

*S.S. Ilyenko, PhD, V.V.Tikhonov, PhD, A.V. Ilyenko, PhD
(National Aviation University, Ukraine)*

Information support for the effective functioning of diagnostic systems and integrated avionics control systems for modern aircraft

Development of the central board diagnostic systems and built-in control systems the operation of complex automated systems of modern aircraft at the design stage and use them in flight and technical operation during maintenance and repair can reduce the number of random abandoned situations in flight to almost impossible.

Introduction. In modern conditions of operation of aviation technology distinguish two approaches to ensuring a high level of safety of flights: the first approach is based on the valuation of actions to be taken to achieve a given level of flight safety in the design, manufacture, operation and maintenance of aircraft, including air traffic control and airfield service; the second approach is based on the organization of preventive measures to maintain the established level of safety of flights.

The system of technical maintenance, which includes maintenance, includes: objects of aviation equipment; aviation personnel; operational documentation; land structures; material and fuel and energy resources; technological equipment and ground handling equipment. This approach allows to ensure the safety and regularity of flights of aircraft, and timely preparation of aircraft for flights; preservation of flight technical characteristics in accordance with regulatory and technical requirements; efficient use of aircraft [1].

Consider a modern approach to diagnostics and maintenance of aircraft on the example of the Aircraft Diagnostic and Maintenance System - ADMS system. ADMS is a centralized tool for most of the maintenance tasks on modern aircrafts. This service system uses the registration of built-in aircraft systems failures in conjunction with access to systems using Line Replaciable Unit / Modul - LRUs / LRMs identified as Member Systems - MSs. Member Systems is a system installed on an aircraft that continuously transmits refusal information.

ADMS is not used to determine if an aircraft is usable before the flight. Technical personnel to find and troubleshoot recovery by only use information ADMS. According to this concept, the refusal of ADMS during a decision does not affect the decision to fly. ADMS is used only for troubleshooting aircraft

ADMS consists of Central Maintenance Computer - CMC, which implements the function of the centralized maintenance calculator and the Aircraft Condition Monitoring Function (ACMF), Remote Terminal (RT), Gateway Data LAN Management Unit (GDLMU). ADMS includes the following components: Central Maintenance Computer - CMC; Multi-Function Display - MFD; Remote Image Bus - RIB for transmitting information from CMC to MFD; Loadable Diagnostic Information - LDI; Member Systems - MSs; switch (switches) to remove the lock for test assignments; event registration button; communication management function; Block GDLMU.

Problem research. The centralized single way of accessing information used by ground personnel for the maintenance of aircraft is the Central Maintenance System - CMS. It is provided that functions performed by the CMS do not provide signaling of the crew for refusals. In addition to outputting information to the MFD, it is possible to use a Remote Terminal (RT) based on a Notebook PC. RT allows technical personnel to access information without using MFD [2-6].

The CMS includes the following components: Central Maintenance Computer (CMC) - installed in the Modular Avionics Unit (MAU); Central Display Unit (CDU) - Multifunction Display (MFD) as part of the display system for outputting CMS information; CCD - for controlling CMS in cabin of pilots; Modular Avionics Unit (MAU) is a container that houses avionics complex modules, including the CMC module; Utility Control System (UCS) - interface system (with different sensors in the form of analog, binary signals and ARINC-429), which connects the avionics complex with aircraft systems by ARINC-429; Data / LAN Management Unit (DLMU) - Connects CMC to DLMU via local LAN; Remote Terminal (RT) - Remote Terminal.

Each MSs performs its own control and saves its own malfunctions. The complete architecture is illustrated in Figure 1. Each system provides information on the technical state in real time and their relationship with the CMC. MAU provides the full collection of ARINC 429 MS for CMC. MAU is a large input / output hub that collects analog and discrete signals as well as ARINC 429 inputs.

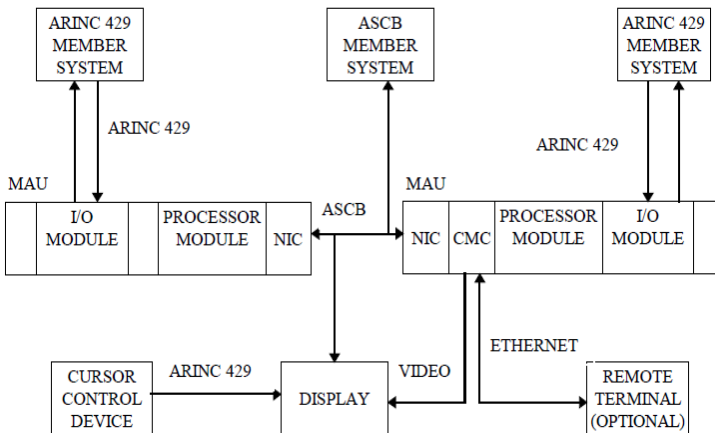


Fig.1. Complete CMS architecture

CMS provides: the only point of access to the failure information for all systems that interact with the CMS; determination, presence of CMS communication with the built-in aircraft systems; collection of data on refusals; memorizing flight failures; review of the individual history of refusal; initiating test control and outputting test results; comparison of data on refusals with time, date, flight segment and other data [2-6].

