MM3D growing house controlling and monitoring unit

Technical manual

Hardware version: v190203
Software version: v0.8
User Manual version: v6.0
Issue date: 2022-03-13

Content

I. Hardware

The device is capable of measuring, controlling and monitoring the characteristics of a growing site.

1. Technical data

Supply voltage:	5V DC (powered by 230 V AC/5 V DC adapter)
Supply current:	max. 2.5 A
Isolation class:	Class II.
Mechanical size:	190 x 140 x 70 mm
IP protection:	IP 54
IK protection:	IK 03
Material of cover:	termoplaszt (ABS)
LAN:	Ethernet (RJ45)

Measured data:

value	range	resolution	accuration	note
temperature	-40...+80 °C	0.1 °C	< ±0.5 °C	Length of sensor cable: max. 20 m
humidity	0-100% RH	0.1 % RH	±2 % RH	

Programmable in- and outputs:

sign	type	note
IN #1	input	TTL level inputs with pull-up resistor, theirs active state is „L”.
IN #2	input	
IN #3	input	
IN #4	input	
OUT #1	output	NO/NC relay contact outputs. Load capacity: 250V 10A AC or 30V 10A DC. The operation of the relays can be switched off with a key switch, this status is indicated by a red LED.
OUT #2	output	
OUT #3	output	
OUT #4	output	

Programmable error lights:

sign	note
ERR #1	Red LEDs on front panel.
ERR #2	
ERR #3	
ERR #4	

2. Administration

Setting:	via SSH
Access data:	with web browser (via HTTP)

3. Description

The device is based on a Raspberry Pi 3 B + microcomputer with Raspbian operating system, which also includes software for operating the unit. No graphics system installed on it.

The device's four TTL-level inputs are equipped with pull-up resistors and have an active level of L. They can be used, for example, to check the position of air vents, doors and windows, check the functioning of the ventilation system (airflow sensor), the water pressure sensor, or the status of the motor or overcurrent protection devices with auxiliary contact.

The device has four relay contact outputs that are capable of switching to relatively high power (2.3 kW at 230V AC). The operation of the relays can be disabled by means of a front key switch; In all cases, external circuits must be provided with overcurrent protection.

There is no need to connect a keyboard or monitor to set up and operate the MM3D, and access to it is always done through SSH. Current status and measured data can be checked using a web browser.

4. Schematic and printed circuit draws

The wiring diagram of the device is shown in Annex 1, PCB draws are in Annex 3-7. You can download it as part of the complete documentation or in separate PS, PDF, SVG and KiCAD formats from the developer / manufacturer's website.

5. Terms of use

6. Look of the device

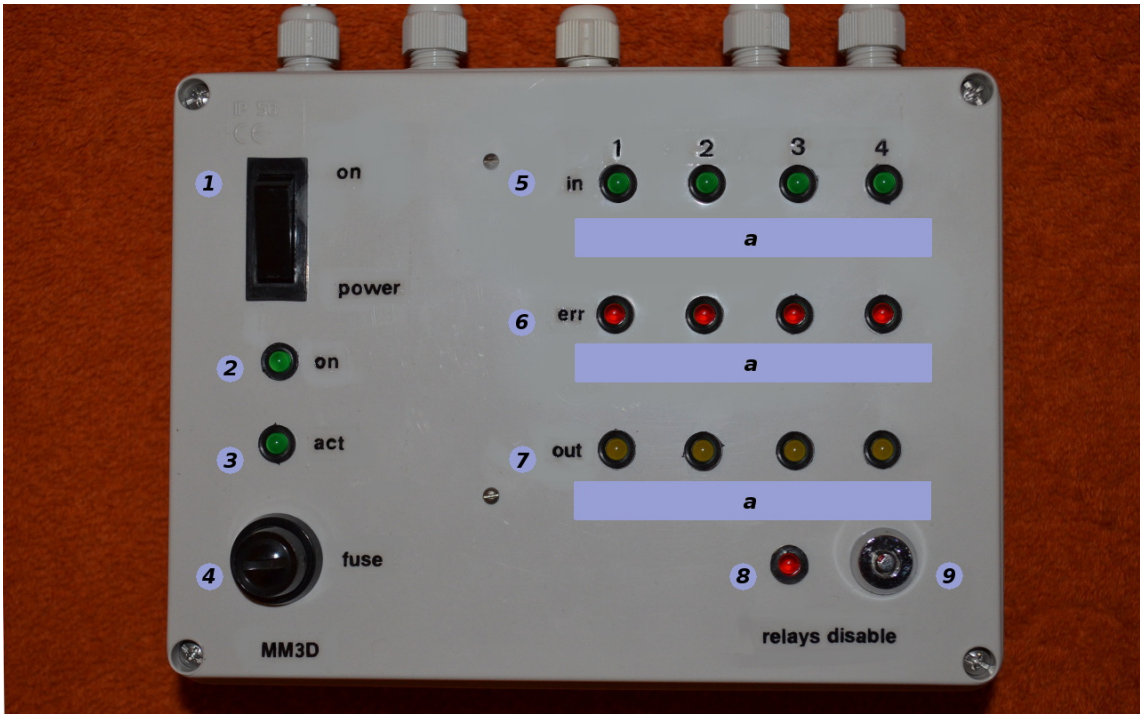


Figure 1: Front panel

a) Manuals and connectors

1: supply voltage on/off switch

2: power on light (green LED)

3: ACT light (green LED)

4: fuse of supply voltage (2,5 A F)

5: IN #1-#4 input active status lights (green LED)

6: OUT #1-#4 output active status lights (yellow LED)

7: ERR #1-#4 error lights (red LED)

8: disable output relays light (red LED)

9: disable output relays switch

a: place for sticky labels

b) Connector pinout

Input terminal (J1):

1: IN GND
2: IN #1
3: IN #2
4: IN #3
5: IN #4
6: -
7: -
8: S1 GND (external sensor GND)
9: S1 data (external sensor data)
10: S1 +5V (external sensor +5V)
11: +5 V in (power voltage input)
12: GND in (power voltage input)

Output terminal (J3):

1: NC1
2: COM1
3: NO1
4: NC2
5: COM2
6: NO2
7: NC3
8: COM3
9: NO3
10: NC4
11: COM4
12: NO4

Numbering on both connectors (terminal blocks) is in the installed position of device from top to bottom.

7. Downloadable documentation

The complete documentation of the hardware in the .tar.gz format compressed file can be downloaded from the manufacturer's website. (Refer to Chapter IV for references.)

