# RutDevKit-STM32L5 reading SGP30 sensor data and transmit with HMS Anybus EtherCAT demonstration

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***Abstract* – Rutronik developed the RutDevKit, which consists of the STM32L562 microcontroller. Sensirion has developed the SGP30 digital multi-pixel gas sensor with two air quality signals (TVOC and $CO_2$). With Anybus, HMS provides the solution for all industrial communication protocols.**

***Index Terms* — *Microcontroller (MCU), Anybus Compact Com (ABCC), Graphical User Interface(GUI),), Central Processing Unit (CPU), Sensirion Gas Sensor (SGP30), Total Volatile Organic Components (TVOC), and Carbone Dioxide ($CO_2$), Programmable Logic Controller (PLC), Universal Asynchronous Receiver Transmitter (UART), Visual Studio (VS). Serial Peripheral Interface (SPI), Anybus Compact Com (ABCC)***

## I. Introduction

This demonstration shows how sensor data (SGP30) is processed RutDevKit-STM32L5 and then transferred to a PLC on an industrial communications bus (Anybus). The used protocol in this demonstration is EtherCAT. The PLC appears as a desktop PC with Beckhoffs TwinCAT software. Figure 1 shows the demonstration hardware components, which are RutDevKit-STM32L5, RutAdaptboard-HMS and the SGP30 sensor is connected using the mikroBUS interface on the Arduino-mikroBUS adapter board.


Fig. 1 Hardware Components

Sensor values are displayed using an application, which is created via Microsoft visual studio and Beckhoff Automation Software TwinCAT. The HMS Anybus protocol is EtherCAT its one of many protocol which HMS Anybus provides. The transaction goes through the RutAdapbtBoard-HMS which consists of the NP40 HMS Chip. The Chip act as a slave and generates a configurable industrial field protocol. In this demonstrator, the protocol is Etcher CAT. The Communication between RutDevKit-STM32L5 and RutAdaptBoard-HMS is implemented via a serial interface. In this demonstrator it is UART.
Figure Version 2 shows the block diagram with connected components.

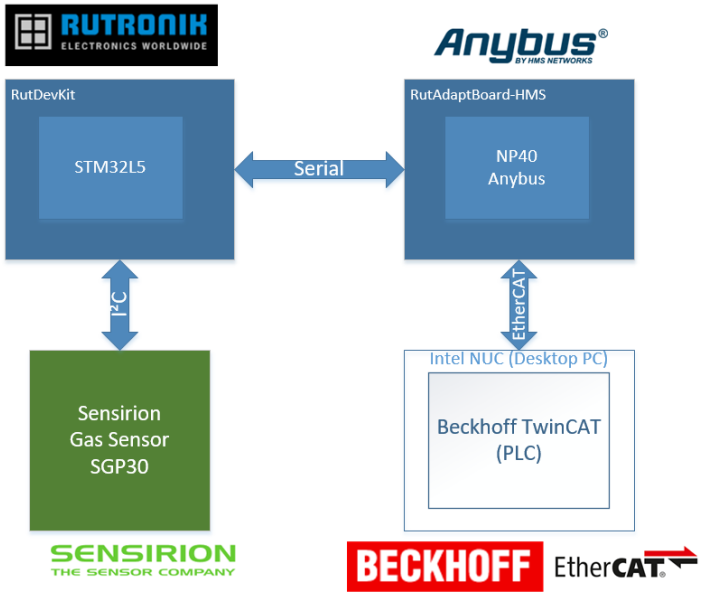


Fig. 2 Block Diagram

## II. PROGRAMMING

The firmware example runs on the STM32L562ZET6Q MCU located in RutDevKit. It was build-using STM32CubeIDE – a free integrated development environment, which is provided by STMicroelectronics. Figure 3 shows the main flowchart of the demonstrator:

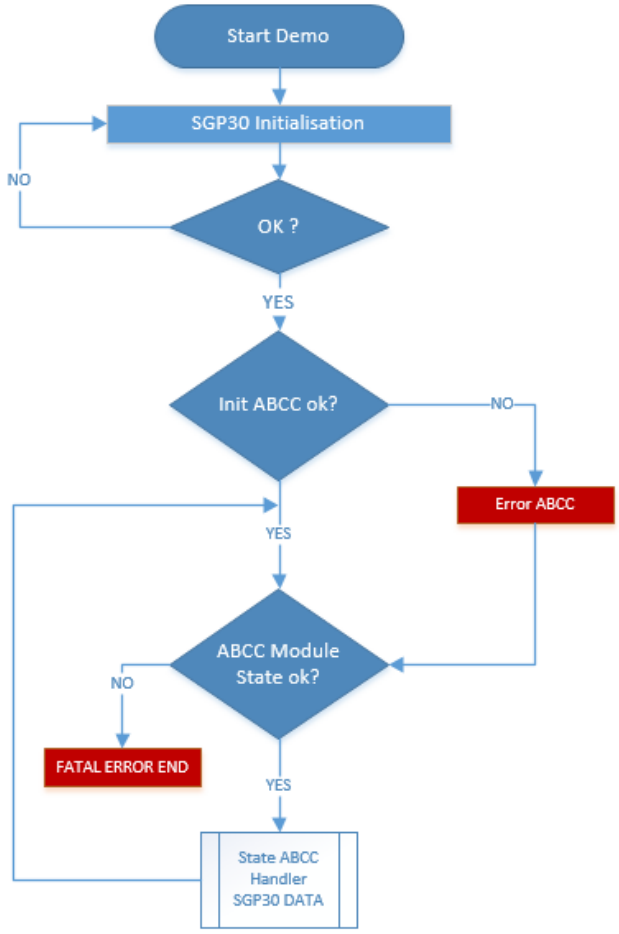


Fig. 3 Flowchart

First the SGP30 initialization will take place. The sensor data transmission handles the I²C interface. After the SGP30 initialization the sensor values are mapped through the ABCC as a data field for the industrial protocol, which is configured in the ABCC initialization. The ABCC driver starts a state machine and calls a state handler. In the state handler, the mapped data will be prepared to perform a transmission to the master, which is PLC TwinCAT. The ABCC state machine can be extended for more variables or more states. SGP30 Sensor data is refreshing every second. The EtherCAT protocol, which gets all the sensor data, is transferred much faster and the sensor data sampling in fact takes place every 60-millisecond, in this demonstrator application.

### *A. PLC Object mapping and GUI design via VS*

TwinCAT detects automatically the EtherCAT protocol when it's correctly configured in Box 1 (CompactCom 40 EtherCAT). Figure 4 shows the TwinCAT project tree with mapped objects.

