LED
Microsensor NT

MIDDLE INFRARED OPTOELECTRONICS
1600 - 5000 nm

LEDs - Photodiodes - Arrays - Sensors

CONTENTS

Rev. 050716

HEAD OFFICE **LED Microsensor NT, LLC** and R&D CENTRE **Microsensor Technology, LLC**
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LED Microsensor NT LLC is a company focused on developing and manufacturing optoelectronic devices for the mid-infrared spectral range. The company offers a wide range of Light Emitting Diodes (LEDs), LED arrays and spectral matched Photodiodes (PDs) that cover the spectral range from 1600 to 5000 nm, optical cells and modules on their basis, related electronic devices.

Our key technology is the epitaxial growth of narrow-band-gap semiconductors based on GaSb-InAs solid solutions.

The company has a professional team of leading Russian scientists with more than 15 years' experience in research and development of heterostructures for the mid-infrared spectral range, design of optoelectronic devices, customer guide and support.

In 2011 Rusnano Corporation made an investment in LED Microsensor NT in order to expand the production of mid-infrared LEDs and PDs. In 2012 a spin-off R&D company Microsensor Technology LLC was arranged, focusing within itself the intellectual capacity and the necessary basis for research and development of new products – LED arrays, optical cells and modules. The company has become a resident of the Skolkovo Innovation Centre and carries out a number of challenging R&D projects.

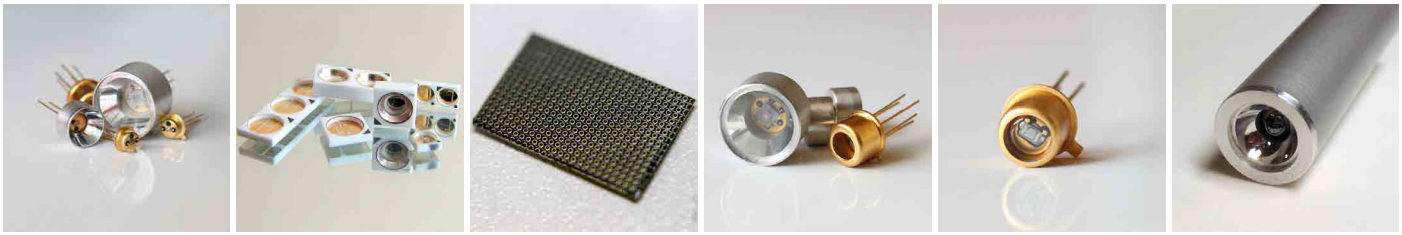
RUSNANO
Russian Corporation of Nanotechnologies

Sk Resident Sk Nuclear

We propose our product as a new powerful base for optical absorption analysis. One of the greatest advantages of this method is that virtually any sample in virtually any state may be studied: liquids, gases, films, powders and surfaces can all be examined with a proper choice of sampling technique. Using LED-PD optopairs for the mid-infrared spectral range has allowed the development of portable sensors with high reliability, fast response time and very low power consumption that can be successfully applied in different areas for matter analysis purposes.

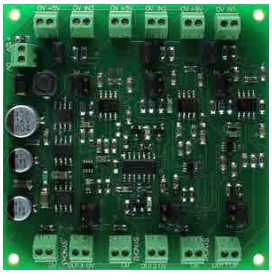
Standard products

Light Emitting Diodes (LEDs), Photodiodes (PDs), LED arrays



Electronic devices and sensor modules

LED driver



Synchronous detector

Methane sensor module

Evaluation kits for CH_4/CO_2 detection

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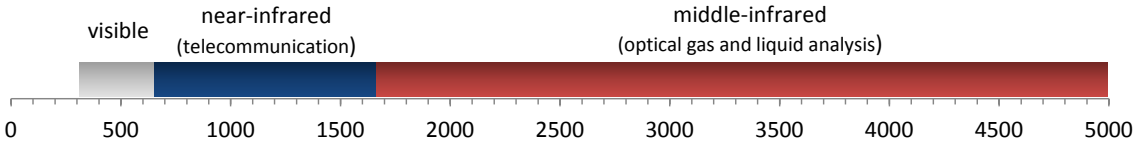
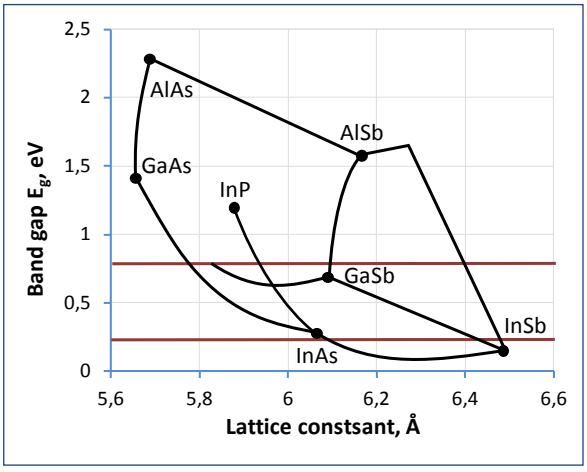
Our products came into existence as a result of intensive investigations in semiconductor physics. First laser heterostructures in the world were created at the end of the 1960th in the Ioffe Physical Technical Institute by Zhores Alferov who was awarded 2000 Nobel Prize in physics for this invention.

LED and PD heterostructures are formed by sequential epitaxy of semiconductor layers on the surface of a crystal substrate. The emission wavelength of an LED and the spectral response of a PD are determined by the energy band gap of the material used in the active layer. Narrow band gap structure based on GaSb-InAs solid solutions enabled creation of emitters and detectors that operate in the middle-infrared spectral range.



Nowadays, semiconductor optoelectronic devices for visible and near-infrared spectral ranges are widely used for lighting and telecommunications. Middle-infrared range is remarkable as many chemical agents have strong absorption bands here: CH_4, H_2O, CO_2, CO, C_2H_2, C_2H_4, C_2H_6, CH_3Cl, HCl, HOCl, HBr, H_2S, HCN, NH_3, NO_2, SO_2, glucose and many others. LEDs and PDs operating in the range from 1600 nm to 5000 nm possess great potential for use in optical analysing systems. High interest in these components is defined by the need of compact, cost-effective, durable sensors with very low power consumption and fast response time.



Using GaInAsSb/AlGaAsSb-based heterostructures lattice matched to GaSb substrate allowed us to create LEDs and PDs for 1.6-2.4 μm spectral range; heterostructures based on InAsSb/InAsSbP-based lattice matched to InAs substrate enabled creation of LEDs and PDs for 2.7-5.0 μm spectral range. The gap from about 2.4 to 2.7 μm is caused by the existence of immiscibility region for GaInAsSb-based solid solutions which depends on the epitaxy temperature and the compound composition.

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A line of standard LEDs (LED chip with a top contact) with peak wavelengths (µm):

NEW	1.03-1.07	1.25-1.33	1.40-1.49	1.50-1.59
	Lms10LED	Lms13LED	Lms14LED	Lms15LED

1.60-1.69	1.70-1.79	1.80-1.89	1.90-1.99	2.00-2.09	2.10-2.19	2.20-2.29	2.30-2.39
Lms16LED	Lms17LED	Lms18LED	Lms19LED	Lms20LED	Lms21LED	Lms22LED	Lms23LED

2.70-2.79	2.83-2.90	3.30-3.44	3.30-3.44	3.45-3.52	3.53-3.69	3.70-3.75	3.60-3.94	3.95-4.09	4.10-4.30
Lms27LED	Lms28LED	Lms34LED	Lms34LEDhp	Lms35LED	Lms36LED	Lms37LED	Lms38LED	Lms41LED	Lms43LED

A line of LEDs with glass covering (increased output optical power up to 5 times) with peak wavelengths (µm):

3.30-3.44	3.70-3.94	4.10-4.30
Lms34LED-CG	Lms38LED-CG	Lms43LED-CG

A line of wide band photodiodes with sensitive area of Ø0.3, 0.5 and 1.0 mm and cut-off wavelengths (µm):

2.4			3.6		NEW 4.1		4.6	
Lms24PD-03	Lms24PD-05	Lms24PD-10	Lms36PD-03	Lms36PD-05	Lms41PD-03	Lms41PD-05	Lms43PD-03	Lms43PD-05

A line of wide band photodiodes with glass covering (increased responsivity up to 5 times) cut-off wavelengths (µm):

3.6		4.6	
Lms36PD-03-CG	Lms36PD-05-CG	Lms43PD-03-CG	Lms43PD-05-CG

Multi-element LED matrices – a number of similar or different LED chips mounted in a single compact package and driven together or independently.

We provide LEDs, LED arrays and photodiodes in standard TO and SMD packages (devices in customized packages could be provided under customer's request):

TO packages	TO-18	TO-18 with PR	TO-5	TO-5 with PR	TO-8
	with/without window		with/without thermoelectric module		
					
Applied to	LED, PD, LED-matrix		LED, PD, LED-matrix		LED-matrix
SMD packages	3.0 x 2.0 mm	3.5 x 3.5 mm		5 x 5 mm for a 3-element matrix	
					
Applied to	LED, PD			LED-matrix	
TO packages with glass covering	TO-18 with glass covering				
					
Applied to	LED, PD				

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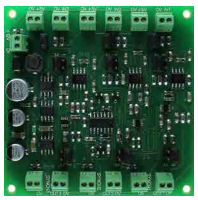
LED drivers	D-41i	D-51i	mD-1c	mD-1p	**NEW** MCD
					
Applied to	One element LED				LED-matrix
PD electronics	PAb preamplifier	PD with a built-in preamplifier		SDM	
					
Applied to	PD			PD with a built-in preamplifier	
Evaluation kits, systems and modules	CDK/CDK-c	MDK/MDK-c	MDS-4	MDS-5/ CDS-5	
					
Applied to	Evaluation kits for CO_2 detection	Evaluation kits for CH_4 detection	CH_4 sensor module	CH_4 and CO_2 evaluation systems	

- LED drivers D-41i, D-51i; minidrivers mD-1c, mD-1p – unpackaged drivers that provide LED power supply in different pulse modes; D-51i additionally enables monitoring of the LED p-n junction temperature judging by current-voltage dependence.
- PD preamplifier PAb – converts the output current signal of a photodiode into a voltage pulse output signal with amplification. It is also available together with a PD built in a metal tube – LmsXXPD-XX-R-PA series, LmsXXPD-XX-RW-PA series, LmsXXPD-XX-TEM-PA series, LmsXXPD-XX-TEM-R-PA series and LmsXX-PD-XX-CG-R-PA series;
- SDM synchronous detector – measures voltage signal from the output of a photodiode preamplifier and converts it to the DC voltage signal proportional to amplitude of voltage from input, designed for operation with LmsXXPD-XX-R-PA series, LmsXXPD-XX-RW-PA series, LmsXXPD-XX-TEM-PA series, LmsXXPD-XX-TEM-R-PA and LmsXX-PD-XX-CG-R-PA series photodiodes and LEDs driven by D-41i, D-51i drivers;
- Evaluation kits, systems and sensor modules:
  - MDS-4 CH_4 sensor module;
  - MDK-c CH_4 detection kit; CDK-c CO_2 detection kit;
  - MDK CH_4 detection kit; CDK CO_2 detection kit;
  - MDS-5 CH_4 detection system; CDS-5 CO_2 detection system.

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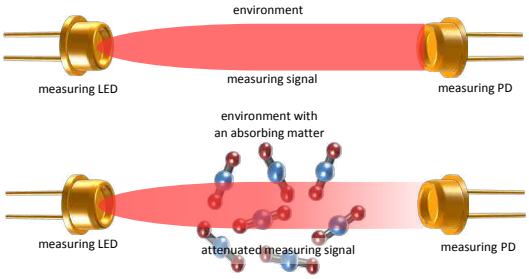
Infrared optical analysis is based on the vibrations of the atoms of a molecule. Infrared radiation passes through a sample and the fraction of the incident radiation that is absorbed at a particular energy is determined. The energy at which any change in the absorption occurs corresponds to the frequency of a vibration of a molecule that is analysed.

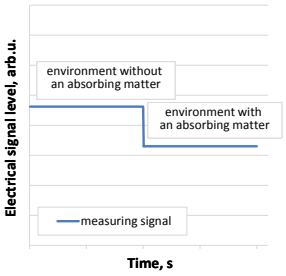
Principle of optical sensing based on LED – PD optopair

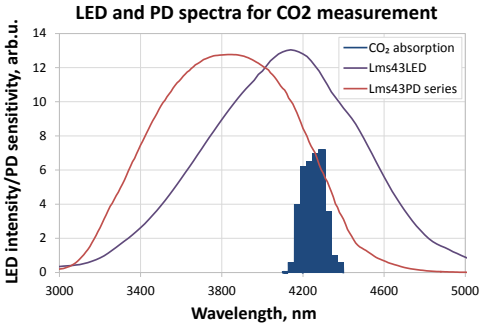
Several measurement schemes can be used for optical sensing depending on the exact application and conditions.

One-channel measurement scheme

Basic measurement technique includes one LED and one photodiode. LED emits radiation at a specific wavelength that corresponds to the absorption band of the analyte, spectrally-matched photodiode detects it and puts out an electrical signal. Presence of the analyte in the environment between the LED and photodiode causes attenuation of the photodiode signal and according to the level of attenuation it is possible to estimate the concentration of the analyte.







Advantages:

- allows designing low-cost solutions;
- enables simple and compact sensor design;
- provides decent results in normal conditions.

This technique is used in most of our evaluation systems and sensor modules.

Influence of temperature changing on the measured signal can be quite essential and may cause certain measurement error. There are several ways to consider this influence:

- use packages with built-in Peltier thermocooler and/or thermistor;

- monitor the intrinsic LED temperature judging by LED current-voltage dependence. Our standard electronics (D-51i LED driver and electronics used in on-board sensor modules) enable this option and puts out signals that carry information about the temperature changing. These signals can be used for the further arranging of the temperature compensation.

Two-channel measurement scheme with one LED and two PDs (measuring and reference)

This scheme includes an additional PD apart from a measuring LED-PD optopair. The additional photodiode is a reference one and is introduced in order to compensate influence of irrelevant effects unrelated to the analyte absorption. Measuring photodiode provides the measuring signal sensitive to presence and concentration of analysed matter, while signal from reference PD remains practically unaffected. Processing of measuring and reference signals allows obtaining stable and reliable measurement results even in harsh environmental conditions thanks to the fact that photodiodes react in the same manner to the external conditions.

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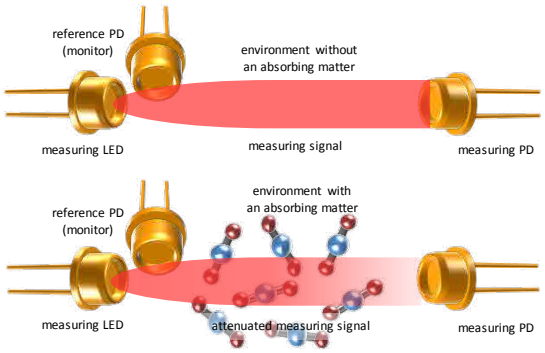
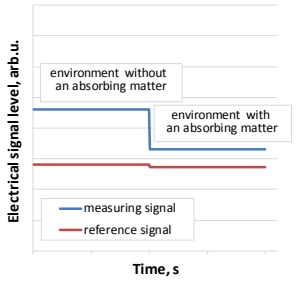
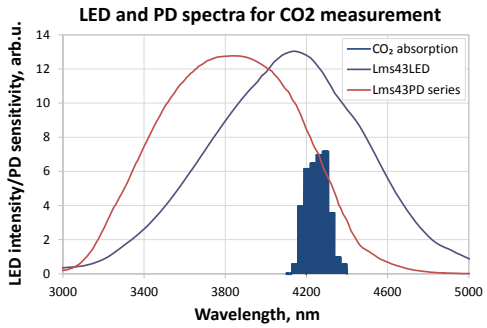
This scheme can be realized using 2 approaches:

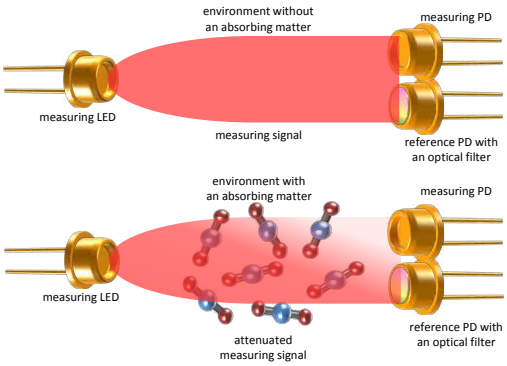
a. reference (monitor) PD has the same sensitivity spectrum as the measuring PD and is deposited close to the LED, thus ensuring the minimal signal attenuation due to short length of an optical path:

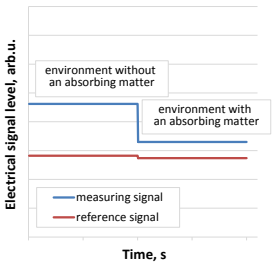


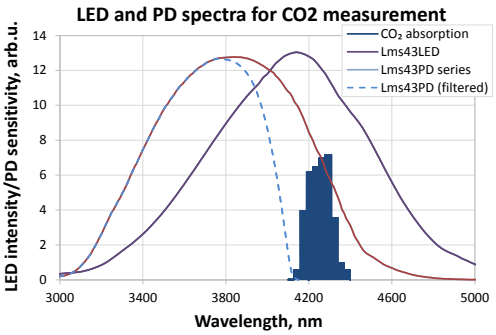




b. reference PD has a spectrum insensitive to a given analyte and is deposited close to the measuring PD. This scheme should include an LED with a spectrum broad enough to provide the emission for two photodiodes with different wavelengths - measuring and reference or two similar photodiodes with additional optical filters to differentiate measuring and reference wavelengths.

