CONSIDERATIONS ABOUT THE FUNCTIONING TRANSPONDERS

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REZUMAT. Lucrarea de faţă prezintă unele informaţii generale despre transpondere, elemente despre sistemul de întreţinere şi utilizarea acestora în domeniul aeronautic civil şi militar. Toate aeronavele şi navele unei organizaţii civile sau militare trebuie să se conformeze în activităţile operaţionale şi de mentenanţă cu reglementările autorităţilor în domeniu, pentru ca, în conformitate cu sistemul de management al erorilor, să se reduca riscul de accident.

Cuvinte cheie: transponder, utilizare, erori, mentenanţă, auto, naval, aviaţie, reglementări.

ABSTRACT. This paper present some general information about transponders, about system maintenance elements and their use in civilian and military aeronautics. All aircraft and ships from a civilian or military organization, must comply in operational activities and maintenance with regulations from relevant authorities, that in accordance with their fault management system, to reduce the risk of accident.

Keywords: transponder, use, errors, maintenance, automotive, vessels, aviation.

1. INTRODUCTION

1.1. Transponder. role, purpose, principle of operation

In basic terms a transponder is a miniaturized electronic chip that has non-volatile memory, the type of memory that does not need constant energy for retention. Along with that electronic chip is a set of windings; very fine wire coiled around a tube. There are two basic types of transponders. The first are the electric coupled transponder systems. Electric coupled transponder systems are not limited to small areas for transmission but can transmit messages or signals for different ranges of distance including several inches to miles, as used in satellites and airplanes. These systems require large amounts of constant electricity to operate. The second type is what automobile manufacturers are using and they are called magnetic coupled transponder systems. Magnetic coupled transponder systems are passive in nature. This means they do not require constant electricity and thus do not need a power source of their own. They operate in the frequency range area of 125 kHz. Since magnetic coupled transponders do not have their own power source they are very limited in range of communication and generally operate in the range of 1 cm to 15 cm. Since the operation in this frequency range that can penetrate materials. The transponder cannot be directly visible.

1.2. Use: automotive, naval, aviation

1.2.1. Automotive use

The process of key identification is similar in most automotive transponder systems. Once a key is inserted into the ignition lock and turned to one of the 'on' or 'run' positions, the induction coil that is mounted around the ignition lock sends out an electromagnetic field of energy. The windings in the transponder chip absorb that energy and power the electronic chip to emit a signal. The signal is usually an alphanumeric sequence which is considered the identification code. The induction coil reads the signal and sends it to a computer device to recognize the signal. If the signal is recognized as being already in the computer's memory the signal is accepted and other electronic components in the vehicle are set into motion to allow the starting of the vehicle or the continuation of the engine running. Immobilizer systems based on Transponders may not be as safe as they are considered to be, because some immobilizer systems tend to remember last key code for so long that they may even accept a non-transponder key even after a few minutes of taking out the original key from ignition.

For this reason exist equipment for transponder cloning with fix cod or crypto.

