Diagonal 8.923mm (Type 1/1.8) Progressive Scan CCD Image Sensor with Square Pixel for B/W Video Cameras

**Description**

The ICX274AL is a diagonal 8.923mm (Type 1/1.8) interline CCD solid-state image sensor with a square pixel array and 2.01M effective pixels. Progressive scan allows all pixels’ signals to be output independently within approximately 1/15 second, and output is also possible using various addition and pulse elimination methods. This chip features an electronic shutter with variable charge-storage time which makes it possible to realize full-frame still images without a mechanical shutter. Further, high sensitivity and low dark current are achieved through the adoption of Super HAD CCD technology.

This chip is suitable for image input applications such as still cameras which require high resolution, etc.

**Features**

- High horizontal and vertical resolution
- Supports the following modes
  - Progressive scan mode (with/without mechanical shutter)
  - 2/8-line readout mode
  - 2/4-line readout mode
  - 2-line addition mode
  - Center scan modes (1), (2) and (3)
  - AF modes (1) and (2)
- Square pixel
- Horizontal drive frequency: 28.6364MHz (typ.), 36.0MHz (max.)
- Reset gate bias are not adjusted
- High sensitivity, low dark current
- Continuous variable-speed shutter function
- Excellent anti-blooming characteristics
- 20-pin high-precision plastic package

**Device Structure**

- Interline CCD image sensor
- Image size: Diagonal 8.923mm (Type 1/1.8)
- Total number of pixels: 1688 (H) × 1248 (V) approx. 2.11M pixels
- Number of effective pixels: 1628 (H) × 1236 (V) approx. 2.01M pixels
- Number of active pixels: 1620 (H) × 1220 (V) approx. 1.98M pixels
- Recommended number of recording pixels: 1600 (H) × 1200 (V) approx. 1.92M pixels
- Chip size: 8.50mm (H) × 6.80mm (V)
- Unit cell size: 4.40µm (H) × 4.40µm (V)
- Optical black:
  - Horizontal (H) direction: Front 12 pixels, rear 48 pixels
  - Vertical (V) direction: Front 10 pixels, rear 2 pixels
- Number of dummy bits:
  - Horizontal 28
  - Vertical 1
- Substrate material: Silicon

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### Pin Description

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$V_{\Phi}$</td>
<td>Vertical register transfer clock</td>
<td>11</td>
<td>$V_{DD}$</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>$V_{\Phi3A}$</td>
<td>Vertical register transfer clock</td>
<td>12</td>
<td>$\phi_{RG}$</td>
<td>Reset gate clock</td>
</tr>
<tr>
<td>3</td>
<td>$V_{\Phi3B}$</td>
<td>Vertical register transfer clock</td>
<td>13</td>
<td>$H_{\Phi2B}$</td>
<td>Horizontal register transfer clock</td>
</tr>
<tr>
<td>4</td>
<td>$V_{\Phi3C}$</td>
<td>Vertical register transfer clock</td>
<td>14</td>
<td>$H_{\Phi1B}$</td>
<td>Horizontal register transfer clock</td>
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<tr>
<td>5</td>
<td>$V_{\Phi2A}$</td>
<td>Vertical register transfer clock</td>
<td>15</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>$V_{\Phi2B}$</td>
<td>Vertical register transfer clock</td>
<td>16</td>
<td>$\phi_{SUB}$</td>
<td>Substrate clock</td>
</tr>
<tr>
<td>7</td>
<td>$V_{\Phi2C}$</td>
<td>Vertical register transfer clock</td>
<td>17</td>
<td>$C_{SUB}$</td>
<td>Substrate bias*1</td>
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<tr>
<td>8</td>
<td>$V_{\Phi1}$</td>
<td>Vertical register transfer clock</td>
<td>18</td>
<td>$V_{L}$</td>
<td>Protective transistor bias</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>GND</td>
<td>19</td>
<td>$H_{\Phi1A}$</td>
<td>Horizontal register transfer clock</td>
</tr>
<tr>
<td>10</td>
<td>$V_{OUT}$</td>
<td>Signal output</td>
<td>20</td>
<td>$H_{\Phi2A}$</td>
<td>Horizontal register transfer clock</td>
</tr>
</tbody>
</table>

*1 DC bias is generated within the CCD, so that this pin should be grounded externally through a capacitance of 0.1µF.
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Ratings</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Against φSUB</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;, V&lt;sub&gt;OUT&lt;/sub&gt;, φ&lt;sub&gt;RG&lt;/sub&gt; – φ&lt;sub&gt;SUB&lt;/sub&gt;</td>
<td>–40 to +12</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;φ2α&lt;/sub&gt;, V&lt;sub&gt;φ3α&lt;/sub&gt; – φ&lt;sub&gt;SUB&lt;/sub&gt; (α – A to C)</td>
<td>–50 to +15</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;φ1&lt;/sub&gt;, V&lt;sub&gt;φ4&lt;/sub&gt;, VL – φ&lt;sub&gt;SUB&lt;/sub&gt;</td>
<td>–50 to +0.3</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;φ1β&lt;/sub&gt;, H&lt;sub&gt;φ2β&lt;/sub&gt;, GND – φ&lt;sub&gt;SUB&lt;/sub&gt; (β – A, B)</td>
<td>–40 to +0.3</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;SUB&lt;/sub&gt; – φ&lt;sub&gt;SUB&lt;/sub&gt;</td>
<td>–25 to</td>
<td>V</td>
</tr>
<tr>
<td>Against GND</td>
<td>V&lt;sub&gt;DD&lt;/sub&gt;, V&lt;sub&gt;OUT&lt;/sub&gt;, φ&lt;sub&gt;RG&lt;/sub&gt;, C&lt;sub&gt;SUB&lt;/sub&gt; – GND</td>
<td>–0.3 to +22</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;φ1&lt;/sub&gt;, V&lt;sub&gt;φ2α&lt;/sub&gt;, V&lt;sub&gt;φ3α&lt;/sub&gt;, V&lt;sub&gt;φ4&lt;/sub&gt; – GND (α – A to C)</td>
<td>–10 to +18</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;φ1β&lt;/sub&gt;, H&lt;sub&gt;φ2β&lt;/sub&gt; – GND (β – A, B)</td>
<td>–10 to +6.5</td>
<td>V</td>
</tr>
<tr>
<td>Against VL</td>
<td>V&lt;sub&gt;φ2α&lt;/sub&gt;, V&lt;sub&gt;φ3α&lt;/sub&gt; – VL (α – A to C)</td>
<td>–0.3 to +28</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;φ1&lt;/sub&gt;, V&lt;sub&gt;φ4&lt;/sub&gt;, H&lt;sub&gt;φ1β&lt;/sub&gt;, H&lt;sub&gt;φ2β&lt;/sub&gt;, GND – VL (β – A, B)</td>
<td>–0.3 to +15</td>
<td>V</td>
</tr>
<tr>
<td>Between input clock pins</td>
<td>Voltage difference between vertical clock input pins</td>
<td>to +15</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;φ1β&lt;/sub&gt; – H&lt;sub&gt;φ2β&lt;/sub&gt; (β – A, B)</td>
<td>–6.5 to +6.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>H&lt;sub&gt;φ1β&lt;/sub&gt;, H&lt;sub&gt;φ2β&lt;/sub&gt; – V&lt;sub&gt;φ4&lt;/sub&gt; (β – A, B)</td>
<td>–10 to +16</td>
<td>V</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>–30 to +80</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Guaranteed temperature of performance</td>
<td>–10 to +60</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>–10 to +75</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

