3000 SIS

Critical Control and Safety System

3000-Q SIS

Product Highlights

- **Multi Processor Architecture**
- **SIL-3 Communications**
- **Comprehensive Diagnostics**
- **Configurable Redundancy**
- **Availability in excess of 99.9999% (6Nines)**
- **12 msec Response Time**

Product Overview

Parallel Processing

RTP's unique multi-processor architecture aids the user in many ways. It minimizes the scan time providing unprecedented speed for identification of process disruption and for responding to such disturbance. In safety applications, the importance of this speed cannot be overstated. The ability to identify and respond to process malfunctions as quickly as possible is key to avoidance of damage to process, equipment, or personnel. For your critical control applications, the 3000 has the ability to solve 300 PID loops, scan I/O, solve logic, handle alarms, perform peer to peer communication and perform other communication in a single 5 millisecond scan.

Each node and chassis processor has multiple cpu's working in parallel to perform a specific function. This architecture enables the system to maintain a 5-millisecond scan regardless of the size of the application or the amount of I/O. Unlike conventional control and safety systems, the scan rate does not increase in proportion to the amount of I/O. Additional computing capability is added as the I/O load grows, meaning that the system never exhibits a scan time in excess of 5 milliseconds. No matter how large the application, the 3000 will provide the highest performance of any safety system.

The cpu's on the Node Processors perform the system's node logic solving, engineering units conversion, input validation and voting, alarm communications, data archiving communications, HMI communications, peer-to-peer communications, and communication validation functions. The cpu's on the Chassis Processors perform the system's chassis I/O scanning, 1 millisecond SOE log time stamping, results validation and voting, I/O bus validation, I/O integrity checking, field device checking, and field wire checking functions. Due to the parallel processing architecture, the 3000 is able to achieve a 12 milli-second response time (screw to screw).

Another benefit of the multi-processor architecture is comprehensive diagnostics. RTP brings more computing power to the task, enabling more diagnostics that, in turn, enables the High Integrity and High Availability the 3000 delivers.

RTP is the Best Technology for Your Investment, Here's Why:

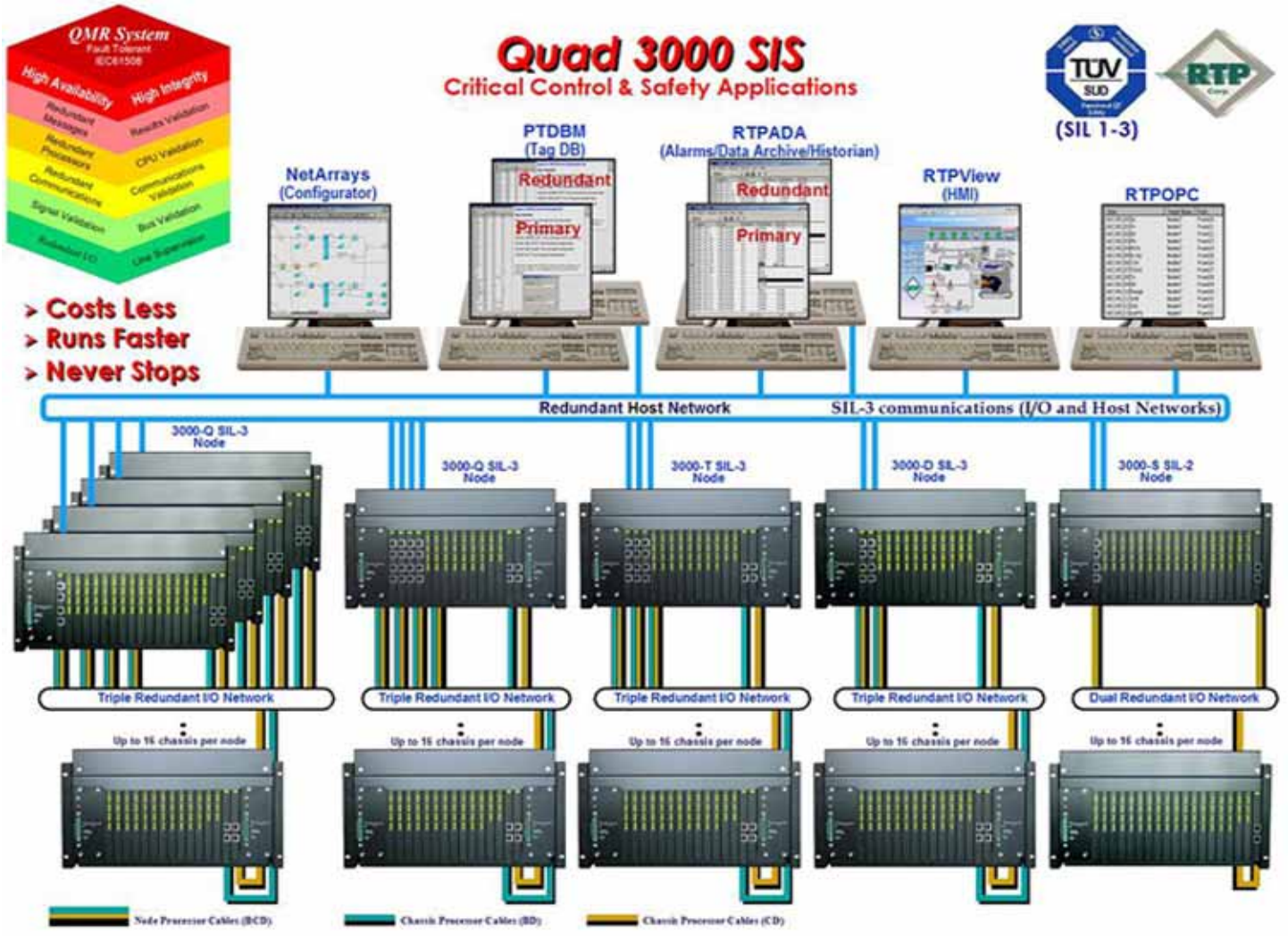
The 3000 is a multi-processor architecture that delivers exceptional Performance and Comprehensive Diagnostics. The results speak for themselves: A Reaction Time of 12 msec, true 1 msec SOE (Analog and Digital), an MTBF of greater than 3000 years, an MTTFS of greater than 4000 years, and a PFDavg of $5x10^{-5}$. ***Compare these numbers to any other system.***

Built-in Proof Test Diagnostics means it will never be necessary to shut down at the proof test interval. Unlimited online downloads of logic and configuration changes do not require a periodic shut down like other systems. ***Compare this functionality to any other system.***

Net Suite Software: One-time price includes unlimited use of Logic Development, Alarm Manager, Data Archive and Historian, and HMI without hardware or software keys. ***Compare this functionality and price to all other systems.***

Finally, a Safety Instrumented System (SIS) should always take the process it protects to a safe state when it is required to do so, and it should never interfere with the operation of the process at any time. ***The 3000 does this better than any other system.***

RTP Corp. • 1834 SW 2nd Street • Pompano Beach, Florida 33069
PHONE (954) 974-5500 • FAX (954) 975-9815 • EMAIL rtpinfo@rtpcorp.com • WEB: www.rtpcorp.com



3000 SIS System Diagram

All I/O and host communications occur over SIL-3 redundant 100 Megabit full duplex Ethernet networks. With an effective bandwidth of 400 MHz, I/O and host updates are more frequent, further enhancing the improved protection the 3000 offers.

For the fastest response, distributed processing is available in certain I/O cards allowing complex algorithms to be performed by the card. This I/O runs its own application resulting in throughputs of 1 millisecond. Such capability is particularly important to high-speed applications such as rotating machinery or exothermic reactions.

