VCAM-010
-
VCAM-020

Manual

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A product of a PHYTEC Technology Holding company

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1 Technical Data

VCAM-010 and VCAM-020:

CCD-sensor:	CCD, 1/3” (4,4 x 3,3 mm)
Lens Adapter:	C-Mount / CS-Mount (similar to M25 x 0,75)
TV-System:	CCIR System B,G,H,I
Synchronization:	15.625 Hz horizontal 50 Hz vertical
Pixels:	500 x 582 (H x V, effective)
Resolution:	410 TV-lines
Minimum Illumination:	< 1 Lux
Signal-/Noise ratio:	> 46 dB
Video Output:	1,0 Vss, 75 Ω (Composite / BAS)
Iris Control:	1,0 Vss, 10 Ω
Power Supply:	12 V DC, < 200 mA
Working Temperature:	-10°C to +50°C
Dimensions:	51 x 51 x 60 mm
Weight:	185 g (VCAM-010) 225 g (VCAM-020)
Mounting:	M25 Thread (1/4” x 8 mm) at top- and bottom
Exposure Control:	AEC (Exposure Time Control) 1/120 s ... 1/10000 s AGC (Gain Control) 2 ... 32 dB
Gamma Correction:	CCIR-Characteristic (VCAM-010)

Only VCAM-020:

Sync-Output:	H-Synchronization (TTL, 75 Ω)
	V-Synchronization (TTL, 75 Ω)
Sync-Input:	V-Synchronization (TTL)
AGC-Control Output:	1,5 V to 4 V

Manual Exposure Time:	1/120, 1/250, 1/500, 1/1000, 1/2000, 1/5000, 1/10.000, (1/100.000)
Manual Amplification:	+5 dB to +32 dB continuous
Gamma Correction:	linear, EIA- or CCIR-Characteristic
Frame:	interlaced or non-interlaced (odd-field)
XSUB-Puls:	can be disabled (TTL-level)

