ANALELE UNIVERSITĂȚII
"EFTIMIE MURGU" REȘIȚA
ANUL XXII, NR. 2, 2015, ISSN 1453 - 7397

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Computer Diagnosis of Output Light Signals

Modern applications for PCs, mobile phones or tablets are increasingly stirring the interest of users and contribute to the labour productiveness in diverse fields. The paper presents the method of computer diagnostic of output signals in railway stations, based on the diagrams and diagnosis software, elaborated by the authors. The diagnostic diagrams were drawn up by using the diagrams from the stations with electrodynamics centralisation (CED) of the CR4 type. The software may run on diverse modern devices and can be also adapted for other types of CED installations. Grace to the answers to different questions asked by the application, the possible causes of the failure or fault may be displayed fast and accurately. The purpose of the computer diagnostic is to reduce the normal diagnosis time.

Keywords: *output light signals, diagrams, computer diagnostic*

1. Introduction

The Signalling Centralizing Blocking Installations (SCB) of the Romanian Railway Company have the role to command and control the deployment of the railway circulation in conditions of safety, both for the passengers and for the merchandise transported.

In the case of a failure, the personnel manipulating these installations warn the maintenance personnel. They come to the place of the failure, perform measurements and verifications in view of establishing the causes having determined the defect then eliminate it. Due to the installation complexity, to interconnections among components and installations, the diagnostic is a lengthy difficult operation, depending on the technical knowledge of the maintenance staff and requires a large volume of time for measurements and elaboration of conclusions. During the entire period of the failure the trains' circulation is restricted to low speed (maximum 20 km/h [1]) provoking delays in the trains' circulation and discomfort to the passengers.

Depending on the type of installations for circulation safety, different diagnosis methods are used: through the permanent acquisition of electric signals and the comparison with certain preset values, by using the fuzzy logic Expert Systems [2], through the logic based on distributed agents [3], through the use of virtual instruments [4] etc.

The proposed method is destined to the CED-CR4 installations, relies on the conception of diagnostic diagram and the creation of software called by the authors SEMExp, in the Visual Basic programming environment. By the use of the SEMExp in the diagnose of the output signal one eliminated the useless steps, reducing thus the diagnostic time. The forwarded method does not imply costs determined by the modification of the installation and does not affect the installation operation.

The paper is part of a set of works treating computer diagnostic for several types of installations of the circulation safety [5-8].

2. Output light signals

Output light signals in a railways station are located on the right side of the riding direction, for each parking track and forbid or allow the exit of the railway vehicles on the current rail or track [9]. The parking tracks in a railroad station are classified into direct tracks and deviated tracks. One considers a direct track the rail situated inside the station in the extension of the current track, without deviation at entry or exit, one considers a deviated track the rail situated inside the station branching out through the railway devices (switches) for the direct track [10].

The indications given by the output light signals on a railway equipped with Automatic Rail Block are the following [1]:

- Red – Stop without passing past the signal;
- Green – Free/go at the set speed. The following signal is on free/go at the set speed;
- Yellow – Free/go at the set speed. Warning! The following signal commands the halt;
- Blinking yellow – Free at the set speed. The following signal is on free/go at reduced speed;
- Green-Yellow – Free/go at reduced speed. The following signal is on free/go at the set speed or reduced speed;
- Yellow - Yellow – Free/go at reduced speed. Warning! The following signal commands the halt;
- Moon white – manoeuvre allowed past the signal, at a maximum speed of 20 km/h.

In the case of a station with CR4 installations (Relay Centralisation of the 4^{th} type), in order to command an output signal on the free/go indication it is necessary to fulfil the conditions presented in Fig. 1.

