VHF SPECIFICATION OF A POSITION MARKER

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The aim of this paper is the specification VHF marker, analysis of the principle of its operation and operational capabilities. To elaborate marker Marker 413 from Thales. Here the architecture of the system and describe the main function of the machine within the block diagram. Here are the possibilities of using the operating equipment at airports or routes.

Key words: Marker, Circuit, Beacon, Signal, Frequency

1 INTRODUCTION

VHF marker is now very important in aviation because of their use for discrete complete navigation data on the value of instantaneous distance of the aircraft from the runway threshold and the safe landing of aircraft. VHF marker transmitters are called vertically oriented directional antenna, whose main task is to inform of the pilot about the horizontal distance from the threshold in those places where it is important during the approach to landing and landing itself. VHF marker is used as a two or three radio beacons signaling directly incorporated into the ILS. This system is an internationally standardized system for aircraft navigation on the final approach for landing. At present it is widespread worldwide as a basic system for instrument approach under the conditions I-III A. categories of minima and provides both horizontal and vertical guidance necessary for the precision approach landing in IFR conditions, the conditions of limited visibility.

2 SYSTEM ILS

ICAO ILS system adopted as standard system in 1947. Subsequently, improved production technologies, improved the technical parameters and increased resistance to interference of the receiver board. The improvement of production in collaboration with highly effective system of monitoring the operational status of ground parts ILS allowed its use for inclusion in each category landing minimums. [1] [2] [7]

ILS system consists of ground and airborne part. On-board of the ILS system is composed of all the receiver signal beacons, that may be combined with the VOR receiver and indicator cross CDI. [1] [2] The land resources include:

- FM Localiser LLZ
- UHF beacon angle of approach – G
- VHF marker – MARKER

In terms of precision guidance and leadership of the aircraft is approach to landing and landing one of the most challenging part of the flight. Exact positioning of the aircraft through the ILS is based on the principle of transmitting ground equipments and measuring the difference modulation depth DDM on board. The difference in depth of modulation value is a function of DDM angular deviation of the aircraft from the exchange rate and glide. In the phase of flight, precision approaches to landing is using the ILS equipment on board aircraft angular deviation evaluated by signals received from LLZ and GP. Information about the position of the aircraft on the glide path is designed zero DDM and the aircraft is indicated zero current ICPI board cross exchange rate and CPI indicator glide path channel. As an indication of the command to repair an aircraft needs to be done on the side where it is deflected cross navigation ruler indicator. [8]

3 VHF MARKER

VHF position signals are modulated transmitters with directional antenna system and vertical radiation pattern so that they cover at a specified place the designated stretch of glide axis. Marker is used to mark the position of a radio navigation aid, or to indicate any position on the line. Its main task is to inform of the pilot about the horizontal distance from the runway threshold in those places where it is important. Such places are marked with radio transmitters signaling beacons. The pilot of the aircraft receives this signal by simple receiver. [6]

The aircraft's crew to fly over such habitats beacon signaled sound and light signaling and the crew is required to inspect these items recommended and the actual amount of the aircraft, which also provides information on the location of the runway threshold. The position lights are installed in the runway at the final approach segment. Transmitters are generating a wave with a frequency of 75 MHz and the amplitude tone 400 Hz, 1300 Hz and 3000 Hz. [3]

VHF marker can be divided into three types, and the inner, middle and outer marker.

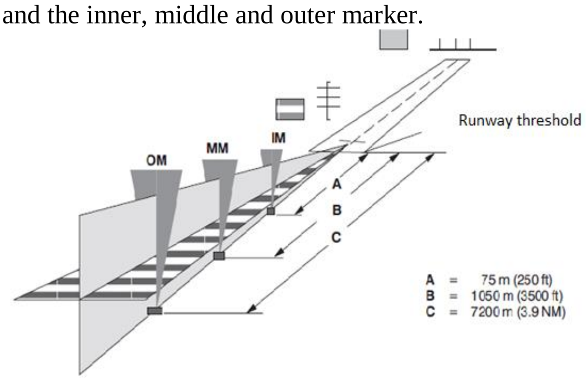

Fig. 1 [Schematic Diagram of ILS Data][9]

Outer Marker (OM)

