

CAMERA MODULE SPECIFICATION

Customer: _____

Customer project name: VD55G0 ModuleProduct Description: CV1222-D-79° - ClearLast update: 2022/07/28

制作 (Drawn)	审核 (Check)	批准 (Approval)
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客户确认: <input type="checkbox"/> 合格 <input type="checkbox"/> 不合格 <input type="checkbox"/> 其它 Customer Approval: Qualifiwd / Failure / Other		客户意见 (Customer Opinions)
批准日期 (DATE)	承认日期 (DATE)	



Revision History

Version	Date [Y/M/D]	Notes	Writer
1.0	22/07/28	Initial released	Yongjian Chen



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2、 Specifications

2.1 Features

- Global shutter technology
- 3D stacked sensor
- Embedded auto-exposure
- 2.6 μm x 2.6 μm BSI pixel
- 0.4 megapixel resolution sensor
 - 640 pixels x 600 pixels
 - Small pixel array size of 1.68 mm x 1.59 mm
 - Optical format 1/9 "
- Die size: 2.6 mm x 2.5 mm
- The smallest global shutter 640 pixels x 600 pixels with 6.5 mm² only
- Operating junction temperature: -30 °C to 85 °C
- Single lane transmitter MIPI CSI-2
- (copyright© 2005-2010 MIPI Alliance, Inc. Standard for Camera Serial Interface 2 (CSI-2) version 1.0) version 1.3, up to 1.2 Gbps per lane
- Fast mode+ I2C control interface
- Linear dynamic range up to 64 dB
- Integrated temperature sensor
- Up to 210 frames per second at full resolution
- Programmable sequences of 4-frame contexts
- Automatic dark calibration
- Dynamic and map-based defective correction
 - Multi context management
 - 4 programmable GPIOs
 - Up to 4-LED control outputs, synchronized with sensor integration periods
 - PWM (pulse-width modulation) control
 - Master/slave external frame start
 - Mirror/flip readout
 - Crop
 - Binning (x2 and x4)
 - Sub sampling (x2 and x4)

2.2 Description

The VD55G0 is a global shutter image sensor optimized for both visible and near infrared domains. The sensor captures up to 185 frames per second in a 640 x 600 resolution format. The pixel construction of this device minimizes crosstalk while enabling a high quantum efficiency (QE) up to near infrared spectrum.

2.3 Acronyms and abbreviations

Table 1. Acronyms and abbreviations

Acronym/abbreviation	Definition
BSI	backside illumination
CCI	camera control interface
CP	charge pump
CPU	central processing unit
CRA	chief ray angle
CSI	camera serial interface
EMI	electromagnetic interference
EMC	electromagnetic compatibility
FoV	field of view
FPN	fixed pattern noise
fps	frames per second
GPIO	general purpose input/output
I2C	inter integrated circuit (bus)
IP	intellectual property
ISL	intelligent status line
ISP	image signal processor
LDO	low dropout regulator
MIPI	mobile industry processor interface
OIF	output interface
OTP	one-time programmable
QE	quantum efficiency
PHY	physical layer
PLS	photo light sensitivity
PWM	pulse-width modulation
STBY	standby
SW	software

2.4 Overview

Table 2. Technical specifications

Feature	Detail
Pixel resolution	640 x 600 (including four borders)
Sensor technology	3D stacked
Pixel size	2.61 μm x 2.61 μm
Analog gain	x1 – x8
Dynamic range (linear mode)	64 dB
Peak signal-to-noise ratio (on pixel)	40 dB
Pixel sensitivity (xx nm)	TBD
Power consumption	TBD
Junction temperature range (Tj)	-30 °C to 85 °C functional
Shutter	Global
Peak quantum efficiency	TBD
Fixed pattern noise (FPN)	TBD
Temporal read noise	TBD
Dark current	14 e ⁻ at 60 °C
Total full well	12000 e ⁻
Photo light sensitivity (PLS)	90 dB
Package option	Bare die
Frame rate at full resolution	185 fps
CSI-2 serial interface data rate	Up to 1.2 Gbps
Pixel output format	RAW 10 and RAW 8
Supply voltages	2.8 V analog supply 1.8 V digital – IO supply 1.15 V digital – core supply
Temperature sensor accuracy	± 3 °C in range -30 °C to 85 °C
External clock frequency range	6 MHz – 27 MHz
Frame synchronization	Internal, external I2C, external HW

2.5 Functional description

2.5.1 Interfaces

Inter-integrated circuit (I2C)

The VD55G0 is configured and controlled via an I2C interface operating in either Fast mode (up to 400 kHz) or Fast+ mode (up to 1 MHz) at 1.8 V. After the CPU boot sequence, the default I2C configuration is Fast mode plus with a sink capability set to 20 mA. Drive capability can be decreased to 4 mA (Fast mode) by writing a dedicated register once the system has booted.

