

# Appendix: Checkmate sensor device

This case has been prepared by the Interdisciplinary Centre for Digital Business Development (DBD), Aarhus University. The case is based on the DIATOMIC project 'Industry 4.0 Living Lab for Acoustic Panel Production' led by Tom Collins. Case authors are Emilie Mathilde Jakobsen and Anita Krogsøe Skou at DBD.

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# PULSE CHECKMATE

# A smart sensor to monitor vibration, temperature humidity and more

Checkmate is a simple to install sensor that connects automatically to Pulse Online, providing real-time visibility, automated alerting, scheduled reports and the ability to review and analyze past data.

It is constructed from a wireless micro-controller with integrated sensors, GSM connectivity, dynamic data protocols and a range of apps that can be installed like on a smartphone

Motors - Electrical motors literally drive industry, using a combination of vibration and temperature checkmate sends alerts based on manufacturer guidelines, helping identify faulty, bearings, cooling issues or alignment

Pumps - Checkmate helps identify faulty pumps using vibration readings to infer pressure issues, excessive usage and temperature spikes.



General machinery - Install in difficult to reach places, moving operations or dangerous spots and safely monitor from anywhere. Checkmate can use an accelerator to detect motion and easily by report abnormal movements

Environmental - Using ambient temperature and humidity, Checkmate can be used in substations, electric boxes and controlled rooms to prevent overheating, identify poor ventilation and many other factors



Extending Checkmate features - Checkmate is a reference design Smart device and extension to the Pulse Online Cloud. It can be extended with new sensors, processing logic or radio modules. Our software can also be used in other PLC devices and microcontrollers, connecting to a network or running independently.

## **TECHNICAL SPECIFICATIONS**

I/O Instrumentation: Vibration detection using 9 axis MPU accelerometer at ±2 ±4 ±8 ±16 Temperature range -40°C - 125°C Humidity range 0 - 100%RH

Measurements: a. mm/s. ° dearees. °C. °F. Kelvin. % RH

Microprocessor: Ultra-low power ARM Cortex-M4F

Operating System: Real-time Operating System

Local storage: Default power:

Mount: Epoxy, magnet, steel banding, custom mounting eyes, threaded mounts. Regulatory compliance - application specific needs on

case by case basis Dimensions (LxWxD): 95 × 57 × 28 mm Weight: 283g



### **CLOUD & CONNECTIVITY**

Cloud technologies : Microsoft Azure Com pute server running Docker .NET, Node.js MongoDB, MSSQL

Messaging & Interfaces: Near real-time: MQTT, AMQP, STOMP Microsoft Azure Service Bus REST Historical data endpoints REST Management endpoints REST User endpoints

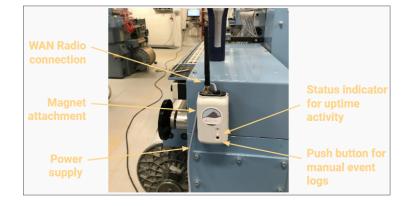
Basic connectivity: GPRS downlink: 85.6 kbps, uplink: 42.8 kbps Modular add-on board provide network connectivity with alternative connections possible such as LPWAN and WiFi

### Operators:

Existing operators with international support, Orange (Belgium), TDC, Vodafone (Denmark)

# Security, Privacy and GDPR:

Security, Privacy and GDPR: Encrypted dedicated platforms ensure client security using SSL certificates Data stored in EU data centres hosted by Microsoft. Personal data relating to user accounts require https secure connections and encrypted passwords.



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