

# MM7D Air quality measuring device

## Technical manual



Hardware version: v200620

Software version: v0.2

Technical manual version: v2.0

Issue date: 2021.02.07.

Draw number: 59/12/1

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	Technical manual				
Name:	Pozsár Zsolt			Date:	2021.02.07.

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## I. Hardware

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## 1. Technical data

Supply voltage:	5 V DC SELV
Supply current:	max. 1 A
Isolation class:	Class III
Mechanical size:	71 x 71 x 27 mm
IP protection:	IP 20
Mass of cover:	termoplast (ABS)
Communication:	Wireless LAN, TTL 3.3V serial port
Getting data:	via HTTP
Administration:	via serial connection

## 2. General description

This device can measure temperature and humidity of growing house air, and detect some unwanted gas (CO<sub>2</sub>, NH<sub>3</sub>, NO<sub>x</sub>, alcohol, benzene etc.) and smoke, and has got three different color status LED. The measured values can be queried and LEDs can be turn on and off via wireless network via HTTP. The device box contains only the temperature and humidity sensor, the gas sensor must be connected with a short cable.

## 3. Schematic and PCB draws

The wiring diagrams of the device is shown in Annex 1, PCB draws are in Annex 2-4. You can download it as part of the complete documentation or in separate PDF, SVG and KiCAD formats from the developer/manufacturer's website. The Gerber files needed for production are included in the package.

## 4. Other draws and documents

Documentation package contents mechanical draw of used box in PDF.

## 5. Terms of use

Hardware documentation can be modified and/or redistributed under the Creative Commons 4.0 Attribution Non-Commercial (CC-BY-NC-4.0) License. You can read the full text of the license online. (Refer to Chapter III for references.)

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## 6. Look of unit

### a) Manuals and connectors

1. POWER signal light (white LED)
2. ACT signal light (blue LED)
3. STATUS signal light (green LED)
4. STATUS signal light (yellow LED)
5. STATUS signal light (red LED)
6. Power supply connector (P1)
7. Console connector (P2)
8. Cable of external gas sensor

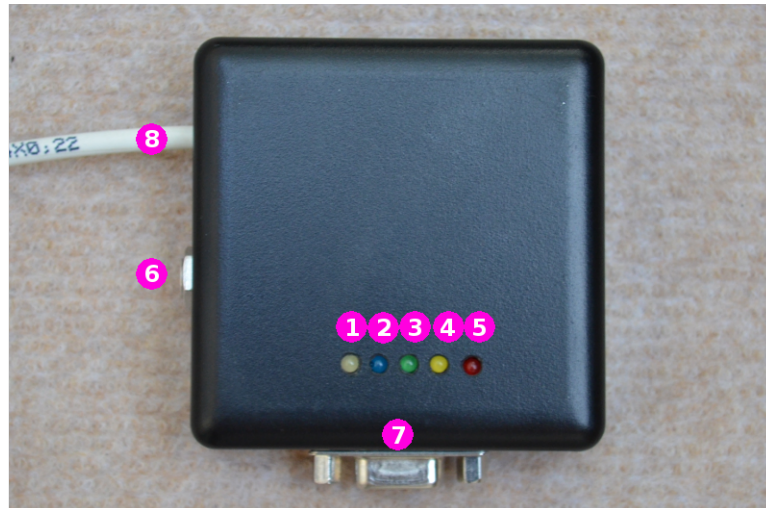


Figure 1: Manuals and connectors

### b) Internal construction

1. Microcontroller (U101)
2. DHT11 sensor (U103)
3. Connector of external gas sensor (U102)
4. Cable of external gas sensor (U102)
5. Power voltage connector (P1)
6. Console connector (P2)

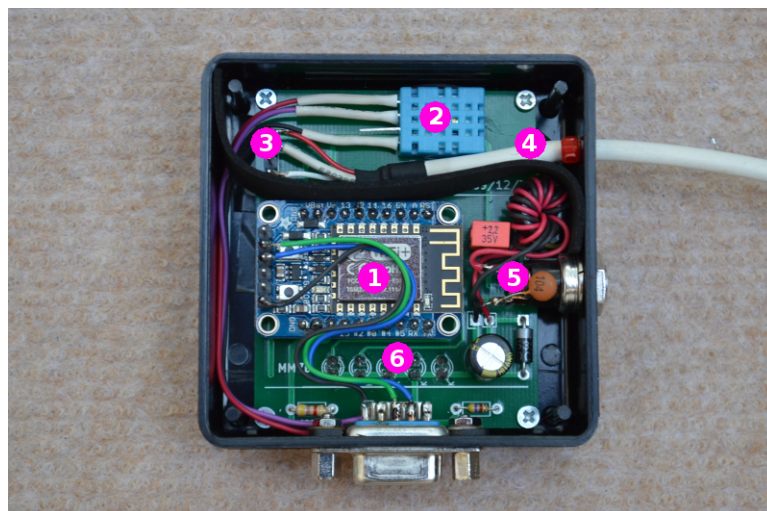


Figure 2: Internal construction

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### c) Pinout of connectors

connector	pin	function	note
P1	center	+ 5 V supply voltage input	ø 5.5/2.1 mm power connector
	shield	GND	
P2	2	serial port RXD	DB9F
	3	serial port TXD	
	5	GND	
U102	1	+5 V	
	2	GND	
	4	Analog data	

## 7. Downloadable documentation

The complete documentation of the hardware in the .tar.gz format compressed file can be downloaded from the manufacturer's website or Github. (Refer to Chapter III for references.) Name of package is: *mm7d-hw-200620-2.0.tar.gz*.

