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MDS-3
EVALUATION SYSTEM FOR
METHANE DETECTION
INSTRUCTION MANUAL



rev. 281014

TABLE OF CONTENTS

General Information	3
Application	3
Packaging arrangement	3
Operation conditions	3
Brief Overview of the Components Included	4
Operating instructions	5-6
Precautions	7
Appendices	8
Appendix 1: Lms34LED main parameters	8
Appendix 2: Lms36PD-05 main parameters	9
Appendix 3: Drivers Applicable for the MDS-3 Evaluation System	10
Appendix 4: MDS-3 Testing Results	11

GENERAL INFORMATION

Application

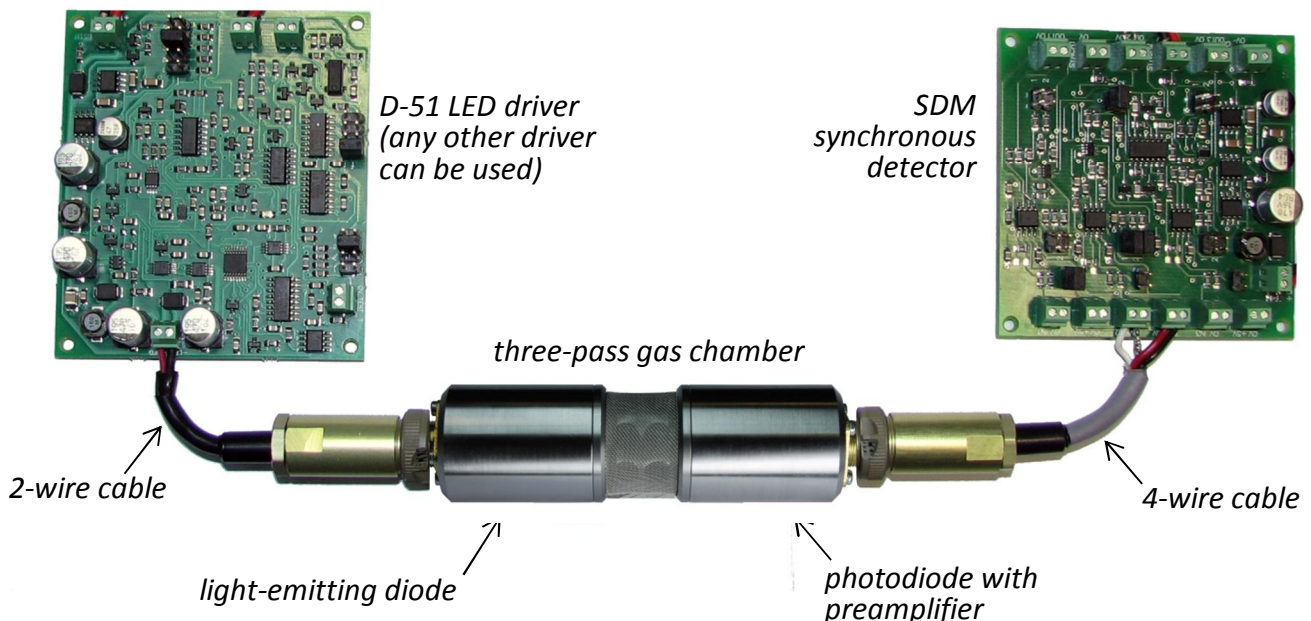
MDS-3 is an evaluation system for CH₄ detection based on mid-infrared LED-PD optopair. It is an out-of-the-box solution that can be launched with minimal effort and can provide fast results.

Packaging arrangement

MDS-3 includes:

- Three-pass gas chamber that incorporates:
 - Light-emitting diode Lms34LED
 - Photodiode Lms36PD-05
 - PD preamplifier
- Built-in driver*/D41/D51 LED Driver (depends on customer request)
- SDM Synchronous Detector
- 2-wire cable for LED – LED driver connection
- 4-wire cable for PD preamplifier – synchronous detector connection

* Built-in driver is incorporated into the gas chamber (in case this driver type is chosen for LED power supply)



Operation conditions

Indoor operation only. Ingress Protection Rating IP00.

BRIEF OVERVIEW OF THE COMPONENTS INCLUDED

- Three-pass gas chamber.

