

Solutions to test imageQuality



Image Engineering
Product Catalog

2023

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 of image quality test equipment and solutions.

Our products and solutions are centered around the 250+ test charts that are expertly designed to assess 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-X analysis software.

All our testing solutions are 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 (see website for full list).

As of June 2021, we have officially become part of the Nynomic Group. With Nynomic as a strategic investor, we now have a partner from a similar background who can provide us with the resources to achieve our goals much faster and at the highest possible level.

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

For more information on Nynomic please visit: <https://www.nynomic.com>

	Information	Sales	Support
Telephone	+49 2273 99 99 1-0	+49 2273 99 99 1-50	+49 2273 99 99 1-60
E-mail	info@image-engineering.de	sales@image-engineering.de	support@image-engineering.de
Fax	+49 2273 99 99 1-10		
Web	www.image-engineering.com		

Contents

imageQuality*solutions*

iQ-Teststand	04
Dynamic Test Stand – DTS	06
iQ-Automator Solution	08

imageQuality*tools*

VCX Solutions	10
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Illumination Devices

iQ-LED	12
LE7	14
iQ-Flatlight	15
iQ-Chart Box	16
CAL Product Line	17
CAL1	19
CAL2	20
CAL3	21
CAL3-XL	22
CAL4-E	23
iQ-Multispectral	24
lightSTUDIO	25
LG3	27
LG4	29
Vega	30

Measurement Devices

GEOCAL	32
camSPECS	34
LED-Panel	36
iQ-Climate Chamber	38
STEVE-6D	39
iQ-Trigger	41
iQ-Near Focus	42
iQ-Defocus	43
EX2-VIS	44

imageQuality*code*

iQ-Analyzer -X	45	iQ-Luminance	48
----------------	----	--------------	----

imageQuality*lab*

Programming Interfaces	47
------------------------	----

Test Laboratory	49	Security / VCX	51
------------------------	-----------	----------------	----

camPAS / Automotive	50
---------------------	----

imageQuality*charts*

TE42 Multipurpose Charts	52	Grayscale Charts	58
TE42-LL / Timing	53	Color Charts	60
Archiving (UTT) Chart	54	Lens Performance Charts	62
TE292 (camSPECS plate)	55	Custom Charts	64
Resolution Charts	56	Chart Sizes	65

Accessories	66	Glossary	68
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iQ-Teststand

Upgrade your test lab with a customized camera test stand

Choose from a wide 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

5 Transparent chart illumination

Multiple lighting options such as 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

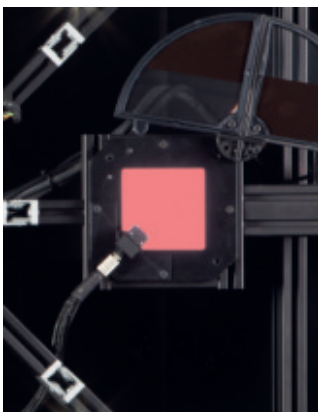
- * Contrast Detection Probability (CDP)
- * Color Separation Probability (CSP)
- * Modulated Light Mitigation Probability (MMP)
- * Motion Artifacts (Blurring)
- * Mounting for distortion compensation



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.

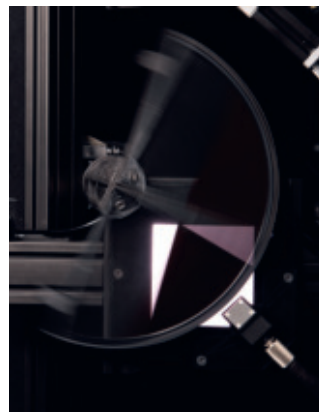
This device is capable of providing a flexible high dynamic scene to the device under test. HDR rendering can be tested and characterized.



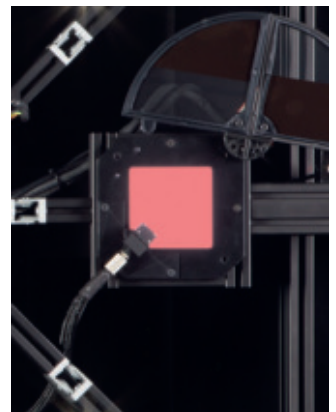
Contrast Detection



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, two rotating off-axis slanted edge targets provide a way to measure a camera's 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

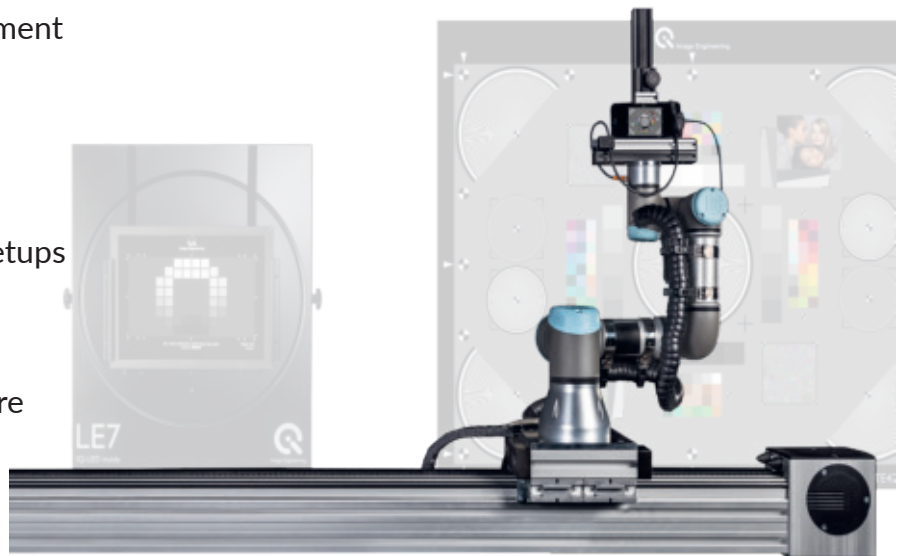
A fully automated camera test is now just one click away

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

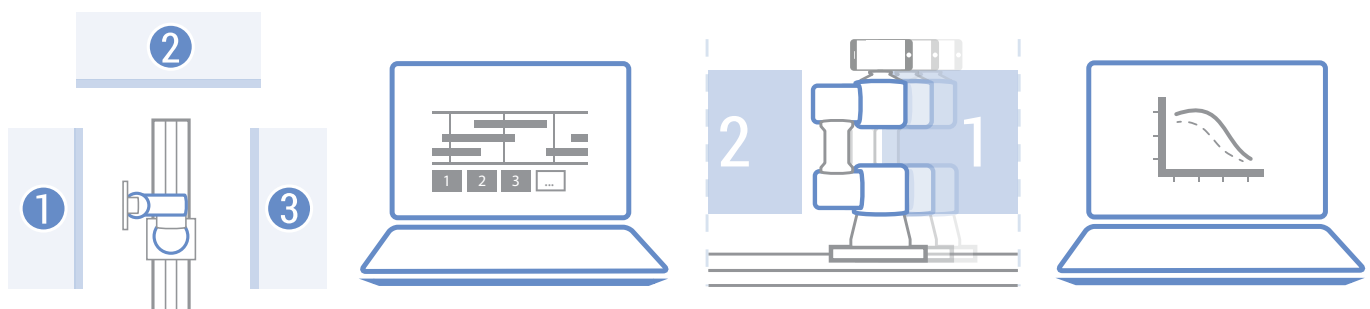
- ✱ Automatic and accurate alignment
 - ▶ to measurement devices
 - ▶ to test charts
- ✱ Manage different hardware setups
- ✱ Customize test workflows
- ✱ Drag and drop control software

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-Test-bench 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.

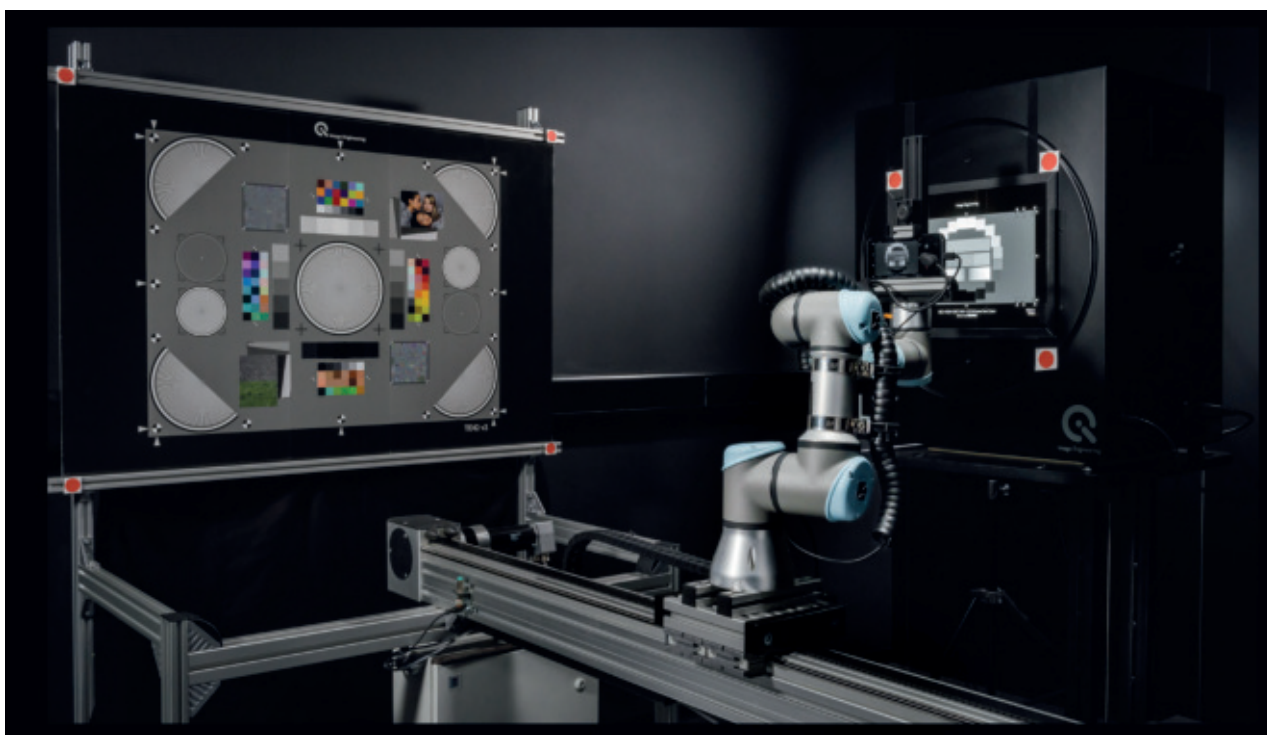
4 Optional: Analysis

Automatic transfer of images from the DUT to your computer for analysis using the iQ-Analyzer-X 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 / UR5
Max. payload	3 kg / 5 kg (available on request)
Max. arm radius	500 mm / 850 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
Available APIs	Some component APIs available on request
At a Glance	iQ-Analyzer-X
Principle	Image quality analysis software

*APIs sold separately.

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 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; the current version is VCX v2020.

See detailed information at www.vcx-forum.org.



VCX WebCam 2023

VCX WebCam 2023 is the latest standard released by the VCX Forum. This release marks one of the first international standards for evaluating image quality testing of video conferencing cameras. Tests are performed in a controlled environment by trusted test labs that test the camera's performance for various metrics, such as auto-exposure, white balance, noise, spatial frequency, etc.

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 chart



VCX-WebCam testing

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 mobile phone 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 mobile phone test.

VCX Solutions Products*		Manual	Automated
Product Description			
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-X	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.

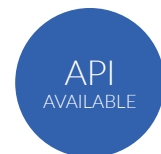
iQ-LED

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.

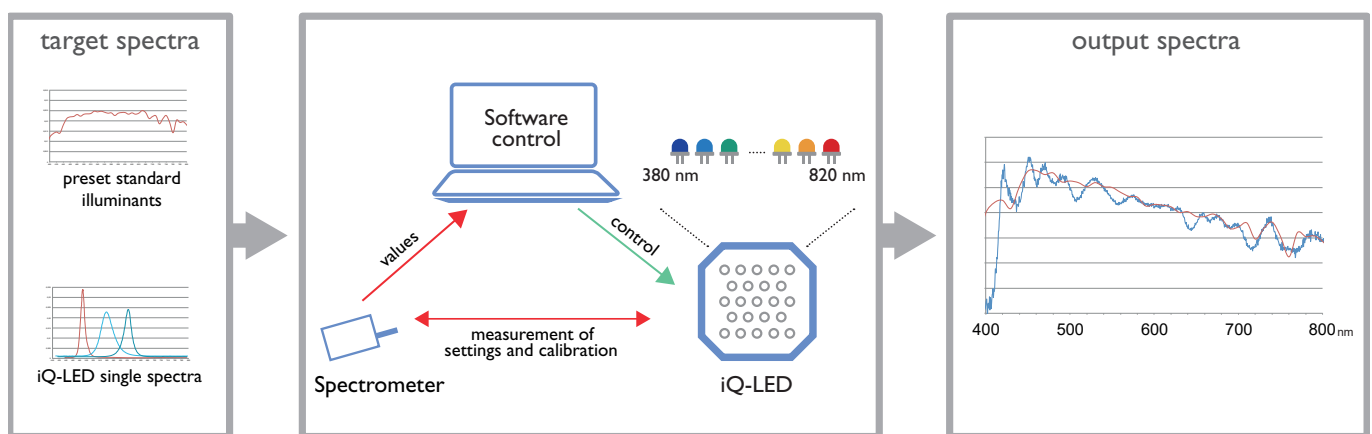
Main Features

- * 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



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.



