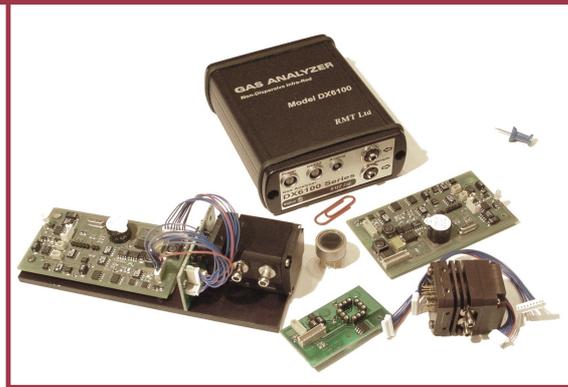


Gas Analyzers 2.2

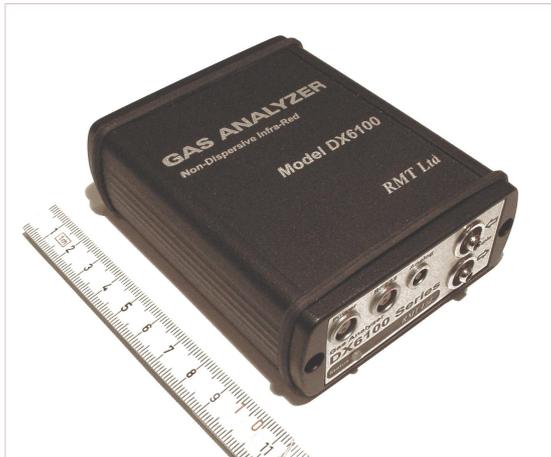


2 Components for Gas Analysis

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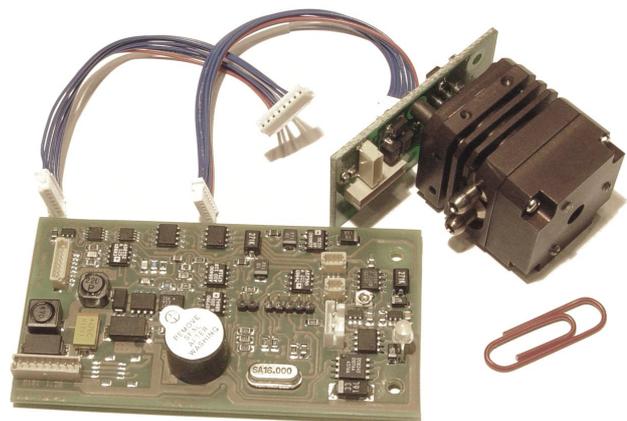
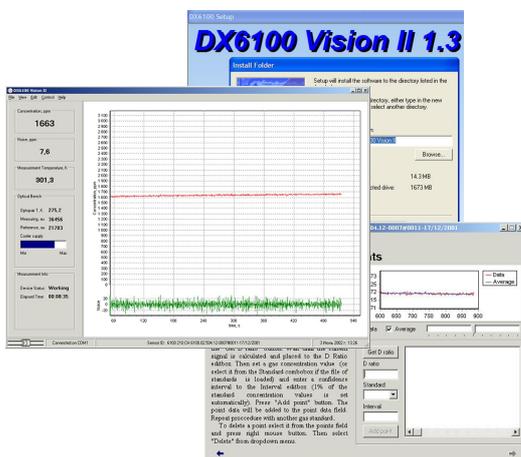
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Modular Gas Analyzer DX6100 Series



Advantages

- ◆ High selectivity and stability
- ◆ Wide range of measured concentrations
- ◆ Small gas sampling cell
- ◆ Fast response
- ◆ Long service life
- ◆ No moving parts
- ◆ Miniature design and small weight
- ◆ Low power consumption



The company RMT Ltd introduces DX6100 series of Modular and OEM non-dispersive infrared (NDIR) Gas Analyzers.

The principle of operation is based on selective absorption of IR radiation by gas molecules.

