JOHNSON CONTROLS

Metasys® Network Automation Engine (NAE)

The Network Automation Engine (NAE) brings an entirely new generation of technology into the Metasys® Building Automation System (BAS). The NAE is a Web-enabled network controller that communicates using Information Technology (IT) and Internet languages. At the same time, the NAE uses the communication technology of the building automation industry, including BACnet™ protocol, LONWORKS® network, and the N2 Bus. Using this technology, the NAE monitors and supervises Heating, Ventilating, and Air-Conditioning (HVAC) equipment, lighting, security, and access control.

A single NAE or a network of multiple NAE devices within a building provides monitoring and control, alarm and event management, data exchange, trending, energy management, scheduling, and data storage. The NAE supports a single or multiple Web browser user interface with password access control and the security protection technology of the IT industry.
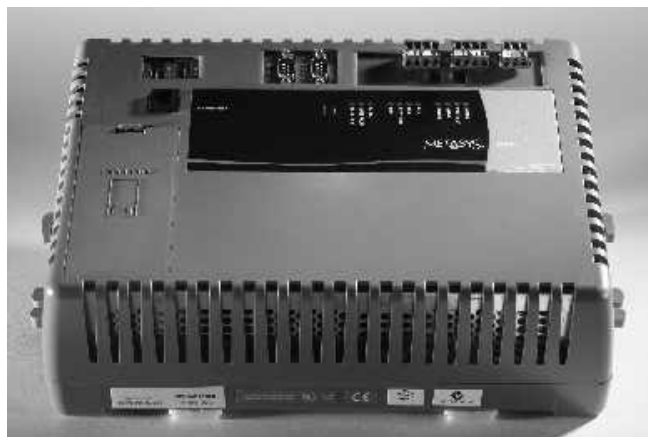

Figure 1: Network Automation Engine

Features and Benefits	
❏ **Communication using commonly accepted IT standards at the automation and enterprise level**	The system can be installed on the existing IT infrastructure within a building or enterprise and uses standard IT communication services over the company intranet, wide area network, or public Internet with firewall protection.
❏ **Web browser-based user interface**	System data in the NAE is accessed from any standard Web browser device connected to the network including remote users connected by dial-up telephone or an Internet Service Provider (ISP).
❏ **Site Director function in one NAE or in an Application and Data Server (ADS) for large installations**	The user accesses all data on one site through one device. The Site Director coordinates displaying data from multiple NAE devices for easy navigation through the entire site.
❏ **User interface and on-line system configuration software embedded in NAE**	The system enables configuration, commissioning, data archiving, monitoring, commanding, and system diagnosis from any device with Web browser software. Separate workstation software is not required.
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Features and Benefits (Cont.)	
❑ **Supervision of field controller networks including N2 Bus, LONWORKS network, and BACnet enabled devices.**	Supports Metasys network N2 controllers, the Metasys Integrator, and connectivity to open standard networks for complete flexibility in the selection of field devices.
❑ **Multiple connection options for data access.**	A Web browser may be connected via the Internet Protocol (IP) network using the Ethernet port, or directly to an RS-232 serial port. For a dial-up connection, the optional internal modem and RJ-11 phone jack or an external modem via one of the USB ports can be used.

NAE Networking

NAEs have multiple connection port options that allow you to build an extremely flexible network at the automation and enterprise level of your system as well as at the field controller and data acquisition level.

Web Browser Access

The user accesses data in the NAE with any type of computer (desktop or laptop) that runs standard Web browser software. The user interface device does not require any special Metasys workstation software. The Web browser can be set up to access the NAE directly over the IP network or via the Internet or public telephone service for remote operation and system fault diagnosis.

IP Ethernet Network

The NAE connects directly to an IP Ethernet network running at 10 or 100 Mb/s. Multiple NAEs communicate with each other over the network and one NAE acts as the Site Director. The Site Director is the point of access to the network on the site from a user interface device. The data transmission on the network uses standard IT protocols, services, and formats including Internet Protocol (IP), HyperText Transfer Protocol (HTTP), Simple Network Time Protocol (SNTP), Simple Mail Transfer Protocol (SMTP), Simple Network Management Protocol (SNMP), HyperText Markup Language (HTML), and Extensible Markup Language (XML). The NAE also supports dynamic IP addressing protocols such as Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS).

