Product Description

Kongsberg MBB Maritime Black Box® Voyage Data Recorder

Kongsberg MBB
Maritime Black Box

Product Description

Document history

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Note

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Glossary

DCU	Data Collection Unit
GPS	Global Positioning System
EMC	Electromagnetic Compatibility
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
I/O	Input/Output
LAN	Local Area Network
MBB ®	Maritime Black Box ®
PSU	Protected Storage Unit
REU	Replay and Evaluation Unit
SOLAS	International Convention for the Safety of Life at Sea
UPS	Uninterruptible Power Supply
VDR	Voyage Data Recorder
VHF	Very High Frequency

SYSTEM OVERVIEW

Experience

Kongsberg Maritime is one of the world's largest suppliers of advanced marine electronics, with more than 30 years of experience with marine automation interfacing. We manufacture advanced navigation systems, marine automation, cargo management, safety systems and maritime simulators for the merchant marine, as well as dynamic positioning and control systems for offshore and research vessels. We have used this unique experience to provide a highly adaptable VDR system that is easily interfaced and installed on both existing and new vessels.

The Kongsberg Maritime Maritime Black Box® Voyage Data Recorder (VDR) is designed to meet or exceed the requirements specified in SOLAS V, IMO A.861 and the performance standard given by IEC 61996.

The main purpose of our Voyage Data Recorder is to record and store relevant ship's data, and to allow reconstruction of ship incidents at sea. Our Voyage Data Recorder can be used to identify the cause of an incident, and in this way make a major contribution to increase operational safety at sea.

Key features

The Maritime Black Box is entirely automatic in normal operation. If the recording stops or data recorded is outside specified data range, the operator is alarmed through the local Operator Panel.

The Maritime Black Box has a modular design for easy installation. Each module complies with the environmental requirements as specified in IEC 60945, including the requirements for radiated emission (EMC), and can be freely installed anywhere without causing disturbance to existing equipment.

Common technology

The use of common technology in the Kongsberg portfolio has allowed us to develop modular products. The benefits of modularity are passed on to our customers through:

- Free flow of information between the Maritime Black Box and the K-range systems
- Well-proven solutions that focus on the complete vessel operation
- Operational consistency
- Reduced spare parts and training requirements

All K-range workstations share navigation and sensor data through the Local Area Network, giving improved safety and easy operation. The Maritime Black Box utilises this for:

- Recording of radar pictures every 15 second
- Recording of navigation sensors and conning information display every second (K-Bridge only)
- Recording of automation parameters and alarms every second (K-Chief only)

Integration of 3rd party applications

3rd party applications and sensors can be interfaced via serial lines or analogue/digital signals. All standard interface NMEA 0183 protocols are supported, as well as a range of proprietary protocols.

