ICM532B
CIF Color CMOS Image Sensor
With USB Output

Outline Specifications
V1.0
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Update history

Version	Changes	Date
V1.0	First B version specifications, with new package information and new format.	0308-2002

Features

- CIF format (352x288) pixels, used with 1/7" optical system.
- QVGA format (320x240) pixels, used with 1/7" optical system
- QCIF format (176x144) pixels, cropped or subsampled, up to 37.5 fps.
- Progressive readout
- Output data format: compressed 8-bit raw data
- Image processing and decompression supported with proprietary software. Image processing functions include color interpolation, color correction, auto white balance, auto exposure, auto anti-flickering, and sharpening.
- Proprietary data compression
- Input/Output interface: USB 1.1 Full Speed
- Electronic exposure control
- On-chip 9-bit ADC
- Correlated double sampling
- Dead pixel and dead column removal
- Power down/Suspend mode
- 8 User Programmable GPIO pins
- Optional 3.3V Serial EEPROM register loading during power-up (24C02/04/08/16)
- Automatic optical black compensation
- Mirror image
- Single 3.3 V power supply

Key Parameters

- Number of Active Pixels: up to 352x288
- Number of Physical Pixels: 362x298
- Frame Rate: up to 30 fps (35 fps QCIF)
- Pixel Size: 6.0 µm x 6.0 µm
- Sensor Area: 2.2 mm x 1.8 mm
- Single Crystal Frequency: 6 MHz
- Exposure Time: 125 µs (@ 25 fps, 1 line) ~ 8 s (@ 12 fps)
- Sensitivity: 1.0 V/lux-sec (555 nm)
- Quantum Efficiency: 38 % (555 nm)
- Dynamic Range: 53 dB (analog), 48 dB (digital)
- Fill Factor: 36%
- S/N Ratio: 45 dB @ 75% full signal level
- Sensitive to infrared illumination source
- Digital Gain: 1 ~ 64 x @ 2^N for all pixels
- RGB Gain: 1/256 ~ 64 x for individual Bayer pattern pixels
- Power Supply: 3.3 V
- Power consumption: 130mW typ.
- Packages: SPLCC48

General Description

ICM-532B is a single-chip, CIF resolution, digital color PC camera with integrated data compression, line buffer and Full Speed USB 1.1 interface. All the image processing functions (color interpolation, color correction, auto white balance, auto exposure, auto anti-flickering, sharpening) are performed by software in the host computer. It incorporates a 352x288 sensor array operating at 6 ~ 30 frames per second in progressive manner. Each pixel is covered by a color filter, which forms a "Bayer pattern." Correlated double sampling is performed by the internal ADC and timing circuitry. The raw data can be adjusted with digital gain. The raw data is compressed using a proprietary compression scheme. The compression allows video out in 8-bit compressed data format through USB 1.1 with 30 frames per second video capability. For higher frame-rates, sub-sampled or cropped QCIF (176x144) modes are available that support 35 frames per second.
8 Pins are supplied that can be programmed by the driver as general purpose I/O pins, with individually selectable output enables. During power-up, the internal control registers can be loaded from an external serial EEPROM. This allows customization of Ve ndor ID and Product ID, as well as initialization of other device parameters.

The 48 MHz clock required for the ICM-532B is provided by an on-chip phase-lock loop that is driven by an external 6 MHz crystal oscillator. Using a PLL reduces power dissipation, electrical noise and the cost of the crystal. It also reduces the need for EMI shielding that would be required if a 48 MHz oscillator were used. The highest frequency external signal is the 12Mbps on the differential USB data pins.

