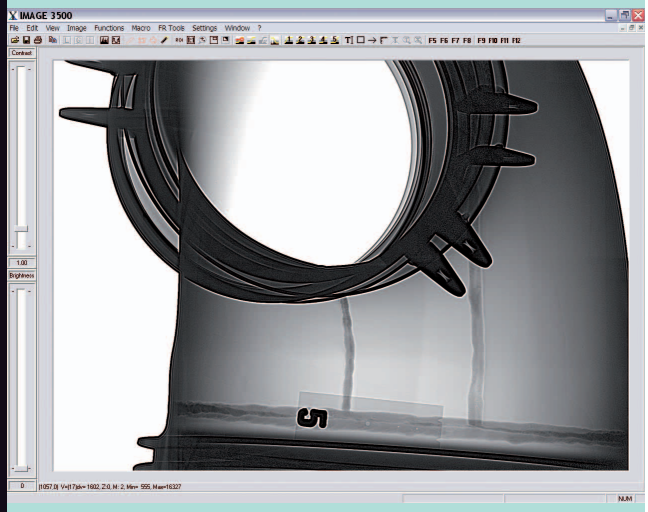
YXLON.Products

Y.IMAGE x500 – Full-scale solutions for image enhancement, memory storage and system qualification



The Y.IMAGE x500 family are software solutions for X-ray inspection specially designed and offered by YXLON. Development focused on easy, intuitive operation with a complex scope of functions. Functionality of the individual packages is customized for the imaging system and thus tailor-made for the application involved.

Products from the Y.IMAGE x500 family support all aspects of inspection activity: from image acquisition using optimally calibrated digital detectors, for example, straight through to the software-supported analysis of system parameters such as spatial resolution or detail detectability.

Using the system qualification implemented for operator-independent testing of image quality, Y.IMAGE 3500 fulfills the strict specification BSS7044 stipulated by the Boeing Company and is being deployed there successfully.

YXLON. The reason why.

- **easy operation and fast introductory training via a user interface in the classic Windows® style**
- **inspection with certainty through a wide range of options for image enhancement and measurement**
- **increased "audit security" through operator-independent analysis of image quality and the protocolling thereof**

YXLON. The reason why

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Full-scale solution

The 8 or 16-bit image enhancement and archiving systems from the Y.IMAGE x500 family are a full-scale solution consisting of the software, a suitable high-performance PC with the Windows® XP operating system and a framegrabber that picks up image information supplied by the detector.

When designing the software interface, the X-ray image and rapid access to the most important functions were a priority. The interface language can be changed during operation.

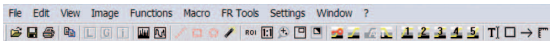


Image data preprocessing

An intelligent preprocessing of the image data supplied by the detector is necessary to obtain an optimum image for further processing. Depending on the program version and detector used, that purpose is served by

- graphic contrast and brightness control (input look-up table) for an analog camera signal
- detector calibration with offset and multigain correction
- manufacturer-specific look-up table as file (e.g. for image plates or digitized film)

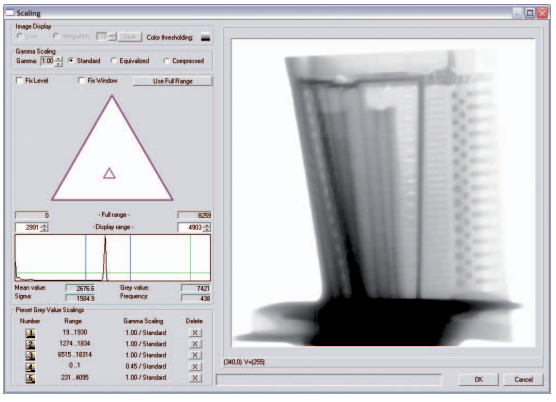
Gray-value scaling

Using a PC, only 256 gray values can be depicted on the monitor at a 24-bit RGB setting. The human eye can differentiate between merely around 60 shades of gray.

A great emphasis was placed on a convenient gray-value scaling in order to be able to obtain "depth-of-field" information in images with up to 65,535 gray values quickly and easily.

