Information and Control Systems (TIACS)

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ABSTRACT

Electronic sub-systems are being developed for heavy duty trucks. However, these sub-systems are being developed as individual entities i.e., information, monitoring, recording, control systems etc. This paper identifies the current, near term, and long range system requirements and suggests ideas for a fully integrated Truck Information And Control System (TIACS) aimed at an orderly approach to a vehicle electronic system for heavy duty trucks.

TODAY'S COMMERCIAL VEHICLE operators are, like most industries, experiencing less profitable cost-revenue relationships. Many industries have demonstrated significant cost reduction and more effective cost control through the use of contemporary electronics. Such electronics are embodied in either sohpisticated data processing systems and/or used for basic product enhancement. The commercial vehicle operator need not be an exception to this technological trend and has available electronic systems technology which will permit reduced operating cost by:

- optimizing asset utilization
- improving productivity
- reducing operating cost

Electronic systems entering the market today have significant potential to improve the cost-revenue relationship for a wide range of commercial vehicle operators. The introduction of electronics to commercial vehicles in all phases of its life including; manufacturing in the basic product or as a part of fleet operations is no longer a debate of "if" but "how fast" it will happen. The earlier set backs experienced with electronic skid controls in the early 70's are now behind us with the industry moving forward with cost effective and reliable electronic products. It is incumbent upon the electronic designer to continue to provide products and services which enhance the overall efficiency of the commercial vehicle operator's fleet.

It is to be recognized that the commercial vehicle annual production on a worldwide basis is small compared to passenger car production. None-the-less, it does provide the opportunity to apply certain electronic systems at competitive costs with impressively short pay-back periods. Electronic suppliers with sound systems skills have recognized the need and have started to supply a range of important cost effective products to the trucking industry.

This trend has been created by a variety of forces including 1) The truck operators need to optimize the use of human and physical resources which leads to greater demands for cost saving and efficiency improving options. 2) Government regulations on noise and exhaust emissions become more stringent each year, requiring engines to run at peak efficiency at all times. 3) As more optional equipment is made available by truck manufacturers, there is less space available for existing and additional features. 4) Rapidly expanding technology, in the field of microprocessors, has permitted the introduction of relatively smaller units with increasingly larger capacities. 5) The trend toward microprocessor based multiplex wiring

* Numbers in parentheses designate references at the end of the paper.

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1977 (1)* the number of microprocessor controlled functions has increased to thirty (Figure 1). This trend over the past decade is expected to be experienced by the truck industry during the balance of this decade. The need for electronics to withstand more harsh environments and to demonstrate positive cost effectiveness will result in a somewhat slower truck introduction than that experienced with passenger cars.

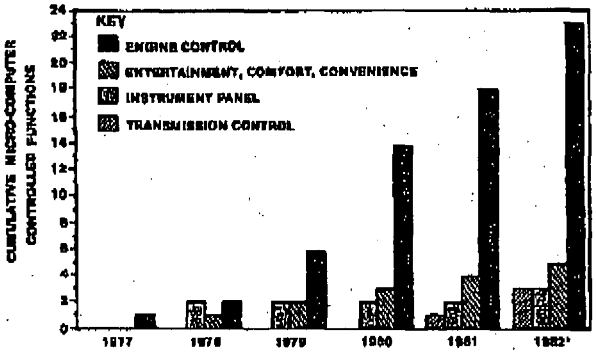

Fig. 1 - Microprocessor controlled functions in passenger cars. These are not necessarily individual processors, as one microprocessor could control multiple functions (2). *Microcomputer controlled functions for the 1982 model year are listed in Table 1.

that control truck road speed, engine speed and PTO speed have been introduced and are in production. In one example (Fig. 2), a solenoid valve controls fuel pressure to the injectors for accurate speed control. A vehicle speed sensor and an engine speed sensor transmit speed data to the electronic control unit (Fig. 3) (3). This unit controls, with extreme accuracy, functions such as: cruise control, variable engine speed governing, torque limiting, and road speed governing.

WEIGHT CONTROL – European countries have or are proposing legislation imposing severe penalties for exceeding established axle and vehicle weight laws. Consequently, the need has arisen to measure axle loads and to derive the payload of commercial vehicles which lead to the development of electronic self-weighing systems. Sensors suitably placed on the vehicle axle measure the load, and an on-board microprocessor provides readouts of gross vehicle payload as well as individual axle loads (Fig. 4). A self-weighing system effectively satisfies the often conflicting requirements of holding the load below the legal maximum and yet maintaining the load close to the limit for efficient truck operation (4).

