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Chapter 1

The PMC System

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INTRODUCTION

The Intellitec ***Programmable Multiplex Control (PMC)*** is a communications and switching system, designed to be used primarily on specialty vehicles to make the design and manufacture of the those vehicles easier and less expensive. The flexibility in its implementation, allows it to be easily used for most signaling and switching functions on the vehicle.

PMC brings a completely new approach to vehicle design. It is not like designing a vehicle harness, or a printed circuit distribution board, where every "i" must be dotted and every "t" must be crossed before installation begins. As long as all the switch and sensor inputs, and all the loads you wish to control are connected to a Module somewhere in the system, the rest is a simple matter of using the Windows™ based program setup All the relationships between inputs and outputs are changeable. If the system does not work right the first time you wire it, it does not mean a complete redesign. All you do is plug the computer into the PMC CPU and modify the setup. If a new switch or load is added, the entire harness does not need to be changed. Just connect the device to the nearest available Output Module, change the program setup, and you are on your way.

The ***PMC II System*** uses two loops of 160 channels to transmit data throughout the vehicle, providing 320 input, or output channels. The 160 channel CPU has only one loop. The function of each of these channels can be defined by the designer to be an input, or output function. The data on that channel is then available on the multiplex bus for use throughout the system. *The definition of each channel is done by the selection of the Modules, which will be explained later.* The relationship of these input and outputs are then defined by the designer through a Windows™ based program using simple Boolean algebra. *(If you are not familiar with Boolean algebra, the following chapters will help you understand it.)* Simply stated, Boolean algebra is a means of describing logic relationships using “AND”, “OR” and “NOT” functions.

A principle advantage of the PMC system is the flexibility it offers the user, both at the point of design and later in the field when the vehicle needs functional updates. Since most electrical functions of the vehicle are available on the multiplex bus, nearly unlimited numbers of interactions can be accomplished simply through the programming of the system.

The Modules of the system "communicate" with each other using Intellitec's proprietary multiplex scheme (U.S. Patent No. 4,907,222 and other Pat. Pend.). *A detailed explanation of this system is available in this manual.* A multiplex system is one that allows the transmission of multiple "bits" of information down a single wire. This can save significant amounts of wire and connections, lower costs, weight and improve reliability.

Multiplexing is not a new idea. It has been in use for more than fifty years. There are many different methods of multiplexing that are used in everything from aircraft to the desk-top computer. The advent of low cost, solid-state electronics and the demand for control of more electrical and electronic loads, has made it attractive for more and more applications. It is now the practical solution for the increasing wiring problems in today's modern vehicles.

Intellitec's multiplexing system is a time division scheme in which time is divided into a given number of segments, each representing a unique bit of information. In the case of the PMC system, the number of time slots is 160. At any given time, one of these bits of information is placed on the "bus", or loop, and is available for any of the transceivers to use as needed. Each of these time slots is 250 microseconds long (.000250 seconds). A complete set of 160 channels requires only 40 milliseconds (.040 seconds) to be sent on the "bus". This means that each input and output channel is checked for its proper status every 40 milliseconds. On the 320 channel system, there are two loops of 160 channels that make up the 320 channels. Communication is taking place on both loops at the same time, so all 320 channels occur in the .040 second time frame. Prior to processing a boolean to turn an output on, the system looks to see if the input involved has been present for two cycles.

System Timing

The PMC system has a total of 160 channels for information. These channels appear serially on the PMC multiplex bus, every 40 milliseconds. The 320 channel system has a Yellow and Blue Loop, each having 160 channels.

The multiplex signal is divided into 16 module groups of ten channels each. At the beginning of a module data group, there is a system reset pulse. Channel A1 occurs at the end of this reset pulse. At the end of the first data window, a clock pulse is sent.

