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**ENVIRONMENT SPECIFICATIONS
FOR THE ELECTRIC AND ELECTRONIC EQUIPMENTS
ELECTRICAL CHARACTERISTICS**

Addendum

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This document completes B21 7110-C

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HISTORY

Index	Date	Nature of the modifications
OR	11/07/2001	Creation of B21 7110. This norm partially replaces B21 7090.
A	23/07/2004	Rewriting.
B	24/05/2005	<p><u>Environment – “General testing environment” § (4.5).</u> Object: reducing the strictness of the environment requirements.</p> <p><u>Test EQ/IC 05 – "resistance to pulses 4 or 4 bis"</u> Object: decrease of the the strictness of the start-up pulse.</p> <p><u>Test EQ/IC 01 – "resistance to pulses 1 or 1bis and 2a"</u> Reminder of B21 7110-A: "Concerned wires: all the power supply wires (successively and simultaneously). The power source associated to a network (e.g.: + VAN ; + CAN ; etc.) must be considered as a relay power source, and tested as such. The test is also applicable to all the outputs that control inductive loads. The test is not applicable if the DUT is powered by a regular voltage supplied by a computer."</p> <p>Object: the purpose of this addendum is to clarify the test method concerning the application of pulses 1 or 1bis to all the outputs that control inductive loads.</p> <p><u>Test EQ/IR 04 – "resistance to electrostatic discharges, powered equipment"</u> Objects: clarification of § 6.4.2.6 for the conformity with the diagram; and decrease of the strictness of the requirement of § 6.4.2.7 for the discharges on insulating parts to 4kV for the points of indirect 1h type (consistency with the requirements for the conductive parts).</p> <p><u>Test EQ/IR 05 – "immunity to the on-board transmitters"</u> Object: addition of an informative appendix on the portable emission equipments.</p> <p><u>Test VH/IR 01 – "Immunity to the radiation field (semi-anechoic or anechoic room)"</u> Object: consistency of the calibration method with the standard ISO 11451-2.</p> <p><u>Test VH/IR 04 – "immunity to the portable on-board transmitters"</u> Object: addition of an informative appendix on the portable emission equipments.</p>
C	20/02/2008	Rewriting of the norm.
addendum	11/03/2010	Addition of the tests EQ/TE08 and EQ/IC13. Modification of the tests EQ/TE02, EQ/TE03, EQ/TE04, EQ/IC01, and EQ/IC03

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1. FOREWORD

This document competes and/or modifies B21 7110-C. The main modifications are:

- Addition of the test EQ/TE08 (resistance to the voltage variation in the usual "volt control" range). Its purpose is to check the immunity of an equipment to slow variations of the voltage, within the usual operating range.
- Addition of the test EQ/IC13 (resistance to the "volt control" voltage pulse). Its purpose is to check the immunity of an equipment to transient over-voltages up to an amplitude of 18 V.
- Modification of the test EQ/TE02: addition of the "quick" cycles of slow voltage decrease and increase for the projects with EEPROM external to the microcontroller. The test protocol also includes a simplification of the test assembly concerning the use of the ground plane.
- EQ/TE03: addition of more voltage dips around the reset voltage. The test protocol also includes a simplification of the test assembly concerning the use of the ground plane.
- EQ/TE04: clarification and decrease of the strictness of the requirements for the test at 24 V.
- EQ/IC01: decrease of the number of pulses and clarification of the requirements for the tests with pulse 1.
- EQ/IC03: decrease of the strictness of the requirement.

2. MODIFICATIONS OF THE TEST PROCEDURES AND/OR REQUIREMENTS

2.1.ELECTRICAL ENDURANCE TESTS

2.1.1.EQ/TE 01: RESISTANCE TO USUAL SUPPLY OVERVOLTAGES

No modification concerning this test.

2.1.2.EQ/TE 08: RESISTANCE TO THE VOLTAGE VARIATIONS WITHIN THE USUAL "VOLT CONTROL" RANGE

Addition of a new test.

2.1.2.1.REFERENCE DOCUMENT

There is no reference document that refers to this test.

2.1.2.2.OBJECTIVE OF THE TEST

The purpose of this test is to check the immunity of the equipments to the voltage variations related to the "volt control" system. The voltages above 14 V correspond to the phases of vehicle deceleration and/or battery charging; the voltages below 14 V correspond to the phases of alternator load shedding.

The main characteristics of the test are: voltage variation within the 10.5 V to 16 V range, with gradients of 2 V/s.