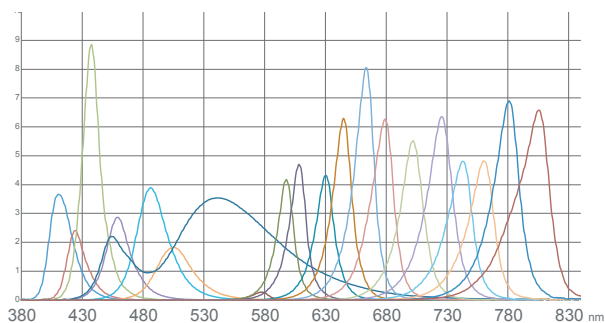
iQ-LED workflow

*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.

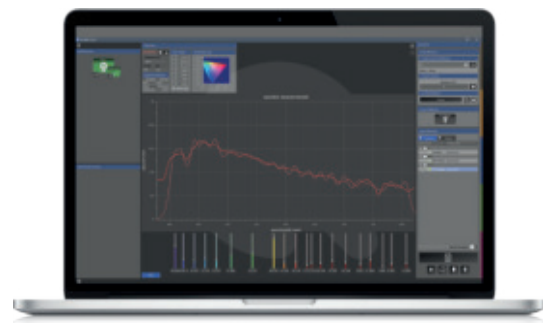
Advanced image quality testing

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 with 20 spectral channels

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: 305 – 1100 nm / Resolution: 2048 pixel / FWHM: 2.5 nm
Control system	Software-based control system via USB (included with all iQ-LED devices), 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	<ul style="list-style-type: none"> • 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

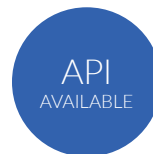
LE 7

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*
- * Accurate low-light testing with LE7-6x-E



LE7 VIS-IR, LE7-E and camSPECS plate

The LE7 VIS-IR uses two normal iQ-LED modules and four iQ-LED VIS-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 range 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 VIS-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 VIS-IR: 2 x iQ-LED V2 plus 4 x iQ-LED VIS-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 VIS-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.

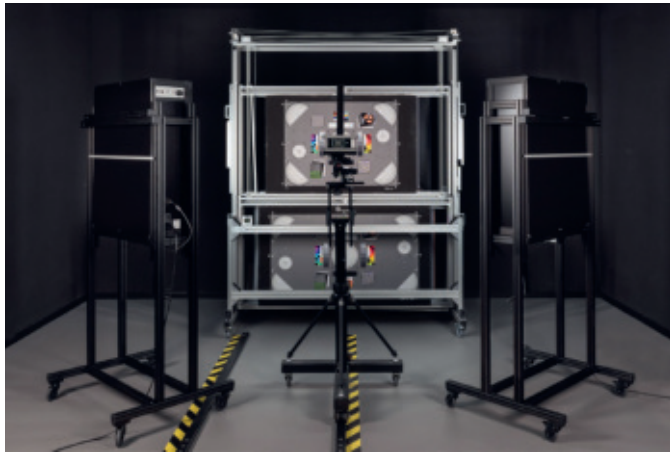
Main Features

- * 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)



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)

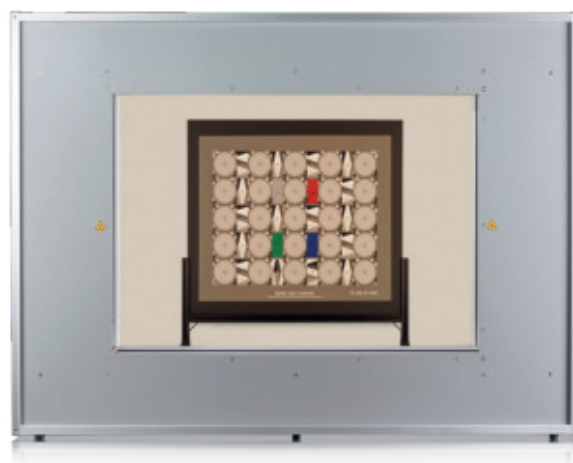
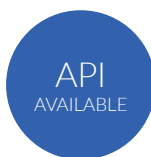
iQ-Chart Box

Uniform illumination of reflective test charts

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

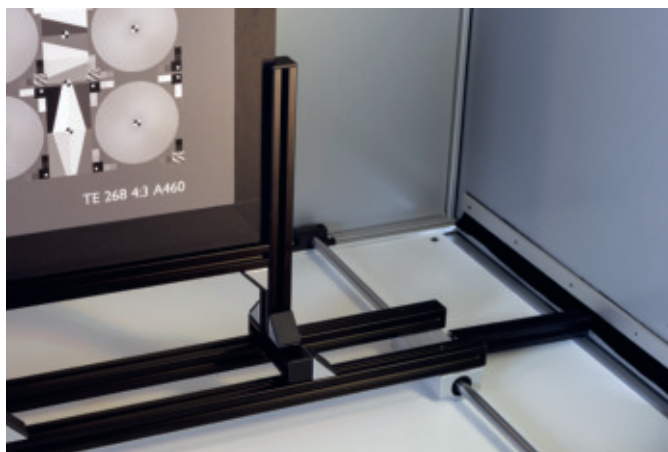
Main Features

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



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
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 lx

*measured at center of A460 sized chart

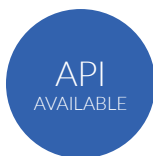
CAL Product Line

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

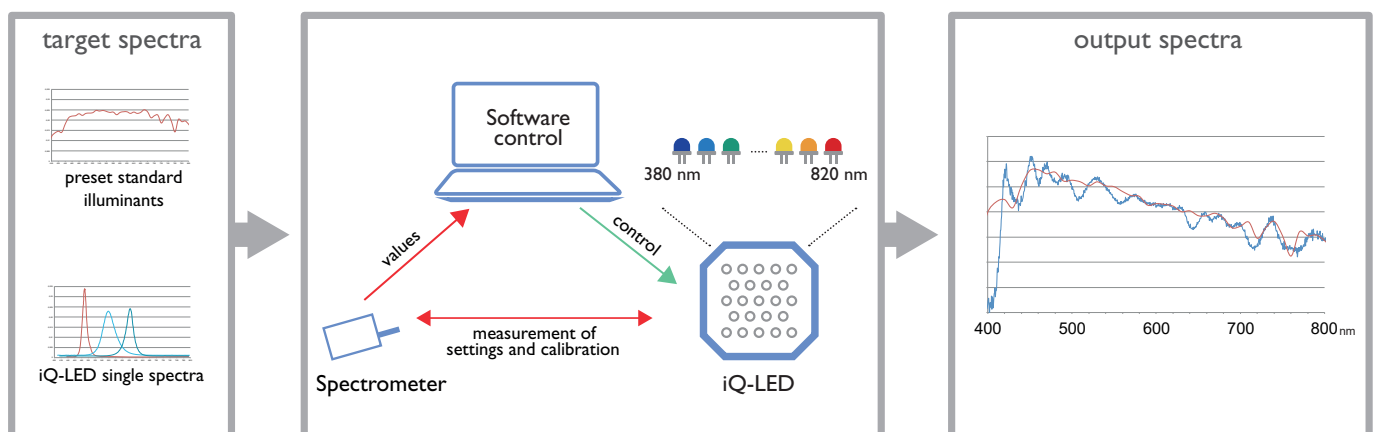
- * Includes all of the features from iQ-LED
- * Measurement of the spectral sensitivity
- * Calibration of gain/sensitivity for exposure
- * Calibrate luminance and color shading
- * Check white balance under various light sources
- * Detection of defect pixels



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.

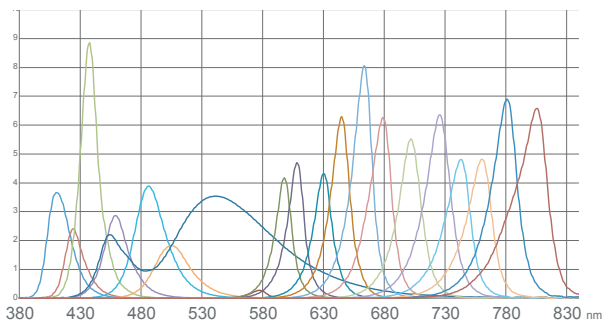


iQ-LED workflow

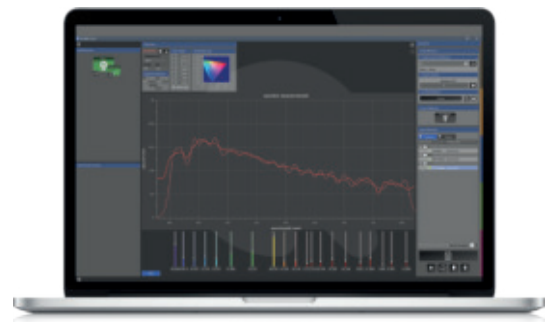
Advanced features of the CAL line

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 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 with 20 spectral channels

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: 305 – 1100 nm / Resolution: 2048 pixel / FWHM: 2.5 nm
Control system	Software-based control system via USB (included with all CAL devices), 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	<ul style="list-style-type: none"> • 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

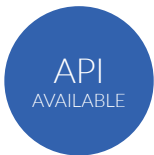
CAL1

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
- * Production line integration



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

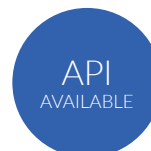
The highly adaptable camera calibration light source

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



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.



Calibrate multiple camera modules at the same time on a production line.

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

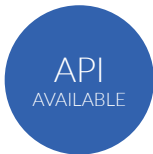
CAL3

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° field of view
- * Production line integration



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

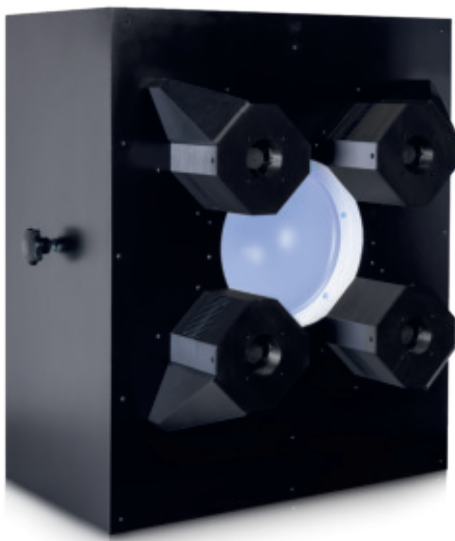
At a Glance	CAL3
Principle	Integrating sphere with uniform illumination for camera calibration and characterization of high field of view cameras.
Output window	38 mm diameter circular output window with bowl shaped diffuser
Light source	1 x iQ-LED V2: 41 SMD high-power LEDs
Uniformity	> 95%* for FOV < 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

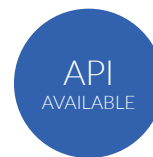
A calibration light source for ultra-wide-angle cameras

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.



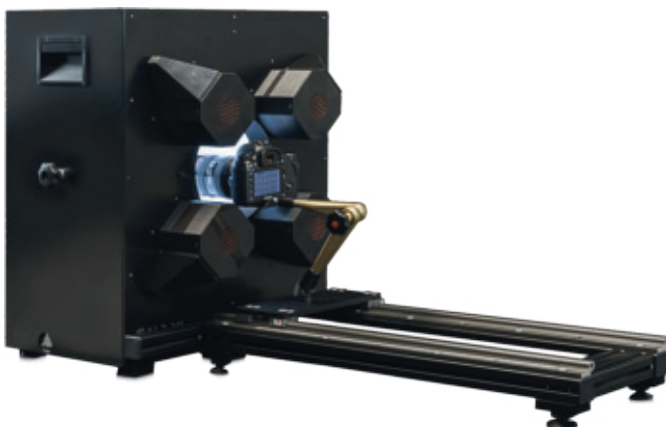
Main Features

- * 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° field of view



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.



CAL3 -XL with the iQ-Align XL

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	4 x 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 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 adapt-ers 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 resolu-tion, 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 measure-ment 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



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-Multispectral 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 VIS-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

*Bandpass filters are optional

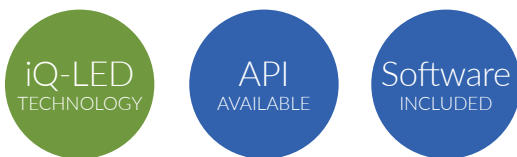
lightSTUDIO

Real scene illumination and testing

Many image quality factors are best measured with test charts. However, many factors also benefit from a real scene analysis. The lightSTUDIO contains multiple objects of various colors and textures for an accurate visual analysis.

Main Features

- * iQ-LED 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

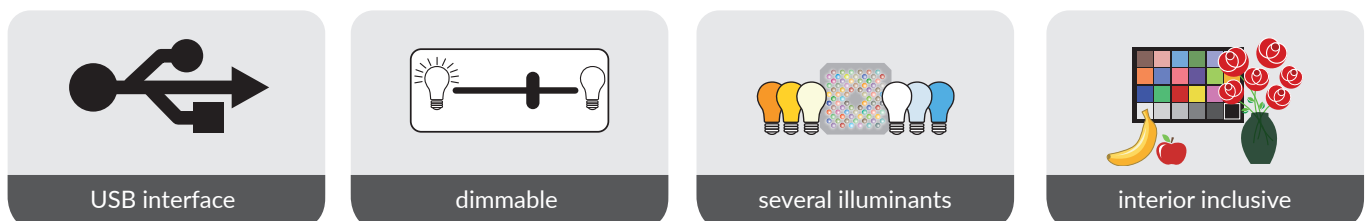


lightSTUDIO lighting options

Every lightSTUDIO is delivered with the same objects to make cross lab testing and comparison more efficient. The standard lightSTUDIO option is the lightSTUDIO-L. This version uses a light head powered by iQ-LED technology to create a spectrally tunable light source. iQ-LED can accurately recreate standard illuminants, e.g., A, D50, D65, and generate custom spectra.

