Optopairs 2.1

2 Components for Gas Analysis

RMT Ltd.

Contents

Coordinated Optopairs for NDIR Gas Analyzers

RMT offers coordinated pairs (solid state Light Emitters and Photodetectors) suitable for application in non-dispersive infrared (NDIR) gas analyzers.

The Optopair consists of high-effective Photodetector and special solid state pulsed Light Emitter.

The spectral response of the Photodetector and spectral emission of the Light Emitter are precisely coordinated for effective operation at absorption lines of measured gases.

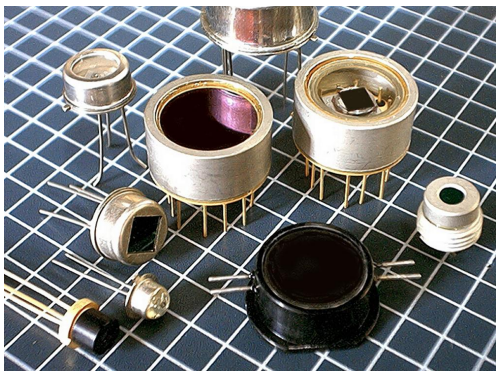
Additional built-in narrow band filters mounted onto Photodetector (or/and Light Emitter) provide high selectivity of measuring schemes.

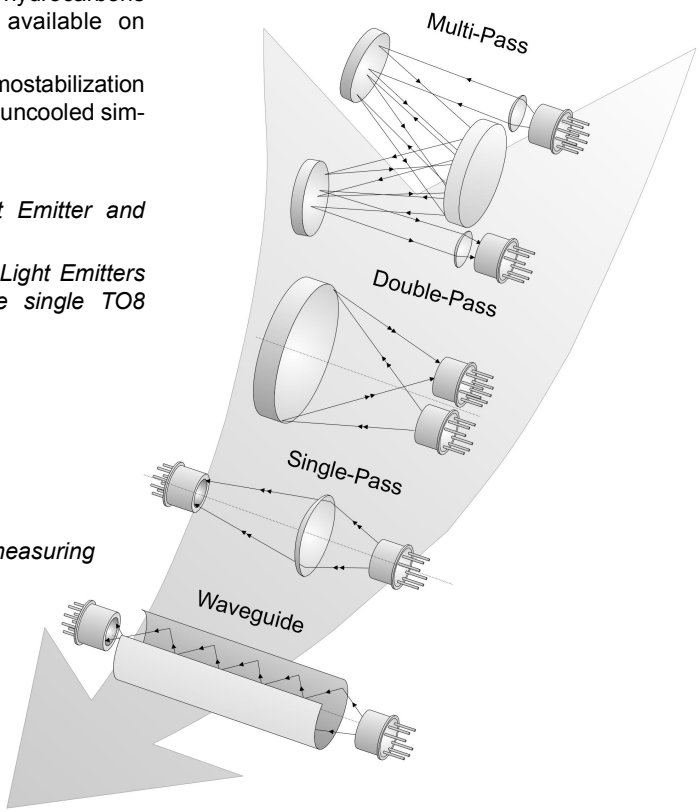
Standard options of the Optopairs are suitable for analyzing of CO_2 (carbon dioxide), CH_4 (methane), hydrocarbons mixtures (C_nH_m). Other gas options are available on request.

Optopairs with built-in TE cooling and thermostabilization are presented as standard options, as well as uncooled simpler types.

Two Optopair series are available:

- *Optopair consisting of discrete Light Emitter and Photodetector*
- *Integrated Optopair consisting of two Light Emitters and Photodetector assembled in the single TO8 package.*





Features

- *No moving parts*
- *Miniature design*
- *Low power consumption*
- *Standard options for a range of measuring schemes*
- *Long operation lifetime*
- *High speed of response*
- *High selectivity*

Available Options

Optopair Type	Measured Gas	Formula	λ_1, µm	λ_2, µm	$\Delta\lambda$, µm
OPR(i)x-4239	Carbon Dioxide	CO_2	4.28	3.90	0.12
OPR(i)x-3439	Hydrocarbons	C_nH_m	3.42	3.90	0.25
OPR(i)x-3230	Methane	CH_4	3.23	3.0	0.08

Notes:

1) Index “i” is valid for integrated type of optopairs

2) Code “x” means uncooled or TE cooled type (see chapter “How to select an Optopair”).

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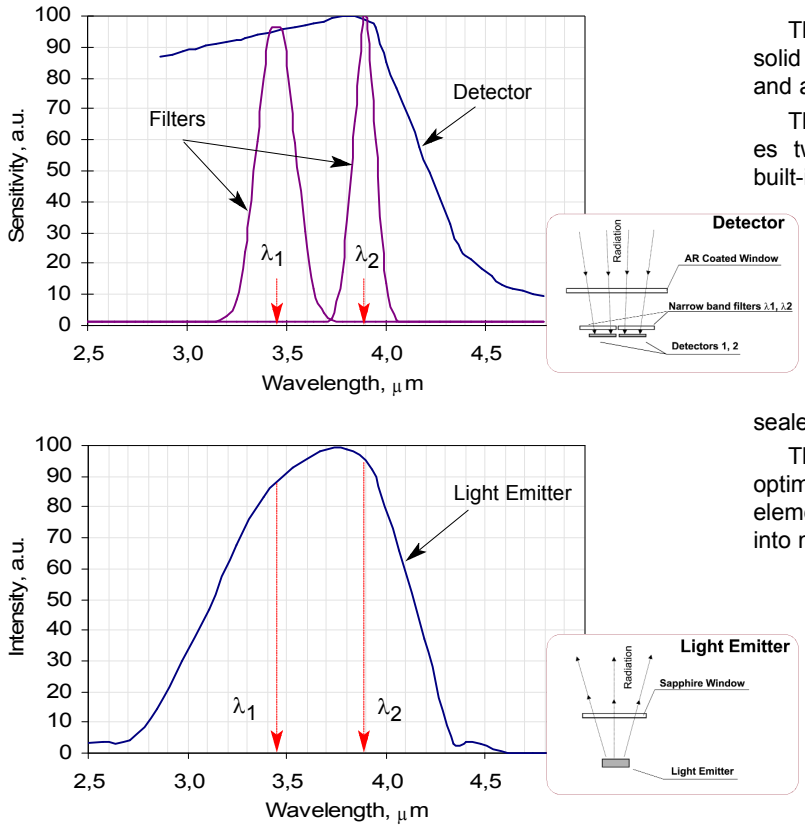
OPR1-3439 Optopair *(hydrocarbons)*



