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**PAS106BCB-283 SINGLE-CHIP CMOS CIF COLOR DIGITAL IMAGE SENSOR**  
**PAS106BBB-283 SINGLE-CHIP CMOS CIF B&W DIGITAL IMAGE SENSOR**

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**General Description**

The PAS106BCB-283/PAS106BBB-283 is a highly integrated CMOS active-pixel image sensor that has a CIF resolution of 356H x 292V. To have an excellent image quality, the PAS106BCB-283/PAS106BBB-283 outputs 10-bit RGB raw data through a parallel data bus. It is available in color or monochrome in 28-pin LCC package.

The PAS106BCB-283/PAS106BBB-283 can be programmed to set the exposure time for different luminance condition via I2C™ serial control bus. By programming the internal register sets, it performs on-chip frame rate adjustment, offset correction DAC and programmable gain control.

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**Features**

- CIF(356 x 292 pixels) resolution, ~1/5" Lens
- Bayer-RGB color filter array
- On-chip 10-bit pipelined A/D converter
- Output formats: 10-bit parallel RGB raw data
- On-chip 6-bit (1 sign bit+ 5 magnitude bit) background compensation DAC
- On-chip programmable gain amplifier
  - ❑ 5-bit color gain amplifier(x4)
  - ❑ 5-bit global gain amplifier (x5)
- Continuous variable frame time(1/2sec~1/30sec)
- Continuous variable exposure time
- I2C Interface
- Digitally programmable registers
- Single 3.3V supply voltage
- 100 mW low power dissipation

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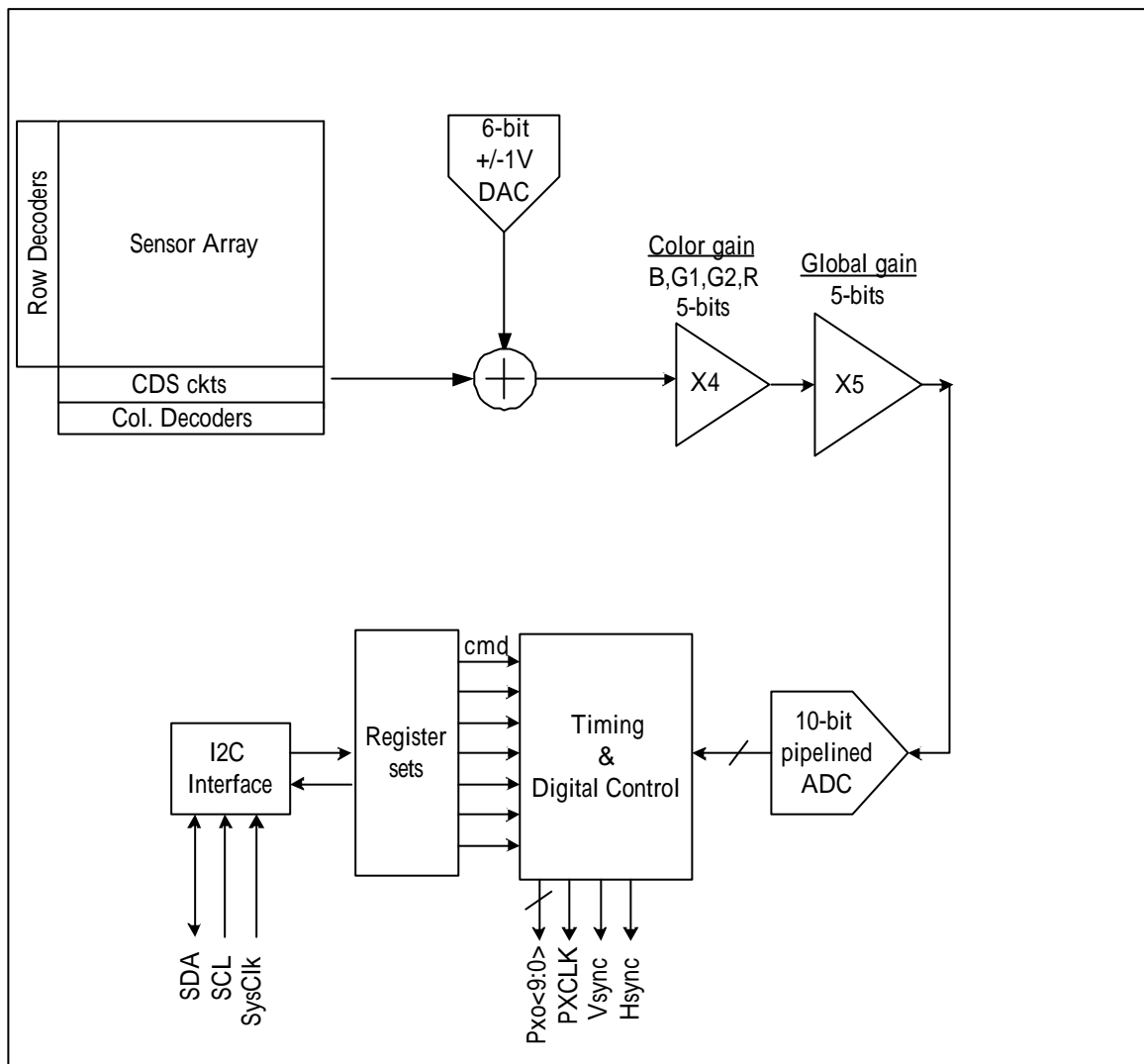
**Key Specification**

