LED

Rich variety of light emitters for wide range of applications

- Surface mount type LED
  L12509-0155G

- Surface mount type LED with lens
  L14096-0085GL

- Bullet-shaped LED
  L12170
LEDs are opto-semiconductors that convert electrical energy into light energy. LEDs offer the advantages of low cost and a long service life compared to laser diodes (LDs).

LEDs are grouped into visible LEDs and invisible LEDs. Visible LEDs are mainly used for display or illumination, where LEDs are used individually. Invisible LEDs, however, are mainly used with photosensors such as photodiodes or CMOS image sensors. Hamamatsu provides various LEDs from red to mid infrared range, which are mainly used in combination with photosensors. Based on crystal growth technology and process technology supporting numerous compound semiconductor materials, we provide a product lineup that covers various wavelengths. The products feature high quality and high reliability backed by strictly controlled assembly process and inspection process.
Features of Hamamatsu LEDs

Product lineup that covers a wide variety of wavelengths

<table>
<thead>
<tr>
<th>Product</th>
<th>Peak emission wavelength</th>
<th>Main applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red LED</td>
<td>650 to 700 nm</td>
<td>Optical switch, PDF data communication, barcode reader</td>
</tr>
<tr>
<td>Near infrared LED</td>
<td>830 to 945 nm</td>
<td>Optical encoder, optical communication (optical fiber communication, FSO), optical switch</td>
</tr>
<tr>
<td></td>
<td>1.2 to 1.55 μm</td>
<td>Moisture measurement, analysis, near infrared lighting</td>
</tr>
<tr>
<td>Mid infrared LED</td>
<td>3.3 to 4.3 μm</td>
<td>Gas detection</td>
</tr>
</tbody>
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Wide variety of packages

<table>
<thead>
<tr>
<th>Package type</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>High reliability</td>
</tr>
<tr>
<td>Plastic</td>
<td>Low cost</td>
</tr>
<tr>
<td>Surface mount type</td>
<td>Compact, thin case</td>
</tr>
<tr>
<td>With lens</td>
<td>Narrow directivity</td>
</tr>
<tr>
<td>For high output</td>
<td>High heat radiation</td>
</tr>
</tbody>
</table>

Custom devices available

In addition to changes in specifications of catalog products, fully customized products that entail new epitaxial wafer crystal growth can be provided.

Thin-film crystal growth under ultra-high vacuum in MBE equipment

Thin-film crystal growth with MOCVD equipment
Hamamatsu Photonics offers various packages of LEDs that support different wavelengths and light outputs.

### Wide-ranging product lineup

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Red LED</th>
<th>Near infrared LED</th>
<th>Mid infrared LED</th>
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<tbody>
<tr>
<td>600</td>
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<tr>
<td>4400</td>
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</table>

**Note:** For details on directivity, see pages 9 and 10.
Light emitting/receiving modules with built-in LEDs and a photosensor are embedded in VICS (Vehicle Information and Communication System) in-vehicle devices.

Optical transmission encoders require a collimated LED to achieve high accuracy.

LEDs are used for POF (plastic optical fiber) communications and FSO (free space optics).

Infrared LEDs with large output are used as light sources for infrared camera imaging. These LEDs are arranged around the camera.

Compact near infrared LEDs are used for measuring skin moisture levels.

Mid infrared LEDs are used for CO₂ density measurements in plant factories.
Red LEDs have a peak emission wavelength in the 660 to 700 nm range. They are used in a wide range of applications including optical switches, POF data communication, and barcode readers. Various types are available including a type with a reflector (cavity) on the metal base to increase the irradiance, a type with lens featuring narrow directivity, and a type that can irradiate over a wide range without a reflector.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Emission area (mm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Cutoff frequency (MHz)</th>
<th>Measurement condition (forward current) (mA)</th>
<th>Photo</th>
<th>Directivity (P9, 10)</th>
<th>Features</th>
<th>Application examples</th>
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<tbody>
<tr>
<td>L10762</td>
<td>660</td>
<td>15</td>
<td>φ0.4</td>
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<td>1.9</td>
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<tr>
<td>L11767</td>
<td>660</td>
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<td>6</td>
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<td>670</td>
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<td>670</td>
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<td>Optical switches</td>
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<td></td>
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<td>L10363</td>
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<td>High reliability, narrow directivity</td>
<td>Optical switches</td>
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</table>