Table 1. **Type of key code**

						COPY RW2	COPY RW3	
	1995 TO 2009	Ref.		RW2 ID	RW3 ID	RW2 + TEXCODE ADV. + PC SW (TEX CLONING)	RW3 + PC SW (TEX CLONING)	
RENAULT								
AVANTIME	2002 - ..	NE73EH2	TEX / CR	4D	60	Y	Y	5
MEGANE	1998 - 2000	NE73EH2	TEX / CR	4D	64	Y	Y	5
MEGANE SCENIC	2000 - 2003	NE73EH2	TEX / CR	4D	60	Y	Y	5
SSANGYONG								
KYRON	2006 - ..	SSY3EH2	TEX / CR	4D	60	Y	Y	6
SUBARU								
FORESTER	1998 - 2003	NSN14EH2	TEX / CR	4D	60	Y	Y	6
FORESTER	2004 - ..	NSN14EH2	TEX / CR	4D	62	Y	Y	6
IMPREZA	2000 - 2004	NSN14EH2	TEX / CR	4D	60	Y	Y	6
IMPREZA	2004 - ..	NSN14EH2	TEX / CR	4D	62	Y	Y	6
LEGACY OUTBACK	1998 - 2003	NSN14EH2	TEX / CR	4D	60	Y	Y	6
LEGACY OUTBACK	2004 - ..	DAT17EH2	TEX / CR	4D	62	Y	Y	6
WRX	2000 - ..	NSN14EH2	TEX / CR	4D	60	Y	Y	6
SUZUKI								
ALTO	2002 - ..	SZ11REH2	TEX / CR	4D	65	Y	Y	6
IGNIS	2000 - ..	SZ11REH2	TEX / CR	4D	65	Y	Y	6
JIMNY	2002 - ..	SZ11REH2	TEX / CR	4D	65	Y	Y	6
LIANA	2001 - 2005	TOY43EH2	TEX / CR	4D	65	Y	Y	7
TOYOTA								
AYGO	2005 - ..	V42EH 2	TEX / CR	4D	XX	Y	Y	8
AVENSIS	2000 - ..	TOY47EH2	TEX / CR	4D	60	Y	Y	7
LAND CRUISER	2004 - ..	TOY43EH2	TEX / CR	4D	XX	Y	Y	7
NISSAN (TRUCK)								
ATLEON	2002 - ..	NSN11EH2	TEX / CR	4D	60	Y	Y	6
CAB STAR	2000 - ..	NSN11EH2	TEX / CR	4D	60	Y	Y	6
CAB STAR	2003 - ..	NSN11EH2	TEX / CR	4D	XX	Y	Y	6

1.2.2. Navy uses – automatic identification system

AIS is a broadcast Transponder system, operating in the VHF maritime mobile Band. It is capable of sending ship information such as identification, position course, speed and more, to other ships and to shore. [1]

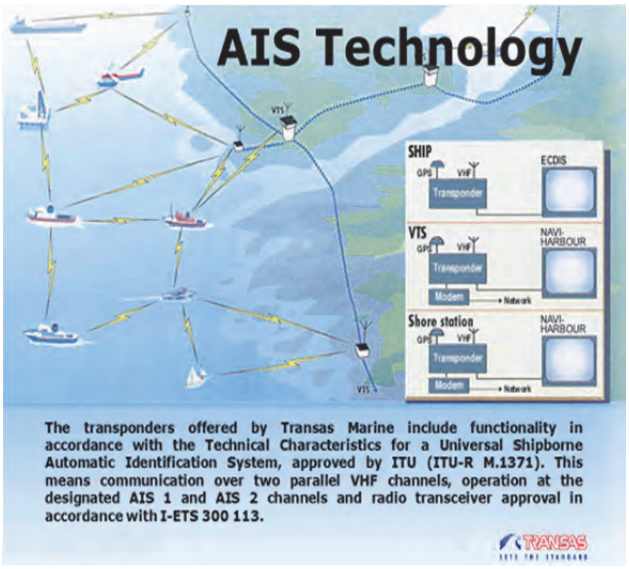

Fig. 1. Diagram of Automatic identification System

AIS Broadcast Information:

– *static data:* MMSI-Maritime Mobile Service Identity, IMO number (where available), call sign &name, length and beam, vessel type, location of the ship, at an update rate of 6 min.

– *dynamic data:* ship's position with accuracy indication and integrity status, UTC, course over ground (COG), speed over ground (SOG), heading, navigation status (manual inputs), rate of turn-ROT, updates rate – dependent on speed and course alternation (2 sec – 3 min).

Voyage related data – if available: draft, hazardous cargo, destination and ETA, route plan.

Two classes of transponders:

● ***Class A AIS Transponders***, required on:

– vessels on international voyages / SOLAS (Tankers, Passenger vessels that are over 150 gross tons, Commercial vessels of 65 feet or more in length, Other vessels over 300 gross tons);

– vessels operating within U.S. Vessel Traffic Service (Towing vessels of 26 feet or more in length and more than 600 horsepower, Passenger vessels, regardless of size, certificated to carry more than 150 passengers for hire, self-propelled commercial vessels of 65 feet or more in length, other than fishing vessels and small passenger vessels certificated to carry 150 or fewer passengers);

– typically used by commercial fishing vessels, tugs, some barges, super yachts;

– rarely used by Military or Coast Guard vessels, Small recreational or fishing vessels.

