

The Fluksometer Manual
Deploying, Troubleshooting, Hacking

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Preface

This version of the Fluksometer Manual is based on commit [3009d840bb7bd6a](#) of the Flukso Git repository.

Chapter 1

Introduction

Let's kick off this manual with a short tour of a Fluksometer's externals. We will introduce each of the Fluksometer's ports, buttons and LEDs.

1.1 Ports

1.1.1 Screw Terminal

The screw terminal contains twelve inputs. A *port* on the screw terminal is defined as a *pair of adjacent inputs*. We have printed the port numbers on the side of the enclosure for easy reference, with the polarity denoted by + and -. Ports 1 to 3 are analog ports that are tuned to accept Flukso split-core current clamps. Ports 4 and 5 can be used for detecting pulses. This includes support for, but is not limited to, the S0 interface¹ common to DIN-rail energy meters. Finally, port 6 offers a half-duplex RS-485 serial interface. Contrary to the other ports, the RS-485 port has its polarity indicated by the letters a and b.

1.1.2 Ethernet

The ethernet port offers support for a 10baseT/100baseTx interface with auto-negotiation and auto MDI/MDI-X crossover detection.

1.1.3 Power Jack

The center-positive power jack accepts a DC voltage between 9V and 15V. The switching adapter should have a minimum rating of 500mA output current.

¹S0 is an open-collector interface standardized in DIN EN 62053-31

1.2 Pushbutton

The pushbutton has a dual function. Which function will be triggered depends on how long the button is pressed.

Toggle reporting mode If you press the button for 2 to 5 seconds, the Fluksometer will toggle its reporting mode to the Flukso server from wifi to ethernet or vice-versa.

Restore defaults If you press the button between 10 and 30 seconds, the Fluksometer will restore its default network settings.

1.3 LEDs

The Fluksometer has five red LEDs on the top of its enclosure. Together these LEDs provide us with an overview of the Fluksometer's internal functioning, the status of its network interfaces and its ability to communicate with the Flukso server. From left to right, these LEDs are:

Wifi If the wifi interface is enabled, the wifi LED will blink. A fast blink rate [approx. twice per second] signals that no wifi connection can be established. A slow blink rate [once every three seconds] signifies that a wifi connection has been successfully set up.

Ethernet The ethernet LED will be on when an ethernet link is established. This can either be a 10baseT or 100baseTX link in full- or half-duplex mode.

Globe After the Fluksometer has finished its boot sequence, the globe LED will be on when it can access the Flukso server. Every time the Fluksometer reports to the Flukso server, the LED will blink in case of a successful call. The globe LED will be turned off when the call is not completed successfully. A successful call has been made when either a 200 or 204 HTTP response code is returned by the Flukso server.

Heartbeat The heartbeat LED is positioned right next to the globe led. While the globe LED informs us about the status of the Fluksometer's external communication, the heartbeat LED allows us to monitor the Fluksometer's internal functioning. This LED will be on when the sensor board is running its firmware. From the moment the Flukso daemon is started during the boot sequence, it will start polling the sensor board every second for data. Each poll triggers a blink of this LED, thus mimicking a real heartbeat. Hence, a 'heartbeat' is an indication of a Fluksometer that has booted, a running Flukso daemon, a sensor board running its firmware and proper communication between the main board and sensor board.

Power The power LED is directly connected to the internal 3.3V supply. A burning LED indicates that power has been applied to the device and the internal voltage regulators are working properly.

Chapter 2

Deploying

This chapter will guide you through the installation steps that should lead to your Fluksometer's successful deployment. Please consult the troubleshooting chapter if you experience any installation difficulties.

2.1 Networking

Out of the box, a Fluksometer will report to the Flukso server via the wifi interface. Please refer to section [2.1.1](#) if you wish to use your Fluksometer in this reporting mode. As detailed in section [1.2](#), the Fluksometer's pushbutton can be used to toggle the reporting mode to ethernet. The networking setup for this case is described in section [2.1.2](#).

2.1.1 Wifi Mode

Power up your Fluksometer and wait until the heartbeat LED starts to blink. Connect your computer to the Fluksometer's ethernet port. Then surf to [192.168.255.1](#). Configure the wifi page with the proper name and security key so that the Fluksometer gets connected with the internet via your local wifi network. After saving¹ these settings, the globe LED on the Fluksometer should light up. To further test your configuration, try surfing to [www.flukso.net](#) while the ethernet cable is still connected to the Fluksometer.

2.1.2 Ethernet Mode

When the reporting mode is toggled to ethernet, the ethernet interface will be set as a DHCP client. The wifi interface will be disabled. Connect the Fluksometer's ethernet port to your network and find out which IP address

¹While saving settings doesn't take long, restarting the whole wifi and networking stack with its dependencies can take more than a minute to complete. Be patient.

