E/e-Mark
Automotive EMC Test Requirements

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Certifying the World, One Product at a Time

Outline

- What is E/e mark?
- E mark approval procedure
- Standards and Regulations
- Test requirement and Test setup

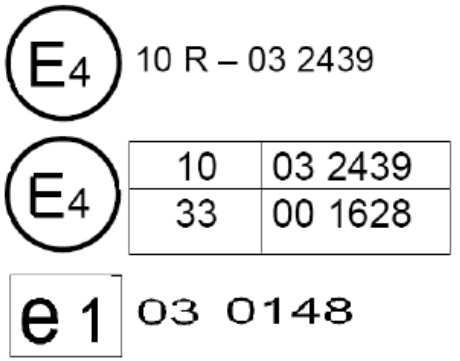
CE Vs. E Mark

To show compliance to European directives such as

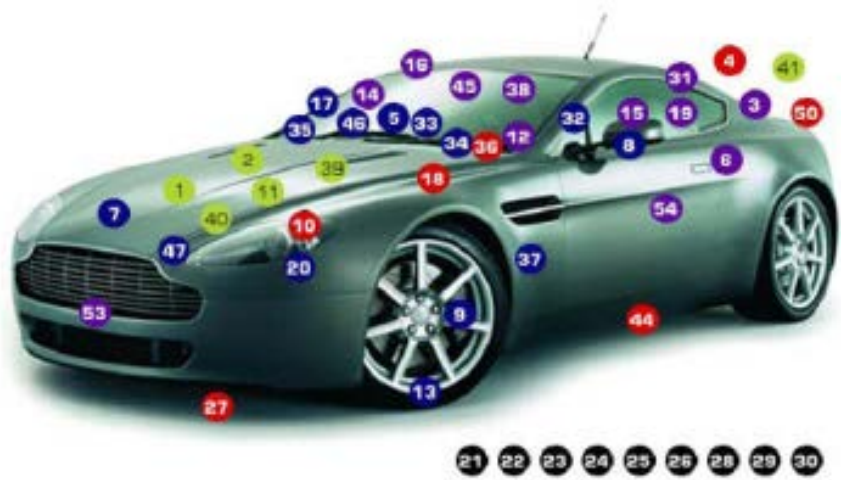
- EMC Directive for ITE, Telecom, lighting, etc.
- R&TTE Directive for modem, cell phone, wireless devices
- Machinery Directive for robot arm in factory, etc.
- Measuring instrument Directive for oscilloscope, etc.
- Medical Device Directive
- Toy directive.

What is E/e-Mark

- To show compliance to Automotive Directive and Regulations in Europe and most of International community.
- For whole vehicles and every components intended to be part of vehicle



Components intended to be part of vehicle



- Sound level 2007/34/EC
- Emissions 2003/76/EC
- Fuel consumption 2004/3/EC
- Engine power 1999/99
- Steering Equipment 1999/7
- Audible Warning 70/388/EC
- Wash/Wipe 94/68/EC
- Antitheft 95/56/EC
- Speedometer 97/39/EC
- Tires 2005/11/EC
- Braking 2002/78/EC
- Headlamps (including bulbs) 1999/17/EC
- Reversing lamps 97/32/EC
- Parking lamps 1999/16/EC
- Side, rear and stop lamps 1999/15/EC
- Towing Hooks 96/64/EC
- Heating systems 2004/78/EC
- Radio Interference (EMC) of vehicle 2009/19
- • Etc.

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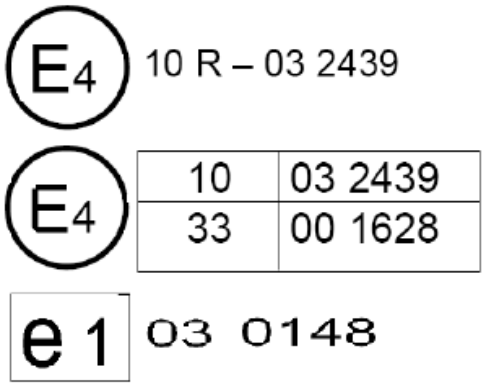
EMC compliance for Vehicle and Components

- For European Union members:
  - Directive 72/245/EEC with amendment 2004/104/EC and 2009/19/EC by EU
- For International and European:
  - ECE Regulation No. 10 Rev. 3 (ECER10.03) by United Nation (UN)
- Unites States
  - SAE and AEMCLARP



Two Types of E mark

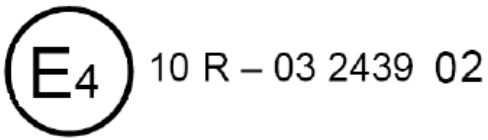
- e mark (lower case e) is recognized in European community only per Directive 72/245/EEC with amendment 2004/104/EC and 2009/19/EC by EU.
- E mark (upper case E) is recognized worldwide including in European community per ECE Regulation by UN.

