Sensor Bridge User Manual

(PN: 532003, 532006, 532007)

220000-EN

Contents

1. Introduction

1.1. Product Summary

Sensor Bridge (later SB) connects sensors with digital or analog outputs (see sensor interface chapter) with an open ethernet HTTP interface. This enables connecting standard sensors with any logger or control device capable of HTTP communication.

SB has a built in support for selected peripherals and it can be used as ethernet to I2C bridge, which allows communication with any I2C-interfaced sensor or chip, as the user can send any I2C command or request required.

SB can be integrated into customer systems or used with Kallio Designs Logging Computer Module (LCM, PN: 532000).

Sensors can be connected to any standard network router and will be accessible as configured in the router, either within the local area network, or over the internet by port forwarding or VPN.

Rugged and simple design is tested for performance in elevated temperatures, ESD, overvoltage and mechanical shocks.

1.2. Support

Contact sales@kalliodesigns.com for any question about installation, integration, technical specification, etc. and your query will be forwarded to the correct party.

Please let us know if you need the device to comply to a certain communication protocol either on the ethernet or the sensor end. Measurement ranges and accuracy can be altered by component selection, but for customized products (hardware or firmware) we need an order for several units, depending on the type of customization.

Firmware and hardware design files of the device are available for customers who have bought large quantities of units. This allows customers to not be dependant on external support and can optimize the products for themselves and verify any theoretical fault modes of a larger system.

2. Getting Started

Connect an 8-26 V, 2 W DC power supply between pin 1 and pin 2 as described in pinout.

Connect the device to your network and use a web browser to access http://192.168.1.190/, which is the default IP the device is shipped with. If you are unable to use the default IP, see SD Card section for changing the IP.

You should see the reading of the internal temperature sensor. If the value is not present, check troubleshooting section.

3. Technical Specification

3.1. Mechanical

Mounting orientation

Mounting the device in an electrical cabinet or wall is recommended to be done so that the green power connector is facing up and other connectors facing down, to prevent dust build up in the device and ethernet connector.

Mounting flanges

Mounting flanges on the Sensor Bridge can be moved by loosening the set screw on the flange. Flanges can be removed by removing the back cover (with ethernet connector) and by sliding the flanges out from the grooves after loosening the set screw.

3.2. Indicator LEDs

Two LEDs are used for error identification and power and traffic indication. See chapter troubleshooting for advice.

3.3. Reset button

Reset button can be used to recover from a lock up situation that may be caused by incidents introducing voltages outside normal operation range. Sensor bridge can also be reset by cutting power input, both being safe methods.

3.4. SD Card

Removal and editing

Unlock microSD card by pressing it and pull it out. Use SD-card reader to edit config.txt within the card. Config.txt is a simple ASCII-file that contains all settings required by the sensor. SD card can be replaced with a standard microSD or SDHC card and configuration file rewritten. Settings are resolved by row number.

Entire contents of config.txt:

```
// MAC address
AA:BB:CC:DD:EE:FF
// IP address
192.168.1.190
```

Code block 1

IP address

IP address can be changed by writing a new address on row 4. Format *“123.123.123.123”*

MAC address

If you have a MAC address conflict or want to have a spare unit with same MAC address from identification, you can change it by changing row 2. Format *“AA:BB:CC:DD:EE:FF”*, hexadecimal, all capital letters.

