### (6) Connecting the ADC (option)

When connecting the video signal to an ADC (AD converter), use the analog VIDEO signal terminal, AD-SP terminal and AD-TRIG terminal. For electrical specifications, refer to 4, "Specifications". Before making connections to the ADC, carefully check the ADC specifications.

### (7) Connecting the power supply for the Peltier element

The temperature control circuit controls the power supply for the Peltier element by monitoring the resistance of the thermistor incorporated in the linear image sensor package. For the Peltier element operation, use a power supply having as low a noise and ripple as possible. Also use power supply wiring with a large cross-section to keep resistance as low as possible. The TE+ and TE- wires in particular must be sufficiently thick ( <18 awg  as short as possible ). For electrical specifications, refer to 4, "Specifications".

⚠ **Caution** **Make sure wiring connections to the Peltier element are correct.**

## 3. Operational Description

The image sensor operation is checked in a dark state so provide a light-shield on the light input window.

### (1) Supplying power to the drive circuit

Check the power supply voltages (Vdd: +5 V, INP, PDN and Vinp: +4.0 V, Fvref: +1.2 V), and then supply the power to the driver circuit. At this point, make sure the current levels are normal. If an excessive current is flowing, the power supply line might be short-circuited. Immediately turn off the power and check the power supply line. Use power supplies with as low noise and low ripple as possible, and the power line wires should be as thick as possible to provide low impedance. Noise generated here will affect the final noise level.

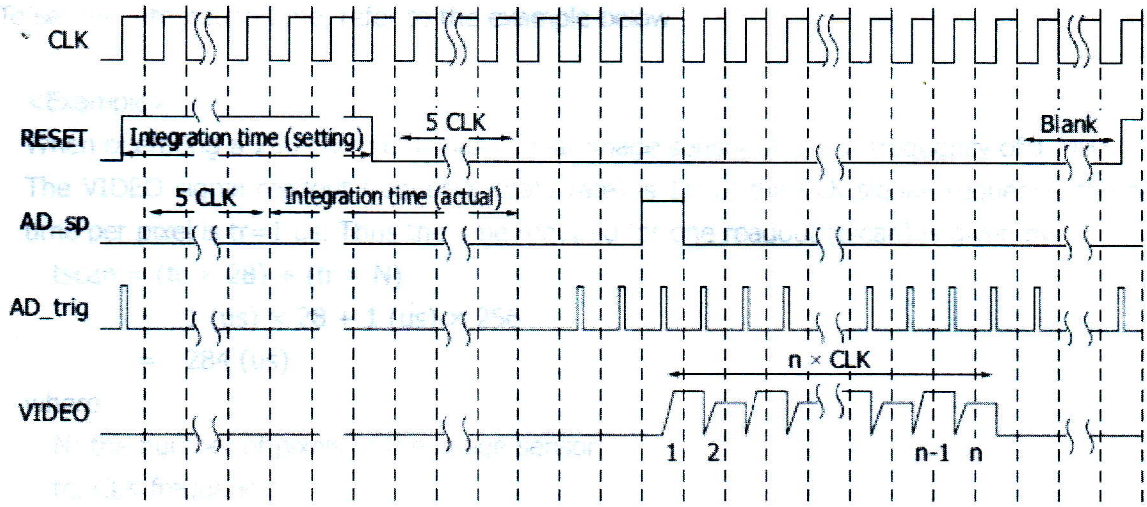
⚠ **Caution** **Use power supplies with low noise and low ripple.**