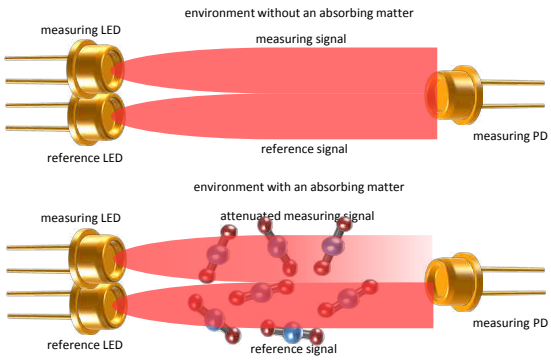


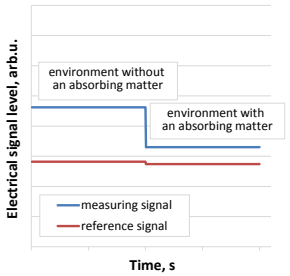


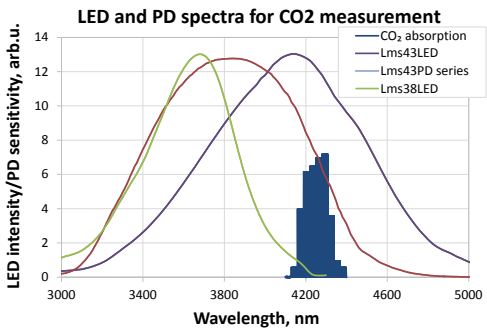


Two channel measurement scheme with two LEDs (measuring and reference) and one PD

This technique includes an additional LED apart from a measuring LED-PD optopair. Measuring LED emits radiation at wavelength corresponding to the maximum absorption of the analyte. Reference LED emits at wavelength that is not absorbed by the analyte. Signal difference between the measuring LED that is partially absorbed in the optical cell and the reference LED is proportional to the concentration of the analyte.







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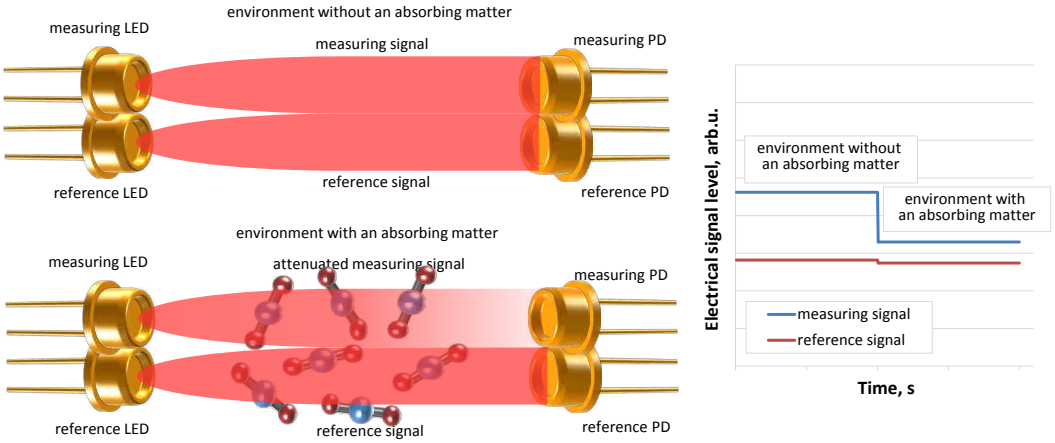
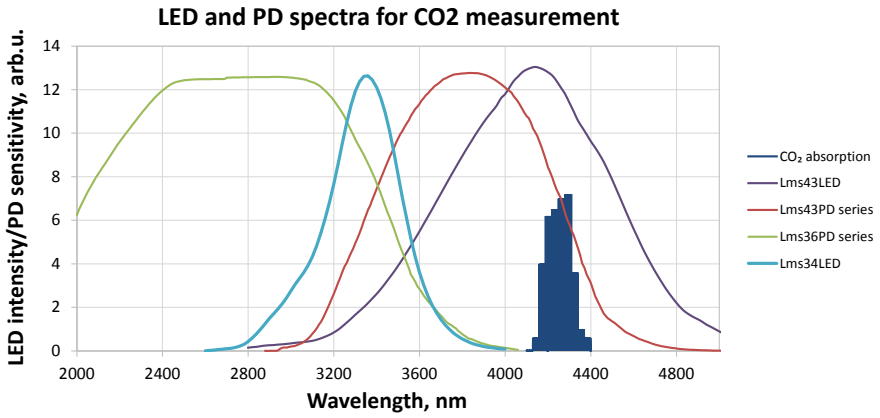
2-channel measurement scheme with 2 LEDs (measuring and reference) and 2 PDs (measuring and reference)

This approach is similar to the previous one with the only difference that additional photodiode is introduced for reference signal detection. The overall scheme includes 2 independent channels: measuring LED-PD optopair (corresponds to the absorption wavelength(s) of the analyte) and reference LED-PD optopair (operates at wavelength(s) away from the analyte absorption). Concentration of the analyte is defined by the signal difference between the measuring and reference PDs.

Common advantages of 2-channel schemes:

- enable compensation of the effects unrelated to the analyte absorption;
- provide better stability of the measurement results comparing to the 1-channel scheme;
- require less frequent calibration than systems based on 1-channel measurement scheme.





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Range of applications

Control of technological processes, examples:

- paper industry (water in paper control);
- oil and petroleum industry (detection of water concentration in oil and oil products);
- thickness testing (thickness of plastic, glass bottles);
- pharmaceutical industry.

Medical diagnostics, examples:

- out-breath control (measurement of carbone dioxide, acetone concentration);
- non-invasive control of glucose in blood, urine;
- cholesterol control.

Ecological monitoring, examples:

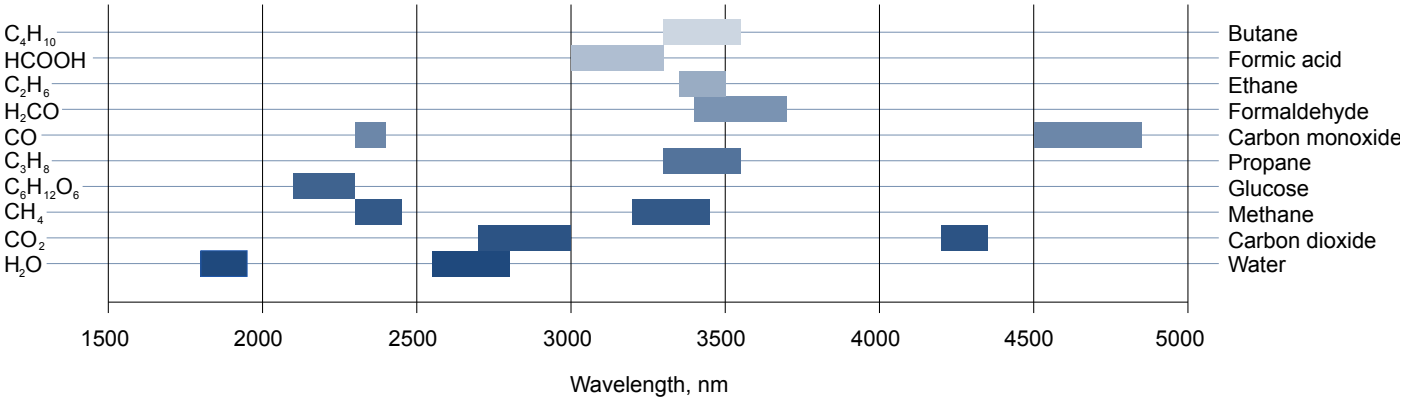
- control of carbon dioxide, carbon monoxide, exhaust gases in the atmosphere;
- control of methane, propane leakage;
- control of hydrocarbons in water.

Food industry and agriculture, examples:

- control of water, fiber, protein concentration in grains, humidity control of coffee beans, corn;
- control of fat and protein in milk.

Spectra are characteristics of the molecules. Frequency of the fundamental vibrations varies with the atomic weight of the constituents. Further spectra exist due to overtones. These are in general much weaker, but there are still possibilities for these to be used for measurement purposes. The absorption strengths also vary with different molecules and therefore, different path lengths should be provided in order to obtain adequate absorption in the required sensitivity range. Small measuring cells can be advantageous, notably when a rapid response is needed. Optical cells that enable multiple pass or long pass of the emission through the analyte can be used for detection of very small concentrations.

There are strong absorption bands of many chemical agents in the mid-infrared spectral range that allows their detection with sensor devices based on LED-PD optopairs or using LED Microsensor NT photodiodes in combination with other sources of infrared radiation. Some of these chemical agents and their absorption bands are presented here.



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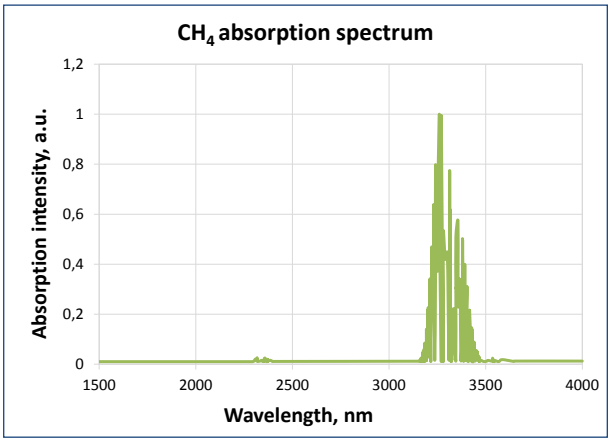
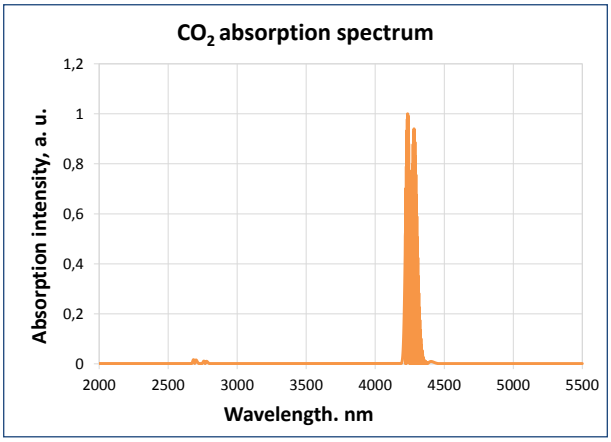


Methane detection

Methane has the main absorption band at 3200-3450 nm. Weaker absorption bands are located around 2300 nm and 1650 nm (the data are taken from HITRAN Catalogue).

For the development of compact optical cells or detection of small methane concentrations we recommend using: Lms34LED and Lms36PD photodiode series. In case of two-channel measurement scheme it is preferable to use a combination of Lms38LED and Lms43PD photodiode series for the reference channel.

For the systems with a long optical path or detection of high methane concentrations the pair: Lms23LED and Lms24PD photodiode series could be used. In case of arranging a two-channel measurement scheme we recommend using Lms20LED and Lms24PD photodiode series for the reference channel.



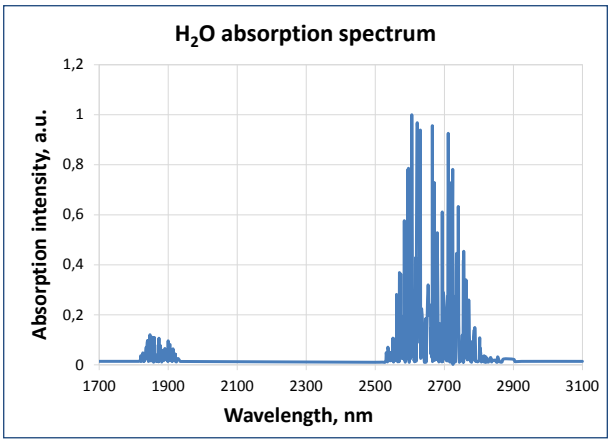
Carbon dioxide detection

Carbon Dioxide has a strong absorption band at 4200-4320 nm spectral range and weaker bands around 2700 nm and 2000 nm (the data are taken from HITRAN Catalogue).

For the development of compact optical cells or detection of small carbon dioxide concentrations we recommend using: Lms43LED and Lms43PD photodiode series. In case of two channel measurement scheme it is preferable to use a combination of Lms38LED and Lms43PD photodiode series for the reference channel.

For the systems with a long optical path or detection of high carbon dioxide concentrations the pair: Lms20LED and Lms24PD photodiode series could be used. For two-channel scheme we recommend using Lms23LED with Lms24PD photodiode series as a reference optopair.

Carbon dioxide detection at ~2700 nm is quite complicated due to the strong water absorption in the same spectral region.



Water detection

Water has strong absorption bands at spectral ranges 2550-2800 nm and 1830-1940 nm (the data are taken from HITRAN Catalog).

We recommend using Lms19LED and Lms24PD photodiode series. In case of two-channel measurement scheme Lms16LED and Lms24PD photodiode series could be used for the reference channel.

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Many different substances have absorption bands in the middle infrared range, but most of analysis and detection tasks are related with measuring only few compounds – water, carbon dioxide, methane and other hydrocarbons:

	CH_4 and other hydrocarbon sensors	• gas industry: natural gas leakage control; • metallurgy: methane concentration control, respective ventilation regulation; • plastic industry: monitoring of plastic bottles thickness and composition; • medical diagnostics: control of fat and other organics in the blood, lymph, tissues; • waste recycling: methane concentration control at landfills.
	CO_2 sensors	• monitoring: CO_2 control on the streets and in the buildings; • agriculture: CO_2 control in greenhouses; • construction: CO_2 control for welding works; • mining: measurement of CO_2 levels in the mines, respective ventilation control; • medical equipment: CO_2 breath control (as an element of capnograph); • automotive industry: exhaust gas control and monitoring of combustion processes inside the engine;
	H_2O sensors	• oil & gas: oil quality control, water in oil analysing; • agriculture: measuring of crops and soil moisture level; • textile industry: humidity measurement of different textile fabrics; • food and beverages: fryers and roasters tuning; • tobacco production: humidity control of dried leaves; • space and aviation: humidity control at high altitudes to assess the degree of icing of the aircraft.

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Wireless stand-alone detectors with low power consumption

Wireless technologies allow creation of stand-alone devices for environmental monitoring, industrial safety, medical usage etc. LEDs and photodiodes are the ideal components to be implemented in such systems due to their extremely low power consumption, fast response and long lifetime. We are glad to announce development of the first LED-PD based sensor family with a battery power supply and integrated wireless data transmission module. First prototype – MDS-4D – is oriented for methane detection and can be applied for solving different tasks, e.g.:

- methane concentration control in the natural gas, oil extraction fields, coal mines, biogas production plants;
- gas concentration monitoring along the pipelines, local gas networks, on the territory of petroleum oil refineries and natural gas processing plants, waste landfill sites;
- methane emissions control in household and industrial applications, where natural gas is used as an energy source;
- methane leakage monitoring in the gas filling stations and vehicles running on gas fuel;
- methane emissions control of agricultural objects (pastures, biomass storages).

Main MDS-4 module features:

- ✓ diffusion type detection;
- ✓ measurement in 0-5% (volume) concentration range;
- ✓ resolution down to 250 ppm in 0-5% (volume) concentration range;
- ✓ very low power consumption – 3.5 mW;
- ✓ quick response time – <2 s;
- ✓ operating temperature range – 0..+40°C;
- ✓ size: 55 x 26 x 14 mm (including optical cell and circuitry);
- ✓ gases: precalibrated for methane, but will respond to most hydrocarbons.

MDS-4 sensor module

MDS-4D sensor

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The major rivals to infrared sensors are electro-chemical devices and semiconductor surface effect sensors, both of which can have very low unit cost compared with the present infrared offerings but have disadvantages in selectivity, fail-to safety, etc. There is a growing trend towards the use of infrared technology.

Present infrared absorption technology utilises several types of emission sources:

- broad-band light sources – filament black body emitters, planar filaments in thin technology – used together with crude and simple optics such as light pipes followed by filters, provide low modulation range (~8 Hz), less suitable for miniaturized sensing devices, low-cost;

- narrow-band sources – laser sources – lead-salt lasers (PbSnSe, PbSSe material systems) with wavelengths up to 14 µm and peak power in the Watt range in continuous wave (CW) mode, require elaborate cooling, frequently cryo cooling; quantum cascade lasers with Bragg feedback gratings (based on GaAs/AlGaAs, GaInAs/AlInAs material systems) allow currently CW-power in the Milliwatt range. Lasers enables detection with very high resolution, distinguishing different absorption lines, but require accurate frequent tuning of the laser wavelength and precise temperature stabilization and have high cost.

For many applications there is no need to distinguish each absorption line and a group of lines (bands) can be used. New optoelectronic devices for the middle infrared spectral range provide completely new possibilities for the creation of portable sensors creation. Using mid-infrared LED-PD optopairs has allowed the development of an instrument that is smaller, less expensive, and more versatile in functionality.