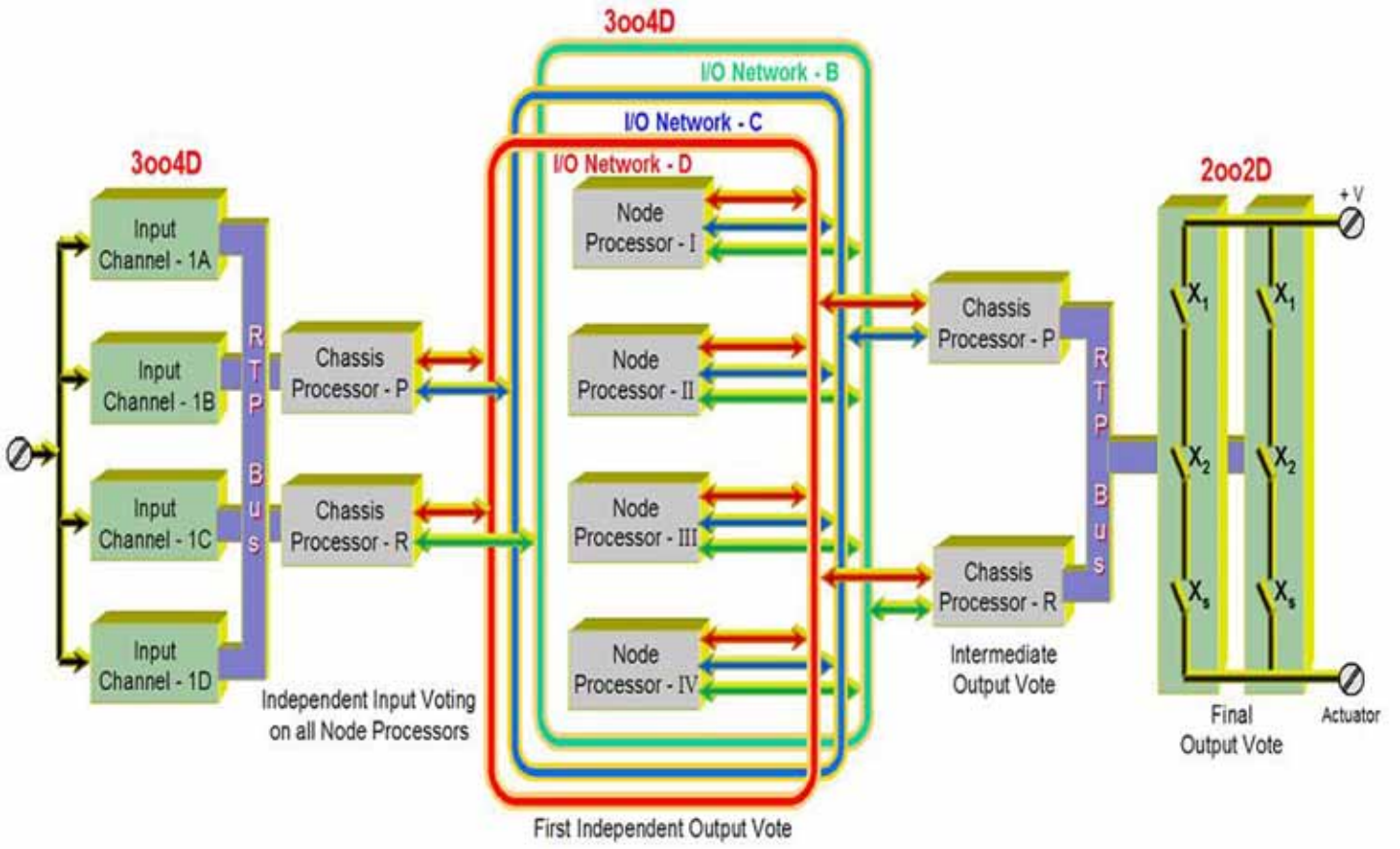
Configurable Redundancy

The 3000 SIS is extremely scalable from small systems of a single chassis up to complex systems of sixteen chassis per node. This unique design is built upon a set of standard hardware and software components that supports multiple architectures. These standard components (which include Node Processors, Chassis Processors, I/O chassis, power supplies and I/O modules) are utilized to construct systems ranginge from simplex to QMR.

The figure above illustrates, from left to right:

- The 3000-Q QMR with four Node Processors distributed in four I/O chassis plus additional I/O chassis with redundant power supplies on a triple redundant I/O network. Each I/O chassis includes redundant chassis processors for maximum availibility.
- The 3000-Q QMR with four Node Processors in one dual-redundant power supply I/O chassis plus additional I/O chassis. Each I/O chassis includes redundant chassis processors.
- The 3000-T TMR with three Node Processors in one dual-redundant power supply I/O chassis plus additional I/O chassis. Each I/O chassis includes redundant chassis processors.
- The 3000-D with two Node Processors in one I/O chassis with dual-redundant power supplies plus additional I/O chassis. Each I/O chassis includes redundant chassis processors.
- The 3000-S with one non-redundant Node Processor plus additional I/O chassis. Each I/O chassis includes one chassis processor.

All five nodes are shown integrated over a SIL-3 Fast Ethernet network, which connects to the supervisory domain comprised of the RTP NetSuite Integrated Software Environment.



3000 QMR Architecture Diagram

Availability equates to redundancy and the ability to modify and repair the processors online. Redundancy in the 3000 can be configured according to the level of availability desired. Redundancy is simple to design and implement; the programming and configuration of a redundant 3000 is identical to that of a non-redundant 3000 using NetArrays (RTP's configuration and logic development software).

Dual-, triple-, or quad- redundant node processors can be located in separate chassis preventing the possibility that a single physical event would take out the safety system. No other TMR or QMR product has this capability.

Redundant I/O can be wired to multiple points on the same card, to different cards in the same chassis, or to different cards in different chassis. The node processors can be configured to validate and vote redundant input values using built-in signal validation algorithms.

The 3000 supports online program and configuration changes. There are no download buffers and all multiple processor issues are handled automatically by the processors themselves.

In a QMR configuration the 3000 has an availability of SIX NINES (99.9999%).

Even more impressive, the Mean Time To Fail Safe (MTTFS) is greater than 4000 years, an order of magnitude better than conventional safety systems. This MTTFS equates to a 90% reduction in nuisance trips attributable to the safety system.

Comprehensive Diagnostics

Diagnostics are the key to integrity. It is imperative that every component in the system, and every system function, be tested every scan. The 3000 provides thie capability without additional hardware or special programming. Advanced built-in diagnostics, certified by TUV, are performed on the wiring between the field device and the I/O card, on the functions of the I/O card, and on the communications between the I/O card and chassis processor. Proof test diagnostics occur transparent to the field device. Proof test diagnostics actually insert a fault condition on each channel, to ensure that the card's fault detection circuitry is capable of detecting any fault condition on every channel. Tests of the diagnostics occur by randomly instructing components to fail diagnostic tests. An example of diagnostics performed include:

- Special purpose I/O cards test the integrity of the line between the I/O module and the input or output device. In some instances additional testing can be performed on the device itself.
- Input and output cards perform tests every scan to insure that the card is capable of changing state when needed.
- The triple redundant I/O network includes additional embedded error checking to insure the integrity of I/O messages. All three networks are used during normal I/O scanning to insure that all the networks are operational.

- Dual-, triple- or quad- redundant I/O values are validated by every node controller. Individual controllers in any redundant scheme are not dependent on each other for information. Each chassis processor sends its information to each node processor. This means that one malfunctioning controller cannot affect the function of other controllers.
- Math and logic functions tests of every node processor and chassis processor are performed every scan to insure that they are functioning correctly.

Any diagnostic test failure is reported. The 3000-Q is designed for continuouis operation, providing on-line replacement of modules without system or process interruption.

3000 QMR Architecture

The 3000 QMR architecture, illustrated on the previous page, provides 3oo4D validation of the inputs. Next the node processors solve the logic independentaly and transmit the results over the triple redundant I/O network to the chassis processors. The chassis processor compares the results and must receive three identical messages before it takes action. Thus the first output vote, a 3oo4D vote in a QMR configuration. The chassis processor transmits the output message to the output module twice, once normal and once inverted. The messages are compared and, if they agree, the output module takes action. Digital output modules provide a 2oo2D validation of the signal before transmitting it to the field device.

Specifications

Node Processor	Mobile Intel® Celeron™ Processor with integrated Intel floating point unit and the 440MX single-component chipset with support for synchronous DMA 2 PCI-based 100 MHz full duplex Ethernet controllers for Host/Inter Processor communications and I/O communications (3000-Q, -T, -D) or redundant Host communications (3000-S) 2 PCI-based 100 MHz full duplex Ethernet controllers for I/O communications 64 MBytes RAM, 64 MBytes Flash
Chassis Processor	Dedicated processor (PLD) to perform I/O scanning RISCore 32300 implements Enhanced MIPS-II instruction set 2 PCI-based 100 MHz full duplex Ethernet controllers 32 MBytes RAM, 4 MBytes Flash
Ethernet Cable Type	STP Category 5 (EIA 568B, Cat 5) shielded Ethernet cables
Sequence Of Events	1-millisecond SOE processing (analog and digital)
Temperature Ranges	
Operating Temperatures	–20° to +60°C (–4° to +140°F)
Storage Temperatures	–25° to +85°C (–13° to +185°F)
Humidity Range	10% to 95% non-condensing
Power Requirements	
AC Input Options	3.2 A @ 85V AC to 250V AC (External 24V DC input available for I/O cards)
DC Input Options	10A @ 24V DC, or 5A @ 48V DC
Chassis Dimensions	Height: 11.3 inches (28.7 cm) Width: 19.0 inches (48.3 cm) Depth: 11.3 inches (28.7 cm)
Chassis Mounting:	
Cabinet / Rack Mounting:	
Horizontal Distance:	18.5 inches (47.0 cm) between holes.
Vertical Distance:	7.5 inches (19.1 cm) between holes.
Hole Diameter:	¼ inches (0.6 cm)
Panel Mounting:	
Horizontal Distance:	8.0 inches (20.3 cm) between three holes.
Hole Diameter:	0.2 inches (0.5 cm)
Required Chassis Clearance:	
Vertical:	2 inches (5.1 cm) for proper forced-air cooling.
Depth:	3 inches (7.6 cm) for cable connections in the front.

Technological Leadership = Improved Performance

Benefits

- ◊ Tighter Control
- ◊ Faster Reaction Times
- ◊ Increased Diagnostics
- ◊ Increased Uptime

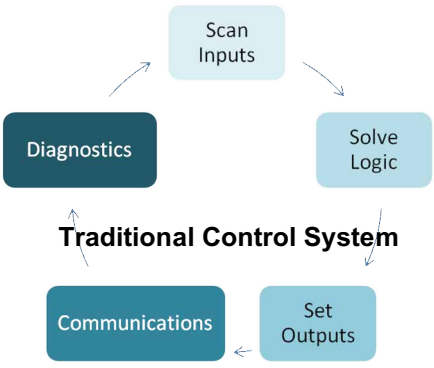
Overview

RTP has fundamentally changed the way control systems work.

