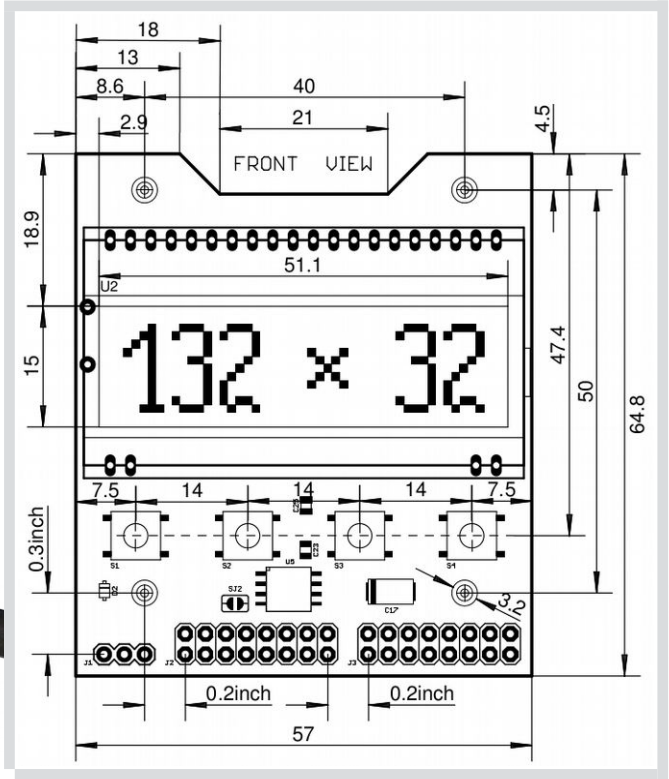

Tauria
Simplifying life with embedded control systems engineering
Measurement
Systems
CONSULTANCY
Firmware
Electronics

GraDis - Miniature Control Unit



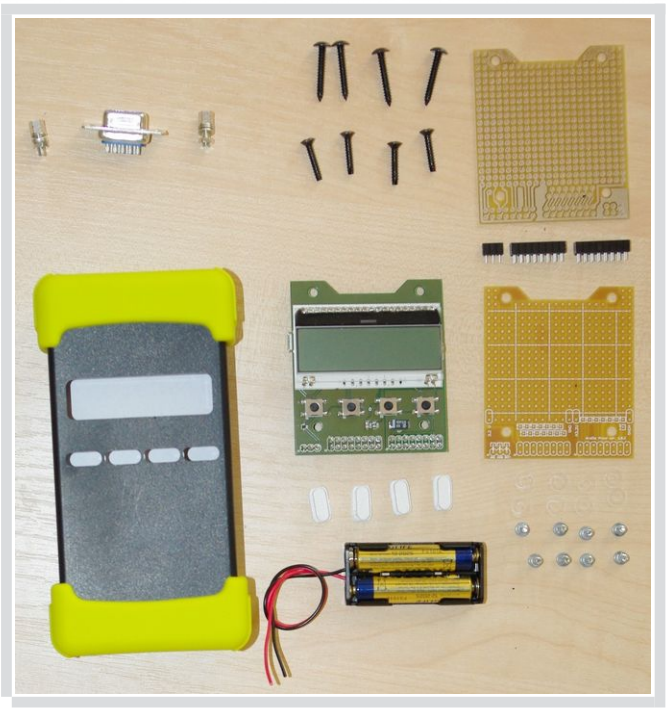
Features:

=> Battery powered with power optimisation
  +> Min 2V with back-light
  +> 2xAAA battery lifetime in years
=> 132x32 pixels dot-matrix display
=> 4 push-buttons for user interaction
=> Up to 74MHz 32bit ARM-Cortex M3 MCU
=> 16 MBytes flash data storage
=> Programmable logic and analogue schematics
=> 1x 20-bit delta-sigma ADC @ 187 SPS
=> 2x 12-bit SAR ADCs @ 1 MSPS
=> 4x 8-bit DACs @ 8 MSPS
=> 4x comparators
=> 4x opamps
=> 4x programmable analog blocks, to create:
  +> Programmable gain amplifier (PGA)
  +> Transimpedance amplifier (TIA)
  +> Mixer
  +> Sample and hold circuit

Useful for:

=> Hand-held instruments
=> Home appliances
=> Manufacturing devices
=> Measurement devices
=> Laboratory devices
=> Medical devices
=> Door controllers
=> "et cetera"

It is good starting point for prototyping an application where simple user interaction is required.



