - 10 s)
Manual control	Operating buttons: switching between single and continuous trigger, Rotatory switch: adjusting the frame rate frequency, time, LCD brightness Display: shows current setting
Operating mode	External trigger, internal single trigger, continuous trigger
Adjustable times	Via USB: 200 µs to 10 s (depending on measurement mode) Manual control: 20 µs to 10 s (depending on measurement mode)
Maximum reading measurement time	1000 x of set time
LED running directions	Left to right, right to left, top to bottom, bottom to top
Frame Rate measurement frequency	Adjustable from 1.0 Hz to 100 Hz
Software system reqirements	PC with Windows 7 operating system (or higher) and USB port
Additional functions	Software control LED-Panel V4 Analysis of images taken from LED-Panel V4

iQ-AF Box

Measure the shutter display of your camera

The iQ-AF (autofocus) Box illuminates test charts at different light levels. The iQ-AF Box is best utilized when combined with the TE261 slanted edge test chart, the LED-Panel, and the iQ-Trigger/-T. Together these devices can accurately measure the shutter speed and other timing values of a camera.

Main Features

- Measure camera shutter speed
- Measure low / bright light shutter delay
- Measure shutter / shooting time lag
- Measure image stabilization and autofocus

Solution OFFER

Standard COMPLIANT

Related products and specifications

The iQ-AF Box can quickly be switched between two different light levels to more accurately measure low and bright light shutter delay. It is often used with STEVE-6D to measure the image stabilization of a camera.

Camera stabilization measurement with the iQ-AF Box

At a Glance	iQ-AF Box
Principle	Lightbox with different light levels
Light sources	4 x fluorescent tubes 18 W 4 x fluoreslcent tubes 36 W D50 (can be switched on/off separately)
Illumination value	20 - 3200 lx
Size of used test chart	A1066 (124.5 x 83.5 cm)
Provided test charts	TE261 (others on request)
Setting of light level	Two rotary control units

iQ-FoV Box

Measure the resolution for a wide field of view camera

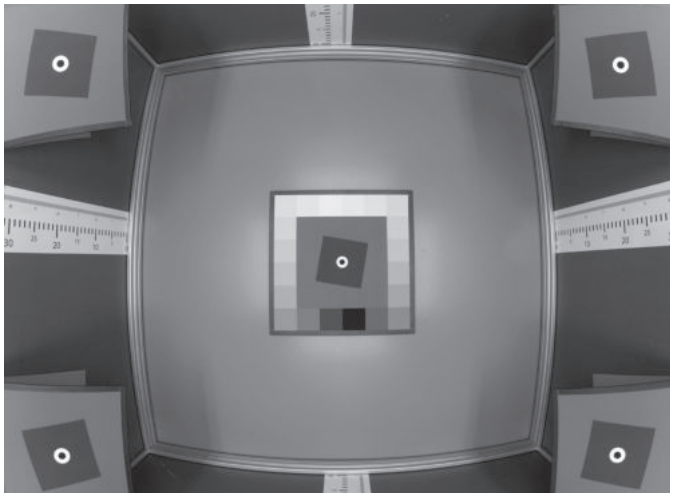
The iQ-FoV Box is a chart illumination positioning system that can be optimized for resolution measurements up to a viewing angle of 180°. Adjust and position the test charts to minimize distortion and adapt to the angle of your camera lens.

Main Features

- High FoV resolution measurements
- Adjustable test charts
- Easy camera alignement
- Various opening angles
- Dimmable illumination system
- Create low-light situations

Product control

The test charts are magnetic, allowing for easy adjustment and positioning depending on the viewing angle of the camera lens. The camera positioning for height and depth is remotely controlled by changing the pitch, yaw, and roll.



iQ-FoV Box interior with measurement scales

At a Glance	iQ-FoV Box
Principle	Test box for high field of view cameras
Light source	8 x 18 W 950 fluorescent tubes/ dimmable D50
Extension arm travel range (depth/ height)	75 cm / 15 cm
Rotation range	Pitch: +/- 15° Yaw: +/-170° (motorized adjustable via remote control)
Rotation range roll	+/- 10° (manually adjustable)

iQ-Climate Chamber

Temperature-controlled camera performance testing

The iQ-Climate Chamber creates different temperature scenarios for camera performance testing. It is currently the only device on the market for testing a camera system in a temperature-controlled environment.

Main Features

- Test range of -30° to 120° C*
- Temperature stability of +/- 0.3° K
- Built-in universal camera mount
- Create test sequences directly on the device

ADAS testing

ADAS cameras can often experience performance issues with fluctuating temperatures. As a result, these systems must be rigorously tested in a lab before they are safe for consumer use. Almost all of the current test methods rely on testing in an actual outdoor setting with, naturally, unpredictable weather conditions. The iQ-Climate Chamber, however, provides a temperature-controlled environment from the confines of a test lab.

At a Glance	iQ-Climate Chamber
Principle	Camera tests under various temperature conditions
Temperature range	-30° to 180° C (-30° to 120° when using the UCM camera mount)
Temperature stability	+/- 0.3° K
Size of camera window	Ø 200 mm
Power supply	230 V / 50 Hz 2. 2 kW for Climate Chamber + 2.3 kW for Heater Variants for 110 V / 60 Hz on request

* The Universal Camera Mount (UCM) in the device has been tested within the temperature range of -30° to 120° C. We do not recommend testing outside of this range.

STEVE-6D

Automatically test the image stabilization of your camera

The Stabilization Evaluation Equipment (STEVE) uses six degrees of freedom to test the optical image stabilizers of your camera. This device can analyze the camera's response to a natural human hand tremor.

Main Features

- Six degrees of freedom
- Control software
- Two different sizes
- CIPA certified

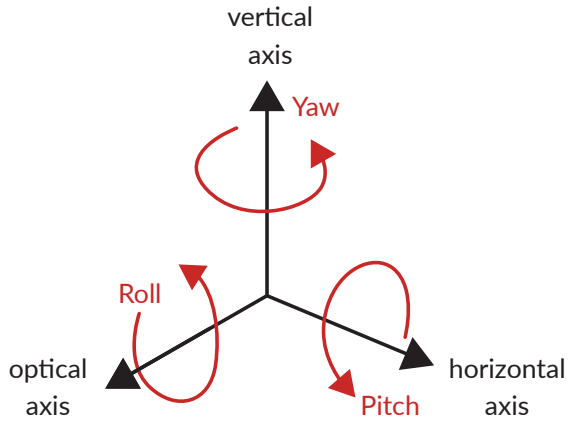
Software INCLUDED

CIPA Camera & Imaging Products Association

STEVE-6DS STEVE-6DL

Related products and sizes

STEVE-6D comes in two different sizes, the STEVE-6DL and the STEVE-6DS. Also included is an iQ-Trigger/-T for timing accuracy. STEVE is best used in combination with the iQ-AF Box and the TE261, the slanted edge test chart.



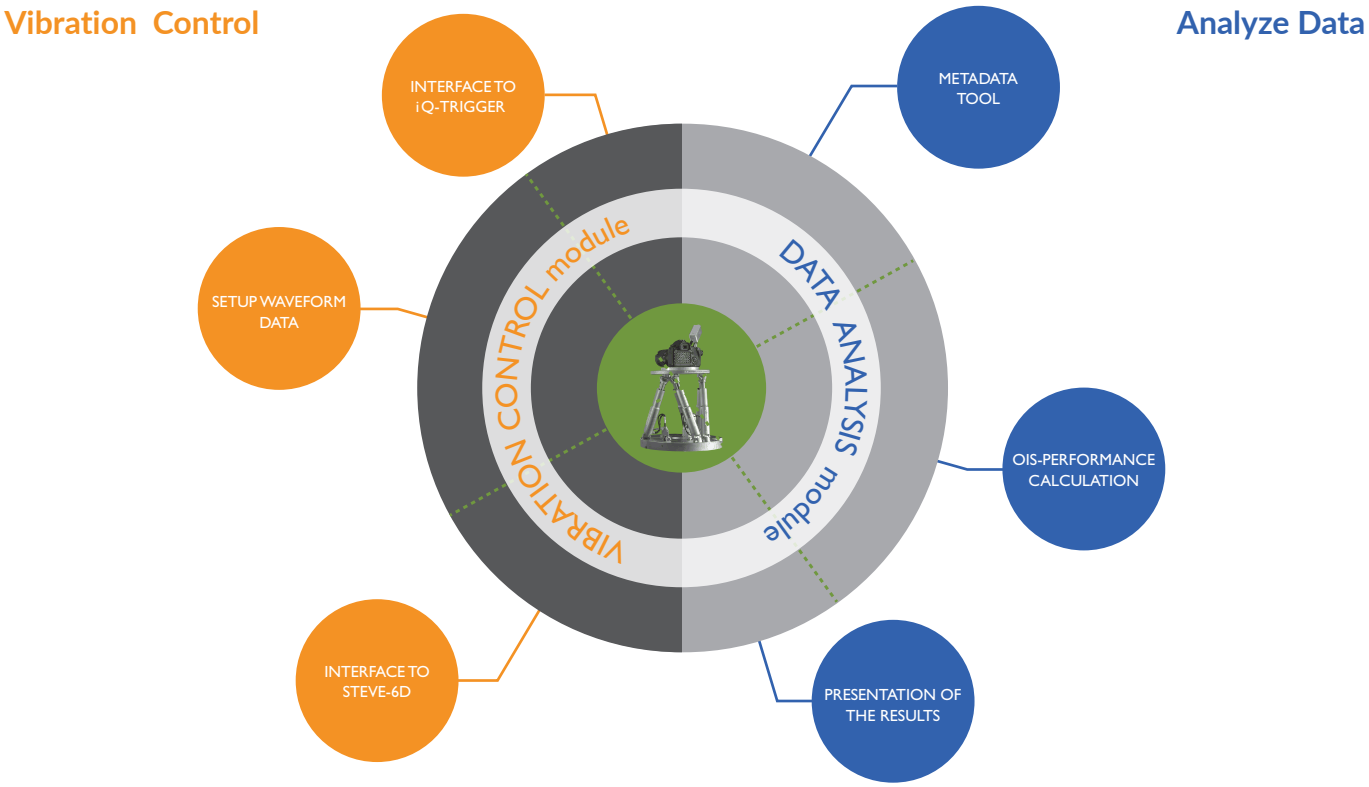
Directions of movement

OIS test with the STEVE 6DL and the iQ-AF Box

STEVE-6D modules

The STEVE-6D software uses two modules: the vibration control module and the analyze data module. The vibration control is used to control the movement of the device. You can choose your pivot point and one of the three CIPA handshakes to set up your waveform data. It is also possible to use sinusoidal motion or to upload custom waveforms with Cartesian coordinates.

The analyze data module calculates the image stabilization performance using a metadata tool. The stabilization results can be displayed in f-stops. The edge spread function (ESF) and spatial frequency response (SFR) will also be displayed.



At a Glance	STEVE-6DS	STEVE-6DL
Max. camera weight	2.5 kg	6.0 kg
Pivot point	Customizable	Customizable
Translation range (X / Y / Z)	± 17, ± 16, ± 6.5 mm	± 50, ± 50, ± 25 mm
Rotation range (X / Y / Z)	± 10, ± 10, ± 21°	± 15, ± 15, ± 30°
Max. linear velocity (X / Y / Z)	25 mm/s	50 mm/s
Max. angular velocity (X / Y / Z)	325 mrad/s	600 mrad/s
Single-actuator design resolution	80 nm	500 nm
Motion type	6-axis sine generator or custom waveform	6-axis sine generator or custom waveform
Mean position error	< 3%	< 3%
Standard accessories	Motion controller C-887, iQ-Trigger, iQ-Mobilemount	Motion controller C-887, iQ-Trigger, iQ-Mobilemount
Optional accessories	iQ-Trigger/-T, iQ-AF Box, TE261, Honey-comb Breadboard, iQ-Anchor for STEVE	iQ-Trigger/-T, iQ-AF Box, TE261, Honey-comb Breadboard, iQ-Anchor for STEVE

iQ-Trigger

A mechanical finger for timing measurements

Eliminate human error and improve the accuracy of your camera testing for various timing measurements. The iQ-Trigger can press the release button of your camera within 20 ms, making it a perfect addition to other products that measure timing accuracy.

