ISO 7637-2:2011
ISO 16750-2
And other common pulses

Pulse 1 - A simulation of transients due to supply disconnection from inductive loads; it applies to a DUT if as used in the vehicle, it remains connected directly in parallel with an inductive load

Pulse 2a - Simulates transients due to sudden interruption of currents in a device connected in parallel with the DUT due to the inductances of the wiring harness

Pulse 2b - Simulates transients from dc motors acting as generators after the ignition is switched off

Pulse 3a/3b - Occurs as the result of switching processes. The characteristics of this pulse are influenced by distributed capacitance and inductance of the wiring harness

Pulse 4 - The voltage reduction caused by energizing the starter motor circuits of the internal combustion engines

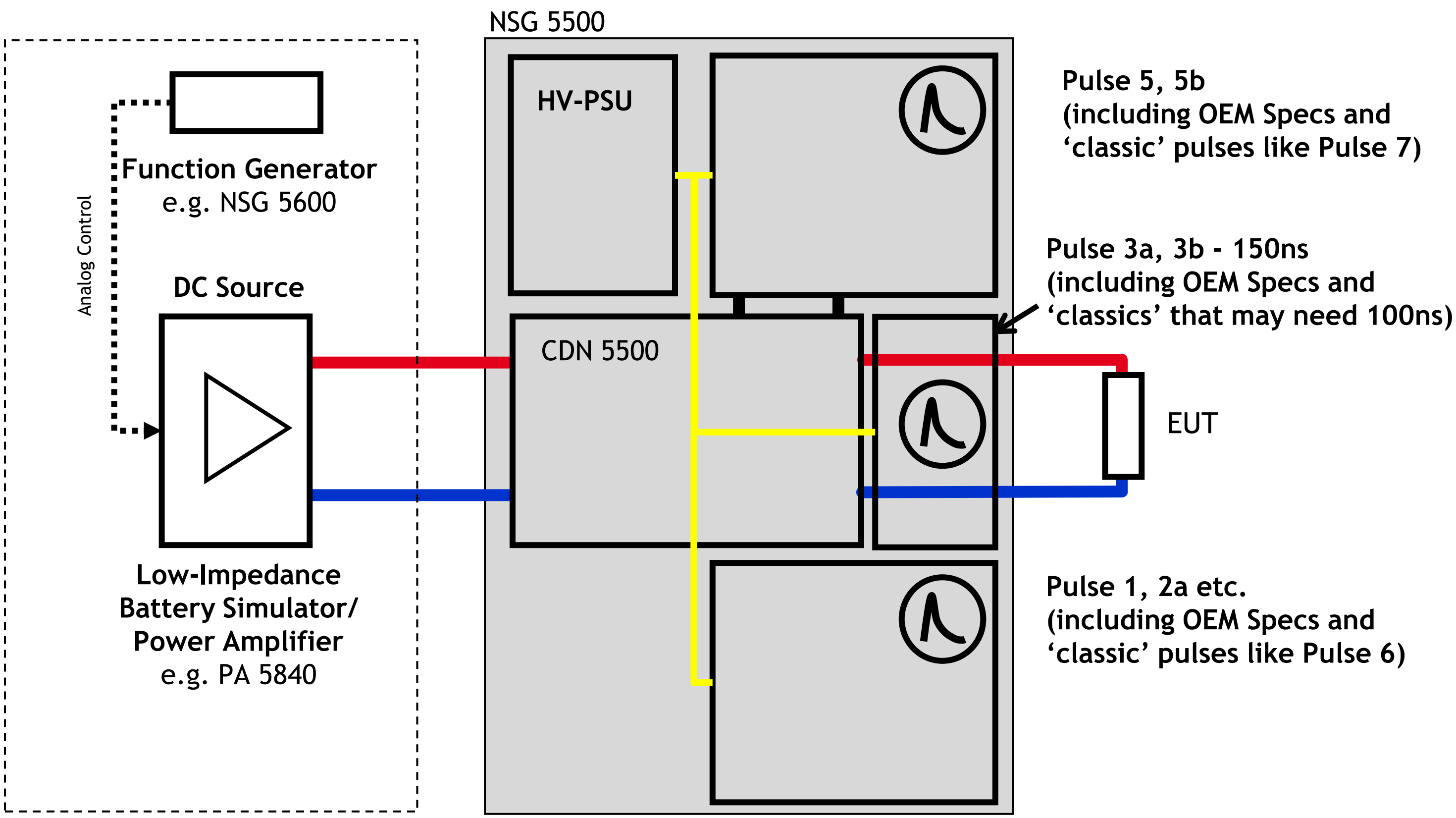
Pulse 4 Variants – Most manufacturer variations of pulse four are generally much more complicated. For example Ford requires up to four arbitrary generators with four outputs to be perfectly synchronized.

Pulse 5 – Simulation of a load dump transient occurring in the event of a discharged battery being disconnected while the alternator is generating charging current with other loads remaining on the alternator circuit at this moment

Magnetic Field Immunity – Simulates magnetic fields generated by electric motors, daytime running lamps, etc. for DUTs with magnetically sensitive devices.

Transformer Coupled Sine Waves – Sinusoidal noise burst coupled on battery lines

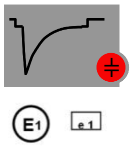
Typical System Setup



All battery events:
Pulse 4, Pulse 2b, etc.
and Battery Voltage generally

All transients:
Pulse 1, Pulse 2a, Pulse 3a and Pulse 3b, 5, 5b etc.)