Since the advent of the technology, all PLC's, SIS Systems, and DCS Systems have worked the same way.

A processor or set of processors scans the inputs, solves the logic, sets the outputs, does communications, and runs diagnostics. Then it starts over again. This means that the scan time (and therefore the reaction time) is dependent on the amount of I/O and the complexity of the logic.

This also means that the diagnostics done by this processor or set of processors directly affects performance. Designers of traditional systems must make trade-off decisions between allowable scan times and the



3000 Controller Family

RTP offers a complete family of high-integrity Critical Control and Safety Systems, all following the standards of IEC61508 and IEC61511 with suitability for SIL-1 through SIL-3 applications.

For the highest level of integrity and availability, the 3000-Q Quadruple Modular Redundant (QMR) System features 3oo4D voting with quad, triple, dual, or simplex I/O.

The 3000-T is built on the same advanced technology as the 3000-Q and offers an Advanced TMR architecture for more reliable 2oo3D voting.

The 3000-D dual redundant system builds on this same technology for 1oo2D applications, providing a low cost SIL-3 solution.

When processor redundancy is not a requirement, the 3000-S single processor configuration provides a high integrity SIL rated system for the price of a standard PLC.

All RTP 3000 Systems are built on the same advanced technology and offer the user flexibility with regard to I/O redundancy. All systems offer advanced diagnostics that insure proper operation of the system and provide real time English language diagnostic messages to assist maintenance and reduce downtime.

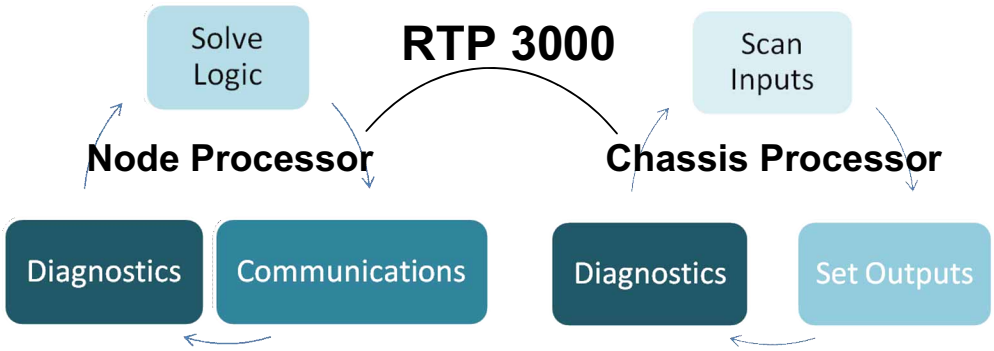
The 3000-Q, 3000-T, 3000-D, and 3000-S support up to 16 chassis of I/O providing high availability systems with I/O counts as large as 10,000 I/O.

amount of diagnostics that will be done.

A combination of these issues explains why industry has been conditioned to expect SIS scan times of several hundred milliseconds and to believe that 1 to 2 second updates on process variables is not only acceptable, but preferable.

Now, RTP has changed all that.

RTP is the first company to change that paradigm. The RTP 3000 has two sets of processors. The Node Processor scans logic, does communications, and runs diagnostics. The Chassis Processor scans I/O, providing 1 millisecond SOE as part of the process, and runs diagnostics on the I/O and on the Node Processor. The two meet at the beginning of each Node Processor scan and exchange information.



While this arrangement may seem simple enough, notice that there could be up to four (4) Node Processors working in parallel and up to thirty-two (32) chassis processors, one or two for each I/O chassis. Thus, RTP increases the processing power as the application grows.

This architecture allows the RTP 3000 to have improved diagnostics and to run at much faster scan times.

No matter how much I/O is added to the system, the scan time will not affected since additional chassis processors will be added each time a new I/O chassis is configured. Basically, the processing power (and the number of processors) increases as the I/O grows.

The Node Processor runs a constant 5-millisecond scan (and can solve 300 PID loops during that scan).

This basic change in the way a control system works leads to the increased speed, increased diagnostic coverage, and the incredible MTTFS that the RTP 3000 exhibits.

And, since the Node Processor and the Chassis Processor are different technologies and they run diagnostics on each other every scan, the system is protected from common mode issues.

Let's see what this does for the process industries.

First, as an SIS, the RTP 3000 results in an order of magnitude reduction of nuisance trips attributable to the SIS. The RTP 3000 has MTTFS numbers in the thousands of years whereas traditional SIS systems have MTTFS numbers in the hundreds of years.

In control applications, the RTP 3000's scan time means that algorithms are solved more frequently resulting the ability to make small adjustments frequently and eliminating the need to make large adjustments infrequently, which can lead to oscillation of process variables.

Since the RTP 3000 can control industrial processes in real time, users might even see reduced need for off-line analysis tools that are designed to predict process events and take corrective action to prevent them. Processes can be run closer to design models and managed in real time.

Conclusion

RTP has demonstrated its technical superiority in applying technology to control and safety applications. By utilizing a revolutionary multi-processor architecture, the RTP 3000 can:

- ◊ Provide tighter control of process applications.
- ◊ Decrease nuisance trips in SIS applications.
- ◊ Provide increased diagnostic coverage allowing for identification of faults, reducing the time needed to identify a fault and therefore both the time to repair the fault and downtime.

RTP Corporation
1834 SW 2nd Street
Pompano Beach, FL 33069
www.rtpcorp.com

Node Processor Card

3000/02-000

PRODUCT HIGHLIGHTS

- **Multi-Processor Architecture**
- **Supports Single, Dual, Triple, and Quad Redundancy**
- **10-year Proof Test Interval**
- **Four Independent 100Base-TX Ports**
- **650 MHz Intel Celeron CPU**
- **64 MBytes SDRAM, 64 MBytes Flash Memory**
- **Temperature Monitor**
- **LED Status Indicators**

3000/02-000 Node Processor Card

PRODUCT OVERVIEW

The 3000/02-000 Node Processor Card is the core component to a 3000 Safety Instrumented System. It provides a central location for communication with host computers, chassis processors, redundant node processors, and node processors that are part of a different 3000 system.

The Node Processor utilizes a multi-processor (CPU) architecture. The CPU's work in parallel, each performing a specific function. At the core, a Mobile Intel® Celeron™ Processor including an integrated floating point unit and synchronous DMA enables a 5 millisecond scan rate. The processor receives and stores the system configuration and user program files in a non-volatile flash memory (Disk on Chip). Using the data received from the Chassis Processor and the user program files, the Node Processor performs input validation and voting, converts engineering units, and solves the logic.

Input data received from Chassis Processors and output data being sent to Chassis Processors is sent across a redundant I/O network using advanced CRC checking to detect faulty messages. Communication across this network is driven by redundant 100 Mbps full duplex Ethernet processors providing interprocessor and I/O communications. In redundant configurations, communication to redundant Node Processors in the system is facilitated via these CPU's.

The 100Mbps full duplex Ethernet processors perform host communications. Information regarding the state of the system is displayed and stored on host network computers via the NetSuite application programs. When on a network with multiple 3000 systems, peer-to-peer data can be transferred between the systems via the host communications network. Stored data records for SOE or FIFO is sent to host network computers for use by NetSuite application programs.

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Net Suite Software: One-time price includes unlimited use of Logic Development, Alarm Manager, Data Archive and Historian, and HMI without hardware or software keys. ***Compare this functionality and price to all other systems.***

Finally, a Safety Instrumented System (SIS) should always take the process it protects to a safe state when it is required to do so, and it should never interfere with the operation of the process at any time. ***The 3000 does this better than any other system.***

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REDUNDANCY

The 3000/02-000 can be configured to operate in a single, dual, triple, or quad redundant architecture. A system with a single node processor will achieve a SIL-2 rating. When in a redundant configuration, the system achieves a SIL-3 rating. Redundant Node Processors can be located in separate chassis preventing the possibility that a single physical event would take out the safety system. No other QMR product has this capability.

In redundant configurations, each node processor receives the input, solves the logic, and sends the outputs independently from the other node processors in the system. In quad redundant configurations, the node processors performs three out of four (3oo4D) voting providing a high integrity, error-free, uninterrupted process operation.

DIAGNOSTICS

Built-in, comprehensive proof test software performs the proof test diagnostics. When the Node Processor is online, the proof test diagnostics run continuously without interrupting the system and verify the comprehensive diagnostics are at work and the readiness of the system to detect a failure. The maximum proof test interval for a 3000 system is 10 years. Proof tests are completed by simply restarting the node processor, which can be accomplished through the user application. With the ease of which proof tests can be accomplished, shorter proof test intervals for the 3000 will leave considerable budget for all other external devices.

