

LZ34C10

1/4-type Color CMOS Image Sensor with 110 k Pixels

DESCRIPTION

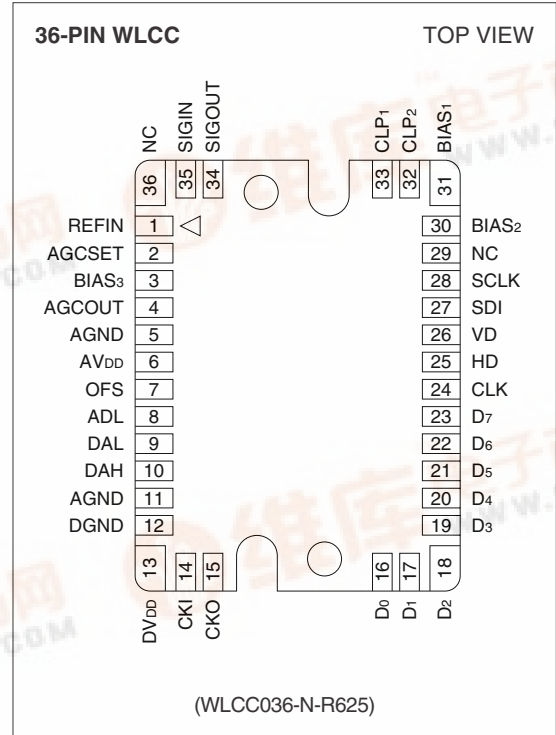
The LZ34C10 is a 1/4-type (4.5 mm) solid-state color image sensor that consists of PN photo-diodes and CMOS (Complementary Metal Oxide Semi-conductor) devices. The sensor further includes a timing generator (TG), a correlated double sampling (CDS) circuit, an auto gain control (AGC) circuit and an analog-to-digital converter (ADC) circuit. With approximately 110 000 pixels (393 horizontal x 299 vertical), the sensor provides a stable digital color image with extremely low power consumption.

FEATURES

- Progressive scan
- Square pixel
- Compatible with CIF standard
- Number of effective pixels : 367 (H) x 291 (V)
- Number of optical black pixels
 - Horizontal : 13 front and 13 rear
 - Vertical : 4 front and 4 rear
- Pixel pitch : 9.4 μm (H) x 9.4 μm (V)
- R, G, and B primary color mosaic filters
- Image inversion function (horizontally and/or vertically)
- Power save mode
- Analog output and 8-bit digital output
- Variable gain control (3 to 30 dB)
- Variable electronic shutter (1/30 to 1/10 000 s)
- Single +3.0 V power supply
- Package : 36-pin WLCC* (WLCC036-N-R625)