Networks in different buildings may be interconnected using standard Wide Area Network (WAN) technologies and network service providers. The speed of transmission depends on the technology used.

Remote NAE

A single remote NAE can be accessed locally by directly connecting a PC with a Web browser to the NAE Ethernet port or to one of the NAE serial ports. Remote access to an NAE can be set up over the Internet using an Internet Service Provider (ISP) line, or over the public telephone network using a modem and the Point-to-Point Protocol (PPP). The NAE offers an optional internal modem or supports an external modem on its USB port.

Application and Data Server (ADS)

The ADS is a software package running on a server platform that provides a location for storage of the system configuration database, trend logs, alarm logs, and audit trails. The ADS can also be configured as the Site Director to coordinate, access, and present data to the user on a Web browser running on the same computer platform or connected over the network, Internet, or telephone line via dial-up communication. The Metasys software supports standard IT firewall technologies for protection against unauthorized access.
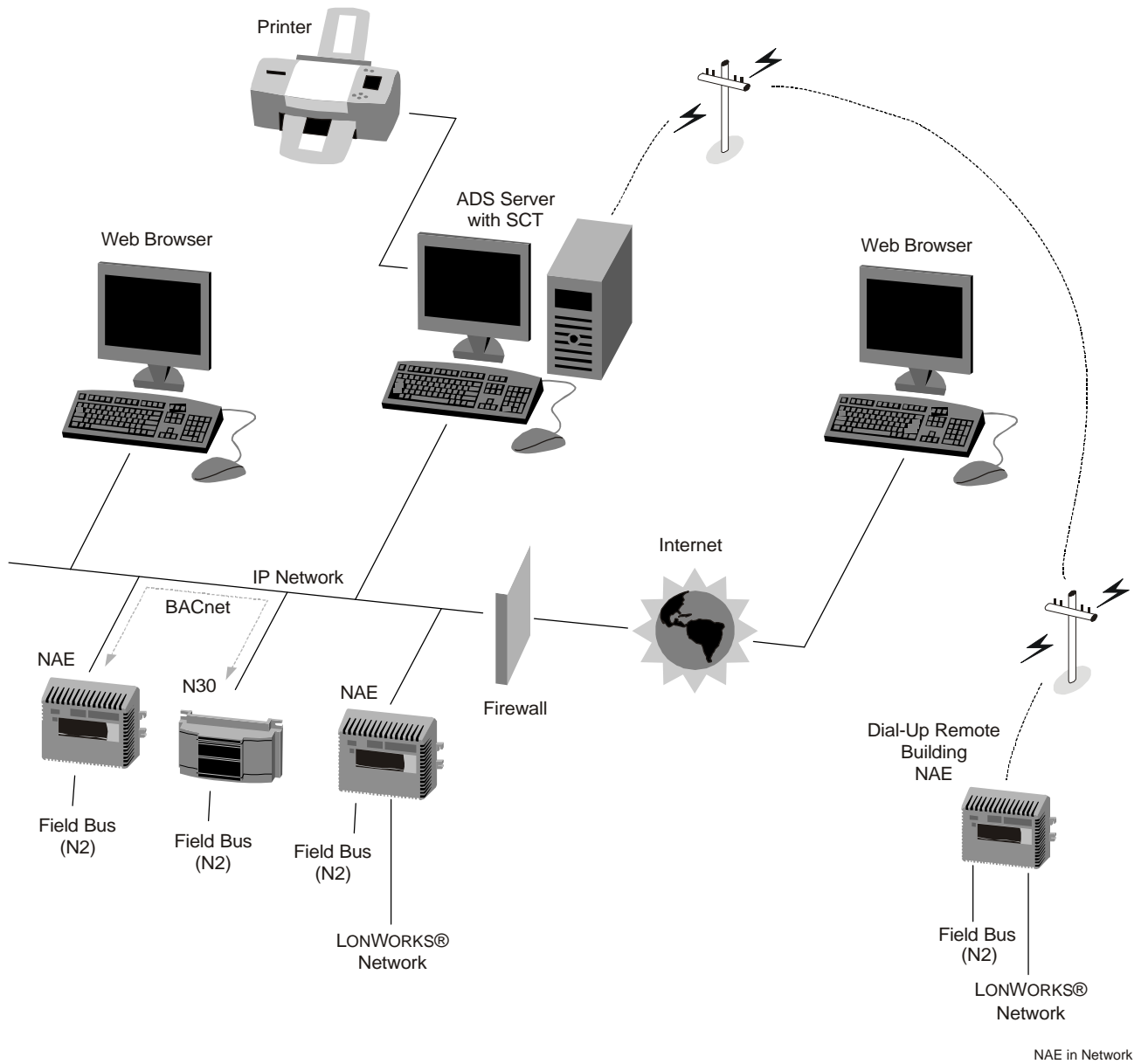
Figure 2: Metasys Network with Multiple NAEs

