Technical Documentation - Advance Information

Single Board Cameras SBC11, SBC13

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1. General information

The SBC Series Single Board Cameras are compact, light-weight black-and-white video cameras on a single PCB with video memory and an image processor.

They integrate a high-resolution CCD sensor with a fast image-processing signal processor. A dynamic RAM is used to store data and video images. Interfaces allow communication with the outside world. The cameras set standards for performance and integration density.

These cameras are built for industrial OEM applications. High goals were set in the design of the product. They are fully functional compatible to the manufacturer's industrial cameras VC11 and VC13, respectively.

Only one supply voltage is required to operate the boards (usually 12 volts). An image processing system or a PC with a frame grabber board is not necessary. Simple control problems can even be implemented with the integrated process interfaces. For more complex control tasks, the cameras can be connected with, for example, a PLC.

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

2. Basic structure

The image is formed by a high-resolution CCD sensor. With the appropriate control chips, it itself is in many ways comparable with 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. Via a bidirectional buffer, it is sent to the DMA interface of the ADSP2181 signal processor, which in turn controls the functions "Record", "Stills", etc. Additionally, the digital video signal is sent to the video output, where it is converted to an analog signal and can be connected to a video monitor.

The electronic circuitry placed on one board which is the same for SBC11 and SBC13 plus a sensor board which is different for SBC11 and SBC13

Description	Designation	Function
Sensor board	SEN059 (SBC11) SEN055 (SBC13)	Receives signals from and controls the CCD sensor, produces the video and clock signals, black-and-white and color versions
SBC main board	SBC-MAIN	Digitalization of the video signal, complete signal processor with memory, DAC for video output signal in black-and-white, interfaces (V24, PLC), power supply 3W

3. Documentation of the boards

3.1 "SEN059" Board

This board takes the picture. The CCD sensor ICX059AL (black-and-white) is used. This board controls the CCD sensor and processes the analog signal. It outputs a pixel clock signal and the video signal.

The signal processor can configure the controller chip for the CCD sensor. This involves the following modes:

field integration internal sync	frame integration external sync
vertical reset	(external sync mode only)
shutter:	high speed (up to 1/10000) low speed (up to 510 half-size images) flickerless

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

3.2 "SEN055" Board

This board is used as a substitute for the "SEN059" board for low budget applications. The CCD sensor used (ICX055AL) has a lower resolution of 500x582 pixels, which is, however, adequate for many applications.

The signal processor can configure the controller chip for the CCD sensor. This involves the following modes:

field integration	frame integration
shutter:	high speed (up to 1/80,000)

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

3.3 "SBC-MAIN", Main Board

The board contains an ADSP 2181 signal processor with 80 KBytes of internal RAM, plus dynamic RAM (DRAM), as well as nonvolatile flash EPROM memory.
The board performs the A/D conversion of the video signal. The signal processor's DMA function allows the video signal to be stored in dynamic RAM. The stored or the live video signal is sent as a digital signal to the DAC, which process the signal for output to a monitor.
An image overlay supplied directly by the signal processor is also forwarded to the video output. This overlay makes it possible to display additional (binary) graphics, text, crosshairs, etc., on the monitor.

processor	ADSP2181 32MHz
DRAM	2 MBytes
Flash-EPROM	512 KBytes
wait states (DRAM)	1 (20 MB/sec)
performance	100 %
clamping	analog

The board includes the video DAC: the digital video signal is converted to an analog signal. The overlay bit and the synchronization signal are heterodyned. The resulting analog output video signal is fed to a PCB connector.

The board contains a high-efficiency wide-range DC/DC converter as power supply. It is also responsible for the galvanic separation of the signals, and tailors the levels of the PLC-signals (4 inputs, 4 outputs).

The board is supplied with a nominal voltage of 12 V (9,5 - 18V). An electronic stabilization of the supply voltage is not necessary. The board is internally galvanically separated from the supply voltage by means of a DC/DC converter, in order to avoid the ground loops and electromagnetic compatibility disturbances which are common. A reverse-voltage protection diode protects the board in case the supply voltage poles are confused.

