

# Vision Components

The smart camera people ...

Technical Documentation VCM40,VCM50

© 1996-2003 ... Vision Components GmbH Ettlingen, Germany

Juni 2004

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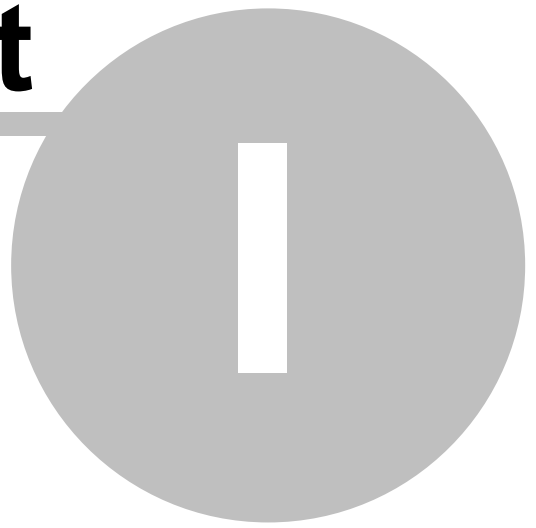
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# Foreword

This documentation was created very conscientiously. No liability is assumed for possible errors or misleading descriptions. The information contained in this documentation is informative and in no way guarantees the characteristics of the product. The right is reserved to make technical changes dictated by the state of the art.

# Part

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# 1 Introduction

## Technical Documentation

### Vision Components'

#### Smart Vision Sensors VCM40, VCM50



## 1.1 General Information

The VCM Series Smart Vision Sensors are compact, light-weight optical sensors equipped with a high-resolution (640x480) sensor chip.

The VCM40 is based on a linear response 640x480 pixel CMOS sensor capable of grey scale and/or color operation.

The VCM50 is based on a 640x480 pixel progressive scan CCD grey scale sensor.

**The VCM40 is suited for 2D inspection on indexed conveyors or in 1D mode on moving conveyors.**

**If you want to inspect fast moving parts in 2D however, the VCM50 might be more suitable.**

VCM sensors feature a built in high-performance DSP with 80 KBytes of on-chip memory which does all the necessary processing.

The VCM series sensors set standards for performance and integration density.

These cameras were designed for industrial applications. High goals were set as regards the image resolution, the sturdiness of the casing, and the electromagnetic compatibility, as mere examples. The cameras are insensitive to vibrations and shocks, while permitting precise measurements and tests. They are ideally suited as OEM cameras for mechanical engineering applications.

Only one supply voltage is required to operate the sensors (24 volts). PLC compliant I/Os with 24V operating voltage and a RS232 serial interface allow for communication with the outside world.

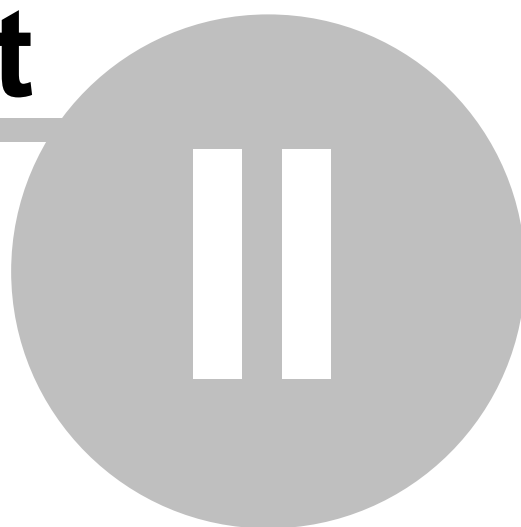
VCM sensors include a small push-button switch and 6 LEDs for monitoring the I/O signals and for a very simple human interface.

For Video output JPEG images can be transferred via serial interface.

This documentation describes the hardware. However, in many cases the software documentation is decisive. For this, please consult the software manuals.