Field Networks and Protocols

The NAE supports multiple field networks and protocols. As an integration engine, the NAE passes data from one field network to another and transmits data from the field networks to the enterprise and automation level of the network. This allows your system to operate as one virtual control network.

Automation Level Communication

NAEs communicate technical data using peer-to-peer messaging over the IP Ethernet network. This means that each NAE device shares data and has access to information on all other NAE nodes on the network to coordinate the overall functions of the building control system at the automation level.

BACnet Protocol Conformance

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) defines the BACnet standard specified on projects by consultants and used by many control systems manufacturers and installers for system connectivity applications.

The automation level communication also supports the BACnet protocol and facilitates the integration of other systems and devices that use this protocol standard into the network. The N30 Supervisory Controller from Johnson Controls can also be integrated into the NAE network at the automation level using BACnet services.

The NAE supports the BACnet services and objects typically used by a workstation and a field controller device, including BACnet alarm and event services. A detailed Protocol Implementation Conformance Statement (PICS) and BACnet Interoperability Building Blocks - BACnet Workstation/BACnet Building Controller (BIBBs - B-WS/B-BC) statement are available from Johnson Controls on request.

The N2 Bus

The N2 Bus is the Johnson Controls field communications trunk that links Application Specific Controllers (ASCs), including the DX-9100, Air Handling Unit (AHU), Unitary Controller (UNT), and Variable Air Volume (VAV) controllers, VAV Modular Assembly (VMA) devices, to a supervisory controller. The N2 Bus provides a robust and economically installed communications network based upon the RS-485 standard.

As a supervisory controller, the NAE supports two N2 trunks, each with up to 100 N2 ASC devices, depending on the data monitored in each device and the required performance.

The N2 Bus also supports Metasys Compatible devices from other manufacturers and the Metasys Integrator® system. The Metasys Integrator system includes an extensive series of software drivers for the integration of other manufacturers' control devices including HVAC equipment, power monitoring devices, lighting panels, card access, security, and fire detection systems.

LONWORKS Enabled Devices

The NAE can also fulfil the role of supervisory controller and communication path to the enterprise and automation levels of the Metasys system for a network of LONWORKS enabled devices. The NAE supports any LONWORKS enabled device if the network interface follows current LONMARK® Guidelines, preferably with the LONMARK Association certification, and uses the Free Topology Transceiver FTT10.

The LONWORKS network interface of the NAE supports all current LONMARK certified devices from Johnson Controls including the Terminal Control Unit (TCU), VMA 1200 controllers, and the LONWORKS enabled programmable Flexible System Controller (FSC).

Software for Efficient Building Operation

System Security

The NAE recognizes legitimate users through the entry of a user ID and a password at the Web browser user interface. User access data is encrypted in the transmission and in the NAE database and user profiles and accounts are managed at a site or system level by the user's security administrator. The authorization levels range from configuring the complete system to only viewing one section of the system or site. The system administrator assigns a user ID, password, and specific NAE data access privileges in each user account.

User Interface

The embedded NAE user interface provides formatted data and graphic screens to any connected Web browser. Authorized users simply log in to the NAE from the Web browser to access the user interface. This imbedded user interface is ideal for smaller networks and remote locations where a separate PC platform to support a user interface is not required.