Supply Voltage	3.3V ± 5%
Array format	356(H) x 292(V)
Optical format	~1/5 "
Pixel Size	7.25µm x 7.25µm
Frame rate	30 fps
System clock	Up to 48 MHz
Max. pixel rate	4 MHz
Sensitivity	1.0V/lux-sec
PGA gain	31.6 dB ma x.
Color filter	RGB Bayer Pattern
Exposure Time	~ Frame time to 1/160000
Scan Mode	Progressive
S/N Ratio	>45dB
Package	28 pin LCC

## 1. Pin Assignment

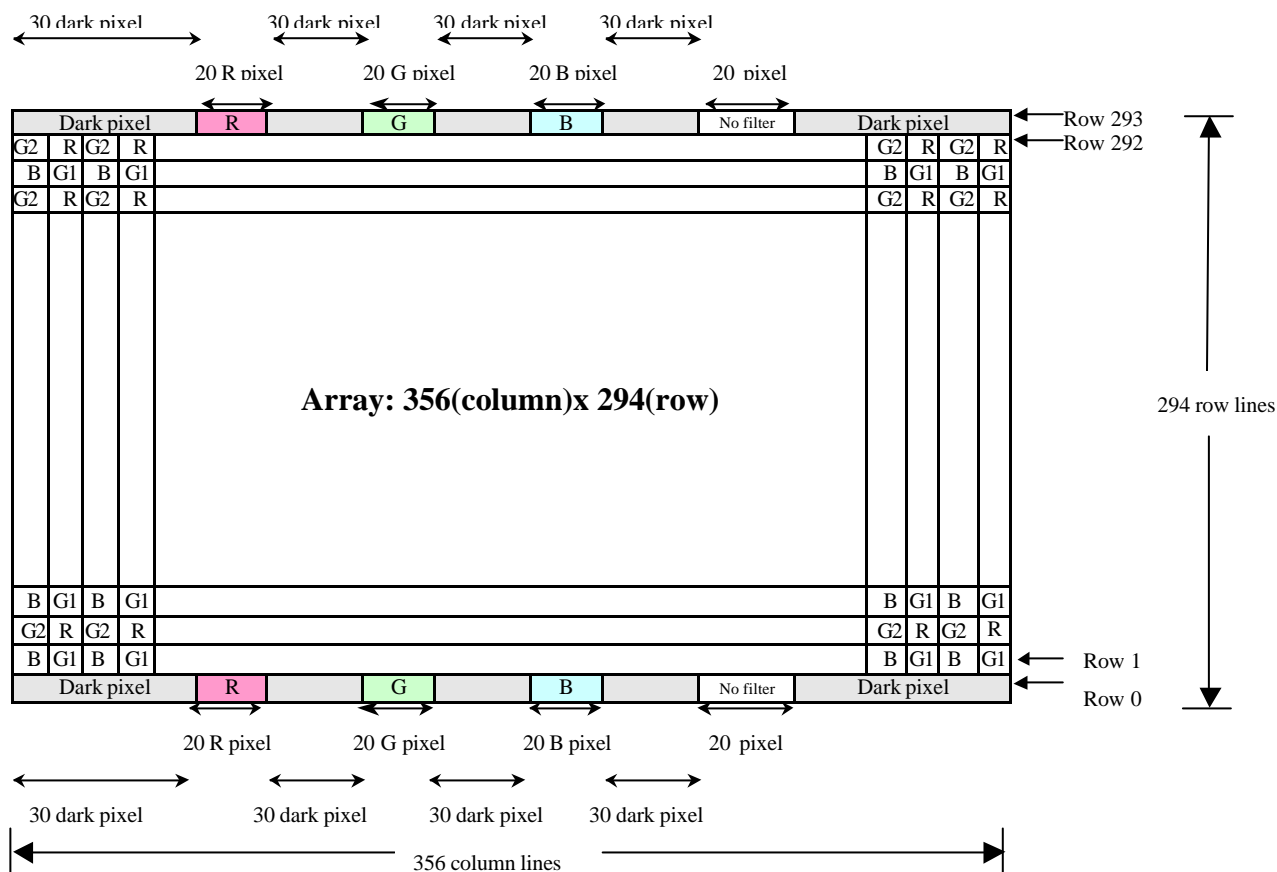
PIN No.	PIN NAME	Type	Definition
1	VLRST	BIAS	Fixed bias input voltage, 1.65V
2	VSSA	GND	Analog ground
3	VRB	BYPASS	Analog voltage reference
4	VRT	BYPASS	Analog voltage reference
5	VDDA	PWR	Analog VDD, 3.3V
6	VDDAY	PWR	Analog VDD, 3.3V
7	VSSAY	GND	Analog ground
8	CSB	IN	Chip select (Low active, chip disabled if high)
9	PXD<9>	OUT	Digital data output
10	PXD<8>	OUT	Digital data output
11	PXD<7>	OUT	Digital data output
12	PXD<6>	OUT	Digital data output
13	PXD<5>	OUT	Digital data output
14	PXD<4>	OUT	Digital data output
15	VDDQ	PWR	Digital VDD, 3.3V
16	VSSQ	GND	Digital ground
17	PXD<3>	OUT	Digital data output
18	PXD<2>	OUT	Digital data output
19	PXD<1>	OUT	Digital data output
20	PXD<0>	OUT	Digital data output
21	PXCLK	OUT	Pixel clock output
22	HSYNC	OUT	Horizontal Synchronization clock
23	VSYNC	OUT	Vertical Synchronization clock
24	SYSCLK	IN	Master clock input
25	SCL	IN	I2C clock
26	SDA	I/O	I2C bi-directional data
27	VDDD	PWR	Digital VDD, 3.3V
28	VSSD	GND	Digital ground

