The S12443 is a CMOS linear image sensor with a compact yet 2496-pixel long photosensitive area (effective photosensitive area length: 17.472 mm). The pixel size is 7 × 125 µm.

**Features**

- **Pixel size: 7 × 125 µm**
- **2496 pixels**
- **Effective photosensitive area length: 17.472 mm**
- **3.3 V single power supply operation**
- **Built-in timing generator allows operation with only start and clock pulse inputs.**
- **Simultaneous charge integration for all pixels**
- **Variable integration time function (electronic shutter function)**
- **Video data rate: 10 MHz max.**
- **Small input terminal capacitance: 5 pF**

**Applications**

- **Barcode readers**
- **Position detection**
- **Image reading**
- **Encoders**

**Structure**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pixels</td>
<td>2496</td>
<td></td>
</tr>
<tr>
<td>Pixel pitch</td>
<td>7</td>
<td>µm</td>
</tr>
<tr>
<td>Pixel height</td>
<td>125</td>
<td>µm</td>
</tr>
<tr>
<td>Photosensitive area length</td>
<td>17.472</td>
<td>mm</td>
</tr>
<tr>
<td>Package</td>
<td>Glass epoxy</td>
<td></td>
</tr>
<tr>
<td>Seal material</td>
<td>Silicone resin</td>
<td></td>
</tr>
</tbody>
</table>

**Absolute maximum ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>Vdd</td>
<td>Ta=25 °C</td>
<td>-0.3 to +6</td>
<td>V</td>
</tr>
<tr>
<td>Clock pulse voltage</td>
<td>V(CLK)</td>
<td>Ta=25 °C</td>
<td>-0.3 to +6</td>
<td>V</td>
</tr>
<tr>
<td>Start pulse voltage</td>
<td>V(ST)</td>
<td>Ta=25 °C</td>
<td>-0.3 to +6</td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature*1</td>
<td>Topr</td>
<td>Ta=25 °C</td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature*1</td>
<td>Tstg</td>
<td></td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Reflow soldering conditions*2</td>
<td>Tsol</td>
<td>Peak temperature 260 °C, 3 times (see P9)</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to the product within the absolute maximum ratings.

*1: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

*2: JEDEC level 2a
# CMOS linear image sensor

## Recommended terminal voltage (Ta=25 °C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>Vdd</td>
<td>3.15</td>
<td>3.3</td>
<td>3.45</td>
<td>V</td>
</tr>
<tr>
<td>Clock pulse voltage</td>
<td>V(CLK)</td>
<td>3</td>
<td>Vdd</td>
<td>Vdd + 0.25</td>
<td>V</td>
</tr>
<tr>
<td>Low level</td>
<td></td>
<td>0</td>
<td>-</td>
<td>0.3</td>
<td>V</td>
</tr>
<tr>
<td>Start pulse voltage</td>
<td>V(ST)</td>
<td>3</td>
<td>Vdd</td>
<td>Vdd + 0.25</td>
<td>V</td>
</tr>
<tr>
<td>Low level</td>
<td></td>
<td>0</td>
<td>-</td>
<td>0.3</td>
<td>V</td>
</tr>
</tbody>
</table>

## Input terminal capacitance (Ta=25 °C, Vdd=3.3 V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock pulse input terminal capacitance</td>
<td>C(CLK)</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td>Start pulse input terminal capacitance</td>
<td>C(ST)</td>
<td>-</td>
<td>5</td>
<td>-</td>
<td>pF</td>
</tr>
</tbody>
</table>

## Electrical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock pulse frequency</td>
<td>f(CLK)</td>
<td>200 k</td>
<td>10 MHz</td>
<td>10 MHz</td>
<td>Hz</td>
</tr>
<tr>
<td>Data rate</td>
<td>DR</td>
<td>-</td>
<td>-</td>
<td>260</td>
<td>Ω</td>
</tr>
<tr>
<td>Output impedance</td>
<td>Zo</td>
<td>70</td>
<td>-</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td>Current consumption</td>
<td>I</td>
<td>14</td>
<td>21</td>
<td>30</td>
<td>mA</td>
</tr>
</tbody>
</table>

*3: f(CLK)=10 MHz
*4: Current consumption increases as the clock pulse frequency increases. The current consumption is 8 mA typ. at f(CLK)=200 kHz.