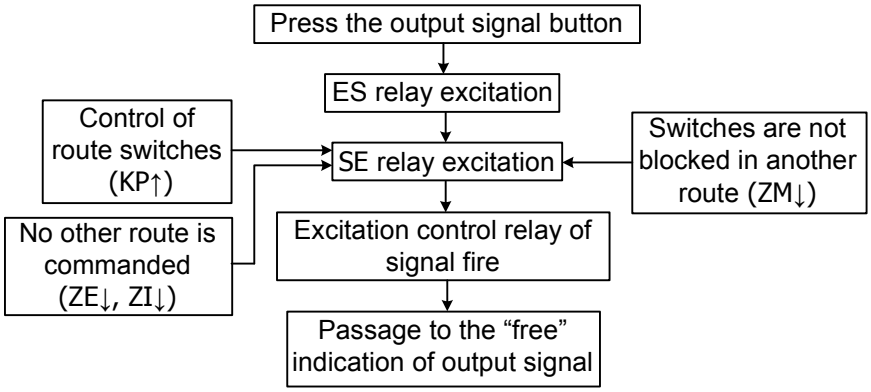

Figure 1. Conditions for the command of free/go setting of an output signal

Thus the permissive command of an output light signal, for a circulation route is made only after the excitation of the SE relay (Output Signal), and for a manoeuvre route after the excitation of the SM relay (Manoeuvre Signal).

The control of the integrity of the filaments of the output signal bulb is made through the relays FV1G (Green Light, Yellow 1), FRA2G (Red Light, White, Yellow 2) whose coil is connected in series with the primary windings of the transformers supplying each bulb [11, 12].

Fig. 2 presents the command diagram of lights (bulbs) of an output light signal. The supply of the output signals is made at the 220 V voltage by day and 180 V by night, at a 75 Hz or 50 Hz frequency.

The control of the permissive indication of an output signal is signalled on the command device through a green bulb, extinguished by default, lighting if the output signal is on the permissive indication.

The command of executing a manoeuvre route with the output signal is controlled through a white bulb. The interruption of the filament at the signal red bulb, or a defect in its circuit is signalled on the command device through the blinking light of the white bulb. Thus, in normal condition, when the output signal is in the red indication, it signals nothing on the command device.

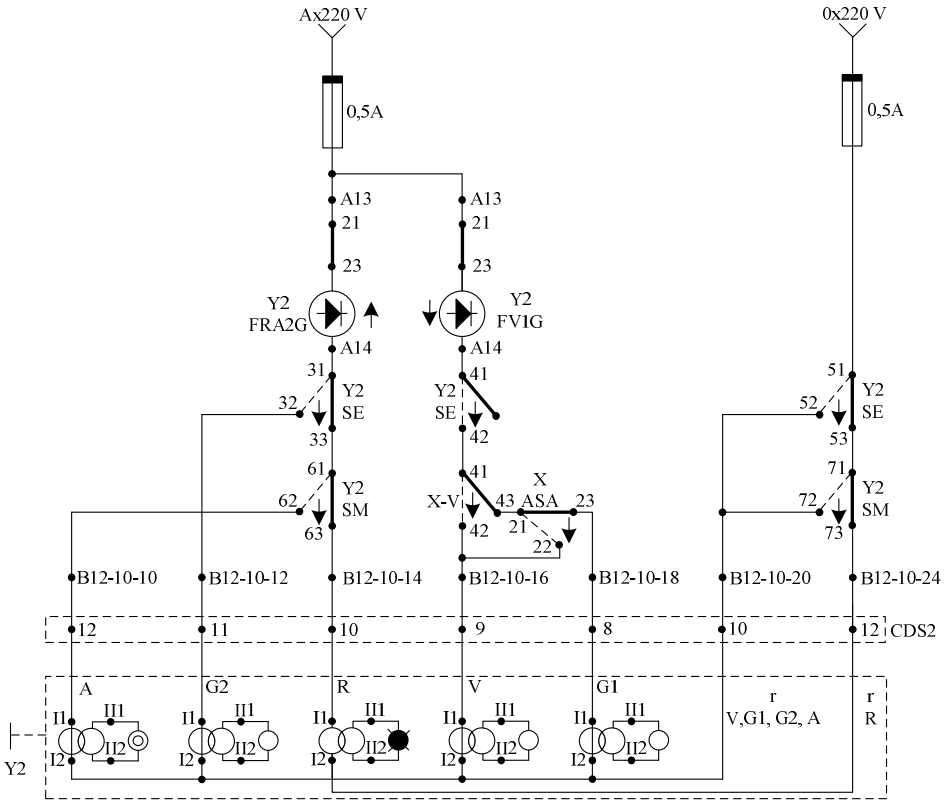

Figure 2. Diagram of fire relays of an output signal

3. Diagnosis diagrams of the output light signals

The main failures which may occur at an output signal:

- Failure at the red indication circuit;
- The output signal cannot be commanded on a permissive indication.