2. Block Diagram



### 3. Pixel Array And Pixel Color Pattern

The output image format of PAS106BCB-283/PAS106BBB-283 is CIF (352x288 pixel array). To provide the co-processor with the extra information it needs for interpolation at the edges of the pixel array, an border of 2 pixels on all 4 sides of the array are available. Fig 3.1. illustrates the pixel array and pixel color pattern.



**Fig 3.1. Pixel array and pixel color pattern**

Note:

1. Pixel color pattern does not apply to monochrome sensor.
2. Pixel read-out proceeds from left to right, and from bottom row to top row.
3. Pixel array not drawn to scale.

### 4. Output timing:

Fixed pixel clock for each line(row), 444pxclk.

4+4 blank pxclk for each line. ( See Fig 4.1. )

1+1 Dark line for each frame.(See Fig 4.2. )

Dark line output format: Fig 4.3.

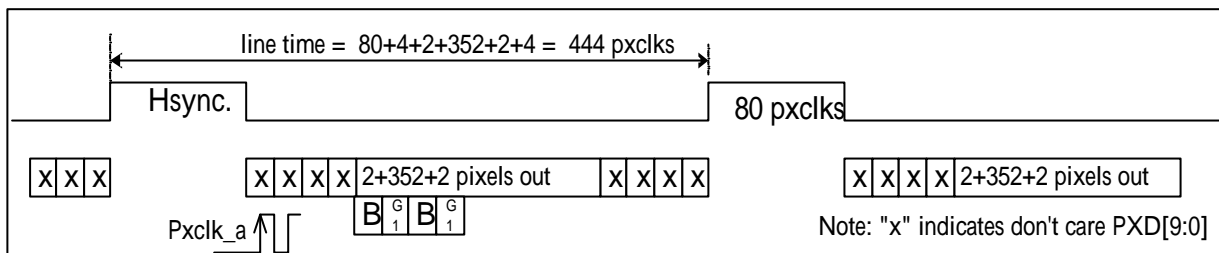


Fig 4.1. Inter-line timing

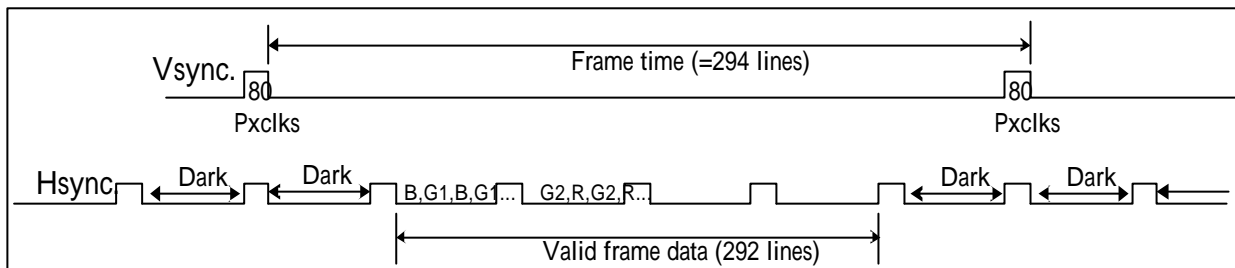


Fig 4.2. Inter-frame timing

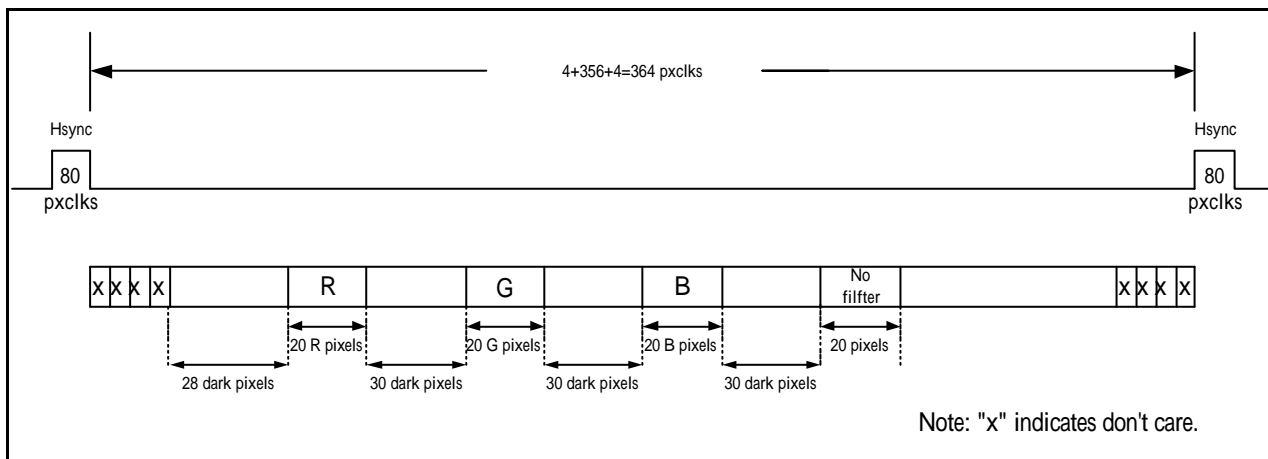


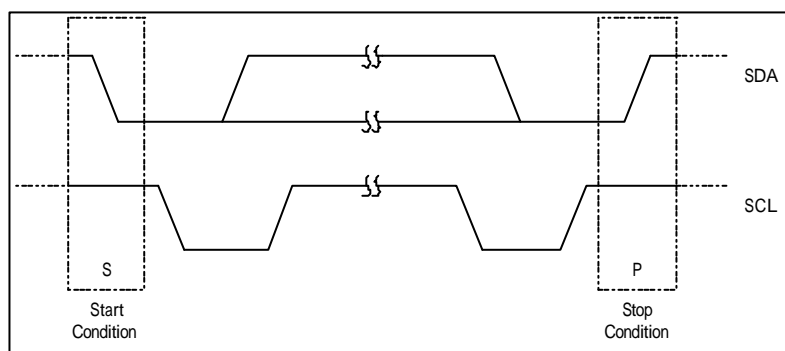
Fig 4.3. Dark line output format

## 5. I2C Bus

PAS106BCB-283/PAS106BBB-283 supports I2C-bus transfer protocol and is acting as slave device. The 7 bits unique slave address is 1000000 and supports receiving / transmitting speed up to 400kHz.

### 5.1 I2C bus overview

- Only two wires SDA (serial data) and SCL (serial clock) carry information between the devices connected to the I2C bus. Normally both SDA and SCL lines are open collector structure and pull high by external pull-up resistors.
