CERTIFICATE NUMBER	23-2464814-PDA
EFFECTIVE DATE	26-Oct-2023
EXPIRY DATE	25-Oct-2025
ABS TECHNICAL OFFICE	Hamburg Engineering Department

CERTIFICATE OF

Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

IMPEDANCE DATAVIB

located at

80 DOMAINE DE MONTVOISIN, GOMETZ LA VILLE, France, 91400

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product:	**Smart Functions**
Model:	**Smart Engine Condition Monitoring System VIB360 SMART**
Endorsements:	**Smart**
Tier:	**2 - PDA Issued**

This Product Design Assessment (PDA) Certificate remains valid until 25/Oct/2028 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau of Shipping

Efstratios Maliatsos, Engineer/Consultant

NOTE: This certificate evidences compliance with one or more of the Rules, Guides, standards or other criteria of ABS or a statutory, industrial or manufacturer's standards. It is issued solely for the use of ABS, its committees, its clients or other authorized entities. Any significant changes to the aforementioned product without approval from ABS will result in this certificate becoming null and void. This certificate is governed by ABS Rules 1-1-A3/5.9 Terms and Conditions of the Request for Product Type Approval and Agreement (2010)

IMPEDANCE DATAVIB
80 DOMAINE DE MONTVOISIN
GOMETZ LA VILLE
France 91400
Telephone: + 33 (0)1 69 35 15 25
Fax: + 33 (0)1 69 35 15 26
Email: a.mayerowitz@impedance.fr
Web: www.vib360world.com

Tier: 2 - PDA Issued

Product: **Smart Functions**
Model: **Smart Engine Condition Monitoring System VIB360 SMART**
Endorsements: **Smart**

Intended Service:
Machinery Health Monitoring (MHM) - Tier 2

Description:
System solution providing implementation of Diagnostic Health Monitoring Functions for Engines.
DataVIB360 is a state-of-the-art early warning Condition Monitoring System. The system is engine-agnostic and does not require test bench or historical data for predicting engine health at the cylinder level.
It utilizes non-intrusive sensing techniques to monitor the Torsional Vibration (deviations in Instantaneous Angular Speed) of the Crankshaft to detect the individual cylinder specific anomalies at nascent stage.
DataVIB360 employs edge analytics, translating the analog data into a dashboard.
With a local storage capacity of 50,000 data points in its intelligent controller, the solution provides data trending, real-time alerts, troubleshooting prompts.

Rating:
DataVib 360 Intelligent Controller (Power Supply: 24 VDC, CPU: 8 GB eMMC, 766 MHz)
FW Sensor (Up to 20 KHz, Resistance: 850 OHm ± 10%)
TDC Sensor (MPU - Up to 20kHz / 850 ohms ± 10% / Piezo electric Peak Press Sensor : 0~5V output signal)

Service Restriction:
Unit Certification is not required for this product.
If the manufacturer or purchaser request an ABS Certificate for compliance with a specification or standard, the specification or standard, including inspection standards and tolerances, must be clearly defined.

Comments:
1. DataVIB360 SMART is assessed as an MHM Tier 2 Smart Function in accordance with section 5 of the ABS Smart Functions Guide.
2. DataVIB360 SMART is assessed for LOW risk in accordance with section 2 and section 6 of the ABS Guide for Smart Functions for Marine Vessels and Offshore Units (Smart Functions Guide).
3. This assessment covers only the Smart Function capability, including algorithms and models, and does not cover the cloud aspects, of the software, and does not warrant that the software is free of any bugs or other anomalies.
4. The assessed version of VIB360 SMART analyzes operational data using physics-based algorithms and models.
5. Subsequent significant modifications to the software, related to, or affecting, the Smart functionality of the assessed version of DataVIB360 SMART, are to be submitted to ABS.
6. Data collection and streaming to DataVIB360 SMART software platform are to be reviewed by ABS for each installation in accordance with the ABS Smart Functions Guide.
7. Each particular application and tool customization is to be approved by ABS.
8. Installation and Commissioning Survey is to be carried out onboard each marine vessel/offshore unit, in accordance with Section 8/2 of the ABS Smart Functions Guide
9. Power and data cables are to comply with the cable requirements in 4-8-3/9 of the Marine Vessel Rules, and with the cable installation requirements in 4-8-4/21 of the Marine Vessel Rules.
10. Power cables are to comply with the cable sizing requirements in 4-8-2/7.7 of the Marine Vessel Rules.
12. The hardware modules and sensors are to be designed such that they will withstand the test conditions stipulated in 4-9-9/Table 1, Nos. 17 and 18 of the Marine Vessel Rules, as applicable.
13, All Risk Levels: Power supplies are to comply with 4-8-3/1.9 of the Marine Vessel Rules.
14. When the hardware modules and sensors are to be installed in a physical location where ambient conditions may affect the system dependability and performance, the module and sensor are to be properly protected, and the protection is to satisfy the requirements in 483/1.11 of the Marine Vessel Rules.
15. The Manufacturer has provided a declaration about the control of, or the lack of Asbestos in this product.