2.1.2.3.CONDITIONS OF APPLICATION OF THE TEST

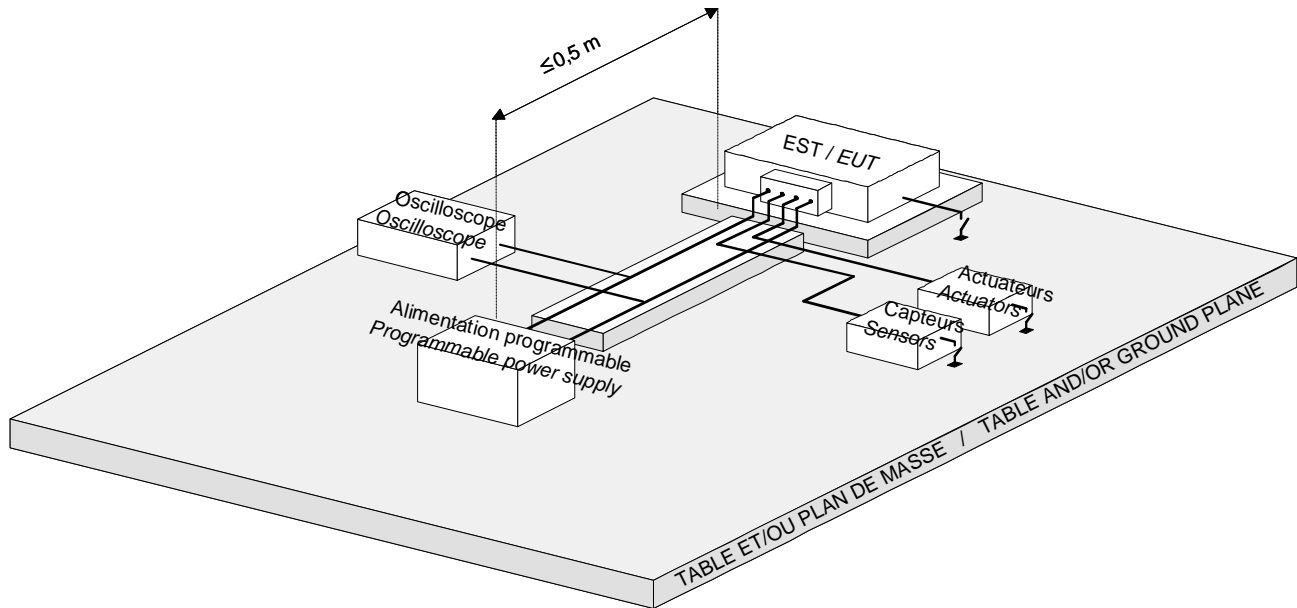
The test of the voltage variation within the usual "volt control" range is applicable to the equipments that meet all the conditions below:

- equipment that might be installed in a vehicle with a volt control system,
- equipment powered by a vehicle battery (not powered by a regulated voltage supplied by another computer).
- equipment with non-regulated voltage and/or exposed by design to voltage variations within the usual voltage range (10.5 - 16.0 V).

The test is carried out on the equipment supply lines taken simultaneously.

2.1.2.4.TEST EQUIPMENTS

- Programmable power source.
- Equipment necessary for checking the proper operation of the DUT.
- Environment of the DUT, actual (sensors, actuators) or simulated.

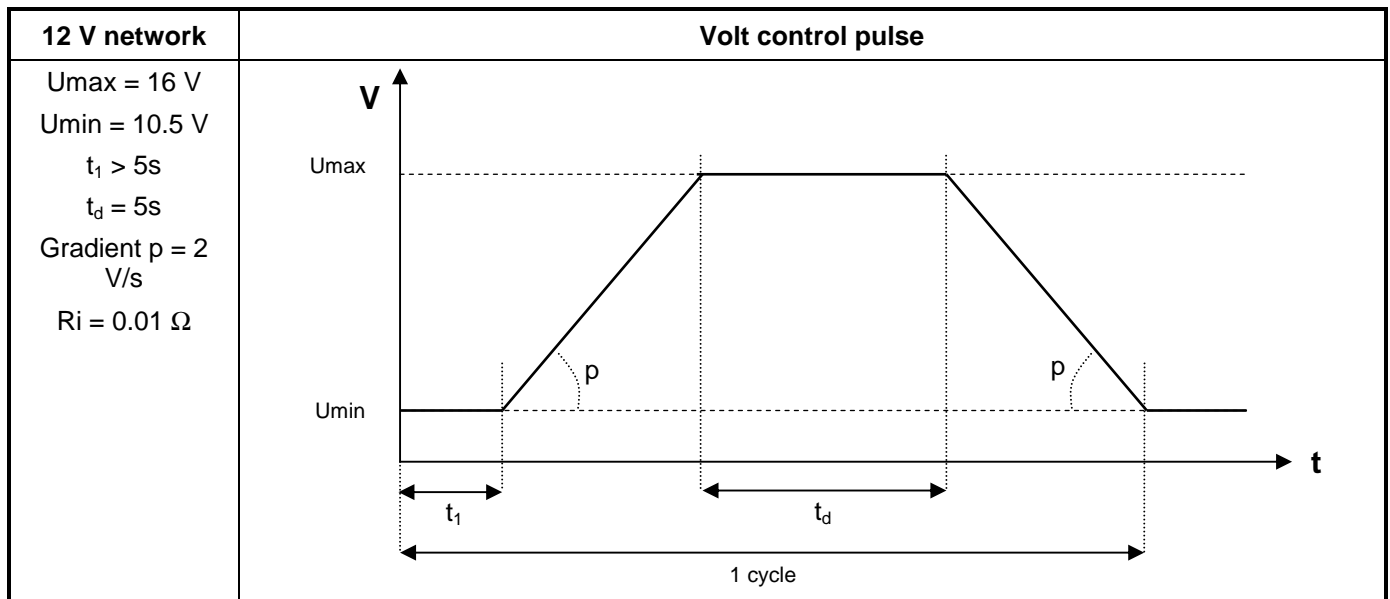
2.1.2.5. ASSEMBLY**2.1.2.6. PROCEDURE****Preparation:**

A wiring harness with a maximum length of 2000 mm is preferably used (alternately, the actual wiring harness can be used). The equipment can be installed equally on an insulating table or on a ground plane. Using the ground plane is only necessary for a direct connection of the DUT or of its sensors / actuators to the vehicle's chassis. In this case, the DUT is linked to the ground plane in conformity with its actual installation on the vehicle, and no other ground connection is authorized.

The power supply wires of the tested DUT must have a maximum length of 500 mm.

Calibration:

Connect the oscilloscope (with the DUT disconnected) at the output of the programmable power source (high impedance input), and adjust the generator to obtain the specified pulses.