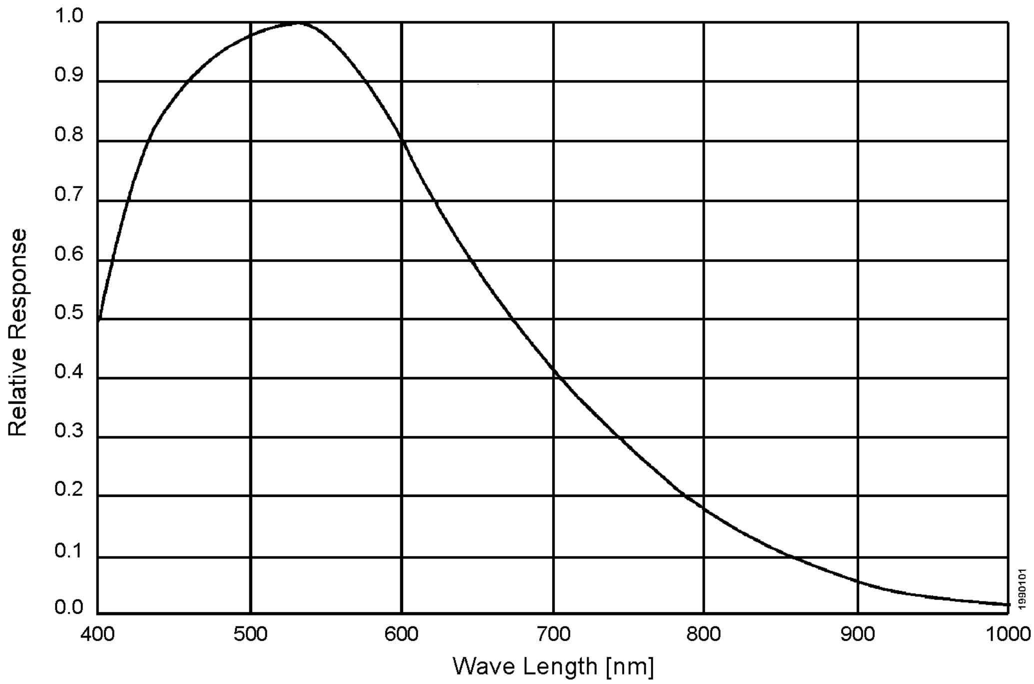

Figure 1.1: Spectral Sensitivity of the Sensor

General Survey of the Control Units and the Connectors

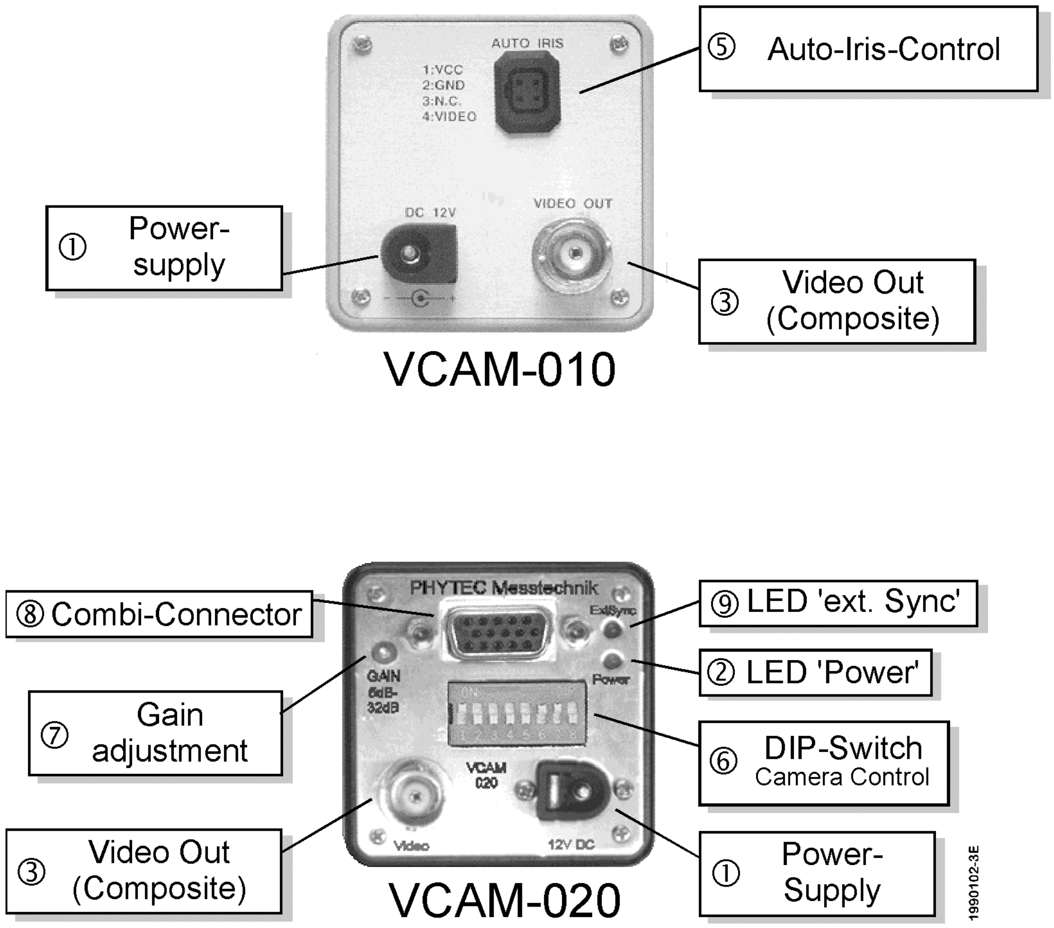

Figure 1.2: Position of the components VCAM-010/ VCAM-020

Note: The socket ⑧ can not be connected directly to a VGA-monitor or to a pcGrabber ! The signal to this socket is different to the pin assignment of this device. In case of direct connection a damage to the VCAM-020 or to the connected device might be possible.