## Electrical and optical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V, f(CLK)=10 MHz]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral response range</td>
<td>λ</td>
<td>400</td>
<td>1000</td>
<td>-</td>
<td>nm</td>
</tr>
<tr>
<td>Peak sensitivity wavelength</td>
<td>λp</td>
<td>700</td>
<td>-</td>
<td>-</td>
<td>nm</td>
</tr>
<tr>
<td>Photosensitivity*5</td>
<td>Sw</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>pV/(lx·s)</td>
</tr>
<tr>
<td>Conversion efficiency*6</td>
<td>CE</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>μV/e*</td>
</tr>
<tr>
<td>Dark output voltage*7,8</td>
<td>Vd</td>
<td>0.4</td>
<td>4.0</td>
<td>-</td>
<td>mV</td>
</tr>
<tr>
<td>Saturation output voltage*8</td>
<td>Vsat</td>
<td>2.8</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Readout noise</td>
<td>Nread</td>
<td>0.4</td>
<td>1.2</td>
<td>2.0</td>
<td>mV rms</td>
</tr>
<tr>
<td>Dynamic range 1*9</td>
<td>Drange1</td>
<td>1666</td>
<td>-</td>
<td>-</td>
<td>times</td>
</tr>
<tr>
<td>Dynamic range 2*10</td>
<td>Drange2</td>
<td>5000</td>
<td>-</td>
<td>-</td>
<td>times</td>
</tr>
<tr>
<td>Output offset voltage</td>
<td>Vo</td>
<td>0.7</td>
<td>1.0</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Photosresponse nonuniformity*5,11</td>
<td>PRNU</td>
<td>10</td>
<td>-</td>
<td>±10</td>
<td>%</td>
</tr>
<tr>
<td>Image lag*12</td>
<td>IL</td>
<td>0.1</td>
<td>-</td>
<td>-</td>
<td>%</td>
</tr>
</tbody>
</table>

*5: Measured with a tungsten lamp of 2856 K
*6: Output voltage generated per one electron
*7: Integration time=10 ms
*8: Difference from Vo
*9: Drange1 = Vsat/Nread
*10: Drange2 = Vsat/Vd
*11: Image lag increases when the output exceeds the saturation output voltage.

---

**Recommended terminal voltage (Ta=25 °C)**

- **Supply voltage**: 3.15 V (Min.), 3.3 V (Typ.), 3.45 V (Max.)
- **Clock pulse voltage**
  - **High level**: 3 V (Typ.)
  - **Low level**: 0 V (Typ.), 0.3 V (Max.)
- **Start pulse voltage**
  - **High level**: 3 V (Typ.), 0 V (Typ.)
  - **Low level**: 0 V (Typ.), 0.3 V (Max.)

**Input terminal capacitance (Ta=25 °C, Vdd=3.3 V)**

- **Clock pulse input terminal capacitance**: 5 pF (Typ.)
- **Start pulse input terminal capacitance**: 5 pF (Typ.)

**Electrical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V]**

- **Clock pulse frequency**: 200 kHz (Min.), 10 MHz (Max.)
- **Data rate**: 260 Ω (Typ.)
- **Output impedance**: 70 pF (Min.), 21 pF (Typ.)
- **Current consumption**: 30 mA (Typ.)

**Electrical and optical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V, f(CLK)=10 MHz]**

- **Spectral response range**: 400 to 1000 nm
- **Peak sensitivity wavelength**: 700 nm
- **Photosensitivity**: 500 pV/(lx·s)
- **Conversion efficiency**: 25 μV/e*
- **Dark output voltage**: 0.4 mV
- **Saturation output voltage**: 2.8 V
- **Readout noise**: 1.2 mV rms
- **Dynamic range 1**: 1666 times
- **Dynamic range 2**: 5000 times
- **Output offset voltage**: 1.0 V
- **Photosresponse nonuniformity**: ±10 percent
- **Image lag**: 0.1 percent

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### Appearance inspection standards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test criterion</th>
<th>Inspection method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign matter on photosensitive area</td>
<td>10 μm max.</td>
<td>Automated camera</td>
</tr>
</tbody>
</table>

### Spectral response (typical example)

![Spectral response graph](image)

### Block diagram

![Block diagram](image)
**Output waveforms of one pixel**
The timing for acquiring the video signal is synchronized with the rising edge of Trig pulse (See red arrow below.).

### f(CLK)=DR=10 MHz

- **CLK**
  - 5 V/div.
  - 20 ns/div.
- **Trig**
  - 5 V/div.
  - GND
- **Video**
  - 2.7 V (saturation output voltage=2 V)
  - 0.7 V (output offset voltage)
  - GND

### f(CLK)=DR=1 MHz

- **CLK**
  - 5 V/div.
  - GND
- **Trig**
  - 5 V/div.
  - GND
- **Video**
  - 2.7 V (saturation output voltage=2 V)
  - 0.7 V (output offset voltage)
  - GND
### Timing chart

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start pulse cycle</td>
<td>tpi(ST)</td>
<td>70/f(CLK)</td>
<td>-</td>
<td>-</td>
<td>s</td>
</tr>
<tr>
<td>Start pulse high period</td>
<td>thp(ST)</td>
<td>6/f(CLK)</td>
<td>-</td>
<td>-</td>
<td>s</td>
</tr>
<tr>
<td>Start pulse low period</td>
<td>tlp(ST)</td>
<td>64/f(CLK)</td>
<td>-</td>
<td>-</td>
<td>s</td>
</tr>
<tr>
<td>Start pulse rise and fall times</td>
<td>tr(ST), tf(ST)</td>
<td>0</td>
<td>10</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Clock pulse duty ratio</td>
<td>-</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>%</td>
</tr>
<tr>
<td>Clock pulse rise and fall times</td>
<td>tr(CLK), tf(CLK)</td>
<td>0</td>
<td>10</td>
<td>30</td>
<td>ns</td>
</tr>
</tbody>
</table>

*13: Dark output increases if the start pulse cycle or the start pulse high period is lengthened.

