VIMOS SOFTWARE FAMILY

Using VIMOS on FA45 camera

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atto Systems

Wolf Vision Systems

Thank you for your interest in our Vision Inspection and Optical Measurement System (VIMOS). In this manual you will find out how to install and use the VIMOS system on FA45 camera.

Before going on reading the manual, we kindly ask you to read the following

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CONVENTIONS USED IN THIS MANUAL

INFORMATION. This sign marks section in the manual, which is for information only. You can decide to read or skip this section.

ATTENTION. This sign marks section of the manual, which is particularly important for the general understanding of VIMOS. Please, make sure to read this section before proceeding with reading the manual.

TIPS & TRICKS. This sign marks a Tips & Tricks section. Here you can find some practical advises on using the system or get a more detailed explanation of some features. Reading this section may help you in solving a particular problem or give you some ideas but is not vital for understanding VIMOS.

PREMISE. This sign marks a section, which requires you to do something before proceeding with reading the manual. Usually this is a demo program, you have to run or something similar.

File	*Menu item*
File > Open	*Sub-menu item or dialog control*
"1.1 About"	*Section reference. If the section is within the current manual no manual name is specified. When the section is within external manual the name of the respective manual is also included.*
`Ctrl+E`	*Hot-key combination. The first part of the combination specifies which system key to use. Possible values are: Ctrl, Alt, Shift. The second part specifies the normal key to be used in the combination. The plus sign means that you should press these keys simultaneously.*

CONTENTS

1. Introduction

VIMOS is a machine-vision system – it uses digital technology to perform visual tasks such as inspection, measurement, quality assurance and control of visual quality parameters. VIMOS runs on intelligent cameras manufactured by Vision Components, Germany. The cameras are based on DSP processors (CPUs) from Analog Devices and Texas Instruments. These cameras have flash memories, which replace the hard disk of the PC. The flash memory is a non-volatile memory, which means its data is preserved when camera power is switched off.

This manual provides specific information on how to install, register and use VIMOS on **FA45** - a TI-based camera without video-output hardware. This camera is compatible with the TI cameras, manufactured by Vision Components and is distributed only with VIMOS. The camera is equipped with one Ethernet port for LAN connection and one RS422 port for serial communication. Similar to the ADSP-based sensor cameras, this camera has built-in illumination by several bright LEDs. The camera can take both gray-level and color pictures in a Bayer-matrix format. The size of the flash memory is usually 4 Mbytes, 3 of which are available to the user. This camera has no multimedia card, so the VIMOS system files should always be installed in the standard flash.

The manual contains also information about camera resources, flash files and various useful tips when working with VIMOS. Chapter 2 describes how to install VIMOS on the FA45 camera. Chapter 3 describes how to register VIMOS on the camera. Chapter 4 describes how to start VIMOS on the camera. The last chapters discuss various FA45 features, which concern VIMOS.

ATTENTION.A description how to work with the VIMOS kernel – the system module, which actually does the image-processing, can be found in the manual "Using the VIMOS Kernel".

2. VIMOS installation

The installation of VIMOS on FA45 includes two steps:

- Load VIMOS MSF files in the flash memory of the camera (the MSF is a special file format accepted by the cameras).
- Register VIMOS to permit the execution of the VIMOS kernel on the camera.

The FA45 camera has a standard flash memory with usual size 4MBytes (64 sectors x 64Kbytes). The first 16 sectors are reserved for the operating system of the camera. The remaining free space of 3MBytes is available to the user. The standard flash is called the **FD drive**. It needs regular packing when rewriting files – refer to section "*6.2. Flash packing*" for more details.

A VIMOS system, created for the FA45 camera, consists of one main executable module ***vm.exe***, several data files and one registration executable module. All files should be loaded to FD. The main executable module can be used in uncompressed (**VM.MSF**) or compressed form (**VMC.MSF**).

