INSPECTA

The realtime frame grabber for the PCI-Bus

Software Reference
Rev. 1.47

1 General

1.1 Scope of this Manual

This manual is written for the experienced programmer. It describes the use of the MVFG software library for Windows 3.11/95 and Phar Lap Dos-Extender

For an in-depth description of the INSPECTA hardware refer to the Hardware Reference Manual.

Appendix A shows a complete list of the I/O ports and the functions of their bits. Together with the assembler-source-code the INSPECTA hardware can be programmed on the hardware function level.

Differences between INPECTA 1 and INSPECTA 2 are mentioned in the apprpriate chapters.

1.2 Revisionhistory

This manual describes the software:

PCAM.EXE ; starting Apr. 96
MPFGDRV.ASM ; starting Apr. 96

Information presented in this publication has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this document is subject to change without notice.

1.3 Trademarks

2 Software

2.1 Installation hints for Windows® NT/2000/XP

2.1.1 Definition of image memory, compatibility mode

Beginning with driver version 2.27 image memory is allocated in so called „compatibility mode“. For each Inspecta 8MB memory is reserved out of the „NonPagedMemoryPool“.

When using this mode, manual intervention is only necessary for larger image memory then 8MB. (see: Registry)

2.1.2 Definition of image memory, „maxmem“ mode

From driver version greater 1.65 the MAXMEM switch in BOOT.INI reduces the amount of memory for the system to the value defined by MAXMEM:

/MAXMEM=32 ; system can access only 32 MB main memory.

The rest of the physical memory is then available for INSPECTA-2 hardware and the application that uses INSPECTA driver.

The difference between the amount of physical memory and MAXMEM is then the size of the image memory. MAXMEM must be a multiple of 16MB.

The setup procedure does not change the entry in the BOOT.INI file. This must be done by hand. BOOT.INI is hidden and read only. Use the DOS attrib command to allow editing.

```
cd \
attrib boot.ini -r -h -s
```

Then add the switch /MAXMEM=Mbytes decimal to the end of line with the desired WinNT boot partition.

2.1.3 Registry

INSPECTA uses the following keys:

`HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\MpfgNt`

with the below values (example):

```
BlockSize 0x00800000    ; requested length of image memory (example:8MB)
                        ; compatibility mode will return the amount of memory
                        ; the system has actually allocated.
DeviceID 0x00001234     ; Inspecta-2/3 Device ID, 0x00004D41 for Inspecta-4
MemStartPage 0x02000000 ; image memory starts at 32 MB 0 if compatibility mode
MemoryAllocationMode 00000000 ; compatibility mode =0, maxmem mode = 1
DeviceNumber            ; 0 if first Inspecta,
                        ; 1 for second Inspecta in Key MpfgNt1
                        ; 2 for third Inspecta in Key MpfgNt2
                        ; 3 for fourth Inspecta in Key MpfgNt3
```

```
Do not change any othe value!
```

2.1.4 INSPECTA Installation Windows® NT

Use Windows NT **Workstation 4.0 with Service Pack >=3.**
Use the supplied Inspecta setup diskette which copies to the following directories:

%WINBOOTDIR%\system32\driver\mpfgnt.sys: Windows NT device driver
%WINBOOTDIR%\system32\mvfgd32.dll: Windows NT dynamic link library

The mvfgd32.dll carries the same name and contains the same functions as the one for Windows9x. However it is differerent form the Windows9x DLL and must not be intermixed.

The same name was chosen to allow applications run with both operatings systems without recompiling. (Provided that no NT specific functions are used.)

2.1.4.1 Multiple Inspectas in a PC with WinNT

Four registry-keys and four drivers are installed. The number of installed Inspectas are asked at installation time. To change the number of Inspectas you can user the control-applet "Inspecta" at the control panel.
This applet can also be used to change the memory reserved for each Inspecta.

2.1.5 Inspecta first time installation with Windows® 2000/XP

- install the Inspecta in the computer
- switch computer on
- the hardware wizard shows: found a new hardware
- cancel the hardware wizard and ignore possible error messages
- use the Inspecta installation CD in the CD drive and let the CD in the drive until the installation process is complete
- choose language and the correct driver and follow the instructions
- this part of the installation process is finished with a restart of the computer
- the hardware wizard will find the new hardware again
- follow the instructions to install the hardware
- after the finish of this installation you can remove the installation CD from the CD-rom drive
- the installation is now complete
- start the VCAM Utility to test the Inspecta frame grabber.

2.1.6 Inspecta driver update with Windows® 2000/XP

- remove the present Inspecta driver with “Start - Control Panel - add or remove Program’s”
- restart the computer
- put the Inspecta installation CD in the CD-rom drive and let the CD in the drive until the installation process is complete
- choose language and the correct driver and follow the instructions
- this part of the installation process is finished with a restart of the computer
- from the desktop choose

- -win2000 : “my computer – Control Panel – System – Hardware – Device Manager – sound video and game controller - Inspecta Framegrabber – Driver – Update Driver
- -winXP : “start - My Computer – View system informations – Hardware – Device Manager – sound video and game controller - Inspecta Framegrabber – Driver – Update Driver
- follow the instructions until the driver installation is complete
- after finish of this installation part you can remove the installation CD from the CD-rom drive
- the installation is now complete
- shutdown the computer (not only restart, the powersupply must be switched off)
- start the computer and start VCAM Utility to test the Inspecta frame grabber. With the INFO-button you can see the installed driver release, this must fit with the new installed driver release.

2.1.6.1 Multiple Inspectas in a PC with Win2000/XP

The Plug & Play manager will recognize new installed Inspectas and ask for driver activation as described above as many times as additional Inspectas have been added.

2.2 Installation hints for Windows®9x/DOS

2.2.1 INSPECTA Installation from Windows® 95-SR2

There is a setup for installation of Windows9x drivers, which will copy the files to the following directories:

%WINBOOTDIR%\insp2.386
%WINBOOTDIR%\mvfgdrv.dll
%WINBOOTDIR%\mvfgd95.dll
%WINBOOTDIR%\mvfgd32.dll

As the INSPECTA has no private image memory, some system memory at the end of physical memory is excluded from system usage and reserved for exclusive usage as frame buffer. This will be done automatically when loading the VxD. The amount of excluded memory is configurable through an entry in SYSTEM.INI file.

Subsequent calls from the application software makes this memory accessible as ordinary main memory.

The INSP2.386 VxD is resposable for this task. The following entries are inserted by the setup procedure.:

- String „device=INSP2.386“ within the section [386Enh] in the SYSTEM.INI file.
- new section **[INSP2]**
- Within this section keyword: **BlockSize=400h ;**size of frame-buffer in pages (hex).

```
 [INSP2]
BlockSize=400h ; 400h*4096=4MB

[386enh]
.....
device=insp2.386
```

If an image memory greater than 4Mbyte is requested, value BlockSize has to be increased manually. Take into account that the image memory reduces the amount of memory that is managed by the operating system. The image memory is owned by the application that uses the INSPECTA driver.

The Windows memory managers are in general not capable of reserving a huge amount of physical continuous memory. Depending on the size of requested image memory, different strategies are necessary.

The device driver Insp2.386 has an automatic memory sizer to exclude frame buffer memory from the **end** of physical memory. In some rare configurations the memory sizer cannot find the end of physical memory. In those cases or if more than 16MB is to be reserved, start address of frame buffer can be determined by entries in SYSTEM.INI:

Example with 48MB main memory:

[INSP2]
BlockSize=1000h ; 1000h*4096=16MB
XmsStart=2000h ; frame buffer starts at 32MB

[386enh]
.....
device=insp2.386
MaxPhysPage=1fffh ; Windows memory is restricted to 32MB

These changes have to be done manually.

2.2.2 INSPECTA Installation for DOS Extender

INSPECTA DOS driver are available at: www.mikrotron.de

The DOSX disc contains the following modules which are archived in the file: mpfgxxx!.exe (xxx = versionnumber)

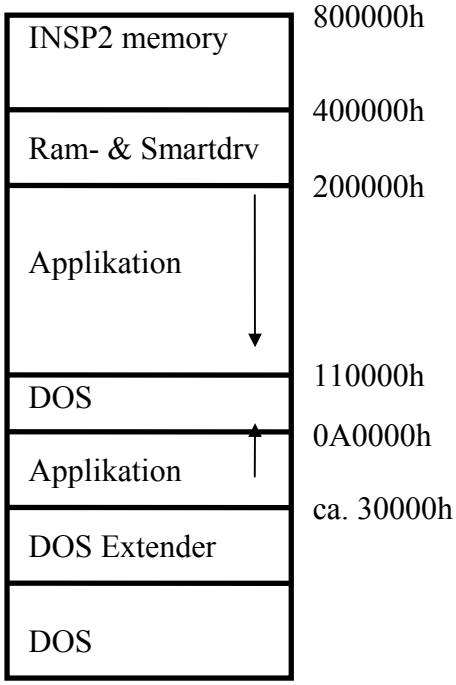
```
MPFGEQU  ASM   Kameraparameter und interne Definitionen
INSP2LIB LIB   Phar-Lap INSPECTA Library
ICAM     EXE   DOS Testprogramm fuer INSPECTA
MVFG     H     DOSX Definitionen
MVFGFNT  H     DOSX Font-Definitionen
MVFGTEXT H     DOSX Text-Definitionen
```

With Phar Lap DOS Extender use the /INT15= switch with the HIMEM.SYS extended memory manager.
Example:

DEVICE=C:\DOS\HIMEM.SYS /INT15=XXXX
The value XXXX = main memory (excluding MVFG image memory) in Kbytes - 1088 - [length of SMARTDRV in KB] - [length of RAMDRIVE in KB].