2 Starting Operation (VCAM-010 / VCAM-020)

2.1 Field of Applications and Safety Instructions

Please pay attention to the specified working conditions setting the camera modules VCAM-010 and VCAM-020 into operation. Please read this manual carefully before starting operation.

- The camera is used for the recording of a picture with a corresponding lens with C-mount. The output signal can be connected to a regular TV-monitor, video recorder or video-digitizer ("Grabber") which satisfies the specifications of the TV-standard. The camera provides the image as a composite-b/w-signal.

  The operative area might be house, office or industrial plant with corresponding encapsulation and screening, as long as the resolution and sensitivity are sufficient. Partially the spectral range is also in the infrared (*see Figure 1.1*).

  Typical applications are monitoring purposes, recording for image processing or for multimedia and video transmission systems with medium quality requirements.
- The operation of the camera is allowed only with the required voltages. The power supply has to be electrically isolated. The power supply has to comply with the VDE-regulations.
- The environmental and working conditions specified under "Technical Data" have to be observed. Especially precipitation is not allowed. The operation in the open or in humid areas requires a corresponding housing. The camera has to be protected from humidity, splash water and heat.
- The application in hazardous locations, close to inflammable liquids, gases or dust is not allowed without the appropriate safety arrangements.
- The device is determined for clean and dry locations. For the applications in machines or for industrial purposes special housings have to be used.

- The application of the camera in safety systems in aviation /space devices and for nuclear or military purposes requires our examination and agreement.
- For applications in industry the corresponding rules for prevention of accidents for electrical installations of the employer’s liability insurance association have to be observed.
- Before operation, in general the device has to be examined, if the device is appropriate for the application and environment. If any doubts should arise, specialist or the manufacturer should be asked.
- The device should be protected of strong shocks or vibrations. It might be required to cushion the device, but the ventilation should be not affected.
- If the device has to be repaired, only a specialist may conduct the repair, utilizing original components. For the connection of the device only tested and approved cables should be used. Good screening and shielded cables are required.

2.2 Information concerning the Lens

The camera is delivered without lens. Any lens with C-mount or CS-mount-can be utilized.
For the application with lenses equipped with CS-mount-thread, a black adapter ring has to be used.

> The lens and the CCD-sensor-chip have to be protected from dust and other pollution. They should not be touched with fingers!

The camera is equipped with an electronic exposure time control. Therefore lenses with manual or automatic exposure time control can be used. Don’t close the manual diaphragm too much, since the signal/noise ratio will increase.

For the model VCAM-020 the exposure time control can be turned off, in order to yield a reproducible brightness of the image for measuring and automation purposes. This is only achievable with constant and artificial illumination. The application of a lens with a manual diaphragm will make the adjustment to the illumination easier. In this case the basic electronic adjustment should not be too sensible, since this will also increase the signal/noise ratio.

Also lenses with video signal controlled diaphragm can be applied. For this purpose the camera provides the corresponding control signal. The electrical connection is described in section *2.7*.

Lenses with electronic diaphragm make sense for applications where extreme brightness fluctuations occur, for example in the open or in the case of opposite light.

If the sharpness can not be adjusted to the optimum, the support must be corrected. For this purpose the Allen screw below the ring of the lens has to be unscrewed. By turning the complete lens with the ring, the support can be adjusted. Focus the lens to an object in an appropriate distance and adjust the support until you get optimum sharpness. Prefer to focus far objects.
Fix the achieved position by tightening the Allen screw.

2.3 Installation

The camera has a mount at the top and the bottom with a 1/4” thread. So the device can be fixed in a suspended or a horizontal position. The maximum length of the thread is 8 mm.
For the installation in hazardous or dusty environment an appropriate housing has to be used.

2.4 Power Supply

The camera requires a regulated power supply with 12 V DC. The current will be about 200 mA. The power supply is connected to socket ①. The middle contact of the plug has to provide positive polarity.

☞ The power supply for the model VCAM-020 can also be applied via the Kombi-connector.