Package's name: *mm3d-hw-190203-6.0.tar.gz*

Content:

```
mm3d-hw
|
|---cad_files                                   KiCAD files
|       |---example                             example of application
|       |       example_routing.pro                 project file
|       |       example_routing.sch                 schematic draw
|       |       README                              information
|       |       *.*                                 other files
|       |
|       |---mm3d                                MM3D unit
|               mm3d_base.pro                       base panel project file
|               mm3d_base.kicad_pcb                 base printed circuit board
|               mm3d_front.pro                      front panel project file
|               mm3d_front.kicad_pcb                front printed circuit board
|               mm3d.pro                            schematic project file
|               mm3d.sch                            schematic draw
|               *.*                                 other files
|
|---documents                                   documentation
|       mm3d-hw_en.pdf                              Technical manual
|       pcb_mm3d_base-comp.ps                       base panel component side
|       pcb_mm3d_base-silk.ps                       base panel silkscreen
|       pcb_mm3d_base-sold.ps                       base panel solder side
|       pcb_mm3d_front-silk.ps                      front panel silkscreen
|       pcb_mm3d_front-sold.ps                      front panel solder side
|       sch_example.pdf                             example schematic draw
|       sch_mm3d.pdf                                MM3D schematic draw
|
|---pictures                                    pictures
|       mm3d.jpg                                    front panel
|       pcb_mm3d_base-comp.svg                      base panel component side
|       pcb_mm3d_base-silk.svg                      base panel silkscreen
|       pcb_mm3d_base-sold.svg                      base panel solder side
|       pcb_mm3d_front-silk.svg                     front panel silkscreen
|       pcb_mm3d_front-sold.svg                     front panel solder side
|       sch_example.svg                             example schematic draw
|       sch_mm3d.svg                                schematic draw
|
|---LICENCE                                     terms of use
|---README.md                                   short description
```

II. Software

1. General description

Operation of the device is provided by Python (control), Perl (data access) and Bash (utilities) scripts.

2. Prepare

Before installing the program, you must install Raspbian OS Lite on Raspberry Pi. Remember to change the default password for the user 'pi', configure the hostname and access to the local network. For easier remote access, use a permanent IP address or configure the IP address assignment on your router.

Prepare operation system:

```
pi@raspberry$ sudo apt-get update
pi@raspberry$ sudo apt-get upgrade
pi@raspberry$ sudo apt-get install git wget
pi@raspberry$ sudo echo "deb http://www.szerafingomba.hu/deb/ ./" >> /etc/apt/sources.list
pi@raspberry$ sudo wget -q -O - http://www.szerafingomba.hu/deb/KEY.gpg | apt-key add -
pi@raspberry$ sudo apt-get update
pi@raspberry$ mkdir $HOME/download
```

3. Download

Download from homepage:

```
pi@raspberry$ cd $HOME/download
pi@raspberry$ wget http://www.szerafingomba.hu/softwares/mm3d/mm3d-sw-0.8-armhf.tar.gz
pi@raspberry$ tar -xzf mm3d-sw-0.8-armhf.tar.gz
```

Download new release from Github:

```
pi@raspberry$ cd $HOME/download
pi@raspberry$ git clone https://github.com/pozsarzs/mm3d-sw.git
```

4. Installation

```
pi@raspberry$ cd mm3d-sw
pi@raspberry$ ./prepare
pi@raspberry$ ./install
```

Install program from internet with package manager:

```
pi@raspberry$ sudo apt-get install mm3d-prepare
pi@raspberry$ mm3d-prepare
pi@raspberry$ sudo apt-get install mm3d-sw mm3d-web mm3d-eec
```

The installed and created on runtime files (important files with info and target of symbolic links):

```
/
├── etc
│   ├── cron.d
│   │   mm3d
│   ├── init.d
│   │   mm3d.sh
│   ├── rc0.d
│   │   K01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── rc2.d
│   │   S01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── rc3.d
│   │   S01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── rc4.d
│   │   S01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── rc5.d
│   │   S01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── rc6.d
│   │   K01mm3d.sh  » /etc/init.d/mm3d.sh
│   ├── systemd
│   │   └── sytem
│   │       mm3d.service
│   └── motd
├── usr
│   ├── lib
│   │   └── cgi
│   │       getdata.cgi
│   │       getenvirconf.cgi
│   │       getpage.cgi
│   └── local
│       ├── bin
│       │   mm3d.py                    daemon program
│       │   mm3d-creatediagrams        diagramok készítése
│       │   mm3d-editenvirconf         edit environment parameters
│       │   mm3d-editenvirconf.bin     edit environment parameters
│       │   mm3d-editmainconf          edit program configuration
│       │   mm3d-getsnapshots          kameraképek letöltése
│       │   mm3d-hwtest.py             hardver check
│       │   mm3d-maintainlog           log maintaining
│       │   mm3d-override              output manual control
│       │   mm3d-startdaemon           start daemon
│       │   mm3d-statusofdaemon        view status of daemon
│       │   mm3d-stopdaemon            stop daemon
│       │   mm3d-updatestartpage       update startpage
│       │   mm3d-viewlog               view log
│       │   mm3d-webpage               view own webpage
│       ├── etc
│       │   └── mm3d
│       │       mm3d.ini               program configuration
│       │       envir.ini              environment parameters
│       └── share
│           ├── doc
│           │   └── mm3d
│           │       AUTHORS             author
│           │       ChangeLog           change log
│           │       control.txt         important variables
│           │       COPYING             licence
│           │       copyright           copyright information
│           │       gpioports.txt       GPIO port default pinout
```

```
│                   │          INSTALL                 installation instruction
│                   │          README                  description
│                   │          VERSION                 version
│                   ├──locale
│                   │   └──??
│                   │          mm3d.msg
│                   ├──man
│                   │   └──man1                       manual pages
│                   │     getdata.cgi.7.gz
│                   │     getenvirconf.cgi.7.gz
│                   │     getpage.cgi.7.gz
│                   │     mm3d.py.8.gz
│                   │     mm3d-creatediagrams.1.gz
│                   │     mm3d-editenvirconf.1.gz
│                   │     mm3d-editmainconf.1.gz
│                   │     mm3d-getsnapshots.1.gz
│                   │     mm3d-hwtest.py.1.gz
│                   │     mm3d-maintainlog.1.gz
│                   │     mm3d-override.1.gz
│                   │     mm3d-startdaemon.1.gz
│                   │     mm3d-statusofdaemon.1.gz
│                   │     mm3d-stopdaemon.1.gz
│                   │     mm3d-updatestartpage.1.gz
│                   │     mm3d-viewlog.1.gz
│                   │     mm3d-webpage.1.gz
│                   └──mm3d
│                         footer_??.html
│                         header_??.html
└──var
   ├──local
   │  ├──lib
   │  │     out1
   │  │     out2
   │  │     out3
   │  │     out4
   │  ├──lock
   │  │     mm3d.lock
   │  │
   │  └──log
   │        mm3d.bak
   │        mm3d.log
   │        debug-*.log                              debug log
   ├──run
   │    mm3d.pid
   └──www
      └──html
         ├──pics
         │    ants.jpg
         │    camera1.jpg
         │    camera2.jpg
         │    dark.png
         │    green.png
         │    humidity.png
         │    mm3d-creatediagrams.tmp
         │    red.png
         │    szerafin.ico
         │    temperature.png
         │    yellow.png
         styles.css
         index.html
         szerafin.ico
```

