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(54) **In-vehicle telematics device**

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(56) References cited:
EP-A- 0 915 443
EP-A- 1 843 430
EP-A1- 1 486 760
EP-B- 1 338 058
WO-A-01/80353
WO-A-2004/030143
WO-A-2005/076409
US-A1- 2003 151 556
US-A1- 2004 051 661
US-A1- 2005 259 013
US-A1- 2007 167 147
US-B1- 6 282 491
US-B1- 6 493 629

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Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to communications and more specifically to a novel and improved telematics communication device for automotive applications. The present invention also relates to a novel and improved method for emergency signalling for automotive applications.

BACKGROUND OF THE INVENTION

[0002] Latest developments in automotive electronics are dealing with the automatic monitoring of the state of a vehicle, such as a car, bus, train, airplane, or any similar vehicle. Such monitoring is based on the integration of numerous sensors into the bodywork such that the vehicle's most important structural and functional parts may be monitored. It is becoming of increasing interest to collect a variety of information, regarding different aspects of a vehicle, which may have different applications depending on their usage.

[0003] As an example, a first level of monitoring could be based on vehicle diagnostics, such as wheel tire pressure or wear, oil or fuel liquid levels, structural integrity measurements, or any other vehicle parameters which give an indication as to the "health" of the vehicle in terms of mechanics and electronics. A second level could be based on vehicle live parameters, such as speed, average fuel consumption, driving distance left till next fuel tank fill up, number of passengers, how many passengers have their seatbelts attached, temperature at different locations of the vehicle, or any other measurements which give an indication of the current state of the vehicle at any one moment in time in terms of its current usage patterns.

[0004] Location determination is one such measurement, giving an indication of the positional state of the vehicle, which has been widely accepted by vehicle users as an aid in route calculation and navigation. Current positioning devices within vehicles are stand-alone units comprising a Global Navigation Satellite Systems GNSS, which may be bought off-the-shelf and fixed to the windscreen or dashboard of the vehicle at a distance easily accessible by the driver. A disadvantage with such systems is that they provide a single functionality without any further connectivity, either externally or with other electronic devices inside the same vehicle.

[0005] Most other vehicle state information is gathered via sensors in a central controller, normally comprised inside a telematic unit. Current telematic units collect sensor data, and after some processing, display the raw data or simple statistic information in the vehicle's dashboard directly. A disadvantage with these current telematic units is also their independence from other vehicle systems as well as their lack of external connectivity.

[0006] Therefore current vehicle units do not provide the possibility for live periodic transmission of vehicle telematic data to an external entity, such as a server, or data warehouse. Furthermore, these parameters are an example of information which belongs to the same vehicle, however they are provided independently from each other. In other words, their delivery to the user of the vehicle is performed in a mutually independent manner. It is therefore the user, being the driver or passenger, which decides how to use or combine the information being provided via a variety of sources.

[0007] Therefore there is a need to take advantage of the synergistic effect of the combination of a variety of vehicle statistical data, currently only available in a mutually independent manner. Furthermore, there is a need to combine location information with other vehicular data in order to provide the users of the vehicle with location based services, and also in order to provide location based services which are vehicle specific. Such service provision would be dependent on a combination of vehicular state information, and vary according to the first, second, or other levels of vehicle diagnostics provided by the multiple sensors or electronic control units throughout the vehicle.

[0008] One example where such information is advantageous if provided in combination is in solving current traffic problems in large urban areas. Another example would be for vehicle manufacturers to analyse the driving habits of their customers. Yet another example would be for the public traffic authorities to understand why certain "black" spots cause so many accidents.

[0009] Yet another vital application is the transmission of an SOS emergency signal in cases of distress, or heavy vehicle accident, to a central node for further routing to the appropriate emergency services, such as police, ambulance, fire brigade, or the like. Such a service is being developed in several countries, and may be known as automatic emergency call, or eCall system.

[0010] Current commercialised positioning units which may be considered for use in possible eCall systems have developed from previous positioning units in that they incorporate external communication functionality to a central server. The idea with these current eCall systems is that they transmit the position of the vehicle when activated. However the disadvantage with these current solutions is that they cannot provide any other vehicle information to any external entity as they are limited to transmitting only position information which has been determined within the same unit.

[0011] Another disadvantage to the current eCall units available to vehicle users is that whereas the main unit is installed somewhere in the vehicle (central console, central tunnel, trunk, or similar location), the antennas for wireless communication, for example cellular, and/or navigation service provision via a Global Navigation Satellite System GNSS, are external, installed on top of the roof, windshield or other part of the vehicle, depending on the specific cellular or GNSS antenna characteristics. Hence the connection from the positioning unit to the antennas requires typically a long coaxial cable for each antenna.

[0012] The choice of having an external antenna connection has the advantages of good electromagnetic characteristics, such as good transmission and reception performance. However, on the other hand, external antennas increase integration costs (cost of cabling, connectors and operator installation time), as wiring cannot be standardized (as it varies from vehicle to vehicle). Additionally, external antennas easily suffer breakage, either due to clipping with external objects, such as the roof of a tunnel or garage, or due to other acts, such as vandalism.

[0013] Another problem with current eCall units is their dependence on the wired connection with the vehicle's main power supply. Since they have not been designed with the possibility of complete loss of connectivity due to an accident, when vehicles comprising these current units undergo a heavy crash, the unit's wired connections are severed, in addition to the whole unit being destroyed in the process. Therefore they would neither have electric power, nor wired connections to the external antennas, for emitting a distress signal after the accident. This could have disastrous consequences in case of accidents where the chance of survival of injured passengers depends directly on the reaction time of the emergency services.

[0014] Documents EP 1338 058 B and WO 01/80353 A disclose communication and control systems/ antennas incorporated into the rearview mirror assemblies of a vehicle. The former document discloses a multiservice antenna system integrated in a plastic cover fixed in the inner surface of the transparent windshield of a motor vehicle. The shape and design of the antenna arc based on combined miniaturization techniques which permit a substantial size reduction of the antenna making possible its integration into a vehicle component such as, for instance, a rear-view mirror. At least a first antenna of the antenna system includes a conducting strip or wire, being shaped by a space filling curve. Similarly, document WO 01/80353 A discloses a vehicle communication and control system that may be readily installed in a vehicle and that utilizes minimal additional wiring. According to some of the disclosed embodiments of said document, the electrical components of the "brick" of a communication and control system are integrated into a rear-view mirror assembly. Preferably, the microwave antenna (50) for the GPS (80) and the cellular telephone antenna (114) are also integrated into the rear-view mirror assembly.

[0015] Documents US 2007/167147 A1 and EP 1 486 760 A1 refer to wireless communication means providing an emergency notification, for instance, positioning information of a vehicle. In particular, document US 2007/167147 A1 discloses a method and apparatus for providing emergency notification by a wireless mobile device in response to triggering a sensor. A detection system, which may be located within a vehicle, comprises one or more sensors configured to sense an emergency event and transmit a message via a wireless link regarding the emergency event. The integrated vehicle telematic system disclosed in document EP 1 486 760 A1 comprises wireless communication means and means for receiving data from a positioning system to derive positional information. The telematic system further comprise integrated antenna means for said wireless communication means and said means for receiving data from a positioning system. The telematic system is further adapted to be arranged at a location within said vehicle providing for good antenna properties.

[0016] Reduced size antenna systems are described in documents US 2005/259013 A1 and US 2003/151556 A1. The former relates generally to a new family of antennas with a multiband behaviour and a reduced size. The general configuration of the antenna consists of a multilevel structure which provides the multiband behaviour, combined with a multilevel and/or space-filling ground-plane. The multilevel structure consists of two arms of different length that follow a winding parallel path spaced by a winding parallel gap (parallel to the arms) with a substantially similar shape as each of said arms, that is, with a similar winding path as the aims. The resulting antenna covers the major current and future wireless sendees, opening this way a wide range of possibilities in the design of universal, multi-purpose, wireless terminals and devices.

[0017] Document US 2003/151556 A1 discloses an antenna system including a fractalized element that may be a ground counterpoise, a top-hat located load assembly, or a microstrip patch antenna having at least one element whose physical shape is at least partially defined as a first or higher iteration deterministic fractal. The resultant fractal element may rely upon an opening angle for performance, and is more compact than non-Euclidean ground counterpoise elements or the like. A vertical antenna system includes a vertical element that may also be a fractal, and a vertical antenna can include vertically spaced-apart fractal conductive and passive elements, and at least one fractal ground element. Various antenna configurations may be fabricated on opposite surfaces of a substrate, including a flexible substrate, and may be tuned by rotating elements relative to each other, and/or by varying the spaced-apart distance therebetween. Fractalized ground counterpoise elements and/or microstrip patch antenna systems may be fabricated on a flexible printed circuit substrate, and/or placed within the support mount of a cellular telephone car antenna.

SUMMARY OF THE INVENTION

[0018] It is therefore an object of the present invention to provide a solution to the above mentioned problems.

[0019] The invention is defined by the independent claims. Further aspects of the invention are outlined in the dependent claims. Embodiments which do not fall within the scope of the claims do not describe part of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The features and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings, in which like reference characters identify correspondingly throughout.

Figure 1	shows a functional block diagram of an exemplary in-vehicle telematics communication device according to the present invention.
Figure 2	depicts the inside of an exemplary in-vehicle telematics communication device according to the present invention.
Figure 3	depicts the housing of an in-vehicle telematics communication device according to the present invention.
Figure 4	is a graphic representation of various antenna integration strategies possible according to the teachings of the invention.
Figure 5	is a graphic representation of cellular antenna characterization at different locations.
Figure 6	is a graphic representation of GNSS antenna characterization at different locations.
Figure 7	is a graphic representation of Bluetooth antenna characterization at different locations.
Figure 8	is a graphic representation of the radiated emissions from the vehicle in an example GNSS band.
Figure 9	is a graphic representation of the radiated emissions from the vehicle in an example cellular band.
Figure 10	represents graphically the flexibility and malleability of the housing of an exemplary device according to the present invention.
Figure 11	represents graphically the modularity of the housing of an exemplary device according to the present invention.

DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

[0021] From the following description, it will be understood by the person skilled in the arts that although any one preferred aspect of the invention already provides solutions to the problems of the prior art devices and methods, the non-obvious combination of multiple aspects provides additional synergistic advantageous effects over the prior art.

[0022] FIG. 1 depicts the functional block diagram of an example telematics communication device 100. The device 100 is adapted to support a wide range of services, such as:

- Automatic emergency notification (eCall);
- Manual emergency notification;
- Breakdown assistance (bCall);
- Remote vehicle diagnostics;
- Toll collect;
- Pay as you drive (PAYD);
- Stolen vehicle location;
- Remote door lock/unlock;
- Fleet management.

[0023] In order to provide such wide ranging services, numerous telematic data must be collected from different sensors. The multiple sensor units fixed all over the vehicle may transmit raw measurements to a central processing unit. They may also be integrated within a single module together with an electronic control unit, where a preprocessing of measurements is performed, in order to transmit to the central controller, or even to other modules, data already in a state which might be further utilised.

