

Arduino ASC-Kit shield

2/5/2017

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1 Specifications

- External Micro-USB plug or any regulated power supply 5V/2A
- Main heater controlled by a single relay (SPDT – single latch 5V coil - 250VAC—10A)
- Air solar ventilation controlled by a relay (SPDT – single latch 5V coil - 250VAC—10A) *
- One user-controlled relay (SPDT – single latch 5V coil)
- Two numerical temperature sensors for user applications (-50/+125 °C)
- Heated zone measurement accuracy (DHT22 sensor):
 - temperature +/- 0.2 °C
 - humidity +/- 1%
- Network connection by Wifi or Ethernet cable
- Embedded Webserver (uhttpd / Linino on Arduino Yun)
- REST requests format for parameters access (compatible with most modern Home Automation systems)

** the thermostat may be used without an air solar ventilation, in that case it is a classical single zone thermostat*

2 Heaters regulation

2.1 Main heater and solar heater

The system controlled by the ASC-Kit is composed of a central heater and a solar ventilation. The controller regulates the temperature of a single zone by activating the heaters in an on/off principle.

The set points of both heaters are adjusted automatically in order to reduce the demand on the main heater if the solar energy is available.

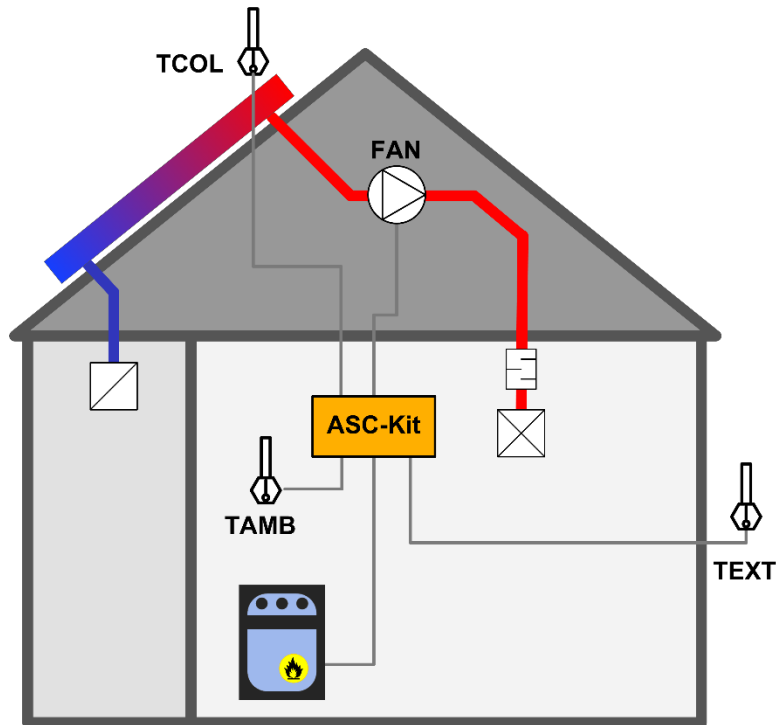


Figure 1: Regulation of the main heater coupled to an air solar ventilation

2.2 Main heater and ventilated wood fire

While initially developed for air solar ventilation systems, the principle can be applied to other situations where an auxiliary heating system is used. A common case is a wood fire with a ventilation able to diffuse the heated air either in a single zone, or in the ventilation ducts of the house. The controller is able to activate the auxiliary blower in case of fire use and to reduce automatically the demand on the main heater.

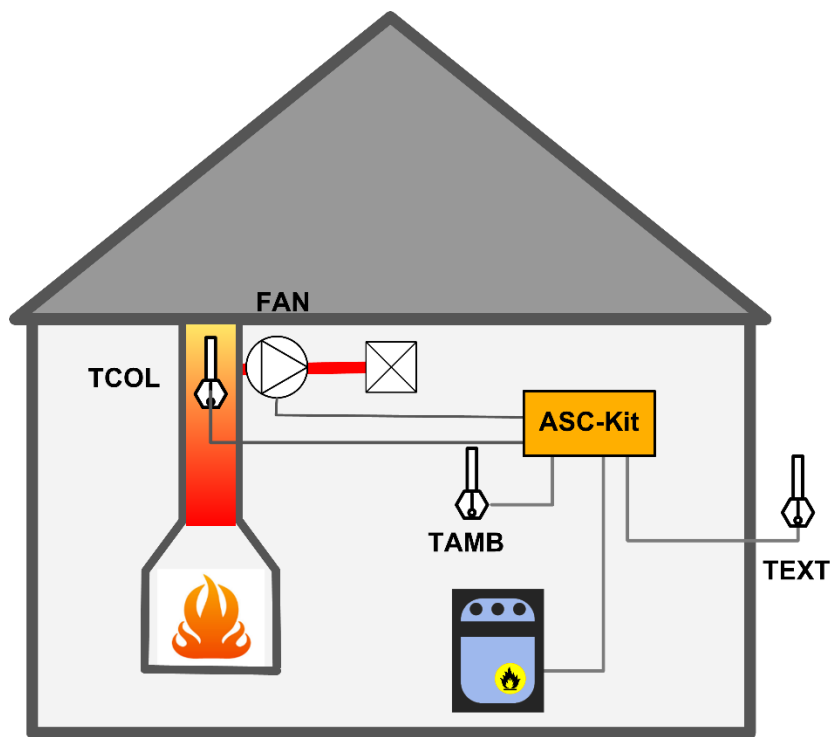


Figure 2: Regulation of the main heater coupled to ventilated wood fire (the wood fire icon is designed by Freepik.com)

2.3 Regulation principle

The controller needs two temperatures to activate the main heater and the auxiliary one (TAMB and TCOL). The external temperature (TEXT) and the ambience humidity (HAMB) are not required for the regulation.