Main advantages that mid IR LEDs and PDs bring for optical sensing:

- ✓ Low power consumption
- ✓ Compact size
- ✓ Low cost

- ✓ Long lifetime
- ✓ No need in frequent calibration

- ✓ Short response time

- ✓ Multi-element LED design

Ability to design autonomous wireless sensors (remote control systems)

Ability to analyze objects moving at high speed (paper and plastic fabrication process)

Saving budgetary on system maintenance (DCV, HVAC systems)

Ability to arrange multi-wavelength emitters and very compact cost-effective LED spectrometers on their basis

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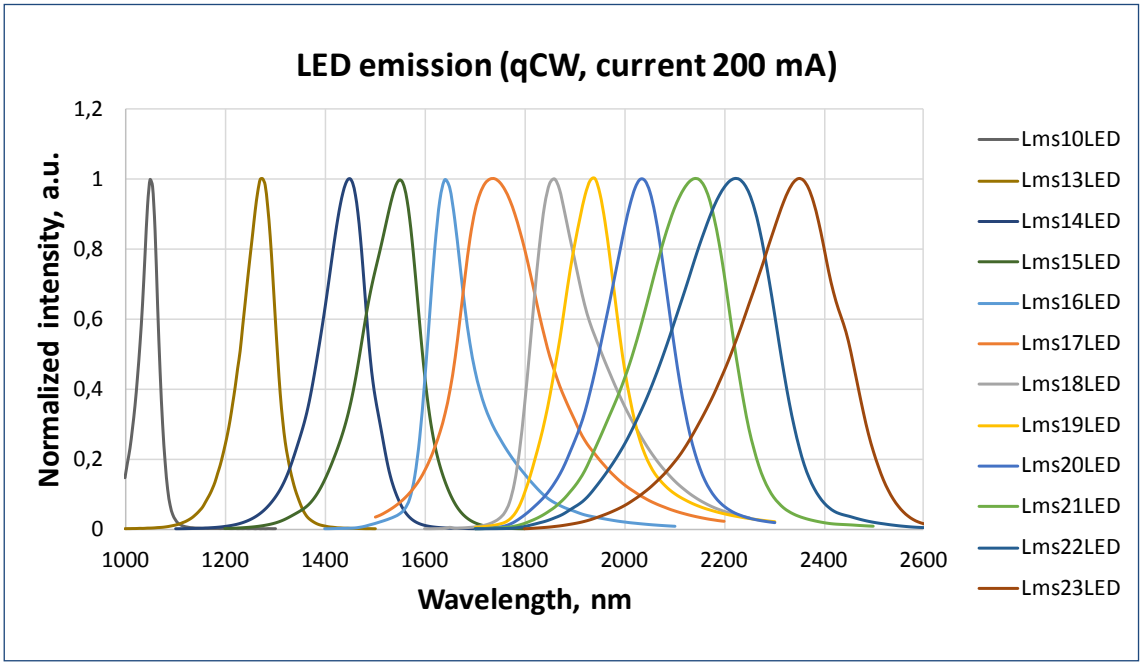
Light Emitting Diodes for 1.0 - 2.3 µm spectral range



	Standard LED models - Lms MIR LED (1.0 – 2.3 µm)											
	Model	Peak emission wavelength, µm		FWHM of the emission band, nm		Power, mW				Voltage, V (200 mA)	Maximum operating current, mA		Operating temperature range, °C
						QCW mode*1 (200 mA)		Pulse mode*2 (1 A)					
		min	max	min	max	min	max	min	max		QCW mode*1	Pulse mode*2	
NEW	Lms10LED	1.03	1.07	70	100	12	20	30	40	1.1-1.4	200	1000	from -60 to +90
NEW	Lms13LED	1.25	1.33	70	100	10	18	25	35	0.9-1.2			
NEW	Lms14LED	1.40	1.49	90	120	7	15	20	25	0.8-1.1			
NEW	Lms15LED	1.50	1.59	110	140	7	15	20	25	0.8-1.1			
	Lms16LED	1.60	1.69	120	150	7	15	20	25	0.7-1.1			
	Lms17LED	1.70	1.76	160	220	5	10	15	20	0.7-1.1			
	Lms18LED	1.80	1.89	100	200	0.7	1.1	4.5	6.5	0.5-2.5	250	2000	
	Lms19LED	1.90	1.99	100	200	0.8	1.2	5	7	0.5-2.5			
	Lms20LED	2.00	2.09	150	250	0.8	1.2	5	7	0.5-2.5			
	Lms21LED	2.10	2.19	150	250	0.8	1.2	5	7	0.5-2.5			
	Lms22LED	2.20	2.29	150	250	0.8	1.2	5	7	0.5-2.5			
	Lms23LED	2.30	2.39	170	270	0.6	1.0	4	6	0.5-2.5			

*1 Repetition rate: 0.5 kHz, pulse duration: 1 ms, duty cycle: 50%

*2 Repetition rate: 0.5 kHz, pulse duration: 20 µs, duty cycle: 1%

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For the applications that don't require high optical power we offer LED models with flexible pricing, so you can order LEDs with lower power for significantly lower prices:

Standard LED models – Lms MIR LED (1.8 – 2.3 µm)						
Model	Peak emission wavelength, µm		Power, mW QCW mode*		Category	Price Discount
	min	max	min	max		
Lms18LED	1.80	1.89	0.7	1.1	A	standard
			0.5	0.69	B	-40%
			0.3	0.49	C	-70%
Lms19LED	1.90	1.99	0.8	1.2	A	standard
			0.6	0.79	B	-40%
			0.3	0.59	C	-70%
Lms20LED	2.00	2.09	0.8	1.2	A	standard
			0.6	0.79	B	-40%
			0.3	0.59	C	-70%
Lms21LED	2.10	2.19	0.8	1.2	A	standard
			0.6	0.79	B	-40%
			0.3	0.59	C	-70%
Lms22LED	2.20	2.29	0.8	1.2	A	standard
			0.6	0.79	B	-40%
			0.3	0.59	C	-70%
Lms23LED	2.30	2.39	0.6	1.0	A	standard
			0.45	0.59	B	-40%
			0.3	0.44	C	-70%

* Repetition rate: 0.5 kHz, pulse duration: 1 ms, duty cycle: 50%, current: 200 mA

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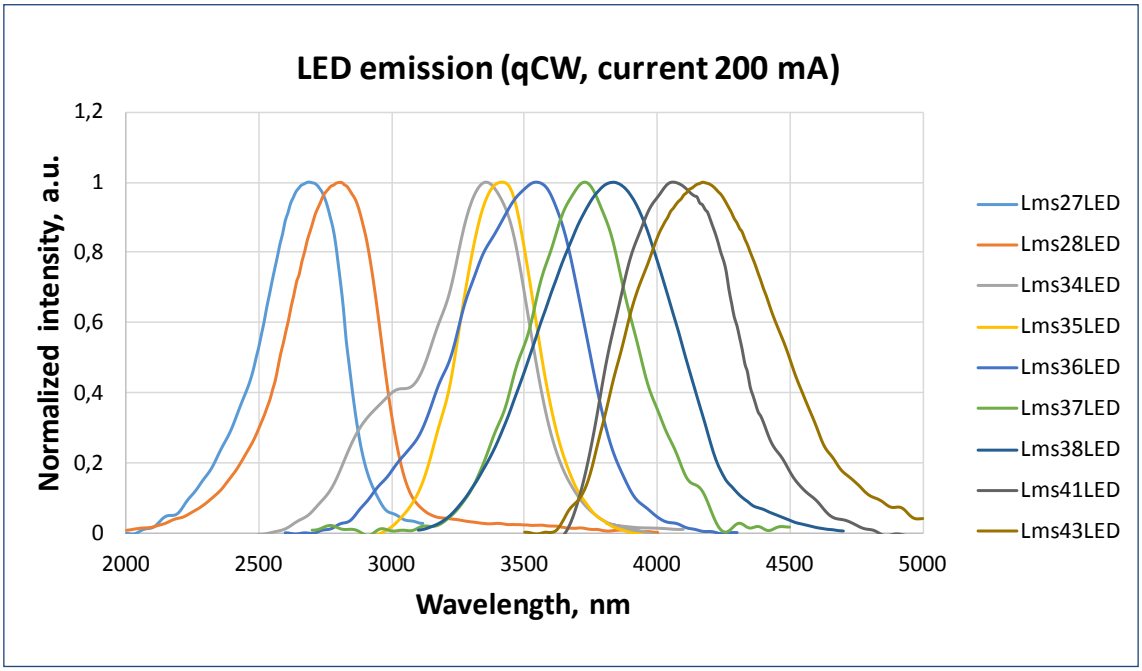
Light Emitting Diodes for 2.7 - 5.0 µm spectral range



	Model	Peak emission wavelength, µm		FWHM of the emission band, nm		Power, µW				Voltage, V (200 mA)	Maximum operating current, mA		Operating temperature range, °C
						QCW mode*1 (200 mA)		Pulse mode*2 (1 A)					
		min	max	min	max	min	max	min	max		QCW mode*1	Pulse mode*2	
	Standard LED models – Lms MIR LED (2.7 – 4.3 µm)												
NEW	Lms27LED	2.70	2.79	300	500	12	25	100	180	0.2-1.0	250	2000	from -60 to +90
NEW	Lms28LED	2.83	2.90	300	500	20	40	150	300	0.2-1.0			
	Lms34LED	3.30	3.44	250	600	20	45	150	350	0.2-1.3			
NEW	Lms34LEDhp	3.30	3.44	250	600	45	80	350	500	0.2-0.8			
NEW	Lms35LED	3.45	3.52	300	600	20	40	150	300	0.2-0.8			
	Lms36LED	3.53	3.69	300	600	15	40	120	300	0.2-0.8			
NEW	Lms37LED	3.70	3.75	300	600	12	30	100	150	0.2-0.8			
	Lms38LED	3.76	3.94	400	700	12	30	100	150	0.2-0.8			
	Lms41LED	3.95	4.09	400	1200	12	30	100	200	0.2-0.8			
	Lms43LED	4.10	4.30	400	1200	15	50	120	370	0.2-0.8			
	LED models with a glass cover – Lms MIR LED-CG (3.4 – 4.3 µm)												
	Lms34LED-CG	3.30	3.44	250	600	80	-	500	-	0.2-1.3	250	1000	from 0 to +50
	Lms38LED-CG	3.70	3.94	500	700	45	-	300	-	0.2-0.8			
	Lms43LED-CG	4.05	4.30	600	1200	25	-	150	-	0.2-0.8			

*1 Repetition rate: 0.5 kHz, pulse duration: 1 ms, duty cycle: 50%

*2 Repetition rate: 0.5 kHz, pulse duration: 20 µs, duty cycle: 1%

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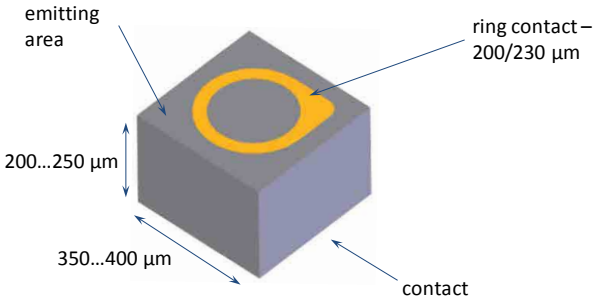
Standard Mid Infrared LED chip



This shape of LED chip is typical for most of LED Microsensor NT standard LED models (Lms XX LED series).
Main features are:

- small size of the LED chip (close to point source);
- effective heat dissipation from the active layer;
- uniform current distribution in the active region;
- cost effective (due to small size).

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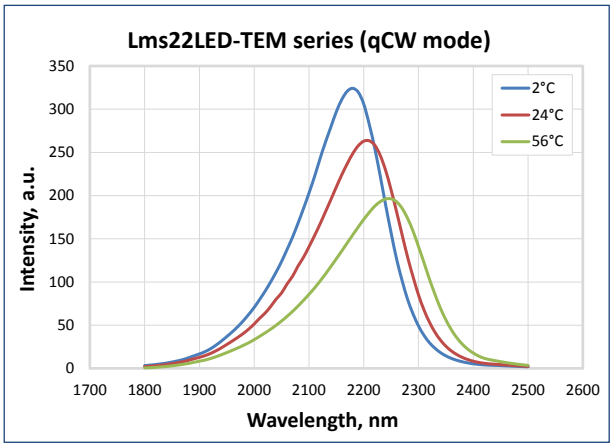
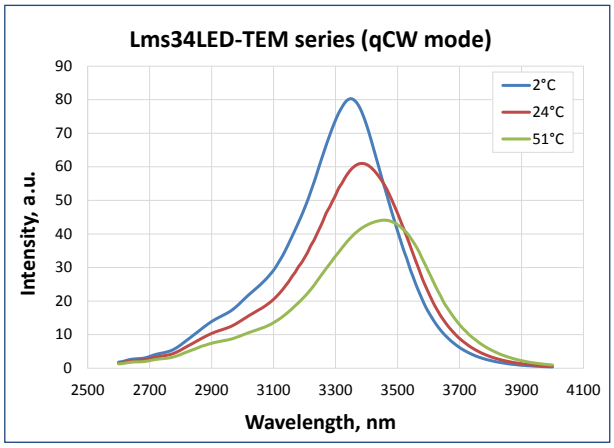
Temperature dependences of optical characteristics

It is typical for all semiconductor radiation sources to have intensity decreasing with temperature increase. This decrease of the emission intensity is related to several temperature-dependent factors, including non-radiative recombination via deep levels, surface recombination and carrier loss over heterostructure barriers. In addition to this, peak wavelength shifts to longer wavelengths when the temperature rises.

We can offer several ways to control LED temperature:

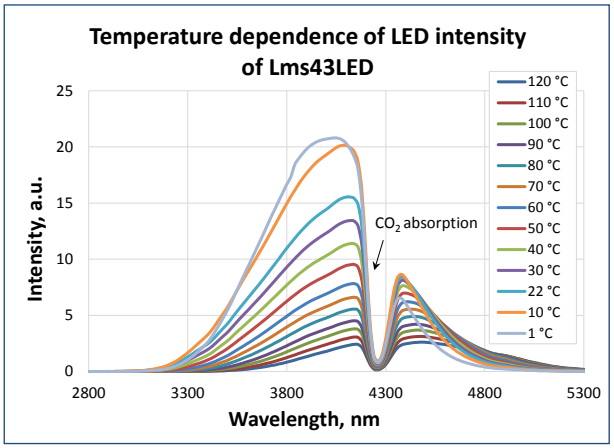


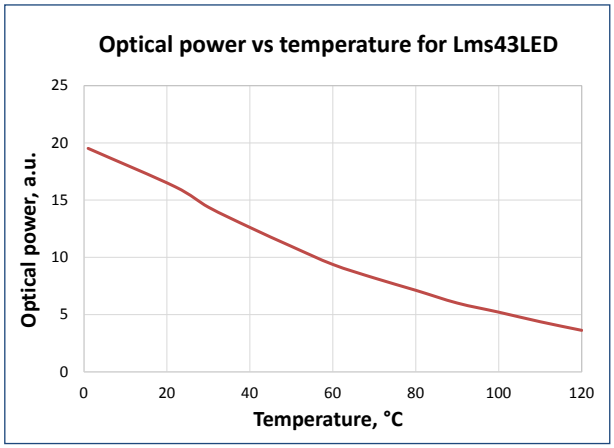


- Mounting of an LED chip into a package with a thermoelectric module (Peltier element) enables stabilization of the temperature of an LED chip, providing wavelength tuning in a certain wavelength range.
- Monitoring the intrinsic LED temperature judging by the LED current-voltage dependence:

short current pulse is applied and corresponding voltage is measured, this voltage value depends on LED (p-n) junction temperature. Temperature compensation scheme can be further arranged considering this dependence. This option is provided by D-51i LED driver produced by LMS NT (see section Electronics of the Catalogue and/or manual for D-51i LED driver).

Our LEDs can operate in a wide temperature range, which certainly broadens their field of application. As an example, Lms43LED spectra at 1 - 120°C temperature range are presented below.





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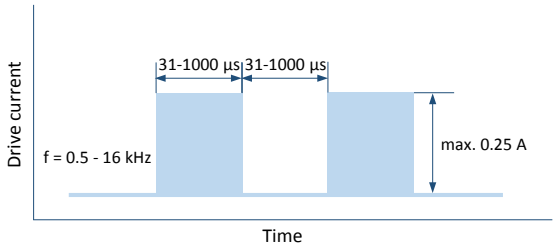
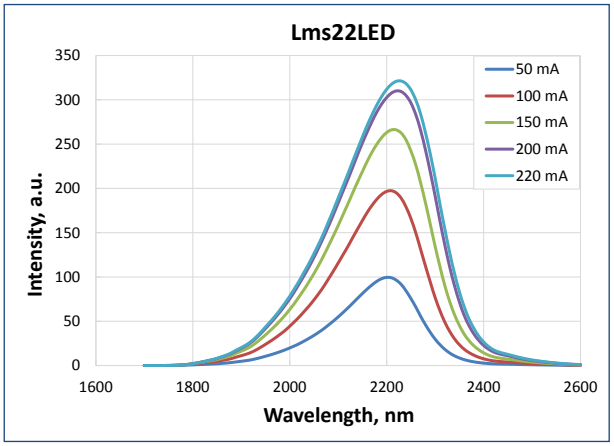
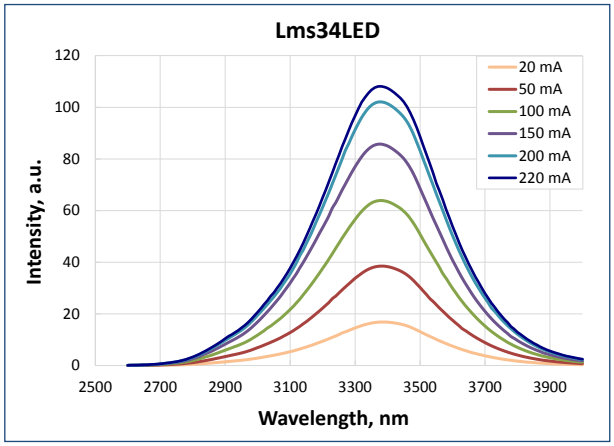
LEDs offer numerous benefits due to the possibility for different operational modes. The optical parameters of LED strongly depend on the operational regime that you choose. We recommend using pulse modes with duty cycle 50% (quasi-continuous wave mode) or 25% to receive maximum average power. These modes provide signal modulation at a certain frequency and allow higher output intensity to be obtained than is the case when using hard CW (continuous wave) mode; therefore, hard CW mode is not recommended. To obtain the maximum peak optical power we recommend using short pulse modes (less than 50 µs).

