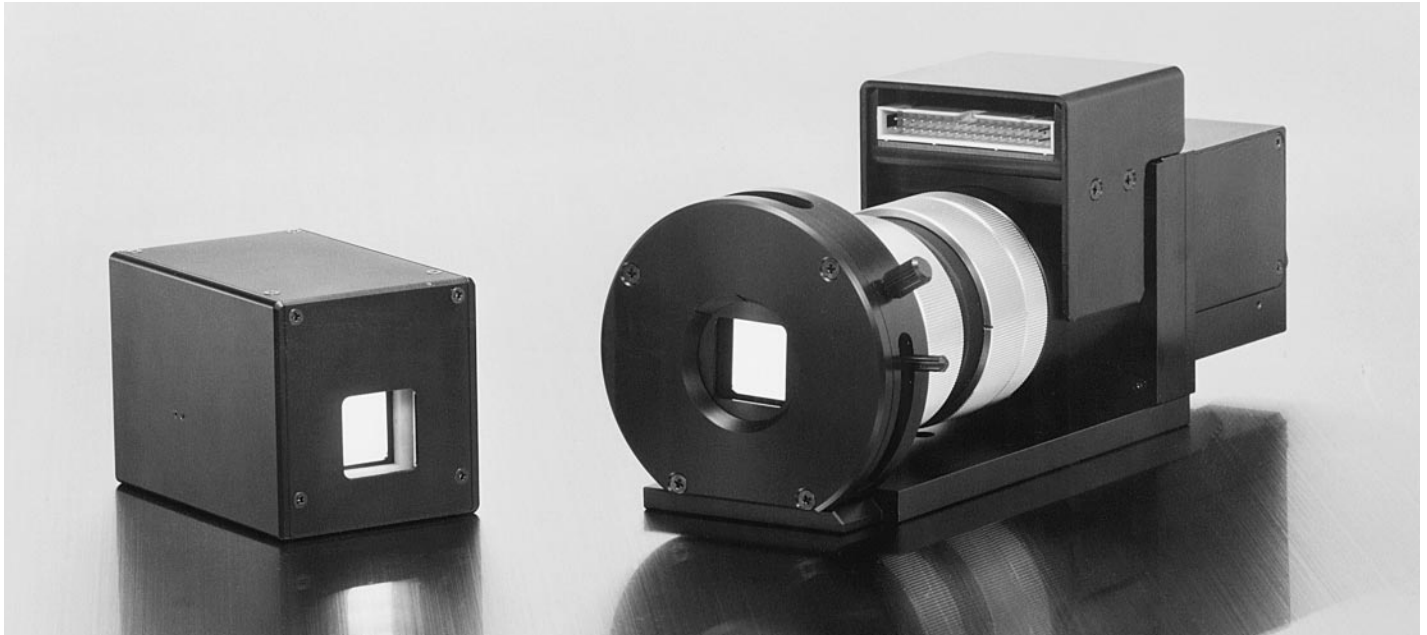


NEW

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 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 laser diode 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 and lens coupling and the L7666 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

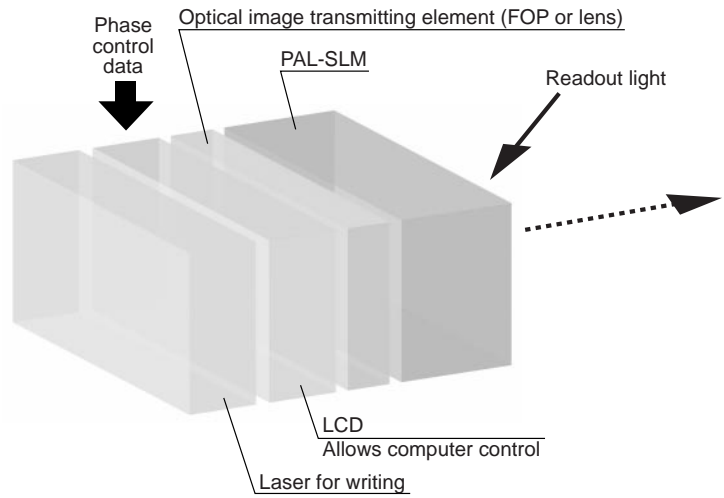
APPLICATIONS

- 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 laser.



