1/7 inch 110k pixel Primary color filter

CIF CMOS Image Sensor with A/D converter

TCM5053LU

Technical data sheet

(Tentative Ver. 4.6)

April 17th, 2001

TOSHIBA Corporation

Semiconductor Company, System LSI Division
Marketing & Engineering Group
Digital Consumer System LSI & Image Sensor

Feature

Item	Contents
Optical format	1/7 inch
Total pixel numbers	392(H) x 306(V) (120k pixels)
Signal pixel numbers	372(H) x 292(V) (110k pixels)
Pixel pitch	5.4um(H) x 5.4um(V)
Image size	2.009mm(H) x 1.577mm(V)
Aspect ratio	11(H) : 9(V)
Power current consumption	12mA(typ) @30fps
Signal output	Progressive scanning
Color filter array	RGB primary color filter Bayer arrangement(G checked, R/B in line sequence)
Output format	9bit digital and proportional output in parallel
Frame rate	30fps @4.185MHz(data rate) to 10fps @1.395MHz(data rate)
Master clock frequency	8.37MHz(30fps) to 2.79MHz(10fps)
Package	Optical lens unit
Additional functions	- Variable electronic shutter Internal synchronization mode (serial command setting): From 2H to 309H by 1H External synchronization mode (ESR pulse input setting): From 1H to 309H and from 1V by 1H From 2H to 309H and from 1V to 16V combined with camera DSP TC90A81F - Variable gain control - Built-in feed back clamp: Optical black level is fixed to 32LSB - Synchronization generator is implemented - Command setting by micro wire - 2.3 to 3.6V digital input/output is available

Maximum Ratings (Vss=0V)

Characteristics	Symbol	Rating	Unit
Power supply voltage	Vdd	-0.5 to 3.7	V
	Vddiio	-0.5 to 4.4	
Input voltage	Vin	-0.3 to Vdd +0.3	
Input current of protection diode	Iin	+/- 20	mA
Storage temperature	Tstg	-30 to 75	Centigrade

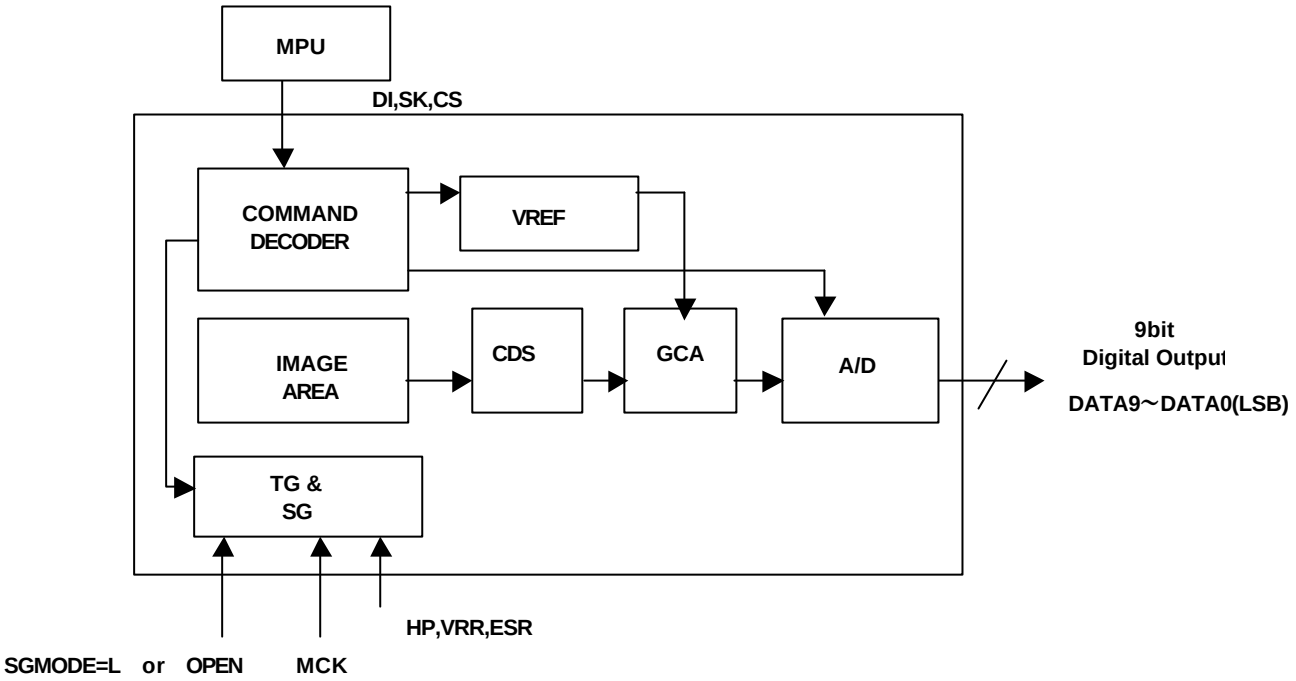
Recommended operating conditions (Vss=0V)

