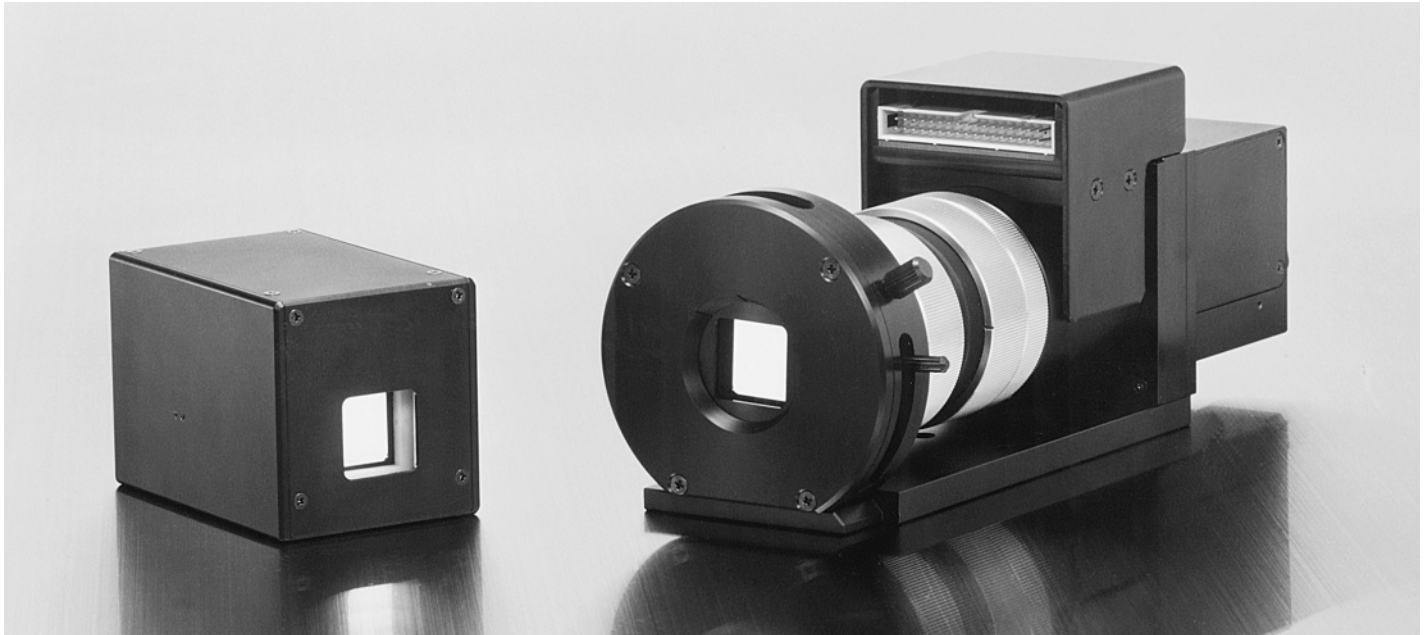


SLM MODULE

PPM (Programmable Phase Modulator)



▲ Left: X8077, Right: X8267

OVER VIEW

The PPM or Programmable Phase Modulator is an electrically-addressed phase modulator using an optical image transmitting element to couple an optically-addressed PAL-SLM (Parallel Aligned Nematic Liquid Crystal Spatial Light Modulator) with an electrically-addressed intensity modulator.

Conventional optically-addressed phase modulators are difficult to control by computer, while electrically-addressed phase modulators have the drawback that unwanted diffraction light is generated due to the pixel structure in the electrical signal input section and that light utilization efficiency is low because of a small fill factor. The PPM uses an LCD to allow computer control and also employs a newly developed optical system to eliminate diffraction noise originating from the LCD pixel structure. This unique configuration allows easy computer-controlled pixel manipulation yet produces images with no pixel. The PPM also allows optical information processing using optical diffraction with large phase modulation characteristics and spatial Fourier optics.

Two PPM models, X8077 and X8267, are now available. The X8077 incorporates a compact LD (laser diode) module as the light source for image input from a VGA type LCD, and has a FOP (fiber optic plate) as the optical transmitting element. The X8267 also incorporates a compact LD module but uses a XGA type LCD coupled with an optical lens. The readout light, modulation level and response speed can be optimized to meet your particular needs. The previous model X7550 using a conventional VGA type LCD coupled with an optical lens and the L8279 laser module are also available.