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



*Halogen light options are only available on request.



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



*The product images and the interior object images are only example images and do not fully reflect the end product.

LG3

A flexible lightbox with high power and flicker generation

Get more out of high dynamic range test targets by illuminating them with up to 150000 lx 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 up to 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 a 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 up to 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 and 128 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 \pm 5%
Maximum / Minimum illumination values	Low mode: < 10 to > 6500 lx Normal mode: < 100 to > 65000 lx High mode: approx. 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 [lx] or luminance [cd/m ²] 32 kHz PWM

*We recommend using a PRC Krochmann RadioLux for measuring the exact intensity.

**Measured on a chart plane.

***Absolute intensity range depends on the inserted chart

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 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 \pm 5%
Maximum / Minimum illumination values	Normal mode: 0 – 100% / 32 kHz / 100 to 65000 lx ** Low mode: 0 – 100% / 32 kHz / 10 to 6500 lx **
Uniformity of illumination	> 95% for active chart area*, 280 x 157.5 mm > 85% at < 1% of max. intensity
Dimmable	32 kHz PWM

*Measured on a chart plane

**Absolute intensity range depends on the inserted chart

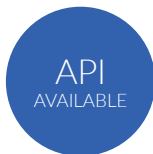
Vega

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



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, or a set with either three or seven light sources. Every set comes with a controller and control software. In addition, we offer unique grayscale test charts specifically designed for high-performance measurements using Vega. Charts are always sold separately.



Vega Starter Set



Vega set with seven light sources



Unique Vega test charts

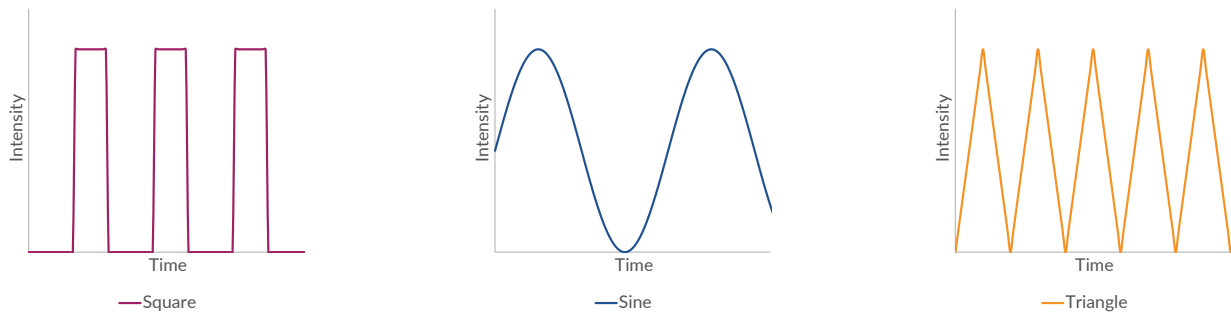
*API sold separately

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 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)	<ul style="list-style-type: none"> > 95% at 100% output intensity > 94% at 10% output intensity > 90% at 1% output intensity > 90% at 0.1% output intensity
Illumination stability	$\pm 0,5\%$
Correlated Color Temperature (CCT)	4900 K (± 200 K)
Color Rendering Index (CRI)	> 95
Minimum luminance	0.1 – 0.5 cd/m ²
Maximum luminance	55,500 – 61,500 cd/m ²
Dim function	<ul style="list-style-type: none"> • Software based • 10⁶ - 10 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	<ul style="list-style-type: none"> • Intensity • Frequency • Duty cycle • Mode selection • Phase shift
API (C/C++/Python)*	Optional

*API sold separately

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
- * Measure distortion, focal length, principle point
- * Calibrate large-field-of-view cameras
- * Stereo camera alignments and adjustments
- * IR option available

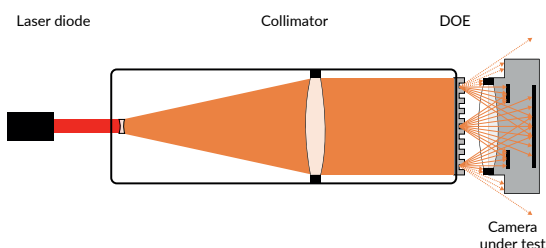


The importance of geometric calibration

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.

GEOCAL XL and GEOCAL IR

The GEOCAL XL is ideal for geometric calibration of cameras with large front lenses and in instances where the distance between the camera and GEOCAL needs to be large (e.g., calibrating through a windshield). The IR version expands the laser diode wavelength range to 935 nm for geometric camera calibrations in the NIR region.



An example of how the GEOCAL functions

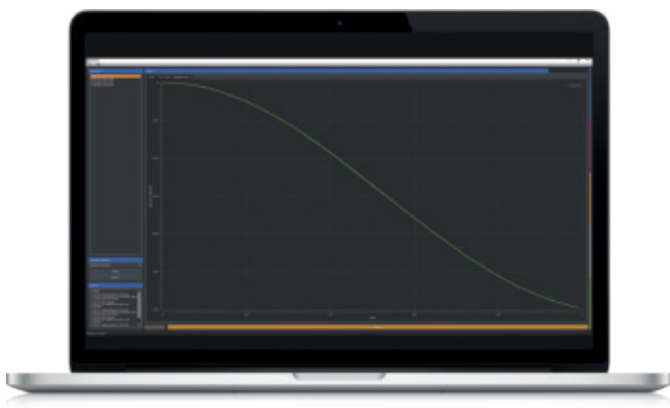


GEOCAL XL

*To a certain extent.

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 setups 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	GEOCAL-XL
Principle	DOE-based geometric calibration of digital cameras	DOE-based geometric calibration of digital cameras
Light source	Frequency-stabilized diode laser	Frequency-stabilized diode laser
Wavelength	632.8 nm	632.8 nm
Diffractive optical element (DOE)	Generates a very evenly distributed grid of light points, virtually originating from infinity	Generates a very evenly distributed grid of light points, virtually originating from infinity
Output window	Usable aperture: Ø* 77 mm	Usable aperture: Ø* 155 mm
Usable FoV	Approx. 30° – 120°	Approx. 30° – 120°
Software system requirements	PC with Windows 10 operating system (or higher)	
Additional functions	<ul style="list-style-type: none"> • Spectral measurement based on 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 • CIECAM16 implementation for profile creation • Use of 2D- and 3D-MLUT for profile creation • Export all results to XML or plain text files 	

*Camera lens needs to have an equal or smaller diameter.

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



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

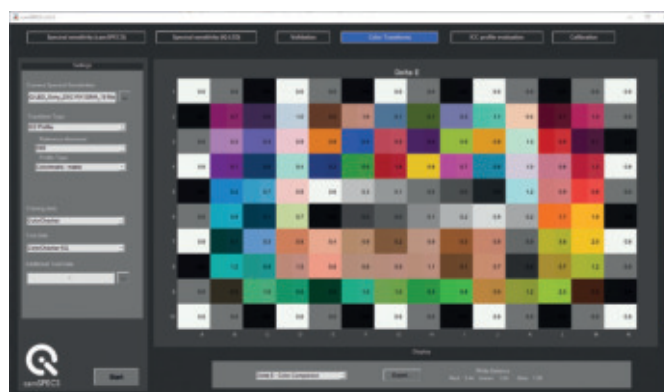
Both of the camSPECS options come with evaluation software. This software calculates the spectral sensitivity with the images and the calibration data of the filters as a direct measurement. The software also includes a module that can be used to evaluate the color correction matrix (CCM) for the camera. Color transform generation is possible once the spectral sensitivities are determined. This process is done by converting camera values to color metric values.

in-situ Database

In addition to the camSPECS software, we also offer an in-situ database. This database greatly expands on the 14 spectral radiances offered in ISO 17321-1 and includes numerous objects and scenes that people typically photograph. Each object is available in two variants, incident light and white tile corrected.

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 10 operating system (or higher)	
Additional functions	<ul style="list-style-type: none"> • Spectral measurement based on 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 	

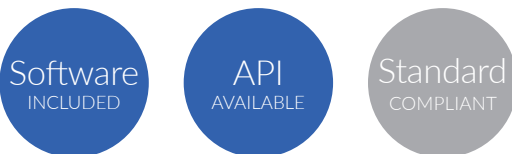
LED-Panel

Accurate camera timing measurements

The LED-Panel, now in its fifth version (V5), is a solution for measuring and analyzing all of the relevant timing features. It is also optimized to evaluate the autofocus performance of your digital camera.

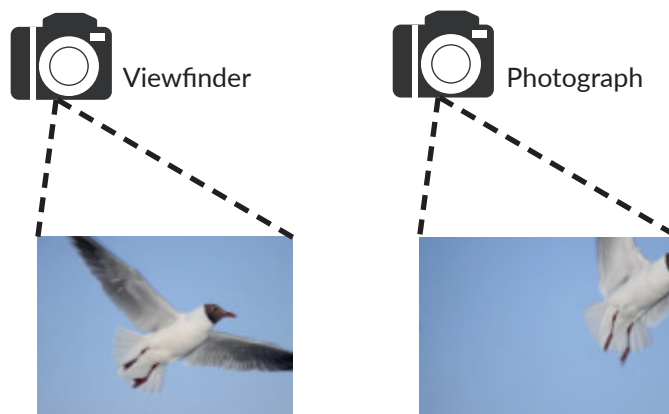
Main Features

- * Measure all timing parameters
- * Multiple IR versions available
- * Applicable to ISO 15781 and IEC 62676-5
- * Command line interface and control software



LED-Panel VIS-IR and custom wavelengths

The LED-Panel VIS-IR expands the testing range to the infrared region. It is available with a peak wavelength of either 850 nm or 940 nm. We also offer the C++ API (as a separate option) to modify various LED-Panel functions for specific requirements.



Shooting time lag, subject missed



Timing measurement solution

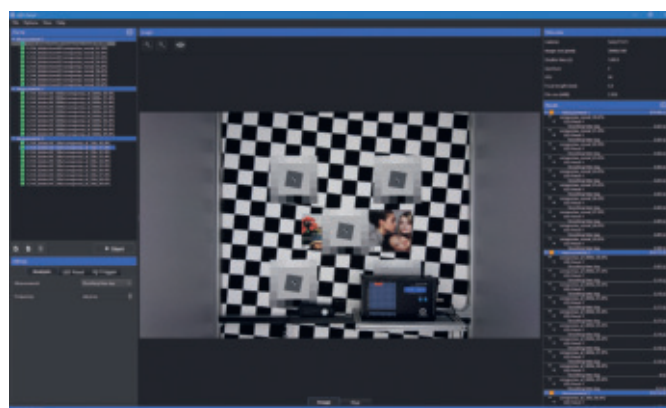
Timing measurement device

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 VIS-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)
Manual control	Operating buttons: switching between single and continuous trigger, Rotatory switch: adjusting the frame rate frequency, time, LCD and LED-array brightness. Display: shows current setting
Operating mode	External trigger, internal single trigger, continuous trigger
Adjustable times	Via USB and / or manually: 20 μ s 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 200 Hz
Software system requirements	PC with Windows 7 operating system (or higher) and USB port
Additional functions	Software control LED-Panel V5 Analysis of images taken from LED-Panel V5

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.

