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(54) Mounting of an antenna on a vehicle roof with maintained high voltage protection

(57) A system for vehicles is provided, comprising a first unit arranged on the outside of the vehicle and a second unit arranged on the inside of the vehicle, and communication means to provide a communication contact between said first and second units. The communication means further provides a galvanic separation between the first and second units. Thanks to this separation, a reliable high-voltage protection is achieved without distorting the communication signals. The invention is particularly useful for internet solutions for trains.

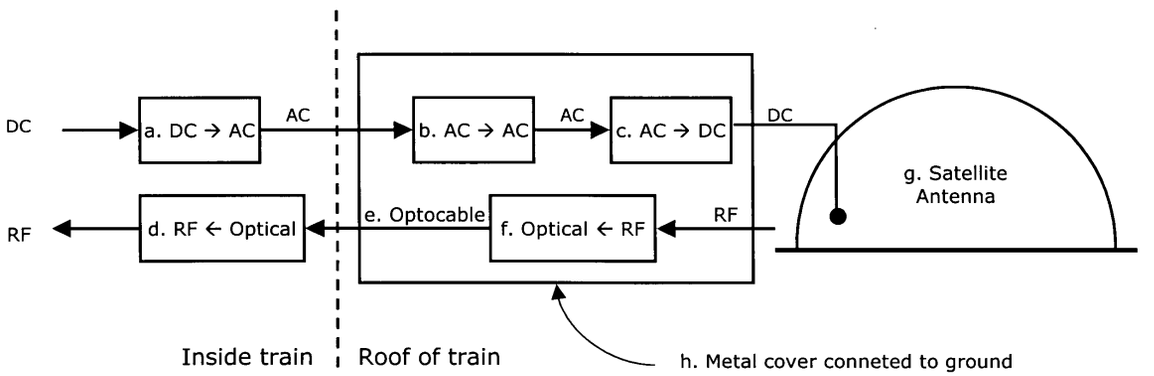

Fig. 1

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Description

Field of invention

[0001] The present invention relates to a system for vehicles comprising a first unit arranged on the outside of the vehicle and a second unit arranged on the inside of the vehicle, and communication means to provide a communication contact between said first and second units. Particularly, the invention relates to systems comprising communication units, such as antennae, mounted on vehicles running in the vicinity of high-voltage lines or supplies, such as train. Further, the invention relates to a corresponding method.

Background of the invention

[0002] In order to ensure safety for the inside of a train carriage, all equipment mounted on the roof of a train with connections inside the carriage must be protected from the high voltage power lines above the train track (in Sweden 16 kV), so that in case a power line falls down on the train, the inside of the carriage is protected.

[0003] Today this is accomplished by shortcutting the external equipment to the train roof using metallic conductors, thereby avoiding the current going inside the carriage. Approximate requirements on these conductors are 40.000 A during a 125 ms period, thus the dimension are approximately 95 mm^2 for copper. This is the minimum to make sure the short-cut protection for the power supply unit reacts.

[0004] However, there is a growing need to provide communication equipment, such as antennas, on external surfaces of vehicles. For example, the present applicant, Icomera, has developed a unique mobile data technology platform that may serve as a vital ingredient in an Internet-enabled train solution. The novelty of the technology is that it uses all available data channels e. g. GSM, Satellite, and DBV-T; and combines them into one virtual network connection. The technology will automatically select among the available channels and use the most cost effective combination that fulfils the users' availability, bandwidth and reliability requirements. The users connect to the Internet via their own laptop or PDA computers equipped with WLAN (Wireless Local Area Network).

[0005] In case the system requires an external satellite antenna to be mounted on the train's roof, there are a number of things to consider. This satellite antenna comprises e.g. the active antenna, sensors, gyro, mechanical steering and a protective plastic frame (to support from shifting weather conditions, wind and sudden pressure changes from entering tunnels etc). If the standard method were to be used, i.e. using thick copper wires as a metal cage to encapsulate the antenna's plastic frame or to include the thick copper wires in the plastic frame, the received signal would be compromised severely in terms of e.g. polarisation and signal strength. This method could be used but only with very high power on received satellite signal, something that would restrict the geographical coverage. In case of phase array antennas (flat antennas) the above-discussed problem is even more serious.