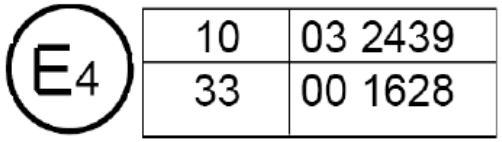
Two type of E mark (Cont'd)

- If E mark (upper case E) is accepted worldwide, why do we need e mark (lower case e)?
- Manufacturer specific e.g. BMW only accepts e mark (lower case e)
- Product can have both E mark and e mark
- We recommend E mark for our customers

E mark (upper case E)

- Uses ECE Regulation by United Nation (UN)
- 4 = country granting the approval (e.g. 4 is Netherlands)
- 10R = number of regulation (e.g. Regulation No. 10 for EMC)
- - 03 = revision of Regulation (e.g. Regulation No. 10 Rev. 3)
- 2439 = Approval number for the product under each regulation
- (i.e. there can be more than one approval number for product)
- 02 = change/amendment to the approval





List of Country Codes

- E1 Germany
  E2 France
  E3 Italy
  E4 Netherlands
  E5 Sweden
  E6 Belgium
  E7 Hungary
  E8 Czech Republic
  E9 Spain
  E10 Yugoslavia
  E11 United Kingdom
  E12 Austria
  E13 Luxembourg
  E14 Switzerland
  E16 Norway
  E17 Finland
  E18 Denmark
  E19 Romania
  E20 Poland
  E21 Portugal
  E22 Russian Federation
  E23 Greece
  E24 Ireland
  E25 Croatia
  E26 Slovenia
  E27 Slovakia
  E28 Belarus
  E29 Estonia
  E31 Bosnia and Herzegovina
  E32 Latvia
  E34 Bulgaria
  E37 Turkey
  E40 The former Yugoslav Republic of Macedonia
  E42 European Community
  E43 Japan
  E45 Australia
  E46 Ukraine
  E47 South Africa

e Mark (lower case e)

- Uses CE directives by European Union (EU)
- 1 = country granting the approval (e.g. 1 is Germany)
- 03 = 2004/104/EC amendment of automotive
- directive 72/245/EEC
- 0148 = Approval number for the product under each
- regulation (i.e. there can be more than one approval
- number for product)
- 01 = change/amendment to the approval

e 1 03 0148 01

List of Country Codes

- e1 Germany
  e2 France
  e3 Italy
  e4 Netherlands
  e5 Sweden
  e6 Belgium
  e7 Hungary
  e8 Czech republic
  e9 Spain
  e11 United Kingdom
  e12 Austria
  e13 Luxembourg
  e17 Finland
  e18 Denmark
  e19 Romania
  e20 Poland
  e21 Portugal
  e23 Greece
  e24 Ireland
  e26 Slovenia
  e27 Slovakia
  e29 Estonia
  e32 Latvia
  e34 Bulgaria
  e36 Lithuania
  e49 Cyprus
  e50 Malta

Type Approval Procedures

- **Electrical/electronic sub-assembly (ESA) type approval**
- - test ESA individually
- - affix E mark and/or e mark on ESA
- - ESA is then allowed to be installed in every vehicle
- - whole vehicle is deemed to conform to regulations
- **Vehicle type approval**
- - all ESAs must be installed in vehicle
- - test entire vehicle - every vehicle manufactured needs to be tested and affix E mark and/or e mark

ESA Type Approval

- ESA = Electrical/electronic sub-assembly Electrical and/or electronic device or system e.g. Rearview display system: Camera + Display +Wiring harness
- Intended to be part of a vehicle including associated electrical connections and wiring
- Mechanically fastened to the vehicle which cannot be disassembled or removed without use of tools
- Not use restricted by technical means to immobilize vehicle (e.g. parking brake)
- Not Passive components (e.g. spark plugs, cables, passive antenna)

Two Types of ESA

- Related to Immunity related functions - Safety related functions
- Not related to Immunity related functions

Five Immunity related functions

1. Functions related to direct control of the vehicle
   a) change in: e.g. engine, gear, brake, suspension, active steering, speed limitation devices
   b) affecting drivers position: e.g. seat or steering wheel positioning
   c) change in driver's visibility: e.g. dipped beam, windshield wiper
2. Functions related to driver, passenger and other road user protection: e.g. airbag, seatbelt

Five Immunity related functions (Cont'd)

- 3. Functions which when disturbed cause confusion to the driver or other road users
  - Incorrect operation of e.g. stop lights, left-turn/ right-turn signal lights, indicators related to paragraph 1 (e.g. engine) and paragraph 2 (e.g. airbag) which might be observed in direct view of the driver
  - Incorrect operation of e.g. anti-theft alarm, horn
- 4. Function related to vehicle data bus functionality
- 5. Functions which when disturbed affect vehicle statutory data: e.g. speedometer, odometer

Test requirements for ESA related to Immunity related functions

- 1 Radiated Emissions Broadband (30MHz – 1GHz) per CISPR 25: 2002
- 2 Radiated Emissions Narrowband (30MHz – 1GHz) per CISPR 25: 2002
- 3 Transient Emissions per ISO 7637-2: 2004 (N/A if ESAs that are not switched, contain no switches or contain no inductive loads)
- 4 Transient Immunity per ISO 7637-2: 2004
- 5 Conducted Immunity using BCI (20 – 200MHz) per ISO 11452-4: 2005
- 6 Radiated Immunity in ALSE (200MHz – 2GHz) per ISO 11452-2: 2004

Test requirements for ESA not related to Immunity related functions

- Radiated Emissions Broadband (30MHz – 1GHz) per CISPR 25: 2002
- Radiated Emissions Narrowband (30MHz – 1GHz) per CISPR 25: 2002
- Transient Emissions per ISO 7637-2: 2004 (N/A if ESAs that are not switched, contain no switches or contain no inductive loads)
- Transient Immunity per ISO 7637-2: 2004

Aftermarket ESA

- If ESA is related to immunity related functions, need E mark and/or e mark approval
- If ESA is not related to immunity related functions,

1. Do not need E mark and/or e mark approval
2. Perform testing per test requirement for ESA not related to immunity related functions
3. Issue DOC per EMC directive
4. Affix CE mark on the product
5. Then ESA is allowed to be installed or used in vehicle

