

DICOMatic 2.0 readOmatic Module

User's Guide



division of
VIRTUAL MAGIC INC.
MONTREAL, CANADA

DICOMatic 2.0: readOmatic Module USER'S GUIDE
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1 Introduction

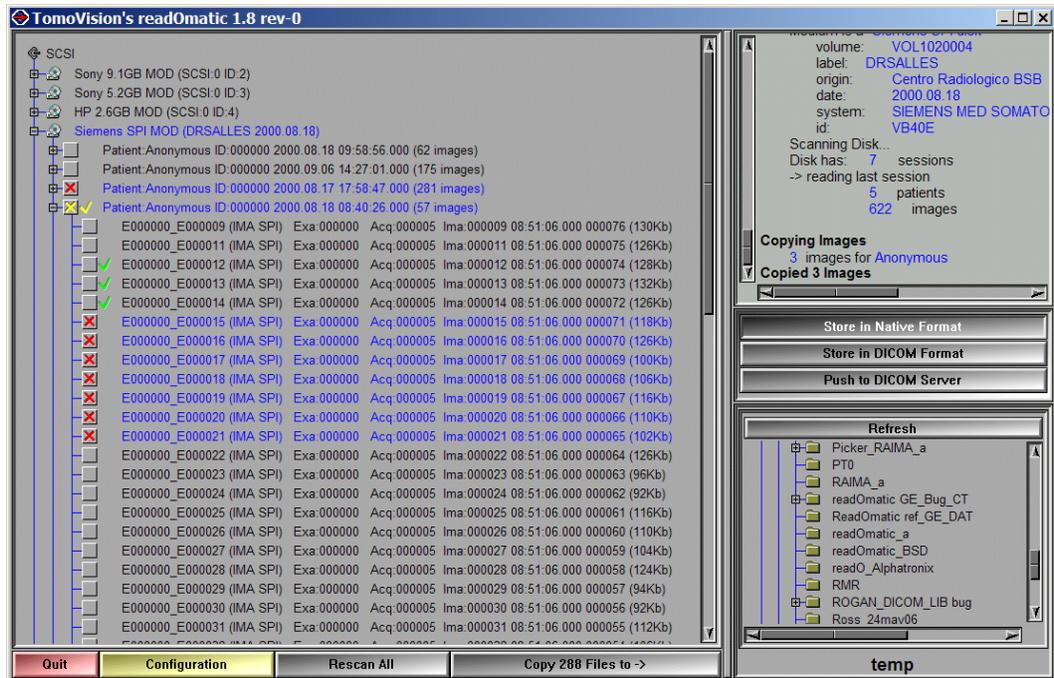
ReadOmatic is a product designed to help you read the archive media of the different medical scanner manufacturers. ReadOmatic will read most tapes, MOD (Magneto Optic Disk) and WORM (Write Once Read Many) disks.

ReadOmatic will read the data from the archive media and copy it to your PC. If the data is medical images, readOmatic can be linked to the DICOMatic software to convert the images to the DICOM format and with a free DICOM push software to send this data over the DICOM network.

ReadOmatic interfaces directly with your tape drives and MOD drives through the SCSI bus. You just have to connect the drives to your SCSI bus, place the media in the Drive and start readOmatic. The program will:

- scan the SCSI bus to locate your drive;
- analyse the media to recognize the format used to write the data;
- scan the media to extract the directory information from it.

You can then select the files you want to transfer and readOmatic will read it from the media and copy it to your PC disk.



The licenses

To use readOmatic, you need a license “dongle” (USB key) and a valid tokens. Without these, readOmatic will nevertheless read the media, but:

- it will only let you extract 5 images;
- the images will be named “readOmatic_DEMO_1” to “readOmatic_DEMO_5”;
- you will not be able to use the “Save in DICOM Format” and “Push to DICOM Server” options.

Despite these restrictions, you should be able to fully evaluate whether the program answers your needs.

2 Installation

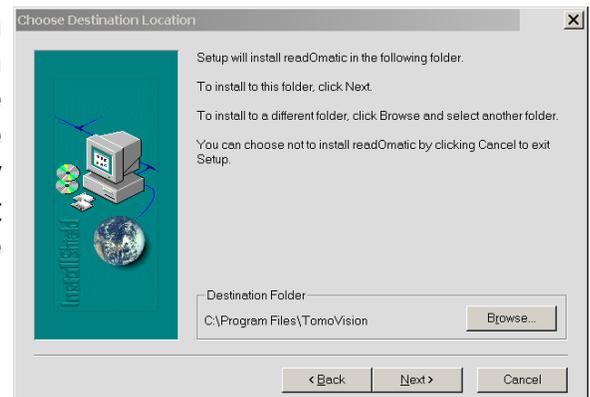
If you have the program's CD, just inserting the CD in the drive should start the installation script. In the absence of the CD, you can install the software directly from the download page at the Web site <http://www.TomoVision.com>.

Note:

To install the software from the Web pages, you will need to have the "WinZip" software on your system. "WinZip" can be found at <http://www.winzip.com>.

To install the software directly from WinZip, click on the "Install" button in the WinZip interface. Alternatively, you can uncompress the files from the ".zip" archive to a temporary directory and click on the "setup.exe" icon to start the installation program.

By default, readOmatic will be installed in the C:\Program Files\Tomovision directory. If you want the program to be installed somewhere else, you will have the option to select the desired directory during installation. You should not change the program's location after the installation.



2.1 Updates

New versions of the program are regularly placed on the web site. You should visit the web site periodically to make sure you have the latest version.

To install a newer version of the software, follow the "First Install" instructions, and install the new version in the same directory as the old one. This will overwrite the old program with the new one. You do not need to uninstall the old version.

2.2 Uninstall

To uninstall the software, use the Windows "Add/Remove Programs" application in the normal manner.

3 The Licenses

TomoVision products use 2 layers of protections. A hardware layer, provided by the HASP (Hardware Against Software Piracy) dongles from Aladdin, and a software layer consisting of encrypted license activation codes and a token counter stored in the dongle's memory.

3.1 The HASP dongle

A dongle is a hardware device connected to the USB port. The dongle used by TomoVision has its own timer and memory. All the information needed to license your products is included in the dongle, so it's easy to move your application to a new computer.

If the dongle is not present on your computer, or if its drivers are not installed, the software will run in "demo" mode and some functions will not be available.



HASP dongle for the USB port

3.2 The License Tokens

DICOMatic licenses work with tokens. Each action of the program will consume tokens. You buy these tokens from TomoVision. The token count is stored in a counter in the dongle's memory. When all the tokens are consumed, and the token count reaches zero, the software will only run in "demo" mode.

You can buy additional tokens and add them to the dongle at any time. TomoVision will generate a license code containing your tokens and send it to you by email. You then use the TomoVision_License program to add these tokens to the dongle's counter.

The licenses codes are specific to a dongle and are only valid once. Using them in TomoVision_License on another dongle or more than once for their intended dongle will have no effect.

There are 2 types of Tokens, the **30 days tokens** and the **Permanent tokens**.

3.2.1 The 30 days tokens

The dongles are always shipped with 30 days tokens. The reasons for this are twofold:

- As soon as we get a P.O., we ship the dongle with the 30 days tokens. This enables you to start working with the product immediately while the payment is handled by the accounting department of your institution.
- If the dongle gets lost in transit, we can replace it without worrying about multiple licenses being issued, since the tokens in the lost dongle will expire in 30 days anyway.

Also, when you order additional tokens, we will first send you a license code for 30 days tokens. Once we receive payment for your order, we will send you the license code for the permanent tokens by email.

As the name implies, 30 days token are only valid for 30 days. The 30 days are controlled by an internal clock in the dongle and are independent of your computer's clock. The 30 days are counted from the moment the license was generated at our office.

3.2.2 The Permanent tokens

The license codes for the Permanent tokens are sent by email and you must use the TomoVision_License program to add them to the dongle's counter.

When you add Permanent tokens to the dongle's counter, any 30 days tokens that where used will be subtracted from the Permanent token total.

WARNING:

The permanent tokens must be added to the dongle's counter with the TomoVision_License program within 30 days of their creation at our office. After that deadline, the TomoVision_License program will reject them and you will have to contact TomoVision for replacement codes.

3.3 The TomoVision_License program

The TomoVision_License program is used to read and write license codes in the HASP dongle and to generate a registration form if needed. Each dongle has an unique ID number. This unique ID is used by TomoVision when the license codes are generated, so the licenses are only valid for a specific dongle.

The TomoVision_License program is installed automatically along with your TomoVision application. But you can also download it directly from the “Tools and drivers for the license dongle” page in the Download section of TomoVision’s web site.

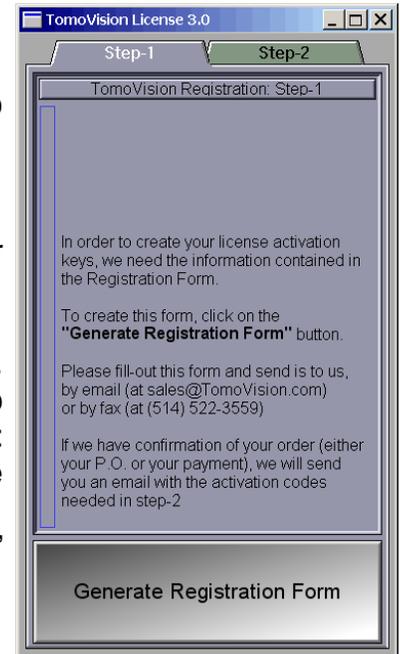
Start the TomoVision_License program from the **start\program\TomoVision** menu.

3.3.1 Generating the Registration Form

Unless asked for by TomoVision, you do not need to generate a registration form.

