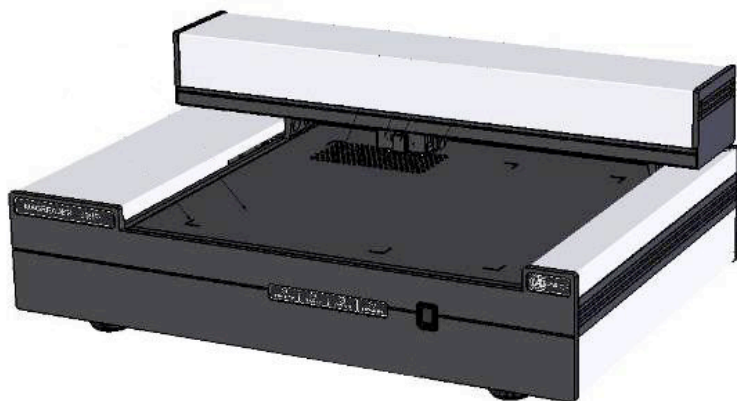




Two-coordinate magneto-optical scanner MAGREADER

REGULA 7701

User's Guide



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1 FUNCTION

Two-coordinate magneto-optical flatbed scanner MAGREADER (hereinafter referred to as "scanner") is intended for expert investigations of magnetic protection elements of documents.

The scanner allows to visualize images executed with magnetic dyestuffs, tapes, fibers and other magnetic materials. The read-in images are displayed on a PC monitor and can be stored as files of normal raster graphic formats.

The scanner delivery set includes specialized software that allows an expert to implement secondary digital processing of scanned images for the purpose of their analysis, comparison, estimation of geometric parameters and sizes, improvement of legibility and clearness.

The PC images obtained with the help of MAGREADER scanner provide with the possibility to document the investigation results and to replenish the databases of the document protection elements with images of their magnetic patterns.

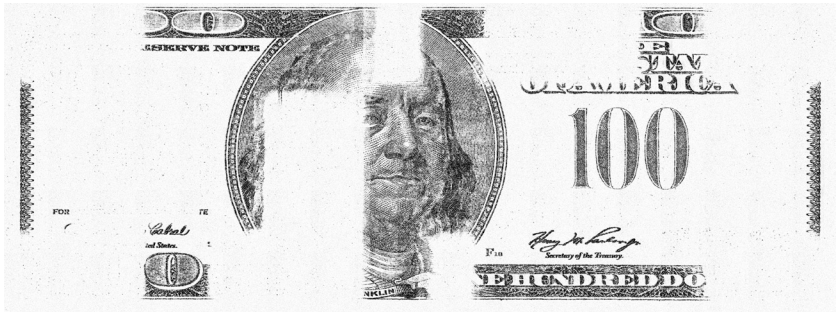
2 APPLICATION FIELDS

Possible application fields of MAGREADER scanner:

- Forensic criminalistics: authenticity verification of securities, banknotes; classification of forgery methods of securities, banknotes; investigation of damaged documents (reading of spilt texts executed with magnetic dyestuffs)
- Production of securities, banknotes, forms: quality control of magnetic protection elements; investigation of techniques and materials of magnetic printing
- Banking: authenticity verification of securities, banknotes
- Customs supervision of banknote authenticity

To illustrate the device application possibilities, the magnetic pattern image of a 100-dollar banknote of the 2006-year pattern read with the help of MAGREADER scanner, is given below (Figure 1).

Figure 1



3 DEVICE DESIGN

MAGREADER scanner consists of the following major components (Figure 2): base (A) along which the portal (B) moves in the forwards-backwards direction. Inside the portal the carriage, with the installed on it magneto-optical head (C), moves in the right-left direction. The sensors of the document right edge (1) and the document bottom edge (2) are installed on the magneto-optical head body.

ON/OFF power button (3) and four LED (light-emitting-diode) indicators: "ready" (4), "scan" (5), "error" (6) and "power" (7), are located on the front panel of the device base.

Four adjustable supports with plastic thrust bearings that prevent surface damage, are located on the base bottom surface. The device is installed on the adjustable supports.

The scanner object stage (9) with rubber surface has the tags (10) for the document positioning on the stage. The perforated area (11) with the inlets of the document pneumatic pressing is located in the top left corner of the object stage.

The socket (12) for PSU (power supply unit) connection, the USB-cable socket (13) for the connection to the PC and the output window (14) of the document pneumatic pressing are located on the back panel of the scanner base (Figure 3). The threaded hole (15) is intended for installing the fixer from "Transportation set" (see paragraph 8 **Transportation and Storage**).

Figure 2

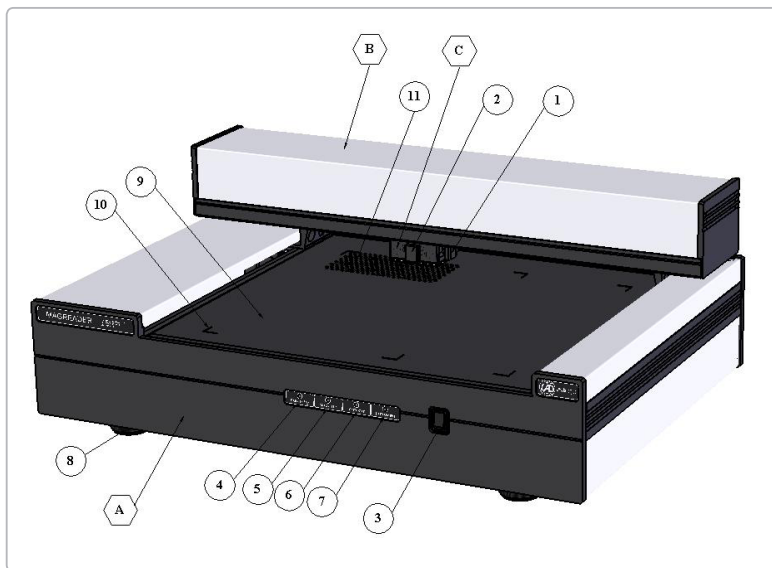


Figure 3



4 DELIVERY SET

The delivery set contains:

1. two-coordinate magneto-optical MAGREADER scanner;
2. PSU;
3. PC (optionally);
4. specialized software;
5. USB cable;
6. Transportation set;
7. User's Guide;
8. Test-objects set.

The characteristics of the PC and PSU are given in paragraph **7 Technical characteristics.**

The instructions on the use of the set for fixation at transportation are given in paragraph **8 Transportation and Storage.**

5 COMPOSITION AND OPERATION OF DATUM NODES

The device object stage is intended for locating and fixing the investigated object on it. The document is placed on the stage orientating its position according to the tags. The top left corner of the document turns out to be matched with the perforated area of the document pneumatic pressing.

The centrifugal fan connected by the duct system with the stage perforated area is located under the object stage at the device base. Air rarefaction produced by the fan attracts the document top left edge to the object stage surface. The document is fixed with enough effort to prevent its sporadic movements during the contact with the magneto-optical head. The object stage surface has a rubber cover to produce additional cohesion of the document with it.

When activating the device, the pressing fan operates at the reduced turns. When executing with the help of the device the operations connected with the magneto-optical head movement, the mode of the fan increased turns is activated and the additional effort of the document pressing is produced.

Scanning of the investigation object surface is carried out with the help of the magneto-optical head (MO-head). The crystalline film of garnet ferrite containing bismuth (magneto-optical crystal) is the head sensing element. This film has been grown on the special optical substrate. The physical operating principle of MO-head is based on Faraday effect that consists in the ability of a number of crystalline substances under the influence of magnetic field to rotate the polarization plane of the light reflected from their surface (Faraday rotation).

