

LZ34B1B

1/4-type Color CMOS Image Sensor with
350 k Pixels

DESCRIPTION

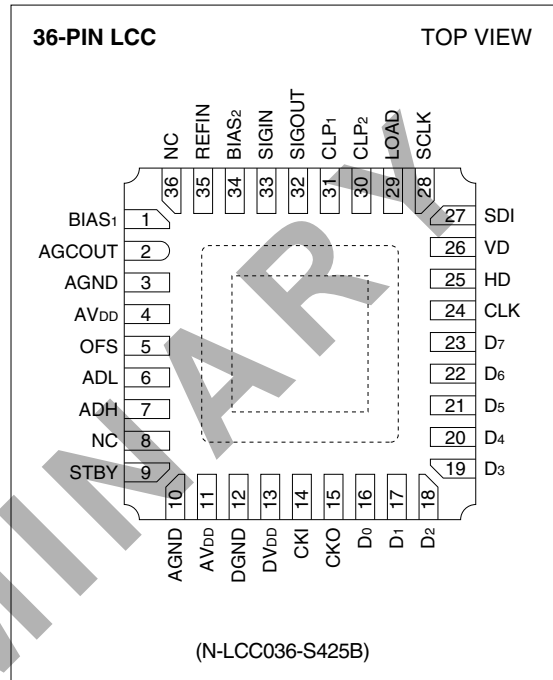
The LZ34B1B is a 1/4-type (4.5 mm) solid-state color image sensor that consists of PN photo-diodes and CMOS (Complementary Metal Oxide Semiconductor) devices. The sensor further includes a timing generator (TG), a correlated double sampling (CDS) circuit, an auto gain control (AGC) circuit and an analog-to-digital converter (ADC) circuit. With approximately 350 000 pixels (703 horizontal x 499 vertical), the sensor provides a stable digital color image with extremely low power consumption.

FEATURES

- Progressive scan
- Square pixel
- Compatible with VGA standard
- Number of image pixels : 655 (H) x 493 (V)
- Number of optical black pixels
 - Horizontal : 24 front and 24 rear
 - Vertical : 3 front and 3 rear
- Pixel pitch : 5.6 μm (H) x 5.6 μm (V)
- R, G, and B primary color mosaic filters
- Image inversion function (horizontally and/or vertically)
- Available for two types of power save mode
 - AGC and AD circuits become power-off with serial data
 - All circuits become power-off with STBY pin
- Monitoring mode
- Analog output and 8-bit digital output
- Variable gain control (3 to 30 dB)
- Variable electronic focal plane shutter (1/15 to 1/7 875 s)
- Single +2.8 V power supply
- Package : 36-pin LCC* (N-LCC036-S425B)

