

IMMUNITY TEST OF PERSONAL COMPUTER

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ABSTRACT

This paper deals with problems arising at the electromagnetic compatibility testing. These problems which were appearing during the surge immunity test of personal computer are described. The paper would like to point at these problems and give some information about the test and results of the test.

1 INTRODUCTION

The surge immunity is a simulation of electromagnetic interference, which arises in the atmosphere (such as thunder strike), in contact actions or in defects in energy high-voltage net. Such interferences penetrate into the low-voltage power nets as impulses with high energy up to 50 J, which may have thermal effects. They fill in the frequency spectrum range from 1 kHz to 1 MHz and their high energy could cause the damage of the electronic devices also without the direct galvanic linkage only by the electromagnetic induction. These surge impulses can have different effects depending on the output impedance of source (generator) and input impedance of the testing device.

Two cases may appear:

a) if the input impedance between the input's clamps of the testing device is higher than output impedance of the source, the generator of the testing signal creates the **surge voltage** between the clamps of the testing devices. The life cycle of the voltage impulse is given in Fig. 1;

b) if the input impedance between the input's clamps of the testing device is relatively small, the generator of the testing signal creates **current surge**.

The generator of surge test signal has to respect these two situations and it has to correspond with standard which describes

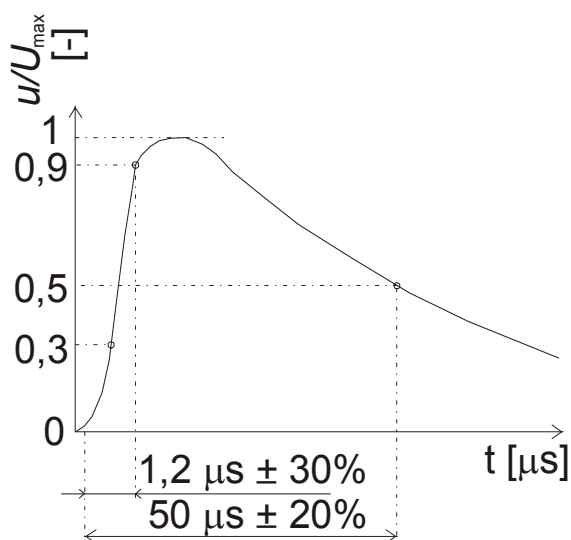


Fig. 1: Surge voltage test signal for open-circuit test [6]

the surge immunity test. The generator must be able to generate both of signals: surge voltage and current surge. This generator is called the *Combination Wave Generator*. The generator provides both life cycles: surge voltage signal without the load and current surge signal in short circuit. These two signals differ about rise time and fall time of the impulse. The shape, size and parameters of the surge voltage impulse are given in Fig. 1 as well (it is often called as impulse 1.2/50 μ s). Current surge has a similar live cycle as the surge voltage impulse, but it has got another time scale (it is often called as impulse 8/20 μ s). The real shapes of the surge voltage and current would also be different from these shapes. It depends on the output impedance of the generator and input impedance of the testing device. This shape can also be changing during the immunity test.

2 IMMUNITY TEST

This test was carried out within the teaching of the electromagnetic compatibility subject in the electromagnetic compatibility laboratory. A personal computer 486 DX2 was tested against the surge impulses. Computer was chosen for two main reasons:

1. its minimum configuration contains a screen (monitor), which is suitable for spying interferences, which can arise,
2. this type of the computer is old and its performance is not enough. It has been put out of operation, so when it will be destroyed by surge impulse this fact will not be important. It was supposed that the computer is not so electromagnetic compatible.

The test was processed in correspondence with the ČSN EN 61000-4-5 standard [6] which orders how to do surge immunity test. The testing levels were chosen from the ČSN EN 61000-6-1 [5] standard. Testing levels, which were chosen, are listed in Tab. 1. Surge

Tab. 1: *Immunity; input / output AC supply clamp (input and output clamps)*

Phenomenon environment	Specification of test	Unites and characterization of quantities	Basic standard	Functional criterion
surge test	1.2/50 (8/20)	$T_r/T_f \mu$ s	61000-4-5	B
wire against ground	± 2	kV (charging voltage)		
wire against wire	± 1	kV (charging voltage)		

immunity test is ordered only for the AC supply clamps. The functional criterions were chosen from this standard as well.