To excite the magnetic field on the images executed on the document by magnetic dyestuffs, MO-head has the magnetization system which is based on NeFeB-magnets. The force lines of the magnetic field, produced by the magnetization system, are located in the magneto-optical crystal plane and do not lead to Faraday effect. When the magnetic dyestuff particles get to the bias magnetic field, they provoke local transversal deviations of the magnetic field. The thickness transverse component of the magnetic field influences the magneto-optical crystal producing local zones of Faraday rotation which are transformed into the visible image of MO-head optical scheme.

Two reels (right and left) with the cores made of soft magnetic steel are additionally included to the content of MO-head magnetization system. These reels form the device are named scrambler. The scrambler is intended for producing series of impulses of alternating magnetic field in MO-crystal plane to delete "clusters" – results of the merger of MO-crystal domain cluster into a single domain ob-

served as a monochrome spot.

LED is the light source in MO-head optical scheme. The luminous flux emitted by the LED passes through the polarizer plate and is transformed into the polarized light beam. The polarized light deviates 90° from the beam-splitting plate and through the lens is going to MO-crystal. The image executed by the magnetic dyestuff on the document surface provokes transversal deviations of the magnetic field of the magnetization system, which repeat the form of the initial image. The polarization plane of the light fallen on the crystal surface rotates in the places which contain the transversal component of the magnetic field. Further the reflected light passes through the second polarizer (analyzer), and the monochrome image corresponding to the magnetic image on the document is formed on its surface. This image comes through the objective lens to CCD-sensor built in MO-head of TV-camera.

The video signal comes from TV-camera in MO-head to the video capturer, which forms the video frame transmitted by USB-channel to USB-hub and from there to the PC.

The obtained image frame is displayed in CADR software window. MO-head shifts in the longitudinal or transverse direction to the following document area to form a new frame.

There are 3 electromechanical drives of step motors applied in MAGREADER scanner for MO-head transferences: MO-head drive, carriage drive and portal drive. The bipolar diphase step motors are used in the drives.

MO-head drive moves it in the vertical direction. When inputting the image frame, MO-head is descended and pressed with MO-crystal surface to the investigated object. This MO-head position is called an operating position/on-position. At all motions in the horizontal directions MO-head is beforehand ascended and diverted from the document surface to avoid the crystal surface damage. This position is called a filling position. Particularly in the filling position the document removal and fill are carried out. MO-head drive is of the cam type. The cam is installed on the step motor (M3) axis and has two steady positions.

The drive composition has two sensors intended for detecting MO-head position. The sensors are optical infrared and operate on reflection. The disk with the cover made of light-absorbing material and with the tag made of the IR light-reflecting material, is installed on one axis with the drive cam. Subject to the cam position the tag is installed opposite the sensor of operating mode or opposite the sensor of filling position. Subject to this one of the sensors is in 0 (0...+2V) state, while the other is in 1 (+2...+5V) state. If when inquiring the sensors

both of them are in 1-state or both of them are in 0-state, the signal about the failure in the device operation will go off.

MO-head drive is mounted on the carriage that moves inside the device portal in the transverse (right-left) direction. These motions/transferences ensure the carriage drive. The given device is of a tooth-belt type. The toothed belt is fixed on the right and left ends of the portal bar. The toothed wheel is installed on the axis of the step motor fixed on the carriage. Two running rollers which provide with the necessary spanning angle of the toothed wheel are installed on the motor arm. When rotating the toothed wheel, the carriage moves along the portal bar on the roller system supplied with the devices for the gap choice.

The carriage drive has the sensor of the carriage leftmost position. The sensor is of the same type as the drive sensor of MO-head. The sensor is installed on the portal bar and is directed by the radiator-receiver to the bar surface area covered with light-absorbing material. The plate with the tag made of IR-light-reflecting material is fixed on the carriage. If the tag edge is in the zone of the sensor radiator-receiver when the carriage is in motion, sensor transfers from 0- state to 1-state. The sensor 1-state indicates that the carriage has reached the leftmost position. On reaching this state the carriage stops moving. The setup of the carriage leftmost position is carried out by the plate shift. Moreover, two adjustable stops, which are physical limiters of the carriage leftmost and rightmost position, are fixed on the portal bar. The supply of signal current lines and power to the carriage is carried out by the flat daisy cable.

The portal transference is carried out with the help of the portal drive. Two guides of the portal rectilinear motion are fixed at the right and left side of the device object stage. The guides have rectilinear gutters that prevent the portal transverse shift.

The right and left roller supports, provided with the articles/devices for the gap choice, are moving correspondingly along the guides. The portal bar, inside which the carriage moves, is installed on the supports.

The portal drive is of a tooth-belt type. The drive set contains two step motors. The motors are installed on the supporting arms of the device object stage under the stage surface. The toothed wheel is installed on each motor axis. The tension roller with the spring article/device corresponds to each toothed wheel. Two toothed belts are tightened between toothed wheels and jockeys/tension rollers. Each belt is fixed in one point on the right and on the left roller support/bearing correspondingly.

Thus, when rotating simultaneously the step motors, translational rectilinear motion of the portal along the guides takes place, that ensures MO-head transference in the longitudinal (forwards-backwards) direction.

The portal drive has the sensor of the portal far- most position. The sensor is of the same type as the drive sensor of MO-head. The sensor is installed on the bottom side of the object stage and is directed by the radiator-receiver to the base surface area covered with light-absorbing material. The plate with the tag made of IR-light reflecting material is fixed on the left roller support/bearing. If the tag edge is in the zone of the sensor radiator-receiver when the carriage is in motion, sensor transfers from 0- state to 1-state. The sensor 1-state indicates that the portal has reached the far-most position. On reaching this state the portal stops moving. The setup of the portal far-most position is carried out by the plate shift/displacement.

Two adjustable stops, which are physical limiters of the portal far-most and close-most position, are fixed on each portal guide. The supply of signal current lines and power to the portal is carried out by the flat daisy cable.

To carry out automatic search of the scanned document end, the sensors of the document right edge and the document bottom edge are installed on the device MO-head. The sensors are optical infrared and operate on reflection. They are installed the in the way their radiator-receivers are directed to the object stage surface covered with the material of reflection low coefficient of Infrared light. The sensors are set up in the way the quantity of IR light reflected from the stage surface corresponds to their 0-state, and the quantity of IR light reflected from the paper surface corresponds to 1-state.

When the device performs the scan operations with automatic search of the document end, CADR control program inquires about the state of sensors. In addition, the program makes the correction which takes into account that the installation places of sensors are displaced/shifted for some distance relative to MO-head center. When the program finds out that, subject to the correction, MO-head has crossed the document boundaries, the scan process stops.

The confunction control of the scanner nodes is carried out by the control unit (CU) executed constructively in the form of the printed wiring pattern located in the device base bottom. The main component of CU is AVR Atmel 8535 microcontroller. The following CU components operate under the microcontroller control: step motor drivers, drivers of shaker/scrambler reels, control drivers of the fans of the document pneumatic pressing and CU cooling, triggers of DP1...DP6 sensors. CU receives the commands of the PC according to CADR program functioning. The PC commands comes from the port to CU USB-socket, after which they are trans-

formed by USB-COM transformation module into the command format of the microcontroller. The microcontroller operation algorithm is stored in the form of the program in its memory. The microcontroller is connected to the programmer with the help of the socket on CU pattern.

