RAPID EXCHANGE SYSTEM FOR TESTING WIRELESS NETWORKS

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ABSTRACT
Systems are disclosed for removably mounting a signal testing unit to a suitable vehicle surface, and optionally providing for an electrical connector to a power source, GPS antenna, and cellular antennas such that moving a signal testing unit from one vehicle to another can be accomplished more easily. The mounting system includes a mounting bracket that is attachable to a vehicle surface. A signal testing unit is positioned within the mounting bracket and held in a secure position relative to the mounting bracket by set screws, flanges, springs, or other suitable mechanism. One embodiment of the mounting bracket includes three adjacent panels that define a U-shaped channel for receiving the signal testing unit. Alternatively, the mounting bracket includes four adjacent panels that define a box for receiving the signal testing unit.
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CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from provisional U.S. Patent Application No. 60/505,822, entitled, “Bracket to Hold Mobile Testing Unit in Vehicle,” which was filed Sep. 24, 2003, and which is incorporated herein by reference in its entirety.

BACKGROUND OF INVENTION

[0002] Signal network operators frequently use signal testing units to measure and improve signal coverage, such as cellular coverage, in a geographical area. The signal testing units are positioned in the coverage area and collect geographical position data and various radio communication related parameters, such as signal strength. This information is analyzed to troubleshoot and improve the coverage of cellular networks. Currently, signal network operators drive the signal testing units around a geographical area to collect data. Typically, the signal testing unit is placed in a vehicle in an unsecured manner or is semi-permanently mounted to the vehicle. When the signal testing unit is unsecured, it can be easily transferred from one vehicle to another, but the signal testing unit can be easily damaged, stolen, or interfere with operation of the vehicle. If the signal testing unit is semi-permanently mounted to the vehicle, then the unit cannot be easily transferred, and time and special tools may be required to remove and install the unit.

[0003] Multiple vehicles may be used to collect data in various locations. One option is to install the signal testing unit in each vehicle, but such an approach may be costly.

[0004] Further, when a signal testing unit is transferred to another vehicle, antenna and power connections may be required. The signal testing unit may require connection to a GPS antenna that is external to the testing unit for determining the unit’s location as well as cellular antenna(s) for collecting and reporting the data. Additionally, connection to the vehicle’s power system may be required. Completing these connections may further complicate transferring a signal testing unit from one vehicle to another, for the installation is not compatible with the design of the signal testing unit.

[0005] Therefore, there is a need for an apparatus that provides easy removal of a signal testing unit from one vehicle and installation in another, so as to facilitate the use of signal testing units in different vehicles at different times, for monitoring a signal network, such as a cellular network.

BRIEF SUMMARY OF THE INVENTION

[0006] The embodiments of mounting devices disclosed below provide for a bracket on which to mount a signal testing unit, and optionally provide for a connector to a power source, GPS antenna, and cellular antennas such that moving a signal testing unit from one vehicle to another can be accomplished more easily. The bracket may provide secure (e.g., preventing unauthorized removal) or non-secure mounting of the signal testing unit. The bracket can be installed in or on a fleet of vehicles to facilitate the movement of the signal testing unit from one vehicle to another by providing the operator with a common bracket and optional electrical connection in one centralized area for secure installation and operation of the unit.

[0007] One embodiment of a mounting system is a U-shaped channel bracket that is defined by three adjacent segments. The signal testing unit is mounted into a U-shaped channel. The bracket is securely mounted to a surface of a vehicle by engaging fasteners into the bracket. The testing unit may be held into position within the bracket by set screws, flanges, or compression springs. Additionally, the bracket may include an electrical connector for mating with an electrical connector on the testing unit when the testing unit is positioned within the bracket.

[0008] In an alternative embodiment of the invention, the mounting bracket is a box-shaped bracket that is defined by four or more adjacent segments. The bracket is securely mounted to a surface of a vehicle by engaging fasteners into a segment of the bracket. Like the testing unit of the embodiment described above, the testing unit of this embodiment may be held into position within the bracket by set screws, flanges, or compression springs, and the bracket may include an electrical connector for mating with an electrical connector on the testing unit.

[0009] In a further embodiment, the box-shaped bracket includes a door that encloses the testing unit into the bracket. The door is attached to the bracket by a hinge and swings from an open position to a closed position. Alternatively, the two opposing open edges of the bracket may include channels through which a door may slide adjacent the open edges of the bracket between a closed and an open position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a schematic of a vehicle with a signal testing unit mounted to a surface of the vehicle.

