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VCSBC nano Single Board Series Operating Manual

Hardware specifications and special software functions of SBC nano Single Board Smart Cameras

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since 1996

Foreword and Disclaimer

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Please also consult the following resources for further reference:

"**Knowledge Base / FAQ**" for a searchable data base of SW and HW questions / answers

Description	Title on Website	Download Area on VC website
Quick start Manual for VC camera set up and programming	Getting Started VC Smart Cameras with TI DSP	Service & Support > Download Center
Schnellstart VC – deutsche Version of „Getting Started VC".	Schnellstart VC Smart Kameras	Service & Support > Download Center
Introduction to VC Smart Camera programming	Programming Tutorial for VC20XX and VC40XX Cameras	Service & Support > Download Center
Demo programs and sample code used in the Programming Tutorial	Tutorial Code	Service & Support > Download Center
VC40xx Hardware Manual	VC40XX Smart Cameras Hardware Documentation	Service & Support > Download Center
VCRT Operation System Functions Manual	VCRT 5.0 Software Manual	Service & Support > Download Center
VCRT Operation System TCP/IP Functions Manual	VCRT 5.0 TCP/IP Manual	Service & Support > Download Center
VCLIB 2.0 /3.0 Image Processing Library Manual	VCLIB 2.0/ 3.0 Software Manual	Service & Support > Download Center

- The Light bulb highlights hints and ideas that may be helpful for a development.

- This warning sign alerts of possible pitfalls to avoid. Please pay careful attention to sections marked with this sign.

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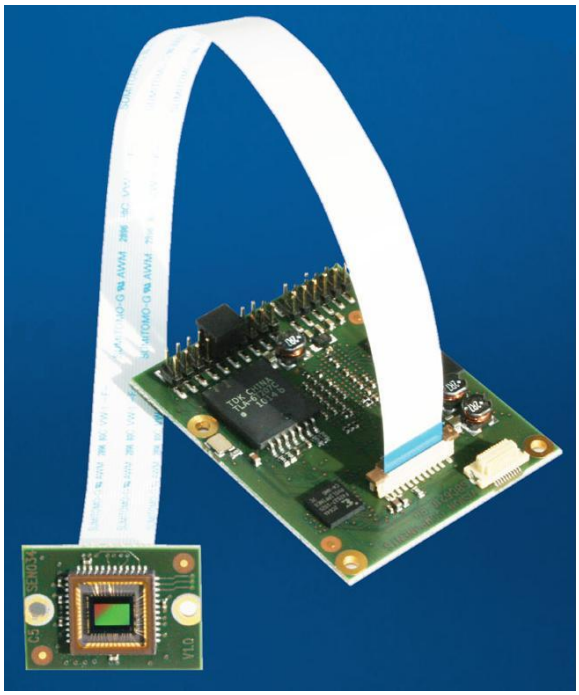
1 General Information

VCSBC nano Single Board Camera



VCSBC nano RH Board Camera

The **VCSBC nano Series Smart Cameras** have been designed for high resolution image processing with a very small form factor. They are the ideal compromise between high performance and low system costs, and thus especially suited for high volume OEM applications. This makes them viable to use a smart camera in even more products than before.

Employing a CMOS sensor, the image resolution can be changed to the ROI required.

Like with all VC Smart Cameras with Texas Instruments DSP, the operation system VCRT allows multi-tasking. This means for instance that user interface commands can execute in parallel without stopping the inspection process. It is also possible to transfer live images via TCP/IP using a background task.

The **VCSBC nano Series Smart Cameras** offer an inexpensive entrance into the world of the high performance intelligent cameras. It has a video output onto a PC via 100MBit Ethernet interface, a high speed trigger input and output, 12-24 V digital Inputs and open collector outputs and additional TTL IOs.

Some **VCSBC nano Smart Cameras** are also available with remote head (**nano RH Series**).

The extremely low power consumption of only 1.5W makes this camera ideally suitable for use in mobile devices.

2 Technical Specifications

2.1 Technical Specifications VCSBC4012nano

Component / Feature	Specification
CMOS Sensor:	1/ 2.5" Aptina MT9P031 - also available with color sensor (Bayer Filter)
Active pixels:	2592(H) x 1944(V)
Pixel size:	2.2(H) x 2.2(V) µm
Active sensor size:	5.70(H) x 4.28(V) mm
High-speed shutter:	28.4 µs + steps of 43.7 µs
Low-speed shutter:	up to 30 sec. adjustable integration time
Integration:	“Electronic rolling shutter” (ERS) and “Global Reset Release” (GRR)
Picture taking:	program-controlled, full-frame / 11.6 frames per second, external high speed trigger
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	80 MHz / 12 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320C64XX signal processor 400 MHz, 3200MIPS
RAM:	64 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 13 full-size grey value images in format 2592 x 1944
Flash EPROM:	4 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable, 3 MB available to user
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x80 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
CE certification:	No CE Certification from Vision Components as the OEM customer is required to certify entire system (including housing, cabling, etc.).
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

2.2 Technical Specifications VCBSC6010nano

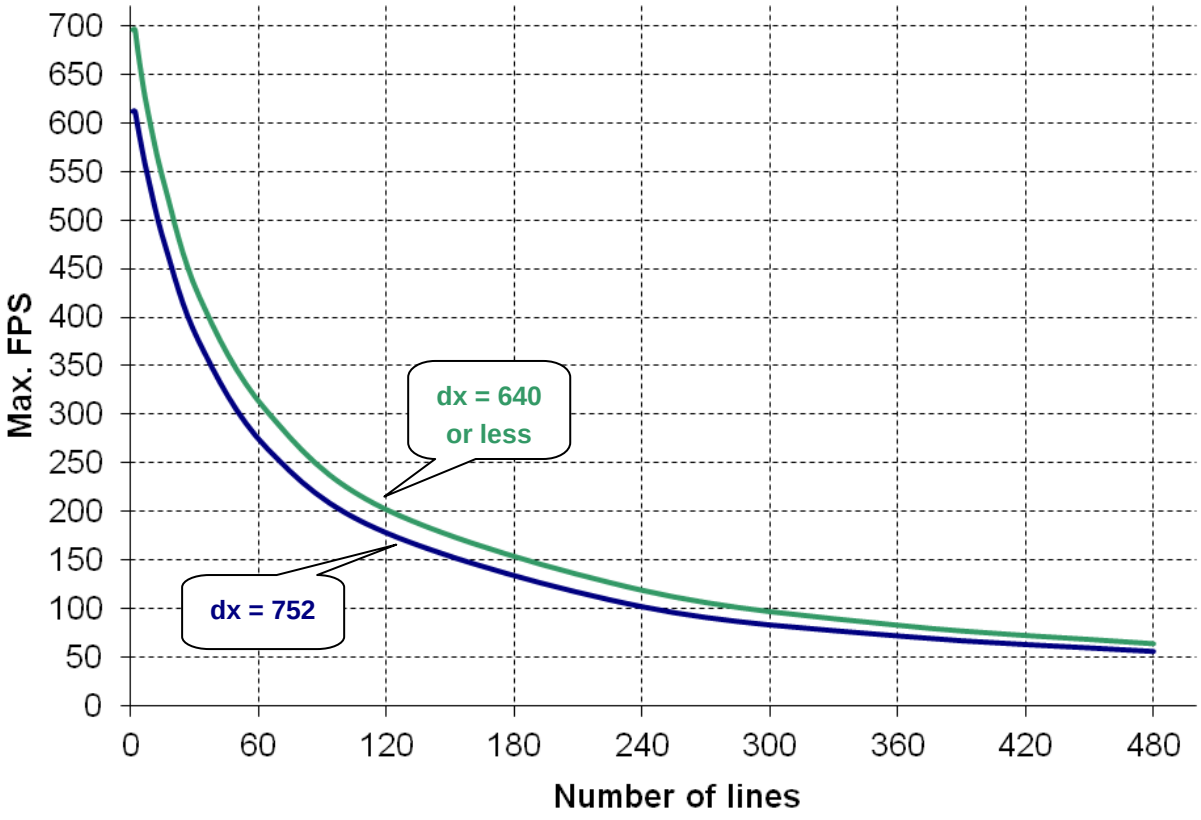
Component / Feature	Specification
CMOS Sensor:	1/3" Aptina MT9V034 - also available with color sensor (Bayer Filter)
Active pixels:	752(H) x 480(V) (Wide VGA)
Pixel size:	6.0(H) x 6.0(V) µm
Active sensor size:	4.51(H) x 2.88(V) mm
High-speed shutter:	34 µs + steps of 34 µs
Low-speed shutter:	up to 2 sec. adjustable integration time
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (55 frames per second) & partial scanning, jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	27 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6431 “Da Vinci” DSP 300 MHz, 2400MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 300 full-size grey value images in format 752 x 480
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

