MEASURE OF EMISSIONS CONDUCTED ON SUPPLY LINES GENERATED BY ELECTRIC, ELECTRONIC AND ELECTROMECHANICAL DEVICES

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1 PURPOSE

Defining test procedure and apparata adapted to verify at the bench and under the different conditions of use, pulse and stationary disturbances emitted by electric/electronic/electromechanical systems on supply lines and measured in the frequency range, are in the limits of this Standard to guarantee the absence of interference with other electronic systems or radioreceiver antenna installed on vehicle.

2 SUBJECT

The present Standard is valid for apparata installed on vehicles with 12V or 24V system and equipped with internal combustion engine with “Otto” or “Diesel” cycle.

Edition	Date	Description of modifications	Group
1	16.07.2001	New.	
2	28.11.2003	Supervisor and Manager added; Title, points 1, 5.3, Table 1, point 5.4 and Table 2 modified.	
3	23.01.2006	Modified: Supervisor and Manager Dept.; Table 3, point 8. Point 7.1 added.	**PEL**
4	21.04.2006	Point 7.1 modified.	
5	15.01.2009	Supervisor, point 6.4 “Acceptability limits – Table 3” changed; editorial changes made. Managing dept. updated.	

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3 GENERAL TEST CONDITIONS

3.1 In general

The tests must be carried out on systems whose electronic components have already passed the functional checks recalled in the general specification IVECO STD. 18–2252 and in specific specifications.

3.2 Test environment

The room must have such sizes as to contain test instruments and table.

Environmental reference characteristics during the test must be:

- Temperature: 20 ± 2°C
- Relative humidity: 45–70%
- Atmospheric pressure: 860–1060 mbar

The test place must be free from disturbances that can affect the test results; otherwise it is necessary to use a screened semianechoic chamber of adequate sizes that must have the following characteristics:

a) minimum screening attenuations with respect to the electromagnetic fields must be:
for electric field 100dB from 100kHz to 10GHz;
while
for magnetic field 60dB from 10kHz to 200 kHz

b) minimum reflection coefficients for anechoic material must be as follows:
   - 35dB or better at 200MHz
   - 50dB or better at 1GHz

4 TEST INSTRUMENTS

4.1 Test table

It must be made of insulating material (for example wood), with sizes adapted to house the ground plane.

4.2 Ground plane

It must be made of sheet with high electric conductivity (copper, aluminium, brass, galvanized steel). Minimum thickness 1.5 mm, minimum sizes 2x1 m.
The ground plane will have to be connected to the building earth line through suitable copper braid welded to the plane itself.

4.3 Power supply

It must have an adjustable voltage between 0 and 40V, 50A, with 12V, 45Ah, 225A buffer batteries.

4.4 **Impedance stabilising network**

It must have the electric circuit and the impedance characteristic when frequency changes like in **Figure 1** and satisfy the following requirements:

– the resistance between terminals P and A must be less than 5 mOhm;

– the impedance measured between terminals P and B, when terminals A and B are short–circuited, must not be offset by more than 10% from the theoretical curve shown in **Figure 2**, in the 100kHz–20MHz frequency band;

– the C2 capacity must withstand continuous voltages equal to at least 1500V;

– the inductance L must withstand the supply current of the tested device.

IMPEDANCE STABILISING LINE (L.I.S.N.)

