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Road vehicles — (EMC) guidelines for installation of aftermarket radio frequency transmitting equipment

Véhicules routiers — Guide sur la compatibilité électromagnétique (CEM) pour l'installation en seconde monte d'équipements radio-téléphone

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Foreword

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO/TS 21609:2003), which has been technically revised.

Road vehicles — (EMC) guidelines for installation of aftermarket radio frequency transmitting equipment

1 Scope

This Technical Specification gives requirements and recommendations for the installation in road vehicles of

— radio frequency (RF) transmitting and receiving equipment,

— "in-road-vehicle" mounting kits for transportable and hand-held RF equipment, and

— ancillary equipment associated with these.

As well as methods for installation, it establishes methods for minimizing the possibility of electromagnetic interference (EMI) between the installed equipment and the vehicle electrical and electronic systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 (all parts) and the following terms, definitions and abbreviated terms apply.

3.1.1
mobile equipment
receiver, transmitter or transmitter/receiver (transceiver) that is intended for installation and use in a vehicle, and powered by the main battery of the vehicle

3.1.2
ancillary equipment
any equipment required as part of the installation in addition to the radio

EXAMPLE Voltage converter

3.1.3
equipment supplier
supplier of the equipment to the installer

Note 1 to entry: The equipment supplier may be a dealer, distributor or manufacturer.

3.1.4
floating system
isolated ground return

3.1.5
ground plane
conducting plane of a minimum dimension proportional to the wavelength λ on which a panel mount antenna is fitted

3.1.6
installer
radio equipment installation technician

3.1.7
radiating element
part of an antenna which radiates the signal

3.1.8
vehicle supplier
supplier of the vehicle, who may be a dealer or the manufacturer/importer of the vehicle

3.2 Abbreviated terms

ABS	anti-blocking system
CB	citizen band
ECU	electronic control unit
EMC	electromagnetic compatibility
EMI	electromagnetic interference
HT	high tension (i.e. the high voltage circuits of the ignition system)
ICE	in-car entertainment
PMR	private mobile radio
RF	radio frequency
RFI	radio frequency interference
VSWR	voltage standing wave ratio

4 General

Installation of RF-transmitting equipment shall be performed by competent personnel. The vehicle and RF transmitting equipment manufacturers' instruction manuals and installation notes shall be followed.

NOTE Vehicle manufacturer's instructions take priority in case of conflict.

It is the responsibility of the competent personnel to ensure the installation complies with national legal requirements for the installation and use of RF equipment in vehicles.

Installation shall be checked for possible interference between the RF-transmitting equipment and the vehicle electric systems in accordance with 6.3.

4.1 Customer liaison and installation requirements

4.1.1 General

The customer shall

— be advised to use a suitable antenna for the particular application and optimum position,

— be made aware of the various fixing locations and mounts available for the items to be fitted, and

— be asked whether or not an ignition switched supply to the equipment is required.

4.1.2 EMC requirements

After-market RF-transmitting equipment for installation in road vehicles shall fulfil the requirements of RF-product relevant EMC standards and road vehicle standards. Contact the road vehicle manufacturer and/or equipment supplier if necessary to ensure that the latest version is used.

The purpose of road vehicle EMC standards (see Table 1) and legal requirements (Table 2) is to ensure

— the protection of broadcast receivers in a residential environment from radio disturbances from vehicles at distances greater than 10 m,

— that vehicle RF-receivers have sufficient protection from unwanted emissions of other electric systems (RF-systems included) installed in the same vehicle, and

— that no vehicle functions are affected because of the susceptibility of RF-systems to radiated or conducted disturbances.

Table 1 — ISO and IEC/CISPR EMC and RFI standards for road vehicles

Standard	Title
ISO 7637 (all parts)	*Road vehicles — Electrical disturbances from conduction and coupling*
ISO 10605	*Road vehicles — Test methods for electrical disturbances from electrostatic discharge*
ISO 11451	*Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy*
ISO 11452	*Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*
ISO 13766	*Earth-moving machinery — Electromagnetic compatibility*
ISO 14982	*Agricultural and forestry machinery — Electromagnetic compatibility — Test methods and acceptance criteria*
CISPR 12	*Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of off-board receivers*
CISPR 25	*Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of on-board receivers*

Table 2 — Selection of EMC regulations for vehicles and equipment

Standard	Title
ECE-R 10	*Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions* *Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility*
1999/5/EC	*Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity*
ECE-R 116	*Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions* *Uniform technical prescriptions concerning the protection of motor vehicles against unauthorised use*
CFR Title 47 Part 15	*Telecommunication, Radio Frequency Devices*

In addition to vehicle standards, RF-product specific EMC standards (see Table 3) are designed to ensure that

— the RF-system operates in environments specified in the applicable radio EMC standard, and

— unwanted emissions are controlled to a specific level.

