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# Application of Optical Wireless Interface in Radio-Electronic Equipment of Aircraft for Diagnostics

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**ABSTRACT:**The article analyzes the problems of improving the avionics system of modern aircraft and introducing ARlNC 429 into them. The structure of wireless diagnostic transmitters and receivers of the optical range for the diagnostic system of radio-electronic equipment is proposed and presented.

**KEYWORDS:** aircraft, avionics, radio electronic equipment, remote diagnostics, wireless connection

## I.INTRODUCTION

When designing aviation radio-electronic equipment, the main role is played by reducing the weight and dimensions by improving the element base used in various devices, as well as through the use of information exchange systems between the nodes of on-board equipment. Therefore, when using wireless technologies, there is a significant reduction in weight and size associated with the absence of electrical wires and cables, which can reduce operating costs.At the same time, the wireless radio frequency system cannot be used to exchange information between onboard devices and systems due to the complex provision of electromagnetic compatibility with the radio electronic equipment installed on board the aircraft.

The wireless system provides greater independence from the routing paths required for communication using electrical wires or optical fibers, and therefore has great capabilities.

Since the inception of the Airbus A320 family of aircraft in the late 1980s, FlyByWire has been a major breakthrough in flight control technology and has also ushered in a new era of flight control. Flight control technology has changed over the past 40 years from mechanical transmission systems. Recent developments in the field of airborne data communication interfaces allow multiplexing of several types of data over a single bus.[1]

The most common airborne interface standards are the ARINC 429 data transmission standards for civil aviation.

The most recent development in flight control interfaces is FlyByLight technology - "Flying through the light" The development is based on the use of optical fibers instead of metal wires, has proven to be very useful in reducing the weight and increasing the throughput of onboard interfaces. This technology is currently applied on the Boeing 787[2, 3].

The use of FlyByWire and FlyByLight technologies in onboard interfaces has several disadvantages. First of all, this is an increase in the weight of an aircraft when using various materials (wires or optical fibers) to build an environment for the exchange of information between systems of onboard equipment. Apart from the extra weight, a serious drawback is the relatively low reliability of the communication elements. There is a risk of damage to the elements that create the physical communication channel (wires or optical fibers), which leads to the loss of data in the system.One of the most common methods to improve the reliability of fiber or wired connections is to back up the physical transmission channels, which adds weight. [5, 6].

To overcome these disadvantages, it is most expedient to use wireless communication lines of onboard equipment.

The radio frequency range, as mentioned earlier, is unsuitable for use in an on-board wireless communication network due to the difficulty of ensuring electromagnetic compatibility with the installed elements of avionics systems that interfere with their operation. For the same reasons, it is inappropriate to use a Wi-Fi-type wireless interface on

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board an aircraft. In this regard, the most suitable range for use in an on-board wireless communication network is the optical, in particular infrared range.

To create open optical channels, hollow areas inside the aircraft fuselage, as well as wing cavities, air ducts, and other elements are used. Removing electrical cables creates additional areas for redundancy.[7, 8]

Advantages of the optical wireless interface implemented on the basis of the ARlNC 429 standard allows you to choose this standard.

When developing a general functional diagram of the system, it is necessary to take into account that the proposed method of monitoring parameters can be used on any aircraft where a centralized system of built-in parameter monitoring is installed. Such a system is currently installed on all types of aircraft operated by the National Airline "Uzbekistan Havo Yollari" (AIRBUS-320, BOEING-757, BOEING-767). [4].

The aircraft is equipped with an ARINC-429 signal converter (airborne interface standard) into an optical signal converter for its transmission to an optical data transmission line. The converter functions include modulation of transmitted data and detection of received data.

The ARINC 429 standard, also known as the MARK 33 DITS specification, is a privately held, commercial company designed to provide interoperability and interoperability between different manufacturers' avionics. Historically, avionics manufacturers did not initially have to comply with this standard, but soon it became practically mandatory, as aircraft manufacturers included only units that meet the ARINC 429 requirements in the lists of equipment approved for installation on board aircraft.

The proposed scheme for the implementation of the wireless interface of the optical range is shown in Fig. 1.

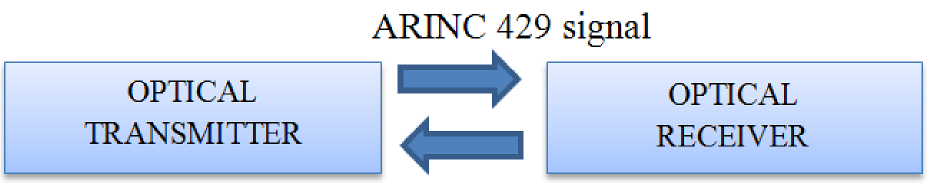


Figure. 1. Optical wireless interface

The system consists of an optical transmitter and an optical receiver.

Let us consider in detail the operation of the optical transmitter and receiver.

A TTL data stream is formed from the bit sequence of a 32-bit ARINC 429 word, which is fed to the LED driver (Fig. 2).

