About Optimal Value of UWB Pulse Repetition Rate for Assessment of the Electronic Devices Immunity

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***Abstract*—**Pulse repetition rate (PRR) is one of the key parameters predetermining the degree of danger for pulsed electromagnetic disturbances for electronic devices. The approach to choose this parameter for carrying out tests of the mentioned devices is offered here. This approach takes into account the possibility of malfunctions of tested devices as a result of the transition of active elements to the saturation mode. As an example, the minimum value of PRR, which allows the eliciting this effect during testing for the power unit, is defined.

Keywords—electromagnetic coupling, disruptions in electronic devices, key parameters of electromagnetic disturbances, IEMI

I. INTRODUCTION

There is a need for choosing adequate means for carrying out immunity tests of electronic devices due to the influence of ultrashort electromagnetic pulses (USEMP). As a rule, all available USEMP sources are used. The variation of test pulse characteristics is performed with the limits provided by these sources during tests, and the pulse repetition rate (PRR) belongs to a set of these characteristics. We suggest a methodical approach to choosing the given parameter when preparing tests of electronic devices. The offered approach to the device testing includes the preliminary analysis of the main mechanisms of the USEMP influence on the DUT. An example using this approach is considered below.

II. MECHANISMS OF ELECTRONIC DEVICES FAILURES AS A RESULT OF USEMP INFLUENCE

In [1] authors of the present paper have pointed out three effects, which lead to devices failures as a result of the USEMP influence, namely: irreversible failures of some elements; incorrect transfer of bits in data links; and transition of active elements into the saturation mode. In [2] features of the failures caused by the first two of the listed effects are described. The knowledge of these features allows developing the plan of the tests giving the basic data for the reasonable forecast of the probability of the electronic device failures caused by these effects.

As to the third effect, we could not find references containing recommendations about the tests allowing one to give a forecast concerning the probability of failures of an equipment as a result of the transition of its active elements to a saturation mode in the electromagnetic environment. To address this issue, the way of choosing a value of one of key parameters for such tests, namely the choice of PRR, is offered below.

The condition of failures, which are consequences of the transition of device active elements to the saturation mode, consists in the simultaneous fulfillment of the following inequalities:

$$U_{in} > U_{sat};\ W_{in} > W_{sat};\ f > \Delta T^{-1}. \qquad (1)$$

Here: U_{sat}, W_{sat}, and ΔT, respectively, are the minimum value of the voltage, which initiates the transition of active elements to the saturation mode; the minimum value of the absorbed energy providing a steady transition of elements to this mode; and the minimum time interval of discontinuation of the saturation mode (the relaxation time).

Thus, for an assessment of the possibility of failures, which are a consequence of active elements transitioning to the saturation mode, it is necessary to subject test objects to the influence of electromagnetic pulses with PRRs more than ΔT^{-1}. Therefore before carrying out tests, it is necessary to define somehow a value of the ΔT parameter for the device under test (DUT).

The experiments for the determination of ΔT values for a power unit and some video cameras have been carried out. These experiments have shown that the relaxation time of the DUTs is in a range from hundreds of microseconds to several milliseconds.

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