PLC I/O signals:
The board has four optically decoupled inputs and four decoupled outputs for controlling machines and processes.
The PLC-compatible inputs (12-V- to 24-V level, the positive signal is switched) include an input protection circuit. When the inputs are operated at 24 V, the input current is approximately 5 mA. At least 8 volts are required to reliably sense a logic high signal. At this voltage, the current is 1 mA. The inputs are optically decoupled.

The PLC outputs are also optically decoupled. The output signal of the optocoupler controls a MOS-FET which in turn switches the 12 - 24 V signal. A diode protects the transistor, for example in case of inductive loads.
A protective diode ensures the poles of the supply voltage from the power supply of the PLC cannot be confused. It is important for both the external supply voltage of the outputs (+12 to +24V) as well as GND (GNDIn) of the power supply of the PLC to be connected.
Since the outputs are not short cuircuit protected, we recommend a 2A fast fuse for the positive voltage supply.

Technical data on the I/O signals:

Inputs:

Operating voltage:	12 V to 24 V
Absolute maximum voltage:	voltages greater than 40 V can destroy the inputs
Type:	galvanically separated by photocoupler
Input current:	5 mA
Threshold value:	8 V
Internal signal delay:	approx. 500 µsec
Interrupt input:	only IN0, otherwise polling operation

Outputs:

Operating voltage:	12 V to 24 V, external source
Absolute maximum voltage:	voltages greater than 40 V can destroy the outputs
Type:	galvanically separated by photocoupler / P-channel MOSFET
Switching voltage:	+12 V or + 24 V is switched
Current:	175 mA per output
Absolute maximum current:	currents greater than 700 mA can destroy plugs and cables Always consider the total sum of all output currents
Switching power:	max. 4.2 W (24 V * 175 mA)
Reverse voltage protecion	yes, for external voltage
Protection against inductive loads:	reverse diode
Resistance when switched on:	< 0,5 Ohm

4. Plug Assignments

The boards have three PCB connectors and an alternative connector, which have the following functions:

V24(RS232) and Video	**P2**	
POWER	**P3**	
PLC-I/O (24 Volts)	**P4**	**(standard)**
TTL-I/O	P5	(optional, as an alternative to P4)

All use the same ultra-compact 10 pin crimp style connectors ZHR-10
An assembled version of the connector with multi color open ended cables is available.

Pin Assignment for the V24 (RS232) Interface (P2)

Signal	Pin	cable color
V24 RxD	1	white
V24 TxD	2	brown
V24 CTS	3	green
V24 RTS	4	yellow
V24 GND	5	grey
V24 +12V Out	6	pink
Video Out	7	blue
Video GND	8	purple
	9	red
	10	black

Pin Assignment for the Power Plug (P3)

Signal	Pin	cable color
Power GND	1	white
Power GND	2	brown
Power 12V	3	green
Power 12V	4	yellow
Reset GND	5	grey
Reset In	6	pink
-15V In (*)	7	blue
+15V In (*)	8	purple
+5V In (*)	9	red
GND In (*)	10	black

(*) These pins should not be connected - they are reserved for a version without DC/DC converter power supply.

Pin Assignment for the PLC I/O Plug P4

Signal	Pin	cable color
OUT0	1	white
OUT1	2	brown
OUT2	3	green
OUT3	4	yellow
IN0	5	grey
IN1	6	pink
IN2	7	blue
IN3	8	purple
+24V IN	9	red
GND IN	10	black

Pin Assignment for the TTL I/O Plug P5

Signal	Pin	cable color
Q0	1	white
Q1	2	brown
Q2	3	green
Q3	4	yellow
I0	5	grey
I1	6	pink
I2	7	blue
I3	8	purple
+5V Out	9	red
GND	10	black

