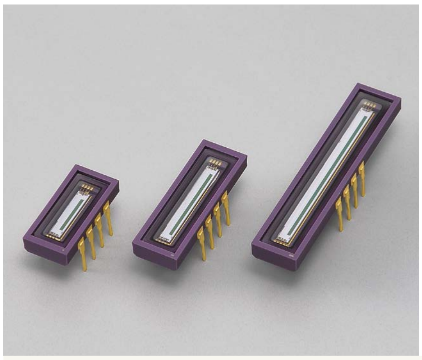
HAMAMATSU

PHOTON IS OUR BUSINESS



CMOS linear image sensors

S8377/S8378 series

Built-in timing generator and signal processing circuit; 5 V single supply operation

The S8377/S8378 series is a family of CMOS linear image sensors designed for image input applications. These linear image sensors operate from 5 V single supply with only start and clock pulse inputs, making them easy to use. The signal processing circuit has a charge amplifier with excellent input/output characteristics and allows signal readout at 500 kHz.
The photodiodes of the S8377 series have a height of 0.5 mm and are arrayed in a row at a spacing of 50 µm. The photodiodes of the S8378 series also have a height of 0.5 mm but are arrayed at a spacing of 25 µm. The photodiodes are available in 3 different pixel quantities for each series: 128 (S8377-128Q), 256 (S8377-256Q, S8378-256Q), 512 (S8377-512Q, S8378-512Q) and 1024 (S8378-1024Q). Quartz glass is the standard window material.

Features

- **Wide photosensitive area**
  Pixel pitch: 50 µm (S8377 series)
  25 µm (S8378 series)
  Pixel height: 0.5 mm
- **On-chip charge amplifier with excellent input/output characteristics**
- **Built-in timing generator allows operation with only start and clock pulse inputs**
- **Maximum operating clock frequency: 500 kHz**
- **Spectral response range: 200 to 1000 nm**
- **5 V single power supply operation**
- **8-pin small package, S8377 and S8378 series are pin compatible.**

Applications

- **Image input devices**
- **Optical sensing devices**

Structure

Parameter	S8377-128Q	S8377-256Q	S8377-512Q	S8378-256Q	S8378-512Q	S8378-1024Q	Unit
Number of pixels	128	256	512	256	512	1024	-
Pixel pitch	50			25			µm
Pixel height	0.5						mm
Package length	15.8	22.2	35.0	15.8	22.2	35.0	mm
Number of pins	8						-
Package	Ceramic						-
Window material	Quartz						-

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vdd	Ta=25 °C	-0.3 to +10	V
Gain selection terminal voltage	Vg	Ta=25 °C	-0.3 to +10	V
Clock pulse voltage	V(CLK)	Ta=25 °C	-0.3 to +10	V
Start pulse voltage	V(ST)	Ta=25 °C	-0.3 to +10	V
Operating temperature	Topr	No dew condensation*1	-20 to +60	°C
Storage temperature	Tstg	No dew condensation*1	-20 to +80	°C

*1: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Recommended terminal voltage

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	4.75	5	5.25	V
Gain selection terminal voltage	High gain	Vg	0	-	0.4	V
	Low gain		Vdd - 0.25	Vdd	Vdd + 0.25	V
Clock pulse voltage	High level	V(CLK)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	V
Start pulse voltage	High level	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	V

Electrical characterisitics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency*2	f(CLK)	0.1 k	-	500 k	Hz
Output impedance	Zo	-	1	-	kΩ
Power consumption	P	-	15	-	mW