Characteristics	Symbol	Rating			Unit
		Min	Typ	Max	
Power supply voltage	Vavdd	2.7	2.8	2.9	V
	Vdvdd	2.7	2.8	2.9	
	Vdvddio	2.3	-	3.6	
Input voltage	Vin	0 to Vdvddio			
Operating temperature	Topr	-20 to 60			Centigrade

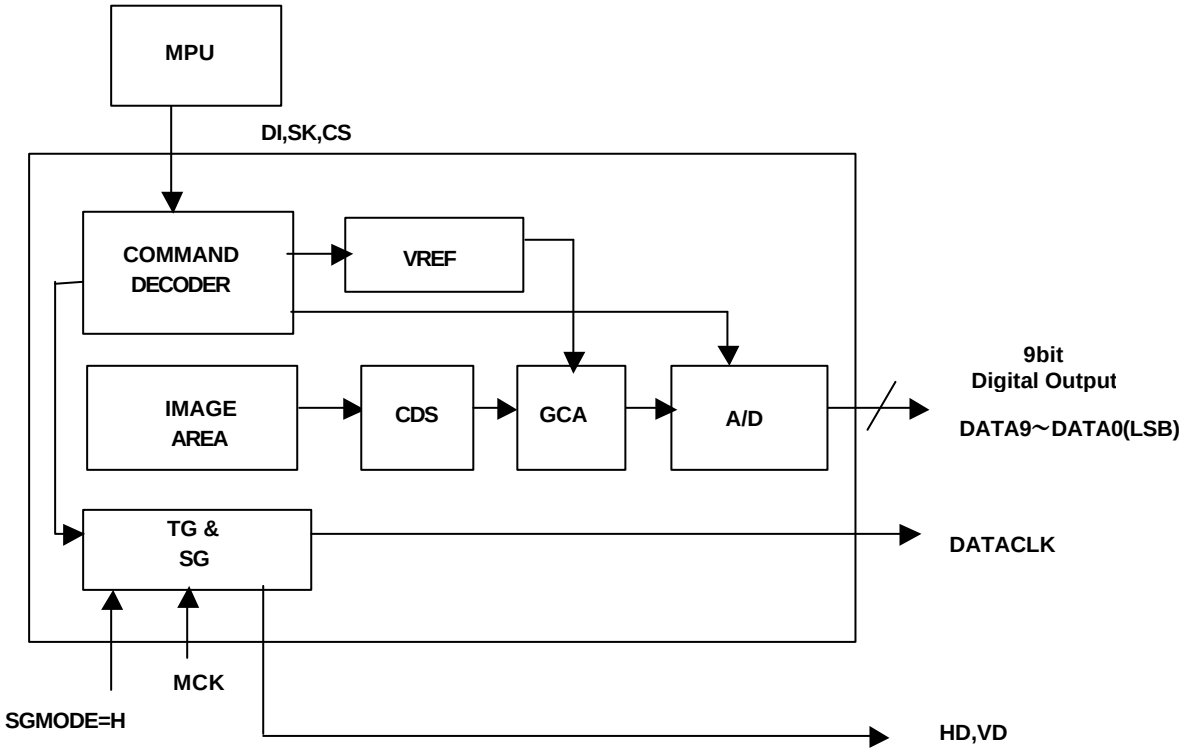
Block Diagram

Input of SGMODE controls synchronizatio n mode between external synchronization mode and internal. In the case of ext. sync. mode, HPA, VRR and ESR pulse should be supplied to sensor. On the other hand, HD, VD and data clock is generated from sensor on int. sync. In that case electronic shutter speed is controlled by command setting.