Please pay attention for correct connection of the power supply. Wrong polarity or excess voltage might destroy the camera. The voltage should be regulated without any spikes. Defects arising from faulty power supplies will invalidate the warranty for the device.

2.5 Video-Output

At the BNC-socket "Video Out" ③, the camera provides the image as composite-video signal (BAS-signal). This signal can be applied to standard monitors. The output impedance is 75 Ω. For optimal image transmission a shielded cable with 75 Ω has to be used and must be terminated at the end with this impedance.

The length of the cable should not exceed 100m. Otherwise an video amplifier has to be used in order to compensate the loss. Depending on the requirements concerning to the quality of the signal, better shielded cables have to be used.

2.6 Electronic Exposure Time Control (VCAM-010)

The camera VCAM-010 is equipped with an electronic exposure time control, which will adjust the exposure time to the optimum of the illumination. The exposure time can be adjusted from 1/120 sec to 1/10.000 sec.

☞ For measure- and automation purposes, which require a reproducible sensitivity, the application of the model VCAM-020 is recommended.

2.7 Auto-Iris-Output

The VCAM-010 provides a connector, which is appropriate for lenses with automatic diaphragm control. Appropriate lenses are those, which are controlled via the video signal. At socket ⑤ the video signal is provided without synchron pulse (control signal). In addition the 12V- power supply is provided. *Figure 2.1* shows the pin assignment.

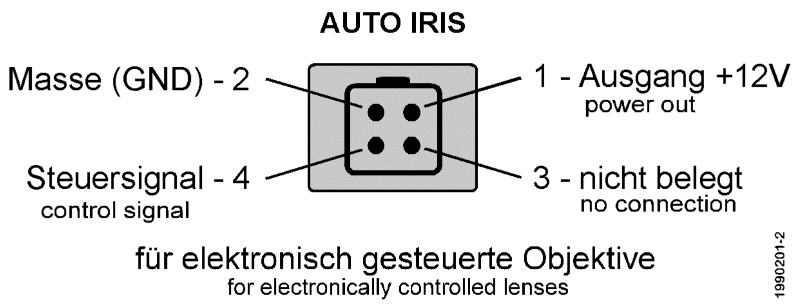

Figure 2.1: Auto-Iris-Output

Model VCAM-020 does not provide this socket. The iris-control signal is provided at the Kombi connector ⑧ .

3 Additional Functions VCAM-020

Model VCAM-020 has some additional functions and connections. Synchron signals can be applied and accepted, exposure time and amplification can be adjusted manually and the production of images and the gamma correction can be influenced.
All signals are provided at the Kombi-connector ⑧. It is a HD-DB-15-connector, which is tightened by two screws.
Figure 3.1 depicts the pin assignment.

⑧ **Kombi-Connector**			
Pin	**Signal**	**Direction**	**Level**
1	SIGNAL GND	-	GND
2	VSYNC	OUT	TTL
3	SYNC_IN	IN	TTL
4	Auto-Iris Control signal	OUT	1Vss
5	SYNC IDENT	OUT	TTL
6	SIGNAL GND	-	GND
7	HSYNC	OUT	TTL
8	POWER GND	-	GND
9	SIGNAL GND	-	GND
10	ENB (Enable XSUB-Pulse)	IN	TTL
11	POWER GND	-	GND
12	POWER IN +12V	-	PWR
13	SIGNAL GND	-	GND
14	VIDEO OUT (Composite)	OUT	1Vss
15	AGC_CON	OUT	1,5...4V

Figure 3.1: Pin Assigment of the Kombi-Connector (VCAM-020)

Many additional functions are configured via the DIP-switches ⑥. *In Figure 3.2* the assignment of the separate switches is shown.