Channel A2 follows A1, followed by another clock pulse, and so forth. At the end of the ten channel A group, there is a synchronization pulse that signals the system that the next group of ten channels is beginning. This sync pulse is shorter than the system reset pulse. The sync pulses also act as clock pulses. *The signal appears as shown below.*

The CPU acts as a Master, sets up these timing signals and puts them on the PMC multiplex bus for use by all the slave input and output modules. The signal is generated by the microprocessor in the CPU module.

In addition to the timing function, the processor is performing the Boolean logic that has been programmed into the system. The Booleans are calculated in order, starting with the earliest equation. In other words, the Boolean for channel A1, if there is one, will be the first to be calculated. Then, the one for channel A2, if there is one, will be calculated. *This is an important point to remember when writing certain Booleans, as the value of the earliest channels may change before the later channels are calculated.* This can also be of help in performing certain latching and timing functions and when programming the timers. These calculations are not synchronous with the system timing.

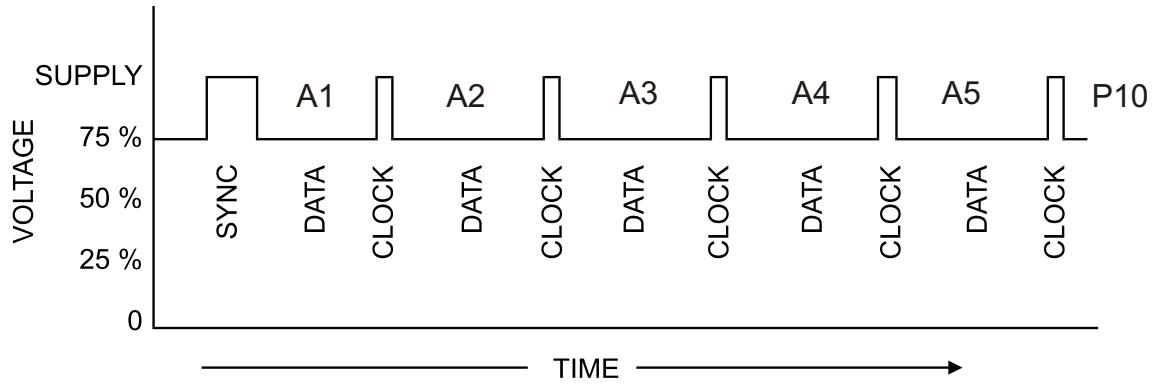


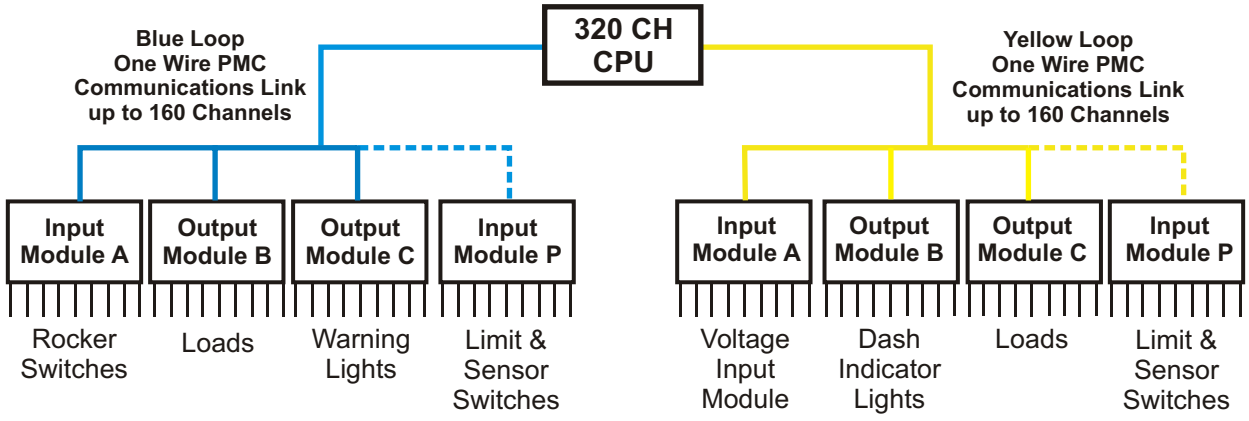
Figure 7

The PMC System

The PMC system consists of a Master CPU Module and a series of remote Input/Output modules. The CPU module is the "traffic cop", setting up the time slots. It also contains the vehicle specific setup program that determines the relationships between the signals on the bus. The I/O modules provide access to the system, both inputs and outputs. They are generalized units designed for flexibility in the vehicle application.

There can be up to 32 unique addresses for I/O modules; each module can include up to ten channels and each channel represents a switch input, or output to operate a load. The address of the I/O modules is identified by dip switches, or jumpers on each module, with an address of A through P (1 - 16). On the 320 channel system, modules can be physically wired to either the Blue or Yellow Loop of the CPU. The 160 channel CPU has only one loop; each loop handles 16 modules. Each channel of a module will have a unique address that can be controlled by the CPU. The CPU is programmed to determine which channels are outputs and what input events allow an output to turn on.

Up to 32 modules provide for as many as 320 inputs or outputs



PC INTERFACE Windows™ based Graphical User Interface is utilized to simply point and click to identify relationships between inputs and outputs.

TIMERS The 320 channel system has 160 software timers that can be used to create timed functions, such as, flashers, or delayed turn off's, eliminating the need for separate timer modules. The 160 channel system has 10 timers.

