



# The Smart Workpiece Carrier

## Strain Measurement with the XDK



# XDK

### Introduction and Challenge

*How can we measure strain during production? Engineers producing oxygen sensors for Bosch needed a wireless solution to determine where unwanted strain could occur and cause possible damage to the parts during production. The products in question are lambda sensors that regulate gas and diesel engines. Undetected misalignments may damage the oxygen sensors during production. Strain is one of the physical properties that can be monitored to control its impact on product delivery and sensor cost.*

### Approach

The Cross Domain Development Kit (XDK), introduced by Bosch Connected Devices and Solutions (BCDS) in 2016, provides a wireless solution to the problem. The XDK contains a wide range of microelectromechanical systems (MEMS) sensors from Bosch Sensortec and Akustica, both fully owned subsidiaries of Robert Bosch GmbH. They are specialists in MEMS sensors and microphone solutions with the know-how to make consumer products smarter and more connected. The XDK is not much larger than a matchbox (60 x 40 x 22 mm), contains a battery and the eight most popular sensors, and can be connected with

other devices via USB, Bluetooth or Wi-Fi. The small form factor of the XDK makes it possible to fit the kit onto the workpiece carrier.

Drivers for all system components are included. The functionality of the XDK can also be expanded to build in new features by using the included extension board. An operating system is already on the XDK and ready to go. It is based on the open source operating system FreeRTOS, enabling real-time IOT applications. The XDK offers the possibility of using all the desired hardware components with the API provided.

## Use Case

Manufacturing engineers in South Carolina working for Bosch requested assistance to improve strain measurement in the oxygen sensor production. “They had a wired measurement system using National Instruments equipment that was connected to a laptop via USB”, explained Joe Nater, Engineering Development Technician at Robert Bosch.

“Our task was to change the wired system to a wireless system. The Bosch XDK worked out to be the best solution because of its size to fit on a workpiece carrier, and easy-to-integrate external transducer measurement.” The result is the XDK Smart Workpiece Carrier.

**Joe Nater, Engineering Development Technician at Robert Bosch**

The Bosch XDK is installed on the workpiece carrier (a tray that secures parts during production) to gauge the strain during production of oxygen sensors. Four off-the-shelf strain gauges are mounted to the part during manufacturing. These gauges are connected through adapters to the XDK’s expansion port.

On the software side, a data streamer program on the XDK Workbench is used for data processing. The data are transmitted wirelessly from the XDK Smart Workpiece Carrier to an iPhone app.

The measurement system will be developed further. “One of the next steps will be to integrate two I/O channels instead of one channel, with no lag in data transfer”, said Travis. “With the limitations of the low sample rate, we will see if all important data is collected. After that, we will give feedback to the XDK development team to help implement the best possible solution.”

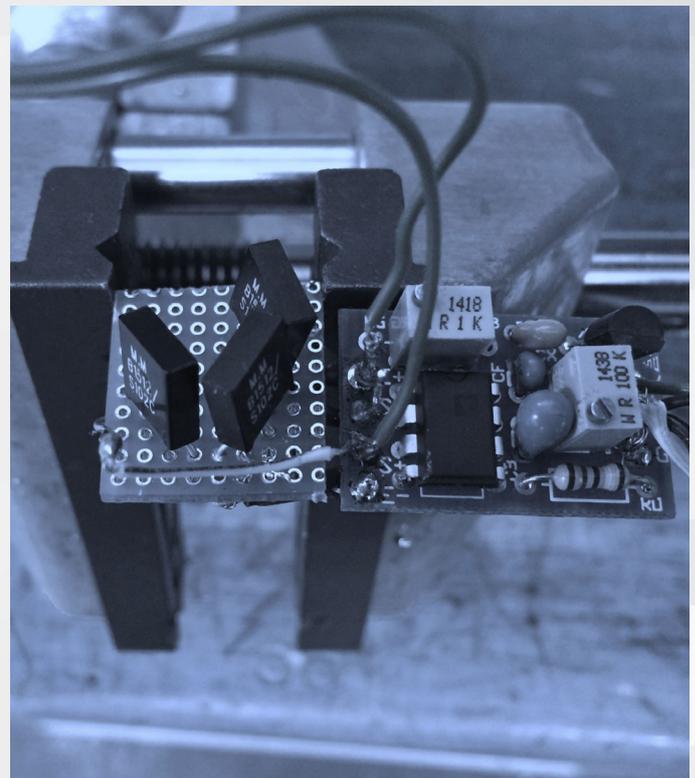
## The Role of Bosch Connected Devices and Solutions

As an innovative company, Bosch Connected Devices and Solutions (BCDS) can draw on extensive experience in sensors and software solutions. By combining our expertise with partners from different business entities such as Bosch Sensortec and Akustica, we can enable new value proposals and new ways of creating value.

With the XDK, BCDS offers an all-in-one scalable hardware platform with ready-to-use software. There is no need for component selection, hardware selection, hardware assembly, or deployment of a real-time operating system. Drivers for all system components are included.

In addition BCDS offers the XDK Workbench, a development platform that every buyer of the XDK can download free of charge, along with typical applications and a user community.

The XDK Smart Workpiece Carrier provides wireless technology for strain measurement at a good price. The small form factor of the XDK is another important reason for choosing this solution.



## Solutions and Benefits

In this use case, the motivation was to develop a wireless application to monitor strain, impacting product delivery, product cost, and product sustainability during production. Right now the work focus is on strain measurement during oxygen sensor manufacture. The smart workpiece carrier can be implemented for other products to monitor other physical properties related to product damage by taking the right signal condition input through the external connector block to the I/O.

The XDK can thus be used as a predictive maintenance and part protection tool with the help of historical data collection. This is a first step towards a smart manufacturing process where data are used to optimize production. Beyond the measurement of physical properties of products, the XDK can also be used for troubleshooting purposes in all kinds of applications. It is possible to collect a large quantity of data relevant to site safety with the aid of the different sensors.

## Conclusion

This use case, monitoring product properties during production, shows the potential of the XDK as a tool for smart manufacturing applications. Benefit from this solution can be realized by using the XDK for measuring further physical properties or for optimizing maintenance of production facilities. The adjustment of production processes to the requirements of new product lines can be speeded up and customized individually by collecting large amounts of data. This can improve product quality and profitability of production lines. The manufacturing process becomes smarter, safer and also more environmentally sustainable. The increased flexibility and adaptability will allow manufacturers to more effectively address today's dynamic, global markets.



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## About Bosch Connected Devices and Solutions

*Bosch Connected Devices and Solutions GmbH is based in Reutlingen, Germany and is a 100% owned subsidiary of Robert Bosch GmbH. As an innovative company, it serves the new market for the Internet of Things. We offer compact electronic devices, comprehensive software and end-to-end solutions in many fields of application. Our main businesses are in the areas of Connected Mobility and Industry 4.0 and Logistics. We improve everyday life, increase comfort, security and productivity.*

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