General Specification for Vehicles, Electromagnetic Compatibility

Verification Part

1 Introduction

In the event of a conflict between the text of this specification and the documents cited herein, the text of this specification takes precedence.

Note: Nothing in the specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Note: In the event of a conflict between the English and the domestic language, the English language shall take precedence.

1.1 Scope. This document applies to the Electromagnetic Compatibility (EMC) of passenger vehicles, light duty trucks and medium duty trucks. It is accepted by all parts of General Motors (GM) and, therefore applicable to all GM automotive products worldwide.

This document is one document out of a series of six global EMC documents which specify EMC test and validation requirements. The complete series consists of the following documents:

GMW3091, GMW3094, GMW3097, GMW3100, GMW3103 and GMW3106.

Note: All six documents of equal revision are carrying the same release date.

Note: During development of this document it was first called GMW12559 and then GMW12001V.

1.2 Mission / Theme. This document specifies test procedures for verification of compliance to EMC requirements defined in GMW3091. It refers to International EMC Standards whenever possible but also describes GM internal test procedures if necessary.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 Normative.

IEC 489-3
IEC CISPR 12
IEC CISPR 25
ISO 11451-1
ISO 11451-2
ISO 11451-3
ISO 10605
ISO 7637-2
95/54/EC

2.2 GM.

GMUTS L-6Y-2
GMUTS L-6Y-3
GMW3091
GMW3097
GMW3100
GMW3103
GMW3106

2.3 Additional. Automobile Type Approval Handbook for Japanese Certification

3 Test of Requirements

3.1 Test Equipment and Test Samples.

3.1.1 Test Equipment. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Test Samples. Not applicable.

3.2 Test of Product Characteristic.

3.2.1 Test of Performance Requirements.

3.2.1.1 Radiated Emissions, Vehicle Tests.

3.2.1.1.1 Radiated Emissions at 10 m.

3.2.1.1.1.1 Purpose. The test methods in this paragraph specify procedures for measuring radiated emissions at 10 m distance from the vehicle. The objective of this test is to measure noise emitted from the vehicle which may interfere with adjacent receivers.

3.2.1.1.1.2 Test Equipment. The test equipment shall comply with the requirements of IEC CISPR 12.

3.2.1.1.1.3 Test Procedure.

- For countries where compliance with 95/54/EC is required (legal requirement for Europe) use test method 95/54/EC with the following specification.

  The 10 m distance shall be used.

- For vehicles which are intended to be sold in Japan, compliance with the Automobile Type Approval Handbook for Japanese Certification (Paragraph 11-1, Article 17-2 (4), Electrical System and Paragraph 11-2, Article 4-11A, Electric System) is required.

- For all other countries use test method IEC CISPR 12 with the following specification:

  The 10 m distance shall be used.

3.2.1.1.2 Interference to On-Board-Receivers.

3.2.1.1.2.1 Purpose. The test methods in this paragraph specify procedures for measuring radiated emissions. The objective of this test is to measure noise emitted from the vehicle which may interfere with on-board receivers.

3.2.1.1.2.2 Test Equipment. The test equipment shall comply with the requirements of IEC CISPR 25.

3.2.1.1.2.3 Test Procedure. Use test method IEC CISPR 25 with the following specifications:

For special bands the following antennas shall be used:

- If the system is equipped with an external antenna (e.g. GPS) this antenna shall be used.
- If the system is equipped with an antenna integrated into a module (e.g. RKE), a vertically polarized quarter wave monopole over a groundplane (minimum quarter wave radius disc) shall be used. This antenna shall be placed as close as possible to the location of the module which contains the internal antenna (e.g. footwell, dashboard, rear deck lid, etc.). This location shall be specified in the test plan.

Noise is divided into three different categories:

- Spark generated noise: Noise generated by sparks, such as ignition systems, brush type motors etc.
- Non-spark generated noise: Noise generated by electronic sources, such as microprocessors, clocks, PWM etc.
- Switch pop noise: Noise generated due to switching of a contact, such as brake light switch, turn signal relays, etc.

Note: For systems which generate more than one category of noise, each category has to be tested separately.

Test Receiver settings for spark generated and non-spark generated noise:

- Run a scan with Pk+ detector and with AV detector.
- For spark generated noise and non-spark generated noise:

  Step size ≤ 0.5 × Resolution BW,
  Measure time ≥ 1 ms.

Note: For spark generated noise sources the envelope of the measured spectrum has to be taken as the measurement result.

Spectrum analyzer settings for spark generated and non-spark generated noise:

- Run two sweeps with Pk+ detector.
- Sweep time:

  Either sweep time (s) ≥ coupled sweep time of the spectrum analyzer
  or sweep time (s) ≥ 2500 / Pulse repetition frequency (Hz)
  whichever produces a greater sweep time.

Test Receiver settings for switch pop noise:

- Run a scan with Pk+ detector.
- Step size 50 kHz for LW, 100 kHz for MW, measure time 5000 ms.
- Cycle switch or contact continuously during scan.

Spectrum Analyzer settings for switch pop noise:

- Run sweep with Pk+ detector.
- Sweep time ≥ 20 s for LW and ≥ 40 s for MW.
- Cycle switch or contact continuously during sweep.

For countries where compliance with 95/54/EC is required (legal requirement for Europe) the test according to 95/54/EC shall also be performed.

Note: For LW and MW testing, the vehicle must be shield isolated from the chamber (e.g. transformer or choke).

Note: Until completion of the new EMC facility in Milford Proving Ground the on-vehicle antenna test may also be performed in the GMNA EMC shielded test chamber in Milford Proving Ground (without absorbers).

3.2.1.1.3 Subjective Radio Listen Test.

3.2.1.1.3.1 Purpose. The test methods in this paragraph specify procedures for the subjective evaluation of interference to the radio.

3.2.1.1.3.2 Test Equipment. This test requires:

- Radiated emissions test equipment shall comply with the requirements of IEC CISPR 25 (see paragraph 3.2.1.1.2 of this document).
- CD player used as audio signal source.
- CD with tracks of quiet music, loud music and voice signals. All signals shall be recorded in stereo.
- CD with tracks of no signal.
- Audio cassette with no signal.