*<sup>2</sup> +24V (Max.) is guaranteed when clock width < 10µs, clock duty factor < 0.1%.
+16V (Max.) is guaranteed during power-on or power-off.
Bias Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>VDD</td>
<td>14.55</td>
<td>15.0</td>
<td>15.45</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Protective transistor bias</td>
<td>VL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*3</td>
</tr>
<tr>
<td>Substrate voltage adjustment range</td>
<td>No line addition*1</td>
<td>VSUB</td>
<td>Internally generated value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-line addition*2</td>
<td>VSUB2</td>
<td>8.8</td>
<td>14.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Substrate voltage adjustment accuracy</td>
<td>ΔVSUB</td>
<td>Indicated voltage – 0.2</td>
<td>Indicated voltage</td>
<td>Indicated voltage + 0.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Reset gate clock</td>
<td>φRG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*5</td>
</tr>
</tbody>
</table>

*1 Progressive scan mode, 2/8-line readout mode, 2/4-line readout mode, center scan modes (1) and (3), and AF modes (1) and (2)
*2 2-line addition mode and center scan mode (2)
*3 VL setting is the VVL voltage of the vertical clock waveform, or the same voltage as the VL power supply for the V driver should be used.
*4 Substrate voltage (VSUB2) setting value indication
   The substrate voltage (VSUB) for modes without line addition is generated internally.
   The substrate voltage setting value for use with vertical 2-line addition is indicated by a code on the bottom surface of the image sensor. Adjust the substrate voltage to the indicated voltage.
   VSUB2 code – 1-digit indication
     
     The code and the actual value correspond as follows.

<table>
<thead>
<tr>
<th>VSUB2 code</th>
<th>Actual value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.8</td>
</tr>
<tr>
<td>2</td>
<td>9.0</td>
</tr>
<tr>
<td>3</td>
<td>9.2</td>
</tr>
<tr>
<td>4</td>
<td>9.4</td>
</tr>
<tr>
<td>5</td>
<td>9.6</td>
</tr>
<tr>
<td>6</td>
<td>9.8</td>
</tr>
<tr>
<td>7</td>
<td>10.0</td>
</tr>
<tr>
<td>8</td>
<td>10.2</td>
</tr>
<tr>
<td>9</td>
<td>10.4</td>
</tr>
<tr>
<td>A</td>
<td>10.6</td>
</tr>
<tr>
<td>B</td>
<td>10.8</td>
</tr>
<tr>
<td>C</td>
<td>11.0</td>
</tr>
<tr>
<td>D</td>
<td>11.2</td>
</tr>
<tr>
<td>E</td>
<td>11.4</td>
</tr>
<tr>
<td>F</td>
<td>11.6</td>
</tr>
</tbody>
</table>

* Example] “h” indicates a VSUB2 setting of 11.6V.

*5 Do not apply a DC bias to the reset gate clock pin, because a DC bias is generated within the CCD.

