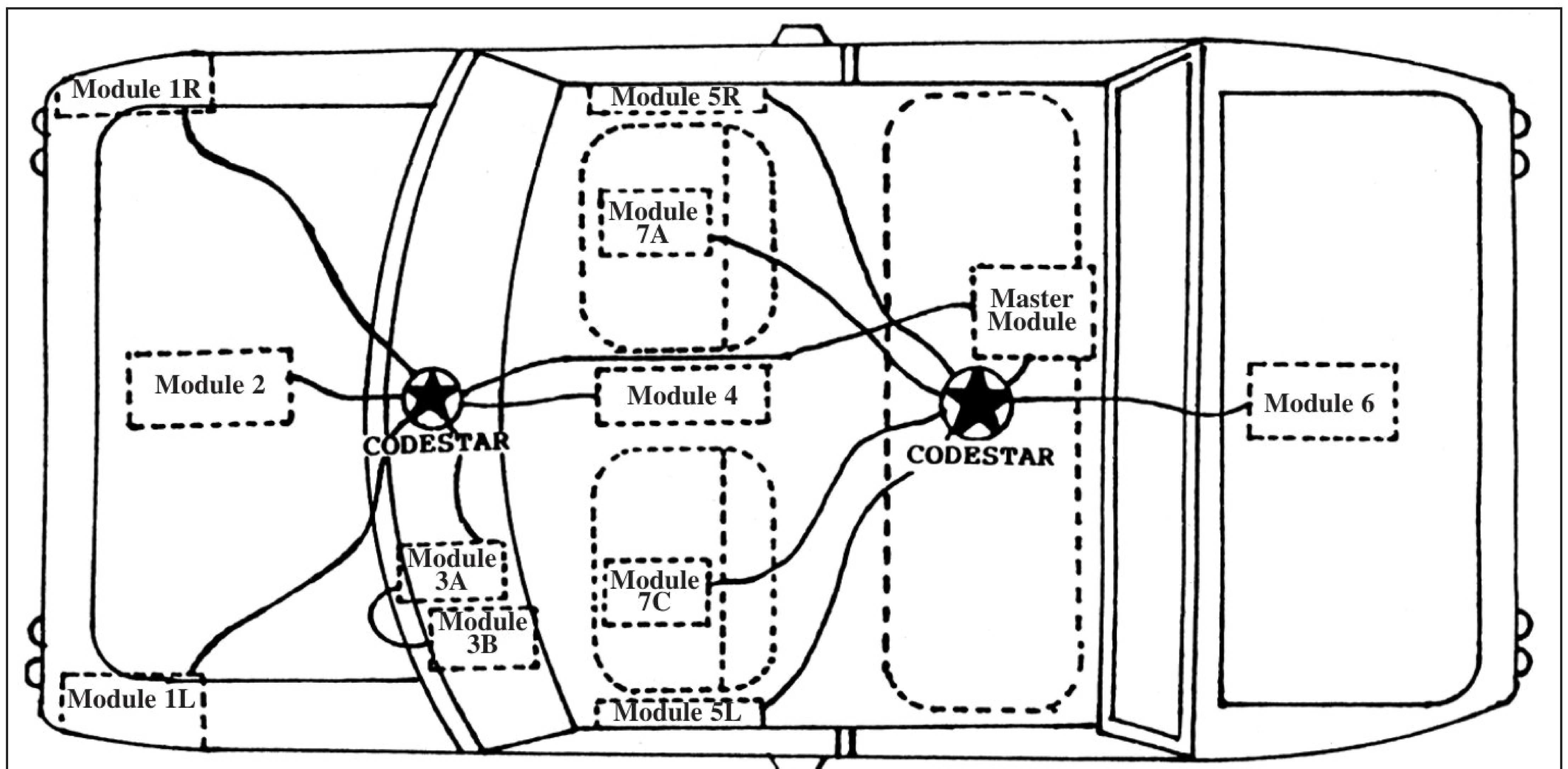
Fiber Optics of the Future



Opto-One Plastic Fiber Optic (POF) local area network controlled automobile.

RENEWS readers who were lucky enough to have attended the Hanover Trade Fair last April would have seen what is believed to be the first fiber optically controlled car model.

The model used 100 feet of polymer optical fibers (POFs) and a computer local area network (LAN) system to replace as much as 2,000 meters or 6,700 feet of complex multiple wire harnesses that interconnect car lamps, switches, motors and relays. In the car, only a 12-volt power wire remained, in addition to the polymer optical fiber and optoelectronic LAN system.

The polymer optical fiber was developed by Hoechst AG and the car LAN system was developed by Codenoll Technology Corporation, an affiliate of U.S.-based Hoechst Celanese.

The car's optoelectronic LAN system is said to offer several potential advantages for future automotive technology. It is immune to electromagnetic interference. It offers high transmission rates needed to control the highly complex electronic systems in cars of the future, avoids short circuits and saves weight and space.

