NexusApollo™
End User Guide

Version 1.0 | December 2024

AutomataNexus LLC

CRITICAL SAFETY WARNINGS

HIGH VOLTAGE ELECTRICAL HAZARDS

- **DANGER: AC HIGH VOLTAGE** - This system monitors electrical equipment operating at 208V, 480V, 600V and higher
- **DEATH OR SERIOUS INJURY** can occur from electrical shock
- **ONLY QUALIFIED ELECTRICIANS** should install electrical monitoring sensors
- **TURN OFF POWER** at the main breaker before ANY electrical connections
- **VERIFY ZERO ENERGY** using a properly rated voltage tester before beginning work
- **USE PROPER LOCKOUT/TAGOUT** procedures during installation

DC VOLTAGE WARNINGS

- Control circuits may operate at 24VDC, 48VDC, or 110VDC
- Some sensors operate at 5VDC, 12VDC, 24VDC
- Even low voltages can be dangerous in wet conditions

POWER METER INSTALLATION

- MFM384 Power Meters connect to HIGH VOLTAGE systems
- CURRENT TRANSFORMERS must be installed by qualified electricians
- NEVER install CTs on energized circuits without proper safety procedures
- Improper installation can cause EQUIPMENT DAMAGE, FIRE, OR DEATH
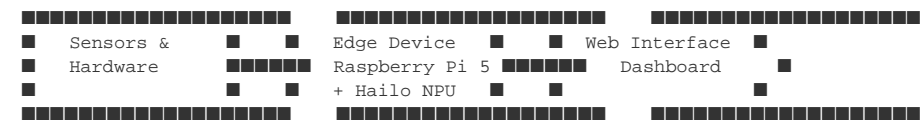
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1. System Overview

1.1 About NexusApollo™

NexusApollo is an advanced AI-powered HVAC fault detection and energy management system that combines:

- **8 Specialized AI Models** for comprehensive system analysis
- **21-Sensor Diagnostic Suite** for complete equipment monitoring
- **Real-time Data Processing** using Hailo-8 NPU acceleration
- **Professional Reporting** capabilities for service documentation
- **Remote Access** via secure web interface

1.2 System Architecture

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■■■■■■■■■■■■■■■■■■■     ■■■■■■■■■■■■■■■■■■■■      ■■■■■■■■■■■■■■■■■■■
■    Sensors &     ■  ■  Edge Device   ■   ■  Web Interface  ■
■    Hardware      ■■■■■■ Raspberry Pi 5 ■■■■■■  Dashboard      ■
■                 ■  ■  + Hailo NPU    ■   ■                 ■
■■■■■■■■■■■■■■■■■■■     ■■■■■■■■■■■■■■■■■■■■      ■■■■■■■■■■■■■■■■■■■
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1.3 Key Capabilities

- **Fault Detection**: Identifies 90+ different fault types across HVAC systems
- **Predictive Maintenance**: AI predicts equipment failures before they occur
- **Energy Optimization**: Continuous monitoring for efficiency improvements
- **Real-time Monitoring**: 10Hz sensor sampling with <10ms AI inference
- **Professional Reports**: Automated generation of diagnostic and maintenance reports

2. Hardware Components

2.1 Core Computing Platform

Raspberry Pi 5 (8GB)

- **Processor**: Quad-core ARM Cortex-A76 @ 2.4GHz
- **Memory**: 8GB LPDDR4X-4267 SDRAM
- **Storage**: 1TB NVMe SSD via PCIe 3.0
- **Operating System**: Raspberry Pi OS Bookworm 64-bit

Hailo-8 NPU AI Accelerator

- **Performance**: 26 TOPS (Tera Operations Per Second)
- **Efficiency**: Optimized for real-time AI inference
- **Models**: Runs 8 Apollo AI models simultaneously at 193,964 FPS

2.2 I/O and Interface Boards

Sequent Microsystems MegaBAS

- **Analog Inputs**: 8 channels (0-10V, 10K thermistor, PT1000)
- **Analog Outputs**: 4 channels (0-10V)
- **Digital I/O**: 8 inputs, 4 relay outputs
- **RS485 Ports**: 2 ports for Modbus devices
- **I2C Address**: 0x48 (stackable 0x48-0x4F)

2.3 Power Monitoring Hardware

■■ HIGH VOLTAGE EQUIPMENT ■■

SELEC MFM384 3-Phase Power Meter

- **Voltage Range**: Up to 690V AC line-to-line
- **Current Monitoring**: Via external current transformers
- **Communication**: RS485 Modbus RTU
- **Measurements**: Voltage, current, power, energy, power factor, THD

