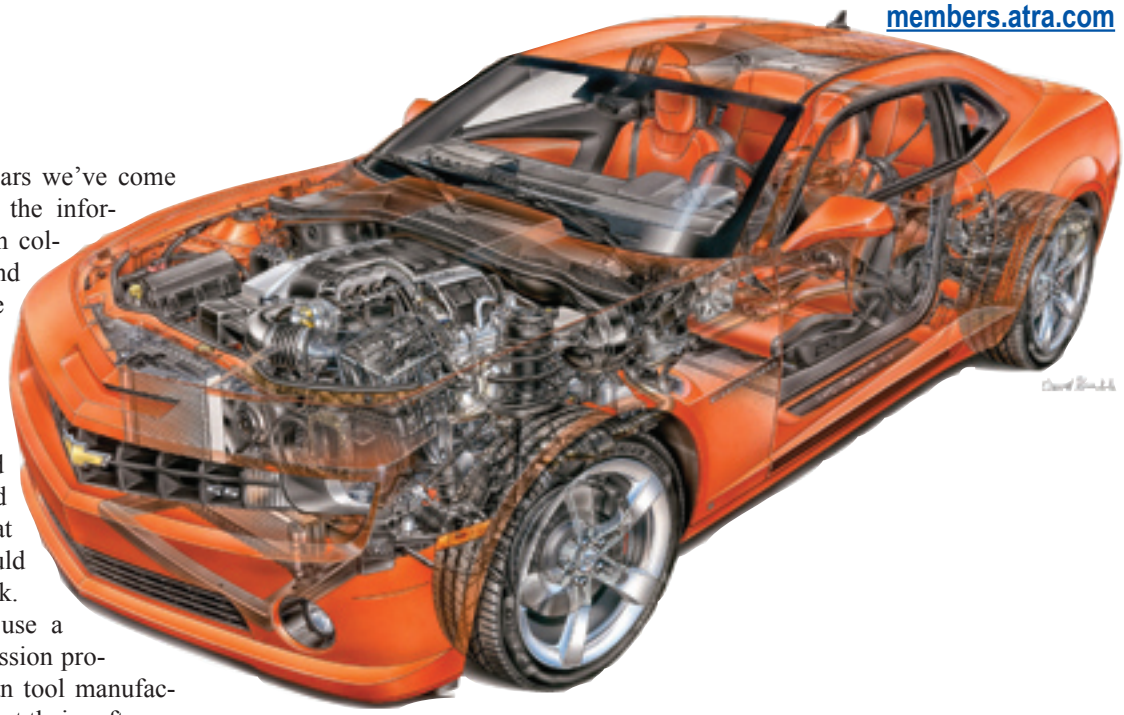
A Closer Look at Vehicle Data Communications

by Steve Garrett
members.atra.com



Through the years we've come to depend on the information we can collect with a scan tool. And through those years, the data communication systems or data buses have become more complex. With OBD-II, many of us hoped that the data bus would be standardized and that all our problems would be solved. No such luck.

Today's vehicles use a variety of data transmission protocols. This forces scan tool manufacturers to constantly adapt their software to those changes. This can be quite a challenge, even if they're working with a single brand of vehicle. Let's look at GM as an example: GM has used all of these data communication protocols over the years:

- UART (Universal Asynchronous Receive and Transmit)
- E&C (Entertainment and Comfort)
- SBI (Simple Bus Interface)
- SPI (Serial Peripheral Interface)
- LIN (Local Interconnect Network)
- Keyword 81,82 and 2000
- Class 2
- CAN (Controller Area Network) or GMLAN (General Motors Local Area Network)

