

Preliminary

Contact Image Sensor (CIS) Module

Product Name	M206-A3C
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Approval		Notes		
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Issued	January 12, 2006	Revision no.		
All specifications of this device are subject to change without notice.				

Revision control sheet

Revision No.	Date	Item of change and content	Reason	Approved	Designed

Features:

- Resolution selectable: 300 dpi / 600dpi resolution
- Pixel number: 7224 pixels
- Very high speed scanning rate: 0.3 ms / line / color
- Three video output
- Three different LED light source: Blue, Green and Red
- Dual light source structure: -45 degree and +45 degree angle against document
- Optical scanning length: 305.55 mm
- Low power supply: 3.3 V or 5 V
- Pixel readout rate: 24.6 Mega-pixel/sec
- Dimension: 19.8 mm (H) x 24 mm (W) x 345 mm (L)

Description:

The M206-A3C is a very high speed, linear Contact Image Sensor (CIS) module. The module built in three different LED (Blue, Green and Red) light source. In order to prevent the shading problem on the conventional CIS module, a dual light source structure is used. One light source is -45 degree against the document, the other is +45 degree against the document. It is suitable to an A3 size document scanner machine.

Figure 1 shows a cross sectional view of the M206-A3C module. It consists of three different LED light sources to illuminate the document, an one-to-one erect graded index micro lens array to focus the document image on the photo-detector array, an array of linear CMOS image sensors to convert the image to an electronic signal, a cover glass to protect the sensor array from dust, a 12-pin connector for the power supply and video signal and 10 pin connector for the light source. The module dimensions are 24 mm in width and 19.8 mm in height and 345 mm in length. Figure 2 shows a block diagram of the M206-A3C module.

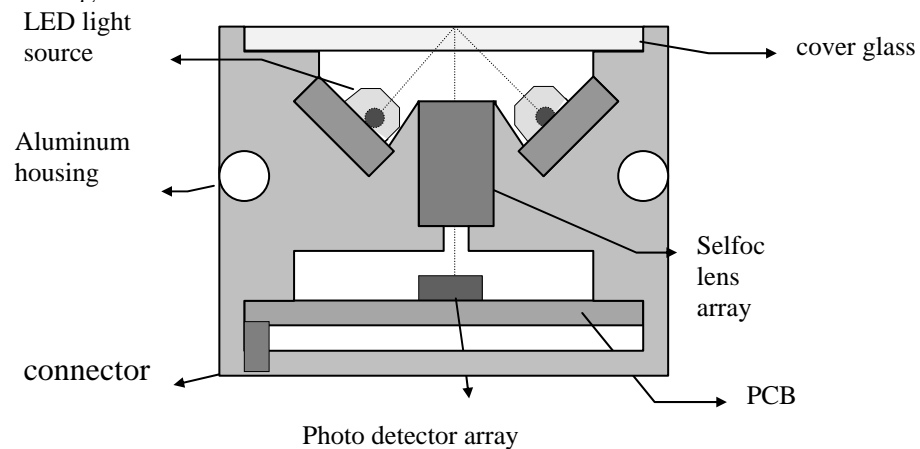
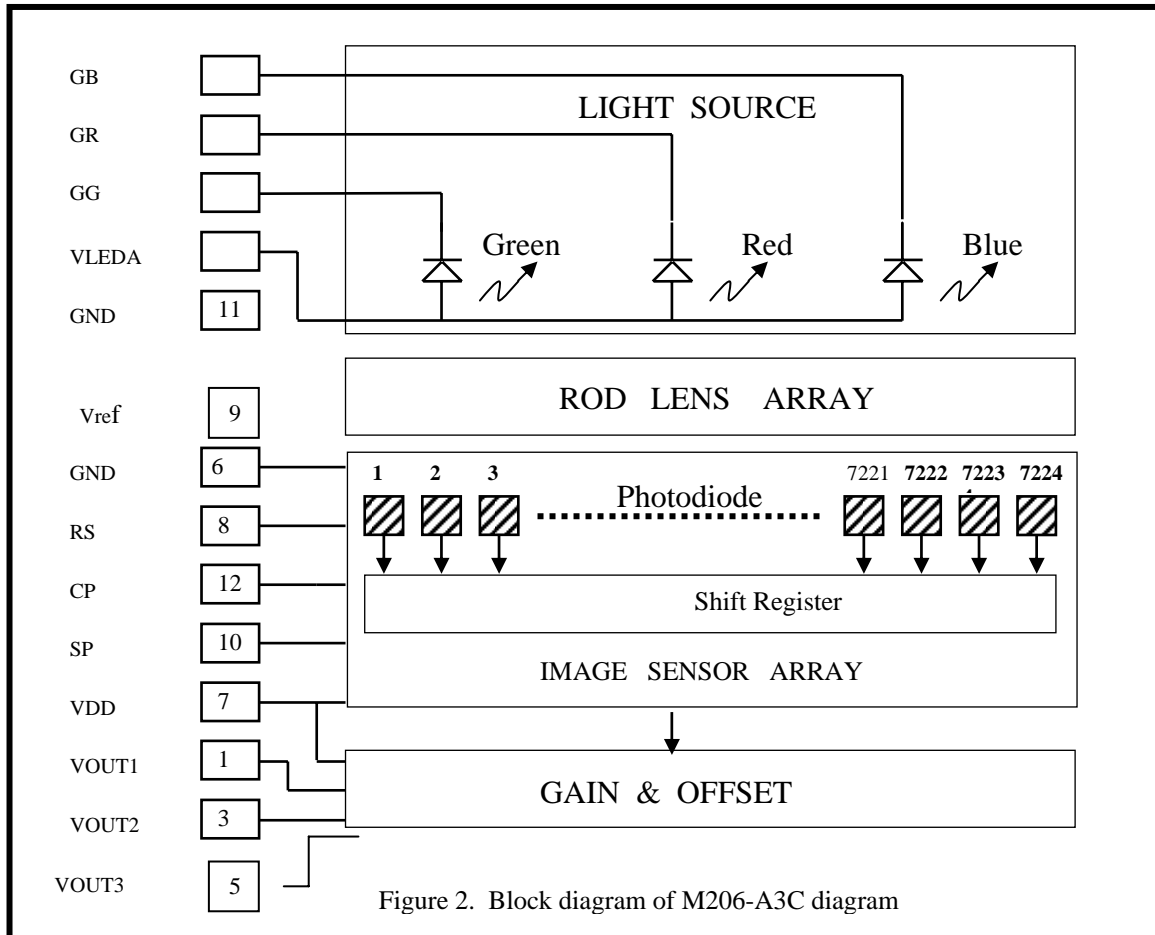


