

AS/NZS 4448:1997
IEC/CISPR 25:1995

AS/NZS 4448

Australian/New Zealand Standard[®]

**Limits and methods of measurement
of radio disturbance characteristics
for the protection of receivers used
on board vehicles**

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AS/NZS 4448:1997

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee TE/3, Electromagnetic Interference. It was approved on behalf of the Council of Standards Australia on 19 November 1996 and on behalf of the Council of Standards New Zealand on 30 October 1996. It was published on 5 March 1997.

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TE/3 on Electromagnetic Interference. It is identical with and has been reproduced from IEC/CISPR 25 (1995), *Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles*, prepared by CISPR Sub-Committee D.

The objective of this Standard is to provide the manufacturers and designers of electric and electronic components for use in vehicles with radio disturbance limits and methods of measurement in order to protect the operation of receivers used on board the vehicles.

Statements expressed in mandatory terms in notes and figures are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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<i>Reference to International Standard or other Publication</i>		<i>Australian/New Zealand Standard</i>	
CISPR		AS/NZS	
12	Limits and methods of measurement of radio interference characteristics of vehicles, motor boats, and spark-ignited engine-driven devices	2557	Limits and methods of measurement of radio interference characteristics of vehicles, motor boats, and spark-ignited engine-driven devices
16	Specification for radio disturbance and immunity measuring apparatus and methods	1052	Specification for radio disturbance and immunity measuring apparatus and methods
16.1	Radio disturbance and immunity measuring apparatus	1052.1	Radio disturbance and immunity measuring apparatus
IEC			
50	International Electrotechnical Vocabulary	1852	International Electrotechnical Vocabulary
50(161)	Electromagnetic compatibility	—	

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INTRODUCTION

This standard is designed to protect receivers from disturbances produced by conducted and radiated emissions arising in a vehicle.

Test procedures and limits given are intended to provide provisional control of vehicle-radiated emissions, as well as component/module conducted/radiated emissions of long and short duration.

To accomplish this end, this standard:

- establishes a test method for measuring the electromagnetic emissions from the electrical system of a vehicle;
- sets limits for the electromagnetic emissions from the electrical system of a vehicle;
- establishes a test method for testing on-board components and modules independent from the vehicle;
- sets limits for electromagnetic emissions from components to prevent objectionable disturbance to on-board receivers;
- classifies automotive components by disturbance duration to establish a range of limits.

NOTES

- 1 Component tests are not intended to replace vehicle tests. Exact correlation between component and vehicle test performance is dependent on component mounting location, harness length, routing and grounding, as well as antenna location. Component testing, however, permits components to be evaluated prior to actual vehicle availability.
- 2 Annex D provides helpful methodology for resolution of disturbance problems.

AUSTRALIAN/NEW ZEALAND STANDARD

**LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE
CHARACTERISTICS FOR THE PROTECTION OF RECEIVERS USED
ON BOARD VEHICLES****Section 1: General****1 Scope**

This standard contains limits¹⁾ and procedures for the measurement of radio disturbances in the frequency range of 150 kHz to 1 000 MHz. The standard applies to any electronic/electrical component intended for use in vehicles and large devices. Refer to International Telecommunications Union (ITU) publications for details of frequency allocations. The limits are intended to provide protection for receivers installed in a vehicle from disturbances produced by components/modules in the same vehicle²⁾. The methods and limits for a complete vehicle are in Section 2 and the methods and limits for components/modules are in Section 3.

The receiver types to be protected are: sound and television receivers³⁾, land mobile radio, radio telephone, amateur and citizens' radio. For the purpose of this standard, a vehicle is a machine which is self-propelled. Vehicles include (but are not limited to) passenger cars, trucks, agricultural tractors and snow mobiles.

The limits in this standard are recommended and subject to modification as agreed between the vehicle manufacturer and the component supplier. This standard is also intended to be applied by manufacturers and suppliers of components and equipment which are to be added and connected to the vehicle harness or to an on-board power connector after delivery of the vehicle.

This standard does not include protection of electronic control systems from radio frequency (r.f.) emissions, or from transient or pulse-type voltage fluctuations. These subjects are expected to be included in ISO publications.

Since the mounting location, vehicle body construction and harness design can affect the coupling of radio disturbances to the on-board radio, Section 3 of this standard defines multiple limit levels. The level class to be used (as a function of frequency band) is to be agreed upon between the vehicle manufacturer and the component supplier.

