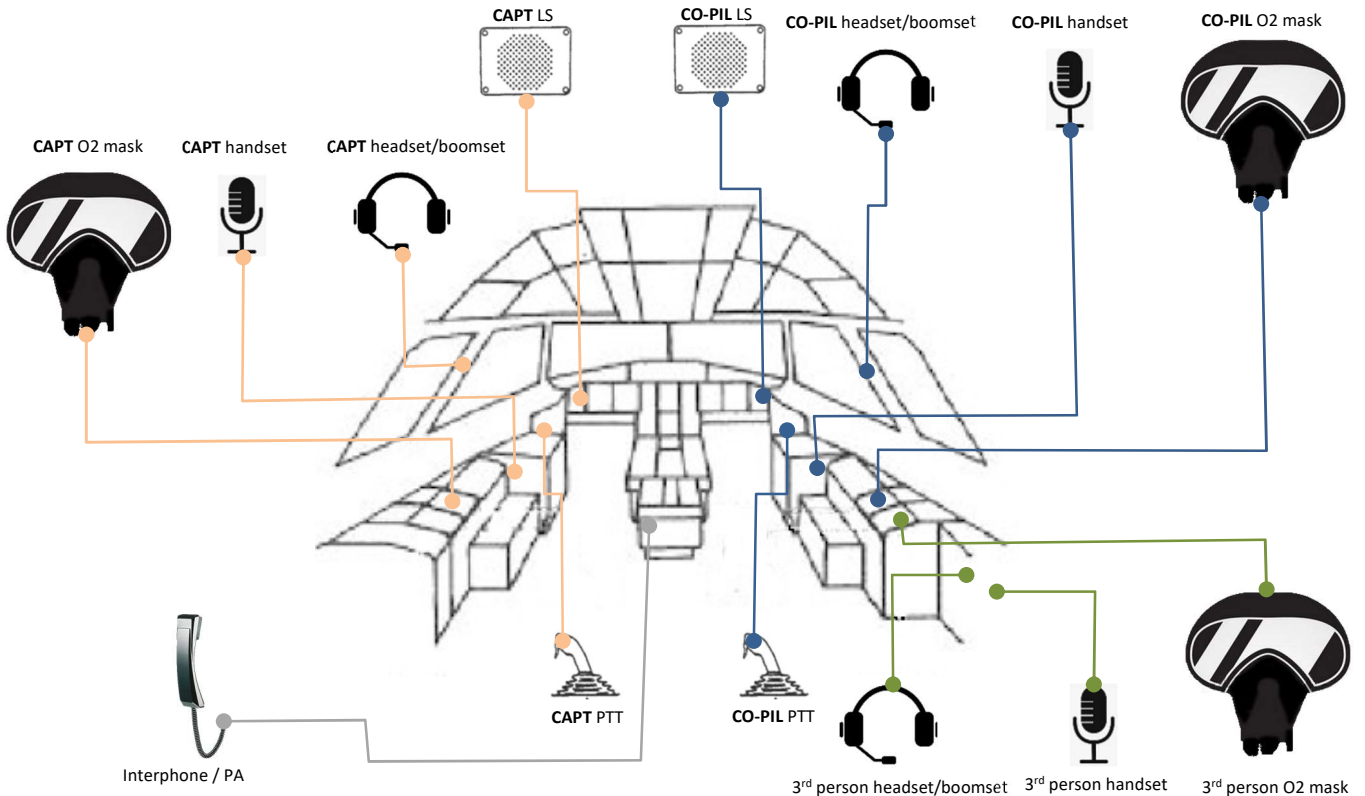


# Functional description of MS804 audio/CVR system

Various audio pick-up sources and their position in the cockpit:



Each pilot (captain, co-pilot) has:

- A headset fitted with a mouth microphone (BOOMSET)
- A hand-held microphone (HANDSET)
- An oxygen mask fitted with an internal microphone (O2 MASK)
- A microphone activation command (PTT (Push To Transmit))
- A Loudspeaker (LS)

The third person position does not have a PTT or loudspeaker.

## Audio Management Unit (AMU)

All these audio pick-up sources (microphones) and associated peripheral equipment (loudspeakers and PTT) are managed by the Audio Management Unit (AMU). This computer receives all the audio signals, amplifies and conditions (filters) them, and then sends them to the processing, broadcasting<sup>1</sup> and recording units (CVR).

The AMU has three distinct functions for managing the pick-up sources:

- Microphone signal used for radio transmission
- Microphone signal used for interphone exchanges (cockpit and/or cabin)
- Microphone signal sent to the various CVR input channels

Each pilot selects the transmission and reception sources from his Audio Control Panel (ACP).

<sup>1</sup> Cockpit interphone function, radio transceivers, link with cabin interphone, passenger announcements, etc.

### 1/ Radio transmission function

When a radio is active and selected for reception and/or transmission, there are three ways for each pilot to send a message:

- Either by using the boomset microphone after pressing and holding the PTT button on the side stick (or the RAD switch on the audio selection box).
- Or by using the hand-held microphone after pressing and holding the PTT built into this microphone.
- Or by using the oxygen mask microphone - when removed from the oxygen box and placed over the face - after pressing and holding the PTT on the side stick (or the RAD switch on the audio selection box).