If TomoVision asks for it, you should:

- Make sure the HASP dongle is connected to your computer.
- Start the TomoVision_License program.
- Click on the “Generate Registration Form” button. This will create a registration file in the c:\temp directory. This file will be named: “TomoVision_xxyyyzz_reg.dat”, where xxyyyzz is the current date in the form day/month/year.
- Fill out this form (you can use Windows “Notepad” or any other editor to edit the form).
- Email the form to “sales@TomoVision.com”

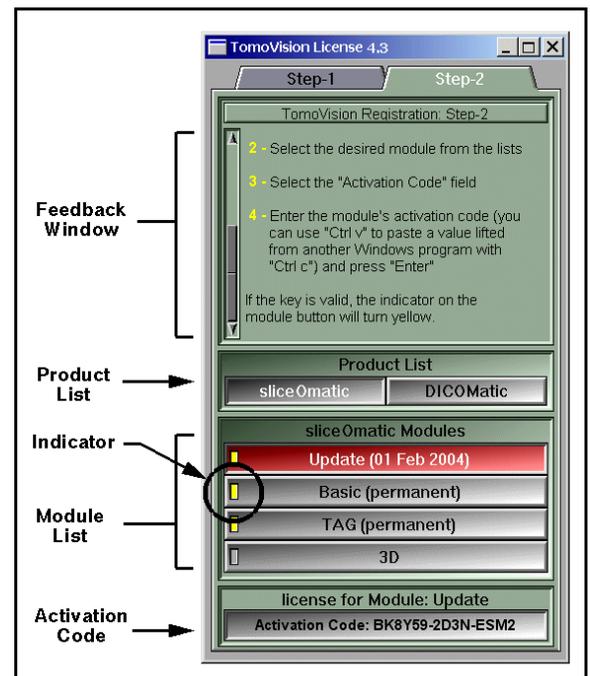


3.3.2 Activating the Licenses

The program “TomoVision_License” is used to add the license tokens to the dongle’s counter.

Just drag & drop the license codes file, sent to you by TomoVision, on the License program. All the license codes present in the file will be entered. The indicators on the corresponding buttons in the module list should turn yellow and the counters will be updated.

If the code is invalid or a problem has occurred, a text message will explain the reason in the text feedback window.



3.4 This Module's token usage

ReadOmatic consume one token for each file it read from an archive media.

The only exception are for DLT tapes and DVD disks that use $\frac{1}{4}$ of token per files.

When saving in DICOM format, readOmatic also use the conversion module of DICOMatic to convert the images from their original format to DICOM. This conversion will also consume tokens.

Each image file converted will use one token.

However, if a file contains multiple images, then the module may use more than one token depending on the number of images and their size in pixels. The module will use $\frac{1}{16}$ of token for each image of 64x64 pixels or smaller, $\frac{1}{4}$ of token for images between 64x64 and 128x128 pixels and 1 token each for bigger images. The resulting count will be rounded up to the next integer.

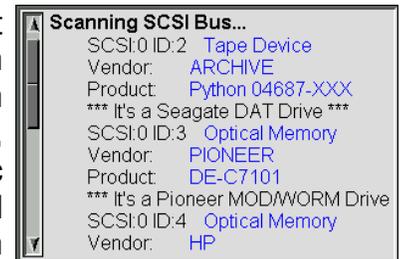
4 How does it work?

There are many steps involved in transferring the images from the archive media to your PC disk.

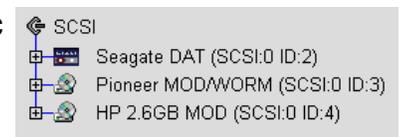
4.1 Identifying the SCSI devices

4.1.1 Scanning the SCSI Bus

When you start readOmatic, one of the first things it does is scan the SCSI bus to find the devices it can use. Even though the text feedback of this operation is slightly different for Windows 95, 98, NT and 2000, the actual operations are quite similar. ReadOmatic queries all the devices it finds on the SCSI bus and compares them with a list of “known” devices kept in the “SCSI_List.dat” file. From that list, readOmatic should be able to recognize most tape drives, as well as most MOD or WORM drives.



Each of the SCSI devices recognized by readOmatic will have an icon in the browser's window.

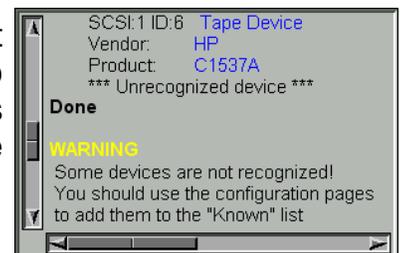


4.1.2 The SCSI_List.dat file

The SCSI_List.dat file contains a description of all the SCSI devices that readOmatic is able to recognize. At the present time, readOmatic is only able to read tapes and optical disks, so only tape and optical disk drives are listed in the file. For a detailed description of the file syntax, please refer to Section 8: “The SCSI_List.dat file syntax”. The program compares the device’s manufacturer and model information of each of the drives on your SCSI bus with each of the devices described in the file, starting with the first description and going down the file until it finds a match.

4.1.3 Adding a new drive

If the program cannot identify some of your devices, it will give you a warning. You can add these devices to the SCSI_List.dat file either with the configuration’s interface (see section 5.3.3) or by editing the file directly (see the file syntax in section 8).



4.2 Identifying & Inventorying the medias

The next step is reading the media in the drives.

This step is initiated by the user either by expanding the tree list of a device (clicking on the “+” icon in front of a device’s icon) or by clicking the “Rescan All” button. The “Rescan All” button has the same effect as expanding the tree of all the devices.



Before it can read the content of the media, readOmatic must recognize the format that the media is written in. There are almost as many media formats as scanner models! Some formats are “standard” (such as the FAT-16 format of DOS disks or the “ufs” format of UNIX disks). Other formats are specific to a manufacturer. See section Appendix A: “The Media Formats” for a more detailed list.

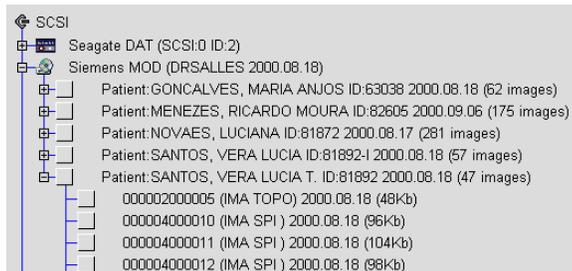
Most media formats are identified from the first data blocks on the media. If readOmatic is unable to identify the format, it will generate a “unknown format” message and create a copy of the first block in the scratch directory. You should contact TomoVision to obtain assistance in reading this media.

If the format is recognized, the program then scans the media to create a list of all the files/images it contains. Most formats have a directory that can be used to generate this list, but in some cases, either the directory does not exist or it is known to be unreliable. In these cases, readOmatic will scan the entire media to create the content list. As this can be rather long, a warning message is displayed, giving you the chance to change your mind.



In some cases, when readOmatic has to scan the entire media, it will offer you the possibility of reading and saving the media content while it scans. This possibility is only offered for a few tape formats. Since the content structure is not known yet, the files saved with this option will all be in the same directory (the subdirectory “readOmatic” in your scratch file directory) without any subdirectory for studies or series.

Once the media content is known, readOmatic will display it in a tree structure. Depending on the media, this tree structure will either be a "directory/subdirectory/files" structure, a "patient/study/series/images" structure, or a variation on these.



If you change the media in a drive, you can rescan all the devices by clicking on the "Re-Scan All" button, or you can re-scan a specific drive by collapsing and expanding the tree list of this drive. If a drive has already be scanned, readOmatic will ask you to confirm that you want to rescan the drive.

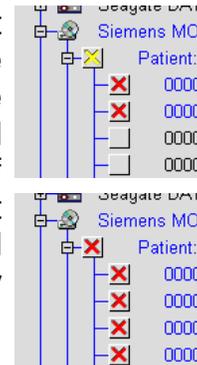


4.3 Transferring the data

To copy images or files from the media to your hard disk, you need to select the files you want to transfer, select the target directory and click on the "Copy" button.

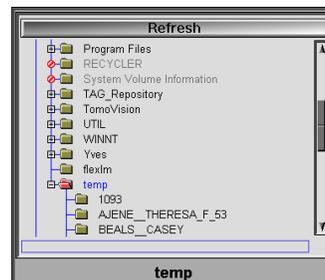
4.3.1 Selecting the files

To select a file for transfer, click on its box icon. You can select multiple files by clicking and dragging a selection region over the files. You can press the CTRL key to add/remove a file from the selection, or the Shift key to select contiguous files. A red "x" will appear in the box icon of all the selected files. If some but not all of the files in a branch are selected, a yellow "x" will appear in that branch's icon box. If all the branch's files are selected, a red 'x' will appear in its icon box. You can also select all the files in a branch by clicking directly on the branch's icon box.



4.3.2 Selecting the target directory

The target directory selection uses an interface similar to Windows Explorer. Just scroll the list and expand the directories until you get the desired target. Select it by clicking on its icon. There is no direct mechanism for creating a new subdirectory in readOmatic. For that you will need to create the subdirectory with one of Windows utilities and then click on the “Refresh” button to force readOmatic to re-draw its directory list.

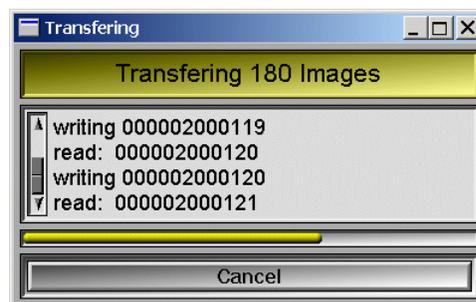


4.3.3 Starting the transfer

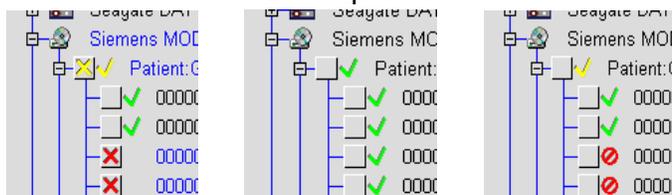
You start the transfer of the images from the media to the target directory by clicking on the “Copy xxx Files to ->” (the name of the target directory is at the bottom of the directory selection box, just at the right of the arrow in the “Copy xxx Files to” button).



A progress window will open to give you a feedback of the files transfer. If you cancel the transfer, be aware that not all SCSI operation can be aborted, so the actual cancellation may be delayed until the current operation is completed.



For each file transferred, a check mark will appear beside the file's icon box and the red “x” marking the file for transfer will be removed. If some but not all the files in a branch are transferred, a yellow check mark is placed beside the branch's icon box. If all the files in the branch are transferred, the check mark will be red. If readOmatic is unable to transfer a file, a red circle with a slash symbol is displayed beside the icon box of the problem file.



4.3.4 File names and directories

When readOmatic is transferring from a directory/sub-directory/file structure, it will recreate the source tree in the target directory. Otherwise, it will create a sub-directory for each study and place the images in that subdirectory. (This behaviour can be modified with the readOmatic.ini file, see Section 5.2 for more details.)

If the image's name can be extracted from the media, it will be used. Otherwise, readOmatic assigns a name to the image from its study, series and image number. The exact syntax of these names is:

Exxxx_Syyy_Izzzz

“E” (for Exam) followed by the exam's ID or number

“S” (for Series) followed by the series' number

“I” (for Image) followed by the image's number.

