By Michael Colgin, Divelbiss Corporation

It goes without saying electronic controls are having a huge impact in both the utility vehicle and mobile equipment markets. Steer by wire, electronic shifters, and distributed hydraulic controls - just to name a few - are more the norm than the exception. A "tricked out" tractor cab resembles the cockpit of a jumbo jet far more than a traditional farm machine. In many cases, these advances in technology will make the difference between whether a company will survive or expire as world markets evolve.

As has been pointed out frequently in this and other industry publications, the smaller O.E.M. is at a distinct disadvantage when it comes to designing with the electronic technologies. To develop an electronic control suitable for industrial or mobile equipment use, a skilled and experienced engineering team is required.

The list will include at least one electronics engineer, the software designer, a draftsman skilled in printed circuit board layout, and possibly a mechanical engineer with experience in electronics packaging design. All in all, a rather formidable department upgrade no matter what the company´s size. Moreover, the investment isn´t complete with the addition of engineering staff. Once the control is designed, it still requires extensive testing before it can be offered to the market; and after that phase is completed, the product still needs to be manufactured. These market entry costs create a situation for the manufacturer where the "build vs. buy" decision quite often results in the boss telling someone, "Find something we can use and find it quickly!"

Independent suppliers and major players such as the hydraulics houses have addressed this issue in part by offering a catalog of interrelated modular control devices. The pre-designed modules tie together to create a control system. By utilizing this approach, final design and build can remain inside the organization. Where usage is low, this can be an excellent solution. Development costs and design times are lower and the end product will be quick to market. The solution does, however, have inherent shortcomings.

- The machine designer is forced to work with what's available - often creating a square peg in a round hole scenario.
- What happens when a new situation develops where there is no supporting module available?
- Costs can rise quickly as modules are added to a solution since each must have its own housing, power supply, and mechanical interconnects.
- System reliability can suffer from the additional mechanical interconnects.

As quantity requirements rise, this solution probably will not remain cost effective.

Divelbiss PLCs have been used successfully in coal mining equipment and tire manufacturing test vehicles for several years so "mobile" and "off-road" are not totally foreign words to the engineering team. The PLC on a Chip™ based products offer several advantages not readily available in other solutions, and moreover, the products lend themselves well to mobile and off-road application.

Ladder programming makes the difference

The HEC-1000 Harsh Environment Controller package will look familiar. It uses the same Deutsch housing several other manufacturers chose for their controls. However, the controller inside is based on PLC on a Chip technology. Because the HEC-1000 is a PLC rather than a dedicated electronic control module, it provides the engineer far more flexibility in his design choices.

Dick Morley, recognized as the "father" of the PLC, once described the first commercially available PLC as, "a box of

relays." Ladder logic is a graphic programming language closely resembling the electrical diagram for a group of relay circuits. Programmable controllers use ladder logic extensively because engineers and field service technicians easily understand it. EZ Ladder® software supports over 50 functions including timers, counters, a real time clock, PID loops, and frequency selection for PWM.

The HEC-1000 was originally developed for remote location monitoring and control and supplies quite a bit of capability from a small footprint. There are six inputs of which two can be selected for high speed counting up to 40 KHz. In addition, there are two 0 to 20mA 10-bit analog input channels. One of the two CAN ports supports J1939 network communication. The six outputs, each of which is selectable as digital on/off or programmed frequency PWM, help complete the unit´s overall versatility.

At times the controller must become an integral part of the product. The PLC on a Chip microprocessor offers an effective solution for these instances. Available at both chip and pre-designed module levels, an obvious advantage of PLC on a Chip is the ability to be easily embedded in the manufacturer's product.

Embedded control is a major advantage

Each integrated circuit package (chip) provides complete programmable logic controller functionality. If we allow our imagination to wander, the possibilities are endless. A wide range of products can benefit from embedded intelligence. Pumps, process valves, a myriad number of sensors, motors, and compressors can all make use of these features. The ability to monitor and react based on speed, temperature, time, or a logical set of events can be a real plus.

The direct digital I/O capability is 33 inputs and 33 outputs. Should more I/O be required by the application, that total can be expanded to over 300 utilizing the Divelbiss High Density I/O bus structure. The PWM output frequency is programmable in a range from 1.4 Hz through 47 KHz to enable control interface with valves from multiple sources.

The chips are programmed in ladder logic with function block using the EZ Ladder software that parallels the IEC-61131 standard. Support is provided for J1939 and Modbus® communication within the software. Embedding intelligence in this manner provides the manufacturer a low cost, quick to market controls solution with the added advantage of intellectual property protection not found in some other solutions.

Future considerations

CAN networking is readily accepted by the industry as a means for distributed control solutions. Protocols are presently in development (OptiCAN) that will allow diverse PLC on a Chip based products to network without sacrificing the performance of individual devices. Another version of the Harsh Environment Controller with embedded wireless is in the development pipeline. Monitoring asset use and tracking becomes an affordable management tool for fleet owners as the cost of GPS enabled devices decreases. PLC on a Chip modules are being used on a wireless mesh network for equipment control at client nodes. Another PLC on a Chip based controller has just recently been introduced that plugs into a standard relay socket and lists for under $100. We believe the future for these and other electronic controls in this industry will continue to excite.