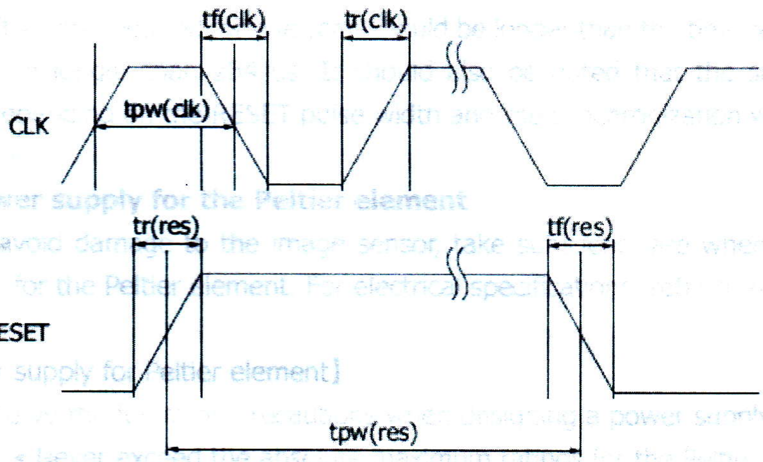
### (2) Control signal input from the pulse generator

While referring to the timing diagram shown in Figure 3-1, supply two types of control signals (CLK, RESET) to the linear image sensor from the pulse generator. Each input signal should be H-CMOS level. The linear image sensor may malfunction if used at other levels. The L period of the RESET signal should be longer than the "number of channels + 28" pulses. The CLK signal frequency determines the VIDEO readout frequency, and the H period of the RESET signal determines the integration time of the linear image sensor. The H period of the RESET signal should be longer than 6 pulses of the CLK signal.

See section 4, "Specifications", for the electrical specifications of the CLK and RESET signals.
The linear image sensor operates normally even when the CLK and RESET signals are not synchronized. Integration time actually starts at the falling edge of the 5th CLK pulse after the RESET pulse goes high, and ends at the falling edge of the 5th pulse after the RESET pulse goes low.

Figure 3-1: Pulse Timing Diagram




Note:
n=number of channels

n=256

* **Integration time (actual)** = Integration time (setting)

**Minimum L** period of RESET signal: "number of channels + 28" pulses

**Minimum H** period of RESET signal: "6 CLK pulses"

* **Blank period** should be 20 CLK pulses or longer.

| Parameter | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operation frequency | | fop | 0.1 | 1 | 5 | MHz |
| Clk pulse width | | tpw(clk) | 60 | 500 | 5000 | ns |
| Clk pulse rise time | | tr(clk) | 0 | 20 | 30 | ns |
| Clk pulse fall time | | tf(clk) | 0 | 20 | 30 | ns |
| Reset pulse width | High | tpw(res) | 6 | - | | clks |
| | Low | | 284 | - | - | |
| Reset pulse rise/fall times | | tr(res), tf(res) | 0 | 20 | 30 | ns |

【Setting the integration time】

To set the integration time, refer to the example below.

<Example>

When operating a 256-channel InGaAs linear image sensor at a CLK frequency of 1 MHz:

The VIDEO signal readout frequency (data rate) is 1/1 of the CLK signal frequency, the readout time per pixel is tr=1 us. Thus the time required for one readout (tscan) is given by:

$$\begin{aligned} tscan &= (tc \times 28) + (tr \times N) \\ &= 1\ (us) \times 28 + 1\ (us) \times 256 \\ &= 284\ (us) \end{aligned}$$

where

N: the number of pixels of the image sensor

tc: CLK frequency

The time required for one scan should be longer than the time required for one readout, so set the time longer than 284 us. It should also be noted that the scan time becomes slightly longer depending on the RESET pulse width and the synchronization with the CLK signal.