Content of package - only important files:

<b>mm7d-hw</b>	
<b>cad_files</b>	<b>KiCAD files</b>
<b>mm7d</b>	<i>documentation of PCB</i>
mm7d.pro	project file
mm7d.sch	schematic draw
mm7d.kicad_pcb	PCB draw
mm7d.drl	drilling file
mm7d-*.gbr	Gerber files
<b>wiring</b>	<i>internal wiring</i>
wiring.pro	project file
wiring.sch	schematic draw
<b>documents</b>	<b>documentation</b>
mm7d_en.pdf	Technical manual
pcb_*.pdf	pcb draws
sch_*.pdf	schematic draws
<b>pictures</b>	<b>pictures</b>
mm7d.jpg	look of the unit
pcb_*.svg	PCB draws
sch_*.svg	schematic draws
LICENCE	terms of use
README.md	short description

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## II. Software

Titles:	MM7D Air quality measuring device	Rev.:	200620	Pages:	7/23
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## 1. General description

The device measures three characteristics of the air, which can be queried remotely and it has got three status LED, which can be set remotely.

The program displays initialization steps and error messages on the serial console.

When an HTTP request is received, the client's IP address and username argument are checked. If appropriate, perform a measurement or turn the status LEDs on / off. After displays the result on the web interface. Incoming requests are indicated by the flashing of the blue activity LED.

New things in 0.2 version:

- Sets limit values, gives all measured parameter and switches status LEDs automatically in one HTTP request.
- Automatic measure with one minute interval.

## 2. Setup

You can found source file of software in *software* directory. Before installing the program, you need to set these values:

```
// settings
const char* wifi_ssid      = "";
const char* wifi_password  = "";
const String uid           = "";
const String allowedaddress = "";
```

## 3. Installation

Use a serial cable and Arduino IDE software to install program to microcontroller. Before installation procedure unpack required libraries from *libraries* directory or clone from Github.com to *~/Arduino/libraries/*.

## 4. Using the device

The device operates automatically does not require any human intervention.

### a) Data set and retrieval via HTTP

Examples for how to use argument:

<http://192.168.1.12/set/greenled/off?uid=bob>

<http://192.168.1.12/operation?uid=bob&h1=75&h2=80&h3=90h4=95&t1=12&t2=18&t3=22&t4=25&g=10>

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### URL of information and data pages:

URL	type	description	args.
<a href="http://ipaddress/">http://ipaddress/</a>	text/html	Start and information page	
<a href="http://ipaddress/version">http://ipaddress/version</a>	text/plain	Get software name and version	
<a href="http://ipaddress/operation">http://ipaddress/operation</a>		Get all data and set limit values	uid, h1-4, t1-4, g
<a href="http://ipaddress/get/all">http://ipaddress/get/all</a>		Get all data	uid
<a href="http://ipaddress/get/humidity">http://ipaddress/get/humidity</a>		Get relative humidity in %	
<a href="http://ipaddress/get/temperature">http://ipaddress/get/temperature</a>		Get temperature in °C	
<a href="http://ipaddress/get/unwantedgaslevel">http://ipaddress/get/unwantedgaslevel</a>		Get rel. level of unwanted gases in %	
<a href="http://ipaddress/set/all/off">http://ipaddress/set/all/off</a>		Switch off all LEDs	
<a href="http://ipaddress/set/greenled/off">http://ipaddress/set/greenled/off</a>		Switch off green LED	
<a href="http://ipaddress/set/greenled/on">http://ipaddress/set/greenled/on</a>		Switch on green LED	
<a href="http://ipaddress/set/redled/off">http://ipaddress/set/redled/off</a>		Switch off red LED	
<a href="http://ipaddress/set/redled/on">http://ipaddress/set/redled/on</a>		Switch on red LED	
<a href="http://ipaddress/set/yellowled/off">http://ipaddress/set/yellowled/off</a>		Switch off yellow LED	
<a href="http://ipaddress/set/yellowled/on">http://ipaddress/set/yellowled/on</a>		Switch on yellow LED	

uid: user ID

h1-4: relative humidity limit values in percent

t1-4: temperature limit values in percent

g: relative unwanted gas level limit value in percent

### b) Connect to console via serial port

The console connector of the device and the RS-232 serial port of the computer must be connected by means of a level shifter adapter with a null modem cable. The level shifter adapter is required due to the different voltages of the logic levels (0 V / 3.3 V and -12 V / + 12 V).

The console connector of the device and the USB port of the computer must be connected using an Adafruit 954, FTDI TTL-232R-RPI or similar 3.3V serial / USB cable.