The optical chamber has length of the optical path of 70÷80 mm and maximal diameter of 28 mm. Inside the chamber there are: light-emitting diode Lms34LED and photodiode Lms36PD-06, which are placed on spherical mirrors that enable triple passage of the LED emission before reaching the PD; PD preamplifier connected to the photodiode; built-in driver (in case this driver type is chosen for LED power supply).



MDS-3 optical chamber

- Light-emitting diode Lms34LED

Standard LMSNT light-emitting diode with 3.4 μm peak wavelength, which is placed on spherical mirror. For detailed information and set of characteristics please refer to **Appendix 1**.

- Photodiode Lms36PD-05

Standard LMSNT photodiode with 3.6 μm cut-off wavelength, which is placed on spherical mirror. For detailed information and set of characteristics please refer to **Appendix 2**.

- Built-in/D41/D51 LED Driver (depends on customer request)
LED Driver is a power supply for Lms34LED. It has a set of adjustable parameters to customise the desired operation mode of an LED. For brief information about drivers, please refer to **Appendix 3**. For comprehensive information about drivers please refer to the Instruction Manual appropriate to your driver model.



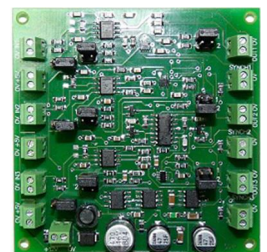
D51 LED Driver

- PD preamplifier

PD preamplifier amplifies the current, generated by photodiode, and converts it into voltage signal. There is straight correspondence between PD current and resulting output voltage, 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.

- SDM Synchronous Detector

SDM synchronous detector measures the voltage signal from the output of photodiode preamplifier and converts it to the DC voltage signal proportional to amplitude of voltage from input. For comprehensive information about the synchronous detector please refer to the appropriate Instruction Manual.