- Indicates the input boundary glide where you need to verify the correct height of the aircraft and activity of the aircraft during final approach to landing
- External signal is 5,556 ÷ 11,112 km (3.5 ÷ 6 NM) from the runway threshold.
- Usually placed at a distance of 7.2 kilometers from the threshold of runway.
- Modulation frequency 400 Hz ± 2.5%.
- Identification signal is sent at a rate of two series of commas, dashes per second.
- The pilot hears the tone in the speaker or headphones and turns on his blue light.
- The beam intersects the glide slope beam of approximately 1400 ft (426.72 m) above the runway.
- In some installations, the ILS outer marker replaced NDB (omnidirectional signal). [4], [1]

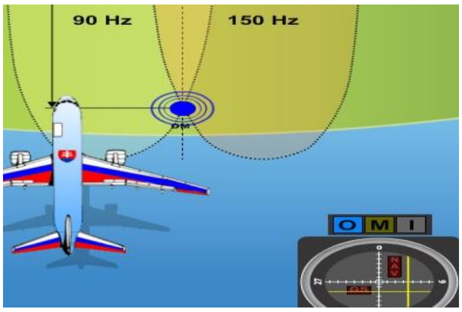

Fig. 2 [Aircraft at Outer Marker][1]

Middle Marker (MM)

- Indicates the DH spot, that place of transition from instrument to visual approach
- Located approximately 0.5 to 0.8 Nm 926 ÷ 1482 m from the runway threshold. When passing over it the aircraft of 200 to 250 ft (60.96 ÷ 76.2 m).
- It is thus placed at a distance of 1050 m (3500 ft) + - 150 m (500 ft) from the runway threshold in the direction of landing a maximum of 75 m (250 ft) away from the extended runway center line
- Modulation frequency of 1300 Hz ± 2.5%
- Identification signal is transmitted smoothly dot – comma
- Speed of audio signal identification are two lines or six dots per second
- Visual is flying over Stren indicated marker lamp orandžovej color. [9], [1]

Inner Marker (IM)

- Is used for indication of the arrival runway threshold and should be used for systems I and II category
- Is located at a distance between 75 m (250 ft) to 450 m (1500 ft) from the runway threshold and a maximum 30 m away from the extended runway center line.
- Emits a wave AM
- Modulation frequency of 3000 Hz ± 2.5%
- The identification signal has the shape of a series of dots, the rhythm of six dots per second.
- Alarm - white flashing [4], [1]

Principle of operation of position signals is based on the creation of a zone for arriving aircraft, which will be the crossing of the crew of the aircraft above the beacon signal generated information. This signal is composed of two forms, namely acoustic and optical. [5]

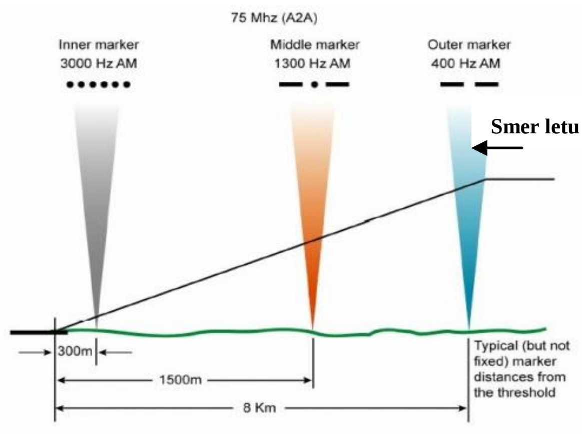

Fig. 3 [Function and distribution of Markers] http://www.vacc-cz.org/wiki/index.php/ILS

Received signals are demodulated and received identification tones continue to band filters. Due to the type of signal will pass some of the filters identification signal that causes the launch acoustic signal and illuminate the indicator lights that will answer the type of signal.