2.3 Technical Specifications VCSBC6210nano

Component / Feature	Specification
CMOS Sensor:	1/3" Aptina MT9V034 - also available with color sensor (Bayer Filter)
Active pixels:	752(H) x 480(V) (Wide VGA)
Pixel size:	6.0(H) x 6.0(V) µm
Active sensor size:	4.51(H) x 2.88(V) mm
High-speed shutter:	34 µs + steps of 34 µs
Low-speed shutter:	up to 2 sec. adjustable integration time
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (55 frames per second) & partial scanning, jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	27 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 300 full-size grey value images in format 752 x 480
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

The following diagram shows the **maximum** reachable (with the shortest shutter time) framerate according to the number of captured lines for the **VCSBC6010** and **VCSBC6210**, in 2 cases:

- with an image width of 752 pixels
- with an image width of 640 pixels or less



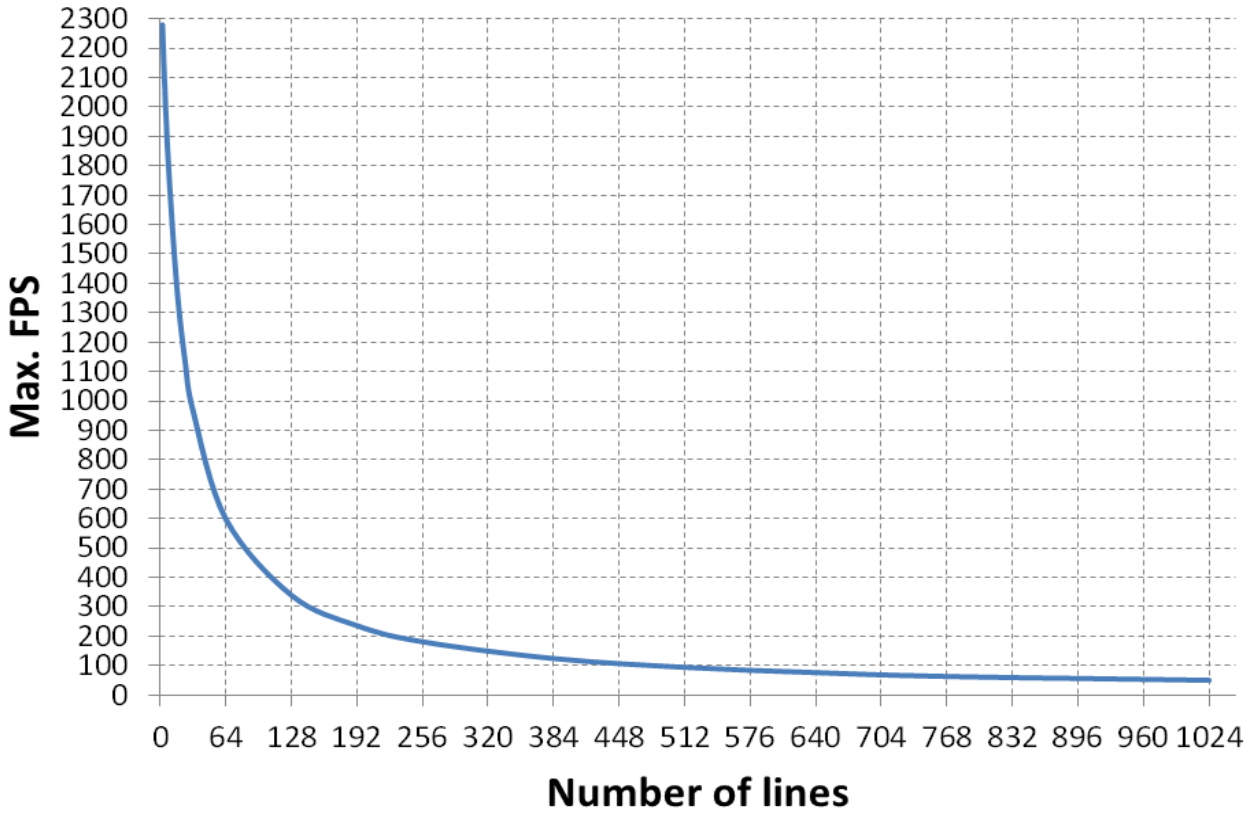
The following table gives some example values.

Number of lines	Max. framerate (FPS) dx = 752	Max. framerate (FPS) dx = 640 or less
480	56	64
360	72	83
240	102	119
120	178	202
64	265	303
32	375	422
16	475	535
8	545	612
4	588	664
2	612	696
1	612	696

2.4 Technical Specifications VCSBC6211nano

Component / Feature	Specification
CMOS Sensor:	1/1.8" e2V EV76C560 - also available with color sensor (Bayer Filter)
Active pixels:	1280(H) x 1024(V)
Pixel size:	5.3(H) x 5.3(V) µm
Active sensor size:	6.8(H) x 5.5(V) mm
High-speed shutter:	21 µs + steps of 21 µs
Low-speed shutter:	up to 1.35 sec. adjustable integration time
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (50 frames per second) & partial scanning (up to 4500 fps for 1280x1), jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	100 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 90 full-size grey value images in format 1280 x 1024
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

The following diagram shows the **maximum** reachable (with the shortest shutter time) framerate according to the number of captured lines for the **VCSBC6211**:



The following table gives some example values.

Resolution	Max. framerate (FPS)
1280 x 1024	50
1280 x 768	63
1280 x 640	76
1280 x 512	94
1280 x 384	124
1280 x 256	181
1280 x 192	236
1280 x 128	339
1280 x 64	598
1280 x 32	965
1280 x 16	1392
1280 x 8	1795
1280 x 4	2092
1280 x 2	2280
1280 x 1	4500

2.5 Technical specifications VCSBC6212nano

Component / Feature	Specification
CMOS Sensor:	1/ 2.5" Aptina MT9P031 - also available with color sensor (Bayer Filter)
Active pixels:	2592(H) x 1944(V)
Pixel size:	2.2(H) x 2.2(V) µm
Active sensor size:	5.70(H) x 4.28(V) mm
High-speed shutter:	28.4 µs + steps of 43.7 µs
Low-speed shutter:	up to 30 sec. adjustable integration time
Integration:	“Electronic rolling shutter” (ERS) and “Global Reset Release” (GRR)
Picture taking:	program-controlled, full-frame / 11.6 frames per second, external high speed trigger
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	80 MHz / 12 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 13 full-size grey value images in format 2592 x 1944
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

2.6 Technical specifications VCSBC6215nano

Component / Feature	Specification
CMOS Sensor:	1/1.8" e2V EV76C570 - also available with color sensor (Bayer Filter)
Active pixels:	1600(H) x 1200(V)
Pixel size:	4.5(H) x 4.5(V) µm
Active sensor size:	7.2(H) x 5.4(V) mm
High-speed shutter:	1 µs
Low-speed shutter:	up to 1.28 sec. adjustable integration time
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (42 frames per second) & partial scanning, jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	100 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 60 full-size grey value images in format 1600 x 1200
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	Not available
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non-condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non-condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈1.5W

The following table gives some example values of maximum reachable framerates for the VC6215.