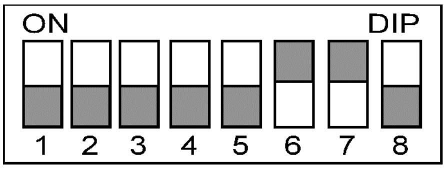

Image Mode	
ON	non-interlaced
OFF	interlaced

Gamma Correction			
5	6	7	MODE
OFF	OFF	OFF	
OFF	OFF	ON	
OFF	ON	OFF	EIA
OFF	ON	ON	CCIR
ON	OFF	OFF	LINEAR
ON	OFF	ON	NOT ALLOWED
ON	ON	OFF	
ON	ON	ON	

Automatic Light Control	
ON	manual Gain + Shutter
OFF	AGC + AEC enabled

Shutter Speed			
2	3	4	SPEED
OFF	OFF	OFF	1 / 120 s
OFF	OFF	ON	1 / 250 s
OFF	ON	OFF	1 / 500 s
OFF	ON	ON	1 / 1000 s
ON	OFF	OFF	1 / 2000 s
ON	OFF	ON	1 / 5000 s
ON	ON	OFF	1 / 10000 s
ON	ON	ON	1 / 100000 s*)

1990302

*) Operation not guaranteed

Figure 3.2: Functions of the DIP-Switches

(The shown positions of the switches depicts the standard mode)

3.1 Power Supply

The voltage supply is provided via socket ① similar to the model VCAM-010 .In addition model VCAM-020 allows the application of the power supply via the Kombi-connector ⑧. Pin 12 has to be connected to +12V of the power supply, pin 8 to GND.

It is not allowed to use both sockets ①/⑧ simultaneously!

3.2 Video Output

The composite-video signal can be received from the BNC-socket ③ or via the Kombi-connector ⑧ . The video signal is found at pin 14. As GND, pin 9 or pin 13 can be used.

If the signal is accepted from both sockets simultaneously, the impedance might be changed and the quality of the image might suffer or even fail.
Therefore both sockets should not be used simultaneously!

3.3 Auto-Iris-Signal

Model VCAM-020 provides at pin 4 of the Kombi-connector ⑧ the control signal for the adjustment of the diaphragm of the lens with automatic controlled iris. The video signal has no synchron pulse.
More information on electronically controlled lenses can be found in section *2.7*.

3.4 Synchron Signal-Output

For the control of image processing systems, the horizontal and vertical synchron signal of the VCAM-020 can be accepted separately. Both signals have negative polarity (active low) and TTL-level. At pin 2 of ⑧ the vertical synchron signal (*VSYNC*), and at pin 7 the horizontal signal (*HSYNC*) is found.

Please use shielded cables for the synchron signal.
The output impedance is 75 Ω. The signal should not be transmitted over longer distances.

3.5 Synchron Signal-Input

Via the input SYNC_IN (socket ⑧, pin 3) a vertical synchron signal can be applied to the VCAM-020. The start of the image scan can be synchronized with other image sources or the digitizer board.

The input can handle TTL signals. The applied signal must have a frequency of 50 Hz, so that the camera can operate properly. The signal is low-active. During low-level the camera is reset and remains in this status, until the signal has reached again high-level. For the synchronization a signal with short low pulses is recommended (t_L < 1µs).

The camera switches automatically from internal to external operation by the application of the synchron signal. The control lamp ⑨ will be shining as soon as the camera is switched to external synchronization.

3.6 Manual Exposure Control

With switch 1 of the DIP-switch ⑥ the VCAM-020 can be operated with manual exposure control. If the switch is in position *OFF*, the camera operates automatically. The exposure is regulated by two controls: The EEC (Electronic Exposure Control) controls the exposure time of the image according to the illumination. The exposure time is selected from 8 steps in the range 1/120 sec to 1/100.000 sec. A subsequent analogue AGC, (Automatic Gain Control) provides a fine tuning, so that the step wise switching of the EEC is not recognized.

Adjustment of the switch 1 to *ON* will allow to tune the exposure time and the amplification manually and automatic operation will be prevented.

3.6.1 Adjustment of the Exposure Time

Adjustment of switches ⑥ - 1 to *ON* , activates switches ⑥ - 2,3,4 . With the help of this switches the required exposure time will be set. *Figure 3.2* shows the assignment of the switch positions to the exposure time.

