Confidential

To:SAMPLE ACCOUNTS

Type:LE0178

Test Data Sheet Of LE0178

~ 1pc ~

21 March, 2014

HAMAMATSU PHOTONICS K.K.
Laser Group

Reported by:

Confirmation:

Approval:

HAMAMATSU

Datasheet for
Type:LE0178
S/N:4703-2776-C04

Confidential

■ Absolute maximum ratings

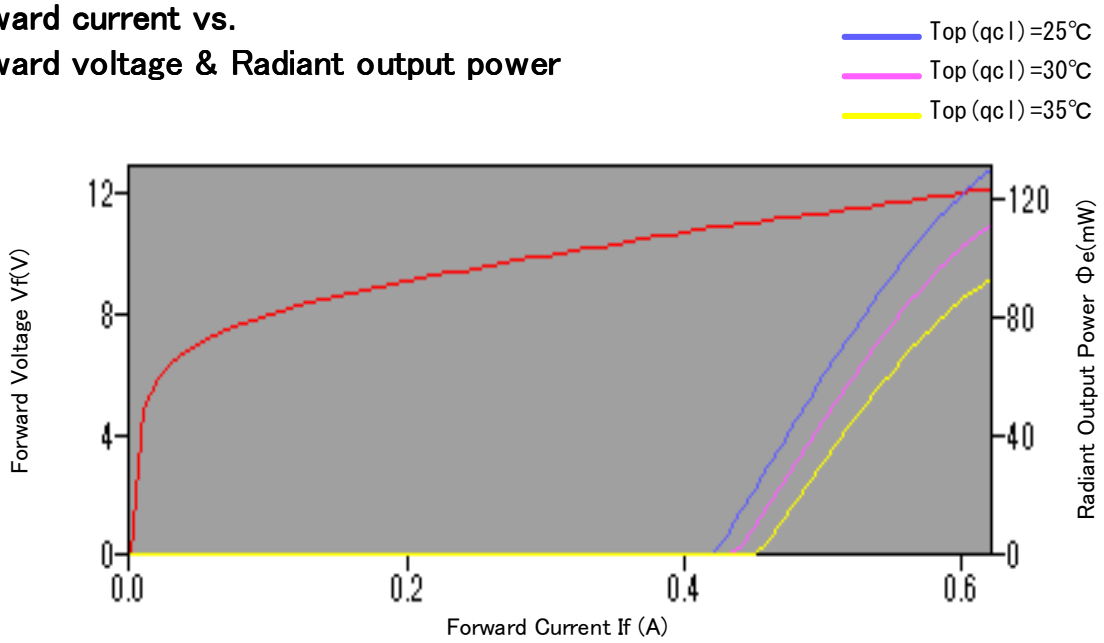
Top(qcl)=20 ℃, Unless otherwise specified

Parameters	Symbols	Ratings	Units
Forward current	Ifmax	0.62	A
Forward voltage	Vfmax	12.4	V
Reverse voltage	Vr	0.0	mV
TEC current (Cooling mode)	Ic	+3.7	A
TEC current (Heating mode)		-1.5	A
TEC voltage	Vc	±13.0	V
Operating temperature (Case)	Top(c)	+10 to +60	℃
Operating temperature (QCL)	Top(qcl)	0 to +55	℃
Storage temperature	Tstg	-20 to +65	℃