The controller activates the heaters with on/off regulation principle. The accuracy of the regulation is defined by a hysteresis parameter (HYST) which can be adjusted to the specific situation (Figure 3). In order to limit the commutation frequency, the user can define a minimum time within each states (on/off).

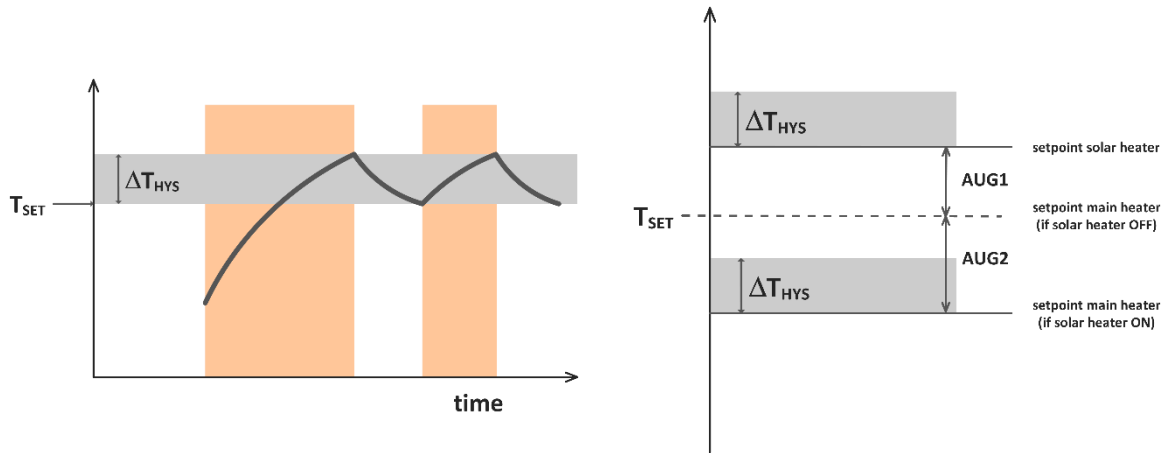


Figure 3: Illustration of the on/off temperature regulation (left) and parametric adjustment of the heaters setpoints (right)

SENSOR		REQUIRED
TAMB	Ambiance temperature (single zone)	YES
HAMB	Ambiance relative humidity (single zone)	NO
TCOL	Collector or auxiliary heater air temperature	YES
TEXT	External temperature	NO IF CONF1 = 1 YES IF CONF1 = 2

Table 1: Sensors for heaters regulation

2.4 Controller parameters

2.4.1 User parameters

PARAMETER	DEFAULT	UNIT	
TSET	22	°C	Main heater setpoint temperature
DTECO	3.5	°C	Main heater setpoint reduction in ECO mode
MODEMH	1	-	Main heater mode (0=OFF, 1=HEAT, 2=ECO, 3= FREEZE PROTECT)
MODESH	1	-	Solar heater mode (0=OFF, 1=HEAT)

2.4.2 Configuration parameters

PARAMETER	DEFAULT	UNIT	
TMHON	300	sec	Minimum time main heater ON
TMHOFF	300	sec	Minimum time main heater OFF
TMHON	300	sec	Minimum time solar heater ON
TMHOFF	300	sec	Minimum time solar heater OFF
DTSHON	6	°C	ΔT (TCOL-TAMB) for solar heater ON
DTSHOFF	3	°C	ΔT (TCOL-TAMB) for solar heater OFF
AUG1	2	°C	ΔT setpoint solar heater
AUG2	0	°C	ΔT setpoint main heater
TFP	5	°C	Setpoint for the freeze protect mode
DTDHT	0	°C	Overheating of the DHT sensor
HYST	1	°C	Hysteresis parameters
VFAN	400	m ³ /h	FAN flow rate (est.)
CONF1	1	-	Air flow (1=recirculation, 2=external)
SYSTEM	1	-	SYSTEM=1 for single zone without solar heater SYSTEM=2 for single zone with solar heater

2.4.3 Outputs

PARAMETER	UNIT	
NLOOPS	1/sec	Number of loop executed per second
PSOLTH	W	Heating solar power (est.)
SWSH	-	Solar heater switch state (0=OFF, 1=ON)
SWMH	-	Main heater switch state (0=OFF, 1=ON)
STATESH	-	Solar heater state (0=OFF, 1=OFF)
STATEMH	-	Main heater state (0=OFF, 1=OFF)
STATECTRL	-	Controller state (0=STOP, 1=RUN, 2=INIT, 3=FAIL1, 4=FAIL2)
ERRSENSOR	-	Sensor error diagnostic
ERRCTRL	-	Controller error diagnostic
INDSH	Wh	Estimated energy from the solar heater
TCSH	h	Cumulated time solar heater usage
TCMH	h	Cumulated time main heater usage

3 Hardware

3.1 Compatibilities with Arduino boards

The Arduino **ASC-Kit shield** has been developed for the Arduino-Yun board. The PIN allocation should be compatible with most Arduino boards with the standard board design like: Arduino Uno, Arduino Mega, Arduino Ethernet...