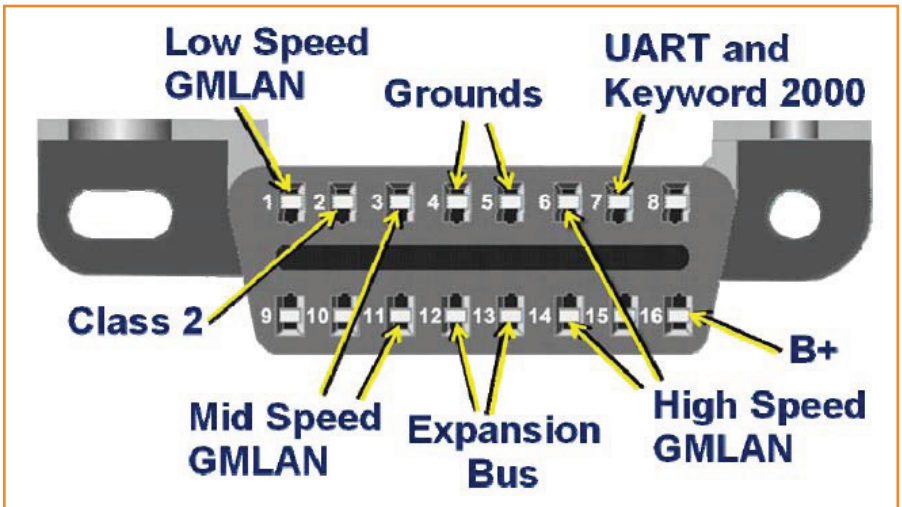


Figure 1

With the average GM vehicle containing more than a mile of wire, dozens of computers, hundreds of connectors, and thousands of terminals, the need for a standardized diagnostic system became imperative. A new system was introduced for the 2010 model year on the Chevrolet Camaro, Cadillac SRX, GMC Terrain, Buick Allure and LaCrosse. The new platform, known as the *Global Diagnostic System* or *GDS*, will be introduced in all GM vehicles in 2010/2011 models.

The new diagnostic system still uses several communication protocols from previous models, but it will also

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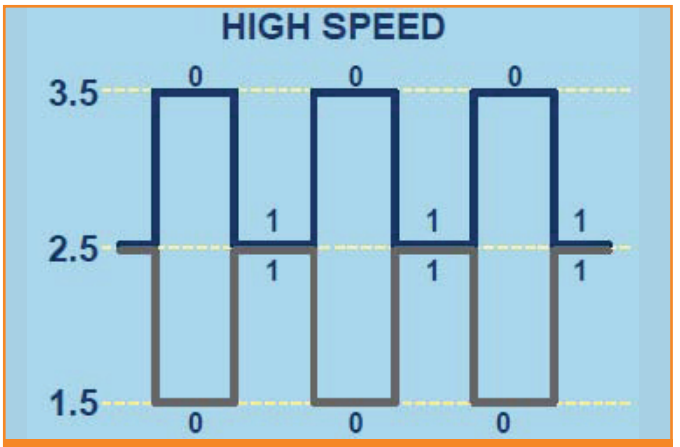