Spectral Responses of Photodetector with narrow-band Filters and light Emitter

The Optopair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The dual-element detector comprises two photosensitive elements, two built-in narrow band interference filters:

- *one filter is near the absorption band of tested material (base channel)*
- *the other one is far from the absorption band (reference channel)*

The Detector is installed into the sealed metal-glass package.

The semiconductor Light Emitter is optimized for the operation of the dual-element Photodetector. It is mounted into miniature metal package.

Optical and Electrical Characteristics

Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1	Angle of view	deg	70
Wavelength λ_1	μm	3.45	Wavelength λ	μm	3.75
Wavelength λ_2	μm	3.90			
Band Width $\Delta\lambda_{0.5}$	μm	0.25	Band Width $\Delta\lambda_{0.5}$	μm	0.95
Time Constant, τ	μsec	<30	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	85
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$1.0x10^8$	Output Power(2) (PW)	μW	550
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$1.0x10^8$			
Sensitivity, S_U			1. I_{op}=80 mA, U=2 V		
Measuring Channel, λ_1	V/W	60	2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms		
Reference Channel, λ_2	V/W	60	3. All parameters are referred to 300 K		
Element Dark Resistance	kOhm	20...100			

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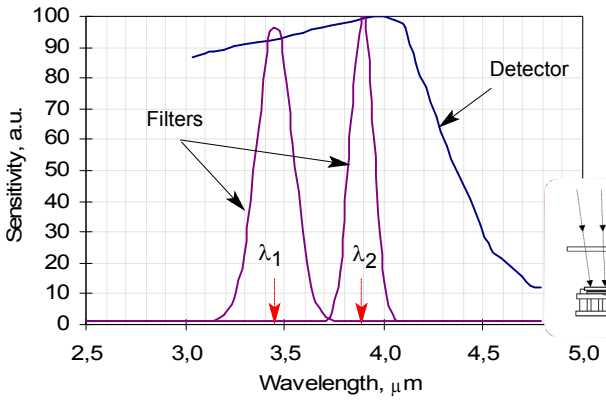
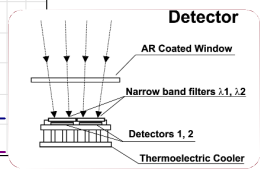
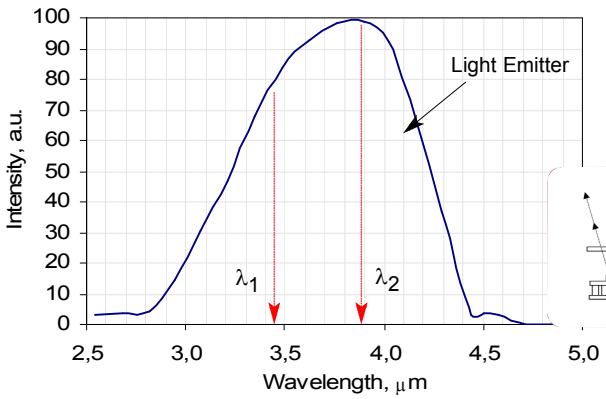
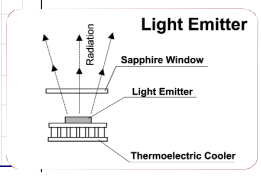
OPR2-3439 TE cooled Optopairs *(hydrocarbons)*









Spectral Responses of Photodetector with narrow-band Filters and light Emitter

The Optopair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The element detector comprises two photo-sensitive elements, two built-in narrow band interference filters:

- *one filter is near absorption band of tested material (base channel)*
- *the other one - is far from the absorption band (reference channel).*

The sensitive elements with filters are placed onto the cooling surface of a single-stage thermoelectric module.

A thermosensor is used for thermostabilization.

The semiconductor Light Emitter is optimized for operation of the dual-element Photodetector.

The Light Emitter also is also onto the cooling surface of a single-stage thermoelectric module with a thermosensor.

Optical and Electrical Characteristics

Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1	Angle of view	deg	70
Wavelength λ_1	μm	3.45	Wavelength λ	μm	3.85
Wavelength λ_2	μm	3.90			
Band Width $\Delta\lambda_{0.5}$	μm	0.25	Band Width $\Delta\lambda_{0.5}$	μm	0.95
Time Constant, τ	μsec	<100	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	110
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$3.5x10^8$	Output Power(2) (PW)	μW	700
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$3.5x10^8$			
Sensitivity, S_U					
Measuring Channel, λ_1	V/W	300			
Reference Channel, λ_2	V/W	300			
Element Dark Resistance	kOhm	20...100			