[0011] FIG. 1A is an illustration of an embodiment of a signal testing unit with one electrical connector.

[0012] FIGS. 2-5A illustrate mounting assemblies and systems according to different embodiments of the invention.

DESCRIPTION OF INVENTION

[0013] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0014] Generally the embodiments of mounting devices disclosed below provide for a bracket on which to mount a signal testing unit, and optionally provide for a connector to a power source, GPS antenna, and cellular antennas such that moving a signal testing unit from one vehicle to another can be accomplished more easily. The bracket may provide secure (e.g., preventing unauthorized removal) or non-secure mounting of the signal testing unit. The bracket can be installed in or on a fleet of vehicles to facilitate the move-
ment of the signal testing unit from one vehicle to another by providing the operator with a common bracket and optional electrical connection in one centralized area for secure installation and operation of the unit.

[0015] FIG. 1 depicts an embodiment of the system described above in which the signal testing unit 20 is mounted to a wall 13 inside the vehicle 10. In other embodiments, the testing unit 20 can be mounted against any suitable surface, such as a bulkhead, shelf, roof, floor, or exterior surface of the vehicle, using a bracket. The vehicle 10, which typically is a fleet vehicle, provides connections to a GPS antenna 11a, cellular antennas 11b, 11c, and a power source 14. In the embodiment shown in FIG. 1, the signal testing unit 20 has separate connectors 21 that connect with the power source 14, a GPS antenna 11a, and cellular antennas 11b, 11c. In another embodiment, as shown in FIG. 1A, the signal testing unit 20 includes one connector 22 that provides a connection with the power source 14, the GPS antenna 11a, and the cellular antennas 11b, 11c. In alternative embodiments, one or more of the antennas may be internal to the signal testing unit 20 and no connection to an external antenna 11a-c is required. Furthermore, the signal testing unit 20 may contain an internal energy source and not require connection to an external power source 14.

[0016] FIG. 2 depicts an embodiment of a mounting bracket 400. The mounting bracket 400 defines a U-shaped holder 405 into which a user may place the signal testing unit 40. Three segments, including a center segment 409 and two side segments 410, 411, are connected to define the U-shaped holder 405.

[0017] In an alternative embodiment, side segment 411 includes a lock-receiving portion 403 for receiving a locking mechanism, such as a padlock, locking cylinder, eye/hasp, or other suitable locking mechanism known in the art, to prevent unauthorized removal of the testing unit 40 from the holder 405. The signal testing unit 40 further includes a lock-receiving portion 25 that aligns with the lock-receiving portion 403 of the testing unit 40. In the embodiment of the mounting assembly shown in FIG. 2, the lock-receiving portions 45, 403 are tabs that have an aperture in the center of each tab. When the testing unit 40 is mounted onto the bracket 400, the tab 45 of the testing unit 40 and the tab 403 of the bracket 400 are aligned so that the apertures are coincident and allow insertion of a padlock or locking cylinder.

[0018] In one embodiment, a vehicle-mounting flange 402 extends inwardly from each side segment 410, 411 towards the opposing side segment and includes a fastener receiving portion 401 for receiving a fastener to mount the holder 405 to a suitable vehicle surface 13. In one embodiment, the fastener receiving portion 401 is an aperture, and a bolt or screw is engaged through each aperture 401 and into the vehicle surface 13 to hold the bracket 400 in a substantially stable position relative to the vehicle surface 13. Alternative embodiments of the mounting bracket 400 may utilize fasteners such as pins, straps, clamps, adhesives, welds, or other suitable fasteners known in the art that can be used to secure the bracket 400 to the vehicle surface 13.

[0019] In the embodiment shown in FIG. 2, the signal testing unit 40 is secured in a stable position relative to the holder 405 by engaging a plurality of set screws 406 through a plurality of spaced apart threaded apertures 404 positioned along the two side segments 410, 411 of the holder 405 until the set screws 406 contact the side of the testing unit 40. FIG. 2 shows the apertures 404 positioned in a column down the center of each side segment 410, 411, but alternative positioning would be sufficient as long as the set screws 406 were able to contact the testing unit 40 and prevent its movement relative to the holder 405.