ENGINE CONTROL		
Electronic Spark Timing Idle Speed Control (Kicker) Open Loop Throttle Body Injection Exhaust Gas Recirculation (On/Off) In-Line Diagnostics Modulated Displacement Spark Knock Control (Turbo) Closed Loop Port Fuel Injection (Venturi Hot Wire MAF)	Exhaust Gas Recirculation (Linear) Secondary Air Control Idle Speed Control (Linear) Open Loop Port Fuel Injection (Vane MAF) Serial Communications Closed Loop Continuous Flow TBI (Vortex MAF) Closed Loop Port Fuel Injection (Hot Wire MAF)	Closed Loop Carburetor Control Cannister Purge Early Fuel Evaporation Closed Loop Port Fuel Injection (Vane MAF) Cruise Control Electric Fan Control A/C Clutch Control Early Fuel Evaporation Closed Loop Throttle Body Injection
TRANSMISSION CONTROL		
Torque Converter Clutch	4 Speed Automatic with O/D and TCC	Shift Schedule Selection
ENTERTAINMENT, COMFORT, CONVENIENCE		
Electronically Tuned AM/FM/CB Radio with Clock	Electronic Climate Control Memory Seat	Tripcomputer Land Navigation (W/CRT)
INSTRUMENT PANEL		
Gas Discharge IP Speed, Fuel, and Engine Data	Vacuum Tube Flourescent IP	Tachometer

Table 1 - Microcomputer controlled functions for 1982 passenger cars, listed by area controlled (2)

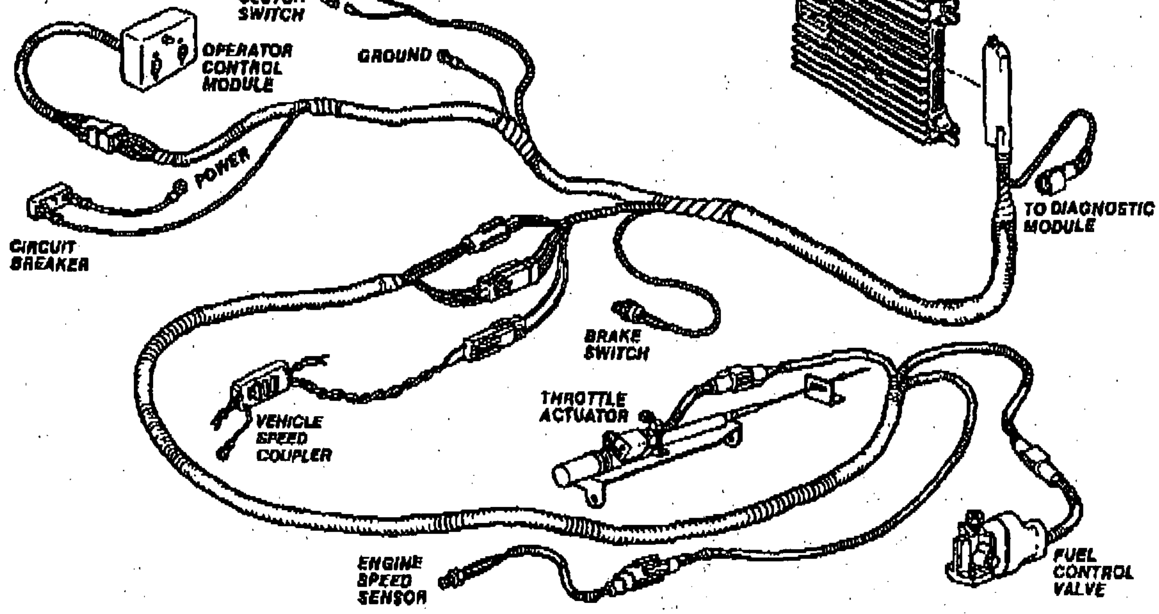

Fig. 2 - Electronic cruise and speed control components (TRW ETEC™ System)(3)

