JZG – 703 SYSTEM RAILROAD MODULES FAILURE TEST EQUIPMENT

Associate Prof. Ph.D. Anelia Ivanova Dosseva
Ass. Prof. M.Sc. Nikola Serafimov Serafimov
Ass. Prof. M.Sc. Mesrob Hampik Palabikyan

Technical University Sofia, Faculty of Telecommunications (FKTT), St. Clement Ohridski Blvd. 8, BG – 1756 Sofia, Bulgaria, Phone: +359 2 965 2026, e – mail: nsse@tu-sofia.bg

The paper describes main design principles of a railroad modules failure test equipment in a JZG – 703 automatic locomotive signalization system, being applied in Bulgaria. A corresponding test equipment is being designed consequently. Failure test equipment is being designed in accordance with formulated input and output parameters and algorithm of operation, the latter reflecting specific operation features of railroad electronic modules.

1. Introduction

Train flow control and railroad traffic safety, aiming to prevent train entering in an occupied railroad section and maximal permissible speed limiting is achieved by means of automatic locomotive signalization systems. These systems transmit data directly from railroad, thus ensuring control over machinist actions and, upon necessity, leading to an extraneous alarm situation locomotive stop. The corresponding functions, executed by these systems, as well as their building electronic components, define exchangeable information capacity and railroad equipment.

Two types of automatic locomotive signalization systems are being used in Bulgaria: JZG – 703 from ERICSSON and Altracs BDZ from ALCATEL.

JZG – 703 system consists of discrete electronic components and integrated circuits elements- gates, flip – flops, inverters, etc., which in turn requires more railroad inductors - . The latter send data from locomotive road.

The second system conforms to EU ETCS (European Train Control System) Level 1 - specifications, elaborated in the last few years. It consists of contemporary electronic components and building blocks and is capable of processing and sending almost unlimited amounts of data from locomotive road. Railroad equipment control of both systems is accomplished by means of a data logger unit, being an indivisible part of their corresponding combinated locomotive equipment. The data logger saves in its memory the most important information about the last 6 – 18 minutes of system activities and data from 6 ETCS or 18 JZG railroad inductor groups. Upon necessity, data from memory could be analyzed and interpretted, thus locating railroad equipment disturbances and faults. In Altracs system the latter is being carried out automatically, by means of portable computers and appropriate software. The JZG – 703 system presumes manual measurements and data decoding in order to locate the fault reasons. It is not very convenient, since corresponding Hamming – Sterner code telegram tables should be used and subjective fault reasons analysis should be carried out. Besides of that, it should be determined if the appropriate telegram is eligible, in accordance with the test point type.

In order to automate the above described process a module for automatic fault – tolerance control of the electronic modules and railroad inductors in JZG – 703 system is being suggested.

2. Functional requirements

The fault – tolerance control module reads the input information, being generated at the coder ouputs in parallel, as two 8 – bit code combinations, the latter based upon a modified Hamming code H (8, 4).

Each of these combinations (16, all of them) consists of 4 information and 4 control bits. The overal number of 1s in a code combination is 4. Only three of them are used (s. table 1), thus forming the Y – and Z – words at the coder output, i.e. at fault – tolerance control unit input. The number in the first column of the table means the Y- and Z – word index.

Table 1

Nr.	Information bits	Control bits
1	1 1 0 1	0 1 0 0
2	0 0 1 0	1 0 1 1
3	0 0 0 1	0 1 1 1

Logical "1" at coder ouput, i.e. at fault – tolerance control module input is a voltage in the range 7,5 ÷ 10 V, and logical "0" – a voltage not greater than 2 V.
X1, X2 and X3 outputs of the fault – tolerance control module generate signals in the form of a DC or AC / 50 Hz voltage of 30 V / 15 W (the current is in the range 280 ÷ 500 mA). The signal is continuous or pulsing with a frequency of 1 Hz and a duty – factor in the range (40 ÷ 60 %). The maximum current at idle state is 28 mA. All of the rest combinations at fault – tolerance control module outputs should not be read by the coder and be assumed as an inhibit condition for the train. X – signals imitate signal lamps voltage and serve as a supply source for the coder. In accordance with the X – signals, as well as Y- and Z – words, generated by the coder, and input to the fault – tolerance control module, the fault – tolerance state of the coder is being analyzed. An appropriate message is being output at the indication panel and a control LED is turned on.

