Solutions to test imageQuality

Image Engineering
Product Catalog

2017/2018

DEAR CUSTOMERS,

Thank you for your continued passion in high image quality.

Founded in 1997, Image Engineering is an independent test lab for digital cameras. At our new Headquarters in Horrem Germany, we test all types of cameras in order to provide well-known magazines, system integrators and camera manufacturers with reliable test results. Apart from testing cameras, we actively design and develop image quality test equipment. Over the past 20 years, we have grown into the world's leading supplier for camera test equipment.

At the heart of the IE products are the more than 280 different test charts for the assessment of almost all aspects of image quality and signal analysis. From there, we also provide chart illumination, chart and camera mounting, and evaluation software essentially covering the entire system of image quality testing. By combining the charts and the iQ-Analyzer software, you are provided with a comprehensive camera characterization. Throughout the last decade, additional devices have been created in order to test everything from image stabilization and timing aspects (i.e. frame rate and shutter lag), to measuring the spectral sensitivity of cameras. Our latest development introduces a spectrally variable light source that can be used for illumination and camera calibration.

To get started with your own testing we offer a wide range of options, from a single test chart to a fully automated production line test stand. All of the equipment provided is regularly used in our own lab, and we follow the test methods based on the ISO standards. In addition, our company's staff participates in several organizations devoted to developing and optimizing camera tests and equipment, ensuring that we are keeping pace with the constantly changing technology. Today's products fulfill the needs of many application areas including mobile devices, automotive, machine vision, broadcast, medical, and surveillance. With today's rapidly changing technology, we understand that everyone has different requirements. If you can't find what you are looking for, our engineers are more than happy to assist in developing individual solutions to fit your needs.

Thank you for your interest in Image Engineering, we look forward to working with you!

Best Regards,
Your Image Engineering Team

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Changes to products and technical data reserved.

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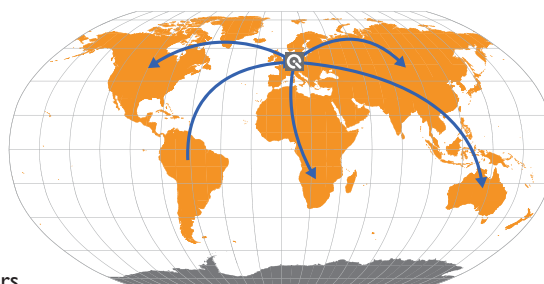
For worldwide delivery you can find a list with all distributors on our website:
www.image-engineering.com/company/resellers

iQ-TESTSTAND

Customized test stands to fit your individual requirements

Over the past few years Image Engineering has developed a large variety of components for camera test stands. A whole range of products have been constructed from simple chart holders to fully automated production line solutions. The motorized modules of the iQ-Teststand are controlled by using a USB interface and come with an SDK/API. These components have now been put together to form a modular system that can easily be customized for individual requirements. If there is a missing part, it can be added without constructing a completely new solution. Therefore, camera stands can now be arranged faster and more cost efficient than ever before.

A camera test stand can be divided into seven product groups. For each one of these groups we offer a variety of solutions resulting in a complete test stand.

Basic iQ-Teststand

iQ-Teststand without motorization.

1	iQ-Chartmount-V
2	iQ-Monopod
3	iQ-Mobilemount and 3-Way head
4	Hedler Tungsten halogen light units*

Automated iQ-Teststand

iQ-Teststand with automatization for illumination, camera-chart distance and chart mounting.

1	iQ-Chartmount-V (motorized, PC controllable)
2	iQ-Bench (motorized, PC controllable)
3	iQ-Cameramount
4	iQ-Flatlights* (PC controllable)
5	LE7 (PC controllable)
6	iQ-LED or iQ-Drive API
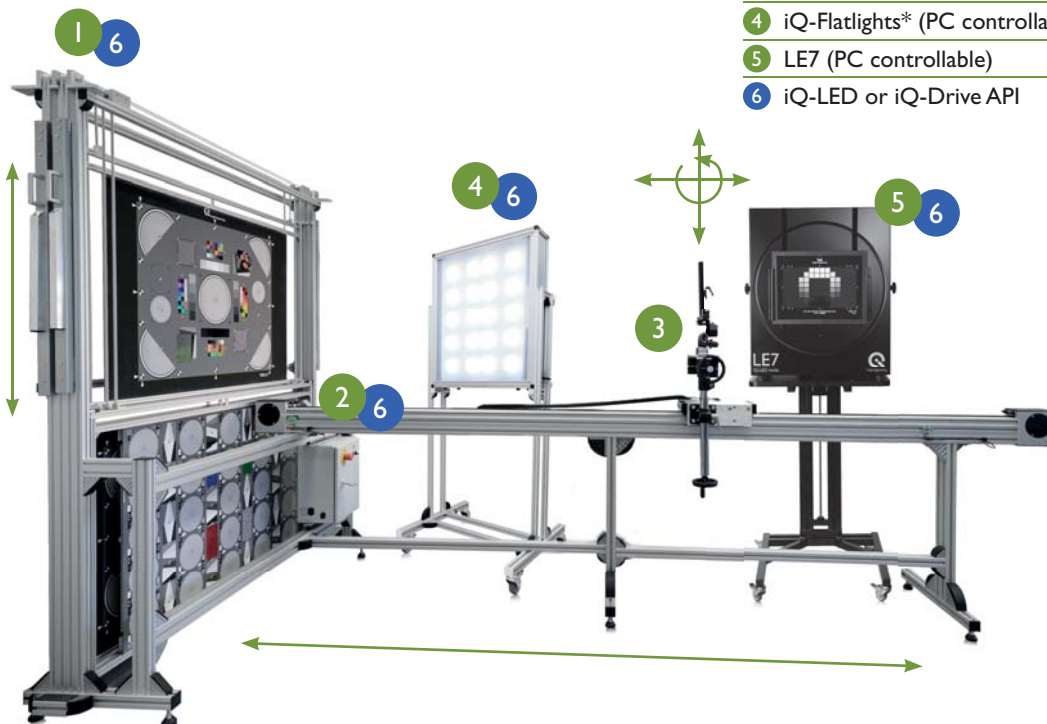
*The illustrations show only one light source for a better overview. Complete test stands always include two light sources.

1 CHART MOUNTING

For chart mounting, we offer different versions from a simple wall and table mount to a fully automated version of the iQ-Chartmount-V.
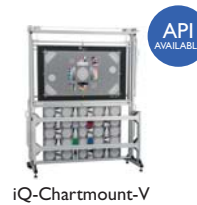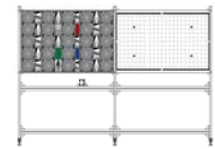
iQ-Chartmount-V   iQ-Chartmount-H

2 CAMERA-CHART DISTANCE

We provide two different systems to adjust the chart camera distance. iQ-Monopod for large distances (manual operation only) and iQ-Bench, a system based on a linear guide that can be motorized.

iQ-Monopod   iQ-Bench

3 CAMERA ALIGNMENT

In order to align the camera to the chart in the simplest way, it is best to use a 3-Way camera head with the iQ-Monopod. iQ-Cameramount is necessary for positioning the 3-Way camera head on the iQ-Bench. If automatic control is desired you can use the iQ-Alignrig or the iQ-Hexalign with various fine adjustment possibilities.

3-Way tripod head   iQ-Cameramount   iQ-Alignrig   iQ-Hexalign

4 REFLECTIVE CHART ILLUMINATION

Our program currently includes four types of illumination sources for reflective charts. You can choose between a fluorescent tube light source, Tungsten halogen light units, or a lightHEAD that is equipped with halogen bulbs and fluorescent tubes. For the fully automated solution we also provide iQ-Flatlights with a C++ Application Programming Interface (API) as another option. For a homogeneous illumination two light sources are always needed.

lightHEAD   Fluorescent tubes   iQ-Flatlight with LEDs   Tungsten halogen light unit

5 TRANSPARENT CHART ILLUMINATION

We produce different kinds of illumination devices to ensure a uniform illumination on transparent charts. LE6 is equipped with a halogen bulb. LE7 uses iQ-LED technology. LG3 offers extremely high intensities and variable frequencies from 10 - 500 Hz with 432 LEDs.

LE6   LE7   LG3

6 ANALYSIS AND CONTROL SOFTWARE

The iQ-Analyzer software is the market leading solution in the image quality analysis domain. For a meaningful and exact analysis, it is important to have precise control of the instruments. Besides the included user-friendly desktop control software, we offer every customer an opportunity to create programs, whose capabilities and appearance satisfy each individual demand. We also optionally provide a C++ Application Programming Interface (API) for many solutions (respectively a command line interface (CLI) for iQ-Analyzer).

7 iQ-HOUSING

If the camera test stand is not set up in a specialized room, then it is crucial to cover it from stray light and other aspects of the surrounding environment by using an appropriate form of housing.

Product descriptions can be found on the respective product pages.

STARTER KITS

Starter Kits are a perfect way to get started with your own image quality tests

As technology continues to advance, so too does the imaging industry. Today there are more cameras available on the market than ever before. Image applications are steadily expanding to new areas with different requirements, and as a result, the demand for a variety of image quality tests has grown as well.

Through Image Engineering's many years of experience and direct contact within the imaging industry, we have identified what is most important for each test area. For that reason, we have put together different Starter Kits to help you start your own image quality measurements.
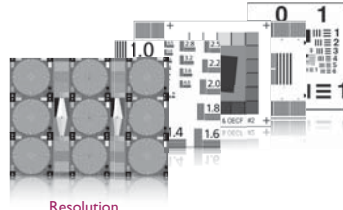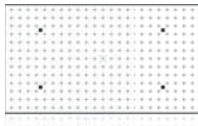
TEST CHARTS

ILLUMINATION DEVICES* AND MOUNTING

Universal Multipurpose

Color

LE6

CAL4

OECF

Resolution

LG3

SOFTWARE

Distortion

Luminance and Color Shading
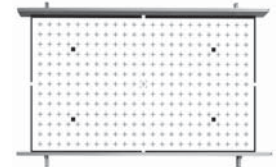
iQ-Wallmount

* Reflective chart ilumination is not included in the kits.

PHOTO

After many years of image quality experience, we have prepared a kit with the most important equipment to test a digital still camera. Without the use of a transparent target, there is no reliable way to measure the dynamic range. To solve this problem, we have included the TE264 to measure noise, OECF, dynamic range and ISO speed (ISO 14524, ISO 15739 and ISO 12232). A transparent target needs a uniform illumination, which the LE6** perfectly provides. The integrating sphere illuminates the TE264 with tungsten light and can be changed to daylight using the color conversion filter. When linked with the TE255, you have a uniform light source to measure luminance and color shading (ISO 17957). For color reproduction, a reflective X-Rite ColorChecker SG (TE230) is included in the kit. Along with that comes the TE251 (ISO 17850) chart, which can be used for measuring distortion and chromatic aberration. Finally, resolution can be measured using sinusoidal Siemens stars and slanted edges (ISO 12233). Also included is a basic wall mount for holding the reflective targets. Last but not least, in order to evaluate all the images taken with the sample camera, the kit contains the iQ-Analyzer, the most flexible analysis software for image quality evaluation.

** LE7 upgrade available

MACHINE VISION

Due to the versatile applications of cameras in industrial image processing, the requirements for these cameras differ depending on the application. As true multi talents, image-processing systems can scan the quality, identify components, read codes, provide important data for optimizing the production process, and control machines. With the Machine Vision Kit, all of the most important quality criteria for the optics and sensors can be tested including: dynamic range, resolution, sensitivity, noise and image refresh rate. Lighting can usually be controlled in machine vision, so a standard contrast of 10,000:1 for the OECF chart is sufficient. However, since the tonal levels are used for automatic detection and evaluation of elements in the image, it is helpful to get the OECF as detailed as possible. For this reason, the TE269B with its 36 gray levels, combined with the LE6** integrating sphere, has been added to the kit. As for color, resolution, distortion, shading etc., the standard charts (TE253, TE230, TE251, TE255, CF5400) in addition to the iQ-Analyzer software, can be used for evaluation.

SECURITY

The constant growth in camera technology is expanding the requirements for imaging technologies in the field of security. New functions such as motion and face detection have become normal features. Data flow is continuously growing and with it the demand for image material with a defined quality, thus making a software-based evaluation possible. This Starter Kit is based on basic requirements and the current state of technology.

A security camera needs to work under various conditions, from direct sunlight to very low light levels, often using tungsten or LED lights. In order to cover those high contrast levels, the cameras have a high dynamic range and it may be best to use the TE269C (according to the upcoming standard IEC 62676-5: video surveillance systems) in front of the LG3 light box. For measuring resolution and optical parameters, the standard targets (TE253, TE251) can be used in combination with the iQ-Analyzer software.

CELL PHONE

It is normally challenging to test cameras that cannot be manually adjusted to lighting conditions. This is especially the case for camera modules in cell phones and other mobile devices. Therefore, our Cell Phone Starter Kit consists of the TE42 with an average reflection of approx. 18% and a standard contrast range. This can be used to determine various image quality aspects including resolution, distortion, color reproduction and texture loss. The LE6* integrating sphere uniformly illuminates the TE270X chart for OECF and noise measurements according to ISO 14524 and ISO 15739. This specific chart has a variable center density, which is used to manipulate the automatic exposure control. By exchanging the chart with the TE255 diffusor plate, the setup can be used to determine luminance color shading, which is an issue especially for small camera modules. The captured images are evaluated using the iQ-Analyzer software, which is also part of the kit.

AUTOMOTIVE

In the automotive area, two image quality aspects dominate our current customers' requests. One is OECF in combination with high dynamic range, and the other is spatial resolution. With that in mind, our Starter Kit consists of an LE6-100 or LG3 and a TE269 OECF chart with a contrast of 1,000,000:1, which equals a 120 dB dynamic range. The TE261 reflective chart with slanted edges (size A1066) allows to measure the spatial frequency response (SFR), even for cameras with a high level of geometric distortion. Also included is the iQ-Analyzer software, which allows the analysis of these two image quality aspects in addition to many others. Moreover, it can be integrated into customer applications using the CALI, or be used in stand-alone mode with its own graphical user interface.

MEDICAL / ENDOSCOPY

Most medical imaging applications are designed to capture images in a macroscopic or microscopic scale, meaning the test charts have to be small. In order to ensure uniform illumination, CAL4, an integrating sphere with a diameter of 30 cm and a flange for the typical medical light sources, is included in the Starter Kit (light source is not provided with the kit). This way the test is performed with the same light source that is used in later applications. Perpendicular to the illumination, the integrating sphere has an opening with a chart holder for the 5 x 5 cm charts. The TE253 9x (according to ISO 12233) with sinusoidal Siemens stars is provided in D35 size for resolution measurement. In order to measure the OECF, dynamic range, and noise, the TE240 chart with 24 gray steps (according to ISO 21550) is part of the package. Color can be checked with a transparent version of the X-Rite ColorChecker (TE188 D35). For visual determination the TE250 and the TE132 resolution chart, standardized in ISO 3334 for microfilm analysis, are included.

BROADCAST

The Starter Kit Broadcast consists of a set of transmissive test charts and the LE6* integrating sphere. This set is a suitable solution to set up and align multiple cameras.

The TE259 is an OECF chart with horizontal gray scales, suitable for the analysis of gamma (OECF) using a waveform monitor. The color rendition chart TE226 allows analyzing and controlling of the color reproduction. The TE225 with its regular line structures is used for visual resolution assessment or an analysis performed with a waveform monitor. Last but not least, the multipurpose TE167 chart is part of the package in order to address several remaining aspects including the geometric performance of the system.

SCANNER

In general the image quality of scanners and cameras is tested using charts that are a degree better than the expected test result of the device under test. The TE240, which measures the dynamic range according to ISO 21550, is available as a transparent and reflective chart. In reflection, the achievable contrast is limited to about 2.4 densities. In transmission, the user can select between 4.0 and 6.0 densities. The IT8 color target (TE258) is the standard target for color profiling, and we provide it in a reflective and a transmissive version with a large color gamut. The TE250 (transparent test chart) is used for visual resolution measurement for scanners, according to ISO 16067, and is done traditionally with the slanted edge target QA-62 (reflective).

* LE7 upgrade available
For assembling each kit, please see the following table.

| Products	Product Description	Photo	Machine Vision	Security	Cell Phone	Automotive	Medical / Endoscopy	Broadcast	Scanner
Test charts									
Universal Multipurpose									
TE42	multipurpose test chart · A1066				x				
TE261	slanted edges 16:9 · A1066					x			
TE167	HDTV universal test chart · D280							x	
Resolution									
AI QA-62	slanted edge target · scanner SFR & OECF								x
TE132	ISO test pattern No. 2 · D35						x		
TE225	HDTV resolution chart · D280							x	
TE250	USAF 1951 transparent chart · D35						x		x
TE253 9x	modulated sinusoidal Siemens star · A1066 S/H/L	x	x	x			x		
Color									
TE188	color rendition chart (X-Rite) · D35						x		
TE226	HDTV color rendition chart · D280							x	
TE230	X-Rite ColorChecker SG mounted on TE182	x	x						
TE258	IT8 scanner characterization chart								x
OECF									
TE182	neutral gray 18% remission · A1066	x	x						
TE240	ISO 21550 scanner dynamic range chart						x		x
TE259	OECF · noise test chart · 20 steps · D280							x	
TE264	OECF 20 ISO 14524 / 1573 revision · D280	x							
TE269	OECF 36 · D280 A/B/C		xB	xC		xB			
TE270X	chart with variable center density · D280				x				
Geometry Grid Registration									
TE251	distortion · chromatic aberration · crosses · A1066	x	x	x					
Signal Evaluation									
TE255	diffusor plate (for shading measurement) · D280	x	x		x				
TE285	IR reflection · A360			x					
Mounting									
iQ-Wallmount	wall mounting frame for charts in size · A1066	x	x	x	x	x			
Ilumination Devices									
LE6	integrating sphere with halogen light source	x	x		x	x		x	
CF-5400	conversion filter 5400 K for LE6 · D280	x	x		x				
LG3*	lighting box with a wide range of intensities and special flicker mode			x					
CAL4	integration sphere without own light source						x		
Software									
iQ-Analyzer	image quality analysis software	x	x	x	x	x			

*API (application programming interface) available

TURNKEY SOLUTIONS

Everything you need for high quality camera testing

Image Engineering is not only a manufacturer of test equipment, but also an independent test laboratory for image quality. Every day we strive to expand our expertise on the characterization of digital image quality. With the hope of bringing you the best equipment and knowledge, we continuously test all types of cameras in the lab, including SLRs, compact cameras, mobile devices, video or broadcast cameras. Specialty cameras from the automotive, medical and security industries are also frequently tested in our lab. When manufacturers come to us with new questions, our engineers develop the appropriate solutions to answer them. In all applicable areas, our specialists always work

based on the requirements originated from practical use.

The development department designs the appropriate charts for all the necessary camera characteristics, and the illumination equipment to go with it. The measuring devices are always designed to comply with the requirements of the current and future international standards. The iQ-Analyzer, a special analysis software, is updated regularly. In addition, individually adaptable systems are designed for chart, camera and lighting mounts. In short, Turnkey Solutions were created in order to provide a "full service" performance for your own test lab.

TEST CHARTS	MOUNTING	ILLUMINATION	ANALYSIS
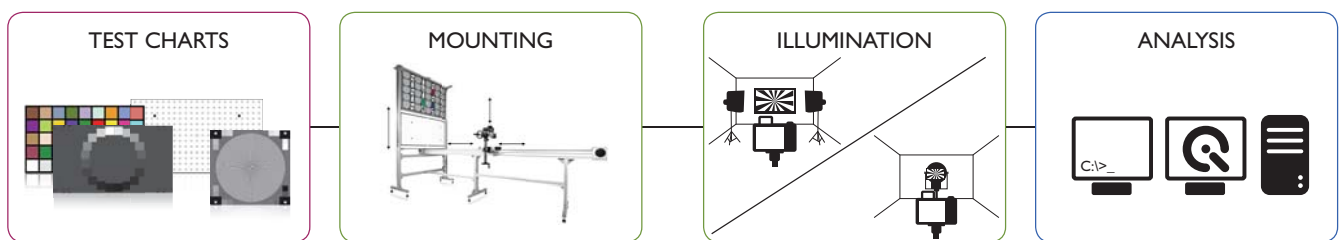
Test Charts

The most important rule in camera testing is the chart must be better than the camera being tested. We provide the high quality you need to test your devices. Our test chart portfolio contains over 280 test charts for all relevant measuring methods and applications. They are available in different sizes, fit technical requirements and many of them are available in reflective and/or transparent versions.