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GOMETZ LA VILLE
France 91400
Telephone: + 33 (0)1 69 35 15 25
Fax: + 33 (0)1 69 35 15 26
Email: a.mayerowitz@impedance.fr
Web: www.vib360world.com

Tier: 2 - PDA Issued

Notes/Drawing/Documentation:
See Attached File

Terms of Validity:
This Product Design Assessment (PDA) Certificate remains valid until 25/Oct/2028 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

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STANDARDS

ABS Rules:
- 2023 Rules for Conditions of Classification, Part 1 - Marine Vessels Rules 1-1-4/7.7, 1-1-A3, 1-1-A4
- 2023 Rules for Conditions of Classification, Part 1 - Offshore Units and Structures: 1-1-4/9.7, 1-1-A2, 1-1-A3
- 2022 Guide for Smart Functions for Marine Vessels and Offshore Units

National:
NA

International:
NA

Government:
NA

EUMED:
NA

OTHERS:
NA

23- 2464814-PDA

IMPEDANCE DATAVIB (479333)
Attachment to
23- 2464814-PDA covering
Smart Engine Condition Monitoring System VIB360 SMART
Issuance Date: 26-October-2023
Expiry Date: 25-October-2025
Intended Service:
Machinery Health Monitoring (MHM) - Tier 2

Drawing List

Engineering Office:	Hamburg Engineering Department	
Submitter:	IMPEDANCE DATAVIB (479333)	
Drawing No	**Revision No**	**Drawing Title**
PDA Application Form	-	PDA Application Form
Correspondence	-	Data VIB360 ABS Preliminary Comments on ConOps
Correspondence	-	Smart_Functions_Marine_Presentation_Neptunus Power_Oct_2022_Detailed_R1
Correspondence	-	Request Client
Correspondence	-	Correspondances_Risk Assessment_Outcome
VIBOX2 Specifications v1r0 07	-	VIBOX2 System Specifications v1r0 07
Correspondence	-	Smart Guide Risk Level Assignment_External(MHM)
Smart Guide Risk Level Assignment_External(MHM_Tier II)_Client_IMPEDANCE	-	Smart Guide Risk Level Assignment_External(MHM_Tier II)_Client_IMPEDANCE
2023 07 VIB360 User Guide - V1	-	2023 07 VIB360 User Guide - V1 (Smart Description and System Specifications)

2023 10 ABS -System Assessment Response - PDA	-	2023 10 ABS -System Assessment Response - PDA
2023 10 docx for clarification for TDC and FW (Smart Function Description)	-	2023 10 docx for clarification - ABS notes (Smart Function Description)
2023-10- Vib360-Anomaly Detection Backend and UI_Spec_ConOps	-	2023-10- Vib360-Anomaly Detection Backend and UI_Spec_ConOps
2023-10-20-VIB360 WORLD-39_S ARM SOLUTIONS-BROCHURE - ABS	-	2023-10-20-VIB360 WORLD-39_S ARM SOLUTIONS-BROCHURE - ABS
SEPT - Supporting explanation (Functionl Assessment)_System Description	-	SEPT - Supporting explanation (Functionl Assessment)_System Description
2022-11-Vib360-Product -ABS PDA Documentation (1)	-	2022-11-Vib360-Product -ABS PDA Documentation (ConOps)
Functional Requirements_Document Submission for ABS PDA_2	-	Functional Requirements_Document Submission for ABS PDA_2
2023-07-Operation Manual_VIBOX Conroller	-	2023-07-Operation Manual_VIBOX Conroller
Case Studies - 1 of 3	-	Case Studies - 1 of 3
Case studies - 2 of 3	-	Case studies - 2 of 3
Case studies - 3 of 3	-	Case studies - 3 of 3
Annexue 1 - Alerts & Instructions - Mapping	-	Annexue 1 - Alerts & Instructions - Mapping
Annexure 2 - Theory behind Torsional Vib	-	Annexure 2 - Theory behind Torsional Vib (Physical Model)

