AUTOMATA CONTROLS

NexusEdge

Version 1.0.2

Next-Generation Building Automation System with AI-Powered Control and Real-Time Monitoring

End User Guide

December 2024

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1. Getting Started

Welcome to NexusEdge

NexusEdge is a comprehensive building automation system designed by Automata Controls. It provides real-time monitoring, intelligent control, and AI-powered insights for your HVAC equipment, boilers, pumps, and other building systems.

Accessing the System

NexusEdge is accessed through a web browser. Your facility administrator will provide you with the URL to access the system. The interface is fully responsive and works on desktop computers, tablets, and mobile devices.

Supported Browsers

- Google Chrome (recommended)
- Mozilla Firefox
- Microsoft Edge
- Safari (macOS/iOS)

Navigation Overview

The sidebar on the left side of the screen provides access to all NexusEdge features. Click on any menu item to navigate to that section. The main pages available include:

D **Dashboard**
System overview, real-time readings, equipment status

C **Controls**
Equipment I/O control and manual overrides

A

Analytics

Historical data visualization and trends

!

Alarms

Alarm management and email notifications

Quick Tip

Hover over any navigation item to see a description of what that page contains.

2. Dashboard Overview

The Dashboard is your central hub for monitoring the entire building automation system. It provides a comprehensive view of all equipment, sensor readings, and system health at a glance.

Real-Time Readings Card

The NexusEdge Readings widget displays live sensor data from all connected equipment. This includes temperature sensors, current transformers, pressure sensors, and more. The widget has four tabs:

Setpoint Tab

- **Current Temperature:** Shows the current measured temperature from the primary sensor
- **Setpoint Value:** The target temperature the system is trying to maintain
- **Trend Indicator:** Shows if the system is heating up, cooling down, or within deadband
- **Preset Buttons:** Quick access to common setpoint values
- **Outdoor Air Reset:** Toggle to enable automatic setpoint adjustment based on outdoor temperature

Inputs Tab

- Displays all sensor inputs including temperatures, currents, and status signals
- Values are color-coded to indicate normal, warning, or critical conditions
- Supply and return temperatures for heating/cooling loops
- Pump and fan motor current readings
- Digital status inputs (boiler status, freezestat, etc.)

Outputs Tab

- **Digital Outputs (Triacs):** Shows ON/OFF status of equipment enables
- **Relay Outputs:** Additional digital output channels
- **Analog Outputs:** Shows voltage output and percentage for modulating controls like valves and VFDs

Alarms Tab

- Shows any active alarms or warnings

- Quick access to alarm acknowledgment

Weather Display

The weather bar at the top of the dashboard shows current outdoor conditions including temperature, humidity, and weather description. Click the edit icon to change your location's ZIP code.

Equipment Status Indicators

Customizable status indicators show the real-time state of your equipment. Click the eye icon to show/hide indicators, or click the settings icon to customize which equipment is displayed.

System Information Panel

The system information panel displays key metrics about the NexusEdge controller:

Metric	Description
CPU Usage	Real-time processor utilization with historical graph
Memory Usage	RAM utilization with historical graph
Uptime	How long the system has been running
IP Address	Network address (click eye icon to reveal)
Hailo-8 NPU	Neural processing unit status and utilization
OpenZL Cache	Data compression cache statistics

Trend Graph

The trend graph provides real-time visualization of sensor data over time. You can:

- Select different sensors to display
- Choose time ranges (1 hour, 6 hours, 24 hours, 7 days)
- Zoom and pan to examine specific time periods
- Export data for further analysis

Freezestat Reset

If a freezestat condition occurs (freeze protection tripped), a reset button will appear on the dashboard. Click this button to reset the freezestat after the condition has been corrected.

Important

Only reset the freezestat after verifying that the freeze condition has been resolved and equipment is safe to operate. Contact your facility manager if you are unsure.

3. Controls Page

The Controls page provides direct access to all hardware inputs and outputs connected to the NexusEdge controller. This is where you can view real-time I/O status and apply manual overrides when needed.

Board Selection

NexusEdge supports multiple I/O boards including:

- **MegaBAS:** 8 analog inputs, 4 triacs, 4 analog outputs
- **MegaIND:** Industrial I/O with additional analog outputs
- **16-Input:** 16 universal analog inputs
- **16-Relay:** 16 relay outputs for equipment control

Click on a board card to select it and view its I/O channels.

