Arduino Solarmeter

Software manual

Use this manual to configure and install the software in your Arduino

1/5/2013 Revision 9.1

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Introduction

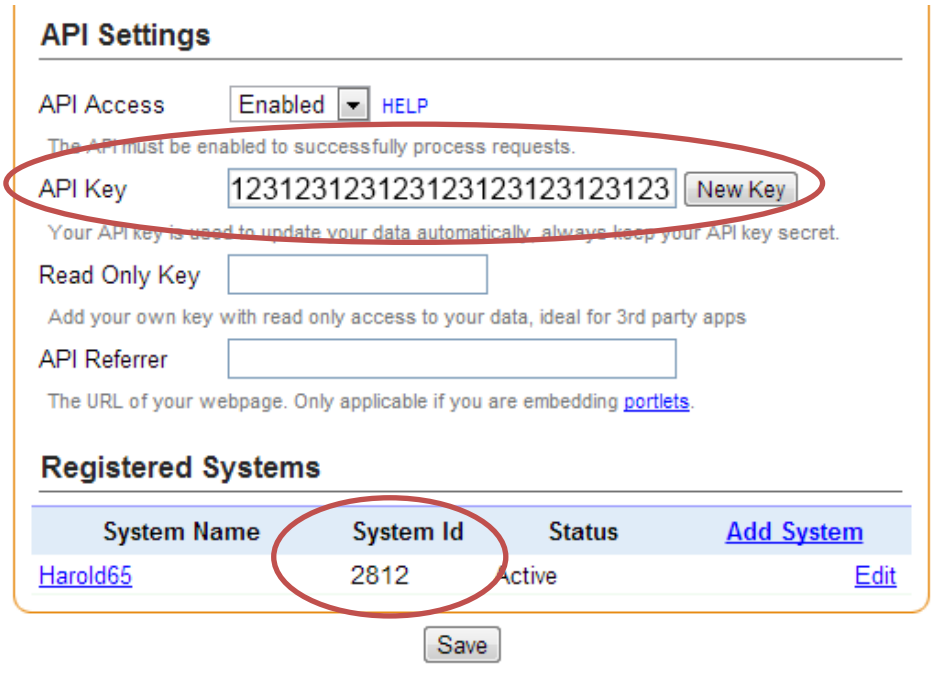
The ***Arduino Solar Meter*** software runs on the Arduino. It has to be downloaded via a host system. This can be any computer that can run the Arduino IDE (Integrated development Environment) program.

The program will be uploading data to the PvOutput site. To do this, an account has to be created. See the next chapter on how to do this.

PvOutput

Before you can send data to PvOutput you have to create an account and add one or more systems.

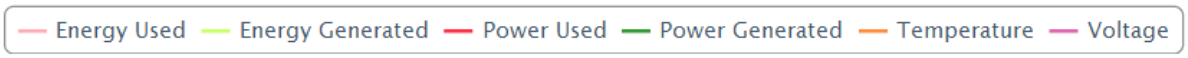
Once you have done this, go to the settings page and scroll to the bottom. You will see something like this:



The API key is needed once and is used to 'login' to your account. Do not give this number away or others can use your account.

The System ID (or SID) is created for every system you have added. This is also used to show the graphs and is public to everyone. To view the system above, for instance, you go to: http://pvoutput.org/intraday.jsp?sid=2812

Every PvOutput SID has a number of variables to log to. These show up on the live page in different colors.



Parameter:	Field	Graph color	Solarmeter:
v1	Energy Generation	Green area	
v2	Power Generation	Green line	2
v3	Energy Consumption	Red area	
v4	Power Consumption	Red line	4
v5	Temperature	Orange	5
v6	Voltage	Purple	6
v7	Extended value 1	Custom	
v8	Extended value 2	Custom	8
v9	Extended value 2	Custom	
v10	Extended value 2	Custom	10
v11	Extended value 2	Custom	
v12	Extended value 2	Custom	12

V1 and v2 belong together and show Todays generated energy and the actual power generation.

V3 and v4 also belong together for the consumed energy and power.

V5 and v6 do not have a total but only display actual values on the live pages.

V7 to v12 are only available if you are a donor of PvOutput.

To make the configuration not too complicated, the solarmeter sensors must be connected to one of the variables in the last column. The corresponding energy values will automatically be added to the variable one row above.