Mounting

The precise alignment of the camera and the chart to each other is essential for reliable and meaningful test results. The options for camera positioning range from a conventional monopod to an optical bench with fully automated camera fine adjustment via a hexapod. For charts, the right options are available for every requirement, from a simple wall mounting to an automated exchange chart holder.

Illumination

The homogeneous test chart illumination is only one prerequisite for reliable measurement data. Versatile requirements arise from real lighting situations. In order to be as comprehensive as possible, the available types of reflective and transparent chart illumination range from conventional halogen bulbs to spectrally adjustable iQ-LED lighting units.

Analysis

The iQ-Analyzer is an excellent tool for image quality analysis based on international standards and our experts' extensive experience. Test data can be generated in a user-friendly manner and the computer results are provided as a text or XML file.

CUSTOM MADE SOLUTIONS

The following Turnkey Solutions are selected examples for potential setups. Modern imaging systems and their related requirements may call for custom designed variations of a test system to enable all measurements.

On the hardware side, many different equipment types are available. Everything from a simple test chart to a spectrally tunable light source, from a cell phone mount to a fully automated test stand, and from a simple test pattern to a scene with moving parts and high dynamic range capabilities. We combine software, hardware and services to create a complete solution that serves your individual needs. You will not receive a standard off-the-shelf product, but a system that has been constructed, adjusted

and tuned to meet your individual expectations. We have an answer for each of your measuring needs. If you are interested in a software controllable version of our products, please do not hesitate to contact us. Our engineers are looking forward to helping you with your project.

CONSULT	DESIGN	IMPLEMENT

Details on the products can be found on their respective product page.

BASIC

All you need for basic camera assessment

Providing as much information as possible with a budget-friendly setup, the Basic Kit contains everything you need to set up a test environment for a large variety of cameras. The most important component is the TE42, our multipurpose test chart that covers the most relevant image quality parameters. The TE42 works smoothly with the iQ-Analyzer software; from a single image you can check the resolution at the image center and the corners, as well as texture loss, distortion, shading, color reproduction and noise characteristics. The Tungsten halogen light units with softboxes are suitable to illuminate the reflective charts. These bulbs provide a uniform illumination, which makes setup quick and easy and ensures reliable color measurement by providing a continuous light spectrum. What is the easiest way to hold the test chart? Simply mount it to the wall with the iQ-Wallmount.

The chart can be mounted tightly and does not occupy any floor space. Finally, there is a 3-Way head on top of the tripod, which makes it easy to align the camera to the chart for the most meaningful results.

EXPERT

The advanced solution with various charts and features

Do you develop high quality cameras? If so, then you should also be using high quality test equipment. The Expert Kit contains everything you need for precise testing. In order to receive comprehensive information about the system being tested, several images need to be taken of different test targets. To make testing fast and convenient, we have developed the iQ-Chartmount-V, which reduces time spent on camera setup when switching charts. The charts are stored and protected in the Chartmount-V and each time one is needed, it can easily be pulled into position by using a handle without actually touching the chart. When the camera is mounted on top of the iQ-Bench it can simply be moved back and forth, wasting no time with realignment while keeping testing fast and reliable. Also in the kit is the iQ-Analyzer software, which analyzes the images captured from the various test targets. The selection of high quality test charts that are included comply with the latest ISO standards and cover the most important aspects of image quality analysis. This includes a
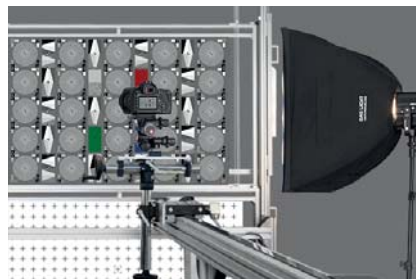
detailed check of the resolution at 25 different areas in the image, the color reproduction of 140 different color patches, detailed geometric distortion, noise and dynamic range measurements from a high dynamic range test chart, and shading in every detail. High quality lighting is crucial for obtaining meaningful results. The LE7, with its unique LED technology, is perfect for this task as transparent targets and the halogen lamps guarantee high quality for the illumination of reflective charts.

LENS

Get to know your lens-camera system in detail

The lens is a vital part of an imaging system, so it is worth a detailed check. All of the tools needed to analyze a lens are included in this package. The most important criterion that describes a lens is the Modulation Transfer Function (MTF). Using the TE268 test chart, in combination with the iQ-Analyzer, you have an ISO 12233 compliant solution that provides a deep insight into the lens and system performance. With 25 sinusoidal Siemens stars, you can obtain up to 600 MTFs for different positions in the field, as well as different orientations from a single image. Distortion and shading, the two other major quality aspects of a lens are just a picture away. The TE251 slides quickly into the field of view using the vertical iQ-Chartmount-V, making checking distortion and chromatic aberrations quick and easy. The LE6 * with test chart TE255 provides a uniform flat field, perfect for shading measurements on an extremely high precision level. Do you need

to check a zoom lens? The iQ-Monopod, together with the 3-Way camera head, takes the hassle out of the camera's alignment to the chart. The iQ lab uses this setup to test hundreds of lenses a year.

*LE7 upgrade available.

TIMING MEASUREMENT

Beyond start up time and shutter lag

An international standard on how to measure shutter release time lag, shooting time lag, shooting rate and startup time is available now. Since Image Engineering is part of the ISO group that developed this standard and Dietmar Wueller, our CEO, has been the editor of the document, we know it very well and have designed a Timing Measurement Kit, according to ISO 15781, to meet the requirements.

The iQ-AF Box, with dimmable fluorescent tubes, illuminates the TE261 test chart and is slightly more sophisticated than the chart printed in the standard itself. With its slanted edges, it can also be used for resolution measurements and focus accuracy tests. Two LED-Panels in the upper left and lower right corners are electronically connected to be started simultaneously from a single switch. Whichever LED-Box shows the earlier LED lighting up in the image, after pressing the shutter release button, is the one that will be used for the analysis. We also deliver an

iQ-Trigger with the kit to operate the switch accurately. The iQ-Trigger can be attached to a tripod and adjusted to operate the exposure button and the switch at the same time.

IMAGE STABILIZATION

High performance and comprehensive image stabilization test equipment

Capturing well-focused high-resolution images, even under low light conditions, is one of the major performance characteristics of a digital camera. This is the reason why many cameras have built-in image stabilization.

We have developed our Turnkey Solution "Image Stabilization" to evaluate the performance of the optical or electronic image stabilization systems built into cameras. The solution is built around the compact and highly dynamic camera-shaking device called STEVE-6D, which has an unique 6 axis positioning system. When using the included software solution, the tester can define any arbitrary motion with six degrees of freedom, thus putting STEVE-6D in a controlled vibration. The software also controls iQ-Trigger, a remote-controlled "mechanical finger," which presses the camera's shutter button. The resulting images are evaluated

by the software's analysis module. The results provide insight into the image stabilizer's performance. The set up combination of the the STEVE-6D, iQ-Trigger, the Honeycomb Breadboard, (used to mount STEVE-6D), and the iQ-AF Box with the TE261 chart, enables a comprehensive test and analysis of the performance of image stabilization systems.

SECURITY

Get prepared for IEC 62676-5, the new image quality standard for surveillance cameras

The new IEC 62676-5 standard has been developed to make the specifications for video surveillance comparable. This standard specifies measuring methods, while also unifying the presentation of image quality criteria. The IEC 62676-5 standard more appropriately prepares the documentation concerning the quality of surveillance cameras for all parties involved.

The arrangement of this Turnkey Solution allows measurements to be carried out according to specifications. The package contains the resolution chart TE253 with Siemens stars. The OECF test chart TE269C fulfills the requirements for the special distribution of gray scale. Moreover, this allows for the determination of the dynamic range, the OECF and the image noise (SNR, visual and temporal noise) of a camera system. Distortion can be measured using the TE251. The TE281 flare chart is included to assess
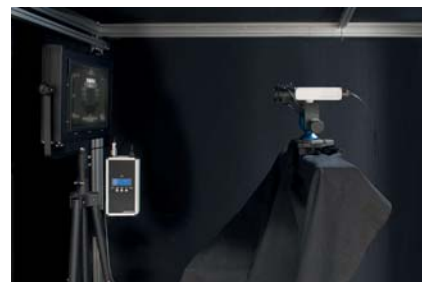
susceptibility to stray light. The maximum frame rate can be determined under given lighting conditions using the LED-Panel. Also included are all modules for the best possible lighting and exposure measurement, devices for fitting, the charts, the camera, and the proven iQ-Analyzer analysis software.

For assembling each kit, please see the following table.

Turnkey Solutions / Products	Product Description	Basic	Expert	Lens	Timing Measurement	Image Stabilization	Security
Test charts							
Universal Multipurpose							
TE42	multipurpose test chart · A1066	x					x
TE261	slanted edges 16:9 · A1066				x	x	
Resolution							
TE253 9x	modulated sinusoidal Siemens star · A1066 S/H/L						x
TE268	combinaton of resolution pattern · A1066		x	x			
Color							
TE230	X-Rite ColorChecker SG mounted on TE182		x				
OECF							
TE264	OECF 20 ISO 14524 / 1573 9 revision · D280		x				
TE269	OECF 36 · D280 A/B/C						xC
Geometry Grid Registration							
TE251	distortion · chromatic aberration · crosses · A1066		x	x			x
Signal Evaluation							
TE255	diffusor plate (for shading measurement) · D280		x	x			
TE285	IR reflection · A360						x
Black To White							
TE281	flare target according to the upcoming ISO 18844 · A1066						x
Mounting							
Chart Mounting							
iQ-Wallmount	wall mounting frame for charts in size · A1066	x					
iQ-Chartmount-V*	vertical sliding chart holder with integrating sphere support		x	x			x
Camera and Illumination Mounting							
Manfrotto 055XPROB	the 055XPROB is an extremely versatile tripod	x			x		
Manfrotto Junior Geared Head 410	this unique head offers gear movement in three directions	x	x	x	x		x
iQ-Monopod	mono stand with rail system for precise camera positioning			x			x
iQ-Cameramount	special mount for vertical and horizontal camera movement		x				
iQ-Bench*	a system based on a linear guide that can be motorized		x				
Camera plate	camera mounting for STEVE					x	
iQ-Mobilemount	tripod mount for mobiles and tablets					x	
HoneycombBreadboard	platform for mounting STEVE-6D					x	
Ilumination Devices							
Back Illumination							
LE6	integrating sphere with halogen light source			x			
CF-5400	conversion filter 5400 K for LE6 · D280			x			
LE7* 4x	integrating sphere that uses the new iQ-LED light source		x				x
LG3*	lighting box with a wide range of intensities and special flicker mode						x
Front Illumination							
Hedler Tungsten halogen light	tungsten halogen bulbs	2 x	2 x				2 x
Fluorescence Illumination	fluorescent tubes			2 x			
Measurement Devices							
STEVE-6DS or STEVE-6DL	camera shaking device					x	
iQ-AF Box	illumination box with four dimmable fluorescent tubes				x	x	
LED-Panel*	to determine shutter and shooting time lag, autofocus time, frame rate and exposure times of digital imaging devices				2 x		x
iQ-Trigger* and/or iQ-Trigger-T*	mechanical finger that can press the shutter release button				x	x	
Gossen Digipro F2	exposure meter for high precision incident light measurement	x					
Gossen MAVOLUX 5032 B USB	digital luxmeter and luminance meter class B		x	x	x		
PRC Krochmann RadioLux 111	digital luxmeter and luminance meter class L						x
Software							
iQ-Analyzer	image quality analysis software	x	x	x			x
LED-Panel	control and analysis				x		
STEVE-6D	control and analysis					x	

* API (application programming interface) available

LG3

Dimmable lighting box with extremely high intensity and variable flicker mode

Through modern lighting technology, the LG3 creates new possibilities in image laboratories by considerably expanding the test areas for dynamic range measurements. The LG3 is capable of illuminating a high contrast test target with over 150,000 lx. As a result, measurements of high dynamic range can also be achieved with short, practical exposure times. In addition, the user can dim the intensity while the LG3 temperature management ensures that the light CCT (correlated color temperature) does not change. Another unique aspect of the LG3 is the flicker mode. With this feature the user can choose between a constant pulse width modulation mode of 32 kHz and variable duty cycle, or the flicker mode with a range of 10 to 500 Hz and variable duty cycle. With the LG3, light sources working with variable frequencies can be simulated, e.g. traffic lights, vehicle and street lighting. Now cameras in the security and automotive area can be tested and optimized for a wide range of real life situations.

Main Features:
- high intensity >150,000 lx
- low intensity <10 lx
- flicker mode with adjustable frequency and duty cycle
- high homogeneity >95%
- dimmable in fine steps
- stabilized intensity in normal and low intensity mode
- correlated color temperature (CCT) of 5000 K

pre-production sample image

Via the external control and supply unit, two illumination methods can be selected in three intensity ranges.
1. Pulse width modulation PWM
2. Flicker modus 10-500 Hz

Each with:
- normal modus: 0-100% 32 kHz / <100 to >65000 lx
- low modus: 0-100% 32 kHz / <10 to >6500 lx
- high modus: 100% max. 60s lighting duration / >150000 lx

LE6

The spherical illuminator works on the principle of an integrating sphere

A halogen light source illuminates the interior of the sphere, which is coated with a special white diffuse coating. Due to the internal design, the measuring window can be used up to a picture size of 280 x 210 mm, and is illuminated extremely uniform. A special construction allows dimming the light down to approx. 1% of the maximum illumination without changing the color temperature. For LE6 illuminators, a USB interface is available as an option. Meaning the light intensity can be measured and controlled by a Windows PC.

Main Features:
- high intensity of approx. 8000 lx (LG6-50 3000 lx)
- minimal intensity of approx. 80 lx (LG6-50 30 lx)
- thermal radiator with 3200 K +/- 50 K
- constant spectrum over the entire intensity range
- changing of the color temperature through filters
- high homogeneity >96%

CAL4

Integration sphere for the measurement of light sources in the medical area

The CAL4 was developed for measuring resolution, color, OECF, dynamic range and noise when using the endoscopy light source. The integrating sphere provides a uniform illumination over the whole chart plane. Simply connect the integrating sphere with the endoscopies (light projector) light source, to a fiber optic cold-light cable, by using one of the four adapters that are compatible for the most common light projectors.

Main Features:
- high homogeneity >97% in the active area
- adaptable to the most common light projectors

For technical specificatons, please see the following table.

	LE6-50	LE6-100	LG3	CAL4
Principle	dimmable halogen light source with constant color temparture	dimmable halogen light source with constant color temparture	light source with a wide range of intensities and special flicker mode	special solution for medical application
Light source	12 V / 50 W halogen bulb	12 V / 100 W halogen bulb	432 LEDs	adaptable to the most common projectors
Color temperature	3200 K +/- 50 K	3200 K +/- 50 K	approx. 5000 K +/-5%	depends on the projector
Maximum / Minimum illumination values	approx. 30 - 3000 lx	approx. 80 - 8000 lx	low modus: <10 to >6500 lx normal modus: <100 to >65000 lx high modus: >150,000 lx	depends on the projector
Uniformity of illumination	>96%	>96%	>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%)	50 mm x 50 mm output >97%
Dimmable	1 - 100% of max. illumination	1 - 100% of max. illumination	approx. 1000 steps in 2 modes feedback of illumination level in [%] and illuminance [cd/m²] 32 kHz PWM	depends on the projector
Power supply	80 W / 90 - 260 VAC 50/60 Hz	120 W / 90 - 260 VAC 50/60 Hz	110 V / 230 V, 400 W	depends on the projector

* measured on chart plane

iQ-LED TECHNOLOGY

The most flexible LED-based light source is the heart of all adaptive Image Engineering lighting products

Create your own light by adjusting the 22 channels in the visible range to suit your needs. You can automatically simulate standard light sources, reconstruct the daylight distribution from dawn until dusk, create patches of a high-saturated color chart, or reconstruct the spectral distribution of a measured light source. By using the individual channels, you can even measure the spectral sensitivities of a camera.

The iQ-LED provides you with the closest match to standard D light sources in a broad range from 400 up to 820 nm. Aside from many other predefined light sources, you will also be able to generate your own custom spectra in combination with the spectral radiometer EX1. The intensity variation is realized with a pulse width modulation (PWM) of 32 kHz, in order to enable working with short exposure times. Linear tuning of the intensity for each channel using 1000 steps provides an accurate way to manipulate every part of the spectrum. The internal temperature stabilization enables a constant spectrum for a period of a fraction of a second, to well over a few hours. A software-based, quick and easy self-calibration avoids any kind of effects caused by burn-in or long-term degradation of the LEDs on predefined spectra, ensuring a long lifetime. Due to its extremely short response time, light settings can be changed with frequencies of up to 40 Hz. The technical characteristics of the iQ-LED are particularly designed for the higher requirements in the area of camera testing and camera calibration. On request, we supply the iQ-LED system (single or multi iQ-LED devices) as a stand-alone version. We combine it with a NIST traceable calibrated micro spectrometer and the control software, which allows you to create your own light source adapted to your needs.

The standard module of the iQ-LED consists of 22 different channels and 80 LEDs arranged on a 10 x 10 cm board. This board can be combined with other boards to form larger and more intense light sources. The iQ-LED extension module was developed to extend the spectral range to the infrared region. It also consists of 80 LEDs on a 10 x 10 cm board, but it has 11 channels mostly in the IR region. It is typically used

iQ-LED
TECHNOLOGY

API
AVAILABLE
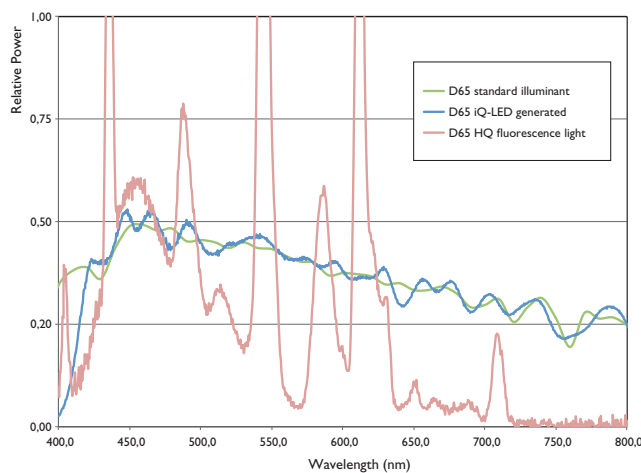
iQ-LED

Comparison of D65 spectra:
HQ Fluorescence and iQ-LED

in combination with two standard iQ-LED modules so as to level the intensities of all channels. In order to offer you an opportunity to integrate the iQ-LED in your individual test procedures, we optionally provide a C++ Application Programming Interface (API) for the entire iQ-LED product line.

Main Features:
- predefined standard illuminants (A, B, C, D50, D75)
- black body curve by selected CCT (correlated color temperature)
- auto generation of external measured or imported spectra
- creation of individual test sequences
- real time display of spectral measurement
- real time calculation of CCT, CRI, illumination level
- C++ API available

LE7

Uniform, multispectral, iQ-LED powered chart illumination par excellence

The LE7 is based on a 0.5m integrating sphere. The main version is equipped with two iQ-LED elements (for very high illumination levels, versions with four and six iQ-LEDs are also available). Due to the optimized positioning of the iQ-LED elements in the upper and lower front areas of the machine, a 97% uniformity is reached in the active chart area. By keeping a constant spectral distribution, the predefined illumination level can be changed by simply typing in a new illumination value into the control software. To give you an even more personalized approach, individual spectra can be generated. Combined with EXI, the device allows you to reproduce your individual light sources, with a high accuracy guaranteed in any light source at every intensity level.