Fig. 3 shows the diagnosis diagram for the situation when there is a failure at the red indication circuit, i.e. when the white bulb blinks on the command device.

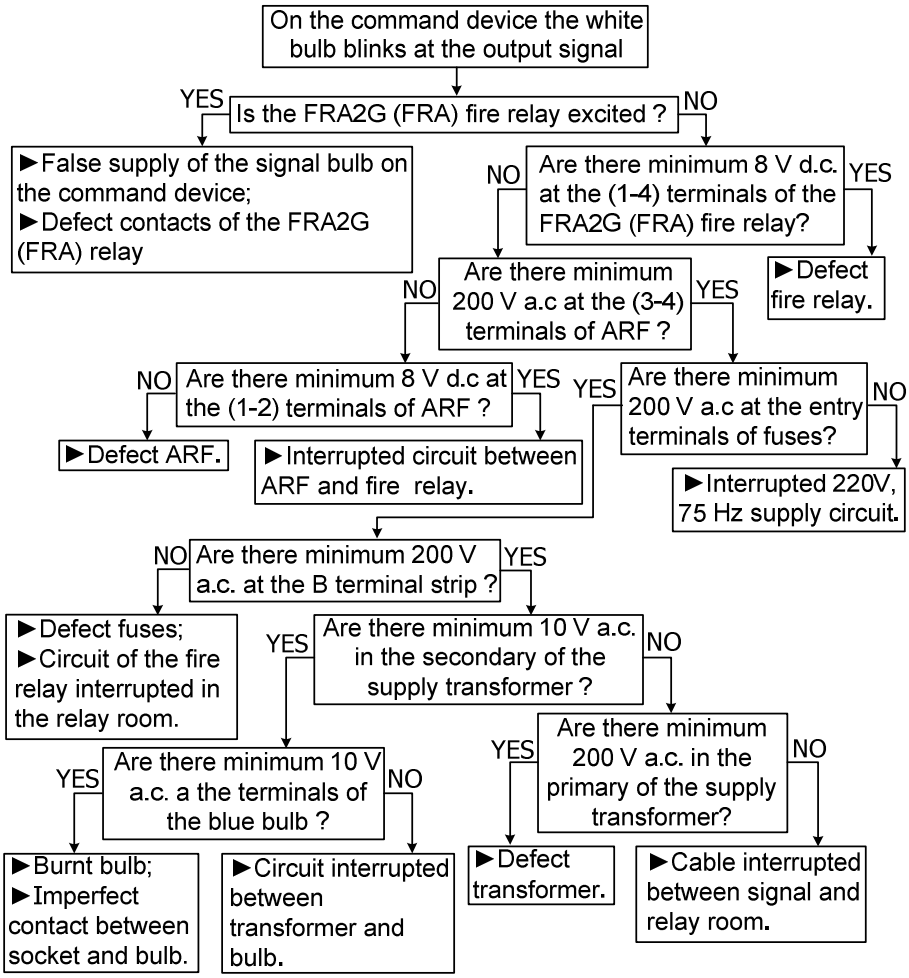

Figure 3. Diagnostic diagram of the output signal when the white bulb blinks on the command device

For the situation when the output signal cannot be controlled on a permissive indication (of circulation or manoeuvre) one elaborated the diagnostic diagram presented in Fig. 4. The sequence of the diagnose steps is presented in this figure for:

- A manoeuvre route;
- A shipment route from the direct track;
- A shipment route from the deviated track;
- A passage route onto the direct track;
- A passage route onto the deviated track.

