CUSTOM SOLUTIONS

SEALEVEL®

About Sealevel

For 25 years, Sealevel has provided innovative, reliable hardware and software products to enable computer connectivity and control. Today, we manufacture more than 300 standard products and house our design, sales, support, and manufacturing in our 48,000 sq. ft. facility on a 17-acre site in Liberty, South Carolina. Our state-of-the-art facility has ESD tiling installed in all engineering and manufacturing areas to protect electronic components from damage during assembly and test. Sealevel is proud to be ISO 9001:2008 registered, and all of our I/O products carry an industry-leading lifetime warranty.

Because the needs of our customers are ever evolving, we are constantly developing new products that leverage emerging technology. We are obsessive and passionate about what we do - from customer service to intuitive design to technical support. We do our jobs to the best of our abilities because we understand the products we create help our clients make the world stronger, safer and better.

CORE PRODUCT OVERVIEW

COMPUTING/HMI
Designed for I/O intensive applications, Sealevel's family of embedded I/O servers combines the reliability of a PLC with the configurability of an industrial computer.

SERIAL SOLUTIONS – ASYNCHRONOUS & SYNCHRONOUS
Sealevel asynchronous and synchronous serial interfaces are designed for high-speed applications and support RS-232, RS-422, RS-485, and RS-530 electrical interface standards.

I/O SOLUTIONS – DISTRIBUTED, DIGITAL & ANALOG
Monitor and control real-world signals with any computer using Sealevel digital and analog I/O products. Select from field-proven optically isolated inputs, Reed and Form C relay outputs, TTL interface to solid-state relays, A/D, and D/A functionality.

Custom Design Specification

Sealevel makes hundreds of standard products, but often OEM customers need a solution tailored to fit their unique requirements. Sealevel understands the advantages an optimized design can offer. Customizations range from oscillator modifications for non-standard serial baud rates to the development of completely private labeled industrial computers integrated with I/O functionality from one of our standard products. If an off-the-shelf solution doesn't meet your requirements for performance, quality, or cost, call us to turn Sealevel's expertise into your next product.

· Design Specification & Project Management
· Electrical Design
· Mechanical Design
· Software Design
· Product Compliance & Certification
· Environmental Stress Screening (ESS)

DESIGN SPECIFICATION & PROJECT MANAGEMENT

Great products begin with great definition. Clearly defining the scope and deliverables is a key element of all successful product design efforts. Sealevel's experienced staff works with you to understand the details of your requirements and then works to create both a Statement of Work and Project Schedule. As the project progresses, Sealevel provides frequent updates and schedules review meetings to coincide with key project milestones in each phase of the development.
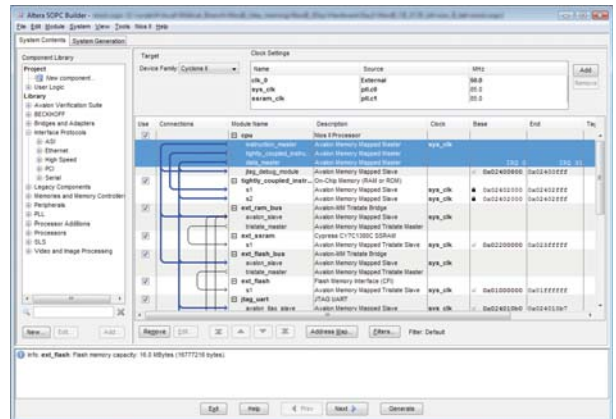
ELECTRICAL DESIGN

Sealevel has provided custom I/O board design for customers since 1986. Whether you need a plug-in card solution (such as PCIe or PMC) or a complex system design, our experience can be leveraged to create the design you need on time and within budget.