The LE7 comes in a lightproof-box, with an integrated micro spectrometer to verify your spectral distribution in real time, similar to our CAL1. Moreover, when linked with the iQ-LED C++ API interface, it is possible to integrate the control into custom software, or create your own operating software.

iQ-LED TECHNOLOGY

API AVAILABLE

Main Features:
• high homogeneity >97%
• free selectable spectral distribution
• constant spectral distribution for every intensity level

LE7-IR

Tuneable light spectrum extended to IR

LE7-IR is a unique device for illuminating transparent test charts, and also to test and calibrate cameras that are sensitive to infrared light. Essentially it is an advanced LED light source that can emulate nearly every spectral characteristic of light in the range from 380 up to 1050 nm. The LE7-IR has four iQ-LED modules with 22 channels that cover the visible spectrum and two additional iQ-LED extension modules with 11 channels, mostly in the IR region, for extending the spectral range. The spectral compilation is evenly distributed over 31 color LED channels and two white LED channels.

iQ-LED TECHNOLOGY

API AVAILABLE
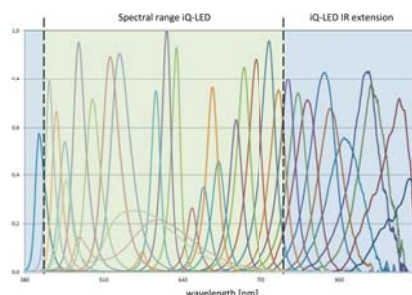
Main Features:
• high homogeneity >97%
• extended spectral range from 380 up to 1050 nm

	LE7 WITH 2 iQ-LED	LE7 WITH 4 iQ-LED	LE7 WITH 6 iQ-LED	LE7-IR
Principle	integrating sphere			
Light source	2 x iQ-LED 160 LEDs, 22 channels (20 color, 2 white) 32 kHz PWM	4 x iQ-LED 320 LEDs, 22 channels (20 color, 2 white) 32 kHz PWM	6 x iQ-LED 480 LEDs, 22 channels (20 color, 2 white) 32 kHz PWM	4 x iQ-LED 2 x iQ-LED IR extension 480 LEDs, 33 channels (31 color, 2 white) 32 kHz PWM
Spectral range	400 – 820 nm			380 – 1050 nm
Predefined standard illuminants	D50, D55, D65, D75, A, B, C Planckian spectral curve by selected temperature (1900 - 18,000 K)			
Uniformity of illumination	active chart area (>97%) resp. full chart area (>96%)			
Illumination stability	+/- 2%**			+/- 2% (380 – 820 nm) +/- 4% (820 – 1050 nm)
Maximum / Minimum illumination values	Standard D illuminants: 1400 lx	Standard D illuminants: 2800 lx	Standard D illuminants: 4200 lx	Standard D illuminants: 2800 lx
	max: up to 2000 lx min: down to 25 lx	max: up to 4000 lx min: down to 25 lx	max: up to 6000 lx min: down to 25 lx	max: up to 4000 lx min: down to 25 lx
	max. and min. depending on illuminant and required curve fit/CRI			
	for low intensity use the system can be combined with a neutral density filter			
Intensity use	depending on illuminant, for low intensity use the system can be combined with a neutral density filter			
Spectral measurement	integrated NIST traceable calibrated micro spectrometer			
Spectral range /spectrometer	350 – 800 nm / resolution: 1024 pixel			350 – 1050 nm resolution: 2048 pixel
Features	easily adjustable spectral distribution of the emiting light via 22 (LE7-IR 33) software controlled LED channels, standard illuminants or reproduction of external measured spectra, self defined arrangements including single channels for color calibration, creation of test sequences, application programming interface (API) available on request			

** measured for selected standard illuminants after changing an illuminant at optimal temperature
See complete datasheet for detailed information.

CAL

Camera characterization and calibration light sources

Today more than ever camera technology is subject to constant change. In order to keep pace with the market's quality requirements, the need for a reliable test system grows. For the characterization and calibration of cameras in the laboratory, or in the production line, the specialists of Image Engineering have developed the CAL product line. These compact calibration light sources are equipped with multispectral iQ-LED technology and offer the highest degree of flexibility in your choice of lighting type. You only need one device for all light sources such as A, D50, D65, or any other standard light source or self-generated spectra. For spectral sensitivity measurements, the CAL product line allows for the individual activation of each of the 20 narrow band color channels.

The special design, connected with a non-reflecting special diffuser filter, ensures an even light distribution on the measuring plane. As a result of the iQ-LED's very short response time, a full calibration can be performed in a few seconds if the image processing and transfer in the camera is fast enough.

The easy-to-use iQ-LED control software controls the CAL devices or, if upgraded with the iQ-LED C++ API, they can be integrated into your individual test procedures.

Possible applications are:
• calibration of the exposure control
• detection of defect pixels
• determine the luminance and color shading
• check of the auto white balance under various light sources (i.e. A, C, D50 D55, D65, D75)
• measurement of the spectral sensitivity

CAL1

The one light source solution in the field of camera characterization and calibration

Its compact design consists of one iQ-LED element in a 0.3 m integrating sphere that illuminates a 70 mm opening.

Main Features:
• high homogeneity >98%
• fast calibration
• free selectable spectral distribution
• integrated micro spectrometer

iQ-LED TECHNOLOGY

API AVAILABLE

CAL3

Camera calibration light source based on iQ-LED for wide-angle lenses

Its design consists of one spectral programmable iQ-LED element in a 0.3 m integrating sphere that illuminates a 38 mm concave curved luminous surface.

Main Features:
• high homogeneity >95%
• fast calibration
• free selectable spectral distribution
• concave curved luminous surface for wide-angle lenses
• integrated micro spectrometer

iQ-LED TECHNOLOGY

API AVAILABLE

CAL2

The small light source for the flexible integration into a production line

The CAL2 is also based on our 22 channel spectrally tunable iQ-LED light source and can be adapted for the use in many different areas. Therefore, this device can substitute for multiple devices on a production line. It solves 90% of all calibration issues and it saves time and money. The 60 x 60 mm large opening allows you to calibrate multiple cellphone camera modules at the same time, while also making calibration faster and more accurate than with any other device.

The device can also be used for camera calibration and testing purposes when space is limited. In this case, the spectrometer, utilized for calibrating the device, is separated from the light source. This means one single spectrometer can be operated for several calibration stations equipped with the CAL2. Should there be any special requirements regarding implementation into your test setup and workflow, the whole system can be customized to fit your needs. The special internal design, for which we have a patent pending, allows you to achieve a similar uniformity (>96%) and intensity (up to 3000 lx) that we have in the CAL1 with its integrating sphere.

iQ-LED
TECHNOLOGY

API
AVAILABLE

Main Features:
• high homogeneity >96%
• fast calibration
• free selectable spectral distribution
• micro spectrometer for calibration
• ideal for production line integration

iQ-ALIGN

Precise adjustment for extreme wide-angle cameras in front of calibration light sources CAL1 and CAL3

For a comfortable and precise adjustment of cameras in the security and automotive area, we recommend iQ-Align. It can be used with the calibration light sources CAL1 and CAL3. The camera align system is based on a linear guidance in combination with an iQ-Mobilemount.

	CAL1	CAL2	CAL3
Principle	integrating sphere	our patented edge box with adaptable design	integrating sphere
Light source	1 x iQ-LED: 80 LEDs, 22 channels (20 color, 2 white) / 32 kHz PWM		
Spectral range	400 – 820 nm		
Uniformity of luminance in active area	70 mm circle* output >98%	60 x 60 mm output window >96%	>95%* for FOV <160° at min. 10 mm depth inside diffuser for 160°- 180° FOV and at min. 20 mm depth inside diffuser
Predefined standard illuminants	D50, D55, D65, D75, A, B, C, Planckian spectral curve by selected temperature (1900 up to 18,000 K) depending on illuminant		
Illumination stability	+/- 2%**		
Standard D illuminants	2000 lx		1700 lx
Maximum / Minimum illumination values	max. up to 3000 lx min. down to 25 lx	max. up to 3000 lx min. down to 25 lx	max. up to 2500 lx min. down to 25 lx
		depending on illuminant and required curve fit / CRI	

* measurement performed in the center of diffusor, standard illuminant D65
** measured for selected standard illuminants after changing an illuminant at optimal ambient temperature

iQ-FLATLIGHT

The spectrally tunable source to illuminate large areas

The iQ-Flatlight is designed to illuminate larger areas, such as our size A1066 test charts, or even small rooms with the comfort of a spectrally tunable light source. Based on your needs, you can select every spectral distribution from the standard D50, or D65 over tungsten to narrow band colored illumination. The iQ-Flatlights are normally sold as a pair, where each of the two units has an approximate luminous area of 0.7 x 0.7 m^2 and consist of 10 or 20 iQ-LED modules. The construction allows the lights to be fixed on ceilings or walls in different ways. In combination with a camera test stand, they come on rollable stands that can be adjusted in front of the test charts in a flexible way to achieve uniform illumination. The illumination of large charts and areas has never been more flexible.

Main Features:
• illuminates large areas
• fast calibration
• free selectable spectral distribution
• micro spectrometer included

iQ-FLATLIGHT	
Principle	diffuse light panel
Light sources	10 or 20 Image Engineering iQ-LED units: 80 LEDs/unit / 22 channels (20 color, 2 white) / 32 khz PWM / 1 or 2 F11 fluorescent tubes OSRAM L 18W/940
Spectral range	400 – 820 nm
Predefined standard illuminants	D50, D55, D65, D75, A, B, C, Planckian spectral curve by selected temperature (1900 up to 18,000 K) CRI up to 99, depending on illuminant and intensity
Illumination stability	+/- 2%**
Maximum / Minimum illumination values	10 units | two flatlights, illumination on chart: predefined illuminants: up to 400 lx without defined spectra: up to 1000 lx 20 units | two flatlights, illumination on chart: predefined illuminants: up to 800 lx without defined spectra: up to 2000 lx condition: two iQ-LED flatlights placed beside a IE A1066 size test chart in ~80 cm distance and ~45° viewing angle

** measured for selected standard illuminants after changing an illuminant at optimal temperature

iQ-LED
TECHNOLOGY

API
AVAILABLE

EX1

Measure daylight or light sources with one of the smallest calibrated spectral radiometers

The EX1 is based on the same micro spectrometer that is used in our adaptive lighting products. With its compact design and connection through just one USB cable to your laptop, you can measure the spectral distribution of any kind of light source when and wherever needed. The EX1 comes fully NIST traceable calibrated and with an easy-to-use software. After measuring a light source, you can import the spectral distribution to all of your iQ-LED products control software and reproduce it in just a few seconds.

Main Features:
• usable everywhere
• easy and quick handling
• measure spectral distribution

EX1	
Principle	linear CMOS detector, directive measurement (~25° FOV)
Spectral range	350 – 800 nm
Resolution	1024 pixel
Integration time	10 μsec. – 10 sec.
Control system	software based control
System requirements	Windows 7 operating system (or higher)
Recommended calibration period	once a year, regardless of the operating hours

iQ-CHART BOX

Compact LED illumination unit for reflective charts

The iQ-Chart Box makes it possible to illuminate reflective test charts quickly and homogeneously. It is the compact solution for providing optimal conditions for the image quality testing of cameras and cell phones. The light source consists of 8 iQ-LED modules that are spectrally tunable so that D50, D65 or tungsten illuminants, as well as custom spectral distributions can be created. Chart changing is carried out quickly and easily by means of a movable carriage. For automated testing, a C++ API is available just as it is for all the other iQ-LED based products.

iQ-LED
TECHNOLOGY

API
AVAILABLE

iQ-CHART BOX	
Principle	chart holder with illumination device (includes micro spectrometer), software controlled
Light sources	8 x Image Engineering iQ-LED units: overall 640 LEDs 2 white and 20 color channels, 32 khz PWM, spectral range: 400 – 820 nm , 4 x 18 W fluorescent tubes D50
Maximum / Minimum illumination values	max. up to 500 lx standard D illuminants: 400 lx* min. down to 25 lx with ND filters down to 1,5 lux* (depending on illuminant and required curve fit / CRI)*
Dim function	software based by presetting of intensity (lx / watt) while calibration device is connected, further dimming via included ND filters 1000 step software based dim control (fluorescent tube)
Predefined standard illuminants	D50, D55, D65, D75, A, B, C Planckian spectral curve by selected temperature (1900 - 18,000 K)

Main Features:
- compact
- high uniformity
- free selectable spectral distribution
- creation of test sequences
- low light conditions with ND filters down to 1,5 lx
- auto generation of external measured spectra
- spectrometer (350 – 800 nm) NIST traceable
- iQ-LED control software
- C++ API is available

* measured at center of A460 sized test chart

iQ-FOV BOX

Resolution of high field of view cameras under close scrutiny

Measuring the resolution of high field of view cameras requires a specific solution. The iQ-FoV Box is the flexible tool to perform image quality measurements for resolution aspects. Due to the adjustable positioning of the test charts, the distortion of the test pattern in the image is minimized and the analysis method for slanted edges is applicable. Images, corresponding to one of the two specified setups, can be analyzed automatically with the iQ-Analyzer.

Interior with measurement scales
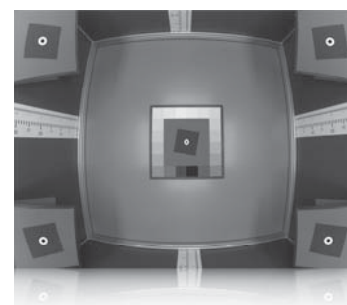
iQ-FOV BOX	
Principle	test box for high field of view cameras
Light sources	8 x fluorescence tubes 18 W / 950, dimmable D50
Extension arm travel range (depth / height)	75 cm / 15 cm
Rotation range	Pitch: +/- 15° Yaw: +/- 170° (motorized adjustable via remote control)
Rotation range roll	+/- 10° (manually adjustable)

Main Features:
- for fisheye cameras up to a viewing angle of 180°
- flexible positioning of test charts
- dimmable illumination
- accurate positioning system for the camera

LIGHTSTUDIO

Real scene lighting for visual analysis

Although test charts are used to test digital cameras and perform objective measurements, there are certain aspects when testing a camera that require a real scene. One aspect is correct white balancing for different types of illuminants. Another is the determination of the visual loss of detail due to noise reduction. So, while it is of course possible to perform tests with real scenes, the question becomes, how to make these tests comparable over time? Not only that, but how best to compare results with others from around the world?

To answer these questions, Image Engineering has developed the lightSTUDIO. It provides the standard types of illumination, and at a height of 60 cm, width of 125 cm and depth of 75 cm, it is large enough to illuminate an entire tabletop scene. In order to achieve a worldwide comparison between labs, the lightSTUDIO comes with the complete interior (see picture to the right). Each object* was carefully chosen after extensive testing to determine which ones provide the most unique information.

Standard lightSTUDIO-S*

Main Features:
- reproducible illumination of an entire tabletop scene
- switchable light settings
- comparison of testing results between different labs
- different test criteria
- different options available

Additional features

lightSTUDIO-L with iQ-LED lightHEAD (API available)
The lightHEAD can be exchanged for a LED based one that uses 20 narrow band LED channels and 2 white LED channels to spectrally match almost every standard light source. One set of fluorescent tubes has also been added to get the spiky spectrum characteristic for these sources.

lightSTUDIO-M with moving targets
When comparing compression technologies, artifacts, motion blur and other aspects in videos, the lightSTUDIO can be equipped with moving targets. One of these is a horizontally moving frame that can hold a variety of targets, including a dead leaves target or a slanted edge target. A second movable section is a rotating plate located on the back wall of the box, which also allows for speed adjusting (up to 600 rpm). In order to stabilize the whole setup with moving parts, the option for moving targets also comes with a rack on which the box is mounted.

lightSTUDIO-H with HDR option
Another aspect that is important for modern digital cameras is the ability to capture high contrast scenes. In order to really create a high contrast scene, it is necessary to add some back illuminated test patterns or images to the box. Two LG light boxes with transparent charts are used for this purpose. In order to avoid stray light, which reduces the contrast in the foreground, the light boxes are placed in the back of a surrounding black box. This box is inserted in the center part of the back wall of the lightSTUDIO. Contrast ratios of more than 10,000:1 can be reached.

lightSTUDIO-T with twin option
The lightSTUDIO Twin offers a space-saving solution for multiple scenes with different illumination. With the same footprint as the lightSTUDIO standard, it provides two separated chambers with independent light sources. Auto white balance can be tested under specific conditions. The "Twin" option can also be used as a standard lightSTUDIO when the separated light sources are controlled simultaneously.

A mixture of additional features is possible.

*The interior of lightSTUDIO can change, please have a look at lightSTUDIO interior changelog.pdf on our website (www.image-engineering.com).

Standard features of the lightSTUDIO

| USB interface | dimmable | several illuminants | interior inclusive |

Moving charts in front of the background

iQ-LED TECHNOLOGY

API AVAILABLE

HDR option

iQ-LED TECHNOLOGY

API AVAILABLE

Twin option

API AVAILABLE

CAMSPECS

Measure spectral sensitivity fast and efficiently

camSPECS is a fast and affordable solution for measuring the spectral sensitivity of a digital camera system because all interference filters are mounted in a single "test chart" (access to RAW image files* required). It contains the hardware and software tools that are necessary to perform the measurements.

The camSPECS hardware consists of metal housing with a stabilized power supply for the halogen light source. The 39 interference filters are mounted to the front plate. The interference filters provide monochromatic light from 380 nm to 760 nm. Inside the housing, the device is equipped with a heat absorbing filter, a diffusor plate and a neutral density filter plate for each interference filter. The last provides almost equal power output for the interference filters, so that the dynamic range of a typical consumer camera is not exceeded. Neutral density filters in between are used to compensate for possible non-uniformities (such as shading in the camera) over the filter area.

HARDWARE	
Principle	illumination box with filter panel Spectroradiometer EX1 for calibration
Light source	Halogen (24 V / 250 W) Osram 64657 HLX
Durability of light source	300 h
Wavelength range	380 - 760 nm (10 nm steps)
Bandwidth	10 nm (380 - 760 nm)
Off band rejection	4.0 optical densities
Diameter interference filters	10 mm
Diameter ND filters	6 mm

* In this context, Image Engineering uses the term "RAW file" for files that are created by a digital camera in "RAW-Mode" and are readable by the software dcraw. This does not include RAWfiles that do not follow any readable image file format. You will have to convert these files to 16 bit linear tiff first.

CAMSPECS SOFTWARE

Convenient evaluation software

The evaluation software makes measuring fast and convenient. It calculates the spectral sensitivity with the images and the calibration data of the filters as a direct measurement (similar to a monochromator). The software reads image files such as TIFF or common RAW files* and can perform a dark frame subtraction if needed. Non-Bayer pattern sensors (e.g., sensors with RGB-IR or RGBC pattern) can also be evaluated. In this case, all four channels are measured independently.

The main application for the spectral sensitivities is the calculation of color correction matrices (CCM). With the CIECAM16 model and the export of ICC and Adobe ACR profiles with 2D and 3D-MLUT rendering. An additional feature incorporates the assessment of the measurement setup by comparing real camera data with predicted RGB values.

For the calculation of individual CCMs, the spectral radiances of natural objects from the in-situ database may be applied. The software incorporates a fast and database-driven measurement of spectral sensitivity using the iQ-LED technology. With focal plane captures of all single channels of an iQ-LED device (such as the CAL2), and the corresponding spectral power distributions, it is possible to measure spectral sensitivities in the end-offline production. For high precision measurements, the creation of a dedicated database of two master cameras is the sole requirement. For a standard application, a ready-to-use database is available.

SOFTWARE
spectral sensitivity measurement
spectral sensitivity measurement based on iQ-LED technology applicable for production line
creation of ICC and Adobe ACR profiles
use of 2D- and 3D-MLUT for profile creation
CIECAM16 implementation for profile creation
test procedure for evaluating CCMs with different training data
RAW file* processing / dark frame subtraction / batch processing
validation by comparing camera and predicted RGB values
generation of Color Correction Matrices (CCM) (RGB to XYZ and RGB to sRGB) with three different algorithms
calculation of white balance multipliers
calculation of Digital Still Camera / Sensitivity Metamerism Index (DSC/SMI)
visual evaluation of ICC profiles with real images
calibration with included spectro radiometer
export of all results to XML or plain text files

STABILIZATION EVALUATION EQUIPMENT

Automated OIS tests

The Stabilization Evaluation Equipment (STEVE) was designed for the qualitative analysis of image stabilizing systems under reproducible, realistic conditions. The STEVE bundle, composed of hardware and software, is designed for performing custom handshakes, and calculating the image stabilization performance of optical and electronically stabilized systems.

To determine the influence of the handshake it is necessary to combine STEVE with a test chart. We recommend the iQ-AF Box with TE261.

STEVE-6D

Automated OIS tests with six degrees of freedom

The STEVE-6D permits high precision and fast simultaneous movements in as many as 6 degrees of freedom. The pivot point is freely selectable. Every axis is separately controllable by using CIPA, custom waveform data or a sine wave generator.