Note 1*Art thou WAN or LAN?*

The default settings listed on the network page will mostly work just fine. Should this not be the case, it's important to understand which section on the network page applies to which interface. In wifi mode, the *Local Network* or *LAN* section refers to the ethernet interface while the *Internet Connection* or *WAN* section is associated with the wifi interface. So if you want to assign a fixed IP address to the wifi interface, then you should set the *Protocol* for the *Internet Connection* to *manual* and fill in the additional form fields. Conversely, if you wish to change the IP settings on the ethernet interface, then the *Local Network* section should be edited.

We understand this configuration aspect will be the cause of some confusion. We however cannot apply the *ethernet* and *wifi* naming to these sections directly since they are swapped when toggling the Fluksometer into ethernet mode. The *Internet Connection* will in this case refer to the ethernet interface and the *Local Network* to the wifi interface.

it has been assigned by your DHCP server. Power up your Fluksometer and wait until the heartbeat LED starts to blink. The globe LED should now be on. Surf to the Fluksometer's ethernet IP address. No further network configuration steps should be required. In case you do need to change something, you should read note 1 first.

2.2 Configuring Sensors

The sensor configuration will be synchronized with the Flukso server each time you save the sensor page. A synchronization can only be successful when the Fluksometer has internet connectivity. You should therefore make sure the globe LED is lit before commencing this configuration step. If not, then goto section 2.1.

2.2.1 Status

The status section lists a couple of parameters to help you verify that your Fluksometer is configured and operating correctly.

System Time The Fluksometer's system time is presented in UTC. If this time setting is showing a Jan 1970 date, then your network firewall might be blocking NTP's UDP port 123.

Flukso server ping test When generating the sensor page, the Fluksometer will try pinging the Flukso server and report the outcome. A failed ping indicates a networking problem, so please consult section 2.1 before continuing the sensor configuration.

Last synchronisation time Saving this sensor page will trigger a synchroni-

sation action with the sensor board and the Flukso server. This entry shows last time a synchronisation attempt was made.

Last synchronisation status The last synchronisation status indicates the last synchronisation attempt's outcome.

2.2.2 Services

Your Fluksometer will by default be configured to report its measurements to the Flukso server. Clear the checkbox if you want to stop all communication with the Flukso server. Since no HTTP calls will be initiated to the server anymore, the globe LED will be turned off.

The Fluksometer can make its sensor measurements available through a local JSON/REST API as well. While the Flukso server allows you to analyze your historical data and derive trend information, this local API is useful for monitoring your sensors in real-time. Sixty datapoints with a second resolution will be made available via the local API. No historical data is stored on the Fluksometer itself. Set the checkbox if you wish to enable the local API feature.

2.2.3 Current Clamp Setup

Select the number of phases that apply for your current clamp setup. When selecting 3 phases, the three current clamp ports will be grouped and presented as a single sensor #1. Sensors #2 and #3 will be disabled automatically after saving. When selecting 1 phase, each clamp port will be sampled separately and mapped to sensors #1, #2 and #3 respectively.

2.2.4 Sensors

As already indicated in the previous section, a sensor is a *logical* entity that can aggregate multiple *physical* screw terminal ports as defined in section 1.1.1. Since the screw terminal contains a maximum of six ports, six sensors per Fluksometer will suffice. A sensor is defined by a unique identifier. Sensors can be enabled or disabled individually. Leave sensors in a disabled state when not in use. An enabled sensor requires a name. This name will be used in the Flukso website's charts. It's important that you assign a distinct name for each enabled sensor associated with your account. By convention, we use *main* for total household electricity consumption and *solar* for photo-voltaic production. When adding other users to your chart on the Flukso website, the main sensors will be the ones on display. A sensor can only contain ports of the same class. Ports that have different classes cannot be aggregated into a single sensor. We now introduce each of the three classes in turn:

Analog Ports #1, #2 and #3 are analog ports. They accept Flukso split-core current clamps of 50A, 100A, 250A and 500A. A three-phase setup requires all current clamps to be identical. Besides the current range, you can also specify the line voltage for each clamp. The default is 230V,

which applies to the mains electricity voltage in most European countries. Australia and New-Zealand have a 240V power grid. Please consult this [Wikipedia article](#) if you are unsure about your country's mains voltage.

Pulse Ports #4 and #5 on the screw terminal are pulse ports. They are mapped to sensors #4 and #5 respectively. A meterconstant defines the amount of flow represented by each pulse. For electricity, the unit is Wh per pulse² while water and gas are specified in liter per pulse. Fractional meterconstants are allowed down to 0.001.

Uart The RS-485 port #6 is mapped to sensor #6. The baud rate is set to a fixed 115200.

2.3 Securing the Fluksometer

Disconnect all cables from the Fluksometer. Now find a suitable location near the fuse box to install the device. Mounting holes have been provisioned on the back of the Fluksometer. Alternatively, you can use a plastic cable tie or velcro.