The NAE that has been defined as the Site Director can gather data from other NAEs on the same network and combine data for presentation on one screen on the connected Web browser. In larger installations, the NAE can pass its data to an ADS server on the network that acts as Site Director. Users can access data from an NAE or ADS server at any point in the network with a Web browser.
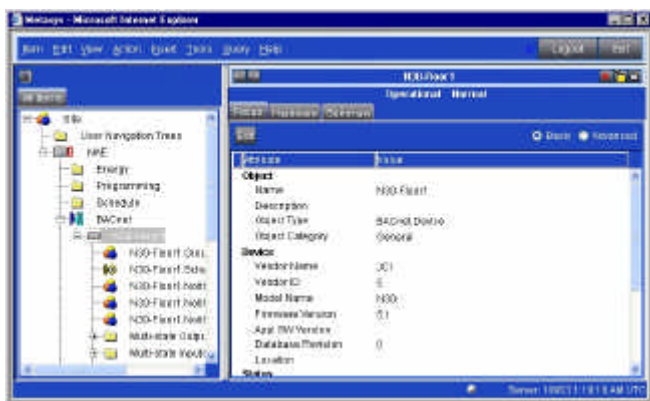

Figure 3: Metasys User Interface Screen

Monitoring and Control

The NAE software is specifically designed to meet the needs of building owners and managers to efficiently monitor and control all the mechanical and electrical systems in a typical building such as:

- heating, ventilation, and air conditioning units

- central equipment including chillers and boilers

- lighting and electrical distribution

- power generation and energy monitoring equipment

- interfaces to security and fire detection systems

The NAE gathers monitored equipment data from the field control devices. The NAE coordinates commands and sends them to the equipment at the required priority for the safe operation of the building.

The user can access information via a navigation tree that represents the logical grouping of network devices and point data names defined by the user when configuring the system. The user can also create a customized tree with groups and names based on device location in the building or on system groups.

Transaction Recording

All user actions performed through the NAE, including log on and off, commands to equipment, changes to parameters, and changes to the system configuration are recorded in the NAE audit trail log.

Alarm and Event Processing

When a value exceeds a defined limit or changes to an off-normal state, the NAE sends alarm or event messages to online Web browsers, pagers, e-mail servers, and printers on ADS servers. The message routing depends on the source, time, and type of the event. The information is also stored immediately in a local log file on the NAE, later transmitted to a site log file on a server, and can be viewed at any time from a Web browser to trace the history of alarms and events on the site.

The alarm and event information may include a predefined message to facilitate a fast response to the system problem. When the user with the appropriate password authority acknowledges or clears an alarm, the site log file is updated.

The user may also request a summary of all current alarms in the NAE.
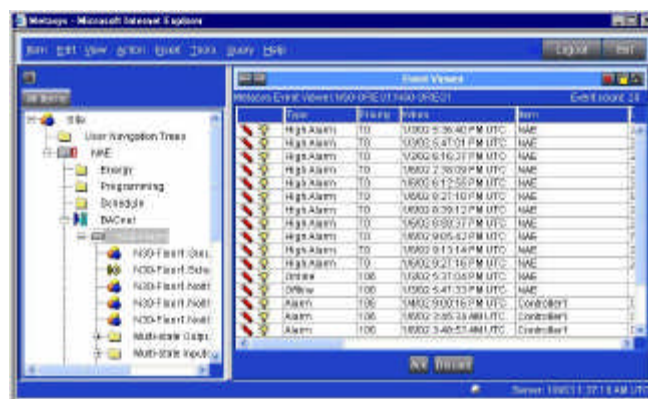

Figure 4: Alarm and Event Screen

Historical Trend Data

The NAE supports trending of any monitored value at user-defined periods ranging from a few seconds to one week. Trend logs are initially stored in the NAE Flash memory. Trend log information can be transferred to a historical database on the ADS when the NAE files are full, or at user-defined intervals. Trend logs are useful for analyzing the performance of building control systems and locating the source of system problems. Historical trend data records are required in many industries including pharmaceutical and food processing plants to document the ambient conditions during manufacture.
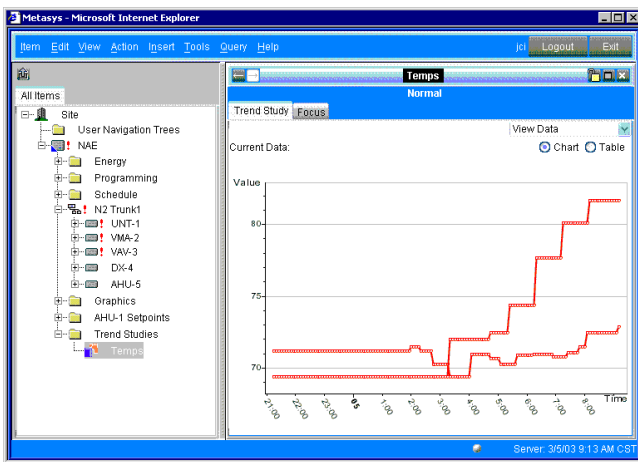

Figure 5: Trend Screen

Totalization Data

Analog and pulse totalization features in the NAE monitor the use of energy and other consumables. Users can generate reports for cost allocation within a facility or to support energy and cost reduction programs.