In the unlikely event of all three microphones being used simultaneously, the hand-held microphone has priority over the other two for radio transmission.

### 2/ Interphone function

This function is activated when the pilots set the INT/RAD switch on their respective ACP to INT. The two pilots converse via the boomset microphone and the radio transmission is only activated on pressing the PTT on the side stick or temporarily switching the INT/RAD switch to RAD.

Note: the wearing of a headset and the use of the boomset are recommended by operational procedures when the aircraft is climbing (or descending) up to (down from) FL100. On climbing through FL100, both pilots set their INT/RAD switch to the middle (neutral) position and remove their headsets; the latter are generally placed in their rest position, on a support on the side windshield post.

In cruise flight, radio and interphone activities (exchanges with the cabin) are generally followed by the pilot monitoring by means of his loudspeaker; voice messages are generally transmitted using the hand-held microphone.

### 3/ Signal distribution to CVR function

As mentioned above, the AMU receives all the audio pick-ups from the sources used by the flight crew. For each cockpit position<sup>2</sup> - regardless of the selections made on their ACP<sup>3</sup> - it sums the signals received as follows:

- Continuous "hot mike" pick-up<sup>4</sup> from boomset microphone.
- Pick-up of the oxygen mask microphone when the mask is active (i.e. when the oxygen box has been opened and until it is reset).
- Pick-up of the hand-held microphone when the PTT button on the hand-held microphone is pressed.

The signal obtained is then mixed with what the pilot receives in his headset, ensuring relative proportionality between the sources<sup>5</sup>; it is then adapted (filtering, control of signal dynamics and impedance adaptation) for presentation at the CVR input.

Note: It should be noted that on the Airbus *Single Aisle* family (A318 to A321), the various aural warnings generated by the flight system are not sent in the signal to the pilot's headset<sup>6</sup> and are de facto not mixed on the corresponding CVR channels.

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<sup>2</sup> Pilot, co-pilot, third person

<sup>3</sup> There are three ACPs, one for each cockpit position.

<sup>4</sup> This function is required by EASA and CAA regulations. It was optional under FAA regulations.

<sup>5</sup> Regulatory specifications require that the pilot's voice be given priority over reception sources, radio, interphone and warnings (when recorded on the CVR channel).

The summed signal produced for the third person is supplemented by the CVR data time-stamp signal (FSK<sup>7</sup>) and the "Passenger Address" (PA) reception signal.

### **Cockpit Voice Recorder system**

It consists of the voice recorder (CVR), the cockpit area microphone (CAM) and a pre-amplification unit (CU (Control Unit)).

The CVR installed on MS804 had a recording capacity of two hours on average. It received the signal on four input channels as follows:

- Channel 1 input: captain's audio mix (microphones and reception equipment) delivered by the AMU
- Channel 2 input: co-pilot's audio mix (microphones and reception equipment) delivered by the AMU
- Channel 3 input: third persons audio mix (microphones, reception equipment, coded time and PA) delivered by the AMU
- Channel 4 input: CAM signal delivered by the CU).

The four input channels have different characteristics in terms of input dynamics and bandwidth. Channels 1 to 3, commonly referred to as "pilot channels", come from the AMU. They do not benefit from a global dynamic control, so audio signals can be presented in a state of saturation at the input of the CVR, which offers a lower permissible dynamic range on the "pilot channels" (0.5 Vrms) than on the channel dedicated to the signal coming from the CAM (2.5 Vrms). Channels 1 to 3 are dedicated to recording conversations (speech signal) and their bandwidth is limited to 150 Hz-3500 Hz.

Channel 4, on the other hand, which is assigned to the CAM signal, receives a signal that is pre-filtered and dynamically controlled by a compressor-limiter stage integrated into the CU; the function of this stage is to instantly crush any high-level signal received by the CAM microphone itself, and gradually restore the dynamic range once the loud sound event has disappeared. Channel 4 is dedicated to recording the background noise in the cockpit and has a slightly wider bandwidth, but remains limited to 150 Hz-6000 Hz.

The CVR recorder is located in the tail of the aircraft, in the non-pressurised area below the vertical fin.