- RF signal generator with a frequency range of 0.15 MHz to 108 MHz capable of external AM and FM modulation and with preemphasis (50 µs and 75 µs) for the FM modulation. For 76 MHz to 108 MHz stereo modulation is required. The generator shall have an adjustable output power level capable of generating up to approximately 0 dBm.
- Modulation analyzer for measurement of modulation index and deviation of the RF signal (may be internal to the RF signal generator).

3.2.1.1.3.3 Test Procedure. Use the CD player as a modulation source for the RF signal generator. The RF signal generator output shall be connected to a suitable transmitting antenna (e.g. 85 cm rod antenna) located approximately 1 m from the vehicle radio antenna. The transmitting antenna shall be positioned next to the vehicle and shall have no contact with the vehicle.

Note: If CD player and RF signal generator are located inside the anechoic chamber, care must be taken to ensure that noise emitted by the test equipment does not cause any interference to the vehicle radio.

Using test method IEC CISPR 25 (see paragraph 3.2.1.1.2 of this document) with the vehicle inside an anechoic chamber determine the unmodulated signal generator levels necessary to generate a receiving antenna terminal voltage of 30 dB(µV) at each of the following default frequencies (all frequencies in MHz):

LW: 0.153; 0.198; 0.234; 0.270;

MW: lowest tunable frequency, 0.81; 1.08; 1.35, highest tunable frequency

VHF Japan: 76.2; 82.7; 87.7

VHF: 87.7; 91.7; 95.7; 99.7; 103.7; 107.7

and additionally at the following frequencies:

Spark generated noise sources shall be tested at all frequencies quoted above and additionally at the frequency with the maximum value in each band.

Non-spark generated noise sources shall be tested at all frequencies quoted above and additionally at all frequencies determined by following the flowchart in Figure 1.

Switch pop sources shall be tested at all frequencies quoted above and additionally at the frequency with the maximum value in each band (optional test).

Note: Only those frequencies which are available in the entertainment system of the vehicle have to be tested.

Note: During determination of the necessary transmission power care must be taken to avoid the influence of persons inside the chamber. It is recommended that those persons who will carry out the subjective assessment are already sitting inside the vehicle during this time.

Note: This test may also be performed in an open field site, provided that the environmental noise is low enough. If suitable radio stations are available they may be used instead of the signal generator.

Note: This test can be performed in a shielded chamber until an anechoic chamber is available at Milford Proving Ground.

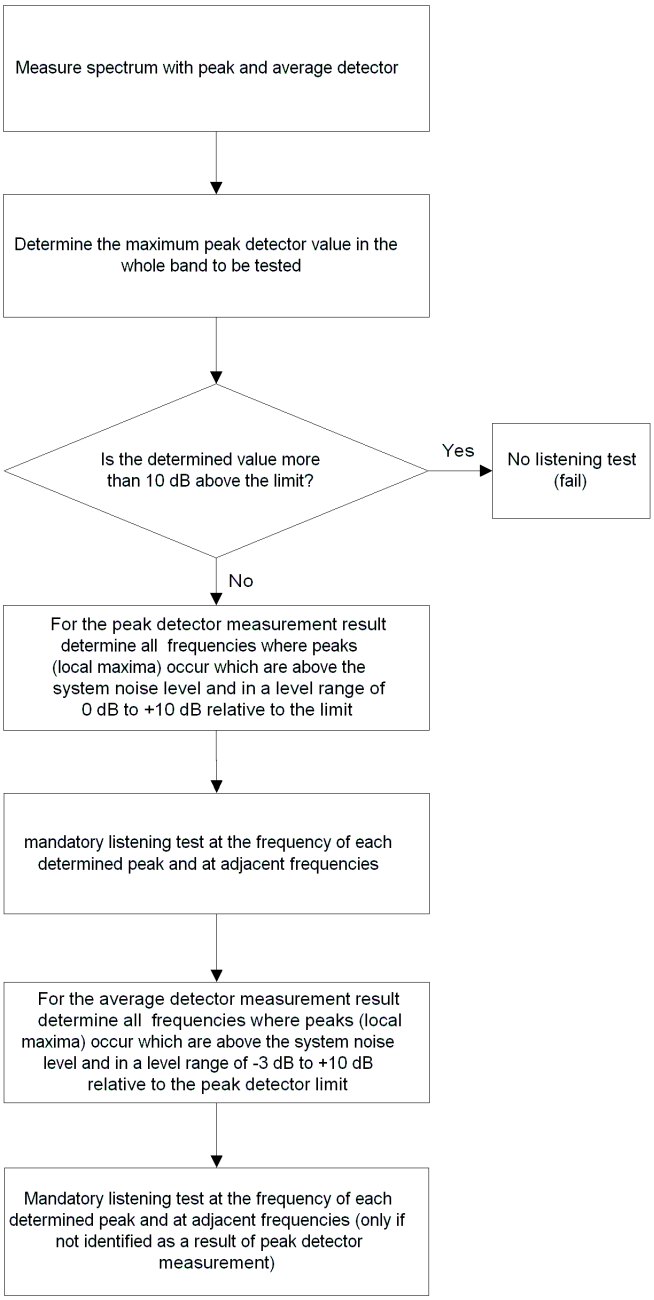
For evaluation of LW and MW frequency ranges (150 kHz to 300 kHz and 530 kHz to 1725 kHz) use AM modulation. The measured AM-modulation shall be 80 % for the loudest passage of the CD.

For evaluation of the VHF frequency range (76 MHz to 108 MHz) use FM stereo modulation. For radios which have a deemphasis of 75 µs (e.g. North America) the preemphasis of the signal generator shall be set to 75 µs. For radios which have a deemphasis of 50 µs (e.g. Europe and Japan) the preemphasis of the signal generator shall be set to 50 µs. The measured deviation shall be 75 kHz for the loudest passage of the CD.

Set the RF signal generator level to achieve 20 dB(µV), 30 dB(µV) and 40 dB(µV) receiver antenna terminal voltage (CW) by adding or subtracting the appropriate difference to the RF generator output level determined earlier.

Note: For vehicles intended to be sold in Australia in addition use 10 dB(µV) receiver antenna terminal voltage.