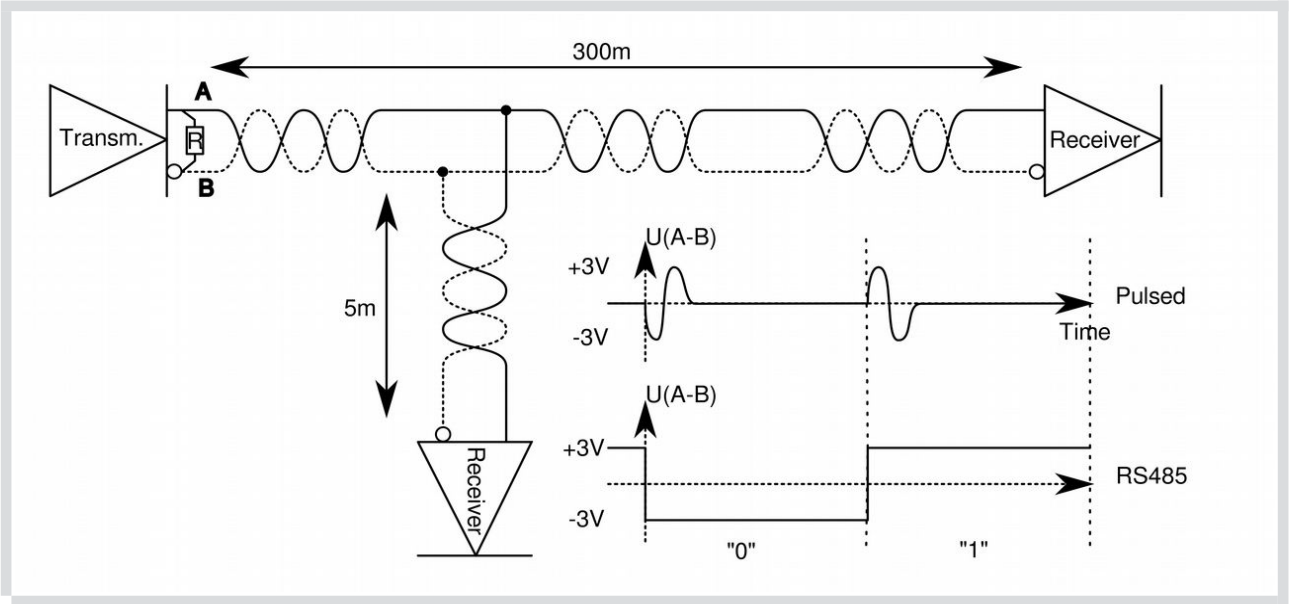
=> CapSense®support, up to 62 sensors
=> On-board USB 2.0 interface with µUSB socket
  +> Other communication options as an extension
=> Cost optimisation possibilities depending on application requirements

Ultra Low Power Wired Field-bus

The communication focus for Internet of Things (IoT) has been mainly wireless with battery powered devices. For fixed installations where power consumption is much higher than a battery would provide during a 10 year period, wired power with wired communication would be needed. Example systems are heating, ventilation and air conditioning. Using wired communication would leave wireless space free for non-stationary communication.

On the physical communication layer the world has many wired protocols, like RS485, M-Bus and so on. We believe that for IoT the power demand for the communication must be even lower than the existing protocols provided. Today's methods require careful wiring because the signal reflections on the bus will make the data reception fail.

We are proposing a physical communication layer protocol that uses short pulsed signals. The data transmission rate will be comparable to RS485. We propose to transmit short pulses of energy on the bus network when the state of the transmitted information bit changes from “1” to “0” or from “0” to “1”. We propose electrical signalling that does have 3 states: “1”,”0” and “n”. State “1” is transmitted on the raising edge of signal voltage ***U*** between wires ***A*** and ***B***. State “0” is transmitted on the falling edge of signal voltage ***U*** between wires ***A*** and ***B***. State “n” means nothing is transmitted and the data remains “1” or “0”. Voltage at the bus state “n” is in the range -0.5V to 0.5V. The bus requires only one signal terminator ***R*** which must consume the reflected signal energy before the moment of the next pulsed signal transmission.

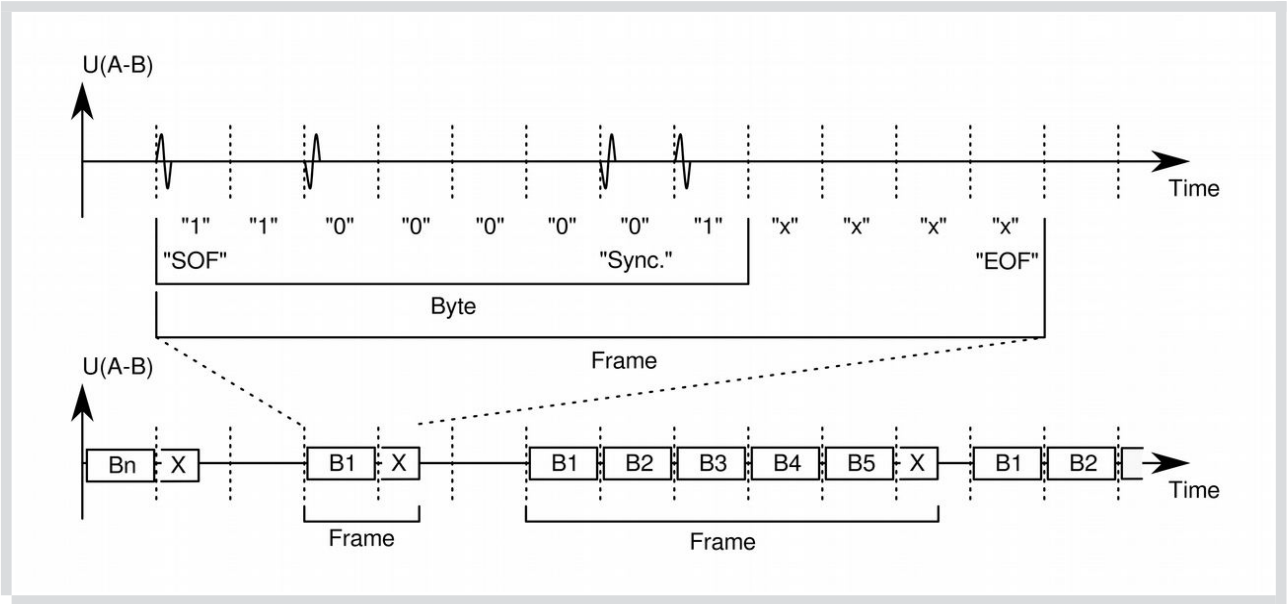


Most of the time, the messaging bus would not be powered in state “n” contrary to the existing systems. Therefore, less energy is spent for the data transmission. The transmitter and the receiver can be designed to consume energy only when the short pulse is transferred.