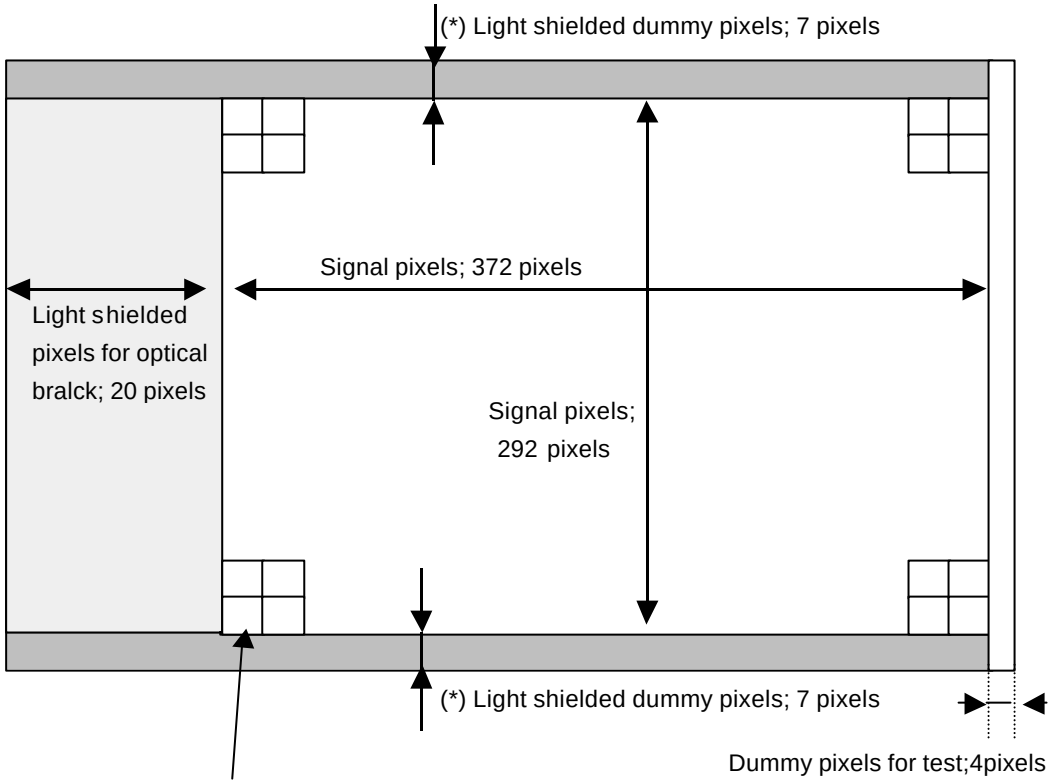
External synchronization mode



Internal synchronization mode



Pixel Arrangement



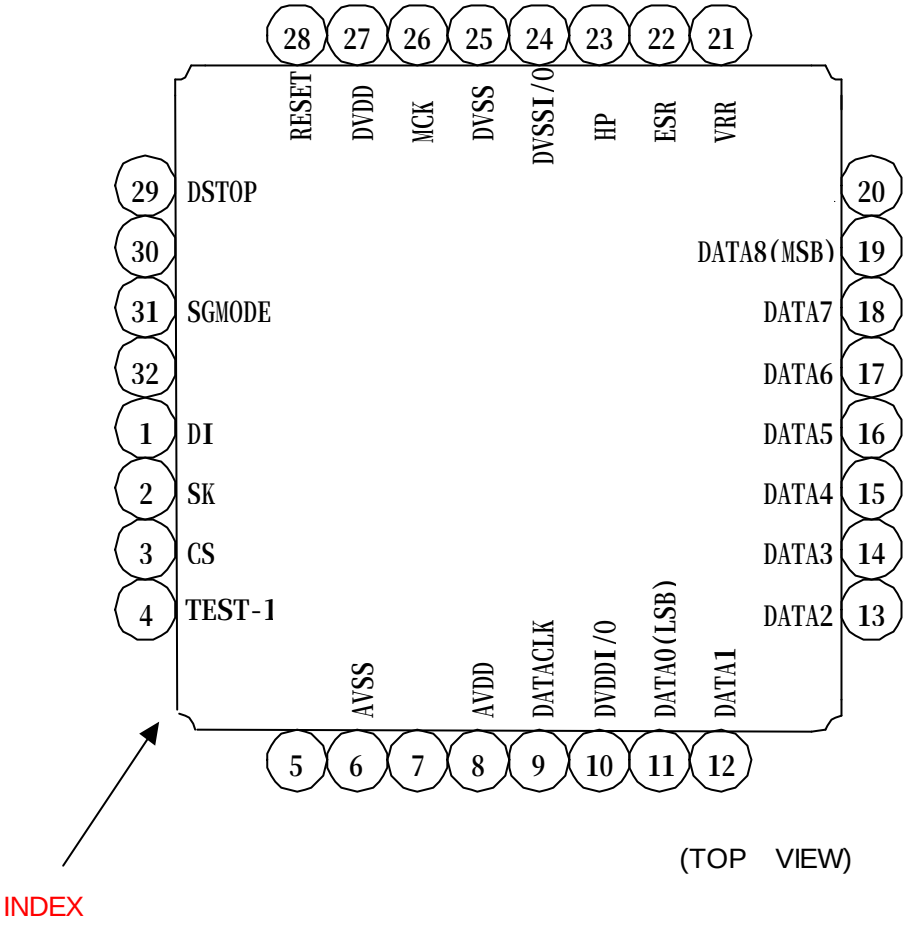
R: Red pixel Gr: Green pixel B: Blue pixel

: Light shielded dummy pixels is not guaranteed for black reference.