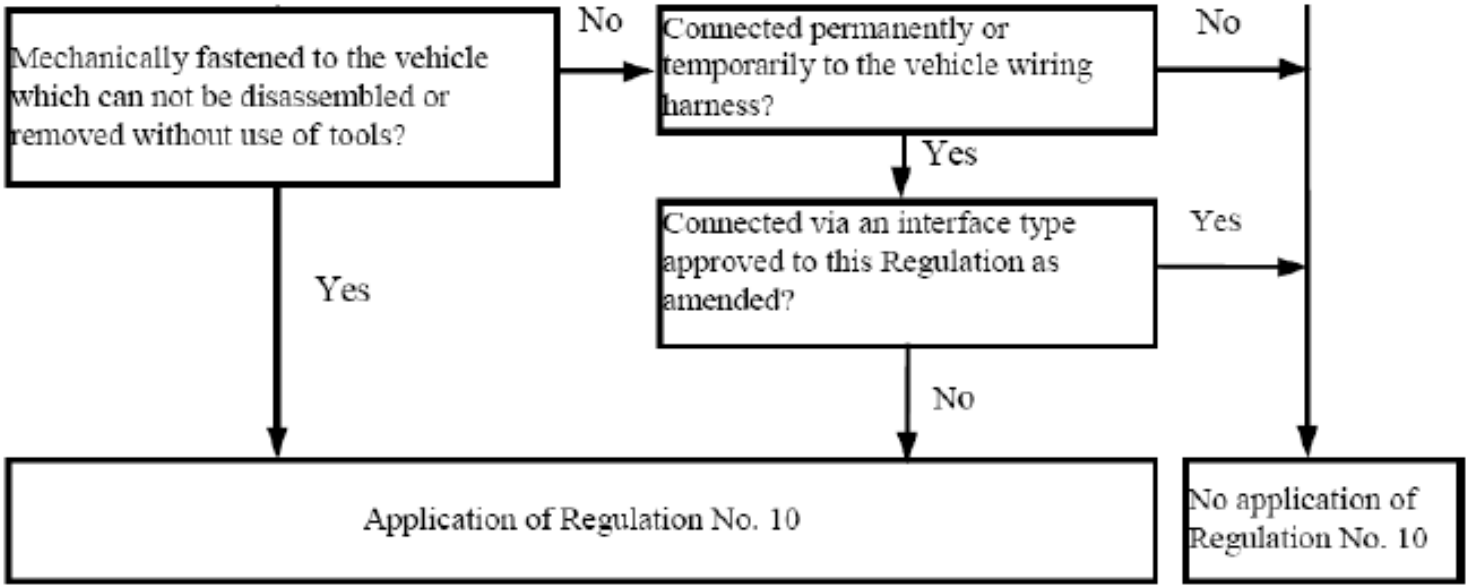
CE mark or E/e mark for aftermarket ESA

- Car radio, CE mark
- Car amplifier, CE mark
- Car alarm, E mark/e mark
- Radar detector, CE mark
- LCD display for car, CE mark
- Car charger, E mark/e mark???

Car Charger

- Car Charger is not related to immunity related function so no E/e mark approval
- However, if a device (e.g. cell phone) is connected to the car charger which has no E/e mark approval, the device needs to have E/e mark approval

Car Charger



- *But cell phone manufacturers will unlikely obtain E/e mark approval*
- *Therefore, car charger manufacturers are forced to obtain E/e mark approval*

Test requirement for whole vehicle

- Radiated Emissions Broadband
- (30MHz – 1GHz) per CISPR 25: 2002
- 2 Radiated Emissions Narrowband
- (30MHz – 1GHz) per CISPR 25: 2002
- 3 Radiated Immunity in ALSE (20MHz –
- 2GHz) per Annex 6 of ECER10.03

Exemptions

- Vehicle or ESA does not include oscillator > 9kHz, No test is required
- Vehicle which does not have ESA with “immunity related functions”, need not be tested for radiated immunity
- No ESD test
- Note: For vehicles with tires, vehicle body/chassis is considered to be an electrically isolated structure
- Loss of function of receivers during immunity test when test signal is within receiver band, is not considered failure
- RF transmitters shall be tested in transmit mode. Emissions of fundamental frequency and out-of-band emissions resulting from modulation process are disregarded during radiated emissions