# Part

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## 2 Basic Structure

- VCM40 : The image is acquired from a linear response CMOS sensor. The CMOS sensor delivers digital pixel values
- VCM50 : The image is acquired from a CCD progressive scan sensor. The CCD sensor delivers an analog signal. With the appropriate control chips, it is in many ways comparable with image acquisition from a conventional video camera. However, instead of a "real" video signal, a staircase-shaped signal is sent which is very advantageous for the later digitalization. The staircase-shaped signal is digitized. This 8-bit video signal can be used for various purposes.

The main differences to "standard smart cameras" are "JPEG output" via serial interface and on the other hand an extremely low price for a fast and industry proven vision system

The VCM Vision Sensors come in NEMA4 casing (IP65) and include a simple LED ring strobe and micro video lens.

### 2.1 General Board Description

The electronic circuitry of the cameras is placed on three boards.

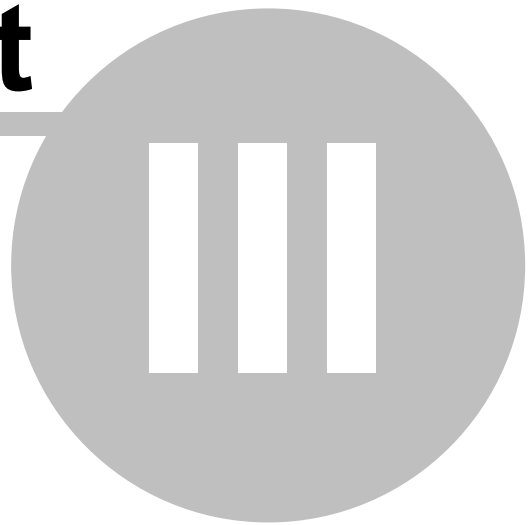
The following presents an overview of the boards:

Description	Function
Sensor board	Receives signals from and controls the CCD sensor. Produces the video and clock signals.
CPU board	Digitalization of the video signal. Complete signal processor board with memory Switched Power Supply 3W, PLC interfaces, Serial interface etc
Memory board	contains 8MB DRAM



# Part

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### 3 Documentation of the boards

This chapter provides a detailed description of all PCBs used in the cameras:

- [The Sensor Boards](#)<sup>[8]</sup> deliver the image to be processed
- [The CPU Board](#)<sup>[9]</sup> process the image
- [Technical Data on the I/O signals](#)<sup>[10]</sup>

#### 3.1 The Sensor Boards

This Chapter provides a detailed description of the sensor boards in use:

- VCM40 : [The VCM40 Sensor Board](#)<sup>[8]</sup>
- VCM50 : [The VCM50 Sensor Board](#)<sup>[9]</sup>

##### 3.1.1 The VCM40 Sensor Board

This board is used in the VCM40.

It controls the CMOS sensor. It outputs a digital pixel signal

The CMOS sensor used is suited for industrial machine vision tasks.

It can be used as

- 1D grey scale sensor
- 1D color Sensor
- 2D grey scale sensor
- 2D color sensor

It provides the following features:

- 1/3" sensor
- VGA resolution: 640x480 pixels
- square pixel format
- Electronic rolling snap shutter 0.5msec .. 2sec
- can be triggered externally

The VCM40 is suited for 2D inspection on indexed conveyors or in 1D mode on moving conveyors.

If you want to inspect fast moving parts in 2D however, go for the VCM50

The board includes a programmable device (FPGA). The above functions could be provided with this custom-programmed chip only.

The diverse features of this boards (high-speed and low-speed shutter, external trigger, etc.) are configured mainly via software.

For the exact setting of the configuration, refer to the description of the configuration program in the **software documentation**.

