

LZ34C10

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

DESCRIPTION

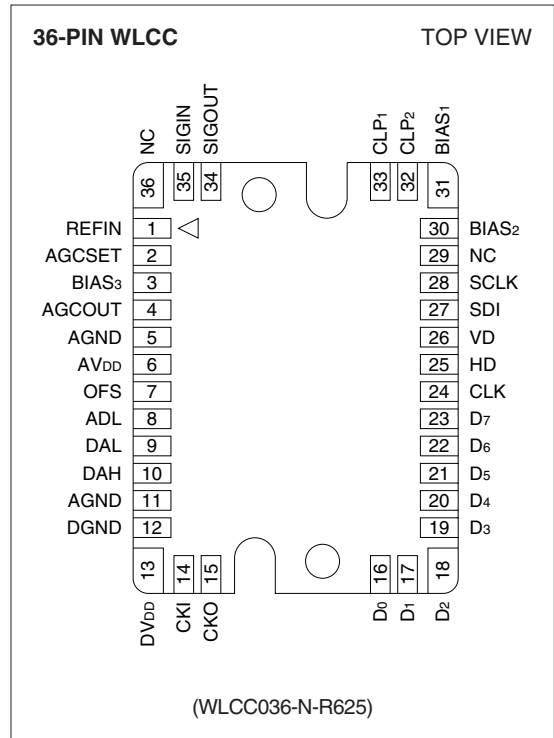
The LZ34C10 is a 1/4-type (4.5 mm) solid-state color image sensor that consists of PN photodiodes and CMOS (Complementary Metal Oxide Semi-conductor) devices. The sensor further includes a timing generator (TG), a correlated double sampling (CDS) circuit, an auto gain control (AGC) circuit and an analog-to-digital 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

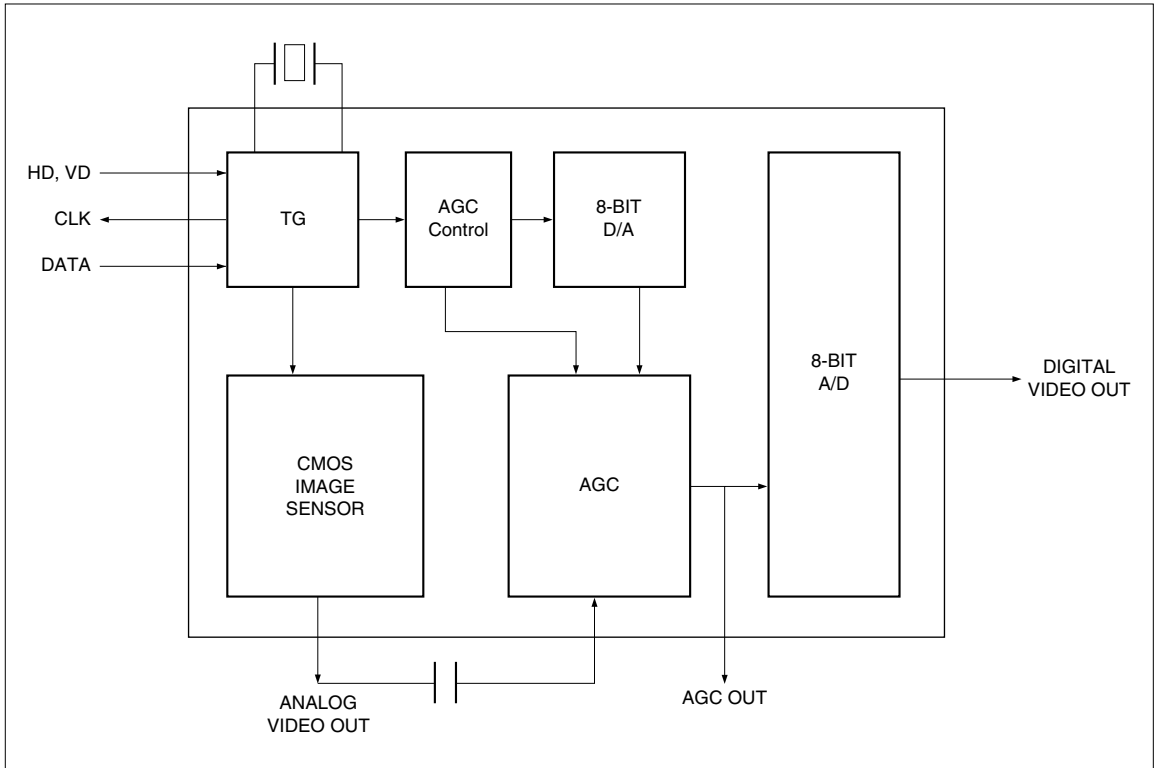
PIN CONNECTIONS



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 | AV _{DD} | – | 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 | DV _{DD} | – | 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(T_A = +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, 1mmt) is used.)