DC characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply current</td>
<td>Idd</td>
<td>7.0</td>
<td>10.0</td>
<td>13.0</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>
## Clock Voltage Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Waveform diagram</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout clock voltage</td>
<td>$V_{VT}$</td>
<td>14.55</td>
<td>15.0</td>
<td>15.45</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical transfer clock voltage</td>
<td>$V_{VH1}, V_{VH2}$</td>
<td>$-0.05$</td>
<td>0</td>
<td>0.05</td>
<td>V</td>
<td>2</td>
<td>$V_{VH} = (V_{VH1} + V_{VH2})/2$</td>
</tr>
<tr>
<td></td>
<td>$V_{VH3}, V_{VH4}$</td>
<td>$-0.2$</td>
<td>0</td>
<td>0.05</td>
<td>V</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{VL1}, V_{VL2}, V_{VL3}, V_{VL4}$</td>
<td>$-8.0$</td>
<td>$-7.5$</td>
<td>$-7.0$</td>
<td>V</td>
<td>2</td>
<td>$V_{VL} = (V_{VL3} + V_{VL4})/2$</td>
</tr>
<tr>
<td></td>
<td>$V_{\psi V}$</td>
<td>6.8</td>
<td>7.5</td>
<td>8.05</td>
<td>V</td>
<td>2</td>
<td>$V_{\psi V} = V_{VHn} - V_{VLn} \ (n = 1 \ to \ 4)$</td>
</tr>
<tr>
<td></td>
<td>$V_{VH3} - V_{VH}$</td>
<td>$-0.25$</td>
<td>0</td>
<td>0.1</td>
<td>V</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{VH4} - V_{VH}$</td>
<td>$-0.25$</td>
<td>0</td>
<td>0.1</td>
<td>V</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{VHH}$</td>
<td>0.5</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
<td>High-level coupling</td>
</tr>
<tr>
<td></td>
<td>$V_{VHL}$</td>
<td>0.5</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
<td>High-level coupling</td>
</tr>
<tr>
<td></td>
<td>$V_{VLH}$</td>
<td>0.5</td>
<td>V</td>
<td>2</td>
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<td></td>
<td>Low-level coupling</td>
</tr>
<tr>
<td></td>
<td>$V_{VLL}$</td>
<td>0.5</td>
<td>V</td>
<td>2</td>
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<td></td>
<td>Low-level coupling</td>
</tr>
<tr>
<td>Horizontal transfer clock voltage</td>
<td>$V_{\psi H}$</td>
<td>4.75</td>
<td>5.0</td>
<td>5.25</td>
<td>V</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>$V_{HL}$</td>
<td>$-0.05$</td>
<td>0</td>
<td>0.05</td>
<td>V</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{CR}$</td>
<td>0.8</td>
<td>2.5</td>
<td>V</td>
<td>3</td>
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<td>Cross-point voltage</td>
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<tr>
<td>Reset gate clock voltage</td>
<td>$V_{\phi R}$</td>
<td>3.0</td>
<td>3.3</td>
<td>5.25</td>
<td>V</td>
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<td></td>
<td>$V_{RGLH} - V_{RGLL}$</td>
<td>0.4</td>
<td>V</td>
<td>4</td>
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<td></td>
<td>Low-level coupling</td>
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<tr>
<td></td>
<td>$V_{RG L} - V_{RG Lm}$</td>
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<td>V</td>
<td>4</td>
<td></td>
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<td>Low-level coupling</td>
</tr>
<tr>
<td>Substrate clock voltage</td>
<td>$V_{\phi SUB}$</td>
<td>21.5</td>
<td>22.5</td>
<td>23.5</td>
<td>V</td>
<td>5</td>
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</table>
Clock Equivalent Circuit Constants

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance between vertical transfer clock and GND</td>
<td>$C_{\phi V1}$</td>
<td>3300</td>
<td>pF</td>
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<tr>
<td></td>
<td>$C_{\phi V2A}, C_{\phi V2B}$</td>
<td>1200</td>
<td>pF</td>
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<td>$C_{\phi V2C}$</td>
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<td>pF</td>
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<tr>
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<td>$C_{\phi V3A}, C_{\phi V3B}$</td>
<td>1000</td>
<td>pF</td>
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<td></td>
<td>$C_{\phi V3C}$</td>
<td>1800</td>
<td>pF</td>
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<td></td>
<td>$C_{\phi V4}$</td>
<td>6800</td>
<td>pF</td>
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<tr>
<td>Capacitance between vertical transfer clocks</td>
<td>$C_{\phi V12} (A, B)$</td>
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<td>$C_{\phi V12C}$</td>
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<td>$C_{\phi V13} (A, B)$</td>
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<td>$C_{\phi V13C}$</td>
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<td>$C_{\phi V14}$</td>
<td>2700</td>
<td>pF</td>
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<td></td>
<td>$C_{\phi V2} (A, B), 3(A, B)$</td>
<td>470</td>
<td>pF</td>
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<td></td>
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<tr>
<td></td>
<td>$C_{\phi V2} (A, B), 3C$</td>
<td>680</td>
<td>pF</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>$C_{\phi V2} (A, B), 4$</td>
<td>680</td>
<td>pF</td>
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<tr>
<td></td>
<td>$C_{\phi V2C}, 3(A, B)$</td>
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<td>pF</td>
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<tr>
<td></td>
<td>$C_{\phi V2C}, 3C$</td>
<td>820</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$C_{\phi V2C}, 4$</td>
<td>1800</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$C_{\phi V3} (A, B), 4$</td>
<td>820</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$C_{\phi V3C}, 4$</td>
<td>1500</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance between horizontal transfer clock and GND</td>
<td>$C_{\phi H1}$</td>
<td>100</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$C_{\phi H2}$</td>
<td>100</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance between horizontal transfer clocks</td>
<td>$C_{\phi H1}$</td>
<td>47</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance between reset gate clock and GND</td>
<td>$C_{\phi RG}$</td>
<td>2</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance between substrate clock and GND</td>
<td>$C_{\phi SUB}$</td>
<td>820</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical transfer clock series resistor</td>
<td>$R_1, R_4$</td>
<td>30</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$R_2 (A, B, C), 3(A, B, C)$</td>
<td>62</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical transfer clock ground resistor</td>
<td>$R_{GND}$</td>
<td>15</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal transfer clock series resistor</td>
<td>$R_{H}$</td>
<td>7</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal transfer clock ground resistor</td>
<td>$R_{H2}$</td>
<td>20</td>
<td>kΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset gate clock and series resistor</td>
<td>$R_{RG}$</td>
<td>4.7</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1)** Expressions using parentheses such as $C_{\phi V2} (A, B), 3C$ indicate items which include all combinations of the pins within the parentheses.