The reflections on the bus network do not interfere with the data transmission because no reflections will arrive to the receiver before the first edge of the data pulse. The wiring becomes more robust in comparison to RS485.

The bus may be around 300m in length. Short branches in the range of 5 meters are permitted. Estimated half-duplex data rate would be 15.6 kB/*s*.

When the transmittable data does not change during the time of 4 bits, then the pulse of the last state will be re-transmitted for synchronisation of the receiver with the transmitter. The end of data frame (EOF) will be formed by keeping the transmitter in the state “n” during the time of 5 bits. The first pulse for bit “1” or “0” after the EOF is at the same time as the start of the data frame (SOF). Data is transmitted in multiples of full Bytes (8 bits).



Partially transmitted Byte ***X*** must be discarded because it contains no data. Before ending the transmission with EOF, multiple Bytes can be transmitted in tight sequences. The Bytes transferred together will behave as a single stream of bits and there is no need to transmit a pulse at the beginning of every following byte.

The described frame forming requires a Byte transmission time of 8 bits. In RS485 usually the UART frame is used. UART requires a Byte transmission time of 10 bits. The pulsed method has therefore a 25% higher data density at the same baud rate.

Energy spent for forming the signal on the bus is proportional to the voltage in square of the signal and the time length of the signal pulse inside the wire and inversely proportional to the impedance of the signal cable. When signal voltage and line impedance are the same compared to RS485 set-up, then the time length is going to be the only difference. In the case RS485, the voltage is constantly applied over the entire time of the frame transmission. In the pulsed method, the voltage is applied in short slices. As shown before, the amount of pulses depends on the message transmitted.

At the worst case, the binary message **10101010** or **01010101** requires one pulse for every bit. If the pulse duration is 1 micro second and the bit time is 8 micro seconds, then sending pulses on the bus requires 8 times less energy per data bit. UART transmits 10 bits per Byte and pulsed method transmits 8 bits per Byte. Sending pulses on the bus requires 10 times less energy per data Byte than with RS485 at the worst case.

At the best case, the binary message **0**000**0**000 or **1**111**1**111 requires 2 pulses: Start and Sync pulses. It is 4 times less than at the worst case scenario. The bit which requires a pulse is drawn in bold. At the best case the pulsed method requires 40 times less energy than RS485.

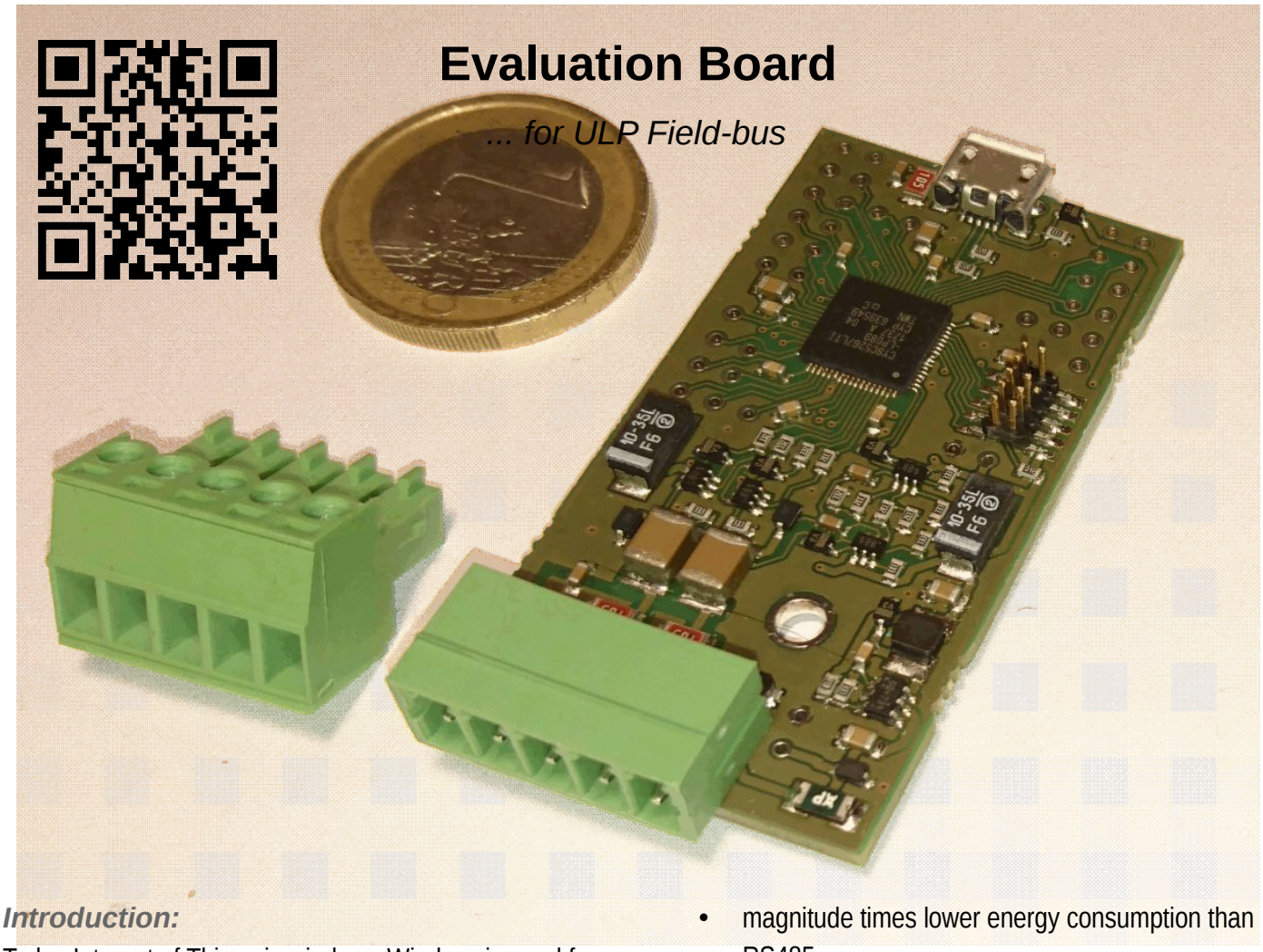
The real energy savings would be somewhere in between the best and the worst case scenarios. For example, the message "Hello World!" transmitted in the ASCII binary encoding (**010**0**10**00 0**11**00**101** **01**1**01**1**0**0 0**11**01**1**0**0 0**11**01**1**11 **0**0**10**000**0** 0**1010101** 0**11**01**1**11 **01**11**0**0**10** 0**11**01**1**0**0** 0**11**00**10**0 00**10**000**1**) would require 51 pulses in total. This is on average 4.25 pulses per Byte and the savings per message is 18.8 times compared to RS485.