It that is installed with the package manager is placed in the /usr directory instead of /usr/local.

3. Settings

Edit main settings:

```
mm3d@raspberry$ mm3d-editmainconf
```

The shellscript stops the service and opens the mm3d.ini file in the default editor. After saving the file, it refreshes the homepage and launches daemont. Content of configuration file:

```
; +-------------------------------------------------------------------------+
; | MM3D v0.6 * Growing house controlling and remote monitoring system      |
; | Copyright (C) 2018-2022 Pozsár Zsolt <pozsar.zsolt@szerafingomba.hu>    |
; | mm3d.ini                                                                |
; | Main settings                                                           |
; +-------------------------------------------------------------------------+

[user]
; User's data
usr_nam=User's name                             ; user's name
usr_uid=00000000                                ; user's ID
usr_dt1=User's city                             ; more data (eg. country)
usr_dt2=User's address                          ; more data (eg. address)
usr_dt3=Growing house number                    ; more data (eg. growing house)

[names]
; Name of error lights and ports
nam_err1=unnamed #1                             ; name of error lights
nam_err2=unnamed #2
nam_err3=unnamed #3
nam_err4=unnamed #4
nam_in1=unnamed #1                              ; name of inputs
nam_in2=unnamed #2
nam_in3=unnamed #3
nam_in4=unnamed #4
nam_out1=unnamed #1                             ; name of outputs
nam_out2=unnamed #2
nam_out3=unnamed #3
nam_out4=unnamed #4

[ports]
; GPIO port number of error lights and ports
prt_act=24
prt_err1=14
prt_err2=15
prt_err3=18
prt_err4=23
prt_in1=2
prt_in2=3
prt_in3=4
prt_in4=17
prt_sens=11
prt_out1=27
prt_out2=22
prt_out3=10
prt_out4=9

[sensors]
; Type of temperature and humidity sensor
;sensor_type=AM2302
;sensor_type=DHT11
sensor_type=DHT22
```

```
[directories]
; Directories of program
dir_htm=/var/www/html/                          ; webserver's directory
dir_lck=/var/local/lock/                        ; lock file's directory
dir_log=/var/local/log/                         ; logfile's directory
dir_msg=/usr/local/share/locale/                ; message files' directory
dir_shr=/usr/local/share/mm3d/                  ; other files' directory
dir_tmp=/var/tmp/                               ; place of temporary files
dir_var=/var/local/lib/mm3d/                    ; workfiles's directory

[openweathermap.org]                            ;login data
api_key=00000000000000000000000000000000
base_url=http://api.openweathermap.org/data/2.5/weather?
city_name=Tiszafoldvar

[ipcameras]                                     ; Show IP cameras' picture
cam_show=1
cam1_enable=0
cam1_jpglink=http://camera1-th01.lan/snapshot.cgi?user=username&pwd=password&count=0
cam2_enable=0
cam2_jpglink=http://camera2-th01.lan/snapshot.cgi?user=username&pwd=password&count=0

[others]
; Language of webpage
lng=en
;lng=...
; Storing time of log
day_log=7
; Enable/disable verbose debug log
dbg_log=0
; Number of log lines on web interface
web_lines=30                                    ; Showed log lines
```

Set growing environment parameters:

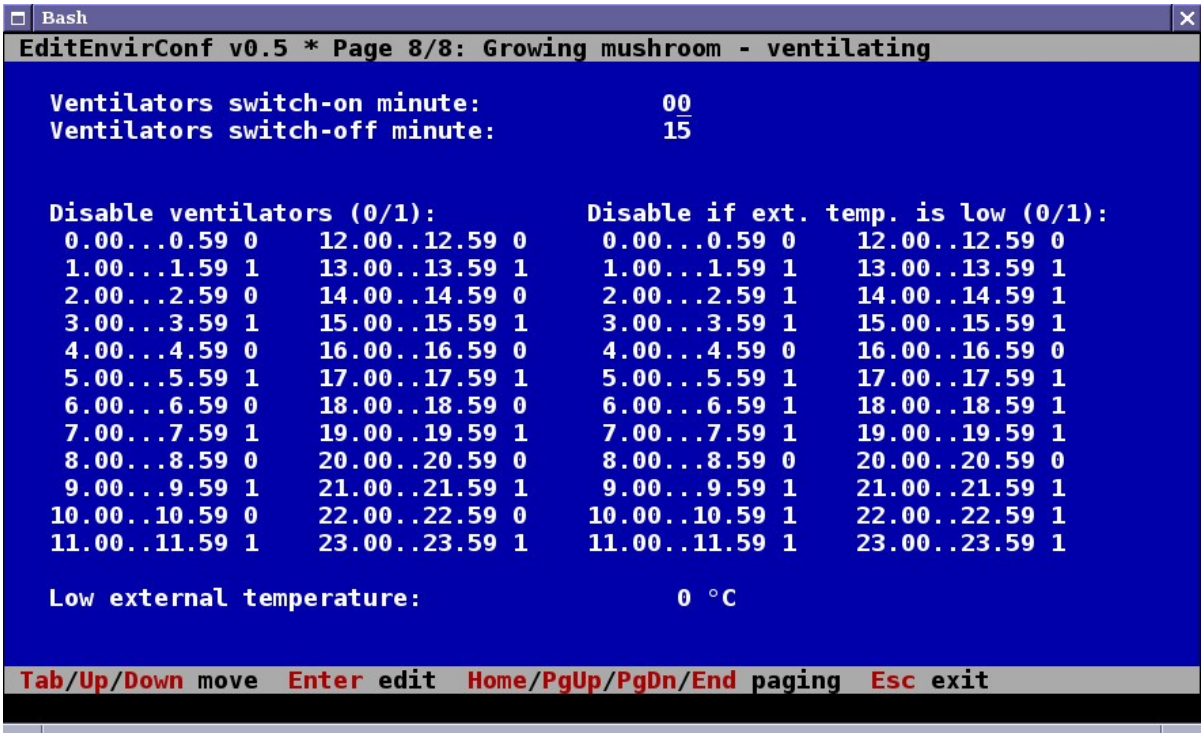


Figure 2: mm3d-editenvirconf

```
mm3d@raspberry$ mm3d-editenvirconf
```

The shell program starts the setup program and then resumes the service after saving and exiting.