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Test:

Start the DUT for a minimum period of 10 minutes.

Apply for 5 times the "volt control" pulse with one minute recurrence to all the power supply lines taken simultaneously, while monitoring the DUT.

Test report:

Among other items, the test report must include the following:

- Assembly used: wiring harness, DUT environment.
- Parameters observed and faults encountered during the test.
- Characteristics of the pulse applied.

2.1.2.7.REQUIREMENTS

Requirements	Operating classes	Levels of customer impact
General case	A	0 (b)
Case of the DUT and/or of the functions for which temporary malfunctions are tolerated (a)	B	1 (b)

- (a) Case of some DUT and/or functions that pilot an actuator (for instance: windscreen wiper, for which a temporary modification of the speed is allowed), of the functions like lighting and/or rheostat control (for which a temporary variation of the lighting is allowed). This case must be specified by the NTS/TS. By default, the general case is applied.
- (b) If the DUT delivers a regulated voltage for another computer or sensor, it must remain within its tolerances during the test.

2.1.3. EQ/TE 07: RESISTANCE TO THE EXCEPTIONAL SUPPLY VOLTAGE

No modification concerning this test.

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2.1.4.EQ/TE 02: RESISTANCE TO THE SLOW DECREASE AND INCREASE OF THE SUPPLY VOLTAGE

Replace the whole section by the following:

2.1.4.1.REFERENCE DOCUMENT

This procedure conforms to the norm ISO 16750-2, except for the "test 2", which proposes other gradients with 100 cycles.

2.1.4.2.OBJECTIVE OF THE TEST

This test is intended to check the immunity of the equipments to the slow increase and decrease of the voltage of the on-board network.

The slow decrease / increase of the voltage corresponds to the slow discharging / charging of the battery, when the vehicle is stopped. In addition, the test contributes to testing the robustness of the software, and especially to limiting the risks of EEPROM freezing (case of the EEPROM external to the microcontroller) during the reset phases.

In addition, the requirements related to this test allow specifying the expected operation below 8.0 V.

The main characteristics of the test are the following:

- Initial voltage of 16 V.
- Test 1: decrease and increase of the voltage by 0.5 V/minute (one cycle).
- Test 2: decrease and increase of the voltage by 16 V/minute (100 cycles).

2.1.4.3.CONDITIONS OF APPLICATION OF THE TEST

The test 1 is applicable to the all equipments with active electronics, with a microcontroller, and/or with on-board software.

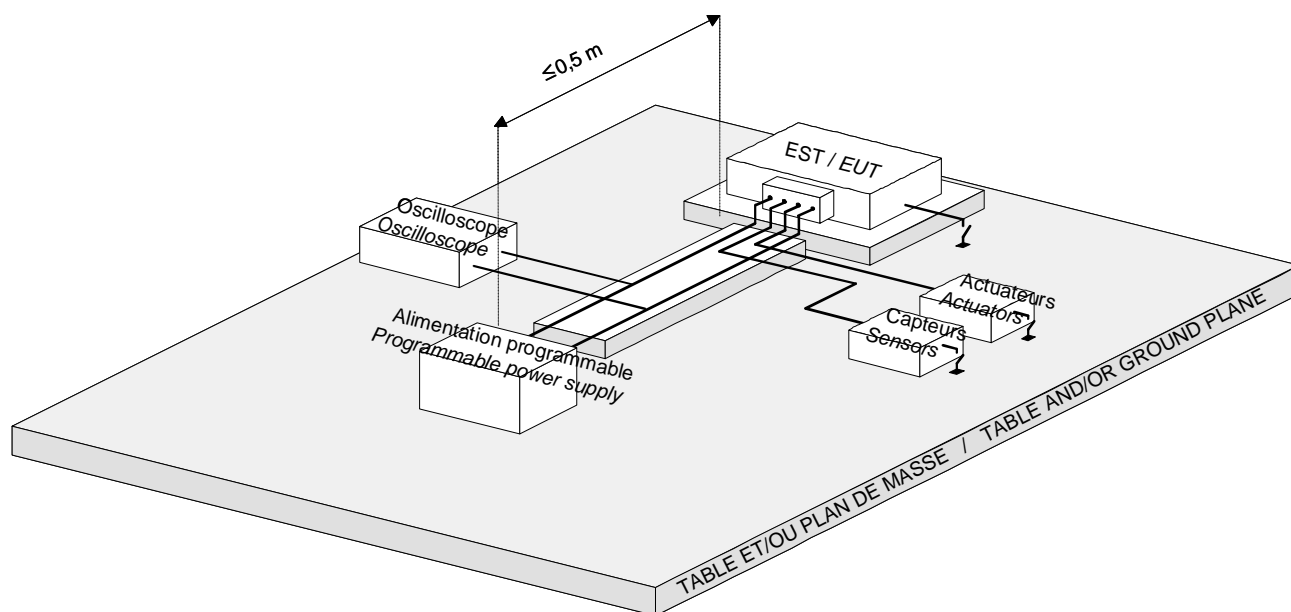
The test 2 is applicable to the all equipments with active electronics, with a microcontroller, and/or with on-board software, and with an EEPROM external to the microcontroller.

The two tests are carried out on the supply lines of the equipment taken successively and simultaneously.

2.1.4.4.TEST EQUIPMENTS

- Programmable power source.
- Equipment necessary for checking the proper operation of the DUT.
- Environment of the DUT, actual (sensors, actuators) or simulated.
- Insulating support with a thickness of 50 mm.