[0024] Example measurements could include a subset from a plurality of telematic data, such as:

- wheel tire pressure or wear;
- liquid levels (oil, fuel, coolant), average fuel consumption, driving distance left till next fuel tank fill up;
- structural integrity measurements;
- speed, acceleration, maximum speed reached;
- number of passengers, how many passengers have their seatbelts attached;
- temperature at different locations of the vehicle;
- airbag deployment flag as an indicator of the occurrence of an accident;
- window open/close, doors locked/unlocked.

[0025] The performance of the telematics device is dependent on a plurality of parameters:

- wireless communication reception sensitivity;
- wireless communication transmission range;
- internal data communication;
- processing power;
- overall volume and weight;
- ease of integration and installation at production line;
- accuracy of positioning system;
- availability and integrity in the positioning.

[0026] The power supply means of device 100 comprises a DC/DC converter 105 connected to the vehicle's main power supply line 101. Power supply means also comprises an internal backup battery 104 connected to the remaining circuitry and processing means 108 via switch 107. Thanks to its high processing power, the unit is able to run several services and communication technologies at the same time, and can operate as the main telematics gateway of the vehicle.

[0027] Processing means 108 comprises means for control processing 109 as well as means for internal communications 110 with the rest of the vehicle. These two functionalities may be comprised within the same programmable micro-controller or they may be independent inter-connected units, as depicted via the broken line.

[0028] Control processing means 109 is adapted to detect a loss of connectivity, via data line 106, with the vehicle's main power supply line 101 and therefore activate switch 107 to connect the internal backup battery 104. Such automatic detection of loss of power has the advantage of providing service continuity in case the telematics communication device's connection to the vehicle's cables is lost, for example, due to a crash. Therefore the device of the present invention can continue to function and transmit data independently from this connection, at least temporarily, for a duration of several hours.

[0029] Such data provision continuity may be vital in order to request the immediate assistance of emergency services. After connectivity with the vehicle's main power supply line 101 is re-established, processing means 109 is adapted to recharge the internal backup battery 104 via internal recharging circuitry. Once recharged, means 109 is adapted to disconnect switch 107, thereby leaving battery 104 ready for the next eventuality.

[0030] Means for internal communications 110 provides connectivity with multiple modules throughout the vehicle. Each module may comprise a single sensor unit, a single electronic control unit ECU, or a combination of sensor and electronic control units. Therefore the internal communications means 110 interfaces with at least one module via data cable 102. Such connectivity is possible as the means for internal communications implements a data networking protocol which interfaces with similar protocols in the different modules.

[0031] Therefore data from the sensors and/or electronic control units are routed via the vehicle cable to the telematics communication device. This data is received by the means for internal communications 110 and may be further routed either as non-processed raw data, or a combination of such information may be further processed by the control processor means 109. Whereas prior art telematics units comprised a plurality of connections to multiple points within the vehicle, the number of external connectors in the device of the present invention has been reduced to only one, the main connector of the vehicle.

[0032] An example of one such networking protocol is the CAN protocol for vehicle data communications. In such example data cable 102 would be a CAN Bus, and every module within the vehicle would comprise a CAN communications unit connected to the CAN Bus. However any other protocol providing internal data connectivity over a common communications line may be implemented.

[0033] Processing means 108 is adapted to further connect with wireless communications means via switch 111 and connection 120. Means 108 can therefore open or close this switch depending on whether the telematics device is to have wireless functionality or not. In the case where the only connection of the telematics device is intended through wireline connection, this section would be disconnected from the means for power supply.

[0034] Wireless communication means may comprise an internal wireless communication section and external wireless communication sections, both functionalities being shared by a common wireless controller 114. It will be understood by the person skilled in the art that the two functionalities may be implemented as completely independent units as well.

[0035] Wireless controller 114 comprises a radio frequency section for long range communications and a Bluetooth module 116 for short range communications. A position determination module 112, comprising a Global Navigation Satellite System as well as optional inertial sensors, provides the additional location information in case necessary.

[0036] Radio frequency section comprises at least one transceiver for cellular communications, connected to RF antenna 115. When more than one cellular communication protocol is being implemented, the plurality of transceivers may be implemented as a software definable radio SDR unit, sharing a common antenna. Optionally, separate antenna units may be provided, or in combination with separate transceiver units. Common cellular standards currently in use are based on the GSM, CDMA, or OFDMA standards. Optionally antenna 115 may be a multiple input multiple output MIMO antenna. The implementation of such a cellular unit, according to the plurality of communication protocols, is within the scope of the person skilled in the art and will not be further detailed here.

[0037] Wireless controller 114 has a data connection to processing means 108 to collect the data being provided via the wireline connection, either in raw format or processed, in order to transmit it to vehicle-external servers, or vehicle internal modules.

[0038] Bluetooth module 116 has also the functionality for internal data communications due to its short range communication characteristics. Therefore it complements the internal communication means section for providing data to, and receiving from, sensors and/or electronic control units which do not necessarily have a cable connection via the internal data networking protocol.

[0039] This additional connectivity is especially advantageous in case the standard cable connections 118 and 102 are lost, for example due to a heavy accident. In such a situation the Bluetooth module 116, connected to the vehicle's speakers and microphone, would provide an uninterrupted audio link between the passengers of the vehicle and the operator of a central emergency service. Such audio link is instrumental in saving lives when be used for providing vital first aid instructions either to the passengers themselves or to pedestrians.

[0040] Similarly, the Bluetooth module may be configured to act as a backup external transmission device by attempting to link to an on-board phone, or a passenger phone with activated Bluetooth functionality. Periodic dialling of the default emergency services telephone number would provide redundancy in attempting to notify the appropriate emergency services.

[0041] Another advantageous example for this wireless connectivity is to have a Bluetooth SOS button in the vehicle's dashboard. Therefore a user may still request assistance manually via the wireless connection, even if the standard cable connection 119 is lost. The button may also be in the form of an LED, which would be activated in case of an accident to signal visually the position of the SOS button.

[0042] The position determination module 112 may be based on a plurality of location determination services. One such system is the Global Positioning System GPS, readily made available for use for the general public. Other systems such as GLONASS, IRNSS or COMPASS also exist for different geographical regions in the world. In the case of Europe the satellite-based system being developed is the GALILEO satellite system.

[0043] The GNSS system implemented may be additionally complemented via inertial sensors located within module 112. Inertial sensors have the functionality of improving the location estimate calculated from the signals received via the plurality of satellite transponders. In particular, they have the functionality of updating the current location of the vehicle in the interval between the reception of different satellite signals. Therefore since the location is constantly tracked, at any one time very accurate position information will be available.

[0044] Dead reckoning is the process of estimating a vehicle's current position based upon a previously determined position, or fix, and advancing that position based upon known speed, elapsed time, and course. Classic schemes of Inertial Navigation Systems INS include external motion sensors such as gyroscopes, accelerometers and other devices besides a GNSS receiver. These sensors increase highly both the final price of the equipment and the complexity of the installation into vehicles.

[0045] The telematics communication device object of the present invention provides the innovative solution whereby the telematic information gathered via the vehicle's data bus is used for building an INS based on these data. With such procedure the accuracy of the positioning service is improved in hard environments with low satellite coverage in a cost effective and reliable manner.

[0046] Relevant telematic data, in addition to the location information provided by the GNSS module, obtained from the vehicle's internal communication bus could be:

- Yaw rate provided by a gyroscope;
- Differential wheel ticks;
- Unified wheel ticks;
- Acceleration provided by accelerometers.

[0047] Particular advantage of this characteristic is provided in areas where satellite coverage is blocked by large obstacles, such as building or tunnels in urban zones, or forest or mountains in rural zones. Therefore location information provision will still be possible when the vehicles are transiting through regions of low satellite signal level reception.

[0048] Prior art positioning applications suffer from a basic limitation in that they do not guarantee service availability nor service integrity. These two aspects are indispensable for the provision of a plurality of services. Service integrity is an important component for the implementation of GNSS safety critical applications as well as for liability-critical applications. The latter applications are delicate in that performance problems can generate significant legal or economic consequences when not properly identified.

[0049] The telematics communication device of the present invention conforms to the service requirements in order to provide the necessary guarantee to fulfil service availability and integrity needs. This is possible due to the integration of a Protection Level PL calculation with each position determination. The Protection Levels correspond to the radius of a plurality of circumferences centered at calculated positions. The multiple circumferences build a region where the actual calculated position is guaranteed to a pre-determined level. The telematics communication device of the present invention has been designed to comply with a protection level with a probability of 99.9999%.

[0050] Protection Level analysis while designing the device filters the wrong detections and thereby avoids problems caused by erroneous calculations. This is especially important in liability-critical applications: for example, in an electronic toll collect system that charges the user depending on the number of kilometers driven within a specific road or zone.

[0051] FIG. 2 depicts a section of the inside of an exemplary telematics communication device of the present invention. The compact design can be readily appreciated in this configuration 200. A section of the power supply means 201 is contiguous to the internal backup battery 202. Connector 203 provides wireline connectivity between the device and the rest of the vehicle. In particular, the telematics communication device is provided with electric power supply via this connector. Likewise, most data communication and exchange with the rest of the vehicle normally takes place via connector 203.

[0052] A particular advantage of the device of the present invention is the complete integration of the antennas from the different communication means, thereby removing the necessity of having a long external coaxial cable connecting the telematics device with external antennas. Similarly, the antennas are protected from tampering, therefore guaranteeing permanent connectivity. The various antennas of the at least one communication module, from the group of cellular RF, Bluetooth or GNSS antennas, are built in such a way that they comply with the compact limitation of the device's housing. The integrated cellular and Bluetooth antennas 205 are designed not to be contiguous with GNSS antenna 204 in order to minimise interference.

[0053] The integration of prior art external antennas into such small devices is possible via the use of miniaturized communication antennas based on space-filling geometries or Planar Inverted F Antenna PIFA structures.

[0054] In an embodiment at least one antenna may be a space-filling curve antenna in the form of a circuit board, with a printed pattern based, at least in part, on specific space-filling curve geometry. Due to the pattern fixing process, there is no constraint that the board be flat. The circuit board may have many different shapes and forms, be flat or curved, spherical or conical, as long as it can contain the copper serigraphy which will form the antenna pattern.

[0055] The high adaptability of the pattern design allows for the integration of the miniature antenna into a wide variety of shapes. However, no matter the shape or form of the antenna, its space-filling curve pattern is designed in order to enable it to receive either GNSS signals, or receive and transmit RF signals or Bluetooth signals.

[0056] Antennas based on space-filling curves are characterised by their self-similar repetitive designs, enabling to maximise their length, or increase their perimeter, to cover inside sections or outside structures, of the supporting material which can receive or transmit electromagnetic signals. A space-filling curve can be described as a curve that is large in terms of physical length but small in terms of the area in which the curve can be included. Whatever the design of such space-filling curve is, it can never intersect with itself at any point except the initial and final point (that is, the whole curve can be arranged as a closed curve or loop, but none of the parts of the curve can become a closed loop). A space-filling curve can be fitted over a flat or curved surface, and due to the angles between segments, the physical length of the curve is always larger than that of any straight line that can be fitted in the same area (surface) as said space-filling curve.