6. Using the device

The device works automatically after installation and does not require human intervention. Checking and configuring your operation is only possible remotely via a network.

The device can be configured via SSH, the environmental characteristics can be set via SSH or with XMMEEC program. In the second case, a key-based login is required.

The set environment characteristic, the current status and the measured data can be checked with a web browser or MM3DRead program. Many data can be queried over HTTP without a browser. See *getdata.cgi.7.gz* manual page for details.

7. 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 IV for references.)

8. Downloadable software package

The package can be downloaded from the manufacturer's website in a .tar.gz compressed file. (Refer to Chapter IV for references.) Name of current package: *mm3d-sw-0.8-armhf.tar.gz*

Content of package:

```
mm3d-sw
├──binary                  binary files
├──documents               documentation
├──manuals                 manual pages
├──messages                translated webpage text
├──packaging               files for make deb packages
├──programs                programs (Python)
├──scripts                 programs (Bash)
├──settings                settings
├──source                  source code
├──webpage                 components of webpage
├──install                 installer script
├──prepare                 script for prepare OS
├──uninstall               uninstaller script
├──LICENCE                 terms of use
└──README.md               short description
```

III. Example of application

The example illustrates the co-operation of the analog controllers MM1A and MM2A. The operation of the growing house requires controlled lighting and ventilation, heating and humidification. The wiring of the house is in annex 2.

Input and output function:

sign	function	note
Inputs		
IN #1	-	
IN #2	water pressure sensor	low pressure: opened contacts
IN #3	operation mode switch	growing mushroom: opened contacts
IN #4	-	
Outputs		
OUT #1	Humidifying	magnetic valve with 24V AC solenoid
OUT #2	Lighting	fluorescent lamps
OUT #3	Ventilation	
OUT #4	Heating	electrical heaters
Error lights		
ERR #1	Humidity	Bad humidity.
ERR #2	Low water pressure	Pressure of the incoming water is low for the operation of the humidifier system.
ERR #3	Wrong values-	Wrong measured values.
ERR #4	Temperature	Bad temperature.

IV. Related links

1. Hardware

Full documentation	http://www.szerafingomba.hu/equipments/mm3d/mm3d-hw-190203-6.0.tar.gz
Github	https://github.com/pozsarzs/mm3d-hw.git
Technical manual	http://www.szerafingomba.hu/equipments/mm3d/technical-manual-190203-6.0-en.pdf

Schematic draws:

Example (KiCAD)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d-example.tar.gz
Example (PDF)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d-example.pdf
Example (SVG)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d-example.svg
MM3D (KiCAD)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d.tar.gz
MM3D (PDF)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d.pdf
MM3D (SVG)	http://www.szerafingomba.hu/equipments/mm3d/sch_mm3d.svg

Printed circuit boards:

MM3D base (PS)	http://www.szerafingomba.hu/equipments/mm3d/pcb_mm3d_base-ps.tar.gz
MM3D base (SVG)	http://www.szerafingomba.hu/equipments/mm3d/pcb_mm3d_base-svg.tar.gz
MM3D front (PS)	http://www.szerafingomba.hu/equipments/mm3d/pcb_mm3d_front-ps.tar.gz
MM3D front (SVG)	http://www.szerafingomba.hu/equipments/mm3d/pcb_mm3d_front-svg.tar.gz

2. Software

Software package	http://www.szerafingomba.hu/softwares/mm3d/mm3d-sw-0.8-armhf.tar.gz
Github	http://github.com/pozsarzs/mm3d-sw.git

3. Terms of use

CC-BY-NC-4.0	https://creativecommons.org/licenses/by-nc/4.0/legalcode
CC-BY-NC-4.0	https://creativecommons.org/licenses/by-nc/4.0/
EUPL v1.2	https://eupl.eu/1.2/en/

