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PURPOSE

This document contains the General Specifications for automotive electric and electronic devices (E/E), whether components or systems. It classifies the E/E devices and defines, as a function of said classification, related requirements in order to ensure:





- Correct device operation within the whole range of conditions met during operation.
- Great success of integration on vehicle.
- Vehicle compliance with legislation and standard requirements.

Moreover, this Specification defines the general requirements to be met by E/E devices after integration on vehicle.

NOTE: Procedure 07898 (PRO code) describes process to be carried out to implement system/component Procurement Specification.

Change	Date	Description
-	01/27/03	Issue 10 - Editorial changes. Supervisor and Manager changed. Updated paras.: 1.3, 1.6, 2.2, 2.4.7, 2.7.2, 2.7.3 and added paras.: 1.9, 2.6.3, 2.8.5, 2.8.6, 2.10.7. (SS)
A	02/03/03	- Corrected Fiat 1 pulse duration and changed Fiat 4 pulse duration as well as Fiat 1 and Fiat 2 application point. (SS)
-	07/15/03	Issue 11 - Changed drop test, thermal tests and chemical/physical tests. (SS)
-	02/01/06	Issue 12 - Changed for compliance with legislation requirements on electromagnetic compatibility. - At para 2.7.9 adjusted OL-OM (LW-MW) limits to CISPR25 class 4. - Revised table at para 7. - Changed reference standard at para 10.3 - Changed paras 1.2, 2.6.4 and 2.7.1. - Added para 2.1.4. - Changed test 1 para 2.8.5 (SS) - Cancelled para 2.13.6 - Changed Bulk Current curves at para 2.7.7
-	03/23/07	Issue 13 - Fully revised. (SS)

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1

GENERAL REQUIREMENTS

1.1

Document hierarchy

Nothing in this specification supersedes in force laws and/or regulations applicable in countries where vehicle is marketed.

This specification requirements are additional to legislation and standards applicable in countries where vehicle is marketed.

All references to documents, specifications, standards are intended as related to official Fiat Group Automobiles documents. Where required, reference is made to explicitly mentioned international standards.

For the purposes on this specification, no reference can be made to another documentation/standard regulations different from mentioned herein.

No document can amend and/or supersede requirements set forth in this Specification, except for:

- A. A device design requirement
- B. A specific device P.S. requirement
- C. A device targeted specification requirement
- D. A device design exemption
- E. A device targeted specification exemption, only if called out in related drawing.

Value of exemptions is limited to specific model outfit. In case of device carry over, exempted features shall be re-examined.

In case of inconsistency between the Italian version and the version in another language, the Italian version shall prevail.

1.2

General contractual requirements

The general contractual directives are contained in P.S. 9.01100 and 9.01100/01.

1.3

Product development requirements

1.3.1

Development and maintenance process

In order to ensure adequate project quality, device shall be developed and maintained as per directives of Standard ISO/TS 16949, even if Supplier is not certified as per this Standard. Within the framework of this device development and maintenance, Supplier shall pay special care to completeness, coherence, up-grade level, documentation consistency in order to promptly report any failure or problems found.

1.3.2

Design constrains

Hardware electric/electronic circuits shall comply with Std. 09035 guidelines.

Device software shall comply with Std. 09004.

1.3.3**Design quality**

This Specification requires that design is implemented so that each device component is sized to satisfy extreme use conditions.

Positive result of all tests required by this Specification shall be project ensured by means of calculation or, if they are not possible, by means of common best practices.

1.3.4**Document transparency**

Supplier shall ensure to Fiat Group Automobiles, or to an agreed third party:

- Examination of device development and maintenance documentation, including internal design review documentation.
- Examination of device criticalities and risks analysis documentation.

Unless otherwise specified, the maximum term to comply with Fiat Group Automobiles requirements for the examination of said documentation is 25 solar days, that become 10 solar days in case of severe operating product problems and 5 solar days in case of development time delay. Any refusal or obstacle to provide documentation above represents a severe contractual infringement.

Device and related development shall be documented as per P.S.9.01102/09 Electronic control systems – Technical Supplier Documentation.

1.3.5**Design reviews**

During device development and changes, Fiat Group Automobiles and Supplier shall constantly monitor the good outcome of activities as per standard requirements:

- A. 09006 Project design review
- B. 09006/01 Project design review - Design review Software
- C. 09006/02 Project design review - Design review Hardware
- D. 09006/03 Project design review - Design review System Engineering & Diagnosis(*)
- E. 09006/04 Project design review – Network & Diagnostic Protocol Design Review

(*) Under preparation at this specification issue date.

2**CLASSIFICATION CRITERIA**

Based on its type, impact of its function on vehicle, behavior of each function during tests and its work environment, each device is classified as described at following paras.

Classification codes must be clearly and unquestionably shown on device drawing. In case of no indication on drawing, classifications shown on Targeted Specification or related Specification shall be applicable.

2.1

Device type

As a function of its hardware components, device shall be classified as follows:

TYPE	DEFINITION
E1	Device without electronic components (e.g. incandescent lamp, etc.)
E2	Device with passive electronic components with no control function (e.g., LEDs, varistors, resistor filters, capacitors, inductances)
E3	Device with control/monitoring functions (e.g.: electronic modules, active sensors, display systems and, more generally, devices equipped with microcontrollers, integrated circuits, transistors, etc.)

2.2

Function classification

For the purposes of this Specification, each individual function performed by device shall be classified as per table below:

FUNCTIONAL CLASS (Standard 00160)	TEST GROUP	DEFINITION
CF1	FG0	Functions whose decay might: <ul style="list-style-type: none">• Bring about an impediment or severe trouble to vehicle control• Affect safety of passengers and/or of other road users (e.g.. ABS, Airbag, power steering, etc.)
	FG1	<ul style="list-style-type: none">• CF1 functional class functions not included in class FG0• Functions that might cause vehicle stop, in case of malfunction (e.g. Immobilizer, etc.)• Functions impacting on homologation/legislative requirements applicable in country where vehicle is marketed (e.g.: external lighting devices, windscreen wiper, odometer, tachometer, beam aim adjustment, CAN networks, functions as per Directive 2004/104/EC, functions as per ONU R10 regulation, etc.)
CF2	FG2	Functions not included in functional class CF1

2.3**Installation classification**

Relevant installation sites because of thermal/chemical aspects).

Device shall be fitted as per directives shown on specific drawing; in case of no design directives, device shall be installed, oriented and protected as on vehicle.

Classes featuring device installation are:

CLASS	DEFINITION
CI1 or CI1/CC	Installation in engine compartment.
CI2 or CI2/CC	Installation on powerplant/transmission unit.
CI3 or CI3/CC	Installation in passenger compartment or trunk.
CI4 or CI4/CC	Installation on vehicle exterior.
CI5 or CI5/CC	Installation in the door compartment.

Device classified as belonging to one of CI/CC classes, must be designed and built so as to allow conformal coating or resin painting with no need of further variants.

The need to perform conformal coating or resin painting shall be declared in specific device P.S. or drawing.

2.4**Environmental temperature class**

Thermal stresses shall be classified as mentioned below.

CLASS	MAX CONTINUOUS OPERATION TEMP.	MAX NON-OPERATING TEMPERATURE	ENVIRONMENT
T1	65°C	85°C	Protected from heat sources
T2	80°C	100°C	Exposed to moderate heat sources
T3	100°C	120°C	Exposed to intense heat sources
T4	120°C	140°C	Exposed to very intense heat sources
SPECIAL APPLICATIONS			
T5/1	130°C	140°C	Cooling circuit
T5/2	150°C	160°C	Engine oil/cyl. head circuit
T5/3	850°C	850°C	Exhaust pipes
T5/4	1100°C	1100°C	Exhaust pipe/catalytic converter
CLASS	MIN. CONTINUOUS OPERATION TEMP.	MIN. NON-OPERATING TEMPERATURE	ENVIRONMENT
TM1	-30°C	-40°C	Temperate and cold
TM2	-40°C	-50°C	Arctic or extremely cold

CLASS	MAX THERMAL GRADIENT DURING OPERATION
VT1	2 °C/min
VT2	5 °C/min
VT3	10 °C/min
VT4	20 °C/min
SPECIAL APPLICATIONS	
VT5	100 °C/min

Considering the different device installation possibilities on vehicle, other temperatures can be defined in specific device P.S. and/or on drawing.

Moreover, specific device P.S. might define acceptable parametric tolerances within a given temperature range.

Finally, drawing shall show points of temperature measurement on device as well as admissible max. temperature value when working at upper margin of defined ambient temperature range, in a 1 m/s ventilated room.

2.5

Vibration classification

(Installation sites that are important for vibrations).

During normal operation, the system/component undergoes stresses that depend on the point where it is installed on the vehicle; thus, the following classes are identified:

CLASS	DEFINITION
V1	Devices installed on engine/transmission unit
V2	Device installed on chassis/body
V3	Device installed on body moving parts
V4	Device installed on wheel knuckle

2.6

Classification of supply and test voltage

Device shall keep behavior required by table below in all conditions defined by its classes (environmental, electric, etc.).

Supply voltage shall be measured at device under test terminals.

SUPPLY VOLTAGE CLASS	Supply voltage range (V)							Test voltage (V)	
	-13 < 0	0 < 4.5	4.5 < 6	6 < 9	9 < 10	10 < 12	12 < 16	Vmin.	Vmax.
A1	M3	M3	M3	M3	M2	M1	M1	10	16
A2	M3	M3	M3	M1	M1	M1	M1	6	16
A3	M3	M3	M2	M1	M1	M1	M1	4.5	16

M1, M2 and M3 operating classes are defined in para. 3.4.

Devices belonging to engine cranking chain (e.g. starter, etc.) shall be A3 classified.

2.7**Transient interference classification**

Transistors are inserted in all electric connections for electromagnetic coupling, whose nature depends on cable route.

Considering this, devices shall be grouped in Classes below:

CLASS	DEFINITION
SI1	Devices having connecting wires, power supply excluded, which are subject to coupling with engine ignition system wires
SI2	Devices having connecting wires, power supply excluded, which are not subject to coupling with engine ignition system wires

2.8**Electrostatic discharge classification**

During vehicle installation, use and maintenance phases, device can be subject to variable intensity electrostatic discharges depending on conditions at which device is exposed.

These discharges are classified in table below.

CLASS	DEFINITION
SE1	Device or part of device subject to discharges applied by a user inside vehicle (in passenger compartment) (e.g. automatic air conditioning push-buttons, etc.). (1)
SE2	Device or part of a device subject to discharges applied by a user outside vehicle (devices outside vehicle such as aerial, engine ECU, etc.) (1)

(1) Discharge might take place during vehicle installation, use and maintenance.

A device might require more than one electrostatic discharge classification. All devices requiring immunity to electrostatic discharge tests (para [3.9.1](#)) shall be class SE3 tested.

2.9**Quiescent current classification**

Depending on its class, device shall meet consumption at rest requirements.

Code	Voltage	I@T _{max}	I@T _{amb}	Power-off delay
CC1	12.6±0.1V	5 mA	3 mA	1 min. (*)
CC2	12.6±0.1V	1 mA	0.7 mA	1 min. (*)
CC3	12.6±0.1V	0.7 mA	0.5 mA	1 min. (*)
CC4	12.6±0.1V	0.5 mA	0.3 mA	1 min. (*)
CC5	12.6±0.1V	0.3 mA	0.1 mA	1 min. (*)

(*) : unless otherwise defined in specific device P.S.

Test conditions below shall be met:

T_{\max} temperature shall be $60 \pm 5^{\circ}\text{C}$. Device to be kept in oven at this temperature for 1 hour, connected to its complete wiring.

T_{amb} is specified in the Test environment, para. [3.3.1](#).

Quiescent current consumption measurements at T_{amb} and T_{\max} shall be done on same sample.

2.10

Additional type approval classification

Some devices might need additional type approval as required by requirements of legislation or voluntary, insurance etc. applicable standards, or because it is either not convenient or impossible to type approve them with vehicle. For this reason, all devices shall be classified as below.

The additional type approval can be required also if vehicle is type approved with concerned device on board.

CLASS	DEFINITION
RG-0	Devices type approved as first vehicle equipment and with no additional type approval requirements as to vehicle requirements.
RG-1	Devices, both first equipment and additional or component line, requiring one or various type approvals (e.g. remote control transmitter and receiver, immobilizer, etc.)

See Standard 01931 for the list of devices for which Ministerial type approval is always required.

3

PRODUCT QUALIFICATION REQUIREMENTS

Submit device to tests and checks specified at paras below, specifying that test result meets target limits.

Qualification to be carried out as per Procedures 07740 and 07741.

Test reports to be identified univocally and, when required, they must be drawn up on standard Fiat Group Automobiles form.

Supplies shall hand in samples and qualification documentation for period defined as per P.S. 9.01100.

3.1

Joint analysis of test samples

Supplier shall provide detailed test plan and keep it always updated. A complete and updated list of laboratories where Supplier carries out each test shall be attached to planning. Fiat Group Automobiles reserves the possibility to attend one or various tests and jointly carry out analysis on samples under test.

3.2

Test results discrepancies

In case of discrepancies or claims concerning tests carried out by Supplier, questioned tests shall be repeated by a qualified laboratory as per Std. ISO 17025 chosen by Fiat Group Automobiles.

3.3**Test conditions**

Power supply devices to comply with Std. 7.Z0100.

Unless otherwise specified, power supply voltages are intended measured at device terminals.

3.3.1**Test environment**

Unless otherwise required, tests shall be carried out at conditions below:

Power supply voltage	13,5 ± 0.1 V
Environ. temperature	23 ± 5°C
Environ. relative humidity	45 to 70%
Environ. pressure	860 to 1060 mbar

3.3.2**Samples under test operating conditions**

Before tests during which device must operate, it shall be supplied for minimum 15 minutes as per design modalities, unless otherwise required by specific test.

3.3.3**Test equipment**

Tests to be carried out on part as supplied (with brackets, protections etc.) and, unless otherwise required, installed as on vehicle, with controls, sensors and loads actually present on vehicle, connected in same conditions as vehicle system.

In case control simulators, sensors and users must be used for specific needs, they shall be fully equivalent to actual replaced devices.

Equipment, test set-ups and methodologies used by Supplier for qualification shall be certified as required by Procedure 07740, para "Self-qualification requirements".

For each test, Supplier shall attach technical data of used equipment and instruments to the test plan and then to test reports.

