USING AUTOMATIC TRANSMISSIONS TO MEET YOUR NEEDS

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ABSTRACT

This paper deals with the electronic enhancements available with the Allison MD and HD transmissions. It explains what combinations are recommended for utility and municipal vehicles. As a consequence, further explanation related to the work normally performed by body builders relevant to the features of the electronic transmission is covered. Additionally, the advantages of electronics for the mechanic when performing maintenance on the vehicle are discussed. These subjects include the use of the ProLink diagnostic tool, internal trouble codes, and maintenance tips. Other topics covered include transmission ratings, mechanical features, and specifying the proper transmission for the work you need to do. Summarizing all these features collectively provides the driver, mechanic and fleet manager an opportunity to achieve the greatest benefit and return on their investment.

SCOPE

This paper considers the evolution in technology within commercial truck transmissions. Therein exists the ability to take advantage of electronically controlled transmissions for increases in productivity and reduced societal costs.

INTRODUCTION

I ask each of you to pick a point in time (pick 100 years ago, 1000 years, 50 years, etc.). Once you pick your point in time, think about how man has always found ways to be more productive. Man is constantly looking for ways to improve a process whereby productivity increases and costs decrease. Today we are more productive than people 50 years ago. Fifty years ago, people were far more productive than their ancestors. Let us extrapolate this trend into the future. We can logically conclude that man will continue to find methods to further increase productivity at less cost to society. Technology will be exploited to increase productivity and reduce societal costs while improving our working environment.

EVOLVING TRANSMISSION TECHNOLOGY

Transmissions for medium and heavy duty trucks and buses have evolved significantly over time. The 1950's and 1960's saw automatic transmissions introduced into trucks and buses. The 1970's and 1980's saw both first and second generation electronic controls introduced. These controls displaced hydraulic valving while providing very precise shifting. Transmissions of these earlier eras were used for the sole function of transmitting torque to propel the vehicle.

Today, technology is emerging whereby powerful computers are being used to not only control the transmission's shifts but also control the operation of the vehicle. This technology is being pursued to increase the vehicle's productivity and make for a safer and more enjoyable work environment while providing a reduction in societal cost.

ELECTRONIC CONTROLLED TRANSMISSIONS

The latest generation of an electronically controlled transmission has recently occurred. Many individuals are not aware that these transmission systems can be used as a central controller for many vehicle functions besides transmitting torque. I will cover this technology and give examples of how it can provide the following:

- Control vehicle body functions;
- Provide system interlocks;
- Increase vehicle productivity ;
- Eliminate or reduce ancillary "add-on" systems;
- Make for safer operating environment;
- Make for an improved operator environment;
- Increase vehicle reliability and durability; and
- Simplify vehicle troubleshooting and repair

SYSTEM OVERVIEW

My expertise is with Allison Transmission. I will discuss the Allison World Transmission that was introduced in 1991. I have been involved with the World Transmission from its inception when the "Voice of the Customer" was being

developed. This was done prior to the actual design process to establish the needs of the customer.

The World Transmission is a heavy duty six speed, fully automatic transmission for medium and heavy duty trucks and buses. Its rating is up to 500 Horsepower. It uses "closed loop" technology to control shift quality. Central to its system is a digital microprocessor that monitors various input signals and makes appropriate commands. Besides controlling the shifting of the transmission, this controller can simultaneously be used as a central controller for the vehicle.

MAJOR COMPONENTS OF THE SYSTEM

The following components work together to make the system work:

- *Transmission.* The transmission is a six speed assembly. Its shifting is electronically controlled.
- *Electronic Control Unit* (ECU). This is the "controller" of the system. The ECU is a powerful 64K computer. The ECU is connected to the transmission and various components by using a wiring harness. The ECU not only controls the shifting of the transmission but also can control the operation of special functions beneficial for the vocation in which it is being used.
- *Shift Selector.* The operator of the vehicle makes range requests of the system through the shift selector.
- *Throttle Position Sensor.* This device senses the position of the accelerator pedal. When a vehicle has an electronic engine, this component is eliminated and the engine and transmission would talk electronically.
- *Vehicle Interface Module* (VIM). This is a pre-wired watertight box containing six relays. It serves as a convenient junction point for body builders. Commands from the ECU to the vehicle body are communicated through this relay box.
- *Vehicle Interface Wiring Connector* (VIW). This is a connector where the body inputs its request to the ECU. This connector exists for the convenience of the body builder.
- *Diagnostic Data Reader Connector* (DDR). This is a connector where a Pro-Link 9000 Diagnostic and Reprogramming Tool is connected.