Our engineers use advanced electrical schematic capture, layout and routing, and modeling tools from Altium. Over the years, we have developed an extensive library of parts and reference designs that allow new product designs to be produced reliably and quickly to improve your time to market.
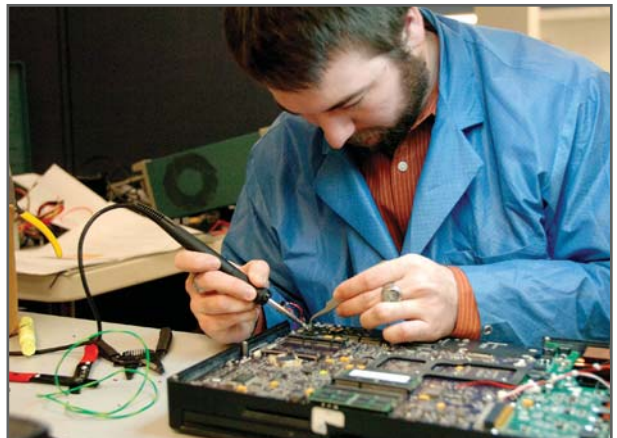
Field Programmable Gate Arrays (FPGAs) lend flexibility to a design. Sealevel's electrical engineers have years of FPGA experience in high-speed logic design and bus interfacing with PCI and PCIe as well as many high-speed serial buses. We use the latest tools including Altera's Quartus and Nios embedded development suite, Xilinx's ISE design suite, Lattice's Diamond/ispLEVER, and Microsemi's Actel Libero IDE. In addition, we have full simulation capability with Aldec's Active-HDL for FPGA design entry and simulation.

The latest tools, such as Altera shown above, are used to speed electrical design development.

Areas of Expertise:

· RISC Single Board Computer Design
· COM Express Baseboard Design
· 8, 16, and 32-bit Microcontroller-based CPUs
· Serial I/O – Asynchronous or Synchronous
· Optically Isolated Serial and Digital
· Ethernet to Serial or Digital
· USB to Serial or Digital
· Digital Inputs and Outputs
· CAN Bus
· EtherCAT
· Wireless Connectivity (WiFi, Zigbee)
· Analog (A/D, D/A and Audio)
· MIL-STD-1553
· Embedded Ethernet Switches

Our engineers work with your team from conception to completion to develop a product that meets your specifications.

MECHANICAL DESIGN

Using advanced 3D modeling tools from SolidWorks, complex mechanical projects are accomplished with amazing speed and accuracy. Every aspect of the design is modeled, including board and connector placement, so there are no surprises when prototypes arrive. These models are used to communicate the design with you before we build to ensure that all expectations are met.

For applications that require extended temperature operation, we employ thermal modeling to predict environmental performance. These simulations help determine the best component selection and placement in the design phase, saving valuable time and money required to correct problems otherwise not found until prototype testing.
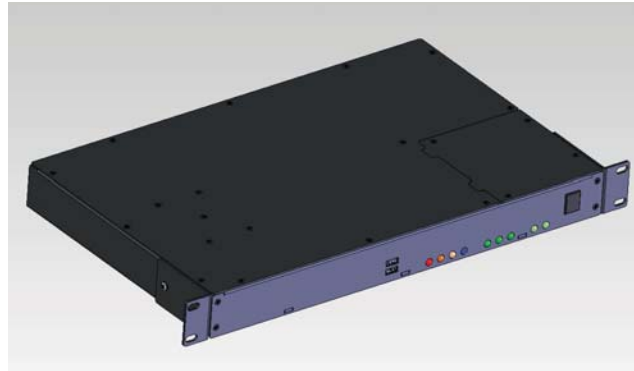

SolidWorks 3D modeling software speeds design development.
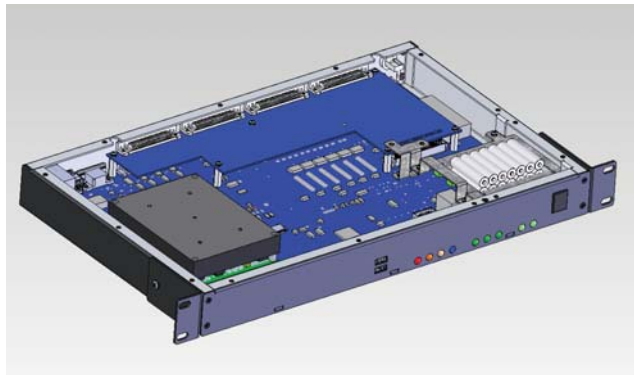
3D modeling includes all PCB and subassembly placement to verify fit.