### 3.1.2 The VCM50 Sensor Board

This board is used in the VCM50

It controls the CCD sensor, processes the analog signal and outputs an 8bit (of 10 bit) digital signal. The progressive scan type CCD sensor used (SONY ICX098AL-6) is ideally suited for industrial machine vision tasks. In contrast to the conventional technique it provides the following features:

- 1/4" sensor
- VGA quality resolution: 640x480 pixels
- square pixel format
- full-frame shutter
- can be triggered externally
- sensor read out in full-frame mode (non-interlaced)
- shutter speed down to 40  $\mu$ sec

The board includes a programmable device (FPGA). The above functions could be provided with this custom-programmed chip only.

The diverse features of this boards (high-speed and low-speed shutter, external trigger, etc.) are configured mainly via software.

For the exact setting of the configuration, refer to the description of the configuration program in the **software documentation**.

## 3.2 The CPU Board

The board is used in the VCM40 and VCM50 cameras.

It contains an ADSP 2185 signal processor with 80 KBytes of internal RAM, plus 8MB dynamic RAM (DRAM), as well as 512K nonvolatile flash EPROM memory. The board performs the A/D conversion of the video signal.

Board Name	CPU
Processor	ADSP2185 75MHz
VCC	3.3V
DRAM	8 MBytes
Flash-EPROM	early versions 512 KBytes , later 2MB
Performance with respect to VC11	200-300 %

### 3.3 Technical Data on the I/O signals

The cameras of the VCM series have 2 x 24V digital inputs and 4 x 24Vdigital outputs

The camera is supplied with a nominal voltage of 24 V (+/- 10%). The camera stabilizes the supply voltage electronically. A reverse-voltage protection diode protects the camera in case the supply voltage poles are confused.

#### **PLC I/O signals:**

The camera has two digital inputs and four digital outputs for controlling machines and processes.

The PLC-compatible inputs (24-V level, the positive signal is connected) include an input protection circuit. When the camera is operated at 24 V, the input current is approximately 5 mA. The threshold for a logic high signal is 8V. At this voltage, the current is 1 mA.

**Technical data on the I/O signals:****Inputs:**

Operating voltage:	24 V
Absolute maximum voltage:	voltages greater than 40 V can destroy the inputs
Input current:	1 mA
Threshold value:	8 V
Internal signal delay:	none

**Outputs:**

Operating voltage:	24 V +/- 10%, external source
Absolute maximum voltage:	voltages greater than 28 V can destroy the outputs
Type:	galvanically separated by optocoupler / P-channel MOSFET
Switching voltage:	+12 V or + 24 V is switched (high-side switch)
Current:	400mA per output
Absolute maximum current:	2A per output / current is limited by short circuit protection <b>do not short more than one circuit at a time</b>
Protection	Short circuit / overload (chip temperature)
Switching power:	max. 9.6 W (24 V * 400 mA)
Reverse voltage protection	yes, for external voltage
Protection against inductive loads:	built in
Overcurrent protection:	0.5A - 2.0A per output
Resistance when switched on:	< 0,8 Ohm

**The output current limitation is a protective feature. Do not use or design-in this function for any purpose. The device also does not withstand a short circuit or overcurrent of more than one output.**

**Part**

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**IV**

## 4 The Plug Assignments

### Pin Assignment for the VCM sensor connector

Signal	Pin	cable color
V24 RX +	1	white
V24 RX -	2	brown
V24 TX +	3	green
V24 TX -	4	yellow
IN0	5	grey
IN1	6	pink
OUT0	7	blue
OUT1	8	purple
OUT2	9	grey / pink
OUT3	10	red / blue
Power VCC(24V)	11	red
Power GND	12	black

The first 4 signals are used for a 10mA current loop interface.  
These signals are converted to a standard RS232 signal inside of the DSUB connector.