For instance, if you connect an S0 meter to ‘2’, the actual power measured will be shown as a green line and the corresponding energy value for that day will be logged to variable ‘v1’ and show as a green area.

If you connect an Analog sensor to ‘6’, only the actual value will be logged to v6

If you put multiple sensors on the same variable, their values will be added.

If you do not want values to be added, you have to put them on a separate graph by using a different SID

Downloads

Arduino IDE	http://arduino.cc/en/Main/Software
Arduino Solar Meter	http://solarmeter.codeplex.com/

Installation

Unzip the file *Arduino-1.0.3-window.zip* or the version that you need and place the files in some user folder.

Unzip the file *Solarmeter_V9.zip* and copy the two folders to the same user folder where you placed the Arduino software.

You now have a folder structure like this:

```
\Arduino-1.0.3
  \Libraries
    <all standard Arduino libraries>
    FlashMini
    MSTimer2
    Time
  \Projects
    \Solarmeter
      AnalogSensor.cpp
      AnalogSensor.h
      BaseSensor.cpp
      BaseSensor.h
      FerrarisSensor.cpp
      FerrarisSensor.h
      Logging.ino
      Mail.ino
      PVoutput.ino
      S0Sensor.cpp
      S0Sensor.h
      PvOutput.ino
      Solarmeter.ino
      Time.ino
      userdefs.h
      Webstuff.ino
```

The main program is called *Solarmeter.ino*. All other files are classes and functions used by the main program.

Make sure you have all the capitals right. Arduino is case sensitive!

The file *userdefs.h* is used to configure the system. Normally you only need to edit this file and do not need to change the others..

Configuration

In the *userdefs.h* file there is a number of options you have to select before you can build the software.

Note: The software will not check if the options set in this file are correct. There simply is no room in the arduino to check all correct combinations. If the program does not work or is showing strange data, most likely there is a mistake in this file. So please check this carefully.

File logging settings	Meaning
#define USE_LOGGING	Logging to SD card is enabled Note: due to a bug in the Arduino precompiler, you also have to change a line in Sorarmeter.ino: remove the slashes before //#include <SD.h>.
//#define USE_LOGGING	Logging to SD card is disabled

PvOutput settings	Meaning
#define PVOUTPUT_API_KEY "xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"	Replace the xxx with your own API key
#define UPDATEINTERVAL 5	The update interval must match what you have set in the PvOutput settings: PvOutput->Settings->System->Live settings->Status interval

Sensor settings	Meaning
#define NUMSENSORS 3	Set this value to the total number of sensors you want to use. If you have 1 S0 meter and 1 Gas sensor, set NUMSENSORS to 2
S0Sensor S1(p,n,sid,v);	For every S0 sensor you have, add this line and replace the parameters as follows: S1 = a unique name for the sensor p = the digital pin where the sensor is connected n = the number of pulses per kWh that this sensor generates sid = the pvoutput SID where you want the data to be logged v = the variable number of the SID. See PvOutput for an explanation
AnalogSensor S2(a,n,sid,v);	For every Analog sensor you have (gas), add this line and replace the parameters as follows: S2 = a unique name for the sensor a = the analog pin where the sensor is connected n = the number of pulses per m^3 that this sensor generates sid = the pvoutput SID where you want the data to be logged v = the variable number of the SID. See PvOutput for an explanation.
FerrarisSensor S3(a1,a2,n,sid);	For every Analog sensor you have (gas), add this line and replace the parameters as follows: S2 = a unique name for the sensor

	a = the analog pin where the sensor is connected n = the number of pulses per m^3 that this sensor generates sid = the pvoutput SID where you want the data to be logged The FerrarisSensor always logs to v3 and v4
Temperature T1(station,sid)	By using this sensor, the actual temperature will be retrieved from XML.BUIENRADAR.NL. The station number is a string with the number of a nearby weatherstation. Go to http://gratisweerdata.buienradar.nl/#Station to find this number or go directly to xml.buienradar.nl and lookup a nearby station and its number. sid = the pvoutput SID where you want the temperature to be logged. The Temperature sensor always logs to v5
BaseSensor* sensors[] = {&S1,&S2,&S3};	This line defines the scanning order of the sensors in the software. Each defined sensor must be in this list or it will not be used by the software. Also the sequence must be so that different SID's appear in ascending order. The number of items in the list must match NUMSENSORS. Also do not change the formatting of this line.