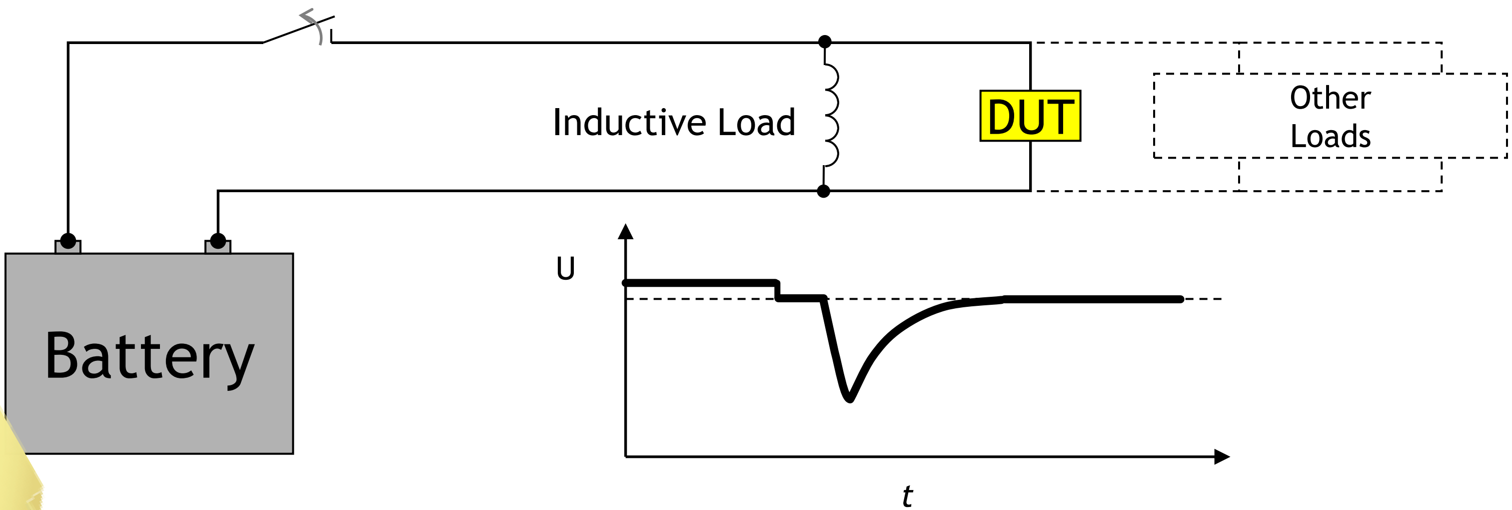
Conducted Automotive EMC Example Pulse 1



INTERNATIONAL STANDARD — ISO 7637-2:2011(E)

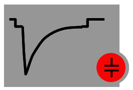
5.6.1 Test pulse 1

This test is a simulation of transients due to supply disconnection from inductive loads; it applies to a DUT if, as used in the vehicle, it remains connected directly in parallel with an inductive load (see Figure E.1 in Annex E).

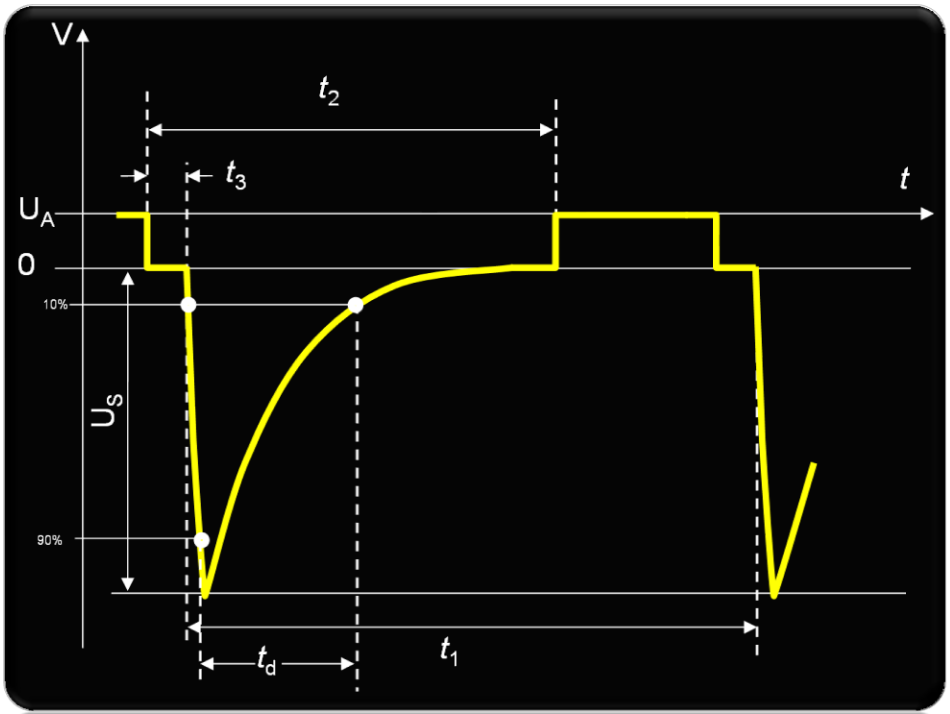


This is the immunity simulation of what we discussed before for inductive kickback.

Conducted Automotive EMC Example Pulse 1



E1 e1



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2011-03-01

Table 2 — Parameters for test pulse 1

Parameters	Nominal 12 V system	Nominal 24 V system
U_s	−75 V to −150 V	−300 V to −600 V
R_i	10 Ω	50 Ω
t_d	2 ms	1 ms
t_r	$(1\ {}^{0}_{-0,5})$ µs	$(3\ {}^{0}_{-1,5})$ µs
t_1 [a]	⩾0,5 s	
t_2	200 ms	
t_3 [b]	<100 µs	

[a] t_1 shall be chosen such that it is the minimum time for the DUT to be correctly initialized before the application of the next pulse and shall be ⩾0,5 s.