- Only the master can initiate a transfer (start), generates clock signals, and terminates a transfer (stop).
- Start and stop condition: A high to low transition of the SDA line while SCL is high defines a start condition. A low to high transition of the SDA line while SCL is high defines a stop condition. Please refer to Fig 5.1.
- Valid data: The data on the SDA line must be stable during the high period of the SCL clock. Within each byte, MSB is always transferred first. Read/write control bit is the LSB of the first byte. Please refer to Fig 5.2.
- Both the master and slave can transmit and receive data from the bus.
- Acknowledge: The receiving device should pull down the SDA line during high period of the SCL clock line when a complete byte was transferred by transmitter. In the case of a master received data from a slave, the master does not generate an acknowledgment on the last byte to indicate the end of a master read cycle.



**Fig 5.1 Start and Stop Conditions**

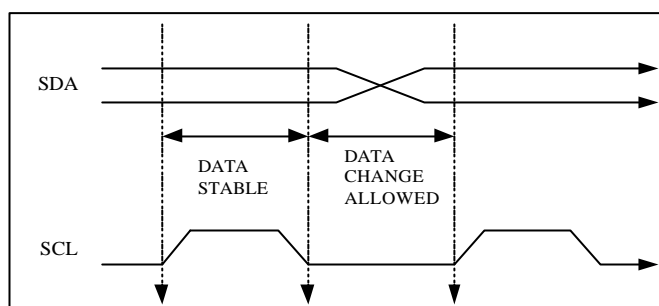
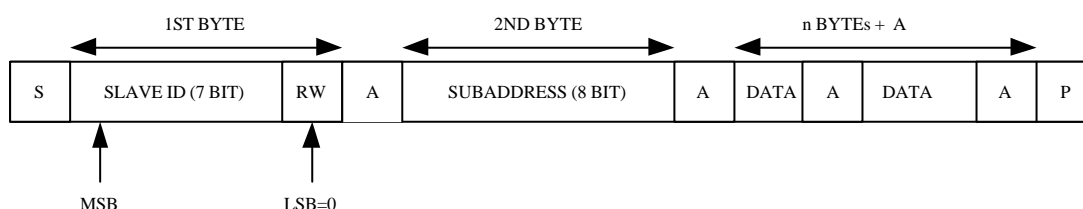


Fig 5.2 Valid Data

## 5.2 Data Transfer Format

### 5.2.1 Master transmits data to slave (write cycle)

- S : Start
- A : Acknowledge by slave
- P : Stop
- RW : The LSB of 1<sup>ST</sup> byte to decide whether current cycle is read or write cycle.  
RW=1 read cycle, RW=0 write cycle.
- SUBADDRESS : The address values of PAS106BCB-283/PAS106BBB-283 internal control registers  
(Please refer to PAS106BCB-283/PAS106BBB-283 register description)