Resolution	Max. framerate (FPS)
1600 x 1200	42
1600 x 1024	49
1600 x 768	64
1600 x 640	77
1600 x 512	96
1600 x 384	127
1600 x 256	185
1600 x 192	240
1600 x 128	345
1600 x 64	609
1600 x 32	984
1600 x 16	1420
1600 x 8	1795

2.7 Technical Specifications VCSBC6222nano RH

Component / Feature	Specification
CMOS Sensor:	2/3" CMOSIS CMV2000 - also available with color sensor (Bayer Filter)
Active pixels:	2048(H) x 1088(V)
Pixel size:	5.5(H) x 5.5(V) µm
Active sensor size:	11.3(H) x 6.0(V) mm
High-speed shutter:	16.3 µs + steps of 5.1 µs
Low-speed shutter:	-
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (46 frames per second) & partial scanning, jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	100 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 50 full-size grey value images in format 2048 x 1088
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	n.a.
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈2.0W

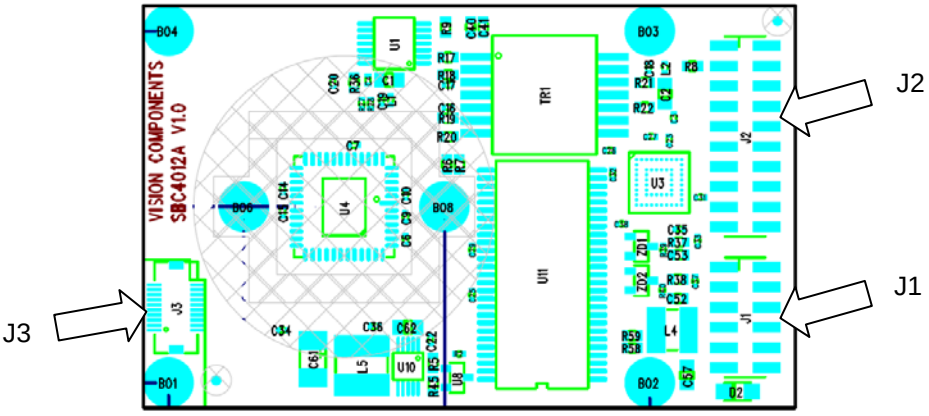
2.8 Technical Specifications VCSBC6224nano RH

Component / Feature	Specification
CMOS Sensor:	1" CMOSIS CMV4000 - also available with color sensor (Bayer Filter)
Active pixels:	2048(H) x 2048(V)
Pixel size:	5.5(H) x 5.5(V) µm
Active sensor size:	11.3(H) x 11.3(V) mm
High-speed shutter:	27.3 µs + steps of 5.1 µs
Low-speed shutter:	-
Integration:	Global shutter
Picture taking:	program-controlled or external high speed trigger, full-frame (23 frames per second) & partial scanning, jitterfree acquisition
Parallel image acquisition	Not available
Clamping:	Internal to sensor
A/D conversion:	100 MHz / 10 bit, only the 8 most significant bits used for grey values
Input LUT	none
Image Display	Via 100 Mbit Ethernet onto PC
Processor:	Texas Instruments TMS320DM6435 “Da Vinci” DSP 700 MHz, 5600MIPS
RAM:	128 Mbytes SDRAM (synchronous dynamic RAM)
Memory capacity:	Up to 25 full-size grey value images in format 2048 x 2048
Flash EPROM:	32 Mbytes flash EPROM (nonvolatile memory) for programs and data, in-system programmable
SD card:	n.a.
Process interface:	2 inputs / 4 outputs, outputs 4x400 mA
Additional LVTTL IOs:	4 Inputs, 4 Outputs, I2C Clock and Data signals (I2C also used internally for Sensor control), trigger Input, Flash output
Ethernet interface:	10/100 Mbit
Serial interface:	Optional
CE certification:	CE Certification from Vision Components
Storage Conditions	Temperature: -20 to 60 deg C, Max. humidity: 90%, non condensing.
Operating Conditions	Temperature: 0… +55 deg C, Max. humidity: 80%, non condensing.
Power Supply	24V +/-20% DC, max. 300 mA
Power Consumption	≈2.0W

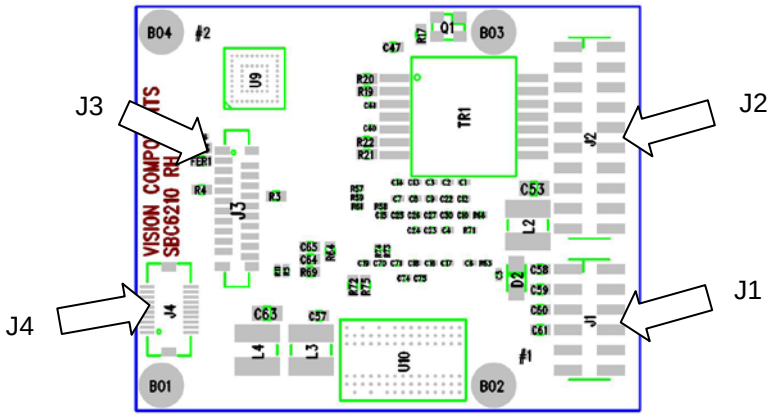
The following table gives some example values of the maximum reachable framerate with the VCSBC6222 and VCSBC6224 cameras.

Resolution	Max. framerate (FPS)
1024 x 768	120
1024 x 256	370
640 x 480	320
2048 x 64	637
2048 x 1	15 – 24 kHz

3 Camera Interfaces



VCBSC nano



VCBSC nano RH

The **VCSBC nano** Series camera boards incorporate the following connector interfaces:

J 1 : Power and IO Connector
J 2: Ethernet, trigger and Expansion Port Connector
J 3: Emulator Connector

The **VCSBC nano RH** Series camera boards incorporate the following connector interfaces:

J 1 : Power and IO Connector
J 2: Ethernet, trigger and Expansion Port Connector
J 3: Sensor head connector
J 4: Emulator Connector

All cameras of the SBC nano series are available with remote head (6210, 6211, 6212, 6215).

The pin assignments, electrical specifications as well as available accessories are shown for each interface connector in the following sections.

J1: Power Supply and IO Interface

The J1 connector includes the camera power supply and the digital IOs.

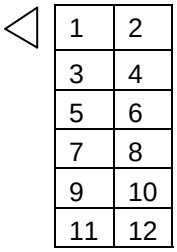
3.1.1 Pin Assignments J1 camera socket

Pin Number	Signal	Core Color[1]
1	Out0	Blue
2	Power (24V)	Red
3	Out1	purple
4	Power GND	Black
5	Out2	Grey/ red
6	In0	Green
7	Out3	Blue/ red
8	In1	Yellow
9	GND	grey
10	GND	white
11	N.C.	pink
12	3.3V out	brown

J1 Standard VCSBC nano and VCSBC nano RH:
Molex: ***8783212-20***

Note that the pin allocation differs from the J3 connector of the VCSBC4018/16 board cameras!

