Aviation Working Principles

AeroAlert

ICERS II System

INDEX

Introduction

This manual has been developed with the purpose of providing the general ideas and operating principles of the two main modules that constitute the project. Through a synthesized yet concise explanation, it imparts the basic design specifications and technical qualities upon which both pieces of equipment should rely, should there be a desire to assess the feasibility of their implementation in contemporary aviation. Its role is to define the objectives and scope of the aeronautical equipment that forms part of the project proposal, outlining their internal composition and the interconnections between these components. This not only facilitates an understanding of their functioning but also sheds light on the interconnectedness of the various equipments. Furthermore, significant emphasis is placed on communication between these equipment sets, detailing protocols and formal codes designed to fulfill the information exchange objective among them.

Recommendations:

The reading of this document is recommended for informational purposes, extending its audience to any reader interested in both the concept and its feasibility. This approach allows for a critical analysis of the potential development and impact that the project proposal could generate in the aviation industry, as well as on the safety of civil society.

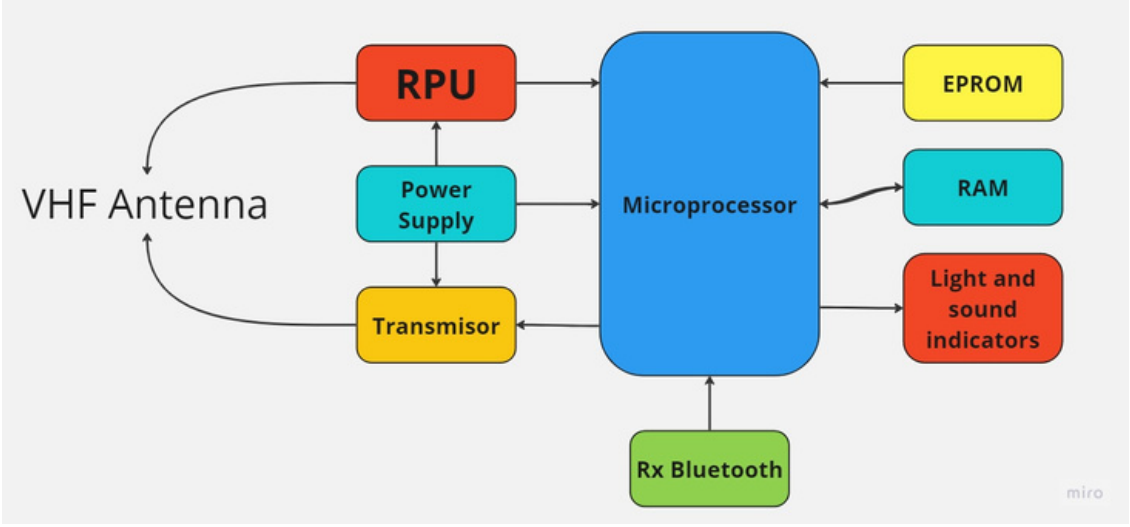
System modules:
Guidelines

A.E.S Module:

Acronym for Automatic Emergency System, this module is hosted in the cockpit, and responsible for receiving information from the sensors, processing it, notifying in cockpit, communicating with the ground equipment and, in case of an emergency, to communicate with the aircraft's native autopilot.

The A.E.S. module is composed of:

- A microprocessor
- Antenna (For VHF receiving and transmitting)
- RPU (Receiver Processor Unit)
- VHF transmitter
- EPROM
- RAM memory
- Light and aural indicators
- Power Supply
- Bluetooth receiver