Figure 1. Cross section view of M206-A3C.

Functional block diagram:



VOUT1: pixel #1 to #2408

VOUT2: pixel # 2409 to # 4816

VOUT3: pixel # 4817 to # 7224

Pin description:

Table 1. The pin out description of the M206-A3C CIS module.

1. 12 pin connector for power supply and video signal line

Pin #	Symbol	Direction	Name and function
1	Vout 1	Output	First stage video output signal
2	Gnd	Power	Ground (0 Volts)
3	Vout 2	Output	Second stage video output signal
4	Gnd	Power	Ground (0 Volts)
5	Vout 3	Output	Third stage video output signal
6	Gnd	Power	Ground (0 Volts)
7	VDD	Power	Module power supply (3.3 Volts)
8	RS	Input	300 dpi / 600 dpi resolution selectable
9	Vref	Input	Reference voltage for the sensor; normally, 1 V
10	SP	Input	Start pulse
11	GND	Power	Ground (0 Volts)
12	CP	Input	Clock pulse

2. 10 pin connector for LED light source

Pin #	Symbol	Direction	Name and function
1	G_Blue_1	Input	Cathode for Blue LED light source
2	G_Red_1	Input	Cathode for Red LED light source
3	G_Green_1	Input	Cathode for Green LED light source
4	N/C		No connection
5	VLED	Power	Common Anode for LED light source (+ 12 V)
6	VLED	Power	Common Anode for LED light source (+ 12 V)
7	N/C		No connection
8	G_Blue-2	Input	Cathode for Blue LED light source
9	G_Red_2	Input	Cathode for Red LED light source
10	G_Green_2	Input	Cathode for Green LED light source

PERFORMANCE CHARACTERISTICS

(All shipped modules are tested under the following test conditions)

Table 2. Operating Conditions and Typical Output Response (25 °C) for 300 dpi resolution
Test Conditions: VDD=3.3 V, VLED = 12V

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Line scanning rate	Tint		0.3		ms / line	1
Clock frequency	Tclk		4.1		MHz	

Pixel output frequency	Fpix		8.2		MHz	
Bright signal output (B)	Vpcmax	1			V	2
Bright signal output (G)	Vpcmax	1			V	2
Bright signal output (R)	Vpcmax	1			V	2
Bright output no-uniformity	Upc			30	%	3
Minimum output of dark signal	Vdmin	1.0			V	4
Dark output non-uniformity	Ud			0.2	V	5
Modulation transfer function At red light source	MTF	20			%	6

TERMS AND DEFENITIONS

The parameters of the test conditions in Table 2 are defined as:

- 1 Tint is the integration time or line scanning time. Tint is determined by the interval between two start pulses (SP).

