subCAN™ – A Powerful, Compact Subsea Control System

Electric ROV systems have been traditionally used as observation vehicles required to carry payloads typically amounting to not much more than a pair of cameras and a sonar system. However, in recent years, they have been expected to carry higher levels of equipment, all made possible by the reduction in size and weight of many oceanographic sensors.

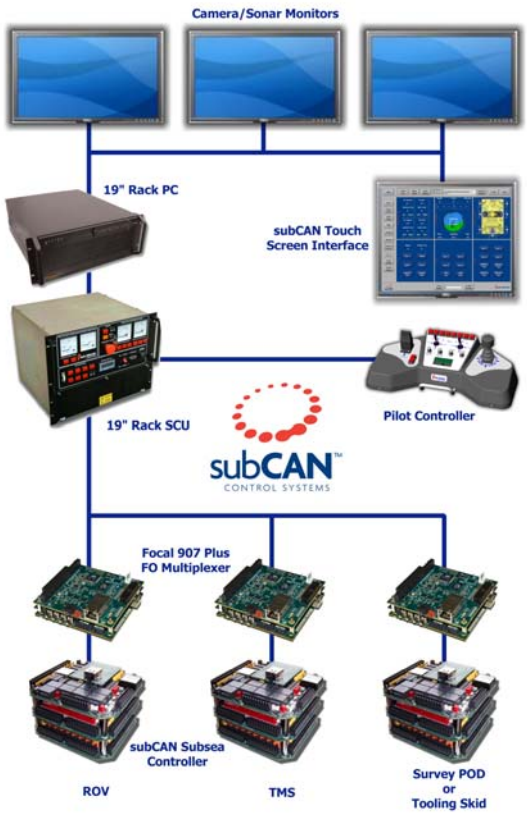
ROV manufacturers have responded to these requirements by introducing neutrally buoyant tooling and sensor skids for the small electric ROVs, however, all these additions have left the existing the 'OBSROV' control system creaking at the seams and vastly underpowered.

This situation led Sub-Atlantic to develop their new **sub**CAN™ control system. Although designed for use on small ROVs, the system lends itself to be applied most subsea control applications.

Overview

The system architecture comprises of industry proven topside equipment; a basic PC running Windows GUI (Graphical User Interface), a pilot's hand control unit and touch screen monitor. The topside PC communicates with compact subsea control boards located in the ROV, TMS, tooling skids, etc.

On first observation, the simplicity and compactness of the **sub**CAN™ components might mislead the viewer into thinking that the control system functionality would be very limited, yet the unique design boasts scalable capacity and the features found in the latest generation work-class ROVs. This includes multiple/expandable digital and analogue channels, diagnostics, fault protection and AutoPositioning. Control loops are carried out on the subsea control boards, minimising system latency.



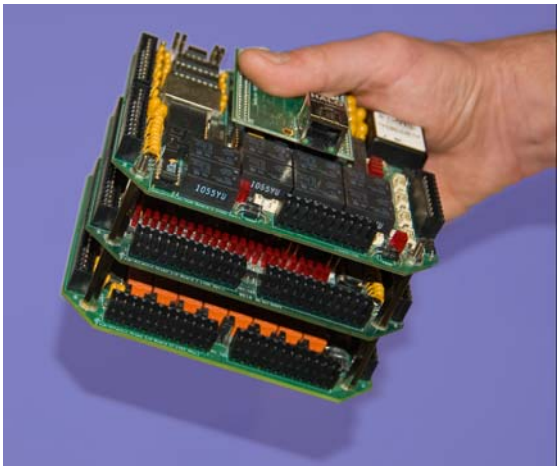
subCAN system layout is simple and intuitive. The pilot controller provides all ROV controls and switches close to hand. The touch screen interface shows system status, alarms and diagnostics at a glance. Additional controls and set-ups can be implemented via the touch screen interface.

One subsea controller is used for each sub-system. On-board diagnostics, both on the controller and the FO multiplexer, communicate status back to surface.

Due to their very high capacity, additional equipment and sensors are easily incorporated into the subsea controllers.

