Pyroelectric Linear Arrays
PYROSENS
For Measurement Applications

www.dias-infrared.com
PYROSENS – Pyroelectric Linear Arrays 128LTx, 256LTx and 510LTx

with 128, 256 or 510 Elements and Integrated CMOS Multiplexer

Linear Arrays in Volume Production
The LTx family of pyroelectric linear arrays is specifically designed for non-contact temperature measurement and infrared spectrometry. The arrays include a lithium tantalate chip with 128, 256 or 510 elements. The signals produced by the elements are processed in a CMOS circuit. Signal processing is carried out by the analogue circuitry, including an adapted low-noise preamplifier for each pixel, a multiplexer, an output amplifier. The pyroelectric chip and CMOS readout circuit are located on a thick film substrate, which is mounted inside a hermetic metal housing. The incident radiation passes through a window or filter, is transparent to infrared wavelengths, and reaches the sensitive elements.

The preamplifiers transform the signal charges of each pixel into a signal voltage, include bandwidth limiting and pass the amplified signal to the sample & hold for the read-out process. The digital inputs are CMOS compatible.

For measurement of the detector temperature a sensor (type AD 590) is integrated into the package. It provides an output current which is proportional to the temperature.

In common with all pyroelectric detectors, the incoming infrared radiation needs to be modulated for a measurement to be made.

Technical Data

<table>
<thead>
<tr>
<th>Features</th>
<th>Maximum/minimum Conditions</th>
<th>Typical Responsivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>– 128, 256 or 510 pixel arranged in one line</td>
<td>– VDD, VD2: –0.3 V to 7 V</td>
<td></td>
</tr>
<tr>
<td>– NEP (128 Hz) down to 1.1 nW (128LTx, 256LTx), 1.3 nW (510LTx)</td>
<td>– Digital inputs CLK, RES, VVR, VDR, VSH: –0.3 V to VDD + 0.3 V</td>
<td></td>
</tr>
<tr>
<td>– Dynamic range &gt; 75 dB</td>
<td>– Chopping frequency fCh: 10 Hz to 512 Hz</td>
<td></td>
</tr>
<tr>
<td>– Modulation frequency up to 512 Hz</td>
<td>– AD590+ to AD590–: –20 V to 44 V</td>
<td></td>
</tr>
<tr>
<td>– Output voltage 2.5 V ± 2 V</td>
<td>– Analog output2: ± 5 mA</td>
<td></td>
</tr>
<tr>
<td>– Integrated CMOS multiplexer</td>
<td>– Maximum irradiance: 50 mW/mm²</td>
<td></td>
</tr>
<tr>
<td>– High long-term stability</td>
<td>– Soldering temperature: 300 °C</td>
<td></td>
</tr>
<tr>
<td>– Simple mode of operation</td>
<td>– Storage temperature: –20 °C to 80 °C</td>
<td></td>
</tr>
<tr>
<td>– Operation at ambient temperature</td>
<td>– Operation temperature: –15 °C to 70 °C</td>
<td></td>
</tr>
<tr>
<td>– Small package</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Coated silicon or germanium as infrared window</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Broad band windows (&gt; 1.3 µm) or special filters on request</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Customized arrays with up to 510 elements with special sizes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 All voltages refer to ground (pin 10, 15).
2 Not short resistive.
3 All values for VDD = 5 V, VD2 = 2.5 V. 4 See data sheet of Analog Devices. 5 Valid for 510LTx.
Pyroelectric linear arrays – types and features

<table>
<thead>
<tr>
<th>Type</th>
<th>128LT SP0.5</th>
<th>128LT SP1.0</th>
<th>128LTI SP0.5</th>
<th>128LTI SP1.0</th>
<th>256LTI SP0.5</th>
<th>256LTI SP1.0</th>
<th>510LTI SP0.5</th>
<th>510LTI SP1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixel number</td>
<td>128</td>
<td>128</td>
<td>128</td>
<td>128</td>
<td>256</td>
<td>256</td>
<td>256</td>
<td>510</td>
</tr>
<tr>
<td>Pixel width in µm</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Pixel length in µm</td>
<td>100</td>
<td>100</td>
<td>500</td>
<td>500</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Pitch in µm</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>25</td>
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</tbody>
</table>

Electro-optical specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>128LT SP0.5</th>
<th>128LT SP1.0</th>
<th>128LTI SP0.5</th>
<th>128LTI SP1.0</th>
<th>256LTI SP0.5</th>
<th>256LTI SP1.0</th>
<th>510LTI SP0.5</th>
<th>510LTI SP1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsivity $S_r$ in V/W</td>
<td>230000</td>
<td>540000</td>
<td>230000</td>
<td>540000</td>
<td>620000</td>
<td>620000</td>
<td>680000</td>
<td>680000</td>
</tr>
<tr>
<td>Noise voltage $U_n$ in mV</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.2</td>
<td>1.1</td>
<td>1.9</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>NEP in nW</td>
<td>3.0</td>
<td>1.5</td>
<td>3.9</td>
<td>2.2</td>
<td>4.9</td>
<td>3.5</td>
<td>1.1</td>
<td>1.4</td>
</tr>
<tr>
<td>MTF (R = 3lp/mm)</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Uniformity of $S_r$ in %</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