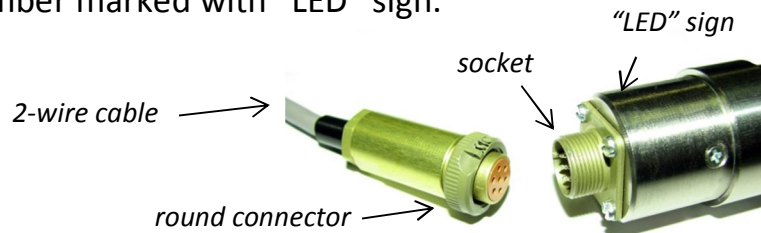
SDM

Synchronous Detector

OPERATION INSTRUCTIONS

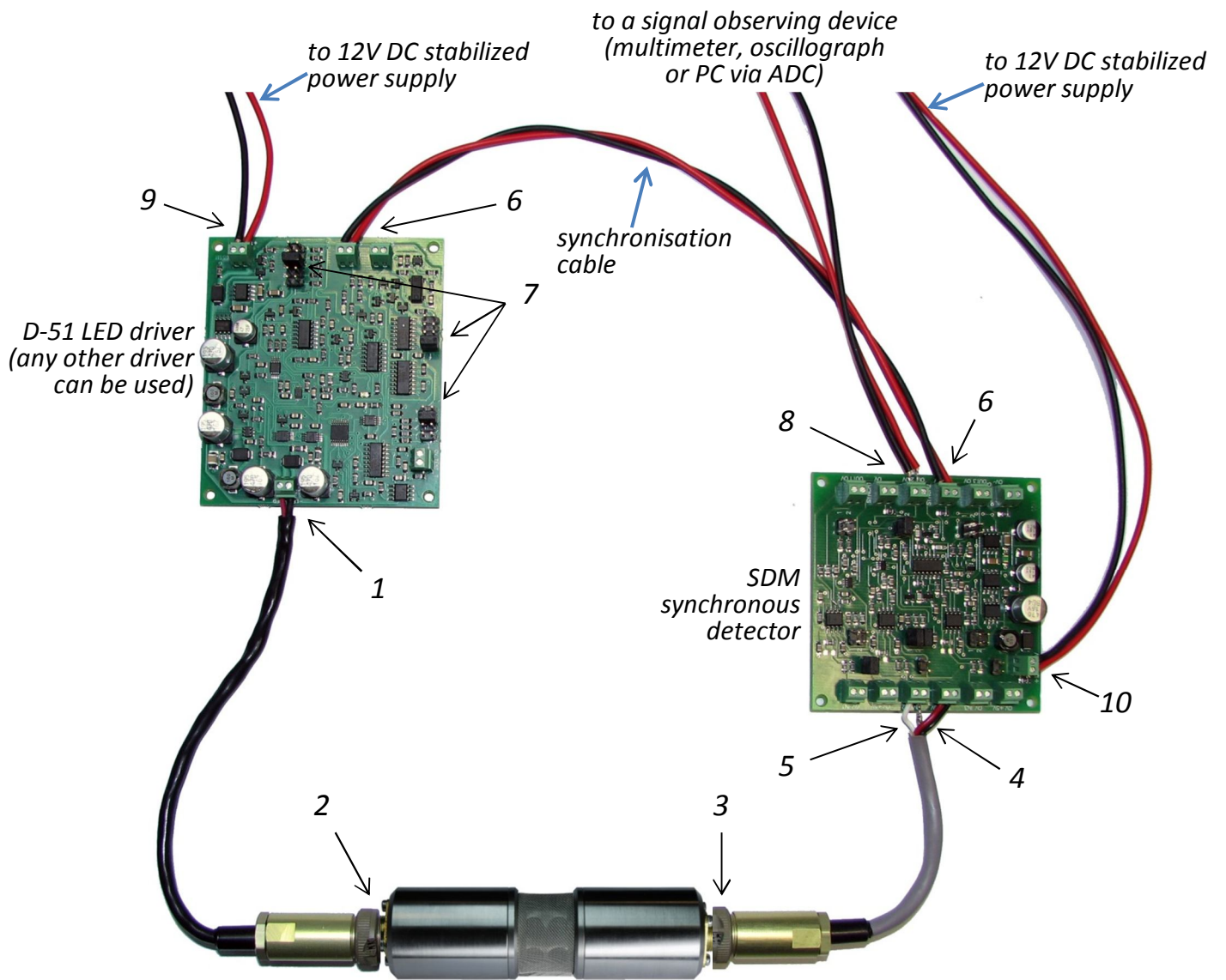
Connections

1. Connect the 2-wire cable to the LED connection terminal block of LED driver.
Note! Red wire must be connected to the red dot or “+” sign of the driver socket.
2. Connect the round connector of the 2-wire cable to the socket of MDS-3 optical chamber marked with “LED” sign.



3. Connect the round connector of the 4-wire cable to the socket of MDS-3 optical chamber marked with “PD” sign.
4. Connect the red and black wires of 4-wire cable to the signal input terminal block of SDM synchronous detector.
Note! The red wire must be connected to the “+” sign of the signal input terminal block of synchronous detector.
5. Connect the white and uninsulated wires of 4-wire cable to the power output terminal block of SDM synchronous detector.
Note! The red white must be connected to the “+” sign of the power output terminal block of synchronous detector.
6. Connect the synchronisation output of the LED driver with the synchronization input of the synchronous detector via synchronization cable.
7. Select the needed mode of the LED driver.
Note! You can find out more about driver modes and their adjustment in the appropriate driver Instruction Manual.
8. Connect signal output terminal block with signal observing device (multimeter, oscillograph or PC via ADC).
9. Connect a 12V DC stabilized power supply to the LED driver. It will turn on.
10. Connect a 12V DC stabilized power supply to the SDM synchronous detector. It will turn on.

OPERATION INSTRUCTIONS



PRECAUTIONS

- ⚠ Turn on the power supply of the LED Driver and SDM synchronous detector only after all connections are made and tested.
- ⚠ Do not switch driver regimes during operation.
- ⚠ Do not disassemble the optical chamber; otherwise the optical system will be damaged.
- ⚠ Do not use multimeter to control and adjust current of the LED.