2. Vpc(n) is the effective output signal of every pixel and is defined by:

$$Vpc(n) = Vp(n) - Vd(n)$$

Vp(n) is the output signal of the nth pixel using a white image target with 0.05 Optical Density (OD).

Vd(n) is the output signal of the nth pixel in the black target.

Dark output is obtained at black target by turning on the LED.

Vpcavg is defined by

$$Vpcavg = \sum_{n=1}^m [Vpc(n)];$$

Where n = 1, 2, ..., m;

3. Upc is the white output non-uniformity with dark signal subtracted and is defined by:

$$Upc = ((Vpcmax - Vpcmin) / (Vpcmax)) \times 100\%$$

Vpcmax = MAX[Vpc(n)]; is the maximum effective output signal

Vpcmin = MIN[Vpc(n)]; is the minimum effective output signal

Where n = 1, 2, ..., m

4. Vdmin is the minimum output signal in the dark and is defined by:

$$Vdmin = MIN [Vd(n)];$$

Where n = 1, 2, ..., m;

5. Ud is the dark output non-uniformity and is defined by:

$$Ud = Vdmax - Vdmin$$

Vdmax = MAX[Vd(n)]; is the maximum dark output signal

Vdmin = MIN[Vd(n)]; is the minimum dark output signal

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6. Figure 4 shows a typical output response of the module using a MTF image target.

Modulation Transfer Function is defined by:

$$MTF = MIN\{ [(V_{max} - V_{min}) / (V_{max} + V_{min})] \} \times 100\%$$

V_{max} is the maximum output signal using the MTF image target with

Correspond to dark signal (V_d) subtracted

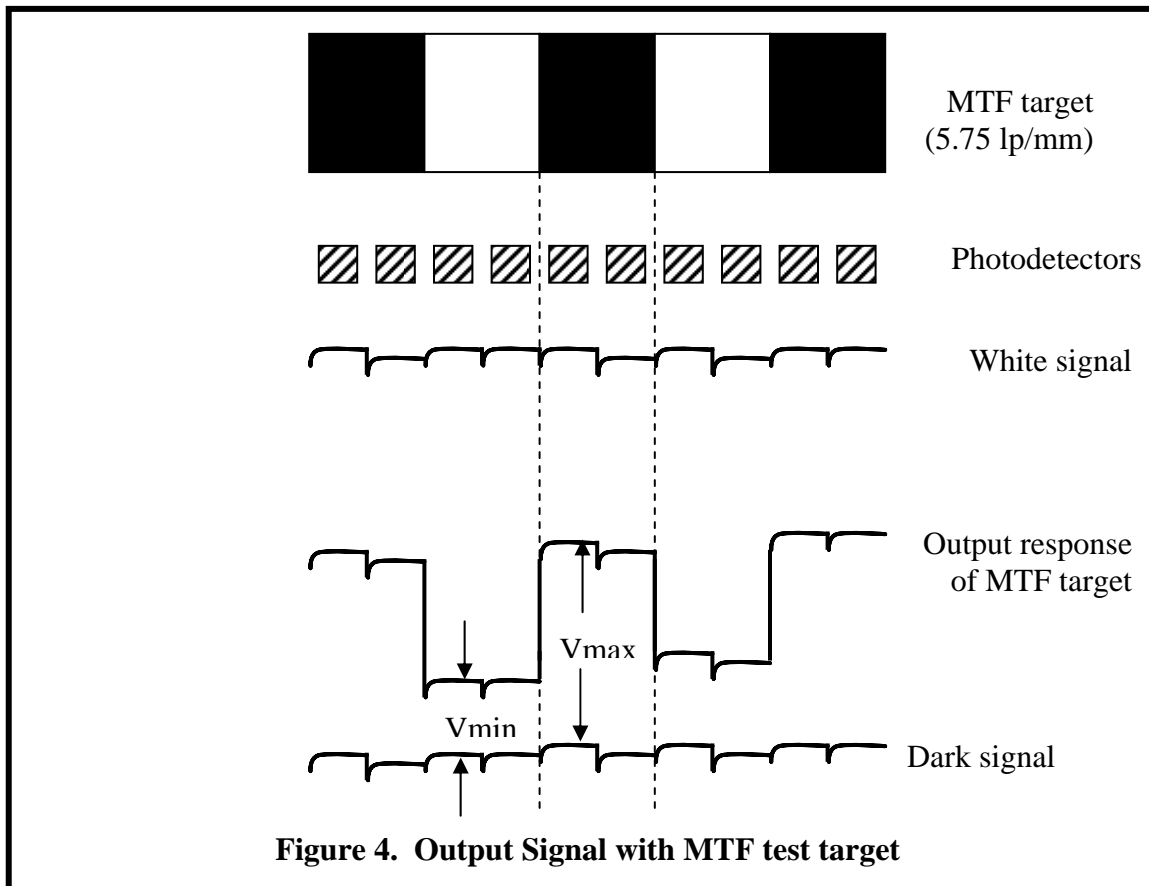
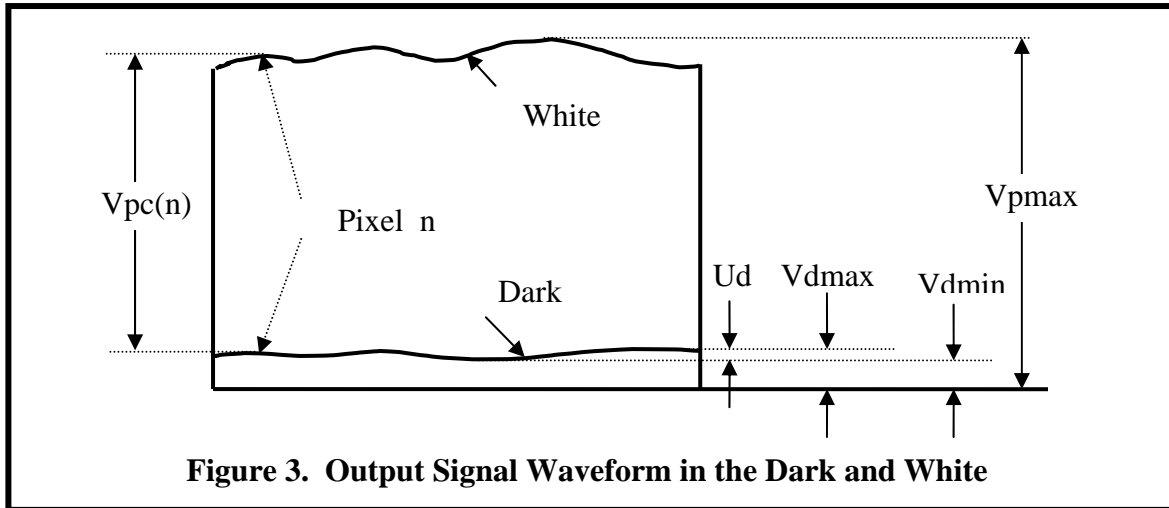
V_{min} is the minimum output signal using the MTF image target

Correspond to dark signal (V_d) subtracted

MTF image target is 5.75 lp/mm

Note:

1. All parameter is measured at 300 dpi resolution and VOUT1
2. Dark compensation is achieved by subtracting the dark level of every pixel.
3. For the best performance, two points correction (dark and white) is strongly recommended.



ELECTRICAL REQUIREMENTS

Table 3. Absolute Maximum Ratings

Parameter	Symbol	Max	Min	Unit
Power supply voltage	VDD	3.6		V
Power supply current	IDD	10		mA
LED power supply voltage	VLED	12.5		V
Red LED power supply current / bar	ILED	250		mA
Green LED power supply current / bar	ILED	400		mA
Blue LED power supply current / bar	ILED	400		mA
Input voltage		VDD + 0.5	-0.5	V
Output voltage		VDD + 0.5	-0.5	V
Operating temperature	Top	50	0	°C
Storage temperature	Tstg	75	-25	°C
Operating humidity	Hop	90	10	RH %
Storage humidity	Hstg	90	10	RH %