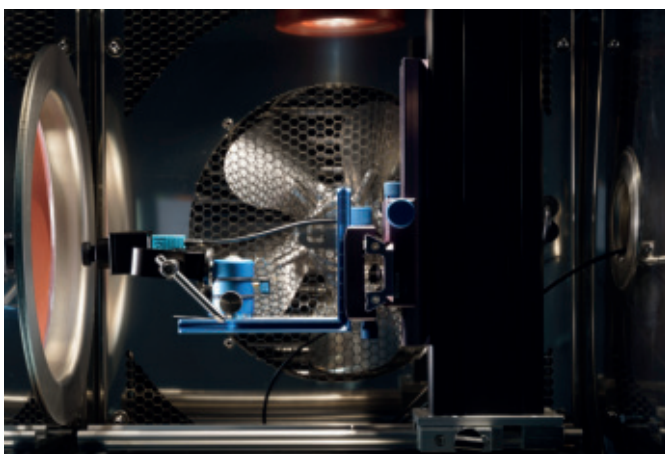
Main Features

- * 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
- * Software control



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.



iQ-Climate Chamber internal view

At a Glance	iQ-Climate Chamber
Principle	Camera tests under various temperature conditions
Temperature range	-30 to 120 °C
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



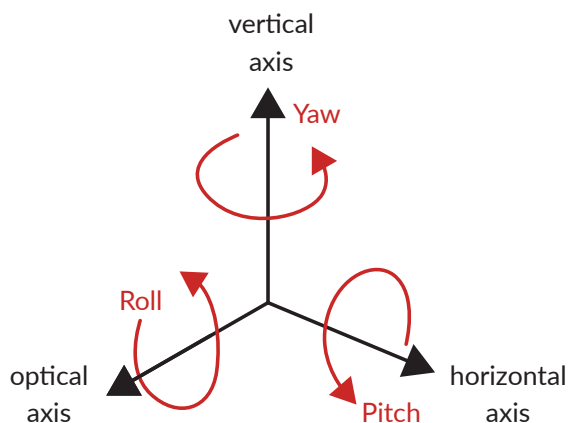
STEVE-6DS



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

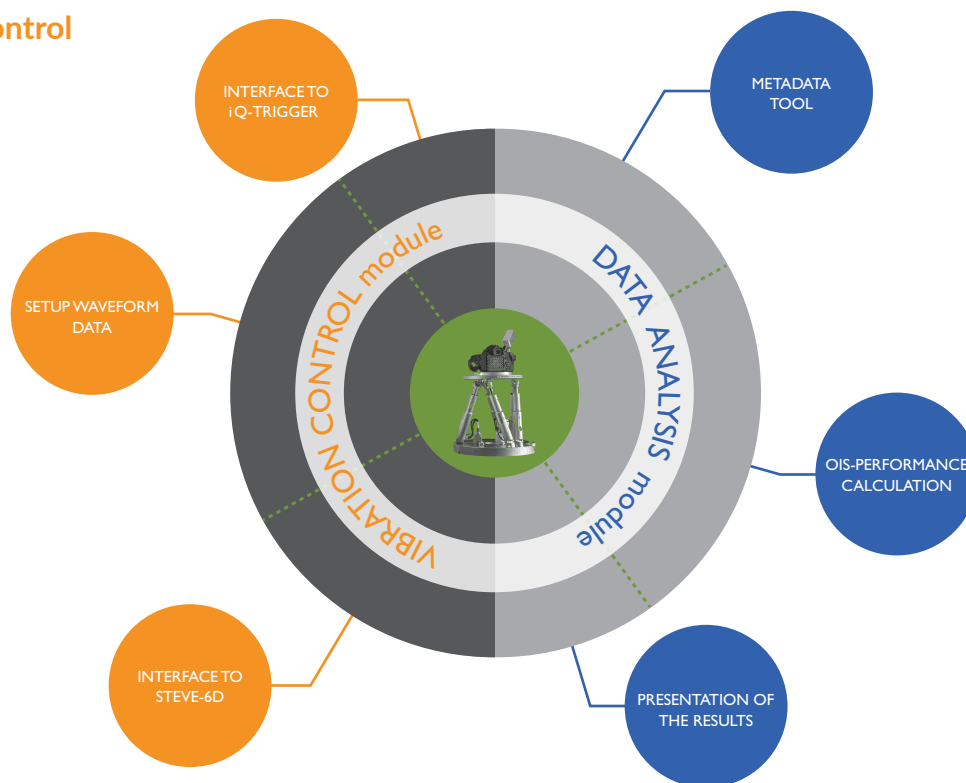
STEVE-6D modules

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.

Vibration Control

Analyze Data



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 mm, ± 16 mm, ± 6.5 mm	± 50 mm, ± 50 mm, ± 25 mm
Rotation range (X / Y / Z)	$\pm 10^\circ$, $\pm 10^\circ$, $\pm 21^\circ$	$\pm 15^\circ$, $\pm 15^\circ$, $\pm 30^\circ$
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, Honeycomb Breadboard, iQ-Anchor for STEVE	iQ-Trigger/-T, iQ-AF Box, TE261, Honeycomb 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



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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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-Near Focus

Evaluating the autofocus performance of a camera system

iQ-Near Focus will help you evaluate the autofocus performance of a camera. This device consists of a high-contrast, motorized, and translucent checkerboard test chart that will assist with precisely focusing the camera at a near distance.

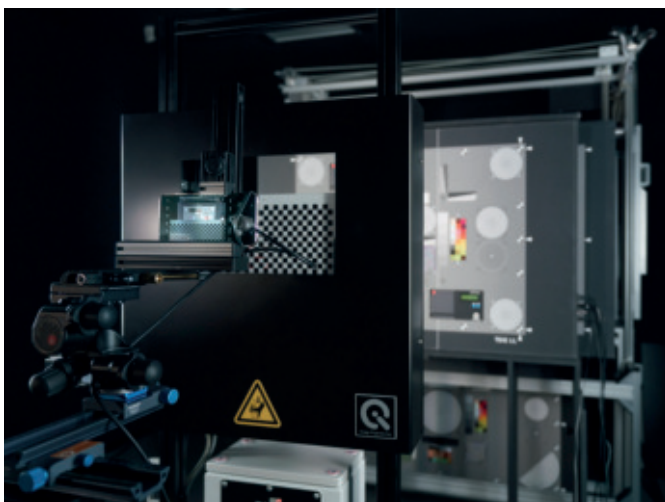
Main Features

- * Remote triggering of the autofocus process
- * A high contrast translucent checkerboard target
- * Easy integration with the LED-Panel



Related products and specifications

The iQ-Near Focus can be easily implemented with the LED-Panel, our popular timing measurement device. The LED-Panel can measure all essential timing measurements, including shooting time lag, shutter lag, exposure time, start-up time, etc. Together with the iQ-Near Focus, you have a powerful solution for analyzing your camera system's timing and autofocus performance.



iQ-Near Focus with iQ-Mobilemount

At a Glance	iQ-Near Focus
Principle	An automated solution for remote triggering of the autofocus process using a high contrast translucent target.
Max. stroke distance of chart	290 mm
Specialties	<ul style="list-style-type: none"> • Reversible motion-profile (down→up / up→down) • Adjustable delay between down and up motions in steps of 1 s • Designed for optimal workflow with the LED-Panel
Height-adjustable frame	<ul style="list-style-type: none"> • Range of adjustments: 20 cm • Minimum height (center of chart to the floor): approx. 149 cm • Maximum height (center of chart to the floor): approx. 169 cm

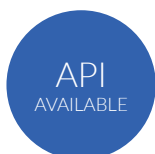
iQ-Defocus

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



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	<ul style="list-style-type: none"> • Optimal workflow with the iQ-Mobilemount • Adjustable depth
API (C++)	Included in iQ-Defocus product bundles

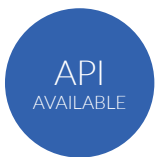
EX2

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



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 ($\approx 25^\circ$ FOV), or cosine corrector add-on ($\approx 180^\circ$ FOV)
Spectral range	200 - 1100 nm (irradiance calibration: 305 - 1100 nm)
Resolution	2048 pixel/FWHM 2.5 nm
Integration time	30 μ s – 59 s
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 high speed 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++. 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.

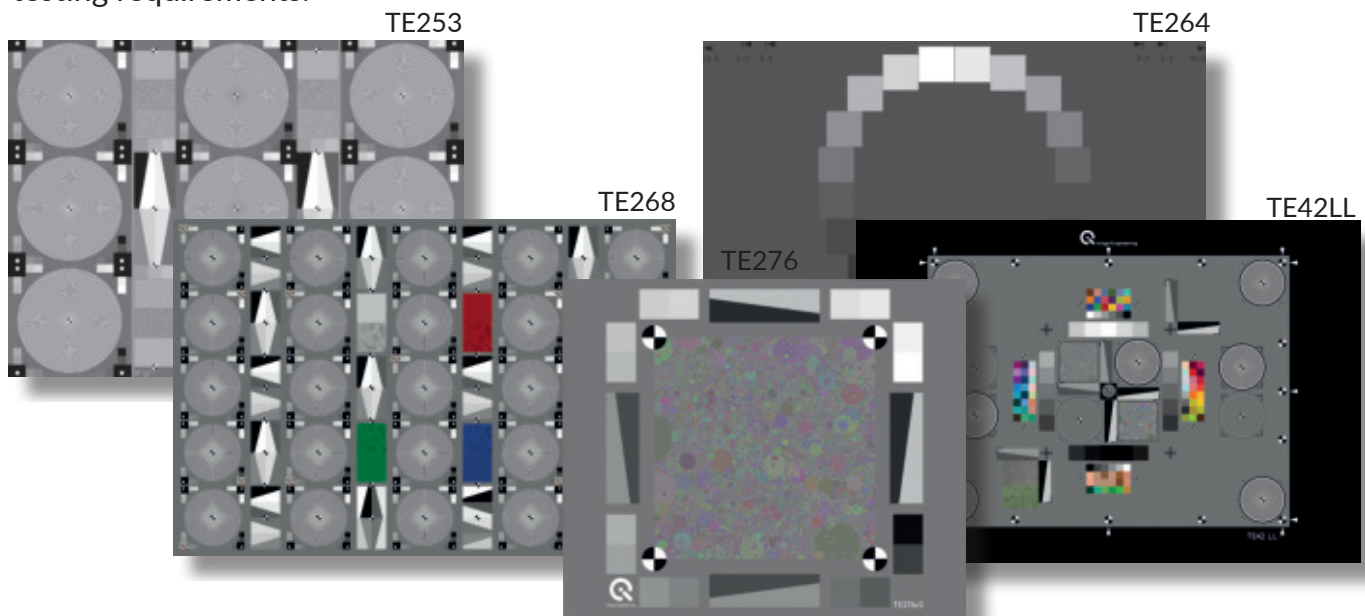
Main Features


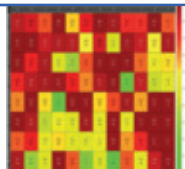
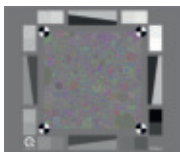
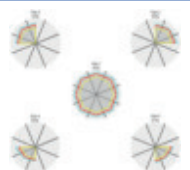


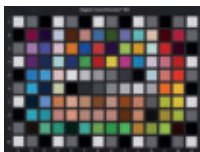
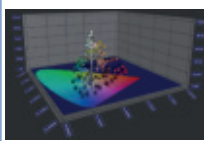


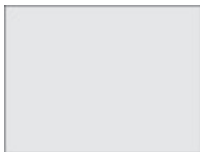
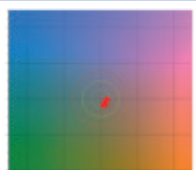

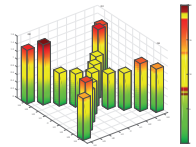


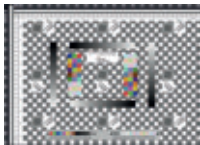

- * Flexible user interface
- * Automation feature
- * Database storage for all results
- * Automatic chart detection
- * Custom test templates
- * Analyze with individual reference data
- * Live Video Import and Analysis
- * Network license functionality



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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> Camera OECF (ISO 14524) ISO speed (ISO 12232) Noise and dynamic range (ISO 15739) White balance 	
Color		<ul style="list-style-type: none"> Color reproduction – Delta E* Difference luminance, chroma and hue – Delta (L*, C*, H*) Visual noise Selectable chromatic adaptation and color difference formulas 	
Distortion		<ul style="list-style-type: none"> Lens geometric distortion (ISO 17850 & IEEE P1858 CPIQ) TV-distortion Lateral chromatic aberration Longitudinal chromatic aberration 	
Shading		<ul style="list-style-type: none"> Lens vignetting Luminance shading in f-stops or as a percentage Color shading Noise (depending on image field) 	
Flare*		<ul style="list-style-type: none"> Flare measurement over the image field (ISO 18844) Dark frame subtraction (optional) 	
Video		<ul style="list-style-type: none"> Capturing frames from video files 	
UTT		<ul style="list-style-type: none"> Scanners and archiving (ISO 19264) Pass/Fail assessment Size A4 – A0 	

*Coming soon

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 and Python sample scripts for our iQ-LED, GEOCAL, Vega and LG3 APIs. 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
Vega API	X	X	Vega	Full control over Vega devices
iQ-Drive API	X		iQ-Bench-M // iQ-Automator iQ-Chartmount-VM // 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	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	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-X	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

*Coming soon

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

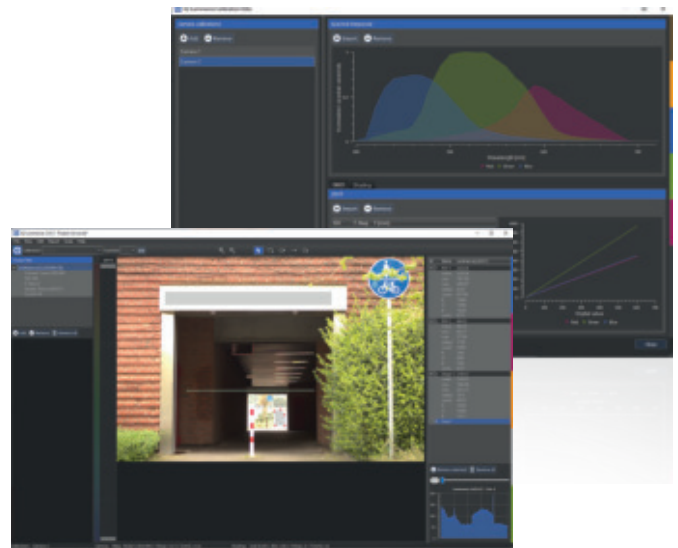
iQ-Luminance

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.