The World Administrative Radiocommunications Conference (WARC) lower frequency limit in region 1 was reduced to 148,5 kHz in 1979. For vehicular purposes, tests at 150 kHz are considered adequate. For the purposes of this standard, test frequency ranges have been generalized to cover radio services in various parts of the world. Protection of radio reception at adjacent frequencies can be expected in most cases.

1) Only a complete vehicle test can be used to determine the component compatibility with respect to a vehicle's limit.

2) Adjacent vehicles can be expected to be protected in most situations.

3) Adequate television protection will result from compliance with the levels at the mobile service frequencies.

It is assumed that protection of services operating on frequencies below 30 MHz will most likely be provided if the limits for services above 30 MHz are observed.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50 (161): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

CISPR 12: 1990, *Limits and methods of measurement of radio interference characteristics of vehicles, motor boats, and spark-ignited engine-driven devices*

CISPR 16-1: 1993, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

3 Definitions

For the purpose of this International Standard, the following definitions apply.

3.1 receiver terminal voltage (antenna voltage): The voltage generated by a source of radio disturbance and measured in dB(μ V) by a radio disturbance measuring instrument conforming to the requirements of CISPR 16-1.

3.2 component continuous conducted emissions: The noise voltages/currents of a steady-state nature existing on the supply or other leads of a component/module which may cause disturbance to reception in an on-board receiver.

3.3 antenna matching unit: A unit for matching the impedance of an antenna to that of the 50 Ω measuring receiver over the antenna measuring frequency range.

3.4 antenna correction factor: The factor which is applied to the voltage measured at the input connector of the measuring instrument to give the field strength at the antenna. The antenna correction factor is comprised of an antenna factor and a cable factor.

3.5 compression point: The input signal level at which the gain of the measuring system becomes non-linear such that the indicated output deviates from an ideal linear receiving system's output by the specified increment in dB.

3.6 class: A performance level agreed upon by the purchaser and the supplier and documented in the test plan.

3.7 device: A machine which is not self-propelled. Devices include, but are not restricted to chainsaws, irrigation pumps, air compressors, lawn mowers, and stationary or mobile concrete mixers. (See CISPR 12, clause 1, note 3.)

The following definitions are necessary for an understanding of this standard and are contained in IEC 50(161):

3.8 artificial mains network [line impedance stabilization network (LISN, USA)]: A network inserted in the supply mains lead of apparatus to be tested which provides, in a given frequency range, a specified load impedance for the measurement of *disturbance voltages* and which may isolate the apparatus from the supply mains in that frequency range. [IEV 161-04-05]

NOTE – Artificial mains network is abbreviated AN.

3.9 bandwidth

3.9.1 bandwidth (of an equipment): The width of a frequency band over which a given characteristic of an equipment or transmission channel does not differ from its reference value by more than a specified amount or ratio.

NOTE – The given characteristic may be, for example, the amplitude/frequency characteristic, the phase/frequency characteristic or the delay/frequency characteristic. [IEV 161-06-09 modified]

3.9.2 bandwidth (of an emission or signal): The width of the frequency band outside which the level of any spectral component does not exceed a specified percentage of a reference level. [IEV 161-06-10]

3.10 broadband emission: An *emission* which has a *bandwidth* greater than that of a particular measuring apparatus or receiver. [IEV 161-06-11]

3.11 disturbance suppression: Action which reduces or eliminates *electromagnetic disturbance*. [IEV 161-03-22]

3.12 disturbance voltage; interference voltage (deprecated in this sense): Voltage produced between two points on two separate conductors by an *electromagnetic disturbance*, measured under specified conditions. [IEV 161-04-01]

3.13 narrowband emission: An *emission* which has a *bandwidth* less than that of a particular measuring apparatus or receiver. [IEV 161-06-13]

3.14 peak detector: A detector, the output voltage of which is the peak value of an applied signal. [IEV 161-04-24]

3.15 quasi-peak detector: A detector having specified *electrical time constants* which, when regularly repeated identical *pulses* are applied to it, delivers an output voltage which is a fraction of the peak value of the pulses, the fraction increasing towards unity as the pulse repetition rate is increased. [IEV 161-04-21]

3.16 electromagnetic environment: The totality of electromagnetic phenomena existing at a given location. [IEV 161-01-01]

3.17 shielded enclosure; screened room: A mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and the external environment. [IEV 161-04-37]

4 Requirements common to vehicle and component/module emissions measurement

4.1 General test requirements and test plan

4.1.1 Test plan note

A test plan should be established for each item to be tested. The test plan should specify the frequency range to be tested, the emissions limits, the disturbance classification (broadband long or short duration – or narrowband), antenna types and locations, test report requirements, supply voltage and other relevant parameters.