● **Class B AIS Transponders.** Class B is similar to the Class A, except that Class B: Has a slower reporting rate than a Class A (e.g. every 30 sec. when under 14 knots, vs. 10 sec. for Class A); Does not transmit the vessel's IMO number or call sign; does not transmit ETA or destination, navigational status; does not transmit ROT information, maximum present static draught; Is only required to receive, not to transmit, text safety or binary messages; Lower power transmitter 2 watt vs. 12.5 watt on Class A.

Class A and B AIS Transponders have computer compatible interface and chart plotters via NMEA and RS232 / USB, 12-24v DC Power Required, **switch options for "silent mode" and SRM**.

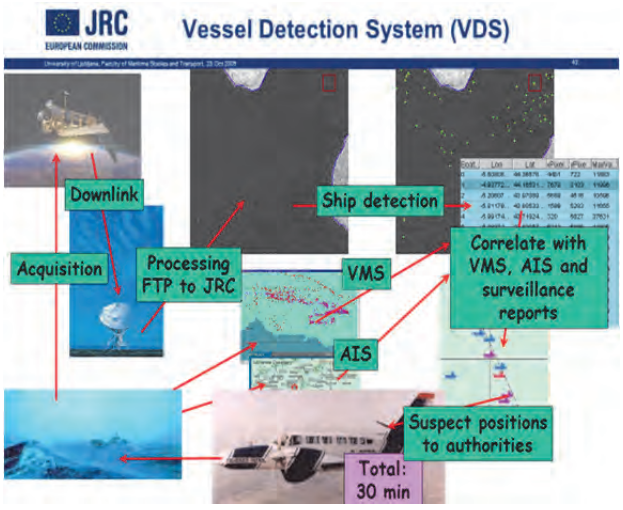

Fig. 2. Vessel Detection System - VDS.

1.2.3. Aviation use on ground traffic control – GTC, air traffic control – atc and maintenance

The ATC is using two types of radars for tracking aircraft route:

– the first type of radar determines the position of the electromagnetic waves reflected back by the plane and sent to it;

– the second type of radar requests information from each plane from an onboard transponder.

Commercial and military airplanes may soon disappear from the radar and if flying at low altitudes, electromagnetic signal is obstructed by mountainous terrain or the curvature of the Earth. For these reasons, the planes are difficult to track permanently by radar, **especially if the transponders are switched off intentionally**. [3], [4]

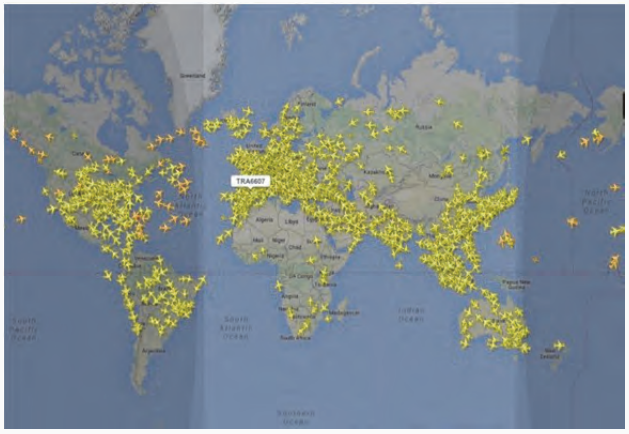

Fig. 3. Word sky with a flight identification.

For example, IFF – Identified friend or foe – BAE Systems transponder products are standard for the US Navy and US Army. Transponders identify aircraft and ships as friendly forces by responding to interrogations from ground-based or airborne IFF systems. BAE Systems transponder products, are incorporating all the advanced features from European Data Relay Systems. The identification security of both the interrogations and responses is ensured by cryptographic coding of the challenges and replies. The crypto module is loaded with an operational code key that is inserted each day. The module conforms to DoD AIMS 97-1000 and STANAG 4193 Part I standards.

For example, BAE Systems has delivered over 10,000 transponders. Their advanced IFF products enable warfighters to identify friendly forces and make informed decisions in time-critical situations. For optimal situational awareness, IFF technology can be used on existing, new, and emerging platforms.

For maintenance operations we can use the Aeroflex IFR 6000 to test all modes of transponder operation including Modes: A, C, S, Altitude reporting, ADS-B in/out, UAT and DME. Altitude data is supplied to the transponder from the altitude encoder or digitizer which then transmits that information to ATC, this altitude is displayed on the IFR 6000 during testing. The accuracy of the IFR 6000 enables us to easily meet or exceed all manufacturer specifications.

