# More Than Just CPU Performance—Criteria for Choosing an x86-based Embedded Computer

*Bruce Chen, Project Supervisor, Marketing Communications*
*Fion Lu, Specialist, Marketing Communications*
*support@moxa.com*

## Introduction

x86 is a CISC-based structure that is widely used in embedded computers today. Unlike RISC-based computers, which are designed for specific industrial applications and minimize power consumption, x86-based computers are often used to perform more complicated tasks in a greater variety of industrial applications. Many users choose their x86-based computers based simply on hardware specifications (such as CPU and memory) and system performance. However, to meet the demands required for different industrial applications, it is best to choose an x86-based computer with features tailored to the specific application that also works well as a reliable front-end control unit. As a result, selecting the best x86-based embedded computer for your industrial applications is a bit more complicated. This white paper explains the different factors users need to consider when choosing an optimal x86-based embedded computer for various industrial applications.

### 1. Wide Temperature

When x86-based computers are required to perform more complicated industrial tasks or used in harsh environments, it is crucial to choose computers that support wide operating

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Moxa manufactures one of the world's leading brands of device networking solutions. Products include industrial embedded computers, industrial Ethernet switches, serial device servers, multiport serial boards, embedded device servers, and remote I/O solutions. Our products are key components of many networking applications, including industrial automation, manufacturing, POS, and medical treatment facilities.

**How to contact Moxa**
Tel: 1-714-528-6777
Fax: 1-714-528-6778
Web: www.moxa.com
Email: info@moxa.com

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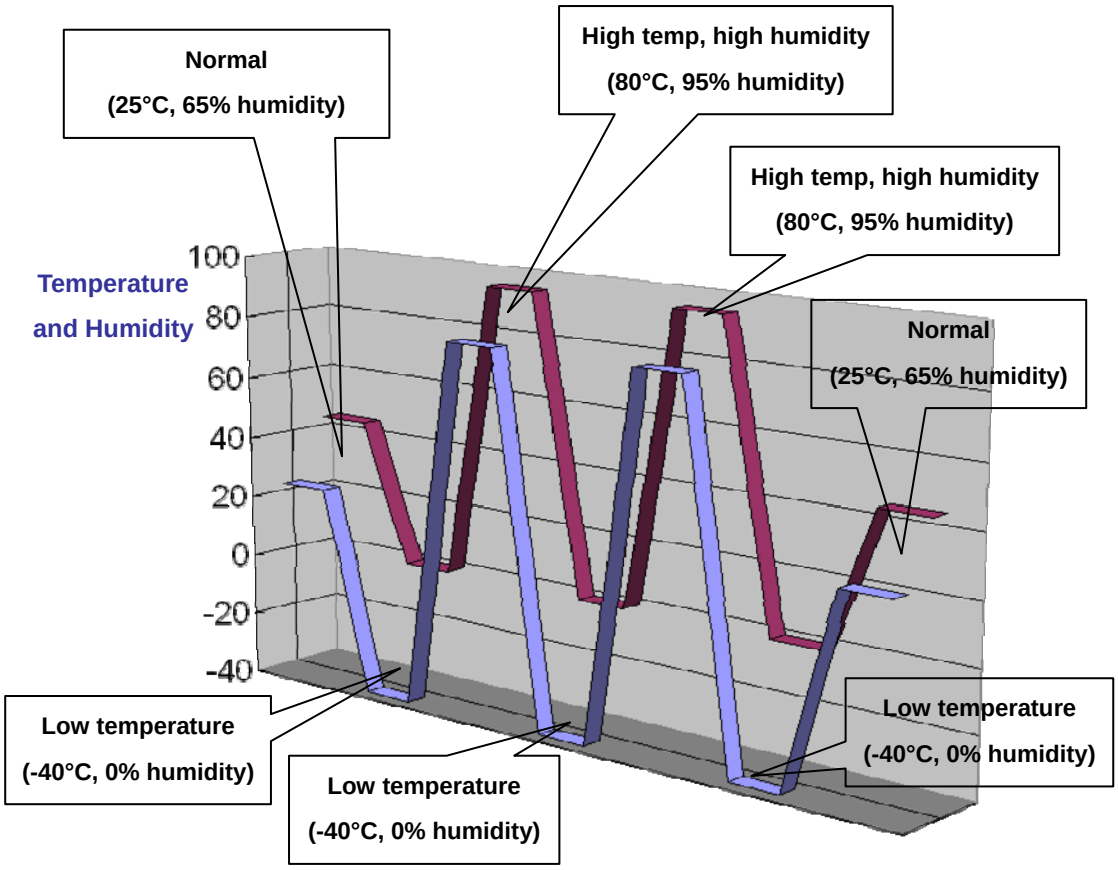
temperature. To reduce both power consumption and heat, x86-based computers require a precise hardware design. However, it can be very challenging for hardware designers to build a structure that can perform complex industrial tasks without generating too much heat at the same time.