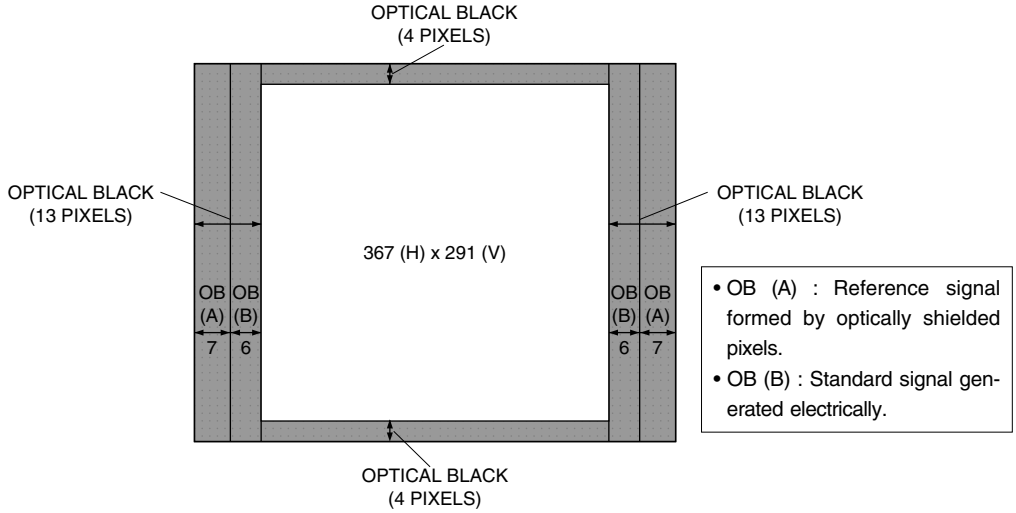
- Measurement point : Analog image signal output (pin no. 34), before AGC circuit and AD converter.

| 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 |

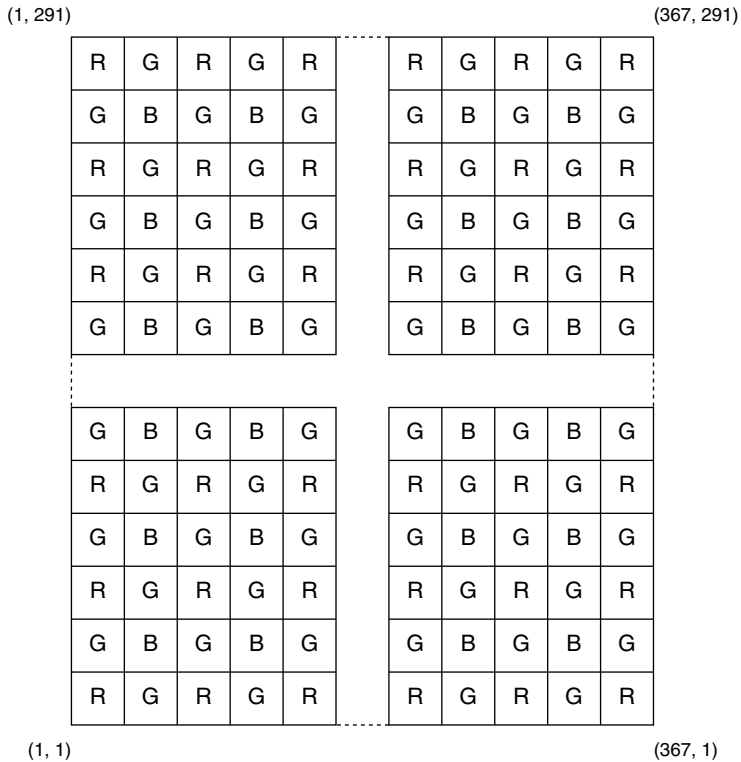
NOTES :