☞

- The setting of a too long exposure time will overexpose the CCD-element. This will cause no damage. But it might occur, that by setting shorter exposure times it will take some time until an image will appear again since the charge on the CCD-chip has to diminish.

- Shorter exposure times are recommended for the recording of fast moving objects, since the depth of focus will be improved by the utilization of the manual adjustment of the diaphragm.

- For very short exposure times stroboscopic effects might occur, caused by fluorescent lamps or others. In this case use continuous illumination (DC filament lamps). Only very short events like flashs are outside the exposure time window and are not recognized.

- For exposure times shorter than 1 / 100.000 sec the specifications of the CCD-sensor are not guarantied anymore.

- In order to gain the maximum exposure time (highest sensitivity), the XSUB-pulse of the CCD-sensor has to be turned off (see section 3.9.2)

3.6.2 Adjustment of the Amplification

After the crude adjustment of the exposure time according to the illumination, the fine tuning is achieved with the *GAIN*-control ⑦ .
The electrical amplification of the video signal can be varied in the range from about +5 dB to + 32 dB. In order to increase the amplification, turn the trimming potentiometer clock wise. Turning counter clock wise will decrease the amplification.
The range of the potentiometer is several turns. If the end position is reached, the setting screw still can be turned, but the amplification will not change.
In order to record the amplification, which might be interesting to reproduce the setting for another VCAM-020, a control voltage can be taken from connector ⑧ which depends on the setting.
The voltage value at AGC_CON (connector ⑧, pin 15) is in the range from 2 V to 4 V and reverse proportional to the amplification in dB. The amplification can be depicted from the diagram *Figure 3.3* .

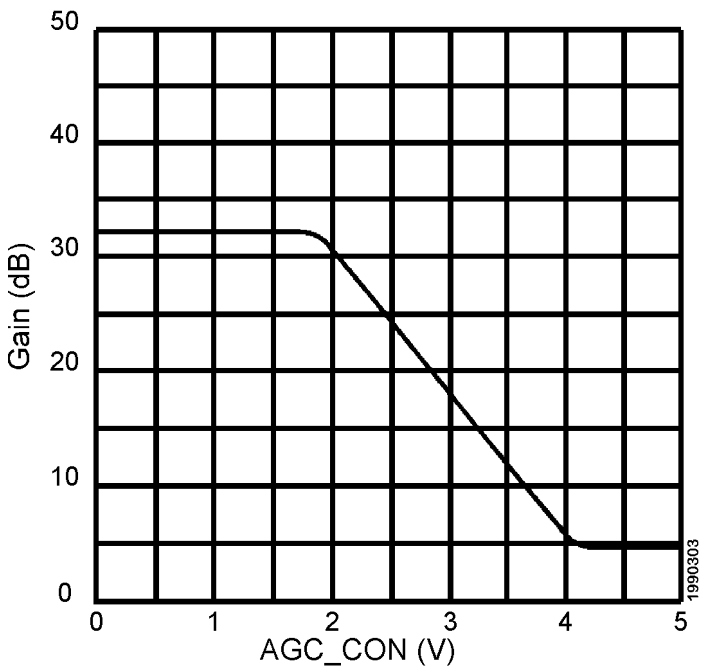

Figure 3.3: Control voltage AGC_CON

☞ ● The amplification can be adjusted only if DIP-switch ⑥ - 1 is set to *ON* .

- The control voltage AGC_CON has to be measured with a high impedance meter, $R_{IN} > 1$ MΩ. The output should not be loaded. With automatic exposure control (⑥ - 1 is *OFF*) the voltage indicates the amplification adjusted by the control.

3.7 Adjustment of the Gamma Correction

The gamma correction causes a nonlinear adjustment of the brightness/voltage ratio of the video signal. With this normalized error correction curve, the picture tube characteristic is corrected at the receiver.
The most TV-systems with CCIR standard assume a gamma value of 2.8 , whereas the systems with US EIA-standard (correspond to CCIR systems M,N) use a gamma value of 2,2 .
For european systems the gamma-correction is adjusted to CCIR standard, for receivers with US standard to EIA.
In some cases - for example digitization with a framegrabber without gamma-correction - better results are achieved, when no gamma correction is executed by the camera. Here a linear output characteristic is desired.