The Maritime Black Box requires a buffered audio output on the VHF unit and a buffered RGB output on the radar display unit. Amplifiers are used if signals are weak. These are usually supplied by the VHF/radar maker.
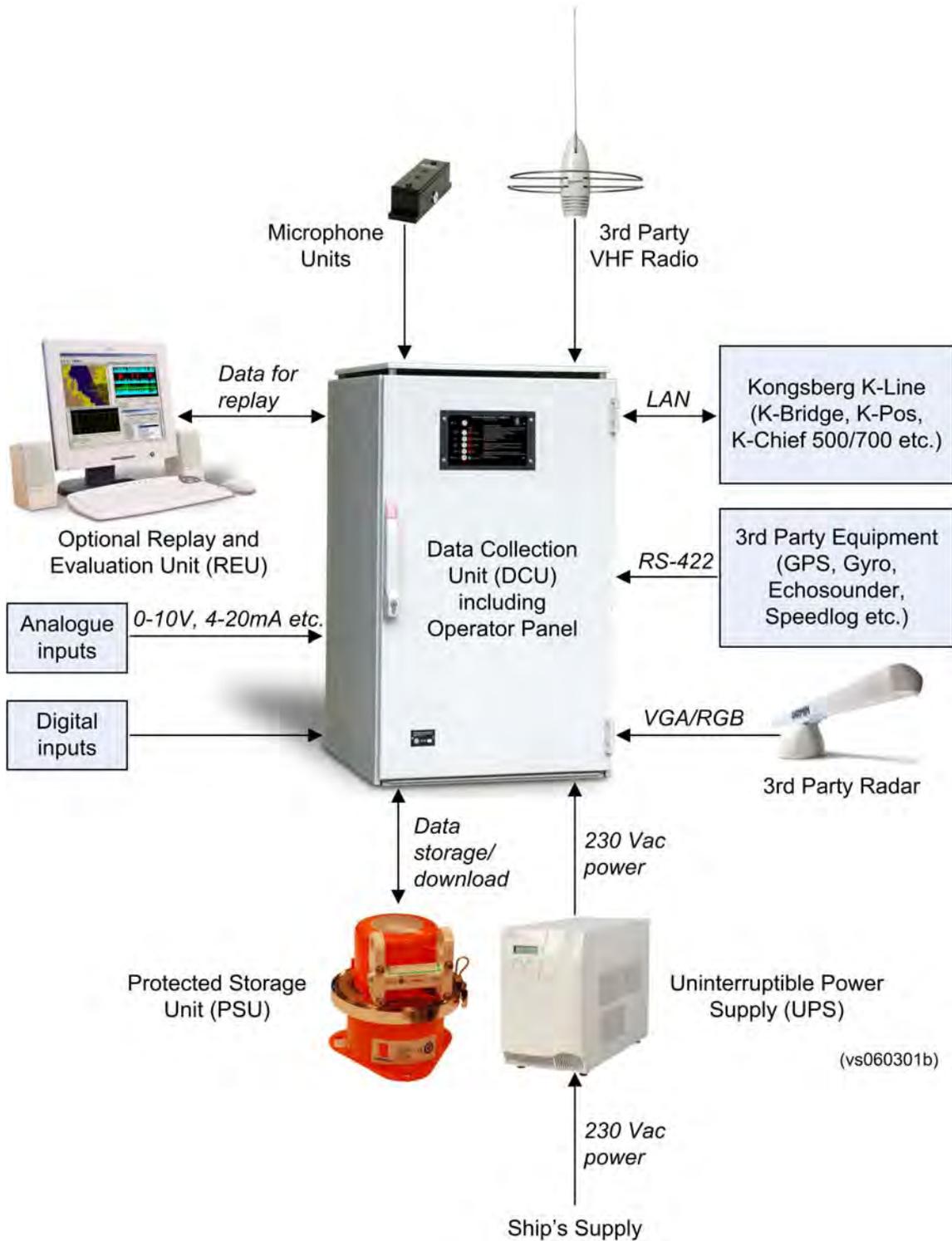
Required data from 3rd party should be available on a form as stated by IEC 61996. If not, the data will only be recorded if specially agreed.

UNIT DESCRIPTIONS

Overview

Our Voyage Data Recorder consists of the following units:

- Data Collection Unit
  - The Data Collection Unit (DCU) is interfaced with ship's equipment to collect, process and store all relevant ship's data for a period of 12 hours, as required by IMO A.861.

- Microphone Units
  - The microphones are used for recording of bridge audio, meeting the audio quality requirements as described in IEC 61996.

- Uninterruptible Power Supply
  - The Uninterruptible Power Supply (UPS) is connected to the ship's emergency power supply, with a battery package providing more than the required 2 hours of audio recording during a black-out.

- Protected Storage Unit
  - The Protected Storage Unit (PSU) stores data received from the DCU on a solid state recording medium. The PSU is calamity resistant by means of a protective capsule. It is located on top of the ship's superstructure in order to provide easy recovery following an incident.

- Replay and Evaluation Unit (option)
  - The Replay and Evaluation Unit (REU) is used to replay and evaluate previously recorded time synchronized voyage data. The REU is in addition an excellent tool for training purposes. Data stored in the PSU can be downloaded through the DCU for replay or long-term storage of data.

Microphone Units

3rd Party VHF Radio

Data for replay

Optional Replay and Evaluation Unit (REU)

Analogue inputs — 0-10V, 4-20mA etc.

Digital inputs

Data Collection Unit (DCU) including Operator Panel

LAN — Kongsberg K-Line (K-Bridge, K-Pos, K-Chief 500/700 etc.)

RS-422 — 3rd Party Equipment (GPS, Gyro, Echosounder, Speedlog etc.)