3.3.4**Signal quality test**

During tests as per para [3.9](#), all device signals (inputs, outputs, power supply, etc.) shall be monitored to check that their parameters fall within design values with an appropriate margin, to ensure required operation.

3.3.5**Diagnostics check**

To be carried out for devices requiring diagnosis.

Before each test, check that diagnosis indicates no error, neither present nor in memory. In case of stored errors, clear error memory.

Unless otherwise required, diagnosis shall indicate no error at the end of each test.

3.3.6**Number of samples**

Unless otherwise required, each test must be carried out on a minimum number of 3 samples. A sample might be used for various tests, in agreement with para 6.2 and as per agreements between Fiat Group Automobiles and Supplier.

All samples under test shall be uniquely identified with indelible marking. Identification shall be shown on test reports.

3.3.7**Electric operating conditions**

The electric operating conditions define conditions of device during test.

CLASS	DEFINITION	OPERATING CONDITION
OC1-1	Device not connected.	Device not supplied
OC1-2	Device connected and installed on vehicle but not supplied.	
OC2-1	Key off, no function engaged (e.g. sleep, stand-by, etc.)	Device connected and installed as on vehicle in powered-up system and key off conditions.
OC2-2	Device operating with key off. One or various out-of-key functions are activated.	
OC3-1	Key on, device with no function activated	Device connected as on vehicle in powered system conditions and key ON, with engine running or not depending on condition required by vehicle.
OC3-2	Device in running condition. One or more functions are activated	

3.3.8**Operation and electric tests**

Operation and electric test requirements define which checks shall be carried out during device testing.

LEVEL	DEFINITION
FT0	No device function monitoring during test is required
FT1	Perform continuous device operation check, stimulating all inputs and outputs (if OC2-1 and/or OC3-1 operating conditions are required, perform passive monitoring without engaging functions). Monitor and record device behavior continuously, checking that specifications are met. Monitor and record temperature at any critical points continuously.
FT2	Perform continuous device operation check, stimulating all inputs and outputs. Monitor and record device behavior continuously, checking that specifications are met. Monitor and record temperature at any critical points continuously. Monitor and record all device parameters continuously (e.g. power supply voltage, current draw, voltage drops, response time, frequency values, duty cycle, etc.) making sure that they meet specification targets.

Inputs and outputs include both physical signals coming from vehicle system and signals related to vehicle communication network (messages, etc.).

All monitoring and measurement operations must take place automatically, with no need of manual assistance.

Acquired data shall be filed in open formats (e.g. ASCII, XML, etc.), equipped with legend and shall be subjected to same preservation constraints as samples.

3.3.9

Measurement uncertainty

Unless otherwise required by Test Standards, measurement shall have uncertainty equal to or lower than specified in table below.

Voltage, current, power	$\pm 1\%$
Resistance and impedance	$\pm 3\%$
RF power	$\pm 1\text{ dB}$
RF current	$\pm 1\text{ dB}$
Electromagnetic field	$\pm 1\text{ dB}$
Time, frequency	$\pm 1\%$
Temperature	$\pm 2^{\circ}\text{C}$
Length, distance	$\pm 1\%$
Mass, weight, acceleration	$\pm 1\%$

Measurement uncertainties shall be declared in test reports.

3.4

Behavior mode of each function performed by device

Device behavior during and after test shall be classified as per table below.

Requirement Specification shall detail behaviors M1, M2, M3, M4 for each function, as well as recovery conditions.

Class	Definition
M1	All device functions are performed as per requirement specification. No recovery function intervention admitted. During electric and electromagnetic tests (para 3.9), interference applied during test/measurement shall have no effect on device.
M2	The application of interference to device generates behaviors that fall within tolerances, as per requirement specification. When stopping interference, device returns to regular operation. Memory functions shall have type M1 operation (no corruption of volatile and non-volatile memories).
M3	The application of interference to device generates out-of-tolerance behaviors but in compliance with down-graded/recovery operation specifications. When stopping interference, device returns to regular operation (M1) within max 50 ms time.

Class	Definition
M4	<p>The application of interference to device generates out-of-tolerance behaviors but in compliance with down-graded/recovery operation specifications. When stopping interference, device does not return to regular operation.</p> <p>To return device to regular operation (M1), just an intuitive action of user on vehicle control is sufficient.</p>

Device shall never perform an undesired operation (not included in requirement specification) nor loose control, whether temporary or permanent (e.g. that can be reset with battery disconnection, etc).

3.5

Date management

For systems using a date, Supplier shall point out information management modality to ensure, by means of specific operation tests, that no problems nor troubles of any kind take place on occasions of potentially critical date change (e.g. 01/01/2000).

3.6

General requirements

3.6.1

Appearance

Check that device is free from surface defects such as oxidation, distortion or failure which could degrade efficiency and reliability.

3.6.2

Dimensions and tolerances

Device shall comply with related design indications.

3.6.3

Marking

Each device shall be clearly and indelibly marked in the area, if any, specified on drawing:

- Supplier alphanumerical code as per Design Standard 07610.
- Date of manufacture (as per Std. 0.00013).
- Rated operation voltage.
- Marking for material recycling as per standard 07416.
- Other markings as per drawing.

3.6.4

Materials

All materials contained in products must comply with Italian and international laws on safety, ecology and environment.

Supplier shall comply with requirements of P.S. 9.01102.

Materials shall comply with related drawing requirements; material selection, unless binding design requirements, is left to the initiative of Suppliers; however, device shall satisfy this P.S. test requirements and any other device specific P.S. test requirements. Materials not included in Fiat Group Automobiles standards shall in any case be previously approved by Fiat Group Automobiles.

Non-metallic materials shall be minimum "Fire self-extinguishing" when tested as per Std. 7-G2000.

Non-metallic materials of devices supplied by a permanent voltage (e.g. battery) shall be UL94 V-0 or superior flame resistance class.

3.6.5

Surface coatings

Device shall comply with related design indications.

3.6.6

Connections and fittings

Connections and fittings to be made as agreed and shown on drawing. Complete connection (male and female) shall be as per P.S. 9.91320/02.

For power connections, max. temperature values admitted during continuous operation shall also be shown in specific device P.S. if different from P.S.9.91320/02 requirements.

Values of contact cleaning currents (connectors, contactors, etc) and signal recognition thresholds shall be declared in device P.S. or Specification.

If above is lacking, table values as per para 5.2.6 of Std. 09035 shall be applicable, corrected as below:

- Signal source (switch, relay, etc.) shall ensure, throughout vehicle life defined by reliability specification and in any operating conditions, a contact strength within values defined by Requirement Specification when cleaning current, equal to 50% of value shown in table above, is pulsed with ON/OFF cycle with closed contact, that might be from 100% ON to 1% ON – 99% OFF.
- Device reading the signal shall provide a contact cleaning current equal to 120% of minimum required value shown in table above, in any operating and environmental conditions, throughout vehicle life specified in reliability specification.
- Device reading the signal shall acknowledge closed circuit level when related contact has a resistance up to 120% of value shown in table mentioned above.

Signal characteristics and their correct recognition shall be ensured throughout condition range defined by device classification and throughout vehicle life.

3.6.7

Connection requirements between platform modules

All devices whose reference ground is different from that of the respective sensors, actuators, inputs, outputs and those with two or more incoming grounds, shall be capable of withstanding unbalance of ± 1.0 V between grounds without malfunctioning (M1).

Moreover, all interconnected vehicle devices and those with two or more supplies shall correctly perform their functions when subjected to power supply voltage unbalance of ± 2.0 V without showing not inducing mutual malfunctions (m1).

Communication devices, CAN and LIN lines are an exception to ground unbalance requirements. In fact, they shall comply with requirements defined in documents 07324 "CAN nodes, CAN physical level standard Fiat Specifications" and 07328 "LIN NODES - Network operating specifications".

3.7

Electric characteristics

To be performed on type E1 devices and, only if required by related Specification, even on type E2 and E3 devices.

3.7.1**Insulation resistance**

Test as per Standard 7.Z0250, applying voltage between each terminal and metal casing (where applied) and between terminals that are insulated from each other.

Insulation strength shall be > 1M Ω , unless otherwise defined by related Specification.

3.7.2**Breakdown voltage**

Test as per Standard 7.Z0200, applying voltage between each terminal and metal casing (where applied) and between terminals that are insulated from each other.

Breakdown voltage shall be > 500 V eff. unless otherwise required in related Specification.

3.8**Device characteristic test**

Device functions and parametric characteristics detailed in Requirement Specifications shall be tested as per paras [3.8.1](#), [3.8.2](#), [3.8.3](#), [3.8.4](#).

3.8.1**Operating limit conditions**

Check device operation and parameters as per table below.

Temperature changes shall be performed in OC1-2 condition (para [3.3.7](#)).

Device shall be checked at any temperature in conditions OC2-1, OC2-2, OC3-1.

OC3-2 (para [3.3.7](#))

Operating conditions (conditions OC2-1, OC2-2, OC3-1, OC3-2 of para [3.3.7](#)) shall be tested by FT1 type modalities (para [3.3.8](#)) immediately after thermal test. At the end, carry out operation test immediately (para [3.3.2](#)) and then perform parametric characteristic test with FT2 type modalities (para [3.3.8](#)).

Ref.	TEMPERATURE	SUPPLY VOLTAGE	OPERATING MODE REQUIRED
A	temp. required in para. 3.3.1	Voltage required in para. 3.3.1	M1
B	minimum temperature for continual operation as defined by TM class of the device	minimum supply voltage as defined in class A of the device	M1
C	minimum temperature for continual operation as defined by TM class of the device	max supply voltage as defined in class A of the device	M1
D	max temperature for continual operation as defined by T class of the device	minimum supply voltage as defined in class A of the device	M1
E	max temperature for continual operation as defined by T class of the device	max supply voltage as defined in class A of the device	M1

Thermal stabilisation to be performed as per table at para [3.11.4](#).

Power supply circuit shall be as on vehicle.

3.8.2**Correct electronic system integration on CAN communication bus**

For electronic systems linked to CAN communication bus, supplier self-qualification plan shall include tests of correct operation and integration of each individual node within data transmission system as per Standards below:

- A. 07320 Network operating specifications for class B
- B. 07321 Network operational specifications for the Class C network
- C. 07322 Network operating specifications for gateway
- D. 07324 CAN nodes - Physical CAN level Standard Fiat specifications
- E. 07325 CAN nodes - Standard Fiat message nodes for class B networks.
- F. 07326 CAN nodes - Standard Fiat message nodes for class C networks.
- G. 07331 CAN nodes - Standard Fiat message map for class B networks with 29-bit IDs.
- H. 07332 CAN nodes - Standard Fiat message map for class C networks with 29-bit IDs.
- I. 7-Z0140 Electronic systems - High-speed CAN nodes - Physical level test.
- J. 7-Z0141 Electronic systems - CAN nodes - Messages map check.
- K. 7-Z0142 Electronic systems - Low-speed CAN nodes - Network management test.
- L. 7-Z0146 Electronic systems - High speed CAN nodes- Physical level check.
- M. 7-Z0147 Electronic systems - High-speed CAN nodes - Network management test.
- N. 7-Z0148 Electronic systems - CAN nodes - Gateway check

3.8.3**Correct electronic system integration on LIN communication bus**

For electronic systems linked to LIN communication bus, supplier self-qualification plan shall include tests of correct operation and integration of each individual node within data transmission system as per Standards below:

- 07328 Electronic systems – LIN Nodes – Network operating specifications

3.8.4**Diagnostics and electronic system programming**

For devices equipped with diagnostics functions and/or reprogrammable, related functionalities developed by supplier shall comply with standards below:

- A. **07234** General specification on diagnostics
- B. **07209** Standard Fiat for CAN and K line advanced diagnostics protocol.
- C. **07223** Fiat Standard diagnostic Protocol on line K - KWP2000.
- D. **07274** Fiat CAN standard diagnostic protocol
- E. **07284** General programming requirements for Flash Eeprom.
- F. **07284/01** General programming requirements for Flash EEPROM, extension for ECU as per Std. 07209 communication protocol.
- G. **09009** General diagnostics specification as per Std. 07209 communication protocol.
- H. **7-Z0050** Electronic systems - Self-diagnostics function checks.
- I. **7-Z0059** Electronic systems – Checking self-diagnostics functions for systems complying with Std. 07209 communication protocol.
- J. **7-Z0070** Electronic systems – Flash-EEPROM programming requirement on-vehicle test
- K. **7-Z0071** Electronic systems – Flash-EEPROM programming requirements on-vehicle test as per Std. 07209 communication protocol.
- L. **7-Z0145** Electronic systems - CAN nodes - Transport Protocol test
- M. **D2xxx** "Targeted Diagnostics Specification" or CAN CDD file.
- N. **07234/01** ON-board electronic systems – serviceability requirements.

Self-qualification test plan shall therefore include test of diagnostics performance provided by device as per Std. listed above.

Any exclusions shall absolutely be detailed in Targeted Specification.

3.9

Electrical and electromagnetic tests

3.9.1

List of electric and electromagnetic tests

Tables below specify electric and electromagnetic on/off-vehicle tests to be carried out on the various types of devices.

BENCH TESTS				
TYPE OF COMPONENT		E1	E2	E3
Para. 3.9.2	Immunity to ageing of vehicle system		X	X
Para. 3.9.3	Resistance to accidental connections	X	X	X
Para. 3.9.4	Resistance to supply overvoltage	X(1)	X(1)	X
Para. 3.9.5	Behavior at power supply fluctuations		X(1)	X
Para. 3.9.6	Immunity to conducted transient disturbances		X(2)	X
Para. 3.9.7	Immunity to induced transient disturbances		X(1)	X
Para. 3.9.8	Immunity to RF current on harness (B.C.I.)		X(1)	X
Para. 3.9.9	Immunity to electromagnetic fields		X(1)	X
Para. 3.9.10	Immunity to low-frequency magnetic fields.	X(3)	X(3)	X(3)
Para. 3.9.11	Immunity to electrostatic discharges		X	X
Para. 3.9.12	Emissions in frequency domain	X	X	X
Para. 3.9.13	Transient interference emissions on power supply lines	X	X	X

X Required test

(1) only if required by associated Specification.

(2) pulses 1, 2 and 5 only.

(3) only if required by related Specification. However, to be carried out if device contains elements sensitive to magnetic fields (e.g. inductive sensors, Hall effect sensors, Immobilizer system, audio systems, etc.).