3.1. Pinout

Front panel

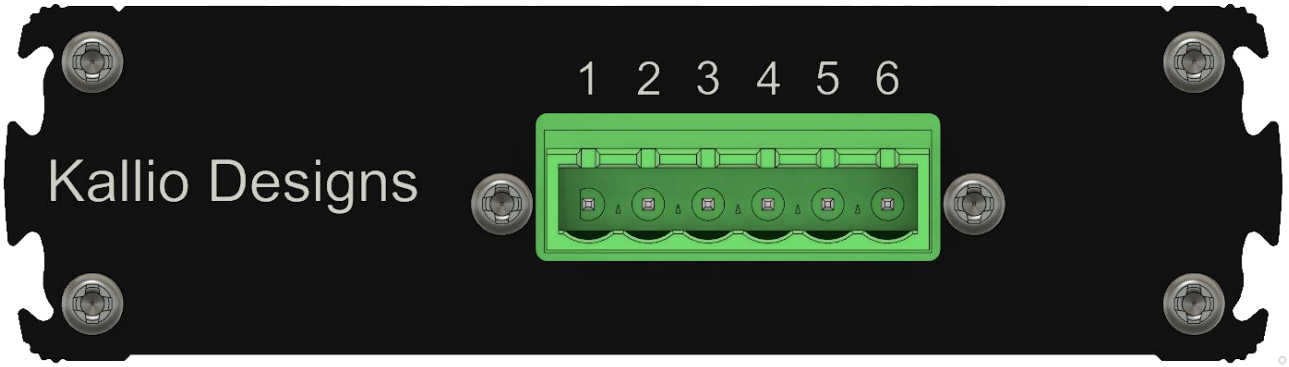

Image 1

Pin no	Description
1	GND
2	8 – 26 V Input
3	I^2C SCL / Pulse input / Analog signal -
4	I^2C SDA / Analog signal +
5	GND, can be used for supplying power to a sensor
6	+5V Output, can be used for supplying power to a sensor

Table 1

Rear panel

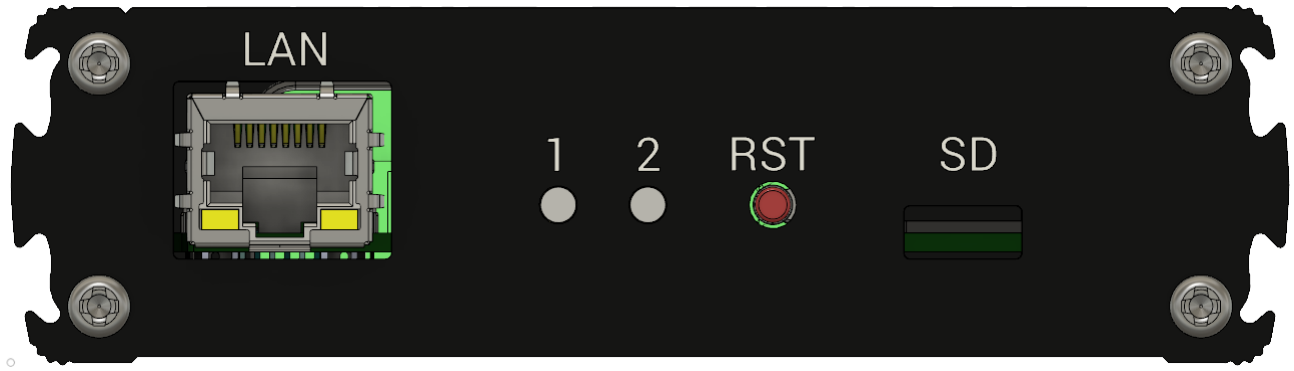

Image 2

Item	Description
LAN	RJ45 connector to connect the device to a local network
LED 1	Green power indicator led, on when device is powered
LED 2	Debug LED, Red on error, Blue on network traffic, Green as neutral debugging
RST	Reset button for resetting the device
SD	Micro SD card to hold device configuration data

Table 2

3.1. Electrical Characteristics

Common characteristics

Description	Conditions	Min	Typical	Max	Unit
Power supply					
Supply voltage		8		26	V
PoE voltage		21		72	V
Operating power			1	2	W
Idle current draw (8 V)			110		mA
Idle current draw (12 V)			77		mA
Idle current draw (24 V)			42		mA
Power output					
Voltage			4.7		V
Current supply			500		mA
Operating conditions					
Operating temperature	non-condensing	0		60	ºC
Communications					
Poll interval		1			s
Internal temperature sensor					
Range		0		80	ºC
Accuracy			2		ºC

Table 3

Model 532007, Sensor Bridge Current

Description	Conditions	Min	Typical	Max	Unit
Input resistance			120		Ohm
Input voltage range		0		10	V
Input current range		0		22	mA
Accuracy			400		uA
Accuracy (4 – 20 mA range)			2		%

Table 4

Model 532006, Sensor Bridge Voltage

Description	Conditions	Min	Typical	Max	Unit
Input impedance			11		kOhm
Input voltage range		0		10	V
Accuracy			30		mV