STEVE-6D is available in two versions with the same range of functions, but they differ in the maximum possible load (up to 2.5 kg for the STEVE-6DS and up to 6kg for the STEVE-6DL). The measurements from STEVE-6DS are much more accurate, while the STEVE-6DL is much faster. Both devices are certified by CIPA under the conditions of Verification Method of Vibratory Apparatus for CIPA DC-X011.

Included in the delivery for STEVE-6D is the hardware (hexapod), the control and analysis software, the automated shutter-triggering device (iQ-Trigger), as well as the iQ-Mobilemount. Ideally, STEVE-6D should be combined with the test chart TE261 and the iQ-AF Box.

Main Features:
•	high precision and fast simultaneous movements
•	6 degrees of freedom
•	custom waveforms
•	sine generator
•	freely selectable pivot point
•	STEVE-6D certified by CIPA
•	control and analysis software included
•	iQ-Trigger and iQ-Mobilemount included

STEVE-6DS (small)   STEVE-6DL (large)
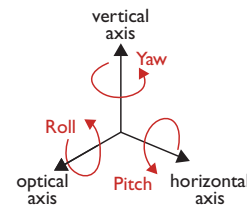
STEVE-2D

Stability measurement

STEVE-2D is calibrated to provide the best performance at the most significant frequency / amplitude combination of the human vibration of 4 Hz and 0.2 degrees. The whole range of available frequencies and angles of the movement corresponds to the properties of the typical human vibration.

For the initial setup, the mounting stage allows for adjusting the camera position. The movement parameters of the two axes can be controlled separately. Moving along a single axis (yaw or pitch) is possible, as well as simultaneous operation in a parallel or antiparallel way. Both, simple sine shaped motion and individual curves (e.g. to simulate a real handshake), can be produced and logged.
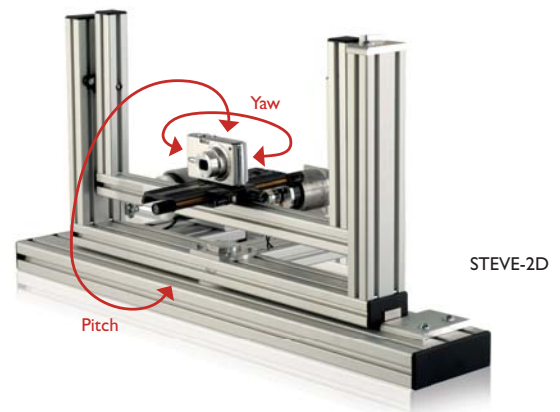
STEVE-2D

SOFTWARE STEVE-6D

The software consists of two modules:

Main Features:

I. VIBRATION CONTROL module
to control the movement

interface to STEVE-6D
>   pivot point can be freely selected

interface to iQ-Trigger
>   triggering of the camera

set up waveform data
- with the sine wave generator for every axis
- choose one of the two/three CIPA handshakes
- or upload a custom waveform with Cartesian coordinates

II. DATA ANALYZE module
calculation of the image stabilization performance

Metadata tool
>   set camera metadata
>   necessary pixel pitch and shutter time
>   image batch processing for IS-Performance calculation
>   comparison for IS on/off or estimated edge width

displays the results
- stabilization performance in f-stops
- the edge spread function "ESF"
- spatial frequency response "SFR"
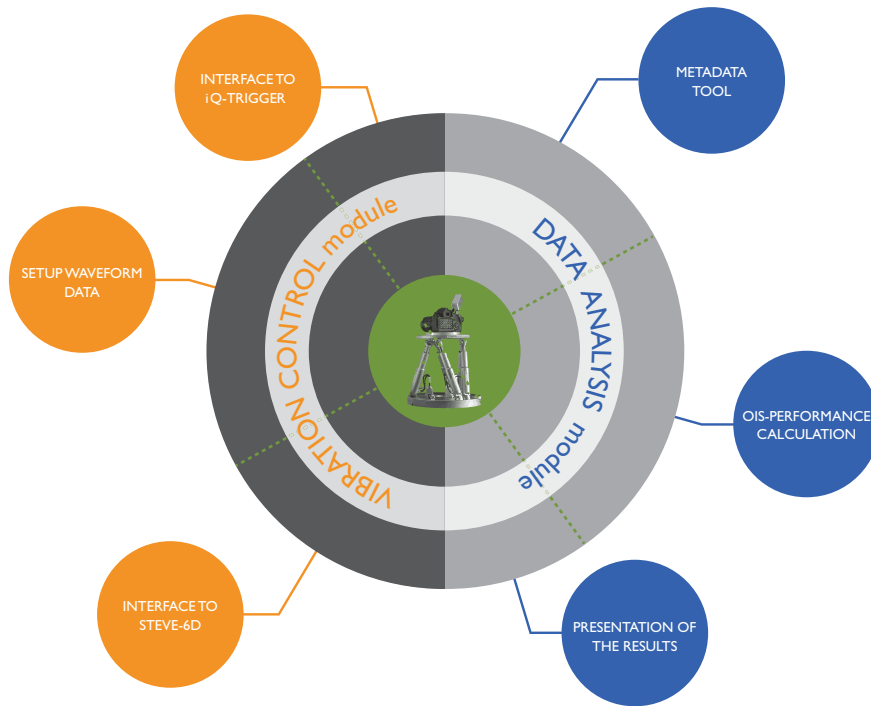
	STEVE-2D	STEVE-6DS (PI H-811)	STEVE-6DL (PI H-840)
Max. camera weight	5.0 kg	2.5 kg	6.0 kg
Pivot point	fixed	customizable	
Translation range (X / Y / Z)	not available	± 17, ± 16, ± 6.5 mm	± 50, ± 50, ± 25 mm
Rotation range (X / Y / Z)	0.1 - 0.5° (optimized for 0.1 - 0.2°)	± 10, ± 10, ± 21°	± 15, ± 15, ± 30°
Max. linear velocity (X / Y / Z)	not available	25 mm/s	50 mm/s
Max. angular velocity (X / Y / Z)	not available	325 mrad/s	600 mrad/s
Single-actuator design resolution	-	80 nm	500 nm
Motion type	2-axis sine generator or custom waveform	6-axis sine generator or custom waveform	
Mean position error	< 5%	< 3%	
Standard accessories	camera mounting stage, controller box, USB cable	motion controller C-887, iQ-Trigger, iQ-Mobilemount	
Optional accessories	iQ-Trigger/-T, iQ-AF Box, TE261, Honeycomb Breadboard, iQ-Anchor for STEVE		

For detailed and technical specifications please have a look at www.imimag-engineering.com.

iQ-AF BOX

Main Features:
- storage for 2 intensities
- easy switching between the stored intensities
- fluorescent tubes right/left/top/bottom can be switched on/off separately
- test pattern optimized for good focusing ability

The iQ-Autofocus Box is designed to illuminate a test chart at different light levels

In combination with the LED-Panel, the iQ-AF Box can be used for low/bright light shutter and shooting time lag measurements of digital cameras. The test pattern used supports the operation of different autofocus systems in order to ensure a reliable focusing ability. A switch can quickly shift between two previously adjusted light intensities without measuring the illuminance again. We recommend the Timing Measurement Turnkey Solution, which provides everything you need for timing measurement (page 11).

iQ-AF BOX	
Principle	light box with different light levels
Light sources	4 x fluorecent tubes 18 W 4 x fluorecent tubes 36 W D50 (can be switched on/off separately)
Illumination values	20 - 3200 lx
Size of used test chart	A1066 (124.5 x 83.5 cm)
Provided test charts	TE261 (other on request)
Setting of light level	two rotary control units

LED-PANEL

Precise timing measurement with software control and analysis

The LED-Panel V4 is the ideal time measurement device to determine the important timing values for digital camera systems. It is now possible to record extremely precise measurements with an accuracy greater than one millisecond with this device. The LED-Panel uses operator-friendly software and has a USB interface that is controlled from a computer. A command line interface next to the control software is also included.

With the LED-Panel the user can separately measure shooting time lag and shutter release time lag. Once measured, they then can be subtracted in order to have a precise auto focus performance. Also, the display refresh mode allows for the measurement of the display refresh rate, and the continuous mode is able to measure frame rate and exposure time. In the rolling shutter mode, the 10 LED rows move simultaneously. The direction of the LED sequence can be changed.

Measurable Parameters:
- shooting time lag (including AF)
- shutter release time lag
- autofocus time
- negative shooting time lag
- burst frame rate
- display refresh rate
- exposure time
- rolling shutter speed
- startup time

*depending on measurement mode

Main Features:
- analysis of images, taken from the LED-Panel
- creating individual test sequences
- providing result output as text and XML file
- can be combined perfectly with iQ-Trigger and iQ-AF Box

LED-PANEL	
Principle	array of LEDs to perform timing measurements on digital cameras
Operating mode	external trigger, internal single trigger, continuous trigger
Adjustable times	via USB: 200 µs to 10 s* manual control: 20 µs to 10 s*
Maximal reading measurement time	1000 x of set time
LED running direction	left to right, right to left, top to bottom, bottom to top
Accuracy	<0,06% from 1 ms to 10 s
display refresh rate	adjustable from 1.0 Hz to 100 Hz

iQ-TRIGGER

Mechanical finger

Timing is a critical measurement for imaging devices. The human finger can be a source of inaccuracy that you want to avoid in a lab environment. iQ-Trigger is a mechanical finger that can press the release button of a camera within 25 ms. For touch screens, the touch pen tip can be used, and it is possible to select the start on the LED-Panel when pressing or releasing the touch screen.

iQ-Trigger can be used for different measurement tasks and links seamlessly with other devices, such as STEVE, LED-Panel, lightSTUDIO with moving targets, and motor-driven test stands.

Software and remote triggering

iQ-Trigger and iQ-Trigger-T are shipped with a USB Interface (USB Box), a stand-alone control software, and a C++ API. The control software allows you to use your mechanical fingers out-of-the-box. The API offers you the possibility of flexibly integrating iQ-Trigger into your environment. With the USB Box you can control iQ-Trigger from your computer or use the included manual remote.

Main Features:
• releasing the exposure button
• different modes: single exposure, serial mode
• shutter release when pressing or releasing the finger

iQ-TRIGGER-T

iQ-Trigger-T

The automatic camera shutter release for touch screens

iQ-Trigger-T simplifies and accelerates the testing of mobile phone cameras, integrated tablets and other devices and digital cameras operated via touch display. At the same time, the automatic triggering device increases the accuracy and reliability of test routines. Using the iQ-Trigger-T with an API means that it can be pressed reliably in freely programmable intervals, and with a delay of only 0.5 ms, iQ-Trigger-T can also be used as a remote shutter release for cameras with capacitive touch screens. For example, the exposure of a series with a freely definable frame rate or for the production of time-lapse photography.

iQ-DEFOCUS

Defocusing aid for fully automatic cameras

Many cameras only have a fully automatic focus. In order to obtain reliable values for the various time measurements, it is necessary to reset them to infinity or to the factory default settings. The new iQ-Defocus is helpful in this situation. It is placed in front of the lens to bring the camera's focus system back to the reproducible starting position, thus providing a reliable basis for time measurements. Technical data was not yet available before the printing date. Please visit www.image-engineering.com for up-to-date data.

Main Features:
• defocusing

iQ-ANALYZER

Image analysis for professionals

iQ-Analyzer is the market leading solution in the image quality analysis domain. It is a must have for every camera manufacturer, independent of application area, especially when combined with the high quality test charts and illumination devices developed by Image Engineering. All over the world, many engineers have been successfully using iQ-Analyzer for years. Broadcasting, archiving, medical devices and photography are just a few sectors in the imaging industry where the iQ-Analyzer succeeds. In addition to these areas, iQ-Analyzer has proven its value in the development and quality assurance of mobile devices, such as webcams, cell phones, notebooks and tablet computers, as well as in automotive, security and machine vision applications. iQ-Analyzer is a versatile tool, which adheres to international standards.

// WORKFLOW

INPUT

TEST CHARTS & ILLUMINATION

STILL IMAGING DEVICES

VIDEO DEVICES

IMAGE & VIDEO FILES

8 BIT 16 BIT RAW AVI MOV

FRAME GRABBER

ANALYSIS

iQ-ANALYZER

C:\>_

OUTPUT

MEASUREMENT RESULTS DIAGRAMS

MEASUREMENT RESULTS TEXT AND XML FILES

DIAGRAM EXPORT

PDF PNG PS

IMPORT IN SPREADSHEETS AND DATABASES

EXCEL
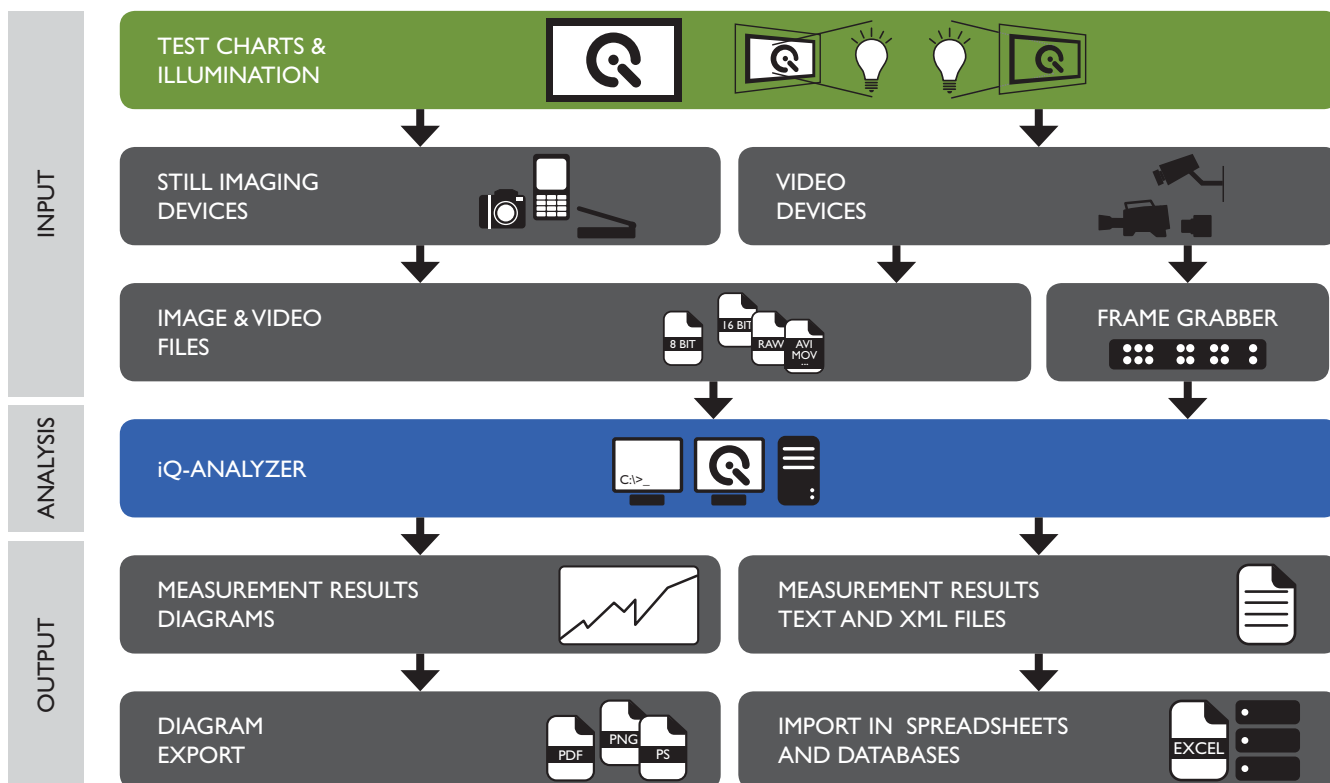
// FEATURES EXTRACT

VERSATILE USER INTERFACE
iQ-Analyzer comes with a well-designed multilingual graphical user interface and advanced data visualization. A full-fledged command line interface (with the exception of the video module) enables the user to integrate the capabilities of iQ-Analyzer into individual workflows.

FLEXIBLE OUTPUT FORMAT
In addition to the visual representation of the measurement data, the numerical results can be saved as plain text or XML files. These common non-proprietary file formats allow convenient import and further processing in spreadsheets or databases.

QUICK RESULTS ASSESSMENT
Measurement results can either be checked against custom specs or compared to a "golden master" reference measurement.

RAW FILES SUPPORT
iQ-Analyzer supports RAW image files in all modules and is able to convert and save them using user specific parameters.

BATCH EXPORT OF RESULT DIAGRAMS
A right-click on a result diagram will open a context menu allowing it to be added to the export list. Your batch export lists can easily be saved and managed.

// MAINTENANCE PROGRAM

Become a member of our **Maintenance Program** and benefit from free releases of iQ-Analyzer. Moreover, our experienced engineering team will consult and support you in all matters.

The **Advanced Maintenance Program** additionally includes a two-day training course with customer-oriented content, either online, at the Image Engineering facilities or on-site at your location (travel expenses excluded).

An annual membership fee applies for both Maintenance Programs. However, every iQ-Analyzer license includes a free standard membership for one year. Thereafter, it will expire if not extended.
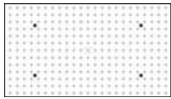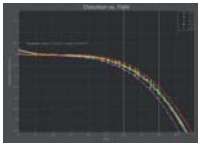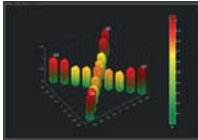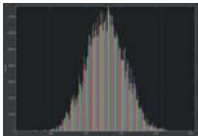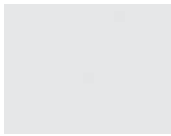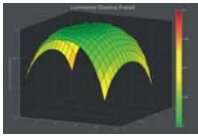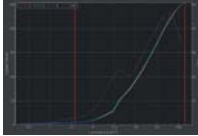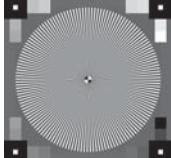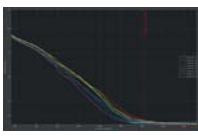
// LICENSING

SINGLE USER: You can install the software on as many computers as you wish and then use it on the one with the USB dongle plugged in or with a single network license.

MULTIPLE USERS: We offer a discount for the second and following single user licenses purchased by the same company.

SITE LICENSE: Licenses for up to ten simultaneous users, as well as licenses for an unlimited number of simultaneous users are available upon request.

iQ-ANALYZER MODULES

MODULE	EXAMPLE CHARTS	KEY FEATURES	SCREENSHOT SOFTWARE
COLOR		• color reproduction Delta E* • luminance difference Delta L* • chroma difference Delta C* • hue difference Delta H* • selectable chromatic adaptation and color difference formulas	
DISTORTION		• lens geometric distortion • (ISO / CPIQ) – TV-Distortion (EBU / SMIA) • chromatic aberration	
FLARE		• measurement of flare over the imaging field (upcoming ISO 18844) • optional dark frame subtraction	
HISTOGRAM		• defective pixel: dead and hot, single and cluster • histogram	
SHADING		• luminance shading in f-stops or as a percentage • color shading • noise depending on image field	
OECF		• camera OECF (ISO 14524) • ISO speed (ISO 12232) • fixed pattern noise, total noise, temporal noise, visual noise (ISO 15739) • dynamic range (ISO 15739) • white balance	
RESOLUTION		• SFR on slanted edges and MTF on sinusoidal or bitonal Siemens stars (ISO 12233) • texture loss measurement on low contrast Siemens stars (ISO19567-1:2016) and on dead leaves (upcoming ISO19567-2)	
42		• analysis of the TE42 "Forty Two" test chart • quick check for cameras, mobile phones and other devices • get the most important image quality parameters with one shot of the TE42 with this module	
MEASUREMENT		• on-the-fly analysis • any image input • navigator view for panning and zooming • selections of different shapes (line, rectangle or circle) • statistics within the selections (min, max, standard deviation and mean) • contour plot • immediate simplified measurements (e.g. 2D-FFT, visual noise or SFR)	
VIDEO		• live video signal acquisition • video file acquisition • waveform / vectorscope • histogram analysis • color difference analysis • color comparison by making one camera a reference • capturing single frames and passing them on to other modules for further analysis	

iQ-API EXTENSIONS

Application interfaces for automated testing

The vast majority of our products come with user-friendly desktop applications for controlling the hardware and analyzing the images. Sometimes however, there is also a need for integration of our products into already existing software systems, or you can write your own custom applications to meet each individual requirement. With our Application Programming Interfaces (APIs) we offer you software building blocks with immense flexibility. Our APIs are written in a very wide-spread and highly performant C++ programming language.

