

Installation and configuration manual

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Copyright and third-party information as required

Document Revisions

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29/02/2016	1.0	Initial Draft

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1 SmartPID SPC1000 overview

1.1 Scope and Purpose

The purpose of this document is to describe in detail the installation and configuration process of the SPC1000 smartPID controller

1.2 SmartPID technical characteristics

The below table summarize the technical characteristic of SmartPID

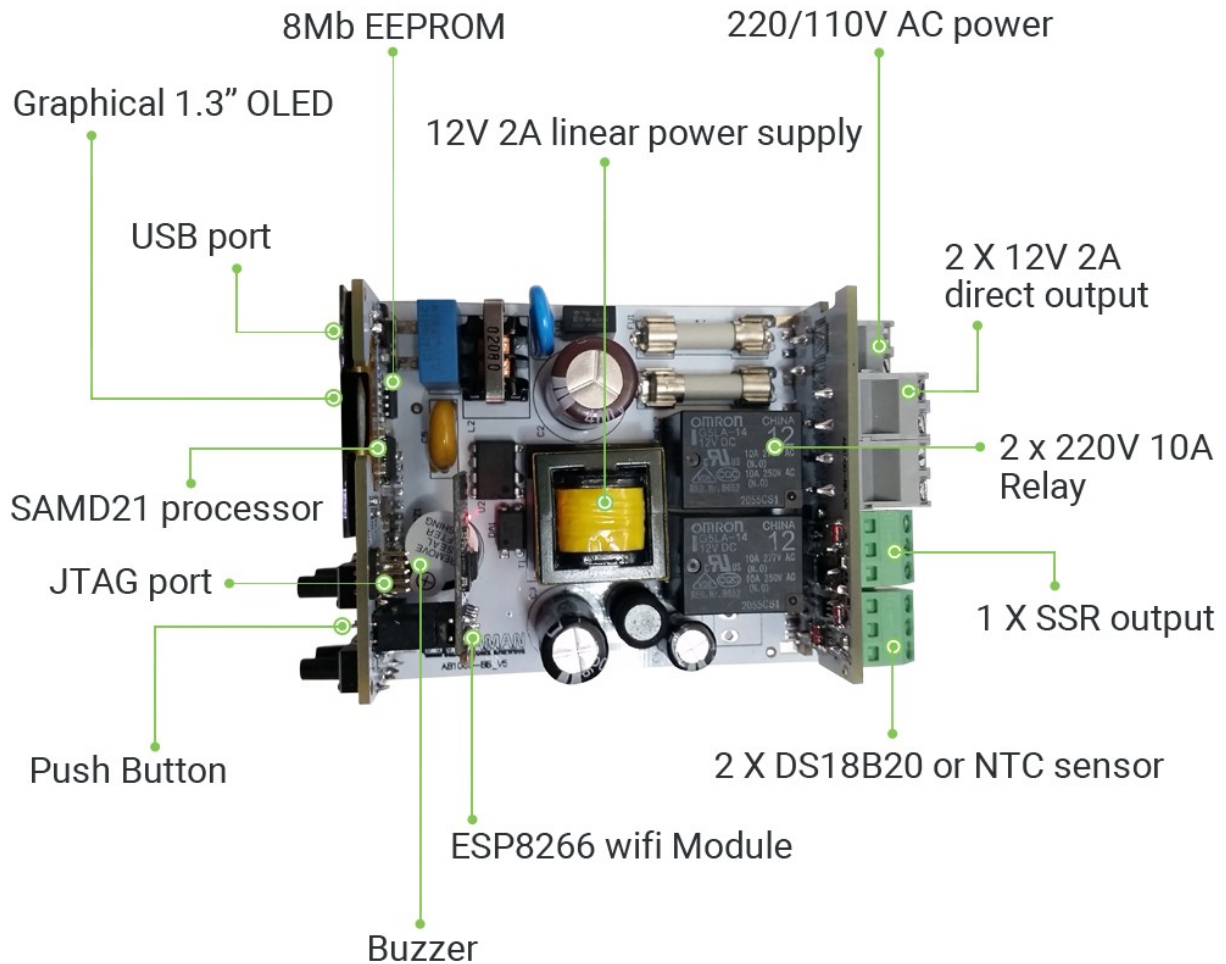
FEATURE	SmartPID SPC1000
Control channel	2
Control mode	Heating/Cooling/Thermostatic
PID alghoritm	Y
ON/OFF algorithm	Y
PID autotune	under development
NTC sensor	2
DS18B20 digital sensor	2
Sensor calibration	Y
Accuracy	0.125C (DS18B20)
Resolution	0.1C
Temperature range	-55C+125C (DS18B20)
250VAC/10A Relay Output	2
SSR Output (PWM)	1
12V 2A direct drive output	2
220v/110v AC power	Y
Box measurement	DIN 36x72x75
OLED graphical display	1,3"
USB port	Y
I2C Expansion port	Grove I2C port (3v3)
PC/Web configuration	Y