INTEGRATION TESTS

TYPE OF COMPONENT		E1	E2	E3
Para. 3.16	System integration bench test	X	X	X

X Required test

ON-VEHICLE TESTS

TYPE OF COMPONENT		E1	E2	E3
Para. 3.17.1	Operating logics strength test	X(1)	X(1)	X
Para. 3.17.2	Immunity to radiated electromagnetic fields	X(1)	X(1)	X
Para. 3.17.3	Measurement of electromagnetic emissions irradiated by devices fitted on vehicle	X	X	X
Para. 3.17.4	Emissions picked up by the on-board receiver antenna	X	X	X
Para. 3.17.5	Transient disturbance emission	X	X	X
Para. 3.17.6	Immunity to electrostatic discharges		X	X

X: Required test

(1) only if required by associated Specification.

In case of inconsistency between test levels/limits defined in Std. below and those mentioned in this Specification, the latter shall prevail exclusively.

3.9.2**Immunity to ageing of vehicle system**

All devices for which this test is required as per para [3.9.1](#) shall be subjected to tests as per paras [3.9.2.1](#), [3.9.2.2](#), [3.9.2.3](#) during limit operating conditions test (para [3.8.1](#)).

3.9.2.1**Immunity to potential differences between supplies.**

Perform tests below on device and on each individual component (ECUs, actuators, etc.):

- Bring each individual device ground connection to +1V potential as to vehicle system ground and check that device behaves as type M1.
- Bring each individual device ground connection to -1V potential as to vehicle system ground and check that device behaves as type M1.
- Bring each individual device + supply connection to +2V potential as to vehicle system + supply and check that device behaves as type M1.
- Bring each individual device + supply connection to -2V potential as to vehicle system + supply and check that device behaves as type M1.

NOTE: Vehicle system means the faithful bench reproduction of on-vehicle system related to device under test.

Tests to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)).

Device operation to be tested as per level FT1 (para [3.3.8](#)) but level FT2 might be needed as per Requirement Specification.

In case a group of ground or + terminals are interconnected inside component with a route having resistance lower than $0.5\ \Omega$, they might be considered as a single conductor.

Test might be carried out as per Std. ISO/WD16750-2_N272; in this case, operating conditions and result assessment criteria shall be as per this Specification.

For CAN and LIN lines, refer to documents 07324 "CAN Nodes – FIAT Standard CAN physical level specifications" and 07328 "LIN NODES – Network operating specifications".

3.9.2.2

Immunity to low insulation resistance

Bring each sensor/ switch connected to device, or belonging to it, one after the other, to open circuit position and make a parallel connection to a resistor of value as per para 5.2.6 of Std. 09035, in Roff column cell corresponding to switch type and installation class.

No change to acquired status on said sensor/switch to take place.

In case of analogue input with resistive code, carry out test in all positions.

Test to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)).

Device operation to be tested as per level FT1 (para [3.3.8](#)) but level FT2 might be needed as per Requirement Specification.

3.9.2.3

Immunity to high contact resistance

Bring each sensor/ switch connected to device, or belonging to it, one after the other, to closed circuit position and make a series connection to a resistor of value as per para 5.2.6 of Std. 09035, in Ron column cell corresponding to switch type and installation class.

No change to acquired status on said sensor/switch to take place.

In case of analogue input with resistive code, carry out test in all positions.

Test to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)).

Device operation to be tested as per level FT1 (para [3.3.8](#)) but level FT2 might be needed as per Requirement Specification.

3.9.3

Resistance to accidental connections

Regardless to operating status, device (for which this test is required by table as per para [3.9.1](#)), connected to supply voltage and in any condition, shall not suffer any characteristic alteration due to tests as per paras [3.9.3.1](#), [3.9.3.2](#), [3.9.3.3](#).

During these tests, device:

- Shall not generate potentially dangerous situations for persons, vehicle or objects
- Shall not generate undesired actuations nor cause them in other vehicle system components
- Shall not cause the intervention of protection devices that do not reset automatically
- Shall not damage itself nor other vehicle components

In case behaviors different from specified at paras [3.9.3.1](#), [3.9.3.2](#), [3.9.3.3](#) are admitted for technical-manufacture reasons, they shall specifically be shown in related Specification/Targeted Specification.

After each test as per para [3.8.1](#), test shall behave as per type M1.

3.9.3.1**Battery terminal reversal**

Reverse power supply voltage at battery terminals for at least 5 minutes. Test to be carried out with wiring and connections equivalent to those on vehicle. During test, device shall have minimum type M3 behavior.

3.9.3.2**Short circuit to power supply**

Perform tests below on device and on each individual component (ECUs, actuators, etc.):

On all inputs and outputs whose reference voltage is ground, perform:

- Permanent short circuit to ground
- Short circuit to power supply for minimum 1 s

On all inputs and outputs whose reference voltage is power supply, perform:

- Permanent short circuit to power supply
- Short circuit to ground for minimum 1 s

On all inputs and outputs both connected to ground and to power supply (e.g. potentiometers), perform:

- Permanent short circuit to ground
- Permanent short circuit to power supply

On all inputs and outputs connected to voltages different from V_{batt} (e.g. V_{ref}), perform:

- Short circuit to V_{batt} for minimum 1 s
- Permanent short circuit to V_{ref}
- Permanent short circuit to ground

On each device unit (ECU, actuator, etc.)out power supply, perform tests below:

- Permanent short circuit to ground
- Short circuit to V_{batt} for minimum 1 s
- Permanent short circuit of each out power supply

To consider a short circuit as permanent, it must be kept for a minimum time, however not less than 15 min, in order to ensure that device thermal balance conditions are reached.

Tests on outputs and bidirectional terminals shall be performed with output both ON and OFF.

For out signal ground terminals (rated current lower than 150 mA) and only if individually listed in applicable Requirements, short circuit test to + power supply might be replaced by test below:

Repeat cycle ([Figure 1](#)) 5 times with 1 min interval (t_c) between 2 consecutive cycles.

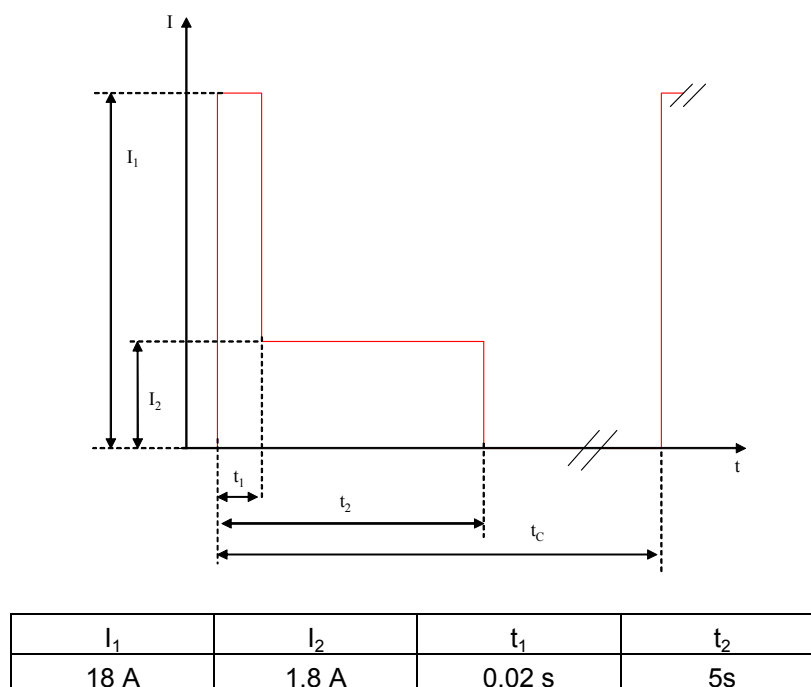


Figure 1

3.9.3.3

Power supply disconnection

Perform tests below on device and on each individual component (ECUs, actuators, etc.):

- At ground disconnection, temporary at first and then permanent. Perform test at first on each individual connection, then by groups, including the case of all ground disconnection.
- Reconnect all grounds and then submit device to power supply cut out, temporary at first and then permanent. Carry out test on each connection at first and then by units, including the case of all power supply cut out.

During tests, device shall behave as per type M2 or M1.

Tests to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)).

Device operation to be tested as per level FT1 (para [3.3.8](#)) but level FT2 might be needed as per Requirement Specification.

It is admitted that this test be carried out as per Std. ISO/WD16750-2_N272, with following exception:

- Absolutely comply with levels and directives of this Specification.

3.9.4

Resistance to supply overvoltage

Devices (for which this test is required by table at para [3.9.1](#)) shall be exposed to following supply overvoltages:

- +18V for 60 min at max. continuous operation temperature defined for operating class T
- +24V for 1 min at max. continuous operation temperature defined for operating class TM and at 23°C.

Table below shows behavior required as a function of operation and voltage class for admissible test voltages.

TEST GROUP	TEST VOLTAGE	PERMITTED BEHAVIOR					
		Voltage A1 (10 - 16 V)	Class	Voltage A2 (6 - 16 V)	Class	Voltage A3 (4.5 - 16 V)	Class
FG0, FG1	18 V	M1		M1		M1	
	24 V	M1, M2, M3		M1		M1	
FG2	18 V	M1, M2, M3		M1, M2 (*)		(**)	
	24 V	M1, M2, M3		M1, M2 (*)		(**)	

(*) The relevant P.S. might indicate that behavior mode M3 is acceptable for some functions of the devices belonging to voltage class A2.

(**) Not applicable on class FG2 being an operation class not applicable to voltage class A3 devices.

Tests to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)) for 24V voltage, OC3-1, OC3-2 for 18V voltage.

Device operation to be tested as per level FT1 (para [3.3.8](#)) but level FT2 might be needed as per Requirement Specification.

3.9.5

Behavior at power supply fluctuations

All devices for which this test is required as per para [3.9.1](#) shall be subjected to tests as per paras [3.9.5.1](#), [3.9.5.2](#), [3.9.5.3](#) during limit operating conditions test (para [3.8.1](#)).

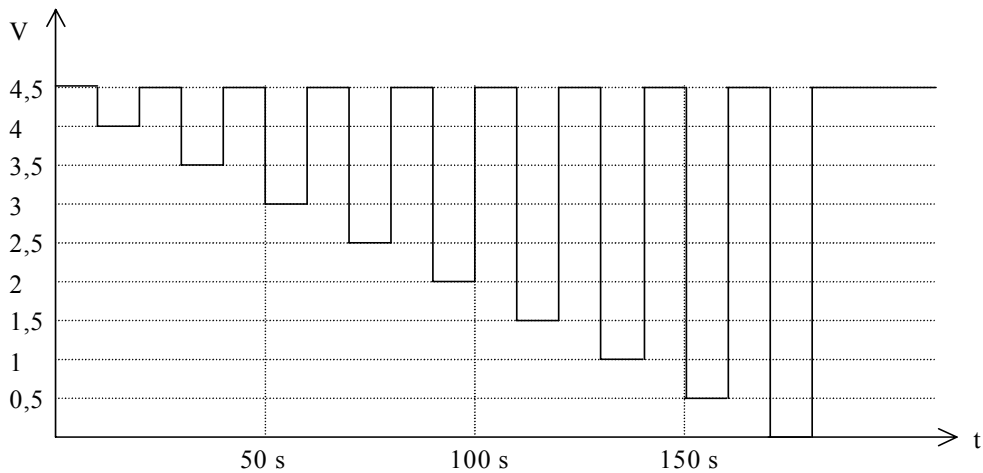
3.9.5.1

Reset behaviour at voltage drop

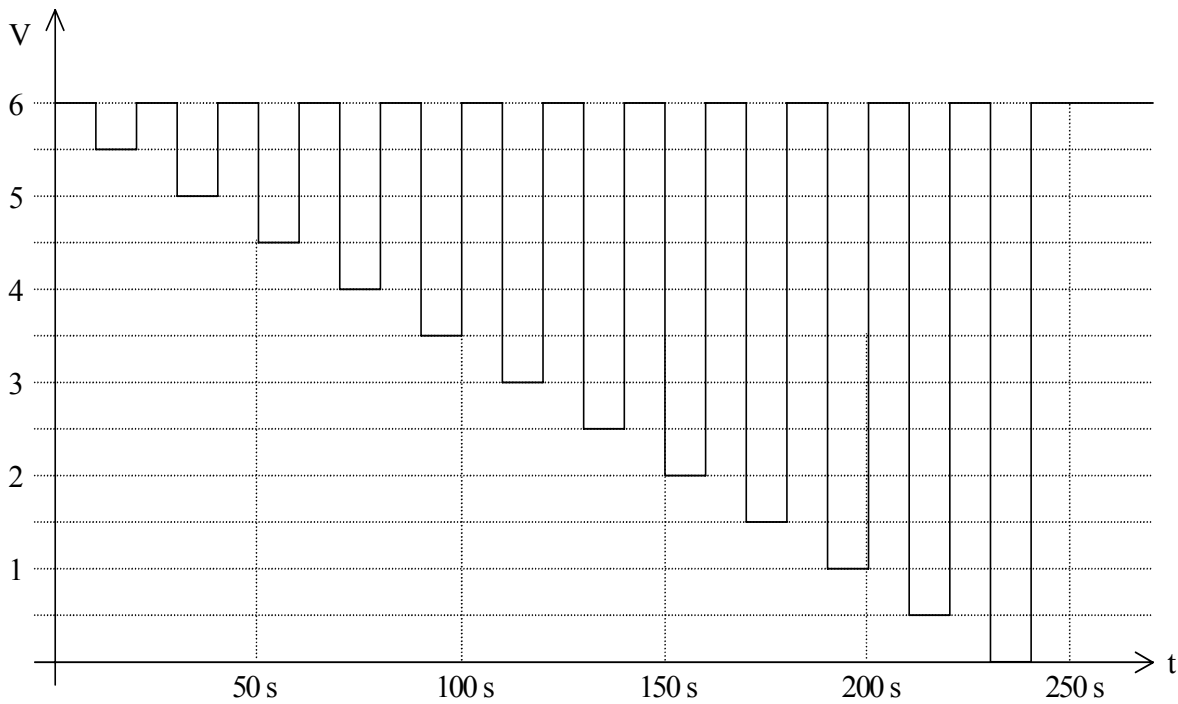
Devices shall be submitted to test below in operating condition OC2-1, OC2-2, OC3-1, OC3-2:

- Power device at constant voltage for minimum 10 s at a value variable by decreasing steps of 0.5 V, from minimum operating voltage defined (para [2.6](#)) up to 0 V.
- 10 s after each test voltage, bring power supply voltage back to minimum operating value, keep it for 10 s and check that device behavior is as per para [2.6](#), with reference to function to be carried out, performing a type FT2 check.