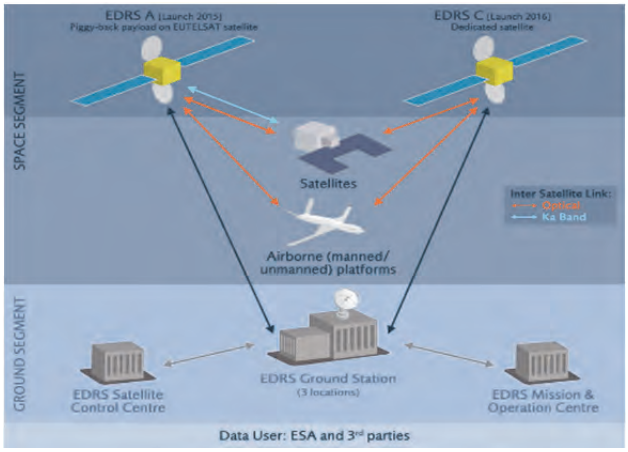

Fig. 4. European Data Relay System's - EDRS type A and C.

2. AVIATION REGULATIONS:

For the past two years EUROCONTROL's Safety Improvement Sub-Group (SISG) has been working on its Top 5 ATM Operational Safety Priorities. One of these is the risk of operations without a transponder or with a dysfunctional one. A transponder for aviation is an avionic system located on board of the aircraft that provides information about the aircraft identification and barometric altitude to the ATC system on the ground and to TCAS on other aircraft. The reply from the transponder is also used by radar on the ground to determine the position of the aircraft. The information to the ground is provided in response to an interrogation by systems such as secondary surveillance radar (SSR) or multiple systems. ADS-B (Automatic Dependent Surveillance – Broadcast) capable transponders also allow the aircraft to 'broadcast' information to ground stations and other aircraft without interrogation. Transponders are not just carried by commercial aircraft they are also used by helicopters, military aircraft, General Aviation, gliders and UAS. Some airside ground vehicles are also equipped with transponders.

In 20.10.2014 was translated in romanian and approved by the civilian and military authorities for the COMMISSION IMPLEMENTING REGULATION (EU) No 1207/2011 of 22 November 2011 laying down requirements for the performance and the interoperability of surveillance for the single European sky.[5],[6]

3. CONCLUSIONS

1. Technical Provisions for Mode S Level 2 Services and Extended Squitter, International Civil Aviation Organization, Second Edition- 2012 who are the purpose to specify technical provisions for the formats and associated protocols used in Mode S services and extended squitter. These detailed technical provisions supplement requirements contained in Annex 10 - Aeronautical Telecommunications, Volume III (Part I - Digital Data Communication Systems), and Volume IV - Surveillance Radar and Collision Avoidance Systems, and are necessary to ensure global interoperability.

The provision of Mode S services, specified in this document, include the following:

a) Data formats for transponder registers;

b) Formats for Mode S specific protocols: traffic information broadcast and data flash;

c) Mode S broadcast protocols, including: uplink broadcast and downlink broadcast.

2. The owner and the Part 145 Organization or EMAR 145 Organization, must to decide for a civil or military aircraft, the right configuration of IFF in accord with last regulation on this field.

3. Design a system integrated in IFF, who respond automatically at ground request for information or design a switch for manual selection for the pilot in command.

4. The national acquisition regulation, the IFF complexity, the number of aircraft ho need system modification, is the determinant factor for costs and deadline terms to implement.

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[4] https://www.google.ro/search?q=aircraft+on+european+sky&espv=2&biw=1366&bih=623&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiH4-ydkMHLAhWpApoKHVuBA7gQ_AUIBigB#imgrc=zymXze-Lh1MxPM%3A

[5] Doc 9871, *Technical Provisions for Mode S Services and Extended Squitter*, Order Number: 9871, ISBN 978-92-9249-042-3.

[6] Regulamentul de punere în aplicare (UE) nr. 1207/2011 AL Comisiei din 22 noiembrie 2011 de stabilire a cerințelor pentru performanța și interoperabilitatea funcției de supraveghere în cadrul Cerului unic European.

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