#### Connection parameters

speed (baudrate): 115 200 bps

data bits: 8

parity bit: no

stop bit: 1

flow control: no

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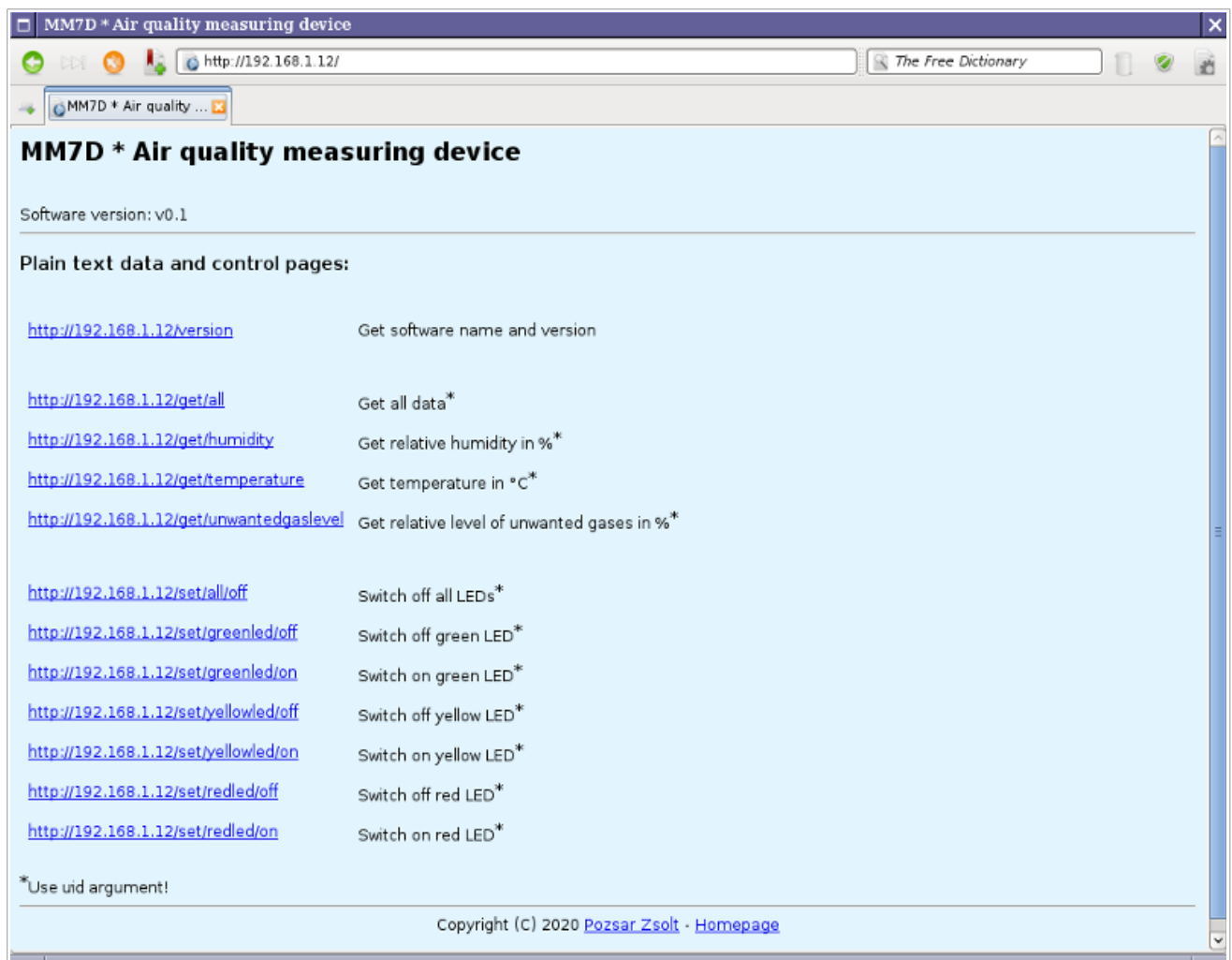


Figure 3: Start page

## Connect via linux terminal

Name of ports (device files):

RS-232 serial port: /dev/ttyS0, /dev/ttyS1, ...

serial/USB converter: /dev/ttyUSB0, /dev/ttyUSB1, ...

Make sure you are a member of the dialout group:

```
username@localhost$ id
```

If not, set up your group membership:

```
username@localhost$ sudo usermod -a -G dialout username
```

Connect with GNU Screen program:

```
username@localhost$ screen port_name 115200
```

Connect with Minicom program:

```
username@localhost$ minicom -b 115200 -o -D port_name
```

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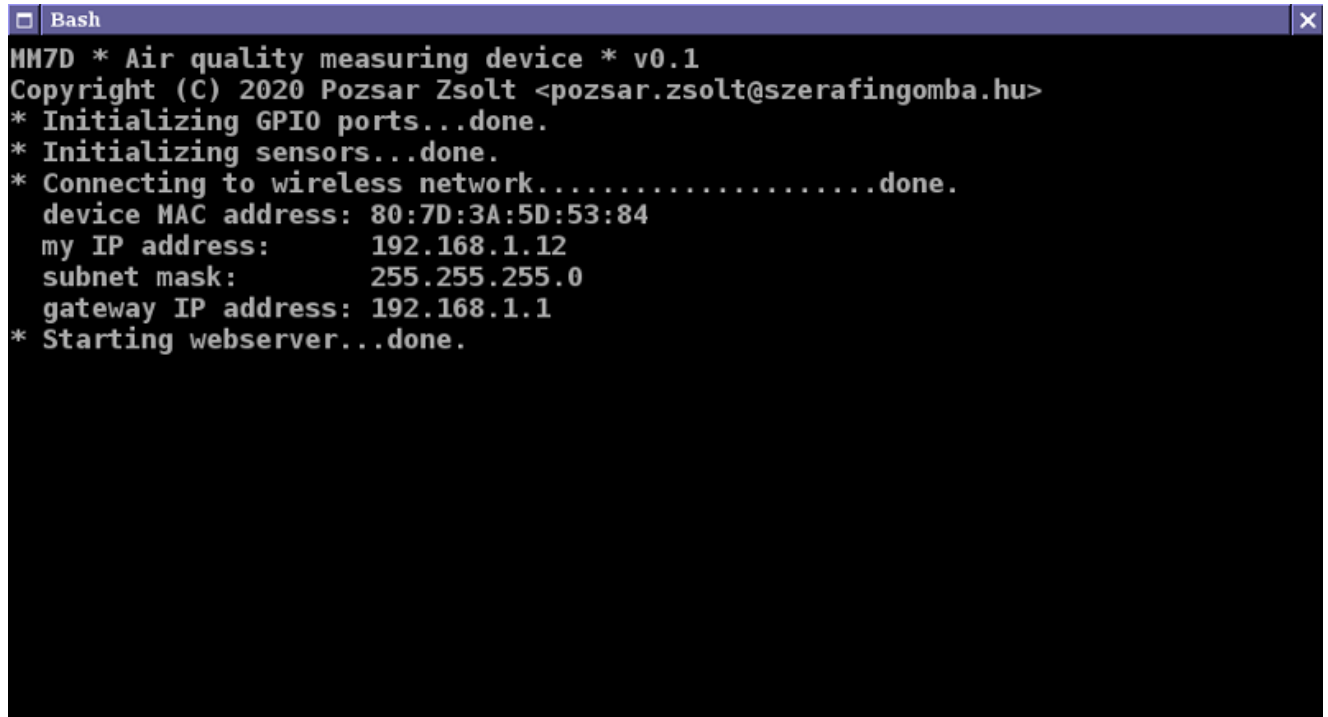
## Connect with Windows terminal (Putty)

Name of ports:

RS-232 serial port: COM1, COM2, ...

serial port/USB converter: variable, see the device manager

Select the serial connection mode and communication port, set the speed and start the connection.



```
Bash
MM7D * Air quality measuring device * v0.1
Copyright (C) 2020 Pozsar Zsolt <pozsar.zsolt@szerafingomba.hu>
* Initializing GPIO ports...done.
* Initializing sensors...done.
* Connecting to wireless network.....done.
device MAC address: 80:7D:3A:5D:53:84
my IP address:      192.168.1.12
subnet mask:       255.255.255.0
gateway IP address: 192.168.1.1
* Starting webserver...done.
```

Figure 4: Serial console with messages

## 5. Check operation

You can check operation of controller with a web browser, use index.html in *testpage* folder.