[0057] The self-similar repetitive design is obtained via a multi-scalar repetition of a pattern, or motif, and results in the advantageous characteristics described, among which are its ability to operate simultaneously at a plurality of frequency bands, and frequency ranges, as well as providing the possibility of integration. The inconvenience of the long coaxial cables connecting external antennas with the telematics unit of the prior art is solved by providing at least one antenna with a highly compact pattern. This characteristic enables the space-filling curve antenna to be implemented in an exceptionally small surface area, allowing it to be integrated with a single housing.

[0058] The space-filling curve pattern may be printed on a standard copper printed circuit board. An example of such a board would be the thin FR4 PCB (example dimensions: 35μm Cu, 0.2mm thick) as well as other supports which offer a good compromise between ease of assembling, flexibility, cost and dielectric properties. As supports for the copper either blended plastic films, Moulded Interconnected Device MID technology, cartons or flex-film may be used. Other materials which offer the advantageous feature during integration of flexibility are ceramic-based materials. The antenna may be integrated into the device by attaching it via clips or heatstaking it to the device.

[0059] One example of how a space-filling curve antenna may be designed is following the Hilbert geometry as it offers a very high degree of miniaturisation. Consequently, it also offers good integration characteristics inside the device. The Hilbert geometry allows for a variety of designs where different patterns vary in complexity and degree in which the space of the antenna is filled. The overall effect is to change the antenna's effective length and therefore electromagnetic properties.

[0060] As can be seen from FIG. 4 various designs exist offering a good compromise between performances and integration power. FIG 4A depicts the front cover 401, the back cover 403 and the printed circuit board 402 of an exemplary device according to the present invention, where the antennas are assembled in the PCB . FIG. 4B depicts the PCB 402 with the pattern printed 420 on the board. FIG. 4C depicts the pattern printed on a flexible plastic film 430, which may then be fixed on any surface of the housing or the board. FIG. 4D depicts the integration of the antennas 440 using MID technology.

[0061] However other antenna geometries exist which offer the advantages of high degree of miniaturisation. Antenna patterns may be designed by using the Koch geometry or the Meander geometry. Further miniaturisation may also be achieved via the use of a PIFA configuration, consisting on connecting two parallel conducting sheets, said sheets separated either by air or a dielectric, magnetic or magnetodielectric material, said sheets connected through a conducting strip near one of the sheets corners and orthogonally mounted to both sheets. The antenna is fed through a coaxial cable, said coaxial cable having its outer conductor connected to first sheet, being the second shit coupled either by direct contact or capacitatively to the inner conductor of said coaxial cable.

[0062] Space-filling curve antennas may also be designed as a conducting arm, part of the arm being shaped as a space-filling curve, or as a miniature microstrip patch antenna, part of said space-filling curve antenna being shaped as a space-filling curve, based on any of the abovementioned geometries. Space-filling curve antennas may also be formed as a superposition of two conducting sheets. These conducting sheets may have a space-filling curve pattern designed on them, or they may have a gap shaped as a space-filling curve.

[0063] The various patterns are carefully designed in order to provide a good compromise between antenna performance and degree of integration. The correct choice while designing the geometry of the antenna will depend on a number of factors, as well as finally affect the performance of a number of parameters of the antenna 100. Among these factors and parameters are antenna size, its relative gain, electromagnetic radiation patterns, impedance characteristics, degree of flatness or curvature, frequency range of operation, antenna efficiency, specific absorption rate and polarization.

[0064] It is to be understood that the advantageous features of the preferred embodiments of the present invention are equally applicable to other types of space-filling curve antennas such as, IFA, monopole, dipole, coupled monopole, or loop antennas, and the person skilled in the art is able to apply the miniaturisation and integration teachings described to space-filling curves and PIFA antennas to any combination of antennas.

[0065] The antennas depicted in FIG. 2 are located inside the housing of the telematics device. However the at least one antenna may be also integrated on the exterior of the back cover. In either configuration the shape of the antenna's board is chosen to fit in with the rest of the components.

[0066] The advantages of integrating the miniature space-filling curve antenna within the same housing as the remaining components are readily apparent, as the pattern may be also designed to optimise its fit in relation to the remaining components, following the constraints of the printed circuit board size, area and forms, as can be appreciated from FIG. 4D. When integrated within the housing the space-filling curve antenna pattern is designed to be located substantially along the outer perimeter of the communications device or of the antenna's PCB, in order to maximise its irradiating characteristics and minimise the interference and electromagnetic coupling of other electronic modules. The space-filling curve may also be designed to be integrated either in parallel to the PCB or perpendicular to it. Either way, or even at any other angle, the advantages of flexibility while designing the pattern exist in order to achieve the advantages of highest integration and lowest interference reception.

[0067] FIG. 3 depicts the housing of an exemplary telematics communication device of the present invention. Device 300 is designed to be embedded inside vehicles and be able to operate in extreme situations, for example, after a heavy accident, where most of the vehicle's integrity has been compromised. Even after the whole vehicle's mechanic structure has been destroyed, device 300 is able to operate in order to transmit, for example, an SOS emergency signal with the necessary telematic information.

[0068] Device 300 comprises a housing 301, wherein all the different components providing the advantageous aspects of the invention are integrated, and a connector 302, for connecting the various data cables to the internal vehicular data network and the power line to the vehicle's main power supply.

[0069] All the components of the telematics communication device are integrated in a compact manner resulting in a discrete small telematics box. Such device can be positioned inside the vehicle in remote locations, such as in vehicle zones protected by the vehicle's own structure. Such positioning safeguards the telematics communication device's integrity best in situation of heavy collision. Therefore the correct internal component layout design within housing 301 provides the advantage of flexibility while installing the device inside the vehicle, and allows it to be placed in the safest less accident-prone zones.

[0070] Such placement of the telematics communication device has the additional advantage whereas important components will not be easily accessible for by-passers. In particular, it will be very difficult to steal such a device, tamper with it, and therefore extra protection against vandalism is provided.

[0071] These advantages may be obtained also by designing the housing of the telematics communication device in order to provide it with a degree of flexibility to fit the shape and form of the place within the vehicle where it will be lodged. Such flexibility may be provided by building the housing from an inherently flexible and mouldable material, which once placed within the vehicle, may be solidified into place, for example through heating, or via a chemical reaction, or the application of electricity. FIG. 10A depicts an example housing of a device before fitting into the vehicle, and FIG. 10B depicts the housing conformed to the spacing of the vehicle. Such procedure would enable the device to be fit into non-uniform spaces, around or in-between existing objects, therefore optimising space occupation as well as overall protection, due to the shaping of the flexible part 1001 of the structure. Either the whole structure or part of it may be made conformable.

[0072] The housing of the device itself may also be designed to comprise at least two inter-connected modules 1101, 1102, as in FIG. 11, wherein the connection 1103 is made from a thin flat flexible material or cable. Antenna elements could be placed in one of these modules, whereas other electronic components, usually bigger in size, could be placed in other modules. Depending on the overall size and layout of the internal components, the telematics communication device could comprise two, three or more of these modules electrically and physically connected with each other so that the device may be fit into a free space within the vehicle even in difficult to reach zones, or spaces with a not well defined shape, for example, around or in-between other components and objects, such as pipes, or vehicle mechanical parts. The modularity of the device's structure provides the flexibility during placement, and allows finding the optimal place and orientation for the antenna elements inside the vehicle.

[0073] A combination of these integration strategies is also possible. The housing could be designed to be modular, as in FIG. 11, and have at least one flexible malleable module 1102. Such a combination would maximise the integration capabilities of the device in non-accessible zones, therefore increasing its security against theft and structural deformations due to heavy crashes.

[0074] The small size of the device allows it to be placed in more accessible locations as well. Such necessities may arise in order to extend the possibilities of integration and vehicle-dependent customisation, especially when the main vehicle parts have already been mounted, and the less accessible regions are not an option for device placement anymore. More common locations where the telematics communication device may therefore be placed are for example under the dashboard, inside the glovebox, inside the central console, or inside the trunk.

[0075] In general terms, the smaller the volume the easier its integration inside the vehicle. In an exemplary device according to the present invention the device has approximate dimensions which do not exceed 120mm x 65mm x 35 mm. Moreover, its design can be customized in several forms and shapes in order to fit inside places with very different dimensions and configurations inside the vehicle bodywork.

[0076] The device's integrity is further safeguarded by the correct choice of materials for the housing 301. Special plastic polymers may be chosen which provide the housing with extra mechanical strength, which in turn will result in a device 300 less prone to damage when under stress. Example materials may be based on glass fibre reinforced polyamides, or polypropylene with talc. The shape and form of housing 300 is also so designed to improve the crash-resistant characteristics of the telematics communication device 300. The resulting compact and robust electronic and mechanical design is able to withstand the stresses and G-forces present in an accident scenario.

[0077] In order to provide the exemplary device with an even higher resistance to heavy loads and pressure, existent in vehicle crash scenarios, the space within the housing of the telematics device may be filled with a solidifying material, such as silicon or resin, so that after solidification extra strength is provided to the walls of the device in addition to the increase in device integrity.

[0078] Dynamic scenarios have been simulated in order to determine the stresses and G-forces applied to the unit in case of vehicle crash when installed in several vehicle locations. The material of the packaging has been selected to provide the best mechanical behaviour while maximizing antenna performance.

[0079] These integrated antennas may also be optimized for performance by choosing the correct placement of the device inside the vehicle. Since the resulting telematics communication device object of the present invention comprises complex communication circuitry and a plurality of electronic modules, thorough integration studies have to be performed to find out the best location for the device in order to guarantee correct operation while maximizing the performance of the device.

[0080] The main design guidelines in order to achieve optimised overall system performance depend on a combination of the placement of the components within the device as well as the placement of the device inside the vehicle. This combination of placements should take into account that in order to optimise performance, an iterative procedure optimising several parameters is necessary, whereby the different antennas:

- should have a good reference plane (ground plane);
- should be placed as far away as possible from any metallic elements;
- should be placed as far away as possible from any source of radiated noise, or capacitative coupling.

[0081] Additionally, the GNSS antenna could be placed in such manner to have as much a direct view of the sky as possible. A view angle of approximately 170° is recommended. The use of other sources of information to aid in location determination in case GNSS reception is compromised should not be discarded.

[0082] In order to achieve such optimised performance, a thorough integration study is normally necessary. The vehicle normally has bodywork with metal based components which attenuate GNSS signal reception and introduce undesirable reflected signals received by the antenna, commonly known as multipath components. Moreover, metal and plastic components attenuate both cellular and Bluetooth signal reception and reduce the transmission range of the device. Furthermore, the telematics communication device should be installed in a place where it can continue to operate after an accident.

[0083] The combined optimisation of all these different factors results in a non-obvious iterative procedure yielding the optimal placement for the device inside the vehicle. Due to all these different complexity factors, and due to the fact that every vehicle is different, such optimisation has to be done on a case by case basis.