3D Board Visualization

The Controls page features interactive 3D models of each I/O board. You can rotate and zoom the model to visualize the physical board layout. This helps identify terminal connections and wiring points.

Viewing Input Values

The Inputs section shows all analog and digital input channels with their current values:

- Temperature sensors display in degrees Fahrenheit
- Current sensors display in Amps
- Voltage inputs display in Volts
- Digital inputs display ON/OFF status

Manual Override Mode

For outputs, you can switch between **Auto** mode (controlled by the logic engine) and **Manual** mode (direct user control).

Applying a Manual Override

1. Locate the output you want to control
2. Click the Auto/Manual toggle to switch to Manual mode
3. For digital outputs: Click the ON/OFF toggle
4. For analog outputs: Use the slider or enter a specific voltage value
5. Click Save to apply the override

Caution

Manual overrides bypass the automatic control logic. Equipment may not respond to temperature changes or safety conditions while in manual mode. Always return outputs to Auto mode after maintenance or testing is complete.

Output Types

Triac Outputs (24VAC)

Triac outputs are solid-state switches used to control 24VAC equipment such as:

- Boiler enable signals
- Pump enable signals
- Damper actuators
- Valve actuators

Status is displayed as ON (energized) or OFF (de-energized).

Relay Outputs

Mechanical relay outputs for higher-current loads or dry contact applications:

- Fan starters
- Compressor contactors
- Alarm contacts

Analog Outputs (0-10VDC)

Analog outputs provide variable voltage for modulating control:

- Valve position control (0-10V)
- VFD speed reference
- Damper position control

Display shows both the voltage (0-10V) and percentage (0-100%). Some outputs may be configured as "Reverse Acting" where 10V = 0% and 0V = 100%.

Configuration Export/Import

The Controls page allows you to export the current board configuration as a JSON file for backup purposes. You can also import a previously saved configuration to restore settings.

Pro Tip

Before making any configuration changes, export a backup of your current settings. This allows you to quickly restore the original configuration if needed.

4. Analytics & Trends

The Analytics page provides powerful data visualization and historical analysis capabilities. View trends, identify patterns, and gain insights into your building's performance over time.

Equipment Overview

The overview tab displays all configured equipment with their current status and key metrics:

- **Boilers:** Supply temperature, status, firing rate
- **Heat Pump Loops:** Supply/return temperatures, valve position
- **Pumps:** Running status, motor current
- **Air Handlers:** Supply air temperature, fan status

Interactive Charts

Click on any equipment to open a detailed trend chart showing historical data. Charts are powered by Plotly and support:

- **Zoom:** Click and drag to zoom into a specific time period
- **Pan:** Hold shift and drag to pan the view
- **Reset:** Double-click to reset the view
- **Hover:** Hover over data points to see exact values and timestamps
- **Legend:** Click legend items to show/hide specific data series

Time Range Selection

Choose from preset time ranges to analyze different periods:

Range	Data Points	Best For
1 Hour	High resolution	Recent events, troubleshooting
6 Hours	Medium resolution	Morning/afternoon trends

24 Hours	Medium resolution	Daily patterns
7 Days	Aggregated	Weekly patterns, energy analysis
30 Days	Aggregated	Monthly trends, seasonal analysis

AI-Powered Analysis

Click the "Analyze with NexusForge" button to get AI-powered insights about your equipment performance. The AI will analyze trends and provide recommendations for optimization.

Multi-Sensor Comparison

You can overlay multiple sensors on the same chart for comparison. This is useful for:

- Comparing supply vs. return temperatures to see delta-T
- Correlating outdoor temperature with heating/cooling demand
- Analyzing pump current vs. valve position
- Identifying equipment cycling patterns

Data Export

Export historical data for external analysis:

- **CSV Export:** Download data as a comma-separated file for Excel or other tools
- **PNG Export:** Save the current chart as an image
- **Report Generation:** Generate a summary report with key statistics

Equipment Status Cards

Each equipment card displays:

- Equipment type icon (color-coded)
- Current primary sensor value
- Status indicator (running/stopped)
- Mini trend sparkline showing recent history

Understanding the Color Codes

- **Orange:** Boilers and heating equipment
- **Blue:** Heat pump loops and cooling
- **Cyan:** Pumps and fluid handling
- **Light Blue:** Air handlers and ventilation

Real-Time Updates

Charts automatically update every 30 seconds with the latest data. A timestamp in the header shows when data was last refreshed. Click the refresh button to manually update the data.

