PABM1 Passive Airband Monitor

PLEASE READ THIS INSTRUCTION MANUAL BEFORE USING THE PABM1!

The PABM1 Passive Air Band Monitor by Vortex Electronics is a non-interfering AM receiver for the radio band used for air traffic control. It receives all nearby transmissions within the band used for voice communications between civilian aircraft and air traffic control centers.

FAA (Federal Aviation Administration) regulations generally forbid the use of receivers onboard commercial aircraft because a normal receiver's local oscillator can radiate signals that could interfere with aircraft communication and navigation systems. However, the **PABM1 Passive Air Band Monitor** directly detects nearby AM signals in the 118 to 137 MHz VHF (very-high-frequency) aircraft voice band without the use of internal oscillators, and thus cannot interfere with aircraft communications and navigation equipment.

WARNING!

Listening to airband frequencies without a license is an offense in some countries (e.g., the UK).

Please check local laws for the legality of possessing and using the PABM1.

At the time of this writing, it is completely legal in the US to listen to Air Traffic Control (ATC) communications. Specifically, 18 U.S. Code § 2511 "Interception and disclosure of wire, oral, or electronic communications prohibited" **allows** listening to air band transmissions according to the following sections of Chapter 2:

> "(g) It shall **not** be unlawful under this chapter or chapter 121 of this title for any person —
>
> (i) to intercept or access an electronic communication made through an electronic communication system that is configured so that such electronic communication is readily accessible to the general public;
>
> (ii) to intercept any radio communication which is transmitted—
>
> …
>
> (IV) by any marine or aeronautical communications system"

Although you can use this receiver while awaiting your flight's boarding call, **always ask permission from the flight crew before using the receiver onboard an aircraft.**

This receiver's sensitivity is low, and in the air, you generally hear only the pilot-to-ground side of two-way traffic. Fortunately, in controlled airspace, a pilot must repeat all commands so that air-traffic controllers can verify that the pilot clearly understood their instructions.

While the aircraft remains at the departure gate, you typically hear a pilot repeating flight clearance, altitude restrictions, and other instructions—for example, "KLM 662 heavy, cleared for Amsterdam … FL320 five minutes after departure. Departure frequency is 127.4, squawk 4312." "Heavy" means that the aircraft is a large jet, "FL320" means that the aircraft is cleared to fly at 32,000 feet, and "squawk" is the aircraft's four-digit identification number. To contact departure control, the pilot retunes the aircraft radio to 127.4 MHz. When the pilot enters the squawk into the aircraft's transponder, the flight controllers can identify the aircraft on-radar screens as KLM flight 662. Each time the aircraft enters a new segment of

the taxiway on its way to the runway and again for takeoff clearance, the pilot contacts ground control to get taxi clearances.

Shortly after takeoff, the pilot contacts departure control: “KLM 662, radar contact, climb and maintain FL320, turn right heading 120, proceed on course.” From then on, the pilot contacts flight controllers upon reaching predefined altitudes or when entering a different flight-control center's airspace. Approximately 30 minutes before reaching its destination, the aircraft begins its descent, and the pilot contacts approach control. Just before landing, you hear the final clearance: “KLM 667 heavy, winds 030 at 12, cleared to land runway 33.”

1 Passive Monitoring

In 1961, the FCC (Federal Communications Commission) prohibited the operation of FM receivers on board aircraft since they were determined to interfere with the operation of navigation and communication systems. The FAA (Federal Aviation Administration) subsequently determined that other personal electronic devices could be potentially hazardous to aircraft systems if operated aboard aircraft and prohibited their use.