Table 4. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	VDD		3.3		V
Red LED power supply voltage	VLED		12.0	12.5	V
Green LED power supply voltage	VLED		12.0	12.5	V
Blue LED power supply voltage	VLED		12.0	12.5	V
High-level input voltage	Vih	VDD-0.7		VDD+0.4	V
Low-level input voltage	Vil	0		0.7	V
Clock frequency	Tclk		4.1		MHz
Clock duty cycle			50		%
Integration time	Tint		0.3		ms
Operating humidity	Hop	10		85	RH %
Operating temperature	Top	0	25	50	°C

Table 5. LED Light Source Characteristics (12V, 25 °C)

Parameter	Peak emission wavelength (λ_p)	Current / light bar
Blue LED	470 nm	270 ~ 324 mA
Red LED	640 nm	270 ~ 324 mA
Green LED	560 nm	165 ~ 198 mA

TIMING DIAGRAM

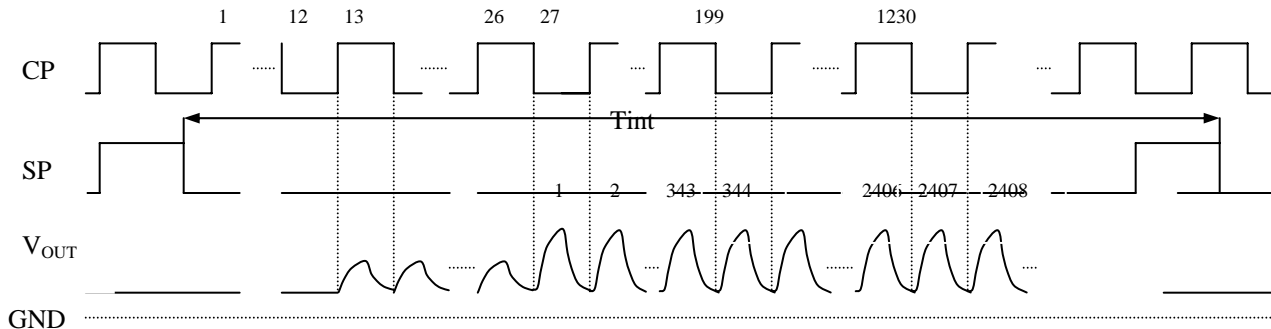


Figure 5. Timing diagram of the M621-A3C module.

Table 6. Timing Requirements and Switching Characteristics (V_{dd}=3.3V and 25°C)

Parameter	Symbol	Min	Typ	Max	Unit
Clock Frequency	tclk		4.1		MHz
Clock Pulse width	tw		125		Ns
Clock Duty	Tw/to		50		%
SP Setup Time	tst	50		to-tw	ns
SP Hold Time	tht	50		to-tw	ns
Signal Delay Time	td		50		ns

Figure 5 shows the module timing. Refer to table 6 for timing parameters. Notice the M621-A3C output data is twice the clock frequency. The new pixel data is available after every clock transition. Due to parasitic capacitance, the data does not instantaneously change to its final value. This makes it necessary to delay the read until the value has time to stabilize. Normally the data is sampled at $0.75 * tclkh$ and $0.75 * tclkl$ after the clock transition. Some experimentation may be necessary, dependent upon the application.