Software Support

- Computer & OS requirements: 750 MHz, 64M memory for 30 fps; 300 MHz, 64M memory for 12 fps.
  Windows 98, Windows ME, Windows 2000
  Macintosh OS 9.
- Driver support
  - WDM USB driver
  - TWAIN
  - DirectShow
  - VFW extension driver
  - Proprietary DirectShow decoder
  - Installation software

Applications

- PC camera
- Embedded Solutions (Notebooks, LCD monitors)

1. Pin Assignments

Pin #	Name	Class	Function
36	DN	B,IO	USB D- connection
37	DP	B,IO	USB D+ connection
40	XIN	A,I	6 MHz Crystal Input
39	XOUT	A,O	6 MHz Crystal Output
3,5,34	Reserved	D,O	Leave Unconnected
44	Test	D, I, N	Leave Unconnected
2	Clock_S	D, IO	Serial clock, for external serial EEPROM
1	Data_S	D, IO	Serial data, for external serial EEPROM
16	RSET	A,I	Resistor to Ground = 75 KW
8	RSTN	D,SI,U	Chip Reset, active low
15	RAMP	A,O	Analog Test Output
46	GPIO 0	D,IO	User Programmable I/O, Requires External Pull-up
47	GPIO 1	D,IO	User Programmable I/O, Requires External Resistor
48	GPIO 2	D,IO	User Programmable I/O, Requires External Pull-up
10	GPIO 3	D,IO	User Programmable I/O
11	GPIO 4	D,IO	User Programmable I/O
12	GPIO 5	D,IO	User Programmable I/O
13	GPIO 6	D,IO	User Programmable I/O
14	GPIO 7	D,IO	User Programmable I/O
7,27,31	VDDA	P	Sensor & PLL Analog Power
9,28,30	GNDA	P	Sensor & PLL Analog Ground
19	VDDD	P	Sensor Digital Power
17	GNDD	P	Sensor Digital Ground
4,26,33, 38,41,43	VDDK	P	Digital Power
6,29,32, 35,42,45	GNDK	P	Digital Ground
18	GNDS	P	Substrate Ground

Class Code: A – Analog signal, D – Digital signal, I – Input, SI – Schmitt Input, O – Output, IO – Bidirectional, P – Power or ground, U – Internal pull-up, N – Internal pull-down, B – USB Pad

2. Functional Description

ICM-532B is a single-chip USB digital color imaging device. It includes a 352x288 sensor array, 352 column–level ADC, and correlated double sampling circuitry. All the programmable parameters are set by writing through the USB interface which can address the register file consisting of 8-bit registers. The internal CIF image sensor is based upon the ICM-102B. The output format is USB 1.1 compatible compressed video data using a single ISOCHRONOUS channel. Dead pixels and dead columns are

removed, to generate a high quality image.

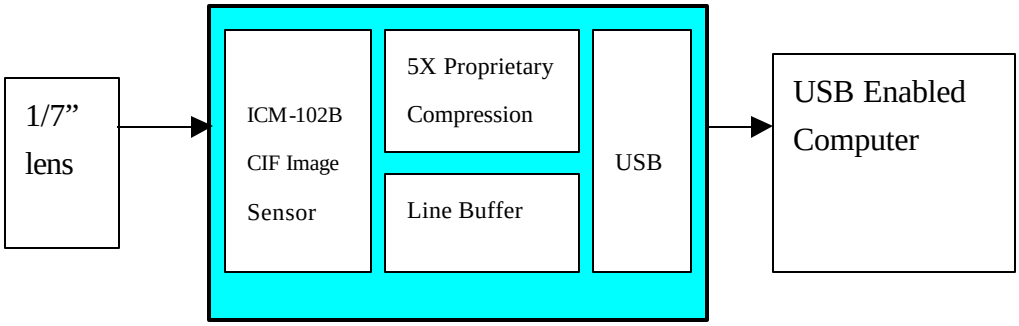

Figure 1. Block Diagram

3. Electrical Characteristics

3.1. DC Characteristics

1. General DC Characteristics

Symbol	Parameter	Rating			Units
		Minimum	Typical	Maximum	
I_{DD}	Operating Current @ V_{CC}=3.3 V, 25 °C		40		mA
I_{DDS}	Suspend Current @ V_{CC}=3.3 V, 25 °C			500	uA
I_{IL}	Input Low Current	-1		1	µA
I_{IH}	Input High Current	-1		1	µA
I_{OZ}	Tri-state Leakage Current	-10		10	µA
C_{IN}	Input Capacitance		3		pF
C_{OUT}	Output Capacitance		3		pF

C_{BID}	Bi-directional Buffer Capacitance		3		pF
R_O	USB Output Impedance	6		18	Ω
R_L	Input Pull-up/down Resistance		50		KΩ