* Leadless Chip Carrier

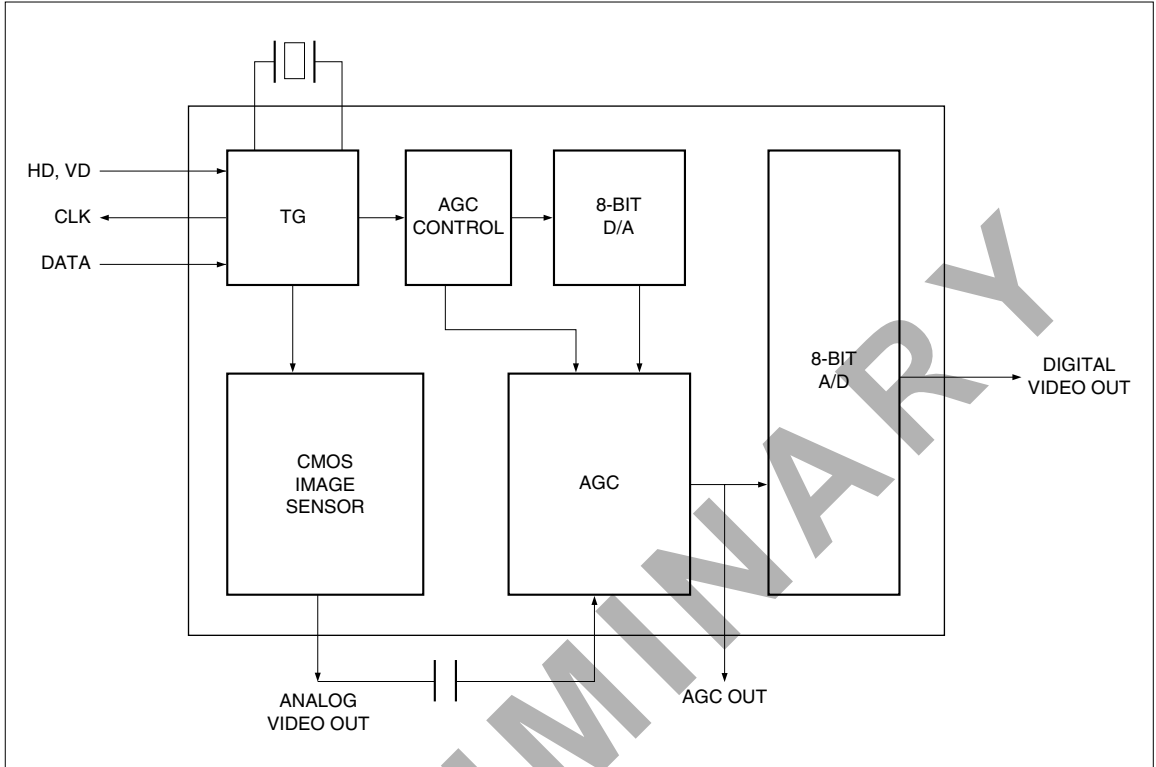
PIN CONNECTIONS



PRECAUTIONS

- Refer to "PRECAUTIONS FOR CMOS IMAGE SENSORS".

BLOCK DIAGRAM



PIN DESCRIPTION

PIN NO.	SYMBOL	I/O	A/D	DESCRIPTION
1	BIAS ₁	–	Analog	Analog bias voltage 1 for image sensor
2	AGCOUT	O	Analog	AGC output
3	AGND	–	Analog	Analog ground
4	AVDD	–	Analog	Analog power supply
5	OFS	–	Analog	Offset bias voltage for AGC output
6	ADL	–	Analog	Bottom ADC reference voltage
7	ADH	–	Analog	Top ADC reference voltage
8	NC	–	–	No connection
9	STBY	I	Digital	Standby control mode*
10	AGND	–	Analog	Analog ground
11	AVDD	–	Analog	Analog power supply
12	DGND	–	Digital	Digital ground
13	DVDD	–	Digital	Digital power supply
14	CKI	I	Digital	Clock input for oscillator (12.27 MHz)
15	CKO	O	Digital	Clock output for oscillator
16	D ₀	O	Digital	ADC signal output (LSB)
17	D ₁	O	Digital	ADC signal output
18	D ₂	O	Digital	ADC signal output
19	D ₃	O	Digital	ADC signal output
20	D ₄	O	Digital	ADC signal output
21	D ₅	O	Digital	ADC signal output
22	D ₆	O	Digital	ADC signal output
23	D ₇	O	Digital	ADC signal output (MSB)
24	CLK	O	Digital	Clock output (6.135 MHz)
25	HD	I	Digital	Horizontal drive pulse input
26	VD	I	Digital	Vertical drive pulse input
27	SDI	I	Digital	Control data input (AGC gain, offset, shutter control, image inversion, etc.)
28	SCLK	I	Digital	Shift clock for data
29	LOAD	I	Digital	Load pulse for data input
30	CLP ₂	–	Analog	Analog bias voltage 2 for clamp circuit
31	CLP ₁	–	Analog	Analog bias voltage 1 for clamp circuit
32	SIGOUT	O	Analog	Analog image signal output
33	SIGIN	I	Analog	Analog image signal input
34	BIAS ₂	–	Analog	Analog bias voltage 2 for image sensor
35	REFIN	I	Analog	Reference voltage for analog input
36	NC	–	–	No connection

* Standby mode functions

High level : Standby mode (all circuits power-off), Low level or open : Normal mode (all circuits active)

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power supply voltage	V _{DD}	-0.3 to +4.6	V
Input signal voltage	V _φ	-0.3 to V _{DD} + 0.3	V
Storage temperature	T _{STG}	-40 to +80	°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE	
Power supply voltage	V _{DD}	2.6	2.8	3.0	V		
Operating temperature	T _{OPR}	-20	+25	+50	°C		
Oscillation frequency	Normal mode	F _{CK}	12.27		MHz		
	Monitoring mode						
Digital input voltage	LOW level	V _{φL}	0		0.2V _{DD}	V	1
	HIGH level	V _{φH}	0.8V _{DD}		V _{DD}	V	
Analog input voltage		(Connect to pin through a capacitor)				2	
Analog bias voltage		(Connect to GND through a capacitor)				3	

NOTES :

1. Applied to input pins STBY, HD, VD, SDI, SCLK and LOAD.
2. Applied to input pins SIGIN and REFIN. Do not connect to DC directly.
3. Applied to pins BIAS₁, BIAS₂, OFS, ADL, ADH, CLP₁ and CLP₂.
Do not connect to GND directly.