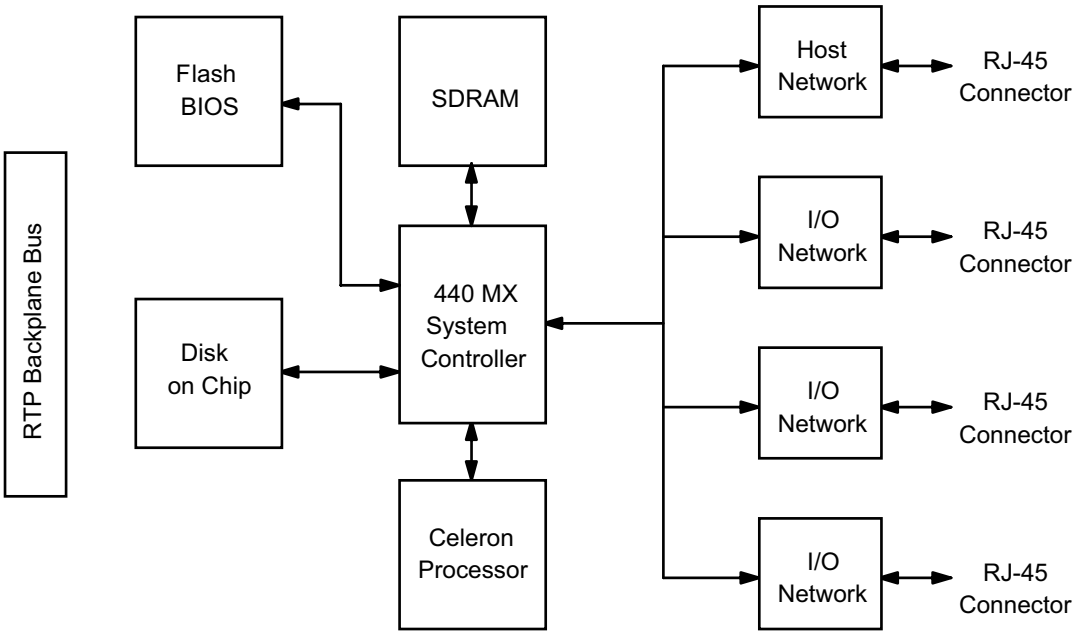
LED's on the Node Processors front panel indicate whether the card has power and provide an indication of the system health and redundancy status.

NETWORKING

Convenient communication ports are provided by four front-panel mounted RJ-45 connectors that accept standard Ethernet cables. The ports have dedicated functions. The top two ports are for host and interprocessor communications. For a single Node Processor system, the top two ports are used for redundant host communication. In systems with redundant Chassis Processors, the second port is also used for I/O communication. The bottom two ports are for communication with the chassis processor across the redundant RTP I/O network.

ON-LINE REPAIR

The 3000/02-000 card's "hot swappable" design allows it to be plugged into or removed from a live RTP chassis.



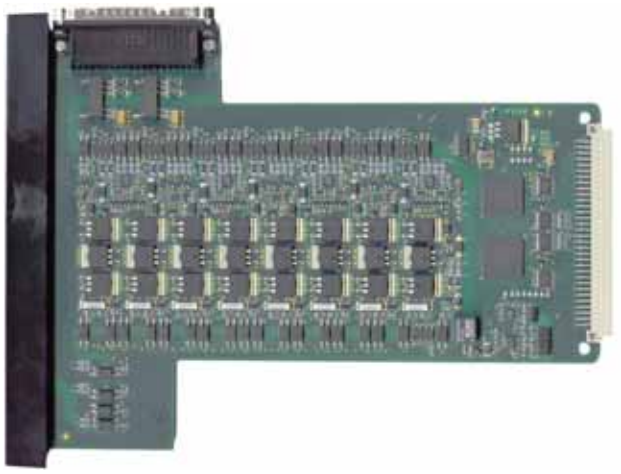
3000/02-000 Node Processor Card

8-Channel SIL-3 Supervised Digital Output Card

3005/08-000

Product Highlights

- 8 High-Current Output Channels
- Output Range from 20V to 60V DC
- Readback of Output Voltages
- Supports Dual and Triple Redundancy
- Duplicate Control Logic Circuitry
- Active Output Circuit Testing
- Supervised Output Lines and Loads
- I/O Bus Checking Diagnostics
- LED Output State and Card Health Indicators
- Hot Swappable



3005/08-000 8-Channel Supervised Digital Output Card

Product Overview

The 3005/08-000 Supervised Digital Output Card is TUV approved for SIL-3 applications. It provides an interface to 8 field output devices for any 3000 system. Each channel consists of two solid-state switches connected in series, and a safety switch; all three switches must be activated to power the field load. All channels are isolated from the RTP chassis ground. Voltages from 20V to 60V, at up to 0.75A, may be controlled by the output channels. This card is IEC 61131-2 qualified and performs comprehensive diagnostic tests on all output channels and backplane communications; any errors detected are reported to the operating program.

For increased availability, an output channel of two or three cards may be connected in parallel to the same field device for a redundant configuration. Watchdog timers are included to disable all output channels simultaneously in the event of a card error.

Duplicate digital integrated circuit chips (one operating on inverted data) perform identical I/O Bus checking diagnostics on all output data and command transfers to the card. Each transfer is performed twice (all the data bits in the second transfer are inverted.) Both logic chips check for transmission errors, and then check for agreement with the other before activating the two output FET switches. Both logic chips must agree to activate a FET switch before the FET can be turned on. The safety switch allows the card to turn off its respective channel during power up or in response to a fault condition. The output will remain off until enabled by the operating program. Any reset signal generated by the card's logic activates the safety switch and de-energizes all eight channels.

The card performs active circuit tests on the output switches, open field wiring tests, load supervision tests, and cable detection tests to verify that the card is operating properly and connected to the field load.

Channel and card health status is visible through 9 LED indicators on the card's the front panel. For field maintenance, these cards may be replaced with a spare, without powering-down the chassis.

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Electrical Specifications

Module Safety Integrity Level	SIL 3
Number of Outputs	8 channels
Output Configuration	3 series-connected FET switches per channel with common external voltage and return terminals
Isolation	500V AC/DC to RTP chassis ground
Maximum Open Circuit Voltage	60V DC
Maximum Closed Circuit Current	0.75A, protected by slow acting fuse
Maximum Voltage Drop @ 1A	2.5V
Minimum Load	10 mA per channel
Maximum Leakage Current	2 mA during testing (Outputs Off)
Switching Times	< 50 µsec Off to On < 50 µsec On to Off
Power Requirements	+5V DC @ 400 mA typical
External Field Power	+20V to +60V DC @ 6.5A maximum
Power Dissipation	18 Watts, 62 BTU/hr

Environmental*

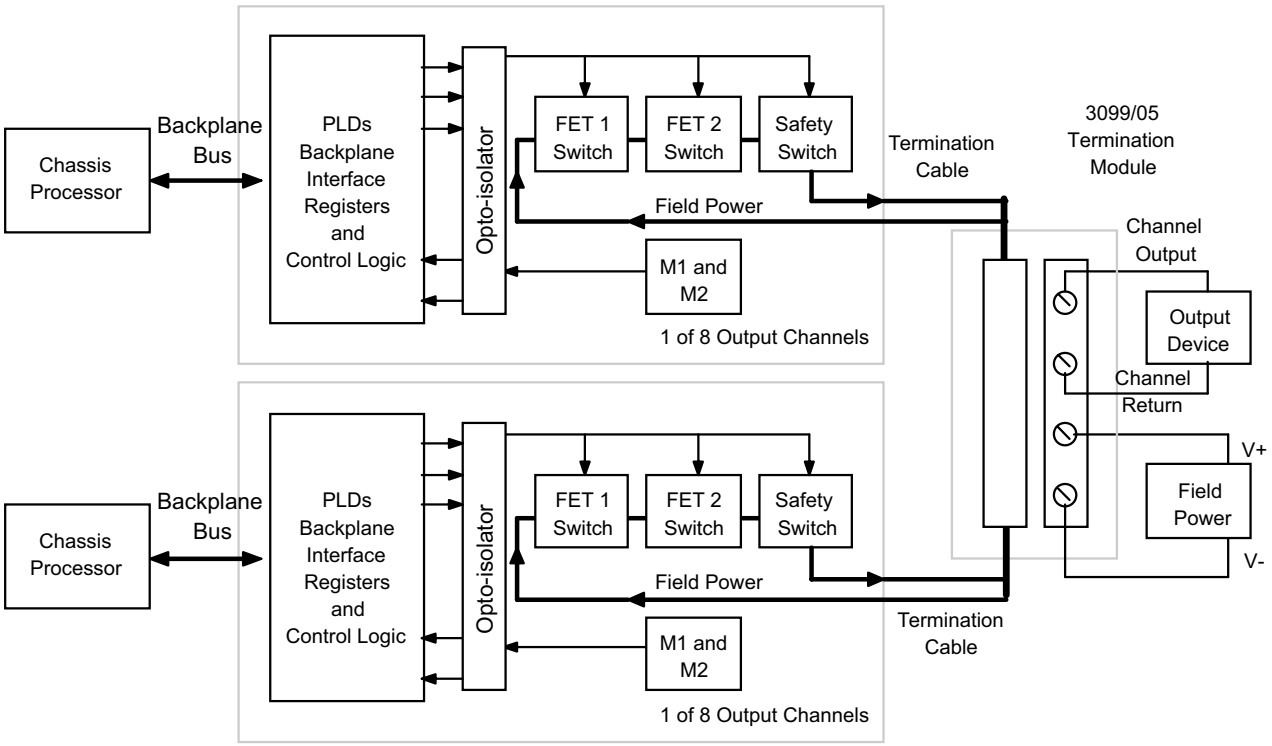
Operating Temperature Range	–20ºC to +60ºC
Storage Temperature Range	–25ºC to +85ºC
Relative Humidity Range	10% to 95%, non-condensing

