RMT Ltd.
Joint Stock Company

Optical Unit DX6006 Series

User Guide

Edition November 1998

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Limited Warranty

RMT Ltd. warrants that DX6006 Optical Units, if properly used and installed, will be free from defects in material and workmanship and will substantially conform to RMT's publicly available specification for a period of one (1) year after date of DX6006 Optical Unit was purchased (whatever purchased separately or as a part of gas analyzer system).

If the DX6006 Optical Unit which is the subject of this Limited Warranty fails during the warranty period for the reasons covered by this Limited Warranty, RMT, at this option, will :

REPAIR the DX6006 Optical Unit; **OR**

REPLACE the DX6006 Optical Unit with another DX6006 Optical Unit.

Trademark Acknowledgments

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Contents

Introduction

Company RMT Ltd. introduces new series of optical units DX6006 suitable for designing of portable gas analyzers.

They are the key parts of optical gas analyzers.

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

Dx6006 Optical Unit contains of gas sampling cell, optoelectornic coordinated pair of light emitter and detector, and electronic PCB for output signal pre-amplification and driving by optoelectronic components.

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

New types of middle infrared light emitters and photodetectors with built-in thermoelectric cooling are used.

There are several models suitable for the following gases : CO_2,

Advantages

- ✓ *high selectivity and stability,*
- ✓ *wide range of measured,*
- ✓ *concentrations,*
- ✓ *the long service life.*

Features

- ✓ *no moving parts,*
- ✓ *minimum dimensions and light weight,*
- ✓ *minimum power consumption.*

Principles of Operation

The DX6006 is based on Non-Dispersive Infra-Red Spectroscopy (NDIR). Classical double channel scheme is realized.

Intensities of two light beams, passed through measuring gas sampling cell, are compared.

One of the beams (measuring channel) has the wavelength which is tuned to optical absorption line of measured gas.

The other one (reference channel) server for control and it's wavelength maximum lies out from the absorption line.

According to fundamental low, light absorption in gas volume is proportional to absorbing gas concentration :

$$I = I_o \times \exp(-\alpha \times L \times X),$$

where $\mathbf{I_o}$, **I** *- intensities of light before and after gas volume pass;* α *- absorption coefficient of the gas at chosen light wavelength;* **L** *- optical pass length;* **X** *- gas concentration.*

At fixed **L** and known absorption (α) it is possible to find gas concentration using measurement of intensity of light (measuring channel) from light emitter passed to photodetector.

Reference channel used for indirect measuring of initial intensity of light and allows to eliminate actual measurements conditions

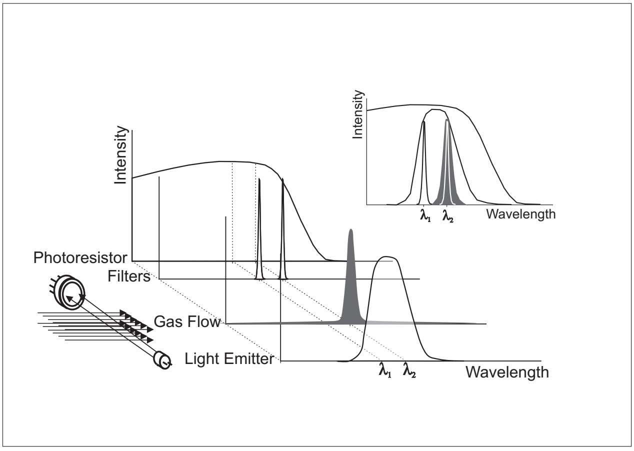
Operation Overview

The DX6006 optical unit is specially designed for fast response, high sensitivity, low noise and low power consumption gas analyzer designing.

A number of design features contribute to the performance :

- The infrared source is a special pulsed light emitter which operates in microsecond range.
- The light source has long life (> 10000 hours) and assembled with built-in miniature TE coolers for its thermostabilization.

- Radiation from light emitter is passed through gas sampling cell, reflects from spherical mirror and focused onto dual element photodetector.
- Both sensitive elements of the detector are similar.
- First one (measuring channel) is covered by miniature narrow band (0.02 µm) optical filter tuned to absorption line of measured gas.
- Second one also has built-in narrow-band filter, but its wavelength lies out from absorption of the gas.
- Both sensitive elements and its filters are placed onto miniature built-in thermoelectric cooler. The detector can be cooled and regulated down to -20 °C.
- Heat dissipated from warm side of TE coolers of light emitter and detector leads to few degrees of overheating of gas cell above ambient. This factor plays the role of vapor anti-condensation at operation in wet conditions.
- Light emitter and detector are mounted at miniature PCB. It provides optoelectronic components driving and output



Optical-Mechanical Design

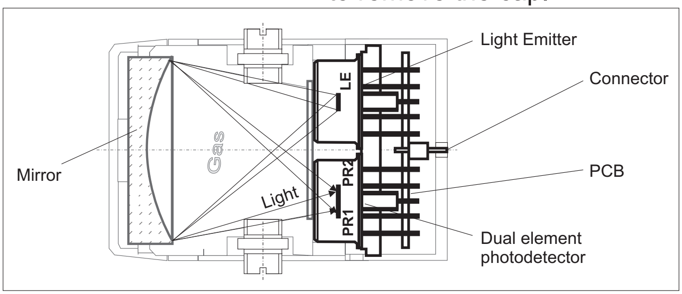
The Optical Unit is designed as integrated device. It consists of isolated double pass gas sampling cell (spherical mirror and sapphire window are placed at the end sides) and opto-pair with electronic module (miniature PCB) with output connector.

Gas sampling cell has four gas inlets. For standard deliveries two of four gas inlets are closed, but other ones have gas inputs pipes with 4.2 mm internal diameter.