5. Alarms & Notifications

The Alarms page provides comprehensive alarm management including viewing active and historical alarms, configuring email notifications, and acknowledging alarm conditions.

Alarm List

The main alarm list displays all recorded alarms with the following information:

Column	Description
Timestamp	Date and time the alarm occurred
Type	Category of alarm (High Temp, Low Temp, Equipment Fault, etc.)
Description	Detailed description of the alarm condition
Value	The measured value that triggered the alarm
Threshold	The configured threshold that was exceeded
Severity	Low, Medium, High, or Critical
Status	Acknowledged or Unacknowledged

Severity Levels

- **Low:** Informational alerts, no immediate action required
- **Medium:** Warning conditions that should be monitored
- **High:** Significant issues requiring attention
- **Critical:** Emergency conditions requiring immediate action

Acknowledging Alarms

Click the checkmark button next to an alarm to acknowledge it. Acknowledging an alarm indicates that the condition has been reviewed. The alarm will show:

- Who acknowledged the alarm
- When it was acknowledged

Email Notifications

NexusEdge can send email notifications when alarms occur. To configure notifications:

1. Click the "Recipients" tab
2. Click "Add Recipient"
3. Enter the recipient's name and email address
4. Click Save

Managing Recipients

The Recipients tab allows you to manage who receives alarm notifications:

- **Add:** Add new email recipients
- **Enable/Disable:** Toggle notifications for specific recipients
- **Delete:** Remove recipients from the list

Email Templates

NexusEdge uses professional HTML email templates that include:

- Clear alarm severity indication
- Sensor/equipment information
- Current value and threshold
- Timestamp of the event
- Direct link to the NexusEdge dashboard

Forwarding Alarms

You can forward specific alarms to additional recipients not in your regular list:

1. 1 Click the forward icon next to an alarm
2. 2 Enter the email address
3. 3 Click Send

Test Notifications

Use the "Test Email" feature to verify your email configuration is working correctly. This sends a test alarm notification to the specified address.

Alarm Monitoring Settings

Toggle the main monitoring switches to:

- **Monitoring Enabled:** Turn alarm monitoring on/off
- **Email Notifications:** Enable/disable all email notifications

Best Practice

Configure at least two email recipients for critical systems - one primary and one backup - to ensure alarm notifications are always received.

6. Equipment Management

The Equipment page provides a complete inventory of all HVAC equipment connected to and controlled by NexusEdge. This serves as your asset management system for building equipment.

Equipment Inventory

View all configured equipment with key details:

- **Equipment Name:** Descriptive name (e.g., "Boiler-1", "AHU-North")
- **Type:** Category (Boiler, Pump, Air Handler, Chiller, etc.)
- **Make/Model:** Manufacturer and model information
- **Serial Number:** Equipment serial number
- **Facility Asset Number:** Your organization's asset tag
- **Status:** Current operational status

Equipment Types

NexusEdge supports a wide variety of HVAC equipment:

Heating Equipment

Boilers, furnaces, steam generators, heat exchangers, radiant heaters

Cooling Equipment

Chillers, cooling towers, DX systems, evaporative coolers

Air Handling

Air handlers (AHU), rooftop units (RTU), DOAS, VAV boxes, fan coils

Fluid Handling

Pumps, expansion tanks, heat pump loops, domestic hot water systems

Equipment Details

Click on any equipment to view detailed information:

- Full equipment specifications
- Associated sensors and controls
- Maintenance history
- Performance data
- Control logic association

Real-Time Status

Each equipment card shows real-time status information:

- **Green:** Equipment running normally
- **Yellow:** Equipment in warning state
- **Red:** Equipment fault or alarm
- **Gray:** Equipment offline or disabled

7. NexusForge AI Assistant

NexusForge is NexusEdge's built-in AI assistant, powered by local AI models. It provides intelligent assistance for troubleshooting, optimization, and answering questions about your building systems.