Figure 2

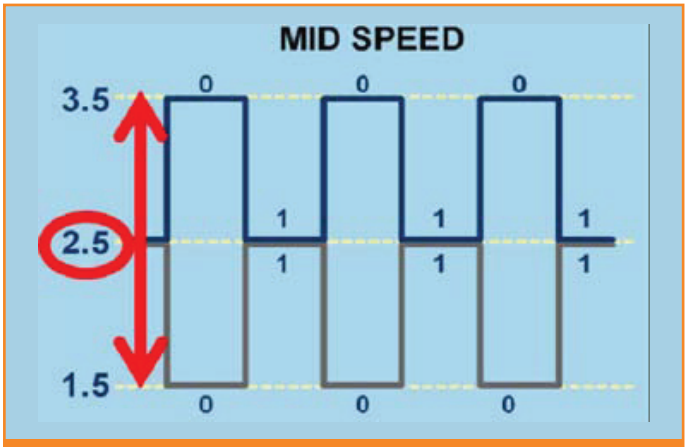


Figure 3

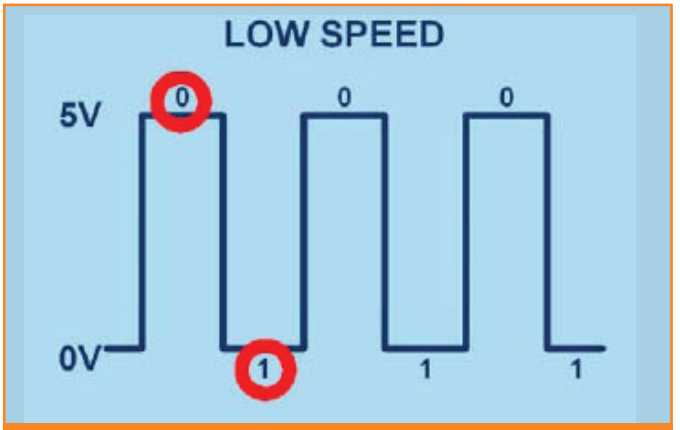


Figure 4

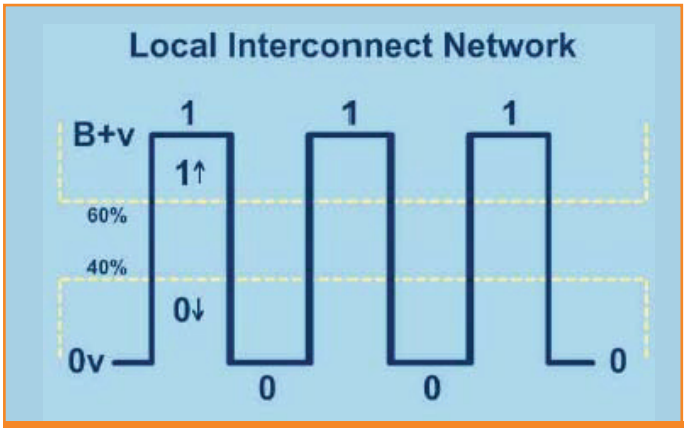


Figure 5

vary greatly when it comes to diagnostic processes and equipment. To understand the typical Global Architecture (Global A) we'll need to look at the data bus and its operation. The standardized, 16-pin DLC connector that you connect to your scan tool will have these pin assignments (figure 1):

Pin 1 — Low Speed GM LAN
Pin 3 — Mid Speed GM LAN; + terminal
Pin 4 — Scan Tool Ground
Pin 5 — Common Ground
Pin 6 — High Speed GM LAN; + terminal
Pin 11 — Mid Speed GM LAN; – terminal
Pin 12 — Expansion Bus High Speed GM LAN
Pin 13 — Expansion Bus High Speed GM LAN
Pin 14 — High Speed GM LAN; – terminal
Pin 16 — Scan Tool Power B+

The primary function of the vehicle data bus is still communication between the different control modules. GM has used several different data bus configurations, including:

- Ring Network — Connects each module through a serial data line.
- Star Network — Serial data lines from all the modules are connected at a single point; typically a splice pack.
- Ring/Star Hybrid — A combination of the two common bus configurations.

Let's take a look at some of the basics for a GM data bus system:

Power Moding — Power moding was introduced on GM vehicles many years ago to reduce electrical loads, wiring, and improve module response time during wakeup. Years ago, GM modules required a wakeup signal for the module to come on line. This was typically accomplished using an input from the ignition switch.

In today's vehicles, wakeup is accomplished by an assigned Power Mode Master module (PMM). The PMM is typically the BCM or DIM. The PMM receives the input from the ignition switch and then relays that information to the other modules through serial data on the data bus. Messages to the modules include:

- Off/A Sleep — Modules need to power down.
- Off Awake — Modules need to wake up and get ready for work.
- RAP (Retained Accessory Power) — Modules that are used after the key is turned off but before the door is opened should stay awake for a set period of time; all others should sleep.
- Accessory — Modules that are used when the key is in the accessory position should stay awake.
- Run — All modules should be awake.
- Crank — Modules that are used for cranking the engine should wake up while all others should continue to sleep.