Event and run-time totalization features, including the number of times specific events occur and how long equipment has been in operation, provide data for servicing and maintenance programs and for early identification of possible system problems.

Scheduling

The scheduling feature allows the user to define building occupancy periods and the start and stop times for mechanical or electrical equipment. Operating parameters such as temperature setpoints and power consumption limits can be set according to the time of day. Users can schedule an event for one or more days of the week, for a holiday, or for particular calendar dates.

Schedules can be defined in one NAE for the whole site or for just the equipment controlled by that NAE. Each NAE has the graphical user interface to easily set up the schedules from a Web browser.
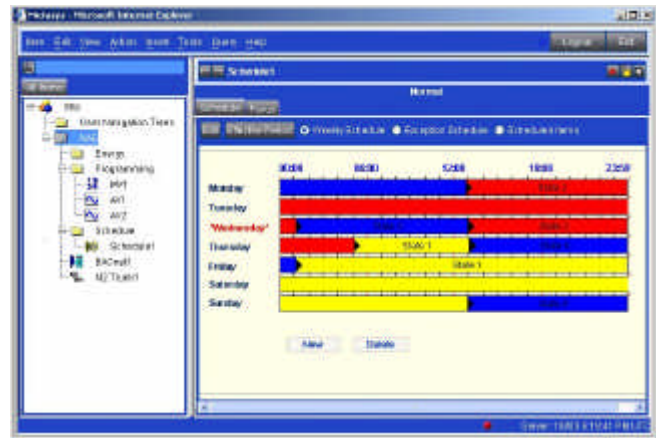

Figure 6: Schedule Screen

Network-Wide System Interlocking

Interlocking enables the NAE to take information from one or more field controllers, make logical comparisons and issue a set of control instructions to other field controllers anywhere on the network. Interlocking also facilitates sharing analog or binary data between controllers. For example, interlocking can be used to eliminate the need for wiring an outside air temperature sensor to each controller, saving hardware and installation costs.

Optimal Start

Optimal Start automatically determines the correct time to start heating and cooling systems to ensure that the facility is ready for occupants at the scheduled time. It adjusts to seasonal variations and minimizes the energy used.

Database Configuration Management

Using the System Configuration Tool (SCT), project engineers can define the system configuration and database offline for later download to the NAE over the network. Alternatively, the user can define the database online, on a Web browser connected directly to an NAE, connected locally via the Ethernet network, or connected from a remote location via a wide area network. In either case, the database is normally archived on the SCT or ADS server.

All the software required for database configuration resides on the SCT or NAE, and users do not need to have a local copy of the database on the Web browser in order to make authorized changes.

The configuration data for application specific N2 controllers on the field networks can be downloaded through the NAE without affecting system operations.
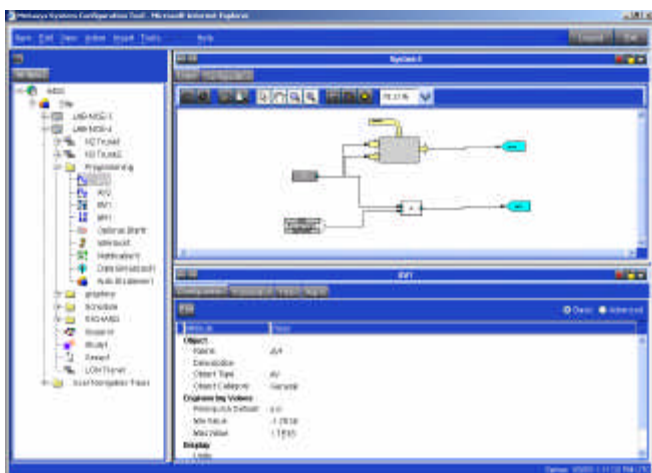
Figure 7: SCT Screen

Hardware Features

The NAE provides industrial level reliability for the building controls market and includes:

- industrial Single Board Computer (SBC)

- Windows® XP embedded operating system

- non-volatile solid-state Flash Card memory to store all programs and data

- battery backup to save data from Dynamic Random Access Memory (DRAM) into Flash memory after a power failure

- real-time clock with battery backup

- Light-Emitting Diodes (LEDs) for power, communications, and fault to allow easy servicing

NAE Product Code Numbers

Table 1 lists the code numbers for the new NAEs.