Pin Configuration

Pin No.	Symbol	Function	Pin management
1	DI	Serial data input	
2	SK	Serial clock input	
3	CS	Data enable input	
4	TEST1	Test terminal	Connected to GND(AVSS) via a capacitor of 0.1uF
5	TEST2	Test terminal	Connected to GND(AVSS) via a capacitor of 2.2uF
6	AVSS	Analog GND (VSS)	0V
7	TEST3	Test terminal	No connection
8	AVDD	Analog power supply (VDD)	2.8V +/- 0.1V. Bi-passed condenser(4.7uF and 0.1uF) is preferable.
9	DATACLK	Data clock output (a half of master clock)	
10	DVDDIO	Digital I/O power supply (VDD)	2.3 to 3.6V. Bi-passed condenser(4.7uF and 0.1uF) is preferable.
11	DATA0	AD output(LSB)	
12	DATA1	AD output	
13	DATA2	AD output	
14	DATA3	AD output	
15	DATA4	AD output	
16	DATA5	AD output	
17	DATA6	AD output	
18	DATA7	AD output	
19	DATA8	AD output(MSB)	
20	TEST4	Test terminal	No connection
21	VRR(VD)	Vertical timing pulse start pulse input / VD pulse output	
22	ESR (STR)	Electrical shutter start pulse input	
23	HP(HD)	Horizontal timing start pulse input / HD pulse output	
24	DVSSIO	Digital I/O GND (VSS)	0V
25	DVSS	Digital GND (VSS)	0V
26	MCK	Master clock input	8.37 MHz(30fps) to 2.79MHz(10fps)
27	DVDD	Digital power supply (VDD)	2.8V +/- 0.1V. Bi-passed condenser(4.7uF and 0.1uF) is preferable. Output impedance of power supply is recommended to be under 0.5 ohm @10kHz.
28	RESET	Reset for parameter setting	Connected to DVDDIO via 100k to 1M ohm. Connected to GND via 0.1uF. In the case of combination with camera DSP(TC90A81F), connected to SENRST.
29	DSTOP	Read stop control input (pull-up)	1: Active / 0: Halt
30	TEST5	Test terminal (pull-down)	No connection
31	SGMODE	Internal / external synchronization mode (pull-down)	0: External sync (HPA,VRR and ESR input) 1: Internal sync (HD,VD output)
32	TEST6	Test terminal	Connected to AVSS

Pin arrangement



Optical and electrical characteristics

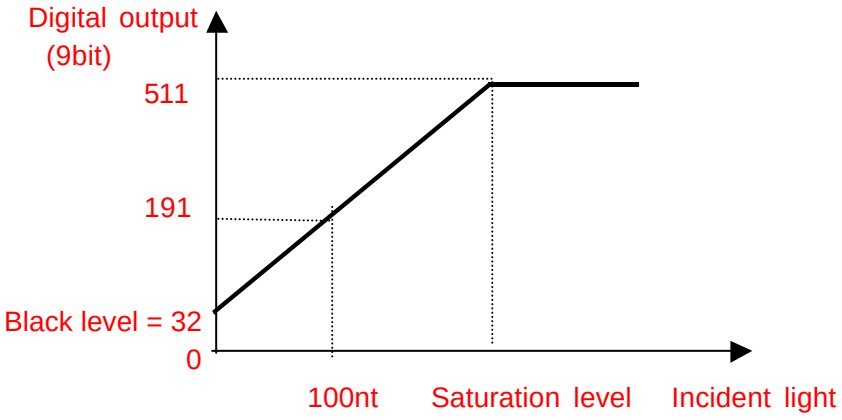
Item	Symbol	Conditions	Min	Typ	Max	Unit
Sensitivity (G output)	R(G)	Condition *1	143	191	-	LSB
Blooming margin	BLM	500 times as standard condition	No blooming			
S/N (dark)	S/N	Standard condition	-	57	-	dB
Decay lag	LAG	G output; over 20mV	-	3	7	LSB
Power current	IDD	Frame rate; 30fps	-	12	-	mA

- Setting value of internal gain amplifier; once (0dB)
- (***LSB) means 10 bit digital output not include 32LSB for black level.
- Signal output includes 32 LSB for black level.

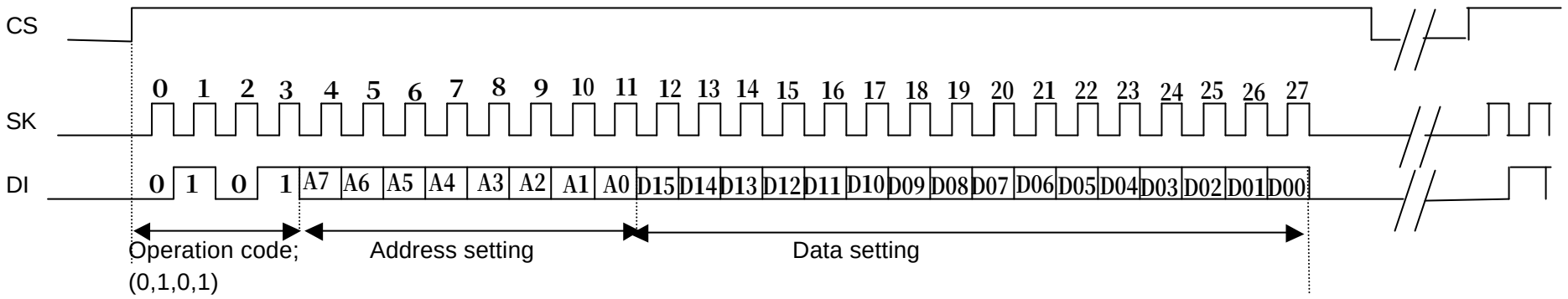
Standard conditions (Tc=60 degrees Centigrade)
- Driving conditions:
  Frame rate; 30fps, Electronics shutter; Off (1/30s), VDD=2.8+/-0.1V
  Parameter setting value; Default
- Light source: Color temperature; 3200K, Tangusten light
- Optical lens; Fujinon CF25L (F0.85, f=25mm), F2.8
- Standard signal level: G output (average) 250mV

Condition *1
- Luminance of object; 100nt
- Driving and optical conditions are same as standard conditions.