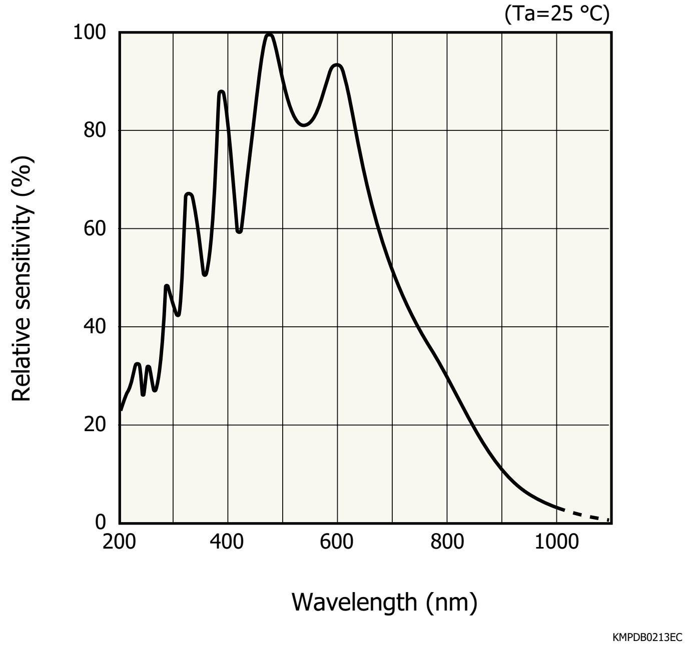
*2: Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V, Vg=5 V (low gain)

Electrical and optical characteristics [Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V]

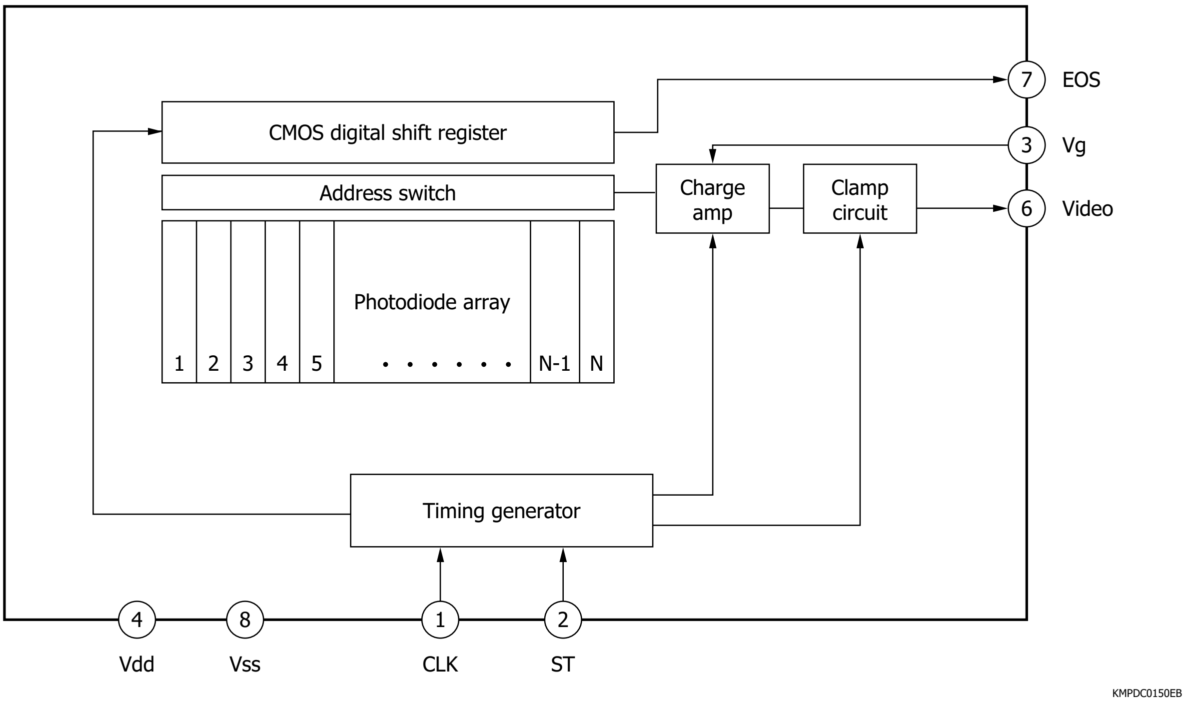
Parameter		Symbol	S8377 series			S8378 series			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Spectral response range		λ		200 to 1000			200 to 1000		nm
Peak sensitivity wavelength		λp	-	500	-	-	500	-	nm
Photosensitivity	High gain	Sw	-	22	-	-	22	-	V/lx·s
	Low gain		-	4.4	-	-	4.4	-	
Dark current		I_D	-	0.01	0.03	-	0.01	0.03	pA
Saturation charge		Qsat	-	12.5	-	-	6.3	-	pC
Feedback capacitance*3 of charge amplifier	High gain	Cf	-	1	-	-	0.5	-	pF
	Low gain		-	5	-	-	2.5	-	
Dark output voltage*4	High gain	Vd	-	1.0	3.0	-	2.0	6.0	mV
	Low gain		-	0.2	0.6	-	0.4	1.2	
Saturation output voltage	High gain	Vsat	2.8	3.2	-	2.8	3.2	-	V
	Low gain		2.1	2.5	-	2.1	2.5	-	
Saturation exposure*5	High gain	Esat	-	145	-	-	145	-	mlx·s
	Low gain		-	570	-	-	570	-	
Readout noise	High gain	Nread	-	0.4 (-128Q)	-	-	0.9 (-256Q)	-	mV rms
			-	0.5 (-256Q)	-	-	1.3 (-512Q)	-	
			-	0.8 (-512Q)	-	-	2.1 (-1024Q)	-	
	Low gain		-	0.1 (-128Q)	-	-	0.2 (-256Q)	-	
			-	0.15 (-256Q)	-	-	0.3 (-512Q)	-	
			-	0.2 (-512Q)	-	-	0.4 (-1024Q)	-	
Output offset voltage		Voffset	0.8	1.0	1.2	0.8	1.0	1.2	V
Photoresponse nonuniformity*6		PRNU	-	-	±3	-	-	±3	%

