Foreword

One of China’s basic state policies is to drive economic and social transformation by following a new path of industrialization boosted by information technology (IT). Industrialization, the process in which a country transforms itself from a primarily agricultural society into one based on the manufacturing of goods and services, was reinforced by the decisions made at the 17th National Congress of the Communist Party Congress (CPC). The Congress emphasized the need to accelerate the integration of next-generation IT and industrialization in order to:

- Achieve comprehensive integration;
- Develop integrated IT applications in a variety of sectors;
- Increase the level of IT applications in R&D, design, production, equipment, and operation management;
- Quickly upgrade traditional industries using leading-edge technologies to improve the quality and efficiency of industrial growth;
- Complete the shift to an industrial power.

As the point where IT and industrialization meet, computer control systems play a critical role in supporting China’s efforts to explore new ways of industrialization across many industries, and in doing so, strengthen the country. This is also reflected in the policies formulated by the State Council and a number of ministries. For example, the 12th Five-Year Plan for National Economic and Social Development of the People’s Republic China passed in 2011 requires that “great efforts should be made to help the growth of strategic, emerging industries such as energy conservation and environmental protection, next-generation IT, biotechnology, high-end equipment manufacturing, new energy sources, new materials, and alternative fuel vehicles”. Likewise in 2012, the State Council stated that the manufacturing equipment industry should focus on intelligent equipment that provides functions such as perception, decision-making, and execution, and makes breakthroughs in perception and control devices. This includes developing new types of sensors, smart instruments and meters, automatic control systems, and industrial robots, along with the associated key technologies like servo, execution, and drive parts. This focus will allow China to embrace a new round of industrial evolution and attain new heights of global-economic, scientific, and technological accomplishments.

Intel® Atom™ platform provides an innovative architecture for smart industry-specific applications

Nearly every sector is exploring the ways to improve productivity using smart technologies and many companies are seeking secure, high-performance and minimum-power options that boost operating efficiency through effective production monitoring and management. Therefore, Intel has introduced its Atom™ processor E3800 family that provides industry-specific smart application development with SoC solutions featuring high stability and reliability through scalable hardware and software modules.

The Intel® Atom™ processor E3800 product family, as the first system-on-chip (SoC) designed for intelligent systems, delivers outstanding computing, graphical, and media performance while operating in an extended range of thermal conditions. These SoCs based on the Silvermont microarchitecture utilize the industry-leading 22nm process technology with 3-D Tri-Gate transistors, integrate higher energy efficiency CPUs and faster graphics cards, feature built-in security capabilities and deliver significant improvements in computational performance and energy efficiency.

Figure 1. Features of the Intel® Atom™ Processor E3800 Product Family
Based on pipeline architecture, the Intel Atom processor E3800 product family (Figure 1) provides the following features and benefits:

• Enhanced graphics: delivers fast, high-definition (HD) video and other medium conversions, 3D functions, and vivid web browsing;
• Powerful storage operations: uses the processor’s integrated memory controller with error correcting code to maintain a high level of data integrity, reliability, and system uptime that is necessary for plant equipment (usually operating 24/7);
• Data and operational security: guarantees endpoint security, protects content, and ensures that only authorized software is able to run on the device through auxiliary hardware functions, such as Intel® AES New Instructions (Intel® AES-NI) and secure boot.

The Intel Atom processor E3800 product family has exceptional performance within a thermal design power (TDP) range of just 5W to 10W, making it ideal for industrial control systems and enabling business users to develop, construct, and deploy applications faster, which enables them to focus on creating new value-added services.

**EMA* aids in making industrial control and operations smarter**

Founded in 2008, EMA* is committed to R&D and services development in order to provide customers with a wide range of smart, innovative products and solutions. The company’s focus on smart buildings, smart industries, and smart embedded products has created a powerful network of technical services and marketing, including industry leaders such as Intel. In doing so, EMA has become the product and technical service provider for a large number of major vendors at home and abroad. With a belief in the perfect combination of science and arts for its products, EMA aims to become the most influential global player in the evolution of smart cities and the Internet of Things (IoT).