Datasheet for

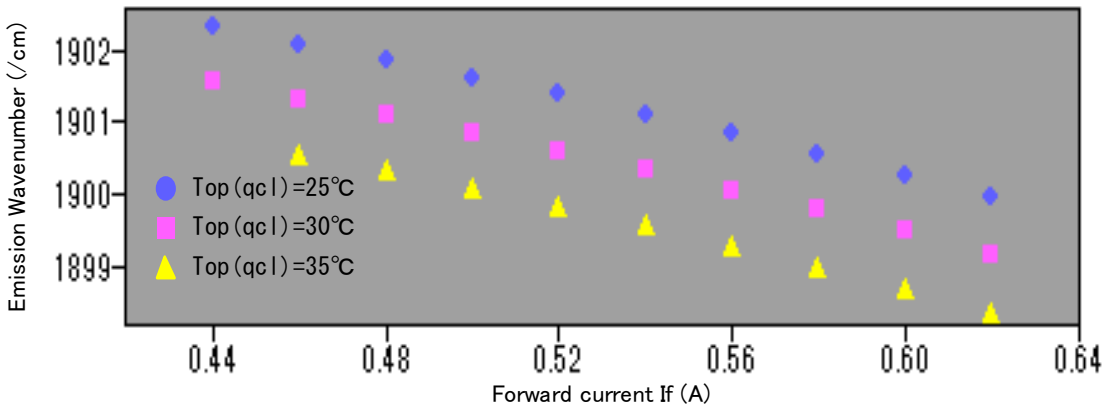
S/N : 4703-2776-C04

1, Forward current vs. Forward voltage & Radiant output power



2, Emission wavenumber data

Forward current (A)	Emission wavenumber data (/cm)		
	Top(qcl)=25℃	Top(qcl)=30℃	Top(qcl)=35℃
0.44	1902.31	1901.56	-
0.46	1902.07	1901.32	1900.56
0.48	1901.86	1901.08	1900.32
0.50	1901.62	1900.84	1900.08
0.52	1901.38	1900.59	1899.84
0.54	1901.11	1900.32	1899.57
0.56	1900.84	1900.05	1899.27
0.58	1900.56	1899.78	1899.00
0.60	1900.26	1899.48	1898.70
0.62	1899.96	1899.18	1898.36



HAMAMATSU

— Read the following instructions carefully before using the Quantum Cascade Laser —

In order to use our Quantum Cascade Laser (QCL) properly, read the following instructions carefully. The instructions contain important information concerning practical use, storage and transportation. After readout the instructions, keep it where it can be referred to easily.

⚠ DANGER (Class 3B Laser)
Invisible Laser Radiation – Avoid Exposure to Beam

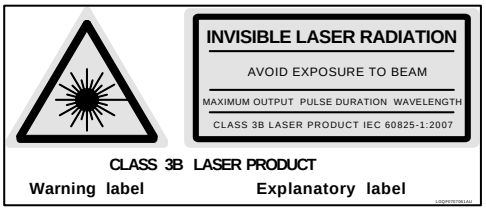
● Exposure to the Laser Beam

The Laser emits invisible laser radiation. The instrument which uses the LASER, operated under ordinary conditions, is classified as Class 3B according to the laser product classification code IEC 60825-1. Direct laser beams or indirect laser beams viewed through lenses or reflected by mirrors may damage your eyes or skin. In particular exposing the eye to the laser beam may cause serious damage.

When using the Class 3B Laser, for safe operation, ensure that the following countermeasures are taken:

- ◆Install the remote interlock
- ◆Equip a key-operated master control
- ◆Set the beam stop or attenuator against the laser beam
- ◆Set the device for informing the user the laser beam is turned on
- ◆Display the warning label in the laser product
- ◆Ensure that the beam path terminates at the appropriate point
- ◆Ensure prevention of unexpected mirror reflection
- ◆Wear eye protection (goggles, window-shield etc.)
- ◆Wear skin protection (protective clothing)
- ◆Ensure all users have appropriate education and training for safety of laser products

See IEC 60825-1:2007 for more details concerning the above countermeasures



● Toxic Substances

Hazardous compounds such as GaAs (Gallium Arsenide) are used in the Laser chip. Attention should be paid to the following:

- · Removing the Laser chip from the product, breaking it into pieces or melting it are all extremely dangerous.
- · Hazardous compounds of Laser chip may be exposed if the surface is fractured. Therefore, do not touch the Laser chip with bare hands no matter if it is fractured.
- · Disposing the Laser must be subject to the local regulations at the end-user site.

⚠ Handling Precautions ・・・ Negligence following the instructions may lead to the degradation of the Laser

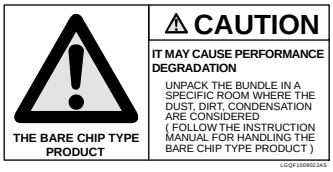
● Protection against Electrostatic Discharges

The Laser is an Electrostatic-Discharge Sensitive (ESDS) device that may be damaged or deteriorated by electrostatic discharges. When handling the Laser, ensure the following measures are taken:

- · The conductive sheet which is electrically grounded through 1 MΩ resistor should be laid on all worktables and floors of the work area.
- · Operators should wear wrist straps and conductive fingerstalls grounded through 1 MΩ resistor.
- · For containers which may make contact the Laser in transportation and storage, use antistatic or static dissipating material (e.g. static free bags or conductive cases shielded with static dissipating styrene). Connect electrodes when they are transported or kept in storage. (When the short-circuit parts are attached to the Laser, they must be used for the connection).