## 6. Terms of use

This program is free software: you can redistribute it and/or modify it under the terms of the European Union Public License 1.1 version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

You can read the full text of the license online. (Refer to Chapter III for references.)

Titles:	MM7D Air quality measuring device	Rev.:	200620	Pages:	11/23
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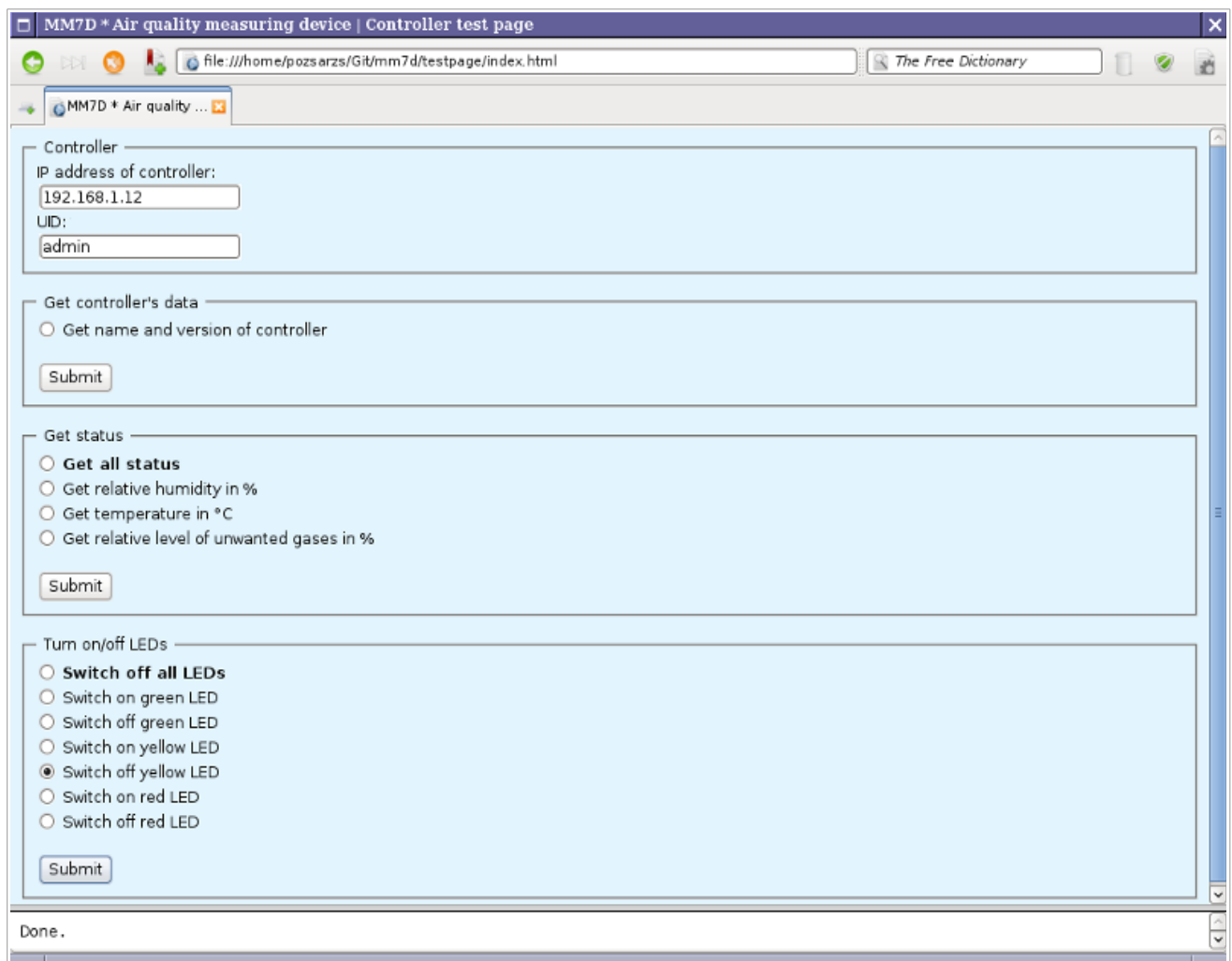


Figure 5: Test page

## 7. Downloadable software package

The software package in .tar.gz format compressed file can be downloaded from the manufacturer's website or Github. (Refer to Chapter III for references.)

Name of package is: *mm7d-sw-0.2.tar.gz*.

Content of package - only important files:

<b>mm7d-sw</b>	
—documents	<b>documentation</b>
*	documentation
—libraries	<b>external libraries</b>
*.tar.gz	libraries in archive file
clone	clone script
—testpage	<b>test page</b>
index.html	startpage
—source	<b>source code</b>
mm7d.ino	source code
—LICENCE	terms of use
—README.md	short description

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### III. Related links

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## 1. Hardware

Full package	<a href="http://www.szerafingomba.hu/equipments/mm7d/mm7d-hw-200620-2.0.tar.gz">http://www.szerafingomba.hu/equipments/mm7d/mm7d-hw-200620-2.0.tar.gz</a>
Download from Github	<a href="http://github.com/pozsarzs/mm7d-hw.git">http://github.com/pozsarzs/mm7d-hw.git</a>
Technical manual	<a href="http://www.szerafingomba.hu/equipments/mm7d/technical-manual-200620-0.2-2.0-en.pdf">http://www.szerafingomba.hu/equipments/mm7d/technical-manual-200620-0.2-2.0-en.pdf</a>