EMA has three divisions, one of which includes the Smart Industries and Services division that produces computer numerical control (CNC) systems, servo drives, intelligent manufacturing systems, industrial robot control systems, and machine vision control systems. Powered by core technologies, the division is able to customize factory automation systems quickly for customers. The intelligent embedded division provides customers with leading embedded core modules, boards, systems, peripherals, and innovative embedded software. The company strives to help customers reduce costs and achieve faster time to market of new products with advanced embedded technologies and services.

By leveraging the company’s great experience in supplying smart industrial control and IT applications in the manufacturing sector, promoting vigorous innovation, and partnering with global leaders in the IT industry, EMA’s three divisions provide systematic, professional services for IT applications in factories and smart production control in a variety of industries and fields.

**About ECNC**

The EMA Computer Numerical Control System* (ECNC*) is a high-performance, high-stability industrial control system launched by EMA based on its years of R&D innovations in industrial control technologies. As an innovative CNC system platform, the ECNC provides a high degree of hardware and software. It enables customized product solutions for robot control systems and industrial automation control systems to meet customer requirements.

**Figure 2. ECNC* Hardware Assembly**

The ECNC hardware platform, shown in Figure 2, employs an advanced open architecture based on a power-efficient, high-performance, 64-bit CPU from the Intel Atom processor E3800 product family. Equipped with an embedded industrial control board, a fanless sealed case with enhanced oil and dust resistance, and I/O interfaces for high-speed serial communication, the platform provides six-axis control (up to 32 axes), visual locating, 3D display, and intelligent loading and unloading. Delivering high-performance and high reliability in a compact structure, it is well-suited for industrial applications such as glass engraving, processing centers, and industrial robot control. Figure 3 shows the key interfaces of the ECNC hardware platform.
The ECNC employs the Linux* operating system, which has been enhanced to satisfy the real time requirements of delay-critical, numerical control (NC) interpolation. It offers high stability and high scalability by supporting a 1 millisecond interpolation period and 0.0001 mm of system resolution. The major elements of the ENC software platform are shown in Figure 4.
White Paper for EMA Computer
Number Control System
ECNC Helps China in Its
New Industrialization

**ECNC’s benefits include:**

- Industrial-grade design: embedded industrial motherboard based on industrial versions of the Intel Atom processor E3800 product family and solid state drives (SSDs);
- Sealed case: effectively resists oil and water stains, extending the service life of the product and enhancing its stability;
- A variety of interfaces: 4x USB/1x VGA/2x NET/1x RS232;
- Powerful motion control: highly-efficient, adaptive prospective algorithm, highly-reliable S-type acceleration and deceleration algorithm, and highly-smooth quintic interpolation algorithm;
- Control mode: Maximum rate of 6 Mbps impulse output;
- Easy wiring and expansion for high-speed serial communication;
- Standard I/O configuration, 28 inputs/14 outputs (scalable to 128 inputs/64 outputs), and two independent brake inputs/outputs;
- 3D graphic display, powerful functions, and easy-to-use interface;
- High scalability: for I/O, multivariate analysis (MVA), and automatic loading and unloading

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**Typical application case: ECNC**

**key features help boost customer productivity**

The 64-bit Intel Atom processor E3800 product family reduced the execution time of the ECNC’s motion algorithm from 260 microseconds (µs) to 140 µs, allowing the system to do more computing in the same control cycle, thereby boosting reliability and efficiency. Furthermore, the CPU consumes less power and enables a fanless, sealed-case design, which improves ECNC’s mean time before failures (MTBF) and ensures operation reliability in adverse factory conditions with heavy oil and water stains.

Before the redesign of the ECNC, it used to take a glass engraving and milling machine client 126 seconds to process the cover glass for a mobile phone. After the system was improved by adding a smart prospective algorithm and by intelligently controlling the acceleration of the fast move and cutting functions with quintic interpolation, the process time was cut to 111 seconds, a 12.9 percent productivity improvement.

Using the latest processors based on innovative Intel® architecture, the ECNC helps pave the way for smart industrial control systems. It will supplant low-integration, high-cost systems with traditional CNC, robot control, and industrial automation, thus ushering in a new era of smart control for the whole industry and the manufacturing sector, and contributing to China’s new industrialization.

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