[5]

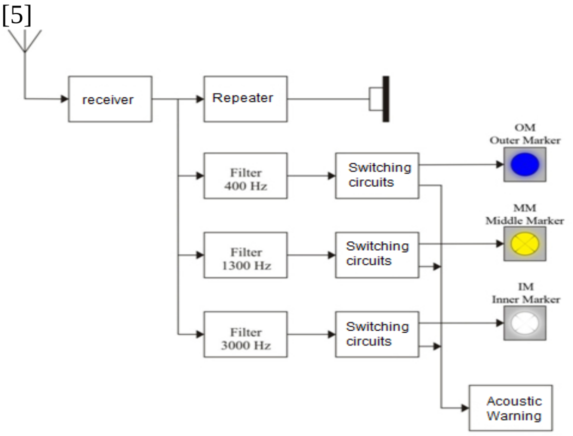

Fig. 4 [Block diagram of the receiver VHF marker][1]

4 MARKER 413

Marker 413 is adjustable VHF signal produced by the French company Thales. [9]

A marker beacon is a component of the Instrument Landing System (ILS); it serves as a navigation aid during ILS landing procedures, whereby the pilot of the aircraft flying over the marker beacons during the landing approach is provided via radio with distance markings indicating his current distance from the runway threshold. The marker beacons are conform to the ICAO recommendations in Annex 10 and to the technical requirements of the Deutsche Flugsicherung GmbH (DFS). [9]

Two — or in special cases three — marker beacons are required for the ILS landing procedure. They are known as the OUTER marker, MIDDLE marker and INNER marker in accordance with their point of installation, whereby the inner marker is only installed on request. Each marker beacon transmits on a carrier frequency of 75 MHz a particular code via an associated antenna vertically upwards. In the case of the OUTER marker the carrier frequency is modulated with 400 Hz and dash keyed. In the case of the MIDDLE marker the carrier frequency is modulated with 1300 Hz and is dash—dot keyed. In the case of the INNER marker the carrier frequency is modulated with 3000 Hz and is dot keyed. [9]

The antennas of the marker beacons have a vertically upward radiation characteristic. The antenna of the OUTER marker beacon is located approximately 7 km, that of the MIDDLE marker beacon approximately 1 km and that of the INNER marker beacon approximately 75 m ahead of the runway threshold. The transmitter and antenna can be installed ± 75 m both sides of the runway center line extension in the case of the OUTER and MIDDLE marker beacons. In the case of the INNER marker beacon on the other hand, the antenna is installed on the runway center line extension, the transmitter is installed approximately 60 maway fromthis line. [9]

The Marker 413 device of the NAV 400 air navigation system complies with the requirements of EC Guideline 89/336/EEC in its implementation. [9]

Individually, the device fulfills the requirements of the following EMC Guidelines:

EN 55022	August 1994	Interference Transmittal, Class B
EN 50082—	January 1992	Interference Resistance
PR ETS 300 339	June 1993	EMC for Radio Transmission Devices

As a verification for the fulfillment of requirements, the EC Basis Model Certification with the registration number B130466J has been received for the device from BAPT, based on which the CE Designation may be applied. Furthermore, the device fulfills the requirements of the FTZ 17 TR 2013 Standards/ Licensing Test Regulations, June 1989, for the radio transmission interface. For this, the Basis Model Test Certification with the registration number A 130466J has been received from BAPT as verification of the fulfillment of requirements. Based on this, the device may bear the international designation of licensing approval.[9]

The transmitter operates with a carrier frequency of 75 MHz generated by a quartz oscillator. This carrier is amplitude—modulated via a modulator with an AF of 400, 1300 or 3000 Hz (depending on the point of installation of the marker beacon). The AF is either dash keyed, dashdot kyed or dot keyed, likewise depending on the point of installation of the marker beacon. When conditioned in this manner the carrier frequency is supplied via the RF amplifier to the antenna switch, and from there to the transmitter antenna. [9]

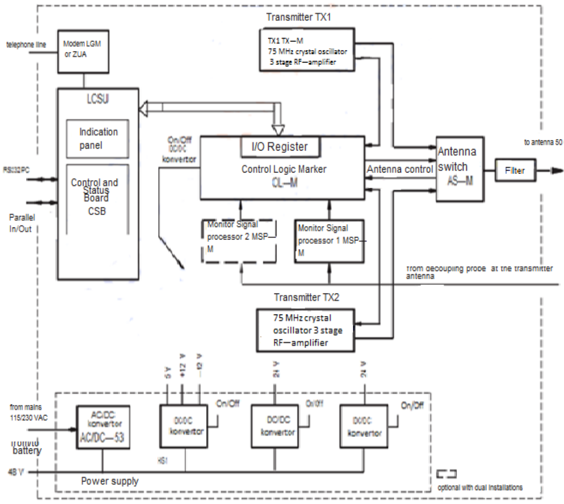

Fig. 5 [Simplified block diagram][9]