Relation between analog and digital output
- Setting value of internal gain amplifier; once (0dB)
- Linear gain



Command setting Standard serial input setting



- SK: Less than 1/8 MCK
  Ex) When MCK=8.37MHz at 30fps, SCLK=Less than 1.04MHz

Command table(1); Standard serial input setting

Setting item (Default value)	Address setting								Data setting																
	A7	A6	A5	A4	A3	A2	A1	A0	D15	D14	D13	D12	D11	D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	D00	
Up/down Conversion(D15: 0)	0	1	1	1	0	0	0	0	1/0	*	*	*	*	*	*	*									0: Normal 1: Inverted
Gain setting (D07 to D00: 11000000(0dB))										*	*	*	*	*	*	*	1	1	0	0	0	0	0	0	0: Max 255: Min
																	MSB							LSB	
Electronic shutter setting (D15 to D6: 0000000000 (Off))	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	*	*	*	*	*	*	Off 2H to 309H
									MSB									LSB							
Low power mode (D6: 0)	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1/0	0	0	0	0	0	0	0: Normal 1: Low power

*: Don’t care

Note:

1) CMOS sensor can be operated under default setting value w/o sending command
2) Whole of setting command in same address should be set at the same time.
3) Electronic shutter control by command setting is available at internal synchronization mode. When external synchronization mode, ESR pulse input can control electronic shutter speed.

Gain setting table

Typical value

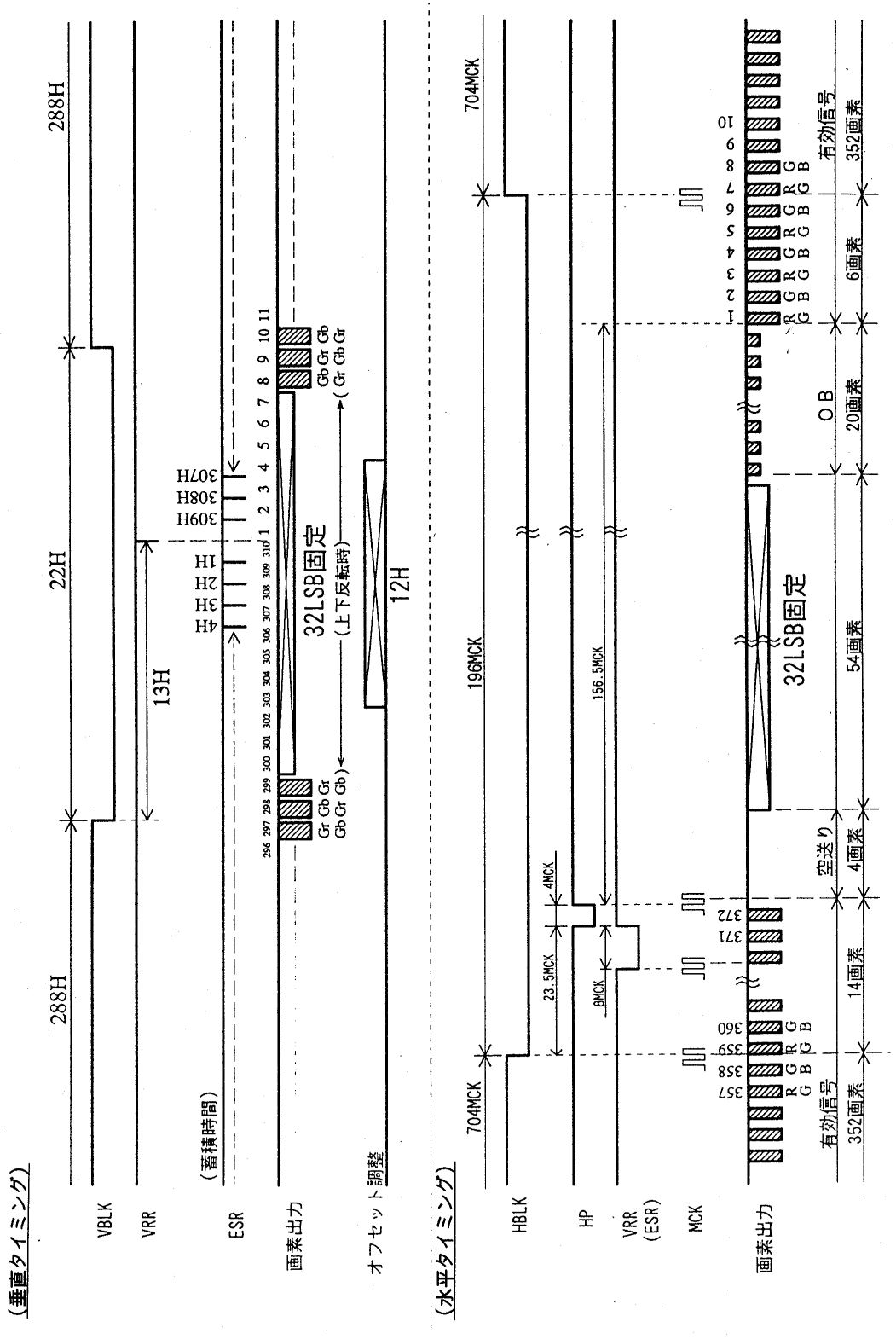
Gain (dB)	Setting data							
	D7	D6	D5	D4	D3	D2	D1	D0
-2.4 (Min)	1	1	1	1	1	1	1	1
0 (Typ)	1	1	0	0	0	0	0	0
3	1	0	0	0	1	0	0	0
6	0	1	1	0	0	0	0	0
9	0	1	0	0	0	1	0	0
12	0	0	1	1	0	0	0	0
18	0	0	0	1	1	0	0	0
20 (Max)	0	0	0	1	0	0	1	1