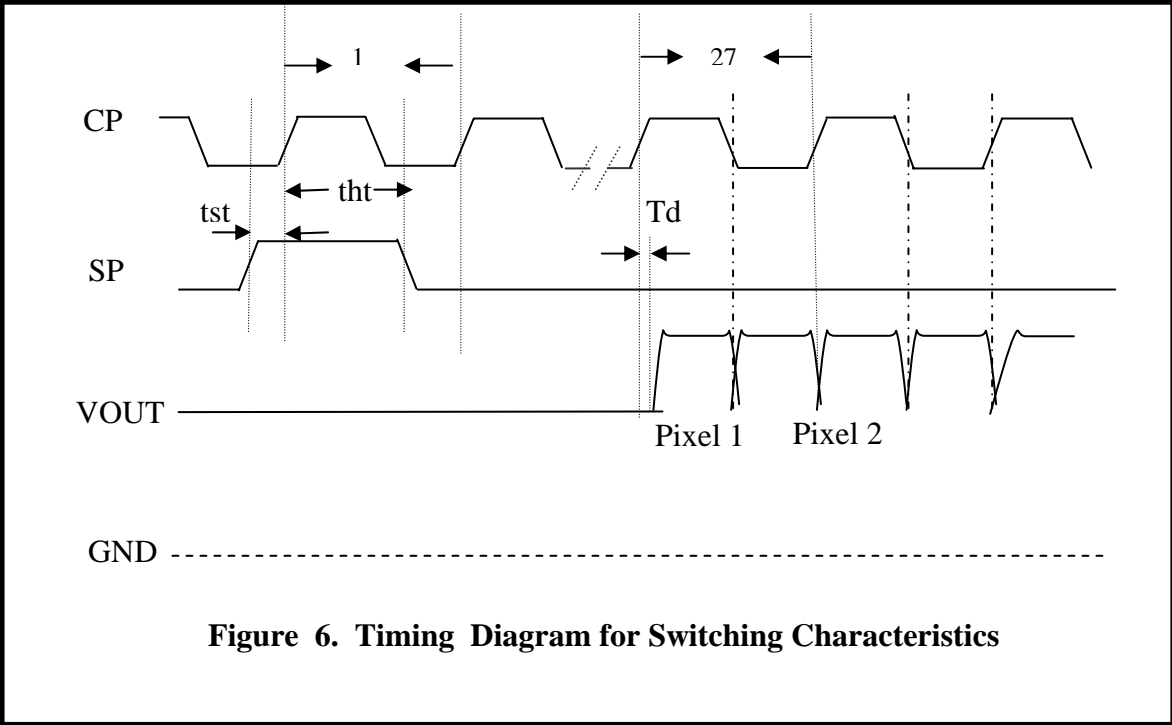


Figure 6. Timing Diagram for Switching Characteristics

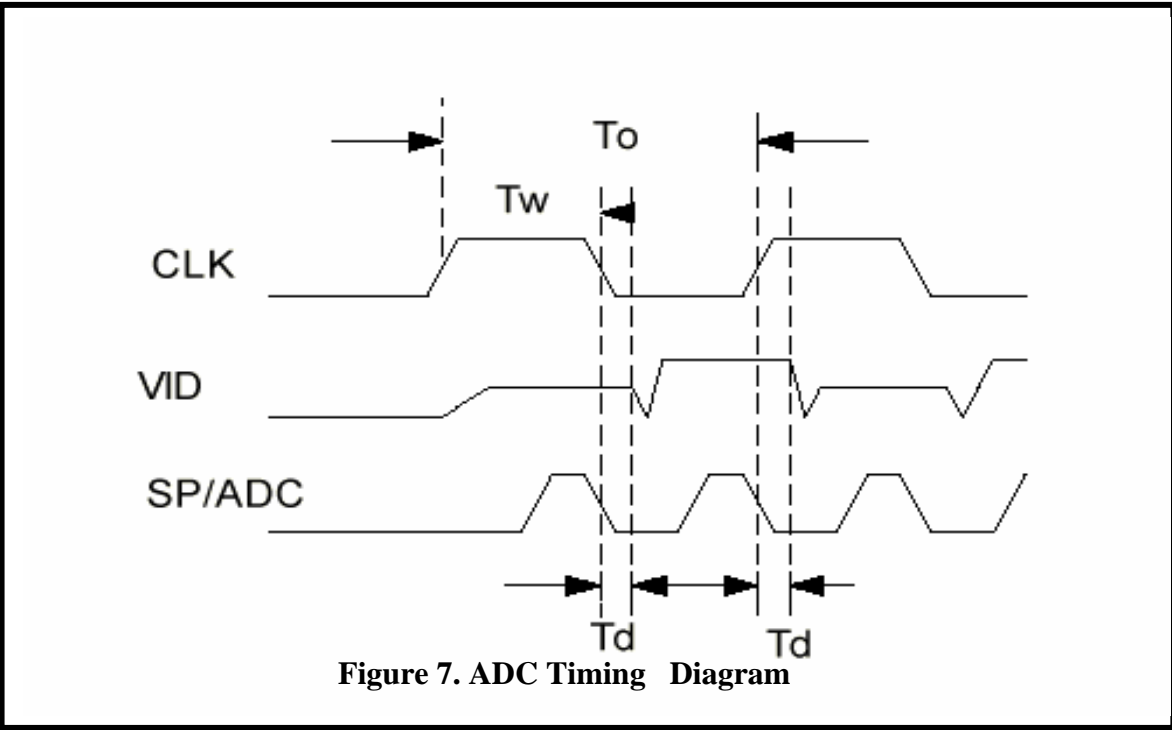


Figure 7. ADC Timing Diagram

MACHINAL PROPERTIES AND DIMENSION

Table 7. Mechanical Properties and Dimensions

Parameter	
Number of photo-detectors	7224 elements
Effective number of photo-detectors	7224 pixels (1 to 7224) VOUT1: pixel # 1 ~ # 2408 VOUT2: pixel # 2409 ~ # 4816 VOUT3: pixel # 4817 ~ # 7224
Pixel-to-pixel spacing	42.25 μm
300 dpi resolution	Pixel #1 add #2; #3 add #4, ...
Optical readable length	305.55 mm
Module height	19.8 mm
Module width	24 mm
Module length	345 mm
Connector	12 pin for power and signal; 10 pin for LED light source