TNT uses extended memory starting with address XXXX+1088 (KB) downwards.

If SMARTDRV is used, the Phar-Lap exe´s TNT, 386ASM. 386LINK, 386LIB, and HCD3861.EXE, HCD3862.EXE must be configured with the switch -extlow 110000h. (with the Phar Lap configuration programme: CFIG386).
See also DOS-Extender documentation.



This is an example for 4MB main memory and 2*2MB INSP2 memory. Thre is also 1MB SMARTDRV and 1MB RAMDRIVE installed.

Use following entrys in CONFIG.SYS:
DEVICE=C:\DOS\HIMEM.SYS /INT15=1024
DEVICE=C:\DOS\RAMDRIVE.SYS 1024 /E
....
and in AUTOEXEC.BAT:
LH C:\DOS\SMARTDRV.EXE 1024
....
Configure TNT DOS-Extender as follows:
CFIG386 -clear TNT -extlow 110000h

2.3 Level1 Functions

With the Level1 API, only a few functions are necessary to initialize the Inspecta, select a specific camera and obtain an image. Level1 functions are implemented in WinNT/2k/XP only.

The separate manual “level1e.pdf” contains the description of these functions and some examples. It may be downloaded from our homepage www.mikrotron.de.

2.4 Level0 Functions

Although they provide the same functionality, the function prefixes for Phar Lap DOS-Extender and Windows differ. Windows calls start with **mvfg_**functionname. DOS-Extender calls start in general with **mfg_**functionname. The following manual covers both descriptions. Some functions are available only with DOS-Extender (e.g: display functions), others only with Windows.

2.4.1 INSPECTA-Initialization

A basic initialization (here with DOSX notation) consists of the following functions:

```
mfgtest();              /*  tests MVFG INSPECTA */
vmfg_isr(0x10);         /* the interrupt vector provided by PCI-BIOS is
                        connected with the MPFGDRV provided service routine */
mfg_int(0x410);         /* select VD falling edge as interrupt source */
```

/* software is now ready to grab frames, if they should be displayed, the display functions must be set up. */

```
init928(0);             /* use VGA resolution 640 * 480 * 8 bpp */
palette928(0);          /* 8 Bit greyscale with 4 overlay colors */
mfg_clip(0);            /* clear any pending clip-window */
```

/* now functions to select input devices must be called. See the next section for further examples. */

```
mfg_modcam (0x51);      /* select internal grey scale as video source */
```

To terminate the application. the interrupt must be deselected.

```
mfg_int(0);       /* deselect PCI INTA */
vmfg_isr(0);      /* restore original interrupt vectors */
```

Conforming to this structure, the description of functions is divided into the sections: initialization, device selection, frame memory management, utilities and history

2.4.1.1 mvfg_test (), mfgtest()

Synopsis: LONG mvfg_test (void);
Description: This function initializes INSPECTA
Returns: == 0 OK
!= 0 Errorcode:
-2 memory base address not found ; DOSX only
-3 cant map phys -> lin ; DOSX only
-6 memory banks do not exchange ; INSPECTA 1 only
-8 no clock from self test
-10 no frame data valid from self test
-11 no line data valid from self test
-13 WRONG CPU (386) ; DOSX only
Any error stops further activity.

Example:
```
LONG        lMvfgError;

if (lMvfgError = mvfg_test())
{
wsprintf( acBuffer, "Error %lh with initialization of INSPECTA",
lMvfgError );
...
}
```

Remarks: Error codes -2, -3, and -6 can only occur in DOSX platforms.
Error code -6 does not occur with INSPECTA 2.

2.4.1.2 mvfg_isr (irqmode)

Synopsis: void mvfg_isr (DWORD irqmode);
Description: this function defines interrupt status (on/off) and source

Parameters: Bits 0 - 7 = 0 : interrupt off
> 0 : interrupt on
Bits 8 - 15 interruptsource
possible values for interrupt source see next section

Returns:

Example:
```
/* select VD falling edge as interrupt source and switch on
the interrupt */
mvfg_isr ( 0x0400 | 0x10 );
```
Remark: windows only

2.4.1.3 vmfg_isr (int_mode)

Description: The PCI-BIOS defined IRQ is connected with the interrupt service routine in module MPFGDRV.
Parameters: int_mode > 0 : vector for service routine installed
= 0 : previous vector restored

Remark: DOSX only

2.4.1.4 mfg_int (int_mode)

Description: mfg_int selects interrupt source and activates/deactivates the INTA output from INSPECTA.

Parameters: 'int_mode' can have the following values:

Bits:	0..7	= 0:	deactivate INTA
		> 0:	activate INTA
	8..9	= 0	
	10	= ISRC0 interrupt source 0	
	11	= ISRC1 interrupt source 1	
	12	= ISRC2 interrupt source 1	
	13..32	= 0	

int_mode =	0x010	; activate hor. freq/128
	0x410	; activate falling edge of VSYNC analog
	0x810	; activate start/stop flipflop is set
	0xC10	; activate falling edge of HSYNC analog
	0x1410	; activate falling edge of VSYNC digital
	0x1C10	; activate falling edge of HSYNC digital

Remark: DOSX only

2.4.1.5 mvfg_maskint (onoff, mask), mfg_maskint

Synopsis: void mvfg_maskint (onoff, mask);

Parameter: onoff = 0: chosen interrupt will be masked.
onoff = 1: chosen interrupt will be enabled except short timeperiods defined by the driver.
mask: selected IRQ

Description: mfg_maskint deselects or selects chosen system interrupts. When using camera control functions with a HSYNC defined timing, (e.g: variable shutter) this function assures that no higher priorized interrupts distores the timing.

If the application enables a specific interrupt once (mvfg_intmask (1, mask)), the driver software disables and reenables this interrupt automatically only when necessary.
If the application disables a specific interrupt (mvfg_intmask (0, mask)), this will be done immediate. The application must then reeanble this interrupt (mvfg_intmask (1, mask)) as soon as possible.

Definition of ‘mask’ parameter:

```
;31-16,15,14,13,12,11,10,9,8,7,6,5,4,3,2,1,0
;  0   !  !  !  !  !  !  ! ! ! ! ! ! ! ! ! IRQ0: Timer
;  0   !  !  !  !  !  !  ! ! ! ! ! ! ! ! !-- IRQ1: Keyborad
;  0   !  !  !  !  !  !  ! ! ! ! ! ! ! !---- IRQ2: Interrupt Controller 1
;  0   !  !  !  !  !  !  ! ! ! ! ! ! ! !------ IRQ3: Serial Port 2
;  0   !  !  !  !  !  !  ! ! ! ! ! ! !-------- IRQ4: Serial Port 1
;  0   !  !  !  !  !  !  ! ! ! ! ! !---------- IRQ5: Parallel Port 2
;  0   !  !  !  !  !  !  ! ! ! ! !------------ IRQ6: Diskette Controller
;  0   !  !  !  !  !  !  ! ! ! !-------------- IRQ7: Parallel Port 1
;  0   !  !  !  !  !  !  ! ! !---------------- IRQ8: Real Time Clock
;  0   !  !  !  !  !  !  ! !------------------ IRQ9: Software redirected to INT0Ah
;  0   !  !  !  !  !  !  !-------------------- IRQ10: reserved
;  0   !  !  !  !  !  !------------------------ IRQ11: Reserved
;  0   !  !  !  !  !--------------------------- IRQ12: Reserved
;  0   !  !  !  !----------------------------- IRQ13: Coprozessor
;  0   !  !  !------------------------------- IRQ14: Fixed Disk Controller
;  0   !  !--------------------------------- IRQ15: Reserved
```

2.4.1.6 mvfg_datpnt (), mfg_datpnt ()

Synopsis: LPLONG mvfg_datpnt (void);

Description: This function provides a pointer to the MVFG data area. With windows use the index provided by MVFGDRV.H. With DOSX use the variables direct. They are all „public“.

Remark: The structure of the data area and the meaning of the variables can be seen in the provided assembler source of MPFGDRV.ASM. The given defaults are valid until a function changes them.

Returns:

Example:

```
LPLONG      lpMvfgDat;

lpMvfgDat = mvfg_datpnt ();

/* find number of pixel per line for the actual camera */
wsprintf( acBuffer, "Number of Pixel/Line = %ld",
lpMvfgDat[ MVFGD_LINELEN] );
```

2.4.1.7 mvfg_alloc(void);

Synopsis: HGLOBAL mvfg_alloc(void);
Description: This funktion finds a global memory handle for the MVFG - image memory.

Returns: != 0 memory handle.
== 0 function failed.

Example:

```
HGLOBAL    MvfgHandle;

if ( !(MvfgHandle = mvfg_alloc()))
{
exit ( 1 );
}
```

Remark: Windows only

2.4.1.8 mvfg_lock(HGLOBAL sel);

Synopsis: LPVOID mvfg_lock(HGLOBAL sel);
Description: This function places a lock for the MVFG memory and returns a pointer to this area.

Returns: != 0 pointer
== 0 function failed.

Example:

```
LPVOID      lpMvfgSpeicher;

if (!( lpMvfgSpeicher = mvfg_lock( MvfgHandle )))
{
exit ( 1 );
}
```

Remark: Windows only

2.4.1.9 mvfg_unlock(HGLOBAL sel);

Synopsis: BOOL mvfg_unlock(HGLOBAL sel);
Description: releases the Lock for the MVFG memory

Returns: == 0 lock released.
!= 0 function failed.