We consciously avoid dependencies on third-party frameworks, using only standard ISO C++ and its Standard Library (STL) in our interfaces. The APIs come along with extensive documentation, code snippets and example projects. Their high-level interfaces are easy to learn and do not require in-depth knowledge of single components to get started, which significantly reduces development costs.

Some of our products also offer a Command Line Interface (CLI), enabling you to automate tasks without any programming skills. You can begin just by issuing text commands in the Windows Command Prompt or by scripting them in batch files.

API (APPLICATION PROGRAMMING INTERFACE)		
API (C++)	RELATED PRODUCTS	KEY FEATURES
iQ-Drive API	iQ-Alignrig iQ-Bench-M iQ-Chartmount-VM iQ-Hexalign iQ-Rotation lightSTUDIO-M (-LM, -LMH, -SM, -SMH)*	full control over our motor-driven products and hexapods
iQ-LED API	CAL1, CAL2, CAL3 LE7 iQ-LED iQ-Chart Box iQ-Flatlight lightSTUDIO-L (-LH, -LM, -LMH)* EX1	full control over iQ-LED technology as well as over our built-in and stand-alone spectrometer
iQ-Standardlight API	lightSTUDIO-S (-SH, -SM, -SMH, -ST)* iQ-Flatlight iQ-Chart Box lightHEAD-S (stand-alone)	controlling the fluorescent and halogen light sources in various devices
iQ-Trigger API	iQ-Trigger (-T)	controlling iQ-Trigger when connected via the USB-Box
LED-Panel API	LED-Panel iQ-Trigger (-T)	full control over the LED-Panel and connected iQ-Trigger
LG API	lightSTUDIO-H (LH, LMH, SH, SMH)* LG3	controlling the HDR extension of the lightSTUDIO-H and the LG3 device

CLI (COMMAND LINE INTERFACE) INCLUDED		
CLI	PRODUCTS	KEY FEATURES
iQ-Analyzer CLI	iQ-Analyzer	full-featured image analysis for batch processing
LED-Panel CLI	LED-Panel iQ-Trigger (-T)	full control over the LED-Panel and connected iQ-Trigger
lightSTUDIO-S CLI	lightSTUDIO-S (-SH, -SM, -SMH, -ST)*	controlling the fluorescent and halogen light sources in the lightSTUDIO-S devices

* For explanations of the various types, please have a look at page 20

iQ-LUMINANCE

Turn your camera into a luminance meter

iQ-Luminance is a convenient tool that will help turn your camera into a luminance meter. Using a calibrated camera for this purpose allows you to outperform conventional luminance meters while keeping your costs low. The iQ-Luminance software calculates luminance values from the image data taken by the calibrated

camera in consideration of lens shading. The obligatory camera calibration provides the knowledge on how the raw RGB data from the camera can be mapped to the luminance, while still keeping in mind various exposure settings. This device and lens-specific calibration is performed in our iQ lab.
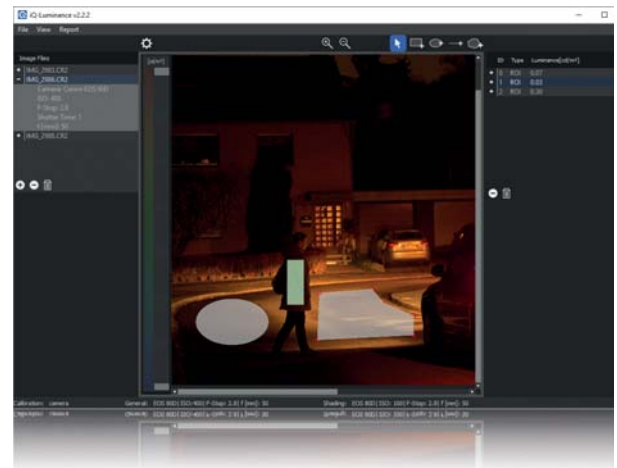
IN-SITU DATA

In-situ spectral radiances

The only commonly known source for some in-situ measured spectral radiances until now was ISO 17321-1. It describes the principle of how the color characterization of a digital camera works, and it provides spectral radiances for 14 common objects. Our in-situ spectral radiance data project was started in order to collect several thousand measurements of all different kinds of objects under various illuminations. These objects include typical scenes that people photograph.

Why in-situ?

In many cases the spectral radiation of objects is not only the reflected light, but some objects, such as leaves, have a transmissive part. In other cases inter-reflections between the objects modify the spectral radiance in certain scenes. As a result, some objects, such as the human skin, appear totally different in real life compared to the skin tones of a reflective color target.

What for?

The collected data can be used as a scientific data base for different studies related to natural objects. However, the main reason for collecting the data was to provide training data for the color characterization of digital cameras in combination with their spectral sensitivities. Currently, a total number of approx. 2500 measurements is available. With the database, you can optimize your color correction matrix based on real life data, by far exceeding the potential of a ColorChecker.

What is the content?

The database is divided into categories for thematic selection of objects, such as plants, human skin color or illumination type. Each object contains the spectral reflection in the range from 380 to 780 nm in two variants. One includes the incident light, while in the other this light is removed (white tile corrected).
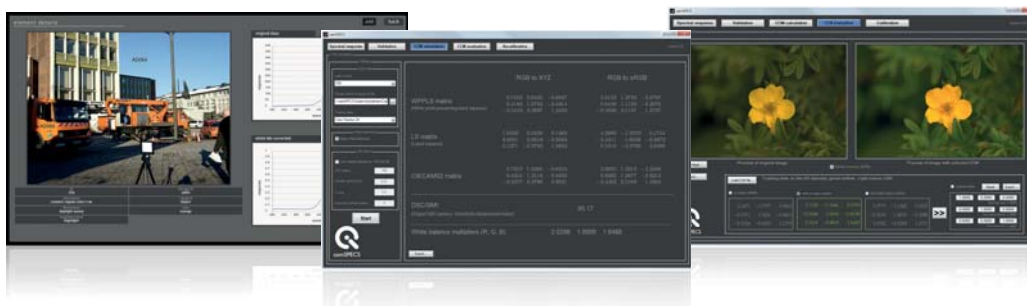
* In this context, Image Engineering uses the term "RAW file" for files that are created by a digital camera in "RAW-Mode" and are readable by the software dcraw. This does not include RAW-files that do not follow any readable image file format. You will have to convert these files to e.g. 16 bit linear tiff first.

iQ LAB – TEST SERVICES FOR YOU

The iQ lab is our onsite testing facility designed to measure any information you may need regarding your imaging system. Our expertly trained engineers can test everything you require – whether resolution, spectral sensitivity, dynamic range, color reproduction, image stabilization, noise and timing – the iQ lab can help you improve your image quality. Using the latest international standards, our staff will provide you with a professional report detailing the test results, which can be relied upon to help advance your products.
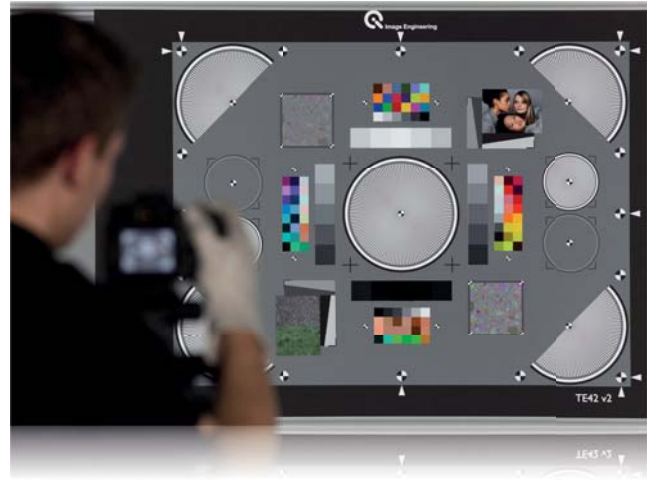
Our expertise – your benefit

When you work with the iQ lab, you can choose between regular measurements based on the tests we do for magazines (see table for details), or you can request special tests and test conditions. We will gladly help you find and create the right measurement procedure to collect all the relevant information you need to improve your imaging device.

While you may have your own testing lab, it can still be highly beneficial to receive an external, neutral opinion on your latest developments. Every year the iQ lab sees hunderdes of cameras and lenses from leading camera and lens manufacturers from all over the world, giving it the proper experience and the necessary capability to put the results in the right contex for you.

IQ-DATA – EASY ACCESS – EASY BENEFIT

We also offer access to all measurement data for all consumer/system cameras and lenses based on our tests for magazines. The so called iQ-Data consists of more than 300 consumer cameras, 300 SLRs and mirrorless system cameras, as well as more than 1200 lens camera combinations that continues to grow every day. The database is an ideal tool for setting up a side by side quality comparison of various devices. Test images are also available.

You can choose between three types of access to the iQ-Data.

iQ-Data full: For a yearly fee, you will receive unlimited access to all measurement data. This access also includes up to five individual measurements. Product tests for an individual company will only be visible to that company and remain confidential.

iQ-Data lens: For a yearly fee, you will receive unlimited access to all measurement data for all the lens-tests. This access also includes up to five individual measurements.
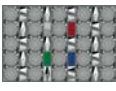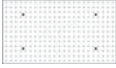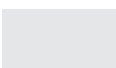
iQ-Data camera: With this license, you will receive access to all camera measurement data (consumer & system cameras).

Curious?
Contact us at iqlab@image-engineering.de
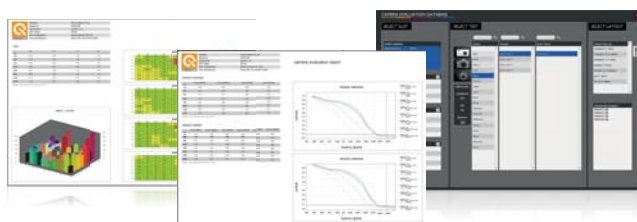
extract from a test report

MEASUREMENTS ON A REGULAR BASIS

Test Procedures	tested with	settings	measurement data for	available on iQ-Data
		What we measure	**What you get**	
Camera Tests				
Image quality measurement	reflective	all ISO-speeds (except ISO 200), f5.6, JPEG & RAW	resolution center (Siemens star) texture loss (dead leaves) sharpening (slanted edges) color reproduction	x x x x
	transparent	all ISO-speeds (except ISO 200), f5.6, JPEG & RAW	visual noise/signal to noise ratio dynamic range used digital values white balance	x x x x
Timing measurement		ISO 100, f5.6, 50 mm, JPEG, 30 lx and 300 lx JPEG, RAW	shutter time lag shooting time autofocus speed startup time frame rate and sequence	x x x x x

Cameras are tested with two different lenses: for the image quality we take the best resolving lens on the market, so every resolution measurement of a brand is comparable to each other. The same applies for the time measurements.

Lens Tests				
Image quality measurement	reflective	ISO 100, open aperture and two steps closed aperture, wide-angle, standard and tele focal length, manual focus for lenses with a bigger aperture than f2.0 also a measurement at f5.6 takes place	resolution center/corners for 3 focal lengths and 2 apertures contrast center/corners for 3 focal lengths and 2 apertures autofocus accuracy wide-, standard-, tele-angle resolution center/corners for 3 focal lengths and f5.6 contrast center/corners for 3 focal lengths and f5.6	x x x - -
	reflective	ISO 100, open aperture, wide-angle, standard- and tele-focal-length	distortion wide-angle (Lens Geometric Distortion) distortion standard-angle (Lens Geometric Distortion) distortion tele-angle (Lens Geometric Distortion) chromatic aberration for the 3 focal lengths	x x x x
	reflective	ISO 100, open aperture and two steps closed aperture, wide-angle, standard and tele-focal-length for lenses with a bigger aperture than f2.0 also a measurement at f5.6 takes place	shading wide-angle, open and two steps closed aperture shading standard-angle, open and two steps closed aperture shading tele-angle, open and two steps closed aperture visual noise shading wide-, standard-, tele-angle f5.6	x x x x
Autofocus speed measurement		ISO 100, wide-angle, standard and tele-focal-length	autofocus speed wide-angle autofocus speed standard-angle autofocus speed tele-angle	- - -
		additional test is made for the macro-quality of macro lenses.	resolution distortion	

All lenses are tested with predefined cameras depending on their purpose. For every brand two cameras, one with an APS-C sensor and one with a full-frame sensor, are predefined. So every lens measurement of a brand is comparable to each other.

Mobile Camera Tests				
Image quality measurement	reflective	default settings of camera: 1000 lx, 5500 K default settings of camera: 4x-zoom: 1000 lx, 5500 K default settings of camera: -2EV equates 250 lx); 5500 K default settings of camera: -4EV (equates 63 lx); 5500 K default settings of camera, flash activated: -4 (equates 63 lx); 5500 K	resolution center/corners (Siemens stars) texture loss (dead leaves) sharpening (slanted edges) dynamic range visual noise signal to noise ratio color reproduction distortion wide- and tele-angle shading wide- and tele-angle	
Timing measurement		ISOauto, wide-angle and tele-angle if available, 30 lx and 300 lx	shutter delay shooting delay wide-angle shooting delay tele-angle	
Image stabilization		two settings: 800 lx and 40 lx; STEVE - movement is a sine shaped function with 4 Hz and an amplitude of 0,14°		
Luminance calibration		You want to use your camera as a luminance meter? We can calibrate your camera and also offer a software solution, so that you can measure the luminance values in a scene captured with a camera. This improves your workflow significantly, as you measure the data and the scene at the same time.		

Found what you are looking for? Contact us for ordering and pricing details or if you would like any further information.
Haven't found what you're looking for? Don't hesitate to contact us and together we can create a special measurement for you. iqlab@image-engineering.de

TE42 // FORTY TWO

The TE42 is a multipurpose test chart and is available for cameras with sampling rates between 2 and 170 megapixels. It was designed to get a quick overview of a camera's image quality performance by taking just a single image under a given illumination condition. The TE42 consists of structures for the analysis of resolution, texture reproduction, acutance, dynamic range, noise, color reproduction, distortion, shading, chromatic aberration and visual analysis. All of these can be automatically analyzed by using the iQ-Analyzer software.

Main Features:
- Dynamic range can be measured up to 10 f-stops (due to the limitations of a reflective target)
- Resolution is measured in the center and the corners of the image
- Enhanced linearization features around the Siemens stars for resolution analysis
- Low contrast Siemens stars support the ISO 19567 texture standard
- Slanted edges at different contrast levels for an analysis of sharpening applied to the image
- Distortion is measured as TV-distortion
- Color reproduction is measured with ColorChecker SG comparable colors
- A colored random circle structure (dead leaves) at two different contrast levels for improved texture analysis
- Positioning of dead leaves and visual images at the same radial distance to the center
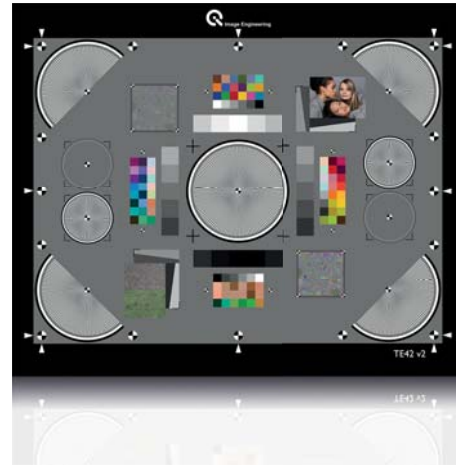
In order to produce all of the necessary structures with the required specifications, the chart contains materials from different production processes.

- For the standard (S) version, the outer parts are produced on matt paper to avoid specular reflections from the light source, especially for wide-angle analysis. With this material, the maximum sampling rate of the camera under test should be no greater than 30 megapixels.
- A high-resolution version (H) is available on photographic material. This allows the analysis of cameras with up to 170 megapixels, but puts some constraints on the illumination.

ARCHIVING

TE262 // UTT Universal Test Target

The Universal Test Target is designed to evaluate the image quality of scanners and other digital input devices for archiving. It is available in various sizes ranging from A4 to A0. For further information on the target specification see www.universaltesttarget.com
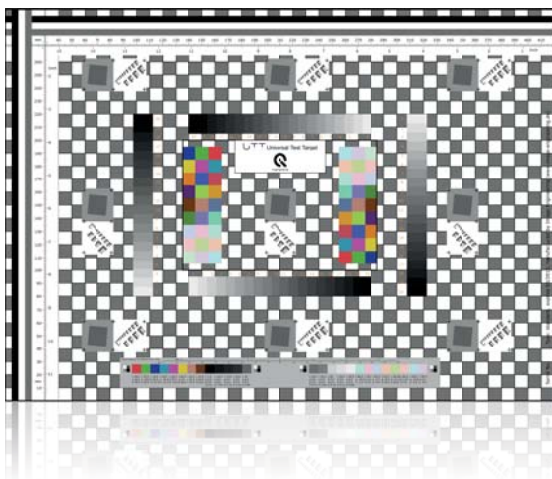
The chart covers the following topics in archival scanning:
- uniformity
- banding and registration
- distortion and deviations
- resolution (slanted edge and visual)
- dynamic range and OECF
- noise evaluation
- color reproduction
- color registration
- the use of additional reference charts

TE263 // Scan Reference Chart

The chart consists of gray steps, color patches, a scale and resolution pattern. It allows automatic analysis of each scanned page and – in combination with the right software – indicates when a specific page happens to be out of specs.

TE263 extended
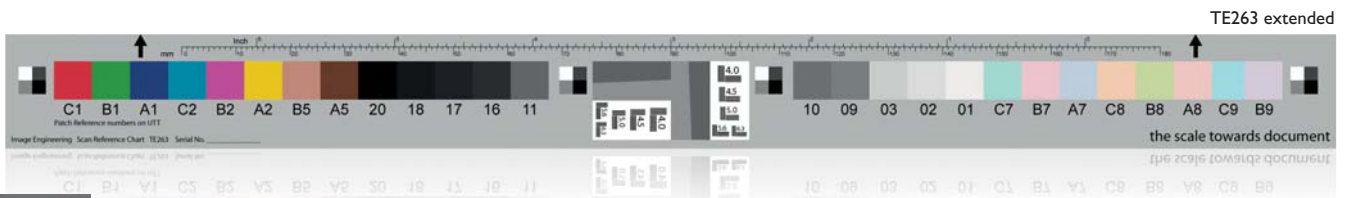
COLOR

Color rendition targets are used to check the quality of color correction (rendition) in cameras. This can be a subjective analysis for pleasing colors, or it can be a measurement for color reproduction quality. For the latter, the image is converted into CIELAB space and then the color values are compared to the measured colors of the original target. The best way to calibrate color correction in cameras is to measure the spectral sensitivities with a camSPECS device. The most common chart in this area for cameras is the x-Rite ColorChecker, which we sell under TE188 and the IT8 for scanners under TE258. The TE226 is an extended transparent version of the ColorChecker. For cameras, an extended version is the x-Rite ColorChecker SG, which has become a standard target, sold under TE230.

TE188

TE226

TE258

TE230

OECF

Measuring the characteristic curve of a camera is one of the most important tests. The resulting function is called the opto electronic conversion function (OECF). OECF, noise and dynamic range measurements, according to ISO14524 and ISO15739 in their latest revision (2013), are based on the TE264, TE269 or TE270. For the standard charts, the gray levels are generated on lithographic film using a half toning process. This could cause problems with high-resolution cameras, but can be solved by slightly defocusing the camera. In addition, we have designed the optional x-version of the TE264 on fine grain photographic material for cameras where defocusing is not an option (such as phone cameras). The TE264X is offered at almost any contrast level up to 1,000,000:1. For an analysis with a waveform monitor we recommend TE223 with its horizontal gray scales. Cameras without manual exposure control can be tested using the TE270X chart. This uses two polarizing filters in the center of the chart to fool the automatic exposure. By turning the filters, the density (transmission) of the central part of the test chart is modified. TE269 is one of our most important charts and provides more data points with its 36 patches. The selection of the suitable OECF charts should generally be based on the dynamic range of the test device. The chart should have a contrast ratio that is higher than the expected dynamic range of the camera under testing.