The fault – tolerance control module algorithm of operation is based upon the consistency in accordance with table 2.

Table 2

	X1	X2	X2F	X3	Y1	Y2	Y3	Z1	Z2	Z3
1	*				*			*		
2		*			*					*
3			*		*				*	
4		*		*		*				*
5	*			*		*		*		
6			*	*		*			*	
7							*			*

3. Block diagram and algorithm of operation.

The input unit should implement all electrical circuits for the coder and form the corresponding levels and polarity of the appropriate signals, as well as pulse timing, grounding. It has to control input signals electrical parameters, such as level and polarity, current, pulse timing – frequency, period, slopes.

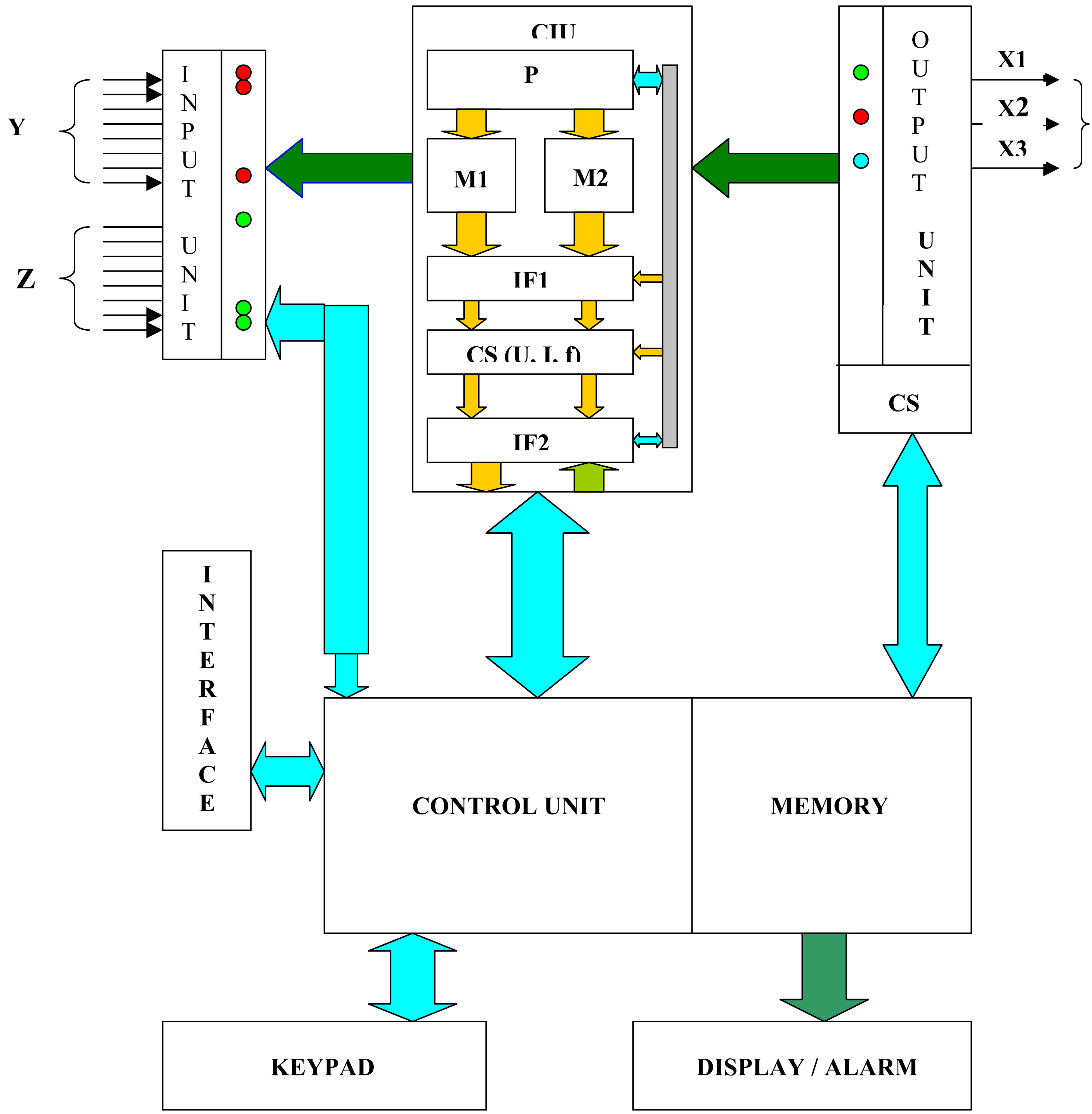
It should convert input signals (both static and dynamic) in a pulse sequence, ready to be processed by the control unit. Input unit implements the overall protection of the input test points - overvoltage and overcurrent protection.