[0020] In an alternative embodiment shown in FIG. 2A, a U-shaped flange 415 is connected to the side segments 410, 411 and the center segment 409 and extends inwardly from and normal to the segments. The flange 415 extends sufficiently inwardly to prevent the movement of the testing unit 40 relative to the holder 405 in a direction normal to the flange 415.

[0021] In another alternative embodiment, as shown in FIG. 2B, the signal testing unit 40 is secured in a stable position relative to the holder 405 by engaging compression springs 420. The compression springs 420 are positioned on each of the inwardly facing surfaces of the side segments 410, 411. When the testing unit 40 is inserted into the holder 405, the springs 420 are engaged and urged into pressurized contact with the testing unit 40, which prevents the testing unit 40 from any substantial movement relative to the holder 405.

[0022] The use of set screws, flanges, or compression springs allows for some flexibility in mounting testing units of various sizes. However, if a unit significantly differs in size from other units, it may be desirable to adjust the width between the side segments 410, 411 of the U-shaped holder 405 to accommodate the testing units 40. In the embodiment shown in FIG. 2C, the center segment 409 includes a first panel 412 that is connected to side segment 411 and a second panel 413 that is connected to side segment 410, and the first 412 and second panels 413 are slidably connected with each other. As shown in FIG. 2D, the bottom face of the first panel 412 includes two screws 431 that extend normal to the bottom face and are positioned to form a line that is parallel to the axis A-A along which the two panels 412, 413 slide relative to one another. A slotted bracket 434 is attached to the second panel 413, and the screws 431 attached to the bottom of the first panel 412 are positioned within the slot 435 of the slotted bracket 434. The positioning of the screws 431 in the slot 435 maintains the horizontal positional relationship of the first panel 412 and the second panel 413 and prevents the panels 412, 413 from moving relative to each other at an angle from their common axis A-A.

[0023] When the first panel 412 slides relative to the second panel 413, side segment 410 is moved relative to side segment 411. For example, if the first panel 412 is moved in one direction relative to the second panel 413, the side segment 411 moves closer to side segment 410. Conversely, if the first panel 412 is moved in the other direction relative to the second panel 413, side segment 411 moves away from side segment 410.

[0024] FIGS. 2-2D illustrate mounting brackets that do not incorporate an electrical connector. When mounting brackets do not incorporate electrical connectors, the operator may have to connect the signal testing unit’s connector(s) to an external antenna(s) and/or power source(s) after the signal testing unit is installed or mounted to the bracket. Thus, an embodiment of the testing unit 40 described above in relation to FIG. 2 typically would have one or more
connectors 46 for connection with an external antenna(s) 11a, 11b, 11c and/or power source(s) 14, if required. The connectors 46 may mate with connectors adjacent the bracket 400 or the connectors may be integrated into the bracket 400, such as the connector 506 described below in relation to FIG. 3A.

[0025] FIG. 3 shows an open box-shaped mounting bracket 500 mounted to a suitable vehicle surface 13 and dimensioned to receive a signal testing unit 50. In this embodiment, the box-shaped mounting bracket 500 includes at least one fastener receiving portion 501 on each of the five faces of the bracket 500, and the fastener receiving portions 501 are positioned so that any face is capable of being mounted to the vehicle surface 13. The mounting bracket 500 is mounted to the vehicle surface 13 by engaging a fastener, such as those discussed in relation to FIG. 2, into the fastener receiving portion 501 on one of the faces of the bracket 500. Alternatively, a flange attached to the external portion of the bracket (not shown) could be used for receiving a fastener.

[0026] In one embodiment, an electrical connector 506, typically providing power, GPS signal, or cellular signals, is positioned on the interior back face 505 of the bracket 500. When the testing unit 50 is properly positioned within the mounting bracket 500, the connector 506 aligns with a mating connector 51 that is positioned on the back surface of the signal testing unit 50. Normally, a user will slide the testing unit 50 into the mounting bracket 500 until the connectors 506, 51 engage.