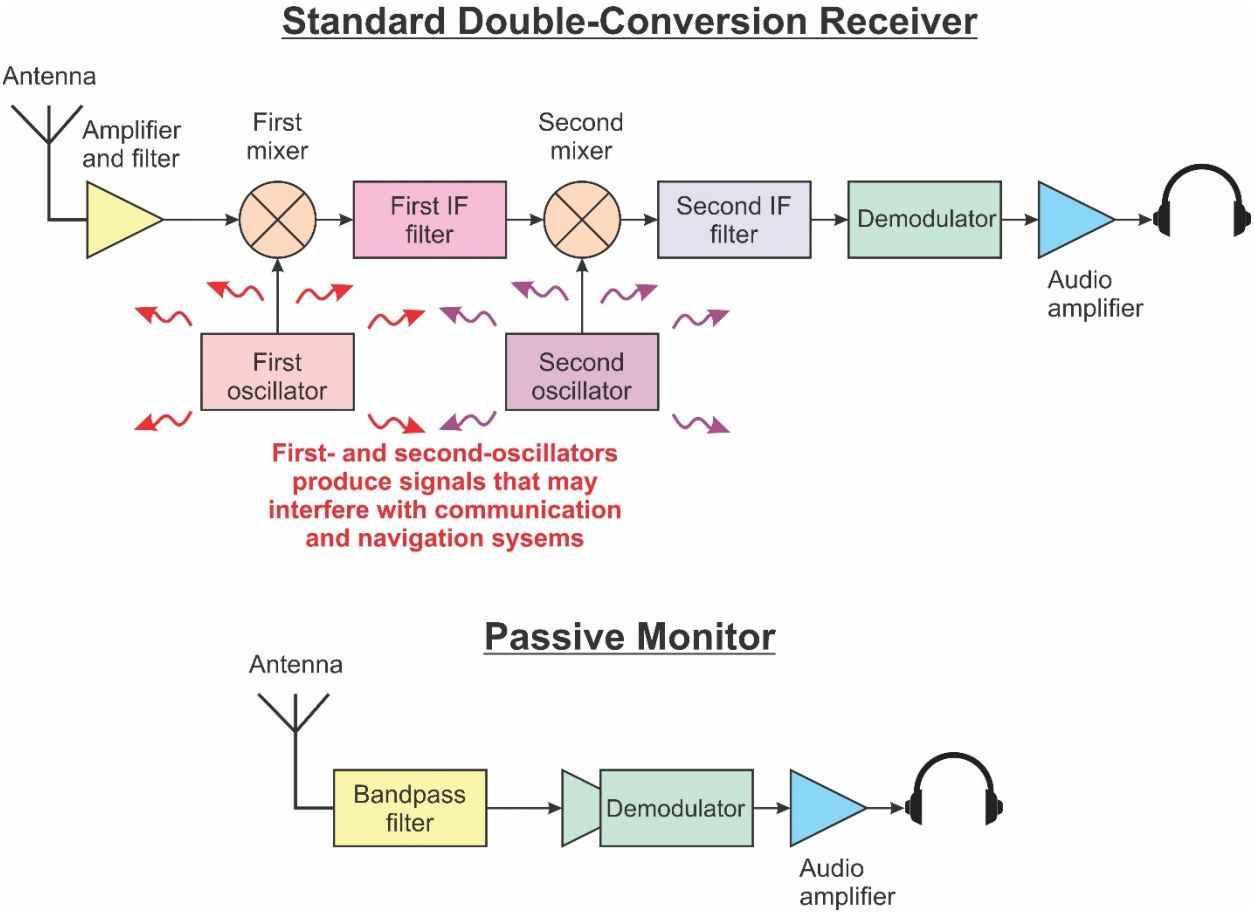

Figure 1 – Standard receiver vs. passive monitor. Standard heterodyne receivers have one or more oscillators that produce radio signals used for tuning to a desired frequency. Signals from these oscillators that escape the receiver may interfere with communication and navigation signals. In contrast, a passive monitor does not contain any oscillators or other radio-frequency sources that may radiate interfering signals.

The reason normal receivers have the potential of interfering with aircraft communications is that they internally produce radio signals as part of the receiving circuitry. As shown in Figure 1, standard receivers have one or more oscillators that produce radio signals used by the radio to tune to a specific frequency. Signals from these oscillators that escape the receiver may interfere with communication and navigation signals.