* Window Leadless Chip Carrier

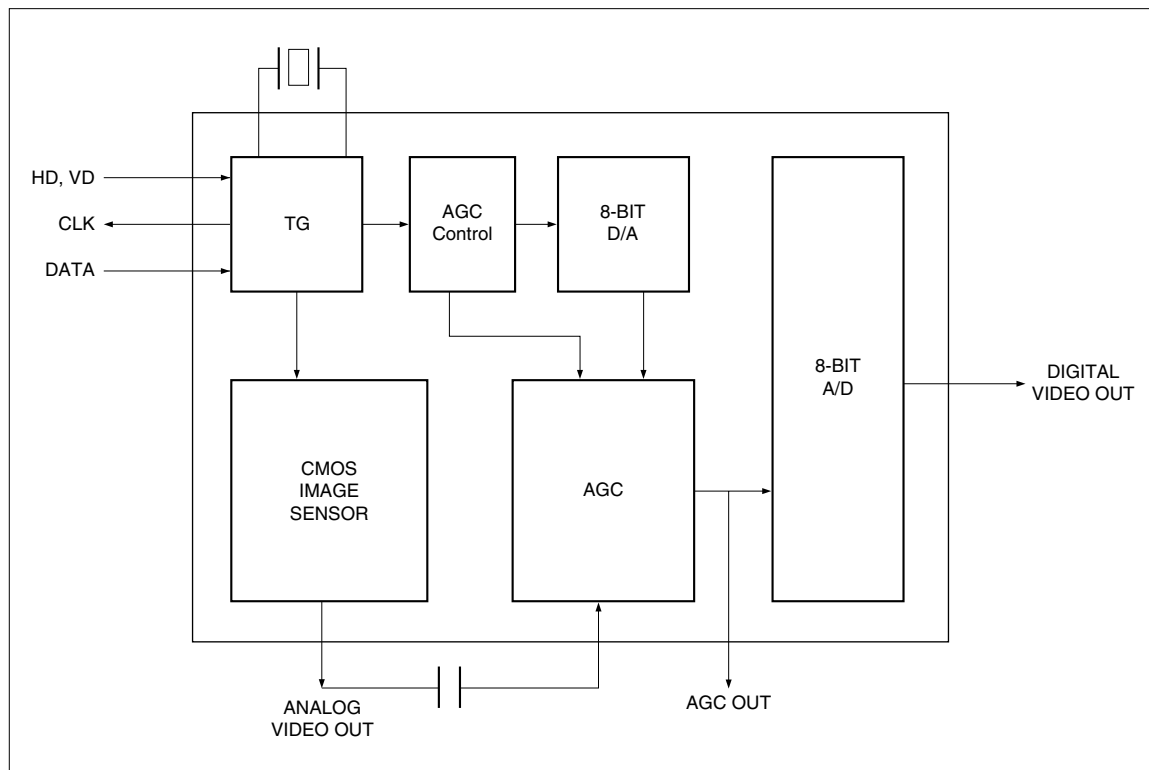
PIN CONNECTIONS



PRECAUTIONS

- The exit pupil position of lens should be more than 15 mm from the top surface of the CMOS image sensor.

BLOCK DIAGRAM



PIN DESCRIPTION

PIN NO.	SYMBOL	I/O	A/D	DESCRIPTION
1	REFIN	I	Analog	Reference voltage for analog input
2	AGCSET	–	Analog	Resistor for AGC
3	BIAS ₃	–	Analog	Analog bias voltage 3 for image sensor
4	AGCOUT	O	Analog	AGC output
5	AGND	–	Analog	Analog ground
6	AVDD	–	Analog	Analog power supply
7	OFS	–	Analog	Offset bias voltage for AGC output
8	ADL	–	Analog	Bottom ADC reference voltage
9	DAL	–	Analog	Bottom DAC reference voltage
10	DAH	–	Analog	Top DAC reference voltage
11	AGND	–	Analog	Analog ground
12	DGND	–	Digital	Digital ground
13	DVDD	–	Digital	Digital power supply
14	CKI	I	Digital	Clock input for oscillator
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 (9.0 MHz)
25	HD	I	Digital	Horizontal drive pulse input
26	VD	I	Digital	Vertical drive pulse input
27	SDI	I	Digital	Data input (AGC gain, offset, shutter control, etc.)
28	SCLK	I	Digital	Shift clock for data
29	NC	–	–	No connection
30	BIAS ₂	–	Analog	Analog bias voltage 2 for image sensor
31	BIAS ₁	–	Analog	Analog bias voltage 1 for image sensor
32	CLP ₂	–	Analog	Analog bias voltage 2 for clamp circuit
33	CLP ₁	–	Analog	Analog bias voltage 1 for clamp circuit
34	SIGOUT	O	Analog	Analog image signal output
35	SIGIN	I	Analog	Analog image signal input
36	NC	–	–	No connection

ABSOLUTE MAXIMUM RATINGS

(TA = +25 °C)

PARAMETER	SYMBOL	RATING	UNIT
Power supply voltage	V _{DD}	−0.3 to +4.3	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}	2.7	3.0	3.3	V	
Operating temperature	T _{OPR}	−20	+25	+60	°C	
Oscillation frequency	f _{CK}		9.0		MHz	
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 HD, VD, SDI and SCLK.
2. Applied to input pins SIGIN and REFIN. Do not connect to DC directly.
3. Applied to pins BIAS₁, BIAS₂, BIAS₃, OFS, ADL, DAL, DAH, CLP₁ and CLP₂.
Do not connect to GND directly.

CHARACTERISTICS (1/30 s progressive scan readout mode)

($T_A = 25\text{ }^{\circ}\text{C}$, Operating conditions : The typical values specified in "RECOMMENDED OPERATING CONDITIONS". Color temperature of light source : 3 200 K, IR cut-off filter (CM-500, 1mm) is used.)