A part of the RF is coupled out via the RF amplifier, demodulated and supplied to the Control Logic Marker (CL—M) via a second output for monitoring the depth of modulation and the code. A part of the RF radiated by the transmitter antenna is coupled out via a coupling probe at the antenna and supplied to the Monitor Signal Processor (MSP—M). If the nominal values for the three monitored functions: transmitter power, modulation depth and code (transmitter failure) are not obtained, the Control and Status Board (CSB) changes over to the standby transmitter, and the transmitter antenna is likewise switched to the standby transmitter via the antenna switch. The design and functioning of the standby transmitter are identical to those of the service transmitter. The remote control unit, via which the various monitoring operations and commands are implemented, transmits a changeover message to the tower. [9]

The mechanical design of the marker beacon is based on ”ISEP” module technique located in a 19” housing. All plug—in cards are accommodated on a assembly carrier (subrack) behind a front panel which can be hinge—opened. A control and indication panel (part of the LCSU) is located on the front panel. The subrack is a 19” slide in unit. Rails made out of plastic are located at the top and at the bottom of the subrack to guide the plug—in subassemblies with the standard size of 100 x 160 mm. The mechanical design of the Marker consists of:[9]

- Mains switch
- DC switch (PSS)
- TNC female plug for antenna and monitor
- Covering made of transparent plastics
- Socket for rotective earth/potential equalization
- Battery terminals
- Measuring line terminals for battery voltage measurement
- Socket for power supply cable (AC)

Tab. 1 [Overview Subassemblies][9]

SUBASSEMBLY DESIGNATION	ABBR.	CODE NUMBER
Transmitter Marker	TX—M	8314430101
Antenna Switch	AS—M	8314433101
Control Logic Marker	CL—M	8314423100
Monitor Signal Processor	MSP—M	8314422101
Local Communication and Status Unit	LCSU	83144 21101
Control and Status Board (part of LCSU)	CSB Marker	
Control and Indication Panel(partof LCSU)		
Modems:		
Dedicated line Modem 2)	ZUA 29/	8313172601
	LGM1200MD	8404583233
Switched line Modem 2)	LGM 28.8	8404583241
AC/DC—Converter	AC/DC—53V	8314412301
DC/DC—Converter5V/8A,±12V/1A	TrivoltGK60	8314412100
DC/DC—Converter 48 V/24V/1A	Monovolt	8314412200

The antenna takes the formof a Yagi antenna with four elements and one coupling probe. It has a large bandwidth and horizontal polarization. The antenna gain is 4.8 dB with respect to the half—wave antenna. [9]

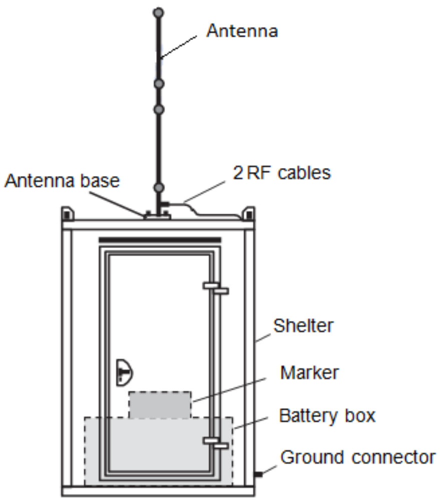

Fig. 6 [Antenna mounted onto the shelter roof] [9]

5 CONCLUSION

The paper presents a specification VHF position signals used in aviation. Based on an analysis of the principles of operation and the requirements for individual systems, we have created a comprehensive picture of the use of VHF signals position in civil aviation. The analysis conducted led to the conclusion that at present in the process of managing an accurate approach to the runway and landing aircraft using the very systems that provide high accuracy, efficiency and safety of operation. Constant development of aviation imposes requirements on development of new improved technologies that could increase the continuity and operational safety

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