INTERNATIONAL STANDARD

ISO 7637-1

First edition
1990-06-01

Road vehicles — Electrical disturbance by conduction and coupling —

Part 1:
Passenger cars and light commercial vehicles with nominal 12 V supply voltage — Electrical transient conduction along supply lines only

Véhicules routiers — Perturbations électriques par conduction et par couplage — Partie 1: Voitures particulières et véhicules utilitaires légers à tension nominale de 12 V — Transmission des perturbations électriques par conduction uniquement le long des lignes d'alimentation

Reference number
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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7637-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles.*

This first edition of ISO 7637-1 cancels and replaces the first edition of the Technical Report (ISO/TR 7637-1 : 1984), of which it constitutes a technical revision.

ISO 7637 consists of the following parts, under the general title *Road vehicles — Electrical disturbance by conduction and coupling*:

— *Part 0: General and definitions*

— *Part 1: Passenger cars and light commercial vehicles with nominal* 12 V *supply voltage — Electrical transient conduction along supply lines only*

— *Part 2: Commercial vehicles with nominal* 24 V *supply voltage — Electrical transient conduction along supply lines only*

NOTES

1 Future parts of this International Standard will cover *Vehicles with nominal* 12 V *supply voltage — Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines; Vehicles with nominal* 24 V *supply voltage — Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines; On-board vehicle test procedures.*

2 The second element of the general title of ISO 7637 is now given as *"Electrical disturbance..."* instead of the *"Electrical interference..."* used previously.

Annex A forms an integral part of this part of ISO 7637.

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Road vehicles — Electrical disturbance by conduction and coupling —

Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage — Electrical transient conduction along supply lines only

1 Scope

This part of ISO 7637 specifies test methods and procedures to ensure the compatibility to conducted electrical transients of equipment installed on passenger cars and light commercial vehicles fitted with a 12 V electrical system. It describes bench tests for both the injection and measurement of transients.

Functional status classifications for immunity to transients are given in annex A.

NOTE — General guidelines for the evaluation of transient emissions, test procedures for which are given in clause 3, will form the subject of a future addendum.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 7637. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7637 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6722-3 : 1984, *Road vehicles — Unscreened low-tension cables — Part 3: Conductor sizes and dimensions.*

3 Test procedures

3.1 General

Methods for measuring the transient emission on supply lines and test methods for the immunity of devices against such transients are given. These tests, called "bench tests", are made in the laboratory. [1)]

The bench test methods, some of which require the use of the artificial network, will provide comparative results between laboratories. They also give a basis for the development of devices and systems and may be used during the production phase.

A bench test method for the evaluation of the immunity of a device against supply line transients may be performed by means of a test pulse generator; this may not cover all types of transients which can occur in a vehicle. Therefore, the test pulses described in 4.6 are characteristic of typical pulses.

In special cases, it may be necessary to apply additional test pulses. However, some test pulses may be omitted, if a device — depending on its function or its connection — is not influenced by comparable transients in the vehicle. It is part of the vehicle manufacturer's responsibility to define the test pulses required for a specific device.

To ensure proper vehicle operation in the electromagnetic environment, on-board testing is essential.

3.2 Test temperature and test voltage

The ambient temperature during the test shall be 23 °C ± 5 °C.

The test voltages shall be as follows:

$$U_A = 13{,}5\ \text{V} \pm 0{,}5\ \text{V}$$

$$U_B = 12\ \text{V} \pm 0{,}2\ \text{V}$$

unless other values are agreed upon by the users of this part of ISO 7637, in which case such values shall be documented in the test reports.

1) A future part of ISO 7637 will cover on-board vehicle tests.

3.3 Transient emissions test

3.3.1 Voltage transients

Voltage transients from the disturbance source, the device under test, are measured using the artificial network to standardize the impedance loading on the device under test (see 4.1). The disturbance source is connected via the artificial network to the shunt resistor R_{s1} (see 4.2), the switch S (see 4.3) and the power supply (see 4.4), as given in figure 1.

The leads between the terminals of the disturbance source, the device under test, and the artificial network shall be laid out in a straight parallel line and shall have a length of 0,5 m ± 0,05 m.