For example, $C_{\phi V2} (A, B), 3C$ indicates $[C_{\phi V2A}C, C_{\phi V2B}C]$. 
Note 2) $C_{\phi 2a \beta}$ and $C_{\phi 3a \beta} (\alpha = A \text{ to } C, \beta = A \text{ to } C \text{ other than } \alpha)$ are sufficiently small relative to other capacitance between other vertical clocks in the equivalent circuit, so these are omitted from the equivalent circuit diagram.
Drive Clock Waveform Conditions

(1) Readout clock waveform

\[ V_{VH} = \frac{(V_{VH1} + V_{VH2})}{2} \]
\[ V_{VL} = \frac{(V_{VL3} + V_{VL4})}{2} \]
\[ V_{\phi V} = V_{VHn} - V_{VLn} \quad (n = 1 \text{ to } 4) \]

(2) Vertical transfer clock waveform

\[ V_{\phi 1} \]
\[ V_{\phi 2A}, V_{\phi 2B}, V_{\phi 2C} \]
\[ V_{\phi 3A}, V_{\phi 3B}, V_{\phi 3C} \]
\[ V_{\phi 4} \]
(3) Horizontal transfer clock waveform

Cross-point voltage for the $H_{\phi 1B}$ rising side of the horizontal transfer clocks $H_{\phi 1A}$ and $H_{\phi 2B}$ waveforms is $V_{CR}$. The overlap period for $twh$ and $twl$ of horizontal transfer clocks $H_{\phi 1}$ and $H_{\phi 2}$ is two. ($\beta = A, B$)

(4) Reset gate clock waveform

$V_{RGLH}$ is the maximum value and $V_{RGLL}$ is the minimum value of the coupling waveform during the period from Point A in the above diagram until the rising edge of RG.

In addition, $V_{RGL}$ is the average value of $V_{RGLH}$ and $V_{RGLL}$.

$$V_{RGL} = \frac{V_{RGLH} + V_{RGLL}}{2}$$

Assuming $V_{RGH}$ is the minimum value during the interval $twh$, then:

$$V_{\phi RG} = V_{RGH} - V_{RGL}$$

Negative overshoot level during the falling edge of RG is $V_{RGLm}$.

(5) Substrate clock waveform
### Clock Switching Characteristics (Horizontal drive frequency: 28.6364MHz)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>twh</th>
<th>twl</th>
<th>tr</th>
<th>tf</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout clock</td>
<td>$V_T$</td>
<td>3.3</td>
<td>3.5</td>
<td>0.5</td>
<td>0.5</td>
<td>$\mu$s</td>
<td>During readout</td>
</tr>
<tr>
<td>Vertical transfer clock</td>
<td>$V_{\phi 1}, V_{\phi 4}, V_{\phi 2u}, V_{\phi 3c}$ ($u = A \text{ to } C$)</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal transfer clock</td>
<td>$H_{\phi 1\beta}$ ($\beta = A, B$)</td>
<td>10</td>
<td>12.5</td>
<td>10</td>
<td>12.5</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$H_{\phi 2\beta}$ ($\beta = A, B$)</td>
<td>10</td>
<td>12.5</td>
<td>10</td>
<td>12.5</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Reset gate clock</td>
<td>$\phi_{RG}$</td>
<td>4</td>
<td>7</td>
<td>24</td>
<td>2</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Substrate clock</td>
<td>$\phi_{SUB}$</td>
<td>2.1</td>
<td></td>
<td></td>
<td>0.5</td>
<td>0.5 $\mu$s</td>
<td>When draining charge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>two</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal transfer clock</td>
<td>$H_{\phi 1A}, H_{\phi 1B}, H_{\phi 2A}, H_{\phi 2B}$</td>
<td>8</td>
<td>10</td>
<td>ns</td>
</tr>
</tbody>
</table>

### Clock Switching Characteristics (Horizontal drive frequency: 36MHz)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>twh</th>
<th>twl</th>
<th>tr</th>
<th>tf</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout clock</td>
<td>$V_T$</td>
<td>4.0</td>
<td>4.2</td>
<td>0.5</td>
<td>0.5</td>
<td>$\mu$s</td>
<td>During readout</td>
</tr>
<tr>
<td>Vertical transfer clock</td>
<td>$V_{\phi 1}, V_{\phi 4}, V_{\phi 2u}, V_{\phi 3c}$ ($u = A \text{ to } C$)</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal transfer clock</td>
<td>$H_{\phi 1\beta}$ ($\beta = A, B$)</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$H_{\phi 2\beta}$ ($\beta = A, B$)</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Reset gate clock</td>
<td>$\phi_{RG}$</td>
<td>4</td>
<td>5.5</td>
<td>8</td>
<td>2</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Substrate clock</td>
<td>$\phi_{SUB}$</td>
<td>1.67</td>
<td></td>
<td></td>
<td>0.25</td>
<td>0.25 $\mu$s</td>
<td>When draining charge</td>
</tr>
</tbody>
</table>

*1 When two vertical transfer clock drivers CXD3400N are used.

*2 $t_f \geq t_r - 2\,\text{ns}$, and the cross-point voltage ($V_{CR}$) for the $H_{\phi 1\beta}$ ($\beta = A, B$) rising side of the $H_{\phi 1\beta}$ and $H_{\phi 2\beta}$ waveforms must be $V_{\phi H}/2$ [V] or more.
Spectral Sensitivity Characteristics (excludes lens characteristics and light source characteristics)

![Graph showing spectral sensitivity characteristics](image)

Image Sensor Characteristics \((Ta = 25°C)\)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Measurement method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>S</td>
<td>335</td>
<td>420</td>
<td>545</td>
<td>mV</td>
<td>1</td>
<td>1/30s accumulation</td>
</tr>
<tr>
<td>Saturation signal Vsat</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td>mV</td>
<td>2</td>
<td>Ta = 60°C</td>
</tr>
<tr>
<td>Saturation signal Vsat2*1</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear Vsat2*1</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear Vsat2*1</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear Sm</td>
<td></td>
<td>-100</td>
<td>-92</td>
<td></td>
<td>dB</td>
<td>3</td>
<td>Progressive scan mode*4</td>
</tr>
<tr>
<td>Smear Sm</td>
<td></td>
<td>-94</td>
<td>-86</td>
<td></td>
<td>dB</td>
<td></td>
<td>2/4-line readout mode*5</td>
</tr>
<tr>
<td>Smear Sm</td>
<td></td>
<td>-88</td>
<td>-80</td>
<td></td>
<td>dB</td>
<td></td>
<td>2/8-line readout mode*6</td>
</tr>
<tr>
<td>Video signal shading SH</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>%</td>
<td>4</td>
<td>Zone 0 and I</td>
</tr>
<tr>
<td>Video signal shading SH</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>%</td>
<td></td>
<td>Zone 0 to II†</td>
</tr>
<tr>
<td>Dark signal Vdt</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td>mV</td>
<td>5</td>
<td>Ta = 60°C, 14.985 frame/s</td>
</tr>
<tr>
<td>Dark signal shading ΔVdt</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>mV</td>
<td>6</td>
<td>Ta = 60°C, 14.985 frame/s, *7</td>
</tr>
<tr>
<td>Lag Lag</td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
<td>%</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

\*1 Vsat2 is the saturation signal level in 2-line addition mode, and is 200mV per pixel.