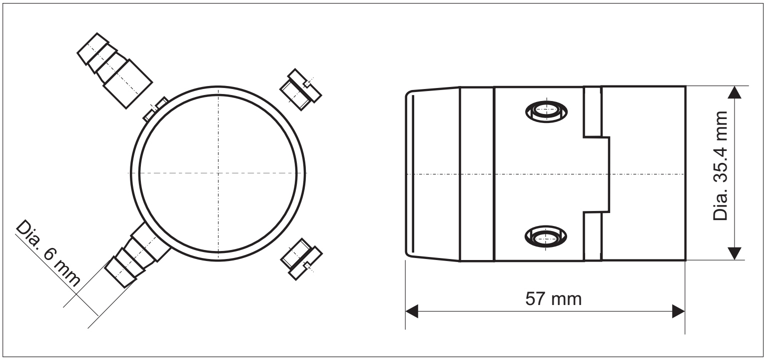
Gas sampling cell could be easily disassembled for service of internal optics (mirror and window). For this purpose the cover cap of mirror is opened and mirror could be removed.

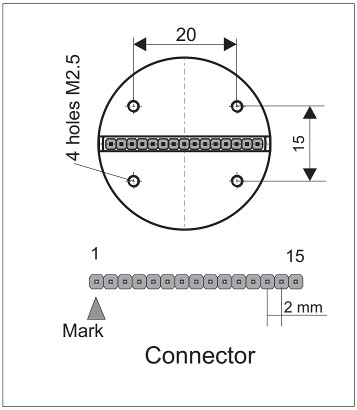
The mirror has special SiO_2 safety layer.

At the back side of the optical units another aluminum cap covers electronic module. This cap has four holes for mounting of the Optical Cell. It is possible to remove the cap.



Dimensions





- Aspiration and Diffusion sampling modes are available,
- In standard option the Optical Units are made from anodized aluminum. Stainless steel option is available on request.

Calibration

The Photodetector output signal is non-linear with respect to measuring gas concentration. In spite of theoretical formula, a light intensity, passed through gas cell, is the integral of various optical rays from Light Emitter.

Moreover sensitivity of Photodetector and performance of Light Emitter depend very from its operating temperatures.

Thus, every DX6006 Optical Unit is provided by individual calibration.

The first calibration is made by manufacturer.

The factory standard calibration uses not less than 5 reference gases with concentrations within specified measuring range.

The polynomial formula is used:

$$X = A_3 \times Y^3 + A_2 \times Y^2 + A_1 \times Y + A_0$$

$$Y = \frac{D_0}{D}$$

$$D = \frac{Um}{Ur}$$

*where **X** - gas concentration [ppm], $\boldsymbol{A_3 \ldots A_0}$ - polynomial coefficients; $\boldsymbol{U_m}$, $\boldsymbol{U_r}$ - outputs of measuring and reference channels; $\boldsymbol{D_0}$ - "zero" ratio at zero concentration of measured gas.*

Calibration results are attached to specifications of DX6006 optical unit. Also the calibration data is stored in on-board E^2PROM memory chip.

The calibration data is presented as :

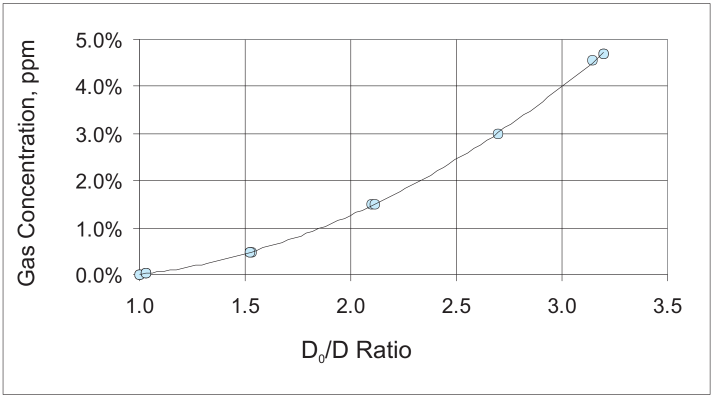
T [K x 10] - operating temperature of Light Emitter and Photodetectors kept by built-in TE coolers.(they are the same for both emitter and detector);

T_a [K x 10] - ambient temperature (is valid for operation of DX6006 Optical Units with RMT's Electronic Controller Module DX6001)

D_0 [ ] - “zero” ratio

$A_{3...}A_0$ [ ] - polynomial coefficients.

Format of calibration data stored in E^2PROM memory chip is described below in "E^2PROM" Chapter.



The actual calibration of a typical DX6006 : D_0/D is the ratio of measuring -to-reference channel outputs (U_m/U_r) at zero (D_0) and fixed (D) concentrations, correspondingly.

Re-Calibration

In standard option DX6006 Optical Unit is delivered with one calibration data. The calibration is made at optimal operating temperature.

User can make re-calibration in any time. It is possible to do this at other operation temperatures, with larger set of reference gases (larger order polynomial) and to replace stored data by new one.

According to customer demands the re-calibration could done by manufacturer on request.

On-board memory have additionally 4 data block for more calibrations - totally up to 5 different calibrations.

The polynomial coefficients $\mathbf{A}_j$ depend on design of Optical Unit's optical scheme. It is not necessary to make re-calibration often.

Zero Adjustments

To ensure the high accuracy, simple adjustment can be made during operation to adjust Optical Units' ‘zero’.

The zero parameter $\mathbf{D_0}$ should be periodically set by flowing through Optical Unit gas with zero concentration. For instance, nitrogen, argon and so on.

Part Number Designations

DX6006-XX-XXX-X-X-X-XX-XX

Part Number

Gas

Code	Gas
01	CO_2
02	C_nH_m
03	CH_4
04	CO
05	H_2O

Concentration Range
In ppm,
Includes two significant digits of the concentration value followed by the number of zeros to follow

Electronic Scheme Code
(Not for specifying in Order Form)

Opto-Mechanical Modification
(Not for specifying in Order Form)

Operating Temperature

Code	Gas
1	+10 to +45 °C
2	−10 to +45 °C

Heat sink option

0 - standard
1 - optional

Gas Sampling Option

A - Aspiration
D - Diffusion

An example:

DX6006-03-A-504-0-1-02-50-02-41

[**DX6006**]	Optical Unit
[**-03**]	for CH_4 concentration measuring,
[**-504**]	0...5.0·10^4 ppm (0...5% vol) concentration range,
[**-A**]	aspiration option,
[**-0**]	without additional heat sink,
[**-1**]	for operation within +10 to +45 °C temperature range,
[**-02**]	opto-mechanical modification #02,

Electronics, Functional Diagram

DX6006 Optical Unit is supplied by electronic module (PCB). Two modifications are available: DX6006-4.10 and DX6006-5.00. It is connected with some differences of optoelectronic components required for different gases and measuring parameters.