Hardware engineers use several cooling methods to control the temperature inside an embedded system where the CPU must perform complicated tasks simultaneously. These methods include installing an optimal hardware layout design, efficient heat sinks, or heat pipes to facilitate heat dissipation out of the computer. Using dynamic BIOS throttling efficiently cools the system down but also lowers system performance at the same time. Whichever method is used, the ultimate goal is to keep the system cool while improving performance for industrial applications.

However, the more effort hardware engineers invest in improving an embedded computer's cooling system, the more challenging it is to make it suitable for cold temperatures at the same time. Incorporating a self-warming system provides an efficient solution to keep an embedded computer warm when the temperature is too cold.

**Extreme Temperatures from -40 to 75°C**

All Moxa's embedded computers have passed a 120-hour uninterrupted burn-in and on-off test to guarantee stable operation under harsh environments and extreme temperatures from -40 to 75°C.




## 2. Diverse Peripherals

As x86-based computers are often required to perform sophisticated industrial tasks, support for diverse peripheral devices is an important consideration. The most common way to interface multiple peripherals, especially in industrial applications that still rely on legacy equipment, is via serial communication.

### 2.1 Serial Communication

The RS-232/422/485 interface is still the most common communication protocol for industrial data acquisition and transmission. One of the principal challenges programmers face when dealing with serial communication is preventing data loss during data transmission. To solve this problem, Moxa's patented ADDC technology guarantees reliable RS-485 data communication. Its unique wide serial baudrate supports

non-standard baudrates and transmissions from 50 bps to 921.6 Kbps.

## Moxa's Patented Flow Control Technology: Automatic Data Direction Control

When using RS-485 two-wire communication, one of the most important factors to determine is when to switch the transmitter on and off. Because of the restrictions imposed by the RS-485 interface, only 1 node (on an RS-485 2-wire bus) can switch its transmitter on at any given time. A node must switch its transmitter on in order to send data, and then switch it off after the last data bit has been sent.

- There are 2 ways to switch a transmitter on and off:
  1. Use the RTS signal to control the transmitter "manually by software."
  2. Use ADDC (Automatic Data Direction Control).
- ADDC switches the transmitter on and off "precisely by hardware," effectively simplifying the complexity of timing control by software.

### 2.2 Ethernet Ports (Switch Ports and LAN Ports)

As TCP and IP have become standard protocols in network communication, all x86-based computers are equipped with Ethernet ports for device communication. However, only computers with multiple Ethernet ports (switch ports and LAN ports) support redundancy to ensure network reliability and continuous operation.

### 2.3 DI/DO/AI/AO

DI, DO, AI, and AO interfaces are commonly used in the security and environmental monitoring markets. An x86-based computer can serve as an ideal control unit if embedded with these interfaces.

### 2.4 CAN Ports

CAN-bus interface is also a common protocol used in industrial automation for devices running CAN open protocol.

### 2.5 Expansion Slots

An x86-based computer requires a large capacity for data storage and processing. The most commonly used memory expansion interfaces include SD, USB, and additional HDD sockets. Choosing an x86-based computer that supports these features makes it easier for you to upgrade your storage capacity.

### 2.6 Modular Flexibility

As requirements for industrial applications vary according to the task and field site conditions, a flexible design that can accommodate different applications is the optimal solution. For example, some field sites may require more serial ports and can benefit from a multiple serial port expansion module. Other users may need additional Ethernet-based devices that can be used at the field site; a multiple LAN port expansion module offers the most cost-effective interface expansion method.

The modular flexibility of Moxa's DA-682 embedded computer provides 5 peripheral modules for selection, including a Universal PCI expansion adaptor for additional peripherals.


## 3. Specific Certifications for Industrial Markets

Industrial applications generally require specific certifications to ensure safety and compliance with industry standards and regulations. When choosing an x86-based computer, make sure you have taken these industry-specific certifications into consideration. For example, the power automation market often requires IEC 61850-3 certification to ensure full protection for device I/O signals. Meanwhile, DNV certification

is required for x86-based computers used in marine applications.

## Summary

Considering all the different factors affecting reliable and efficient operation in industrial applications, choosing the ideal x86-based embedded computer can be a daunting task. By incorporating these simple guidelines into your selection process, you will not only save yourself initial headache but nip potential problems in the bud. So the next time you're in the market for an x86-based computer, be sure to consider the following:

1. Wide operating temperature from -40 to 75°C
2. Support for various peripheral communication interfaces including serial ports, Ethernet ports, DI/DO/AI/AO channels, CAN ports, and expansion slots
3. Modular design for flexible deployment to meet different application demands
4. Certifications for specific markets, such as IEC 61850-3 for power automation and DNV for maritime applications