Main Features

- USB interface
- Control software and C++ API
- Smooth integration with other products

API AVAILABLE

Software INCLUDED

iQ-Trigger

iQ-Trigger-T

iQ-Trigger-T

The iQ-Trigger-T (touch) option is our mechanical finger for touch screen devices. This device can press the release button of your camera within 0.5 ms.

At a Glance	iQ-Trigger
Principle	Remote control for triggering hard and soft buttons of digital cameras
Latency	20 ms (depending on position)
Specialties	• Easy adjustment • Exchangable finger tips • Comes with Manfrotto L bracket and mounting plate type 405
API(C++)	Included in iQ-Trigger product bundles

At a Glance	iQ-Trigger-T
Principle	Remote control for capacitive touch screens
Latency	< 0.5 ms
Specialties	• Vibration-free triggering of DUT • Sticks on all clean and smooth surfaces for easy mounting • Designed to fit into iQ-Mobile-mount
API(C++)	Included in iQ-Trigger product bundles

iQ-Defocus

Automatically restart the autofocus system of a camera

Integrate the iQ-Defocus into your workflow to improve the timing measurement analysis of the camera under test by continually restarting the camera's autofocus system.

Main Features

- Automatic focus on infinity or factory setting
- Easy integration into test setup
- Remote trigger
- Software control

API AVAILABLE

Related products and specifications

The iQ-Defocus is primarily used in conjunction with the LED-Panel or the DTS. Easily attach the device to the iQ-Mobilemount and control via integrated software in the LED-Panel or DTS.

iQ-Defocus with iQ-Mobilemount

At a Glance	iQ-Defocus
Principle	Automated solution for remote trigger of the autofocus process through a provided uniform translucent target
Latency	20 ms
Max. stroke distance	Approx. 11 mm
Specialties	• optimal workflow with the iQ-Mobilemount • adjustable depth
API (C++)	Included in iQ-Defocus product bundles

EX2

A convenient way to measure different spectra

The EX2 is an external measuring device for measuring and generating custom spectra through our various iQ-LED devices.

Main Features

- Small compact design
- Spectral range of 305 – 1100 nm
- Spectral resolution of 2.5 nm
- NIST traceable calibrated

API AVAILABLE

EX2-V2

The latest version of the EX2 combines both the visible and IR spectrum into one device. It has a more comprehensive spectral range of 200 - 1100 nm (irradiance calibration: 305 - 1100 nm), ensuring that it covers both spectrums.

The EX2 is delivered with an attached USB cable

At a Glance	EX2-V2
Principle	Direct measuring via optical fiber opening (~25° FOV), or cosine corrector add-on (~180° FOV)
Spectral range	200 - 1100 nm (irradiance calibration: 305 - 1100 nm)
Resolution	2048 pixel/FWHM 2.5 nm
Integration Time	1.05 ms – 10 min
Control System	Software-based control (iQ-LED software, iQ-LED API, or camSPECS express control software)

iQ-Analyzer-X

The next generation of image quality evaluation

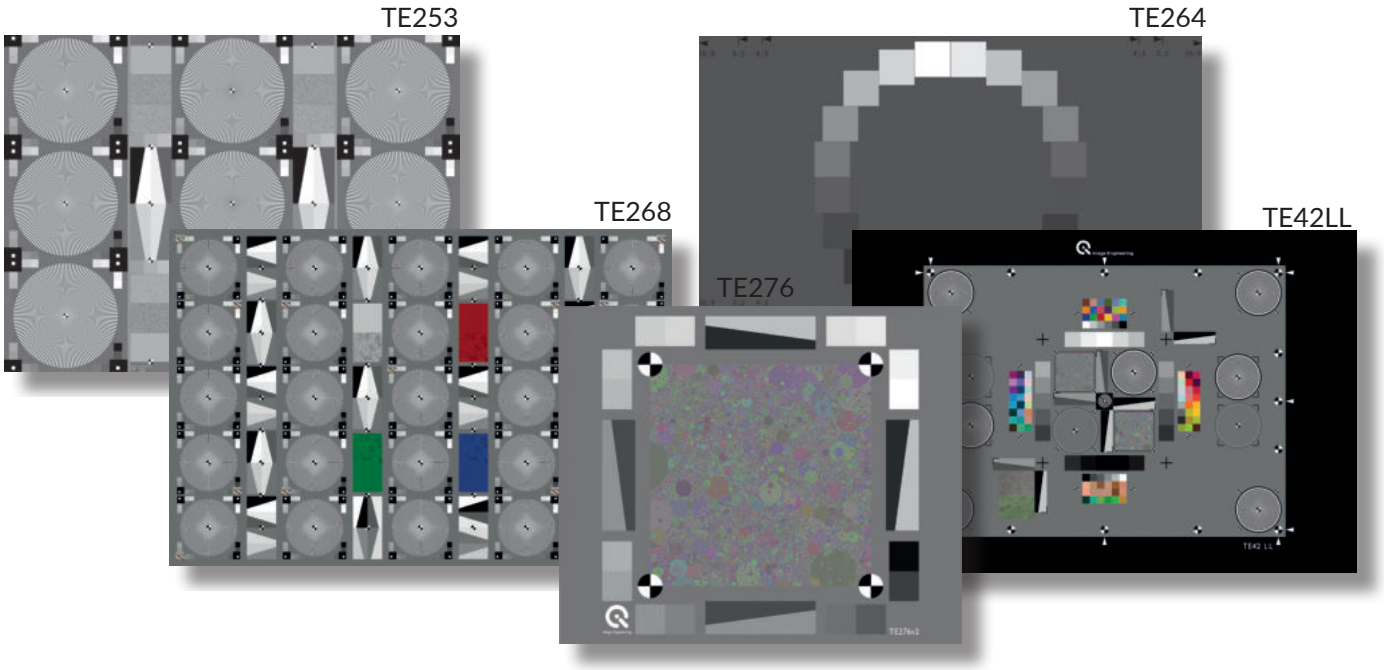
The iQ-Analyzer-X is an analysis software for analyzing the image quality performance of camera systems. In this phase of the iQ-Analyzer series, we have built the software using only C++ and no longer rely on Mathworks Matlab. As a result, we have created an exceptionally modern and advanced software for image quality evaluation. We are offering the iQ-Analyzer-X as a free download from our website.

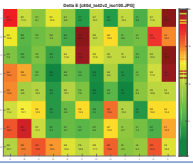
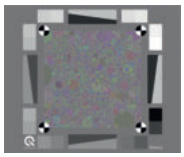
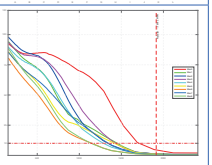
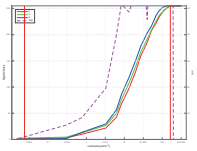
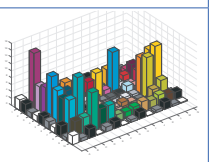
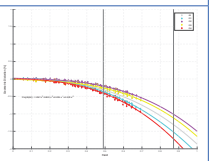
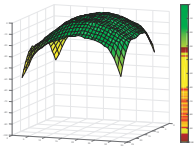
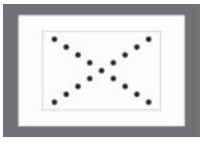
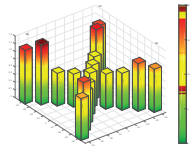
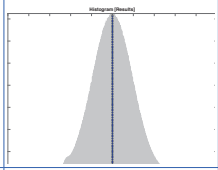
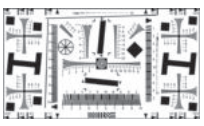
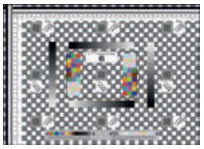
Main Features

- Built completely on C++
- Flexible user interface
- High-speed analysis
- Database storage for all results
- Automatic chart detection
- Custom test templates
- Analyze individual reference data

Test chart support

The iQ-Analyzer-X supports the analysis of numerous test charts for evaluating the various KPIs of camera systems. The software itself can automatically detect the chart under test and provide you with analysis results in seconds. Custom test charts can also be supported to cover all of your testing requirements.



KPIs	Example Charts	Main Features	Results
42 multipurpose		• Analysis of the TE42 multipurpose test chart • A quick overview of the camera systems image quality • Most important image quality factors with one image	
Resolution		• SFR on slanted edges • MTF on sinusoidal or bitonal Siemens stars (ISO 12233) • Texture loss on low contrast Siemens stars (ISO 19567-1) • Texture loss on dead leaves (ISO 19567-2)	
OECF		• Camera OECF (ISO 14524) • ISO speed (ISO 12232) • Noise and dynamic range (ISO 15739) • White balance	
Color		• Color reproduction – Delta E* • Difference luminance, chroma and hue – Delta (L*, C*, H*) • Visual noise • Selectable chromatic adaptation and color difference formulas	
Distortion		• Lens geometric distortion (ISO 17850 & IEEE P1858 CPIQ) • TV-distortion • Lateral chromatic aberration • Longitudinal chromatic aberration	
Shading		• Lens vignetting • Luminance shading in f-stops or as a percentage • Color shading • Noise (depending on image field)	
Flare		• Flare measurement over the image field (ISO 18844) • Dark frame subtraction (optional)	
Histogram		• Intensity histogram • Defective pixels outside tonal range – dead, hot, single, cluster	
Video		• Live video and video file acquisition • Waveform monitor, vectorscope, histogram display • Color difference analysis • Live color comparison (when one camera is a reference)	
Measurement		• On-the-fly analysis (2D-FTT, visual noise, SFR) • Selections of differently shaped regions of interest • Contour plot • Histogram display	
UTT		• Scanners and archiving (ISO 19264) • Pass/Fail assessment • Size A4 – A0 and “mini” test target • Metamorfoze compliant	

Programming Interfaces

Application Programming Interfaces (API) for flexible integration

The various iQ-APIs have been developed as flexible building blocks to integrate our image quality testing products into already existing software systems or custom designs. All of our API interfaces are written in the C++ programming language. The C++ interface only depends on the standard ISO C++ and its Standard Library (STL).

We also offer C interfaces for our iQ-LED and our GEOCAL API. The C interface can be used in various programming languages and SDKs, such as Python, Matlab, MS Visual Basic, or Labview.

,

API	C++	C	Related Products	Key Features
iQ-Drive API	X		iQ-Alignrig // iQ-Bench-M // iQ-Automator iQ-Chartmount-VM // iQ-Rotation lightSTUDIO-M (-LM, -LMH, -SM, -SMH)*	Full control over motor-driven products
iQ-LED API	X	X	CAL1 // CAL2 // CAL3 // CAL3-XL iQ-LED // LE7// EX2 // iQ-Chart Box (LED light only) iQ-Flatlight (LED light only) lightSTUDIO-L (-LH, -LM, -LMH)*	Full control over iQ-LED technology as well as over our built-in and standalone spectrometers
iQ-Standardlight API	X		lightSTUDIO-S (-SH, -SM, -SMH, -ST)* iQ-Flatlight (fluorescent tubes only) iQ-Chart Box (fluorescent tubes only) lightHEAD-S (stand-alone)	Controlling the fluorescent and halogen light sources in various devices
iQ-Trigger API	X		iQ-Trigger (-T)	Controlling iQ-Trigger when connected via the USB-Box
LED-Panel API	X		LED-Panel // iQ-Trigger (-T)	Full control over the LED-Panel and connected iQ-Trigger
LG API	X		lightSTUDIO-H (LH, LMH, SH, SMH)* LG3 // LG4	Controlling the HDR extension of the lightSTUDIO-H, LG3 and LG4
iQ-Timecode API	X		iQ-Timecode	Controlling the iQ-Timecode available with a lightSTUDIO
GEOCAL API		X	GEOCAL	Evaluating images captured with the GEOCAL device

Command Line Interface (CLI)

Some of our products also offer a Command Line Interface. The CLI will enable you to automate certain tasks without having any programming knowledge. Control the software by simply issuing text commands in the Windows command prompt or scripting a batch file.