Figure 1: Flowchart to determine whether listening test is necessary for a particular component at a frequency where non-spark generated noise has been measured.



Listen to the audio when modulating the RF signal with quiet music, loud music and voice signals. Assess its quality subjectively using the GMUTS rating scale in Table 1. Testing shall be performed at the default frequencies and frequencies resulting from following the flowchart which are available in the vehicle entertainment system.

If the vehicle entertainment system includes a cassette player, assess the quality by listening to the noise present when a cassette which contains no audio signal is played by this cassette player.

If the vehicle entertainment system includes a CD player, assess the quality by listening to the noise present when a CD which contains no audio signal is played by this CD player.

Table 1: GMUTS rating scale for each test point

GMUTS	Noise Assessment	Evaluation	Signal
10	Noise not noticeable even by trained evaluators	No noise noticeable in signal at all	Clean
9	Noise noticeable only by trained evaluators	Very little noise in background of signal	Slight trace of noise
8	Noise noticeable only by critical customers	A little noise noticeable, but not objectionable	Slight trace of noise
7	Noise noticeable by all customers	Some noise noticeable, but not objectionable	Very light noise
6	Noise rated disturbing by some customers	Light noise, objectionable	Light noise
5	Noise rated disturbing by all customers	Moderate noise but station understandable, will only listen if important	Borderline
4	Signal quality rated as failure by some customers	Station is present, but annoying noise. Will not listen	Objectionable
3	Entertainment system complained as bad failure by all customers	Station is somewhat present, but unusable	Not acceptable
2	Limited operation of entertainment system	Can tell that a station is present	Bad
1	Entertainment system non operational	No station present	Very bad

3.2.1.1.4 Land Mobile Radio Audio Test. The Land Mobile Radio Audio Test according to the relevant sections of IEC 489-3 may be performed over the frequency range specified in that test procedure instead of performing the on-vehicle test according to the relevant sections of IEC CISPR 25. The connection between test equipment and vehicle shall be made directly at the loudspeaker connector.

Note: This test is optional and may be called out for specific vehicle programs.

3.2.1.1.5 GPS Jamming Test.

3.2.1.1.5.1 Purpose. The test methods in this paragraph specify procedures for an objective evaluation of interference to the GPS receiver, to be used if the emissions from a spark generated noise source exceeds the radiated emissions requirements (see Figure 3).

3.2.1.1.5.2 Test Equipment. This test requires:

- GPS receiver (in vehicle or Motorola Oncore evaluation kit model # GTEVAL002 or equivalent)
- PC with GPS receiver software installed
- GPS satellite simulator (IFR model # GPS-101 or equivalent)
- Vehicle mounted GPS antenna
- Anechoic chamber

3.2.1.1.5.3 Test Procedure. Use the GPS satellite simulator (known as the simulator) as the GPS reference signal source. The simulator must be connected to a suitable transmitting antenna (e.g. IFR GPS-101 horn antenna or equivalent).

The transmitting antenna shall be positioned next to or above the vehicle and shall have no contact with the vehicle.

Note: If the simulator and PC are located inside the anechoic chamber, care must be taken to ensure that the noise emitted by the test equipment does not cause any interference to the vehicle GPS receiver.

The vehicle GPS antenna shall be connected to the GPS receiver and the C/N_0 of the simulated GPS signal shall be monitored (see Figure 2).

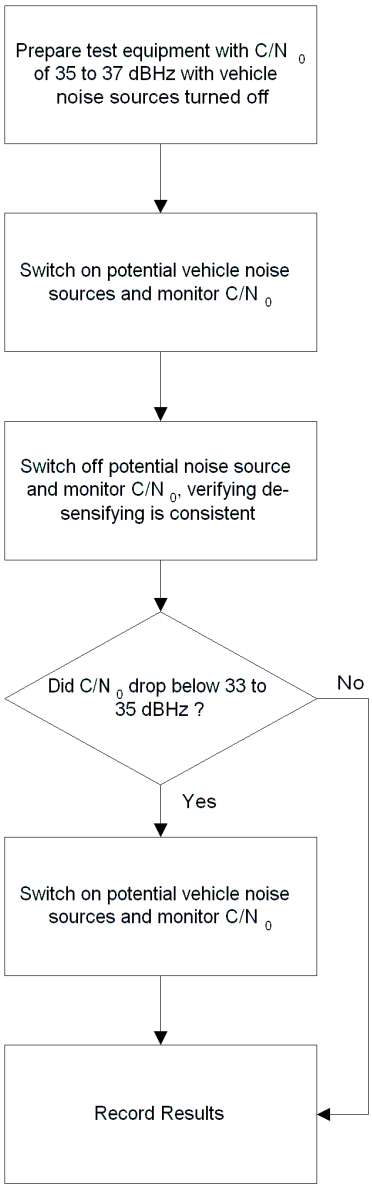
The vehicle and all other interference sources shall be switched off.

When the portable GPS receiver "sees" the satellite simulator, the C/N_0 displayed should be between 30 dBHz and 55 dBHz for the one satellite being simulated. The output of the simulator shall be adjusted so that the C/No displayed is 36 dBHz, some dither +/-1 dB is expected.

A test shall be carried out with ignition on / spark generated sources off, with ignition on / spark generated noise sources on, and with engine running. Other operating modes shall be tested if specified in the vehicle test plan.

With any C/N_0 degradation found it shall be verified that this degradation is caused by the vehicle (e.g. by switching spark generated noise sources off and on or cycle ignition switch). The overall C/N_0 degradation shall be recorded.

Figure 2: Flowchart on performing the GPS Jamming Test



Note: C/N_0 of 35 dBHz is considered a “fringe” or weak satellite signal. The GPS receiver will typically lose “lock” at C/N_0 of less than 30 dBHz. This is seen by a C/N_0 reading of 0.