1. I_{op}=80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 263 K

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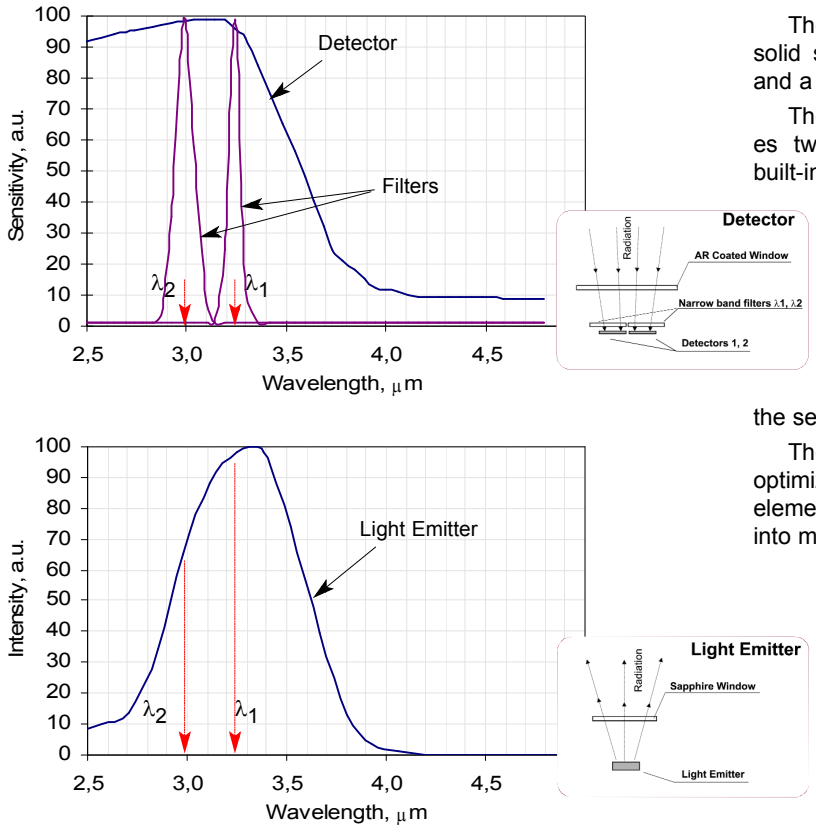
OPR1-3230 Optopairs *(methane)*



Spectral Responses of Photodetector with narrow-band Filters and light Emitter

The Optopair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The dual-element detector comprises two photosensitive elements, two built-in narrow band interference filters:

- *one filter is near the absorption band of tested material (base channel)*
- *the other one is far from the absorption band (reference channel)*

The Detector is installed into the sealed metal-glass package.

The semiconductor Light Emitter is optimized for the operation of the dual-element Photodetector. It is mounted into miniature metal package.

Optical and Electrical Characteristics

Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1	Angle of view	deg	70
Wavelength λ_1	μm	3.23	Wavelength λ	μm	3.3
Wavelength λ_2	μm	3.00			
Band Width $\Delta\lambda_{0.5}$	μm	0.08	Band Width $\Delta\lambda_{0.5}$	μm	0.7
Time Constant, τ	μsec	<30	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	85
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$0.4x10^8$	Output Power(2) (PW)	μW	550
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$0.4x10^8$			
Sensitivity, S_U					
Measuring Channel, λ_1	V/W	30			
Reference Channel, λ_2	V/W	30			
Element Dark Resistance	kOhm	20...100			

1. I_{op}=80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 300 K

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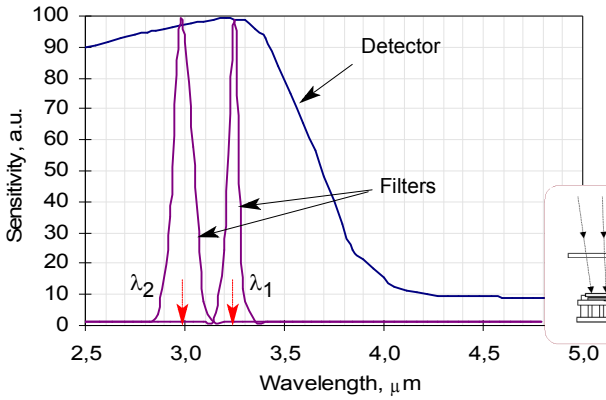
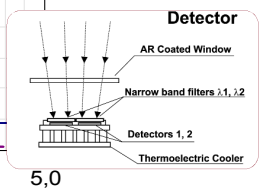
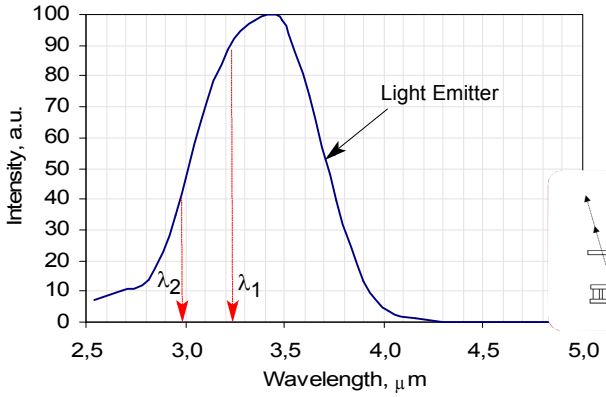
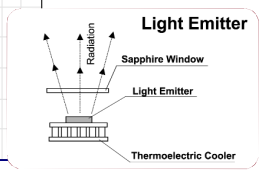
OPR2-3230 TE cooled Optopairs*(methane)*









Spectral Responses of Photodetector with narrow-band Filters and light Emitter

The Optopair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The element detector comprises two photo-sensitive elements, two built-in narrow band interference filters:

- *one filter is near absorption band of tested material (base channel)*
- *the other one - is far from the absorption band (reference channel).*

The sensitive elements with filters are placed onto the cooling surface of a single-stage thermoelectric module.

A thermosensor is used for thermostabilization.

The semiconductor Light Emitter is optimized for operation of the dual-element Photodetector.

The Light Emitter also is also onto the cooling surface of a single-stage thermoelectric module with a thermosensor.