TE269

TE264

TE270X

TE223
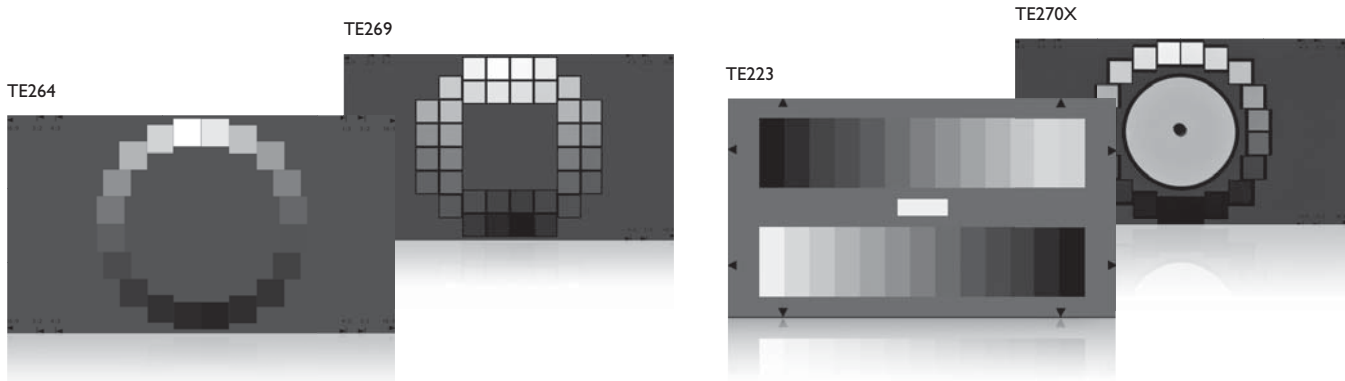
RESOLUTION

One of the most important values when testing a digital camera is the resolution. According to ISO 12233 (digital still cameras) and ISO 16067 (scanners), resolution is the ability of an image capture device to reproduce fine details in the captured scene. It is important to see that the number of pixels are not the same as the resolution. The number of pixels are necessary, but they are not a sufficient requirement to get to a certain resolution. Other optical parts such as the lens, the antialiasing filter, as well as image processing, have a significant impact on the resolution of a camera. The smaller the pixels get, the higher the influence of optical components on the resulting resolution.

TE268 (fixed aspect ratio; 4:3 and 3:2 available)

TE253 9x
(aspect ratio variable)
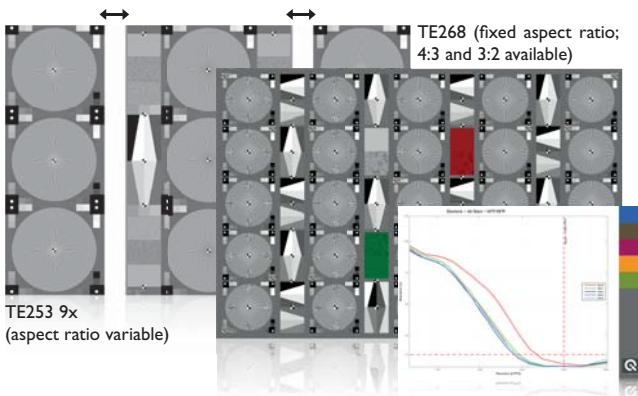
Our standard chart for resolution measurements is the sinusoidal Siemens star chart TE253 (part of the latest ISO 12233 revision). The chart allows the analysis of the resolution at 9 positions in the image, which helps to evaluate the fall off from optical center to the corners. It comes in 3 separate columns to allow the adjustment of the chart to various image aspect ratios.

To get even more information over the entire image field, the TE268 consists of 25 Siemens stars. Another approach for measuring the resolution of a camera is the analysis of a slanted edge. This method is described in detail in ISO 12233, but can only be applied to images where almost no sharpening and compression is used. This is because these image processing steps affect edges in a way that the edge analysis no longer represents the resolution of the camera.

A pilot study published at the 2008 Electronic Imaging Conference, has shown that both methods (the Siemens star and slanted edge) deliver the same results when applied to uncompressed and unsharpened images.

A unique manufacturing technology has led to a new generation of TE253 and TE268 (H series) with the sinusoidal Siemens stars. This technology produces extremely high-resolution continuous tone structures on photographic paper, enabling cameras to be measured with up to 180 megapixels using our standard A1066 target size. To get there, we decreased the size of the center mark on each Siemens star from 12 mm to 5 mm. To accurately detect the smaller marks the camera should produce a minimum sample rate of 8 megapixels.

Size comparison of the center mark:
regular/high resolution
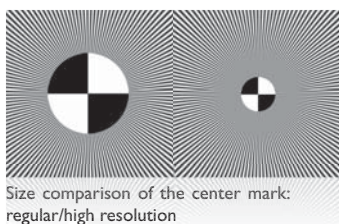
TEXTURE LOSS

Sinusoidal Siemens stars with reduced contrast are eminently suited to analyze texture loss, meaning the loss of fine details with low contrasts. The loss of texture in an imaging system is caused by noise reduction or other image processing techniques.

TE280

TE276
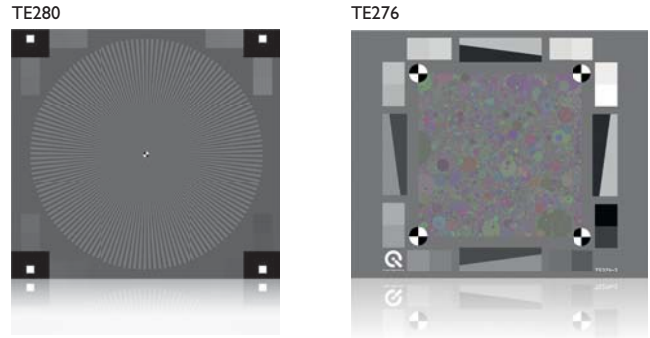
The ISO 19567-1 standard for texture analysis includes a measurement method using low contrast Siemens stars.

The Resolution module of the iQ-Analyzer, our analysis software, supports the analysis of the stars including the new TE280 chart. Using Siemens stars with a reduced contrast (18% modulation), you can benefit from the well-known advantages of sinusoidal Siemens stars. The result of the analysis using the iQ-Analyzer delivers the full MTF in addition to other numerical results such as limiting resolution (MTF 10) and acutance.
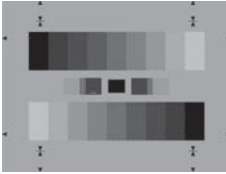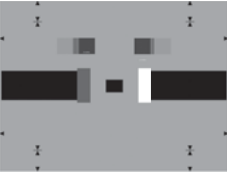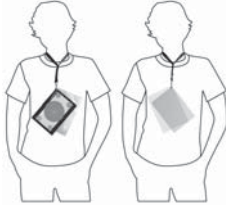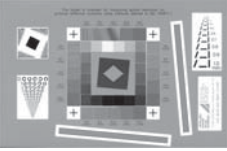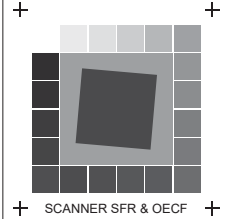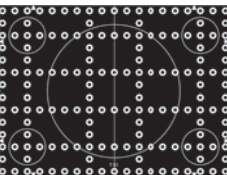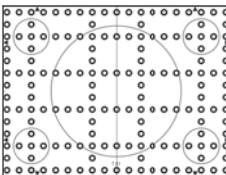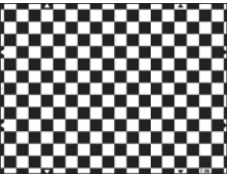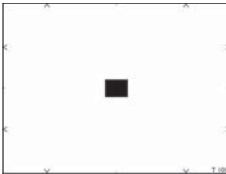
TE276 consists of dead leaves structures and the necessary surrounding markers for registration and linearization, making it the ultimate solution for texture analysis. In various publications, we can show that the latest approach "Dead Leaves_cross" is so far, the best solution to describe the texture loss (see our website for details). You can find the same dead leaves structures and low contrast Siemens stars on TE42, the multipurpose test chart for image quality measurement.

low light
low contrast

bright light
low contrast

low light
high contrast

bright light
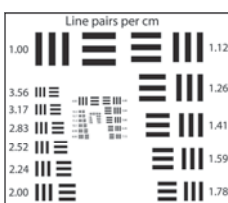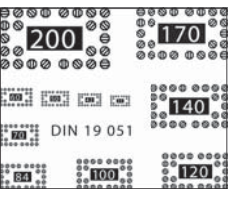high contrast
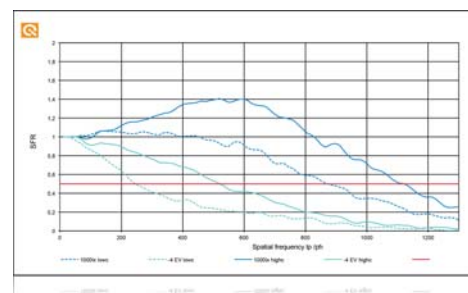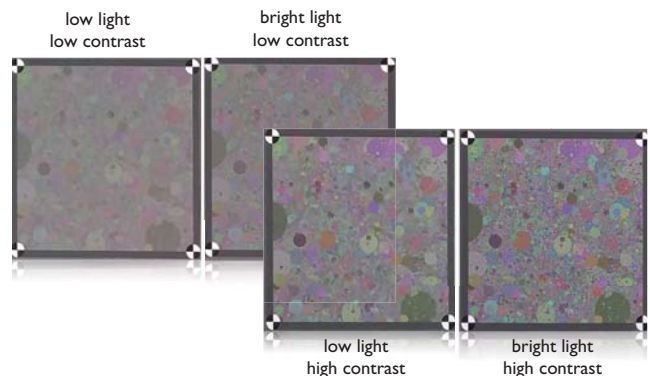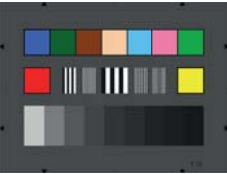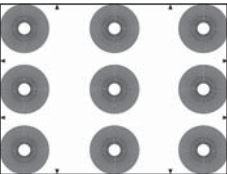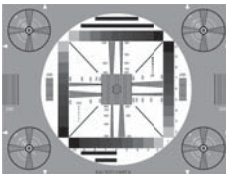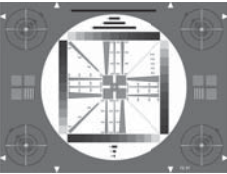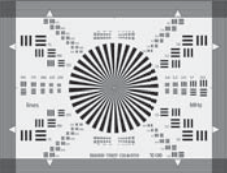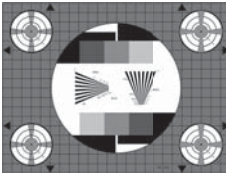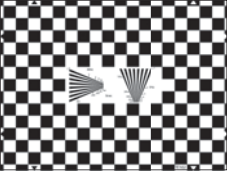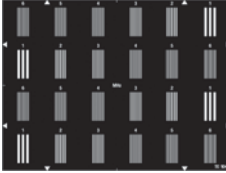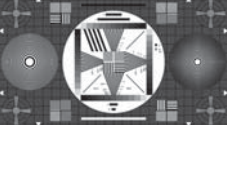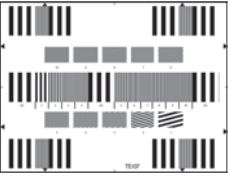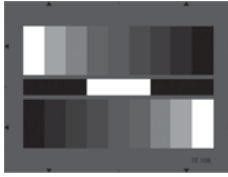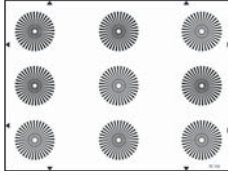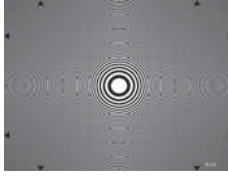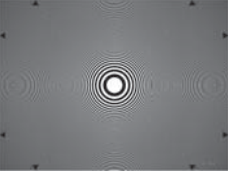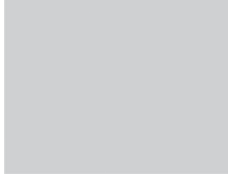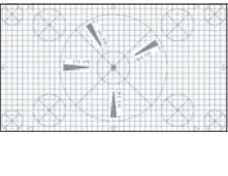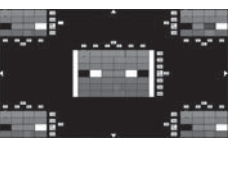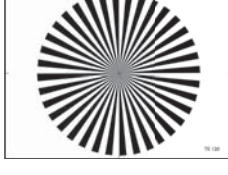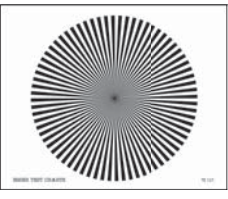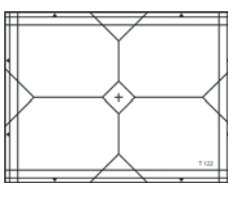
The SFR based on the Dead Leaves_cross method of the image above
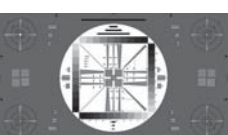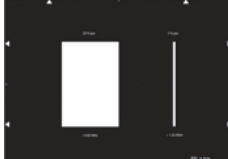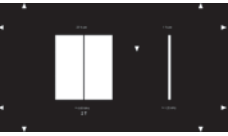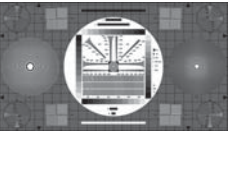
TEST CHARTS SORTED BY NUMBER
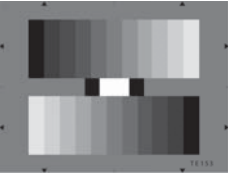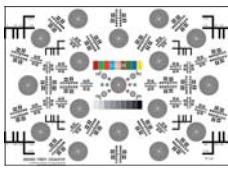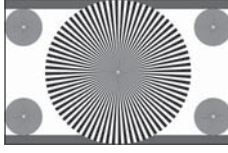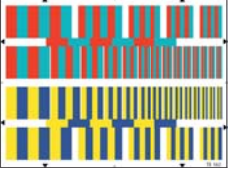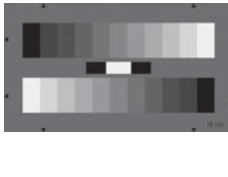
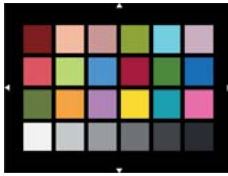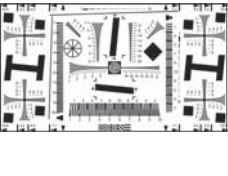## Selection of the most important test charts

● OECF/Gamma	● Back Focus	● Color	● Black to White	● Special Manufacturer
● Resolution/Multiburst	● Geometry Grid Registration	● Signal Evaluation	○ Universal Multipurpose	

BBC61A ●
Flesh Tone Reference Test Chart (BBC approved)
The flesh tone test chart is designed for evaluating the flesh tone rendition of electronic cameras. The chart, developed by the BBC London, is a four color offset print. The spectral remission of the flesh tones approximates the natural flesh tone very well.

BBC64 ●
Color Camera Gray Scale Test Chart (with super black hole)
The BBC64 is designed for the accurate adjustment of camera flare corrections and the setting of black level. Two 9-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically (gamma = 0.45).

BBC65 ●
Studio Camera Line-Up Test Chart (with super black hole)
The BBC65 is designed to be used in conjunction with the test chart BBC61A Flesh Tone Reference when very close color matching is required. BBC65 was developed to fulfill the need for a simplified studio test chart that gives only the necessary information for routine day-to-day camera line-up in the shortest possible time. Black, white and gray fields, along with black lines with different frequencies are positioned on a gray background.

Double-Checker ● ○
With the Siemens star TE148 on one side and the white balance sheet TE115 on the other, this target is a practical and essential tool for every cameraman. The neckband is a practical way to easily use it in daily work.

QA-61 ●
Includes a slanted edge, an alphanumeric resolution chart, a Landolt Ring chart, and gray step patches. Horizontal, vertical and slanted Ronchi patterns are provided at 6 to 40 c/mm. Applied Image has also provided (as permitted in section 4.1.2 of the standard) a T-100 Digital Electronic Pixel Target, which has horizontal, vertical and slanted bars in widths from 0.1 to 1.0 mm (width to length ratio is 1:5).

APPLIED IMAGE Inc.

SCANNER SFR & OECF

APPLIED IMAGE Inc.

QA-62 ●
Includes a dark gray 25 mm square that is rotated 5 degrees on a gray field. Surrounding grayscale patches change in discrete steps from white to black. Twenty patches are provided, measuring 9x9 mm each. The four corner-crosses measure 2.625" (66.68 mm) from center to center. The upper right grayscale patch is equal in density to the background of the rotated square (0.50 density). The lower left grayscale patch is equal in density to the center rotated square (1.10 density).

T01B / T01B 16:9 ●
Geometry Test Chart / Ring TB (black surrounding)
The T01 is designed to measure the geometry of cameras and monitors. Circular rings are arranged in a grid in such a way that at ideal geometry, their center points are located in the intersection points of a grid raster of lines in an electronic test generator (black surrounding).

T01W / T01W 16:9 ●
Geometry Test Chart / Ring TB (white surrounding)
The T01 is designed to measure the geometry of cameras and monitors. Circular rings are arranged in a grid in such a way that at ideal geometry, their center points are located in the intersection points of a grid raster of lines in an electronic test generator (white surrounding).

T03 ●
Depth Of Modulation 0.5 / 5 MHz
The T03 is designed for evaluating the uniformity of a TV camera´s modulation depth. Between the line raster rows, two white bars of different lengths are arranged on a black background (upper part) respective, while two black bars of different lengths are arranged on a white background (bottom part).

T04 16:9 ●
Bar Test Chart (IEC 61146)
The bar test chart is designed for checking the transmission characteristics of TV cameras at intermediate and deep frequencies. It consists of horizontal bars with a white-on-black and black-on-white background pattern.

T06 ●
Chess Board Test Chart
The T06 test chart is designed for checking geometry and resolution. It is composed of black and white square fields that are surrounded by rectangular fields at the edges, which correspond to the grid raster lines of electronic test generators.

T10B ●
Scattered Light Test Chart 99% (IEC 84/60B)
The T10B is designed to measure localized flare of camera systems. In the center of the chart is a black area surrounded by a white area in a way that the average picture level is 99%.
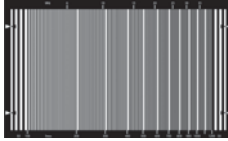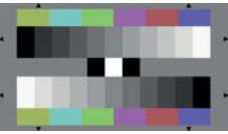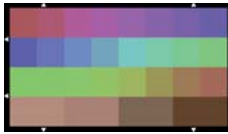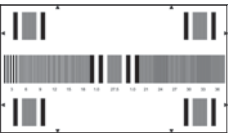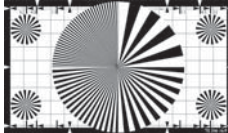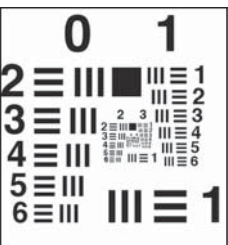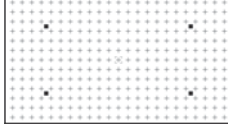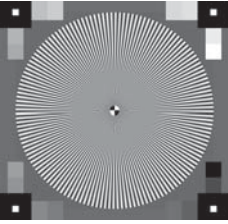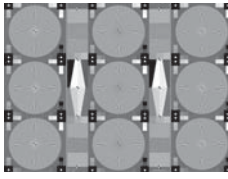
● OECF/Gamma   ● Back Focus   ● Color   ● Black to White   ● Special Manufacturer
● Resolution/Multiburst   ● Geometry Grid Registration   ● Signal Evaluation   ○ Universal Multipurpose

T13   ● ●
EBU Universal Film Test Chart (EBU Tech. 3087 · specification 8/1.1)
The T13 is designed for checking color and neutral gray reproduction, relative modulation depth, gradation and granularity of film material for television. On a neutral gray background three groups of test components (grays, colors, resolution patterns) are arranged within the picture-relevant area.

TE42   ● ● ● ● ○
Forty Two · Multipurpose chart for fast camera testing
This chart contains everything you need to measure the OECF: dynamic range (contrast limited to 1000:1), color reproduction quality, white balance, noise, resolution, shading, distortion, and kurtosis (see page 32).

TE83   ●
ITE Grayscale Chart I (Gamma = 0.45)
The TE83 is designed for the evaluation of the halftone reproduction of an electronic camera. Two 11-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically (gamma = 0.45).