CHARACTERISTICS (1/15 s progressive scan readout mode)

(TA = +25°C, Operating conditions : The typical values specified in "RECOMMENDED OPERATING CONDITIONS".

Color temperature of light source : 3 200 K, IR cut-off filter (CM-500, 1mmt) is used.)

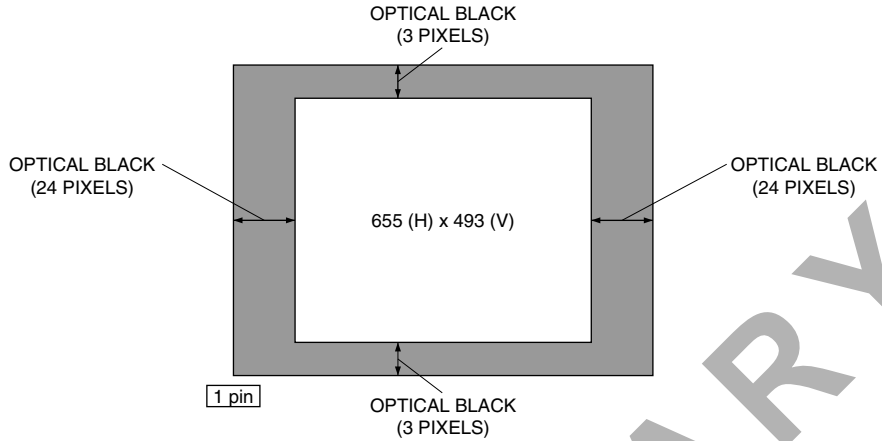
- Measurement point : Analog image signal output (pin No.32), before AGC circuit and AD converter.

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Standard output voltage	VO		150		mV	1
Photo response non-uniformity	PRNU			14	%	2
Saturation output voltage	VSAT	400	700		mV	3
Dark output voltage	VDARK		2	3	mV	4
Sensitivity (Green channel)	R (G)	150	250		mV	5
Supply current	IVDD		13		mA	6
Standby current	ISTBY		1	10	μA	7
Vertical line fixed pattern noise	VFPN		0.5	1.1	mVp-p	8

NOTES :

1. The average output voltage of G signal under uniform illumination. The standard exposure conditions are defined as when VO is 150 mV.
2. The image area is divided into 10 x 10 segments under the standard exposure conditions. Each segment's voltage is the average output voltage of all pixels within the segment. PRNU is defined by $(V_{max} - V_{min})/V_o$, where Vmax and Vmin are the maximum and minimum values of each segment's voltage respectively.
3. The image area is divided into 10 x 10 segments. Each segment's voltage is the average output voltage of all pixels within the segment. VSAT is the minimum segment's voltage under 10 times exposure of the standard exposure conditions.
4. The difference between average output voltage of the image area and that of the OB area, under non-exposure conditions.
5. The average output voltage of G signal when a 500 lux light source with a 90% reflector is imaged by a lens of F4, F50 mm.
6. Total current of analog and digital power supplies, in the dark and at the standard load conditions.
7. Total current of power supply in standby mode. (Pin No.9 (STBY) is fixed to "H" level and other input pins are fixed to "H" level or "L" level.)
8. One mean horizontal line signal $\langle b_i \rangle$ is obtained by adding all the horizontal line signals $\langle a_{ij} \rangle$ vertically and dividing them by the line number. $\langle x_i \rangle$ is the deviation of the center pixel from the average of successive 5 pixels in $\langle b_i \rangle$. VFPN is the maximum absolute value of $\langle x_i \rangle$.

PIXEL STRUCTURE



COLOR FILTER ARRAY

(1, 493)

(655, 493)

R	G	R	G	R	R	G	R	G	R
G	B	G	B	G	G	B	G	B	G
R	G	R	G	R	R	G	R	G	R
G	B	G	B	G	G	B	G	B	G
R	G	R	G	R	R	G	R	G	R
G	B	G	B	G	G	B	G	B	G
G	B	G	B	G	G	B	G	B	G
R	G	R	G	R	R	G	R	G	R
G	B	G	B	G	G	B	G	B	G
R	G	R	G	R	R	G	R	G	R