2.1.4.5. ASSEMBLY



2.1.4.6. PROCEDURE

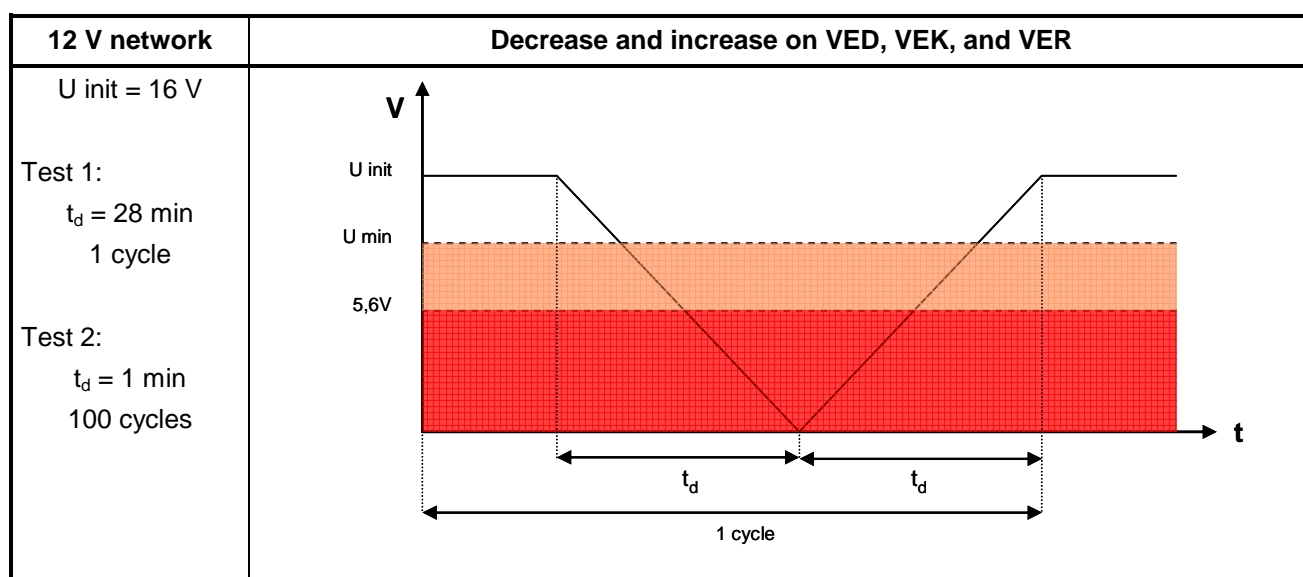
Preparation:

A wiring harness with a maximum length of 2000 mm is preferably used (alternately, the actual wiring harness can be used). The equipment can be installed equally on an insulating table or on a ground plane. Using the ground plane is only necessary for a direct connection of the DUT or of its sensors / actuators to the vehicle's chassis. In this case, the DUT is linked to the ground plane in conformity with its actual installation on the vehicle, and no other ground connection is authorized.

The power supply wires of the tested DUT must have a maximum length of 500 mm.

Calibration:

Adjust the programmable power source to obtain the specified supply voltage, at the terminals of the DUT connector, in conformity with the wave profile below.



Note: the time between all the cycles must be adapted to the reset time of the equipment, to check the correct restart between all the cycles.

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Test:

Start the DUT for a minimum period of 10 minutes.

Apply the test cycle 1 (gradient of 0.5 V per minute, i.e. t_d of 32 minutes) once, successively to all the power supply lines (VED, VEK, and VER), then simultaneously to all, while monitoring the DUT.

Apply the test cycle 2 (gradient of 14 V per minute, i.e. t_d of 1 minute) 100 times, successively to all the power supply lines (VED, VEK, and VER), then simultaneously to all, while monitoring the DUT.

Test report:

Among other items, the test report must include the following:

- Assembly used: wiring harness, DUT environment.
- Parameters observed and faults encountered during testing, including below U_{min} .

2.1.4.7.REQUIREMENTS

Test 1 or 2	Behavior during the test	Behavior at the end of the cycle / of each cycle
U test > U min	In conformity with the test EQ/TE 01	
U min > U test > 5.6 V	Type A operation for the functions necessary to the vehicle start-up. C / D type operation for the rest.	General case: nominal behavior, without data loss in the non-volatile memories. Case of the equipments for which a stop can be tolerated (e.g.: car radio): class D, without data loss in the non-volatile memories.
U test < 5.6 V	No requirement	General case: nominal behavior, without data loss in the non-volatile memories. Case of the equipments for which a stop can be tolerated (e.g.: car radio): class D, without data loss in the non-volatile memories.

Notes:

- For the equipments with safety strategies that require it, the required class can be type D for the test on each power supply line successively (case to be specified in the STN/ST).
- For the voltages below U_{min} , the behavior of the equipment must be communicated both during the voltage decrease and increase (thresholds for transmitting or not frames through the network, threshold of operation of the diagnostic, reset voltage, current consumption, etc.).
- For the equipments that require a software strategy of "power latch" (requirement of power supply after the standby command, for instance to backup the functional context in the EEPROM before cutting off the product), a downgraded operation can be authorized after the cycle. This case must be specified in the STN/ST.

2.1.5. EQ/TE 03: REINITIALIZATION TEST

Replace the whole section by the following:

2.1.5.1.REFERENCE DOCUMENT

This procedure is in conformity with the norm ISO 16750-2.

2.1.5.2.OBJECTIVE OF THE TEST

This test is intended to check the proper reset of the equipments during the fluctuations of the on-board network.

These voltage fluctuations can be caused by the activation of large consumers (on a discharged battery) and/or by the sudden variation of current generated by a short circuit followed by the melting of a fuse.