In contrast, the PABM1 Passive Air Band Monitor does not contain any oscillators or other radio-frequency sources that may radiate interfering signals. Signals picked up by the antenna are filtered within the airband and then directly demodulated to produce audio. The reason why this is not done in normal receivers is that direct demodulation makes it very difficult to tune to a specific frequency, allowing all signals within a band to come through simultaneously. In the case of our airband monitor this is an advantage since no knowledge of the frequency used for air traffic control is necessary, thus requiring no tuning.

2 The Airband

The VHF airband comprises the range of frequencies between 108 and 137 MHz and is sub-divided as shown in Figure 2.

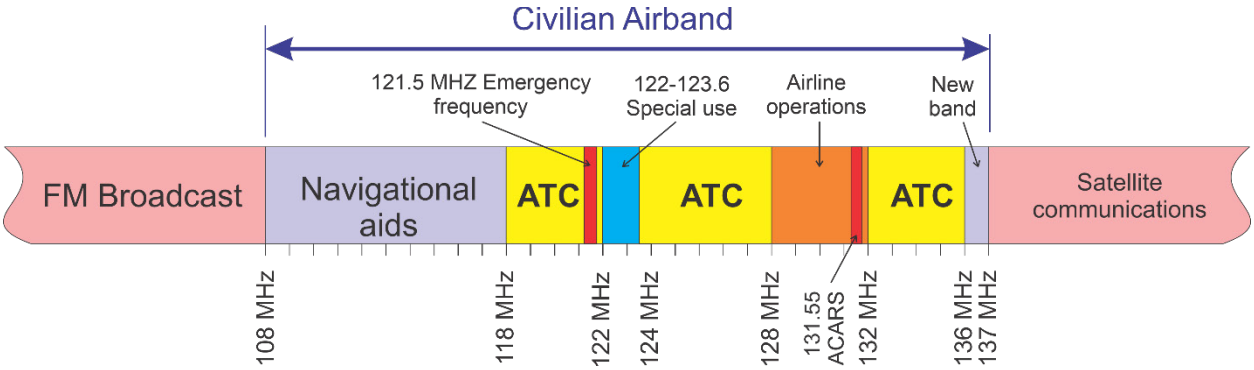

Figure 2 – The civilian airband

The lower 10 MHz of the band, from 108–117.95 MHz, are reserved for navigational aids such as VOR beacons, and precision approach systems such as ILS localizers.

The upper 19 MHz of the band, from 118–137 MHz, are divided into channels used mostly for AM voice communications. This is the specific range where the PABM1 is most sensitive.

Air Traffic Control (ATC) is assigned to the 118-122 MHz, 123.6-128.8 MHz, and 132-135.975 MHz ranges. These contain most control tower, ATIS, ground control, clearance delivery, approach control, departure control, and Air Route Traffic Control Center (ARTCC) frequencies.

ATIS is the Automatic Terminal Information Service, which continuously transmits recorded aeronautical information in busy airports and their immediate surroundings. ATIS broadcasts contain current weather information, active runways, available approaches, and any other information required by the pilots, such as important notices to airmen (NOTAMs).

The 122-123.575 MHz is assigned to private aviation services, flight service stations, balloons, gliders, airshow communications, and other miscellaneous aeronautical communications.

Internal airline communications, for example speaking with mechanics, requesting wheelchair assistance, speaking with ground crews, etc. happen in the 128.8-132 MHz range.

The 136-136.975 MHz range or “new band” was added to the airband in the 1990s. The most common use is for Air Traffic Control.

You will sometimes hear loud chirps on your PABM1. They come from the Aircraft Communications Addressing and Reporting System or ACARS. It is a digital communications system that aircraft use to send and receive short messages to and from ground stations, commonly at a frequency of 131.550 MHz which is within the range of the PABM1 and so cannot be filtered. The short "beep" at the beginning of the message is the preamble of the ACARS message, and the rest of the burst, which sounds like loud radio static, is the actual data stream of the message. ACARS communications include ATC messages to request or provide clearances, aeronautical operational control messages, and airline administrative control messages.