Application Information

A Driver timing diagram

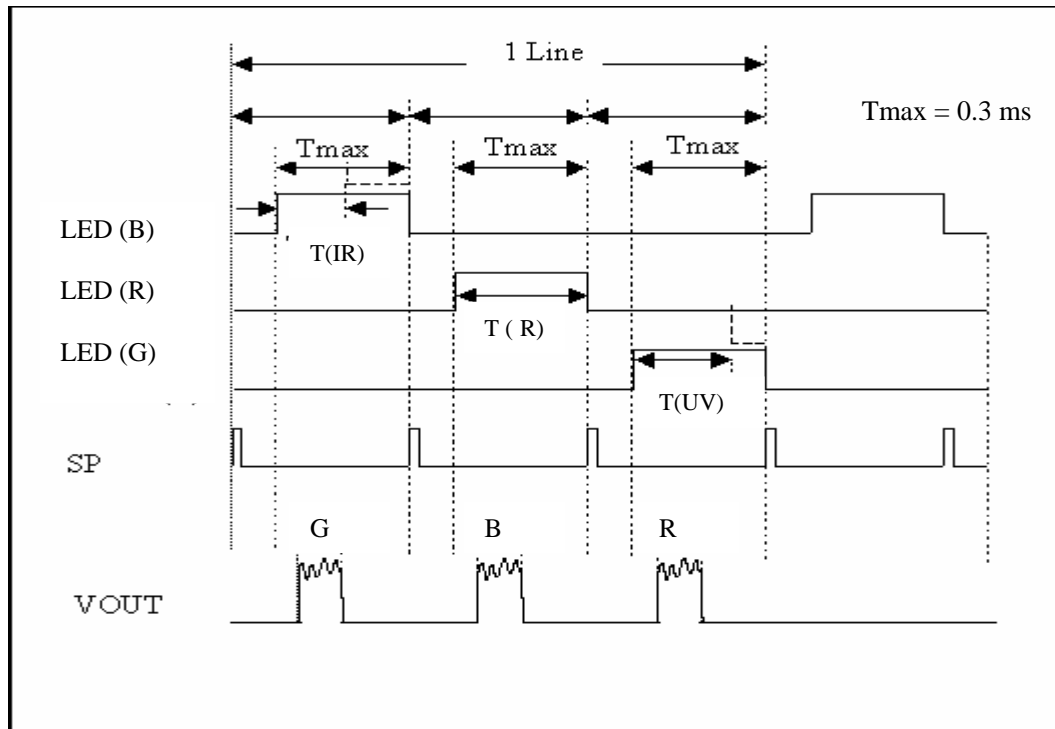


Figure 8 shows functional timing for the color mode operation. In this mode all three LEDs are pulsed. The following instruction is used to set the output signal level for the three colors. First the current of the three LEDs are set. Then the pulse width of the three colors are set to maximum ($T_{\text{blue}}=T_{\text{red}}=T_{\text{green}}=T_{\text{max}}$). Then, the output signal is measured and the video

signal with the least amplitude is recorded and the pulse width is kept. Then, the pulse width of the other two colors is reduced until the output signal of all three video output signals are at the same level. For example, The UV LED pulse is set to T_{max} , and infrared and red LED pulse width is reduced as shown in Figure 8.

D A/D interface

There are several ways for the output signal to interface with A/D converter, as illustrated below. Method A is the simplest and Method C provides the best performance.