For the indication of operating modes CU is connected with LED indicator panel. One of them the "power" is directly connected to 12V supply line connected with CU. The microcontroller controls the operation of the rest: "ready", "scan" and "error". The "ready" indicator turns off for the period when the scanner performs an operation and turns on after its completion indicating that the device is ready to perform the following operation. The "scan" indicator signalizes the performance of the document scan operation. The "error" indicator turns on if there is a failure in the device operation.

The lines, with the help of which the video signal comes from MO-head camera, are connected to CU pattern. These lines pass as transit to the video socket to which USB-video-capturer is connected.

The scanner CU and video-capturer are connected to USB-hub which in turn is connected to USB-socket on the back panel. Through this socket the scanner is connected by the cable with one of the PC USB ports.

The node conjunction of MAGREAFER scanner when performing the document scan operation is carried out in the following way.

6 OPERATION ORDER

6.1 Preparing for operation

Install the scanner on the flat horizontal surface. With the help of adjustable supports reach the device steady position on the supporting surface.

Before the initial device activation:

- Make sure there are no visible defects or damage. If there are any defects or damage, apply to your supplier.
- Remove the rubber pad (1) and the fixer (2) (Figure 15) from the transportation set by unscrewing the screw (3) (Figure 16) on the back panel of the scanner base. Keep the set components during the device lifetime.

Remove foreign objects and documents from the working table.

Connect CU to socket 12 (Figure 3).

Connect plug (type B) of USB cable from the device delivery set to socket 13 (Figure 3). Connect other plug (type A) of the other end of cable to the correspondent USB socket of PC.

Make sure that ON/OFF power button 3 (Figure 2), on the device front panel, is in the "deactivated" position. Connect CU plug to the wall outlet of 220V.

Put ON/OFF power button 3 to the "activated" position.

After activating power supply, the "Power" indicator 7 must be lighting on the device front panel. Then the device will perform the self-testing procedure that can be observed as the series of /motions of the portal, the carriage and MO-head. The self-testing procedure will take a few seconds. Then the motions stop and the "ready" indicator 4 is lighting. The lighting state of the "power" and "ready" indicators with the not lighting state of the "scan" 5 and "error" 6 indicators testifies that the device is in normal state and is ready for operation.

6.2 Scanner software setting

The software, delivered in the set with MAGREADER scanner, contains: 1) CADR program for scanner control 2) driver of the scanner CU 3) video-capturer driver. The setting order of the software is the following.

Install CD with the scanner software to the PC disk drive. Create the working folder and copy the software to it.

Turn on the device power supply (the "power" indicator is lighting). Connect the scanner with the PC USB-port by USB cable from the delivery set.

The operating system will detect new devices (the scanner CU and video-capturer) and will start automatically the utility of driver installation

(Device Driver Installation Wizard). The driver installation order is not important. During the installation process indicate the ways to the corresponding drivers: Y\drivers\com-Ftdi — for the scanner CU

Y\drivers\USB_video_device_203|Driver|Driver32 – for the video-capturer where Y is the working folder name.

After installation user can control that device is installed and work properly. For this user calls Device Manager. There are two variants of video capture device. First is set in section of Imaging devices as “USB 2.0 High-Quality Video Adapter” device. And the second is set in section of Audio, video and game device as “USB 2861 device. Also USB Serial Port devices must be shown in section Ports (COM & LPT). Both devices (USB video capture and USB Serial Port) must be shown in appropriate section without any marks (such as exclamation mark or question-mark). Otherwise the device is not ready for processing.

Then it is necessary to set in MAGREAD.INI initialization file of CADR program the number of COM-port through which the program will be connected to the scanner. Enter Control Panel of your PC and select System section. In the opened System Properties window select Hardware tab and press Device Manager button in it. The device list will open. This list has Ports (COM & LPT) section. Open this section by the double click of the mouse left button. Find the following section: USB Serial Port (COM N) in the opened subscription. Here N is Com-port number to which the scanner is connected. Remember this number.

Enter the folder of CADR program setting, and then \Modules sub-directory. Find MAGREAD.INI file in the file list. Open it for example with the help of Notepad utility. In the file content you will see the lines:

```
[MAGREADER]  
COM=X
```

where X is COM-port number to which CADR program refers in order to establish connection with the scanner.

In X place input Com-port N number found in Ports (COM & LPT) list of Device Manager window. Save and close the updated MAGREAD.INI file.

The operation of COM-port setting is performed one time with the initial scanner cable connection to the PC USB socket. At the following scanner connections it shall be performed only if you have connected the device to another USB socket from those available in your PC. (For example, if the previous socket is occupied by an article/device). We recommend as far as possible to connect the scanner to the same socket of your PC.

When the drivers are set and COM-port number is indicated, CADR software is ready for a start. The start of CADR.EXE executable can be performed directly from the working folder or with the help of the shortcut located in any convenient place.

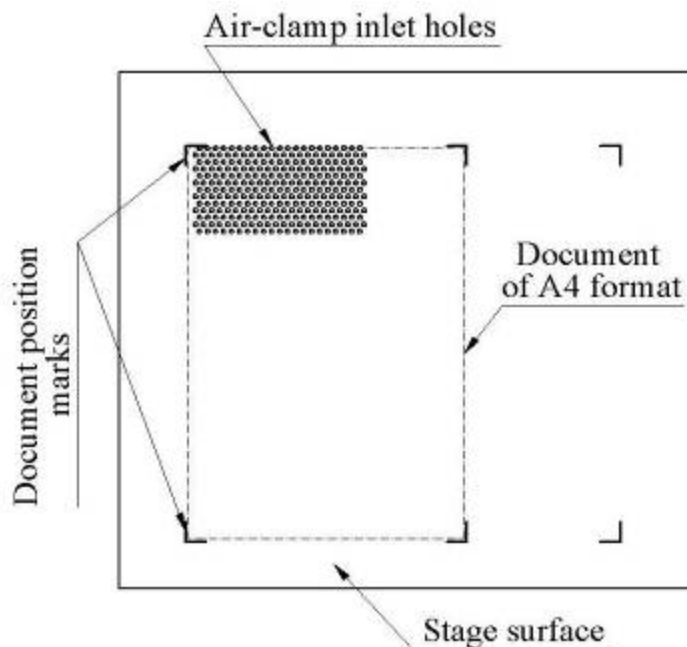
6.3 Operation execution

Place the investigated document on the scanner object stage. The document must cover the perforated area of the pneumatic pressing in the stage top left corner (Figure 4). It will attract the document to the stage surface.

Attention! When placing the document the scanner MO-head must be in the filling (top) position. In the same position the document removal from the object stage is carried out. Avoid! the motion of the investigated document when MO-head is in the operation (bottom) position in order not to damage MO-crystal surface. It is not a mistake if you transfer the portal using the tools of "Documents scanning" (see the paragraph 6.4 of the Guide) when placing the document. This legal method increases the convenience of the document bookmark easing the access to the pneumatic pressing zone.

Start CADR software by the double click on the software shortcut or by the double click on the pictogram of CADR.EXE file in the folder where it is set.

Figure 4



Press "Documents scanning" button in the opened window. "Documents scanning" window will appear in CADR software window. The function control of MAGREADER scanner is carried out from "Documents scanning/join" window.

Using the function of the frame single input, execute where necessary the search of the document fragments which are subject to scanning.

Specify sizes and position of the scan area.