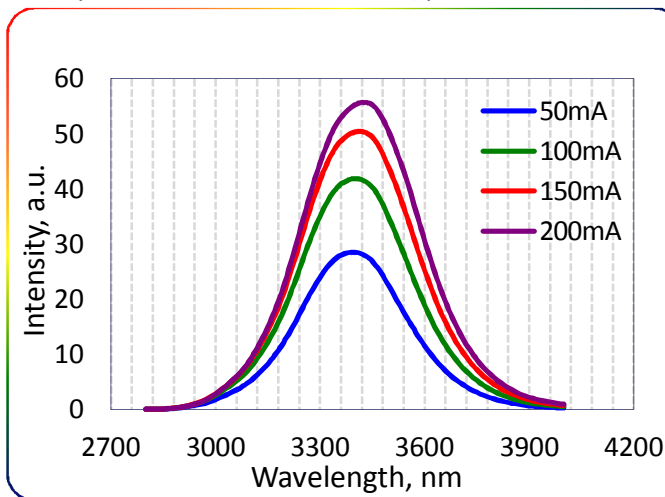
Note! Please refer to your provider if you have any questions.

APPENDIX 1

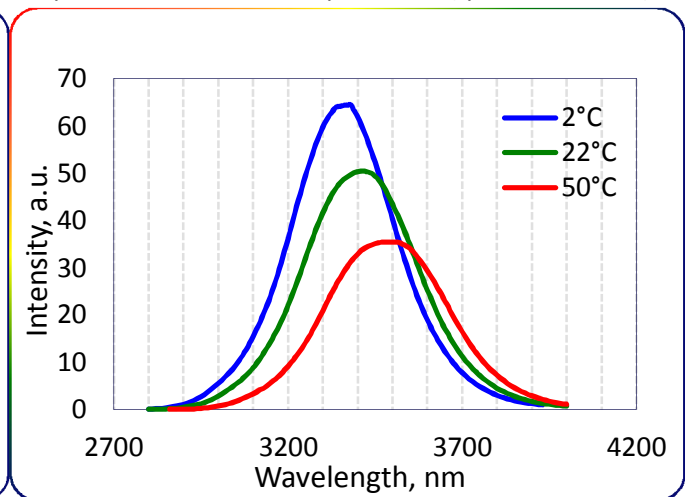
Lms34LED Main Parameters (QCW operation mode, $f=0.5$ kHz, $T=24^{\circ}\text{C}$)

Parameters	Units	Conditions	Ratings		
			Min	Typ	Max
Peak emission wavelength	μm	$T=300$ K, $I = 150$ mA qCW	3,30	3,40	3,49
FWHM of the emission band	nm	$I = 150$ mA qCW	400	500	600
Quasi-CW Optical Power	μW	$I = 200$ mA qCW	25,0	35,0	45,0
Pulsed Peak Optical Power	μW	$I=1$ A, $f=1$ kHz, duty cycle 0.1%	320	400	480
Voltage	V	$T=300$ K, $I=200$ mA	0,2	-	0,5
Switching time	ns	$T=300$ K	10	20	30

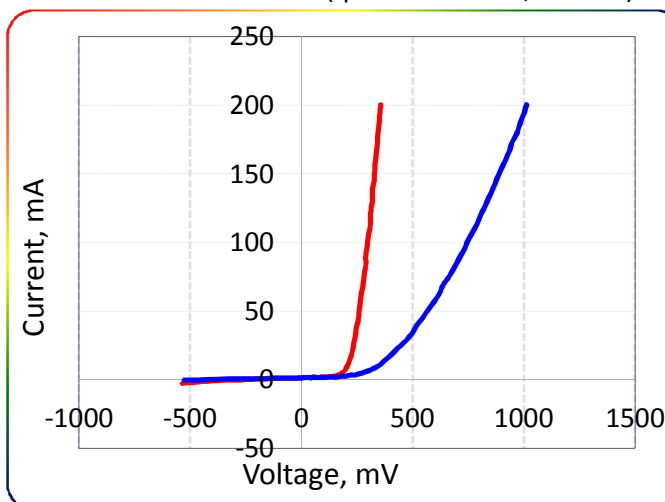
Spectra at different currents (qCW, $T=300$ K)



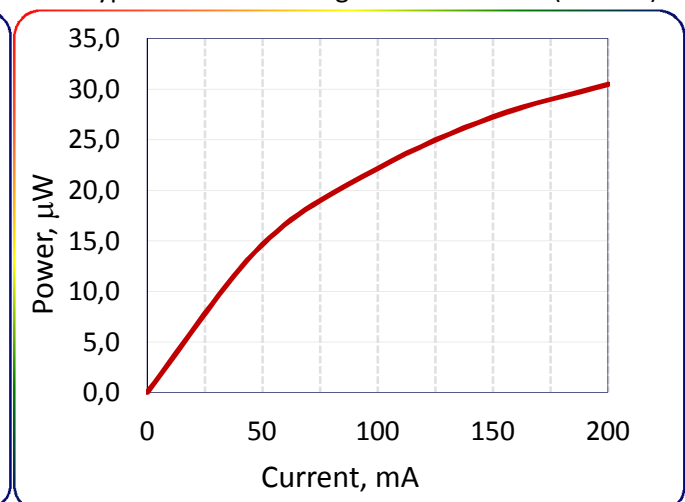
Spectra at different temperatures (qCW, $I=150$ mA)