If there is more than one acquisition, the “I” character is replaced by a single uppercase letter representing the acquisition number (A=acquisition 1, B=acquisition 2...).

If a file with the same name already exists, depending on the value of the “overwrite” flag, it will be either overwritten (default) or a new image will be created with a number appended to its name. (Ex: “E0001_S001_A0001.ima”, “E0001_S001_A0001 (2).ima”, “E0001_S001_A0001 (3).ima”...) The “overwrite” flag is in the readOmatic.ini file and can be modified with the configuration interface (see Section 5.2 for more details).

4.4 Optional DICOM conversion

ReadOmatic can be interfaced with TomoVision's DICOMatic to automatically convert the images read from the media to the DICOM format.



Note:

converting images to DICOM will consume additional tokens.

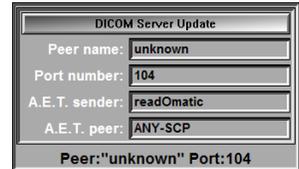
If you attempt to convert an image without the enough license tokens, an error message stating the you do not have tokens will be displayed in the text feedback window. The image will nevertheless be converted, but a “demo” watermark will be add to it and some of the DICOM tags will not be present.

4.5 Optional DICOM networking

You can also interface readOmatic with a DICOM push program to push the DICOM converted images directly to the DICOM network.

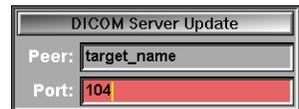


When you activate the “Push to DICOM Server” option, the directory selection window will be replaced by a DICOM Server specification window.



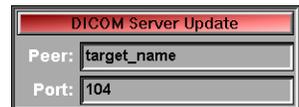
This window is used to specify the Server configuration required by the DICOM push program. You must give:

- the name of the computer that will act as a server in the “peer” line;
- the Ethernet port number used by your DICOM network in the “port” line (by default, the DICOM network uses the port 104);
- the “Application Entity Titles” of both the sender and the server.



To change one of these values, simply click on the input box, type in the new value and press “Enter”.

The new values will not be activated until you click on the “DICOM Server Update” button. Clicking on this button will also cause readOmatic to write the new server parameters to the readOmatic.ini file, so that these values will be remembered the next time you start readOmatic.



5 Operation

5.1 Starting the program

5.1.1 From the “Start” menu or the program’s icon

readOmatic can be started from the menus under “Start, Programs, Tomovision”. Alternatively, you can start the program by clicking on its icon.



5.1.2 From the command line

If you want to add one of the optional command line arguments when you start readOmatic, you need to start it from a command line. See Appendix C: “Command line arguments” for more information on this subject.

5.1.3 The readOmatic.ini file

Some of the program’s configurations can be controlled with the readOmatic.ini file.

There can be 2 copies of this file: one is in the installation directory (by default: C:\Program Files\TomoVision), the other is in the user’s environment space (on XP: C:\Documents and Settings*user_name*\Application Data\TomoVision, where *user_name* is the current user).

The program will read the copy in the installation directory first, and then, if the file is present, read the copy in the user’s environment space. The parameters from this second copy will override the parameters from the first copy.

A configuration interface can be used to modify most of the readOmatic.ini parameters. Please refer to sections 5.3.1 and 5.3.2.

For a more detailed discussion of the readOmatic.ini file, please refer to section 7.

5.1.3 The SCSI_List.dat file

This file is used to identify the SCSI devices that are present on your system.

There can be 2 copies of this file: one is in the installation directory (by default: C:\Program Files\TomoVision), the other is in the user’s environment space (on XP:

C:\Documents and Settings*user_name*\Application Data\TomoVision, where *user_name* is the current user).

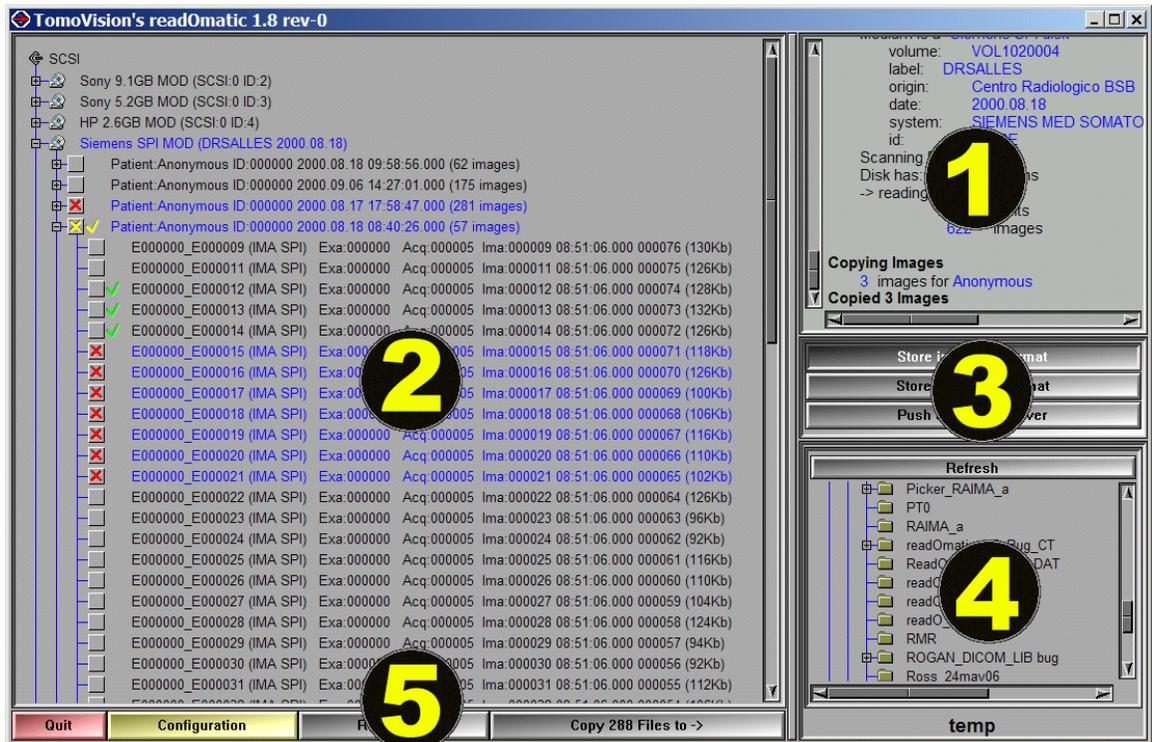
The program will attempt to read the copy in the installation directory first. If the program cannot read the copy in the installation directory, it will then read the copy in the user's environment space instead.

A configuration interface can be used to modify the SCSI_List.dat file. Please refer to section 5.3.3.

For a more detailed discussion of the SCSI_List.dat file, please refer to section 8.

5.2 The program's Interface

ReadOmatic's interface is composed of 5 windows. The vertical separator between windows 1, 3, 4 and 2, 5 can be dragged left or right to change their width.



5.2.1 The text feedback

The program communicates with you through the text feedback window.

5.2.2 The SCSI and media content tree

This window lists all the SCSI devices the program has found. You can “expand” the content of any of the SCSI devices. This will cause the program to read the content of the media in the drive. You can then select any of the files you want to extract from this media from this window.

5.2.3 The transfer mode selection

When extracting file from the media, you have 3 choices.

Saving them in the native format: a exact copy of the files, as they are on the media, will be placed in the target directory.

Note:

If the files are not medical images, use this mode.

Saving them in DICOM format: the files to be extracted from the media will then be sent to DICOMatic for conversion before being placed in the target directory.

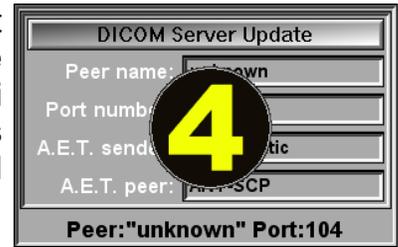
Pushing them to the DICOM server: the files will be extracted from the media, sent to DICOMatic for conversion, and the resulting converted DICOM images will then be sent to the DICOM push program instead of being saved in the target directory.

5.2.4 The target directory selection

Depending on the current mode, this window will either display the directory tree starting at “My computer” (mode “Store in Native format” and “Store in DICOM format”), or the DICOM push program’s parameters (mode “Push to DICOM server”).

In the directory tree mode, you can select where you want to save the files extracted from the media with this interface. The interface will not let you create a new directory. If you want to add a new directory, you have to do it with the standard Windows’ interface and click the refresh button so that the window will reflect these changes. The default directory proposed in the interface can be modified either in the configuration window or directly in the readOmatic.ini file (see sections 5.3.1 and 7.3).

In the DICOM Push mode, you can edit the different parameters used to talk to the DICOM server. These parameters can also be modified in the readOmatic.ini file (see sections 5.3.1 and 7.5). If you make changes to the parameters, you need to click the “DICOM server update” button to activate these changes.



5.2.5 The command buttons

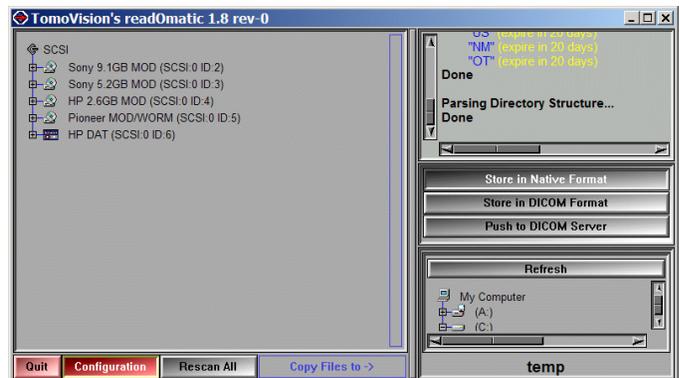
The main commands of the program are activated by pressing the corresponding buttons on the line. There are 4 buttons:

- Quit Exit the program.
- Configuration Open the configuration window. See section 5.3 for more details.
- Rescan All Rescan all the SCSI devices. It is equivalent to closing and expanding the list for each of the devices.
- Copy n files to Start the transfer process. Depending on the transfer mode you selected, the files will be either copied directly to the selected directory, converted in DICOM and copied to the selected directory, or pushed to the specified DICOM server.