Device addressing uses a CCI protocol with 2 byte sub addresses.

The default sensor address, 0x20 (including R/W bit), can be overridden:

- Permanently if a non-null value is stored in the OTP dedicated register
- Dynamically with a CPU command when the CPU state is SW STBY

Camera serial interface (CSI)

The sensor is ready to connect via a single lane mobile industry processor interface (MIPI) CSI-2 serial interface.

The single lane MIPI CSI-2 serial interface supports up to 1.2 Gbps. It is the industry standard for low electromagnetic interference (EMI) and excellent electromagnetic compatibility (EMC) high-speed interfacing.

Resolution is scalable between RAW8 and RAW10.

2.5.2 Power supplies

The power supplies required by the sensor are:

- 2.8 V for the analog blocks
- 1.8 V for the digital I/Os
- 1.15 V for the core digital logic and MIPI CSI-2 output drivers

The pixel array requires different positive and negative voltages, all internally generated by charge pumps and regulators. Two voltage references, internally generated, need external decoupling capacitors.

The internal CPU handles the entire power management of the sensor to guarantee the lowest power consumption at any given time.

2.5.3 Clock

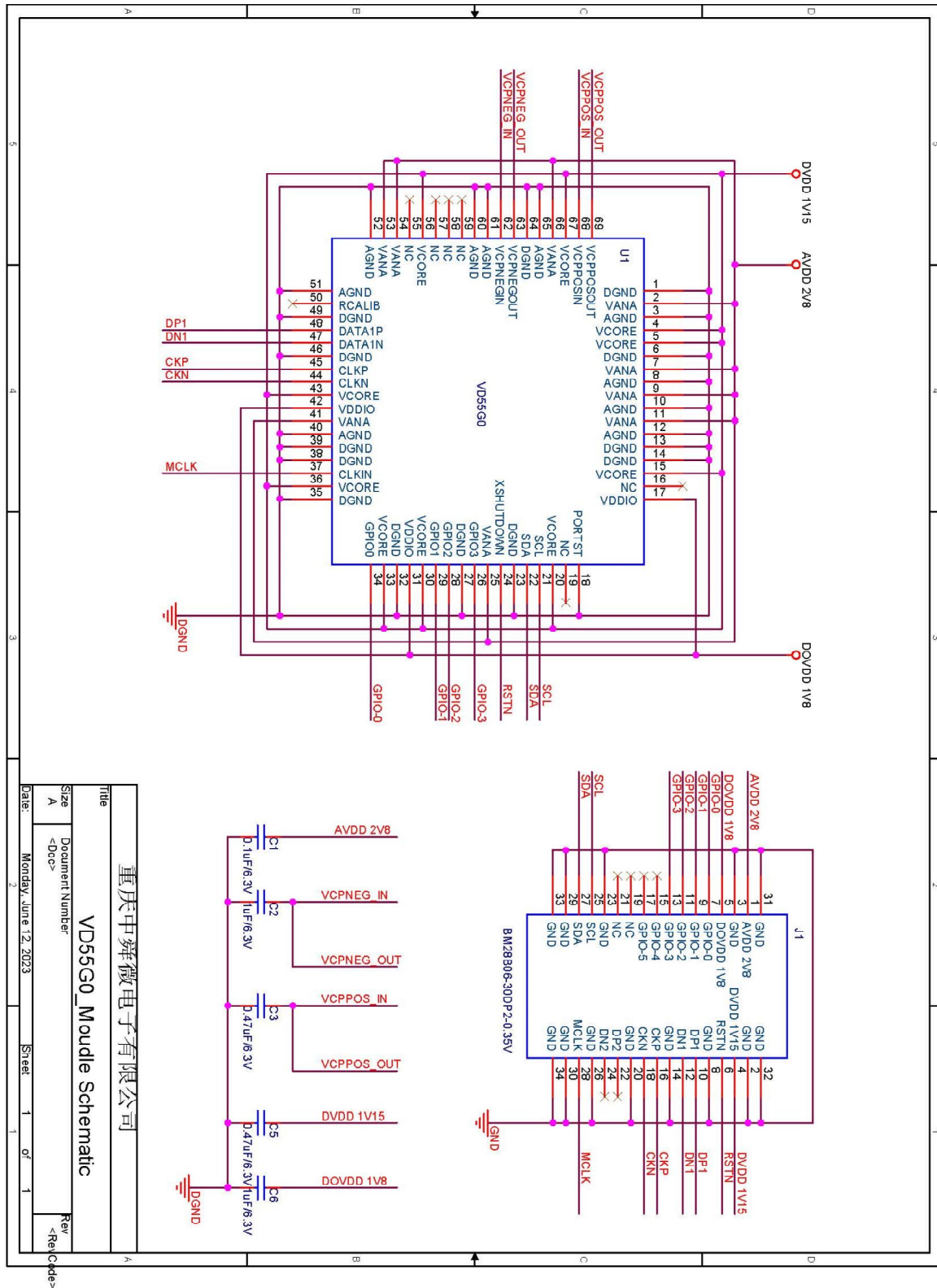
An input clock is required from an external digital clock source in the range of 6 MHz to 27 MHz.