Subsea Control System

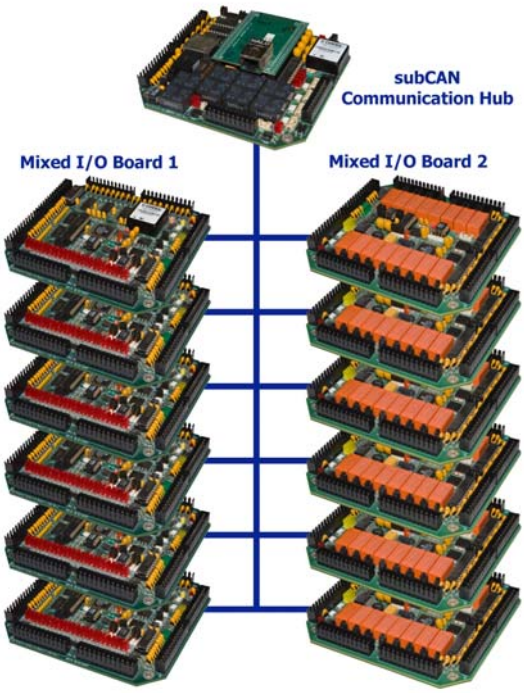
Small electric ROVs dictate very tight dimensional constraints on control system components, requiring high density electronic design together with good thermal management practices.



*The subsea components of subCAN consist of three PCBs, a **Communication Hub PCB** and two **Mixed I/O PCBs**. For the most complex control applications, numerous I/O PCBs can be tagged on to the Communications Hub to provide massive I/O capacity.*

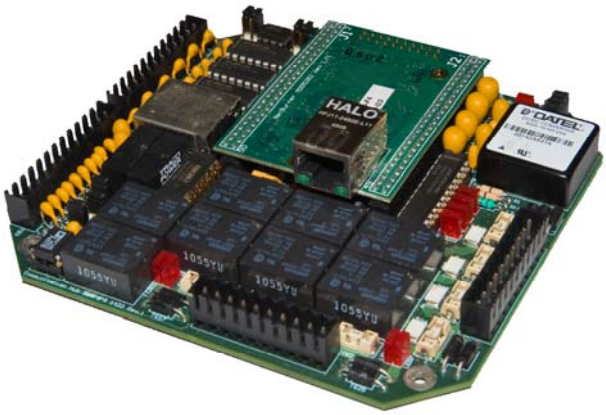
This image demonstrates how high capacity performance can be ingeniously designed into a very small package.

The very real possibility of sea water ingress into the ROV system mean that protection from over-voltage and over-current are paramount. This has been addressed with either fuses, self healing fuses, over current protected FETs and transient voltage suppressors on all interfaces. An isolatable Ground Fault/Line Insulation Monitoring system is provided as a core component of the control system.



subCAN is expandable. For high capacity applications, numerous Mixed I.O Boards can be run off a singe Communications Hub

Communication Hub



Functionality
1 off Ethernet 10/100 BaseT.
1 off RS485/RS232 to 115200 Baud.
4 off RS232 to 115200 Baud.
3 off CAN (Controller Area Network) to 1M bit/s
4 off switch-able power channels, 8 amps each, to 24VDC.
Isolate-able ground fault system.
Single axis rate gyro.
Up to 16 jumper selectable addresses.
Voltage current and temperature feedback.
All the communication and power channels are over voltage and over current protected.

The *Communication Hub* serves as the "brains and heart" of the control system. This PCB consists of a dual processor design with 80 MIPS of processing power. The main processor is a Freescale Coldfire processor (32 bits @ 60MIPS) running a pre-emptive real time operating system. The secondary processor looks after the housekeeping and I/O functions on the board and also extends the number of communication interfaces on there is a Microchip dsPIC micro-controller (16 bits @ 20MIPS). All power and communication pass though the Communication Hub to the other PCBs and certain components within the control system sub-structure (very high bandwidth devices such as sonars and cameras communicate through the fibre optic multiplexer). The Communication Hub communicates with the topside control system via RS232 or RS485. The firmware on the PCB can be updated via the RS232 or RS485 interface negating the normal requirement to open up the subsea pod for firmware changes.