Optical and Electrical Characteristics

Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1.0	Angle of view	deg	70
Wavelength λ_1	μm	3.23	Wavelength λ	μm	3.4
Wavelength λ_2	μm	3.00			
Band Width $\Delta\lambda_{0.5}$	μm	0.08	Band Width $\Delta\lambda_{0.5}$	μm	0.7
Time Constant, τ	μsec	<100	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	110
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$1.2x10^8$	Output Power(2) (PW)	μW	700
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$1.2x10^8$			
Sensitivity, S_U			1. I_{op}=80 mA, U=2 V		
Measuring Channel, λ_1	V/W	200	2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms		
Reference Channel, λ_2	V/W	200	3. All parameters are referred to 263 K		
Element Dark Resistance	kOhm	20...100			

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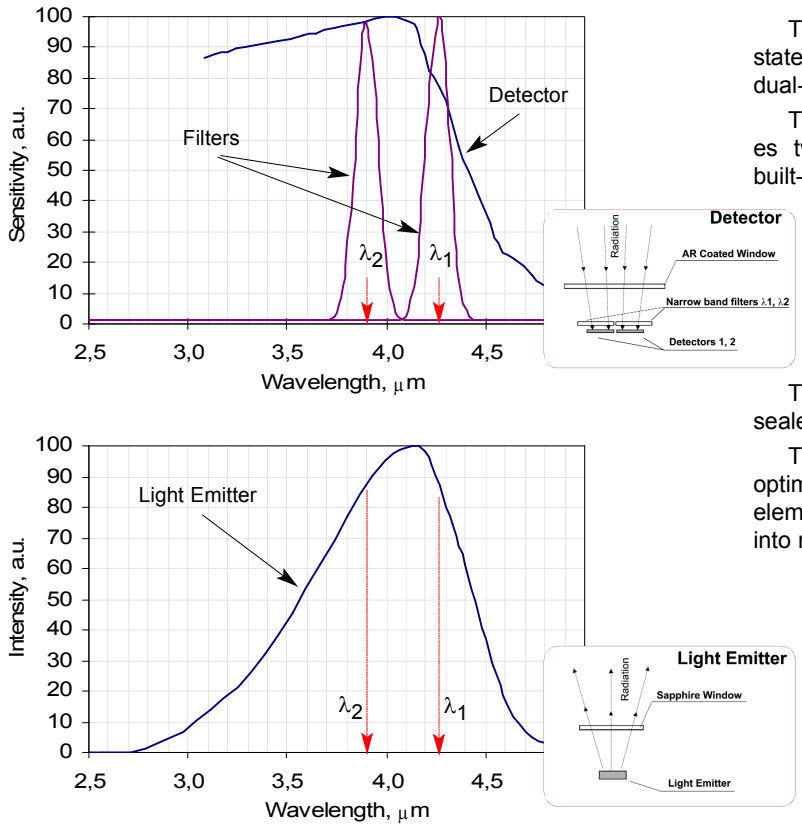
OPR1-4239 Optopairs *(carbon dioxide)*



Spectral Responses of Photodetector with narrow-band Filters and light Emitter

The pair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The dual-element detector comprises two photosensitive elements, two built-in narrow band interference filters:

- *one filter is near the absorption band of tested material (base channel)*
- *the other one is far from the absorption band (reference channel)*

The Detector is installed into the sealed metal-glass package.

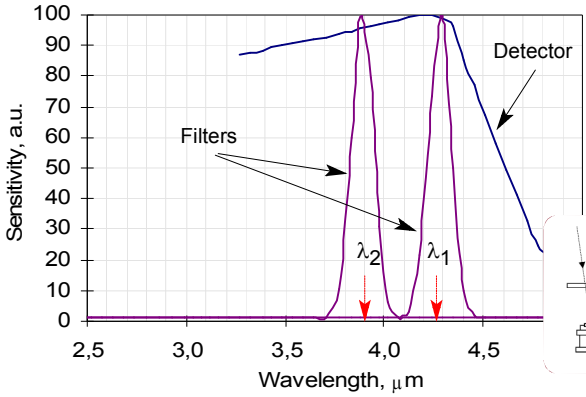
The semiconductor Light Emitter is optimized for the operation of the dual-element Photodetector. It is mounted into miniature metal package.

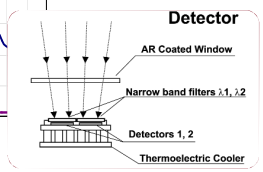
Optical and Electrical Characteristics

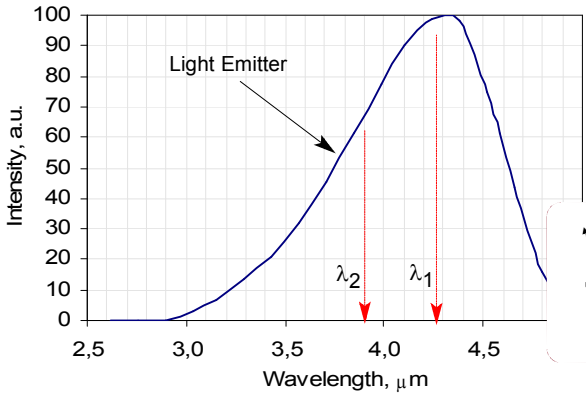
Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1.0	Angle of view	deg.	70
Wavelength λ_1	μm	4.28	Wavelength λ	μm	4.15
Wavelength λ_2	μm	3.90			
Band Width $\Delta\lambda_{0.5}$	μm	0.12	Band Width $\Delta\lambda_{0.5}$	μm	0.80
Time Constant, τ	μsec	<10	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	80
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$0.5x10^8$	Output Power(2) (PW)	μW	500
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$0.5x10^8$			
Sensitivity, S_U					
Measuring Channel, λ_1	V/W	30			
Reference Channel, λ_2	V/W	30			
Element Dark Resistance	kOhm	20...100			

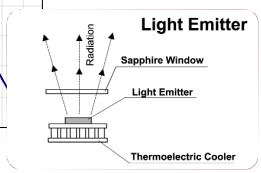
1. I_{op}=80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 300 K

OPR2-4239 TE cooled Optopairs*(carbon dioxide)*









Spectral Responses of Photodetector with narrow-band Filters and Light Emitter

The Optopair consists of a special solid state Light Emitter (light source) and a dual-channel Photodetector.