[0084] Such thorough integration study may be based in part on simulations and tests performed to measure antenna performance in different locations for the different modules, such as GNSS, cellular and Bluetooth. FIG. 5 is a graphic representation of different electromagnetic properties of the communication modules in different placements (glove box, dashboard), with different types of space-filling curve antennas (PIFA, radio PIFA, monopole) operating at different frequencies (920 Mhz, 1795 MHz). FIG. 6 is a similar graphic representation of the GNSS module performance at different angular elevations, whereas FIG. 7 depicts the case for the Bluetooth module.

[0085] Interference caused by emissions in the same frequency band is commonly known as in-band noise. Measurements aimed at characterising the in-band noise of the GNSS module is depicted in FIG. 8, and in FIG. 9 for cellular communications. The correct antenna design, integration within the housing and placement of the device within the vehicle is a compromise between all these different characterisation patterns.

[0086] Therefore a discrete crash-tolerant telematics communication device for integration inside vehicles has been described which is able to transmit complex vehicle state information avoiding the use of any external antennas. Such transmission enables the provision of services which are tuned specifically to the state of the vehicle at the instant of telematic information compilation. The vehicle state information may include, in particular, vehicle positioning information, thereby enabling the provision of location based services dependent on the remaining telematic parameters of the vehicle.

[0087] A method of telematic communication is thereby enabled not possible in prior art positioning units or telematic units. The vehicle incorporating the telematics communication device of the present invention will be able to collect a variety of sensor data, and processed information from a variety of electronic control units, and periodically transmit the information to an external communication node connected to a server or database.

[0088] The information from multiple vehicles may optionally be used by traffic authorities to monitor countrywide traffic parameters. The information may optionally be used by vehicle manufacturers in order to monitor the state of the vehicle and use this information as feedback in the design process and improvement of the vehicles. The information may optionally be used by private service providers pushing information to the vehicle's display modules informing the driver and/or passengers not only of services available in the vicinity of the vehicle, such as restaurants or hotels, but more specifically, information linked to the current state of the vehicle. In the case it is detected the tyre pressure or the fuel level is low, the route to the next service station may be indicated. If the telematics data is indicative of a vehicle manufacturer specific problem, the next manufacturer service station may be indicated.

[0089] If the device's control processing means detects a state of anomalous functioning of the vehicle after having combined a plurality of telematic data from different sensors, a data and audio link with a service station may be provided, where an operator located in a remote location may have access directly to the telematic data in order for it to be analysed by a technician understanding the details of vehicle mechanics and electronics. In such a situation an overall diagnostic as to the severity of the malfunction may be given and the appropriate actions to be followed proposed.

[0090] Such telematic data need not be limited only to vehicle specific information, but since sensors will be installed throughout the vehicle passenger compartment, even various health monitoring schemes may be installed either as a standard procedure, or for passengers with a medical record, live monitoring of the vital signs.

[0091] This guaranteed transmission of vehicle state information to emergency services during periods of vehicle anomalous functioning is advantageously available without interruption even after a heavy accident. A method of emergency signalling in a telematic communication device is thereby enabled not possible in prior art positioning units or telematic units.

[0092] When the device detects a continuous worsening of the vehicle state, or a driver's state, due to the telematic information being read and processed, or a sudden variation in telematic levels being monitored indicative of a major change in the state of the vehicle, or due to loss of functionality of the main wired data connection, or any such similar information indicative of an accident, the telematics communication device is still enabled to transmit an SOS emergency signal requesting the immediate assistance by emergency services, such as ambulance, police, or fire brigade. The autonomous power supply means provides continued electric power, enabling the continued functioning of the remaining components. The external communication means periodically transmits an emergency signal including the latest telematic data, be it either from the vehicle or its passengers, to a central emergency service center. This data may comprise current telematic data available via the internal communication means if any wireless connection is still available, and may also comprise an audio link so that an operator may either provide instructions as to first aid help, or just reassure the people involved in the accident.

[0093] In chain accident scenarios involving a plurality of vehicles, gathering a centralised picture of this scenario, including data such as number of vehicles, number of passengers involved, if any are old people, children, or people which requires special medical attention, is vital for providing the best optimised emergency services.

[0094] After the accident, the plurality of telematic data collected may be analysed by the appropriate traffic authority intending to find out the causes of the accident, in order to prevent such a situation from happening again.

[0095] Therefore, the telematics communication device of the present invention provides a variety of advantageous characteristics amongst them the increased security of vehicle transit.

[0096] It is to be understood to the skilled person in the art that the disclosure of the various embodiments of the invention is intended as non-limitative preferred examples and realisations of the inventions, and therefore features of different embodiments may be readily combined within the scope of the general inventive concept described.

[0097] The various logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented of performed with a general purpose processor, a digital signal processor (DSP), and application specific integrated circuit (ASIC), a field programmable gate array (FPGA), or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine.

[0098] The methods or algorithms described may be embodied directly in hardware, in a software module executed by a processor, or a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art.

[0099] Those skilled in the art should appreciate that the foregoing discussion of one or more embodiments does not limit the present invention, nor do the accompanying figures. Rather, the present invention is limited only by the following claims.

Claims

1. A telematics communication device for installation in a vehicle, comprising:

    a housing (301);
    power supply means (101, 104, 105, 107);
    means (110) for internal data communications with at least one module of the vehicle, wherein said means (110) for internal data communications comprises a data cable (102) to connect to a data cable of the vehicle;
    means (109) for control processing adapted to determine a state of the vehicle based on data received from the at least one module of said vehicle; and means (114, 116) for external communications for transmitting at least one signal including the vehicle state information;
    characterised in that
    the means for internal and external communications comprise respectively at least one space-filling curve antenna (115, 117) integrated with the housing (301) of the device, wherein the at least one space-filling curve antenna (115, 117) is fixed on a surface of the housing and wherein the at least one space-filling curve antenna is from the group of Planar Inverted F Antenna PIFA, Inverted F Antenna IFA, or microstrip patch antenna; and
    the housing is at least partly, or fully, made of a flexible mouldable material adapted to be solidified by heating, by a chemical reaction or by electricity, and wherein the solidifying step is configured to be applied after the device has been placed within a free space inside the vehicle conforming to non-uniform structures and spaces around and in-between other vehicle components.

2. The telematics communication device of claim 1, further comprising a connector (203) for electrically connecting the device with the vehicle when placed inside.

3. The telematics communication device of claim 2, wherein the plurality of different means are integrated within a single housing (301).

4. The telematics communication device of claim 3, wherein the means (114, 116) for external communications is adapted to transmit an audio signal, a light signal or an electromagnetic signal, or a combination thereof.

5. The telematics communication device of any of the preceding claims, wherein telematics communication device comprises a printed circuit board and wherein the at least one integrated space-filling curve antenna is integrated with the housing of the device (440), or inside its back cover (430), or a combination thereof, and is placed at any angle to the printed circuit board of the telematics communication device.

6. The telematics communication device of any of the preceding claims, wherein the power supply means comprises
    a connection (105) configured to connect to the main vehicle power supply; and
    at least one internal backup battery (104) adapted to be activated when the main vehicle power supply, or the connection to the main vehicle power supply, fails to operate.

7. The telematics communication device of claim 6, wherein the at least one internal backup battery is a rechargeable battery (104) adapted to be recharged whenever connected to the main vehicle power supply.

8. The telematics communication device of any of the preceding claims, wherein the means (110) for internal data communications is based on a standard vehicular protocol for data networking.

9. The telematics communication device of any of the preceding claims, wherein the means for external communications (114, 116) comprises at least a radio frequency RF module based on cellular communication protocols over the GSM or CDMA air interface.

10. The telematics communication device of any of the preceding claims, further comprising means (112) for position determination based on cellular techniques or via a global navigation satellite system GNSS positioning protocol, wherein the means for position determination includes an antenna (113) integrated within the housing of the device, and the signal with the vehicle state information comprises also vehicle location information.

11. The telematics communication device of claim 10, wherein the means (112) for position determination

comprises at least one inertial sensor, and is adapted to update the location of the vehicle using information from the at least one module even during temporal absence of any cellular or satellite positioning information.

12. The telematics communication device of any of the preceding claims, wherein the means (109) for control processing is adapted to automatically detect a state of anomaly, emergency or crash, based on data received from the at least one module, and notify the means for external communications for transmitting at least one emergency signal and/or establish an audio link with an emergency control centre.

13. The telematics communication device of claim 12, further adapted for triggering the state of emergency of the vehicle manually by the user by means of the activation of an emergency button.

14. The telematics communication device of any of the preceding claims, wherein the housing comprises a flexible module (1001) or at least two flexibly interconnected modules (1101, 1102) permitting relative movement between them, thereby allowing the housing to be placed within a free space inside the vehicle conforming to non-uniform structures and spaces around and in-between other vehicle components.

15. The telematics communication device of any of the preceding claims, wherein the housing is partly made of special plastic polymers, such as glass fibre reinforced polyamides, or polypropylene with talc, and the physical characteristics of the device, such as shape and form, have been designed to withstand the mechanical stresses in case of crash of the vehicle.

16. A method of emergency signaling for vehicles with a telematics communication device according to any of the preceding claims, the method comprising the steps of:

determining a vehicle emergency state by the means (109) for control processing means based on data received from the at least one module via the means (110) for internal data communications;
transmitting at least one signal including information about the vehicle state via the means (114, 116) for external communications.

Patentansprüche

1. Telematik-Kommunikationsvorrichtung zum Einbau in ein Fahrzeug, umfassend:

ein Gehäuse (301);
Stromversorgungsmittel (101,104,105,107);
Mittel (110) zur internen Datenkommunikation mit mindestens einem Modul des Fahrzeugs, wobei das Mittel (110) zur internen Datenkommunikation ein Datenkabel (192) zum Verbinden mit einem Datenkabel des Fahrzeugs umfasst;
Mittel (109) zur Steuerverarbeitung, die angepasst sind, um einen Zustand des Fahrzeugs basierend auf Daten, die von dem mindestens einen Modul des Fahrzeugs empfangen wurden, zu bestimmen; und
Mittel (114, 116) zur externen Kommunikation zum Übertragen mindestens eines Signals, das die Fahrzeugzustandsinformationen beinhaltet;
dadurch gekennzeichnet, dass
die Mittel zur internen und externen Kommunikation jeweils mindestens eine raumfüllende Kurvenantenne (115, 117) umfassen, die in das Gehäuse (301) der Vorrichtung integriert ist, wobei die mindestens eine raumfüllende Kurvenantenne (115, 117) auf einer Oberfläche des Gehäuses befestigt ist und wobei die mindestens eine raumfüllende Kurvenantenne aus der Gruppe der planar invertierten F-Antennen, PIFA, der invertierten F-Antennen, IFA, oder der Microstrip-Patch-Antennen ist und das Gehäuse zumindest teilweise oder vollständig aus einem flexiblen formbaren Material hergestellt ist, das durch Erwärmen, durch eine chemische Reaktion oder durch Elektrizität verfestigt werden kann, und wobei der Verfestigungsschritt eingerichtet ist um angewendet zu werden , nachdem die Vorrichtung in einem freien Raum innerhalb des Fahrzeugs platziert wurde, der ungleichmäßigen Strukturen und Räumen um und zwischen anderen Fahrzeugkomponenten entspricht.