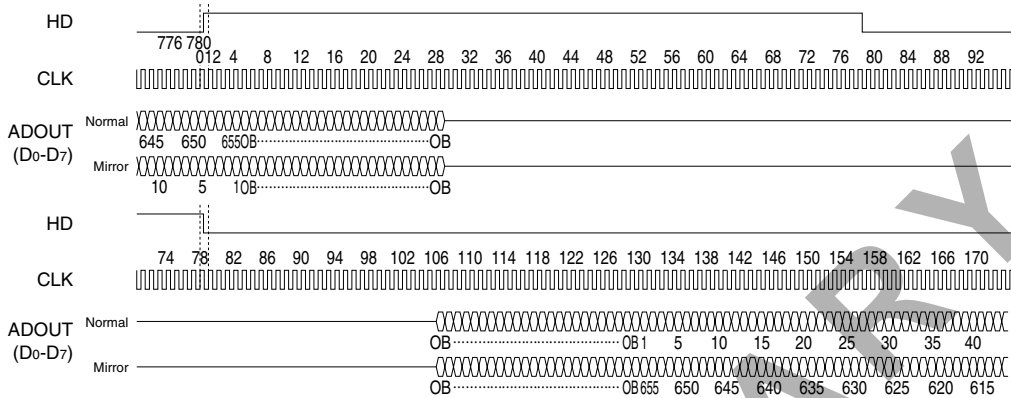
(1, 1)

(655, 1)

TIMING CHART

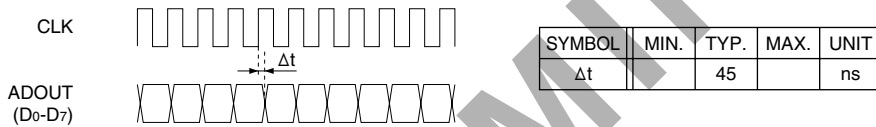
[Normal Mode]

HORIZONTAL PULSE TIMING



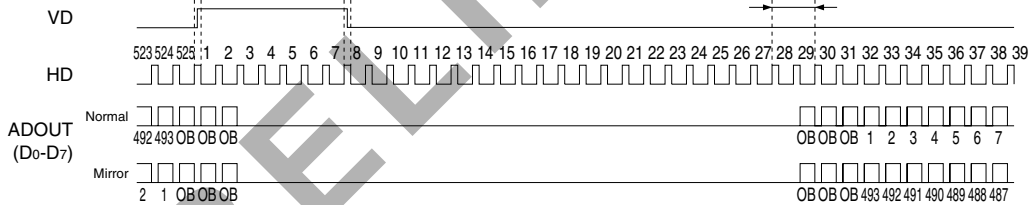
- The rising edge of the HD pulse must be between two rising edges of CLK (0) and CLK (1).
- The falling edge of the HD pulse must be between two rising edges of CLK (78) and CLK (79).

PHASE RELATIONS BETWEEN DIGITAL OUTPUT (ADOUT) AND CLOCK (CLK)



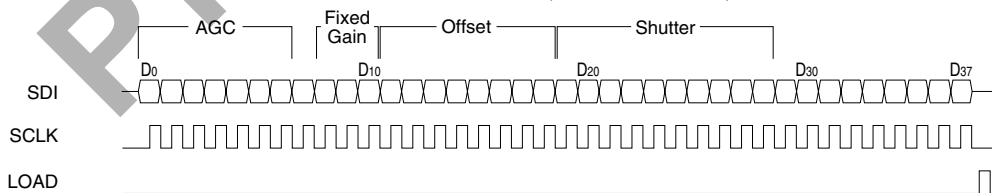
VERTICAL PULSE TIMING

SDI, SCLK, LOAD Forbidden Period



- The rising edge and falling edge of the VD pulse must be in high period of the HD pulses.

SERIAL DATA TIMING (SDI, SCLK, LOAD)