Figure 3: Flowchart to determine whether GPS Jamming Test is necessary

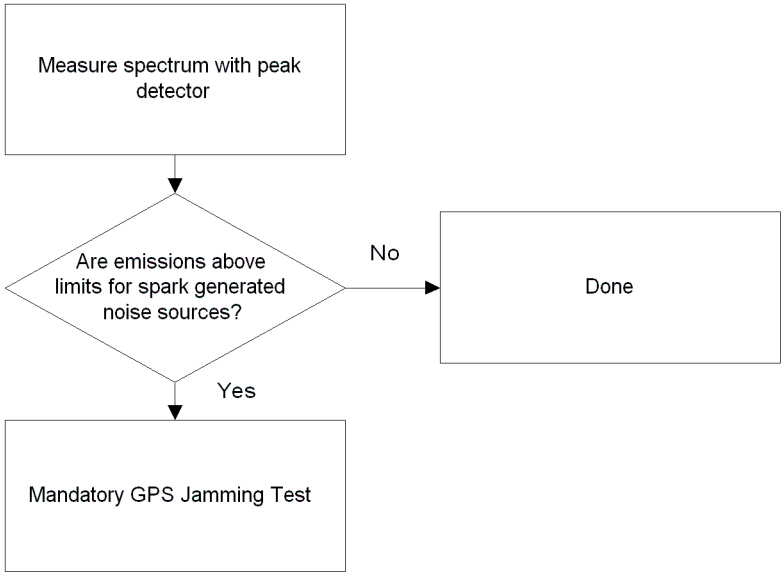


Table 2: Test frequency calculation

Frequency range	f_0	n	lowest test frequency in range	Corresponding Q
0.1 MHz...< 1 MHz	0.1 MHz	7	0.1 MHz	10
1 MHz...< 30 MHz	1 MHz	7	1 MHz	10
30 MHz...< 400 MHz	30 MHz	25	30 MHz	36
400 MHz...< 1 GHz	400 MHz	25	400 MHz	36
1 GHz...9.57 GHz	1000 MHz	50	1 GHz	72

3.2.1.2 Radiated Immunity, Vehicle Tests. Use the test frequencies determined by the following equation for the frequency ranges in Table 2 for the following test:

- 3.2.1.2.1 Immunity to Electromagnetic Fields from Off-Board Sources

$$f_{test} = f_0 \cdot 2^{\left(\frac{k}{n}\right)}$$

where

f_0 base frequency

k frequency index number (0,1,2,...)

n number of steps per octave

Note: Frequencies have to be rounded to at least 4 significant digits

Example: For the frequency range 5.4 GHz...5.7 GHz, the test frequencies are (rounded to 4 significant digits):

k	f_{test}
122	5.426 GHz
123	5.502 GHz
124	5.579 GHz
125	5.657 GHz

When deviations occur, care must be taken to identify the deviation profile accurately.

3.2.1.2.1 Immunity to Electromagnetic Fields from Off-Board Sources.

3.2.1.2.1.1 Purpose. This test method specifies a procedure for testing the immunity of the vehicle to electromagnetic fields produced by off-vehicle radiation sources.

3.2.1.2.1.2 Test Equipment. The test equipment shall comply with ISO 11451-1 and ISO 11451-2.

3.2.1.2.1.3 Test Procedure.

Note: Until completion of the new EMC facility in Milford Proving Ground this test may also be performed according to GMUTS L-6Y-3.

Note: The tests with radar signal may also be carried out in an open field test site with real radar transmitters.

Note: For countries where compliance with 95/54/EC is required (legal requirement for Europe) the test according to 95/54/EC shall also be performed.

Note: For vehicles that exceed the 3 dB beamwidth of the antenna, multiple antenna positions for side exposure may be called out in the test plan.

Use test methods according to the relevant sections of ISO 11451-1 and ISO 11451-2 with the following specifications:

- Use modulation types specified in GMW3091, paragraph 3.2.1.2.1.1.
- The applicable frequency range is 100 kHz to 9.57 GHz.
- Use the test frequencies determined by equation for frequency ranges in Table 2.
- Use the substitution method.
- For calibration and during the actual test of a vehicle, forward power shall be used as reference parameter.
- During calibration in the frequency range above 100 MHz, floor absorbers shall be used. Any other calibration method, which can be shown to eliminate the influence of the reflected ground beam during calibration above 100 MHz, is allowed.
- Prior to performing the test, the vehicle shall be centered on the turntable (center of the vehicle is the center between front and rear bumper).
- The vehicle reference point is the calibration reference point. The vehicle reference point shall be located at the front axle when illuminated from the front position (Position [1], see Figure 4).
- From 100 kHz to 30 MHz the test shall be performed at the 0° position of the vehicle with vertical polarization. If the field generating device is capable of testing the horizontal polarization (e.g. E/H-field generator), the test shall also be performed with horizontal polarization at the 0° position of the vehicle.
- From 30 MHz to 9.57 GHz the test shall be performed at a minimum of 4 vehicle orientations with vertical polarization only (see Figure 4):

  0° (front position [1])

  +90° (LHD passenger side [3])

  180° (rear position [5])

  -90° (LHD driver side [7])

  In all orientations, the antenna shall not be moved.
- For vehicles that exceed the 3 dB beamwidth of the antenna, the test shall also include at least the following vehicle orientations with vertical polarization only as specified in the test plan (see Figure 4):

  +45° (LHD passenger side [2])