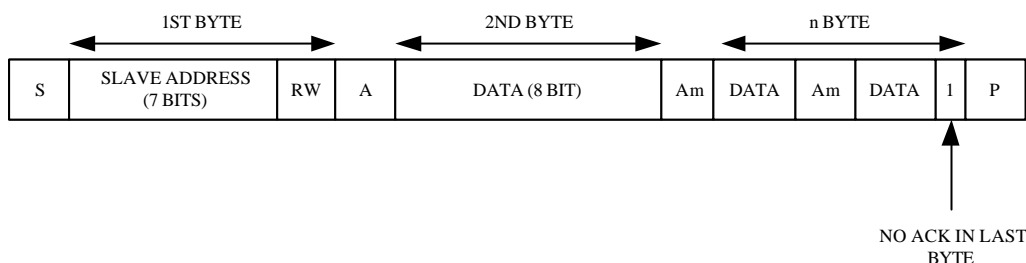


During write cycle, the master generates start condition and then places the 1<sup>st</sup> byte data that are combined slave address (7 bits) with a read/write control bit to SDA line. After slave(PAS106BCB-283/PAS106BBB-283) issues acknowledgment, the master places 2<sup>nd</sup> byte (sub-address) data on SDA line. Again follow the PAS106BCB-283/PAS106BBB-283 acknowledgment, the master places the 8 bits data on SDA line and transmit to PAS106BCB-283/PAS106BBB-283 control register (address was assigned by 2<sup>nd</sup> byte). After PAS106BCB-283/PAS106BBB-283 issue acknowledgment, the master can generate a stop condition to end of this write cycle. In the condition of multi-byte write, the PAS106BCB-283/PAS106BBB-283 sub-address is automatically increment after each DATA byte transferred.

The data and A cycles is repeat until last byte write. Every control registers value inside PAS106BCB-283/PAS106BBB-283 can be programming via this way. (Please refer to Fig 5.3.)

5.2.2 Slave transmits data to master (read cycle)

- The sub-address was taken from previous write cycle
- The sub-address is automatically increment after each byte read
- Am : Acknowledge by master
- Note there is no acknowledgment from master after last byte read



During read cycle, the master generates start condition and then place the 1<sup>st</sup> byte data that are combined slave address (7 bits) with a read/write control bit to SDA line. After issue acknowledgment, 8 bits DATA was also placed on SDA line by PAS106BCB-283/PAS106BBB-283. The 8 bit data was read from PAS106BCB-283/PAS106BBB-283 internal control register that address was assigned by previous write cycle. Follow the master acknowledgment, the PAS106BCB-283/PAS106BBB-283 place the next 8 bits data (address is increment automatically) on SDA line and then transmit to master serially. The DATA and Am cycles is repeat until the last byte read. After last byte read, Am is no longer generated by master but instead by keep SDA line high. The slave (PAS106BCB-283/PAS106BBB-283) must releases SDA line to master to generate STOP condition. (Please refer to Fig 5.3.)



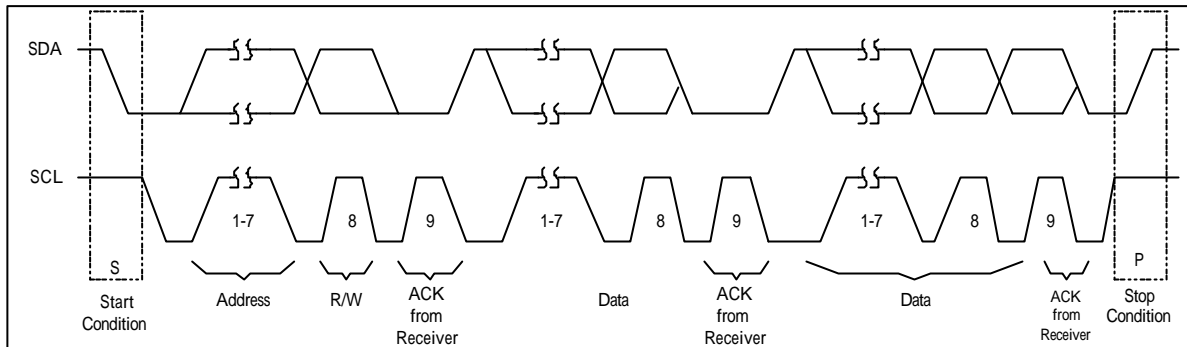
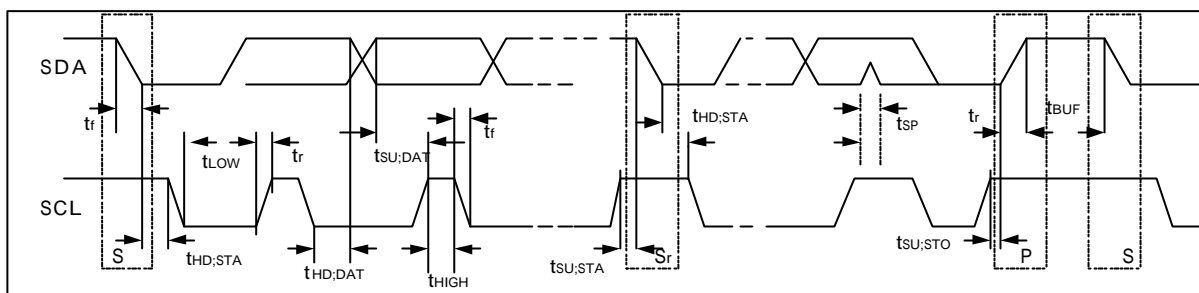