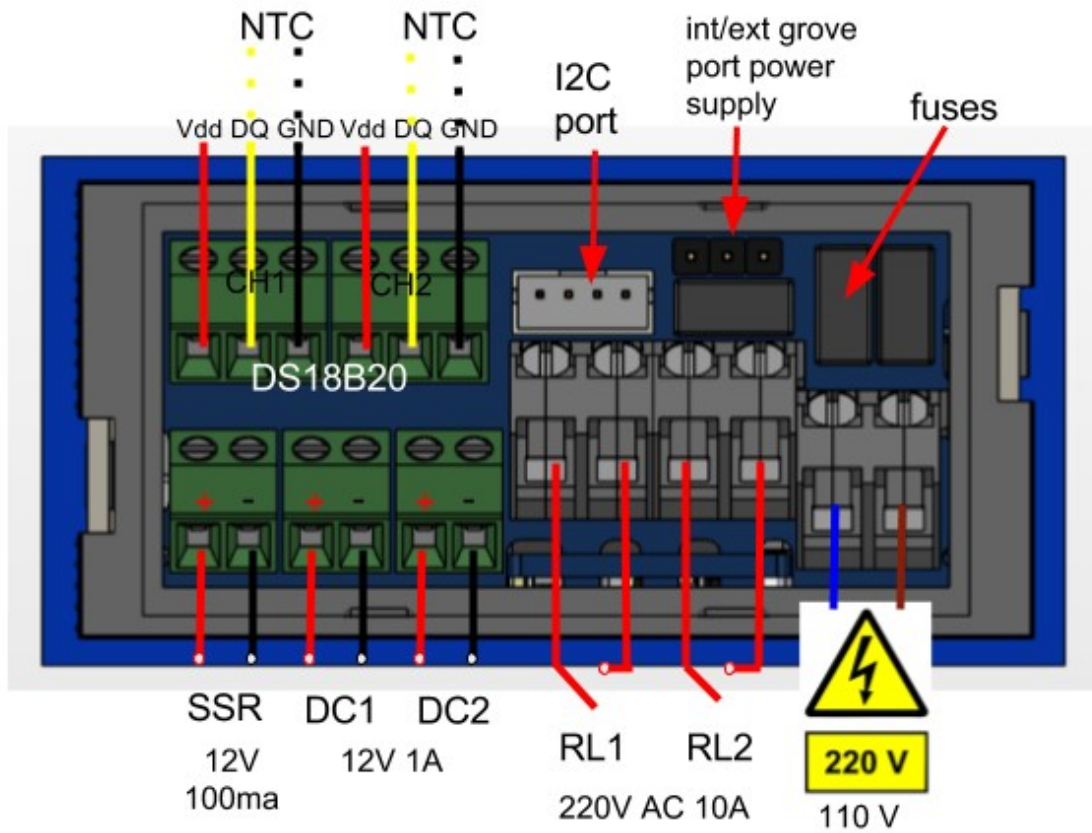
Data logging (USB / WiFi)	8Mb
WiFi Connection	Y
Remote management/configuration	Y
Automation process control	Y
Multiple application support	Y
Arduino compatible	Y

1.3 SmartPID HW description

SmartPID is constituted by 3 main boards assembled together and inserted in a DIN small box

On the front panel you have the 1.3" OLED graphical display , the push buttons for interactions and the USB port for data logging/FW upgrade. On the back panel are located the terminal block for the temperature probe sensors , the relay output, the 12V output, the I2C expansion port as well the 220/110V AC power input





The schema report the connections of all terminal blocks and connectors

the 3 ports input connectors can be used either for one wire bus with DS18B20 temperature sensor (no parasitic resistor is needed) or for 10K NTC sensors

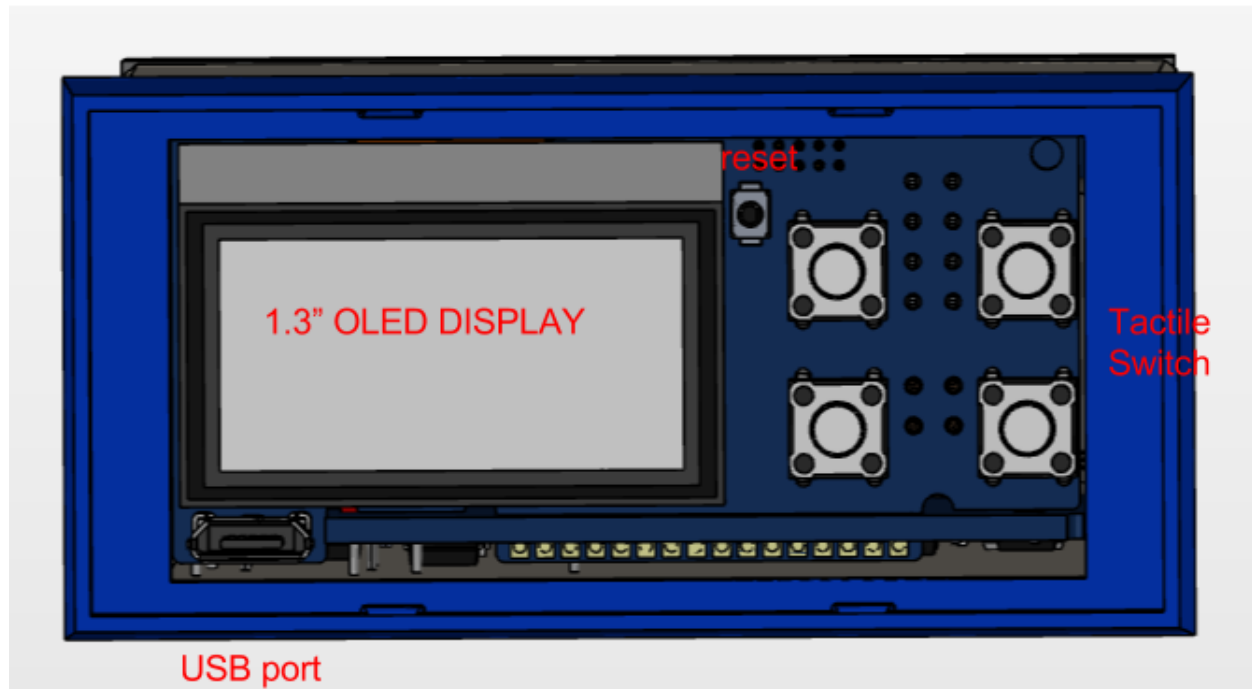
The I2C port has a pinout compatible with **grove** bus with 3V3 poer supply selectable

