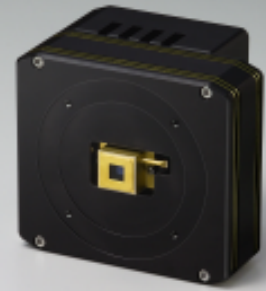


NEW

IMAGE SENSOR

CCD multichannel detector head C7973

Designed for back-thinned CCD area image sensor



C7973 is a high sensitivity multichannel detector head for use with back-thinned FFT-CCD area image sensors (S7963, S7964, S7965) that offer high UV sensitivity and quantum efficiency. C7973 incorporates a low-noise driver/amplifier circuit that provides reliable operation from simple external signals. C7973 includes a highly stable temperature controller that cools the sensor to a preset temperature level ($T_s = -10\text{ }^\circ\text{C}$) as soon as the power is turned on. If the cooler fails and causes internal circuitry to overheat, the built-in protection circuit automatically turns off the power to the thermoelectric cooler. Despite its compact size, the housing configuration is designed for good heat dissipation, and threaded mounting holes on the front panel allow connections to other devices such as monochrometers.

Features

- Designed for back-thinned CCD area image sensor *1
- Line binning operation/area scanning operation *2
- Driver/amplifier circuit for low noise CCD operation
- Highly stable temperature controller
Cooling temperature: $-10 \pm 0.05\text{ }^\circ\text{C}$
($T_a = 10$ to $35\text{ }^\circ\text{C}$)
- Simple signal input operation
- Compact configuration

Applications

- Fluorescence spectroscopy
- Raman spectroscopy
- Other low-light-level detection

The table below shows CCD area image sensors applicable for C7973.

Since C7973 does not include a CCD area image sensor, so select the desired sensor and order it separately.

| CCD area image sensor | | | |
|-----------------------|------------------|-------------------------|----------------------------------|
| Type No. | Number of pixels | Number of active pixels | Active area [mm (H) × mm (V)] |
| S7963 | 80 × 72 | 64 × 64 | 1.536 × 1.536 |
| S7964 | 124 × 56 | 108 × 48 | 2.592 × 1.152 |
| S7965 | 232 × 56 | 216 × 48 | 5.184 × 1.152 |

*1: In normal CCD image sensors that receive light from the front surface, the active area is covered with electrodes for charge transfer. These electrodes cut off UV radiation incident on the image sensor and also reduce the quantum efficiency. In contrast, back-thinned CCD image sensors have a unique structure in which the back of the active area is finely ground to allow light to enter from the back surface. This structure ensures high UV sensitivity and quantum efficiency because incident light need not pass through the electrodes.

*2: The FFT-CCD was originally designed as a two-dimensional image sensor. However, it can be operated like a linear image sensor having a large active area by transferring all the pixel signals in the vertical direction to the horizontal register (this is referred to as line binning).

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■ Absolute maximum ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--|--------|------|------|-----------|------|
| Supply voltage (for digital circuitry) | VD1 | -0.5 | - | +7 | V |
| Supply voltage (for analog circuitry) | VA1+ | - | - | +18 | |
| | VA1- | - | - | -18 | |
| Supply voltage | VA2 | - | - | +30 | |
| | VD2 | - | - | +7 | |
| | Vp | - | - | +7 | |
| | VF | - | - | +14 | |
| Digital input voltage | - | - | - | VD (1, 2) | |
| Operating temperature | Topr | +10 | - | +35 | °C |
| Storage temperature | Tstg | 0 | - | +70 | |