Optical Unit	Gas	Module
DX6006-01	(CO_2)	DX6006-4.10
DX6006-02	(C_nH_m)	DX6006-4.10
DX6006-03	(CH_4)	DX6006-4.10
DX6006-04	(CO)	DX6006-5.00
DX6006-05	(H_2O)	DX6006-4.10

Functional Diagram is presented in Fig. EF-1.

Differences are connected with some functionality of pre-amplifiers and absence of pin **TC1** and pin **TC2** in output connector in model DX6006-5.00.

Darken areas at electronic module's scheme mark internal parts of Light Emitter and Detector.

Output numbering coincides with numbers of connector pins.

The main functions of electronic modules are as following:

- power supply of optoelectronic components,
- pre-amplification of output signals of measuring and reference channels of Detector,
- driving by Light Emitter,
- switching off TE coolers (only for version 4.10),
- storage of operating and individual calibration data of Optical Unit.

Six pins are used for power driving of Optical Unit:

- power input +5 V for pre-amplifiers and precise 4.096 V reference (pin 2),
- "Ground" of measuring part of electronics (1),
- power part's "Ground" (15),

- power supply of light emitter (6),
- power supply of TE coolers of Llight Emitter (7),
- power supply of TE cooler of Photodetector (9).

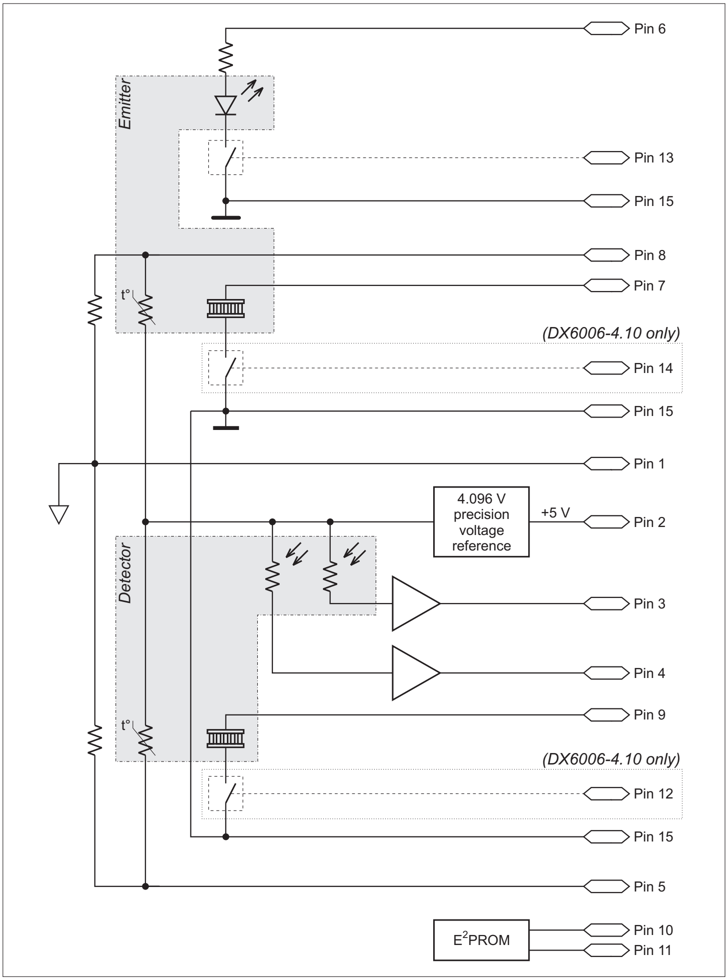


Fig. EF-1 ***DX6006-4.10/DX6006-5.00 Functional Diagram***

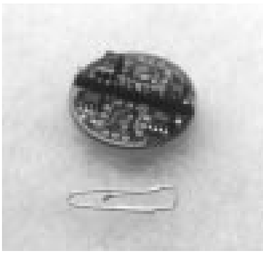
Pre-amplifiers of measuring and reference channels are similar. Amplification coefficient is 21. Reference channel output is connecter to pin 4, measuring one - pin 3.

The power MOSFET switch is used to drive by Light Emitter (connector pin 13).

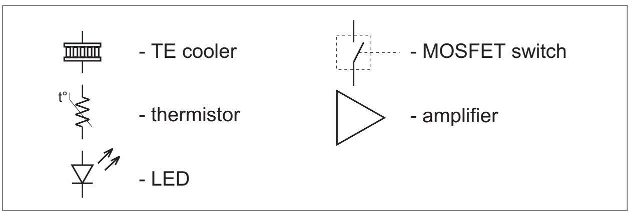
In 4.10 type both TE coolers of Light Emitter and Photodetector could be disabled through pin 14 and pin 12, correspondingly.

The sensitive elements of Detector and Thermistors supplied by precise 4.096 V reference. Load resistors' (serial to thermistor) nominals optimized for maximal linearity and sensitivity in operation temperature range of optoelectronic components. The outputs of Light Emitter's thermistor and Detector's one are contacted to pins 8 and 5, correspondingly.