[0006] Similar problems are encountered for other types of systems requiring units of the system to be mounted on external surfaces of the vehicle, when said units need to be in communication contact with internal units.

Objective of the invention

[0007] It is therefore an objective of the present invention to provide an improved method for mounting equipment onboard train roofs, with maintained high voltage protection and a low degree of signal distortion.

[0008] The objective is achieved by a method and a system according to the appended claims.

Summary of the invention

[0009] According to a first aspect of the invention, a system for vehicles is provided, comprising a first unit arranged on the outside of the vehicle and a second unit arranged on the inside of the vehicle, and communication means to provide a communication contact between said first and second units, wherein the communication means provides a galvanic separation between the first and second units.

[0010] Accordingly, instead of using the shortcut method for high voltage protection of equipment mounted on top of a train, the solution is to galvanically separate the equipment on the roof from the equipment inside the train.

[0011] Preferably, the galvanic separation comprises an optical component, and most preferably the communication means comprises an RF/optical converter arranged outside the vehicle, an optical/RF converter arranged inside the vehicle, and an optical fiber connecting said converters.

[0012] Thus, the antenna's RF-signal is converted into an optical signal, lead through an optical fiber into the carriage where it is reconverted into a RF-signal for the satellite receiver. Hereby, essentially no distortion is impaired on the signal, and at the same time a very efficient high-voltage protection is achieved.

[0013] Radio-optical transformers are per se previously known, but are heretofore used to relay RF-signals over long distances, since the optical fiber allows almost unlimited fiber lengths compared to the normal coaxial cables, which reduce the signal strength by the meter.

[0014] The first unit arranged on the outside of the vehicle preferably functions as an interface to at least one telecommunications network, said unit preferably comprising an antenna. For example, the antenna could be a part of the Icomera system discussed previously. The

second unit could be operational as a gateway between an local network operating within the vehicle and an external network. Further, the second unit could serve as a, preferably wireless, interface towards further units within the vehicle.

[0015] The first unit is further preferably supplied with power without any galvanic connection to the interior of the vehicle. Most preferably, the first unit is supplied with power through a safety 1:1 power transformer. Hereby, the external unit could be supplied with power from within the vehicle, and still maintaining the high-voltage protection of the system. Alternatively, it is e.g. also possible to arrange an external power supply for the external unit, such as an externally mounted electric accumulator.

[0016] The first unit could further be enclosed in a protective casing, said casing being grounded. Hereby, the safety properties of the system are increased even further.

[0017] According to a second aspect of the invention, it is provided a method for transferring communication signals between an indoor and outdoor environment of a vehicle, comprising the steps: providing a first unit in the outdoor environment of the vehicle; providing a second unit in the indoor environment of the vehicle; and transferring communication signals between the first and second units, wherein the communication signals are lead through a galvanic separation.

[0018] The method corresponds to the system according to the invention, as discussed previously, and similar advantages are achieved.

[0019] The invention is especially useful for internet-enabled train solutions. However, the invention is not only relevant for trains but for electric trams, buses, vans, cars etc as well. Further, the invention is not only relevant for antennae but for all equipment, especially communication equipment, mounted on top of a vehicle roof with overlying high power lines.

[0020] These and other aspects of the invention will be apparent from and elicidated with reference to the embodiments described hereinafter.

Brief description of the drawings

[0021] For exemplifying purposes, the invention will be described to embodiments thereof illustrated in the attached drawings, wherein:

Fig. 1-4 are schematic views of a system according to embodiments of the invention to be implemented onboard a train.