Start the document scanning. Start the single-step transference of the carriage, the portal and the scanner MO-head. In CADR software window the scanned image will begin its formation from separate frames. The blinking of the "scan" and "ready" indicators testifies the normal performance of the scan process.

After the scan process completion the carriage, the portal and MO-head stop their motion. The head is transferred to the filling position. The activated "ready" indicator with the deactivated "scan" indicator testifies the normal process completion.

Estimate the scan results on the PC screen. If it is necessary make corrections of the scan area position and sizes and start the process again.

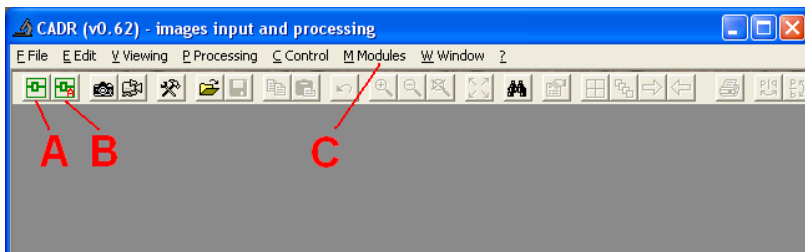
If you are not satisfied by the obtained image, save it on the PC hard disk or on any other media connected to the PC using the menu items [File]-> [record] of CADR software.

If it is necessary execute electronic processing of the obtained images using the tools and functions of CADR software (see their description in CADR_ENG.DOC file from the scanner software set). Also see the paragraph 6.5 "The description of "MAGREADER Complex" module of CADR software".

6.4 The description of "Documents scanning" subprogram of CADR software

The call of "Documents scanning" subprogram is carried out automatically with CADR software start. Otherwise the subprogram can be started by pressing A button in the top left corner of the program window (Figure 5).

Figure 5



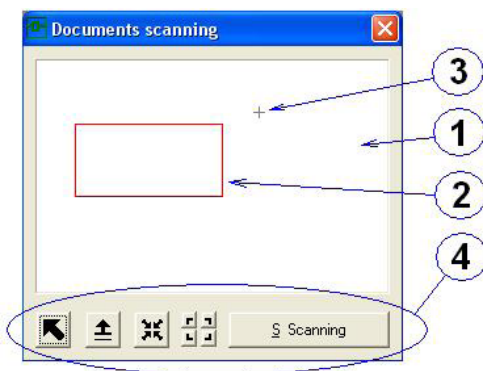
"Documents scanning" window appears. Its appearance/aspect is shown in Figure 6.


The white rectangular field 1 that occupies the major part of the window area, is equivalent to the surface of the scanner object stage. It is called the operating field of "Documents scanning" window. There is the red blinking selection box 2 on the operating field surface. It is intended for specifying the sizes of the scanner object stage area, where the scanning of the document or its fragment will be executed.


Besides the selection box, there is the black crossline of cursor 3 on the working table. The cursor is intended for specifying the parameters and position of the selection box as well as for indicating on the scanner object stage the points, to where MO-head should be transferred.


There is a number of functional buttons in the "Documents scanning" window bottom. These buttons are used for scanner control:

Figure 6



 — transfers MO-head to the filling (top) position, and transfers it to the top left corner of the object stage.

 — diverts MO-head from the document surface (transference to the filling position).

 — transfers MO-head to the operating (bottom) position and inputs the image single frame. (The operation can also be started by the double click of the mouse right button on any point of the operating field holding <Alt> button simultaneously).



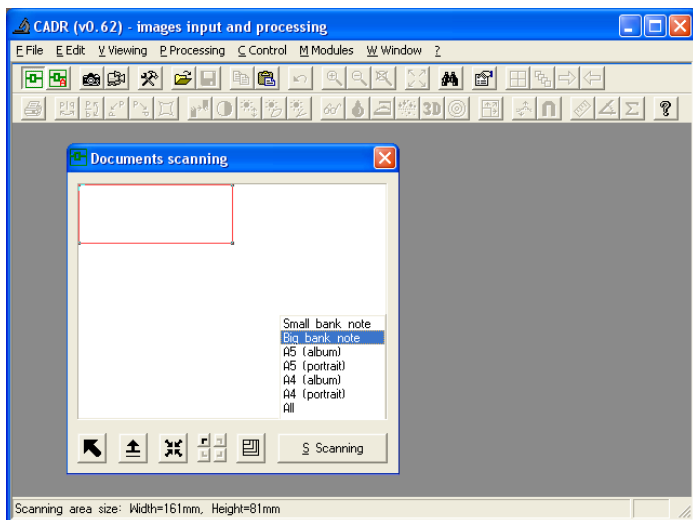
— group of four buttons. Each button transfers the corresponding corner of the selection box of the scan area to the point indicated by the cursor on the operating field.



— opens the window for choosing a preliminary assigned document format (Figure 7). Repeated click on any of the functional buttons closes the window.

The set of the preliminary assigned document formats is: "Small bank note", "Big bank note", "A5 (album)", " A5 (portrait)", "A4 (album)", " A4 (portrait)", "All". When one of the formats is chosen the frame changes its size and its numeric value indicates in the information string at lower part of the CADR program.

Figure 7



— starts the scan operation of the document fragment specified by the selection box with the linkage of separate frames and the image screening to CADR software window.

To transfer MO-head to the required point of the investigated document, set the cursor crossline in the corresponding point of the window operating field, click twice the mouse right button. The portal and the carriage will transfer MO-head to the required point of the object stage.

If it is necessary to perform the same operation (MO-head transference) with the following image frame screening, press and hold <Alt> button while clicking twice the mouse right button. MO-head will transfer to the indicated place, will drop on the document surface and one image frame will be read and screened to the separate window.

The performance of the described above operations of MO-head transference helps to define the coordinates of the document area which is subject to scanning, if it is necessary to scan only its parts.

To change the sizes and position of the selection box, click the mouse left button on "Documents scanning" window for the window activation. Direct the cursor to one of the selection box corners with the help of the mouse. Press the mouse right button and pull the window corner for the required distance in the required direction. Release the mouse button. Repeating these operations, obtain the required box sizes and position. (The same operation can be performed using the cursor and the button group for the indication of the corner position of the selection box).

To perform the scan operation of the area specified by the selection box, press "Scanning" button from the button set located below the operating field. The scanner portal and carriage are activated and the document frame-by-frame scanning will begin with the simultaneous screening of the linked image to CADR software window.

To perform the scan operation with automatic search of the document end, press "Scanning" button holding <Alt> button simultaneously. As a result the scan operation will begin with the inquiry of the sensors of the document right and bottom edge. The selection box sizes and position are ignored, and MO-head motion is performed from the top left corner of the object stage till the detection of the document bottom right edge by the sensors.