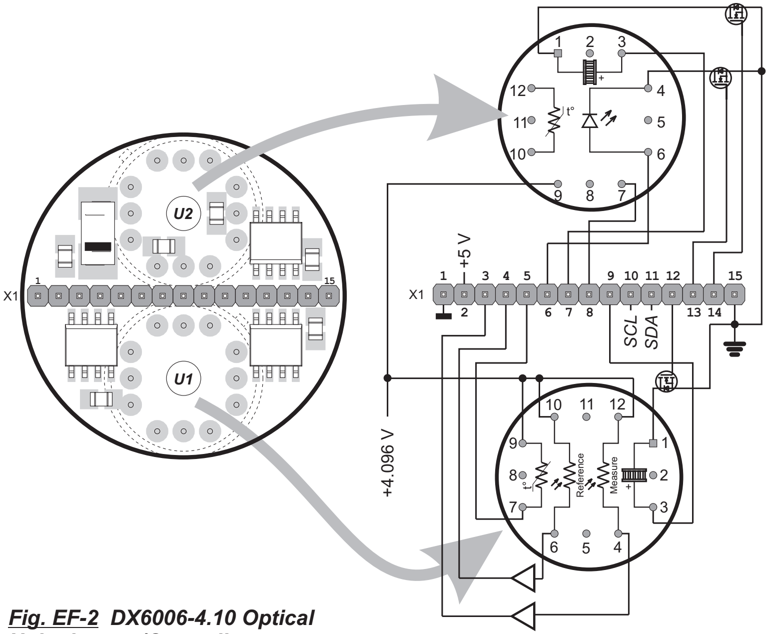
Identification and operation parameters of optical unit are stored into on-board E^2PROM memory (16 Kb). The data are available through pin 10 and pin 11 in full accordance with standard interface I^2C™.



Legend



I^2C™ is a Trademark of Philips Corp.



<u>Fig. EF-2</u> DX6006-4.10 Optical Unit pinouts (Controller connection side view)

DX6006-4.10 pin function description

Pin	Mnemonic	Description
01	GNDA	Ground reference point for analog circuitry and E^2PROM
02	+5V	Optical Unit supply voltage
03	OUT	Measuring channel output
04	OUTREF	Reference channel output
05	TR1	Thermistor of photodetectors
06	ELED	LED power supply
07	ETC2	LED's cooler power supply
08	TR2	Thermistor of LED
09	ETC1	Photodetector's cooler power supply
10	SCL	I^2C interface. Synchronization line
11	SDA	I^2C interface. Data line
12	TC1	Photodetector's cooler enable transistor
13	LED	LED enable transistor
14	TC2	LED's cooler enable transistor
15	GNDP	Ground reference point for power circuitry

DX6006-5.00 pin function description

Pin	Mnemonic	Description
01	GNDA	Ground reference point for analog circuitry and E^2PROM
02	+5V	Optical Unit supply voltage
03	OUT	Measuring channel output
04	OUTREF	Reference channel output
05	TR1	Thermistor of photodetectors
06	ELED	LED power supply
07	ETC2	LED's cooler power supply
08	TR2	Thermistor of LED
09	ETC1	Photodetectors cooler power supply
10	SCL	I^2C interface. Synchronization line
11	SDA	I^2C interface. Data line
12	-	*- Not connected -*
13	LED	LED enable transistor
14	-	*- Not connected -*
15	GNDP	Ground reference point for power circuitry

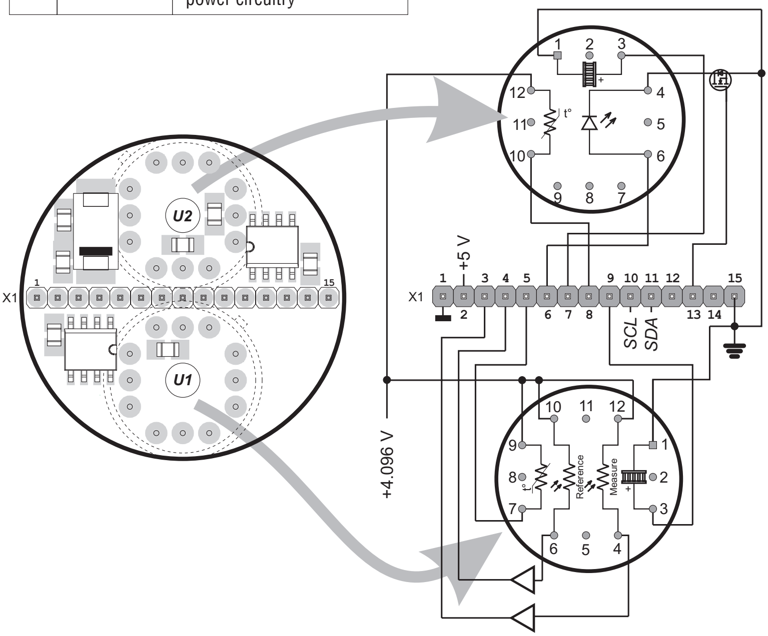


***Fig. EF-3** DX6006-5.00 Optical Unit pinouts (Controller connection side view)*

Light Emitter

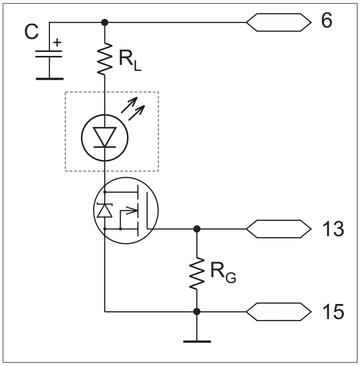


Fig LE-1 ***LED drive switch***

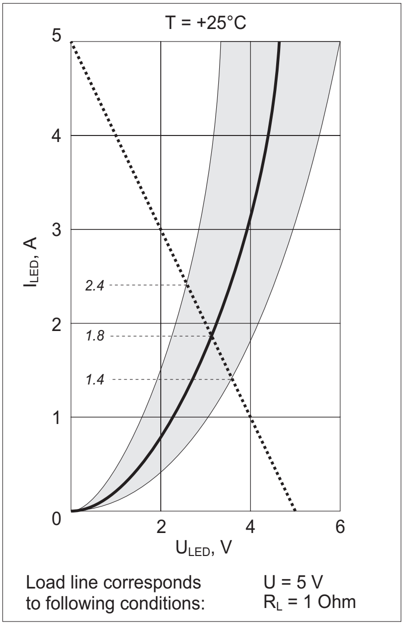


Fig. LE-2

Electronics Scheme (Fig. LE-1.) for driving by of Light Emitter provides stable current pulses up to 5 A through the Emitter with duration of 50…100 µsec.