The embedded software is only compatible with the Arduino Yun (BRIDGE communication).

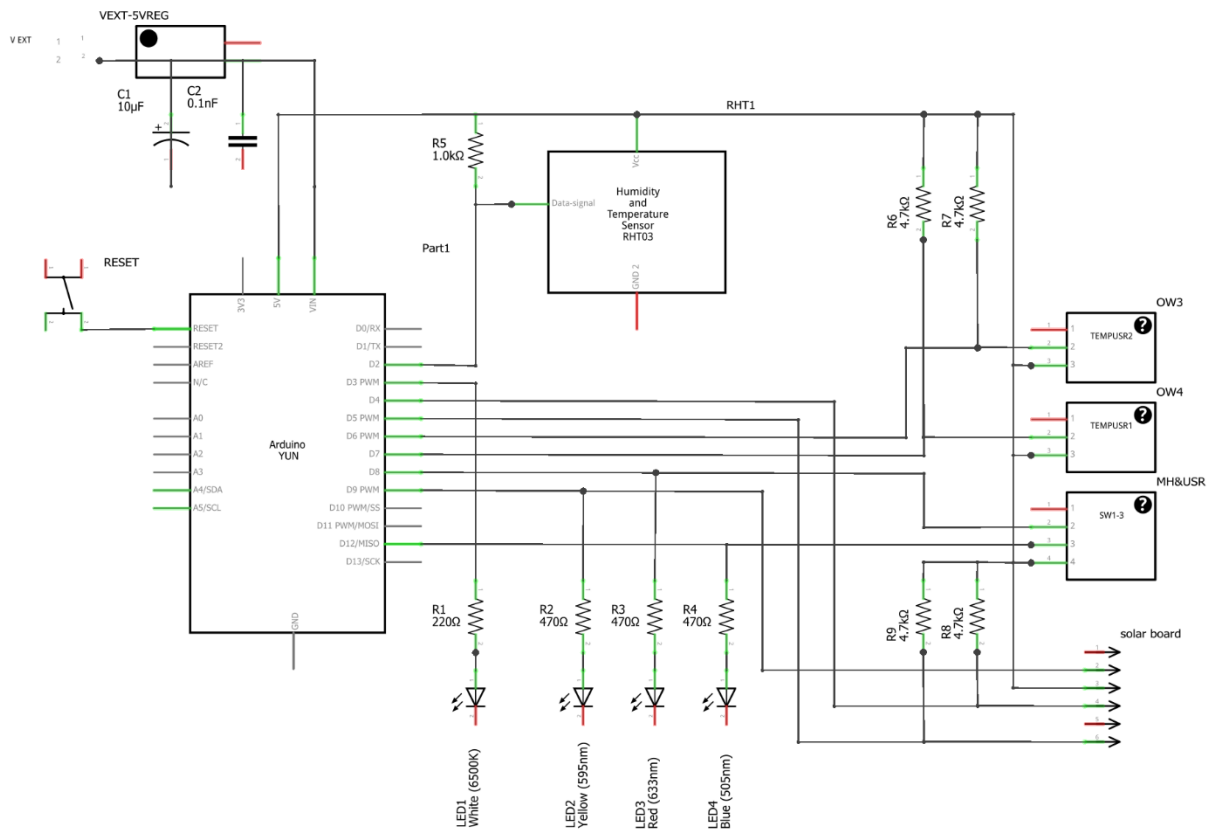
3.2 PINs allocation

PIN#	Label	Configuration	Usage	Comment
D0	(Tx)	OUT		Bridge
D1	(Rx)	IN		Bridge
D2	DHT	IN	DHT bus (TAMB + HAMB)	Model DHT22 (DHT11)
D3~	LED1	OUT	LED Status	
D4	OW3	IN	1-wire (TCOL or TUSR3)	CS (on ETHERNET)
D5~	OW4	IN	1-wire (TEXT or TUSR4)	
D6~	OW1	IN	1-wire (TUSR1)	
D7	OW2	IN	1-wire (TUSR2)	
D8	SW2	OUT	Main heater (SWMH) or SWUSR2	Red LED
D9~	SW3	OUT	Solar heater (SWSH) or SWUSR3	Yellow LED
D10~	-	-		CS (on YUN)
D11~	-	-		SDI
D12	SW1	OUT	User relay (SWUSR1)	Blue LED
D13	-	-		CLK
A0	-	IN	-	
A1	-	IN	-	
A2	-	IN	-	
A3	-	IN	-	
A4	-	IN	-	
A5	-	IN	-	