FEATURES

- Compact
- Easy computer-controlled electrical writing
- Output image has no pixel structure
- Large amount of phase modulation
- High diffraction efficiency
- Diffraction light noise at LCD greatly reduced

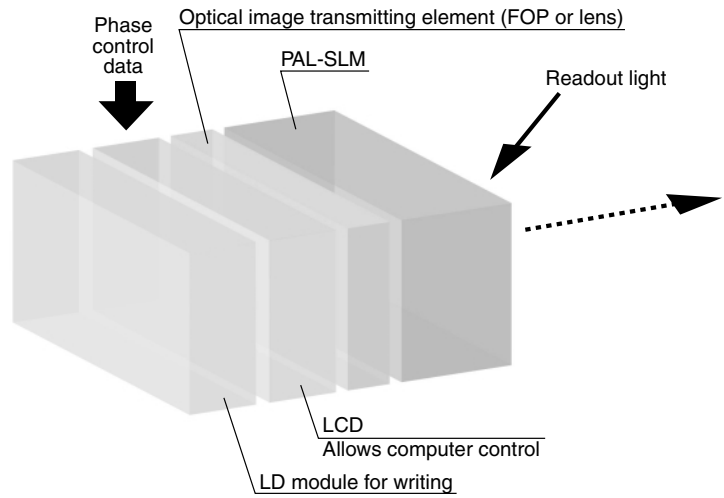
APPLICATIONS

- Flexible laser marker
- Molecular laser scalpel
- Adaptive optics
- E-Commerce

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INTERNAL STRUCTURE

The PPM consists of a PAL-SLM (Parallel Aligned Nematic Liquid Crystal Spatial Light Modulator) efficiently coupled with an electrical signal input type LCD by an optical image transmitting element (FOP or lens) and also incorporating a write-in LD module.



OPERATING CHARACTERISTICS

Figure 1 shows typical diffraction efficiency measured when a binary phase lattice (lattice image of (a) in Figure 2) is input to the PPM. A high diffraction efficiency nearly equal to the theoretical maximum value (40.5 %) is obtained.

To increase the diffraction light intensity even further, the input of a sawtooth lattice image like that shown in (b) of Figure 2 is usually effective. However, creating a sawtooth lattice image like this requires a great number of pixels.

Figure 2 shows models having double the maximum display spatial frequency (for example, device (a): 9.5 lp/mm and device (b): 19 lp/mm). A lattice image displayable with device (a) at the maximum spatial frequency is a binary phase lattice with a lattice pitch of 105 μm . At this point, device (b) is capable of displaying an image with double the frequency (in other words, 1/2th the controllable pixel pitch), so a 4-step sawtooth phase image can be displayed within the same lattice pitch. This means that theoretically double the diffraction efficiency is obtained.

The relation between devices (a) and (b) holds true between the X8077 and X8267. The X8267 can display a 4-step sawtooth phase lattice image near the maximum display spatial frequency while the X8077 shows no more than binary phase lattice images. The X8267 therefore delivers an actual diffraction efficiency of 70 % or more.

Figures 3 (b) and (c) show an output image from the PPM obtained at different phases when LCD information in (a) is input. The LCD pixel structure disappears in the PPM output images in both (b) and (c). As can be seen from (c), the phase modulation at 2π radian can be obtained.