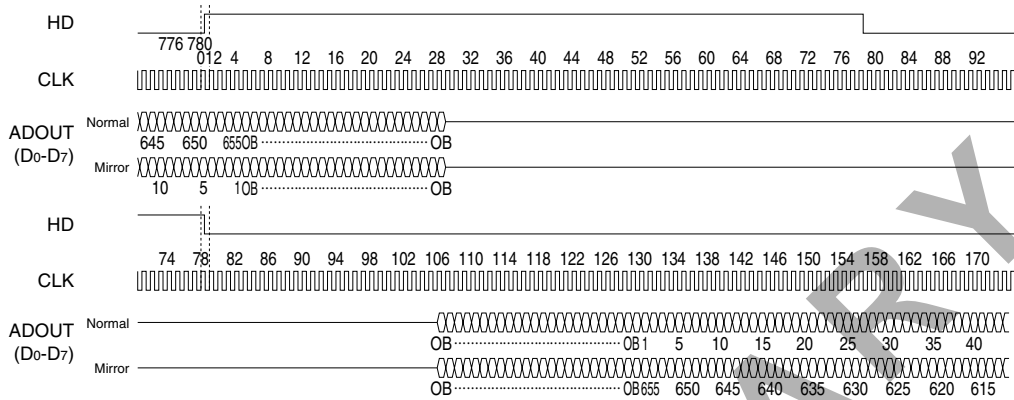


- Data in SDI are taken at the rising edge of SCLK.
- Clock frequency of SCLK should be less than 1/2 of that of CLK.
- Do not insert the SDI, SCLK and LOAD pulses between 28H* and 29H*. Refer to "VERTICAL PULSE TIMING".
- Refer to "SERIAL DATA INPUTS" for the contents of serial data from D0 to D37.

* It means ordinal number of the HD pulse.

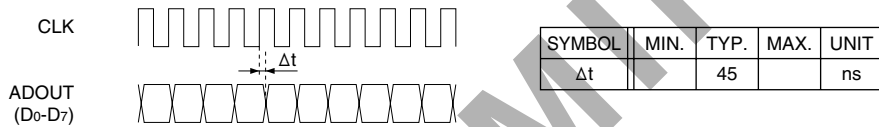
[Monitoring Mode]

HORIZONTAL PULSE TIMING

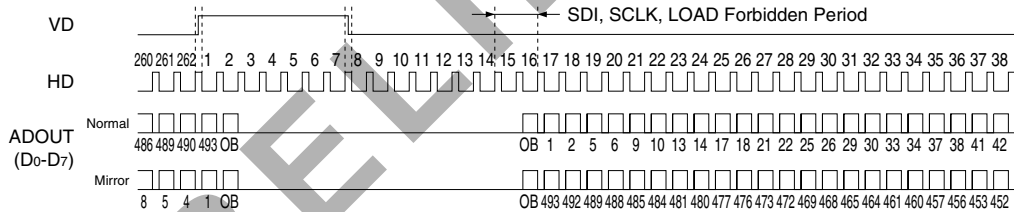


- The rising edge of the HD pulse must be between two rising edges of CLK (0) and CLK (1).
- The falling edge of the HD pulse must be between two rising edges of CLK (78) and CLK (79).

PHASE RELATIONS BETWEEN DIGITAL OUTPUT (ADOUT) AND CLOCK (CLK)

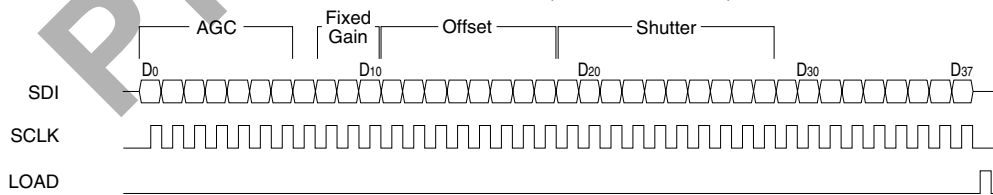


VERTICAL PULSE TIMING



- The rising edge and falling edge of the VD pulse must be in high period of the HD pulses.

SERIAL DATA TIMING (SDI, SCLK, LOAD)



- Data in SDI are taken at the rising edge of SCLK.
- Clock frequency of SCLK should be less than 1/2 of that of CLK.
- Do not insert the SDI, SCLK and LOAD pulses between 15H* and 16H*. Refer to "VERTICAL PULSE TIMING".
- Refer to "SERIAL DATA INPUTS" for the contents of serial data from D₀ to D₃₇.

* It means ordinal number of the HD pulse.