VGA/RGB — 3rd Party Radar

Data storage/ download

230 Vac power

Protected Storage Unit (PSU)

Uninterruptible Power Supply (UPS)

(vs060301b)

230 Vac power

Ship's Supply

Data Collection Unit (DCU)

The Data Collection Unit (DCU) interfaces, records and processes data from all relevant ship's equipment through interfacing sensors, equipment, microphones and radars. The DCU sends the recorded data to the Protected Storage Unit (PSU) for storage.

The DCU consists of the following main modules:

- A computer (PC) for recording, processing and storing of data in the PSU.

- An audio recording interface for processing of VHF and voice communication on the Bridge. It has 12 input channels for microphone and radio signals. The Kongsberg standard delivery includes two channels for VHF and four for microphones.

- A serial interface providing input for 12 serial lines (NMEA 0183 or RS-422).

- An optional interface with 16 channels for analogue or digital signals.

- A front mounted Operator Panel for monitoring and operation.

The PC and interfacing modules are located inside the DCU cabinet. All interfacing modules are approved according to E10 and IEC 60945, allowing flexible mounting, even directly on rotating equipment.

The DCU is supplied in a standard cabinet. However, all modules making the DCU are separately type approved. This allows flexible delivery of the system, and not limited to the cabinet described above.

External cables are pulled to relevant connection terminals through the bottom of the cabinet.

Computer (PC)

The PC can hold data for more than 30 days using a standard 120 GByte hard disk. Radar signals are connected directly to the PC – for the Kongsberg K-Bridge through a LAN connection, for other radars through a dedicated frame grabber card mounted inside the PC.

This standard industrial PC is also used by the Kongsberg DataChief® C20 and K-Chief 500 alarm, monitoring and control system, where functionality and reliability has been proven through deliveries of thousands of units to ships worldwide.

Operator Panel

The user interaction with the MBB system is very limited. Operation and alarm functions are provided through the Operator Panel. The panel provides easy operation of system status and all mandatory alarms. The panel is mounted into the front of the DCU, but may also be wall mounted or mounted into existing consoles.
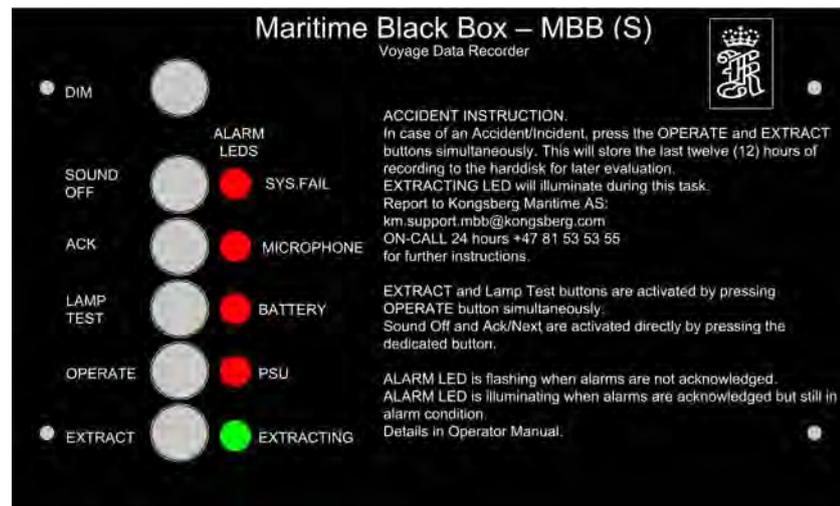
Audio recording process

An internal audio recording module interfaces VHF and microphones, and records these audio signals. The module has 12 channels for interfacing to microphones and VHF sets. The audio channels can be used in any configuration, but the standard supply is two channels for VHF communication and four channels for bridge microphones.

Audio signals from the different channels are sent directly to the PC through a USB interface, where the audio recording application modulates the signals prior to storing the data in the PSU.

Radar images

Radar images are recorded using two different methods:

- An internal radar recorder – used when Kongsberg's K-Bridge navigation system is present.
- A dedicated frame grabber card – used to record images from 3rd party radar suppliers.

Radar images from the K-Bridge system are recorded using a print screen function that creates a snapshot of the currently presented radar screen. The snapshots are then sent to the PC through a LAN interface.