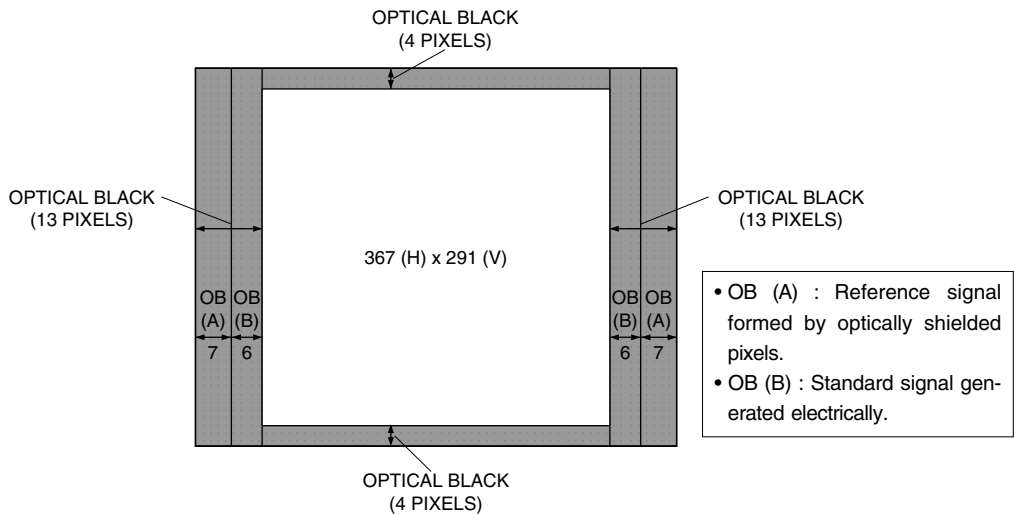
- Measurement point : Analog image signal output (pin no. 34), before AGC circuit and AD converter.

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Standard output voltage	V_O		150		mV	1
Photo response non-uniformity	PRNU			14	%	2
Saturation output voltage	V_{SAT}	600	1 000		mV	3
Dark output voltage	V_{DARK}		2	6	mV	4
Dark signal non-uniformity	DSNU		3	10	mV	5
Sensitivity (Green channel)	R	210	350		mV	6
Supply current	I_{VDD}		10		mA	7
Vertical line fixed pattern noise	VFPN		0.4	1.0	mVp-p	8

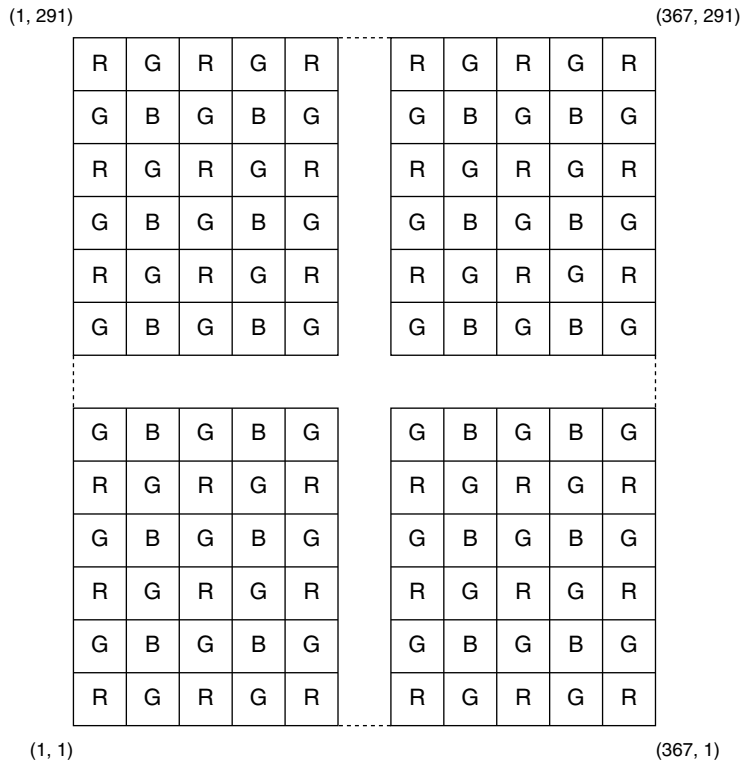
NOTES :

