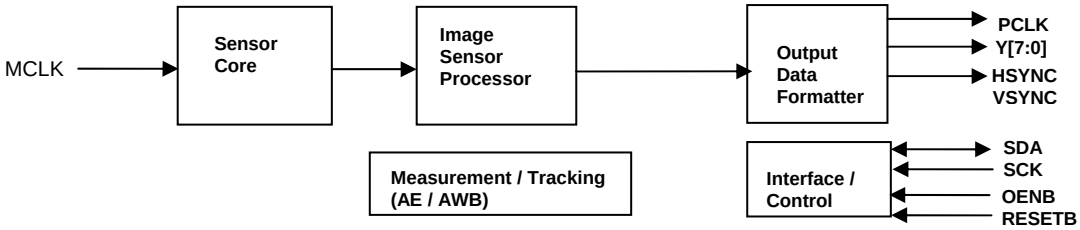
MC501CB MagnaChip VGA 1/7.4" SOC sensor



Description

The MC501CB VGA sensor integrates a CMOS pixel array with a full featured Image Processing chain to create a high quality camera solution for the camera phone market. The 3.0µm pixel technology and integrated digital noise reduction combine to achieve high quality, low noise images. The MC501CB supports a 1/7.4" optical format enabling Total Track Lengths near 3.0mm. The 640x480 pixel array operates up to 30fps at full VGA (640X480) resolution and up to over 30fps at QVGA.

Low power consumption and few required external discrete devices makes the MC501CB ideal for small form factor mobile consumer devices. The SOC sensor's registers are programmed through an efficient, two-wire serial control interface (SIF). Various interpolated RGB, YUV, and Raw Bayer (RGB) output formats are supported. Pixel samples are synchronized to the associated pixel clock (PCLK) as well as vertical and horizontal synchronization signals (VSYNC/HSYNC).

Key Features

- Resolution: 640H X 480V
- Color Filter: RGB Bayer
- Frame Rate: 30fps @24MHz, Programmable
- Power Supply: 2.8V/1.8V
- Power Consumption : 75mW(Typ) @30fps
- Standby Current : 100 uA(Max)
- Sensitivity : 900mV/lux.sec
- Dynamic Range: 60dB(Max)
- SNR : 42dB(Max)
- ADC : 10Bit
- Functional Operation Temperature : -20 ~ 60 Degree
- Master Clock : 24MHz (Typical), 27MHz(Max)
- Output Format:YUV4:2:2, RGB4:4:4, RGB5:6:5, ITU565-like
- Host Interface : Two-Wire Serial Bus Interface
- Windowing : Programmable
- Sub-Sampling : 1/4, 1/16 (QVGA, QQVGA)
- Image Scaling : 1x ~ 1/64x
- Image Flip : X/Y Flip
- Auto Exposure / Auto White Balance
- Anti-Flicker : Auto / Manual
- Black Level Calibration
- Strobe Control : support Xenon /LED Type
- On-Chip Dead Pixel Correction
- Edge Enhancement and Noise Clipping
- Brightness, Color Saturation
- Gamma Correction, Color Correction
- Lens Shading Correction
- Image Effect : Mono, Sepia, Negative, Sketch Embossing