*1: POF core diameter=φ1 mm, length=1 m, Z (distance between the cap surface and the fiber end)=0.3 mm
These near infrared LEDs have a peak emission wavelength in the 830 to 945 nm range. They are used in a wide range of applications including optical switches, optical fiber communication, FSO, optical rangefinders, near infrared lighting, and encoders. A wide product lineup (high output, high-speed response, superior collimation, current confinement type with mini light spot, high reliability type for in-vehicle applications, etc.) is available.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Emission area (mm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Cutoff frequency (MHz)</th>
<th>Measurement condition</th>
<th>Photo</th>
<th>Directivity (P9, 10)</th>
<th>Features</th>
<th>Application examples</th>
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<tbody>
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<td>L14336-0083R</td>
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<td>Encoders</td>
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<td>L13141-0085K</td>
<td>850</td>
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<td>1.5</td>
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<td>Narrow directivity, current confinement type</td>
<td>Optical switches</td>
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<td>Current confinement type, mini light spot</td>
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<td>L14096-0085GL</td>
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<td>1.45</td>
<td>50</td>
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<td>Optical switches</td>
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<tr>
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<td>Optical switches</td>
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<td>High output, surface mount type</td>
<td>In-vehicle</td>
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<td>Near infrared lighting</td>
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<td>Near infrared lighting</td>
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<td><img src="image" alt="Image" /></td>
<td>High output, surface mount type</td>
<td>In-vehicle</td>
</tr>
</tbody>
</table>

*2: light output  *3: PCF200 fiber end output  *4: GI50 fiber end output  *5: Pulse value=10 μs, duty ratio=1%
These high output near infrared LEDs have a peak emission wavelength at 1 μm or higher. 1.2 μm, 1.3 μm, 1.45 μm, and 1.55 μm peak emission wavelength types are available. They are used for moisture measurements, analysis, near infrared lighting, and so on. Various packages (metal package, with lens, bullet-shaped) are available.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Emission area (mm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Cutoff frequency (MHz)</th>
<th>Measurement condition</th>
<th>Photo</th>
<th>Directivity (P.9, 10)</th>
<th>Features</th>
<th>Application examples</th>
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<tbody>
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<td>Analysis, near infrared lighting</td>
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<td>Surface mount type, compact</td>
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<td>L12509-0155K</td>
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<td>50</td>
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<td>Analysis, near infrared lighting</td>
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<td>50</td>
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<td>Analysis, near infrared lighting</td>
<td></td>
</tr>
<tr>
<td>L12509-0155P</td>
<td>1450</td>
<td>120</td>
<td>ϕ3.0</td>
<td>3.8</td>
<td>0.8</td>
<td>15</td>
<td>50</td>
<td></td>
<td></td>
<td>High output</td>
<td></td>
</tr>
<tr>
<td>L12509-0155G</td>
<td>1450</td>
<td>120</td>
<td>ϕ0.31</td>
<td>3</td>
<td>0.8</td>
<td>15</td>
<td>50</td>
<td></td>
<td></td>
<td>Surface mount type, compact</td>
<td></td>
</tr>
</tbody>
</table>
### Mid infrared LED

Mid infrared LEDs with peak emission wavelengths in the middle infrared region (3.3 μm, 3.9 μm, 4.3 μm) feature high output and are used for gas detection. They are used in combination with quantum type detectors such as InAsSb photovoltaic detectors.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Emission area (mm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Rise time max. (μs)</th>
<th>Measurement condition</th>
<th>Photo</th>
<th>Directivity (P9, 10)</th>
<th>Features</th>
<th>Application examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>L13771-0330M</td>
<td>3300</td>
<td>300</td>
<td></td>
<td>0.25</td>
<td>2.1</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td>High reliability</td>
<td>Methane detection</td>
</tr>
<tr>
<td>L13771-0330C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surface mount type</td>
<td>Reference light source for gas detection</td>
</tr>
<tr>
<td>L13454-0390M</td>
<td>3900</td>
<td>500</td>
<td>1.04</td>
<td>0.2</td>
<td>1.7</td>
<td>1</td>
<td></td>
<td>80</td>
<td></td>
<td>High reliability</td>
<td>CO₂ detection</td>
</tr>
<tr>
<td>L13454-0390C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surface mount type</td>
<td></td>
</tr>
<tr>
<td>L13201-0430M</td>
<td>4300</td>
<td>700</td>
<td></td>
<td>0.3</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High reliability</td>
<td></td>
</tr>
<tr>
<td>L13201-0430C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surface mount type</td>
<td></td>
</tr>
</tbody>
</table>