The differential double frequency optical scheme provides a high accuracy in wide ranges of humidity and temperature due to the internal thermostabilization.

A new type of middle infrared (IR) integrated Optopair (Detector and Light Emitters) with built-in thermoelectric cooling is used.

The light sources are pulsed solid state middle-IR Light Emitters. The Photodetector is based on the Lead Selenide (or Lead Sulphide) photoresistor.

There are several models suitable for the following gases: CO₂, CH₄, C_nH_m.

Other optional gas analyzers are available on request.

Both complete modular and OEM versions are available.

Principles of Operation

The Non-Dispersive Infra-Red Spectroscopy (NDIR) measurement method is implemented in the DX6100 Analyzer.

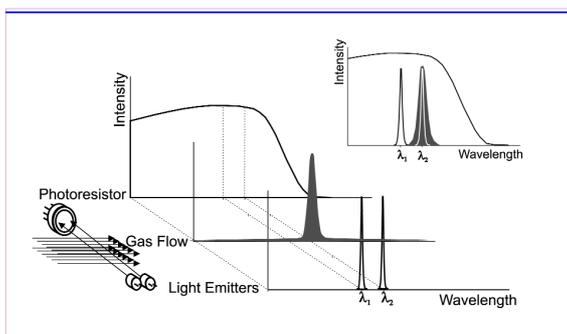
The analyzer provides gases concentration measurement based on the classical double channel optical scheme.

One of the beams (measuring channel) has the wavelength tuned to the optical absorption line of the measured gas. The other beam (reference channel) has the wavelength that is out of the adsorption band of the measured gas.

After passing through the gas sampling cell the two light beams intensities are compared.

The reference channel is used for indirect measuring of the initial light intensity and allows to eliminate

actual measurements conditions: total transparency of gas volume, optics imperfection and so on.



The principle of gas concentration measurement realized in the DX6100 analyzer

Design Features

The DX6100 Gas Analyzer is specially designed for fast response, high sensitivity, low noise and low power consumption.

A number of design features contribute to the performance :

- ◆ The infrared sources are special narrow-band pulsed Light Emitters operating in a microsecond range. The light sources have long life (more than 10,000 hours).
- ◆ Radiation from Light Emitters passes through gas sampling cell, reflects from the mirrors and is focused onto wide-band Photodetector.
- ◆ Light Emitters and Photodetector chips are integrated into a single housing and placed onto a miniature TE cooler for thermostabilization.
- ◆ Microcontroller provides temperature regulation with better than 0.1°C accuracy. The temperature is software selectable from the ambient value down to -20°C.
- ◆ Heat dissipated from the warm side of TE coolers results in few degrees of overheating of gas sampling cell above the ambient. This factor plays the role of vapor anti-condensation at high moisture operation.
- ◆ All driving function of Light Emitters and

Detector are operated by the on-board microcontroller.

- ◆ Pre-amplified outputs are maintained by the microcontroller. The final result is digital data of measured gas concentration and is available in realtime through the RS-232C or an analog port.
- ◆ For the signal processing the calibrated data of Optical Unit is used. The data is stored in Optical Unit's EEPROM.
- ◆ The RS-232C port is also used for the remote control from a computer.



Operation Overview

The order of measurements with the DX6100 device is as follows:

1. The individual calibration of device is required using standard gas mixtures.

The Detector output signal is non-linear with respect to the measured gas concentration. The intensity of light that passed through the gas sampling cell is the integral of various optical rays from Light Emitter. The sensitivity of Detector and performance of Light Emitter depend very much on their operating temperatures.

The Detector output signals (both measuring and reference channels) are measured while calibration gases with known concentration are passing through the gas sampling cell. The data obtained are used for polynomial extrapolation of calibration results.

The polynomial coefficients and the "zero" ratio are stored into the device internal on-board EEPROM memory.

The first calibration is made by the manufacturer.

The factory standard calibration uses not fewer than five standard gas mixtures.

Several calibrations are made at different ambient temperatures (in the specified operating range) and at corresponding optimal operating temperatures of the integrated Detector-Emitter pair.