### Schematic and PCB draws (PDF):

Schematics	<a href="http://www.szerafingomba.hu/equipments/mm7d/sch_mm7d-1.pdf">http://www.szerafingomba.hu/equipments/mm7d/sch_mm7d-1.pdf</a> <a href="http://www.szerafingomba.hu/equipments/mm7d/sch_mm7d-2.pdf">http://www.szerafingomba.hu/equipments/mm7d/sch_mm7d-2.pdf</a>
PCB solder side	<a href="http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-sold.pdf">http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-sold.pdf</a>
PCB component side	<a href="http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-comp.pdf">http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-comp.pdf</a>
PCB silkscreen	<a href="http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-silk.pdf">http://www.szerafingomba.hu/equipments/mm7d/pcb_mm7d-silk.pdf</a>

## 2. Software

Software package	<a href="http://www.szerafingomba.hu/software/mm7d/mm7d-sw-0.2.tar.gz">http://www.szerafingomba.hu/software/mm7d/mm7d-sw-0.2.tar.gz</a>
Download from Github	<a href="http://github.com/pozsarzs/mm7d-sw.git">http://github.com/pozsarzs/mm7d-sw.git</a>

## 3. Terms of use

CC-BY-NC-4.0	<a href="https://creativecommons.org/licenses/by-nc/4.0/legalcode">https://creativecommons.org/licenses/by-nc/4.0/legalcode</a>
CC-BY-NC-4.0	<a href="https://creativecommons.org/licenses/by-nc/4.0/">https://creativecommons.org/licenses/by-nc/4.0/</a>
EURL v1.2	<a href="https://eupl.eu/1.2/en/">https://eupl.eu/1.2/en/</a>

## 4. Developer and manufacturer

Homepage	<a href="https://www.szerafingomba.hu">https://www.szerafingomba.hu</a>
E-mail	<a href="mailto:info@szerafingomba.hu">info@szerafingomba.hu</a>

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## IV. Annexes

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## Content

1. Error messages and signs
2. Internal wiring
3. Schematic of printed circuit board
4. PCB solder side
5. PCB component side
6. PCB silkscreen

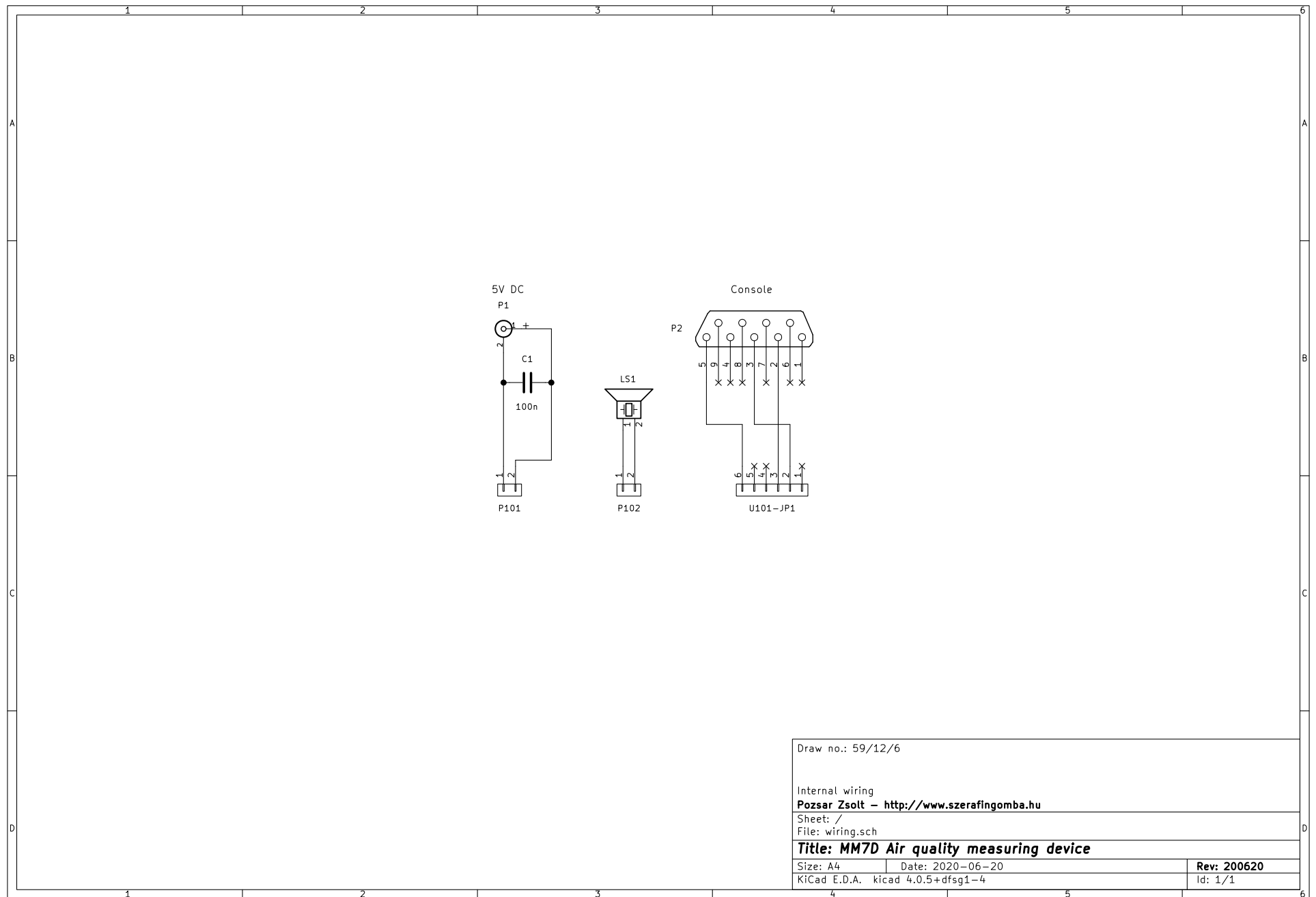
Titles:	MM7D Air quality measuring device	Rev.:	200620	Pages:	16/23
	Technical manual				
Name:	Pozsár Zsolt			Date:	2021.02.07.