3 Using Your PABM1 Passive Air Band Monitor

3.1 Basic Operation

Figure 3 shows a block diagram of the PABM1 Passive Airband Monitor. The headphone’s cable acts as an antenna to pick up transmissions in the 118 to 137 MHz civilian air traffic control band. This range of frequencies is selected by a passive filter before being fed to the AM demodulator. Received audio is then presented to the audio output amplifier. The volume of received audio is controlled via potentiometer.

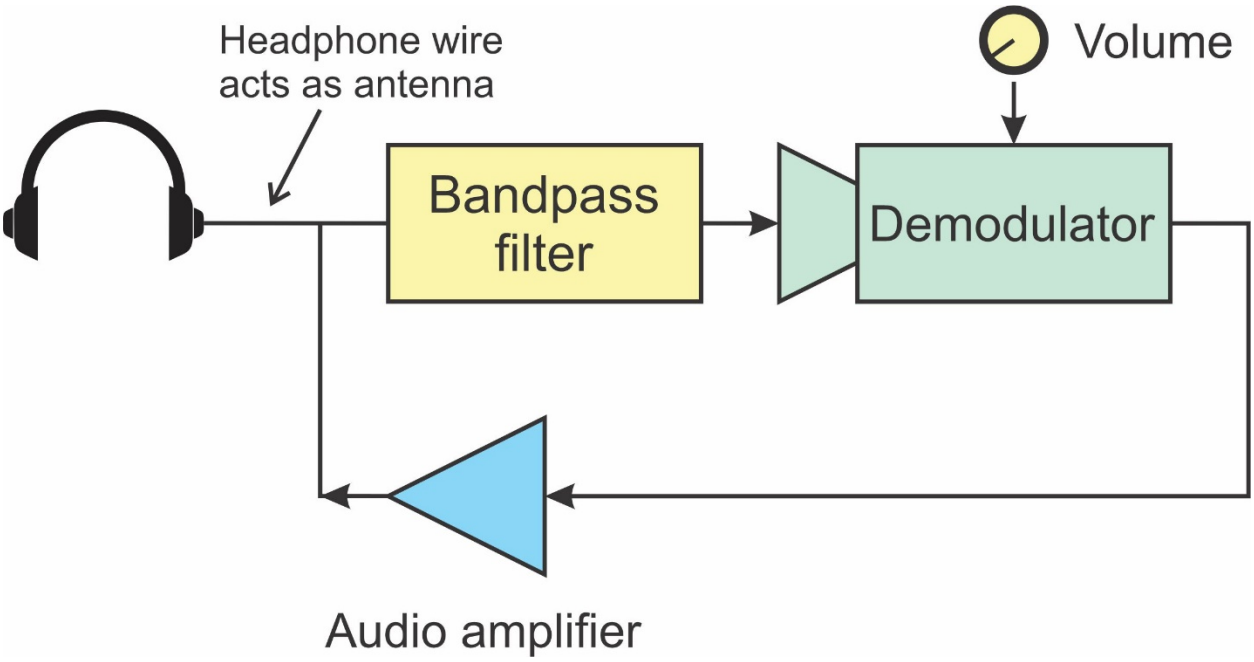

Figure 3 - Block diagram of the PABM1

Figure 4 – The PABM1 Passive Air Band Monitor

The PAMB1 is powered from one 9V battery. Please use a 9V **alkaline** battery. Mount it as shown in Figure 4, **making sure that you install it with the correct polarity**.

WARNING!

The PABM1 is not protected against reverse polarity! Always take care to insert the batter correctly according to the designation of polarity (⊕ and ⊖) on the battery and the battery holder. A battery which is placed in reverse will cause damage to the device.

Next, connect a pair of stereo headphones to the jack labeled “headphones.” Do not force the plug so as not to unsolder the jack from the circuit board.

Turn ON the PABM1 by sliding the power switch towards the ON position. The green LED indicator should turn on.

Adjust the VOLUME potentiometer to a comfortable level. At this point it is possible that you will hear communications and ACARS bursts from aircraft in the vicinity. Since by its nature the PABM1 is a very wideband receiver, you may hear nearby FM stations. If you are indoors, you may also hear powerline hum and signals radiated by nearby digital devices.