The shown signal encoding with short pulses is easy to implement in the hardware. It is possible to implement more complex encoding, where at the worst case scenario the energy savings would be 16 times compared with RS485. The best case scenario would stay almost the same and data density would be the same as for UART. Transmission of the "Hello World!" message would be 23.9 times more energy efficient than on RS485. Because of the high complexity of the mentioned encoding, it is left out from this article.

This article has been published in magazine of "Electronics Maker" on February 20, 2019
https://electronicsmaker.com/ultra-low-power-wired-field-bus

Evaluation Board

... for ULP Field-bus



Introduction:

Today Internet of Things is wireless. Wireless is good for many situations, and it is good to keep wireless ether space silent as Silence is Golden. Therefore Earth, Moon and Mars are going to need a WIRED NERVE SYSTEM of smart buildings and machines. Benefits that Wired Internet of Things brings:

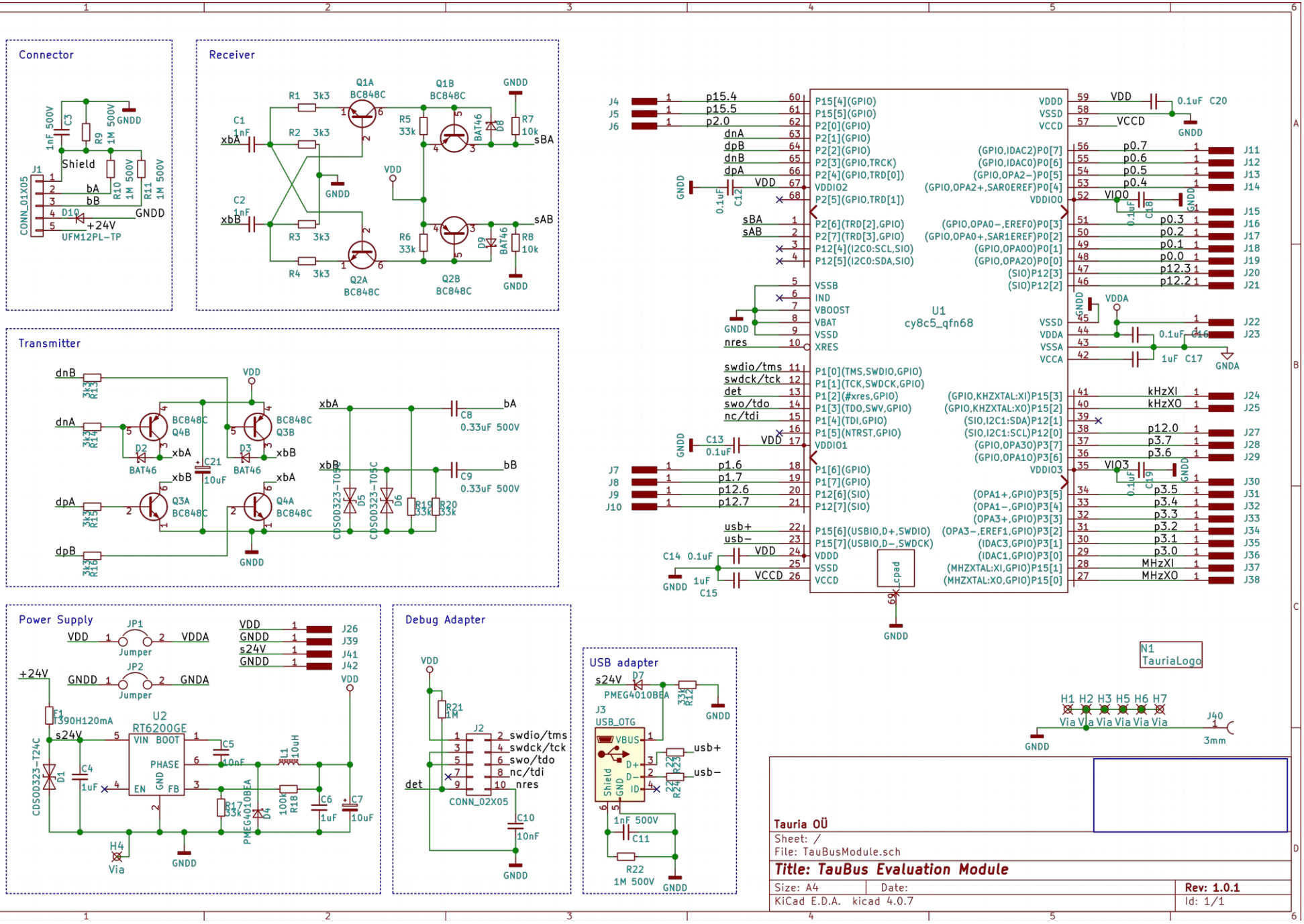
- No batteries and no chemical waste management – power over wire.
- Higher bandwidth– the signal path is narrow line in space.
- Open and easy to understand protocol.
- Suitable for low end and ultra cheap electronics.
- World's record on Low power consumption on wired communication.
- Physical barrier against DoS attack.