2.1. The VIMOS distribution file

A VIMOS system for FA45 camera is usually distributed in a ZIP file with name `Vxyys_FA45.ZIP`, where:

`xyy`	VIMOS version `x.yy`
`s`	Optional sub-version letter

Examples:

    V272_FA45.ZIP   VIMOS version 2.72
    V272a_FA45.ZIP   VIMOS version 2.72a

Typical contents of a VIMOS distribution ZIP file:

File	Description
VM.MSF	Uncompressed MSF file with the main VIMOS executable module ***vm.exe*** (the VIMOS kernel).
VMC.MSF	Compressed MSF file with the main VIMOS executable module ***vm.exe*** (the VIMOS kernel).
VMSYS.MSF	MSF file with merged VIMOS data files and the registration module ent_key.exe.
VMAUTO.MSF	VIMOS autoexec file, used to start VIMOS kernel on camera power on.
VCTIO.MSF	VCTIO program used by the Simulator and some atto-System terminals to transfer files between PC and camera.
TI_USER.TXT	Text file with the latest information, which is not included in the manuals (optional).

Further in this manual you will learn which files should be installed on camera and how. Some files are needed for a given type of installation only. Some files are utilities, which do not need to be used in the first installation. For example:

- Load **VCTIO.MSF** to FD to increase significantly the MSF transfer speed. It is also needed by the Simulator for some special operations - for example to control the built-in illumination when taking pictures by the "Camera Files Functions" dialog.
- Load **VMAUTO.MSF** to FD if you are going to run VIMOS in stand-alone mode in a factory environment and VIMOS should be started automatically on camera power on.

2.2. VIMOS installation

Unpack the distribution file into a working folder. Load the basic system files **VM.MSF** (or **VMC.MSF**) and **VMSYS.MSF** to the standard flash (the FD drive). If there is enough flash space you may use the uncompressed main executable module **VM.MSF**. If you are short in flash space, you should use the compressed file **VMC.MSF** instead.

We recommend the following space-saving procedure:

- Erase the flash by the "Clean flash" command in the "Camera Files Functions" dialog of the Simulator, or by the "*er*" shell command.
- Load **VCTIO.MSF** to FD. The presence of this file will increase greatly the speed of the next transfer operations.
- Load **VMSYS.MSF** to FD.
- Register VIMOS, delete the **ent_key** module from FD and pack the flash (see chapter "3. VIMOS registration").
- Load **VMC.MSF** (compressed) or **VM.MSF** (uncompressed) FD. Note: On FD the compressed file *vm.exe* is seen with extension *128* as *vm.128*. Uncompressed executable files are seen with extension *000*.
- Delete the **vctio** module if you want to increase the free flash space as much as possible. Keep **vctio** in the flash for fast transfer of user-program and other files.

Read section "*2.3.Loading files to the camera*" to learn how to load MSF files to camera.

ATTENTION. *Remember that you need additional flash space for the system configuration file **ini.vm**, as well as for user-programs and other files, which are necessary for the VIMOS operation. Some files should be loaded from PC to camera while others are created by the VIMOS itself. You need to perform regular packing of the flash by dynamic execution of the "Delete and pack" tool in run-mode and/or by packing the flash on VIMOS exit (see 6.2. Flash packing" for more details).*

2.3. Loading files to the camera

Section "*2.3.1. Using the Simulator*" describes how to load MSF files to the FA45 camera. The Simulator provides all functions, which are necessary to install and work with VIMOS on the camera, and you may skip reading of the next section "*2.3.2. Using a general-purpose TCP terminal*". The second section is intended for VIMOS users, which want to learn more about the camera operating system and how to load and run other camera programs. A general-purpose terminal provides communication with the camera shell – you can enter commands (texts terminated by the Enter key) and the camera returns on the terminal its response.