The cable sizes shall be chosen in accordance with ISO 6722-3.

The disturbance voltage is measured at the terminals P and B of the artificial network (see figure 1) using a voltage probe and an oscilloscope or waveform acquisition equipment.

Repetitive transients are measured with switch S closed. If the transient is caused by a supply disconnection, measurement is started at the moment of opening switch S.

3.3.2 Current transients

The test setup for measuring the disturbance current is shown in figure 2.

The disturbance source is connected via the artificial network to the power supply. Resistor R_{s2} (see 4.2) is connected to the terminals of the artificial network on the power supply side (see figure 2).

The leads between the terminals of the disturbance source and the artificial network shall be laid out in a straight parallel line and shall have a length of 0,5 m ± 0,05 m.

The disturbance source is disconnected by the switch S.

The disturbance current measurement is started when switch S is opened.

The disturbance current should be measured between the artificial network and the device under test as close to the artificial network as possible.

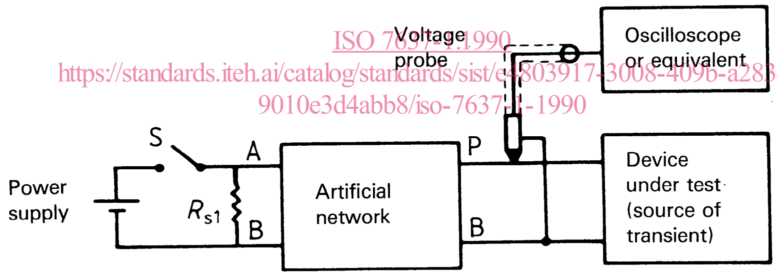


Figure 1 — Conducted voltage transients measurement test setup

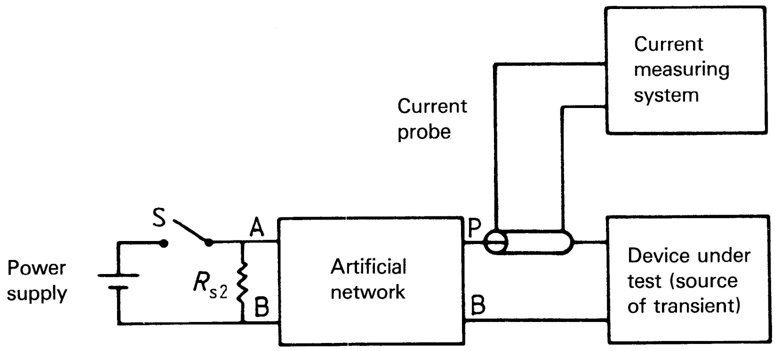


Figure 2 — Conducted current transients measurement test setup

3.4 Transient immunity test

The test setup for transient immunity measurements of electrical/electronic devices is given in figure 3.

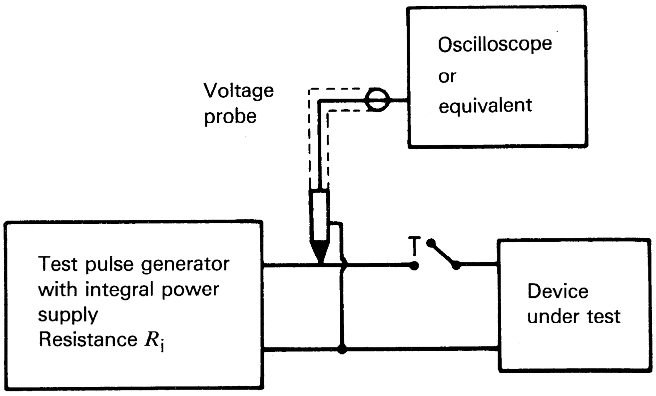


Figure 3 — Transient immunity test setup

The leads between the terminals of the test pulse generator and the device under test shall be laid out in a straight parallel line and shall have a length of 0,5 m ± 0,05 m.