Quasi-continuous wave (quasi-CW) mode:

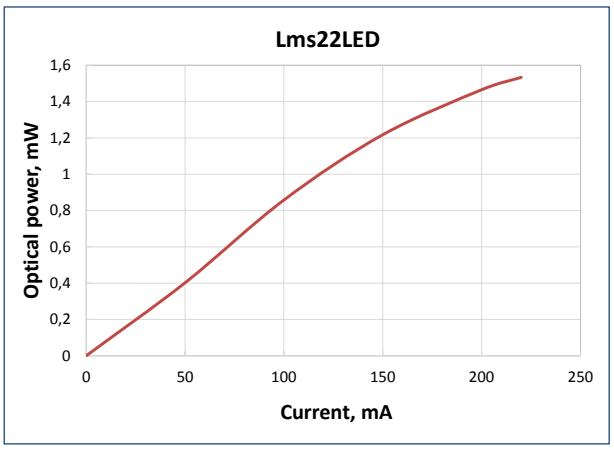


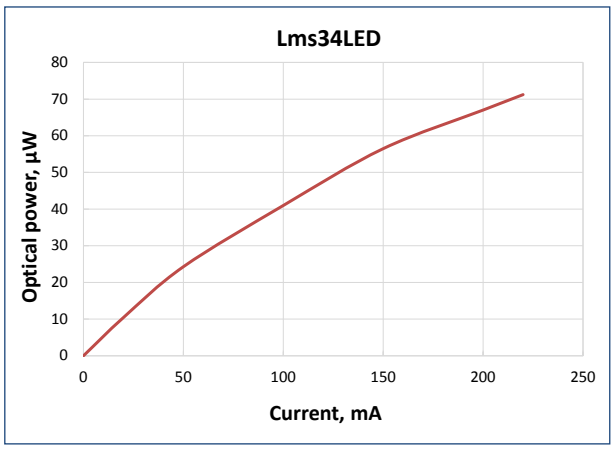
Spectra at different currents in the quasi-CW mode (frequency 0.5 kHz, duty cycle 50%):





Power dependence on current in the quasi-CW mode (frequency 0.5 kHz, duty cycle 50%):





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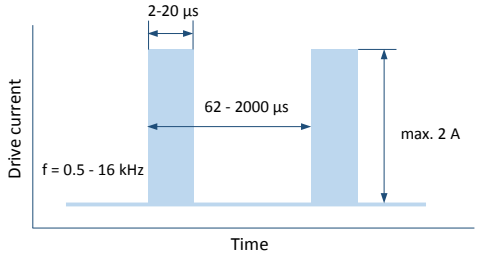
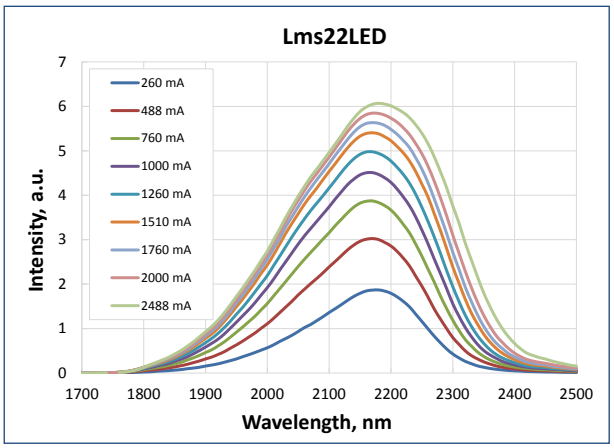
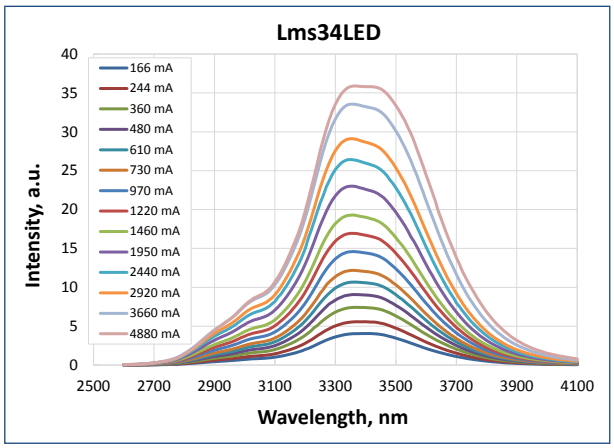
High peak optical power can be achieved at operation mode with short current pulses.

Pulse mode:

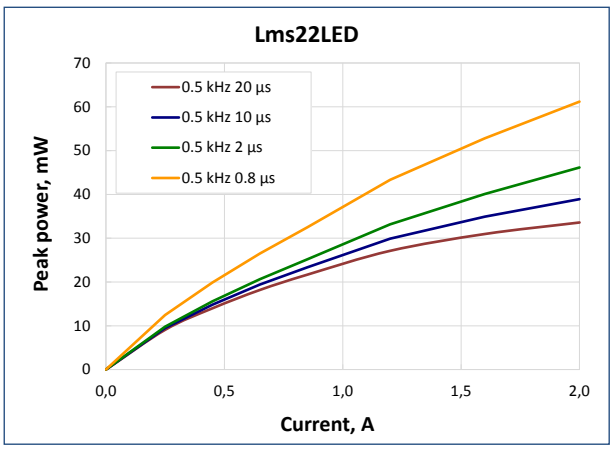


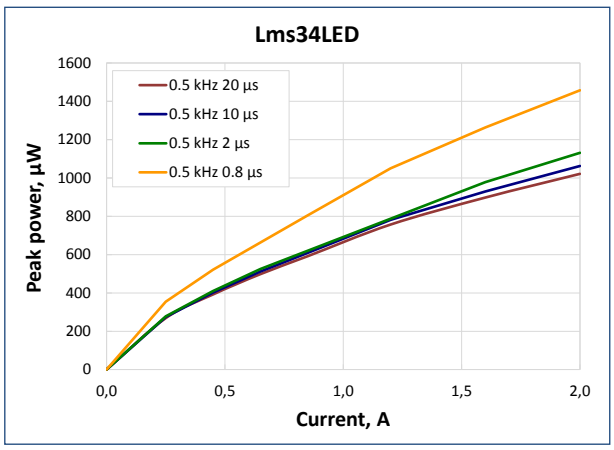
Radiation spectra at different currents in the pulse mode:(pulse 2 us, frequency 8kHz)





Optical power dependence on the drive current in the pulse mode:





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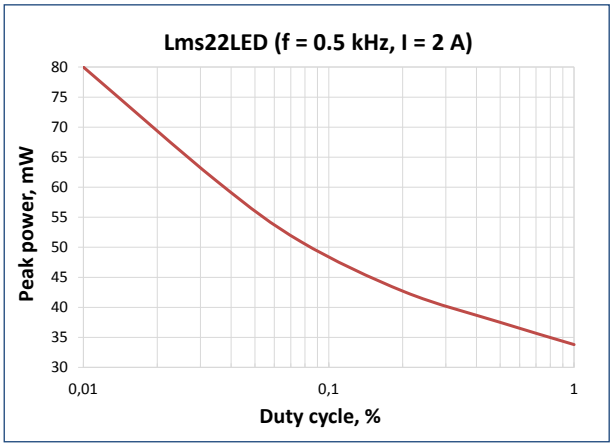
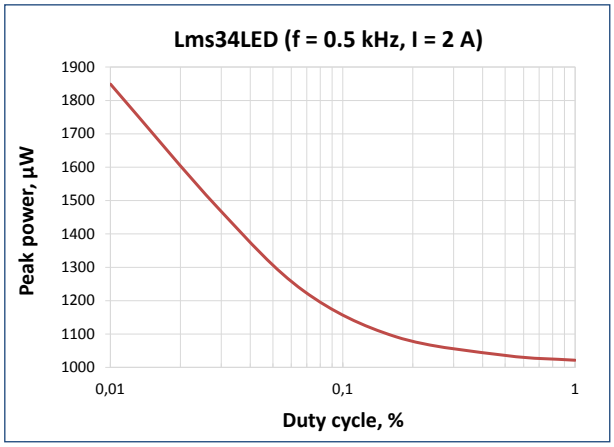
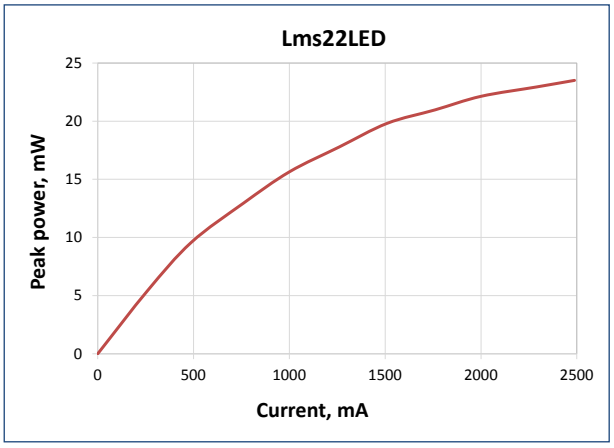
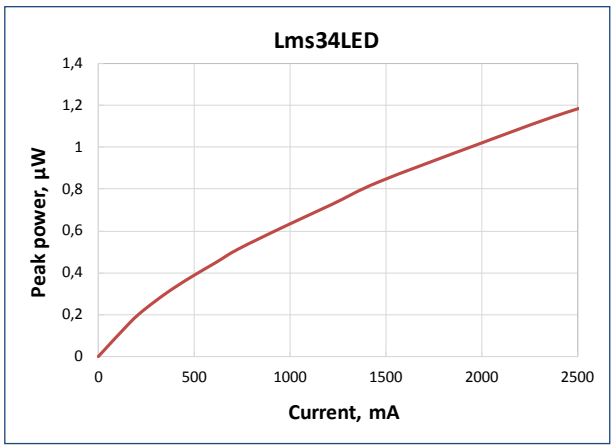
Power dependence on the duty cycle (duty cycle = pulse duration/pulse period):





Power dependence on current in the pulse mode (pulse duration 8 µs, repetition rate 2 kHz):

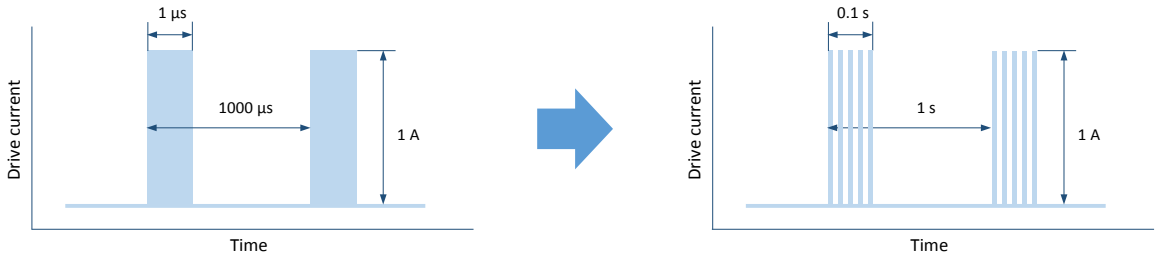




Pulse operation mode provides not only high peak optical power but also helps to **decrease power consumption essentially.** For example, LED with 3.4 µm peak wavelength is driven at pulse mode:

- current amplitude 1 A;
- pulse duration 1 µs;
- frequency 1 kHz (period 1 ms);
- LED forward voltage at 1 A is about 0.5 V.

Average power consumption during pulse period: 1 A x 0.5 V x 1 µs / 1000 µs = 0.5 mW. Further decrease of power consumption up to 0.05 mW can be achieved by applying packets of pulses: 100 pulses in a packet, duration of one packet – 0.1 s, pause between packets - 0.9 s.



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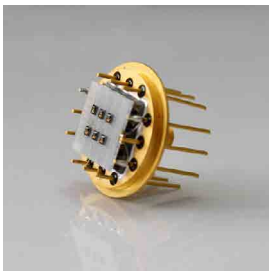


Tiny size of an LED chip (0.4 × 0.4 mm), narrow-band emission spectrum, short response time and low thermal flux enables creation of very compact multi-element LED arrays and matrices emitting at one or different wavelengths.

Parallel connection of several LED chips that emit at the same wavelength and driving them together can provide significant increase of total optical power.

Connecting LED chips that emit at different wavelengths and driving them independently, or applying short current pulses sequentially to each chip, enables scanning of a certain spectral range with the help of a very compact radiation source.

Currently we offer two standard LED matrix types - 4-element one-wavelength arrays and 6-elements multi-wavelength array.

Standard 4-element one-wavelength LED arrays

4-element LED matrix with one peak wavelength at 3.4 µm or 4.3 µm.

Standard one-wavelength LED matrix models											
Model	Peak emission wavelength, µm		FWHM of the emission band, nm		Power, µW				Voltage per chip, V (200 mA)	Maximum operating current, mA		Operating temperature range, °C
					QCW mode*1		Pulse mode*2					
	min	max	min	max	min	max	min	max		QCW mode	Pulse mode	
Lms34LED-4M	3.30	3.44	250	600	70	200	500	1300	0.2-1.3	1000	8000	from -60 to +90
Lms43LED-4M	4.10	4.30	700	1000	50	150	400	1000	0.2-0.8			

*1 Repetition rate: 0.5 kHz, pulse duration: 1 ms, duty cycle: 50%, current: 800 mA.

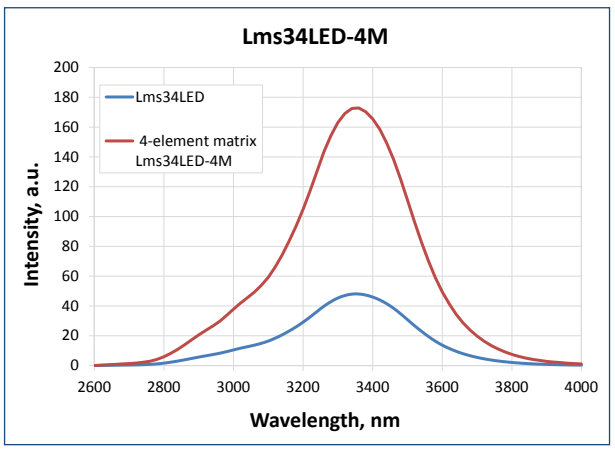
*2 Repetition rate: 2 kHz, pulse duration: 0.5 µs, duty cycle: 0.1%, current: 4 A.

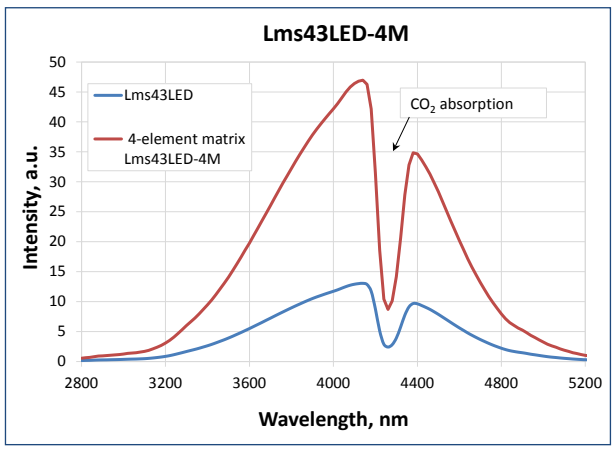
These arrays are available in the following packages:

TO-18 with a cap (without a glass window) or reflector (with/without a glass window) - models: LmsXXLED-4M, LmsXXLED-4M-R and LmsXXLED-4M-RW;

TO-5 with a thermoelectric module with a cap (with a glass window) or reflector (with a glass window) - models: LmsXXLED-4M-TEM, LmsXXLED-4M-TEM-R.