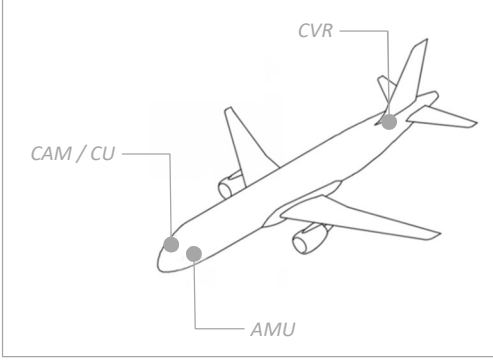
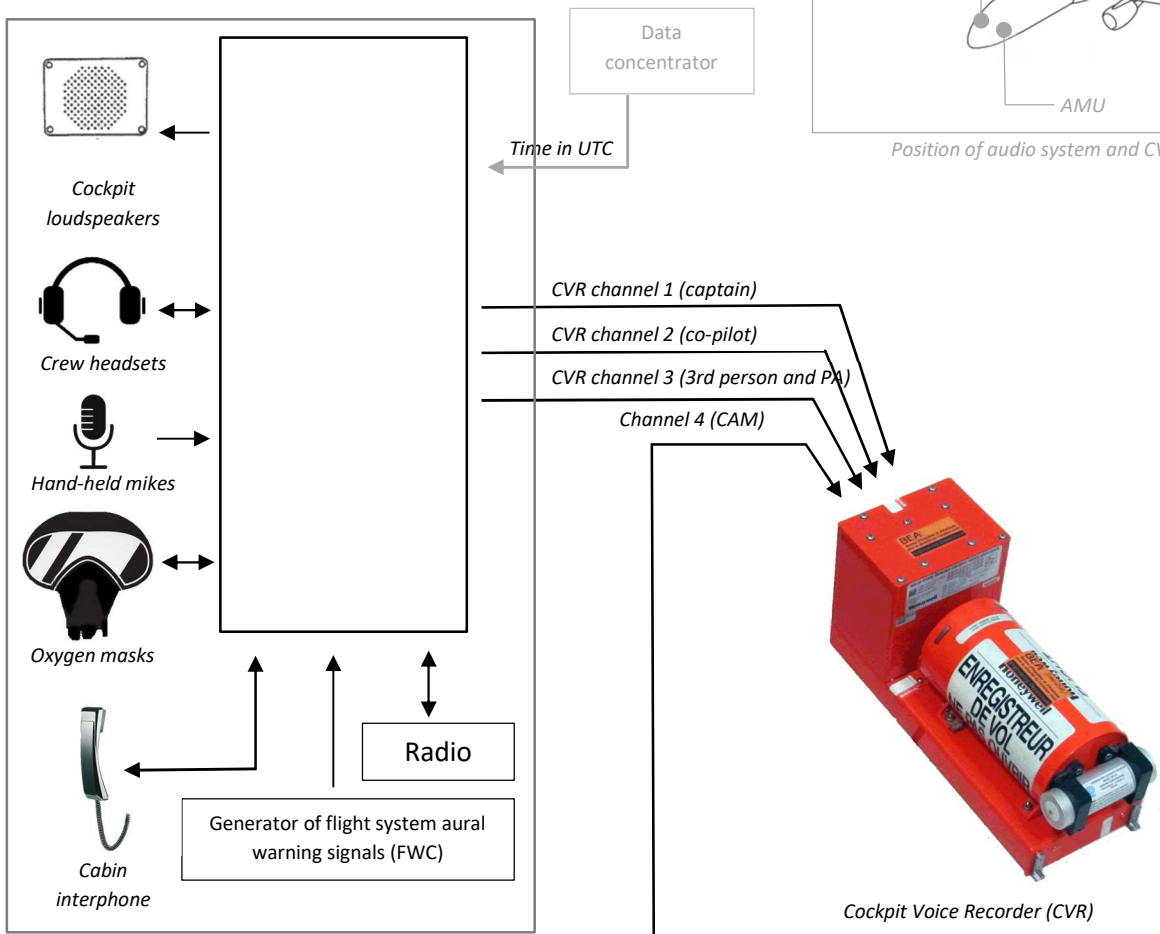
The CAM is located at the bottom of the overhead panel, in the upper right-hand corner of the captain's windshield. As previously mentioned, its function is to pick up the background noise in the cockpit, voice exchanges between crew members when they are not wearing their headsets, and as far as possible conversations between the flight crew and third parties (cabin crew, ground crew, others, etc.) present in the cockpit.

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<sup>6</sup> They are sent directly to the loudspeakers of the two pilots (their sound level cannot be adjusted by the crew). However, they are more or less perceptible in the reception signal because they are picked up in the background noise by the boomset microphones.

<sup>7</sup> This is an audible "blip" emitted every four seconds. It contains a (32 bit) digital code which converts UTC time into analogue by means of Frequency-Shift Keying (FSK). This time reference is transmitted by the data concentrator (FDIU) to the two flight recorders (CVR and FDR).

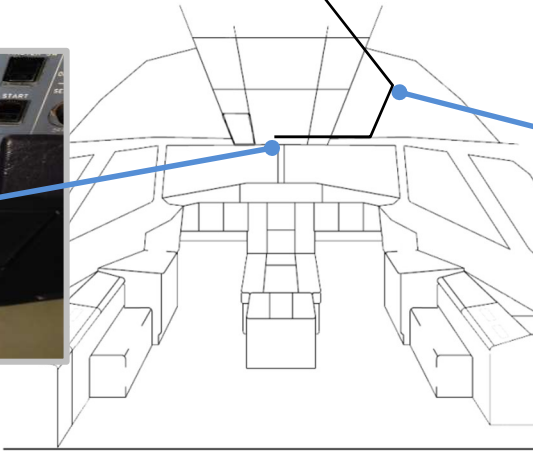
**Schematic description of CVR and its connections with the audio system**



Position of audio system and CVR parts



Cockpit area microphone



CVR system



Pre-amplifier (CU hidden under a cover panel).