The Grove I2C connector has the standard layout. Pin 1 is the SCL signal and Pin 2 is the SDA signal. Power and Ground are the same as the other connectors.

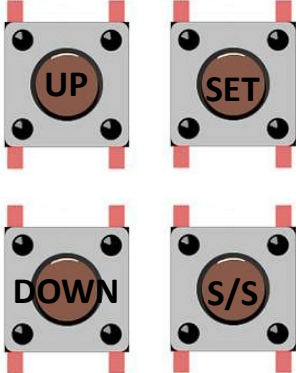
pin1	I2C Clock
pin2	I2C Data
pin3	Power for Grove Module, 3.3V
pin4	Ground

There are many types of I2C Grove sensors available. Most are 5V/3.3V devices, but there are a few that are only 3.3V or 5.0V. You need to check the specifications.

for further details see http://wiki.seeed.cc/Grove_System/



The front board 4 tactile switch that are used for multiple functions

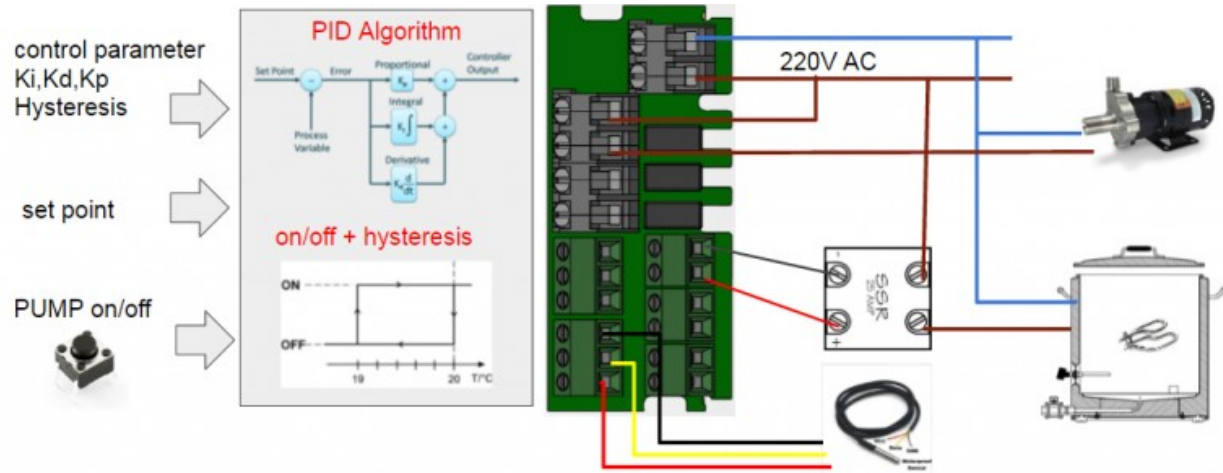
	<ul style="list-style-type: none"> a) UP/DOWN <ul style="list-style-type: none"> a. Scroll in configuration menu b. Increase decrease temperature value c. Scroll in value in configuration menu a) SET <ul style="list-style-type: none"> d. Select/enter a specific menu e. Select/confirm a specific value f. Confirm action upon prompt request b) Start/Stop <ul style="list-style-type: none"> g. Start process h. Stop Process i. log press exit from the current menu
---	--

2 SmartPID integration

Via HW set up configuration SmartPID can be adapted to mange different applications, below some example to illustrate the flexibility and multiple set up possible

Single channel – PID (on/off) control mode – heating + pump

SmartPID reads temperature from 1 probe and drive the heating element in order to get the setup temperature