Output intensity of the 4-element arrays





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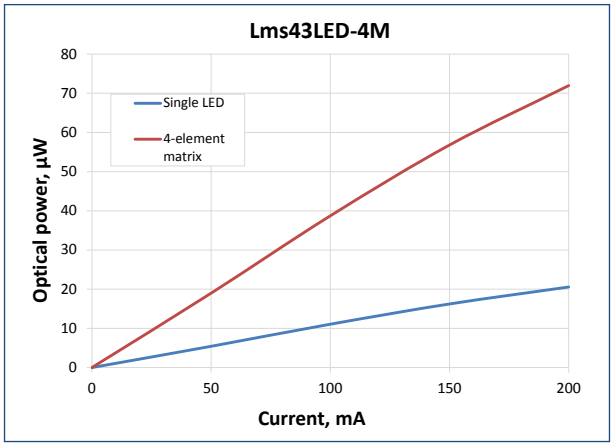
Power dependence on current in the QCW mode (frequency 0.5 kHz, duty cycle 50%)



Lms13-14-16-17-19-21LED-6M 6-element multi-wavelength LED array*

Main LED chip parameters											
LED chip #	Peak emission wavelength, µm		FWHM of the emission band, nm		Power, mW				Voltage, V (200 mA)		Operating temperature range, °C
					QCW mode*1		Pulse mode*2				
	min	max	min	max	min	max	min	max	min	max	
Lms13LED	1.25	1.33	70	100	8	10	25	35	0.9	1.2	from -60 to +90
Lms14LED	1.40	1.49	90	120	7	9	20	25	0.8	1.1	
Lms16LED	1.60	1.69	120	150	6	8	20	25	0.7	1.1	
Lms17LED	1.70	1.79	160	220	5.5	7.5	15	20	0.7	1.1	
Lms19LED	1.90	1.99	100	200	0.8	1.2	5	7	0.8	1.2	
Lms21LED	2.10	2.19	150	250	0.6	1	5	7	0.8	1.2	

*1 Repetition rate: 0.5 kHz, pulse duration: 1 ms, duty cycle: 50%, current: 200 mA.
*2 Repetition rate: 0.5 kHz, pulse duration: 20 µs, duty cycle: 1%, current: 1 A.

*LED dies included in the array can be changed by the manufacturer

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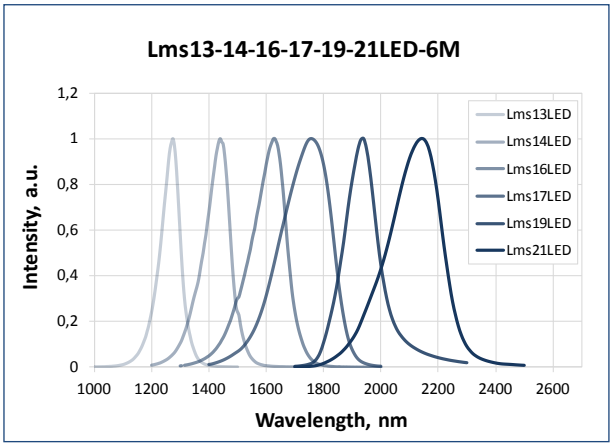
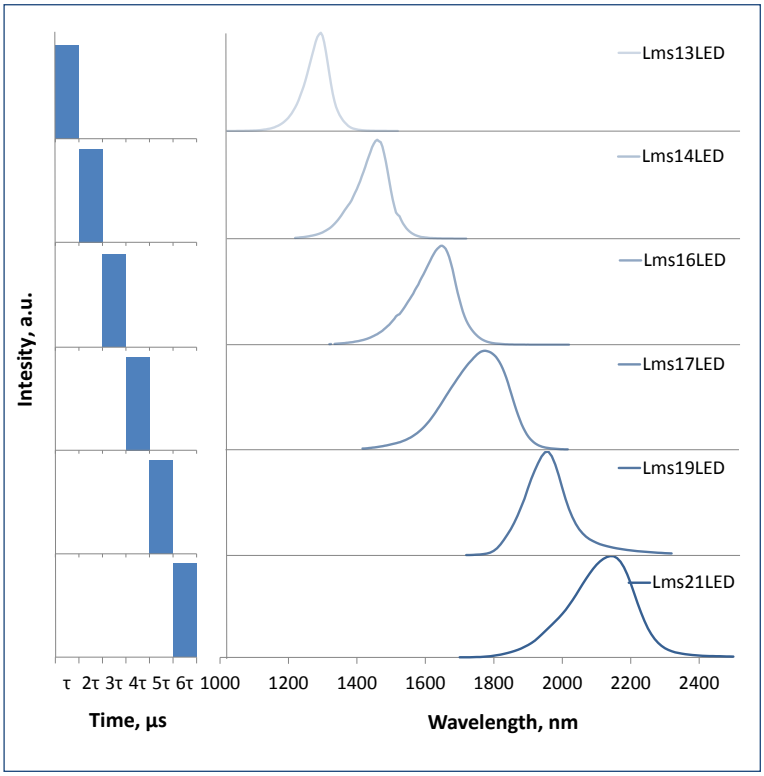
LED array spectra



Availability to drive LED dies independently allows scanning the spectral range from 1.3 µm to 2.1 µm. Such approach is used in our new device - LED analyzer (LA-1T) which contains 8-element multi-wavelength LED array and a wide-band photodiode (more information available on the page 47).



6 element multi wavelength LED array is available in the following packages:

- TO-5 with a cap (with a glass window) - Lms13-14-16-17-19-21LED-6M;
- TO-8 with a thermoelectric module with a cap (with a glass window) - Lms13-14-16-17-19-21LED-6M-TEM;

These standard matrix types are the basic versions that were designed mainly to give an idea about the possible array arrangement and evaluate its performance. We are always open to consider a special solution for the exact customers' needs.

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For the custom arrays and matrices the number of elements included depends on the application and the chosen package type. Standard TO-type packages offered by RMT Ltd. can be used. Packages with built-in thermoelectric modules (Peltier elements) provide temperature stabilisation of LED chip parameters. Using these packages allows creation of different variations of LED arrays, some of them are presented below.

LED matrix type	Package type			
	TO-18	TO-5	TO-5 TEM	TO-8 TEM
One-wavelength LED matrices				
LmsXXLED-2M	✓	✓		
LmsXXLED-2M-TEM			✓	
LmsXXLED-3M	✓	✓		
LmsXXLED-3M-TEM			✓	
LmsXXLED-4M	✓	✓		
LmsXXLED-4M-TEM			✓	✓
LmsXXLED-6M		✓		
LmsXXLED-6M-TEM				✓
LmsXXLED-9M		✓		
LmsXXLED-9M-TEM				✓
LmsXXLED-12M		✓		
LmsXXLED-12M-TEM				✓
LmsXXLED-16M		✓		
LmsXXLED-16M-TEM				✓
Multi-wavelength LED matrices				
Lms X1-X2 LED-2M (2 peak wl)	✓	✓		
Lms X1-X2 LED-2M-TEM (2 peak wl)			✓	
Lms X1-X2-X3 LED-3M (3 peak wl)		✓		
Lms X1-X2-X3 LED-3M-TEM (3 peak wl)			✓	✓
Lms X1-X2 LED-4M (2 peak wl)	✓	✓		
Lms X1-X2 LED-4M-TEM (2 peak wl)			✓	✓
Lms X1÷X4 LED-4M (4 peak wl)		✓		
Lms X1÷X4 LED-4M-TEM (4 peak wl)				✓
Lms X1÷X6 LED-6M (up to 6 peak wl)		✓		
Lms X1÷X6 LED-6M-TEM (up to 6 peak wl)				✓
Lms X1÷X9 LED-9M-TEM (up to 9 peak wl)				✓

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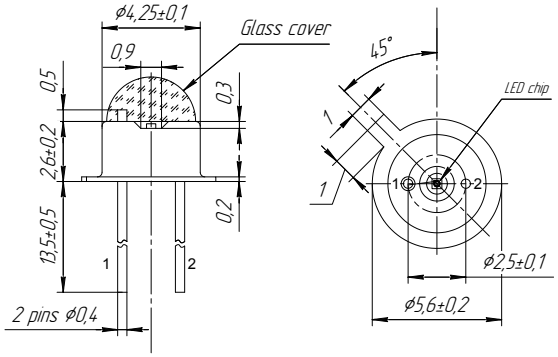
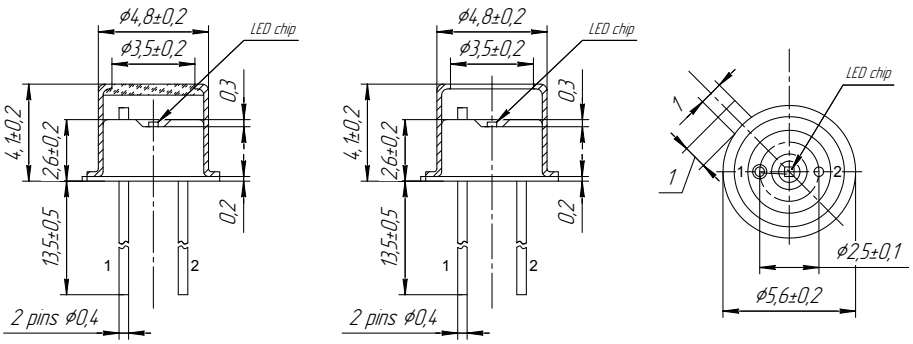
Generally, LEDs are mounted in the package that provides two electrical leads, a transparent optical window for the emission and heat-sinking. An LED chip is soldered/ glued to the package surface that is connected to the one of the lead wires. Top contact of the chip is connected to the other lead with a bonding wire.

We offer a range of standard packages for LEDs and LED-matrices as follows:

TO-18 package with glass cover

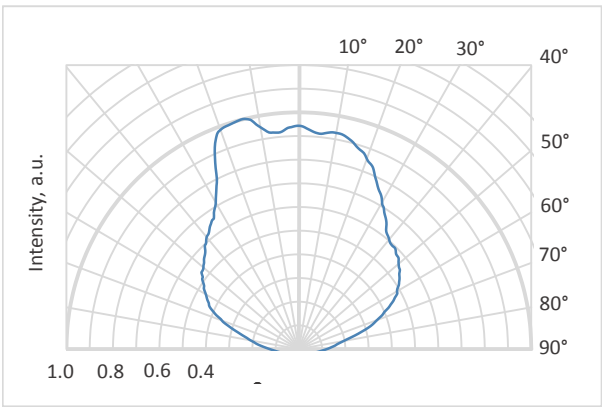


TO-18 with a cap with/without a glass window



Radiant characteristics for LED models in TO-18 package:

package with a cavity



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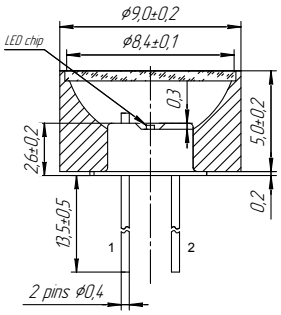
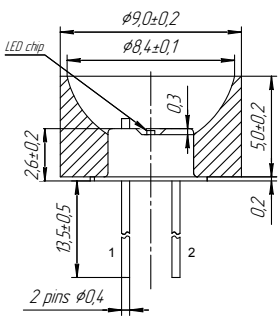
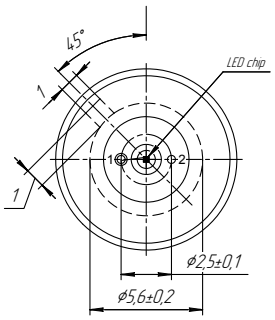
TO-18-R and TO-18-RW with a parabolic reflector with/without a glass window

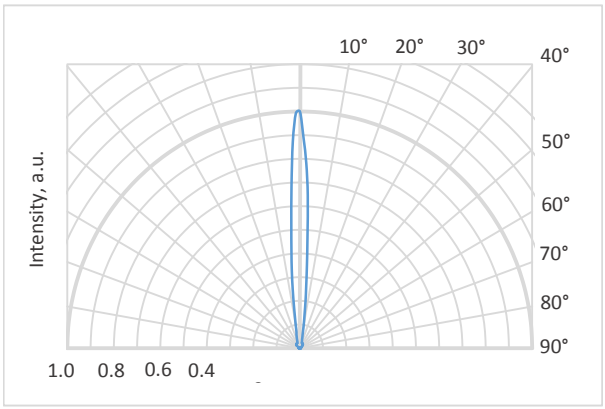






Radiant characteristics for LED models in TO-18 package with a parabolic reflector:

package with a cavity



TO-18 package:

- very miniature packages with limited area for mounting;
- material – kovar, finish – gold/plating;
- the number of lead pins is 2 or 3;
- equipped with a cap (with/without a glass window) or a parabolic reflector (with/without a glass window).

LED models with glass cover are provided without cap/reflector.

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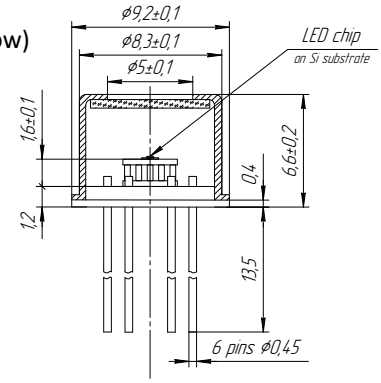
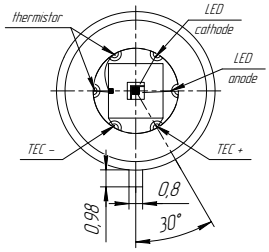
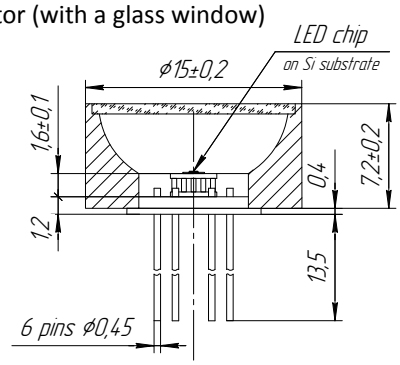
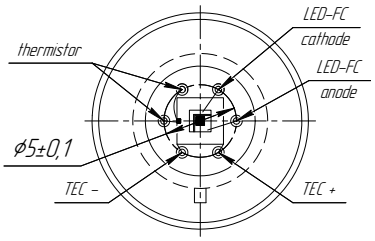
TO-5-TEM with a cap (with a glass window)





TO-5-TEM-R with a parabolic reflector (with a glass window)

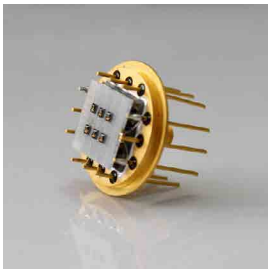


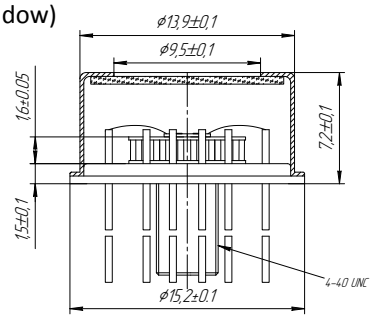


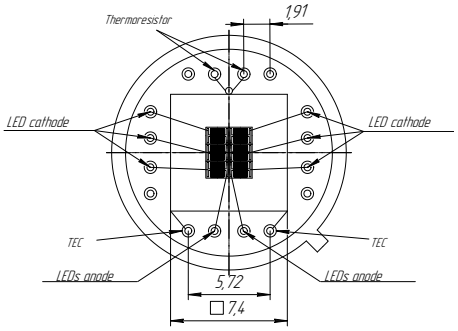
TO-5-TEM package:

- small packages with 3.2 x 3.2 mm² thermocooler surface open for mounting ;
- header material – kovar, finish – gold/plating; thermocooler ceramics – Al_2O_3;
- the number of lead pins is 6 or 8;
- built-in thermoelectric module (TEM) – thermocooler and thermoresistor – provides LED chip temperature adjustment and stabilization in the range +5 to +55 °C;
- equipped with a cap (with a glass window) or a parabolic reflector (with a glass window).

TO-8-TEM with a cap (with a glass window)







- compact packages with 7.4 x 7.4 mm² thermocooler surface open for mounting;
- header material – kovar, finish – gold/plating, thermocooler ceramics – Al_2O_3;
- the number of lead pins is 12 or 16;
- built-in thermoelectric module (TEM) – thermocooler and thermoresistor – provides LED chip temperature adjustment and stabilization in the range +5 to +55°C;
- equipped with a cap with a glass window that protects LED device from damage.

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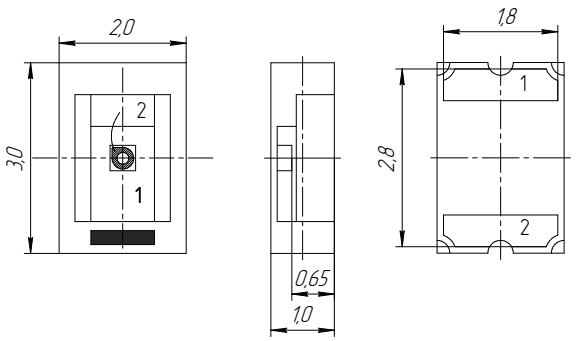
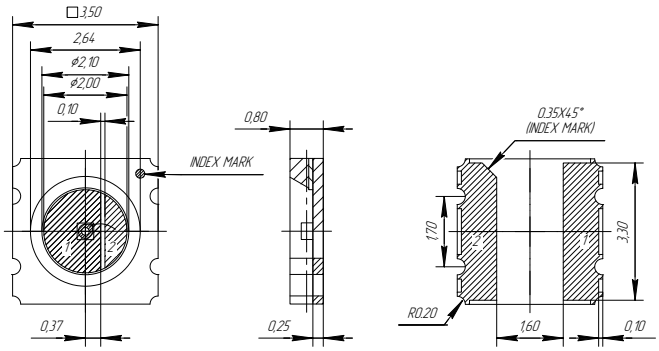
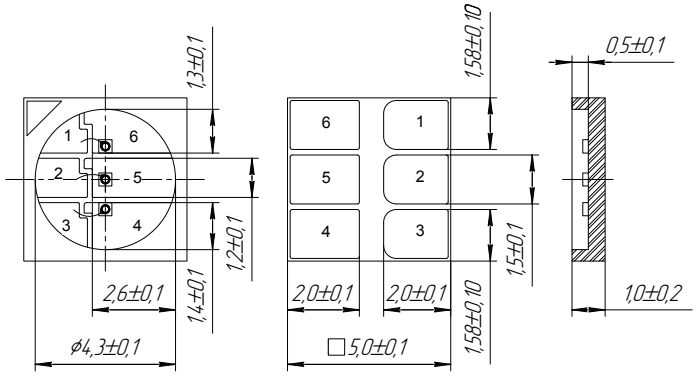
SMD CS3020 3 × 2 mm*



SMD CS35 3.5 × 3.5 mm*



SMD CS5-3M 5 × 5 mm*



***All SMD packages can be substituted by other ones.**

- tiny packages for surface mounting;
- anode and cathode are led to the metalized areas on the back side of the ceramic surface;

In addition to our standard packages, we are ready to offer specifically designed solutions according to our customers' needs.