### LED array (2-chip type)

This LED array incorporates a 670 nm red LED chip and an 870 nm near infrared LED chip. It is provided in a surface mount type, compact package (3.5 × 2.8 × 1.8 mm) and is suitable for optical switch light sources.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Cutoff frequency (MHz)</th>
<th>Measurement condition</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>L10922</td>
<td>670</td>
<td>25</td>
<td>4</td>
<td>1.8</td>
<td>3</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>870</td>
<td>45</td>
<td>18</td>
<td>1.47</td>
<td>40</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

### Light emitting/receiving module

This VICS in-vehicle module employs six 870 nm LED chips and one Si photodiode in a plastic package.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Pulse radiant intensity*1 (mW/sr)</th>
<th>Pulse forward voltage*1 (V)</th>
<th>Cutoff frequency (MHz)</th>
<th>Measurement condition</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>P12793</td>
<td>870*2</td>
<td>45*2</td>
<td>1550</td>
<td>6.7</td>
<td>15</td>
<td>900</td>
<td></td>
</tr>
</tbody>
</table>

*1: 4 kHz, duty ratio=50%, 4 ms ON, average peak value during pulse operation  
*2: If=100 mA

### SIP type LED

These LEDs are provided in a compact, plastic package with the LED chip molded in transparent resin and with a lens.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Peak emission wavelength (nm)</th>
<th>Spectral half width (nm)</th>
<th>Radiant flux (mW)</th>
<th>Forward voltage (V)</th>
<th>Measurement condition</th>
<th>Features</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>L10881</td>
<td>650</td>
<td>25 max.</td>
<td>-4.5 dBm*3</td>
<td>1.9</td>
<td>20</td>
<td>High output for 156 Mbps optical link</td>
<td></td>
</tr>
<tr>
<td>L5276</td>
<td>880</td>
<td>50</td>
<td>2.2</td>
<td>1.3</td>
<td>20</td>
<td>For optical switches</td>
<td></td>
</tr>
<tr>
<td>L6286</td>
<td>940</td>
<td>45</td>
<td>0.8*4</td>
<td>1.25</td>
<td>20</td>
<td>For encoders</td>
<td></td>
</tr>
<tr>
<td>L6895-10</td>
<td>940</td>
<td>60</td>
<td>1.2*4</td>
<td>1.25</td>
<td>20</td>
<td>For encoders</td>
<td></td>
</tr>
</tbody>
</table>

*3: fiber coupled optical power  
*4: minimum value
The directivities of the representative products for each type of package are provided below. The directivity may vary to some degree between individual products. For the directivity of individual products, refer to the datasheet.

**Directivity (typical examples)**

1. **Resin potted type (no reflector)**
   - Metal package

2. **Resin potted type (with reflector)**
   - Metal package

3. **Flat cap**
   - Metal package

4. **With mini lens**
   - Metal package

5. **With lens**
   - Metal package

6. **With lens (high collimation)**
   - Metal package

7. **Low-profile flat cap**
   - Metal package

8. **With ball lens**
   - Metal package
Plastic package

9 Bullet-shaped (ϕ5 mm)

10 Bullet-shaped (ϕ3 mm)

Surface mount type

11 COB (chip-on-board)

12 COB with lens

13 COB with lens (high output)

Premolded type

14 Premolded type

15 Ceramic type
Main Products

Opto-semiconductors
- Si photodiodes
- APD
- MPPC
- Photo IC
- Image sensors
- PSD
- Infrared detectors
- Optical communication devices
- Automotive devices
- X-ray flat panel sensors
- Mini-spectrometers
- Opto-semiconductor modules

Electron tubes
- Photomultiplier tube modules
- Microchannel plates
- Image intensifiers
- Xenon lamps / Mercury xenon lamps
- Deuterium lamps
- Light source applied products
- Laser applied products
- Microfocus X-ray sources
- X-ray imaging devices

Imaging and processing systems
- Cameras / Image processing measuring systems
- X-ray products
- Life science systems
- Medical systems
- Semiconductor failure analysis systems
- FPD / LED characteristic evaluation systems
- Spectroscopic and optical measurement systems

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- Applied products of semiconductor lasers
- Solid state lasers

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Quality, technology, and service are part of every product.

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