The test pulse generator (see 4.6) is set up to provide the specific pulse polarity, amplitude, duration and resistance with switch T (see 4.3) open. (The appropriate values are selected from annex A.) Next, the device under test is connected to the generator by closing switch T.

Depending on the real conditions, the function of the device under test should be evaluated during and/or after the application of the test pulses.

For correct generation of the required test pulses, it may be necessary to switch the power supply on and off. The switching can be performed by the test pulse generator if the power supply is integral to it.

4 Test instrument description and specifications

4.1 Artificial network

The artificial network is used as a reference standard in the laboratory in place of the impedance of the vehicle wiring harness in order to determine the behaviour of equipment and electrical and electronic devices. A schematic diagram is given in figure 4.

The artificial network should be able to withstand a continuous load corresponding to the requirements of the device under test.

The resulting values of impedance $|Z_{PB}|$, measured between the terminals P and B while terminals A and B are connected together, are given in figure 5 as a function of frequency assuming ideal electric components. In reality, the impedance of an artificial network should not deviate more than 10 % from the curve given in figure 5.

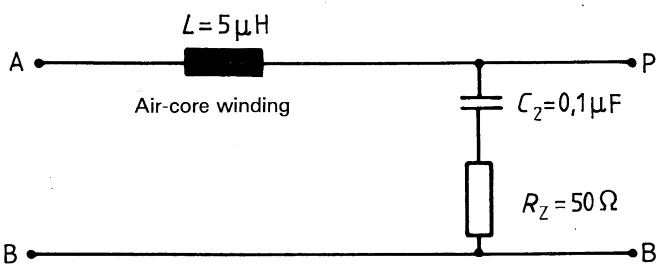
The main characteristics of the components are as follows:

— maximum continuous load current, I = 70 A

— inductance, L = 5 µH (air-core winding)

— internal resistance between terminals P and A: R_L < 5 mΩ

— capacitor, C_2 = 0,1 µF for working voltages of 200 V_{ac} and 1 500 V_{dc}



Key

A: Power supply terminal

B: Common terminal

P: Terminal of device under test

Figure 4 — Schematic diagram of artificial network

4.2 Shunt resistors R_{s1} and R_{s2}

The shunt resistor R_{s1} (see figure 1) simulates the dc resistance of other vehicle devices which are connected in parallel to the device under test and are not disconnected from it by the ignition switch. R_{s1} is selected to correspond to the resistance measured on the wiring harness between the disconnected ignition switch terminal and ground, with the switch off, and shall be specified by the vehicle manufacturer. In the absence of any specification, a value of R_{s1} = 40 Ω shall be used. If a wire-wound resistor is used, the winding shall be bifilar (i.e. with a minimum reactive component).

Shunt resistor R_{s2} (see figure 2) is used during current transient measurements. In the absence of any specification, a value of R_{s2} = 2 Ω shall be used. The shunt resistor shall have an adequate power dissipation rating.

4.3 Switch S and switch T

The switch S (see figures 1 and 2) significantly influences the disturbance transients when tests are performed in accordance with 3.2.

NOTE — A specification for a switch S with reproducible properties is in preparation. In the interim it is proposed to use a standard production switch that is used with the device under test and to perform a sufficient number of tests to ensure a statistically valid sample.