Fig 5.3 Data Transfer Format

### 5.3 I2C Bus Timing



### 5.4 I2C Bus Timing Specification

PARAMETER	SYMBOL	STANDARD-MODE		UNIT
		MIN.	MAX.	
SCL clock frequency	$f_{scl}$	10	400	kHz
Hold time (repeated) START condition. After this period, the first clock pulse is generated.	$t_{HD:STA}$	4.0	-	us
Low period of the SCL clock	$t_{LOW}$	4.7	-	us
HIGH period of the SCL clock	$t_{HIGH}$	0.75	-	us
Set-up time for a repeated START condition	$t_{SU:STA}$	4.7	-	us
Data hold time. For I2C-bus device	$t_{HD:DAT}$	0	3.45	us
Data set-up time	$t_{SU:DAT}$	250	-	ns
Rise time of both SDA and SCL signals	$t_r$	30	N.D.	ns(note 1)
Fall time of both SDA and SCL signals	$t_f$	30	N.D.	ns(note 1)
Set-up time for STOP condition	$t_{SU:STO}$	4.0	-	us
Bus free time between a STOP and START	$t_{BUF}$	4.7	-	us
Capacitive load for each bus line	$C_b$	1	15	pF
Noise margin at the LOW level for each connected device (including hysteresis)	$V_{nL}$	0.1 $V_{DD}$	-	V
Noise margin at the HIGH level for each connected device (including hysteresis)	$V_{nH}$	0.2 $V_{DD}$	-	V

Note1: It depends on the "high" period time of SCL.

## 6. Specifications

### Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
Vdd	DC supply voltage	-0.5	3.8	V
Vin	DC input voltage	0.5	Vdd+0.5	V
Vout	DC output voltage	-0.5	Vdd+0.5	V
Tstg	Storage temperature	0	70	

### DC Electrical Characteristics (VDD=3.3V±5%, Ta=0°C~40°C )

Symbol	Parameter	Min.	Typ.	Max.	Unit
<b>Type :PWR</b>					
VDD	Analog and digital operating voltage	3.15	3.3	3.45	V
IDD	Operating Current		35		mA
<b>Type :IN &amp; I/O Reset and SYSCLK</b>					
VIH	Input voltage HIGH	2.0		VDD	V
VIL	Input voltage LOW	0		0.8	V
Cin	Input capacitor			10	pF
I <sub>lkg</sub>	Input leakage current			1.0	uA
<b>Type : OUT &amp; I/O for PXD0:9, PXCLK, H/VSYN &amp; SDA, load 10pf, 1.2k , 3.3 volts</b>					
VOH	Output voltage HIGH	Vdd-0.2			V
VOL	Output voltage LOW			0.2	V

### AC Operating Condition

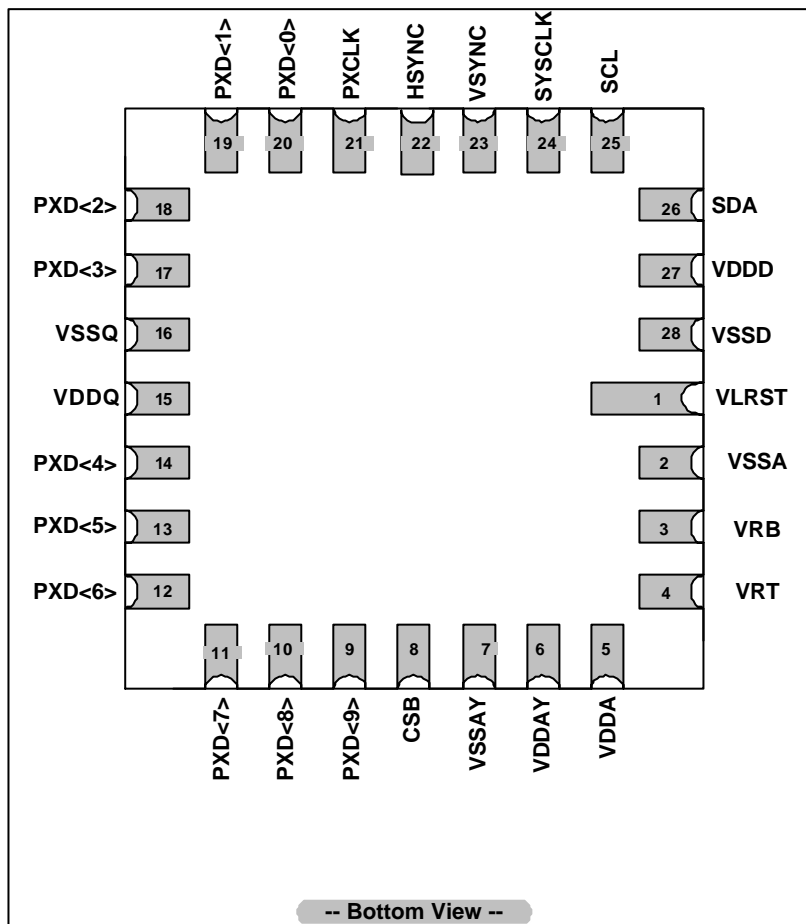
Symbol	Parameter	Min.	Typ.	Max.	Unit
fsysclk	Master clock frequency	8		48	MHz
fpxclk	Pixel clock output frequency			4	MHz