Possible heating output configurations

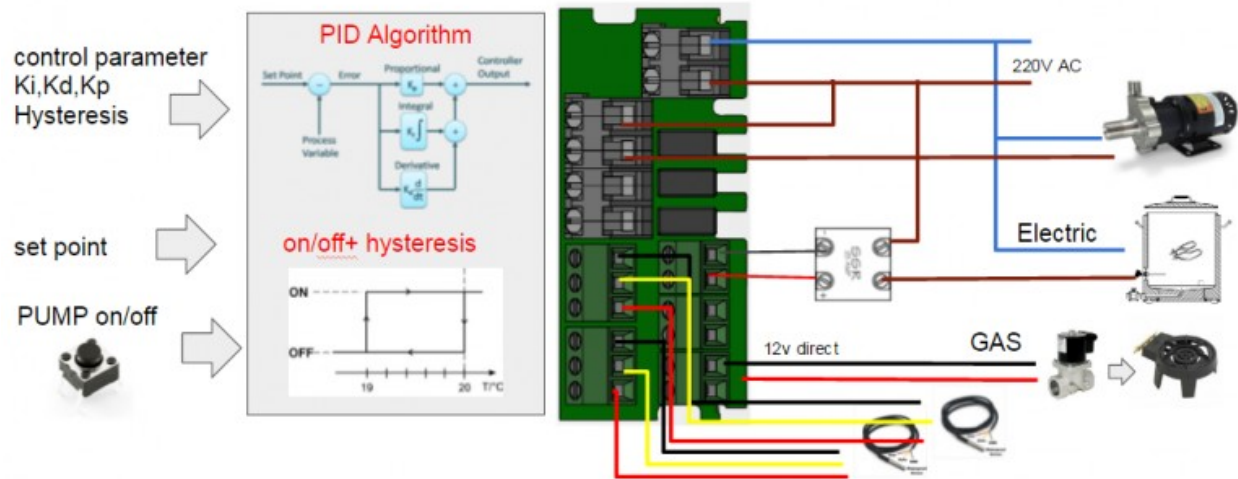
- SSR for electric heating [PID+PWM control algorithm]
- 220V AC relay for electric heating [ON/OFF algorithm]
- Direct solenoid valve drive for GAS heating [ON/OFF algorithm]

Manually drive the PUMP (soft switch) with tow possible configurations

- 220V AC realy pump drive
- 12V DC direct pump drive

DUAL channel – PID (on/off) control mode – heating (gas or electric)

SmartPID reads temperature from 2 probe and drive 2 heating element interdependently in order to get 2 different set up temperature



Possible heating output configurations

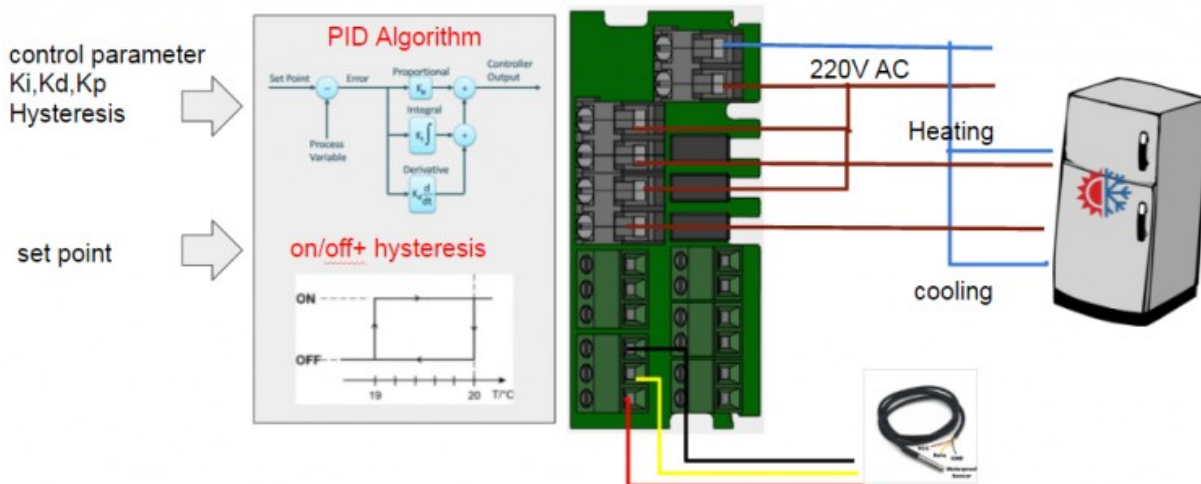
- 1 x SSR for electric heating [PID+PWM control algorithm]
- 1 x 12V direct solenoid valve drive for GAS heating [ON/OFF algorithm]

Manually drive the PUMP (soft switch) with tow possible configurations

- 220V AC realy pump drive
- 12V DC direct pump drive

DUAL channel – ON/OFF control mode – thermostatic

SmartPID reads temperature from 1 probe and drive one heating element and one cooling element in order to keep temperature stable (fermentation chamber)



Possible heating output configurations

- 220V AC relay for electric heating [ON/OFF algorithm]
- 220V AC relay for electric heating [ON/OFF control algorithm]

3 SmartPID wifi configuration

SmartPID has an internal wifi module that allow the application to communicate to an external server and push all log data and process parameter.