CLI	Related Products	Key Features
iQ-Analyzer CLI	iQ-Analyzer	Full-featured batch processing for image analysis
LED-Panel CLI	LED-Panel iQ-Trigger (-T) iQ-Defocus	Full control over the LED-Panel and connected iQ-Trigger, iQ-Defocus
lightSTUDIO CLI	lightSTUDIO-S (-SH, -SM, -SMH, -ST)*	Controlling the fluorescent and halogen light sources in the lightSTUDIO-S devices

*For explanations of the various types, please have a look at page 26

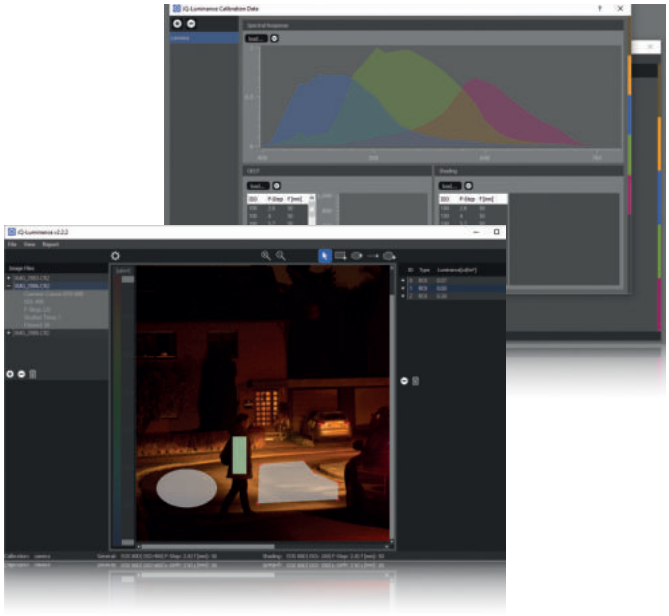
iQ-Luminance

Turn your camera into a luminance meter

With proper calibration*, you can use the iQ-Luminance software to turn your camera into a luminance meter that will provide different advantages compared to conventional luminance meters.

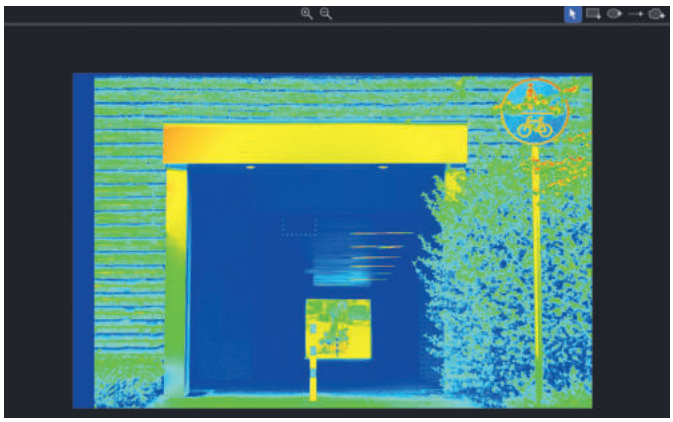
Main Features

- Calculate luminance values from image data
- Map raw RGB data to the luminance
- Calibrate at multiple f-stop levels
- Calibrate for various ISO-settings

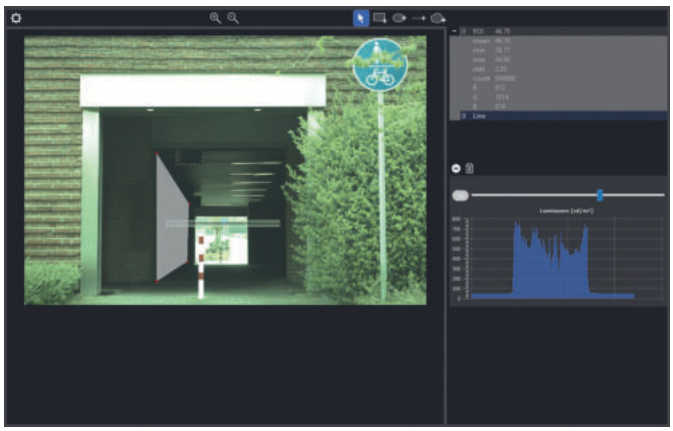


Evaluate the image

Rectangular, circular or polygonal regions of interest (ROI) can be drawn on the image to more efficiently evaluate the selected area. The corresponding luminance is then visualized as a grayscale or false-color image.



Luminance false-color display



Luminance values display

*Please note that you must send your camera to our test lab for a specific luminance calibration before you can begin measuring luminance on your own.

In-situ Data

An in-situ spectral radiance database

Our in-situ database is a collection of several thousand spectral radiance measurements of various objects and scenes that people typically photograph. The database began as a way to provide training data for the color characterization of digital cameras in combination with their spectral sensitivities. Now you can optimize your color correction matrix based on real-life data instead of using a ColorChecker.

Main Features

- Approx. 2500 measurements
- Objects under various illuminations
- Measurement data range: 380 to 780 nm

Why in-situ?

Until now, the only commonly known source for in-situ measured spectral radiances was ISO 17321-1, which provides spectral radiances for 14 common objects. Our database has approx. 2500 spectral radiance measurements using numerous objects and lighting situations. Each object is available in two variants, incident light, and white tile corrected.

Selection of biological objects

Element details

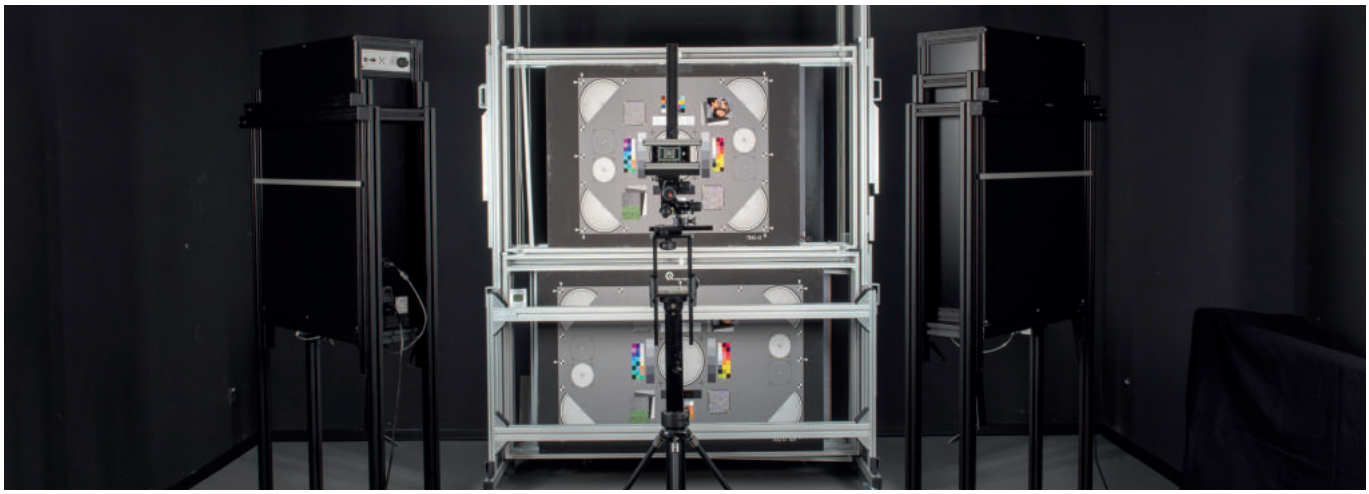
Test Laboratory

One of the world's largest independent image quality test labs

Over the last 20 years, our onsite testing facility has grown into the world's largest independent and objective image quality test lab. Every year we receive hundreds of different camera systems from various imaging-related industries such as mobile phone and automotive manufacturers.

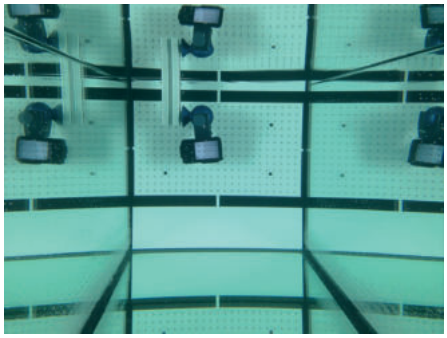
Each camera system we receive is put under a comprehensive image quality test by one of our specially trained engineers. The tests that we use on a daily basis (we test for magazines every day) are always adapted to the most up-to-date international standards for all of the various image quality factors. We also work with companies to develop a custom test procedure if there are certain advancements and requirements within their industry before a modified standard is released.

Once the testing is complete, our engineers can analyze the results and provide an objective report on where the camera system under test can improve its image quality.



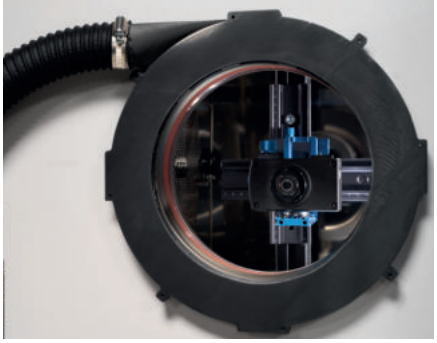
Unique camera tests

While most of our everyday testing is for magazines or industry-specific tests, our lab also performs special tests upon request. Underwater camera testing, drone, temperature fluctuations, and broadcast cameras are just a few examples of the unique cameras and tests we can do in our test lab.



Underwater camera testing

Testing for camera flare



Test with changing climate conditions

Image quality testing of automotive cameras and sensors

Automotive imaging is one of the newer industries that the test lab is actively testing. We are working closely with the IEEE-P2020 to establish certain industry-wide parameters and key performance indicators (KPI) for autonomous (ADAS) vehicles.

One KPI that we are currently testing in the lab is contrast detection probability (CDP). CDP is an analysis of how well a camera or sensor is able to detect objects and different contrasts in its field of view. We test for CDP and other image quality factors with the DTS and LG3, a few of the latest automotive camera testing devices.

Image quality testing of security cameras

The lab is also actively testing for security and surveillance cameras outlined in the IEC 62676-5, the first international standard for image quality testing of security camera systems. Factors outlined in the standard include resolution, dynamic range, signal to noise ratio (SNR), distortion, and flare.

Our lab closely follows the IEC 62676-5 standard and uses uniquely designed test charts to test the image quality factors from the standard. We use iQ-LED illumination devices such as the iQ-Flatlight to create a diverse array of lighting situations, including those with low-light and high intensity, to ensure the security system is effective in all different types of environments.

