DIAGNOSIS OF HELICOPTER MODULAR AVIONICS

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Summary. The aim of the article is to present the analysis and processing of one of the avionics components in an avionics kit of helicopter BELL. At this time an avionics system on aircraft is complex structure and level of intelligent control has become important for trouble-free operation. The complexity, interconnection and cooperation of these systems is a difficult diagnosis which is time-consuming. Time is very important in aviation, let alone rescues the ingredients, which must be in a perfect technical background ready for immediate start for rescue. It is important to know to what extent and depth it is needed to integrate core system and the individual partial calculations break down into smaller subsystems. The aim of nowadays technology is less weight and better evaluation of capacity. Article is present device for easy and quick check of an avionic subsystem on the helicopter Bell 429.

Keywords: avionics device, control unit, data bus, shading, serial communication bus,

1. INTRODUCTION

The development of computer technology and local area networks and Internet in 1990 supported the explosion of information and access to them. Great research of microprocessor technology, increasing the number of integrated circuits, reducing weight, improving their performance parameters, the possibility of greater carrying capacity and better overall compatibility and reducing production rates and production costs and mass production have led to a revolution in aviation [2].

These facts led to the revolutions in avionics systems, architectures board systems of their organization and cooperation between the systems themselves. Today, these systems are known as Integrated Modular Avionics abbreviated IMA. The development of the nowadays avionics has been affected by number of factors. The development was influenced by the rapid growth of other technologies that are the absolutely normal for life and we cannot imagine the day without them today.

A better access to the information supported greater and faster cooperation and communication of between manufacturers and research and development centres. Research and development centres have responded to the manufacturers of avionics to evaluate the data from the sensors comprehensively and the concept of information evaluation was launched or judged by the pilot himself. The navigation demand and spatial orientation has increased with respect to the increasing number of passenger and demand of faster airmail and cargo. It was therefore necessary that the navigation has been more current. This could be achieved that individual systems had to start cooperating with one other. The purpose of this is the correction of errors and deviations in navigation. These errors could cause in today's aviation a disaster. The success can be credit to the mass development of electrical technology, for example - mobile technology. By the time, aviation has introduced a new term "take it from the shelf and exchange" and also even in today's consumer electronics apply similar expressions. Therefore, the price is available for consumer and the market value of the product of regular consumption decreases rapidly. The benefit of modular avionics system in aviation has impact on contributed rapid replacement of equipment and itself endurance [1].