## (3) Power supply for the Peltier element

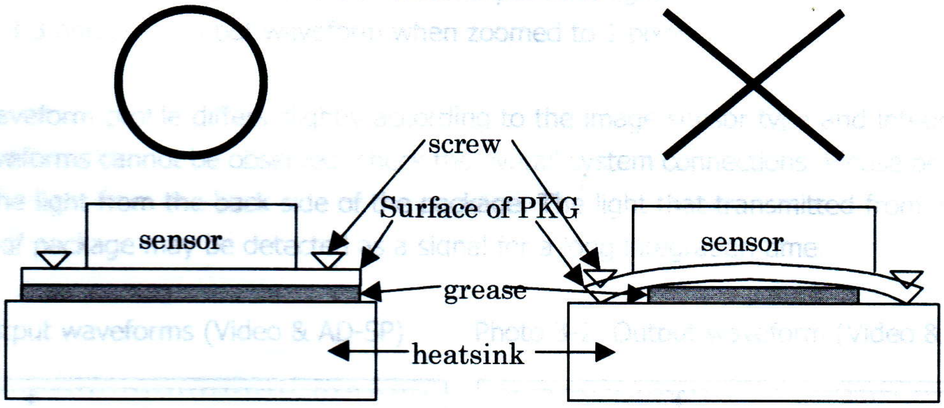
To avoid damage to the image sensor, take sufficient care when designing the power supply and heatsink for the Peltier element. For electrical specifications, refer to 4, "Specifications".

【Power supply for Peltier element】

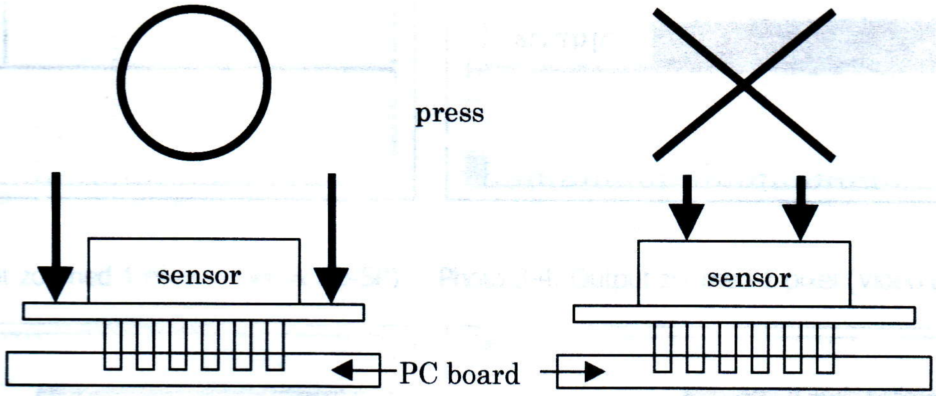
Observe the following precautions when designing a power supply for the Peltier element.

- Never exceed the absolute maximum ratings for the Peltier element.
- Use caution to avoid reversing the polarity on the power supply connection. Turning on the power supply while misconnected will damage the image sensor.
- Use a power supply having as low a noise and low ripple as possible, and also use power supply wiring with a large cross-section to keep resistance as low as possible. The TE+ and TE- wires in particular must be sufficiently thick.
- Be sure to provide an excess current prevention circuit to protect the Peltier element from being damaged.
- Provide a protection circuit that monitors the operating temperature on the heat emitting side of the heatsink and stops the current supply to the Peltier element if the heatsink temperature exceeds the specified level due to excessive cooling.
- While referring to Figure 4-1, set the optimum voltage and current values that maintain the target temperature.

**Caution**




- When fastening the image sensor package to the heatsink or printed circuit board, do not press on the upper side of the package. If you do this, the faceplate bonding point may warp resulting in package leaks or the faceplate coming off.




【Thermistor】

A thermistor is incorporated in the image sensor package to allow monitoring of the sensor temperature. For electrical specifications of the thermistor, refer to 4, "Specifications".

### (4) Monitoring of VIDEO signal

Since the drive capability at the image sensor output end is small (*2), the analog video signal should be corrected by the buffer amp and then monitored on the oscilloscope.

*2: A load of 20 kΩ of larger can be driven when the readout frequency is 5 MHz.

【Output in dark state】

Check that dark output waveforms like those shown in Photo 3-1 is obtained.

After you have confirmed that the image sensor operation is correct, allow light to illuminate onto the image sensor. This incident light should be DC light as far as conditions permit. If modulated light such as fluorescent lamp lighting enters the image sensor, the image sensor output appears to fluctuate and might be mistaken for abnormal operation.