[b] t_3 is the smallest possible time necessary between the disconnection of the supply source and the application of the pulse.

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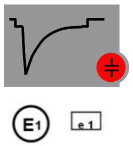
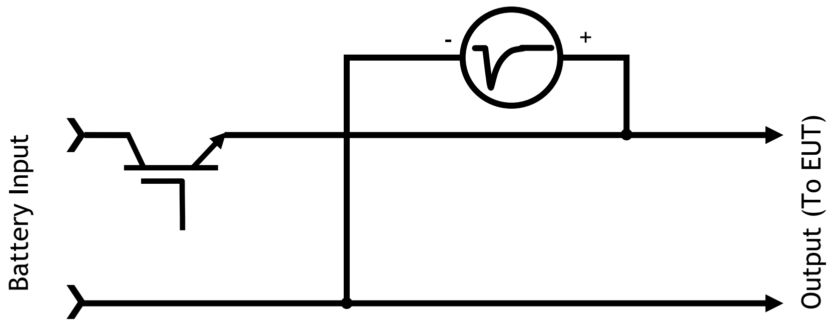
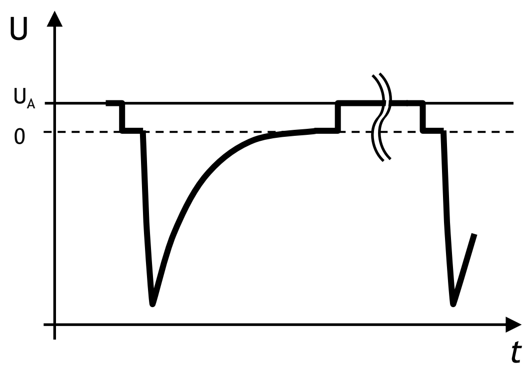
Pulse 1 Coupling