This evaluation board offers Transceiver circuit built from few transistors. With this evaluation kit you can participate in World Changing transformation of technology of things communication. The target is:

- Open standard for building Wired Bus Network in true IoT spirit.
- magnitude times lower energy consumption than RS485.
- State of art energy saving on message transfer with Short Pulses.
- Automatic power-on power off during single pulse transfer.

Board Info:

- Cypress 8x8mm QFN-68 PSoC 5LP MCU with programmable logic and ARM Cortex M3 CPU.
- USB connection with PC.
- 5 Wire terminal for 24V bus power, twisted-pair signal and shielding.
- Switched DC down converting power supply.
- 36 IO pin-hole terminals for MCU pins 24V power, 3.3V power for interfacing with your application.
- Cypress UDB and Datapath components for transmitting and receiving (does not require specific libraries), supports DMA and hardware CRC calculation.
- We target the same UDB and Datapath components for PSoC 4 too.


Connector
Receiver
Transmitter
Power Supply
Debug Adapter
USB adapter
U1
cy8c5_qfn68
U2
RT6200GE
Tauria OÜ
Sheet: /
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Title: TauBus Evaluation Module
Size: A4
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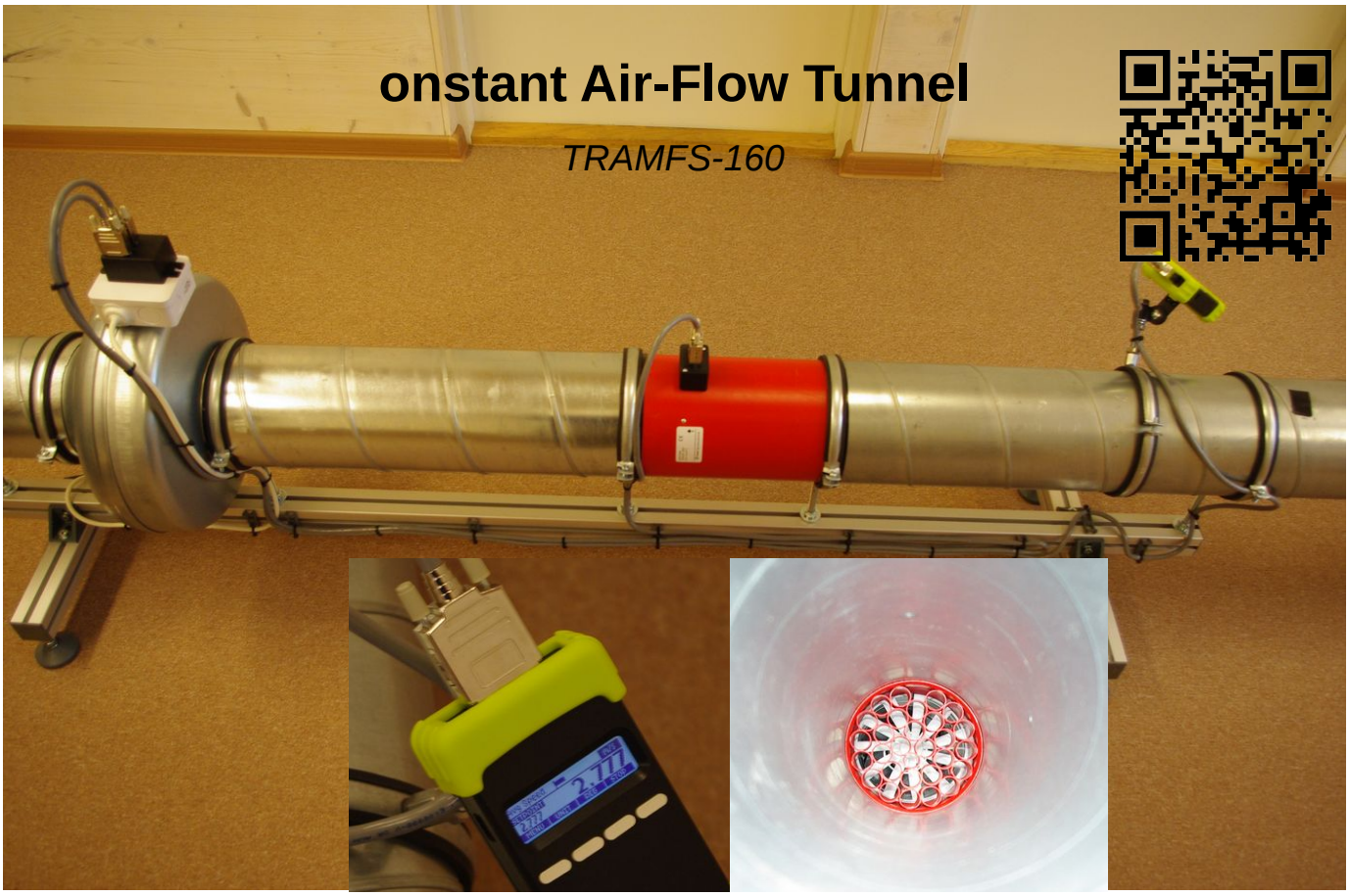
Id: 1/1