■ Electrical characteristics

(Ta=25 °C, VD1=+5 V, VA1+=+15 V, VA1=-15 V, VA2=+24 V, VD2=+5 V, Vp=+5 V, VF=+12 V, unless otherwise noted)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | |
|-----------------------------------|-------------------------------------|--------------------|-------|---------------------|-------|----|
| Digital input | High level | V _{IH} | +2.0 | - | +5.0 | V |
| | Low level | V _{IL} | -0.5 | - | +0.8 | V |
| CLK frequency | f _{CLK} | - | - | 1 | MHz | |
| Data video readout frequency | f _v | - | - | f _{CLK} /4 | Hz | |
| Start pulse width | t _{st} | 1/f _{CLK} | - | - | s | |
| Digital output | High level (I _o = -6 mA) | V _{IH} | +2.0 | - | - | V |
| | Low level (I _o =+6 mA) | V _{IL} | - | - | +0.8 | V |
| Power supply operating conditions | | | | | | |
| Voltage | Digital circuitry | VD | +4.75 | +5.0 | +5.25 | V |
| | Analog circuitry | VA1+ | +14.5 | +15.0 | +15.5 | V |
| | | VA1- | -14.5 | -15.0 | -15.5 | V |
| | | VA2 | +23.5 | +24.0 | +24.5 | V |
| | Other | VD2 | +4.75 | +5.0 | +5.25 | V |
| | | Vp | +4.75 | +5.0 | +5.25 | V |
| VF | | +11.75 | +12.0 | +12.75 | V | |
| Current | VD1 (+5 VDC) | - | - | - | +200 | mA |
| | VA1+ (+15 VDC) | - | - | - | +100 | mA |
| | VA1- (-15 VDC) | - | - | - | -100 | mA |
| | VA2 (+24 VDC) | - | - | - | +30 | mA |
| | VD2 (+5 VDC) | - | - | - | +30 | mA |
| | Vp (+5 VDC) Ta=25 °C | - | - | +1.0 | +2.0 | A |
| | VF (+12 VDC) | - | - | +100 | - | mA |

■ Electrical and optical characteristics

(Ta=25 °C, Ts= -10 °C, VD1=+5 V, VA1+=+15 V, VA1=-15 V, VA2=+24 V, VD2=+5 V, Vp=+5 V, VF=+12 V)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|----------------------------------|------------|------|-------------|------|-------------------------|
| Spectral response range | λ | - | 200 to 1100 | - | nm |
| Full well capacity | Vertical | - | 300,000 | - | e ⁻ |
| | Horizontal | - | 600,000 | - | |
| Conversion gain *3 | Sv | - | 4 | - | μV/e ⁻ |
| Dark current | DS | - | 60 | 180 | e ⁻ /pixel/s |
| Readout noise | Nr | - | 30 | 60 | e ⁻ rms |
| Dynamic range | DR | - | 100,000 | - | - |
| Photo response non-uniformity *4 | PRNU | - | ±3 | ±10 | % |

*3: Including the circuit gain.

*4: Measured at 50 % of the full well capacity.

■ Specifications for temperature controller (C7041)

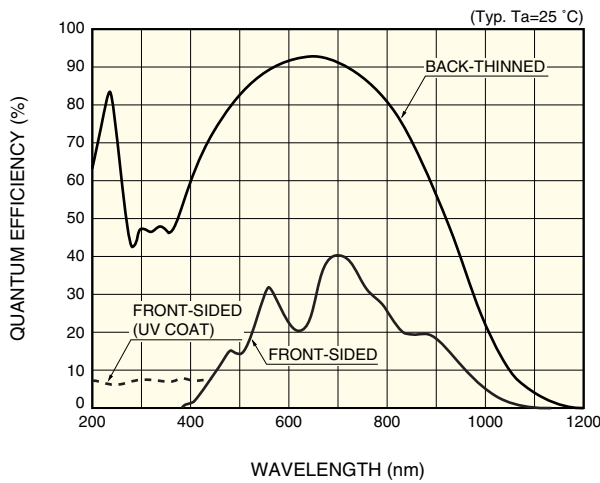
($T_a=25\text{ }^\circ\text{C}$, $T_s=-10\text{ }^\circ\text{C}$, $V_{D1}=+5\text{ V}$, $V_{A1+}=+15\text{ V}$, $V_{A1-}=-15\text{ V}$, $V_{A2}=+24\text{ V}$, $V_{D2}=+5\text{ V}$, $V_p=+5\text{ V}$, $V_f=+12\text{ V}$)

| Parameter *5 | Symbol | Min. | Typ. | Max. | Unit |
|--|--------------|-------|------|-------|------------------|
| Cooling temperature | T_s | -11 | -10 | -9 | $^\circ\text{C}$ |
| Temperature control range | ΔT_s | -0.05 | - | +0.05 | $^\circ\text{C}$ |
| Power dissipation of TE-cooler element | P_p | - | - | 2 | W |
| Cool down time to reset temperature | t_o | - | - | 5 | min. |
| Setting temperature for overheat protection *6 | T_o | - | +45 | - | $^\circ\text{C}$ |

*5: Other functions include error display, automatic power off, and detection of electrical opens and shorts by the thermosensor.