5.3 The Configuration window

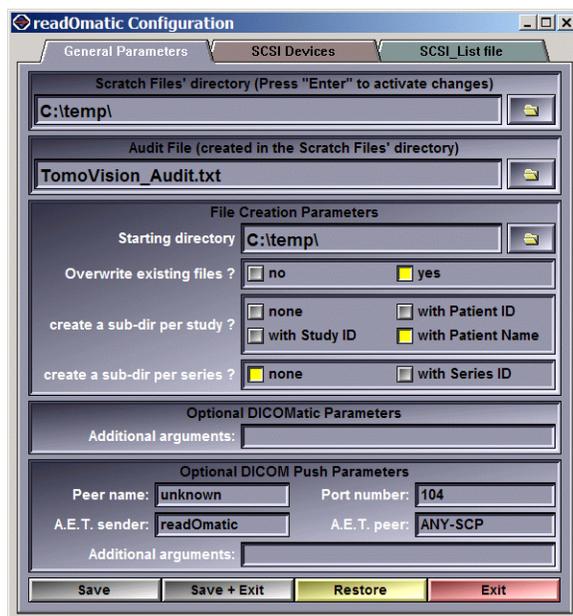
The Configuration window is accessed by clicking the “Configuration” button.

The behaviour of readOmatic is controlled by 2 files: the readOmatic.ini file and the SCSI_Init.dat file. Each of these can be edited interactively through the Configuration window.



5.3.1 The “General Parameters” page

This page enables you to modify the parameters set by the “readOmatic.ini” file in the user’s “Documents and Settings” directory. The exact syntax and content of the “readOmatic.ini” file is discussed in more details in Section 7.



Scratch files directory Any temporary, trace and audit files created by DICOMatic will be created in this directory.

Audit file The “AUDIT” messages created by the program will be appended at the end of this file. See section 9 for a discussion of the audit file.

File Creation Parameters When copying files from the media to your disk, you have a few options:

Starting directory The root of the created file tree will start in this directory. This is the directory that is proposed by default in the target directory window.

Overwrite existing files When creating a file, if another file with the same name already exists, the program will either overwrite it, or use a numbered suffix in the file name to obtain a unique file name.

Create a sub-dir per study The program can create a new subdirectory for each study. The name of this sub-directory can be: the Patient’s name, the Patient’s ID or the Study’s ID.

Create a sub-dir per series The program can create a new subdirectory for each series. The name of this subdirectory is the series’ number.

DICOMatic Parameters If you use the “Save in DICOM” option, readOmatic will convert the images to DICOM using DICOMatic. The parameters you enter here will be appended “as is” at the end of the DICOMatic command line. You can use it to provide additional arguments to the conversion program.

DICOM Push Parameters If you use the “Push to DICOM server” option, readOmatic will convert the images to DICOM using DICOMatic and then push the resulting DICOM file to the server using either OFFIS' store SCU or Mallinckrodt's send_image. The text you enter here will be used to create the “push” program command line arguments.

Peer name Name of the computer where you send the images. It can also be an URL number.

Port Number The port on the PC used to establish the communication. By default, DICOM uses the port 104.

A.E.T. sender The “Application Entity Title” of the sender. This is the name you give to the sending application. By default it is “readOmatic”.

A.E.T. peer This is the name of the application receiving the images. Your PACS may need this name to be correct in order to accept the images. Please consult your local PACS administrator if you need this information.

Additional arg. The text you enter here will be appended “as is” at the end of the DICOM push program's command line. You can use it to provide additional arguments to the push program.

5.3.2 The “SCSI Drivers” page

This page enables you to modify the parameters set by the “readOmatic.ini” file in the user’s “Documents and Settings” directory. The exact syntax and content of the “.ini” file is discussed in more details in Section 7.



SCSI Preferred Interface

ReadOmatic can use either the ASPI or the SPTI interface when talking to the SCSI devices. If both are present, you can select the interface the program will use.

Note:

It is recommended to use the ASPI interface!

Skip HD Devices

ReadOmatic will skip any SCSI device that advertises itself as Hard Drive (HD). However, some MODs identify themselves as HD instead of MOD. If this is the case of your drive, you will not want to skip the HD.

Skip CD Devices

ReadOmatic will skip any SCSI device that advertises itself as Compact Disc (CD). However, some MODs identify themselves as CD instead of MOD. If this is the case of your drive, you will not want to skip the CD.

Note:

If you select not to skip the HD or CD devices, you will get an “unrecognized device” message for each of your hard disks or CD drives on your system. You can eliminate these messages by adding the line:

* * “skip remaining devices” DEV_SKIP

at the end of the SCSI_List.dat file. (See section 8.4)

Use WORM sessions

Since WORM disk cannot be erased, when data is being added or removed from a WORM disk, a new session is created. Usually the last session on the disk reflects what the user wants the disk to contain. However, you sometime may want to look at the content of previous disk sessions.

Show “Hidden” files?

Some file systems have “hidden” files; you can ask readOmatic to display or hide these files.

Use DICOMDIR?

If a DICOMDIR file is present in your filesystem, readOmatic can use it to present the content of your disk in a patient/study/series/image tree instead of the directory/sub-directory/files tree. Or alternatively, if the program has problems with the syntax of a DICOMDIR file, you can skip it and the program will present you with the content of the disk in a directory/sub-directory/files tree.

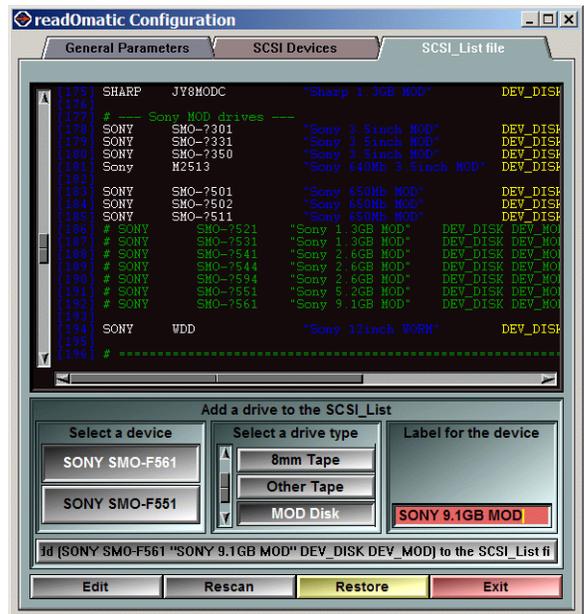
5.3.3 The “SCSI_List File” page

This page enables you to modify the “SCSI_List.dat” file. The exact syntax of the file is discussed in more details in Section 8.

The upper portion of the window contains a listing of the SCSI_List.dat files. The lower portion permits you to add unrecognized SCSI devices present on your system to the list.

Each entry in the list is composed of 3 parts:

- A device identification. When readOmatic starts, it queries all the devices on the SCSI buss with the “INQUIRY” command. The devices answer that query with two strings that identify them, a manufacturer name and a model name.
- A label string used to identify the drive in readOmatic’s interface.
- A drive type identifier composed of one of the strings: “DEV_DISK” or “DEV_TAPE”; the drive type can be further qualified with one of the strings: “DEV_9TRACK”, “DEV_DAT”, “DEV_DLT”, “DEV_EXABYTE” for tape devices or “DEV_MOD”, “DEV_WORM”, “DEV_MOD DEV_WORM” for disk devices. The



“DEV_SKIP” identifier can be used for devices that you want the program to disregard.

All the potentially interesting devices that the program found on your SCSI bus and that were not already in the SCSI_List.dat file will be presented in the “select a device” list. To add one of these device to the SCSI_List file, you must select it, associate a drive type to it and add a text label. You then need to “click” the proposed line to add it to the file.

Edit: You can also use a regular text editor to directly edit the SCSI_List.dat file.

Rescan: You must rescan the SCSI_List.dat file to actualise any changes you made to the file.

Restore: This will cause the program to replace the version of the SCSI_List file present in the user’s environment space directory with the version from the installation directory.

Exit: Close and exit the configuration window.

6 Windows and the SCSI Bus

SCSI devices are interfaced differently on the different versions of the Windows operating system. Here's a brief description of the SCSI interfaces supported under the different versions of Windows.

6.1 Windows 95 & 98

Under Windows 95 & 98, the SCSI devices are accessed through a library called the ASPI (for Advanced SCSI Programming Interface). This DLL library is included with the release of Windows, but you can also find a more up-to-date version on the Adaptec Web site.

6.2 Windows NT and 2000

Under Windows NT, 2000 and XP, the SCSI devices are accessed with the SPTI interface (for SCSI Pass Through Interface). This is not a library, but a technique supported by the SCSI drivers of your SCSI devices.

You can also add a third party's ASPI interface (such as Adaptec's) to have both interfaces present on these systems, but apparently this does not solve the inherent limitations of NT. If the ASPI is present on your system, readOmatic will use it, otherwise it will use the native SPTI.

Strangely enough, some of the operations possible with the ASPI library cannot be duplicated by the SPTI interface! This means that under Windows NT and Windows 2000, readOmatic may be unable to perform some operations.

Under Windows NT or 2000, you might encounter the following restrictions when reading tapes:

- It is impossible to read outrageously large data blocks with the SPTI. If you attempt to read a tape that use data blocks larger than 64Kb, you will receive the following message:

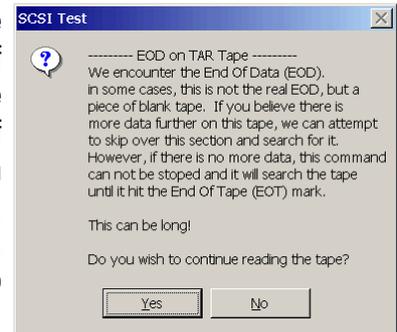


- Some manufacturers (like Picker) will leave a few feet of unrecorded tape between studies. The tape drives will recognize this space as a End Of Data

(EOD). So, when readOmatic encounters an EOD, it treats it with suspicion: is it really an EOD or just a buffer between studies?

Under Windows 95 & 98, the program will attempt to read pass the EOD with a "Skip to File Mark" command. If after a certain time, the program has not encountered the file mark, it will abort the command and reach the conclusion that it was indeed an EOD.

Under Windows NT & 2000, once the "Skip to File Mark" command is sent, it cannot be aborted! If there really is no more data after the EOD, the command will run until it reaches the EOT (End of Tape). Depending on the length of the tape, this can take a long time. So, under Windows NT and 2000, before sending the "Skip to File Mark" command, the program will ask you if you have reason to suspect that there is still more data after the EOT.



You can also install the latest version of the ASPI on windows NT, but apparently this does not solve the inherent limitations of NT. If the ASPI is present on your system, readOmatic will use it, otherwise it will use the native SPTI.