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

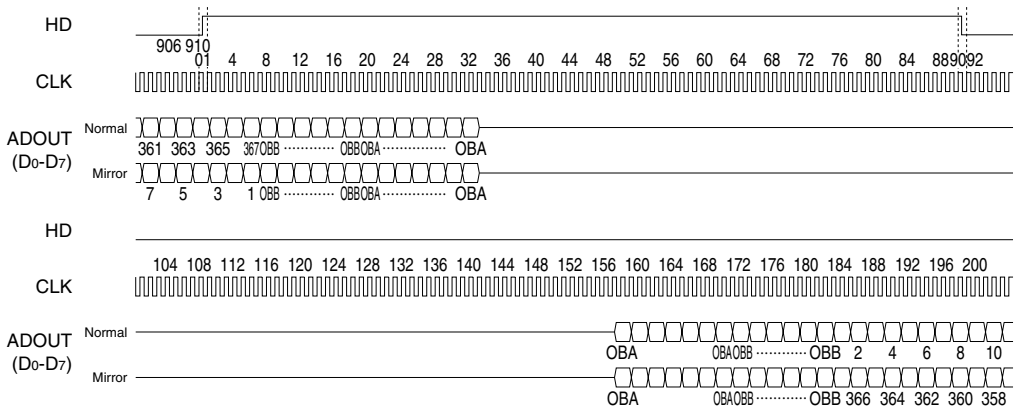


COLOR FILTER ARRAY



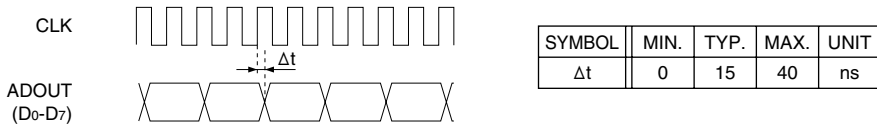
TIMING CHART

HORIZONTAL PULSE TIMING

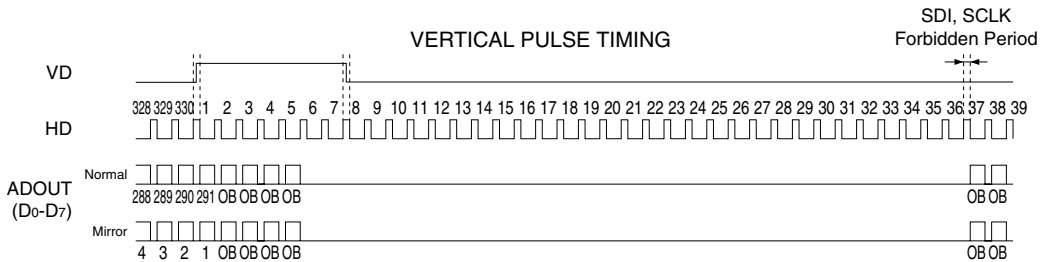


- The rising edge of the HD pulse must be between two rising edges of CLK (0) and CLK (1).
- The falling edge of the HD pulse must be between two rising edges of CLK (78) and CLK (79).

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

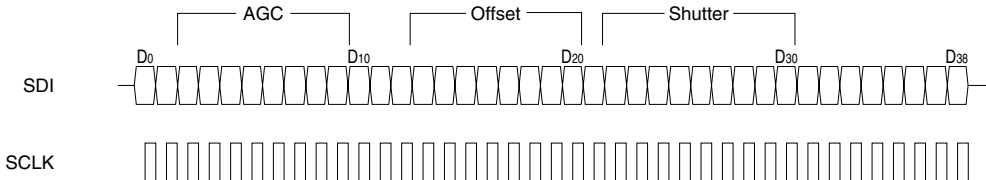


VERTICAL PULSE TIMING



- 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 | AGC7 (MSB) | Auto gain control (0 to 20 dB) | |
| D3 | AGC6 | | |
| D4 | AGC5 | | |
| D5 | AGC4 | | |
| D6 | AGC3 | | |
| D7 | AGC2 | | |
| D8 | AGC1 | | |
| D9 | AGC0 (LSB) | | |
| D10 | | Not used. | |
| D11 | | (Fix to low level.) | |
| D12 | | | |
| D13 | OFS7 (MSB) | Offset level control of AGC output (0.9 to 1.5 V) | |
| D14 | OFS6 | | |
| D15 | OFS5 | | |
| D16 | OFS4 | | |
| D17 | OFS3 | | |
| D18 | OFS2 | | |
| D19 | OFS1 | | |
| D20 | OFS0 (LSB) | | |
| D21 | | Not used. (Fix to low level.) | |
| D22 | SHT8 (MSB) | Shutter speed control (Exposure time is 1 to 1/330 frame period.) | |
| D23 | SHT7 | | |
| D24 | SHT6 | | |
| D25 | SHT5 | | |
| D26 | SHT4 | | |
| D27 | SHT3 | | |
| D28 | SHT2 | | |
| D29 | SHT1 | | |
| D30 | SHT0 (LSB) | | |
| D31 | MIRH | | H : Horizontal mirror inversion image, L : Normal image |
| D32 | MIRV | | H : Vertical mirror inversion image, L : Normal image |
| D33 | SAD1 (MSB) | Phase selection of AD clock (Fix to low level.) | |
| D34 | SAD0 (LSB) | | |
| D35 | MAX2 (MSB) | Selection of fixed gain (3 to 10 dB) | |
| D36 | MAX1 | | |
| D37 | MAX0 (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.