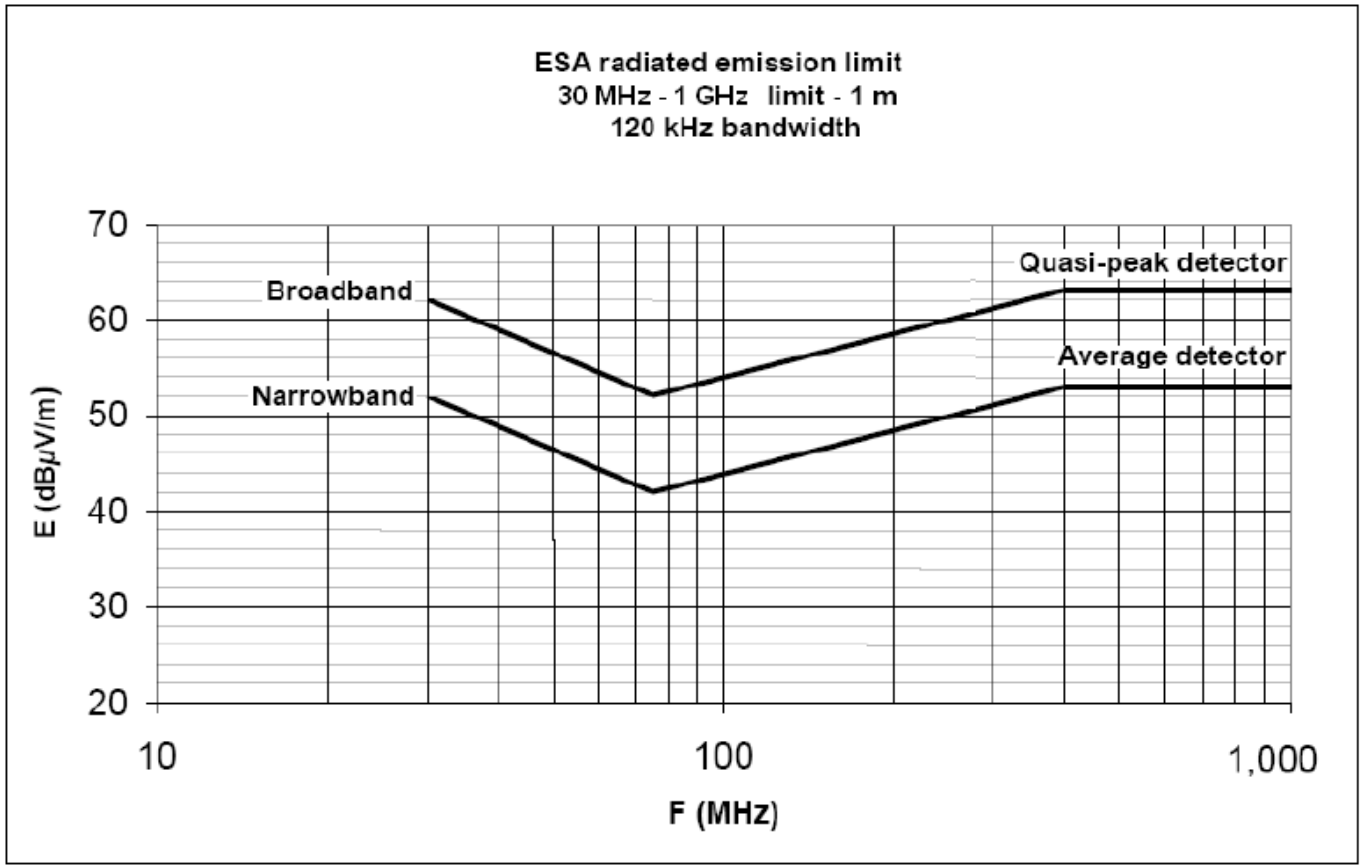
Test Requirement for ESA

1. Radiated Emissions Broadband (30MHz – 1GHz) per CISPR 25: 2002
2. Radiated Emissions Narrowband (30MHz – 1GHz) per CISPR 25: 2002
3. Transient Emissions per ISO 7637-2: 2004 (N/A if ESAs that are not switched, contain no switches or contain no inductive loads)
4. Transient Immunity per ISO 7637-2: 2004
5. Conducted Immunity using BCI (20 – 200MHz) per ISO 11452-4: 2005
6. Radiated Immunity in ALSE (200MHz – 2GHz) per ISO 11452-2: 2004

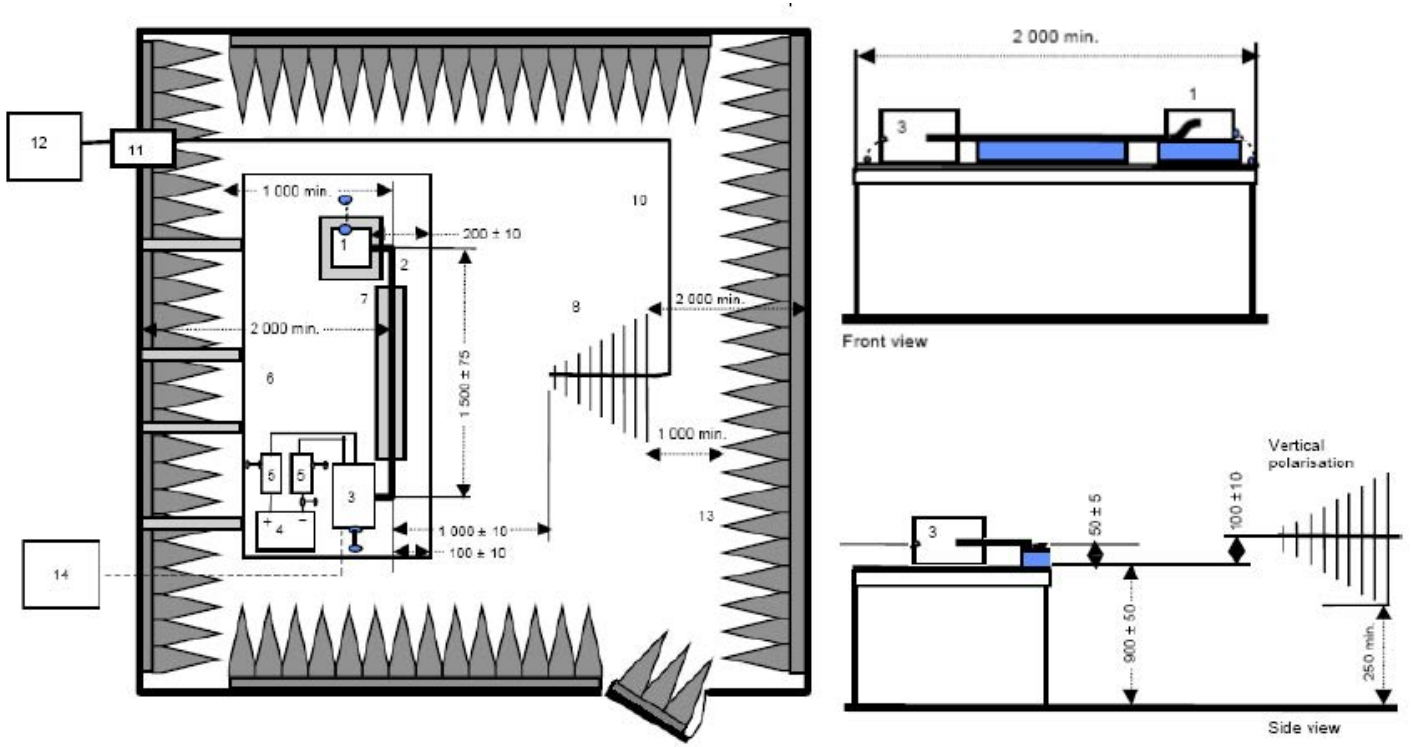
Radiated Emissions, Broadband and Narrowband for ESA