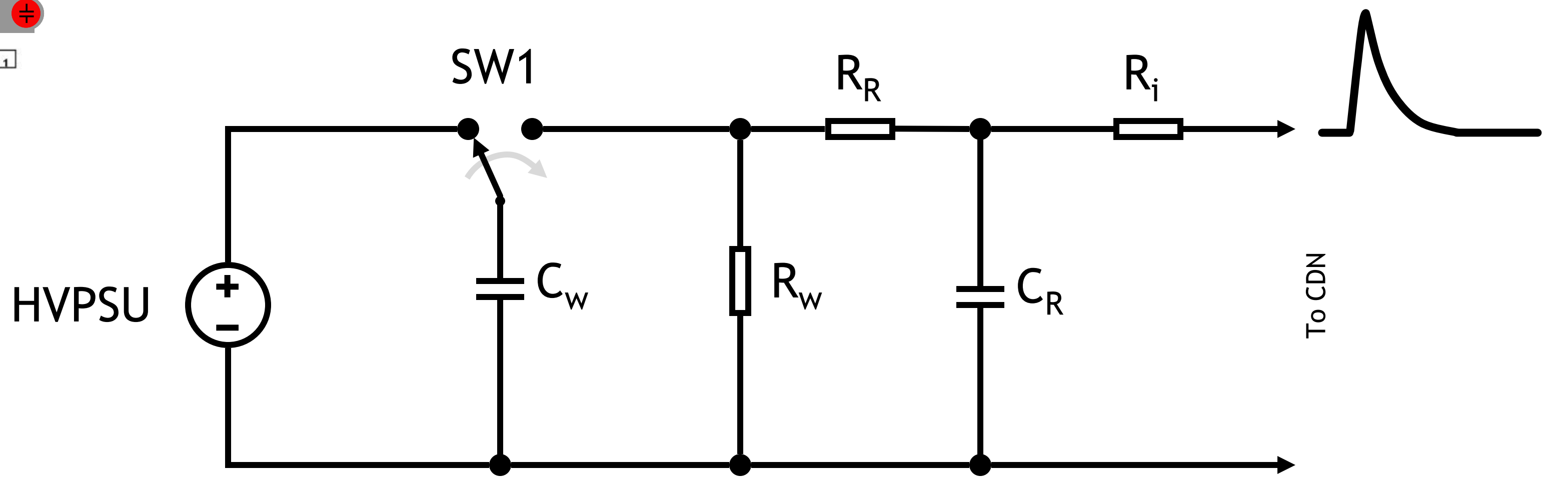




Pulse 1 Block Diagram



Typical Transient Generator Circuit



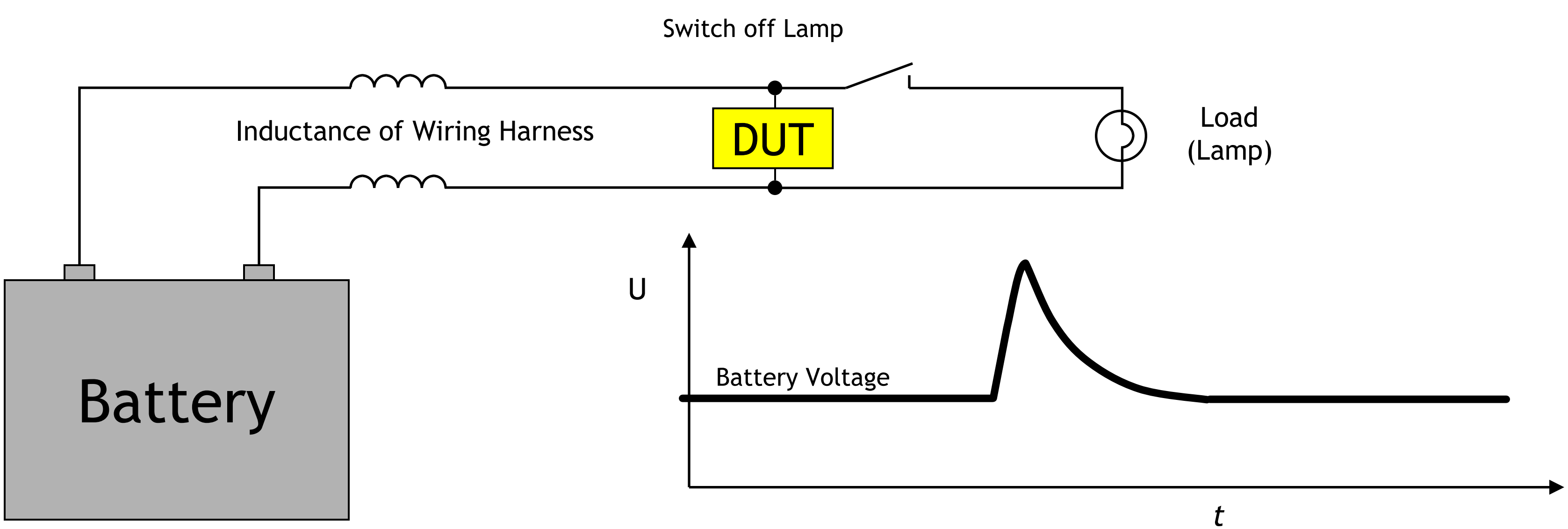
- C_W gets charged before the pulse
- The 'Fire' signal sets SW1 (a pair of IGBTs) to discharge C_W through the pulse shaping network.
- C_W and R_W combined determine the pulse width.
- R_R and C_R combined determine the rise time.
- R_i is the output impedance, but combines with R_R and the ESR of CW to determine the real R_i.

Conducted Automotive EMC Example
Pulse 2a

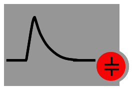
INTERNATIONAL STANDARD **ISO 7637-2:2011(E)**

5.6.2 Test pulses 2a and 2b

Pulse 2a simulates transients due to sudden interruption of currents in a device connected in parallel with the DUT due to the inductance of the wiring harness (see Figure E.2 a) in Annex E).



Conducted Automotive EMC Example
Pulse 2a



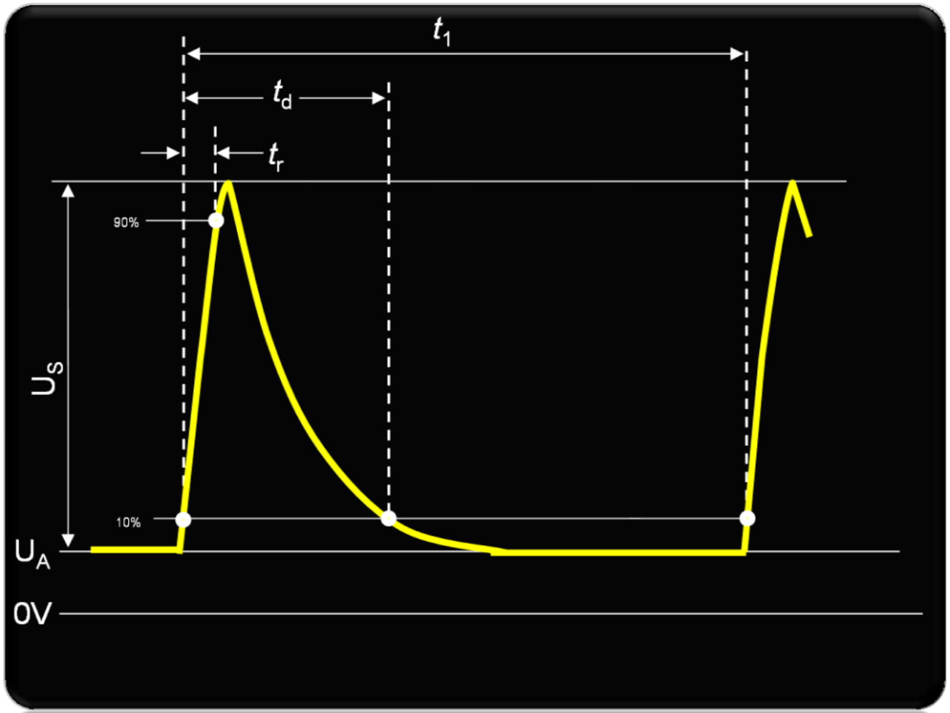


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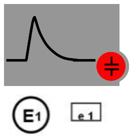
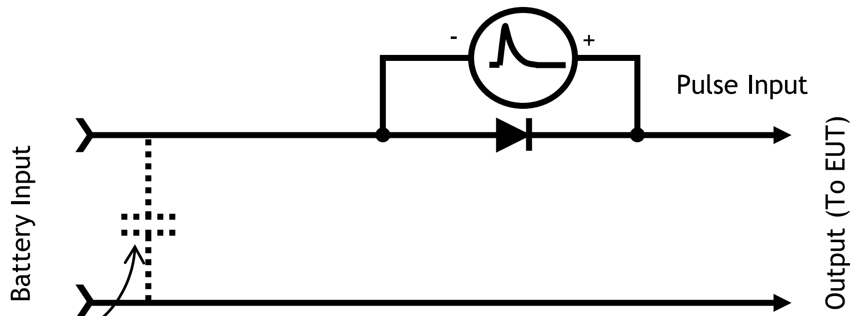
Table 3 — Parameters for test pulse 2a

Parameters	Nominal 12 V and 24 V system
U_s	+37 V to +112 V
R_i	2 Ω
t_d	0,05 ms
t_r	$(1\ {}^{0}_{-0,5})$ µs
t_1[a]	0,2 s to 5 s

[a] The repetition time t_1 can be short depending on the switching. The use of a short repetition time reduces the test time.