Functional criterion **A**: The personal computer must be in a normal running cycle during the testing period and after the test as well. The data-loss not allowed. The picture on the screen must be perfect without any interference. The accidental occurrence of letters in T602 text editor is not allowed.

Functional criterion **B**: Trembling picture on screen is allowed during the test. The program, which was running on computer, does not have to work well during the test. Time delays produced by the computer during the test are allowed, but only during the test no after the test. After test, the computer had to work as before the test. Accidental occurrence of letters in Word editor during the test is allowed, but it must not influence the stability of the computer system.

Functional criterion C: An unprompted reset of the computer or an error leading to the forced restart of the operating system without the chance to save the data.

The testing configuration was formed by Combination Wave Generator (Seaward Thor) and testing computer. Both devices were on the wooden table, with sizes of $700 \times 1500 \times 767$ millimetres. ČSN EN 61000-4-5 is not ordered the position of devices. They were on tabled with 100 millimetres between each other.

Table was 250 millimetres in front of the wall which was covered by the reference ground plain. It was used as a shielded. The reference ground plain was under the table and it was connected to a ground. The experimental configuration is showed in Fig. 2. The testing device was connected into socket which was located on the front panel of Combination Wave Generator Thor. Text editor T602 was running on the computer in DOS system. Test contained five surge impulses of one polarity.

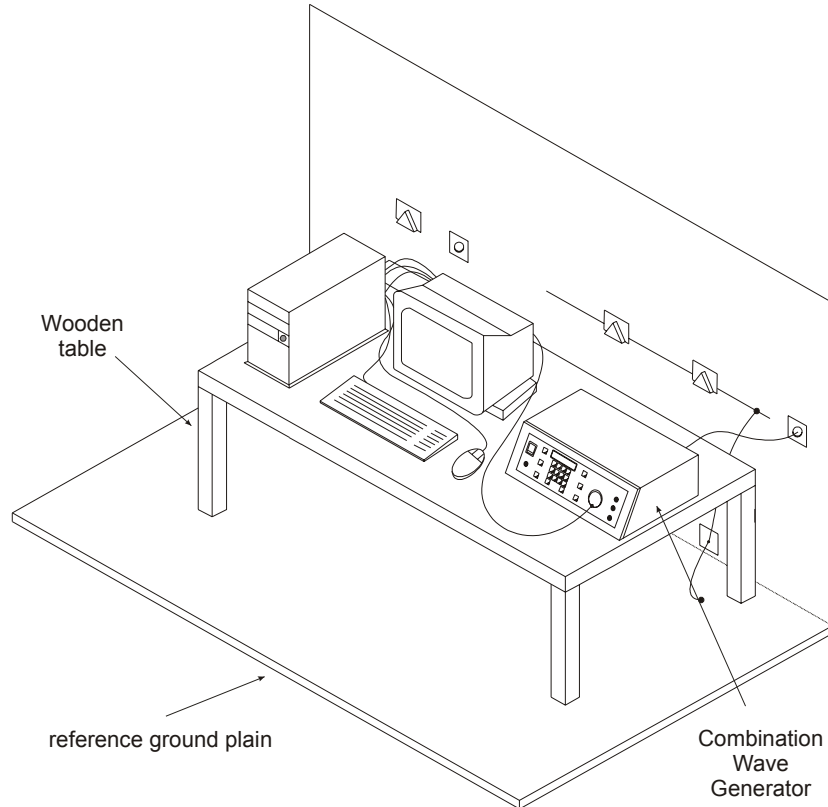


Fig. 2: *Experimental configuration*

Impulses were separated from each other by the time pause. Time pause was set from 30 to 60 seconds and it depended on the concrete situation. Generally it was set from the longest time gap to 30 second, because sometimes mistakes were appeared. The computer did not often continue in its activity. Some of test results are given in Tab. 2. It was done more than 50 tests and there are only several of them. Each test for each wire as well as for their combinations respected the same order. At first, the testing level was set on the lowest level. The angle of injection was changed in these values 0° , 90° , 180° , 270° . Tests ended at “the worst case”, which was value 90° or 270° , for positive respective or negative polarity. After that, the test was repeated with higher testing level (higher testing voltage). When the testing device did not work normal or some problems were appeared, the test was cancelled.