Via the smartphone dedicated app it's possible to

1. perform the initial setup and configure once the relevant parameters
2. retrieve and visualize the log data from the cloud server
3. Modify from remote the set point

the SmartPID architecture is client server and in order to mange and store data in the cloud public **thingspeak** service is used



For mor details on thingspeak features see <https://thingspeak.com>

Each smartPID should be associated to a thingspeak channel and is uniquely identified by a channel ID. Each thingspeak account can have multiple channels and so mange multiple smartPID

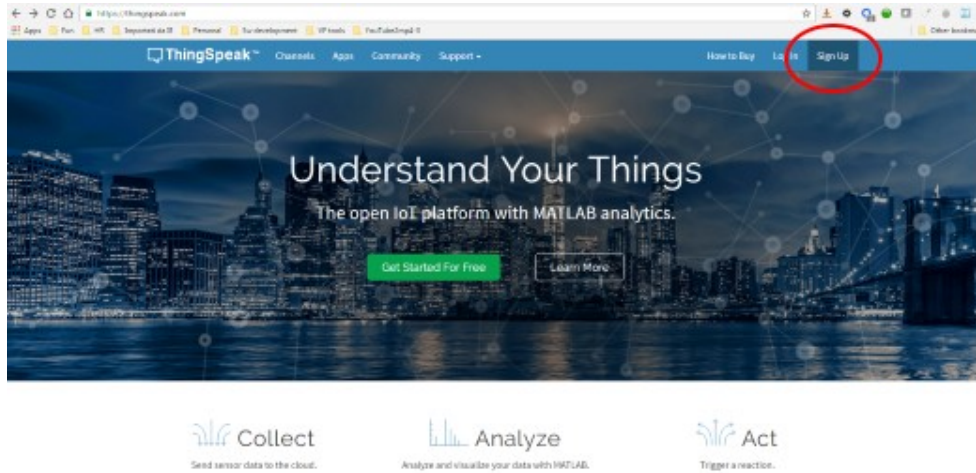
In order to complete the wifi configuration and channel associations 4 mains logical step must be executed

1. Create a thingspeak account and create the channel
2. Create a smartPID account using the smartphone app and associate to the thinsgspeak account
3. Activate wifi on smartPID and connect the smartphone (or laptop) with direct connection
4. Configure the smartPID via smartphone app (or web browser) updating following values
 - a) Wifi SSID and password
 - b) Channel ID to associate to the smartPID
 - c) web server port / baud rate [can be left to default value]

for step by step procure see below paragraph

3.1 Thingspeak server configuration

1. Connect to <https://thingspeak.com/>
2. Select Sign Up:



3. Select Create account and fill the form

Log in to your MathWorks Account

[Forgot your password?](#)

➔

Create MathWorks Account

 ⓘ
 ⓘ
 ▼

By clicking continue, you agree to our privacy policy

Create Account

Log In

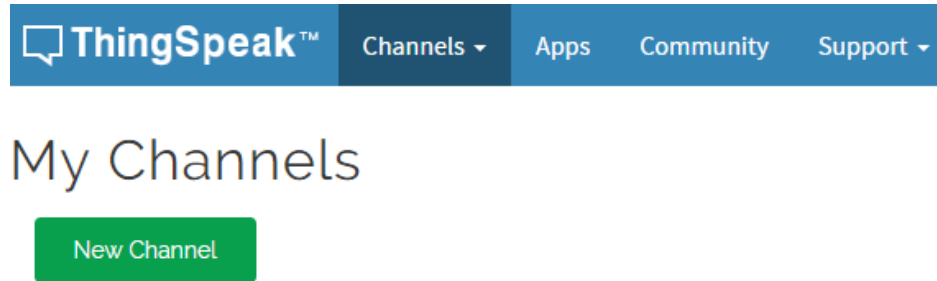
Cancel

Continue

4. Verify Your account: go to your inbox and click the link in the received email
5. Press Continue and Sign in with your credentials and agree to terms.

Now you need to create a channel to feed the data from SmartPID, each channel can be public or private depending on your needs

6. Press on New Channel:



7. Fill the form for channel definition

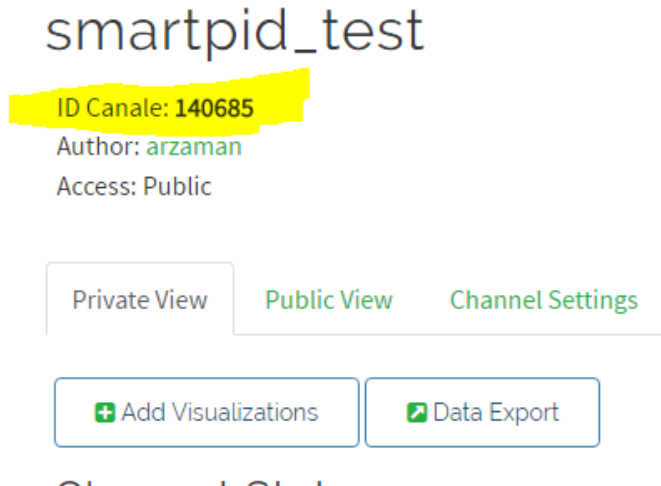
Note that **Name** and **Description** can be filled as you prefer, the other fields **must be filled as suggested , same order and label**

All the other fields can be left empty.