Electronic shutter setting table (only for internal sync mode)

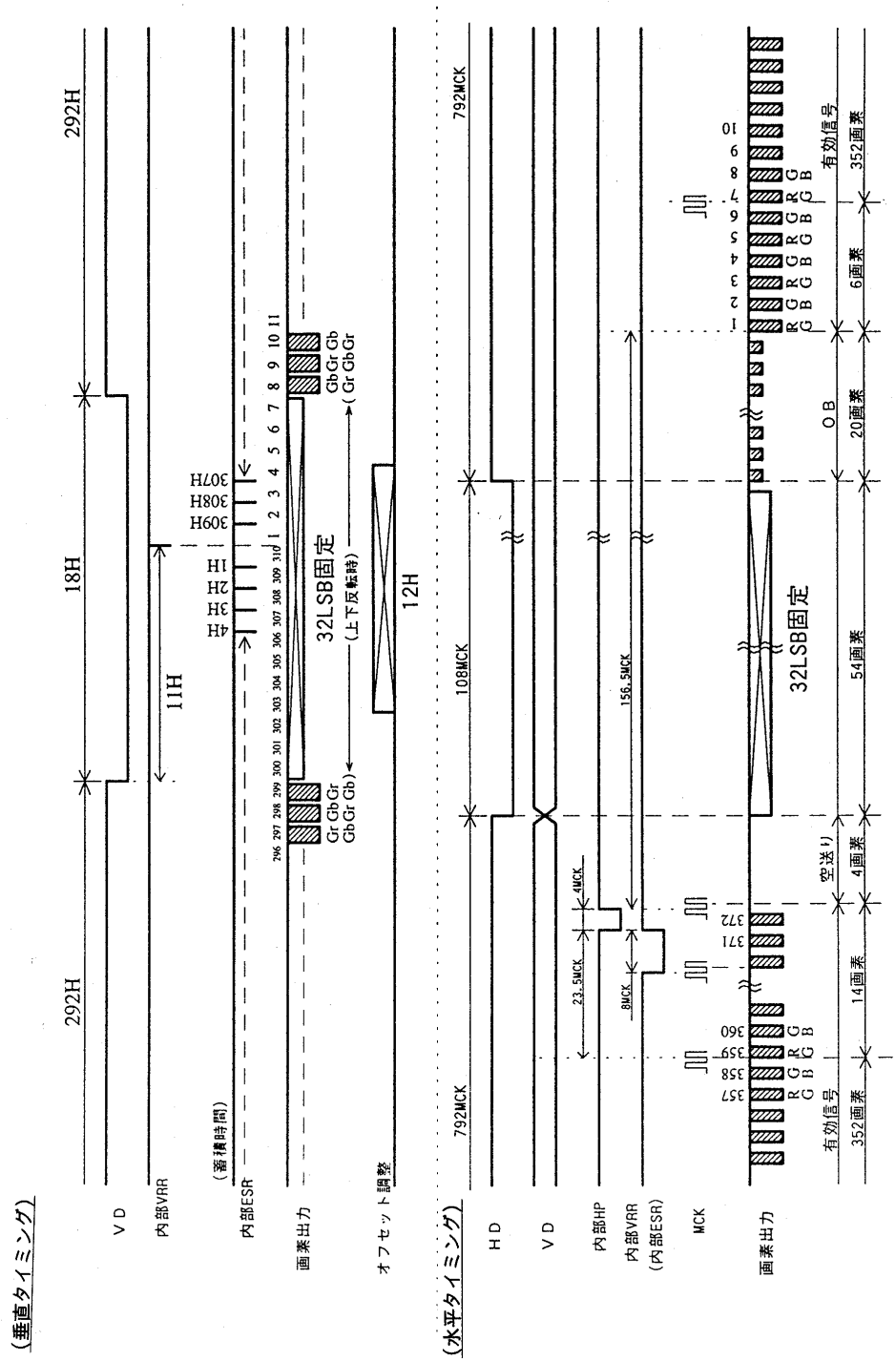
Typical value

Electronic shutter speed (storage time)	Setting data									
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6
Shutter off(310(H))	0	0	0	0	0	0	0	0	0	0
2(H)	0	0	0	0	0	0	0	0	0	1
3(H)	0	0	0	0	0	0	0	0	1	0
4(H)	0	0	0	0	0	0	0	0	1	1
:	:	:	:	:	:	:	:	:	:	:
307(H)	0	1	0	0	1	1	0	0	1	0
308(H)	0	1	0	0	1	1	0	0	1	1
309(H)	0	1	0	0	1	1	0	1	0	0