4.1.2 Determination of conformance with limits

If the type of disturbance is unknown, tests shall be made to determine whether measured emissions are narrowband and/or broadband to apply limits properly as specified in the test plan.

Figure 1 outlines the procedure to be followed in determining conformance with limits.

4.1.3 Categories of disturbance sources (as applied in the test plan)

Electromagnetic disturbance sources can be divided into three types:

- a) continuous/long duration broadband and automatically actuated short-duration equipment;
- b) manually actuated short-duration broadband;
- c) narrowband.

NOTE – For examples, see 4.1.4 and 4.1.5 and table 1.

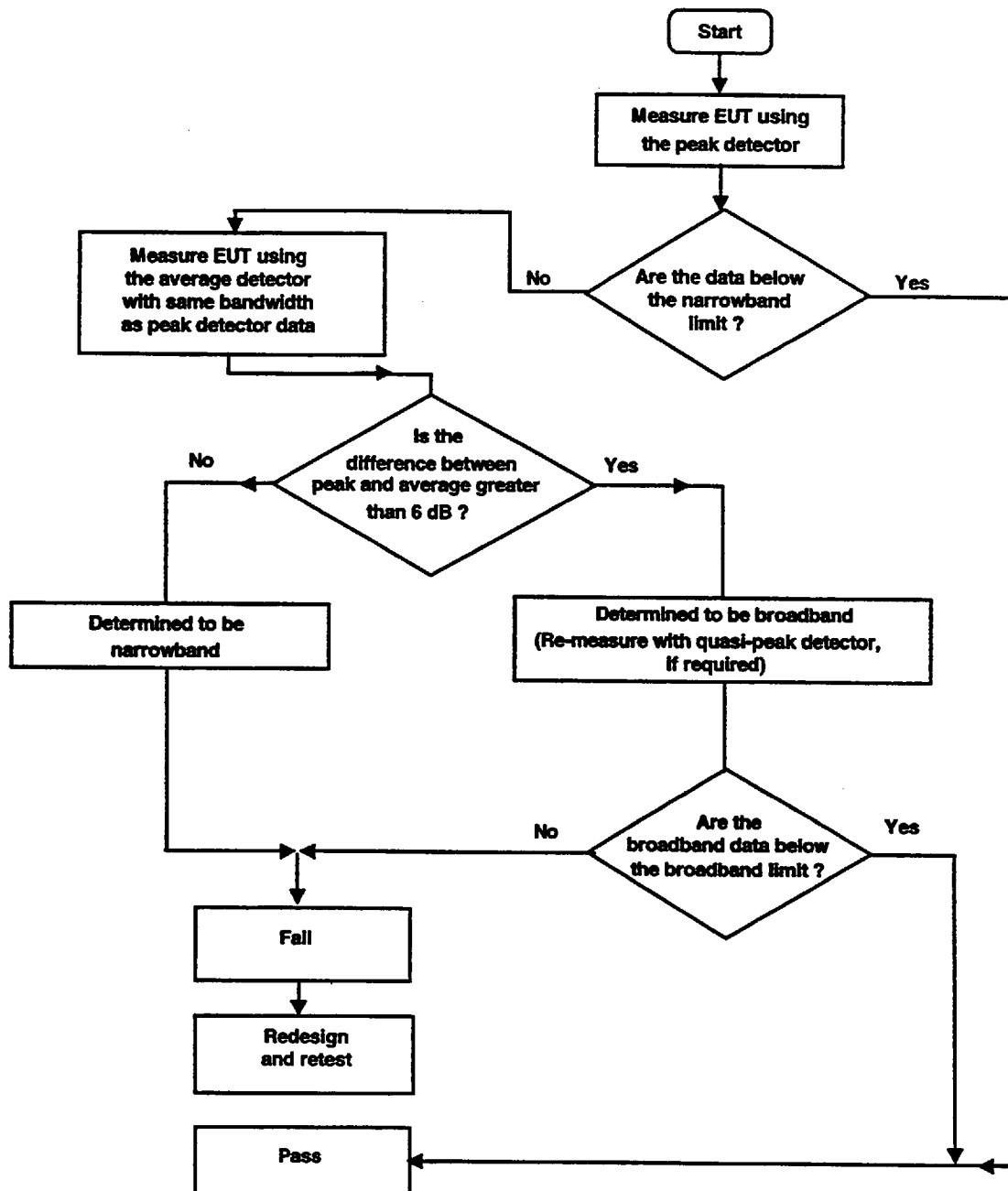


Figure 1 – Method of determination of conformance of radiated/conducted disturbance

4.1.4 Examples of broadband disturbance sources

NOTE – The examples in table 1 are intended as a guide to assist in determining which limits to use in the test plan.