Description of preferred embodiments

[0022] With reference to Fig 1-4, the embodiments of the invention will now be discussed in more detail. Fig 1-4 schematically illustrates different variants of a system for how to mount equipment, in these cases a satellite antenna, onboard train roofs, with maintained high voltage protection and no signal distortion.

[0023] The DC/AC transformer (a) transforms the direct current from the train power supply into alternating current, which is led up on the roof of the train, to the safety power transformer (b), which connects to the AC/DC converter (c) which ultimately feeds the satellite antenna (g) with power.

[0024] Thanks to the safety power transformer (b), the satellite antenna (g) is fed with power from within the train without being galvanically connected to the inside of the train.

[0025] The RF signal from the satellite antenna (g) is converted by the RF/optical converter (f) into an optical signal. Led through an optical fiber (optocable (e)) into the train, the signal is converted back by an optical/RF converter (d) into a normal RF signal, ready to attach to the satellite card inside the train.

[0026] Thanks to the optical fiber (e), the RF signal from the satellite antenna (g), can be relayed into the train without any galvanic connection to the inside of the train.

[0027] The safety power transformer (b), the AC/DC power transformer (c) and the RF/optical converter (f) may be integrated in one box as in Fig 1 and Fig 2. The RF/optical converter (f) may be integrated with the satellite antenna (g) as in Fig 3 and Fig 4.

[0028] The box that covers the subunits (h) may be placed inside the train as in Fig 2 and Fig 4 or outside the train as in Fig 1 and Fig 3. Either way, it is preferred that a metal cover is arranged around the components, and to connect the cover to ground.

[0029] As is illustrated in the discussed embodiments, the first unit arranged outside the train is in all cases the end unit, i.e. the antenna (g). Further, the second unit arranged inside the train in all cases comprises the DC/AC converter (a) and the optical/RF converter (d). The other components may be arranged both outside and inside the train, in various combinations.

[0030] Specific embodiments of the invention have now been described. However, several alternatives are possible, as would be apparent for someone skilled in the art. For example, the embodiments above relate to trains, but the invention is likewise applicable for other vehicles, and especially vehicles with high-voltage lines in the nearby environment. Further, the first unit arranged outside the vehicle is an antenna in the above discussed examples, but may also be any other electronic unit or a combination of several components, and the same applies for the second unit. Further, the galvanic separation is preferably an optical component, but other galvanic separation means may be used to this end. The communication channel through the galvanic separation as provided by the invention may also be shared by several systems, whereby e.g. the channel may be shared by means of multiplexing. Hereby, the cost for each system could be reduced, since only one RF/optical converter and one optical/RF converter are

needed. Such and other obvious modifications must be considered to be within the scope of the present invention, as it is defined by the appended claims. It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting to the claim. The word "comprising" does not exclude the presence of other elements or steps than those listed in the claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, a single unit may perform the functions of several means recited in the claims.

Claims

1. A system for vehicles comprising a first unit arranged on the outside of the vehicle and a second unit arranged on the inside of the vehicle, and communication means to provide a communication contact between said first and second units, wherein the communication means provides a galvanic separation between the first and second units.

2. The system of claim 1, wherein the galvanic separation comprises an optical component.

3. The system of claim 2, wherein the communication means comprises an RF/optical converter arranged outside the vehicle, an optical/RF converter arranged inside the vehicle, and an optical fiber connecting said converters.

4. The system of any one of the claims 1-3, wherein the first unit arranged on the outside of the vehicle functions as an interface to at least one telecommunications network, said unit preferably comprising an antenna.

5. The system of any one of the claims 1-4, wherein the first unit is supplied with power without any galvanic connection to the interior of the vehicle.

6. The system of claim 5, wherein the first unit is supplied with power through a safety power transformer.

7. The system of any one of the preceding claims, wherein the second unit is operational as a gateway between a local network operating within the vehicle and an external network.

8. The system of any one of the preceding claims, wherein the second unit serves as a, preferably wireless, interface towards further units within the vehicle.