Figure 1: Comparison of diffraction efficiency

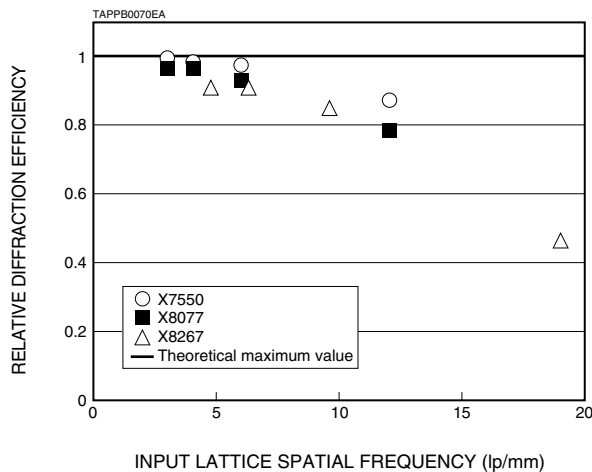


Figure 2: Diffraction ability at different number of pixels

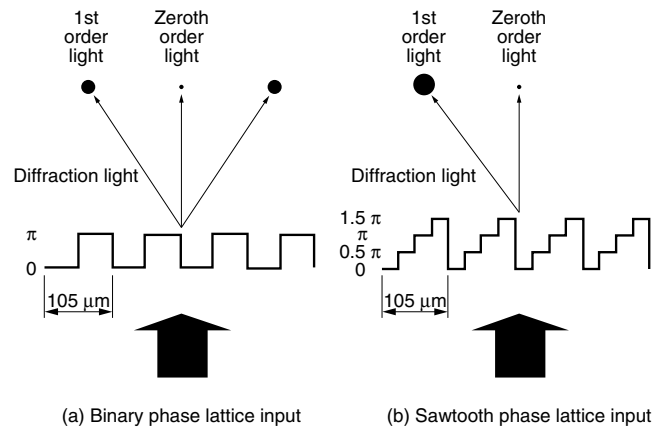
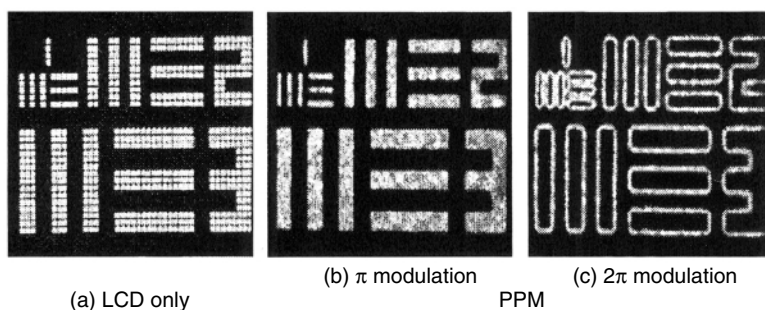


Figure 3: Output image comparison



TAPPC0097EA

SPECIFICATIONS

| Parameter | X8077 | X8267 | Unit |
|---|--|---|--|
| Features | <ul style="list-style-type: none"> · FOP optical transmitting. · Most compact model. · Compact LD module built-in. · Output image without pixel structure. | <ul style="list-style-type: none"> · More control point with an XGA type LCD. · Compact LD module built-in. · More compact than that the former VGA type model. · Output image without pixel structure. | — |
| Input signal (IBM PC/AT [Windows/DOS]) | VGA | XGA | — |
| Number of control pixels | Approx. 230 000 | Approx. 590 000 | pixels |
| Effective image area | 20 × 20 (Four corners rounded) | | mm |
| Optical image transmitting element | FOP | Lens | — |
| Phase modulation level (readout light wavelength: 633 nm) | More than 2π | | radian Min. |
| Maximum display spatial resolution | 12 | 19 | Lp/mm |
| LCD | Display type | | Active matrix monochrome 1.3-inch LCD |
| | Display mode | | Transmission mode, normally-white, TN type |
| | Number of pixels (H × V) | | 644 × 488 1024 × 768 |
| Input voltage | 100 to 240 (50 Hz / 60 Hz) | | V ac |
| Power consumption | 40 | 45 | VA |
| Weight | Approx. 450 | Approx. 1600 | g |

READOUT LIGHT WAVELENGTH

Hamamatsu designs and optimizes device elements according to light wavelengths used in your application.

Standard devices

| Suffix | Suitable wavelength range |
|--------|---------------------------|
| -11 | 500 nm to 600 nm |
| -12 | 600 nm to 700 nm |
| -13 | 700 nm to 800 nm |
| -14 | 800 nm to 900 nm |
| -15 | 1000 nm to 1100 nm |
| -16 | 400 nm to 700 nm |

Custom devices

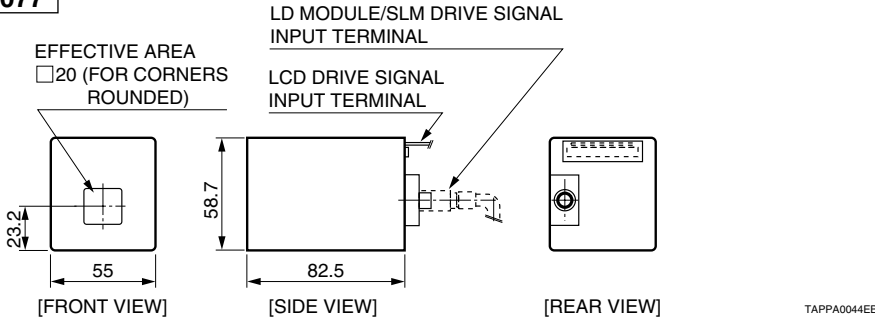
We are able to produce devices that meet your requirement in the wavelength range from 400 nm to 1550 nm.