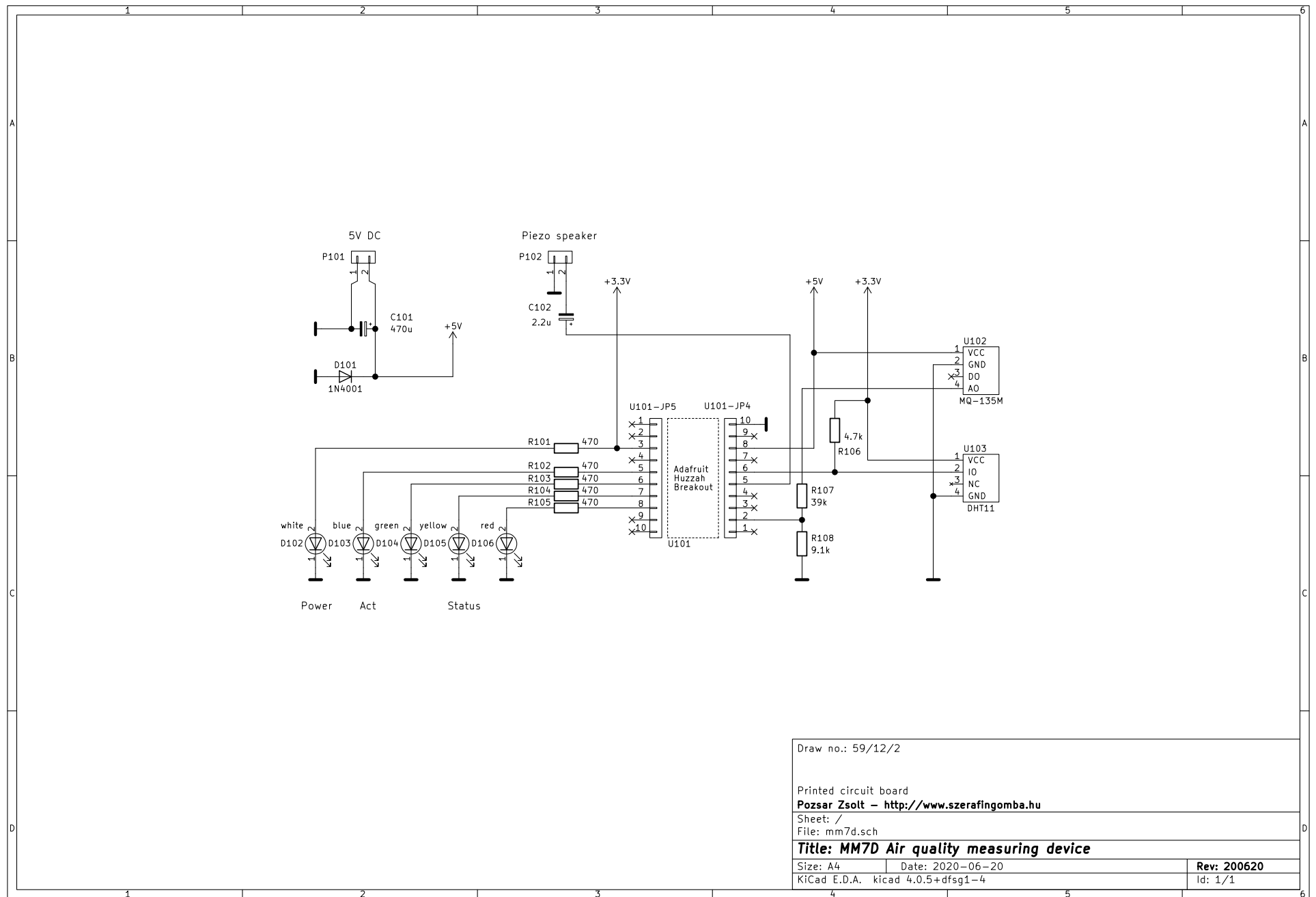
Sign	Message	Web	Console	Yellow light	RED light	Sound
E01	Failed to read CO <sub>2</sub> sensor!	value: 999	yes	no	no	beep
E02	Failed to read T/RH sensor!	value: 999	yes	no	no	beep
E03	Authentication error!	yes	yes	no	no	2x beep
E04	Not allowed client IP address!	yes	yes	no	no	3 x beep
E05	Page not found!	yes	yes	no	no	no
	argument g = relative gas level	no	no	yes	no	no
	argument g < relative gas level	no	no	no	yes	no
	argument h1 < relative humidity	no	no	no	yes	no
	argument h1 < relative humidity < h2	no	no	yes	no	no
	argument h3 < relative humidity < h4	no	no	yes	no	no
	argument h4 < relative humidity	no	no	no	yes	no
	argument t1 < temperature	no	no	no	yes	no
	argument t1 < temperature < t2	no	no	yes	no	no
	argument t3 < temperature < t4	no	no	yes	no	no
	argument t4 < temperature	no	no	no	yes	no