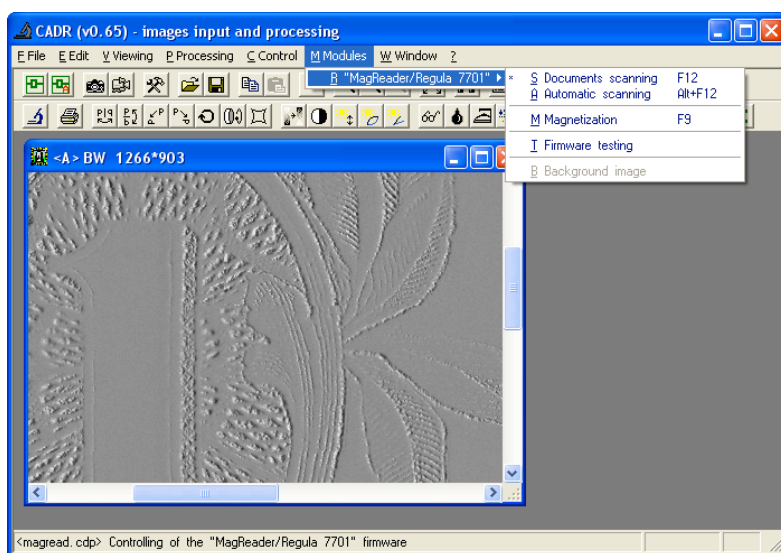
Button B (Figure 5) is meant for starting scanning process at automatic mode. In this case the search of the document end (its right lower corner) is carried out by the optical sensors. At this mode the MO-head moves from left upper corner of the object stage until the right lower corner of the document will be detected. The window "Documents scanning" does not open in this case. The attention should be paid that the area scanned at the automatic mode exceeds the size of the investigated document.

The automatic mode could be also activated from the "Documents scanning" window. For this operation the <Alt> key should be hold and button "Scanning" pressed simultaneously. The scanning of the document will start with checking the optical sensors state. The size and position of the selection box is ignored.

6.5 Description of "MAGREADER" module of CADR software

"MAGREADER" program module provides with the access to those functions of CADR program which are intended for operating with the scanner. The reference to the module functions is carried out through "Modules" item in CADR program menu (Figure 8). The list of these functions is given below.

Figure 8



Documents scanning. Calls "Documents scanning" window, which function and operation are described in the paragraph 6.4 of the given Guide.

Automatic scanning. Starts the scan operation in the automatic mode with the search of the document end with the help of the optical sensors.

Magnetization. Calls "Magnetization" function described bellow.

Complex testing. Enables to repeat the start of the scanner self-testing procedure, which is performed at the device activation.

Background image. Is not available in the given device version.

6.6 Result processing

CADR specialized software provides the user with a vast tool set to process the visualized magnetic images. Their complete description is given in the User's Guide for the software.

We give the description of two functions of CADR software below: "Deviation from the average" and "Magnetization", which are the most commonly used for the processing of magnetic images exactly on the documents.

"Deviation from middle" function

To start "Deviation from middle" function, download the processed image to the program. It can be performed by scanning the document which contains the magnetic image or by loading/downloading one of the previously saved images with the help of [File] - > [Reading] menu. Then click the mouse right button on C button (Figure 9) in the lower row of the button menu. "Deviation from the average" window will open in CADR software window.

If when starting CADR software for the first time, the indicated button has not appeared in the menu, click twice the mouse right button on the white space of the button lower row while holding simultaneously <Ctrl> button. Customize Toolbar window will appear, with the help of which it is possible to locate the call button of the required function to the program button menu.

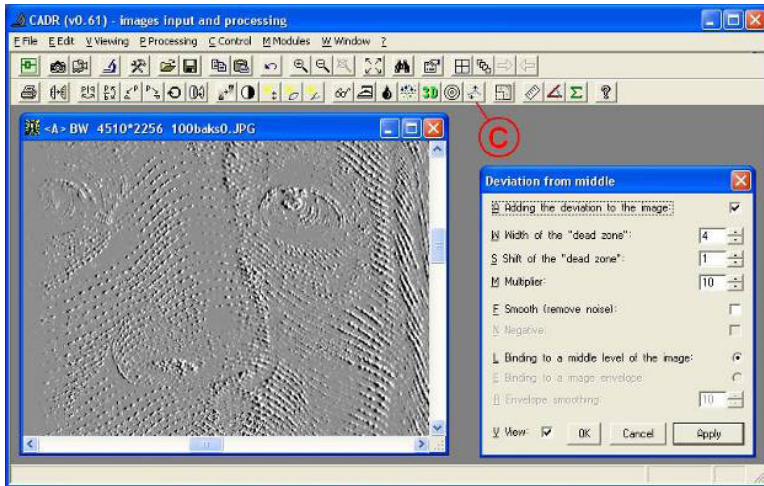
The given function calculates the average value of the brightness of the points that compose the processed monochrome raster image. The deviation from this value for some magnitude "plus" or "minus" is considered to be the "dead zone". The point brightness values, which are in the "dead zone" range, are replaced by the average value. The brightness, that exceeds the upper limit value of the "dead zone", intensifies. The brightness, that is less than the lower limit/boundary value, diminishes.

The parameter composition and function of the image processing of "Deviation from the average" function are the following.

Width of the "dead zone" — specifies the range width of the point brightness deviation from the average value. Within its limits the brightness adjustment to the average value takes place.

Shift of the "Dead zone" — allows shifting the "dead zone" for some positive or negative value relative to the brightness average value.

Figure 9



Multiplier — determines the brightness change degree of the points, the values of which are beyond the limit/boundary values of the “dead zone”.

Smooth (remove noise) — decreases the contrast of the points which have occasional brightness deviation on the general image background.

Adding the deviation to the image — if the flag is not set in this line, the average value is subtracted from all values of the image point brightness. The following options operate in this mode:

Negative — changes the processed image to a negative one

Binding to a middle level of the image — transformation of the image point brightness relative to the average value.

Binding to a image envelope — transformation of the image point brightness subject to the corrections to the uneven distribution of illumination on the space of the input/introduced frame.

Envelope smoothing — calculation parameter of the correction to the uneven distribution of illumination on the space of the input frame.

View — if the flag is set in this line, all changes of the image processing parameters will provoke simultaneously the corresponding image changes.

OK — exit from the “Deviation from the average” function saving the parameter values of the image processing specified in its window. The image changes are not saved. The image returns to the state which it had before “Deviation from the average” function call.

Cancel — exit from the “Deviation from the average” function without saving the parameter values of the image processing specified in its window. The image returns to the state which it had before “Deviation from the average” function call.

Apply — exit from the “Deviation from the average” function saving the parameter values of the image processing specified in its window. The image changes are saved.

“**Deviation from the average**” function can be called by clicking twice the mouse left button to C button (Figure 9). In this case the function will be executed without screening the parameters to the window display. In this case the parameter values of the image processing will correspond to the latest saved.

“**Magnetization**” function

CADR software has “Magnetization” function which allows estimating the magnetic properties of the dyestuff, which was used to produce the visualized magnetic image. The numeric parameter calculated by the function is a complex characteristic that is proportional to the residual magnetization of the magnetic material and its concentration in the dyestuff.

The source data for the given function calculation is the brightness distribution of the magneto-optical image, that is connected with the intensity of the magnetic field produced by the dyestuff magnetic material. The intensity of the magnetic field is estimated in the range from the sensitivity threshold of the magneto-optical crystal to the intensity of complete re-magnetization.

To call “Magnetization” function double-click with left mouse button on the D button (Figure 10a) or choose the menu [Modules] -> [“MAGREADER”] -> [Magnetization] (Figure 10b) or press <F9> keyboard button, when the window with the visualized image is active in CADR software.

Function window 1 and frame 2 which covers the image rectangular zone, in which the dyestuff property estimation is performed, will appear on the image background (Figure 10a). The zoomed image fragment corresponding to this zone is displayed in window 3. The zone size can be changed with the value change in window 6.