2.4 Sensor Hardware

Temperature Sensors

- **Belimo 10K-2 NTC**: Duct air temperature (-50°C to 150°C)
- **Belimo 01CT-5LL**: Cable temperature sensor (-40°C to 150°C)
- **PT1000**: High-accuracy temperature sensing

Pressure & Velocity Sensors

- **Veris PX3DLX02**: Differential pressure transducer (0-10V output)
- **Siemens QVM62.1**: Air velocity sensor (0-10V, 0-16/33/49 ft/s ranges)
- **WitMotion WT901C485**: 9-axis vibration sensor (RS485 Modbus)

3. Safety Requirements

3.1 Electrical Safety

Qualified Personnel Requirements

- **Electrical work** must be performed by licensed electricians
- **HVAC connections** require certified HVAC technicians
- **System configuration** can be done by trained operators

Personal Protective Equipment (PPE)

- Safety glasses
- Insulated gloves rated for voltage present
- Arc flash protection clothing (as required)
- Non-conductive footwear
- Hard hat in industrial environments

Lockout/Tagout Procedures

1. **Identify** all energy sources
2. **De-energize** equipment at main disconnect
3. **Lock out** energy sources with personal locks
4. **Verify** zero energy with properly rated meter
5. **Test** meter on known live source
6. **Install** appropriate warning tags

3.2 Environmental Specifications

Parameter	Operating	Storage
Temperature	-10°C to 50°C (14°F to 122°F)	-20°C to 60°C (-4°F to 140°F)
Humidity	10% to 85% RH (non-condensing)	5% to 95% RH (non-condensing)

4. Installation Guide

4.1 Pre-Installation Planning

Site Survey Requirements

1. **Electrical Panel Access**: Verify accessibility for CT installation
2. **Network Connectivity**: Ensure Wi-Fi or Ethernet availability
3. **Physical Mounting**: Identify secure mounting location for device
4. **Sensor Locations**: Plan optimal sensor placement
5. **Safety Considerations**: Identify all electrical hazards

4.2 Device Installation

Physical Mounting

1. Select location away from sources of vibration
2. Ensure adequate ventilation (minimum 6" clearance)
3. Mount device using provided brackets
4. Connect display using wireless HDMI adapter
5. Connect Ethernet cable if not using Wi-Fi

4.3 Current Transformer Installation

■■ HIGH VOLTAGE - QUALIFIED ELECTRICIANS ONLY ■■

1. **DE-ENERGIZE** circuit completely
2. **VERIFY** zero energy with meter
3. Install CT around single conductor (not cable bundle)
4. Ensure CT polarity marking faces load
5. Connect CT secondary to MFM384 inputs
6. **NEVER** leave CT secondary open when energized

5. Initial Setup & Configuration

5.1 First Boot

1. Connect power adapter to device
2. Wait for boot sequence (2-3 minutes)
3. Green LED indicates system ready
4. Display will show Apollo Nexus logo

5.2 Network Configuration

1. Connect to device Wi-Fi hotspot: "ApolloNexus-XXXX"
2. Open web browser to 192.168.4.1
3. Configure Wi-Fi SSID and password
4. Device will reboot and connect to network

5.3 Web Interface Access

Default Credentials

Setting	Value
URL	http://[device-ip]:3000
Username	devops
Password	Invertedskynet2$

SECURITY NOTE: Change default passwords immediately after installation

6. Operating Instructions

6.1 Dashboard Overview

- **Real-time Sensor Values**: Live readings from all configured sensors
- **System Status**: Overall health indicator
- **Active Alarms**: Current fault conditions
- **Equipment Cards**: Status of monitored equipment
- **AI Insights**: Automated recommendations

Navigation Menu

- Dashboard: Main overview screen
- Equipment: Detailed equipment views
- Sensors: Sensor configuration and readings
- Energy: Power consumption analysis
- Diagnostics: AI fault detection results
- Reports: Generate and view reports
- Settings: System configuration

6.2 Equipment Status Indicators

Color	Meaning
Green	Normal operation
Yellow	Warning condition
Red	Fault detected
Gray	Communication error

7. Sensor Configuration

7.1 Adding Sensors

1. Navigate to **Sensors** → **Add Sensor**
2. Select equipment to monitor
3. Choose sensor type (Temperature, Pressure, Current, Vibration, etc.)
4. Configure hardware settings:
• **Board Type**: Select I/O board (MegaBAS, 16-UNIV-IN, etc.)
• **Board Address**: I2C address of board
• **Channel**: Input channel number
• **Input Range**: Match to sensor output (0-10V, 10K-3, PT1000)
• **Scaling**: Set min/max values for 0-10V sensors