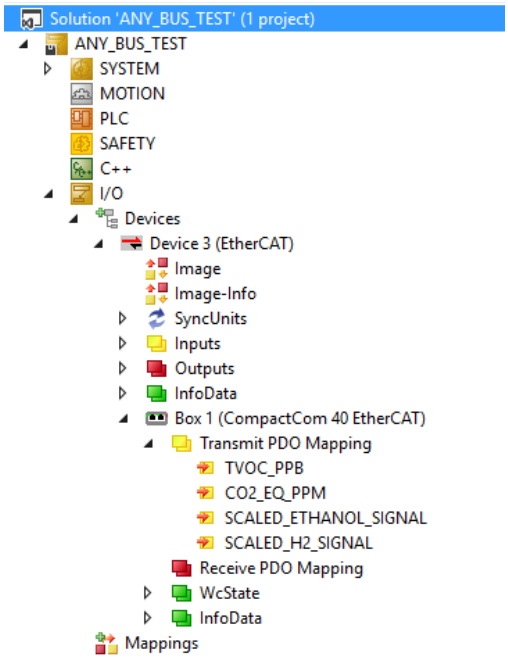


Fig. 4 TwinCAT Project tree

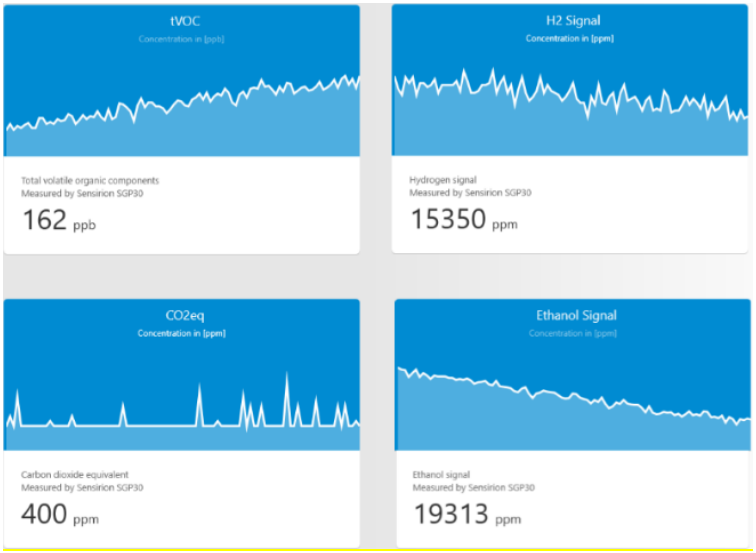


Fig. 5 Gas Sensor Graphical Demonstration

Figure 5 shows the diagramms of data from the sensor. The **$CO_2$** values are displayed in three different colors: blue, orange and red. The application will change the diagrams color from blue to orange if the **$CO_2$** value is bigger than 1000 ppm (parts per million). If the value is even bigger than 2000 ppm, the color will change from orange to red. Guide range limits values for carbon dioxide concentrations in indoor air areas:

- Source: https://wissenwiki.de/Kohlenstoffdioxid

## III. GUI Presentation

Figure 11 shows the whole GUI from the Desktop PC where two applications are running at the same time. The Graphic GUI is presents the Visual Studio software and the data delivering is performing by the PLC TwinCAT from Beckhoff.

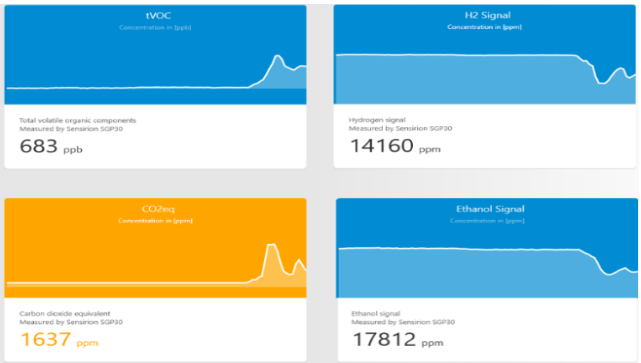


Figure 6 **$CO_2$** value > 1000

Figure 6 shows a warning state because the bad air quality rises above 1000 ppm. Figure 7 shows a higher danger scenario witch **$CO_2$** value >2000 ppm

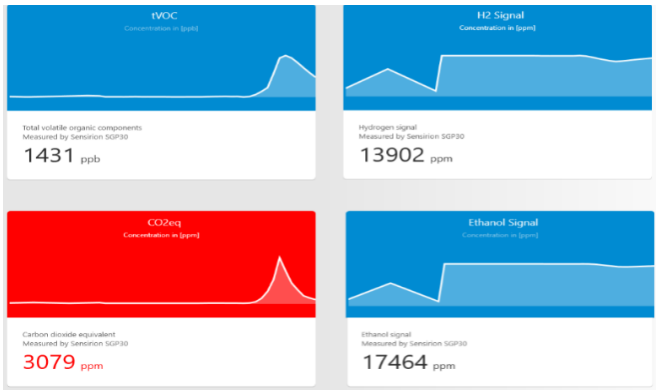


Figure 7. **$CO_2$** value > 2000

## IV. Summary

This demonstration shows how the RutDevKit is able to work witch the HMS ABCC device via the UART interface. In addition, the MCU transmits in a very efficient I²C process the SGP30 gas data. The MCU can also communicate via the SPI interface, which transmits data faster in a full duplex mode. All interfaces can be monitored and reach a high safety standard by the AURIX controller.

## References

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