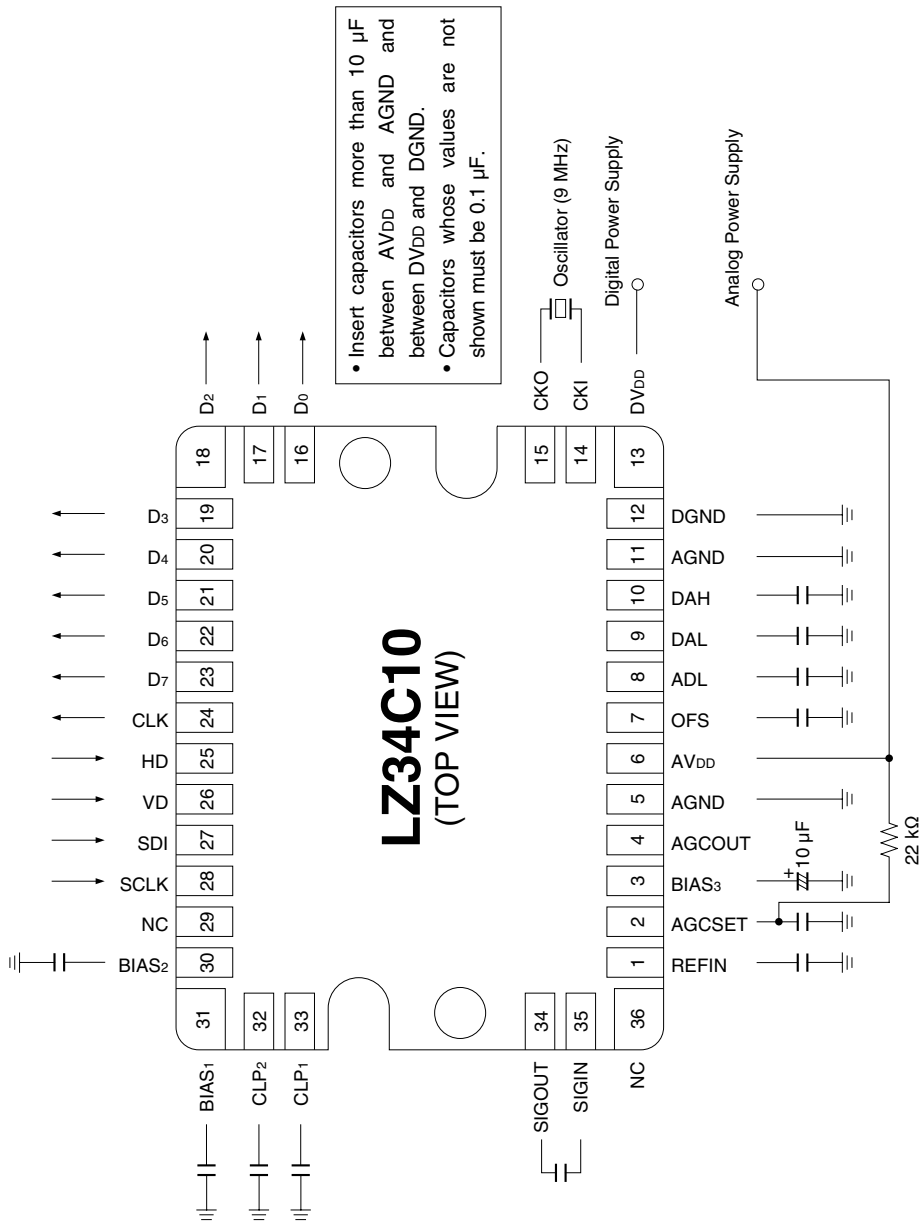
| SHUTTER SPEED (Exposure Time Unit : 1H) | D22 | D23 | D24 | D25 | D26 | D27 | D28 | D29 | D30 |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 330 | L | L | L | L | L | L | L | L | L |
| 329 | L | L | L | L | L | L | L | L | H |
| 328 | L | L | L | L | L | L | L | H | L |
| . | | | | | | | | | |
| 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



PACKAGE

(Unit : mm)

36 WLCC (WLCC036-N-R625)