Figure 10a

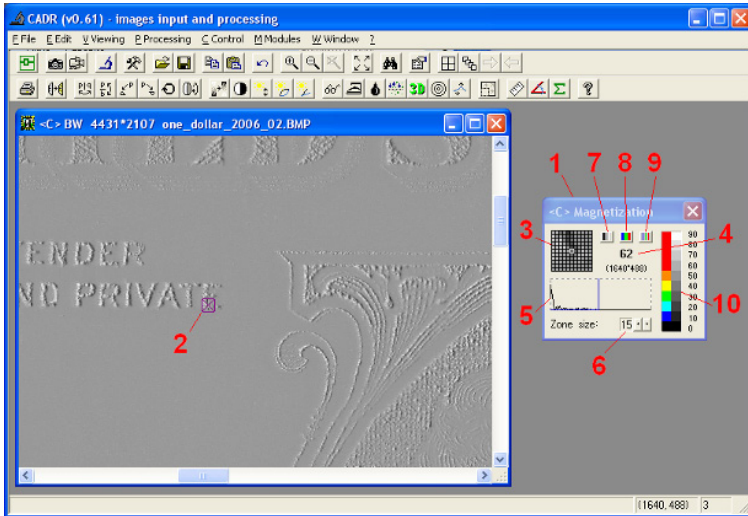
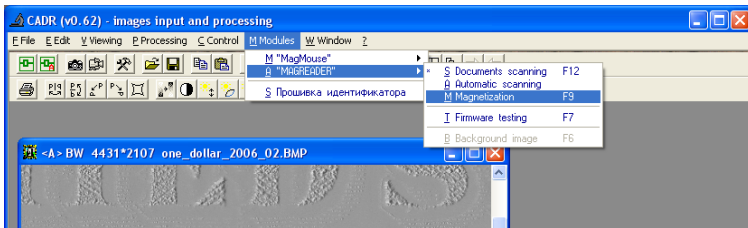


Figure 10b



To move the border in the image space, direct the cursor to its center and press the mouse right button.

If the border can not be observed in the image window when calling "Magnetization" function, it shall be called by clicking twice on area 3.

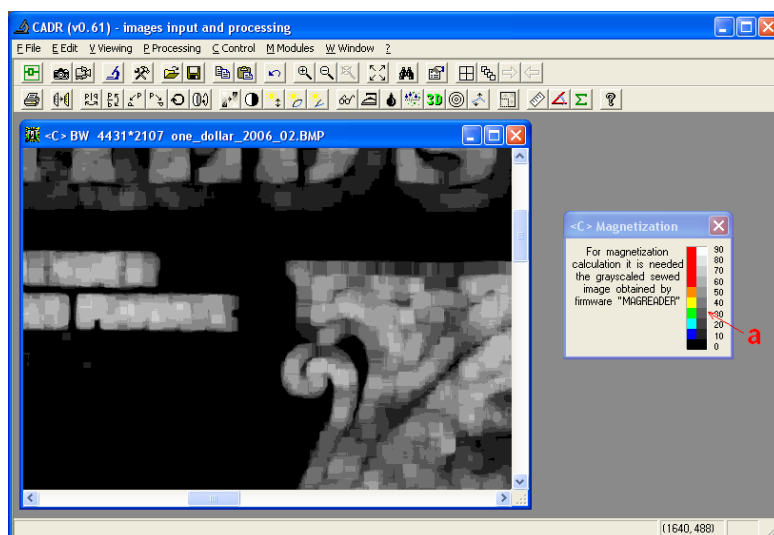
The brightness distribution of the image pixels corresponding to the image processed zone is shown by histogram 5.

The resultant numeric parameter 4 is shown in the top right corner of "Magnetization" function window.

The group of buttons 7, 8 and 9 activate function which performs calculation and visualization of the intensity of the magnetic field produced by the dyestuff magnetic material on the document surface. Functionality of each button differs by the produced result.

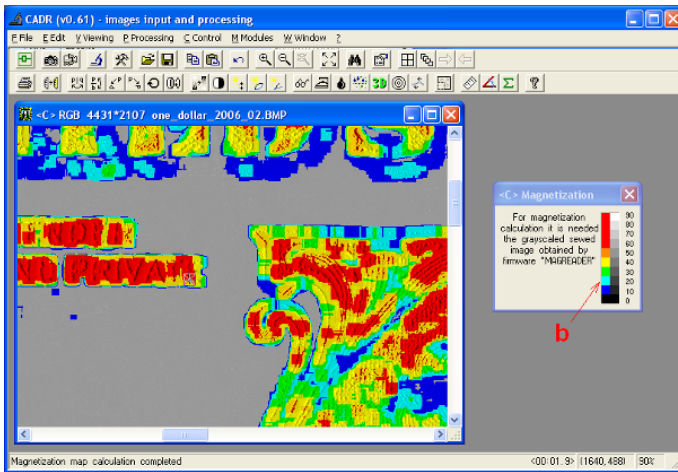
Button 7 produces the result of document surface magnetization distribution in the current window. Magnetization level is displayed by gray color gradation which corresponds to left column (a) of scale 10. Magneto-optical image is hidden under the distribution image and image background is substituted with black color (Figure 10c).

Figure 10c



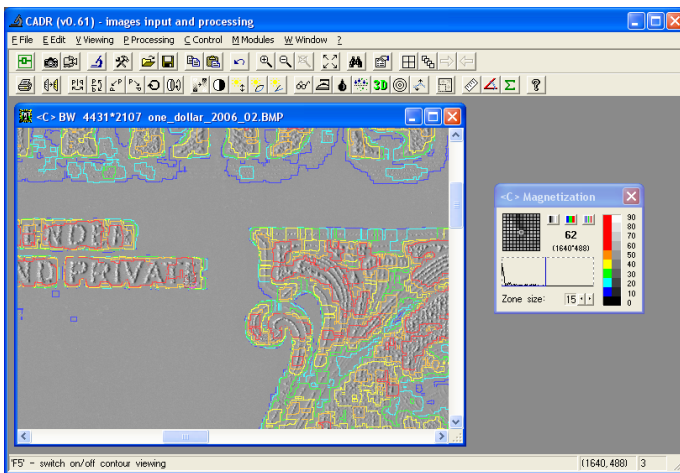
Button 8 displays magnetization distribution in color gradation (left column (b) of scale 10). Magneto-optical image stays the same and its background (gray) is not changed (Figure 10d).

Figure 10d



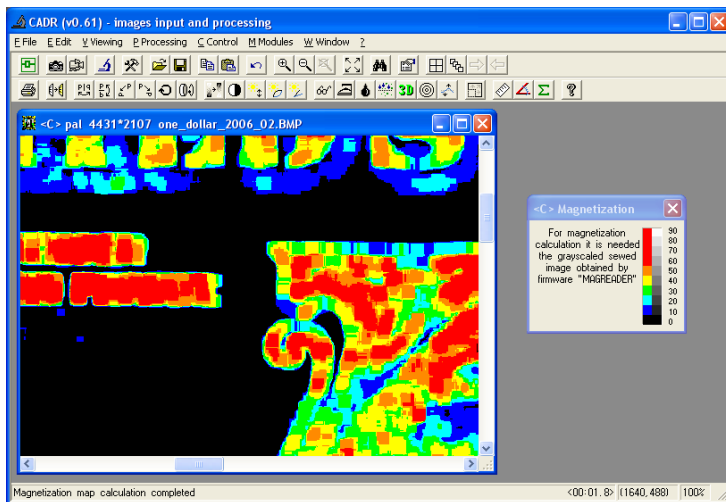
Button 9 displays magnetization distribution in contoured color areas. Magneto-optical image and its background stay unchanged (Figure 10e). It is also possible to measure local magnetization intensity using Frame 2.