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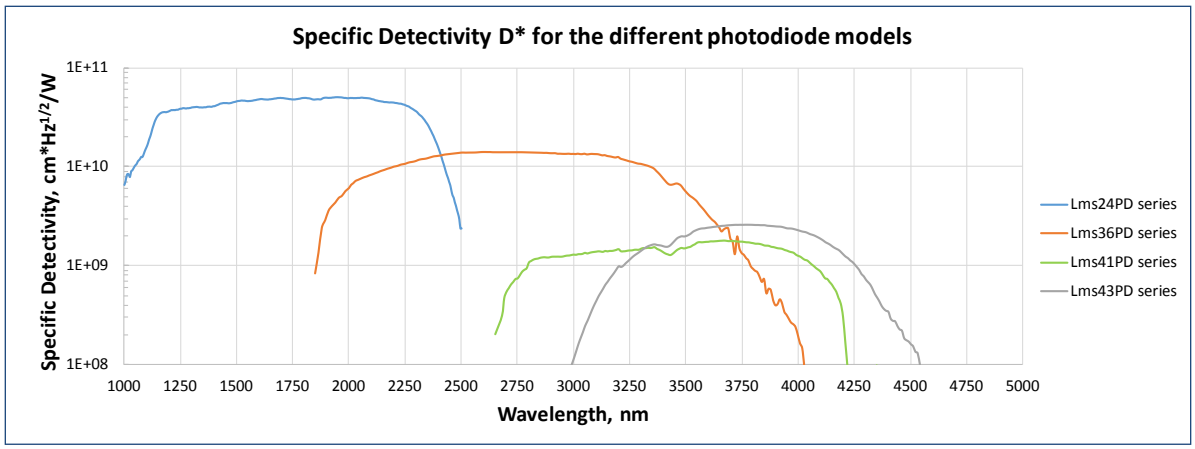
Photodiodes with cut-off wavelengths about 2.4 µm, 3.6 µm, 4.1 µm and 4.3 µm:



	Model	Sensitive area, mm	Max. sensitivity range, µm	Cut-off wave length, µm	Dark current, µA	Resistance, kOhm (10 mV)	Capaci-tance, pF	Photo-sensitivity, A/W	Noise equivalent power, $W/Hz^{1/2}$	Specific Detectivity, $cm*Hz^{1/2}/W$
	Standard photodiode models – Lms MIR PD									
	Lms24PD-03	0.3	1.85-2.30	2.42-2.43	10-60 (-1V)	5-20	50-200	0.7-1.0	$(0.9\text{-}2.5)*10^{-12}$	$(1.0\text{-}3.5)*10^{10}$
	Lms24PD-05	0.5	1.1-2.3	2.40-2.46	10-100 (-1V)	4-18	200-600	0.9-1.1	$(0.9\text{-}2.0)*10^{-12}$	$(2\text{-}5)*10^{10}$
	Lms24PD-10	1.0	1.8-2.3	2.38-2.41	150-700 (-1V)	0.6-2.0	1600-1800	1.0-1.2	$(2.4\text{-}5.2)*10^{-12}$	$(1.7\text{-}3.7)*10^{10}$
	Lms36PD-03	0.3	2.45-3.10	3.7-3.8	50-600 (-0.1V)	0.2-0.6	200-300	0.7-0.8	$(6\text{-}13)*10^{-12}$	$(2\text{-}4)*10^{9}$
NEW	Lms36PD-05	0.5	2.2-3.4	3.6-3.7	50-1000 (-0.1V)	0.2-0.8	600-1400	1.0-1.5	$(3\text{-}9)*10^{-12}$	$(4.5\text{-}14)*10^{9}$
NEW	Lms41PD-03	0.3	3.5-4.0	4.25-4.3	1500-5500 (-0.1V)	$(13\text{-}30)*10^{-3}$	-	0.9-1.1	$(2.1\text{-}4.0)*10^{-11}$	$(0.8\text{-}1.4)*10^{9}$
	Lms41PD-05	0.3	3.6-4.0	4.4	5500-10000 (-0.1V)	$(5\text{-}8)*10^{-3}$	-	1.2-1.5	$(3.0\text{-}4.4)*10^{-11}$	$(1.0\text{-}1.4)*10^{9}$
	Lms43PD-03	0.3	3.8-4.2	4.6-4.7	2500-5500 (-0.1V)	$(15\text{-}25)*10^{-3}$	-	1.8-2.2	$(1.2\text{-}1.8)*10^{-11}$	$(1.7\text{-}2.6)*10^{9}$
	Lms43PD-05	0.5	3.5-4.2	4.5-4.8	8000-25000 (-0.1V)	$(4\text{-}6)*10^{-3}$	-	1.0-1.6	$(3\text{-}6)*10^{-11}$	$(0.6\text{-}1.0)*10^{9}$
	Standard photodiode models with a glass cover – Lms MIR PD-CG									
	Lms36PD-03-CG	0.3	2.4-3.1	3.7-3.8	50-600 (-0.1V)	0.2-0.6	200-300	N/A	N/A	N/A
	Lms36PD-05-CG	0.5	2.2-3.4	3.6-3.7	50-1000 (-0.1V)	0.2-0.8	600-1400	N/A	N/A	N/A
	Lms43PD-03-CG	0.3	3.8-4.2	4.6-4.7	2500-5500 (-0.1V)	$(15\text{-}25)*10^{-3}$	1300-2600	N/A	N/A	N/A
	Lms43PD-05-CG	0.5	3.5-4.2	4.5-4.8	8000-25000 (-0.1V)	$(4\text{-}6)*10^{-3}$	-	N/A	N/A	N/A

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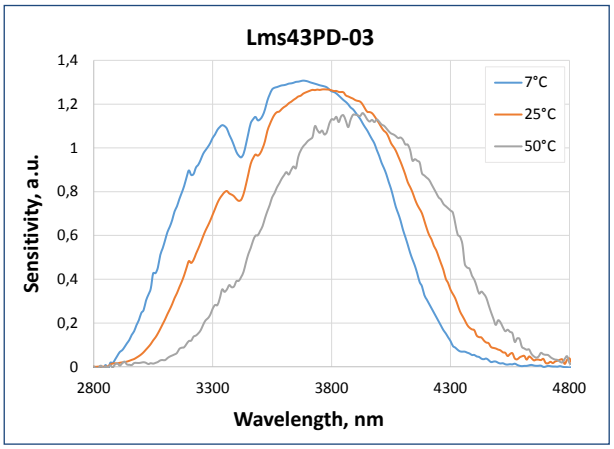
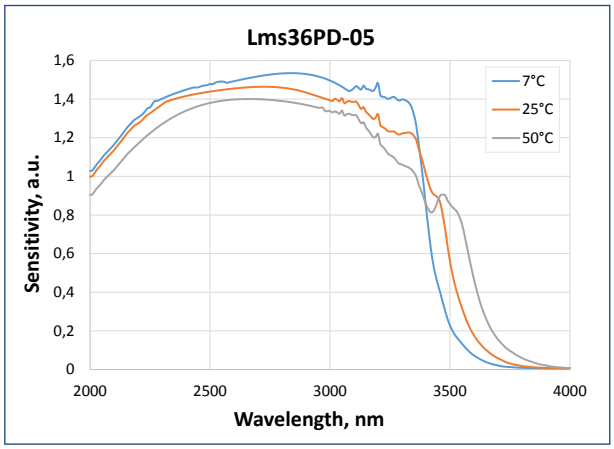
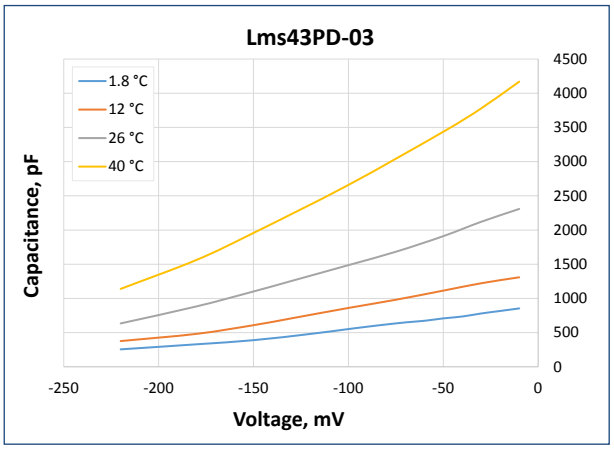
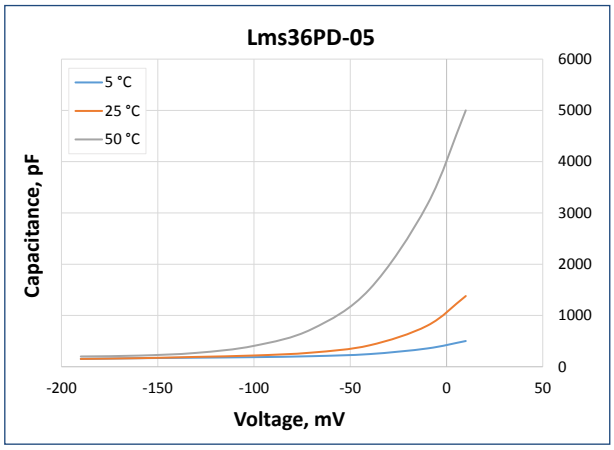
Temperature shift of spectral response



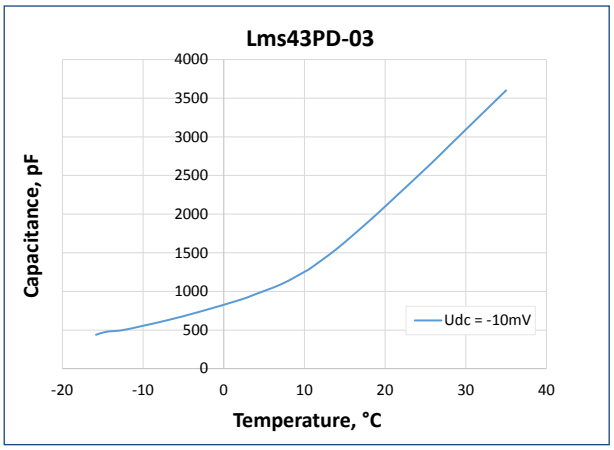


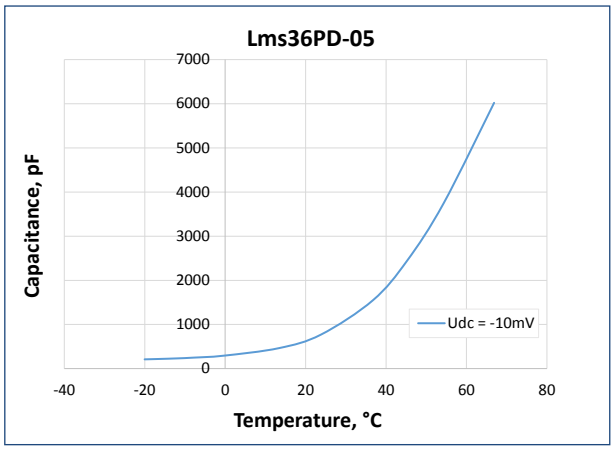
Capacitance vs. reverse voltage





Capacitance vs. temperature (measured at reverse bias 10 mV)





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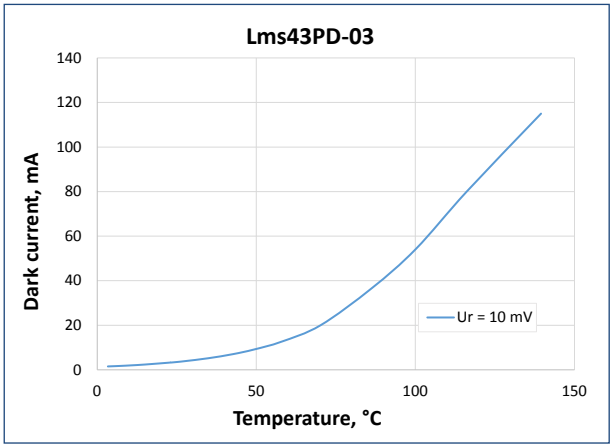
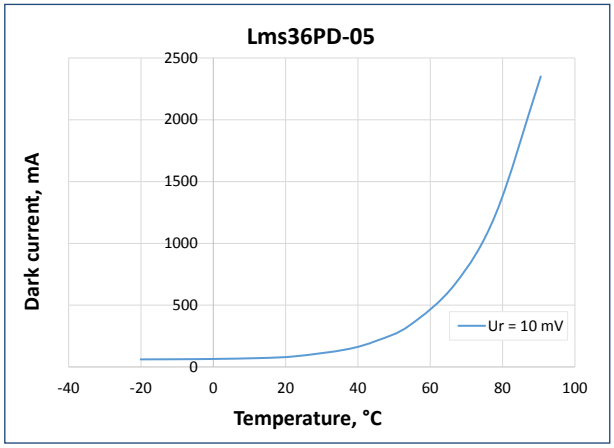
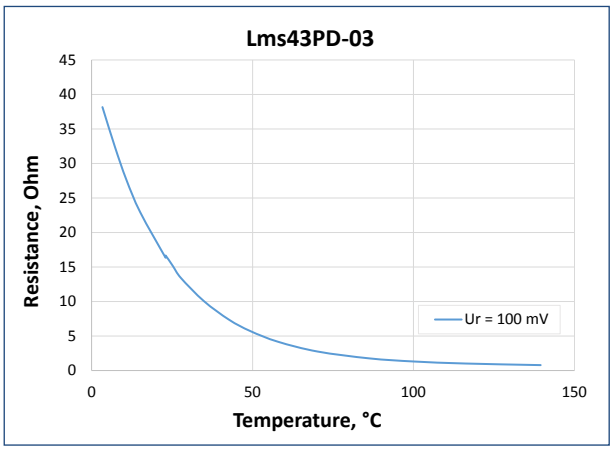
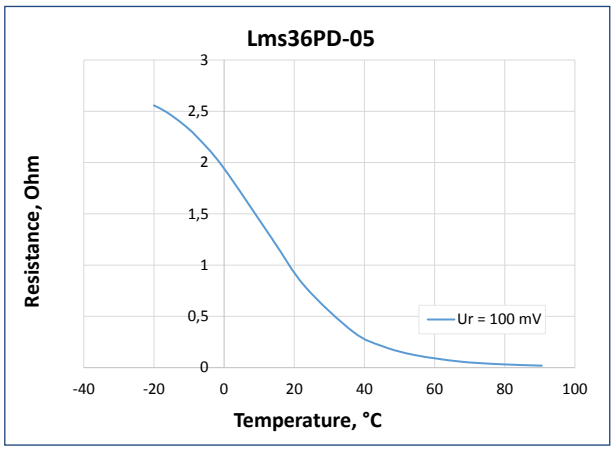
Dark current vs. temperature (measured at reverse bias 10 mV)



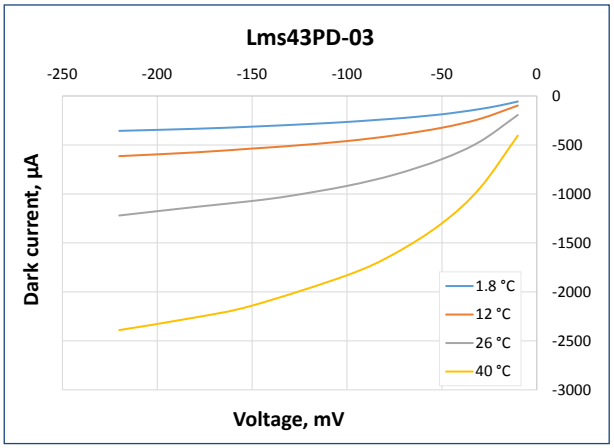


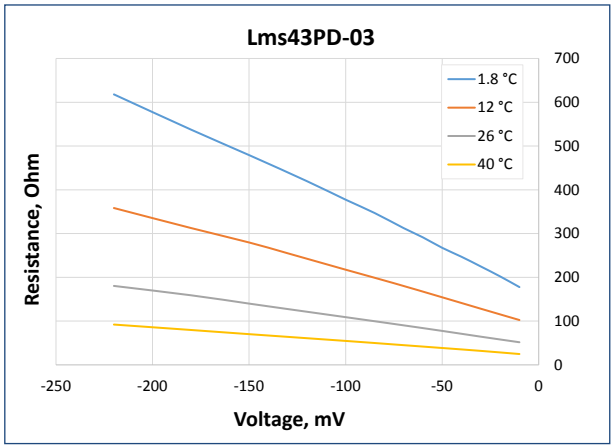
Shunt resistance vs. temperature (measured at reverse bias 100 mV)





Lms43PD-03 dependences of dark current and shunt resistance vs. reverse voltage at different temperatures





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All the above mentioned PD models are available coupled with a preamplifier - PAb type (for more information about PAb please refer to the page 42):

Model without a glass window	Model with a glass window	Model with a glass cover	Models with a built-in thermoelectric module with a cap with a glass window are available under request	Models with a built-in thermoelectric module with a reflector with a glass window are available under request
Lms24PD-03-R-PA	Lms24PD-03-RW-PA	-	Lms24PD-03-TEM-PA	Lms24PD-03-TEM-R-PA
Lms24PD-05-R-PA	Lms24PD-05-RW-PA	-	Lms24PD-05-TEM-PA	Lms24PD-05-TEM-R-PA
Lms24PD-10-R-PA	Lms24PD-10-RW-PA	-	Lms24PD-10-TEM-PA	Lms24PD-10-TEM-R-PA
Lms36PD-03-R-PA	Lms36PD-03-RW-PA	Lms36PD-03-CG-R-PA	Lms36PD-03-TEM-PA	Lms36PD-03-TEM-R-PA
Lms36PD-05-R-PA	Lms36PD-05-RW-PA	Lms36PD-05-CG-R-PA	Lms36PD-05-TEM-PA	Lms36PD-05-TEM-R-PA
Lms43PD-03-R-PA	Lms43PD-03-RW-PA	Lms43PD-03-CG-R-PA	Lms43PD-03-TEM-PA	Lms43PD-03-TEM-R-PA
Lms43PD-05-R-PA	Lms43PD-05-RW-PA	Lms43PD-05-CG-R-PA	Lms43PD-05-TEM-PA	Lms43PD-05-TEM-R-PA

Photodiode models with preamplifier work in photovoltaic mode (with zero bias). Current generated by photodiode is amplified and converted by preamplifier into a pulse voltage signal. There is straight correspondence between PD current and resulting output voltage. The signal converted by preamplifier will have the same form, frequency and pulse duration as the photocurrent signal from photodiode.