The LAN control system uses two "stars," passive polymer fiber optic signal routing devices based on technology already in use in computer networks manufactured by Codenoll. The LAN control modules operate asynchronously to control individual components such as locks, dashboard indicators, lights and turn signals.

An LCD instrument panel was conceived by VDO Adolf Schindling AG specifically for use with the LAN system. In addition, the car's central lighting unit for its real lights was developed by Hoechst AG and Helmut Hund GMBH.

The Hoechst polymer optic fibers are characterized as offering low cost production, simple processibility, high flexibility and are immune to vibrational stresses. As a result, they are an alternative to quartz glass optical waveguides for applications covering short distances, presently less than 100 meters. Hoechst and Codenoll Technology Corporation are investigating applications of polymer optical waveguides in local area networks and multiplex systems for automobiles, aircraft, trains and ships.

As automobiles become more sophisticated, as any electrical rebuilder is aware, electrical and electronic components and subsystems make up more and more of their content. Currently, individual wires connect each electrical device (e.g. headlight) to its controller(s) (e.g. switch). As more devices are added, the amount of wiring and interconnections increases. The Hoechst/Codenoll Polymer Optical Fiber Automobile Local Area Network replaces major signal carrying portions of complex multiple wire harnesses used to interconnect the electrical components (lamps, switches, motors and relays) contained in a conventional automobile with the single pair of polymer optical fibers.

Automobile wiring harnesses can contain as much as 2,000 meters of wire in some of the more sophisticated automobiles. In the Hoechst/Codenoll implementation, the signal carrying wires are replaced by tens of meters of polymer optical fiber with only the 12-volt power wires remaining. This is said to increase reliability and maintainability while reducing EMI susceptibility, size and weight.

The Hoechst/Codenoll implementation is a passive fiber optic star network system as shown in Figure 1. Individual fiber optic control modules are placed at locations where, in a conventional automobile, dense wire bundles would be required. These fiber optic control modules allow up to 16 output functions (i.e. lamps, motors and relays) to be energized and up to 21 input functions (i.e. switches and sensors) to be read.

Since each of these functions would normally require individual wires, each module in the Hoechst/Codenoll system eliminates a cable harness which might contain up to 37 individual wires, each having a connection (and, therefore, a potential failure point) at each end and replaces it with a single pair of polymer optical fibers.

The network consists of 12 individual modules, each containing Codenoll Codelink Transmitters and Receivers, and two passive Codenet Codestar Polymer Optical Fiber Stars.

The Master Module directs the traffic between the control modules around the car. It also provides an external interface to a personal computer for diagnostic, simulation and demonstration purposes.

Codenet Codestar Passive Polymer Optical Fiber Star #1 interconnects Port 1 of the Master Module with the Control Modules in the front of the automobile. (See diagram, page 5.)

Codenet Codestar Passive Polymer Optical Fiber Star #2 interconnects Port 2 of the Master Module with the Control Modules in the rear of the automobile. (See diagram, page 5.)

Control Modules 1L and 1R control the parking, signal, fog, bright, hazard and head lamps as well as the horn contained in the left and right fenders respectively. In addition, sensors provide these modules with information about the operational status of the lamps which are then displayed in the dashboard display. This module could be upgraded to include active suspension, anti-skid braking, traction control and other local systems.

Control Module 2, located in the engine compartment, currently controls the air conditioner/heater fans and the windshield wiper. It can be upgraded to handle engine monitoring sensors and operate fuel injection and other local systems.

Control Module 3A, located in the dashboard, allows the Master Module to read the state of all the dashboard switches and controls.

Control Module 3B is an LCD display module provided by VDO. It replaces the standard displays and gauges found in a conventional automobile with a three panel integrated display module.

Control Module 4, the Operator's Console, provides sensors to read the position of the transmission shift lever. Controls for the air conditioner/heater and brake sensors also are fed to this module. This module could be upgraded for electronic driver control, audio system and telephone systems as well as other local systems.

Control Modules 5L and 5R, located in the driver and passenger doors respectively, read the window switches, the lock switches and the side view mirrors and seat position controls. They output to the lock solenoids, mirror position motors and window motors located in the doors. The left and right doors can control their own functions as well as the other doors' functions and the seats, through the POF network.

Control Module 6, located in the trunk, controls the fiber optic central lighting package, which uses a pair of centrally located halogen lamps and fiber optic bundles of polymer optical fiber, to provide illumination to lamp lenses mounted to the rear of the car. In addition, rear fog lamps and passenger compartment lamps are controlled via this module. As with the front left and right modules, the operational status of the lamps is sensed and passed via the network to the electronic dashboard.

Control Modules 7L and 7R control the driver's and passenger's seat, respectively. The seat heater and motors that provide 10 degrees of freedom are controlled through this module.

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