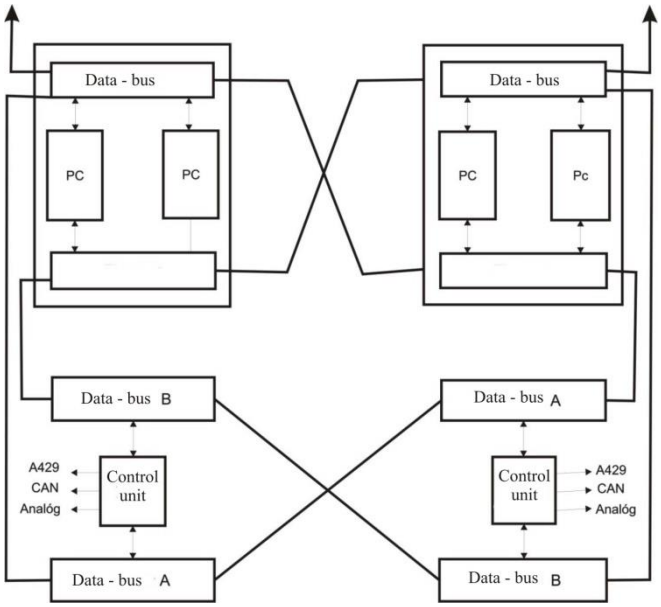

Figure. 1 Intelligent avionics bus networks in helicopter

2. PRECISE DEFINICION TRANSPONDER – GARMIN GTX

Transponder Garmin has receiver and transmitter which uses the same frequencies like TCAS. Interrogation is supported by 1030 MHz and reply is transmitted by 1090 MHz. Each of units supports identification which is provided via ATCRBS in Mode A/C and Mode S which can fully supply Mode A/C. ADS-B technologies improve cautions and warning what provides safer flight. Transponder Garmin GTX supports automatic reply for interrogation of attitude during flight, it means that automatically provides information about height, course, number of flight, speed to another aircraft in its volume. However, in the same time it provides this information to the ATC. ATC workers are addicted for this information because they need to know which aircraft passes their air volume under their control. Transponder Garmin GTX has display unit which is built in front panel, which provides information about current state to the crew. The displayed information is setup code of flight, pressure height, barometric height, reply symbols and actual mode. Electricity input for reply is max 28V/1,6A and for interrogation 28V/0,85A [5].
Aircraft transponder Garmin GTX 330 is installed for higher volume of safety. It operates on common frequencies for all worldwide transponder because it is a rule. A unique advantage of this transponder is that it is compatible with older operation Modes which provides less information than the newest Mode S, also the same for support for the ground stations.

Figure. 2 avionics system – Garmin technical layout

It uses Mode S. Mode S has more advantages like Mode A/C. For example, compatibility with older transponder and older ground ATC equipment, it provides more information about airframe on which it is installed, more punctual height. Last mentioned advantage of punctual height is replied by 25 ft. This current measurement of height is provided by adaptive trackers. Adaptive trackers depend on magnitude of prediction of errors. These α and β tracker are adaptive constant which adapt to increasing of height in ft/s. The value of α tracker is 0,4 if the direct changing of height is 7ft/s and the value of β tracker is 0,1. If the prediction of errors is less than 22,5 ft than the value of α is 0,5 and the value of β is 0,167. If the flight is directed at the same level, then the values of the trackers are α=0,6 and β=0,257 [6].

The process of choosing the right encoder has succumbed criteria which emerges from used transponder on helicopter which has been chosen. Helicopter has used transponder GTX 330. Due to datasheet and required output it has been selected two device encoder. The datasheet has offered two options. It has been encoder Shadin and encoder Icarus. Both of them are parallel/serial. Shadin Avionics serializer has been chosen, because of its easier construction and better connection to the circuit [5].

Serial communication RS -232 can interconnect two devices and provide serial communication between them. It means that single bits has been "carried" one by one in serial on one single wire, pair wire, due to both side communication.

The Shadin Avionics is manufacturer of the altimeter encoder, low resolution serializer. It has provided data for Mode A/C/S which are converted to the right format for reading via RS-232 for GPS. Low resolution serializer is named due to the fact of the resolution of height which is provided to the airframe and is divided after 100 ft. Device is equipped by microprocessor, it is a reason why we can use it without pressure input. When it does not need pressure input, than it can be used for diagnostic at sea level.

This serializer is compatible with the most of the transponders which don't need to stroboscopic input of coder. Output from serialize is valid signal for all the time [4].

On the output of the serializer is RS-232 serial format of communication. The speed of the communication is 9800 baud per second, volume of the information is 8 bit without parity and information include one stop bit. The measurement scale of the Shadin serializer 9000 is from -1000 ft up to 62 000 ft. The guaranteed functionality of the device depends on never exceeded measurement range itself. The serializer can support two independent transponder units in real time. It means that one serializer is enough on airframe, but aviation always makes a deposit for a system.

3. PRACTICAL DESIGN OF CHECK DEVICE FOR GARMIN GTX 327/330 FUNCTIONALITY

The aim of the aviation is quick preparation and check before flight. The task for us was created device which can check as fast as possible condition of communication chain among serializer, transponder and antenna at ground level. Continuously studying task was created image of the check device.