4.1.3 Vehicle supplier's warranty

Installation of mobile radio equipment to any part of the vehicle, other than an authorized connection or mounting location, might invalidate the vehicle warranty. If in doubt, the vehicle or equipment supplier shall be consulted.

4.1.4 Electromagnetic and radio frequency interference

Full consideration shall be given to the positioning of mobile RF-transmitting equipment such that electromagnetic interference (EMI) and radio frequency interference (RFI) is minimized between the RF transmitting equipment being installed and the vehicle electrical and electronic systems.

Mobile equipment might include radio equipment, ancillary equipment, antenna and feeder cable.

4.1.5 Radio equipment and ancillary items

Prior to the installation of the radio equipment or any other ancillary items, it is essential that the vehicle manufacturer's and equipment supplier's instructions be followed, in order to ensure that the safe operation of the vehicle is not impaired.

Care shall be taken when planning the installation that any additional equipment used does not constitute a safety hazard and does not contravene safety regulations.

Care shall be taken to ensure that any microphone/handset lead is not installed such that the lead can interfere with the vehicle controls or driver.

Where a hand portable or transportable unit is installed in road vehicles, the correct car adapter kit specified for the product shall be used.

Table 3 — Selection of EMC product standards for RF equipment

Standard	Title
EN 301 489–1	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements*
EN 301 489–2	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 2: Specific conditions for radio paging equipment*
EN 301 489–3	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*
EN 301 489–4	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links, Broadband Data Transmission System Base stations, ancillary equipment and services*
EN 301 489–5	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 5: Specific conditions for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech)*
EN 301 489–6	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 6: Specific conditions for Digital Enhanced Cordless Telecommunications (DECT) equipment*
EN 301 489–7	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)*
EN 301 489–8	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 8: Specific conditions for GSM base stations*
EN 301 489–9	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 9: Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices*
EN 301 489–10	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 10: Specific conditions for First (CT1 and CT1+) and Second Generation Cordless Telephone (CT2) equipment*
EN 301 489–11	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 11: Specific conditions for terrestrial sound broadcasting services transmiters*
EN 301 489–12	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 12: Specific conditions for Very Small Aperture Terminal, Satellite Interactive Earth Stations operated in the frequency ranges between 4 GHz and 30 GHz in the Fixed Satellite Service (FSS)*
EN 301 489–13	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 13: Specific conditions for Citizens' Band (CB) radio and ancillary equipment (speech and non-speech)*
EN 301 489–14	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 14: Specific conditions for analogue and digital terrestrial TV broadcasting service transmitters*
EN 301 489–15	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 15: Specific conditions for commercially available amateur radio equipment*
EN 301 489–16	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 16: Specific conditions for analogue cellular radio communications equipment, mobile and portable*

Table 3 *(continued)*

Standard	Title
EN 301 489–17	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for broadband data transmission systems*
EN 301 489–18	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 18: Specific conditions for Terrestrial Trunked Radio (TETRA) equipment*
EN 301 489–19	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Received Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications*
EN 301 489–20	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 20: Specific conditions for Mobile Earth Stations (MES) used in the Mobile Satellite Services (MSS)*
EN 301 489–22	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 22: Specific conditions for ground based VHF aeronautical mobile and fixed radio equipment*
EN 301 489–23	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 23: Specific conditions for IMT–2000 CDMA Direct Spread (UTRA and E-UTRA) Base Station (BS) radio, repeater and ancillary equipment*
EN 301 489–24	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT–2000 CDMA Direct Spread (UTRA and E-UTRA) for mobile and portable (UE) radio and ancillary equipment*
EN 301 489–25	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 25: Specific conditions for CDMA 1x spread spectrum mobile stations and ancillary equipment*
EN 301 489–26	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 26: Specific conditions for CDMA 1x spread spectrum base stations, repeaters and ancillary equipment*
EN 301 489–27	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 27: Specific conditions for Ultra Low Power Active Medical Implants (ULP–AMI) and related peripheral devices (ULP–AMI–P)*
EN 301 489–28	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 28: Specific conditions for wireless digital video links*
EN 301 489–29	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 29: Specific conditions for Medical Data Service Devices (MEDS) operating in the 401 MHz to 402 MHz and 405 MHz to 406 MHz bands*
EN 301 489–31	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 31: Specific conditions for equipment in the 9 kHz to 315 kHz band for Ultra Low Power Active Medical Implants (ULP–AMI) and related peripheral devices (ULP–AMI–P)*
EN 301 489–32	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 32: Specific conditions for ground and wall probing radar applications*
EN 301 489–33	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra Wide Band (UWB) communications devices*