It is possible to store up to 15 such calibrations for further application.

2. During a routine operation the detector output signals are measured. Using a known "zero" value and polynomial coefficients the gas concentration is calculated with a high accuracy as a function of measuring and reference channels signals ratio.

Resulted concentration is calculated in absolute mmol/m³ units.

The device provides (if required) recalculation of the concentration into relative ppm units. But to convert absolute units (mmol/m³) into relative (ppm) ones it is necessary to know ambient temperature and pressure.

The values of ambient temperature and pressure can be inputted by a user manually into the device memory at the beginning of the experiment.

Default values are extracted by the device micro-controller from the memory and correspond to the ambient conditions at calibration procedure.

It is also possible to use the value of measured ambient temperature provided by the on-board digital thermosensor.

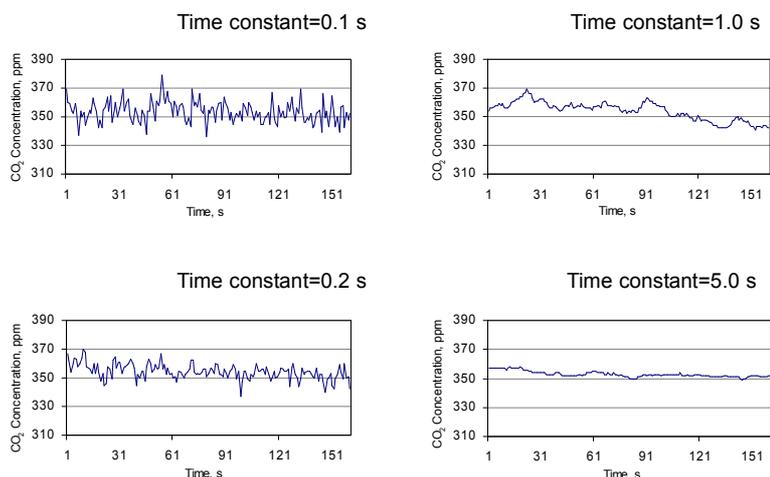
3. To preserve high accuracy of the device it is necessary to make "zero" adjustments periodically as recommended in the DX6100 User's Guide.

4. Periodicity of the device recalibration is 1 year. It can be done at the Manufacturer's factory or by a user with the help of the corresponding DX6100 Vision II software.

Noise level

Adjustable noise level is realized due to application of digital filtration algorithm.

The main parameter of the digital filter is Time constant. It is adjustable in the range 0.1...60 s.



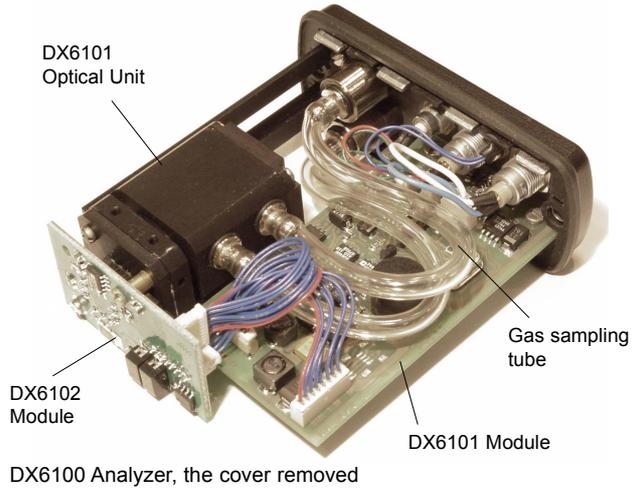
Inside the Analyzer

The DX6100 Analyzer consists of three main parts:

- ◆ DX6106 Optical Unit
- ◆ 6101 Controller Module
- ◆ 6102 Optocomponent Mating Module

Those parts combined together and housed into a body form a complete version of the DX6100 Analyzer.

The same components taken separately, supplemented by a set of special cables, form a Kit for OEM applications (DX6100 OEM) analyzer.

