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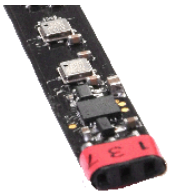

PRESSURE STRIPS DATASHEET

Our Pressure Strips bring a completely new concept into pressure sensing by allowing the measurement of pressure along a line with very little installation effort. It takes the user only a few minutes to install the sensor on the aerodynamic body under investigation while obtaining a large quantity of information.
We have made use of the vast spread of the MEMS technology (Micro Electro Mechanical Systems) in consumer electronics and built our solution on a low cost absolute pressure sensors. This made the concept not only very helpful for the investigation of aerodynamic phenomena but also cost effective for the customers.
These sensors are part of MCCA measurement system (Multi-Constant-Current-Anemometry) that has been under development since 2011.

FEATURES

Concept: The concept of the Pressure Strips consists of 24 miniature absolute pressure sensors spaced by 10 millimeters on a flexible strip that bends easily and repeatedly in the areas between the sensors. Each device is equipped with connectors on each end so that several devices can be connected into each other to obtain a strip up to 4 meters in length.

Pressure measurement: The pressure sensors used are absolute barometric pressure sensors while experimental investigation of pressure distribution on a body usually requires the measurement of pressure relative to a reference pressure. The system supposes the measurement of reference pressure by a dedicated pressure strip and subtracting its value algebraically rather than physically. By using a pressure strip for reference pressure measurement the system gets rid of the temperature dependency of the sensors.

Data interface: Each device contains one microcontroller that communicates with all 24 onboard pressure sensors on one side and shares the data with the outside world via a digital communication bus on the other side. The use of a bus interface allows the users to connect multiple Pressure Strips in any thinkable topology while reading all of their values through a single cable – Figure 1.

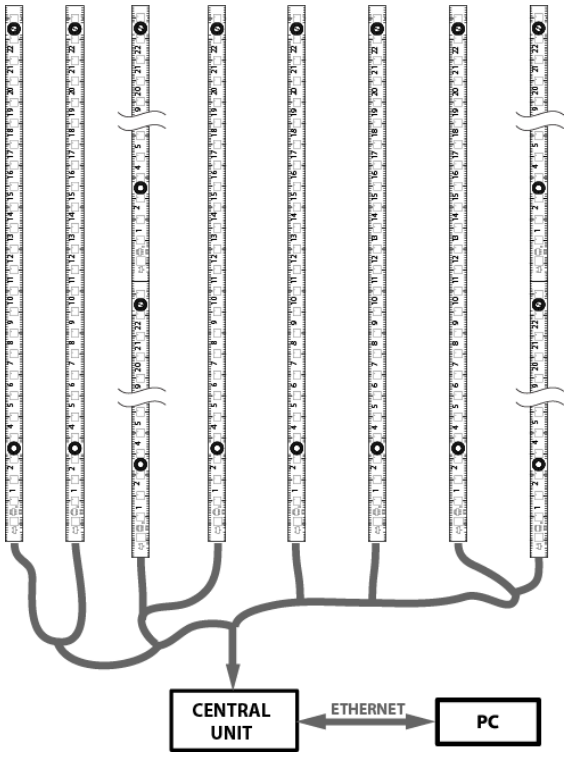

Figure 1: Connection of multiple Pressure Strips by a communication BUS

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PRESSURE SENSORS

Calibration: Custom calibrations of every single pressure sensor used on the Pressure Strips are done to boost up the accuracy. A recalibration interval is not precisely known yet since the sensors have been in use for less than a year. A preliminary calibration interval is suggested for 12 months.

Accuracy: The accuracy of the pressure sensors has been investigated following the custom calibration process and its individual components are summarized in a table. Please note that the reference pressure measurement principle gets rid of the temperature dependency and therefore only nonlinearity and hysteresis error is of concern.

Dynamic properties: The internal sampling frequency of the pressure sensors is little above 60Hz and is internally filtered down to 10Hz to make the reading as close to synchronous across the sensors as possible. However the bottleneck of the data throughput is the communication BUS which allows to read the data at 10Hz from one Pressure Strip, 5Hz from two Pressure Strips and so on.