*Annex 1: Warning and error messages and signs*

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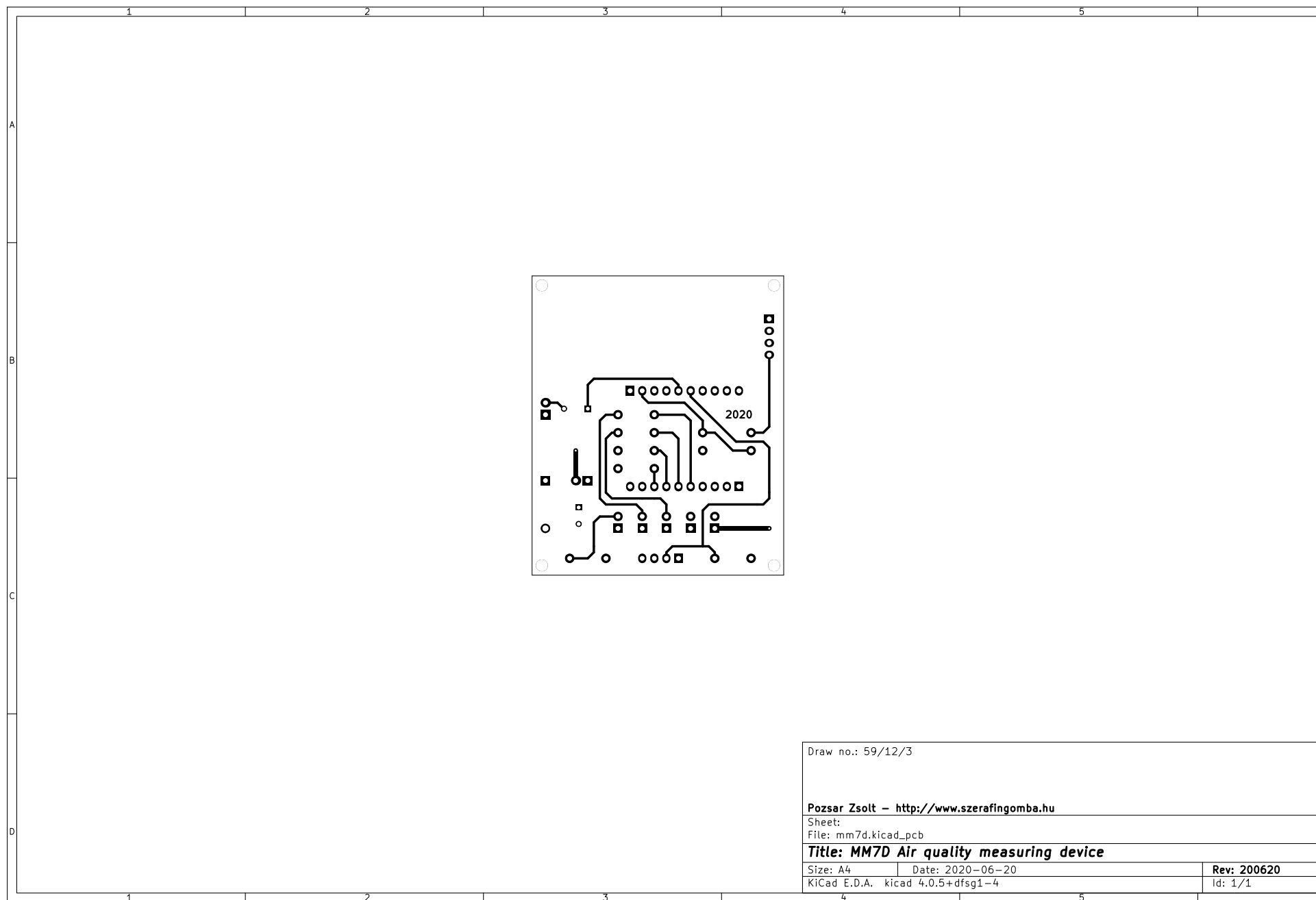


Annex 2: Internal wiring



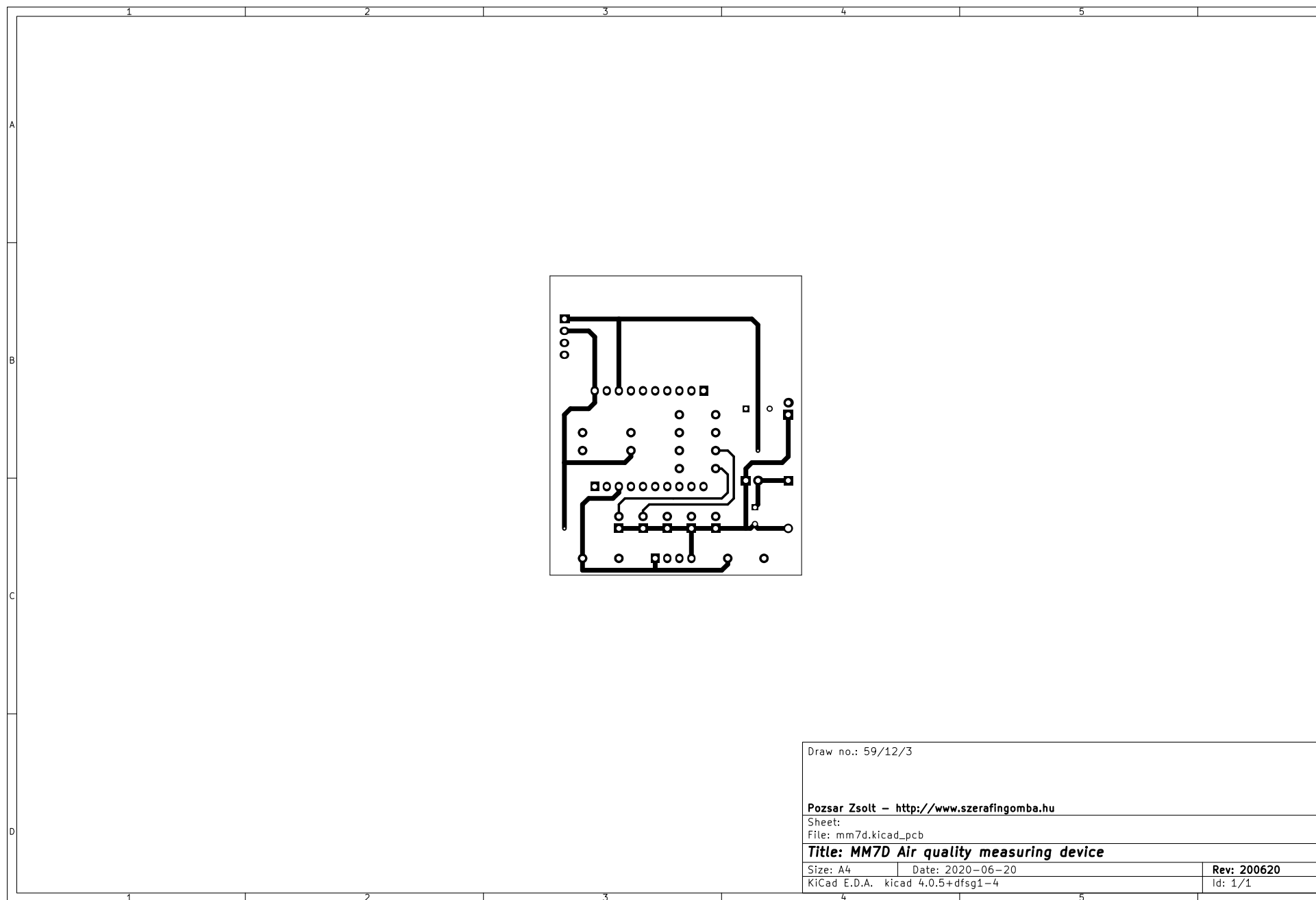
Draw no.: 59/12/2		
Printed circuit board		
Pozsar Zsolt – <a href="http://www.szerafingomba.hu">http://www.szerafingomba.hu</a>		
Sheet: /		
File: mm7d.sch		
<b>Title: MM7D Air quality measuring device</b>		
Size: A4	Date: 2020-06-20	Rev: 200620
KiCad E.D.A. kicad 4.0.5+dfsg1-4		Id: 1/1