**Complies with IEC 61131-2*

Termination Module*

3099/05-000	8-Ch Supervised Digital Output Triple Termination Module
3099/05-100	8-Ch Supervised Digital Output Single Termination Module
Termination Cable	Included with 3005/08-000 Card

**Consult factory for a complete list of all available terminations*



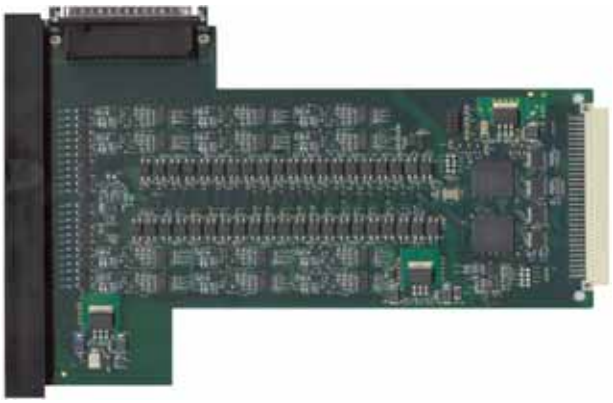
Dual Redundant Output Configuration

12-Channel SIL-3 Supervised Digital Input Card

3001/01-000

Product Highlights

- **12 Supervised Input Channels**
- **Supports Dual, Triple, and Quad Redundancy**
- **Channel On-State and Off-State Diagnostics**
- **Walking-Zero Tests for Channel Crosstalk**
- **Proof Test Diagnostics**
- **I/O Bus Checking Diagnostics**
- **Power Supply Voltage Monitors**
- **LED Input State and Card Health Indicators**
- **Hot Swappable**



3001/01-000 12-Channel Supervised Digital Input Card

Product Overview

The 3001/01-000 card is TUV approved for SIL-3 applications. It can interface up to 12 field sensors to any 3000 system. All input channels are isolated from the RTP chassis ground. All channels share a common external 24-volt power source. This card is IEC 61131-2 qualified and performs comprehensive diagnostic tests on all input channels and backplane communications for detecting internal faults; any errors detected are reported to the operating program.

The card can be configured as single, dual, triple, or quad redundant. One field sensor can be connected in parallel to two, three, or four 3001/01-000 cards creating redundant inputs. When using redundant configurations, the signal validation (input voting) function can be used to validate the inputs received by the node processor. Redundant configurations increase system availability. Input filters can be configured by the user at 1 msec or 5 msec. The change of any input channel initiates the logging of a time-stamped sequence-of-events (SOE) record with 1 msec resolution.

When connected to the input sensor, the 3001/01-000 card performs field wiring and switch supervision. In addition, input line short tests validate the input circuits' ability to detect a line short. Walking-zero tests validate the proper logic 1 and logic 0 level sensing at the field input by overriding the field connected signal.

Proof test diagnostics, which are transparent to the input device, actually insert a fault condition on each channel, to ensure that the card's fault detection circuitry is capable of detecting any fault condition on every channel.

I/O bus checking diagnostics, card address tests, and configuration tests are performed each time the controller accesses the card. All data and control transfers are performed twice, once using the actual data and then using the inverted data. Both versions of the data are compared to verify that no errors exist. Cable detection tests verify that the termination cable is properly connected to the card. Any faults detected set status bits in an error detection variable returned to the user application program.

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Channel and card health status is visible through 13 LED indicators on the card's the front panel. For field maintenance, these cards may be replaced with a spare, without powering-down the chassis.

Electrical Specifications

Module Safety Integrity Level	SIL 3
Number of Inputs	12 channels
Input Filters	1 msec or 5 msec, software configurable
Isolation	$>10^9$ Ω to RTP chassis ground, 10 pF capacitance per channel to RTP chassis ground
Isolation Voltage	500V DC field input to RTP ground
Data Polarity	High True
Nominal Input Circuit Voltage	24V DC, open circuit
Line Fault Current	200 mA maximum Automatically resetting thermistor line protection
Line Short Detection	≥ 3.39 mA
Logic 1 Signal Detection	$2.26 \leq I_E \leq 3.39$ mA
Logic 0 Signal Detection	$0.23 \leq I_E \leq 2.26$ mA
Walking Zero Test	Duration < 200 µsec
Wire Break Detection	≤ 0.23 mA
Power Requirements	+5V DC @ 510 mA typical from chassis power supply +24V DC nominal @ 0.2A max. from external power source (Fault protected with 0.5 Amp. automatically resetting thermistor)

Environmental*

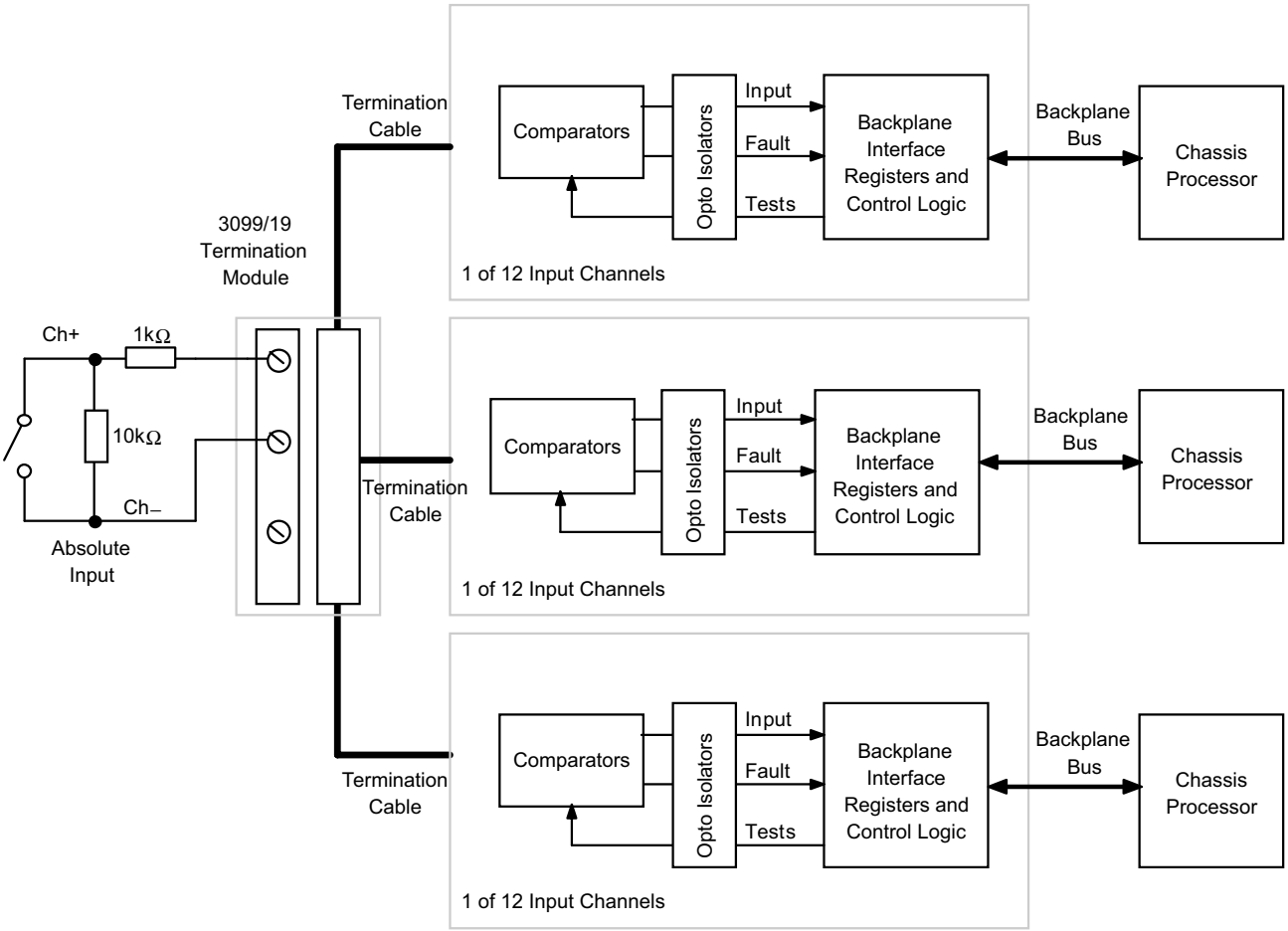
Operating Temperature Range	–20ºC to +60ºC
Storage Temperature Range	–25ºC to +85ºC
Relative Humidity Range	10% to 95%, non-condensing

**Complies with IEC 61131-2*

Termination Module*

3099/19-000	12-Ch Supervised Digital In Triple Termination Module
3099/19-100	12-Ch Supervised Digital In Single Termination Module
Termination Cable	Included with 3001/01-000 Card

