



# Embedded Algorithm Testing Using JTAG

## Success Story

### Customer

One of our clients in the gas detection industry is renowned for offering a broad range of devices, from off the shelf instruments to special peer network structured instruments. The instruments that this company develops help save human lives in industrial environments and hazardous places on daily basis.

They have offices in 20+ locations worldwide, 20,000+ live instruments and 5000+ networks containing devices as a service. This company takes the gas detection responsibly and provides hassle free services including the standard compliances required for the gases emission and detection. Undoubtedly, quality is of utmost importance in situations where the lives of workers in a manufacturing area or residents of a community depend on you.

The major services provided by this company include:

- » Gas detection in hazardous environments
- » Gas assessment sharing between instruments
- » Gas detection as a service
- » Area profiling for prediction of possible dangers in future
- » Compliance of gas detection in industries for regulatory purpose

### Challenges

For safety critical embedded systems, precision of environment variables being measured is of the highest importance.

This company engaged Powersoft19 SQA to measure and monitor values of toxic gases in the atmosphere in order to warn workers of hazardous atmospheric conditions.

The instruments were required to sense physical conditions, convert physical conditions into electrical signals, record these as data and then turn the data into visible readings on the instrument.



Once converted to electrical signals, the algorithm that takes these electrical signals and scales them to an industrial standard reading value needed to be tested with absolute precision. Any oversight in the algorithm could lead to catastrophic results in the field. For example, a gas of 100PPM (Parts per million) could be interpreted as 10PPM (Parts per million) if a decimal coefficient of algorithm was overlooked.

### Solutions

To successfully carry out the testing of the algorithm, we needed to perform tests based on a specific set of values acquired from the algorithm mathematically. This specific set of values included all border conditions, upper and lower limits of the algorithm in test.

In order to overcome these challenges, we used code debugging with the JTAG (Join Test Action Group) standard which enabled us to recreate the actual scenario and execute the firmware step by step. Using the JTAG, we were able to test, monitor and imitate the behavior of the instruments' algorithm in safety critical situations.

We performed following techniques of testing on this algorithm using JTAG:

- » Equivalence Class Partitioning
- » Boundary Value Analysis
- » Business Decisions Testing

For enhanced coverage of the algorithm, our safety experts and ISTQB certified technical analysts went one step further and designed test cases based on Modified Condition/ Decision Coverage technique to make sure that no error was left unearthed from the algorithm part.

## Achievements

Following are the key achievements of this project:

- » Grey-box testing with JTAGs and Emulators
- » MC/ DC technique and its applications
- » IAR Embedded Workbench Tool
- » Analysis of parameters constituting algorithm of gas detection sensors

## Business Results

- » Extensive testing of algorithm helped the client achieve high quality of the product with no report of algorithm failure or missed gas detection
- » The improved product quality brought an increase in the number of satisfied customers to the gas detection company
- » Reduced product maintenance costs and risks improved the product profitability

## Contact Us

Explore ways to use our expertise in growing your business while establishing a valuable partnership with us.

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