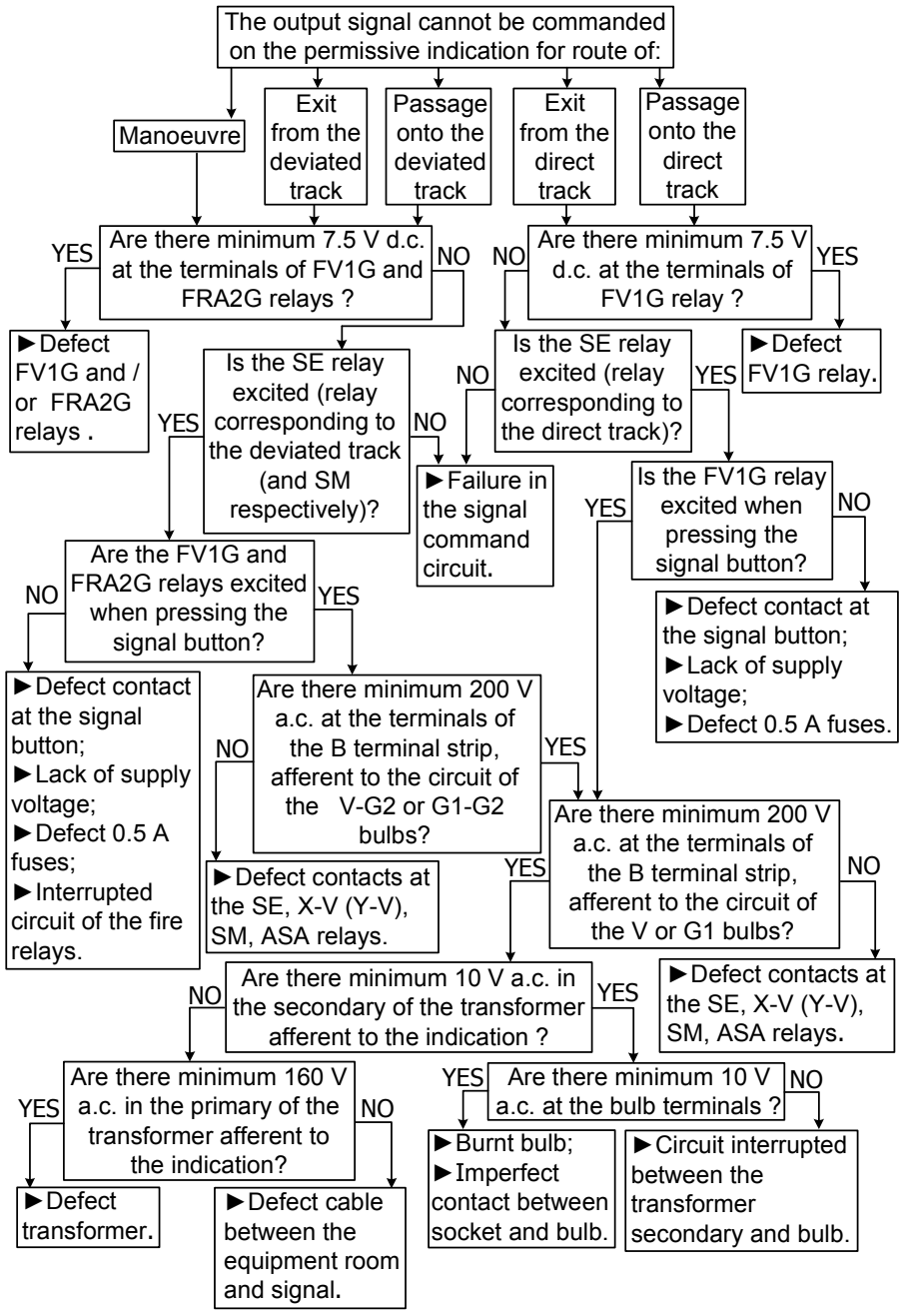

Figure 4. Diagnostic diagram of the output signal, when it cannot pass to a permissive indication

The paper does not discuss the situations when the failure occurs at other types of installations interacting with the output signal (switches, track circuits, passages on the railroad level, incompatible routes etc). It is considered thus that all the conditions are fulfilled necessary for the excitation of the SE relay (output signal) from the track where the route starts.