*3: Vg=5 V (low gain), Vg=0 V (high gain)
*4: Integration time=100 ms
*5: Measured with a tungsten lamp of 2856 K
*6: Photoresponse nonuniformity (PRNU) is the output nonuniformity that occurs when the entire photosensitive area is uniformly illuminated by light which is 50% of the saturation exposure level. PRNU is defined as follows:
PRNU= ΔX/X × 100 [%]
X: average output of all pixels, ΔX: difference between X and maximum or minimum output

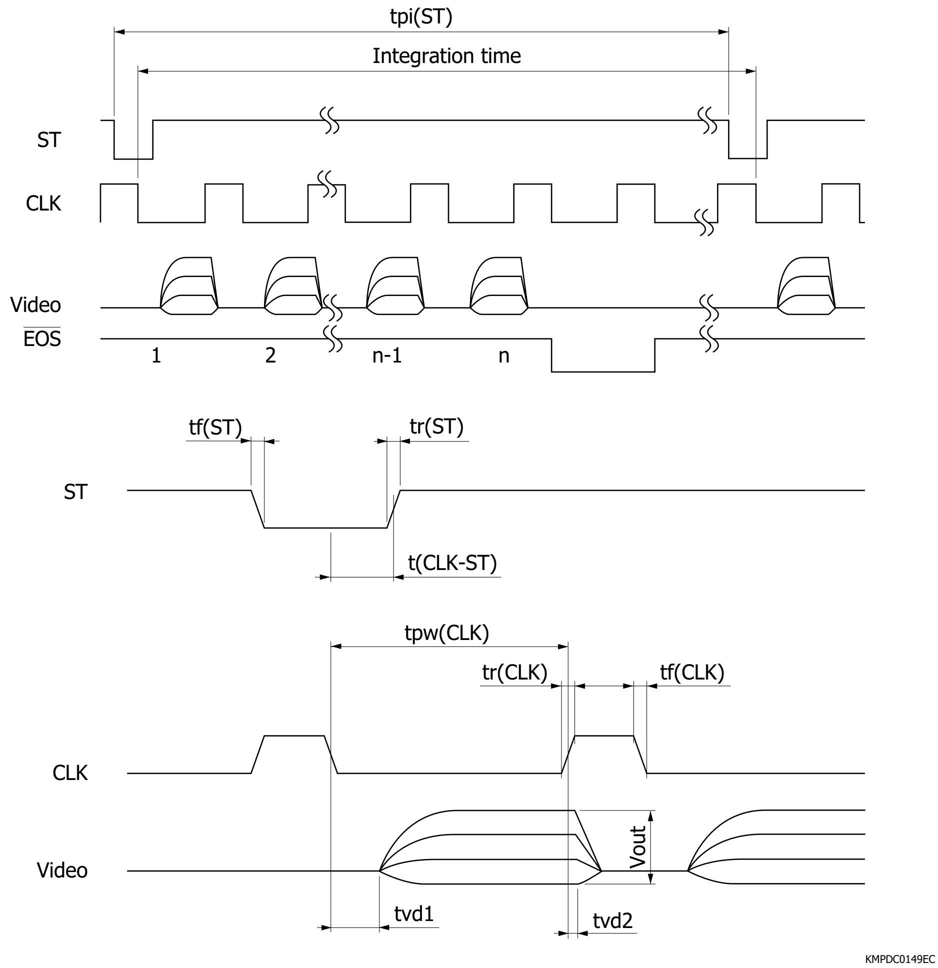
Spectral response (typical example)