Note:

It is recommended to use the ASPI interface!

7 The readOmatic.ini file

The readOmatic.ini file is used to set a number of the program's internal variables.

The program can read this file from two different locations. The first is in the installation directory (by default: "C:\Program Files\TomoVision"). The second (if present) is in the user's environment space (by default in XP: "C:\Documents and Settings*user name*\Application Data\TomoVision"). If a parameter is defined in both versions of the file, the one in the user's environment space version will be used.

7.1 The syntax

The file's syntax is fairly simple:

- Everything on a line following a ";" character is a comment and will not be read by the program.
- The lines are composed of a keyword, followed by a "=", followed by an argument.
- Arguments containing spaces must be protected by quotes (example: `scratch = "c:\name with spaces must be quoted"`).
- The keywords are not case sensitive, but the arguments are.

7.2 General configuration parameters

`scratch= dir_name` Set the name of the directory used for temporary and trace files to "*dir_name*" (default value is C:\temp\).

`audit= file_name` Set the name of the audit trace file. This file will be created in the scratch directory. If this parameter is not defined, no audit file will be created. (default value is "TomoVision_Audit.txt").

`mode= value` ReadOmatic has 3 operational modes: "Store in Native Format", "Store in DICOM format" or "Push to DICOM server". The corresponding value can be selected with 0, 1, or 2 (default value is 0).

`trace= value` Starting trace level value (between 0 and 5) (default value is 0).

nethasp= value Enable (value=1) NetHASP licenses (default value is 0).

7.3 File creation parameters

dir= string String is the name of the starting directory of the “target directory selection” window.

over= value When creating image files, if the file already exists, readOmatic can either overwrite the file (value=0) or create a new file by appending a number to its name (value=1). (Ex: “toto.ima”, “toto (2).ima”, “toto (3).ima”...) (default value is 0)

tree= value When transferring images, readOmatic can create sub-directories for each study/series it encounters. Values can be 0, 1, 2, 3, 11, 12 or 13 (default value is 1) where:
0 = no subdirectory
1-3 = subdirectory for each study
11-13 = subdirectory for each series and each study.
With options 1 or 11, the study directory's name is created from the study ID or study number.
With options 2 or 12, the study directory's name is created from the patient's ID.
With options 3 or 13, the study directory's name is created from the patient's name.

7.4 DICOMatic and DICOM push parameters

DICOMatic= string... Everything on the line following the “DICOMatic=” keyword is placed in a character string and is used as optional arguments that are passed on to the DICOMatic program. (See the DICOMatic documentation for the available arguments and their descriptions.)

peer= string String is the name of the DICOM server name passed on to StoreSCU. It can also be the URL address of the server. (default value is “unknown”)

port= string String is the DICOM port passed on to StoreSCU. (default value is 104)

- AET_snd= *string*** The Application Entity Title of the sender. (default value is readOmatic)
- AET_rcv= *string*** The Application Entity Title of the receiving station. (default value is ANY_SCP)
- push_arg= *string...*** Everything on the line following the “push_arg=” keyword is placed in a character string and is used as optional arguments that are passed on to the StoreSCU or send_image program. (See the StoreSCU and send_image documentation for the available arguments and their descriptions.)

7.5 SCSI setup parameters

- SPTI= *value*** If both interfaces are present, readOmatic can use either the ASPI (value = 0) or the SPTI (value = 1) interface when talking to the SCSI devices. (default value is 0)
- SCSI_Skip_HD= *value*** ReadOmatic will skip any SCSI device that advertises itself as Hard Drive (HD). However, some MODs identify themselves as HD instead of MOD. If this is the case of your drive, you will not want to skip the HD. (default value is 0)
- SCSI_Skip_CD= *value*** ReadOmatic will skip any SCSI device that advertises itself as Compact Disc (CD). However, some MODs identify themselves as CD instead of MOD. If this is the case of your drive, you will not want to skip the CD. (default value is 1)

7.6 Disk setup parameters

- session= *value*** When reading a WORM disk, you have to option of seeing all the sessions ever written to the disk (value = 1) or only the latest session (value = 0). (default value is 0)
- hidden= *value*** Some file systems have “hidden” files; you can ask readOmatic to display (value = 1) or hide (value = 0) these files. (default value is 0)
- DICOMDIR= *value*** If a DICOMDIR file is present in your filesystem, readOmatic can use it to present the content of your disk in a

patient/study/series/image tree instead of the directory/sub-directory/files tree. (default value is 1)

7.7 Default readOmatic.ini file

```
; --- readOmatic.ini file used by TomoVision's readOmatic ---
;
; Modified: 26 Jan 2007 17:27, by: martel
;
; Syntax:
; - everything on a line following a ";" character is a comment.
; - the lines are composed of a keyword (terminated by "=")
;   followed by a space followed by an argument.
; - arguments containing spaces must be protected by quotes
;   ex scratch: "c:\name with spaces must be quoted"
; - the key words are not case sensitive.

; =====
;                               General configuration Parameters
; =====

; --- scratch directory for temp, trace and audit files ---
; scratch = dir_name (default = c:\temp\)
scratch= "C:\temp\"

; --- Audit file name ---
; audit = file_name (default="TomoVision_Audit.txt" in the search dir)
audit= "TomoVision_Audit.txt"

; --- Initial conversion mode flag ---
; mode= 0  Store in Native Format
; mode= 1  Store in DICOM Format
; mode= 2  Push to DICOM Server
mode= 0

; =====
;                               File creation Parameters
; =====

; --- starting directory for target directory selection ---
; dir= dir_name (default = c:\temp\)
dir= "C:\temp\"

; --- File overwrite flag ---
; over= 1  overwrite existing files
; over= 0  create a new file with a " (n)" appended
over= 1

; --- subdirectory tree creation flag ---
; tree= 0      none, all files in the same folder
; tree= 1      one folder per study using the Study ID as name
; tree= 2      one folder per study using the Patient ID as name
; tree= 3      one folder per study using the Patient Name as name
; tree= 11-13  one folder per study + one folder per series
tree= 3

; =====
;                               DICOMatic conversion Parameters
; =====

; --- The following parameters are used with the DICOMatic program ---
; DICOMatic=  everything on the line following "DICOMatic:" is sent
;               "as is" to the "DICOMatic" command
DICOMatic=

; =====
;                               DICOM Push Parameters
; =====

; -- The following parameters are used with the DICOM Push program ---
```

```
; -- You can use either OFFIS' StoreSCU or Mallinckrodt's send_image --
; peer=      the name of the computer receiving the images
;             (default= unknown)
; port=      the internet port number used for the transmission
;             (default= 104)
; AET_snd=   the Application Entity Title of the sender
;             (default= readOmatic)
; AET_rcv=   the Application Entity Title of the receiving station
;             (default= ANY-SCP)
; push_arg=  everything on the line following "push_arg:" is sent
;             "as is" to the "storescu" or "send_image" command
; Note: AE Titles are case sensitive!
peer= unknown
port= 104
AET_snd= readOmatic
AET_rcv= ANY-SCP
push_arg=

; =====
;             SCSI Setup Parameters
; =====

; --- SCSI NT Interface ---
; SPTI= 0   use the ASPI interface if present (default)
; SPTI= 1   use the SPTI interface on NT systems
SPTI= 0

; SCSI_Skip_HD= 0   Include Hard Disk when scanning SCSI bus
; SCSI_Skip_HD= 1   Skip all Hard Disk when scanning SCSI bus (default)
SCSI_Skip_HD= 0

; SCSI_Skip_CD= 0   Include CD-ROM when scanning SCSI bus
; SCSI_Skip_CD= 1   Skip all CD-ROM when scanning SCSI bus (default)
SCSI_Skip_CD= 1

; =====
;             Disk setup Parameters
; =====

; --- WORM disk sessions ---
; session= 0   only read the last session (default)
; session= 1   read all sessions (including deleted images)
session= 0

; --- Show/hide hidden files ---
; hidden= 0   do not display hidden files (default)
; hidden= 1   read and display hidden files
hidden= 0

; --- DICOMDIR file ---
; DICOMDIR= 0   do not use the DICOMDIR files
; DICOMDIR= 1   use the DICOMDIR files (default)
DICOMDIR= 1
```

The default readOmatic.ini file

8 The SCSI_list.dat file syntax

The program can read this file from two different locations. The first is in the installation directory (by default: "C:\Program Files\TomoVision"). The second (if present) is in the user's environment space (by default in XP: "C:\Documents and Settings*user name*\Application Data\TomoVision"). If the file is present in both locations, the one in the user's environment space version will be used.

8.1 The syntax

The file's syntax is fairly simple:

- Everything on a line following the ";" character is a comment and is not read by the program.
- Each device or device family description takes one line.
- Empty lines are skipped.
- Each line is composed of 3 parts separated by spaces or tabs:
 - The device's manufacturer and model (2 strings)
 - The device's textual description (between quotes)
 - The device's flags.

8.2 The Device's Manufacturer and Model

The drive manufacturer and model must match the strings used by the drive to advertise its presence on the SCSI bus. (It is part of the information returned by the device when it receives the SCSI command "Inquiry".)

You can use a "unix like" character substitution scheme in the manufacturer and model name. In this syntax:

- `*` will match 0 or more characters (but not the "." character)
- `?` will match 1 character
- `[abc]` will match 1 character with the characters between brackets (here a, b or c)
- `[a-c]` will match 1 character with the characters in the range between brackets (here from a, to c)
- `[!abc]` will match 1 character with any characters but the characters between brackets.

Ex: `toto*` will match all strings starting with "toto"
 `toto?` will match "toto1" but not "toto" or "toto11"

```
toto[14] will match "toto1" and "toto4" but not "toto2"  
toto[1-4] is equivalent to toto[1234]
```

The program automatically appends a "*" at the end of the manufacturer's name and a ".*" at the end of the model's name. So the following line:

```
manuf model "textual description" DEV_DISK
```

is equivalent to:

```
manuf* model*.* "textual description" DEV_DISK
```

8.3 The Device's description

The second argument is a description of the SCSI device. This string must be between quotes ("") and can contain spaces. The content of this string is used to describe the SCSI device in readOmatic's interface.