The MOSFET transistor is used as switch key which is driven by TTL logic signals.

The resistor $\mathbf{R_G}$ in gate circuit fixes closed state of transistor at absence of activity from external electronic scheme.

Loading Resistor $\mathbf{R_L}$ (1 Ohm) limits and stabilize current through light emitter.

The typical volt-ampere plot of the Light Emitter is presented at Fig. LE-2.

Darken area means technological deviations of Light Emitter performance.

According to the Fig. LE-2 at $\mathbf{R_L}$=1 Ohm typical pulsed current is about 1.8 A (1.4…2.4 A).

Capacitor **C** together with other external capacitors,, works for accumulation of pulse energy for light emitter.

Typical recommended schematics for driving by the Light Emitter is presented at Fig. LE-4.

Power Supply 5 V (+4…+6 V are available) through resistor **R** charges capacitor **C** in time duration between pulses. Total capacity (capacitor **C** and available external ones) must be enough for pulse current stability (Fig. LE-3) within

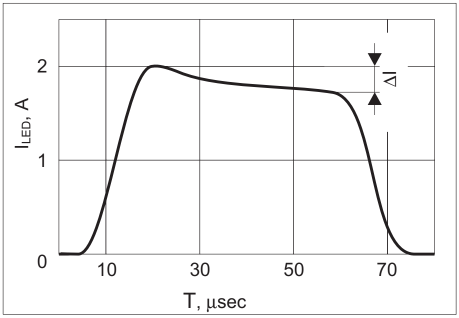


Fig. LE-3 ***Typical current pulse shape through Light Emitter***

Light Emitter Specifications

T = +20°C

Parameter	Units	Min	Nom	Max	Comments
Electrical Parameters					
Light emitter					
CW Current	A			0.2	
Pulse Current	A			4	Q = 200, t = 100 µs
Direct Voltage Drop	V		4.5	5.5	I = 4 A
Switch Key					
Operating voltage	V	-12		+12	Pin. 13
Resistance	mOhm			4	At +4.5 V - pin 13
Resistor Nominal	Ohm	0.95	1.0		
Dynamical Parameters					
Time Constant	µs			1.5	Pins. 3 and 4

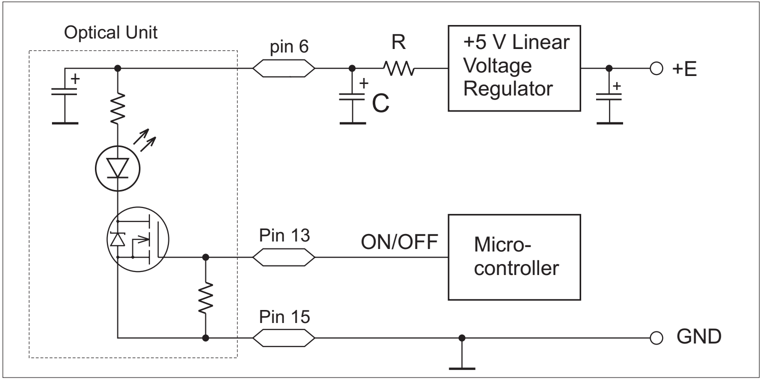


Fig. LE-4 ***Typical LED control circuit***

Preamplifiers

The pre-amplifiers' (measuring and reference channels) schematics is presented at Fig. PA-1 and PA-2.

The both channels are identical. There are only difference in components nominals, because some difference of sensitive elements of measuring and reference channels. Every pre-amplifier is a half part of dual Op Amp.

Amplification coefficient is 21 without signal inversion.

Load resistors nominals are optimized for coordination with resistivity of sensitive elements (at operating temperature range).

Typical (recommended) outside schematics is

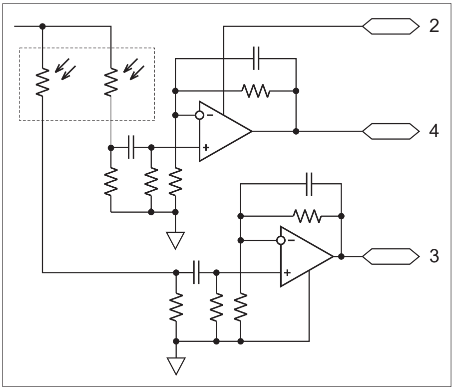


Fig. PA-1. Pre-amplifiers of DX6006-4.10

Amplifiers specifications

T = +20°C; Eп = 5 V ±5%

Parameter	Units	Min	Nom	Max	Comments
Electrical parameters					
Pre-Amplifiers					
Operating voltage	V	4		6	Pin. 2
Operating Current	mA			1.45	Pin. 2
Output current	mA	-3		+3	Pin. 3,4
Dinamical Parameters					
Rice Time	µs		15		Pin. 3,4
Foult Time	µs		15		Pin. 3,4

placed in Fig. PA-1.

Warning. In designing of external electronics it is necessary to note that output signals of pre-amplifiers are referenced to “ground’ rail (Fig. PA-4). This means that if to use unipolar external amplifiers, then they must have Rail-to-Rail input.

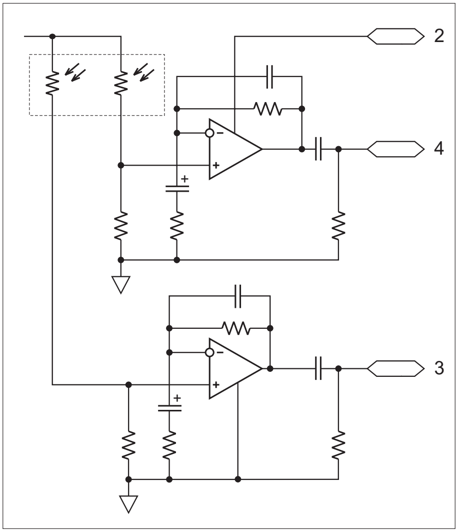


Fig. PA-2 ***Pre-amplifiers of DX6006-5.00***

Moreover it is necessary to take into account that output signal of measuring channel in dependance of gas concentration should be changing within orders of value. To preserve accuracy at large measuring gas concentrations it is necessary to use external amplifier of measuring output with variable amplification coefficient. It is to co-ordinate the amplified signal with an ADC range.