In addition, the test contributes to testing the robustness of the software, and especially to limiting the risks of EEPROM freezing (case of the EEPROM external to the microcontroller) during the reset phases.

The main characteristics of the test are the following:

- Voltage decrease to 0 V by steps of 0.5 V or less (around the reset voltage).
- Fluctuation time $t_d = 5$ s, cycle time $T = 15$ s or more if required by the equipment reset time.

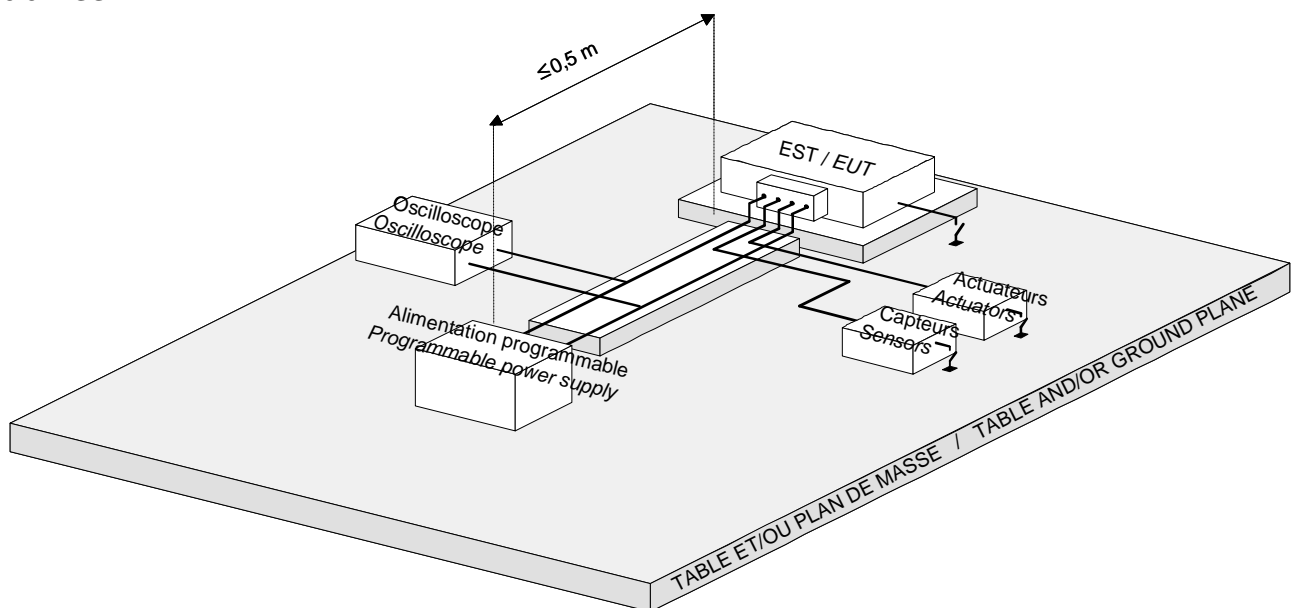
2.1.5.3.CONDITIONS OF APPLICATION OF THE TEST

This test is applicable to all equipment having active electronics, a microcontroller and/or onboard software. The test is carried out on the equipment supply lines (VED, VEK, VER) taken successively and simultaneously.

2.1.5.4.TEST EQUIPMENTS

- Programmable power source.
- Equipment necessary for checking the proper operation of the DUT.
- Environment of the DUT, actual (sensors, actuators) or simulated.
- Insulating support with a thickness of 50 mm.