TE84   ●
ITE Grayscale Chart II (Gamma = 1)
The TE84 is designed for the evaluation of the halftone reproduction of an electronic camera. Two 11-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically (gamma = 1.0)

TE94   ●
ITE Radial Resolution Chart
The TE94 is designed for checking resolution over the whole picture area. It consists of nine sector stars of 90 (black and white) sectors each. Resolution measurement with TV lines is independent from TV standard.

TE95   ○
ITE Resolution Chart / EIAJ Test Chart A
The TE95 test chart is designed for general (visual) appraisal of electronic cameras. It consists of circular figures, multibursts, vertical wedge-sharped rasters, diagonal lines and gray scales.

TE97   ○
High Resolution Universal Test Chart 1000 CP/PH (= 2000 lines)
The TE97 is designed for the measuring and quick (mostly visual) appraisal of transmission characteristics of high resolution non-broadcast cameras. In addition to other features, it contains gray scales, multibursts and resolution wedges with different frequencies (vertical and horizontal).

TE99   ●
Multiburst Test Chart (High-Class in Mega Cycle Chart)
The TE99 is designed to measure frequency response of the modulation depth of electronic cameras. A line raster is arranged in the center of the test chart and produces frequencies of 0.5 to 10 MHz in the output of the TV camera. Bar rasters are located in the corners of the test chart and produce frequencies of 0.5 and 5 MHz.

TE100 / TE100 16:9   ●
Lens Focus Test Chart
The TE100 is designed for the adjustment of camera lenses, checking back focal distance and resolution, and establishing cushion and barrel distortion. It consists of a Siemens star, outlined arrows and several black and white line pairs.

TE101   ○
Standard Test Chart
The TE101 is designed for the general (visual) appraisal of TV cameras. The circular figures and the grid make a rough evaluation of the geometry possible. The wedge-shaped line rasters are used for the visual appraisal of the resolution limit. The gray scales are designed for the evaluation of the halftone reproduction.

TE102 / TE102 16:9   ○ ●
Chess Board Test Chart
The TE102 test chart is designed for checking the geometry, resolution and uniformity of signal generation. It is composed of black and white square fields. Two resolution wedges in the middle of the chart allow for the checking of vertical and horizontal resolution.

TE104   ●
Multiburst Test Chart 1-6 MHz (negative)
The TE104 is designed for resolution measurements, mainly for visual tests. It consists of four rows, each with six fields of multiburst frequencies (1-6 MHz).

TE105 16:9   ○
Universal Test Chart
The TE105 test chart is designed for the general (visual) appraisal of 16:9 TV cameras. It includes circular figures, gray scales, wedge-shaped line rasters, zone plates, a grid, diagonal and horizontal lines.

TE106 / TE106 16:9   ●
Color Bar Test Chart
The TE106 is designed for checking the color rendition of TV cameras. The picture area is divided into six color bars showing the three primary colors red, green and blue, and the secondary colors cyan, yellow and purple. In addition, there is one bar of white and black. The succession corresponds to that of an electronically generated color bar.
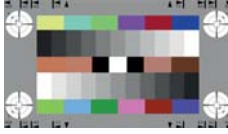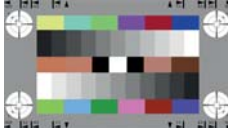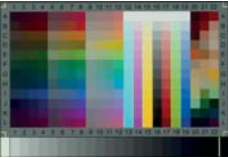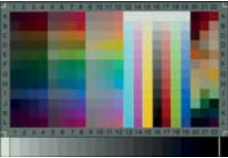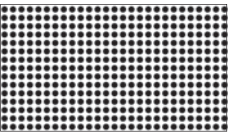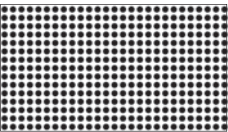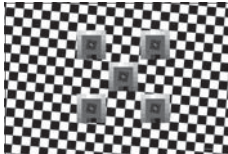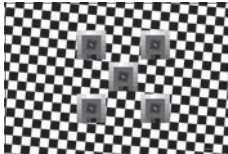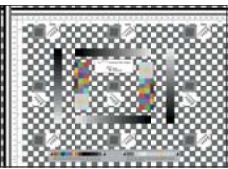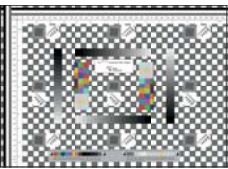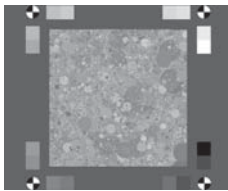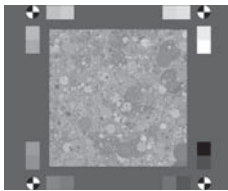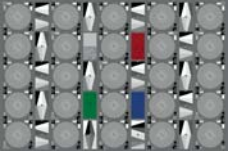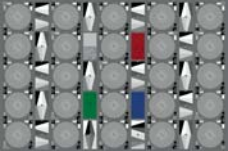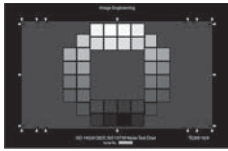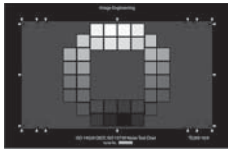
● OECF/Gamma   ● Back Focus   ● Color   ● Black to White   ● Special Manufacturer

● Resolution/Multiburst   ● Geometry Grid Registration   ● Signal Evaluation   ○ Universal Multipurpose

TE107 / TE107 16:9 ●
Multiburst Test Chart (0-10 MHz)
The TE107 is designed for checking the frequency response and the uniformity of an electronic camera. A line raster is arranged in the center of the test chart which produces frequencies of 0.5 to 10 MHz in the output of the TV camera.

TE108 ●
Log. Gray Scale Test Chart (9 steps)
The TE108 is designed for the evaluation of the halftone reproduction of an electronic camera. Two 9-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically.

TE109 ●
Log. Gray Scale Test Chart (5 steps)
The TE109 is designed for the evaluation of the halftone reproduction of an electronic camera. Two 5-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically.

TE110 ●
9 Sector Stars Test Chart (36 cycles)
The TE110 is designed for the adjustment of camera lenses, checking back focal distance and checking resolution over the picture area. The test chart consists of nine sector stars. Within the sector stars are two circular lines, which mark a 625 and a 312 line structure (525 / 262 in the NTSC version).

TE111B / TE111B 16:9 ●
Critical Flesh Tones Test Chart
The flesh tone test chart is designed for evaluating the flesh tone rendition of electronic cameras. The picture shows the portraits of three women with ideal and critical flesh tones.

TE113 / TE113 16:9 ●
Zone Plate With MHz-Grid
The TE113 is designed for checking the resolution characteristics and "cross color" interferences of TV cameras and TV transmission systems. The test chart shows a zone plate over the whole image area where the spatial frequency of the rings has a linear increase towards the edges. The line grid marks the spatial frequency in vertical and horizontal direction.

TE114 ●
Zone Plate Test Chart
The TE114 is designed for checking the resolution characteristics and "cross color" interferences of TV cameras and TV transmission systems. The test chart shows a zone plate over the whole image area where the spatial frequency of the rings increase linearly towards the edges.

TE115 / TE115 16:9 ● ●
White Balance Chart 70% Reflectance
The TE 115 chart is designed for white balance. The density of the white area is 0.15 (based on BaSO4=0). This corresponds to a remission of 70%.

TE116 16:9 ●
HDTV Grid Test Chart
The TE116 is designed for the operational adjustment and control of HDTV cameras. It consists of circles permitting rough visual appraisal of scan linearity. Lines serve the purpose of adjusting registration, while wedges account for resolution appraisal.

TE117 16:9 ○
HDTV Universal Test Chart
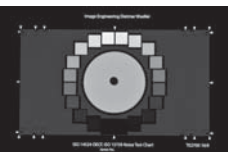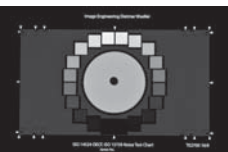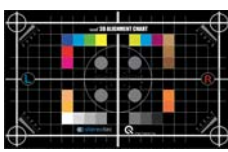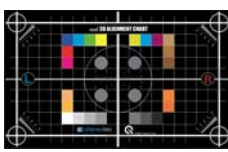The TE117 is designed for the quick (mainly visual) appraisal of an HDTV camera´s transmission characteristics. It comprises of a gray background on which circles, gray scales, horizontal and vertical lines are positioned.

TE118 16:9 ●
HDTV Resolution Test Chart (100-600 CP/PH)
The TE118 is designed for checking the resolution characteristics of HDTV cameras. Five fields with different line grids and black and white reference are arranged on a black background. The line grids are inclined at different angles.

TE120 ●
Sector Star Test Chart (36 cycles)
The TE120 test chart is designed for the adjustment of camera lenses and checking back focal distance. It shows a 36 sector Siemens star on a white background.

TE121 ●
Sector Star Test Chart (72 cycles)
The TE121 test chart is designed for the adjustment of camera lenses and checking back focal distance. It displays a 72 sector Siemens star on a white background.

TE122 / TE122 16:9 ●
CCD Registration Test Chart
The TE122 is designed for measuring registration errors in a CCD camera.

● OECF/Gamma	● Back Focus	● Color	● Black to White	● Special Manufacturer
● Resolution/Multiburst	● Geometry Grid Registration	● Signal Evaluation	○ Universal Multipurpose	

TE123
100% Red ●
The TE123 is designed for measuring the behavior of the chrominance channel expressed as the signal-to-noise ratio.

TE124 16:9 ●
HDTV Resolution Test Chart (100- 600 CP/PH)
The TE124 is designed for checking the resolution characteristics of HDTV cameras. The test chart with an aspect ratio of 16:9 shows nine blocks containing 42 resolution patterns each in the center area. The corner fields have 20 resolution patterns.

TE125 16:9 ●
HDTV Zone Plate Test Chart (600 CP/PH · asymmetric)
The TE125 zone plate test chart is particularly suited for the visual determination of a high definition camera´s resolution. It shows an asymmetrically arranged one zone plate ranging from 0 to 600 CP/PH, as well as two zone plate sectors with their centers located in the left corners. The gore-shaped gaps are gray.

TE127 16:9 ●
Log. Gray Scale Test Chart (9 steps)
The TE127 is designed for the evaluation of the halftone reproduction of a camera with a 16:9 aspect ratio. Two 9-graduated counter-current gray scales are arranged on a gray background. The gray scales being graduated logarithmically.

TE128 16:9 ○
ITE High Resolution Chart
The TE128 is designed for measuring a quick (mostly visual) appraisal of transmission characteristics of high resolution non-broadcast cameras. It consists of a gray background, a white circle, gray scales, multibursts, resolution wedges with different frequencies (vertical + horizontal) and circular rings.

TE129 ●
Black Pulse Bar Test Chart
The TE129 is used to measure the low and intermediate frequency response (streaking) and flare in video systems. A black rectangle (width equal to 25% of picture width; approx. 0.05 MHz) and a narrow black pulse (width equal to 1% picture width; approx. 1.25 MHz) are shown on a white background.

TE129 16:9 S ●
Black Pulse Bar Test Chart (+2T pulse)
The TE129 is a chart with an additional 2T-pulse in the middle of the black 25%-pw-pulse.

TE130 ●
White Pulse Bar Test Chart
The TE130 is used to measure the low and intermediate frequency response (streaking) and flare in video systems. A white rectangle and a narrow white pulse are shown on a black background.

TE130 16:9 S ●
White Pulse Bar Test Chart (+ 2T pulse)
The TE130 is a chart with an additional black 2T-pulse in the middle of the white 25%-pw-pulse.

TE132 ● ●
ISO 3334 (DIN19051) Test pattern No. 2 (1-18 LP/mm · sheet with 12 patterns)
This chart is designed for resolution measurements. Five pairs of lines (black and white) with frequencies from 1-18 line pairs per millimeter are printed on a white background. The patterns are ordered counterclockwise by decreasing resolution on the chart.

TE135 ●
Multiburst (Megacycle) Test Chart (0.5 · 1 · 1.5 · 2 · 2.5 · 3 · 5 · 6 MHz)
The test chart is designed for measuring the amplitude frequency response of the luminance channel, i.e. the amplitude of the output signal relative to a reference level as a function of frequency. A multiburst with different frequencies is shown on a gray background.

TE138 ●
Line pairs per cm (1-28.5 LP/cm · set of 10 pcs.)
The TE138 is designed for resolution measurements. Frequencies from 1-28.5 line pairs per centimeter are printed on a white background. The patterns are ordered clockwise by decreasing resolution on the chart.

TE143 ●
ISO 446 (DIN 19051) Test pattern No. 1 (sheet with 20 pattern)
The TE143 is designed to check the readability of document reproductions. In pattern number 84, the direction of the two lines inside the octagon must be recognized without problems for seven out of eight symbols.

TE145 ●
Test Signal Test Chart · Line 17
The TE145 is designed for measuring several signal parameters according to the definitions set in CCIR Recommendation 569. It consists of a gray scale, a color gradient, and gray and black bars of different sizes.
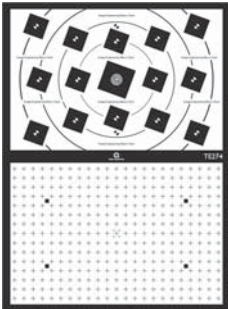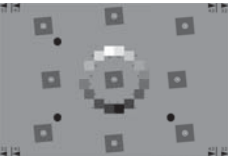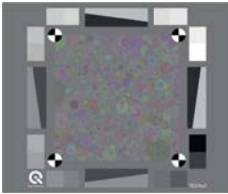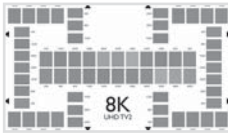
● OECF/Gamma ● Back Focus ● Color ● Black to White ● Special Manufacturer
● Resolution/Multiburst ● Geometry Grid Registration ● Signal Evaluation ○ Universal Multipurpose

TE146 ●
Test Signal Test Chart · Line 18
The TE146 reproduces the test signal, line 18 as specified in CCIR Recommendation 473. With measurement instruments the test signals can be evaluated in a simple and partially automatic way. It includes a multiburst with different frequencies.

TE147 ●
Test Signal TC · Line 18 with 0.2 MHz
The TE147 reproduces the test signal, line 18, as stated in CCIR recommendation 473. With measurement instruments the test signals can be evaluated in a simple and partially automatic way. It consists of a multiburst with different frequencies.

TE148 16:9 ●
Sector Star Test Chart (36 Cycles)
The TE148 is designed for adjustment of camera lenses and checking back focal distance. It contains a large Siemens star in the center and four smaller ones positioned in the corners of the test chart.

TE152 ●
**Frequency Response TC
(1-8 MHz continuously)**
The TE152 is designed for checking the frequency response of a camera. The test chart shows vertical lines over the whole image area ranging from 1 to 8 MHz.

TE153 ●
Log. Gray Scale Test Chart (11 steps)
The TE153 is designed for evaluation of the halftone reproduction of electronic cameras. Two 11-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically. The contrast range of the gray scales is 40:1.

TE155 ●
**Window Test Chart
3/10 Picture Height (IEC 61146)**
The TE155 is designed for evaluating the degree of the spurious image that remains after removing the still subject being shot. Therefore, the black test chart has a transparent square in the center.

TE156 ●
Window Test Chart 1% (IEC 61146)
The TE156 is designed to measure blooming and smearing effects of CCD cameras. The transparency includes a black area with a white (transparent) area. The transparent area has 1% of the picture area, marked by the white arrows.

TE158 ○
**Cine Test Chart with format markings for 1:1375 (35 mm) · 1:166 (S16) · 16:9 (HDTV) · 1:185 · 1:2.
Resolution power is given for three different enlargements**
The TE158 is designed for evaluating the image quality of film cameras and can be used for cameras of different formats. It comprises of sector stars, several test elements, a linear gray scale, and nine color patches.

TE159 ●
**Sinusoidal Multiburst Test Chart (IEC 61146)
(0.5 · 1 · 1.5 · 2 · 2.5 · 3 · 4 · 5 · 6 MHz)**
The TE159 is designed for measuring the horizontal static resolution. It shows vertical bars, the density variation of which gives a sinusoidal video response.

TE161 16:9 ●
Sector Star Test Chart (72 cycles)
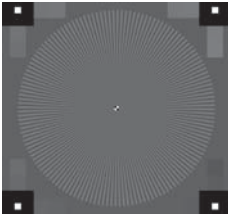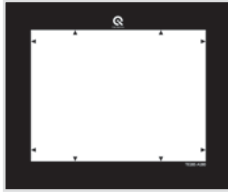The TE161 test chart is designed for the adjustment of camera lenses and checking back focal distance. It consists of a large Siemens star in the center and four smaller ones positioned in the corners of the test chart.

TE162 ●
Chrominance Response Test Chart (IEC 61146)
The TE162 is designed to measure the amplitude frequency response of the chrominance channels. The test chart is a color multiburst pattern, covering a spatial frequency range from 100 kHz to 1.5 MHz.

TE165 16:9 ●
Log. Gray Scale Test Chart (11 steps)
The TE165 is designed for evaluation of the halftone reproduction of 16:9 electronic cameras. Two 11-graduated counter current gray scales are arranged on a gray background. The gray scales being graduated logarithmically. The contrast range of the gray scales is 40:1.

TE167 16:9
○
HDTV Universal Test Chart
The TE167 test chart is designed for the general appraisal of HDTV cameras. It consists of gray scales, circular figures, a grid, sector stars, multibursts and resolution wedges.

TE169 ●
EBU/CAM Test Chart (EBU Tech. 3237)
TE169 is designed to measure color reproduction. The chart includes 18 color patches and six patches from white to black.

TE170 ●
Electronic Still Picture Resolution Chart (ISO 12233)
The TE170 chart is designed to measure the resolution of still cameras. It contains resolution wedges up to 2000 lines per picture height. In addition, it incorporates slanted edges for SFR measurements.

TE175 ●
Streaking Measurement Test Chart
The TE175 is designed for the measurement of disturbance caused by the video level in black areas to the right of or below the areas. Horizontal white lines are positioned on a black background.

● OECF/Gamma	● Back Focus	● Color	● Black to White	● Special Manufacturer
● Resolution/Multiburst	● Geometry Grid Registration	● Signal Evaluation	○ Universal Multipurpose	

TE182 / TE182 16:9 ●
Neutral Gray 18% remission
The TE182 is an 18% gray test chart.

TE188 / TE188 16:9 ●
**Color Rendition Chart
(X-Rite ColorChecker)**
The TE188 was designed with respect for the well-known "ColorChecker". The chart consists of 18 color patches and a 6-step gray scale, and is used in photography, film and TV.

TE192 / TE192 16:9 ●
Saw Tooth Signal Test Chart
The TE192 is designed for cameras without an integrated electronic saw tooth signal, allowing the visualization of the gamma correction on the oscilloscope. It shows a linear continuous progression from 0% to 100% transmission set on a gray background.

TE194 ●
Aliasing Test Chart
The TE194 is designed for measuring aliasing. The chart consists of eight rows of rectangular bars with the spatial frequencies of 1, 2, 4, 6, 8, 10, 12 and 14 MHz.

TE195 ●
Ikegami CPU Test Chart
The TE195 is designed for the setup of Ikegami cameras.

TE197 16:9 ●
**OECF Test Chart (ISO 14524) Contrast
20:1 · 80:1 · 160:1 · 1000:1 · 4000:1**
The TE197 is designed for evaluating the opto electronic conversion function of a camera. The chart consists of a circular ordered 12-step-gray scale on a gray background.

TE202 ●
Sector star 20 Cycles
The TE202 is designed for adjustment of camera lenses and checking back focal distance.

TE203 ●
**Double Saw Tooth Test Chart
(digital signal quantisation)**
The TE203 is designed to check cameras for quantization errors. It consists of a high and low contrast saw tooth.

TE205 ●
Gamma Measurement Test Chart
The TE205 is designed to check the gamma setting of the camera. The chart shows ten gray steps from 1-10% transmission and ten gray steps from 10-100% transmission.

TE218 A + B ●
Autofocus Test Chart Set (IEC 61146)
The TE218 is designed to check the autofocus system of a camera. It includes two different sizes of Siemens stars.

TE219 16:9 ●
**Noise Measurement Test Chart
(ISO 15739) 20:1 · 80:1 · 160:1 · 1000:1**
The TE219 is designed for noise measurement of still images. It contains circular and horizontal positioned gray fields, one gradient field, and one field containing a diagonal multiburst with different frequencies.