onstant Air-Flow Tunnel

TRAMFS-160



This is air-flow reference measure device. It keeps steady airflow through the tunnel and updates the flow-rate 2 times in second. Value is shown on graphical LCD display with back-light. With this device you can:

- Verify that your anemometers are fit to work.
- Train new employees to perform real air-flow measurements on field.
- Tune your air-flow measurement performance.

The device can be placed on floor, on table or mounted on to the wall. Different measurement point options are available: by default we make 2 perpendicular holes with diameter of 10mm.

ATTRIBUTE	VALUE
Maximum dimensions L x W x H:	3 m x 45 cm x 73 cm
Maximum average air speed:	7.6 m/s;* (20 m/s w. booster).
Calibrated range for dia 160mm:	0.69–8.29 m/s *
Reading precision:	5% from reading
Calibrated temperature range:	10–40 oC
Calibrated air pressure range:	900–1100 hPa
Sampling interval:	~0.5 s
Power supply:	AC 240 V 50 Hz

*) The calibration will cover booster speed range. Booster is additional fan and pipework for reaching higher airflow speeds.

Control and value unit does show air-flow in following units:

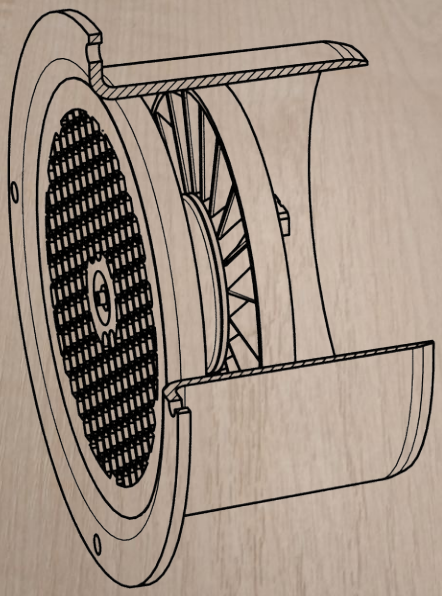
- m3/h – cubic meters in hour,
- L/s – litres in second,
- m/s – average speed meters in second.

Reference anemometer is calibrated to show volumetric airflow: m3/s or L/s. The calculation into average speed is done taking into account that the effective air tunnel diameter is 160mm. When constructing into front of the tunnel a pipe with smaller diameter, then inside that pipe corresponding air speed is higher. When the effective air tunnel diameter is higher, then the corresponding average air speed is lower than shown on display. We can help you to calibrate the display unit to show average speed for your particular tunnel.

Air speed inside tunnel depends on the distance of measurement point. Near the walls air almost stands still and in the middle should be highest. In real system, the airflow is not symmetric either. This reference tunnel resembles real system and shows accurate average speed or airflow volume.

Fresh Air Anemometer

FAM-VF100



The Fresh Air Anemometer is an air-flow measurement device installed stationary into the building management system. It measures the airflow continuously over time. The measurement results are provided periodically with a period of 1–2 seconds. The following data is provided:

- Average airflow [L/s] of last second (period).
- Average airflow [L/s] of last running minute. The value is renewed once in a second.
- Average airflow [L/s] of the last running hour. The value is renewed once in a minute.
- Average airflow [L/s] profile in the last 24 running hours. The profile is renewed once in a minute.

ATTRIBUTE	VALUE
For duct diameter:	100 mm
Calibrated range:	5–15 L/s
Calibrated reading precision:	15% from reading
Calibrated temperature range:	-25–60 oC
Calibrated air pressure range:	900–1100 hPa
Sampling interval:	1–2 s
Measurable range:	2–40 L/s
Power supply:	DC 8–24V
Current consumption @ 24V:	5–6 mA
Resistance* @ 5...15 L/s:	2.6±0.4 L s^{-1} $Pa^{-0.5}$

*) Resistance is measured together with air intake.

The anemometer communicates with the building management system using the industrial standard Modbus RTU communication protocol. The RS485 interface survives up to 48V potential difference relative to a ground signal. The anemometer is capable of automatically adjust to swapped data D1 and D0 signals.