# Part

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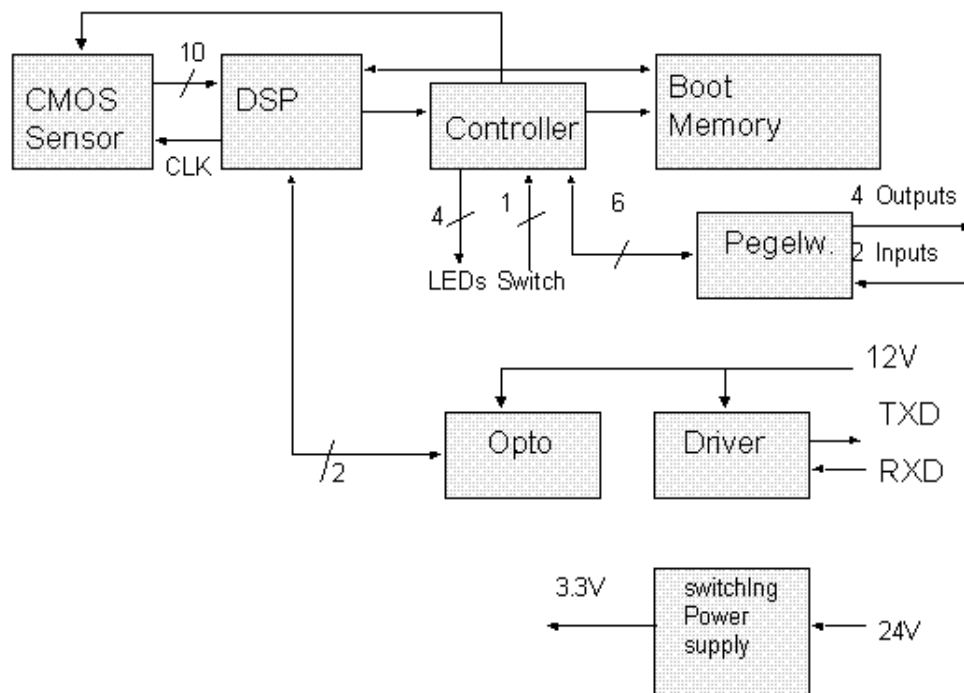


V



## 5 The Block Diagram

Block diagram of the VCM40



The Block diagram of the VCM50 uses a CCD sensor instead of a CMOS sensor. Both VCM40 and VCM50 include 8MB DRAM.

# Part

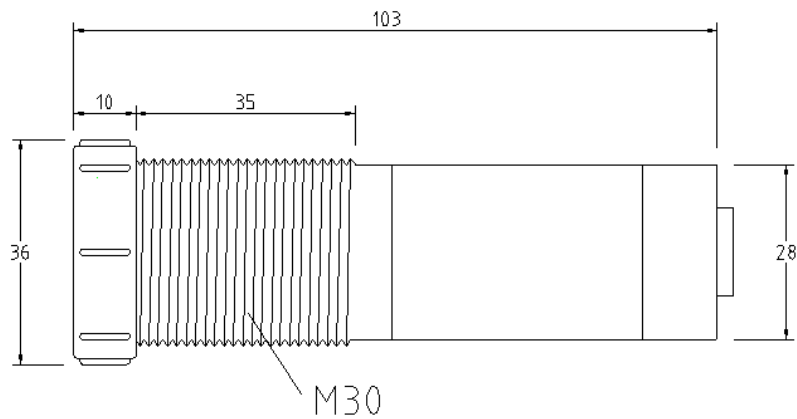
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VI

## 6 Mechanical dimensions

### Mechanical dimensions of VCM40 and VCM50



The length of the VCM sensors is about 100mm plus connector.  
The diameter of the cylindrical casing is 30mm.  
Around the front part of the housing there's a thread.