SOFTWARE DESIGN

Modern electronics invariably have a software component. Sealevel's staff includes software engineers, computer engineers, and computer scientists for a team adept in solving the most complex embedded software challenges. Our engineers use industry-standard software development processes to ensure the highest quality deliverables. Past projects include development of custom BSPs, microcontroller firmware, drivers, APIs and utilities. Whether you are using Windows 7, Windows Embedded CE, Linux or no OS at all, we can help.
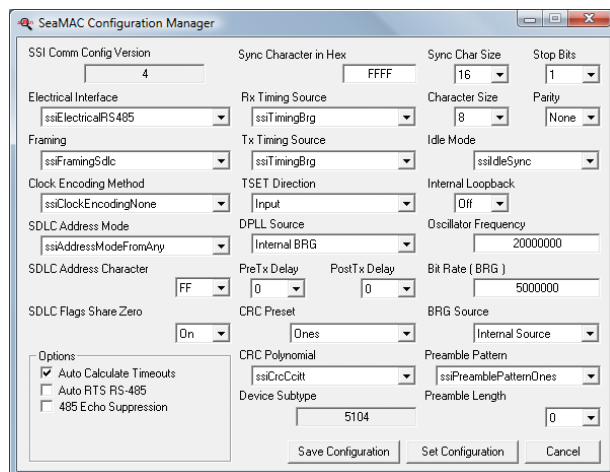
Easy menu driven setup and installation software.

PRODUCT COMPLIANCE & CERTIFICATION

Using a "design for certification" approach, Sealevel can manage the entire process of custom product development certified to many military and commercial standards including:

- MIL-STD-810F
- MIL-STD-464A
- MIL-STD-1472F
- MIL-STD-461F
- MIL-STD-901D
- MIL-STD-167-1
- NEMA, IP and ATEX
- FCC, CE
- UL, CSA
- Class I, Div 1; Class I, Div 2 Hazardous Areas
- Component Derating Process per NASA GSFC Preferred Reliability Practices

Sealevel has the test equipment and knowledge to provide screening of prototypes for EMI emissions and susceptibility as well as environmental performance including temperature and rain testing prior to testing at certified labs. This pre-test screening saves the time and cost of official laboratory testing until passing results are proven likely. Sealevel maintains relationships with certified testing laboratories, including Clemson University's International Center for Automotive Research (CU-ICAR) located near our facility, to make receiving final, official certifications simple.

ENVIRONMENTAL STRESS SCREENING (ESS)

For products that require the highest reliability, Environmental Stress Screening (ESS) can accelerate defects that may otherwise not be detected until a field failure occurs. This is done by subjecting the unit under test to rapid thermal cycling and vibration testing that can precipitate latent defects such as cold solder joints, loose fasteners, or poor wire crimps. Defects found during ESS can be addressed rapidly to determine root cause and effect a corrective action to eliminate recurrence and improve the overall quality level of the product.

Once a product is released for production, Sealevel's extensive manufacturing capabilities provide a trouble-free pipeline to meet delivery demands. Our in-house test equipment includes modern thermal chambers and vibration stations suitable for large volume production orders requiring ESS. Whether your market is military or commercial, Sealevel offers the knowledge and tools to bring the highest level of quality to your next product design.
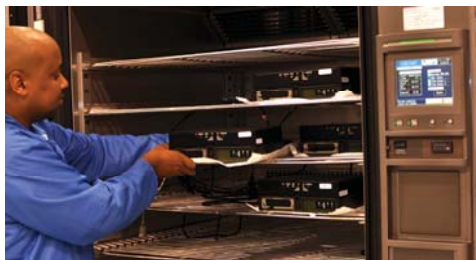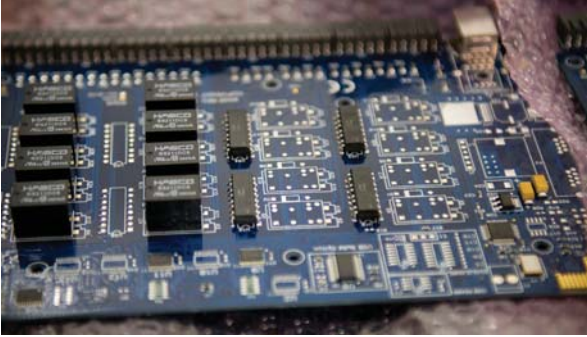