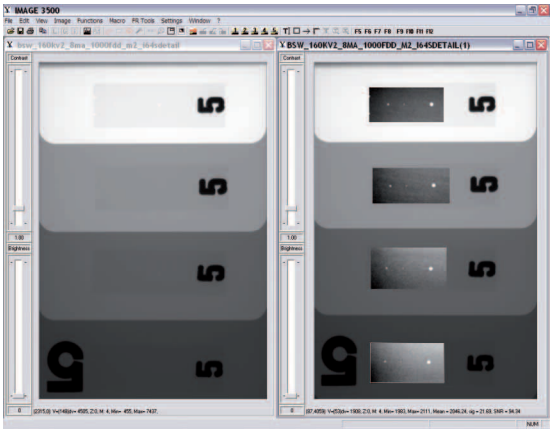
With all versions, by "drag"-drawing a rectangle via mouse it is thus possible to scale the image in such a way that all values from white to black appear in this rectangle.

In the case of Y.IMAGE 2500-D and Y.IMAGE 3500, a "triangular slider" with histogram display is included, too.



A spatial gray-value scaling is quite helpful when pictures with a large material thickness area are supposed to be documented.

The visibility of penetrameter holes can be depicted using only one image on a calibrated gray-scale card:

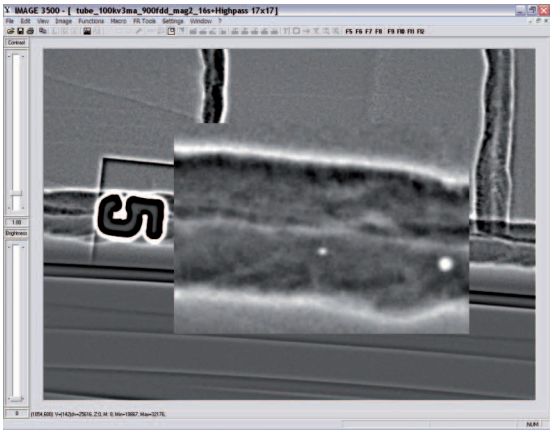


Depiction

All products in the IMAGE x500 family are able to depict additional images above, next to or below each other besides the live image.

In addition, the full-screen mode should be mentioned as well as 1:1 depiction, in which each detector pixel is depicted on one monitor pixel. The image can be inverted in order to obtain a depiction like the accustomed one from film technology.

Magnification functions and a magnifying glass adjustable for size and magnification factor are available for more precise examination.



With the "YXLON optimized Zoom" (YoZ) function, sub-pixel interpolation avoids bothersome "staircasing" in the course of magnifying. This deals with a mathematical procedure in which the existing information in an image is utilized intelligently.

	Y.IMAGE 2500i[1]	Y.IMAGE 2500i-R[1]	Y.IMAGE 2500-D[2]	Y.IMAGE 3500[3]
Image data preprocessing				
Graphic contrast and brightness adjustment (Input Look-Up table) for analog camera signal	•	•	•	•
Detector calibration for dark current, magnification (up to 20 working points) and non-linearity, automatic pixel correction			•	•
■ Input Look-Up tables as loadable file, e.g. for image plates or digitized film			•	•
■ Detector calibrations e.g. for different energies and materials, can be stored and retrieved			•	•
■ Rotating, mirroring and inverting	•	•	•	•
Depiction				
Gray-value scaling via mouse by "drag"-drawing a rectangle; contrast optimization for the rectangle's gray values	•	•	•	•
■ Gray-value scaling via mouse scrolling wheel			•	•
Triangular slider for gray-value scaling with histogram depiction; 6 storable and retrievable gray-value scalings			•	•
Histogram equalization and compression			•	•
Local gray-value scaling within any chosen rectangular areas	•	•	•	•
Continuously present controls for brightness and contrast	•	•	•	•
■ 16-bit brightness control			•	•
1:1 mode (detector pixel = monitor pixel)	•	•	•	•
■ 2 * 2 pixel binning of live image	•	•	•	•
■ Noise reduction in the case of inspection in motion by adjustable averaging		•	•	•
Full-scale image depiction	•	•	•	•
■ Zoom function using just 1 mouse click or via scrolling wheel	•	•	•	•
Choice of detail using sub-pixel interpolation (YoZ - YXLON optimized Zoom)	•	•	•	•
Movable magnifying glass; adjustable size and magnification	•	•	•	•
Inverted depiction (equivalent to film depiction)	•	•	•	•
Multi-document depiction (images are depicted above, beside or below each other)	•	•	•	•
■ Freely selectable background color	•	•	•	•
Additional window for a reference image with identical image processing		•	•	•
■ Variable overlay of the unfiltered image by a 16-bit filtered image ("background subtraction"), filter selectable			•	•
■ ASTM reference images for castings (E155 / E2422)				•
Image processing				
Noise reduction through integration	•	•	•	•
Filter functions, incl. UNDO function	•	•	•	•
Convenient filter designer for 8-bit filters (filters with filter kernels from 3 * 3 to 11 * 11 can be created and edited)	•	•	•	•
■ 40 predefined 8-bit filters, 13 groups (high pass, band pass, low pass, median, sharpness etc., each with different degrees of effectiveness)	•	•	•	•
■ 40 predefined 16-bit filters, 13 groups (high pass, band pass, low pass, median, sharpness etc., each with different degrees of effectiveness)			•	•
Arithmetic linking of 2 images	•	•	•	•
Gray-value enhancement via normalization	•	•	•	•
Threshold binarization with coloring of relevant areas	•	•	•	•