Example: mvfg_unlock (MvfgHandle);
Remark: Windows only

2.4.1.10 mvfg_size (HGLOBAL sel);

Synopsis: DWORD mvfg_size (HGLOBAL sel);
Description: This function returns the size of the MVFG frame memory.
Returns: memory size in bytes.

Example: --
Remark: Windows only

2.4.1.11 mvfg_contWriteInit (DWORD PhysAddr);

Synopsis: mvfg_contWriteInit (DWORD PhysAddr);
Desription: INSPECTA-2 is initialized for continuous recording of long sequences up to 4Gbyte. DWORD PhysAddr is physical start address of image memory. Image memory is physical contiguous memory. Use together with mvfg_contWrite (NrOfFrames, Circular).

Returns: --

Example: --

Remark: Use driver > 1.65 and INSPECTA-2 hardware Rev. >4, IMP Nr. >317. No multiplane camera modes. All lines except those while VSYNC active are recorded. Interlace even & odd fields are not combined to frames.

2.4.2 Camera selection

These functions define video-source, sync-source, clock-source and white and black levels. The frame format (linelength, number of lines etc) are also covered in this section. Use a Panasonic WV CD-50 with intern tact and Sync (both signals provided by INSPECTA) as an example.

```
mfg_modcam(0x28);       /* analog camera without pixel clock and with
sync                    input*/

/* use the next 8 function calls only if the default settings from
mfg_modcam ( 0x28 ) need to be changed. */

mfg_camsel(0);          /* choose the upper D-connector, channel red as
                        input*/
mfg_whitelevel(192);    /* white level is 192 * 1,2V/256 = 0,9V */
mfg_blacklevel(32);     /* black level is 32 * 1,2V/256 = 0,15V */
mfg_synclevel(1);       /* Sync-level is 125 mV above sync tip, has
effect
                        only, if a composite sync mode has been selected
*/
mfg_blank (84);         /* blank time from HD falling edge to start of
                        line = 2*84 * Pclk = 11,84 usec */
mfg_black(26);          /* number of black lines at begin of frame = 26
*/
h_start(603,472,1,0);   /* 603 == linelen, 472 == numlin: including
number
                        of black lines, 1 == interlace,
                        0 == req_frm : this frame is stored only on the
first
                        place in memory */
mfg_pal(1);             /* 625 lines / 50 Hz european format */
```

2.4.2.1 mvfg_modcam (mode), mfg_modcam (mode);

Synopsis: LONG mvfg_modcam (DWORD mode);

Description: define video, sync and clock source, A/D converter levels and image format. The mode is usually unique for each camera.

Parameters: The table in APPENDIX B shows the possible parameter sorted by value and function.

Returns:
= 0 OK
-1 unknown mode
-2 a camera with external clock was selected, but no clock was found.

Example:

```
LONG        lMvfgError;

if  ( lMvfgError = mvfg_modcam ( 0x8C ))   /* PULNIX 9700, digital */
{
wsprintf( acBuffer, "no clock from TM9700");
...
}
```

mfg_modcam matches INSPECTA to the connected camera. Bits 4..30 of mode are a „magic number“ which represents a specific camera. Bits 0..3 are copied to the camera control bits mc0..mc3.

If bit 31 of mode is not set, the global variables dwords linelen, numlin, interlace and req_frm are written with mode-specific values. The function h_start which uses these variables is called to define the format of the frame.

The variable DWORD seq_color defines the frame memory organisation according to the following table:

```
seq_color       ; 0: one plane
                ; 1: three consequitive pages, offset is defined by variable [pel_frm]
                ; 2: two frames interlaced (sony xc7500, Kodak ES 1.0)
                ; 3: two frames non-interlaced
```

The variable DWORD colour_type defines the pixel representation in frame memory according to the following table:

```
colour_type     ; 1 = 3:3:2 8bpp, 1-plane, rgb
                ; 2 = 5:6:5 16bpp, 1-plane, rgb
                ; 3 = 8:8:8 8bpp, 3-planes, rgb
                ; 4 = 8:8:8:8 32bpp, 1-plane, xrgb
                ; 5 = 8:8:8 24bpp, 1-plane, rgb
                ; 6 = 16:16:16 48bpp, 1-plane, rgb
                ; 7 = 8:8:8:8 32bpp, 1-plane, 4-cameras b&w
                ; 8 = 8:8     16bpp, 1-plane, 2-cameras b&w
```

Also mfg_blank, mfg_whitelevel, mfg_blacklevel and mfg_sync are called.

2.4.2.2 mvfg_camsel (camnr), mfg_camsel (camnr)

Synopsis: void mvfg_camsel (DWORD camnr);

Description: 'mvfg_camsel()' selects one of six (eight cameras with the additional high-speed A/D adapter MAD 1020) cameras as video, clock and sync source or destination.

camnr	Video	Connector
0	green	P1
1	blue	P1
2	red	P1
3	green	P1 (MAD1020)
4	green	P2
5	blue	P2
6	red	P2
7	green	P2 (MAD1020)

The definition of green input for camnr 3=0 and 7=4 changes if the additional high-speed A/D converter board is used with the INSPECTA-2. Camnr 3 or 7 selects the connector 1 or 2 on the add. adapter board.

With modes for multi-channel cameras (e.g.: 0x78, 0xC0, 0xEC, 0x148, colorcameras) camnr: 0..3 selects P1 and camnr: 4..7 selects P2.

Returns: --

Example: --
mfg_camsel writes the global variable mfg_camnr.

2.4.2.3 mvfg_digsel (camnr)

Synopsis: void mvfg_whitelevel (DWORD camnr);

Description: selects one of several digital cameras which are connected to the digital multiplexer MUX 5000. See the MUX 5000 documentation for the description of valid camnr.

Returns: --

Example: --

2.4.2.4 mvfg_whitelevel (whitelevel), mfg_whitelevel (whitelevel)

Synopsis: void mvfg_whitelevel (DWORD level);
Description: sets the whitelevel of the video A/D
whitelevel = 1.2V/ 256 * whitelevel
Returns: --
Example: --

2.4.2.5 mvfg_blacklevel (blacklevel), mfg_blacklevel (blacklevel)

Synopsis: void mvfg_blacklevel (DWORD level);
Description: sets the blacklevel of the video A/D
blacklevel = 1.2V/256 * blacklevel
Returns: --
Example: --

The video signal is clamped to 0 Volt during the front porch.

2.4.2.6 mvfg_synclevel (synclevel), mfg_synclevel (synclevel)

Synopsis: void mvfg_synclevel (DWORD level);
Description: defines the threshold for sync separation

Parameters: 0 25 mV
1 125 mV
Returns: --
Example: --

2.4.2.7 mvfg_blank (blank_time) , mfg_blank (blank_time)

Synopsis: void mvfg_blank (DWORD blank);

Description: the parameter blank_time is used to skip black pixels at the begin of a line. It defines the number of pixelclocks *2 to lengthen the internal HSYNC signal. It starts with the falling edge of the incomig HSYNC and is adjusted to stop with the first valid pixel of the line. Thus blank_time defines the length of the stored line. As this length must be divisible by 4, there are blank_time values that result in an misaligned image.

Blank_time depends on the camera type and can be manually adjusted with the programme ICAM.EXE or VCAM95.EXE.

Returns: --

Example: --

2.4.2.8 mvfg_pal (0/1), mfg_pal (0/1)

Synopsis: void mvfg_pal (DWORD pal);

Description: defines number of lines per frame if an internal sync mode is selected or the generation of an internal VSYNC signal if a linescan mode is selected
pal = 0 --> 525 lines, NTSC/RS-170 or 128 lines if linescan
pal = 1 --> 625 lines, CCIR or 256 lines if linescan
The above parameter description is valid for **INSPECTA-2 Rev. 4,5,6 with firmware code > IMP317.**

Returns: --

Example: --

2.4.3 Memory-management

Functions mvfg_hstart (), h_start and mvfg_selframe (), mfg_selframe und mvfg_lines(), mfg_lines define, how the video lines are stored in image-memory.

mvfg_xchg(), mfg_xchg flip image-memory.

mvfg_input () flip image-memory with the next vertical sync.
mvfg_set_vflag(), mvfg_get_vflag() set or read the das _fgtv_valid flag.

The _fgtv_valid flag controls the automatic flipping of image-memory within the VSYNC interrupt service routine. It is checked within the mfg_sync routine (which is called through the interrupt service routine) and if = 0 , the function mfg_xchg is called and _fgtv_valid is set to 1 again.