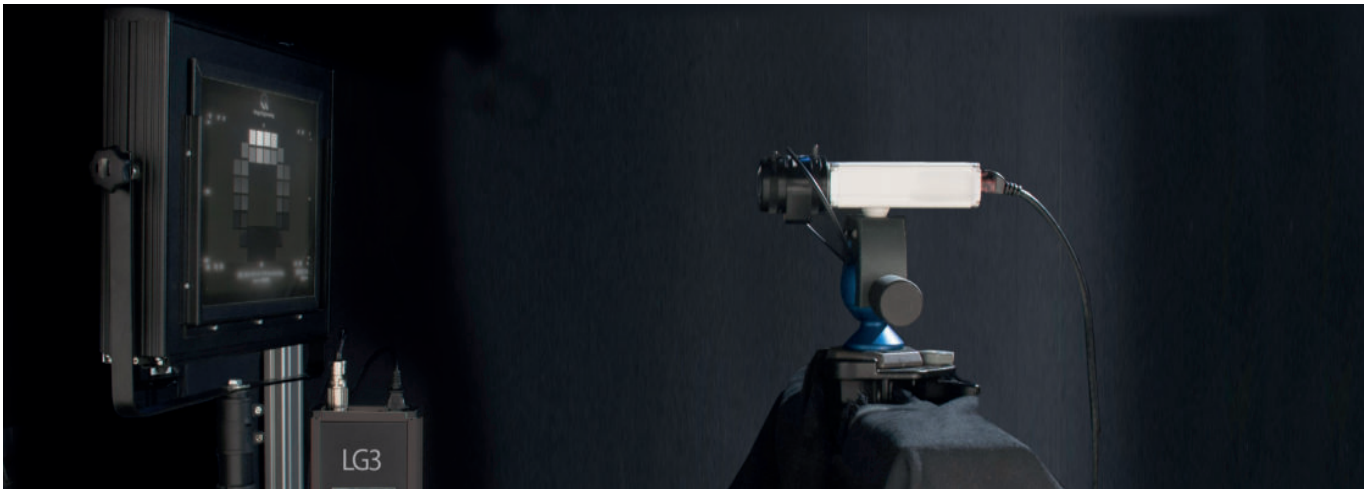
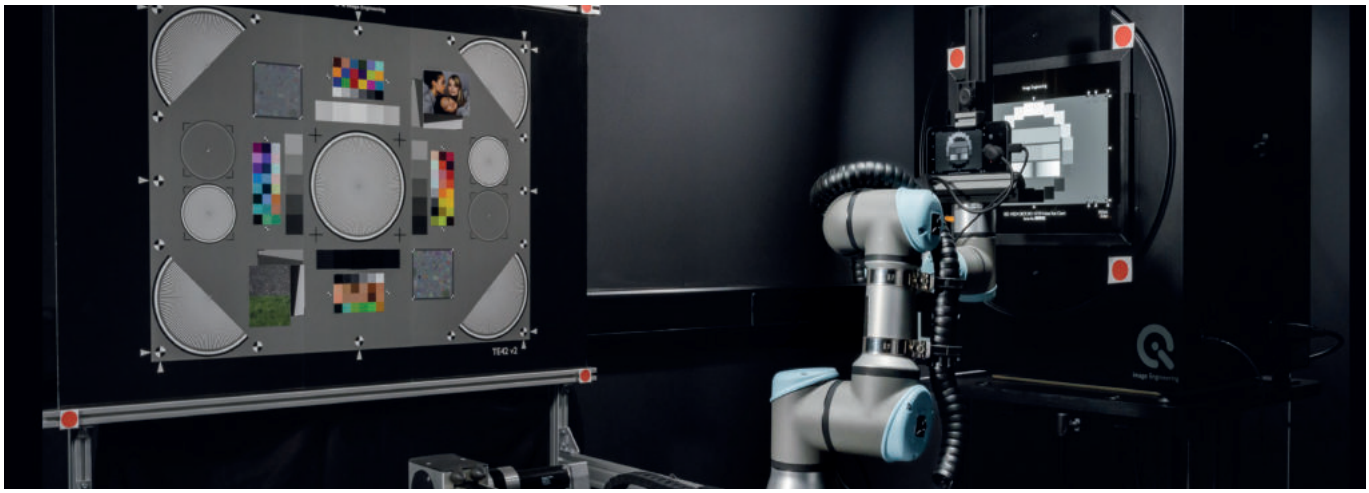


Image quality testing for mobile phone cameras

A mobile phone camera test is one of the labs most often requested tests. Using specifically designed equipment and following international standards and working groups such as CPIQ, the lab has developed a comprehensive analysis for mobile phone image quality.

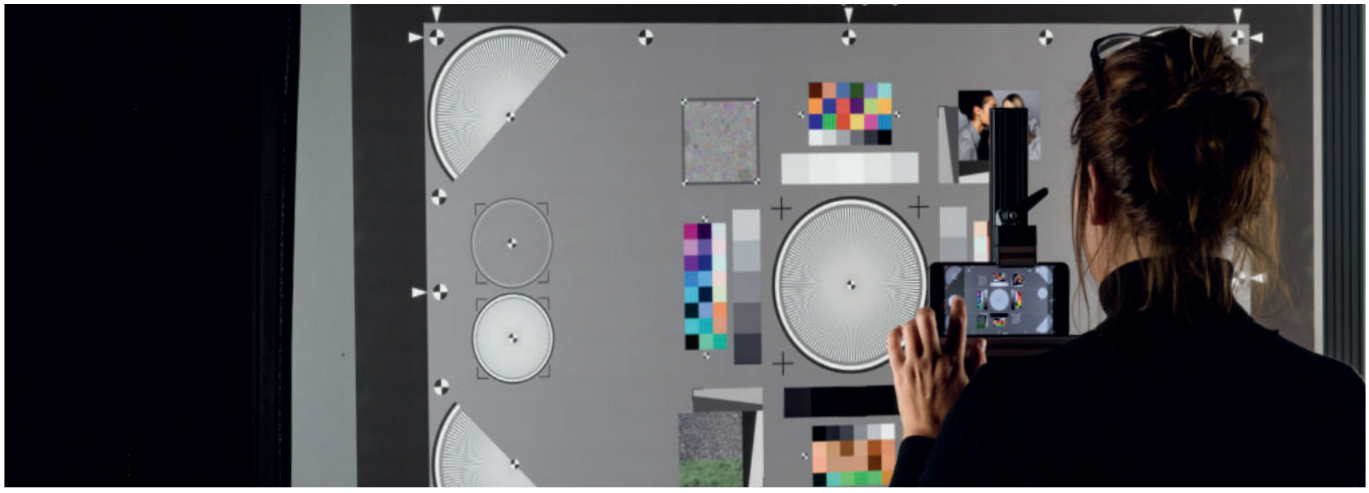
As the importance of mobile phone cameras grows, we continue to research and develop more advanced testing techniques. The TE42 is a multipurpose chart for measuring multiple image quality factors in a single image, while the iQ-Automator can perform a fully automatic test with just one click and eliminate human error. These devices, as well as others, allow the lab to effectively test mobile cameras.



Our lab is a trusted VCX test lab

VCX is a non-profit organization with the goal to provide consumers with a numeric score on the image quality of different mobile phones in the market. The score is determined with an objective test performed by an officially certified lab. An updated list of scores can be found at vcx-forum.org.

Our test lab is the first of only a few trusted VCX test labs, which means that we are able to perform all of the necessary tests outlined in the VCX whitepaper. The image quality score is calculated by measuring and combining the sum of the camera's various objective components. Our lab tests for each component and sends the final score to VCX or the requesting group.



TE42

A multipurpose test chart for a quick image quality overview

The TE42 chart is a multipurpose test chart that can quickly gather an overview of a camera's image quality performance in a single image. The chart is designed with multiple objects on the same chart plane for testing a wide variety of image quality factors, all of which can be analyzed using the iQ-Analyzer-X software (not included with chart).

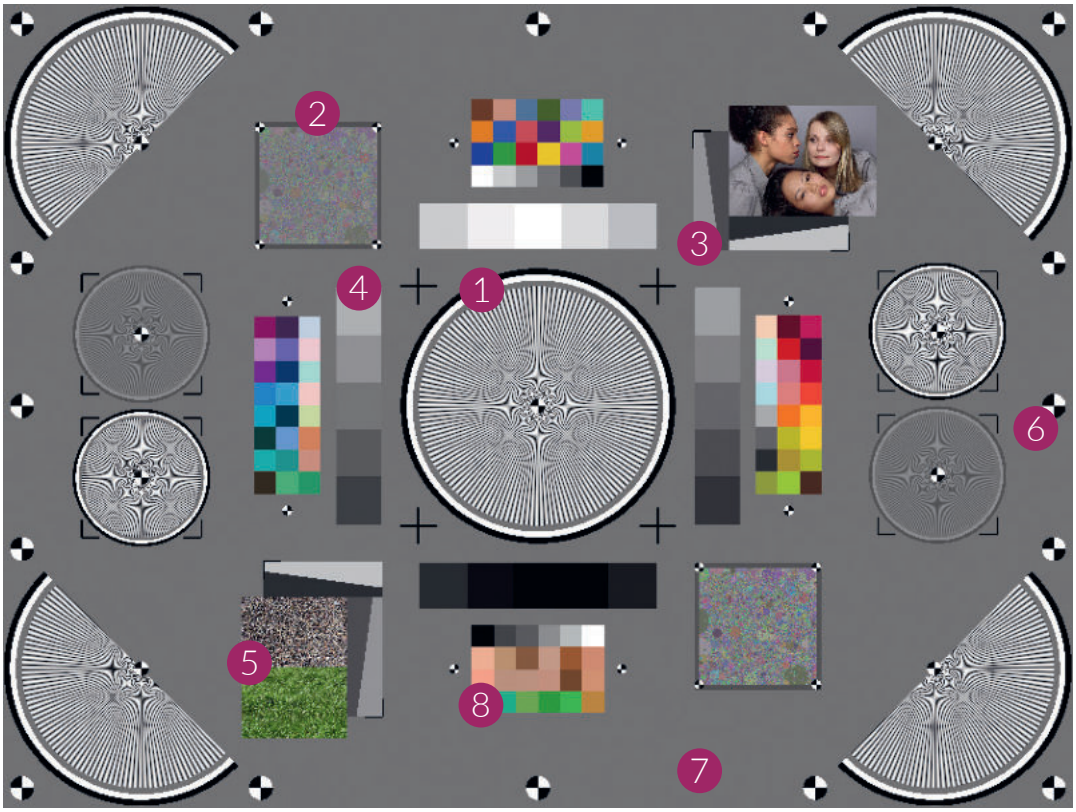
We often use the TE42 in our test lab, and it has become one of our most popular test charts due to its flexibility.

iQ Analyzer SUPPORT

Standard COMPLIANT

The TE42 chart plane has properties for analyzing many different image quality factors including:

1. Resolution ISO 12233:2014
2. Texture loss ISO 12233:2014
3. Sharpening ISO 12233:2014
4. OECF and Noise ISO 15739
5. Visual analysis
6. Distortion
7. Shading
8. Color reproduction



TE42-LL

A multi-purpose test chart for low-light performance testing

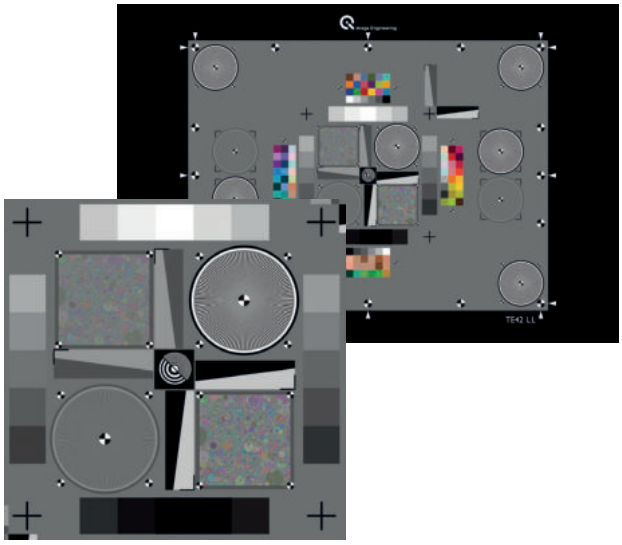
The TE42-LL test chart is a multi-purpose test chart used primarily for measuring the low-light performance of digital cameras as described by ISO 19093. This chart is based around the original TE42 chart but now has all of the important structures, such as the low-light Siemens stars and slanted edges, at the center of the layout so as to avoid fall off at the corners.

Main Features

- The exact chart recommended in ISO 19093
- Test targets all equal distance from each other
- Analyze all important low-light factors in one image

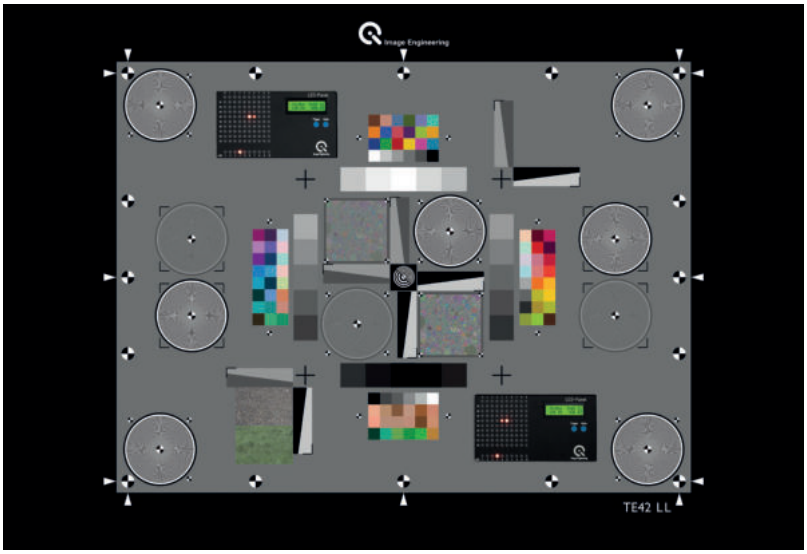
iQ Analyzer SUPPORT

Standard COMPLIANT



TE42-LL Timing

The TE42-LL Timing chart is the same chart only now it incorporates two LED-Panels for measuring the important timing features of a camera in a low-light situation. The LED-Panel can analyze all of the various timing factors described in ISO 15781, including shooting and shutter release time lag.



