**Product Highlights**
- Triple Modular Redundancy
- Family of Fault-Tolerant Control Systems
- High-Integrity Validation

**High-Integrity Control System Overview**

The unique RTP High-Integrity Control System (HICS) protects your process as well as providing continuous access to process data with a combination of multiple levels of redundancy and data validation that can be configured to meet your precise requirements.

**Triple Modular Redundancy:** For mission-critical processes and applications, there is no substitute for Triple Modular Redundancy (TMR). Following this philosophy, RTP has developed a high integrity control system with TMR architecture specifically for process control. Data validity checking routines ensure your process is protected and downtime eliminated.

The RTP approach provides added design flexibility compared to traditional TMR systems. Where past TMR systems were limited by their dependence on hardware interconnections between processors to maintain adequate synchronization and local I/O, RTP has applied advanced communications technologies and a fast, Ethernet-based I/O bus. As a result, the three controllers that comprise an RTP TMR system can be housed separately to ensure survivability in a catastrophe such as a fire. I/O chassis can be located remotely eliminating the high cost and complexity of long field wiring to the controllers. To further protect data availability, chassis with dual power supplies can be used at both the processor and the I/O levels.

**High-Integrity Validation:** Redundancy protects against hardware failure to ensure high system availability, but what about error checking? An RTP HICS is perfectly suited for high-integrity, fault tolerant applications. The CPUs are validated to ensure proper CPU performance, memory integrity and calculation integrity. Communications are validated using advanced built-in CRC routines on both the host and the I/O communications bus. Its high-integrity chassis controllers validate system information to ensure error-free performance, while providing the assurance of hardware availability.

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**RTP2300 High-Integrity Control System**

Error checking on the bus (I/O chassis backplane) ensures no corruption of data going to, or from, the CPU. On the card level, the line (field wiring) is supervised to ensure continuity to the field, plus on-board diagnostics perform read-back of outputs and even calibration checks on the A/D converters! For critical operations, such as program changes, special routines check and recheck the program validity. Lastly, in TMR configurations, outputs from all three processors are sent to the I/O chassis, where the data validation occurs, as close to the process as possible.

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**Tired of the rest – try the best!**

RTP NetSuite includes all the tools you will ever need to design, simulate, test, integrate, and maintain your industrial control applications. Following the IEC 61131 standard, NetSuite is a fully integrated software workbench that dramatically reduces the time it takes to develop, deploy, commission and maintain your control application.

RTP engineers each NetSuite module so it works together seamlessly as a single solution: the powerful, networked RTPView HMI; NetArrays graphical configurator; data archives; alarms; trending; and global tag management database—all interact seamlessly. NetArrays includes advanced controls (e.g. Fuzzy Logic, robust PID control blocks) and powerful online commissioning tools. Favorite application or custom software? NetSuite includes an OPC server for a common interface to diverse process control applications.

RTP’s Hassle-Free Software Policy provides an unrestricted site license with free upgrades for a one-time registration fee, no maintenance fees, regardless of tag count or number of seats. Contact RTP at [www.RTPCorp.com](http://www.RTPCorp.com) for your free demonstration CD-ROM.
HICS Architecture

The RTP HICS architecture is based upon a family of control systems that combine peer-to-peer communications, a common chassis design and the powerful RTP NetSuite monitoring and control software.

- **RTP2300T**: For the highest level of integrity and availability, the RTP2300T Triple Modular Redundant system features data validation and communications validation with triple, dual or common I/O, to provide the level of redundancy required for the most economical cost.

- **RTP2300D**: Built on the same advanced technology as RTP2300T for a dual-redundant solution. The high-integrity dual-redundant solution uses advanced diagnostics to assist in results adjudication. The RTP2300D features dual-redundant processors, triple, dual or common I/O as required, and up to 32 remote I/O chassis, all built upon the same components and configuration environment (RTP NetSuite) as the RTP2300T. Both the RTP2300T and RTP2300D support a medium to large, distributed control system architecture of up to 10,000 I/O points per node.

- **Micro2000 Series**: For smaller systems, the Micro2000D Series HICS provides a high-integrity solution using dual processors and dual I/O. The Micro2000D Series uses a subset of the same components as the RTP2300T and RTP NetSuite software.

- **RTP NetSuite software**: PC-based control and monitoring software for control logic, archiving, alarming, trending and HMI, a central tag database; PC-based simulation and OPC and DDE servers. Requires no keys or licenses. Powerful RTPView HMI and SCADA system software included with every copy of NetSuite.