2.1.5.5. ASSEMBLY



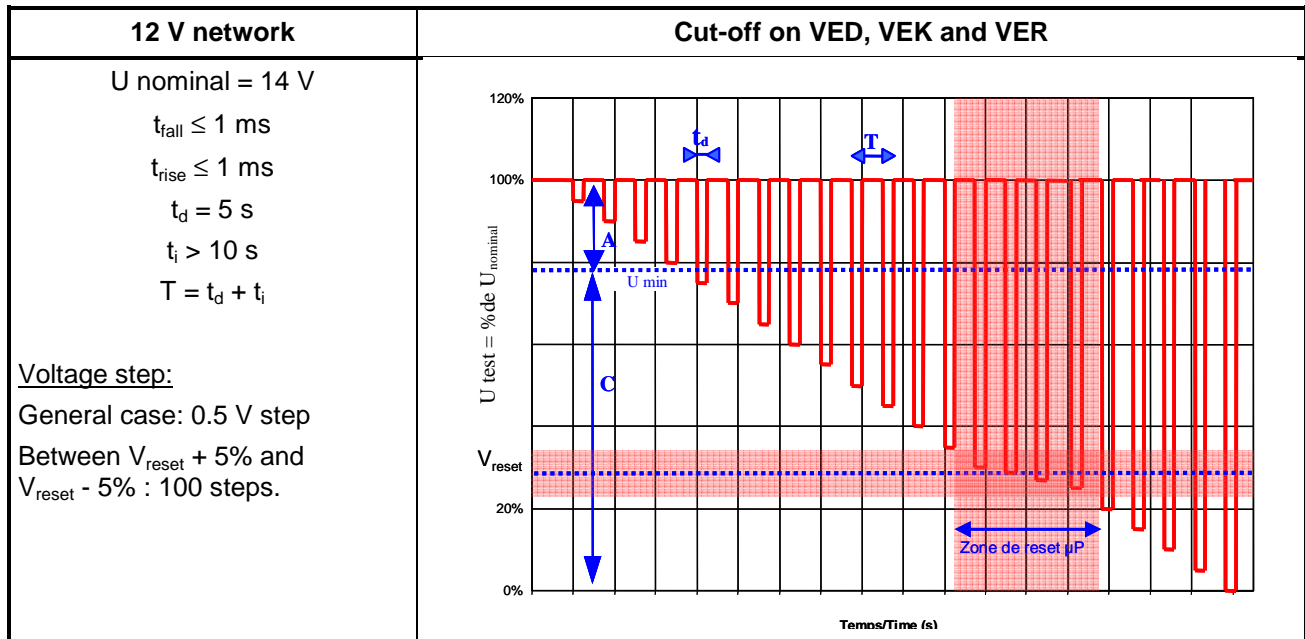
2.1.5.6. PROCEDURE**Preparation:**

A wiring harness with a maximum length of 2000 mm is preferably used (alternately, the actual wiring harness can be used). The equipment can be installed equally on an insulating table or on a ground plane. Using the ground plane is only necessary for a direct connection of the DUT or of its sensors / actuators to the vehicle's chassis. In this case, the DUT is linked to the ground plane in conformity with its actual installation on the vehicle, and no other ground connection is authorized.

The power supply wires of the tested DUT must have a maximum length of 500 mm.

Calibration:

Replace the DUT by a 1 kΩ resistance, connect the oscilloscope to the resistance terminals, and adjust the generator to obtain the following wave profile:



Around the reset voltage of the product, the voltage dips to be applied must be refined as follows:

- Determine the reset voltage threshold V_{reset} for the equipment.
- At the voltage levels between $V_{reset} + 5\%$ and $V_{reset} - 5\%$, apply at least 100 voltage dips, in voltage step of maximum 50 mV. If the accuracy of the power source allows it, preferably apply smaller steps. Example of numerical application for a V_{reset} of 5.6 V:
 - 100 steps of 5.6 mV each for covering the range between [5.32 – 5.88] V.
 - Or: 20 groups of 5 voltage dips, separated by 28 mV per group to cover the range between [5.32 – 5.88] V.

Test:

Start the DUT for a minimum period of 10 minutes.

Apply the fluctuation cycle successively on each power supply line (VED, VEK and VER), then on the all of them, while monitoring the DUT.

Test report:

Among other items, the test report must include the following:

- Assembly used: wiring harness, DUT environment.

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- Parameters observed and faults encountered during the test.
- Characteristics of the pulses applied.

2.1.5.7.REQUIREMENTS

Test	Operating classes	Levels of customer impact
Reset (Non-safety equipment and function)	C (see the notes)	Not applicable

Notes:

- *For the equipments with safety strategies that require it, the required class can be type D for the test on each power supply line successively (case to be specified in the STN/ST).*
- *The operation during the test must remain type A within the usual voltage range defined in § 2.1.*
- *The operation during the test must not generate random operations (untimely activations), or data modifications in the EEPROM.*
- *Between all the fluctuation times t_d , the operation of the equipment must be type A, without the time t_d generating losses of the non-volatile memory.*
- *For the equipments that require a software strategy of "power latch" (requirement of power supply after the standby command, for instance to backup the functional context in the EEPROM before cutting off the product), a downgraded operation can be authorized after the cycle. This case must be specified in the STN/ST.*

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2.1.6.EQ/TE 04: RESISTANCE TO UNUSUAL SUPPLY VOLTAGES

In the § "procedure", replace the paragraph "test" by the following:

Test:

- Start the DUT for a minimum period of 10 minutes.
- Cut off the DUT for at least 10 seconds.
- Apply the maximum voltage for 1 minute to all the supply lines (12 V), while monitoring the DUT.
- **Decrease the voltage to the nominal value of 14 V, and apply it for 1 minute to all the power supply line (12 V) while monitoring the DUT.**
- Cut off the DUT for at least 10 seconds.
- Apply the reverse voltage for 1 minute to all the power supply lines (12 V), while monitoring the DUT. Apply the reverse voltage limited to – 2 V for 100 ms to all the power supply lines of 42 V, while monitoring the DUT. Repeat the cycle at least 5 times.

Replace the requirements by the following:

REQUIREMENTS

Test	Operating classes	Levels of customer impact
Maximum voltage	C or D after a return to 14V (note 1) C after passage through 0 volts	2 (note 2)
Reverse voltage	D	2

Note 1: for some functions, the equipment cannot return to nominal operation upon the return from 24 V to 14 V. This case must be specified in the STN/ST.

Note 2: for the test at the maximum voltage of 24 V, all the functions necessary for the start-up must be maintained.

2.1.7.EQ/TE 05: RESISTANCE TO GROUNDING AND TO THE CONNECTION TO THE POSITIVE TERMINAL OF THE NETWORK

No modification concerning this test.

2.1.8.EQ/TE 06: RESISTANCE TO LONGER OVERLOADS

No modification concerning this test.

2.1.9.EQ/IC 01: RESISTANCE TO PULSES 1 AND 2A

Decrease the number of pulses from 5000 to 500 and modify the requirements as follows. The rest of the procedure remains identical to B21 7110-C.

OBJECTIVE OF THE TEST**Pulse 1:**

This test is intended to check the immunity of the equipments to transient voltages generated by the disconnection of the power supply to the inductive loads (motors, etc.) powered in parallel with the DUT.

The main characteristics of the test are the following:

- 500 pulses of + 100 V.
- Pulse width: 2 ms.

Pulse 2a:

This test is intended to check the immunity of the equipments to transient voltages due to a sudden variation of a current through an inductor connected in series with the DUT (generally, the distributed inductive coil of the wiring).