4. Developer and manufacturer

Homepage	https://www.szerafingomba.hu
E-mail	info@szerafingomba.hu

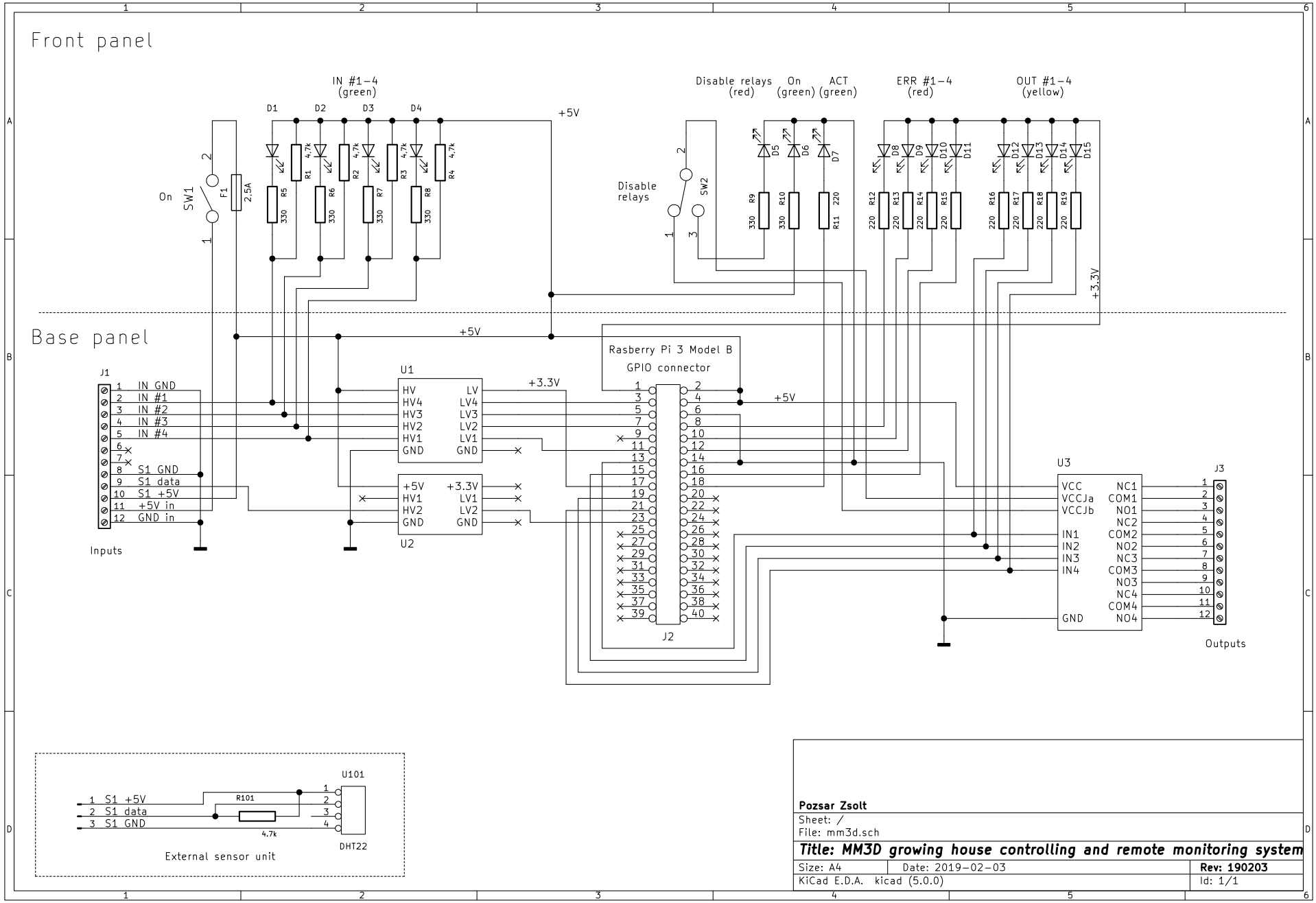
V. Annexes

1. Schematic draws

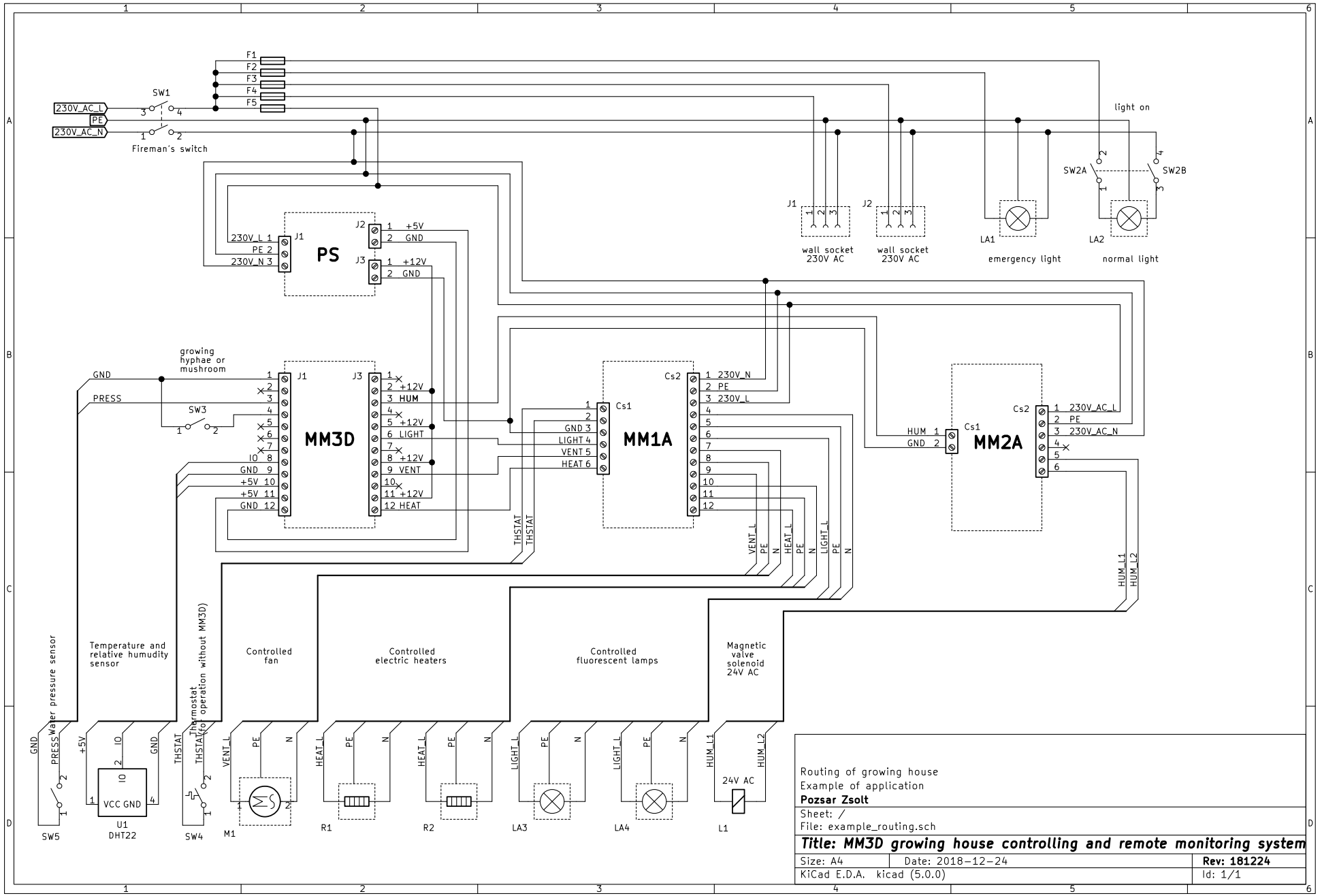
1. Schematic of MM3D
2. Example of application

