Rugged Displays Suit Up for Challenging Environments

A number of design issues come into play when outfitting a display system for harsh environment applications. Complex tradeoffs drive the choices between tailored designs and standard integrated solutions.

By David Lippincott,Chassis Plans

Designing military computing systems for field deployment within potentially harsh environments presents a number of challenges. Among those are high and low ambient temperatures, dust, moisture, vibration, shock and the inevitable risk of abuse by users who are operating under pressure-packed conditions. These challenges can be especially difficult when designing the displays and keyboards that provide critical user interface functions and also are exposed to the greatest risk of damage. Rugged displays are engineered inside and out for the intended environment to survive natural and human-caused events. A rackmount display engineered for a controlled datacenter environment, for example, will not survive the rigors of the battlefield

For instance, an entire rackmount system with user interface might be packed into the back of a four-wheel-drive or tracked vehicle and subjected to jarring rides across a dusty desert to set up in remote locations dictated by the mission. Other systems may need to function within airborne or shipboard environments that present additional challenges of shock, ambient temperature swings, atmospheric pressure variations and/or exposure to moisture. In some situations, the systems need to be quickly booted up at remote sites or operational while on the move—like in a Humvee-based communications center, for example (Figure 1).

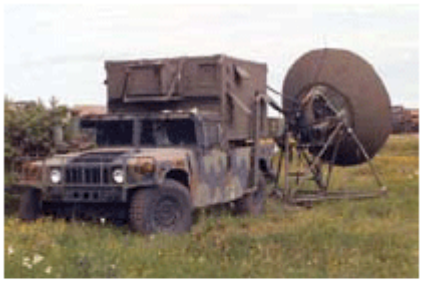

Figure 1

Many rugged display systems require the ability to be quickly booted up at remote sites or to be operational while on the move—like in this Humvee-based communications center, for example.

Even in relatively benign environments such as command centers, displays and keyboards need to be designed to withstand the “human factor” such as spilled coffee or water, which can cause a catastrophic failure for an unsealed keyboard assembly. The most carefully controlled command center

in the current combat arena is still a severe environment as compared to the worst civilian installation.

Integrated Approach

In any of these environments, it can be very helpful to have rackmount displays and keyboard assemblies that slide away into the rack, both to save space and to protect the display and keyboard when not in use. Integrating the keyboard and display together also allows for efficient, simplified servicing by providing a single field-replaceable unit that can be easily swapped out if necessary. Rack space can be expensive or not available so the thinnest 1U display/keyboard is often the only option.

A number of key environmental specifications and Mil-Spec standards should be kept in mind when designing a rackmount display/keyboard assembly for field deployments. These include:

- MIL-STD 187-1 (vibration)
- MIL-STD 901d Class A (shock, hammer and barge test)
- MIL-STD 810C (non-operating temperature)
- MIL-STD 810F (environmental testing, shock, vibration, humidity, blowing dust, rain, salt fog, temperature, thermal shock)
- MIL-STD 461D (EMI)
- MIL-STD 2036A (shipboard motion)
- MIL-HDBK 188 (communications systems design)
- NEMA-4 & IPC-65 (sealing for enclosure protection and user safety)

Although full compliance with all of the above standards may not be required for every application, designers should be familiar with these and other applicable specifications in order to meet required system survivability objectives while balancing overall cost and performance goals for equipment.

It is also important to address overall system design issues as they relate to the display. For example, LCD screens have a tendency to experience performance degradation (slower responsiveness) at low operating temperatures, so some system designs specifically provide for heating the display during operation. High-temperature operation typically presents an engineering challenge to manage heat in the enclosure and component temperature limits.

Other key application-specific considerations for displays include a variety of ambient lighting conditions and viewing angle, ranging from sunlight readability to darkened conditions using night-vision goggles. In addition, physical space is almost always at a premium in field deployment environments, with a growing demand for maximizing the screen space that can be leveraged into a 1U or 2U amount of rack space and/or fit into a ruggedized transit case. Battle conditions require more information to be presented to the war fighters. Screen resolution is directly related to available information so higher screen resolutions and sizes have become a prime consideration in system design. Trading off against larger displays is the requirement for transportability (weight) and installed depth for transit case applications.

Ruggedized Solutions

In many cases, system designers are turning to suppliers that can provide ruggedized display solutions, which can deliver the required performance and flexibility to be adapted for use in a wide range of operating conditions and functional requirements.