8.4 The Device's flags

The remaining arguments on the line are the device's flags. These flags are used by the program to operate the device. There are 2 levels of flags: a general description (DEV_TAPE, DEV_DISK, DEV_SKIP) and a more detailed description (DEV_9TRACK, DEV_DAT, DEV_DLT, DEV_EXABYTE for tapes, DEV_MOD, DEV_WORM, DEV_CD, DEV_DVD for disks). You can have more than 1 flag to describe the device:

```
ex:      a DAT tape would be:  
        DEV_TAPE DEV_DAT
```

```
        a typical Optical drive (that can read both MOD and WORM) would be:  
        DEV_DISK DEV_MOD DEV_WORM
```

The DEV_SKIP is used to skip a device without creating an entry in the ReadO_Unknown file. It tells the program that we are aware of the existence of this device but do not want to use it. Thus, the line:

```
HP CD-WRITER "skip this device" DEV_SKIP
```

will skip the HP's CD burner. The line:

```
* * "skip all remaining devices" DEV_SKIP
```

will cause all the devices to be skipped! If you use this line, it must be at the end of the file or none of the devices described after it will be seen by the program.

8.5 Adding a new device

If one of your SCSI devices was not in the list when readOmatic scanned the SCSI bus, it will have created an entry for it in the readO_unknown.dat file in the scratch directory. You can use the configuration's interface to add the unknown device to the SCSI_List.dat file, or you can do it manually.

The information you need to create the new entry in the list file is contained in the readO_Unknown.dat file. Typically the readO_Unknown contains messages looking like this:

```
the device at SCSI:1 ID:6 is not in the list!  
From the SCSI information we know:  
Device Type:    Tape Device  
Manufacturer:   HP  
Model:          C1537A  
Firmware:       L708
```

You use the Manufacturer and Model information to create the missing line in SCSI_List.dat. The first argument is from the manufacturer and model information. The other arguments are from your knowledge of the device.

From the example above, the new line in the SCSI_List would be:

```
HP C1537A "HP DAT" DEV_TAPE DEV_DAT
```

9 The audit file

By default the program creates an audit trail of your actions. This file will be named “TomoVision_audit.dat” in the scratch directory. You can change these default values through the configuration interface (Section 5.3.1) or directly in the readOmatic.ini file (Section 7).

Each time readOmatic scans a media, it will place an entry, stating the request and the content of the media (only the dir or patient/study/series information, not the files or images) at the end of the audit file.

```
readOmatic: (31 Jan 2007, User=martel) is scanning 8mm (SCSI:1 ID:1) Picker "PICR" Tape
readOmatic:           Study:1177 (115, ID:115)
readOmatic:           Serie:1 (1 images)
readOmatic:           Serie:2 (2 images)
```

Each time you transfer one or more images from the media to the PC, it will append the request and its results at the end of the audit file.

```
readOmatic: (31 Jan 2007, User=martel) is transferring 3 Images from 8mm (SCSI:1 ID:1)
                                                    Picker "PICR" Tape
readOmatic:           to file: C:\temp\PICR\115\E1177_S1_A000001.ima
readOmatic:           to file: C:\temp\PICR\115\E1177_S2_C000002.ima
readOmatic:           to file: C:\temp\PICR\115\E1177_S2_B000001.ima
readOmatic: Copied 3 Images
```

If the “Store in DICOM format” or the “Push to DICOM server” options were selected, the results of these operations will also be written to the audit file.

```
readOmatic: (31 Jan 2007, User=martel) is transferring 3 Images from 8mm (SCSI:1 ID:1)
                                                    Picker "PICR" Tape
readOmatic:           to file: C:\temp\tomo_00000.ima
DICOMatic: (31 Jan 2007 11:48:33, User = martel) converting file: tomo_00000.ima
readOmatic:           to DICOM file: "C:\temp\PICR\115\E1177_S1_A000001.ima
readOmatic:           to file: C:\temp\tomo_00001.ima
DICOMatic: (31 Jan 2007 11:48:33, User = martel) converting file: tomo_00001.ima
readOmatic:           to DICOM file: "C:\temp\PICR\115\E1177_S2_C000002.ima
readOmatic:           to file: C:\temp\tomo_00002.ima
DICOMatic: (31 Jan 2007 11:48:33, User = martel) converting file: tomo_00002.ima
readOmatic:           to DICOM file: "C:\temp\PICR\115\E1177_S2_B000001.ima
readOmatic: Copied 3 Images
```

Store in DICOM format

```
readOmatic: (31 Jan 2007, User=martel) is transferring 3 Images from 8mm (SCSI:1 ID:1)
                                                    Picker "PICR" Tape
readOmatic:          to file: C:\temp\tomo_00001.ima
DICOMatic: (31 Jan 2007 11:51:49, User = martel) converting file: tomo_00001.ima
readOmatic:          to DICOM file: C:\temp\E000000_C000008.dcm
readOmatic:          to network: DICOM_Test_Network
readOmatic:          to file: C:\temp\tomo_00001.ima
DICOMatic: (31 Jan 2007 11:51:49, User = martel) converting file: tomo_00002.ima
readOmatic:          to DICOM file: C:\temp\E000000_C000009.dcm
readOmatic:          to network: DICOM_Test_Network
readOmatic:          to file: C:\temp\tomo_00001.ima
DICOMatic: (31 Jan 2007 11:51:49, User = martel) converting file: tomo_00003.ima
readOmatic:          to DICOM file: C:\temp\E000000_C000010.dcm
readOmatic:          to network: DICOM_Test_Network
readOmatic: Copied 3 Images
```

Push to DICOM server

Appendix A: The different SCSI drives

ReadOmatic can read a number of different archive medias and formats. In order to do this, the first thing you need to know is what SCSI drive to use. This will be covered in “The different SCSI drives” section. Then, readOmatic needs to recognize the format used to write the data. This will be discussed in “The different media formats”. Finally, the medical images themselves can be written in a number of different image formats, a brief discussion of these can be found in “The different image formats”.

The first thing to know is: is the data on a tape or on a disk?

A.1 The Tape Drives

The 4 main categories of tapes used for medical archives are:

The 9 track tape

These old cumbersome tapes used to be very popular but are seldom used anymore. ReadOmatic supports 11 different scanner formats using 9 track tapes



The QIC150 tape

These tapes were extensively used as backup media on most UNIX systems. Most of these tapes are written using the TAR format and readOmatic should read them.



The 4mm DAT tape

These small cassettes are used by GE for their scanners. GE uses a neat propriety of these tapes: they can have 2 partitions. This enables GE to store a directory of the tape in one partition and the data in the other. ReadOmatic will read both the GE formatted DAT tapes and the standard TAR format DAT tapes.



DAT drives come in 3 densities: standard (DDS), double (DDS-2) and quad (DDS-3) density. To our knowledge, GE only uses the standard (DDS) density.

Exabyte 8mm tape

These cassettes are mostly used by Picker. ReadOmatic will read those tapes.



Exabyte tapes come in 2 densities: 5Gb (read by the EXB-8205 drive) and 10Gb (read by the EXB-8505 drive). Picker only uses the low density for their IQ/PQ tapes.

A.2 The Optical Disk Drives

Optical disks are also a popular media for medical archives. These disks can be either re-writable Magneto Optical Disks (MOD) or Write Once Read Many (WORM) disks. Disks comes in 3 sizes: 3½ inch, 5.2 inch and 12 inch. The most popular format is the 5.2 inch disk. It comes in densities ranging from 650Mb to 9.1Gb.

The main thing to watch for is: is it a Pioneer disk? In the world of MOD, there are 2 kind of disks, Pioneers and all the others. Only a Pioneer drive can read a Pioneer disk and a Pioneer drive can only read Pioneer disks. Almost all the other disks are mutually compatible.

Typically, the DEC-702 disk is a Pioneer MOD, and the DC-502A is a Pioneer WORM disk.

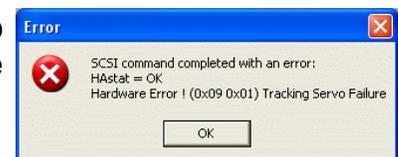


MOD Disks



Pioneer MOD Disks

Since they are physically identical, it is easy to mix up these disks. If you attempt to read a disk with the wrong drive, an error message will be displayed.



A.3 The Pioneer Optical Drives

Pioneer has a limited number of disk drives:

- the DE-C7001 reads 650mb MOD disks

The different SCSI drives

- the DD-C5001 reads 650mb WORM disks
- the DE-7101 reads 650mb MOD and WORM disks
- the DE-9101 reads 1.7Gb MOD and WORM disks

By default, the 7001 cannot read WORM disks and the 5001 cannot read MOD disks. The 7101 and the 9101 can read both **but** you have to tell them! The 9101 and the 7101 can be placed in “emulation mode” where they will believe that they are either a 7001 or a 5001, up to the point where they will advertise themselves to the SCSI bus as a 7001 or a 5001! If you have a 7101 or a 9101 and want to use both MOD and WORM, you have to make sure that the DIP switches (or jumpers) at the back of the drives are set correctly. (Usually, by default they are not! All switches are at 0 and the drive is in DE-C7001 emulation.)

The DE-UH7101 is the internal and the DE-SH7101 the external version of the DE-C7101 drive. At the back of the drive you have a 16 pin Header connector. These pins are organized in a 8x2 jumper configuration. The first 5 columns (starting from the right when you look at the drive from the rear) are used to configure the drive (on the external version, these 5 jumpers are connected to the 5 DIP switches at the back of the drive). The other 3 jumpers are used to set the SCSI address of the device.



DE-SH7101 External DIP switches



Internal Header connector

The jumpers are (right to left):

- Mode (2/0) 0:RW (MOD=7001), 1:WO (WORM=5001)
- Mode (1/0) 2:SCSI II (MOD+WORM=7101)
- Reserved
- Reserved
- Parity Check (Disable/Enable)

You want mode=2 (jumper 1 closed, 2 open) to read both MOD and WORM disks.

The 9101 is quite similar to the 7101, but instead of a 16 pin Header connector, it has a 18 pin Header connector. The first 6 columns of jumpers are:

- Terminator (Disable/Enable)
- Mode (2/0) 0:RW (MOD=7001), 1:WO (WORM=5001)
- Mode (1/0) 2:SCSI II (MOD+WORM=7101)

- Reserved
- Reserved
- Parity Check (Disable/Enable)

Apparently, the 7001 can also read WORM disks, but the mode jumpers or dip switch have to be set correctly, and unlike the 7101 and 9101, it can only read 1 media type each session. In other words, to change types you need to turn off the drive, change the jumper settings and turn the drive on again.

Appendix B: The different media formats

Unless stated otherwise, all the following formats can be read by readOmatic. Usually, the program takes the image “as is” from the media and places it on the PC. The only exceptions are for the GE Signa_5 images from a DAT tape and for the ISAC images from a MOD disk.