1. The average output voltage of G signal under uniform illumination. The standard exposure conditions are defined as when V_O 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 V_{max} and V_{min} 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. V_{SAT} is the minimum segment's voltage under 10 times exposure of the standard exposure conditions.
4. The difference between average output voltage of the effective area and that of the OB (A) area, under non-exposure conditions.
5. The image area is divided into 10 x 10 segments under non-exposure conditions. DSNU is defined by $(V_{dmax} - V_{dmin})$, where V_{dmax} and V_{dmin} are the maximum and minimum values of each segment's voltage respectively.
6. The average output voltage of G signal when a 1 000 lux light source with a 90 % reflector is imaged by a lens of F4, F50 mm.
7. Total current of analog and digital power supplies, in the dark and at the standard load conditions.
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

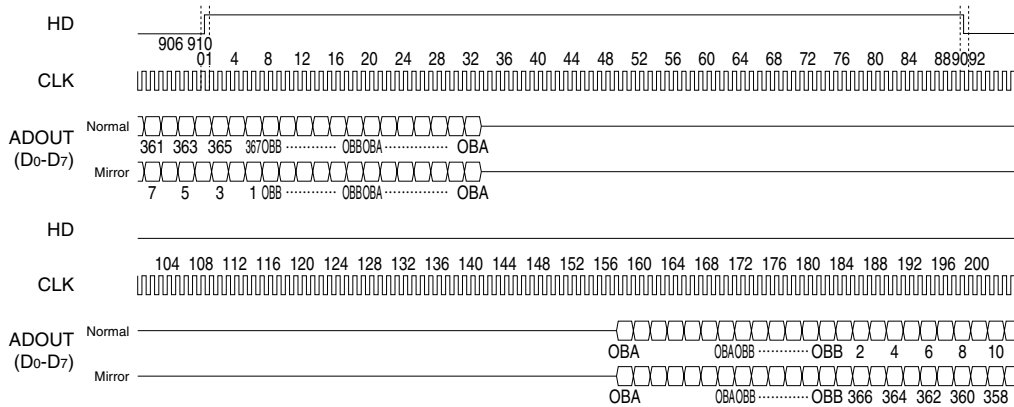


COLOR FILTER ARRAY



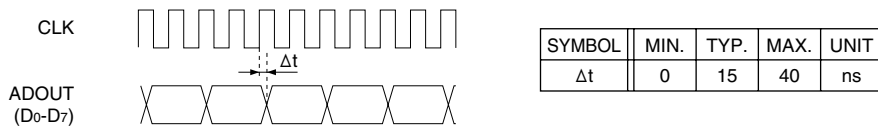
TIMING CHART

HORIZONTAL PULSE TIMING

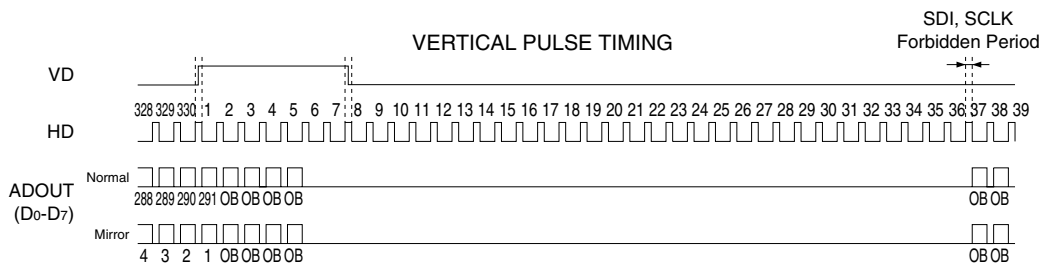


- The rising edge of the HD pulse must be between two rising edges of CLK (0) and CLK (1).
- The falling edge of the HD pulse must be between two rising edges of CLK (78) and CLK (79).