3. The SEMExp application for the output signals diagnostic

The SEMExp diagnosis software is created by using the Visual Basic programming environment and follows the same structure as the other applications designed for the diagnose of other SCB installations [5-8]. The software created communicates with the maintenance staff through modern devices and asks them diverse questions. The maintenance personnel must select the defect installation and the manner of signalling manifestation thereof. Following the answers given by the maintenance personnel (resulted from the observations and/or measurements) to key questions, the application will display the following questions that must be answered (Fig. 5) or the cause of failure (Fig. 6).

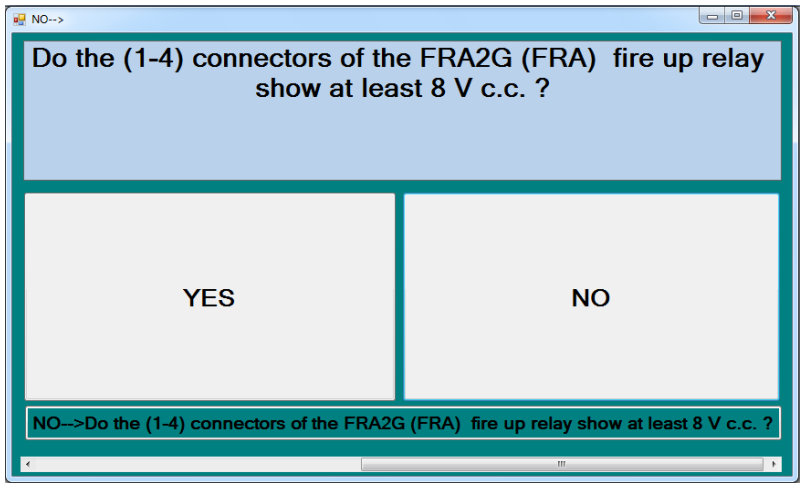

Figure 5. Screenshot of the diagnosis software

The software allows the return to the previous questions and resuming of questions, having a friendly interface, without the requirement of specific knowledge of computer programming.

This application is part of a library of programmes destined to the diagnose of the SCB installations, of different types which will eventually be interconnected and will provide an ideal guide for the diagnosis of failures.

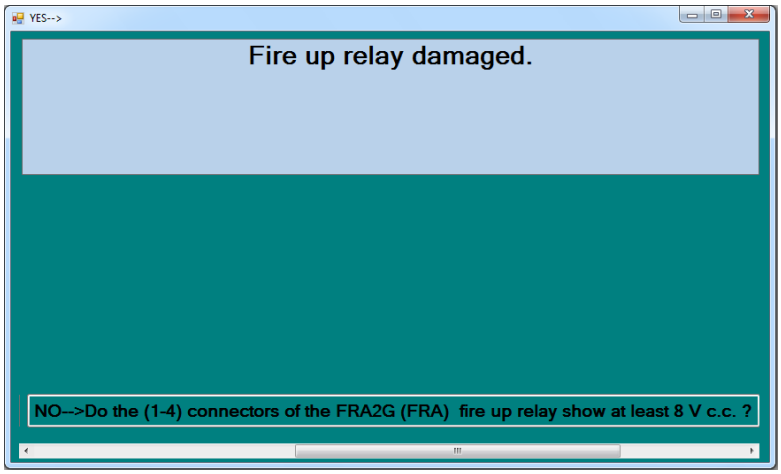

Figure 6. Image with the causes of failure

4. Conclusion

The paper promotes the use of modern devices in the diagnosis of railway circulation installations, electro dynamically centralised, which are not equipped with acquisition and monitoring systems.

The use of the SEMExp software does not require costs of implementation in the existing installation it may be used through the computer, tablet or mobile phone, at the disposal of the maintenance personnel.

The use of SEMExp diagrams and software brings about the following advantages:

- Substantial reduction of the diagnostic time;
- Elimination of wrong decisions made by the maintenance staff, which sometimes risk to lead to railway events;
- The increase of the competitiveness of the maintenance personnel by the introduction of this subject in the training sessions.

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