2.4 Attaching Current Clamps

For safety reasons, switch off the main electricity supply when installing the current clamps. Attach a clamp to each non-neutral line in the fuse box. Close the clamps firmly. You should hear a double click. The lip should lie flush with the clamp's body.

2.5 Connecting Sensor Clamp Cables

Connect a cable from each current clamp to the Fluksometer's screw terminal. Use the red wire for positive polarity and the black one for negative polarity.

2.6 Powering Up

Switch the main electricity supply back on. Activate the Fluksometer by inserting its power plug.

²Most small energy meters define their meterconstant in imp/kWh. 1000, 2000 and 5000 imp/kWh values on the energy meter equal meterconstants of 1, 0.5 and 0.2 Wh/pulse on the Fluksometer respectively.

2.7 Registering

Visit www.flukso.net/user/register and fill in the form to create your account. Once logged in, you can associate the Fluksometer with your account. Click on the *My account* → *Devices* tab and submit the Fluksometer's serial number. You should now see this Fluksometer added to the device list.

Point your browser to www.flukso.net. A first reading should be visible on the hour chart within five minutes from powering up.

2.8 Congratulations

You are now part of the Flukso community!

Chapter 3

Accessing

Once the Fluksometer is operational, it will start collecting data on its configured ports. These measurements are sent to the Flukso server and stored in a time series database. You can access the data in chart form via the [Flukso website](#). The same data is also made available in a machine-readable format via the RESTful API.

3.1 Version

This chapter is a description of v1.0 of the Flukso API. Although only a single version is currently in use, you are required to specify the version for each API call. This will prevent any existing code from breaking when new, incompatible versions of the API are introduced in the future.

You can include the versioning parameter either as part of the header (`X-Version: 1.0`) or as a query parameter (`&version=1.0`).

3.2 Token

The server will verify each time whether a correct token has been specified for the requested resource. For extracting information, you can use two types of tokens:

Sensor-level token A default token is generated for each sensor providing full read access to the sensor resource. The database structure has been conceived to support multiple tokens per sensor, each with different access restrictions. This functionality is however not currently activated. It might be interesting when you want to make a subset of your sensor data available to a third-party service for further processing. This would allow you to revoke this specific token at any time without affecting other services accessing the same sensor data.

Account-level token A token is also made available to each account, which you can regard as an API key. This single token allows you to access data of all devices and sensors associated with your account.

3.3 Data Types

unix_time()	int32 representing the number of seconds elapsed since midnight UTC of Jan 1, 1970
time_range()	minute, 15min, hour, day, week, month, year, decade, night
unit()	watt, kwhperyear, eurperyear, audperyear, lpermin, lperday, m3peryear

3.4 Retrieving sensor time series data

request	retrieve sensor data in time series format from flukso.net		
verb	GET		
url	https://api.flukso.net/sensor/<sensorid>		
query params	interval	time_range()	time range for which values should be returned, from now - interval till now
	start	unix_time()	start time
	end	unix_time()	end time
	resolution	time_range()	format data in this resolution
	unit	unit()	convert values to specified unit
	callback	string()	jsonp function name
response	a JSON array containing [unix timestamp, value] array elements		

Query Parameter Compatibility The most straightforward way to extract time series data from the platform is by use of the **interval** query parameter. E.g. specifying **interval=month** will return one month worth of data in a **day** resolution, the default resolution for this interval. A default resolution can be overridden by including it explicitly in the query parameters. If you would like to fully customize the interval, then you should instead use the **start** and, optionally, **end** parameters. Below is a compatibility matrix detailing which parameters are Required [R], Exclusive [X] or Optional [O].

	interval	start	end	resolution
interval	R	X	X	O
start	X	R	O	O

Example 1

```
icarus75@cirrus:~$ curl -k -v -X GET -H "Accept: application/json"
-H "X-Version: 1.0" -H "X-Token: d8a8ab8893ea73f768b66b45234b5c3a"
```

```
"https://api.flukso.net/sensor/c1411c6b4f9910bbbab09f145f8533b9?
interval=month&unit=watt"
```

```
> GET /sensor/c1411c6b4f9910bbbab09f145f8533b9?interval=month&
unit=watt HTTP/1.1
> User-Agent: curl/7.19.7 (i486-pc-linux-gnu) libcurl/7.19.7
OpenSSL/0.9.8k zlib/1.2.3.3 libidn/1.15
> Host: api.flukso.net
> Accept: application/json
> X-Version: 1.0
> X-Token: d8a8ab8893ea73f768b66b45234b5c3a
>
< HTTP/1.1 200 OK
< Server: nginx/0.7.64
< Date: Thu, 07 Jul 2011 10:34:35 GMT
< Content-Type: application/json
< Connection: keep-alive
< Content-Length: 494
<
[[[1307664000,234],[1307750400,169],[1307836800,72],[1307923200,71],
[1308009600,103],[1308096000,263],[1308182400,176],[1308268800,165],
[1308355200,261],[1308441600,400],[1308528000,139],[1308614400,235],
[1308700800,151],[1308787200,141],[1308873600,113],[1308960000,301],
[1309046400,210],[1309132800,166],[1309219200,286],[1309305600,237],
[1309392000,241],[1309478400,148],[1309564800,125],[1309651200,187],
[1309737600,248],[1309824000,263],[1309910400,143],[1309996800,191],
[1310083200,"nan"]]]
```