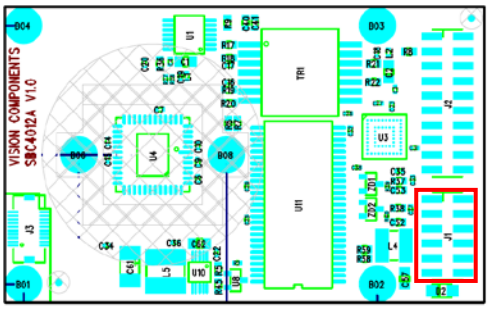
Pin Locations



1	2
3	4
5	6
7	8
9	10
11	12

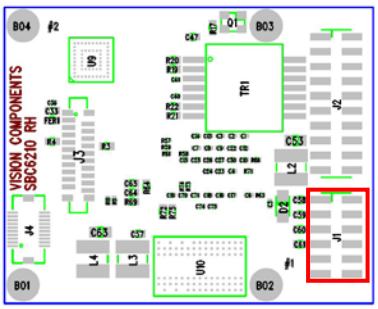
If board orientation as shown below:

VCSBC nano



J1

VCSBC nano RH



[1] According to matching Power / PLC Cable VK000173

3.1.2 Electrical specifications digital IO s J1 interface

The camera has two PLC compatible inputs and four PLC compatible open-collector outputs for controlling machines and processes.

Inputs and outputs are not galvanically separated from the supply voltage.

A protective diode ensures, the poles of the supply voltage from the power supply of the PLC can not be swapped.
The outputs are floating when high – external pull up resistor required.

Input Signals IO interface

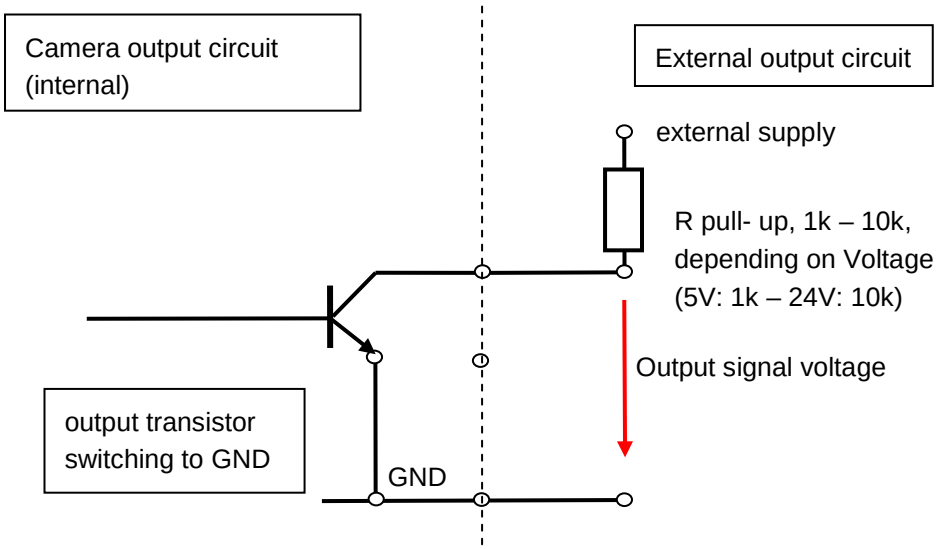
Nominal voltage:	12 – 24 V
Absolute maximum voltage:	voltages greater than 40 V can destroy the inputs
Type:	Circuit GND directly connected
Input current:	1 mA @ 24V
Threshold value:	10 V
Internal signal delay:	- No delay for direct IO access - 10ms delay for DSP polling

The PLC-compatible inputs (24-V level, the positive signal is detected) include input protection circuits. A minimum voltage of 10V is required to reliably sense a logic high signal.

Output Signals IO Interface

Operating voltage:	Depends on external output supply
Absolute maximum voltage:	voltages greater than 40 V can destroy the outputs
Type:	BC850 open collector
Switching voltage:	negative switching (NPN), output high switching to GND
Current:	max. 80 mA per output
Absolute maximum current:	total currents greater than 80 mA per output can destroy plugs and cables no inductive/ capacitive load allowed
Switching power:	max. 1.0 W per output
Protection against inductive loads:	no
Resistance when switched on:	20 Ohm
Short circuit protection:	No protection

Suggested external circuit for using camera outputs NPN



3.1.3 Electrical specifications of the VCSBC nano Series Power Supply J1 interface

Nominal Voltage:	12V – 24V
Nominal Power Consumption[2]:	1.5W
Minimum operational voltage (including ripple):	9V
Minimum nominal Operating voltage and corresponding current:	12V 116mA [3]
Maximum nominal Operating voltage and corresponding current:	24V 70mA [3]
Maximum operational Voltage (including ripple):	30V
3.3V output maximum current	100 mA

Power must be connected to the 12 pin J1 I/O connector.

Camera power is regulated, so only an unregulated power source of 12 V to 24V is required. The camera is, however, very sensitive to power supply interruption. Please make sure, that the voltage never exceeds the limits of < 9V, > 30V even for a short period of time. In case of trouble it is recommended to backup the power supply by a capacitor or a battery large enough to prevent power interruptions.

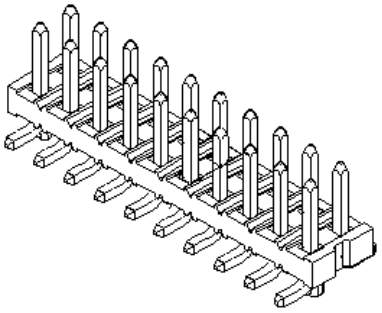
[2] Typical power consumption without using the onboard 3.3V supply.
[3] Current drawn from the 3.3V on board signal needs to be added to these figures.

3.2 J2: Expansion Port / Trigger Interface

Note that the LVTTL IOs are very sensitive. Only use driving electronics suitable for LVTTL IO's!

3.2.1 Pin Assignments J2 camera socket

Pin Number	Signal
1	I2C_Clock
2	I2C_Data
3	Trig_in
4	Trig_out
5	Q00 / RS232_TX[4]
6	I00 / RS232_RX [4]
7	Q01
8	I01
9	Q02
10	I02
11	Q03
12	I03
13	TxD+
14	TxD-
15	GND
16	GND
17	RxD+
18	RxD-
19	GND
20	GND



Core Colors Ethernet
Blue
Red
N.C.
N.C.
Pink / black
Green
N.C.
N.C.

Cable colors shown valid for using VC's Ethernet cables – see the accessory overview in section 4.

Signal description:

Q00 – Q03	digital LVTTL outputs
I00 – I03:	Digital LVTTL input (without pull-up resistor)
I2C_Clock and I2C_Data	I2C serial Bus Interface for additional peripherals (Refer to the Texas Instruments documentation[5] for further details) Note that the I2C Bus is used internally to program the sensor! Caution is advised when programming the I2C in order not to block system tasks!
Trig_in and Trig_out	Trig_in and Trig_out – are not opto isolated, so special care must be taken or Isolation has to be done externally!

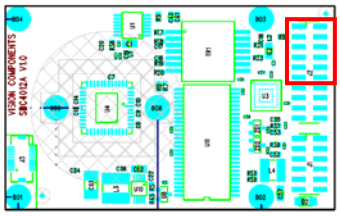
[4] RS232 signals : optional. Not available on the VCBSC4012nano camera!

[5] "TMS320C6000 DSP Inter-Integrated Circuit (I2C) Module Reference Guide", Literature Number: SPRU175A, Oct. 2002

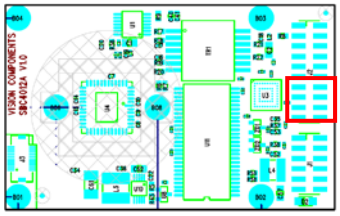
Pin Locations

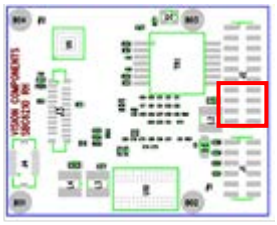
◁

1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20



top part of **J2** interface for I2C Bus, Trigger Interface and additional LVTTL





lower part of socket for Ethernet

Please refer to Appendix C & D for the pin 1 orientation on the camera board socket.