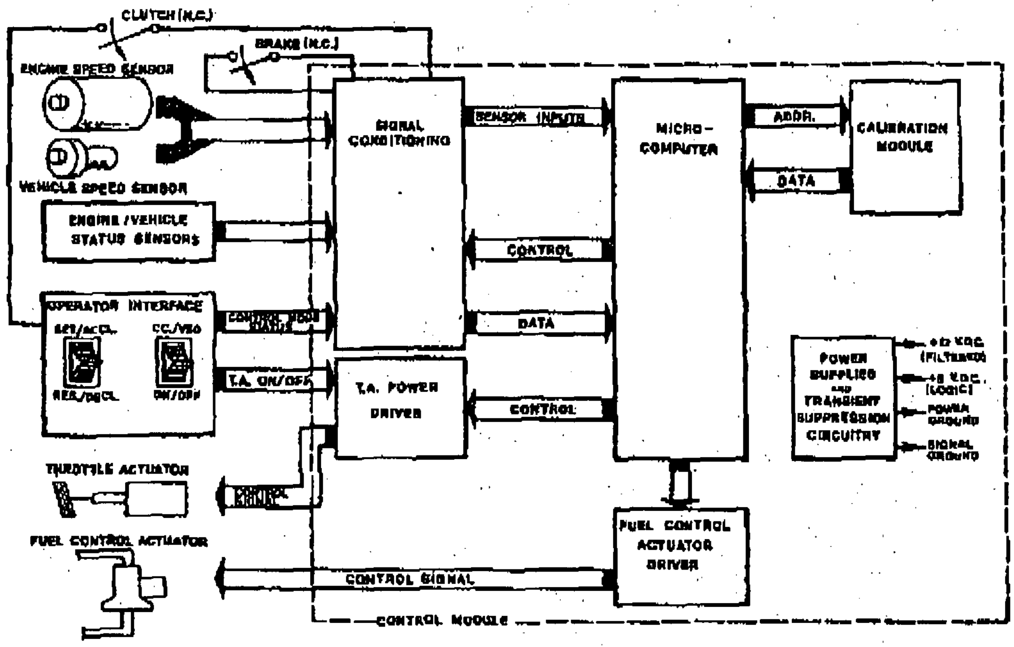

Fig. 3 - Electronic Control Module and System Schematic

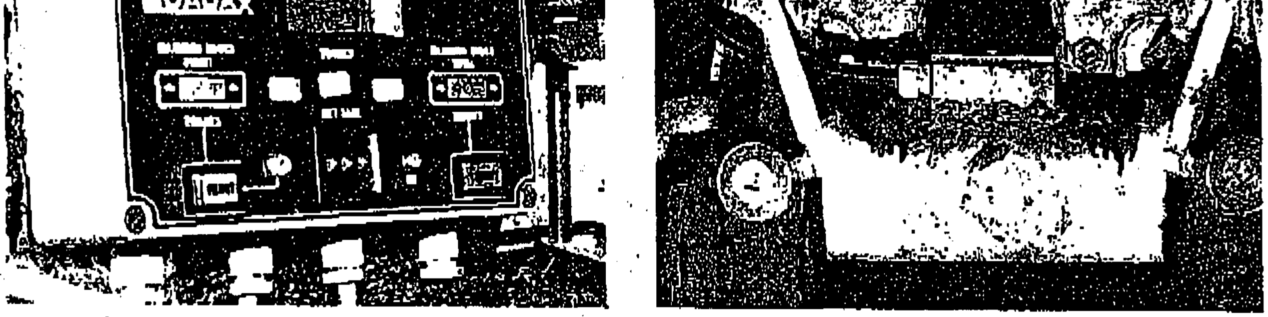

Fig. 4 - Self-weighing system displays are mounted in the truck cab, (on the left) providing digital readouts of axle housings and payload weights. Strain sensors are located on the appropriate axles of the trailer and the tractor (right) (TRW Loadax System)(4)

TRIP RECORDERS - An electronic trip recorder such as the unit shown in Fig. 5, is a product used to keep a log on the vehicle's activity. Data such as engine speed and vehicle speed are recorded and can be produced as histograms (Fig. 6) at the vehicle terminal, to show the amount and percent of time of vehicle operation under different conditions (idle, over 55 MPH, at governed RPM, etc.). The recorder provides a means of reviewing the operator's driving profile and permits the fleet operator to optimize vehicle utilization and scheduling.