The Fresh Air Anemometer is a crucial part of the system that:

- Makes sure that the room is ventilated according to the required standards.
- Monitors for the need for duct cleaning.
- Together with VAV valves, it balances the ventilation system automatically.
- Compensates for the weather wind effects for the balance of the ventilation system.
- Minimizes energy losses through ventilation by avoiding over-ventilation.
- Distributes heating expenses based on the ventilation.

Contact Us:

Peeter Vois
CEO, CTO

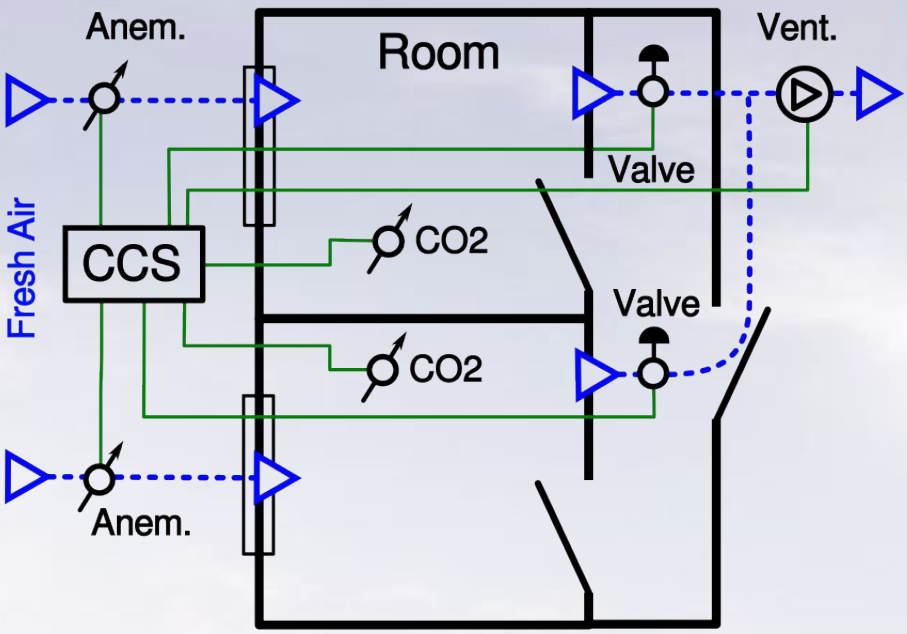
peeter@tauria.ee

Martin Norström
Sales Engineer

martin.norstrom@tauria.ee

Partially Forced Ventilation Application

Fresh Air Anemometer



The Issue of Ventilation Balance:

Passive houses are built with minimal energy losses through walls windows and doors. Together with the very effective insulation, also parasitic ventilation is removed and the air moves only through predefined ducts. House with central ventilation system does have poor control over ventilation of every single room. The ventilation of the room is dependent on the opening of the doors and windows. The wind speed around the house will affect how different rooms are ventilated. It may happen that one room is over-ventilated as other room is under-ventilated.

The Solution for Ventilation Balance:

When ventilation of every room is regulated with the Central Control System (CCS), then all the factors that may cause the room to be under or over-ventilated are compensated by closing or opening the Valves of the different rooms. In order to close or open the valve, reference measurements are needed. For this purpose the anemometer is suitable device.

The Issue of Filter Cleaning Schedule:

Ventilation ducts tend to fill up with the dust. To reduce the expenses of duct cleaning and to improve room air quality, the dust filters are used in the system. When dust filters are filled, then not enough of air does move through the ventilation. The balance of ventilation may change if some rooms produce more dust than others.

The Solution for Filter Cleaning Schedule:

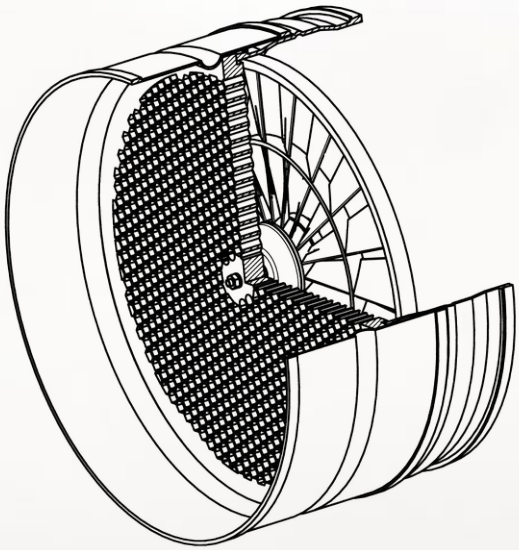
Anemometer gives direct information about the fresh air movement into the rooms. When filters are filling up with the dust the fresh air movement into the rooms will reduce. Thus knowing the information, the CCS can open the valves and increase the Ventilator's speed to compensate the effect. When despite of the countermeasures some rooms are not well ventilated, the CCS can inform about the need of full system clean-up or partial system clean-up.

Detection of Open Window:

When fresh air movement speed into the room through the anemometer drops sharply, then it most likely means that a alternative path of air movement has been created. Either door or window has been opened. This will affect balance of ventilation system. The CCS will then adjust the Valves to keep other rooms ventilated.

InFlow Anemometer

BAM-100,125,160,200,250



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- Average airflow [L/s] profile in the last 24 running hours. The profile is renewed once in a minute.