- Broadband emission: emissions which has a bandwidth greater than EMI receiver bandwidth
- Narrowband emission: emissions which has a bandwidth less than EMI receiver bandwidth
- frequency range: 30MHz – 1GHz, EMI receiver bandwidth = 120kHz
- Test setup per CISPR 25: 2002
- QP limit for broadband emissions, Average limit for narrowband emissions
- 1 meter measuring distance from the tip of the antenna

ESA Radiated Emissions limits



Radiated Emissions Test setup for ESA



Radiated Emissions Test setup for ESA

- Power supply voltage 13.5±0.5 Vdc for 12 Vdc components or 27.0±1.0 Vdc for 24 Vdc components
- Biconilog antenna is acceptable but need 1 meter antenna correction factor from the tip of the antenna
- Perform testing both Vertical and Horizontal polarity
- Ground plane 2 m (min) x 1 m (min) with 20 cm clearance around the EUT
- EUT shall be grounded if required by manufacturer installation
- Ground plane shall be bonded to shielded enclosure with ground straps at distance less than 30 cm apart
- Ground straps shall have 7:1 ratio dimension
- 5uH/50Ω LISN with 50Ω termination

Transient Emissions for ESA

- Test setup per ISO 7637-2: 2004
- Measure inrush current of the ESA
- Using Oscilloscope (with BW ≥ 400MHz) and electronic switch/ automotive relay
- Test setup is similar to Radiated Emissions

ESA Transient Emissions test setup

- Test two positions of electronic switch, Rs= 40 Ω
- For slow pulse, switch located 6 cm from the LISN
- For Fast pulse, switch located 10 cm from the LISN
- Note: Negative lead is grounded at the LISN on battery

Two types of Transient Emissions

1. Slow pulses (millisecond range or slower) – switch located between battery and LISN
2. Fast pulses (nanosecond range – microsecond range) – switch located between LISN and EUT
   - Note: there is no pass/fail limit for the pulse duration of the transient emission pulses

ESA Transient Emissions test method

- Per ISO 7637-2: 2004
- Perform test with switch open, close and remain close with EUT in normal operation and capture ten waveforms per each switch position
- Report the highest positive and negative amplitude per switch location
- Each mode of the operation of the EUT needs to be tested

Conducted Immunity for ESA

- Test setup per ISO 11452-4: 2005
- Frequency range: 20 – 200MHz
- using BCI probe
- 80% AM modulation with 1kHz sine wave
- Test level = 60 mArms (in 50Ω system)
- Dwell time = 2 second
- Step size = 5%
- EUT performance Criteria A

Radiated Immunity for ESA

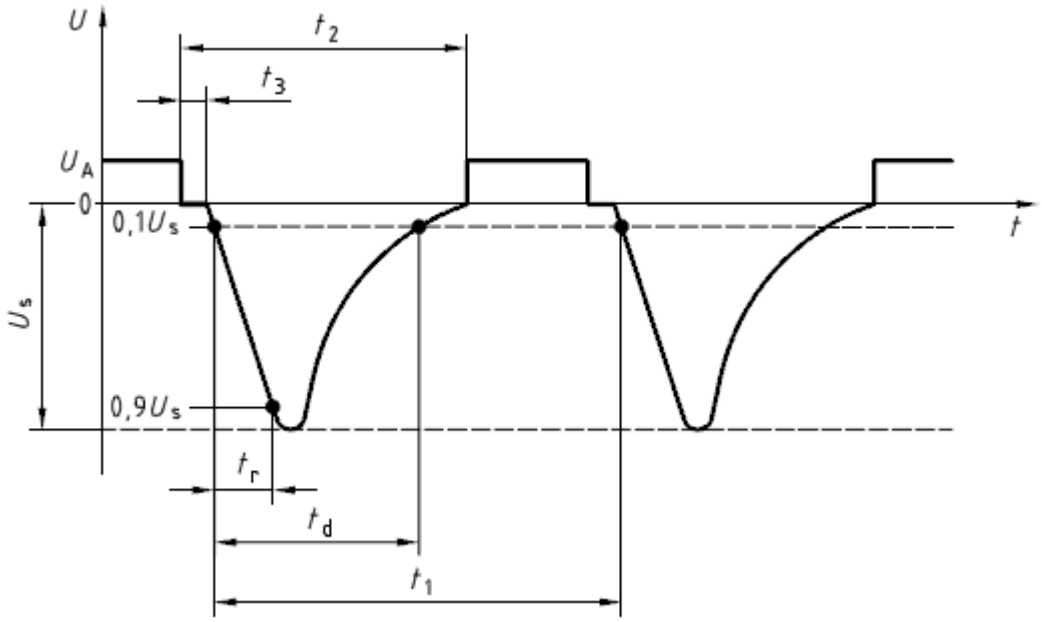
- Test setup per ISO 11452-2: 2004
- Frequency range: 200MHz – 2GHz
- Using log periodic antenna and horn antenna
- Perform test in vertical polarity only per ECE10.03 Annex 9
- Frequency range 200MHz – 800MHz, shall be 80% AM modulation with 1kHz sine wave, Frequency range 800MHz – 2GHz, shall be pulse modulation with on time 577 µs and period 4.6 ms
- Test level = 30 V/m, Dwell time = 2 second
- EUT Performance Criteria A