TE262 / TE263

A universal test target (UTT) for archiving

The UTT chart is a multipurpose test chart designed to evaluate the image quality of scanners and other digital input devices for the archiving industry. It is available in various sizes ranging from A4 to A0. The iQ-Analyzer software (not included with chart) can automatically analyze the image and provide the test results.

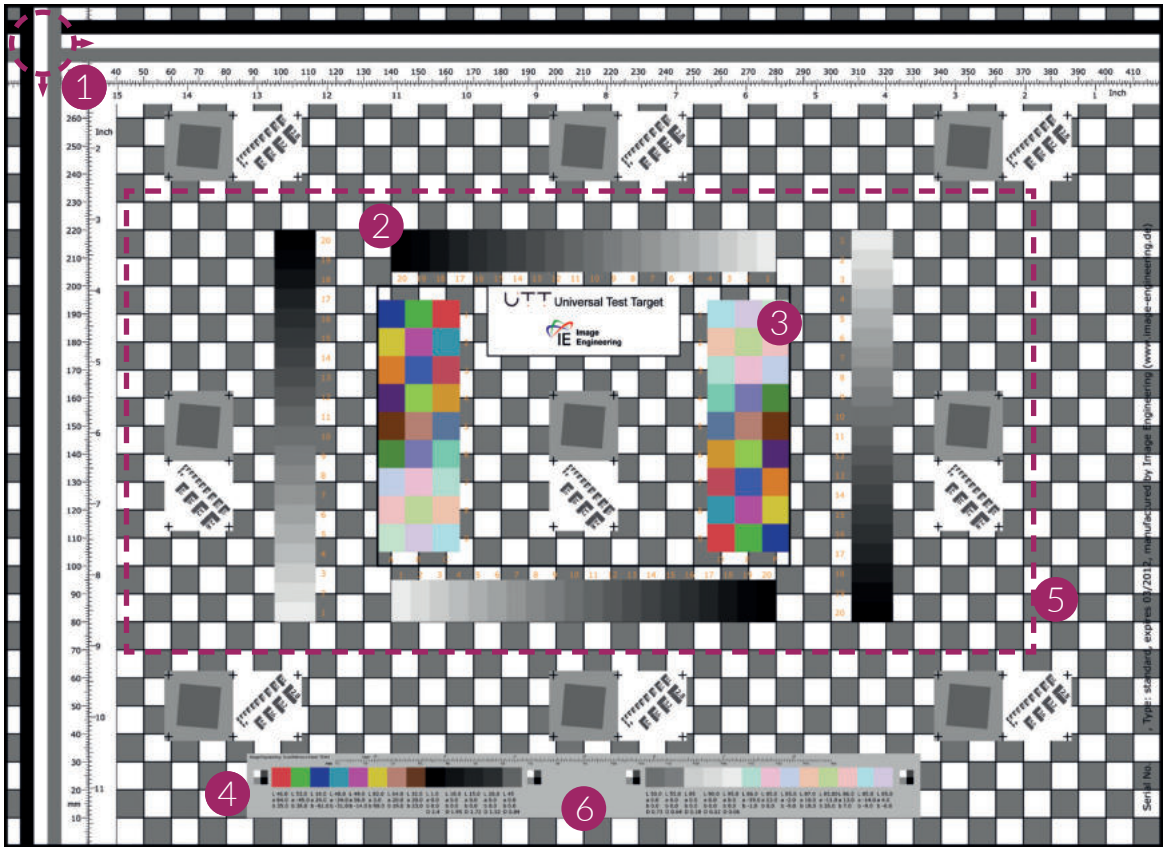
This chart can be used in accordance with ISO 19264, which describes a method for analyzing image quality in the archiving industry for both scanners and digital cameras.

iQ Analyzer SUPPORT

Standard COMPLIANT

The chart can measure the following topics in archival scanning:

1. Defect pixels and Shading
2. Dynamic range, OECF and Noise
3. Color reproduction
4. Resolution (slanted edge and visual)
5. Shading and Distortion
6. Additional chart TE263



TE292 the camSPECS plate

Spectral sensitivity measurements with the camSPECS front plate

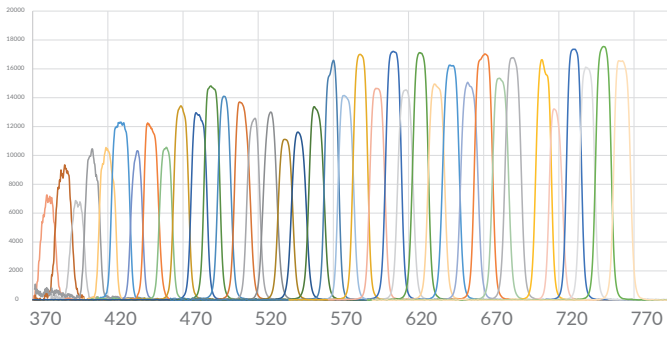
The TE292 chart (also known as the camSPECS plate) is the most recent development in the camSPECS product line. It is designed after the front plate of the full camSPECS device with all of the interference filters mounted onto one “test chart” for fast spectral sensitivity measurements and camera color calibration.

Main Features

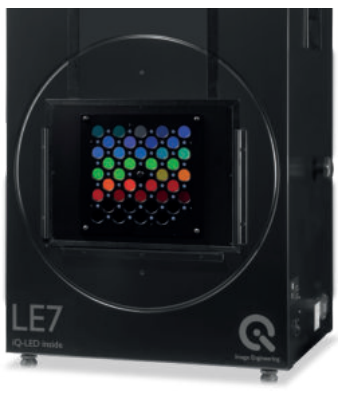
- Transparent test chart designed for the LE7
- The LE7 includes all features from iQ-LED*
- Measure spectral sensitivities in a single image
- Both an original and XL version available
- Evaluation with camSPECS software
- Software/external calibration device included

iQ-LED illumination with the LE7

The camSPECS plate is a standalone product that has been developed to be used primarily with the LE7, our iQ-LED integrating sphere for uniform illumination.** iQ-LED technology consists of a spectrally tunable light source that uses 20 individual spectral channels to generate custom spectra for more accurate camera characterization and calibration. The LE7 includes iQ-LED control software, and we also offer a C or C++ API as a separate option.



Wavelengths [nm] of the TE292 filters



LE7 with TE292 XL

*See iQ-LED page for more details. More information also available on our website.
**The plate cannot be used by itself and requires a broadband uniform illumination device for functionality. The plate and device are sold separately.

Resolution charts

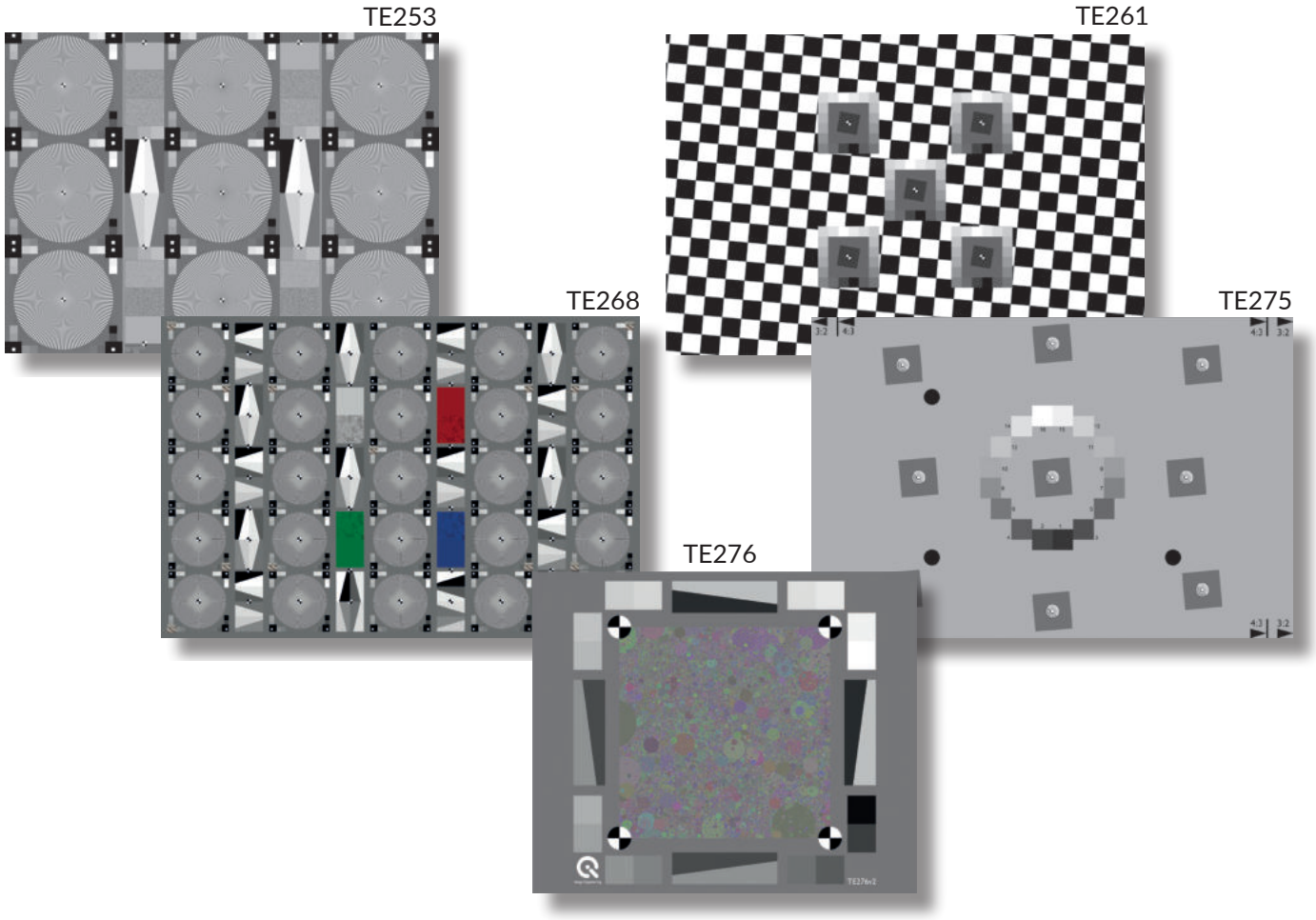
Uniquely designed test charts for measuring camera resolution

Image resolution is the ability of a digital camera to reproduce the fine details of a scene. In other words, how clear a human observer perceives an image is based on the resolution of the camera system. As a result, it is vital to thoroughly test and analyze the resolution of a camera system.

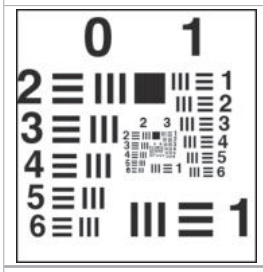
The most reliable way to test camera resolution is to use test charts. There are many different test charts that are specially designed to test camera resolution. These charts normally include objects such as sinusoidal Siemens stars or slanted edges, both of which are based on ISO 12233.

Another important image quality factor relating to resolution is texture loss or the loss of fine details with low contrast within the image. Texture loss is caused by the camera system reducing the noise of an image, which often results in the loss of important texture.

Texture loss is best measured using a Dead Leaves chart as opposed to traditional gray targets. Dead Leaves charts create a more natural testing structure for texture loss.