2. Telematik-Kommunikationsvorrichtung nach Anspruch 1, ferner umfassend einen Verbinder (203) zum elektrischen Verbinden der Vorrichtung mit dem Fahrzeug, wenn sie im Inneren platziert ist.

3. Telematik-Kommunikationsvorrichtung nach Anspruch 2, wobei die Vielzahl der unterschiedlichen Mittel in einem einzigen Gehäuse (301) integriert ist.

4. Telematik-Kommunikationsvorrichtung nach Anspruch 3, wobei die Mittel (114, 116) zur externen Kommunikation geeignet sind, ein Audiosignal, ein Lichtsignal oder ein elektromagnetisches Signal oder eine Kombination davon zu übertragen.

5. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei die Telematik-Kommunikationsvorrichtung eine Leiterplatte umfasst und wobei die mindestens eine integrierte raumfüllende Kurvenantenne mit dem Gehäuse der Vorrichtung (440) oder in ihrer Rückabdeckung (430) oder einer Kombination davon integriert ist und in einem beliebigen Winkel zur Leiterplatte der Telematik-Kommunikationsvorrichtung angeordnet ist.

6. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Stromversorgungsmittel umfasst:

eine Verbindung (105), die konfiguriert ist, um mit der Stromversorgung des Hauptfahrzeugs zu verbinden; und
mindestens eine interne Sicherungsbatterie (104), die angepasst ist, um aktiviert zu werden, wenn die Hauptfahrzeugstromversorgung oder die Verbindung zur Hauptfahrzeugstromversorgung ausfällt.

7. Telematik-Kommunikationsvorrichtung nach Anspruch 6, wobei die mindestens eine interne Sicherungsbatterie eine wiederaufladbare Batterie (104) ist, die angepasst ist, um bei jedem Anschluss an die Hauptstromversorgung des Fahrzeugs aufgeladen zu werden.

8. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Mittel (110) zur internen Datenkommunikation auf einem Standard-Fahrzeugprotokoll zur Datenvernetzung basiert.

9. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Mittel zur externen Kommunikation (114, 116) mindestens ein Hochfrequenz-RF-Modul umfasst, das auf zellulären Kommunikationsprotokollen über die GSM- oder CDMA-Luft-Schnittstelle basiert.

10. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, ferner umfassend ein Mittel (112) zur Positionsbestimmung basierend auf zellulären Techniken oder über ein globales Navigationssatellitensystem, GNSS, - Positionierungsprotokoll, wobei das Mittel zur Positionsbestimmung eine in das Gehäuse der Vorrichtung integrierte Antenne (113) beinhaltet, und das Signal mit den Fahrzeugzustandsinformationen auch Fahrzeugortungsinformationen umfasst.

11. Telematik-Kommunikationsvorrichtung nach Anspruch 10, wobei das Mittel (112) zur Positionsbestimmung mindestens einen Trägheitssensor umfasst und angepasst ist, um den Standort des Fahrzeugs unter Verwendung von Informationen aus dem mindestens einen Modul auch bei zeitlicher Abwesenheit von jeglicher zellulären oder satellitengestützten Positionsinformation zu aktualisieren.

12. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Mittel (109) zur Steuerverarbeitung angepasst ist, um einen anomalen Zustand, Notfall oder Crash auf der Grundlage von Daten, die von dem mindestens einen Modul empfangen wurden, automatisch zu erkennen und das Mittel zur externen Kommunikation zur Übertragung mindestens eines Notsignals zu benachrichtigen und/oder eine Audioverbindung mit einer Notfallleitstelle herzustellen.

13. Telematik-Kommunikationsvorrichtung nach Anspruch 12, ferner angepasst zum manuellen Auslösen des Notfallzustandes des Fahrzeugs durch den Benutzer mittels der Betätigung einer Notruftaste.

14. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Gehäuse ein flexibles Modul (1001) oder mindestens zwei flexibel miteinander verbundene Module (1101, 1102) umfasst, die eine Relativbewegung zwischen ihnen ermöglichen, wodurch es dem Gehäuse ermöglicht wird, in einem freien Raum innerhalb des Fahrzeugs platziert zu werden, der uneinheitlichen Strukturen und Räumen um und zwischen anderen Fahrzeugkomponenten entspricht.

15. Telematik-Kommunikationsvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Gehäuse teilweise aus speziellen Kunststoffpolymeren, wie beispielsweise glasfaserverstärkten Polyamiden, oder Polypropylen mit Talk besteht und die physikalischen Eigenschaften der Vorrichtung, wie Form und Ausbildung, so ausgelegt sind, dass sie den mechanischen Belastungen im Falle eines Zusammenstoßes des Fahrzeugs standhalten.

16. Verfahren zur Notfallsignalisierung für Fahrzeuge mit einer Telematik-Kommunikationsvorrichtung gemäß einem der vorhergehenden Ansprüche, wobei das Verfahren die Schritte umfasst:

Bestimmen eines Fahrzeug-Notfallzustandes durch das Mittel (109) zur Steuerverarbeitung Mittel basierend auf Daten, die von dem mindestens einen Modul über das Mittel (110) zur internen Datenkommunikation empfangen wurden;
Übertragen mindestens eines Signals, das Informationen über den Fahrzeugzustand beinhaltet, über das Mittel (114, 116) zur externen Kommunikation.

Revendications

1. Un dispositif de communication télématique destiné à une installation dans un véhicule, comprenant :

un boitier (301) ;
un moyen d'alimentation de puissance (101, 104, 105, 107) ;
un moyen (110) destiné à des communications internes de données avec au moins un module du véhicule, ledit moyen (110) destiné à des communications internes de données comprenant un câble de données (102) destiné à se connecter à un câble de données du véhicule ;
un moyen (109) destiné à un traitement de contrôle apte à déterminer un état du véhicule sur la base de données reçues depuis le au moins un module dudit véhicule ; et
un moyen (114, 116) destiné à des communications externes pour l'émission d'au moins un signal comprenant l'information d'état du véhicule ;
caractérisé en ce que
les moyens destinés à des communications internes et externes comprennent respectivement au moins une antenne courbe remplissant le volume (115, 117) intégrée au boitier (301) du dispositif, la au moins une antenne courbe remplissant le volume (115, 117) étant fixée sur une surface du boitier et la au moins une antenne courbe remplissant le volume faisant partie du groupe d'une antenne en F inversé plane PIFA, d'une antenne en F inversé IFA, ou d'une antenne patch microruban ;
et le boitier est au moins partiellement, ou totalement, réalisé en un matériau souple apte à être solidifié par chauffage, par une réaction chimique ou par l'électricité, et l'étape de solidification étant configurée pour être appliquée après que le dispositif a été placé à l'intérieur d'un volume libre à l'intérieur du véhicule en se conformant à des volumes et à des structures non uniformes autour, et entre, d'autres composants du véhicule.

2. Le dispositif de communication télématique de la revendication 1, comprenant en outre un connecteur (203) destiné à connecter électriquement le dispositif au véhicule lorsqu'il est placé à l'intérieur.

3. Le dispositif de communication télématique de la revendication 2, dans lequel la pluralité de moyens différents sont intégrés au sein d'un unique boitier (301) .

4. Le dispositif de communication télématique de la revendication 3, dans lequel le moyen (114, 116) destiné à des communications externes est apte à émettre un signal audio, un signal lumineux ou un signal électromagnétique, ou une combinaison des précédents.

5. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le dispositif de communication télématique comprend une carte de circuit imprimé et dans lequel la au moins une antenne courbe intégrée remplissant le volume est intégrée au boitier du dispositif (440), ou à l'intérieur de son capot arrière (430), ou à une combinaison des précédents, et est placée en faisant un angle quelconque avec la carte de circuit imprimé du dispositif de communication télématique.

6. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le moyen d'alimentation de puissance comprend
une connexion (105) configurée pour se connecter à l'alimentation de puissance principale du véhicule ; et
au moins une batterie interne de secours (104) apte à être activée lorsque l'alimentation de puissance principale du véhicule, ou la connexion à l'alimentation principale du véhicule, ne fonctionnent plus.

7. Le dispositif de communication télématique de la revendication 6, dans lequel la au moins une batterie interne de secours est une batterie rechargeable (104) apte à être rechargée chaque fois qu'elle est connectée à l'alimentation de puissance principale du véhicule.

8. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le moyen (110) destiné à des communications internes de données est basé sur un protocole standard de mise en réseau de données pour véhicule.

9. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le moyen destiné à des communications externes (114, 116) comprend au moins un module radiofréquence RF basé sur des protocoles de communication cellulaire via l'interface radio GSM ou CDMA.

10. Le dispositif de communication télématique de l'une des revendications précédentes, comprenant en outre un moyen (112) de détermination de position basée sur des techniques cellulaires ou via un protocole de positionnement de système mondial de navigation par satellites GNSS, le moyen de détermination de position comprenant une antenne (113) intégrée au sein du boitier du dispositif, et le signal avec l'information d'état du véhicule comprenant également une information de localisation du véhicule.

11. Le dispositif de communication télématique de la revendication 10, dans lequel le moyen (112) de détermination de position comprend au moins un capteur inertiel, et est apte à mettre à jour l'emplacement du véhicule en utilisant une information provenant du au moins un module même pendant une absence temporaire de toute information de positionnement cellulaire ou par satellite.

12. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le moyen (109) destiné à un traitement de contrôle est apte à détecter automatiquement un état d'anomalie, d'urgence ou d'accident, sur la base de données reçues en provenance du au moins un module, et à le notifier au moyen destiné à des communications externes pour émission d'au moins un signal d'urgence et/ou établissement d'une liaison audio avec un centre de contrôle d'urgences.

13. Le dispositif de communication télématique de la revendication 12, apte en outre à déclencher l'état d'urgence du véhicule manuellement par l'utilisateur au moyen de l'activation d'un bouton d'urgence.

14. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le boitier comprend un module souple (1001) ou au moins deux modules interconnectés de manière flexible (1101, 1102) pouvant bouger l'un par rapport à l'autre, de manière à permettre ainsi au boitier d'être placé à l'intérieur d'un volume libre à l'intérieur du véhicule en se conformant à des volumes et à des structures non uniformes autour, et entre, d'autres composants du véhicule.

15. Le dispositif de communication télématique de l'une des revendications précédentes, dans lequel le boitier est partiellement réalisé en polymères plastiques spéciaux, tels que des polyamides renforcés de fibre de verre, ou du polypropylène avec du talc, et les caractéristiques physiques du dispositif telles que sa forme et son contour ont été conçues pour résister aux contraintes mécaniques en cas d'accident du véhicule.