2.6 Video pipe

The video pipe performs a number of functions designed to ensure an image of high quality. These functions include:

- Analog sub sampling
- Pattern generation
- Defective pixel correction
- Dark calibration
- Auto exposure
- Digital binning
- Embedded status lines
- Output interface
- Context
- Crop

2.7 Schematic

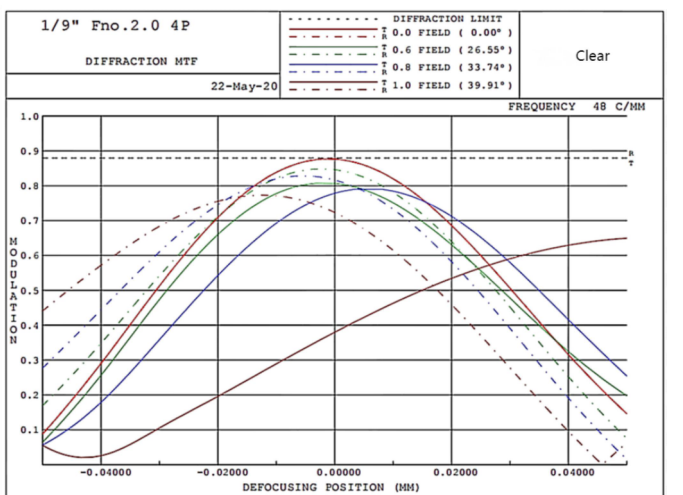
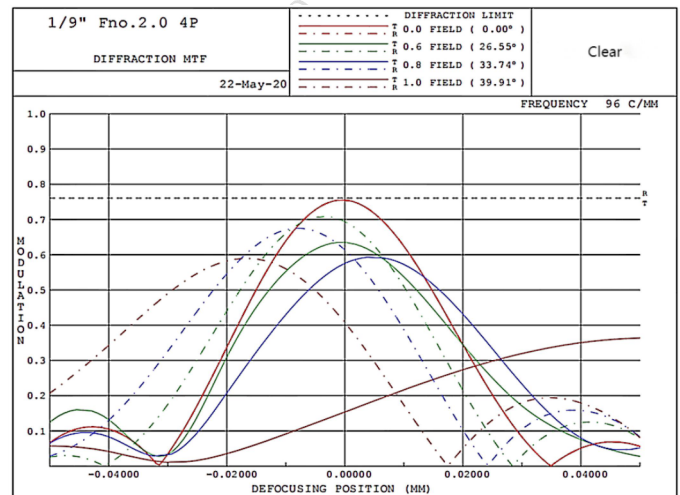
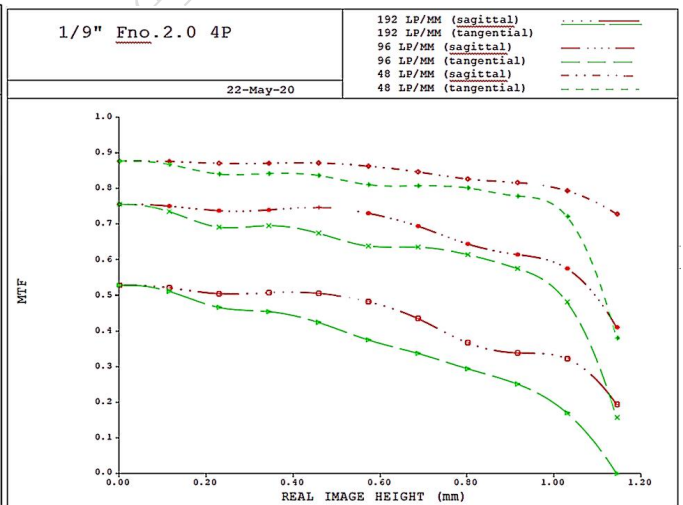
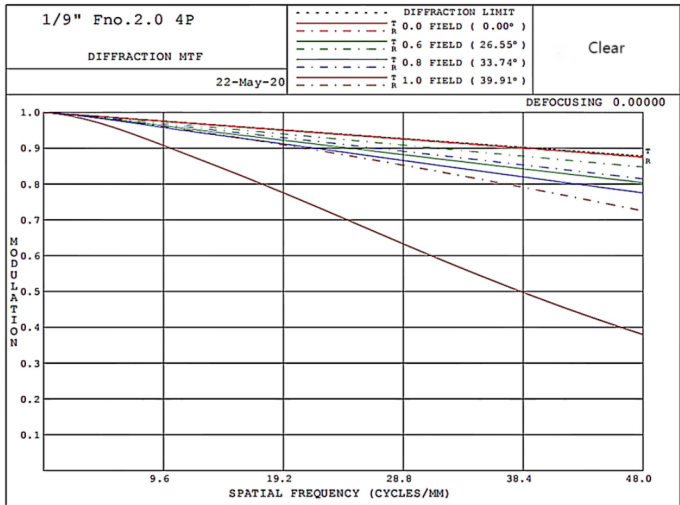
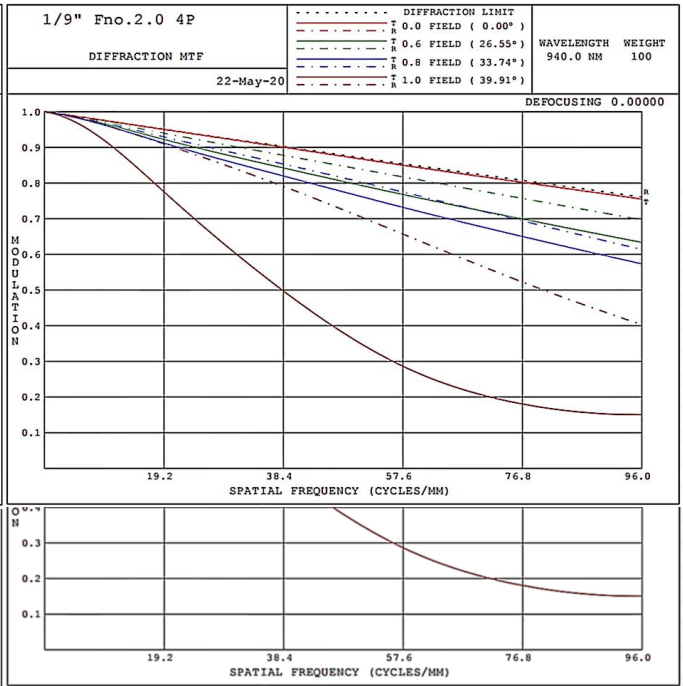
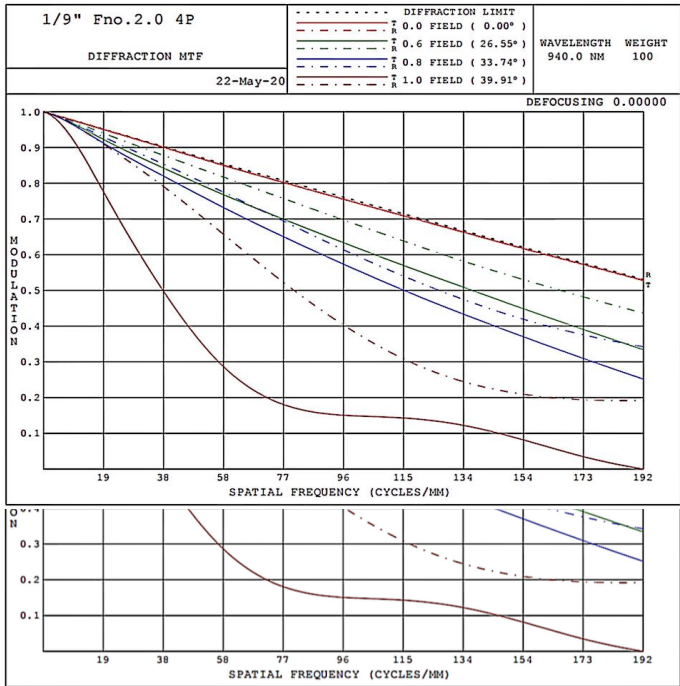