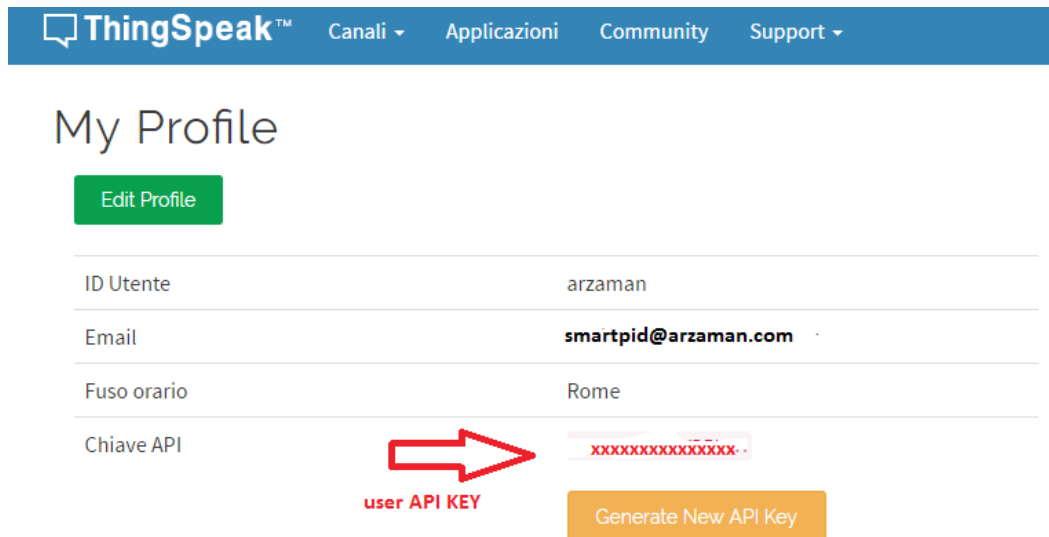
New Channel

Name	<input type="text" value="Whatever you want"/>
Description	<input type="text" value="Whatever you want"/>
Field 1	<input type="text" value="sample time"/> <input checked="" type="checkbox"/>
Field 2	<input type="text" value="channel"/> <input checked="" type="checkbox"/>
Field 3	<input type="text" value="control mode"/> <input checked="" type="checkbox"/>
Field 4	<input type="text" value="heating cooling mode"/> <input checked="" type="checkbox"/>
Field 5	<input type="text" value="set point"/> <input checked="" type="checkbox"/>
Field 6	<input type="text" value="current temperature"/> <input checked="" type="checkbox"/>
Field 7	<input type="text" value="PWM out"/> <input checked="" type="checkbox"/>
Field 8	<input type="text" value="PID direction"/> <input checked="" type="checkbox"/>

8. Press Save Channel and take note of your channel ID that should be uniquely assigned to your smartPID



9. Select ACCOUNT→ my profile and take note of the **USER API KEY**



the API key is the way smartPID can connect to your channel in a secure and trusted way and you have to insert it in the configuration phase via the smartphone app

3.2 WiFi Configuration

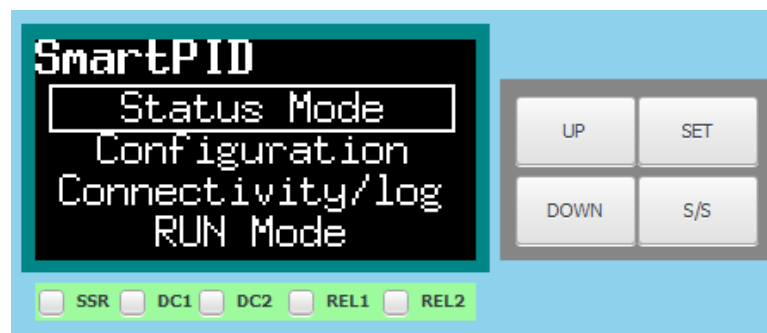
In this paragraph it is explained how to configure the SmartPID WiFi connection using the internal ESP8266 WiFi module

In order to input in an easy way all the relevant data (SSID, WIFI PWD , user API KEY etc...) you can use your smartphone and a dedicated app [android 5.0 or greater] that connects directly to the SmartPID or in alternative a laptop PC using a browser

SmartPID configuration

The wifi module can be configured in various mode 0=off, 1= Client, 2= AP, 3= Auto this mode will be used for the parameter configuration over wifi

1. Take your smartPID device and take familiarity with the interface:



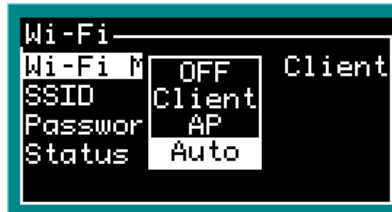
2. Select Connectivity/log on the smartPID device and press **SET** (upper right button):