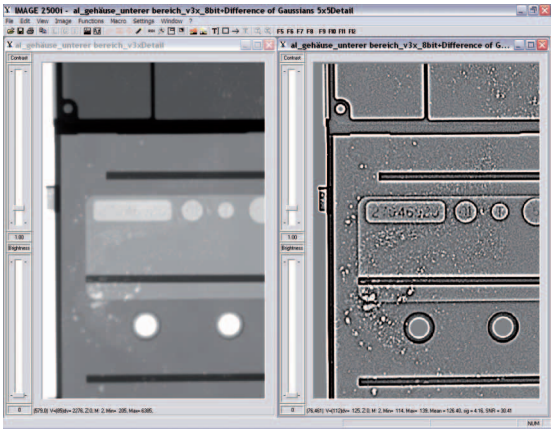
■ New or enhanced feature as of version 2.12

[1] Optimized for Image Intensifier with analog video interface, e.g. Y.XRSxx2 and Y.XRSxx3
[2] Optimized for Image Intensifier with digital interface, e.g. Y.XRSxx5
[3] Optimized for digital flat-panel detectors, e.g. Y.Panel XRD

	Y.IMAGE 2500i[1]	Y.IMAGE 2500i-R[1]	Y.IMAGE 2500-D[2]	Y.IMAGE 3500[3]
System qualification				
Automatic measurement of EN 462-5 platinum duplex wire for operator-independent determination of spatial resolution		•	•	•
Automatic, operator-independent determination of detail visibility (1T and 2T hole) of an ASTM E1025/E1742 image quality identifier (IQI)				•
Statistics box for measuring and archiving gray-value distribution in an image; up to 7 freely definable areas are analyzed				•
System qualification report for qualification or validation of image quality. Automatic storage as screen shot of report box. System qualification corresponds to Boeing BSS7044.				•
Operator administration for qualification and validation				•
Call up customer's own documentation (e.g. work instructions in PDF format) via IMAGE program interface				•
Measuring and marking				
Calibration in floating decimal-point format with freely definable measurement units	•	•	•	•
Simple length and surface area measurement (rectangle and ellipse)	•	•	•	•
Measurement using magic wand function; freely definable threshold	•	•	•	•
Storage and retrieval of calibrations	•	•	•	•
Measurement within gray-shade profile; optionally automatic placement of start and end marker on flanks or peaks	•	•	•	•
Definable X-Y ruler in image and in print-out	•	•	•	•
Text input can be positioned freely	•	•	•	•
Graphic symbols can be positioned freely (arrow, x, circle, rectangle and company´s logo on request)	•	•	•	•
Storing images				
Storage of entire image or a crop on hard-disk drive, CD or DVD (CD or DVD using enclosed supplementary software) or 3.5" diskette	•	•	•	•
Optional adoption of current gray-value scaling into the stored image	•	•	•	•
Storage formats: bmp, tif, jpg, jpg2000	•	•	•	•
Memory depth: 8 bit or 16 bit (tif, jpeg2000 only)	•	•	•	•
Image export (as 8 bit) via clipboard interim storage	•	•	•	•
Insert company logo and/or image heading, incl. e.g. inspection item, operator, date, time etc. when saving	•	•	•	•
Storage in multi-TIFF format; stores several images in one file. Images already existing in the file cannot be altered or deleted.		•	•	•
Additional functions				
Histogram (gray-value distribution) for the entire image or definable areas; gray values of image data or display; linear or logarithmic	•	•	•	•
Line profile (gray-value profile along a line with a definable width); gray values of image data or display; absolute or as a percentage	•	•	•	•
Macro-recording for image enhancement functions using the "Pause" function. Macros can be linked using function keys.	•	•	•	•
Print entire image or an ROI (Region of Interest)	•	•	•	•
Choice of languages for dialogs; can be changed during operation	•	•	•	•
Adjustable directories for filters, calibrations, images etc.	•	•	•	•
Operator administration		•	•	•
Graphical "underperforming" pixel editor; classification of pixels according to various criteria; manual editing possible			•	•
Fade-in of "underperforming" pixels or clusters in image; display of "underperforming" pixels as text			•	•