With the switches 5 - 7 of the DIP-switches ⑥ the setting of the gamma-correction is adjusted. The possible combinations of the setting are shown in *Figure 3.2*.

Only three combinations of the switches are valid. The combinations designed with a dash, provide no signal for the image.

The three settings designed as *“not allowed”* are prohibited combinations and should not be set!

3.8 Frame-/ Field Mode

A TV-image is composed of two *fields*. The fields follow in two consecutive video signals which contain alternately even and odd lines of the image. Both fields interlaced, result in a *frame*. The separation of the image into two fields is called *interlacing* , and is executed to reduce flicker. The frame shows the total resolution, each field only the half resolution. The horizontal resolution is the same for both.

Some applications require only the half resolution of a field. This can be selected by the switch “Image Mode” : If the switch 8 of the DIP-switch ⑥ is *OFF*, the camera produces frames (standard mode). If the switch is set to ON, both fields of a frame contain the same information of the field with odd line number (that is the first recorded field).

This mode is utilized, in case the resolution of the digitized image requires only one field. Since the information of both images is the same, it is indifferent which field is digitized and no steps will show up in the image. Since the fields are identical the waiting time is reduced in the average to the half.
Also for flashed images it is recommended, to use the field mode (see below).

3.9 Operation with Photo Flash

The VCAM-020 is not a special camera for flashed pictures. But the camera provides a mode, which allows the processing of flashed pictures. For many cases good results will be achieved.

3.9.1 Introduction

For some applications it is required, that fast moving objects are recorded with an electronic flash, in order to avoid fuzziness caused by the movement. The event which triggers the flash will occur at any given time. The flash in some way is synchronized to this event (for example to the moving object).

Since the flash is asynchronous to the camera and can be triggered at any time, the CCD sensor must be prepared at any time to record the image. This can not be guaranteed when short shutter times are set, since the sensor will be sensitive only for short times. Also the automatic exposure control (AGC, EEC) must be inactive, since the short flash will cause an unpredictable control process.

By inactivating the automatic exposure control and selecting the longest exposure time, the camera will provide the best adjustment with the most sensitive arrangement. Therefore a lens with mechanical diaphragm is required in order to control the amount of light which will impinge the sensor during the duration of the flash. Usually the diaphragm has to be closed very much (presetting of aperture > 16).

The environmental illumination must be much weaker than the flash, so that the flash will work effectively. With the normal illumination the image will be barely recognized.

☞
- Since the duration of a flash will last only for one field, the resolution will be restricted to a single field.
- Further applications for PHYTEC-Products for recording flashed images are found in the application report "Flashed operations with pcGrabber and VCAM", which can be received from PHYTEC .

3.9.2 Adjustment

The VCAM-020 is adjusted to manual exposure control (⑥ - 1 to *ON*) with an exposure time of 1/120 sec (⑥ - 2, ⑥ - 3, ⑥ - 4 all *OFF*). The amplification can be set to any value ⑦.
Since for a setting to 1/120 sec a field will not be exposed completely, in addition the XSUB-pulse has to be deactivated, which causes the charge removal from the CCD-sensor. The pulse is deactivated, by grounding pin "*ENB*" of Kombi-connector ⑧ . it might be soldered a jumper from pin 9 (GND) to pin 10 (ENB).

In order to set the camera in the field mode the switch 8 of the DIP-switch ⑥ has to be set to *ON* .

☞ Even with disabled XSUB-pulse a short time span is present during which the sensor is not sensible (reading time). Therefore it might happen, that the exposure time is too short, and the image might be weaker as normal. The longer the exposure time of the flash is, the less this effect will be recognized. The duration of the flash should be longer than 200µsec.

Notes

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