system, the insulator should be implemented using the type of shrink tubing that is supplied with an adhesive inner liner. In order to provide for ease of installation and removal of the metal contact pin, the insulator should extend ½ to ¾ inch along the length of the flexible insulated wire. The insulator 916 on each of the metal pins 918 may be permanently marked with an easily recognizable identifier to indicate either a) the target system signal to which the metal contact pin should be connected or b) the input on the data recorder to which the metal contact pin is attached. The identifier may be protected from abrasion by installing an additional, transparent insulator over the identifier. Ease of use may also be enhanced by attaching or fixing a duplicate of the identifier on the flexible insulated wire at a location on the flexible insulated wire that is close to protective jacket 914.

The present system will be utilized by selecting the appropriate terminal on the appropriate vehicular connector, and then inserting the corresponding metal contact pin 918 alongside the vehicular wire attached to the terminal and into the body of the vehicular connector, through any existing integral rubber seal, such that the uninsulated section of the metal contact pin 918 is inserted between the plastic connector housing and the metal terminal to which the vehicular wire is attached.

Due to the design of modern motor vehicle connectors and the design of the metal contact pins 918 of the present system, when the metal contact pin is inserted through the integral rubber seal and between the plastic connector housing and the vehicular wire terminal, sufficient pressure will be exerted between the vehicular wire terminal and the metal contact pin so as to ensure a good electrical connection, and so as to provide sufficient friction to retain the metal contact pin within the plastic connector housing and in contact with the vehicular wire terminal until such time as the metal contact pin is intentionally removed from the plastic connector housing.

FIG. 16 illustrates a second embodiment of a universal breakout cable that further consists of a multi-pin in-line connector 922, which connects by means of a short, flexible, multi-conductor cable 920 to the connector 910 which mates with the data recorder. The in-line connector 922 provides an interface to an appropriate and desired electronic sensor, including but not limited to a pressure sensor for the purpose of monitoring vehicular fuel pressure, by means of a sensor cable.

FIG. 21 is a schematic diagram illustrating the design of one embodiment of a sensor cable, which consists of an appropriate multi-pin in-line connector 1032 for mating with in-line connector 922, whereby the in-line connector 922 provides power and ground to an attached sensor, through connecting wires 1034 and an appropriate sensor connector 1030, while also providing a path to connect the sensor output to a desired input to the data recorder. Connector 1032 contains a built-in wire jumper 1024 that acts to connect a digital input on the data recorder to ground, indicating that a sensor is actually present.

FIG. 22 is a schematic diagram illustrating the design of an optional and alternative "auxiliary data probe", constructed without the built-in jumper, that can be connected to in-line connector 922 when an electronic sensor is not in use. The auxiliary data probe consists of a flexible, insulated wire 1034 (similar to 912), a probe pin 1036 (similar to metal contact pin 918), and an insulator (similar to 916), with the insulated wire, metal contact pin, and insulator attached to an appropriate multi-pin in-line connector 1032 to mate with the in-line connector 922. The auxiliary data probe can be connected to a signal of the user's choice.

FIG. 20 is a schematic diagram illustrating the basic concept of a custom breakout cable for use in connecting a vehicular data recorder to specific electrical signals within a specific group of motor vehicles. The custom breakout cable comprises one or more Breakout Cable connector plug(s) 1012 that connect to one or more computer connector(s) 1004 in place of corresponding vehicle wiring harness connector(s) 1006 within a motor vehicle, one or more Breakout Cable jack(s) 1010 to which the corresponding vehicle wiring harness connector(s) are connected, a group of feedthrough wires 1014, one or more add-on instrument connector(s) 1018 which connect to the vehicular data recorder, a group of probe wires 1016 which couple the add-on instrument connector(s) to the Breakout Cable connector plug(s), one or more auxiliary connector(s) 1022, and one or more group(s) of auxiliary interconnect wires 1026 which couple the auxiliary connector(s) to the add-on instrument connector(s).

Electrical signals by which a vehicle on-board computer 1000 controls actuators and receives data from sensors within a vehicle control system 1002 are normally coupled through the computer connector(s) 1004 and attached mating

vehicle harness connector(s) 1006. The current system is implemented by removing the mating vehicle harness connector(s) from the computer connector(s) 1004, attaching the appropriate Breakout Cable connector plug(s) 1012 to the computer connector(s), and attaching the mating vehicle harness connector(s) to the appropriate Breakout Cable connector jack(s). The coupling of all electrical signals between the computer connector(s) 1004 and attached mating vehicle harness connector(s) 1006 is accomplished by the feedthrough wires connecting the corresponding terminals on the Breakout Cable connector plug(s) and the Breakout Cable connector jack(s), so that vehicle operation is unimpeded. Probe wires 1016 are attached to the feedthrough wires 1014 that couple to electrical signals of interest, with the probe wires attaching to appropriate terminals on one or more add-on instrument connector(s) 1018, such that the electrical signals of interest are coupled to the vehicular data recorder. Multiple add-on instrument connectors allow for flexibility in the use of the current system; for example, engine-related signals can be coupled to one connector while transmission-related signals are coupled to a second connector. Where appropriate, an electrical signal coupled through an individual feedthrough wire 1014 can be coupled to more than one of the add-on instrument connectors (some examples are: battery voltage, ground, switched ignition).