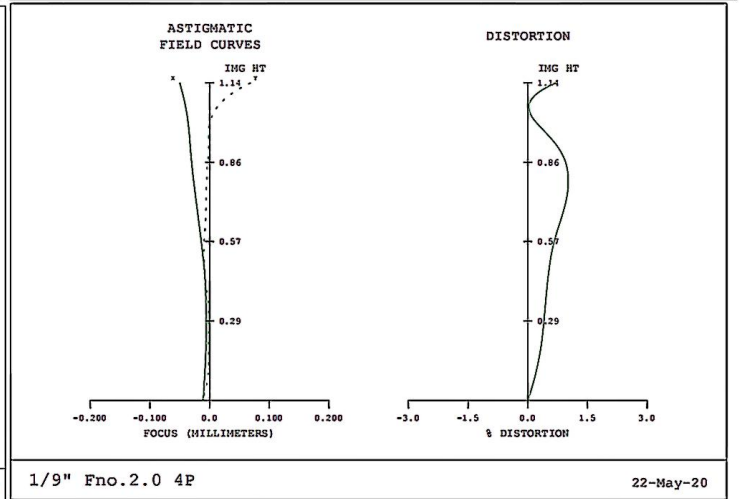
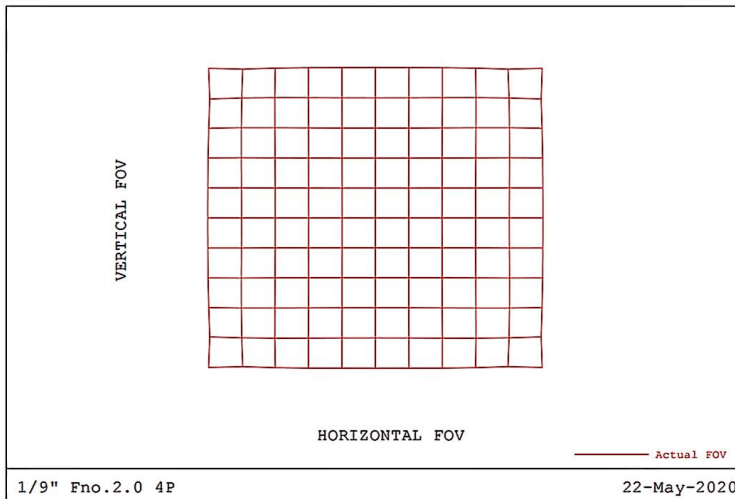
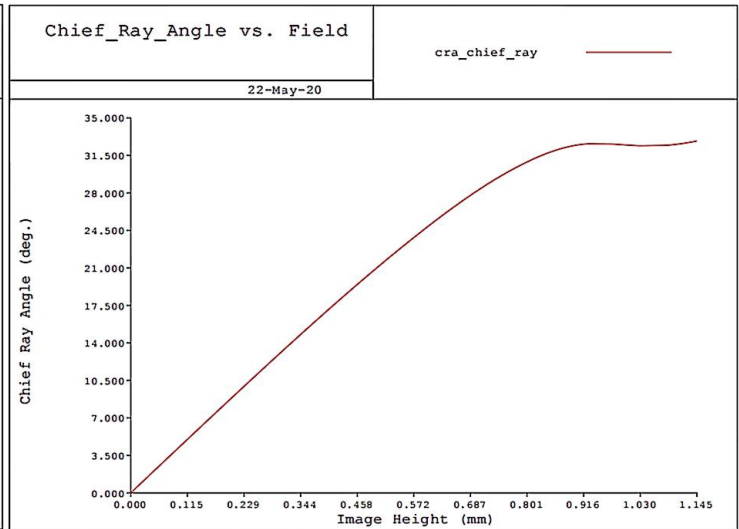
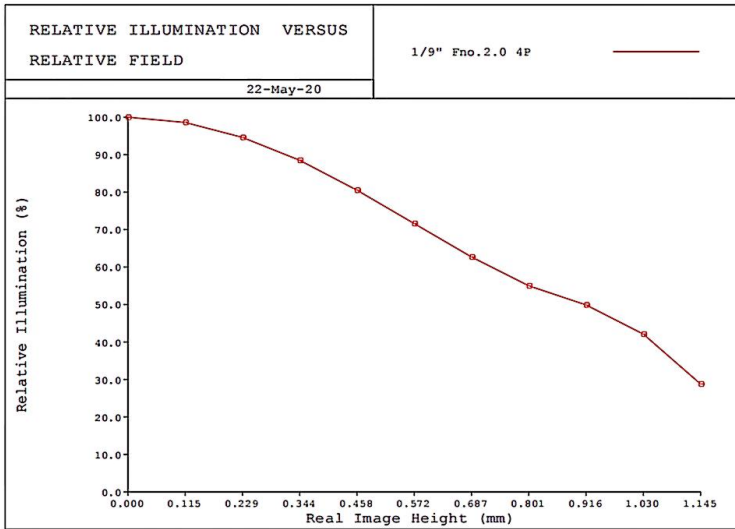
4、 Lens Specification