\*2 Progressive scan mode, 2/8-line readout mode, 2/4-line readout mode, and center scan modes (1) and (3).

\*3 2-line addition mode and center scan mode (2).

\*4 Same for 2-line addition mode and center scan modes (2) and (3).

\*5 Same for center scan mode (1).

\*6 Same for AF modes (1) and (2).

\*7 Excludes vertical dark signal shading caused by vertical register high-speed transfer.
Zone Definition of Video Signal Shading

Measurement System

Note) Adjust the AMP gain so that the gain between [A] and [B] equals 1.
Readout modes

The diagrams below and on the following pages show the output methods for the following nine readout modes.

<table>
<thead>
<tr>
<th>Progressive scan mode</th>
<th>2/8-line readout mode</th>
<th>2/4-line readout mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 (V2C/V3C)</td>
<td>16 (V2C/V3C)</td>
<td>16 (V2C/V3C)</td>
</tr>
<tr>
<td>15 (V2C/V3C)</td>
<td>15 (V2C/V3C)</td>
<td>15 (V2C/V3C)</td>
</tr>
<tr>
<td>14 (V2A/V3A)</td>
<td>14 (V2A/V3A)</td>
<td>14 (V2A/V3A)</td>
</tr>
<tr>
<td>13 (V2B/V3B)</td>
<td>13 (V2B/V3B)</td>
<td>13 (V2B/V3B)</td>
</tr>
<tr>
<td>12 (V2C/V3C)</td>
<td>12 (V2C/V3C)</td>
<td>12 (V2C/V3C)</td>
</tr>
<tr>
<td>11 (V2C/V3C)</td>
<td>11 (V2C/V3C)</td>
<td>11 (V2C/V3C)</td>
</tr>
<tr>
<td>10 (V2B/V3B)</td>
<td>10 (V2B/V3B)</td>
<td>10 (V2B/V3B)</td>
</tr>
<tr>
<td>9 (V2A/V3A)</td>
<td>9 (V2A/V3A)</td>
<td>9 (V2A/V3A)</td>
</tr>
<tr>
<td>8 (V2C/V3C)</td>
<td>8 (V2C/V3C)</td>
<td>8 (V2C/V3C)</td>
</tr>
<tr>
<td>7 (V2C/V3C)</td>
<td>7 (V2C/V3C)</td>
<td>7 (V2C/V3C)</td>
</tr>
<tr>
<td>6 (V2A/V3A)</td>
<td>6 (V2A/V3A)</td>
<td>6 (V2A/V3A)</td>
</tr>
<tr>
<td>5 (V2B/V3B)</td>
<td>5 (V2B/V3B)</td>
<td>5 (V2B/V3B)</td>
</tr>
<tr>
<td>4 (V2C/V3C)</td>
<td>4 (V2C/V3C)</td>
<td>4 (V2C/V3C)</td>
</tr>
<tr>
<td>3 (V2C/V3C)</td>
<td>3 (V2C/V3C)</td>
<td>3 (V2C/V3C)</td>
</tr>
<tr>
<td>2 (V2B/V3B)</td>
<td>2 (V2B/V3B)</td>
<td>2 (V2B/V3B)</td>
</tr>
<tr>
<td>1 (V2A/V3A)</td>
<td>1 (V2A/V3A)</td>
<td>1 (V2A/V3A)</td>
</tr>
</tbody>
</table>

Note: Blacked out portions in the diagram indicate pixels which are not read out. Output starts from line 1 in 2/8-line decimation mode.

1. Progressive scan mode
   In this mode, all pixel signals are output in non-interlace format in 1/14.985s.
   All pixel signals within the same exposure period are read out simultaneously, making this mode suitable for high resolution image capturing.

2. 2/8-line readout mode
   All effective area signals are output in approximately 1/30s by reading out the signals for only two out of eight lines (1st and 6th lines, 9th and 14th lines).
   This readout mode emphasizes processing speed over vertical resolution, making it suitable for AE/AF and other control and for checking images on LCD viewfinders.

3. 2/4-line readout mode
   All effective area signals are output in approximately 1/20s by reading out the signals for only two out of four lines (3rd and 4th lines, 7th and 8th lines, and so on).
4. 2-line addition mode
In this mode, the signals for only two out of four lines (3rd and 4th lines, 7th and 8th lines, and so on) are read out, the vertical register is shifted by 2 bits, and then the signals of the remaining two out of the four lines (1st and 2nd lines, 5th and 6th lines, and so on) are read out and added within the vertical register. All effective area signals are output in approximately 1/20s.

5. Center scan mode (1)
In this mode, the signals for only two out of four lines (3rd and 4th lines, 7th and 8th lines, and so on) are read out. The undesired portions are swept by vertical register high-speed transfer, and the vertical 1136-pixel region in the center of the picture is output by the above readout method. The number of output lines is 568 lines at 36MHz, and 434 lines at 28.6364MHz. The frame rate is increased (approximately 30 frames/s) by setting the number of output lines to that of VGA mode, making this mode suitable for VGA moving pictures. (However, the angle of view decreases.)