Thermal testing supports ESS and extended temperature range certification.

Vibration testing identifies defects prior to shipment.

The Challenge is as Satisfying As the Solution

We are proud to work with the most talented engineers from around the world to solve difficult problems in diverse sets of applications. No matter what your application requirements, Sealevel can provide a solution that perfectly fits your needs.

- **Standard Products** - Sealevel's standard products have been designed to the highest engineering standards and often provide the easiest, most straight-forward solutions. Sealevel currently offers over 300 off-the-shelf products to meet your requirements.

- **Product Modifications** - In other applications, a standard product may almost fit, but not quite. In these instances, we will make minor modifications to a standard product to create an ideal match for your application.

- **Full Custom Solutions** - For complex application requirements or when unique technology is required, full custom solutions offer the best answer.

On the next pages, you will find case studies of real-world examples of Sealevel custom solutions. Sealevel guarantees the same level of expertise and commitment that generated these successes in all of our custom product development. For more information on these case studies or our custom solutions, please contact us at custom@sealevel.com.

WE SET THE DESIGN BAR. THEN WE RAISED IT.

Public Safety Communications

OVERVIEW

A leading company in critical two-way wireless communications systems used by public safety and government organizations contracted Sealevel to design an ultra-reliable industrial computer to monitor and control remote broadcast sites across the United States. Sealevel responded with a solid-state system that included all the dense I/O required packaged in a compact 1U, rackmount enclosure. With over 1,500 units installed and operating successfully to date, this satisfied customer trusted Sealevel to refresh the design and upgrade to a faster processor and more memory for compatibility with today's information assurance software required for new installations.

APPLICATION REQUIREMENTS

- Dual Core Processor
- Minimum 4GB RAM
- Dual 10/100 Ethernet
- 4 x RS-232/422/485 Ports
- VGA Video
- 120 Digital Inputs
- 96 Digital Outputs
- 40 A/D Inputs
- Internal Battery Backup
- -30°C to 60°C Operation

THE SEALEVEL SOLUTION

Sealevel designed a COM Express baseboard with all the required I/O into a rugged, 1U rackmount chassis. A Core 2 Duo COM Express processor module mounts to the baseboard to add the high-speed portion of the system including processor, chipset, memory, and video. An internal battery and power monitoring circuit allows the unit to continue to operate when power loss is detected to effect an orderly power down and record the status of other components in the communications rack. Since the systems are not always in environmentally controlled buildings, all extended temperature parts were selected for the design in order to accommodate the wide temperature specification.

KEY DESIGN CHALLENGE
LONG-TERM AVAILABILITY AND UPGRADEABILITY

Sealevel's electrical design team was challenged to design a hardware architecture that would meet the large amount of I/O required in the small space available while offering guaranteed long-term availability and the ability to upgrade the processor and memory if needed. Sealevel chose the COM Express platform for the computing engine so that application-specific I/O requirements could be incorporated into a baseboard.This approach segments the section of the design likely to change due to the constant improvements in processing technology and allows easy replacement or upgrade of the CPU or memory.