Table 2: PINs allocation in ASC-Kit Arduino shield

3.3 Shield electronic circuit

3.3.1 Schematic

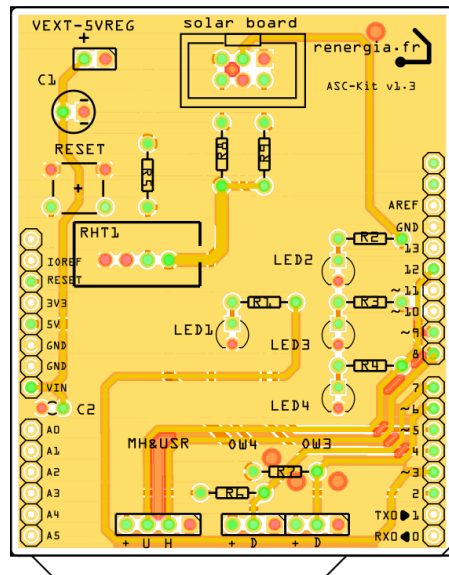


fritzing

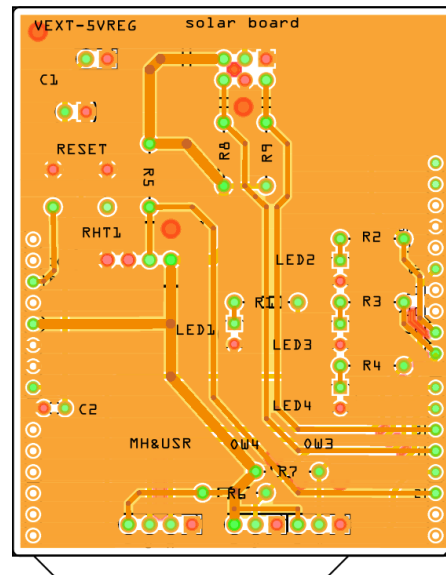
3.3.2 Components list

ID	Value	Comment	Ref	Provider
R1	220 Ω - 1/8W – 5%			
R2	470 Ω - 1/8W – 5%			
R3	470 Ω - 1/8W – 5%			
R4	470 Ω - 1/8W – 5%			
R5	1.0 k Ω - 1/8W – 5%			
R6	4.7 k Ω - 1/8W – 5%			
R7	4.7 k Ω - 1/8W – 5%			
R8	4.7 k Ω - 1/8W – 5%			
R9	4.7 k Ω - 1/8W – 5%			
C1	10 μ F - 10V – elect.			
C2	100 pF - 10V – tant.			
LED1	5mm – White			
LED2	3mm - Yellow			
LED3	3mm – Red			
LED4	3mm – Blue			
J1	2 screws terminal – 0.1"	VEXT-5VREG	TERMB-254002	Creaton
J2	3x2 pins ICD shrouded header	Solar board	CONID-106506	Creaton
J3	Long breakable Header	I/F Yun#1	CONPH-116540	Creaton
J4	IC header	DHT CNX		
J5	Long breakable Header	I/F Yun#2	CONPH-116540	Creaton
J6	Long breakable Header	I/F Yun#3	CONPH-116540	Creaton
J7	4 screws terminal – 0.1"	MH&USR	TERMB-254004	Creaton
J8	6 screws terminal – 0.1"	OW4 - OW3	TERMB-254006	Creaton
J9	Long breakable Header	I/F Yun#4	CONPH-116540	Creaton

3.3.3 Board layouts



Part1



Part1

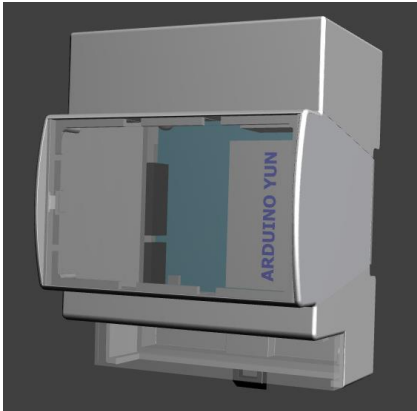
fritzing

fritzing

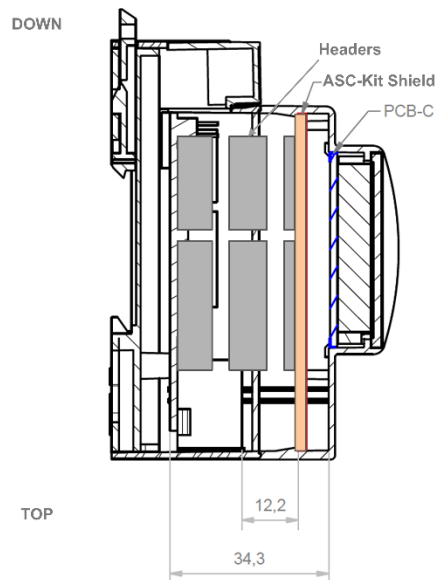
(top view – top & bottom copper layers) – 1 user relay (SWUSR) and two user temperatures (OW3 & OW4) available