PRESSURE STRIPS SPECIFICATIONS	
RANGE	
Pressure measurement type	absolute
Temperature range	15°C to 40°C
Pressure range	93kPa to 107kPa
ACCURACY	
Accuracy over full temperature and pressure range	<10Pa
Nonlinearity and hysteresis over full pressure range	<8Pa
Noise	±5Pa
DYNAMIC PROPERTIES	
Sampling frequency	10Hz
Data readout frequency	
1 PSTRIP on BUS	10Hz
2 PSTRIPs on BUS	5Hz
10 PSTRIPs on BUS	1Hz
ABSOLUTE MAXIMUM RATINGS	
Storage temperature	-40°C to 85°C
Operating temperature	-40°C to 85°C
Overpressure	1000kPa

No more than 10 devices on one BUS are suggested. If more Pressure Strips are needed it is suggested to use multiple Central Units and multiple BUS lines.

MECHANICAL PROPERTIES

Dimensions: Outline dimensions of the Pressure Strips are summarized in Figure 2. Please note that the pressure intake does not correspond to the geometrical center of the pressure sensors. The maximum total height of the device is 1.1 millimeters.

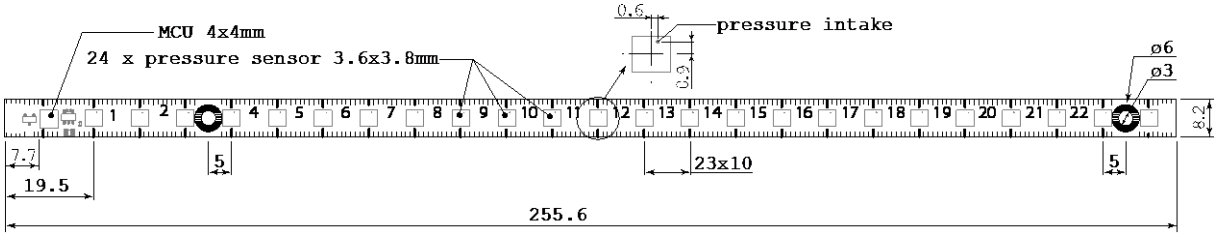

Figure 2: Outline dimensions of the Pressure Strips

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APPLICATION

General suggestions: To make a full use of what Pressure Strips offer it is suggested to place the devices at locations with high pressure gradients. When intended to compare with computational results there will also be an error of position uncertainty. To minimize this error it is suggested to position the devices parallel to the direction of expected pressure gradient.

Invasiveness: The non-negligible outline dimensions of the Pressure Strips cause a certain amount of invasiveness towards the investigated velocity (thus pressure) field. The invasiveness has been investigated first at general aerodynamic bodies then at road vehicle specific applications. The problem may be generally divided in two parts:

1. Distortion of aerodynamic properties of the investigated body.

2. Additional pressure reading error caused by local pressure field generated at the pressure sensors by aerodynamic effects.

Although generally both of the mentioned effects have been found to have non-negligible influence in laminar flow problems, neither of them was visible at high Reynolds flow situations. Concerning road vehicle specific situations there have been no indices showing either of the two effects, although a hard proof has not been obtained.

MEASUREMENT SYSTEM

Hardware connection: The connection of the sensors via the communication BUS is made as simple for the user as possible. A set of cables is available in various lengths with splitters to build custom network topologies. Up to 10 Pressure Strips (maximum suggested amount) can be connected together so that all of their values can be read through a single cable. Central Units with an ETHERNET interface are available for data readout - Figure 3.

Figure 3: Central Unit for data readout with an ETHERNET interface.

Software User Interface: Once the hardware connections are finished the user starts a dedicated software that automatically searches for connected sensors – no setup is needed. The UI displays a preview of the sensors reading for instantaneous analysis. The software is licensed under CTU and comes free with the sensors.

Devices identification: Each Pressure Strip is issued a unique identification number at the end of the manufacturing process that helps its identification throughouht the installation, measurement and postprocessing process. Additionally each device may be issued a specific string name during installation for an easier postprocessing.

Postprocessing: An automatic postprocessing tool is available as a set of Matlab scripts and funcions. The user is responsible for licensing of the Matlab enviroment.

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CONTACT

Please, contact 4Jtech, s.r.o. for more information. We will be happy to answer any of your questions.

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DOCUMENT REVISION HISTORY

Nov 3, 2014	Revision 00	Preliminary release
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