4.1.Overview

Product No.		Edition	00	Date	2020-10-22	
1.Sensor						
Type	1/9'' VD55G0					
Active Array Size	640(H) x 600(V)					
Image size	1.723mm(H) x 1.566mm(V) x 2.29mm(D)					
Pixel size	2.61μm x 2.61μm					
2.Optics						
Focal length	1.348 mm					
F number	2.0 ± 5%					
Field of view	Vertical (V)	59.3° (y'=0.783mm)				
	Horizontal (H)	62.5° (y'=0.835mm)				
	Diagonal (D)	79.8°± 3% (y'=1.145mm)				
Relative illumination	≥28.8% (y'=1.145mm)					
Optical - Distortion	≤1.0%					
TV - Distortion	≤1.0%					
Total track	2.02mm (From front surface of the barrel to image plane at OD60cm,including 0.21mm IRF)					
FBFL	0.52mm					
Barrel Diameter	M2.8 * P0.2					
MTF	On Axis	192 lp/mm	T/S	52.2%		
		96 lp/mm	T/S	75.3%		
		48 lp/mm	T/S	87.6%		
	0.8 Field	192 lp/mm	T/S	(T)24.5% (S)33.0%		
		96 lp/mm	T/S	(T)57.5% (S)60.5%		
		48 lp/mm	T/S	(T)77.8% (S)81.4%		
CRA	< 32.8°					
Max image circle size	Φ2.36mm					
3.Lens						
Spectrum Range	Clear					
Construction	4elements,(4Plastics)					

4.2.Design Simulation Data





4.3.Depth of Field

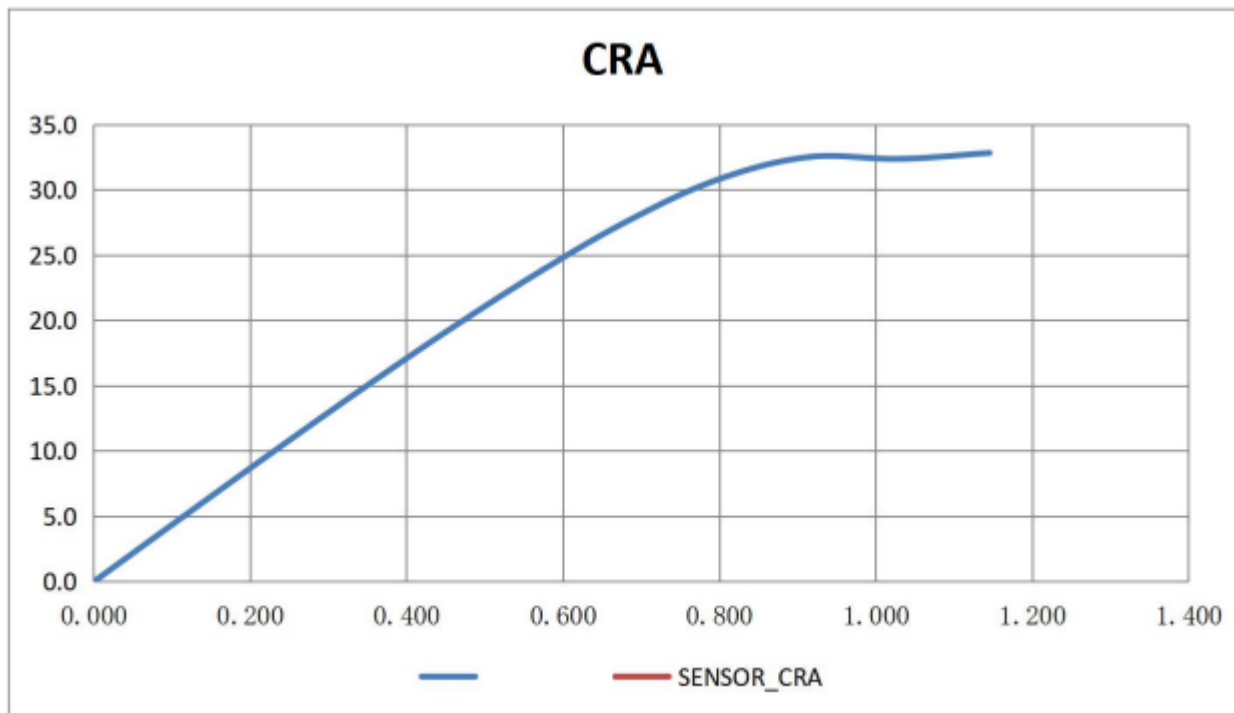
EFL	F/#	pixel size	circle of confusion
1.348mm	2	2.61um	5.22um