Photodiode models with preamplifier are equipped with a parabolic reflector without/with a glass window and packaged in an aluminium tube for protection and screening. Parabolic reflector protects PD device from damage and directs incident radiation on the sensitive area of the photodiode.

For the further signal conversion and synchronous detection of the signals from photodiodes with preamplifiers, we propose SDM synchronous detector. SDM synchronous detector is tuned for optimal operation with LmsXXPD-XX-R-PA/LmsXXPD-XX-RW-PA, LmsXXPD-XX-CG-R-PA and LmsXXPD-XX-TEM-PA/LmsXXPD-XX-TEM-R-PA models and simplifies signal measurement. For more information regarding SDM synchronous detector please refer to the Electronics section, p. 43.

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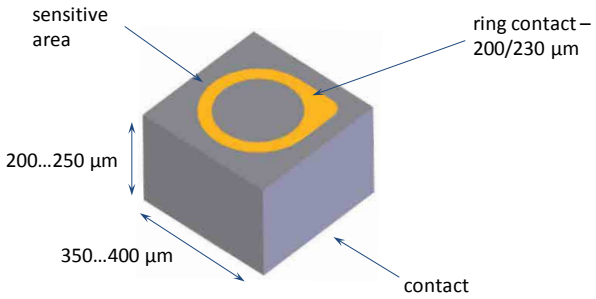
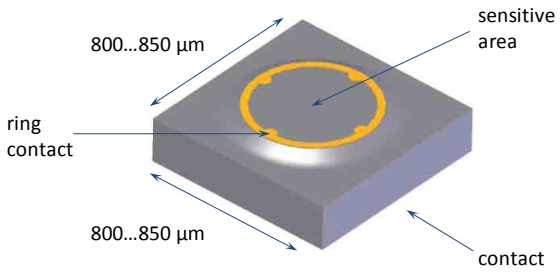
Mid Infrared 0.3 mm photodiode chip



This shape of PD chip is typical for LmsXXPD-03 series photodiodes.
Main features are:

- small size of the PD chip;
- cost effective (due to small size).

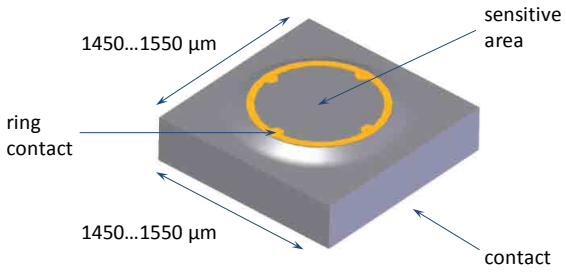
Mid Infrared 0.5 mm photodiode chip



This shape of PD chip is typical for LmsXXPD-05 series photodiodes.
Main features are:

- larger size of the PD active area and, consequently, higher sensitivity;
- mesa shaped structure.

Mid Infrared 1.0 mm photodiode chip



This shape of PD chip is typical for LmsXXPD-10 series photodiodes.
Main features are:

- larger size of the PD active area and, consequently, higher sensitivity;
- mesa shaped structure

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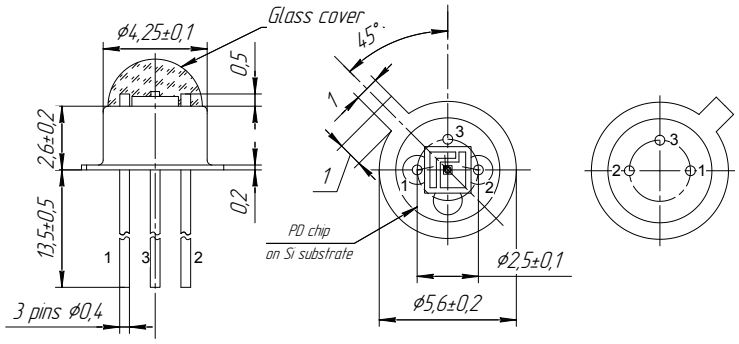
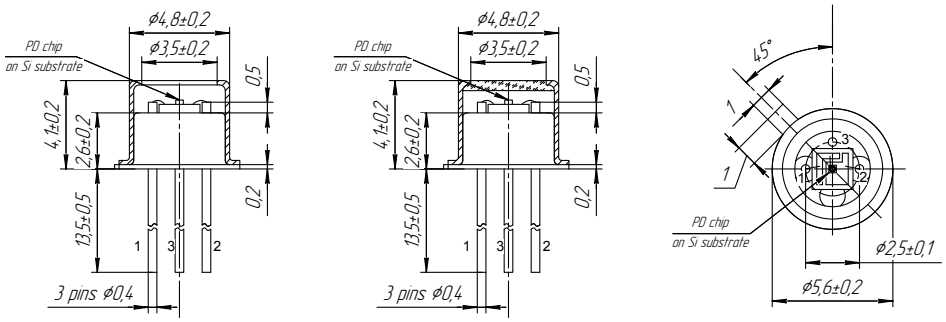
We offer a range of standard packages for PDs as follows:

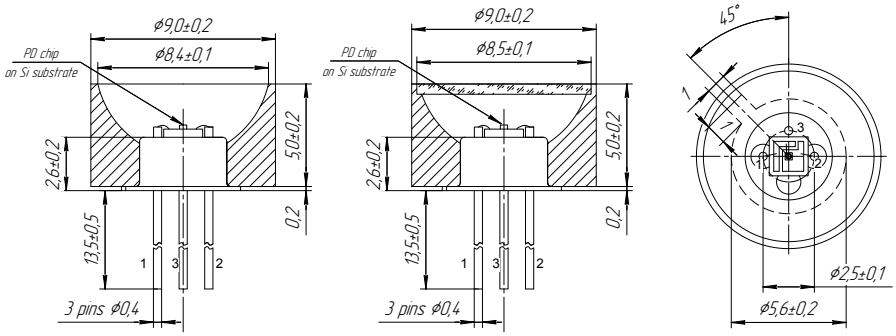
TO-18 with a glass cover



TO-18 with a cap with/without a glass cover



TO-18-R and TO-18-RW with a parabolic reflector with/without glass cover



TO-18 package:

- very miniature packages with limited area for mounting;
- material – kovar, finish – gold/plating;
- the number of lead pins is 2 or 3;
- equipped with a cap (with/without a glass window) or a parabolic reflector (with/without a glass window).

Photodiodes with a glass cover are provided without a cap/reflector.

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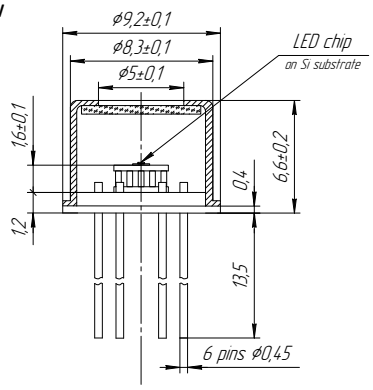
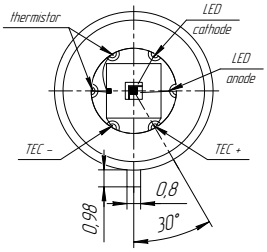
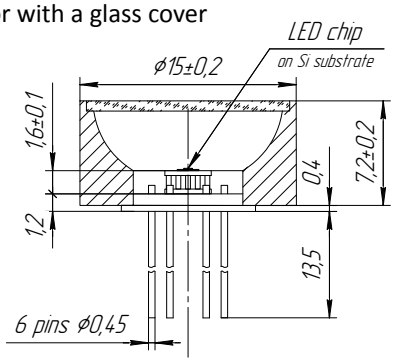
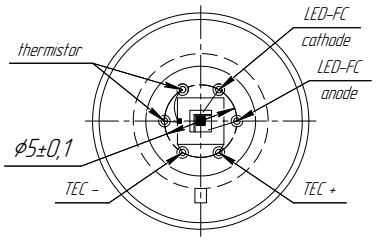
TO-5-TEM with a cap with a glass window





TO-5-TEM-R with a parabolic reflector with a glass cover

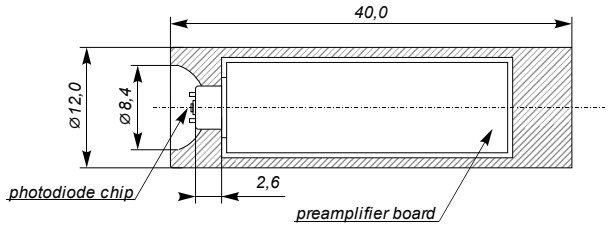


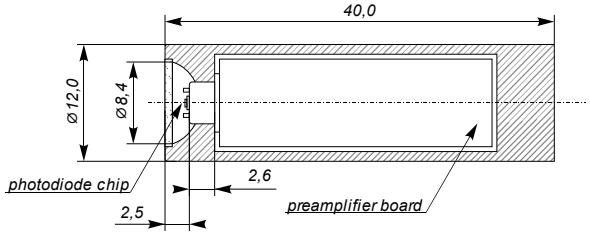


TO-5 package:

- small packages with 3.2 x 3.2 mm² thermocooler surface open for mounting;
- header material – kovar, finish – gold/plating; thermocooler ceramics – Al_2O_3;
- the number of lead pins is 6 or 8;
- built-in thermoelectric module (TEM) – thermocooler and thermoresistor – provides LED chip temperature adjustment and stabilisation in the range +5 to +55°C;
- equipped with a cap (with a glass window) or a parabolic reflector (with a glass window).

Photodiodes with a built-in preamplifier without a glass window LmsXXPD-XX-R-PA and with a glass window LmsXXPD-XX-RW-PA





Photodiode models with preamplifier are equipped with a parabolic reflector without/with a glass window and packaged in an aluminium tube for protection and screening. Parabolic reflector protects PD device from damage and directs incident radiation on the sensitive area of the photodiode.

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In response to customers' requests we have developed different models of electronic units oriented for optimal operation with mid-Infrared LEDs and Photodiodes. Drivers and amplifiers allow the arrangement of a very flexible and easy to use set-up to carry out initial experiments concerning optical absorption measurements of gases, liquids and solid materials in the mid-infrared spectral range. The available operational regimes can be selected to attain the maximum benefits of using the new narrow-band-gap mid-IR LEDs and PDs.

For LED power supply we produce and offer the following driver series:

LED driver D-41i – provides Pulse operation mode.
LED driver D-51i – provides Pulse operation mode; has an additional temperature control (monitoring) feature.
Minidriver mD-1c – provides qCW operation mode with fixed signal data parameters.
Minidriver mD-1p – provides Pulse operation mode with fixed signal data parameters.

For Photodiode signal processing we offer several solutions:

PAb preamplifier board – converts the output current of a photodiode into a pulse voltage signal with amplification. It is also available along with a photodiode in a single metal-tube packing: LmsXXPD-XX-R-PA/LmsXXPD-XX-RW-PA, LmsXXPD-XX-CG-R-PA and LmsXXPD-XX-TEM-PA/LmsXXPD-XX-TEM-R-PA models.

SDM synchronous detector – measures voltage signal from the output of a photodiode preamplifier and converts it to the DC voltage signal proportional to voltage amplitude from the input.

You can select the appropriate electronic device for your experiments using the following tables:

LED models compatibility with drivers

LED\electronic device	D-41i	D-51i	Minidriver mD-1c	Minidriver mD-1p
LmsXXLED (-R; -RW)	✓	✓	✓	✓
LmsXXLED-CG	✓	✓	✓	✓
LmsXXLED-TEM (-R)	✓	✓	✓	✓

PD models compatibility with preamplifier and synchronous detector (SDM)

PD\electronic device	PAb	SDM
LmsXXPD-XX (-R; -RW; -CG)	✓	×
LmsXXPD-XX-TEM (-R)	✓	×
LmsXXPD-XX-R(-R; -RW; -CG-R)-PA	×	✓
LmsXXPD-XX-TEM(-R)-PA	×	✓

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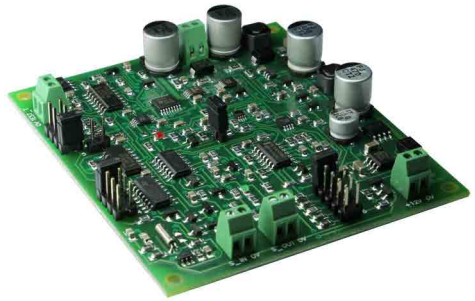
LED driver D-41i



Application

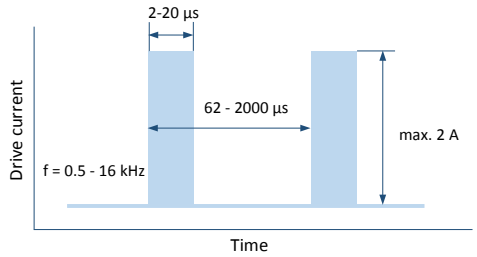
D-41i driver is designed for power supply of MID IR LED models.

Features

- D-41i driver provides pulse mode of operation (the mode of maximum peak optical power of an LED).
- Possibility to choose one of five current values (0.2, 0.6, 1.0, 1.5 and 1.9 A), one of four frequencies (0.5, 2, 8 and 16 kHz) and pulse duration within four values (2, 5, 10 and 20 µs)* via driver's jumpers.
- Synchronisation input terminal block allows:
  - synchronising driver with an external device (synchronous detector etc.);
  - synchronising two or more drivers simultaneously;
  - setting custom frequency of the LED signal.
- Possibility of synchronization with an external device with the help of synchronisation output terminal block.
- Ease of use and durability.

Technical characteristics

Current waveform generated by the driver in pulse mode



Parameters	Value
Input voltage	Stabilised +12 V
Voltage tolerance	-5 to +5 %
Power consumption	< 4 W
Board dimensions	80 × 70 × 15 mm
Synchronization output voltage	5 V

Signal data	Pulse mode
Pulse duration*	2, 5, 10 and 20 µs
Repetition rate	0.5, 2, 8 and 16 kHz
Output current amplitude	0.2, 0.6, 1.0, 1.5 and 1.9 A

*Different values of the pulse duration can be adjusted for the better performance of the LED (LED-PD optopair), follow the data pointed in the specification provided with the ordered driver.

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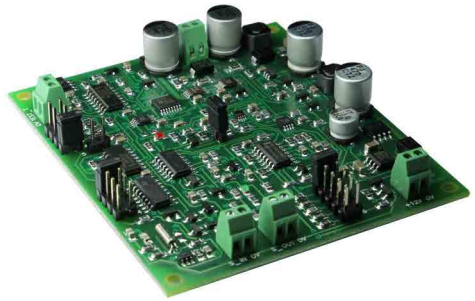
LED driver D-51i



Application

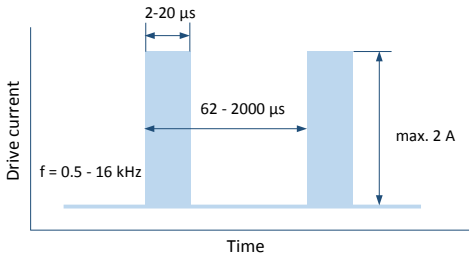
D-51i driver is designed for power supply and intrinsic temperature monitoring of MID IR LED models.

Features

- D-51i driver provides pulse mode of operation (mode of maximum peak optical power of an LED).
- Possibility to choose one of five current values (0.2, 0.6, 1.0, 1.5 and 1.9 A), one of four frequencies (0.5, 2, 8 and 16 kHz) and pulse duration within four values (2, 5, 10 and 20 µs)* via driver's jumpers.
- Synchronisation input terminal block allows:
  - synchronising driver with an external device (synchronous detector etc.);
  - synchronising two or more drivers simultaneously;
  - setting custom frequency of the LED signal.
- Possibility of synchronization with an external device with the help of synchronisation output terminal block.
- Temperature control – possibility to judge about LED p-n junction temperature using current-voltage dependence. Driver generates the low current signal for plugged LED, measures and outputs the voltage. Using the obtained voltage value it is possible to calculate the intrinsic LED temperature.
- Ease of use and durability.