Table 3 *(continued)*

Standard	Title
EN 301 489–34	*Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 34: Specific conditions for External Power Supply (EPS) for mobile phones*
RSS-119	*Radio-transmitters and receivers operating in the Land mobile and fixed services in the frequency range 27,41 – 960 MHz*
RSS-128	*800 MHz Dual-mode TDMA cellular telephones*
RSS-129	*800 MHz Dual-mode CDMA cellular telephones*
RSS-136	*Land and mobile station radiotelephone transmitters and receivers operating in the 26,960 – 27,410 MHz general radio service band*

5 Installation

5.1 Installation process

Care shall be taken in

— choosing the antenna,

— mounting it in a recommended location,

— installing it correctly,

— ensuring that all connections in the antenna feeder are sealed to prevent dirt and water from entering the feeder and affecting its performance,

— ensuring that all connections are electrically tested after installation, and

— ensuring that a satisfactory VSWR reading is obtained.

5.2 Antenna

For transmitting systems with output power levels above 100 mW (peak), an external antenna is strongly recommended.

The external antenna and feeder cable shall be impedance matched with a VSWR < 1,5. The best position for an antenna is on the metallic roof, preferably towards the centre, but where possible with a distance of ≥λ/4 (λ = wavelength) from any opening, such as a sunroof or windows. Care shall be taken when mounting an antenna next to an existing one or when mounting antennas with magnetic bases, as this could affect the accuracy or operation of the compass on vehicles so equipped.

5.2.1 Radiation patterns and ground planes

In order to create a symmetrical, non-directional radiation pattern, an antenna needs to be mounted vertically on a horizontal ground plane with, ideally, a radius of ≥λ/4 at the lowest frequency band used (see Table 4).

Table 4 — Approximate frequency-to-wavelength conversion

Frequency f MHz	Wavelength λ cm	 λ/4 cm
50	600	150
80	375	94
150	200	50
450	66	17
600	49,5	12
900	33	8
1 800	16,5	4

The antenna should not be located close to any electrically resonant structure.

Care shall be taken when siting the antenna close to another, existing antenna. It is necessary to separate them by ≥λ/4 for transmit frequencies $f \leq 600$ MHz and ≥λ for transmit frequencies $f > 600$ MHz (see Table 4).

The antenna should be located as high as possible, the ideal location being on the roof of the vehicle. Any other location could have a marked effect on the radiation pattern of the antenna.

5.2.2 Ground-plane provision

When the antenna installation is to be carried out on a non-metallic surface:

— a ground-plane-independent antenna may be fitted directly to any surface (glass-fibre, etc.) or on to a mounting bracket which may be supplied by the manufacturer;

— a standard antenna may be used with a ground plane fitted to the underside of the panel, for example a metallic plate complying with dimensions given in Table 4.

5.2.3 Fitting the antenna

5.2.3.1 "On-glass" antennas

Care shall be taken to ensure the antenna is mounted clear of the window heater elements, decorative coating, washer/wiper and integral screen receiver antenna where fitted. Before fitting an on-glass antenna, check the manufacturer's instructions and recommendations. In some cases, fitting might constitute a safety hazard and might invalidate the vehicle manufacturer's warranty. On-glass antennas might not be suitable for vehicles with double-glazed screens, reflective coatings or other special glass.

If interference occurs to the "in-road-vehicle" entertainment equipment or other vehicle electrical equipment, repositioning or use of a different type of antenna should be considered.

Scrupulous cleanliness shall be observed and care shall be taken to avoid touching the adhesive surfaces or the glass after cleaning prior to fixing. Care shall be taken to ensure that the glass is within the specified temperature range when fixing the antenna mount in order to obtain a good bond.