- optional internal modem and LONWORKS compatible network cards with PC-104 interface

- removable screw terminals for 24 VAC power, LONWORKS network, and N2 Bus network connections

- standard 9-pin sub-D connectors for RS-232-C serial ports A and B

- standard USB connectors for USB serial ports A and B

- RJ-11 telephone line connector for internal modem

- RJ-45 connector for Ethernet connection

Conclusion

The NAE affirms Johnson Controls' position as a leader in the BAS industry and as an innovator of solutions for the complete management of buildings. The integration of Information Technology and Internet standards into the NAE as well as the use of open protocols for field networks bring the benefits of the global communications and control industries into one system. Web browser based access from any location is a key to the effective use of the automation network.

The Metasys system continues to be the integrating network within buildings and has now been extended to bridge the gap between traditional control systems and the business and communication network systems of the enterprise. The NAE and Metasys Web-enabled network are wise investments that will yield returns to the building owner and operator far into the future.

Table 1: NAE Code Numbers (New)

Product Code Number	Description/Options*
MS-NAE55xx-xx	Network Integration Engine (NAE), 24 VAC power
MS-NAE5510-0	NAE with N2 Bus
MS-NAE5511-0	NAE with N2 Bus, modem
MS-NAE5520-0	NAE with N2 Bus, LONWORKS compatible card
MS-NAE5521-0	NAE with N2 Bus, modem, LONWORKS compatible card

* All models are also available in a Buy American version (add a G after the code number). For the European version, add an E after the code number.

Technical Specifications

Product	Network Automation Engine Product Code: MS-NAE55xx-xxx
Power	Nominal 24 VAC at 50/60 Hz (min. 20 VAC to max. 30 VAC)
Power Consumption	50 VA maximum
Ambient Operating Temperature	0 to 50°C (32 to 122°F)
Ambient Operating Conditions	10 to 90% RH
	30°C (86°F) maximum dew point
Ambient Storage Temperature	-40 to 70°C (-40 to 158°F)
Ambient Storage Conditions	5 to 95% RH
	30°C (86°F) maximum dew point
Data Protection Battery	Data protection on power failure. Rechargeable gel cell battery; 12V 1.2Ah, typical life 3 to 5 years at 21°C (70°F). Order code MS-BAT1010-0.
Clock Battery	Maintains real-time clock through a power failure. On board cell; typical life 10 years at 21°C (70°F)
Processor	300 MHz Pentium® class Geode GX1 MMX enhanced processor (32 bit)
Memory	256 MB Flash card EPROM (non-volatile memory for operating system, configuration data and operations data storage and backup)
	256 MB Synchronous DRAM (Dynamic Random Access Memory) for operations data dynamic memory
Operating System	Microsoft Windows XP embedded
Network and Serial Interfaces	One Ethernet port; 10/100 Mb; 8-pin RJ-45 connector
	Two optically isolated RS-485 interfaces for N2 Bus; 9600 baud; pluggable and keyed 4 position terminal blocks
	Two RS-232-C serial ports; all standard baud rates supported; standard 9-pin sub-D connectors
	Two USB serial ports, standard USB connectors
	Options:
	One LONWORKS compatible port, FTT10; pluggable and keyed 3 position terminal block
	One telephone port for internal modem; up to 56 KBaud; 6-pin RJ-11 connector
Dimensions (L x W x H)	332 x 226 x 96.5 mm (13.1 x 8.9 x 3.8 in.) including mounting feet
	Area required for mounting the NAE (minimum): 408 x 303 mm (16.1. x 12.0 in.) with 148 mm (5.8 in.) free depth.
Housing	Plastic housing with internal metal shield.
	Plastic material: ABS + polycarbonate UL94 5VB
	Protection: IP30 (IEC529)
Mounting	On flat surface with screws on four mounting feet or on dual DIN rail.
Shipping Weight	2.9 kg (6.4 lb.)
Agency Listings	UL Listed and CSA Certified UL 916 Energy Management Listing, CSA C22.2 No. 205, CFR47 FCC Part 15 Class A,
	CE Mark and C-Tick Directive CE Directive 89/336/EEC (EN50081-1, EN50082-2) (order -E models)

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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