2. Electrical DC Characteristics

Symbol	Parameter	Rating			Units
		Minimum	Typical	Maximum	
V_{CC}	Operating Power Supply	3.0	3.3	3.6	V
V_{OH}	Output High Voltage	2.4			V
V_{UL}	USB Output Low Voltage			0.3	V
V_{UH}	USB Output High Voltage	2.8			V

3.2. AC Characteristics

Symbol	Parameter	Rating			Units
		Minimum	Typical	Maximum	
$T_{RISE/FALL}$	USB Switching Times	4	10	20	ns
V_{CR}	USB Cross Point	1.3		2.0	V

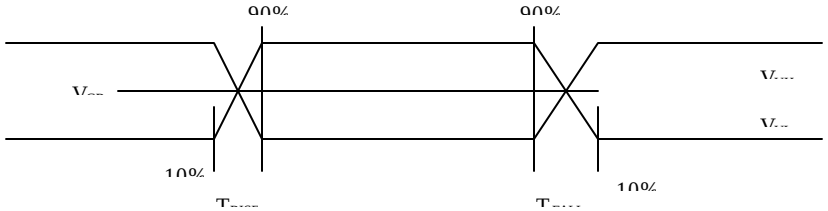

Figure 3. DP/DN Timing

4. Mechanical Information

ICM532B supports SPLCC (Plastic Shrunk LCC48 Packaging) packaging. Note that pin 1 should face up when a lens and the default driver are used.

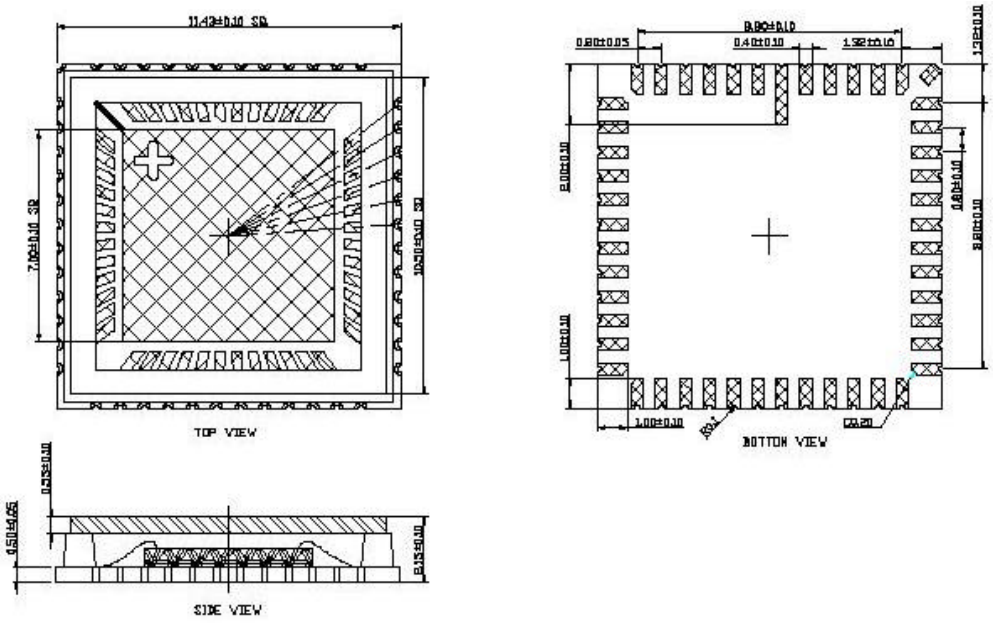

Figure 4. SPLCC48 Packaging

5. Board Design Information

Components:

- ICM-532B
- 6MHz Crystal
- RSET resistor
- USB connector or cable with 1.5kΩ pull-up on DP.
- 3.3v voltage regulator and associated components
- Power Supply filter capacitors
- Pull-up for SDA, SCL, GPIO0 GPIO1, and GPIO2
- If desired: Reset circuitry. A 0.1uF capacitor on RSTN is sufficient for power-on reset.

6. Ordering Information

Part number for different package:

Description	*Part Number*
Shrunk Plastic LCC48 package packaged, USB CIF resolution sensor (3.3 V)	ICM-532Bsa

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