3.2.2 Matching connector and cable for J2 camera socket

3.2.2.1 Use Power and Ethernet cable side by side

Alternatively an additional 12 pin Power Supply / PLC and a 8-pin Ethernet cable (Cable set for VCSBC4012nano, VK000229 see section 4) can be used next to each other to cover all contacts. Since only pin 1,2,5 and 6 of the 8 pin Ethernet connector are connected, place these two plugs on the J2 sockets as shown below:

Pin 1-12 use J1 cable Pin 13-20 use one of the Ethernet cables, (pin number of connector given here):

2	4	6	8	10	12	2	NC	6	NC
1	3	5	7	9	11	1	NC	5	NC

∇

Please refer to section 3.1.1, section 3.2.1 and section 4 for details on these cables.

Pin assignment Ethernet cable VK000251:

PIN (J4)	Cable Color (J4)	Signal	Cable Color (RJ45)	PIN (RJ45)
1	blue	TXD+	Orange/ white	1
2	red	TXD-	Orange	2
3	N/C	GND	N/C	
4	N/C	GND	N/C	
5	Pink / black	RXD+	Green/ white	3
6	green	RXD-	Green	6
7	N/C	GND	N/C	
8	N/C	GND	N/C	

The change of core colors results from connecting two cables (VK000206 and a standard Ethernet cat 5 cable).

3.2.2.2 Manufacture own cable / pcb that sits on top of camera board

The socket J2 has the following part number: 8775967-2050, manufacturer Molex (**www.molex.com**)
The matching connector has the following part number: 51110-2050

Vision Components does not currently manufacture a cable for this connector. Please order the matching connector from the manufacturer Molex.

3.2.2.3 Using VC's wide Ribbon Cable covering J1 and J2

There is a new Ribbon Cable available using a 24 pin Molex conector that connects to all 12 J1 and 20 J2 pins. This cable can be ordered with one connector / open and 2 female molex connectors. For further details please contact sales at this stage: **sales@vision-comp.com** .

3.2.3 Electrical specifications J2 camera socket

All Signals are Low Level TTL (3.3V), not opto isolated.
The electrical specifications given for the trigger input and output are also valid for the remaining LVTTL IOs.

The following Signals have a 1k5 pull up resistor on board:

- I2C_Clock
- I2C_Data
- Trig_in

Trigger IO Specifications:

The board features a dedicated fast TTL trigger input (for use as image capture trigger) and a fast TTL trigger output (as strobe-light trigger). Since both signals are fast at a very low noise margin, it is recommended to keep the cable as short as possible. Use twisted pair or even coaxial cable for this purpose. The trigger input assures a constant image capture delay without jitter.

Electrical Specification of trigger input [6]:

input voltage: Signal LOW	-0.3V – 0.8V (LVTTL)
Input voltage: Signal HIGH	2V – 3.9V (LVTTL)
input current:	N/A
limiting resistor:	1K5 pull up
reverse voltage protection:	none
switching delay:	none

Image trigger on rising or falling input signal works as before – see section 5.4 for details.

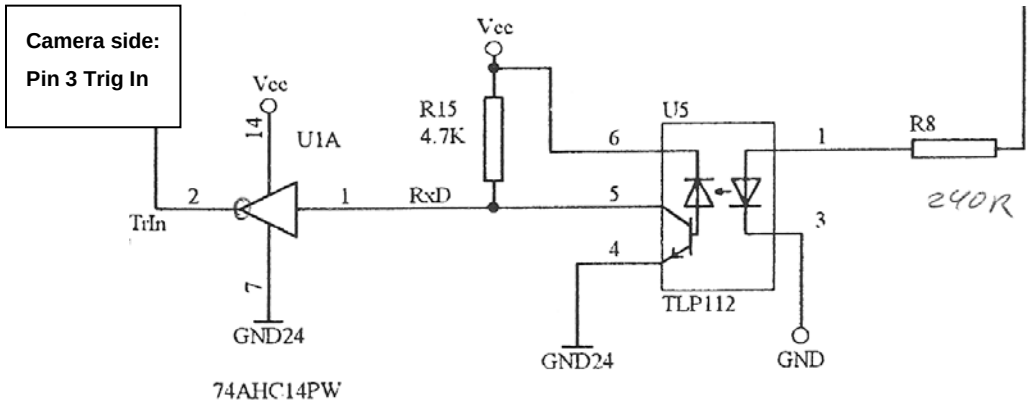
The trigger input and output are very sensitive and not galvanically separated. Opto isolation of the driving circuit is therefore strongly recommended. The following page shows suitable circuits for trigger input and output.

Please note that input and output are not protected against over current. The output is neither protected against short circuit nor reverse voltage spikes from inductive loads.

Use the **VC nano Series** cameras if you can not provide a suitable trigger input driving circuit. These cameras include the same hardware as the VCSBC nano Series Smart Cameras, but overcurrent protection of the inputs and outputs is already included.

[6] The electrical specifications given for the trigger input and output are also valid for the remaining LVTTL IOs.

Recommended driving circuit for the trigger input:

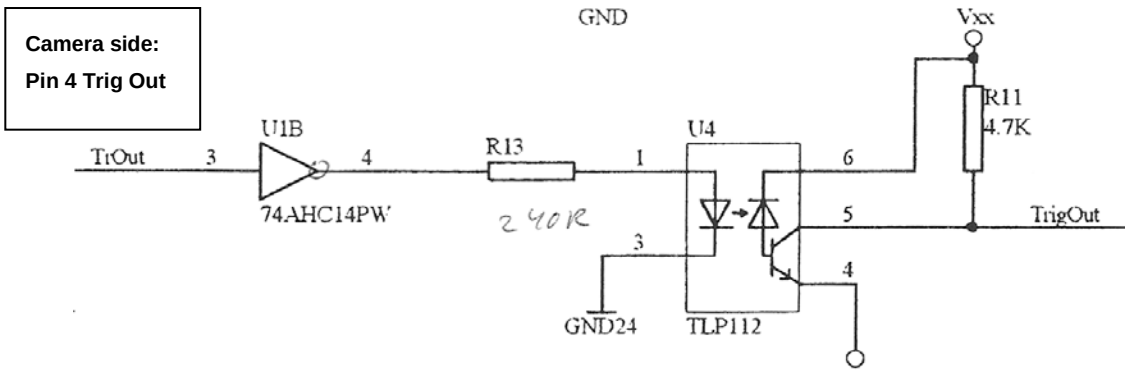


Electrical Specification of trigger output[7]**:**

output voltage signal LOW:	0.4 V with 2mA output current 0.2 V with 1mA output current
output voltage signal HIGH:	2.9 V with 8mA output current 3.1 V with 1mA output current max. 3 V LVTTL
Maximum output current:	max. 8 mA (high), 2mA (low)
pull-up resistor:	none, LVTTL push-pull output