● Handling the Bare Chip Type Laser

When handling the bare chip Laser, dust, expiration, fingerprints, sputum, condensation, and fracture may lead Laser performance degradation. The following countermeasures should be taken:



- · For the bare chip type Laser which is incorporated into the instrument, keep the Laser in an airtight container; do not expose it to the air and keep it away from contact with dust. The air in the container should be kept dry (humidity: less than 40 %).
- · Handle the bare type Laser in a clean room and keep it away from expiration, fingerprints, sputum, and solvents until the installation in the airtight container is completed.
- · Do not touch or drop the Laser chip. Do not clean the Laser in any way.

● Vibration and Shock

Mechanical vibration and shock may damage the Laser and lead to the degradation of its performance. Please pay attention to the following;

- · Do not drop the Laser; once the Laser is dropped, HAMAMATSU will not guarantee the Laser performance.
- · For the products to be installed by screw cramps, do not push the other parts of the Laser.

(Turn the page)

⚠Handling Precautions（continued） ・・・ Negligence following the instructions may lead to the degradation of the Laser

● Storage Conditions

Improper storage condition may lead to the degradation of the Laser performance. Please pay attention to the following;

- Keep the temperature from +5 °C to +30 °C in a desiccator, and the relative humidity should be less than 40 %.
- Do not leave the Laser in a room where is condensing, freezing, wet, corrosive gas filled, and under strong light.
- Keep the Laser in Nitrogen gas when it won't be used for a long period.

● Refrigeration

The Laser generates large amount of heat. When using cooling devices, please pay attention to the following;

- **Peltier Element**
  - Use the Peltier element and cooling plate which have higher performance to cool down against the heat from the Laser.
  - Fix the Laser, heatsink (cooling plate) and Peltier element all together tight enough to have maximum heat conduction. If the device is designed for the screw cramp attachment, fix them tight with screws.
- **Check the Cooling Condition**
  - Measuring peak emission wavelength is one of the methods to confirm the cooling effectiveness. If the peak emission wavelength is within the range of wavelength specified in the data sheet, the Laser is effectively chilled. If the peak emission wavelength is longer than the specified wavelength, the cooling condition may not be satisfied, so please check the devices carefully.

● Disassembling

Disassembling will deteriorate the Laser performance. Do not disassemble the Laser except for the designated parts. If the Laser is disassembled, HAMAMATSU will not guarantee the Laser performance.

● Electrode Connection

- **Anode Block**

  Connect the electrode with a screw. Do not give excessive pressure when connecting.
  Do not use silicone grease or adhesives.
- **Cathode Pad**
  - Screws
    Do not give excessive pressure when connecting.
  - Soldering
    Keep the laser chip away from smoke or flux of the solder.

● Overvoltage/ Overcurrent/ Reverse Voltage

Overvoltage, overcurrent and reverse voltage in the Laser will cause for the immediate breakdown. Please pay attention to the following;

- Do not exceed the absolute maximum ratings. Especially be cautious about the excess forward current, reverse voltage and surge voltage etc. When turning on/off power, the surge voltage is liable to be impressed. Please take some countermeasures against the impressed voltage.
- Install a protection circuit such as resistors, diodes or capacitors in the driver (power supply) to protect the Laser from the excess voltage, current and reverse voltage.
- Connection of Laser with driver should be done while the power of the driver is turned off.

● Others

If the Laser is irradiated by own laser beam, the Laser will be damaged. When using the Laser, please pay attention not to irradiate the reflection laser beam on the Laser.

⚠Warranty

●When using the Laser, please observe the maximum ratings and follow the instruction. HAMAMATSU endeavors to improve the product quality and reliability, but it does not warrant the perfection of the products. When using the products incorporated into an instrument, which may be at risk of one's life or property, please consider about the possible breakdown of the Laser. It should be safety designed or take some countermeasures for safety operation.

●The product has one-year warranty from the day of shipment. The defect report should be also completed to HAMAMATSU within the period. The warranty is limited to the product replacement. Even within the warranty period, it does not cover the loss or damage of the product caused by a natural disaster or improper use such as remodeling or the things against the content of catalog or instruction manual about condition, usage, storage, disposal etc.