Example 2

```
icarus75@cirrus:~$ curl -k -v -X GET -H "Accept: application/json"
-H "X-Version: 1.0" -H "X-Token: d8a8ab8893ea73f768b66b45234b5c3a"
"https://api.flukso.net/sensor/c1411c6b4f9910bbbab09f145f8533b9?
start=1309478400&end=1309996800&resolution=day&unit=watt"
```

```
> GET /sensor/c1411c6b4f9910bbbab09f145f8533b9?start=1309478400&
end=1309996800&resolution=day&unit=watt HTTP/1.1
> User-Agent: curl/7.19.7 (i486-pc-linux-gnu) libcurl/7.19.7
OpenSSL/0.9.8k zlib/1.2.3.3 libidn/1.15
> Host: api.flukso.net
> Accept: application/json
> X-Version: 1.0
> X-Token: d8a8ab8893ea73f768b66b45234b5c3a
>
< HTTP/1.1 200 OK
< Server: nginx/0.7.64
< Date: Thu, 07 Jul 2011 12:45:02 GMT
< Content-Type: application/json
< Connection: keep-alive
```

```
< Content-Length: 122
<
[[[1309564800,125],[1309651200,187],[1309737600,248],[1309824000,263],
[1309910400,143],[1309996800,191],[1310083200,"nan"]]]
```

3.5 Retrieving sensor parameters

request	retrieve sensor parameters from flukso.net		
verb	GET		
url	https://api.flukso.net/sensor/<sensorid>		
query params	param	all	return all sensor parameters
response	a JSON object containing containing all sensor parameters		

Example

```
icarus75@cirrus:~$ curl -k -v -X GET -H "Accept: application/json"
"https://api.flukso.net/sensor/c1411c6b4f9910bbbab09f145f8533b9?
version=1.0&token=d8a8ab8893ea73f768b66b45234b5c3a&param=all"
> GET /sensor/c1411c6b4f9910bbbab09f145f8533b9?version=1.0&
token=d8a8ab8893ea73f768b66b45234b5c3a&param=all HTTP/1.1
> User-Agent: curl/7.19.7 (i486-pc-linux-gnu) libcurl/7.19.7
OpenSSL/0.9.8k zlib/1.2.3.3 libidn/1.15
> Host: api.flukso.net
> Accept: application/json
>
< HTTP/1.1 200 OK
< Server: nginx/0.7.64
< Date: Thu, 07 Jul 2011 13:28:18 GMT
< Content-Type: application/json
< Connection: keep-alive
< Content-Length: 183
<
{"access":1310045295,"type":"electricity","function":"main","class":
"pulse","voltage":null,"current":null,"phase":null,"constant":1.0,
"enabled":1,"lastupdate":[1310045295,1006793948]}
```

3.6 Retrieving real-time sensor data

request	retrieve real-time sensor data directly from the Fluksometer		
verb	GET		
url	http://192.168.255.1:8080/sensor/<sensorid>		
query params	interval	minute	fixed interval
	unit	watt	fixed unit
	callback	string()	jsonp function name
response	a JSON array containing [unix timestamp, value] array elements		

Example

```
icarus75@cirrus:~$ curl -v "http://192.168.255.1:8080/sensor/
c1411c6b4f9910bbbab09f145f8533b9?version=1.0&interval=minute&
unit=watt&callback=realtime"
> GET /sensor/c1411c6b4f9910bbbab09f145f8533b9?version=1.0&interval=
minute&unit=watt&callback=realtime HTTP/1.1
> User-Agent: curl/7.19.7 (i486-pc-linux-gnu) libcurl/7.19.7
OpenSSL/0.9.8k zlib/1.2.3.3 libidn/1.15
> Host: 192.168.255.1:8080
> Accept: */*
>
< HTTP/1.1 200 OK
< Connection: close
< Transfer-Encoding: chunked
< Content-Type: application/json
<
realtime([[1310047446,124],[1310047447,125],[1310047448,125],
[1310047449,125],[1310047450,125],[1310047451,125],[1310047452,125], ...
[1310047501,124],[1310047502,124],[1310047503,124],[1310047504,"nan"],
[1310047505,"nan"]])
```