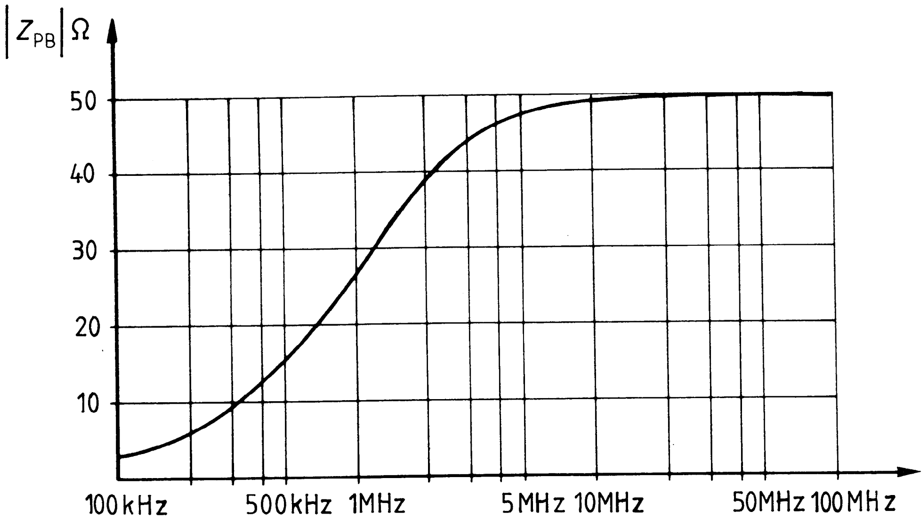


Figure 5 — $|Z_{PB}|$ as a function of frequency from 100 kHz to 100 MHz (AB short-circuited)

The switch T (see figure 3) is a disconnecting switch which does not influence the disturbance transients. The current rating of switch T should be sufficient to handle the required loads.

4.4 Power supply

When a battery is used, a charging source is needed to achieve the specified reference levels.

If a standard power supply (with sufficient current capacity) is used in bench testing to simulate the battery, it is important that the low internal impedance of the battery also be simulated.

The continuous supply source shall have an internal resistance R_i less than 0,01 Ω dc and an internal impedance $Z_i = R_i$ for frequencies less than 400 Hz. The output voltage shall not deviate more than 1 V from 0 to maximum load (including in-rush current) and shall recover 63 % of its maximum excursion within 100 µs. The superimposed ripple voltage, U_r, shall not exceed 0,2 V peak-to-peak and have a maximum frequency of 400 Hz.

4.5 Measurement instrumentation

4.5.1 Oscilloscope

This should preferably be a storage oscilloscope with the following specifications:

— band width: at least 100 MHz

— writing speed: at least 100 cm/µs

— input sensitivity: at least 5 mV/division

The recording may be made with an oscilloscope camera or any other appropriate recording device.

4.5.2 Voltage probe:

— attenuation: 100/1

— maximum input voltage: at least 1 kV

— input impedance, Z, as a function of the frequency, f:

f	Z
1 MHz	> 40 kΩ
10 MHz	> 4 kΩ
100 MHz	> 0,4 kΩ

— maximum length of the probe cable: 3 m

— maximum length of the probe ground: 0,13 m

NOTE — The lengths will influence the measurement results and should be stated in the test report.

4.5.3 Current measuring probe:

— minimum measuring range: 20 A

— maximum working voltage: 500 V

— bandwidth (−3 dB): at least 0 to 15 MHz (Hall effect probe)

— attenuator accuracy: better than 3 %

4.5.4 Waveform acquisition equipment

Equipment that is capable of acquiring fast rise time transient waveforms may be used instead of an oscilloscope.

4.6 Test pulse generator

The test pulse generator shall be capable of producing the test pulses described in 4.6.1 to 4.6.7 and shall be adjustable within the limits given in figures 6 to 13.

Tolerances for the parameters are

± 10 % for time and resistance, and

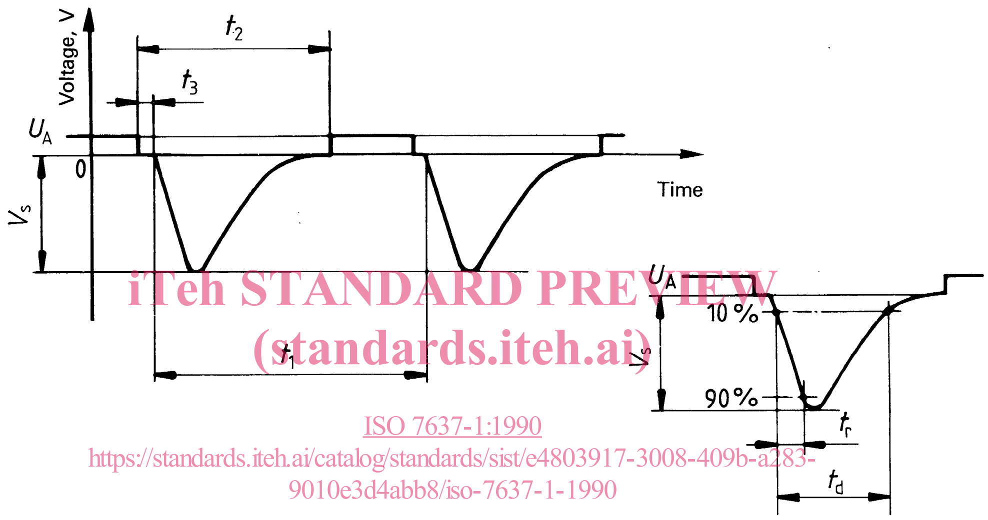
+ 10 % for voltage (V_a and V_s).