Table 1 – Examples of broadband disturbance sources by duration

Continuous	Long duration *	Short duration *
Ignition system	Wiper motor	Power antenna
Active ride control	Heater blower motor	Washer pump motor
Fuel injection	Rear wiper motor	Door mirror motor
Instrument regulator	Air conditioning compressor	Central door lock
Alternator	Engine cooling	Power seat
* As defined in the test plan.		

4.1.5 Narrowband disturbance sources

Disturbances from sources employing microprocessors, digital logic, oscillators or clock generators, etc. cause narrowband emissions.

4.1.6 Operating conditions

When performing component/module tests, the equipment under test (EUT) shall be exercised using typical loads and conditions which simulate installation and operation in the vehicle.

4.1.7 Test report

The report shall contain the information agreed upon by the customer and the supplier.

4.2 Measuring equipment requirements

All equipment shall be calibrated on a regular basis to assure continued conformance of equipment to required characteristics. The measuring equipment noise floor shall be at least 6 dB less than the limit specified in the test plan.

4.3 Shielded enclosure

The ambient electromagnetic noise levels shall be at least 6 dB below the limits specified in the test plan for each test to be performed. The shielding effectiveness of the shielded enclosure shall be sufficient to assure that the required ambient electromagnetic noise level requirement is met.

NOTE – Although there will be reflected energy from the interior surfaces of the shielded enclosure, this is of minimal concern for the measurement of conducted disturbances because of the direct coupling of the measuring instrument to the leads of the EUT. The shielded enclosure may be as simple as a suitably grounded bench-top screened cage.

The shielded enclosure shall be of sufficient size to ensure that neither the vehicle/EUT nor the test antenna shall be closer than a) 2 m from the walls or ceiling, and b) 1 m to the nearest surface of the absorber material used.

4.4 *Absorber-lined shielded enclosure (ALSE)*

For radiated emission measurements, however, the reflected energy can cause errors of as much as 20 dB. Therefore, it is necessary to apply r.f. absorber material to the walls and ceiling of a shielded enclosure that is to be used for radiated emissions measurements. No absorber material is required for the floor. The following ALSE requirements shall also be met for performing radiated r.f. emissions measurements:

4.4.1 *Reflection characteristics*

The reflection characteristics of the ALSE shall be such that the maximum error caused by reflected energy from the walls and ceiling is less than 6 dB in the frequency range of 70 MHz to 1 000 MHz.

4.4.2 *Objects in ALSE*

In particular, for radiated emissions measurements the ALSE shall be cleared of all items not pertinent to the tests. This is required in order to reduce any effect they may have on the measurement. Included are unnecessary equipment, cable racks, storage cabinets, desks, chairs, etc. Personnel not actively involved in the test shall be excluded from the ALSE.

4.5 *Receiver*

Scanning receivers which meet the requirements of CISPR 16-1 are satisfactory for measurements. Either manual or automatic frequency scanning may be used. Special consideration shall be given to overload, linearity, selectivity, and the normal response to pulses.

NOTE – Spectrum analysers and scanning receivers are particularly useful for disturbance measurements. The peak detection mode of spectrum analysers and scanning receivers provides a display indication which is never less than the quasi-peak indication for the same bandwidth. It may be convenient to measure emissions using peak detection because of the faster scan possible with peak than with quasi-peak detection.

When quasi-peak limits are being used, and a peak detector is used for time efficiency, any peak measurements at or above the quasi-peak limit shall be re-measured using the quasi-peak detector.