5.2.3.2 Special and temporary antennas

These can include combined (dual or multi-frequency), ground-plane-independent, low profile, boot lip, magnetic and window clip types. Where applicable, the antenna manufacturer's instructions should be followed with due regard to the vehicle manufacturer's instructions and limitations.

On temporary mount types, care shall be taken with routing the coaxial cable through door/boot openings to minimize risk of damage to the cable.

Combined antennas may be supplied with a separate diplexer unit which should be securely fixed in a location where it is protected against ingress of water and other particles.

5.3 Antenna cable

Coaxial cable connectors shall be used. Shielded and low-loss antenna cable that is impedance matched for the equipment (VSWR < 1,5) shall be used to provide a continuous run between antenna and radio equipment. Excess coaxial cable shall not be coiled, as this may affect the tuning of the antenna as well as producing electrical interference. If possible, the antenna cable should be cut to the correct length.

5.3.1 Routing of the feeder cable

The cable should be routed so as to avoid sharp bends and, where possible, existing vehicle wiring and electronic modules. Safety-sensitive electronic control units (e.g. airbag and ABS systems), circuits and harnesses shall not be used for parallel wiring. If it is necessary to cross other wiring, cross at right angles.

If an extension feeder cable is required, suitable coaxial cable shall be used and correctly terminated with good quality, low-loss connectors. If the antenna cable provided is too short, wherever possible the cable should be replaced by a suitable feeder cable of correct length. Extending the length of the feeder cable will result in additional losses, particularly at frequencies >800 MHz.

Ensure that the feeder cable is not strained or distorted by, for example, excessive tightening of cable ties. When vehicle trim is replaced, make sure that the panels do not trap the feeder cable. Additional care should be taken when installing a glass mount antenna to the rear screen of a hatch-back type vehicle to allow opening and to prevent damage to the feeder cable.

5.3.2 Fitting of the coaxial connectors

Fit the correct antenna connectors at each end of the feeder cable to match the equipment using either crimp or soldered connectors as appropriate. In the case of crimp connectors, use only the correct crimping tool. Ensure that the joints are electrically and mechanically sound.

Before and after replacing any vehicle trim, which might have been removed to install the antenna, it is advisable to carry out the antenna checks specified in 6.1.

5.4 Installation of radio equipment

5.4.1 Mounting of equipment in the vehicle

The following requirements and recommendations are applicable to the installation of radio equipment in the vehicle.

— It shall conform with equipment and vehicle manufacturer's instructions.

— Equipment shall not be able to be damaged or its ventilation restricted. Special care should be taken to ensure that equipment cannot be damaged by ingress of water.

— Access to vehicle equipment in the load storage area shall not be barred, e.g. by wheeljack, fire extinguishers or spare wheel.

— The connections to the equipment should be easily accessible in order that the equipment may be removed for operation in transportable mode, or for repairs and servicing.

— It shall not hinder the operation of airbags or other safety equipment.

5.4.2 Routing of cables

5.4.2.1 General

Where possible, all cables should pass inside or underneath trim and through mouldings in such a way as to afford maximum protection. If necessary, use sleeving, a proprietary protector and/or cable ties where required.

5.4.2.2 Routing

Select a route for the cables, ideally on the opposite side of the vehicle to the fuel pipe, clear of brake pipes, cables, controls, vehicle wiring and any hot components. Under no circumstances shall any cables be attached to the foregoing.

Cables shall be routed so that they avoid

— sharp edges,

— continual bending,

— stress or strain,

— abrasion,

— extreme temperature, and

— becoming a hazard to the occupants of the car.

5.4.3 Power supply

5.4.3.1 General

When available, the manufacturer's instructions for the vehicle and/or the mobile radio equipment shall be used as the primary guide for the connection to a power source. If information is not provided, the following guidelines should be used.

5.4.3.2 Provision of a dedicated/permanent supply

WARNING — Connections shall not be made to any ECU feeds under any circumstances.

A dedicated supply cable should be used for the radio equipment installation which should be as short as possible to the battery positive and negative connections. Do not connect directly to the battery pillars, but use the battery terminals provided.

It is also recommended that, unless a moulded twin supply cable is used, the two supply lines be twisted together along their length in order to reduce induced noise.

The supply cable from the radio equipment should approach the battery in such a way that, when terminated, the two wires cannot be inadvertently reversed, e.g. one wire is shorter than the other.