4 Understanding Pilot Lingo

The purpose of standardized words and pronunciation is to make communications clear regardless of regional variance and accents. Below is some of the lingo to help you understand the communications.

4.1 Phonetic alphabet

Alpha, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-Ray, Yankee, Zulu.

4.2 Number pronunciation

ZE-RO, WUN, TOO, TREE, FOW-ER, FIFE, SIX, SEV-EN, AIT, NIN-ER

4.3 Terms frequently used in pilot/controller communications

It is fairly easy to follow the conversation between pilots and air traffic controllers, but some words have specific meanings that may be different than when used in everyday language. The following terms are some of them [2]:

ABORT− To terminate a preplanned aircraft maneuver; e.g., an aborted takeoff.

ACKNOWLEDGE− Let me know that you have received and understood this message.

BLOCKED− Indication that a radio transmission has been distorted or interrupted due to multiple simultaneous radio transmissions.

CIRCLE TO RUNWAY (+ RUNWAY NUMBER)− Circle to land because the runway in use is other than the runway aligned with the instrument approach procedure.

CLEARED (Type of) APPROACH− Authorization to execute a specific instrument approach procedure to an airport; e.g., “Cleared ILS Runway Three Six Approach.”

CLEARED AS FILED− Cleared to proceed in accordance with the route of flight filed in the flight plan.

CLEARED FOR TAKEOFF− Authorization to depart.

CLEARED THROUGH− Authorization to make intermediate stops at specified airports without refiling a flight plan while en-route to the clearance limit.

CLEARED TO LAND− Authorization to land.

CLIMB TO VFR− Authorization to climb to VFR conditions when the only weather limitation is restricted visibility. The aircraft must remain clear of clouds while climbing to VFR.

FLIGHT LEVEL− An altitude level of constant atmospheric pressure referenced to a standard pressure. Stated in three digits that represent hundreds of feet. For example, flight level (FL) 250 is the altimeter indication of 25,000 feet.

GO AHEAD− Proceed with your message.

GO AROUND− Instruction to abandon approach to landing.

HAVE NUMBERS− Pilot informing that the runway, wind, and altimeter information have been received.

HEAVY - Aircraft capable of takeoff weights of 300,000 pounds or more whether or not they are operating at this weight.

IFR (INSTRUMENT FLIGHT RULES)- Rules for conducting instrument flight. Also used to indicate type of flight plan.

MAYDAY− Distress signal. When repeated three times, it indicates imminent and grave danger and that immediate assistance is requested.

MISSED APPROACH− Maneuver conducted when an instrument approach cannot be completed

ON COURSE− Aircraft is established on the route centerline

OUT− Conversation is ended and no response is expected.

OVER− My transmission is ended; I expect a response.

PAN-PAN: Used by pilots to indicate something unusual with the aircraft that stops short of an immediate emergency. When repeated three times, it indicates urgency and attention.

REQUEST FULL ROUTE CLEARANCE− Request that the entire route of flight be read verbatim in an ATC clearance.

RUNWAY− Defined landing and takeoff area. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees.

SIGMET (SIGNIFICANT METEOROLOGICAL INFORMATION)− A weather advisory issued concerning weather significant to the safety of aircraft.

SQUAWK (Mode, Code, Function) − Specific modes/codes/functions on the aircraft transponder.

VFR (VISUAL FLIGHT RULES) - Rules for conducting flight under visual conditions. Also used to indicate weather conditions that are equal to or better than minimum VFR requirements.

STAND BY− Request to pause for a few seconds, usually to attend to other duties of a higher priority. Also means to wait as in “stand by for clearance.”

SUPER – An aircraft above “heavy” class. The Airbus A-380-800 (A388) is classified as super.

WILCO− I have received your message, understand it, and will comply with it.

5 US Law Regarding Use of Personal Electronic Devices Onboard Aircraft

In the US, the FCC (Federal Communications Commission) has jurisdiction over any RF-emitting electronic device, and the FAA (Federal Aviation Administration) has jurisdiction on electronic devices in use on board aircraft.