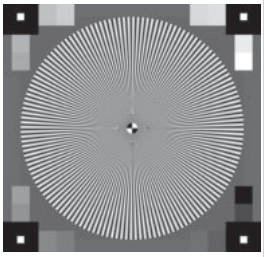


TE250 35 mm



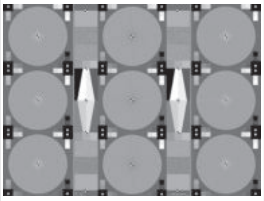
- USAF resolution chart
- Evaluate scanner resolution
- Measurements up to 10,000 ppi
- Transparent

TE253 4:3



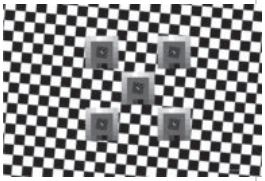
- Modulated sinusoidal Siemens star
- Evaluate camera resolution
- Reflective

TE253 9x 4:3 / 16:9 / 35 mm



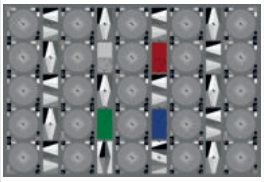
- Follows ISO 12233:2014
- Nine sinusoidal Siemens stars
- Slanted edges and white noise patches
- Transparent/Reflective

TE261 16:9



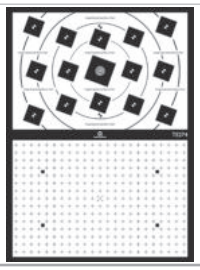
- Slanted edge chart
- Evaluate camera SFR
- Includes low contrast slanted edges
- Reflective

TE268 4:3 / 3:2



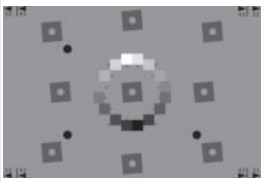
- Lens resolution and sharpness chart
- 25 sinusoidal Siemens stars
- 16 slanted edges in different contrasts
- Four colored dead leaves patterns
- Reflective

TE274 3:2



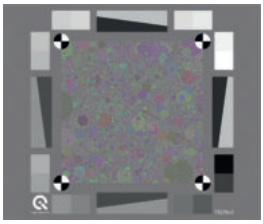
- Macrochart 13 x 13 cm
- Slanted edges for resolution
- Crosses for distortion
- Special alignment frame for positioning
- Reflective

TE275 4:3 / 3:2 (on chart)



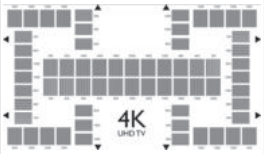
- Slanted edge chart
- Evaluate camera resolution
- ISO 12233:2017
- Reflective

TE276 287 x 287 mm (picture size)



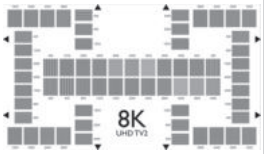
- Dead Leaves chart
- Evaluate texture loss
- Circles in all sizes and colors
- Reflective

TE277 16:9



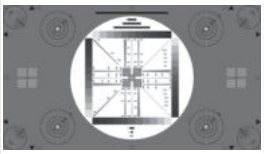
- 4k (UHD TV) resolution chart
- 100-2000 CPH
- Frequency response measurement of a 4K camera
- 50 multiburst fields
- Transparent

TE278 16:9



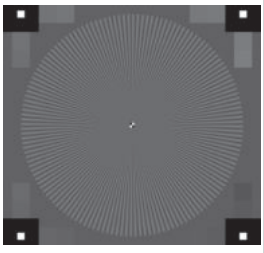
- 8K (UHD TV2) resolution chart
- 200-4000 CHP
- Frequency response measurement of an 8K camera
- 50 multiburst fields
- Transparent

TE279 16:9



- 4k (UHD TV) universal chart
- Quick analysis of transmission characteristics
- Multiple gray scales and resolution wedges
- Transparent

TE280 334 x 271 mm



- Evaluate texture loss
- ISO 19567
- Sinusoidal Siemens star
- 18% and 48% modulation available
- Reflective

iQ-Analyzer and/or iQ-Analyzer-X support

*Complete list of charts can be found on our website: www.image-engineering.com

Grayscale charts

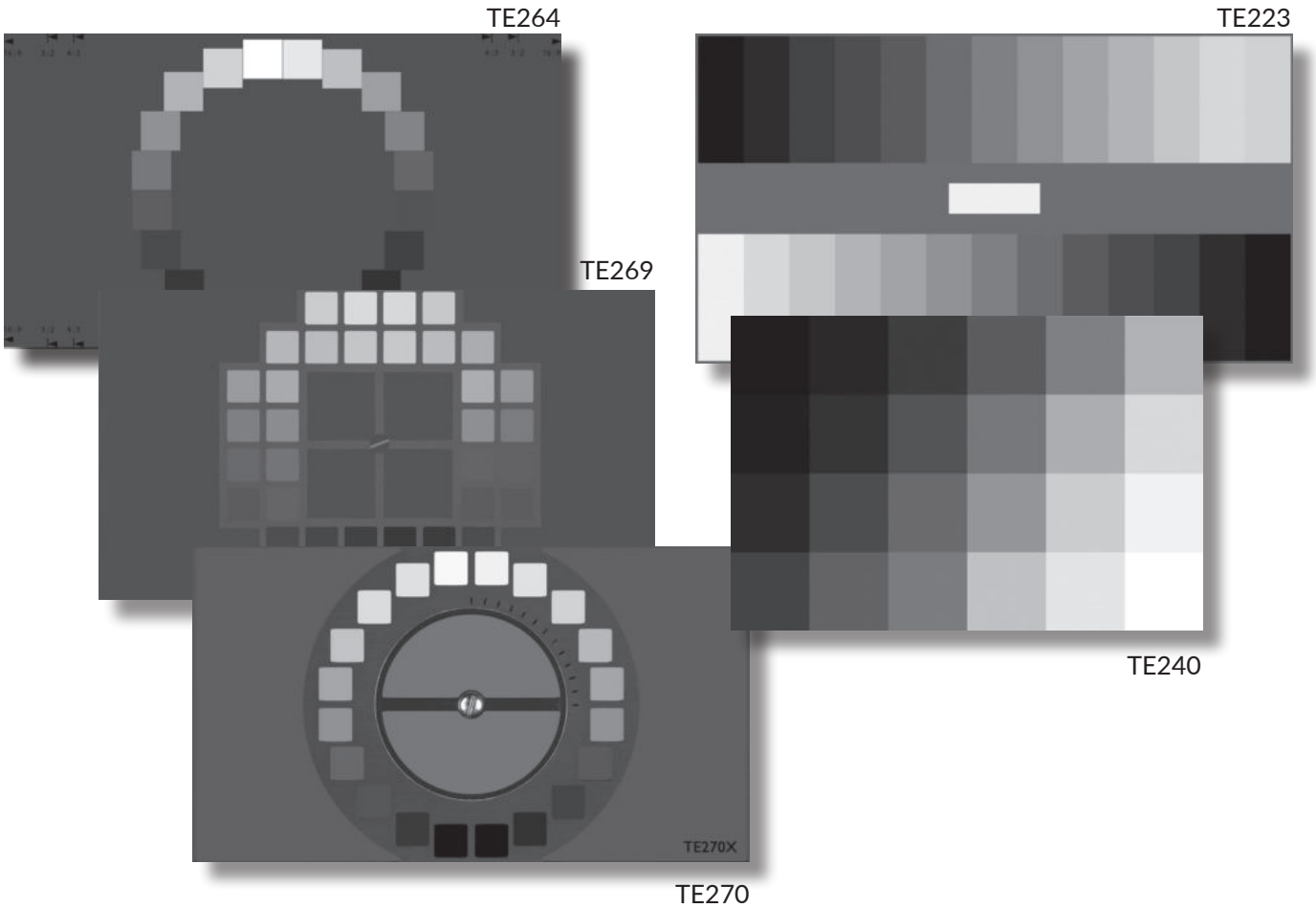
Test charts for analyzing the different grayscale factors

Grayscale refers to the various shades of gray that are present throughout the image. Many different image quality factors are important when measuring how well a camera reproduces the tonal value of an image, including OECF, dynamic range, gamma, and noise.

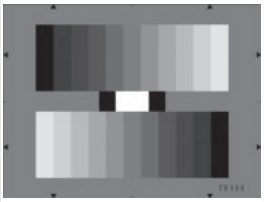
The OECF (opto-electronic conversion function) refers to how the camera system transfers the luminance (gray levels) in the scene from the sensor into digital values in the camera. This is important when measuring the dynamic range and signal noise of a camera system.

Dynamic range describes the ratio between the darkest and lightest gray level in the scene capable of being reproduced by the camera (also known as the contrast image). Signal noise refers to the presence of unwanted artifacts that often results from the camera's high sensitivity settings.

Many of our grayscale charts are developed in accordance with ISO 14524 and ISO 15739, including those for measuring OECF, dynamic range, and noise.



TE153 4:3



- Log. grayscale chart (11 steps)
- Evaluate halftone reproduction
- Two 11-graduated counter current grayscales
- 40:1 contrast range of grayscales
- Transparent/Reflective

TE165 16:9

- Log. grayscale chart (11 steps)
- Evaluate halftone reproduction
- Two 11-graduated counter current grayscales
- 40:1 contrast range of grayscales
- Transparent/Reflective

TE182 9x 4:3 / 16:9

- Evaluate exposure control
- 18% remission
- Transparent/Reflective

TE197 16:9

- ISO 14524
- Evaluate OECF
- 12-step gray scale
- Multiple contrasts
- Transparent/Reflective

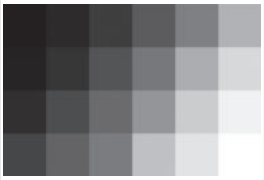
TE205 4:3

- Gamma measurement chart
- Ten gray steps from 1-10% transmission
- Ten gray steps from 10-100% transmission
- Transparent

TE223 16:9

- HDTV log. grayscale chart
- 13 steps with a contrast of 1:200
- Evaluate halftone reproduction
- Two 13-graduated counter current grayscales
- Transparent/Reflective

TE240 32:24 mm (transparent) / 100:150 mm (reflective)



- Evaluate dynamic range of 35 mm scanners
- ISO 21550
- 24 gray patches
- 4.0/6.0 density range (transparent)
- 2.4 density range (reflective)

TE241 16:9

- OECF and noise chart
- Evaluate the characteristic curve of a camera
- 20 gray patches
- Transparent

TE259 16:9

- OECF and noise chart
- Evaluate dynamic range on a waveform monitor
- 20 gray patches
- Contrast range of 10,000:1
- Transparent

TE264 16:9

- OECF chart
- ISO 14524 and 15739
- 12 or 20 gray patches
- Metal frame to avoid stray light and reflections
- Transparent

TE269 16:9

- OECF 36 gray patch chart
- Densities from 0.03 to 6
- ISO 14524/15739 / IEC 62676-5
- Metal frame to avoid stray light
- Contrast up to 1,000,000:1 / 120 dB
- Transparent

TE270 X 16:9

- OECF 20 gray patch chart
- 2 polarizing filters in center of chart
- For cameras that don't have manual adjustment
- Metal frame to avoid stray light and reflections
- Transparent

iQ-Analyzer and/or iQ-Analyzer-X support

*Complete list of charts can be found on our website: www.image-engineering.com

Color charts

Test charts for analyzing the color reproduction of a camera

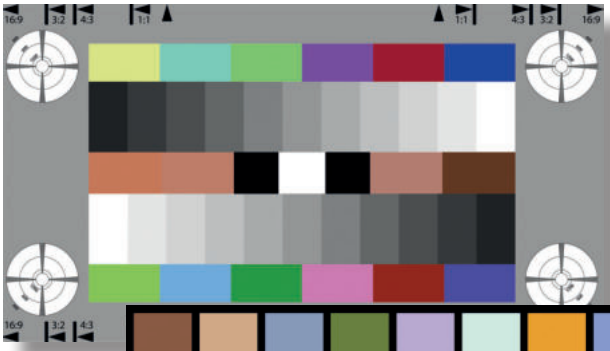
Color reproduction or color accuracy describes how well a camera reproduces the original colors in the digital image. Incorrect color reproduction can lead to unintended or false colors within the image.

Color is one of the more important image quality factors, so it is important to analyze the color accuracy as well as the white balance of a camera to ensure proper color reproduction. The white balance function of a digital camera ensures the balance of objects in the correct colors in correlation to the light source.