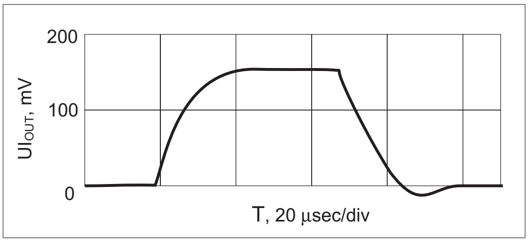


Fig. PA-3 ***Typical pulse at pre-amplifiers’ outputs***

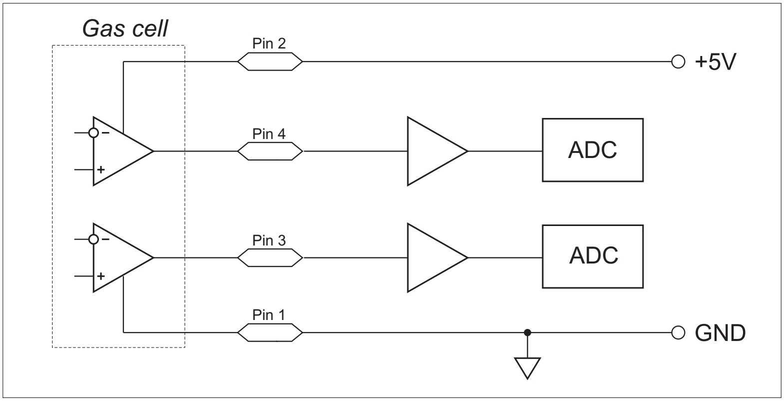


Fig. PA-4 ***Typical amplifier usage circuit***

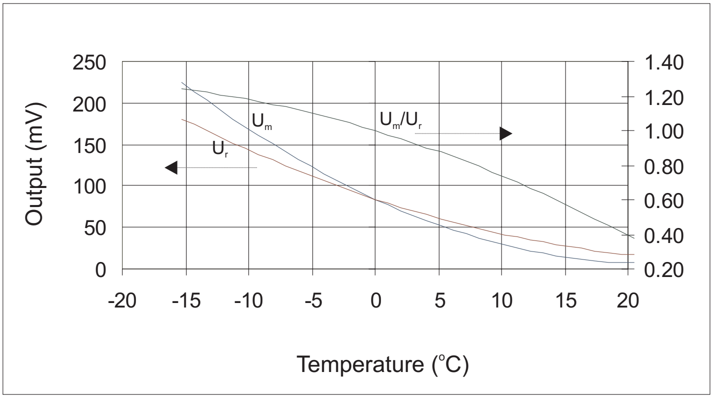


Fig. PA-5 ***Preamplifier Output vs Operation Temperature***

Thermoelectric Coolers

Driving by TE coolers requires particular attention.

First of all, the operation of TE coolers directly affect on performance parameters of Optical Units and gas sensors based on them.

At the second, the TE coolers are the components which consume largest part of power (Fig. TE-3).

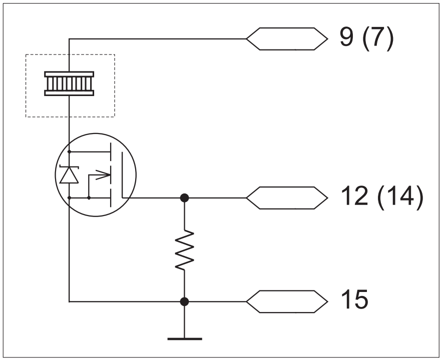


***Fig. TE-1* Schematics of TE coolers in 6006-4.10 module**

Output signal of Photodetector depends very from their temperature (Fig. PA-5).

This ratio is approximately 100%/20 °C. It is equivalent to temperature drift 1%/0.2 °C. It means that if the thermo-stabilization should be with accuracy of 0.1 deg, then accuracy of measurements will be 0.5%.

Accuracy of thermo-stabilization must be not less than required for gas sensing.

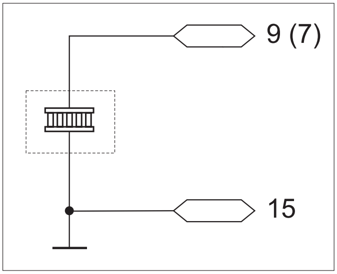


***Fig. TE-2* Schematics of TE coolers in 6006-5.00 module**

Operating temperature of TE coolers must be selected optimal (from Fig. PA-5 and Fig. TE-3): too lower temperature stabilization leads to higher power consumption; at higher temperature the output signals (and signal/noise ration) are lower.

The Optical Unit housing has been designed for additional heat dissipation from warm side of working TE coolers. Maximal heat dissipation is 2 W. At T_a - T_{op}> 40 °C it is necessary to use additional heat dissipation - bigger heat sink (optional available) or fan.

In a custom made algorithm of thermo-stabilization it has to be taken into account that time constant of TE cooler is approximately 2 s.

Electronic Scheme of TE cooling in DX6006-4.10 and DX6006-5.00 are presented at Fig. TE-1 and Fig. TE-2, correspondingly.

An example of recommended scheme of thermo-stabilization is presented at Fig. TE-4 and TE-5.