Digital filters

Flaws in inspection items that an operator might overlook with normal image depiction are made clearly visible through digital image processing.



Products from the Y.IMAGE family make a wide range of effectively performing filters with various areas of application available. Besides these, 8-bit filters containing a filter editor can be created, too. In addition to effective 16-bit filters, Y.IMAGE 2500-D and Y.IMAGE 3500 also offer the option to superimpose a variable 16-bit-filtered image onto the radiographic image.

All filters can be tested trouble-free because their effects can be neutralized using the UNDO function.

Mathematical functions

Alongside image processing via filters, other functions are available such as

- arithmetic linkage of two images
- normalization
- threshold binarization

Reference image

With the exception of IMAGE 2500i, all products from the x500 series offer the possibility to fade in a reference image next to the current image. For instance, catalogs or inspection items with sample flaws can be faded-in this way.

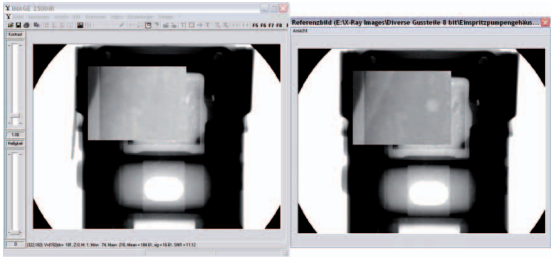


Image processing functions such as

- gray-value scaling, even spatially
- magnification
- adjustable magnifying glass
- inverse image function

are used on the current image thereby, as well as on the reference image.

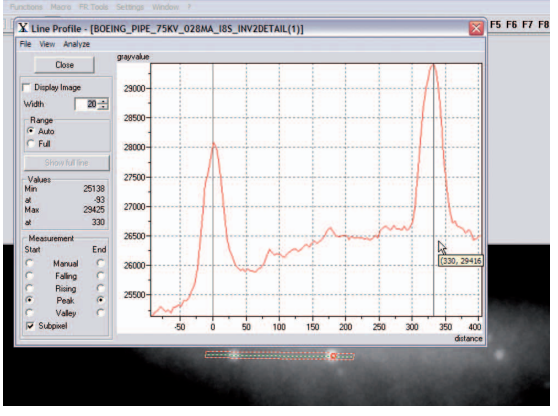
Measuring and marking

All products from the IMAGE x500 family allow the image to be measured, image commenting or image marking.

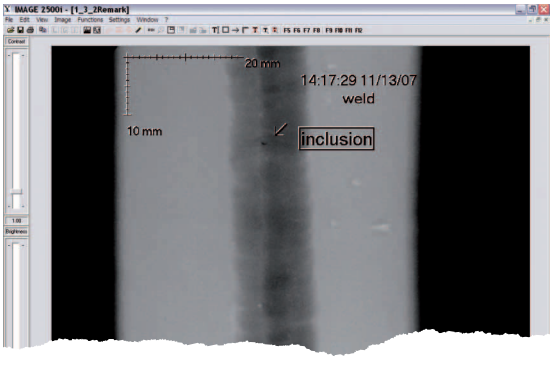
The measurement units are freely definable when performing the necessary calibration prior to measurement. Any number of calibrations can be saved.

Besides simple measurements of lengths and areas – as a rectangle or ellipse – the "magic wand" function with an adjustable threshold is available for complex surface areas.

Precise, reproduceable length measurements are attained using measurement within the gray-scale profile. Support thereby is given by functions that automatically set the start and end markers, e.g. in maximums/minimums or rising and falling flanks.