4 Enclosures

4.1 DIN rail-4 modules

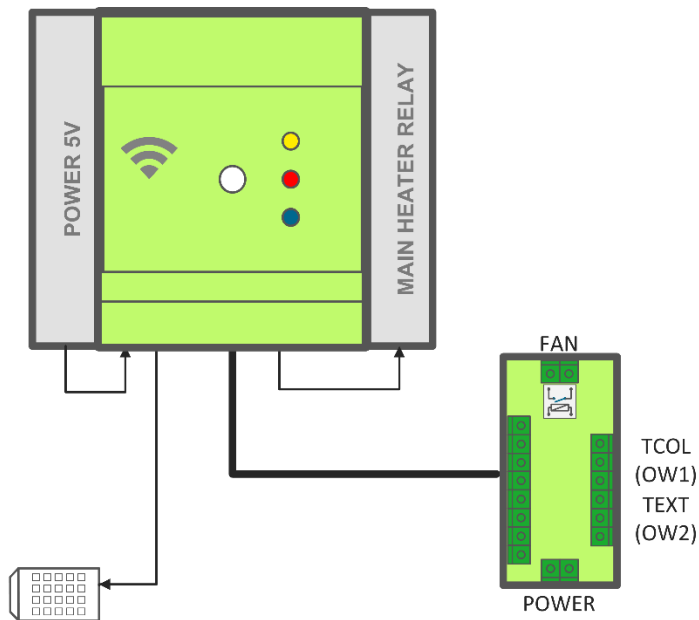


<http://www.italtronic.info/download/embeddedbox/arduinoyun/>



Shield board mounting: adapted from

http://www.italtronic.com/prodotti/embedded_box/embedded_box_arduino_yun/?prodotto=33.0412000.YUN

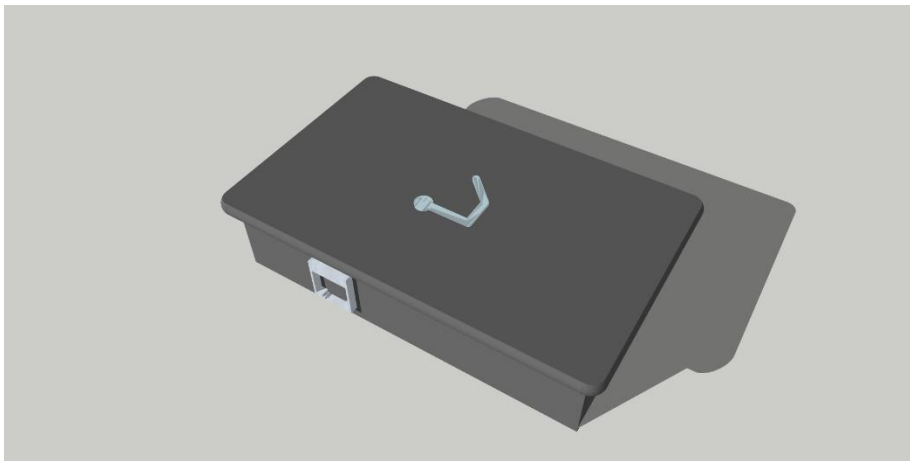
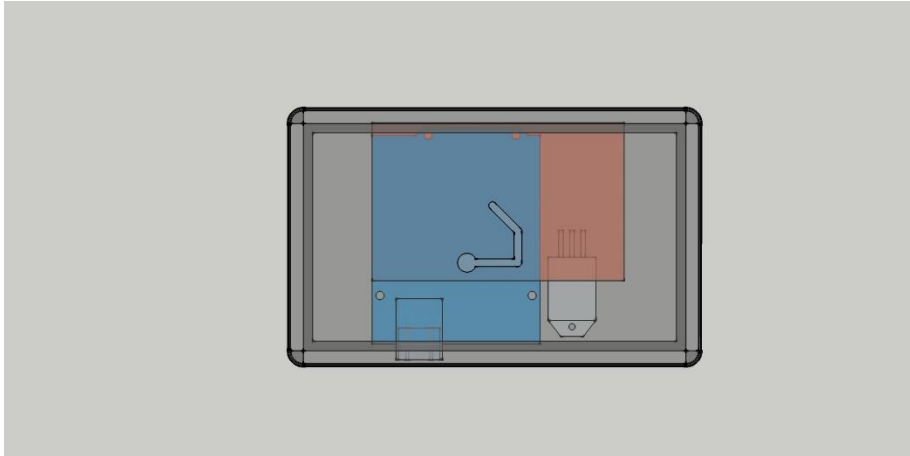


Main zone sensor

Solar board

Figure 4: Example of connection (the main zone sensor may be mounted on the shield board)