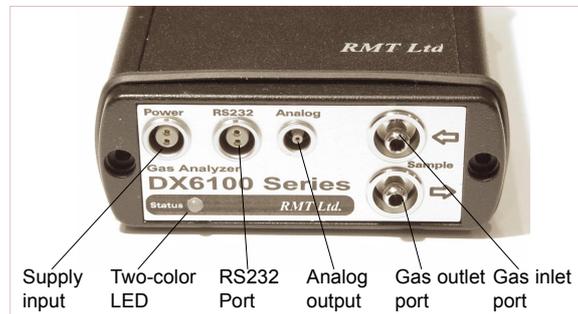


DX6100 Analyzer, the cover removed

Output Connectors

There are the following units on the front panel of the DX6100 Analyzer:

- ◆ Power supply input connector
- ◆ RS-232 connector
- ◆ Analog output connector
- ◆ Two-color LED indicator
- ◆ Inlet and outlet gas ports

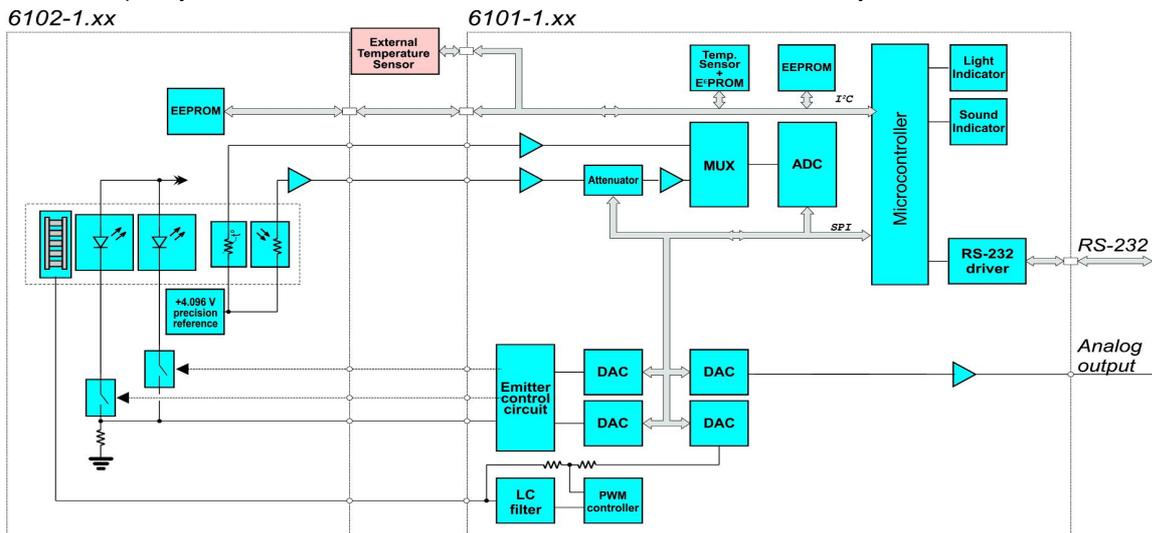


Output Connectors

Functional Diagram

The DX6102 Optopair Mating Module is connected with DX6101 Controller Module by special cable via miniature 20 pin System Interface connectors.

Digital Thermometer is an optional module for the measurement of the absolute value of ambient temperature with 0.5°C accuracy.



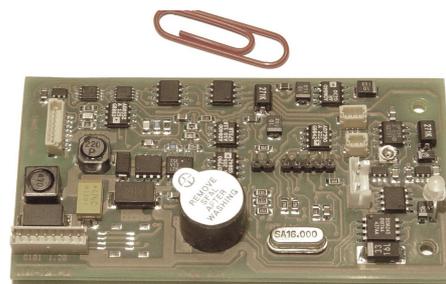
Functional Diagram of the DX6100 Gas Analyzer

DX6101 Controller Module

The 6010 Controller Module provides the following functions:

- ◆ Amplification and processing of Detector's output signals
- ◆ Storage of identifier and individual calibration parameters
- ◆ Thermostabilization of Optopair using built-in PID driving algorithm of built-in TE cooler with thermosensor signals forming for Light Emitters driving
- ◆ Filtering and digitizing of Detector pre-amplified output
- ◆ Conversion of amplified output signals into gas concentration value using the stored calibration data

- ◆ Driving by the gas analyzer through the RS-232 port
- ◆ Light and sound alarm.