16. Un procédé de signalement d'urgence destiné à des véhicules avec un dispositif de communication télématique selon l'une des revendications précédentes, le procédé comprenant les étapes suivantes :

détermination d'un état d'urgence du véhicule par le moyen (109) destiné à un traitement de contrôle sur la base de données reçues en provenance du au moins un module via le moyen (110) destiné à des communications internes ;
émission d'au moins un signal comprenant une information relative à l'état du véhicule par l'intermédiaire du moyen (114, 116) destiné à des communications externes.

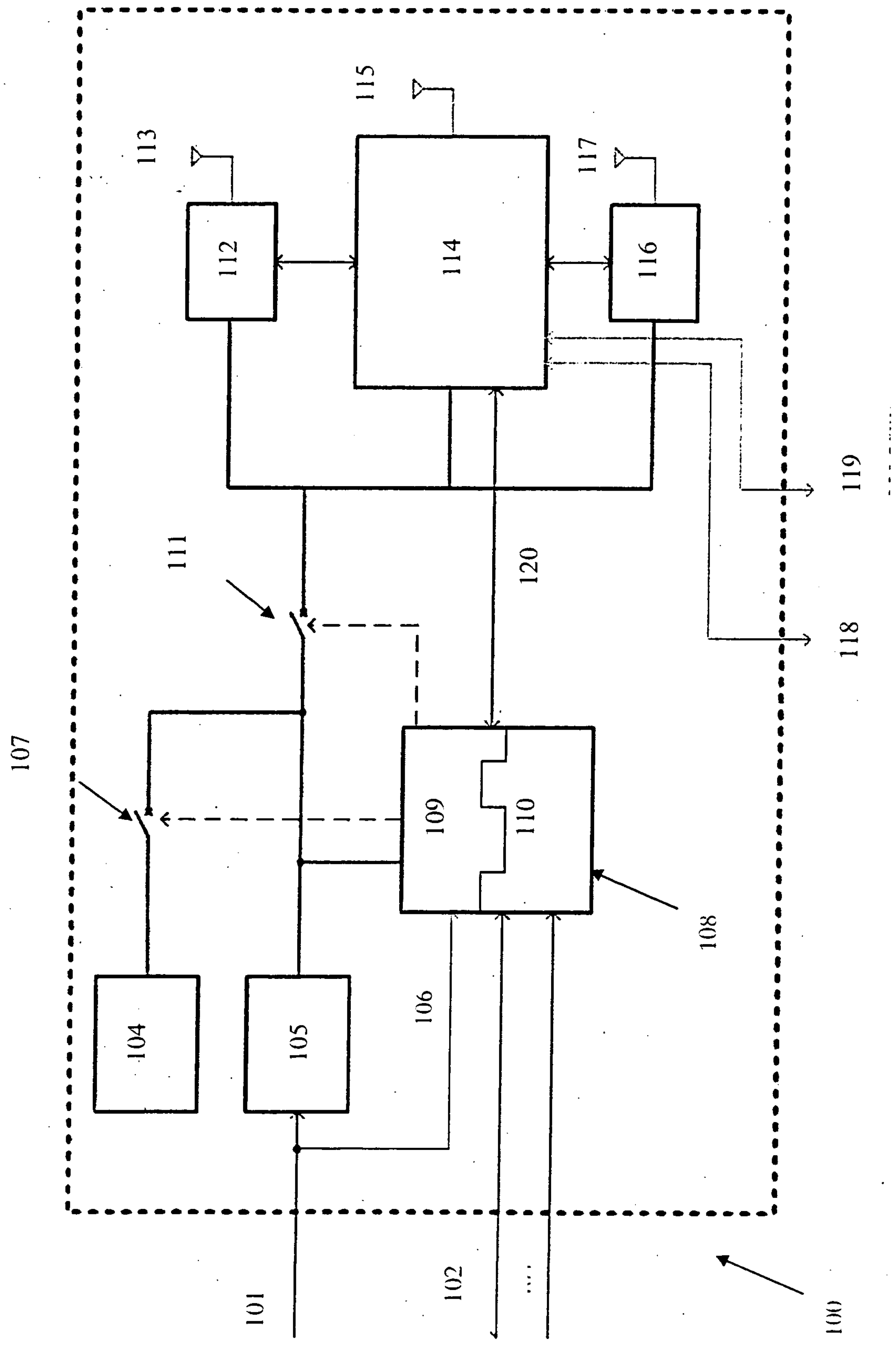
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FIG. 1