Block diagram



Timing chart

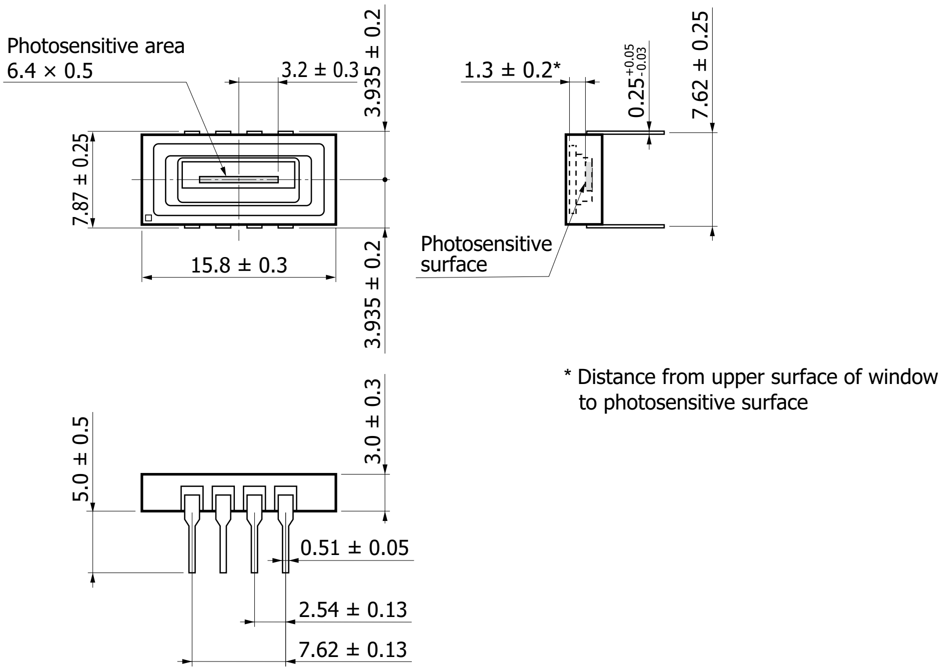


Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse width interval	tpi(ST)	1/f × (number of pixels + 2)	-	-	s
Start pulse rise and fall times	tr(ST), tf(ST)	0	20	30	ns
Clock pulse width	tpw(CLK)	1000 ns	-	5 ms	-
Clock pulse rise and fall times	tr(CLK), tf(CLK)	0	20	30	ns
Clock pulse-start pulse timing	t(CLK-ST)	400 ns	-	5 ms	-
Video delay time 1	tvd1	200	300	400	ns
Video delay time 2	tvd2	50	150	250	ns

Note: The CLK pulse should be set from high to low just once when the ST pulse is low. The internal shift register starts operating at this timming.
Integration time is determined by the interval between the CLK falling edge during the Low period of a start pulse and the CLK falling edge during the Low period of the next start pulse. However, since the charge integration of each pixel is carried out between the signal readout of that pixel and the next signal readout of the same pixel, the start time of charge integration differs depending on each pixel. In addition, the next start pulse cannot be input until signal readout from all pixels is completed.