B.1 The Tape formats

Most magnetic tapes will be written using:

The **TAR** (Tape ARchive) format

This format is used extensively for tape backups and also by Picker for some of its medical tapes such as the **IQ/PQ** family.

The **ANSI** tape format

This old ANSI standard (ANSI X 3.27) was used for 7 and 9 track tapes. It is still sometimes found in more recent tapes.

The other, manufacturer specific, formats read by readOmatic at this time are:

The **PICR** format

used by Picker for their UltraZ systems

The **MR6B** format

used by Picker for their 9 track tapes

The **VH1** format

This format is used for DAT tape format from an unknown manufacturer.

The **Imatron** format

used by Imatron for their 9 track tape format

The **GE** formats

GE use a lot of different tape formats. ReadOmatic can read the following:

- The **GE PACE** format for 9 track and Exabyte GE tapes from Pace systems
- The **GE 8800** format for 9 track tape archive of their CT-8800 systems
- The **GE 9800** format for 9 track tape archive of their CT-9800 systems
- The **GE Genesis** format for 9 track tape
- The **GE Signa** format for 9 track tape

- The “**DAT Archive Format**” format used by GE for its DAT tapes.

Note:

Images on a GE DAT tape are configured slightly differently than the images obtained directly from the GE database with the extraction utility. When reading a GE DAT tape image, readOmatic re-arranges the image's header to the Signa_5 configuration.

B.2 The Disk formats

Magneto Optical disks come in a variety of formats. The “standard” formats are those created by the most popular operating systems, like DOS, Windows, UNIX or VMS. These formats are not specific to medical archives. The data on the disks is organized in a directory/subdirectory/file structure. When it can read the disk, readOmatic will present the content of the disk with a directory/subdirectory/file tree.

The standard formats are:

DOS

DOS (and Windows) uses the **FAT12**, **FAT16**, **FAT32** and **NTFS** format. ReadOmatic can read the FAT16, FAT32 and NTFS format. FAT12 is only used for disk with less than 4096 blocks. We have not run across a FAT12 format on a MOD disk yet.

UNIX

Each variation of UNIX uses a different format. The most common are “**ufs**” and “**BSD**”, but SGI uses “**efs**” and “**xfs**” on their graphic workstations and IBM uses “**jfs**” on theirs. ReadOmatic should read most UNIX variations, but if you get a message stating that you have a disk with an unknown variation, we'd love to hear from you!

MacOS

This format is used by Apple on their disks. The disk format is called **HTF** and can contain multiple partitions with different file systems. The Mac file system is called **HFS** (Hierarchical File System).

VMS

DEC used the “**Files-11**” format for the disks formatted under their VMS operating system.

RT-11

Another format used by old DEC systems. RT-11 does not have a directory hierarchy, all files are in the same directory. Also, to overcome the limited capacity of RT-11, some scanners (Imatron) will create many partitions on the MOD, each partition occupying 64K blocks. ReadOmatic will read these disks. The information will be presented in a partition / directory / file hierarchy.

DICOMDIR

DICOMDIR is not a disk format per se, but rather a file directory that sits on top of the disk format. When readOmatic encounters a DICOMDIR file, it uses the information from that file to structure the file tree with a patient / study / series / image hierarchy.

The other Disk formats are specific to the different scanner manufacturers and are used specifically to store medical images. When it can read the data, readOmatic will present the content of the disk in a Study / Series / Images tree. The formats known to readOmatic are:

Camtronics

This format is used by Camtronics on their systems.

DoroFile

This format has been developed by DoroTech and is used by GE for their WORM disks. When reading a DoroFile disk, readOmatic is unable to recognize if a file has been "deleted" from the disk, so all the files written to the disk will be presented in the tree structure.

GE ODRP

(Optical Disk Raw Partition). This is a format used by GE for some of their MOD disks. It is partially based on the DoroFile format. They also use a DICOM variation of this format for some of their Nuclear Medicine disks.

GE PACE

This is a format developed by Yokogawa for the GE PACE scanners.

Hitachi RM-WXS

Some Hitachi MR scanners (MRP/AIRIS) use this proprietary format. The images extracted from these disks will be in the "HDL1" format.

IS&C

Also called ISAC (Image Save and Carry), this is a format used by a number of Japanese manufacturers, among them Shimadzu and Toshiba.

Note:

Images on IS&C disks are split in 2 components: a header and the image data. When readOmatic reads an IS&C disk, it merges these 2 components to create one NEMA file. Also, if the image data is compressed, readOmatic will uncompress it.

KOM

This a wrapper used to create FAT or NTFS disks on WORM media. It is used by Optimed.

Philips CT-WXS

Some Philips CT scanners (Tomoscan) use this proprietary format. Philips has licensed this format from Hitachi, it is similar to the RM-WXS format.

Philips SPI

Some of Philips scanners (EasyVision and GyroScan) use a variation on the Siemens SPI format for their disks.

Philips US

Some of ultrasound Philips scanners use this format.

Picker RAIMA

These are standard UNIX BSD disks on which Picker (and later Marconi) has written the images using a data base format developed by the Raima Corporation. ReadOmatic is able to extract the images from these disks, unfortunately the data is compressed with an unknown compression scheme.

Siemens SPI

Siemens uses their own format for their WORM and MOD disks.

SIENET

This format is used by Siemens on their SIENET workstation.

Spectrum 32

This format is used by Spectrum on their workstation. It is a variation of the RAIMA format.

Walter Graphtek

WG uses a proprietary format for their EEG archive disks, when reading such a disk, readOmatic will present the data in a dir / file tree.

Appendix C: The different image formats

Even though most manufacturers now offer the DICOM format, there is still a multitude of image formats in circulation. Here is a description of the formats that DICOMatic is able to understand and convert. For each of these, the value of the Conversion Rules variable “FORMAT” used by DICOMatic is specified.

C.1 The DICOM format

The DICOM (Digital Imaging and Communication in Medicine) format, created by NEMA (National Electrical Manufacturers Association), is now the de facto standard for medical images. All recent scanners output their images directly in this format. DICOM supports 2 types of image compression: RLE (Run Length Encoding) and JPEG (JPEG, JPEG-LS and JPEG 2000).

Why would you need to use DICOMatic to convert images from DICOM to DICOM? Over the years, some manufacturers have created images that have problems (errors in their tags or in the compression). DICOMatic should be able to correct most of these errors. DICOMatic will also uncompress¹ the images it reads.

FORMAT = “DICOM_FILE” for files respecting the DICOM part 10 syntax
FORMAT = “DICOM” for other DICOM files
FORMAT = “NEMA_1” or “NEMA_2” for older NEMA files

C.2 CT and MR image formats

The Bruker Paravision format

The Bruker data set is split in multiple files. The “2dseq” file contains the image data. The “reco” “d3proc” and “procs” files, in the same directory as the “2dseq” file, as well as the “imnd”, “acqp” and “subject” files higher in the hierarchy, contain the header information. To create a good DICOM header, DICOMatic attempts to read as many of these files as it can. You must therefore have the complete Paravision tree structure on your disk and drop one of the header files on DICOMatic (either the “d3proc” or the “procs” file).

FORMAT = “BRUKER”

¹ JPEG lossy decompression is done with the public domain Portable Video Research Group PVRG library, JPEG 2000 decompression is done with the JasPer library.

The Dichte pQCT format

This format is used by the Dichte for their pQCT scanner

FORMAT = "DICHTE_PQCT"

The Elscint format

Elscint images start with the first 2 characters: 0xce, 0xfa. The image data in an Elscint image is compressed.

FORMAT = "ELSCINT"

Elscint DICOM images with Lossless Rice compression

These images are used internally by Elscint to store the data. They were not meant to exist outside the console and have probably been copied directly from the SGI disk without using the "export" utility.

FORMAT = "DICOM"

The Hitachi MPR/AIRIS format

These images created by some Hitachi MR scanners start with the 4 characters "HDL1". The images can be either compressed or uncompressed. If the images are uncompressed and not a pilot, then only the data interior to the circular field of view is present in the file. Philips also use this format for some of their scanners.

FORMAT = "HDL1" or "HITACHI_HDL1"

The Imatron format

The Imatron images have a variable size header and a block of non-compressed images.

FORMAT = "IMATRON"

The IS&C format

The IS&C (Image Save and Carry) format (also called ISAC) is used by Japanese scanners (Toshiba and Shimadzu). Images extracted from an IS&C disk can sometimes be presented in multiple parts. The ".INF" file contains a NEMA header and the ".IMG" file contains the image data. To convert these images, both parts must be in the same directory. Drop the ".INF" header file on DICOMatic, it will automatically fetch the corresponding ".IMG" image and merge it with its ".INF" header in a DICOM image. The Toshiba ".IMG" file can be compressed.

FORMAT = "IS&C" or "ISAC"

The GE 9800 Format

The 9800 format was used in really old CT scanners.

FORMAT = "GE_9800"

The GE Signa_3, Signa_4 and Signa_5.x formats

These formats are used extensively by a number of CT and MR scanners from GE. The Signa_4 and Signa_5 formats start with the magic word: "IMGF". The Signa_4 & Signa_5 images offer 4 modes for storing the images: Uncompressed, Compressed, Packed and Compacted.

FORMAT = "GE_SIGNAL_3"

FORMAT = "GE_SIGNAL_4"

FORMAT = "GE_SIGNAL_5"

The GE SYTEC Format

This format is specific to the SYTEC scanner.

FORMAT = "GE_SYTEC"

The GE PACE Format

The PACE format was developed by Yokogawa for the PACE scanner. The PACE format starts with the magic word "!STD".

FORMAT = "GE_PACE"

The Philips HDL1 format

These images use a format similar to the Hitachi MPR/AIRIS format.

FORMAT = "HDL1" or "PHILIPS_HDL1"

The Philips JUSTFF format

These images created by some Philips CT scanners start with the 6 characters "JUSTFF".

FORMAT = "PHILIPS_JUSTFF"

The Philips MRH1 format

These images created by some Philips MR scanners start with the 4 characters "MRH1". At the present time, DICOMatic cannot read these images.

FORMAT = "PHILIPS_MRH1"

The Philips SPI format

Philips EasyVision and GyroScan scanners use a file format similar to the Siemens SPI format.

FORMAT = "SPI"

The Picker IIF format

These files start with the string "IF" and can contain multiple images per files. This format is used by the Nordstar scanner

FORMAT = "PICKER_NORDSTAR"

The Picker IQ/PQ format

The image data in a Picker image can be either compressed or uncompressed.

