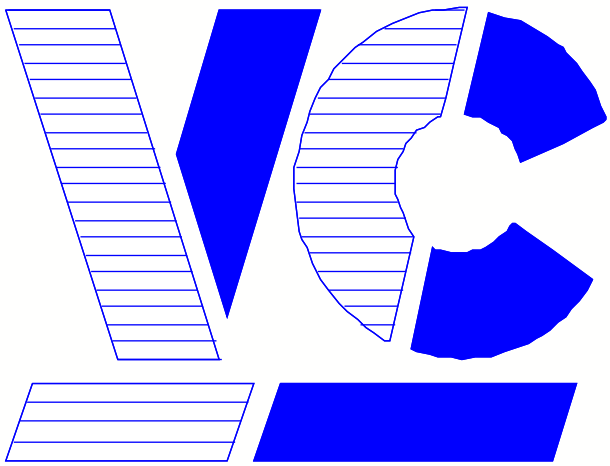

Vision Components

The smart camera people ...

Technical Documentation VCSBC50

Oktober 2003

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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.

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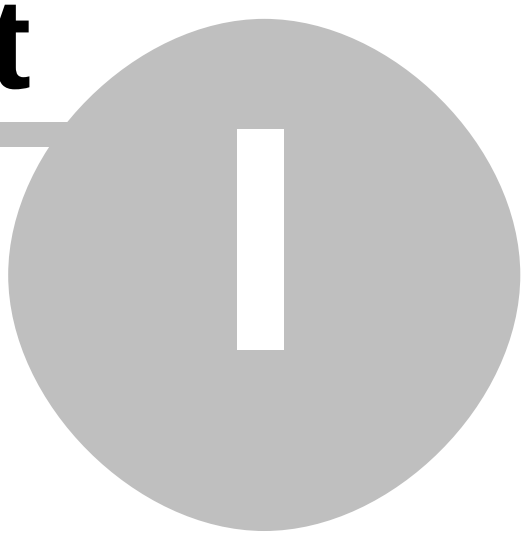

1 Introduction

Technical Documentation

Vision Components

Smart Vision Sensors VCSBC50

1.1 General Information

The VCSBC50 Smart Vision Sensor is a compact, light-weight optical sensor equipped with a high-resolution (640x480) Progressive Scan CCD Sensor chip.

It is perfectly suited for industrial machine vision tasks.
Unlike cameras using CMOS sensors the VCSBC50 sensor is able to inspect fast

moving parts with its built-in global highspeed shutter..

As it comes without housing and with a small footprint, it can perfectly be integrated by OEMs into new or existing machines.

VCSBC50 sensors are not just cameras, but feature a built in high-performance DSP with 80 KBytes of on-chip memory, which does all the necessary processing. The VCSBC50 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 and quality. 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 (12-24 volts). PLC compliant I/Os with 12-24V operating voltage and a RS232 serial interface allow for communication with the outside world.

To improve connectivity there are 12 LVTTL outputs and 2 LVTTL inputs available (3.3V).

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.

The VCSBC50 sensors are fully software compatible to the VCM50 cameras.

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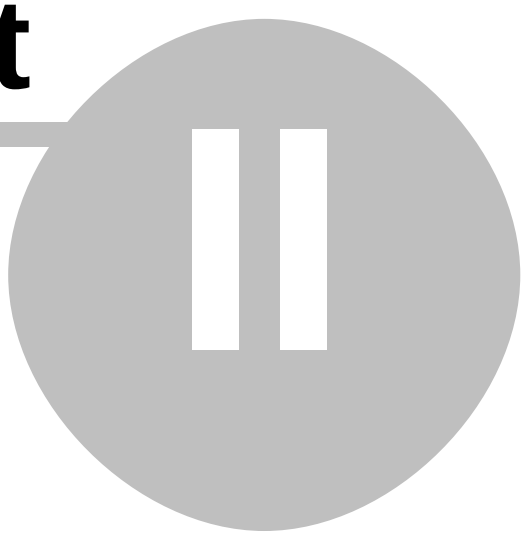

2 Basic Structure

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 VCSBC50 Vision Sensors come as board version without housing and include a holder for 12mm lenses. Lenses and CS-Mount resp. C-Mount lens holders are available as an option.