The element detector comprises two photo-sensitive elements, two built-in narrow band interference filters:

- *one filter is near absorption band of tested material (base channel)*
- *the other one - is far from the absorption band (reference channel).*

The sensitive elements with filters are placed onto the cooling surface of a single-stage thermoelectric module.

A thermosensor is used for thermostabilization.

The semiconductor Light Emitter is optimized for operation of the dual-element Photodetector.

The Light Emitter also is also onto the cooling surface of a single-stage thermoelectric module with a thermosensor.

Optical and Electrical Characteristics

Detector			Light Emitter		
Sensitive Element size	mm	2x2	Emitting area size	mm	2x2
Distance between elements	mm	1.0	Angle of view	deg	70
Wavelength λ_1	μm	4.28	Wavelength λ	μm	4.30
Wavelength λ_2	μm	3.90			
Band Width $\Delta\lambda_{0.5}$	μm	0.12	Band Width $\Delta\lambda_{0.5}$	μm	0.80
Time Constant, τ	μsec	<30	Time Constant, τ	μsec	<2
Detectivity, D*			Output Power(1) (CW)	μW	100
Measuring Channel, λ_1	smxHz$^{1/2}$xW^{-1}	1.5x10^8	Output Power(2) (PW)	μW	700
Reference Channel, λ_2	smxHz$^{1/2}$xW^{-1}	1.5x10^8			
Sensitivity, S_U					
Measuring Channel, λ_1	V/W	200			
Reference Channel, λ_2	V/W	200			
Element Dark Resistance	kOhm	20...100			

1. I_{op}=80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
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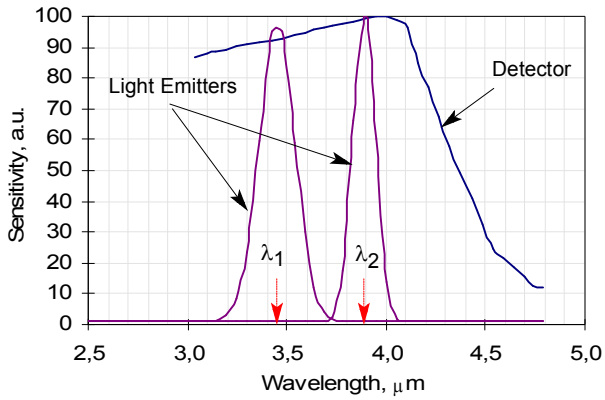
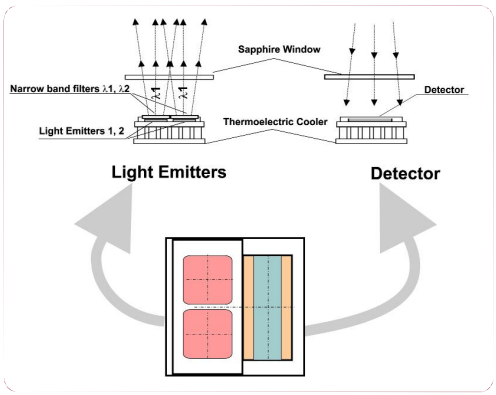
OPRi2-3439 Integrated Optopair *(hydrocarbons)*



Spectral Responses of Photodetector and Light Emitters with narrow-band filters



The integrated device consists of two solid state Light Emitters (light sources) and one Photodetector.

Each Light Emitter has built-in narrow band interference filters:

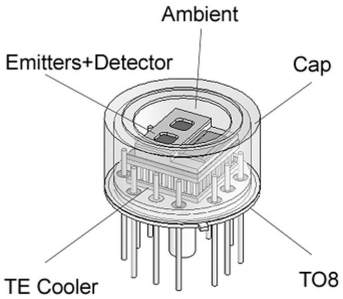
- *one (the first emitter) filter is adjusted to absorption line of a tested gas (the base channel)*
- *the other (the second emitter) - is far from the absorption band (the reference channel).*

Detector is the broad-band PbSe photoresistor.

The Light Emitters and the Detector are mounted on the same plane at cold side of a miniature thermoelectric (TE) cooler and integrated in the single housing.

The TE cooler is used for cooling down and precise temperature stabilizating of the Detector and Light Emitters.

The semiconductor Light Emitters are optimized for operation of the Photodetector.