LED Power Characteristic (quasi-CW mode, $T=300$ K)



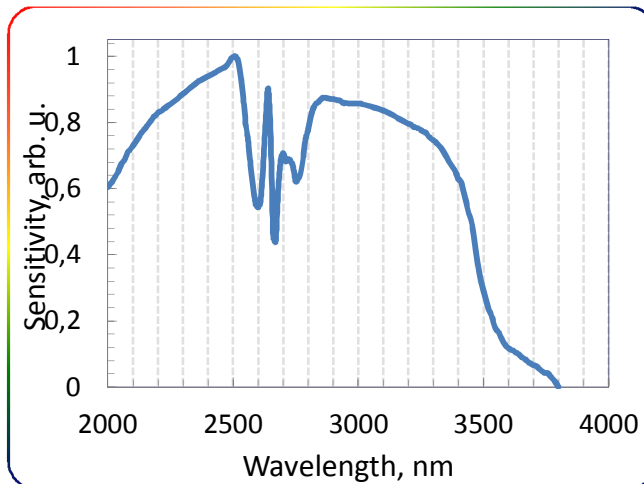
LED Typical Current-Voltage Characteristics ($T=300$ K)



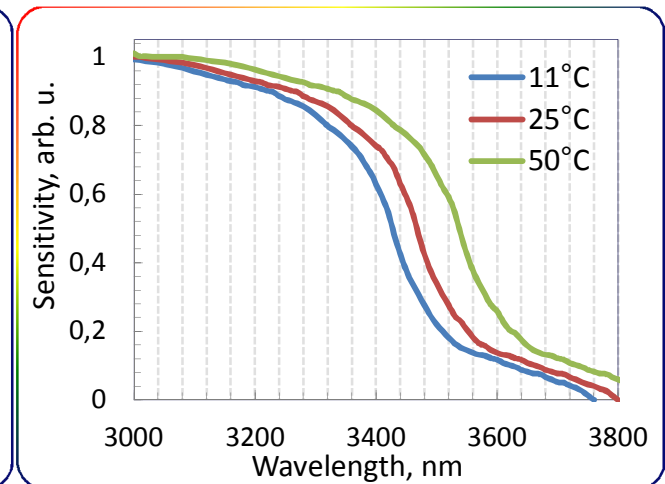
Lms36PD-05 Main Parameters (T=24°C)

Photodiode Parameters	Conditions	Symbol	Value	Units
Cut-off wavelength	T=300 K	λ_{cut}	3.6	mm
Max. sensitivity wavelength (>90%)	T=300 K	λ_p	2.2 — 3.4	mm
Dark current	T=300 K, $V_r=-0,1$ V	I_d	0.5 — 1	mA
Shunt resistance	T=300 K, $V_r=-10$ mV	R_{sh}	0.2 — 0.8	k Ω
Capacitance	T=300 K, $\lambda=\lambda_p$	C	600 — 1400	pF
Sensitivity	T=300 K, $\lambda=\lambda_p$	S	1.0 — 1.5	A/W
Detectivity	T=300 K, $\lambda=\lambda_p$	D^*	(4-14)*10 ⁹	cm ² Hz ^{1/2} ·W ⁻¹




Spectral response (typical)