6101 Controller Module

DX6106 Optical Unit

The DX6106 Optical Unit is the head part of the Gas Analyzer. It consists of an isolated gas sampling cell (the spherical mirror and the sapphire window are placed at the end sides) and a new generation integrated optopair with the DX6102 electronic mating module.

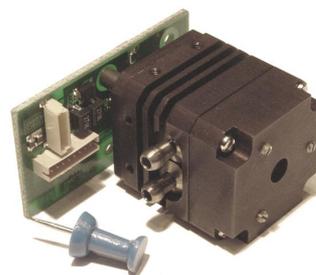
The internal volume of the gas cell depends on the Optical Unit version. The gas sampling cell has two gas inlets with 5.0 mm internal diameter.

The gas sampling cell can be easily disassembled for the service of the internal optics (mirror and window). For this purpose both the top and bottom covers can be removed and the optical components extracted.

The mirror has a special SiO₂ safety layer.

The DX6106 Optical Units are manufactured in two versions: with DX6106.C2 and DX6106.C4 gas sampling cells (See Table).

Depending on what gas and what limiting concentration value must be measured, it is furnished with one or the other sampling cells.

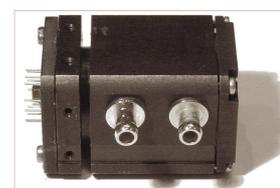


Optical Unit

Gas sampling cell	Number of passes	Total path length, mm	Internal volume, ml
DX6106.C2	2	25	1
DX6106.C4	4	85	10

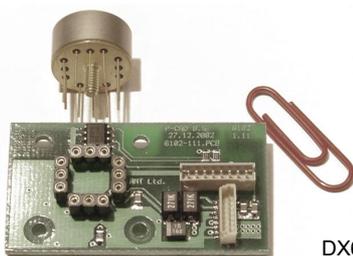


DX6106.C2 Sampling Cell



DX6106.C4 Sampling Cell

DX6102 Optocomponent Mating Module



DX6102 Mating Module

The DX6102 Optocomponent Mating Module provides:

- ◆ Pre-amplification of photodetector's signals
- ◆ Light Emitters driving
- ◆ Power supply of Photodetector and Thermistors with precise voltage supply

Working with DX6100 Analyzer

In general nothing is required for the Analyzer operation except the external power source.

But for many purposes, such as the change of tunings of the analyzer, zero adjustment, calibration and so on, the control computer is necessary.

A user can control the Analyzer with computer in two ways:

1) The remote control by the Analyzer is available using the RS-232 port by a set of microcontroller commands.

The commands can be divided into two groups:

driving commands and setting commands.

All commands have the same format – the symbol string, which consists of the command name identifier and a list of its parameters. Some commands have no parameters. The commands are described in User's Guide.

This way is very useful if a user is going to integrate the DX6100 analyzer into a more complicated system.

2) The second way is based on using the DX6100 Vision II software.

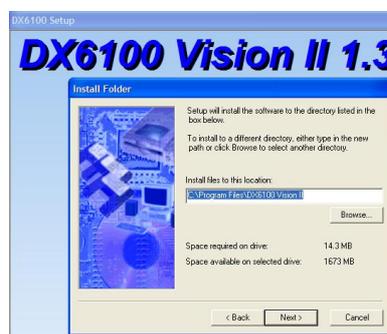
DX6100 Vision II Software

The DX6100 Vision II software provides all possible operational modes of the DX6100 Gas Analyzer. The software has a simple interface and does not demand a User's special knowledge.

The software is delivered with the DX6100 Gas Analyzer.