INFORMATION. *Simulator versions 2.60 and higher have a built-in terminal, which may be used to load MSF files to camera and enter shell commands.*

2.3.1. Using the Simulator

Start the Simulator, select **Camera > Camera Files Functions…** or press the toolbar button to open the **Camera Files Functions** dialog. Setup for loading files by the following operations:

- Select TCP connection and enter correct IP address and port (default IP=192.168.0.65, default port=23).
- Press the **Find Camera** button to check PC-camera connection. The simulator must find the camera without error messages and display a list of flash files (the list may be empty). In case of problems, switch the camera off, then switch on, wait several seconds for camera boot and try again.

- To ensure enough space for the VIMOS kernel, erase all files in the camera flash by the **Clean Camera** button. The file list should become empty.
- Load **VCTIO.MSF** to FD. The *vctio* program provides much faster transfer speed compared to the standard loading operations.

Load the system files, described in section 2.2, to the camera by the **Send MSF** button. For each file press the button and select the MSF file you want to load. Load additional MSF files if necessary.

Now you are ready to register VIMOS and to run the VIMOS kernel on the camera. Refer to "Using the Simulator" manual for more information about the "Camera Files Functions" dialog or other Simulator functions.

2.3.2. Using a general-purpose TCP terminal

You can load the VIMOS MSF files (or other MSF files) using a general-purpose TCP terminal like HyperTerminal, TeraTerm or attoTerminal. Here are some basic rules when working with such terminals:

- Set TCP/IP connection. Set correct IP address (the default IP address of the camera is 192.168.0.65) and use the Telnet port 23. Press several time the Enter key (2 or more) to check the established connection - you should see the shell prompt **'$'**. Now you can enter shell commands. Remember to terminate each shell command by the Enter key.
- Uploading of MSF files. Enter the "**lo**" command and follow the instructions for file uploading of the respective terminal. When the uploading operation is finished, you must see the loaded file by the "**dir**" command (file extension ".000" == ".exe"). **Note:** The attoTerminal program supports direct loading of MSF files without the need of the "**lo**" command.
- Some basic shell commands:

Shell command	Effect
del *file*	Deletes a file. Enter full file name with path and extension.
copy *file1 file2*	Copies *file1* to *file2*. Enter full file names with paths and extensions.
pk	Packs the flash drive.
er	Erases (formats) the flash drive.

3. VIMOS registration

After successful installation of the MSF files, you should register the system to enable the execution of the VIMOS kernel. Send the serial number of your camera to the software vendor and you will receive a VIMOS key. Remember that you are able to register VIMOS when VMSYS.MSF is loaded in the flash.

Start the Simulator, open the **Camera Files Functions** dialog and perform the following operations:

- Paste the VIMOS key into the **Vimos Key** field.
- Press the **Set key** button.

Refer to "Using the Simulator" manual for more details about the "Camera Files Functions" dialog. Another possibility for VIMOS registration is a direct invocation of the **ent_key** module using a terminal.

*TIPS & TRICKS. Erase the **ent_key** module after VIMOS registration to save flash space. To do this select **ent_key** in the file list by a left click and press the **Delete selected** button. Wait for the end of the delete operation and then press the **Pack Flash** button to pack the flash.*

ATTENTION. If you erase camera flash and reload kernel files, you must re-enter the registration code.

4. Starting VIMOS kernel on the camera

Start the Simulator and select **Camera > Start Camera Vimos** or press the toolbar button to start the VIMOS kernel on the camera. The mouse cursor will disappear from the PC monitor, but mouse commands are captured and sent to camera. You can switch between "Capture Mouse" mode and Windows GUI mode (visible mouse cursor) by `Alt+M`.

FA45 has no video-output, but it receives and processes mouse commands via TCP port 23. You can see the combined video/overlay picture on a virtual screen, displayed by the terminal program **attoTerminal** (see "*6.7. FA45 virtual screen*").

ATTENTION. If you are using an AUTOEXEC file, which starts VIMOS on camera power on, and you want to regain access to camera, you should use the "Wait boot…" button in the "Camera Files Functions" dialog of the Simulator. Press the button and then switch on the camera. An additional dialog will be opened. Check "Bypass AUTOEXEC" to skip the AUTOEXEC execution and to restore the communication with the camera shell.