Object Distance (m)	Lens Shift (mm)	Far Field (m)	Near Field (m)
INF	0.000	inf	0.174
5.00	0.000	inf	0.168
4.00	0.000	inf	0.167
3.00	0.001	inf	0.165
2.00	0.001	inf	0.160
1.90	0.001	inf	0.160
1.80	0.001	inf	0.159
1.70	0.001	inf	0.158
1.60	0.001	inf	0.157
1.50	0.001	inf	0.156
1.40	0.001	inf	0.155
1.30	0.001	inf	0.154
1.20	0.002	inf	0.152
1.10	0.002	inf	0.150
1.00	0.002	inf	0.148
0.90	0.002	inf	0.146
0.80	0.002	inf	0.143
0.70	0.003	inf	0.140
0.65	0.003	inf	0.138
0.60	0.003	inf	0.135
0.55	0.003	inf	0.132
0.50	0.004	inf	0.129
0.45	0.004	inf	0.126
0.40	0.005	inf	0.122
0.35	0.005	inf	0.117
0.30	0.006	inf	0.110
0.25	0.007	inf	0.103
0.20	0.009	inf	0.093
0.15	0.012	1.028	0.081
0.10	0.018	0.231	0.064
0.09	0.020	0.183	0.060
0.08	0.023	0.146	0.055
0.07	0.026	0.116	0.050
0.06	0.031	0.090	0.045
0.05	0.037	0.069	0.039

4.4.Chief Ray Angle

sensor diagonal	2.29 mm
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Field	Image Height		SENSOR_CRA	Δh
0.00	0.000	0.0		0.0
0.10	0.115	5.0		5.0
0.20	0.229	9.9		9.9
0.30	0.344	14.8		14.8
0.40	0.458	19.4		19.4
0.50	0.573	23.8		23.8
0.60	0.687	27.8		27.8
0.70	0.802	30.9		30.9
0.80	0.916	32.5		32.5
0.90	1.031	32.4		32.4
1.00	1.145	32.8		32.8



5、Pin Specifications

PIN No.	NAME	Type	Description
1	AVDD	Power	Analog 2.8V power supply
2	GND	Ground	Ground
3	GND	Ground	Ground
4	DVDD	Power	Digital Core 1.15V Power
5	DOVDD	Power	IO 1.8V Power
6	RSTN	I/O	Reset active low
7	GPIO-0	I/O	General purpose I/O and strobe light control-0
8	GND	Ground	Ground
9	GPIO-1	I/O	General purpose I/O and strobe light control-1
10	DP1	Output	MIPI data lane 1 positive
11	GPIO-2	I/O	General purpose I/O and strobe light control-2
12	DN1	Output	MIPI data lane 1 negative
13	GPIO-3	I/O	General purpose I/O and strobe light control-3
14	GND	Ground	Ground
15	GPIO-4	I/O	General purpose I/O and strobe light control-4
16	CLKP	Output	MIPI clock lane positive
17	GPIO-5	I/O	General purpose I/O and strobe light control-5
18	CLKN	Output	MIPI clock lane negative
19	NC	-	-
20	GND	Ground	Ground
21	NC	-	-
22	DP2	Output	MIPI data lane 2 positive
23	GND	Ground	Ground
24	DN2	Output	MIPI data lane 2 negative
25	SCL	Input	SCCB interface input clock
26	GND	Ground	Ground
27	SDA	I/O	SCCB interface data pin
28	MCLK	Input	Input clock
29	GND	Ground	Ground
30	GND	Ground	Ground