*14: The integration time equals the high period of ST plus 34 CLK cycles.

The shift register starts operation at the rising edge of CLK immediately after ST goes low.

The integration time can be changed by changing the ratio of the high and low periods of ST.

If the first Trig pulse after ST goes low is counted as the first pulse, the Video signal is acquired at the rising edge of the 51st Trig pulse.
Operation example

This example assumes that the clock pulse frequency is maximized (video data rate is also maximized), the time of one scan is mini-
mized, and the integration time is maximized.

Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 2548/f(CLK) = 2548/10 MHz = 254.8 µs
High period of start pulse = Start pulse cycle - Start pulse's low period min.
= 2548/f(CLK) - 64/f(CLK) = 2548/10 MHz - 64/10 MHz = 248.4 µs
Integration time is equal to the high period of start pulse + 34 cycles of clock pulses, so it will be 248.4 + 3.4 = 251.8 µs.
**Pin connections**

<table>
<thead>
<tr>
<th>Pin no.</th>
<th>Symbol</th>
<th>I/O</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vdd</td>
<td>I</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>CLK</td>
<td>I</td>
<td>Clock pulse</td>
</tr>
<tr>
<td>3</td>
<td>Vss</td>
<td>-</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
</tr>
<tr>
<td>6</td>
<td>Vss</td>
<td>-</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>Vdd</td>
<td>I</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>8</td>
<td>Video</td>
<td>O</td>
<td>Video signal</td>
</tr>
<tr>
<td>9</td>
<td>EOS</td>
<td>O</td>
<td>End of scan</td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
</tr>
<tr>
<td>11</td>
<td>NC</td>
<td>-</td>
<td>No connection</td>
</tr>
<tr>
<td>12</td>
<td>Trig</td>
<td>O</td>
<td>Trigger pulse</td>
</tr>
<tr>
<td>13</td>
<td>Vcp</td>
<td>I</td>
<td>Bias voltage for booster circuit*15</td>
</tr>
<tr>
<td>14</td>
<td>ST</td>
<td>I</td>
<td>Start pulse</td>
</tr>
</tbody>
</table>

*15: Voltage of approx. 5.5 V, which was boosted by the chip’s internal booster circuit, appears at the terminal. To maintain the voltage, insert a capacitor of about 1 µF between GND and Vcp.

**Recommended land pattern (unit: mm)**

![Recommended land pattern](image)

**Application circuit example**

![Application circuit example](image)
- **Standard packing specifications**

  - **Reel (conforms to JEITA ET-7200)**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Hub diameter</th>
<th>Tape width</th>
<th>Material</th>
<th>Electrostatic characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>330 mm</td>
<td>100 mm</td>
<td>32 mm</td>
<td>Plastic*16</td>
<td>Conductive</td>
</tr>
</tbody>
</table>

*16: Compound of polyacetylene, polypyrrole, polythiophene and polyaniline

- **Embossed (unit: mm, material: plastic*16, conductive)**

  - Packing quantity
    - 1000 pcs/reel
    - Packing specifications may vary on orders less than 1000 pieces.

  - Packing type
    - Reel and desiccant in moisture-proof packing (vacuum-sealed)
· This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 4 weeks.
· The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.

**Precautions**

(1) Electrostatic countermeasures
· This device has a built-in protection circuit as a safeguard against static electrical charges. However, to prevent destroying the device with electrostatic charges, take countermeasures such as grounding yourself, the workbench and tools.
· Protect this device from surge voltages which might be caused by peripheral equipment.

(2) Package handling
· The photosensitive area of this device is sealed and protected by transparent resin. When compared to a glass faceplate, the surface of transparent resin may be less uniform and is more likely to be scratched. Be very careful when handling this device and also when designing the optical systems.
· Dust or grime on the light input window might cause nonuniform sensitivity. To remove dust or grime, blow it off with compressed air.

(3) Surface protective tape
· Protective tape is affixed to the surface of this product to protect the photosensitive area. After assembling the product, remove the tape before use.
Related information
www.hamamatsu.com/sp/ssp/doc_en.html

- Precautions
- Disclaimer
- Image sensor
- Surface mount type products
- Resin-sealed CMOS linear image sensors

Information described in this material is current as of July 2018.
Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

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