**Consult factory for a complete list of all available terminations*



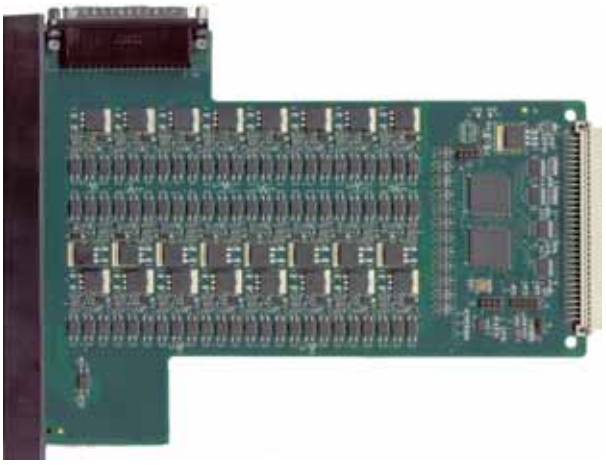
Triple Redundant Input Configuration

16/24-Channel SIL-3 Fault Detecting Digital Output Card

3028/00

Product Highlights

- **16 or 24 Digital Output Channels**
- **Supports Source Voltages from 19V to 30V DC**
- **Monitors Field Wiring**
- **Readback of Output States**
- **Fuse Protected Outputs**
- **I/O Bus Checking Diagnostics**
- **LED Card Health Indicators**
- **Hot Swappable**



3028/00-000 24-Channel Fault Detecting Digital Output Card

Product Overview

The 3028/00 Fault Detecting Digital Output Card is TUV approved for SIL-3 applications. It provides switching control of 16 (-001 version) or 24 (-000 version) points of DC voltage field signals to any 3000 system. All channels are isolated from the RTP chassis ground. Voltages of 19V to 30V DC may be controlled by the output channels. Each channel can source up to 1 amp per channel and is protected by a 1 amp slow acting fuse. This card is IEC 61131-2 qualified and performs comprehensive diagnostic tests on all output channels and backplane communications; any errors detected are reported to the operating program.

To verify the card is connected to the field load and operating properly, the card performs field wiring tests to detect a line open or line short. Channel output state readback tests confirm the actual state of the channel is the commanded state for the channel. Any fault will set the channel to a safe (off) state.

I/O Bus checking diagnostics are performed on all output data and command transfers to the card. Each transfer is performed twice (all the data bits in the second transfer are inverted.) Both transfers are then compared to insure that no errors exist in the data path between the output card and the processor. I/O bus slot address and control signal contention tests are also performed. Cable detection tests verify that the termination cable is properly connected to the card.

Any faults detected set status bits in an error detection variable returned to the user application. Watchdog timers on the card can open all of the output channels in the event backplane communication errors persist.

Following a power-up or reset, all outputs are disabled (off), and remain off until enabled by the operating program.

Card health status is visible through LED indicators on the card's front panel. Channel status is visible through LED's on the cards associated termination module. For field maintenance, these cards may be replaced with a spare, without powering-down the chassis.

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Electrical Specifications

Module Safety Integrity Level	SIL 3 (-001 version) SIL 2 (-000 version)
Number of Outputs	16 or 24 channels
Isolation	500V AC/DC to RTP chassis ground
Maximum Open Circuit Voltage	30V DC
Maximum Closed Circuit	0.5A per channel, Fuse protected to 1A slow acting fuse
Maximum Power Per Channel	0.5W
Maximum Voltage Drop @ 0.5A	1.0V
Minimum Load	10 mA per channel
Maximum Leakage Current	1 mA during testing (Outputs Off)
Switching Times	< 50 µsec
Power On/Reset Condition	All outputs reset to Off state
Power Requirements	+5V DC @ 800 mA supplied by RTP backplane
External Field Power	+19V to +30V DC @ 12.3A maximum

Environmental*

Operating Temperature Range	–20ºC to +60ºC
Storage Temperature Range	–25ºC to +85ºC
Relative Humidity Range	10% to 95%, non-condensing

**Complies with IEC 61131-2*

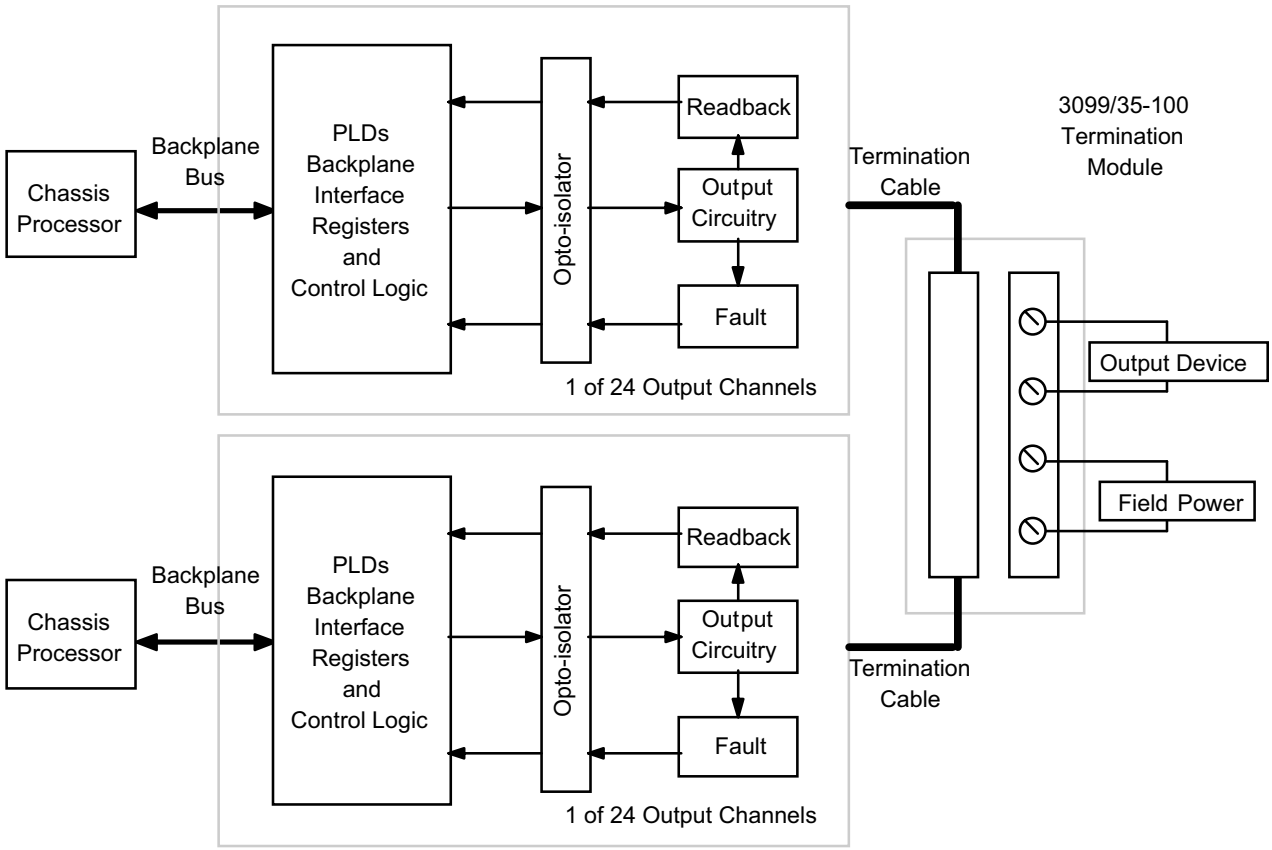
Model Numbers

3028/00-000	24-Channel Digital Output Card, 19-30 VDC
3028/00-001	16-Channel Digital Output Card, 19-30 VDC

Termination Modules*

3099/35-000	24-Ch Digital Output Triple Termination Module w/ Diodes
3099/35-001	24-Ch Digital Output Single Termination Module w/ Diodes
3099/36-000	16-Ch Digital Output Triple Termination Module w/ Diodes
3099/36-001	16-Ch Digital Output Single Termination Module w/ Diodes
Termination Cable	Included with 3028/00 Card

**Consult factory for a complete list of all available terminations*



Dual Redundant Output Configuration

32-Channel SIL-2/SIL-3 Single-Ended Analog/Digital Input Card

3026/00-002

PRODUCT HIGHLIGHTS

- **32 Single-Ended Channels**
- **Current, Voltage, or Digital Inputs Options**
- **Redundant 16-Bit A/D Converters**
- **Supports Dual, Triple, and Quad Redundancy**
- **I/O Bus Checking Diagnostics**
- **Line Supervision Option Available**
- **LED Card Health Indicator**
- **Hot swappable**

3026/00-002 32-Channel Single-Ended Analog/Digital Input Card

PRODUCT OVERVIEW

The 32-Channel Scanning Single Ended Analog/Digital Input Card is TUV approved for SIL-2 and SIL-3 applications. It provides high accuracy, high-level analog measurements or digital inputs. A guard band above and below the full-scale signal range allows signals exceeding the specified input signal range to be detected by software. The change of any input channel state initiates the logging of a time-stamped sequence-of-events (SOE) record with 1 msec resolution. This card is IEC 61131-2 qualified and performs comprehensive diagnostic tests on all input channels and backplane communications for detecting internal faults; any errors detected are reported to the operating program.

Analog-to-digital conversion is performed by redundant 16-bit switched capacitor successive approximation A/D converters (sign bit + 15-bit magnitude). No field adjustments are necessary after initial factory trim. The A/D converters calibration is continually checked by monitoring two internal fixed (high and low) voltages.