**Part**

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## 7 The Technical Specifications

This chapter provides the technical specs for the cameras

- [Technical Specifications VCM40](#)  20
- [Technical Specifications VCM50](#)  22

## 7.1 Technical Specifications VCM40

Sensor	1/3" HDCS 2020
eff. no. of pixels	640(H) x 480(V)
Pixel size	7,4(H) x 7,4(V) $\mu\text{m}$
Chip size	4.74(H) x 3.55(V) mm
Color Filter	Gr R B Gb Bayer color filter
Dynamic Range	60dB
Programmable Gain	1-40 (255 steps)
High-speed shutter	down to 1/50000 sec
Low-speed shutter	up to 2 sec adjustable in 0.5 msec steps
Integration	Electronic Rolling Snap (ERS) / progressive scan
Picture taking	without delay, program-controlled or triggered externally, full-frame
Video Format	programmable window, subsampling 1:2 (H/V) and 1:4
A/D conversion	8/10-bit / max 6.25 MHz
Image display	on a PC or Handheld by JPEG Transfer via Serial Interface
Overlay	none
Frame Rate	11.5 fps for VGA resolution / 33.4 fps for 4:1 subsampling (320 x 240)
Processor	Analog Devices ADSP2185 signal processor 75 MHz
Image/data memory	8 MBytes dynamic memory
Memory capacity	14 full-size images 640x480
Flash EPROM	512-KBytes flash EPROM (nonvolatile memory) for programs and data, programmable in the system
Process interface	2 inputs / 4 outputs, 24 V, outputs 4x400 mA / LED monitoring
Output Protection:	0.5 - 2.0 A overcurrent protection + internal thermal protection
Serial interface	10 mA current loop (non-standard( max. 115200 baud / galvanic separation
	Standard RS232 (V24) by converter in serial cable connector
Video output	only by JPEG Transfer via serial interface

Power supply	built-in switching power supply
Supply voltage	24V +/-10% unregulated, DC, max. 50mA (1.2W)+1600mA (38W) for digital I/O
Electrical connections	VCM sensor connector (12 pin)
Operating temperature	-5 C to 45 C, 80% relative humidity, noncondensing

## 7.2 Technical Specifications VCM50

Sensor	1/4" progressive scan SONY ICX098-AL-6
eff. no. of pixels	640(H) x 480(V)
Pixel size	5.6(H) x 5.6(V) $\mu\text{m}$
Chip size	4.6(H) x 3.97(V) mm
Dynamic Range	60dB
Programmable Gain	1-40 (255 steps)
High-speed shutter	24 $\mu\text{s}$ , 104 $\mu\text{s}$ , 184 $\mu\text{s}$ , ...@ clk =9.375MHz 12 $\mu\text{s}$ , 52 $\mu\text{s}$ ,92 $\mu\text{s}$ ,...@ clk =18.75MHz
Low-speed shutter	up to 2 sec adjustable in 0.5 msec steps
Binning	1x, 2x, 4x
Integration	full frame progressive scan
Picture taking	without delay, program-controlled or triggered externally, full-frame
A/D conversion	8/10-bit
Image display	on a PC or Handheld by JPEG Transfer via Serial Interface
Overlay	none
Frame Rate	25 fps for VGA resolution / Options for 50fpsVGA, 100fps@640x240,100fps@640x120 using binning mode
Processor	Analog Devices ADSP2185 signal processor 75 MHz
Image/data memory	8 MBytes dynamic memory
Memory capacity	14 full-size images 640x480
Flash EPROM	512-KBytes flash EPROM (nonvolatile memory) for programs and data, programmable in the system. New Versions will have 2MB
Process interface	2 inputs / 4 outputs, 24 V, outputs 4x400 mA / LED monitoring
Output Protection:	0.5 - 2.0 A overcurrent protection + internal thermal protection
Serial interface	10 mA current loop (non-standard) max. 115200 baud / galvanic separation Standard RS232 (V24) by converter in serial cable connector
Video output	only by JPEG Transfer via serial interface
Illumination:	built-in, 8 high-efficiency white LED's
Power supply	built-in switching power supply
Supply voltage	24V +/-10% unregulated, DC, max. 50mA (1.2W)+1600mA (38W) for digital I/O
Electrical connections	VCM sensor connector (12 pin)
Operating temperature	-5 C to 45 C, 80% relative humidity, noncondensing
Storage temperature	-25 C to 60 C, 95% relative humidity, noncondensing