Its main characteristics are the following:

- 500 pulses of + 100 V.
- Pulse width 50 μ s.

PROCEDURE**Test:**

- Start the DUT for at least 10 minutes, at the ambient temperature ($23^{\circ} \pm 5$).
- Apply 500 pulses 1 to all the power supply lines (successively), while monitoring the DUT.
- Apply 500 pulses 2a to all the power supply lines (successively and simultaneously) while monitoring the DUT.
- Repeat all the tests (pulses 1 and 2a) placing the DUT at T_{min}EF, and then at T_{max}EF.
- observations and faults encountered during the test, for each testing temperature.

REQUIREMENTS

Test (ambient temperature, T _{min} EF and T _{max} EF)		Operating classes	Levels of customer impact
Pulses 1	functions that must be deactivated when the switched + is cut off	C	see note 1
	functions that must be operational when the switched + is cut off (note 2)	B	0
Pulses 2a		B	0

Note 1 : the reset of the DUT is accepted. However, no loss of data in the memory is accepted, and the malfunction, even temporary, may not generate any fault with a customer impact 2 or 3.

Note 2: the concerned functions are those maintained by a power source, other than the cut-off one, for an equipment with multiple power inputs.

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2.1.10.EQ/IC 10: BEHAVIOR TO PULSES ON OUTPUTS THAT SWITCH INDUCTIVE LOADS

No modification concerning this test.

2.1.11.EQ/IC 02: RESISTANCE TO PULSES 3A AND 3B

No modification concerning this test.

2.1.12.EQ/IC 03: RESISTANCE TO PULSES 5B

Replace the requirements by the following:

REQUIREMENTS

Test levels	Operating classes	Levels of customer impact
Pulses 5b	C	2
Pulses 5b EST operational in case of crash	B	0

2.1.13.EQ/IC 04: RESISTANCE TO SUPPLY MICRO-INTERRUPTIONS

No modification concerning this test.

2.1.14.EQ/IC 05: RESISTANCE TO PULSES 4 OR 4 BIS

No modification concerning this test.

2.1.15.EQ/IC 12: RESISTANCE TO THE RESTART PULSE

No modification concerning this test.

2.1.16.EQ/IC 13: RESISTANCE TO THE "VOLT CONTROL" VOLTAGE PULSE*Addition of a new test.***2.1.16.1.REFERENCE DOCUMENT**

There is no reference document that refers to this test.

2.1.16.2.OBJECTIVE OF THE TEST

This test is intended to check the immunity of the voltage variations during the load switching phases (heated rear window, etc.), during the high voltage supply phases of the "volt control" systems (deceleration phases).

The main characteristics of the test are the following:

- Power supply up to 18.0 V.
- 5 pulses at 1 minute intervals.

2.1.16.3.CONDITIONS OF APPLICATION OF THE TEST

The "volt control" voltage pulse is applicable to the equipments that meet all the following conditions:

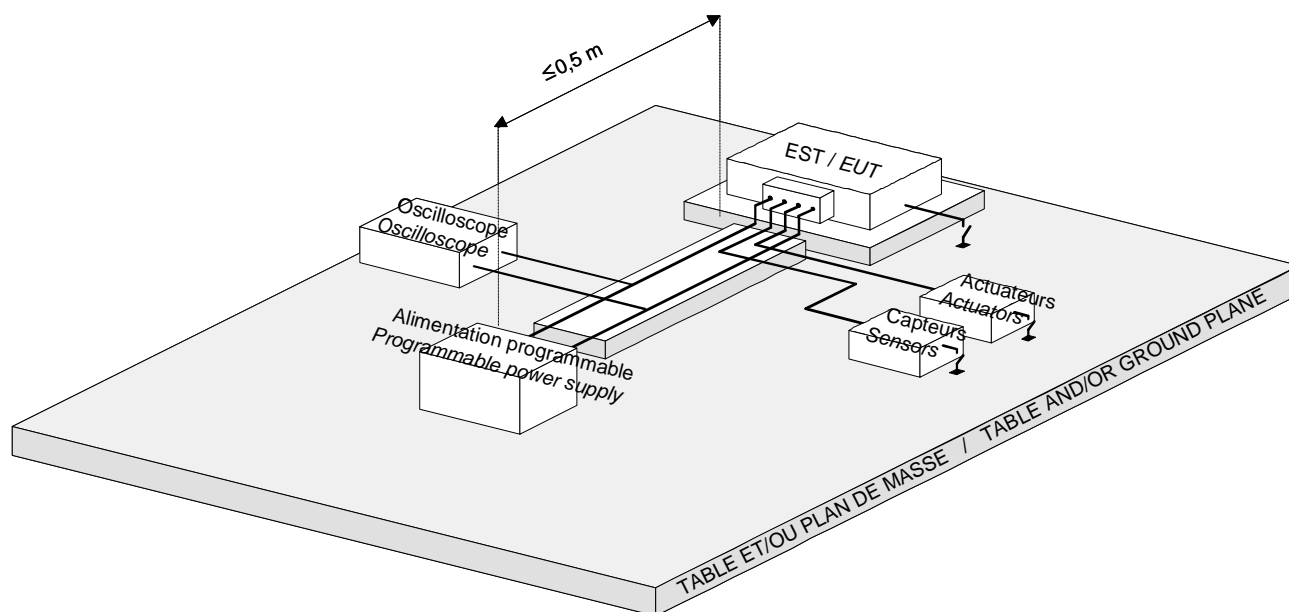
- equipment that might be installed in a vehicle with a volt control system,
- equipment powered by a vehicle battery (not powered by a regulated voltage supplied by another computer).