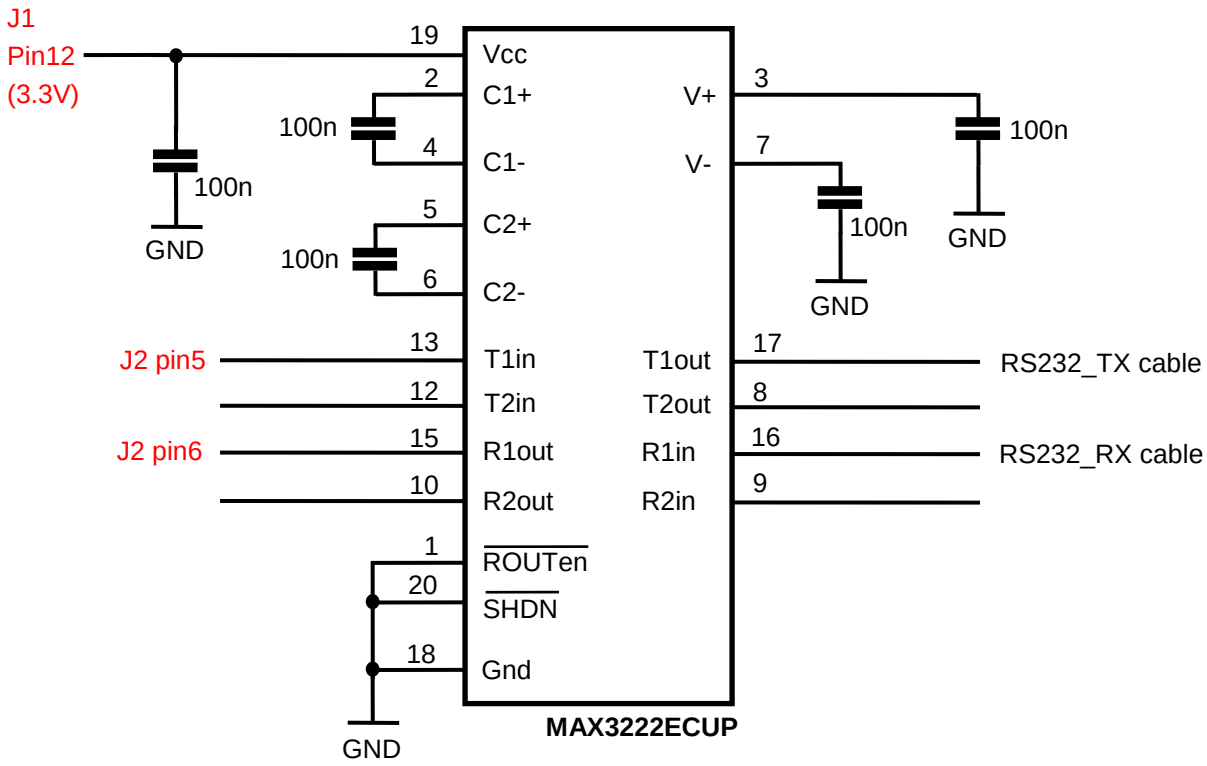
Caution: Place the connectors at the correct position – not reversed or shifted.

Recommended circuit for trigger output:



[7] The electrical specifications given for the trigger input and output are also valid for the remaining LVTTL IOs.

Recommended external Line Driver / Receiver Circuit for use of the RS232 interface



4 Accessories

For interface cables and connectors available also consult the corresponding section in chapter 0 of this manual.

4.1 Camera and Lens holder order numbers:

Product / Service description	Order Number
VCSBC4012nano Smart Camera ***without*** lens holder, b/w sensor	VK000415
VCSBC4012nano Smart Camera ***without*** lens holder, Bayer sensor	VK000416
VCSBC6010nano Smart Camera ***without*** lens holder, b/w sensor	VK001091
VCSBC6010nano Smart Camera ***without*** lens holder, Bayer sensor	VK001092
VCSBC6210nano Smart Camera ***without*** lens holder, b/w sensor	VK001037
VCSBC6210nano Smart Camera ***without*** lens holder, Bayer sensor	VK001059
VCSBC6210nano RH Smart Camera ***without*** lens holder, b/w sensor	VK001066
VCSBC6210nano RH Smart Camera ***without*** lens holder, Bayer sensor	VK001097
VCSBC6211nano Smart Camera ***without*** lens holder, b/w sensor	VK001072
VCSBC6211nano Smart Camera ***without*** lens holder, Bayer sensor	VK001093
VCSBC6212nano Smart Camera ***without*** lens holder, b/w sensor	VK001131
VCSBC6212nano Smart Camera ***without*** lens holder, Bayer sensor	VK001132
VCSBC6212nano RH Smart Camera ***without*** lens holder, b/w sensor	VK001123
VCSBC6212nano RH Smart Camera ***without*** lens holder, Bayer sensor	VK001135
VCSBC6215nano RH Smart Camera ***without*** lens holder, b/w sensor	VK001254
VCSBC6222nano RH Smart Camera ***without*** lens holder, b/w sensor	VK001292
VCSBC6224nano RH Smart Camera ***without*** lens holder, b/w sensor	VK001281
Lens holder C Mount incl. adjustment (IR Filter EK000625 included)	VK000400
Lens holder 12mm (Clear glass window EK000624 included)	VK000057

VCSBC6210nano Smart Camera ***without*** lens holder, b/w sensor, RS232	VK001076
VCSBC6210nano Smart Camera ***without*** lens holder, Bayer sensor, RS232	VK001075
VCSBC6210nano RH Smart Camera ***without*** lens holder, b/w sensor, RS232	VK001098
VCSBC6210nano RH Smart Camera ***without*** lens holder, Bayer sensor, RS232	VK001077
VCSBC6211nano Smart Camera ***without*** lens holder, b/w sensor, RS232	VK001081

4.2 Further accessories available for VCSBC nano Smart Cameras

Product description	Order Number
Power adapter for rail mounting, Input Voltage 100 – 240VAC 50/60 Hz Output Voltage DC 24V +/-5%, max. 300 mA (7.5 W) Equipped with connecting clamps for AC input and 24V output, CE cert.	VK000036
Cable for Expansion Port J2 (use cable set VK000229 see section 3.2) It is recommended to manufacture matching circuit board	VK000229
Power Supply and IO Interface cable for J1	VK000173
Ethernet OEM Cable for J2 (0.5m length, 4 single cores)	VK000206
Ethernet testing Cable for J2 (2.5m length, other end with RJ45 connector)	VK000251
Cable set for VCSBC4012nano (contains VK000206 and VK000173)	VK000229
Clear glass protective sensor window (replaces IR filter in camera head)	EK000624
IR cut filter (camera is shipped with this filter mounted) refer to Appendix B	EK000625

All cable lengths are 0.5m unless stated otherwise.

Please also refer to the VC website www.vision-components.com for an up to date list of accessories.

5 Programming VCSBC nano Smart Cameras

5.1 General settings

Programming the VCSBC6210nano requires at least the VCRT library version 5.29.6, for the VCSBC4012nano VCRT 5.29 is needed. The VCSBC6010nano & VCSBC6211nano camera require VCRT 5.29.18, the VCSBC6212nano VCRT 5.30.1, the VCSBC6215nano VCRT 5.30.10 and the VCSBC6222/6224 VCRT 5.30.1.

Please note that all features (like polarity setting, see **chapter 5.4**) of trigger input and trigger output **are only fully functional from VCRT 5.29.18**!

5.2 Compiling and linking with the VCSBC6xxx nano

It is advised to build your C-code as **relocatable code** (standard setting in the VC template Code Composer project files from VCRT 5.29). In this case VCRT manages the program memory allocation by itself (see Programming Tutorial for more details).

For customers who prefer absolute linking, please pay attention to the fact that the memory start address of the VCSBC6xxx nano has changed in comparison to previous VC cameras. In your link file, replace the memory section with this one:

```
MEMORY
{
   PMEM:   o = 080100000h  l = 100000h  /* intended for initialization */
   BMEM:   o = 080090000h  l = 40000h   /* .bss, .system, .stack, .cinit */
}
```

5.3 Image Acquisition

The CMOS sensors of the VCSBC nano Series cameras allow extra features like:

- partial scanning
- 2x / 4x image binning
- use of Global Reset Release Shutter instead of Rolling Shutter (VCSBC4012nano & VCSBC6212nano only, other VCSBC nano series cameras use a global shutter).

For demo programs showing those features, please have a look at the **Demo Programs section** in the Download Center of our website, or contact our support at **support@vision-components.com**.