Table 5

Model 532003, Sensor Bridge Digital

Description	Conditions	Min	Nominal	Max	Unit
I2C interface					
I2C clock frequency			100		kHz
I2C bus voltage			5		V
Maximum input voltage			5		V
Pulse measurements					
Input impedance	Pulled to +5 V		4.7		kOhm
Frequency range		50		5000	Hz
Frequency measurement accuracy			1		%
Duty cycle range		0		100	%
Duty cycle accuracy			1		%
Pulse low threshold			2,2		V
Pulse high threshold			2,7		V

Table 6

3.2. Dimensions

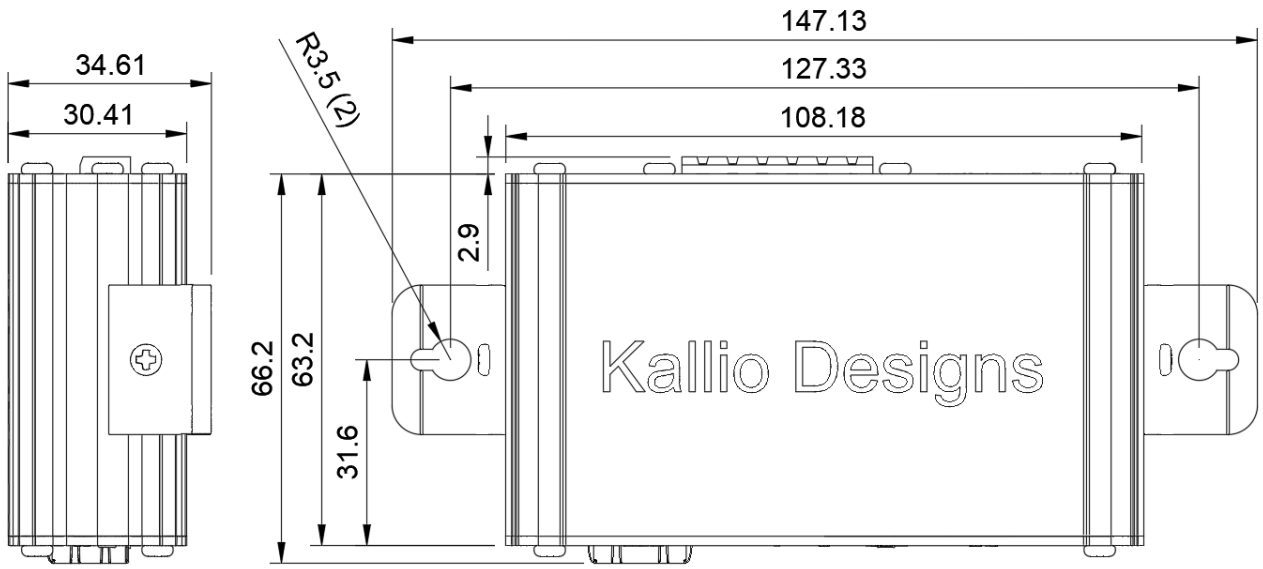

Image 3

PCB dimensions

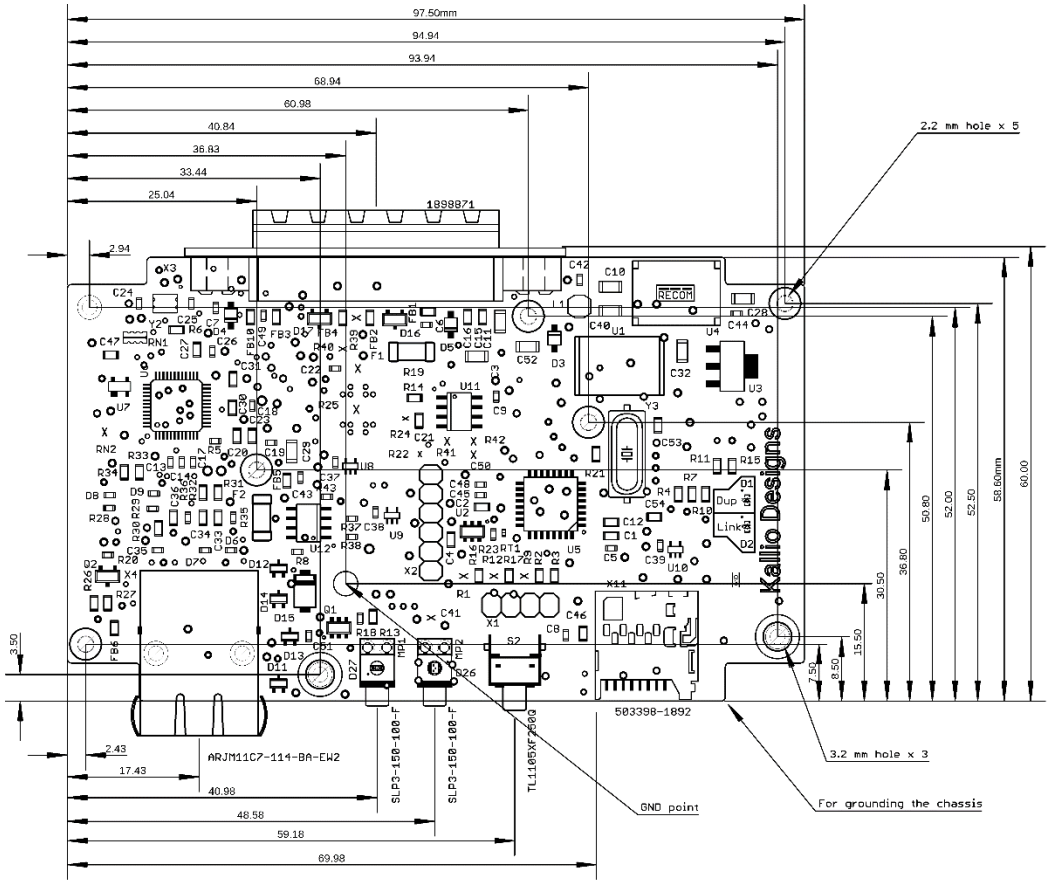

Image 4

4. Interface

4.1. Ethernet

PoE

Supports IEEE 802.3af interface specification. Standard PoE switches can be used to power the Sensor Bridge. You can also use a power injector with voltage range described in electrical characteristics.

Communication protocol

Standard HTTP protocol is used to transfer messages. GET requests return metadata for browsers, while POST requests only transfer the raw measurement value. Commands are sent to the IP of the SB to port 80 or 8085. Both ports behave the same and are provided for compatibility.

Contact us to get access to a test sensor over the internet to see if you can implement the sensor to your system.

4.2. Sensor interface

Different measurement results are obtained by sending a GET or POST request with a specific command. Sensor bridges are separated into different models depending on the chosen interface.

Interface can be tested by accessing the sensor bridge IP with a browser, which will by default request a temperature reading from the internal temperature sensor. With an empty request the sensor bridge will return the result with metadata required by browsers to view the result.

Sending any unrecognized GET commands will return standard “404 Not Found”-response without actual content. If the command is correct, any metadata sent with the message will be ignored and the request remains valid.

4.2.1. Model 532003, Digital

I2C

On custom applications make sure to comply with the electrical characteristics. Interfacing with devices outside officially supported sensors require modifying sensor firmware. Contact us for source code and instructions for modifications.