5. VIMOS files on FA45

This chapter presents some conventions applied for the VIMOS file names. All VIMOS data files receive default extension `".002"`. Complex file names like `"up0.vm"` receive additional extension `".002"` and become `"up0.vm.002"`.

Examples:

```
fd:areaa0.002
fd:ini.vm.002
fd:/user/up1.vm.002
```

Usage of file names when working with terminal:

```
del areaa0            valid
del areaa0.002        valid
del ent_key           valid
del ini.vm            invalid
del ini.vm.dat        valid  (equivalent to "del  ini.vm.002")
```

6. FA45 camera features

This chapter describes some specific FA45 characteristics – the operating system, the file system and some hardware features, which concern the VIMOS operation.

6.1. The FA45 file system

The next sections present some general information about the file system of the FA45 camera. If you are using a terminal, you should read this chapter to learn how to work with flash files. Refer to Vision Components documentation for more details.

6.1.1. Drives and directories

The FA45 camera has one flash drive with name **"fd" (**or **FD)**. The file system of the camera supports directories. The default FD directory for user files is **fd:/user/**. The file paths are defined in UNIX manner using the forward slash '/'.

Examples with the **dir** command:

```
dir                    Shows all files in the current directory
dir fd:                Shows all files in the current FD directory
dir fd:/user/          Shows all files in the specified FD directory
dir fd:/sys/           Shows all hidden system files (equal to dir -x)
```

6.1.2. File names and extensions

The file system supports file names with max length of 8 characters excluding the extension "**.xxx"**. The file type (extension) is a part of the file name - thus the maximum length of the file name is 12 characters. For compatibility with older versions of the operating system, on FD drive you can see only numeric file extensions (as shown by the **dir** command). The file system automatically converts numeric types to text types and vice versa when you use a file name in a shell command.

```
.000 <==> .exe
.001 <==> .asc
.002 <==> .dat
```

For example the file `datafile.002` can be referenced by the name `datafile.dat` on FD although the **dir** command shows `datafile.002`:

```
copy fd:/user/datafile.dat fd:/user/xxx.dat
```

Some shell commands like **copy** require a full file name with drive, path and extension (type). Other commands like **del** do not need file extension for simple file names. The default directory may be omitted from the file name. Examples:

```
copy fd:datatfile.dat fd:xxx.dat
del  fd:xxx.dat
del  xxx.dat        (or del xxx.002)
del xxx             (deletes xxx.000 or xxx.002)
```

6.1.3. Drive capacities, checking the available drive space

The free flash space available for user files is 3Mbytes (48 sectors). The "Camera Files Functions" dialog of the Simulator shows the current free FD space in the "**Free Flash**" field. Using a terminal, you can see the free flash space by the "**mem -f**" shell command.

6.2. Flash packing

The standard flash memory of the FA45 camera (the **FD** drive) has some peculiarities, compared to the hard disk of the PC. The file system of the camera rewrites existing files in the unused area of the flash. The area, where a previous copy of the file resides, is not freed and it can't be used until a pack operation of the flash has been performed. The same rule is valid when deleting files. Thus, after continuous work with the flash, you may encounter a flash overflow.

INFORMATION. *This problem is caused by the electrical properties of the flash PROM chip. The flash memory is organized in sectors of 64K bytes. Files are stored in the flash sequentially without gaps and several files may reside in one sector. To overwrite one byte in the flash, it is necessary to erase a whole sector the byte belongs to.*

When working with VIMOS on FD, you should perform regular packing of the drive. This can be done in one of the following ways:

- Before exit, the VIMOS kernel prompts for a flash packing operation. If the flash is about to be full (for example less than 64K bytes remain free), exit VIMOS by packing.
- Another possibility is to enable automatic flash packing by the "General-purpose configuration" dialog. On FA45 all VIMOS operations in edit mode, which write files to flash, are followed by a flash packing operation (including the exit from VIMOS kernel).
- You may perform dynamic packing during the execution of the user-program by the "Delete and pack" tool. This method should be used if the VIMOS kernel works for a long time without interruption.
- The flash can be packed in non-VIMOS environment by the Simulator (see the "Camera Files Functions" dialog) or by the "**pk**" shell command when using a terminal program.