PV-3TE

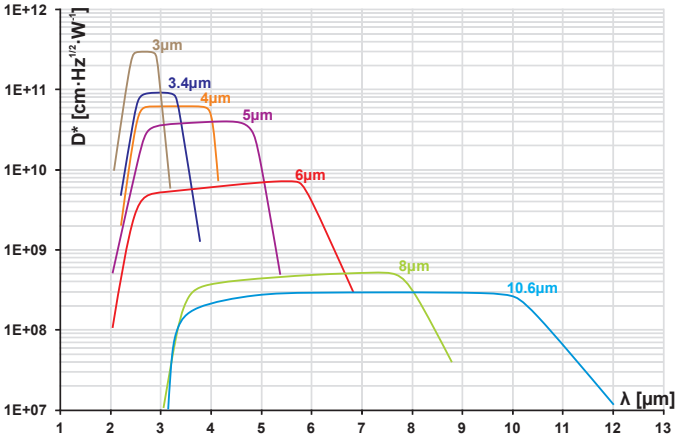
2-12 μm IR PHOTOVOLTAIC DETECTORS THERMOELECTRICALLY COOLED

The **PV-3TE-λ$_{opt}$** photodetectors series (λ$_{opt}$ – optimal wavelength in micrometers) feature IR photovoltaic detector on three-stage thermoelectrical cooler. The devices are optimized for the maximum performance at λ$_{opt}$. Cut-on wavelength can be optimized upon request.

Detector code description

PV - 3TE - 5 - 1x1 - TO8 - wAI203 - 35

- PV: VIGO detector type (I - optical immersion)
- 3TE: Cooling
- 5: Optimal wavelength
- 1x1: Optical area
- TO8: Detector package
- wAI203: Window
- 35: FOV



Example of D vs Wavelength λ for PC Series HgCdTe Detectors. Spectral Characteristics of individual detectors may vary from those shown on the chart.*

Features:

- High performance in the 2 to 12 μm spectral range
- Fast response
- No flicker noise
- Convenient to use
- Wide dynamic range
- Compact, rugged and reliable
- Low cost
- Custom design upon request

IR Detector Specification @20°C

Detector type	Cooling, operating temperature $T\,[K]$	Optimal wavelength *) $\lambda_{opt}\,[\mu m]$	Detectivity** $D^*\left[\frac{cm\cdot\sqrt{Hz}}{W}\right]$ @λ_{peak}	Detectivity** $D^*\left[\frac{cm\cdot\sqrt{Hz}}{W}\right]$ @λ_{opt}	Current responsivity length product @λ_{opt} $R_i\cdot L\left[\frac{A\cdot mm}{W}\right]$	Time constant $\tau\,[ns]$	Resistance optical area product $R\cdot A\left[\Omega\cdot cm^2\right]$	Acceptance angle $\varnothing\,[^\circ]$, $\frac{1}{2NA}$	Optical area*** $[mm\times mm]$	Package	Window****
PV	three-stage TE-cooled (3TE), ~210	3	≥3.0×10^{11}	≥1.0×10^{11}	≥0.5	≤280	≥240	~70, 0.87	0.05×0.05 0.1×0.1	TO8, TO66	wedged Al_2O_3
		3.4	≥9.0×10^{10}	≥7.0×10^{10}	≥0.8	≤200	≥15				
		4	≥6.0×10^{10}	≥4.0×10^{10}	≥1.0	≤100	≥6				
		5	≥4.0×10^{10}	≥1.0×10^{10}	≥1.3	≤80	≥0.3				
		6	≥7.0×10^{9}	≥4.0×10^{9}	≥1.5	≤50	≥0.025				
		8	≥5.0×10^{8}	≥3.0×10^{8}	≥1.0	≤30	≥0.0004		0.025×0.025 0.05×0.05		wedged ZnSe AR coated
						≤45			0.1×0.1		
		10.6	≥3.0×10^{8}	≥1.5×10^{8}	≥0.7	≤10	≥0.0002		0.025×0.025 0.05×0.05		

*) *Other optimal wavelengths available upon request.*
**) *Data sheet states minimum guaranteed D* values for each detector model. Higher performance detectors can be provided upon request.*
***) *Other optical areas available upon request.*
****) *Other windows available upon request.*
[1]) *Optical area available only for uncooled detectors*