FORMAT = "PICKER_IQ/PQ"

The Shimadzu SCT format

The image data in a Shimadzu image is compressed.

FORMAT = "SHIMADZU_SCT"

The Siemens SPI format

Most of the Siemens scanners used to be able to export images either in a device-specific native format, or in a more "standard" SPI format. The SPI format is based on the NEMA-1 (and later NEMA-2) format. SPI images generated by the Somatom scanners can also be compressed.

FORMAT = "SPI"

FORMAT = "SPI_COMPRESSED"

The Siemens Native formats

If a Siemens image is not in DICOM or SPI format, it is probably in one of the following native formats:

- **Numaris-1**

FORMAT = "SIEMENS_NUMARIS_1"

- **Numaris-2**

FORMAT = "SIEMENS_NUMARIS_2"

- **Vision**

FORMAT = "SIEMENS_VISION"

- **Somatom Plus**
FORMAT = "SIEMENS_SOMATOM_PLUS"
- **Somatom Plus-4**
FORMAT = "SIEMENS_SOMATOM_PLUS_4"
- **Somatom AR**
FORMAT = "SIEMENS_SOMATOM_AR"
- **Somatom DR**
FORMAT = "SIEMENS_SOMATOM_DR"

The SMIS format

This is a format used by the Surrey Medical Imaging System (now MRRS).

FORMAT = "SMIS"

The Toshiba Flexart format

These files, starting with the string "VF" are used by Toshiba on their Flexart, MR scanners. At the present time DICOMatic is unable to extract the pixels positions and dimensions from these files. As a consequence of this, the converted images will be of the modality "Secondary Capture" (SC). The patient's information will be extracted from the "patient_database" file if it is present in the parent directory.

FORMAT = "TOSHIBA_FLEXART"

The Varian format

If the pixel data is 32 bits (float or integer), it will be converted to 16 bits short integer in the DICOM images.

FORMAT = "VARIAN"

C.3 Ultrasound image formats

The ATLI format

This format from ATL (Advanced Technology Laboratories) has a very small header (starting with the characters "ATLI") followed by a JPEG image.

FORMAT = "ATL_I"

The DEFF format

The DEFF (Data Exchange File Format) format was created by ATL (Advanced Technology Laboratories). This format is based on the TIFF image format² with a number of private tags.

FORMAT = "DEFF"

The DSR format

The DSR (Digital Storage and Retrieval) format was created by HP and also used by Agilent Technologies. This format is based on the TIFF image² format with a number of private tags.

FORMAT = "DSR"

The Medison format

DICOMatic will convert images written in the Medison Kartesian format.

FORMAT = "MEDISON"

The Kretz File format

There are 2 variations of this format. The "native" format is present in the files with the "V00" extension, and there is also a DICOM variation.

FORMAT = "KRETZ_FILE"

C.4 Nuclear Medicine image formats

The ADAC

DICOMatic will convert images written in the ADAC format.

FORMAT = "ADAC"

The Ge Advance PET

DICOMatic will convert images written in the Ge Advance PET format.

FORMAT = "GE_GEMS_PET"

The Siemens ECAT-7

DICOMatic will convert images written in the Siemens ECAT-7 format.

FORMAT = "ECAT"

² TIFF decompression is done with Sam Leffler's public domain library from Silicon Graphics.

The Interfile format

The Interfile format has been developed for the transfer of images in the nuclear medicine community. This format is composed of an ASCII header followed by the image. The header is composed of a series of key-value pairs.

FORMAT = "INTERFILE_3.2"

FORMAT = "INTERFILE_3.3"

C.5 Application-specific and other image formats

The following formats are used by specific applications or institutions:

The Analyze format

This format is used by the Analyze software of the Mayo Clinic. The Analyze images have 2 components: a ".hdr" header file and a ".img" raw data file. To convert these images, you must drop the header file on DICOMatic.

FORMAT = "ANALYZE"

The Camtronics XA format

This format is used by Camtronics for their XA images. To convert these images, the 1Kb "header" file must be present in the same directory as the images.

FORMAT = "CAMTRONICS"

The IGB format

This format is used by the "Institut de Genie Biomedical" in Montreal. This format is composed of an ASCII header followed by the image.

FORMAT = "IGB"

Lead Technologies / iScan optical scanner

This scanner is used to digitize film. The technology seems to be used by a few manufacturers. Among these is the iScan software from CompuRad. The resulting images are in 2 parts: a TIFF image and a header file. To convert these images, you need to drop the header file on DICOMatic.

FORMAT = "LEAD_OPTICAL"

The Materialise format

This format is used by the Materialise software.

FORMAT = "MATERIALISE"

The Optimed XA format

This format is used by Optimed for their XA images. To convert these images, the "ARCHIVE.PAT" file must be present in the same directory as the images.

FORMAT = "OPTIMED_XA"

The Papyrus format

The Papyrus format is used by the Papyrus software. It is based on DICOM and the images start with the magic word "PAPYRUS".

FORMAT = "PAPYRUS_2"

FORMAT = "PAPYRUS_3.0"

FORMAT = "PAPYRUS_3.1"

The RAW format

This format is used by TomoVision to add a header to raw images or to modify the header information of known images. The RAW header is created with the free "Raw_Header" program from TomoVision. To convert these to DICOM, both the original image and the ".raw" header must be in the same directory. You must drop the ".raw" header on DICOMatic. It will automatically fetch the corresponding original image and merge it with its header in a DICOM image.

FORMAT = "RAW"

C.6 Other "Secondary Capture" formats

The JPEG format

Since the DICOM images can be compressed using the JPEG image format, DICOMatic can read and convert JPEG images. Since the JPEG header does not contain enough information to ascertain the image's origin, JPEG images will be considered "SC" (Secondary Capture) with a modality of "OT" (Other).

FORMAT = "JPEG"

FORMAT = "JPEG-2000" for JPEG2000 code stream

FORMAT = "JP2" for JP2 wrapper

The TIFF format

Since a few Ultrasound formats are based on the TIFF image format, DICOMatic can read and convert TIFF images. Since the TIFF header does not contain enough information to ascertain the image's origin, TIFF images will be considered "SC" (Secondary Capture) with a modality of "OT" (Other).

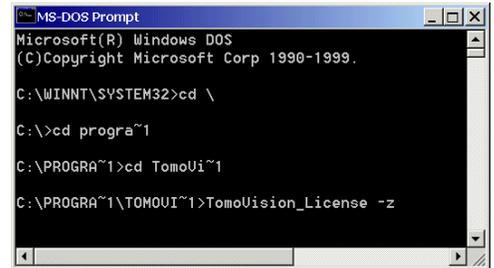
FORMAT = "TIFF"

Appendix D: Using command line arguments

You may need to use command line arguments to enable some of the options of a program. There are 3 ways to do this:

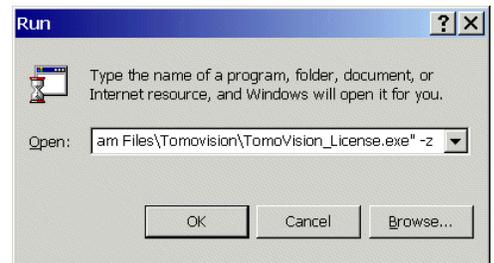
D.1 Start the program from a DOS Prompt

You can open a command prompt (or “DOS”) window by clicking on the “cmd.exe” program in the system32 subdirectory of Windows. In this window, you can type in directly the filename of the executable program, followed by the options, in a DOS Prompt window.



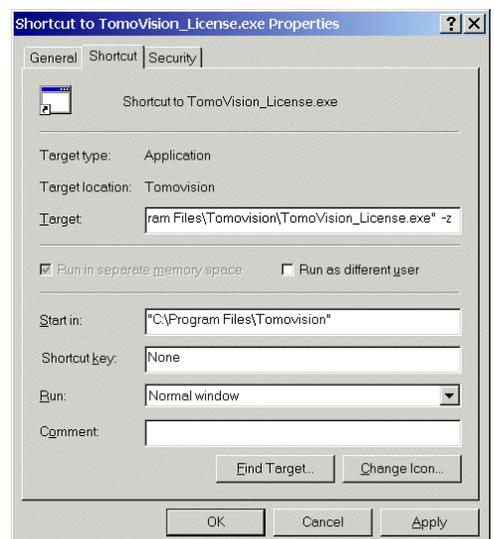
D.2 Start the program from the “Run” window

From Windows “Start” menu, select the “Run” option to open the “Run” window. In this window, you can use the “Browse...” button to browse the file structure until you find the program (by default TomoVision’s programs are installed in C:\Program Files\Tomovision). The program’s path and name will be placed in the “Open” field. You can then add the arguments you wish to use after the quotes in the “Open:” field (-z in this example).



D.3 Start the program from a shortcut

With this technique, the command line arguments will be present each time you start the program from the shortcut. First, create a shortcut to the executable program by right-clicking on its icon and selecting the “Create Shortcut” option. Then, edit the “Target” field of the shortcut properties by right-clicking on the shortcut and selecting the “Properties” option. Under the “Shortcut” tab, add the arguments after the quotes in the Target field.



D.4 ReadOmatic's command line arguments

The available command line arguments for readOmatic are:

```
readOmatic [-c] [-d dir] [-s] [-t val] [-v] [-x pos dim] [-y pos dim] [-z]
```

Where:

- c Suppress error and warning pop-ups.
- d *dir* Starting directory. "*dir*" is the default directory that will be proposed by readOmatic in its target directory window. By default, the "C:\temp" directory is used. If the directory name contains spaces, it must be protected by quotes.
Ex: readOmatic -d "c:\name with spaces\"
- s Series subdirectory. If this argument is present, readOmatic will create a subdirectory for each series when it reads medical images. By default, readOmatic already creates a subdirectory for each study.
- t *val* Trace mode, (*val* must be between 1 and 5). This will force readOmatic to create a trace file in the scratch directory. This file can be used by TomoVision for debugging purposes. Level 5 generates a much more detailed trace than level 1.

Note:

You can also place the program in trace mode by pressing the control key ("Cntrl") simultaneously with a number key. Key "0" disables the trace, keys "1" to "5" place the program in trace level 1 to trace level 5.

- v Pop a window with the program's version and compilation date.
- x *pos dim* Starting horizontal position and dimension of the readOmatic window.
- y *pos dim* Starting vertical position and dimension of the readOmatic window.
- z Enable NetHASP licenses.