5.4.3.3 Supply cable and routing

In addition to 5.4.2.2:

— heavy-duty cable of a low electrical resistance should be used on long cable runs to minimize voltage drop;

— the cable shall be of a higher current capacity than the protection fuse, and the correct fuse shall be fitted;

— the cable should be as short as possible;

— the cable shall be secured well clear of moving parts, (shock absorbers, steering, drive shaft, control pedals, etc.);

— the cable shall be secured well clear of the engine, exhaust system or other hot items;

— the supply cable run should, where possible, be separate from that of the ICE equipment control cables, although they may pass through the same holes in the chassis and body for ease of fitting; suitable grommets should be fitted if additional holes are drilled;

— the cables shall be supported, avoiding sharp bends, and shall not be subjected to strain;

— the cable shall be sited away from ignition coil, HT circuits and ECUs and, where possible, other vehicle wiring.

5.4.3.4 Vehicle electrical supply systems with voltages ≥24 V

IMPORTANT — A 12 V tap shall not be taken from 24 V vehicle batteries.

Most mobile radio equipment operates from a 12 V supply. If the vehicle has a 24 V or higher supply, it is essential that a suitable regulator or converter be used which will provide the nominal supply voltage and current for which the radio equipment is designed. The converter, together with the radio equipment, shall also comply with vehicle EMC requirements and the radio product EMC requirements.

A means of switching off the regulator or converter shall also be provided; this may be via the ignition switch, direct switching from the mobile radio, a master switch or some other means agreed with the customer.

The supply cable to the regulator or converter shall be as short as practicable and suitable fuses should be fitted as close as possible to the supply. The unit shall be mounted in accordance with the manufacturer's instructions. Unless environmentally protected, it should be located in a dry and well-ventilated position.

The installation of the mobile radio equipment shall be carried out such that the integrity of the vehicle isolated power supply is not impaired. Continuity checks between the positive and negative supplies and the vehicle chassis shall be carried out before and after installation to ensure isolation of the power supply is maintained. The checks shall be carried out with the isolation switch in the "on" position.

6 Test and final inspection

6.1 Antenna basic checks

Ensure that the antenna radiating element is specified for the intended use. Before connection to the equipment, wherever possible the antenna should be d.c. tested for

— low electrical resistance between the centre pin of the coaxial connector and the antenna radiating element (<0,3 Ω),

— no existence of connection between the centre pin of the coaxial connector and vehicle earth, and

— low electrical resistance between the body of the coaxial connector and vehicle ground (<0,1 Ω).

Some antennas are d.c. grounded, e.g. glass mount, centre tapped, base loaded. For such systems, consult the manufacturer's installation instructions.

6.2 Test calls

WARNING — Under no circumstances shall any installation technician attempt to modify any radio equipment.

Tests of the radio installations should be made in all operational modes of the radio equipment to check all functions of the mobile radio equipment wherever possible. These checks should be made with the vehicle systems in use after the equipment has been fully installed.

6.3 Disturbance checks

IMPORTANT — Under no circumstances shall any installation technician attempt to modify any affected vehicle device or vehicle system.

Checks shall be made for disturbance from and to all electrical and electronic equipment in the vehicle both in standby and transmit modes to show that no vehicle functions are affected and the vehicle manufacturer's specifications are still met. Initially, the checks should be carried out with the ignition switched on but without the engine running. These tests should be repeated with the engine running. These shall be followed by road tests at various speeds.

If any interference occurs, every effort shall be made to locate and rectify any installation problem.

NOTE Certain RF systems (e.g. GSM phones) transmit with different RF power levels and in this case, the test should be performed when possible at the maximum RF power level.

If a problem is found and cannot be rectified, and it is suspected that the equipment or vehicle is out of specification, the appropriate manufacturer, agent or supplier shall be consulted. If, after following the manufacturer's, agent's or supplier's advice, the problem still exists, it should be noted and the customer shall be advised.