SERIAL DATA INPUTS

DATA	NAME	FUNCTION
D0	AGC ₆ (MSB)	Auto gain control (0 to 20 dB)
D1	AGC ₅	
D2	AGC ₄	
D3	AGC ₃	
D4	AGC ₂	
D5	AGC ₁	
D6	AGC ₀ (LSB)	
D7		Not used. (Fix to low level.)
D8	MAX ₂ (MSB)	Selection of fixed gain (3 to 10 dB)
D9	MAX ₁	
D10	MAX ₀ (LSB)	
D11	OFS ₇ (MSB)	Offset level control of ADC (0.9 to 1.5 V)
D12	OFS ₆	
D13	OFS ₅	
D14	OFS ₄	
D15	OFS ₃	
D16	OFS ₂	
D17	OFS ₁	
D18	OFS ₀ (LSB)	
D19	SHT ₉ (MSB)	Shutter speed control (Normal mode : Exposure time is 1 to 1/525 frame period.) (Monitoring mode : Exposure time is 1 to 1/262 frame period.)
D20	SHT ₈	
D21	SHT ₇	
D22	SHT ₆	
D23	SHT ₅	
D24	SHT ₄	
D25	SHT ₃	
D26	SHT ₂	
D27	SHT ₁	
D28	SHT ₀ (LSB)	
D29	MIRH	H : Horizontal mirror inversion image, L : Normal image
D30	MIRV	H : Vertical mirror inversion image, L : Normal image
D31	MON	H : Monitoring mode, L : Normal mode
D32	SAD ₂ (MSB)	Phase selection of AD clock D ₃₂ /D ₃₃ /D ₃₄ = L/L/L : -30° D ₃₂ /D ₃₃ /D ₃₄ = L/L/H : -15° D ₃₂ /D ₃₃ /D ₃₄ = L/H/L : 0° D ₃₂ /D ₃₃ /D ₃₄ = L/H/H : +15°
D33	SAD ₁	
D34	SAD ₀ (LSB)	
D35	LPMD ₁	Power save mode D ₃₅ /D ₃₆ = L/L : Normal mode D ₃₅ /D ₃₆ = L/H : AD and AGC off D ₃₅ /D ₃₆ = H/L : AD off D ₃₅ /D ₃₆ = H/H : Inhibited mode
D36	LPMD ₀	
D37	USB	H : Inhibited mode, L : Normal mode

Setting of Auto Gain Control

- One LSB of the gain code represents approximately 0.156 dB.
- Nominal gain values at typical codes are shown below.

AUTO GAIN CONTROL (dB)	D0	D1	D2	D3	D4	D5	D6
0	L	L	L	L	L	L	L
1	L	L	L	L	H	H	L
2	L	L	L	H	H	L	H
3	L	L	H	L	L	H	H
4	L	L	H	H	L	L	H
5	L	H	L	L	L	L	L
6	L	H	L	L	H	H	L
7	L	H	L	H	H	L	L
8	L	H	H	L	L	H	H
9	L	H	H	H	L	L	H
10	H	L	L	L	L	L	L
11	H	L	L	L	H	H	L
12	H	L	L	H	H	L	L
13	H	L	H	L	L	H	H
14	H	L	H	H	L	L	H
15	H	L	H	H	H	H	H
16	H	H	L	L	H	H	L
17	H	H	L	H	H	L	L
18	H	H	H	L	L	H	H
19	H	H	H	H	L	L	H
20	H	H	H	H	H	H	H

Setting of Fixed Gain

- One LSB of the gain code represents 1 dB.

FIXED GAIN (dB)	D8	D9	D10
3	L	L	L
4	L	L	H
5	L	H	L
6	L	H	H
7	H	L	L
8	H	L	H
9	H	H	L
10	H	H	H

Setting of Offset Level

- One LSB of the offset code represents approximately 0.002 V.
- Nominal offset values at typical codes are shown below.

OFFSET LEVEL (V)	D11	D12	D13	D14	D15	D16	D17	D18
0.9	L	L	L	L	L	L	L	L
1.0	L	L	H	L	H	L	H	H
1.1	L	H	L	H	L	H	L	H
1.2	H	L	L	L	L	L	L	L
1.3	H	L	H	L	H	L	H	L
1.4	H	H	L	H	L	H	L	H
1.5	H	H	H	H	H	H	H	H