Temperature shift of spectral response



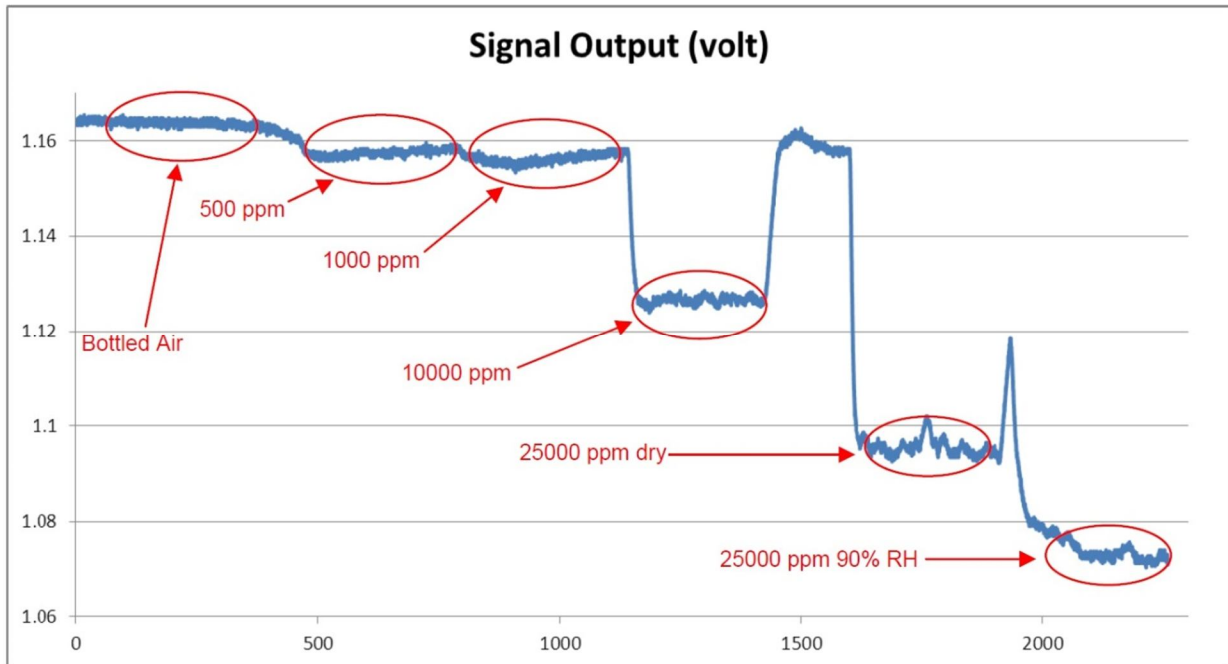
Drivers Applicable for the MDS-3 Evaluation System

<p>LED driver D-41</p> 	<p>D-41 Driver provides Pulse mode operation. Using this mode it is possible to choose one of five current values (0.2, 0.6, 1, 1.5, 1.9 A) and select one of four frequencies (0.5, 2, 8 and 16 kHz) and choose pulse duration within four values (2, 5, 10 and 20 μs).</p> <p>✓</p>
<p>LED driver D-51</p> 	<p>D-51 Driver has the same characteristics as D-41 but also has another important feature:</p> <p>Temperature control – possibility to define 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.</p>
<p>Built-in driver</p> 	<p>Built-in driver can be chosen instead of D-41/D-51 drivers in case the customer needs more compact design of the evaluation system. Built-in driver is incorporated into the CDS-3 optical chamber and works in optimal driving mode for the LED: 1 A current, 500 Hz frequency and 20 μm pulse duration.</p>

APPENDIX 4

MDS-3 testing results

Signal Output with Different Methane Concentration and 90% relative humidity (RH)



MDS-3 Methane Detection Results at ppm Level and 90% Relative Humidity

Gas	ppm	Signal Output (V)	Net Signal Output (mV)	Standard Deviation (mV)	Noise (mV)	Resolution (ppm)
Air (Dry Bottled)	0	1.1638	-0.0466	0.4801	1.3937	(NA)
CH ₄ + Air	500	1.1571	6.6679	0.6196	1.8589	279
CH ₄ + Air	1000	1.1560	7.8138	0.8170	2.4511	627
CH ₄ + Air	10000	1.1267	37.1290	0.7471	2.2413	1207
CH ₄ (50% LEL)	25000	1.0957	68.0611	1.8914	5.6743	4169
CH ₄ (~90% RH)	25000	1.0732	90.5848	1.3851	4.1554	2294

Testing conditions:

Settings of the D-51 driver: pulse current 1A; pulse width 20 μ s; pulse frequency 500 Hz.

Settings of the SDM synchronous detector are: input polarity inversion jumper open; averaging time 100 μ s; output signal gain 1x.