Annexure 2A -Vib360-Engine Diagnostic System	-	Annexure 2A -Vib360-Engine Diagnostic System (ConOps)

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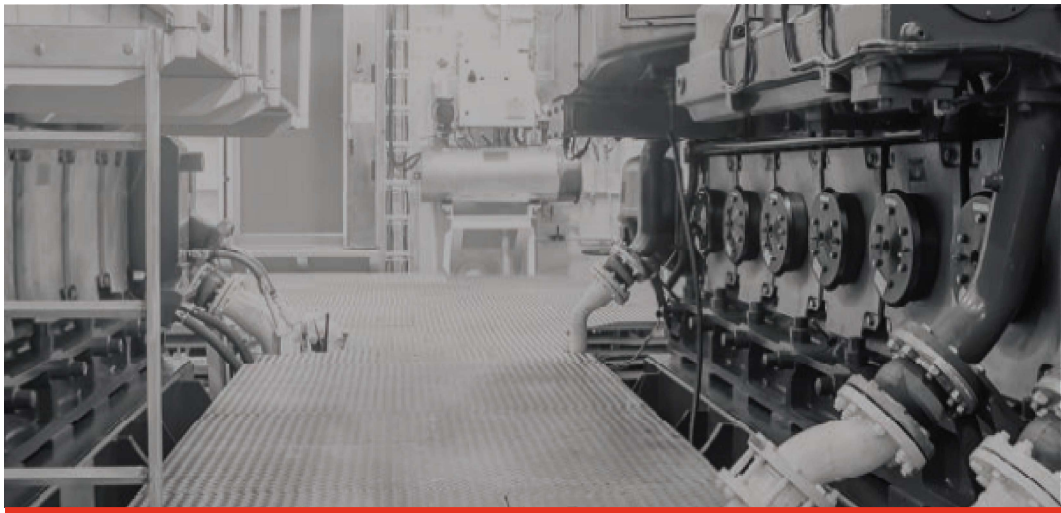
VIB 360 WORLD

SIÈGE SOCIAL
80 domaine de Montvoisin
91400 Gometz la Ville
France

+33 1 69 35 15 25

support-vib360@impedance.fr

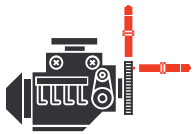
www.vib360world.com



VIB360 WORLD'S ASSET RELIABILITY MANAGEMENT SOLUTIONS

At VIB360 WORLD, we are driven to maintain large, mission-critical assets using cutting edge predictive maintenance technology that enables asset operators to detect emerging faults in their machines in advance, reduce the threat of an unplanned shutdown, extend equipment life.

The pillars of our Asset Reliability Management solution are:



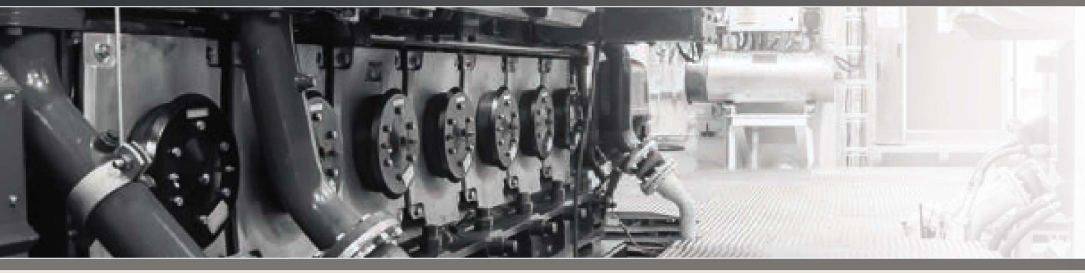
ENGINE CONDITION MONITORING SYSTEM

TORQUESENSE – TORQUE MONITORING SYSTEM

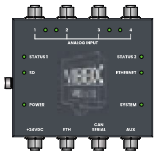
TURBINE CONDITION MONITORING SYSTEM

ENGINE CONDITION MONITORING SYSTEM

VIB 360 WORLD



MPU Sensor

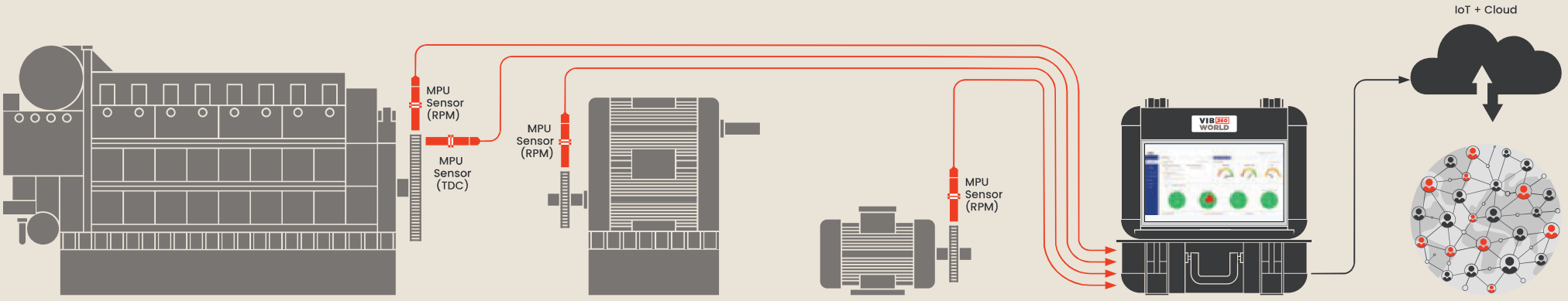


Vibox 1.0

Vibox 2.0

VIB360 WORLD
Portable Diagnostic Tool

Solution Architecture



Value Addition

- Get cylinder-wise health diagnosis on diesel engines. Trend Monitoring for engine health at different RPM.
- Early detection of vibrations: component-level diagnosis to pre-empt emerging faults.
- Special diagnostic modules for motors, bearings, compressors, gearboxes, and diesel engines.
- Receive end-to-end solutions for sensors, design architecture, sensor acquisition, edge computing, IoT storage, and system integration in a easy to handle portable kit.

DataVIB360 is a state-of-the-art early warning Condition Monitoring System. The system is engine-agnostic and does not require test bench or historical data for predicting engine health at the cylinder level.

It is a game-changer in predictive maintenance for engines. It utilizes non-intrusive sensing techniques to monitor the Torsional Vibration (deviations in Instantaneous Angular Speed) of the Crankshaft to detect the individual cylinder specific anomalies at a very nascent stage, setting a new industry standard for early detection.

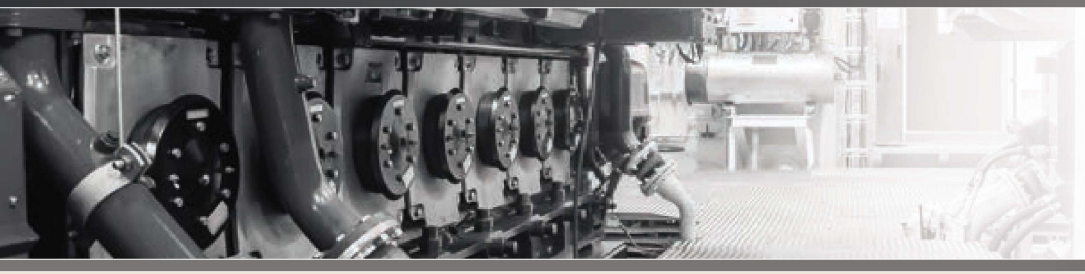
System employs the most advanced edge analytics at an unparalleled resolution; translating the complex analog data into an intuitive dashboard that requires no expert interpretation. With a local storage capacity of 50,000 data points in its intelligent controller, the solution provides data trending, real-time alerts, troubleshooting prompts and lays the groundwork for future AI and ML applications.

Hardware Specifications

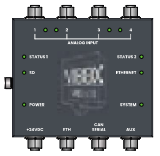
Nominal Input Voltage	24 VDC
Operating Temperature	-40° to +75° C
Communication Interfaces	Ethernet RJ45 USB 2.0 CAN 2.0B
Sensor	IP67
RAM	1GB DDR3L
Internal Memory	64GB
Processor	8GB eMMC
Sampling Rate	60ksps

ENGINE CONDITION MONITORING SYSTEM

VIB 360 WORLD



MPU Sensor



Vibox 1.0

Vibox 2.0

VIB360 WORLD
Portable Diagnostic Tool

Indicators