5.4 Trigger Functions

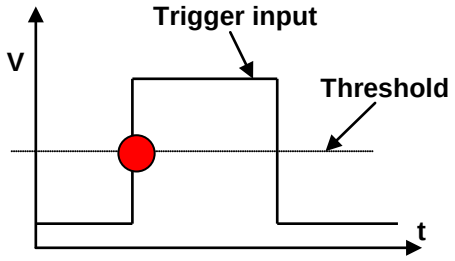
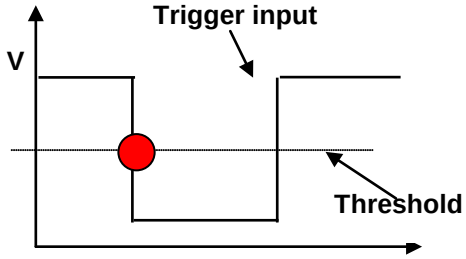
Apart form the inverse TTL logic (see section 3.2.3) and the different status registers, the trigger works like with the VC4XXX cameras.

Please refer to the VCRT5.pdf manual – available from the download area of the VC website.

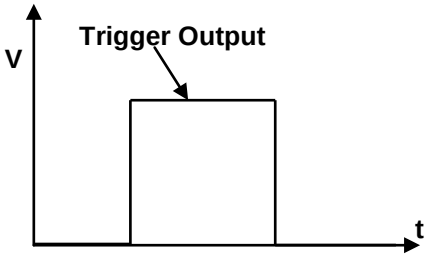
To query the trigger input, use the following command, valid for all VCSBC nano cameras (see demo program trigin.c):

```
if (TRIGINP_PIN)
  print("external trigger = 1\n");
else
  print("external trigger = 0\n");
```

A capture can be triggered on rising edge with TRIGINP_POS() and on falling edge with TRIGINP_NEG().

Signal	Trigger Mode
	TRIGINP_POS() Rising Edge Trigger Signal
	TRIGINP_NEG() Falling Edge Trigger Signal

The trigger output can be set to exposure controlled mode – for instance to control a light source. With TRIGOUT_EXP() combined with TRIGOUT_POS(), the trigger output is high during exposure. TRIGOUT_EXP() combined with TRIGOUT_NEG(), the trigger output is low during exposure.

	Trigger Output Signal in Exposure Controlled Mode: TRIGOUT_EXP(); AND Trigger output set positive: TRIGOUT_POS();

The trigger macros are also described in our programming tutorial.

For SBC6xxx nano cameras, the macros TRIGOUT_USR(), SET_TRIGOUT() and RES_TRIGOUT() (manual trigger output control) are only available from board version 1.2 (version is written on the board, above the sensor)!

5.5 Controlling the TTL IOs on socket J2

Setting and reading the 4LVTTL inputs and outputs is done with help of the hardware registers.

The following macros are available for easier operation (see “vcrt.h”):

- Setting the 4 outputs is done with help of a 4 bit value:

  ```
  #define TTL_OUT(x)          /* SBC nano TTL output */
  ```

- For queering the TTL inputs use the following function:

  ```
  #define GET_TTL_IN()        /* SBC nano TTL input */
  ```

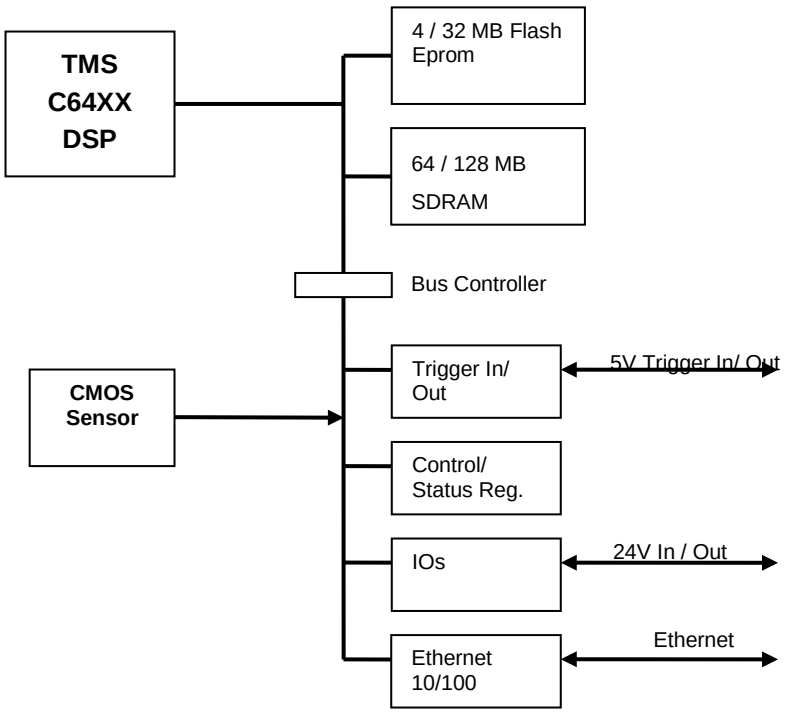
Appendix A: Block diagram VCSBC nano Series

The image is formed by a high-resolution 5 mega pixel CMOS sensor (VCSBC4012nano & VCSBC6212nano), a Wide-VGA CMOS sensor (VCSBC6010nano & VCSBC6210nano) or a 1.3 megapixel CMOS sensor (VCSBC6211nano). The image is then stored in SDRAM memory, which has been increased to 64MB (VCSBC4012nano) / 128MB (VCSBC6010nano, VCSBC6210nano, VCSBC6211nano & VCSBC6212nano).

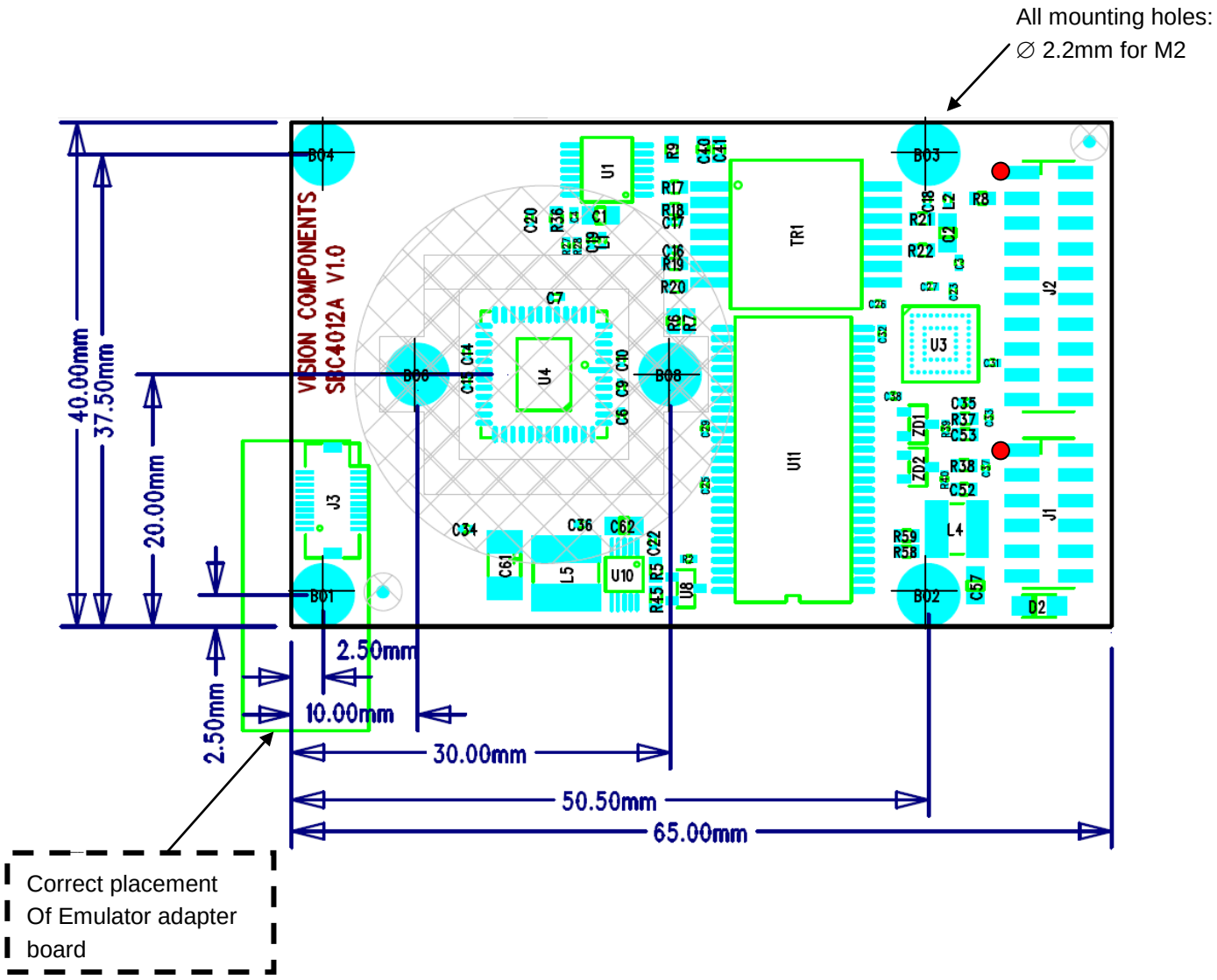
Unlike most other Vision Component Smart Cameras, the VCSBC nano Series cameras do not have a direct video output. However if monitoring of the camera image is required, this can be done by downloading via Fast Ethernet port to PC and display on screen (see "Image Transfer" demo software under "Support -> Customer Area -> Software Utilities").