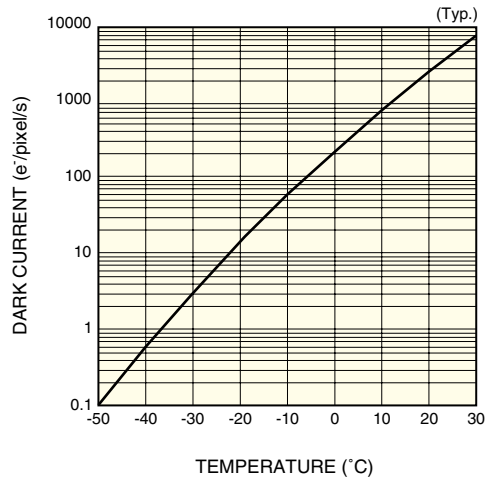
*6: Temperature at back side of housing (between housing and fan).

■ Spectral response (without window)



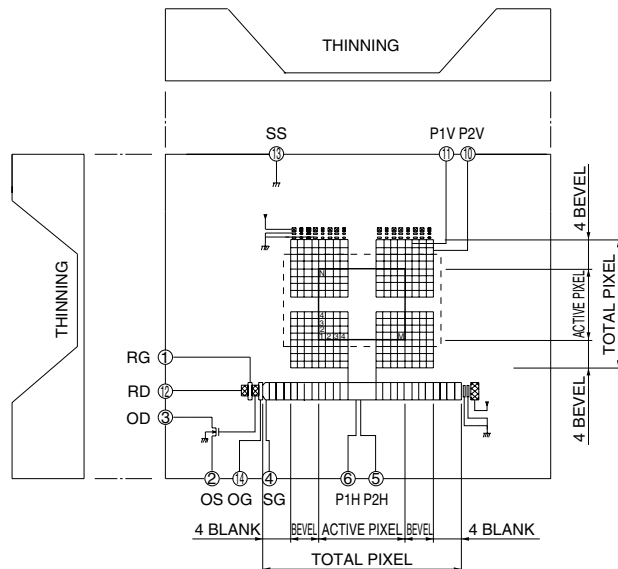
KMPDB0058EA