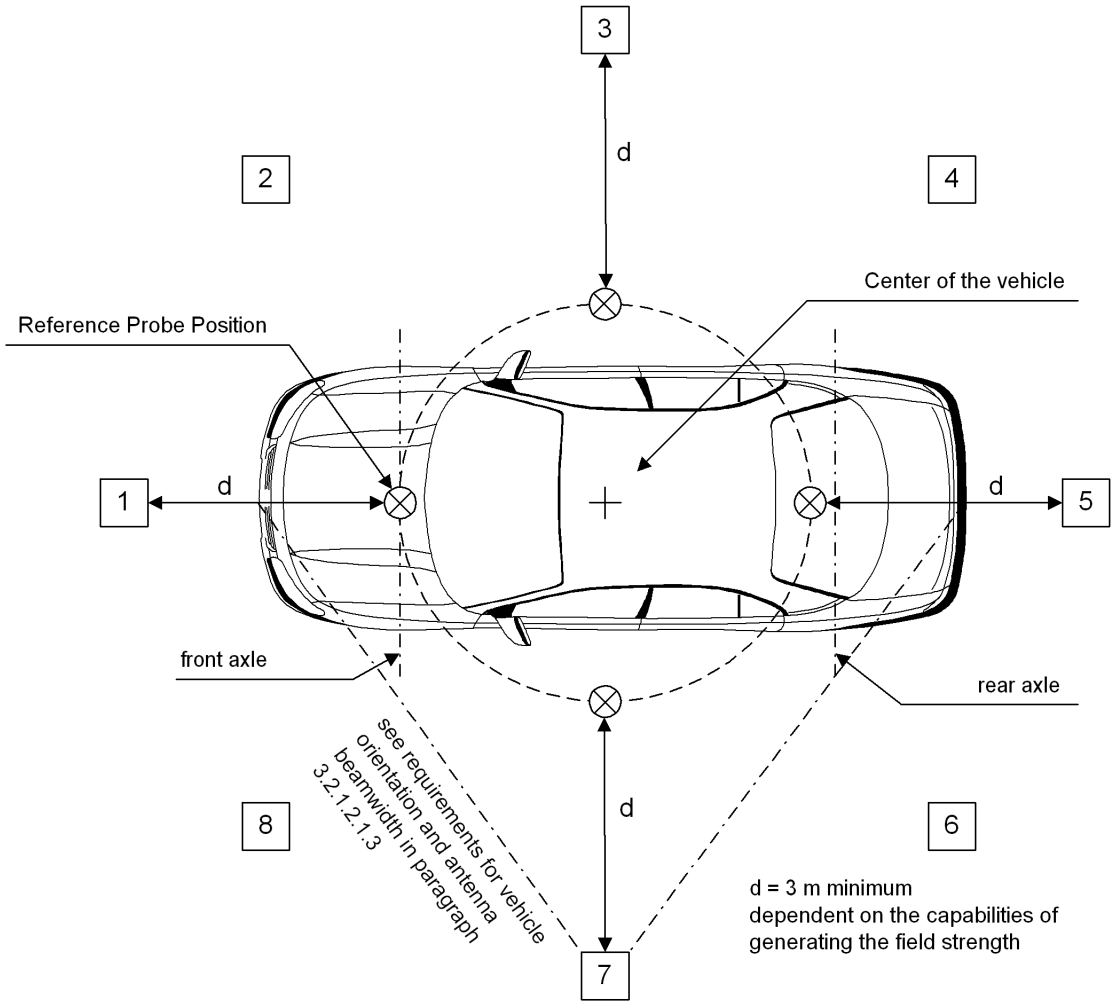
  +135° (LHD passenger side [4])

  -135° (LHD driver side[6])

  -45° (LHD driver side[8])

  In all orientations, the antenna shall not be moved.

Figure 4: Antenna positions for radiated immunity, off-vehicle radiation source



3.2.1.2.2 Immunity to On-Board Transmitters.

3.2.1.2.2.1 Purpose. This test method specifies a procedure for testing the immunity of the vehicle to electromagnetic fields produced by on-board radiation sources.

3.2.1.2.2.2 Test Equipment. The test equipment shall comply with ISO 11451-1 and ISO 11451-3 with the following deviation:

- The applicable frequency range of this test method is 1.8 MHz to 1.98 GHz.

3.2.1.2.2.3 Test Procedure. Use test methods according to the relevant sections of ISO 11451-1 and ISO 11451-3 with the following specification:

- Use the test frequencies and antenna types in Table 3 (Some test facilities do not perform the test in a shielded enclosure and, therefore, must consider issues with radio station licenses. In that case and if a license cannot be obtained for a certain frequency range this frequency range may be ignored).
- Use modulation types specified in GMW3091, paragraph 3.2.1.2.2.1.

Table 3: Test Frequencies and Antenna Types for Test of Immunity to on-board Transmitters

Frequency in MHz	Antenna Type	Default Test Frequencies in MHz	Antenna Positions (additional Australian positions in parentheses)
1.8...2.0	Center Loaded Vertical	1.9	Rear bumper; (Front bumper)
3.5...4.0	Hustler RM 80S or equivalent	3.85	Rear bumper; (Front bumper)
7.0...7.3	Hustler RM 40S or equivalent	7.2	Rear bumper; (Front bumper)
10.1...10.15	Hustler RM 30 or equivalent	10.1	Rear bumper; (Front bumper)
14.0...14.35	Hustler RM 20S or equivalent	14.2	Rear bumper; (Front bumper)
18.07...18.17	Hustler RM 17 or equivalent	18.1	Rear bumper; (Front bumper)
21.0...21.45	Hustler RM 12 or equivalent	21.2	Rear bumper; (Front bumper)
24.89...24.99	Hustler RM 18S or equivalent	24.9	Rear bumper; (Front bumper)
26.18...28.0	Hustler RM 10S or equivalent	26.3, 27.2	Roof, trunk; (Front hood cowl)
28.0...29.7	Hustler RM 10S or equivalent	28.2, 29.2	Rear bumper; (Front bumper)
30...50	Quarter Wave Monopole	30.8, 31.7, 32.6, 33.5, 34.5, 35.4, 36.4, 37.4, 38.5, 39.6, 40.7, 41.8, 43.0, 44.2, 45.5, 46.7, 48.1, 49.4	Roof, trunk; (Front hood cowl)
50...54	Quarter Wave Monopole	50.8, 52.2, 53.7	Roof, trunk; (Front hood cowl)
60...87	Quarter Wave Monopole	60.0, 61.7, 63.4, 65.2, 67.0, 68.9, 70.9, 72.9, 74.9, 77.0, 79.2, 81.4, 83.7, 86.0	Roof, trunk; (Front hood cowl)
120...130	Quarter Wave Monopole	120, 123, 127, 130	Roof, trunk; (Front hood cowl)
144...172	Quarter Wave Monopole	146, 150, 154, 158, 163, 167, 172	Roof, trunk; (Front hood cowl)
220...225	Quarter Wave Monopole	221	Roof, trunk; (Front hood cowl)
380...390	Quarter Wave Monopole	385	Roof, trunk; (Front hood cowl)
400...410	Quarter Wave Monopole	405	Roof, trunk; (Front hood cowl)