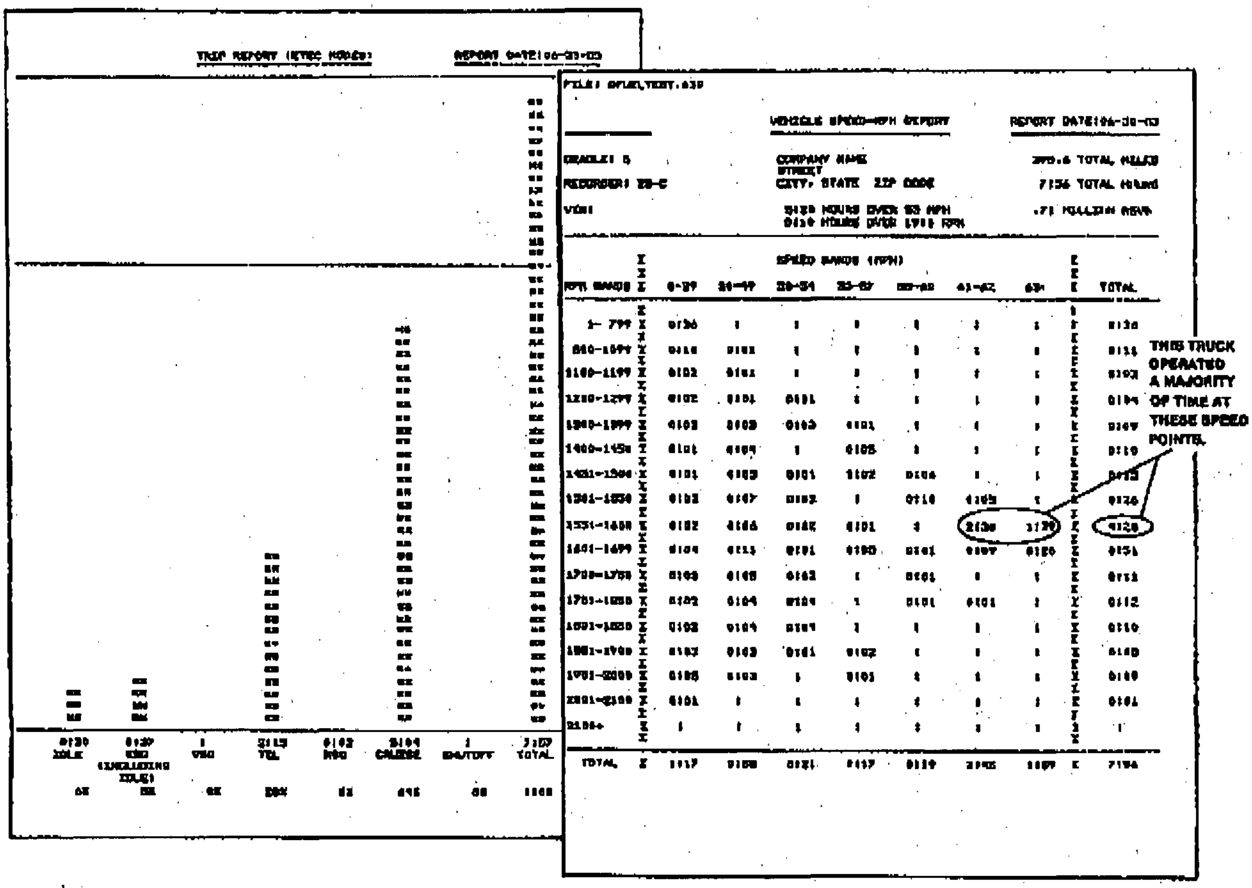

Fig. 6 - Print-out from a truck trip recorder. The left page is a histogram indicating the percent of time the vehicle spent in each driving mode (6% idle, 64% cruise, etc.); the right print-out indicates total time in each rpm band and each mph band

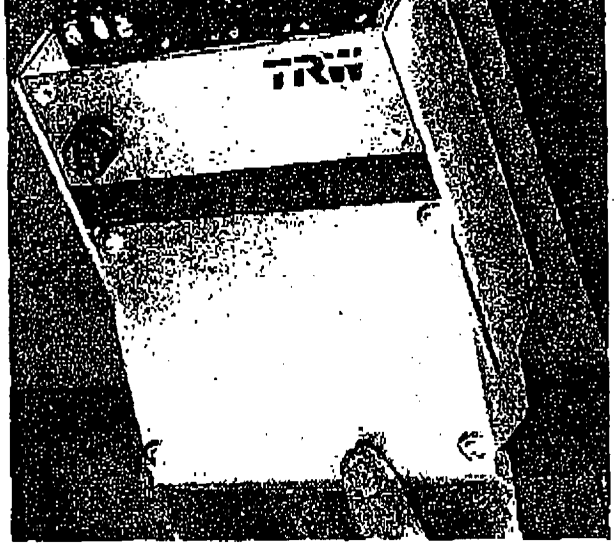

Fig. 5 - Trip recorder module and cradle (TRW Recorder)

transmissions (5). In manual applicat-ions, the driver manually changes gears, but the clutching action is performed automatically in the system shown in Fig. 7. This allows for smoother shifting throughout the gear range and driveability improvements by shortening the shift transition time. With automatic trans-missions, electronics make possible pro-gram selectable shifting, which allows the operator to select a program suited to the application (maximum power performance, optimum fuel economy, etc). In addition, improved driveability and extended life is realized.