This test is not applicable to the equipments operating at nominal parameters (A0) at 18.0 V.

The test is carried out on the equipment supply lines taken simultaneously.

2.1.16.4.TEST EQUIPMENTS

- Programmable power source or pulse generator.
- Equipment necessary for checking the proper operation of the DUT.
- Environment of the DUT, actual (sensors, actuators) or simulated.

2.1.16.5. ASSEMBLY

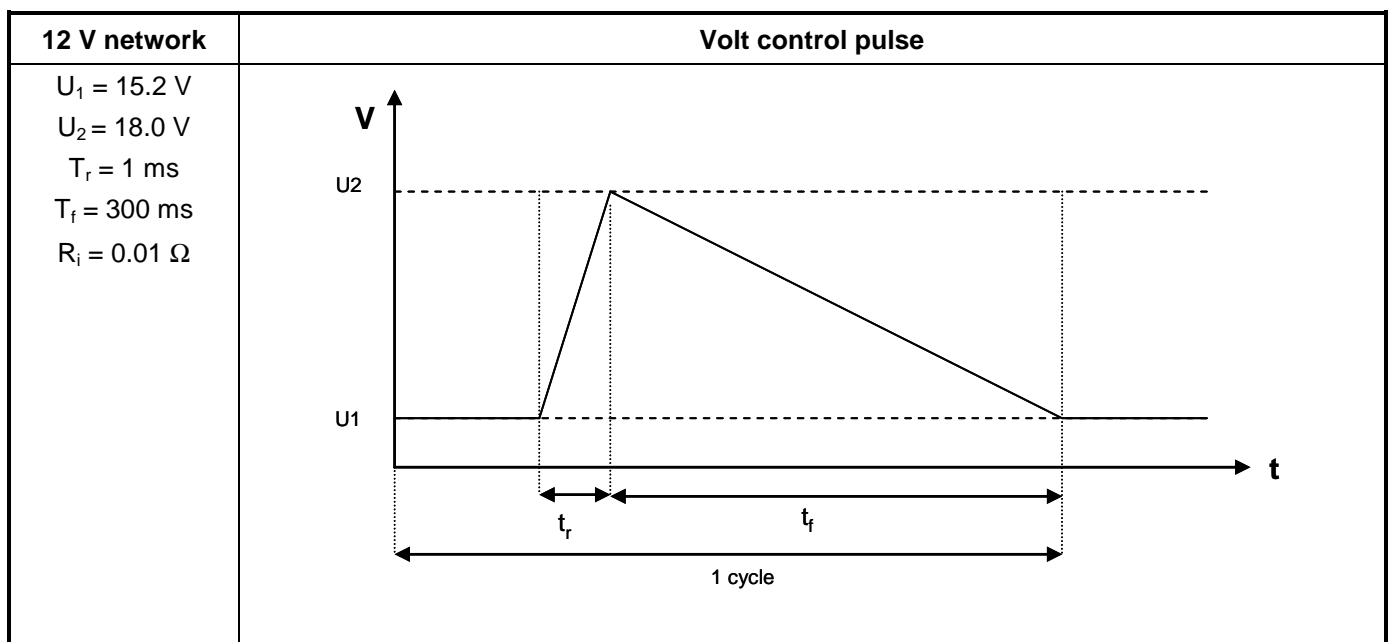
2.1.16.6. PROCEDURE**Preparation:**

A wiring harness with a maximum length of 2000 mm is preferably used (alternately, the actual wiring harness can be used). The equipment can be installed equally on an insulating table or on a ground plane. Using the ground plane is only necessary for a direct connection of the DUT or of its sensors / actuators to the vehicle's chassis. In this case, the DUT is linked to the ground plane in conformity with its actual installation on the vehicle, and no other ground connection is authorized.

The power supply wires of the tested DUT must have a maximum length of 500 mm.

Calibration:

Connect the oscilloscope (EST disconnected) at the output of the pulse generator (high impedance input), and adjust the generator in order to obtain the pulses specified.



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Test:

Start the DUT for a minimum period of 10 minutes.

Apply for 5 times the "volt control" pulse with one minute recurrence on all the power supply lines taken simultaneously, while monitoring the DUT.

Test report:

Among other items, the test report must include the following:

- Assembly used: wiring harness, DUT environment.
- Parameters observed and faults encountered during the test.
- Characteristics of the pulse applied.

2.1.16.7.REQUIREMENTS

Requirements	Operating classes	Levels of customer impact
General case	A	0 (b)
Case of the DUT and/or of the functions for which temporary malfunctions are tolerated (a)	B	1 (b)

(a) Case of some DUT and/or functions that pilot an actuator (for instance: windscreen wiper, for which a temporary modification of the speed is allowed), of the functions like lighting and/or rheostat control (for which a temporary variation of the lighting is allowed). This case must be specified by the NTS/TS. By default, the general case is applied.

(b) If the DUT delivers a regulated voltage for another computer or sensor, it must remain within its tolerances during the test.

2.1.17.EQ/IC 06: RESISTANCE TO RIPPLE VOLTAGES OF THE ON-BOARD NETWORK

No modification concerning this test.

2.2.IMMUNITY TESTS BY CONDUCTION

No modification concerning these tests.

2.3.IMMUNITY TESTS BY RADIATION

No modification concerning these tests.

2.4.TESTS OF RESISTANCE TO ELECTROSTATIC DISCHARGES

No modification concerning these tests.

2.5.EMISSION TESTS BY CONDUCTION

No modification concerning these tests.

2.6.EMISSION TESTS BY RADIATION

No modification concerning these tests.