■ Dark current vs. temperature



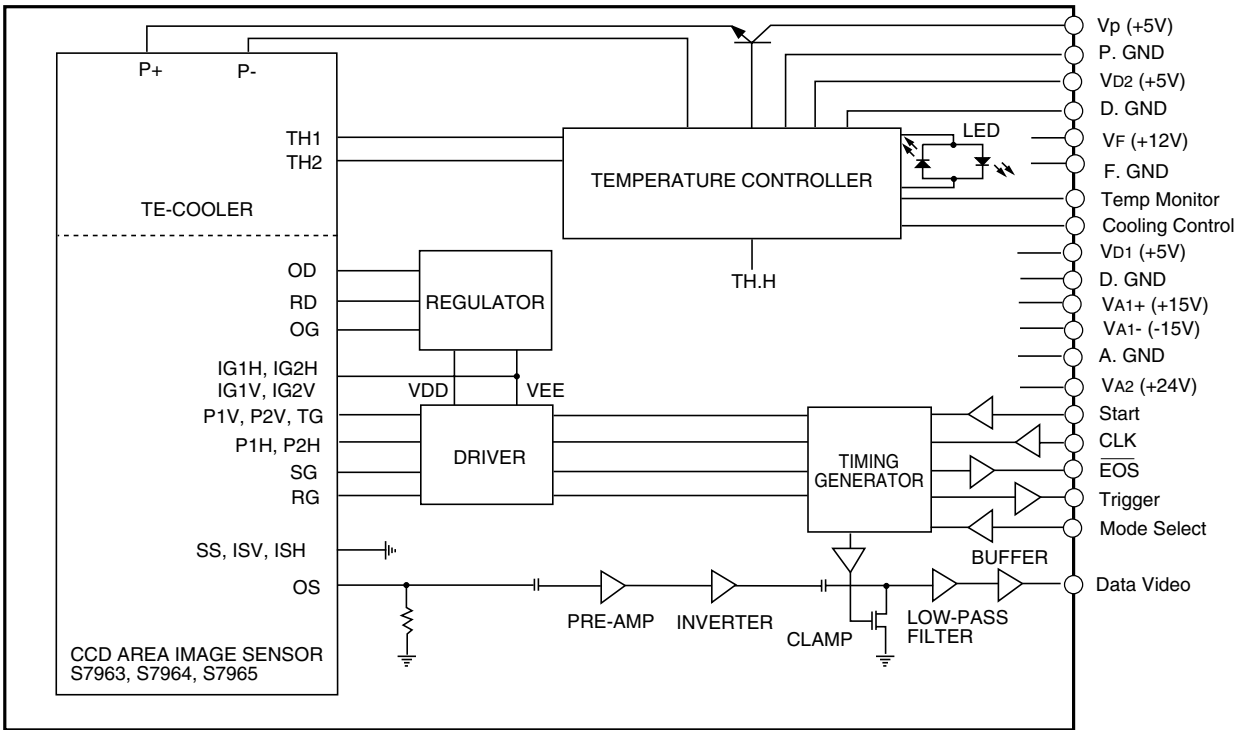
KMPDB0037EA

■ Device structure



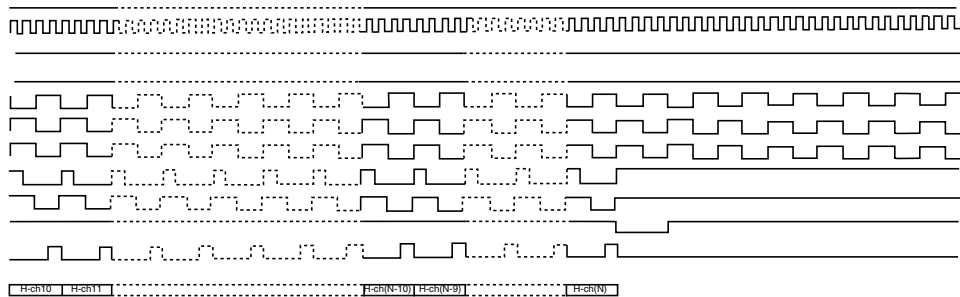
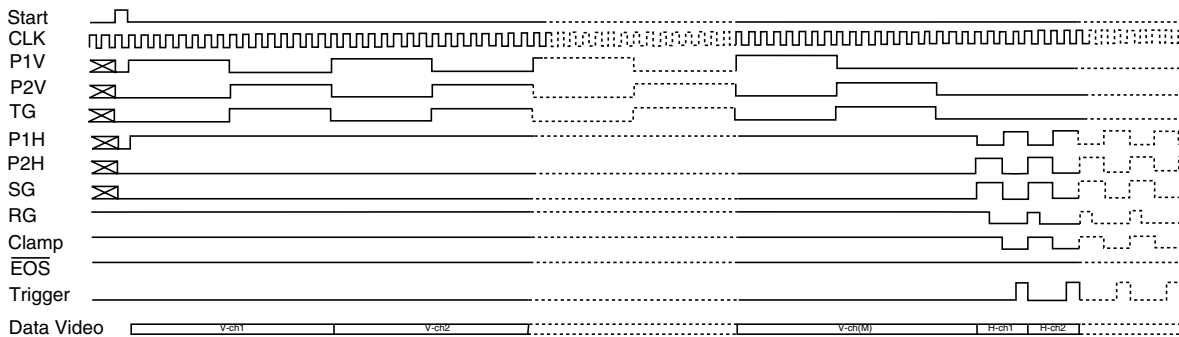
KMPDC0134EA