TE220 ●
**Back Focus Test Chart
(36 cycles with corner stars)**
The TE220 is designed for adjustment of camera lenses and checking back focal distance. It consists of a large Siemens star in the center and four smaller ones positioned in the corners of the test chart.

TE223 16:9 ●
**HDTV Log. Gray Scale Test Chart
13 steps · contrast 1:200**
The TE223 is designed for evaluation of the halftone reproduction of electronic cameras. Two 13-graduated counter current gray scales are arranged on a gray background. The gray scales are graduated logarithmically.

TE224 16:9 ●
HDTV Resolution Test Chart
The TE224 is designed to measure and describe the frequency response of an electronic HDTV camera. The test chart consists of 50 multiburst fields, which are distributed over a 16:9 picture area. The fields are arranged in horizontal and vertical directions in order to measure resolution in both directions.

TE225 16:9 ●
HDTV Resolution Test Chart
The TE225 is designed to measure and describe the frequency response of an electronic HDTV camera. The test chart comprises of 32 multiburst fields, which are distributed over a 16:9 picture area. The fields are arranged in horizontal and vertical directions in order to measure the resolution in both directions.

TE226 16:9 ●
HDTV Color Rendition Test Chart
The TE226, is designed for the evaluation of the color rendition of HDTV cameras. The chart consists of 36 color patches and a 9-step gray scale. In addition to the primary and secondary colors, the test chart contains mainly the colors that are critical in reproduction, e.g. dark and light skin tones, foliage, blue sky, orange, violet and others.

● OECF/Gamma	● Back Focus	● Color	● Black to White	● Special Manufacturer
● Resolution/Multiburst	● Geometry Grid Registration	● Signal Evaluation	○ Universal Multipurpose	

TE230 ●
X-Rite ColorChecker SG
The Digital ColorChecker Semi Gloss (SG) is specifically designed to meet the needs of digital photography. It consists of 140 patches, includes standard ColorChecker, skin-tone reference colors and gray scale steps. It is mounted on an aluminium plate.

TE231 16:9 ●
HDTV Sweep Test Chart
The TE231 is designed for checking the frequency response of HDTV cameras. The test chart shows vertical lines over the whole image area ranging from 100 to 1200 lines.

TE232 16:9 ●
Log. Gray Scale / Color Test Chart 16:9 (super black hole in folders)
The TE232 is designed for the evaluation of the halftone and color reproduction of an electronic camera. Two 11-graduated counter current gray scales are arranged on a gray background (graduated logarithmically), and there are two color patches representing the three primary colors as well as the three secondary colors.

TE233 16:9 ●
Color Chart with 24 colors and 4 skin tones
The TE233 is designed for measuring the color reproduction of HD cameras for selective color correction, and also for making color reference shootings for post production. The chart is composed of color patches including the three basic colors, the secondary colors and patches with four skin tones.

TE234 16:9 ●
Color Gradation Test Chart
The TE234 consists of different color grades. It is used to check quantization errors which result in visible steps in the grades.

TE235 ●
Surveillance Camera Test Chart
The TE235 is desigend for the on-site testing of surveillance cameras. The chart roughly corresponds to the size of a person. It consists of different line pairs, a sector star, a gray scale and color fields. It is supplied with a tripod which allows the chart to be tilted and turned by 360°.

TE239 16:9 ●
HDTV In Mega Cycle Test Chart
The TE239 is designed for checking the frequency response and uniformity of the modulation depth of HDTV cameras. The test chart consists of multiburst fields, which are distributed over a 16:9 picture area. The fields are arranged in horizontal and vertical directions in order to measure resolution in both directions.

TE240 ●
ISO 21550 Scanner Dynamic Range Chart
The TE240 is designed to check the 35 mm-scanner dynamic range. It has 24 gray-patches with a density range of 4.0 or 6.0. The reflective version consists of a 2.4 density range.

TE241 16:9 ●
OECF / Noise Chart with 20 gray patches 10,000:1 (ISO 14524 · ISO 15739)
The TE241 is designed to measure the characteristic curve of digital cameras. It is an extended OECF chart and has 20 patches with a contrast range of 10,000:1, 100,000:1 and if needed 1,000,000:1.

TE246 16:9 ●
4 Quadrant Sector Star
The special star consists of four segments, each with a different number of cycles. So it is possible to focus the wide angle and the tele position for an optimal adjustment of the focusing point. This is essential for positioning the flange focal distance without a special collimator.

TE250 ●
USAF Resolution Test Chart 35 mm
The USAF resolution test chart on film in 35 mm is useable for scanner resolution up to 10,000 ppi.

TE251 16:9 ●
Distortion · Chromatic Aberration · Crosses
The TE251 is designed to measure the distortion of digital cameras. It contains black crosses on a white background.

TE253 ●
Modulated Sinusoidal Siemens Star
The TE253 is designed for checking resolution. The chart contains a radially sine modulated Siemens star in the center of the image, gray patches and black squares with a small white square are in the corners.

TE253 9x ●
Modulated Sinusoidal Siemens Star (fol.* ISO 12233)
A set of 9 stars arranged in 3 columns. The TE253 9x is designed for checking resolution. The chart contains nine radially sine modulated Siemens stars, gray patches and black squares (with a small white square in it) slanted edges and white noise patches.

- ● OECF/Gamma
- ● Back Focus
- ● Color
- ● Black to White
- ● Special Manufacturer
- ● Resolution/Multiburst
- ● Geometry Grid Registration
- ● Signal Evaluation
- ○ Universal Multipurpose

TE255 ●
Diffusor Plate To Measure Vignetting
The TE255 is designed to measure shading/vignetting of a digital camera. It is a very precise milk glass that is used in combination with an integration sphere or a light box.

TE256 16:9 ●
Color and Calibration Test Chart revised Version of TE232 (super black hole in folders)
The TE256 is designed to color align HD cameras.

TE258 ●
IT8 Scanner Characterization Chart
The TE258 is designed to characterize slide/print scanners. It is suitable to create color management profiles for scanners.

TE259 16:9 ●
OECF / Noise Chart with 20 gray patches contrast 10.000:1
The TE259 is designed to check the dynamic range of broadcast cameras on a waveform monitor. It contains a gray step wedge with 20 patches and a contrast range of 10,000:1.

TE260 16:9 ●
Dot Chart
The 'dot' chart consists of two different charts on the front and back side. One of them has 31 lines of dots and the other 15 lines of dots. They can be used to determine distortion and chromatic aberration.

TE261 16:9 ○
Slanted Edges
This target has a tilted checkerboard in the background and five low contrast slanted edges grouped together with surrounding gray patches in the front. It is used to determine the SFR of digital capture devices and is our default chart in combination with the iQ-AF Box and STEVE.

TE262 ○
Universal Test Target (UTT)
The Universal Test Target is designed to evaluate the image quality of scanners and other digital input devices used to create the digital images of documents, photos and other reflective media.

TE263 ○
Scan Reference Chart
The chart consists of gray steps, color patches, a scale and resolution pattern. It allows automatic analysis of each scanned page and, in combination with the right software, provides information for the purpose of showing when a specific page happens to be out of specs.

TE264 16:9 ●
OECF 20 ISO 14524 / 15739 revision
The former OECF chart contains 12 or 20 gray patches in a circular order with three different patterns in the center of the chart. The current version of the OECF chart skips the center patches due to the sometimes occurring straylight. This chart is also offered as TE264X where the 20 gray patches are not rasterized as in the standard version of the chart, which was created on a very fine grained film.

TE265 ●
Dead Leaves
This chart contains a so-called dead leaves (in this case circles) structure. The structure is made up of circles in all sizes and gray levels. It is used to determine the dead leaves SFR, an approach to describe the loss of low contrast fine details.

TE268 25x ●
Lens Resolution Test Chart
The TE268 is designed for resolution and sharpness measurements. 25 sinusoidal modulated Siemens stars, 16 slanted edges at four different contrasts, four colored dead leaves structures and rope structure images make up the chart. A very detailed analysis over nine different image heights is possible with this chart. The chart has an aspect ratio of 4:3 (image size of 810x1080 mm) or 3:2 (image size of 810x1215 mm). It is suitable for systems from 2 MP up to 180 MP.

TE269 ●
OECF Chart (fol.* ISO 15739) D280
The TE269, a 36 patch OECF chart which basically follows ISO 14524, but implements additional steps especially at higher density levels. TE269A, gray patches according to ISO 14524. TE269B, better differentiation of the dark patches. TE269C, according to the upcoming standard IEC 62676-5: Video surveillance systems.

TE270X ●
OECF Chart (fol.* ISO 14524/15739)
The OECF chart is equipped with two polarizing filters in the center of the chart. For cameras that do not allow a manual adjustment of the exposure, the automatic exposure control (AEC) is fooled by modifying the density (transmission) of the central part of the test chart.

TE271 ● ○
3D Alignment Chart A1066
The real 3D Alignment Chart is designed to align and adjust cameras for a 3D shooting. A unique combination of 2D and 3D structures allows the easy and straightforward preparation of the stereoscopic camera setup.

* following

| ● OECF/Gamma | ● Back Focus | ● Color | ● Black to White | ● Special Manufacturer |
| ● Resolution/Multiburst | ● Geometry Grid Registration | ● Signal Evaluation | ○ Universal Multipurpose | |

TE273

●

Natural Skin Tone Charts
The Natural Skin Tone test chart TE273 is designed for evaluating the flesh tone rendition of electronic cameras. The series of five single versions and two different groups provides different skin tones of natural, not made-up persons.

TE274   ● ○
Macro Chart
The TE274 is designed for camera evaluation in macro mode and consists of two main parts: slanted edges for resolution measurement and a cross chart for the evaluation of lens geometric distortion and chromatic aberration. The chart comes with a frame that makes it very convenient to switch between the two different charts.

TE275   ●
Slanted Edge (fol.* ISO 12233:2014)
The TE275 is designed to measure resolution of still cameras. It is a slanted edge chart specified in the new revision of ISO standard 12233 that was published in February 2014.
The contrast of the slanted edges is significantly reduced compared to the old ISO standard from 2000. See the library section on our website for publications describing the pros and cons of different resolution measurement methods.

TE276   ●
Dead Leaves (upcoming ISO19567-2)
The TE276 Dead Leaves Target is used for the analysis of texture loss, which is the loss of low contrast fine details in images due to noise reduction or other image processing techniques. The TE276 supports the new method Dead Leaves_cross, which is described in various publications. See the library section of our website for details.

TE277   ●
4K (UHD TV) Resolution Test Chart 200-4000 CPH 16:9
The test chart consists of 50 multibursts. The fields are arranged both horizontally and vertically in order to measure resolution in both directions. All fields are labeled with the resolution in cycles per picture height. A cycle consists of one black and one white line.

TE278   ●
8K (UHD TV2) Resolution Chart 200-4000 CPH 16:9
The TE278 consists of 50 multibursts. The fields are arranged both horizontally and vertically in order to measure resolution in both directions. All fields are labeled with the resolution in cycles per picture height. A cycle consists of one black and one white line.

TE279   ○
4K (UHD TV) Universal Chart
The TE279 is designed for quick (mainly visual) appraisal of transmission characteristics of 4K (UHD TV) cameras. In the center of the test chart on a gray background (D=0.75; transmission = 18%), is a white circle with gray scales and resolution wedges. On both sides of this central circle, four circles are arranged with resolution wedges. 4:3 and 16:9 format are both marked on the chart.

TE280   ●
Texture Loss Chart (ISO 19567-1)
The TE280 is used for the analysis of texture loss, which is the loss of low contrast, fine details in images due to noise reduction or other image processing techniques. According to ISO19567-1 a low contrast sinusoidal Siemens star can be used to determine texture loss.

TE281   ●
Flare Target according to the upcoming ISO 18844
The TE281 flare test chart is designed to determine the amount of lens flare, which is added to an image by a camera. The super black holes of the TE281 generate the lowest possible black level because they absorb a high proportion of light. But this black level will be affected (raised) by flare.

TE285   ●
IR Reflection (upcoming IEC standard 62676-5)
Test chart with a reflectance of more than 98% to determine the Infra-Red Illumination Operation View Distance according to the IEC standard 62676-5. This specifies the procedures of how to measure relevant image quality parameters in the area of security and surveillance cameras.

* following
A technical description of the test charts can be found on our website: www.image-engineering.com/products/charts/list-all-charts

HD STUDIO KITS

HD STUDIO KIT 3 (K360) LIGHT TRAP	
TE148	sector star (36 cycles)
TE233	color chart (24 colors + 4 skin tones)
TE256	color calibration chart

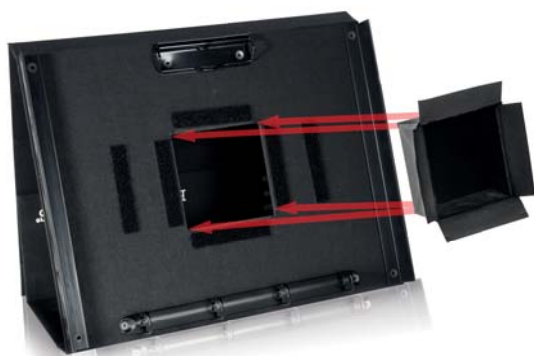| HD STUDIO KIT 4 (K360) LIGHT TRAP	
TE148	sector star (36 cycles)
TE233	color chart (24 colors + 4 skin tones)
TE234	color gradiation test chart
TE256	color calibration chart

HD TRAVEL KITS

HD TRAVEL KIT (K180) NO LIGHT TRAP	
TE115	white balance chart (70% reflectance)
TE148	sector star (36 cycles)
TE256	color calibration chart

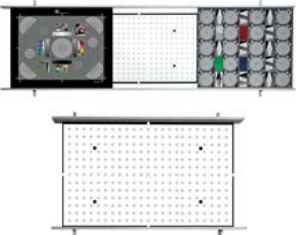| HD TRAVEL KIT SB (K180) LIGHT TRAP	
TE115	white balance chart (70% reflectance)
TE148	sector star (36 cycles)
TE233	color chart (24 colors + 4 skin tones)
TE256	color calibration chart
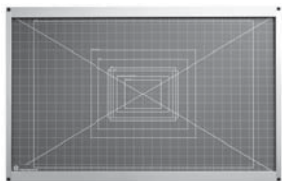
SUPER BLACK HOLE (LIGHT TRAP)

Both, HD Studio Kit and HD Travel Kit SB, include a folded up light trap that is easy to handle. It increases the contrast of the TE256 between the white patch and the two dark holes to at least 2000 : 1.

ACCESSORIES

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

iQ-Foldermount frame for Studio Kits

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

iQ-Wallmount frames for reflective test charts in size A1066

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

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

iQ-Chartmount-V is a vertical sliding chart holder for easily changing charts, manually or automatically with the iQ-Drive API.

API AVAILABLE

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

Tripods for the LE6, LG3 and LG2 series.

iQ-Mobilemount Tripod mount for mobiles and tablets.

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

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 LG2/LG3

GOSSEN MAVO-MONITOR USB

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

Main Features:
- classified according to DIN 5032-7 Class B and CIE no. 69
- silicon photo diode, color corrected with spectral response matched to the spectral photopic vision of the human eye V(λ)
- 3½ digit display
- data storage of max. 100 values
- USB 1.1 interface
- CD ROM with software for processing the measured values and controlling the meter

GOSSEN DIGIPRO F2

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

Main Features:
- silicon blue cell photodiode
- digital display
- measuring range LW –2.5 to +18 (with ISO 100/21°)
- repeatable accuracy ±0,1 LW
- exposure times 1/8000 s to 60 min
- aperture stops f/1 to f/90 9/10

GOSSEN MAVOLUX 5032 B USB

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

Main Features:
- silicon photo diode, color corrected, i.e. its spectral responsitivity is matched to the spectral photopic vision of the human eye V(λ).
- measuring range 0.01 lx to 199900 lx and 0.1 cd/m² to 1999000 cd/m² in 5 ranges (with luminance attachment)
- measurement rate: 2 measurements per second

PRC KROCHMANN RADIOLUX 111

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

Main Features:
- autoranging from 0.001 lx to 360 klx
- luminance adapter
- universal possibilities of application with a wide range of accessories
- serial computer interface with USB adapter in the advanced version
- Class L

MANFROTTO 055XPRO3 TRIPOD

The Manfrotto 055XPRO3 guarantees camera stability and is a secure method to test image quality.

HEDLER TUNGSTEN HALOGEN LIGHT UNIT

Tungsten halogen light comes with two independent switchable tungsten halogen bulbs. The light unit is suited for all photographic fields, mainly when a high intensity light is needed. The continuous spectrum makes it particularly suitable for all kinds of color measurement where fluorescent light sources may cause metamerism problems.

FLUORESCENT TUBE LIGHT SOURCE

Fluorescent tube light sources are an economic illumination system for digital imaging. The color temperature is approx. 5500 K. The six bulbs, each with 55 W, are as bright as the usual 2650 W standard illumination, but the power consumption is only 330 watts. The durability of the bulbs is approx. 7000 hours.

RESTAN

Our PTFE (polytetrafluoroethylene) based RESTAN is the ultimate white reference. It diffusely reflects more than 98% of light in the area between 300 and 1700 nm. This means the reflection level is higher and more uniform, especially at longer wavelengths than the reflectance of barium sulfate (BaSO4).

HONEYCOMB BREADBOARD

The Honeycomb Breadboard is an ideal and useful accessory to securely mount STEVE-6D on a flat and stiff surface when measuring the image stabilization performance of cameras or mobile devices. This platform has the following advantages:

- resists bending when force is applied
- lightweight and portable
- platform sides are made of stainless steel
- countersunk and tapped holes with threads for individual mounting
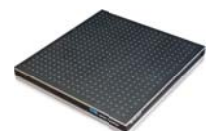
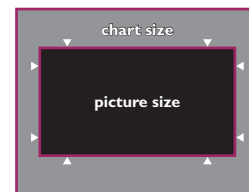## MANFROTTO 410 – 3-WAY HEAD

Extremely compact 3-Way tripod head
The very compact Manfrotto 410 head offers movement in three directions, pan, tilt and side to side tilt. It is suitable for 35 mm SLR medium format cameras and the iQ-Mobilemount.

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 ask for additional information or see our website.

chart size

picture size

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	-	108 x 101	204 x 164 x 2.1
K160	160 x 120	-	204 x 164 x 2.1
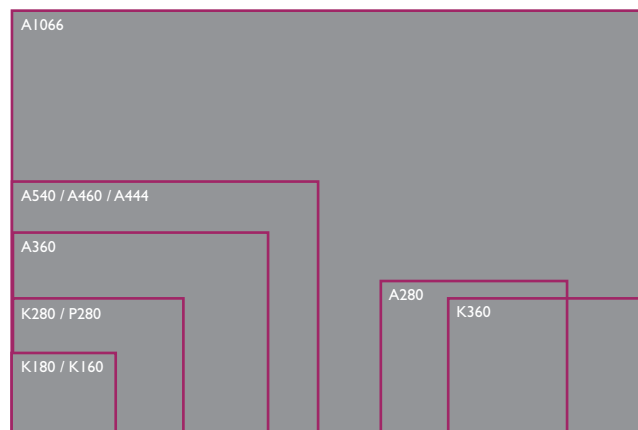
A charts (size 280/360/460) are mounted on aluminium plates.
A charts (size 1066) are mounted on aluminium composite panels (aluminium dibond).
K charts mounted on a black polystyrene plate are only available in combination with test chart folders.
P charts are mounted on black polystyrene plate.

TRANSPARENT			
DESIGNATION	PICTURE SIZE W x H [mm]		CHART SIZE W x H x D [mm]
	4:3	16:9	
D280	280 x 210	280 x 157.5	360 x 280 x 4.6
D240	240 x 180	240 x 135	320 x 290 x 4.6
D240S	240 x 180	240 x 135	360 x 280 x 4.6
D205	205 x 153	205 x 115.3	253 x 202 x 3.5
D120	120 x 90	120 x 67.5	155 x 135 x 4.0
D35	32 x 24	-	50 x 50 x 3-4

SUITABLE TRANSPARENT CHARTS FOR THE FOLLOWING ILLUMINATORS

	D280 / D240S	D240	D205
	Spherical transparency illuminator LE6/LE7 Light box illuminator LG3 Sony Pattern Box	DNP standard viewer	Porta Pattern spherical transparency illuminator
With adapter		Spherical transparency illuminator LE6/LE7 Light box illuminator LG3	Spherical transparency illuminator LE6/LE7 Light box illuminator LG3

For further information please visit our website: www.image-engineering.com

Image Engineering // imageQuality test equipment made in Germany