Temperature sensor settings	Meaning
//#define USE_GRAADDAGEN	If T1 is defined, it will log the actual temperature of the selected weatherstation.
#define USE_GRAADDAGEN	If T1 and G1 (Analog Sensor) are defined, todays gas usage and average temperature are used to calculate a factor. This factor is calculated as: F = (24/hour) * (Gas / (18-Tavg) The factor gives you an indication of the isolation factor of your house. See also http://www.mindergas.nl/degree_days/explanation for an explanation (dutch only)

Mail settings	Meaning
#define USE_MAIL	A mail will be sent once a day
//#define USE_MAIL	Mail function is disabled
#define MAIL_TIME 21	Defines the time of the mail in hours. In this example the mail will be sent at 21:00
#define MAIL_TO "someone@somemail.com"	The destination address

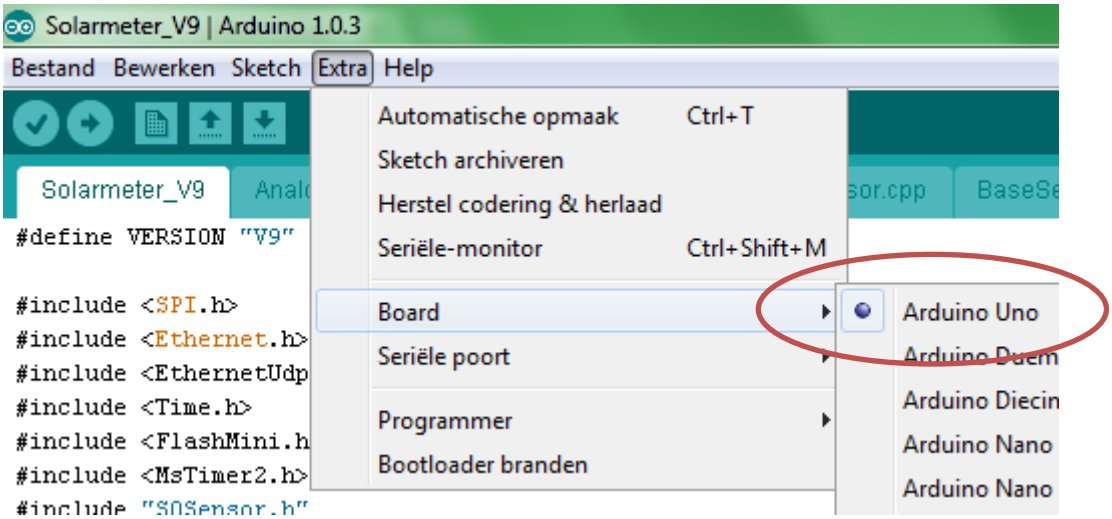
#define MAIL_FROM "arduino@meterkast.nl"	Any valid mail address will do here
#define MAIL_SERVER "smtp.mymailprovider.nl"	Use the address of your own mail provider. Note that google cannot be used as mail provider since this would require authentication.

Network settings	Meaning
static byte mac[] = { 0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED };	The MAC address of the Arduino. Any address will do as long as it is unique in your network.
static byte ip[] = { 192, 168, 1, 99 };	The IP address of the Arduino. This must match the gateway and subnet settings of your router
static byte dnsserver[] = { 8, 8, 8, 8 };	Preferred value is the IP address of your router. If this does not work, fill in the address of your local DNS server. Finally you can use Google's DNS server at 8,8,8,8.