Pulse measurements

Frequency / Pulse Density Modulation (PDM) and Duty Cycle / Pulse Width Modulation (PWM) measurements can be performed. Timeout for the measurement is 500 ms and maximum number of averaged periods is 10 cycles, if the time frame allows for the given frequency.

4.2.2. Model 532006, analog voltage

Analog output sensors can be connected to sensor bridge models 532006 and 532007 depending on if they have a voltage or current output. Higher voltages can be measured by adding a voltage divider and taking into account sensor bridge input impedance and making sure that sensor bridge ground is connected to signal ground level to avoid unexpected current paths.

4.2.3. Model 532007, analog current

For 0 – 20 mA current measurements the sensor bridge has a different hardware configuration to have a lower input impedance. Voltage measurement command is also available.

Running higher than specified currents will be out of measurement range and will cause thermal stress and eventually a potential malfunction.

4.2.4. Request format

All models

Measurement	Command	Unit
Internal temperature sensor	TEMPINT	Celsius

Table 7

PN: 532007, current measurement

Measurement	Command	Unit
0 – 20 mA current	CURRENT	mA

Table 8

PN: 532006, voltage measurement

Measurement	Command	Unit
0 – 10 V	VOLTAGE	V

Table 9

PN: 532003, digital interface

Measurement	Command	Unit
Pulse measurements		
Pulse Frequency (PDM)	PDM	Hz
Pulse Width (PWM)	PWM	% Duty Cycle
I2C		
Start write sequence	I2CSTA[address]	see I2C format
Write one byte	I2CW[data]	
Send data	I2CSENDS	
Send data without stop bit	I2CSENDNS	
Read data	I2CR[address]	
T9602 sensor (PN: 532008)		
Read humidity	T96025D1RH	% Rh
Read temperature	T96025D1T	Celsius
MCP23017 GPIO chip		
Set pin state	MCP[addr]O[port][pin][state]	
Read pin state	MCP[addr]I[port][pin]	

Table 10

I2C format

Commands are sent as hexadecimal, but result of the “Read data” -request is in decimal format to match other response formats. The requesting device can filter out any non-numeric data for security. See I2C interface examples for example usage.