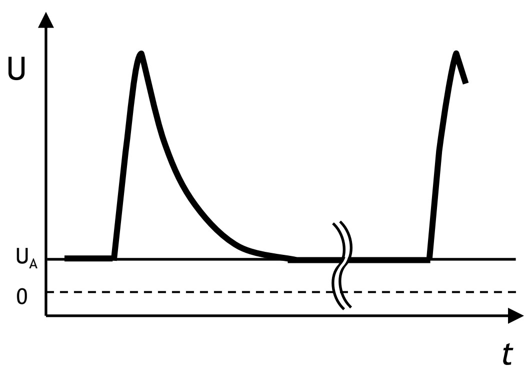
Positive Pulse Coupling Methods





Positive Pulses

Used to simulate
low-impedance battery
when no battery simulator
Is connected

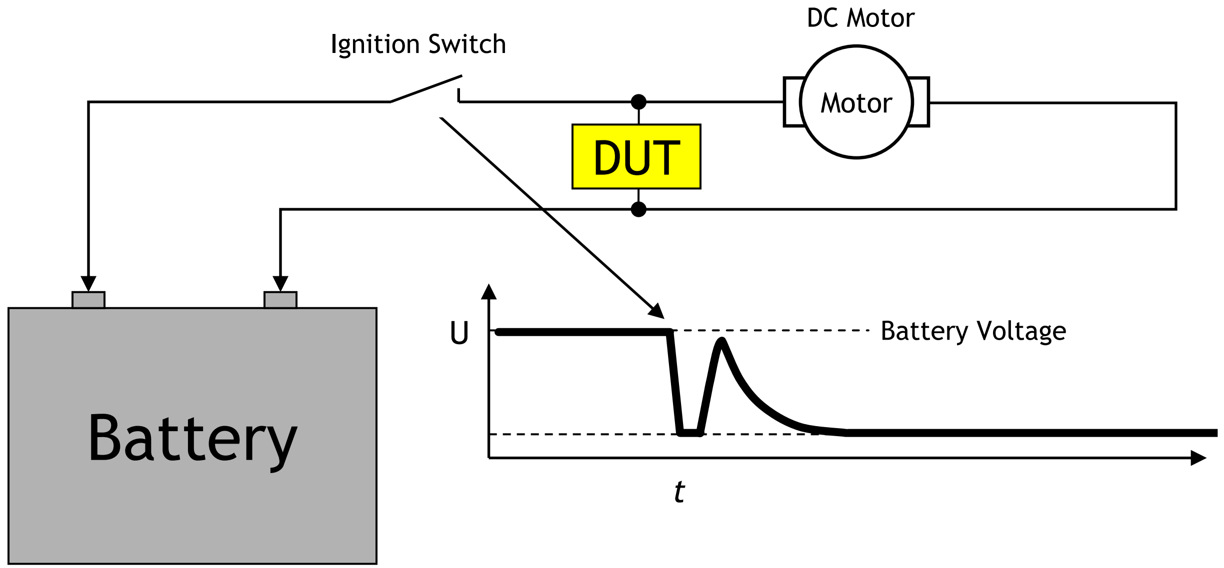


Conducted Automotive EMC Example
Pulse 2b

INTERNATIONAL STANDARD — ISO 7637-2:2011(E)

5.6.2 Test pulses 2a and 2b

Pulse 2b simulates transients from DC motors acting as generators after the ignition is switched off (see Figure E.2 b) in Annex E).



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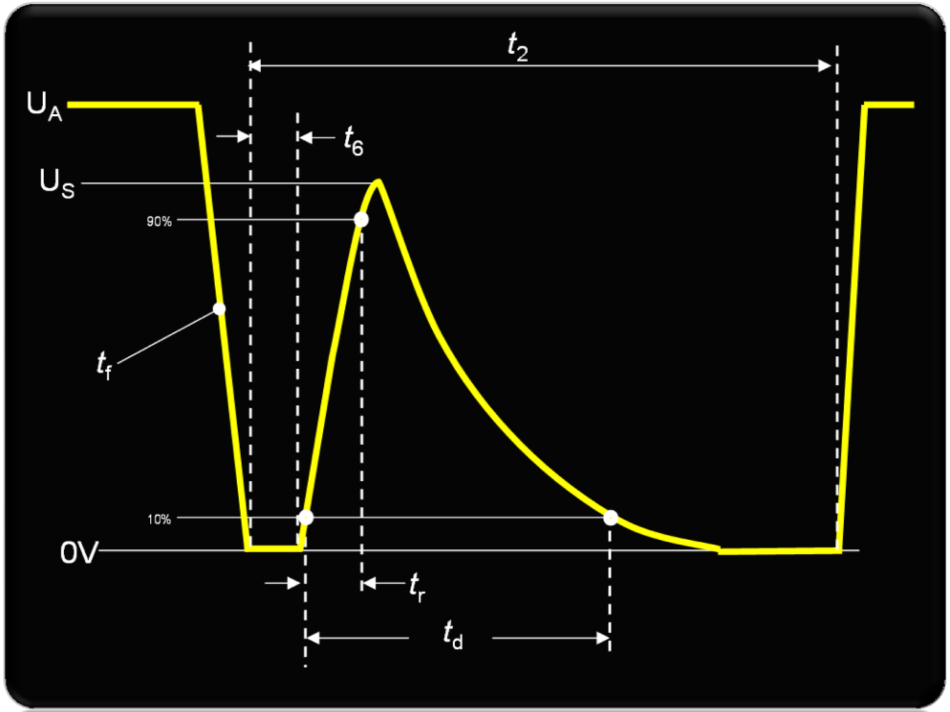
Conducted Automotive EMC Example
Pulse 2b