2. Printed circuit boards

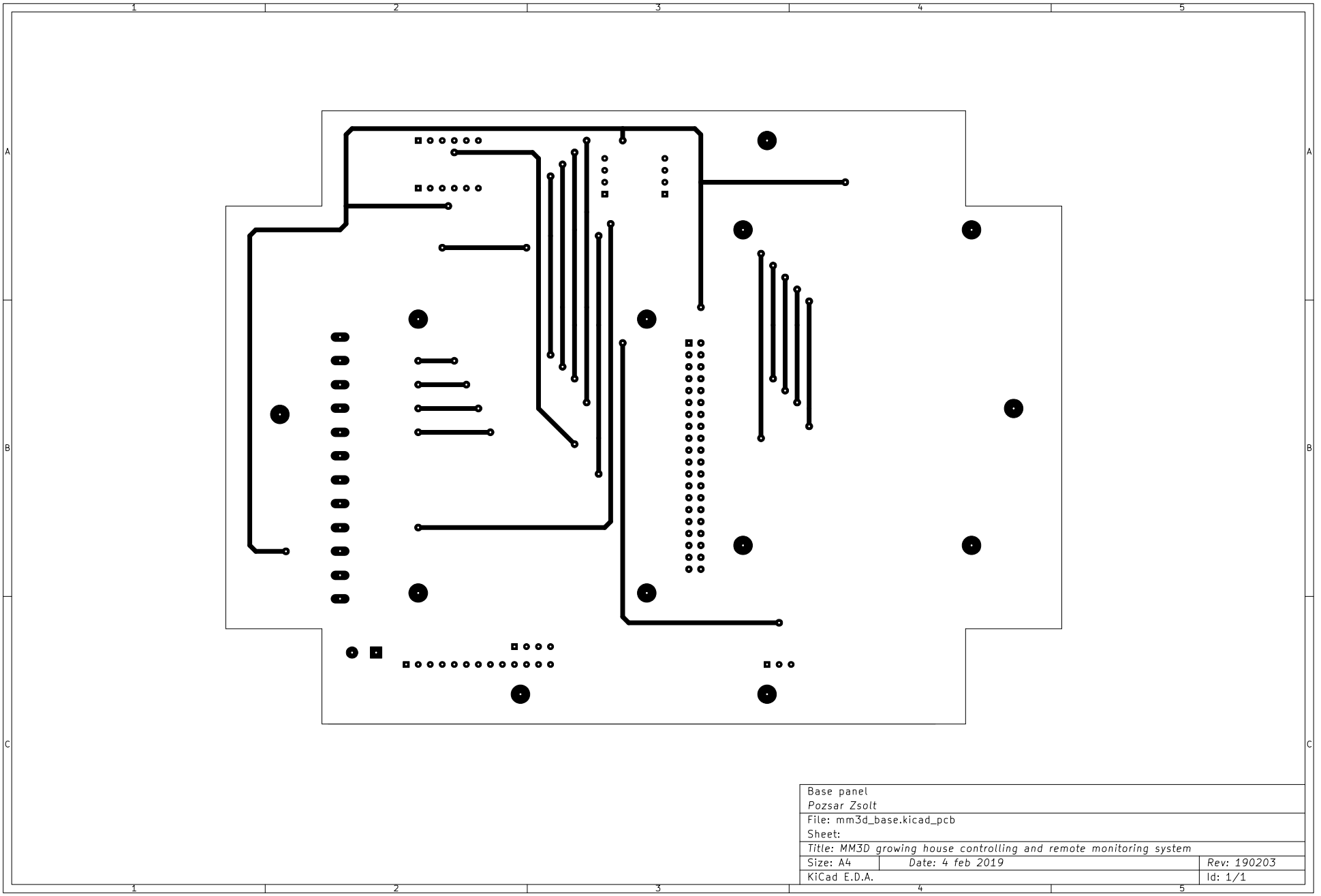
3. Base panel component side
4. Base panel solder side
5. Base panel silkscreen
6. Front panel component side
7. Front panel silkscreen