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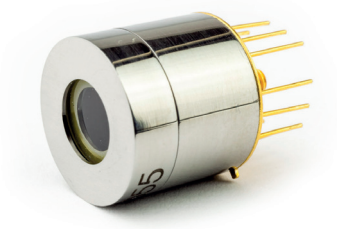
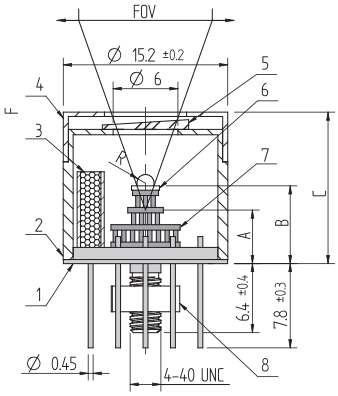
DETECTOR PACKAGES

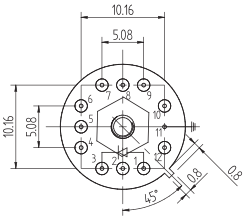
The packages of cooled detectors (TO8, TO66) are filled with dry, heavy noble gases for low thermal conductivity (Kr/Xe mixtures). Water vapor condensation is prevented by careful sealing and water absorbers applied inside the package. The packages are hermetically sealed with IR windows.

TO8 detector package





A – distance from the bottom, of the TO8 package to the focal plane



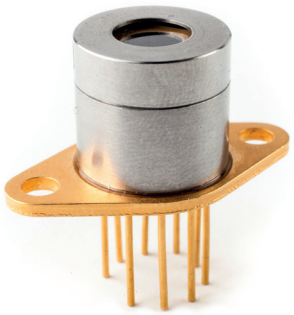
Bottom view

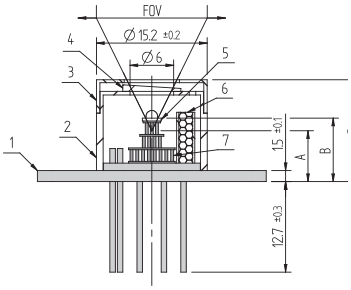
Pin number	Function
1, 3	signal
7, 9	thermistor
2(+), 8(-)	TE cooler supply
11	chassis ground
4, 5, 6, 10, 12,	not used

Dimensions [mm]

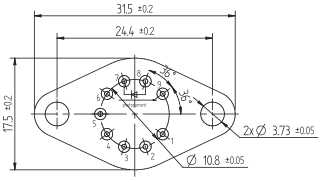
Three-stage thermoelectric cooler (3TE)					
Lens shape	Hyperhemisphere			Hemisphere	Flat
Optical area [mm x mm]	0.5×0.5	1×1	2×2	0.5×0.5 - 2×2	0.01×0.01 - 4×4
R [mm]	0.5	0.8	1.25	0.5 - 1.6	infinity
A [mm]	5.70±0.35	4.80±0.35	3.45±0.35	7.20±0.35	7.20±0.35
B [mm]	7.20±0.35	7.20±0.35	7.20±0.35	7.20±0.35	7.20±0.35
C [mm]	12.4±0.3	12.4±0.3	12.4±0.3	12.4±0.3	12.4±0.3
FOV [°]	~36	~36	~36	~70	~70

TO66 detector package





A – distance from the bottom of the TO66 package to the focal plane



Bottom view

Pin number	Function
7, 8	signal
5, 6	thermistor
1(+), 9(-)	TE cooler supply
11	chassis ground
2, 3, 4	not used

Dimensions [mm]

Three-stage thermoelectric cooler (3TE)					
Lens shape	Hyperhemisphere			Hemisphere	Flat
Optical area [mm x mm]	0.5×0.5	1×1	2×2	0.5×0.5 - 2×2	0.01×0.01 - 4×4
R [mm]	0.5	0.8	1.25	0.5 - 1.6	infinity
A [mm]	7.20±0.35	6.30±0.35	5.00±0.35	8.70±0.35	8.70±0.35
B [mm]	8.70±0.35	8.70±0.35	8.70±0.35	8.70±0.35	8.70±0.35
C [mm]	14.0±0.3	14.0±0.3	14.0±0.3	14.0±0.3	14.0±0.3
FOV [°]	~36	~36	~36	~70	~70

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