DIAGNOSTICS - Mechanical methods of diagnosing and servicing heavy duty trucks are not applicable for today's electronic component systems; fortunately, electronic maintenance and diagnostics technology has kept pace with the rapidly advancing truck electronic systems tech-nology. For example, a mechanic can check out a vehicle's cruise and speed control

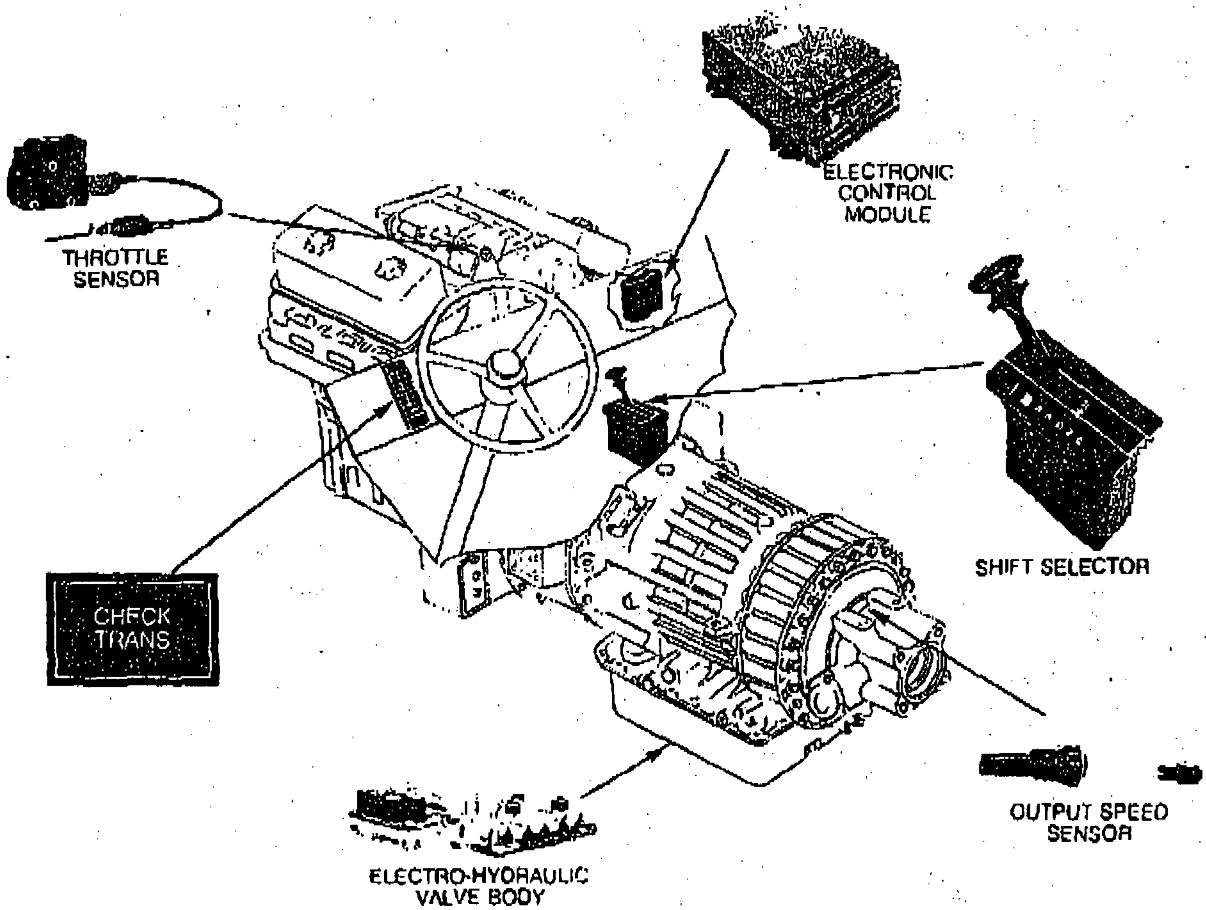

Fig. 7 - Truck installation for a computer aided transmission includes: a microprocessor control unit, an electrohydraulic valve body, a shift selector, a digital display unit and selected sensors (Detroit Diesel Allison Division - GMC)(5)

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