Starting a Conversation

Navigate to the NexusForge page and type your question in the chat input. NexusForge can help with:

- Troubleshooting equipment issues
- Explaining how systems work
- Analyzing sensor data and trends
- Providing optimization recommendations
- Answering HVAC and controls questions

Context-Aware Assistance

NexusForge has access to your building's real-time data and can provide context-aware responses. It knows:

- Current sensor readings and equipment status
- Historical data and trends
- Equipment configuration and setpoints
- Active alarms and conditions

Example Questions

Try Asking NexusForge

- "Why is the boiler supply temperature lower than setpoint?"
- "What's causing the HP loop temperature to fluctuate?"
- "How can I improve the efficiency of the heating system?"
- "Explain what the injection valve does"

- "What are the current readings for all temperature sensors?"
- "Is there anything unusual in today's data?"

AI-Powered Analysis

NexusForge can perform analysis on your data:

- **Anomaly Detection:** Identify unusual patterns in sensor data
- **Efficiency Analysis:** Calculate and compare equipment efficiency
- **Predictive Insights:** Anticipate potential issues based on trends
- **Optimization Suggestions:** Recommend setpoint and control adjustments

Knowledge Base

NexusForge includes a comprehensive knowledge base about:

- HVAC fundamentals and principles
- Control system concepts
- Troubleshooting guides
- Equipment documentation
- Best practices for building operations

Chat History

Your conversation history is preserved during your session. You can scroll back through previous questions and answers. The conversation context helps NexusForge provide more relevant responses to follow-up questions.

Code and Configuration Help

NexusForge can explain control logic and help understand equipment configuration. When showing code or configuration, responses are formatted with syntax highlighting for easy reading.

Model Information

The NexusForge panel shows which AI model is currently being used. NexusEdge uses local AI models for privacy and performance, meaning your data never leaves your building's network.

Getting the Best Results

- Be specific in your questions
- Include relevant context (equipment name, time period, etc.)
- Ask follow-up questions to drill down into topics
- Request explanations if something isn't clear

Limitations

While NexusForge is highly capable, it has some limitations:

- Cannot directly control equipment (for safety reasons)
- May not have information about very recent events (< 30 seconds)
- Complex calculations may require verification

8. Database Viewer

The Database page provides access to NexusEdge's data stores. View historical sensor data, system logs, and configuration information stored in the SQLite databases.

Available Databases

- **metrics.db:** Sensor readings, equipment data, historical trends
- **alarms.db:** Alarm history and acknowledgments
- **audit.db:** System audit logs and user actions

Browsing Tables

Select a database from the dropdown to view its tables. Click on a table name to view its contents. The viewer supports:

- Sorting by column (click column headers)
- Pagination for large datasets
- Search/filter functionality
- Export to CSV

Query Interface

Advanced users can run custom SQL queries to extract specific data. Results are displayed in a formatted table and can be exported.

> **Note**
>
> The Database viewer is read-only for end users. Modifications to database content require administrative access.

Data Retention

NexusEdge automatically manages data retention:

- High-resolution data: 7 days
- Hourly averages: 30 days
- Daily summaries: 1 year
- Monthly summaries: Indefinite

9. Thresholds Configuration

The Thresholds page allows you to configure alarm thresholds for various sensors and conditions. When a sensor reading exceeds these thresholds, an alarm is generated.

Temperature Thresholds

- **High Temperature:** Maximum acceptable temperature before alarm
- **Low Temperature:** Minimum acceptable temperature before alarm
- **Critical High:** Emergency high temperature limit
- **Critical Low:** Freeze protection limit

Current/Amp Thresholds

- **High Current:** Over-current warning for motors
- **Low Current:** Under-current (possible motor failure or no-flow)

Configuring Thresholds

1. 1 Select the sensor or equipment
2. 2 Enter the threshold values
3. 3 Set the severity level for each threshold
4. 4 Configure any time delays (avoid nuisance alarms)
5. 5 Click Save to apply changes

Deadband Configuration

Deadband prevents alarm chatter when a value is near the threshold. For example, a deadband of 2 degrees means an alarm at 80 degrees won't clear until the temperature drops to 78 degrees.