The following example is a full function demo programm for the MVFG frame grabbers:

```
/* module       demo.c
====================================
example program for MVFG demonstration
====================================*/

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <time.h>
#include <ctype.h>
#include <mvfg.h>

 main (int argc, char * argv[])       /* MAIN PROGRAM
=====================================*/
{

printf ("Result of mfgtest: %d\n",   mfgtest());

mfg_camsel(0);      // select camera 0
mfg_modcam(0x68);   // analog interlace, composite sync
mfg_pal(0);         // NTSC frames, mfg_modcam defaults to CCIR

/* the following function calls are not necessary, because mfg_modcam defines
all values to fit to standard RS-170 camera.

mfg_blank(0x45);    // blank time
mfg_black(0x1c);    // number of black lines from vertical
                    // sync rising edge to first visible line

//h_start   (linelen,   numlin,     interlace,  req_frame);
h_start     (0x2d4,     0x25e,      1,          0);

*/

vmfg_isr(0x10);
mfg_int(0x410);     // use VSYNC falling edge as interrupt source

init928(0);         // select s3 mode 103 for 640 x 480 with
                    // 8 bit per pixel
mfg_clip(0);        // clear any clip window
palette928(0);      // b/w palette with 4 overlay colors for bit 0..1
```

```
while (!_kbhit ())  // as long as not key is hit
 {

  _fgtv_valid = 0 ;           // set flag to image-memory flip within next
                              // vertical interrupt
  while( _fgtv_valid == 0 );  // wait until cleared by interrupt service

/* use funktion vmfg_put2win for display
      vmfg_put2win (ptr,     x, y, width, skippix, height, skipline, pitch,
ram)*/
      vmfg_put2win (mfg_lin, 0, 0, 640,   0,       480,    0,        0x2d8, 1);
  }
mfg_int(0);       // deselect mvfg-interrupt
vmfg_isr(0);      // restore original interrupt-vector
init928(-1);      // select vga character mode before exit

}                                       /* end "main" */
```

Example for multiframe-recording:
There are three analog RS-170 cameras synchronized by sync output from INSPECTA. A frame from each camera should be recorded one after the other. Recording should stop after the last frame. Frame memory should be flipped after the application has ended the previous calculations.

```
...
int status;
mfg_modcam (0x28);      // analoge camera, clock and sync to camera
mfg_camsel(0);          // select camera 0
mfg_selframe(0);        // write to image 0 in frame-memory
mfg_startstop(1);       // start recording

/* wait until the bits fdv == 0 and odd == 1 returned by mfg_stat,
   e.g: wait for next full frame */

      while (( status = ( mfg_stat() && 0xa00 ) == 0x800 );

/* now frame 0 is recording */

/* wait until the bits fdv == 0 and odd == 1 returned by mfg_stat,
   e.g: wait for next full frame */

      while (( status = ( mfg_stat() && 0xa00 ) == 0x800 );

/* now the image at position 0 is ready, select next camera and next image
position */

mfg_camsel(1);          // select camera 1
mfg_selframe(1);        // select image position 1

/* wait until the bits fdv == 0 and odd == 1 returned by mfg_stat,
   e.g: wait for next full frame */

      while (( status = ( mfg_stat() && 0xa00 ) == 0x800 );

/* now the image at position 1 is ready, select next camera and next image
position */

mfg_camsel(2);          // select camera 2
mfg_selframe(2);        // select image position 2

/* wait until the bits fdv == 0 and odd == 1 returned by mfg_stat,
   e.g: wait for next full frame */

      while (( status = ( mfg_stat() && 0xa00 ) == 0x800 );

/* now the image at position 2 is ready, stop further recording */

mfg_startstop(0);

....

/* flip image-memory to get access to the previous recorded sequence */

mfg_xchg();       // now frames are accessible
```

This form of sequence-recording has the disadvantage, that the frame immediately following the selection of the new camera cannot be recorded, because writing the line-address table (mfg_selframe (..)) takes too much time.

The functions m(v)fg_multisequence(), m(v)fg_multiframe() avoid this problem, because all controlling is done in the background through the mvfg interrupt service routine, and the line-address table is set up for more than one frame.

2.4.3.1 mvfg_black (black_lines), mfg_black (black_lines)

Synopsis: void mvfg_black(DWORD black_lines);
Description: Defines how many black-lines at the beginning of a frame will be written to the end of the frame-memory and thus not be stored to the actual frame.

Call this function **before** '**mvfg_hstart()**' !

Use the test-tool PCAM.EXE to find out, how many black lines an actual camera has.
Returns: --
Example: --

mfg_black writes the global variable black_lines. Funktion h_start uses it to store all black lines to the end of the frame-memory.

2.4.3.2 mvfg_blackend (black_linesend), mfg_blackend (black_linesend)

Synopsis: void mvfg_blackend (DWORD black_linesend);
Description: Defines how many black-lines at the end of a frame will be written to the end of the frame-memory and thus not be stored to the actual frame.

Call this function **before** '**mvfg_hstart()**' !

Use the test-tool PCAM.EXE to find out, how many black lines an actual camera has.
Returns: --
Example: --

mfg_black writes the global variable black_lines. Funktion h_start uses it to store all black lines to the end of the frame-memory.

2.4.3.3 mvfg_hstart, h_start (linelen, numlin, interlace, req_frm)

Synopsis: void mvfg_hstart (DWORD linelen, DWORD numlin, DWORD interl, LONG requ_frm);

Description: this function defines the format of the frame in memory and where in memory the actual frame is to be stored.

Parameters:

linelen: Number of pixel per line.

numlin: Number of lines per frame **including** lines that should not be stored (invisible lines, defined by 'mvfg_black()' and mvfg_blacklinesend()). INSPECTA does not count HSYNCS while VSYNC is low, but it counts all serration and equalizing pulses which are recovered from a composite video signal just before and after the VSYNC is low. Therefore numlin is usually less then the 525/625 lines expected from a standard RS-170 or CCIR video signal. Linescan cameras use either 128 or 256 lines depending on the parameter of mvfg_pal (videomode).

interl: Type of frame 1 = interlaced, 0 = non interlaced.

requ_frm: Position in frame-memory, where the actual frame has to be stored. Each position consumes as many bytes as the variable pel_frm shows. The position number starts with 0. If req_frm == -1, line-table is set up to accomodate as many frames as fit into frame-memory. (max. 8192 lines per plane or 32768 lines if singleplane.) If req_frm == -2, -3, -4.... frame memory is set up for 1, 2, 3 ... consequtive frames.

The above parameter description is valid for **INSPECTA-2 Rev. 4,5,6 with firmware code > IMP317.**
Use the test-tool ICAM.EXE or VCAM95.EXE (PCAM.EXE for INSPECTA-1) to find the actual parameters of the selected camera.

Returns: --

Example:

```
/* define the geometry of a frame of a  PULNIX  TM9700 when using
digital video. The TM9700 delivers non-interlaced video. Write only to
position 0 in frame-memory. */

mvfg_hstart( 0x300, 0x20d, 0x0, 0x0 );
```

Global variables:

Calling-parameters linelen, numlin, interlace und req_frm are stored to global variables with the same name.

The global variable dword pel_frm is calculated as: (= linelen*(numlin-black)), also the global variable dword frame_nr as: ((=[mfg_len]/pel_frm), number of frames per image memory size)

The function h_start uses the global variable black_lines, to store unwanted lines at the begin of a frame to the end of frame-memory: (=[mfg_len] - linelen). The Funktion mfg_black writes this varible, h_start processes it.

The function h_start uses the global variable black_linesend, to store unwanted lines at the end of a frame to the end of frame-memory: (=[mfg_len] - linelen). The Funktion mfg_blacklinesend writes this varible, h_start processes it.

2.4.3.4 mvfg_selframe (framenr), mfg_selframe (framenr)

Synopsis: void mvfg_selframe (LONG nr);

Description: mvfg_selframe uses h_start (see previous function) in that only the parameter req_frm is passed. For all other parameters the contents of the appropriate global variables is used.

Parameters: 'framenr' must be: **0 <= nr <= MaxFrames**.

If 'framenr' == -1, line-table is set up to accomodate as many frames as fit into frame-memory. (max. 2048 lines per channel)

Returns: --

Example: --

2.4.3.5 mvfg_PhysBuffer (*framestruc), mfg_PhysBuffer (*framestruc)

Synopsis: void mvfg_PhysBuffer (*framestruc);

Description: mfg_ PhysBuffer(*framestruc) includes within the structure *framestruc all parameters necessary to define image format.

*framestruc:
+0 physical buffer address (byte address)
+4 physical buffer length
+8 single/double buffer: 0/1
+12 linelen
+16 numlin
+20 interlace 0/1
+24 req_frame -1, 0..frame_nr
+28 blacklines >=0<numlin
+32 blacklinesend >=0<(numlin-blacklines)
+36 seq_color 0,1,2

double_buffer:
0: only one image buffer
1: two image buffers, length = physical_buffer/2

seq_color:
0: single plane b&w
1: three planes for three b&w or one RGB camera
2: two planes interlaced into each other, for two-tap sensors like SONY XC-7500

Returns: --
Example: --
Remark: --

2.4.3.6 mvfg_input (DWORD timeout)

Synopsis: LONG mvfg_input (DWORD timeout);

Description: This function waits for the next VSYNC of one or as many full frames as defined in mvfg_hstart with parameter req_frm <0). Then it flips the frame-memory within the vertical service routine.
If the 'timeout' counter expired before the VSYNC was encountered, the function returns with an error code. The internal timeout counter is the Windows msec timer. For compatibility, the parameter: (DWORD timeout) is expressed in microseconds.

Returns: == 0 success!
== EMVFG_TIMEOUT timeout!

Example:
```
if ( mvfg_input ( 0x100000 ) == EMVFG_TIMEOUT )
{
wsprintf( acBuffer, "timeout !" );
...
}
```

Remark: Windows only

2.4.3.7 mvfg_inputEx(int flag, DWORD timeout)

Synopsis: LONG mvfg_inputEx(int flag, DWORD timeout)

Description: ‚mvfg_inputEx()‘ extends the funktion ‚mvfg_input()‘ with those controls described in function ‚mvfg_set_vflag()‘.
While this function waits for an image to be ready, the associated thread is suspended, so that no CPU time is wasted.

int	flag	Same meaning as with ‚mvfg_set_vflag()‘
DWORD	timeout	Timeout to return if no video is present. **If a sequence of frames is grabbed, take care for long enough timeout!** This values is given in [µs] .