3 CONCLUSION

This experiment was carried out for getting information. The Information will be used in electromagnetic subject which has been teaching in Institute of Radio Electronics. The most important thing was the following the standards and verifying the methodology of the testing of electromagnetic immunity. The results of test have been very valuable for the teaching. During the testing, several problems with a control unit of a hard-drive and

a keyboard were appeared very often. These problems concerned the each couple of supply wires, but not in the same phase of the test. Very often the solution of problems was the restart of the computer without saving the data. Sometimes the computer restarted itself during the test. But when the computer tried to boot up, the control unit reported an error. It was necessary to set up BIOS of the computer. Some tests for some couples of

Tab. 2: *Several test's results*

Couple of Wires	Test Level [kV]	Angle [°]	Count of Pulses [-]	Time Gap [s]	Functional criterion
+ L - N	0,5	120	3	60	C (HDD)
- L + N	0,5	180	5	60	C (HDD)
- L + N	0,5	180	5	60	C (HDD)
- N + E	0,5	0	5	30	B
+ L - E	1	270	1		C (reset)
+ L - E	1	90	1		C (reset)
+ L - E	1	270	1		C (reset)
- N + E	1	270	5	30	C (reset)
- L + E	2	90	1		C (reset)
- N - E	2	90	1		C (reset)

Explanatory note: B – It was situation with jittering of screen.
 C (HDD) – It was problems with hard drive.
 C (reset) – It was unprompted restart of the computer and it was produced by test signal.

wires had to be cancelled because of the chance of destruction of the computer. Hence the worst case did not check. So we can say that the personal computer 486 DX2 did not satisfy applicable standards and it should not be used in the homes or offices. But this simple test will be able to show to students the structure of the electromagnetic testing and several standards. It will give them the real image about the test's structure.

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REFERENCES

- [1] Svačina, J.: Elektromagnetická kompatibilita, principy a metody (Electromagnetic compatibility, principles and methods). Brno University of Technology. 2001 „Připojujeme se k Evropské Unii“ (join to European Union), volume 2
- [2] Vaculíková, P., Vaculík, E. aj.: Elektromagnetická kompatibilita elektronických systémů (Electromagnetic compatibility electronic systems). Grada Publishing, Prague 1998
- [3] Vondrák, M.: Elektromagnetická kompatibilita v teleinformatice - cvičení (Electromagnetic compatibility in teleinfomatic). Textbook of Department of Electromagnetic Field, CTU in Prague. Publisher CTU, Prague 1998

- [4] User guide of Seaward Thor
- [5] ČSN EN 61000-6-1: Elektromagnetická kompatibilita (EMC) – Část 6-1: Kmenové normy – Odolnost – Prostředí obytné, odhodní a lehkého průmyslu (ČSN EN 61000-6-1: Electromagnetic compatibility (EMC) - Part 6-1: Tribal norms - Immunity - Live, business and light industry environment). Czech technical norm, Czech normalization institute. Prague 2002
- [6] ČSN EN 61000-4-5: Elektromagnetická kompatibilita (EMC) – Část 4-5: Zkušební a měřicí technika – Rázový impulz – Zkouška odolnosti (ČSN EN 61000-4-5: Electromagnetic compatibility (EMC) - Part 4-5: Testing and measuring instrumentation - Immunity - Surge immunity test - Immunity test). Czech technical norm, Czech normalization institute. Prague 1997
- [7] ČSN EN 61000-4-5 ZMĚNA Z1: Elektromagnetická kompatibilita (EMC) – Část 4-5: Zkušební a měřicí technika – Rázový impulz – Zkouška odolnosti (ČSN EN 61000-4-5: Electromagnetic compatibility (EMC) - Part 4-5: Testing and measuring instrumentation - Immunity - Surge immunity test - Immunity test). Czech technical norm, Czech normalization institute. Prague 2001