Also it is available for free download from RMT website:

www.rmtltd.ru

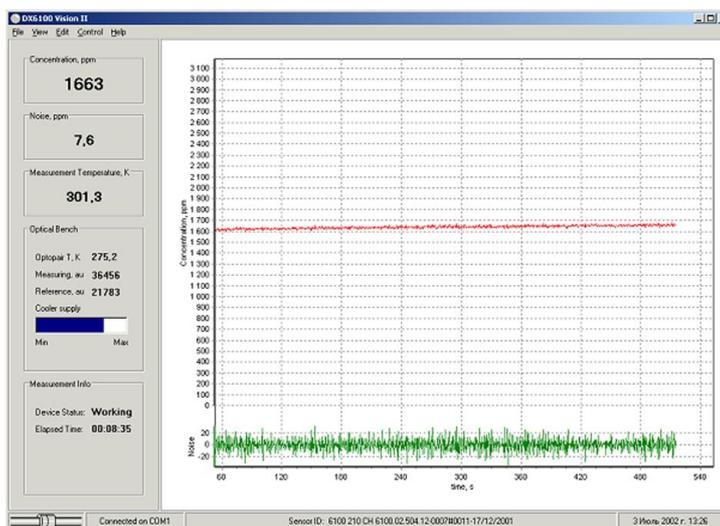


Setup Window

System Requirements

To run the DX6100 Vision II software the following system requirements must be met or exceeded:

- ◆ Intel Pentium class computer with Windows 95/98/2000 operating system
- ◆ Free COM port
- ◆ 16 MB of RAM (32 MB recommended)
- ◆ 6 MB free hard drive space
- ◆ CD ROM drive
- ◆ Mouse or compatible pointing device



Main Window

Parameters of Analyzer Adjustment

The DX6100 Vision II program allows an adjustment of various operation parameters of the device. The following parameters are among them:

- ◆ *Parameters of Light Emitters and Photodetector operation (pulse duration, Emitter current, Detector gain, synchronization and others)*
- ◆ *Telemetry structure (output parameters, repeating rate, duration of measurements and others)*
- ◆ *Warning levels*
- ◆ *Analog output adjustment and others*

But before editing a parameter study the device description thoroughly, please. Many of available parameters should be adjusted very carefully by experienced users only or along the manufacturer's recommendation.



Setting Window

Calibration

One of the very useful utility of the DX6100 Vision II software is Calibration subroutine.

The program allows users to carry out quite a complex procedure of the device calibration.

The first calibration in a specified concentration range is made by the manufacturer.

A user can perform any recalibration with the use of the program.

According to the instructions the procedure consists of several steps that must be completed by a user.

First of all, a user need to have a set of standard gases with concentrations in specified range. Then a user is to start the Calibration program and follow instructions step-by-step.

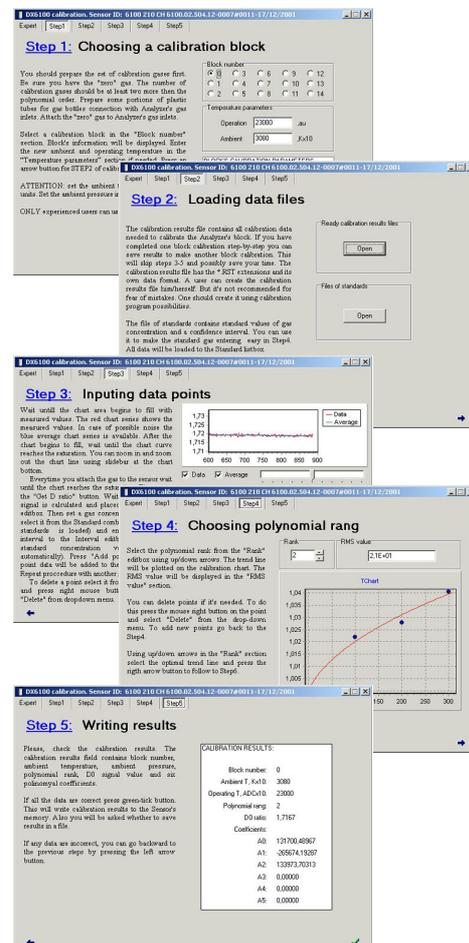
The advisable periodicity of the device recalibration is 1 (one) year. It could be done at the factory of the manufacturer or by a User with the help of DX6100 Vision software.