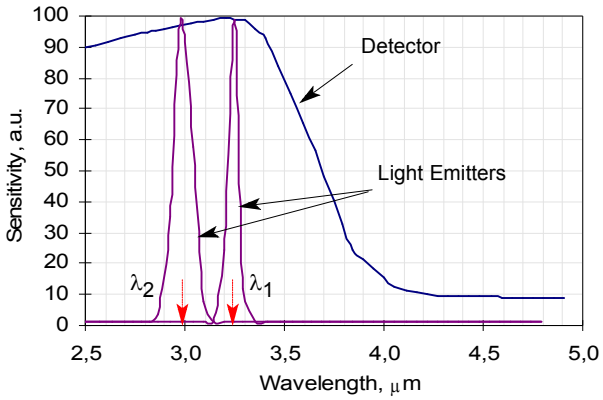


Optical and Electrical Characteristics

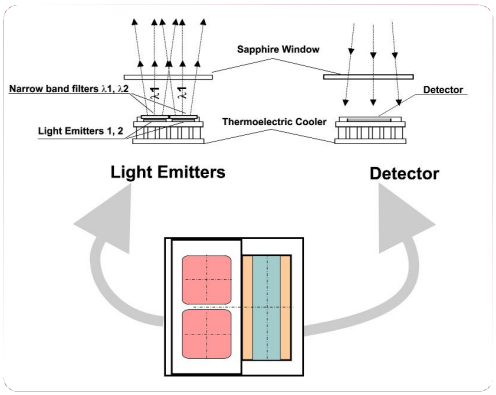
Detector			Light Emitters		
Sensitive Element size	mm	1.5x5.5	Emitting area size	mm	2x2
Spectral Range	μm	2...4.5	Distance between elements	mm	1.0
Wavelength max λ_{max}	μm	4.0	Angle of view	deg	70
Time Constant, τ	μsec	<100	Channels		
Detectivity, D*			Wavelength λ_1	μm	3.4
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$>3.5x10^8$	Wavelength λ_2	μm	3.9
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$>3.5x10^8$	Band Width $\Delta\lambda_{0.5}$	μm	0.25
Sensitivity, S_U			Time Constant, τ	μsec	<2
At Measuring Channel, λ_1	V/W	>300	Output Power at λ_1 and λ_2		
At Reference Channel, λ_2	V/W	>300	CW(1)	μW	110
Dark Resistance	kOhm	6…30	Pulsed(2)	μW	700

1. I_{op}= 80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 263 K

OPRi2-3230 Integrated Optopair *(methane)*



Spectral Responses of Photodetector and Light Emitters with narrow-band filters



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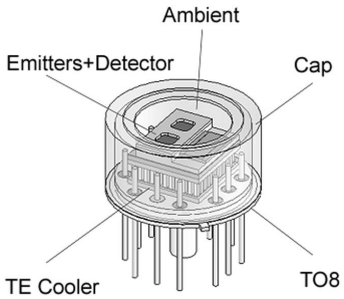
The Light Emitters and the Detector are mounted on the same plane at cold side of a miniature thermoelectric (TE) cooler and integrated in the single housing.

The TE cooler is used for cooling down and precise temperature stabilizating of the Detector and Light Emitters.

The semiconductor Light Emitters are optimized for operation of the Photodetector.



Optical and Electrical Characteristics

Detector			Light Emitters		
Sensitive Element size	mm	1.5x5.5	Emitting area size	mm	2x2
Spectral Range	μm	1…3.8	Distance between elements	mm	1.0
Wavelength max λ_{max}	μm	3.2	Angle of view	deg.	70
Time Constant, τ	μsec	<100	Channels		
Detectivity, D*			Wavelength λ_1	μm	3.23
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$>1.2x10^8$	Wavelength λ_2	μm	3.0
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$>1.2x10^8$	Band Width $\Delta\lambda_{0.5}$	μm	0.08
Sensitivity, S_U			Time Constant, τ	μsec	<2
At Measuring Channel, λ_1	V/W	>200	Output Power at λ_1 and λ_2		
At Reference Channel, λ_2	V/W	>200	CW(1)	μW	110
Dark Resistance	kOhm	6…30	Pulsed(2)	μW	700

1. I_{op}= 80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 263 K

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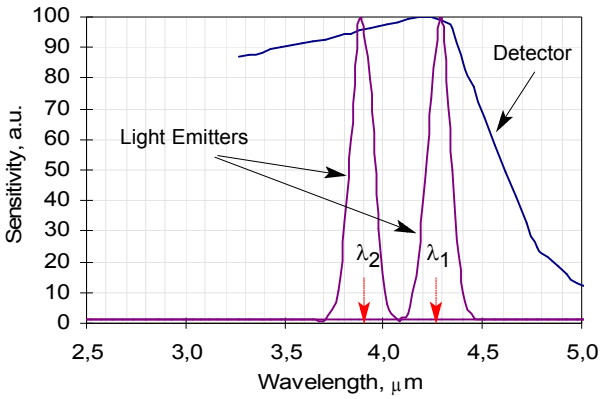
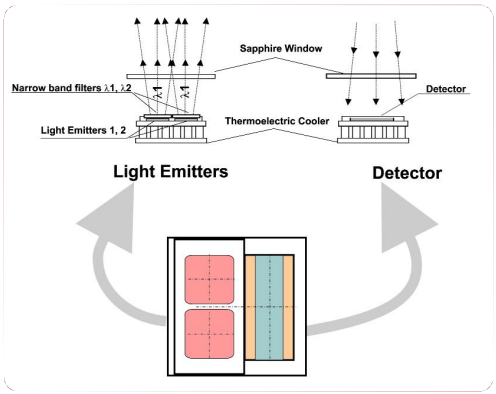
OPRi2-4239 TE cooled Integrated Optopair *(carbon dioxide)*



Spectral Responses of Photodetector and Light Emitters with narrow-band filters



The integrated device consists of two solid state Light Emitters (light sources) and one Photodetector.

Each Light Emitter has built-in narrow band interference filters:

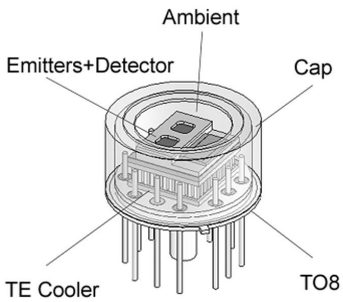
- *one (the first emitter) filter is adjusted to absorption line of a tested gas (the base channel)*
- *the other (the second emitter) - is far from the absorption band (the reference channel).*

Detector is the broad-band PbSe photoresistor.

The Light Emitters and the Detector are mounted on the same plane at cold side of a miniature thermoelectric (TE) cooler and integrated in the single housing.

The TE cooler is used for cooling down and precise temperature stabilizating of the Detector and Light Emitters.

The semiconductor Light Emitters are optimized for operation of the Photodetector.