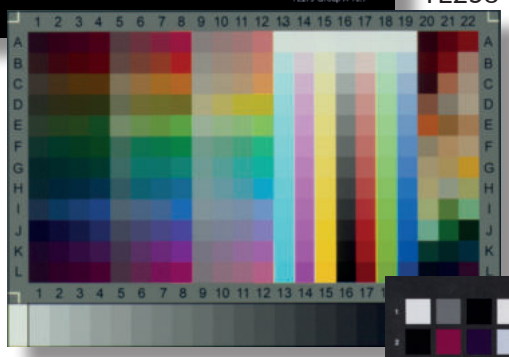
Color targets are best when checking color accuracy and white balance. For generating a color correction matrix, we recommend measuring the spectral sensitivities with the camSPECS express.

TE273

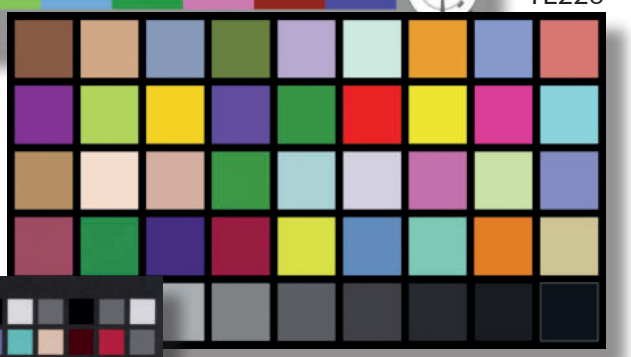
TE256



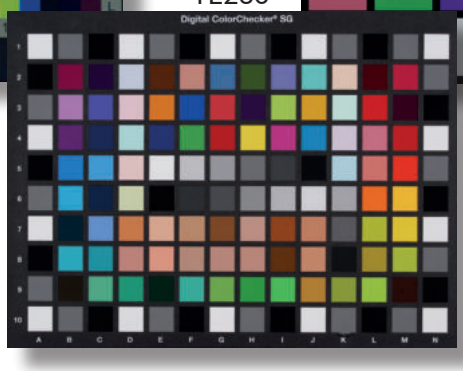
TE258



TE226



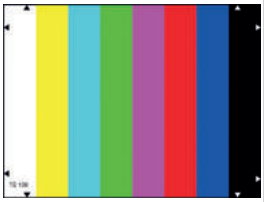
TE230



BBC61 4:3

- Flesh tone reference chart
- BBC approved
- Reflective

TE106 4:3 / 16:9



- Evaluate color rendition
- Primarily for TV cameras
- 6 color bars
- Transparent/Reflective

TE188 4:3 / **TE188** 16:9 (X-Rite ColorChecker)

- Evaluate color rendition
- 18 color patches
- 6-step grayscale
- Transparent/Reflective

TE226 16:9

- HDTV color rendition
- 36 color patches
- 9-step grayscale
- Transparent

TE230 4:3 (X-Rite ColorChecker SG)

- Evaluate color rendition
- 140 color patches
- 14 skin-tone patches
- Reflective

TE233 16:9

- Evaluate color reproduction
- 24 color patches
- 4 skin tone patches
- Reflective

TE234 16:9

- Evaluate color gradation
- Check for quantization errors
- Reflective

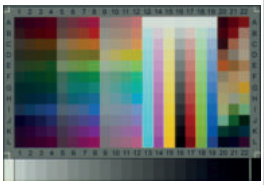
TE235 500 x 1800 mm

- Surveillance camera chart
- On-site testing
- Chart roughly the size of a person
- Reflective

TE256 16:9

- Evaluate color and calibration
- Color align HD cameras
- Reflective

TE258 35 mm film / 5 x 7-inch paper

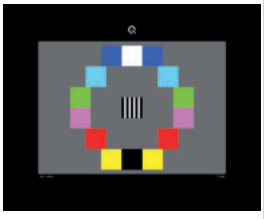


- T8 scanner characterization chart
- Create color management profiles
- Transparent/Reflective

TE273 16:9

- Natural skin tones
- Single image varieties
- Group image varieties
- Transparent/Reflective

TE289 4:3



- Color reproduction of a mirror replacement system
- ISO 16505:2015
- Munsell (advanced) version
- Reflective print (basic) version

iQ-Analyzer and/or iQ-Analyzer-X support

*Complete list of charts can be found on our website: www.image-engineering.com

Lens performance charts

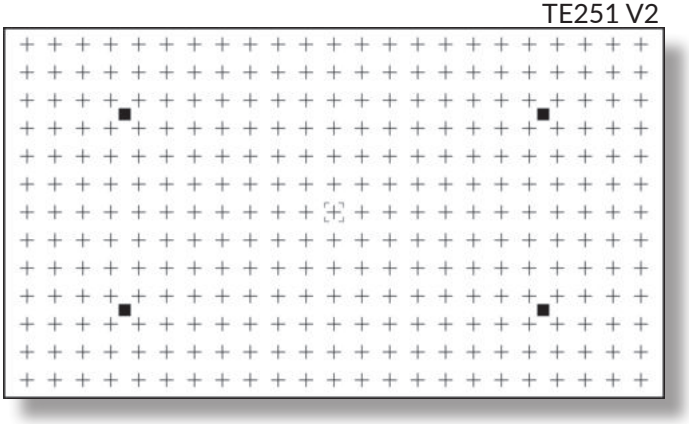
Test charts for measuring the performance of a lens

The performance of a lens depends on how the image is affected by different image quality factors, including lens distortion, shading/vignetting, and flare. These factors are frequently a result of optical aberrations and light reflections from the optical components within the lens and are oftentimes unavoidable.

Distortion leads to unnatural curves in the image and almost always occurs due to a scale variation created by the optics of the lens. Shading/vignetting is when the brightness of an image fades over the image field and can be caused by the design of the lens. Flare refers to scattered light in the image that was caused by unwanted reflections in the optical path.

While these factors often depend on the surrounding environment, they can also be tested using specifically designed test charts. We have developed a wide variety of test charts to test for distortion, shading/vignetting, and flare.

TE251 V2

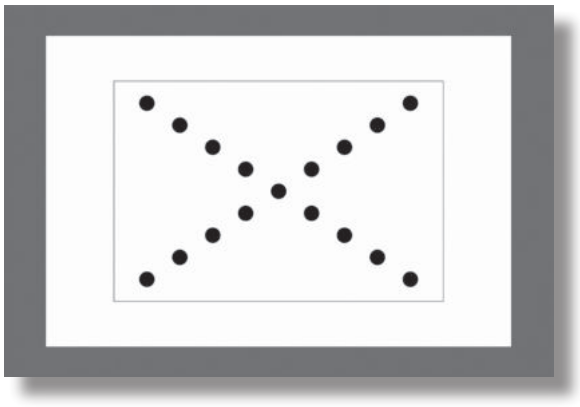


Geometry grid to measure lens distortion

TE255

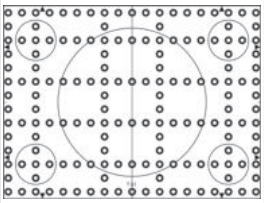
Diffuser plate to measure vignetting

TE281



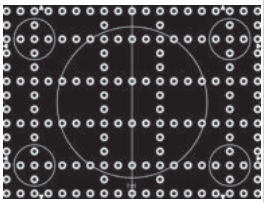
Flare chart based on ISO 18844

T01W 4:3 / 16:9



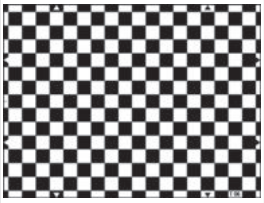
- Geometry ring chart
- Measure geometry of cameras and monitors
- Rings arranged on grid with white surrounding
- Transparent/Reflective

T01B 4:3 / 16:9



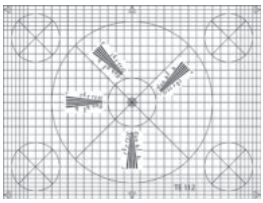
- Geometry ring chart
- Measure geometry of cameras and monitors
- Rings arranged on grid with black surrounding
- Transparent/Reflective

T06 4:3 / 16:9



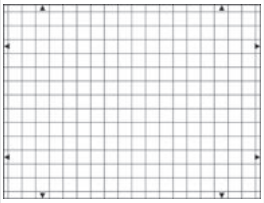
- Chess board chart
- Evaluate geometry and resolution
- Transparent/Reflective

TE112 4:3



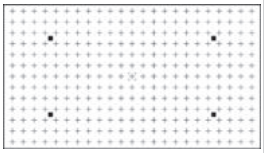
- Grid chart
- For adjustment and control of TV cameras
- Grid lines for adjusting registration
- Wedges for resolution appraisal
- Transparent/Reflective

TE183 4:3



- 19/14 Grid chart
- IEC 84/60B
- Adjustment and control
- Visual appraisal of scan linearity
- Lines for adjusting registration
- Transparent/Reflectiv

TE251 V2 16:9

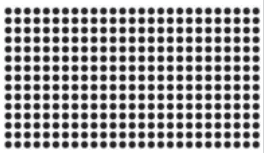


- Distortion and chromatic aberration chart
- ISO 17850,
- IEC 62676-5, IEEE P1858 CPIQ
- 15 x 27 black crosses
- Transparent/Reflective

TE255 4:3 / 16:9

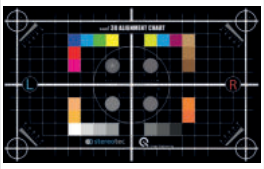
- Diffuser plate
- Evaluate shading/vignetting
- 61% transmission
- Transparent
- Included in the scope of delivery of the LE7

TE260 16:9



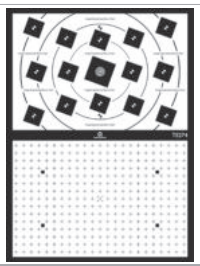
- Dot chart
- Two charts different charts on front and back sides
- Evaluate distortion and chromatic aberration
- Reflective

TE271 16:9



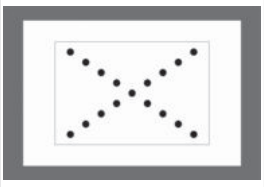
- 3D alignment chart
- Align and adjust 3D cameras
- Combination of 2D and 3D structures
- Reflective

TE274 3:2



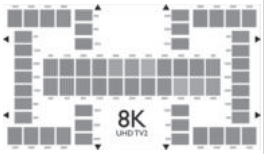
- Macrochart 13 x 13 cm
- Slanted edges for resolution
- Crosses for distortion
- Special alignment frame for positioning
- Reflective

TE281 3:2



- Flare chart
- ISO 18844
- 17 light traps (super black holes)
- Evaluate scattering light
- Reflective