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

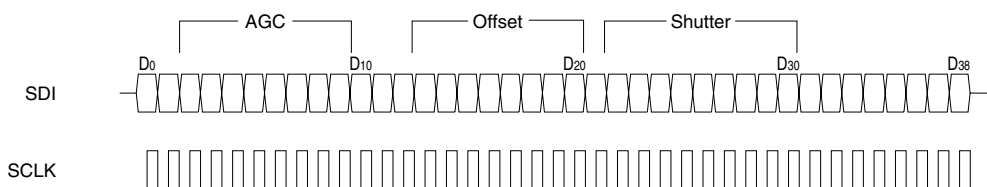


VERTICAL PULSE TIMING



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

SERIAL DATA TIMING (SDI, SCLK)



- Data in SDI are taken at the rising edge of SCLK.
- Clock frequency of SCLK should be 1/16 of that of CLK.
- Do not insert the SDI and SCLK pulses between 36H* and 37H*. Refer to "VERTICAL PULSE TIMING".
- Refer to "SERIAL DATA INPUTS" for the contents of serial data from D0 to D38.

* It means ordinal number of the HD pulse.

SERIAL DATA INPUTS

DATA	NAME	FUNCTION
D0		Not used.
D1		(Fix to low level.)
D2	AGC ₇ (MSB)	Auto gain control (0 to 20 dB)
D3	AGC ₆	
D4	AGC ₅	
D5	AGC ₄	
D6	AGC ₃	
D7	AGC ₂	
D8	AGC ₁	
D9	AGC ₀ (LSB)	
D10		Not used.
D11		(Fix to low level.)
D12		
D13	OFS ₇ (MSB)	Offset level control of AGC output (0.9 to 1.5 V)
D14	OFS ₆	
D15	OFS ₅	
D16	OFS ₄	
D17	OFS ₃	
D18	OFS ₂	
D19	OFS ₁	
D20	OFS ₀ (LSB)	
D21		Not used. (Fix to low level.)
D22	SHT ₈ (MSB)	Shutter speed control (Exposure time is 1 to 1/330 frame period.)
D23	SHT ₇	
D24	SHT ₆	
D25	SHT ₅	
D26	SHT ₄	
D27	SHT ₃	
D28	SHT ₂	
D29	SHT ₁	
D30	SHT ₀ (LSB)	
D31	MIRH	H : Horizontal mirror inversion image, L : Normal image
D32	MIRV	H : Vertical mirror inversion image, L : Normal image
D33	SAD ₁ (MSB)	Phase selection of AD clock
D34	SAD ₀ (LSB)	(Fix to low level.)
D35	MAX ₂ (MSB)	Selection of fixed gain (3 to 10 dB)
D36	MAX ₁	
D37	MAX ₀ (LSB)	
D38	LPMD	H : Power save mode (AGC and AD off), L : All active

Setting of Auto Gain Control

- One LSB of the gain code represents approximately 0.078 dB.
- Nominal gain values at typical codes are shown below.

AUTO GAIN CONTROL (dB)	D2	D3	D4	D5	D6	D7	D8	D9
0	L	L	L	L	L	L	L	L
1	L	L	L	L	H	H	L	H
2	L	L	L	H	H	L	H	L
3	L	L	H	L	L	H	H	L
4	L	L	H	H	L	L	H	H
5	L	H	L	L	L	L	L	L
6	L	H	L	L	H	H	L	H
7	L	H	L	H	H	L	L	H
8	L	H	H	L	L	H	H	L
9	L	H	H	H	L	L	H	H
10	H	L	L	L	L	L	L	L
11	H	L	L	L	H	H	L	L
12	H	L	L	H	H	L	L	H
13	H	L	H	L	L	H	H	L
14	H	L	H	H	L	L	H	H
15	H	L	H	H	H	H	H	H
16	H	H	L	L	H	H	L	L
17	H	H	L	H	H	L	L	H
18	H	H	H	L	L	H	H	L
19	H	H	H	H	L	L	H	L
20	H	H	H	H	H	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)	D13	D14	D15	D16	D17	D18	D19	D20
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.