RTP Family of High-Integrity Systems

**RTP2300T HICS**

The RTP2300T HICS is a TMR system that supports any combination of triple-redundant, dual-redundant and single I/O, in up to a total of 32 I/O chassis. It includes three RTP2300 processors; factory-configured for TMR, in three physically separate chassis (target nodes).

**Target Node**: Each RTP2300T Target Node is hosted in one of an available 32 I/O chassis. The Target Node consists of an embedded controller, common communications card...
Unique to RTP is the use of separate processor modules to achieve unparalleled system flexibility and performance. The RTP2300 embedded controller is responsible for all system functions with the exception of I/O scanning and voting. Each I/O chassis, including the chassis that hosts the RTP2300 controller, has a Communications Card (CCC) that executes the I/O scanning, floating point conversion, and results voting. RTP has chosen to place results voting at the I/O chassis to minimize the opportunity for data corruption and maximize system response, which is so critical in process control. This design allows RTP to take advantage of an advanced multi-processor (up to 99 processors in a 32-chassis system) parallel processing architecture in a truly distributed fashion unlike prior generation TMR systems.

The standard RTP2300T chassis can accommodate up to 16 hot-swappable analog, digital and special function I/O cards. The optional dual-powered chassis can accommodate 12 I/O cards.

**Embedded Controller:** The Intel-architecture embedded controller includes nonvolatile (disk-on-chip) memory, which contains the Target Node’s real-time run-time executive (Viking Engine) and the downloaded control application. Upon power-up or reset, the embedded controller initialization routines copy the contents from the disk-on-chip memory into its executable RAM before entering its run state.

The embedded controller utilizes advanced technology such as parallel processing, math co-processors and synchronous DMA mode support, resulting in high-speed logic solving while simultaneously performing error checking and validation, I/O calls, peer-to-peer communications and communicating with the SCADA/HMI operator stations. All I/O values are reported with each scan to provide a higher level of integrity than report by exception routines. Peer-to-Peer communications report by exception to reduce network traffic; however, the user can define refresh time intervals where all peer variables are reported. This allows the user to manage network integrity by balancing network traffic and data integrity.

The embedded controllers contain a total of four Ethernet processors that are factory-configured to support secure high-speed communications, such as host, interprocessor and I/O bus networking. Each communications port is truly redundant all the way to the processor. If a communications interface fails, the network interface will use another one of the multiple paths available. Additionally, RTP built advanced error-checking routines into the host, interprocessor and I/O bus structure, ensuring secure and accurate communications.

The I/O bus incorporates the latest, direct-connect Ethernet network topology (shown in the diagram). This ensures that private, dedicated lines carry all field connections—ensuring secure transmissions with the convenience of standard Ethernet connectivity. Multiple I/O chassis can be placed throughout the plant, close to field devices. The benefits of this approach are reduced field wiring and installation costs, the utilization of fiber optic isolation, and a truly distributed architecture.

**TMR Data Integrity:** The RTP2300T is factory-configured for TMR application to support two-out-of-three output data voting that ensures the highest levels of integrity and availability. Each RTP2300T target node solves the logic and sends the resultant outputs to the associated I/O chassis. Within the I/O chassis, the CCC processor performs data validation checking prior to driving the outputs. Each I/O chassis performs an independent two-out-of-three voting for its associated outputs. Therefore, if the system's outputs are located in multiple I/O chassis, the voting is distributed over these chassis.

Distributed voting, performed as close as possible to the process, enhances integrity by moving potential fault variables out of the response. Furthermore, results voting at the I/O chassis level results in a much more responsive, high-speed system. High-speed processing means more data adjudications per second, resulting in higher resolution and greater integrity.

Results deviations are recorded as “soft” errors, or faults, and will not lead to a controller shutdown. This fault-tolerant capability allows for continued TMR system operation during spurious “soft” errors, while protecting the process. If any deviation in hardware or network operation is detected, the operator is notified immediately and the offending controller is taken offline. Meanwhile, the application continues to run unaffected on the remaining two controllers. While this is an abnormal state for the RTP2300T, the system now performs as a dual-redundant system, continuing to provide high integrity and high availability. The RTP2300T can withstand another failure and continue plant operation while operator action restores the system integrity.

The RTP2300T is designed to put you in control; in control of the process and in control of the system response (adjudication). The RTP2300T was designed to compensate for the vagaries of process control to keep the plant operating—safely.