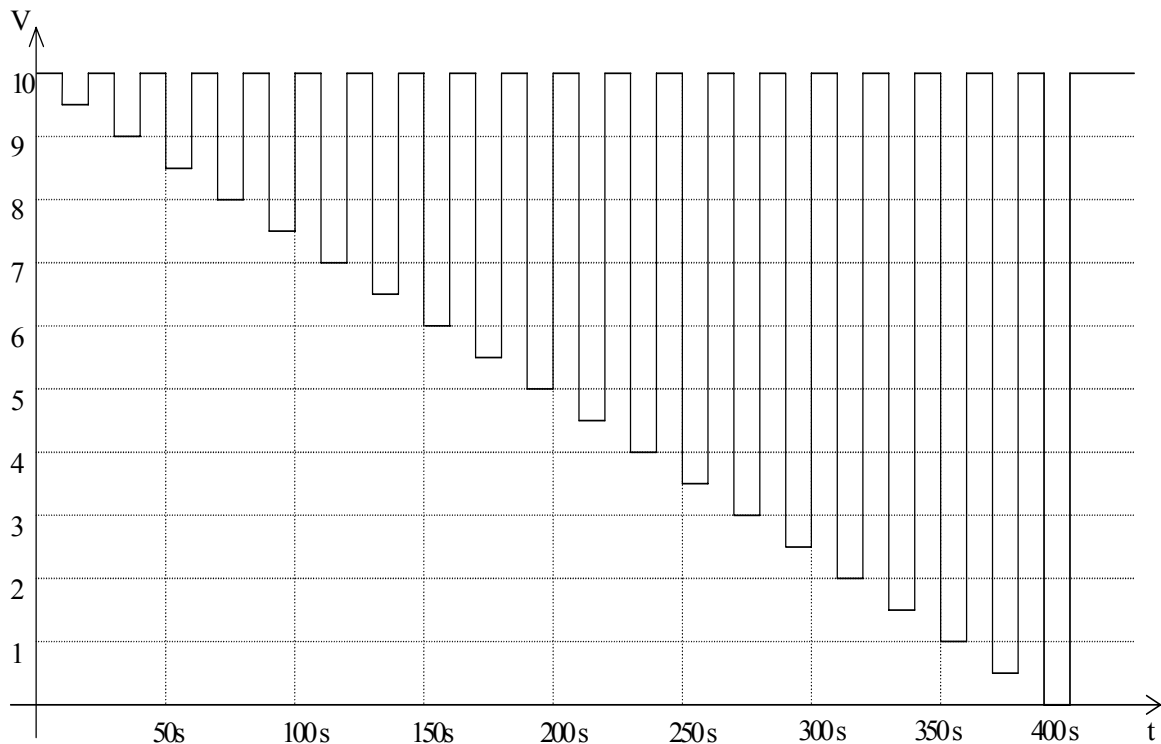
Test is to be carried out as per graphics below.



Voltage drop test for A3 voltage class device



Voltage drop test for A2 voltage class device



Voltage drop test for A1 voltage class device

3.9.5.2

Reset behaviour at battery voltage drop out

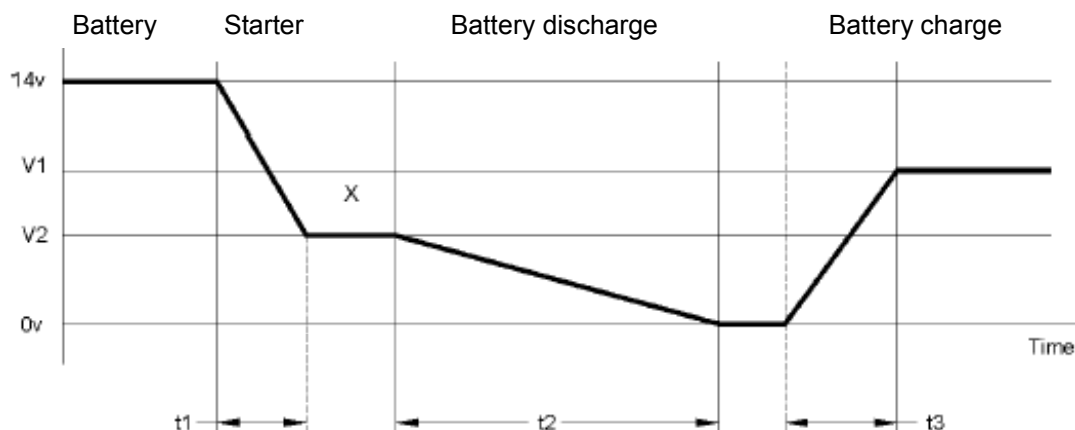
Devices equipped with a stabilized power supply unit or voltage regulator shall be submitted to following test for checking device immunity to battery voltage reductions (e.g. at engine start-up and battery disconnection) as well as increases (e.g. battery recharge).

Test consists of:

- Powering device at 14V constant voltage and set wave shape with parameters mentioned in table herein below, performing a type FT2 operation test in OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)) operating conditions during a period of time identified by letter "X".
- At the end of each test, bring power supply voltage back to 14V and check that device behaves as per para [2.6](#), performing a type FT2 check in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)).

DUT shall suffer no damage, degradation in performance, or undesired actuation of any function.

Voltage (V)		Time (s)		
V1	V2	T1	T2	T3
10	6	0.01	10	1
10	6	0.1	600	10
10	6	0.5	3600	120
10	6	1	28800	7200



3.9.5.3

Immunity to micro interruptions

Devices to be submitted to tests below:

On each power supply line individually and then on all lines at the same time, apply all pulses below:

Ref.	TYPE OF INTERFERENCE	Number of pulses (test time)	Operating condition	Permitted behavior	Application point	Reference standard
A	Burst of supply micro-interruptions lasting 1 ms	25 bursts	OC2-1, OC2-2 OC3-1, OC3-2	M1	<ul style="list-style-type: none"> +key + battery +key and +battery 	7-Z0444
B	Supply micro-interruptions lasting 3, 10, 30 ms	15 cycles for each duration	OC2-1, OC2-2 OC3-1, OC3-2	M1, M2	<ul style="list-style-type: none"> +key + battery +key and +battery 	7-Z0444
C	Supply micro-interruptions lasting 100, 300, 1000, 3000 ms	15 cycles for each duration	OC2-1, OC2-2 OC3-1, OC3-2	M1, M2, M3	<ul style="list-style-type: none"> +key + battery +key and +battery 	7-Z0444
D	Misuse cycle key Off/On cycle a	200 bursts	OC2-1, OC2-2 OC3-1, OC3-2	M1, M2	+key	7-Z0444
E	Misuse cycle key Off/On cycle b	200 bursts	OC2-1, OC2-2 OC3-1, OC3-2	M1, M2	+key	7-Z0444

Before each test, device shall be set in appropriate operating condition as per para [3.3.2](#).

3.9.6

Immunity to conducted disturbances

Devices (for which this test is required by table at para [3.9.1](#)), shall be submitted to all tests as per paras [3.9.6.1](#), [3.9.6.2](#), [3.9.6.3](#) in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)). Interferences to be applied to all power supplies and to all lines that might be connected to power supply lines (e.g. power supply inputs, outputs, etc.), both on each device terminal and on power supply nodes in vehicle circuit.

3.9.6.1**Immunity to conducted transient disturbances**

Immunity test to conducted transient interference to be carried out as per Std. 7-Z0441.

Test might be carried out as per Std. SO 7637-2:2004 but in absolute compliance with directives and requirements of this P.S.

Tests to be carried out as defined in table below, with type FT1 monitoring (para [3.3.8](#)).

Ref.	TYPE OF INTERFERENCE	Internal generator resistance R_i	Amplitude V_s (Us)	Pulse parameter	Number of pulses (test time)	Permitted behavior	Application point
A	FIAT 1: generated at key-off with inductive loads present (ISO 1)	10 Ω	-100 V	td=2 ms	5000 pulses	M1 ¹	+key +key and +battery
B	FIAT 2: generated at key-off with inductances in series with loads or electrical motors running (ISO 2a)	2 Ω	+200 V	td=0,05 ms	5000 pulses	M1	+key +key and +battery
C	FIAT 3a: generated by bounces and/or arcs at activation of switches or relays (ISO 3a)	50 Ω	-150 V	tr=5 ns td=0.1 μ s t1=0,1 ms t4=10ms t5=100ms	30 min	M1	+key and +battery
D	FIAT 3b: generated by bounces and/or arcs at activation of switches or relays (ISO 3b)	50 Ω	+100 V	tr=5 ns td=0.1 μ s t1=0,1 ms t4=10ms t5=100ms	30 min	M1	+key and +battery
E	FIAT 5: generated by a disconnected battery terminal while current is supplied from generator to battery (load-dump) (ISO 5a)	2 Ω	+ 70 V ²⁾	td=400 ms	15 pulses	M1, M2 ³⁾	+key and +battery

1) Operation M3 admitted during pulse parts at negative or no voltage.

2) All devices installed on vehicles where all alternators are equipped with Zener diodes, test shall be carried out with a suppressor at Load Dump generator output cutting pulse to +40V (ISO 5b).

3) Where required, M1 operating mode to be ensured.

3.9.6.2**Interferences at start-up**

During these tests, operating mode to be OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)), with type FT1 monitoring.

Perform all tests mentioned in table below:

Ref.	TYPE OF INTERFERENCE	Amplitude	Pulse parameter	Number of pulses (test time)	Permitted behavior	Application point	Ref. std.
A	FIAT 4: generated at engine start-up	Vb2=+4.5 V	tr=15 ms t6= 50 ms t7= 50 ms	100 pulses with 30 second interval between two consecutive pulses	M1 for voltage class A3 M1, M2 ¹⁾ for voltage class A2 M1, M2, M3 ²⁾ for voltage class A1	+key and +battery	7-Z0444
B	Sinusoidal variation of supply voltage at 1 Hz and 5 Hz: generated at engine start-up	+6V to +8V	-	5s per frequency	M1 for voltage classes A2 and A3 M2 For voltage class A1	+key and +battery	7-Z0444

¹⁾ During initial phase of 4.5 V test pulse, a regular operation interruption is admissible provided it does not cause spurious actuations or loss of stored data; however, device shall return to type M1 operation within 50 ms from beginning of 6V phase.

²⁾ Behavior to comply with para 2.6 table. Behavior to return to type M1 within 50 ms from voltage increase to minimum test voltage.

3.9.6.3

Sinusoidal burst

Test device as per table below.

TYPE OF INTERFERENCE	Amplitude	Test time	Performance target	Application point	Ref. standard
Sinusoidal burst 0.1-20 MHz frequencies, duration 100 ms, period 1 ms , applied with current clamp: generated by bounces and/or arcs at activation of switches or relays	200 mApp (peak-peak)	2s per frequency	M1	+key and +battery	7-Z0443

3.9.7

Immunity to induced transient disturbances

Test device as per paras 3.9.7.1 and 3.9.7.2.

Tests to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para 3.3.7), with type FT1 device monitoring (para 3.3.8).

3.9.7.1

Coupling clamp method

Devices to be tested as required by table at para 3.9.1, both class SI1 and class SI2, shall be exposed to interferences shown in table. Device required behavior to be as shown in table.

Ref.	TYPE OF INTERFERENCE	Amplitude	Test time	Required behavior	Reference standard
A	FIAT 3aS	-300 V	30 min (1)	M1	7-Z0440
B	FIAT 3bS	+300 V	30 min (1)	M1	

(1) for each application points subdivided as follows: 10 min on each individual conductor and 20 min on each connector harness.

Test might be carried out as per Std. ISO 7637-3:1995, with exceptions below:

- Insulating supports with relative dielectric constant lower than 1.4 (Fig. 1, Key 3 and Key 1)
- Absolutely comply with levels and directives of this Specification.

3.9.7.2

Susceptibility to coupling with ignition system cables

For class SI1 devices only, just for cables subject to coupling above, immunity to interferences induced on signal cables from ignition system cables shall be tested as per methodology below:

a) LOW-VOLTAGE INTERFERENCES

Mate cables of device under test, one cable after the other, for 1 ± 0.05 m, with coil primary pilot cable. Test shall last 1 hour and device shall behave as type M1.

b) HIGH-VOLTAGE INTERFERENCES

Mate cables of device under test, one cable after the other, for 0.5 ± 0.05 m, with coil secondary HV cable.

Test shall last 1 hour and device shall behave as type M1.

During both tests, monitor signal on DUT terminal related to mated cable and enter in test report.

Mating between circuit under test cable and interfering circuit shall be performed by contact, keeping DUT harness and any ground surface at a distance of 0.15 ± 0.05 m.

Characteristics of cables used for testing shall be representative of cables used on vehicle. Discharge to be performed using spark gaps, without using suppressors and/or discharge current limiters, with a discharge frequency corresponding to 2500 thru 7000 engine rpm.

During both tests, trigger voltage shall not be lower than 15 kV.

In exceptional cases, vehicle electric project manager might allow performing one of these tests, or both of them, with actual vehicle cable instead of mating on each individual cable.

3.9.8

Immunity to RF bulk current injection

Devices (for which this test is required by table at para [3.9.1](#)) shall be submitted to a radio frequency current within 1 thru 400 MHz frequency range, injected on harness with modality defined by reference standard.

Test to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)), with type FT1 device monitoring (para [3.3.8](#)).

Table below shows, as a function of operating class, the level of severity and corresponding required behavior mode.