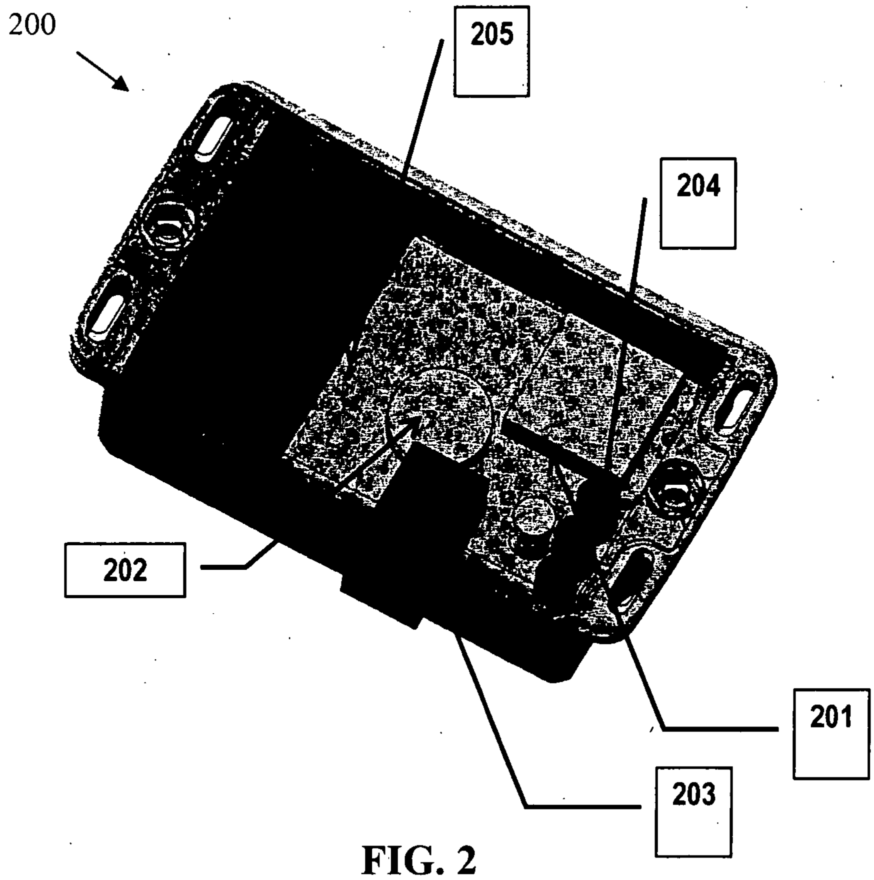


FIG. 2

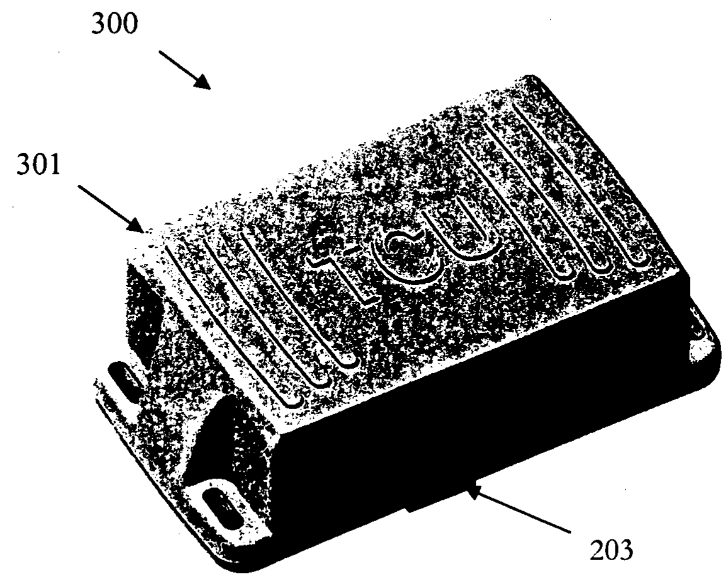


FIG. 3

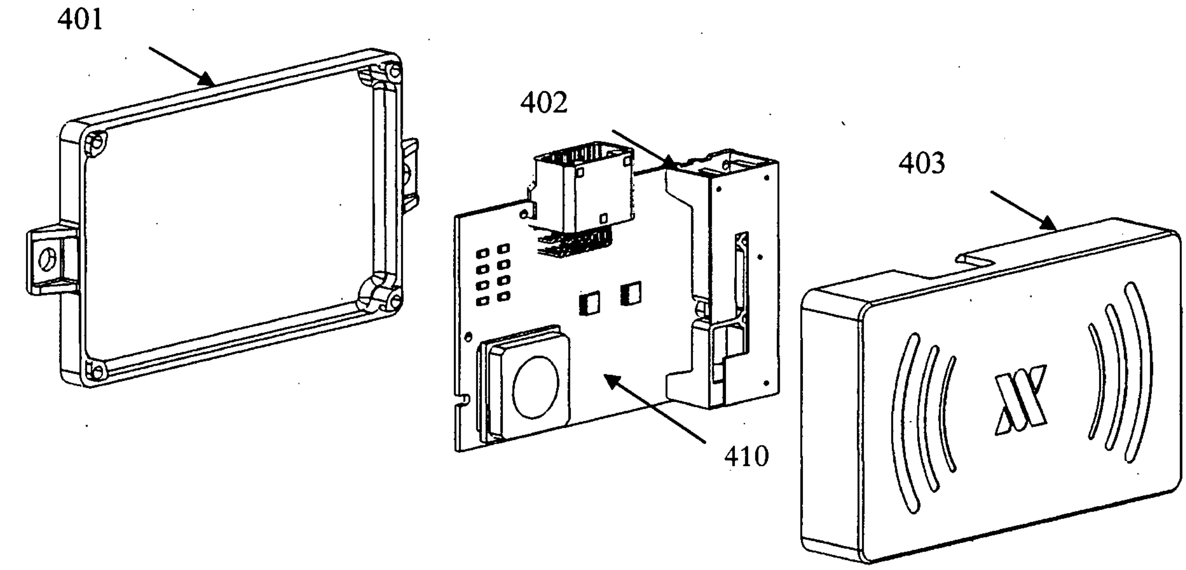


FIG. 4A

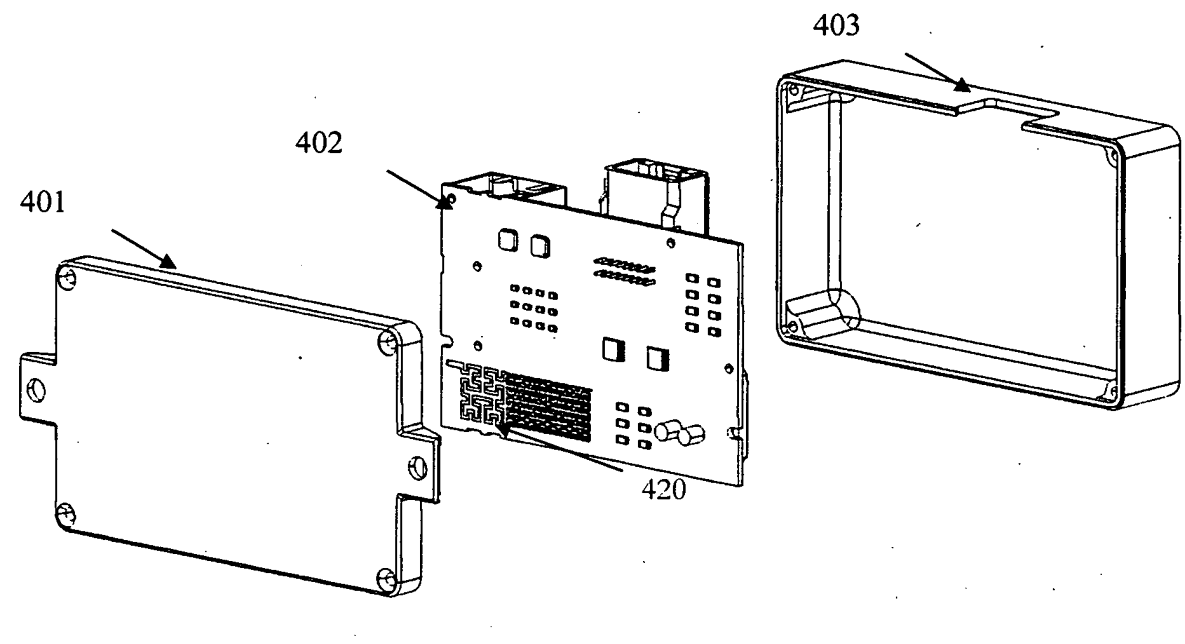


FIG. 4B

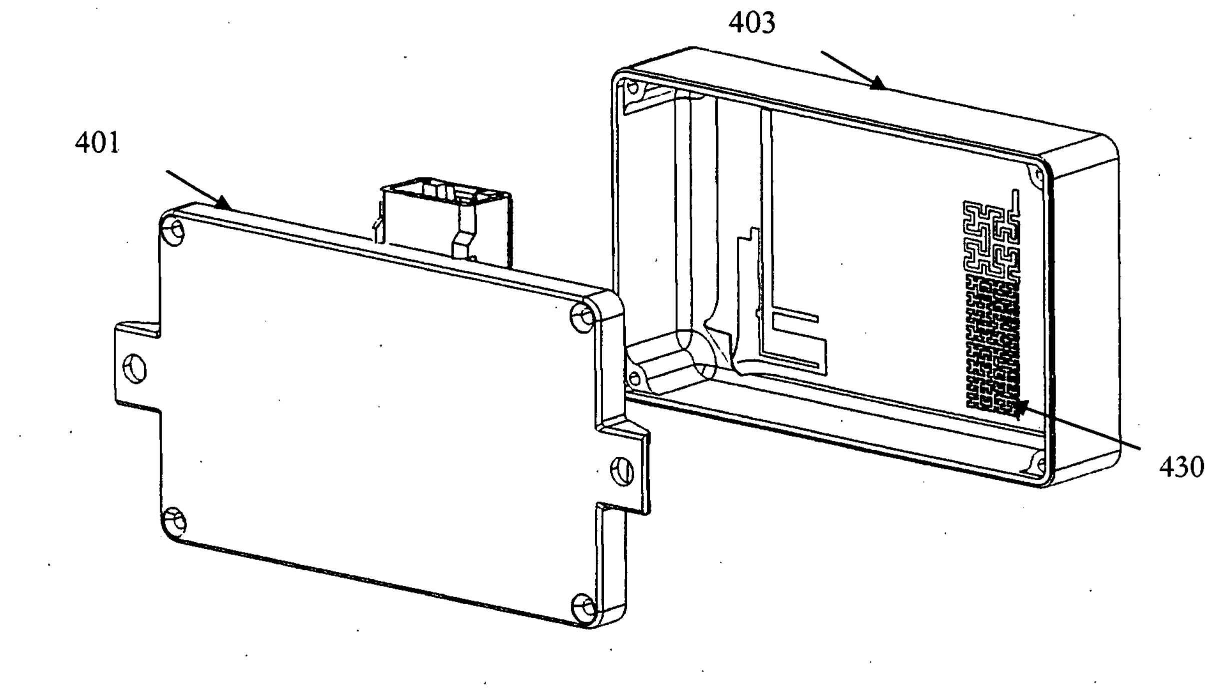


FIG. 4C

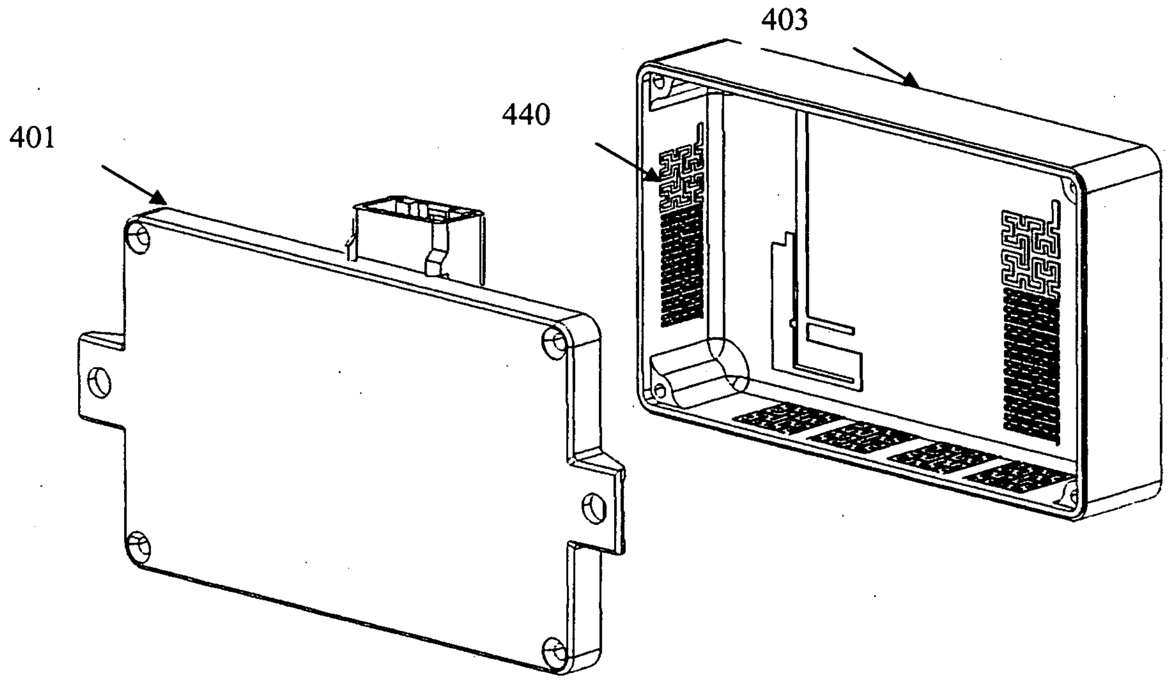


FIG. 4D

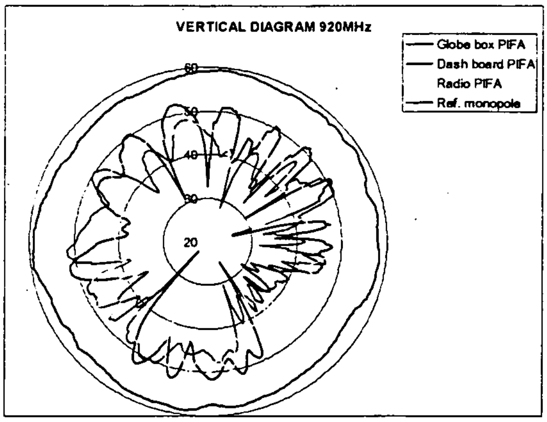


FIG. 5A

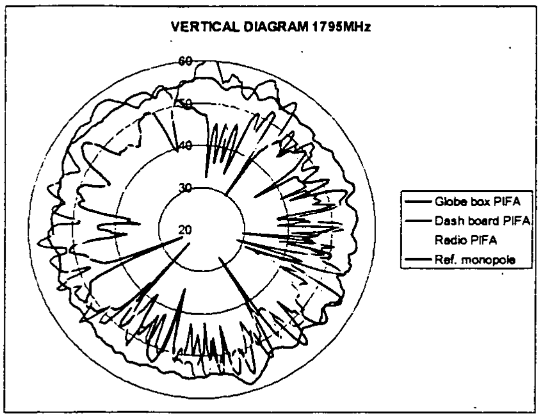


FIG. 5B

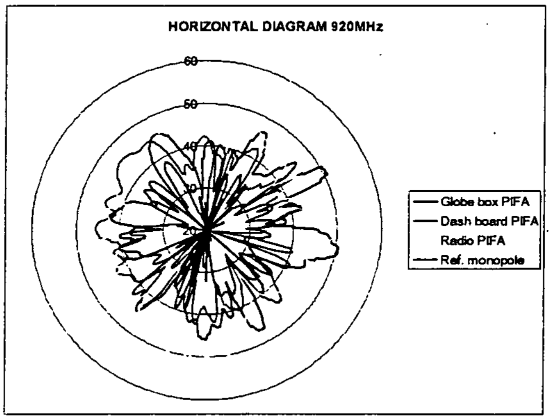


FIG. 5C

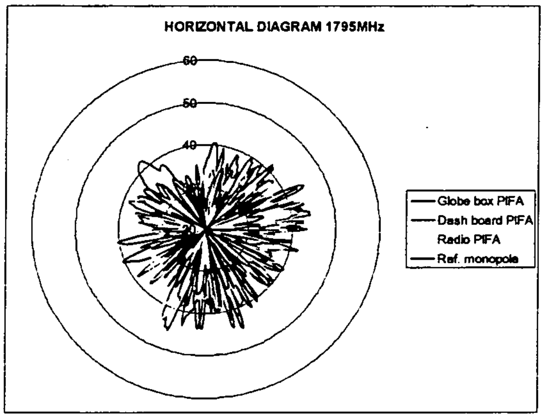
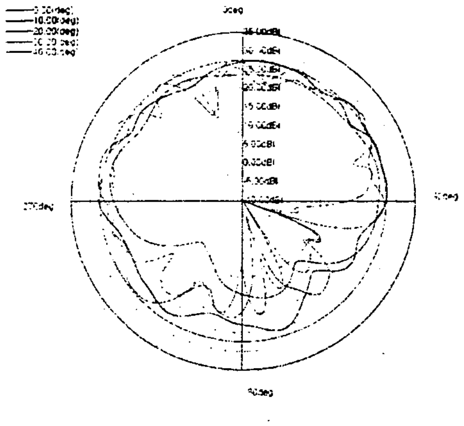


FIG. 5D

FIG. 5

Frequency 1575,42 MHz / GPS 0° to 40° Elev.