[0027] In an alternative embodiment, the connector 506 on the interior back face 505 further includes a guiding device, such as guide pins or channels, for urging the connector 506 on the bracket 500 into mating alignment with the connector 51 on the testing unit 50. In the embodiment shown in FIG. 3A, guide pins 507 are positioned on either side of the connector 506, and the connector 51 on the signal testing unit 50 includes bores 52 for receiving each pin 507. The relative positions of the pins 507 and bores 52 facilitate the alignment and proper engagement of the connector 506 on the bracket 500 with the connector 51 on the signal testing unit 50 when the signal testing unit 50 is being placed into the mounting bracket 500. Other guiding devices may be substituted for the pins 507 and bores 52 shown.

[0028] The connector 506 on the mounting bracket 500 is connected with the power source 14, GPS antenna 11a, and cellular antennas 11b, 11c that are connected to the vehicle 10, as discussed in connection with FIG. 1. In other embodiments, two or more connectors may be used to provide connections to such devices individually, or in different combinations. Additionally, the external GPS antenna and the external cellular antennas may be positioned inside or outside of the vehicle.

[0029] FIG. 4 is an alternative box-shaped mounting bracket 600 in which the box-shaped mounting bracket 600 has a door 601 dimensioned to enclose the box opening 610 and prevent the signal testing unit 50 from entering or exiting the mounting bracket 600 while the door 601 is in a closed position. In one embodiment, the door 601 is connected to an edge of the bracket opening 610, either along a side edge or along the top or bottom edge, by a hinge 602, for movement between a closed position and an open position. The door 601 occupies a closed position when the door 601 is positioned so that the signal testing unit 50 may not enter or exit the mounting bracket 600. The door 601 occupies an open position when the door 601 is positioned so that the signal testing unit 50 may enter or exit the mounting bracket 600.

[0030] The door 601 further includes a lock-receiving tab 603 on the door edge opposite the hinge such that when the door 601 occupies a closed position, a locking mechanism, such as the locking mechanisms discussed in relation to FIG. 2, may be engaged into the lock-receiving tab 603 and a corresponding tab 604 positioned on an edge of the box opening, to prevent the unauthorized removal of the signal testing unit 50. In place of the tabs 603, 604, appropriate locking mechanisms include hasp and eye hooks, cylindrical locks, and latches.

[0031] In one embodiment, the door 601 has an access opening 607 such that when the door 601 is in a closed position, the connector(s) 51 on the signal testing unit 50 are available for connection through the access opening 607, which is too small for removal of the testing unit 50. Alternatively, the access portion 607 may be on the side or other portion of the mounting bracket 600 depending on the position of connectors 51 on the testing unit 50, such that the connectors 51 on the signal testing unit 50 are available after insertion of the testing unit 50 into the mounting bracket 600.

[0032] In FIG. 4A an alternative closure in the form of a slidable door 601a is shown. The open edges of the box-shaped mounting bracket 600 provide a pair of opposing channels 602a through which the door 601a may slide adjacent the open edges of the mounting bracket 600 between a closed and open position, for the purposes described in connection with the embodiment discussed above.

[0033] FIG. 5 shows an alternative embodiment to the box-shaped mounting brackets depicted in FIGS. 3 and 4, in which a box-shaped mounting bracket 700 again is enclosed by a movable door 706 that swings on a hinge. The mounting bracket 700 fastens to a suitable vehicle surface (not shown) similar to the box-shaped mounting bracket 500, 600 discussed with FIGS. 3 and 4. One side of the box-shaped mounting bracket 700 defines an access opening 701 that is positioned to align with the connectors 51 on the signal testing unit 50. The access opening 701 is dimensioned large enough to allow the connectors 51 on the signal testing unit 50 to extend through the access portion 701 while preventing the remainder of the signal testing unit 50 from extending through the access portion 701.

[0034] The mounting bracket further includes a conventional host 703 and a mating eye 704 to secure the door 706 into a closed position. In one embodiment, as shown in FIG. 5A, the eye 704 is positioned on the side of the door 706 opposite the hinge, and the host 703 is positioned on the side of the bracket 700 to align with the eye 704 when the door 706 is in a closed position. When the door 706 is in a closed position, the host 703 is placed over the eye 704 and a lock is attached to the eye 704 to secure the door 706, thus preventing removal of the signal testing unit 50. When the embodiment in FIG. 5 is utilized, the connectors 51 of the signal testing unit 50 may be connected to a power source 14, GPS antenna 11a, or cellular antennas 11b, 11c through a grouping of connectors positioned near the mounting bracket 500.
The box-shaped mounting bracket embodiments described above in relation to FIGS. 3-5 may further include compression springs, such as the springs 620 shown in FIG. 4A. The springs 620 are attached to at least two opposing, inwardly facing surfaces of a box-shaped bracket 600. The compression springs 620 may be like those described in relation to FIG. 2B, positioned to engage the testing unit 50 when it is inserted into the bracket 600 and prevent its movement relative to the bracket 600.