The electronic circuitry of the cameras is placed on one board.

The following presents an overview of the sections:

Description	Function
Sensor section 6	Receives signals from and controls the CCD sensor. Produces the video and clock signals.
CPU section 7	Digitalization of the video signal. Complete signal processor with 8MB DRAM, and 2MB Flash Memory Switched Power Supply 2W, PLC interfaces, Serial interface etc
I/O section 7	2 PLC Inputs, 4 PLC Outputs, 12LVTTL Outputs, 2 LVTTL Inputs, RS232

The camera is supplied with a nominal voltage of 12-24 V . The camera stabilizes the supply voltage electronically. A reverse-voltage protection diode protects the camera in case the supply voltage poles are confused.

2.1 The Sensor Section

It controls the progressive scan 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)

- ultra short shutter speed
- 2x binning, 4x binning

The image is acquired from a progressive scan CCD 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.

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

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

2.2 The CPU Section

It contains an ADSP 2185 signal processor with 80 KBytes of internal RAM, plus 8MB dynamic RAM (DRAM), as well as 2MB of nonvolatile flash EPROM memory.

Processor	ADSP2185 75MHz
DRAM	8 MBytes
Flash-EPROM	2 MBytes
Performance with respect to VC11	200-300 %

2.3 The I/O Section

The cameras of the VCSBC50 series have 2 x 24V digital inputs and 4 x 24Vdigital outputs

The PLC-compatible inputs include an input protection circuit.

Technical data on the I/O signals:

- PLC I/O 8
- Low Voltage TTL Signals 9

The RS232 Interface and the power supply share a common ground. The user should therefore avoid ground loops, which is a common source of failure in factory electronic equipment.

2.3.1 PLC I/O

Inputs:

Operating voltage:	12-24 V
Absolute maximum voltage:	voltages greater than 30 V can destroy the inputs
Input current:	0.8 mA @ 12V, 1.6mA @ 24V
Threshold value:	low < 2.5V, High > 8 V
Internal signal delay:	none

Outputs:

Operating voltage:	12-24 V external source
Absolute maximum voltage:	voltages greater than 30 V can destroy the outputs
Switching voltage:	+12 V or + 24 V is switched (high-side switch)
Current:	400mA per output
Absolute maximum current:	2A per output short circuit protected. **Do not short more than one circuit at a time**
Protection	Short circuit / overload (chip temperature)
Switching power:	max. 9.6 W per Output (24 V * 400 mA)
Reverse voltage protecion	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. Overloaded output drivers may generate excessive heat.

2.3.2 Low Voltage TTL Signals

Inputs:

Operating Voltage	3.3V
Threshold Value	Low <0.7, High >1.5
Pull Up Resistor	on-board 4K7

Outputs:

Operating Voltage	3.3V
Max. Output Current	24mA

The RS232 Interface:

Baurate	<= 115200 baud
Bits per Character	8
Parity	None
Start Bits	1
Stop Bits	1
Hardware Handshake	none