For purposes of documentation, symbols, the company logo or a ruler can be superimposed onto the radiographic image.



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Detector calibration

Alongside dark current calibration, IMAGE 2500-D and IMAGE 3500 also offer "multigain correction" for calibrating digital detectors. This correction can be performed for up to 20 different X-ray parameters. In the case of Y.Panel XRD, for example, signal-to-noise ratios of over 1000 are already possible using only about 3 X-ray images for correction. In the case of Y.XRS xx5 with 1 megapixel, correction is fast enough to depict 30 images per second.

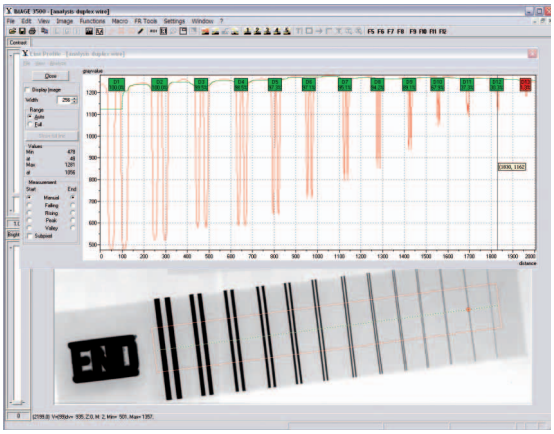
"Underperforming" pixels

Besides calibration, IMAGE 2500-D and IMAGE 3500 also support the determination of "underperforming" pixels. In alignment with the strict YXLON philosophy, disproportionately noisy and non-linear pixels are excluded from imaging in addition to "dead" or constantly glowing "hot" pixels. Their gray-scale value is calculated via adjacent pixels without any substantial loss of information. The underperforming pixels can be faded into the current image or viewed in a list for informational purposes.

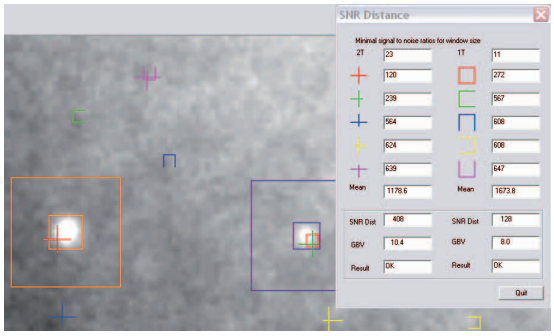
System qualification

The image's spatial resolution, detail detectability and signal-to-noise ratio (SNR) can be tested and protocolled using system qualification.

The operator is guided through various steps via a monitor dialog. In compliance with EN 462-5, a platinum duplex wire is placed for spatial resolution. The software determines the no longer identifiable duplex wire automatically.



An objective statement on detail detectability is obtained by measuring the ratio of the signal hub of the 1T and 2T holes of an ASTM E1025 / E1742 penetrameter to the noise in the sector adjacent to the holes.



Deviations in the 3 parameters spatial resolution, contrast sensitivity and SNR can thus be detected, e.g. when a shift begins.

Automation

In addition to the storage and retrieval of various gray-value scalings, a macro-recorder is available which records image enhancement functions such as noise reduction through integration and subsequent filtering. The macros can also be assigned to function keys.

Document-authentic archiving

When saving images in the open, standardized multi-TIFF format, several recordings of an inspection item can be stored and named differently yet coherently in one file. IMAGE software continues to enable the addition of images into that file, but not deletion or modification.

Scope of delivery

Y.IMAGE x500 is pre-installed on a PC containing:

- miditower or 19" industrial PC housing
- Intel® QuadCore CPU ≧ 2.4 GHz
- main memory ≧ 2 GB
- framegrabber (insofar as required by detector)
- hard-disk drive ≧ 160 GB
- 3.5" diskette drive (1.44 MB)
- CD/DVD writer, incl. software
- electromagnetic compatibility accessories
- mouse, keyboard
- Windows® XP, German edition
- hard-disk image and recovery software

For more detailed information about integrated detectors and available monitors, please contact YXLON Sales. In addition to the extensive reference manual, YXLON also offers a tutorial on achieving optimum image quality.

Data subject to change without notice.
Printed in Germany. 9499.211.18610.HL01

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