Transient Immunity for ESA

- For DC power port only (12 Vdc and/or 24 Vdc)
- Six transient pulses per ISO 7637-2: 2004
  - Pulse 1
  - Pulse 2a
  - Pulse 2b
  - Pulse 3a
  - Pulse 3b
  - Pulse 4

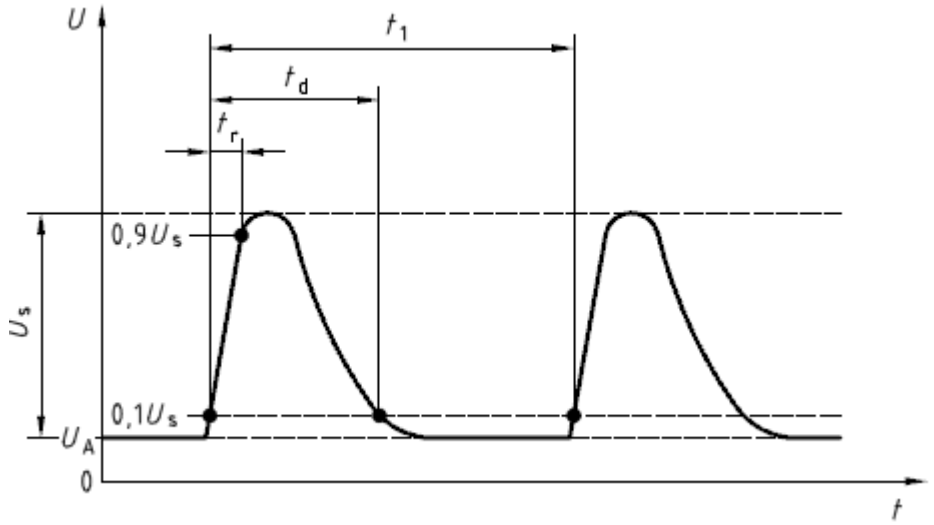
Pulse 1

- Transient due to supply disconnection from inductive loads



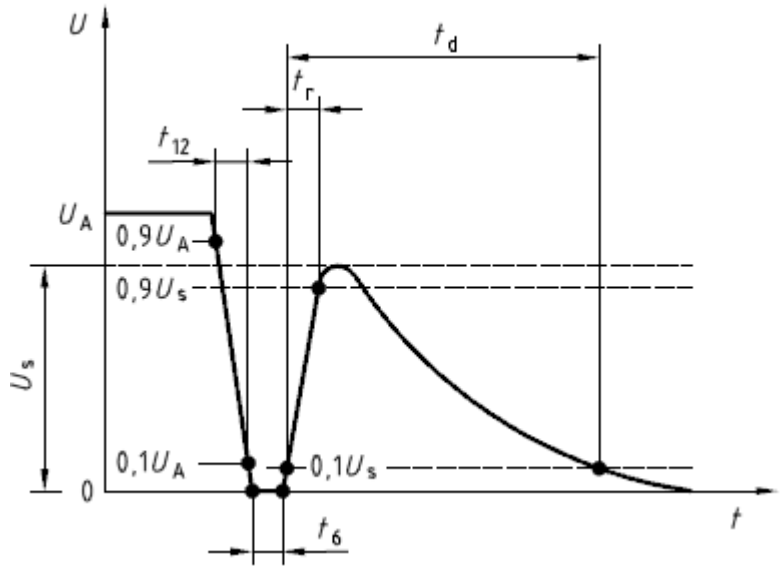
Pulse 2a

- Transient due to sudden interruption of currents in a device connected in parallel with EUT due to the inductance of the wiring harness