Radar images from 3rd party radar suppliers are recorded by interfacing the monitor that presents information to the operator.

Serial interfaces

An internal module interfaces ship information available on serial lines. This module has 12 channels for interfacing serial NMEA 0183 or RS–422 signals, and one dedicated channel for sending MBB status information to 3rd parties.

Analogue/digital interfaces

Dedicated modules can be used for interfacing analogue and digital signals from ship's equipment. If required, the DCU cabinet will be supplied with one such module, making 16 signals available for interfacing to analogue or digital sources. However, a practically unlimited number of modules can be supplied for interfacing, but this must be evaluated and quoted in each project.

Microphone Units (MU)

The microphones are used for recording of bridge audio. Four microphones for installation on the bridge ceiling are supplied as standard.

To verify microphone functionality, each microphone is equipped with a speaker for testing of microphone reception. The speaker gives a non-abusive signal every 12 hours. This signal is detected by the PC, hence verifying the operational status of the microphones.

All metal surfaces are coated with satin black powder paint.

Uninterruptible Power Supply (UPS)

The Uninterruptible Power Supply (UPS) shall be connected to the ship's emergency power supply.

Its main function is to maintains a continuous supply of electric power to the MBB system when ship's power is not available, but the UPS also protects MBB components against voltage and frequency fluctuations.

Basic power control functions are accessible on the front panel of the UPS.

Protected Storage Unit (PSU)

The Protected Storage Unit (PSU) is a fully IMO compliant final recording medium. It also complies with all relevant IEC requirements.

Its solid-state recorder utilises proven aircraft technology to provide storage capacity exceeding 12 hours of radar, sensor and audio data. The final recording medium is stored in a protective capsule within the PSU.

An underwater locator beacon is fitted to aid in locating the recorder in the event of a catastrophic incident. The PSU will preferably be located on top of the bridge so as to maximise the probability of its survival and recovery following an incident. The unit is equipped with a quick release mechanism for easy recovery.

The PSU is designed to survive extreme environmental conditions:

- Shock: 11 millisecond duration of 50 g

- Penetration: 3 metres, 250 kg drop test

- Fire: 1100 ºC for 1 hour, 260 ºC for 10 hours

- Deep sea immersion: 30 days at 6,000 metres depth

Replay and Evaluation Unit (REU)

The Replay and Evaluation Unit (REU) is used to replay and evaluate previously recorded time synchronized voyage data.

REU software is always included in the MBB delivery, but the REU hardware is not included in the standard scope of supply. However, for training purposes it is recommended to include the REU in the installation.

The REU can replay data that is downloaded from the PSU or recorded in parallel, as data sent to the PSU is stored directly on the REU's hard disk. This avoids interruption of the recording process for data download. Audio, radar and other parameters recorded can be replayed co-ordinated or separately, providing flexibility for evaluation of the recorded data.

The REU can also be used to provide on-line data from the MBB system to other systems, such as Kongsberg's Electronic Logbooks (K-Log), Kongsberg's FleetMaster information management system or other ship administrative applications.

MBB INTERFACES

An essential part of the MBB is to interface the various sensors that provide the operational information to be recorded. There are many possible solutions, depending on the types of equipment on-board for navigation, propulsion control, alarm monitoring and control, process control and so on.

The figure below illustrates a situation where the ship has a fully integrated system from Kongsberg Maritime. In this case all the parameters and the radar image can be retrieved from these systems.

The other extreme is illustrated by the figure below, where none of the systems providing data are supplied by Kongsberg Maritime. In this case each individual data source must be identified, with physical connection points, data formats, estimated data quality etc.

Protected Storage Unit (PSU) — LAN Connection — **Data Collection Unit (DCU)** — Serial interfaces / Analogue interfaces / Digital interfaces (vs060301f2)

The table summarises how related Kongsberg Maritime systems on-board can be used as data sources for the MBB versus 3rd party systems. General purpose interface modules are provided to interface 3rd party signals.