Returns: == MVFG_OK image ready
== EMVFG_TIMEOUT Timeout happened

Example: mvfg_inputEx(3, 1000000); // grab image

Remark: this funktion is only available with WiNT/2K/XP

2.4.3.8 mvfg_get_event (DWORD event_id)

Synopsis: Handle mvfg_get_event(DWORD event_id)

Description: mvfg_get_event() returns the handle of an Inspecta events.
Inspectas driver serves this event in its interrupt service routine and signals the status of the capture process.
This event is a „manual reset event object“, which will be set but not reset by the driver.

Following Event-ID's are defined:

ID	Description
MVFGEVENT_VALID_FLAG	The event is set (signaled), as soon as an image is completely captured.

Returns:

!=	NULL	Handle of the event.
==	NULL	Handle not available.

Example:

```
// capture a frame with the Valid-Flag Event:

// get handle for the Valid-Flag Event
hValidFlagHandle = mvfg_get_event( MVFGEVENT_VALID_FLAG );

ResetEvent( hValidFlagHandle );     // clear Valid-Flag Event

mvfg_set_vflag( 3 );            // trigger input of next frame

// Wait for frame ready, timeout 1s
WaitForSingleObject( hValidFlagHandle, 1000 );
```

Remark: this funktion is only available with WiNT/2K/XP

2.4.3.9 mvfg_set_vflag (int flag);

Synopsis: void mvfg_set_vflag (int flag);

Description: This function sets the _fgtv_valid flag. This flag is checked in every VSYNC service routine.
Depending on the value for 'flag' the following action is taken:

int flag = 0 : image memory pointer is loaded pointing to the other memory block after the next VSYNC of a full frame.

int flag = 1 : no more action regarding the memory pointer or the grabbing process is taken.

int flag = 2 : image memory pointer is toggled pointing to the other memory block after every VSYNC of a full frame.

int flag = 3 : image memory pointer is loaded pointing to the other memory block after the next VSYNC of as many full frames as defined in mvfg_hstart with parameter req_frm <0.

int flag = 4 : grabbing is stopped after the next VSYNC of one or as many full frames as defined in mvfg_hstart with parameter req_frm <0.

Returns:

Example: See function 'mvfg_get_vflag ()'.

Remark: Windows only, for DOSX use the global variable DWORD _fgtv_valid directly.

2.4.3.10 mvfg_get_vflag (int iFlag);

Synopsis: LONG mvfg_get_vflag (int iFlag);

Description: Read the actual value of the _fgtv_valid flag.

Returns: == 1 action according to request parameter (see: mvfg_set_vflag) is taken.
== 0,2,3,4 action not yet been taken.

Example
```
mvfg_set_vflag ( MVFG_VALID ); // request flipping on next VSYNC.
// wait for done
while ( !mvfg_get_vflag ( MVFG_VALID ));
```

Remark: Windows only, for DOSX use the global variable DWORD _fgtv_valid directly.

2.4.3.11 mvfg_xchg (), mfg_xchg ()

Synopsis: void mvfg_xchg (void);

Description: This function flips frame-memory immediately.
If this should be synchronized with a VSYNC, wait for VSYNC with mvfg_stat () and the bit MVFG_FRAME_VALID. (or better: use the mvfg_set_vflag(..) or the mvfg_input () functions)

Returns: --

Example:
```
/* wait for VSYNC */
while ( !(mvfg_stat ( void )  & MVFGS_FRAME_VALID ));

/* flip frame-memory */
mvfg_xchg();
```

2.4.3.12 mvfg_ActualDmaPointer (), mfg_ ActualDmaPointer()

Synopsis: DWORD mvfg_ ActualDmaPointer(void);

Description: This function reads the actual writeposition of the PCI-DMA and returns the next lower linenumber.

Returns: actual write position modulo linelength.

Example: --

Remark: this function is available for INSPECTA-2 rev. > 1.50.

2.4.3.13 m(v)fg_DefineNextImage (ImageNr, ShutterTime, DoubleBuffer)

Synopsis: DWORD m(v)fg_DefineNextImage(DWORD ImageNr, DWORD ShutterTime, DWORD DoubleBuffer);

Beschreibung: Inspecta-2 linetable is loaded with new lineaddressees. Thus the next image is written to a position defined by ImageNr. DoubleBuffer 1/0 aktivates or deactivates the hardware controlled exchange of memory blocks.

For cameras with asynchronous shutter a hardware controlled shutter time in units of linetimes can be selected. ShutterTime 0 is used for cameras with camera controlled shutter-time.

ImageNr defines the position of the image in image memory. The return value is the offset within the image meory for th selected image. For ImageNr == -1 the returnvalue is the index of the last image that fits completely into image memory.

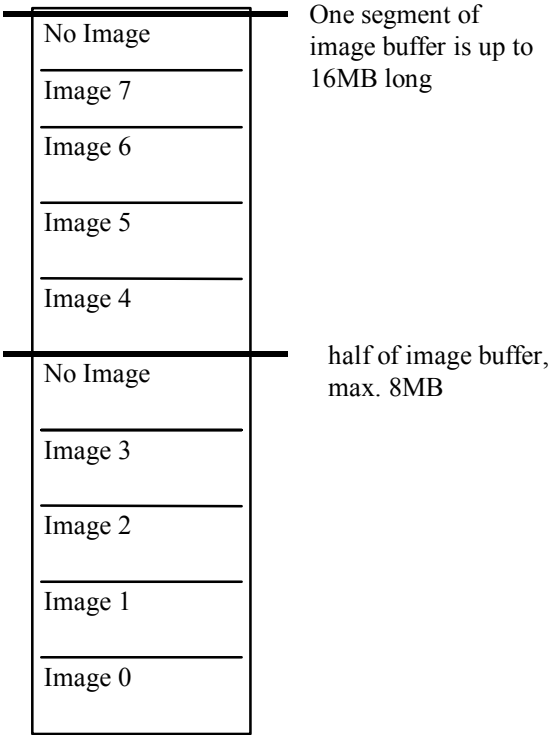
Image memory structure:
Inspecta-2 hardware divides image memory into 16MB segments. A segment can be less than 16Mbytes, the physical start address plus buffer length must not cross a 16Mbyte memory boundary. There are as many 16MB segments as fit into the amount of memory defined as image memory.

DoubleBuffer = 1 divides the image memory into two parts of same length.

Distribution of images in image memory:

For one image there is (numlin * linelen) image memory reserved. There are as many images reseved as fit into one half of image memory or into 8MB. Image memory beyond the last completely defined image and the 8/16MB boundary is not accessed by Inspecta-2 hardware.

If image memory is longer than 16MB the memory structure as shown in the illustration below is repeated, the next image with ImageNr = 8 starts at image memory offset 16MB



.

Returns: Offset in image memory for the selected ImageNr. Or index of the last image that fits completely into memory if ImageNr == -1.

Example: --

Remark: Processing time is ca. 0.5 usec per line, e.g.: an image with numlin = 508 the function consumes ca. 1msec. If DoubleBuffer = 1 consumed time also doubles. If shutter times >0 are selected, each increment (linetime) adds also 0.5 usec.
If request parameters are the same as with the last call, no time is consumed.
Use m(v)fg_DefineNextImage with Rev.>= 1.77 and INSPECTA-2 hardware

2.4.4 Cameracontrol

The following functions control specific features of a camera. For example: ‘async shutter’ which means an exposure time which is shorter than the frame time, or ‘integration’ which means an exposure time which is a multiple of frame time.

mvg_startstop // enable or disable recording
mvfg_photo(), mfg_photo // open and close the ‘shutter’ of a camera

Camera control functions can be called at any time by the application, or beeing called through the interrupt service routine every VSYNC or every HSYNC. The application provides ‘descriptors’ which are used by the service routine to do the requested action.

2.4.4.1 mvfg_startstop (DWORD flag); mfg_startstop (DWORD flag)

Synopsis: void mvfg_startstop (DWORD flag);
Description: This function starts or stops grabbing immediately.

Possible values for 'flag':

MVFG_STOP = 0 stop recording
MVFG_START = 1 start recording

Returns: --
Example: --

2.4.4.2 mvfg_stat (), mfg_stat ()

Synopsis: DWORD mvfg_stat (void);
Description: this function returns the actual status of the MVFG.

Returns: mfg_stat () returns four byte status code:

Bits:

0=MC0	camera special fct. control 0
1=MC1	camera special fct. control 1
2=MC2	camera special fct. control 2 / VINIT
3=MC3	camera special fct. control 3 / integration
4=CAM0	select one of two a/d input triples
5=RGBX0	data width
6=RGBX1	data width
7=RGBX2	data width
8=LDV	1=linedata valid
9=FDV	1=frame data valid (analog or digital)
10=PHO	1=Photo has been started and is not ready
	0=Photo is ready (or not started)
11=ODD	1=Odd field
12=pixel clock/4	(>= rev. 4): internal pixel clock/4
13= undefined	(>= rev. 4)
14=FDV digital	1=digital camera frame data valid
15=undefined	
16	1= connects video red data buffer to red channel
17	1= connects video green data buffer to red channel
18	1= connects video blue data buffer to red channel
19	1= connects digital video data buffer to red channel
20	1= interrupt enabled
21	undefined
22	undefined
23 DIS_WR	1= disable writing to fifo
24=AM0	camera mode bit 0
25=AM1	camera mode bit 1
26=ISRC0	interrupt source 0
27=ISRC1	interrupt source 1
28=DIS_EOL	disable end of line processing if set
29=PAL	525/625 lines
30=STEST1	camera mode bit 2
31=STEST	camera mode bit 3

ISRC [0..2] =	; interrupt occurs on
0/0	; hor. freq/128
1/0	; disable write to fifo
0/1	; falling edge of VSYNC
1/1	; falling edge of HSYNC

2.4.4.3 mfg_fdvhi ()

Synopsis: DWORD mfg_fdvhi (void);
Description: this function waits for fdv (VSYNC) going high.