Optical and Electrical Characteristics

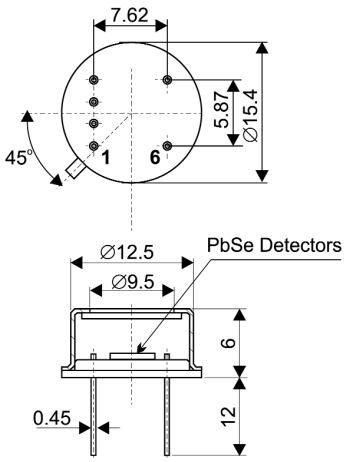
Detector			Light Emitters		
Sensitive Element size	mm	1.5x5.5	Emitting area size	mm	2x2
Spectral Range	μm	2...4.5	Distance between elements	mm	1.0
Wavelength max λ_{max}	μm	4.2	Angle of view	deg.	70
Time Constant, τ	μsec	<30	Channels		
Detectivity, D*			Wavelength λ_1	μm	4.27
Measuring Channel, λ_1	$smxHz^{1/2}xW^{-1}$	$>1.5x10^8$	Wavelength λ_2	μm	3.9
Reference Channel, λ_2	$smxHz^{1/2}xW^{-1}$	$>1.5x10^8$	Band Width $\Delta\lambda_{0.5}$	μm	0.12
Sensitivity, S_U			Time Constant, τ	μsec	<2
At Measuring Channel, λ_1	V/W	>200	Output Power at λ_1 and λ_2		
At Reference Channel, λ_2	V/W	>200	CW(1)	μW	100
Dark Resistance	kOhm	6…30	Pulsed(2)	μW	700

1. I_{op}= 80 mA, U=2 V
2. I_{op}= 650 mA, U=2 V, Q=15, τ_p= 4 ms
3. All parameters are referred to 263 K

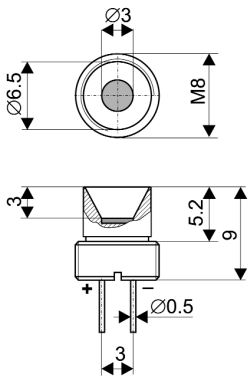
Dimension Outlines (all dimensions are given in mm)

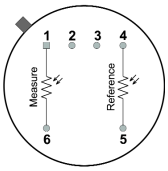
D5-11 Uncooled Optopair

Detector - TO8 housing



Light Emitter - Standard metal housing



Pin	Function	Bottom View
1	Photoresistor, measuring channel	
2	Not connected	
3	Not connected	
4	Photoresistor, reference channel	
5	Photoresistor, reference channel	
6	Photoresistor, measuring channel	

Absolute Maximum Ratings

Detector	Light Emitter	
Bias Voltage	Direct Current, max	Pulsed Current, max
V	mA	A
6	200	1.5

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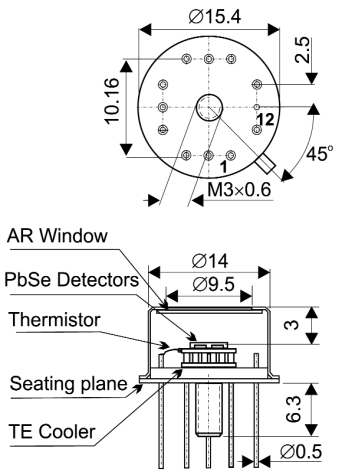
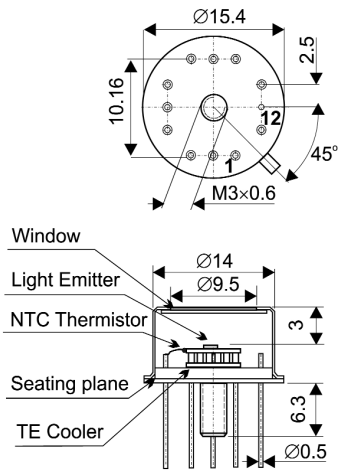
Dimension Outlines (all dimensions are given in mm)

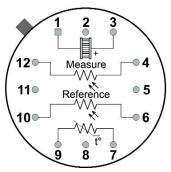
D12-12 **TE cooled Optopair**

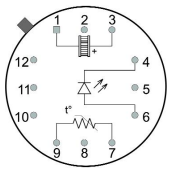
Detector - TO8 housing



Light Emitter - TO8 housing



Pin	Function	Bottom View
1	TE Cooler (-)	
2	Not connected	
3	TE Cooler (+)	
4	Photoresistor, measuring channel	
5	Not connected	
6	Photoresistor, reference channel	
7	Thermistor	
8	Not connected	
9	Thermistor	
10	Photoresistor, reference channel	
11	Ground	
12	Photoresistor, measuring channel	

Pin	Function	Bottom View
1	TE Cooler (-)	
2	Not connected	
3	TE Cooler (+)	
4	LED, cathode	
5	Not connected	
6	LED, anode	
7	Thermistor	
8	Not connected	
9	Thermistor	
10	Not connected	
11	Ground	
12	Not connected	

Absolute Maximum Ratings

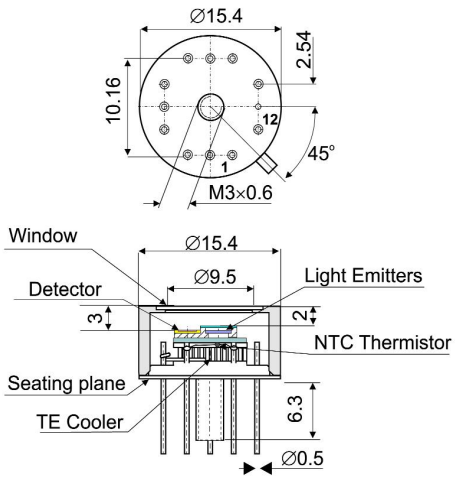
Detector	Light Emitter		Both		
Bias Voltage	Direct Current, max	Pulsed Current, max	Typical TE Cooler Power near maximal cooling		Thermosensor
V	mA	A	Current, A	Voltage, V	
6	200	1.5	1.3	2.2	2.2 kOhm & -3.4%/deg
			0.4*	4*	

Note: * - option for portable applications.