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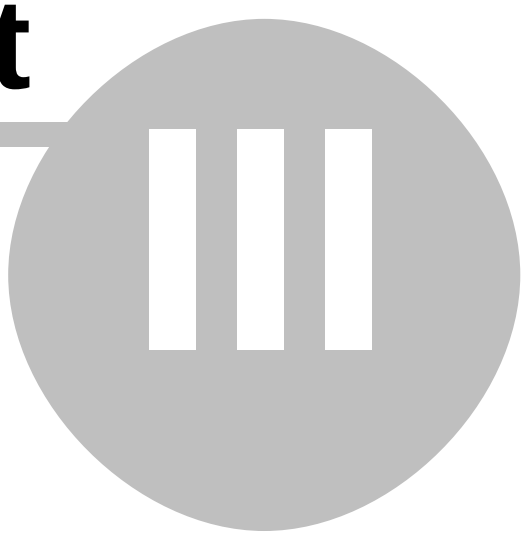
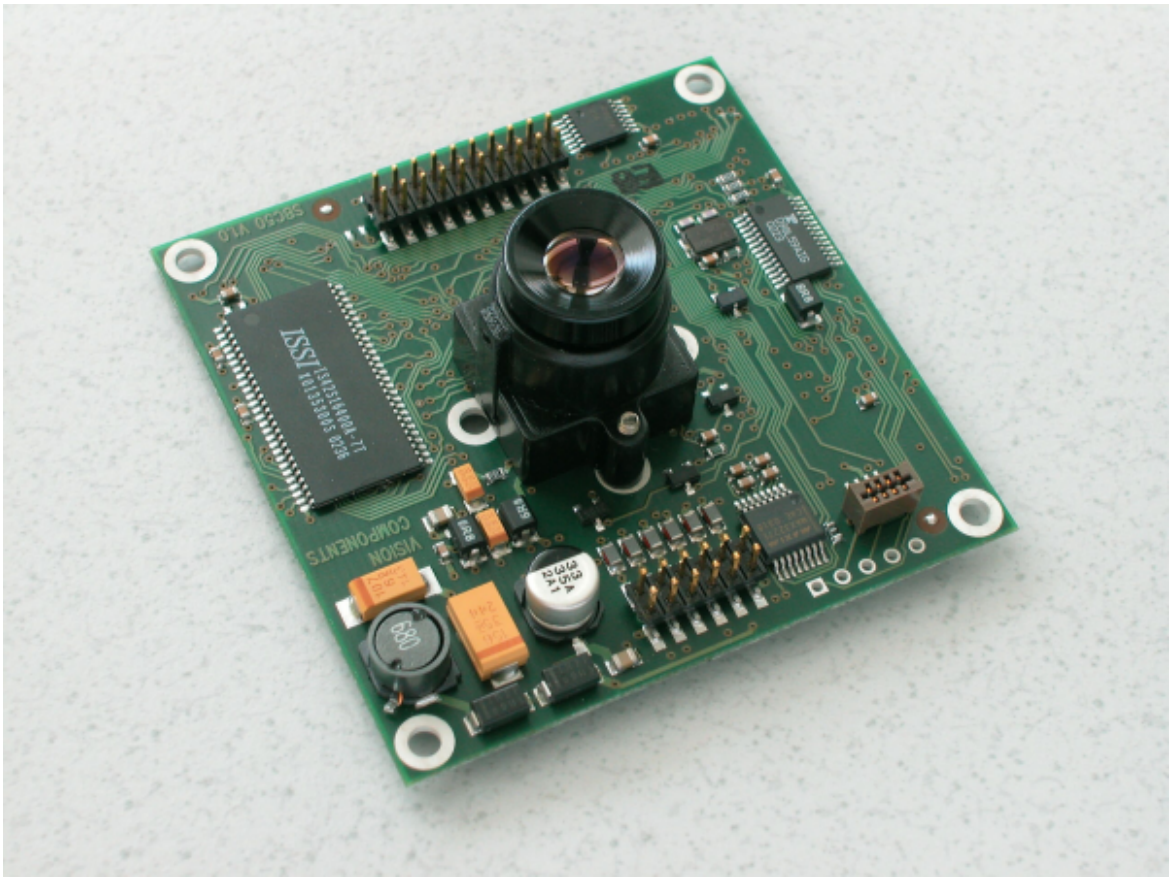


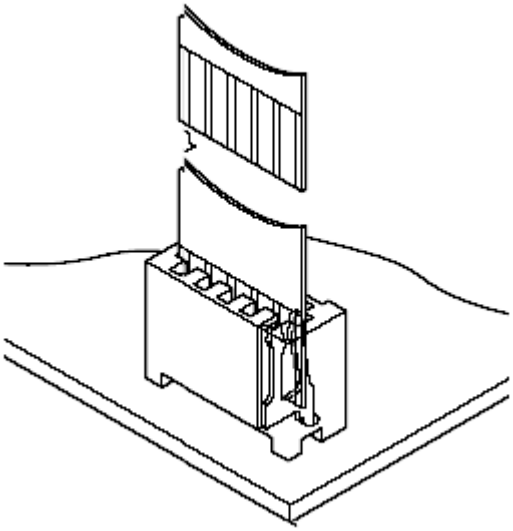
3 The Connectors

The VCSBC50 connectors:



ST1 12 **Illumination Connector**
ST2 13 **Expansion Port Connector**
ST3 14 **Sensor Connector**

3.1 ST1 Illumination Connector



SBC50 Illumination Connector (ST1)

Pin	Signal
1	GND
2	+24V (1)
3	Marker enable (2)
4	Illumination enable (2)

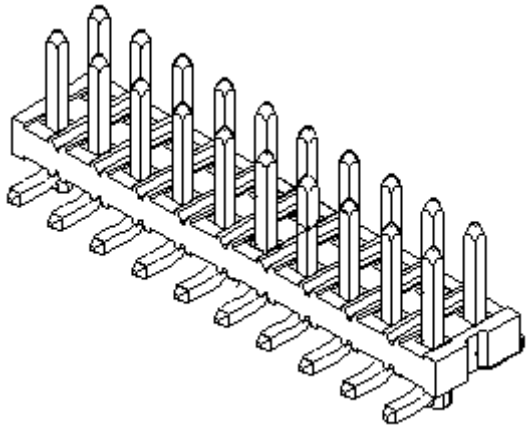
Legend:

(1) Voltage is filtered but not regulated (i.e. voltage equals Power supplied to board)
Maximum current: 100mA
(2) 3.3V active high CMOS/TTL signals, intendend to switch illumination / marker

CAUTION: be careful not to reverse the flat cable

Flat cables are available in 80mm and 200mm

3.2 ST2 Expansion Port Connector



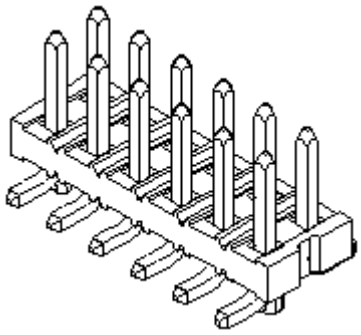
SBC50 Expansion Port Pin Assignment (ST2)

Pin	Signal	Pin	Signal
1	Q01 (G0)	2	Q03 (G1)
3	Q05 (G2)	4	Q07 (G3)
5	Q09 (G4)	6	Q11 (G5)
7	Q12	8	Q13
9	Q00 (R0)	10	Q02 (R1)
11	Q04 (R2)	12	Q06 (R3)
13	Q08 (R4)	14	Q10 (R5)
15	Switch Inp.	16	Overcurrent Input
17	R0	18	DT0
19	Vcc (3.3V)	20	GND

Legend:

Q00 – Q13	digital LVTTL outputs when used as LED outputs, connect G0 and R0 to the red and green inputs of bicolored LED, common anode of LED to Vcc
Switch Inp.	LVTTL input with built-in pull-up resistor, may be directly connected to switch (to GND).
Overcurrent Input	LVTTL input with built-in pull-up resistor, used as internal overcurrent signal for VCM50 may be used as general purpose input, may also be connected to switch (to GND).
DR0	RS232 receive signal may be used for different communication link (e.g. RS485) In this case, connect output of RS485 receiver with DR0 and remove JP1 (0R Resistor) on main board
DT0	RS232 transmit signal may be used for different communication link (e.g. RS485) In this case, connect input of RS485 transmitter with DT0
Vcc	3.3V board main voltage, Imax = 100mA

3.3 ST3 SBC50 Sensor Connector



Pin Assignment for the SBC50 sensor connector (ST3)

Pin	Signal	Cable color	Cable color	Signal	Pin
1	Out0	blue	red	Power (24V)	2
3	Out1	purple	black	Power GND	4
5	Out2	grey / pink	green	TxD	6
7	Out3	red / blue	yellow	GND	8
9	In0	grey	white	RxD	10
11	In1	pink	brown	GND	12