Setting of Shutter Speed

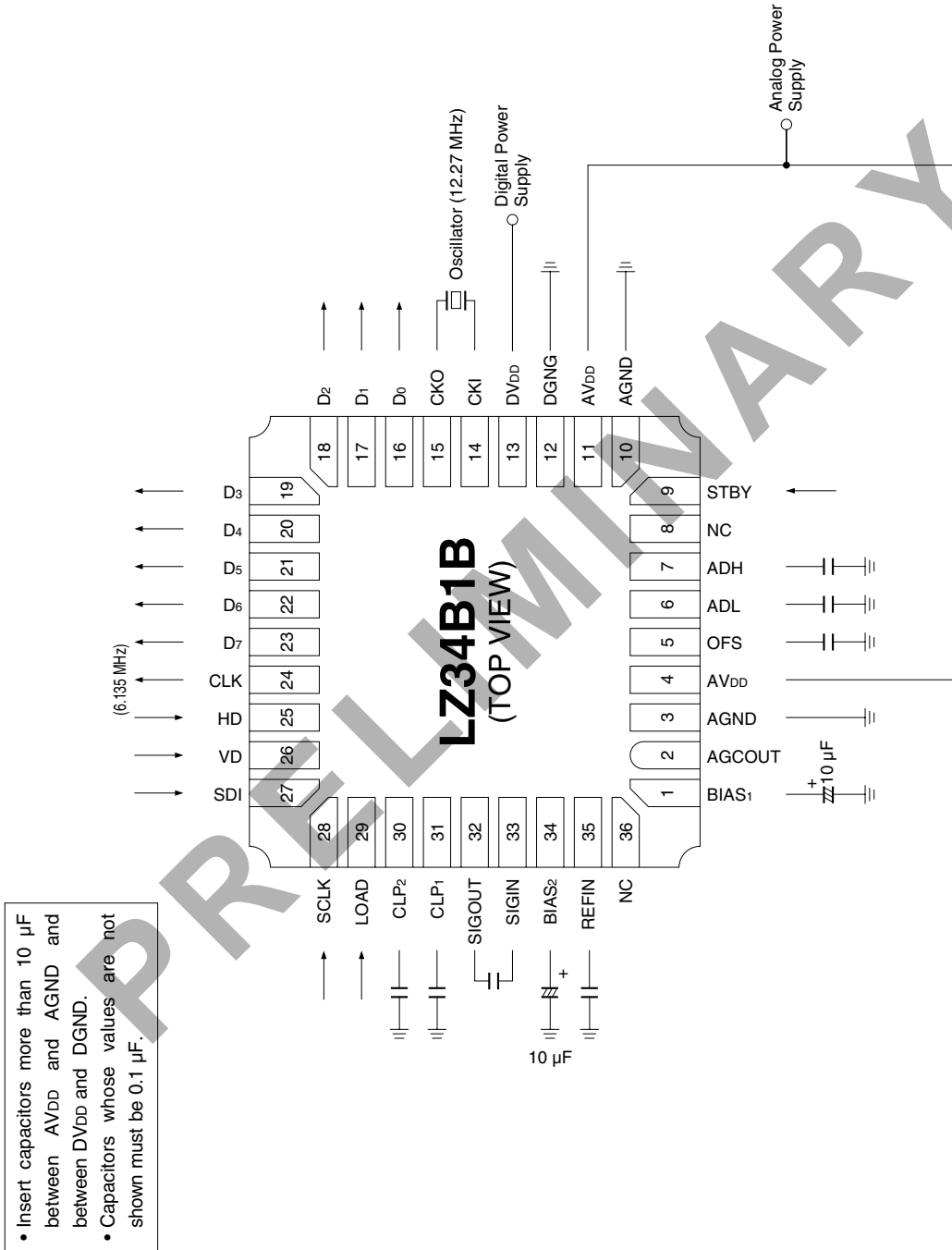
- One LSB of the shutter speed code represents 1H, where 1H is the HD pulse period.
- Shutter speed values at typical codes are shown below in normal mode, monitoring mode and USB mode.

SHUTTER SPEED (Exposure Time Unit : H)		D19	D20	D21	D22	D23	D24	D25	D26	D27	D28
Normal	Monitoring										
525	262	L	L	L	L	L	L	L	L	L	L
•	•										
•	•										
265	2	L	H	L	L	L	L	L	H	L	L
264	1	L	H	L	L	L	L	L	H	L	H
263	262	L	H	L	L	L	L	L	H	H	L
•	•										
•	•										
27	262	L	H	H	H	H	H	L	L	H	L
26	262	L	H	H	H	H	H	L	L	H	H
25	262	L	H	H	H	H	H	L	H	L	L
•	•										
•	•										
2	262	H	L	L	L	L	L	H	L	H	H
1	262	H	L	L	L	L	L	H	H	L	L
525	262	H	L	L	L	L	L	H	H	L	H
•	•										
•	•										
525	262	H	H	H	H	H	H	H	H	H	H