Data items	Kongsberg Maritime system	Interface type	3rd party interface type
Radar	K-Bridge	LAN	Frame grabber
VHF audio	MBB	Analogue	Analogue
Bridge audio	MBB	Analogue	N/A
Position	K-Bridge	LAN	Serial or I/O
Speed	K-Bridge	LAN	Serial or I/O
Time & date	K-Bridge	LAN	Serial or I/O
Heading	K-Bridge	LAN	Serial or I/O
Depth	K-Bridge	LAN	Serial or I/O
Main alarms	K-Chief	LAN	Serial or I/O
Rudder order & response	K-Bridge/K-Chief	LAN	Serial
Engine order & response	AutoChief	LAN	Serial or I/O
Hull openings	K-Chief	LAN	Serial or I/O
Water tight and fire doors	K-Chief	LAN	Serial or I/O
Accelerations and hull stress	K-Chief	LAN	Serial
Wind speed & direction	K-Bridge	LAN	Serial or I/O
Fire alarms	K-Chief	LAN	Serial or I/O

TECHNICAL SPECIFICATIONS

Conformance with normative requirements

The Maritime Black Box system is designed to conform to the normative requirements described in the table below.

Description	References
DCU functionality	IEC 61996
DCU environmental	IEC 60945
Audio quality	IEC 60268-16
Radar recording quality	IEC 61996
PSU environmental	IEC 60945
PSU survivability	IEC 61996
REU functionality (see note)	IEC 61996
Type approval	Det Norske Veritas (DNV)

Note

The REU is not a part of the VDR according to IEC 61996 specification, however to meet the functional requirements a replay unit must be available for investigation after accidents.

Supported interfaces

- Local area connection (LAN) to Kongsberg Maritime's systems, including navigation and automation

- Up to twelve serial lines supporting RS-422, NMEA 0183 Protocol

- Analogue 0-10 V, 4-20 mA, digital signals, pulse and sync signals

- RGB VESA video signals

Data recorded

Video	
Parameter	**Description**
Radar	Radar image as displayed to the operator. An interface to radar is included in the standard delivery.

Audio	
Parameter	**Description**
Bridge audio	Bridge audio is recorded through microphones located on the bridge. Four microphones are included in the standard delivery.
Communication audio (VHF)	In- and outbound communication from the ship's VHF. An interface to VHF is included in the standard delivery.

Parameters (other data)	
Parameter	**Description**
Data and time	Date and time is derived from a device external from the ship, normally a GPS.
Ship position	Latitude and longitude is derived from an electronic position-fixing system (GPS).
Ship speed	Ship speed is normally recorded from the ships' Speed Log.
Ship heading	Ship heading is recorded as indicated by the ship's compass or gyrocompass.
Echo sounder	This includes depth under keel, the depth scale currently being displayed and other status information if available.
Rudder order and response	Rudder order and response angle on rudder is recorded, including status and setting of autopilot if fitted.
Engine order and response	Including position of engine telegraphs, both ordered speed and propeller response. Bow and stern thrusters are also recorded if fitted.
Main alarms (IMO mandatory alarms on the bridge)	Including the status of all mandatory alarms on the bridge, more specifications in the preceding paragraph.
Accelerations and hull stresses	Where a ship is fitted with hull stress and response monitoring equipment all the data items that have been pre-selected within that equipment is recorded.
Wind speed and direction	The wind speed and direction is recorded from the navigation system. Both true and relative wind is recorded, including each direction.
Hull openings status	Including all IMO mandatory status information of hull openings that's required to be displayed on the bridge.
Watertight and fire door status	This includes all IMO mandatory status information that's required to be displayed on the bridge.

Recording frequencies

Audio

Audio are recorded continuously, where bridge audio are recorded with 12 kHz and VHF audio with 8 kHz bandwidth.

Radar

Radar image is recorded with a frequency of one per 15 seconds.

Parameters

Parameters are a common name of all other data recorded than audio and radar, and are recorded with a frequency of 1 Hz.

Features

- Fully compliant with IEC 61996 (Shipborne Voyage Data Recorder)
- Availability of wide range of interfacing modules
- Two hours uninterruptible power supply
- Twelve hours of cumulative data storage capacity
- On-board playback of recorded data
- Optional interface with the ship's administrative network
- Parallel recording on hard disk (30 days)

Other benefits

- Recorded VDR data is primarily intended for incident analysis. However, since the MBB contains essential ship's data, this can also be made available for:
- Electronic logbooks
- Vessel maintenance
- On-board training
- Reporting and trending
- Vessel routing
- Weather and hydrographic data collection

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