PUBLIC SAFETY COMMUNICATIONS

Semiconductor Fabrication
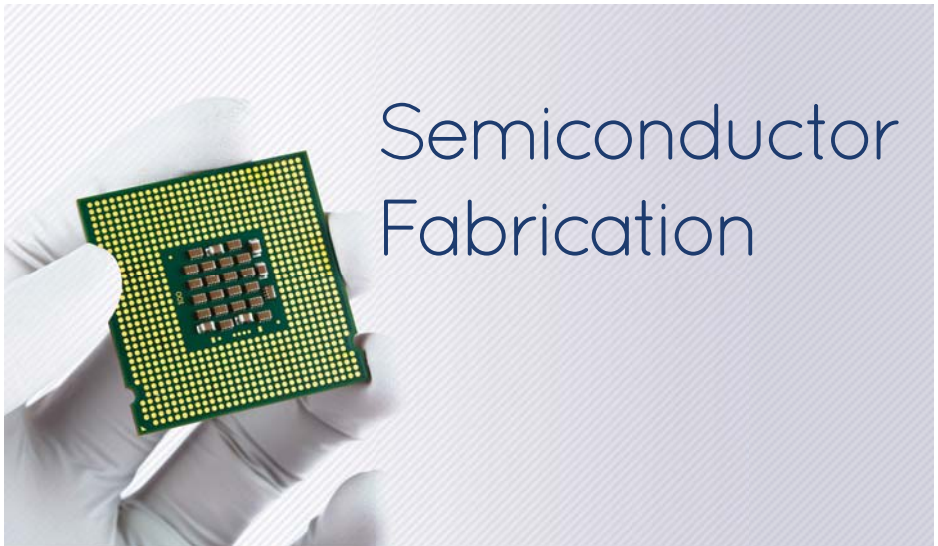
OVERVIEW

A leading manufacturer of semiconductor fabrication equipment needed a way to communicate with a large number of serial devices from an industrial computer running their process control software. This customer preferred using the computer's USB port, but required isolation to protect the computer from potentially harmful voltage spikes present in their manufacturing environment. Sealevel leveraged our expertise in USB and serial connectivity to design a custom, isolated USB to 16-port serial solution designed to the customer's specifications.

APPLICATION REQUIREMENTS

· 16 x RS-232 Serial Ports
· Isolated USB Connection
· Fast, Reliable Serial Communication on Multiple Ports Simultaneously
· 24VDC Power Input
· Private-labeled Appearance
· 1U, 19" Rackmount Enclosure

THE SEALEVEL SOLUTION

Relying on our extensive experience in USB serial solutions and custom chassis design, Sealevel delivered working prototypes meeting all functional requirements in only six weeks. The product was based on Sealevel's unique USB to serial technology that provides faster, more reliable communications than UART-based solutions. The upstream USB serial connection was isolated using a Complex Programmable Logic Device (CPLD) along with high-speed digital isolators to protect against voltage anomalies (including ground loops) that can occur in industrial environments.

KEY DESIGN CHALLENGE

MAXIMIZING DATA USB TO SERIAL THROUGHPUT

Achieving fast, error-free operation via USB on 16 serial ports simultaneously required an alternative electrical design to the traditional UART-based architecture found in most USB serial devices in order to eliminate the bottleneck between the microcontroller and the UART.

Sealevel's design coupled each serial port with a dedicated USB UART chip. This design offers throughput equivalent to connecting 16 single port USB serial adapters to the host and allows each serial port to run at maximum speed.