The OEM must tell you what pulse width to test!

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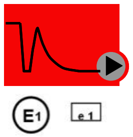
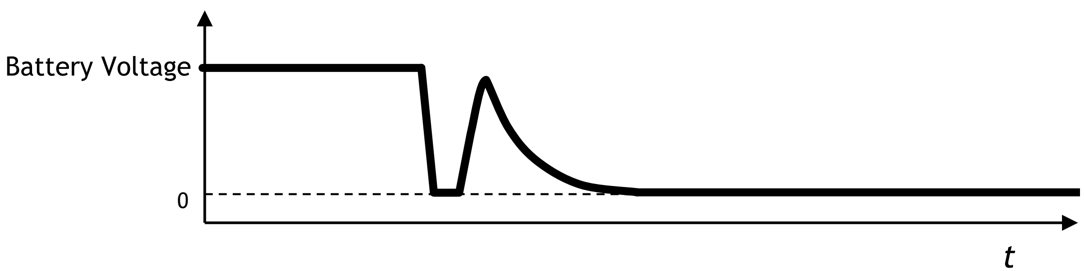
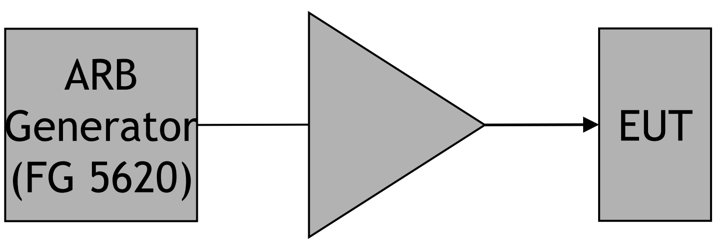
Table 4 — Parameters for test pulse 2b

Parameters	Nominal 12 V system	Nominal 24 V system
U_s	10 V	20 V
R_i	0 Ω to 0,05 Ω	
t_d	0,2 s to 2 s	
t_{12}	1 ms ± 0,5 ms	
t_r	1 ms ± 0,5 ms	
t_6	1 ms ± 0,5 ms	