3. Select Wi-Fi and press the **SET** button:



4. Set Wi-Fi mode to Auto and press the **SET** button
in this configuration the wifi module broadcast a wifi signal SPC1000_xxxxxxx



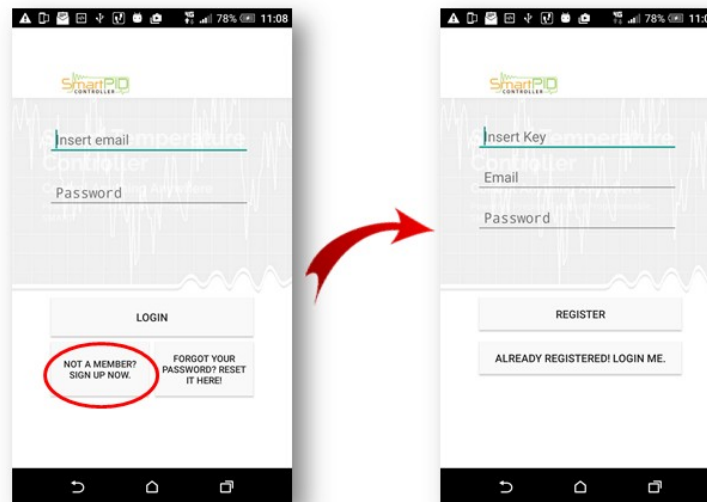
Smartphone APP configuration

5. Go to the Play Store and install SmartPID app on your Android smartphone

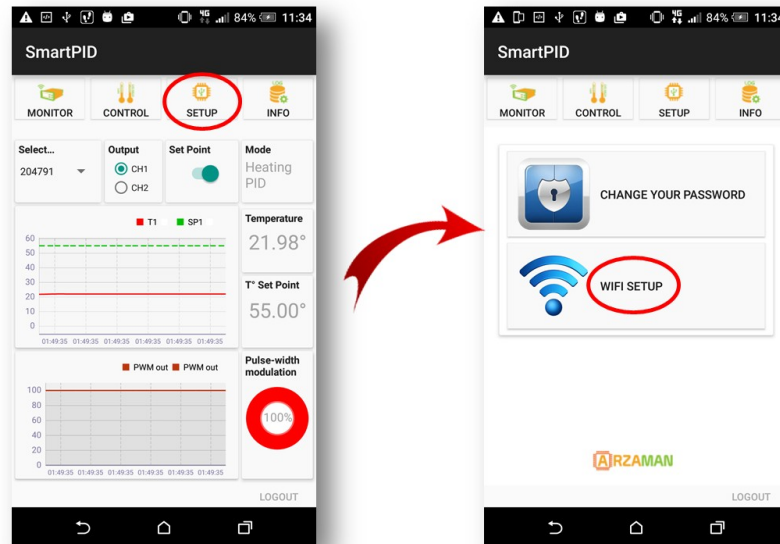
[the APK is still not released on the googl play and should be installed manually]



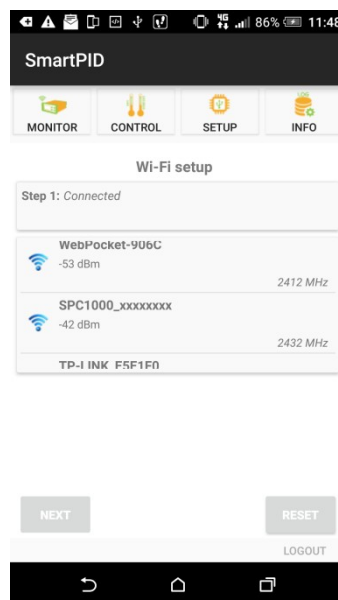
6. Launch the app and sign up in order to link the app with the thingspeak profile
You should register your SmartPID account using a valid email address , your password and insert the **USER API KEY** that you note down from your thingspeak profile [see chapter 3.2 , step 9]



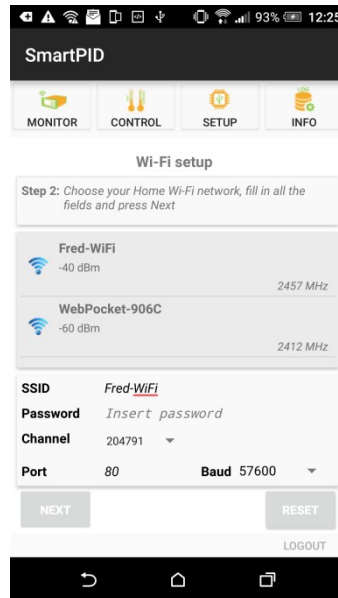
7. Choose in the App SETUP-> Wi-Fi setup



8. The app scans all available WiFi networks , keep you smartphone close to SmartPID. Choose SPC1000_xxxxxxxx network (xxxxxxxx is the serial number of your smartPID) and insert the following default password: **smartpid!** and press the **Next** button:



9. Choose your home Wi-Fi network, insert the password of your router and all the other parameters if necessary like the channel ID that you want to associate to your smartPID, the port and the baud rate and press the **Next** button



SmartPID connection to WiFi router

Once you have configured the smartPID it will reboot and immediately after it connects to your WiFi router. In order to verify the proper configuration follow below steps

10. Select Connectivity/log on the smartPID device from the top menu and press the **SET** button



11. Select Logging and set it to Wi-Fi and press the **SET** button



12. Select status menu and your IP address assigned by the router and your SSID will be reported

```

Wi-Fi Status—
Connected
IP    123.123.123.123
SSID
123456789012345678901
23456789012
  
```

Process parameter logging

Now you can activate your logging via wifi and verify the thingspeak server connection

13. Got to the connectivity and log menu and select logging

```

Connectivity/log
  Logging
    Wi-Fi
    Server
  
```

14. activate the log via wifi

```

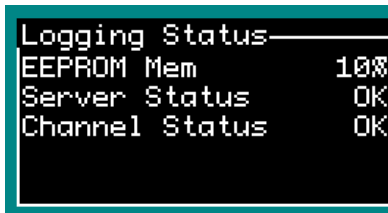
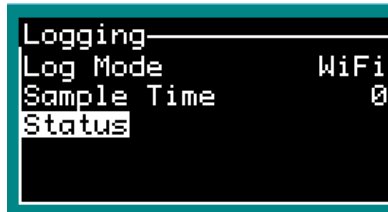
Logging—
Log Mo  OFF      OFF
Sample  WiFi      15
Status  USB
        WiFi+USB
  
```

15. verify the channel status

```

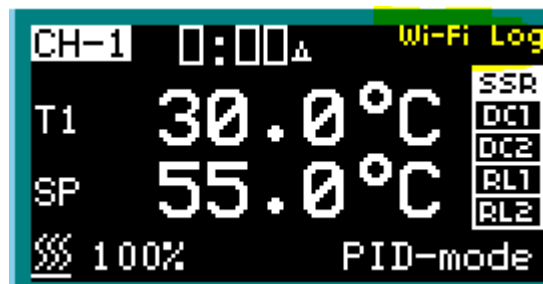
Logging Status—
EEPROM Mem      10%
Server Status   -
Channel Status  -
  
```

16. Select the status and press the **SET** button



Now every time that SmartPID is in RUN MODE the process data (set point, current temperature and PWM percentage) are pushed to the things peak server

In the top right corner of the run mode screen you can see both indication of wifi connection and logging activation



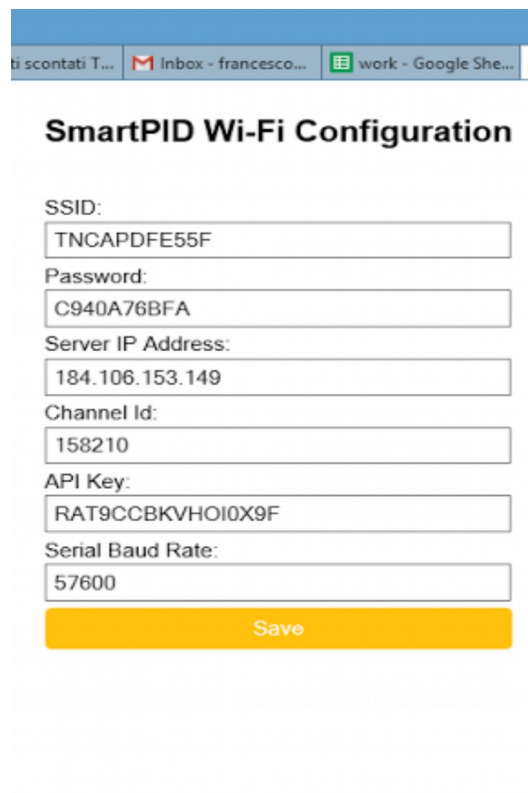
3.3 WiFi configuration via browser

In case it's not possible to use an android (5 or greater) smartphone it's possible to complete the wifi configuration using a web browser on a laptop or even on the smartphone

the thingspeak configuration steps and smartPID steps are exactly the same, what changes is that instead of using the app to input the parameter the browser should be opened at the following url

<http://192.168.56.1>

the browser will present a form to be filled



The screenshot shows a web browser window with the title "SmartPID Wi-Fi Configuration". The form contains the following fields and values:

Field	Value
SSID:	TNCAPDFE55F
Password:	C940A76BFA
Server IP Address:	184.106.153.149
Channel Id:	158210
API Key:	RAT9CCBKVHOI0X9F
Serial Baud Rate:	57600

At the bottom of the form is a yellow "Save" button.

the values that are needed are

1. SSID of the Wi-Fi network to be connected
2. PWD of the wifi network
3. Server IP address is the thingspeak server 184.106.153.149
4. Channel ID is the value associated to the channel during the thingspeak setup
5. API KEY is the user API KEY
6. Serial baud rate is the communication speed between Wi-Fi module and the controller

once you have saved the value the smartPID reboot and the next steps are same as for the configuration via smartphone

4 Arduino configuration

5 Firmware upgrade