



CDS TECHNICAL GUIDE

The Evolution of Embedded Panel PC's

Introduction

Embedded Panel PCs have become a core component in modern industrial automation, transportation, medical equipment, building management, and intelligent retail systems. Their evolution has been driven by the convergence of processing, display, networking, and control technologies into a single integrated platform.

Engineers now expect embedded Panel PCs to provide not only computational capability, but also advanced graphics performance, multi-touch interactivity, environmental robustness, and long-term availability. This guide offers an engineering-focused narrative on the development, architecture, performance characteristics, and system-integration considerations of modern Panel PCs supplied by Crystal Display Systems Limited (CDS).

Technology Overview: From Simple Terminals to Intelligent Nodes

The first generation of Panel PCs emerged as basic operator terminals, using resistive touch sensors and low-power microprocessors. These early designs offered limited graphics capability and supported only simple HMI tasks such as parameter entry, system monitoring, and alarm notification.

As demand grew for more sophisticated interfaces, the architecture of Panel PCs began to incorporate:

- Higher-resolution TFT LCD panels
- Projected capacitive (PCAP) multi-touch
- Embedded x86 and ARM processors
- Industrial I/O such as RS-485, CANbus, and GPIO
- Operating systems including Windows Embedded, Linux, and Android

Today's embedded Panel PCs function as autonomous computing modules capable of running full SCADA, machine-vision, and IoT-edge workloads. CDS provides Panel PCs across a spectrum of form factors, processor classes, and environmental ratings to meet industrial integration requirements.

Core Architectural Elements of Modern Embedded Panel PCs

1. Display Subsystem

The embedded display defines the visual performance of the Panel PC. CDS offers:

- IPS TFT LCDs with wide 80°/80°/80°/80° viewing angles
- Resolutions from 800×480 up to Full HD and 4K
- High-brightness options up to 3000 cd/m²
- Optical bonding for improved readability

2. Processing Core

Panel PCs commonly use one of two processor families:

- ARM Cortex-A series for low-power and Android/Linux applications
- Intel Atom, Celeron, i3/i5 for Windows or high-load automation applications

Processing selection impacts system performance, thermal design, OS compatibility, and longevity.

3. Touch Interface

CDS primarily integrates:

- Projected capacitive (PCAP) touch with glove and water-rejection modes
- Resistive 5-wire touch for legacy environments

4. I/O and Connectivity

Embedded Panel PCs include:

- USB 2.0/3.0
- Ethernet 1–2 GbE ports
- RS-232/422/485
- CANbus (on selected models)
- Digital I/O
- Expansion via mini-PCIe, M.2, or GPIO

5. Storage and Memory

Typical configurations:

- 2–16 GB RAM
- 16–256 GB SSD/eMMC storage

6. Power and Thermal Design

Panel PCs operate from 9–36 VDC industrial power and incorporate fanless cooling strategies using aluminium housings and thermal conduction paths.

Technical Specifications

Engineers evaluating Panel PCs must review the following parameters:

Display

- Size range: 7"–32"
- Typical resolution: 1280×800, 1920×1080
- Brightness: 350–1500 cd/m² (HB versions up to 3000 cd/m²)
- Touch: PCAP or resistive

Processor Performance

ARM Platforms:

- Low power consumption
- Suitable for lightweight HMI/IoT

Intel Platforms:

- Higher compute capability
- Virtualisation and Windows compatibility
- Wider peripheral support

Environmental Ratings

- Operating temperature: $-20\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ (model dependent)
- IP65/IP67 front bezel options
- Vibration resistance: 2G–5G depending on model

Power

- Input voltage: 9–36 VDC
- Power consumption varies with processor and brightness

IO Interfaces

- LVDS/eDP (internal)
- HDMI or DisplayPort (external, depending on model)
- Serial COM ports with isolation options

Application Scenarios and Industry Use Cases

Industrial Automation

Panel PCs now serve as edge-compute nodes in smart factories. Their wide temperature range, sealed front bezels, and integrated PCAP touch allow reliable operation in dusty, humid, or vibration-prone environments.