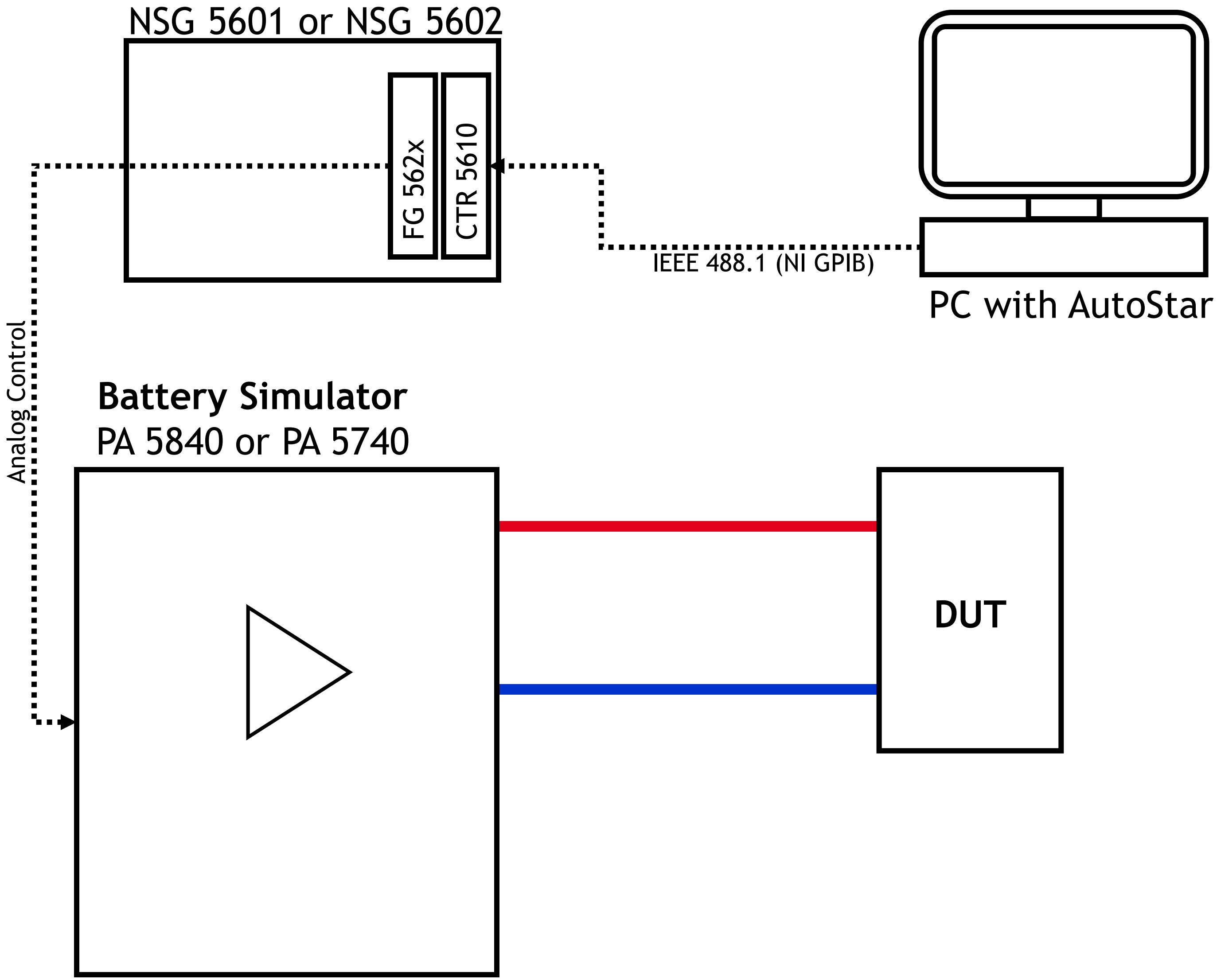
Pulse 2b Block Diagram







Typical System Setup for Arbitrary Waveforms

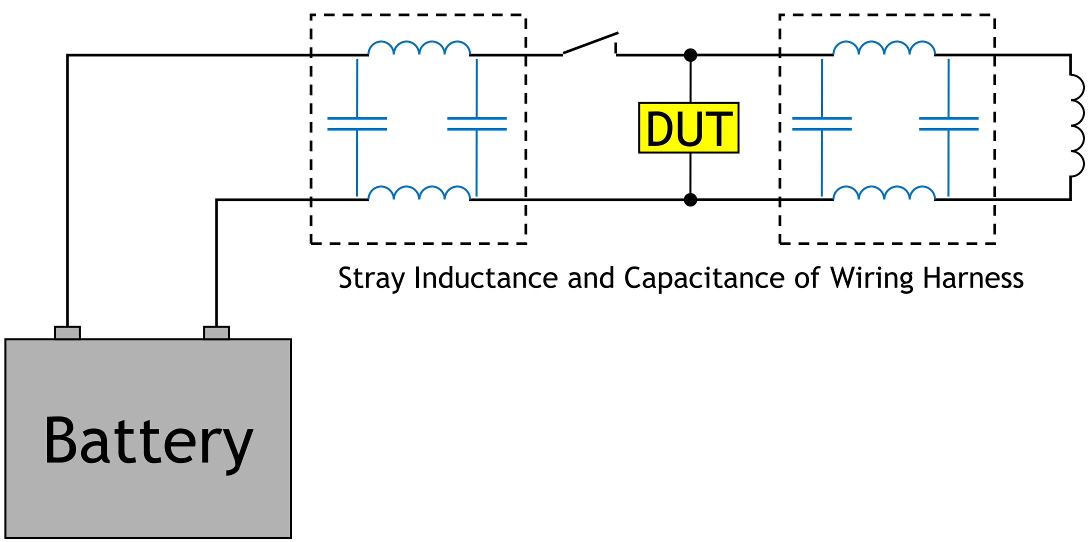


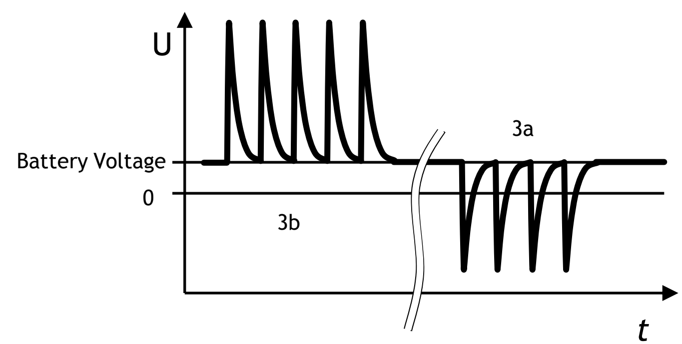
Conducted Automotive EMC Example
Pulse 3a/3b

INTERNATIONAL STANDARD | **ISO 7637-2:2011(E)**

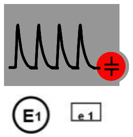
5.6.3 Test pulses 3a and 3b

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 (see Figure E.3 in Annex E).