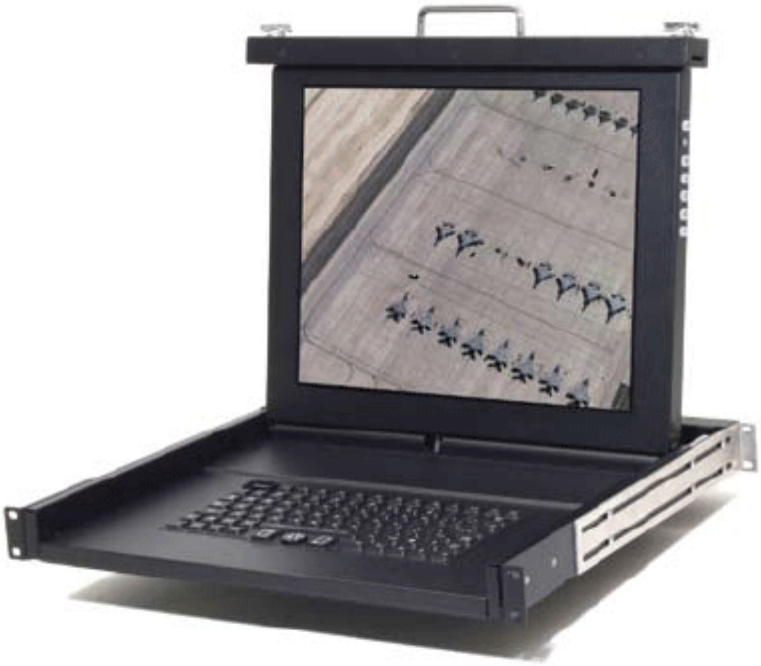

Figure 2

This integrated display/keyboard assembly from Chassis Plans starts with a NEMA-4-compliant, optically bonded and sealed 17" display with NEMA-4-compliant keyboard, which are integrated together in a short-depth clam-shell design, 1U high, primarily for transit case and vehicle installation.

For example, the integrated display/keyboard assembly in Figure 2 starts with a NEMA-4-compliant, optically bonded and sealed 17” display with NEMA-4-compliant keyboard, which are integrated together in a short-depth clam-shell design, 1U high, primarily for transit case and vehicle installation. An available option includes an optically bonded safety/filter glass for enhanced display protection and superior daylight viewability. Touch screens can also be provided depending on mission requirements.

Clam-Shell Design

The clam-shell design is held open with two high-torque hinges that provide stability for easily positioning the display at a variety of viewing angles for both static and moving vehicle operation. Rugged ball bearing slides and integrated mounting brackets allow the assembly to be easily secured into any standard 19” rack and provide quick setup for operation and/or storage for transport. The drawer is held closed by either a keyed cam-lock or optional thumb screws.

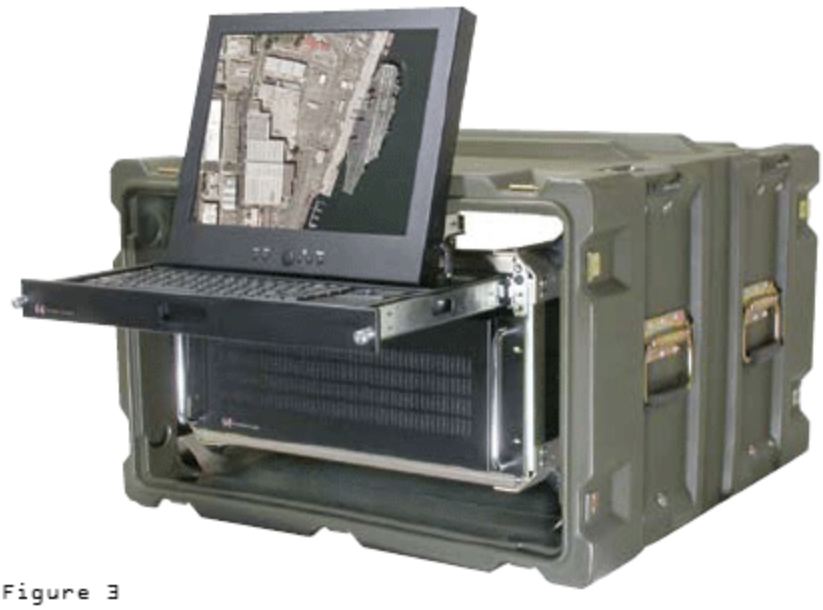

Figure 3

This system employs telescoping rear arms to extend the display up to 36 inches, and optional transit case arms allow the same basic unit to be adapted for compact transit case applications. The basic rackmount unit is only 17 inches deep and supports three different arm lengths. The short arms are used for the 17-inch depth and the telescoping long arms provide the 36-inch depth.

Telescoping rear arms provide the flexibility to extend the display up to 36 inches, and optional transit case arms (Figure 3) allow the same basic unit to be adapted for compact transit case applications. The basic rackmount unit is only 17 inches deep and has three different arms (short, regular and long). The short arms are used for the 17-inch depth and the telescoping long arms provide the 36-inch depth.

Designed for use in a variety of ambient light conditions, the SXGA 1280 x 1024 monitor provides high-contrast, sunlight viewability and low-light performance. The keyboard backlight also has five levels of adjustability, allowing for use with night goggles. Large On Screen Display (OSD) buttons and the pressure-sensitive keyboard pointing device accommodate easy operation, even if the user is wearing gloves or protective gear, and they are also watertight to protect the unit during usage in moisture and dust-intensive operating conditions.

Unique Challenges

While the fundamental issues of ruggedized display design apply across a wide range of applications and operating environments, every application presents a unique mix of specific implementation challenges. The demands of diverse mission-critical programs cannot be handled by a simplistic “one-size-fits-all” approach; nor is it practical to mount a new “from-the-ground-up” design for each new application. The most cost-effective solution is to select both product solutions and vendor relationships that can span a wide range of requirements and support custom-tailoring wherever needed.

Ultimately, the overall goal of any ruggedized system design is to leverage core engineering expertise and product features, while combining optimal performance, reliability and survivability within acceptable cost parameters. By starting with a ruggedized display/keyboard assembly that is designed to meet the key MIL-STD and NEMA requirements while providing a high level of adaptability and

configurability, system designs can tailor the specific design to meet both their environmental and budgetary objectives.

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