【Output when exposed to light】

Photo 3-1 to 3-4 show output waveforms when the image sensor is exposed to light.

Photo 3-1 and 3-2: Output waveform when exposed to light

Photo 3-3 and 3-4: Output waveform when zoomed to 1 pixel

NOTE: The waveform profile differs slightly according to the image sensor type and integration time. If the above waveforms cannot be observed, check the overall system connections. Please be careful about incidence of the light from the back side of the package. The light that transmitted from a glass part of the back side of package may be detected as a signal for a long integration time.

Photo 3-1: Output waveforms (Video & AD-SP)

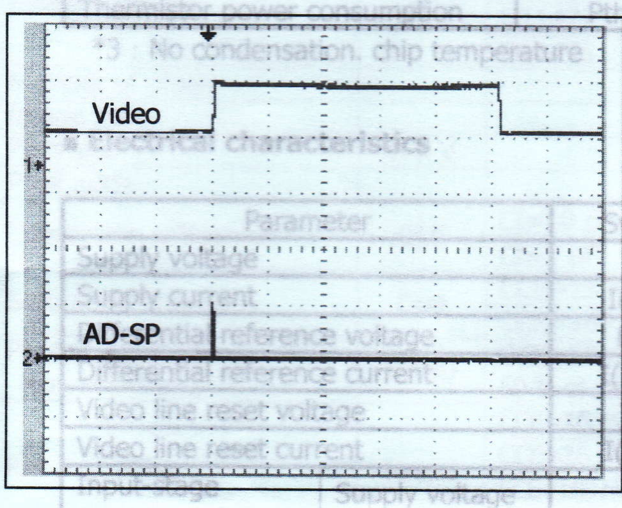



Photo 3-2: Output waveform (Video & AD-TRIG)

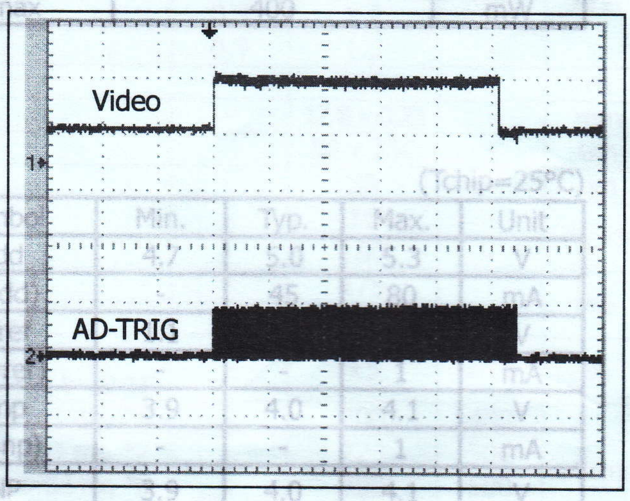



Photo 3-3: Output zoomed 1 pixel (Video & AD-SP)

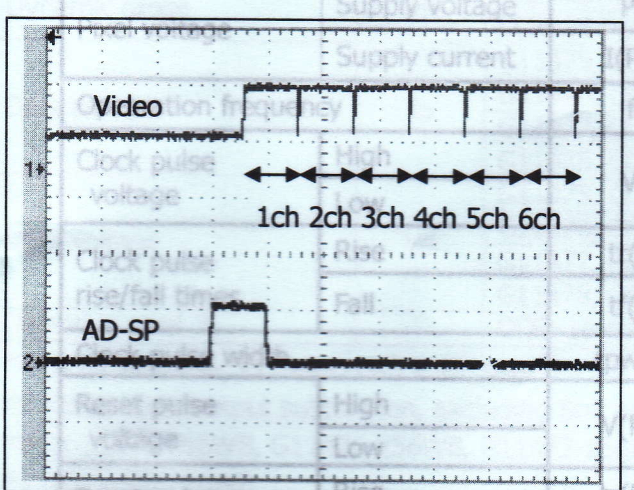



Photo 3-4: Output zoomed 1 pixel (Video & AD-TRIG)