Pulse 3a/3b



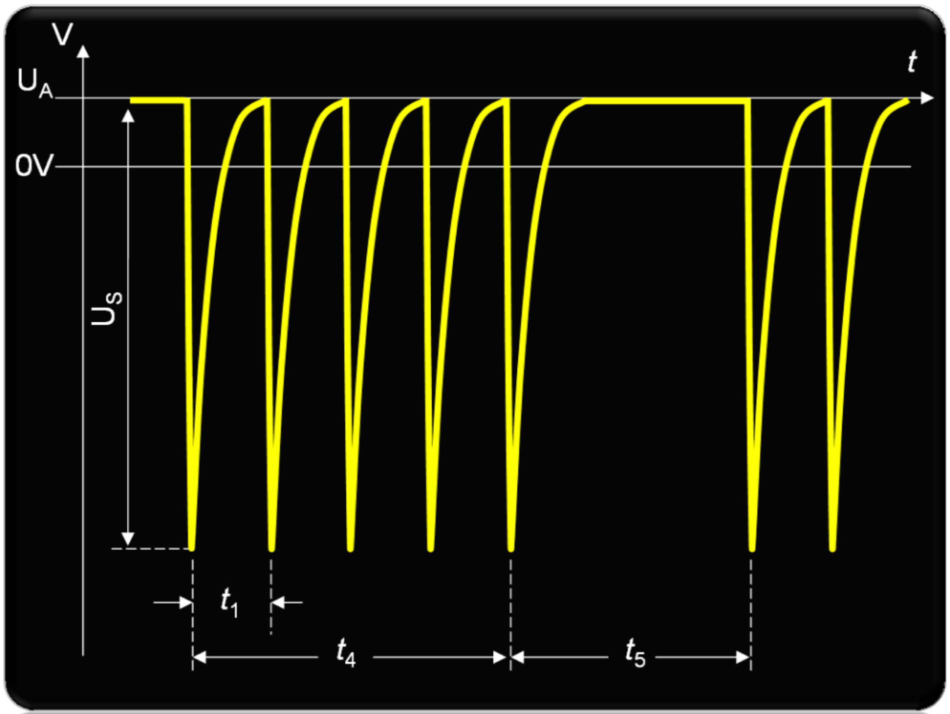


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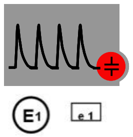
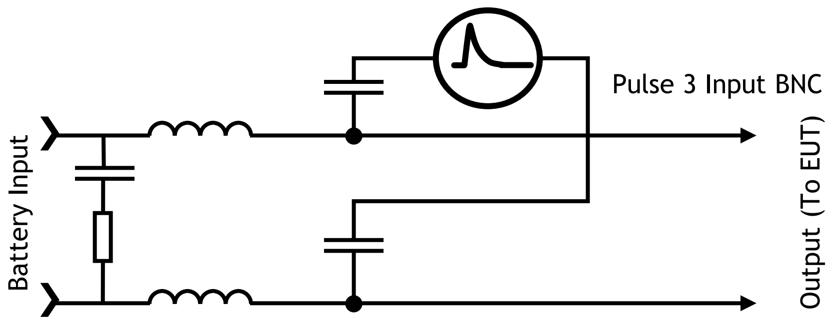
Table 5 — Parameters for test pulse 3a

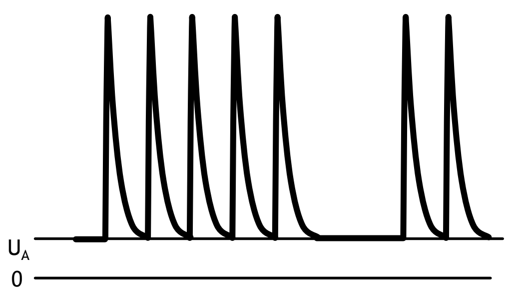
Parameters	Nominal 12 V system	Nominal 24 V system
U_s	−112 V to −220 V	−150 V to −300 V
R_i	50 Ω	
t_d	150 ns ± 45 ns	
t_r	5 ns ± 1,5 ns	
t_1	100 µs	
t_4	10 ms	
t_5	90 ms	

Pulse 3 Block Diagram





Burst (3a/3b) Pulses



Pulse 3 (cont.)
Two Pulse Widths in Common Use

E1 e1

Depending on interpretation, it is *not* possible to comply with all standards with only one pulse width available. Only Teseq has a Pulse 3 generator with both 5/100 and 5/150 pulse shaping networks!

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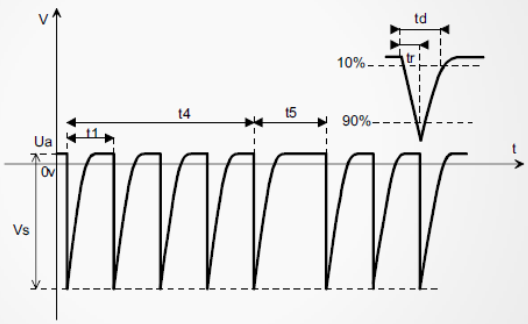
12 V Powernet	Pulse 3a
U_a = 13,5 V V_s = -150 V R_i = 50 Ω t_d = 0,1 µs t_r = 5 ns t_1 = 10 µs – 1 ms (f_1 = 1 kHz – 100 kHz) t_4 = 10 ms t_5 = 90 ms	 Test pulse 3a train

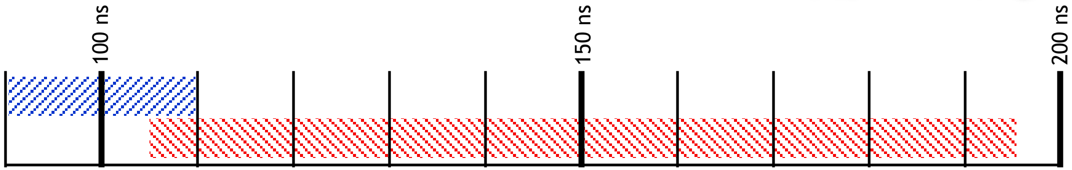
Unless otherwise specified, the variables used shall have the following tolerance

- ± 5% for the specified voltages and currents.
- ± 10% for time slots and distances.
- ± 10% for resistors and impedances.
- ± 1 dB for power.
- ± 3 dB for strength of field.

INTERNATIONAL STANDARD **ISO 7637-2:2011(E)**

Table 5 — Parameters for test pulse 3a

Parameters	Nominal 12 V system	Nominal 24 V system
U_s	–112 V to –220 V	–150 V to –300 V
R_i	50 Ω	
t_d	150 ns ± 45 ns	
t_r	5 ns ± 1,5 ns	
t_1	100 µs	
t_4	10 ms	
t_5	90 ms	



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