ATTRIBUTE	VALUE
For duct diameters [mm]:	100, 125, 160, 200, 250
Calibrated range [L/s]:	TBD
Calibrated reading precision:	15% from reading
Calibrated temp. range [ºC]:	-25–60 oC
Calibrated air pressure range [hPa]:	900–1100
Sampling interval [s]:	1–2
Measurable range [L/s]:	TBD
Power supply [V]:	DC 8–24
Current consumption @ 24V [mA]:	5–6
K* @ 5...15 L/s [L s^{-1} $Pa^{-0.5}$]:	TBD

*) Resistance is measured together with air intake.

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The Fresh Air Anemometer is a crucial part of the system that:

- Makes sure that the room is ventilated according to the required standards.
- Monitors for the need for duct cleaning.
- Together with VAV valves, it balances the ventilation system automatically.
- Compensates for the weather wind effects for the balance of the ventilation system.
- Minimizes energy losses through ventilation by avoiding over-ventilation.
- Distributes heating expenses based on the ventilation.

Contact Us:

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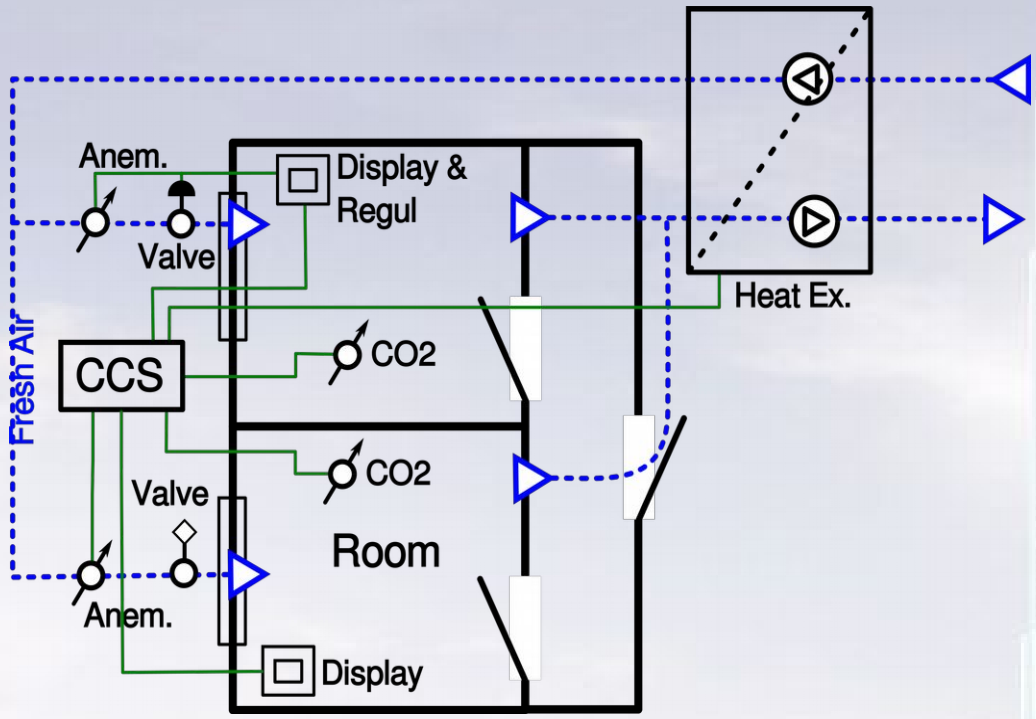
Fully Forced Ventilation Application

Fresh Air Anemometer



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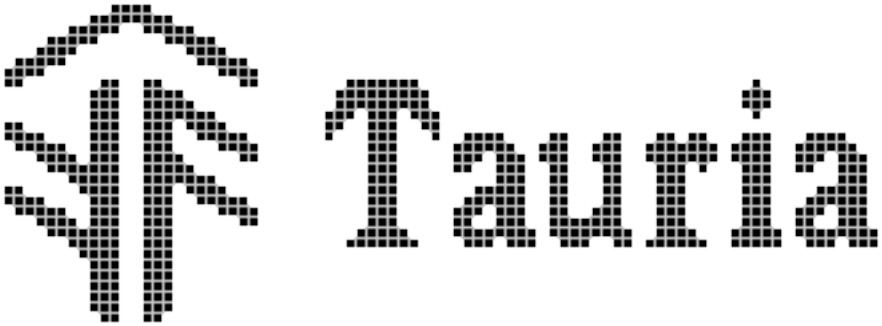

About Tauria

Our Mission:

"Simplifying life with embedded control systems engineering"

Our Services:

We can help you from idea to production with:

- Requirement research, analysis and documentation.
- Proof of concept evaluation.
- Firmware and software development for various micro-controllers 8 & 32 bit and for Linux and servers. (ASM, C, C++, PHP, Python, Javascript, Cypress PSoC UDB components, Verlilog)
- Electronic & PCB design. (Eagle, KiCad)
- Mechanical & 3D design. (Varicad)
- Product management.
- We understand also physics. For firmware development it is good to know how the nature works. We have partners in Estonia who do assembly of the devices in small and large series.

It is possible to help you in many ways:

- Consultancy – intellectual property of developed product will belong to our customer.
- Sales contract – we provide required amount of devices or license to customer with agreed price.

Our Contacts:

WWW: http://www.tauria.eu

E-MAIL: tauria@tauria.eu