**Part**

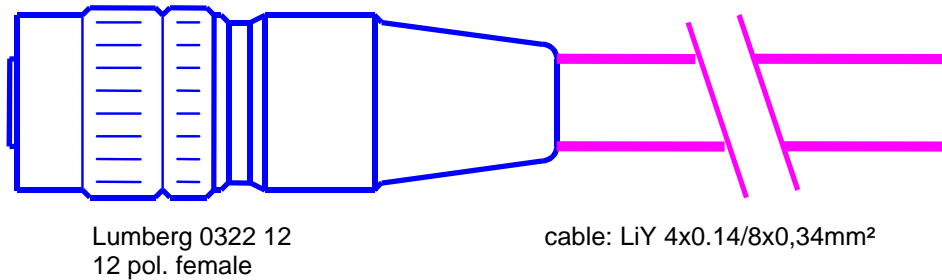


## 8 The Accessories

### 8.1 The VCM Cable

#### VCM RS232 / V24 cable / part1

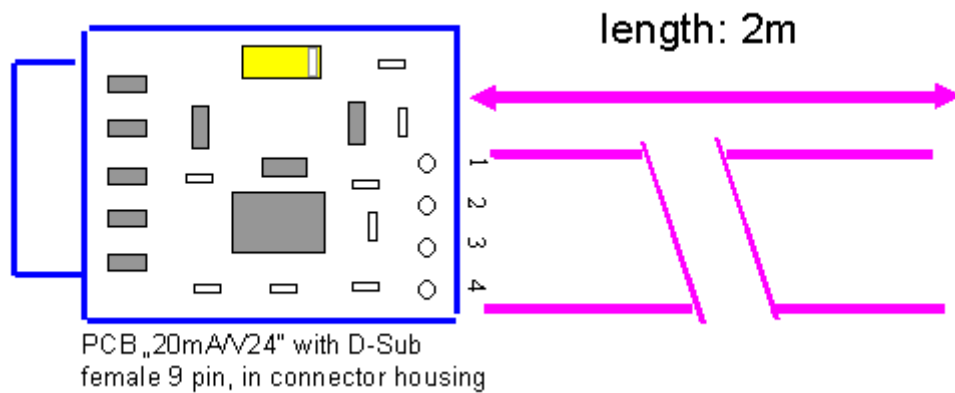
imprint: „VCM V24 "+ Length



connector Lumberg 0322 12 (12pol. female)

Signal	Pin	color
GND	L	black
+24V	M	red
Out0	F	blue
Out1	G	violett
Out2	H	gray / pink
Out3	J	red / blue
In0	K	grey
In1	A	pink
V24 TxD-	B	yellow
V24 TxD+	C	green
V24 RxD-	D	brown
V24 RxD+	E	white

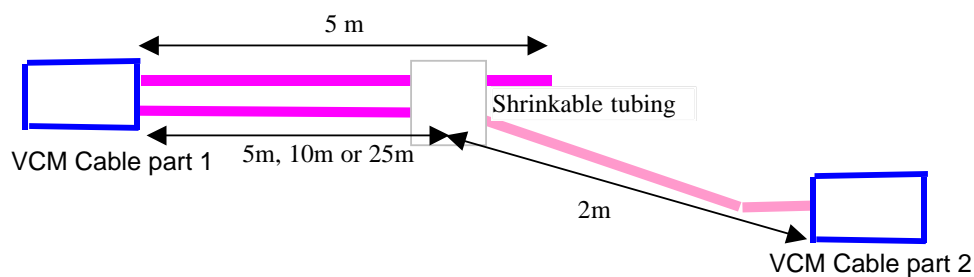
## VCM V24 / RS232 Cable part2



cable LiYCY 4x0,25mm<sup>2</sup>, connected on one side to PCB 20mA/V24 soldered to a 9pin female connector and assembled in a connector housing