7.2 0-10V Sensor Scaling

Scaling Formula:

```
Actual Value = Scale Min + (Voltage / 10) × (Scale Max - Scale Min)

Example - QVM62.1 Air Velocity (0-33 ft/s range):
  Scale Min: 0, Scale Max: 33
  At 5V input: 0 + (5/10) × (33-0) = 16.5 ft/s
```

8. Monitoring & Diagnostics

8.1 Apollo AI System - 8 Specialized Models

Model	Specialization	Accuracy
APOLLO	Master Coordinator - orchestrates all analysis	99.92%
AQUILO	Electrical Systems - power quality, 13 fault types	96.70%
BOREAS	Refrigeration - leaks, slugging, 17 fault types	91.91%
NAIAD	Water Systems - hydraulics, 16 fault types	99.99%
VULCAN	Mechanical - bearings, vibration analysis	98.10%
ZEPHYRUS	Airflow - ventilation, IAQ, 17 fault types	99.80%
COLOSSUS	Integration - multi-system correlation	100%
GAIA	Safety Validation - 5-state classification	100%

8.2 Performance Metrics

- **Sampling Rate**: 10Hz for critical measurements
- **Data Throughput**: 1.8M readings per day
- **Storage**: 6+ months of data on device
- **AI Processing**: <10ms inference latency
- **Total AI FPS**: 193,964 FPS across 8 models

9. Troubleshooting

Symptom	Likely Cause	Solution
No power LED	Power supply issue	Check 12V adapter connection
Cannot access web	Network issue	Check IP address and cables
Sensor error	Wiring/config issue	Verify connections and I2C addresses
High CPU temp	Airflow blocked	Clean vents, check ambient temp
AI model errors	Hailo device issue	Check /dev/hailo* device nodes
Comm timeout	RS485 issue	Check termination resistors

9.1 I2C Device Detection

```
# Run from SSH terminal
sudo i2cdetect -y 1

Expected addresses:
  0x48-0x4F: MegaBAS boards
  0x40-0x47: 16-UNIV-IN boards
  0x38-0x3F: 8RelIND boards
```

10. Maintenance

10.1 Maintenance Schedule

Frequency	Tasks
Daily	Verify system status, check alarms, review trends
Weekly	Review performance, check calibration, verify communications
Monthly	Clean filters, check cables, update configurations
Annual	Full calibration, electrical inspection, software updates

11. Technical Specifications

11.1 System Specifications

Parameter	Specification
Processor	Raspberry Pi 5, Quad-core ARM Cortex-A76 @ 2.4GHz
Memory	8GB LPDDR4X-4267 SDRAM
Storage	1TB NVMe SSD, PCIe 3.0
AI Accelerator	Hailo-8 NPU, 26 TOPS
AI Performance	193,964 FPS across 8 models
NPU Utilization	55% running full ensemble
Inference Latency	<10ms
Data Storage	6+ months high-resolution on-device

11.2 Electrical Specifications

Parameter	Specification
Input Voltage	12V DC ±10%
Power Consumption	25W typical, 35W maximum
Power Adapter	100-240V AC, 50-60 Hz input
Analog Input Range	0-10V DC, >10MΩ impedance
Analog Resolution	12-bit ADC, ±0.1% accuracy
Thermistor Types	10KΩ Type 2, Type 3
Digital Inputs	3.3V to 24V DC, 2500V isolation

12. Appendices

Appendix A: Default I2C Addresses

Board Type	Default Address	Stack Range
MegaBAS	0x48	0x48-0x4F
MegaIND	0x50	0x50-0x57
16-UNIV-IN	0x40	0x40-0x47
8RelIND	0x38	0x38-0x3F
16RelIND	0x30	0x30-0x37
16-U-OUT	0x58	0x58-0x5F

Appendix B: MFM384 Modbus Registers

Parameter	Register	Type	Units
Voltage L1	0x0000	Float	V
Voltage L2	0x0002	Float	V
Voltage L3	0x0004	Float	V
Current L1	0x0010	Float	A
Current L2	0x0012	Float	A
Current L3	0x0014	Float	A
Power Total	0x0020	Float	kW
Energy Import	0x0048	Double	kWh
Power Factor	0x0038	Float	-
Frequency	0x003A	Float	Hz

Appendix C: Emergency Contacts

Technical Support: support@automatanexus.com

Electrical Emergency: Call local emergency services (911)

System Recovery: Hardware reset - hold button 10 seconds

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