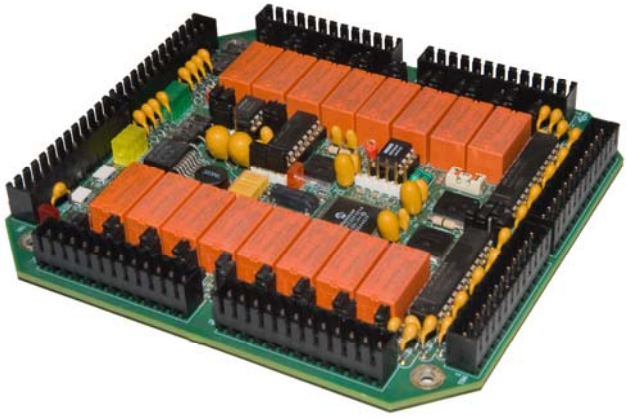
Mixed I/O Boards

The mixed I/O boards extend the functionality of the communication hub board on its CAN interface to control and interface to thrusters, valves, motors and sensors, providing low voltage power and various electronic interfaces and signals. If a sensor type is identified which is not found to be interface-able on the following two I/O boards, more boards can be produced which then "hang off" the CAN interface. The firmware on these boards is relatively simple due to the fact that they are relatively dumb devices that basically do as commanded by the Communication Hub, reporting back diagnostic information, voltages, currents, temperatures, etc.

Mixed I/O Board I

Functionality
1 off RS485/RS232 to 115200 Baud.
1 off RS232 to 115200 Baud.
2 off CAN (Controller Area Network) to 1M bit/s.
12 off analogue outputs, +/-10VDC @ +/-5ma, 16 bit resolution.
24 off digital outputs, 24VDC @ 1 amp, high side driver, maximum 20 amps.
4 off solid state relay outputs, +/-15VDC and high impedance, 100mA.
8 off analogue inputs, +/-10VDC, 0-5VDC software selectable, 12 bit resolution.
16 off digital inputs, contact closure to activate.
5V supply to 100mA.
Up to 16 jumper selectable addresses.
Voltage current and temperature feedback.
All the communication, power and I/O channels are over voltage and over current protected.

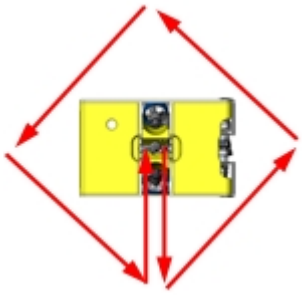
Mixed I/O Board II



Functionality
1 off RS485/RS232 to 115200 Baud.
1 off RS232 to 115200 Baud.
2 off CAN (Controller Area Network) to 1M bit/s.
16 off relay outputs, SPDT, NO, NC, C, 250VAC to 5 amps.
16 off analogue inputs, +/-10VDC, 0-5VDC software selectable, 12 bit resolution.
5V supply to 1A.
Up to 16 jumper selectable addresses.
Voltage current and temperature feedback.
All the communication, power and I/O channels are over voltage and over current protected.

Applications

subCAN™ is suited to the vast majority of subsea control application from ROVs, tooling and intervention tasks. Sub-Atlantic have recently introduced AutoPosition system to their ROVs which allows hands-off operation and features such as position hold, waypoint routing, etc.



AutoPosition allows the pilot to fly hands-off while the ROV can either maintain current position (in strong currents) or move in pre-designated paths input numerically.

Conclusion

Due to the high speed communication networks employed within this system, latency is undetectable by the human in control. Any tight (from a time constraint perspective) control loops can be carried out either sub-sea on the communication hub board(s) or on the PC(s) depending upon where the control is required. The size, I/O density, flexibility, robustness and cost of the sub-sea components meet the most stringent requirements of most sub-sea related control system tasks. The speed, flexibility and diagnostic feedback make the operator control interface simple to run, fault find and also provide a very responsive environment for sub-sea work.

Any further information can be obtained by contacting Sub-Atlantic.