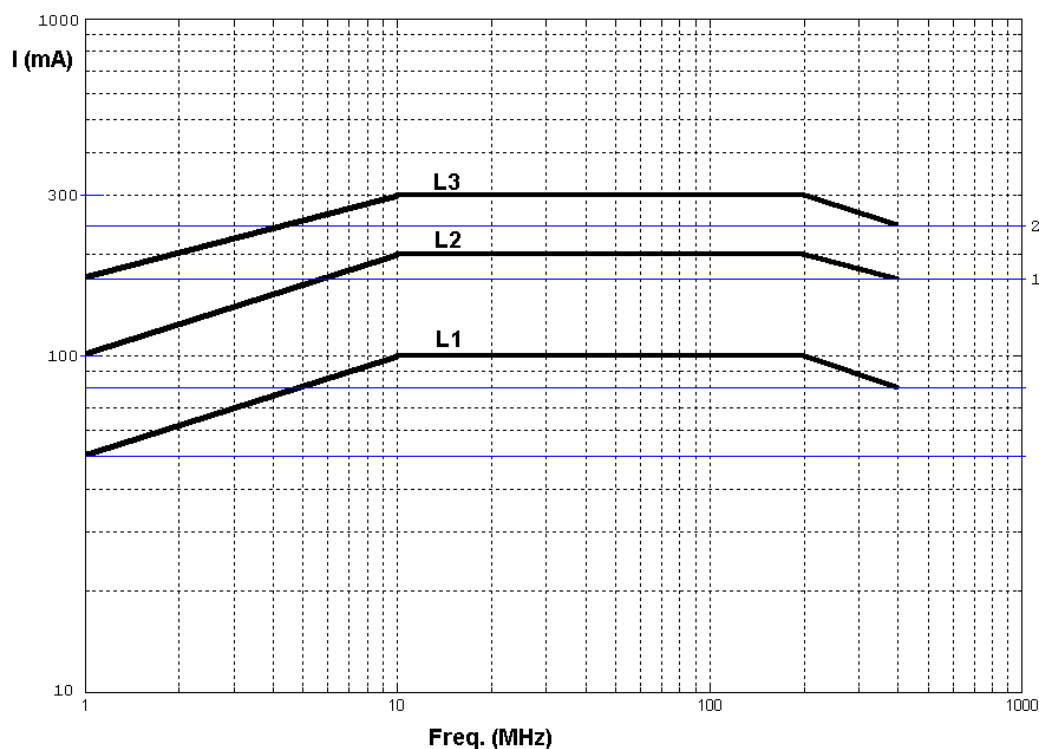
TEST GROUP	SEVERITY LEVEL	PERMITTED BEHAVIOR	Reference standard
FG0	L3 (★)	M1, M2, M3	7-Z0446
FG0, FG1	L2	M1	
FG2	L1	M1	

(★) Test with this severity level to be performed only for devices whose operation degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.) During this test, no operation degradation admissible that might:

- Degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.).
- Affect safety of passengers and/or of other road users.

Test shall be carried out both with CW signal (without modulation) and with AM 80% $f_m=1$ kHz modulation, having the same peak-to-peak width of non-modulated signal.

Intensity of current, expressed in mA rms, is shown in graphic below as a function of severity level



Test might be carried out as per Std. ISO 11452-4:2005, para 8.3.2 (closed loop), with exceptions below:

- With reference to fig. 2 of Std. ISO 11452-4:2005 para 8.3.2, power injection clamp (Key 10) shall be placed at 210 ± 10 mm from device instead of 900 ± 10 mm.
- Power limit to be set at 25 W
- Minimum stay time at each frequency: 2 s
- Test to be carried out with 1 MHz frequency step from 1 to 220 MHz and with 2.5 MHz step from 220 MHz to 400 MHz.
- Absolutely comply with levels and directives of this Specification

3.9.9**Immunity to electromagnetic fields**

Carry out test as per para [3.9.9.1](#) on device.

Tests to be carried out in operating conditions OC2-1, OC2-2, OC3-1, OC3-2, with type FT1 device monitoring.

3.9.9.1**Immunity to electromagnetic fields generated by aeriels**

Devices (requiring this test as per table at para [3.9.1](#)) shall be submitted to an electromagnetic field within 220 MHz to 2.5 GHz frequency range; table below indicated electromagnetic field intensity and corresponding required behavior mode.

TEST GROUP	TEST FIELD STRENGTH (V/m rms)	PERMITTED BEHAVIOR	Reference standard
FG0	200 (1)	M1, M2, M3	7-Z0449
FG0, FG1	150	M1	
FG2	50	M1	

(1) Test with this severity level to be performed only for devices whose operation degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.) During this test, no operation degradation admissible that might:

- Degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.).
- Affect safety of passengers and/or of other road users.

Modulations to be used during test are shown in table below:

FREQUENCY FIELD	MODULATION
220 to 2500MHz	CW (continuous wave without modulation)
220 to 800MHz	AM (wave width modulated by a 1 kHz frequency sinusoidal wave, with 80% modulation depth, having same peak-to-peak width of non-modulated signal)
800 to 2500 MHz	PM (pulse modulation, with 577 μ s duration burst and 4600 μ s period).

Test to be carried out with aerial polarized both horizontally and vertically.

Test might be carried out as per Std. ISO 11452-2:2004, with exceptions below:

- Frequency step of 2.5 MHz from 200 MHz to 400 MHz, 5 MHz from 400 MHz to 1 GHz, 10 MHz from 1 GHz to 1.7 GHz, 5 MHz from 1.7 GHz to 2 GHz, 10 MHz from 2 GHz to 2.5 GHz.
- For frequencies greater than 1 GHz, the aerial (and calibration) shall be moved to front of device under test.
- Absolutely comply with levels and directives of this Specification.

3.9.10**Immunity to low-frequency magnetic fields**

Devices (for which this test is required by table at para [3.9.1](#)) shall be submitted, during their regular operation (OC2-1, OC2-2, OC3-1, OC3-2 (para [3.3.7](#)), with type FT1 monitoring (para [3.3.8](#)), to a low-frequency magnetic field with characteristics below:

FREQUENCY FIELD [Hz]	LEVEL (db μ A/m)
15 to 1000	170
>1 to 10 kHz	$170 - (30 \cdot \log(f/1000))$
>10 to 150 kHz	140

Test to be carried out as per Std. 7-Z0450, with a non-modulated sinusoidal wave (CW), with logarithmic frequency steps of 25 points/decade (9.7% increase)

Required behavior mode is M1.

Test might be carried out as per Std. ISO 11452-8:2005 para 7.2.2. but in absolute compliance with directives and requirements of this P.S.

3.9.11**Immunity to electrostatic discharges**

Devices (for which this test is required as per table at para [3.9.1](#)) shall be submitted to electrostatic discharge tests as per paras [3.9.11.1](#) and [3.9.11.2](#).

3.9.11.1**Immunity to handling electrostatic discharges**

Submit device non operating and not connected to harness (OC1-1) to electrostatic discharge tests, both in the air and in contact, as per table below.

CLASS	VOLTAGE	CAPACITY	RESISTANCE	Reference standard
SE3	± 4 kV	150 pF	2 k Ω	7-Z0445

Discharges to be applied to all points of each device (including pins). Device shall not suffer any characteristic change nor permanent damages.

Test might be carried out as per Std. ISO 10605: 2001 para 7, with exceptions below:

- Absolutely comply with levels and directives of this Specification.

3.9.11.2**Immunity to electrostatic discharges in operation**

During its regular operation (OC1-2, OC2-1, OC2-2, OC3-1, OC3-2 with type FT1 monitoring), device shall be submitted to electrostatic discharge tests described in table below.

CLASS	VOLTAGE	CAPACITY	RESISTANCE	Reference standard
SE1	± 8 kV	330 pF	2 k Ω	7-Z0445
SE2	± 15 kV	150 pF	2 k Ω	

Discharges shall be applied to all device points that can be reached during manufacture, use and maintenance of vehicle (e.g. car radio aerials, display on dashboard, control devices on dashboard, connectors, etc.). Behavior mode shall be as follows:

TEST GROUP	PERMITTED BEHAVIOR
FG0, FG1	M1
FG2	M1, M2, M3

Device shall not suffer any characteristic change nor permanent damages.

Test might be carried out as per Std. ISO 10605: 2001 para 5, with exceptions below:

- Absolutely comply with levels and directives of this Specification.

3.9.12

Emission test (in frequency domain)

Devices (for which this test is required as per table at para [3.9](#)) shall be submitted to bench tests as per paras [3.9.12.1](#) and [3.9.13.2](#).

Type E1 and E2 devices shall be broad band (BB) tested with peak detector. In case non-compliances are found, repeat test with quasi-peak detector in frequency range showing non-conformities, extended by 10% on both sides.

Type E3 devices shall be submitted both to narrow band (NB) tests with peak or average detector and to broad band (BB) tests with peak detector. In case non-conformities are found during broad band (BB) tests, repeat test using quasi-peak detector in frequency range revealing such non-conformities, extended by 10% on both sides.

Device under test operating conditions shall be chosen so as to maximize emissions.

3.9.12.1

Radiated emissions

Devices installed on test set-up, in operating conditions, shall not radiate radiofrequency interferences at greater levels than those shown in table below, expressed in dB ($\mu\text{V}/\text{m}$).

Tests to be carried out as per Std. 7-Z0472.

Test might be carried out as per Std. CISPR 25: 2002 para 6.4, with exceptions below:

- From 1 to 2.5 GHz, aerial to be positioned in front of DUT
- Absolutely comply with levels and directives of this Specification.

FREQUENCY BAND (MHz)	NARROW BAND LIMIT (dBμV/m)	BROADBAND LIMIT (dBμV/m)	
		PEAK DETECTOR	QUASI-PEAK DETECTOR
0,15 to 0,3	31	66	53
0,53 to 2	26	59	46
5,9 to 6,2	34	48	35
26,9 to 54	34	48	35
54 to 60	$44 - 25.13 \log (f/30)$	$67 - 25.13 \log (f/30)$	$55 - 25.13 \log (f/30)$
60 to 70	$44 - 25.13 \log (f/30)$	66	53
70 to 87	24	37	24
87 to 108	30	37	24
108 to 115	$34 + 15.13 \log (f/75)$	$57 + 15.13 \log (f/75)$	$44 + 15.13 \log (f/75)$
115 to 172	24	37	24
172 to 185	$34 + 15.13 \log (f/75)$	$57 + 15.13 \log (f/75)$	$44 + 15.13 \log (f/75)$
185 to 195	$34 + 15.13 \log (f/75)$	61	48
195 to 225	$34 + 15.13 \log (f/75)$	$57 + 15.13 \log (f/75)$	$44 + 15.13 \log (f/75)$
225 to 235	$34 + 15.13 \log (f/75)$	62	49
235 to 260	$34 + 15.13 \log (f/75)$	$57 + 15.13 \log (f/75)$	$44 + 15.13 \log (f/75)$
260 to 300	$34 + 15.13 \log (f/75)$	63	50
300 to 330	24	37	24
330 to 360	$34 + 15.13 \log (f/75)$	$57 + 15.13 \log (f/75)$	$44 + 15.13 \log (f/75)$
360 to 400	$34 + 15.13 \log (f/75)$	65	52
400 to 420	$34 + 15.13 \log (f/75)$	68	52
420 to 512	24	37	24
512 to 580	45	68	53
580 to 620	45	66	53
620 to 730	45	68	53
730 to 770	45	66	53
770 to 820	45	68	53
820 to 1000	30	43	30
1000 to 2500	30	43	30

At overlapping frequencies between bands, smaller emission limit is applicable.

For devices operating for a short time and with manual operation, if they do not impact on vehicle type-approvability concerning electromagnetic compatibility, broad band test limits are increased by 10 dB.

3.9.12.2

Conducted emissions on power supply lines

Devices installed on test set-up, in operating conditions, shall not generate radiofrequency interferences at greater levels than those shown in table below, expressed in dB (μV).

Tests to be carried out as per Std. 7-Z0470.

FREQUENCY BAND (MHz)	NARROW BAND LIMIT dB(μ V)	BROADBAND LIMIT dB(μ V)	
		PEAK DETECTOR	QUASI-PEAK DETECTOR
0.15 to 0,3	70	93	80
0.53 to 2	50	79	66
5.9 to 6.2	45	65	52
26.9 to 54	40	65	52
68 to 87	30	49	36
87 to 108	36	49	36

For devices operating for a short time and with manual operation, if they do not impact on vehicle type-approvability concerning electromagnetic compatibility, broad band test limits are increased by 10 dB.

At overlapping frequencies between bands, smaller emission limit is applicable.

Test might be carried out as per Std. CISPR 25: 2002 para 6.2.2, with exceptions below:

- Absolutely comply with levels and directives of this Specification.

3.9.13

Transient interference emissions on power supply lines

During their regular operation (including switch on and off) and during ignition key ON/OFF, devices (for which this test is required by table at para [3.9.1](#)), installed on set-up and tested as per paras [3.9.13.1](#) and [3.9.13.2](#), shall not generate interferences whose width is out of + 60 thru - 60 V range.

Device under test operating conditions shall be chosen so as to maximize issued transient amplitude.

3.9.13.1

Slow pulses

Slow pulse measurement (equal to or longer than 1 μ s) shall be carried out as per Std. 7-Z0471. Transient interferences shall be measured at impedance stabilization network terminals (and referred to 0 V, terminal B). Perform at least 15 measurements for each operating condition and enter readings on test report.

The switch used for testing shall be electronic, have a switching time smaller than 300 ns and be free from bounces. Test equipment shall be able to generate, on a load of 1mH + 1.5 Ω , a negative overvoltage ranging between 210 and 360 V.

Test might be carried out as per Standard ISO 7637-2 :2004, fig. 1a, with Rs=40 Ω , with exceptions below:

- Absolutely comply with levels and directives of this Specification.

3.9.13.2

Fast pulses

Carry out test as per Std. ISO 7637-2:2004, fig. 1b, both using switching device on vehicle and switching device as per Std. ISO 7637.

Carry out minimum 15 measurements for each operating condition and enter all measurements on test report.

Test to be carried out at device under test terminals.

3.10**Mechanical tests**

Table below specifies tests to be carried out on all devices.

TYPE OF COMPONENT			E1	E2	E3
BENCH TESTS	para. 3.10.1	Connections	X	X	X
	para. 3.10.2	Device restraint performance	X	X	X
	para. 3.10.3	Drop test	X	X	X
	para. 3.10.4	Vibration strength	X	X	X
	para. 3.10.5	Mechanical Shock	X	X	X
	para. 3.10.6	Door/trunk/hood closing test	X	X	X

3.10.1**Connections**

Mechanical characteristics of terminals and device connectors shall be as per P.S. 9.91320/02 (see para [3.6.6](#)).

Pull-out tests must be applied also to cables going out directly from the device.

3.10.2**Device restraint performance**

Install device under test as on vehicle using design items (nuts, screws, supporting brackets), locking them at predefined torques.

Apply to device, in both directions of the 3 main axis as to supporting surface, a load equal to 8 times mass device with a minimum value of ≥ 20 N.

No permanent separations nor deformations admissible on device restraint points.

3.10.3**Free fall test (to be performed with shock protections, where relevant)**

Perform test, dropping device in any direction from 1 m high, unless otherwise defined in applicable specific device P.S., on a smooth and rigid steel or concrete surface.