Zero Adjustment

To ensure high accuracy, a simple adjustment can be made during operation to adjust the "zero" ratio.

The procedure requires to start the sensor in the Calibration mode and to flow up any "zero" gas through the gas sampling cell.

The new "zero" coefficient will be stored in EEPROM in place of the old value after the adjustment procedure is complete.



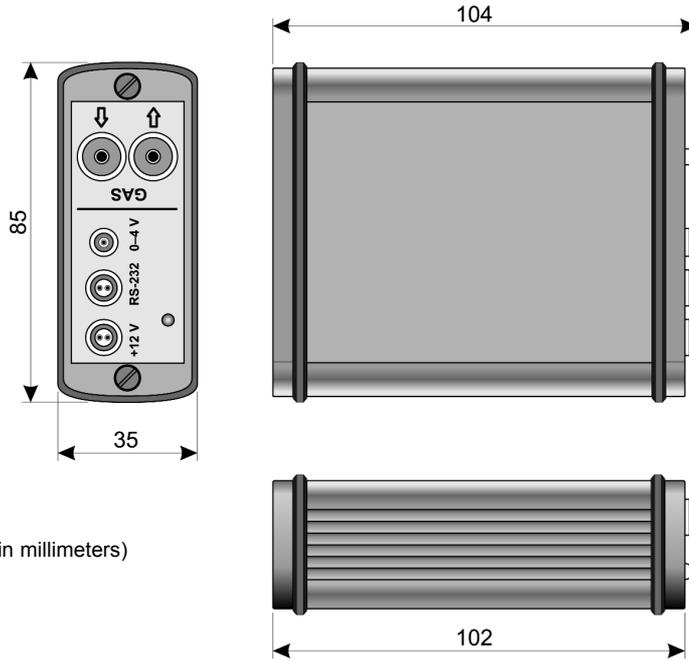
Calibration Procedure

Housing and Dimensions

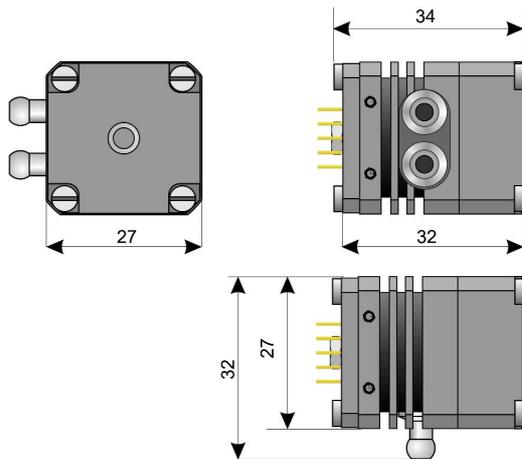
The enclosure of the Analyzer is made of a painted aluminum alloy.

The extruded body of the enclosure is closed by covers from end faces.

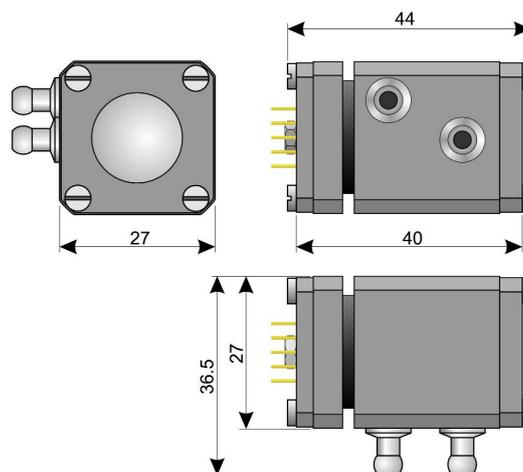
The rubber gaskets placed between the body and covers provide the enclosure with water resistance.