16 x RS-232 Serial Ports

Isolated USB

24VDC Power Input

SEALEVEL®
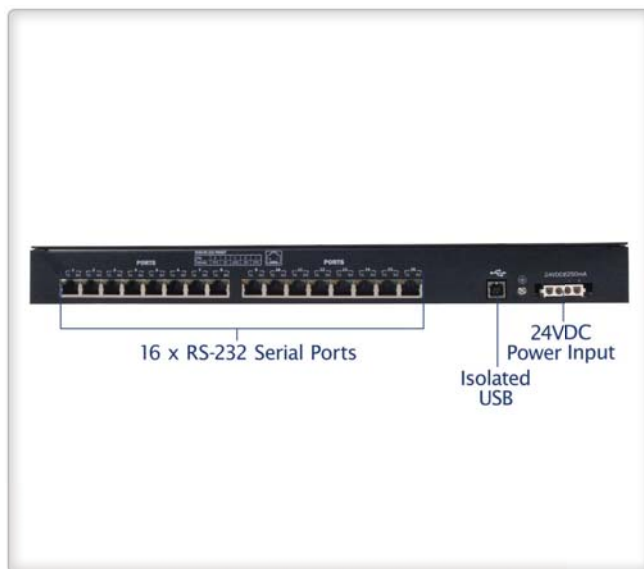
Remote Monitoring

OVERVIEW

Corporate branding is vital to the success of retail stores and hotels, and attractive signage is an important part of the brand message. A customer that designs lighted corporate signs for use on the exterior of buildings needed a way to remotely control and monitor their signs, so they approached Sealevel for a solution. A key goal was to provide an alert with failure data to a back-office server in the event of full or partial failure of a letter in the sign. Sealevel designed a custom embedded computer based on our Relio R9 platform to meet the 0°C – 70°C temperature range and facilitate the customer's unique I/O requirements.

APPLICATION REQUIREMENTS

· 12 Relay Outputs with Current Sensing
· 10/100 BaseT Ethernet
· Optional Wi-Fi (802.11)
· RS-485 for Secondary Unit Expansion
· 24VDC Power
· 0˚C – 70˚C Operating Temperature Range
· Customer Specific Remote Monitoring and Control Firmware

THE SEALEVEL SOLUTION

Using Sealevel's Relio R9 RISC-based embedded I/O server platform, Sealevel engineers created a custom system that met all of the customer's application requirements. The result was a small, embedded I/O server that monitors and controls outdoor LED signage through an Internet connection to a host control system. Since our customer lacked in-house software expertise, Sealevel's software team provided application-specific firmware that allows the embedded I/O server to operate autonomously to report failure data and respond to commands from the host.

KEY DESIGN CHALLENGE
DESIGNING AN I/O CIRCUIT FOR RELAY OUTPUT THAT SENSES CURRENT DRAW

A unique I/O circuit was required to allow remote control of the LED sign operation (off/on) and to monitor for failed or dimmed letters. Sealevel designed a hybrid input/output circuit that controls power to the sign through relays and also monitors the current supplied to the sign to determine if all letters are functioning properly. Because the current required for each letter varies due to size and shape, the circuit is designed to first "learn" the proper operational current of each letter of the sign from which a threshold of full or partial failure can be determined.

Ethernet   12 Relay Outputs with Current Sensing

RS-485 Expansion   24V Power
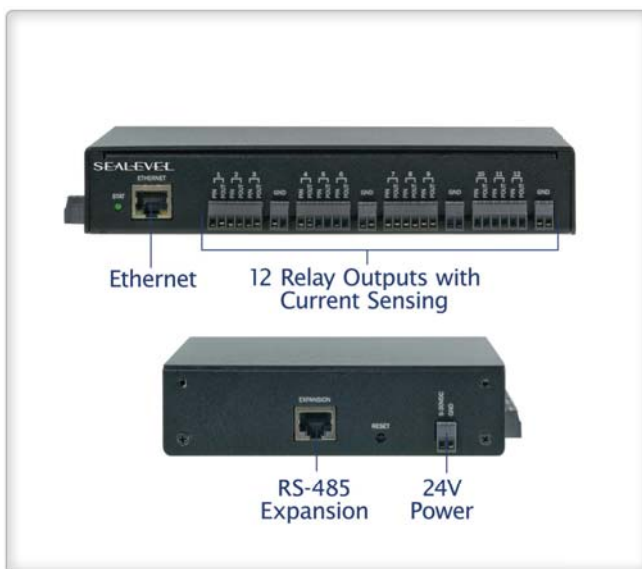
USB to Synchronous Adapter

OVERVIEW

The U.S. military uses several manufacturers for tactical radios that provide data communications and situational awareness on the battlefield, making it difficult to achieve interoperability from one radio to another. To solve this problem, Sealevel partnered with the Defense Information Systems Agency (DISA) to develop the ACC-188, a non-proprietary, interoperable USB synchronous interface that works seamlessly with DISA's PDA-184 tactical data communications software application.