Drop height shall be tested from part under test point closer to test surface.

Release should cause device under test to fall free from its suspended position, with minimum disturbance at release.

After test, device shall behave as per M1.

No breaks, cracks nor deformations admissible.

Test to be carried out in OC1-1 operating condition.

3.10.4**Vibration strength**

To be performed with device correctly mated to electric connector and harness placed and fastened as on vehicle.

Unless otherwise specified, during tests, device shall operate in vehicle use conditions related to applied stresses (OC2-1, OC2-2, OC3-1, OC3-2 with type FT1 monitoring).

3.10.4.1

Sinusoidal and random vibrations for Class V1 devices

NOTE: For devices fitted on engine (V1), actual operating conditions substantially depend on their location on engine. Therefore, final approval of these devices shall take place by means of vibration tests defined based on checks carried out on final configuration vehicle. Test type might remain as described below (sinusoidal + random), however changing vibration amplitude (Applicable standards: 7-A7509, 7-A7510, 7-A7525).

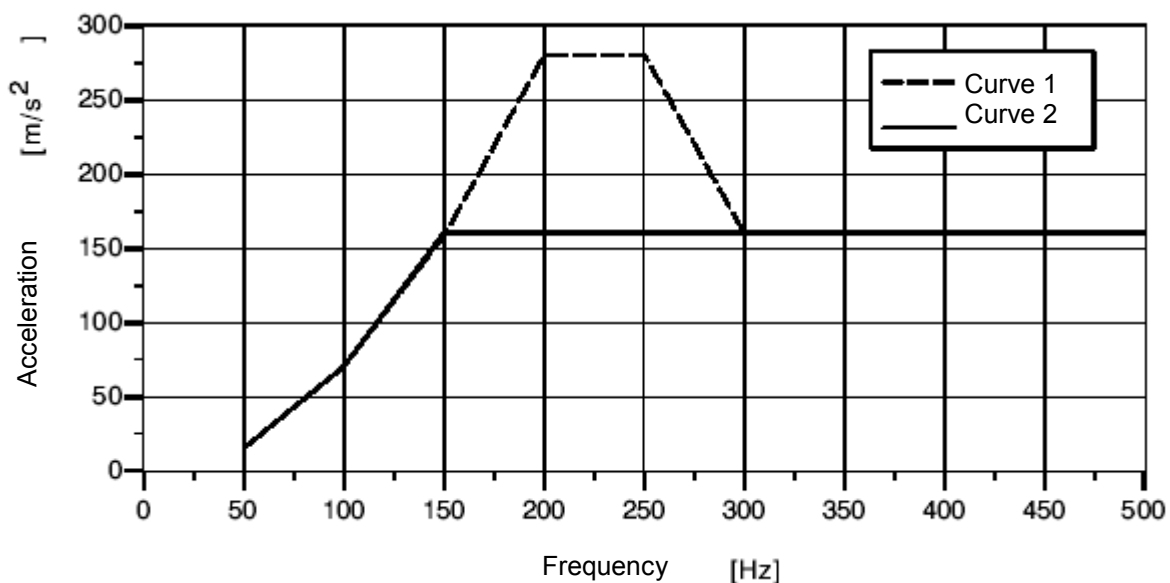
Submit device that has passed 100 fast temperature cycle test as per para [3.11.4](#) at cumulative tests A-B below.

A) test with sinusoidal vibration:

- Test temperature : max. continuous operation
- Sweep in frequency : 1 octave/min
- Test duration : 24 h for each main axis

NOTE: Curve 1 is applied to devices for which use of ≤ 5 -cylinder engines is planned. Curve 2 is applied to devices for which use of > 5 -cylinder and 4-cylinder engines with counter-rotating shafts is planned.

In case device should be installed several engine types above, curve 1 is applicable.

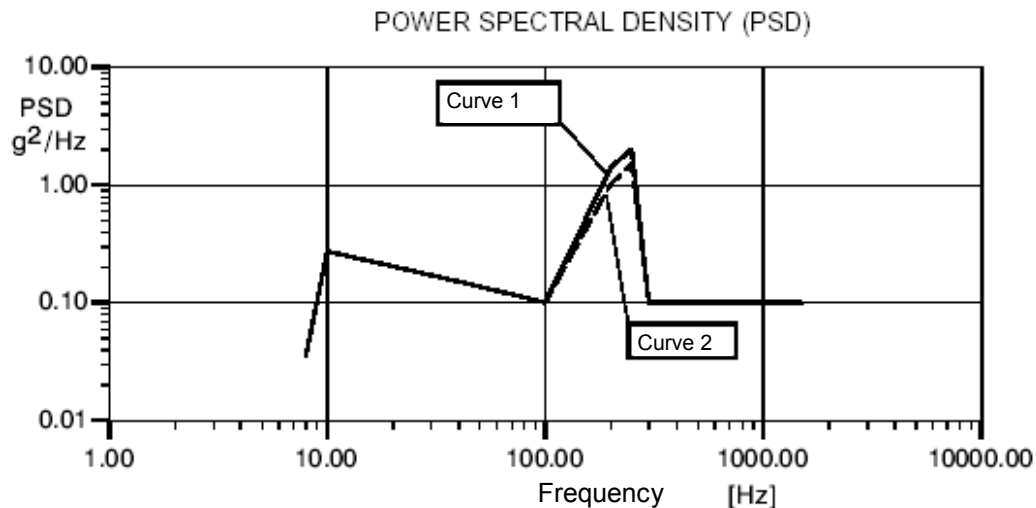


CURVE 1			CURVE 2		
Frequency [Hz]	Vibration amplitude (mm) _{pk}	Acceleration [m/s ²]	Frequency [Hz]	Vibration amplitude (mm) _{pk}	Acceleration [m/s ²]
> 50	0.177	-	> 50	0.177	-
-	-	-	151	-	160
200	-	280	-	-	-
250	-	280	-	-	-
300	-	160	-	-	-
500	-	160	500	-	160

During test, check for no lack of continuity nor malfunctions on connections.

B) test with random vibration:

- Test temperature : max. continuous operation
- Test duration : 100 h for each main axis



FREQUENCY [Hz]	CURVE 1	CURVE 2
	PSD [g^2/Hz]	PSD [g^2/Hz]
8	0.0350	0.0350
10	0.270	0.270
40	0.150	0.150
100	0.100	0.100
200	1.40	1.00
250	2.00	1.50
300	0.100	0.100
1500	0.100	0.100
G_{rms}	17.45 g	16.25 g

During test, check for no lack of continuity nor malfunctions on connections.

Repeat tests A and B and operation tests required by relevant P.S. and make sure that "as new" limits are still met (para [3.8.1](#)). Also inspect part under test for any distortion, breakage or damage.

3.10.4.2

Sinusoidal vibrations for Class V2-V3-V4 devices

Perform test as per Standard 7.R0100, exposing devices to stresses below:

	DEVICES, CLASS V2, V3	DEVICES, CLASS V4
Oscillation frequency	5 thru 200 Hz	5 thru 200 Hz
Peak shift	5 mm (5 to 12 Hz)	30 mm (5 to 10 Hz)
Peak acceleration	30 m/s ² (12 to 200 Hz)	120 m/s ² (10 to 200 Hz)
Sweep velocity	1 oct/min	1 oct/min
Duration	8 h per axis (3 axis)	8 oh per axis (3 axis)

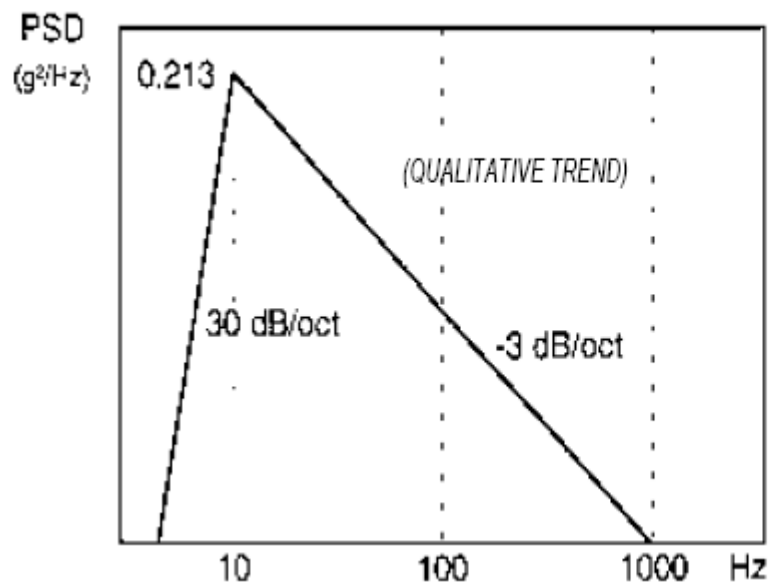
Take note of any critical frequency, deformations, breaks or other damages and repeat operation tests as per specific device P.S., checking that "as new" limits are still met (para [3.8.1](#)).

3.10.4.3

Random vibrations for Class V2-V3-V4 devices

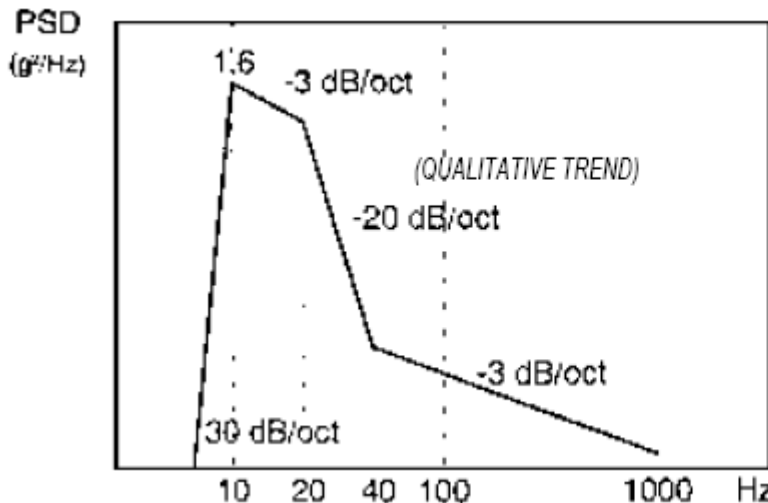
Install device (for which this test is required by table at para [3.10](#)) on energizer in order to reproduce vibration profiles below (they can be modified in each case as a function of on-vehicle installation type), to be detected on device restraint point; during test, device shall be submitted to a temperature cycle and supplied as per para [3.11.3](#) (slow temperature cycles).

- for Class V2, V3 devices:



Oscillation Frequency: from 5 to 1000 Hz
Initial slope: >30 dB/oct
Power Spectral Dens.: 0.213 g²/Hz at 10 Hz
Slope from 10 to 1000 Hz: -3 dB/oct
Acceleration: 3.15 g(RMS)
Duration: 8 hrs per axis (3 axis)

- for Class V4 devices:



Oscillation frequency: from 5 to 1000 Hz
Initial slope: >30 dB/oct
Power Spectral Density: 1,6 g²/Hz at 10 Hz
Duration: 8 hrs per axis (3 axis)

- for Class V3 devices, in addition to 1st test, specific device P.S. shall define appropriate vibration profile simulating moving part closing.

Repeat functional tests required by relevant P.S. and make sure that "as new" limits are still met (para [3.8.1](#)). Also inspect part under test for any distortion, breakage or damage.

3.10.5

Mechanical shock

Device shall be submitted to both mechanical shock tests shown below, above stress levels below, without any damage nor performance degradation.

Test 1 refers to hollows, while test 2 refers to mechanical stress loads following minor impacts.

Therefore, all devices shall be tested, regardless from installation site, as per Std. IEC 60068-2-27 Ea, performing test 1 at first and then test 2 on the same device, normally supplied and correctly mated to related electric connector(s) and with harness placed and fastened on vehicle.

	Test No. 1	Test No. 2
Acceleration [m/s ²]	245	981
Duration of rated mechanical stress	15	11
Shape of rated mechanical stress	Half sine	Half sine
Number of impacts per axis (positive and negative)	10 x 6=60	3 x 6=18

3.10.6

Door/deck lid/hood closing test

Device to be submitted to specific mechanical stress tests for closing components (door, deck lid, tailgate and hood) beyond stress levels listed in table, with no damages nor performance degradation, undesired operation, discontinued or no operation.

Moreover, device shall not show any mechanical degradation (break, cracks, squeaking, knocking, etc.), same for restraints and mounts. All connectors suitable to production purposes shall have required mechanical integrity.

Therefore, all devices belonging to installation site concerned by said stresses, regularly supplied and correctly mated to related electric connector(s) and with harness placed and fastened on vehicle, shall be tested, regardless from concerned installation site, as per Std. IEC 60068-2-29 Eb.

Acceleration	392 m/s ²
Duration of rated mechanical stress	6 ms
Shape of rated mechanical stress	Half sine

Closure	Number of mechanical stresses (in main direction)
Driver side door	100 000
Passenger side door/tailgate	50 000
Trunk lid	30 000
Rear doors	20 000
Hood	1500

3.11**Temperature tests**

Table below specifies tests to be carried out on devices as a function of their installation class.

In order to carry out tests listed in table below, use equipment as per specification directives.

Devices shall be prepared complete with all their parts on one support reproducing position on vehicle due to their location and restraints.

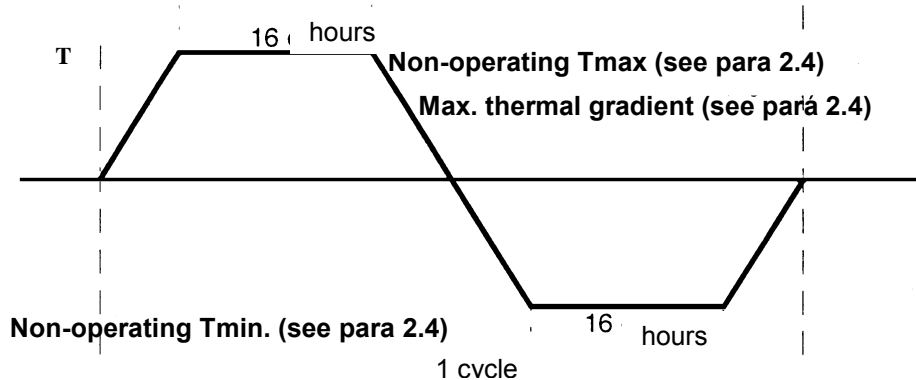
Devices operating when live shall be installed so that prescribed voltage can be applied during test and as per installation constraints referred to electric ground.