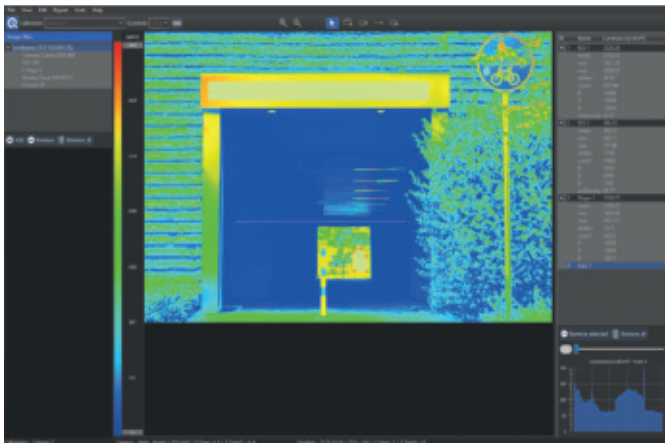
Main Features

- * Calculate luminance values from image data
- * Map raw RGB data to the luminance
- * Calibrate at multiple f-stop levels
- * Calibrate for various ISO-settings
- * Comprehensive ROI selection tool
- * Export results as PDF report and XML file
- * Import / export ROIs

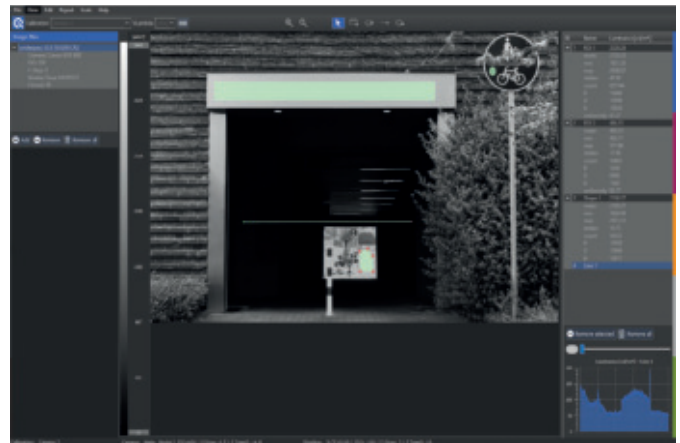


Evaluate the image

Rectangular, circular, line-shaped 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.

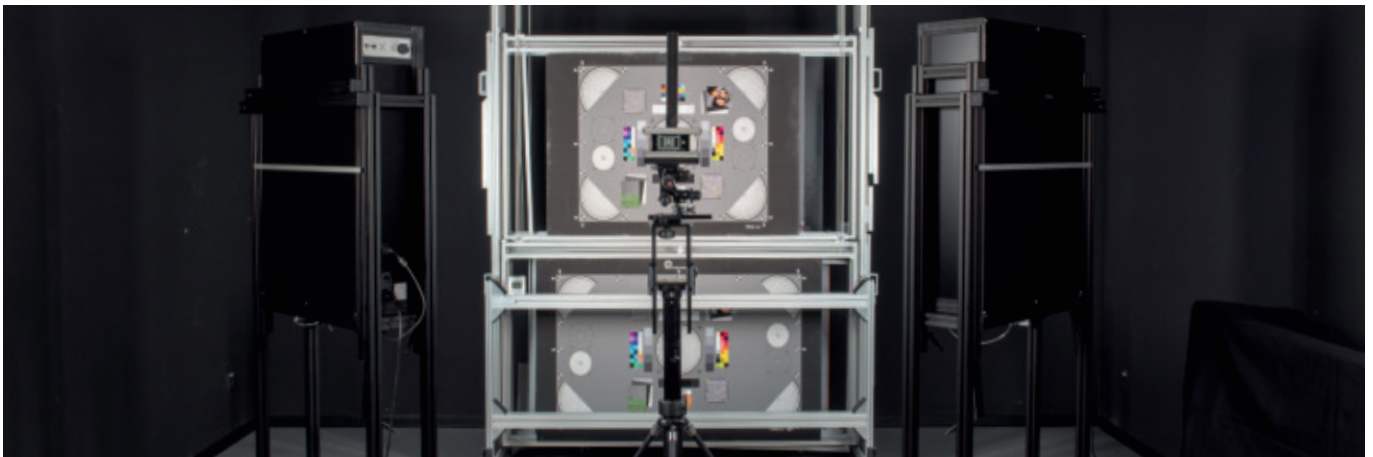
Test Laboratory

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

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

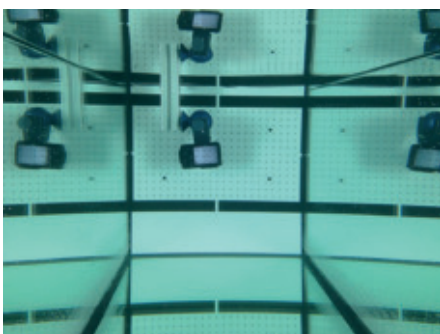
Each camera system we receive is put under a comprehensive image quality test by one of our specially trained engineers. The tests that we use on a daily basis are always adapted to the most up-to-date international standards for all of the various image quality factors. We also work with companies to 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

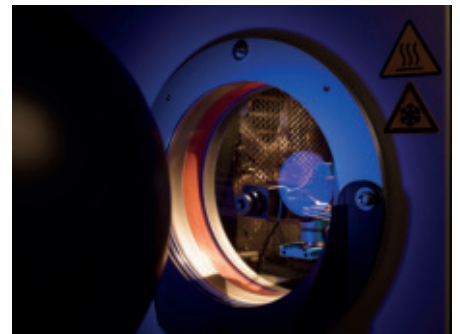
While most of our everyday testings is for industry-specific tests, our lab also performs special tests upon request. Underwater camera testing, drone, temperature fluctuations, and broadcast cameras are just a few examples of the unique cameras and tests we can do in our test lab.



Underwater camera testing



Testing resolution of a drone camera



Test with changing climate conditions

Camera Performance for Automotive Systems – camPAS

The camPAS test concept is a uniquely designed performance test for camera and sensor systems within the automotive industry. We offer camPAS to automotive manufacturers who need independent and objective results to support their development decisions as a trusted third party.

The automotive camera industry is experiencing an exceptional advancement in camera system technology. With such rapid changes, it has become difficult for the testing standards to keep up. We currently model camPAS tests on the pre-release of the IEEE-P2020 international standard. Many of our test engineers are actively participating in the development of the standard.



camPAS testing overview

camPAS is developed as a third-party solution for end device manufacturers and component suppliers. We provide objective results based on a custom test agreement between the manufacturer or supplier and us as the third party. The results are always kept confidential between Image Engineering and the other party.

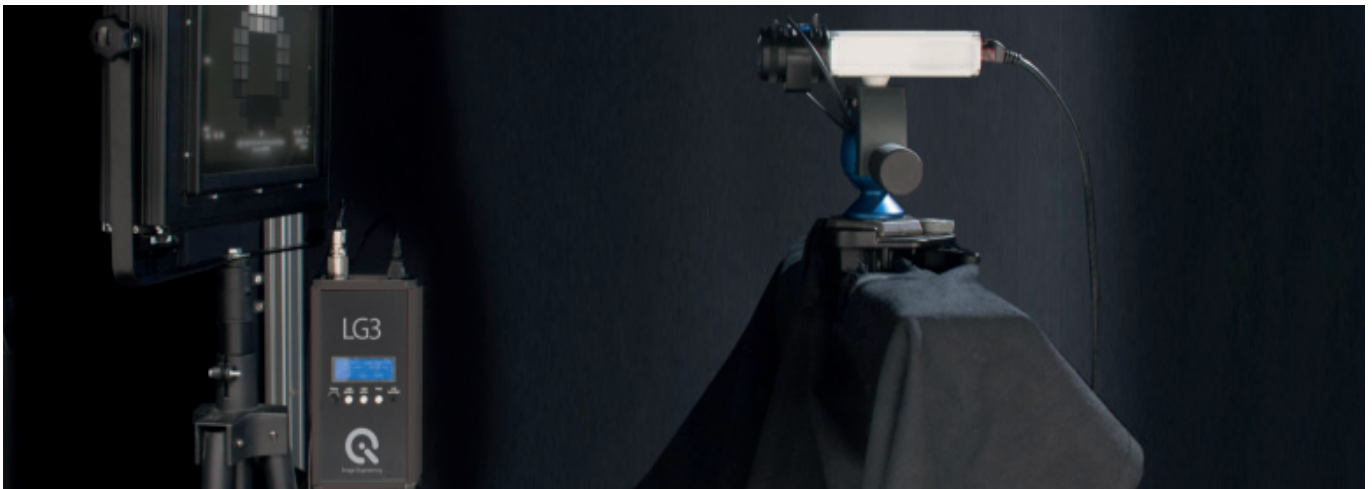
The test itself consists of the most important KPIs for evaluating automotive camera system performance. Tests include contrast detection probability (CDP), modulated light mitigation probability (flicker), high dynamic range (HDR), linking objective image quality measurements with a visual assessment of low-light performance, etc. Each test can be customized to meet specific requirements.



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-Flat-light 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.



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.

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.



TE42

A multipurpose test chart for a quick image quality overview

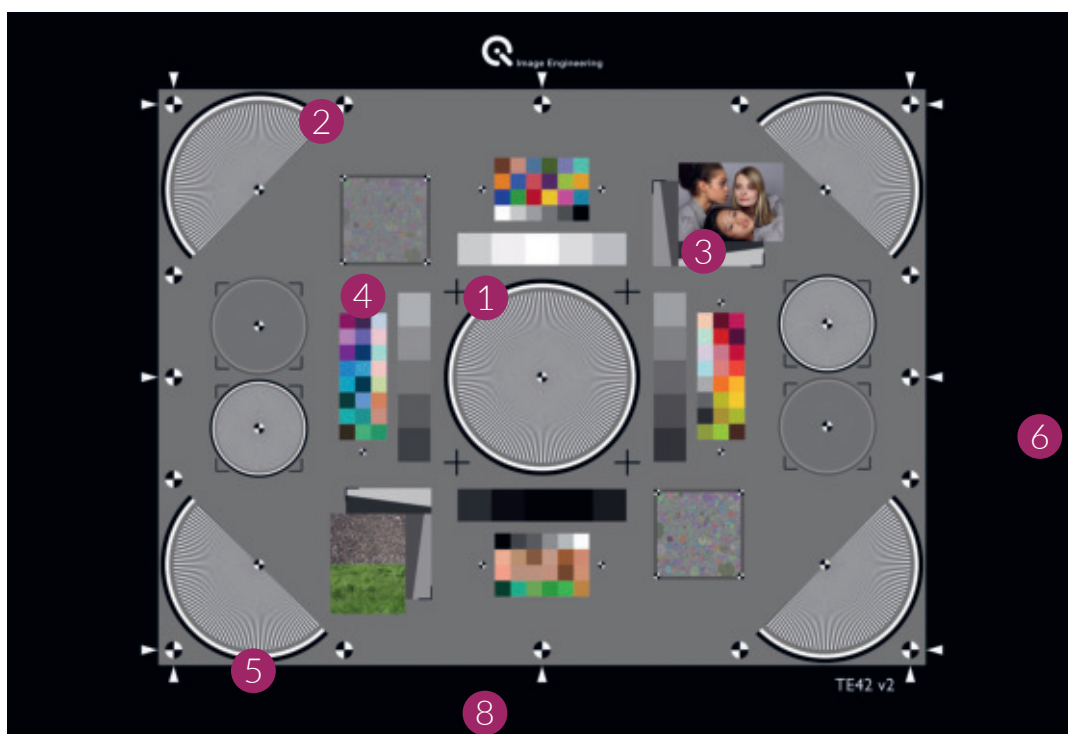
The TE42 chart is a multipurpose test chart that can quickly gather an overview of a camera's image quality performance in a single image. The chart is designed with multiple objects on the same chart plane for testing a wide variety of image quality factors, all of which can be analyzed using the iQ-Analyzer-X 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.



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

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



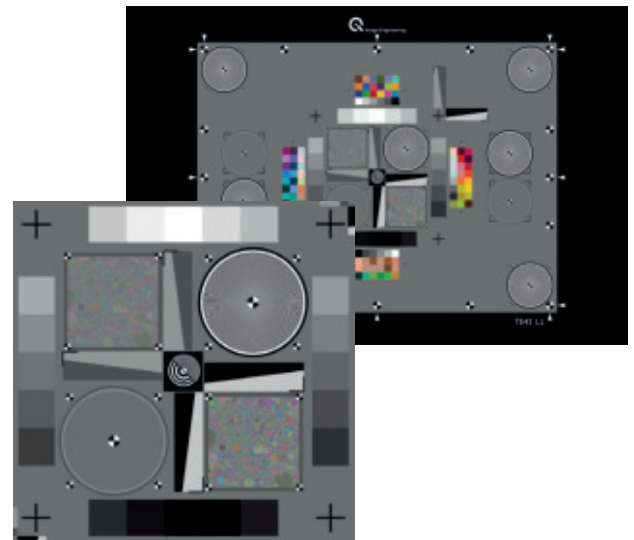
TE42-LL

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.