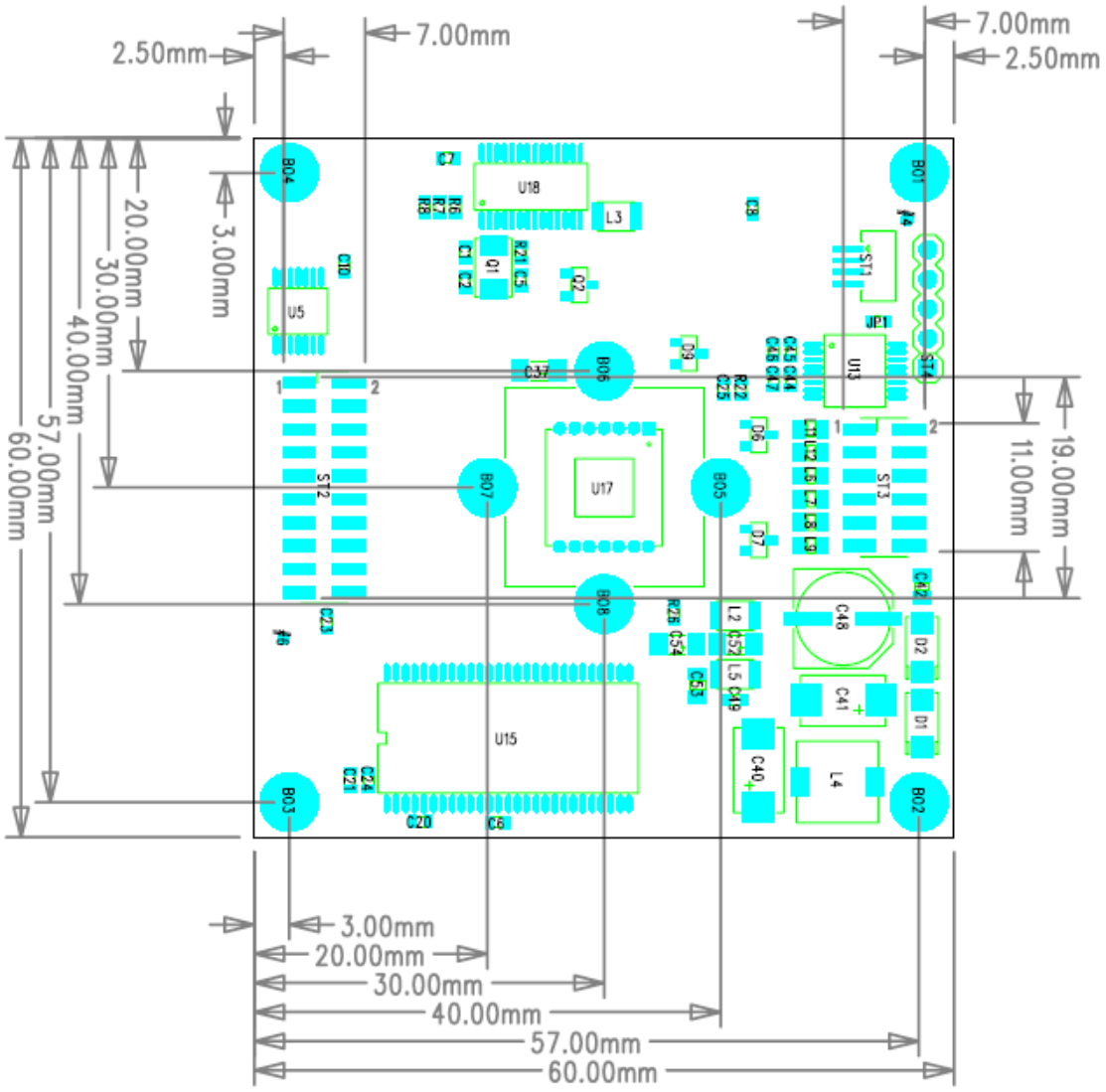
Power supply (Power 24V):

Nominal Voltage:	12V – 24V
Minimum operational voltage (including ripple):	9V
Maximum operationalVoltage (including ripple):	30V