Returns: 0 if o.K, -1 if timeout (app. 0.5sec)
Example: --
Remark: DOSX only

2.4.4.4 mfg_fdvlo ()

Synopsis: DWORD mfg_fdvlo (void);
Description: this function waits for fdv (VSYNC) going low.

Returns: 0 if o.K, -1 if timeout (app. 0.5sec)
Example: --
Remark: DOSX only

2.4.4.5 mvfg_photo (time), mfg_photo (time)

Synopsis: LONG mvfg_photo (LONG shuttertime);

Description: Use this function for cameras with an (electronic) shutter. Mvfg_photo (time) counts either HSYNC pulses, the cameras pixelclock or 1us pulses to time the exposure time.

Next table shows the use of the different timebases depending on camera and Inspecta model. (ET = Exposuretime, LT = time for one horizontal line)

Kameratyp	Inspecta-2/3	Inspecta 4D	Inspecta 4C
Linescan	No ETcontrol possible	ET=1/Pixelclock* time $ET_{max.}$=1/Pixelclock* 65530	ET = 1µs * time $ET_{min.}$= 2µs $ET_{max.}$= 8ms
Area scan camera without LDV/HSYNC while waiting for trigger, e.g.; Adimec 1000M Teli CSB4000CL Basler Ax02k JAI-M4	No ETcontrol possible	ET=1/Pixelclock* time $ET_{max.}$=1/Pixelclock* 65530	ET = 10µs * time $ET_{min.}$= 20µs $ET_{max.}$= 80ms
Area scan camera with LDV/HSYNC while waiting for trigger	ET = LT * time	ET = LT * time	ET = LT * time

Returns: 0

Example: /* wait for an external trigger. As soon as the trigger is encountered, process mfg_photo (), then call mvfg_input ().*/

```
/* wait for trigger, use opto-coupled input, bit 0 */
while ( mvfg_ppin() & 0x01 );

mvfg_photo ( 40);      /* process shutter       */

return mvfg_input ( timeout );
```

2.4.4.6 mvfg_ScanPeriod (ScanPeriod), mfg_ScanPeriod (ScanPeriod)

Synopsis: void mvfgScanPeriod(DWORD ScanPeriod);

Description: Sets the frequency of the Start of Scan Signal for a linescan camera. Parameter ScanPeriod counts in pixel clocks.

ScanPeriod is greater or equal (physical number of pixels per scanline), and less than 65530.

If a linescan camera is to be triggered by an external SOS (exposure) signal, (e.g.: from en external rotary encoder) and Inspecta-2/3 or Inspecta-4A is used, mvfgScanPeriod(128) suppresses any internally generated SOS signal.

Inspecta-4D/C use a separate bit, which is controlled by the function mvfg_linescan ().

Returns: --

Example: --

mfg_ScanPeriod writes the global variable start_scan.

2.4.4.7 mvfg_contWrite (DWORD NrOfFrames, DWORD Circular);

Synopsis: mvfg_contWrite (DWORD NrOfFrames, DWORD Circular);

Beschreibung: Starts grabbing for sequences of frames up to the requested number of frames.

With interlaced cameras, every field is recoreded seperatedly. There are double as many fields recoreded as defined by DWORD NrOfFrames.

DWORD Circular = 0: one time recording, _fgtv_valid = 1 after stop of grab.

DWORD Circular = 1: recordig restarts automatically after NrOfFames expired. Stop recording with mvfg_startstop (0).

Returns: global variable (frm_cnt) or DatPointer[MVFGD_FRM_CNT] counts number of recorded frames. If frm_cnt = 0 the sequence is ready.

Example: --

Remark: Use driver > 1.65 and INSPECTA-2 hardware Rev. >4, IMP Nr. >317. No multiplane camera modes. All lines except those while VSYNC active are recorded. Interlace even & odd fields are not combined to frames. Use mvfg_blank (blanktime) to suppress black pixel at begin of line. Before using m(v)fg_ContWrite (..) an initialization with mvfg_contWriteInit (DWORD PhysAddr) is necessary.

2.4.4.8 m(v)fg_Snap (DWORD mode, DWORD stop/exchange);

Synopsis: m(v)fg_Snap (DWORD mode, DWORD stop/exchange);

Description: m(v)fg_Snap starts grabbing with hardware controlled shutter, or enables a external trigger signal on input 0 of the opto-coupled inputs to start exposure of a single frame. On end of frame grabbing can be stopped or memory blocks can be exchanged.

Parameter mode:

= 0: *start grab on next vsync, stop or toggle and stop then, _fgtv_valid = 1 (not implemented.)*

= 1: *start grab on next vsync, stop or toggle and stop then, _fgtv_valid = 1 (not implemented.)*

= 2: *start toggling on next even field, continue until vsync after requested stop, _fgtv_valid = 1 (not implemented.)*

= 3: start random shutter, stop or toggle and stop when ready; _fgtv_valid = 1 when ready

= 4: enable external shutter on opto-in bit 0 high pulse, stop or toggle and stop when ready, _fgtv_valid flag = 1 when ready

= 5: grab multiple images as long as external signal on opto-in bit 0 is high. Use mvfg_selframe (# frames) to define maximum number of images.

= 8: Clear enable external trigger. Used if a previous mvfg_Snap (4, x) is to be terminated without an external trigger signal..

Parameter stop/exchange:

= 0: stop if action done

= 1: stop and exchange (except mode 2) if action done

Returns: --

Example: --

Remark: Use driver >= 1.77 and INSPECTA-2 hardware rev. >4, IMP Nr. >=383. If mvfg_Snapx is used with **Inspecta-2/3,** the opto-coupled outputs (see: **funktion mvfg_ppout()) are no longer useable**.

2.4.4.9 m(v)fg_Snapx (DWORD mode, DWORD stop/exchange, DWORD photo_time);

Synopsis: m(v)fg_Snapx (DWORD mode, DWORD stop/exchange, DWORD photo_time);

Description: m(v)fg_Snapx starts grabbing with hardware controlled shutter, or enables a external trigger signal on input 0 of the opto-coupled inputs to start exposure of a single frame. On end of frame grabbing can be stopped or memory blocks can be exchanged.

Parameter mode:

- *= 0: start grab on next vsync, stop or toggle and stop then, _fgtv_valid = 1 (not implemented.)*
- *= 1: start grab on next vsync, stop or toggle and stop then, _fgtv_valid = 1 (not implemented.)*
- *= 2: start toggling on next even field, continue until vsync after requested stop, _fgtv_valid = 1 (not implemented.)*
- = 3: start random shutter, stop or toggle and stop when ready; _fgtv_valid = 1 when ready
- = 4: enable external shutter on opto-in bit 0 high pulse, stop or toggle and stop when ready, _fgtv_valid flag = 1 when ready
- = 5: grab multiple images as long as external signal on opto-in bit 0 is high. Use mvfg_selframe (# frames) to define maximum number of images.
- = 8: Clear enable external trigger. Used if a previous mvfg_Snapx (4, x, y) is to be terminated without an external trigger signal..

stop/exchange:

- = 0: stop if action done
- = 1: stop and exchange (except mode 2) if action done

photo_time exposure time, same definition as in m(v)fg_photo ().

Returns: --

Example: --

Remark: Use driver >= 1.77 and INSPECTA-2 hardware rev. >4, IMP Nr. >=383. If mvfg_Snapx is used with **Inspecta-2/3,** the opto-coupled outputs (see: **funktion mvfg_ppout()) are no longer useable**.

2.4.4.10 mvfg_GrabberSelect (DWORD number);

Synopsis: DWORD mvfg_GrabberSelect (DWORD number);

Description: mvfg_GrabberSelect selects one of four Inspectas in an WinNT PC. All subsequent Inspecta calls are directed to the selected Inspecta.

Function mvfg_datpnt () will return the pointer to the selected Inspecta driver data area.

Image memory start address is defined in WinNT Registry through „MemStartPage“ parameter in key: [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\MpfgNtx] whereas MpfgNtx (x=0..3) is the driver for the corresponding Inspecta. (see also: 2.1.3)

Parameter number: = 0..3: one of four Inspectas

Returns: the number of the last selected Inspecta or –1 if selected Inspecta is not present.

Example: --

Remark: Use driver >= 2.12 and INSPECTA-2 hardware rev. >4, IMP Nr. >=445

2.4.4.11 mvfg_Linescan ()

Synopsis: void mvfg_Linescan (DWORD dwScanRate, DWORD dwExpTime, DWORD dwEnaEnc, DWORD dwDivider);

Description: This function combines all parameters that are necessary to define an operation mode of a linescan camera that is connected to an Inspecta-4D (RS-644 parallel) or Inspecta-4C (CameraLink).

dwScanRate: divides the pixelclock of a camera by this value and thus defines the horizontalfrequency of a linescancamera, as long as dwEnaEnc == 0 . This value must be greater than the linelength of the camera and less than 65535 .

dwExpTime:

Cameratyp	Inspecta-2/3	Inspecta 4D	Inspecta 4C
Linescan	No Expcontrol possible	SZ=1/Pixelclock* time $SZ_{max.}$=1/Pixelclock* 65530	SZ= 1µs * time $SZ_{min.}$= 2µs $SZ_{max.}$= 8192µs

.

dwEnaEnc: Deactivates or activates the input of an external encoder.

= 0 Encoder is inactive

= 1 a single phase encodersignal on bit 2 of the opto-coupled input divided by: *dwDivider* triggers a line.