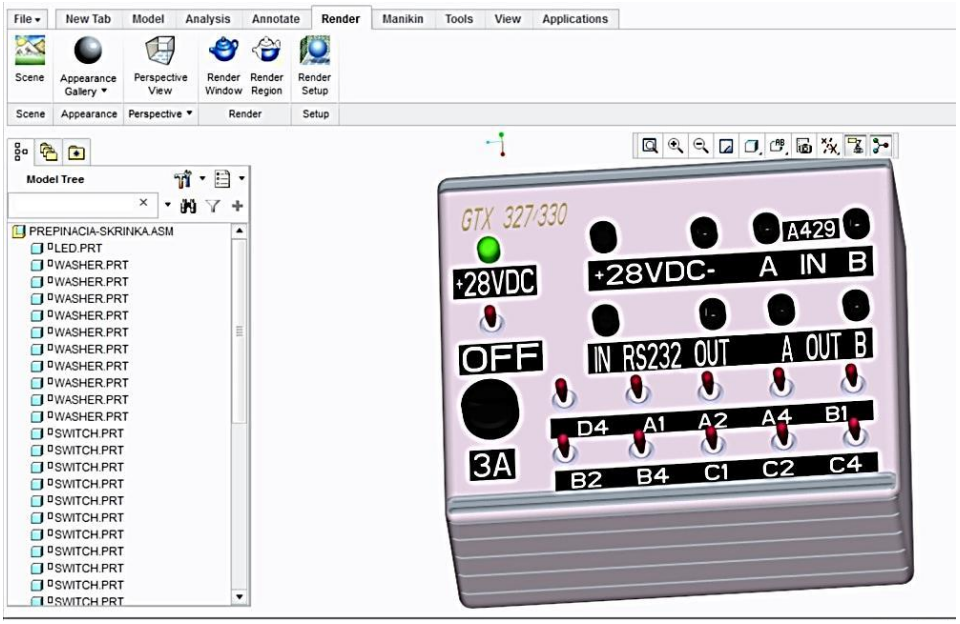

Figure. 3 Technical design with use PTC Creo - parametric environment

During designing check device, there were created wiring diagram – interconnections. Interconnections were created according to the manuals for GTX 327/330 and serializer encoder. For maintenance personnel was created check up table for reply correct height of transponder. Interconnection´s wiring was developed just for the important pins on GTX 320/330 , it is not general interconnection but there are two separate interconnections. Everything was fit for GTX 327/330 [3].

3.1. Check procedure and preparation method for GTX 327/330

Everything what you need for check of the transponder is power source, interconnections wiring, low resolution serializer encoder and stand for check up reply, ATC 600.

1. At first you have to interconnect transponder, altitude encoder and Check Device according to wiring diagram.
2. Every time check main switch and code switchers ensure that they are shifted to position "OFF".
3. Connect power wire to the Check Device.
4. Switch power source on, 27 VDC.
5. At Check Device shift the main switch to position "+28VDC" (upper position). LED has to light up over the main switch.
6. Turn on transponder GTX 327/330 to the configuration mode, in one time you must press and hold at control panel "FUNC" and "ON" according to manual "190-00187-02" (3.3 Configuration pages)
7. Set up the transponder according to "CONFIGURATION ITEMS" in manual: 190-00187-02 Revison J May 2003.

Figure. 4 Control unit for avionics check device

3.2. Check up of basic parameters with simulator ATC 600

Set up the antenna to the same height as the antenna of transponder, the distance between the antennas must be minimum 38 cm (14, 96 in) via coaxial cable. When the simulator ATC-600 is running, must be minimum distance hold [5].
Check up of conversion from GRAY code via SHADIN 9000- T to RS 232 format
Leave the kit interconnected like at the transponder check.
Turn on transponder to the configuration menu by push and hold the buttons “FUNC” and “ON”.

Figure. 5 Garmin with the required information

We setup configuration page like on the image. There we can check translation from Gray code to the altitude.
Notes:
Measurement has been repeated as by the check of the serializer.

- Switch on the ATC-600A must be shift to AC/ALT position.
- At simulator ATC 600A must be displayed data of altitude and light “INV” can´t lights up. Subsequently turn off altitude on transponder. At simulator ATC-600 lights up indicator “NO ALT”
- Turn on reply of altitude, push button “ALT”, at the same time data appears at simulator ATC-600A.
- Continuously simulate altitudes by the Check Device and do a check up at the simulator ATC-600A.
- Measurement have to be written down to the protocol.

4. CONCLUSION:

Nowadays avionics systems are very complicated because of conception of modern control application and built-in test. Everything focuses on precisely work and current and correct data without errors. Start up with new diagnostic element implemented right to the avionics unit of body enhances reliability, in other words flights become safer. The task of the airframe control is directed to the operators (pilots), who have to receive and turn over during the flight a lot of information, which tend to the stabilization of body in single part of flight. With new electronic technology in cockpit comes new age of reading and understanding the data which operators have. This process of reading information is important for check up during whole flight. A lot of information is handling by airframe itself. Then pilots have more time for more important control things. At this time it is important to setup new diagnostic system to maintenance because of easier and quicker primary diagnostic. Cockpit is very complicated and avionics modules and units are interconnected among themselves and it is very difficult to find error in a short time. Due to this problem we have to divide integrated avionics systems to the smaller parts.

Acknowledgements
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5. LITERATURE LIST

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