Gate Way Module — Since 1986, many GM vehicles have used a master module to control data transmission on the bus. With a CAN/GM LAN network, the BCM typically acts as the gateway or master control module. The

gateway module translates and prioritizes the messages sent on the bus. In other words, the BCM acts as the interpreter and traffic cop for the system.

CAN/GM LAN — The CAN data bus isn't new, but it's becoming more common throughout the industry. GM has its own version of the CAN system known as the GM LAN. The GM LAN supports three types of bus configurations: low speed (33.3 kilobits per second), mid speed (95.2 kilobits per second) and high speed (500 kilobits per second) data transmission.

The *high speed bus* (figure 2) consists of a twisted wire pair that transmits a voltage signal that switches high and low to create the data signal. The high speed GM LAN bus is terminated with a pair of 120 ohm resistors. One line is driven high (3.5 volts) while the other data line is pulled low (1.5 volts) in a specific sequence to create the signal.

With a CAN-type system, each message is assigned a unique identifier to classify the type message and its priority. Each module on the bus processes only the messages related to the identifiers stored in the module's programmed listing. If more than one module is trying to communicate at the same time, priority is assigned to the message that has the greatest importance.

The *mid speed GM LAN bus* (figure 3) is very similar in operation to the high speed circuit, with one exception: the controllers attached to it. The mid speed GM LAN uses the same type of message transmission protocols that the high speed system does. The mid speed bus consists of a twisted wire pair that transmits a voltage signal that switches high and low to create the data signal. The mid speed GM LAN bus is terminated with resistors.

The *low speed GM LAN* is a single-wire circuit that replaced the class 2 data circuits on many GM vehicles (Figure 4). The GM low speed LAN is bidirectional and operates at three times the speed of a class 2 communication circuit. The circuit toggles from 0-5 volts. To wake up the modules on the bus, the voltage level is pulsed to 10-12 volts. The modules are connected in parallel on the low speed bus.

LIN — The Local Interconnect Network (LIN) is used to reduce the cost of data bus communications. The LIN is a single-wire network that toggles between system voltage and ground to produce series of voltage pulses.

Multiple LIN circuits are used in GM vehicles. A LIN circuit doesn't connect directly to the DLC; it communicates with various sensors, actuators and modules on its own circuit.

An example of a LIN circuit would be the power windows on a late model GM (figure 5). The window switch commands the driver or passenger door control module to open or close the window. The module performs the commanded operation while communicating with other modules regarding the action it performed.

GM Expansion Bus — This bus circuit can be referred to by many different names, but the function is the same. The expansion bus is designed to reduce the congestion on the high speed bus. By adding a bus that is designed and functions the same as the high speed bus reduces the amount of traffic on the primary high speed bus. This is like adding parallel freeway to reduce traffic congestion in a large city.

With the global architecture, lots of things have changed. For decades tech-

nicians have used the Tech 2 scan tool to help diagnose vehicles. With Global A vehicles, the Tech 2 will no longer function. GM now uses a PC-based program known as *GDS* or *Global Diagnostic System* (figure 6) to interface with the vehicle. This means you need to ask your scan tool manufacturer if your scan tool will be compatible with this new system. Lots of other areas have also changed, including:

- Swapping computers for test purposes can cause major problems. While this isn't new with some GM vehicle platforms, it's an issue with all Global A applications. Swapping an ECM, BCM, EBCM, SDM, ECC, IPC as well as many other modules can prevent the engine from starting or set trouble codes. In some instances you won't be able to clear these codes.

The modules are all coded with specific ID information codes when they're programmed at the assembly plant. So modules that have nothing to do with starting the engine can prevent it from starting. In addition, other symptoms may occur such as the IPC odometer reading "----," the radio displays "Locked," or "service the theft system" is displayed on the DIC.

Not only do the Global A vehicles use controller security codes to prevent vehicle theft, they also use a new type of coding known an *Environmental ID*. This type of coding is designed to prevent someone from stealing a vehicle by swapping modules and keys. The Immobilizer Master (BCM) identifies itself to the other modules. If it has the correct ID, the other modules will respond with a specific Environmental ID code. The BCM will look at all the modules' Environmental IDs and, if they're correct, it'll allow the vehicle to operate.