4.2 3D printing design for wall mounting



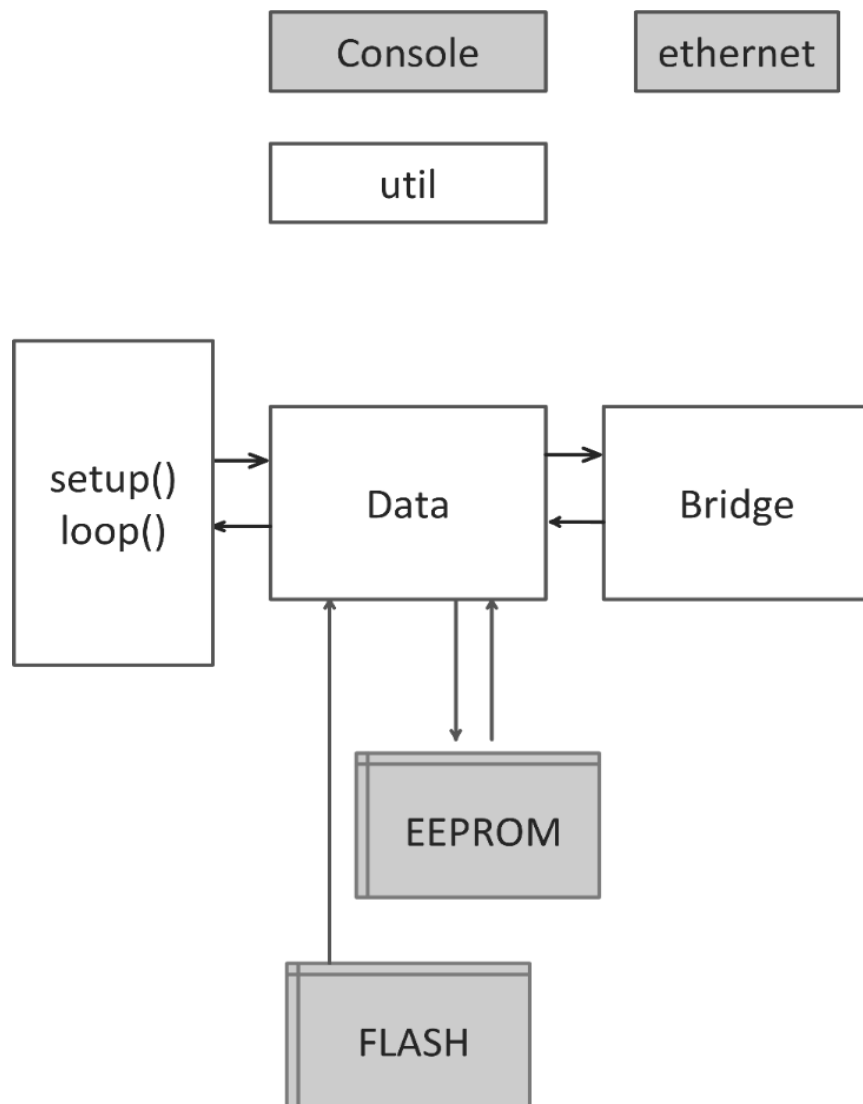
(could be done – just waiting for s/o to do it!)

5 Software

5.1 Installation

See <https://github.com/karldm/asckit> for on-line documentation and examples (under construction).

5.2 Software utilities



5.3 Sketch homemonitoring.ino

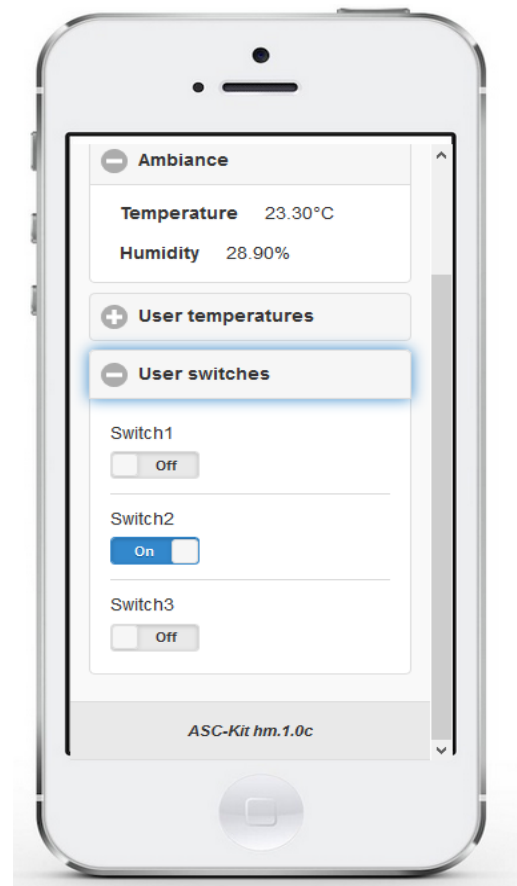
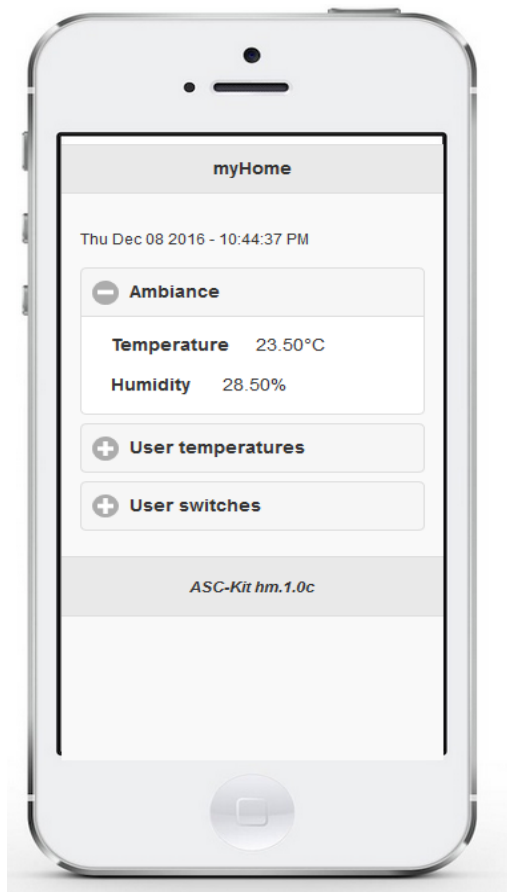
5.3.1 Installation