FUNCTIONS

Previously mentioned was the ability of this system to control functions that enhance the operation and productivity of the vehicle. These will be referred to as Functions. A Function is defined as an operational instruction given to the ECU (or directed by the ECU)—resulting in the performance of a special transmission or vehicle response.

Three types of Functions exist. All utilize the ECU as the central controller: 1) *Input Functions* are activated and deactivated by switching electrical power or ground to the ECU; 2) *Output Functions* are used to activate vehicle systems or components when certain conditions are met; and 3) *Input/Output Functions* are a combination of Input and Output Functions

There are over 38 Functions that have been created thus far. These Functions have been developed considering the needs of each vocation for which the transmission is being applied. These Functions are developed to improve the vehicle's productivity, safety, reliability, serviceability and overall cost. An abbreviated list of the Functions includes: Secondary Shift Schedule, PTO Enable, Auxiliary Range Inhibit, Fire Truck Pump Mode, Automatic Neutral for PTO, Two Speed Axle Enable, ABS, Range Indicated, Output Speed Indicator, 4th Lockup Pump Mode, Automatic Neutral for Refuse & PTO Enable, and Automatic Neutral for Refuse Packer & PTO Enable with Service Brake Status.

EXAMPLES OF FUNCTIONS

Let us look at a few examples of the Functions with the World Transmission. I will start with a example to show you how simple it can be to integrate this system into a vehicle. Then we will look at more complex and highly productive systems.

Auxiliary Range Inhibit

Envision a vehicle where a device on the body is extended and your desire is that no one can accidentally shift the transmission into range while the device is extended. The device may be outriggers on a construction truck or the aerial bucket on a utility truck. This Function can be used to prevent accidental shifting into range by simply installing a proximity switch on the device to sense its extension. Each one of these Functions has an official circuit diagram. Each circuit has undergone Failure Modes and Effects Analysis (FMEA) prior to it being released and published.

Much of the wiring for this Function will already exist in the chassis. The Vehicle Interface Wiring Connector (VIW) will already exist. A technician would simply connect a piece of 18 gauge wire to Wire #155 at the Vehicle Interface Wiring Connector (VIW) and connect it to a simple single pole switch. The other side of the switch is wired to Wire #161 at the VIW. The Auxiliary Range

Inhibit Function is now fully wired. When the device on the vehicle's body is extended, the switch will be open. This interrupts the circuit path. Any attempt by someone to place the transmission in gear will be inhibited by the ECU. Only when the device is retracted and the switch is closed will the ECU honor a request for range. This is a very useful yet simple system to understand. Let us build on our knowledge and look at more involved systems.

PTO Enable

Think about a vehicle that uses a Power Take Off (PTO) as a secondary power source to operate pumps, generators, or air compressors. Your desire may be to control the operation of the PTO so it will only be engaged when conditions are appropriate. You may want to limit the engagement and operating speed of the PTO to prevent the overspeeding of the device the PTO is driving. You also may desire to restrict the operation of the PTO above certain vehicle speeds. These operating requirements can easily be achieved with the use of the PTO Enable Function. This Function is a combination of an Input and Output Function.