4.5.1 *Minimum scan time*

The scan rate of a spectrum analyser or scanning receiver shall be adjusted for the CISPR frequency band and detection mode used. The minimum sweep time/frequency, (i.e. most rapid scan rate) is listed in table 2:

Table 2 – Minimum scan time

Band 1)		Peak detection	Quasi-peak detection
A	9 - 150 kHz	Does not apply	Does not apply
B	0,15 - 30 MHz	100 ms/MHz	200 s/MHz
C, D	30 - 1000 MHz	1 ms/100 ms/MHz 2)	20 s/MHz
1) Band definition from CISPR 16-1.			
2) When 9 kHz bandwidth is used, the 100 ms/MHz value shall be used.			
NOTE – Certain signals (e.g. low repetition rate signals) may require slower scan rates or multiple scans to ensure that the maximum amplitude has been measured. For the measurement of pure broadband emission, scanning steps greater than the measurement bandwidth are permitted, thus accelerating the measurement of the emission spectrum.			

4.5.2 Measuring instrument bandwidth

The bandwidth of the measuring instrument shall be chosen such that the noise floor is at least 6 dB lower than the limit curve. The bandwidths in table 3 are recommended.

NOTE – When the bandwidth of the measuring instrument exceeds the bandwidth of a narrowband signal, the measured signal amplitude will not be affected. The indicated value of impulsive broadband noise will be lower when the measuring instrument bandwidth is reduced.

Table 3 – Measuring instrument bandwidth (6 dB)

Frequency band MHz		Broadband peak or quasi-peak	Narrowband peak or average
0,15 - 30		9 kHz	9 kHz
30 - 1 000	FM broadcast	120 kHz	120 kHz
	Mobile service	120 kHz	9 kHz

If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth.

For the narrowband/broadband discrimination according to figure 1, both bandwidths (with peak and average detectors) shall be identical.

5 Antenna and impedance-matching requirements – Vehicle test

5.1 Type of antenna

An antenna of the type to be supplied with the vehicle shall be used as the measurement antenna. Its location and attitude are determined according to the production specifications.

If no antenna is to be furnished with the vehicle (as is often the case with a mobile radio system), the antenna types in table 4 shall be used for the test. The antenna type and location shall be included in the test plan.

Table 4 – Antenna types

Band ¹⁾	Antenna type
Broadcast	
LW - AM	1 m monopole
MW - AM	1 m monopole
SW - AM	1 m monopole
VHF - FM	1 m monopole
Mobile services (MHz)	
30 - 54	Loaded quarter-wave monopole
70 - 87	Quarter-wave monopole
144 - 172	Quarter-wave monopole
420 - 512	Quarter-wave monopole
800 - 1 000	Quarter-wave monopole
¹⁾ LW: Long wave MW: Medium wave SW: Short wave VHF: Very high frequency	

5.2 Measurement system requirements

5.2.1 Broadcast bands

For each band, the measurement shall be made with instrumentation which has the following specified characteristics.

5.2.1.1 AM broadcast:

Long wave (150 - 300 kHz)

Medium wave (0,53 - 2,0 MHz)

Short wave (5,9 - 6,2 MHz) *

The measuring system shall have the following characteristics:

- *output impedance of impedance matching equipment*: 50 Ω resistive;
- *gain*: The gain (or attenuation) of the measuring equipment shall be known with an accuracy of $\pm 0,5$ dB. The gain of the equipment shall remain within a 6 dB envelope for each frequency band as shown in figure 2. Calibration shall be performed in accordance with annex A.

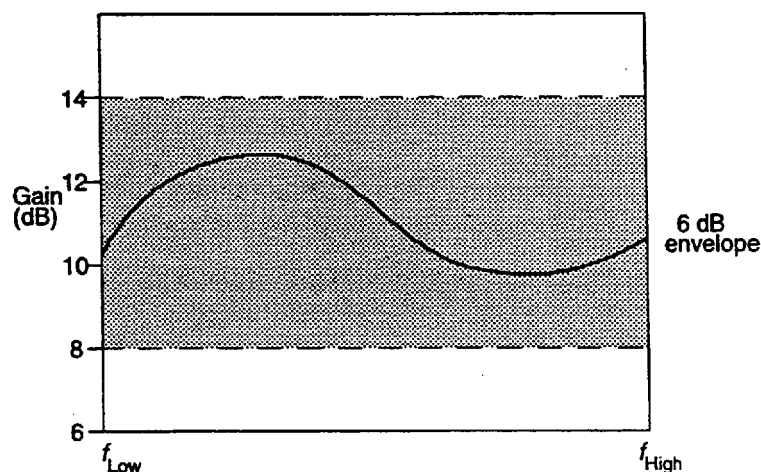


Figure 2 – Example of gain curve

* Although there are several other short-wave broadcast bands, this particular band has been chosen because it is most commonly used in vehicles. It is expected that other short-wave bands will be protected by conformance to the limits in this band.