- Reprogramming is sequential. This means that several controllers are updated at the same time in a specific sequence to prevent software conflicts. Typical programming now requires a lot of data to be transferred (typically 10-40 MB). Programming will take much longer than in the past (up to an hour).

In addition, to protect the modules from unauthorized programming (non GM), the assembly plant uses a process known as *Seed and Key*. The assembly plant installs a specific Seed value during plant programming. When the module is connected to reprogramming equipment, that equipment must provide a specific Key value or the module won't accept the program.

- Many modules require a specific setup procedure to relearn component and system values.
- Many modules require a security code configuration procedure for the module to operate properly. If the configuration codes aren't installed, some modules will lock out immediately, while others will initially operate and then lock out after several key cycles or after battery power has been removed. This could lead to a customer complaint because the engine won't start or other conditions after you performed a repair.

Well as you can see times are still changing… until next time, remember: "In the middle of difficulty lies opportunity."

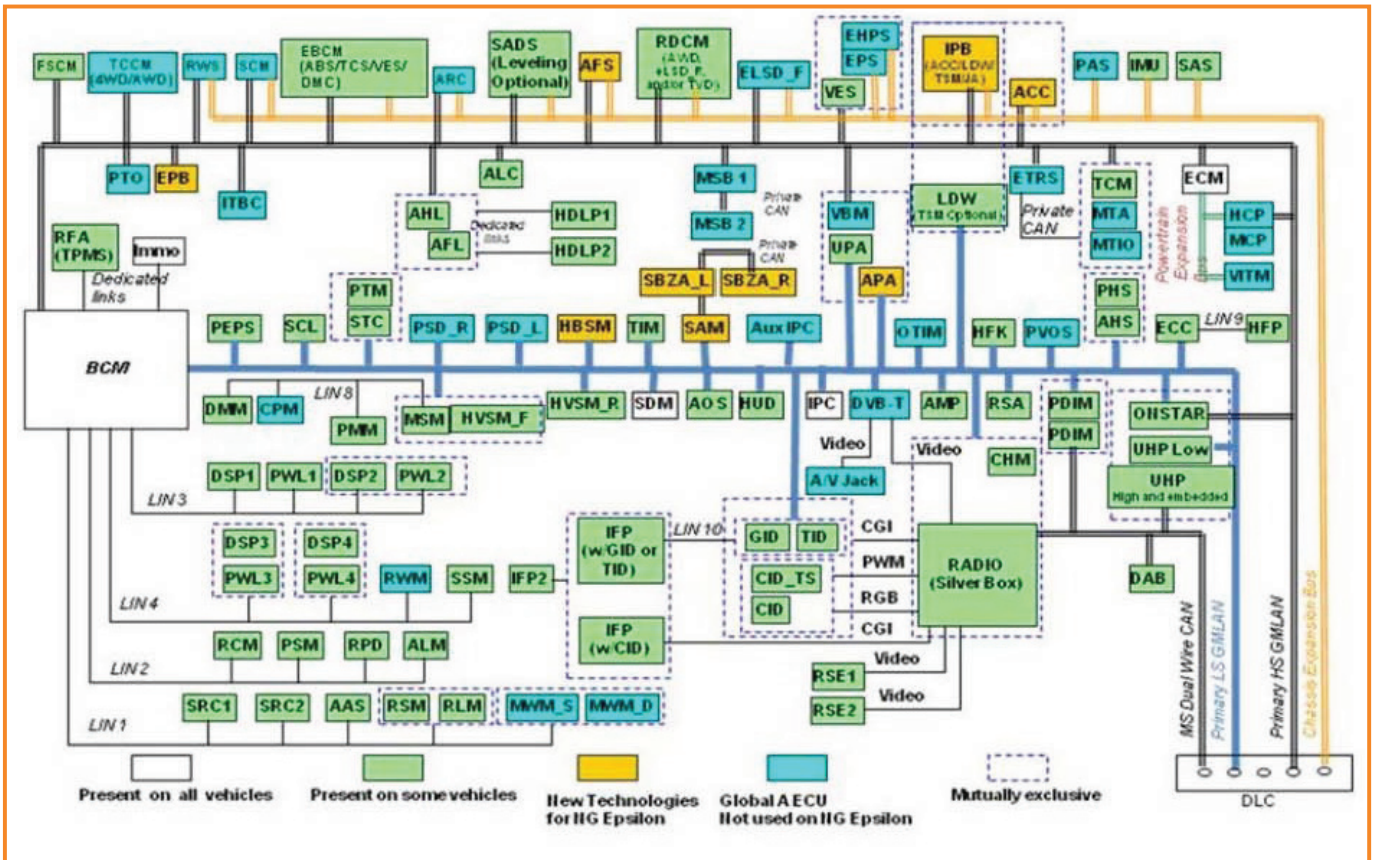


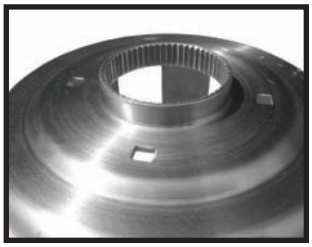
Figure 6

PRODUCT ALERT BULLETIN

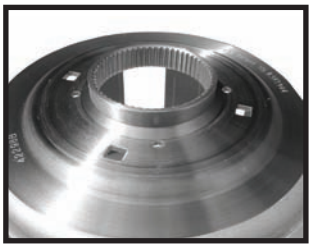
GENERAL MOTORS
700-R4/4L60, 4L60-E, 4L65-E
SUNSHELL