### Sensor Characteristics (To be determined)

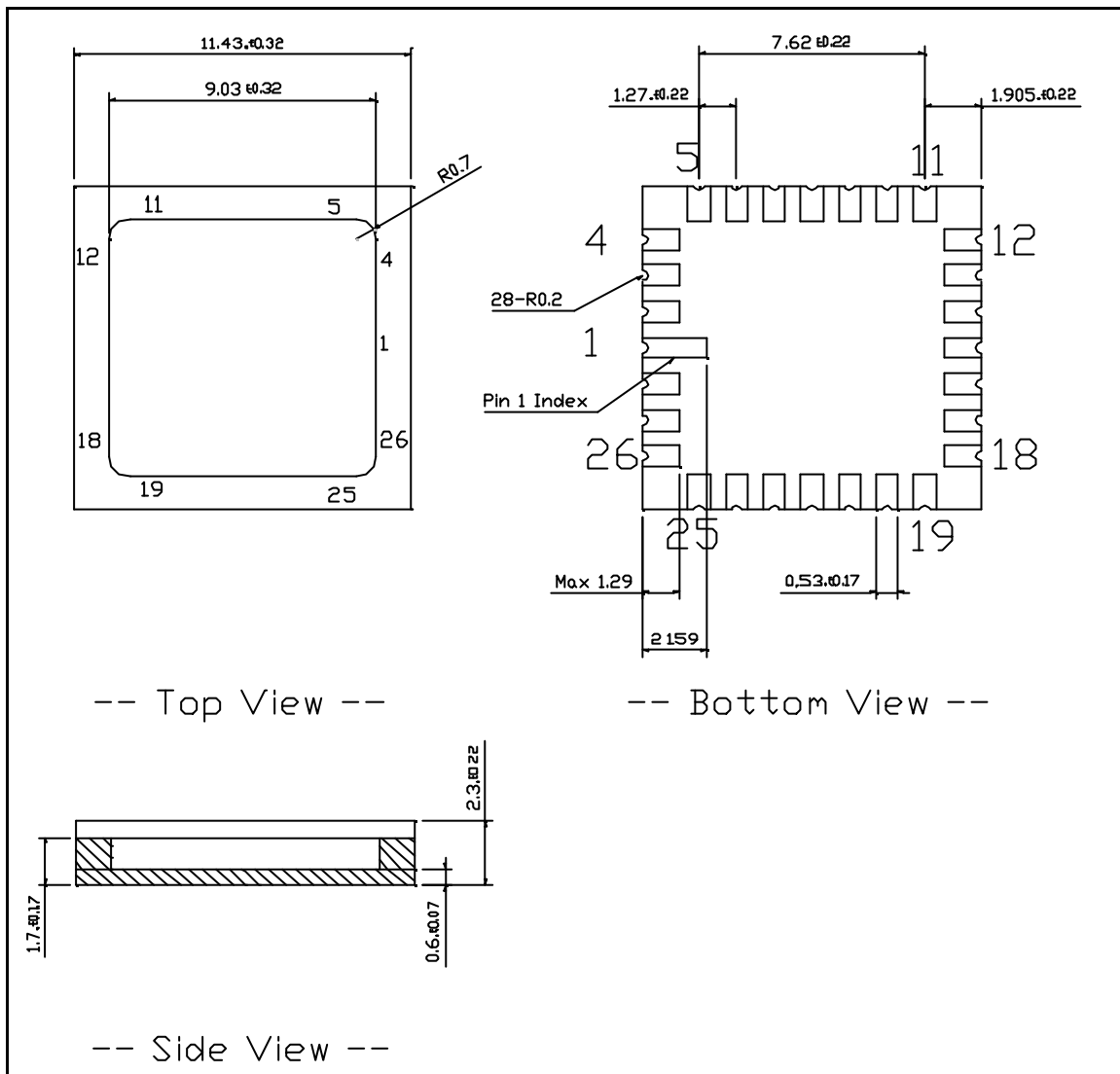
Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Photo response non-uniformity	PRNU		1.02		%	
Saturation output voltage	V <sub>sat.</sub>		1.4		V	
Dark output voltage	V <sub>dark</sub>		52		mV/sec	
Dark signal non-uniformity	DSNU		1.9		Lsb	
Sensitivity ( Red channel )	R		1.2		V/Lux-sec	
Sensitivity ( Green channel )	G		1.0		V/Lux-sec	
Sensitivity ( Blue channel )	B		0.8		V/Lux-sec	