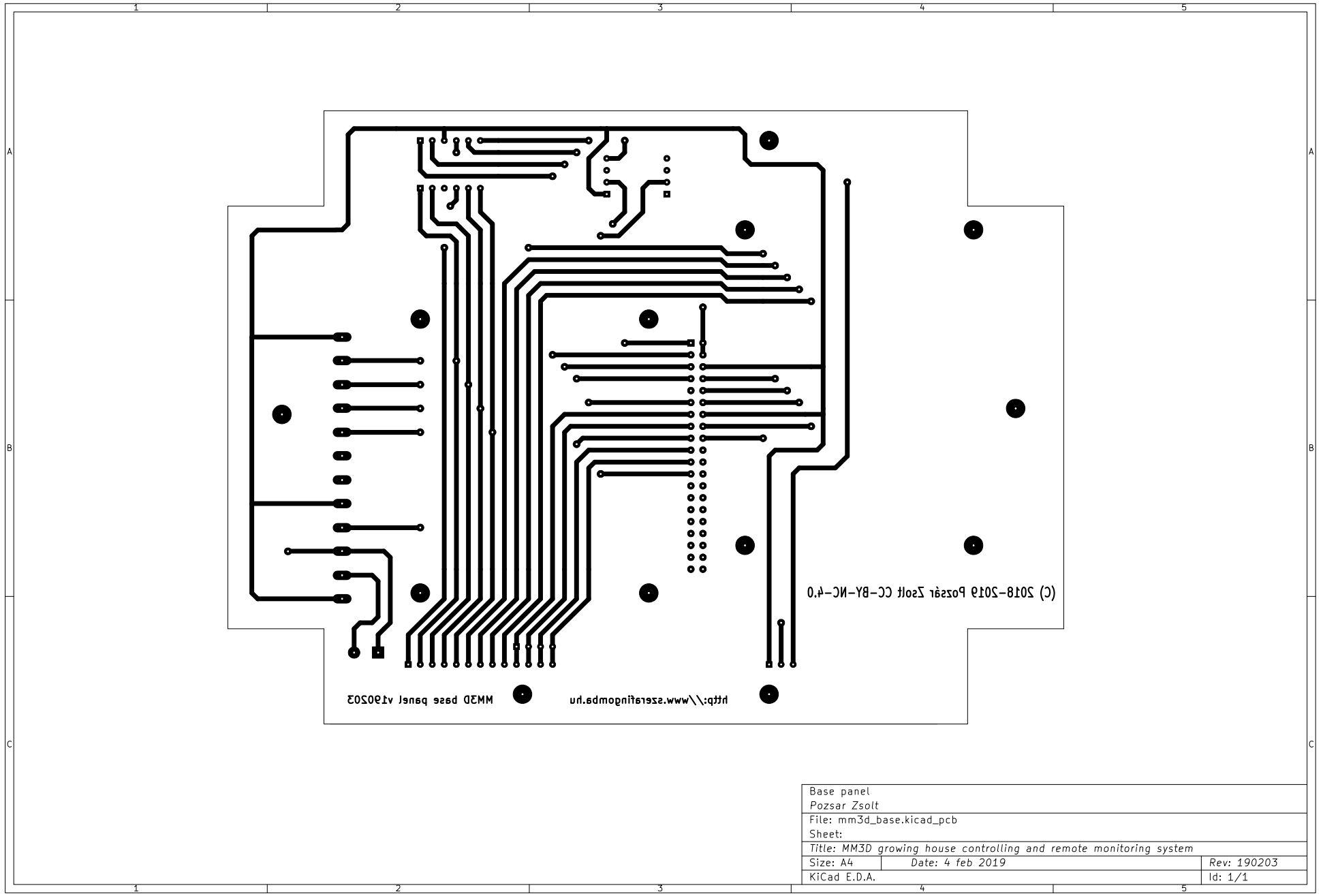
Annex 1: Schematic of MM3D



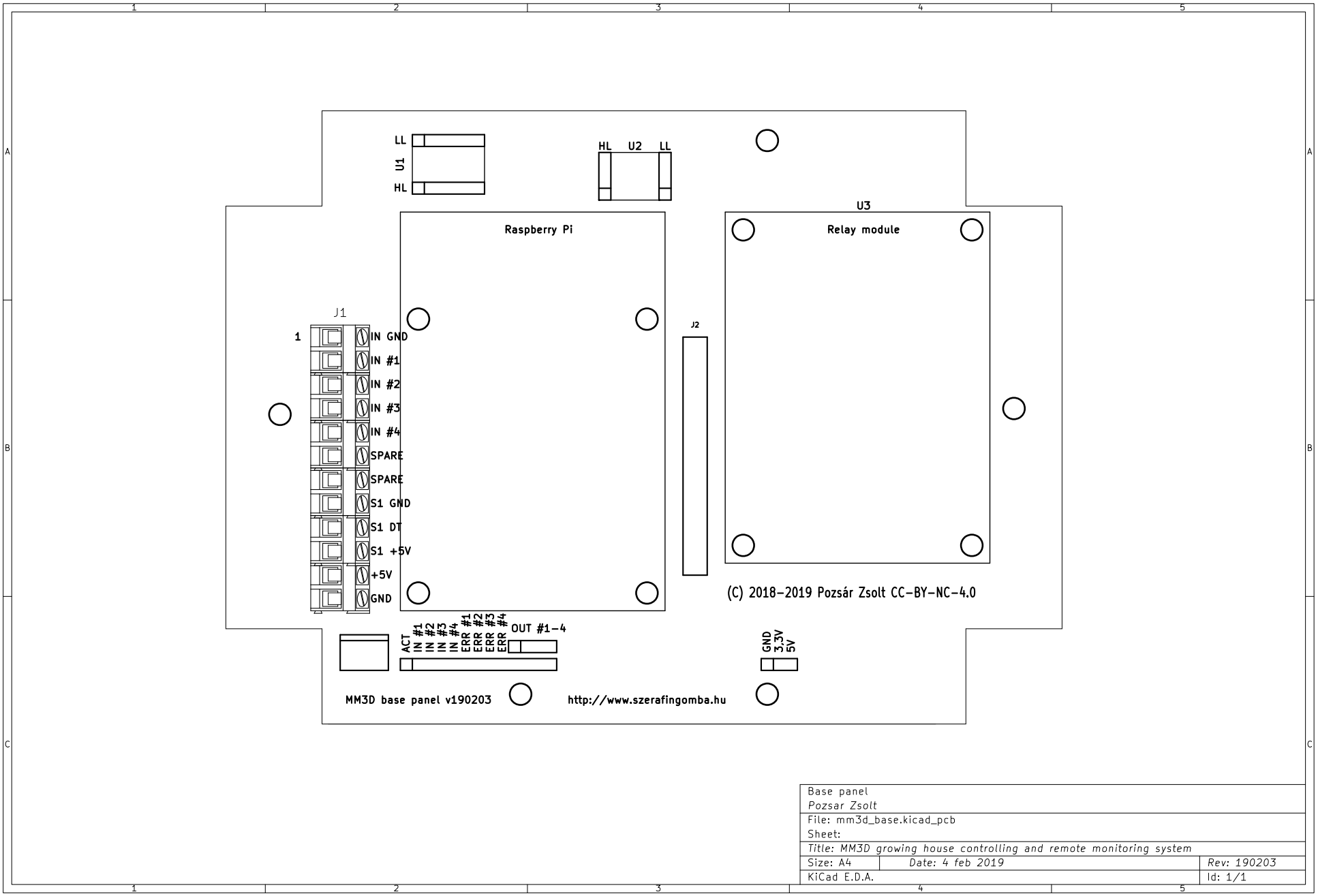
Annex 2: Example of application



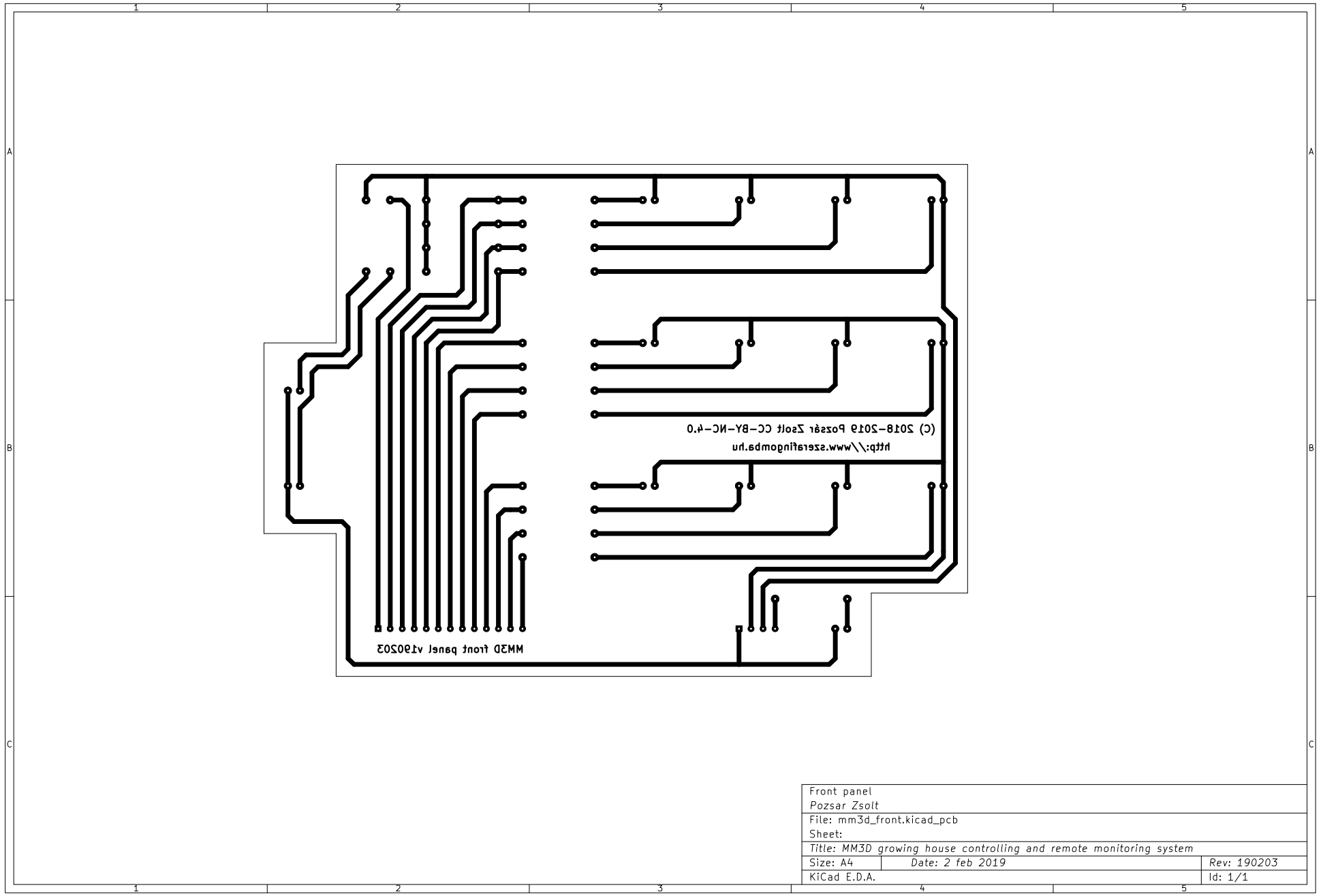