9. The system of any one of the preceding claims, wherein the first unit is enclosed in a protective casing, said casing being grounded.

10. A method for transferring communication signals between an indoor and outdoor environment of a vehicle, comprising the steps:

    providing a first unit in the outdoor environment of the vehicle;
    providing a second unit in the indoor environment of the vehicle; and
    transferring communication signals between the first and second units, wherein the communication signals are lead through a galvanic separation.

11. The method of claim 10, wherein the galvanic separation is provided by means of an optical component.

12. The method of claim 10 or 11, wherein the step of transferring communication signals comprises the substeps:

    converting the signals to an optical signal;
    transferring the optical signals through the galvanic separation; and, optionally,
    reconverting the signals.

13. The method of any one of the claims 10-12, wherein the first unit arranged on the outside of the vehicle provides an interface to at least one telecommunications network.

14. The method of any one of the claims 10-13, wherein the first unit is supplied with power without any galvanic connection to the interior of the vehicle.

15. The method of any one of the claims 10-14, wherein the second unit operates as a gateway between an local network operating within the vehicle and an external network.

Fig. 1

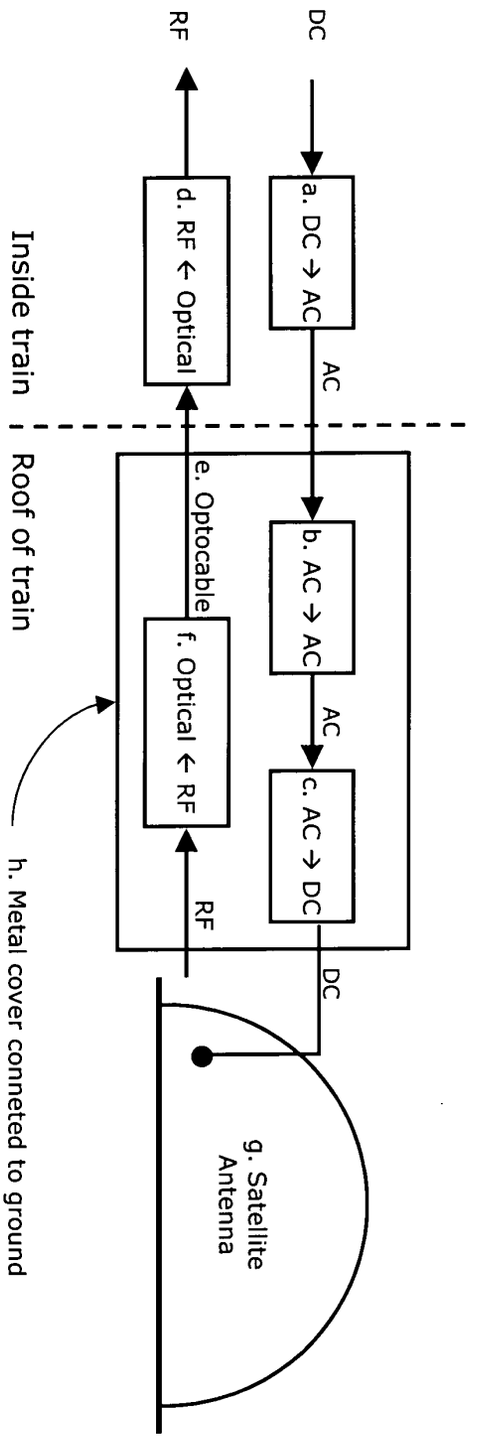

DC
a. DC → AC
AC
b. AC → AC
AC
c. AC → DC
DC
g. Satellite Antenna
RF
d. RF ← Optical
e. Optocable
f. Optical ← RF
RF
Inside train
Roof of train
h. Metal cover conneted to ground