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

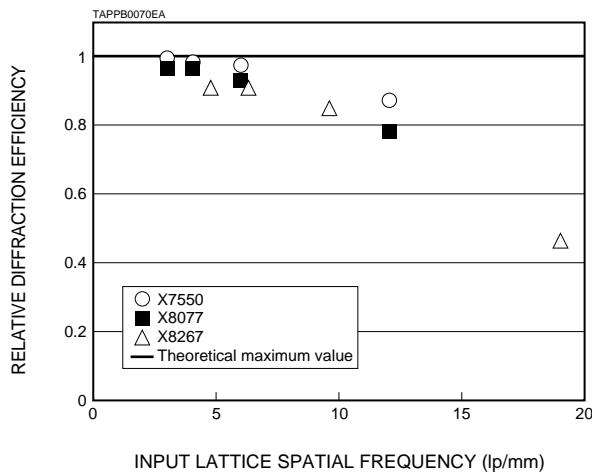


Figure 2: Diffraction ability at different number of pixels

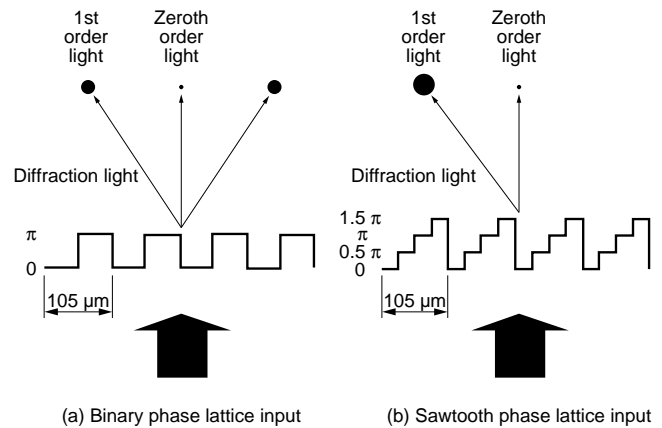
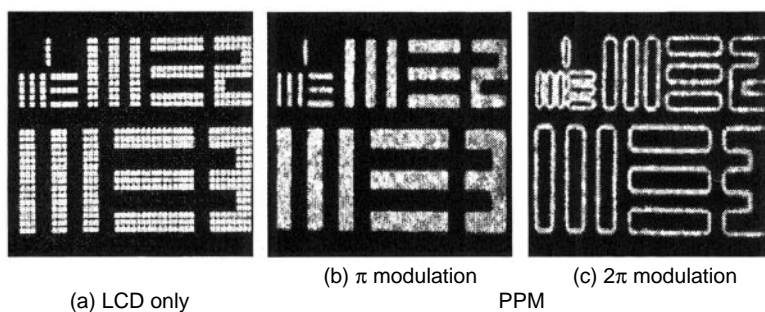


Figure 3: Output image comparison



TAPPC0097EA

SPECIFICATIONS

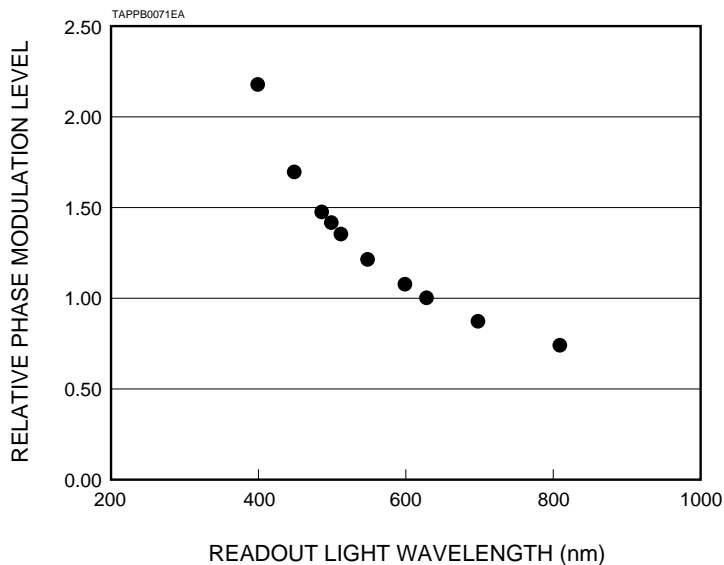
Parameter	X8077	X8267	Unit
Features	<ul style="list-style-type: none"> · FOP optical transmitting. · Most compact model. · Compact LD module built-in. · Output image without pixel structure. 	<ul style="list-style-type: none"> · More control point with an XGA type LCD. · Compact LD module built-in. · 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) [Ⓐ]	2 π		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	85 to 132		V ac
Power consumption	40	45	VA
Dimensions (W × H × D)	55 × 58.7 × 82.5	80 × 93 × 226.3 [Ⓑ]	mm
Weight	Approx. 450	Approx. 1600	g

NOTE: Ⓐ Phase modulation level depends on the readout light wavelength.

Ⓑ Maximum dimensions excluding projecting parts.