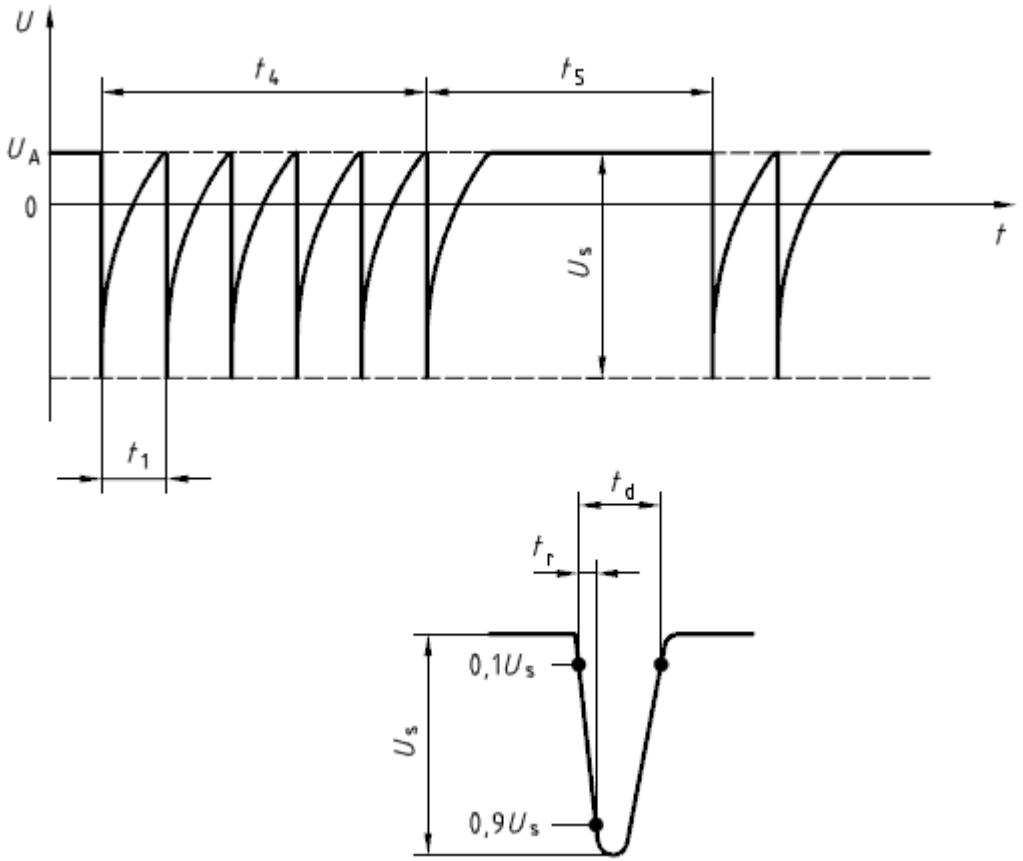
Pulse 2b

- Transient due to sudden interruption of currents in a device connected in parallel with EUT due to the inductance of the wiring harness



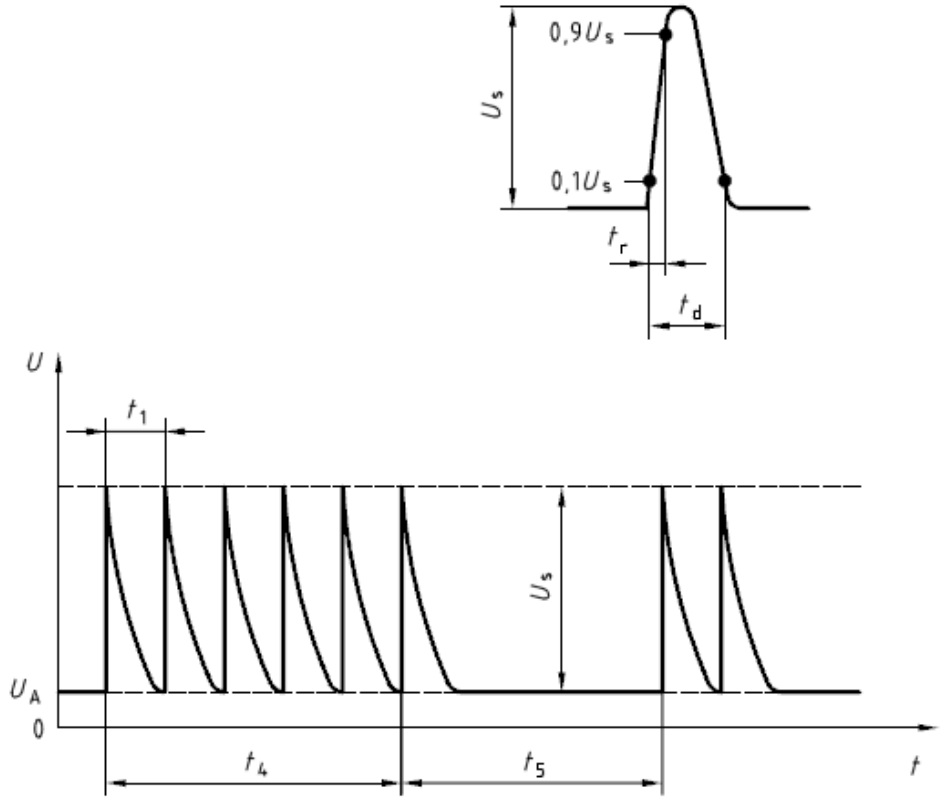
Pulse 3a

- Transient which occur as a result of the switching process



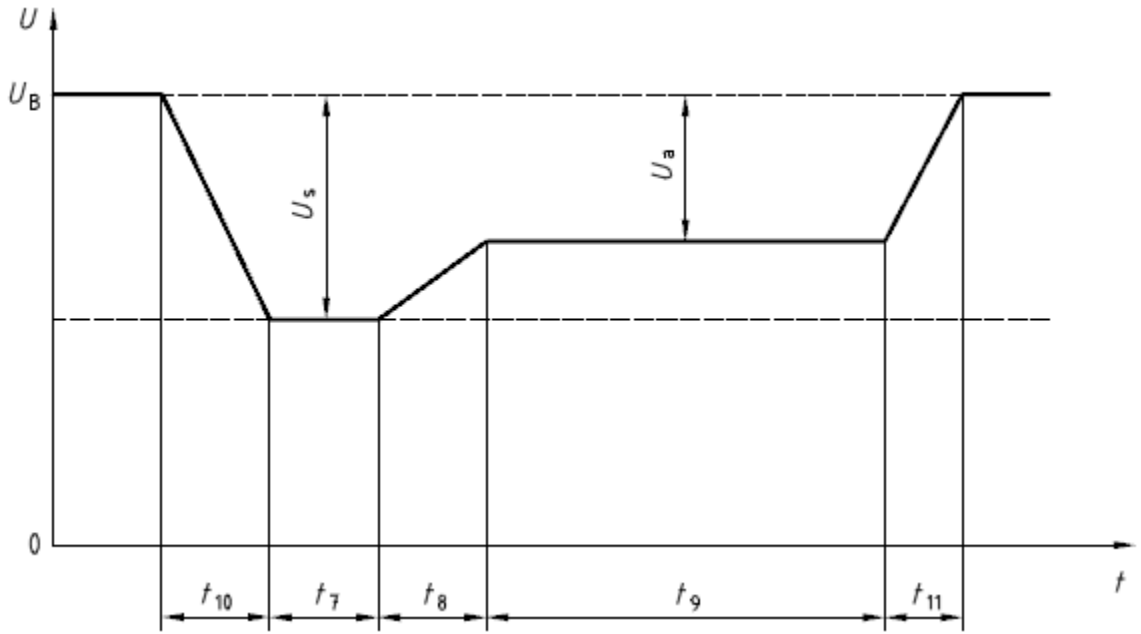
Pulse 3b

- Transient which occur as a result of the switching process



Pulse 4

- Supply voltage reduction caused by energizing the starter-motor circuits of internal combustion engine