Frequency in MHz	Antenna Type	Default Test Frequencies in MHz	Antenna Positions (additional Australian positions in parentheses)
420...450	Quarter Wave Monopole	423, 435, 447	Roof, trunk; (Front hood cowl)
450...470	Quarter Wave Monopole	459	Roof, trunk, interior; (Front hood cowl)
470...510	Quarter Wave Monopole	472, 486, 499	Roof, trunk; (Front hood cowl)
806...815	Quarter Wave Monopole	811	Roof, trunk, interior; (Front hood cowl)
820...849	Quarter Wave Monopole	822, 846	Roof, trunk, interior
851...960	Quarter Wave Monopole	869, 894, 919, 945	Roof, trunk, interior
1240...1300	Quarter Wave Monopole	1247, 1282	Roof, trunk, interior
1429...1453	Quarter Wave Monopole	1433, 1453	Roof, trunk, interior
1477...1525	Quarter Wave Monopole	1473, 1493, 1514	Roof, trunk, interior
1710...1785	Quarter Wave Monopole	1715, 1739, 1764	Roof, trunk, interior
1805...1910	Quarter Wave Monopole	1813, 1838, 1864, 1890	Roof, trunk, interior
1920...1980	Quarter Wave Monopole	1943, 1971	Roof, trunk, interior

Note: A shield isolation choke shall be used for testing below 30 MHz to isolate the vehicle from the test facility.

Note: For interior positions a ground plane shall be used.

Interior positions are:

- Front shelf
- Rear Package shelf
- On front passenger seat
- Between front seats
- Inside trunk (limited to max 10 W)

Note: For vehicles with an OEM installed antenna this position shall also be tested at the maximum power level and appropriate modulation for the applicable radio.

3.2.1.2.3 Immunity to Power Line Magnetic Fields.

3.2.1.2.3.1 Purpose. This test method specifies a procedure for testing the immunity of the vehicle to magnetic fields produced by electrical power lines.

3.2.1.2.3.2 Test Equipment. The magnetic field test shall be performed in an area large enough to accommodate the vehicle and the field generating coils. A dynamometer may also be required to simulate road speeds for activation of certain electronic systems.

The instrumentation shall be immune to the generated magnetic fields at its test location.

This test requires:

- Function generator
  $(16\frac{2}{3}...180)$ Hz sine wave
- Linear power amplifier
  DC to 1 kHz, 2 kW minimum
- Magnetic field intensity meter
  10 Hz to 1 kHz minimum
  0 µT to 100 µT

- True RMS AC Current meter
  10 Hz to 1 kHz minimum
- Magnetic field coils
  Minimum diameter of three meter

Note: The magnetic field intensity meter shall incorporate DC rejection to reject the earth's magnetic field from the measurements.

3.2.1.2.3.3 Test Procedure. Clear all diagnostic trouble codes in all electrical/electronic devices of the test vehicle prior to performing the test.

Use the test setup in Figure 5 and Figure 6.