This system is only slightly more complicated than the previous example. This Function utilizes one of the pre-wired relays reserved in the Vehicle Interface Module. Let us look at the simplicity of this system. Wiring involves finding switched power in the vehicle and running it through a dash mounted toggle switch. From the switch, run a wire to both Wire #118 at the VIW Connector and the F2 Terminal at the VIM. Remember, the VIM is pre-wired. The F3 Terminal at the VIM is the output that is connected to the electrical solenoid of a "hot-shift" PTO. Now the ECU is controlling the operation of the PTO. Engagement and operational speeds are controlled by the ECU and can be field adjustable. The adjustment will be discussed later.

Consider the simplicity of the system and the benefits gained by using the transmission's ECU to control the PTO. The PTO is fully controlled by the ECU and no ancillary system had to be added to the vehicle. The installation is simple and well integrated. Simplicity will bring greater reliability. If any trouble-shooting is required in the future, the published diagrams should be universally known and apply to nearly all commercial trucks.

Automatic Neutral for Refuse Packer and PTO Enable with Service Brake Status

Productivity is of prime importance to refuse operators. Emerging in this industry are automated side loading trucks where a single person operates the entire collection process from the vehicle cab. No longer present are the one or two workers, at the rear of the truck, manually dumping refuse cans into the vehicle. The need of this industry is speed to collect refuse at minimal cost and risk to workers.

A Function has just been released for automated sided loading trucks. This Function interfaces heavily with the vehicle and body creating a highly productive process. The addition of this system on a truck can yield an increase in productivity of 100 extra refuse cans per day.

I will not go through all the details of the circuit but I will describe the full operation of this Function. When the operator stops for a refuse can, the operator begins to extend the arm of the body that will grab the refuse can. When the arm is extended, the ECU commands the transmission to Neutral Range. Second, the engine's fast idle system is enabled by the ECU. Third, the PTO is enabled by the ECU. Once the cycle is completed and the arm is fully retracted, the ECU will command the transmission to engage forward range provided the operator has the service brake pedal depressed. Also, the engine speed will be returned to idle.

ADJUSTABLE PARAMETERS

With the wide operational requirements of users and vocations, various ECU parameters (settings) are adjustable by the factory or in the field. Body builders who have acquired the training and equipment, find it easy to adjust the parameters in the ECU to suit the need of their body and customers. There are 22 parameters which are adjustable. Examples of parameters, often adjusted by body builders, are the engagement and operational speeds for the PTO. Parameters also exist for engagement and operation of the PTO based on transmission output speed (vehicle speed). The parameters are easily adjusted electronically within minutes. The adjustment is done using a very common diagnostic tool called Pro-Link 9000 with a special Reprogramming Cartridge. This tool connects to the vehicle's DDR Connector (typically under the vehicle's dash).

VOCATIONAL PACKAGES

The ECU can contain many Functions. Often a body builder will use several of the available Functions in the ECU to integrate the vehicle. Vocational Packages were designed to "package" many of the common Functions for a particular vocation. This enables users, dealers, and body builders to purchase trucks based on its vocational requirements and have the typical Functions for that vocation existing in the ECU. This means a truck intended

to be a fire truck needs to have its chassis "spec'd" and ordered with a Vocational Package that is useful for the fire truck body builder to use. A chassis that has an inappropriate Vocational Package in the ECU will have to undergo involved recalibration that can add delays and cost to the integration.

CHASSIS SPECIFICATIONS AND ORDERING

Two of the most important steps in the acquisition of a vehicle are the planning and communication prior to the chassis order being issued. I am speaking of the need for the user to begin the process by identifying the operational requirements of the vehicle. Then, jointly working with the truck dealer and the body builder, making sure the operational needs are well understood. This will help to assure the chassis arrives at the body builder in a useable configuration, negating the need for modifications and delays.

Allison is doing its part to help the communication process with truck dealers and body builders. Many truck dealer ordering programs are being supplemented with computer based systems that aid them with the specification process. By inputting vocational needs, the specification program will identify the proper ECU Vocational Package to order in the chassis.

CONCLUSION

Today, certain electronic controlled transmissions can be used as a controller for the vocational requirements of a vehicle. By utilizing them, an integrated installation can yield improvements in productivity, safety, convenience, and ease of maintenance with the overall reduction in societal cost.