Threshold Best Practices

- Set thresholds based on equipment specifications
- Include appropriate safety margins
- Use time delays to prevent nuisance alarms
- Review and adjust thresholds seasonally

10. Occupancy Scheduling

The Occupancy page allows you to define building occupancy schedules. NexusEdge uses these schedules to optimize equipment operation, reducing energy consumption during unoccupied periods.

Weekly Schedule

Define occupied and unoccupied times for each day of the week. The visual schedule editor allows you to:

- Set start and end times for occupancy
- Configure different schedules for weekdays and weekends
- Add multiple occupancy periods per day
- Copy schedules between days

Holiday Schedule

Define special schedules for holidays when the building may have different occupancy patterns:

- Add specific holiday dates
- Set holiday schedules (unoccupied, partial, or custom)
- Configure recurring holidays

Setback Settings

During unoccupied periods, NexusEdge applies setback settings:

- **Heating Setback:** Lower heating setpoint to save energy
- **Cooling Setback:** Raise cooling setpoint during unoccupied times
- **Optimal Start:** Automatically start equipment before occupancy to achieve comfort by arrival time

Override Options

Sometimes you need to override the schedule temporarily:

- **Occupied Override:** Force occupied mode during scheduled unoccupied time
- **Unoccupied Override:** Force unoccupied mode during scheduled occupied time
- **Duration:** Set how long the override should last

11. Refrigerant Monitoring

The Refrigerant page provides specialized monitoring for refrigeration and air conditioning systems. View pressure-temperature charts and monitor system performance.

Pressure-Temperature Charts

Select a refrigerant type to view the saturation pressure-temperature curve. Supported refrigerants include:

- R-410A (most common in modern systems)
- R-22 (older systems)
- R-134a (automotive and small commercial)
- R-404A (low temperature refrigeration)
- And many more...

Using the P-T Chart

1. 1 Select your refrigerant type
2. 2 Enter either pressure or temperature
3. 3 View the corresponding saturation value

Superheat & Subcooling

Calculate superheat and subcooling to verify proper system charge:

- **Superheat:** Suction temperature minus saturation temperature at suction pressure
- **Subcooling:** Saturation temperature at discharge pressure minus liquid line temperature

Sensor Integration

When connected to refrigerant pressure and temperature sensors, NexusEdge automatically calculates and displays superheat and subcooling in real-time.

12. Vibration Monitoring

The Vibration page displays data from connected vibration sensors. Monitor rotating equipment health and detect potential mechanical issues before they become failures.

Vibration Metrics

- **Velocity (mm/s):** Primary vibration measurement
- **Temperature:** Bearing or housing temperature
- **Acceleration (G):** Peak acceleration levels
- **Frequency (Hz):** Dominant vibration frequencies

ISO Vibration Standards

Readings are compared against ISO 10816 vibration severity standards:

Level	Velocity (mm/s)	Condition
Good	< 2.8	Normal operation
Satisfactory	2.8 - 7.1	Acceptable for long-term
Unsatisfactory	7.1 - 18	Schedule maintenance
Unacceptable	> 18	Immediate attention required

Trend Analysis

View vibration trends over time to identify developing issues. A gradual increase in vibration levels often indicates bearing wear or imbalance that should be addressed during scheduled maintenance.

13. Communications (BACnet/Modbus)

The Communications page displays the status of BACnet and Modbus network connections. These protocols allow NexusEdge to communicate with other building automation systems and devices.

BACnet Integration

NexusEdge supports BACnet/IP for integration with enterprise building management systems:

- View BACnet network status
- See connected BACnet devices
- Monitor point mapping status
- View communication statistics

Modbus Integration

Modbus TCP/RTU support for legacy equipment integration:

- View Modbus slave connections
- Monitor register read/write activity
- View communication errors

Connection Status

The status indicators show:

- **Green:** Connected and communicating normally
- **Yellow:** Connected with communication errors
- **Red:** Disconnected or failed

> **Note**

Protocol configuration changes require administrative access. Contact your system administrator to add or modify BACnet/Modbus connections.

14. Plugins System

The Plugins page shows the status of NexusEdge's modular plugin system. Plugins extend the functionality of the core system with specialized features.