Pins – 128LTx, 256LTx and 510LTx

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLK</td>
<td>Input clock CLK (trigger on rising edge)</td>
</tr>
<tr>
<td>2</td>
<td>RES</td>
<td>Input clock RES (active low)</td>
</tr>
<tr>
<td>3</td>
<td>VVR</td>
<td>Input clock VVR (active high)</td>
</tr>
<tr>
<td>4</td>
<td>VDR</td>
<td>Input clock VDR (active high)</td>
</tr>
<tr>
<td>5</td>
<td>VSH</td>
<td>Input clock VSH (active high)</td>
</tr>
<tr>
<td>6</td>
<td>VD2</td>
<td>Operating voltage (+2.5 V)</td>
</tr>
<tr>
<td>7</td>
<td>VDD</td>
<td>Operating voltage (+5 V)</td>
</tr>
<tr>
<td>8</td>
<td>VD2</td>
<td>Operating voltage (+2.5 V)</td>
</tr>
<tr>
<td>9</td>
<td>OUT, OUT1</td>
<td>Analog signal output, analog signal output (odd pixels)</td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>11</td>
<td>n.c., OUT2</td>
<td>Not connected, analog signal output (even pixels)</td>
</tr>
<tr>
<td>12</td>
<td>AD590+</td>
<td>Temperature sensor</td>
</tr>
<tr>
<td>13</td>
<td>AD590-</td>
<td>Temperature sensor</td>
</tr>
<tr>
<td>14</td>
<td>case</td>
<td>Case</td>
</tr>
<tr>
<td>15</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>16</td>
<td>VDD</td>
<td>Operating voltage (+5 V)</td>
</tr>
</tbody>
</table>

Connect pin 6 to pin 8 (VD2), pin 7 to pin 16 (VDD), pin 10 to pin 15 (GND).

Evaluation Kit

Our evaluation kit contains all you need for easy operation of these linear arrays – a small board with complete electronics and a software package. The kit can be controlled by a Windows PC via USB connection.

The power can be provided by the USB port or a separate power supply (9 V). For synchronisation with further external components, such as for radiation modulation, a trigger pulse is provided. The read-out cycle can be adjusted between 1 and 30 lines/s.

1 Typical values, rectangular chopping with 128 Hz, array temperature 25 °C, black body source temperature 400 °C, filter transmission 100 %. 2 No defective element. 3 Only available for 510LTx.
**PYROSENS**

Pyroelectric Linear Arrays

**Internal Readout-Circuit**

![Internal Readout-Circuit Diagram]

**Clock parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Relative value</th>
<th>Minimum value</th>
<th>Typical value</th>
<th>Maximum value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopping frequency $f_{ch}$</td>
<td>$1/t_{ch}$</td>
<td>10</td>
<td>128</td>
<td>512</td>
<td>Hz</td>
</tr>
<tr>
<td>Readout CLK $f_{CLK} = 2 \cdot f_{ch} \cdot 268$</td>
<td>$1/t_{ch}$</td>
<td>0</td>
<td>69</td>
<td>300</td>
<td>kHz</td>
</tr>
<tr>
<td>Reset clock low-impulse duration $t_{RES}$</td>
<td>$1/2 \cdot t_{ch}$</td>
<td>1.8</td>
<td>7.5</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Clock VVR high-impulse duration $t_{VVR}$</td>
<td>$2 \cdot t_{ch}$</td>
<td>7.5</td>
<td>30</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Clock VDR high-impulse duration $t_{VDR}$</td>
<td>$28 \cdot t_{ch}$</td>
<td>200</td>
<td>400</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Clock VSH high-impulse duration $t_{VSH}$</td>
<td>$1 \cdot t_{ch}$</td>
<td>3.5</td>
<td>15</td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Setting time at the output $t_{OUT}$</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td></td>
<td>µs</td>
</tr>
</tbody>
</table>

1 All values for $VDD = 5 \ V$, $VD2 = 2.5 \ V$, $t_{ch,low} = t_{ch,high}$. 2 For $f_{ch} = 512 \ Hz$ must be $t_{VDR} = 56 \cdot t_{ch} = 200 \ µs$. 3 For $f_{ch} = 512 \ Hz$ must be $t_{VDR} = 56 \cdot t_{ch} = 200 \ µs$.

**Clock diagram**

![Clock Diagram]