CHARACTERISTICS

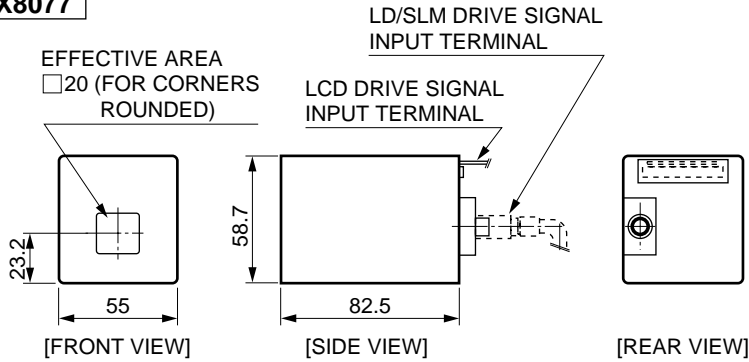
Figure 4: Phase modulation vs. readout light wavelength



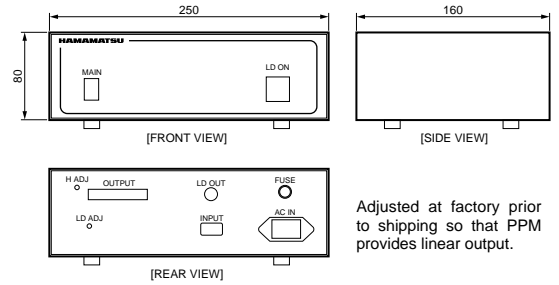
As the refractive index of liquid crystal materials is wavelength dependent, the PPM phase modulation changes with readout light wavelength even if the same liquid crystal conditions are maintained. We optimize the device elements on request, to design a PPM that best suits your application.

DIMENSIONAL OUTLINES (Unit: mm)

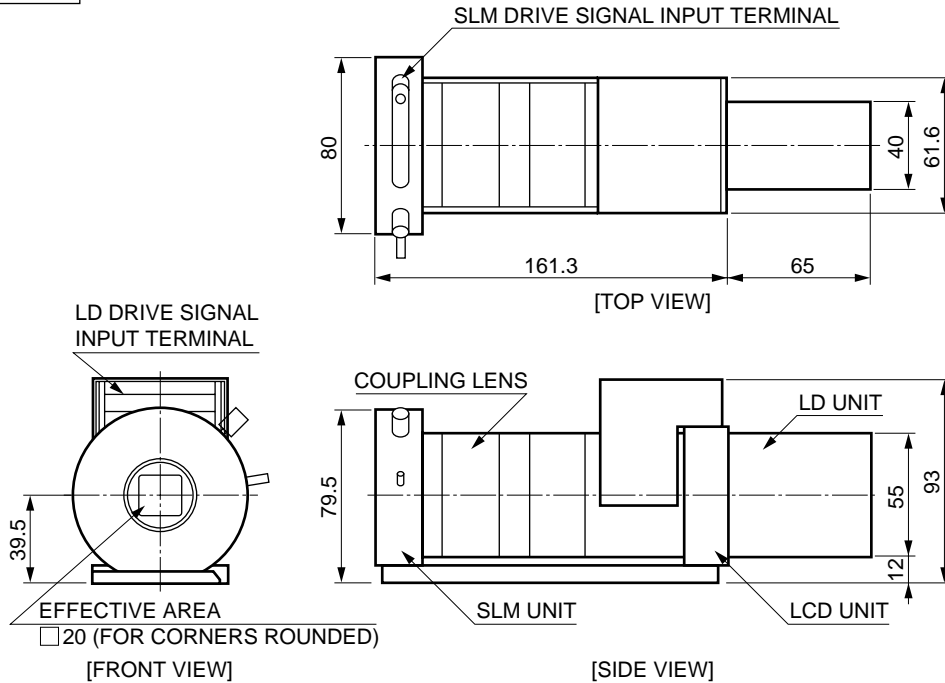
X8077



LD/LCD Driving Power Supply (supplied)



X8267



OPTION (Sold Separately)

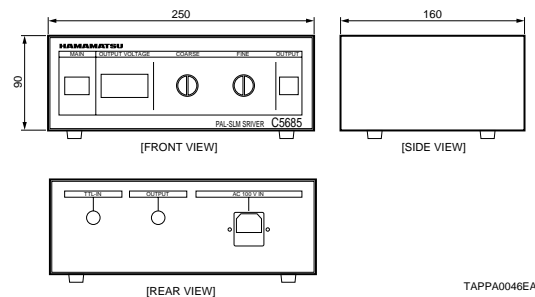
PAL-SLM Driving Power Supply C5685

The C5685 driving power supply is specifically designed to minimize the DC offset that may cause liquid crystal deterioration.

SPECIFICATIONS

Power requirement	85 V ac to 132 Vac
Output frequency	1 kHz (Selectable range from 0.83 MHz to 1 MHz by DIP switch)
Output voltage	±5 V (digital display)
Output waveform	Rectangular waveform
External gate	Output ON/OFF switching by TTL signal

Dimensional Outlines (Unit: mm)



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