Electric diagram

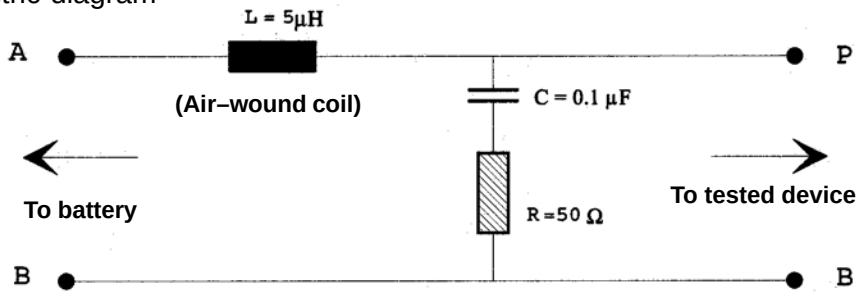


FIGURE 1

Impedance module

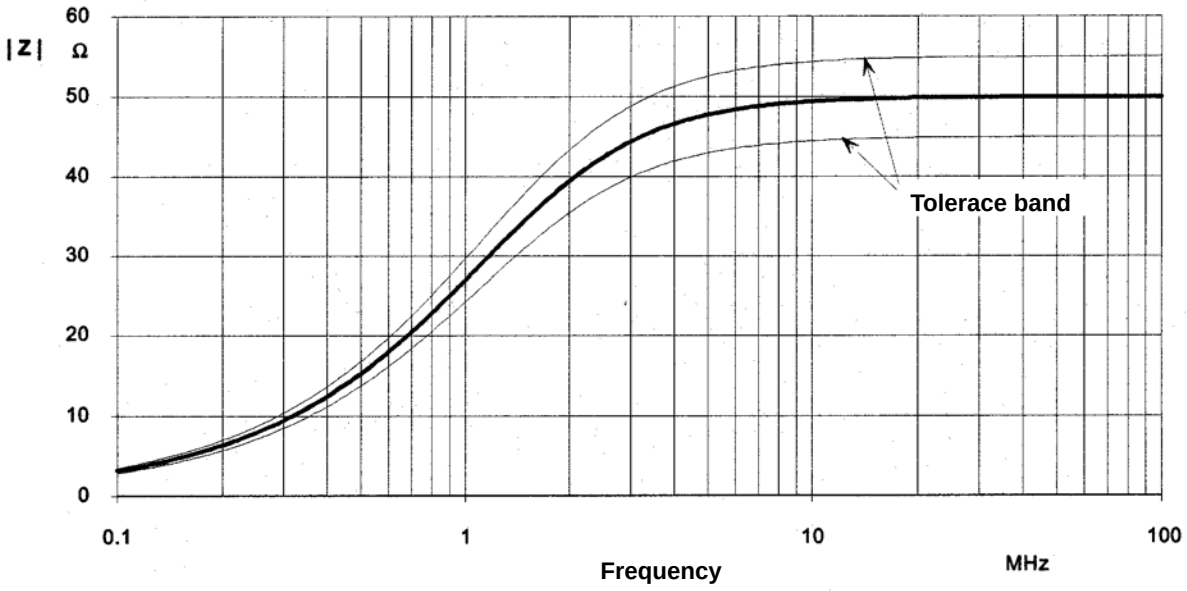


FIGURE 2

4.5 Tested device stimulating system

– It must allow the correct operation of the tested device under normal operating conditions, as provided in the drawing or the related specifications;

– It must be able to correctly interface system sensors and actuators being checked, without modifying their electric characteristics (impedances).

4.6 Receiver or spectrum analyser

It can be a measuring receiver or a spectrum analyser equipped with preselector; in any case, it must have the following characteristics:

– measuring frequency range: 150kHz to 110 MHz

– sensitivity: at least 10 dBuV (equal to –97dBm) at 150 kHz, with bandwidth equal to 10 kHz and with peak detector;

– sensitivity: at least 0 dBuV (equal to –107dBm) at 150 kHz, with bandwidth equal to 9 kHz and with semi–peak detector;

– input impedance: 50 ohm

– bandwidth: selectable at least between the following values: 10kHz and 100kHz; in case of use of semi–peak detector, 9 kHz and 120 kHz

– detector: peak type, for spectrum analyser;
peak type, with mean value and possible semi–peak for measuring receiver.

The detector must have the following rated characteristics:

DETECTOR TIME	CHARGING TIME CONSTANT (tc)	DISCHARGING TIME CONSTANT (ts)	
		0.15 – 30 MHz	Over 30 MHz
SEMI–PEAK	1 ms	160 ms	550 ms
PEAK	<< 10 μs	1 s (*)	
MEAN VALUE	100 ms	100 ms	

(*) Not applicable in case a spectrum analyser is used.

5 TEST PREPARATION

5.1 Equipment arrangement

Get through system people the necessary technical documentation to carry out the test, including:

– Tested system operating conditions.

– Stimulating system.

– System connection lay–out during the tests.

Arrange instruments on the test plane like in the set–up to be reproduced that is included as a diagram in **Figure 3**.