TE278 16:9



- 50 multiburst fields
- Resolution measurement horizontal and vertical
- Transparent

iQ-Analyzer and/or iQ-Analyzer-X support

*Complete list of charts can be found on our website: www.image-engineering.com

Custom Charts

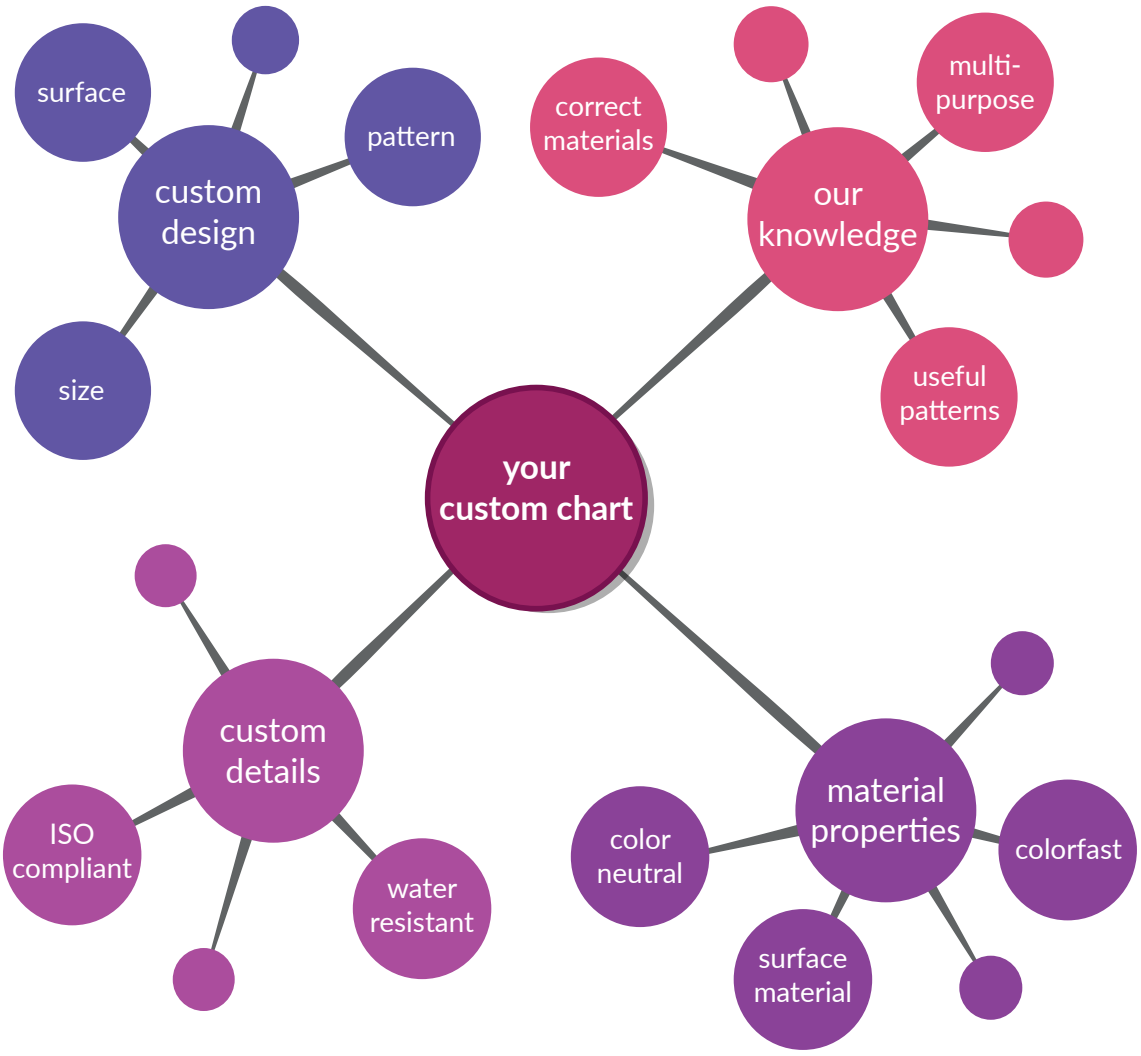
We can help you design a custom test chart

In addition to our 200+ different test charts already available, we also offer the option for test chart customization* for those with different requirements.

We understand that our charts do not always meet the exact specifications required by the customer. As such, we provide the unique opportunity for you to design your own chart layout and then allow our experienced chart production team create it.

During the customization process, you can choose a custom chart design, select different specifications, and use a diverse range of materials for creation.

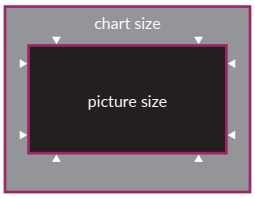
To get started with the customization process, please visit our website and contact our support team directly. We will assist you with getting started and answer any questions you may have about the design process.



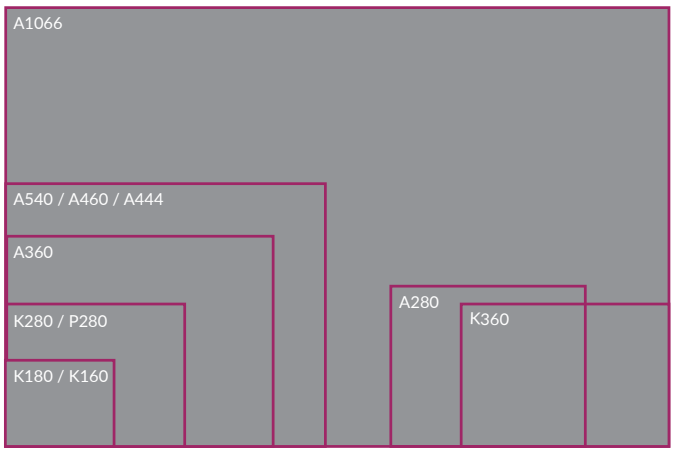
*Not every individual design is possible for print. Please contact us for consultation.

Chart Sizes

The test charts are available in the sizes listed below.
For technical reasons, some charts cannot be manufactured in all sizes.
Please do not hesitate to contact us for additional information. Further information is also available on our website.

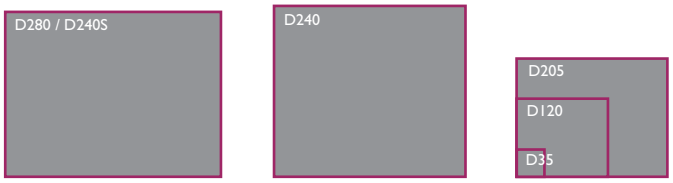


Reflective			
Designation	Picture size* w x h [mm]		Chart size** w x h x d [mm]
	4:3	16:9	
A1066	800 x 600	1066 x 600	1245 x 835 x 3.2
A540	540 x 405	460 x 303.8	600 x 500 x 3.2
A460	460 x 345	460 x 258.8	600 x 500 x 3.2
A444	-	444.4 x 250	600 x 500 x 3.2
A360	360 x 270	360 x 202.5	500 x 400 x 3.2
K360	-	360 x 202.5	390 x 271 x 2.1
A280	280 x 210	280 x 157.5	365 x 305 x 3.2
K280	280 x 210	280 x 157.5	334 x 271 x 2.1
P280	May vary in size with the chart layout		334 x 271 x 2.1
K180	-	180 x 101	204 x 164 x 2.1
K160	160 x 120	-	204 x 164 x 2.1



A charts (size 280/360/460) are mounted on aluminium plates.
A charts (size 1066) are mounted on aluminium composite panels (aluminium dibond).
P charts mounted on a black polystyrene plate are only available in combination with test chart folders.

Transparent			
Designation	Picture size* w x h [mm]		Chart size** w x h x d [mm]
	4:3	16:9	
D280	280 x 210	280 x 157.5	360 x 280 x 4.6
D240	240 x 180	240 x 135	320 x 290 x 4.6
D240S	240 x 180	240 x 135	360 x 280 x 4.6
D205	205 x 153	205 x 115.3	253 x 202 x 3.5
D120	120 x 90	120 x 67.5	155 x 135 x 4.0
D35	32 x 24	-	50 x 50 x 3-4



*Picture size format can vary from the default size. Individual deviation is stated on the specific product page.
** Chart sizes may vary by +/- 2 mm as they are handmade in house.

Suitable transparent charts for the following illuminators

	D280 / D240S	D240	D205	D35
	Spherical transparency illuminator LE6/LE7 Lightbox illuminator LG3/LG4 Sony Pattern Box	DNP standard viewer	Porta Pattern spherical transparency illuminator	CAL4
With adapter		Spherical transparency illuminator LE6/LE7 Lightbox illuminator LG3/LG4	Spherical transparency illuminator LE6/LE7 Lightbox illuminator LG3/LG4	LE6 and LE7

Accessories

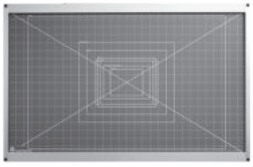
iQ-Tripodmount frame for test charts in size A280 / A360 / A460

iQ-Foldermount frame for Studio Kits

iQ-Tablemount frame for reflective charts A280 / A360 / A460

iQ-Wallmount frames for reflective test charts in size A1066

chartBOARD has a magnetic, neutral gray surface with special alignment marks.



magneticTAPE can be fixed on the backside of all reflective charts.

iQ-Chartmount-V for easily changing charts, manually or automatically.

iQ-Chartmount-H V2 for quickly changing charts manually.

Support with wheels and precise height adjustment for the LE6/LE7 series.

Tripods for the LE6, LG3 and LG4 series.

iQ-Mobilemount
Tripod mount for mobiles and tablets.

Universal Camera Mount
Standalone mount for aligning various cameras

Manfrotto 055X Pro3 Tripod

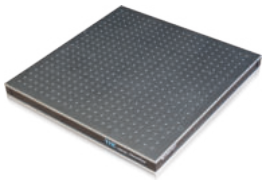
Manfrotto 410-3-Way-Head

iQ-Monopod Tripod for a professional, quick and exact camera positioning.

iQ-Anchor A stabilizing stand with a flat surface for image stabilization measurements.

Accessories

Honeycomb Breadboard
A stabilizing surface for securely mounting STEVE-6D.



Restan
PTFE (polytetrafluoroethylene) white reference.

Hedler Tungsten Halogen Light Unit

Studio Lights LED lights with adjustable correlated color temperature.

Gossen Mavo-Monitor USB

Usable for precise measurements of luminance levels of transparent test charts.

Gossen Digipro F2

An exposure meter for high precision incident light measurement. Ensures the illumination uniformity of reflective test charts.

Gossen Mavolux 5032 B USB

Digital luxmeter and luminance meter classified according to DIN 5032-7 and CIE 69.

PRC Krochmann Radiolux 111

The RadioLux 111 is a precision hand held instrument for photometric measurement.

Cases for storage, protection and transport

- Chart cases for transparent test charts available in all sizes
- Chart cases for reflective test charts available in all sizes
- Cases for spherical illuminators LE6/LE7/CAL3
- Cases for illumination devices LG3/LG4

*Complete list of accessories can be found on our website: www.image-engineering.com

Glossary

Selected Definitons

2D/3D-MLUT	Multi-Look Up Table
ADAS	Advanced Driver Assistance Systems
AF	Autofocus
API	Application Programming Interface (C language)
CAN	Controller Areas Network
CCM	Color Correction Matrix
CTT	Correlated Color Temperature
CIECAM	International Commission on Illumination - Color Appearance Modelling
CIPA	Camera & Imaging Products Association
CLI	Command Line Interface
CRI	Color Rendering Index
DUT	Device Under Test
ESF	Edge Spread Function
FOV	Field of View
FWHM	Full Width at Half Maximum
HDR	High Dynamic Range
ICC	International Color Consortium
iQ	Image Quality
iQ-LED	A Multispectral Light Source
IR	Infrared
KPI	Key Performance Indicator
MTF	Modulated Transfer Function
ND	Non-Diffuser (filters)
NIR	Near Infra-Red
NIST	National Institute of Standards and Technology
OECF	Opto Electronic Conversion Function
ROI	Regions of Interest
SFR	Spatial Frequency Response
SMD	Surface Mount Device
SNR	Signal to Noise Ratio
UTT	Universal Test Target
VCX	Valued Camera eXperience
VIS	*Vis*ual Area of Spectrum

International Standards

IEC 62676-5 – Data specifications, measuring methods, and performance values for security and video surveillance cameras
IEEE P1858 CPIQ – Objective and subjective test methods for cell phone image quality
IEEE P2020 – The working group developing the first standards for autonomous driving systems (ADAS)
ISO 12232 – Method for assigning ISO speed rating, standard output sensitivity, and exposure index and recommendations
ISO 12233 – Methods for measuring resolution and spatial frequency response of digital cameras
ISO 14524 – Methods for measuring opto-electronic conversion functions (OECF) of digital cameras
ISO 19567-1 – Texture reproduction measurements using a cyclic pattern in digital cameras
ISO 19567-2 – Texture analysis for a non-cyclic pattern in digital cameras
ISO 15739 – Measuring noise vs. signal level and dynamic range in digital cameras
ISO 15781 – Methods for measuring shooting and shutter release time lag, shooting rate and start-up time of digital cameras
ISO 16505 - Road vehicles ergonomic and performance aspects of Camera Monitor Systems Requirements and test procedures
ISO 17321-1 – Methods for measuring the color characterization of digital cameras in photography and graphic technology
ISO 17850 – Geometric distortion measurements of digital and mobile phone cameras
ISO 17957 – Shading measurements
ISO 18844 – Image flare definition and measurements of digital cameras
ISO 19084 – Chromatic displacement measurements
ISO 19093 – Methods for measuring low-light performance of digital cameras
ISO 19264 – Methods for analyzing the image quality of archiving systems
ISO 20954 – Image stabilization
ISO 21550 – Dynamic range measurements for electronic scanners
ISO TR 19247 – Guidelines for camera testing
VCX v2020 – Objective mobile phone camera rankings

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