Examples: Devices for 1550 nm

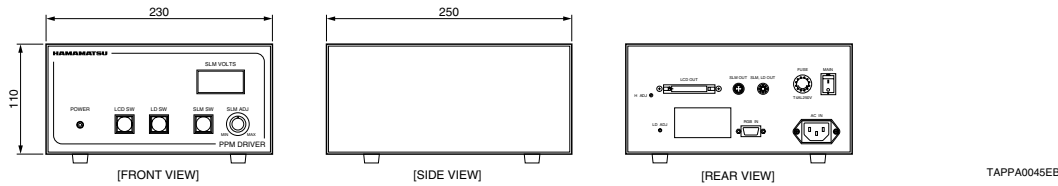
Devices for 500 nm to 800 nm

DIMENSIONAL OUTLINES (Unit: mm)

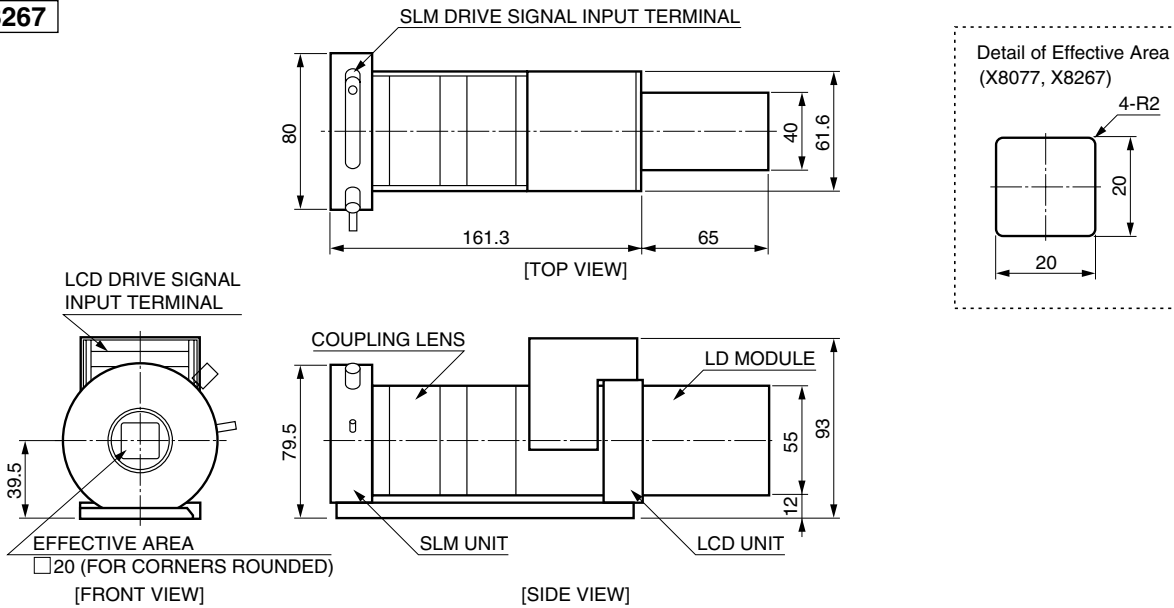
X8077



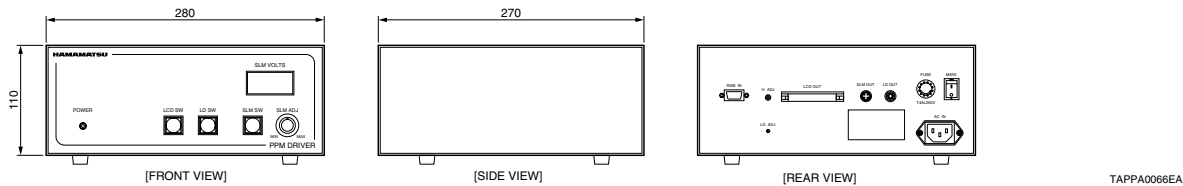
X8077 Driving Power Supply (supplied)



X8267



X8267 Driving Power Supply (supplied)



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HAMAMATSU PHOTONICS K.K., Electron Tube Center

314-5, Shimokanzo, Toyooka-village, Iwata-gun, Shizuoka-ken, 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205

U.S.A.: Hamamatsu Corporation, 360 Foothill Road, P. O. Box 6910, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: usa@hamamatsu.com

Germany: Hamamatsu Photonics Deutschland GmbH, Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658 E-mail: info@hamamatsu.de

France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10 E-mail: infos@hamamatsu.fr

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road Welwyn Garden City Hertfordshire AL7 1BW, United Kingdom, Telephone: 44-(0)1707-294888, Fax: 44(0)1707-325777 E-mail: info@hamamatsu.co.uk

North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171-41 SOLNA, Sweden, Telephone: (46)8-509-031-00, Fax: (46)8-509-031-01 E-mail: info@hamamatsu.se

Italy: Hamamatsu Photonics Italia: S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39)02-935 81 733, Fax: (39)02-935 81 741 E-mail: info@hamamatsu.it

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