

An introduction to The ProCaptura KartoScan Flat Bed Large Format Scanners FBV and VLS



An Introduction to High Quality Scanning

The art of scanning has been through a remarkable development period the last decade. Scanners have become bigger. The optical resolution has increased. Apparently all scanners are reproducing the originals with a sufficient quality. However, when zooming in the fine details, you can see if the scan has been provided with acceptable resolution. And how do you verify the accuracy of the raster picture? For the Norwegian company ProCaptura quality has been the leading star when developing the KartoScan Flat Bed Large Format Scanners FBV and VLS, the most advanced and accurate capturing devices in the image processing industry.

Do you need the KartoScan Flat Bed Large Format Scanners FBV and VLS?

If you work with large size cartographic information, paper maps, technical drawings, scribing foils, transparent topographical foils or similar, and you have a demand for high quality, the KartoScan Flat Bed Large Format Scanners are the best choice. If you work with reprographic processes, printing or x-ray scanning, there may be better alternatives to the KartoScan Flat Bed Large Format Scanners. If you work with smaller size text documents in large volumes, the KartoScan Flat Bed Large Format Scanners are definitely not the right choice for you.

In the following chapters we will set focus on what is of major importance when discussing quality of a scan process.

What is High Resolution... and why?

Resolution is mostly defined as number of “dots” or “pixels” per inch (dpi). In the metric system the resolution is defined as the size of the smallest area you can separate by the camera system. As an example a pixel of the size 0.1 mm square in the metric system is equal to 254 dpi and a pixel the size of 0.05 mm is equal to 508 dpi.



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The KartoScan Flat Bed Large Format Scanners FBV and VLS are operating with a variable true optical resolution. This implies that the resolution is fully defined by the number of pixels seen from the CCD array, the camera, the optical lens and the distance between CCD array and the original document. It gives a one to one relation between the pixel size on the original and a pixel in the CCD array. The information coming into the computer will always be limited to the quality of the combination of the optical lens and CCD array.

Sheet feed scanners (roller scanners) have a fixed optical resolution depending on the number of cameras (lenses) and the maximum scan width for the actual scanner. When changing resolution the raw data are either re-sampled or interpolated from the arrays. This technique has come quite far; however, the effect is limited and will never come up to the quality of true optical resolution. If you feel it is necessary to increase the resolution due to fine details in the document, the only correct way is to choose a higher optical resolution and not manipulate the data from the CCD array.

Choosing resolution depends on the quality and density of the original. It is also important to know what the scanned data (raster) is going to be used for. An original scanned in 250 dpi will be displayed or plotted with acceptable quality as long as you show the raster in a one-to-one relation, but the possibility to zoom in on the display or magnify the plot will be reduced. When the data should be used in a vectorizing or symbol recognition process, the resolution should be set to 500 dpi or higher, depending on the original. The width of a line in the original should be represented with more than 1 pixel, 3 pixels would be fine. If a line on the original is 0.1 mm (0.004") the resolution should be set to 847 dpi or more to fulfill the requirement of 3 pixels. Also the distance between lines can be the target for high resolution. Contour lines in topographic maps can be very dense in mountainous areas. The higher resolution is, the better separations of those contour lines.

KartoScan Flat Bed Large Format Scanners FBV and VLS have a "continuous" range of resolutions from 250 dpi (approx. 0.1 mm) up to 1200 dpi (approx. 0.02 mm). The scanners can also deliver interpolated resolution above 1200 dpi.

Accuracy – the real quality measure

First, do not mix the terms *Resolution* and *Accuracy*. When resolution deals with level of detail, accuracy deals with correct positioning. Accuracy is a measure for the deviation between the recorded position of a pixel and the correct position for the same pixel in the original. This is independent of the size of the pixels (*resolution*).

KartoScan Flat Bed Large Format Scanners FBV and VLS are position controlled X-Y instruments with an absolute accuracy independent of the position of the originals. In contrast, sheet feed scanners (roller scanners) have an accumulated error depending on distance from scan start. They are therefore giving the accuracy in percentage of the length to be scanned. Typical values for accuracy on a sheet feed scanner are $\pm 0.1 \%$ which give an error of 1 mm (0.04") for a length of 1 meter or 2 mm (0.08") for a length of 2 meter.