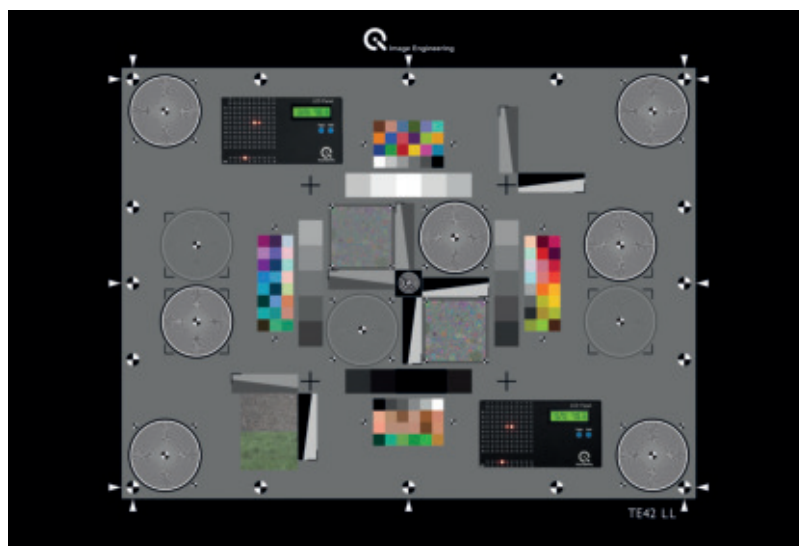
Main Features

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



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

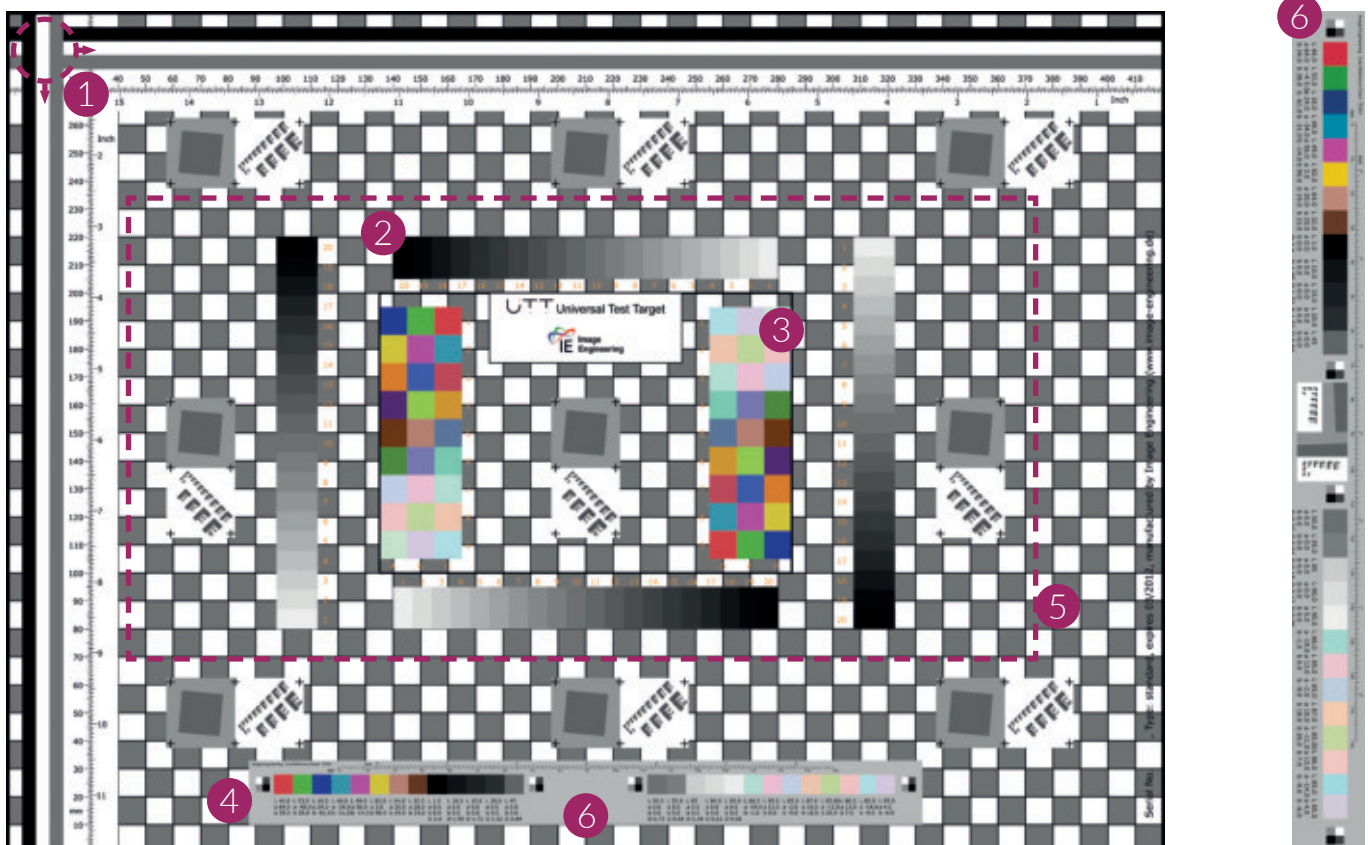
The UTT chart is a multipurpose test chart designed to evaluate the image quality of scanners and other digital input devices for the archiving industry. It is available in various sizes ranging from A4 to A0. The iQ-Analyzer-X software (not included with chart) can automatically analyze the image and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



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



iQ-Analyzer-X support

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

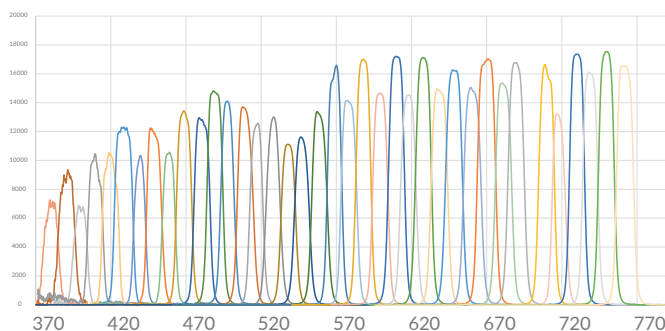


iQ-LED illumination with the LE7

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. The LE7 includes iQ-LED control software, and we also offer a C or C++ API as a separate option.

TE292B VIS-IR

The TE292B VIS-IR version extends the wavelength range from 380 nm to 1050 nm in 10 nm steps and has a total of 68 filters.



Wavelengths [nm] of the TE292 filters



LE7 with TE292B VIS-IR

*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

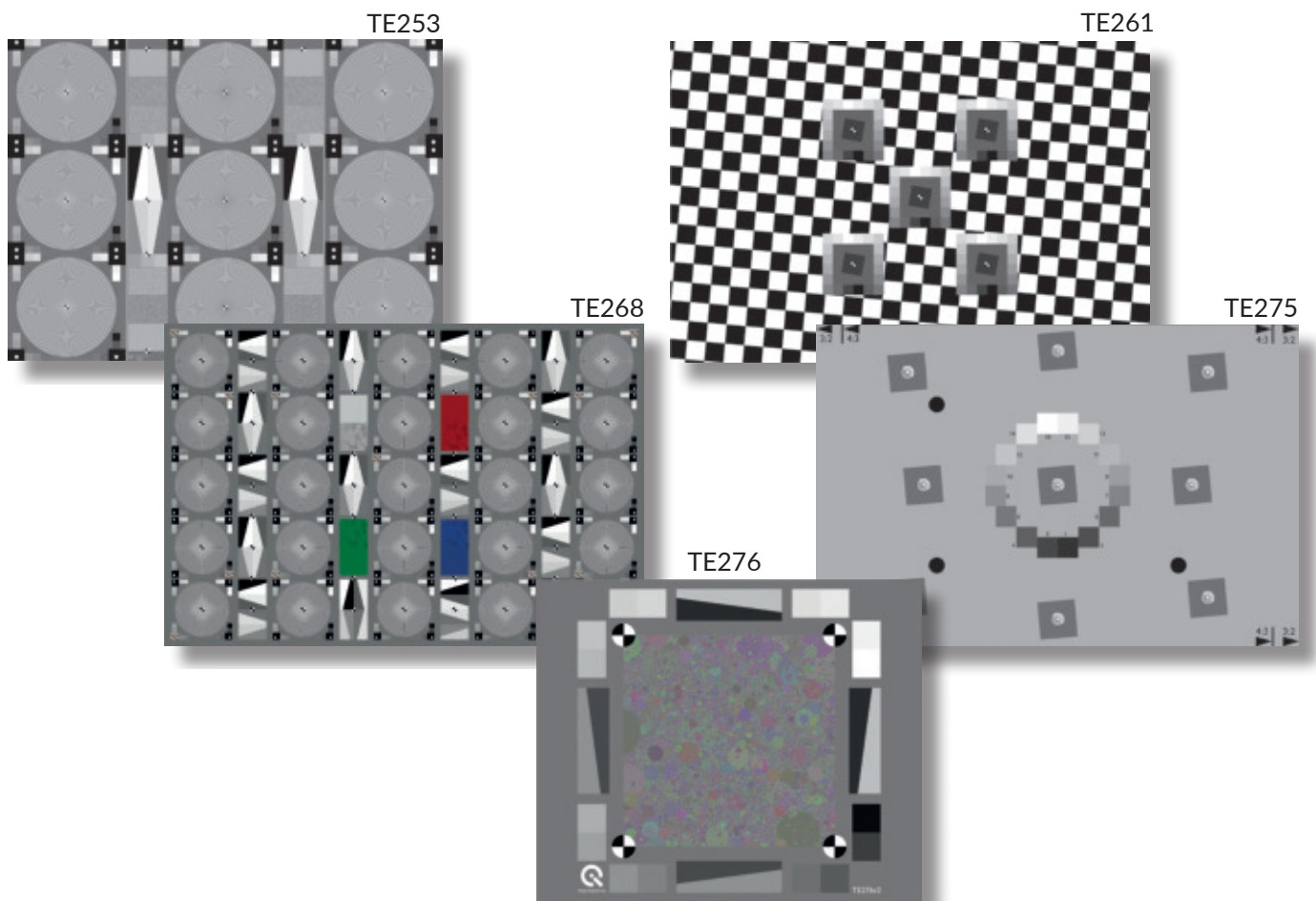
Uniquely designed test charts for measuring camera resolution

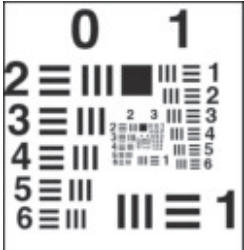
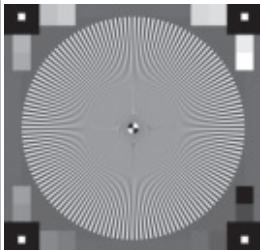
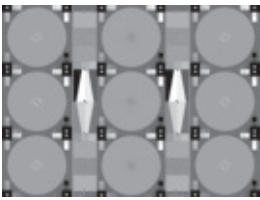
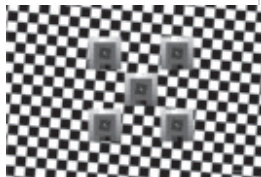
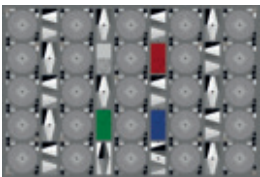
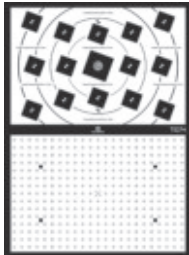

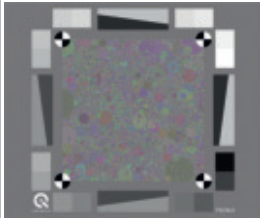
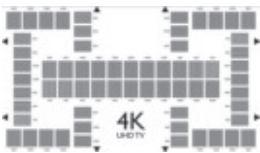
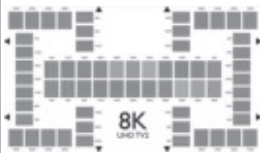
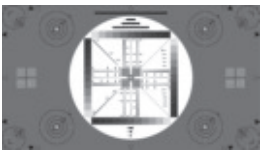
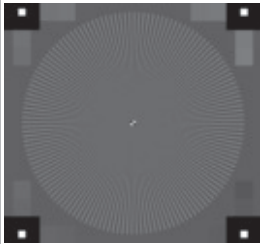
Image resolution is the ability of a digital camera to reproduce the fine details of a scene. In other words, how clear a human observer perceives an image is based on the resolution of the camera system. As a result, it is vital to thoroughly test and analyze the resolution of a camera system.