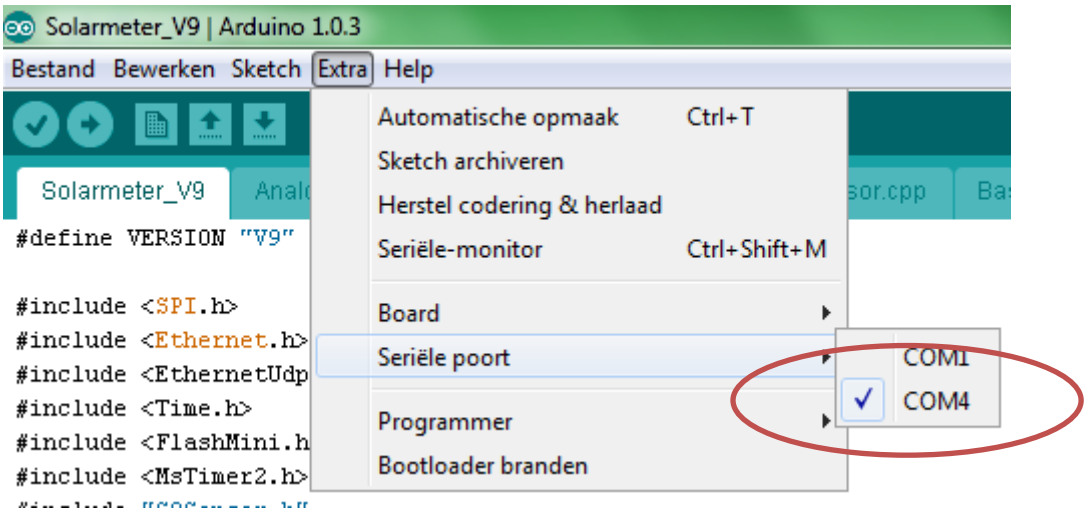
Build and deploy

Once you have configured the system for your needs, all you have to do is build the software and upload it to the Arduino.

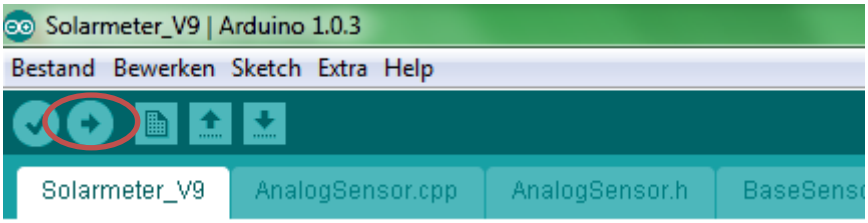
Select the correct Arduino board:



Then select the correct serial port:



Finally press the upload button:



When uploading is finished, you can disconnect the board, put it in your meter cabinet and power up.

Testing

Of course you can test your system by looking into the PvOutput page and see if any data is recorded.

The second method is to log in to Arduino's own web-page. The program will generate a text page containing all values of all sensors:

http://192.168.1.99

A sample of this page will look like this:

```
V9
27.12.12 17:48:00
Uptime=0d+18h
```

```
SID=2812 Type=2 Today=999 TodayCnt=999 Actual=0 Peak=0 Pulse=471180 PPU=1000
```

```
SID=2812 Type=6 Today=2980 TodayCnt=298 Actual=629 Peak=646 Pulse=57200 PPU=100
```

```
SID=2812 Type=5 Today=0 TodayCnt=0 Actual=7 Peak=0 Pulse=0 PPU=1000
+Actual:7.60 Average:7.60 Factor:39.91
```

```
SID=2812 Type=24 Today=12580 TodayCnt=3145 Actual=975 Peak=1212 Pulse=14760 PPU=250
+C=6024 1=301-365:461 2=192-236:291
```

```
PvOutput response=200
DNS status=1
Last NTP update=27.12.12 10:00:00
```

This page will show you:

- The actual version number
- The actual time (synchronized twice a day)
- The uptime in days and hours since the last boot
- For each sensor the SID and the Actual, Today and Peak value for this sensor.
  If a sensor has extra information, it will be displayed on the next line starting with a "+"
- The status of the last upload to PvOutput.. 200 is ok, 0 is no response, 400-499 is configuration error.
- The status of the last call to the DNS server. 1=ok, -1 is timeout
- The time of the last synchronization with the time server.

The values shown at each sensor mean the following:

SID	The System ID where the data is logged to.
Type	The variable where the data is logged to. The Ferraris sensor is type 24
Today	The total for today in real units (Wh or m3)
TodayCnt	The total number of pulses counted today
Actual	The actual production/consumption in real units (Wh/h=W or L/h or ^{O}C)
Peak	The maximum of Actual during the last 5 minutes (or 10 if you changed the interval)
Pulse	The time between the last two pulses in ms.
PPU	The conversion factor from pulses to real units, pulses per unit

Additional info that is sent by the Ferraris sensor:

C=nnnn	The counter for the threshold adjustment. When nnnn reaches 10000 the thresholds will be adjusted
1=aaa-bbb:ccc	The current data for sensor 1. aaa is the lower threshold, bbb the higher threshold and ccc is the last read analog value
2=aaa-bbb:ccc	The current data for sensor 2. aaa is the lower threshold, bbb the higher threshold and ccc is the last read analog value

Additional info sent by the Temperature sensor:

Actual	The actual temperature. Is read once per hour
Average	The average temperature for today
Factor	The gas usage factor