Annex 3: Schematic of printed circuit board

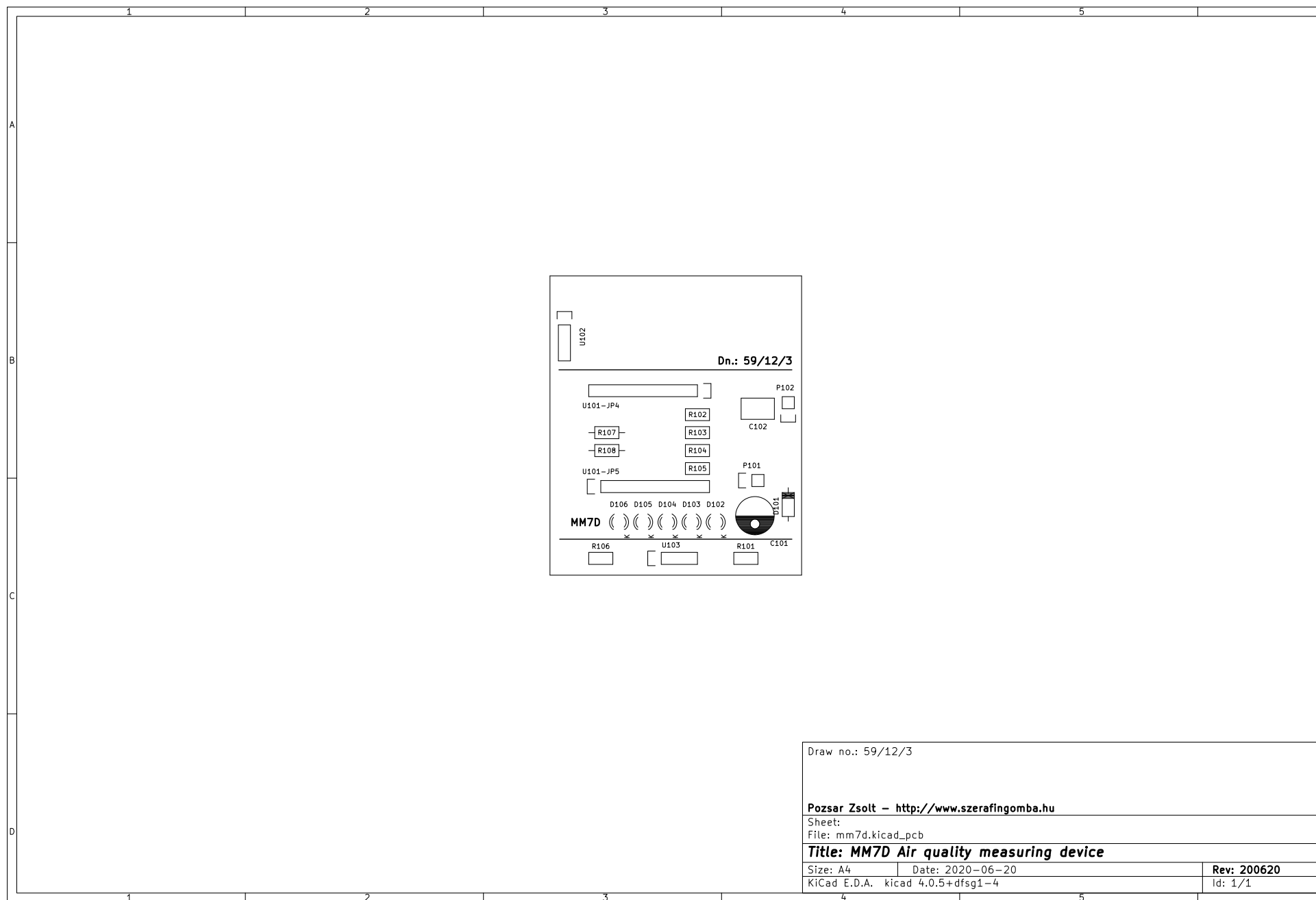


Draw no.: 59/12/3		
Pozsar Zsolt – <a href="http://www.szerafingomba.hu">http://www.szerafingomba.hu</a>		
Sheet:		
File: mm7d.kicad_pcb		
<b>Title: MM7D Air quality measuring device</b>		
Size: A4	Date: 2020-06-20	Rev: 200620
KiCad E.D.A. kicad 4.0.5+dfsg1-4	Id: 1/1	

Annex 4: PCB solder side



Annex 5: PCB component side



Annex 6: PCB silkscreen