System solution of the research problem. The CMS is functionally linked to the MFD display system via the RIB (Remote Image Bus) interface. The SMS

module is connected through the RIB. The software (software) of the MFD transmits the image to the display of the following functions: MWF (Monitor Warning Function) - the function of outputting messages about special situations in aircraft; NIC (Network Interface Controller) - controls the time, date, airplane number and type of aircraft, transmits time tags in an attachment to data transmission to the SMS module; Functional systems involved Member Systems (MSs) that interact with the SMS via ARINC-429 and ASSB. The MSs group includes all refusals and identification data related to the FS FP (parameter information arriving in CMC using ARINC-429); Ground Interlock Switch. To download / read data / programs using a local area network (LAN).

The diagnostic function in the CMS is based on the Loadable Diagnostic Information (LDI) system - downloading diagnostic information, such as a data model or a map that describes MS maintenance data. Maintenance data includes maintenance pages and messages. The LDI data is stored in a database that is not part of the CMS executable, but is the individual files available to the CMS. Data on maintenance pages is stored in LDI. LDI can be changed using the boot system. All failures are stored in the Fault History Database (FHDB) bug database. The history of aircraft failures as a copy of FHDB is stored in the aircraft database module. If the SMS module is replaced, the history of aircraft failures is saved. CMS collects a notification of disclaimers and stores relevant information. CMS displays active maintenance messages and saves them. The Typical data processing used by MSs is illustrated in Figure 1.

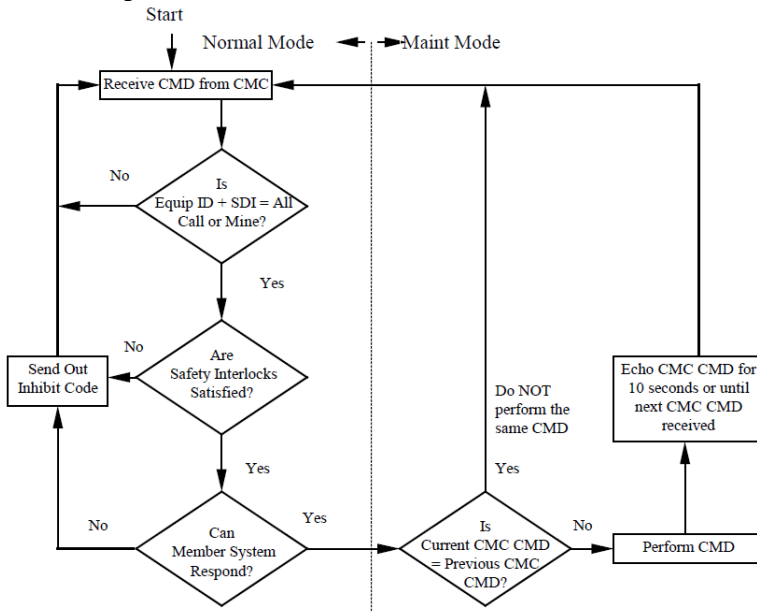


Fig. 5. Typical data processing used by MSs

In the implementation of the function of the built-in control systems, the following criteria for determining the level of hazard are defined, and the conditions for refusal are identified:

NONE - Loss of performance or improper operation of the system affects the safety of the flight of the aircraft and does not increase the workload of the crew;

MIN (Minor) is negligible - the consequences of a failure can lead to limitation of actions or tension when responding to a failure on the side of the crew. A refusal will slightly reduce the safety of the flight, will not lead to flight crew operations that exceed their capabilities;

MAJ (Major) significant - failure can significantly reduce the boundary (lower limit) of safety or functionality of the aircraft, cause the complication of adverse conditions, reduce the efficiency of the flight crew, or lead to damage to passengers;

HAZ (Hazardous) dangerous - Failure can lead to a large reduction of the security boundary or limitation of the capabilities of the crew and aircraft, create a higher workload or physical stress on the crew, which can cause serious injury or death of passengers. This is not acceptable, because in the event of even a rare such failure, this will necessarily lead to a dangerous event;

CAT (Catastrophic) catastrophic - catastrophic failure can cause loss of an aircraft. This is not acceptable, because in the event of such a failure, it will lead to catastrophic consequences.

Conclusions. Maintenance with the help of centralized on-board diagnostic systems and integrated control systems for functional avionics systems of modern aircraft makes it possible to receive information and react to its engineers in a short period of time with the possibility of remote processing of data in case of a refusal situation on board a modern aircraft. Systems such as ADMS include a sufficient functional base and software to perform diagnostic and maintenance functions that allows performing the functions of restoration of the functional systems of the aircraft in the time frame that is present under the current conditions of operation of the aircraft.

References

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3. ARINC Specification 429P3-19 Mark 33 Digital Information Transfer System (DITS) - Part 3 - File Data Transfer Techniques
4. ARINC Report 604-1 Guidance for Design and Use of Built-In Test Equipment (BITE)
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6. PS7024836 BIT Guidelines and Practices (Honeywell supplied systems only).