■ Block diagram



KACCC0163EA

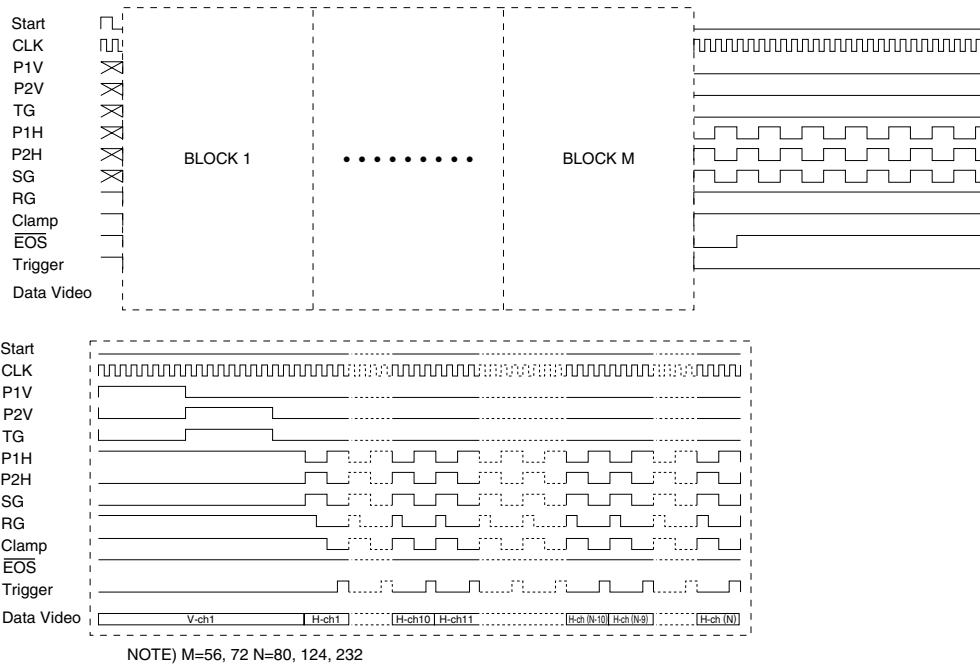
■ Timing chart of line binning operation



M=56, 72 N=80, 124, 232
 V-ch1--V-ch4, V-ch (M-3)--V-ch (M): ISOLATION PIXELS
 H-ch1--H-ch4, H-ch (N-3)--H-ch (N): BLANK PIXELS
 H-ch5--H-ch8, H-ch (N-7)--H-ch (N-4): ISOLATION PIXELS

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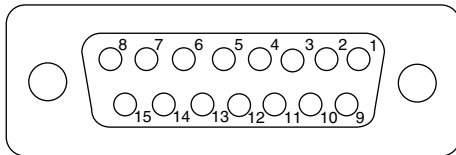
■ Timing chart of area scanning operation



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■ Pin connection of "SIGNAL I/O" connector

15-pin D-sub connector

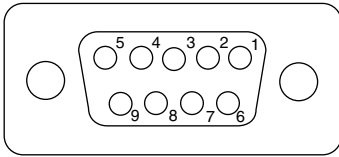


KACCC0069EA

| Pin No. | Terminal name | Description |
|---------|------------------|---|
| 1 | Mode select | Digital input signal used to select between the line binning operation and area scanning operation. HCMOS compatible. High level or left open: line binning operation Low level: area scanning operation |
| 2 | Data video | Analog video output. Positive polarity |
| 3 | VA1+ (+15 V) | Analog power supply |
| 4 | VA1- (-15 V) | Analog power supply |
| 5 | VD1 (+5 V) | Digital power supply |
| 6 | Start | Digital input signal for initializing the circuit. HCMOS compatible. Positive logic. The interval of the Start pulses determines the integration time of the CCD image sensor. |
| 7 | CLK | Digital input signal for operating the circuit. HCMOS compatible. Rising edge operation. |
| 8 | \overline{EOS} | Digital input signal for indicating end-of-scan of the image sensor. HCMOS compatible. Negative logic. |
| 9 | A. GND | Analog ground |
| 10 | A. GND | Analog ground |
| 11 | VA2 (+24 V) | Analog power supply |
| 12 | D. GND | Digital ground |
| 13 | D. GND | Digital ground |
| 14 | D. GND | Digital ground |
| 15 | Trigger | Digital output signal for A/D conversion. HCMOS compatible. Positive logic. |