Pass/Fail Criteria

- Per ECE Regulation No. 10 rev. 3

Test pulse number	Immunity test level	Functional status for systems:	
		Related to immunity related functions	Not related to immunity related functions
1	III	C	D
2a	III	B	D
2b	III	C	D
3a/3b	III	A	D
4	III	B (for ESA which must be operational during engine start phases) C (for other ESA)	D

EUT performance criteria

- Per ISO 7637-2: 2004
- Criteria A: function as designed during and after exposure to disturbance
- Criteria B: function as designed during exposure.
- However, one or more of functions can go beyond
- specified tolerance. All functions return to normal
- automatically after exposure is removed. Memory
- functions shall remain criteria A
- Criteria C: one or more of functions do not perform as designed during exposure but automatically return to normal after exposure is removed
- Criteria D: one or more of functions do not perform as designed during exposure and do not return to normal after exposure is removed

- for 12 V system, Per ISO 7637-2: 2004

Transient Immunity test level

Test pulse[a]	Selected test level[b]	Test level, U_S[c] V				Min. number of pulses or test time[f]	Burst cycle/pulse repetition time	
		I	II	III min.	IV max.		min.	max.
1		g	g	– 75	– 100	5 000 pulses	0,5 s	5 s
2a		g	g	+ 37	+ 50	5 000 pulses	0,2 s	5 s
2b		g	g	+ 10	+ 10	10 pulses	0,5 s	5 s
3a		g	g	– 112	– 150	1 h	90 ms	100 ms
3b		g	g	+ 75	+ 100	1 h	90 ms	100 ms
4		g	g	– 6	– 7	1 pulse	d	d
5 [e]		g	g	+ 65	+ 87	1 pulse	d	d

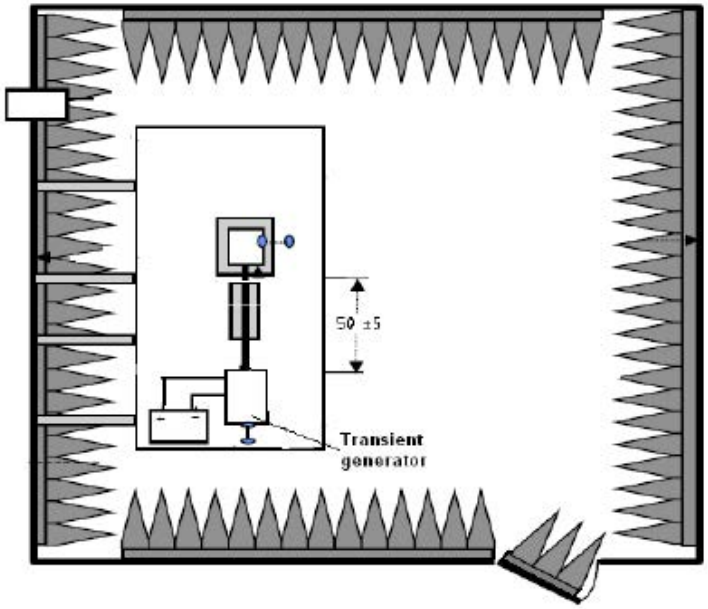
- for 24 V system Per ISO 7637-2: 2004

Transient Immunity Test level

Test pulse[a]	Selected test level[b]	Test level, U_s[c] V				Min. number of pulses or test time[f]	Burst cycle/pulse repetition time	
		I	II	III min.	IV max.		min.	max.
1		g	g	– 450	– 600	5 000 pulses	0,5 s	5 s
2a		g	g	+ 37	+ 50	5 000 pulses	0,2 s	5 s
2b		g	g	+ 20	+ 20	10 pulses	0,5 s	5 s
3a		g	g	– 150	– 200	1 h	90 ms	100 ms
3b		g	g	+ 150	+ 200	1 h	90 ms	100 ms
4		g	g	– 12	– 16	1 pulse	d	d
5[e]		g	g	+ 123	+ 173	1 pulse	d	d

Transient Immunity test setup

- Power Supply wiring harness for pulse 3a and 3b
- shall be laid out in a straight parallel line insulated 5
- cm±5 mm above the ground plane
- No specific requirement for other pulse



References

- Directive 72/245/EEC with amendment
- 2004/104/EC and 2009/19/EC by European Union (EU)
- ECE Regulation No. 10 Rev. 3 (ECER10.03) by United Nation (UN)
- CISPR 25: 2002
- ISO 7637-2: 2004
- ISO 11452-1: 2005
- ISO 11452-4: 2005
- ISO 11452-2: 2004

Thank you

Are there any Questions?

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OSHA NRTL Nationally Recognized Testing Laboratory

A2LA-Accredited to ISO/IEC 17025:2005
(Baltimore: #0591-01, Union City: #0591-02)

FCC TCB Telecommunications Certification Body

SCC CB Standards Council of Canada Certification Body

IECEE NCB National Certification Body

NVLAP-Accredited NIST CAB Conformity Assessment Body

Verizon ITL Independent Testing Laboratory

DSCC-Accredited for Designated MIL-STD Testing

EPCglobal Inc,ɪ Official Test Lab for RFID Hardware Certification Program

DASH7, Official Test Lab for RFID certification program

VCCI - Voluntary Council for Control of Interference (Japan)

ISTA Transit Tested Program Member - International Safe Transit Association

ACIL Member - American Council of Independent Laboratories

Measurement Canada Recognized Test Facility for electricity meters

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