CHANNEL IDENTIFICATION Each channel has the capability of being labeled by the OEM. Label names are usually kept simple. For example, “Left Turn Signal SW”. This allows for easier programming. The names are also stored in the CPU for future diagnostics.

DIAGNOSTICS Although 99% of the PMC system can be diagnosed with a commonly available Volt Meter, a diagnostic system is incorporated in the Windows™ software. *Other diagnostic test equipment is also available from Intellitec.*

SLEEP MODE If sleep mode is enabled, all loads are automatically turned off, if ignition is off and inputs have been idle for a selected time period. During this mode, the CPU and I/O module significantly reduce battery drain.

HIGH SPEED CHANNELS Four such channels are available to control time critical functions, such as brake lights.

VIRTUAL CHANNELS For the 320 channel system, there are 160 virtual channels that exist in memory on the CPU that are used as extra memory to expand input to output relationships. This allows the programmer to write complex vehicle logic requirements. The 160 channel system has 10 virtual channels.

Set-Up Example
Booleans

Setup using Boolean Algebra may sound complicated, but it is really very simple. The picture below represents just one of the graphical user interfaces used in the PMC II Windows™ based software. The software allows you to label each of the modules, as well as their inputs and outputs. This makes them all easily recognizable and programming the vehicle less confusing.

The Boolean editor screen is used to define how a particular output is turned on. In this case, Blue Loop channel C4, “Warning Light 2”, is turned on when the Master switch, Warning Light switch and the virtual warning flasher are all on. You will note, that the switch inputs are connected to the Yellow Loop. Changing the relationship is as simple as a few mouse clicks. Any switch connected as an input, anywhere in the system, Blue Loop or Yellow Loop, it doesn’t matter, can be used to control as many outputs as you like. For example, you may wish to use the neutral safety switch to act as an interlock for a number of different outputs.

As you can see in the diagram, the items listed vertically produce a 3 input "AND" relationship. The screen below is a 3 input “AND” that is “Or’ed” with another 3 input “AND”. Although it may appear that the number of AND and OR's are limited, you will see in further chapters, that *the number of “AND’s” and “ORs” are almost unlimited.* There are *also* screens for a 6 input “AND”, 6 input “OR”, as well as a 3 input “OR” that is “AND’ed” with a 3 input “OR”. With the use of virtual channels these relationships can be expanded even further.

Further explanation of these screens will be provided in later chapters.