Fig. 2

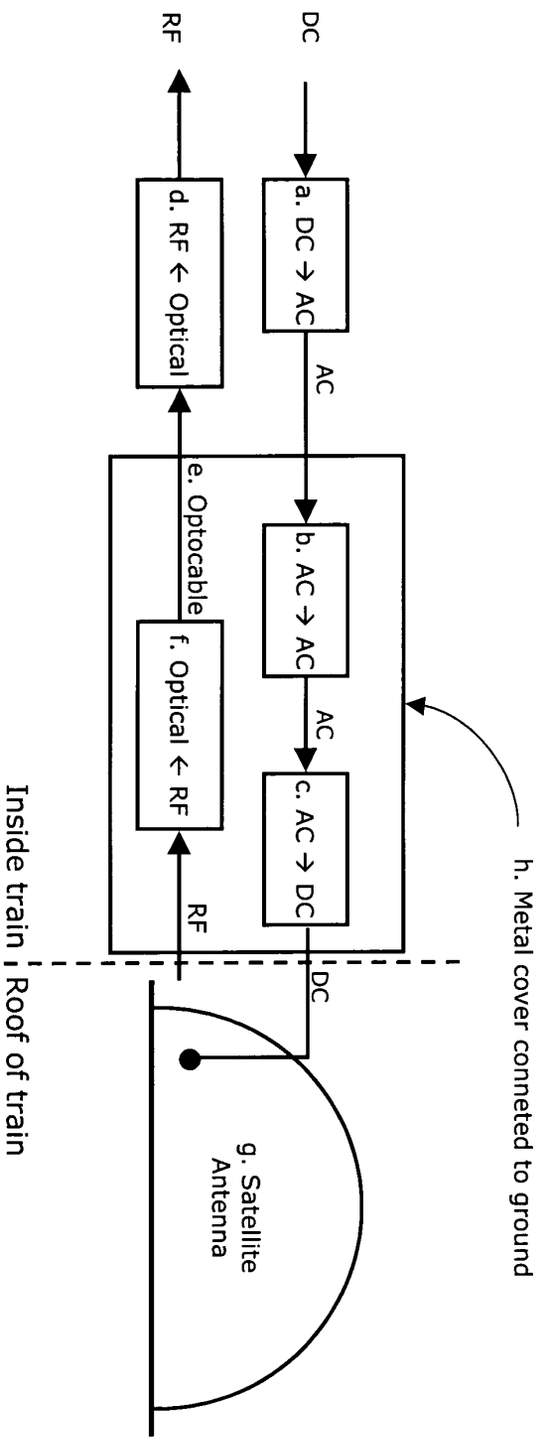

DC
a. DC → AC
AC
b. AC → AC
AC
c. AC → DC
DC
g. Satellite Antenna
RF
d. RF ← Optical
e. Optocable
f. Optical ← RF
RF
Inside train
Roof of train
h. Metal cover conneted to ground