Arrange the system to be checked at a distance of 50 ± 5 mm from the ground plane and insulated therefrom, unless the direct ground connection on body is expressly provided; in such case, the connection with the test plane must be as short as possible.

Arrange the supply line (positive and negative) from test device to impedance stabilising network with two Cu cables with 2.5 mm^2 section, 500 ± 50 mm long, arranged in parallel and mutually approached, spaced by 50 ± 5 mm from the ground plane. In case of a common connector for supply, signal and control lines, cables related thereto must be arranged at 90° ± 15° with respect to supply cables.

Sensors must be stressed through the stimulating system.

Actuators must be the same ones provided in the drawing to be installed on a car. If they are composed of electric motors, the mechanical load must be present or possibly stimulated by means of a brake.

Battery and supply negatives must be connected to the ground plane.

EQUIPMENT ARRANGEMENT SET–UP

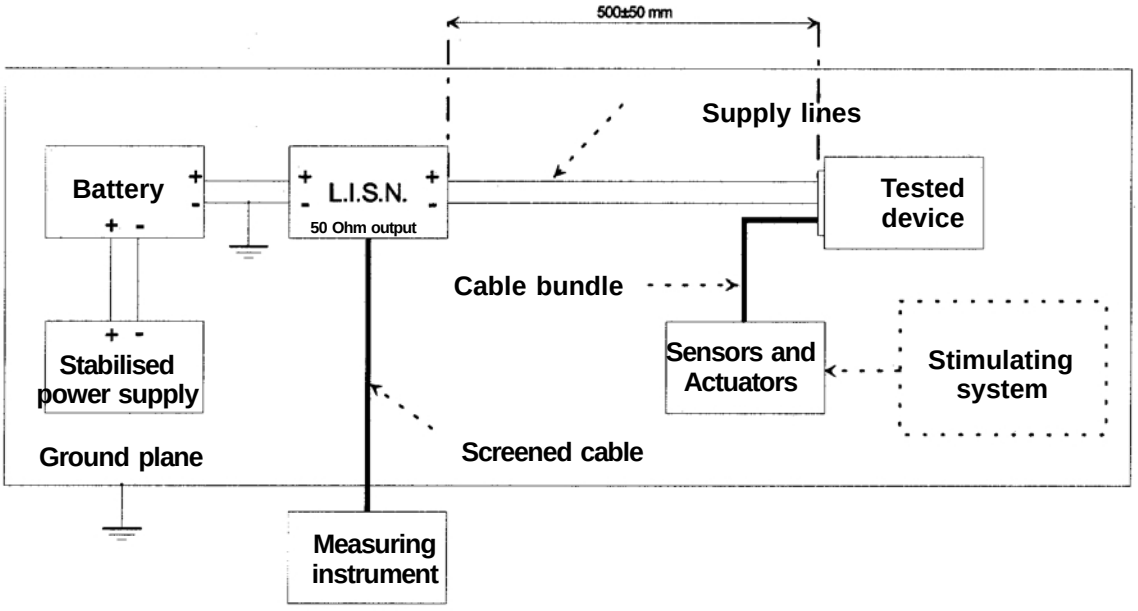


FIGURE 3

5.2 **Test device activation**

– Connect and supply the tested device as provided by the drawing or related specifications.

– Connect the measuring instrument to the L.I.S.N. terminal through a screened coaxial cable.

– Arrange the system under operating conditions mentioned in the specification.

– Apply signals to all electric inputs or physical sensors.

– Activate the system.

5.3 **Arrangements for measuring broad band disturbances**

The measure must be carried out by using peak detector and bandwidth shown in the appropriate column in **Table 1**. When a spectrum analyser is used, the video filter must be adjusted to a value that is equal to at least three times the bandwidth. Alternatively the measure can be carried out with semi–peak detector, in such case by using related bandwidths (**Table 1**).

In case of intermittently–operating devices or anyway rarely–operating devices, operate as follows:

– using a measuring receiver, extend the stay time at every frequency to such a value as to allow proper measurement of disturbance envelope;

– using a spectrum analyser, extend the scanning time and/or insert the memory function (“MAX HOLD”) in such a way as to obtain the satisfactory coverage of the displayed spectrum.