Example formatting

Exact format depends on software or programming language used, but typically accepted values are formatted as follows:

```
Standard port 80 is often used if port is not specified:
http://192.168.1.190/VOLTAGE
192.168.1.190/VOLTAGE

With port specified:
192.168.1.190:8085/VOLTAGE
http://192.168.1.190:8085/VOLTAGE

Actual message transferred to the sensor will be:
GET VOLTAGE
Or
POST VOLTAGE

Line feeds or protocol specific data are not displayed, as that rarely has to be taken into account.
```

Code block 2

5. Security

As there is no password protection or encryption, the senor results are readable by anyone within the connected network who has access to the IP of the Sensor Bridge. Connecting the Sensor Bridge to a LAN network won’t expose it to internet, unless the router connecting LAN to internet has been configured so.

Sensor Bridge runs on a microcontroller and uses an external chip for ethernet communication. The code is not running on an operating system such as Linux or Windows, which makes it less vulnerable to be used for attacks within the network.

Measured data can also reveal if a person is at home, by following the temperature graphs or other critical information, so we don’t recommend revealing the data over the internet or sharing it online. Kallio Designs takes no responsibility for damage caused by such acts.

6. Example usage

6.1. Usage with Logging Computer Module (PN: 532000)

To use Logging Computer Module (LCM) for collecting data from Sensor Bridges you need to connect them to the same network. To use Logging Computer Module, you need to have a PC in the network to access the web based user interface. Logging Computer Module can be used to view the data and export it in csv-format for external manipulation. You can log data with LCM and still be connecting to the Sensor Bridge from other sources.