Applications

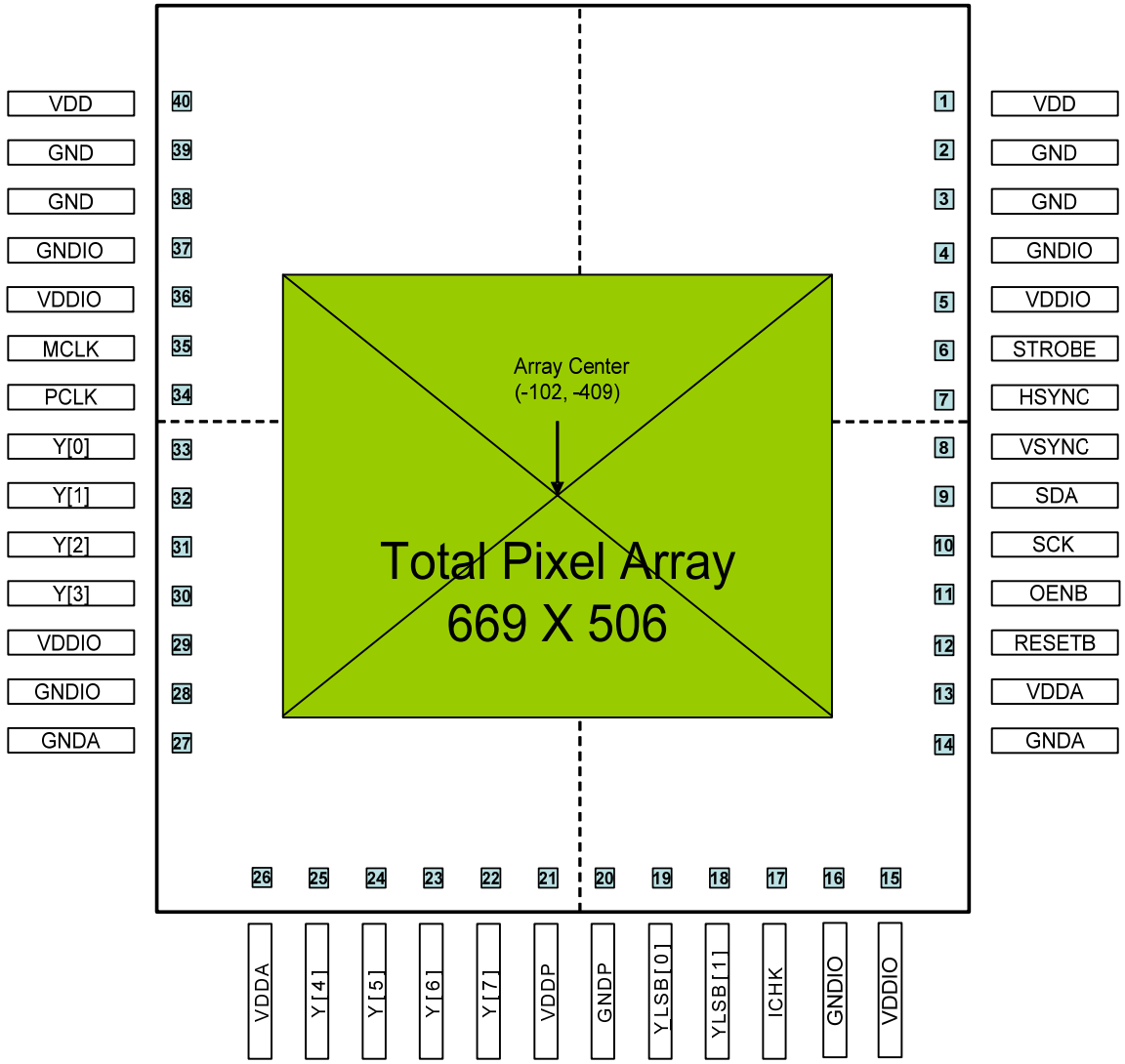
- Mobile Phone Cameras
- PC Cameras / Video Conference
- PDA / Handheld Devices

Key Performance Parameters

Parameter		Typical Value
Pixel Size		3.0 µm x 3.0 µm
Resolution (active pixels)		640H X 480V
Optical Format		1/7.4"
Sensor Array		2.007mm x 1.518mm
Power Supply	Analog	2.8V
	I/O	1.8V ~ 2.8V
	Digital Core	1.8V

Parameter		Typical Value
Frame Rate (VGA)		30fps (@24MHz)
Clock	Master lock	24MHz(Typ)
	Pixel Clock	24MHz(Typ)
SNR_{MAX}		42dB
$Dynamic\ Range_{MAX}$		60dB
Power Consumption		75mW @ 30fps VGA
Packaging Options		Wafer, Reconstructed Wafer, CSP

Die Pad Diagram



Chip Size [unit:um]

- Chip Size : 3393um X 3780um (without scribe lane)

Pixel Array Format [unit:pixel]

- Total Pixel Array Format : 669 X 506
- Addressable Pixel Array Format : 656 X 488
- Active Pixel Array Format : 640 X 480