6、Appearance Specification

Exterior				
NO.	Test Item	Test Conditions	Detection method	Judge standard
1	Module appearance	No dirt, no visible scratches on the surface of the module, no impurities in the plastic	8X magnifier	Pass
2	Lens	There should be no visible scars or dirt when inspected under 800±100Lux intensity head-up and 45-degree reflected light.	8X magnifier	Pass
3	UV Glue	The dispensing length is 1/3-1/2 of the circumference, and the glue cannot overflow to the lens end surface and the lens base	8X magnifier	Pass
4	Sealant	Fill the sealant evenly between the base and the FPC. There should be no gaps or uneven thickness, and there should be no glue overflowing the edge of the FPC to cause the appearance of oversize.	8X magnifier	Pass
5	FPC	1) There is no dirt on the surface, and the printed fonts are clear; 2) The length of the edge burr is less than 1mm, and the width is less than 0.3mm; 3) The length of the edge notch is less than 1mm, the width is less than 0.1mm, each side does not exceed 2 points, and no sharp corners tearing inward are allowed	40X microscope (continuous zoom)	Pass
6	Connector	1) Lack of tin is not allowed, and short circuit with multiple tins is not allowed 2) No foreign matter is allowed in the connector slot 3) PIN feet are not allowed to be lifted	40X microscope (continuous zoom)	Pass
7	Reinforcing steel plate	(1) The surface must not be dirty, rusted or scratched; (2) The height of the positioning column beyond the board surface is $\leq 0.1\text{mm}$	Visually	Pass
8	Accessories	The paste direction is correct, the paste should not exceed the edge of the steel plate, no protrusions, double-sided tape When the protective film is torn off, there must be no glue detachment, deformation, or damage	Visually	Pass
Size				
NO.	Test Item	Test Conditions	Detection method	Judge standard
1	High	Meet the requirements of the drawings	Caliper	Pass
2	Length	Meet the requirements of the drawings	Caliper	Pass
3	Width	Meet the requirements of the drawings	Caliper	Pass

7、Image Specification

Optical performance testing requirements				
NO.	Test Item	Test Conditions	Detection method	Judge standard
1	Dust	Under the white field, take the image and visually observe the entire screen without any visible foreign objects.	Test Fixture. Light box. 6500K white backlight	Pass
2	Imaging direction	Meet the requirements of the drawings	Test Fixture.	Pass
3	Dead & Wound Pixel	1) Under dark field: the total number of bright spots is less than 400 pixels; 2 adjacent pixels The aggregated bright spots are less than 20; there are no aggregated bright spots with more than 3 pixels. 2) Under the white field: the total number of dark spots is less than 400 pixels; 2 adjacent pixels The accumulated dark spots are less than 20; there are no accumulated dark spots above 3 pixels.	Test Fixture. Light box. 6500K white backlight	Pass
4	TV Line	0.3M pixels: the center is not less than 350LW/PH, and the four corners are equal to or equal to 250LW/PH	ISO12233	Pass
5	FOV	Diagonal: $79.8^{\circ} \pm 3\%$	Angle test card	Pass
6	TV distortion	Pincushion distortion (positive number) or barrel distortion (negative number) is not more than 1%	Distortion test card	Pass

8、Reliability Specification

NO.	Test Item	Test Conditions	Judge standard
1	Low Temperature Storage Test	Keep in $-20\pm 3\text{ }^{\circ}\text{C}$ duration for 24 hrs	After the test, the function and appearance should be normal after 2H at room temperature.
2	High Temperature Storage Test	Keep in $+60\pm 3\text{ }^{\circ}\text{C}$ duration for 24 hrs	After the test, the function and appearance should be normal after 2H at room temperature.
3	Low temperature operating	Temperature : $-20\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$ Time :24 hours	After the test, the function and appearance should be normal after 2H at room temperature
4	High temperature operating	Temperature : $60\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$ Time :24 hours	After the test, the function and appearance should be normal after 2H at room temperature
5	Drop test Free fall (Package State)	Surface (floor): Concrete or steel Number of drops: 18 Positions: Random Height: 30cm	After the test, the test function is normal, and there is no obvious abnormality in appearance.
6	Vibration (Package State)	Frequency range: 10—50 Hz amplitude: 2mm Duration 1 h for each position. Test all 3 axes (X, Y, Z)	After the test, the function and appearance should be normal after 1H at room temperature.
Test Conditions: Illumination: $150\pm 10\%$ LUX Color temperature: $6500\pm 150\text{K}$ Headlight Box $600\pm 10\%$ LUX			

9、Packing specification