Recommended values for the evaluation of immunity of devices can be chosen from table A.1.

4.6.1 Test pulse 1

This test pulse is a simulation of transients due to supply disconnection from inductive loads; it applies to a device under test if, as used in the vehicle, it remains connected directly in parallel with an inductive load.

The pulse shape and parameters are given in figure 6.



Parameters

V_s = 0 to − 100 V

R_i = 10 Ω

t_d = 2 ms

t_r < 1 µs

t_1 = 0,5 s to 5 s

t_2 = 200 ms

t_3 < 100 µs

NOTE — The time necessary between the disconnection of the supply source and the application of the test pulse, t_3, shall be minimized.

Figure 6 — Test pulse 1

4.6.2 Test pulse 2

This test pulse is a simulation of transients due to the sudden interruption of current in an inductor connected in series with a device under test.

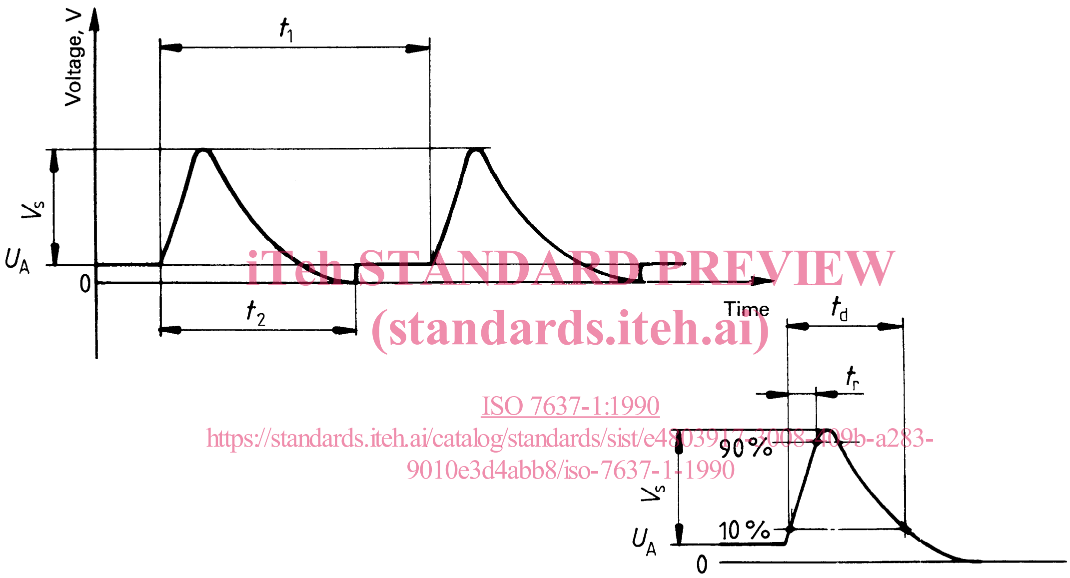
It simulates transients which may for example occur due to the following: after the ignition is switched off, dc motors, which are connected to the same switch as the ignition, may continue rotating due to their inertia, thus acting as generators. Their inductance creates a transient on switching off the supply line.

The pulse shape and parameters are given in figure 7.

4.6.3 Test pulses 3a and 3b

These test pulses are a simulation of transients, which occur as a result of the switching processes. The characteristics of these transients are influenced by distributed capacitance and inductance of the wiring harness.