DX6100 Analyzer Outline Dimensions (in millimeters)



DX6106.C2 Optical Unit Outline Dimensions (in millimeters)



DX6106.C4 Optical Unit Outline Dimensions (in millimeters)

Specifications

Common

Type	NDIR Gas Analyzer	
Detector	Lead Selenide with TE cooler	
Measured Gases (<i>available options</i>)	Carbon Dioxide	CO ₂
	Hydrocarbons	C _n H _m
	Methane	CH ₄
Timing	Output Repeating Rate	0.01...20 Hz
	Average Time Constant	0.1...60 sec
Alarms	Light	Two-color LED
	Sound	>85 dB
Supply Requirements	Voltage	+6 to +15 VDC
	Current	300 mA (max)
Interface	Digital	RS-232C
	Analog	0...4095 mV
Operation Conditions	Moisture Protection	IP65 (excluding OEM version)
	Temperature Range	-10 to +50 °C
	Relative Humidity	5 to 100%
Mechanical (<i>Modular Option</i>)	Dimensions	60x80x122 mm
	Weight	310 g
Mechanical (<i>OEM Option</i>)	<i>Dimensions</i>	
	DX6101 Controller Module	80x43x14 mm
	DX6102 Mating Plate	47x26x8 mm
	DX6106.20 Sampling Cell	34x32x27 mm
	DX6106.40 Sampling Cell	40x36.5x27 mm
	Mounting Base	135x48x3.5 mm
<i>Weight</i>	DX6101 Controller Module	24 g (max)
	DX6102 Mating Plate	8 g (max)
	DX6106.20 Sampling Cell	50 g (max)
	DX6106.40 Sampling Cell	55 g (max)
	Mounting Base	20 g (max)

Carbon Dioxide (CO₂)

Concentration Range ¹⁾	0...1000 ppm	0...5 %vol	0...20 %vol
Noise Level ^{2,3)}	< 3 ppm	< 0.15 %	< 0.15 %
Accuracy ³⁾	10 ppm	0.50%	0.50%
Zero Drift ³⁾		0.02%	

Information furnished by RMT Ltd is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omission. Specifications are subject to change without notice.

Specifications (...continued)

Hydrocarbons (C_nH_m)

Concentration Range ¹⁾	0...1000 ppm	0...5 %vol	0...100 %vol
Noise Level ^{2,3)}	< 3 ppm	< 0.10 %	< 0.15 %
Accuracy ³⁾	10 ppm	0.50%	0.50%
Zero Drift ³⁾		0.02%	

Methane (CH₄) selective

Concentration Range ¹⁾	0...1000 ppm	0...5 %vol	0...100 %vol
Noise Level ^{2,3)}	< 25 ppm	< 0.3 %	< 0.5 %
Accuracy ³⁾	100 ppm	1.0%	1.0%
Zero Drift ³⁾		0.02%	

Notes:

- 1) Optional concentration ranges are available on request.
- 2) At Averaging Time Constant= 0.2 s.
- 3) If value in %, then it means relative units.
- 4) Software adjustable.

Standard Kits

DX6100

#	Item	Code	Q-ty, pcs
1	Gas Analyzer	DX6100	1
2	Power supply cable	DX6100-C-02	1
3	RS-232 cable	DX6100-C-03	1
4	Analog interface cable	DX6100-C-04	1
5	AC/DC adaptor		1
6	DX6100 User Manual		1
7	DX6100 Vision software CD		1



DX6100 OEM

#	Item	Code	Q-ty, pcs
1	Optical Unit	DX6106.xx	1
2	Controller module	DX6101-x.xx	1
3	Optopair mating module	DX6102-x.xx	1
4	Module interconnect cable	DX6100-C-11	1
5	Power supply cable	DX6100-C-12	1
6	RS-232 cable	DX6100-C-13	1
7	Analog interface cable	DX6100-C-14	1
8	AC/DC adaptor		1
9	DX6100 User Manual		1
10	DX6100 Vision software CD		1