Signal	PCB	Color
V24 RxD+	1	white
V24 RxD-	2	brown
V24 TxD-	3	yellow
V24 TxD+	4	green

## VCM RS232 / V24 Cable / part3



VCM cable part 1 soldered to VCM cable part2

connections

pin	color part 1	usage	signal
L	black	open	GND
M	red	open	+24V
F	blue	open	Out0
G	violett	open	Out1
H	gray / pink	open	Out2
J	red / blue	open	Out3
K	gray	open	In0
A	pink	open	In1
B	yellow	to yellow part 2	V24 TxD-
C	green	to green part 2	V24 TxD+
D	brown	to brown part 2	V24 RxD-
E	white	to white part 2	V24 RxD+

# Part

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IX

## 9 CE

### CE Sticker

The cameras have the CE sticker. It certifies that numerous measurements were made proving the device complies with the appropriate EC regulations. Only electromagnetic compatibility was decisive for this product.

This means that the cameras are not permitted to radiate electromagnetic waves in excess of a boundary value layed down in the standard. They must also be insensitive to external radiation (e.g. from cellular telephones). They must not be sensitive to static discharges, etc.

Unfortunately, it is not possible to limit the question of electromagnetic compatibility to just one device or component. The entire system must always be considered.

Thus, the accessories such as cables, power supplies, etc., play a significant role for the VC series cameras.

**The manufacturer guarantees the boundary values for CE compliance only if the original accessories are used.**

### 9.1 Declaration of Compliance

The CE declaration of compliance for the VCM40,VCM50 has the following wording.

#### CE Declaration of Compliance

This certifies that the product designated as follows:

Machine Vision Camera Type VCM40,VCM50

complies with the essential protection demands stipulated in the guideline on electromagnetic compatibility of the Council for Harmonizing Legal Regulations of the Member States (89/336/EWG). This declaration is valid for all examples manufactured according to the attached manufacturing drawings, which are part of this declaration.

The following standards were utilized in judging the electromagnetic compatibility of this product:

EN 50081-2 : 1993  
EN 50082-2 : 1993

This declaration is submitted by

Mr. Michael Engel, owner of the company named below

for the manufacturer

Vision Components GmbH

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Ottostr. 2  
76275 Ettlingen / Germany

Ettlingen, 01.01.2003

# Part

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## 10 Programming

The cameras are programmed in C language by a cross development system. Any commercially available PC can be used. The minimum required configuration is a Pentium II , hard disk, VGA graphics, HD floppy drive and mouse

The original cross development system supplied by Analog Devices (available from VC) includes the following:

- GNU C compiler
- C runtime library
- C source debugger
- ADSP assembler
- ADSP simulator
- Linker
- numerous sample programs (FFT, etc.) in ADSP assembly language

The following libraries and aids are also available:

- Real-time operating system for VC cameras with control of video I/O signals, control of the serial interface and of the PLC I/O signals, file management system for flash EPROM
- Real-time debugger
- In-circuit emulator
- The emulator is connected to the standard serial interface of a PC. The camera housing must be opened and the emulator cable must be connected with the diagnosis plug of the camera.
- The emulator supports debugging in C and assembly language.
- Standard image processing library
- Filters (e.g. Sobel, Median, Laplace, 3x3, etc.), imaging operations (addition, subtraction, etc.),
- transformations (FFT, etc.) image averaging and noise filters, fast binary image processing
- with run-length code (AND, OR, XOR, segmentation, morphological operations), feature extraction (area, center of gravity, momentum, etc.), graphic functions and much more.
- JPEG image compression
- compression and decompression of images according to the JPEG standard
- Measurement library (by third party)
- Subpixel sampling, compensation of optical properties and diffraction effects, auto-focus, best straight line, best circle

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