The pulse shapes and parameters for test pulses 3a and 3b are given in figures 8 and 9 respectively.



Parameters

V_s = 0 to + 100 V

R_i = 10 Ω

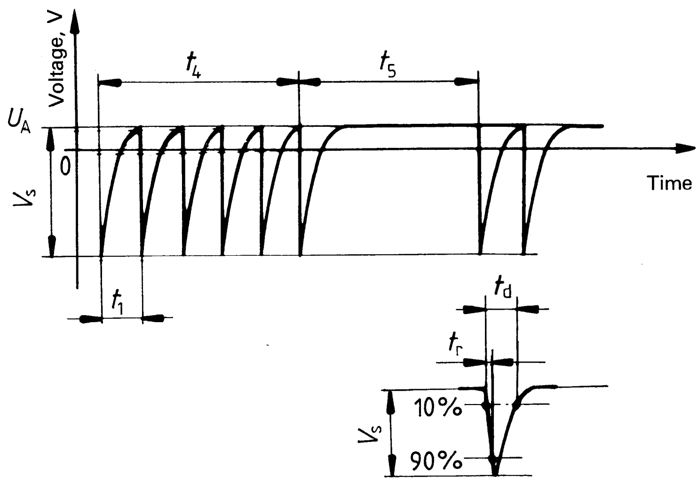
t_d = 0,05 ms

t_r < 1 µs

t_1 = 0,5 s to 5 s

t_2 = 200 ms

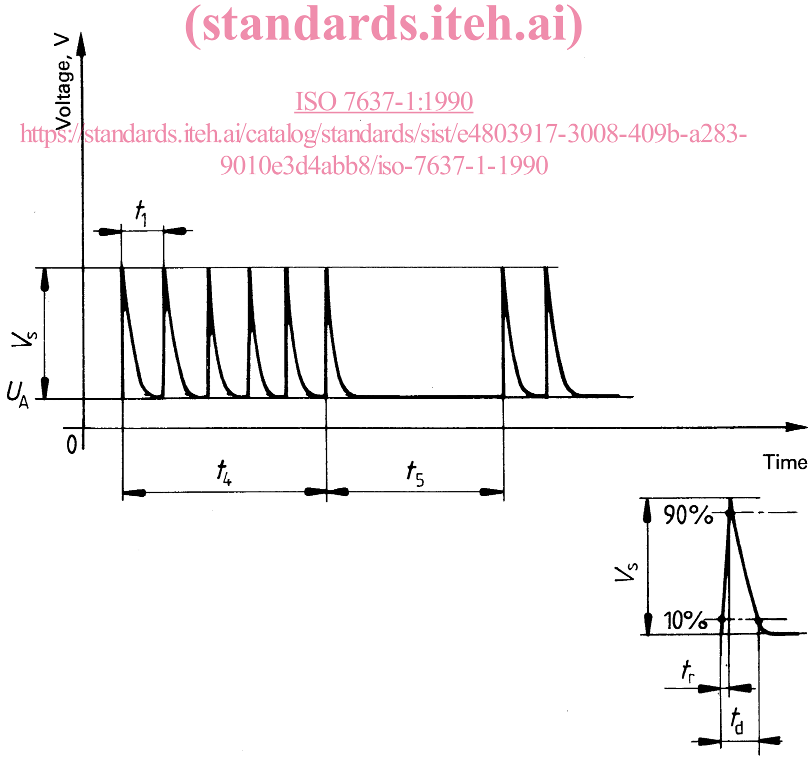
Figure 7 — Test pulse 2



Parameters

- V_s = 0 to −150 V
- R_i = 50 Ω
- t_d = 0,1 µs
- t_r < 5 ns
- t_1 = 100 µs
- t_4 = 10 ms
- t_5 = 90 ms

Figure 8 — Test pulse 3a



Parameters

- V_s = 0 to +100 V
- R_i = 50 Ω
- t_d = 0,1 µs
- t_r < 5 ns
- t_1 = 100 µs
- t_4 = 10 ms
- t_5 = 90 ms

Figure 9 — Test pulse 3b