TE Cooling Specifications

T_{am} = +20°C; E = 5±5% V, unless otherwise noted

Parameter	Units	Min	Nom	Max	Comments
Electrical parameters					
TE coolers					
Operating ΔT	°C	-40			
Operating Voltage	V			4.3	
Operating Current	A			0.4	
Resistivity	Ohm	6.7	6.9	7.1	1 kHz, at +30°C,
Switch key					
Switching voltage	V	-12		+12	Pin. 12 (14)
Resistivity	mOhm			80	At +4.5 V to pin. 12 (14)
Dynamical parameters					
Time Constant	c			10	At I_{TC} = 0 -> I_{TC} = 0.4 A
Time Constant	c			10	At I_{TC} = 1 A -> I_{TC} = 0

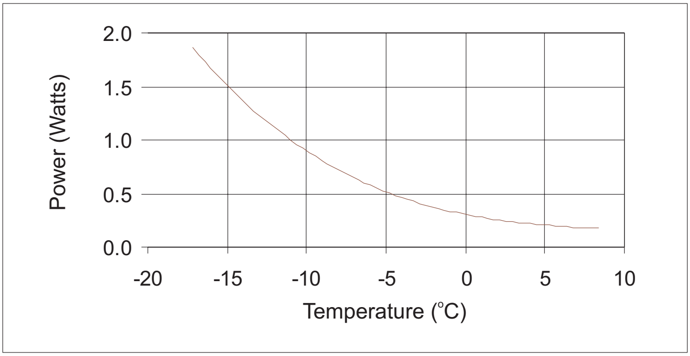


Fig. TE-3 ***TEC Power Consumption vs Operation Temperature***

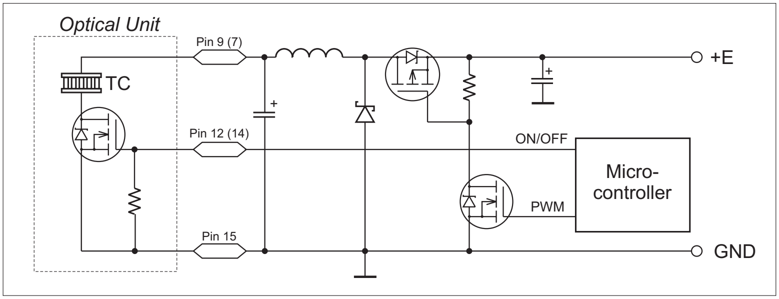


Fig. TE-4 ***Typical TEC control circuit for DX6006-4.10 Module.***

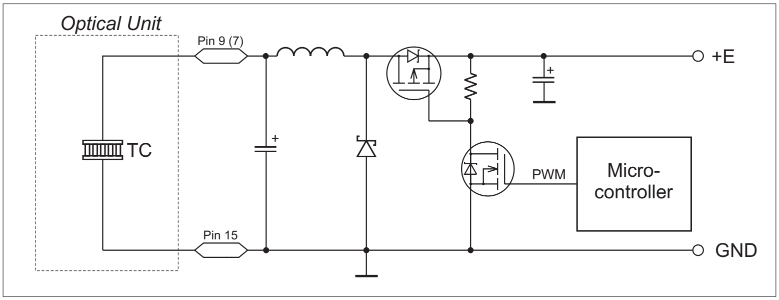


Fig. TE-5 ***Typical TEC control circuit for DX6006-5.00 Module.***

Thermistors

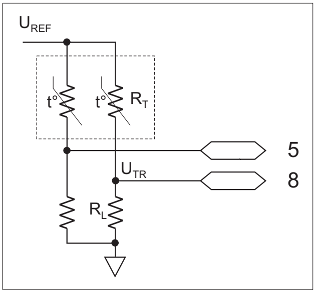


***Fig. TR-1* Thermistors connection in DX6006 module**

For temperature driving by TE coolers, NTC thermistors built-into cold side of TE coolers are used. These thermistors are applied in scheme with serial loading resistor $\mathbf{R_L}$ and reference power supply $\mathbf{U_{ref}}$ (Fig. TR-1).

Output signal from the thermistor scheme depends on its resistivity which change with temperature as :

$$U_{TR} = U_{REF}\left(\frac{R_L}{R_L + R_T}\right)$$

One can see that temperature measurement accuracy depends directly from $\mathbf{U_{ref}}$.
In electronic PCB of Optical Unit is used 4.096 V Precise Voltage Reference.
Typical dependence of thermistor's scheme output vs measured temperature is presented in Fig. TR-2.
Recommended external schematics is presented at Fig. TR-3.
At least 12-bit resolution ADCs are recommended to apply.

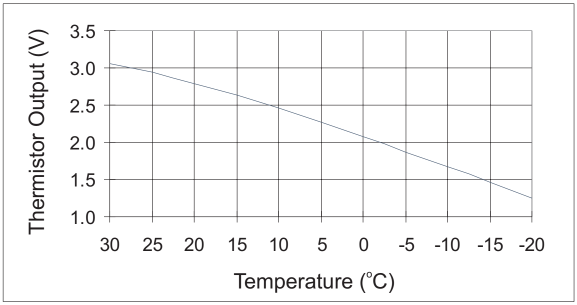


***Figure TR-2* Thermistor's circuit Output vs Measuring Temperature**

Thermistors Specifications

T = +20°C; Eп = 5 V ±5%

Parameter	Units	Min	Nom	Max	Comments
Resistivity	kOhm	2.09	2.2	2.31	at 20 °C
Beta-Constant	$K \cdot 10^{-3}$	2.9	3.1	3.5	

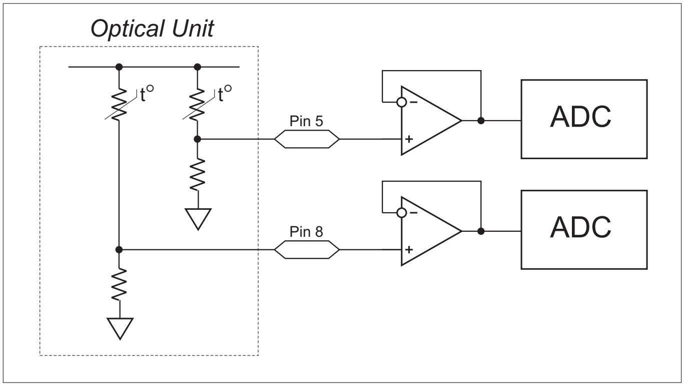


Fig. TR-3 ***Typical thermistor usage***

E^2PROM

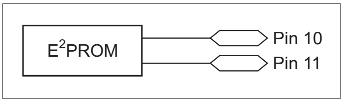


Fig. EP-1 ***I^2C interface connection***

The standard Electrically Erasable PROM (E^2PROM) 24C164 chip is placed in Optical Unit's PCB. It is used to storage of identification code of Optical Unit, calibration data and some additional data for operation of the unit. Additional data are used for operation of the Optical Units with manufacturer's controller DX6001. Without power supply the data are stored not less than 10 years.