Annex 3: Base panel component side



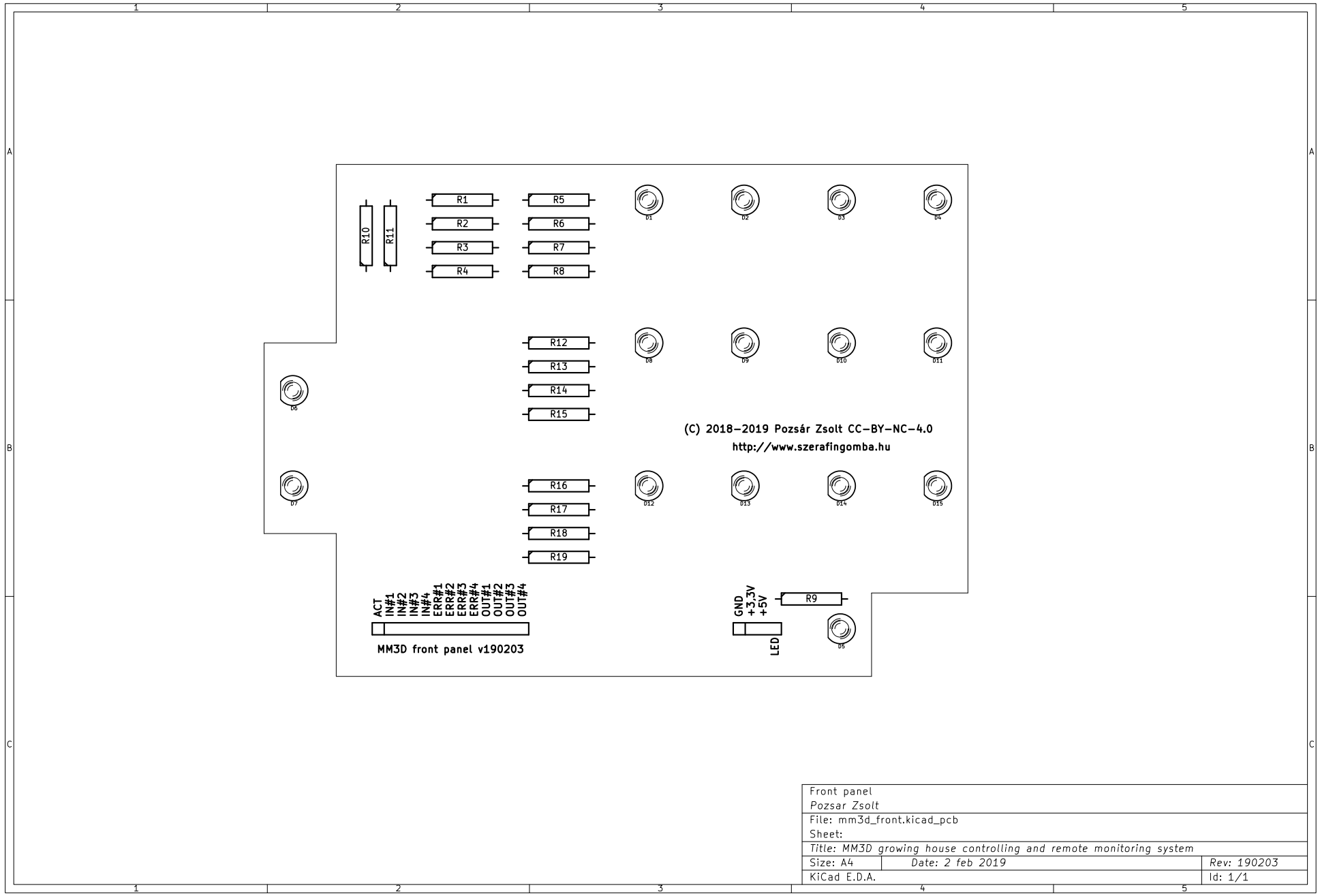
Annex 4: Base panel solder side



Annex 5: Base panel silkscreen



Annex 6: Front panel solder side



Annex 7: Front panel silkscreen