See INSTALL.TXT on <https://github.com/karldm/asckit>

5.3.2 Embedded Webserver usage

From the yun IP address:

[IP]/renergia/hm



<http://www.responsimulator.com>

5.4 Install the sketch airsolarcontroller.ino

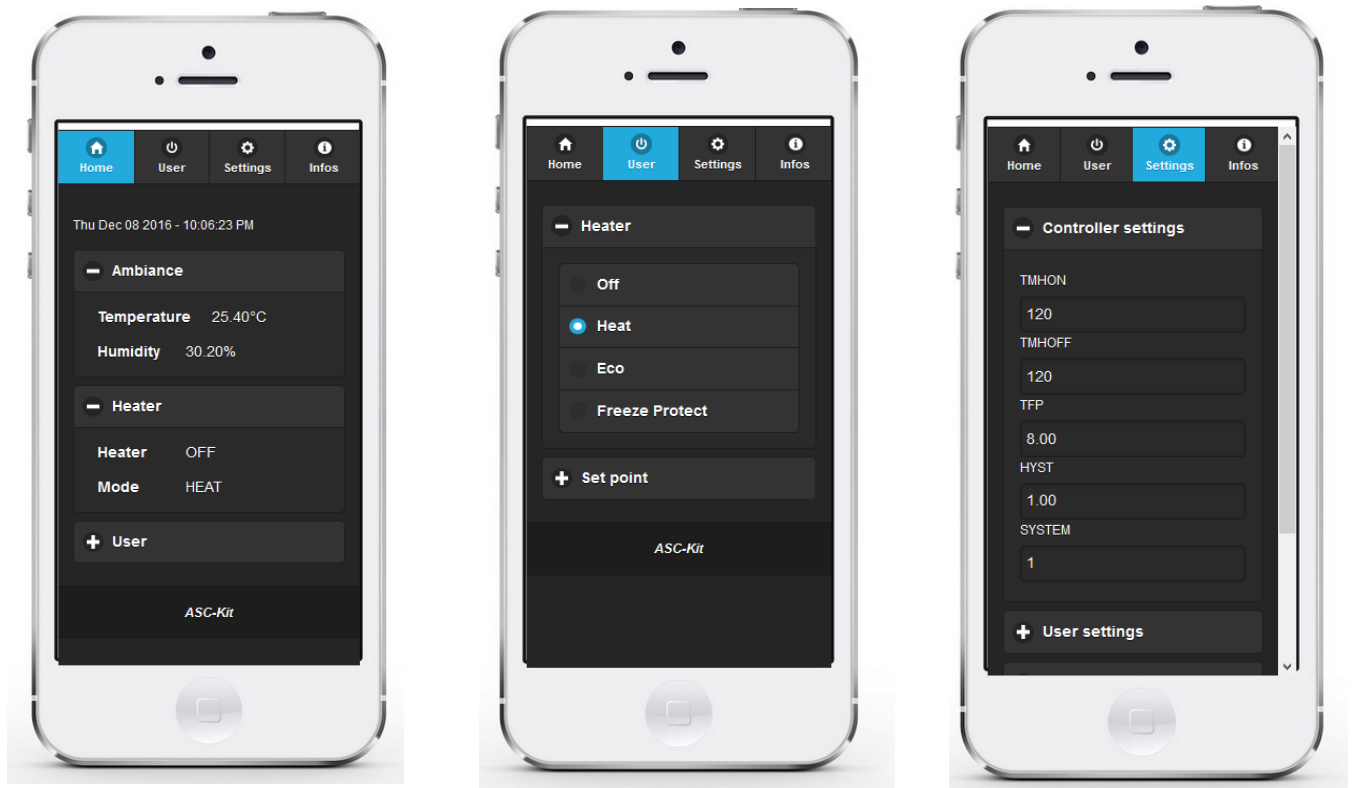
5.4.1 Installation

See INSTALL.TXT on <https://github.com/karldm/asckit>

5.4.2 Embedded Webserver usage

From the yun IP address:

[IP]/renergia/asc



<http://www.responsimulator.com>

5.5 REST access examples (for integration in Home Automation Systems)

To get the ambiance temperature:

[http://\[IP\]/data/get/tamb](http://[IP]/data/get/tamb)

Get all parameters:

[http:// \[IP\]/data/get](http://[IP]/data/get)

To modify the setpoint:

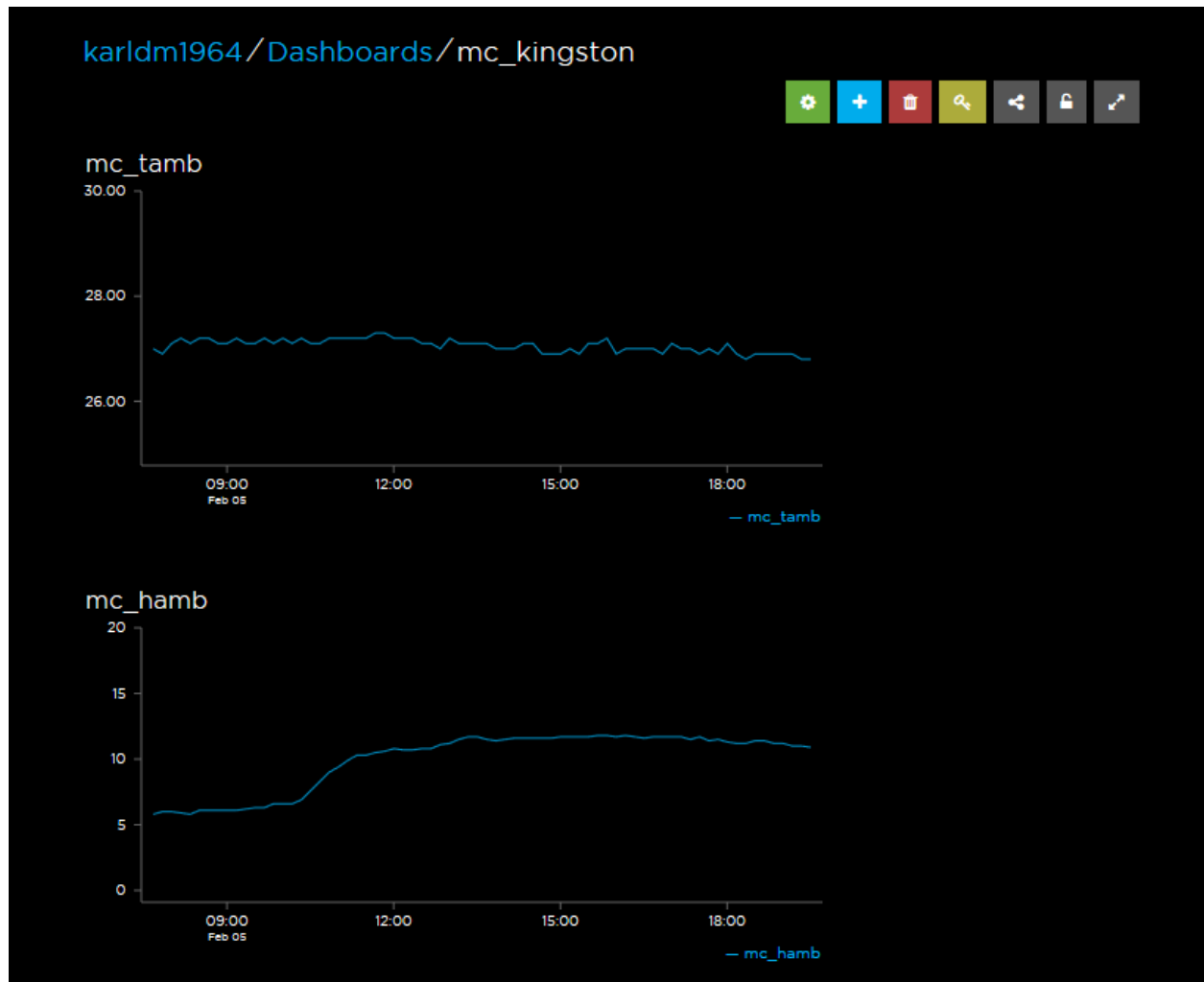
[http:// \[IP\]/data/put/tset/18.00](http://[IP]/data/put/tset/18.00)

You will get a JSON format compatible with most Home Automation Systems.

Note: the access can be protected by a password during the Yun configuration

5.6 Monitoring with io.adafruit.com

- Install the python script
- Open an Adafruit account (<https://io.adafruit.com>)
- Copy your key into the script
- Set up crontab (see procedure in the adafeedsMy.py)
- Create a dash board on io.adafruit



Dashboard example with temperature and humidity

6 Price list

Indicative prices – may vary with the final quantity ordered and the shipment costs

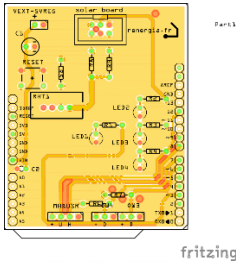


Arduino Yun

105 CAD

<http://www.robotshop.com/ca/fr/microcontroleur-arduino-yun-usb.html>

(incl. 13% VAT & shipment)



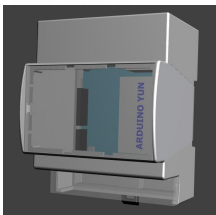
ASC-Kit shield (High quality board from Fritzing) with DHT22 sensor and components

45 CAD



1-board 5V Coil - 2 relays 250VAC-10A

5 CAD



Enclosure DIN-4 modules

15 CAD



2 X DS18B20 – 2M

10 CAD



Power plug 5V/2A – Micro Usb

13 CAD

Solar board (need to control a solar heater or an auxiliary heater)

ON REQUEST

Total

193 CAD

Note: 1 CAD ~0.68€

info: NEST = 400 CAD