Use cases:

- PLC/HMI workstations
- SCADA terminals
- Production dashboards
- Machine-vision interface screens

Transportation and Fleet Management

Ruggedised Panel PCs are used in:

- Bus and rail passenger information systems
- Ticketing kiosks
- Driver terminals
- Vehicle telematics systems

Key requirements:

- Shock-resistant housing
- High brightness for outdoor visibility
- EN50155 compliance for rail environments

Retail and Public Information**Panel PCs function as:**

- Retail media signage
- Interactive kiosks
- POS terminals
- Smart vending interfaces

Touch accuracy, durability, and low maintenance are essential for public use.

Healthcare and Laboratory Systems**CDS Panel PCs are used in:**

- Patient monitoring
- Diagnostic equipment
- Sterile operating environments

Optical bonding and anti-microbial glass options enhance performance in clinical lighting conditions.

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Marine and Military Applications**Applications include:**

- Navigation terminals
- Engine-room displays
- Tactical computing systems

These require extended temperature ranges, sunlight readability, and corrosion-resistant materials.

Integration Guidelines

Mechanical Integration

Engineers must:

1. Verify mounting method (panel mount, VESA, open-frame).
2. Ensure enclosure tolerances match Panel PC bezel dimensions.
3. Provide adequate rear clearance for connectors and airflow paths.

Electronic Integration

1. Ensure stable 9–36 VDC input with minimal ripple.
2. Use shielded cables for RS-485 and CAN bus to minimise EMI.
3. Connect grounding points according to the installation manual.

Thermal Considerations

Fanless Panel PCs dissipate heat through conduction. System integrators should:

- Avoid enclosing the device tightly without airflow
- Provide thermal paths via metal brackets
- Consider ambient temperature in high-brightness models

Touchscreen Integration

PCAP touch requires:

- Proper grounding
- EMI/noise reduction in enclosure design
- Avoidance of excessively thick cover materials that decrease touch sensitivity

Software and OS Deployment

CDS Panel PCs support:

- Windows 10/11 IoT
- Linux Ubuntu/Debian
- Android (ARM models)

Engineers must validate:

- Driver compatibility
- Peripheral support via COM/USB
- Runtime environment requirements

Networking and IoT Integration

Panel PCs are often integrated as IoT gateways. Recommendations:

- Use dual Ethernet for network segmentation
- Enable secure protocols (TLS, SSH)
- Configure watchdog timers for autonomous recovery

<https://crystal-display.com/products/industrial-panel-pcs/>

Troubleshooting Considerations

No Boot or Black Screen

- Verify correct DC voltage input
- Check power-on timing requirements
- Inspect BIOS/UEFI settings (Intel models)

Touch Not Responding

- Recalibrate via OS tools
- Verify firmware version
- Check grounding integrity

Overheating

- Inspect installation environment
- Reduce LCD brightness
- Add thermal conduction pads if the enclosure design allows

Interface Communication Errors

- Verify COM port settings (baud rate, parity)
- Use shielded cables for long RS-485 runs
- Validate USB power availability for peripherals

Conclusion

Embedded Panel PCs have evolved from basic operator terminals into powerful, multifunctional intelligent systems capable of running complex industrial, commercial, and mission-critical workloads. As this guide demonstrates, modern Panel PCs require careful evaluation of display performance, processor selection, environmental characteristics, and integration constraints.

Crystal Display Systems Limited offers a comprehensive portfolio of industrial-grade Panel PCs, with customisation options for touch technology, brightness, environmental sealing, and processing performance. For technical datasheets, engineering consultation, or further specification support, visit www.crystal-display.com or contact the CDS technical team.

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Want More Information? Contact Us Now

Need any additional information?

If you need any assistance with pricing information, technical support or require any additional information our team would be more than happy to assist



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