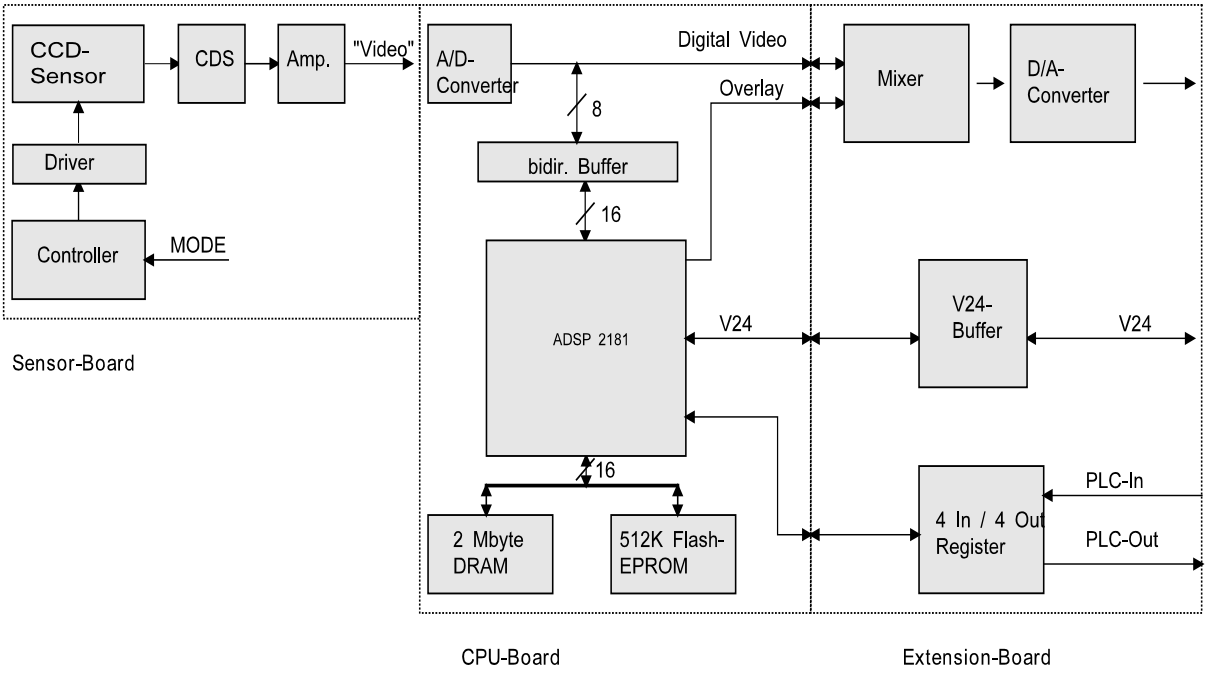
this connector is optional and will be mounted on prior request as an alternative to connector P4 (PLC I/O) It is not possible to use both. All signals have TTL level. They are not intended to be used outside a shielded environment (e.g. a cabinet). They are therefore not EMI protected.

Pin Assignment for the connectors

Location of plugs and mechanical dimensions

5. Block Diagrams, Technical Specifications

Blockdiagram VC11,VC13,VC51



(C) Vision Components

5.1 Technical Specifications SBC11

Sensor:	1/3“ Sony ICX059AL
eff. no. of pixels:	752(H) x 582(V)
Pixel size:	6.5(H) x 6.25(V) µm
Chip size:	6.00(H) x 4.96(V) mm
High-speed shutter:	up to 1/10000 sec., adjustable in 512 steps (half-frame shutter)
Low-speed shutter:	up to 20 sec., adjustable integration time
Integration:	full-frame/half-frame
Picture taking:	free-running or restart reset, full-frame or half-frame
Clamping:	analog
A/D conversion:	14.1875 MHz / 8-bit
Image display:	black-and-white, 256 gray levels: live image, still image, graphics
Overlay:	1-bit overlay, EXOR with bit 7, can be switched off
Processor	Analog Devices ADSP2181 signal processor 32,786 MHz
Image/data memory:	2 MBytes dynamic memory
Memory capacity:	3 full-size images or 7 half-size image in format 752 x 582 (752 x 291) 8 full-size images or 16 half-size image in format 512 x 512 (512 x 256)
Flash EPROM:	512-KBytes flash EPROM (nonvolatile memory) for programs and data, programmable in the system
Process interface:	4 inputs / 4 outputs, optically decoupled 12 V to 24 V, outputs 4x175 mA
Serial interface:	V24 (RS232) max. 115200 baud
Video output :	75 Ohm, 1 Vpp BAS signal 625 lines 50 Hz for black-and-white monitor
Power supply:	built-in switching power supply with galvanic separation
Supply voltage:	12 V +/-20% (max. 18 V) unregulated, DC, max. 350 mA
Electrical connections:	3 connectors (all 10pin): **DC IN** , **V24/Video Out, 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
Vibrations:	< 3g (11 - 200 Hz)
Dimensions:	120x70x18 mm
Lens connection:	None
Attaching pad surface:	N/A
Weight:	approx. 100 g