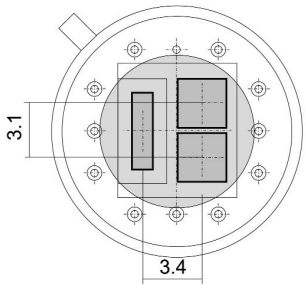
Dimension Outlines (all dimensions are given in mm)

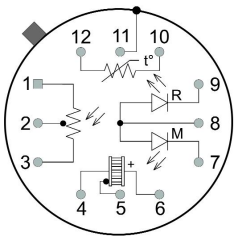
D17	Integrated TE cooled Optopair

TO8 housing



Emitter-Detector Plan (top view)



Pin	Function	Top View
1	Detector	
2	Not connected	
3	Detector	
4	TE Cooler (-)	
5	Shield	
6	TE Cooler (+)	
7	LED1, cathode	
8	LED1&2, anode	
9	LED2, cathode	
10	Thermistor	
11	Ground	
12	Thermistor	

Absolute Maximum Ratings

Detector	Light Emitter		Both		
Bias Voltage	Direct Current, max	Pulsed Current, max	Typical TE Cooler Power near maximal cooling		Thermosensor
V	mA	A	Current, A	Voltage, V	
6	200	1.5	0.4	4	2.2 kOhm & -3.4%/deg

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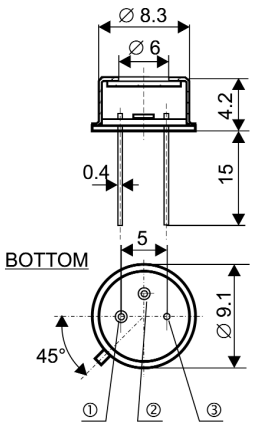
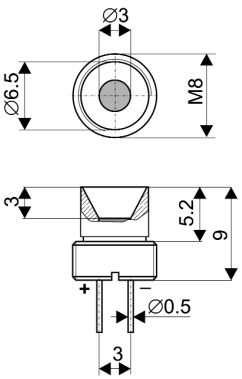
Optional Optopairs

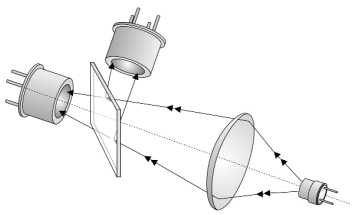
D4-11 Single element Detectors, standard Light Emitter

Detector - TO5 housing



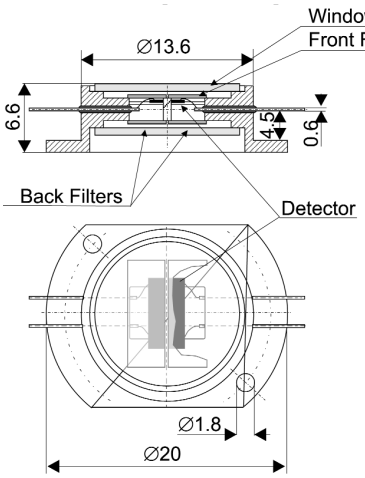
Light Emitter - metal housing



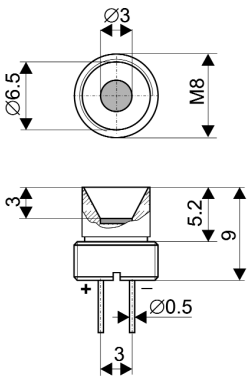


D15-11 Double-side, dual-element Detector, standard Light Emitters

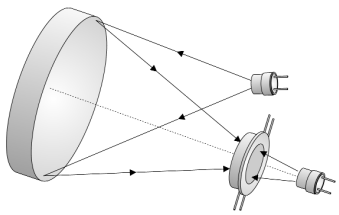
Detector - metal-glass double side housing



Light Emitter - metal housing



Double-beam, double-channel Scheme



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How to Select an Optopair

OPR(i)2-3439-121

Built-in filter

0 - Special Options
1 - FWHM 0.25 μm
2 - FWHM 0.12 μm
3 - FWHM 0.08 μm

TE Cooler option*

0 - No Options (uncooled type)
1 - Standard type
2 - Low currect TEC

Package*

0 - D5-11
1 - D12-12
2 - Special

Wavelength

First element, μm

Wavelength

Second element, μm

Built-in Cooling

1 - Uncooled
2 - Cooled, Single-Stage TEC
3 - Cooled, Two-Stage TEC

Code of Integrated Optopairs

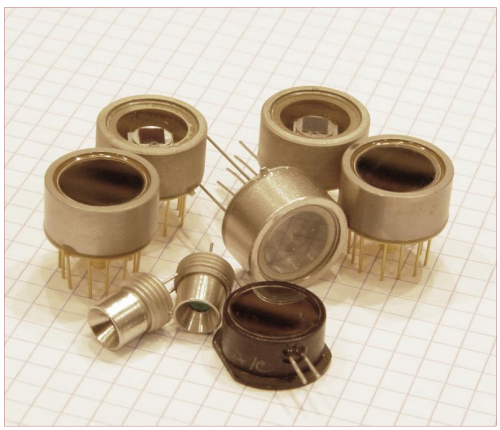
Series designator

Note: * - Is not valid for the OPRi Series (always "0")

An Example:

OPR2-3439-121

- *TE cooled Optopair*
- *First wavelength - 3.4 μm (hydrocarbions)*
- *Second wavelength - 3.9 μm (reference)*
- *Housing type D12-12:*
  - *Detector - D12 housing (TO8 package)*
  - *Light Emitter - D12 housing (TO8 package)*
- *TE coolers of low current*
- *Built-in narrow band filters with FWHM 0.25 μm.*



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