Frequency 1575,42 MHz / GPS 50° to 90° Elev.

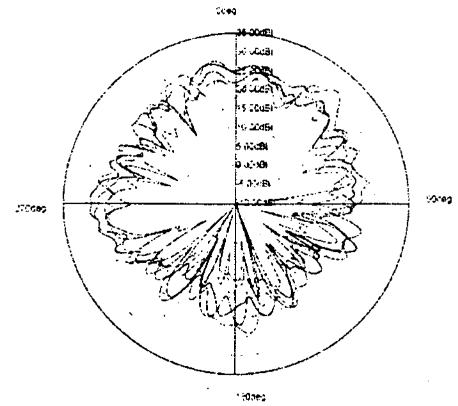
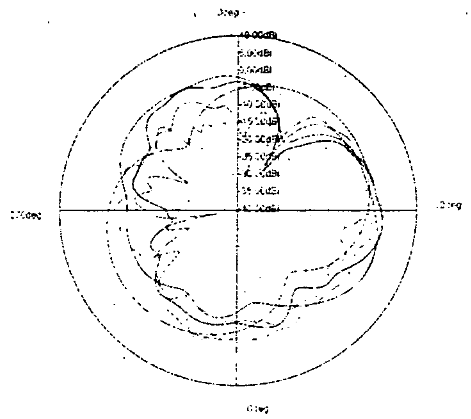


FIG. 6

Frequency 2460 MHz / Bluetooth 0° to 40° Elev.



Frequency 2460 MHz / Bluetooth 50° to 90° Elev.

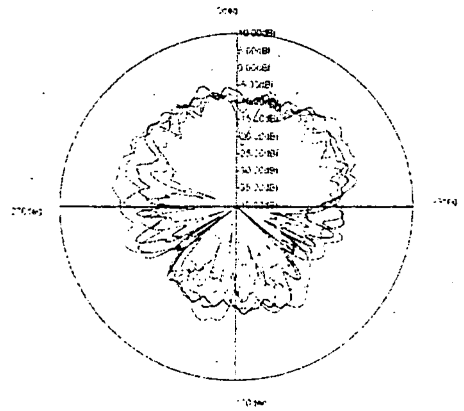


FIG. 7

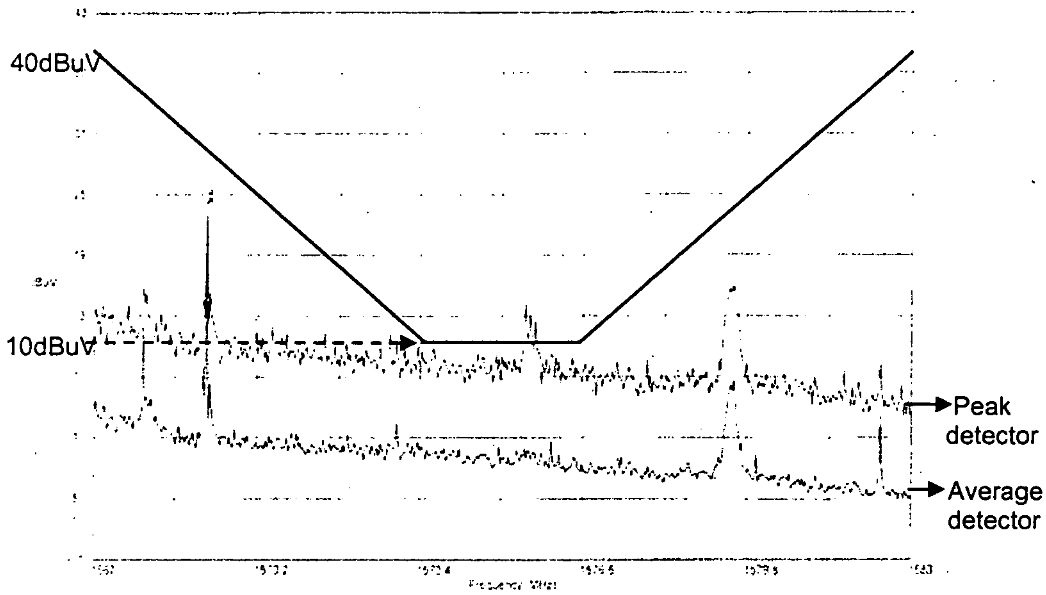

40dBuV
10dBuV
Peak detector
Average detector

FIG. 8

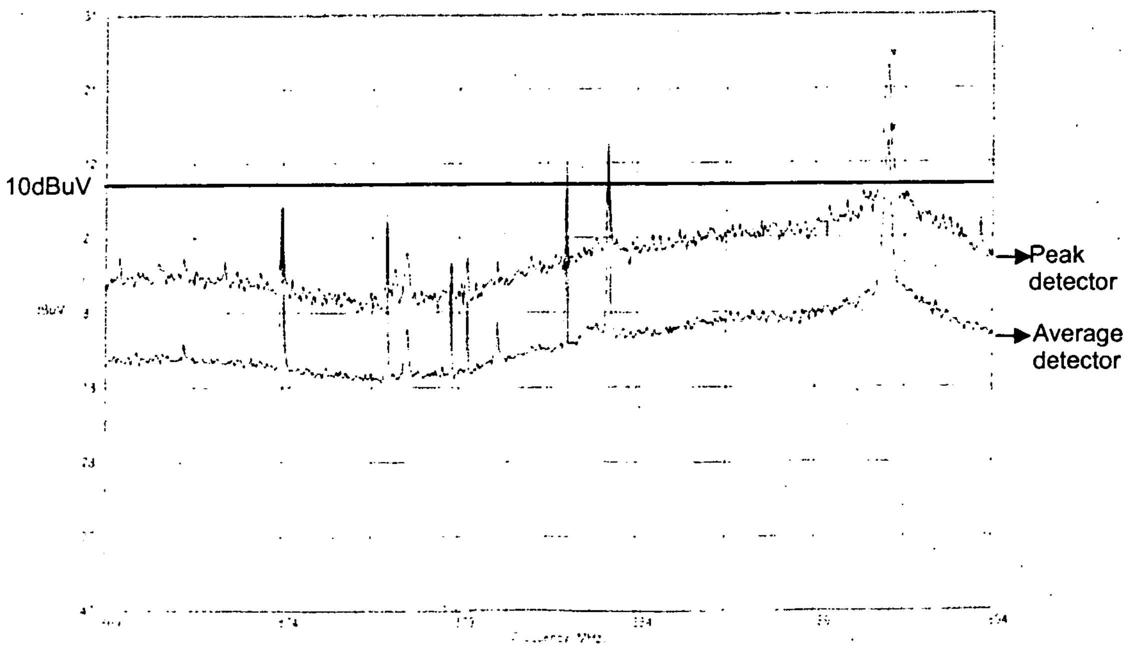

10dBuV
Peak detector
Average detector

FIG. 9

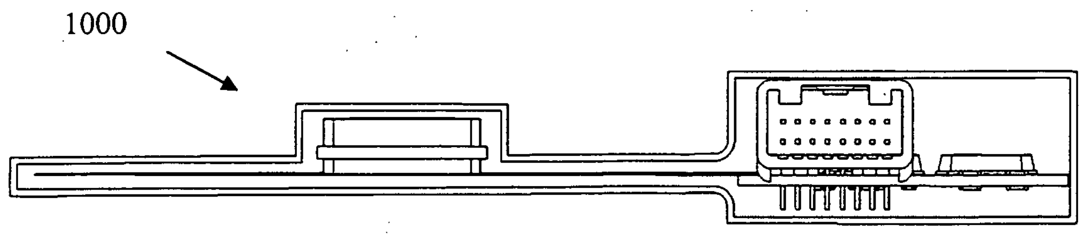


FIG. 10A

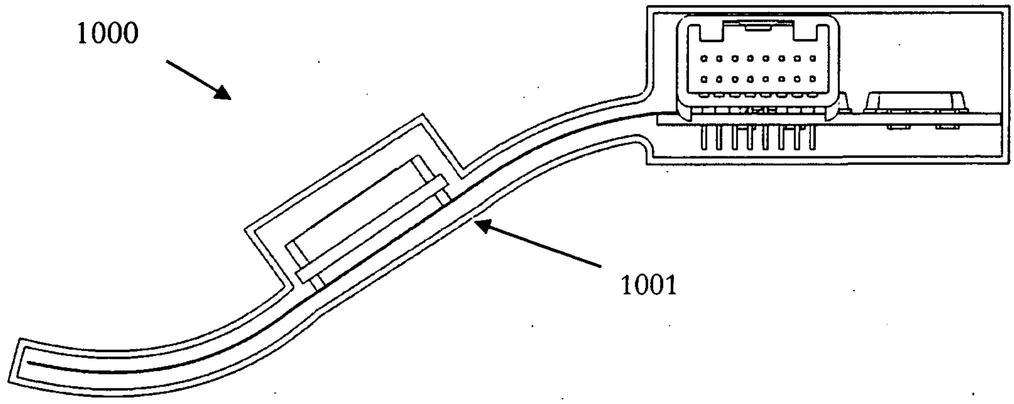


FIG. 10B

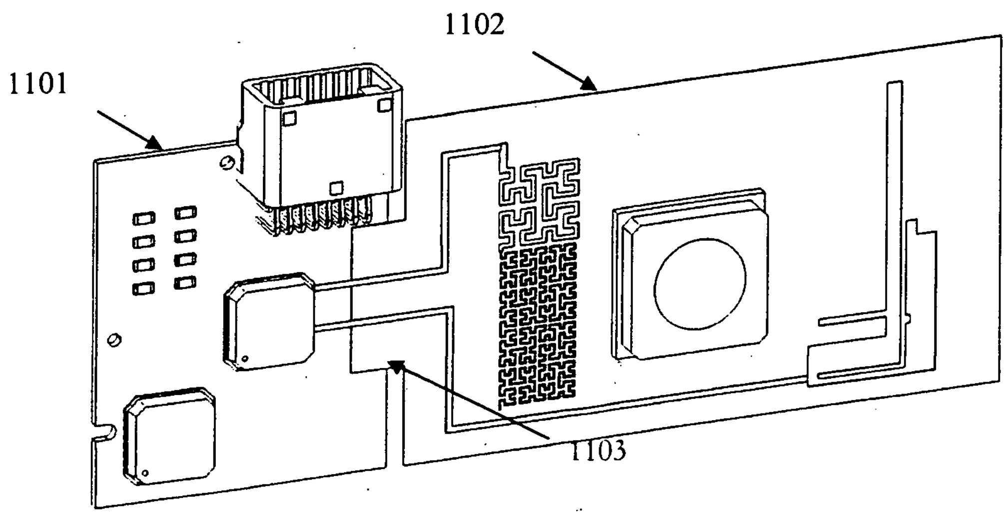


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1338058 B **[0014]**
- WO 0180353 A **[0014]**
- US 2007167147 A1 **[0015]**
- EP 1486760 A1 **[0015]**
- US 2005259013 A1 **[0016]**
- US 2003151556 A1 **[0016] [0017]**