= 2 a bi-phase encodersignal on bit 1 and bit 2 of the opto-coupled input divided by: *dwDivider* triggers a line if the encoder runs in forward direction. In backward direction the pulses are counted without triggering a line. As many pulses in forward direction as previously counted in backward direction must be input before a new line is triggered. Forward/backward direction is defined by connecting the encoder outputs A/B to bit1/2 or bit2/1.

= 3 a bi-phase encodersignal on bit 1 and bit 2 of the opto-coupled input divided by: *dwDivider* triggers a line if the encoder runs in forward direction. In backward direction no pulses are counted. Forward/backward direction is defined by connecting the encoder outputs A/B to bit1/2 or bit2/1.

= 1..3 If no encoder signal is present for more than (pixelclock/65535) a new line is triggered but not captured. An incoming encoderpulse is delayed while this dummy line is running. This avoids an over-exposure of the first lines after longer periods of inactivity.

dwDivider: divides the encoder output by this value and triggers a new line. The divisor is: 1+*dwDivider* for *dwDivider* = 0...255.

Returns: --

Example: --

Remarks: For constant image brightness with changing encoder speeds the linescan camera has to have the ability of exposure control.

If the camera has a programmable exposure time the parameter: dwExpTime is set to shortest possible pulse width that the camera can accept. (In general: 80). Highest linefrequency is then: 1/(ExposureTime+Line Output time)

If Inspecta-4DC controls exposure time (depending on camera manufacturer often called: „level controlled exposure time“), the parameter: dwExpTime is set to the desired length. Maximum linefrequency = 1/(Line Output time) is reached if exposure time is less Line Output time.

If images are triggered with an external triggersignal on Optoin 0 and functioncall: mvfg_photo (PhotoTime)), PhotoTime overtakes the value „dwExpTime“. If necessary this values can be changed on each call of mvfg_photo (PhotoTime).

ExposureTime for different Inspectas is:

Cameratyp	Inspecta-2/3	Inspecta 4D	Inspecta 4C
Linescan	No Expcontrol possible	SZ=1/Pixelclock* time $SZ_{max.}$=1/Pixelclock* 65530	SZ= 1µs * time $SZ_{min.}$= 2µs $SZ_{max.}$= 8192µs

Driverversion >= 2.75 und Inspecta-4D/C hardware is necessary.

2.4.5 Display

The powerful display-functions use VGA-boards with an S3 VGA controller. All resolutions and color depths need 1MB display RAM max.

There are functions which use the S3 graphic engine and others which provide direct access to video RAM.

The graphic engine supports overlays, zoom, hardware BitBlts, polylines with hardware Bresenham, clip and fill functions.

Display functions with direct access to video memory allow data transfer rates up to 40 MB / sec. Thus they provide real time display with more than 25 full-frames per second or color displays with 24 or 32 bit color. these functions display windows with selectable position and size.

2.4.5.1 init928 (gmode)

Description: The graphic controller will be initialized for the requested resolution and color. 1MB of video RAM is sufficient.

Parameters:

```
gmode == 0  for 640 x 480 x 8 resolution
      == 1  for 800 x 600 x 4 resolution
      == 2  for 800 x 600 x 8 resolution
      == 3  for 1024 x 768 x 4 resolution
      == 4  for 1024 x 768 x 8 resolution
      == 5  for 640  x 480 x 24 resolution
      == -1 VGA mode 3 ( 80 x 25 color characters )
```

Returns: --

Example:

```
main ();
{
init928 ( 0 );          /* Init to 640*480*8bit */

...                     // do frame grabbing & image processing here

/* end of programme */
vmfg_isr ( 0 )          // switch off interrupt & restore vector
init928 ( -1 );         // select vga mode 3
}
```

2.4.5.2 palette928 (palette)

The ‘palette’ parameter has the following meanings

```
palette == 0 -> linear 8 bit greyscale with lsb two bits overlay:
                overlay = 0 -> black
                overlay = 1 -> red
                overlay = 2 -> green
                overlay = 3 -> white
palette == 1 -> 3/3/2 red/green/blue 256 color palette
palette == 2 -> expanded 8 bit greyscale
```

If called with palette == 0, the VGA palette increments by one greyscale every four pixel-values. example:

pixel value	VGA output
0	black overlay
1	red overlay
2	green overlay
3	white overlay
4	1
16	4
255	63

the overlay colors are only accessed if the calling parameter RAM in the funtions (vmfg_putxwin, mfg_c, mfg_fill, mfg_line, mfg_pblt) is set.

2.4.5.3 mfg_clip (onoff)

Description: mfg_clip enables or disables a defined clip-window. Be sure to disable mfg_clip, if ms3_setclipwindows has never been called.

Example: mfg_clip(0); // disable a clip-window
mfg_clip(1); // enable a clip-window

2.4.5.4 ms3_setclipwindow (x, y, w, h)

Description: ms3_setclipwindow defines a clip-window which starts at x, y (0, 0 top left of screen) with the size w (width) and h (height).

Example: ms3_setclipwindow (x, y, w, h);

2.4.5.5 mfg_setcolor (foreground, background)

Description: mfg_setcolor defines foreground and background color for mfg_fill(), mfg_c() und ms3_line. The colors depend on the previous selected palette:

2.4.5.5.1 Palette 0 (linear 8 bit greyscale with lsb two bits overlay):

When writing to overlay, the lowest two bits of the parameter foreground (and with mfg_c() the parameter background) define following overlay colors:

foreground = 0: transparent
foreground = 1: red
foreground = 2: green
foreground = 3: white

2.4.5.5.2 Palette 1 (256 colour palette):

Following values result:
foreground = 0: black
foreground = 255: white. The colors are defined by a 3:3:2 / r:g:b byte.

2.4.5.5.3 Palette 2 (expanded 8 bit greyscale):

foreground = 0: black
foreground = 255: white Values between are shades of grey.

2.4.5.6 mfg_fill (x, y, w, h, ram)

Description: mfg_fill fills the requested window starting at x, y (0, 0 top left of screen) with the size w (width) and h (height) with that color that was defined by a previous call of mfg_setcolor(foreground, background). The overlay is filled if RAM = 2, if RAM = 1 the image is filled.

Parameters: x,y: graphic position on screen (lower left zero)
width, height: size of fill rectangle
ram=1: to VRAM
ram=2: to overlay

Example: mfg_fill (x, y, w, h, ram)

2.4.5.7 mfg_c (x, y, width, height, bitmap, ram)

Description: mfg_c copies a bitmap whose length is divisible by eight, to a random position on the image or in the overlay.

Parameters: x,y: graphic position on screen (lower left zero)
width, height: char box size [pixel]
bitmap: bitmap (xsize+7)/8 * ysize bytes
ram=1: to VRAM
ram=2: to overlay

Example: mfg_c (x, y, width, height, bitmap, ram)

2.4.5.8 ms3_line (npoint, xyv, ram, plmode)

Description: ms3_line connects pairs of points who are defined with the vector xyv (pointer to number of npoint pairs of points).

Parameters: xyv: vector of points, "npoint" points
ram=1/2 for write line into VRAM/overlay
plmode=0 -> connected polyline; 1->disjunct vectors

2.4.5.9 ms3_pblt (xs, ys, smask, xd, yd, dmask, width, height, ram)

Description: Copies within video ram a rectangle with an arbitrary pixel aligned starting point using a source mask to a destination rectangle with a arbitrary pixel aligned starting point using a destination mask.

Use this function to move characters with arbitrary size or the mouse cursor over the screen.

Parameters:

xs, ys:	source (UL)
smask:	source bitplane mask
xd, yd:	dest (UL)
dmask:	dest bitplane mask
width, height:	size of rectangle
ram=1/2:	copy in VRAM / Overlay

2.4.5.10 vmfg_put2win (ptr, x, y, width, takepix, height, takeline, pitch, ram)

Description: vmfg_put2win writes image data from a starting point x, y (0, 0, uppper left corner of screen) to a window with the width w (width in pixel) and height h (heigth in lines).

The image can be zoomed down. Zooming is done by ommitting pixel and/or lines and can be adjusted independent for x (takepix) or y (takeline) with a maximum of 6.

Image data starts from pointer ptr (long), the source linelength = pitch.
„Width“ must be choosen so that it is divisibly without remainder by 2*takepix.

Parameters:

ptr:	UL corner of CPU image memory window to transfer
x, y:	UL corner of window in graphics display memory
width:	width of window [pixel] in dest device
takepix:	take each "takepix" pixel per line transfer (0->take all)
height:	height of window [lines] in dest device
takeline:	take each "takeline" line in dest device (0->take all)
pitch:	ptr memory address offset between lines
	example: mapping a 2560 pixel window to 640 display makes: width=640; takepix = 4; pitch=2560
destination:	ram=1:VRAM; 2:OVLY

2.4.5.11 vmfg_put4win (ptr, x, y, width, multx, height, multy, pitch, ram)

Description: vmfg_put2win writes image data from a starting point x, y (0, 0, uppper left corner of screen) to a window with the width w (width in pixel) and height h (heigth in lines).

The image can be zoomed up. Zooming is done by replicating pixel and/or lines and can be adjusted independant for x (multx) or y (multy) with a maximum of 10.

Image data starts from pointer ptr (long), the source linelength = pitch.
„Width“ must be choosen so that it is divisibly without remainder by 2*multx.