Connection diagram

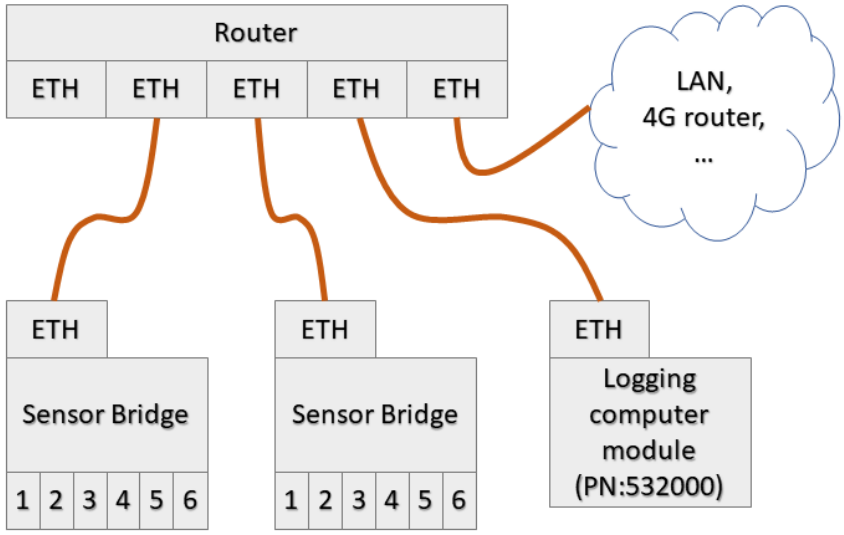

Image 5

6.2. Connecting to sensors

Voltage measurement

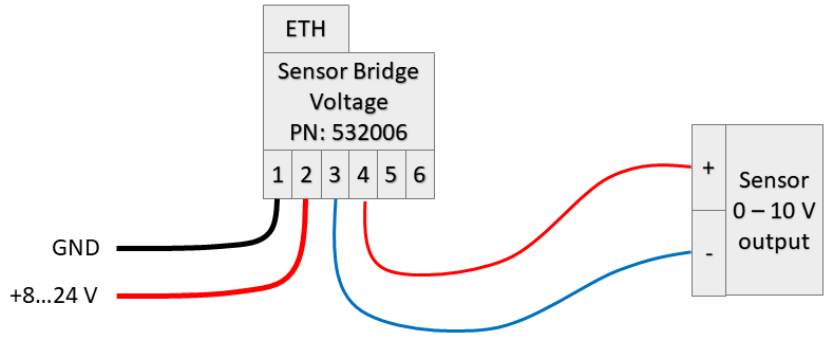

Image 6

Current measurement

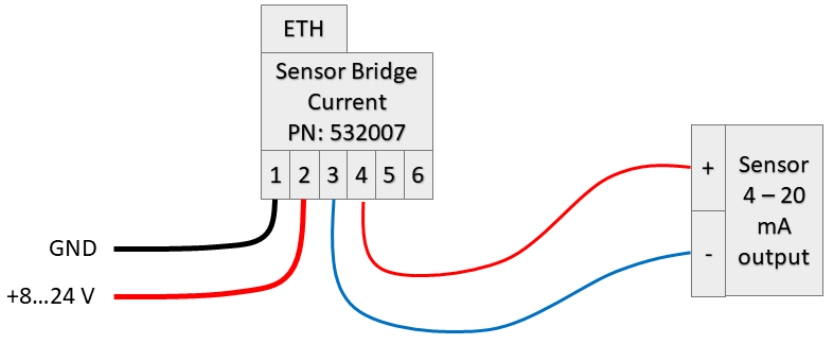

Image 7

Temperature and relative humidity with PN: 532008

To use T9602-5-D-1 without the adapter you need to connect I2C bus to pins 3 and 4.

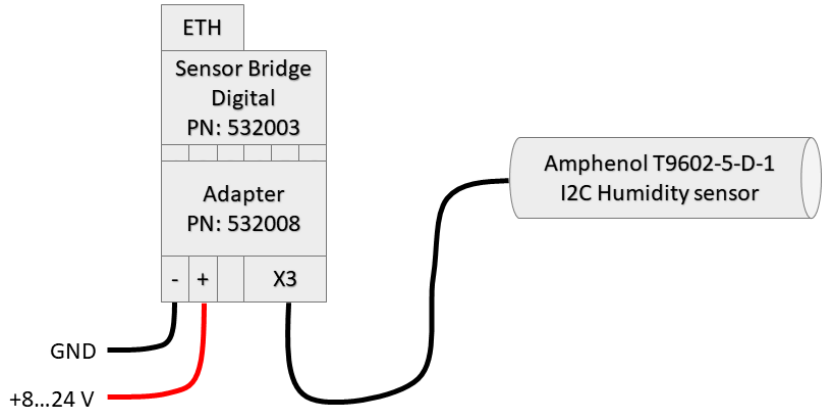

Image 8

Pulse measurements

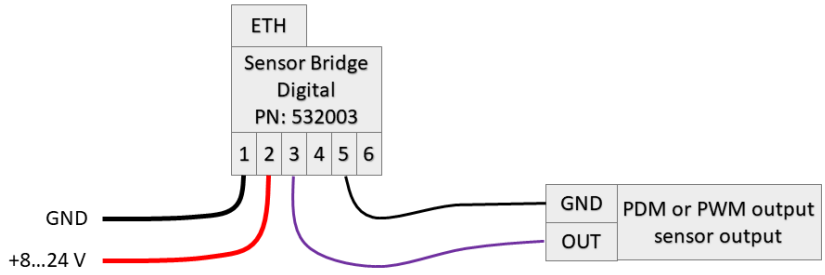

Image 9

6.3. Reading data with Python version 3

1. Install Python 3 or later
2. Write the below contents into a file, for example “C:\read_tempint.py”

```
import urllib.request
print(urllib.request.urlopen("http://192.168.1.190/").read())
input("Press enter to exit")
```

Code block 2

3. Run the script

For example double clicking the file on Windows:

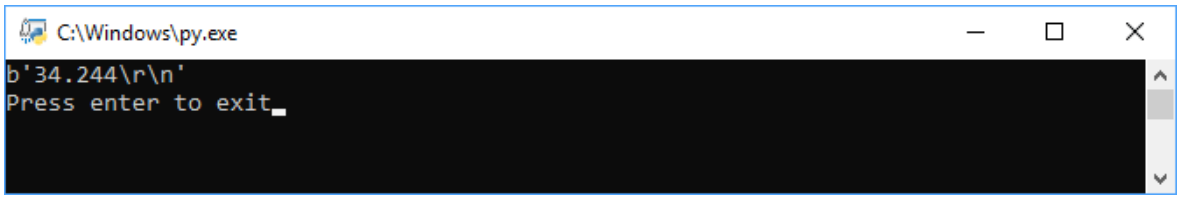

Image 10

Or via Windows Power Shell:

Image 11

Where *34.244* would be the measurement result of internal temperature sensor.