E^2PROM Specification

Parameter	Value
Volume, bit	16 K (2K×8)
Number of re-writing cycles, not less	$10 \cdot 10^6$
Write speed, µs	10

At Fig. EP-2 is presented recommended schematics for usage of the E^2PROM with outside controlled using I^2C interface.

The detailed information on I^2C interface is possible to retrieve from technical data of Microchip Corporation (http://www.microchip.com).

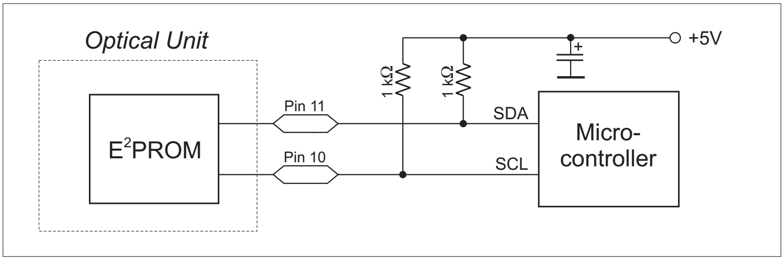


***Fig. EP-2* On-board Memory usage**

E^2PROM Data Format

Various operating parameters are stored in on-board E^2PROM circuit:

- calibration data,
- synchronization parameters,
- measuring mode presets,
- TE cooling algorithm presets,
- Optical Unit identification.

The E^2PROM usage structure is placed in Table EP-1.

Detailed description of usage of all data stored in memory are in User Manual for DX6001 Controller of RMT Ltd. It was designed for optimal operation with DX6006 Optical Units.

E^2PROM Memory Structure

Table EP-1

Item	Address (hex)	Content	Command
1	0000	Calibration data block (first calibration data)	fn 0
2	0018	Calibration data block	fn 1
3	0030	Calibration data block	fn 2
4	0048	Calibration data block	fn 3
5	0060	Calibration data block	fn 4
6	0078	Block of synchronization parameters*	hw
7	0082	Block of parameters of measuring cycle*	jb
8	008C	Parameters of thermostabilization of Detector*	pr
9	0096	Parameters of thermostabilization of Light Emitter*	em
10	00A0	Optical Unit Identifier	id

** - are used only with DX6001 Controller*

Format of First Calibration Data Block

Item	Address (hex)	Description	Name	Units	Format
1	0000	TE coolers Operating Temperature	**t**	unit	int16
2	0002	Ambient Temperature of Calibration	t_{env}	unit	int16
3	0004	“Zero” Value	K_0	-	float
4	0008	Polynomial Coefficient A_3	a_3	-	float
5	0014	Polynomial Coefficient A_2	a_2	-	float
6	0020	Polynomial Coefficient A_1	a_1	-	float
7	0024	Polynomial Coefficient A_0	a_0	-	float

Formats of another reserved (if applied) Calibration Data Blocks are the same as the first one.

Identifier Data Format

Identification Data is written as ASCI string. It contains the following information:

Serial Number

Electronic Scheme Code

Concentration Range
In ppm, Includes two significant digits of the concentration value () followed by the number of zeros to follow.

Gas Code

Code	Gas
01	CO_2
02	C_nH_m
03	CH_4
04	CO
05	H_2O

Part Number

Gas Designator
6 positions max, followed by space symbol

Example:

CO2 6006.01.504.41-0012

[**CO2**] "CO_2"
[**6006**] DX6006 Series
[**01**] CO_2 Gas Option,
[**504**] 0...5.0·10^4 ppm (0...5%) concentration range,
[**41**] electronic scheme revision #4.10,

Installation Tips

It is required an external DC Power Supply with +5 V ±5% and operating current not less than 7.5 mA.

Power Supply is to be connected to pin 2.

It is used for supply of:

- pre-amplifiers of Photodetector,
- thermistors and sensitive elements of Photodetector,
- E^2PROM.

Power Supply for customer external electronics depends of scheme concepts. It is necessary to note only that total current consumption of Light Emitter and TE Coolers of DX6006 Optical Unit is not more than 300 mA, if operating temperature of TE coolers is preset as 0...-5 °C (recommended) .

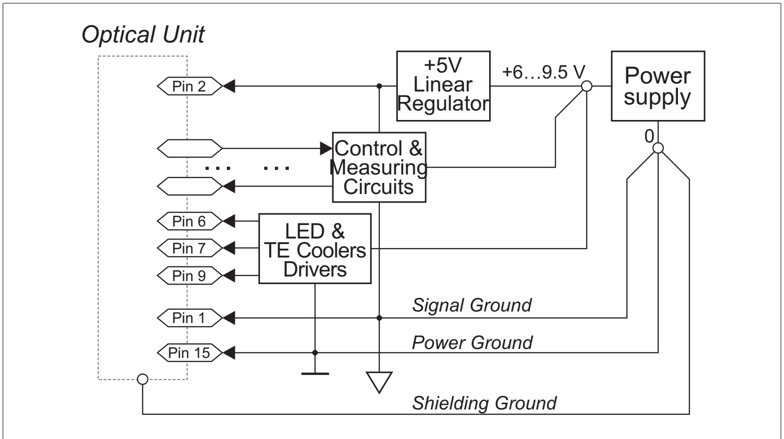


***Fig. IT-1* DX6006 Power Supply connecting**

Recommended connection is presented at Fig. IT-1.

The most important thing is - power circuit part and measuring circuit must be separated and have coupled “Ground” close to power supply.

Shielding “Ground” must contact Optical Unit housing with (Fig. IT-1), customer electronics with using optional cable DX6000-C-05.

Standard Kit

Standard Kit of DX6006 consists of :

1.	Optical Unit DX6006	1 pc.
2.	Interface cable for 15 pins Connector	1 pc
3.	15 pins Connector (female)	1 pc
4.	User Manual	1 booklet
5.	Specification	1

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