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 	<ul style="list-style-type: none"> • USAF resolution chart • Evaluate scanner resolution • Measurements up to 10,000 ppi • Transparent 	TE253 4:3  <ul style="list-style-type: none"> • Modulated sinusoidal Siemens star • Evaluate camera resolution • Reflective
TE253 9x 4:3 / 16:9 / 35 mm 	<ul style="list-style-type: none"> • Follows ISO 12233:2014 • Nine sinusoidal Siemens stars • Slanted edges and white noise patches • Transparent/Reflective 	TE261 16:9  <ul style="list-style-type: none"> • Slanted edge chart • Evaluate camera SFR • Includes low contrast slanted edges • Reflective
TE268 4:3 / 3:2 	<ul style="list-style-type: none"> • Lens resolution and sharpness chart • 25 sinusoidal Siemens stars • 16 slanted edges in different contrasts • Four colored dead leaves patterns • Reflective 	TE274 3:2  <ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • Slanted edge chart • Evaluate camera resolution • ISO 12233:2017 • Reflective 	TE276 287 x 287 mm (picture size)  <ul style="list-style-type: none"> • Dead Leaves chart • Evaluate texture loss • Circles in all sizes and colors • Reflective
TE277 16:9 	<ul style="list-style-type: none"> • 4k (UHD TV) resolution chart • 100-2000 CPH • Frequency response measurement of a 4K camera • 50 multiburst fields • Transparent 	TE278 16:9  <ul style="list-style-type: none"> • 8K (UHD TV2) resolution chart • 200-4000 CHP • Frequency response measurement of an 8K camera • 50 multiburst fields • Transparent
TE279 16:9 	<ul style="list-style-type: none"> • 4k (UHD TV) universal chart • Quick analysis of transmission characteristics • Multiple gray scales and resolution wedges • Transparent 	TE280 334 x 271 mm  <ul style="list-style-type: none"> • Evaluate texture loss • ISO 19567 • Sinusoidal Siemens star • 18% and 48% modulation available • Reflective

Grayscale charts

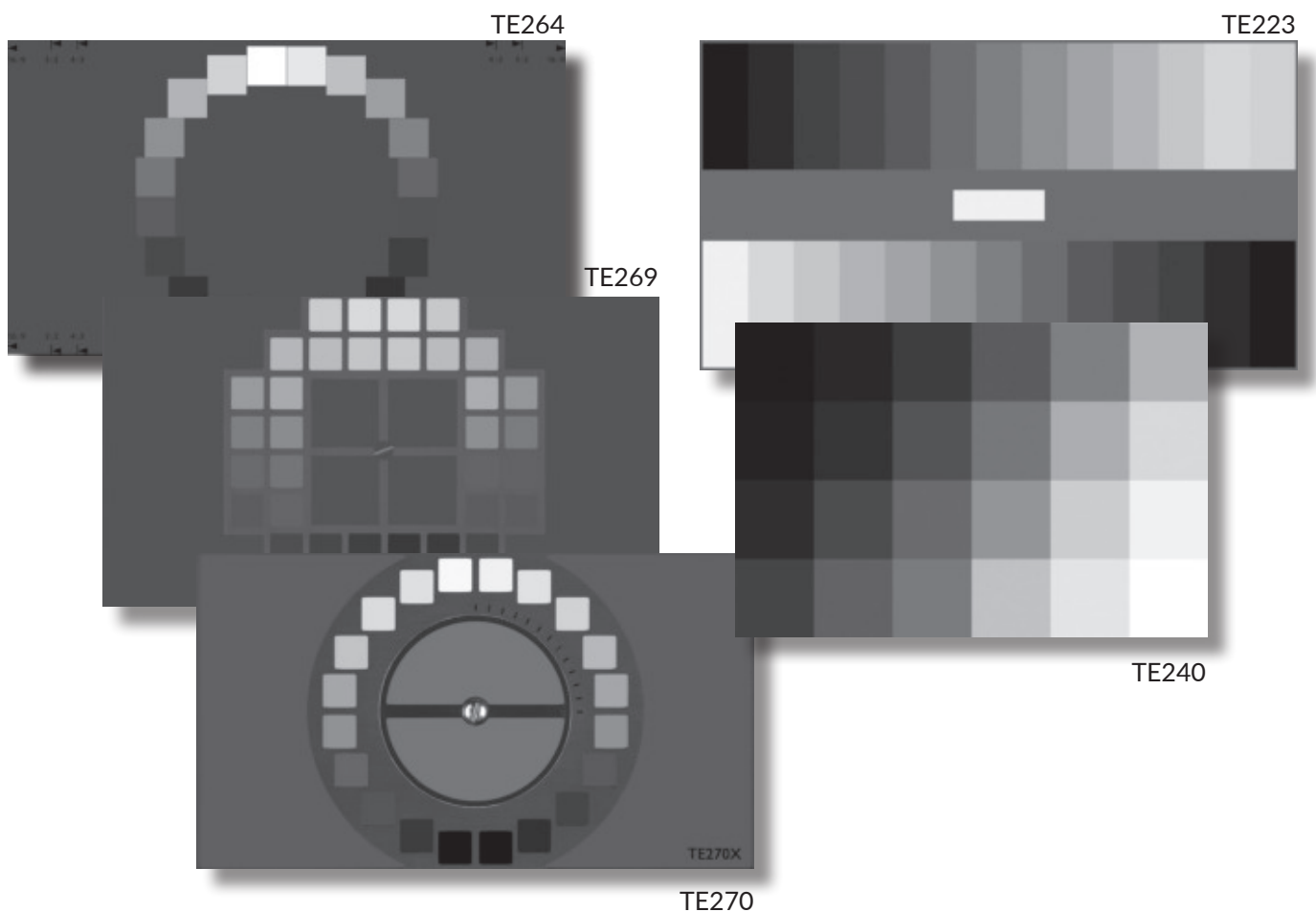
Test charts for analyzing the different grayscale factors

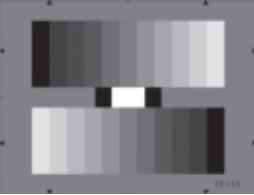



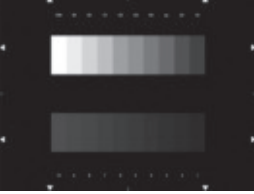











Grayscale refers to the various shades of gray that are present throughout the image. Many different image quality factors are important when measuring how well a camera reproduces the tonal value of an image, including OECF, dynamic range, gamma, and noise.

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 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Evaluate exposure control • 18% remission • Transparent/Reflective 	TE197 16:9 	<ul style="list-style-type: none"> • ISO 14524 • Evaluate OECF • 12-step gray scale • Multiple contrasts • Transparent/Reflective
TE205 4:3 	<ul style="list-style-type: none"> • Gamma measurement chart • Ten gray steps from 1-10% transmission • Ten gray steps from 10-100% transmission • Transparent 	TE223 16:9 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • OECF and noise chart • Evaluate the characteristic curve of a camera • 20 gray patches • Transparent
TE259 16:9 	<ul style="list-style-type: none"> • OECF and noise chart • Evaluate dynamic range on a waveform monitor • 20 gray patches • Contrast range of 10,000:1 • Transparent 	TE264 16:9 	<ul style="list-style-type: none"> • OECF chart • ISO 14524 and 15739 • 12 or 20 gray patches • Metal frame to avoid stray light and reflections • Transparent 
TE269 16:9 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 

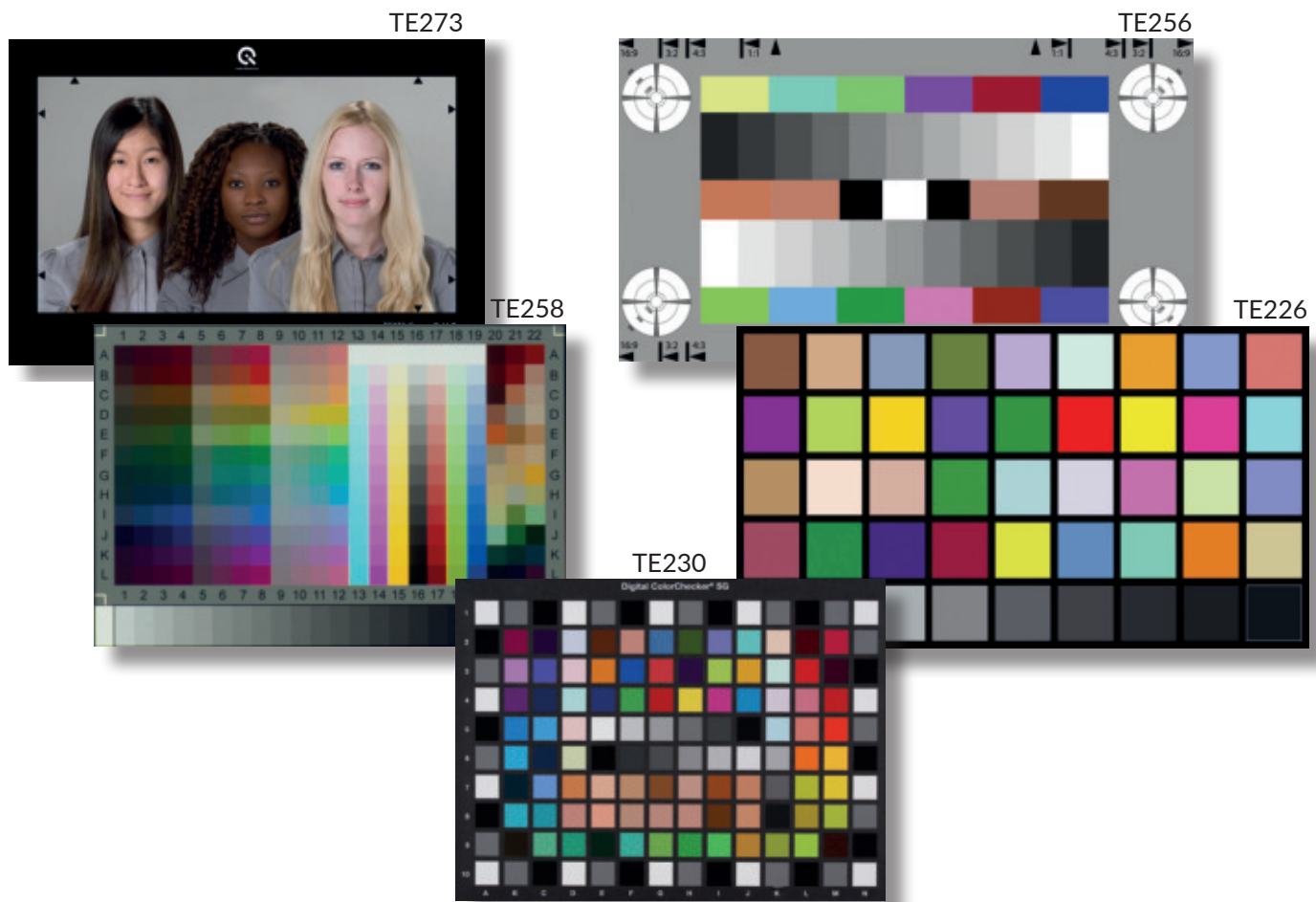
Color charts




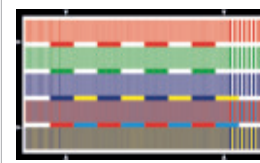



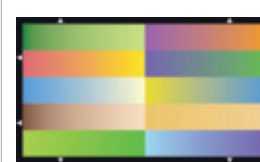

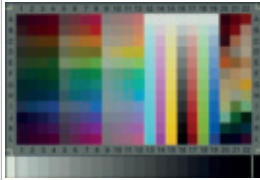


Test charts for analyzing the color reproduction of a camera

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.



BBC61 4:3 	<ul style="list-style-type: none"> Flesh tone reference chart BBC approved Reflective 	TE106 4:3 / 16:9 	<ul style="list-style-type: none"> Evaluate color rendition Primarily for TV cameras 6 color bars Transparent/Reflective
TE188 4:3 / TE188 16:9 (X-Rite ColorChecker) 	<ul style="list-style-type: none"> Evaluate color rendition 18 color patches 6-step grayscale Transparent/Reflective 	TE222 16:9 	<ul style="list-style-type: none"> Color resolution of HD cameras R, G, B, BY and MC multiburst patterns from 2 MHz to 20 MHz
TE226 16:9 	<ul style="list-style-type: none"> HDTV color rendition 36 color patches 9-step grayscale Transparent 	TE230 4:3 (X-Rite ColorChecker SG) 	<ul style="list-style-type: none"> Evaluate color rendition 140 color patches 14 skin-tone patches Reflective
TE233 16:9 	<ul style="list-style-type: none"> Evaluate color reproduction 24 color patches 4 skin tone patches Reflective 	TE234 16:9 	<ul style="list-style-type: none"> Evaluate color gradation Check for quantization errors Reflective
TE256 16:9 	<ul style="list-style-type: none"> Evaluate color and calibration Color align HD cameras Reflective 	TE258 35 mm film / 5 x 7-inch paper 	<ul style="list-style-type: none"> T8 scanner characterization chart Create color management profiles Transparent/Reflective
TE273 16:9 	<ul style="list-style-type: none"> Natural skin tones Single image varieties Group image varieties Transparent/Reflective 	TE289 4:3 	<ul style="list-style-type: none"> Color reproduction of a mirror replacement system ISO 16505:2015 Munsell (advanced) version Reflective print (basic) version

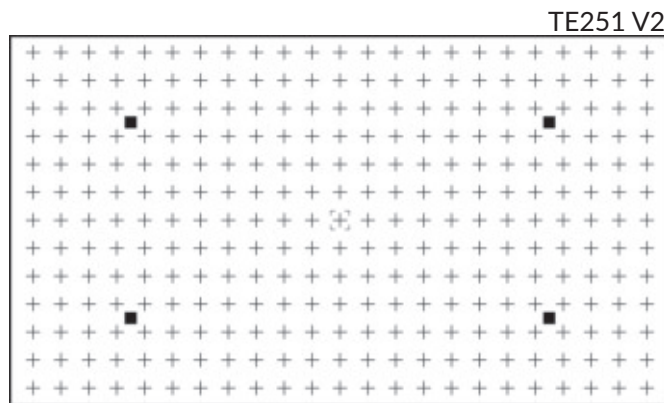
Lens performance charts

Test charts for measuring the performance of a lens

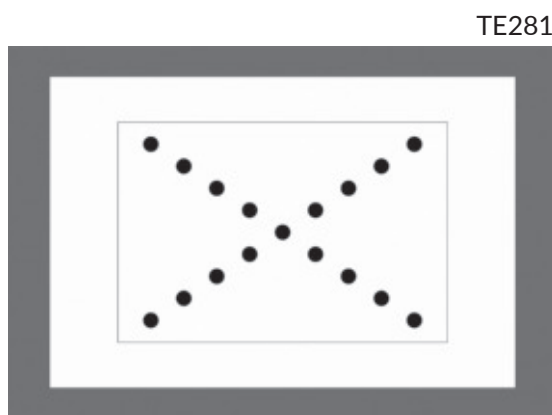
The performance of a lens depends on how the image is affected by different image quality factors, including lens distortion, shading/vignetting, and flare. These factors are frequently a result of optical aberrations and light reflections from the optical components within the lens and are oftentimes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

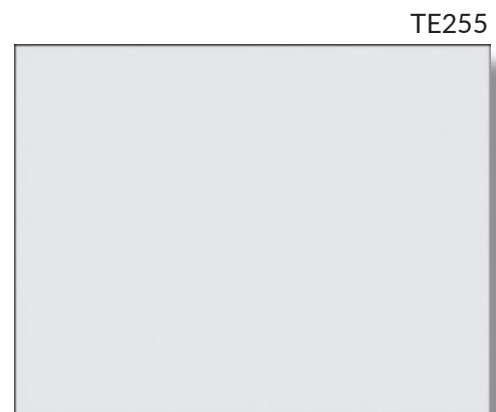
While these factors often depend on the surrounding environment, they can also be tested using specifically designed test charts. We have developed a wide variety of test charts to test for distortion, shading/vignetting, and flare.