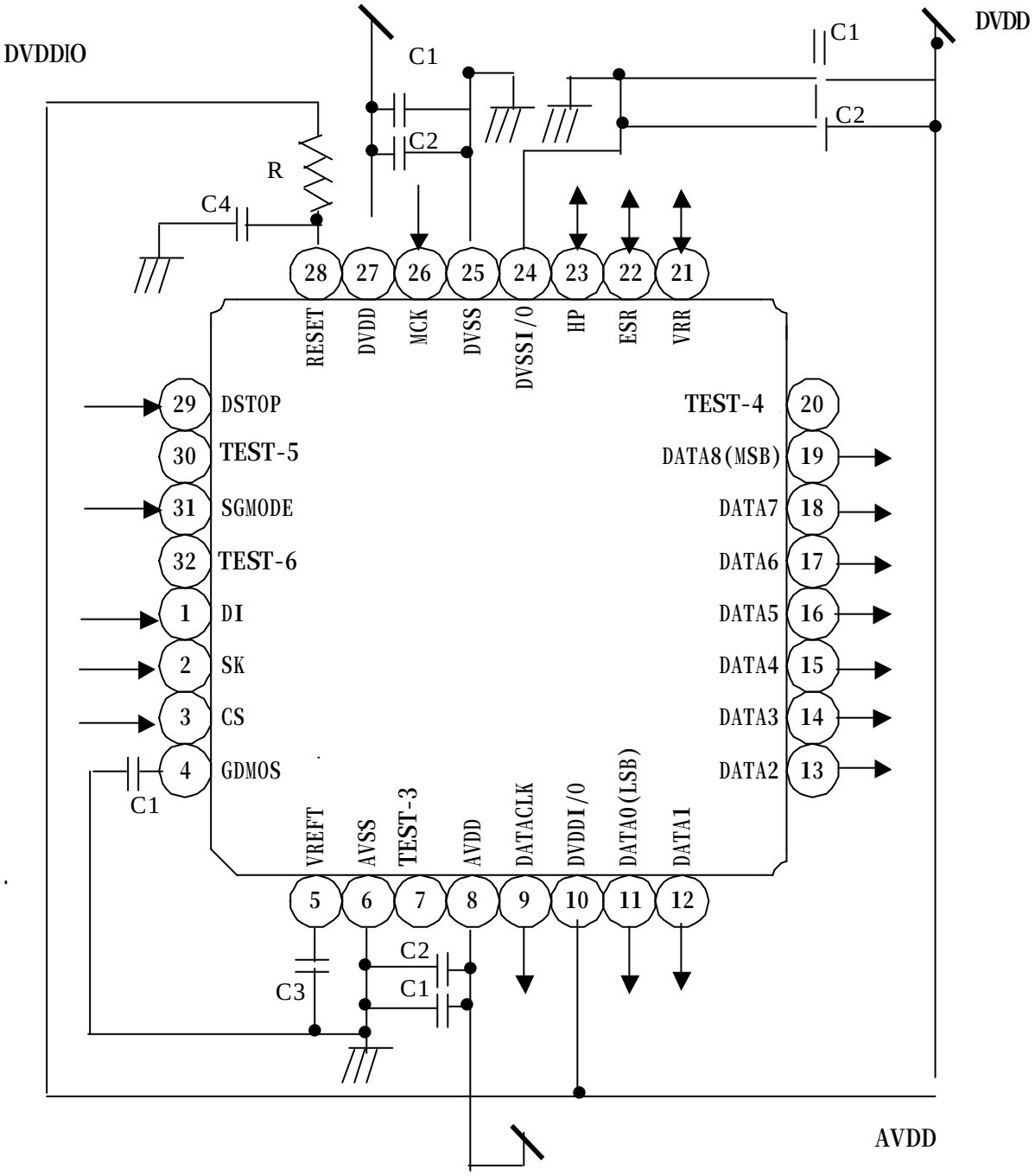
External syncronization mode



Internal synchronization mode



Typical peripheral circuit



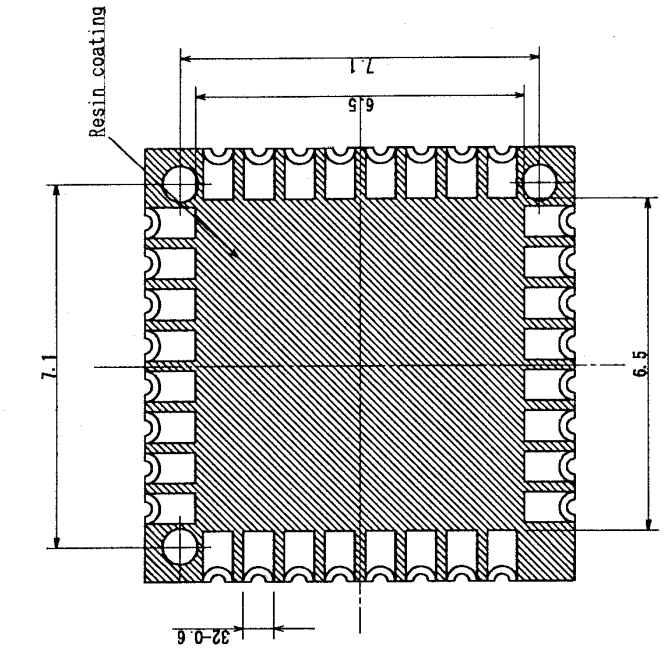
C1, C4:	0.1uF
C2:	4.7uF
C3:	2.2uF
R:	100k to 1M ohm

- Reset terminal (pin No. 28); In the case of combination with camera DSP TC90A81F, RESET terminal is connected to SENRST terminal of TC90A81F w/o R and C4.