Figure 10e



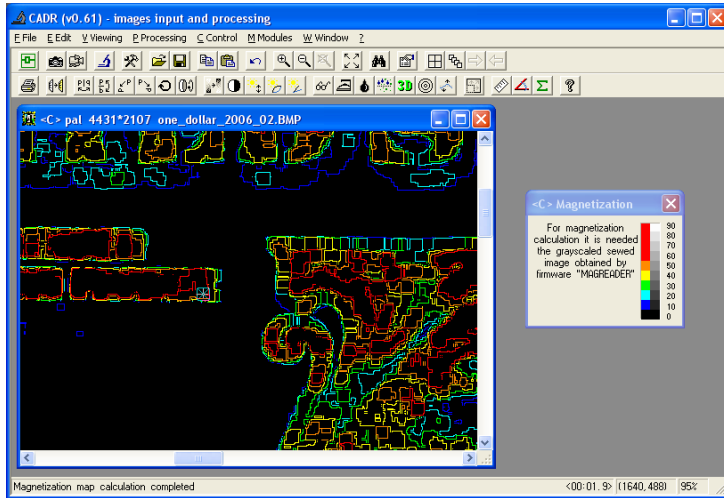
When pressing button 7 together with <ALT> key color scale visualization is displayed. In this case magneto-optical image is hidden under the distribution image and image background is substituted with black color (Figure 10f).

Figure 10f



When pressing button 9 together with <ALT> information is displayed in contoured color areals. In this case magneto-optical image is not shown and image background is substituted with black color (Figure 10g).

Figure 10g

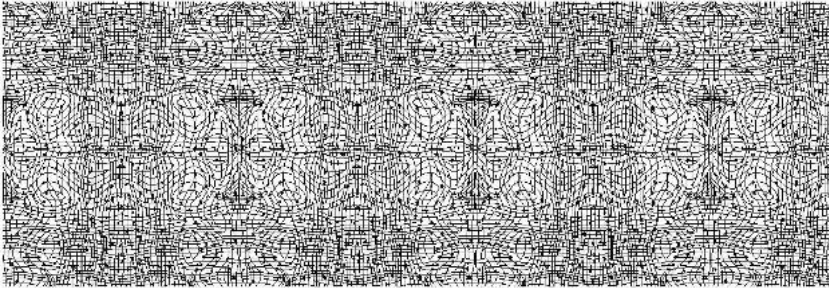


6.7 Test-objects

Test-object N1 (Fig.11) is intended for performing the autotuning procedure.

Figure 11

Test-object N1 (tuning) of "MAGREADER" device



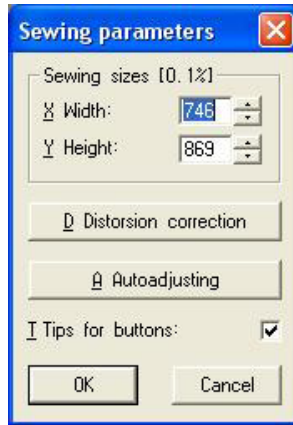
The test-object is a field with the applied pseudo-occasional net-like image. During the device autoadjusting MO-head reads the frame horizontal line with the net image and the frame vertical row/line. At the reading process the correlation and static processing of the input frames takes place. On the ground of the obtained data the values of a number of the device functional parameters are determined. These parameters are input to CU memory.

The access to the autoadjusting procedure is carried out through "Sewing parameters" auxiliary window of CADR software (Figure 12). To call this window, click the mouse right button on A button in the button menu of CADR software (Figure 5).

There is "autoadjusting" button, which starts the procedure, in "Sewing parameters" window. Test-object N1 must be installed on the device object stage.

Attention! The autoadjusting procedure can change the manufacturer's parameter settings of the scanner. It is intended for being performed by personnel when maintaining the device. Users are not recommended to perform this procedure without assistance

Figure 12



Test-object N2 (control-diagnostic 1)

Test-object N2 (Figure 13) is intended for performing the following control-diagnostic operations:

- Estimation of relative error of linear dimensions measuring
- Estimation of MO-head resolution
- Estimation of MO sensitivity and dynamic range

Under the function the test-object field is divided into three parts.

Each part has a scan area from which the test image is obtained. The obtained image is subject to estimation under the corresponding criterion. The estimation procedure is briefly described in the text located below the scan space/area. The examples of the scanned image view at the device correct operation are given below the procedure description.

Control of the relative error of linear dimension measuring is carried out by measuring the scale with millimeter graduation and estimating the measuring relative error.

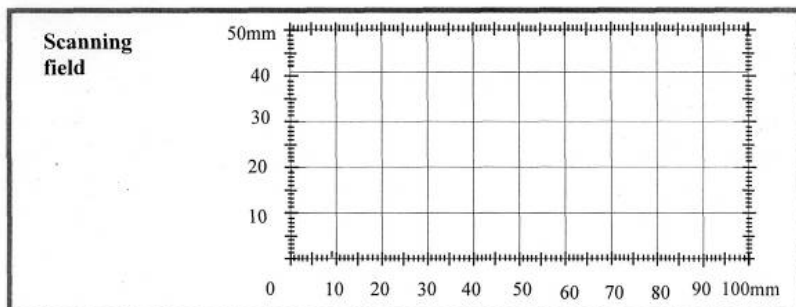
Control of MOB resolution is carried out by monitoring the dense grid on the spatial resolution limit and fulfilling expert judgment of the control results.

Control of MOB sensitivity and dynamic range is carried out by controlling/monitoring the stroke set with the decreasing concentration of the dyestuff and fulfilling expert judgment of the control results.

Figure 13

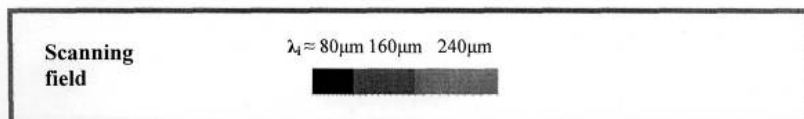
Test-object #2 (control&diagnostics) for “MAGReader” scanner

1. Estimation of relative error for linear dimension measurements

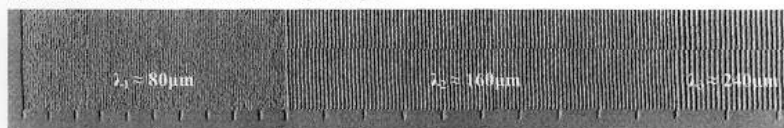


Estimation method. The relative error of measurement is estimated by the formula:
 $\delta = 100\% \cdot (L_{\text{measuring}}/L_{\text{pattern}})$. Permissible error of measurement is $\delta \leq \delta_{\text{max}} = 3\%$.