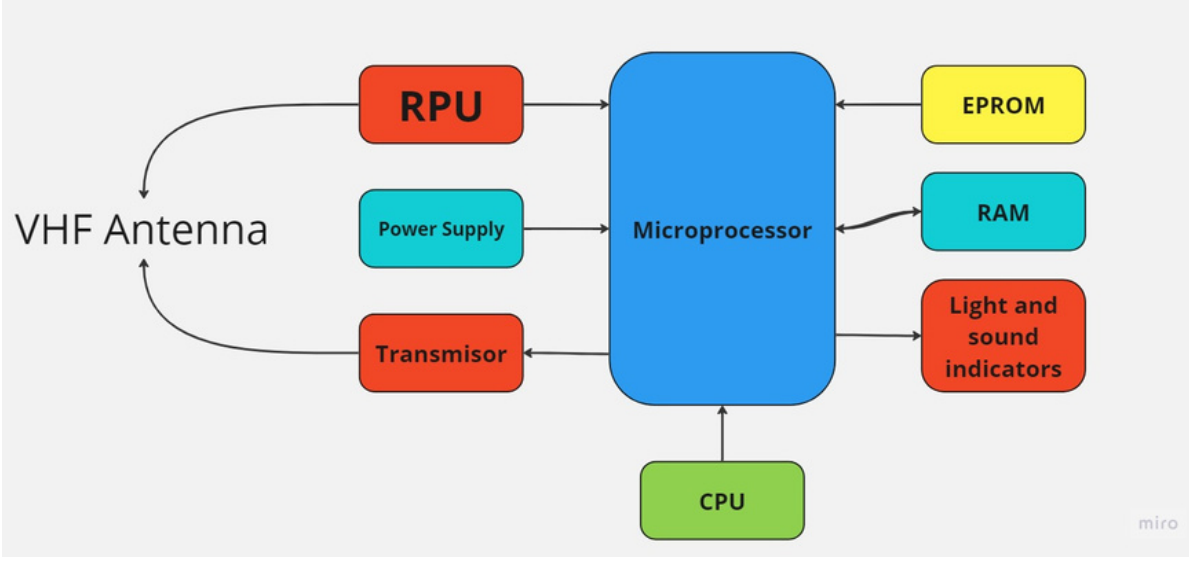


C.T.R.T Module:

Acronym for Control Tower Receiver and Transmitter, as its name indicates, it is a module hosted in ground and managed by the Air Traffic Control, whose purpose is to receive, visually represent and inform emergencies, alerts and/or requests to air traffic controllers. It is also in charge of generating and transmitting instructions to the cockpit equipment (A.E.S. module) in order to make an emergency landing if necessary.

It is made up of:

- ➢RPU (Receiver Processor Unit)
- ➢VHF transmitter
- ➢Omnidirectional VHF antenna
- ➢Microprocessor
- ➢EPROM
- ➢RAM
- ➢CDU
- ➢Aural and light indicators
- ➢Power Supply



Communication Between Modules

Communication Specifications:

- The antenna of the C.T.R.T. module has to be omnidirectional, so that information can be received from any direction (as the name suggests).
- The system operates on VHF and on a fixed frequency, whereby a change of carrier frequency for the different A.E.S. modules is not necessary.
- It uses a coding system to determine the aircraft involved.
- The receivers of both types of equipments can be either homodyne or superheterodyne.
- The operative range of the C.T.R.T. module shall be equal to the radar range of the airspace in which the equipment is operating, which may be 200 nautical miles or 370 kilometres.

Equipments intercommunication:

The C.T.R.T. module is the active entity in the communication, becoming the master of the communication. On the other hand, the A.E.S. module is the slave in this interaction.

Communication is completed in 3 stages:

I.The C.T.R.T. module sends out an electromagnetic wave in a certain period.

II. The A.E.S. module, on receiving the pulse train, responds with an electromagnetic wave, by means of which it conveys two types of information: Its own code and the identification of the Aircraft.

III. Finally, the C.T.R.T. module stores both information, in order to eventually display the aircraft identifier on screen.

From this point on, the C.T.R.T. has a record and knowledge of those aircraft that fly and have flown over the airspace under its jurisdiction.

Codification system:

The A.E.S. module has a unique code, determined at its time of manufacture. Its function is to be able to reject or accept a message sent via the C.T.R.T module. Depending on the message code, For example:
The A.E.S. code is 3782 and the receiver received this message:
5739, "Information", 6758.
The first 4 digits (5739) shall be the A.E.S. code, while the last 4 digits (6758) correspond to the code of the C.T.R.T. module sending the message.
In this case, as the code of the first tranche of information is different from the code provided as an example, the A.E.S. module shall not take the information and proceed to discard the message.
Just as the A.E.S. has a unique code, so has the C.T.R.T.

Protocols

In order to make communications more efficient, the system provides for a series of protocols:

I.The first of these is useful for detection and/or interrogation, outside of emergencies. The C.T.R.T. sends a pulse and the A.E.S., on receiving it, identifies itself with its code and aircraft name.

II. For emergencies, only a C.T.R.T. can send instructions to the aircraft involved, therefore:

A.The ground equipment sends a pulse with its code, the A.E.S. code and the instruction. Instructions are commands, and in case of emergency the first command to be sent is "Connection".

B.When the cockpit equipment receives this message and it matches its code, it saves the code of the ground equipment in RAM memory, so from that moment on it will only read the instructions sent with its code and the code of the ground equipment C.T.R.T. which is connected.

C. At the same time, the A.E.S. module returns a pulse containing its code, the aircraft identifier and the C.T.R.T. module code.

D. This pulse, when received on the ground, can either:

1. Be received by the ground equipment that was connected. In this case, its code matches the one sent, after which the C.T.R.T. module display will indicate "Connected" together with the aircraft name.

2.Be received by other ground equipment. In this case there shall be a code difference, after which the display of the equipment shall indicate "Already Connected".