The PABM1 Passive Air Band Monitor does not have an internal RF oscillator, and does not emit RF energy above 9 kHz, so it is exempt from FCC registration.

The FAA rules about using the PABM1 onboard aircraft is not straightforward. Section 91.21—formerly § 91.19—was established in May 1961 to prohibit the operation of FM receivers on board aircraft since they were determined to interfere with the operation of navigation and communication systems. The FAA subsequently determined other personal electronic devices (PEDs) could be potentially hazardous to aircraft systems if operated aboard aircraft. Amendment 91-35 amended the scope of former § 91.19 to prohibit the use of additional PEDs aboard certain U.S.-registered civil aircraft. Section 91.21, as adopted, was drafted to require the air carrier or commercial operator to determine whether a particular PED will cause radio frequency (RF) interference when operated aboard its aircraft. This AC uses the term “operator” throughout to mean pilot in command (PIC), renter-pilot, or air carrier certificate holder.

Code of Federal Regulations Title 14 "Aeronautics and Space" discusses portable electronic devices in §91.21 [1]:

> "(a) Except as provided in paragraph (b) of this section, no person may operate, nor may any operator or pilot in command of an aircraft allow the operation of, any portable electronic device on any of the following U.S.-registered civil aircraft:
>
> (1) Aircraft operated by a holder of an air carrier operating certificate or an operating certificate; or
> (2) Any other aircraft while it is operated under IFR.
>
> (b) Paragraph (a) of this section does not apply to—
>
> (1) Portable voice recorders;
> (2) Hearing aids;
> (3) Heart pacemakers;
> (4) Electric shavers; or
> (5) Any other portable electronic device that the operator of the aircraft has determined will not cause interference with the navigation or communication system of the aircraft on which it is to be used.
>
> (c) In the case of an aircraft operated by a holder of an air carrier operating certificate or an operating certificate, the determination required by paragraph (b)(5) of this section shall be made by that operator of the aircraft on which the particular device is to be used. In the case of other aircraft, the determination may be made by the pilot in command or other operator of the aircraft."

As such, although the PABM1 Passive Air Band Monitor does not affect aircraft navigation and communication systems, whether or not it can be used on board a specific aircraft is the decision of the "operator of the aircraft," so **always ask permission from the flight crew before using the receiver onboard an aircraft.**

6 Returns and Warranty

Each PABM1 Passive Airband Monitor is inspected and tested before it is shipped. However, because of the nature of the device, it comes with no guarantee. **No warranty is issued, and returns are not accepted**.

TO THE MAXIMUM EXTENT ALLOWED UNDER APPLICABLE LAW, THE PABM1 PASSIVE AIRBAND MONITOR IS PROVIDED "AS IS" AND "AS AVAILABLE" AND VORTEX ELECTRONICS, ITS AFFILIATES, PARTNERS, SUPPLIERS OR LICENSORS MAKE NO WARRANTIES UNDER THIS AGREEMENT, EXPRESS, IMPLIED, OR STATUTORY, BY OPERATION OF LAW OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF TITLE, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTIES ARISING OUT OF COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE UNDER OR IN CONNECTION WITH THE PRODUCT. VORTEX ELECTRONICS DOES NOT WARRANT THAT THE PABM1 PASSIVE AIRBAND MONITOR WILL OPERATE ERROR-FREE, UNINTERRUPTED, OR THAT THEY IT WILL BE SAFE OR SECURE. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY VORTEX ELECTRONICS, ITS AGENTS, OR OTHER REPRESENTATIVES OR EMPLOYEES SHALL

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Finally, Vortex Electronics is not responsible to the buyer, user, or third parties for any claim of special or consequential damages, in accordance to the previous disclaimer.

8 References

1. FAA, *Advisory Circular: Use of Portable Electronic Devices Aboard Aircraft*, AC No: 91.21-1D, 2017.
2. FAA, *Pilot/Controller Glossary*, https://www.faa.gov/air_traffic/publications/media/PCG_10-12-17.pdf