Standard configuration KartoScan Flat Bed Large Format Scanners FBV and VLS hold accuracy within ± 0.1 mm (0.004") independent of distance. With the option *Enhanced Accuracy* the error will be less than 0.05 mm (0.002") independent of distance. This is 10 times better than any sheet feed scanner (roller scanner) on the market.



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The main usage of a scanner is to record data from an analog paper document. However, due to the high accuracy of the KartoScan Flat Bed Large Format Scanners FBV and VLS they can also be used to control the accuracy of the original documents. This can only be done if the accuracy of the scanner is clearly better than the accuracy of the original to be scanned. Compared with a measuring device in the mechanical industry, the accuracy for a document scanner should be 10 times higher than the accuracy of the document.

The combined resolution and accuracy were the main reasons why the airframe producer Boeing selected the KartoScan Flat Bed Large Format Scanners FBV and VLS for scanning the highly detailed 1:1 technical drawings at their plants in Long Beach and Wichita. The same resolution and accuracy were the reasons for the US Government (US Geological Survey) purchase their scanner.

Scan mode – gray, color or black & white

The CCD array in a camera normally records the information from the original in gray scale. For most scanners this is an 8-bit gray scale image. All the scanned pixels are assigned a gray value in the range 0 (black) to 255 (white). Most color cameras have 3 separate CCD arrays, one for each of the colors **R**ed, **G**reen and **B**lue (24-bit RGB). The binary mode generates a black and white image from the recorded gray values. This is done inside the camera by comparing the gray values with a threshold value. Pixels that have a gray value greater than or equal to the threshold are assigned a binary value of 1 (white) and pixels that have a gray value lower than the threshold are assigned a binary value of 0 (black).

Traditionally most scan activities are in binary mode. This is due to the fact that scanning in gray scale is giving up to 100 times larger files even with compression. The disadvantage with binary mode is reduced information compared to scanning in gray scale. The information is reduced from 8 bit /pixel (256 levels of information) to 1 bit/pixel (2 levels). The 8-bit/pixel information are useful when processing data, like vectorizing and symbol recognition.

The reasons for not using gray scale have been storage problems as well as slowing down the processing in the computer. However, since disc capacity and speed have increased tremendously the last few years this is not a problem any more. The combination of much faster computers and new structured software make it also more engaging to work in the world of gray scale.

ProCaptura has taken this opportunity and is always scanning in gray scale even if the final result will be delivered in binary. In this way we never have to scan an original more than once. The gray scale scanning methods were important when the Swedish car manufacturer Volvo Cars scanned more than 25,000 sq ft of technical drawings on the KartoScan Flat Bed Large Format Scanner.

Productivity – a combination of several disciplines

Throughput and *scan time* are different issues. *Scan time* is the time required for a document to physically pass through a scanner and therefore depending of the scan speed. With a resolution of 1200 dpi, 1-3 A0 documents may be captured on the KartoScan Flat Bed Large Format Scanners FBV and VLS per hour. In contrast, *throughput* measures the time of the entire data capture process



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and therefore tell us something about productivity. Most scanner producers highly focus on scan speed. This is, however, a disparagement of the productivity issue. Selection of resolution, calibrating for light and color, cleaning the original for dust, inspection after scanning, post processing operations like de-skewing and de-speckling, etc. are issues which take time and reduce the productivity.

KartoScan Flat Bed Large Format Scanners FBV and VLS offer a range of unique functionalities to maximize the scanning productivity and ensure excellent results. *Auto Naming* and *Raster Orientation* will increase the total productivity. *Tandem Scanning* is a functionality that make it possible to simultaneous scan one original while mounting another original. *Tandem Scanning* together with *Auto Naming* is a powerful combination. Looking at the whole conversion line the time used on scanning is very short compared to all preparations, the vectorization process, the loading of data, etc.

The Norwegian Institute of Land Inventory scanned 25,000 original agricultural and forestry maps on the KartoScan Flat Bed Large Format Scanner with use of *Tandem Scanning*, which increased productivity substantially.

Scan object mounting – several options

KartoScan Flat Bed Large Format Scanners FBV series are some of the few scanners with the possibility to choose between reflected light and transmitted light or to use both at the same time. The new KartoScan FBV comes in two versions with respect to holding the scanning object to the scanner board. The options are between glass plates (GP) or by vacuum (VB). The glass plate solution is necessary when it is required to use transmitted light and the vacuum solution has an advantage when the originals to be scanned have a none even surface i.e. maps on metal plates, maps on cardboards and maps that have been folded and therefore have cease marks.