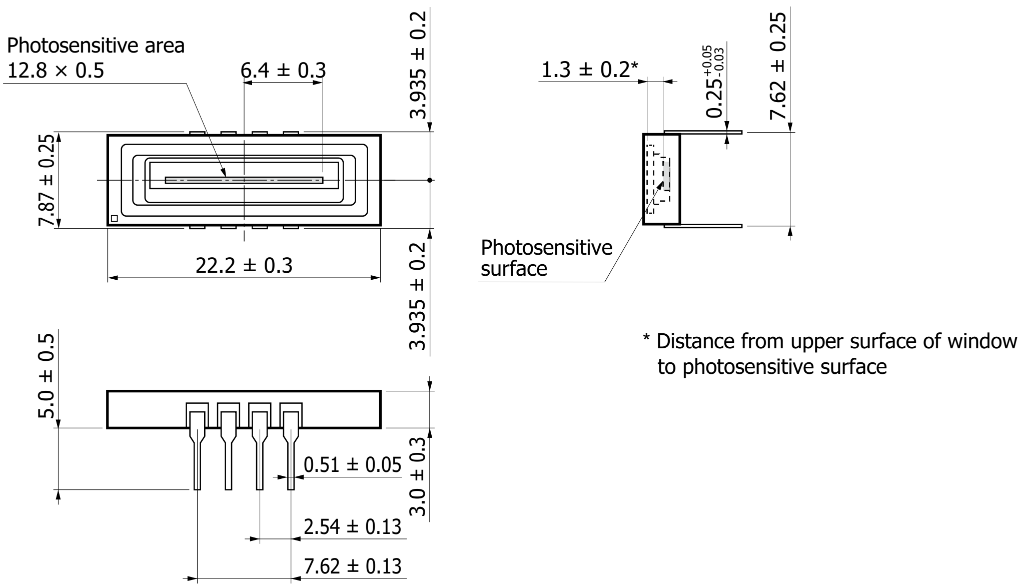
Dimensional outlines (unit: mm)