Setting of Driving Modes

FUNCTION	D31	D37
Normal mode	L	L
Monitoring mode	H	L

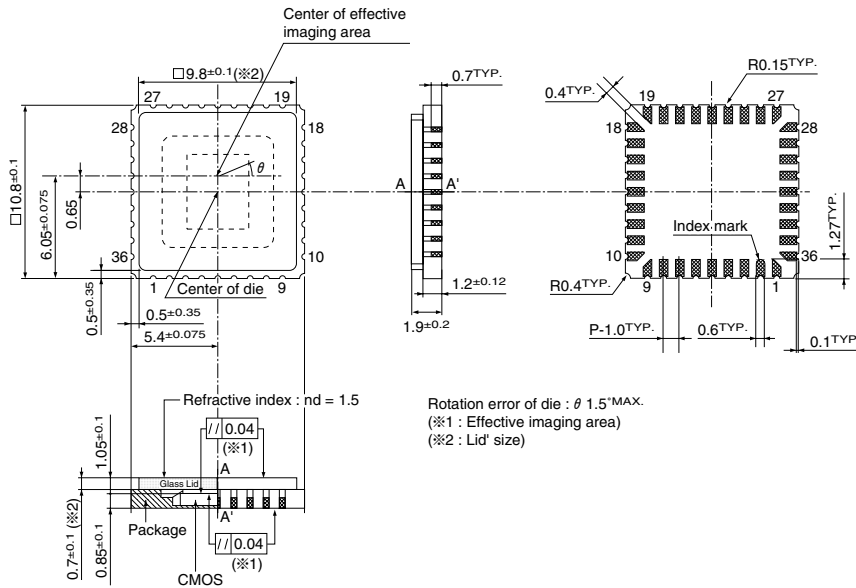
EXAMPLE OF OPERATION CIRCUIT



PACKAGE OUTLINES

36 LCC (N-LCC036-S425B)

(Unit : mm)



PRECAUTIONS FOR CMOS IMAGE SENSORS

1. Package Breakage

In order to prevent the package from being broken, observe the following instructions :

- 1) The CMOS image sensor is a precise optical component and the package material is ceramic.
Therefore,
 - Take care not to drop the device when mounting, handling, or transporting.
 - Avoid giving a shock to the package.
Especially when pins are fixed to the socket or the circuit board, small shock could break the package more easily than when the package isn't fixed.
- 2) When mounting the package on the housing, be sure that the package is not bent.
 - If a bent package is forced into place between a hard plate or the like, the package may be broken.
- 3) If any damage or breakage occurs on the surface of the glass cap, its characteristics could deteriorate.
Therefore,
 - Do not hit the glass cap.
 - Do not give a shock large enough to cause distortion.
 - Do not scrub or scratch the glass surface.
 - Even a soft cloth or applicator, if dry, could cause flaws to scratch the glass.

2. Electrostatic Damage

As compared with general MOS-LSI, CMOS image sensor has lower ESD. Therefore, take the following antistatic measures when handling the CMOS image sensor :

- 1) Always discharge static electricity by grounding the human body and the instrument to be used. To ground the human body, provide resistance of about 1 M Ω between the human body and the ground to be on the safe side.

- 2) When directly handling the device with the fingers, hold the part without pins and do not touch any pin.
- 3) To avoid generating static electricity,
 - a. do not scrub the glass surface with cloth or plastic.
 - b. do not attach any tape or labels.
 - c. do not clean the glass surface with dust-cleaning tape.
- 4) When storing or transporting the device, put it in a container of conductive material.

3. Dust and Contamination

Dust or contamination on the glass surface could deteriorate the output characteristics or cause a scar. In order to minimize dust or contamination on the glass surface, take the following precautions :

- 1) Handle the CMOS image sensor in a clean environment such as a cleaned booth. (The cleanliness level should be, if possible, class 1 000 at least.)
 - 2) Do not touch the glass surface with the fingers. If dust or contamination gets on the glass surface, the following cleaning method is recommended :
 - Dust from static electricity should be blown off with an ionized air blower. For anti-electrostatic measures, however, ground all the pins on the device before blowing off the dust.
 - The contamination on the glass surface should be wiped off with a clean applicator soaked in isopropyl alcohol. Wipe slowly and gently in one direction only.
 - Frequently replace the applicator and do not use the same applicator to clean more than one device.
- ※ Note : In most cases, dust and contamination are unavoidable, even before the device is first used. It is, therefore, recommended that the above procedures should be taken to wipe out dust and contamination before using the device.

4. Other

- 1) Soldering should be manually performed within 2 seconds per pin at 400°C maximum at the tip of soldering iron.
- 2) Avoid using or storing the CMOS image sensor at high temperature or high humidity as it is a precise optical component. Do not give a mechanical shock to the CMOS image sensor.
- 3) Do not expose the device to strong light. For the color device, long exposure to strong light will fade the color of the color filters.