The card can operate in three different modes: current inputs, voltage inputs, or digital inputs. When receiving digital inputs, the 3026/00 can operate in supervised mode or unsupervised mode. Input modes determine which RTP termination module is required for proper card operation. Configuration changes to the card are not necessary. When used in supervised digital input mode, the 3026/00-002 can detect line shorts and line opens.

The 3026/00-002 Analog/Digital Input Card's "hot swappable" design has backplane interface logic to protect the card from damage, and to prevent control and data signal degradation on the bus, when plugged into a live RTP chassis.

I/O Bus self-test functions are performed for all input data, status and command transfers to and from the analog input card. Each transfer is performed twice (all the data bits in the second transfer are inverted.) Both transfers are then compared to insure that no errors exist in the data path between the analog input card and the processor. I/O Bus slot address and control signal contention tests are also performed. Any errors are reported in the card's status register.

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Redundancy support allows the inputs of two, three, or four cards to be connected in parallel to the same input device. When using redundant configurations, the signal validation (input voting) function can be used to validate the inputs received by the node processor. Redundant configurations increase system availability and allows the card to reach a SIL-3 rating. A single front panel LED provides the health status of the card.

SPECIFICATIONS

Module Safety Integrity Level	SIL 2 - Analog SIL 3 - Digital
Number of Inputs	32 channels
Isolation	500V AC/DC channel to RTP system
Full Scale Range:	± 10.00V (± 20.2 mA)
Scan Rate	1000 scans per second
Accuracy	0.01% full scale voltage
Resolution	16 bits
Input Source Impedance:	1 kΩ maximum to meet specifications
Multiplexer Type:	3 Solid-state multiplexer w/ 16 single-ended inputs

Power Requirements

+5V DC @ 400 mA
+24V DC @ 100 mA

Environmental*

Standard Operating Temperature Range: –20ºC to +60ºC

Storage Temperature Range: –25ºC to +85ºC

Relative Humidity Range: 10% to 95%, non-condensing

**Complies with IEC 61131-2*

Model Numbers

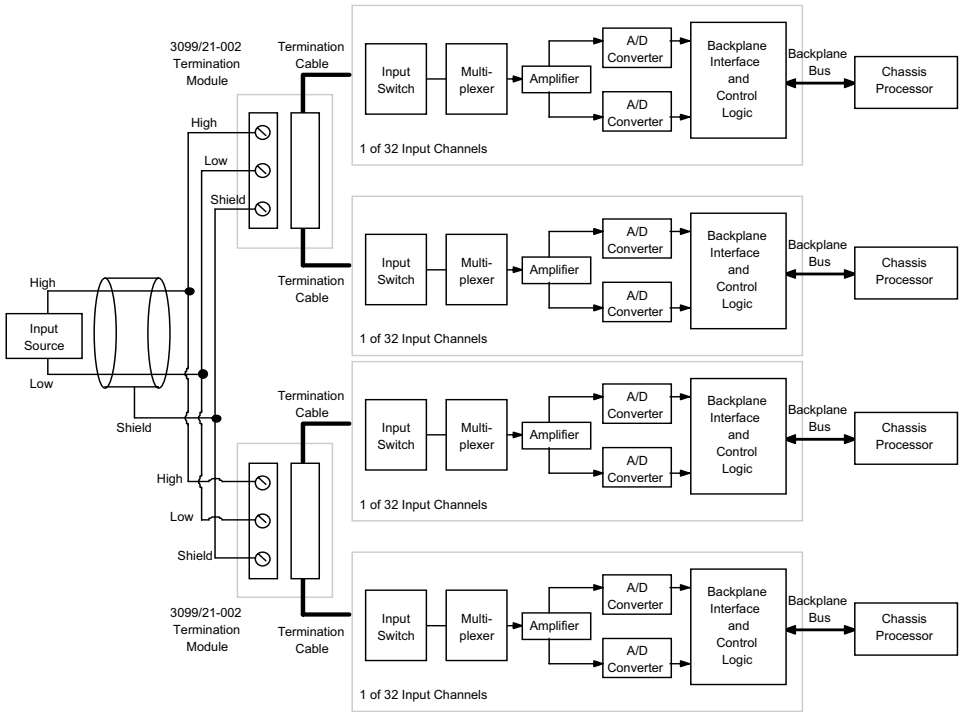
3026/00-002X	32-Ch Single Ended Analog Input Card, 1 kHz scan rate
3026/00-002Y	32-Ch Digital Input Card
Termination Cable	Included with 3026/00-002 Card

Termination Module*

Termination Module	Description	Termination Module	Description
3099/21-002	SIL-3 Triple Termination Module - Voltage Analog Input	3099/21-102	SIL-2 Single Termination Module - Voltage Analog Input
3099/21-007	SIL-3 Triple Termination Module - Current Analog Input	3099/21-107	SIL-2 Single Termination Module - Current Analog Input
3099/21-001	SIL-3 Triple Termination Module - Supervised Digital Input	3099/21-101**	SIL-3 Single Termination - Supervised Digital Input
3099/21-003	SIL-3 Triple Termination - Sinking Digital Input, 24 VDC	3099/21-103	SIL-3 Single Termination - Sinking Digital Input, 24 VDC
3099/21-004	SIL-3 Triple Termination - Sinking Digital Input, 48 VDC	3099/21-104	SIL-3 Single Termination - Sinking Digital Input, 48 VDC
3099/21-005**^	SIL-3 Triple Termination - Sinking Digital Input, 120 VAC	3099/21-105**^	SIL-3 Single Termination - Sinking Digital Input, 120 VAC
3099/21-006**^	SIL-3 Triple Termination - Sinking Digital Input, 240 VAC	3099/21-106**^	SIL-3 Single Termination - Sinking Digital Input, 240 VAC
3099/21-008**	SIL-2 Triple Termination - Sinking Digital Input, 120 VDC	3099/21-108**	SIL-2 Single Termination - Sinking Digital Input, 120 VDC
3099/21-013	SIL-3 Triple Termination - Sourcing Digital Input, 24 VDC	3099/21-113	SIL-3 Single Termination - Sourcing Digital Input, 24 VDC
3099/21-014	SIL-3 Triple Termination - Sourcing Digital Input, 48 VDC	3099/21-114	SIL-3 Single Termination - Sourcing Digital Input, 48 VDC
3099/21-015**	SIL-2 Triple Termination - Sourcing Digital Input, 120 VAC	3099/21-115**	SIL-2 Single Termination - Sourcing Digital Input, 120 VAC
3099/21-016**	SIL-2 Triple Termination - Sourcing Digital Input, 240 VAC	3099/21-116**	SIL-2 Single Termination - Sourcing Digital Input, 240 VAC
3099/21-018**	SIL-2 Triple Termination - Sourcing Digital Input, 120 VDC	3099/21-118**	SIL-2 Single Termination - Sourcing Digital Input, 120 VDC

**Contact factory for a complete list of all available terminations* ***Requires additional +24V DC power source*

^Meets all IEC 61131-2 requirements except standard operating range for digital input (current sinking)



Quad Redundant Input Configuration

MODBUS Serial Communication Card

3019/00-000

PRODUCT HIGHLIGHTS

- Four Configurable Serial Ports
- MODBUS Serial Master and Slave Protocol
- Supports RS232 and RS485 protocol
- Supports RTU and ASCII Transmission Mode
- Supports Full- and Half-duplex Transmission Mode
- Supports Normal and Null Modem Serial Wiring
- 32 MBytes SDRAM, 32 MBytes Flash Memory
- LED Status Indicator
- Hot Swappable

3019/00-000 MODBUS Serial Communication Card

PRODUCT OVERVIEW

The 3019/00-000 MODBUS Serial Communication Card connects to the 3099/25-100 Single Termination Module - MODBUS Serial. The termination module provides four serial ports for communications with MODBUS-compatible controllers. Each serial port has 4 DIP-switches that are used to designate the protocol. It supports integration of an RTP control system with equipment using the MODBUS Serial protocol. All hardware configuration options are located on the 3099/25-100 termination module.

The MODBUS Serial Communication Card manages all aspects of the protocol and data exchange including message translating and formatting, message checking, responding to MODBUS controllers with proper acknowledgments, error, or success codes, and protocol data byte ordering. This built-in intelligence unburdens the RTP controller's processor from the responsibility of managing the MODBUS network.

The card performs bus checking functions on the input, output, and command operations. Data is sent twice, once normal and once inverted. The results are then compared and the data is not acted upon unless the comparison passes. If the check does not pass, an error bit is set in the status register.

The Contention checking circuit monitors the bus command signals for any simultaneous occurrence of two or more command signals. If a simultaneous occurrence is detected, an error bit is set in the status word.

Each MODBUS port can be configured to operate either as a MODBUS master device that requests read and write data transfers from MODBUS slave devices, or as a MODBUS slave device that responds to requests from a MODBUS master. It supports multiple MODBUS servers, asynchronous read and write functions, a multiple outstanding read and write request queue, and coil and discrete I/O formats.

Its "hot swappable" design has backplane interface logic to protect the card from damage, and to prevent control and data signal degradation on the bus, when plugged into a live RTP chassis. A front panel LED indicates overall health status of the card.