■ Pin connection of "TE CONTROL I/O" connector (C7041)

9-pin D-sub connector

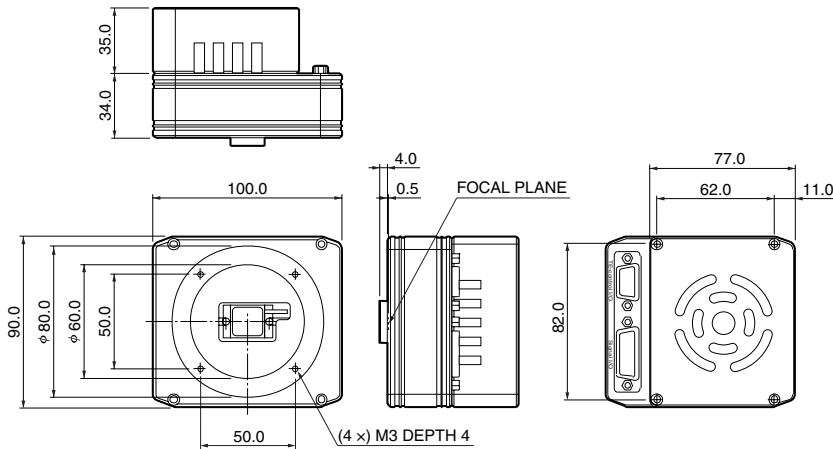


KACCC0075EA

| Pin No. | Terminal name | Description |
|---------|------------------------|--|
| 1 | V _{D2} (+5 V) | Digital power supply |
| 2 | Temp monitor | Analog output signal of the temperature of the CCD image sensor |
| 3 | Cooling control | Digital input signal for starting to cool down. HCMOS compatible. High level or left open: cooling Low level: stand-by |
| 4 | V _p (+5 V) | Power supply for the thermoelectric cooler in the CCD image sensor. (Please use AWG 18 wire) |
| 5 | V _F (+12 V) | Power supply for cooling fan |
| 6 | D. GND | Ground |
| 7 | D. GND | Ground |
| 8 | P. GND | Power supply return of the thermoelectric cooler mounted in the CCD image sensor. (Please use AWG 18 wire) |
| 9 | F. GND | Power supply return for cooling fan |

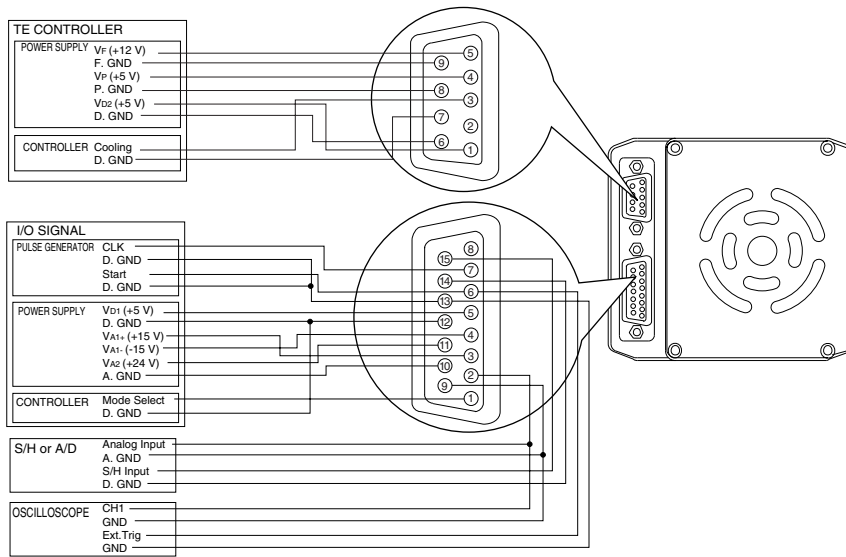
Available for using same power supply (+5 V) for "+V_{D2}" and "+V_p".

■ Dimensional outline (unit: mm)



KACCA0110EA

■ Connection example



KACC00166EA