The first two operations can be performed in VIMOS edit mode when you see combined video/overlay picture on a "virtual" screen (see "*6.7. FA45 virtual screen*"). The flash auto-packing can be configured also in the Editor by the "Flash auto pack" property of the user program.

6.3. PLC input and outputs of FA45 camera

The FA45 camera has 2 input digital lines (IN0-IN1) and for 4 output digital lines (OUT0-OUT3), called **PLC** inputs/outputs. Each line can hold one digital value: 0=OFF (inactive) or 1=ON (active). VIMOS uses these lines to receive information from the outer world (trigger signals for example) and to pass control signals as a result of its operation. VIMOS has tools, which read input PLC lines and write output PLC lines.

The table below shows the electrical properties of the PLC lines of the FA45 camera:

PLC line	ON / OFF line voltage
IN0-IN1	0=no voltage 1=voltage present
OUT0-OUT3	0=no voltage 1=voltage present

6.4. RS422 serial port

FA45 is a new generation camera with two general-purpose I/O ports – one Ethernet port and one RS422 serial port. The VIMOS I/O tools can work with both ports. The TCP server/client tools configure I/O devices for TCP transfer via the Ethernet port. The "Open serial device" tool configures I/O devices for serial transfer via the RS422 port.

6.5. Illumination and shutter

FA45 has built-in illumination LEDs, mounted in a ring around the objective. In normal light conditions (sun light or electrical lamp light) and default shutter (10000ms) you should use the built-in illumination to receive clear and well-lighted pictures on FA45. Set **Lights** to **On** when taking pictures from camera to PC by the "Camera Files Functions" dialog of the Simulator. Use the "**Take CMOS Image**" tool in your VIMOS program to take images with lights control (Illumination = on).

*ATTENTION. You are not able to control FA45 illumination in the automatic picture taking (one of the **shoot** run-modes) and by the "Take image" tool.*

Under normal light conditions you should use different shutter values on black & white and color models of FA45. The black & white model usually requires a shutter value in the range 3000-4000 ms. The color model usually requires shutter of 10000 ms.

6.6. Camera LEDs

FA45 has 4 LEDs, mounted on the back camera panel. You can switch the LEDs on/off by the "**Button & LEDs**" tool (see the manual "*Tools description*" for more information).

6.7. FA45 virtual screen

Although FA45 has no video-output, VIMOS supports all drawings in a virtual overlay page. You can see the combined video/overlay picture on a virtual monitor screen, displayed by the Simulator (refer to "*Using the Simulator*", chapter "*4.5. Virtual screen*" for more details). Remember that this mode decreases the execution speed of the system on the camera and should be used usually for diagnostic purposes only.

7. VIMOS performance on FA45 camera

The FA45 cameras are based on a 400MHz CPU and therefore represent one of the fastest platforms for VIMOS execution. To achieve the best speed you should disable the automatic image taking (i.e. no "shoot" mode). Use the "Take image" or "Take CMOS image" tools to take pictures in your user-programs.

Another method to improve the system performance is to use parallel picture taking and program execution, controlled by the "Take image" tool.

On color FA45 models the "Take CMOS image" tool takes images in two formats – gray-level and color. The color image is native for the camera and therefore is faster. The "Take CMOS image" tool controls also the built-in illumination of FA45. The "Take image" tool has no image-format argument and takes only native color images.

On black & white FA45 models you should use the color image option of the "Take CMOS image" tool, which takes a native sensor image.