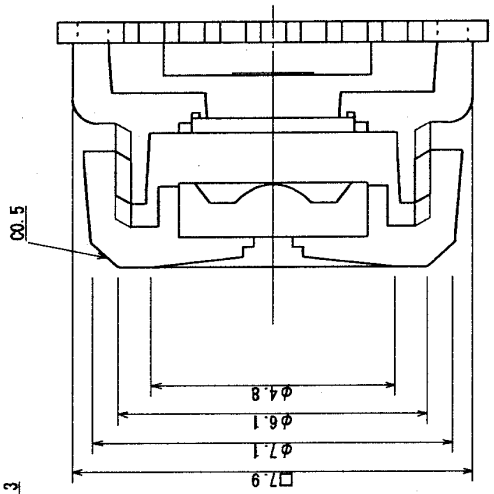
Package outline

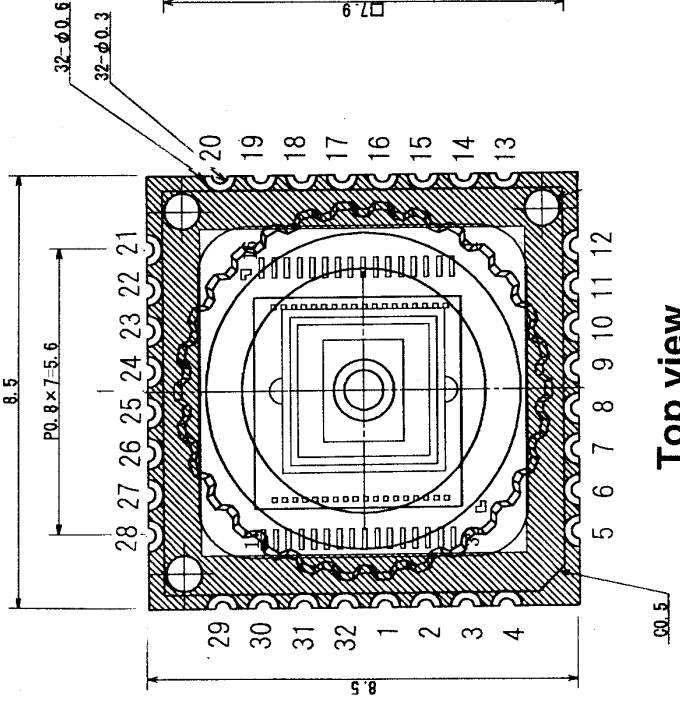
Optical lens specification:

Focusing distance	20cm to infinity
Focal length	2.0mm
F number	F2.8
Field of view	H56.7 / V42.6 / D70.9
MTF	90% center / 45% in diagonal
TV distortion	-3.7%

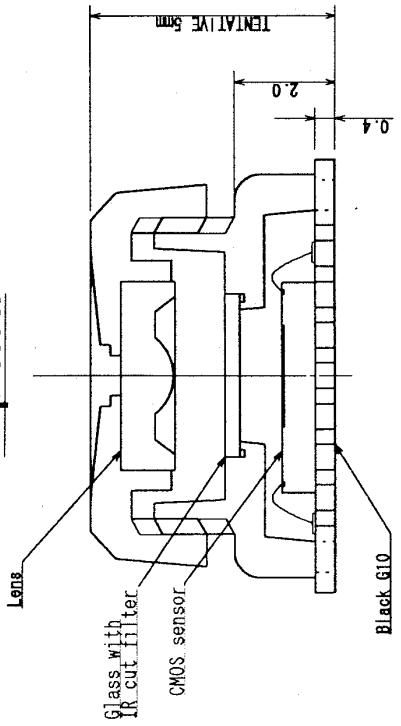


Bottom view





Top view



Notes:
Incident light from bottom and side of PCB should be shielded.