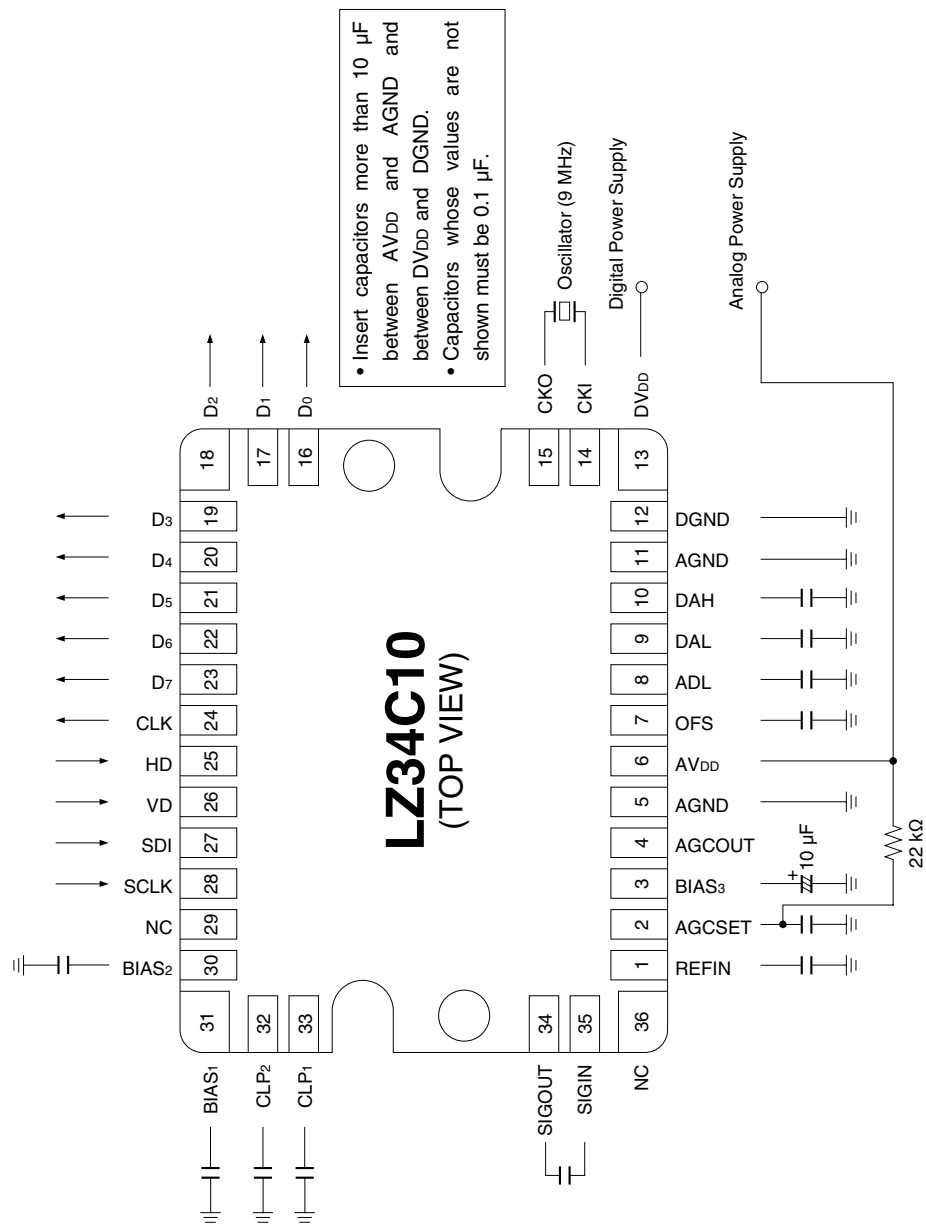
SHUTTER SPEED (Exposure Time Unit : 1H)	D22	D23	D24	D25	D26	D27	D28	D29	D30
330	L	L	L	L	L	L	L	L	L
329	L	L	L	L	L	L	L	L	H
328	L	L	L	L	L	L	L	H	L
.									
300	L	L	L	L	H	H	H	H	L
.									
.									
200	L	H	L	L	L	L	L	H	L
.									
.									
100	L	H	H	H	L	L	H	H	L
.									
.									
10	H	L	H	L	L	L	L	L	L
.									
3	H	L	H	L	L	L	H	H	H
2	H	L	H	L	L	H	L	L	L
1	H	L	H	L	L	H	L	L	H

Setting of Fixed Gain

- One LSB of the gain code represents 1 dB.

FIXED GAIN (dB)	D35	D36	D37
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

EXAMPLE OF OPERATION CIRCUIT



(Unit : mm)

[illegible]

Rotation error of die : $\theta = 1.0^\circ \text{MAX.}$
 (※ 1 : Effective imaging area)
 (※ 2 : Lid's size)