The TMS320C64xx DSP is one of the fastest 32bit DSPs. It features a RISC-like instruction set, up to 8 instructions can be executed in parallel, two L1 cache memories (16 Kbytes each) and a 128 Kbytes L2 cache on chip. Its high speed 64-channel DMA controller gives additional performance. The DSP uses fast external SDRAM as main memory. A flash EPROM provides non-volatile memory.

Block diagram VCSBC nano Series



Appendix B: Drawing Circuit Board VCSBC nano Series

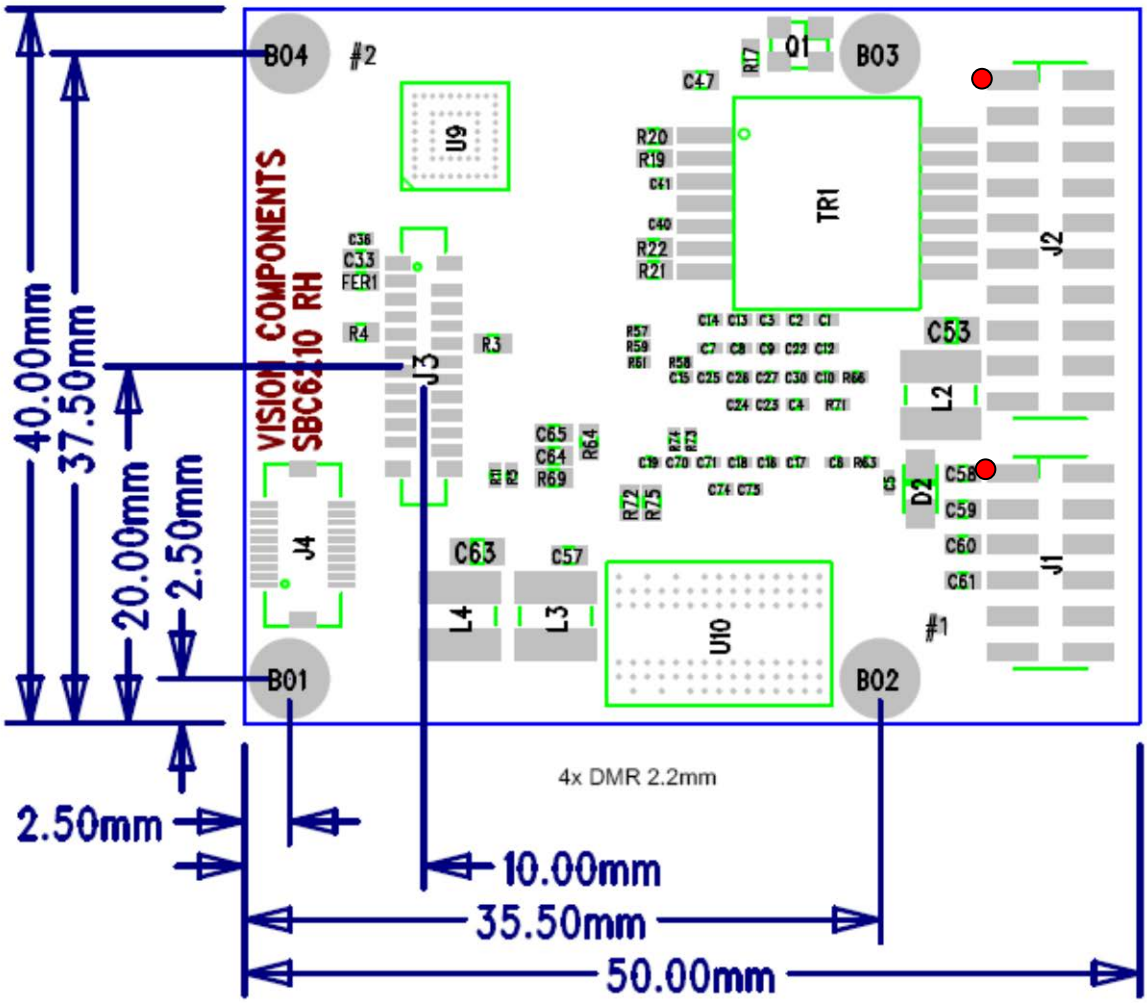


The red dot ● marks the Pin 1 position of each connector.

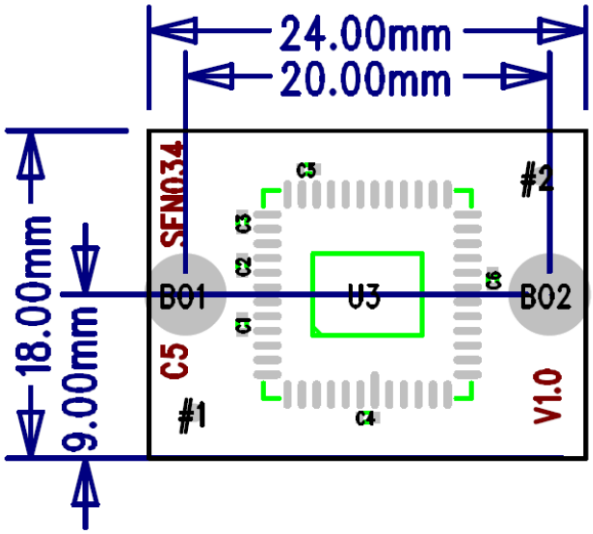
Tolerances: All circuit board dimensions: +/- 0.1mm

Appendix C: Drawing Circuit Board VCSBC nano RH Series

Camera Board



Sensor Board



The red dot ● marks the Pin 1 position of each connector.

Smart Cameras made in Germany

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VC Software Development Kit Ti:	VCRT Operating System VCLIB Image Processing Library
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Software (User- and SW License Registration required)	- Software Updates (VCRT & Libs) - Demo Code - Software utilities
Tech News	Tech News – new SW and Documentation
Knowledge Base / FAQ	FAQ Database with programming Examples and Demo Code
Return / Repair Service	Form for Allocation of Repair Numbers.
Loan systems	Info about VC loan cameras

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