An appropriate input signal for the control unit should be generated in a case of a dangerous failure condition.

The major tasks of the output unit are to implement output channels with the appropriate timing and electrical parameters. It should provide adequate electrical characteristics of output signals by means of controlled voltage, current nad pulse sources, the latter being manipulated by the control unit. The overall protection - overvoltage and overcurrent protection is also provided by the unit. It assures an appropriate signal generation to the control unit in a case of a dangerous failure condition.

Control and interconnection unit. Its major functions are the following:

- Informational, in manual or automatic mode. It should implement read and write operations of all code combinations and corresponding tables, the latter being system and formal.



Failure test equipment block diagram

- Interconnection. In accordance to this function a variety of connection modes should be implemented: input connection to fault – tolerance control unit inputs; output connection to fault – tolerance control unit outputs; system connection to control unit of the fault – tolerance control module.

- Control function aims at increasing the overall control equipment reliability. This is accomplished by means of the following actions:
  – information stream doubling in two hardware independent memories;
  – internal multipurpose and continuous test;
  – bidirectional data exchange with the control unit;

Control unit implements all computational procedures, concerning input circuits control, measurement data logging, as well as corresponding signalization – audible, light, formal, system. Bidirectional data exchange with other computational equipment, such as PC and terminal stations is also accomplished by the control unit by means of input / output interface.

Input / output interface is a standard serial interface implements the physical data link between the control equipment and an external computational complex. Table download and code combinations exchange, as well as stored data output for further analysis and statistics are provided also.

Operators link to control equipment units is accomplished by means of a keypad. The following modes of action are provided: manual, automatic, computational procedure, statistics – trace choice and combinations of computational procedures, reset, data exchange with control and interconnection unit, data exchange with external data processing equipment, test procedures, power supply control.

Control equipment results coulde be defined in three different manners: LED indication, system and audible signalization. LED indication displays input / output channels state. System signalization controls overall equipment units state. Audible signalization traces appropriate modes of action of the power supply source, as well as all predefined failure cases, the latter being a result of critical conditions of the control equipment.

Power supply sources provides a continuous operation of the equipment for a given time interval. A possibility for charging by means of different external charger types is also presumed.

4. Conclusion

The above described automatic railroad modules failure test equipment in a JZG – 703 locomotive signalization system highly diminishes human factor participation in troubleshooting procedures and presumes test data storage for further analysis.

5. References:

1. Ръководство за проектиране на пътната апаратура на системата JZG –703. БДЖ, София, 1983г.
2. Tsutomu Sasao (ed.): Logic Synthesis and Optimization, Kluwer Academic Publishers, Boston 1993.