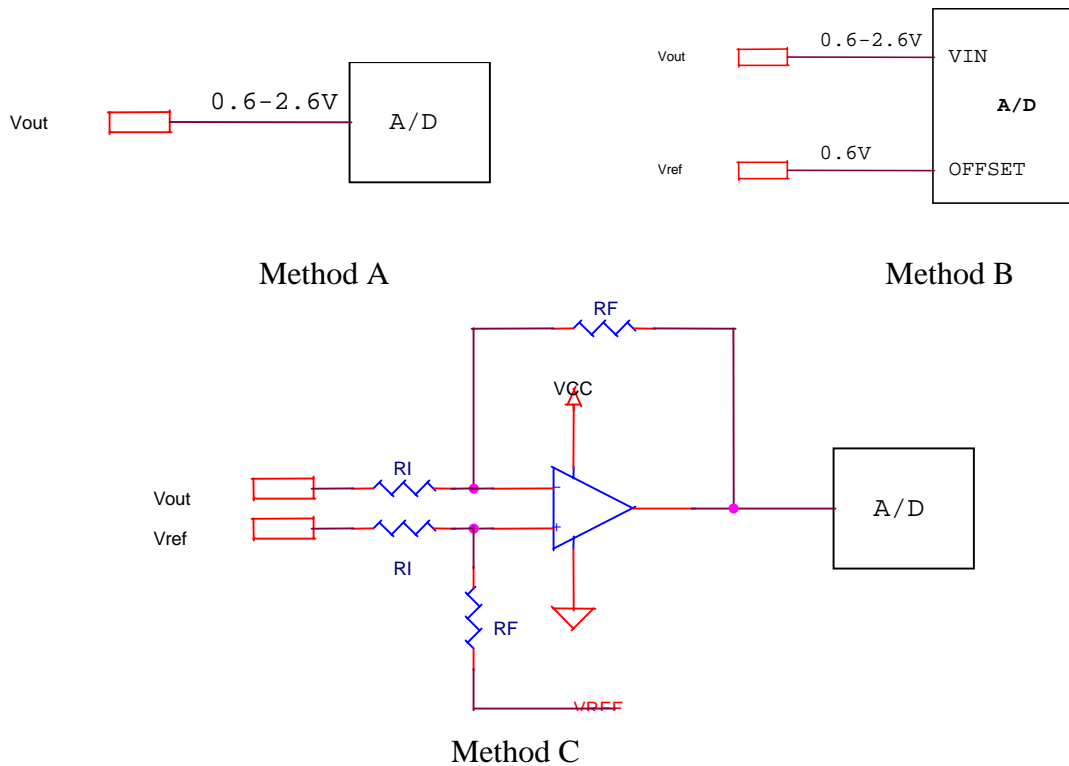


Figure 9. A/D interface

QUALITY ASSURANCE

Table 8. Reliability Test

No.	Item	Conditions
1	High Temperature Burn-In	80°C, 100 h, operating
2	High Temperature High Humidity	75°C, 90 %RH, 100 h, non-operating
3	Low Temperature	-25°C, 100 h, non-operating
4	Thermal Shock	-25°C <> 25°C <> 75°C, 10 cycles, non-operating 30 min 5 min 30 min
5	Vibration	10~55~10 Hz, Amplitude=2 mm, X, Y, Z directions 1 h each, non-operating
6	Free Drop	80 cm, 6 sides, once for each side, packing
7	ESD	200 pF, 200V, R=0 Ω, once for each terminal, non-operating
8	Power Supply On /Off	5000 times, operating

PRECAUTIONS BEFORE USE

- **Extracting / Inserting the Connector**

The maximum number of times that the connector should be extracted and connected is 10. If the connector is inserted and extracted repeatedly more than 10 times, the connector “burrs” may possibly erode and damage the connector.

- **Dirty Glass Surface**

The glass surface should be kept clean. Do not wipe the glass surface with your hand. Do not use the CIS module in a dust-polluted environment. If the glass surface becomes dirty, carefully wipe the surface gently with a clean cloth soaked in alcohol.

- **Stable Operation**

1. The connector pins should not be touched with bare hand or electrostatic charged materials.
2. Noise Suppression
 - 2.1 Insert a low frequency noise suppressing capacitor (100μF) between the power supply VDD (+3.3V) and GND. A high frequency noise suppressing capacitor is already integrated into the printed circuit board.
 - 2.2 Make sure that the module connecting cable is 30 cm or shorter in length. Twisted cable pairs are recommended for CP/GND, VOUT/GND and VLED/GLED.
3. Latch-up

If the supply voltage is higher than the absolute maximum ratings, latch-up may cause severe electrical damage to the module. If the supply current variation changes very

rapidly or the power supply is turned on and off very frequently, make sure that the voltage on each terminal does not exceed the maximum value.

- **Dust**

The module is housed in an air tight structure to protect it from dust. Disassembly or the removal of any component may permit dust to enter into the module.

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Attachment: the configuration and the physical dimensions (unit: mm) of the M206-A3C.