6. Center scan mode (2)
In this mode, the signals for only two out of four lines (3rd and 4th lines, 7th and 8th lines, and so on) are read out, the vertical register is shifted by 2 bits, and then the signals of the remaining two out of the four lines (1st and 2nd lines, 5th and 6th lines, and so on) are read out and added within the vertical register. The undesired portions are swept by vertical register high-speed transfer, and the vertical 1136-pixel region in the center of the picture is output by the above readout method. The number of output lines is 568 lines at 36MHz, and 434 lines at 28.6364MHz. The frame rate is increased (approximately 30 frames/s) by setting the number of output lines to that of VGA mode, making this mode suitable for VGA moving pictures. (However, the angle of view decreases.)
7. Center scan mode (3)
   This is the center scan mode using the progressive scan method.
   The undesired portions are swept by vertical register high-speed transfer, and the picture center is cut out.
   The number of output lines is 580 lines at 36MHz, and 444 lines at 28.6364MHz.

8. AF mode (1)
   In this mode, the undesired portions are swept by vertical register high-speed transfer, and the vertical 940-pixel region in the center of the picture is output in approximately 1/60s by reading out the signals for only two out of eight lines (1st and 6th lines, 9th and 14th lines). The number of output lines is 235 lines at 36MHz, and 170 lines at 28.6364MHz. This mode aims for even faster AF control than 2/8-line readout mode.

9. AF mode (2)
   In this mode, the undesired portions are swept by vertical register high-speed transfer, and the vertical 300-pixel region in the center of the picture is output in approximately 1/120s by reading out the signals for only two out of eight lines (1st and 6th lines, 9th and 14th lines). The number of output lines is 75 lines at 36MHz, and 43 lines at 28.6364MHz. This mode aims for even faster AF control than 2/8-line readout mode.

---

**Note**  Blacked out portions in the diagram indicate pixels which are not read out.
Center scan and AF modes

Description of Center Scan and AF Mode Operation

The center scan and AF modes realize high frame rates by sweeping the top and bottom of the picture with high-speed transfer and cutting out the center of the picture. The various readout modes during center scan and AF operation are described below.

- AF modes
  AF mode (1), (2): The output method is the same as readout in 2/8-line readout mode.

- Center scan modes
  Center scan mode (1): The output method is the same as 2/4-line readout mode.
  Center scan mode (2): The output method consists of 2-line addition readout whereby the signals for only two out of four lines (3rd and 4th lines, 7th and 8th lines, and so on) are read out, the vertical register is shifted by 2 bits, and then the signals of the remaining two out of the four lines (1st and 2nd lines, 5th and 6th lines, and so on) are read out and added within the vertical register.
  Center scan mode (3): The output method is the same as progressive scan mode.

The readout method, frame rate, number of output lines and other information for each readout mode are shown in the table below.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Readout method</th>
<th>Addition method</th>
<th>Frame rate (frame/s)</th>
<th>Number of output effective pixel data lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>28.6MHz</td>
<td>36MHz</td>
</tr>
<tr>
<td>Progressive scan mode</td>
<td>Progressive scan</td>
<td>None</td>
<td>9.99</td>
<td>14.985</td>
</tr>
<tr>
<td>2/8-line readout mode</td>
<td>2/8-line readout</td>
<td>None</td>
<td>29.97</td>
<td>29.97</td>
</tr>
<tr>
<td>2/4-line readout mode</td>
<td>2/4-line readout</td>
<td>None</td>
<td>19.98</td>
<td>19.98</td>
</tr>
<tr>
<td>2-line addition mode</td>
<td>2/4-line readout</td>
<td>Vertical 2-line</td>
<td>19.98</td>
<td>19.98</td>
</tr>
<tr>
<td>Center scan mode (1)</td>
<td>2/4-line readout</td>
<td>None</td>
<td>29.97</td>
<td>29.97</td>
</tr>
<tr>
<td>Center scan mode (2)</td>
<td>2-line addition readout</td>
<td>Vertical 2-line</td>
<td>29.97</td>
<td>29.97</td>
</tr>
<tr>
<td>Center scan mode (3)</td>
<td>Progressive scan</td>
<td>None</td>
<td>29.97</td>
<td>29.97</td>
</tr>
<tr>
<td>AF mode (1)</td>
<td>2/8-line readout</td>
<td>None</td>
<td>59.94</td>
<td>59.94</td>
</tr>
<tr>
<td>AF mode (2)</td>
<td>2/8-line readout</td>
<td>None</td>
<td>119.88</td>
<td>119.88</td>
</tr>
</tbody>
</table>
Measurement conditions

(1) In the following measurements, the device drive conditions are at the typical values of the bias and clock voltage conditions, and the progressive scan readout mode is used.

(2) In the following measurements, spot blemishes are excluded and, unless otherwise specified, the optical black level (OB) is used as the reference for the signal output, which is taken as the value measured at point ["B"] of the measurement system.

Definition of standard imaging conditions

(1) Standard imaging condition I:
Use a pattern box (luminance: 706cd/m², color temperature of 3200K halogen source) as a subject. (Pattern for evaluation is not applicable.) Use a testing standard lens with CM500S (t = 1.0mm) as an IR cut filter and image at F8. The luminous intensity to the sensor receiving surface at this point is defined as the standard sensitivity testing luminous intensity.

(2) Standard imaging condition II:
Image a light source (color temperature of 3200K) with a uniformity of brightness within 2% at all angles. Use a testing standard lens with CM500S (t = 1.0mm) as an IR cut filter. The luminous intensity is adjusted to the value indicated in each testing item by the lens diaphragm.

1. Sensitivity
Set to the standard imaging condition I. After selecting the electronic shutter mode with a shutter speed of 1/100s, measure the signal output (Vₛ) at the center of the screen, and substitute the values into the following formulas.

\[ S = Vₛ \times \frac{100}{30} \text{ [mV]} \]

2. Saturation signal
Set to the standard imaging condition II. After adjusting the luminous intensity to 10 times the intensity with the average value of the G channel signal output, 150mV, measure the minimum values of the signal outputs.