III. In case the aircraft is heading to another airspace, still connected to a C.T.R.T. module from which it is moving away:

- The air traffic controller may use a command to inform to change the C.T.R.T. module in connection.
- The air traffic controller may use a command to set the new C.T.R.T. code.
- The air traffic controller may use a command to disconnect the A.E.S. in question.

A.E.S Module Specifications

Guidelines

➢ A.E.S. module internal communication is carried out through ARINC 429 protocol, between its different sections.

➢ Connection to the aircraft's autopilot needs A.E.S. module as intermediary, either a connection already established at the time of manufacture or via a translator from A.E.S. code to Autopilot code.

➢The A.E.S. module consists of 3 switches:

Reaction Switch: Its usefulness is in the event of an alert and/or emergency, in which the pilot decides on his own that the flight can continue under his command or to provide life/consciousness assurance to the system.

Manual Activation Switch: As its name indicates, its usefulness lies in the manual activation of the A.E.S. module. It should only be used in conditions under which it is appropriate to declare the emergency and give authority to the native autopilot according to the commander's judgement, appealing to the commander's good faith and correct action.

Override Switch: Allows the system to be deactivated in case of system failure detection.

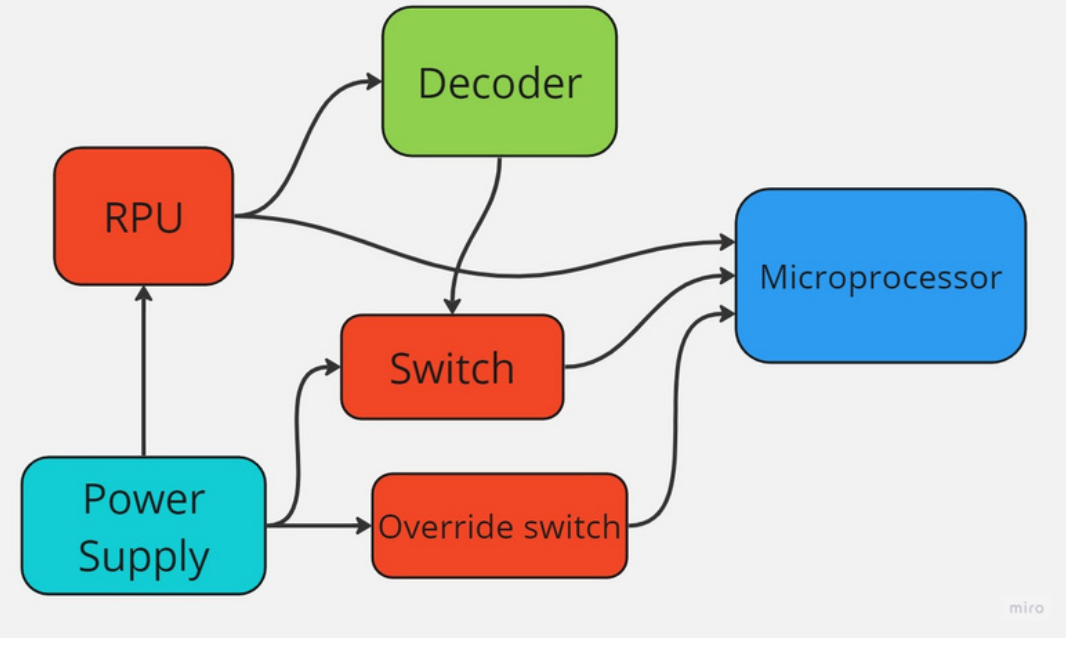
➢The A.E.S. module has a Bluetooth receiver for connection to the pilots wristband devices.

Cases of a malicious nature

For these cases of an intentional nature, the air traffic controller has a command for the A.E.S. can be activated remotely, this is used in cases such as terrorism, hijacking or attempted suicide by the crew.

In the case where the A.E.S. module is not overridden, its internal procedure of is similar to the ones developed in other instructions, i.e. read the code and then execute the instruction, (in this case it will be to activate)

But if someone decides to override the A.E.S. by means of the switch, the operation will slightly change. At the output of the RPU and before entering the microprocessor, a device will be placed to be able to read the code, and a universal one for the activation of the cockpit equipment, and
then to switch it on electrically. The diagram looks like this:



A.E.S Overriding:

The override switch prevents the microprocessor from being powered, because in case of system failure, the microprocessor is the brain of the whole system.
When the microprocessor is switched off, the equipment itself sends a signal to the C.T.R.T. that the microprocessor is deactivated. This is possible, as the switch is a selector key, in its normally open position it is powering the microprocessor, when it is switched, it stops powering it and powers a circuit which is connected to the transmitter and from there the signal is sent to the ground equipment.