The ACC-188 adapter and PDA-184 software enable PC compatible computers (mainly mobile devices) to connect to tactical radios to transmit and receive IP data such as email, text messages, GPS maps, images, coordinates, and other communications. Sealevel functions as the prime contractor for the Department of Defense for the ACC-188 and directly managed the project from initial design through manufacturing.

APPLICATION REQUIREMENTS

- USB Interface to Synchronous RS-232 (MIL-STD-188-184 Waveform)
- Data Rates to 76K bps
- Hot Swappable
- Low Power (<0.3W)
- Shielded to Protect from RF Interference
- Small and Lightweight for Easy Portability
- Resistant to Liquid, Dust, and Dirt

THE SEALEVEL SOLUTION

Sealevel designed a data cable with an integrated USB to synchronous serial converter that provided the fast throughput, low power, and small, rugged, mechanical design required for connecting a tactical radio to a computer's USB port. Based on a Field Programmable Gate Array (FPGA), the ACC-188 requires less than 0.3W of power, which is critical for field use with battery-powered devices. The electronics are encapsulated in an aluminum chassis with rubber overmold to reduce susceptibility to EMI and make the device as rugged as possible while maintaining a small size. Additionally, the mechanical design provides robust shielding to protect from the high-levels of electromagnetic interference (EMI) generated by the radios, eliminating a major flaw associated with other competing designs.

KEY DESIGN CHALLENGE
FAST, RELIABLE USB TO SYNCHRONOUS DATA CONVERSION

Sealevel's engineering team created an innovative design to implement the conversion from the tactical radio's high-speed synchronous serial connection to a standard USB interface compatible with any PC. The heart of the design is an 8-bit microcontroller with integrated USB port and an FPGA. The FPGA includes Transmit and Receive FIFOs for buffering the high-speed serial data to and from the radio for fast, reliable communications.

Aluminum Shell

Multi-Conductor Cable

Printed Circuit Board

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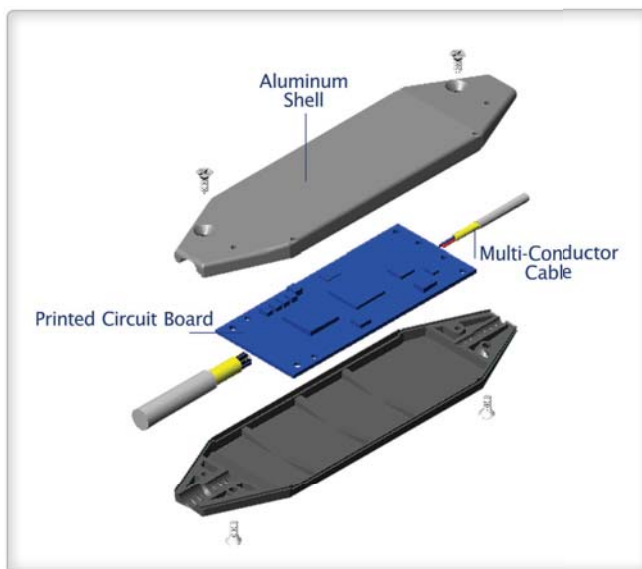
Process Temperature Maintenance

OVERVIEW

Certain process control applications require exposing electronics to harsh environments such as extreme temperature, vibration, water, or chemicals. Using a Human Machine Interface (HMI) in extreme temperatures can be problematic since most HMI's are based on TFT LCD's that cannot be operated without damage below 0˚C without a heating system. Sealevel worked with a customer that makes equipment and wiring for process heat maintenance on a requirement for a rugged, economical HMI that operated to -30˚C. Sealevel's engineering team overcame this challenge by designing an LCD-based HMI capable of operation below 0˚C without heaters.