Part IV

4 Mechanical dimensions

Mechanical dimensions of the VCSBC50



Part V

5 The Technical Specifications

This chapter provides the technical specs for the camera

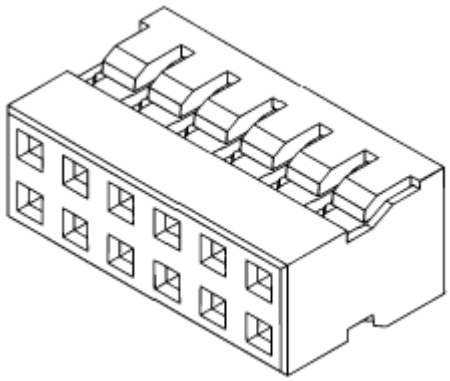
5.1 Technical Specifications VCSBC50

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) µm
Chip size	4.6(H) x 3.97(V) mm
Dynamic Range	60dB
Programmable Gain	1-40 (255 steps)
High-speed shutter	24us, 104us, 184us, ...@ clk =9.375MHz 12us, 52us,92us,...@ 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 esolution, 100fps@640x240, 200fps@640x120 using binning mode / Option for 50fpsVGA,
Processor	Analog Devices ADSP2185 signal processor 75 MHz
Image/data memory	8 MBytes dynamic memory
Memory capacity	24 full-size images 640x480
Flash EPROM	2MB flash EPROM (nonvolatile memory) for programs and data, programmable in the system.
Process interface	2 inputs / 4 outputs, 24 V, outputs 4x400 mA
Output Protection:	0.5 - 2.0 A overcurrent protection + internal thermal protection
Serial interface	Standard RS232 (V24)
Video output	only by JPEG Transfer via serial interface
Illumination:	option: 8 high-efficiency white LED's
Power supply	built-in switching power supply
Supply voltage	12-24V (min 9V, max 30V) unregulated, DC, max. 160mA (1.5W)+1600mA (38W) for digital I/O
Operating temperature	-5 C to 45 C, 80% relative humidity, noncondensing
Storage temperature	-25 C to 60 C, 95% relative humidity, noncondensing
Shock acceleration	< 50 g

Part VI

6 The Accessories

6.1 The VCSBC50 cable



12pin crimp connector, cable length 50 cm

Pin	Signal	Cable color	Cable color	Signal	Pin
1	Out0	blue	red	Power (24V)	2
3	Out1	purple	black	Power GND	4
5	Out2	grey / pink	green	TxD	6
7	Out3	red / blue	yellow	GND	8
9	In0	grey	white	RxD	10
11	In1	pink	brown	GND	12

6.2 Flat Cables

The flat cables in use have 4 wires and a 1mm pitch for through-hole soldering at one side and fit into the ST1 flat cable connector at the other side.
They are available in 80mm and 200mm length.

Part

7 CE resp. FCC

The VCSBC50 sensors modules aren't stand alone devices, but always part of an assembly.

Please note:
Electromagnetic compliance tests cannot be performed for just curcuit boards. It is therefore the users responsibility to undertake the appropriate electromagnetic compliance tests for the complete assembly.

For fully CE / FCC complient devices, we recommend our software compatible VCM50 smart camera.

7.1 Hints for the CE / FCC compliant integration

1. Mount the board to a completely shielded housing (metal housing, esp. steel) with only small holes left for lense and connectors.
2. Electrically connect the different parts of the housing.
3. Attach the board to the housing, with good electrical contact (*)
4. Keep cables for outside connection short
5. In case of problems use shielded cables and / or additional ferrit beds for all outside signals
6. Use EMI filters for all signals not filtered on the board (*), when signals are used outside the housing (ST1, ST2)

(*) The VCSBC50 board contains EMI filters for ST3, but not for other connectors. It is necessary for the correct operation off the filters, to mount the board to the housing / shield using 4 appropriate srews plus lock washers.

Part

8 Programming

The VCSBC50 sensors are fully software compatible to the VCM50 cameras.

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 an 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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