Parameters:

ptr:	UL corner of CPU image memory window to transfer
x, y:	UL corner of window in graphics display memory
width:	width of window [pixel] in dest device
multx:	multiply each pixel "multx" times in X
height:	height of window [lines] in dest device
multy:	multiply each line "multy" times in Y
pitch:	ptr memory address offset between lines

	example:	mapping a 512x512 pixel window 1024x1024 display makes: width=height=1024; multx=multy=2; pitch=512
destination:	ram=1:VRAM; 2:OVLY	

2.4.5.12 linadrs3 ()

Description: linadrs3 enables the direct access to video RAM of the S3 VGA controller.

linadrs3 () maps the physical video RAM address to the actual data-segment and provides a linear address to have access to it.

linadrs3() must be called before using mvfg_dmawin.

2.4.5.13 mvfg_dmawin (x, y, width, height, pointer, pitch, color)

Description: mvfg_dmawin write video data direct to the RAM of the S3-VGA controller. It is the fastest way of writing images to screen.

The direct access of the VGA RAM must be opened by a previously called linadrs3 (). Overlays are destroyed.

Parameters:

x, y:	UL corner of window in graphics display memory
width:	width of window [pixel] in dest device
height:	height of window [lines] in dest device
ptr:	UL corner of CPU image memory window to transfer
pitch:	ptr memory address offset between lines
color=0	-> 8-Bit grey scale
color=1	-> 3/3/2 r/g/b color mode, ptr to other color planes is ptr+[pel_frm]
color=2	-> r/g/b 24 bit color mode ptr to other color planes is ptr+[pel_frm]
color=3	-> r=g=b grey mode

2.4.5.14 linends3 ()

Description: linends3 () closes direct access to S3 RAM.

2.4.6 Miscellaneous functions

2.4.6.1 mvfg_IntCallback (), mfg_IntCallback

Synopsis: void mvfg_IntCallback(* user_proc, segments);

Description: mvfg_IntCallback () provides a pointer to an application-programme to the MVFG interrupt Service routine. The MVFG service routine calls then this application-programme on every interrupt. (every 64usec for interrupt on HSYNCS and every 16 msec on inteerupts on VSYNCS).
Use this function to avoid any polling loops in the application programme (e.g. waiting for an optical sensor).
The parameter ‘segments’ is always 0.

Returns: --

Remark: This function is available with DOSX and Windows95. Do not call any systems functions out of this user programme, because it runs as an extension of the protected-mode service routine.

2.4.6.2 mvfg_IntSource (), mfg_IntSource ()

Synopsis: void mvfg_IntSource (DWORD irqsource);

Description: 'mvfg_IntSource()' defines the source of an interrupt. Use this function in conjunction with mvfg_IntCallback () to define, how often the user supplied programme should be called.

The parameter irqsource is the same as in function mvfg_isr (). Bits 10-12 define the source of an interrupt.

'irqsource' can have the following values:

```
Bits:        0..7   = 0
Bits:        8..9   = 0
             10     = ISRC0 interrupt source 0
             11     = ISRC1 interrupt source 1
             12     = ISRC2 interrupt source 1
Bits:        13..32 = 0

irqsource =  0x000      ; hor. freq/128
             0x400      ; falling edge of VSYNC analog
             0x800      ; start/stop flipflop is set
             0xC00      ; falling edge of HSYNC analog
             0x1400     ; falling edge of VSYNC digital
             0x1C00     ; falling edge of HSYNC digital
```

Returns: --

Example: Call the application programme with every VSYNC.

```
// define (VSYNC) as interrupt source.
mvfg_IntSource ( 0x0400 );

// initialize MVFG-Callback function.
mvfg_IntCallback( (DWORD) myCallBackFkt, 0 );
```

2.4.6.3 mfg_sync ()

mfg_sync () is the processing part of the MVFG interrupt service routine. The interrupt service routine just calls mfg_sync, reenables the interrupt and returns from interrupt.

mfg_sync does everything that has to be done when a VSYNC is encountered:

- looking for the odd field of an interlaced video.
- check for new camera & mode selection and the A/D converter levels within a sequence.
- flip frame-memory if the flag _fgtv_valid == 0
- call the application progrmme if mvfg_IntCallback is activated.

mfg_sync must be called every HSYNC (if this is the source of the interrupt) or every VSYNC. If an application programme has ist own service routine for the MVFG interrupt, mfg_sync has to be called first.

mfg_sync checks & changes the following counters & pointers:

dword int_cnt	increments with every interrupt.
dword frm_cnt	increments mod frame_nr with every full-frame if rotating recording is selected (req_frm = -1), shows otherwise the actual image position in frame-memory.
dword odd_flag	=1 if the just recorded field was an odd field.
dword frm_beg	offset within frame-memry points to the first pixel of the just recorded frame.
dword _fgtv_valid	=1 if frame-memory was just flipped.
dword integ_count	counter for integration time mod full-frames.
dword integration	requested number of full-frames to integrate.
dword stop_start	=1 if recording is not stopped.

2.4.6.4 mvfg_chkclk (), mfg_chkclk (),

Synopsis: DWORD mvfg_chkclk (void);

Description: Checks if a pixel clock is available for the selected camera mode and input channel.

Returns:
0: Pixel clock found
-2: No pixel clock found

Remark: Use this function after selecting a camera mode with external clock input, to check if a camera is connected and working.

Example: --

2.4.6.5 mvfg_ppin (), mfg_ppin (),

Synopsis: DWORD mvfg_ppin (void);
Description: Read the opto-coupled digital input.

Returns:
bits 0 .. 3 state of the four input bits.
1 .. 7 state of the four output bits.

Example: --

2.4.6.6 mvfg_ppout (dout), mfg_ppout (dout)

Synopsis: void mvfg_ppout(DWORD value);
Description: Write the opto-coupled digital output port.

Parameters: bits 0 .. 3 are valid.

Returns: --
Example: --

2.4.6.7 mfg_bmp (parameters)

Description: mfg_bmp write images or a window out of an image to disc. File format is Windows compatible uncompressed *.BMP format.

Parameters:

*file_name:	long pointer to ASCIIZ string with filename	
* ptr:	long pointer to frame buffer	
x:	x position of window, 0 = left	
y:	y position of window, 0 = first line	
width:	width of window in pixel	
height:	height of window in lines	
pitch:	source linelength	
lut:	Look Up Table:	0 = 256 shades of grey 2 = 24 bit RGB color, color planes are expected at an offset of ploff.
*buffer:	long pointer to copy buffer	
ploff:	plane offset for color planes.	

Rückgabewert: 0 = o.K.
x = File Error (create, write, disk full etc.)

2.4.6.8 m(v)fg_SetVideoClock (frequency)

Synopsis: void mvfg_ SetVideoClock(DWORD frequency);
Description: Sets video clock synthesizer to requested value (Hz)

Returns: --

Example: --

Remark: Valid for software revision >= 1.62

2.4.6.9 mvfg_get_info(Z_MVFG_INFO * mvfg_info)

Synopsis: DWORD mvfg_get_info(Z_MVFG_INFO * mvfg_info)

Description: This function returns within the structure ‚mvfg_info' hard- und software-informations of the installed Inspecta.
If the argument is ZERO, only the serial number of the installed Inspecta is returned.

The struture Z_MVFG_INFO contains the following informatios:

Element	Description
driver_version_ms	Most significant bits of fileversion of loaded device-driver.
driver_version_ls	Least significant bits of fileversion of loaded device-driver.
dll_version_ms	Upper 32 bits of fileversion of ‚MVFGD32.DLL'
dll_version_ls	Lower 32 bits of fileversion of Fileversion von ‚MVFGD32.DLL'
hw_type	Type of installed Inspecta: 0 = undefiniert 1 = Inspecta-1 2 = Inspecta-2 3 = Inspecta-3 4 = Inspecta-4
hw_vendorID	Mikrotrons Vendor ID
hw_deviceID	Inspectas Device ID
hw_revID	Inspectas Revision ID
hw_snr	Inspecta-4 serialnumber
hw_imp	Inspectas firmware versioncode

Returns:

!=	0	Inspecta-4 serial number
==	0	Error

Example:

```
Z_MVFG_INFO     mvfg_info;
.
mvfg_get_info( &mvfg_info );
```

Remark: this function is only availabe in WinNT/2K beginning with Rev 2.38

2.4.7 Testfunctions

The two display functions mvga (parameter) and m13vga (parameter) are too slow and have not enough resolution. They are of use for test purposes, because they work with every VGA

2.4.7.1 palette ()

Description: palette () initializes the VGA adapter to mode 0x12 (640x480x16) and adjusts the VGA palette to a linear greyscale with 16 shades of grey. Call it before using the display function mvga (....).

2.4.7.2 mvga (alt_frame_start, frame_start, vga_start, granularity)

Description: mvga (..) displays the frame-memory to the VGA screen with graphic mode 0x12. In addition, mvga (..) has a delta function, in that the pixel values of two consequtive images can be subtracted, and the difference is displayed as a colored pixel. The difference color is:

delta = 0 : black
1 : blue
2 : green
3 : cyan
4 : red etc.

Parameters:

alt_frame_start:	pointer to first pixel of image to compare.
frame_start:	pointer to first pixel of image to display.
vga_start:	pointer to first pixel on VGA screen.
granularity:	zoom down, omit every second, third etc. pixel/line.

2.4.7.3 palette13

Description: palette13 () initializes the VGA adapter to mode 0x13 (320x240x16) and adjusts the VGA palette to a linear greyscale with 256 shades of grey. Call it before using the display function m13vga (....).

2.4.7.4 m13vga (ptr, vga_ptr, granularity)

Description: m13vga writes to standard VGA with mode 0x13. To initialize, call palette928 (0) and palette13 () before.

Parameters:

ptr:	pointer to first pixel of image to display.
vga_ptr:	pointer to first pixel on VGA screen.
granularity:	zoom down, omit every second, third etc. pixel/line.