S8377-128Q, S8378-256Q



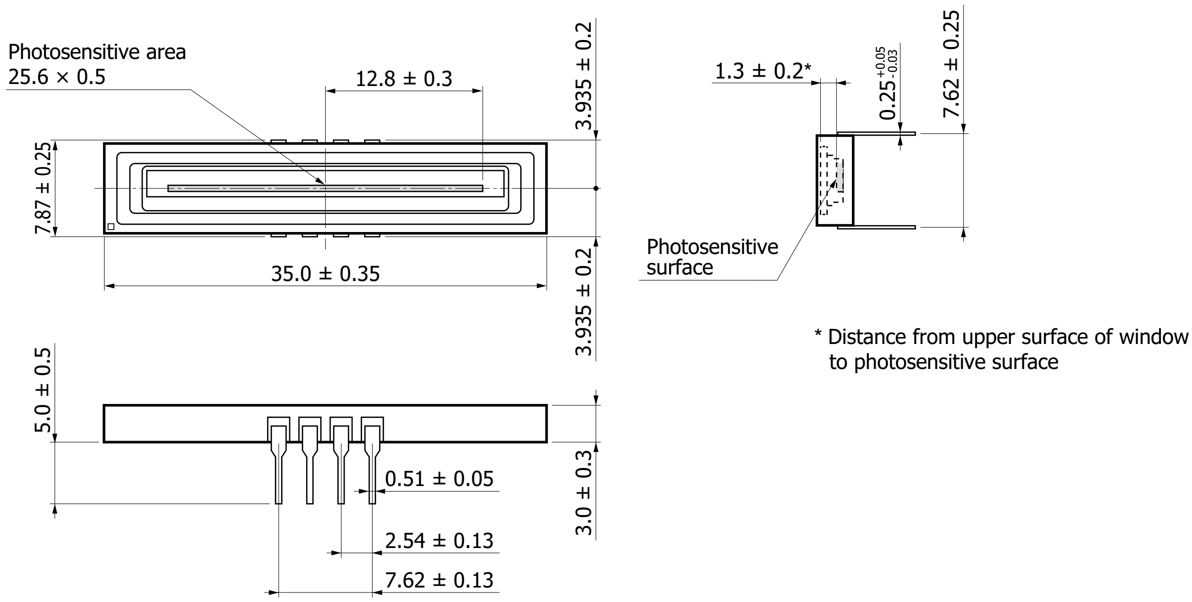
KMPDA0150ED

S8377-256Q, S8378-512Q



KMPDA0151ED

S8377-512Q, S8378-1024Q



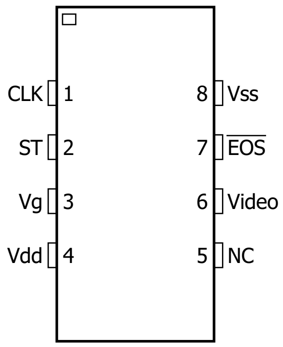
KMPDA0152ED

Pin connections

Pin no.	Symbol	Name of pin	Function
1	CLK	Clock pulse	Pulse input to operate the shift register. The readout time (data rate) equals the clock pulse frequency.
2	ST	Start pulse	Starts the shift register operation. Integration time is determined by the interval between the CLK falling edge during the Low period of a start pulse and the CLK falling edge during the Low period of the next start pulse.
3	Vg	Gain selection voltage	Input of 5 V selects "Low gain" and 0 V selects "High gain".
4	Vdd	Supply voltage	5 V typ.
5	NC	No connection	Open
6	Video	Video signal*7	Signal output. Positive-going signal from output offset voltage
7	$\overline{EOS}$	End of scan	Negative-going signal output obtained at a timing following the last pixel scan
8	Vss	GND	

*7: Connect a buffer amplifier for impedance conversion to the video output terminal so as to minimize the current flow. As the buffer amplifier, use a high input impedance operational amplifier with JFET or CMOS input.

Note: Leave the "NC" terminals open and do not connect them to GND.



KMPDC0151EA

Handling precautions

(1) Electrostatic countermeasures

Although the CMOS linear image sensor is protected against static electricity, proper electrostatic countermeasures must be provided to prevent device destruction by static electricity. For example, such measures include wearing non-static gloves and clothes, and grounding the work area and tools.

(2) Incident window

If the incident window is contaminated or scratched, the output uniformity will deteriorate considerably, so care should be taken in handling the window. Avoid touching it with bare hands.

The window surface should be cleaned before using the device. If dry cloth or dry cotton swab is used to rub the window surface, static electricity may be generated, and therefore this practice should be avoided. Use soft cloth, cotton swab or soft paper moistened with ethyl alcohol to wipe off dirt and foreign matter on the window surface.

(3) UV exposure

The CMOS linear image sensor is designed to suppress performance deterioration due to UV exposure. Even so, avoid unnecessary UV exposure to the device.

Also, be careful not to allow UV light to strike the cemented portion between the ceramic base and the glass.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
· Disclaimer
· Image sensors

■ Technical information
· CMOS linear image sensors

HAMAMATSU

www.hamamatsu.com

HAMAMATSU PHOTONICS K.K., Solid State Division
1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81)53-434-3311, Fax: (81)53-434-5184
U.S.A.: HAMAMATSU CORPORATION: 360 Foothill Road, Bridgewater, NJ 08807, 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, 82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8 E-mail: info@hamamatsu.de
France: HAMAMATSU PHOTONICS FRANCE S.A.R.L.: 19, 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, UK, Telephone: (44)1707-294888, Fax: (44)1707-325777 E-mail: info@hamamatsu.co.uk
North Europe: HAMAMATSU PHOTONICS NORDEN AB: Torshamnsgatan 35 16440 Kista, 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 int. 6, 20044 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41 E-mail: info@hamamatsu.it
China: HAMAMATSU PHOTONICS (CHINA) CO., LTD.: 1201 Tower B, Jiaming Center, 27 Dongsanhuan Beilu, Chaoyang District, 100020 Beijing, P.R. China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866 E-mail: hpc@hamamatsu.com.cn
Taiwan: HAMAMATSU PHOTONICS TAIWAN CO., LTD.: 8F-3, No.158, Section 2, Gongdao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C. Telephone: (886)3-659-0080, Fax: (886)3-659-0081 E-mail: info@hamamatsu.com.tw

Cat. No. KMPD1066E11 Feb. 2022 DN