Introduction

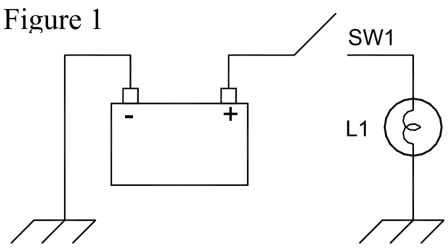
In general, most products supplied by automotive electronics product manufacturers such as Redarc are attached to vehicles to modify or enhance the original vehicle functionality. These are generally "after thoughts" of some kind, which is often true even of modules supplied to OEM customers. Technological advancements in vehicle electronics have reached the stage where they function more like a computer network than the old vehicles we used to know, so many OE supplied modules will need to be compatible with this vehicle network. Redarc are working with a number of customers to introduce new modules that will be compatible with their computer network, and have put together the following article to help keep all their customers abreast of this technology.

Michael Obst is REDARC's Operations Manager and has been working in the electronics industry for over 20 years. He has recently returned from Rome where he attended the 10th International CAN Conference. Attending this conference were representatives from various industries including automotive, medical, railroad, industrial automation, building elevators and academia. This variety provides some insight into the increasing acceptance of CAN for any form of control or communication in harsh environments.

So what is CAN?

It seems that recently some new technology called CAN is being mentioned more frequently. In fact, this technology is over 20 years old! It was initially started in 1983 as an internal project by Bosch to develop an in-vehicle network, and was officially released in 1986. CAN stands for "Controller Area Network" and describes how smart electronic modules can be connected together, not unlike a computer network. The easiest way to describe it is by considering a simple example with a brake light. Up until a few years ago, the simple brake light circuit would certainly have looked something like Figure 1. In this circuit, the brake lamp L1 would light when switch SW1 was closed. This allows current to flow through the switch, interconnecting wires and finally the lamp. With this simple arrangement, for each function we want to control (i.e. lamps) we must have a dedicated current-carrying cable joining it to some trigger (i.e. switch). As our vehicles have become more advanced, the number of functions we wish to control has increased, leading to large bundles of cables. What if it was possible to supply power to a "cluster" of functions and be able to just tell them when to work?

Figure 1



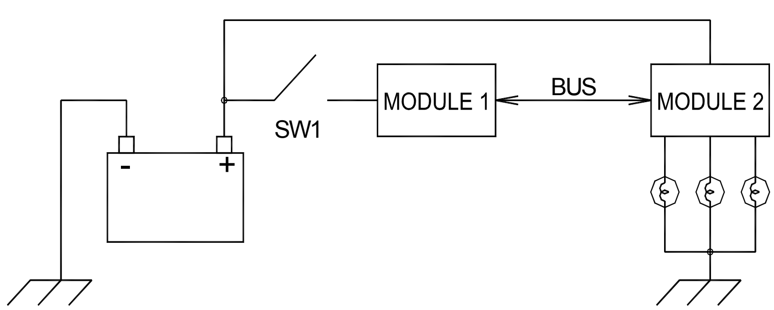
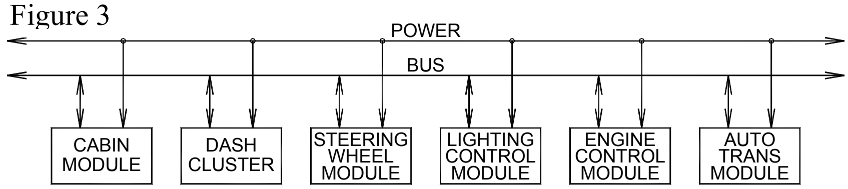


Figure 2

Imagine if the driver could dial up the "telephone number" of the brake light and say "on" or "off". Then dial the number of the left hand indicator and say "on" or "off". Well in effect that is what a CAN system does. In such a system one "cluster" might be the left hand tail/brake/indicator lamp assembly, and another cluster might be the steering column control module. Now the control module digitally samples the switch position and transmits a command to the lamp assembly to turn the corresponding lamp on or off, instead of the switch controlling the lamp directly. This arrangement is shown in Figure 2. The interconnection between the two modules is called the CAN "Bus" and consists of a twisted pair of wires that are used to transmit digital messages. Like in a computer, these messages consist of combinations of "1"'s and "0"'s which would look like +2.5V and –2.5V if they were slow enough to see on a multimeter. In a typical automotive network though, these messages are transmitted so fast that the +2.5V will only last for a few millionths of a second!

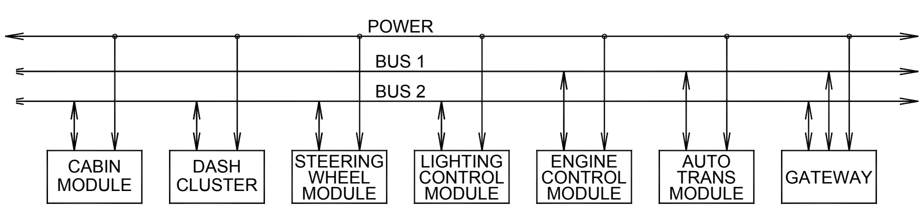
Now that we have a simple CAN network with two modules joined by a data Bus, why would this be useful? Well if we assign each module in this network a unique identifier and a defined priority or urgency, and if we define a set of rules for how we speak to the modules, then it would be possible to add more modules to this same data bus and they could all talk to each other. An imaginary truck CAN network is shown in Figure 3. It should be clear now that a very complex electronic network can be implemented on a vehicle with very simple interconnection facilities. Such a network allows all modules to communicate with each other, so command, status, fault and administrative data flows continuously. So now we can have smart modules performing self-diagnostics, and transmitting their operating conditions around the Bus for all to know. Imagine now you want to add say a reverse sensor. No problems, just connect it to the data bus, define what messages this new module needs to receive and transmit and it is done!

Figure 3



In a real vehicle, there could actually be multiple Buses used. There are many reasons why this would be done, but most of the time it comes down to how quickly a particular message needs to get from one module to another. Imagine if the Automatic Transmission Module needs to send huge amounts of data to the Engine Control Module and they were both high priority modules. Then imagine that the driver opens the door and the Cabin Module wants to tell the Lighting Control Module to turn the cabin light on. Intuitively this message would be low priority, so there could be a significant delay before this message can get through.

Figure 4



So one reason for multiple Buses would be to separate modules with high Bus demand from those with low Bus demand. This is shown in Figure 4. This figure introduces another important concept in CAN systems – the Gateway. Gateway is the term given to a module whose task it is to interface between two different Buses or Bus systems. In our example, the two Buses are both CAN, but they could be operating at different speeds (baud or bits per second). In other applications they could be completely different Bus systems such as CAN and Ethernet. The Gateway could be considered to be a translator or interpreter between different systems, and without these Gateways there could be no cross communication.

Obviously this is a very simplistic view of a potentially very complex system, but hopefully the reader can now understand the concepts involved. For many people, this technology could be frightening, but for most Automotive Electricians it should present an exciting challenge. No matter what the case is, such technology is here now and will become commonplace in the near future. For those of us involved in the industry, our task must be to embrace new technology and help carry it forward.