Installed Plugins

Common plugins include:

OpenZL Cache

High-performance data caching with compression for faster response times

AI Providers

Integration with AI services for advanced analytics and assistance

Legacy Comms

BACnet and Modbus protocol bridge for system integration

AI Response Bridge

MFA approval system for AI-initiated actions

Plugin Status

Each plugin shows:

- Plugin name and version
- Running status (active/inactive)
- Port number (if applicable)
- Health status and uptime

Hailo-8 NPU

The Hailo-8 Neural Processing Unit plugin provides AI inference capabilities for advanced fault detection and diagnostics using 8 specialized neural network models.

15. Settings & Preferences

The Settings page allows you to customize your NexusEdge experience and configure system preferences.

User Preferences

- **Temperature Units:** Fahrenheit or Celsius display
- **Date/Time Format:** 12-hour or 24-hour clock
- **Dashboard Layout:** Customize widget arrangement
- **Refresh Rate:** How often data updates (10-60 seconds)

Notification Settings

- Enable/disable browser notifications
- Configure notification sounds
- Set quiet hours

Display Settings

- Theme selection (if available)
- Font size adjustments
- Chart color preferences

Session Information

View your current session information:

- Username
- Session start time
- Last activity

Saving Settings

Settings are automatically saved to your browser's local storage. They will persist across sessions on the same device.

16. Node-RED & Terminal Access

Node-RED

Node-RED is a flow-based programming tool integrated with NexusEdge. It provides visual programming capabilities for creating custom automation logic, data processing flows, and integrations.

The Node-RED interface allows you to:

- View active automation flows
- Monitor flow execution
- See debug messages
- View flow status

Access Required

Editing Node-RED flows and creating new automations requires administrative access. Contact your system administrator for flow development or modifications.

Terminal

The Terminal page provides a web-based command line interface to the NexusEdge system. This is useful for advanced troubleshooting and system administration.

Terminal access allows:

- Viewing system logs
- Checking service status
- Running diagnostic commands

Access Required

Terminal access is restricted to authorized users only. Administrative credentials are required to execute commands.

Neural BMS

The Neural BMS page provides access to the central Building Management System interface for enterprise integration. This page displays real-time data from all connected NexusEdge controllers in a facility.

17. Administrative Features

NexusEdge includes powerful administrative features for system configuration, maintenance, and advanced control. These features are protected by role-based access control.

Protected Admin Pages

The following administrative pages are available to authorized users:

Feature	Description
Logic Engine	Equipment control logic programming and execution
Board Config	Hardware I/O board configuration and mapping
PID Controllers	PID loop tuning and configuration
Executors	Equipment executor management
BMS Status	Building management system status overview
Audit Logs	System audit and change tracking
Security	User management and access control
AI Models	Hailo-8 NPU neural network management
OpenZL Cache	Cache management and configuration

Administrator Access

To access administrative features, you must have an administrator or DevOps role assigned to your account. Contact your facility manager or Automata Controls support for access requests.

User Roles

- **Viewer:** Read-only access to dashboards and data
- **Operator:** Can adjust setpoints and acknowledge alarms
- **Admin:** Full access to configuration and settings
- **DevOps:** Complete system access including terminal

18. Troubleshooting

Common Issues

Dashboard Not Loading

- Check your internet connection
- Clear browser cache and refresh
- Try a different browser
- Verify the NexusEdge URL is correct

Sensor Readings Show "N/A"

- Sensor may be offline or disconnected
- Check physical wiring connections
- Verify sensor is enabled in board configuration

Equipment Not Responding to Commands

- Check if equipment is in Manual mode (should be Auto for automatic control)
- Verify physical equipment is powered and operational
- Check for active alarms or safety lockouts

Alarms Not Sending Emails

- Verify email notifications are enabled
- Check recipient list has active entries
- Confirm email addresses are correct
- Use Test Email feature to verify configuration

Getting Help

If you encounter issues not covered here:

1. 1 Ask NexusForge AI for troubleshooting assistance

2. 2 Contact your facility manager or building engineer
3. 3 Reach out to Automata Controls support

Support Contact

Automata Controls
Email: support@automatacontrols.com
Web: www.automatacontrols.com