INSTALLATION		CI1	CI2	CI3	CI4	CI5
BENCH TESTS	Para. 3.11.1	Storage temperature	X	X	X	X
	Para. 3.11.2	Heat stroke	X	X		
	Para. 3.11.3	Slow temperature cycles	X	X	X	X
	Para. 3.11.4	Quick temperature cycles	X	X	X	X
	Para. 3.11.5	Permanent humid heat test	X	X	X	X
	Para. 3.11.6	Condensation products	X	X	X	X

Unless otherwise specified, during tests, device shall operate in vehicle use conditions related to applied stresses (OC2-1, OC2-2, OC3-1, OC3-2 with type FT1 monitoring).

3.11.1**Storage temperature**

Device shall be submitted to two temperature cycles of type mentioned below using a chamber for regular temperature cycling tests that shall automatically reproduce cycles with values ranging between 200 thru – 50°C, able to reach and maintain temperatures defined in graphic below in all points, within a $\pm 2^{\circ}\text{C}$ tolerance. Chamber to be built so that in no point samples are exposed to direct radiation thru heating elements.



As the test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

Test to be carried out in OC1-2 operating condition.

3.11.2

Heat stroke

Perform test in an environmental chamber (oven) capable of reaching and maintaining a temperature corresponding to specified severity level within specified tolerance in all points, with $\pm 2^\circ\text{C}$ relative humidity. Chamber shall be constructed in such a way that parts are nowhere subjected to heating by direct radiation of heating elements.

Expose devices (for which this test is required by table at para [3.11](#)), equipped with own connectors, to 120°C temperature (for CI1) or 140°C (for CI2), for 30 minutes after reaching max. operating temperature (OC1-2).

Device shall operate (in operating load condition) during the last 3 min test (OC2-1, OC2-2, OC3-1, OC3-2 with type FT1 monitoring), checking that it behaves as per type M3.

As test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

For specific use cases (see table at para [2.4](#)) related to classes included between T5/1 and T5/4, directives shall be clearly and uniquely defined in specific device P.S.

3.11.3

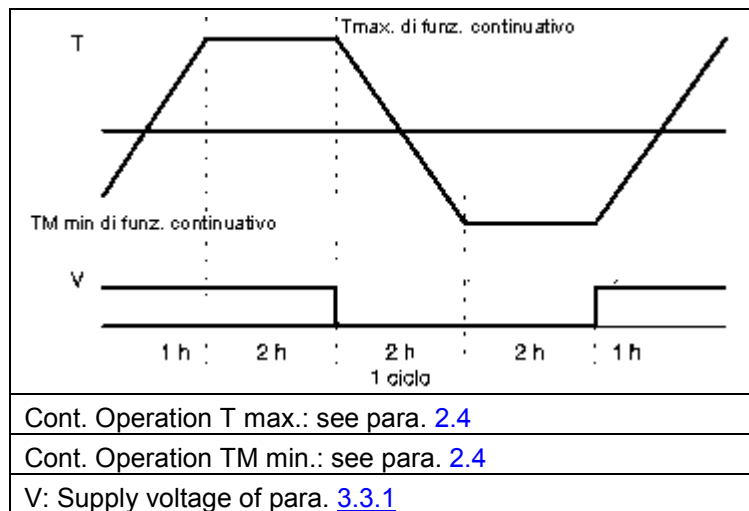
Slow temperature cycles

Perform test using a test chamber at regular temperature cycles, automatically reproducing cycles ranging between 200 thru -50°C and it shall be able to reach and maintain temperatures defined in graphic below in all points, within $\pm 2^\circ\text{C}$ tolerance. Chamber shall be built in such a way that parts are nowhere exposed to heating by direct radiation of heating elements.

Test to be carried out with device operating for period defined in graphic below, adopting required test temperature, depending on device temperature class "T" and "TM" (continuous operation temperatures).

During operation time, device to be supplied and connected as per drawing, implementing operating conditions defined by specific device P.S.

Perform 10 cycles, each one consisting of:



As test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.11.4

Quick temperature cycles

Perform test with one of methods below:

A) A combination of

- 1 Environmental chamber (oven) capable to reach and maintain required operating temperatures in all points (max. non-operating temperatures) depending on device temperature class "T", within a tolerance of $\pm 2^\circ\text{C}$ tolerance and built in such a way that samples are nowhere exposed to heating by direct radiation of heating elements.
- 2 Chamber for low temperature tests (refrigerator) to reach and maintain required operating temperatures in all points (max. non-operating temperatures) depending on device temperature class "TM", within a tolerance of $\pm 2^\circ\text{C}$ tolerance.

B) Or, a combined chamber (hot chamber + cold chamber) with characteristics equivalent to those described in item A.

In both solutions (A or B) transfer from one chamber to the other shall take place in less than 30 s.

Test to be carried out in OC1-2 operating condition.

Stay time in each chamber, depending on device under test, is defined in table below, as well as number of cycles to be performed.

Weight (kg)	Holding time	Number of cycles
< 0.2	1 h	100 for installation classes CI1 and CI2
≥ 0.2 and < 0.8	2 h	
≥ 0.8 and < 1.5	3 h	
≥ 1.5	4 h	50 for installation classes CI3, CI4 and CI5

As the test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.11.5

Permanent humid heat test

Test device, equipped with its connector and any protection.

using a permanent humid hot test chamber able to reach and maintain $40 \pm 2^\circ\text{C}$ temperature with 90 thru 95° relative humidity in all points. Air shall circulate slowly inside chamber that shall be constructed in such a way that samples are nowhere directly exposed to water steam nor condensation. Each device shall have min 5 cm clearance from each internal chamber surface and any other device under test.

Adopt levels of severity below, depending on installation class:

INSTALLATION CLASS	TEST TIME
CI3	72 h
CI1, CI2, CI4, CI5	168 h

During test, device shall be supplied with a voltage having similar trend that voltage used for slow temperature cycling test, i.e. 4 hours of supply voltage application (OC2-1, OC2-2, OC3-1, OC3-2 with type FT1 monitoring) performed at 4 hours rest (OC1-2).

As the test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Remove any traces of humidity produced on surface using ambient temperature compressed air.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.11.6

Condensation products

Perform test on a device fitted with own connectors and any guards applied (OC1-2), alternatively:

1. permanent humid hot test chamber able to reach and maintain $40 \pm 2^\circ\text{C}$ temperature with 90 thru 95° relative humidity in all points. Air shall circulate slowly inside chamber that shall be constructed in such a way that samples are nowhere directly exposed to water steam nor condensation. Each device shall have min 5 cm clearance from each internal chamber surface and any other device under test.
2. low temperature test chamber (refrigerator), capable of reaching and maintaining in all points a temperature of $-10\% \pm 2^\circ\text{C}$.

Transfer between test environments is to take no longer than 3 minutes.

Adopt following levels of severity:

TIME OF EXPOSURE AT DAMP HEAT	TIME AT -10°C
16 h	2 h

As the test is completed, remove device from the chamber and place it in controlled environment as described at para [3.3.1](#) for at least 2 hours for complete reconditioning.

Remove any traces of humidity produced on surface using ambient temperature compressed air.

Repeat operation tests required by relevant P.S. and make sure that "as new" limits are still met. Also inspect part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.12

Acoustic tests

Perform on device all tests related to operating acoustic, legislative, NVH aspects defined in specific device P.S.

3.13

Physical/chemical tests

Table below specifies tests to be performed on devices as a function of their installation class complete with all their parts, on a support reproducing device installation condition on vehicle by position and restraints.

INSTALLATION CLASS			CI1	CI2	CI3	CI4	CI5
BENCH TESTS	Para. 3.13.1	Water tightness strength	X	X	X	X	X
	Para. 3.13.2	Dust test	X	X	X	X	X
	Para. 3.13.3	Corrosion treatment resistance.	X	X	--	X	--
	Para. 3.13.4	Salt spray test	X	X	X	X	X
	Para. 3.13.5	Resistance to industrial atmosphere	X	X	--	X	--
	Para. 3.13.6	Specific fluids resistance	X	X	X	X	--
	Para. 3.13.7	Leakage evaluation	X	X	--	X	--

X: Required test.

--: Testing not required

3.13.1**Water tightness strength**

Perform test (on devices for which this test is required by table at para [3.13](#)) both as new and after 10 slow temperature cycles (see para [3.11.3](#)) on device equipped with own connectors and any guard, as per modalities specified by Std. ISO 20653:2006. Required degree of protection shall in any case be defined by specific device P.S., considering installation on vehicle. If this indication is lacking, table below shall be applicable:

CLASS	DEFINITION	Minimum IP
CI1 or CI1/CC	Installation in engine compartment	IP6K9K
CI2 or CI2/CC	Installation on powerplant	IP6K9K
CI3 or CI3/CC	Installation in passenger compartment or trunk	IP5K2
CI4 or CI4/CC	Installation on vehicle exterior	IP6K9K
CI5 or CI5/CC	Installation in door frame opening	IP5K2 / IP5K3 (**)

(**) NOTE: Code IP5K2 is assigned to devices installed in dry door area, IP5K3 is code assigned to devices installed in humid area.

Device classified as belonging to one of CIx/CC classes, must be designed and built so as to allow conformal coating or resin painting with no need of further variants.

Requirement for conformal coating or resin painting should be reported in specific P.S. and/or targeted specifications.

3.13.2**Dust test**

Perform test (on device for which this test is required by table at para [3.13](#)), equipped with own connectors and any guard, as per modalities specified by Std. ISO 20653:2006 paras 8.3.1 and 8.3.3.2.

In order to carry out this test:

- Use 4.5 kg coarse grade dust for each chamber m³ as per SAE J 726.
- Use a cubic chamber with dimensions appropriate for samples under test, however not smaller than 915 mm side and with minimum 150 mm clearance between samples and walls and between samples, able to stir dust using compressed air or ventilators blowing from up downwards for uniform diffusion throughout chamber.
- Non-ventilated test ambient, 23 ± 5°C temperature, 45 thru 70% relative humidity.

Test shall last 5 hours, stirring dust 2 s at 15 min intervals

At end of test, take out device and remove dust that has accumulated on the outside, using a soft brush. Take care that no further dust enters inside, but do not remove dust that is already there.

Repeat operation checks defined in specific device P.S. to make sure that "as new" targets are still met.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.3**Corrosion treatment resistance**

Submit devices (for which this test is required by table at para [3.13](#)) to oil spray resistance test as per modalities below:

- Test environment as specified in para. [3.3.1](#).
- Test liquid consisting of a mixture of 50% fuel oil (EN590) and 50% oil (UNI 20157).

Expose device to 0.5 l spray till mixture exhaustion, keeping atomizer at a 200 thru 250 mm distance from object. Make sure that jet hits all device parts.

During test, device shall be equipped with own connectors and any protection.

Let device rest for 24 hours in ambient described at para [3.3.1](#).

Repeat the functional checks required by the relevant P.S. and make sure that "as new" limits are still met. Also inspect the part under test for any distortion, breakage or damage.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.4

Salt spray test

Expose devices to salt spray test as per modalities defined in Table 50180 – Method A1 for defined time:

INSTALLATION CLASS	TEST TIME
CI1, CI2	96 h/200 h
CI4, CI5	96 h
CI3	48 h exposing only parts at sight

NOTE: For all devices with CI1, CI2 installation class, stay time shall be agreed from time to time between Fiat Group Automobiles and one of suppliers included in table above. In case this agreement is lacking, stay time to be 200 hours.

During test, device shall be equipped with own connectors and any protection.

Acceptability criteria, from appearance point of view, are as follows:

- Exposure up to 96 hours: no traces of corrosion on base metal.
- Exposure up to 200 hours: corrosion traces admissible provided they do not adversely affect device operation.

At end of test, repeat operation checks defined in specific device P.S. to make sure that "as new" targets are still met.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.5

Resistance to industrial atmosphere (Kesternich test)

Submit device (for which this test is required by table at para [3.13](#)) to industrial atmosphere exposure test as per Std. 50180 - Method D1, for 2 cycles (1 cycle = 8 hours in industrial atmosphere and 16 hours at ambient temperature).

During test, device shall be equipped with own connectors and any protection.

From appearance point of view, acceptability criteria shall be defined by specific device P.S.

Repeat operation checks defined in specific device P.S. to make sure that "as new" targets are still met.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.6

Specific fluids resistance

Expose device (for which this test is required by table at para [3.13](#)) to fluids shown in table below as a function of its installation class.

Perform tests as per paras [3.13.6.1](#), [3.13.6.2](#), [3.13.6.3](#).

INSTALLATION CLASS			
CI1	CI2	CI4	CI3
ASTM 5 oil at 50°C		-	-
Battery solution as per Type C of FIAT Std. 55870 at 23 ± 5°C		-	-
50% mixture coolant fluid (as per Proc. Spec. 9.55523) and water at 50°C		-	-
50% mixture windshield washer fluid (as per Proc. Spec. 9.55522) and water at a 23 ± 5°C			-
Diesel as per Std. EN590 at 23 ± 5°C		-	-
ASTM C gasoline or premium unleaded gasoline (Std. 55509) at 23 ± 5°C		-	-
Brake fluid as per P.S. 9.55597 Class DOT 4 at 23 ± 5°C			-
-		Water and surfactant (5%)	-
-		Protection waxes as per P.S. 9.55846	-
-		Unwaxing products	-
-		-	See para. 3.13.6.2

3.13.6.1**Modalities for classes CI1 and CI2**

Perform test, in a non cumulative way, on device equipped with own connectors and secured as on vehicle operation.

NOTE: During liquid test, precautions below shall be adopted:

- Device or fluid temperature shall never exceed 75% of value corresponding to fluid flammability point;
- Max fluid temperature shall be 50°C.

Pre-heat device for 2 hours at 60 ± 2°C temperature before exposure to each fluid action.

Spray hot liquid at required temperature throughout surface till soaking it completely.

Let device condition for 24 hours at ambient temperature.

Repeat operations above for 2 more times.

At the end of the third exposure to fluid, dry device with a cloth and check for no deformations, breaks nor other damages.

Finally, expose device to an operation test within 10 minutes from end of latest exposure to fluid.

Device shall operate correctly.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.6.2**Modality for class C13**

Perform test with all agents defines by Std. ISO/WD16750-5, table 4.

Wipe to apply agents (using cotton wool soaked in agent) or atomize, using a brush to cover device completely.

Check that treated surface is free from softening, sticking, stains or other alterations.