Reflected light will mainly be used for non-transparent material, but can also be used for transparent foils. Transmitted light, however, is recommended when scanning transparent foils or films with fine details. Specially when scanning scribing foils the transmitted light will give better contrast in the gray scale mode and it is therefore easier to set the threshold value.

Topographical foils and scribing foils need the back light option for creation of the best results, hence both the Topographic Institute of France (IGN) and the Norwegian Institute of Land Inventory have been using the KartoScan Flat Bed Large Format Scanners FBV with back light.

Safety for fragile documents

Old originals are often fragile and even with tears along the edges. Those originals have to be handled very carefully not to destroy them even more. The scan technique used on the KartoScan Flat Bed Large Format Scanners FBV and VLS is very safe for the original. There are no mechanical movements touching the original during the scanning. On the FBV it is necessary to cover the original with a glass plate. On the VLS the glass plate as a cover glass can be useful if the original is



in a shaky condition. When we are scanning old fragile maps from the 17th and 18th century we are using a cover glass also for VLS.

When scanning old maps or fragile originals in general, the most important consideration is, of course, to protect the original. To make sure that the great value that is invested in those maps is not lost forever due to an accidental scan.

This is why 200-year-old urban planning charts from Oslo and more than 50-year-old cadastre maps are being scanned on the KartoScan Flat Bed Large Format Scanners FBV and VLS

All formats

KartoScan Flat Bed Large Format Scanners FBV and VLS deliver any format the client wants, suited to any database application or information system. The best scanner in the market is suited to everyone's needs. ProCaptura is not only a hardware manufacturer, but also a developer of advanced software solutions; hence ProCaptura is capable of providing flexible solutions, adapted to each client's need.

The most accurate scanner includes also a wide range of software

ProCaptura has during its many years of development, created several software applications connected to the operation of the scanner, the post processing of the scanned images and the semi automatic vectorization of the scanned images. Please contact ProCaptura for a more detailed description of these applications. The software delivered with the scanner, depending different configurations, are:

Included

- *Linux, Red Hat, Operating System*
- *Basic Scanning SW Module*
- *Auto-Naming Feature*
- *Large File Viewer*
- *Raster Orientation*

Optional

- *Prime, preprocessing scanning SW*
- *Merge SW*
- *Geo Referencing SW*

Easy to use scanner operation

A standard full-configured PC with Linux operative system controls KartoScan Flat Bed Large Format Scanners FBV and VLS. Combining the standard PC configuration, available all over the world, with the advanced freeware Linux to be downloaded to the computer from anywhere at anytime, ensures a cost efficient and high capacity state of the art solution with high precision and easy to use operation of KartoScan Flat Bed Large Format Scanners FBV and VLS.



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The 80-85° tilted work area has proven to be ergonomically optimal with the KartoScan Flat Bed Large Format Scanners FBV and VLS. The tilted flat bed provides the best work position also for inspection and cleaning purposes.

Environmental considerations

KartoScan Flat Bed Large Format Scanners FBV and VLS are high precision instruments; hence require a stable environment, regarding temperature, humidity, light and vibrations.

The factory – Scandinavian innovation

The KartoScan Flat Bed Large Format Scanners FBV and VLS have been developed and produced over a period of 20 years. ProCaptura is today responsible for the manufacturing and further development of the scanners. Their plant is outside of Oslo along the beautiful Oslo Fjord. Scandinavia has been known for its technology export and innovation. Even if ProCaptura benefits from a demanding local market, today the majority of ProCaptura's products and services are exported to different countries in Europe and Africa, and to the USA.

A wide range of satisfied clients world wide

The first generation KartoScan Flat Bed Large Format Scanners FB series and VLS were delivered to the cartographic institute of the city of Taipei in the Chinese Republic of Taiwan. Later scanners were installed in India and Indonesia.

Today the main customer base is in Europe, with scanners in Paris, Prague, Norrkøping, Oslo, and Zagreb etc. The scanner in Prague has been in operation for 10 years without down time, on two shifts per day, scanning topographical and cadastral maps for the cartographic office.

The real break through came in 1998 when the Boeing Company ordered their first KartoScan Flat Bed Large Format Scanner. Later Boeing has ordered more scanners from ProCaptura and is now in discussions on acquiring their 6th scanner from the Norwegian company. And last year no other scanner in the market qualified to US Geological Survey's specifications, when the US Government Agency tendered for 5 new scanners.



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