Bibliography

[1] ISO 7637 (all parts), *Road vehicles — Electrical disturbances from conduction and coupling*

[2] ISO 10605, *Road vehicles — Test methods for electrical disturbances from electrostatic discharge*

[3] ISO 11451, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*

[4] ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

[5] ISO 14982, *Agricultural and forestry machinery — Electromagnetic compatibility — Test methods and acceptance criteria*

[6] CISPR 12, *Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of off-board receivers*

[7] CISPR 25, *Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of on-board receivers*

[8] ECE-R 10, *Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions. Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility*

[9] 1999/5/EC, *Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity*

[10] ECE-R 116, *Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions. Uniform technical prescriptions concerning the protection of motor vehicles against unauthorised use*

[11] CFR Title 47 Part 15, *Telecommunication, Radio Frequency Devices*

[12] EN 301 489–1, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements*

[13] EN 301 489–2, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 2: Specific conditions for radio paging equipment*

[14] EN 301 489–3, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*

[15] EN 301 489–4, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links, Broadband Data Transmission System Base stations, ancillary equipment and services*

[16] EN 301 489–5, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 5: Specific conditions for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech)*

[17] EN 301 489–6, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 6: Specific conditions for Digital Enhanced Cordless Telecommunications (DECT) equipment*

[18] EN 301 489–7, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)*

[19] EN 301 489–8, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 8: Specific conditions for GSM base stations*

[20] EN 301 489–9, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 9: Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices*

[21] EN 301 489–10, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 10: Specific conditions for First (CT1 and CT1+) and Second Generation Cordless Telephone (CT2) equipment*

[22] EN 301 489–11, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 11: Specific conditions for terrestrial sound broadcasting services transmiters*

[23] EN 301 489–12, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 12: Specific conditions for Very Small Aperture Terminal, Satellite Interactive Earth Stations operated in the frequency ranges between 4 GHz and 30 GHz in the Fixed Satellite Service (FSS)*

[24] EN 301 489–13, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 13: Specific conditions for Citizens' Band (CB) radio and ancillary equipment (speech and non-speech)*

[25] EN 301 489–14, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 14: Specific conditions for analogue and digital terrestrial TV broadcasting service transmitters*

[26] EN 301 489–15, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 15: Specific conditions for commercially available amateur radio equipment*

[27] EN 301 489–16, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 16: Specific conditions for analogue cellular radio communications equipment, mobile and portable*

[28] EN 301 489–17, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for broadband data transmission systems*

[29] EN 301 489–18, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 18: Specific conditions for Terrestrial Trunked Radio (TETRA) equipment*

[30] EN 301 489–19, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Received Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications*

[31] EN 301 489–20, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 20: Specific conditions for Mobile Earth Stations (MES) used in the Mobile Satellite Services (MSS)*

[32] EN 301 489–22, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 22: Specific conditions for ground based VHF aeronautical mobile and fixed radio equipment*

[33] EN 301 489–23, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 23: Specific conditions for IMT–2000 CDMA Direct Spread (UTRA and E-UTRA) Base Station (BS) radio, repeater and ancillary equipment*

[34] EN 301 489–24, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT–2000 CDMA Direct Spread (UTRA and E-UTRA) for mobile and portable (UE) radio and ancillary equipment*

[35] EN 301 489–25, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 25: Specific conditions for CDMA 1x spread spectrum mobile stations and ancillary equipment*

[36] EN 301 489–26, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 26: Specific conditions for CDMA 1x spread spectrum base stations, repeaters and ancillary equipment*

[37] EN 301 489–27, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 27: Specific conditions for Ultra Low Power Active Medical Implants (ULP–AMI) and related peripheral devices (ULP–AMI–P)*

[38] EN 301 489–28, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 28: Specific conditions for wireless digital video links*

[39] EN 301 489–29, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 29: Specific conditions for Medical Data Service Devices (MEDS) operating in the 401 MHz to 402 MHz and 405 MHz to 406 MHz bands*

[40] EN 301 489–31, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 31: Specific conditions for equipment in the 9 kHz to 315 kHz band for Ultra Low Power Active Medical Implants (ULP–AMI) and related peripheral devices (ULP–AMI–P)*

[41] EN 301 489–32, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 32: Specific conditions for ground and wall probing radar applications*

[42] EN 301 489–33, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra Wide Band (UWB) communications devices*

[43] EN 301 489–34, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 34: Specific conditions for External Power Supply (EPS) for mobile phones*

[44] RSS–119, *Radio-transmitters and receivers operating in the Land mobile and fixed services in the frequency range 27,41 – 960 MHz*

[45] RSS–128, *800 MHz Dual-mode TDMA cellular telephones*

[46] RSS–129, *800 MHz Dual-mode CDMA cellular telephones*

[47] RSS–136, *Land and mobile station radiotelephone transmitters and receivers operating in the 26,960 – 27,410 MHz general radio service band*

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