6.4. I2C interface examples

MCP23017 chip is controlled as an example

```
Device is at address 0x27 (hexadecimal).
To set all pins in port A as output:
curl 192.168.1.195/I2CSTA027
curl 192.168.1.195/I2CW00
curl 192.168.1.195/I2CW00
curl 192.168.1.195/I2CSENDS

Set port A pin 2 high (register 0x14, data 0x02):
curl 192.168.1.195/I2CSTA027
curl 192.168.1.195/I2CW14
curl 192.168.1.195/I2CW02
curl 192.168.1.195/I2CSENDS

Read the state of the register 0x14, result will be in decimal format:
curl 192.168.1.195/I2CSTA027
curl 192.168.1.195/I2CW14
curl 192.168.1.195/I2CSENDNS
curl 192.168.1.195/I2CR027
➔ 3.000 (decimal)

To hide command responses in many Linux environments use -silent option and dump the response to /dev/null:
curl -silent 192.168.1.195/I2CR027 > /dev/null
```

Code block 3

6.5. Control MCP23017 GPIO chip using cURL

cURL is shipped with most Linux, Windows and iOS distributions. Enter the following rows to the command line.

```
Device is at address address 0x27 (hexadecimal).
To set pin A4 as output and high state:
curl http://192.168.1.195/MCP27OA41

Read the state of the same pin:
curl http://192.168.1.195/MCP27IA4
0.000
```

Code block 4

6.6. Using with Home Assistant (hass.io, hassbian)

Write the below contents into configuration.yaml.

```
sensor:
  - platform: rest
    resource: http://192.168.1.190/T96025D1RH
    method: GET
    value_template: '{{ float(value) }}'
    name: "Lab Humidity"
    unit_of_measurement: "%"
    scan_interval: 300
```

Code block 5

This will display a humidity indicator on the overview and a graph in history view.

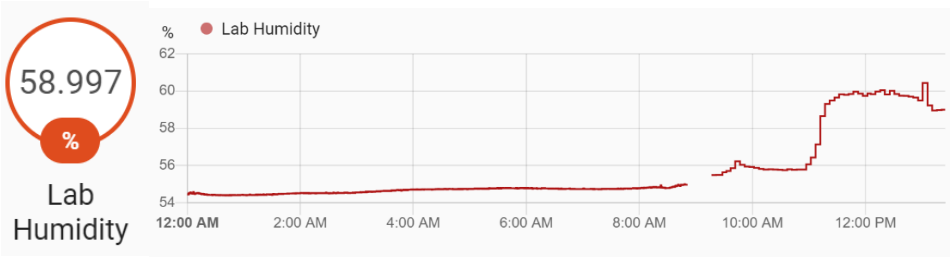

Image 12

7. Accessories and related products

Accessories and related products are available for purchase at http://kalliodesigns.com/.

Part number	Description
532008	Amphenol T9602-5-D-1 Temperature and humidity sensor with a passive adapter for ease of mounting
532000	Logging Computer Module

Table 11

8. Troubleshooting

Symptom	Reason
LED 1 lit green	Device is powered
LED 2 lit green and then flashing green on startup	Normal operation during power up
LED 2 stays red on startup	SD card not present or corrupted
LED 2 Red for 5 seconds on boot up, can't connect	No IP address. Possible reasons: 1. Check if IP address is within DHCP server lease range. 2. IP address conflict 3. IP or MAC on SD card corrupted 4. MAC address conflicts
LED 1 not lit, can't connect	Device is not powered or is damaged.
LED 2 flashing blue, unable to read measurements	Ethernet module is receiving messages. Check message format and if there is a proxy or firewall preventing messages to be sent from Sensor Bridge to the requester.

Table 12