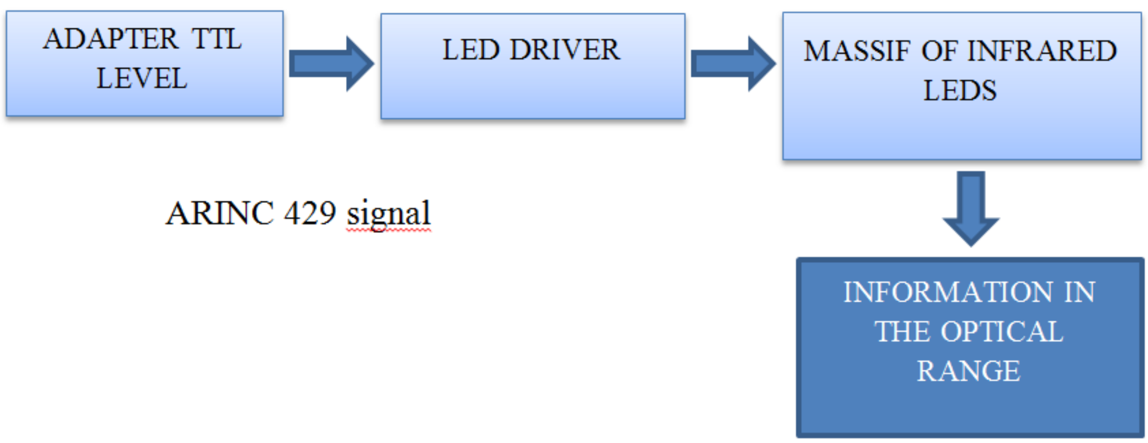


Figure. 2. The structure of the optical transmitter.

The LED driver drives an array of four high-power and infrared light-emitting diodes (IR LEDs), which emit pulses on the rising edge of the TTL signal. In this case, data synchronization is not performed, which means that the duration of each light pulse is equal to the duration of half a bit of an ARINC 429 signal. Thus, the data transmission rate of the optical communication line is equal to the bit rate of the ARINC 429 bus.

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The input circuit of the optical receiver is a detector of light pulses generated by the optical transmitter (Fig. 3). The main element of the input circuit is a highly sensitive PIN photodiode, as well as a signal amplifier and a voltage comparator, whose functions include converting the signal received by the pin photodiode into a TTL signal, which is fed to the microcontroller for further processing.

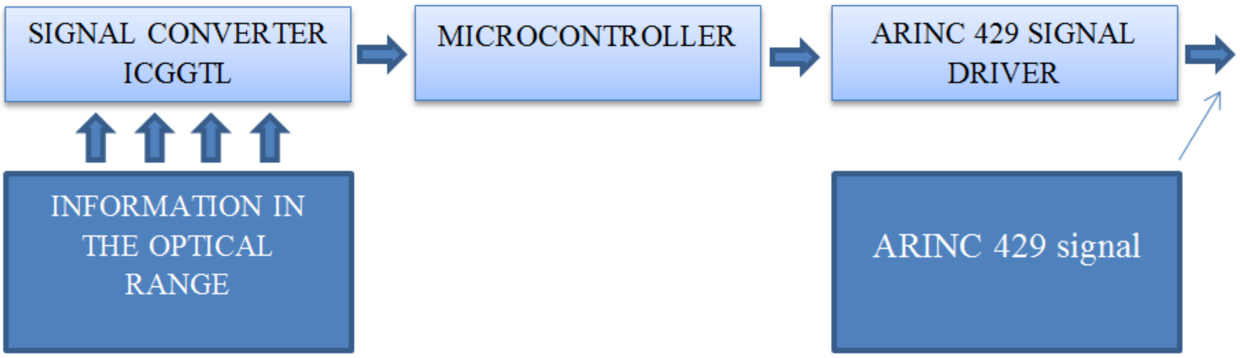


Figure. 3. Optical receiver structure.

In the microcontroller, the TTL signal is restored, which is a control signal for the ARlNC 429 driver, where the TTL signal is converted to the ARINC 429 format.

The conducted research allows us to conclude that in order to improve the diagnostic system of radio-electronic equipment of modern aircraft, it is advisable to introduce ARlNC 429 into them.For this purpose, a wireless diagnostic system of radio-electronic equipment is proposed and the structure of its transmitter and receiver operating in the optical frequency range, in particular, infrared range.

## REFERENCES

1. http:www.aircraft.airbus.com/support-services/ services – Описание системы дистанционный диагностики Airbus-AiRTHM.
2. Leeexplore.ieee.org/document/635042 – ОписаниесистемыдистанционныйдиагностикиBoeing – Aircraft information management system (AIMS).
3. Boeing proprietary – Copyright 787 Training Student Lab Notebook Airplane General, Common Core, and display Crew Alertining – Introduction book 1.
4. http:www.uzairways.com – Официальный сайт национальный авиакомпании “Ўзбекистон Ҳаво Йўллари”
5. https://ieeexplore.ieee.org/document/735881/metrics#metrics
6. Heatley D.J.T., Wisely D.R. 1998, Optical Wireless.
7. Guerrero H., Rodriguez S. Optical Wireless Intra – spacecraft Communications.
8. http://articles.adsabs.harvard.edu//full/2006ESASP.621E.177G/0000177.001.html