One or more appropriate and desired electronic sensors, including but not limited to pressure sensors for the purpose of monitoring vehicular fuel pressure or vehicular transmission pressures, can be coupled to add-on instrument connector 1018 by means of one or more auxiliary connector(s) 1022 and appropriate auxiliary interconnect wires 1026.

A first embodiment of a custom breakout cable of the present system, for use in connecting a vehicular data recorder to late-model OBDII-equipped General Motors (GM) automobiles, will be described in conjunction with FIG. 23 through FIG. 27. FIG. 23 depicts a method of attaching flexible, insulated wires 912 to a GM OBDII header 930 (which is constructed with 160 pin-type contacts) which has been assembled with special straight pins rather than the standard right-angle pins with which the OBD II header is customarily supplied to General Motors for use in vehicular computers.

The flexible, insulated wires are installed into two (2) GM OBDII cable connectors 932 (which are each constructed with 80 socket-type contacts, such that two of these connectors are required). Wires that are designated as feed-through wires (1014 on FIG. 20) are routed away from the GM OBDII cable connectors 932 in one direction, while wires that are designated as probe wires (1016 on FIG. 20) are routed away in the other direction. Note that all contacts in the GM OBDII cable connectors 932 contain a wire 912 that is designated as a feed-through wire, and that more than one wire 912 is installed in any contact containing a wire 912 that is designated as a probe wire. Subsequent to the installation of the flexible, insulated wires into the cable connectors 932, the cable connectors are plugged onto the back of the GM OBDII header as shown in FIG. 24. FIG. 25 depicts the connector assembly of FIG. 24 with the addition of protective jackets 914 on the bundles of wires that are now attached to the connector assembly. FIG. 26 depicts the connector assembly of FIG. 25 enclosed within a protective covering, which can consist of a sheet metal box, plastic box, or epoxy encapsulant 934.

FIG. 27 illustrates a completed embodiment of a custom Breakout Cable according to aspects of the present system. The flexible, insulated wires 912 and protective jackets 914 incorporated in a connector assembly as depicted in FIG. 26 are of sufficient length so as to extend approximately 18 inches from the GM OBDII header 930 and sheet metal box, plastic box, or epoxy encapsulant 934. The flexible, insulated wires which are designated as feed-through wires (1014 on FIG. 20) are coupled to GM OBDII cable connectors 932 in a one-to-one correspondence that provides a connection from pin 1 on header 930 to pin 1 on cable connector 932, a connection from pin 2 on the header to pin 2 on the cable connector, etc.

The flexible, insulated wires which are designated as probe wires (1016 on FIG. 20) are coupled to two separate connectors 910 that individually connect to the vehicular data recorder. As detailed above, each of the connectors 910 can attach to shared and to unique electrical signals present at GM OBDII header 932, in order that different vehicular activity may be recorded by the vehicular data recorder. One connector 910 further attaches by means of a short, flexible, multi-conductor cable 920 to a multi-pin in-line connector 922, whereby an appropriate and desired electronic sensor may be connected to the vehicular data recorder.

FIG. 28 illustrates a second embodiment of a custom breakout cable of the present system, similar to the first embodiment, wherein both vehicular data recorder connectors 910 are coupled to multi-pin in-line connectors 922, allowing for additional use of appropriate and desired add-on electronic sensors. As desired, additional multi-pin in-line connectors 922 can be added, allowing the use of additional add-on electronic sensors, when the add-on electronic device to which connector 910 attaches is configured to facilitate the use of the additional add-on electronic sensors.

A third embodiment of a custom breakout cable of the present system, also for use in connecting a vehicular data recorder to late-model OBDII-equipped General Motors (GM) automobiles, will be described in conjunction with FIG. 29 through FIG. 34. FIG. 29 depicts a custom manufactured male/female metal contact 936, consisting of a pin at one end and a socket at the other end, wherein the pin and socket are dimensionally similar to the pins and sockets employed in the OBDII connectors that are used in the OBDII-equipped automobiles. The custom manufactured male/female metal contact is formed with a through-hole located near its center, providing a means whereby a flexible insulated wire 912 may be attached to the male/female metal contact, typically by means of solder.

FIG. 30 depicts two (2) views of a custom plastic connector housing 938, with a cutaway view depicting a group of male/female metal contacts 936 installed. The plastic connector housing is constructed such that the side which houses the socket side of male/female metal contact 936 will effectively mate with a GM OBDII header 930 that is integral to an automotive computer, whereas the side which houses the pin side of the male/female contact will effectively mate with a GM OBDII cable connector 932 that is integral to an automotive wiring harness. As illustrated in FIG. 30, custom plastic connector housing 938 is designed such that a raised channel 940 is provided on each side of the connector housing, for the purpose of allowing the installation of probe wires within the plastic connector housing.

FIG. 31 is a cutaway view of plastic connector housing 938 which depicts the installation of flexible insulated wires 912 into several male/female metal contacts 936, to serve as probe wires connecting targeted electrical signals within the plastic

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