3. Smear
Set to standard imaging condition II. With the lens diaphragm at F5.6 to F8, adjust the luminous intensity to 500 times the intensity with the average value of the signal output, 150mV. After the readout clock is stopped and the charge drain is executed by the electronic shutter at the respective H blankings, measure the maximum value (Vsm [mV]) of the signal outputs, and substitute the values into the following formula. Smear in modes other than progressive scan mode is calculated from the storage time and signal addition method. As a result, 2-line addition mode and center scan modes (2) and (3) are the same as progressive scan mode, 2/4-line readout mode and center scan mode (1) are two times progressive scan mode, and 2/8-line readout mode and AF modes (1) and (2) are four times progressive scan mode.

\[ Sm = 20 \times \log \left( \frac{Vsm}{200} \times \frac{1}{500} \times \frac{1}{10} \right) \text{ [dB]} \] (1/10 V method conversion value)
4. **Video signal shading**
   Set to the standard imaging condition II. With the lens diaphragm at F5.6 to F8, adjusting the luminous intensity so that the average value of the signal output is 150mV. Then measure the maximum value (Vmax [mV]) and minimum value (Vmin [mV]) of the G signal output and substitute the values into the following formula.

   \[ SH = \frac{(V_{\text{max}} - V_{\text{min}})}{150} \times 100 \% \]

5. **Dark signal**
   Measure the average value of the signal output (Vdt [mV]) with the device ambient temperature of 60°C and the device in the light-obstructed state, using the horizontal idle transfer level as a reference.

6. **Dark signal shading**
   After measuring 5, measure the maximum (Vdmax [mV]) and minimum (Vdmin [mV]) values of the dark signal output and substitute the values into the following formula.

   \[ \Delta V_{\text{dt}} = V_{\text{dmax}} - V_{\text{dmin}} \text{ [mV]} \]

7. **Lag**
   Adjust the signal output generated by the strobe light to 150mV. After setting the strobe light so that it strobos with the following timing, measure the residual signal amount (Vlag). Substitute the value into the following formula.

   \[ \text{Lag} = \frac{(V_{\text{lag}})}{150} \times 100 \% \]

---

**Diagram:**

- VD
- Light
- Strobe light timing
- Output
- Signal output 150mV
- Vlag (lag)
Note) Substrate bias control
Switch the substrate bias adjustment input voltage to DCIN before adjusting the substrate bias in 2-line addition mode and center scan mode (2).
Drive Timing Chart (Vertical Sync)  Progressive Scan Mode

Note) The 1252H horizontal period at 36MHz is 480clk; the 1493H horizontal period at 28MHz is 1860clk.
Note) The 1564 and 1565H horizontal periods at 36MHz are 1021clk; the 1742H horizontal period at 28MHz is 1530clk.
Note) The 511H horizontal period at 36MHz is 1680clk; the 406 and 407H horizontal periods at 28MHz are 1470clk.
ICX274AL

Drive Timing Chart (Vertical Sync)  2/8-line Readout Mode

"a" enlarged
Drive Timing Chart (Vertical Sync) 2/4-line Readout Mode

Note) The 871H horizontal period at 36MHz is 900clk; the 693H horizontal period at 28MHz is 810clk.
Note) The 871H horizontal period at 36MHz is 900clk; the 693H horizontal period at 28MHz is 810clk.
Drive Timing Chart (Horizontal Sync) 2-line Addition Mode

- CLK
- H1A/H1B
- H2A/H2B
- RG
- SHP
- SHD
- V1
- V2A/V2B/V2C
- V3A/V3B/V3C
- V4
- SUB
Note) The 462H horizontal period is 1230clk.
Note) The 581H horizontal period is 601clk.
Drive Timing Chart (Vertical Sync)  Center Scan Mode (1)

"a" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4
Drive Timing Chart (Vertical Sync) Center Scan Mode (1)/(28.6MHz)

"b" enlarged

28800 bits = 14H
27936 bits = 14H
Drive Timing Chart (Vertical Sync)  Center Scan Mode (1)/(36MHz)

"b" enlarged
Note) The 462H horizontal period is 1230clk.
Note) The 581H horizontal period is 601clk.
Drive Timing Chart (Vertical Sync) Center Scan Mode (2)

"a" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4
Drive Timing Chart (Vertical Sync)  Center Scan Mode (2)/(36MHz)

"b" enlarged

10350 bits = 5H

8784 bits

# (3 + 5) # (4 + 6) # (50 + 52)
Drive Timing Chart (Horizontal Sync)  Center Scan Modes (1) and (2)
Drive Timing Chart (Vertical Sync) Center Scan Modes (1) and (2)/(28.6MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

16560 bits
Drive Timing Chart (Vertical Sync)  Center Scan Modes (1) and (2)/(36MHz)

"d" enlarged

H1A/H1B
V1
V2C
V2A/V2B
V3C
V3A/V3B
V4

6210 bits
Drive Timing Chart (Vertical Sync)  Center Scan Mode (3)/(28.6MHz)

Note) The 498H horizontal period is 1260clk.
Note) The 626H horizontal period is 1200clk.
Drive Timing Chart (Vertical Sync)  Center Scan Mode (3)/(28.6MHz)

"b" enlarged

59520 bits = 31H
58608 bits

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18

58608 bits
Drive Timing Chart (Vertical Sync)  Center Scan Mode (3)/(36MHz)

"b" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

49920 bits = 26H

48816 bits
Drive Timing Chart (Vertical Sync)  Center Scan Mode (3)/(28.6MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

34560 bits

#1 #2 #3 #398
Drive Timing Chart (Vertical Sync)  Center Scan Mode (3)/(36MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

#2#1 #3 #330

28800 bits
Drive Timing Chart (Vertical Sync)  AF Mode (1)/(28.6MHz)