Figure 5: Instrumentation Setup for the Magnetic Field Test

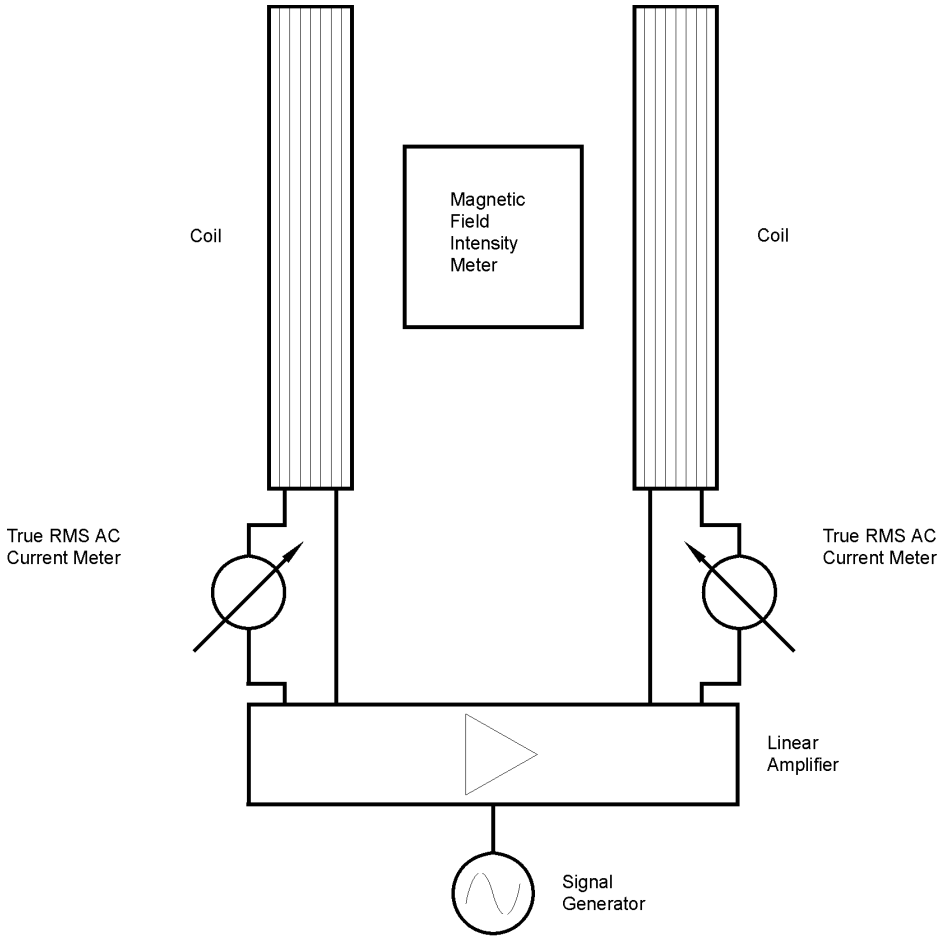
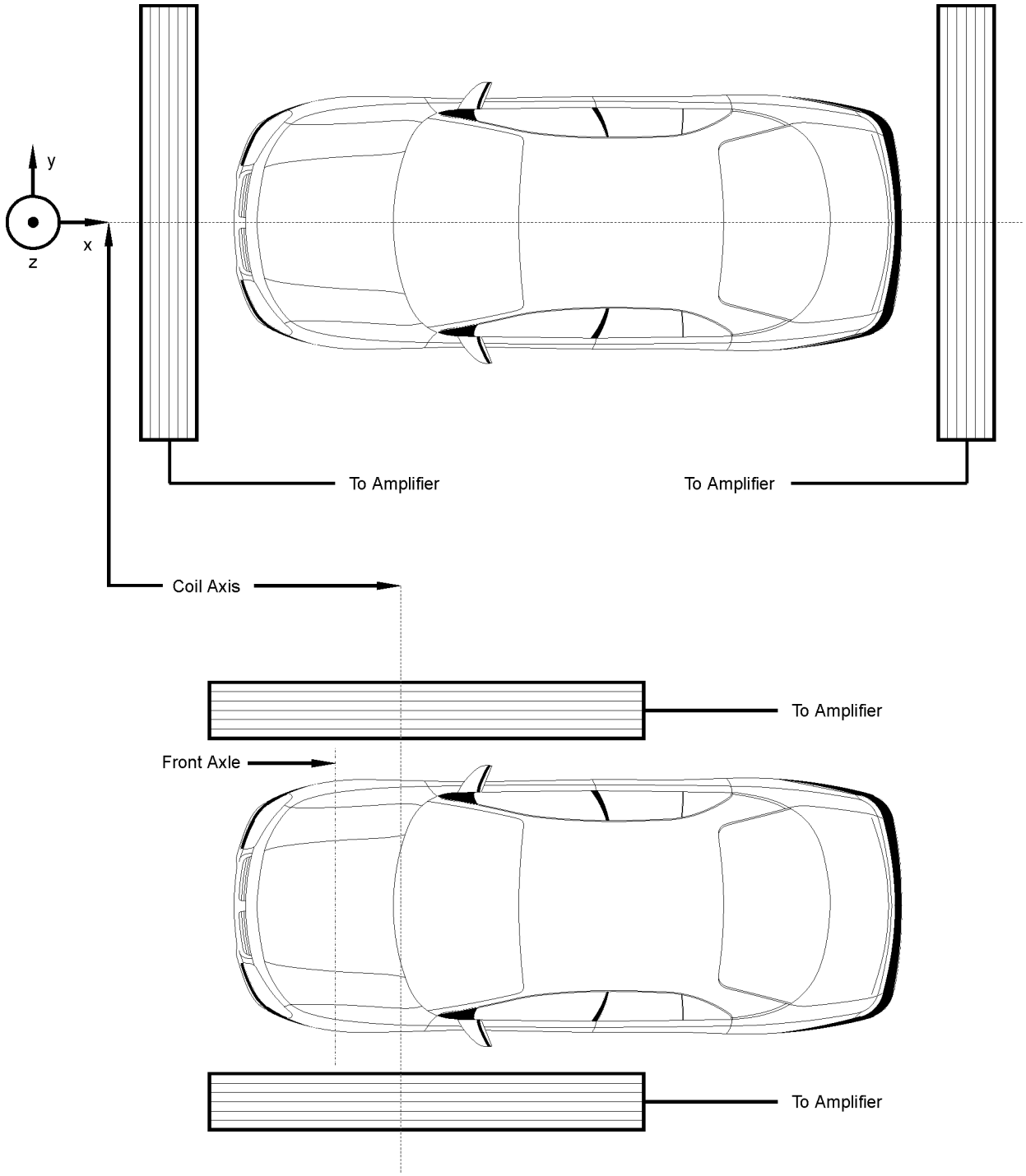


Figure 6: Test Setup for the Magnetic Field Test



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The coil spacing shall be selected to accomodate the vehicle.

The test shall be performed with the magnetic field

- in the longitudinal axis (x-axis)
- in the transverse axis (y-axis)
  - with the coils centered on the reference point (0.4 +0/-0.4) m behind the front axle
  - with the coils centered on the reference point (0.4 +0/-0.4) m in front of the rear axle of the vehicle.

The reference point shall be located on the center axis at the midpoint between the coils

Use the substitution method to establish the magnetic field intensity. Use the RMS current through the magnetic coils as the reference parameter for calibration and test.

The test shall be performed with the frequencies and waveforms (signal generator output waveforms) according to Table 4.

Table 4: Test Frequencies and Waveforms for the Magnetic Field Test

Frequency in Hz	Signal Generator Voltage Output Waveform
$16\frac{2}{3}$	sine wave
50	sine wave
60	sine wave
150	sine wave
180	sine wave

At each field intensity level expose the vehicle for a minimum of 30 s.

Record all operator perceivable effects.

Record all diagnostic trouble codes and verify that they were caused by this test.

3.2.1.3 Conducted Transient Emissions and Immunity (CE/CI), Vehicle Tests.

3.2.1.3.1 CE/CI, Operator Test.

3.2.1.3.1.1 Purpose. This test method specifies a procedure to evaluate the immunity of vehicles to conducted transients generated by the switching of loads. This test is performed to verify that the customer will not perceive deviations of electrical/electronic devices caused by these electrical transients.

3.2.1.3.1.2 Test Equipment. This test requires equipment which enables the operator to record diagnostic trouble codes

3.2.1.3.1.3 Test Procedure. Clear all diagnostic trouble codes in all electrical/electronic devices of the test vehicle prior to performing the test. Operate the test vehicle in different conditions as specified in the test plan (e.g. ignition off, ignition on, park idle, at speed, etc).

Actuate all applicable switches and devices which may generate conducted transients.

Note: If a tested motor can be run to a stop (e.g. seat motor, doorlock, power window motor etc.) the test shall be performed in the motor stall condition as well.

Record all operator perceivable effects.

Record all diagnostic trouble codes and verify that they were caused by this test.

3.2.1.4 Electrostatic Discharge (ESD), Vehicle Test.

3.2.1.4.1 Immunity to Electrostatic Discharge.

3.2.1.4.1.1 Purpose. This test method specifies a procedure for testing the immunity of components, located within the occupant space or trunk (e.g. CD player, switches) of the vehicle and intended to be accessible to the occupant, to electrostatic discharge.