Pad Description

Table 1. Pad Description

Pad	Pad Name	Description	X [um]	Y [um]	I/O
1	VDD	Digital Core Circuit Power Supply Voltage	1605	1600	1.8V
2	GND	Digital Core Circuit Ground	1605	1370	GND
3	GND	Digital Core Circuit Ground	1605	1140	GND
4	GNDIO	Digital I/O Circuit Ground	1605	910	GND
5	VDDIO	Digital I/O Circuit Power Supply Voltage	1605	680	1.8/2.8V
6	STROBE	Pulse to control strobe circuit in camera system	1605	450	Output
7	HSYNC	Horizontal synchronization	1605	220	Output
8	VSYNC	Vertical synchronization	1605	-10	Output
9	SDA	Data for two-wire serial interface	1605	-240	Bi-direction
10	SCK	Clock for two-wire serial interface	1605	-470	Input
11	OENB	OENB enables sensor. Active High	1605	-700	Input
12	RESETB	RESETB initializes sensor. Active Low	1605	-930	Input
13	VDDA	Analog Circuit Power Supply Voltage	1605	-1160	2.8V
14	GNDA	Analog Circuit Ground	1605	-1390	GND
15	VDDIO	Digital I/O Circuit Power Supply Voltage	1283.5	-1798.5	1.8/2.8V
16	GNDIO	Digital I/O Circuit Ground	1053.5	-1798.5	GND
17	ICHK	Internal Bias Current for test (Not Connected)	823.5	-1798.5	NC
18	YLSB[1]	Image Data YLSB[1]. It is used for 10bit output. When 8bit mode is used, it is possible to disconnect this pad.	593.5	-1798.5	Output
19	YLSB[0]	Image Data YLSB[0]. It is used for 10bit output. When 8bit mode is used, it is possible to disconnect this pad.	363.5	-1798.5	Output
20	GNDP	Analog Pixel Circuit Ground	133.5	-1798.5	GND
21	VDDP	Analog Pixel Circuit Power Supply Voltage	-96.5	-1798.5	2.8V
22	Y[7]	Image Data[7]	-326.5	-1798.5	Output
23	Y[6]	Image Data[6]	-556.5	-1798.5	Output
24	Y[5]	Image Data[5]	-786.5	-1798.5	Output
25	Y[4]	Image Data[4]	-1016.5	-1798.5	Output
26	VDDA	Analog Circuit Power Supply Voltage	-1246.5	-1798.5	2.8V
27	GNDA	Analog Circuit Ground	-1605	-1390	GND
28	GNDIO	Digital I/O Circuit Ground	-1605	-1160	GND
29	VDDIO	Digital I/O Circuit Power Supply Voltage	-1605	-930	1.8/2.8V

Pad	Pad Name	Description	X [um]	Y [um]	I/O
30	Y[3]	Image Data[3]	-1605	-700	Output
31	Y[2]	Image Data[2]	-1605	-470	Output
32	Y[1]	Image Data[1]	-1605	-240	Output
33	Y[0]	Image Data[0]	-1605	-10	Output
34	PCLK	PCLK synchronizes D[7:0]	-1605	220	Output
35	MCLK	Master Clock	-1605	450	Input
36	VDDIO	Digital I/O Circuit Power Supply Voltage	-1605	680	2.8V
37	GNDIO	Digital I/O Circuit Ground	-1605	910	GND
38	GND	Digital Core Circuit Ground	-1605	1140	GND
39	GND	Digital Core Circuit Ground	-1605	1370	GND
40	VDD	Digital Core Circuit Power Supply Voltage	-1605	1600	1.8V

Electrical characteristics

Table 2. DC Characteristics

Item	Symbol	Min	Typ	Max	Unit
Digital Core Circuit Power Supply Voltage	V_{DD}	1.7	1.8	1.9	V
Analog Circuit Power Supply Voltage	V_{DDA}	2.65	2.8	2.95	V
Analog Pixel Circuit Power Supply Voltage	V_{DDP}	2.65	2.8	2.95	V
Digital I/O Circuit Power Supply Voltage	V_{DDIO}	1.7/2.65	1.8/2.8	1.9/2.95	V
H level Input Voltage	V_{IH}	0.7*V_{DDIO}			V
L level Input Voltage	V_{IL}			0.3*V_{DDIO}	V
High level Output Voltage (I_{OH} = 4mA, V_{DDIO} = 2.8V)	V_{OH}	0.8*V_{DDIO}			V
Low level Output Voltage (I_{OH} = 4mA, V_{DDIO} = 2.8V)	V_{OL}			0.2*V_{DDIO}	V
High level Output Voltage (I_{OH} = 2mA, V_{DDIO} = 1.8V)	V_{OH}	0.8*V_{DDIO}			V
Low level Output Voltage (I_{OH} = 2mA, V_{DDIO} = 1.8V)	V_{OL}			0.2*V_{DDIO}	V