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SPECIFICATIONS

Isolation
500 VAC/DC field to RTP chassis ground

Power Requirements
+5V DC @ 1.4A

Environmental
Operating Temperature Range: –20ºC to +60ºC
Storage Temperature Range: –25ºC to +85ºC
Relative Humidity Range: 10% to 95%, non-condensing

User Connectors
Number: 4
Type: Serial, user configurable
Protocol: RS-232 and RS-485
Serial Wiring: Null modem and Normal

Supported MODBUS Functions

Code	Function	Supported Port	
		Master	Slave
01	Read Coils	✔	✔
02	Read Discrete Inputs	✔	✔
03	Read Holding Registers	✔	✔
04	Read Input Registers	✔	✔
05	Write Single Coil		✔
06	Write Single Register		✔
15	Force Multiple Coils	✔	✔
16	Preset Multiple Registers	✔	✔

Electrical Specifications
µProcessor: RC4000 RISC processor
Clock Speeds:
CPU 133 MHz
System Bus 66 MHz

Memory: 32 MBytes SDRAM
32 MBytes Flash

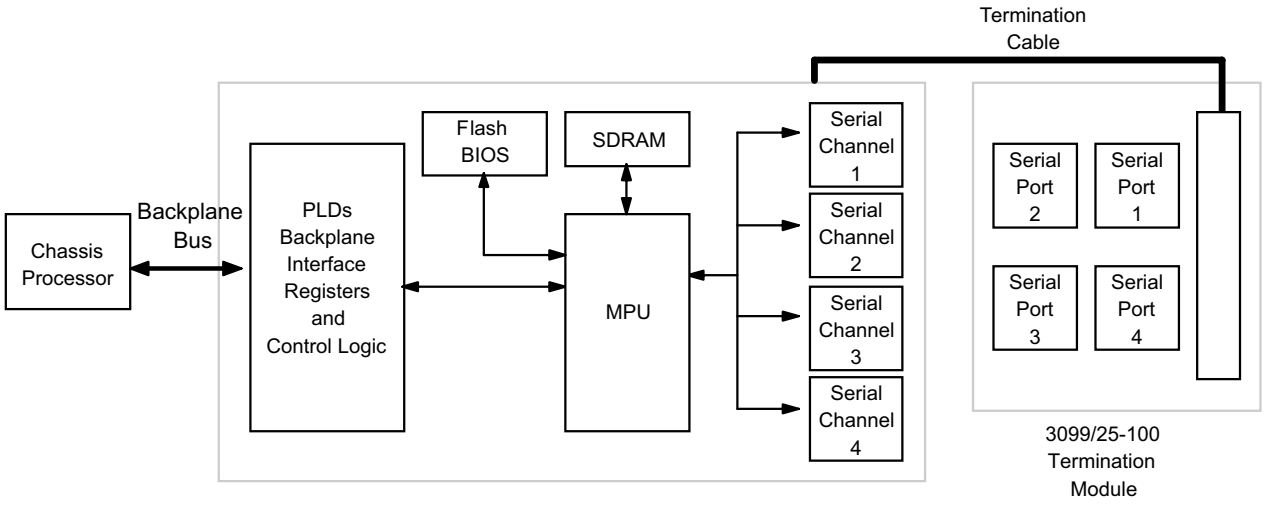
MODBUS Protocol: Serial Master/Slave

Transmission Mode: RTU Full-duplex
RTU Half-duplex
ASCII Full-duplex
ASCII Half-duplex

RS-485 Interface:
Mode*: Full/Half duplex
Receiver Input Resistance: 24KΩ
Protection: Current Limiting
Data Rate: 115.2 kbaud, maximum
1200 baud, minimum
** RS-485 half-duplex requires bias resistors*

RS-232C Interface:
Mode: Full Duplex
Receiver Input Resistance: 5KΩ (max)
Data Rate: 115.2 kbaud, maximum
1200 baud, minimum

Termination Module*
3099/25-100 Single Termination Modbus Serial **Termination Cable** Included with 3019/00-000 card
**Consult factory for a complete list of all available terminations*



3019/00-000 MODBUS Serial Communication Card

MODBUS TCP/IP Communications Card

3000/04-000

PRODUCT HIGHLIGHTS

- **Four Independent 100Base-TX Ports**
- **MODBUS TCP Protocol**
- **650 MHz Intel Celeron CPU**
- **64 MBytes SDRAM, 64 MBytes Flash Memory**
- **Output Validation**
- **LED Status Indicators**
- **Hot Swappable**

3000/04-000 MODBUS TCP/IP Communications Card

PRODUCT OVERVIEW

The 3000/04-000 MODBUS Communications Card provides two 100 MHz Ethernet links for communications with MODBUS-compatible controllers and two 100 MHz Ethernet links for communication with the redundant RTP I/O network. It supports integration of an RTP control system with equipment using the MODBUS/TCP protocol. The 3000/04-000 card can be installed in any 3000 chassis.

The MODBUS Communications Card manages all aspects of the protocol and data exchange including message translating and formatting, message checking and CRC generation and checking, responding to MODBUS controllers with proper acknowledgments and error or success codes, and protocol data byte ordering. This built-in intelligence unburdens the RTP controller's processor from the responsibility of managing the MODBUS protocol.

During each output transfer the MODBUS Card performs a 2oo3 output validation test on the data received from the node processor across the redundant I/O communication network. This test insures the integrity of the communication channels.

The 3000/04-000 card can be configured to operate either as a MODBUS master device that requests read and write data transfers to MODBUS slave devices, or as a MODBUS slave device that responds to requests from a MODBUS master. It supports multiple MODBUS servers, asynchronous read and write functions, a multiple outstanding read and write request queue, and coil and discrete I/O formats.

Convenient connections to the Ethernet ports are provided by four front-panel mounted RJ-45 connectors that accept standard Ethernet cables.

The two MODBUS communication ports can be configured as either separate MODBUS TCP communications ports to two MODBUS TCP networks, or as a pair of redundant MODBUS TCP communications ports to a single MODBUS TCP network.

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SPECIFICATIONS

Power Requirements

+5V DC @ 2.3A

Environmental

Operating Temperature Range: –20ºC to +60ºC
Storage Temperature Range: –25ºC to +85ºC
Relative Humidity Range: 10% to 95%, non-condensing

User Connectors

Number: 4
Type: RJ-45
Cables: STP Category 5 (EIA 568B, Cat 5) shielded Ethernet cables with 4 twisted-pair wires and RJ-45 tips

Electrical Specifications

µProcessor: Intel Mobile Celeron processor with integrated PCI and SDRAM controller, watchdog timer, 2 general purpose timers and 4 DMA channels

Clock Speeds:

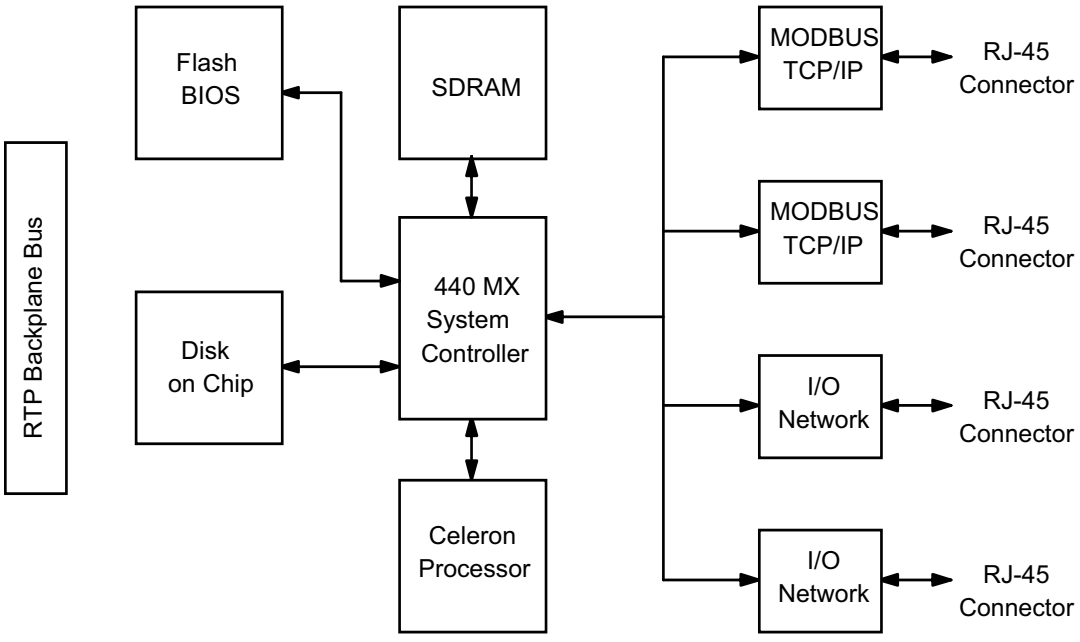
CPU	650 MHz
System Bus	100 MHz
PCI Bus	33 MHz

Ethernet Interface: 4 PCI 100 MHz Ethernet controllers with status indicators

Memory: 64 MBytes SDRAM
64 MBytes Flash

Supported MODBUS Functions

Code	Function	Supported Port	
		Master	Slave
01	Read Coils	✔	✔
02	Read Discrete Inputs	✔	✔
03	Read Holding Registers	✔	✔
04	Read Input Registers	✔	✔
05	Write Single Coil		✔
06	Write Single Register		✔
15	Force Multiple Coils	✔	✔
16	Preset Multiple Registers	✔	✔



3000/04-000 MODBUS TCP/IP Communications Card