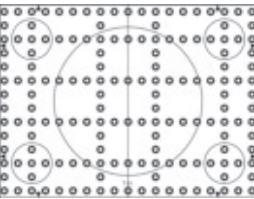
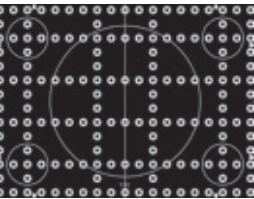
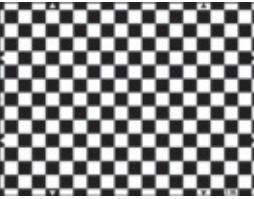
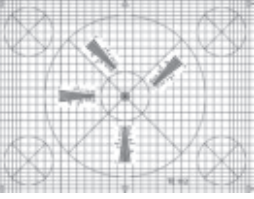


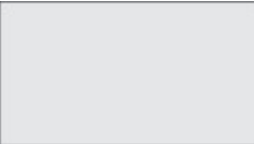
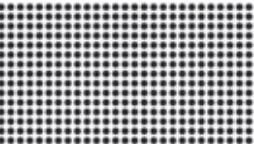

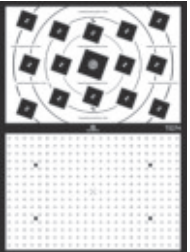
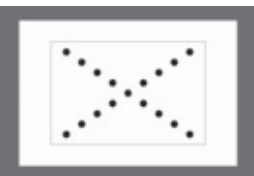
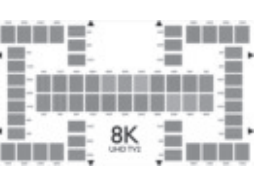
Geometry grid to measure lens distortion



Flare chart based on ISO 18844



Diffuser plate to measure vignetting

T01W 4:3 / 16:9 	<ul style="list-style-type: none"> • Geometry ring chart • Measure geometry of cameras and monitors • Rings arranged on grid with white surrounding • Transparent/Reflective 	T01B 4:3 / 16:9 	<ul style="list-style-type: none"> • Geometry ring chart • Measure geometry of cameras and monitors • Rings arranged on grid with black surrounding • Transparent/Reflective
T06 4:3 / 16:9 	<ul style="list-style-type: none"> • Chess board chart • Evaluate geometry and resolution • Transparent/Reflective 	TE112 4:3 	<ul style="list-style-type: none"> • Grid chart • For adjustment and control of TV cameras • Grid lines for adjusting registration • Wedges for resolution appraisal • Transparent/Reflective
TE183 4:3 	<ul style="list-style-type: none"> • 19/14 Grid chart • IEC 84/60B • Adjustment and control • Visual appraisal of scan linearity • Lines for adjusting registration • Transparent/Reflective 	TE251 V2 16:9 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Diffuser plate • Evaluate shading/vignetting • 61% transmission • Transparent • Included in the scope of delivery of the LE7 	TE260 16:9 	<ul style="list-style-type: none"> • Dot chart • Two charts different charts on front and back sides • Evaluate distortion and chromatic aberration • Reflective
TE271 16:9 	<ul style="list-style-type: none"> • 3D alignment chart • Align and adjust 3D cameras • Combination of 2D and 3D structures • Reflective 	TE274 3:2 	<ul style="list-style-type: none"> • Macrochart 13 x 13 cm • Slanted edges for resolution • Crosses for distortion • Special alignment frame for positioning • Reflective
TE281 3:2 	<ul style="list-style-type: none"> • Flare chart • ISO 18844 • 17 light traps (super black holes) • Evaluate scattering light • Reflective 	TE278 16:9 	<ul style="list-style-type: none"> • 50 multiburst fields • Resolution measurement horizontal and vertical • Transparent

Custom Charts

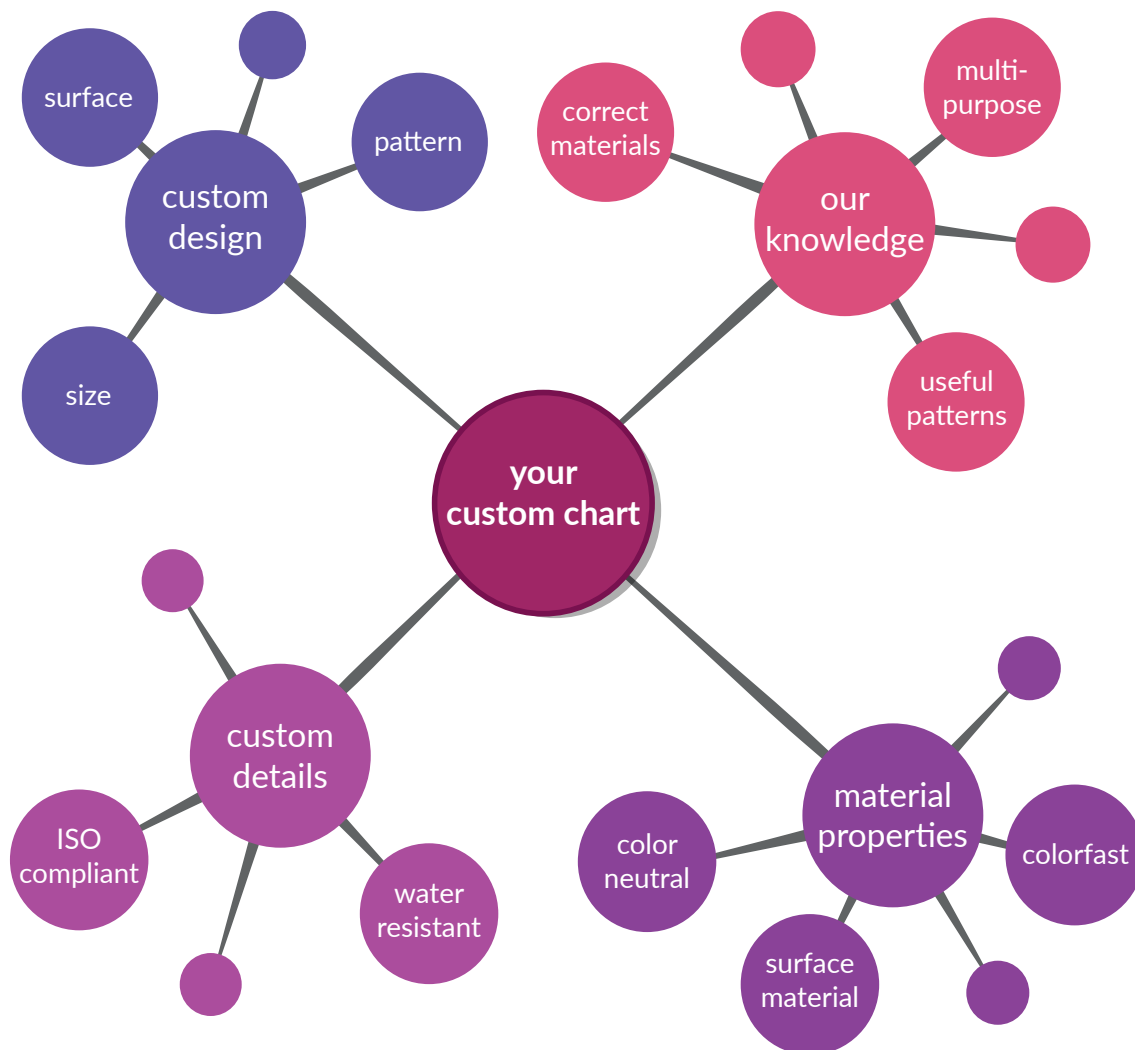
We can help you design a custom test chart

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.

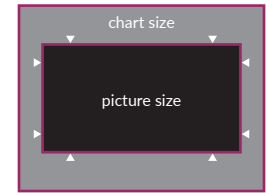


*Not every individual design is possible for print. Please contact us for consultation.

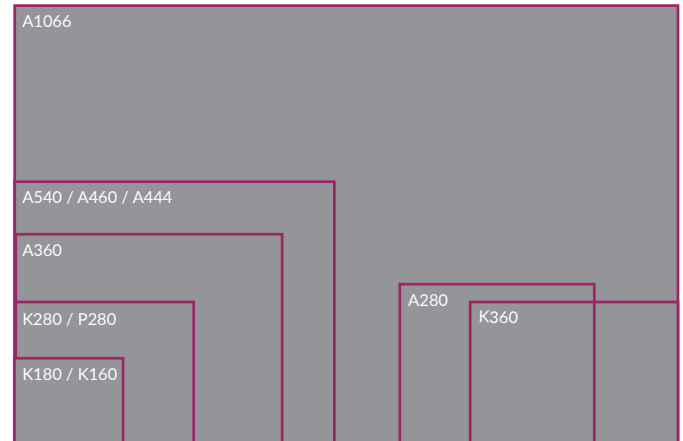
Chart Sizes

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.

K charts are mounted on black polystyrene plates and are only available in 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
D60	60 x 60	-	100 x 100 x 4.5
D35	32 x 24	-	50 x 50 x 3-4



D60 charts are intended to be used with the Vega light source and are constructed with aluminum, PLA plates, and a magnet mount. .

D35 charts are either between glass plates or mounted in slide frames (glassless).

Suitable transparent charts for the following illuminators

	D280 / D240S	D240	D205	D35
	Spherical transparency illuminator 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

*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.

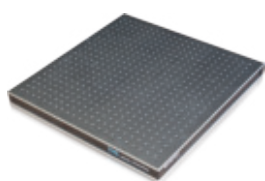
Accessories

<p>iQ-Tripodmount frame for test charts in size A280 / A360 / A460</p> 	<p>iQ-Foldermount frame for Studio Kits</p> 	<p>iQ-Tablemount frame for reflective charts A280 / A360 / A460</p> 	<p>iQ-Wallmount frames for reflective test charts in size A1066</p> 
<p>chartBOARD has a magnetic, neutral gray surface with special alignment marks.</p> 	<p>magneticTAPE can be fixed on the backside of all reflective charts.</p> 	<p>iQ-Chartmount-V for easily changing charts, manually or automatically.</p>  <p>API AVAILABLE</p>	<p>iQ-Chartmount-H V2 for quickly changing charts manually.</p> 
<p>Support with wheels and precise height adjustment for the LE7 series.</p> 	<p>Tripods for the LG3 and LG4 series.</p> 	<p>iQ-Mobilemount Tripod mount for mobiles and tablets.</p> 	<p>Universal Camera Mount Standalone mount for aligning various cameras</p> 
<p>Manfrotto 055X Pro3 Tripod</p> 	<p>Manfrotto 410-3-Way-Head</p> 	<p>iQ-Monopod Tripod for a professional, quick and exact camera positioning.</p> 	<p>iQ-Anchor A stabilizing stand with a flat surface for image stabilization measurements.</p> 

Accessories

Honeycomb Breadboard

A stabilizing surface for securely mounting STEVE-6D.



Restan

PTFE (polytetrafluoroethylene) white reference.



Studio Lights LED lights with adjustable correlated color temperature.



Gossen Mavo-Monitor USB

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



iQ-Align for CAL3

Adjust the camera to the CAL3.



iQ-Align XL for CAL3-XL

Adjust the camera to the CAL3XL.



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 Definitions

2D/3D-MLUT	Multi-Look Up Table	HDR	High Dynamic Range
ADAS	Advanced Driver Assistance Systems	ICC	International Color Consortium
AF	Autofocus	iQ	Image Quality
API	Application Programming Interface (C++/C)	iQ-LED	A Multispectral Light Source
camPAS	Camera Performance for Automotive Systems	IR	Infrared
CAN	Controller Areas Network	KPI	Key Performance Indicator
CCM	Color Correction Matrix	MTF	Modulated Transfer Function
CTT	Correlated Color Temperature	ND	Non-Diffuser (filters)
CIECAM	International Commission on Illumination - Color Appearance Modelling	NIR	Near Infra-Red
CIPA	Camera & Imaging Products Association	NIST	National Institute of Standards and Technology
CLI	Command Line Interface	OECF	Opto Electronic Conversion Function
CRI	Color Rendering Index	ROI	Regions of Interest
DUT	Device Under Test	SFR	Spatial Frequency Response
ESF	Edge Spread Function	SMD	Surface Mount Device
FOV	Field of View	SNR	Signal to Noise Ratio
FWHM	Full Width at Half Maximum	UTT	Universal Test Target
		VCX	Valued Camera eXperience
		VIS	Visual 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
VCX WebCam 2023 - International standard for evaluating image quality testing of video conferencing cameras

Image Engineering GmbH & Co. KG

Im Gleisdreieck 5
50169 Kerpen / Germany
T+49 2273 99 99 1-0
F+49 2273 99 99 1-10
www.image-engineering.com
info@image-engineering.de