Submit device to operation test within 10 minutes from end of each exposure to fluid. Device must operate correctly.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.6.3**Modality for class C14**

Manually wipe for 10 s exposed device surface with cotton wool soaked in water and surfactant.

Perform waxing and de-waxing cycle as per P.S. 9.55846.

Visually check that treated surface is free from soft spots, tackiness, stains or other defects. Slight loss of brightness is allowed.

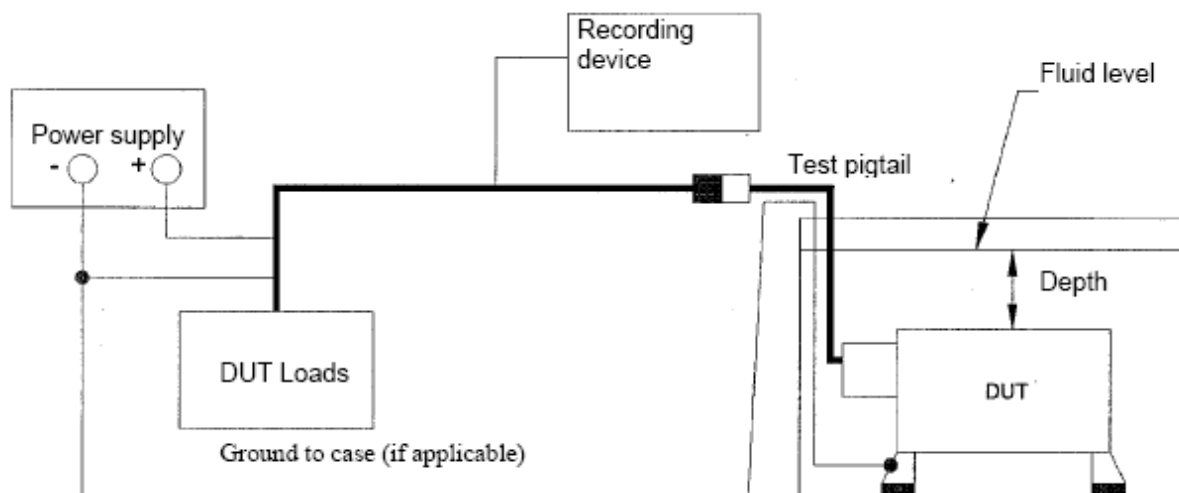
After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.13.7**Leakage evaluation**

Purpose of this test is to check device operation after exposure to thermal shocks induced by air heating and water cooling. Carry out this test on sealed devices to check for seal efficiency.

This test shall be performed for IPX7, IPX8, IPX9K classified devices.

This test performance procedure requires that device be placed in an environmental chamber at T_{max} temperature (para [2.4](#)) for 30 minutes, then dipped in 5% sodium chloride/de-ionized water solution with addition of inert dye.



Water Submersion Test Setup

Test voltage	V_{\max} (para. 2.6)
Fluid temperature	0°C
Device temperature above fluid temperature	T_{\max}
Depth	76 ± 5.0 mm

Device dip time shall be 30 min.

Test to be carried out in OC3-1 operating conditions with type FT1 monitoring.

Repeat this procedure four times for a total of five cycles (wait 10 min between cycles).

At end of test, opened and examined device shall show no lack of casing seal integrity, plastic part bulging, resin seal failure, loss of label adhesion nor adversely affected readability.

After test, device shall pass limit operating conditions test (para [3.8.1](#)).

3.14

Reliability test

Device shall be submitted to reliability test based on a test cycle able to simulate with laboratory tests same device on-field use conditions. Therefore, test cycle shall expose sample to on-vehicle stresses, such as, for instance, temperature cycles (possibly similar and therefore replaced by slow temperature cycles), key on/off, vibrations, key/knob operations, humidity, salt spray, door/hood/tailgate slam; these stresses shall be applied simultaneously.

Total test duration and number of devices to be used shall depend on type of result analysis method to be used (Weibull or Success Run). This information, together with type of test cycle to be used, shall be defined in specific device P.S. or in device Requirement Specification.

3.15

Life test

Test and number of devices to be tested are defined in technical requirements P.S. and/or specific device P.S.

3.16

System integration bench test

3.16.1

Distributed functions check

Test device distributed functions as per Std. 7-Z0149. Test to be carried out by Fiat Group Automobiles.

3.17

On-vehicle tests

Product qualification depends on positive results of on-vehicle tests carried out by Fiat Group Automobiles.

Perform tests from para [3.17.1](#) to para [3.17.6](#).

3.17.1

Operating logics strength test

Test operating logics strength of device installed on vehicle as per Std. 7-Z9201.

3.17.2**Immunity to radiated electromagnetic fields**

Devices (for which this test is required as per table at para [3.9.1](#)) shall be submitted to electrostatic discharge tests as per paras [3.17.2.1](#) and [3.17.2.2](#).

3.17.2.1**Immunity to radiated electromagnetic fields generated outside vehicle**

Devices installed on vehicle in their final configuration shall be submitted, in operating conditions, to an electromagnetic field within frequency range from 10 kHz to 18 GHz.

Test to be carried out with following three types of signals:

- CW (without modulation)
- AM 80% modulation $f_m=1$ kHz, with same peak-to-peak amplitude of the non-modulated signal
- GSM modulation, with 577 μ s duration burst and 4600 μ s period, limited to frequency range greater than 800 MHz.

Table below shows, as a function of operating class, the level of severity and corresponding required behavior mode.

OPERATION	TEST FIELD STRENGTH (V/m rms)	REQUIRED BEHAVIOUR MODE	Reference standard
FG0	150 V/m (★)	M2	7-Z0480
FG0, FG1	100	M1	
FG2	50	M1	

(★) Test with this severity level to be performed only for devices whose operation degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.) During this test, no operation degradation admissible that might:

- Degradation might bring about severe impediments or obstacles to driver vehicle control (e.g. airbag burst, impossibility to operate brakes or steering wheel, spurious uncontrolled operation of brakes or steering wheel, etc.).
- Affect safety of passengers and/or of other road users.

3.17.2.2**Immunity to interferences generated by on-board receivers and transmitters**

Devices installed on vehicle in their final configuration shall be immunity tested, in operating conditions, for interferences emitted by on-board receivers and transmitters, performed as per Std. 7-Z0482.

Behavior shall be type M1.

3.17.3**Measuring electromagnetic emissions irradiated by devices fitted on vehicle**

Devices (for which this test is required as per table at para [3.9.1](#), installed on vehicle in their final configuration, shall not radiate radiofrequency emissions greater than those indicated in table below, expressed in dB (μ V/m). Emissions are measured by peak or quasi-peak detector.

FREQ. BAND (MHz)	BROADBAND LIMIT (dB(μV/m) IF BAND WIDTH		NARROW BAND LIMIT (dB(μV/m) (riv. Average)	Standard
	120 kHz Quasi-peak detector	120kHz Peak detector		
30 to 75	32	52	22	Dir. EC 2004/104 Anx. 4 and 5 and amendments
75 to 400	32+15.13* log (f/75)	52+15.13* log (f/75)	22+15.13* log (f/75)	
400 to 1000	43	63	33	
1000 to 2500	53	73	43	CISPR 12

f = frequency in MHz

In case measurement takes place at a distance of 3 m (instead of 10 m), all table above levels shall be increased by 10 dB.

3.17.4

Emissions picked up by the on-board receiver antenna

Devices (for which this test is required as per table at para [3.9.1](#)), installed on vehicle in their final configuration, shall not radiate radiofrequency emissions greater than those indicated in table below, expressed in dB (μV), during their regular operation.

FREQUENCY BAND (MHz)	NARROW BAND LIMIT dB(μV)	BROADBAND LIMIT dB(μV)		Std. 7-Z0484
		PEAK DETECTOR	QUASI-PEAK DETECTOR	
0.15 to 0.3	6	22	9	
0.53 to 2	0	19	6	
5.9 to 6.2	0	19	6	
26.9 to 54	0	28	6 (15 ¹)	
70 to 87	0	28	6 (15 ¹)	
87 to 108	6	28	6 (15 ¹)	
115 to 172	0	28	6 (15 ¹)	
300 to 330	0	28	6 (15 ¹)	
420 to 512	0	28	6 (15 ¹)	
800 to 1000	0	28	6 (15 ¹)	
1200 to 1300	0	28	6 (15 ¹)	
1700 to 2050	0	28	6 (15 ¹)	
2400 to 2500	0	28	6 (15 ¹)	

- 1) *Only for interferences caused by ignition system.*

For devices operating for a short time and with manual operation, if they do not impact on vehicle type-approvability concerning electromagnetic compatibility, broad band test limits are increased by 10 dB.

For radio broadcasting band frequencies, test shall be carried out using vehicle standard aerial; for frequencies used by receivers and transmitters, a specific aerial shall be used for each concerned band (e.g. Governmental agencies, Ambulances, Fire Brigades, Airport services, etc.).

3.17.5**Transient disturbance emission**

During their regular operation (including switch ON/OFF) and during ignition key ON/OFF, devices for which this test is required by table at para [3.9.1](#), installed on vehicle in final configuration, shall not generate whose width falls within -60V and +60V range in parallel to power supply lines and/or in parallel to inductive loads and -60V / +(60+V_{batt})V referred to body potential if measured on any line.

Test method is described by Std. 7-Z0485.

3.17.6**Immunity to electrostatic discharges**

During their regular operation on vehicle, devices (for which this test is required as per table at para [3.9.1](#)) must be submitted to the following electrostatic discharge test described in table below:

CLASS	VOLTAGE	CAPACITY	RESISTANCE	Reference standard
SE1	± 8 kV	330 pF	2 kΩ	7-Z0483
SE2	± 15 kV	150 pF	2 kΩ	

Table below shown required behavior as a function of operating class.

OPERATION CLASS	REQUIRED BEHAVIOUR MODE
FG0, FG1	M1
FG2	M2

4**REQUIREMENTS FOR PRODUCT MAINTENANCE AND EVOLUTION**

Throughout life cycle, Supplier shall ensure maintenance of device characteristics and performance, e.g. with yearly repetition of all tests as per this P.S., in any case it shall satisfy requirements of Procedure 07741.

4.1**Device change requirements**

If any device aspect is changed as to qualification, all tests as per this P.S. shall be repeated on said aspect, unless otherwise agreed between E&D and Supplier (test exemption, simulation demonstrations and calculations, etc.).

4.2**Requirements for device carry over**

In case of device CARRY-OVER on vehicle models different from those for which it has already qualified, qualification shall take place again as per the issue of this Specification applicable at supply assignment time.

Any exemption from this directive shall be agreed in writing between E&D and Supplier.

5

REQUIREMENTS FOR SUPPLY INSPECTION (to be carried out by Quality acceptance Dept.)

Supply inspection shall be carried out according to P.S. 9.01102/01 (Restricted distribution).

6

SUPPLIER REQUIREMENTS

Supplier must comply with general requirements contained in P.S. 9.01102 "QUALITY OF SUPPLIES" and namely to requirements and requests contained in P.S. 9.01102/09 "Supplier's Technical Documentation".

6.1

Product qualification supplies

Supplier shall submit amount of product specified in purchase order and attach Quality and Conformity Certificate (see P.S. 9.01103). Non-conformities not admitted.

6.2

Production supplies

Supplied product shall conform with drawing and this Specification. When selecting manufacturing process to be adopted and severity of inspections, supplier shall take into account classes of importance that Fiat Group Automobiles has assigned to each characteristic requirements refer to (see para. 7).

NOTE: Checks may be performed on components subjected to non-destructive tests (indicated by ND at para. 7) during product qualification and supply inspection. Devices subjected to destructive tests (D) may not be used for further tests or inspections unless otherwise specified case by case.

7

CLASSIFICATION OF CHARACTERISTICS

CLASSIFICATION OF CHARACTERISTICS		TYPE OF TEST
Appearance	Major	ND
Dimensions and tolerances	As per P.S. 9.01102 unless otherwise specified on drawing	ND
Marking	Zero defects	ND
Materials	◆	D
Surface coatings	◆	D
Connections and fittings	◆	ND
Electric characteristics	◆	D
Function requirements	◆	ND
Electrical and electromagnetic tests	◆	D
Mechanical tests	◆	D
Temperature tests	◆	D
Physical/Chemical tests	◆	D
Reliability test	◆	D
Life test	◆	D

◆ To be filled out as per specific device P.S. as a function of device type, operating class, behavior and installation on vehicle.

8

REFERENCES

7.Z0100 - 0.00013 – 00160 - 01931 -07223 - 07234 -07234/01– 07274 - 07209 - 07284 – 07284/01 - 07324 – 07328 - 07416 – 07610 - 07740 - 07741– 09004 – 09006 – 09006/01 – 09006/02 – 09006/03 – 09006/04- 09009 – 09035 - 7-A7509 - 7-A7510 - 7-A7525 – 7-G2000 - 7-Z0050 – 7-Z0051 – 7-Z0059 – 7-Z0070 – 7-Z0071 - 7.Z0250 - 7.Z0200 - 7-Z0140 – 7.Z0141 – 7-Z0142 - 7-Z0145 – 07320 – 07321 – 07322 – 07325 – 07326 – 07331 – 07332 – 7-Z9201 -7-Z0146 – 7-Z0147 - 7-Z0148 – 7-Z0149 – 7-Z0440 – 7-Z0441 – 7-Z0443 – 7-Z0444 – 7-Z0445 – 7-Z0446 – 7-Z0449 - 7-Z0450 – 7-Z0470 – 7-Z0471 – 7-Z0472 – 7-Z0480 – 7-Z0482 – 7-Z0483 – 7-Z0484 – 7-Z0485 - 7.R0100 - 50180 - 55509 - 55870 - 9.01100 – 9.01100/01 - 9.01102/09 - 9.01102/01 - 9.01103 - 9.01102 - 9.55522 - 9.55523 - 9.55597 - 9.55846 – 9.91320/02 - 2004/104/EC - ONU 10 - CISPR25 – CISPR12 - EN 590 - UNI 20157 - SAE J 726 - IEC 60068-2-27 Ea - IEC 60068-2-29 Eb - ISO/TS 16949 - ISO 17025 - ISO 7637-2:2004 – ISO/WD16750-2_N272 – ISO/WD16750-5 –

ISO 11452-4:2005 – ISO 11452-5:2002 – ISO 11452-2:2004 - ISO/DIS 11452-8:2005 –

ISO 10605:2001 - ISO 20653:2006 - UL94 V-0