Note) The 203 and 204H horizontal periods are 1323clk.
Drive Timing Chart (Vertical Sync)  AF Mode (1)/(36MHz)

Note) The 256H horizontal period is 840clk.
Drive Timing Chart (Vertical Sync) AF Mode (1)/(36MHz)

"b" enlarged

22996 bits
22996 bits = 10H

H1A/H1B V1 V2A V2B V3A V3C V4A/V4B V4A/V4B
Drive Timing Chart (Vertical Sync)  AF Mode (1)/(28.6MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

25872 bits

#2 #1 #3 #339
Drive Timing Chart (Vertical Sync)  
AF Mode (1)/(36MHz)

“d” enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

14112 bits

#1 #2 #3 #180
Note) The 102H horizontal period is 1323clk.
Drive Timing Chart (Vertical Sync)  AF Mode (2)/(36MHz)

Note) The 128H horizontal period is 1596clk.
Drive Timing Chart (Vertical Sync)  AF Mode (2)/(36MHz)

"b" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

68976 bits

70560 bits = 30H

68976 bits
Drive Timing Chart (Vertical Sync) AF Mode (2)/(28.6MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

47040 bits

#1 #2 #3 #640
Drive Timing Chart (Vertical Sync)  AF Mode (2)/(36MHz)

"d" enlarged

H1A/H1B

V1

V2C

V2A/V2B

V3C

V3A/V3B

V4

42336 bits
Drive Timing Chart (Vertical Sync)  AF Modes (1) and (2)

"a" enlarged

H1A/H1B

V1

V2A

V2B/V2C

V3A

V3B/V3C

V4
Notes of Handling

1) Static charge prevention
   CCD image sensors are easily damaged by static discharge. Before handling be sure to take the following protective measures.
   a) Either handle bare handed or use non-chargeable gloves, clothes or material.
      Also use conductive shoes.
   b) When handling directly use an earth band.
   c) Install a conductive mat on the floor or working table to prevent the generation of static electricity.
   d) Ionized air is recommended for discharge when handling CCD image sensors.
   e) For the shipment of mounted substrates, use boxes treated for the prevention of static charges.

2) Soldering
   a) Make sure the package temperature does not exceed 80°C.
   b) Solder dipping in a mounting furnace causes damage to the glass and other defects. Use a ground 30W soldering iron and solder each pin in less than 2 seconds. For repairs and remount, cool sufficiently.
   c) To dismount an image sensor, do not use a solder suction equipment. When using an electric desoldering tool, use a thermal controller of the zero-cross On/Off type and connect it to ground.

3) Dust and dirt protection
   Image sensors are packed and delivered by taking care of protecting its glass plates from harmful dust and dirt. Clean glass plates with the following operations as required, and use them.
   a) Perform all assembly operations in a clean room (class 1000 or less).
   b) Do not either touch glass plates by hand or have any object come in contact with glass surfaces. Should dirt stick to a glass surface, blow it off with an air blower. (For dirt stuck through static electricity ionized air is recommended.)
   c) Clean with a cotton bud and ethyl alcohol if grease stained. Be careful not to scratch the glass.
   d) Keep in a case to protect from dust and dirt. To prevent dew condensation, preheat or precool when moving to a room with great temperature differences.
   e) When a protective tape is applied before shipping, just before use remove the tape applied for electrostatic protection. Do not reuse the tape.

4) Installing (attaching)
   a) Remain within the following limits when applying a static load to the package. Do not apply any load more than 0.7mm inside the outer perimeter of the glass portion, and do not apply any load or impact to limited portions. (This may cause cracks in the package.)

   ![](Compressive_strength.png)
   ![](Torsional_strength.png)

   b) If a load is applied to the entire surface by a hard component, bending stress may be generated and the package may fracture, etc., depending on the flatness of the bottom of the package. Therefore, for installation, use either an elastic load, such as a spring plate, or an adhesive.
c) The adhesive may cause the marking on the rear surface to disappear, especially in case the regulated voltage value is indicated on the rear surface. Therefore, the adhesive should not be applied to this area, and indicated values should be transferred to other locations as a precaution.
d) The notch of the package is used for directional index, and that can not be used for reference of fixing. In addition, the cover glass and seal resin may overlap with the notch of the package.
e) If the leads are bent repeatedly and metal, etc., clash or rub against the package, the dust may be generated by the fragments of resin.
f) Acrylate anaerobic adhesives are generally used to attach CCD image sensors. In addition, cyano-acrylate instantaneous adhesives are sometimes used jointly with acrylate anaerobic adhesives. (reference)

5) Others
   a) Do not expose to strong light (sun rays) for long periods. For continuous using under cruel condition exceeding the normal using condition, consult our company.
b) Exposure to high temperature or humidity will affect the characteristics. Accordingly avoid storage or usage in such conditions.
c) Brown stains may be seen on the bottom or side of the package. But this does not affect the CCD characteristics.
d) This package has 2 kinds of internal structure. However, their package outline, optical size, and strength are the same.

The cross section of lead frame can be seen on the side of the package for structure A.
1. “A” is the center of the effective image area.

2. The two points “B” of the package are the horizontal reference. The point “B’” of the package is the vertical reference.

3. The bottom “C” of the package, and the top of the cover glass “D” are the height reference.

4. The center of the effective image area relative to “B” and “B’” is (H, V) = (6.9, 6.0) ± 0.075mm.

5. The rotation angle of the effective image area relative to H and V is ± 1˚.

6. The height from the bottom “C” to the effective image area is 1.41 ± 0.10mm.
   The height from the top of the cover glass “D” to the effective image area is 1.49 ± 0.15mm.

7. The tilt of the effective image area relative to the bottom “C” is less than 50µm.
   The tilt of the effective image area relative to the top “D” of the cover glass is less than 50µm.

8. The thickness of the cover glass is 0.5mm, and the refractive index is 1.5.

9. The notches on the bottom of the package are used only for directional index, they must not be used for reference of fixing.