3.2.1.4.1.2 Test Equipment. The test equipment shall comply with ISO 10605 with the following deviation:

The ESD simulator waveform verification shall comply with ISO 10605 with the following exceptions:

- The risetime requirement for ESD simulator air discharge verification shall be ≤ 20 ns.
- In determining the RC time constant, calculate the RC time constant in the exponentially decaying portion of the waveform after the leading edge and/or ringing.

3.2.1.4.1.3 Test Procedure. Use test methods according to the relevant sections of ISO 10605 with the following specifications:

- Maintain the vehicle's occupant space or trunk ambient temperature at (23 ±3) °C and the relative humidity from 20 % to 40 % (20 °C and 30 % relative humidity preferred) during testing.
  Note: Until a test facility for this test is available in some locations this test may be performed at humidity levels up to 50 %. In this case the conditions have to be stated in the test report.

- Test each exposed shaft, button switch or surface of electrical/electronic devices normally accessible to an occupant inside the vehicle using:

  1 the contact discharge method (contact discharge tip) and the 330 pF capacitor

  2 the air discharge method (air discharge tip) and the 330 pF capacitor

- according to the test sequence in Table 5 for test numbers 1...7.
- For test number 8 test each exposed shaft, button switch or surface of electrical/electronic devices which can be conveniently accessed when standing outside the vehicle and reaching inside without touching any other part of the vehicle (e.g. any door open, trunk open), using only the air discharge method (air discharge tip) and the 150 pF capacitor according to Table 5.
- The ESD generator reference ground shall be the vehicle body for all tests according to Table 5. In order to prevent the vehicle body or chassis structure from becoming and remaining charged after ESD testing, the vehicle shall be discharged through a 1 MΩ bleed-off resistor connected to building ground before each change of discharge polarity.

Note: Test number 8 is not applicable to inputs/outputs which are connected to the communication bus

3.3 Test of Design and Construction. Not applicable.

3.4 Documentation.

3.4.1 Test Results. Not applicable.

3.4.2 Deviations from Test Procedure. Deviations from the requirements of the test procedures shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports etc.

Table 5: Test Sequence for ESD Vehicle Tests

Test number	Type of discharge	Test voltage level	Minimum number of discharges at each polarity
1	Air discharge (C = 330 pF)	±4 kV	5
2	Contact discharge (C = 330 pF)	±4 kV	5
3	Air discharge (C = 330 pF)	±6 kV	5
4	Contact discharge (C = 330 pF)	±6 kV	5
5	Air discharge (C = 330 pF)	±8 kV	5
6	Contact discharge (C = 330 pF)	±8 kV	5
7	Air discharge (C = 330 pF)	±15 kV	5
8	Air discharge (C = 150 pF)	±25 kV	5

4 Verification

4.1 General. Samples of components or material released to this specification shall be tested for conformity with the requirements of this specification and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g. design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases a shorter test can be agreed to between the responsible GM Department and the supplier

5 Test of Provisions for Shipping

Not applicable.

6 Notes

6.1 Glossary. Not applicable.

6.2 Acronyms, Abbreviations and Symbols.

AC	Alternating Current
AM	Amplitude Modulation
AV	Average
BW	Bandwidth
CD	Compact Disc
CE	Conducted Transient Emissions
CI	Conducted Transient Immunity
CTS	Component Technical Specification
DC	Direct Current
DUT	Device under Test
EC	European Community
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FM	Frequency Modulation
GM	General Motors
GMNA	General Motors North America
GMUTS	General Motors Uniform Test Specification
GMW	General Motors Worldwide
ICES	Interference-Causing Equipment Standard
IEC CISPR	International Electrotechnical Commission Comité International Spécial des Perturbations Radioélectrique (International Special Committee on Radio Interference)
ISO	International Organization for Standardization
ITDC	International Technical Development Center
LHD	Left Hand Drive
LW	Long Wave
MW	Medium Wave
OEM	Original Equipment Manufacturer
Pk+	Positive Peak
RF	Radio Frequency
RMS	Root Mean Square
SINAD	Signal to Noise And Distortion
VHF	Very High Frequency
VTS	Vehicle Technical Specification

7 Additional Paragraphs

Not applicable.

8 Coding System

This specification shall be referenced in other documents, drawings, VTS, CTS, etc. as follows:

GMW3094

where

GMW	GM Worldwide
3094	Sequential Number
	Class: General Specifcation
	Type: All Vehicle
	Category: Electrical Architecture

Example:

“Test of requirements to GMW3094”

9 Release and Revisions

9.1 Release. This specification was first approved in April 1999.

It has been prepared by the GM Global EMC Committee.

9.2 Revisions.

Rev.	Date	Description (Org.)
A	APR 1999	New, was also called "revision 1" (GMNA)
B	OCT 1999	Declassification, Specification is no longer classified as GM Confidential, was also called "revision 1" (GMNA)
C	JUN 2000	Editorial, was also called “revision 1" (GMNA)
D	OCT 2000	Reworked, was also called “revision 2” (ITDC)
E	AUG 2001	Reworked, is also called “revision 3”. Changes against revision October 2000 (revision 2): Radiated Emissions: GPS Jamming test added, details for test of special bands added, details for LMRAT test added. Radiated Immunity: Test frequencies changed, antenna location and vehicle orientation changed, antenna positions for mobile transmitter test changed. Conducted Emissions: Transient analysis eliminated. Conducted Immunity: Load dump test eliminated, transient injection eliminated. Electrostatic Discharge: Number of discharges reduced. All paragraphs: Editorial changes and clarifications. (ITDC)

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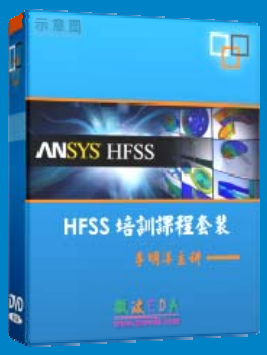

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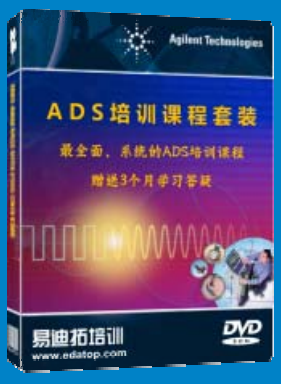

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