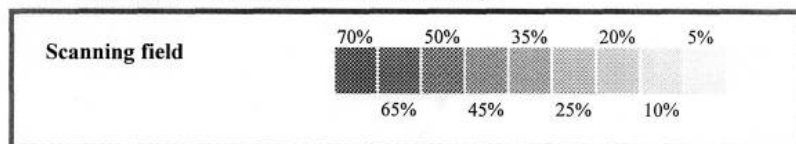
2. Estimation of resolution



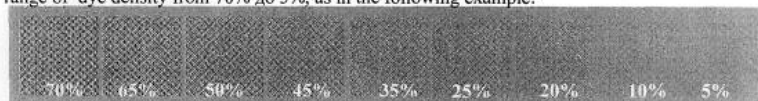
Expert estimation method. Magneto-optical visualization image must show lines in the segments of the strip, having different recording density ($\lambda_1 \approx 80\mu\text{m} \approx 600\text{dpi}$; $\lambda_2 \approx 160\mu\text{m} \approx 300\text{dpi}$; $\lambda_3 \approx 240\mu\text{m} \approx 150\text{dpi}$), as in the following example:



3. Estimation of sensitivity and dynamic range



Expert estimation method. Magneto-optical visualization image must show grid of dots in the range of dye density from 70% to 5%, as in the following example:

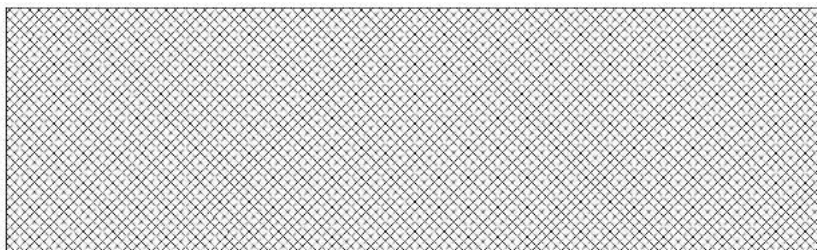


Test-object N3 (control-diagnostic 2)

Test-object N3 (Figure 14) is a uniform grid of lines traced at an angle of 45° with 2mm step. Test-object N3 is intended for controlling the visualization quality and accuracy of linkage in A4 format field by expert judgment/appraisal. Pressing uniformity in the frame limits, pressing evenness/uniformity in the limits of A4 format sheet, positioning errors horizontally and vertically and the angle parameter are estimated.

Figure 14

Test-object N3 (control –diagnostic) of MAGREADER device



6.8 Operation completion

Close CADR software. MO-head will transfer to the filling position and will shift/be displaced to the top left corner of the device object stage.

Turn off the power supply tumbler of the device. All indicators of the front panel will go off.

If the device is not expected to be used for a long period (more than 8 hours), take out the PSU plug from the wall outlet.

6.9 Current maintenance

Keep clean the object stage surface of the scanner. Wipe it regularly from dirt and dust, especially if the device is not used for a long period.

Remember! Dust particles can provoke premature deterioration of MO-head sensitive element.

To remove dust and dirt, use the cleansers intended for the maintenance of plastic surfaces of office equipment (for instance, impregnated tissues, special fluids). When using fluids and tissues, before scanning the document wait until the object stage surface becomes dry.

Do not use cotton wool or similar fibrous materials as well as synthetic cloths for cleaning the stage surface. A soft non-fleecy cotton cloth does best for this procedure.

7 TECHNICAL CHARACTERISTICS

Table 1

Maximum size of the investigated document	325 x 297 mm
Maximum field of vision of the optical input system	11.5 x 15 mm
CCD array	288 x 352 pixels
Size of the single sewed image frame	8 x 10.5 ($\pm 12\%$) mm
Scanning time of A4 format document	max 8 min
Image point size	40 μm in horizontal (X) direction; 43 μm in vertical (Y) direction
System requirements: operational system	Windows XP
Interaction with the PC	by USB bus
Power supply of direct voltage	12 V
Power supply source	impulse unit of secondary power supply (input 180/242 V, 50 Hertz); PSU capacity – 150 W
Scanner overall dimensions (LxBxH)	586 x 415 x 225 mm
Weight of scanner with PSU	10,8 kg

8 TRANSPORTATION AND STORAGE

MAGREADER scanner transportation and storage are carried out in the manufacturer's package.

Keep the packed device from impacts and vibration.

Before putting the device into the package, install the transportation attachments from the transportation set as is shown in Figures 15, 16.

To install transportation attachments/ devices, MO-head must be in the filling position in the top left corner of the scanner object stage. That is why it must be transferred to this position before the device deactivation. If this procedure is impossible to be performed, MO-head may be transferred manually observing two conditions without fail:

- The device must be deactivated
- MO-head shall be lifted slightly with a finger to avoid the sensitive element friction with the object stage surface

Figure 15

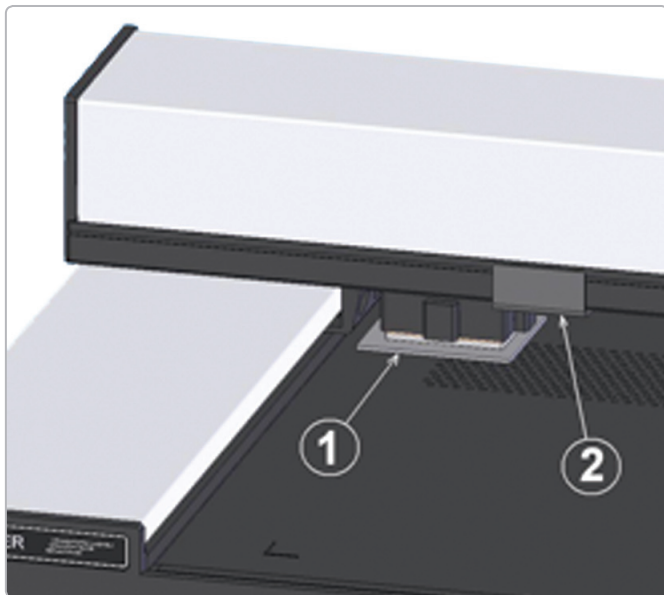


Figure 16



Rubber mat 1 is the first transportation attachment/device to be installed. Make sure there is no dust and dirt on its surface. Clean it in case of need. To install the carper/mat, lift slightly MO-head with a finger.

Install fixer 2 with the help of screw 3 which must be screwed into the hole on the back panel of the device base.

In the device operating period, when the transportation attachments/devices are not used, keep them together in a plastic packet.

The scanner with the installed transportation attachments/devices is packaged in the package as is shown in Figure 17.

The space between the walls, bottom, cover of the box/package and the device must be filled with absorbing bushes made of polyurethane foam from the package set. The space in front of the portal is also filled with absorbing bushes.

It is strictly prohibited to transport the device in the package/box without absorbing bush placing.

Figure 17



Climatic conditions of storage and transportation:

- Air temperature: +5°C...+40°C
- Relative air humidity: up to 80% at +15°C
- Atmospheric pressure: 100 +/- 4 Kpascal (750 +/- 30 mm of mercury column).

The package limit at stack stocking is no more than 5 packages.

UTILIZATION

When the serviceability is expired or operational capability is lost, the utilization of the device shall be carried out in conformity with rules adopted at the user's enterprise and with observance of necessary safety measures.

Only trained personnel are allowed to carry out utilization works.

10**ACCEPTANCE CERTIFICATE**

"Regula, model 7701" two coordinate magnet-optical scanner
MAGREADER

Serial number _____ is produced and approved as disposable for service in conformity with mandatory requirements of state standards and current technical documentation.

Responsible for acceptance:

	_____	_____
	Signature	Full Name
Seal:	_____	
	(YY, MM, DD)	

"Regula Baltija" Ltd.
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Phone: +371 654 31 299
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e-mail: regula@regula.lv
web: <http://www.regula.lv>

11**ACT OF SALE**

(to be filled in by the Seller)

"Regula, model 7701" two coordinate magnet-optical scanner
MAGREADER

Serial number _____ is sold to:

Buyer's Name: _____

Seal:

Date of sale: _____

Device Price: _____



regula
forensic science systems

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