Technical characteristics

Current waveform generated by the driver in pulse mode



Parameters	Value
Input voltage	Stabilised +12 V
Voltage tolerance	-5 to +5 %
Power consumption	< 4 W
Board dimensions	80 × 70 × 15 mm
Synchronization output voltage	5 V

Signal data	Pulse mode
Pulse duration*	2, 5, 10 and 20 µs
Repetition rate	0.5, 2, 8 and 16 kHz
Output current amplitude	0.2, 0.6, 1.0, 1.5 and 1.9 A

*Different values of the pulse duration can be adjusted for the better performance of the LED (LED-PD optopair), follow the data pointed in the specification provided with the ordered driver.

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Minidrivers mD-1c and mD-1p

Application

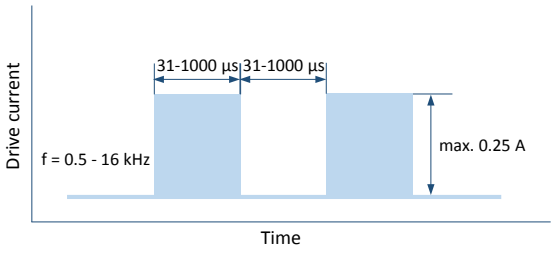
mD-1c and mD-1p minidrivers are designed for power supply of MID IR LED models.

Features

- Minidriver mD-1c provides qCW mode of operation with fixed signal data parameters (amplitude, repetition rate and pulse duration).
- Minidriver mD-1p provides pulse mode of operation with fixed signal data parameters (amplitude, repetition rate and pulse duration).
- Possibility of synchronization with an external device (such as LMSNT SDM synchronous detector) with the help of synchronization output contacts.
- Ease of use and durability.

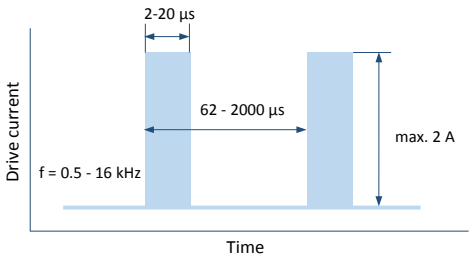
Technical characteristics

Parameters	Value
Input voltage	Stabilised +12 V
Voltage tolerance	-5 to +5 %
Power consumption	< 4 W
Board dimensions	24 × 12 mm
Synchronization output voltage	5 V



mD-1c (qCW)

Signal data	qCW
Pulse duration	500 µs
Repetition rate	1 kHz
Output current amplitude	150 mA



mD-1p (pulse)

Signal data	Pulse mode
Pulse duration	5 µs
Repetition rate	2 kHz
Output current amplitude	2 A

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NEW Multichannel driver MCD

Application

MCD driver is a utility board that unites several functions:

- power supply of LED arrays comprising of Mid-IR LEDs, supporting up to 8 channels;
- photodiode signal processing and amplification;
- synchronisation of LED and photodiode signals.

Features

- Pulse mode operation (mode that provides maximum peak optical power).
- LED current amplitude and pulse duration are preset by manufacture.
- Built-in photodiode preamplifier for PD signal amplification and processing or ability to connect the external photodiode preamplifier.
- Built-in 8-channel synchronous detector, which provides synchronisation with a photodiode preamplifier and further signal amplification.

Compatibility table

One-element LED models	
LmsXXLED	✓
LmsXXLED-R	✓
LmsXXLED-RW	✓
LmsXXLED-TEM	✓
LmsXXLED-TEM-R	✓

Standard multielement LED models	
LmsXXLED-4M	✓
LmsXXLED-4M-R	✓
LmsXXLED-4M-RW	✓
LmsXXLED-4M-TEM	✓
LmsXXLED-4M-TEM-R	✓
Lms13-..-21LED-6M	✓
Lms13-..-21LED-6M-TEM	✓

Technical characteristics

Parameters	Value
Input voltage	Stabilised +12 V
Voltage tolerance	-5 to +5 %
Input current	max. 0.25 A
Board dimensions	105 × 70 × 15 mm
Signal output voltage amplitude	11 V (-4 V for inverted PD signal)

Fixed parameters	Value
Pulse duration	20 μs*
Repetition rate (per channel)	0.5 kHz
Repetition rate (8 channels)	4 kHz
Output current amplitude	0.4 A*
Output signal gain (adjustable)	1x - 10x

*Pulse duration and current values in the table are default, but can be preadjusted by manufacturer according to a customer's request.

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Application

PAb preamplifier is oriented for amplification and conversion of the pulse current signal generated by photodiodes (PDs). The resulted voltage signal has the same form as the photocurrent, i.e. if the photocurrent from photodiode is a meander, the converted signal will be a meander too with the same frequency and pulse duration. Current into voltage conversion coefficient is constant and depends on given photodiode.

Features

- Enables PD operation at photovoltaic mode (with no reverse bias).
- Provides conversion of PD photocurrent to a voltage signal with amplification.
- Adjustment for the exact photodiode type is required for the proper operation.

Compatibility table

Photodiode models	
LmsXXPD-XX	✓
LmsXXPD-XX-R	✓
LmsXXPD-XX-RW	✓
LmsXXPD-XX-CG	✓
LmsXXPD-XX-R-PA	×
LmsXXPD-XX-RW-PA	×
LmsXXPD-XX-CG-R-PA	×
LmsXXPD-XX-TEM	✓ (under request)
LmsXXPD-XX-TEM-R	✓ (under request)
LmsXXPD-XX-TEM-R-PA	×
LmsXXPD-XX-TEM-RW-PA	×

Technical characteristics

Parameters	Value
Input voltage	Stabilised +5 V
Voltage tolerance	-5 to +5 %
Board dimensions	10 × 26 mm

PAb preamplifier is also available along with a photodiode in a single metal-tube packing: LmsXXPD-XX-R-PA/LmsXXPD-XX-RW-PA, LmsXXPD-XX-CG-R-PA and LmsXX-PD-XX-TEM-PA/LmsXXPD-XX-TEM-R-PA

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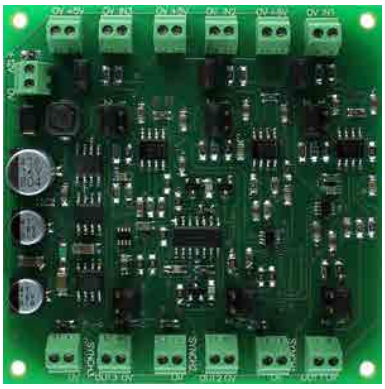

Application

SDM synchronous detector measures voltage signal from the output of a photodiode preamplifier and converts it to the DC voltage signal proportional to amplitude of the voltage from input.

Features

- Three independent channels for detection. One can connect three systems with drivers and preamplifiers and run them through the synchronous detector simultaneously.
- Built-in power supply for preamplifiers.
- Possibility of input polarity inversion using the appropriate jumper. In case of wrong polarity connection from photodiode preamplifier one can simply switch the input polarity inversion jumper.

Technical characteristics

Parameters	Value
Input voltage	Stabilised +12 V
Voltage tolerance	-5 to +5 %
Power supply current, max	< 0.1 A
Board dimensions	70 × 70 × 19 mm
Synchronization output voltage	5 V
Output constant voltage signal, max	10 V

Parameters	Value
Averaging time	100, 200 and 300 ms
Voltage tolerance	1x, 5x and 10x

Parameters	Value
Pulse duration	2 - 20 µs
Repetition rate	0.5 - 16 kHz
Input voltage signal from preamplifier, max	±3 V

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Mid-infrared light-emitting diodes and photodiodes manufactured by LED Microsensor NT, LLC have already found their usefulness in a vast area of applications. For the first-time users we announce sample systems and kits that enable fast preliminary experiments with mid-infrared LED-PD optopairs for different detection purposes.

Evaluation kits for methane (MDK and MDK-c) and carbon dioxide (CDK and CDK-c) detection

Evaluation kit for CH_4 detection (MDK) includes:

- Lms34LED-RW;
- Lms36PD-05-RW-PA;
- org glass optical chamber (optional, under request);
- LED Driver (D-41i / D-51i / mD-1p);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

Evaluation kit for CO_2 detection (CDK) includes:

- Lms43LED-RW;
- Lms43PD-03-RW-PA;
- org glass optical chamber (optional, under request);
- LED Driver (D-41i / D-51i / mD-1c);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

MDK-c and CDK-c are advanced evaluation kits for CH_4 and CO_2 detection with glass-covered LED and photodiode, which includes all the needed components for quick and simple start.

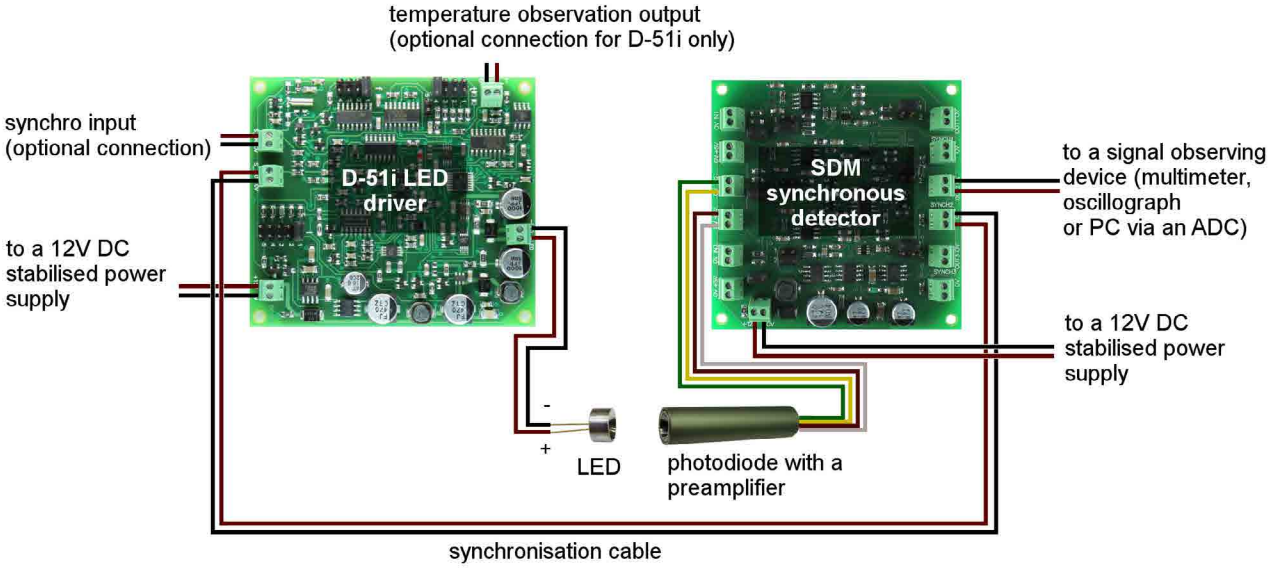
Evaluation kit for CH_4 detection (MDK-c) includes:

- Lms34LED-CG-R;
- Lms36PD-05-CG-R-PA;
- LED Driver (D-41i / D-51i / mD-1p);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

Evaluation kit for CO_2 detection (CDK-c) includes:

- Lms43LED-CG-R;
- Lms43PD-03-CG-R-PA;
- LED Driver (D-41i / D-51i / mD-1c);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

Connection setup



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Evaluation systems for methane (MDS-5) and carbon dioxide (CDS-5) detection

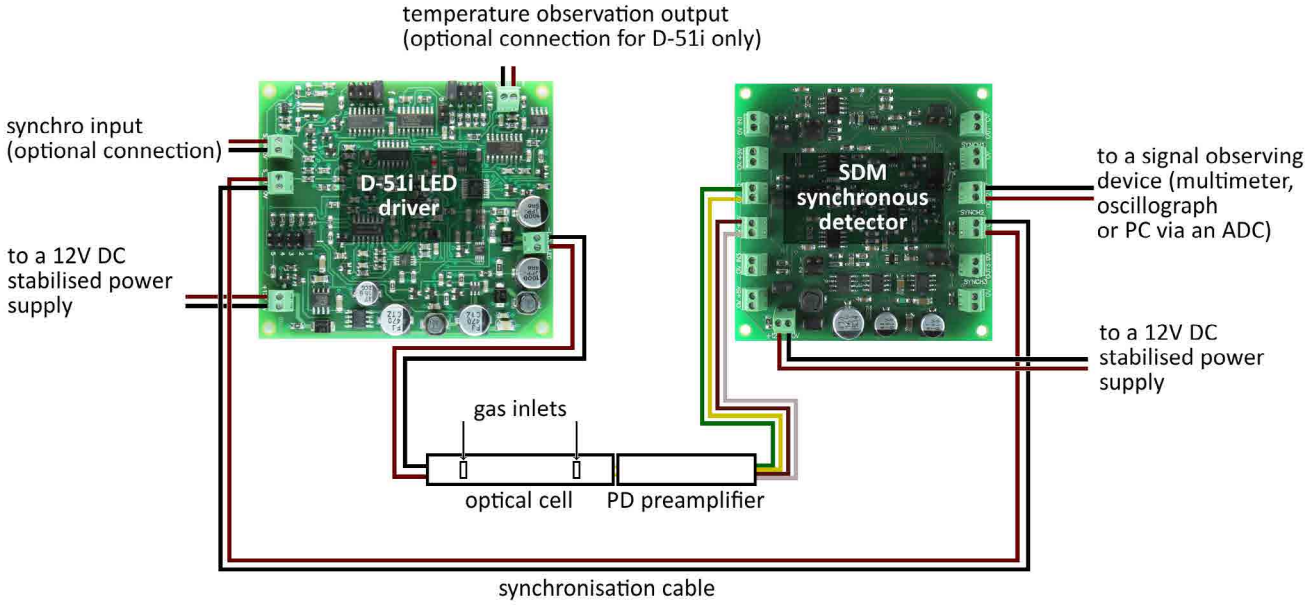
Evaluation system for CH_4 detection (MDS-5) includes:

- optical cell with:
  - Lms34LED-CG;
  - Lms36PD-05-CG;
- PD preamplifier;
- LED Driver (D-41i / D-51i/mD-1p);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

Evaluation system for CO_2 detection (CDS-5) includes:

- optical cell with:
  - Lms43LED-CG;
  - Lms43PD-03-CG;
- PD preamplifier;
- LED Driver (D-41i / D-51i/mD-1c);
- synchronous detector SDM;
- AC/DC Adaptor, connection wires.

Connection setup



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MDS-4 Methane sensor module

Application & Description

MDS-4 is a sensor module for CH_4 detection. It includes a compact optical cell and electronics for LED power supply and PD signal amplification all-in-one.

Features

- Measurement in 0-5% (volume) concentration range.
- Resolution down to 250 ppm in 0-5% (volume) concentration range.
- Very low power consumption – 3.5 mW.
- Quick response time – <2 s.
- Operating temperature range – 0..+40°C.
- Size: 55 x 26 x 14 mm (including optical cell and circuitry).
- Gases: precalibrated for methane, but will respond to most hydrocarbons.
- Possibility of integration with wireless data transfer protocols like Zigbee, WiFi, GPRS.
- Possibility of power battery supply.
- Analogue output signals.

Technical characteristics

Parameters	Value
Power supply voltage	Stabilised +3.3 V
Voltage tolerance	-5 to +5 %
Power consumption	3.5 mW
Board dimensions	55 × 26 × 14 mm
Measuring output voltage signal amplitude	3 V
Temperature output voltage signal amplitude	3 V

NEW MDS-4D sensor prototype with a built-in analogue-digital converter, autonomous power supply and ZigBee/Bluetooth data transmission modules will be available for purchasing in 2016.*

*The design of the device may be changed

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Application & Description

LED Analyser (LA-1T) is oriented for the initial experiments with different liquid (and other) substances, and enables defining the absorption properties of the analysed sample in the spectral range 1.3 – 2.3 µm.

Design

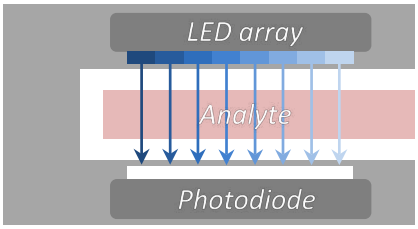
The LA-1T is formed in a single body that includes optical and electronic modules. Optical module utilizes a single pass transmittance scheme and includes:

- 8-element LED array with peak emission wavelengths about 1.3, 1.4, 1.6, 1.7, 1.9, 2.1, 2.2 and 2.3 µm;
- wideband photodiode with a cut-off wavelength about 2.4 µm.

The distance between the LED array and the photodiode is fixed and is about 15 mm. Simple preparation glasses can be used for liquid sample placing. LEDs light up sequentially, photodiode detects the emission passing through the analyzed sample and the obtained signal values are displayed on the main diagram of the program included in the analyser set.

Electronic module enables:

— LED power supply (at a one fixed mode);
— amplification of the photodiode signal;
— synchronous operation of the LED array and the photodiode.
— incorporate ZigBee/Bluetooth wireless data transmission module.



LA-1T optical module

LED analyser is intended to be used as an evaluation tool for the following applications:

- paper moisture control;
- plastic thickness detection;
- water concentration measurement in cut-oil and oil products, with possibility to define ratio of light and heavy hydrocarbons;
- analysis of biomaterials for medical purposes (concentration of sugar in blood, urine etc.);
- express analysis of food – defining deviations from the normal parameters judged by the absorption properties.

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