In all of the embodiments described above, those skilled in the art may choose an appropriate material for the described parts of the mounting brackets and signal testing units. Such materials may include plastics, metals, or other suitable materials. Similarly, the connectors shown may be selected to mate with power sources, antenna, etc., that are being used in the vehicle with the signal testing unit.

1. A mounting system for mounting a signal testing unit on a vehicle surface comprising:
   a bracket including at least three adjacent segments defining a U-shaped channel for receiving said testing unit; and
   a fastening portion for securely mounting said bracket to said vehicle surface.

2. The mounting system of claim 1, said bracket further comprising at least one electrical connector for engaging a mating electrical connector on said testing unit.

3. The mounting system of claim 2, wherein said electrical connector on said bracket connects to a power source, a global positioning system antenna, and a cellular antenna.

4. The mounting system of claim 1, at least one of said segments further comprising a plurality of spaced apart apertures, each of said apertures configured for receiving one of a plurality of set screws, wherein said set screws are configured for engaging said testing unit and preventing movement of said testing unit relative to said bracket.

5. The mounting system of claim 1, wherein said segments include a center segment, a first side segment, and a second side segment.

6. The mounting system of claim 5, wherein said center segment includes a first panel connected to said first side segment and a second panel connected to said second side segment, said first panel being in sliding contact with said second panel such that when said first and second panels are moved relative to each other, said first side segment moves relative to said second side segment.

7. The mounting system of claim 5, further including a U-shaped flange, said flange being connected to said side segments and said center segment and extending inwardly from and normal to said segments, wherein said flanges provide a barrier for preventing movement of said testing unit relative to said bracket.

8. The mounting system of claim 1, wherein said testing unit includes a plurality of pin receivers; and

9. The mounting system of claim 1, wherein each of said segments includes an inwardly facing surface, said mounting system further comprising:

   one or more compression springs positioned on one or more of said inwardly facing surfaces,

   wherein said testing unit engages and compresses said one or more springs when said testing unit is positioned within said channel, said one or more springs urging said testing unit into a substantially stable position.

10. The mounting system of claim 1, wherein at least one of said segments includes a locking portion, said locking portion positioned to align with a mating locking portion on said testing unit when said testing unit is mounted within said bracket.

11. The mounting system of claim 1, at least one of said segments further comprising an aperture through which electrical connectors on said testing unit can pass.

12. A mounting system for mounting a signal testing unit on a vehicle surface comprising:

   a bracket including at least four adjacent segments defining a box for receiving said testing unit; and

   said bracket further comprising a fastening portion for securely mounting said bracket to said vehicle surface.

13. The mounting system of claim 12, said bracket further comprising at least one electrical connector for engaging a mating electrical connector on said testing unit.

14. The mounting system of claim 12, at least one of said segments further comprising an aperture through which one or more electrical connectors on said testing unit can pass.

15. The mounting system of claim 12, at least one of said segments further comprising a plurality of spaced apart apertures, each of said apertures configured for receiving one of a plurality of set screws, wherein said set screws are configured for engaging said testing unit and preventing movement of said testing unit relative to said bracket.

16. The mounting system of claim 12, wherein each of said segments includes an inwardly facing surface, and further comprising:

   one or more compression springs positioned on one or more of said inwardly facing surfaces,

   wherein said testing unit engages and compresses said one or more springs when said testing unit is positioned within said channel, said one or more springs urging said testing unit into a substantially stable position.

17. The mounting system of claim 12, wherein at least one of said segments includes a locking portion, said locking portion positioned to align with a mating locking portion on said testing unit when said testing unit is mounted within said bracket.

18. The mounting system of claim 12, said bracket further including a door for enclosing said testing unit in said bracket.

19. The mounting system of claim 18, wherein said door is slidable mounted onto said bracket such that said door slides between an open position and a closed position.

20. The mounting system of claim 18, wherein said door is pivotally mounted onto said bracket such that said door swings from an open position to a closed position.