## 7. Package Information

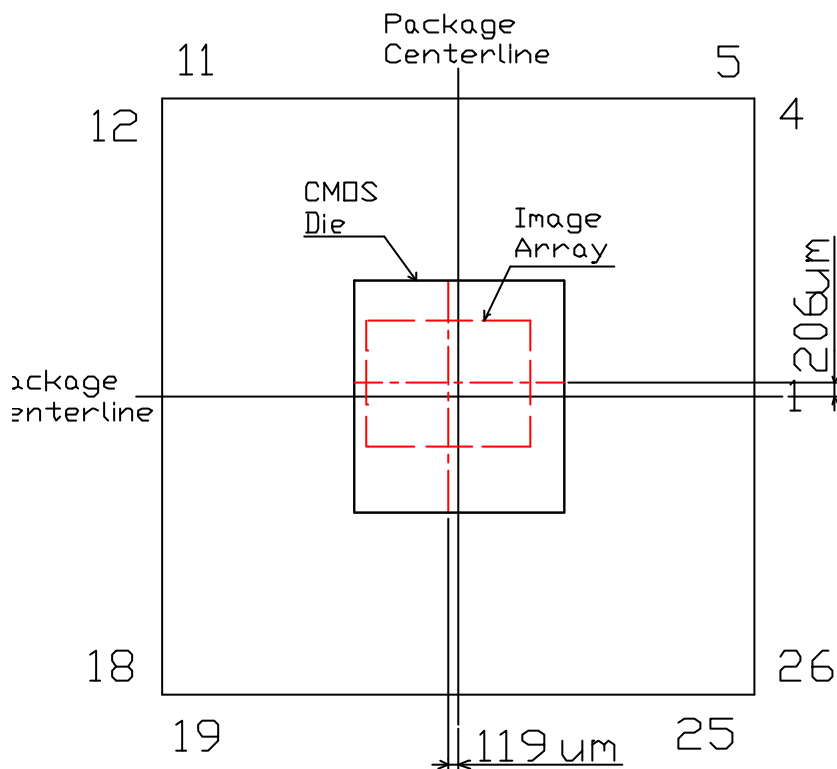
### 7.1. Pin Connection Diagram



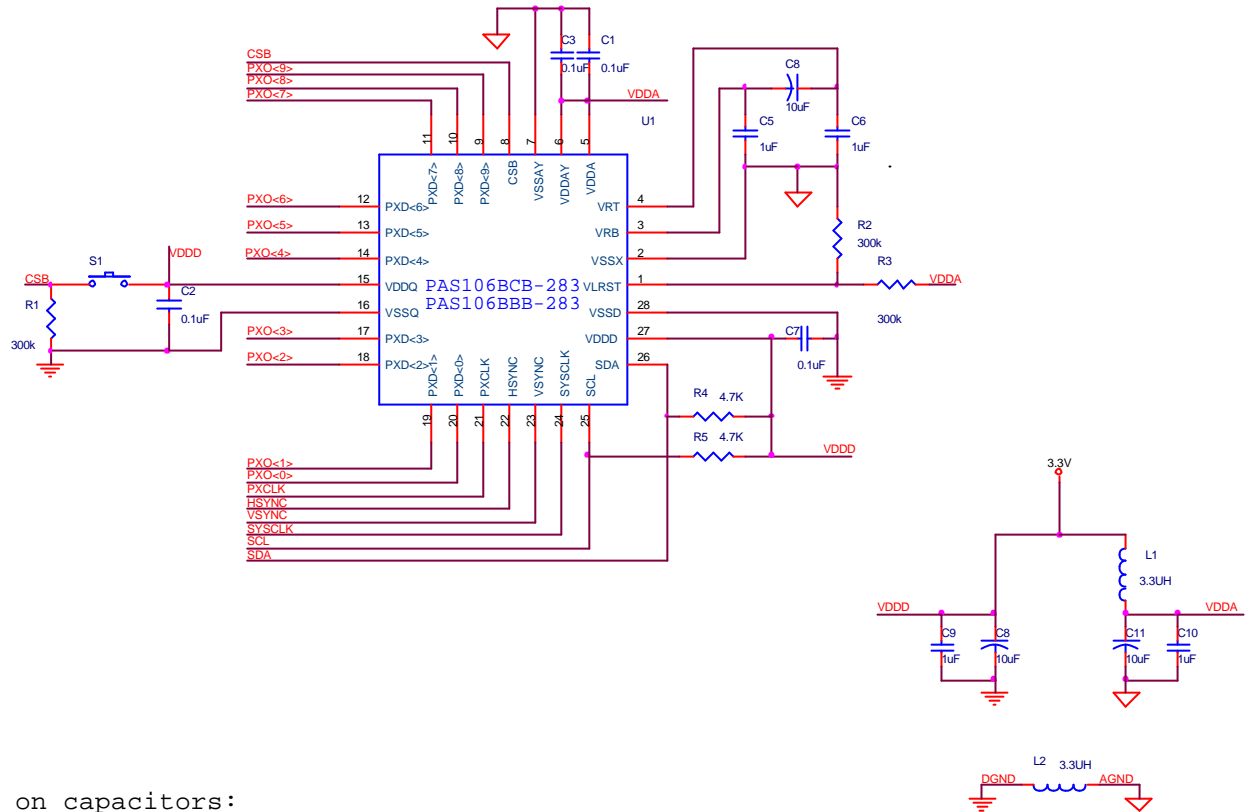
### 7.2. Package Outline



7.3. Sensor center and Die&Package center bias



8. Referencing Circuit Schematic



NOTES on capacitors:

1. The 0.1uF caps for power pins MUST have trace lengths LESS than 5mm.
2. C4, C5 and C6 for pins 2, 3 and 4 MUST have trace lengths LESS than 5mm.

Title			pas106-283 Application circuit
Size	Document Number	Rev	
A4	Jeffery	1.2	
Date:	Thursday, May 16, 2002	Sheet	2 of 2