**Non-Intrusive Initialization:** RTP’s hot-swappable components and “easy out” power supplies, coupled with additional layers of available redundancy, allow for a quick return to a high-integrity solution. When the error condition is cleared through online maintenance activities, non-intrusive reinitialization of the restored controller takes place, and the RTP2300T is again available as a fully functional TMR node. Non-intrusive reinitialization occurs incrementally using advanced data compression techniques, so as not to interrupt the process.

**Signal Validation:** Signal validation routines are supported in all of the RTP High-Integrity Control Systems from the RTP2300T to the Micro2000S. RTP signal validation routines
allow for the control of one logical input produced from up to four redundant inputs (three hardware and one additional logic). There are six algorithms that the user can select to calculate the logical variable from the three physical field variables. The RTP2300T supports both I/O card redundancy and sensor redundancy, which is field-configurable.

**Triple Redundant I/O:** An RTP2300T node supports up to 32 RTP2316, RTP2312 or RTP2308 I/O chassis. These I/O chassis accommodate one CCC processor and either 16, 12 or 8 I/O cards. These chassis can be configured as common (non-redundant), dual-redundant or triple-redundant I/O chassis.

Chassis specified as a redundant I/O pair or a redundant I/O triplet, must have their I/O cards identically configured with their field wiring connected to the same physical input or output point, or to identical redundant input sensors. The primary controller determines which redundant I/O chassis is the primary chassis. Only the primary redundant I/O chassis drives its analog outputs, the outputs on the secondary and tertiary chassis are armed but isolated from the field device. However, inputs are monitored from all redundant I/O chassis. The CCC in each redundant I/O chassis independently performs the two-out-of-three voting to ensure continued data integrity. In the event of a power failure or card failure in the primary I/O chassis, the controller will take that chassis offline and select another redundant I/O chassis as the primary. The pre-armed outputs of the secondary chassis will be automatically connected to the field device for a bumpless transfer. A controller failure does not degrade or cause the switchover of an I/O chassis.

**High Performance I/O:** RTP’s specialized I/O cards support high-integrity applications and/or line supervision for mission-critical applications. Fast scan rates, true 16-bit A/D precision, high CMRR (Common Mode Rejection Ratio), over voltage isolation protection, and superior construction are several of the advantages that hallmark RTP I/O. RTP allows tighter, more accurate control of the process, with a positive impact on the quality of your product.

RTP I/O cards provide a full range of I/O choices: from 5V to 240V AC, 5V to 125V DC, low level millivolt to +10V, 4-20 mA, thermocouples, RTDs, relays and others. Communications cards support Modbus Master and Slave serial communications, and Modbus TCP for connectivity to devices and other systems.

**RTP2300D HICS**

The RTP2300D HICS is a dual-redundant version of the RTP2300T, which performs data validation testing from two sources. The RTP2300D has the same capabilities as the RTP2300T with the exception of data validation from three sources.

**Dual Redundant Data Integrity:** In the RTP2300D, if any deviation in the hardware or network operation is detected, the operator is notified immediately while the system determines the cause of the deviation through the use of comprehensive diagnostics. Once the system determines the cause of the deviation, the offending control is taken offline. If the primary controller was determined to be at fault, a switchover to the secondary will occur, which neither interrupts the normal high-speed I/O scanning, nor suspends the execution of the running control application. Regardless, at this point the system remains in control in a stable, albeit degraded state. This degraded state still exhibits a level of integrity and availability in excess of single CPU systems that are installed in countless process control applications! The difference, however, is that the operator is aware of a malfunction and can take corrective action before any process interrupt.

**Micro2000D Series HICS**

The Micro2000D Series HICS is dual-redundant, stand-alone high-integrity and high-availability solution for small systems. Functionally, the Micro2000D series has the same data integrity capability as the RTP2300D. The difference is that the Micro2000D series is designed for small-to-medium size (400 I/O points or less), stand-alone high-integrity systems and can only be configured with dual-redundant I/O. The High-Integrity Control System figure on the previous page shows the Micro2016D and the Micro2008D; the Micro 2012D with the dual-powered chassis is not pictured.

**Superior Reliability**

RTP products are designed and qualified under the demanding Class 1E Nuclear Safety guidelines for superior reliability, minimal downtime and maintenance, and a high return on investment.

**Optimized for Process Control**

RTP2300 HICS’s are optimized for process control and monitoring. While they may appear to share many features with certified safety systems, RTP Corp. does not intend or suggest that they be used in a system requiring IEC 61508 certification.