APPLICATION REQUIREMENTS:

- 8.4" or 10.4" TFT LCD with Touchscreen
- Ethernet Connectivity
- Minimum 2 Open-Collector Outputs
- Minimum 2 Isolated RS-485 Ports
- Powered from 24VDC
- NEMA 4/IP65 Mounting Bezel
- Private Label Packaging
- Software Imaging for Production Systems

THE SEALEVEL SOLUTION

Since the use of Cold Cathode Fluorescent Lamp (CCFL) backlights results in the 0˚C minimum operating temperature limitation of most standard LCD's, Sealevel sourced an 8.4" TFT LCD that uses newly developed LED backlighting capable of power on at temperatures as low as -30˚C without decreasing the lifespan of the display. A customized version of Sealevel's wide temperature SBC-R9 board provides RISC computing under Windows CE 6.0 in a .NET environment. Now sold as a standard Sealevel product called SeaPAC R9, the system includes a machined aluminum front bezel that maintains NEMA 4/IP65 standards for protection from liquids.

KEY DESIGN CHALLENGE
INCORPORATING NEW LCD TECHNOLOGY INTO A RUGGED HMI DESIGN

The SeaPAC R9 design required a combination of electrical and mechanical expertise to interface the new LCD and resistive touchscreen. To exactly match the customer's I/O requirements, Sealevel created a new version of the Relio R9 industrial computer to provide the correct mix of I/O and the necessary metal assemblies to meet the NEMA 4/IP65 requirement. Custom length video and touchscreen cables were created for the system, and a watertight, attractive bezel assembly was designed for panel mounting. To establish the customer's unique brand identity, the bezel was customized with a color overlay that includes the name of the end product and our customer's logo.

SEALEVEL®

Rugged Laptop Docking Station

OVERVIEW

For the past decade, the U. S. military has used a ruggedized laptop made by a Sealevel customer for diagnostics and maintenance of vehicles and aircraft. Over this time, Sealevel has designed multiple cards for expanding the I/O capabilities of the laptop including MIL-1553, RS-485, Ethernet, USB, and digital I/O interfaces. The latest generation design requirements called for two versions of the laptop with identical functionality, but different sizes. Each system requires a docking station that allows the core mobile device to be lighter and more portable. The customer chose Sealevel to provide a turn-key solution for their dock station requirements, including design and production, in order to meet the stringent time and technical constraints for design and delivery of their new system.

APPLICATION REQUIREMENTS

· Optical Drive
· Modem
· Parallel Printer Port
· RS-232 Port
· Replaceable Battery with Smart Charge Circuitry
· 85-264VAC Power Input, 47-440Hz
· Cast Magnesium Enclosure
· MIL-STD for Shock, Vibration, Moisture, EMC, Radiated Emissions, and Safety

THE SEALEVEL SOLUTION

Sealevel managed the development of the dock designs and all compliance testing to meet an extensive list of MIL-STDs and other key requirements. Our electrical team designed six PCBs to accommodate the I/O requirements in the mechanical envelope available. The complex mechanical assemblies were created in SolidWorks through a collaborative effort between Sealevel, our customer, and the vendor selected to fabricate the tooling and produce the finished cast magnesium enclosure parts. Once prototypes were available, Sealevel test engineers conducted field and laboratory testing to guarantee compliance with the customer's specifications.

KEY DESIGN CHALLENGE
MEETING CRITICAL MILITARY ENVIRONMENTAL AND EMI SPECIFICATIONS

Sealevel's electrical and mechanical engineering team was challenged to design two complete, military-grade docking stations that met challenging packaging requirements and rigorous environmental and EMI compliance standards. The docking stations were designed and tested to an extensive list of required specifications including:

· Operating Temperature -18°C to 60°C
· Composite Wheeled Vehicle Vibration Profile
· Drop and Functional Shock
· Operating and Non-Operating Wind Driven Rain
· Conducted Emissions and Susceptibility

The challenge is as
satisfying as the solution.

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