TABLE 1

Bandwidth and video filter and scanning times for measuring broad band disturbances

Sub–band (MHz)	Bandwidth		Spectrum analyser	
	Peak detector	Semi–peak detector	Video filter	Scanning time
0.15 – 30	9 kHz	9 kHz	30 kHz	100 ms/ kHz
30 – 110	120 kHz	120 kHz	300 kHz	1 ms/ kHz

5.4 **Arrangements for mesuring narrow band disturbances**

For measuring narrow band disturbances use the peak detector or the mean value one adopting the same limits.

The test must be carried out by using bandwidths shown in the appropriate column in **Table 2**. Moreover, in order to attenuate broad band disturbances, it is necessary to proceed as follows:

– when a spectrum analyser is used, insert video filter with values shown in the appropriate column in **Table 2**;

– when a measuring receiver is used, use mean value detector.

During the measure, only activate those tested vehicle devices whose operation provides for the presence of a continuous and repeatable signal, for example units with a fixed frequency clock signal. Therefore, all devices are excluded that operate intermittently or for variable periods of a few seconds and all electromagnetic devices, whose disturbance must be deemed as broad band type.

TABLE 2

Bandwidth and video filter for measuring narrow band disturbances

Sub–band (MHz)	Bandwidth	Video filter (Spectrum analyser)
0.15 – 30	9 kHz	100 Hz
30 – 110	120 kHz	300 Hz

6 TEST EXECUTION MODES

6.1 Background noise

In order to guarantee that the measure is not altered by the ambient electromagnetic noise, it must be repeated with the same modes but deactivating all systems being tested; for every sub–band, the thereby–measured level must be by at least 6 dB lower than the corresponding limit shown in **Table 3**.

6.2 Test device activation

Activate the device that has to be tested in such a way as to maximise the emissions.

6.3 Disturbance spectrum measure

In case a measure receiver is used, the whole measuring frequency band must be explored with a pitch that is alway less than or equal to the bandwidth.
In case a spectrum analyser is used, the measuring frequency band scanning must be carried out:

– by using sub–bands and minimum scanning times shown in **Table 1**, when measuring in broad band;

– according to such sub–bands as to guarantee a distance between samples shown on the instrument display that is lower than or equal to the bandwidth, when measuring narrow band disturbances.

Activate the measuring instrument to carry out the measure and store the results (if possible through automatic acquisition on PC). If possible, previously insert the correction of measured data in instrument or in managing software.
In all measures, the input attenuator of the measuring instrument must be adequately adjusted to correctly display the signal.

In order to check that there are no saturation phenomena on the instrument, repeat the measure after having increased by 10 dB the input attenuation: the absolute level of measured disturbances must remain unchanged within ± 1 dB; otherwise, increase the attenuation until this condition is satisfied and then use this new adjustment to carry out the real measure.

6.4 **Acceptability limits for emissions led on supply lines**

Systems/components, installed on a bench, must not generate, during their normal operation, radio-frequency disturbances at higher levels than those shown in the following **Table 3**, expressed in dBuV/m:

TABLE 3

Acceptability limits

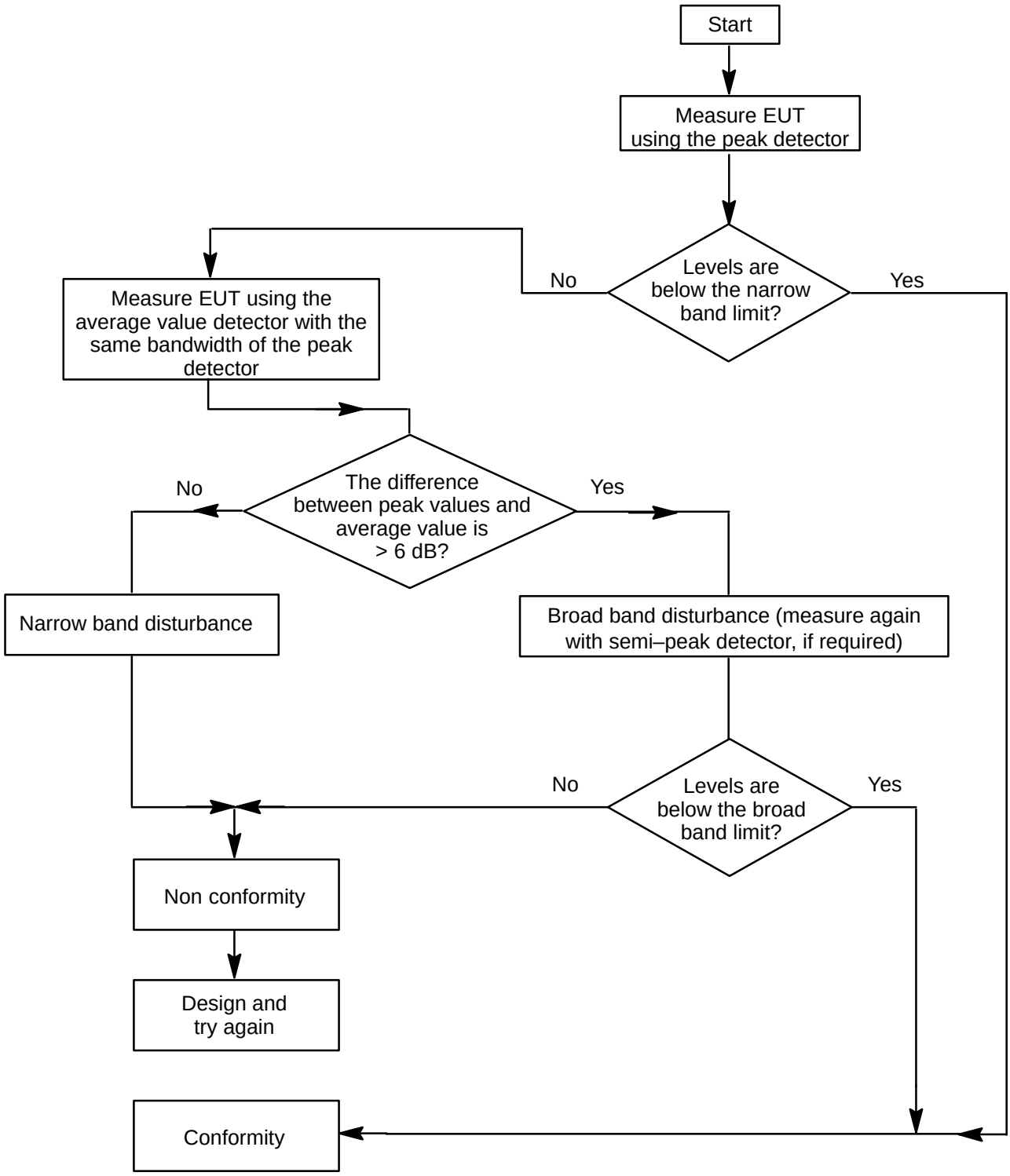
Frequency band (MHz) (*)	Narrow band limits (dBμV)	Broad band limits (dBμV)			
		Peak detector		Semi–peak detector	
	Peak or average detector	Components whose operation is continuous (ex.: windscreen wiper, electrofan, thermal engine, flash–light, etc.)	Components operating for a short time and with manual actuation (ex. stop lights switch, windscreen washer pump, etc.)	Components whose operation is continuous (ex.: windscreen wiper, electrofan, thermal engine, flash–light, etc.)	Components operating for a short time and with manual actuation (ex. stop lights switch, windscreen washer pump, etc.)
0,15 –0,3	70	93	103	80	90
0,30 – 0,53					
0,53 – 2	50	79	89	66	76
2– 5,9					
5,9 – 6,2	45	65	75	52	62
6,2 – 26,9					
26,9 – 68	40	65	75	52	62
68 – 87	30	49	59	36	46
87 – 108	36	49	59	36	46

(*) With same–frequency conditions, the strictest request prevails.

7 ACCEPTABILITY CRITERIA

Operating conditions of the tested device must be chosen in order to maximise the emissions and must comply with the limits included in **Table 3**.

7.1 **Method for determining conformity of conducted disturbances and discrimination between narrow and wide band ones**



8 SHOWING THE RESULTS

For every system being checked, under any test condition, the measure of disturbances conducted on supply lines will have to be included in diagrams showing the amount of disturbances being present in the whole test spectrum from 150 kHz to 108 MHz (dBµV/m – Frequency).

STANDARDS QUOTED

IVECO STD.: 18–2252.