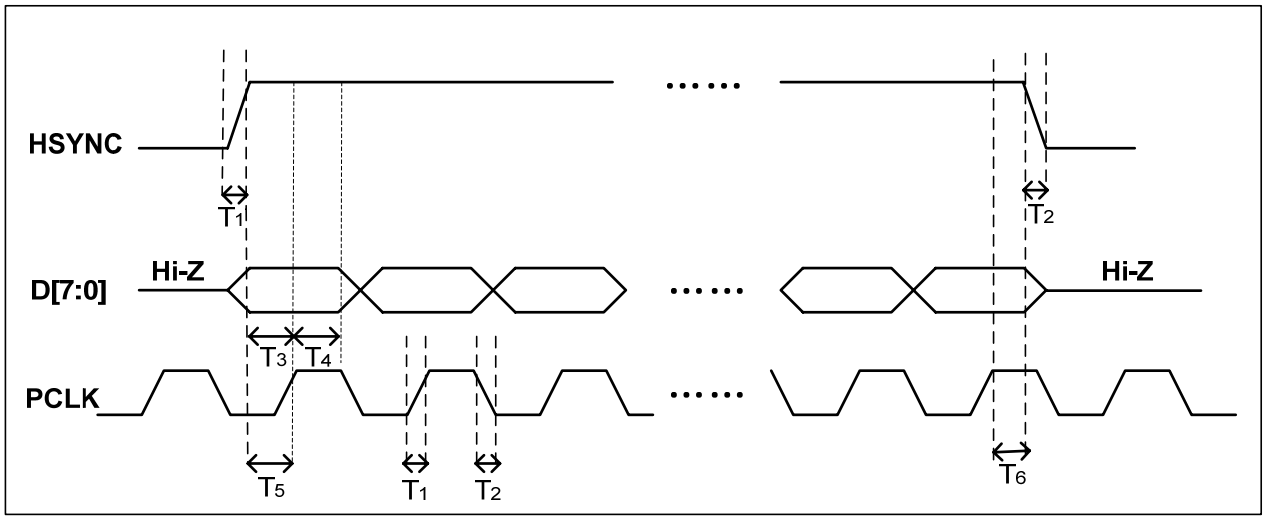


Table 3. AC Characteristics

Item		Min	Typ	Max	Unit	Note
MCLK	Frequency		24	27	MHz	
	Duty Cycle	45	50	55	%	
PCLK	Frequency		24	27	MHz	
	Duty Cycle	40	50	60	%	
SCK	Frequency			400	KHz	
Y[7:0]/PCLK/HSYNC/VSYNC/STROBE Rising time	T_1			4.4/5.2	ns	1/2
Y[7:0]/PCLK/HSYNC/VSYNC/STROBE Falling time	T_2			3.1/3.6	ns	1/2
Setup time of PCLK - HSYNC	T_5	5			ns	
Hold time of PCLK - HSYNC	T_6	5			ns	
Setup time of PCLK – D[7:0]	T_3	5			ns	
Hold time of PCLK – D[7:0]	T_4	5			ns	

Note1) Output load capacitance=20pF, $V_{DD:A}$ &$V_{DD:P}$=2.8V, $V_{DD:C}$=1.8V, $V_{DD:I}$ =2.8V, V_{OH} =2.4V, V_{OL} =0.4V

Note2) Output load capacitance= 20pF, $V_{DD:A}$ &$V_{DD:P}$=2.8V, $V_{DD:C}$=1.8V, $V_{DD:I}$ =1.8V, V_{OH} =1.4V, V_{OL} =0.4V

Table 4. Temperature Characteristics

Item	Symbol	Rating	Unit	Note
Storage Temperature	T_S	-30 ~ 80	°C	
Functional Operating Temperature	T_{FUN}	-20 ~ 60	°C	Camera fully functional
Optimum Operating Temperature	T_{OPT}	5 ~ 30	°C	No visible degradation in image quality
Normal Operating Temperature	T_{OPR}	0 ~ 40	°C	Camera produce acceptable image
Soldering Temperature	T_{SOL}	Max 230	°C	

Table 5. Power Consumption

Item	Condition	Min	Typ	Max	Unit	Note
VGA @ 30fps	V_{DDA} &V_{DDP}=2.8V		12		mA	1
	V_{DDIO} =2.8V(1.8V)		6(4.5)		mA	
	V_{DD}=1.8V		14		mA	
VGA @ 15fps	V_{DDA} &V_{DDP}=2.8V		11		mA	1
	V_{DDIO} =2.8V(1.8V)		3(2.3)		mA	
	V_{DD}=1.8V		7		mA	
Power Sleep [Two-wire serial bus is alive]	MCLK=24MHz		500	1000	uA	2
Standby Current [Hardware Power Down]	V_{DDA} &V_{DDP}=2.8V, V_{DDIO} =2.8V, V_{DD}=1.8V MCLK is supplied		10	100	uA	3

Note1) Because power consumption of VDDIO depends on the output load, system environment and register value, user should supply enough current to sensor for stable operation.

Note2) In this case, user can control the registers by using two wire serial bus.

Note3) We recommend that power should be turned off, when low standby power consumption is required

Revision History

Revision	Script Date	Comments
p1.0	Jan. 23, 2006	Preliminary Release
p1.1	March. 30, 2006	Format changed. Key feature updated (Image Scaling, Image Effect, Strobe control)
p1.2	May. 13, 2006	Add power consumption
p1.3	May. 30, 2006	Change IO Pad name Corrected typo and sales offices.
p1.4	June. 13, 2006	Change VDD Min/Max
p1.5	June. 30, 2006	Corrected AC & Temperature Characteristics, Corrected Power Consumption
v1.0	July 3, 2006	Product Brief for mass production

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