Fig. 3

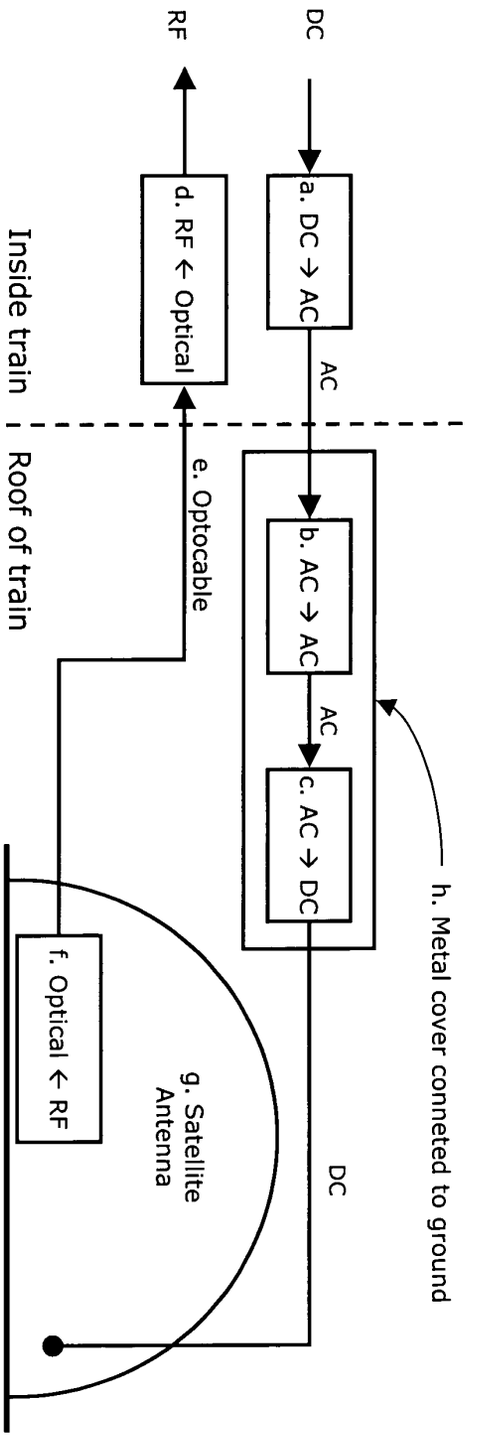
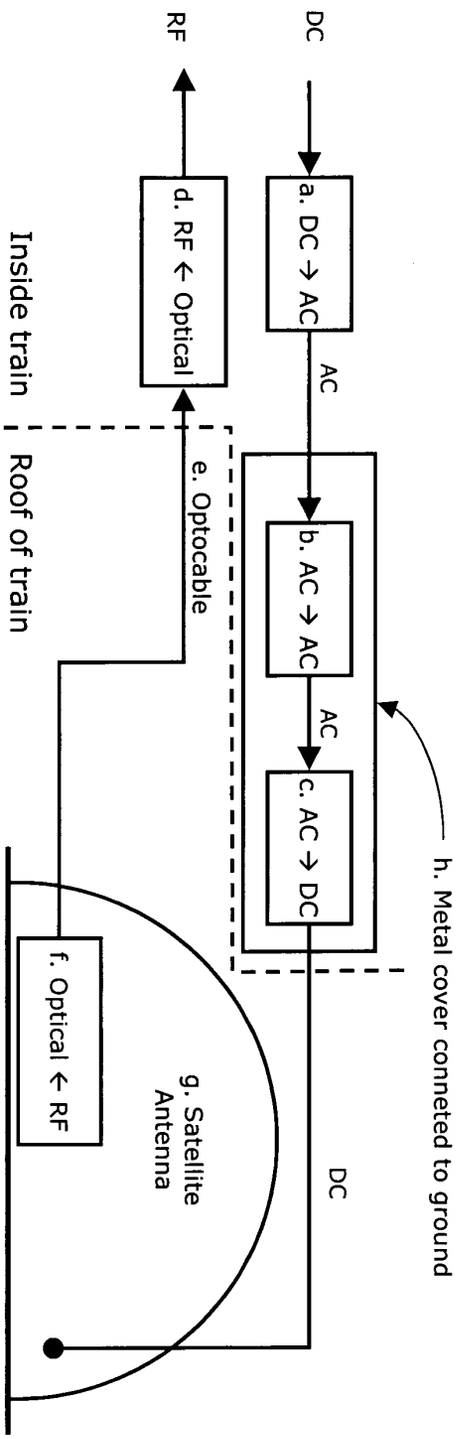

DC
a. DC → AC
AC
b. AC → AC
AC
c. AC → DC
DC
h. Metal cover conneted to ground
RF
d. RF ← Optical
e. Optocable
Inside train
Roof of train
f. Optical ← RF
g. Satellite Antenna

Fig. 4


DC
a. DC → AC
AC
b. AC → AC
AC
c. AC → DC
DC
h. Metal cover conneted to ground
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