It has been brought to our attention that a product called "The Animal" has been recently introduced to the market and has created some confusion between this new product and our redesigned sungear shell "THE BEAST".

"THE BEAST" sungear shell is made solely by Parker Seal Aftermarket Products under US patent No. 6,561,944. We believe it is our responsibility to inform you about the main differences between these two products.



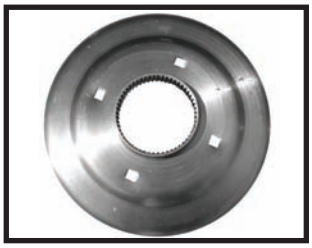
Neck Area
"The Animal"



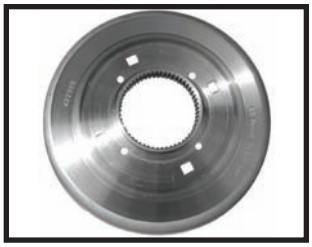
Neck Area
"The Beast"

Marking - Patent No.
"The Beast"

Marking - Part No.
"The Beast"



Top View
"The Animal"



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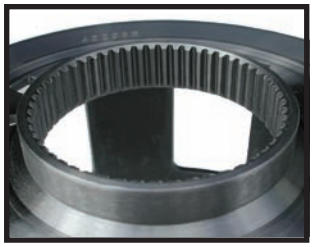

Case Hardened Spline
"The Beast"

Sungear Shell Assembly
"The Beast"

Facts	The Beast	The Animal
Manufactured using a 2 Pc. (middle and low) carbon steel. The wall thickness of the shell body is increased for added strength	Yes	No
Spline is case hardened to better withstand torque during engagement	Yes	No
Better and stronger than conventional OEM design	Yes	No
The sungear shell assembly includes an injection molded plastic washer. The plastic washer has the tabs inserted into holes formed in the neck section of the sungear shell to form the complete sungear shell assembly	Yes	No
Strengthened and reinforced the neck to reduce stress and to eliminate high failure rate at the neck section	Yes	No
Invention protected by US patent	Yes	No

Parker Seal Aftermarket Products 2315 SW 32 Ave Pembroke Park, FL
Phone 954-364-2400 Fax 954-364-2401