5.2 Technical Specifications SBC13

Sensor:	1/3“ Sony ICX055AL
eff. no. of pixels:	500(H) x 582(V)
Pixel size:	9.8(H) x 6.3(V) µm
Chip size:	6.00(H) x 4.96(V) mm
High-speed shutter:	up to 1/80,000 sec., adjustable in 256 steps (half-frame shutter)
Low-speed shutter:	n/a
Integration:	full-frame/half-frame
Picture taking:	free-running, full-frame or half-frame
Clamping:	analog
A/D conversion:	9.46875 MHz / 8-bit
Image display:	black-and-white, 256 gray levels: live image, still image, graphics
Overlay:	1-bit overlay, EXOR with bit 7, can be switched off
Processor	Analog Devices ADSP2181 signal processor 32,786 MHz
Image/data memory:	2 MBytes dynamic memory
Memory capacity:	7 full-size images or 15 half-size image in format 500 x 582 (500 x 291) 8 full-size images or 16 half-size image in format 512 x 512 (512 x 256)
Flash EPROM:	512-KBytes flash EPROM (nonvolatile memory) for programs and data, programmable in the system
Process interface:	4 inputs / 4 outputs, optically decoupled 12 V to 24 V, outputs 4x175 mA
Serial interface:	V24 (RS232) max. 115200 baud
Video output :	75 Ohm, 1 Vpp BAS signal 625 lines 50 Hz for black-and-white monitor
Power supply:	built-in switching power supply with galvanic separation
Supply voltage:	12 V +/-20% (max. 18 V) unregulated, DC, max. 350 mA
Electrical connections:	3 connectors (all 10pin): **DC IN**, **V24/Video Out**, **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
Vibrations:	< 3g (11 - 200 Hz)
Dimensions:	120x70x18 mm
Lens connection:	None
Attaching pad surface:	N/A
Weight:	approx. 100 g

6. Connecting the V24 cable

6.1 Connecting a compatible PC with a 9-pin D sub plug

Pin (PC)		Name	cable color	Pin (camera)
1	DCD	Data Carrier Detect	- / -	- / -
2	RxD	Receive Data	brown	2
3	TxD	Transmit Data	white	1
4	DTR	Data Terminal Ready	- / -	- / -
5	**GND**	**Ground**	**gray**	**5**
6	DSR	Data Set Ready	-/-	- / -
7	RTS	Request to Send	green	3
8	CTS	Clear to Send	yellow	4
9	RI	Ring Indicator	- / -	- / -

leave pink cable open

6.2 Connecting a compatible PC with a 25-pin D sub plug

Pin (PC)		Name	cable color	Pin (camera)
2	TxD	Transmit Data	white	1
3	RxD	Receive Data	brown	2
4	RTS	Request to Send	green	3
5	CTS	Clear to Send	yellow	4
6	DSR	Data Set Ready	-/-	-/-
7	**GND**	**Ground**	**gray**	**5**
20	DTR	Data Terminal Ready		

leave pink cable open

Programming

The cameras are programmed in C with the aid of a cross development system. Any commercially available PC can be used. The required configuration is a 486 or Pentium, 4 MB of extended RAM (8 MB recommended), DOS 3.0 or higher, hard disk, VGA graphics, HD floppy drive and mouse

The original cross development system supplied by Analog Devices 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 *)
  Subpixel sampling, compensation of optical properties and diffraction effects, auto-focus, best straight line, best circle

Applications and Training

There are numerous system houses with image processing know-how which can be consulted for customer-specific applications.

If an application must be developed on-site, individual training sessions or product seminars can be organized. They are generally conducted by free-lance consultants.

We will be happy to send you a list of system houses and free-lance consultants.

*) in preparation